

Review of the Science Strategy for the Peel-Harvey Estuary

(Steve Fisher March 2021)

Introduction and background

A science strategy for the Peel-Harvey estuary was developed in 2010 for the Peel-Harvey Catchment Council (PHCC) by the Murdoch University Centre for Fish and Fisheries Research (Rogers, Hall and Valesini 2010), hereafter referred to as the Science Strategy. The purpose of the Science Strategy was to facilitate planning, delivery and priority setting for research with the aim of “integrating science with the management objectives for the estuary, enabling the future development of new evaluative and predictive tools to facilitate the Council and other management stakeholders in effectively performing their advice and management functions, and to maintain the health of the estuary into the future.”

In summary, the Science Strategy presented 14 recommendations addressing one of three themes:

- Issues of monitoring and science
- Development of models and indices
- Community, governance and science partnerships

In 2014, the PHCC secured funding to employ a Senior Scientist to **provide leadership and better integrate science into the management of the Peel-Harvey Catchment**, closely aligned with the aim of the Science Strategy. Among the Key Duties to be performed by the Senior Scientist are:

- i. to review Peel-Harvey Estuary Science Strategy (2010) and research efforts in the Peel-Harvey Catchment, including literature review
- ii. Prepare a gap analysis for research and monitoring and strategies to reduce the implementation gap
- iii. Prepare an updated Science Strategy for the Peel-Harvey, incorporating broader catchment issues as well as estuarine and riverine
- iv. Using updated Science Strategy facilitate collaborative research programs to address priority research needs

Purpose

The purpose of this document is to meet the objectives of (i) above by considering how the current state (and gaps) in science, research, monitoring, modelling and management responsibilities have and will affect the recommendations from the Science Strategy. Table 1 shows a summary of this review, current at March 2021 which will be used in preparation of an updated Science Strategy (iii above) to be delivered in 2021 to guide future collaborative research programs (iv above).

Table 1: Summary of the Review of the Science Strategy for the Peel-Harvey Estuary: how the current state (and gaps) in science, research, monitoring, modelling and management responsibilities have and will affect the recommendations from the Science Strategy

Recommendation	Response / Comment							
<p>Issues of monitoring and science</p> <p>1. The ongoing successful management of the Peel-Harvey Estuary, including satisfying Ramsar obligations, needs to be built on funding, support for monitoring and the coordination of reporting by the PHCC on the following elements.</p>	<p>The current status (at March 2021) of the monitoring, evaluation and reporting each of these elements is shown below. Refer to the glossary for definitions of abbreviations and acronyms. Note that a new Water Quality Improvement Plan (WQIP) for the Peel-Harvey has been developed in 2017-2020 through the Regional Estuaries Initiative (REI) but has not yet been released.</p> <table border="1" data-bbox="1256 612 2112 708"> <thead> <tr> <th data-bbox="1256 612 1473 708">Program Name</th> <th data-bbox="1473 612 1688 708">Funding Body</th> <th data-bbox="1688 612 1912 708">Delivery Agent</th> <th data-bbox="1912 612 2112 708">Funding Expiry</th> </tr> </thead> </table>				Program Name	Funding Body	Delivery Agent	Funding Expiry
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<p>i. The Water Quality Improvement Plan (EPA, 2008).</p>	<p>REI/ HEWA</p>	<p>State Govt. (DRD)</p>	<p>DWER</p>	<p>2024/25</p>				
<p>ii. Total nutrient loads flowing into the estuary, ideally for phosphorous, nitrogen and organic carbon.</p>					<p>REI/HEWA/ SAPPR</p>	<p>State Govt. (DRD/DPIRD, DPC)</p>	<p>DWER</p>	
<p>iii. Analysis, performance measurement, reporting and adaption of the strategies employed to reduce nutrient flows into the estuary</p>	<p>iv. Key biotic components, including:</p>	<p>ARC Linkage LP150100451</p>	<p>ARC with various partners (DPC, DWER, Murdoch University, CoM, SoM)</p>					<p>Murdoch University / UWA /DWER</p>
<p>a) Submerged macrophyte (macroalgae and seagrass) and littoral and fringing vegetation cover, composition and biomass throughout the estuary (3 yearly intervals);</p>	<p>b) Macrophyte wrack cover, composition and biomass throughout the estuary as a proxy for year-to-year variation in macroalgae and seagrass production;</p>							

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c) The species composition and proxies for biomass of fish and benthic invertebrate communities (including crabs and prawns) throughout the estuary and its adjacent nearshore marine waters (3 yearly intervals);	ARC Linkage LP150100451	ARC and various partners (Murdoch University	2020/21
d) Water bird species counts throughout the estuary (3 yearly intervals).	National Shorebird Count		Birdlife Australia, PHCC	Annual to 2021 and beyond
e) Spatial coverage of other habitat types, such as shallow mudflats, throughout the estuary (every 3 years);	Not addressed – identified as a gap			
f) The composition of the phytoplankton communities at nominated sites throughout the estuary (2 weekly);	REI / DWER /HEWA	State Govt.	DWER	2024/25
g) The growth and reproductive biology of key fish and crustacean species (10 yearly intervals);	DPIRD (Fisheries), MSC	State Govt.	Fisheries, Recfishwest, MLFA	2021
h) Collection of data relevant to human health issues (annually as available).	Not addressed – identified as a gap			
v. Nutrient and non-nutrient contaminant loads in estuarine sediments. 2. That the PHCC be sufficiently funded to enable the ongoing appointment of a Senior Scientist to deliver the following outcomes.	ARC Linkage LP150100451	ARC with various partners	Murdoch University	2019/20
i. The integration of science across the University, Government and broader community sectors and facilitation and co-ordination of a science strategy that	The Department of Regional Development (DRD) provided funding to the Peel-Harvey Catchment Council according to a Grant Agreement			

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addresses current and future risks for the Peel-Harvey Estuary, its catchment and its adjacent riverine and marine waters.	to employ a Senior Scientist for four years to 2018/19 to provide leadership and better integrate science into the management of the Peel-Harvey Catchment.
ii. Provides, with the co-operation of the Western Australian science community and advice from government agencies, reporting on the current and projected status of the ecosystem health of the Peel-Harvey Estuary and its adjacent riverine and nearshore marine waters, and on the performance of catchment management strategies.	The Grant Agreement specifies the following 10 <i>Key Duties</i> to be performed by the Senior Scientist:
iii. Helps establish priorities for research in the Peel-Harvey Estuary, its adjacent riverine and marine waters and its catchment.	<ol style="list-style-type: none"> 1. Establish networks with relevant researchers and research institutions in public and private sectors 2. Review Peel-Harvey Estuary Science Strategy (2010) and research efforts in the Peel-Harvey Catchment, including literature review
iv. Facilitates community liaison and communication on the outcomes of research relevant to the objectives of the PHCC.	<ol style="list-style-type: none"> 3. Establish a portal for future access to research 4. Prepare a gap analysis for research and monitoring and strategies to reduce the implementation gap
v. Facilitates co-investment and funding for monitoring, research and model development and evaluation.	<ol style="list-style-type: none"> 5. Prepare an updated Science Strategy for the Peel-Harvey, incorporating broader catchment issues as well as estuarine and riverine
vi. Maximises the opportunity to build science capacity in the region using PhD programs, relationships with the university sector relevant to estuarine, catchment, riverine and nearshore marine adaptive research (including restoration) and Commonwealth and State funding programs.	<ol style="list-style-type: none"> 6. Using updated Science Strategy facilitate collaborative research programs to address priority research needs 7. Develop the Peel-Harvey Catchment reporting framework 8. Prepare and communicate Annual Report/s based on agreed reporting framework 9. Provide sound and timely scientific advice to PHCC 10. Be an advocate for science and scientific research in the Peel-Harvey Catchment

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	<p>These activities are referred to as the PHCC Science Integration Project hereafter. Funding for this project via the DRD and underwritten by PHCC will cease in 2019/20. It is probable that a revised Science Strategy will re-iterate the need for leadership in science and the integration of scientific method in the measurement and evaluation of PHCC projects in keeping with Goal 4, Facilitating Collaborative Adaptive Management of PHCCs NRM Strategic Directions.</p> <p>Funding for this position (Science Advisor) was continued to June 2021 through DPIRD as a 2017 State Election commitment known as the Peel-Harvey Estuary 1FTE Project.</p>															
<p>3. New investment in science will be required over a number of years for capacity to be developed to enable reliable prediction of the future status of the estuary. The type and accuracy of data required for quantitative modelling will depend on the questions asked, accuracy required, timing and level of risk acceptable for interpretation. Over time, knowledge and data needs to accumulate towards meeting the objective of evolving longer-term modelling and management requirements. Areas in which knowledge gaps have been identified, and thus which require new research, include the following.</p>	<p>In a similar approach to the response to Recommendation 1 above, the current status (March 2021) of qualitative modelling activities that address each of these elements is shown below.</p> <table border="1" data-bbox="1256 906 2112 1110"> <thead> <tr> <th data-bbox="1256 906 1471 1110">Program Name</th> <th data-bbox="1471 906 1686 1110">Funding Body</th> <th data-bbox="1686 906 1912 1110">Delivery Agent</th> <th data-bbox="1912 906 2112 1110">Funding Expiry</th> </tr> </thead> <tbody> <tr> <td data-bbox="1256 1110 1471 1206">i.</td> <td data-bbox="1471 1110 1686 1206"></td> <td data-bbox="1686 1110 1912 1206"></td> <td data-bbox="1912 1110 2112 1206"></td> </tr> <tr> <td data-bbox="1256 1206 1471 1343">ii.</td> <td data-bbox="1471 1206 1686 1343">ARC Linkage LP150100451/ PHCC</td> <td data-bbox="1686 1206 1912 1343">ARC with various</td> <td data-bbox="1912 1206 2112 1343">Murdoch University / PHCC</td> </tr> </tbody> </table>				Program Name	Funding Body	Delivery Agent	Funding Expiry	i.				ii.	ARC Linkage LP150100451/ PHCC	ARC with various	Murdoch University / PHCC
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<p>i. Development of a quantitative food-web to enable an understanding of the trophic pathways for bird and fish populations in the estuary;</p>	<p>Partially addressed – identified as a gap. The link between fish and bird population food webs is currently not being investigated.</p>															
<p>ii. The adoption of remote-sensing technologies to allow mapping of the spatial coverage of submerged macrophytes, accumulations of macrophyte wrack along the shores, littoral and fringing vegetation and shallow mudflats;</p>	ARC Linkage LP150100451/ PHCC	ARC with various	Murdoch University / PHCC	2019/20												

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iii.	Basic but accurate bathymetry that provides data to build a hydrodynamic and sediment transport model for the estuary, capable of defining future impacts of changing water fluxes from river flows, changes in sea level, storm surges and wind conditions;	ARC Linkage LP150100451/ REI	partners / State Govt.	University of WA	
iv.	The role of sediments, particularly monosulphidic black ooze (MBOs), in the de-oxygenation of water and the entrapment and release of nutrients;	ARC-Linkage Project LP0991658		Murdoch University; Bush et al. 2012 and various studies by Morgan et al. 2012.	2011/2012
v.	Estimation of nutrient and sediment fluxes within the estuary, through production of a biogeochemical model based on the hydrologic and sediment transport model that is linked to ocean interchanges and entrance channel modification;			University of WA	2019/20
vi.	Detailed sedimentology throughout the estuary, including in coastal waters and land near the estuary entrance, to facilitate more accurate predictive models of longer term climatic change on the estuary and its foreshores. Its basic form should allow scenario testing for assessing various engineering solutions for adaptive management, and be able to cope with various and changing assumptions around climate change predictions;	Partially met by ARC-Linkage LP150100451			
vii.	Research surveys of recreational fishing be undertaken at least at five-yearly intervals, and that the potential of using fixed video cameras at jetties, shore locations and boat ramps, such as the Department of Fisheries is testing in other locations, should be considered for use in monitoring recreational fishing effort in the Peel-Harvey Estuary in the intervening years.	Harvest Strategy (MSC)	DPIRD (Fisheries)	Fisheries, Recfishwest	2020/2021

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viii.	Development of multi-metric biotic indices (e.g. from fish or benthic invertebrate characteristics) for quantifying year-to-year changes in estuarine health condition;	(i) ARC Linkage LP150100451 (ii) Peel-Harvey Estuary Grants (iii) Wetlands & People (iv) Restoring the Serpentine River	(i) ARC and various partners (ii) DPIRD (iii) NLP/RLP (iv) Alcoa Foundation	Murdoch University	2019/20
ix.	A pre-feasibility study involving an expert panel that identifies the contribution to estuarine nutrient loads by various land uses in the catchment, in order to ascertain the practicality of introducing a pricing or taxing arrangement that requires or enables funds to be applied to the future management of the estuary and its associated riverine and nearshore marine waterways.	<p>The pre-feasibility study for introducing a pricing or taxing arrangement has not been implemented and is identified as a gap.</p> <p>DWER produces nutrient reports for the 13 subcatchments of the Peel-Harvey estuary on a five-yearly cycle with yearly updates. The five-yearly reports present results of a trend analysis of nutrient concentrations as well as linking nutrient loads to various land uses (from 2007) within each subcatchment through modelling. The yearly updates present nutrient concentrations and loads for the preceding year. Both the modelling and the landuse mapping were reviewed in preparation for the scenario modelling for development of a contemporary WQIP delivered through the REI.</p>			
<i>Development of models and indices</i>					
4. That the PHCC:		The ARC Linkage Project LP150100451 was set up to deliver all of these modelling components. The PHCC was a Partner Organisation			
i.	Note that work is funded by the Western Australian Marine Science Institution (WAMSI) and currently progressing to develop a set of qualitative models for				

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<p>supporting the future development of quantitative ecosystem models that will provide decision support tools for the management of the ecosystem health of the Peel-Harvey Estuary;</p>	<p>in this project with the PHCC Science Advisor playing a central role in communication between the research team and the partner organisations, and ensuring the research outcomes meet the expectations and requirements of the partners.</p>
<p>ii. Note that the funding of a modelling workshop to define the type of quantitative model required to meet future management needs of the Peel-Harvey Estuary has been approved by WAMSI. The work on both this and the above initiative is planned to be completed by early 2011 (refer to section 6.1).</p>	
<p>iii. Endorse the merits of the proposed strategy for development of the ecosystem health indices and predictive models as described in Chapter 6.</p>	
<p>iv. Subject to the outcomes of (ii) above, the priority is for the funding of the development of a coupled hydrodynamic, biogeochemical and ecological model, which can be used as a risk-based decision tool by providing predictions of estuarine physical and ecological status arising from current and future population and climate change scenarios. This model should also account for spatial and seasonal shifts in the physico-chemical characteristics of the Peel-Harvey Estuary, as required. The key to building this model is its construction in modular form that allows each component to be built independently and integrated as needed, or as resources allow. The construction of this model could be undertaken by a range of agencies, with the correct governance arrangements. The ownership, coordination and integration of such a tool by the PHCC will be a key driver for its successful completion and utilisation.</p>	
<p>5. Independent of the coupled model referred to above, it is plausible to fund, at lower cost, the development of estuarine health indices, including identification of their main environmental drivers, and provide the resultant information in forms</p>	<p>The development of estuarine health indices based on fish, submerged aquatic vegetation, sediment quality and benthic</p>

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<p>that (i) are easily understood and accessed by the community and (ii) are appropriate for rigorous surveys of ecosystem status. Such an approach could be used to provide a comparative assessment of the ecosystem health of key south-western Australian estuaries over a time series. However, compared to the coupled model, its predictive capacity is limited.</p>	<p>organisms and fish populations was one of the deliverables of the ARC Linkage Project LP150100451.</p> <p>Development of a report card for the Ramsar Site, published in 2019, including shorebirds, water quality (estuarine and catchment) in addition to these biotic health indices through the Science Integration project addresses this recommendation.</p> <p>A revised Science Strategy should focus on continuing the existing monitoring programs that underpin these indicators of estuarine and catchment health and to implement those undertaken through the ARC Linkage project as appropriate.</p>
<p><i>Community, governance and science partnerships</i></p>	
<p>6. Management of estuaries needs to be adaptive and have an effective governance and accountability framework that engages a partnership between the community and governments in understanding not only the future risks for estuaries, their catchments and adjacent riverine and nearshore marine waters, but also in the mitigation strategies to effectively manage complex natural resource issues. The community must be empowered through effective reporting and engagement to bring overall management performance to account, politically and through legislation.</p>	<p>This recommendation also relates to, and is dependent on, implementation of many of the other recommendations especially Recommendations 1 (monitoring), 2 (science integration), 3 (modelling), 5 (health indices) and 9 (management and stewardship responsibilities and arrangements). It aligns closely to the PHCCs Vision and Mission Statement and is likely to remain a long-term aspiration goal for the PHCC when the Science Strategy is reviewed.</p> <p>The ARC Linkage Project LP150100451 investigates the connection between estuarine health and societal expectations of ecosystem services and socioeconomic benefits derived from the Peel-Harvey Estuary. This may be a powerful way to increase community involvement in estuary and catchment management. Other</p>

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	mechanisms for direct community engagement include farm soil testing and nutrient mapping through the REI and Transform Peel.
<p>7. To facilitate an understanding of the effectiveness of existing management programs for reducing nutrient loadings into the Peel-Harvey Estuary, the Auditor General should be requested, via the Environmental Protection Authority (EPA), to undertake a performance audit of the progress of actions proposed by that agency under its Water Quality Improvement Plan (November 2008). This review would effectively establish a benchmark for future audits and reporting. One of the audit outcomes needs to determine a cost effective means of agency performance reporting on a regular basis, including the prospect of ongoing audits every five years.</p> <p>8. That the PHCC work with the Minister for Water and the Minister for Environment to seek:</p>	<p>A new WQIP for catchment of the Peel-Harvey Estuary is under development as a project under the REI from 2017/18 onwards. This project involved a review of the current WQIP (EPA 2008) and actions taken to date to implement the recommendations. The project is being led by DWER. The WQIP was to have actions to satisfy the environmental commitments of the SAPP. The effect of the demise of the SAPP and PHEMC is yet to be determine.</p> <p>The recommendation to include on-going five-yearly performance audits was given in-principle support by PHCC in their response to the Science Strategy in 2011, pending revision of the WQIP. It is therefore likely that this recommendation will be retained in a revised Science Strategy.</p>
<p>i. the establishment of a new reporting framework to require Natural Resource Management (NRM) agencies, Local Government and relevant authorities to report to a single agency charged with providing annually a report on the ecosystem health status of the Peel-Harvey Estuary. This agency would also be responsible for describing the current and predicted impacts on the estuary and its catchment from climate change and anthropogenic activities, and separately on the progress and success of mitigation strategies to reduce risks to the health of this ecosystem.</p>	<p>Development of a reporting framework is being progressed through the Science Integration / 1 FTE and ARC Linkage LP150100451 projects. Predicted impacts on the estuary and catchments will be at least partially addressed through development of a framework for an Estuary Response Model through the ARC Linkage Project. Development of this model was also supported through the commitments of the SAPP.</p>

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<p>ii. the immediate development of an interim reporting format for assessing the ecosystem health status of the Peel-Harvey Estuary within the context of south-western Australia, covering at least the Swan-Canning Estuary, the Leschenault Estuary, the Vasse region, Hardy Inlet, Wilson Inlet and Oyster Harbour.</p>	<p>From a State Government perspective, these projects and initiatives are driven by the DPIRD, DPC and DWER. It is unlikely that a single agency will take responsibility for the on-going collation of data to support the report cards and the model (see 8 iii below).</p> <p>The REI and HEWA (see the response to Recommendation 14 below) encompasses all of these estuaries with the exception of the Swan-Canning, however it does not propose a common reporting format to communicate estuarine health.</p> <p>As discussed above, the ARC Linkage LP150100451 and Science Integration / 1 FTE projects support development of a reporting format for the Peel-Harvey and the outcomes from these will be considered in a revised Science Strategy.</p>
<p>iii. the requirement, by legislation, of relevant Government agencies to report to a single agency on the performance of their functions and programs relevant to the ongoing management of the Peel-Harvey Estuary, its catchment and its adjacent riverine and nearshore marine waterways. Importantly, this should include as relevant, programs such as the Water Quality Improvement Plan (EPA, 2008) and the Monitoring Requirements for the Peel-Yalgorup Ramsar Site (Hale, 2008).</p>	<p>There was a change to the Machinery of Government in 2017/18, with the amalgamation of DoW and DER (to form DWER), and DAFWA, DoF and DRD (to form DPIRD) and Botanic Gardens and Parks Authority, Rottnest Island Authority, Zoological Parks Authority and DPaW (to form DBCA). The function and form of each of these agencies is now established. It is unlikely that legislation will be introduced requiring a single agency to collect and collate information.</p> <p>The Peel-Yalgorup System Ramsar TAG meets annually. At the March 2017 meeting, data from the current monitoring programs were collected and compared against the Limits of Acceptable Change for the various components of the Ramsar site according to the</p>

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	<p>Ecological Character Description of the Peel-Yalgorup Ramsar Site (Hale and Butcher, 2007) and the Monitoring and Evaluation Guide for the Peel-Yalgorup Ramsar Site (Hale, 2008). This resulted in the development of the Baseline Report Card for the Ramsar 482 Peel-Yalgorup System. Collection and collation of data through this collaborative forum is likely to be more effective than legislation.</p>
<p>9. The objectives of the PHCC should change to reflect stewardship responsibilities not only for the catchment, but also for the ongoing ecosystem health of the Peel-Harvey Estuary and its waterways, including its adjacent riverine and nearshore marine areas.</p>	<p>PHCCs Vision for the Peel-Harvey Catchment states <i>“The Peel-Harvey Catchment is once again a flourishing network of interconnected, productive landscapes, with diverse, healthy and resilient ecosystems, globally and locally recognised, acknowledged and embraced for its environmental significance. It is wisely managed by a community that values it – people working together for a healthy environment.”</i></p> <p>PHCCs mission statement is as follows: <i>We are key agents for change towards a healthier Peel-Harvey Catchment. As environmental stewards we will encourage and enable effective catchment management to create a healthier natural environment in the Peel-Harvey by:</i></p> <ul style="list-style-type: none"> • <i>Building community education and capacity</i> • <i>Influencing and leading critical thought and environmental pride</i> • <i>Exemplifying and implementing best practice</i> <p>Neither the vision nor the mission statement preclude having stewardship responsibilities for the ecological health of the Peel-Harvey Estuary and waterways and so the objectives of PHCC do not need to change in this respect.</p>

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	<p>DWER are responsible for the management of estuaries and waterways with DPaW responsible for wetlands and Water Corporation for much of the drainage network. These agencies and PHCC are represented on the Peel-Harvey Estuary Management Committee (PHEMC). PHCC needs to ensure that it works with these agencies and advocates for improving the ecological health of the estuary, waterways, drains and wetlands through these working relationships and PHEMC but does not assume their responsibilities. Current examples are the ARC Linkage Project, REI, Transform Peel and the three-way Drainage Partnering Agreement: Integrating drainage and catchment management in the Peel-Harvey Catchment between DoW, Water Corporation and PHCC.</p> <p>PHCCs response in 2011 to the suggestion that stewardship of nearshore marine areas should be included is unlikely to change in a revised Science Strategy i.e. “...the priorities of the PHCC are the catchment, estuary and Ramsar assets of the Peel-Harvey until capacity allows consideration of extending to the marine environment”, however this issue needs to be considered in a broader context than the Science Strategy.</p> <p>PHCC has also implemented monitoring programs to assess the ecological health of the Serpentine, Murray and Harvey Rivers and the Hotham-Williams system using the protocols described in the South West Index of River Condition (SWIRC).</p>

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<p>10. That the PHCC is sufficiently funded so that its core responsibilities can be undertaken without continually detracting from its role caused by the requirement to seek funds from various sources to ensure its ongoing operations.</p>	<p>PHCC has supported research to protect the ecological health of the nearshore marine environment where there are obvious links to the ecological health of the estuary and waterways e.g. the assessment of the near shore and estuarine dolphin population by the Murdoch University Cetacean Research Unit; the harvest strategies for blue swimmer crab (DoF 2015a) and finfish (DoF 2015b) for the Peel-Harvey estuarine Fishery (DoF and MSC Certification); The Peron Naturaliste Partnership Coastal Monitoring Program and Coastal values assessment, closely linked to the ARC Linkage project.</p> <p>This is an ongoing aspirational goal for the PHCC, and has not yet been achieved. It is as relevant in 2021 as it was at the time the Science Strategy was written (2011) and should remain in a revised version, noting the following:</p> <ul style="list-style-type: none"> • The National Landcare Program / Regional Land Partnerships (NLP/RLP) funding model for 2018/19 to 2022/23 was via a tender process. PHCC was successful in obtaining funds for individual projects, however the organisational core funding to underpin these projects was insufficient. • Funding for the State Government initiatives including the REI and Transform Peel projects ceased in 2019/20, replaced by HEWA • Funding for the Science Integration project ceased in 2019/20 but activity was continued through the Peel Harvey Estuary 1FTE project to June 2021. • PHCC has diversified its funding streams through working with industry e.g. perform restoration works on the Serpentine and

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	<p>Murray Rivers via grants from the Alcoa Foundation for 6 years 2018 – 2023 inclusive.</p>
<p>11. That the Departments of Water and Environment and Conservation, in consultation with the State’s NRM regions, catchment councils and EPA, explore the principles outlined in the Swan and Canning Rivers Management Act 2006 to determine how a similar but more general Act (or modification of the Waterways Conservation Act 1976) could be modelled to provide legislation relevant to the management of the State’s other key estuaries and their catchments.</p>	<p>In 2015 the (then) Labor Opposition proposed the introduction of an Act for the Peel-Harvey Estuary mimicking the Swan and Canning Rivers Management Act 2006. This was abandoned prior to the 2017 State Election.</p> <p>The revised version of the Science Strategy should describe the fate of this attempt. The primary objective of the REI and HEWA is to halt the decline and degradation of six at-risk estuaries in South Western Australia with particular focus on water quality. This is an important step towards recognising and tackling the issues facing estuary management <i>en bloc</i>.</p>
<p>12. It is necessary to secure long-term funding to underpin a monitoring program that measures and reports on the current and predicted ecosystem health of the Peel-Harvey Estuary. The PHCC should consider the science strategy and develop the business case for the adoption and funding (where necessary) of the ongoing and proposed new monitoring and research, as summarised in Appendix 1 in this report. This science strategy will require a long-term funding commitment of about \$14 million, in today’s dollars, over a 10 year period.</p> <p>13. The pathway to gaining security around future funding for monitoring, evaluation and reporting on the current and future predicted ecosystem health of the Peel-Harvey Estuary requires appropriate problem recognition, community support and political action.</p>	<p>This is an ongoing aspirational goal of the PHCC and DWER and DBCA who have a responsibility in management of the estuary and wetlands. Meeting the environmental commitments of the SAPPR, was the most likely mechanism for funding long-term monitoring programs, however this is unlikely to occur with the current suspension of the SAPPR.</p> <p>It is likely that this recommendation will remain.</p> <p>The Science Strategy provides a detailed summary of the current monitoring, evaluation and reporting programs for the Peel-Harvey Estuary. It also identifies gaps and deficiencies and the requirements for future programs to address these. These requirements have been reviewed (in 2015/16) and are subject to ongoing review as part of</p>

Table 1: Summary of the Review of the Science Strategy for the Peel-Harvey Estuary: how the current state (and gaps) in science, research, monitoring, modelling and management responsibilities have and will affect the recommendations from the Science Strategy

Recommendation	Response / Comment
	<p>the Science Integration and 1 FTE projects at PHCC. This is summarised in the responses to Recommendations 1, 3, 4 and 5 above. An on-going problem is convincing funding bodies of the value of monitoring programs.</p> <p>The partnerships formed in the REI projects for the Peel-Harvey Estuary is a formal recognition of roles and responsibilities that State Government Departments, the PHCC, private landholders and the community in general have in improving the water quality and ecological health of waterways in the region.</p> <p>The ARC Linkage Project LP150100451 illustrates the role that local government and universities can play in applied research and how funding from the state and federal government can be leveraged. If implemented, the SAPPR would have provided a whole-of-government approach to land use planning while meeting and providing on-going funding for the associated environmental obligations. These initiatives combined should provide a blueprint for the future management, monitoring, evaluation and reporting of ecosystem health.</p>
<p>14. One possible pathway is for the community to seek a formal, independent, Government-lead inquiry, with appropriate terms of reference, that examines the current status of the State’s significant estuaries with respect to their funding, legislative and governance arrangements and their programs for monitoring, evaluating and reporting ecosystem health status. The inquiry needs to take into account the current and future risks for these estuaries from the impacts of climate change, population growth, freshwater extraction and catchment</p>	<p>The funding of the REI, the Revitalising Geographie Waterways and currently HEWA is a formal acknowledgement by the State Government of the decline and degradation of six of the seven estuaries identified in this recommendation (i.e. all except the Swan-Canning). DBCA Rivers and Estuaries, formerly operatives of the Swan River Trust, receive an ongoing funding allocation for management of Swan-Canning Riverpark.</p>

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Recommendation	Response / Comment
<p>development. The inquiry, as a minimum, ought to focus on the Swan-Canning Estuary, the Peel-Harvey Estuary, the Leschenault Estuary, the Vasse region, Hardy Inlet, Wilson Inlet and Oyster Harbour, and their relevant catchments.</p>	<p>The consultation process for the SAPPB was used as an opportunity for the community, represented by PHCC, community groups and other non-government organisations to bring attention to impacts identified in this recommendation and identify strengths and deficiencies in the commitments to protect the environment in the face of planned future development. The SAPPB was not limited to impacts on estuaries and waterways health, however these were front and centre in the environmental commitments.</p> <p>The SAPPB was a State Government initiative, led by the DPC, but also requires endorsement by the Federal Government DoEE. It was therefore not an independent review, but the whole-of-government approach would have ensured that the department responsible for management of the Peel-Harvey Estuary was not performing the review under its own auspices.</p> <p>This opportunity for the Peel-Harvey was lost with the demise of the SAPPB and so this recommendation is still relevant for inclusion into the Science Strategy when revised in 2021.</p>

Glossary

Abbreviation	Definition
ARC	Australian Research Council
ARC Linkage Project LP0991658	Project entitled 'Hyper-accumulations of monosulfidic sediments: Exploring a biogeochemical extreme to resolve fundamental sulfur biomineralisation pathways' led by Southern Cross University supported by scientists from Department of Water, Department of environment and Conservation' Curtin University, University of WA and funded by the ARC and Partner Organisations, WA Department of Transport, Shire of Murray, City of Mandurah 2009-2012
ARC Linkage Project LP150100451	Project entitled Balancing estuarine and societal health in a changing environment led by Murdoch university supported by researchers from UWA, Sothern Cross University, University of Hull and funded by the ARC and Partner Organisations: Department of Premier and Cabinet, Murdoch University, City of Mandurah, Shire of Murray, Peel-Harvey Catchment Council. 2016-2020
CoM	City of Mandurah
DAFWA	WA State Government Department of Agriculture and Food WA
DBCA	WA State Government Department of Biodiversity Conservation and Attractions
DER	WA State Government Department of Environment Regulation
DoEE	Australian Government Department of the Environment and Energy
DoF	WA State Government Department of Fisheries
DoW	WA State Government Department of Water
DPC	WA State Government Department of Premier and Cabinet
DPIRD	WA State Government Department of Primary Industries and Regional Development
DRD	WA State Government Department of Regional Development
DWER	WA State Government Department of Water and Environmental Regulation
HEWA	Healthy Estuaries WA
MLFA	Mandurah Licensed Fishermen's Association
MSC	Marine Stewardship Council
NLP/RLP	National Landcare Program / Regional Land Partnership
Peel Harvey Estuary 1FTE Project	DRD project number-Proj-1017-0487-2 to support the Science Advisor position at PHCC.
PHCC	Peel-Harvey Catchment Council

PHEMC	Peel-Harvey Estuary Management Committee
REI	Regional Estuaries Initiative: a 4-year program designed to halt the decline and degradation of six at risk estuaries in South Western WA, namely: Peel-Harvey Estuary; Leschenault Estuary; Vasse-Wonnerup Estuary; Hardy Estuary; Wilson Inlet and Oyster Harbour;
SAPPR	Strategic Assessment of the Perth and Peel Region
SoM	Shire of Murray
SWIRC	South West Index of River Condition
WQIP	Water Quality Improvement Plan

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