URBIS

ECONOMIC EVALUATION PEEL HARVEY WATERWAYS

Prepared for Peel Development Commission & Peel Harvey Catchment Council

April 2023

CONTENTS

PREPARED FOR

GOVERNMENT OF WESTERN AUSTRALIA

PEEL Development Commission

PARTNERS

PHCC Working Together Peel-Harvey Catchment Council

CITY OF MANDURAH

Shire of Murray

Urbis acknowledges the important contribution that Aboriginal and Torres Strait Islander people make in creating a strong and vibrant Australian society.

We acknowledge, in each of our offices, the Traditional Owners on whose land we stand.

Cover image credit: Next Level Drone & Photography Services and Visit Mandurah

EXECUTIVE SUMMARY

THE PEEL HARVEY WATERWAYS (PHW) IS AN ICONIC SYSTEM OF RIVERS AND ESTUARIES THAT ATTRACT 3 MILLION TRIPS ANNUALLY. IT IS VITAL NOT ONLY TO THE WESTERN AUSTRALIAN ENVIRONMENT, BUT DELIVERS SIGNIFICANT BENEFITS TO RESIDENTS, VISITORS AND THE BROADER ECONOMY.

An important environmental asset.

The PHW support a large variety of life in the water, on the land and in the skies. As an internationally listed Ramsar Wetland, the Peel-Harvey estuary is recognised for its vital role in supporting migratory birds, aquatic life and endangered or at-risk plant and land animal species. The estuary connects to the Harvey, Murray and Serpentine rivers, which are key water bodies that support agriculture within Western Australia.

The management of the PHW has been uniquely challenging from pressures of human interaction with the estuaries and rivers. Over the 1970s-1980s, significant nutrient loads saw the ecosystem fail, requiring the Dawesville Cut to be built in 1991. To this day, however, the management of the system is challenging. Most recently this was witnessed in the largest fish kill experienced in WA along the Murray in 2017, the flow-on impact of which made its way to the estuaries.

The popularity and economic contribution of the waterways are irreversibly intertwined with the ecological sustainability and management of it and its tributaries. This report demonstrates the multifaceted impact that the quality of these biomes and environments have on the natural, human and economic vitality of not just the Peel region, but the broader WA economy.

There is a clear need to ensure the ongoing health of the PHW for both current and future generations.

A place that invites significant tourism and development.

The PHW support a large variety of activities and activation for local, regional and international visitors, attracting over 3 million estimated visits annually. Further to this, the Peel region is a high-amenity residential area with housing, dining and retail along the marinas and foreshores and into the adjoining natural areas behind the waterways.

Tourism activities are varied however centre around the natural capital in the area. Beyond food and beverage opportunities, a large number of residents and visitors use the waterways for recreational boating and fishing, socialising and sightseeing of the natural surroundings.

Through analysis of Human Movement Data (i.e. mobile phone location data), it is revealed that 37% of visitors to the region interact with the PHW.

In addition to experiences and amenity that attract tourists, the PHW supports residential development in the area and broader region.

An economically significant total and ongoing contribution to WA.

This report assessed the total economic value (TEV) and annual economic contribution of this important environmental asset in line with economic evaluation guidelines.

The evaluation is point-in-time and therefore subject to the current state of the waterways, and will therefore be influenced by any change in health of the ecosystem.

The total estimated economic asset value is estimated at equivalent to $20.8 billion (the equivalent of the construction value of 12 Optus Stadiums).

Annually, the economic contribution of the PHW was estimated at approximated $605.7 million, which supports over 2,000 full-time equivalent (FTE) jobs within the WA economy. While the broader Peel region supports a larger total workforce, this figure is representative of the FTE that is derived from the economic value supported by direct interaction with the PHW. There are likely a larger number of workers that benefit from existence of the waterways.

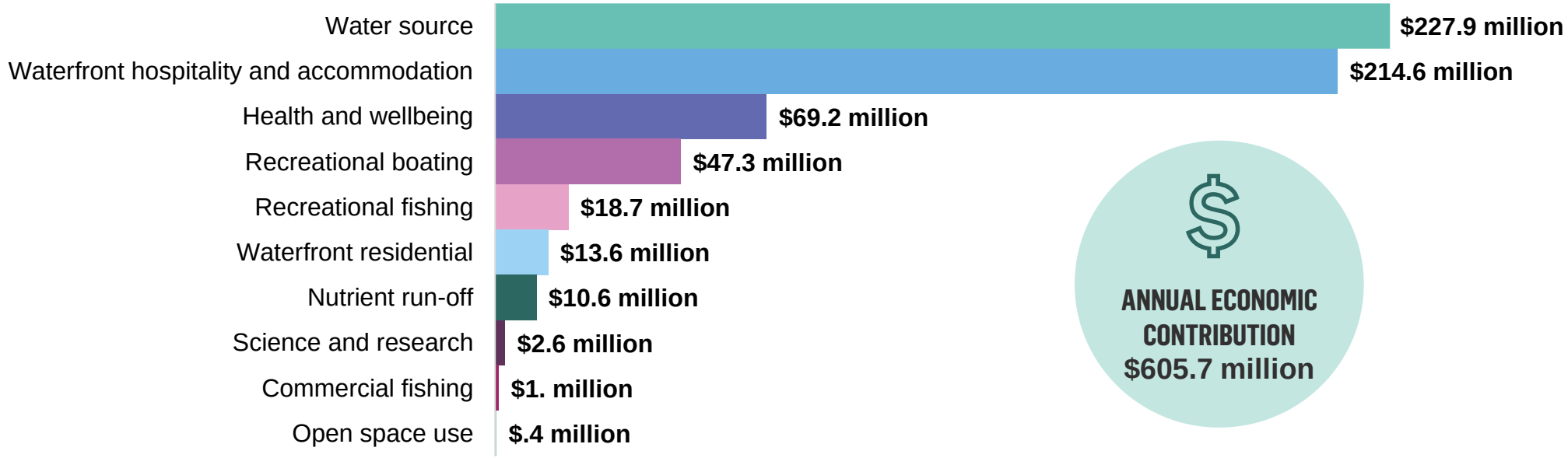
The annual economic contribution of the PHW represents a considerable proportion (7%) of the Peel region's Gross Regional Product which was $8.9 billion in 2021 (REMPLAN).

This ongoing contribution to the economy demonstrates the significant role that maintenance and health of the waterways plays within both the Peel region, and the broader WA economy.

The following pages (pp. 4-5) demonstrate the drivers of value in the PHW and the scale of benefits that they provide to the region. Activation of the area, commercial and recreational activities, health and wellbeing of visitors and residents using the waterways and the support for agriculture upstream all have significant and ongoing impacts on the WA economy.

EXECUTIVE SUMMARY CONT.

Annual Economic Contribution Peel-Harvey Waterways



Source: Urbis
n.b. these values represent the gross value added to the WA economy on an annual basis.

2,086
full-time equivalent jobs

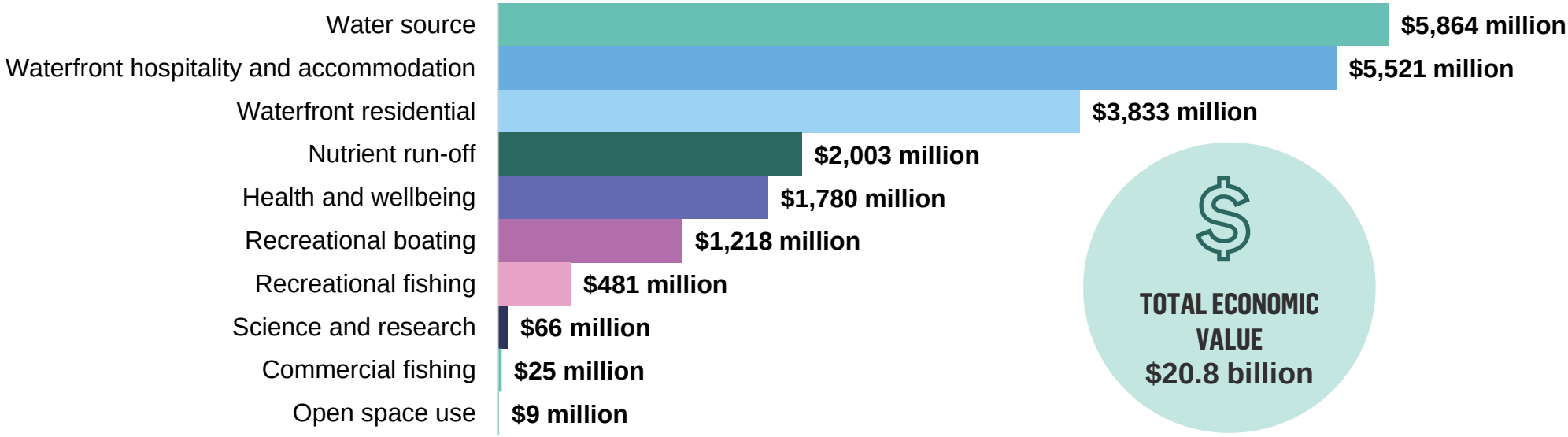
3 million
visits per annum

5 times
Annual economic contribution (GVA) of Ningaloo Reef

Source: REMPLAN, Urbis, Deloitte

EXECUTIVE SUMMARY CONT.

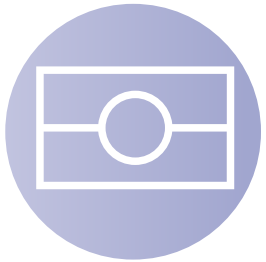
Total Economic Value Peel-Harvey Waterways (@ 3% discount rate over 50 years)



Source: Urbis

Additional Values (Qualitatively Assessed)

BIODIVERSITY



INDIGENOUS CULTURE

BEQUEST

BOAT OWNERSHIP

INTRODUCTION

PROJECT BACKGROUND & PURPOSE

The Peel Harvey waterways (PHW) is a significant natural asset located in Western Australia's Peel region. Internationally significant, the Peel Harvey estuary is recognised as a Ramsar Wetland due to its large scale and ecological importance in supporting protected and endangered species. The Ramsar listing is strongly related to the habitat that it provides for migratory bird species and Thrombolite structures, making it a unique and significant ecosystem.

This project has proactively looked to understand and quantify the value of the Peel Harvey waterways; and enable decision makers to understand the need to maximise this value to support the liveability and prosperity of the Peel region.

Healthy and functioning waterways provide significant socio-economic value to communities and regions. The benefits are broad and can include (directly and indirectly) business conditions, tourism, local population attraction, urban development, liveability and more. As such, in order to understand the importance of interventions to support the future of the waterways, this project will be critical.

PROJECT APPROACH

To understand the economic value of the Peel Harvey waterways, Urbis quantified both a total economic value and an annual economic benefit.

Input from the Peel Development Commission (PDC), Peel Harvey Catchment Council (PHCC) as well as stakeholders provided important context regarding the role the waterways play within the economy and social fabric.

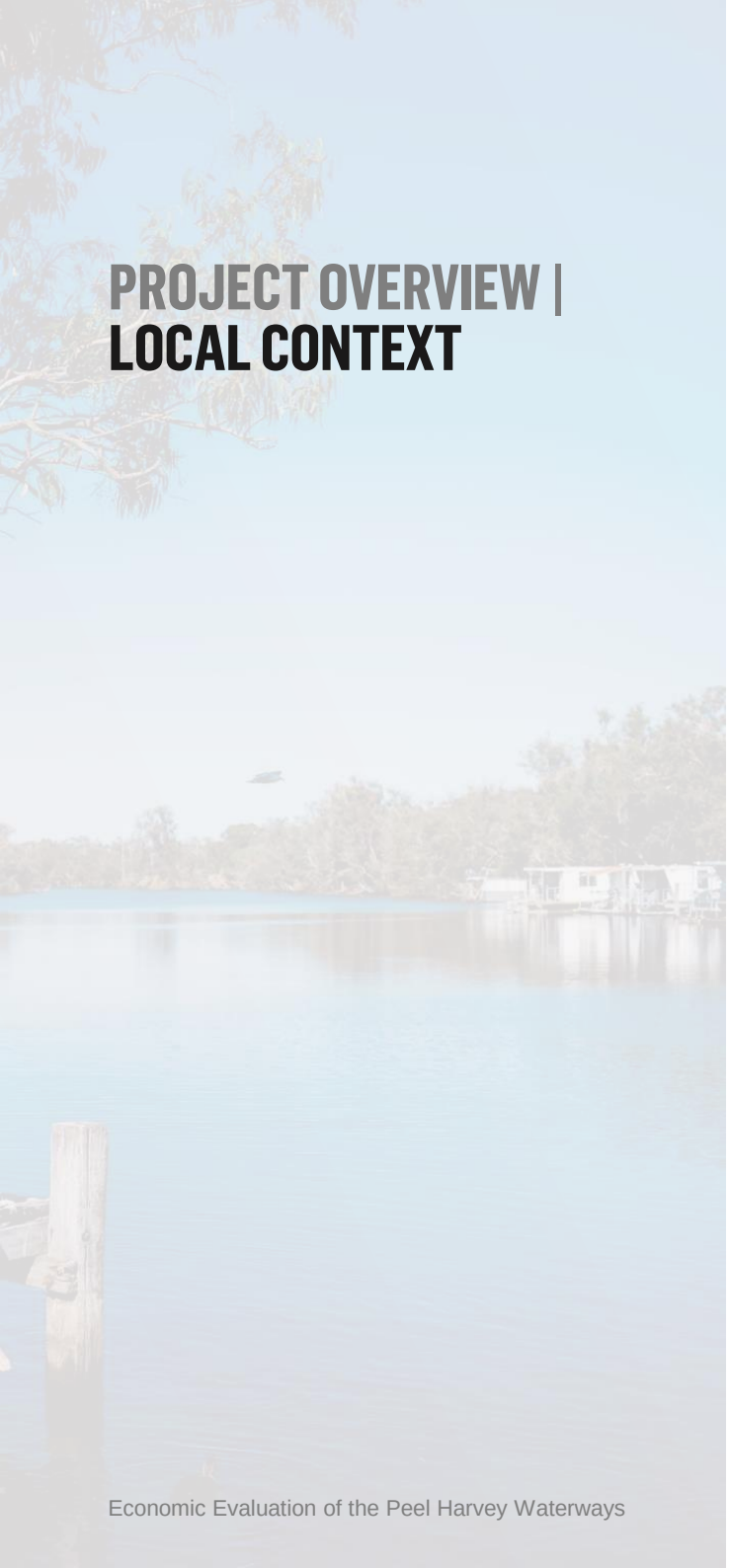
This study includes the following sections.

1) **Project overview** – overview of the study area and key user groups.
2) **Context analysis**– descriptions of how value is derived and the user groups that are impacted.
3) **Economic evaluation** – estimate of the total net economic benefits of the value drivers.
4) **Appendix** – including detailed methodology and human movement data insights

01

PROJECT OVERVIEW

Image credit:Visit Mandurah and Russell Ord Photography



PROJECT OVERVIEW | LOCAL CONTEXT

The Peel Harvey waterways have been a vital natural asset throughout history. First, under the custodianship of the Bindjareb Noongar people, the waterways were a key meeting place, particularly during migratory bird seasons. The waterway provided a meeting place and sustenance and was utilised with traditional practices.

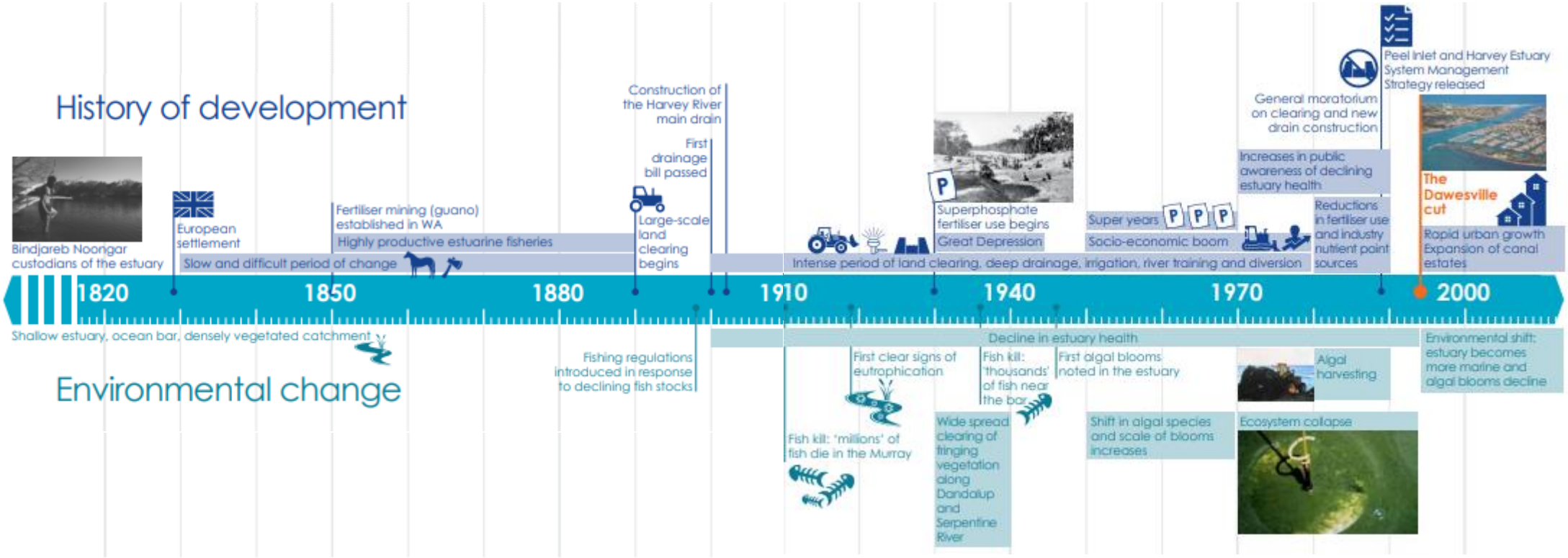
The Department of Water and Environmental Regulation's (DWER) 2020 Peel-Harvey Estuary Protection Plan (Bindjareb Djilba) tracks the history of the waterways (see p.9 for timeline). European settlement had profound impacts on the ecology and saw rapid built form changes, particularly since the 1850s. The waterways were used as a significant fishery, and exports of seafood from the region were of significant local and state value. Into the 1900s, land clearing and agricultural infrastructure saw the beginnings of ecosystem collapse. By 1990, these changes caused a collapse of the system, which pressured the nature of development and activity shift toward a more sustainable residential and tourism focus, and the implementation of the Dawesville Cut.

The Dawesville Cut was a transformational management intervention in response to a long term ecological management and eventual collapse, with the intervention effectively flushing the system. The aim of the Cut was to address the problematic macroalgal blooms that significantly effected the usability and amenity of the PHW. While the intervention was effective, it did not eliminate the cause and algal blooms and fish kills still occur in the Murray and Serpentine rivers.

While there are continued efforts to manage the ecological condition of the PHW, the condition appears to be in a state of decline (DWER). Some symptoms of poor estuary health include fish deaths, low oxygen water and the proliferation of nuisance algae.

The ecological condition of the PHW is inextricably linked to the value that it provides. We will address this link between the ecosystem and the value it provides through the concept of ecosystem services.

PROJECT OVERVIEW | HISTORY OF THE PHW



Source: DWER

PROJECT OVERVIEW | STUDY AREA

Overview

The study area defined for this project includes the Peel Harvey Catchment Council's definition of the Peel Harvey Estuarine System (Peel Harvey waterways (PHW)), and a limited buffer area of land around it.

The PHW defined area stretches through five local government areas, two regions and across hundreds of kilometres. The scale, at 144.2 sq.km, and natural features of the PHW make them a defining character in the Peel Harvey region.

The land area included in the study area for the purposes of data collection and analysis includes a limited collection of environmental protection zones, public open space and any area that is adjacent to the waterways but bounded by a road or building. The rationale for this definition is the need to capture only users who are undertaking activities that are directly driven by the waterways.

Map 1.1 – Study Area

PROJECT OVERVIEW | STUDY AREA ZONES

Overview

We have defined geographical ‘zones’ across the study area to allow analysis of the activation of different parts of the waterways as seen in map 1.2. The zones were chosen to be able to highlight the different usage patterns of different areas that result from the different activities undertaken.

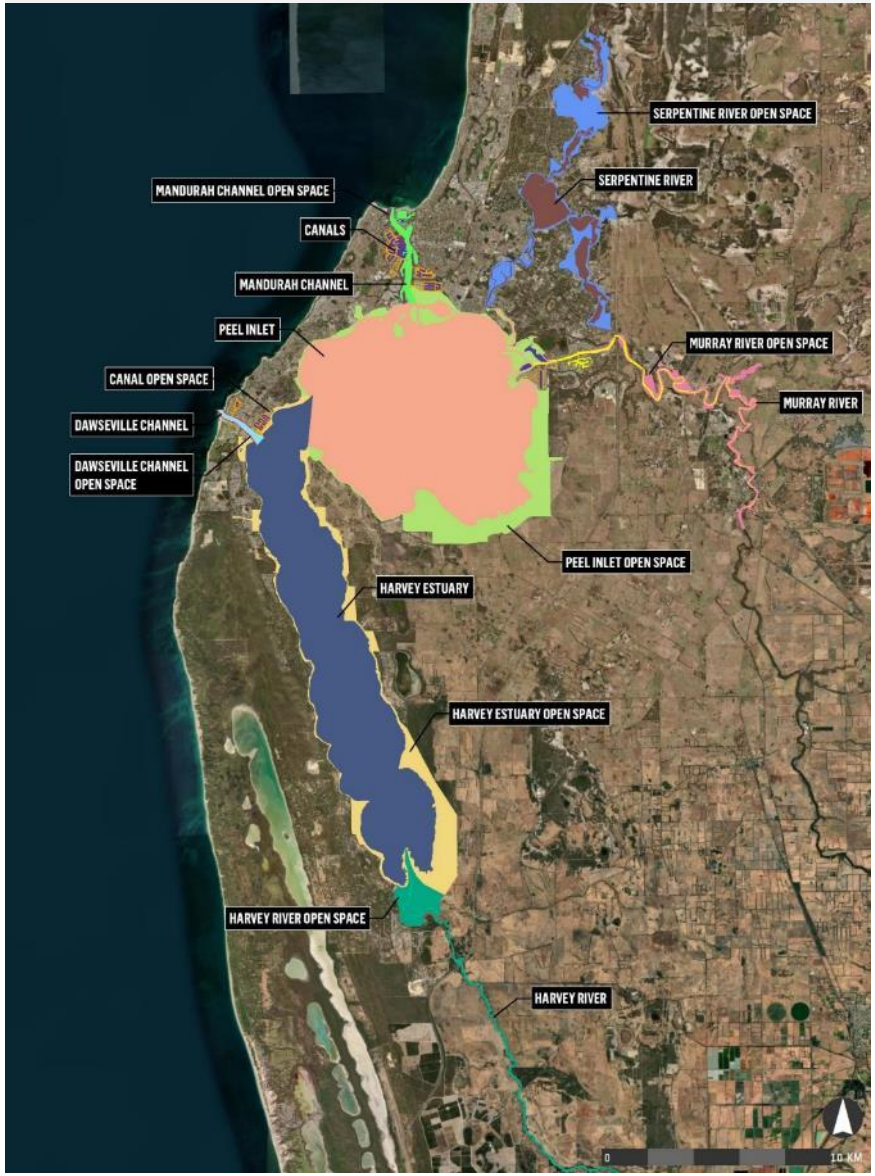
The waterways study area zones include:

- Dawesville Channel
- Mandurah Channel
- Harvey, Murray and Serpentine Rivers
- Harvey Estuary
- Peel Inlet
- The Canals, located across the region.

The Human Movement Data (HMD) analysis also includes areas of open space around the waterways, required to identify activation at the waters edge. Importantly, these areas are conservatively defined to ensure that only use directly related to the waterways is captured. These zones include:

- Canal Open Space
- Dawesville Channel Open Space
- Harvey Estuary Open Space
- Harvey River Open Space
- Mandurah Channel Open Space
- Murray River Open Space
- Peel Inlet Open Space
- Serpentine River Open Space

Map 1.2 – Study Area Zones



PROJECT OVERVIEW | ECOSYSTEM SERVICES

The PHW is a complex ecosystem. To evaluate the system effectively, in a way that provides the most accurate picture for decision makers to draw on, it is necessary to refer to the significant body of work in environmental economics that is concerned with valuing ecosystems.

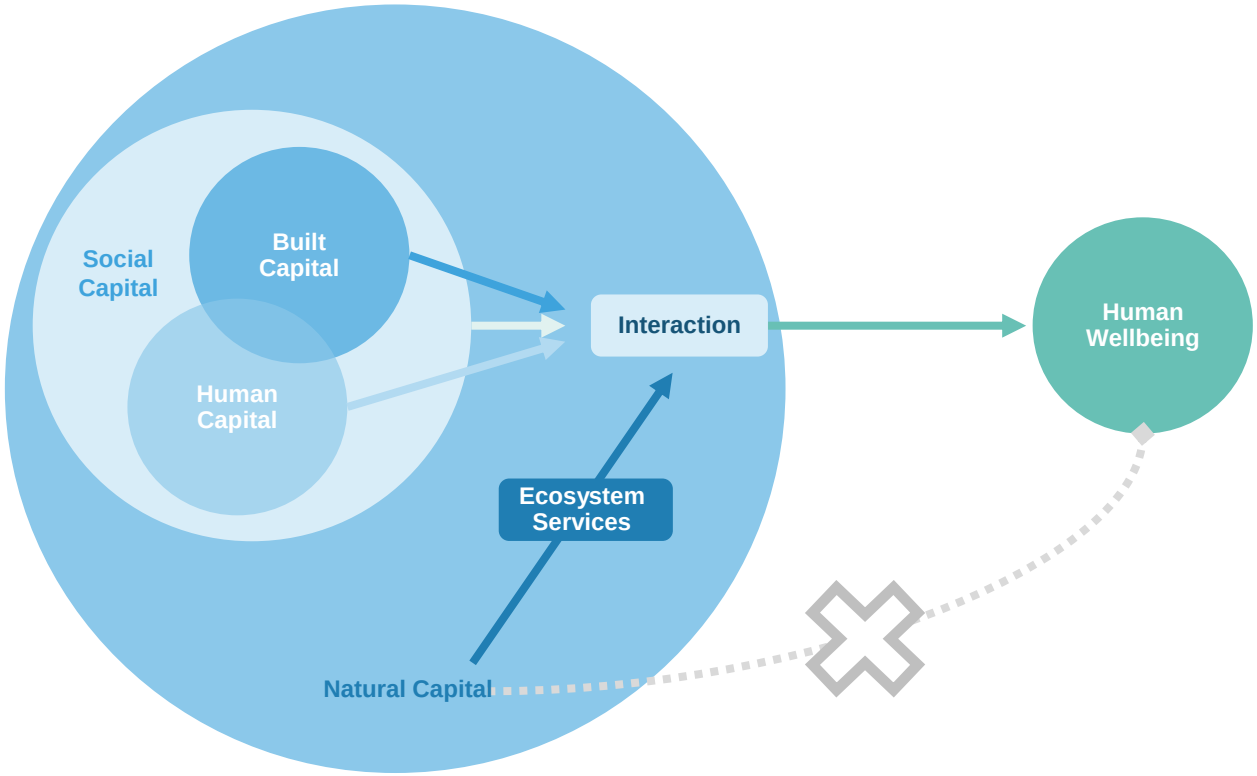
'Ecosystem services' is a valuation approach that rose to prominence in the 1990s as a means of showing that ecosystems provide value beyond just that which is extracted or exploited from them (Constanza et al 2017). This area of research has grown exponentially over the preceding decades, as academics, policy makers, the business community and civil society sought new ways of valuing the ecosystem services that ultimately support human life and wellbeing.

Ecosystem services are 'the ecological characteristics, functions, or processes that *directly* or *indirectly* contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems' (Constanza et al 2017, p.3).

The diagram to the right illustrates the idea that ecosystem services are the process by which natural capital is combined with other forms of capital to provide value to people. Natural capital itself doesn't contribute to human wellbeing without the interaction with other forms of capital.

To use an example from Constanza et al (2017), an ecosystem can offer fish for food, but boats and equipment (built capital) combined with human capital are required to deliver the value.

Biodiversity (or natural capital) is fundamental to the provision of ecosystem services (Department of the Environment, Water, Heritage and the Arts, 2009). The underlying biodiversity of an ecosystem, such as the PHW, is key to the value that it provides through ecosystem services.



Source: Constanza et al 2014 in Constanza et al 2017

PROJECT OVERVIEW | ECOSYSTEM SERVICES CONT.

The UN's Millennium Ecosystem Assessment (2005) categorised ecosystem services as depicted on the right. It highlights the different kinds of value that ecosystems support, many of which are relevant to the PHW estuarine ecosystem.

Section two of this report provides context to the drivers of value specific to PHW, some of which are underpinned by ecosystem services. The identification of these values came about through a combination of desktop research and engagement with a wide variety of stakeholders (see appendix D).

Section three provides qualitative and quantitative valuation of the value drivers identified previously. A number of ecosystem services are covered in the valuation section of this report, including cultural values and seafood as a food source.

While it is not possible to individually value each ecosystem service provided by the PHW, in part to avoid double counting where uses are inextricably linked, it is important to consider the underlying importance of ecosystem services to the quantified values. Simply, it is the services that the ecosystem provides that society is able to derive value from.

Throughout this report, it will be highlighted that the health of the ecosystem and access to the waterways is imperative for users to be able to continue their activities and experience the benefits of this natural asset.

Ecosystem Services

Supporting

Services necessary for the production of all other ecosystem services

- Primary production
- Soil formation
- Nutrient cycling

Regulating

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Water regulation
- Water purification
- Disease regulation

Cultural

Nonmaterial benefits obtained from ecosystems

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Educational
- Cultural heritage

Provisioning

Products obtained from ecosystems

- Food
- Fresh water
- Fuelwood
- Biochemicals

Source: Adapted from Millennium Ecosystem Assessment

02

CONTEXT ANALYSIS

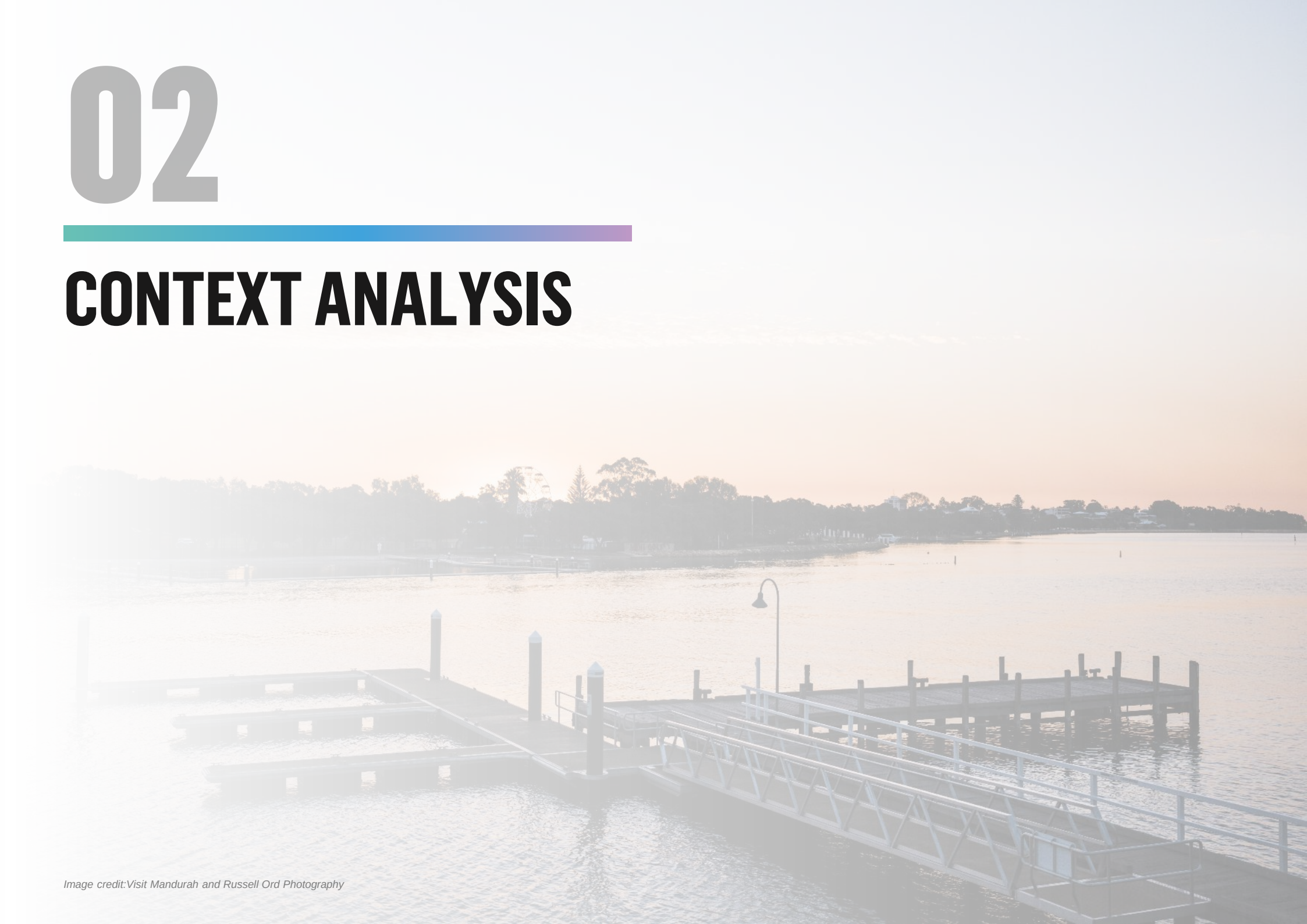


Image credit:Visit Mandurah and Russell Ord Photography

Key Findings

The Peel Harvey waterways are home to a complex and diverse ecosystem.

The Peel-Yalgorup System is recognised as a Wetland of International Importance under the Ramsar Convention, listed in 1990. Some of the area (e.g. Yalgorup lakes) recognised under this convention is beyond the PHW study area and therefore not included in the evaluation in this report.

The biodiversity of the waterways and surrounds is the underlying driver of effectively all sources of derived value. As discussed in section one, the biodiversity of the PHW supports the ecosystem services from which human wellbeing is derived.

For example, the Peel region has a strong association with fishing, both recreational and commercial. These pursuits rely on the provisioning service of the PHW to provide fish to catch.

The biodiversity of the PHW also supports cultural services in a number of ways. The tourism industry in the region relies on the flora and fauna in the system to deliver products that are unique and appealing to tourists. In particular, there are over 100 species of native and migratory birds that attract international visitation. The Peel Harvey estuary is an important part of the East Australasian Flyway for these migratory birds.

Over time as the ecology of the PHW has changed, the services that it supports have likewise changed. This is evident in the substantial decline in the commercial fishery as the available catch has changed.

Globally, there have been political and social movements toward the protection of significant natural ecosystems such as the Peel Harvey waterways as they are recognised for their unique biodiversity. This is captured in frameworks such as the UN Sustainable Development Goals which seek to protect both life on the land and in the sea. Further to this, a large body of research has been conducted to demonstrate the correlation between biodiversity, health, resilience and wealth.

Ultimately, the importance of biodiversity can be seen with people drawn to live, work and recreate in the Peel region as a result of the opportunity to experience a unique natural environment.

The diversity of biomes draws a variety of native and endangered species

Credit:Visit Mandurah and Russell Ord Photography

Key Findings

Boasting unique marinas, access to waterfront dining and retail and a series of boutique food, beverage and accommodation offers, the Peel Harvey waterways is a key value driver of the hospitality sector in the Peel region. The hospitality sector has a strong local spending base, which combined with the visitor market, supports activity around the PHW.

Urbis estimates that 13% of local spending on food and beverage can be attributed to the PHW (based on HMD and spending profile, see appendix C for details).

As shown through our Human Movement Data (HMD) activation analysis, the key catalytic areas land-side are the marinas where significant accommodation and food services offerings are available.

Hospitality in the region relies on the ecology of the Peel Harvey waterways in two primary ways.

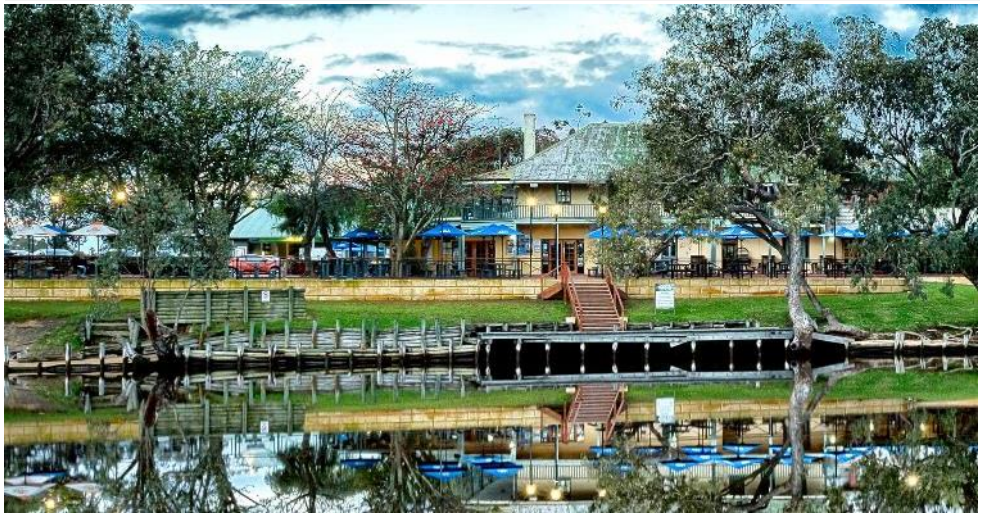
1. The biodiversity in the waterways means fresh, high-quality seafood is readily accessible to diners and casual fishers alike.
2. The current condition of the waterways providing a relatively pleasant waterfront environment and experiences that are free from most nuisance elements that are symptomatic of an unhealthy system (for example: algal blooms or odour).

Management of the ecosystem is therefore key to ensuring the vitality of the hospitality sector is maintained. Urbis calculates that the total spending attributable to the activation of the waterways is approximately $190.6 million annually, based on 2019 visitation spending and $37.8 million in local spending. Further details are contained in section three.

Overall, hospitality is one of the core drivers of the economy in the Peel Region. As this naturally centres around the unique aquatic environments, the waterways are fundamental to the success of the hospitality sector.

It is recognised that there have been multiple instances in recent history that the river has been closed due to poor ecological health, and these closures directly impact the ability for people to recreate and socialise in and around the water. This assessment however considered only the economic value of the current state of the PHW.

Ravenswood Hotel, with access to Murray River Waterfront



Credit:Visit Mandurah and Russell Ord Photography

Credit:Visit Mandurah and Russell Ord Photography

Key Findings

With a vibrant water ecology, the Peel Harvey waterways support significant volumes of both fish and crabs that are viable for commercial fishing operations. Commercial fishery was first established in the PHW in the mid 1800s and there were previously 150 family-based fishers operating in the PHW (Bradby, K; MLFA in DPIRD, 2022).

The fishery is currently managed as part of the West Coast Estuarine Managed Fishery (WCEMF). The commercial blue swimmer crab and sea-mullet fishery received the Marine Stewardship Council (MSC) certification in 2016 and was recertified in 2021.

There is a mix of commercial, recreational and cultural fishing that occurs within the Peel Harvey Estuary. Recently, a voluntary license buy-out scheme saw four of the remaining 11 licenses in 2018 within the Peel Harvey Estuary bought out to ensure a larger blue swimmer crab and fish population for recreation and cultural fishing purposes (DPIRD, 2022).

Data from the Department of Primary Industry and Regional Development (DPIRD), and that collected for MSC certification surveillance, demonstrates the level to which fishing activity occurs in the waterway, captured in table 2.1. Data on cultural fishing practices is not currently recorded.

The PHW is a multi-species fishery, with both blue swimmer crab and finfish retained by commercial fishers. Data provided by DPIRD (2022) indicates that sea mullet is the key finfish species retained by commercial net fishers (at 69% of the total retained catch from haul and gill nets between 2015 and 2019). Over the same period, yellowfin whiting (13%) and yelloweye mullet (8%) were the other prominent catches, with smaller quantities of other species also reported.

The key recorded catches in the area relate to blue swimmer crab and sea mullet, which have both been observed to vary over the reported period. For instance, the blue swimmer crab catch was reported at 96.6 tonne in 2015-16. Urbis has reported the arithmetic mean of the catch over the period in table 2.1.

The ongoing value of fishing to the waterways and those that use it directly rely on the ongoing health of the ecosystem.

Commercial Fishery Species / Volume — Table 2.1

CATCH TYPE	RETAINED CATCH - COMMERCIAL (TONNES) AVERAGE 2015-2019
Blue Swimmer Crab (2016-2021 average)	66.6
Sea mullet (2015-2019 average)	92.4

Source: Department of Primary Industry and Regional Development (DPIRD), 2022; Daume & Hartmann 2021

Credit: Marine Stewardship Council

Key Findings

Commercial fishing is part of a much larger fishing community in the Peel region, with residents and visitors alike travelling to the waterways to fish either by boat or one of the many marinas. The recreational swimmer crab fishery is the first recreational fishery in the world to receive MSC certification.

The waterways support ample opportunities for recreation, both boat-based and from land.

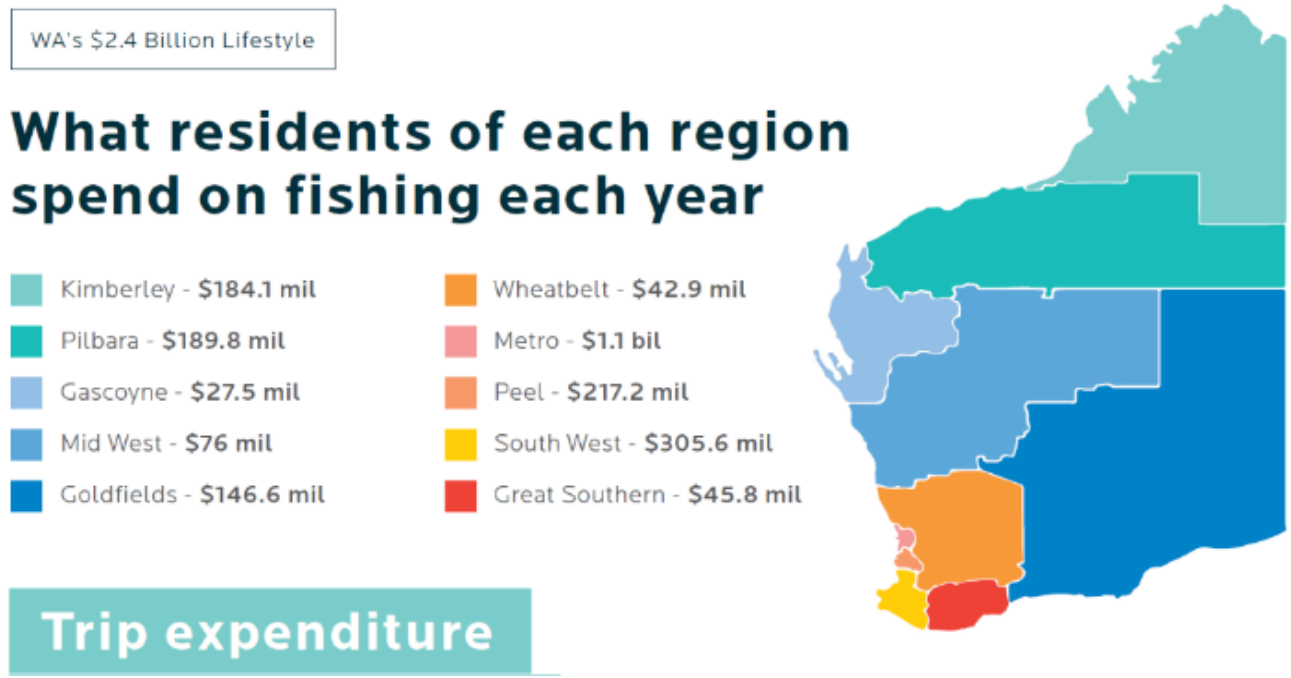
Fishing and boating are two primary examples of water-based activities where residents and visitors to the catchment derive benefit from the waterways.

It is estimated by Recfishwest that recreational fishing in the Peel region supports $217.2 million per year. This estimate is based on expenditure on items including equipment, bait and registration fees.

Beyond the health, socialisation and wellbeing benefits that are derived from the activity, residents are known to catch fish and blue swimmer crabs as a regular part of their diets.

The strong association between the PHW and crabbing is evident in the continued success of Mandurah Crab Fest. The annual event resumed in 2023 after a hiatus due to Covid-19. Since the first event was held in 1999, the festival has grown to become one of WA's most successful free events, drawing crowds of over 100,000 people.

Fishing Economy in Western Australia



Source: Recfishwest

Recreational Fishery Species / Volume — Table 2.2

ANIMAL TYPE	REPORTED CATCH (2020/21) – RECREATIONAL (TONNES)
Blue Swimmer Crab (2020/21)	43*
Sea mullet (2015/16)	0.7

Source: Department of Primary Industry and Regional Development (DPIRD), 2022; Daume & Hartmann 2021
n.b. Recreational catch numbers reflect boat-based catch, with shore-based catch expected to exceed this figure. Not an official government estimate.

Key Findings

There are 10,544 boat owners within the study area and immediate surrounds. Given the proximity to the waterways, it is assumed that they are the main driver of this boat ownership. Boat users may derive value from fishing, other water sports or socialisation and wellbeing.

Map 2.1 highlights the concentration of recreational boat ramps in the study area. Compared to the Perth metropolitan region, the PHW offer a large number of recreational boat ramps that are available to the local community and visitors alike. This is reflected in the higher per capita boat ownership in the study area and surrounds* at 94 per 1,000 residents, compared to 38 per 1,000 residents in Greater Perth. The greater availability of boat ramps in the study area also has positive implications for accessibility of the ocean by boat. This in itself is a benefit of the PHW.

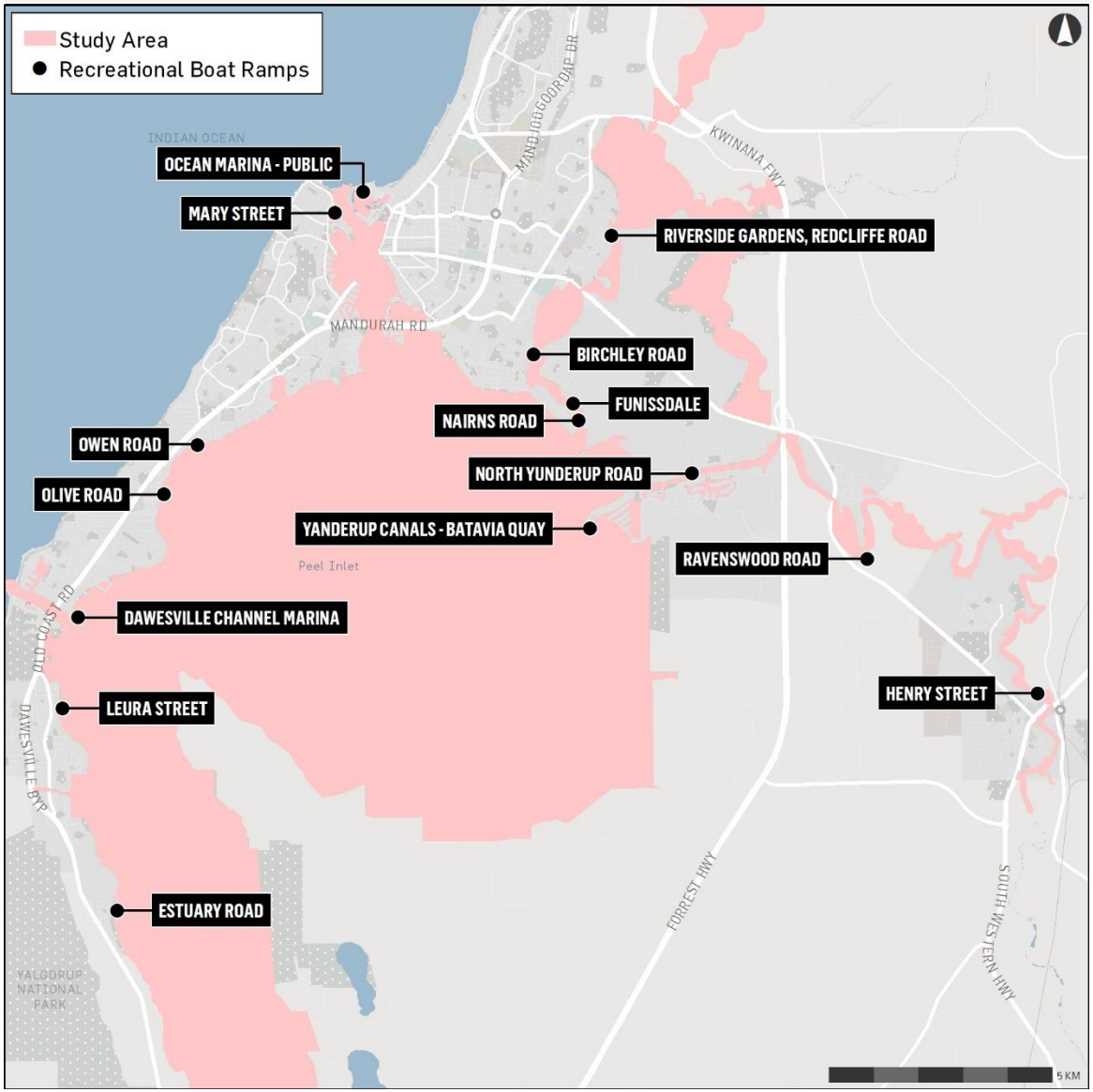
The number of recreational boat ramps across the study area highlights the role of boating as an integral element of the lifestyle of many in the Peel region, and its draw as a holiday destination.

Boat Ownership, Peel Harvey and surrounds, as at end of October 2022 — Table 2.3

POSTCODE	UP TO 7.5M	ABOVE 7.5M	TOTAL
6180	248	19	267
6181	70	5	75
6207	104	4	108
6208	1,660	125	1,785
6209	331	25	356
6210	5,747	656	6,403
6211	1,024	46	1,070
6213	44	2	46
6214	69	2	71
6215	350	13	363
Total	**9,647**	**897**	**10,544**

Source: Department of Transport (DoT) 2022
**Boat ownership data presented in post code geographies due to availability of data. See Appendix A for details on comparison to study area.*

Recreational Boat Ramps, Study Area — Map 2.1



Key Findings

The Peel Harvey waterways are an attractive region for science and research both due to their high biodiversity and degrading environmental quality.

A variety of studies have taken place in the waterways over the past 15 years, with a focus on marine science, biology and geology.

The timeline below displays a variety of headline studies, where the number of researchers and / or grant funding has contributed to the value of the waterways.

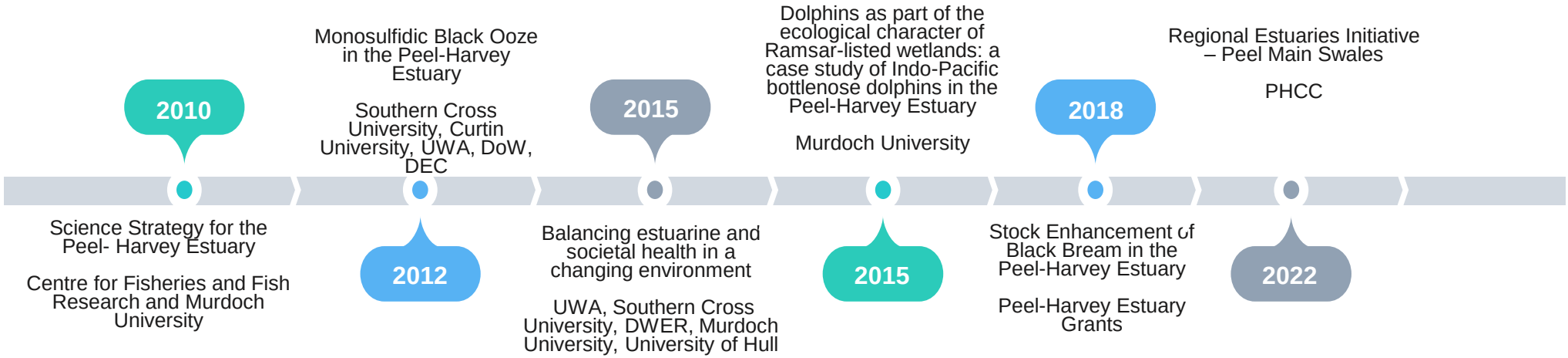
The significant body of research and ongoing government investment in the PHW relates to monitoring and assessing the state of the ecosystem and documenting the unique characteristics of the study area. Documenting is important for various reasons, including certifications of parts of the study area with the Marine Stewardship Council (MSC) and Ramsar Convention.

Examples of monitoring and assessment include DWER and DPIRD's ongoing research and activities in the study area that involve monitoring, surveying, testing and trialling of new management techniques. Projects supported by Australian Research Council (ARC) Linkage grants have also made important contributions to ongoing discussion about managing the PHW ecosystem in an everchanging environment.

Science and research funding represent an indirect-use value of the waterways to researchers, universities, the government and the community as a whole. There are also important synergies between commercial operations and research outcomes. For example, a dolphin research project provides tracing for commercial tour operators.

Peel Harvey Estuary ARC Linkage Project

Source: ARC Linkage Project



Overview

Agricultural nutrient run-off is a major source of nitrogen and phosphorous pollution in the Peel Harvey waterways. This run-off has been the primary factor in algal blooms and fish kills within the waterways over the past couple of decades.

Because of this, the waterways currently provide a service to farmers by removing agricultural run-off from their land. The waterways are therefore providing value to farmers, as an avoided cost to managing this run-off.

There are a variety of management practices available that could reduce the nutrient load currently being carried by the PHW (Table 2.4). This is not a definitive list, with a variety of additional management strategies available to farmers.

As seen in the table, different management strategies decrease nitrogen and phosphorus loads by different amounts. Management strategies also act on different pollution sources; for example infill sewerage only decreases nutrient loads from septic tanks while soil amendment acts on farms' fertiliser.

The combination of all management strategies is therefore required to prevent nutrient run-off reaching the PHW.

The nutrient run-off (from farms) to the PHW has an impact on the ecological character of the PHW. In turn, the ecology of the natural asset impacts other economic values through ecosystem services, as discussed earlier in this report. However, the magnitude or type of impact on the total economic value from one driver to another is beyond the scope of this point-in-time economic valuation.

Management Practices — Table 2.4

Management Practice	Description	Nitrogen Load Reduction	Phosphorus Load Reduction
Riparian Zone Management**	Fencing riparian zones prevents livestock from polluting waterways. Revegetating riparian zones decreases run-off flows into waterways.	30%	5%
Best Practice Fertiliser Management*	Consistent soil testing allows farmers to strategically fertilise pastures to reduce phosphorus usage on soils.	0%	Beef 44% Dairy 36%
Soil Amendment*	Addition of Iron Man Gypsum to pastures increases the retention of phosphorus in soils.	0%	60%
Infill Sewerage*	Removal of septic tanks decreases pollution relating to leakage from septic tanks.	100%	100%
Constructed Wetlands**	Man made wetlands decrease nutrients loads in waterways.	30%	50%
Catchment Revegetation**	Revegetation of cleared land with deep rooted plants decreases nutrient run-off.	0-42%	0-72%

Source: Hydrological and nutrient modelling of the Peel Harvey estuary Catchment, Department of Water and Environmental Regulation, 2021
**Load reduction relative to source of nutrients*
***Load reduction relative to catchment*

Key Findings

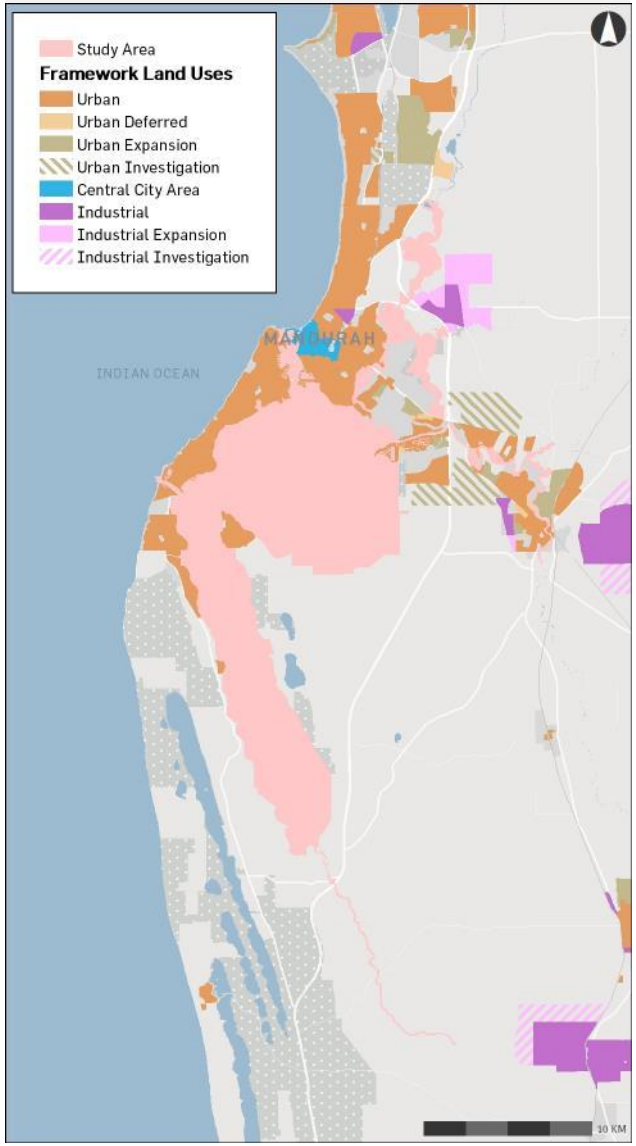
Living on or close to water is highly desirable for many people. Stakeholder engagement highlighted the significance of the waterways in the decision of many to reside in the region.

The South Metropolitan Peel Sub-regional Planning Framework guides land uses in the study area and broader region. The map of a series of relevant land uses identified in the planning framework highlights the fact that urban and industrial development is consolidated around the waterways. It is evident in state-level planning documents that healthy waterways are a key driver of the development pattern in the south of Perth. The waterways contribute to the attractiveness of the area, and therefore the viability for development projects to be able to translate planning policy into development outcomes.

DPLH's Urban Land Development Outlook (map 2.2) articulates the future development by land use. The ULDO is compiled drawing on government and private sector development intentions. The mapped data highlights that much of the future urban development is slated to occur on the boundary of the study area. The residential development areas shown on the map equate to 5,215 dwellings over the next five years, and 21,536 dwellings over the next decade and beyond.

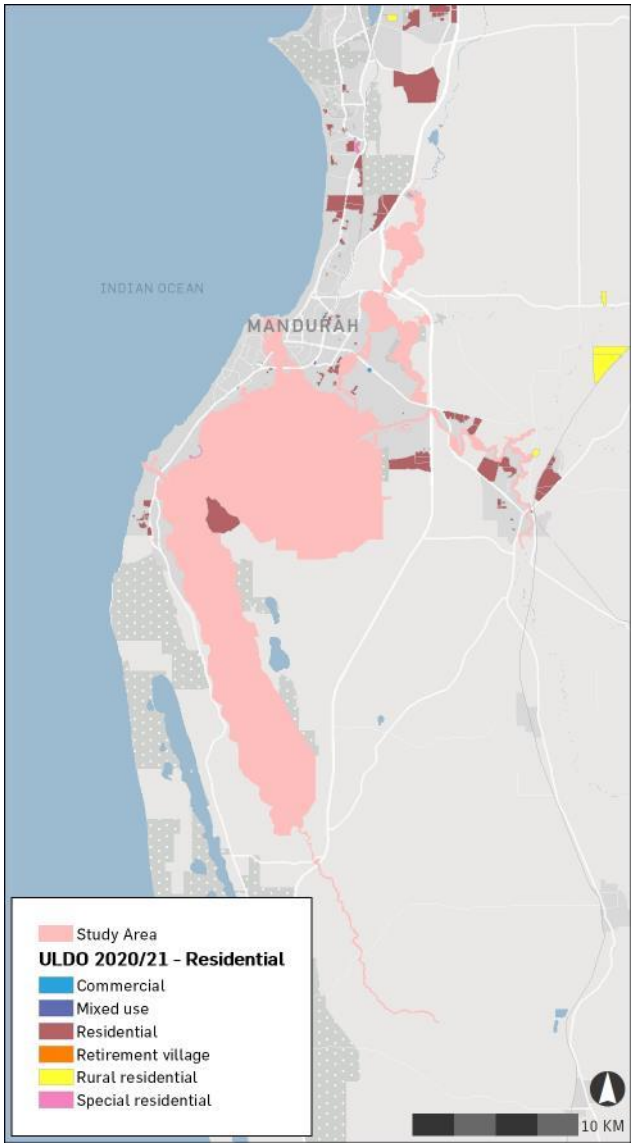
There has been a strong pipeline of urban development over the past 10 years around the Peel Harvey waterways including several marina developments, which directly draw on the waterways to create value (e.g. Mandurah Ocean Marina).

Map 2.2 - Sub-regional Planning Framework Land Uses



Source: Urbis, Department of Planning, Lands and Heritage (DPLH) n.b. Land uses include those that were determined from Planning Investigation Areas in 2022.

Map 2.3 - Urban Land Development Outlook, 2020/21



Source: Urbis, DPLH – Urban Land Development Outlook (ULDO) 2020/21

Key Findings

Previous studies demonstrate that there are significant economic, environmental and health and wellbeing benefits associated with living near and visiting blue spaces such as rivers, oceans and estuaries.

Furthermore, the protection of environmental areas can help maximise the benefits associated with blue space. Australia has a series of key natural environments, however easy and frequent access to blue space is not always afforded. The Peel Harvey waterways, given their size and the scope of recent development, see vast numbers of residents and visitors enjoying water as seen in the HMD analysis further in this section.

Recreational open spaces on the waterways include the following.

- Point Grey
- Coodanup Foreshore Reserve
- Creery Wetlands Nature Reserve
- Len Howard Conservation Park
- Novara Beach Reserve
- Austin Bay Nature Reserve
- Eastern Foreshore Reserve
- Goegrup Lake Nature Reserve
- Henry Sutton Grove
- Warrungup Spring Reserve
- Park Ridge Foreshore
- Island Point Reserve
- Kooljerrenup Nature Reserve
- Mclarty Nature Reserve
- Murray River Foreshore

Literature Review — Table 2.5

REFERENCE	OVERVIEW
White, M et al (2020), Blue Space, Health and Well-being: A Narrative Overview and Synthesis of Potential Benefits.	This paper explores a model of how exposure to blue space such as rivers, lakes and the coast can benefit health and wellbeing. This study identified that people living near blue spaces showed lower rates of poor physical and mental health and was associated with greater psychological connection to the natural world, and in turn this greater connection was associated with more pro-environmental behaviours.
Haeffner, M et al (2017), “Blue” Space Accessibility and Interactions: Socio-economic Status, Race, and Urban Waterways in Northern Utah.	This study aimed to investigate whether living in neighborhoods with a nearby river or canal had any positive impacts on households, and whether proximity to such waterways increased the likelihood of households spending time at them and being familiar with them. To address these questions, the study drew on a sample of households in Northern Utah living in neighborhoods with a nearby river or canal. The study found evidence to support the idea that living closer to blue space means that people are more likely to access its amenity. Further, the report found evidence to suggest that different socioeconomic groups had different levels of familiarity and interaction with such amenity. High socioeconomic status respondents were found to report higher familiarity, which has implications for future research.
Heagney, H.C et al (2019), The Economic Value of Tourism and Recreation across a Large Protected Area Network.	This study emphasizes the importance of protected environmental areas in providing people with recreational opportunity. As such, the study also highlights that societal benefits are unlikely to be optimised in protected environmental areas without considering the needs of the ecosystem.
Lynch, M et al (2020), A Systematic Review Exploring the Economic Valuation of Accessing and Using Green and Blue Spaces to Improve Public Health.	This study explores the economic evidence associated with the public’s value for accessing, using and improving local environments to undertake recreational activity and consuming the associated health benefits of green and blue spaces. The study revealed that the public are willing to pay between £5.72 and £15.64 in 2019 value estimates to improve local environments to gain the health benefits of undertaking leisure activities in green and blue spaces.
Environment Agency (2020), The Social Benefits of Blue Space: a Systematic Review	This report presents the findings of a systematic review of the social benefits of Blue Space carried out by the Environment Agency’s Social Science team between April and September 2018. The study identifies a number of social benefits around recreation, physical and mental health, inequality of access, social interaction, tourism and other areas which are generated from Blue Space.

Introduction to Human Movement Data

The Human Movement Data (HMD) has been sourced from the third-party provider Near. Its mobile location data is aggregated from a variety of high-quality sources, including data from proprietary apps and locational data derived from mobile advertising. Across Australia, the dataset has approximately 6.1 million active unique devices per month. Consequently, the dataset is seen as accurate for this report.

These apps are predominantly English-speaking apps and will have varying levels of penetration across different user groups. Some user groups, for example, Chinese speakers, could potentially have lower penetration rates. There are limitations with specific countries when assessing international visitors, for example, penetration across China is limited due to strict privacy laws.

Since not every visitor to the waterways will have access to a cell phone, or the specific applications that are being tracked, the human movement data provided in this report is a sample of the total visitation to the region. While every effort has been made to increase the accuracy of this data, samples biases may occur within the analysis of this data.

Human Movement Data Constraints

The HMD data assessment includes the following constraints:

- Data has been analysed over the 2019 calendar year, to reflect the likely visitation when not impacted by COVID-19.
- The resident and worker locations of each mobile phone are derived from the device's common evening and common daytime location, respectively.
- The Common Evening Location (CEL) for a device is estimated by determining where a device most frequently appears during the "non-work" hours (evening through morning and weekends). The overnight hours are defined as after 6 PM and before 8 AM.
- The Common Daytime Location (CDL) for a device is estimated by determining where a device most frequently appears during the "work hours (daytime on weekdays. The hours are defined as after 8 AM and before 6 PM from Monday through Friday.

Human Movement Data (HMD) Definitions **Table 2.6**

TERM	DEFINITION
Visit	The number of times unique devices are seen within a particular geographical area. Visit is equal to the number of days each device 'pings'. So, if a device 'ping's 10 times in one day, it is counted as 1 visit.
Visitor	The number of unique devices seen within a particular geographical area.
Activation	General term to describe if a geographical area has a high number of visits. The following analysis refers most frequently to activation and number of visits, rather than visitors (unique devices). This is done for the same reason that tourism data routinely refers to visitor nights rather than unique visitors. In terms of economic contribution, the number of visits is most relevant. For example, if one visitor stays and spends in a region for seven days at a given average daily rate, they will be providing a greater economic contribution to the region than three unique visitors who stayed two days each and spent at the same average daily rate. Where unique visitors to the region can provide useful context, the distinction is made in the reporting in this section.
Place of Residence	The Common Evening Location (CEL) for a device is estimated by determining where a device most frequently appears during the "non-work" hours (evening through morning and weekends). The overnight hours are defined as after 6 PM and before 8 AM, weekends include Saturday and Sunday. The Common Evening Location is a proxy for Place of Residence for each device. ▪ Peel residents are users with CEL in the 10 SA2s referred to as the Peel tourism zone. ▪ WA Residents are users with CEL in WA (excluding Peel residents). ▪ Interstate residents are users with CEL outside of WA. ▪ International residents are users with
Place of Work	The Common Daytime Location (CDL) for a device is estimated by determining where a device most frequently appears during the "work" hours (8 AM – 6 PM through weekdays). The Common Daytime Location is a proxy for Place of Work for each device.
Study Area	Study Area in this section refers to both the water bodies and open spaces mentioned in Map 1.1 and Map 1.2. Each precinct includes both the associated waterbody and open space (i.e. Peel Inlet will include both Peel Inlet waterbody and Peel Inlet open space). The study area has been adjusted to avoid capturing device 'pings' on major roads.

Overview

Relative visitor activity within the study area is displayed in map 2.4. This map graphically displays the relative activation, or number of visits, across the study area.

Zones included in the HMD analysis were defined in map 1.2 with the visitor share to each zone is detailed in table 2.7. The Mandurah Channel has the highest activity level while the Dawesville Channel sees the least. Note that the visitor share adds to over 100% as people can visit more than one zone.

Areas of high activity are coloured red, while lower levels of visitation are displayed in blue.

Specific precincts in the waterways will be analysed in depth in the proceeding slides, including the:

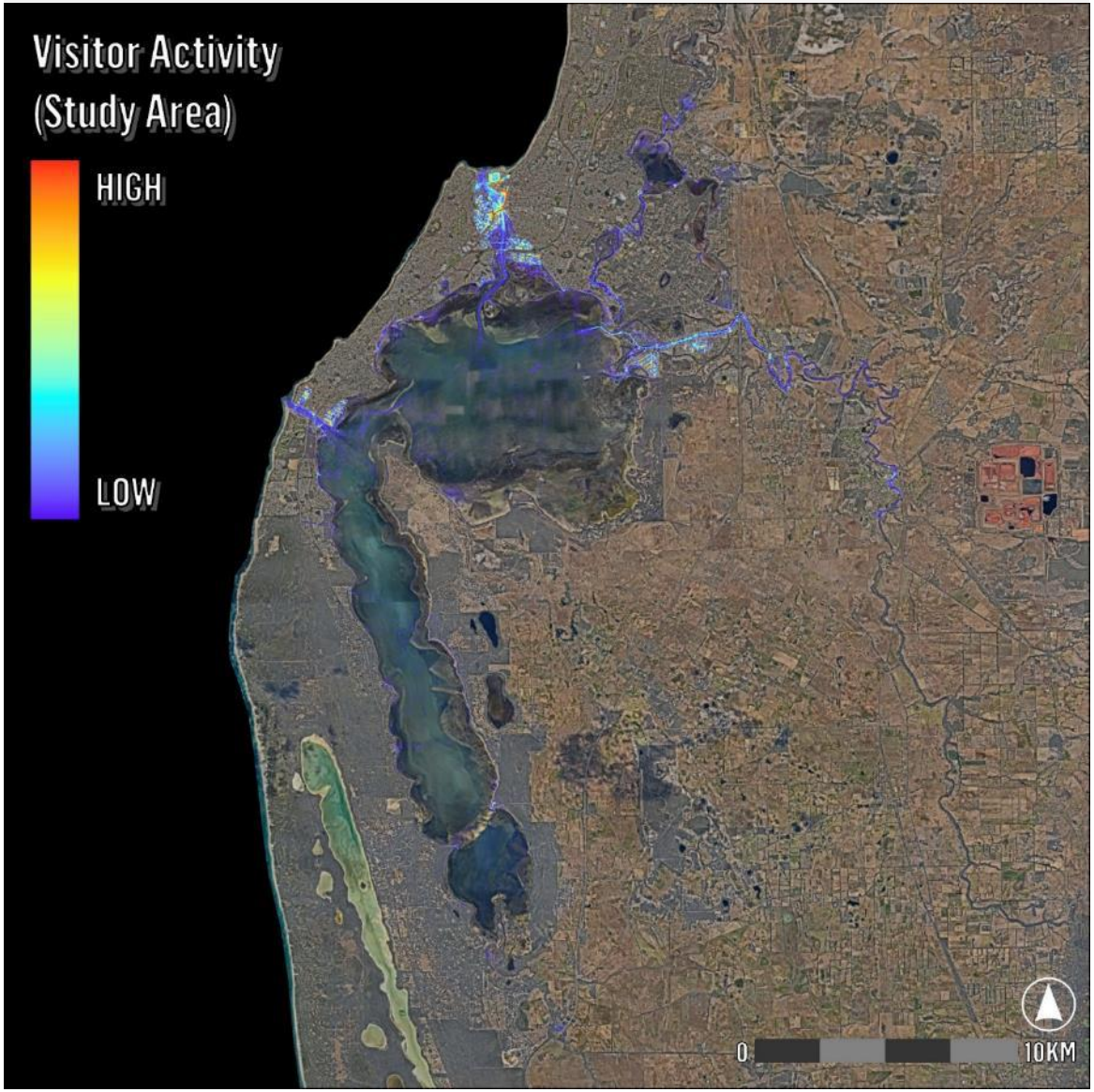
- Mandurah Channel
- Dawesville Channel
- Residential Canals found throughout the waterways

Visitor Share by Zone — Table 2.7

Zone	Visitor Share
Canals	35%
Dawesville Channel	3%
Harvey Estuary	8%
Harvey River	6%
Mandurah Channel	44%
Murray River	18%
Peel Inlet	12%
Serpentine River	17%
Total	**142%**

Source: Near, Urbis

Map 2.4 - HMD Heat Map of Visitor Activity Across the Study Area



Source: Near, Urbis

Key Findings

The Mandurah Channel is a hub of activity within the Peel region as it is located close to the centre of the Mandurah township.

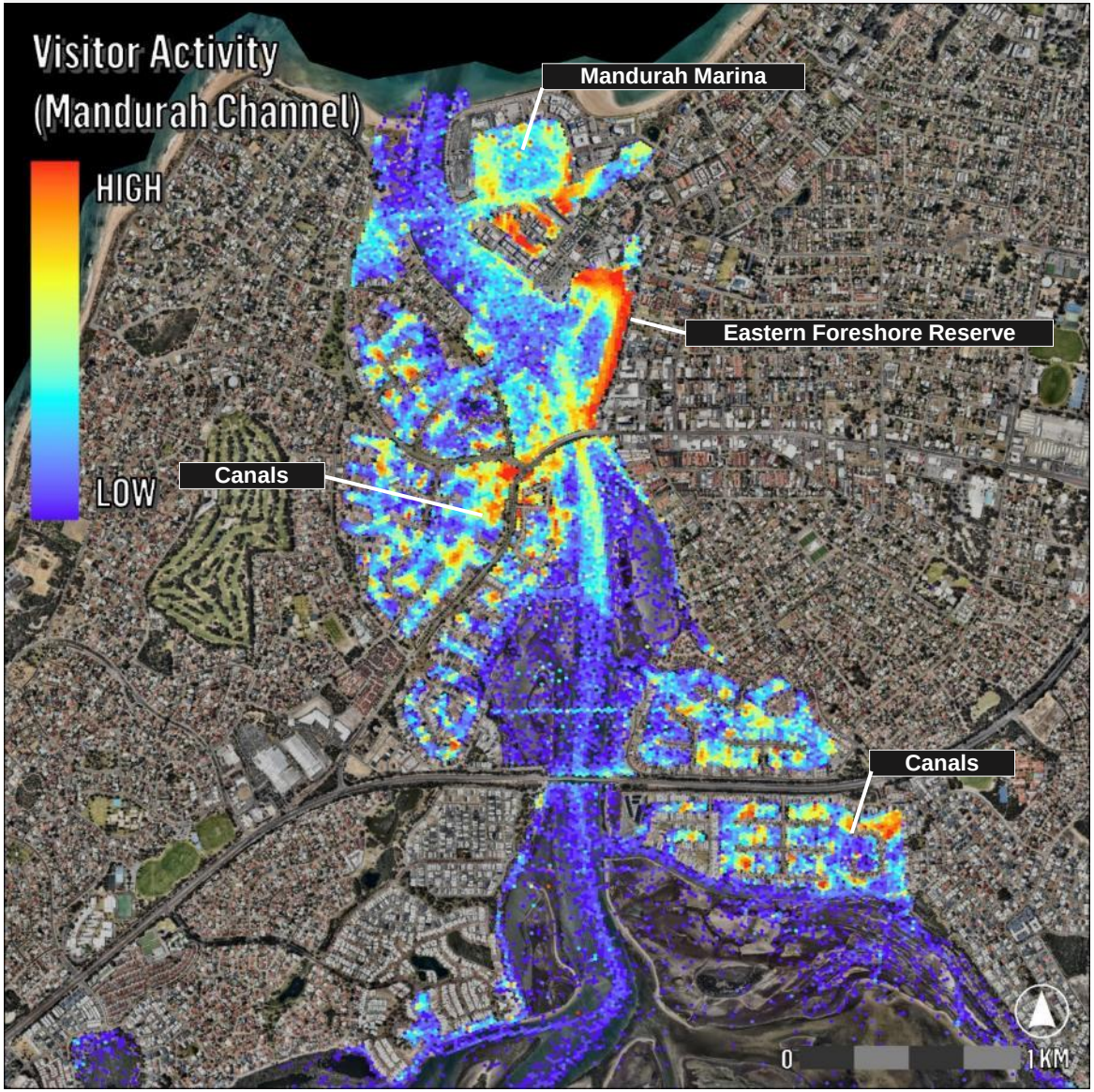
Activity is located along key riverside shopping and restaurant strips as well as within the canals and marinas.

Watercraft looking to travel between the waterways and the open sea regularly use the channel, significantly increasing usage. These users who are travelling out to sea are captured in this analysis and represent an important part of the value of the PHW. The PHW and associated facilities within it (moorings, boat ramps) enable people to access the ocean in greater numbers than would otherwise be possible.

Key Activity Locations

- The Eastern Foreshore Reserve has some of the highest visitation in the study area. The reserve's popularity is accentuated by its adjacency to a major shopping and restaurant strip.
- Mandurah Marina is the largest marina in the region, with high levels of activity both onshore and offshore. The southern area of the marina includes a restaurant and shopping strip, drawing further visitation.
- High levels of activity are found within the nearby canals as residents launch and maintain boats within this area.

Map 2.5 - HMD Heat Map of Visitor Activity in Mandurah Channel



Source: Near, Urbis

Key Findings

The Dawesville Channel was constructed in 1991 as a management strategy for algae blooms within the waterways through a new connection to the sea.

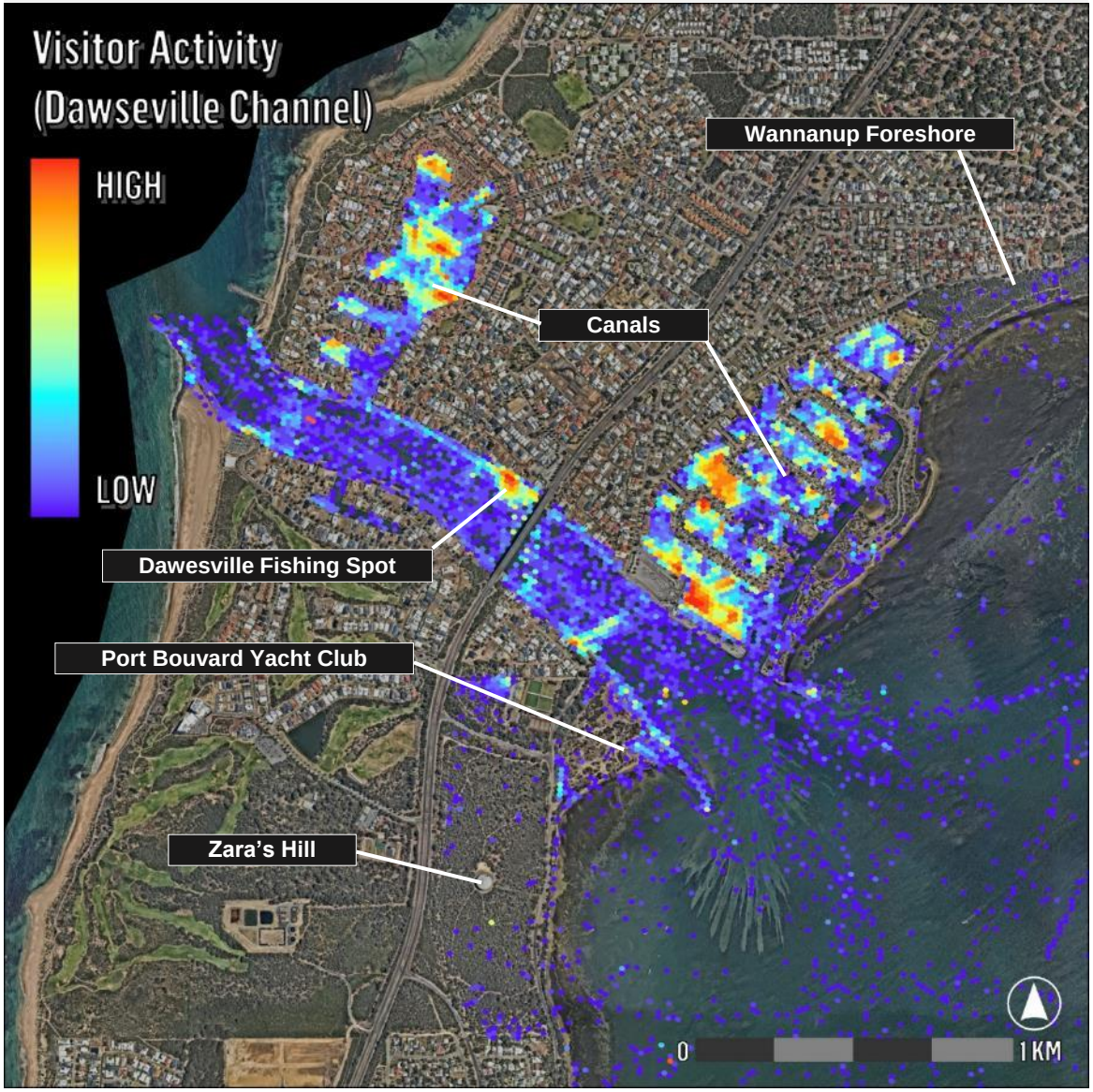
Today the channel is used as a route for vessels to travel between the sea and waterways.

Key Activity Locations

Activity in key recreation areas is evident throughout map 2.6:

- High levels of usage are found within the canals as residents launch and maintain boats within this area.
- The beach strip near to Port Bouvard Yacht Club has evidence of activity both on land and within water as recreational watercraft are launched and landed on the beach.
- Dawesville Fishing Spot is a popular recreational location in the town, with The Cut Tavern located adjacent.
- Caddadup Reserve sees on land activity of bushwalkers.
- The Wannanup foreshore area contains similar activity with both onshore and offshore bushwalker and swimmer visitation evident.

Map 2.6 - HMD Heat Map of Visitor Activity in the Dawesville Channel



Source: Near, Urbis

CONTEXT ANALYSIS | ACTIVATION | VISITS BY HOUR OF DAY

Key Findings

Chart 2.1 shows visitation (i.e. total visits) in the study area by hour as a share of total visitation across the day. Activity is highest around midday as more people move out onto the water for recreation and commercial fishing.

Activity drops off late at night, with the lowest levels around 3am. This can likely be explained by residents and tourists moving off the water and heading home.

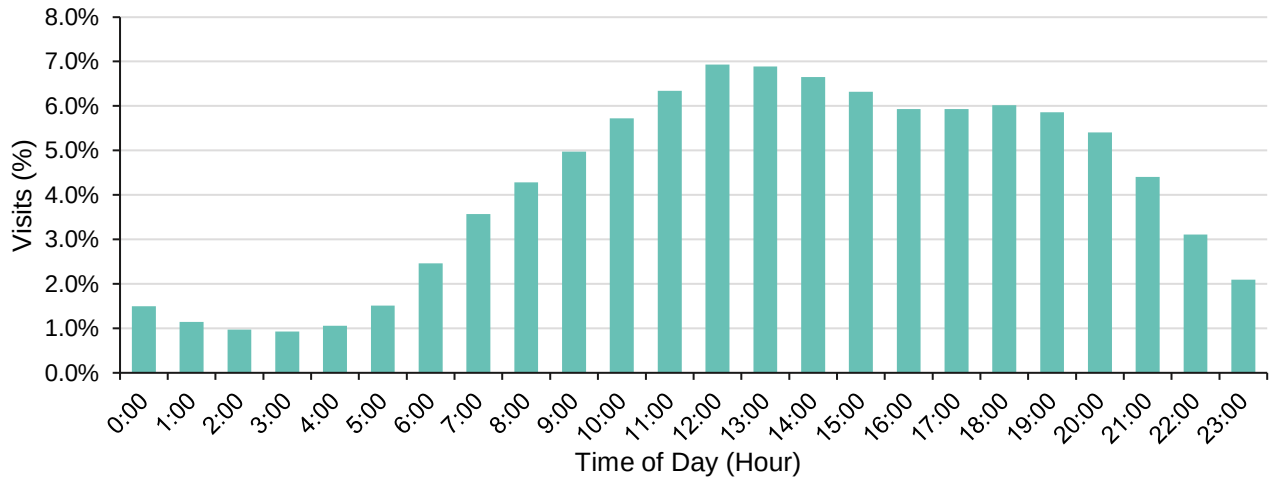
To understand the activity level across precincts, three high activity regions of the waterways were chosen as displayed in chart 2.2.

The Canals and Dawesville Channel show a similar activity profile to the precinct total.

The Mandurah Channel has higher usage in the middle of the day likely driven by its proximity to the town's retail strips.

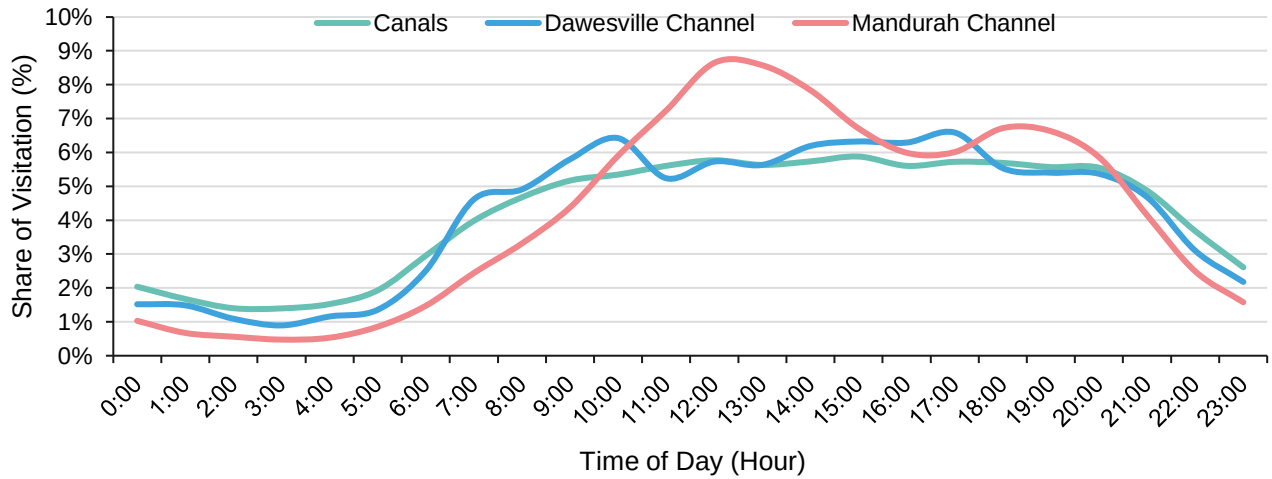
This activity profile emphasises the on water economic value of the waterways for both commercial and recreational operations.

Visits by Hour of Day, 2019 — Chart 2.1



Source: Near, Urbis

Visits by Hour of Day and Location, 2019 — Chart 2.2



Source: Near, Urbis

CONTEXT ANALYSIS | ACTIVATION | VISITS BY DAY OF WEEK

Key Findings

Activity in the study area is found to be highest on the weekends compared to weekdays as displayed in chart 2.3, with a 4% pt difference on average. This affirms the waterways as a prominent recreation location in the region.

Weekday activity is relatively stable throughout at an average of 13% of weekly visits. This further emphasises the economic importance of the waterways for business throughout the work week.

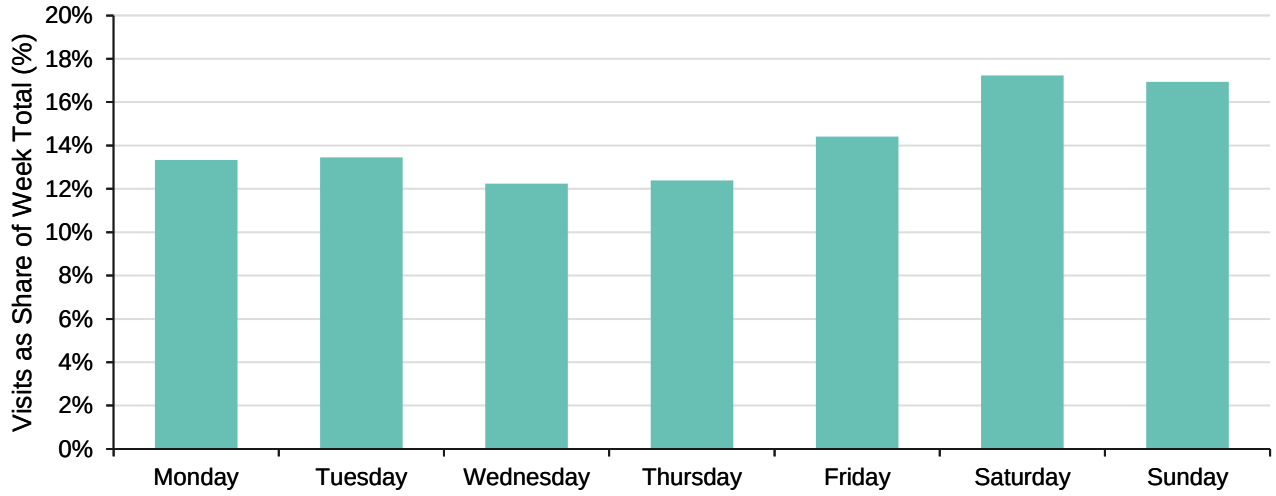
Chart 2.4 displays the activity split for each precinct across the week. For instance, the Canals have 13.9% of their visitation on a Monday. Note that activity may be skewed by the relative sizes of each region.

The Mandurah Channel, Harvey Estuary and Dawesville Channel have the highest usage on the weekend.

High weekend activity in the Mandurah and Dawesville channels can be explained by the fact they are main thoroughfares to the ocean.

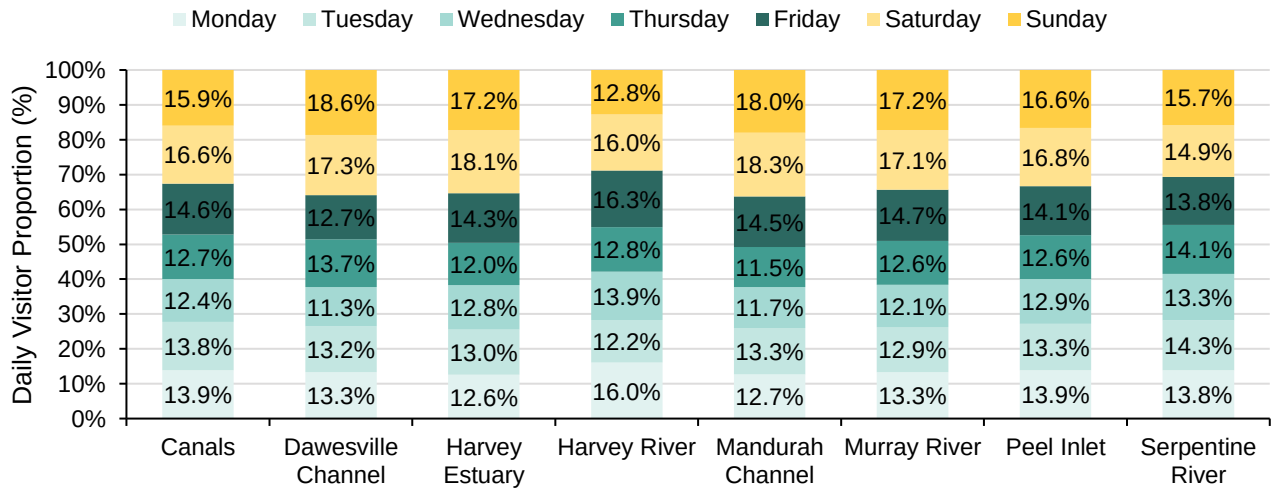
The Harvey Estuary's high weekend activity can be attributed to it being a larger region with a high proportion of the recreational waterway usage.

Visits by Day of Week, 2019 — Chart 2.3



Source: Near, Urbis

Visits by Day of Week and Location, 2019 — Chart 2.4



Source: Near, Urbis

Key Findings

Visitor distribution by home location (CEL) provides information on who uses each of the facilities within the study area as displayed in chart 2.5. See Table 2.6 for details on home location.

On average 53% of visitors over the study period (2019) to the precincts within the study area are WA Residents while 41% are Peel Residents. Only 4.5% are interstate and 1.5% international.

The waterways therefore draw majority of their visitation from across Western Australia, emphasising both their economic and recreational importance to Western Australians.

Peel residents are estimated to interact with the study area 6.9 times on average across the study period (one calendar year). 50% of these residents visited the waterways at least once across the period. Given the tightly defined study area, this is a significant share of the population.

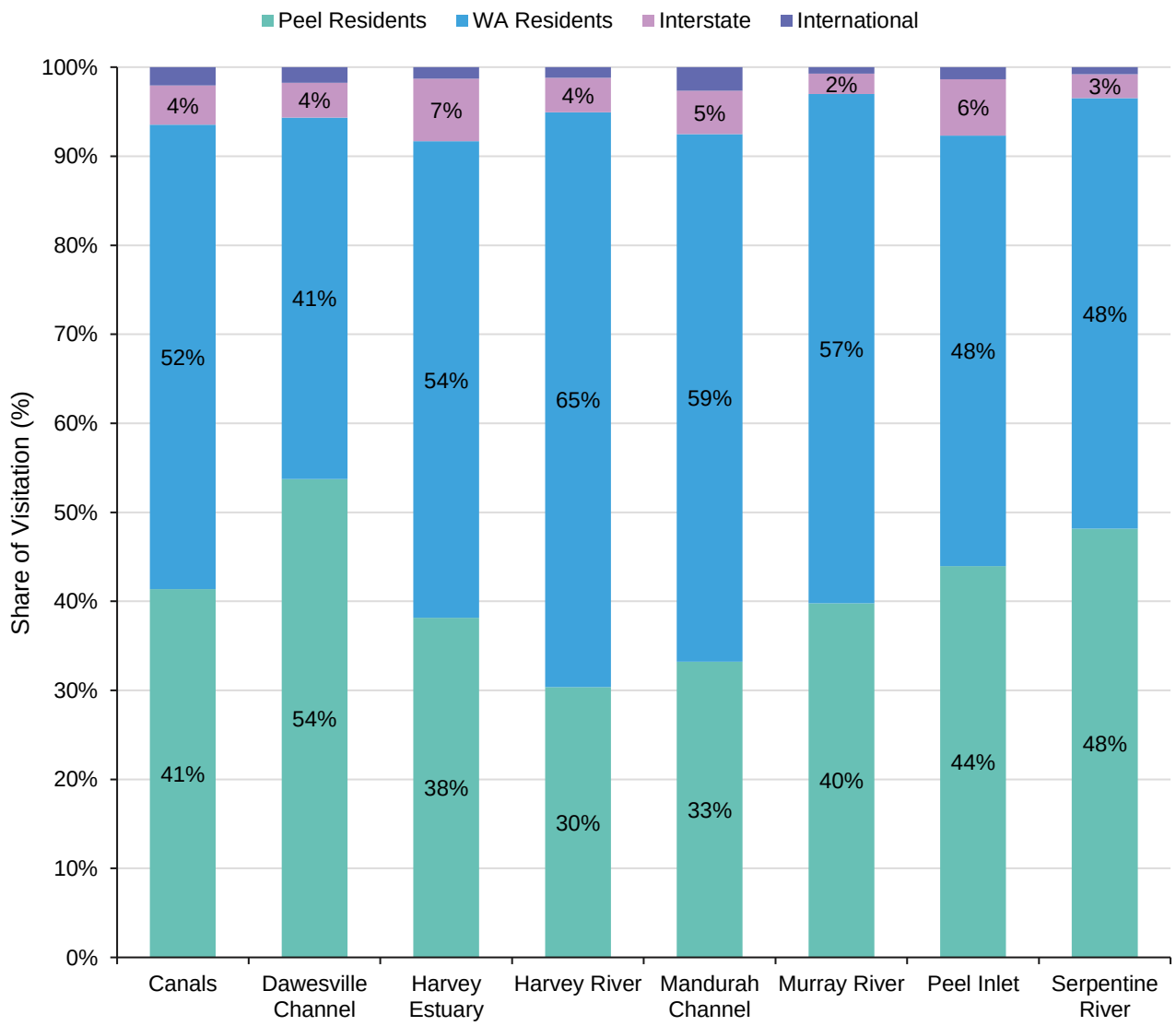
The number of visits to the study area per visitor to the region (i.e. all groups except Peel residents) is estimated at 2.2 on average across the study period. 37% of visitors to the Peel tourism zone interacted with the study area.

Local Peel residents account for the majority of visitation to the Dawesville Channel at 54% while the Harvey River sees the largest proportional usage for WA Residents at 65%.

International visitation compared to domestic from TRA data is displayed in chart 2.7, showing a similarly small visitation to HMD data in chart 2.5. The most international visitation occurs in the Mandurah Channel.

6.1% of visitation is interstate according to TRA data, slightly higher than the HMD average. This can be explained by the fact that TRA and HMD data use slightly different geographic regions.

Visits by Home Location, 2019 — Chart 2.5



Source: Near, Urbis

Key Findings

Tourism Research Australia (TRA) data highlights types of activities that tourists who visit the study area participate in. These figures also show that there is a distinction between the activities that are attractive to tourists from different origins. This TRA data relates to the Peel tourism zone geography, however when analysing alongside HMD data, we can draw some important observations.

Organised activities such as dolphin watching, guided tours and charter boats are more popular with international tourists when compared to domestic visitors.

The results show that there is strong demand for water-based activities in the region from both domestic and international visitors.

By keeping in mind the results of the HMD analysis, it can be rationalised that datapoints in and around the waters edge are made up partially by those who are snorkelling and fishing in the TRA survey.

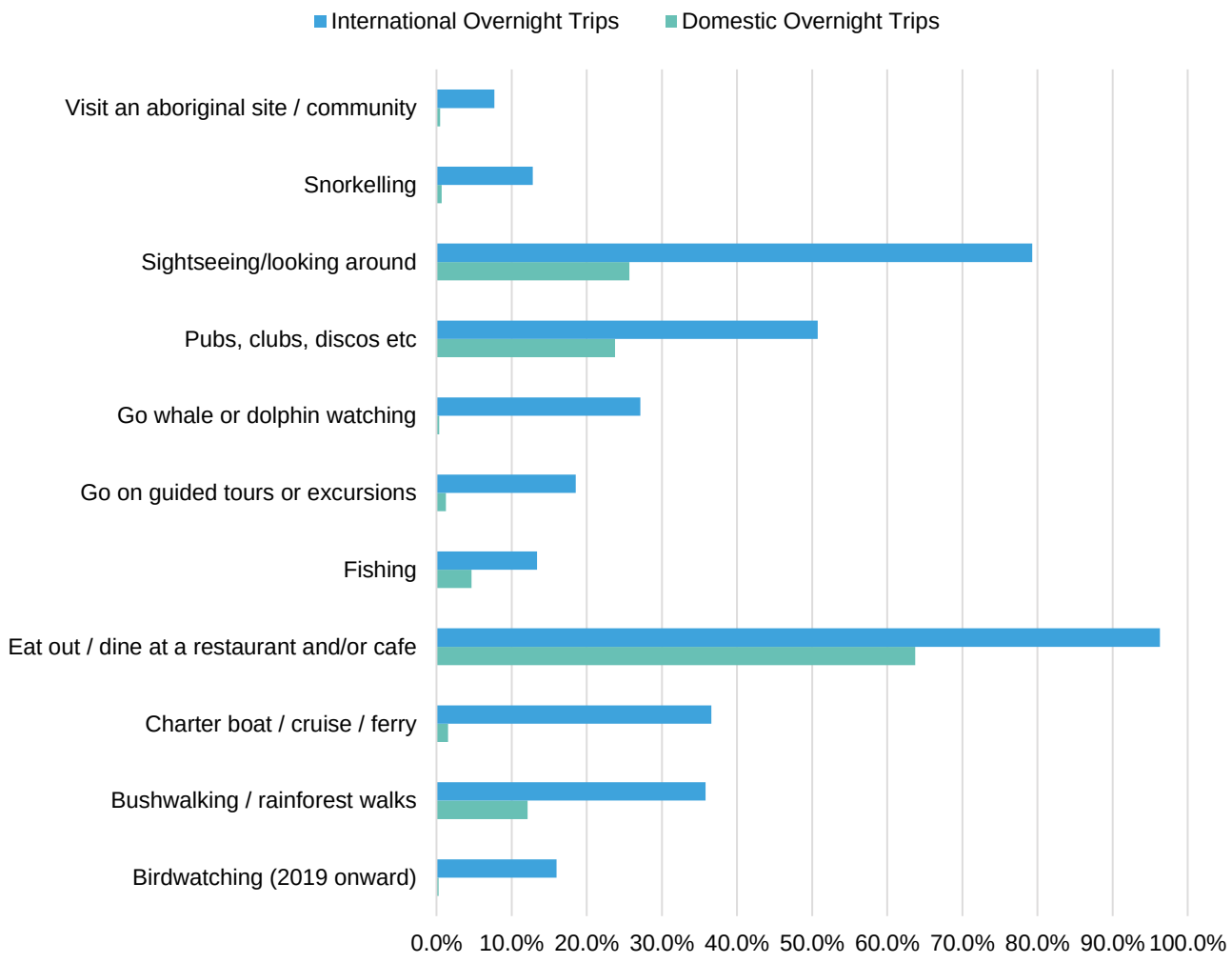
Similarly those on the water are on a Charter boat/ cruise/ferry or whale and dolphin watching.

A portion of those in the bushland around the waterways are visiting taking in the natural amenity, visiting key sites, bushwalking and/or birdwatching.

Eating out is the most common activity for both visitor cohorts, which suggests that most visitors who participate in other activities are also spending on hospitality.

This further emphasises the multifaceted value of the waterways to a variety of people for both recreational, economic and biodiversity reasons.

Activity by Visitor, Peel Tourism Zone, 2019 — Chart 2.6



Source: Tourism Research Australia (TRA)
n.b. Category names are defined by TRA and therefore not all items in a list will be relevant for every tourism region (e.g. rainforest walks).

Key Findings

There is a strong demand for tourism in the region, with the waterways a central attraction and a driver across a variety of activities. As the HMD analysis revealed, approximately 37% of visitors interacted directly with the PHW study area.

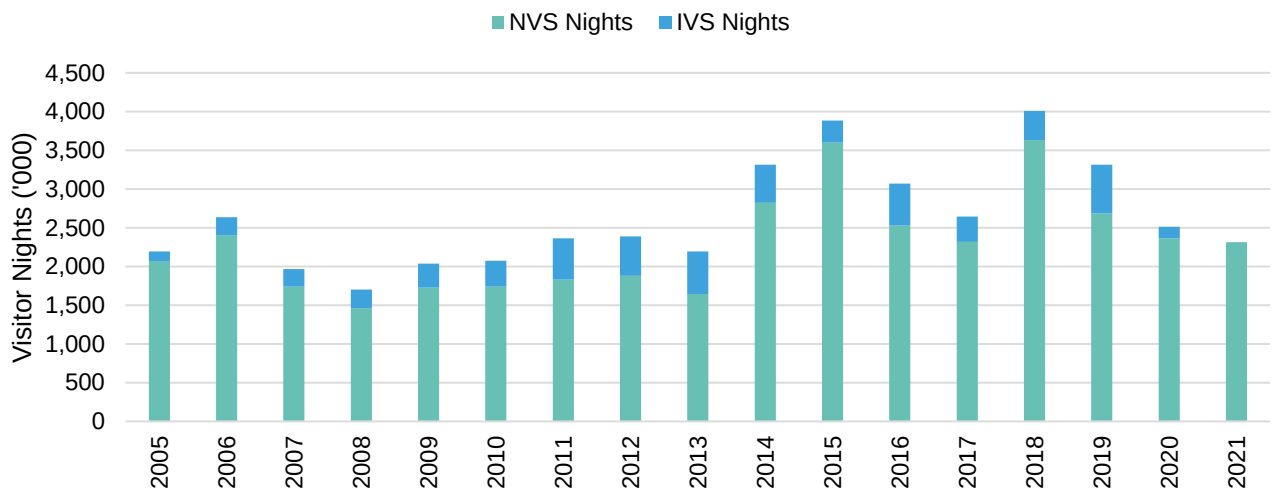
The tourism industry in the region is well-established, with Mandurah winning the 2022 GWN7 Top Tourism Town Award.

The demand for visits from national and international visitors has remained strong over the past decade and a half. Daytrips to the Peel tourism zone, generally from the Perth metro area, make up a significant proportion (over 50% of total days / nights). In 2019, there were 5.1 million day trips, compared to 3.3 million visitor nights (NVS and IVS, combined). This is driven by the close proximity to Perth, and reflects the role of the region as a key destination for families and holiday-goers who live and work in the Perth Metro area.

The tourism figures represented are the total visits to the area defined by ten adjoining Statistical Area 2s (SA2s). A significant proportion of the visitation to the broader Peel region, beyond the geographical extent of the waterways defined earlier in this report as the study area, has been included (see appendix A for detailed geographical terminology descriptions).

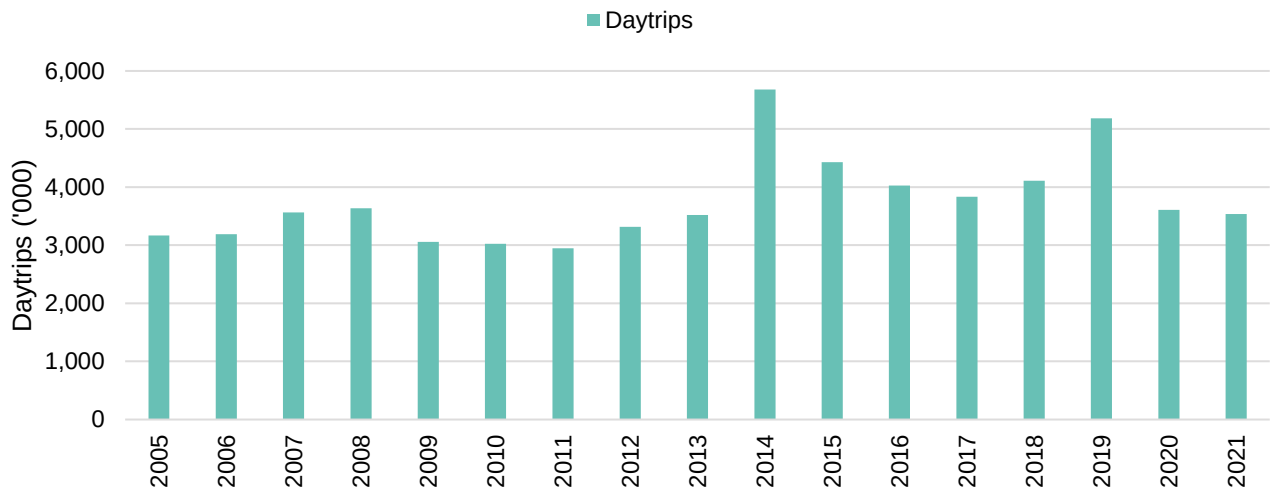
Overall, the tourism statistics to the region describe a region that meets the needs of local visitors, who preference daytrips to the area. Nonetheless, significant overnight visitation suggests the region is also attracting longer-term stays from families.

Visitor Nights, Peel Tourism Zone, 2005-21 **Chart 2.7**



Source: Tourism Research Australia (TRA)
n.b. NVS = 'National Visitor Nights'; IVS= International Visitor Nights

Daytrips, Peel Tourism Zone, 2005-2021 **Chart 2.8**



Source: Tourism Research Australia (TRA)

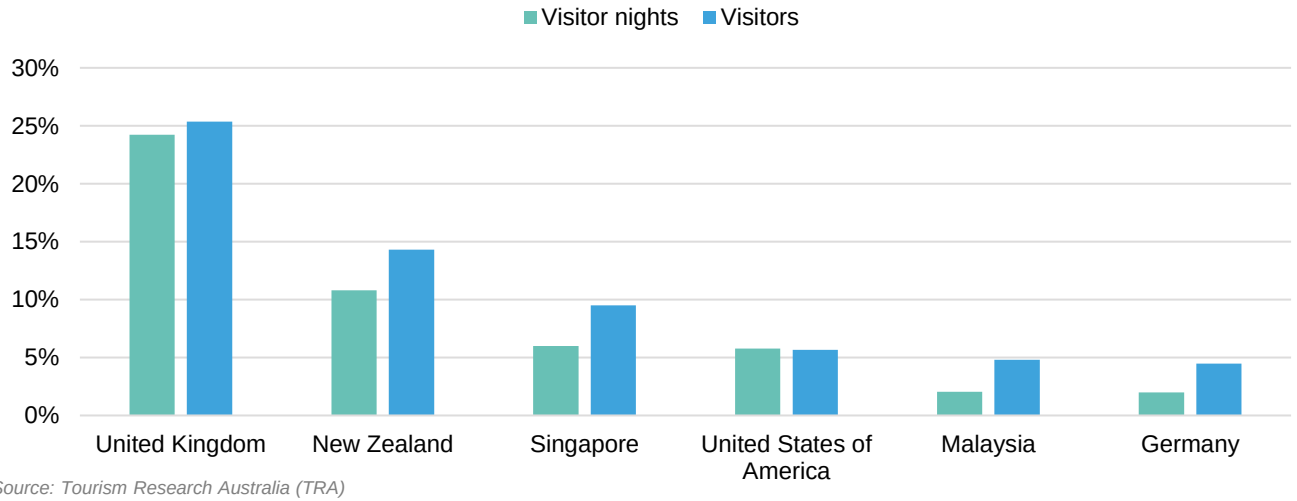
CONTEXT ANALYSIS | INTERNATIONAL TOURIST VISITORS

Key Findings

International tourists are most likely to be visiting the study area from the United Kingdom, followed by New Zealand. These visits are generally driven by people who are visiting friends and relatives who live in the region or in Greater Perth.

The low number of countries of residence with a significant share of total visitors / visitor nights indicates a non-homogenous market and the wide reach of the area for tourists.

Int. Visitor Country of Residence, Peel Tourism Zone, 2010-19 — Chart 2.9



Source: Tourism Research Australia (TRA)
n.b. proportion of visitors / visitor nights is aggregate over the period 2010-19

International Tourism at the Waterways

Credit:Visit Mandurah and Russell Ord Photography

Credit:Visit Mandurah

03

ECONOMIC EVALUATION

Image credit:Visit Mandurah and Russell Ord Photography

ECONOMIC EVALUATION | APPROACH

Overview

This economic evaluation provides two values: a total economic value (TEV) and an annual economic contribution.

TEV is a measurement approach used widely in environmental economics to determine the value of an ecosystem or natural asset. The annual economic contribution measures the annual contribution of the asset to the local economy in terms of value added and employment.

The adjacent graphic demonstrates the types of uses that contribute to the economic valuation of the PHW. Direct use values are drawn from active interaction with the study area. Indirect use relates to economic contributions that do not directly require the use of the waterways, however rely on the waterways' existence and / or proximity.

The TEV and annual economic contribution approaches are consistent with similar evaluations of aquatic ecosystems such as the Great Barrier Reef and Ningaloo Reef (Deloitte, 2017 & 2020).

To calculate the TEV and annual economic benefit of the waterways, annual and once-off benefits or cost-reductions have been estimated across both direct and indirect uses. Further to this, qualitative assessments have been made for values that can either not be adequately estimated, or that would be at risk of over-estimating the economic contribution of the waterways.

Economic contributions have been calculated based on the value drivers defined in section two and categorised to the right.

Each value was calculated, where possible, on an annual basis and once-off benefit considerations have also been determined. The annual economic benefit relates to those impacts that are ongoing and occur or can be realised on a yearly basis. The total economic value considers those once-off benefits that have been estimated, as well as the annual economic benefits, and calculates the discounted 50-year value of the waterways. The total economic value is an asset value, rather than an ongoing flow of benefits. It allows us to capture benefits that the annual economic contribution figure does not. A discount value of 3% has been adopted as the central case, given waterways are a social good and therefore are less likely to be impacted by future discounting (Australian Government, 2020).

Approach

Table 3.1

ECONOMIC VALUE

- **DIRECT USE**
  - WATER
  - HOSPITALITY
  - COMMERCIAL FISHING
  - RECREATIONAL FISHING
  - RECREATIONAL BOATING
  - HEALTH AND WELLBEING
- **INDIRECT USE**
  - URBAN DEVELOPMENT
  - OPEN SPACE
  - SCIENCE AND RESEARCH
  - NUTRIENT RUN-OFF

QUALITATIVE VALUES

- VALUE CONSIDERED
- BOAT OWNERSHIP
- INDIGENOUS CULTURAL SIGNIFICANCE
- BIODIVERSITY VALUE
- BEQUEST VALUE

ECONOMIC EVALUATION | APPROACH CONT.

Overview

Further to those benefits that are readily quantifiable being categorised as direct or indirect uses, the various value drivers that this report seeks to evaluate can be measured using a variety of different techniques.

In broad terms, we can measure items as market or non-market values.

Market components are those that can be measured by a market such as property values, whilst non-market values have no commercial market such as ecological preservation and are valued using proxy values such as:

- Cost of alternatives technique – replacement cost approach (e.g. cost of providing equivalent public open space);
- Shadow project cost technique – cost of providing comparable benefit elsewhere; and
- Revealed and stated preferences techniques – willingness to pay (e.g. contingent valuation surveys).

We have employed a variety of measurement techniques, documented throughout this section, to value the PHW.

In addition to the qualitative measurement techniques, we have provided commentary and quantitative assessments for some values that cannot be reliably monetised.

Measurement Approach

Table 3.2,3,4

Direct Use Value	Measurement Type	Assessment approach
Water	Non-market	Annual cost of water licences
Hospitality	Market	GVA contribution of hospitality spending
Commercial fishing	Market	GVA contribution of commercial fishing catch
Recreational Fishing	Market	GVA contribution of recreational fishing spend
Recreational Boating	Market	GVA contribution of recreational boating spend
Health and Wellbeing	Non-market	Consumer surplus of visitors and residents for engaging in natural environments

GVA is the gross value-added impact of an activity in an are. Each value relates to the Western Australia GVA impact.

Indirect Use Value	Measurement Type	Assessment approach
Urban development	Market	Asset value increase due to waterfront proximity GVA contribution of residential construction
Open space	Non-market	Annual maintenance cost for open space in the study area
Science and research	Non-market	Annual research and development funding unlocked
Nutrient run-off	Non-market	Avoided cost of alternate nutrient disposal

Additional values (qualitatively assessed)
Boat ownership
Indigenous cultural significance
Biodiversity value
Bequest value

Source: Urbis

DIRECT USE VALUE | WATER

Valuation Methodology

The water of the waterways itself is an important natural resource that industrial, agricultural, commercial and private users can derive value from through direct use.

The Department of Water and Environmental Regulation (DWER) is the responsible agency that issues and manages licenses for users.

The analysis of the value of water that is derived from the waterways assesses the total value of groundwater licensed for use from superficial aquifers in the system.

While DWER does not charge a cost for the water that is used from this source, there is an inherent value in the water, as the alternative to land users benefiting from water taken from the waterways is to purchase water at a cost.

Therefore, we have utilised the average cost for different land uses to purchase water from other sources to represent the direct use value of water. There is effectively an opportunity cost that would arise if the waterways were not fit to provide water as a resource.

This benefit valuation is a direct use measured as a non-market value using the cost of alternative technique.

Economic Value of Water — **Table 3.5**

Metric	Unit	Value
Total volume of water allocated on licenses from superficial aquifers	ML	330,900
Cost	$/ML	$600-$1,300
Annual Water Benefit	**$227.9 million**	

Source: DWER, Harvey Water
n.b. different land uses attract different average cost per mega litre of water drawn

Valuation Methodology

To understand the economic impact of hospitality spending resulting from interaction with the PHW, the total spending in the area from both residents and tourists was calculated and the Gross Value-Added (GVA) impact of this spending was incorporated to the total economic value.

For local spending (Table 3.6), spending on hospitality for the region in 2022 has been adopted, based on reporting from MarketInfo (2022).

To ensure that values are reflective of the value drawn from the PHW, a more constrained approach to visitation has been utilised. This ensures that only visitors who interact directly with the waterways are counted in the economic value. We have utilised human movement data (HMD), which demonstrates the interaction effect of residents in the area and the study area. This interaction effect (13%) has been applied to the total resident spend on hospitality related product groups to estimate the total spend that is directly associated with the study area.

Calculated Local (Hospitality) Spend — **Table 3.6**

Metric	Values
Total residential spend	$284.6 million
Residential interaction effect (from HMD)	13%
Total estimated residential spend related to PHW	***$37.8 million***
Total Resident Value (GVA per annum)	**$35.5 million**

Source: MarketInfo, Urbis, Near

DIRECT USE VALUE | HOSPITALITY & TOURISM CONT.

Valuation Methodology

The second element of the hospitality and tourism value is spending by tourists. The tourism spend figure encompasses a wider range of goods and services than the resident spending that is captured in this value. This is to avoid extracting spending categories from the available tourism spend data which could lead to double counting with other values (e.g. recreational fishing or boating).

Spending figures for tourists are based on Tourism Research Australia (TRA) total spending data for 2019. These totals reflect the visitation and spending from a pre-COVID environment, which has been assumed to resume in 2022 onwards (see table 3.7). Our approach to count all tourism spending in this value allows us to maintain the highest level of integrity in this data.

As with resident hospitality spending, HMD has been used to ascertain an interaction effect for visitors who directly interact with the study area.

In total, the estimated spending per annum as a result of interaction with the PHW is $228.2 million, heavily weighted toward tourism spending. This demonstrates the important role tourism plays around the waterway in driving its value. Spending was then converted to the economic measure of GVA to the WA economy. This yields a total economic benefit of $214.6 million per annum as a result of hospitality and tourism.

Our analysis is anticipated to be conservative. It is important to note that tourism across the region may relate to the waterways without direct interaction. This analysis is capturing only direct interaction as assessed by HMD analysis and captured as the interaction effect.

Calculated Visitor (Hospitality & Tourism) Spend — **Table 3.7**

Visitor Type	Proportion of visitor days	Spend per day
International visitors	7%	$67.50
Domestic overnight visitors	32%	$111.00
Domestic daytrippers	61%	$72.50
Total visitor nights (p.a., 2019)	8,496,142	
Total estimated visitor spend (p.a.)	$716.2 million	
Interaction effect with PHW (from HMD)	27%	
Total estimated visitor spend related to PHW	***$190.6 million***	
Total Visitor Value (GVA per annum)	**$179.1 million**	

Source: Tourism Research Australia (TRA), Urbis, Near
n.b. Based on spending and visitation from 2019 (pre-COVID)

Economic Value of Hospitality & Tourism (Total) — **Table 3.8**

User	Value
Total estimated spend from residents	$37.8 million
Total estimated spend from visitors	$190.6 million
Total estimated hospitality and tourism spend related to PHW	***$228.2 million***
Total Value (GVA per annum)	**$214.6 million**

Source: Marketinfo, Tourism Research Australia (TRA), Urbis, Near
See appendix C for details.

DIRECT USE VALUE | COMMERCIAL FISHING

Valuation Methodology

The economic value of commercial fishing has been calculated as the annual gross value-added (GVA) contribution of:

1. the quantified annual gross production value (GPV) of blue swimmer crab catch, and
2. The estimated annual GPV of finfish.

Revenue estimates have been sourced directly from DPIRD catch data, as provided in December 2022. The value per unit is a beach price, which represents the value of the product sold 'straight off the boat'. This figure is expected to be conservative in this setting, where some commercial fishers operating in the PHW operate their own retail store fronts which generate additional economic value.

It is noted that the stock are environmentally driven, and the total catch varies substantially across years (as reported in section 2).

The GVA impact of this to the Western Australian economy has been estimated using REMPLAN input-output modelling, and totals an annual benefit of $954,420 per annum. This modelling approach captures the direct and indirect value added to the local economy that is generated by the catch from the PHW.

Economic Value of Commercial Fishing Activity — **Table 3.9**

Value type	Quantity per annum (average 2016-2021)	Value per unit (average 2016-2021)	Total annual value
Blue Swimmer Crab catch	66.6 tonnes	$6.7/kg*	$461,700 (GPV)
Finfish catch	N/A	N/A	<$1 million
Total Value (GVA per annum)	**$954,420**		

Source: DPIRD, REMPLAN, Urbis
** note: "NB: Beach price data was generated by collecting monthly returns recording prices paid to fishers by fish processors within the WCB. A weighted average price is then calculated for the financial year from the monthly data." – DPIRD, 2022.*

DIRECT USE VALUE | RECREATIONAL FISHING

Valuation Methodology

The economic value of recreational fishing has been calculated as the annual gross value-added (GVA) contribution of spending stimulated by **on-shore fishing** in the Peel region. Of a total of 619,000 fishers in WA (DPIRD, 2022), approximately 9% reside in the Peel region (Recfishwest). A 2018 report from McLeod and Lindner estimates that per-trip spending of $35 (for on-shore related costs) occurs in WA, with an average of 5.3 trips taken every year. Therefore, across the estimated 55,152 fishers in the Peel, a total of $21.7 million of economic activity is generated by this activity.

The GVA impact of this spending is calculated to total $18.7 million per annum.

Notably, this value does not consider the boat-based value of recreational fishing (to avoid possible double counting with recreational boating values calculated on the next page) nor the market value of the estimated catch annually.

Economic Value of Recreational Fishing Activity (shore only) — Table 3.10

Value type	Quantity
Fishers in WA	619,000
Total fishers in Peel (9% of WA)	55,512
Total spend per annum	$21.7 million
Total Value (GVA per annum)	**$18.7 million**

Source: DPIRD, McLeod & Lindner (2018), Ryan et al (2019), REMPLAN, Urbis.
See appendix C for details.

DIRECT USE VALUE | RECREATIONAL BOATING

Valuation Methodology

Recreational boating in the Peel Harvey waterways has a ripple effect through the economy in the form of spending of those with boat licences. Based on Department of Transport data (2022), the total number of licences issued in postcodes adjacent to the study area is 10,544.

Recreational spend per trip has been found to total $565, with an average 9 trips per year taken by recreational boaters (EY, 2020). This expenditure estimate includes items such as vessel maintenance, berth fees, fuel costs, equipment and vessel registration, but excludes vessel asset cost. Therefore, it is seen as reasonable to assume that 100% of these costs are captured in the region as can be associated with the PHW.

Given these assumptions, spending per annum totals $54.8 million. This is equivalent to a total GVA per annum uplift of $47.3 million to the Western Australian economy.

Economic Value of Recreational Boating — **Table 3.11**

Value type	Quantity
Study area boat licenses (as at October 2022)	10,544
Estimated trips per annum	9
Estimated spend per trip	$565
Total estimated annual spend	$54.8 million
Total Value (GVA per annum)	**$47.3 million**

Source: Department of Transport, EY, REMPLAN, Urbis
n.b. it is assumed that the Peel Harvey water system induces 100% of boat license holder spending from postcodes defined as in close proximity to the study area (see p. 15 for details).
See appendix C for details.

DIRECT USE VALUE | HEALTH AND WELLBEING

Valuation Methodology

An active lifestyle, connection to water bodies and ability to be in nature are all key to maintaining individuals' health and wellbeing. The PHW contributes to health and wellbeing through residents' and visitors' direct use of the waterway and its surrounding walks, camping sites and other outdoor spaces. This relies on the health of the waterway insofar as the water must be safe to swim in and the environment pleasant to be in for residents to engage with the space. The quantification of this value is dependent on the level of visitation that is currently supported by the amenity of the PHW.

The consumer surplus of outdoor recreation and activity has been used to estimate the economic benefit related to use of the PHW and its surroundings. Consumer surplus calculates the total economic value of a good or service (in this case recreation and interaction with the PHW), less the opportunity cost (time cost or charge for the good or service). Based on estimates from Heagney et al (2019), the consumer surplus of interacting with and being in natural environments totals $30.60 per trip.

Average annual trips to the study area have been calculated using a mix of HMD analysis and TRA data, and total 3,058,000 per annum (798,000 for residents, and 2,261,000 for non-residents). This yields a total annual health and wellbeing benefit of $69.2 million.

This represents a non-market valuation using a production function technique and benefit transfer from available literature.

Economic Value of Health and Wellbeing — **Table 3.12**

Value type	Quantity per annum.
Per-trip consumer surplus from health and wellbeing gained from being in or around natural environs	$30.60
Estimated trips per annum	3,058,000
Total Value (consumer surplus)	**$69.2 million**

Source: Near, Urbis, Tourism Research Australia (TRA), Heagney et al. 2019
Note: this benefit applied to both domestic and international visitors, and is therefore an indication of total global health and wellbeing impact to visitors

Valuation Methodology

The strong and positive impact of water proximity on property values is well documented. Knight Frank's International Waterfront Index for 2022 found that the average international premium for a waterfront property compared with a non-waterfront home was 40%. Sydney topped the index, with waterfront homes attracting an average premium of 121%, while Auckland ranked second with a premium of 76%.

Homes that aren't directly on the waterfront but do offer proximity to water generally have higher prices too. A study in Texas found that an increase in one feet distance to a lake is expected to lead to a 3.1% decrease in housing price (which is equivalent to approximately -10% in one meter increase) (Landsford and Jones, 1995).

Similarly, access and views of the PHW are capitalised into property prices in the form of sales price premiums. The sale price of over 13,000 properties located within 500m of the waterways has been compared with properties located further inland (over the 34-year period between 1988 and 2022).

Table 3.13 summarises the findings of this analysis. Significant positive property price effects were found with water views and proximity. **A property within 300 metres of the waterway attracted a median price premium of $156/sq.m compared with properties located away from the water. This is equivalent to a total land value uplift of $3.9 billion.** This value uplift is likely to continue into future years, however the difference in price growth cannot be predicted and is not included in the analysis.

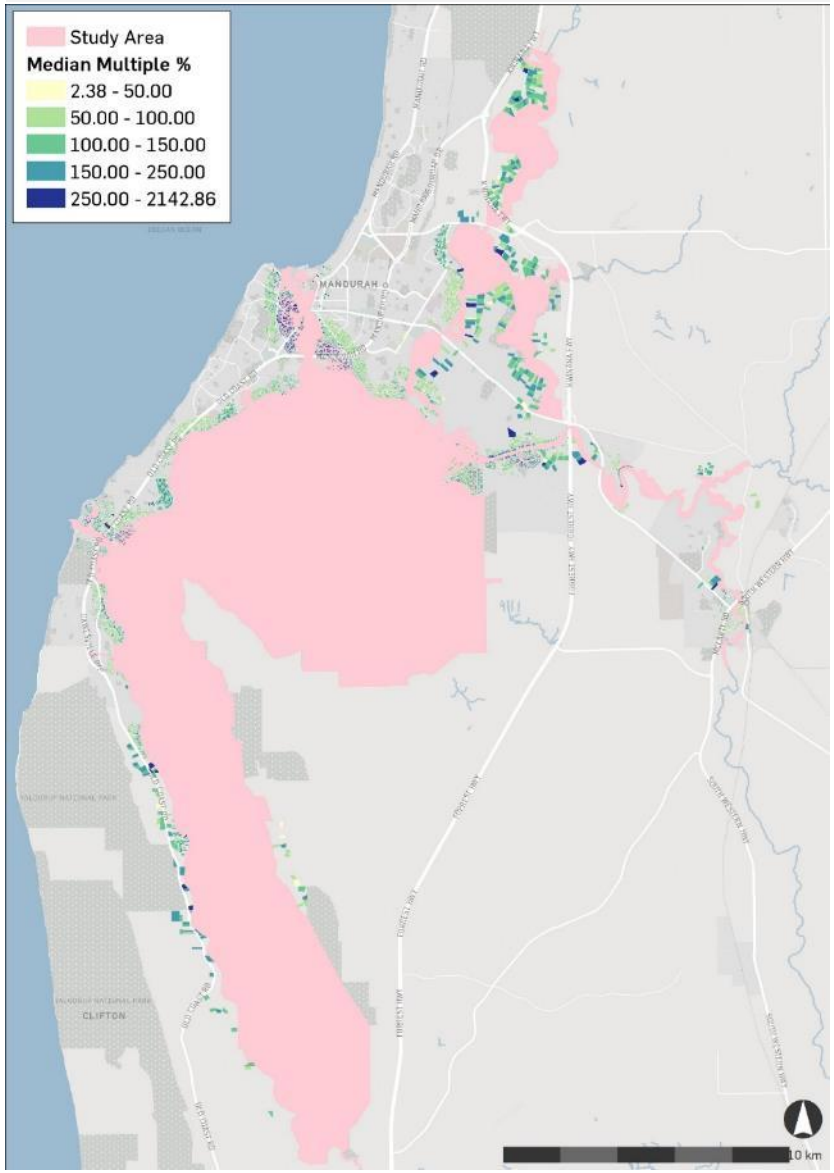
Additionally, an annual economic contribution of urban development has been calculated at $13.6 million p.a. (in GVA terms). See appendix C for detailed methodology.

Uplift in Values for Properties in Proximity to the Waterway **Table 3.13**

Proximity to waterway	Total price uplift	Price uplift per sq.m
0-100m	100%	118%
101-200m	14%	2%
201-300m	5%	0%
301-400m	-1%	-8%
401-500m	-1%	-8%
0-300m (%)	***38%***	***44%***
0-300m ($)	**$112,000**	**$156**

Note: Based on a sample of 13,545 sales between 1988-2022 (adjusted for year of sale) Source: Pricefinder, Urbis

Map 3.1 - Median Multiples within the Study Area



INDIRECT USE VALUE | OPEN SPACE (PARKS)

Valuation Methodology

Indirect value can be obtained from the existence value of public space. This is because citizens value the ability to access and use open space, even if they do not actively visit it. To avoid double-counting with the direct 'health and wellbeing' value, which quantified consumer surplus of such open spaces, the cost of maintenance of these spaces has been used to indicate the public cost borne to maintain these spaces.

Within 300m of the PHW, there is approximately 1,725,345 square metres of open space (Urbis, 2022). The average maintenance costs of public open spaces has been estimated at $0.21 per square metre, per annum (average value derived from information provided by the Shire of Murray).

Combined, this implies a total indirect use value of this open space to be $356,571 per annum due to the implied maintenance cost absorbed by the community to ensure upkeep and access.

This revealed preference for the upkeep of the open space within the study area is a non-market measurement technique.

Map 3.2 - Open Area Identified within 300m of Water Body

Economic Value of Open Space — Table 3.14

Metric	Unit	Value
Open space within 300m of PHW	sq.m	1,725,345
Average maintenance cost	$ per sq.m	0.21
Total Value (per annum)	**$ per annum**	**$365,571**

Note: Urbis, Shire of Murray

INDIRECT USE VALUE | SCIENCE AND RESEARCH

Valuation Methodology

Research spending and employment represents an indirect use value of the Peel Harvey waterways, detailed in the visual to the right.

Average research spending per annum is calculated based on research spending in the waterways since 2009.

Average researcher employment per annum is calculated based on research in the waterways since 2015 that has not released its research budget.

By inputting these values into an input-output economic analysis model (REMPLAN), a total gross value added per annum is calculated. This is the amount that will contribute to the total economic value of the waterways.

Gross value added is defined as the value of the output produced after deducting the value of goods and services lower in the value chain.

In this context, this means the value of the research, minus the value of intermediate goods used in the research process. This could include scientific equipment such as microscopes or test-tubes. Gross value added therefore just defines the value of the research itself, without any other interfering costs.

A detailed research methodology can be found in Appendix C.

Economic Value of Science and Research — Table 3.15

Value type	Quantity per annum
Average research spend per annum (published research spend)	$869,819
Average researcher FTE per annum (for projects with unpublished research spend)	4.9
Estimated research spend for projects with unpublished spend	*$1.51 million*
Total estimated research spend per annum	$2.38 million
Total Value (GVA per annum)	**$2.58 million**

Source: Urbis, REMPLAN, see appendix C for details

Valuation Methodology

Table 3.16 details agricultural nutrient run-off management strategies, their associated cost for farmers in the Peel Harvey waterways, and how often that cost would be incurred.

Separate approaches were used to value each management practice, based on available data. These approaches are detailed in Appendix C.

One-off and per annum total values have been calculated. The one-off total value is assumed to be incurred in 2023, while the per annum value is attributed every year. This approach has been taken to quantitatively evaluate this non-market value.

In the current context, as relates to this point-in-time economic evaluation, the nutrient run-off that effects the PHW is a shadow project cost (or avoided cost) in economic terms. That is to say, that the PHW are currently taking on nutrient run-off that would be required to be managed in other ways (and at a cost) were the waterways not available for this use.

Therefore, we can measure the total cost of management strategies as a minimum bound for the value of the waterways to farmers for removing agricultural nutrient run-off. Conversely, management costs themselves can be viewed as a proxy for the value that a society places on maintaining a natural asset (as is the approach we have taken to the evaluation of open space).

It is necessary to recognise that to maintain or improve the natural ecology of the waterways, these management strategies could need to be implemented.

Additionally, it must be noted that the significant majority of the management practices only relate to the total economic value of the asset, as they are one-off costs. The PHW provide a relatively small annual economic benefit of $10.6 milion in terms of managing nutrient run-off.

Management Practices **Table 3.16**

Management Practice	Description	Value	Repetition
Riparian Zone Management	Fencing Revegetation	$17,293,667 $9,882,500	42 Years One-Off
Best Practice Fertiliser Management*	Core Samples	$15,060,850	3 Years
Soil Amendment	Gypsum	$121,000,000	25 Year
Infill Sewerage	Septic Tank Removal	$65,725,000	One-Off
Constructed Wetlands	Construction Cost	$14,778,400	One-Off
Catchment Revegetation	Direct Seeding and Tube stock	$1,692,000,000	One-Off
One-Off Total	$1,725 million		
Yearly Total	$10.6 million		

Source: Hydrological and nutrient modelling of the Peel Harvey estuary Catchment, Department of Water and Environmental Regulation, 2021, PHCC, Urbis

QUALITATIVE VALUES | BOAT OWNERSHIP VALUE

Findings

Boat ownership in the Peel region is the highest within WA, with 10,544 vessels registered, equivalent to a rate of 94 per 1,000 residents (DoT). These boats represent significant assets in the region and indicate a willingness to pay of residents that has not been completely captured within the total economic value. Further to this, the Peel Harvey waterways holds the majority of the main berths from which boats are launched in WA. As a result, the total asset value and turnover within the boat industry in WA is indirectly attributable to the Peel Harvey waterways.

In total, there are over 100,000 registered boats in WA, and the marine industry employs 26,000 FTE staff and 8,000 contractors (Boating Industry Association of WA, 2022). Nationally, turnover of over $9 billion was recorded in the 2021-22 financial year (Boating Industry of Australia, 2022), indicating the large share of the economy that is supported by recreational boat ownership.

Overall, the asset value of boats was not calculated for the analysis, given there would be double-counting across the residential asset value and recreational boating spend values quantified within the model. This is because houses that would be able to house expensive assets, such as a boat, are likely to command a premium in the market and the spend in the economy of boat owners is not untangled across spending categories.

Boats in Mandurah, January 2023

Credit: Mandurah Cruises (Instagram)

QUALITATIVE VALUES | INDIGENOUS CULTURAL VALUE

Key Findings

The cultural value of the Djilba (waterways) is intrinsically important for the Bindjareb Noongar people, the Traditional Owners of the waterways.

Reconciling an economic evaluation approach with the value that Traditional Owners place on the waterways is not a viable measurement approach. This view is articulated by Bindjareb Noongar Traditional Owners in previous work commissioned by the PHCC. The Bindjareb Perspectives report to the PHCC states that: “both traditional and western models of land usage and management are worlds apart and therefore mutually incomprehensible.” (Walley & Nannup, 2012).

Therefore, it is considered appropriate to qualitatively assess the cultural value attributed to the waterways by First Nations people, rather than attempt to attribute an economic value.

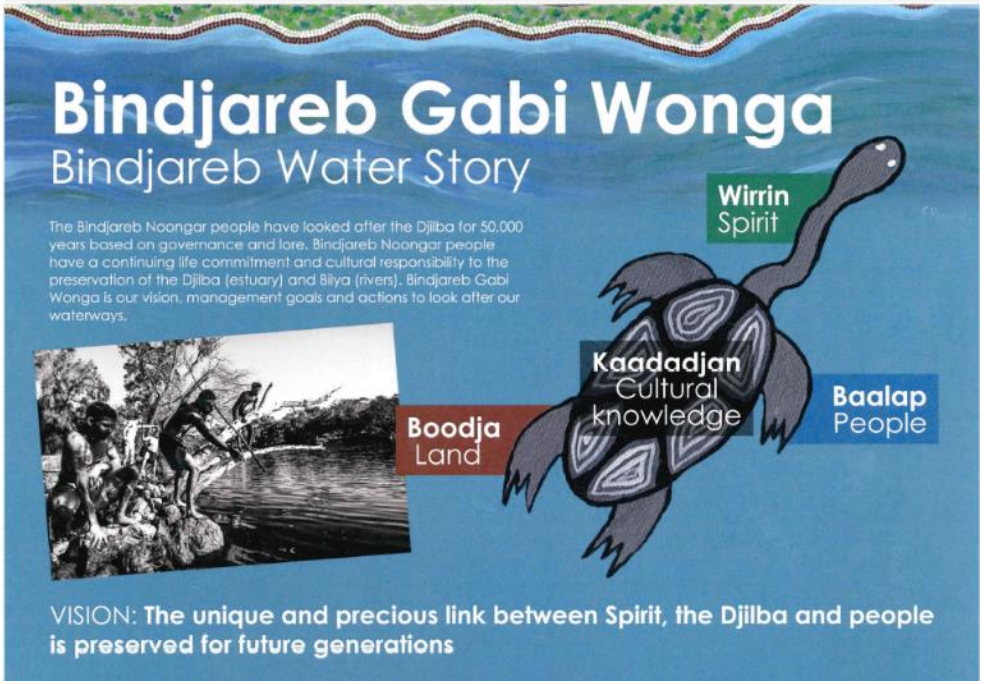
The Bindjareb Noongar people have looked after the Djilba for 50,000 years. The Bindjareb Noongar vision for and perspective of the waterways is articulated in the Bindjareb Gabi Wonga (2019), which informed the Bindjareb Djilba (2020 protection plan). The Bindjareb Water Story outlines the links between:

- Wirrin (spirit);
- Boodja (land); and
- Baalap (people).

It highlights the importance of the waterways to all aspects of cultural life, stating that: “our waterways health is connected with our own health and wellbeing”.

Current generations of the Biindjareb Noongar people maintain an on-going connection to the waterways and are concerned about their declining health and productivity. They continue many cultural practices and beliefs and maintain a strong advocacy for protection of the waterways. The Bindjareb Noongar people are involved in the management of the waterways through contribution to the Bindjareb Dilba Protection Plan, on-country work via Aboriginal ranger programs and other employment opportunities, and providing advice to government and industry. There is active support to increase opportunities for a greater, more consistent role for Bindjareb Noongar people in the management of the waterways. Community leaders actively share cultural knowledge with the broader community, including through cultural tourism.

The Bindjareb Gabi Wonga articulates the Binjareb Noongar perspective on the waterways



Credit: Nannup et al (2019)

QUALITATIVE VALUES | INDIGENOUS CULTURAL VALUE CONT.

Key Findings

The Noongar people have derived value from the Djilba in many ways throughout history to the present. The Bindjareb Culture is an oral one and locations around the PHW were intrinsically tied with access and the ability to pass down stories and knowledge. The privatisation of land has interrupted Bindjareb Noongar access to these sites and the remaining sites hold high cultural value.

Gibbs (2011) notes that historically First Nation's population on the Swan Coastal Plain was focused along the PHW. Notably, it is well documented that the PHW were the site of a large annual winter meeting of people from as far as the south-west (Gibbs 2011). At Barragup on the Serpentine River, hundreds of people from different communities would gather at the beginning of winter for a major ceremonial event. The event is estimated to last from a month to three months. The gathering saw the various communities gathered at Barragup participating in a range of activities:

- Fish weir – a fish trap (*mungah*) was reconstructed at the time of the gathering when conditions were favourable and fish were abundant in this part of the system, predicating the timing of the annual gathering.
- Food collection – the abundance of fish caught in the weir were distributed amongst visitors by the hosts.
- Ceremonial and social activities – such as dancing, singing and ceremonies including betrothal, friendship ceremonies and corroboree.
- Sporting and athletic competition – such as swimming races and spear and boomerang throwing.

There are at least 356 culturally significant sites in the Peel-Harvey Catchment (Dortch et al cited in Hale & Butcher, 2007). These include water sources, skeletal material / burial, mythological, camping, and ceremonial sites. See appendix C for details.

Mandjoogoordap Dreaming operate cultural tours

Credit:Visit Mandurah and Russell Ord Photography

QUALITATIVE VALUES | BIODIVERSITY VALUE

Key Findings

The Peel Harvey waterways are a hub of biodiversity in Western Australia, recognised as a Wetland of International Importance under the Ramsar Convention.

As discussed earlier in this report, biodiversity sits at the core of all economic and recreational values calculated as part of this report.

The diverse ecosystem provides ecosystem services that, combined with other forms of capital, contribute to human wellbeing and deliver value. As the biodiversity of the PHW underpins the services that it provides, it has not been calculated as a separate value to avoid the potential for double counting with several other values calculated in this report.

Table 3.17 details three key reports that each use a different method to calculate the value of biodiversity in natural ecosystems. To complete a similar valuation of the waterways, a Willingness to Pay (WTP) survey would be required.

Literature Review

Table 3.17

Reference	Overview
Marsdon Jacob Associates (2012), Literature Review of the Economic Value of Ecosystem Services that Wetlands Provide	This report uses a Willingness to Pay (WTP) survey to find the economic value of different flora and fauna in the Murray River (Victoria) wetland ecosystems to the community. This includes values for: ▪ An increase in waterbird breeding ▪ Native fish population increase ▪ Healthy vegetation population increase ▪ Improved waterbird habitat
De Groot et al (2006), Valuing Wetlands: Guidance for valuing the benefits derived from wetland ecosystem services	Part 3 of the Ramsar Technical Report series calculates a per kilometer value for benefit value of wetlands in developing countries. This can be split into the various ecosystem services provided including: ▪ Recreation ▪ Flood Control ▪ Water Treatment ▪ Biodiversity ▪ Habitat Nursery ▪ Climate Regulation ▪ Water Supply ▪ Raw Materials
Deloitte Access Economics (2017), At what price? The Economic, Social and Icon value of the Great Barrier Reef	This report calculates the WTP of the national and international community for the continued protection Great Barrier Reef using a survey. Deloitte finds an average WTP of $1.98 per person across surveyed countries (including India, China, USA and UK). In calculating the total economic value of the Great Barrier Reef, Deloitte including the Australian average weekly willingness to pay at $1.30.

QUALITATIVE VALUES | BEQUEST VALUE

The bequest value of the Peel Harvey waterways is the willingness to pay (WTP) of someone today so the waterways are available for future generations.

From the investment made into this report itself to the construction of the Dawesville Channel, it is evident that the community values the waterways for future generations.

The bequest value is therefore spread throughout this report and contained as a part of almost every value, as people and the community make investments, decisions and interventions in and about the future of the waterways.

Bequest values are included as a part of:

- The science and research undertaken at the waterways to the improve their condition for current and future generations.
- Buying of fishing licences to ensure fish and blue swimmer crab populations thrive for current and future generations.
- Infrastructure investments in community facilities such as shops near the waterfront to be used by current and future generations.
- Community initiatives such as bush regeneration and waterway clean ups.
- On-ground management efforts, including the work of multiple government agencies.

Current discussion in the economic evaluation space around bequest values are ongoing (Economic Society of Australia, 2022). The intergenerational nature of assets such as the Peel Harvey waterways are complex to evaluate given the usual process of discounting, however emerging literature suggests cross-generational values are either stable over time, or increase due to them becoming normalised in our societies (ibid.).

How to Calculate the Bequest Value

To estimate the value of the waterways to future generations, a Contingent Valuation (CV) survey would be required.

This valuation methodology involves a survey being released to a sample of both Australians and the international community asking how much a person is WTP to maintain or improve the estuary for future generations. A range of questioning techniques are available to acquire an unbiased WTP from survey participants, and could inform further analysis of population-specific economic measures.

While a potential measurement technique that has been employed in similar economic evaluations of natural assets, it is beyond the scope of this study.

Protecting and maintaining the waterways for future generations

Clean Up Peel Waterways, Credit: Peel Harvey Catchment Council

Revitalisation Project on Harvey River, Credit: Water Corporation

Valuation Findings

Annual economic contribution was calculated through summing the direct and indirect values outlined in this section of the report. In total, the annual economic contribution of the waterways is $605.7 million.

The 3 million annual visitation figure presented here informed the calculation of the annual economic contribution. The annual visitation figure is derived from HMD, TRA and other data sources used throughout this report to quantify the value. Of these visits, which represent occasions where people interacted directly with the PHW study area, we estimate that the large majority (85%) were taken by visitors to the Peel tourism zone. The vast majority of these visits (85%) were from residents of WA. This analysis highlights the importance of the PHW not only to the Peel region, but to WA.

Water usage is the largest economic contributor, however given the significance of direct human interaction with the PHW, waterfront hospitality and tourism is the biggest value driver by output amount.

From this economic contribution, significant employment is also stimulated in the WA economy. Using REMPLAN input-output modelling, the industry generating outcome (hospitality, commercial fishing, science and research etc.) has been calculated. In total, an estimated 2,086 FTE jobs are supported on an annual basis through the economic outcomes and activity that is supported by the PHW, specifically. This is approximately 10x as many ongoing roles as Optus Stadium (Deloitte, 2020), and is a likely underestimate of the total employment given construction and other built form outcomes have not been considered.

While the broader Peel region supports a larger total workforce, the employment figure assessed here is representative of the FTE that is derived from the economic value supported by direct interaction with the PHW. There are likely a larger number of workers that benefit from existence of the waterways.

Annual Economic Contribution — Table 3.18

Annual Economic Contribution	
Direct Use	$578.6 million
Indirect Use	$27.1 million
Estimated Annual Economic Contribution	$605.7 million

Source: Urbis

2,086

full-time equivalent jobs

3 million

visits per annum

Source: REMPLAN, Urbis

EVALUATION FINDINGS | TOTAL ECONOMIC VALUE

Valuation Findings

The total economic value of the waterways includes the one-off values of urban development and run-off impacts, and totals $20.8 billion at a 3% discount rate. Even at a highly conservative 10% discount rate, a total economic value of $11.1 billion indicates that the waterways are of profound economic significance to the WA economy.

Additional to this value are the qualitative benefits mentioned within this section: boat ownership, Indigenous culture, biodiversity and bequest. All of these further cement the clear need to continually maintain or improve the waterways to provide economic, social, cultural and environmental outcomes to the WA economy and population.

Total Economic Value

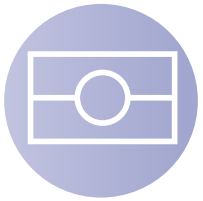
Table 3.19

Total economic value (50 years), with discount rate comparisons				
Value Type \ Discount Rate	**3%**	**7%**	**10%**	**Total (undiscounted)**
Direct Use	$14.9 billion	$8.0 billion	$5.7 billion	$28.9 billion
Indirect Use	$5.9 billion	$5.5 billion	$5.3 billion	$6.4 billion
Total Economic Value	$20.8 billion	$13.5 billion	$ 11.1 billion	$ 35.3 billion
Adopted Total Economic Value (@ 3% discount rate)	**$20.8 billion**			

Source: Urbis

Additional Values (Qualitatively Assessed)

BIODIVERSITY



INDIGENOUS CULTURE

BEQUEST

BOAT OWNERSHIP

APPENDIX A

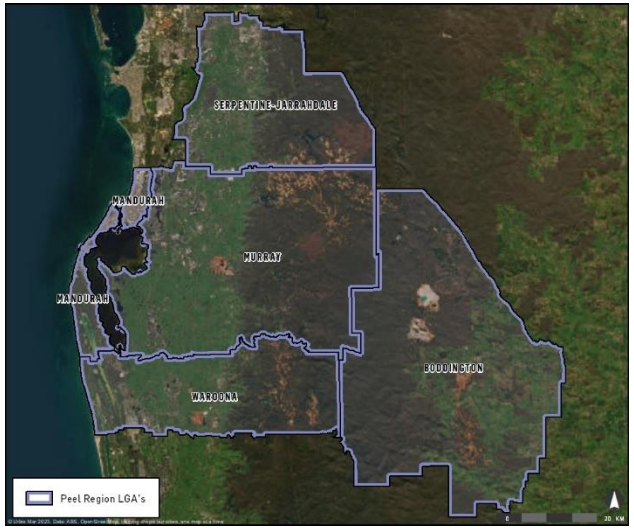
TERMINOLOGY & DEFINITIONS

Image credit: Sky Pixels and Visit Mandurah

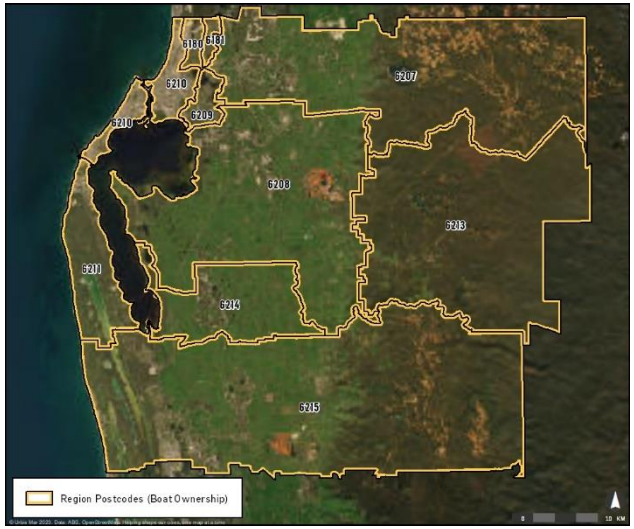
APPENDIX A | GEOGRAPHIES

We have utilised multiple geographical areas throughout this report. It is important to understand that where a variety of geographies have been used for the purpose of collecting data from different sources, the valuation has been calculated to only include value that is derived from within the study area. This has been achieved with a number of analysis techniques, including utilising Geographic Information System (GIS) technology.

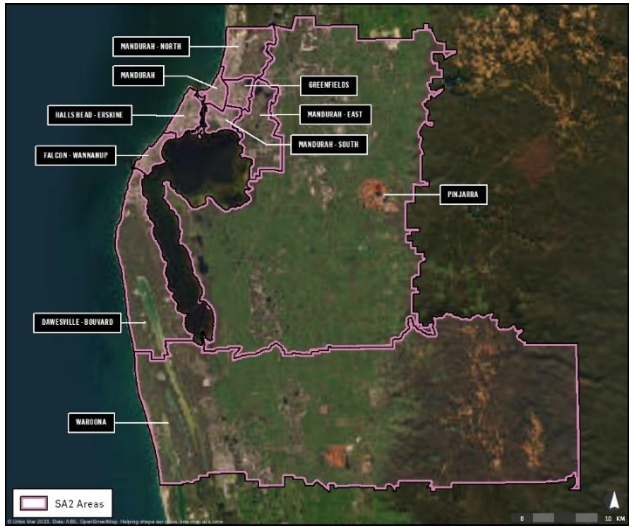
'Study Area'
The geographical extent of the evaluation.
The study area 'waterbody' is the **Peel Harvey waterways** (PHW) as defined by PHCC (and interchangeably referred to as such in this report). The 'open space' boundary is a buffer zone that includes environmental protection zones, public open space and any area that is adjacent to the waterways but bounded by a road or building.



'Peel Region'
The five LGAs that make up the Peel Region.



'Peel Region Postcodes'
Geographical area for boat ownership data.
This grouping includes the postcode areas that most closely align to the Peel region. This area is used to collect data reported by the Department of Transport on boat ownership in the region.



'Peel Tourism Zone' - Statistical Areas 2s
The collection of SA2s that covers the entire study area and surrounds.
This area is used in particular to collect TRA data. Where the context section reports the results for the entire Peel Tourism Zone, it is important to recognise that the evaluation estimates the portion of the visitation that is directly attributable to the study area, by utilising HMD and GIS tools.

APPENDIX A | GLOSSARY OF TERMS

Activation is a relative term that refers to the amount of activity in a geographical area. In the case of HMD this refers to the relative number of visits (i.e., not unique visitors) that a precinct sees.

Biodiversity comprises of animals, plants and microorganisms, their genetic variation and their organization into populations that assemble into ecosystems and is fundamental to the provision of ecosystem services. (Department of the Environment, Water, Heritage and the Arts, 2009).

Direct Impacts are the initial round of economic output, employment and household income generated by an economic activity.

Discount Rates represent the view that people prefer immediate benefits over future benefits and additionally enable for opportunity costs to be reflected when making judgements about the value of a project.

Economic Output is a measure of the gross revenue of goods and services produced by commercial organisations and gross expenditure by government agencies.

Ecosystem services are the ecological characteristics, functions, or processes that *directly* or *indirectly* contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems (Constanza et al, 2017; Millenium Ecosystem Assessment, 2005).

Full-Time Equivalent (FTE) Job Years refers to the total number of full-time equivalent jobs that can be supported over a 12-month period.

Gross Value Added (GVA) is a measure of the value of goods and services produced in an area, industry or sector of an economy during a certain period of time. GVA is measured in constant 2020 dollar (i.e. excluding inflation) excluding GST.

Hospitality expenditure is calculated as consumer spend on the product categories food catering and liquor. This includes food and beverage purchases for consumption at a venue, for example a restaurant or café, and take-away food for consumption elsewhere.

Indirect Impacts are production-induced effects. Production-induced effects (Type I) are additional output, employment and household income resulting from re-spending by firms that receive payments from the sale of services to firms undertaking production. Consumption-induced effects (Type II) are additional output, employment and household income resulting from re-spending by households that receive income from employment in direct and indirect activities.

Induced Impacts are the expected outcomes of a project versus the business of usual approach whereby the project is not implemented.

Net Present Value is the sum of the present value of benefits and costs over a period of time.

Present Value reflects the current dollar value using a prescribed discount rate.

Total Economic Value is the value derived from a natural asset from both use and non-use values.

Tourism expenditure is the amount paid for the acquisition of consumption goods and services, as well as valuables, for own use or to give away, for and during tourism trips (United Nations' International Recommendations for Tourism Statistics 2008). Therefore, tourism spend captures a broader set of goods and services than local hospitality spend.

APPENDIX B

HUMAN MOVEMENT DATA

Image credit: Sky Pixels and Visit Mandurah

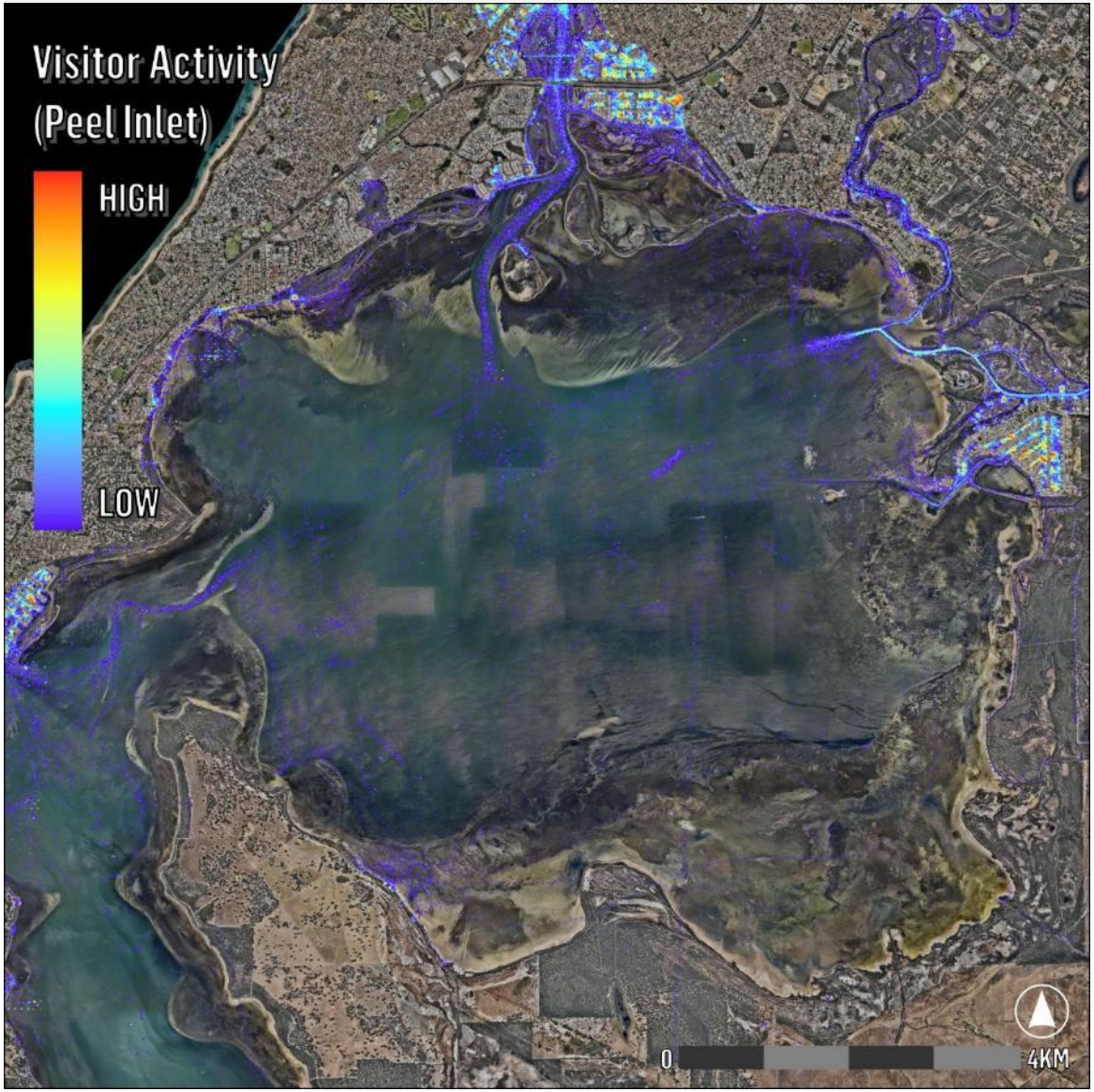
Key Findings

Map B.1 depicts activity in the Peel Inlet. This larger scale map allows the routes of watercraft to be followed, showing the areas of the inlet where boat activity is the highest.

The edge of the waterway also shows swimmer and bush walker activity, centered around:

- Point Grey
- Coodanup Foreshore Reserve
- Len Howard Conservation Park
- Novara Beach Reserve
- Pleasant Grove Reserve
- Austin Bay Nature Reserve

Map B.1 - HMD Heat Map of Visitor Activity in the Peel Inlet



Source: Near, Urbis

Key Findings

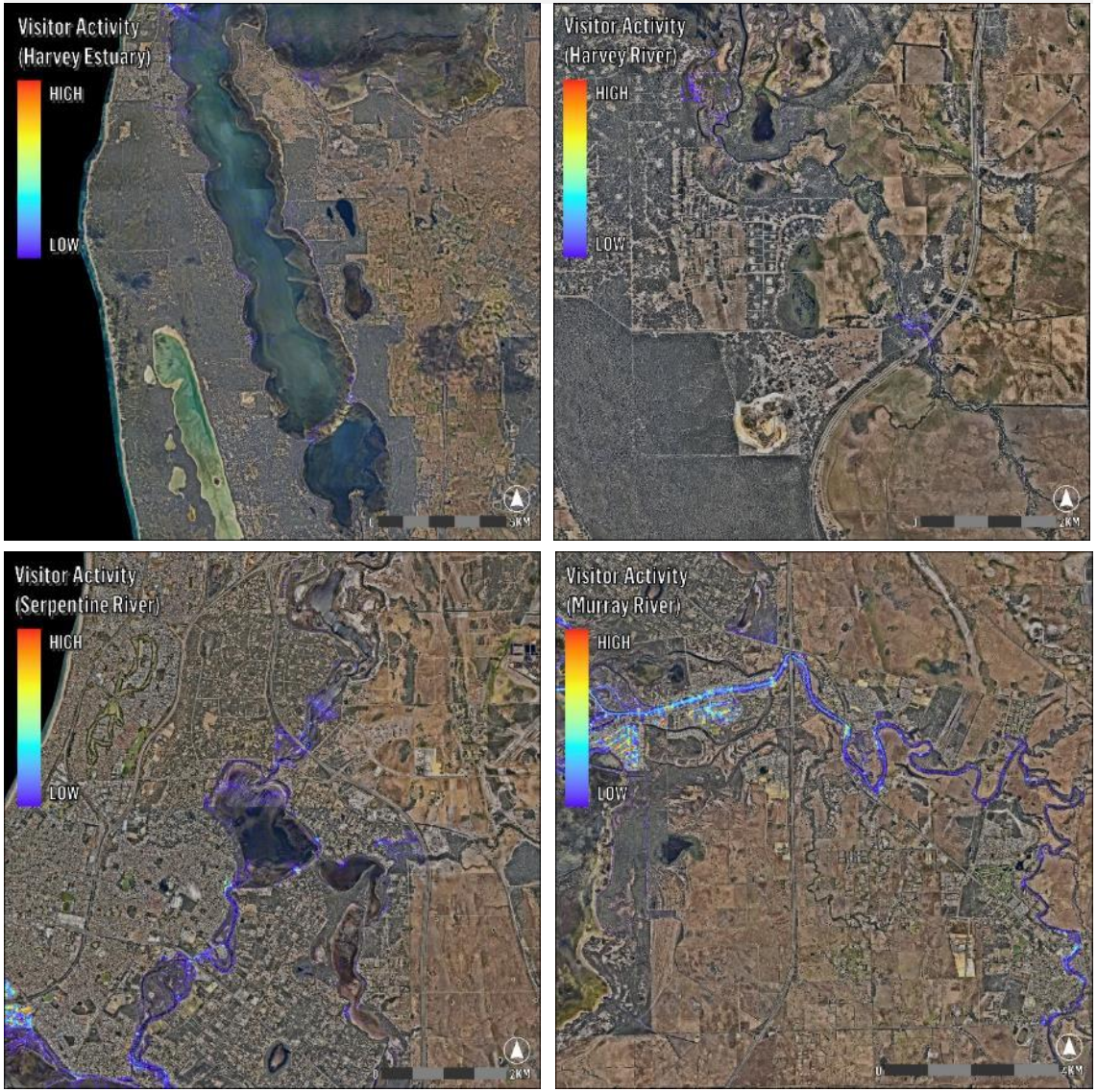
Maps B.2, B.3, B.4 and B.5 depict low activity zone of the Peel Harvey waterways.

These include the Murray, Harvey and Serpentine rivers, of which the Murray shows the highest level of activity as it passes through a number of residential areas.

The Harvey River has the lowest level of visitation of any zone in the waterways, with 2 key clusters where main roads cross the river.

The Harvey Estuary sees visitation to campgrounds along it edges such as Heron Point as well as evidence of bush walkers, bird watches and swimmers.

Maps B.2,3,4,5



Source: Near, Urbis

APPENDIX B | ACTIVATION | VISITS BY HOUR OF DAY

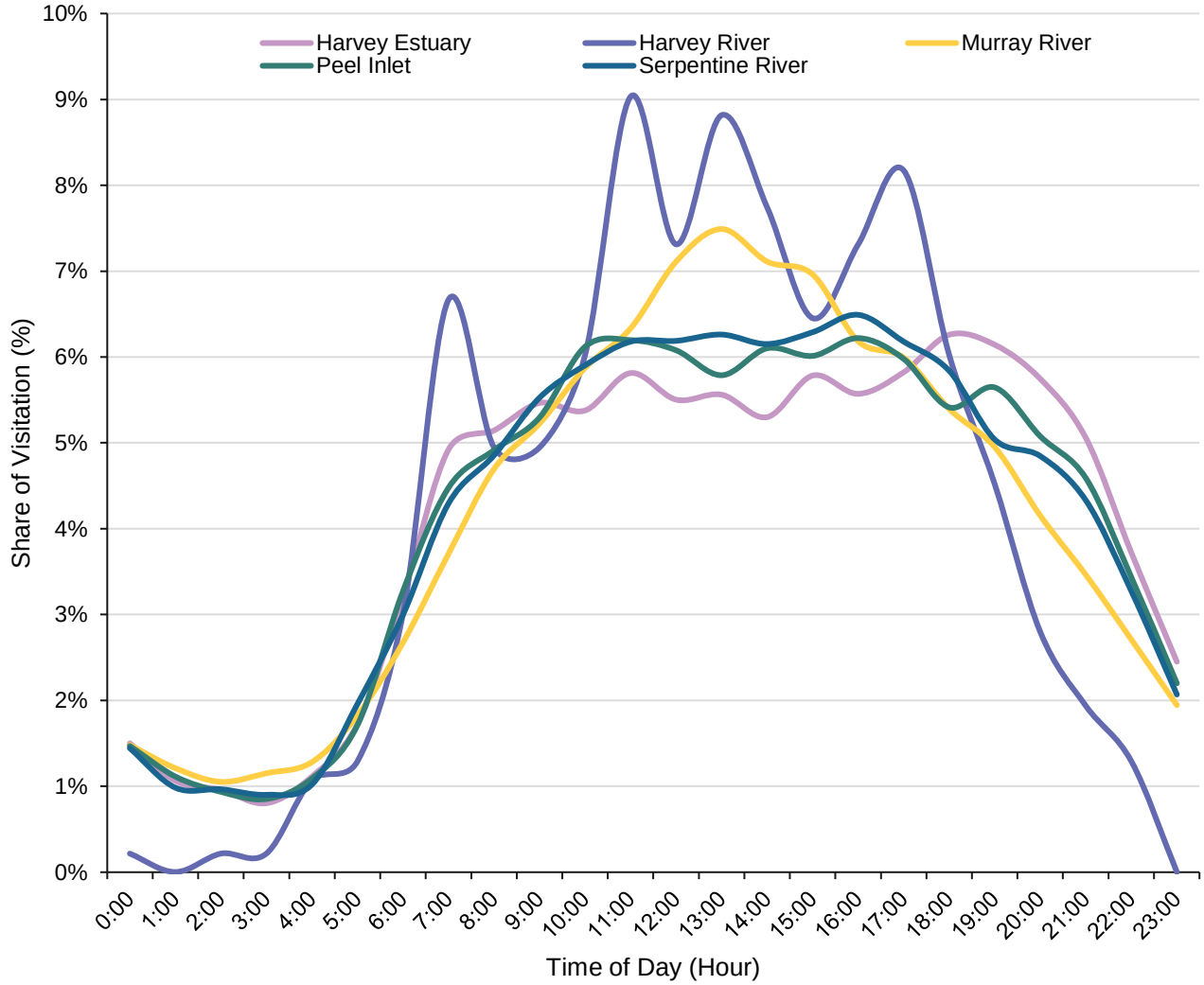
Key Findings

Graph B.1 depicts the visitation to the waterways by hour of day for locations not included in chart 2.2.

The Harvey River shows a highly variable visitation profile, but this can be attributed to its low level of absolute visitation skewing results.

The Harvey Estuary, Peel Inlet, Murray River and Serpentine River follow the general trend.

Visits by Hour of Day and Location, 2019 — Chart B.1



Source: Near, Urbis

APPENDIX C

ECONOMIC EVALUATION

Image credit:Visit Mandurah and Russell Ord Photography

APPENDIX C | INPUT-OUTPUT METHODOLOGY

The REMPLAN Methodology

Analysis presented here uses REMPLAN economic modelling to assess current and potential economic impacts. REMPLAN provides a modelling tool that is accepted and used by various government bodies in Australia. It uses an Input-Output model that captures inter-industry relationships within an economy, based on the ABS 2019/20 National Input Output Tables (I/O Tables). It can assess the area-specific direct and flow-on implications across industry sectors in terms of employment, wages and salaries, output and value-added, allowing for analysis of impacts at the State of Western Australia level.

Key points regarding the workings or terminology of the model are as follows:

- REMPLAN uses either the value of investment or employment generation as the primary input. For this analysis, the value of total upfront investment has been used as the key input to assess the benefits of the construction phase.
- Outputs from the model include employment generated through the project and economic Gross Value Added (GVA) at the State level.
- Outputs from the model include employment generated through the project at both the local and the state level.
- Both the direct and indirect employment are modelled:
  - *Direct* refers to the effect felt within the industry as a result of the investment. For example, the construction phase will directly result in the creation of construction jobs.
  - *Indirect* effects are those felt within industries that supply goods to the industries directly affected.
- It should be noted that the results presented in this report are estimates only based on the existing state of economic activity in the area. Due to the static nature of input-output modelling, they have the potential to overstate the actual effects. The approach Urbis adopts in accounting for this is presented adjacent. Nonetheless, the analysis still reflects the fact that employment growth will be positive for the State and the local area.

Reporting of Impact Modelling Results

Urbis have adopted a conservative approach to estimating and reporting economic and employment benefits using the REMPLAN modelling tool so as to not overstate the likely effects. Key areas where Urbis' approach is designed to not overstate the effects include:

- While REMPLAN defines the supply chain linkages between local industries and allows the assessment of multiplier effects as a result of a direct input into an industry, the nature of the ABS I/O Tables and indeed the set-up of the model suggests there is likely some double-counting therefore overstatement of the flow-on effects.
- Wherever applicable, Urbis have chosen to report *Gross Value Added (GVA)* rather than '*Output*' as the economic benefit of a certain development project or activity, as it is considered a more accurate, albeit conservative, estimate of benefit which excludes items such as tax and subsidies which are included in '*Output*'.

APPENDIX C | HOSPITALITY METHODOLOGY & ASSUMPTIONS

The hospitality spend by both visitors and locals was calculated based on two factors:

1. Visitation (direct interaction with the waterways); and
2. Spend rates.

VISITATION

The first element, visitation, relies on HMD to quantify the amount of visitation from both locals and visitors to the study area. In the case of visitors, this figure is derived from the total visitation to the region as reported by Tourism Research Australia (TRA). The region is defined by ten Statistical Areas 2s (SA2s) and referred to as the 'Peel tourism zone':

- Pinjarra
- Mandurah – South
- Mandurah East
- Halls Head – Erskine
- Falcon – Wannanup
- Dawesville – Bouvard
- Greenfields
- Mandurah
- Mandurah – North
- Waroona.

To ensure that the value calculated only includes economic activity that is directly attributable to the waterways, the total visitation to the region was multiplied by an interaction effect that was derived from HMD.

The same approach was taken to ascertain the level of visitation to the study area by residents of the SA2s, using HMD.

SPENDING

The second element, spending rates, was calculated differently for visitors and locals.

Visitor spending rates were assumed from TRA data for the ten SA2s defined previously. The spend per day by visitor type was applied to the total visitor nights for each visitor type to calculate a total visitor spend per annum in this area. This total was then multiplied by the interaction effect to derive an estimate for the economic activity directly attributable to the waterways.

The calculation of spending rates for local users was calculated using a different approach. We utilised MarketInfo spending market estimates for the region defined by the ten SA2s. The spending market for the product group categories food catering and liquor was adopted. This total was then multiplied by the interaction effect to derive an estimate for the economic activity directly attributable to the waterways.

The total estimated spend per annum was converted to GVA as per the REMPLAN methodology outlined earlier in this section.

Note on MarketInfo: The retail spending market was estimated using MarketInfo – a micro-simulation model developed by MDS Market Data Systems Pty Ltd. This model is based on information from the ABS' Household Expenditure Survey (HES), the Census of Population and Housing and other information sources that provide up-to-date information on changes in spending behaviour and/or income levels (e.g. Australian National Accounts, Australian Taxation Statistics, etc.). MarketInfo is used widely by stakeholders in the retail industry and by other consultants preparing Retail Sustainability Assessments/Economic Impact Assessments.

The model uses micro-simulation techniques to combine propensity to spend on particular commodities with the socio-economic characteristics of individuals to derive spending per capita estimates on a small area basis (i.e. the Statistical Area 1 level).

Methodology

To calculate the economic contribution of recreational fishing on the PHW, we have adopted expenditure assumptions based on McLeod and Lindner's report *Economic Dimension of Recreational Fishing in Western Australia.* The adopted spending figure includes only those items that relate to onshore fishing, to avoid double counting spending related to recreational boating.

To calculate the economic contribution of recreational boating, we have adopted expenditure assumptions adapted from EY's report to the Victorian Fisheries Authority and Better Boating Victoria, *The economic value of recreational boating in Victoria*. In the absence of a WA example, this contemporary study from another Australian state is expected to be appropriately transferable to the WA context. Items included in the average spend per trip figure include costs associated with vessel maintenance, as well as equipment purchases, some of which relate to on water fishing. The figure does not include the asset cost of a vessel.

Both the recreational fishing and recreational boating expenditure figures adapted from contemporary studies have been adjusted for inflation.

The per trip expenditure has been multiplied by the number of fishers and boaters, and their propensity to fish or boat (from sources listed on pp. 43-44), to calculate the annual economic contribution.

Expenditure Assumption, Recreational Fishing (shore only) — Table C.1

Item	Average $ per trip
Expenditure on Rods, reels, pots (ETC.) $/yr	$24
Expenditure on Clothing (SHOES, HATS) $/yr	$3
Expenditure on Diving gear (INCL HIRE) $/yr	$4
Expenditure on Fishing club membership $/yr	$1
Average cost per trip ($2018)	*$32*
Average cost per trip ($2022)	**$34.99**

Source: adapted from McLeod and Lindner, 2018

Expenditure Assumptions, Recreational Boating — Table C.2

Item	Average $ per boater per trip
Vessel hire and equipment	$21.56
Trailers and trailer maintenance	$20.18
Berth fees	$31.17
Launching or parking fees	$27.44
Food and accommodation	$64.13
Boat fuel costs	$54.11
Boat maintenance	$50.64
Equipment to support boating activity (e.g. safety gear, fishing gear)	$39.58
Clothing (e.g. wetsuit)	$43.30
Vessel club fees	$20.20
Licensing costs	$29.30
Vessel registration	$38.84
Vessel maintenance	$27.05
Trailer maintenance	$16.72
Other	$47.7
Average cost per boater per trip ($2018)	*$531.93*
Average cost per boater per trip ($2022)	**$564.59**

Source: adapted from EY, 2020

APPENDIX C | URBAN DEVELOPMENT METHODOLOGY & ASSUMPTIONS

Methodology

The potential uplift factor to waterfront dwellings was calculated based on median price data for dwellings within 300m of the study area compared to benchmark of 501-5,000m from the study area. The median price figures were sourced from Pricefinder land sales data analysed using GIS to group sales into categories based on distance from the study area (i.e. waterfront). Median prices were adjusted for year of sale.

To determine the total economic value from waterfront urban development, the calculated uplift factor was applied to all land within 300m of the study area that is zoned such that urban development could occur.

The annual economic contribution of urban development was also calculated, based on the proportion of dwellings constructed per annum. An adjustment of 80% is made to the median price per sq.m to allow for the variation between build cost and sale price.

The GVA impact of this to the Western Australian economy has been estimated using REMPLAN input-output modelling, and totals an annual benefit of $13.6 million.

Waterfront Urban Development Uplift Assumptions — **Table C.3**

Item	Value
Median price per sq.m within 300m of study area	$608 per sq.m
Median price per sq.m at benchmark of 501-5,000m of study area	$403 per sq.m
Uplift factor	36%
Urban area with 300m of study area	24,643,673 sq.m
Total waterfront urban development benefit (one-off)	**$3.9 billion**

Source: Urbis, Pricefinder
n.b. urban area includes all land with a zoning that allows urban development
Median price figures are source from Pricefinder and adjusted for year of sale.

Annual Economic Contribution Assumptions — **Table C.4**

Item	Value
Median price per sq.m (avg. 2020-21)	$1,002 per sq.m
Proportion of properties constructed per annum (avg. 2020-21)	0.05%
Urban area within 500m of study area	41,912,717 sq.m
Annual construction activity	***$16.1 million***
Total Value (GVA per annum)	**$13.6 million**

Source: Urbis, Pricefinder

APPENDIX C | SCIENCE AND RESEARCH METHODOLOGY & ASSUMPTIONS

Methodology

The Peel Harvey waterways are host to a variety of research projects focused primarily on biology and marine science.

To calculate the economic value of these research projects a gross valued added methodology was employed.

The following tables C.5 and C.6 detail research projects undertaken in the Peel Harvey waterways. While not exhaustive, this list was compiled with input from PHCC. Where the availability of information varied across projects, we have employed a number of assumptions to estimate the relevant economic output, with these assumptions detailed to the right.

This approach is conservative and the final output figure should be regarded as a minimum bound of the potential economic contribution of science and research.

The gross value added calculated from these methodologies was summed together to reach a total gross value added of $2.58 million per annum.

Research with Known Budget Methodology

For research projects with a single budget over their research period, the combined average yearly research spending was calculated at $410,738. Controlling for inflation, average yearly research spending amounted to $459,819.

We have also included the per annum resource allocation for a number of ongoing research efforts, which equates to a further $410,000 per annum.

The average research spending per annum is calculated through the sum of these two numbers, equalling $869,819.

This value was input into the REMPLAN input-output model to calculate a gross value added of $940,802.

Research with Unknown Budget Methodology

For projects with an unknown budget the average yearly number of researchers working on a project was calculated. We have calculated the average FTE for these projects with the following assumptions:

- Each researcher listed contributes 0.5 FTE of effort to the project
- Where the project timeframe couldn't be reliably sourced, it is assumed the project duration was 2 years.

This results in an estimate of approximately 4.9 FTE per annum.

The average researchers per annum was input into the REMPLAN input-output model to calculate a gross value added of $1.6 million.

Research with Known Budget **Table C.5**

Project Name	Organisation	Project Completion Year	Budget
Ramsar Science Management	Funded by Australian Government	2023	$904,000
Lake Clifton Water & Salt Budgets as Major Drivers of Thrombolite Survival	UWA for PHCC Funded by Australian Government	2024	$182,000
Peel Water Research Infrastructure Porject (Gabi Bidi - Water Pathways)	Funded by WA State Government	2024	$512,000
Regional Estuaries Initiative - Peel Main Drain Swales	PHCC Funded by WA State Government	2025	$1,450,000
Saving Lake McLarty Phase 1: Addressing acidification, hydrology and habitats	Funded by WA State Government	2022	$351,000
Science Advisor		Ongoing	$120,000 p.a.
Stock Enhancement of Black Bream in the Peel-Harvey Estuary	Funded by WA State Government through Peel-Harvey Estuary Grants	2023	$243,941
Balancing estuarine and societal health in a changing environment (LP150100451)	Funded by ARC Linkage Project grants with additional contributions by City of Mandurah, universities (see below) and industry partners Project led by Dr Matt Hipsey and Fiona Valesini with supporting research components from Southern Cross University, University of Hull, UWA, DWER and Murdoch University	2019	$1,180,000
Monosulfidic Black Ooze in the Peel-Harvey Estuary	Funded by ARC Linkage Project grants Southern Cross University, Curtin University, UWA, DoW, DEC	2013	$656,994
Science Strategy for the Peel-Harvey Estuary	Centre for Fisheries and Fish Research and Murdoch University	2010	$40,000
Fish Community Index	Funded by Alcoa Foundation Healing Bilya – Saving the Murray and Serpentine Rivers; Wetlands and People (NLP).	2023	$105,000
Impacts of Fire on Water Quality in the Harvey River Basin	ECU, Melbourne University, DWER, HRRT, PHCC	2017	$30,000
Sulfur Cycling in Toxic Oozes, Microbialites and Petroleum	Australian Research Council *33% of total project funding attributed to PHW	2019	$151,558
Fishing impacts on Peel Harvey Estuary shorebirds	Marine Stewardship Council	Ongoing	$170,000
Estuarine Monitoring: Nutrient and algae monitoring of the estuary	DWER	Ongoing	$90,000 p.a.
Catchment Monitoring: Sampling of nutrient flows into the estuary	DWER	Ongoing	$75,000 p.a.
Science and Management: Seagrass surveys, innovative monitoring trials and modelling	DWER	Ongoing	$165,000 p.a.
Innovative Remediation Trials: Testing soil remediation products	DWER	Ongoing	$80,000 p.a.

Research with Unknown Budget **Table C.6**

Project Name	Organisation	Project Completion Year	No. Researchers
Dolphins as part of the ecological character of Ramsar-listed wetlands: a case study of Indo-Pacific bottlenose dolphins in the Pel-Harvey Estuary, WA Research	Murdoch University Cetacean Research Unit Funded by Murdoch University, City of Mandurah, Peel Development Commission with donations from Mandurah Cruises, Mandurah Volunteer Dolphin Rescue Group and John and Bella Perry	2022	1
River Health Assessments	Variously funded by Peel-Harvey Estuary Grants and Three Rivers One Estuary	2022	7
Stability and change in a changing environment: soft-bottom benthic mollusks in the Peel–Harvey Estuary over 42 years	Curtin University, WA Museum and Museum of Natural History, Chicago	2022	4
Marine Stewardship Council Certification and re-certification (includes various research components)	DPIRD	2016	4
Phosphorus status and saturation in soils that drain into the Peel Inlet and Harvey Estuary of Western Australia	DPIRD	2021	2
West Coast Estuarine Managed Fishery (Area 2: Peel Harvey Estuary) & Peel Harvey Estuary Blue Swimmer Crab Recreational Fisheries	Government of Western Australia Department of Fisheries	2015	7
Hydrological and nutrient modelling of the Peel Harvey estuary catchment	Government of Western Australia Department Water and Environmental Regulation	2021	5

Methodology

The riparian zone is the immediate area surrounding a river or creek, defined as 30m on either side in this report. Fencing riparian zones prevents livestock from directly polluting rivers. Vegetating riparian zones prevents nutrient run-off from reaching a waterway as plants absorb a portion of the nutrients.

Table C.7 details the methodology used to cost vegetating all unvegetated and fencing all and un-fenced riparian zones in the Peel Harvey waterways system.

An average fencing cost is calculated from a variety of sources detailed in table C.7 equalling $4,833 per km. The revegetation cost is assumed to use direct seeding of plants.

The total length of river requiring fencing is multiplied b the average fencing cost to calculate the river fencing cost of $17,293,667.

The total length of river requiring revegetation is multiplied by the revegetation cost to calculate the river revegetation cost of $9,822,500.

Summing these values together calculates the total riparian management cost of $27,116,167.

Riparian Zone Management Cost Summary **Table C.7**

Statistic	Value	Unit	Source
Total River Length Requiring Fencing	3,578	km	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Total River Length Requiring Revegetation	3,929	km	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Fencing Cost			
Riparian Zone Fencing Cost	6,000	$/km	NSW Government Riparian Restoration Incentive Scheme
Riparian Zone Fencing Cost	4,000	$/km	Charles Stuart University
Riparian Zone Fencing Cost	4,500	$/km	DAWE Enhancing Remnant Vegetation Price Guide
Average Fencing Cost	4,833	$/km	
Revegetation Cost			
Direct Seeding	2,500	$/km	NSW Government Riparian Restoration Incentive Scheme
Cost Summary			
River Fencing Cost	17,293,667	$	
River Revegetation Cost	9,822,500	$	
Total Riparian Zone Management Cost	27,116,167	$	

Methodology

Riparian zone fences degrade over time and therefore need to be replaced. A sample of sources for various fence lifetimes are listed in table C.8.

From this, the average fence lifespan is calculated at 23 years. His will determine how often fences will be valued in the valuation model.

It is assumed riparian zone vegetation is a one off cost.

Fence Lifespan Calculation

Table C.8

Fence Type	Value	Unit	Source
Wooden Fence	20	Years	Pacific Fence & Wire
Wooden Fence	25	Years	21 Timbers
Treated Boards	15	Years	University of Georgia
PVC Rails	20	Years	University of Georgia
High Tensile Polymer Coated	33	Years	University of Georgia
Barbed Wire	35	Years	University of Georgia
Suspension Fencing	33	Years	University of Georgia
Woven Wire Fencing	33	Years	University of Georgia
Cedar	22.5	Years	Mossy Oak Fence
Spruce	5.5	Years	Mossy Oak Fence
Pine	8.5	Years	Mossy Oak Fence
Treated Wood	30	Years	Mossy Oak Fence
Metal	27.5	Years	Mossy Oak Fence
Average Fence Lifespan	23.69	Years	

APPENDIX C | NUTRIENT RUN-OFF METHODOLOGY & ASSUMPTIONS | BEST PRACTICE FERTILISER MANAGEMENT

Methodology

Best practice fertiliser management involves farmers adding the optimal amount of fertiliser to the soil to fertilise their crops while minimising nutrient run-off.

To do this farmers must test the soil in their fields to determine the fertiliser, phosphate and nitrogen levels.

As shown in table C.9, the Department of Primary Industries and Regional Development Western Australia recommends 3 to 4 cores samples per hectare of farmland to determine nutrients levels. Core sampling costs are based on the soil testing cost of a local soil sampling company at $37 per core.

The total area of beef and dairy land in the Peel Harvey region is 116,300 hectares. By multiplying this area by the number of cores per hectare and their cost, the total soil sampling cost is $15,060,850.

Soil sampling is recommended to be undertaken every 3 years by the Department of Primary Industries and Regional Development.

Farmers are assumed to use highly-soluble phosphorus fertilisers on low-PRI soils.

Riparian Zone Management Cost Summary **Table C.9**

Statistic	Value	Unit	Source
Beef Farmland Peel Harvey	1,119	km^2	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Dairy Farmland Peel Harvey	44	km^2	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Total Area Beef and Dairy	116,300	Ha	
Core Samples			
Core Sample Number	3.5	Cores/ha	Department of Primary Industries and Regional Development Western Australia
Core Sample Cost	37	$/core	Precision SoilTech
Total Soil Testing Cost	15,060,850	$	
Core Sample Timing	3	Years	Department of Primary Industries and Regional Development Western Australia

Methodology

The application of gypsum to farmers soils is one type of soil amendment, which will reduce phosphorus export by 60% according to the Department of Water and Environmental Regulation (DWER).

The DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment estimates that 1 million tones of gypsum would be required to decrease phosphorus export by 60% across all farmland in the Peel Harvey region. While this is only theoretical, it would be necessary to reduce phosphorus run-off into the Peel Harvey waterways under this approach.

To cost this management method, the 1 million tones of soil amendment is multiplied by the commercial price of bulk gypsum, calculating a total soil amendment cost of $121,000,000 as detailed in table C.10.

The assumed $0.121 per kg cost for gypsum is likely to be lower if this management scenario where to occur to discounts and economies of scale in production.

The application timeframe for soil amendment is estimated to be 25 years (PHCC).

Soil Amendment Summary

Table C.10

Statistic	Value	Unit	Source
Required Soil Amendment in Peel Harvey Region	1,000,000,000	kg	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Gypsum Cost			
Bulk Gypsum Cost	0.121	$/kg	Bunnings Warehouse
Soil Amendment Cost	$121,000,000	$	
Application Timeframe	25	Years	PHCC

Methodology

Septic tanks release harmful pollutants into ground water catchments in the Peel Harvey waterways. Removing all septic tanks in the region that are in the estuary catchment will prevent all nutrient run-off from septic tanks into the waterways.

It is assumed all properties with septic tanks removed will be connected to the sewerage system, although this has not been costed due to a lack of information on the length of required sewerage pipes.

The DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment records 11,950 septic tanks in within the Peel Harvey waterways catchment shown in table C.11.

Septic tank removal costs are assumed to be the average cost of $5,500 per tank. Although this is dependent on specific conditions of each tank such as how difficult it is to remove.

The total septic tank removal cost is calculated by multiplying the total number of tanks by the removal cost to equal $65,725,000. This is assumed to be a one of cost.

This cost does not include the associated cost of reconnecting properties to main sewerage and is therefore conservative.

Infill Sewerage Summary **Table C.11**

Statistic	Value	Unit	Source
Total Septic tank to be removed in Peel Harvey Region	11,950	Tanks	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Septic Tank Removal Cost	5,500	$	Hometown Demolition
Total Septic Tank Removal Cost	65,725,000	$	

APPENDIX C | NUTRIENT RUN-OFF METHODOLOGY & ASSUMPTIONS | CONSTRUCTED WETLANDS

Methodology

Constructed wetlands are man made wetlands used to filter pollutants from river systems.

The DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment identifies seven key locations where constructed wetlands could be constructed in the Peel Harvey waterways. These wetlands cover a total of 812 hectares as shown in table C.12.

Assuming less than 3,785m^3 of water per day is flows through each wetland, the estimated cost per hectare is $18,200.

Multiplying the total area by the cost per hectare calculates the total constructed wetlands cost of $14,778,400.

This is assumed to be a one-off cost.

Operational costs of constructed wetlands are significant, but key data on water loads in these wetlands is not available. This value has therefore not been calculated.

Constructed Wetlands Summary **Table C.12**

Statistic	Value	Unit	Source
Required Constructed Wetlands in the waterways	7	Wetlands	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Total Area of Required Constructed Wetlands	812	ha	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Constructed Wetlands Construction Cost			
Wetlands treating less than 3,785m^3 per day of water	18,200	$/ha	Brown and Caldwell Engineering
Total Constructed Wetlands Construction Cost	14,778,400	$	

APPENDIX C | NUTRIENT RUN-OFF METHODOLOGY & ASSUMPTIONS | CATCHMENT REVEGETATION

Methodology

Catchment revegetation by deep rooted vegetation is required over 564 square kilometres of the Peel Harvey region to decrease nutrient run-off from soils according to the DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment.

The average cost of these methods is estimated at $30,000 per hectare in the PHW catchment (provided by PHCC). This estimate includes costs such as plants, tree guards/stakes, labour costs for planting, and one year of maintenance.

The total revegetation cost for the region is calculated by multiplying the required catchment revegetation area by this average cost to reach $1.7 billion. This is assumed to be a one-off cost.

Catchment Revegetation Summary — **Table C.13**

Statistic	Value	Unit	Source
Total Catchment Revegetation Area Peel Harvey Waterways	564,000	ha	DWER Hydrological and nutrient modelling of the Peel Harvey estuary catchment
Revegetation Costs			
Average cost of revegetation for good condition bushland	$12,000	$/ha	PHCC
Average cost of revegetation for poor condition bushland	$40,000	$/ha	PHCC
Average cost of revegetation for PHW catchment	$30,000	$/ha	PHCC
Total Revegetation Cost	$1,782,000,000	$	

Selected Aboriginal Sites in the Peel Yalgorup Ramsar site **Table C.14**

Name	Type	Description
Peel Inlet	Water source	Fresh-water spring in inlet, accessible to animals.
Point Grey	Skeletal material/burial	Two Aboriginal leaders shot by European settlers and buried here.
Ancient Reef 2	Other	A large pinnacle 2.5 m high protruding 2.5 m from the edge of the estuary. On the opposite side of the estuary is a burial site on a large hill.
Caves Hill	Mythological	A large hill of an ancient reef or limestone.
Lookout Point	Lookout	A high point on the estuary shore where people could see the campfires of other family groups on the western side of the estuary.
Buchanan Scarred Tree	Modified Tree	Scar on old “bluegum” possum tree.
Point Grey	Camp	Traditional camping area on north and west sides of Point Grey used by Aboriginal people until recent decades.
Stony Point	Camp	Camp site
Egg Island Harvey Estuary	Ceremonial	A scrub-covered island on which a stone, the size and shape of an emu egg, had mythological and ceremonial importance. Those who mishandled the stone reputedly fell ill.
Mealup Point Reserve	Wild celery; Quondong tree; Tea- tree; Moss; Peppermint trees; frogs; bandicoots; lizards; mice	Moss-covered limestone ridge provides habitat for small animals, also the Woodatj, a mischievous evil little man
McLarty Reserve	Emu Berry Bush; Kwondong; Cowslip Orchid; Spider Orchid; Swamp banksia; Blue Hovea; Tongue kodong;	Fruiting of emu berry bushes showed when it was time to hunt for emu chicks. Quartz flakes found.

Source: Dortch et al cited in Hale and Butcher 2007

APPENDIX C | EMPLOYMENT IMPACTS BY SECTOR

Employment Impact from Annual Economic Contribution (by Sector) **Table C.15**

Employment	Direct Effect (Jobs FTE)	Supply-Chain Effect (Jobs FTE)	Total (Jobs FTE)
Livestock, Grains & Other Agriculture		48	48
Aquaculture		2	2
Forestry & Logging			
Fishing, Hunting & Trapping	2	1	3
Agriculture, Forestry & Fishing Support Services		3	3
Mining		3	3
Manufacturing		64	64
Electricity, Gas, Water & Waste Services		10	10
Construction	30	28	58
Wholesale Trade		20	20
Retail Trade		23	23
Accommodation & Food Services	1,307	11	1,318
Transport, Postal & Warehousing		29	29
Information Media & Telecommunications		9	9
Financial & Insurance Services		14	14
Rental, Hiring & Real Estate Services		27	27
Professional, Scientific & Technical Services	8	54	62
Computer Systems Design & Related Services		4	4
Employment, Travel Agency and Other Administrative Services		27	27
Building Cleaning, Pest Control and Other Support Services	2	28	30
Public Administration & Safety		7	7
Education & Training		4	4
Health Care & Social Assistance		1	1
Heritage, Creative & Performing Arts		6	6
Sports & Recreation	284	23	307
Gambling			
Other Services		9	
TOTAL	**1,633**	**454**	**2,086**

Source: Urbis, REMPLAN

APPENDIX D

ENGAGEMENT

Image credit:Visit Mandurah and Russell Ord Photography

APPENDIX D | ENGAGEMENT LIST

Urbis, in conjunction with the Peel Development Commission and Peel Harvey Catchment Council, undertook a program of engagement during the development of the Evaluation. Urbis engaged with key stakeholders to identify external views and obtain key data points, from stakeholders on the ground. The stakeholder engagement, along with the preliminary research, informed the Evaluation, creating an evidence-based and well-informed document.

Organisations represented during the engagement process are as follows:

- Bindjareb Elders
- City of Mandurah
- Community Leaders
- Department of Primary Industry and Regional Development
- Department of Planning, Lands and Heritage
- Department of Water and Environmental Regulation
- Mandurah Licensed Fishing Association
- Peel Chamber of Commerce & Industry
- Recfishwest
- SeaWest
- Shire of Murray
- Shire of Serpentine Jarrahdale
- Shire of Waroona
- Visit Mandurah

APPENDIX E

REFERENCES

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APPENDIX E | REFERENCES

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COVID-19 AND THE POTENTIAL IMPACT ON DATA INFORMATION

The data and information that informs and supports our opinions, estimates, surveys, forecasts, projections, conclusion, judgments, assumptions and recommendations contained in this report (Report Content) are predominantly generated over long periods, and is reflective of the circumstances applying in the past. Significant economic, health and other local and world events can, however, take a period of time for the market to absorb and to be reflected in such data and information. In many instances a change in market thinking and actual market conditions as at the date of this report may not be reflected in the data and information used to support the Report Content.

The recent international outbreak of the Novel Coronavirus (COVID-19), which the World Health Organisation declared a global health emergency in January 2020 and pandemic on 11 March 2020, has and continues to cause considerable business uncertainty which in turn materially impacts market conditions and the Australian and world economies more broadly.

The uncertainty has and is continuing to impact the Australian real estate market and business operations. The full extent of the impact on the real estate market and more broadly on the Australian economy and how long that impact will last is not known and it is not possible to accurately and definitively predict. Some business sectors, such as the retail, hotel and tourism sectors, have reported material impacts on trading performance. For example, Shopping Centre operators are reporting material reductions in foot traffic numbers, particularly in centres that ordinarily experience a high proportion of international visitors.

The data and information that informs and supports the Report Content is current as at the date of this report and (unless otherwise specifically stated in the Report) does not necessarily reflect the full impact of the COVID-19 Outbreak on the Australian economy, the asset(s) and any associated business operations to which the report relates. It is not possible to ascertain with certainty at this time how the market and the Australian economy more broadly will respond to this unprecedented event and the various programs and initiatives governments have adopted in attempting to address its impact. It is possible that the market conditions applying to the asset(s) and any associated business operations to which the report relates and the business sector to which they belong has been, and may be further, materially impacted by the COVID-19 Outbreak within a short space of time and that it will have a longer lasting impact than we have assumed. Clearly, the COVID-19 Outbreak is an important risk factor you must carefully consider when relying on the report and the Report Content.

Where we have sought to address the impact of the COVID-19 Outbreak in the Report, we have had to make estimates, assumptions, conclusions and judgements that (unless otherwise specifically stated in the Report) are not directly supported by available and reliable data and information. Any Report Content addressing the impact of the COVID-19 Outbreak on the asset(s) and any associated business operations to which the report relates or the Australian economy more broadly is (unless otherwise specifically stated in the Report) unsupported by specific and reliable data and information and must not be relied on.

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This report is dated **April 2023** and incorporates information and events up to that date only and excludes any information arising, or event occurring, after that date which may affect the validity of Urbis Pty Ltd's (Urbis) opinion in this report. Urbis prepared this report on the instructions, and for the benefit only, of **Peel Development Commission** (Instructing Party) for the purpose of an **Economic Evaluation** (Purpose) and not for any other purpose or use. Urbis expressly disclaims any liability to the Instructing Party who relies or purports to rely on this report for any purpose other than the Purpose and to any party other than the Instructing Party who relies or purports to rely on this report for any purpose whatsoever (including the Purpose).

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All surveys, forecasts, projections and recommendations contained in or made in relation to or associated with this report are made in good faith and on the basis of information supplied to Urbis at the date of this report. Achievement of the projections and budgets set out in this report will depend, among other things, on the actions of others over which Urbis has no control.

Urbis has made all reasonable inquiries that it believes is necessary in preparing this report but it cannot be certain that all information material to the preparation of this report has been provided to it as there may be information that is not publicly available at the time of its inquiry.

In preparing this report, Urbis may rely on or refer to documents in a language other than English which Urbis will procure the translation of into English. Urbis is not responsible for the accuracy or completeness of such translations and to the extent that the inaccurate or incomplete translation of any document results in any statement or opinion made in this report being inaccurate or incomplete, Urbis expressly disclaims any liability for that inaccuracy or incompleteness.

This report has been prepared with due care and diligence by Urbis and the statements and opinions given by Urbis in this report are given in good faith and in the belief on reasonable grounds that such statements and opinions are correct and not misleading bearing in mind the necessary limitations noted in the previous paragraphs. Further, no responsibility is accepted by Urbis or any of its officers or employees for any errors, including errors in data which is either supplied by the Instructing Party, supplied by a third party to Urbis, or which Urbis is required to estimate, or omissions howsoever arising in the preparation of this report, provided that this will not absolve Urbis from liability arising from an opinion expressed recklessly or in bad faith.

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