Department of **Water and Environmental Regulation**

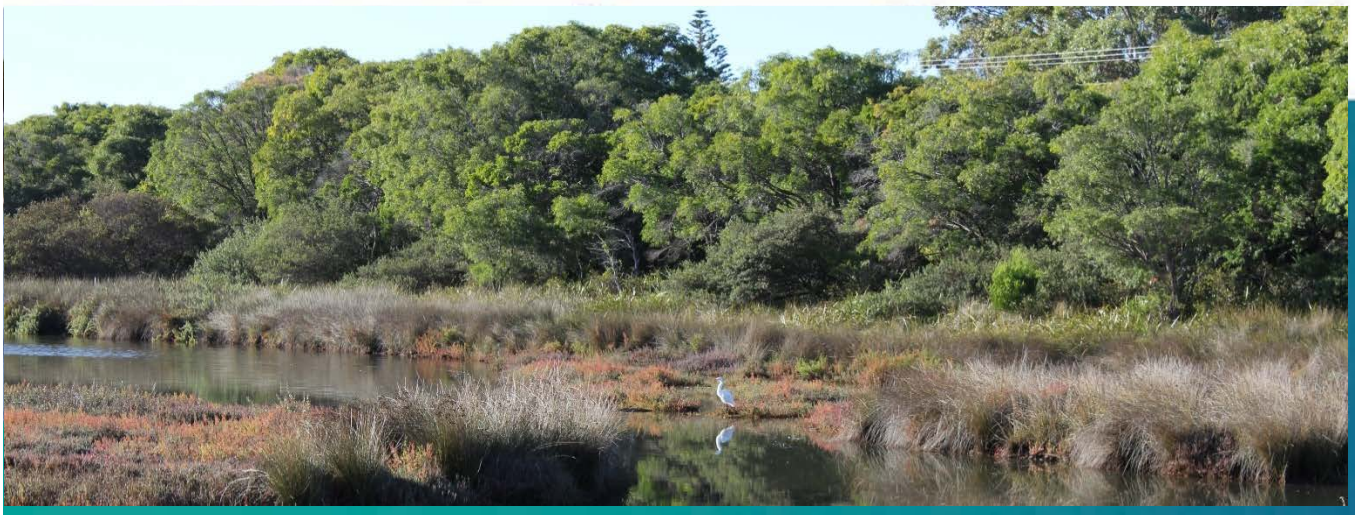
Department of **Primary Industries and Regional Development**

GOVERNMENT OF WESTERN AUSTRALIA

Toby Inlet

Waterway Management Plan

May 2019



City of Busselton

Geographe Bay

Revitalising Geographe Waterways

VASSE taskFORCE

Contents

Figures

Tables

Acknowledgement of Nyungar people and country

The Wadandi Nyungar people are acknowledged as the traditional custodians of Toby Inlet and its catchment. Toby Inlet is a significant place of camping, fishing, hunting, and gathering food. Waterways are fundamental to life and wellbeing, and Aboriginal custodians have a spiritual connection that tasks them with the responsibility to look after these important environments.

Executive Summary

Background

Toby Inlet is a small estuary near the town of Dunsborough, Western Australia, about 250 km South of Perth. It is narrow and elongated, extending parallel to the coastline of Geographe Bay for approximately 6 km. Catchment development and hydrological changes have led to water quality and sedimentation problems in Toby Inlet. Remnant vegetation in adjacent areas is threatened by weed invasion, disturbance and illegal clearing. Despite these problems, Toby Inlet, and associated wetlands and remnant fringing vegetation retain natural values, which contribute to the amenity of the area and enjoyment by the local community.

This Waterway Management Plan (WMP) was initiated though the Revitalising Geographe Waterways program, in response to community concerns about water quality issues in key water assets in the Geographe Bay Catchment. The community have long been involved in management of Toby Inlet and its catchment, largely through the efforts of the Toby Inlet Catchment (TIC) Group to undertake research, management planning and on-ground works throughout the catchment. However there is a need for greater clarity in management roles and for a lead organisation to support community initiatives.

The WMP was developed using a collaborative approach that has allowed for extensive consultation to inform future management of Toby Inlet that aligns with community priorities, is well-understood and accepted, and has commitment to implementation by stakeholders.

Purpose and scope

The City of Busselton (the City) has developed this WMP to provide future management actions that will work towards realising the vision for Toby Inlet:

> *A healthy waterway and fringing vegetation that is actively managed, protected, valued and enjoyed by the community.*

The study area for the WMP includes the main waters of Toby Inlet, adjacent public reserves and wetland areas upstream to Quindalup Siding Road. The WMP includes a description of the characteristics and management issues for Toby Inlet, and provides objectives for future management. Through a review of available management options and consideration of stakeholder input, a comprehensive series of management strategies, each with specific actions, has been developed to guide works that will contribute to the objectives and overall vision for Toby Inlet.

Management focus areas

Management issues for Toby Inlet have been grouped into nine focus areas, with sixteen associated management objectives. These are summarised here in order of importance as rated during community consultation. The strategies and associated actions are provided in the table below, with the expected outcomes for each focus area. Owing to the interconnected nature of the system, many management strategies contribute to more than one objective.

1. Sedimentation

Extensive sediment deposition is evident in much of Toby Inlet, with deposits in the upper reach seasonally exposed during low water levels. This is a high priority management issue, which results in poor amenity associated loss of open water vistas and unpleasant odours during low water levels. Sediment deposition also interferes with water flow, fish movement and recreational use.

Objectives:

- Reduce catchment sediments and contaminants from existing and new developments entering Toby Inlet.
- Manage existing sediment to improve water quality, water flow and amenity of Toby Inlet.

2. Amenity

The issue of amenity in Toby Inlet is directly related to sedimentation, water quality and ecology. Amenity is also linked to recreation and access, which provide opportunities to enjoy Toby Inlet.

Objective:

- Improve visual amenity, public health and odours so that residents and visitors alike can enjoy Toby Inlet.

3. Water flow

Water flow within Toby Inlet has been significantly altered through drainage and diversion since European settlement. Reduced catchment flows are considered to have two main consequences: reduced winter flushing, contributing to poor water quality and sedimentation; and less frequent connection to the ocean, reducing summer flushing and increasing winter flood risk.

Objective:

- Optimise all water flow in Toby Inlet to balance improvement of water quality, protection of ecological values and public amenity, while maintaining flood protection.

4. Water quality

Water quality in Toby Inlet, associated wetlands and catchment tributaries has declined due to increased loads of sediments and nutrients, and poor flushing. Elevated nutrient levels typically cause increased growth of algae, including microscopic algae (phytoplankton) and filamentous algae (macroalgae), which impact amenity and can pose a public health risk. Macroalgal blooms in particular have been problematic. They are unsightly and can cover large areas of water, restricting access, and support breeding of nuisance midges. Decomposition of the algae reduces oxygen levels in the water and contributes to accumulation of sulfidic organic sediments.

Objectives:

- Reduce and manage nutrients and other pollutants entering Toby Inlet to improve water quality and lessen the frequency and severity of algal blooms.
- Minimise any additional nutrients entering Toby Inlet from new developments and agricultural intensification.

5. Toby Inlet Ocean Exchange

The status of Toby Inlet's connection to the ocean directly affects water quality and water levels. When the sand bar at the mouth of the inlet is closed during summer, water quality is poor and conducive to algal growth. When the sand bar is open, tidal flushing dilutes the nutrient concentrations and

reduces residence time, limiting algal growth. When the sand bar is closed during winter, water levels in Toby Inlet can become high enough to cause localised flooding problems. Declining water quality has likely increased the demand for the Inlet to be opened, and this will be an important ongoing component of managing Toby Inlet.

Objective:

- Actively manage the Toby Inlet mouth to maximise ecology, water quality and recreational values.

6. Ecology

Toby Inlet and associated wetland area retains many important ecological attributes, which contribute to regional biodiversity and are valued highly by the local community. Remnant vegetation in the study area has natural value, provides important habitat and supports ecological functions. Key threats to vegetation are weed invasion, unauthorised clearing within public reserves and unmanaged access. The aquatic habitats of these systems are closely linked to the fringing vegetation and support diverse populations of aquatic fauna and waterbirds.

Objectives:

- Restore, maintain and protect the ecological values of Toby Inlet.
- Reduce the impacts of threatening processes on the ecological values of Toby Inlet.

7. Recreation and Education

Toby Inlet provides significant recreational opportunities, including fishing, swimming, paddling, birdwatching, exercising and passive enjoyment; and also opportunities for people to learn about the ecology and history of the area. Poor water quality and sedimentation issues restrict access for recreation within the water, and poor visual amenity and odours affect other activities. Unmanaged access has degraded fringing vegetation and caused some bank erosion. There is significant potential for improving recreational and educational opportunities in and around Toby Inlet.

Objectives:

- Improve and manage public access for recreational purposes that support the amenity and ecological values of Toby Inlet.
- Facilitate appropriate water based recreational activities with consideration to the ecological values and water quality of Toby Inlet.
- Raise community awareness of Toby Inlet's recreational, cultural and ecological values.

8. Heritage

Toby Inlet holds significant cultural value for the Wadandi people due to the abundance of resources and the natural protection from weather conditions. The area has been important for hunting and camping for many years both pre- and post-settlement. Aboriginal people are well aware of the decline in health of the inlet and the relationship to drainage changes and land development. A key issue raised by Aboriginal representatives was minimising additional access and infrastructure for recreation, while retaining access for Aboriginal people.

The area around Toby Inlet was an important part of early European colonisation. Quindalup was the primary settlement established in 1866, with a school, supporting local timber export. There is also a history connected to whaling.

Objective:

- Understand, protect and preserve the heritage values of Toby Inlet.

9. Governance

An independent review of waterway management highlighted the need for Toby Inlet to have a designated manager, and for greater clarity of management roles for various organisations. The Toby Inlet Catchment Group has been instrumental in past management, but implementation of an existing management plan has been limited by a lack of funding and support from relevant organisations.

The review also recommended that research and monitoring need to be a component of future management. This would facilitate ongoing assessment and reporting of progress and allow for adaptive management based on outcomes and new knowledge.

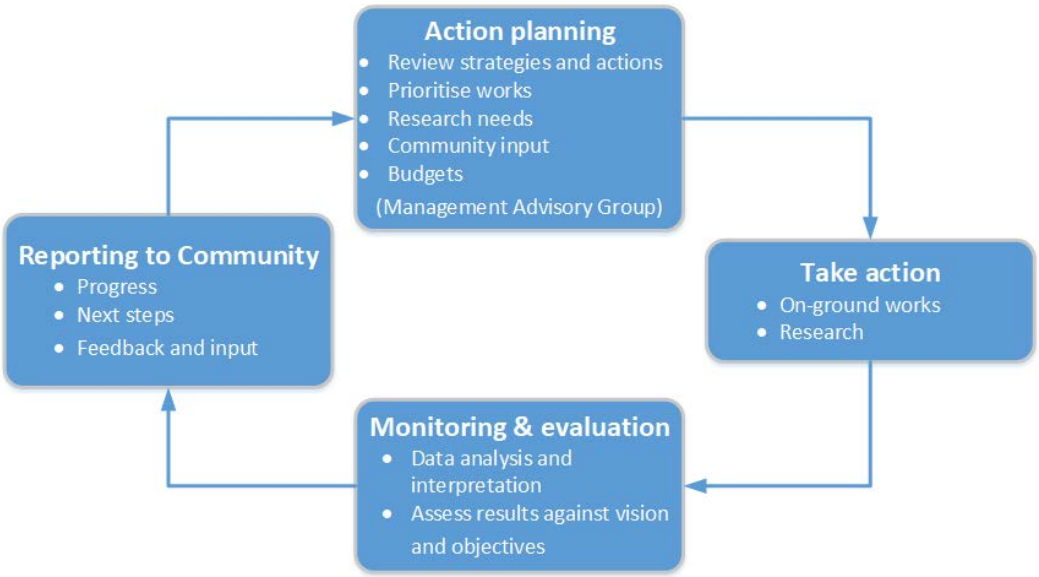
Objectives:

- Develop and maintain partnerships and a collaborative approach between stakeholders and the community when managing Toby Inlet.
- Involve the community in the future management of Toby Inlet.
- Adopt evidence based decision making in the long term management of Toby Inlet.

Implementation

The lead role of the City in the future management of Toby Inlet will be recognised through endorsement and adoption of this Waterway Management Plan. Other key stakeholders will continue to have important roles in many aspects of implementation, and there is an ongoing need for community reporting and feedback. A framework for implementation is provided that defines roles and responsibilities for management and an adaptive cycle for management.

Implementation process for the Toby Inlet Waterway Management Plan:



Management Strategies and Actions for Toby Inlet and expected outcomes for each focus area

Focus areas: Water Quality (WQ); Toby Inlet Ocean Exchange (TIOE); Ecology (E); Water Flow (WF); Sediments (S); Amenity; Recreation and Education (ARE); Culture and Heritage (CH); Governance (G).

Management Strategy	Management Actions	Expected outcomes (related focus area)
Optimal management of Toby Inlet ocean exchange	• Maintain Toby Inlet ocean outlet, the Station Gully culvert and the Station Gully outlet in accordance with the Operational Procedures (Appendix 2). • Monitor the status of the outlet through a telemetered system to determine when opening of the sand bar is necessary. • Ensure the culvert between Station Gully and Toby Inlet remains open to improve water quality in the upper reach of Toby Inlet, east of the ocean outlet.	Sand bar management (TIOE) Defined management (G) Reduced algal growth (WQ, A) Less sediment exposure (S, A) Improved amenity (A, RE) Enhanced fish movement (E, RE) Optimising Water flow (WF)
Investigate sediment removal	• Define priority areas for sediment management and determine sediment composition and volume for these areas, building on previous sediment investigations. • Assess potential outcomes and impacts of sediment removal from priority areas and undertake a cost/benefit analysis of strategic sediment removal. • Assess whether sediment agitation would facilitate mobilisation and flushing of sediment deposits on Toby Inlet.	Evidence-based decision-making (G) Less sediment exposure (S, A) Improved amenity (A, RE) Manage existing sediment (S) Optimising Water flow (WF)
Prevent further sedimentation	• Improve understanding of sediment sources and transport through water quality monitoring. • Develop an education approach to reducing sediments inputs from the catchment. • Identify and ensure management of potential erosion problems from new developments and changes in land use during the planning process, through implementing the Better Urban Water Management framework. • Investigate key sediment sources in the catchment and potential for works to stabilise drains and increase sediment trapping within the drainage network.	Reduce catchment sediments (WQ, S) Minimise development impacts (S, G) Evidence-based decision-making (G)
Rehabilitate exposed sediment deposits	• Identify areas of exposed sediments that could be revegetated to improve habitat and amenity and stabilise sediments. • Undertake trial revegetation of samphire in exposed sediment.	Creation of new habitat (E) Covering unsightly sediment deposits (S, A)
Reducing nutrient sources from the catchment	• Completion of scheduled infill sewerage works in residential areas adjacent to Toby Inlet. • Review the sewerage works once completed, and address any lack of connection to sewerage infrastructure through education campaigns or incentives if deemed necessary. • Ensure Geographe Bay catchment management initiatives extend to the Catchment of Toby Inlet, including: implementation of best management practices; and community education to reduce inputs from gardening and livestock activities in urban and special rural areas.	Reduce inputs of nutrients and other pollutants (WQ) Reduce catchment sediments (S) Reduced algal growth (WQ, A) Minimise development impacts (WQ, G)

	• Increase potential for nutrient assimilation in the rural drainage network in conjunction with sediment trapping and through restoration. • Identify opportunities for reducing nutrient, sediment and pollutant sources through upgrades to stormwater infrastructure. • Continue current water quality monitoring within Toby Inlet, and extend routine monitoring to include associated wetlands and catchment tributaries, to ensure information requirements for prioritising and reviewing management initiatives are met. • Support educational campaigns that aim to reduce nutrients in runoff through individual and community actions (e.g. Bay OK) and investigate options to improve nutrient management in public open space. • Minimise future nutrient sources from new development and land use change at the planning stage through implementing the *Better Urban Water Management* framework. • Support implementation of the Vasse Wonnerup wetlands Geographe Bay Water Quality Improvement Plan.	Evidence-based decision-making (G)
Effectively manage foreshore reserves	• Prepare and implement a prioritised works program for weed control and revegetation. • Support community efforts in weed control and revegetation. • Ensure revegetation in high amenity areas is appealing and maintains vistas to increase community support for these activities. • Effectively manage recreational access to protect and enhance the key values of reserve areas. • Create awareness of reserve boundaries through bollards and signage where appropriate. • Develop information resources for landholders to raise awareness of reserve boundaries, the importance of fringing vegetation, weed problems and the restrictions on clearing native vegetation and building jetty structures. • Assess foreshore reserve areas that have no public access and develop appropriate management actions to benefit the broader public. • Develop a policy for jetties that ensures structural integrity and protection of adjacent foreshore areas and prevents establishment of new structures.	Conservation of vegetated habitat (E) Reduce threatening processes (E) Improved amenity (A) Managing access (RE) Maintaining fringing vegetation buffer (WQ) Preventing bank erosion (S)
Understanding fauna	• Support further research on aquatic and terrestrial fauna and bird populations to inform management initiatives and assess outcomes. • Pursue a community science approach to collecting bird data. • Develop information resources to increase community interest and understanding of fauna.	Awareness and understanding of ecological values (RE) Community involvement in management (G) Evidence-based decision-making (G)
Improving facilities for community appreciation	• Seek community input on the *Access Management Plan* for Toby Inlet (SW Environmental 2018), and subsequently develop and implement appropriate access-ways and recreational infrastructure. • Determine requirements for additional parking in support of improved facilities.	Improved public access and amenity (RE) Support for appropriate activities (RE)

	• Enhance bird habitat in connection with existing and potential bird watching sites. • Encourage bird watchers to join a community science approach to collecting bird data. • Support schools in using Toby Inlet as an outdoor learning environment, including provision of information resources and consideration of an outdoor classroom.	Awareness and understanding of ecological values (RE) Community involvement in management (G)
Providing informative resources	• Develop appropriate signage in connection with improved access and facilities to inform the community about: ecological values of Toby Inlet; location and use of access and facilities; cultural and historical values; and management initiatives underway. • Prepare and distribute fact sheets and educational material for key management focus areas, relevant to schools, community members and natural resource managers. • Continue to update the Revitalising Geographe Waterways website with information on Toby Inlet and its management.	Awareness of recreational, cultural and ecological values (RE)
Recognising Aboriginal custodianship	• In partnership with local Aboriginal people, include reference to traditional custodianship of the waterways and land in development of information resources. • Manage future access in a way that avoids additional disturbance and considers protection of potential sites of Aboriginal significance – however activities of local Aboriginal people, such as fishing, camping, the gathering of bush foods and family recreational and educational activities, will not be restricted by implementation of this plan. • Seek to improve partnerships with the Nyungar community to increase their involvement in the management, protection and restoration of Toby Inlet and the study area. • Consult further with Aboriginal representatives in regard to specific works which result from this plan. • Support programs that engage the Aboriginal community in implementation of works associated with this plan.	Understanding and protecting heritage values (CH) Community involvement in management (G)
Conserve historical values	• Identify and ensure appropriate maintenance of sites historical importance. • Develop interpretive material to increase understanding of local history, and to promote, appreciate and access historical sites.	Understanding and protecting heritage values (CH)
Defined and collaborative management	• City to consider securing management order over waterways and adjacent public lands in study areas, to facilitate implementation. • Establish a Management Advisory Committee comprised of representatives from the City, Toby Inlet Catchment Group, Department of Water and Environmental Regulation, Water Corporation, GeoCatch, South West Catchments Council, Wadandi representatives and broader community representatives. • Support the Toby Inlet Catchment Group as active participants in planning, on-ground works, and as a key link to the community.	Collaborative approach to management (G) Community involvement in management (G)

	• Facilitate the development of locally-active Friends of Toby Inlet groups to advocate and coordinate on-ground work in reserves and on private property. • Define and resolve issues around vesting of Unallocated Crown Land.	
Evaluate and adapt management actions	• Continue monitoring of water quality in Toby Inlet. • Review monitoring requirements for catchment tributaries and groundwater. • Undertake assessment of macroalgal growth. • Ensure timely reporting of monitoring and research outcomes to the management advisory group. • Review future management actions in light of monitoring and research outcomes.	Evidence-based decision-making (G)

1 Introduction

The City of Busselton (the City) has developed this Waterway Management Plan (WMP) to guide future management actions that will lead to improved water quality and ecological health for the Toby Inlet and associated reserves and wetlands within the study area. The vision for Toby Inlet, developed in partnership with the community and stakeholders, is:

> *A healthy waterway and fringing vegetation that is actively managed, protected, valued and enjoyed by the community".*

1.1 Background to this Waterway Management Plan

Catchment development and hydrological changes have led to water quality and sedimentation issues in Toby Inlet for many years. Nutrient enrichment has resulted in seasonal blooms of filamentous algae (macroalgae), which reduce amenity and recreation values by blocking open waters and causing foul odours when they decompose. Sediment deposition in the Inlet has created shallower conditions which are exposed at low water levels, reducing visual amenity and contributing to odour problems. Phytoplankton blooms and stranding of fish in shallow pools have occasionally resulted in fish deaths in the Inlet.

This WMP is part of Revitalising Geographe Waterways (RGW), a $15 million program developed to improve water quality and ecosystem health in key water assets. Within the RGW program, the City has been identified as the lead agency for progressing improved waterway management within the Lower Vasse River and the Toby Inlet, and was given responsibility to prepare Waterway Management Plans for these systems. The Department of Biodiversity, Conservation and Attractions was given responsibility to develop an Operational Plan for the Vasse-Wonnerup Wetland Systems.

The RGW program is one of five focus areas of the Vasse Geographe Strategy, a State Government initiative to address water quality in the Geographe Bay catchment (Figure 1). The program also includes two projects directly related to the Toby Inlet WMP: the Reconnecting Toby Inlet hydrological modelling project; and the infill sewage project for residential areas adjacent to Toby Inlet.

The Vasse Geographe Strategy was initiated by an independent review of waterways management (Hart 2014), commissioned by the State Government in response to serious community concerns about water quality issues. The Vasse Geographe Strategy is overseen by the Vasse Taskforce, comprising representatives from:

- Department of Water and Environmental Regulation (DWER)
- City of Busselton (the City)
- Shire of Capel
- Geographe catchment Council (GeoCatch)
- Department of Biodiversity, Conservation and Attractions (DBCA)
- Department of Primary Industries and Regional Development (DPIRD)
- Department of Planning, Land and Heritage (DPLH)
- South West Catchments Council (SWCC)
- Water Corporation (WCorp)
- Busselton Water (BW)

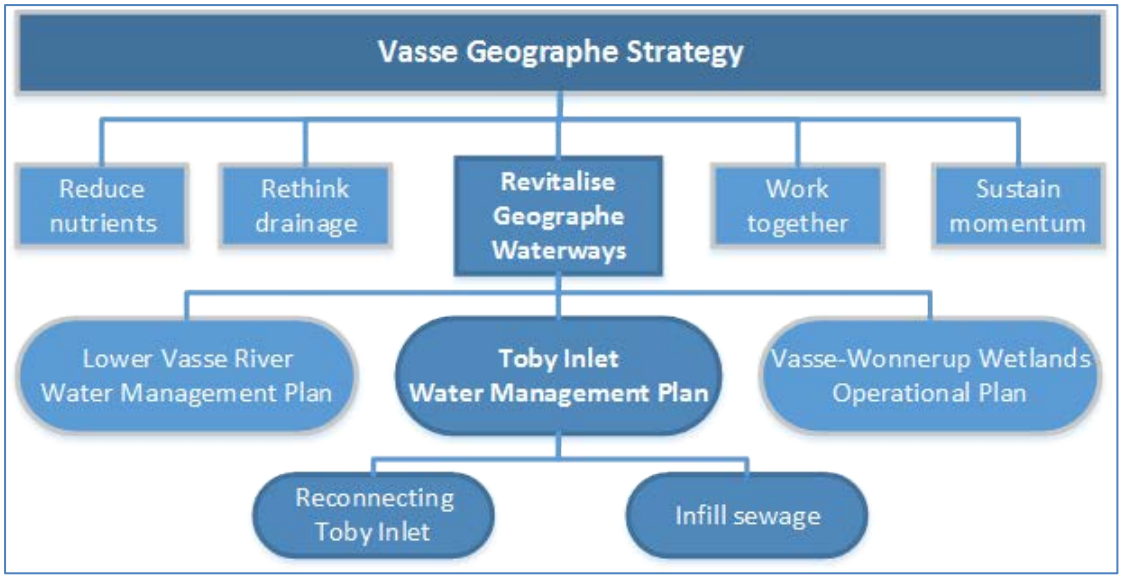


Figure 1. Management framework for the Toby Inlet Waterway Management Plan.

1.2 Study Area Description

Toby Inlet is a small estuary near the town of Dunsborough, Western Australia, about 250 km South of Perth (Figure 2). It is narrow and elongated, extending parallel to the coastline of Geographe Bay for approximately 6 km. It is situated on the Swan Coastal Plain and is connected to seasonal wetland areas upstream. The study area for the WMP is 118 hectares, encompassing Toby Inlet itself, adjacent public reserves, and the wetland area extending upstream approximately 2.7 km from Caves Road to Quindalup Siding Road. Quindalup Siding Road acts as a physical barrier to other wetlands to the east. The study area also includes a short reach of Station Gully Drain between Caves Road and the beach (150 m), which dissects the easternmost section of Toby Inlet (500 m) commonly referred to as the Deadwater. Station Gully Drain is openly connected to the Deadwater, but is only connected to Toby Inlet via a culvert under the access road to the beach.

1.2.1 Landscape and hydrology

Toby Inlet has a catchment area of approximately 33 km^2 including large areas of Swan Coastal Plain, and bounded by the Whicher Scarp to the south. The portion on the coastal plain areas is characterised by deep sandy soils and seasonally inundated flats, which have been subject to extensive clearing and drainage for agriculture. Only around 30% of native vegetation remains in the Toby Inlet catchment, with key remnants occurring in foreshore reserves, on private land adjacent to the wetland areas, and on reserves and private land in the upper catchment.

Artificial drainage, undertaken for much of the Swan Coastal Plain in the early 1900s to improve agricultural value, has changed the hydrology of Toby inlet and its catchment. This included drainage and redirection of flow within wetland areas to the south of Toby Inlet, and diversion of the upper reaches of Station Gully, Annie Brook and Mary Brook into a single drain into Geographe Bay at the eastern end of Toby Inlet (Station Gully Drain). These changes have effectively reduced the original catchment area of the inlet and the volume of water conveyed. The average annual rainfall in the

catchment is 651mm (10-year average, BoM 2018), with declining rainfall evident over the last 20 years (Figure 3).

Toby Inlet is intermittently connected to the ocean, either naturally or artificially, at two points: via a channel to the east of Station Gully; and via a culvert to Station Gully, which then flows to the ocean. The connection of Toby Inlet to the ocean is likely to have always been intermittent, but it is thought that reduced flows from the catchment have decreased natural breaching of the sand bar.

Figure 2. Toby Inlet locality and study area, and routine monitoring sites.

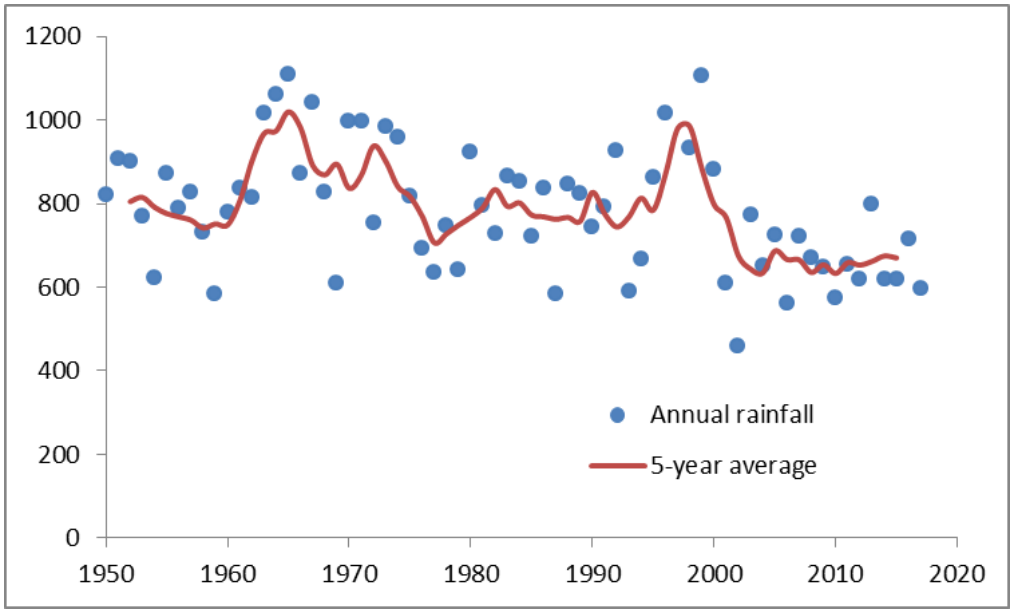


Figure 3. Rainfall records for Cape Naturaliste (BoM 2018). The 5-year average for each year includes two years before and after.

1.2.2 Land use and tenure

From the mouth of the Inlet to 300m upstream of Caves Rd, the study area is entirely within publicly-owned land (Figure 4). Upstream from this point the wetland areas are privately owned, with the exception of a drainage reserve in the central section approximately 800m long and 20m wide (Responsible agency DWER). Public lands include reserves vested in the City, unallocated Crown land (UCL) and road reserves (Appendix 1).

The eastern 1.5km section of Toby Inlet is entirely within public reserve between Caves Road and Geographe Bay, and is managed by the City. West of this, the Inlet is surrounded by residential development. Despite the foreshore being entirely public land, many sections are inaccessible to the public and are managed by adjacent private landholders. Clearing of foreshore vegetation, weed invasion, lawn encroachment and dumping of garden refuse are common problems in these areas. Many residents have established private jetties, which vary in quality and at times debris from these structures floats into the Inlet. Upstream of Caves Road, land use is mainly rural.

Agriculture (50%) and rural residential areas (32%) are the dominant land uses in the catchment. The remaining area consist of existing and future urban development (8%: residential, business and industrial), and reserves and public open space (10%). There is currently considerable urban residential development occurring on coastal plain areas to the south west of Toby Inlet.

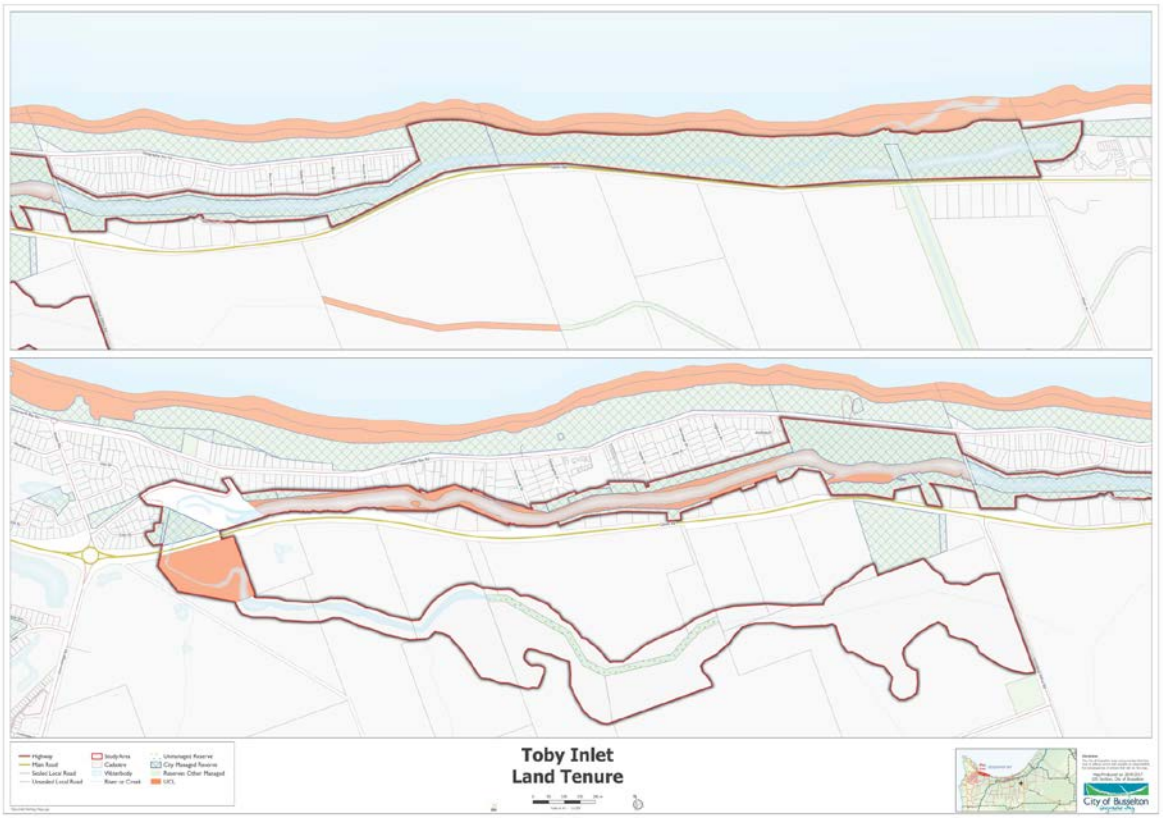


Figure 4. Toby Inlet study area land tenure.

1.2.3 Natural and social values

Toby Inlet study area retains high natural values that are important for conservation purposes, and contribute to the amenity of the area and enjoyment by the local community. The Inlet itself provides habitat for fish, crabs, frogs and aquatic macroinvertebrates that support food webs. The surrounding reserves include important areas of intact remnant vegetation, including areas of the Threatened[1] Coastal Saltmarsh ecological community. Foreshore vegetation and open waters support many species of waterbirds. Remnant vegetation throughout the study area provides habitat for other birds and terrestrial fauna including the Critically Endangered[2] Western Ringtail Possum (*Pseudocheirus occidentalis*) and the Priority 4 Quenda[3] (*Isoodon obesulus fusciventer*, also known as the Southern Brown Bandicoot).

Residential areas adjacent to Toby Inlet in Quindalup benefit from its quiet location away from central Dunsborough and the natural amenity of its proximity to the protected waters of Toby inlet and Geographe Bay. The remnant vegetation, water vistas, birdlife and fishing opportunities are enjoyed by the local community and visitors to the area.

[1] *Environmental Protection and Biodiversity Conservation Act* 1999 (Commonwealth) (EPBC Act)
[2] Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2017 (WA); (EPBC Act)
[3] Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2017 (WA)

1.3 History of Management

It is important to acknowledge past and ongoing work of the community-based Toby Inlet Catchment (TIC) Group in advocating and undertaking active management of Toby Inlet, associated wetlands and broader catchment. In 1996-97, the TIC Group initiated surveys on vegetation (Weston 1997), terrestrial fauna (HAS 1997), birds (Clay and Clay 1996), and water quality and aquatic macroinvertebrates (Streamtec 1997). The outcomes of this work highlighted degradation of terrestrial and aquatic habitats in the Inlet and its catchment. Data from these surveys was used to prepare the *Toby Inlet and Associated Wetlands Management Plan* (Comer and Clay 1999) for the TIC Group. TIC Group has also prepared the *Toby Inlet Catchment Management Plan* (Clay 2002) to direct catchment scale works to improve water quality and manage flora and fauna.

The Toby Inlet Steering Committee was formed in 2003, which included community members from TIC Group, Dunsborough Coast and Land Care, Sussex LCDC and the Quindalup Strip Preservation Committee; councillors and an officer from the (then) Shire of Busselton; and officers from GeoCatch and the Water Corporation. The TIC Group prepared the *Management Plan for the Toby Inlet Foreshore and Waters* (Clay 2005), supported by the Steering Committee and adopted by the (then) Shire of Busselton.

The issues, objectives and actions in the 2005 management plan remain relevant. Since the adoption of the 2005 management plan, further work has been done to monitor water quality; determine needs and outcomes of opening the sand bar; understand sediment characteristics in the inlet; and to assess and improve the health of foreshore vegetation.

1.4 Process for developing the Waterway Management Plan

The WMP has been developed using a collaborative approach that has allowed for extensive consultation to work towards future management of Toby Inlet that aligns with community priorities, is well-understood and accepted, and has commitment to implementation by stakeholders. Key stakeholders that have contributed to this WMP are:

- City
- Community members
- Aboriginal people
- Toby Inlet Catchment Group
- Dunsborough Coast and Land Care
- GeoCatch
- Department of Water and Environmental Regulation
- Water Corporation

The process for developing the WMP is shown in Figure 5. The consultation process has contributed directly to identifying and developing the management issues, vision, management objectives, management strategies and actions for the WMP. Activities undertaken for consultation are outlined in the following sections. The consultation process and the overall WMP have been informed by review of existing information about Toby Inlet and by new information gained through projects undertaken during the planning process. It is important to note the adaptive nature of this WMP. It

has been prepared at a point in time, using the information currently available. Implementation will require an ongoing process of monitoring and evaluation to guide future actions.

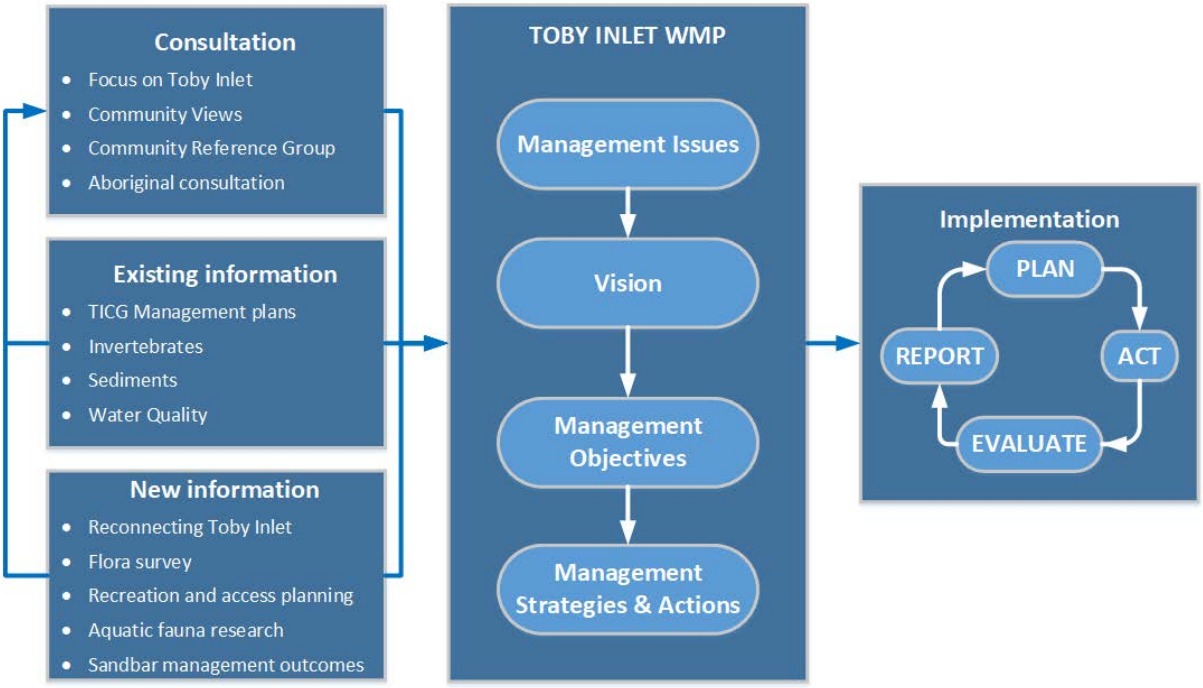


Figure 5. Process for developing the Waterway Management Plan for Toby Inlet.

1.4.1 Community consultation

Consultation with stakeholders was an integral part of preparing this WMP. The aims of consultation were:

- To understand community issues and concerns about Toby Inlet;
- Gain input, ideas, feedback into future management of the Toby Inlet;
- To get support from the community on proposed actions; and
- To raise community awareness and understanding of local water quality issues.

Early consultation events were widely advertised to attract a broad representation from the community. The first of these, *Focus on Toby Inlet* in June 2015, provided information on current understanding of Toby Inlet and sought to identify issues of most importance to the community. The *Community Views* event in March 2016 was also open to whole community and facilitated rating of management issues, valued characteristics and desired change (Figure 6; AHA 2016). These results reflected a high level of importance on issues related to the health of Toby Inlet and associated amenity (82%). Other issues rated as important were recreation and access, heritage, flood and management. The outcomes of this consultation were used to formally identify key management issues, as outlined in Section 2 of the WMP. Information provided by the community and suggested management actions were used to develop draft management objectives, and were considered when reviewing management options.

Following initial consultation, a Community Reference Group (CRG) was formed to provide ongoing input to WMP. This group was formed by inviting participants of earlier events to nominate for ongoing involvement. It also included representation from the Department of Water and Environmental Regulation and GeoCatch, as key supporting partners in development of the WMP. Facilitated workshops with this group were held to develop the vision, management objectives (AHA 2017a, 2017b) and management strategies and actions (AHA 2018) for the WMP.

1.4.2 Aboriginal consultation

Aboriginal people are important stakeholders. In recognition of Aboriginal people as the traditional custodians of country, and understanding the particular significance of waterways to Aboriginal people, additional consultation was undertaken to facilitate input to the WMP.

The draft management objectives were presented to the South West Boojarah (SWB) Working Party via the South West Aboriginal Land and Sea Council (SWALSC) in May 2017. An overview of the Revitalising Geographe Waterways Program was also provided at a Working Party meeting in November 2017.

The Aboriginal Heritage Survey was undertaken with representatives of the Aboriginal community (members of the SWB Working Party and the Harris family, as nominated by SWASLC) in February 2018, encompassing the study areas of all three plans included in the RGW program. The Survey was facilitated by Brad Goode and Associates (2018) and included briefings and a bus tour of key sites of the Toby Inlet study area for discussion of scientific investigations, future management actions and the content of the plan. Information from this consultation has been considered in the development of management objectives and actions in this WMP.

The study area is within the South West Boojarah Indigenous Land Use Agreement Area, which is one of six Indigenous Land Use Agreement areas that form part of the South West Native Title Settlement Area[4]. There is a historical camping ground within the survey area, which has been lodged as an Aboriginal Site under the Aboriginal Heritage Act (1972) and is awaiting an outcome.

[4] Current information on the South West Native Title Settlement: http://www.noongar.org.au

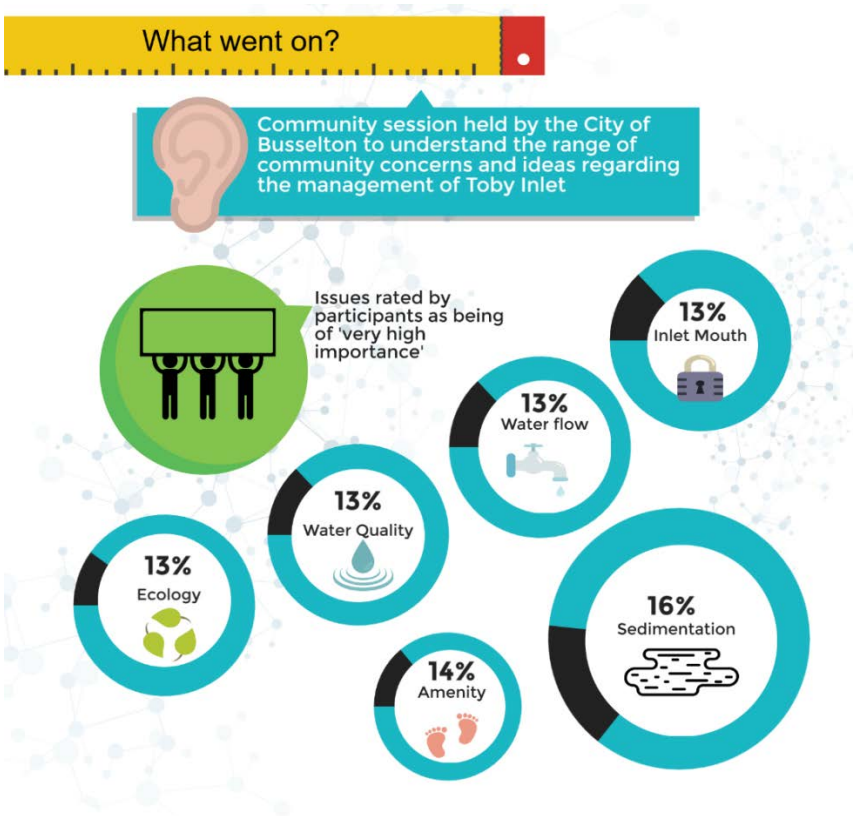


Figure 6. Outcomes from identifying and rating management tissues for Toby Inlet at the *Community Views* consultation session, March 2016.

2 Management Issues

The consultation process lead to the development of nine focus areas for management as follows:

- Sedimentation
- Amenity
- Water flow
- Water quality
- Toby Inlet mouth
- Ecology
- Recreation and education
- Heritage
- Governance

A summary of key management issues and information for these focus areas is provided in this section.

2.1 Sedimentation

Extensive sediment deposition is evident in much of Toby Inlet, with deposits in the upper reach of seasonally exposed during low water levels. Although sediment accretion in estuaries is a natural long-term process, it has been accelerated in Toby Inlet by increased sediment loads from the catchment and by excessive growth of algae in response to nutrient enrichment (discussed further in the section on water quality). Sediments deposits in Toby Inlet broadly comprise two sources: soils from the catchment, transported to and deposited in the Inlet; and accumulation of organic material within the Inlet. There is concern about the build-up of sediment in Toby Inlet for the following reasons:

- Poor amenity due to loss of open water vistas and unpleasant odours of exposed sediment during low water levels.
- Blocking of water flow in the inlet, preventing flushing of nutrients and organic material from the system.
- Reduced depth throughout the Inlet, restricting fish movement and creating potential for fish stranding in shallow pools.
- Smothering of benthic habitats, potentially impacting ecology.
- Reduced depth restricting recreational activities such as use of watercraft.

Areas of deposition downstream of Caves Road are generally sandy to a depth of 0.5m over clay and lateritic rock, and considered to be recent deposition from catchment sources (Norrish 2005, ENV 2007). Sandy deposits are also evident in other parts of the Inlet but these have not been characterised. Aerial photographs of the area show that substantial sediment deposits have been present for more than 20 years (Figure 7). These sediments have been identified as potential acid sulphate soils (ENV 2007, Figure 8) and the implications of this for management are discussed in Section 4.1.

Siltation from catchment sources is associated with clearing and drainage. Clearing of vegetation mobilises soils, and artificial drainage often creates unstable banks and channels, contributing sediment downstream. Earthworks and drainage for residential development results in exposed soils susceptible to erosion, and can be observed in drains within the Toby Inlet catchment (add photo).

Urban development in close proximity to Toby Inlet is often considered a key source of sediment. Diversion of flows may have decreased potential for flushing of sediments through the system to the ocean, exacerbating accumulation of 'sediment slugs'.

In downstream sections of Toby Inlet, accumulation of organic material has contributed significantly to sedimentation. Monosulfidic black ooze (MBO) has been found in the lower reach of Toby Inlet, from a point approximately 700m downstream of Caves Road Bridge (ENV 2007, Ward et al. 2009; Figure 8). MBO commonly forms in areas of high primary productivity, where seasonal growth and decomposition of algae results in accumulation of soft organic material with high concentrations of iron monosulfides (Ward et al. 2009). Growth of phytoplankton and filamentous macroalgae in Toby Inlet has been enhanced by increased nutrient loads from the catchment. MBO presents a risk of rapid acidification when disturbed, causing deoxygenation. Analysis of these sediments did indicate high potential for acidification, but also found that acid neutralising capacity (ANC) may be sufficient to buffer this effect (Ward et al. 2009).

"There used to be little streams 25 years ago. They have all been filled in and the birds and vegetation suffers." Community views report 2016

Figure 7. Comparative aerial photographs of sediment deposition in Toby Inlet downstream of Caves Road, from 2018 (left) and 1997 (right).

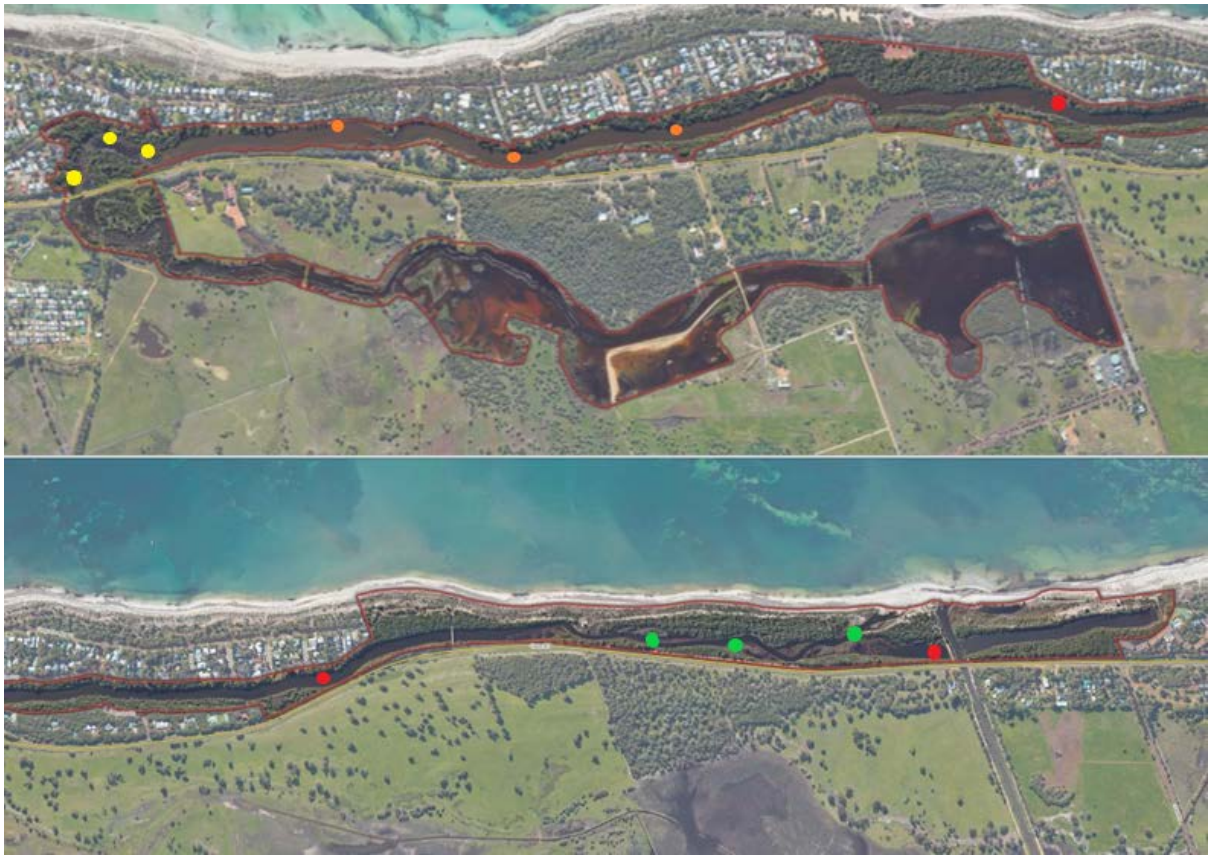


Figure 8. Acid sulphate soil and monosulfidic black ooze (MBO) presence in Toby Inlet sediments. Yellow markers show sand-dominated sediments with potential acid sulphate soils but no MBOs found in 2007 study. Orange sites show MBOs and potential acid sulphate soils in 2007 study. Green sites show no potential acidity or MBOs found in 2009 study. Red sites show MBOs and potential acid sulphate soils in 2009 study.

2.2 Amenity

Amenity describes the attractiveness of a place, and the 'visual' appeal of Toby Inlet was the characteristic most valued by participants in community consultation. Amenity was rated as one of the most important management issues, showing that people are concerned about threats to the amenity of Toby Inlet. The issue of amenity in Toby Inlet is directly related to sedimentation, water quality and ecology. Amenity is also linked to recreation and access, which provide opportunities for the public to enjoy Toby Inlet.

During low water levels, exposure of sediment deposits reduces amenity associated with open water vistas, and can result in unpleasant odours. The loss of amenity is a key reason that sedimentation in Toby Inlet has been identified as the highest-rating management issue.

In relation to water quality, seasonal macroalgal blooms are common in some parts of the inlet due to high nutrient concentration and still conditions. These masses of filamentous algae are unsightly, and cause unpleasant odours when they decompose. The algae also provide good habitat for non-biting midge larvae which may contribute to nuisance populations. As noted in Section 2.1, this material also accumulates in the Inlet and contributes to sedimentation problems.

Phytoplankton blooms occur occasionally in Toby Inlet, but have not been persistent and are usually dominated by harmless species. Isolated blooms of blue-green algae, which create a public health risk, occurred in May 2013 and February 2018, but did not persist. Further decline in water quality has potential to increase algal blooms in Toby Inlet, impacting amenity and recreation.

Quindalup Special Character Area

The Quindalup Special Character Area (SCA) Policy was developed by the (then) Shire of Busselton in 1996 to guide urban development in a way that maintains the natural amenity of the area. The Toby Inlet study area is located within this policy area. The character of the area is described as *a relaxed holiday atmosphere, this is attributable to its low density of housing which is contained within a bush and seaside setting, surrounded by natural environs.* The policy provisions apply to all public and private land within the SCA. The Quindalup SCA Policy notes the extensive remnant vegetation on private and public land in the area as a significant characteristic, and outlines development controls to protect native vegetation.

2.3 Water flow

Water flow within Toby Inlet has been significantly altered through drainage and diversion since European settlement. Notably, the catchments of Carbunup River, Station Gully (aside from interchange at the culvert) and a number of other smaller waterways have been diverted and no longer connects to the Inlet or contribute to its flow. Prior to this, Toby Inlet was connected to the Deadwater and outflow to the ocean was via the current Station Gully outlet (anecdotal). There is also a perception by some community members that construction of dams in the catchment has contributed to reduced flow (including the Dunsborough Lakes development).

Reduced catchment flows are considered to have two main consequences: reduced winter flushing, contributing to poor water quality and sedimentation; and less frequent connection to the ocean. The issue of reduced ocean connectivity is discussed further in Section 2.5.

There is community support for increasing water flows from catchment sources with the aim of mobilising sediment deposits within the Inlet. Altering water inflows may improve water quality through:

- Increasing summer/autumn flow to reduce water residence time and so reduce potential for algal growth.
- Diluting nutrient concentrations by adding lower nutrient-content inflows.
- Increasing winter velocity to scour sediments.

Potential for reconnecting catchment flows to Toby Inlet has been investigated through the *Reconnecting Toby Inlet* hydrological modelling project (Frazer and Hall 2018), and this management option is discussed further in Section 4.3.

2.4 Water Quality

2.4.1 Surface Water

Water quality in Toby Inlet and its tributaries has declined due to increased loads of sediments and nutrients, and poor flushing. Sources of excess nutrients include runoff from agricultural and residential areas, and leachate from septic systems in nearby residential areas (DoW 2010). Elevated nutrient levels typically cause increased growth of algae, including microscopic algae (phytoplankton) and filamentous algae (macroalgae), which impact amenity and can pose a public health risk.

Nitrogen levels in the Toby Inlet are consistently higher than ecosystem protection guidelines for estuaries, particularly in spring and summer (Figure 9a). Concentrations tend to be higher in upstream sites, and are lowest near the ocean entrance in summer and autumn. This may reflect opening of the sand bar in summer autumn period and a limited flushing effect upstream.

Phosphorus concentrations in Toby Inlet are highly variable and while average values are below the ecosystem protection guideline, samples frequently exceed this throughout the Inlet (Figure 9b). Extremely high total phosphorus occurs during summer at the more upstream sites, while concentrations near the ocean outlet are low. This may reflect ocean flushing, but may be due to uptake of phosphorus by filamentous macroalgae.

While nutrient concentrations appeared higher in the most upstream site, phytoplankton growth is greater lower in the Inlet (indicated by chlorophyll a, Figure 9c). Many types of phytoplankton are harmless, but at high densities can have unpleasant odours and form unsightly scums. Some species are toxic to humans and animals, including fish. Phytoplankton sampling by DWER since 2012 shows that the levels in Toby Inlet are mostly below the recreational guideline of 20,000 cells/mL (Figure 9e). However, harmful algal species have been found frequently at low densities. Blooms of blue-green algae have been detected twice since 2012.

Macroalgal blooms are currently more problematic than phytoplankton in Toby Inlet (Figure 10). They are not toxic but are unsightly and can cover large areas of water, restricting access and impacting visual amenity. Macroalgae also provides ideal habitat for breeding of nuisance midges. When large blooms of macroalgae decompose, this reduces oxygen levels in the water and sediments. Accumulation of this material has contributed to the formation of sulfidic sediments, including MBO. Although excessive growth of macroalgae is a serious management concern, no assessment or monitoring of species or biomass has been undertaken.

Fish deaths have occurred in Toby Inlet in late September 2006 (limited information available) and on 6 March 2014 (about 1000 fish). The 2014 incident was a result of stranding of fish associated with extremely low tides draining the lower sections of the Inlet. Fish deaths can be caused by low oxygen conditions, harmful phytoplankton or by stranding in warm shallow waters. Low oxygen levels have been associated with phytoplankton blooms in Toby Inlet, and fish have been observed congregating near the closed mouth of the Inlet when oxygen is low.

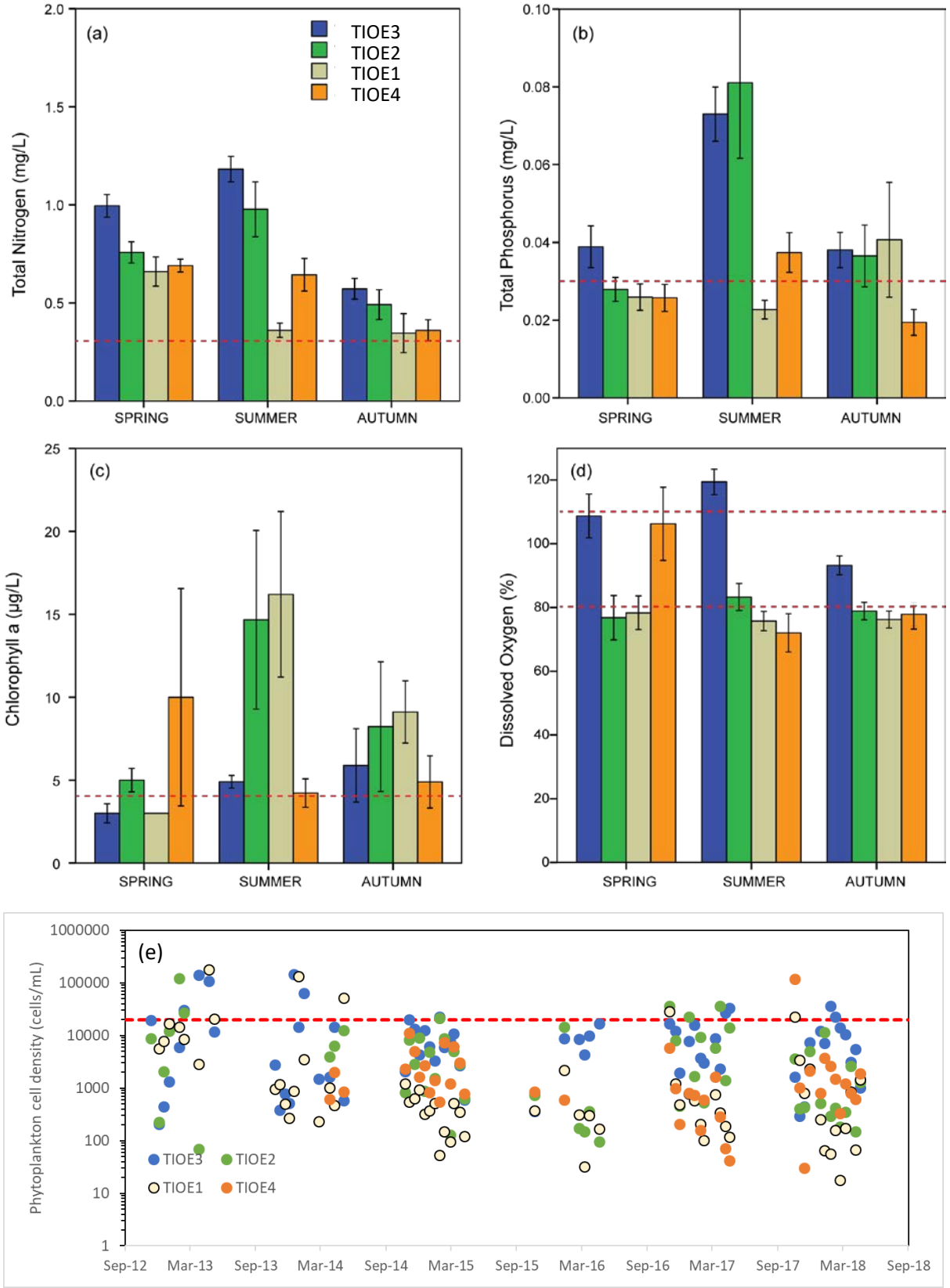


Figure 9. Average concentrations of water quality indicators (a-d) and phytoplankton density (e) in Toby Inlet (data courtesy DWER (DWER 2018). Sites TIOE3, 2 and 1 are located east to west respectively from Quindalup Siding Road to the ocean exchange and TIOE4 is just near the culvert exchange with Station Gully, as shown in Figure 1. Red dashed lines are guideline values for protection of estuarine ecosystems (a-d) and recreational use (e) (ANZECC and ARMCANZ 2000). Note logarithmic scale in (e). Error bars are +/- standard error.

Figure 10. Macroalgae growing in Toby Inlet (DoW 2010).

2.4.2 Groundwater

On the coastal plain, groundwater and surface water are closely related. Summer water levels in wetlands are often expressions of the superficial aquifer. Groundwater quality around Toby Inlet and in catchment areas is not well understood. Though there are numerous monitoring bores in the catchment, sampling has been inconsistent and there has been no analysis of data. This was not raised as an issue during community consultation, but could have implications for future management.

There have been concerns raise by community members in the past (late 1990s) and very recently about salt water intrusion in groundwater in the Dunsborough foreshore area generally, as a possible cause for the declining health of Peppermint trees. Dunsborough Coast and Land Care (DCALC) initiated a groundwater study for Dunsborough foreshore and Toby Inlet in partnership with the (then) Water and Rivers Commission. Fourteen monitoring bores were installed for assessment of salinity, nutrients and pH. However, results of the sampling program are not publicly available.

2.5 Toby Inlet ocean exchange

The common understanding among the community is that reduced water flow from the catchment has reduced the natural opening of Toby Inlet to Geographe Bay. The status of the sand bar has direct influence on water quality and water levels. When the sand bar is closed during summer, water quality is poor and conducive to algal growth. When the sand bar is open, tidal flushing dilutes the nutrient concentrations and reduces the residence time, limiting algal growth. When the sand bar is closed during winter, water levels in Toby Inlet can become high enough to cause localised flooding problems for nearby residential properties.

A memorandum of understanding for artificial opening of the sand bar was signed by key management bodies in June 2000, including the (then) Shire of Busselton, (then) Water and Rivers Commission, GeoCatch and Water Corporation. This specified that the preferred management for Toby Inlet and

Station Gully was as a common ocean outlet. The purpose of opening the sand bar was to prevent flooding of nearby properties and to increase tidal flushing to improve water quality. Managing a single ocean outlet became difficult owing to extensive sand build-up. In early 2005, the (then) Department of Environment trialled excavation of a separate ocean outlet for Toby Inlet with the aim of improving water quality in the Inlet through tidal flushing.

Although water quality is generally improved by ocean exchange, problems have occurred with excessively low water levels during low tides. Very low water levels impede recreational boating activities and lead to greater exposure of sediment deposits, reducing visual amenity and causing poor odours. There is also anecdotal evidence of fish stranding in upstream areas at very low tides.

Declining water quality has likely increased the demand for the Inlet to be opened, and this will be an important ongoing component of managing Toby Inlet.

2.6 Ecology

Toby Inlet and associated wetland area retains many important ecological attributes, which contribute to regional biodiversity and are valued highly by the local community. The vegetation communities within and surrounding Toby Inlet and associated wetlands have intrinsic conservation value and provide important habitats for terrestrial and ecological functions. The aquatic habitats of these systems are closely linked to the fringing vegetation and support diverse populations of aquatic fauna and waterbirds.

The ecology of Toby Inlet provides amenity value and supports recreational activities such as fishing, watercraft use, bird-watching and exercise pastimes. A summary of the ecological components of the Toby Inlet study area and associated management issues is provided below.

2.6.1 Vegetation

The foreshore of Toby Inlet contains large areas of intact vegetation, owing to preservations within reserves, most of which are managed by the City. The management of vegetation and conflicting landscaping and gardens of adjoining properties is a key issue.

A recent survey of flora and vegetation was completed for the City by Ecoedge (2017). The study area contains at least fifty native species within seven different vegetation communities (0), including two vegetation units that fit criteria for the Coastal Saltmarsh threatened ecological community[5]. Weston (1997) described three broad types of vegetation communities: fringing wetland and estuarine, coastal scrub, and forests and woodlands.

There are at least fifty species of weeds present in the study area, and 14 of these are considered environmentally significant (0the most significant of these is Arum lily (*Zantedeschia aethiopica*), which currently occurs as localised infestations at many sites (Ecoedge 2017). Bridal creeper and grassy weeds are also problematic. Grassy weeds continue to invade native vegetation, and there is progressive encroachment of lawns into reserve areas in some locations. There are number of potentially invasive garden escapees that pose a threat in the study area. Dumping of garden refuse

[5] EPBC Act 1999

and direct planting of exotic species within reserves, as well as spreading from private gardens, contribute to this problem.

Other key threats to vegetation are unauthorised clearing within public reserves and unmanaged access.

Despite the presence of a range of environmental weeds, the foreshore vegetation is considered generally in fair to good condition. Forty percent of vegetation is rated as very good to excellent condition. The study area is also in high proximity to a Regional Ecological Linkage. In addition to the conservation value of the flora itself, fringing vegetation of wetland areas is a vital component of wetland health. Functions include:

- supporting terrestrial and aquatic food webs;
- habitat for terrestrial and aquatic fauna;
- foreshore stabilisation;
- maintaining cooler temperatures;
- interception of nutrients and sediments in runoff; and
- nutrient uptake and processing.

Future works to rehabilitate fringing vegetation must be mindful of maintaining suitable amenity to avoid future conflicts with landowners and preventing ongoing encroachment of lawns and gardens into reserve areas.

2.6.2 Birds

Birds are an important part of the Toby Inlet ecosystem and are appreciated by members of the community and by visitors. No formal bird monitoring data is available for the study area, however surveys were conducted during spring in 1996 and results are reported in Clay (2005). This survey recorded 68 bird species including 26 waterbirds and 42 forest birds. Given the level of community interest in birds there is an opportunity to engage people in data sharing to better understand bird populations of Toby Inlet.

The surrounding vegetation and open water areas are important habitat for birds. Threats to bird populations include degradation of habitats, predation by domestic and feral animals, and disturbance from human activities.

2.6.3 Aquatic Fauna

Though impacted by modified hydrology, nutrient enrichment and sedimentation, Toby Inlet is considered to provide important fish habitat. Sheltered estuarine systems such as Toby Inlet are important for fish breeding, particularly for estuarine species which require both fresh- and salt-water for different phases of growth and reproduction. Estuaries also tend to be highly productive, supporting aquatic invertebrate communities that provide an important food resource for fish and waterbirds.

Aquatic invertebrates

Aquatic invertebrate sampling of Toby Inlet in 1997 found a combination of estuarine and freshwater species, with more diverse wetland-type communities at upstream sites. Though species diversity was high at some sites, the system was considered dominated by cosmopolitan species characteristic of a degraded system (Streamtec 1997).

Recent sampling downstream of Caves Road in November 2017, prior to opening of the sand bar, also found higher-diversity wetland communities in more upstream regions and lower-diversity estuarine communities downstream (Tweedley et al. 2018). This study found a relatively diverse aquatic invertebrate community, including species that are intolerant of pollution and low oxygen levels, indicating a fairly healthy ecosystem. Other notable fauna observed during the study by Tweedley et al. (2018), were: Southern Bobtail Squid (*Euprymna tasmanica*, Blue Swimmer Crab (*Portunus armatus*) and Western King Prawn (*Penaeus plebejusI*). A list of taxa from both these studies is provided in Appendix 7.

The effect of opening of the sand bar on the invertebrate population, and implications of this in terms of food resources for fish and birds, have not been assessed. The recent sampling provides a useful baseline for future assessments in Toby Inlet.

Fish

Fish in Toby Inlet have long provided a food resource for Aboriginal people, and fishing has been a valued recreational pursuit for many years. There is a general perception that the fish population has declined in Toby Inlet, though it is still perceived as providing important fish habitat.

A recent study of the fish population in Toby Inlet (Tweedley et al. 2018) provides the first formal description of the fish population. For this study, fish were sampled in November 2017 and March 2018, prior to and following the opening of the sand bar (11th December 2017). The type of fish found were typical of those found in other south west estuaries and include estuarine and marine species and some freshwater-estuarine fish. Several marine species known for using estuaries as nursery areas were present. Mosquitofish, which is aggressive to native fish and not able to be controlled, was also recorded.

Following opening of the sand bar in December 2017, fish density remained similar to before opening, but species diversity increased owing to an increase in the number of marine species which recruited into the estuary. However in general, the fish population was more influenced by timing of life cycles than by opening of the sand bar.

2.6.4 Other Fauna

The terrestrial vegetation provides habitat for many species of birds and other fauna, including two mammal species of conservation significance: the Critically Endangered[6] Western Ringtail Possum (Ngwayir, *Pseudocheirus occidentalis*); and the priority 3 listed[7] Quenda (Southern Brown Bandicoot). A site survey and summary of observations by local residents in November 1996 found these two mammals, Grey kangaroos present, two species of frogs, 13 species of reptiles and the possible

[6] Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2017 (WA); (EPBC Act)
[7] Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2017 (WA)

presence of Water Rat (Rakali, *Hydromys chrysogaster*) (Hart et al. 1997) (Appendix 6.). The Brush-tailed Phascogales (*Phascogale tapoatafa*) may also be present, and is listed as a conservation-dependent species[8].

Impacts on vegetated habitat, predation by domestic and feral animals and fire are the main threats to these native mammals. Remnant vegetation is at risk of degradation from physical disturbance, inappropriate fire regimes, weed invasion and physical disturbance.

2.7 Recreation and Education

Toby Inlet provides significant recreational and educational opportunities. Activities such as fishing, swimming and paddling on the Inlet have been important recreational pastimes since early European settlement during the mid to late 1800's. Bird watching and other passive enjoyment activities are also important. Toby Inlet is the focus of a number of tourism accommodation businesses on and around the inlet. The visual amenity and opportunity for recreational pursuits are critical to both visitors and local residents alike. Poor water quality and sedimentation problems restrict access for recreation within the water, and visual amenity and odour problems affect other recreational activities. This affects a broad cross section of the community, visitors and local businesses.

Despite these problems, a number of trails, beaches and open space adjoining the Toby Inlet continue to provide recreational opportunities and these are highly valued by the community. However, unmanaged access has led to disturbance of foreshore vegetation and erosion of banks in some locations. There is significant potential for improving recreational and educational opportunities in and around Toby Inlet, by addressing water quality and sediment problems, improving facilities and providing information resources.

Private use of reserves and private jetties

Considerable areas of foreshore reserves do not have public access and some areas adjacent to private property owners are managed for private purposes. The condition of foreshore vegetation and bank stability in these areas varies from remnant vegetation in good condition to extensive clearing and bank instability. Illegal clearing of native vegetation within public reserves to improve views is an ongoing problem. Private use of public reserves by residents conflicts with access by the broader public; but some residents are concerned that increased public access will create security issues.

These privately used foreshore reserves include a number of private jetties. They have been present in Toby Inlet for many years and in general have not been raised as a key management issue. However there is an issue relating to the structural integrity of these jetties and the materials they are built from. For example a jetty made from plastic drums has come apart and a plastic drum floated in the Inlet. In addition, building of more jetty structures may cause inappropriate disturbance to foreshore areas. The City currently has no policy regarding these structures.

[8] Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2017 (WA)

2.8 Cultural Heritage

2.8.1 Aboriginal heritage

Toby inlet holds significant cultural value for Wadandi people. In pre-European times, local groups traditionally gathered to conduct ceremonies and take advantage of food resources. Following European settlement, the area continued to be used for camping, with evidence of several historical camps still present from times when Aboriginal people were not permitted to live in town (BGA 2018). There is a historical camping ground within the survey area, which has been lodged as an Aboriginal site under the *Aboriginal Heritage Act 1972* and is awaiting an outcome.

On-site discussions with local Aboriginal representatives were held during the preparation of this plan. The group described historical use of Toby Inlet and surrounds by Aboriginal People for camping and fishing and the substantial changes to the area since European settlement (BGA 2018). The group related the decline in water quality and fish abundance to the substantial changes in drainage and development of the surrounding lands. A key issue raised by the group was minimising additional access and infrastructure for recreation, while retaining access for Aboriginal people.

2.8.2 European History

The area around Toby Inlet was an important part of early European colonisation. Quindalup was the primary settlement established in 1866, supporting local timber industry, and is the site of the original school. There is also a history connected to whaling.

This extract about European history is from the Management Plan prepared by Clay (2005):

Toby Inlet was named after Captain Jacob Toby, of the coastal schooner 'Ellen'. The Ellen used to take on water at Meelup, and while in the area Captain Toby would moor close to the mouth of Toby Inlet and barter with the local residents, exchanging knives, tools, sugar and tea for fresh produce (Guinness, 1984; Smith, pers.comm2004). In the 1800's Jack Molloy commenced construction of a boat in the sheltered waters of Toby Inlet near the sand bar. The boat was well into construction when the mouth broke out, and washed away the boat supports. The boat was buried by sand and left at the site. This incident is referred to as 'Molloy's Folly" (Smith, pers. comm.).

The European history of Toby Inlet, is documented by several authors (Guiness, 1984; Kinsella, 1990: Horwitz & Wardell-Johnson, 1996). Anecdotal evidence supports the fact that Toby Inlet used to be considerably deeper than it is today. In the 1920's the channel was deep enough for small boats, and due to the accretion of sediments, this is obviously no longer possible. In 1967 the Inlet was dredged by a very unsophisticated piece of equipment, along the north bank, from a point just west of the Edgewater subdivision to a point some 400 metres east of this sub-division. From this point to the ocean a channel was cut to allow passage for small boats (Ken Davies pers.comm.2004).

In 1994 the Water Authority constructed a bund across the Inlet, at the western end of Campion Way to allow for the maintenance of an existing water main. It is said by the locals that after maintenance had been completed, the bund was not completely removed, thus restricting water flow (Ken Davies pers.comm.2004).

2.9 Governance

Governance was not identified as a priority issue of concern in the community views session, but was indicated as an area needing change. It was recognised as an important focus area during the development of management objectives, and is clearly an important overarching issue for implementation of the WMP.

The independent review of water asset management (Hart 2014) highlighted the need for Toby Inlet to have a designated manager, which was further supported in the State Government response. The review acknowledged the work of the Toby Inlet catchment Group in developing the existing management plan (Clay 2005). However, implementation of this plan has been limited by a lack of funding and support from relevant organisations, and the management roles have not been clear.

The existing management plan is not connected to any targets or monitoring, so progress and outcomes have not been measurable. The community have been dissatisfied with the progress of management for Toby Inlet. Although there has been no formal tracking of progress, there is a general perception in the community that the ecological health of Toby Inlet has continued to decline (Hart 2014).

The review also recommended that identifying research needs should be a component of future management. Annual reporting to the community on the health of Toby Inlet and the effectiveness of management was also recommended, with government support, which will require clear goals/targets and associated monitoring.

> *Management of Toby Inlet is minimalist at best. The community-based Toby Inlet Catchment Group have developed a Management Plan for Toby Inlet, and could do a serviceable job of managing the Inlet if they had more funding and greater backup from CoB and DoW* (Independent Review - Hart 2014).

3 Management Objectives

Sixteen management objectives across the nine the focus areas are listed below. These objectives were strongly guided by community input. They provide important statements for future assessment of the implementation of this WMP.

3.1 Sedimentation

1. Reduce catchment sediments and contaminants from existing and new developments entering Toby Inlet.
2. Manage existing sediment to improve water quality, water flow and amenity of Toby Inlet.

3.2 Amenity

3. Improve visual amenity, public health and odours so that residents and visitors alike can enjoy Toby Inlet.

3.3 Water quality

4. Reduce and manage nutrients and other pollutants entering Toby Inlet to improve water quality and lessen the frequency and severity of algal blooms.
5. Minimise any additional nutrients entering Toby Inlet from new developments and agricultural intensification.

3.4 Water flow

6. Optimise all water flow in Toby Inlet to balance improvement of water quality, protection of ecological values and public amenity, while maintaining flood protection.

3.5 Toby Inlet ocean exchange

7. Actively manage the Toby Inlet mouth to maximise ecology, water quality and recreational values.

3.6 Ecology

8. Restore, maintain and protect the ecological values of Toby Inlet.
9. Reduce the impacts of threatening processes on the ecological values of Toby Inlet.

3.7 Recreation and Education

10. Improve and manage public access for recreational purposes that support the amenity and ecological values of Toby Inlet.
11. Facilitate appropriate water based recreational activities with consideration to the ecological values and water quality of Toby Inlet.
12. Raise community awareness of Toby Inlet's recreational, cultural and ecological values.

3.8 Cultural Heritage

13. Understand, protect and preserve the heritage values of Toby Inlet.

3.9 Governance

14. Develop and maintain partnerships and a collaborative approach between stakeholders and the community when managing Toby Inlet.
15. Involve the community in the future management of Toby Inlet.
16. Adopt evidence based decision making in the long term management of Toby Inlet.

4 Review of Management Options

Development of management strategies for Toby Inlet involved consideration of a range of potential initiatives. Some of these are based on fundamental waterway management approaches, such as minimising nutrient and sediment loads, and enhancing the important function of fringing vegetation. Other initiatives involve further work to better understand potential outcomes and challenges. Many of the strategies and actions build on community suggestions for future management of Toby Inlet.

4.1 Sediment Removal

There is strong community support for active removal of sediments from Toby Inlet. Community input indicates that this is driven by perceptions that sediment removal will lead to outcomes in the following areas:

- Flushing of water through the system to improve water quality.
- Removal of unsightly sediment deposits.
- Addressing unpleasant odours associated with exposed sediments.
- Deepening of the Inlet to improve boating conditions.
- Improved conditions for fish.

Removal (dredging) of sediment could be progressed if it can be justified on ecological grounds, rather than for amenity outcomes only.

4.1.1 Challenges

Previous investigations (ENV Australia 2007) have shown a layer of sandy sediments approximately 0.5m deep in the area of obvious sediment deposits downstream of Caves Road. This area would be a likely focus of sediment removal should it be deemed an appropriate action. This area did not contain MBOs but did contain potential acid sulphate soils (PASS). Potential for acidity means sediment removed would require treatment for disposal.

The deeper area downstream was assessed as having a surface layer of MBO in the sediments and also contained PASS (ENV Australia 2007). The presence of MBOs is probably linked to a history of macroalgal blooms in the area. Disturbance of MBOs can cause deoxygenation, heavy metal release, nutrient release, sulphide toxicity and bad odours.

Removal and transport for disposal would involve significant costs, and may also cause physical disturbance to the environment. Further investigations would be needed to prioritise areas for sediment removal; determine volumes and characteristics of the sediment to inform disposal options; and assess potential environmental impacts. Volumes of sediment have been estimated for the large area of deposition downstream of Caves Road as:

- Deepening the channel to -0.4m AHD: 1684m^3
- Removal of large sandy deposit to 0.4m AHD: 714m^3

4.1.2 Potential outcomes of removal

The main objective associated with this approach is improved amenity: removal of sediment deposits would improve water vistas for some local residents; and deepening the Inlet would improve access for watercraft. Outcomes for water quality and ecology and potential impacts of removal are also possible but not well understood, and further investigation is needed to assess potential for both beneficial outcomes and negative impacts.

Removal of sediment in the upper and lower reaches of Toby Inlet was included in hydrological modelling done for the *Reconnecting Toby Inlet* project. This indicated some potential for improvement in water quality through increased water circulation in the estuary: reducing the bathymetry to -0.5mAHD (removing about 300mm of sediment) would create additional regular flushing of about 2%, or 100m (Frazer and Hall 2017).

Deeper conditions may also improve open water habitat for fish and birds, but this is not known. There are risks of negative impacts on the environment, which may in turn have negative effects on amenity. Risks associated with sediment removal in Toby Inlet include:

- disturbance of acid sulphate soils and monosulfidic black ooze;
- physical disturbance of bed and bank habitats; and
- damage to fringing vegetation.

Before a recommendation can be made with regards to sediment removal, management should focus on defining priority areas for sediment management and understanding the costs and benefits of removal.

4.1.3 Alternatives to removal

Other than removal, some potential management options to address sedimentation in Toby Inlet are:

- Minimising future sediment loads into the system.
- Mobilisation of sediment through agitation to resuspend sand into the water column, using a hydraulic sludge pump during high flows, to facilitate its movement into to the ocean.
- Acceptance of sediment deposits and rehabilitation (e.g. planting) of these areas to improve ecology.

4.2 Toby Inlet ocean exchange

Connectivity of Toby Inlet to the ocean has direct effects on water quality and water levels. Potential connections are via a culvert into Station Gully, which is intermittently open to the ocean; and via a direct separate channel to the west of Station Gully. The status of these connections depends on flows coming from the catchment and the nature of the sand bars, determined by coastal processes.

The Toby Inlet Ocean Entrance Study in 1999 (Rogers and Associates 1999) identified a common channel for Station Gully and Toby Inlet as the more desirable option to improve water quality and alleviate flooding, as the combined flows from the systems have greater potential to maintain the opening. In June 2000, a Memorandum of Understanding (MoU) was developed which specified management of Toby Inlet/Station Gully with a common ocean outlet to ensure:

1. *Protection of residential properties from flooding.*
2. *Maintenance of tidal flushing to maintain water quality in the Inlet.*
3. *Protection of rural properties from flooding.*

This MoU was signed by representatives of the (then) Shire of Busselton, Water Corporation, Toby Inlet Catchment Group, (then) Water and Rivers Commission and the Geographe Catchment Council.

The *Reconnecting Toby Inlet* hydrodynamic modelling study (Frazer and Hall 2018) determined that a separate ocean connection for Toby Inlet resulted in tidal flushing of 72% of the Inlet, compared with only 36% flushing via Station Gully. A key difference for this study was additional bathymetric survey in the area, which showed that the narrow connection between Station Gully and Toby Inlet allowed only very limited exchange between the two waterways. Thus much greater flushing of Toby Inlet is achieved via a separate ocean connection.

This work also determined a minimum sill height for the channel of -0.15 m AHD to avoid excessive draining of the Inlet on low tides. Very low water levels have caused problems with past sand bar openings owing to increased exposure of sediments, and isolation of shallow pools that provide unfavourable conditions for aquatic fauna. Recommendations from this study were:

- The Toby inlet mouth is kept open throughout the year, with a minimum sill elevation of -0.15 m AHD from October to June to avoid very low water levels during low tides.
- Keeping the culvert between Station Gully and Toby Inlet open permanently.
- Potentially, to investigate a second cut for Toby Inlet if increased flushing of the upper estuary is considered necessary.

A telemetered data logging system is in place to monitor water levels and sill height of the ocean connection.

4.2.1 Summer - water quality protection

During 2017-2018 the opening of the mouth of Toby Inlet has been maintained. A draft operational procedure is in place to keep the sandbar open, with a minimum sill elevation of -0.15 m AHD (Appendix 2. The sand bar was opened in November 2017. It stayed open until late March 2018 and was re-opened on 6th April 2018. The feedback from the community on this management initiative has generally been positive.

4.2.2 Winter - flood protection

The *Reconnecting Toby Inlet* project recommends the ocean outlet be kept open all year (Frazer and Hall 2018). However, periodic closing of sand bar through natural processes during winter creates unpredictability in works requirements to achieve this. A trigger level for flood protection purposes would be useful to initiate opening of the sand bar in winter. Detailed water level data (15-minute intervals) from the telemetered monitoring system provides some useful information for setting trigger levels for winter sandbar opening.

Intense storms in May and June 2018 resulted in a high level of sand deposition on the beach and very high water levels in Toby Inlet. Despite large rainfall events, there was insufficient flow to naturally cut through the sand bar. Water levels were in the vicinity of 1.5m (above sea level AHD) from 10th to 14th June, following a series of rainfall events from the 25th May (Figure 11). Photographs of the area

during this time show minor flooding in adjacent lands at these water levels (Figure 12). The sand bar was opened on 13th June 2018, lowering water levels to about 0.8m within two days. This opening was effective, and the outlet remained open intermittently for about four weeks. Rising water levels initiated further opening of the sand bar on 24th July when water levels were around 1.1m. In this instance the sand bar closed within two days.

Maintaining the ocean outlet throughout winter may incur excessive costs if it closes frequently. An appropriate trigger level would direct works only when there is a risk of flooding, and coincide with sufficient flows to maintain the opening. Given the flooding observed when water levels were at 1.5m, and the lack of a consistent channel when opened at around 1.1m, an appropriate trigger level would be at a height between these levels.

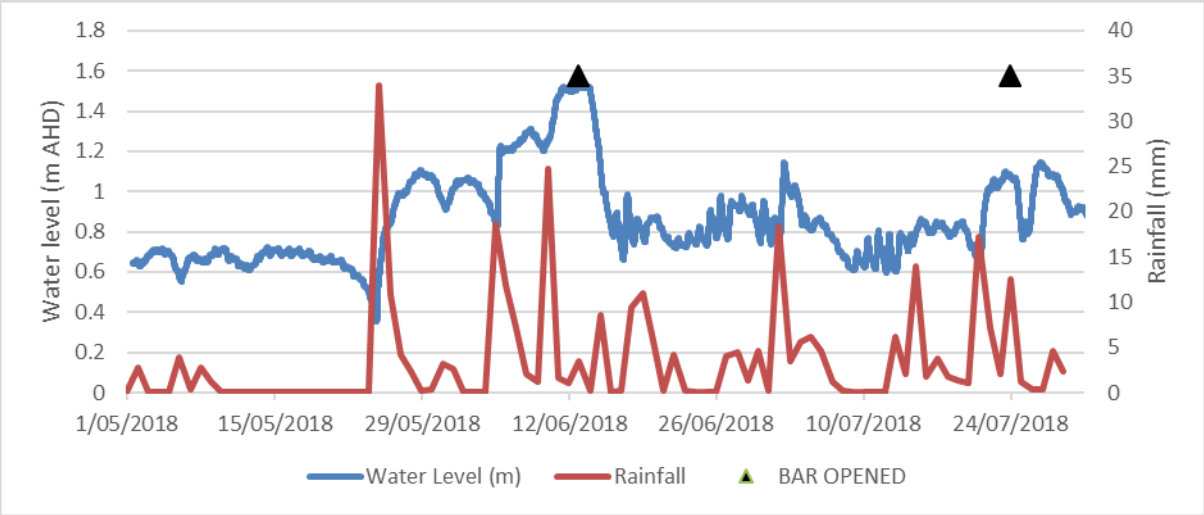


Figure 11. Water levels (blue line) at the Toby Inlet ocean outlet, daily rainfall (red line) and times when sand bar was opened (black markers) during May, June and July 2018. Rainfall data from BoM (2018).

Figure 12. Photos showing minor flooding in the vicinity of Toby Inlet from 11th - 13th June 2018.

4.3 Reconnecting catchment flows

Water flow within Toby Inlet has been significantly altered since European settlement. Notably, the Carbunup River and a number of other smaller waterways have been diverted and no longer connects to the Inlet or contribute to its flow. These changes have resulted in a significant decline in flows and influence the accumulation of nutrients and sediments in the system. The *Reconnecting Toby Inlet* hydrological modelling study investigated options to reinstate flow through Toby Inlet through reconnection of catchment tributaries (Frazer and Hall 2018).

Increasing water flow may improve water quality through dilution of nutrients and by reducing water residence time (flushing). Nutrient concentrations in Station Gully, with a predominately agricultural catchment, are higher than in Toby Inlet, so additional flow from this source may have a negative effect on water quality through increased nutrient loads (Frazer and Hall 2018). Flushing of the estuary has minimal effect on water quality during winter, but is needed during summer when water quality problems occur. However, owing to seasonal flows, there is little potential for catchment flows to provide summer flushing, do the reconnection of catchment sources would not provide this benefit (Frazer and Hall, 2018). There is insufficient water available from other sources, such as Dunsborough lakes dams, to provide summer and autumn flows.

Increasing catchment inflows is also perceived as an option for addressing sedimentation problems. Although the volume of flow through Toby Inlet would be increased by additional catchment water flows, the flat landscape means that flow velocities would remain low, and would not facilitate sediment scouring (Frazer and Hall 2018). It is also worth considering that if velocities were sufficient to mobilise sediment, there may also be a risk of increased sediments from the catchment to Toby Inlet (not assessed).

4.4 Recreation Planning

Community feedback on recreation in and around Toby Inlet was sought during the consultation process and via a specific online survey (City's *Your Say* platform). These forums have indicated very

clearly that management should focus on encouraging passive recreation, and on improvements to existing access rather than increasing accessibility.

Aboriginal consultation revealed a strong desire to maintain a passive level of recreation in and around Toby Inlet. Representatives also suggested that additional infrastructure and signage in the area should be minimised.

An access management plan has been developed to identify existing recreational access and infrastructure in the study area and opportunities for improvements (SWE 2018). This plan identifies four categories for management:

i. Vegetated areas with no tracks: to be retained as high conservation value areas with no further access.
ii. Vegetated areas with existing tracks: to be improved and potentially linked to each other and parkland areas enhance access for recreation and management purposes (e.g. weed control and infill planting).
iii. Parkland cleared areas: existing high-use areas where improved infrastructure and formal paths would be appropriate and foreshore protection may be needed.
iv. Private property access only: not accessible for assessment and unlikely to be suitable for further public access.

Management options identified in the plan include improvements to existing tracks and the potential for additional tracks and/or a boardwalk; potential sites for canoe access, bird watching facilities, picnic facilities and outdoor classroom; and protection works for revegetation, weed control and erosion control. The concept plans for these options provide an ideal basis for further community consultation and project development.

4.5 Managing foreshore reserves

Foreshore reserves require improved management to protect remnant vegetation from weed invasion and physical disturbance from uncontrolled access. Revegetation is also needed in some degraded areas, particularly along banks where vegetation is important for stabilisation and ecological functions.

The Ecoedge (2017) vegetation survey report provides mapping of weeds that would form a basis for strategic control. This report also proposed five areas for revegetation based on size (≥ 1500m^2), accessibility for implementation, and low density of existing vegetation (Ecoedge 2017). These should be further considered in consultation with the community. Weed control and revegetation is needed to ensure protection of natural values in the study area. Some further planning may be needed to direct these efforts.

Recreation and access planning also provide recommendations for areas requiring weed control and revegetation in association with managing access and addressing foreshore erosion, and improving recreation opportunities (SW Environmental 2018). Pathways provide opportunities to formalise boundaries of reserves or interfaces between areas of parkland and natural vegetation.

Some foreshore reserves adjacent to private properties do not have public access to undertake an assessment of management issues or opportunities for improvement. The condition of foreshore

vegetation, bank stability and integrity of private jetties in this area varies. A process of assessment of these areas is needed that identifies:

- inappropriate management of public land;
- jetty structures that require maintenance or removal;
- areas of recreational value for the broader community;
- required management actions to conserve ecological values; and
- potential fire risk.

This process could also be used to develop relationships with local landholders and foster community stewardship for ongoing management, such as through formation of localised *Friends of* groups that could partner with the Toby Inlet catchment Group. In addition, a policy relating to current and future jetty structures would be valuable to minimise potential impacts of the structures and ensure adjacent foreshore areas are protected.

4.6 Catchment management

The portion of the catchment closest to the Inlet has experienced rapid urban development and this is projected to continue into the future. Unsewered urban areas of Quindalup have been identified as a significant nutrient source, particularly through the critical summer months. Sewerage infill works in this area are imminent (update progress as needed). Once completed, the connection of properties to this infrastructure will be vital to ensure outcomes from this investment. There may need to be targeted awareness campaign to maximise connection.

The broader Toby Inlet catchment contains a range of land uses with significant portions dominated by native vegetation, beef grazing, lifestyle blocks and highly developed urban or commercial areas. Management of the broader catchment is beyond the scope of this plan. However, as the catchment has substantial influence on the health of waters within the study area, it is logical that its implementation would support initiatives that reduce catchment sources of nutrients and sediments. GeoCatch has a lead role in catchment management including improved land use management practices, waterway restoration and educational approaches. In addition, the Toby Inlet Catchment Group has long advocated catchment management and could partner with GeoCatch to extend initiatives in the Toby Inlet catchment.

There is also a role for land use development planning in catchment protection. Proposals for changes in land use and new developments can trigger the imposition of new environmental protection requirements. This applies directly to the objective: *reduce catchment sediments and contaminants from existing and new developments entering Toby Inlet.* The use of planning approaches is part of the governance framework for this plan.

4.7 Governance arrangements

The independent review of water asset management (Hart 2014) highlighted the need for Toby Inlet to have a designated lead manager. The City was recognised as the most appropriate manager for Toby Inlet, and this has been supported by the Western Australian Government in its response to the review. It is appropriate that the City adopts this role, given its management responsibility for a large proportion of adjacent foreshore reserves. Although the City is responsible for overall implementation

of management actions, several key stakeholders also have important roles, outlined below. These roles and responsibilities are also summarised in Table 1, Section 6.

The City's management responsibility is generally limited to the study area and does not extend into the broader catchment. Ongoing management initiatives in the catchment, in particular to address issues of nutrient enrichment and sedimentation, are a fundamental component of waterways management. GeoCatch, with the support of DWER, is the lead manager for catchment management. The Water Corporation has management responsibility for its rural drainage network. This network extend into the Station Gully catchment, but is not part of the existing Toby Inlet catchment.

DWER has an ongoing role in providing support for the management of Toby Inlet through continued involvement in water science, modelling and monitoring. If the implementation of this WMP is to be funded through ongoing investment in a broader program for Geographe Bay catchment waterways, DWER is likely to continue to have an important project management and networking role.

The Toby Inlet Catchment (TIC) Group also has an active role in the management of Toby Inlet and its catchment, with a long history in management planning and on-ground works. Members of TIC Group are important advocates in the community for protection of Toby Inlet, increasing support for, and recognition of, improved management. The group continues to undertake restoration activities such as weed control, revegetation and feral animal control. This greatly assists with management of public reserves, and should continue to be supported by the City.

Establishment of "Friends of Reserves" groups for sections of Toby Inlet foreshore has been suggested during consultation as a way of fostering community stewardship to assist with and maintain restoration efforts. These groups could partner with TIC Group, increasing overall capacity. The City recognises the valuable contribution of volunteers to environmental management, and has a commitment to supporting volunteer groups such as TIC Group and Friends of Reserves groups.

The City also has an important role in its planning capacity. Through the *Revitalising Geographe Water*ways program, the City has been responsible for the *Optimising Planning Tools* project to review the potential role of planning in water resource protection.

4.8 Research needs

Research is needed to enable assessment and reporting on progress of management initiatives and to fill knowledge gaps. Research outcomes need to feed back into management planning through an adaptive process. The key research areas for Toby Inlet are summarised below.

Water quality: Ongoing water quality monitoring is an essential part of long-term assessment and reporting for waterway health. There appears to be an adequate sampling program for open waters of Toby Inlet. Investigative sampling within of tributaries and groundwater in the Toby Inlet catchment should be considered to ensure information requirements for prioritising and reviewing management initiatives are met.

Water flow: Assessment of the potential for existing flows to move sediment in association with resuspension of sediment through agitation may require further modelling or a trial.

Sediments: If removal of sediment is deemed appropriate in the future, further studies of physical and chemical characteristics will be needed to inform priority locations, the removal technique and disposal options.

Bird life: There has been little formal surveying of bird life of Toby Inlet, so the overall importance of the study area for providing bird habitat and the particular sites of importance are not well understood. There is an opportunity for community-based surveying to assist in prioritising management initiatives (e.g. habitat restoration) and in developing information resources for visitors.

Aquatic fauna: Fish and aquatic invertebrates are good indicators of waterway health. Recent research has provided baseline information for future monitoring and reporting. Community involvement in this research has highlighted the potential for educational opportunities that engage people in the management of Toby Inlet.

Aquatic flora: There have been no studies of macroalgae and other aquatic plants in Toby Inlet and associated wetlands. Aquatic flora has an important structuring role, with a strong seasonal influence on habitat and water quality and hence on aquatic fauna and food web interactions. The extent and composition of macroalgal growth (as blooms or at non-nuisance levels) have not been formally monitored and may provide a good indicator of water quality.

5 Management Strategies and Actions

The management strategies and actions included here have been developed to work towards meeting the management objectives and vision for Toby Inlet. Specific actions have been grouped into strategies for each of the management focus areas, although many have potential outcomes for several objectives. A framework for implementing the WMP is provided in Section 6, including the roles and responsibilities of key stakeholders and a process for ongoing action planning, reporting and review.

5.1 Toby Inlet ocean exchange

5.1.1 Strategy OE1: Optimal management of Toby Inlet ocean exchange

Effective management of the Toby Inlet ocean exchange has clear outcomes for water quality by through dilution of nutrient concentrations and preventing algal growth. Establishing a minimum sill height during summer will reduce areas prone to sediment exposure and associated problems with visual amenity and odours. Management of the sand bar is also important in mitigating the flood risk for adjacent properties.

Management actions:

OE1.1 Maintain Toby Inlet ocean outlet, the Station Gully culvert and the Station Gully outlet in accordance with Operational Procedures in Appendix 2.

OE1.2 Monitor the status of the outlet through a telemetered system to determine when opening of the sand bar is necessary.

OE1.3 Ensure the culvert between Station Gully and Toby Inlet will be left open to improve water quality in the upper reach of Toby Inlet, east of the ocean outlet.

5.2 Sedimentation

5.2.1 Strategy S1: Investigate sediment removal

There is strong community support for active removal of sediments from Toby Inlet, however the main objective associated with this approach is improved amenity. Outcomes for water quality and ecology and potential impacts of removal are not well understood, and further investigation is needed. An alternative approach to mobilising sediment may be mechanical agitation of sediments in depositional areas during high flows. There is community support to further investigate potential to mobilise deposited sediment.

Management actions:

S1.1 Defining priority areas for sediment management and determine sediment composition and volume for these areas, building on previous sediment investigations.

S1.2 Assess potential outcomes and impacts of sediment removal from priority areas and undertake a cost/benefit analysis of strategic sediment removal.

S1.3 Assess whether sediment agitation would facilitate mobilisation and flushing of sediment deposits on Toby Inlet.

5.2.2 Strategy S2: Prevent further sedimentation

Existing land uses in the catchment and ongoing development are likely to continue to contribute additional sediment to the drainage system, wetlands and Toby Inlet. Minimising sources of sediments and trapping mobile sediments before they reach receiving waters is important to prevent further deposition.

Management actions:

S2.1 Improve understanding of sediment sources and transport through water quality monitoring (refer to WQ1.6).

S2.2 Develop an education approach to reducing sediments inputs from the catchment.

S2.3 Identify and ensure management of potential erosion problems from new developments and changes in land use during the planning process, through implementing the *Better Urban Water Management* framework.

S2.4 Investigate key sediment sources in the catchment and potential for works to stabilise drains and increase sediment trapping within the drainage network.

5.2.3 Strategy S3: Rehabilitate exposed sediment deposits

Revegetation of exposed sediments may address amenity issues. It would also stabilise the sediments, provide additional habitat, and trap additional sediments and nutrients entering the Inlet.

S3.1 Identify areas of exposed sediments that could be planted to improve habitat and amenity and stabilise sediments.

S3.2 Undertake trial revegetation of samphire in exposed sediment.

5.3 Water quality

Increased nutrient loads from the catchment are a major cause of water quality decline. Actions to reduce point and non-point sources of nutrients are thus a fundamental component of managing water quality. Management of the sand bar to provide flushing during summer and autumn is a key strategy to improve water quality in Toby Inlet (Strategy OE1). However, ocean flushing does little to address water quality issues in the upper reach of Toby Inlet or in the upstream wetland environments.

5.3.1 Strategy WQ1: Reducing nutrient sources from the catchment

Nutrients are a key driver of algal blooms, so ongoing load reduction actions are a fundamental part of management. Infill sewerage works is important to addressing nutrient sources from adjacent residential areas. Reducing nutrient inputs at the catchment level is a long-term management initiative, fundamental to protecting water quality in receiving aquatic environments.

Management actions:

WQ1.1 Completion of scheduled infill sewerage works in residential areas adjacent to Toby Inlet.

WQ1.2 Review the sewerage works once completed, and address any lack of connection to sewerage infrastructure through education campaigns or incentives if deemed necessary.

WQ1.3 Ensure Geographe Bay catchment management initiatives extend to Toby Inlet catchment, including: implementation of best management practices; and community education to reduce inputs from gardening and livestock activities in urban and special rural areas.

WQ1.4 Increase potential for nutrient assimilation in the rural drainage network in conjunction with sediment trapping and through restoration.

WQ1.5 Identify opportunities for reducing nutrient, sediment and pollutant sources through upgrades to stormwater infrastructure.

WQ1.6 Continue current water quality monitoring within Toby Inlet, and determine required monitoring for associated wetlands and catchment tributaries, to ensure information requirements for prioritising and reviewing management initiatives are met.

WQ1.7 Support educational campaigns that aim to reduce nutrients in runoff through individual and community actions (e.g. Bay OK) and investigate options to improve nutrient management in public open space.

WQ1.8 Minimise future nutrient sources from new development and land use change at the planning stage through implementing the *Better Urban Water Management* framework.

WQ1.9 Support implementation of the Vasse Wonnerup wetlands Geographe Bay Water Quality Improvement Plan.

5.4 Ecology

5.4.1 Strategy E1: Effectively manage foreshore reserves

Foreshore reserves in the study area contain important areas of vegetation, provide habitat for native fauna and contribute to heathy aquatic ecology. These reserves present considerable opportunity for conservation, however active management is needed to address threats of weeds, pests, unmanaged access, clearing of native vegetation, and vegetation decline.

Management actions:

E1.1 Prepare and implement a prioritised works program for weed control, revegetation and feral animal control.

E1.2 Support community efforts in weed control, revegetation and feral animal control.

E1.3 Ensure revegetation in high amenity areas is appealing and maintains vistas to increase community support for these activities.

E1.4 Effectively management recreational access to protect and enhance the key values of reserve areas.

E1.5 Create awareness of reserve boundaries through bollards and signage where appropriate.

E1.6 Develop information resources for landholders to raise awareness of reserve boundaries, the importance of fringing vegetation, weed problems, and the restrictions on clearing native vegetation and building jetty structures.

E1.7 Assess foreshore reserve areas that have no public access and develop appropriate management actions to benefit the broader public.

E1.8 Develop a policy for jetties that ensures structural integrity and protection of adjacent foreshore areas and prevents establishment of new structures.

5.4.2 Strategy E2: Understanding fauna

There is limited formal knowledge of the fauna of Toby Inlet. Recent research on fish and aquatic invertebrates has provided an important baseline and has had excellent outcomes for community engagement. While there is some knowledge of the occurrence of other fauna in the study area such as birds and mammals, this is not based on formal surveys. Increased understanding of fauna can be achieved through scientific and community based approaches to improve information, and sharing this knowledge with the broader community.

Management actions:

E2.1 Support further research on aquatic and terrestrial fauna and bird populations to inform management initiatives and assess outcomes.

E2.2 Pursue a community science approach to collecting bird data.

E2.3 Develop information resources to increase community interest and understanding of fauna.

5.5 Amenity, Recreation and Education

Strategies for amenity, recreation and education have been combined owing to overlap between these focus areas. All relate to the interaction between people and Toby Inlet, and improving potential enjoyment.

5.5.1 Strategy ARE1: Improving facilities for community appreciation

There is a need to formalise access and improve recreational facilities around Toby Inlet, but with a clear focus on passive recreational pursuits, such as walking and running, bird watching, fishing and non-motorised water sports. The *Access Management Plan* for Toby Inlet provides an excellent basis for improving recreational opportunities and access around Toby Inlet (Appendix 9. Although this has been developed with consideration of outcomes of previous community consultation, further review and feedback from the community will be required prior to its implementation.

Management actions:

ARE1.1 Seek community input on the *Access Management Plan* for Toby Inlet (SW Environmental 2018), and subsequently develop and implement appropriate access-ways and recreational infrastructure.

ARE1.2 Determine requirements for additional parking in support of improved facilities.

ARE1.3 Enhance bird habitat in connection with existing and potential bird watching sites.

ARE1.4 Encourage bird watchers to join with a community science approach to collecting bird data.

ARE1.5 Support schools in using Toby Inlet as an outdoor learning environment, including provision of information resources and consideration of an outdoor classroom.

5.5.2 Strategy ARE2: Providing informative resources

Management strategies around education often include interpretive signage. However given the desire for passive recreation in the Inlet and minimal facilities, extensive signage is not appropriate around Toby Inlet. Some signage regarding the values and management of the Inlet, and access points would be appropriate. Information in other forms would also be valuable for those who are interested, including learning resources for school groups. This includes printed resources and online information.

Management actions:

ARE2.1 Develop appropriate signage in connection with improved access and facilities to inform the community about: ecological values of Toby Inlet; location and use of access and facilities; and management initiatives underway.

ARE2.2 Prepare and distribute fact sheets and educational material, printed and online, for key management focus areas, relevant to schools, community members and natural resource managers.

ARE2.3 Continue to update the Revitalising Geographe Waterways website with information on Toby Inlet and its management.

5.6 Culture and Heritage

Heritage values in the vicinity of the Toby Inlet study area include traditions and history of Aboriginal people and European settlement.

5.6.1 Strategy CH1: Recognising Aboriginal custodianship

Toby Inlet holds significant cultural value for the local Wadandi people, as important place for food resources and camping. The area has continued to be an important camping and fishing area since European settlement. An area of campgrounds has been lodged for assessment as a Registered Aboriginal Site under the *Aboriginal Heritage Act* (1972).

Aboriginal representatives indicated clearly that they did not support extensive cultural information on signs in the area. However, acknowledgement of the significance of the area to Aboriginal people may be appropriate on signs for other purposes, and in other information resources suggested in this

plan. There is also potential to recognise Aboriginal peoples' connection to the area through other means, such as artwork or design of recreational facilities.

As traditional custodians, Aboriginal people are concerned about declining health of the environmental and should also be given opportunities to contribute to the future management of Toby's Inlet.

Management actions:

CH1.1 In partnership with local Aboriginal people, include reference to traditional custodianship of the waterways and land in development of information resources.

CH1.2 Manage future access in a way that avoids additional disturbance and considers protection of potential sites of Aboriginal significance – however activities of local Aboriginal people, such as fishing, camping, the gathering of bush foods and family recreational and educational activities, should not be restricted by implementation of this plan.

CH1.3 Seek to improve partnerships with the Nyungar community to increase their involvement in the management, protection and restoration of Toby Inlet and the study area.

CH1.4 Consult further with Aboriginal representatives in regard to specific works which result from this plan.

CH1.5 Support programs that engage the Aboriginal community in implementation of works associated with this plan.

5.6.2 Strategy CH2: Conserve historical values

There is a great deal of history associated with the whaling industry and European settlement in the study area. It is important that future generations have access to historical information and that historical sites are maintained.

Management actions:

CH2.1 Identify and ensure appropriate maintenance of sites historical importance.

CH2.2 Develop interpretive material to increase understanding of local history, and to promote, appreciate and access historical sites.

5.7 Governance

Management of Toby Inlet requires leadership which is most appropriately provided by the City. There is strong interest in the management of Toby Inlet from a broad range of stakeholders with varying interests and responsibilities. A collaborative approach to management is needed, that facilitates ongoing input from stakeholders and provides support to active members of the community, in particular the Toby Inlet Catchment Group. Partnerships with researchers are also valuable to improve our understanding of the system, inform management decisions and monitor success or otherwise of management actions.

5.7.1 Strategy G1: Defined and collaborative management

The City has coordinated the development of this WMP, and has overall responsibility for implementation. However other stakeholders have important roles in undertaking and supporting many management actions. Collaboration of stakeholders will therefore be essential to successful future management of the Toby Inlet study area. Major stakeholders and their roles in the future management of Toby Inlet and the study area are summarised in Table 1.

Management actions:

G1.1 City to consider securing management order over waterways and adjacent public lands in study area, to facilitate implementation.

G1.2 Establish a Management Advisory Committee comprised of representatives from the City, Toby Inlet Catchment Group, Department of Water and Environmental Regulation, Department of Biodiversity Conservation and Attractions, Water Corporation, GeoCatch, South West Catchments Council, Aboriginal representatives, and community members.

G1.3 Support the Toby Inlet Catchment Group as active participants in planning, on-ground works, and as a key link to the community.

G1.4 Facilitate the development of locally-active Friends of Toby Inlet groups to advocate and coordinate on-ground work in reserves and on private property.

G1.5 Define and resolve issues around vesting of Unallocated Crown Land.

5.7.2 Strategy G2: Evaluate and adapt management actions

Implementation will require an ongoing process of monitoring and evaluation of outcome, and future management will need to be informed by this proves and by new information gained through research. Long term water quality data is a fundamental tool for defining management issues and assessing outcomes of management. While an established routing monitoring program is in place for Toby Inlet itself, available data for catchment tributaries and groundwater is inconsistent. Biological monitoring approaches are valuable to assess current and future ecological health, and to provide interesting information for the community. Recent sampling of aquatic fauna has helped establish a baseline for future assessment of decline or improvement. Despite the nuisance growth of macroalgae in Toby Inlet, there has been no assessment of species or estimates of biomass.

Management actions:

G2.1 Continue monitoring of water quality in Toby Inlet.

G2.2 Review monitoring requirements for catchment tributaries and groundwater.

G2.3 Support future sampling of aquatic fauna.

G2.4 Undertake assessment of macroalgal growth.

G2.5 Ensure timely reporting of monitoring and research outcomes to the management advisory group.

G2.6 Review future management actions in light of monitoring and research outcomes.

6 Implementation

6.1 Roles and responsibilities

The lead role of the City in the future management of Toby Inlet will be recognised through endorsement and adoption of this WMP. This will task the City with responsibility for coordinating implementation, however key stakeholders will have ongoing roles in many aspects of the WMP. These roles and responsibilities are defined in Table 1.

As captured in action G1.2 a Management Advisory Group is recommended to oversee implementation of this WMP, comprised of representatives from the City, Department of Water and Environmental Regulation, Department of Biodiversity Conservation and Attractions, Water Corporation of WA, GeoCatch, Wadandi representatives and broader community representatives.

6.2 Implementation process

An adaptive process of action planning, works, evaluation and reporting is recommended for the WMP, summarised by Figure 13. The strategies and actions presented provide a basis for planning actions for a specified period of time, dependent on available budgets and identified priorities. This would be a key role of the Management Advisory Group. Outcomes of these actions are measured through adequate monitoring, with results assessed in terms of progress towards the management objectives and vision. Reporting of outcomes to the community is essential to maintain community support and this forum would provide an opportunity to gain input to the next action planning cycle.

Table 1. Key stakeholders for future management of Toby Inlet and main roles and responsibilities.

Stakeholder	**Roles and Responsibilities**
City	Overall implementation of the WMP. Management of reserves. Maintenance of Toby Inlet ocean exchange. Operation of Station Gully culvert. Support to community groups.
Toby Inlet Catchment Group	Undertaking weed control, revegetation and feral animal control activities. Advocating protection and enhancement of Toby Inlet. Representing community interests in future management of Toby Inlet and reserves. Leadership for citizen science opportunities.
South West Boojarah Working Party	Advocating protection and enhancement of Toby Inlet. Providing input ion management decisions to ensure maintenance of cultural values.

	Engagement of Aboriginal people in management decisions and actions.
Department of Water and Environmental Regulation	Monitoring of water quality. Technical contributions to management decisions.
GeoCatch	Support to private landholders to improve land and waterway management in the catchment. Educational programs to minimise nutrient and sediment loads. Education, habitat restoration, and community group support for protection of Western Ringtail Possums.
Water Corporation	Maintenance of Station Gully ocean exchange. Maintenance (ownership) of Station Gully culvert. Managing flooding risk.
Department of Biodiversity, Conservation and Attractions	Coordinate native wildlife management programs and implement recovery plans for native flora and fauna of conservation significance. Provide guidance and direction to community group in relation to the protection and conservation of Western Ringtail Possums. Providing information about native flora and fauna.
South West Catchments Council	Support for funding opportunities.
Friends of reserves groups	Future role in local-level advocacy and management actions.

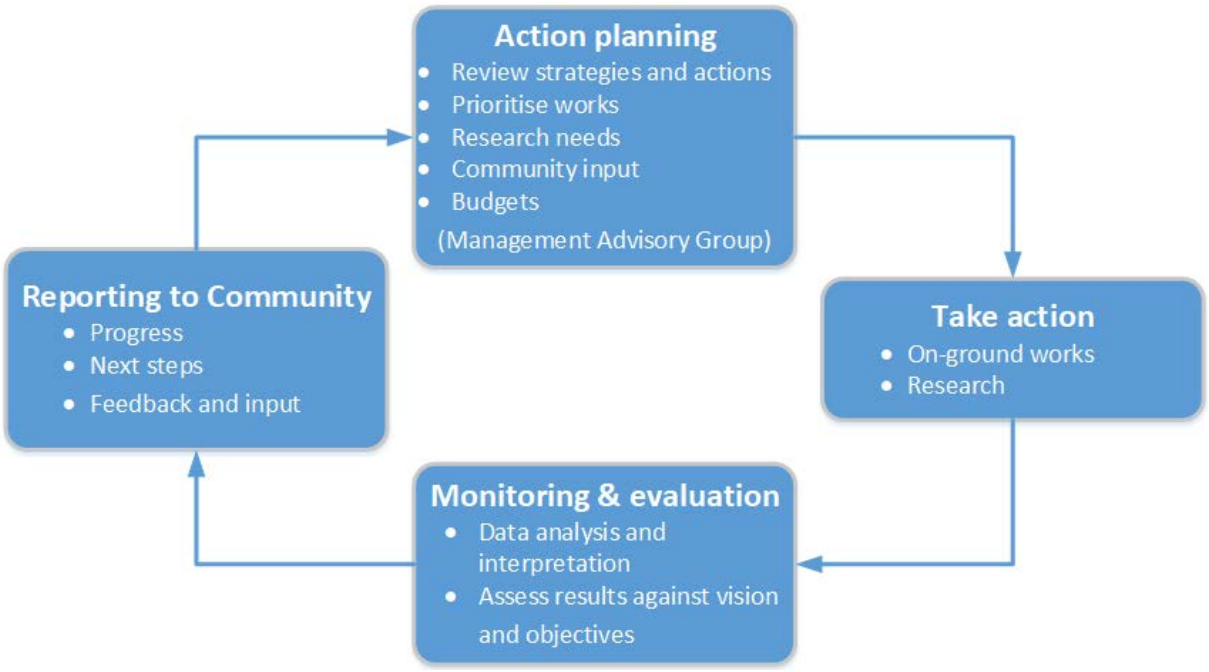


Figure 13. Implementation process for the Toby Inlet Waterway Management Plan.

7 References

Andrew Huffer and Associates (2016) *Report from 'Community Views' session regarding Toby Inlet*. Outputs report for the City.

ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. National Water Quality Management Strategy. Australian and new Zealand Environment and Conservation Council and Agriculture and Resource management Council of Australia and New Zealand.

BoM (2018). Climate data online, http://www.bom.gov.au/climate/data/ Bureau of Meteorology, Australian Government. Accessed 29/06/2018.

Brad Goode and Associates (2018). *Report of an Aboriginal Heritage Survey for the Vasse Wonnerup Wetland Operational Plan and the Lower Vasse River and Toby Inlet Water Management Plans in the City, Western Australia*. Brad Goode and Associates.

Bush, R. T., Fyfe, D. and Sullivan, L. A. (2004) Occurrence and abundance of monosulfidic black ooze in coastal acid sulphate soil landscapes. *Australian Journal of Soil Research* 42: 609-616.

Clay, B. (2002) *Toby Inlet Integrated Catchment Management Plan.* Toby Inlet Catchment Group, Dunsborough.

Clay, B. (2005) *Management Plan for the Toby Inlet Foreshore and Waters*. Toby Inlet Catchment Group, Dunsborough.

Clay, B. and Clay, P. (1996). *Toby Inlet Waterbirds and Forestbirds.* In: Clay, B. T. and Weston, A. S. (1997) *Toby Inlet and Associated Wetlands Draft Management Plan* Sussex Land Conservation District Committee, Busselton.

Comer, S. and Clay, B. (1999) *Toby Inlet and Associated Wetlands Management Plan*. Toby Inlet Catchment Group, Dunsborough.

Department of Water (2010) Vasse Wonnerup Wetlands and Geographe Bay Water Quality Improvement Plan. Department of Water, Government of Western Australia.

DWER (2018) Data extracted from Water Information Reporting Tool. Department of Water and Environmental Regulation. http://www.water.wa.gov.au/maps-and-data/monitoring/water-information-reporting

Ecoedge (2017) *Report of a Flora and Vegetation Survey at Toby Inlet*. Report prepared for the City. Ecoedge, Bunbury.

ENV Australia (2007) *Toby Inlet, Dunsborough Acid Sulphate Soil Investigations* Report prepared for Toby Inlet Catchment Group.

Frazer, J. and Hall, J. (2017) *Reconnecting Toby Inlet: options for increasing water circulation in Toby Inlet to improve water quality – a Revitalising Geographe Waterways Project*, Water Science Technical Series report no. 80, Department of Water and Environmental Regulation, Western Australia.

Hart, B. (2014) Independent Review of the Current and Future Management of Water Assets in the Geographe Catchment, WA: Discussion Document.

Hart, Simpson and Associates (1997) *Toby Inlet Terrestrial Fauna.* In: Clay, B. T. and Weston, A. S. (1997) *Toby Inlet and Associated Wetlands Draft Management Plan* Sussex Land Conservation District Committee, Busselton.

M P Rogers & Associates (1999) Toby Inlet Ocean Entrance Management Study. Report to the Water and Rivers Commission.

Rogers and Associates (1999) *Toby Inlet Ocean Entrance Management Study.* Produced for the Geographe Catchment Council, Shire of Busselton, and the Sussex Land Conservation District Committee. MP Rogers and Associates Pty Ltd.

South West Environmental (2018) *Access Management Plan Toby Inlet, Quindalup.* Report for City.

Streamtec (1997) *Toby Inlet Aquatic Study*. Report ST 268. Streamtec Pty Ltd.

Tweedley. J. R., Cottingham, A., Krispyn, K. N. and Beatty, S. J. (2018) *Influence of bar opening on the fish fauna of Toby Inlet*. Centre for Sustainable Aquatic Ecosystems, Murdoch University.

Western Australian Planning Commission (2008) Better Urban Water Management. Western Australian Planning Commission and Department for Planning and Infrastructure, State of Western Australia.

Weston, A. S. (1997). *Toby Inlet Vegetation and Flora*. In: Clay, B. T. and Weston, A. S. (1997) *Toby Inlet and Associated Wetlands Draft Management Plan* Sussex Land Conservation District Committee, Busselton.

8 Appendices

Appendix 1. Land tenure listing

Current vesting details for public lands in the study area.

TYPE	PIN	RESERVE	CURRENT PURPOSE/LEGAL USE	CURRENT VESTING
Reserve	1039621	23572	RECREATION	City
Reserve	532402	31944	PUBLIC RECREATION	City
Reserve	532412	31944	PUBLIC RECREATION	City
Reserve	11342942	31591	PUBLIC RECREATION	City
Reserve	11767346	46	LANDSCAPE PROTECTION AND	City
Reserve	1341995	26122	PUBLIC RECREATION	City
Reserve	1051637	26122	PUBLIC RECREATION	City
Reserve	532482	26122	PUBLIC RECREATION	City
Reserve	1208973	26122	PUBLIC RECREATION	City
Reserve	1107483	36262	PUBLIC RECREATION	City
Reserve	532377	36262	PUBLIC RECREATION	City
Reserve	532386	36262	PUBLIC RECREATION	City
Reserve	532394	36262	PUBLIC RECREATION	City
Reserve	1153703	45169	PUBLIC RECREATION &	City
Reserve	1112023	46086	PUBLIC RECREATION, DRAINAGE	City
Reserve	1214511	46086	PUBLIC RECREATION, DRAINAGE	City
Reserve	532322	26524	PUBLIC RECREATION	City
Reserve	532329	26524	PUBLIC RECREATION	City
Reserve	532342	26524	PUBLIC RECREATION	City
Reserve	532350	26524	PUBLIC RECREATION	City
Reserve	532494	36429	RECREATION	City
Reserve	1186196	45436	PUBLIC RECREATION	City
Reserve	1215108	45436	PUBLIC RECREATION	City
Reserve	523991	29844	PUBLIC RECREATION	City
Reserve	523992	29844	PUBLIC RECREATION	City
Reserve	523989	37416	WATER SUPPLY	Water Corporation
Reserve	524084	40677	DRAINAGE	Water Corporation
Reserve	1287021	26225	RECREATION & ROAD	DEPARTMENT OF LANDS (SLSD)
Reserve	1034792	32282	DRAIN	DEPARTMENT OF WATER
UCL	11676813			
UCL	1237261			
UCL	11154519			
UCL	11154521			
UCL	11627253			
UCL	11608890			
UCL	11154520			

Appendix 2. Operational Procedures for maintenance of Toby Inlet sand bar

OPERATIONAL PRACTICE AND PROCEDURE

OPENING AND MAINTENANCE OF THE TOBY INLET SAND BAR AND CULVERT

PURPOSE

This document details the procedures that apply to the opening and maintenance of the Toby Inlet sand bar and the culvert between Toby Inlet and Station Gully. The main purposes of opening the sand bar are to improve water quality in the inlet by increasing water flushing and reduce the likelihood of algal blooms and to mitigate flooding risks to neighbouring properties.

OE1.4 Ensure the ocean outlet is kept open through the period from 1 November to 31 April to improve water quality, with a minimum sill height of -0.15m AHD to prevent excessively low water levels.

OE1.5 Open the sand bar during the period 1 May to 31 October if water levels exceed an interim trigger value of 1.3m AHD. The outcomes of this approach will be monitored and management guidelines adapted accordingly.

SPECIFICATIONS

Ocean entrance

Summer – water quality improvement

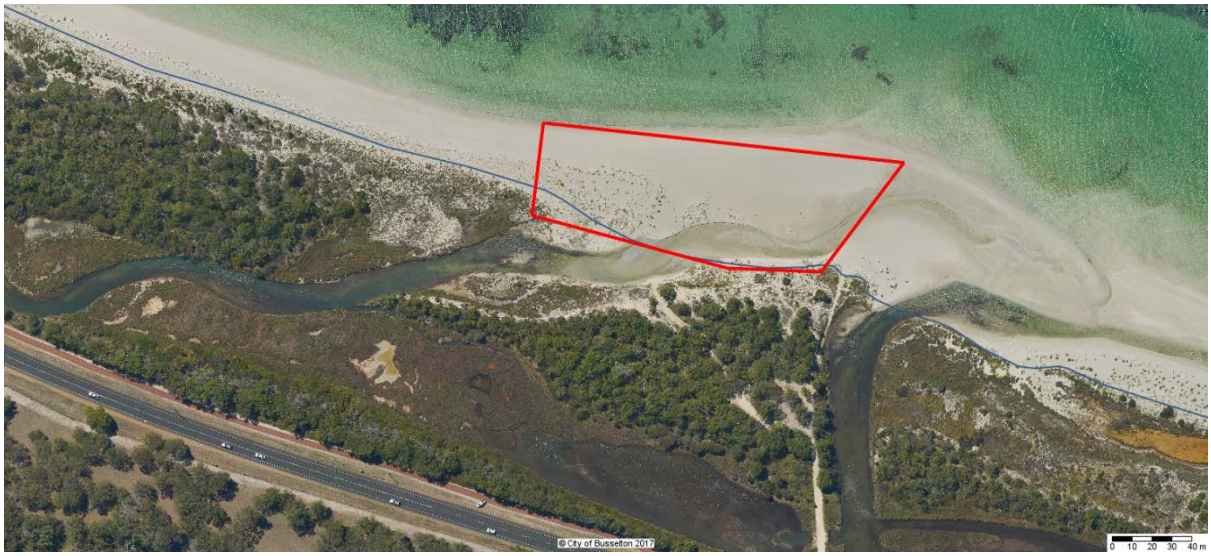
1. The Toby Inlet mouth is maintained open from 1 November to the 30 April at a minimum sill elevation of -0.15m AHD.
2. Opening to be facing approximately 45 degrees eastward, to the width of inlet.
3. Opening to be located in area highlighted in aerial photo below, subject to seasonal varibility of inlet's position.
4. Opening works to coincide with rising tide and greatest tidal variations (as practicable).
5. Sand removed to be deposited to the east of opening and flattened out to not impede access by pedestrians and horses.
6. Machinery to access site via Quindalup boat ramp.
7. Sand bar to be open within two weeks of notification received of it being closed.

Winter – flooding mitigation

1. The Toby Inlet mouth is to be opened when water levels reach 1.3m AHD, causing a potential flooding risk to neighbouring properties and infrastructure.
2. Opening to be located in area highlighted in aerial photo below, subject to seasonal varibility of inlet's position.
3. Opening works to coincide with lowering tide.
4. Sand removed to be deposited to the east of opening and flattened out to not impede access by pedestrians and horses.
5. Machinery to access site via Quindalup boat ramp.

Culvert

1. Culvert between Station Gully drain and Toby Inlet to remain open all year around.



RESPONSIBILITIES

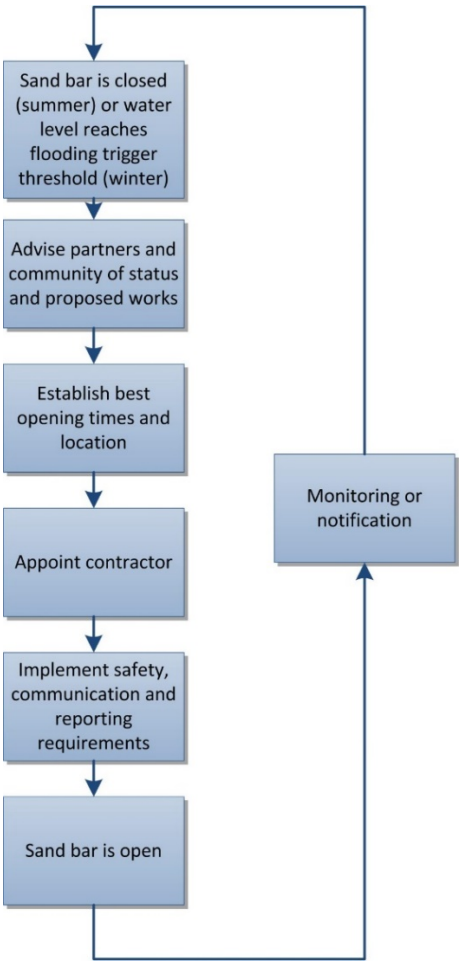
The City is responsible for:

- Monitoring status of the Toby Inlet ocean entrance, with a minimum of a check per fortnight during the period of October to May.
- Organising, supervising and funding the manual opening of the Toby Inlet ocean entrance by machinery as required from October to June.
- Notifying other stakeholders (including the Water Corporation and Department of Water and Environmental Regulations) and the public of upcoming maintenance works.
- Ensuring public safety during operations, including at works site and upstream of Toby Inlet.
- Keep records of sand bar opening times.
- Maintaining the culvert between Toby Inlet and Station Gully in a good state of repair and open all year around.

The Water Corporation and the Department of Water and Environmental Regulations are responsible for:

- Notifying the City if it becomes aware that the Toby Inlet entrance has closed.
- Provide any information that may assist the City in managing the opening of the Toby Inlet ocean entrance.
- Opening Station Gully ocean outlet for flood protection purposes as necessary.

PROCESS TO BE FOLLOWED IF SAND BAR CLOSES (FLOWCHART)



Appendix 3. Plant species found within the Toby Inlet study area

List of vascular flora identified in the study area during survey by Ecoedge (2017)

FAMILY	SPECIES	COMMON NAME	NATURALISED
Aizoaceae	*Carpobrotus edulis*	Hottentot Fig	*
Anacardiaceae	*Schinus terebinthifolius*		*
Apiaceae	*Apium prostratum*	Sea Celery	
Apiaceae	*Centella asiatica*	Centella	
Apiaceae	*Daucus glochidiatus*	Australian Carrot	
Apocynaceae	*Vinca major*	Blue Periwinkle	*
Araceae	*Zantedeschia aethiopica*	Arum Lily	*
Araliaceae	*Hedera helix*		*
Araliaceae	*Trachymene pilosa*	Native Parsnip	
Asparagaceae	*Acanthocarpus preissii*		
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*
Asparagaceae	*Lachenalia bulbifera*		*
Asphodelaceae	*Trachyandra divaricata*		*
Asteraceae	*Carduus pycnocephalus*	Slender Thistle	*
Asteraceae	*Cotula coronopifolia*	Waterbuttons	*
Asteraceae	*Gazania linearis*		*
Asteraceae	*Hypochaeris glabra*	Smooth Cats-ear	*
Asteraceae	*Olearia axillaris*	Coastal Daisybush	
Asteraceae	*Osteospermum jucundum*		*
Asteraceae	*Osteospermum ecklonis*		*
Asteraceae	*Senecio jacobaea*	Ragwort	*
Asteraceae	*Sonchus asper*	Rough Sowthistle	*
Asteraceae	*Symphyotrichum squamatum*	Bushy Starwort	*
Boraginaceae	*Echium plantagineum*	Paterson's Curse	*
Casuarinaceae	*Allocasuarina fraseriana*	Sheoak	
Chenopodiaceae	*Atriplex hypoleuca*		
Chenopodiaceae	*Atriplex prostrata*		
Chenopodiaceae	*Rhagodia baccata*	Berry Saltbush	
Chenopodiaceae	*Salicornia quinqueflora*	Beaded Samphire	
Chenopodiaceae	*Suaeda australis*	Seablite	
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Cupressaceae	*Callitris preissii*	Rottnest Island Pine	
Cyperaceae	*Baumea juncea*	Bare Twigrush	
Cyperaceae	*Carex divisa*	Divided Sedge	*
Cyperaceae	*Ficinia nodosa*	Knotted Club Rush	
Cyperaceae	*Gahnia trifida*	Coast Saw-sedge	
Cyperaceae	*Lepidosperma gladiatum*	Coast Sword-sedge	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	
Dilleniaceae	*Hibbertia cuneiformis*	Cutleaf Hibbertia	
Ericaceae	*Leucopogon parviflorus*	Coast Beard-heath	

FAMILY	SPECIES	COMMON NAME	NATURALISED
Euphorbiaceae	*Euphorbia paralias*	Sea Spurge	*
Euphorbiaceae	*Euphorbia terracina*	Geraldton Carnation Weed	*
Fabaceae	*Acacia cochlearis*	Rigid Wattle	
Fabaceae	*Acacia cyclops*	Coastal Wattle	
Fabaceae	*Acacia littorea*		
Fabaceae	*Acacia saligna*	Orange Wattle	
Fabaceae	*Chamaecytisus palmensis*	Tagasaste	*
Fabaceae	*Dipogon lignosus*	Dolichos Pea	*
Fabaceae	*Hardenbergia comptoniana*	Native Wisteria	
Fabaceae	*Lotus subbiflorus*		*
Fabaceae	*Melilotus indicus*		*
Fabaceae	*Podalyria sericea*		*
Fabaceae	*Templetonia retusa*	Cockies Tongues	
Fabaceae	*Trifolium campestre*	Hop Clover	*
Geraniaceae	*Geranium molle*	Dove's Foot Cranesbill	*
Geraniaceae	*Geranium solanderi*	Native Geranium	
Geraniaceae	*Pelargonium capitatum*	Rose Pelargonium	*
Goodeniaceae	*Dampiera trigona*	Angled-stem Dampiera	
Goodeniaceae	*Scaevola crassifolia*	Thick-leaved Fan-flower	
Hemerocallidaceae	*Dianella revoluta*	Blueberry Lily	
Iridaceae	*Watsonia meriana*	Bulbil Watsonia	*
Juncaceae	*Juncus kraussii*	Sea Rush	
Lauraceae	*Cassytha racemosa*	Dodder Laurel	
Liliaceae	*Lilium* sp.		*
Loganiaceae	*Logania vaginalis*	White Spray	
Moraceae	*Ficus carica*	Common Fig	*
Myrtaceae	*Agonis flexuosa*	Peppermint	
Myrtaceae	*Eucalyptus rudis*	Flooded Gum	
Myrtaceae	*Melaleuca cuticularis*	Saltwater Paperbark	
Myrtaceae	*Melaleuca osullivanii*		
Myrtaceae	*Melaleuca rhaphiophylla*	Swamp Paperbark	
Myrtaceae	*Melaleuca* sp.		*
Myrtaceae	*Melaleuca viminea*	Mohan	
Orchidaceae	*Cyrtostylis robusta*		
Orobanchaceae	*Parentucellia viscosa*	Sticky Bartsia	*
Oxalidaceae	*Oxalis corniculata*	Yellow Wood Sorrel	*
Oxalidaceae	*Oxalis pes-caprae*	Soursob	*
Papaveraceae	*Fumaria muralis*	Wall Fumitory	*
Phyllanthaceae	*Phyllanthus calycinus*	False Boronia	
Plantaginaceae	*Plantago lanceolata*		*
Poaceae	*Ammophila arenaria*	Marram Grass	*
Poaceae	*Austrostipa compressa*		
Poaceae	*Austrostipa flavescens*		
Poaceae	*Avena fatua*	Wild Oat	*

FAMILY	SPECIES	COMMON NAME	NATURALISED
Poaceae	*Briza maxima*	Blowfly Grass	*
Poaceae	*Bromus diandrus*	Great Brome	*
Poaceae	*Lagurus ovatus*	Hare's Tail Grass	*
Poaceae	*Lolium perenne*	Perennial Ryegrass	*
Poaceae	*Piptatherum miliaceum*	Rice Millet	*
Poaceae	*Poa porphyroclados*		
Poaceae	*Sporobolus virginicus*	Marine Couch	
Poaceae	*Stenotaphrum secundatum*	Buffalo Grass	*
Polygalaceae	*Comesperma virgatum*	Milkwort	
Polygonaceae	*Muehlenbeckia adpressa*	Climbing Lignum	
Polygonaceae	*Rumex brownii*	Swamp Dock	*
Ranunculaceae	*Ranunculus muricatus*	Sharp Buttercup	*
Rhamnaceae	*Spyridium globulosum*	Basket Bush	
Rosaceae	*Rosa chinensis* x *multiflora*		*
Santalaceae	*Exocarpos sparteus*	Broom Ballart	
Santalaceae	*Santalum acuminatum*	Quandong	
Solanaceae	*Solanum linnaeanum*	Apple of Sodom	*
Stylidiaceae	*Stylidium adnatum*	Common Beaked Triggerplant	
Thymelaeaceae	*Pimelea argentea*	Silvery Leaved Pimelea	
Typhaceae	*Typha orientalis*	Typha	

Appendix 4. Revegetation species the Toby Inlet study area

Suggested revegetation species for main soil types in the Toby Inlet study area (Ecoedge 2017)

Saline Soils:
Atriplex prostrata
Ficinia nodosa (Knotted Club Rush)
Juncus kraussii (Sea Rush)
Melaleuca cuticularis (Saltwater Paperbark)
Salicornia quinqueflora (Beaded Samphire)
Suaeda australis (Sea Blite)

Loams:
Acacia saligna (Orange Wattle)
Agonis flexuosa (Peppermint)
Eucalyptus rudis (Flooded Gum)
Exocarpos sparteus (Broom Ballart)
Hakea varia
Hibbertia cuneiformis (Cutleaf Hibbertia)
Jacksonia furcellata
Kunzea micrantha
Melaleuca viminea (Mohan)
Spyridium globulosum (Basket Bush)
Viminaria juncea (Swish Bush)

Quindalup Dunes:
Agonis flexuosa (Peppermint)
Spyridium globulosum (Basket Bush)
Acacia littorea
Acacia cochlearis
Hibbertia cuneiformis (Cutleaf Hibbertia)
Leucopogon parviflorus
*Hardenbergia comptoniana (*Native Wisteria)
Lepidosperma gladiatum (Sword Sedge)

Appendix 5. Birds of Toby Inlet and associated wetlands

Bird species reported to occur in the study area, from a survey by Clay and Clay (1996, cited in Comer and Clay 1999).

COMMON NAME	SPECIES NAME
Water Birds	
Hairy-headed Grebe	Poliocephalusi poliocephalus
Australasian Grebe	*Tachybaptus novaehollandiae*
Australian Pelican	*Pelecanus conspicillatus*
Darter	*Anhinga melanogaster*
Little Black Cormorant	*Phalacrocorax sulcirostris*
Little Pied Cormorant	*Phalacrocorax melanoleucos*
White Faced Heron	*Ardea novaehollandiae*
Great Egret	*Egretta alba*
Sacred Ibis	*Threskiornis aethiopica*
Straw-necked Ibis	*Threskiornis spinicollis*
Yellow Billed Spoonbill	*Platalea flavipes*
Black Swan	*Cygnus atratus*
Australian Shelduck	*Tadorna tadornoides*
Pacific Black Duck	*Anas superciliosa*
Grey Teal	*Anas gibberifrons*
Australian Wood duck	*Chenonetta jubata*
Musk Duck	*Biziura lobata*
Pink-eared Duck	*Malacorhynchus membranaceus*
Hardhead	*Aythya australis*
Osprey	*Pandion haliaetus*
Eurasian Coot	*Fulica atra*
Purple Swamphen	*Porphyrio porphyrio*
Hooded Plover	*Charadrius rubricollis*
Black-fronted Plover	*Charadrius melanops*
Greenshank	*Tringa nebularia*
Silver Gull	*Larus novaehollandiae*
Caspian Tern	*Hydropgne caspia*
Crested Tern	*Sterna bergii*
Fairy Tern	*Sterna nereis*
Bush Birds	*Scientific Name*
Black-shouldered Kite	Elanus notatus
Whistling Kite	*Haliastur sphenurus*
Brown Goshawk	*Accipiter fasciatus*
Australian Kestrel	*Falco cenchroides*
Laughing Turtle-dove*	*Streptopelia senegalensis*
Common Bronze wing	*Phaps chalcopterai*
Red-tailed Black Cockatoo	*Calyptorhynchus magnificus*

White-tailed Black Cockatoo	*Calyptorhynchus baudinii/latirostris?*
Red-capped Parrot	*Purpureicephalus spurius*
Western Rosella	*Platycercus icterotis*
Australian Ringneck	*Barnardius zonarius*
Tawny Frogmouth	*Podargus strigoides*
Laughing Kookaburra	*Dacelo novaeguineae*
Sacred Kingfisher	*Halyconi sancta*
Rainbow Bee-eater	*Merops ornatus*
Welcome Swallow	*Hirundo neoxena*
Tree Martin	*Hirundo nigricans*
Richard's Pipit	*Anthus novaeseelandiae*
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*
Scarlet Robin	*Petroica Multicolor*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Grey Fantail	*Rhipidura fuliginosa*
Willie Wagtail	*Rhipidura leucophrys*
Splendid Fairy-Wren	*Malurus splendens*
White-browed Scrub-Wren	*Sericornis frontalis*
Western Gerygone	*Gerygone fusca*
Western Thornbill	*Acanthiza inornata*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Varied Sitella	*Daphoenositta chrysoptera*
Rufous Treecreeper	*Climacteris rufa*
Red Wattle Bird	*Anthochaera carunculata*
Brown Honeyeater	*Lichmera indistincta*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Western Spinebill	*Acnathorynchus superciliosus*
Silvereye	*Zosterops lateralis*
Australian Magpie-Lark	*Grallina cyanoleuca*
Dusky Woodswallow	*Artamus cyanopterus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Gymnorhina tibicen*
Australian Raven	*Corvus coronoides*

Appendix 6. Other Fauna likely to occur in study area

Fauna identified as present or likely to be present in the study area in the survey by Hart et al. (1997)

Frogs		
	Litoria adalaidensis* Litoria moorei* Crinia georgiana Heleioporus eyrie Limnodynastes dorsalis Pseudophryne glauerti Ranidella insignifera	
Reptiles		
Turtle	Chelodina oblonga*	Long-necked turtle
Gecko	Phyllodactylus marmoratus*	
Legless lizards	Aprasia repens Pygopus lepidopodus	
Dragon lizards	Pogona m. minor*	Western bearded dragon
Skinks	Bassiana trilineata* Cryptoblepharus plagiocephalus Egernia kingie* Egernia napoleonis* Glaphyromorphus australis Hemiergis peronei Lerista distinguenda* Menetia greyii* Morethia lineoocellata* Tiliqua r. rugose*	
Monitors	Varanus gouldii Varanus rosenbergi	
Snakes	Ramphotyphlops australis Drysdalia coronate Echiopsis curta Notechis scutatus occidentalis*	 Tiger snake

	Pseudonaja affinis affinia* Rhinocephalus gouldii Rhinocephalus nigriceps	Dugite
Mammals		
	Pseudocheirus occidentalis* Isoodon obesulus* Macropus fuliginosus* Hydromys chrysogaster	Western ringtail possum Southern brown bandicoot Western grey kangaroo Rakali, Water rat
Introduced species		
	Mus musculus* Rattus rattus Vulpes vulpes* Felis catus Oryctolagus cuniculus*	

*Evidence of presence found

Appendix 7. Aquatic invertebrates of Toby Inlet and associated wetlands

Aquatic invertebrates found in Toby Inlet during the two surveys by Streamtec (1997) and Tweedley et al. (2018).

Phylum / Order		Family / Species		Streamtec (1997)	Tweedley et al. (2018)
Nematoda			Nematoda sp.	✓	
Mollusca					
	Gastropoda	Ancylidae	Ferrissia petterdi	✓	
			(?) Fluviopupa sp.	✓	
		Planorbiidae	Physastra sp.	✓	
		Tateidae	Potamopyrgus sp.		✓
	Veneroida	Galeommatidae	Arthritica semen		✓
	Littorinimorpha	Pomatiopsidae	Coxiella striatula		✓
Annelida	Oligochaeta		Oligochaeta spp.	✓	
	Cnidaria			✓	
	Hydrozoa	Hydridae	Hydra sp.	✓	
	Arachnida			✓	
	Acarina		Hydracarina sp.	✓	
	Phyllodocida	Nereididae	Simplisetia aequisetis		✓
	Spionida	Spionidae	Pseudopolydora kempi		✓
	Polychaeta	Capitellidae	Capitella captitata		✓
	Polychaeta	Orbiniidae	Scoloplos normalis		✓
	Canalipalpata	Serpulidae	Ficopomatus enigmaticus		✓
Crustacea					
	Cladocera		Cladocera sp.	✓	
		Daphiidae	Daphinia sp.	✓	
	Ostracoda	Ilyocypridae	Ilyodromas sp.	✓	
			Ostracoda sp.	✓	
	Copepoda	Cyclopoida	Cyclopidae sp.	✓	
		Harpacticoida	Harpacticodae sp.	✓	

	Amphipoda	Gammaridae	Perthia sp.	✓	✓
			Amphipod sp.	✓	
		Aoridae	Grandidierella propodentata		✓
		Melitidae	Barnardomelita matilda		✓
	Decapoda	Palaemonidae	Palaemonetes australis	✓	
		Parastacidae	Cherax quinquecarinatus	✓	
	Isopoda	Armadillidae	Oniscidea sp.		✓
	Malacostraca	Chiltoniidae	Austrochiltonia subtenuis		✓
Crustacea	Mysida	Mysidae	Mysida sp. 1		✓
Insecta					
	Ephemeroptera	Leptophlebiidae	Bilbumena	✓	
		Baetidae	Baetis soror	✓	
		Caenidae	Tasmanocoenis tillyardi (Lestage)	✓	
	Odonata Zygoptera	Coenagriidae	Ischnura aurona	✓	
	Odonata Zygoptera	Coenagriidae	Odonata sp. 1		✓
	Odonata Zygoptera	Coenagriidae	Odonata spp.		✓
	Odonata	Aeshnidae	Austrolestes annulosus		✓
	Anisoptera	Corduliidae	Hemicordulia tau Selys	✓	
	Diptera	Simuliidae	Austrosimulium sp.	✓	
			Simulium ornatipes (Skuse)	✓	
		Ceratopogonidae	Ceratopogonidae sp. F	✓	
		Chironomidae		✓	
			Chironomidae sp. 1		✓
			Chironominae sp. 2		✓
			Chironominae spp.		✓
			Chironominae occidentalis		✓

			Chironominae alternans		✓
			Procladius sp.		✓
		Tipulidae	Tipulidae sp. A	✓	
			Tipulidae sp. B	✓	
			Tipulidae sp. X	✓	
			Unidentified spp.	✓	
		Empidadae	Empididae sp. B	✓	
			Unidentified spp.	✓	
		Culicidae	Culicidae sp. B	✓	✓
			Unidentified sp.	✓	
		Muscidae spp.	Unidentified sp.	✓	
		Stratiomyidae spp.	Unidentified sp.	✓	
		Syrphidae sp.		✓	
		Ephydridae	Ephydridae sp. X	✓	
	Lepidoptera		Lepidoptera sp. X	✓	
			Unidentified sp.	✓	
	Trichoptera	Ecnomidae	Ecnomus pansus/turgidus complex	✓	
			Oecetis sp.	✓	
			Notalina fulva	✓	
Insecta			Triplectides australis	✓	
			Oxyethira retracta	✓	
			Hellethira sp. C	✓	
		Leptoceridae	Notalina spira		✓
	Odonata	Aeshinidae	Aeshinidae sp.		✓
	Hemiptera	Notonectidae	Paranisops sp.	✓	
	Coleoptera		Carabidae sp.	✓	
		Dytiscidae	? Rhantus sp.	✓	
			Necterosoma sp. B	✓	
			Liodesus sp.	✓	
			? Megaporus sp.	✓	
			Platynectes decempunctatus	✓	

			Homeodyetes scutelaris	✓	
			Dytiscid sp. X	✓	
		Hydrophilidae	Hydrophilidae sp. A	✓	
			Hydrophilidae sp. X	✓	
			Hydrophilidae spp.	✓	
			Berosus approximans	✓	
			Berosus sp.	✓	
			Haliplidae sp.	✓	
		Lestidae	Austrolestes annulosus		✓

Appendix 8. Fish survey results 2017-2018

Fish species captured in nearshore and offshore waters of Toby Inlet before (November 2017) and after (March 2018) opening of the sand bar (Tweedley et al. 2018).

Species name	Common name	Estuarine use group*	November 2017	May 2018
Nearshore waters				
Leptatherina wallacei	Western Hardyhead	EF	✓	✓
Atherinosoma elongata	Elongate Hardyhead	E	✓	✓
Pseudogobius olorum	Bluespot Goby	EF	✓	✓
Gambusia holbrooki	Eastern Gambusia	FEO	2.36 ✓	✓
Gambusia holbrooki	Eastern Gambusia	EF	3.24 ✓	✓
Favonigobius lateralis	Southern Longfin Goby	EM	3.10 ✓	✓
Leptatherina presbyteroides	Silver Fish	EM		✓
Amniataba caudavittata	Yellowtail Grunter	E	✓	✓
Pelates octolineatus	Western Striped Grunter	MEO		✓
Mugil cephalus	Sea Mullet	MEO	✓	✓
Rhabdosargus sarba	Tarwhine	MEO	✓	✓
Galaxias occidentalis	Western Galaxias	FEO	✓	
Craterocephalus mugiloides	Spotted Hardyhead			✓
Sillago burrus	Western Trumpeter			✓
Pseudorhombus jenynsii	Smalltooth Flounder			✓
Atherinomorus vaigiensis	Common Hardyhead			✓
Acanthopagrus butcheri	Black Bream		✓	
Offshore waters		**EUFG**		
Mugil cephalus	Sea Mullet	MEO	✓	✓
Amniataba caudavittata	Yellowtail Grunter	E	✓	✓
Acanthopagrus butcheri	Black Bream	E	✓	✓
Aldrichetta forsteri	Yelloweye Mullet	MEO	✓	✓
Pelates octolineatus	Western Striped Grunter	MEO		✓
Rhabdosargus sarba	Tarwhine	MEO		✓
Arripis georgianus	Australian Herring	MEO		✓
Sillago schomburgkii	Yellowfin Whiting	MEO		✓
Pomatomus saltatrix	Tailor	MEO		✓
Gerres subfasciatus	Common Silverbiddy	MEO		✓
Sphyraena novaehollandiae	Snook	MS		✓
Pseudorhombus jenynsii	Smalltooth Flounder	MEO		✓
Nearshore waters				
Leptatherina wallacei		EF	✓	✓
Atherinosoma elongata		E	✓	✓
Pseudogobius olorum		EF	✓	✓
Gambusia holbrooki		FEO	✓	✓
Afurcagobius suppositus		EF	✓	✓
Favonigobius lateralis		EM	✓	✓
Leptatherina presbyteroides		EM		✓
Amniataba caudavittata		E	✓	✓
Pelates octolineatus		MEO		✓
Mugil cephalus		MEO	✓	✓

Rhabdosargus sarba		MEO	✓	✓
Galaxias occidentalis		FEO	✓	
Craterocephalus mugiloides				✓
Sillago burrus				✓
Pseudorhombus jenynsii				✓
Atherinomorus vaigiensis				✓
Acanthopagrus butcheri			✓	
Offshore waters		**EUFG**		
Mugil cephalus		MEO	✓	✓
Amniataba caudavittata		E	✓	✓
Acanthopagrus butcheri		E	✓	✓
Aldrichetta forsteri		MEO	✓	✓
Pelates octolineatus		MEO		✓
Rhabdosargus sarba		MEO		✓
Arripis georgianus		MEO		✓
Sillago schomburgkii		MEO		✓
Pomatomus saltatrix		MEO		✓
Gerres subfasciatus		MEO		✓
Sphyraena novaehollandiae		MS		✓
Pseudorhombus jenynsii		MEO		✓

* Estuarine usage functional groups: E, solely estuarine; MEO, marine estuarine-opportunist; MS, marine straggler; FEO, freshwater estuarine-opportunist; EF, estuarine & freshwater; E, solely estuarine; EM, estuarine & marine; MEO, marine estuarine-opportunist)

Appendix 9. Access Management Plan for Toby Inlet

Access Management Plan

Toby Inlet, Quindalup

JUNE 2018

SW environmental

Photo: Toby Inlet

Version control

Project number:	SW175			
Project file path:	SW175 Toby Inlet access planning			
Client:	City of Busselton			
Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
V1.1	19/06/18	Shane Priddle SW Environmental	Robyn Paice (City of Busselton)	Shane Priddle SW Environmental
V1.0	14/06/18	Shane Priddle SW Environmental	Robyn Paice (City of Busselton)	Shane Priddle SW Environmental

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Contents

Executive Summary

The City of Busselton ('the City') is preparing a Water Management Plan for Toby Inlet and required a conceptual plan for improving access and recreation facilities around Toby Inlet. The vision for the management plan is "*A healthy waterway and fringing vegetation that is actively managed, protected, valued and enjoyed by the community*". One of the key management strategies is to improve access and facilities for community enjoyment that incorporate appropriate rehabilitation measures such as weed control, revegetation and erosion control.

This Access Management Plan has been prepared in consideration of the above and to meet the required scope of work. The study area includes the areas of Toby Inlet from the south western corner of the Palmers Estate downstream to the foot bridge crossing on Caves Road just east of the residential area of Quindalup. There was a preference to focus on the northern side of Toby Inlet.

This Access Management Plan for Toby Inlet categorised the Toby Inlet reserve into four access management precincts:

- **Vegetated areas (no tracks):** Areas of intact remnant native vegetation where there are no access tracks or only small foot tracks through vegetation. They often extend from the private property areas all the way to the foreshore vegetation or high water mark. Native vegetation has a high biodiversity conservation value and tracks should be generally avoided in these areas. Without clearing, these areas do not require any further attention.
- **Vegetated areas (existing tracks):** Areas consisting of intact remnant native vegetation with existing tracks. Tracks often link up sections of other precincts, such as street parking to foreshore parklands, or have been constructed as fire breaks. With the exception of the Geographe Bay foreshore path and footbridge east of Geographe Bay Road, most of these tracks are in need of maintenance or could be improved with either a 1.2m red hot mix seal in high traffic areas or at flood risk (e.g. foreshore areas) or compacted limestone along the firebreaks.
- **Parkland cleared (existing constructed tracks or maintained grassy areas):** Extensive sections of foreshore that have been cleared and are subject to ongoing maintenance (e.g. mowing). They are typically located in high use areas and would be ideal public parks. The construction of formal pathways following the contour of the inlet edge would encourage public use of these areas, are in close enough proximity to parking to be ideal locations for recreational infrastructure such as tables, barbeques, an outdoor class room or other passive recreation features. Additional parking may be required at these locations and should be considered in line with any infrastructure improvements. These existing high use areas are also typically the areas that are most degraded along the inlet banks. The loss of riparian vegetation has had numerous negative effects on the overall health of the inlet.
- **Private property access only:** Extended areas of foreshore reserve that are only able to be accessed by the adjacent private landowners. As these areas were not able to be accessed they were not surveyed in detail, nor is a pathway likely to be suitable.

Each precinct has unique opportunities to improve access and associated infrastructure (recreation facilities) around Toby Inlet. Site specific recommendations have been made in Appendix A including existing access, and recommended weed control, revegetation and erosion control. Additional opportunities including canoe access points, a boardwalk and clearing for new tracks was also discussed and could further enhance the existing Toby Inlet reserve.

A continuous pathway along the inlet could be achieved between Mc Dermott Street and Campion Way (approximately two kilometres) with the recommendations made in this report. Apart from the far western section around Palmers, Wilson Avenue and some isolated locations (e.g. Bloor Street) the other areas are inaccessible due to private property and/or vegetation.

1 Introduction

1.1 Background

The City of Busselton ('the City') is preparing a Water Management Plan for Toby Inlet and required a conceptual plan for improving access and recreation facilities around Toby Inlet.

The vision for the management plan is "*A healthy waterway and fringing vegetation that is actively managed, protected, valued and enjoyed by the community*".

One of the key management strategies is to improve access and facilities for community enjoyment that incorporate appropriate rehabilitation measures such as weed control, revegetation and erosion control.

Public consultation has shown very clearly that management should focus on encouraging passive recreation, and on improvements to existing access rather than increasing accessibility. There is also a perception that access pathways should act as barriers for protection of foreshore vegetation. The draft management actions for the management plan in relation to this are to develop and assess options for low-key access and recreation facilities in the area, such as:

- Install BBQ and seating at McBride Park or Wilson Avenue.
- Formalise carpark and access ways to horse beach, and improve signage.
- Provide some bird information and seating in appropriate, quiet areas.
- Investigate need for and location of bird hide.
- Enhance habitat for birds in connection with bird watching sites.
- Provide appropriate canoe-launching access at Mc Quade Park and address existing erosion.
- Improve existing walkways, and use these as reserve boundaries to protect fringing vegetation.
- Manage firebreak as bike access way.
- Determine requirements of additional parking in support of improved facilities.

This Conceptual Access Plan or 'Access Management Plan' has been prepared in consideration of the above and to meet the scope of work outlined below.

1.2 Scope of works

The study area includes the areas of Toby Inlet from the south western corner of the Palmers Estate downstream to the foot bridge crossing on Caves Road just east of the residential area of Quindalup. There was a preference to focus on the northern side of Toby Inlet. The study area is shown in Figure 1-1.

The scope of the consultation is to:

1. Review of 2017 vegetation survey as it relates to weed mapping and vegetation condition within the project area.
2. On-site meeting with City officer to discuss project.
3. Site survey to ground-truth existing pathways and access.
4. Recommendations for improvements to:
    - access pathways,

- canoe-launching area/s (provide ideas and examples for this),
- bird watching places,
- resting and observing areas.

5. Identify any requirements for weed control, erosion control and revegetation associated with these improvements. Note these will be generally high level, as in recommending areas that require these actions, rather than identifying site specific, prescriptive actions on how to undertake the actions.
6. Digitising of existing access, pathways, facilities, and recommendations.
7. Preparation of maps that clearly show existing features and recommendations.
8. A brief report that:
   - describes existing access/facilities,
   - outlines the recommendations and rationale,
   - links recommendations to maps.

Mapping layers will be provided as PDF in the report and as ESRI shapefiles.

Figure 1-1 Toby Inlet study area

2 Methods

This Access Management Plan was prepared based on desktop review and ground truthing.

2.1.1 Desktop review

Recent high resolution aerial photography (provided by the City of Busselton, 2018) was reviewed over the study area and potential tracks and lineal areas of vegetation disturbance digitised for follow up ground truthing. As many areas across the study area back onto private property with limited public access, this was useful to determine general land use and existing access opportunities.

A flora and vegetation report (Ecoedge 2017)[1] was also commissioned by the City for the broader study area. The flora and vegetation report results (vegetation types, condition and weeds and recommended revegetation locations) were reviewed, summarised in Section 3.2, and considered in the preparation of this Access Management Plan.

2.1.2 Ground truthing

The mapped areas were ground truthed by walking over the site on foot and investigating some inaccessible areas by drone (DJI Mavic Pro). A site meeting was carried out with Robyn Paice (Senior Environment Officer, the City) on 4th May and follow up fieldwork was carried out over two days by SW Environmental on 11th and 12th June 2018.

2.1.3 Limitations

Some areas were unable to be accessed due to a combination of the high water level at the time of the survey, heavy vegetation or tenure issues (private land uses or property restricting access). The high water level was due to the inlet not being open and an accumulation of water following seasonal rains. Some seasonally accessible low laying tracks may have been missed in this report. Whilst high water levels restricted access, it also provided insight as to where any access tracks and other recreational infrastructure may not be suitable or would be under water if constructed.

Heavy vegetation was not considered to be a constraint in terms of access. The management actions outlined a clear preference *to improvements to existing access rather than increasing accessibility* and *protection of foreshore vegetation*. These areas were therefore not considered further for access.

Private property backs onto the Toby Inlet along extended sections, with fencing, clearing and retained remnant native vegetation extending right to the Inlet itself (often within the reserve). For the most part, other than direct access from an adjacent house, there are no existing pathways along these sections nor would future proposed paths likely to have the support of the adjacent landowner.

The underwater, vegetated and restricted access locations throughout the study area are generally not considered appropriate for pathways in line with the management plan actions and scope of work.

[1] Ecoedge (2017) Report of a Flora and Vegetation survey at Toby Inlet. Unpublished report to the City of Busselton.

3 Results

3.1 Existing environment and tenure

The 47 ha study area is located along the Toby Inlet, a 118 ha low energy coastal lagoon that meanders from the eastern edge of the Dunsborough Township east to the mouth at Geographe Bay. It is formed from the flooding and drainage of low laying sumplands south of Caves Road. The study area comprises a combination of Crown Land and reserves vested in or managed by the City.

The residential locality of Quindalup is located between Toby Inlet and the Geographe Bay foreshore. It is long and narrow in extent, well less than 100m wide at some locations, with many of the residential properties backing directly onto the reserves associated with the inlet. Historic pressures from with local development and secondary uses relating to the recreational opportunities offered by the inlet (access, water sports, fishing, picnics, water craft launching etc) have created additional pressures on the inlet, such as impacts to foreshore riparian vegetation and bank stability. A general background on Toby Inlet and land uses will be addressed in more detail in the Water Management Plan.

3.2 Vegetation (including weeds)

Ecoedge (2017) carried out a flora and vegetation report which is useful in identifying

- areas of intact vegetation or areas of conservation significance that should be avoided in terms of access,
- areas that are already cleared or degraded,
- areas of weeds that will require management.

A summary of the flora and vegetation report (Ecoedge 2017) is provided below. One hundred and four vascular plant taxa were recorded for the survey area, almost 50% were naturalised, planted, or non-locally native species. The high proportion of non-native species reflects the long disturbance history of much of the vegetation, the degree of urbanisation, and the narrow width of much of the inlet foreshore reserves.

Of the non-native species, 14 were considered potential or actual environmentally significant weeds. Two groups of weeds ("mixed agricultural weeds" and "mixed garden escapees") were recorded; those that have probably been present in the native vegetation for 100 years or more (e.g. Bridal Creeper, Blue periwinkle, Arum Lily, Onion Weed and Hare's Tail Grass) and are more or less naturalised, and those that are more recent garden escapees such as *Dimorphotheca ecklonis* (Cape Daisy) and *D. juncundum* (African Daisy) an *Lilium* spp. which are seen invading the surrounding bushland from gardens established on Crown land adjacent to the inlet. Weeds are shown in Appendix A where they should be considered in context of access management.

No State or federal listed threatened flora, Priority flora or other flora of conservation significance were found. Several Environmentally Sensitive Areas (ESAs) have been designated within the survey area associated with the Toby Inlet, which is classified as a Conservation Category wetland.

Nine native vegetation units were recognised, six of them part of the Vasse Complex (Wetland and Estuarine Fringe Vegetation units) and three of them in the Quindalup Complex (Beach and Dune Vegetation units). Four other non-native or planted vegetation units were also mapped (**Ammophila arenaria* – *Spinifex hirsutus* grassland, Plantation (Amenity plantings), Heavily Disturbed Area (includes lawn areas with scattered *A. flexuosa* or *Melaleuca* spp.), and Water (Toby Inlet)).

About 35.5 ha of Quindalup Complex vegetation was mapped in the survey area, most of it in Very Good or Excellent condition. Two of these vegetation units fit the diagnostic criteria of the Federally-listed Threatened ecological community "Subtropical and Temperate Coastal Saltmarsh", which is also listed as a Priority 3 ecological community at the State level. In particular, *Salicornia quinqueflora* low shrubland and *Juncus kraussii-Ficinia nodosa* closed sedgeland fit within the Coastal Saltmarsh TEC criteria. There was 5.7 ha of Coastal Saltmarsh TEC (comprised of the above two vegetation units) in the survey area, most of it in Good or Very Good condition.

Just over 40% of the remnant vegetation within the survey area was classified as "Very Good" or "Excellent" condition. These areas were mainly in the eastern part of the survey area on Crown reserves (A class reserve No. 46 and Sussex lots 4748 and 4857). Almost all of the remnant native vegetation on privately owned land south of Caves Road was classed as "Degraded".

A regional ecological linkage runs through the survey area for much of its length (Molloy et al 2009)[2]. As a result of the location of this linkage, survey area vegetation has been assigned proximity rating values of 1a, 1b and 1c, which are the three highest ratings.

Ecoedge (2017) identified areas that would benefit from revegetation, associated with where the Toby Inlet crosses Caves Road. These are shown in Appendix A. They are broad scale (only areas over 1500 m^2 are mapped) and best adopted separately to this Access Management Plan. Finer scale recommendations are addressed further in this document (Sections 3.3, 3.4 and Appendix A).

In addition to the conservation values highlighted by Ecoedge (2017) several threatened fauna may also utilise the site for habitat and as an important connection along the inlet foreshore, including the Critically Endangered Western Ringtail Possum (WRP).

3.3 Existing access, infrastructure and opportunities

Throughout the Toby Inlet reserve, existing access types are generally reflective of current foreshore usage patterns and demand. Built up areas typically have more frequent visitors, a higher need for formalised access and require management intervention the most. Long term trends of population increase are likely to result in higher foreshore usage and access requirements. This has been considered in relation to opportunities in this Plan.

3.3.1 Existing access and opportunities

There are numerous existing pathways from formal vehicular tracks and firebreaks, concrete paths, cleared and maintained parkland areas to informal access through native vegetation. Considering access types the study area can generally be broken up into several management precincts:

- Vegetated areas (no tracks),
- Vegetated areas (existing tracks),
- Parkland cleared (existing constructed tracks or maintained grassy areas),
- Private property access only.

These are mapped in Figure 3-1 (detailed in Appendix A) and are described below. Additional location specific recommendations, such as track closures and revegetation opportunities are also made in the Appendix.

[2] Molloy, S., Wood, J., Hall, S., Wallrodt, S. and Whisson, G. (2009) *South West Regional Ecological Linkages Technical Report*, Western Australian Local Government Association and Department of Environment and Conservation, Perth.

Figure 3-1 Toby Inlet access management precincts

Vegetated areas (no tracks)

These areas consist of intact remnant native vegetation where there are no access tracks or only small illegal foot tracks through vegetation. They often extend from the private property areas all the way to the foreshore vegetation or high water mark. Native vegetation has a high biodiversity conservation value and tracks should be generally avoided in these areas. For the most part these areas do not require any further attention other than small illegal foot tracks.

Vegetated areas (existing tracks)

These areas consist of intact remnant native vegetation with existing tracks. Tracks often link up sections of other precincts, such as street parking to foreshore parklands, or have been constructed as fire breaks. Typical examples include

- the 1.2m sealed access to the foreshore from Geographe Close and Stone Street (Maps 5 and 6),
- the 3m wide emergency access to the foreshore from Lagoona Place (Map 6),
- the degraded 1m sealed access to the foreshore from Robbies Close (Map 7),
- the fire trail linking the foreshore to Geographe Bay Road east of Robbies Close (Map 7),
- the unsealed 3m wide firebreak from the Dunsborough Boat Club overflow carpark to Campion Way (Map 7 and 8),
- the existing Geographe Bay foreshore walk and footbridge east of Geographe Bay Road (Map 12).

With the exception of the Geographe Bay foreshore walk and footbridge east of Geographe Bay Road, most of these tracks are in need of maintenance or could be improved with either a 1.2m (or City standard) red hot mix seal in the high traffic areas or those at risk of flooding (e.g. foreshore areas), or compacted limestone along the firebreaks. Formalising tracks would encourage use and contain potential impacts that might otherwise occur (e.g. minimise trampling along the edges). Some existing areas need to be repaired (e.g. existing concrete path south of Geographe Close, shown in Figure 3-2). Location specific management recommendations are provided in Appendix A.

Figure 3-2 Existing path south of Geographe Close needing repair.

Figure 3-3 Existing path near Stone Street requiring maintenance.

Figure 3-4 Emergency access off Lagoona Place that could be improved with new hot mix.

Figure 3-5 Firebreak from the Boat Club overflow carpark to Campion Way that could be formalised with compacted limestone.

Parkland cleared (existing constructed tracks or maintained grassy areas)

These include extensive sections of foreshore that have been cleared and are subject to ongoing maintenance (e.g. mowing). They are typically located in high use areas and would be ideal public parks. Examples include

- the parkland at Wilson Avenue (currently no pathway),
- Campion Way (Mc Quade Park) (currently no pathway),
- the area west of Palmers Estate (low use) (grass pathways / firebreaks),
- the resort areas off Lagoon Place and south of Robbies Close (existing 1.2m pathway), and
- the grassy area at Bloor Street (currently no pathway).

The construction of formal pathways following the contour of the inlet edge would encourage public use of these areas, are in close enough proximity to parking to be ideal locations for recreational infrastructure such as tables, barbeques, an outdoor class room or other passive recreation features. Pathways can also provide boundaries for protection of foreshore vegetation. Additional parking may be required at these locations and should be considered in line with any infrastructure improvements.

These existing high use areas are also typically the areas that are most degraded along the inlet banks. The loss of riparian vegetation has had numerous negative effects on the overall health of the inlet, including but not limited to

- Loss of bio filter mechanism (plants) for sediments and pollutants entering the inlet from upslope,
- Increased erosion (the areas with no vegetation stabilising the bank are those with the most erosion issues),
- Loss of habitat connectivity (particularly important for fauna such as WRP).

The areas between the existing / proposed tracks should be revegetated, with occasional trees but low sedges such as coastal sword-sedge (*Lepidosperma gladiatum*) or local provenance wetland species. It may be important to maintain a balance between the existing visual amenity of the inlet as an asset, given that some areas have already been cleared.

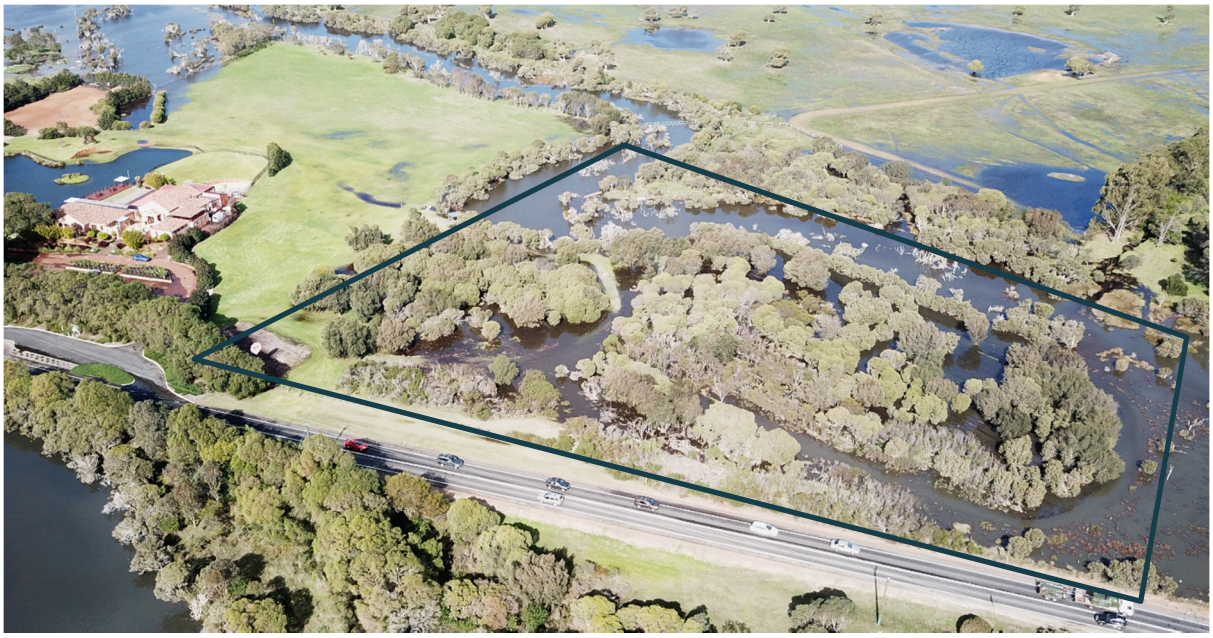

Figure 3-6 Caves Road, Palmers Estate to the left and the section of Toby Inlet outlined within the study area in the mid ground. Note although flooded in this picture there are extensive mowed grassy walkways that could be formalised with crushed limestone.

Figure 3-7 Maintained parkland at Wilson Avenue where a defined pathway would define the reserve boundary and protect fringing vegetation.

Figure 3-8 Example of erosion at Mc Quade Park (Campion Way) due to loss of stabilising foreshore vegetation.

Figure 3-9 Example of erosion at Mc Quade Park (Campion Way) due to loss of stabilising foreshore vegetation.

Figure 3-10 Cleared area off Bloor Street.

Figure 3-11 Cleared area off Bloor Street showing clearing from adjacent landowner and fencing to the water edge.

Private property access only

There are extended areas of foreshore reserve that are only able to be accessed by the private landowners that back onto it. This is either due to

- Inappropriate management by adjacent landowners (e.g. Figure 4-10 above) where through fencing or personal use of the reserve, public access is difficult or discouraged,
- Restricted access due to terrain, narrow foreshore reserve, or sections of intact vegetation or other obstacles (such as high water level).

As these areas were not able to be accessed they were not surveyed in detail, nor is a pathway likely to be suitable.

These areas will be a challenge to the City in terms of ensuring appropriate foreshore management and will likely be addressed in the broader Water Management Plan. There are several sections that could be used by the public where a landowner(s) could be contacted, but in isolation and without connectivity to other pathways, they are limited in what they can offer in this Plan.

Figure 3-12 Example of restricted access and private property adjacent to the reserve.

3.3.1 Additional existing infrastructure and opportunities

Existing

Additional existing recreational infrastructure noted during fieldwork included passive infrastructure elements that may improve the recreational experience associated with the access, or that may encourage access by enriching the foreshore environment.

Existing additional infrastructure is very limited along the foreshore, to the point of being neglected. This is probably due to low use historically coupled with low demand for new infrastructure. Existing infrastructure observed in relation to the foreshore access, included (refer to Appendix A for waypoint locations):

- Bird hide (WP 1)[3] (Map 1)
- Foot bridge (WP 2)[3] (Map 1)
- Bench seat (WP 3) (Map 3)
- Seat (WP 4) (Map 6)
- Water taps (WP 5, 6, 7) (Map 9)
- Derelict table (WP 8) (Map 9)
- Bench seat (WP 9) (Map 9)

These are shown in the photos below. There are a number of pontoons and other informal structure private property structures that may require inspection and assessment by the City as to whether they should be removed due to a public liability risk (risk delegation signage might be more appropriate than removal).

[3] Note these are outside or on the edge of the study area or within other insecure tenure.

Figure 3-13 Bird hide (WP 1)

Figure 3-14 Foot bridge (WP 2)

Figure 3-15 Bench seat (WP 3)

Figure 3-16 Seat (WP 4)

Figure 3-17 Bench seat (WP 9)

Figure 3-18 Derelict table (WP 8)

Opportunities

There are opportunities for the development of new low key infrastructure to enhance the foreshore and encourage public access. Examples include (see Appendix A):

- Wilson Avenue: Barbeque or picnic table within the parkland at Wilson Avenue.

- WP 10: Bird hide (easy access, good cover and existing bird attracting snags within the inlet. Drawback would be possible low water level during summer months).
- WP 11: Bench seat or bird hide (easy access, good cover and though a lack of existing snags within the inlet and possible low water level during summer months).
- Resort area between Geographe Close and Stone Street Bench: add bench seat.
- End of Stone Street (WP 12): Add compacted ramp for canoe access or fishing, otherwise close off and revegetate.
- Parkland area off Lagoona Place (WP 13): Add seat / table in the park areas, and consider fishing platform (stabilised bank) along a small section of degraded bank.
- Track off Campion Way (WP 14): Add compacted ramp for canoe access or fishing, otherwise close off and revegetate.
- Mc Quade Park (Campion Way): Barbeque or picnic table within the parkland. Consider fishing platform (stabilised bank) along a small section of degraded bank. Formalise a canoe launching area in the eastern edge of the park (where there is existing scouring of the bank). Remove bollards and add parking bays at the eastern end of the park.

Foreshore access from public roads are typically hard to find and should be clearly sign posted. Access points along the cul de sacs would benefit most from this:

- Mc Dermott Street
- Geographe Close
- Stone Street
- Whatman Street
- Lagoona Place
- Bloor Street

3.4 Other opportunities

Other opportunities for further consideration include canoe access points, a boardwalk around areas of limited access, and clearing for the construction of new tracks.

3.4.1 Canoe access points

Formal canoe (or equivalent such as stand up paddleboard) access points are required at different locations along the Inlet. Canoes appear to be being launched at several locations including Mc Quade Park (within the eroded area at the eastern edge of the park), Stone Street and off Campion Way.

Given the demand for use at these locations it is recommended that all of these locations are formalised. A formal entry point should consider the following:

- Close access to parking,
- Located downstream enough so that water levels are adequate for most of the year,
- Ensure the natural bank is stabilised,
- Ensure construction materials will withstand periodic inundation,
- Include appropriate signage,
- Alternative use as a fishing platform.

Figure 3-19 Examples of stepped retaining walls that could be enlarged for canoe access, or as a fishing platforms in degraded areas.

Figure 3-20 Example of graded access to the water mark. Note that retaining walls would still be required at the bank cutting. Source: https://www.lcfpd.org/launches/

3.4.2 Boardwalk

The construction of timber boardwalks, whilst generally out of the scope of this consultation, should be considered in areas where there is

- Dense vegetation or private property along the foreshore limiting foreshore access,
- High scenic quality,
- Tracks would contribute to connecting other access areas and improve the overall value of the foreshore,
- Could be also used as a fishing platform.

These are low key features, relatively cheap to build, with low construction impacts if constructed during summer low water level months (with little or no clearing required). They have been adopted with high success by other local governments in high value sensitive coastal lake locations such as Bottom Lake, Merimbula (Bega Valley Shire Council) (see Figure 3-21) and Narooma Foreshore (Eurobodalla Shire Council). A starting point for the installation of a boardwalk might be the 100m and 70m private property sections between Stone Street and Lagoona Place, which would then enable a continuous pathway of about two kilometres long.

Figure 3-21 Boardwalk examples around Bottom Lake, Merimbula

3.4.3 Clearing

The clearing of native vegetation for the purposes of walking tracks is generally exempt from requiring a clearing permit under the walking tracks exemption (*Regulation 5, Item 13* of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*). This exemption however does not apply in Environmentally Sensitive Areas (ESAs) such as the mapped Conservation Category wetland section of Toby Inlet. Clearing that is not exempt requires a clearing permit in accordance with the *Environmental Protection Act 1986*.

Whilst there is a general preference to avoid native vegetation in line with the Toby Inlet draft management actions, low impact clearing could be carried out at specific locations

- To maintain continuity and connectivity of the existing track network, thereby improving the overall value and usage of the asset,
- Control impacts to native vegetation, e.g. provide a formal, controlled access to the foreshore where existing access has been informally achieved. In some cases if there has been informal access then there may be a demand to access the foreshore at that location.

An example would be the construction of a pathway along Campion Way road reserve linking Mc Quade Park to the east to the existing pathway off Campion Way to the Boat Ramp parking lot. Low impact clearing of sword sedge would be required.

Figure 3-22 Clearing required for a pathway along the southern Campion Way roadside (see red line).

4 Conclusions

Toby Inlet reserve was categorised into four access management precincts:

- Vegetated areas (no tracks)
- Vegetated areas (existing tracks)
- Parkland cleared (existing constructed tracks or maintained grassy areas)
- Private property access only

Each type has unique opportunities to improve access and associated infrastructure (recreation facilities) around Toby Inlet. For at least some locations the recommendations associated with these opportunities could be implemented relatively easily to meet the Water Management Plan vision of "*A healthy waterway and fringing vegetation that is actively managed, protected, valued and enjoyed by the community*".

A continuous pathway along the inlet could be achieved between Mc Dermott Street and Campion Way (approximately two kilometres). Apart from the far western section around Palmers, Wilson Avenue and some isolated locations (e.g. Bloor Street) the other areas are inaccessible due to provide property and/or vegetation. Site specific recommendations have been made in the Appendix including existing access, recommended weed control, revegetation and erosion control. Additional opportunities including canoe access points, a boardwalk and clearing for new tracks was also discussed and could further enhance the existing Toby Inlet reserve.

Appendix A Access Management Maps (2018)