

WATERSHED Torbay



Watershed Torbay Catchment Restoration Plan

APRIL 2005

PREFACE

The Watershed Torbay Catchment Restoration Plan is prepared following community concern about the deteriorating health of the Torbay catchment located on the South Coast of Western Australia. The Torbay Catchment Group, in partnership with the Department of Environment, was successful in application for funding through the National Rivers Consortium as one of two demonstration catchments in Australia. The key expected demonstration value of the Watershed Torbay project was to develop an understanding of catchment processes through research and community consultation leading to preparation of a whole of catchment management plan for restoration or environmental health values, particularly for waterways and wetlands.

The Restoration Plan is based on a partnership approach linking community interest with government, industry and research organisations. Documentation of the plan that follows here is presented in a strategic format that is intended to be used by the partner organisations to set priorities, attract funding and implement the actions of the plan.

Section A provides background information about the catchment, the community and the range of issues to be addressed to improve the health of the catchment.

Section B provides the strategic framework for targeted investment in resource condition change. Analysis of relevant research information links the aspirational goals and objectives identified by the community with Resource Condition Targets for seven Management Themes. The RCT's provide a measure of what may reasonable be expected to be achieved within approximately 20 years through investment into the proposed actions.

Section C identified the actions required. These are listed in order to achieve Management Action Targets. The MAT's are set for approximately 5 years and are intended to focus the proposed actions on achievement of resource condition change.

Section D provides a framework and set of indicators for monitoring and evaluation of the Restoration Plan. The framework is focused on processes of adaptive management.

The Torbay Catchment Group will lead in implementation of the Watershed Torbay Catchment Management Plan through arrangements with its partner organisations.

FOREWORD

We all love living in the Torbay area with its temperate climate, safe environment, wonderful coastline and relaxed rural lifestyle. Torbay has the advantages of being close to services in both Albany and Denmark while not being threatened by any large scale development. Our clean, fresh air is regarded as amongst the best in the world, free of industrial pollution and full of goodness from the Southern Ocean air flows. Many of us enjoy the close contact with nature, being able to grow some of our own food, having safe space around us and for our children to grow up in, as well as the caring friendliness of neighbours and the local community.

We must recognise that some of our past and current practices are impacting on the quality of the environment. There are problems with poor water quality in our creeks, wetlands, lakes and inlets leading to increasing algal blooms; damage from recreational use especially on the fragile coastal hills, erosion in drains and creeks, acidity and water logging of soils and salinity in the upper catchment.

There are additional pressures likely in the near future. The Marbelup Brook has been identified as the preferred next major source of public water supply for the City of Albany. The Albany irrigated tree farm, located in the upper catchment, is reaching its capacity to treat the City of Albany's waste water. Increasing numbers of people are moving into the area putting more pressure on resources which demands good planning. As well, there are increasing sources of nutrients from agriculture and urban development.

It is important to recognize the valuable assets in the catchment, the resources we use, the aspects we treasure and our historical links. If we truly value the assets, we need to work out how to protect them and to urgently start to repair the often unforeseen damage that has occurred in the past and before things get any worse.

This Watershed Torbay Catchment Restoration Plan is an attempt to do just that. It has been the result of the work of a dedicated group of local residents and agency representatives working together over the past four years with significant input from many of you. Thanks go to the Watershed Torbay Steering Committee, the Technical Advisory Group, the Drainage Management Group, the Torbay Catchment Group and the support team who had to carry out most of the tasks.

A plan is good: implementing the plan is far better! Now is the time for each one of us to start to make things happen. This plan is for everyone and I really encourage all in the community to come on board and help restore the catchment to a healthier condition. We can then be really proud of where we live combined with the satisfaction of the knowledge that we are passing on a better environment to future generations. After all, commitment from each one of us and just an hour or so out of our often hectic lifestyle, would all mount up to making a huge difference!

Andrew Marshall Chair, Torbay Catchment Group Chair, Watershed Torbay Community Steering Committee

ACKNOWLEDGEMENTS

The Watershed Torbay project had its genesis in mid 2000, when one of the officers in the South Coast Region of the Water and Rivers Commission, Jody Oates, returned from attending a national conference. Jody excitedly came into my office reporting the opportunity being provided by the National Rivers Consortium to establish waterways restoration demonstration catchments throughout Australia, and its desire to have one in WA.

After many conversations, competition from other catchments, and almost a year of planning, Torbay was eventually nominated by the Water and Rivers Commission to the Consortium.

The Commission had been working with the Torbay Catchment Group for several years trying to help facilitate resolution of communication issues about the Torbay bar management and algal blooms. The Group enthusiastically welcomed the opportunity to participate in the project, and this was confirmed through an early visit by Phil Price, former CEO of Land and Water Australia, and myself to the Torbay Catchment Group.

The formal project submission was prepared by Julie Pech, Luke Pen and myself, and eventually the project was signed off and formalised through a contract agreement in Mid 2001.

The entire Watershed Torbay Project owes its success to very many people, not least of which is David Weaver from the Department of Agriculture who suggested the great name for the project.

The project was undertaken through extensive discussion and consultation with community members and agencies. A Steering Committee comprising community members, representatives of the Torbay Catchment Group, and State and Local government agencies, was the key overseeing group. The Torbay Catchment Group was the major driver of on-ground works and community consultation. Without the motivation and commitment of these groups, the project would not have been successful.

I sincerely thank all members of the Torbay Catchment Group, members of the Watershed Torbay project steering committee, members of the drainage management group, and other community participants who have been involved in all aspects of the project over the past 4 years. A particular thank you to John Simpson, first Chairman of the Steering Committee, and Andrew Marshall, Chairman of the Torbay Catchment Group, who also Chaired the Steering Committee after John resigned due to ill health.

There are two amazing people who have contributed strongly to the ethic, approach and outcomes of the project, Julie Pech and Louise Duxbury. Julie provided the project and catchment support role, and her supreme organisational skills, knowledge of the catchment and community links were vital to the project. Louise was the community participation and communications coordinator, studying her PhD while working part time in this role. Louise's insights on best practice community change and her wonderful open and participatory approach were very welcomed by the community, scientists and project team.

There has been strong input from a range of agency personnel, science and research staff throughout the project, both through the Technical Advisory Group and individual project components. Their cooperative and partnership style and support was essentially in achieving

good outcomes for the project and catchment, and I really appreciate the good advice and guidance given. In particular, Andrew Maughan had an ongoing and pivotal role in establishing monitoring, supporting a range of research projects, and modelling drainage scenarios. The project contribution, cooperation, and advice from both the Department of Agriculture and Water Corporation staff was very important.

Finally a thank you to Viv Read, our patient and very competent consultant who prepared both the drainage report and the final draft of the restoration plan.

Naomi Arrowsmith, Principle Investigator and Project Manager, Watershed Torbay

EXECUTIVE SUMMARY

The Torbay Catchment is located on the south coast of Western Australia between the towns of Albany and Denmark where land use change has led to community concern about deteriorating health of the catchment. The Torbay Catchment Group formed in response to these concerns. The group has developed a vision for their preferred future of the catchment:

".. to have an environmentally clean, balanced ecology supporting a prosperous community in which people respect each other's use of the catchment and waterways"

This vision provides the lead for research and management planning in the catchment.

'Watershed Torbay' was initiated in June 2001 as an integrated whole of catchment waterways restoration project. The project aimed to undertake research, community and stakeholder consultation, and preparation of a restoration plan order to achieve a balance of environmental, social and economic outcomes for the catchment. The National Rivers Consortium invested in research and planning for catchment restoration through Land and Water Australia (LWA) with State funding contributions from the Department of Environment (DoE), Department of Agriculture (WADA) and the Water Corporation (WC).

The Watershed Torbay Catchment Restoration Plan provides strategic direction for long term resource condition change through targeted investment into prioritised actions set within a 3-year Implementation Program. The Restoration Plan provides a whole of catchment approach to management based on the integration of research information, local knowledge and the values held by the community. Community input has been critical in the decision making process, with the community as the 'driver' of restoration priorities and actions, with a strong science underpinning.

The key environmental issues in the catchment are related to the condition of the waterways and wetlands. The natural drainage system has been significantly altered and is now dependent upon manual operation to control wetland water levels and the potential for flooding. Lake Manarup has been managed for flood mitigation purposes rather than as a wetland. Lake Powell and Torbay Inlet are now two wetlands with the highest occurrence of algal blooms in Western Australia. Nutrients from a small number of point sources are a part of the cause, but the extensive sandy soils indicate that diffuse sources of nutrient are the most significant cause. There is recent concern about the extent of impacts caused by acid sulphate soils.

While farming is the dominant land use in the catchment, almost 80% of landholders earn most of their income off-farm. Many properties are small with non-viable farming enterprises. There are some commercial tree plantations although the community is resistant to an increase in this land use. Treated waste water sourced from Albany is discharged to one tree farm in the catchment. Water resources for public supply are sought from the Marbelup Brook sub-catchment. Nature conservation values are significant in wetland, bush and coastal habitats.

Through processes of community consultation, seven Management Themes were identified:

1. Algal Blooms and Water Quality
2. Water Quantity
3. Drainage Management
4. Habitat and Biodiversity Management
5. Farming Systems
6. Land Use Planning
7. Education and Communication

These themes provide the basis to development of the Restoration Plan. Broad goals and objectives are identified for each Management Theme.

Natural assets in the catchment are identified for land, water resources, biodiversity and infrastructure and well as cultural and heritage values. These provide a specific focus for targeted investment in catchment management.

The primary expected outcome from the Restoration Plan is improvement in the condition of natural resources. Targets for Resource Condition Change are set for the Management themes considering a period of approximately 20 years.

To achieve resource condition change, targeted actions are proposed for a shorter time period. Management Action Targets are set for medium term achievement.

The Restoration Plan has 16 targets for resource condition change and 33 Management Action Targets. The 3-Year Action Plan (Section C) provides the actions, priorities, estimated costs and role and responsibilities for achieving these targets. While partner organisation contributions are to be arranged through an Investment Plan, the estimate of external funding required for implementation of the 3-year Implementation Plan actions is approximately \$1.6m.

The community recognises that full restoration of environmental values in the catchment may not be possible without considerable loss of social and economic values. It is also understood that significant change may take a long time. There is good understanding that management of the natural systems of the catchment involves considerable uncertainty and that many factors may change with time. An Adaptive Management framework is significant to the Restoration Plan to ensure that decisions are based on monitoring and evaluation results. Section D outlines the processes linking M&E to adaptive decision-making and provides a set of indicators to measure change.

Review of the Restoration Plan is required within 3 years for re-investment through a second-phase 3-year Implementation Program.

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Abbreviations

ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
CALM	Department of Conservation and Land Management
CENRM	Centre of Excellence for Natural Resource Management
CoA	City of Albany
DoE	Department of Environment (formerly Waters and Rivers Commission)
DPI	Department of Planning and Infrastructure
DRF	Declared Rare Flora
FPC	Forest Products Commission
MAT	Management Action Target
N	Nitrogen
NRM	Natural Resource Management
P	Phosphorus
RCT	Resource Condition Target
SCRIPT	South Coast Regional Initiative Planning Team
TAG	Watershed Torbay Technical Advisory Group
TCG	Torbay Catchment Group
TN	Total Nitrogen
TP	Total Phosphorus
TPS	Town Planning Scheme
WADA	Western Australian Department of Agriculture
WALIS	West Australian Land Information System
WRC	Waters and Rivers Commission
WC	Water Corporation

WATERSHED Torbay

Watershed Torbay Catchment Restoration Plan

SECTION A

PROJECT DESCRIPTION

A1.0 Introduction

A1.1 A National Case Study of Community-based Catchment Management

The Torbay Catchment is located on the south coast of Western Australia between the towns of Albany and Denmark. It is the catchment area to the Torbay Inlet within which there are several small waterways inter-connected through a series of wetlands. The low-lying wetlands were naturally influenced by marine inflow and tidal sequences which are now controlled by a system of drains and constructed flow regulators to reduce flooding of land used for horticulture and associated infrastructure. However, the community and agencies responsible for land and water management have increasing concern about the health of the wetlands and have sought a coordinated catchment-scale approach to manage their landscapes.

‘Watershed Torbay’ was initiated in June, 2001 to undertake the science, consultation, planning and implementation of a restoration plan program balancing environmental, social and economic outcomes for the future of the catchment. A partnership approach to engaging community, government and others with interest in the wellbeing of the catchment was adopted. The project proposal developed by the lead agency, the West Australian Department of Environment, in conjunction with the Torbay Catchment Group, gained the support of the National Rivers Consortium as a case study in developing community-based approaches to catchment restoration. It is one of several case studies in Australia. Previously, planning for restoration of waterways has focused on sections of streams rather than taking a whole of catchment approach, Watershed Torbay is working across the whole catchment.

The National Rivers Consortium invested in research and planning for catchment restoration through Land and Water Australia (LWA) with State funding contributions from the Department of Environment (DoE), and in-kind contributions from the Department of Agriculture (WADA) and the Water Corporation (WC). The expected outcomes were:

- to show the benefits of stream restoration at the catchment scale with a research component to project activities;
- to demonstrate community participation as an essential component;
- to incorporate monitoring and evaluation within ongoing adaptive management processes: and
- to achieve an action oriented learning environment through the collective work of researchers, agencies and community groups.

The project outcomes rest on an approach that values community participation, is committed to forming long term partnerships, uses a civic science approach to research and is committed to adaptive management.–The ‘Watershed Torbay’ project made it possible to develop a Restoration Plan based on research and management for the whole catchment with the community as the ‘driver’ of restoration priorities and actions. This has occurred through the Torbay Catchment Group in cooperation with agencies responsible for land and water management in the catchment. As part of the commitment to adaptive management a Communication Learning Log has been progressively written during the project to record major steps taken during the four year

Watershed Torbay project. Direct quotes from key leaders from the community and partner agencies are included. The Learning Log is available on the website www.torbay.scrib.org and will be available on the CD compiling the information on the Watershed Torbay project.

A1.2 Approach to Restoration Planning

The framework for the Torbay river restoration plan, shown in Figure A1, was adapted from Koehn et al., 2001.

The framework has been important in making the roles of the stakeholders and the research team clear. The key stakeholders - through community workshops, a catchment wide survey and the Watershed Torbay project steering committee and sub committees - have been the major drivers in developing the vision and objectives for the restoration plan.

The technical assistance group and contract researchers have provided information on possible actions to meet the objectives, adding to those suggested by the community and the steering committee. The technical assistance group has provided information about the current state of the catchment and provided a better understanding of how the catchment works. The key role of the technical team has been to give their assessment of how effective the proposed actions would be in working on the desired objectives.

The steering committee, with an emphasis on the community representatives, has then made judgments about how practical the proposed actions would be to implement, and how acceptable they are, that is, how willing landholders would be to undertake proposed actions. The integration of research information, local knowledge and the values held by the community has been critical in the decision making process.

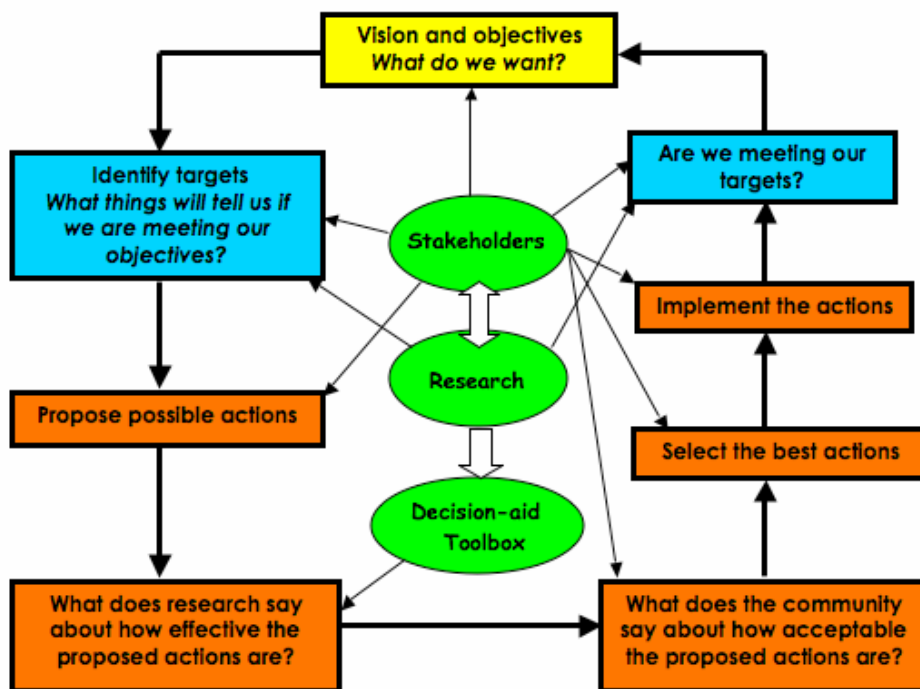


Figure A1 The Torbay Catchment Restoration Plan Framework

Through the project it has been recognised that work on a range of elements of change is needed to support the planning process. Communication work to build pressure for change and develop a shared vision has been undertaken throughout the project. The building of local skills through field days workshops, presentations by researchers and development of trials has been important in developing capacity to change and is a strong element in the Restoration Plan. While the Watershed Torbay project has focused on the preparation of the Restoration Plan, the Torbay Catchment Group has continued to gain financial support to undertake on the ground works. This has been important for maintaining local enthusiasm for catchment repair work. The Restoration Plan is based on the need to keep working on all key elements of change:

- Pressure for Change
- Clear Shared Vision
- Capacity to Change
- Actionable First Steps

The Restoration Plan includes an action plan and monitoring and evaluation framework.

A1.3 Vision for the Future

The vision for the future of the catchment is to have:

".. an environmentally clean, balanced ecology supporting a prosperous community in which people respect each other's use of the catchment and waterways" .

The vision represents the aspirations of the community. It recognises differing and changing values within the community where some people are deriving their living through agriculture, horticulture and tourism while others as seeking improved semi-rural lifestyle values. The vision also reflects the importance of ecological systems for life support.

In 1990, the Torbay Waterways Protection Committee was formed in response to concern about outfall of primary treated effluent from Albany's Timewell Road Wastewater Treatment Plant, discharged into Five Mile Creek and Lake Powell. Presentation of a report on the environmental status of the Torbay Catchment was attended by 80 people at a community meeting in 1999 indicating the level of community concern. Following this meeting the Torbay Catchment Group was formed.

The 'Watershed Torbay' project was initiated in 2001 response to community growing concern about declining environmental health within the catchment. The project was formed to demonstrate an integrated approach to land use and natural resource management at a catchment scale.

Commencement of the project was on the basis that it would recognise changing land use and community values and aim to meet community expectations for environmental restoration combined with economic and social benefits.

Three community forums were held within the catchment (at Elleker, Torbay and Redmond) during 2002. The purpose of these was to identify the environmental, social and economic issues for the catchment, to suggest possible solutions and to provide input on visions for the future of the catchment. Following the forums a postal survey of catchment landholders was distributed. A third of households responded and provided further input to guide the development of the restoration plan.

Most people within the catchment consider that action is required particularly in relation to:

- The increased incidence of algal blooms in wetlands and watercourses in the lower catchment,
- Management of drainage,
- Loss of lifestyle quality for residents over several months of the year during blooms, degradation of streams, and
- Meeting Albany's drinking water requirements.

The community priorities for issues raised during the community forums and survey have been the basis for development of seven themes for management in the restoration plan. They are:

1. Algal Blooms and Water Quality

- 2. Water Quantity**
- 3. Drainage Management**
- 4. Habitat and Biodiversity Management**
- 5. Farming Systems**
- 6. Land Use Planning**
- 7. Education and Communication**

The detailed outcomes from the community forums are available at www.torbay.scrib.org. The goals set by the community for the 'Watershed Torbay' project reflect changing values towards catchment management for sustainable use of natural resources. They also show strong interest by community for involvement in planning and willingness to participate in integrated catchment management.

A1.4 Restoration Planning Team

The Torbay Catchment Group (TCG) members have experience with many environmental restoration actions including weed management, waterways fencing and revegetation, foreshore condition surveys, macro-invertebrate monitoring, managing a major artificial wetland construction project, and stream restoration projects (including revegetation, pool and riffle construction; stock and vehicle crossings and off stream watering points).

Following a decision by the group to participate in the Watershed Torbay project, the Watershed Torbay Steering Committee was established to oversee the project, ensure a participative approach, and to broker arrangements.

The Watershed Torbay Steering Committee has responsibility for preparation of the Watershed Torbay Restoration Plan. The catchment group will have on-going responsibility for implementation and monitoring of the river restoration plan.

The 'Watershed Torbay' Community Steering Committee provided direction for the demonstration program and reported back to the Torbay Catchment Group. Members on the Watershed Torbay Steering Committee are people who represented the interests, uses and values of the catchment and who share a personal commitment to better management.

The specific requirement to 'develop a plan to improve drainage management' in the catchment has been addressed by the Drainage Steering Group of the 'Watershed Torbay' project. Members represented a range of community, industry and government organisations.

The 'Watershed Torbay' Technical Advisory Group (TAG) provided direction for research requirements of the demonstration program. The TAG provided direction for research to develop an understanding of the biophysical processes in the catchment and identification of effective and practical management responses to issues.

The following is the full list of people who contributed through one of these groups to the success of the project:

Andrew Marshall, Chair

John Simpson, Former Chair

Phil Mellon, community
 Chris Westacott, community
 Terri Harwood, community
 Diane Evers, local government
 Danny Burkett, Water Corporation
 Sarah Comer, CALM
 Peter Collins, CALM
 Louise Duxbury, Green Skills
 Melissa Vernon, community
 David Weaver, Department of Agriculture
 Des Wolfe, local government
 John Blaney-Murphy, community
 Maurice McCormick, community
 Mark Taylor, community,
 Bill North, community
 Noel Bignell, community
 Paul Close, CENRM
 Naomi Arrowsmith, Department of Environment
 Julie Pech, Department of Environment
 Prof Peter Davies, CENRM

Phillip Marshall, community
 Ron Masters, Department of Agriculture
 Andrew Maughan, Department of Environment
 Phil Shephard, City of Albany
 Chris Gunby, Department of Environment
 Monty Walker, community
 Graeme Wright, Water Corporation
 Dale Holley, community
 Lionel Downes, community
 Graeme Heighton, community
 Malcolm Robb, Department of Environment
 Brad Degens, Department of Environment
 Kristina Fleming, SCRIPT
 Steve Janicke, Department of Environment

Preparation of the Restoration Plan was undertaken through the 'Watershed Torbay' Community Steering Committee assisted through a Support Team coordinated through the Department of Environment. The Support Team was managed by Naomi Arrowsmith (Project Manager) and included Andrew Marshall (Chair of the Watershed Torbay Steering Committee), the Project Officer (Julie Pech), and the Communications Coordinator (Louise Duxbury).

A1.5 Research Approach

The Watershed Torbay project had a very strong focus on science to underpin and inform appropriate management actions for the catchment. Some 15 individual research projects were chosen to be conducted, grouped into five broad theme areas:

- Environmental flows
- Algal blooms: processes and drivers
- Managing the lower drainage system
- Catchment nutrient sources
- Social and economic issues.

Consistent with the project commitment to a civic science approach to research, researchers contracted to undertake work for Watershed Torbay were required to respond to a set of criteria based on a civic science approach:

What is the capacity of the research to answer the key community questions?

Will the research provide information to influence the selection and implementation of actions?

How transportable is the research to other catchments throughout Australia?

How urgent is the research in terms of influencing actions (this is the priority), or is it addressing a long-term issue?

What is the likelihood of obtaining other potential funding sources instead of National Rivers Consortium funding under the Watershed Torbay project?

What is the direct cost of the proposal and the extent to which there is matching funds for it?

What is the research proposal's potential to give results that lead to low cost land-use management change that is behavioural change?

A summary of relevant research projects coordinated through the TAG is provided in the supporting documentation.

A1.6 Structure of the Restoration Plan

The Watershed Torbay Catchment Restoration Plan consists of four sections (Figure A2). The Plan incorporates all relevant information leading to the actions to be taken. It also provides a framework for monitoring and evaluation linked through adaptive management to the implementation processes. The Plan outlines resource and capacity requirements for efficient implementation of the actions and effective communication of the results.

The **Project Description** section provides:

- An outline of the demonstration program and the restoration planning team;
- A vision for the future of the catchment;
- A description of the catchment and communities; and
- An assessment of the land use and natural resource management issues.

The **Assets, Goals and Targets** section provides:

- Identification of valued catchment assets and community values;
- Goals and objectives identified through community processes; and
- Targets for resource condition change.

The **Action Plan** provides:

- Management Action Targets and proposed actions;
- Estimated costs allocation for a 3-year implementation program;
- Identification of key roles and lead responsibilities; and
- Feasibility assessment for achievement of targets.

The **Monitoring and Evaluation Plan** provides:

Current monitoring, analysis and trends;
An “Adaptive Management’ framework; and
Indicators of change for goals, objectives and targets.

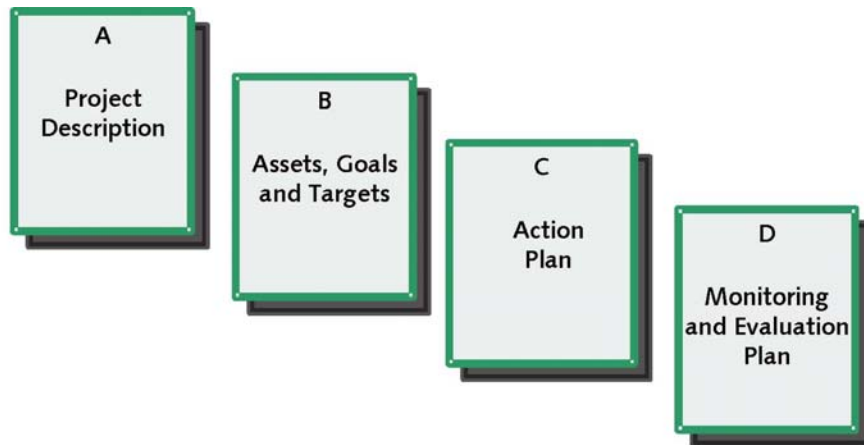


Figure A3 – Sections of the Restoration Plan.

The Restoration Plan is supported by a resource kit, and which all supporting information is compiled, and associated information is available on the ‘Watershed Torbay’ website (www.torbay.scrib.org).

A2.0 Catchment Description

A2.1 Location and Overview

The Torbay catchment is located 26km west of Albany on the south coast of Western Australia (Figure A3). It is within the South Coast natural resource management (NRM) region.

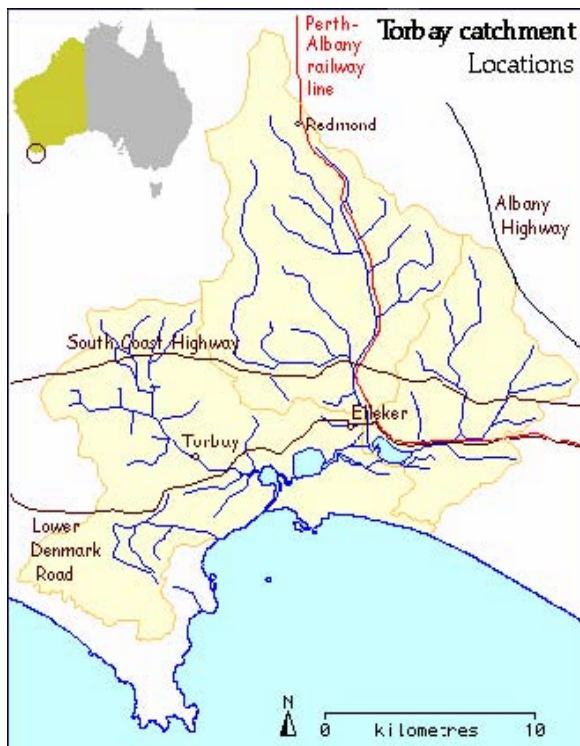


Figure A3 – Location of the Torbay Catchment

The area of the catchment is 330km² of which 33% remains as natural vegetation, 51% is used for grazing, 5% has commercial timber plantations and 1.6% is occupied by waterways and wetlands.

Other land uses in the catchment include horticulture (irrigated and non-irrigated), intensive animal industries (including piggeries), seasonal commercial fishing (in the Torbay Bay) and a growing tourism industry. A waste-water treatment plant for the town of Albany previously discharged effluent into the Torbay catchment. This followed secondary treatment managed by the Water Corporation under a licence issued by the Department of Environmental Protection license arrangements. This is now irrigated to a commercial timber plantation within the catchment.

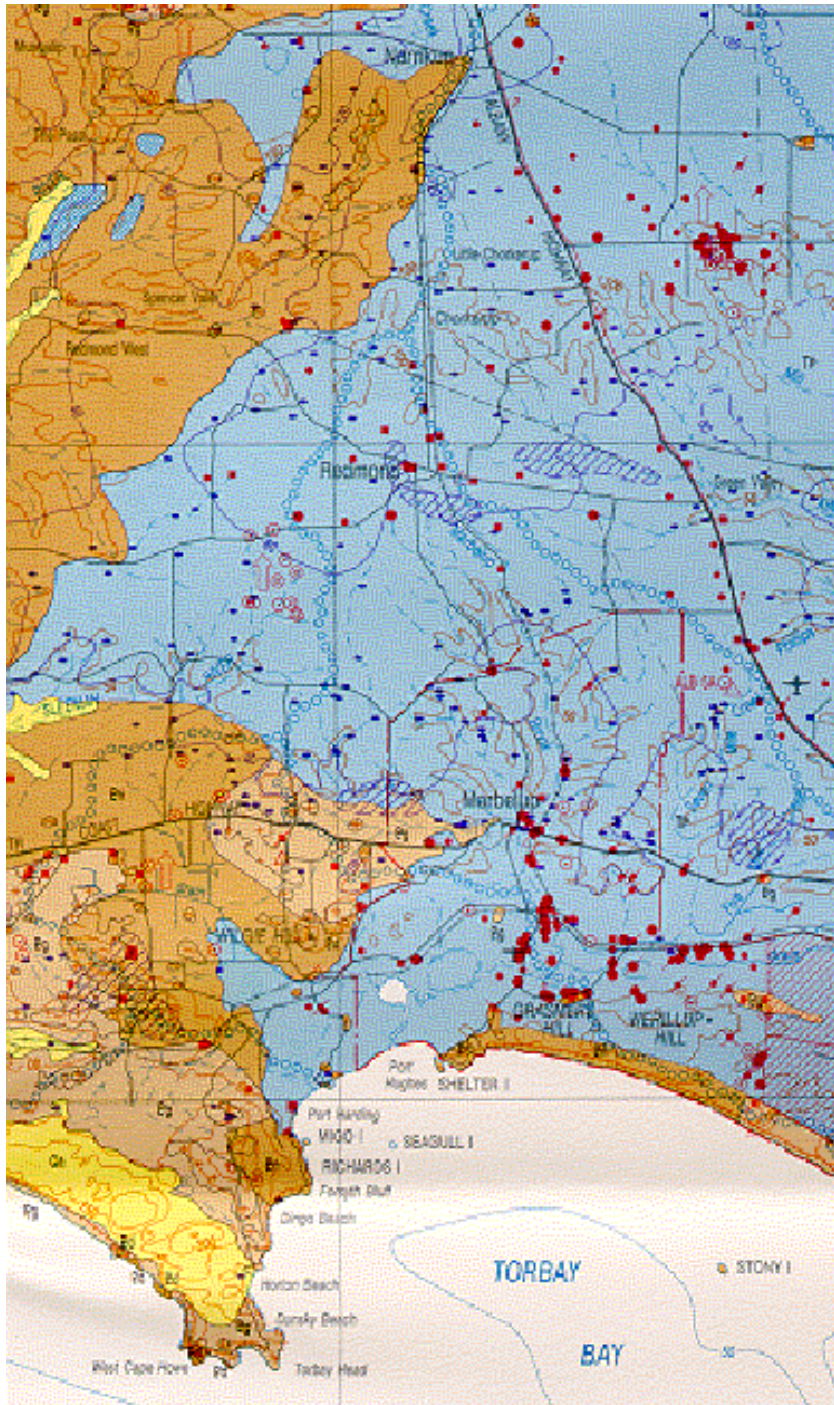
Climate is a Mediterranean type with cool, wet winters and warm to hot summers, with significant summer rainfall. Most of the rain comes from fronts associated with low-pressure systems passing over, or to the south of the area. The annual average rainfall for the area ranges from 1000mm to 800mm away from the coast. Variability of rainfall is low for WA. Pan evaporation rate is about 1200 mm. per annum, and is less than rainfall in 4 to 5 months of the year. The growing season generally exceed 10 months. Average monthly minimum and maximum temperatures range between 14°C and 26°C in summer and 7°C and 16°C in winter.

The small communities of Cuthbert, Elleker, Redmond and Torbay are located within the catchment. There are 563 rural properties with an average size of 100 - 150ha which suggests that there are many rural residents who may have off-farm interests. The West Cape Howe National Park is significant. The district is serviced by major and minor roads and the Perth-Albany freight railway.

A2.2 Geology, Landforms and Soils

The valley floor of the Torbay catchment is underlain by granitic, gneissic and doleritic rocks of Proterozoic age that form impermeable bedrock in the area. These rocks largely constrain the depth to which groundwater can infiltrate below the land surface. Bedrock outcrops to the north of the wetlands in the lower part of the catchment and in coastal cliffs (Figure A4).

The catchment valley floor (sometimes referred to as Grassmere Valley) is of deep (up to 150 meters) alluvial, colluvial and marine sediments. There is some suggestion of it being a previous marine strait (a seaway) during an earlier era (Hodgkin and Clark, 1990). Crystalline bedrock is overlain by sediments of Tertiary to recent age (Gozzard, 1989; Smith, 1997). The most permeable sediments in the area are calcareous sands in coastal dunes which have been patchily cemented to form a sandy limestone, and it is likely that most of the groundwater flow in the lower part of the Torbay catchment takes place within these materials. These sediments contain fresh groundwater of a suitable quality for potable use.



Torbay

catchment (adapted from CALM, 1995)

Low-lying areas in near-coastal parts of the Torbay catchment are underlain by estuarine and shallow marine silty and sandy sediments of Holocene age (i.e. sediments that formed since the last ice age within the last 10,000 years). These sediments contain significant amounts of the iron sulfide mineral pyrite and they are highly reactive when exposed to air. Excavation of these

materials can create acid sulfate soils and the risk of discharging acidity and metals into the drainage system. Acid sulfate soils were first identified at Ewerts Swamp where a horticultural scheme failed because drainage had exposed pyrite to the air causing acidified soil and groundwater (Woodward, 1917). The potential occurrence of acid sulfate soils is shown in Figure A5.

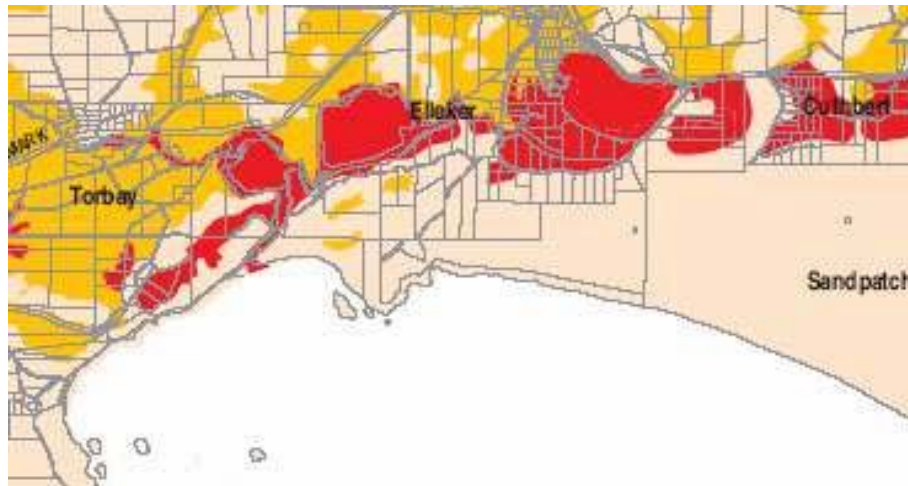


Figure A5, Distribution of Acid Sulphate Soils in the Lower Torbay Catchment

A2.3 Wetlands and waterways

The location of wetlands and waterways in the catchment is shown in Figure A6.

The wetlands of the Torbay catchment are distinctive within the region as being a small associated set of water bodies influenced by both riverine and coastal processes. The waterways that contribute to the wetlands are relatively small and some are now significantly altered by drainage. Prior to alteration of the natural drainage system, the wetlands functioned hydrologically as one system – the water level for all components were the same and were influenced simultaneously by rising floodwaters behind the naturally formed sand bar. The valley floor was also simultaneously influenced by saline water intrusion under tidal influence when the sand bar was open. The sand bar breached as a natural occurrence when water levels rose to about 1.1 meters AHD (Australian Height Datum) behind the bar.

Marbelup Brook, Five-mile Creek and Seven-mile Creek previously discharged into Lake Powell. The lake was originally of greater area (bounded by the approximate location of the Grassmere/Elleker Road) and discharged through an outlet that is now known as North Creek. Overflow from the lake was direct into Lake Manarup (also previously known as Red Hill Lagoon) which discharged to Torbay bay when the sand bar was breached and water levels in Torbay Inlet were lowered.

Marbelup Brook is the only natural river that flows into Lake Manarup and then Torbay Inlet. The lake is less than 1km² in area and is shallow but has a wide margin of fringing vegetation including paperbark trees and sedges.

The hydraulic gradient of the natural wetland system is very low. The amplitude of tides within the Torbay Bay ranges from 40 cm to 130 cm. Larger tidal sequences caused salt water to intrude upstream of the Lower Denmark Road along Marbelup Brook and through Lake Powell to the current Cuthbert horticultural area when the bar was open. Conversely, the wetlands and adjacent valley floors were probably well drained with low tide sequences. With evaporation, the wetlands were probably dry for periods of quite variable length. These factors suggest that the wetlands would have had considerable variation in hydro-period (including a drying sequence) and in salt concentration under natural conditions. It can be expected that the wetlands were well flushed on a seasonal basis.

Local information sources suggest Lake Powell to have been quite deep (estimates of over 4 meters) and with white sand beaches however Hodgkin and Clark (1990) note that the original depth was probably about 1 meter and is now about half that depth.

The lake extended to an area that is approximately bounded by the Elleker-Grassmere Road, an area significantly greater than the current water body. Remnants of the original foreshore can be seen in aerial photographs, and the lake bed topographic relief is evident along Woodides Road near Elleker. The lake was previously used for swimming, and occasionally the dry lake bed was suitable for bike-riding and horse-training. Lake Powell is now an 'A-Class' Reserve managed by the Department of Conservation and Land Management (CALM). It is recognised for high numbers of waterbirds (resident and migratory).

The Torbay catchment is now the most significantly altered wetland system on the south coast. The swamp valley between Torbay Inlet and Princess Royal Harbour has a fertile soil and was developed for agriculture in the late 19th century when drains were dug in Seven Mile Swamp (now known as Ewatts Swamp) to the east of Lake Powell discharging into Lake Manarup. Exposure of the soil to air by drainage and cultivation caused oxidation of iron pyrite in the soil leading to acidification of the land which is now not suitable for use.

There are 180km of waterways within the catchment. Foreshore surveys show some to remain in good ecological condition (see resource kit, and www.torbay.scrib.org). The major waterways (listed from east to west) are Five-mile Creek, Seven-mile Creek and Marbelup Brook that previously drained naturally into Ewart Swamp and Lake Powell, and Unndiup Creek that drains into Torbay Inlet (Figure A6).

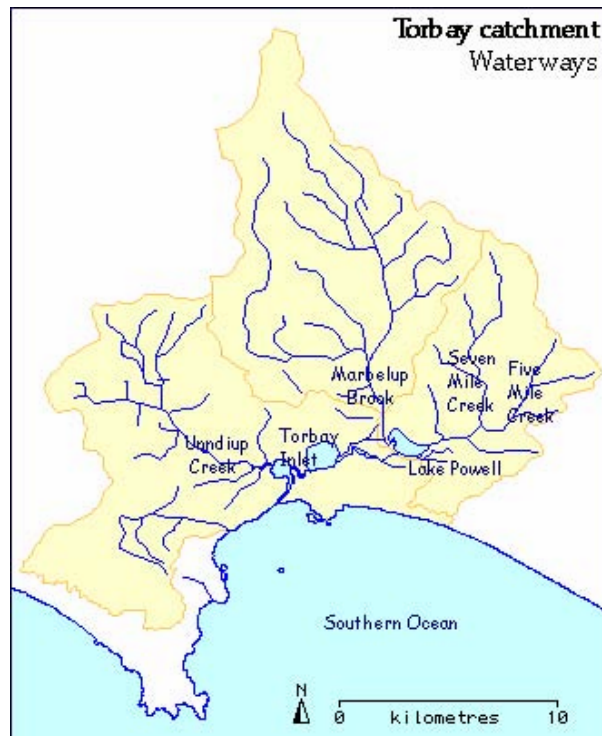


Figure A6, Waterways of Torbay Catchment

The sub-catchments defined for use within the program area are shown in Figure A7.



Figure A7, Torbay Sub-Catchments

A2.4 Torbay Catchment Estuary

Like most other estuaries of the south west of Western Australia, tidal exchange into Torbay Inlet is obstructed by sand bars and the water changes seasonally from nearly fresh to marine.

Torbay Inlet is now only a small part, (about 1 km²) of what was formerly a larger estuarine system that included Lake Manarup which is now a compensating basin alongside the drain from Marbellup Brook and Lake Powell. Floodgates prevent estuary water entering the two lakes or backing up into cultivated land in swamps to the east.

Estuaries on the South Coast are of very recent origin, they are only about 6000 years old. In the last ice age sea level was more than 100 m lower than it is now, the coastline was 30-40 km further south near the edge of the continental shelf, and there were valleys and perhaps lakes where the estuaries are now. When the polar ice began to melt 20 000 years ago, the sea level rose rapidly and by about 6000 years ago had reached its present level; sea water flooded the valleys and they became the estuaries and coastal lagoons of today.

At first the estuaries were always open to the sea and sea water mixed freely with fresh water from the rivers, but subsequently sand eroded from the sea bed and eroded from the dunes has narrowed the mouths of most south west estuaries. Now exchange with the sea is restricted to periods when the bars are open, they are poorly flushed and the salinity regime is totally different from that of 6000 years ago.

When first formed, the Torbay catchment estuary was probably much deeper than it is now, perhaps even with a valley to hard rock. The sea level may also have been up to 2 metres higher than it is now. Sediments eroded from the catchment and sand from the beach has progressively filled the estuary. Coarse sediment brought by floods has built a large river delta. Waves have smoothed the sandy shoreline and built beach ridges that the vegetation has stabilised. Marram grass and other salt tolerant plants have trapped sediment. These same processes are continually reshaping the Torbay Inlet estuary today.

A2.5 Water Resources

Most of the catchment is within the Albany Groundwater Area although no groundwater bores are currently used for public supply. Allocation of groundwater for private bores is under license arrangements with the Department of Environment. The Marbelup Water Reserve was formed in 1986 as a Priority 3 area for public water supply. Consideration is being given to allocation of 6 gegalitres (GL) of the total 16GL of annual stream flow in Marbelup Brook for public water supply in Albany. An estimation of Environmental Water Requirements is an important part of this consideration under the 'Watershed Torbay' project.

A2.6 Spatial Information and Management

Spatial information describing the catchment is available on a site within the Western Australian Land Information System (WALIS) website : (<http://atlas.walis.wa.gov.au/>)

atlaswa/index.cfm?topic=south_coast&infoproduct=south_coast®ion=regions®ion_code=20). Table A1 lists the information that is available.

Table A1. Spatial information for the Torbay catchment. Information layer	Scale	Custodian
Infrastructure		
WA Base Map	1:100 000	Geoscience Australia
Cities and Towns	1:250 000	Geoscience Australia
Railways	1:250 000	Geoscience Australia
Roads and tracks	1:250 000	Geoscience Australia
Environment		
Landform classification	1:25 000	Agriculture WA
Soil classification	1:50 000	Agriculture WA
Strahler stream network	n.a.	Agriculture WA
Catchments	n.a.	Agriculture WA
Subcatchments	n.a.	Agriculture WA
Environmental Management Units	n.a.	Agriculture WA
Riparian Zone Risk Areas	n.a.	Agriculture WA
Major waterbodies	1:250 000	Geoscience Australia
Minor water bodies	1:250 000	Geoscience Australia
Water Quality evaluation sites	1:50 000	Agriculture WA
Loadsite water quality catchments	n.a.	Agriculture WA
Snapshot water quality catchments	n.a.	Agriculture WA
Landform Classification	1:25 000	Agriculture WA
Torbay Catchment	1:25 000	Water and Rivers Commission
Torbay Subcatchment	1:25 000	Water and Rivers Commission
Marbelup Brook Foreshore Conditions	n.a.	Water and Rivers Commission
5 Mile and 7 Mile Cks Foreshore Conditions	1:25 000	Water and Rivers Commission
Agriculture		
Existing landuse capability rating	n.a.	Agriculture WA
Low existing landuse Capability Areas	n.a.	Agriculture WA
Annual horticulture capability	n.a.	Agriculture WA
Cropping capability	n.a.	Agriculture WA
Grazing capability	n.a.	Agriculture WA
Perennial horticulture capability	n.a.	Agriculture WA
Integrated Land Use	n.a.	Agriculture WA

A3.0 Community Characteristics

A3.1 Land Use and Community History

Aborigines inhabited the Torbay Catchment for thousands of years, but there is now very little direct evidence of how they lived and how their society was organised. Several sites are on the register of the Department of Indigenous Affairs Aboriginal Sites of Significance. The coast provided access to marine food sources and a corridor for travel between the areas around Princess Royal Harbour to the east and Wilson Inlet to the west.

A number of British and French explorers and whalers sailed along the south coast from the late 16th century onwards, but the area was not settled or the hinterland explored by Europeans until the British settlement was established at Albany in 1826.

Initially whaling, sealing and timber-cutting were the main activities in the Torbay area, but the construction in 1889 of the Perth to Albany railway, which enters the northern boundary of the catchment through Redmond, runs south to Torbay and then turns east to Albany, opened up the region for settlement and farming. The WA Land Company built the railway in return for grants of land, which it then tried, with limited success, to sell to immigrants as smallholdings. In 1896 the government took over the land and the railway.

The railway was also important in the life of all the settlers: it brought supplies and mail, and until cars became common, it was the fastest way to get to Albany, with the only alternatives being horses or walking. Even in the 1930s the 20 kilometre trip by motor vehicle from Redmond, near the northern catchment boundary, to Albany, would take five hours due to the poor state of the roads as the following excerpt from the local newspaper at the time indicates: “..they have their troubles, and it is hardly necessary to say that their chief trouble comes from the state of the roads in winter. They are called roads, though they are mere bush tracks....in my trip to and through Grassmere, I passed along mere rugged tracks which in winter must be veritable Sloughs of Despond (Albany Advertiser, 1899).”

When the catchment was first settled the main farming activity was market gardening, which was quite successful since the recently discovered goldfields around Kalgoorlie encouraged a huge influx of people and thus a strong demand for fresh vegetables. Much of the land used was only 0.5 to 1 metre above sea level, even up to 10 km from the sea, and it was subject to flooding, sometimes with salt water.

A barrage with floodgates half a kilometre from the bar was completed in 1912 in an unsuccessful attempt to prevent salt water backing up onto the farm land. It was built of Californian redwood and worked fairly well until about 1920. However sand built up against the downstream side, shallowing it from 5m on the upstream side to 60 cm on the downstream side. Gaps between the timbers allowed sea water to flow back into the Inlet and attempts to block these with sheets of iron obstructed outflow so that water did not get away fast enough and flooding continued. The decking was first burnt about 1928 and repaired and subsequently burnt several times before the barrage was blown up by the army in 1985 as a demolition exercise and became derelict. Some of the piles still stand.

A drainage scheme was operating during the 1930's when potatoes were grown in Seven Mile Swamp (now Ewart Swamp). The drainage infrastructure was also installed to protect the road and rail infrastructure from localised flooding. The peat-based lake bed caught fire during this period. Fire is considered locally to be the initiator of processes of oxidising iron pyrites resulting in significant acidification of the soils, however Hodgkin and Clark (1990) attribute the cause to drainage and cultivation. They quote an early observation by Woodward (1917): The poisonous mineral solutions in the soil of the "Seven Mile Swamp" are due to the oxidation of the iron pyrites in the soil itself owing to the mineral being brought in contact with the air by drainage and cultivation. Ewart Swamp is not suitable for horticulture and is considered to be a potential source of acidic effluent water to the wetland system.

Fish flourished for a time throughout the drainage system, probably until the water became too acid (pH 3.5 from the 1910s to 1940s). Lake Manarup is now also shallow. It is managed as a compensation basin and often dries out in summer.

During the 20th century cattle and sheep farming largely replaced vegetable growing as the main farming activity. More recently, tree plantations and tourism have grown in importance. The Timewell Road waste-water treatment plant for Albany previously discharged effluent into Five-mile Creek following secondary treatment, or when detention capacity at the plant was exceeded. Organised community re-action to these arrangements in response to nutrient enrichment and mal-odour problems in Lake Powell resulted in new arrangements with improved treatment and effluent discharge to a commercial timber plantation within the catchment.

With flooding under control and the area of Lake Powell inundation significantly reduced as a result of the drainage controls, residential development in the former lake bed commenced. There are now many households in this landscape position. Their protection from flooding is currently dependent upon operation of the drainage system which was inadequate to control the significant localised flooding that occurred in 1992.

There have been recent housing development approvals for sites located within the bed of Ewart Swamp, an area also dependent upon operation of the drainage scheme for flood control.

A3.2 Community Statistics

Information from the Australian Bureau of Statistics (ABS) for two areas of the 2001 census is relevant to the upper and lower parts of the Torbay catchment. These show the community characteristics to be similar throughout the catchment although there are a greater number of older people living in the lower parts (Table A2). Income is medium to low compared on a State basis.

Table A2 Socio-economic attributes of Torbay catchment residents (a) Age structure; (b) Ancestry; and (c) Income.

Table A2 (a) Age structure of Torbay catchment residents People	Lower Catchment	Upper Catchment	Total
Aged 0–14 years	138 (24%)	91 (32%)	229 (26%)
Aged 15–29 years	93 (16%)	47 (17%)	140 (16%)
Aged 30–44 years	142 (24%)	71 (25%)	213 (25%)
Aged 45–64 years	167 (29%)	55 (20%)	222 (26%)
Aged = 65 years	44 (7%)	18 (6%)	62 (7%)
Total	584 (67%)	282 (33%)	866

Table A2(b) Ancestry of Torbay catchment residents

	Lower Catchment	Upper Catchment	Total
Australian & NZ	234 (30%)	125 (35%)	359 (32%)
English	298 (38%)	109 (31%)	407 (35%)
N West European	153 (20%)	71 (20%)	224 (20%)
S&E European	40 (5%)	16 (5%)	56 (5%)
Asian	9 (1%)	5 (1%)	14 (1%)
Other	9 (1%)	0 (0%)	9 (1%)
Not stated	35 (5%)	30 (8%)	65 (6%)
Total	778	356	1134

Table A2(c) Annual income for people aged > 15 years in the upper and lower catchment

Annual Income	15– 19 yrs	20– 24 yrs	25– 34 yrs	35– 44 yrs	45– 54 yrs	55– 64 yrs	65– 74 yrs	= 75 yrs	Total
Negative /nil	26	0	6	6	8	12	0	0	58
\$0–\$26K	40	12	54	81	61	73	44	12	377
\$26K–\$52K	0	3	25	50	40	18	15	3	154
>\$52K	3	0	3	12	3	3	0	3	27
Not stated	16	3	3	7	3	6	6	3	47
Total	85	18	91	156	115	112	65	21	449

A survey sent to the 580 landholders in the Torbay catchment resulted in 173 responses (Duxbury, 2003). The results from the survey are indicative only, as the survey was not random and respondents were skewed to the older age brackets and those with higher education levels. The information provided indicates that over 70% of landholdings are small (<100 Ha) and 38%

are less than 10 Ha. The most common land use is for cattle and sheep production although a high proportion of landholders use their land mainly for residential purpose. There are 4 aquaculture enterprises, 2 dairies and 2 piggeries. Almost 80% of respondents indicated that less than half of their income was generated from their property and almost 50% indicated that none of their income was from the land.

A4.0 Land Use and Natural Resource Management

A4.1 Introduction

Land in the Torbay catchment was originally settled and cleared for agricultural and horticultural use. Agriculture remains the dominant industry however the use of land is changing in response to increasing numbers of residents attracted to the area for lifestyle reasons. The 'Restoration Plan' project recognises the processes of change and aims to provide an integrated framework for linking the range of land uses that occur with management of natural resources.

A4.2 Agriculture

Conventional agriculture within the Torbay catchment is based on annual pasture-based grazing systems for cattle and sheep. The area used for grazing (17,000 Ha) is 51% of the catchment. There are limited areas cropped for cereal production. There are two dairies and two piggeries within the catchment. There are many small land holdings with landholder generating off-farm income.

A relatively recent change in land use is to commercial timber production. There is now approximately 5% (1700 Ha) of the catchment established to tree plantations. Most of this area is planted with Blue Gums (*Eucalyptus globulus*) in 10-12 year rotations under share-farm contract arrangements.

The existence of Cuthbert, Torbay, Elleker and Redmond owes much to the historical success of local farming enterprises. There is a strong feeling within the community that farming should remain a major land use as a driver of the local economy and as a key attraction of the local landscape. However, farming practices will need to become economically and environmentally sustainable in order to meet community expectations regarding the protection of environmental values.

A4.3 Horticulture

The Torbay and Cuthbert areas are well recognised as traditional potato growing areas particularly for seed potato production. While some pumpkins are grown and the area is suitable for cauliflower production, potatoes are the major horticultural crop. The area currently produces about 50% of WA's requirements for seed potato production.

Two separate locations are identified as associated with the Torbay Drainage System. The first is on land serviced by the Cuthbert Drain where there is an estimated 100Ha of land suitable and potentially available for horticulture. The second location is south of Lake Powell where there is an estimated 80Ha of land is suitable and previously used for horticulture. There are currently three growers in the Cuthbert area using approximately 60 Ha annually and four growers in the Lake Powell area using approximately 32Ha annually.

The suitability of land for annual horticulture in the Lake Powell area is dependent upon control of flooding and inundation and upon high groundwater levels to maintain suitable soil moisture status during the growing period. Current management of the Torbay Drainage system reduces the risk of floods, waterlogging and crop drought although some risk of these events remains. For a viable industry to continue, there is limited opportunity to alter production practices. The growing season is not flexible without supplementary irrigation. There are no obvious alternative horticultural crops tolerant of waterlogging and inundations that would be economically comparable.

A4.4 Commercial Fishing

The commercial fishing industry that occurs within Torbay Bay is based on catches of herring and salmon during the February-April period annually. Licensed operations are at two locations, one at Cosy Corner on the west end and the other near Mutton Bird Island at the east end. The industry is based on relatively low-value product but may generate approximately \$0.25m from the bay each year.

A4.5 Residential use

The town community of Elleker is located adjacent to Lake Powell. Residential blocks of land within the townsite are small but more recent residential development is on larger blocks of land in surrounding areas. There is a number of relatively small 'hobby farms' (4-10Ha) adjacent to the drainage system or that overlooks the wetlands.

Residential development within the bed of former lakes is a significant issue. There are houses within the former bed of Lake Powell and some are within the former bed of Ewart Swamp. These areas are at risk of flooding both by surface water inundation and by groundwater rise. Groundwater levels in these low-lying areas seem to be highly connected with water levels in Lake Powell based on local information about water levels in dams rising and falling consistently with water levels in the lake.

Most residential properties within the former lake-bed areas have on-site sewage treatment by conventional septic tanks and leach drains. More recent housing approvals have required installation of nutrient retaining treatment systems. There are risks to public health from waste treatment in flood-prone areas.

Many residents are concerned about the water quality in the wetlands and waterways. Mal-odours from Marbelup Brook immediately downstream from the Marbelup Plug are the main cause for concern. This location coincides with a former rubbish tip (not used since the mid-1970's) and with a depression in the streambed. Other complaints are about mal-odours from Lake Powell at some times of the year.

Those who live adjacent to North Creek consider that poor water quality and algal blooms diminish their lifestyle. Residents adjacent to Lake Manarup are concerned about the health of the wetland ecosystem due to artificially low water levels and are concerned about wind blown sediment within the lake when dry. Residents in these areas are generally concerned about the potential impact of environmental degradation on aesthetics and their property values.

A4.6 Nature Conservation

Lake Powell is an 'A-Class' reserve managed by the Department of Conservation and Land Management (CALM). It is well known for species richness, diversity and population size of water birds. It is regionally significant wetland. One reason for its high value as a wetland for water birds is that it has continuous water and reasonable depth. The high nutrient levels and prolonged algal blooms seem to not negatively affect bird breeding and use of the wetland. Higher bird numbers are partly due to the raised nutrient status of the water which has encouraged the growth of the Typha providing nesting areas and high levels of macro-invertebrate activity outside of the periods of algal blooms.

Lake Manarup and Torbay Inlet are identified as Vacant Crown Land administered by the Department of Land Administration. They are currently without dedicated management responsibility or effort. Both water bodies are considered locally to be of high conservation value but also at high risk. Lake Manarup does not reach full conservation value because of artificially controlled water levels for flood mitigation purposes. Torbay Inlet has decreasing water depth due to sedimentation, has poor water quality and experiences intense algal blooms.

A4.7 Recreation Opportunities

Local memories of the wetlands are often about swimming in fresh water, sailing up the lagoon to Torbay inlet and catching marron easily or fish that were 'worth eating'. Current residents would like to have increased recreational opportunities because it is significant to the lifestyle that they have sought by living there. Swimming, fishing and canoeing are the most popular water-based recreation. Windsurfing and sailing small craft is an interest. Potentially toxic algal blooms are of concern especially as young people either don't read warning signs or ignore them, and also for animals.

An increasing number of people are attracted to the tranquillity of the valley. Many enjoy the Grassmere-Elleker Road drive and appreciate the opportunities for casual contemplation along the way. There are also an increasing number of people camping near Torbay Inlet since improvements were made to access roads. These long-stay campers are generally interested in passive recreation and appreciate a healthy and diverse environment.

The potential for local tourism is recognised. The attractive landscape, environmental values and close proximity to Albany are significant. Further deterioration of environmental values is a deterrent to development of a tourism industry. There is recognition of the advantages of strong regional identification based on local conservation values.

A4.8 Land Use Planning

Land use change in the Torbay catchment is regulated under the Town Planning and Development Act (1945) through the Local Planning Strategy (LPS) and the Town Planning Schemes (TPS) operated by the City of Albany. The TPS provides guidelines and controls for subdivision and use and development of the land.

The LPS and TPS are currently under review as required under the Act. The new scheme will:

- Identify land within proposed rural zones (eg. general, priority, rural townsite and rural residential zones) in accordance with the State Planning Policies, the State Planning Strategy and the Lower Great Southern Region Strategy.
- Place controls on land use and development within the zones to achieve the stated objectives of the zones.
- Identify areas that require additional controls (e.g. areas subject to flooding, land use conflict, other non-agricultural use).

The revised scheme will provide for growth of Elleker subject to the preparation of a detailed townsite plan. Figure A8 illustrates the current residential areas of Elleker.

Some more intensive forms of rural land use will require land capability assessment to be prepared by the proponent to support the application (eg. intensive agricultural industries).



Figure A8. Residential development in Elleker and south of Lake Powell.

At a regional scale, the Department of Planning and Infrastructure is preparing the Lower Great Southern Planning Strategy. This provides direction for sustainable regional development. In some parts of the catchment, a lack of detailed land use planning has resulted in community conflict and environmental problems. In working towards the achievement of a community vision, there is a need for the Local and State Governments to understand the particular and special needs of the Torbay catchment, and coordinate planning strategies to address environmental problems or reduce environmental degradation.

A5.0 Surface Water Drainage System

A5.1 Natural Surface Water Drainage

Prior to alteration of the natural drainage system, the wetlands of the valley floor functioned hydrologically as one system – the water level for all components were the same and were influenced simultaneously by rising floodwaters behind the naturally formed sand bar. The valley floor was also simultaneously influenced by saline water intrusion under tidal influence with the sand bar was open. The sand bar breached as a natural occurrence when water levels rose to about 1.1 meters AHD (Australian Height Datum) behind the bar.

Marbellup Brook, Five-mile Creek and Seven-mile Creek previously discharged into Lake Powell. The lake was originally of greater area (bounded by the approximate location of the Grassmere/Elleker Road) and discharged through an outlet that is now known as North Creek. Overflow from the lake was direct into Lake Manipur. (Note: this water body is sometimes referred to as a lagoon although it is not a true lagoon landform. A lagoon is the water body that occurs behind a sand bar and is influenced by saline intrusions. While it may be argued that this occurs now, the water body was filled by fresh inflow from Lake Powell overflow under natural drainage system.) Lake Manipur previously discharged to Torbay bay when the sand bar was breached and water levels in Torbay Inlet were lowered.

The hydraulic gradient of the natural wetland system is very low. The amplitude of tides within the Torbay Bay ranges from 40 cm to 130 cm. Larger tidal sequences caused salt water to intrude upstream of the Lower Denmark Road along Marcell's Brook and through Lake Powell to the current Cuthbert horticultural area when the bar was open. Conversely, the wetlands and adjacent valley floors were probably well drained with low tide sequences. With evaporation, the wetlands were probably dry for periods of quite variable length. These factors suggest that the wetlands would have had considerable variation in hydro-period (including a drying sequence) and in salt concentration under natural conditions. It can be expected that the wetlands were well flushed on a seasonal basis.

A5.2 Sub-catchment Drainage

Soon after European settlement, land associated with wetlands within the Torbay catchment was recognised as being suitable for horticulture except for the risk of flooding. Drainage schemes were variously implemented until the current drainage system was constructed during the 1950's. The Torbay drainage system is a part of the Albany Drainage District, one of six districts established for agricultural land drainage of flood control in WA.

The natural sequence of surface water run-off has been altered considerably by drainage to control flooding and waterlogging in the six sub-catchments in the Watershed Torbay project area. Two of the sub-catchments (Torbay and Torbay West) discharge directly to the ocean or the inlet. Drainage in the other four sub-catchments is part of an integrated 3-level surface water control system. Drainage within the sub-catchments is listed below:

Seven Mile (upper) with 1.58 km of drains in the Seven Mile creek discharging into the Grassmere Drain.

Seven-mile (lower) with 9.74 km of drains from the Five Mile Creek and Cuthbert horticultural area (the Grassmere Drain) discharging into Lake Powell (the 'Middle Level' system).

Marbelup Brook with 4.32 km of drains discharging directly into the Torbay Inlet (the 'High Level' system) – a total annual flow of 16GL.

East Torbay with 16.78 km of drains (via North Creek) discharging directly into Lake Manarup (the 'Low Level' system).

Torbay East with 33.22 km of drains that discharge directly into the western side of the Torbay Inlet.

Torbay West with 3.88 km of drains that have direct ocean outfall.

Table A3. Drainage within sub-catchments	9.74 km
7 Mile Lower Sub-catchment	
7 Mile Upper Sub-catchment	1.58 km
East Torbay Sub-catchment	16.78 km
Marbelup Sub-catchment	4.32 km
West Torbay Sub-catchment	3.88 km
Torbay East Sub-catchment	33.22 km
TOTAL	69.52 km

In total there are approximately 70 km of excavated drains in the Watershed Torbay project area excluding feeder drains constructed on individual properties (Table A3). There are 180km of waterways within the project area.

The main areas of community concern about the drainage system are:

- Low water levels in Lake Manarup (unsuitable for water birds and wind mobilised sediments within the lake when dry)
- Acidic discharge water from the Low Level system into Lake Manarup.
- Mal-odours from Marbelup Brook below the Plug, and on occasions from Lake Powell.
- Water quality in North Creek for water-based recreation.
- Algal blooms in Lake Powell and Torbay Inlet.

With an increasing number of smaller landholdings and changing land use in the project area there are changing expectations for water resource management towards improved wetland health. This is significant for operation of the 3-level drainage system.

A6.0 Purpose of Restoration Plan

The Watershed Torbay Catchment Restoration Plan combines the expectations of community, as expressed through their Vision for the catchment, with science-based information. It provides a framework for implementation of priority actions through targeted investment under partnership arrangements. Partners to the project include many private landholders within the community as well as government and other public organisations. The Restoration Plan aims to achieve this vision through practical targets, strategies and actions.

The Restoration Plan also provides a 'blueprint' for change management. A key demonstration value of the project is recognition of the need for change in management practices. The goals, targets and actions of the Restoration Plan are focused on the changes that are feasible and acceptable.