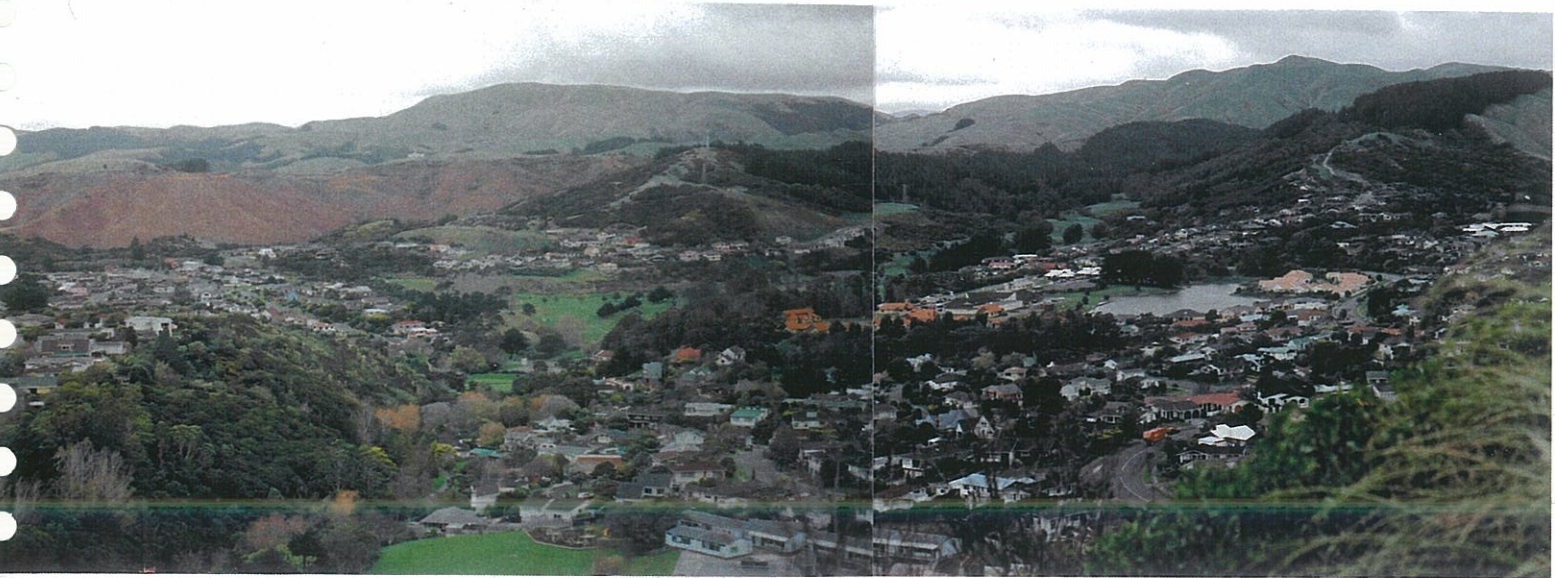


# **PAUATAHANUI INLET RESTORATION PLAN**

## **Stage 2- Southern and Western Catchments**



**Prepared by Paul Blaschke and Clive Anstey; March 2004**

**Report for Porirua City Council and Greater Wellington**

**Pauatahanui Inlet Restoration Plan  
Stage II  
Southern and Western Catchments**

**Report for Porirua City Council  
and  
Greater Wellington**

**Paul Blaschke and Clive Anstey**

**March 2004**



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## Executive Summary

This report is the second stage of the Pauatahanui Inlet Restoration Plan. It focuses on the southern and western edges of the Pauatahanui Inlet and their contributing catchments including the whole of Duck Creek. The purpose of the project is to produce an integrated restoration plan for:

- publicly and privately owned lands on the southern and western urban margins of Pauatahanui Inlet (including Duck Creek catchment); and
- the natural watercourses (including their riparian margins) and stormwater channels entering the southern and western urban margins of the inlet with particular emphasis on restoration techniques with the potential to reduce the inflow of silt, sediment and pollutants.

The total land area covered by Stage 2 of the Pauatahanui Inlet Restoration Plan (PIRP) is about 1350 ha or just under 13% of the total Pauatahanui Inlet catchments. Three principal areas are recognised within the Stage 2 PIRP area. The first two of these are the Browns Bay and Duck Creek catchments. The third major area is the Inlet edge from Camborne to the Pauatahanui Wildlife Reserve, including Golden Gate and the Southern Inlet itself. For more detailed consideration of restoration options the area has been further subdivided into ten "management sectors", each with a distinctive environmental character and management issues.

An objective in developing this document has been to provide a coherent framework within which the many diverse issues and concerns of communities can be discussed and debated. The document reflects this framework in its structure. Specific issues and concerns are placed within their wider environmental and social contexts in order to better see their relationships one to another, and their significance within the bigger picture. This in turn means that discrete actions are considered in their wider frameworks of effects. For example, protecting or restoring vegetation at the top of a catchment will have benefits within wider economic, social, as well as environmental, contexts.

Most of the issues and concerns raised by communities related to a perceived loss of environmental quality as a result of development. The loss of water quality in the Inlet was seen as the central concern. However, overall environmental quality in both the Inlet and the catchments was seen to have declined in the last few decades. Consultation highlighted the tension between desires to hold onto 'natural' values associated with the past and desires for a more 'developed' future. Inevitably there were concerns expressed about restoration as a constraint. Two related questions arose:

- Is the project a restoration or a protection project?
- If the latter, to what state is the Pauatahanui Inlet to be restored?

Restoration is generally defined as the act of 'bringing back to original state by rebuilding or repairing etc, or bringing back to health'. This definition implies that we are aiming to take the Pauatahanui Inlet back to some former state. However, the project has been approached with the vision of the Pauatahanui Inlet Action Plan firmly in mind: "...to protect the integrity of existing ecosystems and to restore degraded ecosystems...". Actions towards such a vision must clearly include protecting existing ecosystems, especially those that are less degraded, as well as restoring or re-creating degraded ecosystems. Together, the protection and restoration actions comprise *environmental enhancement*. This interpretation of restoration is consistent with the purpose of the Resource Management Act.



- Develop, implement and monitor effective controls on subdivision in terms of both vegetation removal and the management of sediment, especially within all Significant Ecological Sites.
- Monitor the quality of storm water entering the Inlet from SH1 before and after the installation of filters.
- Explore options for enhanced filtering of stormwater off SH1 and SH58 before it enters the Inlet.
- Limit all vehicle access to the inter-tidal area to the cars of residents, and for essential Council maintenance, and where possible assist owners with alternative access and parking away from the estuary edge.

#### **Stormwater**

- Provide inundation areas at the bottom of Duck Creek where the retention and filtering of storm-water can occur.
- Consider ways in which development can reduce impermeable surfaces and increase the management of stormwater with natural rather than engineered systems.
- Plant all areas subject to 1 year ARI floods in lower Duck Creek in low growing native riparian grasses and shrubs, and kept these free of structures.

#### **Biodiversity Protection**

- Ensure the protection of indigenous vegetation in the upper part of the Brown's Bay catchment either in Reserves or in covenants.
- Explore with landowners options to protect indigenous vegetation across Whitby's western slopes.
- Develop and implement an animal pest and weed control strategy for the catchments of Pauatahanui Inlet.
- Survey public and private land along the southern escarpment to identify areas where the vegetation cover is inadequate and ensure its restoration.
- Investigate the possibility of extending Duck Creek Saltmarsh Reserve.
- Develop a comprehensive non-statutory package targeting all landowners who manage areas of indigenous vegetation, especially Sites of Ecological Significance and areas of riparian vegetation.
- Complete stabilisation and restoration planting along Mana foreshore. between Pascoe Avenue and the first section of Camborne walkway.
- Consider zoning Golden Gate as a 'Special Character Area' with appropriate planning provisions.

#### **Resilience**

Resilience derives from a combination of the above and evolves over time. Some actions can make a particularly valuable contribution to resilience so that its priority is increased.



The vegetation cover and ecological processes of the Pauatahanui Inlet catchment have been totally transformed over the last 160 years. Most of the catchment is used for primary production or residential use so that restoration to a “natural” indigenous state is not a realistic aim. Rather than restoring the Inlet to rigorously defined standards a more practical objective is to concentrate on ensuring healthy ecosystems that are able to support both the indigenous and the introduced, ecosystems which are resilient to future environmental stresses and able to sustain a diversity of life and values. This approach focuses on ‘bringing back to health’ and ‘safeguarding the life supporting capacity of ecosystems’. Such an approach ensures an integrative focus, a focus on the underlying and essential systems that support the natural, the indigenous, and we humans.

Fundamental to life support is water, both its quality and the regulation of its flow. Its capture and distribution is clearly associated with vegetation. Water ways and their associated vegetation form life supporting frameworks within which cultural development can be supported. With development comes impermeable surfaces and the capture of stormwater carrying pollutants. The cleaning and management of this water in its return to natural waterways is critical to sustaining the life supporting capacity.

Four desired outcomes were identified by the consultants in consultation with stakeholders. The outcomes are:

**Water quality is maximised**

**Stormwater is managed safely**

**Biodiversity, natural character and amenity is maintained and enhanced**

**Environmental resilience is increased through good environmental design**

These outcomes are closely linked. All vegetation contributes in one way or another to sustaining water regimes. Vegetation provides terrestrial habitat and its shade helps regulate water temperatures. Connected frameworks of vegetation buffer streams and provide corridors for wildlife. Well-connected and coherent patterns of vegetation confer a character which is natural and contributes to valued amenity. Frameworks of water and vegetation provide settings for walkways and cycleways. And healthy and connected systems afford resilience.

The Action Programme in this project sets out 68 actions arranged into the ten management sectors. Also included are generic actions. Priority actions identified in the plan under each of the outcomes are outlined below. The table provided at the end of the final chapter sets priorities in accordance with these four key areas of concern and recognises the overlaps between them.

### **Water Quality**

- Plan and implement a re-vegetation programme for the upper reaches of Duck Creek catchment. Aim to re- establish a cover of woody vegetation over approximately a third of the total area, on steeper slopes and in riparian areas, and within the Landscape Protection Zone, with the objective of reducing sedimentation and flooding.
- Ensure the maintenance of a dense vegetation cover along the edges of waterways passing through Camborne and crossing the escarpment.
- Establish a full vegetation cover, woody if possible, on all slopes over 35<sup>0</sup>, whether in private or public ownership.

## ACKNOWLEDGEMENTS

This report has benefited greatly from the input of Colin Hickling, Connell Wagner Ltd, who provided hydrological expertise and reviewed the draft.

In the course of developing this plan consultation has been as wide as possible within the time constraints of the project. The consultants have met with local iwi, community groups and private organisations; including:

- Pauatahanui Inlet Community Trust
- Ngatitōa Iwi
- Paremata and Whitby Residents' Associations
- Guardians of Pauatahanui Inlet
- Friends of Belmont Regional Park
- Plimmerton Rotary Club
- Forest and Bird Protection Society
- Significant landowners such as Whitby Coastal Estates and Silverwood Forests

The consultants have also had numerous discussions with officers of the following organisations:

- Wellington Regional Council and Porirua City Council
- Department of Conservation
- Transit NZ

All people who have given time to attend consultation meetings and all representatives of these organisations who have generously given time, ideas and enthusiasm to the project are warmly thanked. Among this large group our special thanks to Matt Trlin, Manager of Environmental Policy at Porirua City Council, for his helpful supervision and enthusiastic support throughout the project.



## INTRODUCTION

### Background to project

In August 2000 the former Pauatahanui Inlet Advisory Group<sup>1</sup> finalised and published "*Towards Integrated Management*", an action plan for the future management of the Inlet and its surrounding catchments. This action plan was a landmark document for environmental management in Porirua City. As part of giving effect to the action plan the Porirua City Council and Greater Wellington, in conjunction with the Pauatahanui Inlet Community Trust, are jointly undertaking a programme to manage the environment of the Inlet and its catchment.

An important early component of the programme was development of a comprehensive restoration plan for terrestrial, estuarine and riparian habitats in the catchment, as recommended in "*Towards Integrated Management*". This was to be phased in three stages over a three-year period. Stage I covered public reserves on the northern and eastern fringes of the Inlet, Stage II covered the southern and western fringes, the urban and southern portions of the catchment, and Stage III the remainder of the rural (northern and eastern) portions of the catchments.

In 2002 Clive Anstey and Paul Blaschke undertook Stage I of the Pauatahanui Inlet Restoration Plan (PIRP), guided by "*Towards Integrated Management*". That project, reported in August 2002, was adopted by Porirua City Council in April 2003 and has subsequently been made widely available as a guide to councils and other agencies and organisations in planning and undertaking projects related to restoration.

Since the first stage of work on this plan began in April 2002, there has been some encouraging activity towards integrated restoration and management of the Inlet's unique resources. Some highlights of this work are shown in Appendix 1.

Overall, then, there is a healthy interest in the well-being of the Inlet and its catchments, but against a backdrop of still ill-defined unease concerning trends in ecological health, as discussed in the first stage of the PIRP. The overriding issue to be addressed is still the health of the estuarine environment and perceptions of its deterioration. The challenge is to more exactly confirm the possible sources of deterioration, and to develop a mix of initiatives to improve the health of the Inlet and simultaneously bring other ecological and amenity and cultural benefits to the landscape. Without doubt this will require a wide focus on linkages between land and water, and on the health of the catchment – both the urban and rural parts – as well as the health of the Inlet. To reverse the processes of deterioration and fragmentation and move *Towards Integrated Management* will require that ecological systems and the cultural values and patterns are understood and that their relationships as expressed in the Pauatahanui landscape are clearly defined.

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<sup>1</sup> The group comprised representatives from Porirua City Council, the Wellington Regional Council (now Greater Wellington), other agencies and community groups. It was replaced by the Pauatahanui Inlet Community Trust in 2002.



## Purpose of this Restoration Plan

The Stage II restoration plan is intended to focus on the southern and western edge and the wider southern areas of Pauatahanui Inlet including the whole of the Duck Creek catchment. The purpose of the project as stated in the project brief was *to produce an integrated restoration plan for:*

- *publicly and privately owned lands on the southern and western urban margins of Pauatahanui Inlet (including Duck Creek catchment)<sup>2</sup>; and*
- *the natural watercourses (including their riparian margins) and stormwater entering the southern and western urban margins of the inlet with particular emphasis on restoration techniques with the potential to reduce the inflow of silt, sediment and pollutants to these watercourses.*

As for the previous plan, the starting point has been the vision expressed in *Towards Integrated Management*. This vision is stated in Box 1.

### **Box 1 - A Vision for the Inlet and Catchment**

*“The Pauatahanui Inlet and its catchment are managed to:*

*Enhance the quality of the environment by protecting the integrity of existing ecosystems and by restoring degraded ecosystems wherever possible.*

*Enable people to enjoy recreational activities and to undertake economic activities without compromising the reasonable foreseeable needs of present and future generations.*

*This can only be achieved by management agencies and the community working together.”*

One of the fundamental considerations in the implementation of this plan (more so than for Stage I) is to reconcile the requirements for publicly and privately owned land in the catchment, and to balance requirements for public and private actions. To what extent does the vision in *Towards Integrated Management* represent community aspirations?

As will be seen in subsequent sections, discussions with stakeholders during the project reinforced the validity of the above vision. This was despite the significantly different views on the balancing of private and public values and the means of achieving the vision.

Over the next few years the new requirements for Long-Term Council Community Plans under the Local Government Act 2002 will provide an opportunity to further validate and where necessary to refine the vision. The Trust is shortly to undertake a Strategic Plan which may also result in changes to the vision and objectives of *“Towards Integrated Management”*. In the meantime the consultants preparing this plan have attempted, within the requirements of the brief, to treat the project as a form of community planning and to treat

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<sup>2</sup> The boundaries of the study area are shown in Map 1 and described in the individual sector descriptions.



their role as catalysts and resource people for this process. The stakeholders in the process are those organisations listed in the acknowledgements. It is recognised that there is a wider community of interest, especially organisations and individuals with an interest in the wider Pauatahanui catchment and Porirua City issues.

The process used by the consultants in developing this stage of the PIRP was essentially very simple, and similar to that adopted for Stage I. The essential steps are summarised in Appendix 2.

The process in the context of the PIRP project is shown in Fig 1.

## Integration

*Towards Integrated Management* makes it clear that the overriding issue to be addressed in each of the three restoration projects is the ecological health of the estuarine environment. This is the primary integrative objective for the project. The Inlet is the “sink” for catchment activities and the effects of those activities, as well as being the most significant ecological resource in its own right.

A particular focus for this stage of the PIRP is the potential effects on the Inlet and the catchment of two significant developments in lower Duck Creek. The closure of the Duck Creek golf course in 2002 and subsequent proposal by the owner to subdivide the entire area for residential development<sup>3</sup> has coincided with the logging of a major part of Silverwood Forest and the prospect of further residential subdivision of open space in the future. Although both these developments are taking place on privately owned land that has had residential zoning for many years, it is inevitable that proposals for development on land with such high amenity and recreational values would arouse significant public scrutiny and controversy. Both these projects have the potential for large sediment inputs and riparian impacts, and are of major significance for environmental management in the lower catchment.

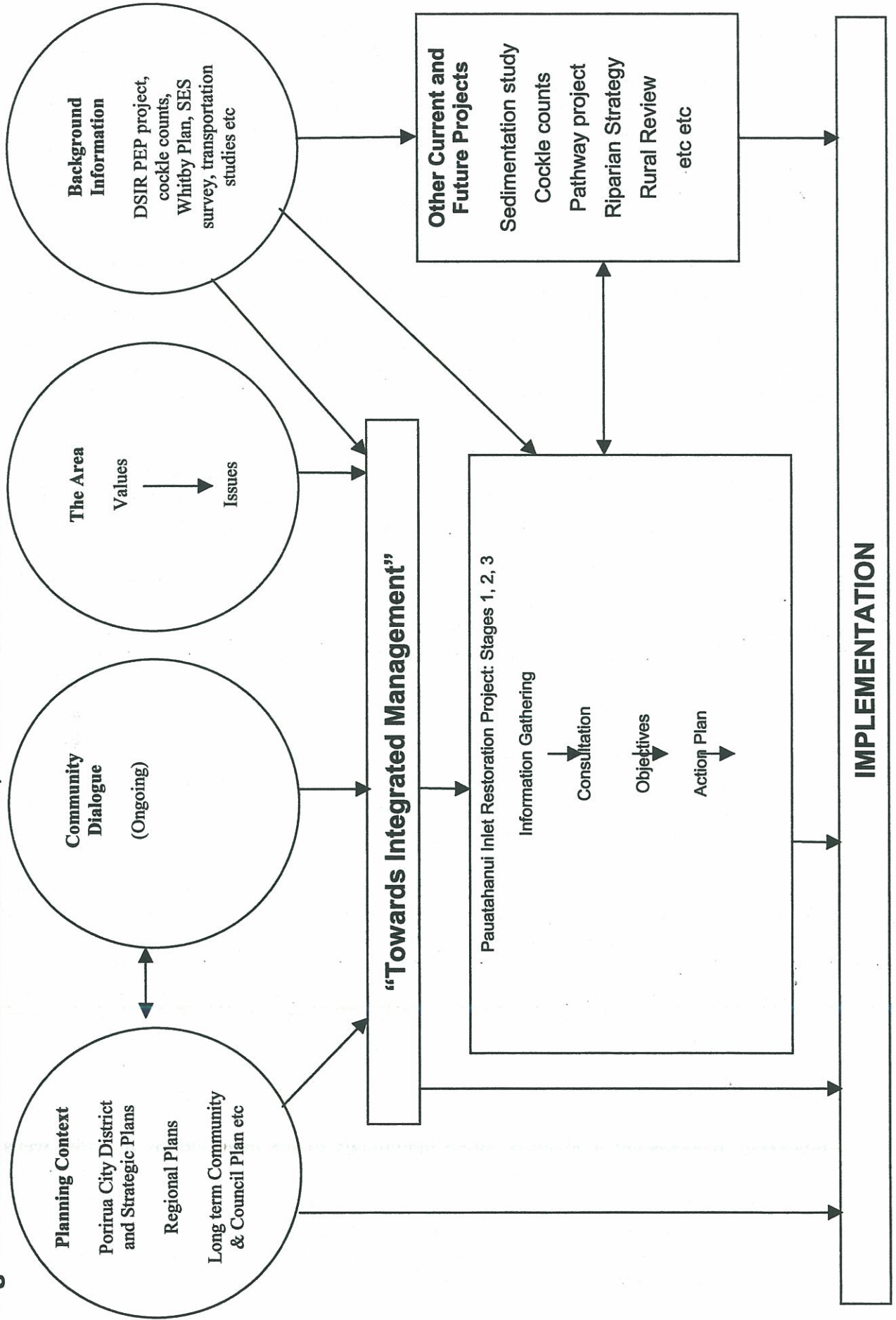
These are undoubtedly significant issues for Duck Creek, the largest part of the Stage II PIRP area. Nevertheless, these two development scenarios are by no means the only two significant issues for environmental management in the area. There are particular concerns for a number of issues in which individual activities are small and sometimes imperceptible, but cumulatively may be very significant for the Inlet and catchment. The challenge for this stage of restoration is to make clear the connections between what may often appear as inconsequential activities and their cumulative effects, throughout the catchment.

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<sup>3</sup> Some parts of Silverwood Forest and areas of current subdivision in eastern Whitby lie within the lower Pauatahanui Stream catchment. As at the end of 2003 resource consents have only been applied for and granted for part of the total area proposed for subdivision.



**Fig. 1. Pauatahanui Inlet Restoration Plan, Process and Context**





For example, management of water from roads and other hard surfaces is a particular focus of this stage of the PIRP. Stormwater from State Highway 1 enters the Inlet at Dolly Varden Beach, State Highway 58 runoff drains into the Inlet around the entire southern edge, and the urbanised area of Whitby discharges road runoff into Browns Bay and Duck Creek Reserve. Contaminants from vehicles are invisible and each individual road journey contributes very little. Cumulatively, however, the contamination may be so severe that, although still poorly documented, it is now suspected that road runoff may be bringing dangerously high levels of pollutants into the fragile Inlet ecosystem (see Chapter 4).

The ongoing fragmentation of ecosystems in the catchments of the Inlet is a critical concern. So too is the attrition of significant natural areas (ecological sites) within those ecosystems. Fragmentation impairs the functioning of ecosystem processes and reduces the amount of natural habitat available for wildlife and organisms that contribute to the environment in various ways. The exacerbation of erosion and siltation from exposed soils with the clearance of woody vegetation may well be contributing to the deterioration of the estuarine environment.

Whereas the Stage 1 Restoration Plan was largely confined to the estuarine edge, Stage 2 includes the entire catchment of Duck Creek. In this Stage 2 investigation residential development has assumed a far greater significance than was the case in Stage 1. Around the northern and eastern edges of the Inlet structures are few, and generally set well back from the Inlet edge or buffered by substantial areas of vegetation. Along the western and southern edges however, residential development hugs the edges of the Inlet with strong competition for access and views. Almost every resident who is able to wants to optimise views, and some are prepared to clear vegetation to do so. There are now significant sections of the Inlet edge that are dominated by structures, along with exposed rock and clay, where formerly the view was dominated by vegetation.

Encroachment into the sensitive estuarine environment takes many forms and seriously threatens not only ecological but also the visual integrity of the estuarine edge. Maintenance of the remaining natural character of the environment, and especially the Inlet edge (the interface between land and water), is an important unifying theme for this study.

Management of water – both its quantity (effectively the management of stormwater flows) and its quality – is another integrating theme. Integrated management in the Pauatahanui catchment requires that roads and rivers throughout the catchment, along with walkways and cycle-ways, are treated as being related by their association with water. The streams of the area have high intrinsic and amenity values, but are also the conduit through which pollutants, including sediment, pass into the Inlet. The importance of riparian management has already been recognised in *Towards Integrated Management*. Water management is, in turn, often inseparable from vegetation management. Vegetation is a further integrating theme for the coherence of both the ecological and the visual environments.

Integrated management is about enabling individuals to see their actions in wider webs of connections and relationships. Building an overview of the Pauatahanui landscape and establishing the significance of the various places within it requires an ongoing dialogue between individual residents and the agencies responsible for planning and statutory management. It is through this process of engagement, a process incorporating local knowledge, experience, and aspirations, that a sensible way forward will be found.



Reversing the process of deterioration and fragmentation and moving towards sustainability will require that ecological and cultural values and patterns are more sympathetically aligned, and also reconciled with economic values where there are tensions. This plan has been developed with this longer term objective in mind.

## Restoration or protection?

In consulting with communities two related questions have arisen:

- Is the project a restoration or a protection project?
- If the latter, to what state is the Pauatahanui Inlet to be restored?

Restoration is generally defined as the act of 'bringing back to original state by rebuilding or repairing etc, or bringing back to health' (New Zealand Oxford Dictionary). This definition implies that we are aiming to take the Pauatahanui Inlet back to some former state.

The project has been approached with the vision of *Towards Integrated Management* firmly in mind: "...to protect the integrity of existing ecosystems and to restore degraded ecosystems...". Actions towards such a vision must clearly include protecting existing ecosystems, especially those that are less degraded, as well as restoring or re-creating degraded ecosystems. Together, the restoration and protection actions comprise *environmental enhancement*.

This interpretation of restoration is consistent with the concept of sustainable management as defined in the Resource Management Act. The Act requires that people manage natural resources in a way that provides for their social, economic and cultural well being while, among other things, safeguarding the life supporting capacity of water, soil and ecosystems; and avoiding remedying or mitigating any adverse effects of activities on the environment.

The vegetation cover and ecological processes of the Pauatahanui Inlet catchment have been totally transformed over the last 160 years. Most of the catchment is used for primary production or residential use so that restoration to a "natural" indigenous state is not a realistic aim. Bringing the catchment back to the state described by the Pauatahanui Environmental Project in the late 1970s might be a more realistic aim. At that time there were more indigenous fragments, less pressure from weeds, and less sedimentation from earthworks and land development. There were probably more natural hydrological processes and higher populations of key indigenous species in both the estuarine and freshwater ecosystems. However at that time it is also likely that there was high sedimentation from farmed soils (from areas now largely planted in exotic trees or naturally regenerating), high nutrient runoff levels from topdressing, and very poor riparian values. In some respects it may therefore be feasible to enhance aspects of the 1970s environment.

However, rather than restoring the Inlet and catchment to some rigorously (and possibly arbitrarily) defined benchmark, it may be more practical to concentrate on ensuring healthy ecosystems that are able to support both indigenous and introduced elements, ecosystems resilient to future environmental stresses. This approach focuses primarily on the 'bringing back to health' aspect of restoration, and the 'safeguarding the life supporting capacity of ecosystems' aspect of sustainable management.

## Uncertainty and Precaution

One of the themes coming through the information reviews and discussions, and reflected in this document, is the lack of proven conclusions about the environmental condition of the study area. This uncertainty has been a fundamental challenge for this project. The concerns about the declining health of the Inlet, introduced above, have not yet been scientifically "proven". However, in the judgement of the consultants these concerns are not only widespread but also justified. The consultants feel that given the critical importance of the health of the Inlet to the environment of Porirua City it is appropriate to focus the discussion of restoration options around such concerns. This is an example of acting on a precautionary principle, because if we waited for incontrovertible evidence of contaminant pollution, for example, we may well cross a threshold of environmental deterioration from which it would be extremely difficult to recover.

However, we do need to be cautious about the basis of statements of concern. The report attempts to base assertions on what is documented. Beyond this, the consultants have stated where they have interpreted value judgements in the report as being a "community consensus" as expressed in the consultation meetings for the project. Value judgements that are not attributed to "community consensus" in the consultation meetings are the considered judgements of the consultants. These judgements are not necessarily the views of Porirua City Council and Greater Wellington.



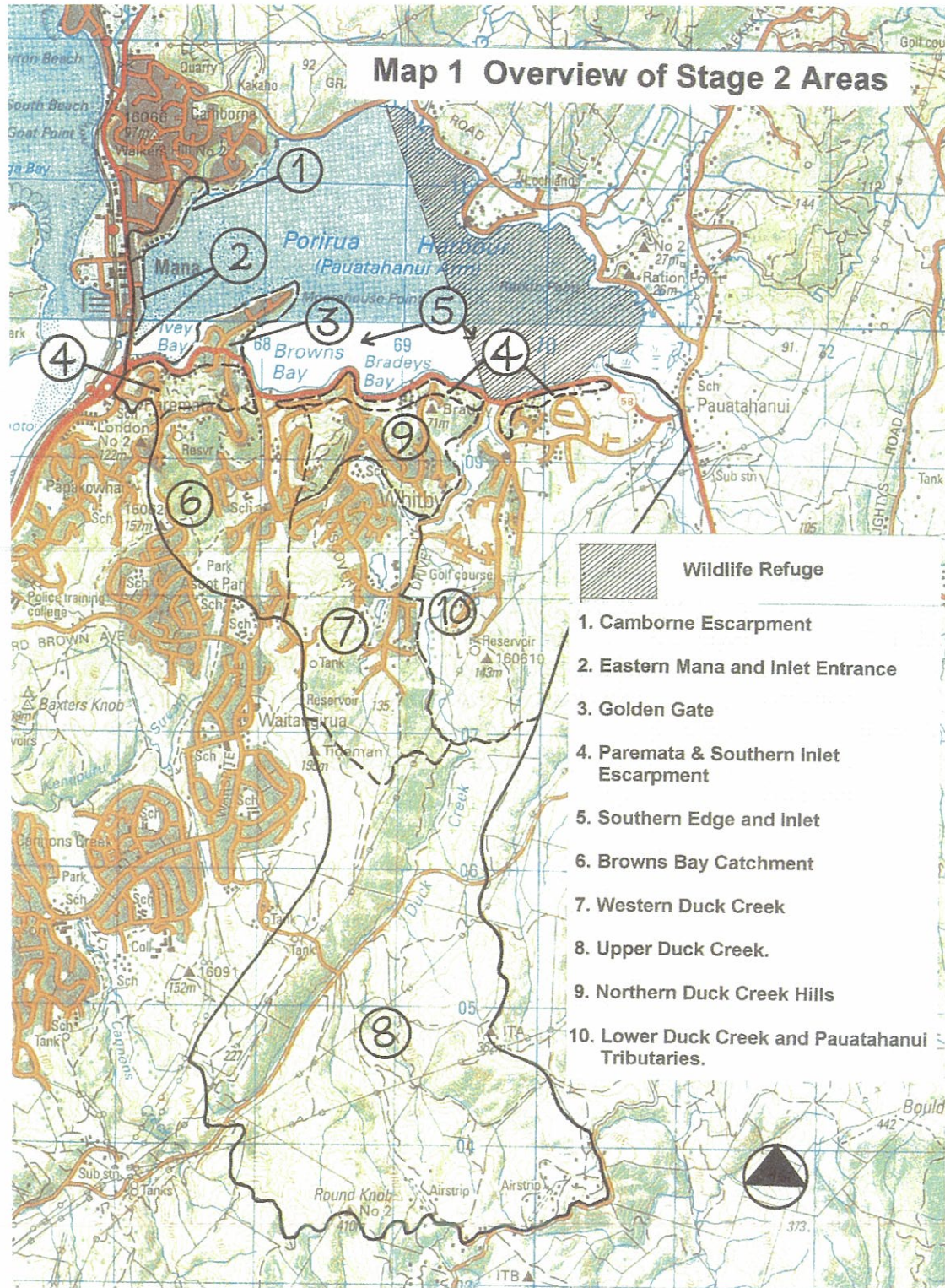
## GEOGRAPHICAL OVERVIEW

The total land area covered by Stage 2 of the PIRP is about 1350 ha or just under 13% of the total Pauatahanui Inlet catchment. Three principal areas are recognised within the total Stage 2 PIRP area. The first two of these are the principal catchments of the plan area: the Browns Bay and Duck Creek catchments. The third major area is the Inlet edge all the way from Camborne to the Pauatahanui Wildlife Reserve, including Golden Gate and the southern Inlet itself. In this third area, the critical land-water interface is between the coastal land edge and the estuarine marine environment of the Inlet, whereas in the first two areas the land-water interface is between catchment land and the streams flowing through it.

For more detailed consideration of restoration options (Chapter 4) the study area has been subdivided into ten “management sectors”, each with a distinctive environmental character and management issues. Most sectors are based around sub-catchments of Duck Creek and Browns Bay. Map 1 shows the areas and management sectors. Inevitably, there are some minor overlaps on a strict catchment basis, and accepted for practical reasons.

In this chapter a brief geographical overview of the three principal areas is provided, focussing on important natural features including Significant Ecological Sites recognised in a recent survey for Porirua City Council (Boffa Miskell 2001a; see Chapter 3 for more discussion of these). The management sectors are described in more detail in Chapter 4 where sector-specific restoration options are discussed. (and also in Appendix 1.) Maps 4-6 show restoration issues and options for the three major areas. Appendix 2 provides notes on the history of development within the study area, especially Whitby Village, setting a useful context for current issues.







## Area Descriptions

### The Inlet Edge

#### Management Sectors

1. **Camborne Escarpment**
2. **Mana Foreshore and Inlet entrance**
3. **Golden Gate**
4. **Paremata and the Southern Inlet Escarpment**
5. **Southern Inlet**

An escarpment forming the western and southern edges of Pauatahanui Inlet, from southern Camborne all along to the Pauatahanui Wildlife Reserve. Rises to 100 m a.s.l in the Paremata area. Includes a small peninsula (Shearers and Moorhouse Points) forming the Golden Gate management sector. Visually prominent and attractive visual backdrop to the Inlet. Partly bush-covered but bush areas have been significantly fragmented and some parts have been intensively developed for housing. The escarpment is broken by the Browns Bay and Duck Creek streams. Foreshore areas include Dolly Varden Beach in eastern Mana and Ivey, Browns and Bradeys Bays along the southern Inlet edge and a few small rocky outcrops and narrow beach and foreshore areas along the southern Inlet edge.

The Inlet between Mana and Moorhouse Point includes extensive tidal sandbanks and cockle beds - one of the largest inter-tidal zones in the whole Inlet - as well as the relatively deep Inlet entrance which is vital for tidal flushing of the whole Inlet. The Mana shore edge, although highly modified, contains the only remaining sand dunes on the Inlet. There are also some small and very fragmented eelgrass beds remaining along the foreshore, mainly in the vicinity of Ivey Bay and the SH1 and rail bridges.

The Inlet Edge has the smallest land area of the three areas (only about 100 ha land area) but the highest proportion of public land, as recreation, road, or foreshore reserve. There are about 10ha of natural areas (excluding the estuary), and parts of four Significant Ecological Sites (Boffa Miskell 2001a): Camborne Inlet Scarp, Browns Bay Escarpment Bush, Bradeys Bay Escarpment Bush, and Ivey Bay Bush.

This area has the longest history of residential occupation of the three, but also includes some recent residential enclaves along the escarpment. The area contains SHI on the southern Mana esplanade and the Paremata bridge, and the westernmost section of SH58 – together the busiest arterial routes in Porirua City. There is also heavy foot traffic along the Mana foreshore and around the Ivey Bay boatsheds and kindergarten.

It also includes the southern part of the Pauatahanui Inlet itself, the focal point of the catchment and the PIRP and arguably the most important ecological resource in Porirua City. The eastern third of the Inlet is protected as a Wildlife Refuge (Map 1).





**Ivy Bay Foreshore and view along Golden Gate Edge**



**Camborne Walkway**



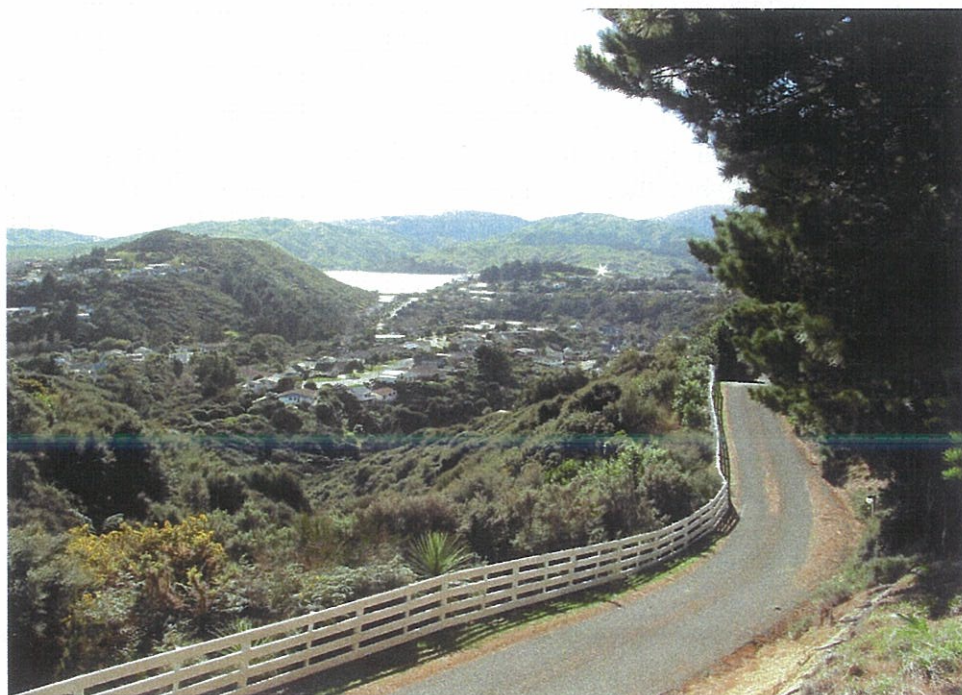
## Browns Bay Catchment

### Management Sectors

#### 6. Browns Bay Catchment

Consists of the Browns Bay catchment, except for the escarpment fronting the Inlet at the lower end of the catchment. About 130 ha in area, less than 1% of the total Pauatahanui catchment area. A mixture of built up areas in the central and eastern parts of the management sector, areas of pine trees, regrowth native vegetation and on the western hills, small areas of riparian vegetation associated with watercourses, and grassy open space around Postgate Park and Browns Bay Reserve. Some heavy traffic on Postgate Drive. Predominantly private land but includes some significant PCC reserves and adjoins Ascot Park in eastern Porirua. Large PCC reserve running below Kahu Rd which contains part of the Ascot Park Bush SES (Boffa Miskell 2001a).

The catchment was urbanised rapidly in the 1970s, with much sedimentation into Browns Bay (Healy 1980). Reserves that were originally excluded from development because of inaccessibility and set aside for amenity purposes now perform an invaluable ecological function. For example riparian areas along the headwaters of Browns Bay stream contain typical native riparian species and reasonable bird populations. A geographical and ecological link between Pauatahanui Inlet, Whitby and the Porirua Harbour catchment. In the lower part of the catchment water from the Browns Bay stream, augmented by stormwater, vanishes into pipes, emerging briefly to cross Browns Bay Park before entering the sea.



View from the Western Hills onto Postgate Drive



## Duck Creek Catchment

### Management Sectors

7. **Western Duck Creek**
8. **Upper Duck Creek**
9. **Northern Duck Creek Hills**
10. **Lower Duck Creek and Pauatahanui tributaries**

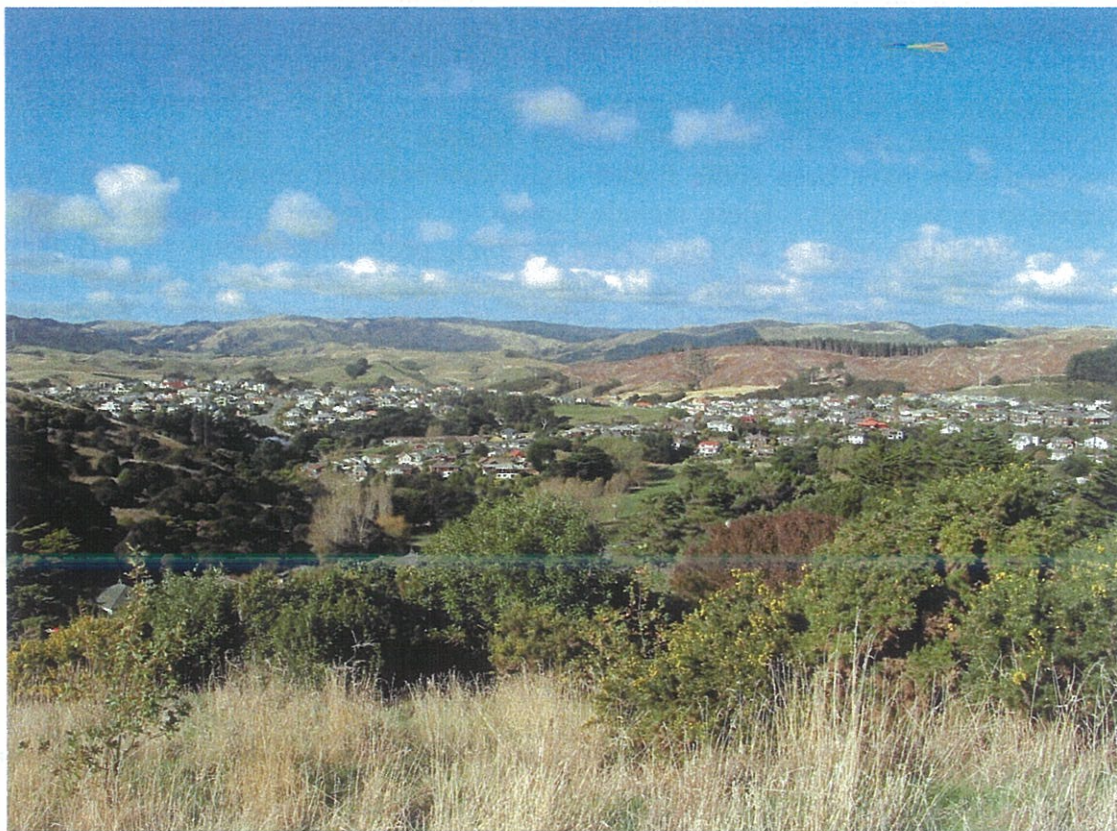
The largest part of the PIRP Stage 2 area, comprising 1050 ha of the Duck Creek catchment and about 50 ha of the Pauatahanui catchment in the far north-eastern corner of the study area. The upper catchment (management sector 8) is steep hill country, with shallow soils, rocky outcrops and a somewhat incised stream. This sector, the largest in the plan area, is the most rural in character, being almost all in pine forest or pasture, except for some regenerating areas close to the stream bottoms and steeper parts of the hills. The remainder of the area is fairly gentle hill country surrounding the flat Duck Creek stream channel. These management sectors have a mixture of houses, standing and cleared pine forest (to be sown in pasture pending eventual subdivision) regenerating kanuka and manuka dominated bush, small areas of more advanced regeneration with shrub hardwoods, and some grassed open space.

Duck Creek, as the largest stream in the study area, is an important ecological feature, with several native fish species including galaxids. The lower end of Duck Creek contains natural open saltmarsh vegetation and links the catchment with the Inlet. There are eight other Significant Ecological Sites (Boffa Miskell 2001a): Latitude Close, Whitby West Bush, Exploration Drive Kanuka Forest, Navigation Drive Kanuka Bush, Duck Creek Saltmarsh, James Cook Drive Bush, Samwell Drive Bush, Endeavour Park Bush remnant, and Scorseby Grove Kanuka Forest, totalling 44 ha. Some of these SES contain remnants of good podocarp-hardwood forest, but these areas are very fragmented. The lower Duck Creek management sectors are the most recently urbanised parts of the study area; they are still experiencing strong development pressure so that the fragmentation of natural areas and ecological processes is ongoing.





**Western Hills**



**View across Duck Creek with recent logging in background.**



## OVERVIEW OF CURRENT VALUES AND MANAGEMENT ISSUES

In this chapter a summary of current values and management issues is given. This is preceded by a brief discussion of information sources for the project.

### Information Sources

The sources of information for the Pauatahanui Inlet Restoration Plan are varied. The principal source of scientific information about the Inlet and its catchment remains the Pauatahanui Environmental Programme (PEP), a large study led by the former department of Scientific and Industrial research in the 1970s. The study largely arose out of concerns about the effects of development on the Inlet, especially sedimentation. It had very ambitious objectives:

*“... understanding the present environment, defining its sensitive features, producing data of assistance to planners to enable wise management of this natural resource as a viable entity, and establishing baselines for monitoring changes resulting from development”.*

The scope of the study was broad, as reflected in the contents of the synthesis volume, as well as the many individual scientific papers that were separately published (Healy 1980). The synthesis volume alone covered human history, landscape and geology, the catchment today, the Inlet today, inlet processes, and the impact of the catchment on the Inlet.

Most recently the PEP synthesis volume was updated by a literature review that summarised research between the PEP and 2000 (Boffa Miskell 2000). Since that synthesis was completed there have been some further significant research projects, most of which are referred to in this report. These include the survey of Sites of Ecological Significance in Porirua City (Boffa Miskell 2001a), a water sampling programme (Hooper 2002), the fifth in the series of sampling of cockle populations undertaken by the Guardians of Pauatahanui Inlet (Tovey and Grange 2002), and a study of cockle health (Hine in press).

There are two further important current projects in progress which will considerably advance our knowledge of the Inlet and catchments, and options for restoration. The first is a study of urban stormwater containments in several catchments in the Wellington region, including Duck Creek and Browns Bay Creek. In 2003 these catchments were monitored for heavy metals, PAHs, and sediments during flood flow conditions. Some interim results are incorporated into Appendix 6. Full results will be available later in 2004.

The second initiative was a workshop on “De-stressing Estuaries”, convened by PICT, Porirua City Council and Greater Wellington, at Pauatahanui in October 2003. The workshop summarised current New Zealand knowledge about estuaries and their management and restoration, and then discussed its application to restoration in the Pauatahanui Inlet. Experts from around New Zealand attended, along with Pauatahanui Inlet stakeholders including councillors and council staff, tangata whenua, landowners and community groups. Appendix 7 summarises the contents and aims of individual sessions of the workshop. A focus of New Zealand work reviewed was the considerable research relating to the Waitemata Harbour, beginning in the late 1970s and building in part on the



PEP (Williams 1979-1983), which provided the scientific basis for the considerable amount of work that has been done by the Auckland Regional Council in erosion, sediment and contaminant control in urban estuaries and their catchments (see references in Auckland Regional Council publications in the bibliography). A further highlight was the documentation of Maori cultural values associated with estuaries, for the Pauatahanui Inlet in particular.

Proceedings from the workshop are currently being compiled. When complete and available they will provide a very useful resource for further research and restoration work. Some of the obvious research gaps relevant to the southern catchments are discussed in Chapter 4. In the meantime, however, it was clear to us from work elsewhere in New Zealand that there is a clear threat of long-term degradation in the Pauatahanui Inlet, and that a precautionary approach to the sustainable management of the Inlet and catchment, difficult as this may be, is essential.

In planning such an approach the continuing relevance of the PEP findings has been questioned, given that the survey is about 30 years old and many changes have occurred in the catchment. However, in the consultants' opinion, many of the basic conclusions about environmental processes in the Inlet and catchment remain valid. In fact the 2000 literature review (Boffa Miskell 2000)<sup>4</sup> concluded that "the principal conclusions of the [Healy] report appear to be still sound today. Subsequent studies have added to our knowledge but not fundamentally changed it". As an example, the recent storm water modelling of Duck Creek (BECA 2003) used a different method of calculating and presenting stormwater flows in the catchment than the PEP. However, the authors of the BECA report consider that "...the DSIR report is generally supportive, and certainly not inconsistent with, the BECA report. In fact, on the matter of peak daily flows, the DSIR results are very close to the BECA results."<sup>5</sup>

## Values

### Natural Values

#### Ecodomains and dominant vegetation

Cues to ecological restoration and especially to appropriate planting can be found by reference to ecodomains (areas subject to similar environmental factors). These were mapped for Porirua City in the recent Inventory of Ecological Sites (Boffa Miskell 2001a).

There are a number of areas with indigenous vegetation deemed to be 'significant' in terms of the Resource Management Act. These have been identified as 'Sites of Ecological Significance' in a recent survey commissioned by Porirua City Council (Boffa Miskell 2001a). Some, but by no means all of these areas, fall into council reserves. Whitby has a significant number of important remnants located on private land. The location of Sites of Ecological Significance is shown on Map 2. The map shows the distribution of these sites across public reserves and private land.

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<sup>4</sup> Paul Blaschke was the principal author of that review.

<sup>5</sup> Letter from P Steel, Director of Civil Engineering, BECA, to M Trlin, Porirua City Council, 30 July 2003.



## Wildlife

**Estuarine areas:** The Pauatahanui Inlet is recognised as the most significant estuarine wetland in the lower North Island, and of national, possibly international, significance. Some of the most important values are associated with the Pauatahanui Wildlife Reserve at the eastern end of the Inlet, just to the east of the study area. This area was dealt with in Stage I of the Restoration Plan. However southern and western shores of the Inlet and their adjacent areas also have important values. The Mana sandbank is one of the richest habitats in the Inlet. It has high densities of many estuarine species and is an important habitat for shore birds such as oystercatcher and red-backed gull. Other species such as shags, herons and pied stilt are common along the southern shore. 30 marine fish species are recorded from the Inlet in the PEP study. Some of the common species such as yellow-eyed mullet and sandy flounder were noted as being abundant near the mudflats off Duck Creek and the Inlet was regarded in the 1970s as being a regional important fish “nursery area” (Healy 1980).

**Freshwater fish:** Inland from the Inlet, a high diversity of freshwater fish are present in several catchment streams, including Duck Creek where at least 7 species were recorded in the last survey in 1983 (records from the NIWA freshwater fish database). These species included several inanga and eel species including some that are nationally or regionally threatened and two that are considered vulnerable<sup>6</sup> in the Wellington region. These two are the giant kokopu and the short-jawed kokopu, although the record for the latter is of doubtful accuracy (but the species was present in the Horokiri Stream in 1989).

**Birds:** A range of native birds have been recorded from inland areas, particularly in the larger and better quality bush remnants (see Appendix 1).

## Social Values

### Recreation values

The recreation values and the quality of experiences the Inlet affords are high, both generally and in specific places. Significant recreation activities currently enjoyed around the Inlet include walking, cycling, swimming, fishing, windsurfing, sailing and bird watching. Away from the Inlet edge a further wide range of sports and leisure activities occur. Of particular note is the sophisticated network of walkways through Whitby that serve both practical and recreational purposes, connecting community centres and facilities as well as lookouts and play areas.

There is also a strong possibility that the recreational use of the Inlet may rapidly increase with an awakening to its attractions and the improvement in access and services. The current proposal for a “pathway project” to provide a secure cycling and/or walking route around the whole Inlet (see further discussion in Chapter 4) may serve as a catalyst for this increase.

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<sup>6</sup> The technical criterion for vulnerability is that the species faces a high probability of extinction in the wild in the medium-term future.



### *Visual and amenity values*

For the most part the landscape to the north and west is grazed with small fenced and treed enclosures on the river flats and expansive open pasture on steeper rolling hills. There is a strong sense of space with expansive views across the water to distant hills. Estuarine vegetation, grass, and woody vegetation, dominates the edge of the Inlet and provides a natural transition from water to land. By contrast, the landscapes of the southern and eastern parts of the Inlet are very much more cultural and development dominates the edges. However, the steeper and less accessible areas remain undeveloped for housing. There are substantial areas in reserves and these provide a vital continuity in vegetation cover along edges and on higher promontories.

There are scattered areas of indigenous remnants, predominantly manuka/kanuka, along the scarps above the Inlet and on steeper faces within the Whitby area. For the most part however the vegetation is a mix of exotic and indigenous species. The recent removal of mature pines from visually prominent areas, Silverwood Forest and the reserves along the northern hills of Whitby, has created a sense of change and transition. The challenge for the future development and management within the Inlet will be to retain the delicate balance between natural and built elements; spectacular views across the inlet attract development to its edges so that there is constant pressure to improve access and increase structures.

## **Cultural Values**

### **Maori Cultural Values**

The Pauatahanui district had been settled by Maori for many hundreds of years before European settlement, and there is a rich genealogy of the district's people: their life in the area and their use of its resources (Healy 1980, Sheehan 1988).

Traditionally the Inlet was of enormous value as a source of kai moana to the tangata whenua, Ngati Toa (Pomare 2003). Currently its use for food is much diminished and some iwi members do not eat kai moana from the Inlet due to fears of pollution. However, it is still highly regarded by Maori as a fish nursery. Both tangata whenua and non-Maori recreational fishers are likely to regard enhancement of the Inlet fisheries as being a very high priority. In some New Zealand districts the ability of tangata whenua to be able to harvest kai moana for their marae is regarded as an important integrative environmental indicator.

### **European Historic Values**

The area also has a long history of European settlement, mainly as a farming settlement, which is reasonably well documented (Healy 1980; Heath and Balham 1884; Sheehan 1988; also many unpublished historical resources in the Porirua Museum).



## **Economic Values**

High, and increasing, property values in the coastal environments of the study area are to a large degree attributable to the high recreation and amenity values associated with the Inlet. The Inlet is seen as a “desirable place to live”. There is also an awakening to the value of having indigenous birds as neighbours. A Landscape Protection Zone at the back of Whitby affords some protection to the character and visual amenity of the inland backdrop.

## **Management Issues**

Management issues are discussed in detail in Appendix 4 and summarised below. Many are related to the management of water, its movement down through the catchments of the project area, through the residential areas around the Inlet, and out into the estuarine environment. Land uses along the way are the critical determinants of both the quantity and the quality of the water entering the Inlet.

**Erosion in the catchment resulting in sedimentation into the Inlet.** Issues for the management of sedimentation include:

- Vegetation management in the upper catchment of Duck Creek to reduce peak flows and minimise soil erosion.
- Vegetation management in the riparian areas of the lower catchments to minimise streambank erosion and trap sediment entering streams.
- Vegetation management on escarpments, particularly above the southern edge of the inlet and around Golden Gate Peninsula.
- Soil disturbance and sedimentation resulting from subdivision.
- Soil disturbance/sedimentation resulting from vegetation and forest removal.

## **Coastal Erosion**

- Ongoing erosion and siltation off the escarpment.
- The movement of sand along the toes of dunes and the threat of attrition.
- The protection of the edge along the seaward side of State Highway 58.

**Water Quality** is a critical issue for both in-stream values as well as the biological health of the estuary. There are clear indications of water quality problems in the Inlet but their significance is generally unclear. The main issues for water quality include:

- Monitoring to better identify the sources and significance of contamination.
- The need for a more comprehensive understanding of “biological health” in the the estuary. The continued monitoring of the cockle population is vital.
- Understanding the significance of heavy metals and polynuclear aromatic hydrocarbons (PAH’s) off roads and other hard surfaces in the catchment.
- Farm runoff and stream loadings of nitrates and phosphates.



- Faecal coliforms and nutrient pollution issues in the estuarine environment, especially in the western Inlet.
- The effects of intensified and more widespread subdivision on water quality.

**Stormwater management and the design of infrastructure.** Issues relate to the capture and movement of stormwater in the built environment, and the role of intensified and more widespread subdivision in affecting stormwater management, such as:

- Areas of impermeable surfaces and their reduction in new subdivision.
- The use of natural systems to capture, clean, and transport water.
- Ponds and retention areas; their application to the project area.
- Vegetation removal in steeper areas and along waterways, and its effects on drainage and stormwater management. Map 3 illustrates the patterns of drainage in relation to the vegetation cover and highlights the fragmentation of vegetation, and in particular the gaps in riparian vegetation.

**Indigenous Biodiversity and threats to natural ecosystems:**

- Vegetation clearance and the fragmentation of indigenous vegetation.
- Sedimentation and the smothering of estuarine plants, eel grass in particular.
- Inadequate appreciation of the significance of vegetation and a poor understanding of protection management.
- Divided responsibility for management between public and private owners.
- The Duck Creek Saltmarsh Reserve (DOC) and the Crowsnest Lookout and Molyneux Close Reserves (PCC) are the only ecological links between the catchment and the inlet. The first reserve is very small and the latter two in poor condition.
- Vehicles in the intertidal areas have serious adverse impacts on flora and fauna in these areas.

#### **Wildlife Issues**

- Retention of small fragmented populations of birds and other wildlife in small remaining natural areas that in some cases are being further fragmented.
- Retention of freshwater fish populations in streams which are subject to storm water and erosion stresses, and barriers to movement.
- Public desire to restore and enhance wildlife populations (especially of birds) within residential areas.

#### **Pest and Weed Issues**

- Weeds across public and private land require containment.
- The dumping of weeds in reserves.
- The monitoring and control of possums, stoats and feral cats.
- The extent, significance and possible control of *Undaria*.



### **Management of reserve areas**

- The pattern of existing reserves: Map 2 shows that there is a very significant disjunction between areas formally protected in public reserves, and current Sites of Ecological Significance.
- Management of regeneration and succession: what is the desired vegetation?
- Management of reserve edges to maintain healthy remnants.

### **Management of private residential lots (urban and rural)**

- Fragmentation of natural areas.
- Choosing appropriate species for planting.
- Choosing appropriate materials for landscaping to avoid over-hardening.
- Weed and pest management.

### **Visual Landscape**

- The fragmentation of vegetation with a loss of coherence and containment.
- The increasing dominance of built structure, particularly in the coastal environment.
- The loss of an 'indigenous' character generally.

### **Recreation**

- Threats to an existing connectedness and accessibility.
- Improve access to and around the inlet edge.
- Linkages between the coast, coastal hills, and inner Whitby.
- The quality of recreational settings.

**Advocacy and Information.** Protecting the quality and functioning of the estuarine environment requires an intimate and well co-ordinated effort between public agencies and private landowners:

- Understanding of the relationship between the ecology and amenity values.
- Debate about the importance of design and the impacts of buildings in the coastal environment.
- The value of restoration; what, where and how much.
- Water, use and disposal.



## Summary – An Ecological Health Balance Sheet

<b>Assessment for <i>Catchment</i></b>	
<b>Positive</b>	<b>Negative</b>
<ul style="list-style-type: none"> <li>✓ High proportion of open space and relatively low hard surface ratio in developed residential areas.</li> <li>✓ Reasonable amount of remaining indigenous or regenerating vegetation cover and sites of ecological significance.</li> <li>✓ Conservative pastoral management with generally good grass cover maintained.</li> <li>✓ Good standard of exotic tree plantation management and maintenance of riparian values during recent logging.</li> </ul>	<ul style="list-style-type: none"> <li>• Continuing fragmentation and loss of some indigenous vegetation including areas of ecological significance.</li> <li>• Continuing sedimentation and runoff, especially from earthworks.</li> <li>• Potential for all these problems to be exacerbated through currently zoned further residential development</li> <li>• Continuing and largely un-addressed weed and animal pest threats.</li> <li>• An approach to subdivision which continues to be directed towards amenity and recreation rather than ecological outcomes; exotic rather than indigenous plants dominating.</li> <li>• Generally poor riparian quality and largely unknown in-stream values.</li> </ul>
<b>Overall assessment: Fair but declining ecological health</b>	

<b>Assessment for <i>Inlet</i></b>	
<b>Positive</b>	<b>Negative</b>
<ul style="list-style-type: none"> <li>✓ Fair to good water quality.</li> <li>✓ High diversity and abundance of estuarine biodiversity.</li> <li>✓ Tidal flushing dissipates some pollution and sediment.</li> </ul>	<ul style="list-style-type: none"> <li>• Continuing sedimentation into Inlet.</li> <li>• Some pollution from excess nutrients, heavy metals and PAHs</li> <li>• Historical high loss of cockle numbers.</li> <li>• Loss of health of large numbers of cockles.</li> <li>• High recent loss of key eel grass habitat.</li> <li>• Ongoing 'hardening' of edges with structures.</li> <li>• Vehicles continue to drive on sensitive inter-tidal areas.</li> <li>• Extensive invasion by <i>Undaria</i> alga.</li> </ul>
<b>Overall assessment: Fair but declining ecological health</b>	



## RESTORATION AND ENHANCEMENT ACTION PROGRAMME

In this chapter, a programme of objectives and actions is presented which is designed to address the “ecological balance sheet” presented in the previous chapter and to respond to the perception of declining ecological health on land and water.

In this chapter the earlier discussion of areas, values, and issues is further developed to provide a summary of outcomes and objectives for restoration in the study area. Restoration and enhancement actions needed to achieve those outcomes are then discussed in detail.

The action programme is arranged in four sections:

1. A discussion of generic restoration and enhancement themes. These are principally achieved through *planning and other strategic initiatives*, so the title and content of this section reflects this emphasis.
2. A discussion of *sector-specific restoration and enhancement options*. These are, arranged by the management sectors shown in Map 1 and using a common format that reflects the headings of the endorsed restoration aims. In general these options are more oriented to on-the-ground and in-the-water actions.
3. A discussion of *other specific restoration and enhancement options* that are action-oriented but not specific to one management sector.



## **Outcomes and Objectives of Restoration**

These four outcomes and associated objectives were developed in the early part of the project and endorsed at the second consultation meeting on 23 July 2003. They have since been slightly edited.

Comments on drafts of these outcomes and objectives have emphasised the primary of the first outcome of maximising water quality. This is enclosed by the consultants and was discussed in the section on integration in Chapter 1. It should also be pointed out that the other three outcomes all support enhanced water quality in some way, as well as contributing other aspects of environmental quality and amenity.

### **Water quality is maximised *by***

- Minimising erosion and sedimentation from:
  - Land development and subdivision
  - Logging
  - Farming
- Reducing sedimentation and contamination discharges into the Inlet through:
  - Riparian planting
  - On-site water quality treatment

### **Stormwater is managed safely *by***

- Minimising stormwater peaks during development
- Minimising recontouring
- Minimising hard surfaces in developed areas (associated with both residential structures and with roads)
- Retaining and enhancing water retention areas

### **Biodiversity, natural character and amenity is maintained and enhanced *by***

- Maintaining existing significant indigenous vegetation to greatest possible extent
- Enhancement and restoration planting in selected reserves
- Planning and implementing animal pest and weed control strategically
- Maximising opportunities for enjoyment of walkways and cycleways

### **Environmental resilience is increased through good environmental design *by***

- Doing all the above and:
- Maintaining unrestricted tidal flows in and out of the Inlet, and the ecological connections between the Inlet and the Porirua Harbour
- Maintaining and enhancing the Pauatahanui Inlet as a high-quality sustainable source of kai-moana
- Maintaining and enhancing connections between vegetation areas
- Buffering waterways with vegetation
- Maintaining and developing good seed sources to support bird populations
- Monitoring what's going on.







## Planning and Strategic Initiatives for Restoration

### *Subdivision and Development Controls*

The most immediate threat to remnant indigenous vegetation, waterways, and the quality of water entering the Inlet is subdivision. Some councils now require that post development peak stormwater flows do not exceed pre-development peak flows. This then creates an incentive to retain vegetation, minimise impermeable surfaces, and discharge stormwater into areas of natural cover rather than pipes. In adopting such strategies developers minimise ground disturbance and potential siltation. In the longer run contamination, either from road or roof run-off, should pass through natural filtering systems before entering streams.

There is now a considerable literature on the management of stormwater to reduce peak flows and contaminants including sediment (see for example the forthcoming proceedings of the 2003 Pauatahanui Science Workshop and ARC 2000 which has a large literature summary). These aims can be met by a range of measures that are realistically achievable in the catchments of the Stage 2 area, including:

- a) Limit filling of gullies (except for road crossings) and encourage native plantings on gully floors.  
This improves water quality and encourages light and shade and hence habitat.
- b) Encourage retention of steeper slopes as public land with bush planting.  
This reduces source erosion and sediment.
- c) Provide flood storage areas where feasible to enable storm peak flows to be kept at or near storm peaks from the existing catchment conditions.  
By controlling peak flows downstream, flooding is limited and erosion can be mitigated.
- d) Where reasonably flat land is available, provide interception ponds and grass wetlands which will reduce peak flows and sediment and other contaminants entering the estuary.
- e) Consider changes to road design (particularly residential and low traffic areas), whereby stormwater from roads can filter over grass berms or similar, before entering piped systems. This will filter some contaminants and can slow runoff in regular storm events.
- f) For large pavement areas (e.g. car parks, major roads) look to minimise gross pollutants by provision of special sump debris sacks or similar. It should be noted that such facilities raise maintenance needs and require more conservative sump design as they can limit sump discharge. Their beneficial effect on contaminants such as hydrocarbons is not great.

Swales, rain gardens, ponds, and wetlands are all options now being adopted. Ponds in series will generally be less efficient than single ponds, and wetlands are always preferable to simple ponds. (Wetlands filter, break down contaminants, store sediment, and are safer with children.) Wetlands are particularly useful where catchments are geologically stable, of moderate slope, and soils have high clay or silt content. If there is space it is more efficient to have one large, rather than a number of small, wetlands. The aim is to catch the first flush of stormwater runoff (typically 5 -15mm) and retain this for long enough for initial



precipitation of contaminants to occur (typically about two to three days). Dissolved metals are up to 1000 times higher in this first flush than at background levels.

A further implication of requiring improved on-site stormwater management is to force a greater focus on retaining vegetation as well as planting and restoration. There is a need for a more integrated approach to the design and management of vegetation across ownership boundaries and agreements on suitable species to achieve improved stormwater cleaning and habitat enrichment.

Improved outcomes from subdivision will require that both the council and developers are prepared to review plan rules, standards, specifications and practices. And committed to effective monitoring of compliance with plan and resource consent conditions. There is also an ongoing need for education and advocacy to reduce activities or redesign technologies that produce pollutants, so that pollution does not inexorably rise as development and residential density increases. There is also the need for a market demanding development which is softer on the environment and more responsive to the special character of places. Such a market is developing, and premium real estate values are attaching to places in the Pauatahanui Inlet.

## **District Plan**

The current District Plan provisions for residential subdivision are informed by 'Residential Needs and Standards', a report prepared by Porirua City Council. This report challenged traditional views about bulk and location requirements influencing property values. The report identified issues such as living adjacent to coastal areas or outstanding views and site development works such as landscaping and residential amenities as having a far greater influence on value than the layout of sections and buildings. Accordingly the District Plan has a number of policies that recognise the importance of the matters referred to in this report. Of particular interest is Policy C 9.1.15:

*"To recognise, protect and enhance the existing ecological and landscape features in the Whitby Landscape Protection Area, including Duck Creek and Resolution Ridge, through subdivision design, location, roads, low residential densities, allotment size and the management of earthworks and vegetation clearance."*

In view of the restoration objectives of the council it is recommended that the intent of this policy is implemented across the whole of the study area.

Tighter controls on earthworks and vegetation clearance are needed, especially on slopes over 35°. Vegetation clearance restrictions should be the same for both rural and residential areas, 100m<sup>2</sup>.<sup>7</sup> Low vegetation, especially in riparian areas, can be extremely important for streambank protection and water management and vegetation clearance provisions should be revised to consider protection of vegetation that is less than 3m high in such situations. Larger lot sizes, vegetation retention, and limits on site coverage all assist in protecting ecological, and amenity, values. To be able to effectively retain vegetation, however, there is

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<sup>7</sup> Controls on vegetation clearance should not however impose unreasonable constraints on essential infrastructural management such as protection of roads, transmission lines etc.



a need for incentives to be available (even where some type of statutory provisions also apply). At present suitable incentives would appear to be lacking in an otherwise comprehensive set of policies and rules.

## Vegetation Protection

Previous sections have stressed the need to retain woody vegetation for erosion and water management. There are also important reasons for protecting natural vegetation because of its indigenous biodiversity values, as well as its cultural, amenity and recreational values. Porirua City has a sound basis for the management and protection of important natural vegetation in the form of its survey of Significant Ecological Sites (SES) (Boffa Miskell 2001a). The survey report discusses a comprehensive range of statutory and non-statutory management and protection measures that could be used for Porirua City. This work should now be used to develop a comprehensive advocacy package targeting landowners who manage areas of indigenous vegetation, especially SES and areas of riparian vegetation. This package would include incentives such as rates relief, financial assistance with weed and pest control, fencing, as well as information on plants and planting. The package should also include information on covenanting options. Such measures would be used in conjunction with any planning control measures for vegetation protection that may be developed.

The policy to develop a package like this would require considerable consultation because it does affect property rights. However, its aim of vegetation protection is entirely consistent with the agreed strategic restoration priorities discussed in the first section of this chapter. In fact, measures to retain existing natural vegetation are of higher priority than restoration programmes because it is more feasible and efficient and far cheaper in the long run, to protect what is there than to attempt to recreate it.

## Animal Pest and Weed Control

Systematic plant and animal pest monitoring and control should be an integral part of the Management Strategy for Significant Ecological Sites in Porirua City (Boffa Miskell 2001a), which would provide an opportunity for weeds and animal pest issues around the entire Inlet and in all catchments to be treated in an integrated way; and appropriate to their significance. There are several factors that should be seen as warnings against any complacency in management:

- The Pauatahanui Inlet has such high national ecological significance that there should be a low threshold of tolerance to plant and animal pests.
- There has been little systematic survey of plant and animal pests in the area. The survey of Ecological Sites in Porirua City (Boffa Miskell 2001a) suggests a prevalence of aggressive weeds that will need sustained attention if restoration objectives are to be achieved; research for this report endorses this observation.
- Above all, a “steady as she goes” attitude towards weeds and animal pests on the land may be tolerable, but the same cannot be said of weeds in the waters of the Inlet. The current distribution and spread of the aggressive seaweed pest *Undaria* in the Inlet is a case in point. *Undaria* is now well established around Mana Marina and in the western part of the Inlet and its control is apparently beyond current technical capability.



Unfortunately *Undaria* is now likely to have permanent significant effects on the ecology of the Inlet.

- Surveillance for further new marine pest plants and animals should be a high priority and one requiring a high degree of coordination between agencies.
- Significant indigenous remnants outside of reserves are often not subject to adequate weed and pest control and need to be managed in a manner consistent with council reserves.

In the study area the highest priority for weed and pest control is more intensive control of priority weeds in PCC reserves and some road reserves, accompanied by educational material encouraging the parallel control of these weeds in nearby private properties (the dumping of rubbish and weeds in areas of suburban indigenous vegetation is a widespread issue). Some further specific priority areas are discussed in later sections.

### **Monitoring and Documentation**

The above section has emphasised the monitoring and surveillance of pests and weeds. Other aspects of restoration also require active monitoring, both for condition and for achievement of goals. We are fortunate in having an excellent baseline data from the PEP (Healy 1980) against which to assess change. We also have as a unique time series of cockle population measurements (Grange & Tovey 2002). Aspects of restoration for which monitoring is suggested by this project include:

- Measurement of the amount and nature of sediment entering the Inlet, especially if any areas are dredged prior to eelgrass restoration.
- Nutrients, leakage of sewage and road runoff pollutants entering the Inlet.
- The percentage of impermeable surfaces in residential areas.
- The on-going health and extent of Sites of Ecological Significance.
- Distribution and trend of plant and animal pests.
- The quantity and quality of riparian vegetation.
- The health of the fresh water environment, its flora and fauna (Guardians of Pauatahanui Inlet are currently monitoring stream conditions).
- The type and extent of woody vegetation in upper catchments.
- The success of restoration planting in different ecodomains.
- Bird populations in old and restored habitat (as currently being carried out by the Ornithological Society.)

Further monitoring of the Inlet and catchment is discussed in Boffa Miskell (2000). Only a little of the above monitoring is being carried out already. However, because of the significance and importance of the environment, the Inlet and catchments should be specifically addressed in local and regional government environmental monitoring programmes. Perhaps most importantly, current management should be carefully documented so that its history and its effects are known in the future.



## Information and Interpretation

This project has highlighted the lack of hard data upon which to base priority setting and a strategic direction. There is a need for far better information on specific environmental issues. While this project should not be seen as a research strategy, some obvious information gaps specific to the Inlet include the following:

- The sources and magnitude of contamination from stormwater from different outlets into the Inlet
- The relative significance of different sediment sources to the Inlet.
- The relative significance of different land uses to erosion and sedimentation into the Inlet
- Sedimentation patterns within the Inlet and the vicinity of the Inlet entrance, and changes in these.

It is important to provide information on the history and culture as well as the ecology of the Inlet. There are some excellent local histories to draw on for material (see References), as well as rich sources of information in Porirua's *Pataka* museum.

The quality of the bush areas could be improved through an education campaign to stop the dumping of rubbish, weeds in particular, in areas of suburban indigenous vegetation, too often regarded as waste lands.

Some public information and on site ecological interpretation is available at the Pauatahanui Wildlife Reserve at the eastern edge of the Inlet for interpretation, and more could be provided to the west and south. The new pathway will help facilitate this. On-site interpretation is particularly effective in informing people about ecological and wildlife values; information can be better absorbed in concert with experience. There are limits to how much people will look at on site however, so that 'packaged' information is also required.

Observations of people's activities in the Inlet would suggest that there is often little understanding of the local environment and what sustains its healthy functioning. There is a very real need for accessible information. A well-resourced community information centre for the Inlet (not necessarily staffed full-time) would provide much of this. It would also provide much of the information discussed above and assist in the development of Long Term Council Community Plans, a requirement of the revised Local Government Act. Such a place would also be a local centre for advocacy. It could be readily located at one of the Porirua libraries (Porirua City or Whitby). Alternatively in the longer term if it were located on the Inlet edge this would also service users of the Camborne Walkway and the future pathway. Because of the space constraints on the southern edge, one of the 'hubs' discussed in the PIRP Stage I report (Pauatahanui Wildlife Reserve/Pauatahanui village, Motukaraka Point, or the Grays Road end of the Camborne Walkway) would be more likely to be suitable for such a centre.

Perhaps one of the most important observations made in researching this project is the way in which thinking about development has changed since the Whitby Plan was conceived (Appendix 2). In the 1970's there was an awakening to the importance of environmental quality, beauty, amenity, and recreation. But sustainability was not yet on the agenda and indigenous biodiversity was barely even an academic concern.



The PIRP calls for a general 'update' in peoples' perceptions and understanding, an integration of community needs and aspirations with ecological realities. A great deal has changed since the RMA came into force and we are beginning to see the world in new ways. If the community is to become fully engaged in setting its own long term visions then the community needs to be more aware of its ecology. For example, information the council has on Sites of Ecological Significance in Porirua City needs to be made more widely available.

### **Advocacy**

The Action Plan for the Inlet recognises that there is insufficient understanding of the Inlet and the processes affecting it within the community. Restoration can only succeed with support from across the community, even for restoration of public reserves: witness the countless hours spent by members of Forest & Bird, Periodic Detention groups and many others on management of the Pauatahanui Wildlife Reserve and the Horokiri estuary.

Such cooperation is possible not only because of the willingness of many people to pool resources and energy, but also because of the special qualities of the Inlet. This raises the vexed question of how much these special qualities should be advocated and promoted outside of the local community. This is always a difficult choice: if the Inlet's values are "over-promoted", will this engender overuse? The current Pathway project certainly raises this issue. It is suggested that for such a significant "heritage resource" as the Inlet, there needs to be a large group of committed advocates to guard against inappropriate development. Will the local community provide a large enough group? If the answer is no, there may well be a need to advocate and promote in a wider regional setting, to increase the number of such advocates.



### **Summary: Planning and Strategic Initiatives Action Points**

- Review planning provisions as these relate to vegetation clearance and development controls, especially for all Sites of Ecological Significance.
- Explore the possibility of establishing 'Special Character Areas' as is initially proposed for Golden Gate.
- Develop a comprehensive advocacy package targeting landowners who manage areas of indigenous vegetation, especially sites of ecological significance and areas of riparian vegetation.
- Develop a discrete but cross referenced information package on vegetation within the Whitby area and its catchments highlighting Sites of Ecological Significance, the importance of riparian vegetation, and the need for coherence and connectedness.
- Develop a discrete but cross referenced information package on water management in the Whitby area including reference to engineering options and the use of natural systems to filter road runoff.
- Ensure that all information and advocacy efforts are well integrated so that the relationships between vegetation and biodiversity management, water management, and natural character and recreation are clear.
- Develop an education campaign to stop the dumping of rubbish, weeds in particular, in areas of suburban indigenous vegetation.
- Ensure that all rock used around the estuary edge comes from the same place or is of the same character and colour.
- Develop and implement an animal pest and weed control strategy for the whole of the PIRP area.
- Establish a monitoring system to track changes in vegetation cover with the objective of building a resource of information for advocacy purposes.
- Continue monitoring water quality in the Browns Bay outfall and in Duck Creek.
- Develop a pest monitoring system and a mechanism for providing status updates for the community. Panels and indicators such as those used for fire hazard reporting could be considered.



## Sector-specific Restoration and Enhancement Options

### Management Sector 1 - Camborne Escarpment

*A bush-covered escarpment forms the northernmost outlier of the study area. Part of the north-western edge of Pauatahanui Inlet, adjacent to the Mana foreshore. Attractive visual backdrop to the western Pauatahanui Inlet. The vegetation is mainly regenerating mahoe-dominated forest, with some sizeable native hardwood trees emerging from the canopy. The native bush has been significantly fragmented and planted into. The vegetation is generally fairly open although an understorey layer of naturally seeded indigenous shrubs occurs in damper places along the lower slopes. Weeds are prevalent, with wandering willie and pampas among the most serious, but some tall poplar trees add to the visual diversity of the management sector. Predominantly council reserve, but includes private properties between the top of the Camborne reserve and the Mana watershed on Mana View Road.*

### Water Quantity and Quality

The small catchment area means that water capture off roads and other hard surfaces is limited, and vehicle use tends to be restricted to local access only. Most of the stormwater is piped into well vegetated waterways extending up into residential areas although some is discharged onto the steeper slopes of Camborne Reserve and released through groundwater flow into the Inlet. In both instances the reserve plays a particularly significant role, and therefore a full vegetation cover should be maintained (see below). If this is done, the combination of low energy flows and a good vegetation cover would mean that sedimentation and stormwater contamination should not be a significant issue. In severe storms localised erosion on the escarpment will cause minor disruption on the foreshore path and sedimentation into the Inlet. This should be taken into account in maintenance planning. Although many of the boatshed sites along the base of the escarpment have sewerage reticulation, any sewage contamination from the area is a direct threat to water quality in the Inlet so that high standards of waste management need to be maintained.

### Biodiversity and Natural Character

The vegetation cover along the Camborne escarpment is important not only to its stability but also as a defining characteristic of the western Inlet. The escarpment has acted as a visual buffer between the Inlet and the suburbs of Camborne and Mana. For the most part the visual integrity of the inlet edge has been maintained by having houses kept back to the upper edges of the escarpment. Structures on or below the escarpment have been modest in scale, often limited to boat sheds. Looking into the Inlet from the road and rail bridges it has been the combination of modest seaside structures in a bush setting, which has made the Inlet special. Public reserves along the escarpment and down to the waters edge have afforded vital protection to the character and integrity of the edge as well as providing for public access.

Most of the Camborne Scarp, as well as the streams cutting across it, lies within PCC reserves. Maintaining existing riparian vegetation (which is generally in good condition)



along streams is a priority. A low and dense cover of grasses and shrubs is vital to 'clean' stormwater passing through the reserves, with shade trees kept back from riparian areas.

Although the existing vegetation cover is adequate in terms of soil protection, more intensive planting of indigenous species along the escarpment, along with weed control, would greatly add to indigenous biodiversity as well as amenity values. Control of weeds such as pampas, wondering willie and ivy is a priority in this ecologically and visually important management sector. As this is done, gaps created by weed control should be filled by clumped native shrubs to extend the subcanopy layer and act as seed sources. This process should start on the lower, damper, slopes adjacent to the walkway. In the longer term, replacement of exotic dominants (poplar, eucalypts etc) by supplementing the existing indigenous dominants titoki, ngaio, kowhai and ribbonwood would be justified because of the high ecological significance of the area.

### **Recreation and Access**

Access down the escarpment and along the edge of the Inlet is very well provided for and the combination of vegetation, boatsheds, and views across the inlet makes for an extremely satisfying walk. Although the walking surface needs to be hardened and well drained (as per Stage I proposals), retaining the existing informality and the historic association of the track with the boatsheds will be important. Implementation of the biodiversity proposals will also enhance the quality and character of the area for walkers.

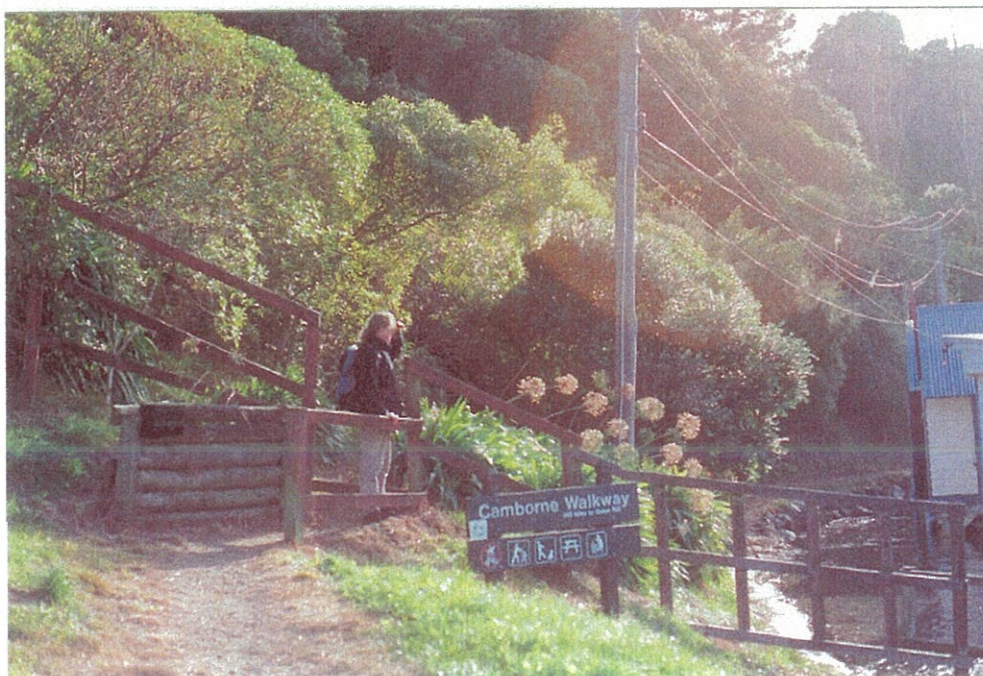
### **Summary: Camborne Escarpment Action Points**

- Ensure the maintenance of a dense vegetation cover along the edges of waterways passing through Camborne and crossing the escarpment.
- Give priority to weed control along the escarpment within planned strategic animal pest and weed control (including land in private ownership) because of its ecological and visual importance.
- Plant groups of native shrubs in gaps created by weed control.
- Progressively plant indigenous hardwood trees to replace current exotic dominants in the escarpment canopy.





**Vegetation in reserves waterways is critical for stormwater management.**



**Enhance planting with natives trees along the escarpment above the walkway.**



## Management Sector 2 - Eastern Mana and the Inlet Entrance

*The Pauatahanui Inlet edges adjoining the Inlet entrance, together with adjacent flat areas of the eastern side of the Mana Sandspit, Ivey Bay and the narrow foreshore on the southern side of the Inlet between SH1 and Ivey Bay. The whole management sector has been extensively modified, and contains the busiest arterial routes in Porirua City, as well as heavy foot traffic. Despite this, the management sector has some vital ecological values and is a unique part of the whole Inlet, linking the northern and southern shores across the Inlet entrance. It contains one of the largest inter-tidal zones in the Inlet and some important remaining eelgrass beds, and thus forms a key feeding ground for many of the Inlet's bird and fish populations. The relatively deep Inlet entrance is vital for tidal flushing of the whole Inlet. The Mana shore edge, although highly modified, contains the only remaining sand dunes on the Inlet.*

### Water Quantity and Quality

SH1 and associated urban infrastructure provides a large area of paving so that in heavy rain stormwater management may be a water quality issue with regard to contaminants. Stormwater from SH1 drains out across some of the most extensive cockle beds in the Inlet. In addition, stormwater captured from roads through Ngati Toa Domain is piped into the inlet. There have been anecdotal reports of sewage overflow from pipes adjacent to SH1 at Mana.

With the upgrade of SH1 and the widening of Mana Esplanade the hard surface area will be increased. Transit NZ and Porirua City Council are currently discussing the use of siphon filters in the sumps catching water off roads before it passes through pipes into the Inlet. It will then be possible to monitor and analyse the trapped contaminants and to develop a more comprehensive understanding of the nature and significance of the contaminants coming off State Highways 1 and 58, and other roads. The monitoring of stormwater contaminants are strongly recommended and the question of what kind of filter most effectively reduces pollution into the Inlet needs further investigation.

This study does not deal with the development of the new SH1 bridge and the upgrade of Mana Esplanade; this development has been the subject of separate and comprehensive consultation and environmental mitigation is a condition of consent. However, because of concerns over the maintenance of Inlet tidal flows, which is so important to the ecological functioning of the whole Inlet ecology, it is recommended that tidal flow and deposition patterns at the Inlet entrance channel and on the Mana inter-tidal zone continue to be monitored by tidal gauging and also, possibly using permanent photo points.

### Natural Character and Biodiversity

For the most part the existing simple treatment of the Eastern Mana Foreshore Reserve (Dolly Varden Beach Shoreline), with grasses and clumps of mixed shrubs on broken sections of the foreshore, is appropriate, and blends in with the treatment of private sections fronting onto the reserve. This existing character should be retained.



Recent planting around the area where Pascoe Avenue meets the foreshore should be continued. The small remnant dunes, the only recognisable ones remaining around the Inlet, are unstable and in need of an improved vegetation cover. The planting of indigenous coastal dune species (predominantly grasses and shrubs) on the dune areas up to the landward boundary of the reserve would serve to strengthen the coherence of the natural character, add biodiversity of a very depleted ecosystem type, and to some extent buffer the reserve from adjoining properties while adding to their privacy. This planting should be undertaken in consultation with neighbours, who should be encouraged to continue planting the same species on dune areas within their properties.

The recent report on erosion in Porirua City (BECA 2003) proposes dune reconstruction and re-vegetation along Dolly Varden Beach Shoreline, with or without a seawall. Observation suggests that where there is a strong root mat the edge is fairly stable. Vegetation is clearly the key to stabilisation. There may, however, be a need for a low wall in some places where erosion is actively occurring and where people move between the dunes and the beach. This wall, perhaps 200-300mm showing above the level of the beach, would absorb wave energy and eventually be covered with vegetation. Wall ends would need to be protected to ensure that erosion was minimised while plants established. Natural stone would be the preferred material for this wall but the Porirua City Council should liaise with Transit to ensure that a common source of rock is used for all edge works around the Inlet.

### **Recreation and Access**

The management sector forms an important continuum between the Camborne Escarpment and the southern shore of the Inlet. The Mana Eastern Foreshore and the Camborne walkway together provide an outstanding mix of recreational opportunities in an extremely attractive setting. The access is unformed but easy, and is adequate. Good pedestrian access to and along this area should be retained regardless of progress on the pathway proposal. However, this recommendation does not apply to informal vehicle access used from Ivey Bay to properties on the western Golden Gate management sector (see next section) and Mana shoreline. Vehicles should be discouraged from access to the intertidal area from Ivey Bay, except under strict control.



### **Summary: Mana, the inlet entrance and edge Action Points**

- Monitor the quality of stormwater entering the estuary from SH1 before and after the installation of filters in sumps.
- Monitor tidal flow and deposition patterns at the channel opening to Pauatahanui Inlet.
- Discourage vehicle access on the inter-tidal area accessed from Ivey Bay.
- Complete restoration planting on the sand dune along the foreshore between Pascoe Avenue and the first section of Camborne walkway.
- Liase with property owners along the Mana foreshore when planning restoration work and provide opportunities for extending planting onto private land.
- Stabilise remnant dune areas along the Mana Foreshore with planting where required and stabilise dune toes at the high tide mark with a 200-300mm rock wall where wave action is causing erosion.





**Stabilisation planting between Pascoe Avenue and Camborne Walkway**



**Sections of the Mana foreshore require stabilisation; the cooperation of adjacent property owners will be essential.**



## Management Sector 3 - Golden Gate

*A small steep-sided peninsula protruding into the southern Pauatahanui Inlet between Ivey and Browns Bay. Visually prominent from many parts of the Inlet, forming an attractive tree-filled suburban landscape. Many native trees are growing in gardens and there is limited regeneration in a few undeveloped parts of the escarpments, but there are no significant natural areas. All private residential land apart from the foreshore reserve. Housing development comes close to the water's edge in many parts.*

### Water Quantity and Quality

There are steep sections of escarpment around the peninsula and where vegetation cover is inadequate soil erosion can be an issue during heavy rain. However the catchments are small. Water captured on roofs, paved surfaces and roads, drains off the peninsula and into the inlet. Most of this is filtered through vegetation along the way. Although the levels of contaminants in stormwater coming off the peninsula are unlikely to be high, they may be adding to contaminants generated from Ivey and Browns Bays, especially if there is leakage from old sewerage or stormwater pipes, which has been reported by residents.

### Natural Character and Biodiversity

Golden Gate is, in a visual sense, the 'centrepiece' of the Inlet and therefore critical in setting the landscape character of the Inlet as a whole, as it is seen from much of the Inlet. Golden Gate embodies the positive attributes of the traditional natural, as well as cultural, character. However, in more recent times the larger buildings and hardened surfaces also expresses a new affluence that does not appear to be always sensitive to the values of the Inlet, either its ecology or its special character.

Silt runoff from recent house site excavations in combination with heavy vehicles has caused significant disturbance in the inter-tidal area, which has adverse effects on water quality as well as biodiversity values. This should be taken into account in processing resource consents and building permits, with conditions aimed at minimising such impacts, together with information to landowners with the same aim. Vehicle access from Ivey Bay and Trevor Terrace across the tidal area should be strictly controlled, and generally avoided, to avoid the compaction of shell beds, the crushing of delicate vegetation and damage to the inter-tidal zone. Any permitted use should be restricted to essential council maintenance and residents' access required for moving heavy items etc. Size of all permitted vehicles, including Council vehicles, should be limited and vehicles required to stay as close as possible to the shoreline. This aim could be assisted by provision of alternative access and parking to residents, where possible, away from the estuary edge and provision of parking at the bottom of Trevor Terrace.

The edges and tidal areas of the peninsula support the only remnants of salt marsh vegetation at the western end of the inlet. The success of restoration in the more extensive eastern reserves suggests that similar efforts around the peninsula could greatly enhance habitat values. Shell Point sits between the two. Shell Point offers particular opportunities to restore and extend existing saltmarsh vegetation and an opportunity to undertake restoration with flaxes and marsh ribbonwood in the terrestrial section of the reserve. A guideline on



restoration planting aimed at residents of the peninsula, highlighting the visual and ecological values which could be enhanced, would be a useful part of such work.

Esplanade Reserves around the peninsula are discontinuous and marine erosion has resulted in their seaward boundaries being located in the inter-tidal area, along with a number of private property boundaries. The critical vegetation cover around the peninsula escarpments is for the most part on private land, with reserve land limited to very narrow strips at the base of the escarpment.

Maintaining a healthy cover of vegetation on the escarpment is critical in holding soil and filtering stormwater. The restoration of the natural indigenous cover should be undertaken to ensure that the coherence and integrity of the natural character is retained. Such initiatives, which are most usefully undertaken as a combined council/landowner project, create the opportunity to promote a greater awareness and responsibility within the immediate community. The Golden Gate community could, as a clearly defined geographic entity with a very distinctive character, be a model for such an initiative.

### **Recreation and Access**

The Golden Gate Peninsula is an attractive visual backdrop to intensively used recreation areas (Dolly Varden Foreshore and the Camborne walkway), rather than a destination in itself. A formal access-way, requiring tracks and board walks, along the edge of the peninsula would be overly intrusive and probably have a high environmental impact. Promotion of access and public use should be consistent with Porirua City Council's encroachment policy. It should recognise and protect the existing low key character and minimising or removing superfluous structures to ensure that they do not impede access at low tide; the walking experience should be unstructured with a minimum of signs. The promotion of access and public use should be consistent with Councils Reserves Policy (PCC 2003) and the 'encroachment resolution process' as outlined in the Golden Gate Esplanade Reserves Management Plan. Protecting the privacy of residents, and engaging in joint restoration initiatives, should over time allow the council to deal with the difficult encroachment issues discussed in the Golden Gate Reserve Management Plan (Boffa Miskell 2001). Restoration initiatives must recognise historic places and traditional uses such as boat sheds as part of an evolved and valued character.

The Porirua City Council Walkways Strategy recognises the peninsula as a walk but does not propose any track formation or boardwalking. The council also has a policy of consolidation so that when opportunities arise the council will acquire land to complete a continuum of Esplanade Reserves.

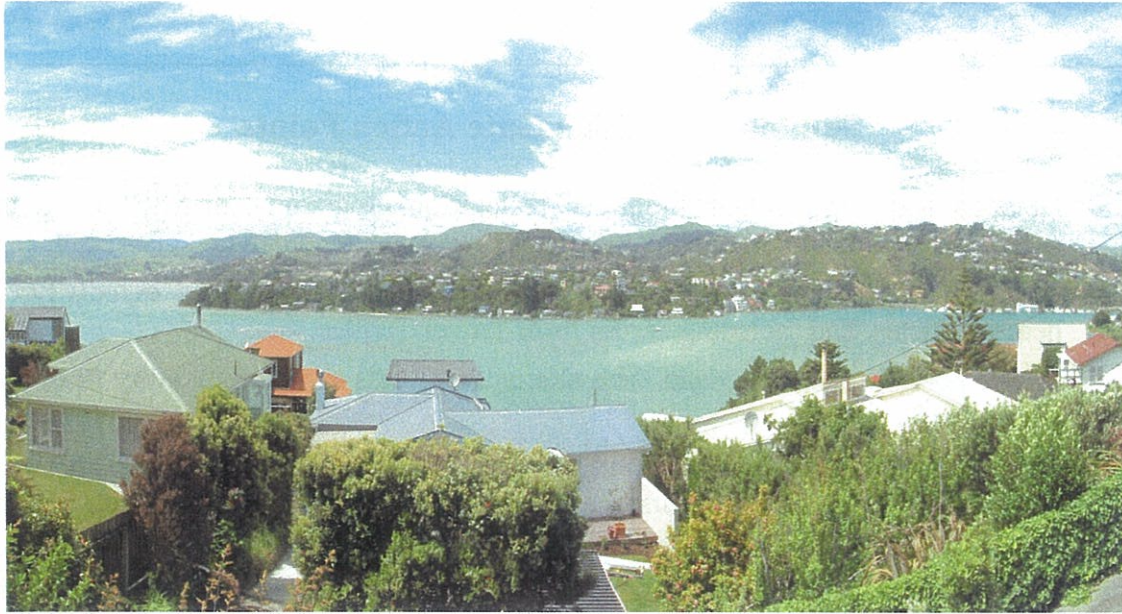
The high visual values associated with the peninsula should be recognised and the special attributes of its character respected. Any infrastructure development associated with the peninsula should be low key and in keeping with an existing informality and freedom.



### **Summary : Golden Gate Action Points**

- Develop and implement a saltmarsh restoration programme at Shell Point to demonstrate the restoration potential along the edges of Golden Gate Peninsula.
- Avoid or strongly control all vehicle movement on intertidal areas, especially of heavy vehicles, and including access from Trevor Terrace.
- Where possible assist residents with alternative access and parking away from the estuary edge.
- Minimise silt runoff associated with construction along the estuary edge through conditions on resource consents and building permits, together with information to landowners.
- Investigate the possibility of zoning Golden Gate a 'Special Character Area' with appropriate planning provisions supported by a design guideline. The provision would recognise the contribution the special character of the peninsula makes to the Inlet as a whole, especially as seen from SH1.
- Develop a guideline on restoration planting for residents of the peninsula.
- Investigate the need for increased storage capacity at the pump station off Golden Gate.





The special character of Golden Gate Peninsula is central to the experience of the Inlet as a whole.

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## **Management Sector 4 - Paremata & Southern Inlet Escarpment**

*A narrow coastal escarpment extending along the whole southern edge of the Pauatahanui Inlet, broken only by the mouths of the Browns Bay and Duck Creek streams. The visually dominant part of the whole study area as seen from the Inlet, and for road travellers along SH1 and SH58. It is partly vegetated but also intensively developed for housing in some parts, including part of the established suburb of Paremata as well as new subdivisions in eastern Whitby. Has been subject to serious degradation and encroachment for many decades. Vegetation is native in some parts, including distinctive and ecologically significant small hardwood forest remnants. There are also sections of mature pine trees. A mixture of Porirua City Council and Transit New Zealand road reserve, and private residential land. The escarpment is as significant to the visual coherence and character of the inlet as it is to its ecological health; the two go hand in hand.*

### **Water Quantity and Quality**

Although the escarpment does not constitute a significant catchment area it is subject to stormwater discharges from above, notably into the reserve above Paremata. Clearance and site excavation is a recurring theme around the escarpment. Considerable areas are still recovering from the removal of pines and macrocarpa. In spite of a regenerating vegetation cover there are areas of bare clay so that even moderate rain sees sediment being carried down the escarpment and into the Inlet. The sediment carried down in stormwater is supplemented by the periodic collapse or slumping of parts of the bank alongside SH 58. More recent house site excavation has left further banks exposed.

Most of the stormwater from roads and houses at the top of the escarpment flows through pipes directly to the Inlet. The quantities are not great compared with other Whitby outlets. It may be possible, however, in some instances to re-engineer stormwater discharge onto the escarpment, or into waterways crossing it. A healthy cover of vegetation would need to be maintained to filter out at least some of the contaminants, and prevent erosion along water channels.

### **Natural Character and Biodiversity**

The character and quality of vegetation on the escarpment is absolutely critical to the health of the Inlet, the wildlife on its edges, and how people experience the Inlet as a place to visit and live. The escarpment along the southern side has been subject to serious degradation and encroachment since European settlement; the State Highway is cut back into the escarpment and easy access has enabled clearance of its warm dry faces, initially for farming, but more recently residential development has encroached from the top of the escarpment.

Current vegetation is generally an intimate mix of indigenous and introduced species but there are significant and representative remnants of the original vegetation cover along the escarpment. These remnants are indicative of what grows and what might be possible over more extensive areas. Fortunately a significant proportion of the escarpment is in some form of reservation so that a well coordinated restoration programme is possible. Sections in private ownership are generally steep and inaccessible so that over time sensitive planting



and/or natural regeneration should see the integration of public and private space with a coherent cover of vegetation.

Many of the reserve areas along the southern side of the Inlet are entering a second phase of development. Reserves have protected not only indigenous remnants but also areas on steeper land unfavourable for housing. Most of this was planted with exotic trees and shrubs. However excessive clearance continues to occur above and on some parts of the escarpment in association with new housing development. To re-establish a cover on exposed clay is extremely difficult but necessary. Re-establishment of vegetation cover is an issue over considerable areas, including where exotic trees are felled for safety reasons.

All areas of bare earth with slopes of 35° or greater should, regardless of ownership, be restored with a vegetation cover within 5 years. Initial cover may be most efficiently achieved by grass hydro-seeding in the steepest scarps adjacent to SH58. The choice of species should have regard to the need to protect views and achieve a dense groundcover.

Porirua City Council can lead the way with restoration by leading a planning process to differentiate between those areas that can be left to regenerate naturally and those where active planting is to be undertaken, and in planning for replacement of pines in reserves as they mature. Molyneux Close Reserve is a very important section of the escarpment where pines have been partially removed and restoration planting has not yet adequately covered exposed soil. This area is also very important to the visual quality of the Duck Creek entrance to Whitby. The restoration initiatives undertaken so far should be extended, with the collaboration of property owners. Steeper areas with exposed soil are unlikely to develop a vegetation cover without active intervention and it is these areas that contribute most to sediment runoff. These areas need to be targeted first.

There is a need for concerted advocacy effort to raise the community's awareness of the sensitivity of the inlet edge to degradation, and to promote a greater recognition of the special attributes of the edge and how its treatment affects the character of the whole Inlet. The relationships between vegetation cover, structures, ecological processes and the general well-being of both people and their environment needs to be better appreciated. An illustrated guideline on 'Protecting the Edge' (possibly combined with the proposed Golden Gate guideline) would raise awareness and enable the community in accepting a greater role in protecting what matters to them.

### **Recreation and Access**

Reserves along the southern side of the inlet are an integral part of community open space and incorporate walkways, lookouts, and play areas. There are spectacular lookouts along the top of the escarpment but these are generally accessed from within Whitby rather than from the Inlet edge; they are 'local' assets. Any future pathway along SH58 should have clear and safe pedestrian linkages into the Whitby area, particularly to the lookout points along the Northern Hills.



### **Summary: Paremata and Southern Inlet Escarpment Action Points**

- Undertake a detailed survey of public and private land along the escarpment to identify areas where the vegetation cover is inadequate and/or deteriorating. Differentiate between those areas that can be left to regenerate naturally and those where active planting is to be undertaken.
- Establish trial plantings as a joint venture between the council and landowners. Consider nurse crops of exotic species as shelter for the natural regeneration of natives.
- Assist existing and future property owners in recognising the value of native and exotic vegetation and actively promote its protection and restoration.
- Ensure that any future pathway along SH58 has clear and safe pedestrian linkages into the Whitby area, particularly to the lookout points along the Northern Hills.
- Ensure that there is a vegetation cover on all slopes over 35° by 2010.
- Investigate the re-routing of small stormwater discharges onto well-vegetated sections of the escarpment





**Subdivision has pushed the edges with vegetation removal and earthworks**



**Exposed and eroding surfaces need a vegetation cover.**



## **Management Sector 5 - Southern Edge and Inlet**

*The southern Pauatahanui Inlet edge, including SH58 and all land seaward of it, and the southern Inlet, between Shearers Point and the Pauatahanui Wildlife Reserve. The land areas are very restricted, comprising the SH58 roadway, very small rocky beach outcrops between the road and the shore, and a narrow foreshore and inter-tidal strip. But this management sector includes the southern part of the Pauatahanui Inlet, the key ecological resource in Porirua City. With such a sharp transition it is very easy to under-estimate the close relationship between land and water. All land is public, either road or foreshore reserve.*

### **Water Quantity and Quality**

Although the SH58 road does not constitute a large catchment area the water from it runs directly into the Inlet. Natural drainage off the escarpment, as well as stormwater from the roads and houses immediately above become part of the discharge from SH58.

Hooper's work show that there is a measurable contamination of sediments in Browns Bay and at the mouth of Duck Creek (Hooper 2002). The exact contribution of contaminants from SH 58 is unknown, but from the available traffic figures it appears that if there is heavy metal and PAH contamination of the Inlet, much of it is coming from this management sector. This is because traffic counts on SH 58 are very high and contamination from SH58 would be supplemented by that from Whitby which has large traffic counts and stormwater drains spilling out into the inlet. This is dealt with in the appropriate sections below.

Options for filtering of stormwater off SH58 before it enters the estuary should be examined. These would include grass strips, and filters. In some places road engineering to reduce the amount of contaminants onto the road may be feasible.

### **Natural Character and Biodiversity**

The natural character of the Inlet edge derives more from the escarpment than from the inter-tidal area; the actual edge of the Inlet, also the outside edge of SH58, is clearly culturally dominated, with stone retaining walls and minimal vegetation.

The ongoing Guardians of Pauatahanui cockle counts (Grange & Tovey 2002), provide a valuable indicator of the status of biological health within the Inlet. In the 2001 sampling cockles continued to be found in densities similar to those previously recorded, with greatest densities along the southern shores. Juveniles were recorded in similar but slightly lower numbers than in 1998, but still in considerably higher numbers than in the previous surveys. Overall, numbers would appear to have stabilised over the past two surveys, compared with the large decrease recorded between the 1970s and mid 1990s surveys. There has been a slight mean increase in cockle size since 1998.

The cockle population would appear to be generally much more stable in terms of both numbers and sizes, except at Motukaraka and Camborne where the population continues to decline. Areas of greatest density were Browns Bay, Pauatahanui Stream, and Bromley. The



lowest densities were at Camborne. The significance of eelgrass in the habitat of cockles suggests that the protection and restoration of eel grass beds continues to be a priority. It is suggested that a detailed site-specific expert evaluation of options for eel-grass restoration within the whole Inlet be undertaken, possibly in conjunction with dredging of built-up sediment from the Inlet bottom in priority localities. This project was also discussed and recommended (without exact localities being specified) in the Pauatahanui Inlet Restoration Plan Stage 1 report.

Cockles have proven to be an excellent species with which people could work to monitor the Inlet environment. Eelgrass could be an equally important indicator species. Unfortunately the observations of changes in the Inlet eelgrass communities are largely anecdotal. It is recommended that a monitoring and restoration programme be established to better understand the current state of eelgrass communities and develop options for its enhancement. Sites for this work should be chosen which are accessible to the community so that people can see directly what is happening to the health of the Inlet. This programme should include investigation of options around the western side of Golden Gate Peninsula, discussed in management sector 3.

These Recommendations for eelgrass restoration and monitoring should not detract from a priority to first improve habitat quality (especially water clarity) so that existing eelgrass beds are able to survive and expand. These recommendations to reduce sediment and pollutants entering the estuary, are discussed elsewhere.

Research and monitoring should also extend the recommended tidal gauging and study of deposition patterns at the Inlet entrance (discussed in Management Section 2) to provide a full new hydrological model for the Inlet. This would update the PEP work of the same type (Healy 1980) and constitute an important part of the assessment of changes in the estuarine environment since the 1970s.

### **Recreation and Access**

In surveys of residents undertaken by the Porirua City Council when developing their Walkways Strategy the provision of a walkway around the inlet was the top priority. The Plimmerton Rotary Club has picked up the development of the walkway as a '2005 Centennial' project and a programme of development is currently under discussion.

The proposed 'pathway' (as the project is now known) around the Inlet incorporates the southern section. Transit New Zealand has agreed to make planning provision for space for such a project in their ongoing maintenance of SH58. Transit proposes to construct approximately 380m of new rock along protection seawall along SH58 over the next 15 years. During the same period approximately 730m of existing wall will be replaced. In total some 45% of the southern Pauatahanui Inlet coastal edge is to be renewed. Transit have a long term consent to undertake this work and in the process will make provision for the incorporation of the pathway.

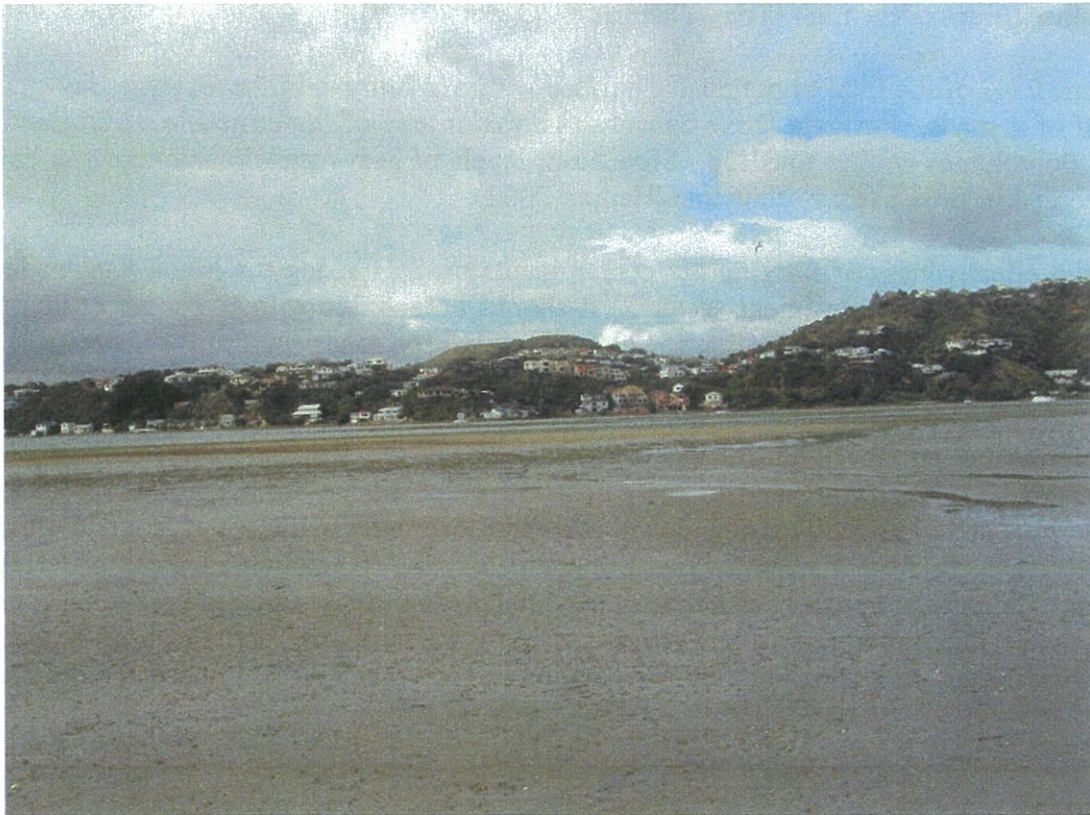
Sections of SH58 not to be modified (some 1.3 km) include areas of ecological value such as rocky promontories, boat ramps, areas with established vegetation, and areas with a wide road shoulder. All these areas, apart from boat ramps and their immediate surroundings,



should be maintained in a close to a natural state as possible. In renewed edge portions, areas of constructed rock wall should be designed to mimic natural rocky shores. To maximise the area of more natural coastline, there should be no construction of vehicle lay-bys on the seaward side of the road.

### **Summary: Southern Edge and Inlet Action Points**

- Continue monitoring the cockle populations and their health.
- Undertake a detailed site-specific expert evaluation of options for eel grass restoration within the whole estuary.
- Explore options for filtering stormwater off SH58 before it enters the estuary.
- Continue monitoring environmental conditions in the Inlet and research on determining limiting factors for key estuarine species.
- Product an updated hydrological model for the Inlet.





## Management Sector 6 - Browns Bay Catchment

*Most of the Browns Bay catchment, except for the front escarpment. A mixture of built up areas in the central and eastern parts, areas of pine trees, regrowth native vegetation and on the western hills, small areas of riparian vegetation associated with watercourses, and grassy open space around Postgate Park and Browns Bay Reserve. Predominantly private land but includes some significant PCC reserves and adjoins Ascot Park in eastern Porirua. Reserves that were originally excluded from development because of inaccessibility and set aside for amenity purposes now perform an invaluable ecological function. For example riparian areas along the headwaters of Browns Bay stream contain typical native riparian species and reasonable bird populations. A geographical and ecological link between Pauatahanui Inlet, Whitby and the Porirua Harbour catchment. In the lower part of the catchment the Browns Bay stream, augmented by stormwater, vanishes into pipes, emerging briefly to cross Browns Bay Park before entering the sea.*

### Water Quality and Quantity

During the residential development of the 1970s Browns Bay catchment attracted considerable attention as a source of sedimentation. Observations and anecdotal evidence since that time suggests that the catchment is now much more stable. For a series of photographs taken following heavy rain in June 2003 showed that during that episode the Browns Bay outfall was the least discoloured of the five main outfalls along the eastern and southern sides of the inlet (Tony Thomas, PCC, pers.comm.).

Some 27% of the total impermeable surface within Whitby is in the Browns Bay catchment, half of it roads. Postgate Drive constitutes a major area of impermeable surface and carries traffic volumes similar to SH58. Significant levels of heavy metal contamination have been recorded in Browns Bay sediments (Hooper 2002).

If the effectiveness of filtering out contaminants on SH1 along the Mana Esplanade can be established (see management sector 2) it should be possible to make some estimate of the value of undertaking similar filtering along heavily used roads such as Postgate Drive. In the interim there is a need to secure the protection of important vegetation for its stormwater retention and filtering value in the main tributaries of the catchment. More than half of the impermeable surface within the catchment is above the Omapere Street - Postgate Drive junction. At this upper end of the catchment much of the stormwater is discharged into natural waterways and carried down to pipes. Similarly with water coming down onto Postgate drive from the east. Because the remaining vegetation in these waterways still forms a significant proportion of the upper catchment and it is in good condition, it performs a critical function for the management of both water quality and the buffering of storm events. Retention of this remaining vegetation in good condition is important (see below).



## **Natural Character & Biodiversity**

The Postgate Drive entrance to Whitby is particularly attractive, with Browns Bay Park on the eastern side and extensive areas of indigenous vegetation on the hills to the west. The shelter and containment of high ground and the vegetation on either side of Postgate Drive provides an interesting contrast to the open and expansive character of the Inlet.

The catchment has some very significant indigenous remnants, both in reserves and on private land. The regrowth on the western hills is dominated by kanuka and mahoe, but there are emergent tree ferns and shrub hardwoods, and small areas of riparian vegetation with *Carex* species in the gully behind Postgate Park. The regrowth bush also contains kowhai and ribbonwood seedlings and reasonable bird populations. Bellbirds have been recorded.

There is a need to ensure that the integrity of existing indigenous vegetation in the upper part of the catchment (especially riparian areas) is protected through council reserves or other means of protection. The secure protection of at least part of the Ascot Park Site of Ecological Significance is of particularly high priority for a number of reasons. As well as its biodiversity values, this area is particularly important for riparian and slope protection and regulation of water quality and quantity as it forms a significant proportion of the upper catchment area. It is also an important linkage between Whitby and the Porirua basin, and is one of the closest areas of indigenous vegetation to eastern Porirua which has few indigenous areas remaining. Other ecological areas may be protected through the package of measures discussed generically, including education, covenanting, building and subdivision controls etc. The recent lifting of designations leaves some riparian areas with an unresolved tenure, which should be resolved.

To protect water quality, active restoration of bush areas should be undertaken where bank erosion is occurring, often associated with excess shade and too little ground cover. The quality of these bush areas could also be improved through a reduction in dumping of weeds and other rubbish.

## **Recreation and Access**

The Browns Bay Catchment includes some 126 hectares of open space and residential development. The open space, most but not all of it in reserves, is on steeper land at the top of the catchment. The pattern of reserves provides a coherence and connectedness which is not only ecological but also affords a network of potential walkway connections (including into Ascot Park). Bush settings make these walkways particularly attractive. The active management and enhancement of the ecological values of reserves clearly has benefits for the natural character and amenity values of the Browns Bay Catchment and would improve the quality of recreational experiences.



### **Summary: Brown's Bay Catchment Action Points**

- Ensure that the integrity of existing indigenous vegetation in the upper part of the catchment (especially riparian areas) is protected through council reserves or other means of protection.
- Investigate the possible acquisition or other means of protection of areas formerly designated for roading where these traverse key tributaries of the catchment.
- Undertake an investigation to establish the levels of contamination in stormwater picked up off Postgate Drive. Consider cleaning devices such as those being investigated for the Mana Esplanade.





**Natural waterways with dense bush**



**Postgate Drive with hard surfaces and drains.**



## **Management Sector 7 - Western Duck Creek**

*The western and least built up part of the lower Duck Creek catchment, with two tributary streams draining an area of 90ha and feeding the main Duck Creek from the west. The hills of this management sector form the western backdrop to Whitby, with a mixture of houses, regenerating kanuka and manuka dominated bush, small areas of more advanced regeneration with shrub hardwoods, and some grassed open space. There are small highly fragmented and degraded remnants of mature bush on the lower hill slopes. Predominantly private and tenure, but some of the key Whitby West Bush SES is in Porirua City Council Reserve. Forms the main ecological and visual linkage between the Browns Bay and Duck Creek catchments.*

### **Water Quantity and Quality**

The extensive areas of bush cover and the limited impermeable surface means that water quality and stormwater management is generally not likely to be a problem, currently. Runoff is well buffered by the regenerating vegetation covering much of the hills, and the ponds associated with Whitby Village are able to absorb some of the peak runoff. The filtering effects of vegetation and the opportunity for sediment and contaminants to settle out in the ponds makes the contamination of the western tributary from this source unlikely. However all the privately owned land is zoned suburban even though the hill areas are currently in low density residential development. Close subdivision of these hills would initiate another cycle of sedimentation and increased stormwater peaks if not closely controlled.

### **Natural Character & Biodiversity**

The Western Duck Creek hills are perhaps the most critical landscape elements in defining the unique character of Whitby. The western hills have long, steep, and prominent slopes with very strong coherence due to the almost continuous vegetation cover dominated by kanuka and manuka, punctuated by small grassed enclaves. These western faces catch all day sun which gives them a particular visual prominence.

The challenge for the future will be to maximise the retention of the vegetation cover, both for its biodiversity and catchment protection values. This applies especially to SES areas in private ownership. The limited PCC reserves are confined to access strips and riparian vegetation associated with ponds. The scattered remnants of mature indigenous forest across the lower slopes, with tawa and podocarps in the canopy, have not been well sustained within residential development, and the only remaining mapped forest ecological site, at Latitude Close, has been so fragmented that it is assessed as having amenity rather than ecological values. However, care by owners can maintain and enhance these amenity values. Within council reserves currently dominated by exotic species, thinning out the canopy of exotic species, macrocarpa and alders in particular, so that there is sufficient light to reach through to the forest floor, will enable indigenous regrowth.

Providing information about the significance of remnant indigenous vegetation and an advocacy for its protection, supported by sound management advice, is critical for the



western catchment of Duck Creek. As discussed generically above, a package of measures to retain existing vegetation cover is necessary. In this sector, individual owners of the larger hill blocks should be approached to discuss the values attaching to their vegetation, the management requirements, and possible council assistance.

### **Recreation and Access**

The public pathway linking Adventure Drive and The Mainsail is essential and functional. Pathways associated with the Whitby ponds are both functional and attractive. Reserves tend to be limited in their purposes to access.

### **Summary: Western Duck Creek Action Points**

- Explore options with owners of larger holdings to secure the long term protection of indigenous vegetation across Whitby's western slopes.
- Thin out the canopy of exotic species in council reserves, macrocarpa and alders in particular, so that there is sufficient light to enable indigenous regrowth.





**Given sufficient light under exotic trees, natives will regenerate.**





**Retaining woody vegetation on steep faces along the western hills is critical.**



## Management Sector 8 - Upper Duck Creek

*Southernmost and largest management sector (nearly 700 ha) of the study area, consisting of the hourglass shaped upper part of the Duck Creek catchment. Steep hill country, with shallow soils, rocky outcrops and a somewhat incised stream. Almost all in pasture or pine forest, except for scattered areas of native regeneration. Much of the pine forest will be logged in the next few years and is zoned residential. The main streams contain native fish populations and much of the stream length has reasonable riparian vegetation. Public land (DOC, WRC and PCC reserves) and private land owned by Landcorp and a forestry company. Most of the public land is managed as a farm park in conjunction with Belmont Regional Park.*

### Water Quantity and Quality

Duck Creek Catchment covers over 80% of the study area. Upper Duck Creek, some two thirds of the total catchment, clearly catches the greatest part of the rainfall. Recent modelling carried out by Porirua City Council (BECA 2003) calculates Mean Annual Flood flows of  $7.8\text{m}^3/\text{sec}$  at the top of the former golf course and  $9.3\text{m}^3/\text{sec}$  at the SH58 outlet.

Much of the upper catchment is steep and the catchment drops in elevation from over 400 metres to sea level over a fairly short distance (less than 5 km). Although there are few recent erosion scars vegetation cover is light over much of the upper catchment with rock and scree exposed. Riparian vegetation is patchy with a lot of minor stream bank erosion.

Healy (1980) observed that of the estimated 1650 tonnes of sediment coming out of Duck Creek each year during the Pauatahanui Environmental Programme, 63% of it could come from one major annual flood event. The sediment is likely to be generated from a combination of stream bank attrition, sheet and mass movement erosion. From the areas of different land uses involved and the general understanding of erosion under these land uses (Healy 1980; Boffa Miskell 2000) it is likely that much of the total sediment currently comes from the upper catchment, and is likely to proceed fairly directly into the Inlet (i.e. there do not appear to be large amounts of sediment in storage in the middle or lower parts of the catchment).

At the time of the PEP the Duck Creek catchment was a mix of grazed catchment with limited urban development. In more recent years the planting and landscaping (including ponds) that is associated with more settled urban land, along with reduced grazing and regeneration in the upper catchment may well have reduced total silt loads. However removal of woody vegetation cover anywhere in the catchment, without other considerations, may well be leading to an increase in siltation risk.

A reduction in sediment generation in the upper catchment is clearly highly desirable for the ecological health of the Inlet. This will primarily require an enhanced cover of woody vegetation on steep slopes and along water courses. Woody vegetation absorbs the energy of rainfall and runoff, binds the soils and leads to a build up in organic matter, all of which reduces erosion rates and holds water to reduce runoff peaks. In fact the establishment of forest in formerly grazed catchments can reduce water outflows by between 30% and 50% (Boffa Miskell 2000; Page *et al.* 2000).



Currently, some 4.5ha in the upper catchment is subject to planting with natives by Transit NZ, as a mitigation measure in the event of the Transmission Gully motorway proposal going ahead. The planting is primarily designed to mitigate sediment movement from cut and fill. The establishment of woody vegetation over a further significant portion of the Upper Duck Creek Catchment, including riparian areas, would significantly reduce flooding in the lower catchment and greatly reduce sediment outflows. As a cheaper alternative to native planting over such a large area, pines and/or eucalypts could be planted at variable stockings as a nurse crop for natives, and eventually removed. Alternatively those immediately below open tops might be retained as stock shelter.

Further analysis needs to be undertaken to explore options and implementation mechanisms for the establishment of a woody vegetation cover over the steeper areas of the Upper Duck Creek Catchment. This needs to be designed in a way which reduces flooding, nutrient input and sedimentation, enhances biodiversity, in conjunction with any continuing stock management and any other future land uses (e.g. wind power generation), and recognises the importance of the open tops to the recreational users of Belmont Regional Park. Upper Duck Creek is traversed by several high voltage transmission lines by Transpower NZ Limited. Any re-vegetation plan should also take into consideration the need to avoid vegetation establishment which could adversely affect these transmission lines.

The only other recorded water quality issue beyond the obvious one of sedimentation is nutrients; high levels of nitrogen have been recorded in Lower Duck Creek (Hooper 2002). Whether this originated from farming operations in the upper catchment or from golf course maintenance is unclear. There is a need to monitor water coming off the farmed area for nutrients. This work needs to be undertaken as part of a more comprehensive monitoring programme, discussed below.

### **Natural Character & Biodiversity**

The steep slopes with deeply incised streams below and high exposed tops above make for a spectacular landscape. The sense of the wild and remote so close to densely populated areas makes the Belmont Regional Park a special and popular place. To retain the existing character, some open space is essential, and this would require continuation of some grazing; without stock the area would revert and over time panoramic views would be lost. However, the enhancement of riparian woody vegetation in sheltered gullies would be highly desirable, both as shelter for the colonisation of further indigenous flora and fauna and for improved freshwater habitat, as well as for the reduction of erosion discussed above. Riparian protection throughout this management sector is a priority, through a combination of planting and fencing.

One of the defining features of the character of Whitby is the containment of hills and their cover of vegetation. In recognition of the significance of the hills to the south of Whitby the District plan recognises a Landscape Protection Area. Within this area there are constraints on vegetation removal and a minimum lot size of 1 ha.

With the logging of Silverwood Forests a significant loss of visual containment has occurred. The back of the forest area is however within a Landscape Protection Area so that future



subdivision will have to respect the requirement to limit structures and favour woody vegetation, to recognise and provide for natural character.

Although the former Whitby golf course is not within the Landscape Protection Area, current concept proposals for subdivision appear to recognise the value of indigenous remnants on the back faces of Whitby on the edge of the upper catchment, by providing for relatively large lot sizes. This allows for the possibility of retaining and enhancing woody vegetation and keeping the impact of structures in check, and it is recommended that this concept is promoted by the use of covenanting or other appropriate mechanisms.

In the original 1971 Whitby Plan there was a conscious decision to promote the containment of Whitby with the establishment of a 'town belt'. There was a suggestion that the pine trees on the edge of the residential area be heavily thinned and retained for their amenity and recreational values. (In fact the people of Whitby have always had informal access to the Silverwood Forests).

It would be extremely advantageous to the community if a comprehensive revegetation plan could be developed with the Silverwood Forest owners and considered in conjunction with council reserve acquisition and development. This should be incorporated into any future subdivision plans and associated with public access and reserves. This would be very much in the spirit of the original vision for Whitby.

### **Recreation and Access**

As an essential part of Belmont Regional Park the Upper Duck Creek Catchment is very important for its recreational values. The topography is challenging and the views are spectacular. Access between Belmont Regional Park and Whitby would greatly enhance recreational use from more parts of the region, and allow the development of a wider range of walking tracks. The development of such access is therefore recommended. The most logical connection is up Duck Creek but access from Silverwood Forest should also be considered. Arrangements for this will need to be made with private landowners.

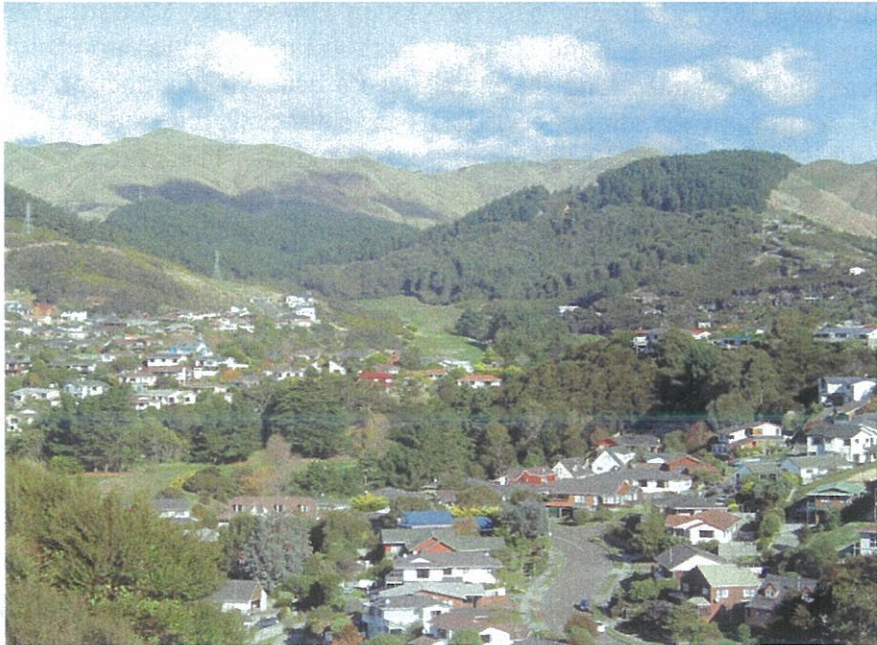
### **Summary: Upper Duck Creek Action Points**

- Plan and implement a restoration programme for the upper tributaries of Duck Creek catchment. Aim to re-establish a cover of woody vegetation over approximately a third of the total area, on steeper slopes and in riparian areas, and within the Landscape Protection Zone, with the objective of reducing sedimentation and flooding.
- Secure the protection of indigenous vegetation on Silverwood Forest land, especially on sites of ecological significance and in riparian areas.
- Ensure the long term provision of public access between Whitby and the Belmont Regional Park.





**Upper Duck Creek-little woody vegetation remains**



**Upper Duck Creek-above the former golf course and pines, and out onto the open tops of Belmont Regional Park.**



## Management Sector 9. Northern Duck Creek Hills

*The western part of the lower Duck Creek catchment. Moderately steep hills with a mixture of housing and reserved areas with a variety of vegetation cover. Vegetation includes mature pines, regenerating scrubby vegetation, and areas of remnant native mature forest and native regeneration. Significant ecological and visual values. There are three sites of ecological significance, several council reserves and extensive areas of open space. Small forest remnants in the PCC reserves have distinctive hardwood and podocarp trees and good bird populations but are threatened by weed invasion. Much of Whitby looks onto these coastal hills which provide a very coherent backdrop of vegetation between Whitby and the Inlet. The reserves are connected by a network of walkways and there are excellent lookout points with views both inland and out across the Inlet.*

### Water Quantity and Quality

There are no issues associated with water quantity; the amount of vegetation cover is more than sufficient to manage the quantities of water in this section of the catchment. There is no evidence of soil movement either on steeper surfaces or in the main tributary of Duck Creek.

It is estimated that the Duck Creek tributary picking up water from the Northern Duck Creek hills picks up water off some 7 ha of impermeable surfaces, perhaps half of this roads. Most of the roading services residential properties in the immediate area. There is however a heavily-used section of Spinnaker Drive from which stormwater is collected and piped directly into the stream. It is therefore likely, given the high traffic volumes, that stormwater contaminant concentrations are relatively high.

Whitby Walkway Reserve, running between Ayton Drive, The Yardarm, Discovery School and Discovery Drive, presents some spatially limited but valuable opportunities to establish retention areas and wetlands along the stream at its base, in conjunction with tree planting (see below). At present the stream corridor is used for a walkway and the associated open space is attractively designed with canopied trees and grass. There are short sections where a re-contouring of the stream and the planting of suitable wetland species could enhance the filtering effects of the stream environment. This warrants further investigation.

### Natural Character and Biodiversity

The Northern Hills and the associated tributary of Duck Creek are very important in defining the character of Whitby. Their significance was clearly recognised by the planners of Whitby when setting aside reserves, providing for walkways, and amenity planting of exotic trees. For the most part these areas also fulfil the purpose of soil and water management.

Over time, community requirements of such areas change. Now there is a greater need for their ecological functioning and ecosystem services functions. There are requirements to protect indigenous biodiversity, and councils wish to spend less on long-term maintenance. For all these reasons it is suggested that over time the predominant vegetation cover in the northern hills reserves changes from exotic to native trees. This will maintain and enhance the important biodiversity values of the current SES within these reserves. It would be



desirable, initially, to establish small areas of natives, perhaps 100-200 square metres, as seed sources. Areas of macrocarpa need to be heavily thinned to allow light penetration for the regeneration of natives. In such sheltered areas wind throw is unlikely to be an issue.

Along the streams a more natural and indigenous, rather than an exotic and manicured, character would also be more appropriate to an ecological purpose. Along open and less entrenched sections of the stream plantings of indigenous riparian species should be undertaken. Plantings adjacent to the stream should not include canopy species; the objective should be to establish a dense cover of sedges, grasses, smaller shrubs etc.

In sheltered and damper areas with an existing cover of native shrubs the planting of native canopy trees such as tawa, titoki, kohekohe, wharangi, and podocarps would be desirable. Weed control is needed throughout reserves. Pampas grass, which has pioneered logged sites, especially in Spinnaker Reserve, poses a significant threat and needs to be removed. Spinnaker Reserve is the exception to the above recommendations; re-establishing a full native cover would be a very ambitious job, and there are also cultural reasons for retaining exotic trees in some parts of Whitby to recognised links to the establishment of the original Whitby suburb.

### **Recreation and Access**

Restoration along the lines suggested above, along the stream and within reserves generally will benefit recreational users through providing a mix of native and exotic vegetation and open space. Open space associated with the stream is important not only for walkers but also for Discovery School and kindergarten children as well as residents along the stream.

### **Summary: Northern Duck Creek Hills Action Points**

- Along open and less entrenched sections of the stream plant indigenous species to establish a dense, low, ground cover. Keep canopy species back from the stream to ensure sufficient light is available for ground cover species.
- Maintain Spinnaker Reserve as a mixture of exotic and indigenous species.
- Undertake weed control in reserves as part of the overall strategy for the inlet. Pampas grass, which has pioneered logged sites, poses a significant threat.
- Lightly thin areas of macrocarpa on the faces above Spinnaker Drive and along the stream at the base of the slope to allow sufficient light for natives to regenerate. Remove any naturally regenerated pines along the stream.
- Investigate the possibility of re-contouring the stream in the recreation reserve below The Yardarm to create a retention area to filter stormwater off Spinnaker Drive before it enters the main Duck Creek.
- In sheltered and damper areas of Yardarm and Duck Creek Reserves with an existing cover of native shrubs inter-plant native canopy trees.
- To assist the shift from exotic towards indigenous vegetation across the steeper faces of the hills establish small areas of natives, as seed sources.





**Lower slopes of Northern hills falling to Duck Creek tributary and walkway**



**A Site of Ecological Significance in a residential setting on Northern Hills.**



## Management Sector 10 - Lower Duck Creek and Pauatahanui Tributaries

*Lower-lying parts of the Duck Creek catchment, from the top of the former golf course and the northern end of Silverwood Forest. Also includes the lower western tributaries of the Pauatahanui Stream which lie within eastern Whitby. Centred around the lower Duck Creek valley, most of the management sector has an enclosed valley feel to it, with the hills of northern and western Whitby and the Upper Duck Creek catchment around. More hilly in the east. The sector has a mixture of housing development of different age and density, together with the large currently open space of the former golf course and the logged parts of Silverwood Forest. Contains several small areas of remnant forest and kanuka and manuka regrowth. Most native vegetation areas are continuing to be fragmented by clearance and weed invasion. However, bird populations appear to be reasonable, including kereru. Duck Creek is the largest stream in the study area, and is an important ecological feature, with several native fish species including galaxids. The lower end of Duck Creek, with open saltmarsh vegetation, is a distinctive counterpart to the rest of the study area. Predominantly private land but including some small PCC and DOC reserves.*

### Water Quantity and Quality

The eastern side of Whitby includes the main Duck Creek Stream and two minor tributaries of the Pauatahanui Stream. From the perspective of the estuarine environment, its health and its biodiversity, the management of the bottom end of Duck Creek is critical; arguably more important than in any other part of the study area. It is here that flooding has the greatest impact, and also that most of the stormwater from the residential area of Whitby enters the stream. Slightly more than half of the water collected from roofs and roads in Whitby enters Duck Creek, almost all of it below Adventure Park. Any stream or stormwater contamination is a concern for both the health of Duck Creek Reserve and the Inlet.

A recent report prepared for Porirua City Council (BECA 2003) identifies flood-prone areas in this management sector. Water remains reasonably well contained in the steeper upper sections where the stream is entrenched. Where the floodplain (former golf course) begins to broaden, however, flooding does become an issue. With flooding comes sediment, most of it carried down from Upper Duck Creek.

There is observable bank erosion at the bottom end of Duck Creek but this is believed to contribute a relatively minor quantity of sediment to the stream compared to the farmed part of the catchment above.

It would appear from BECA 2003 report that peak flows into the inlet are attenuated by the ponding that occurs in the present waterway and flood plains. This can be seen from Table 4.3 (BECA 2003, p11) where, in the possible (but unlikely) ultimate development, the peak flow to the inlet is less than the peak flow further up the catchment. This ponding will also aid in settling sediment prior to entering the inlet.

In many cases, Councils are now requiring large subdivisions to be undertaken in such a way that downstream storm discharge peaks after urbanisation are kept to at or below peak flows from the pre-urbanised catchment. This is particularly important where downstream urbanisation has occurred prior to upstream development (eg parts of Kapiti and Hutt Valley).



In this case some peak flow increases could be acceptable as, provided they are thoroughly understood, they can be managed by engineering works and setting new building at safe levels. However every effort should still be taken to minimise any increases.

In the case of Duck Creek, the flows and flood levels generated in the BECA 2003 report appear to assume the retention of all existing overflow paths and flood plains. If some of the floodable areas are removed by filling, flood plain storage is reduced, the waterway becomes more confined and peak flows and flood levels rise beyond those indicated in the BECA 2003 report. Subdivisional design within the catchment will need to develop new peak flows and flood levels if the flood plains are to be confined.

Regardless, it remains desirable to minimise any increase in peak flows so that velocities in a confined waterway do not leave the risk of greater erosion problems. Some mix of the methods covered in the discussion of generic issues are expected to be necessary to achieve this.

In the upper part of the golf course, (vicinity of cross sections C150 to C156 approx), the stream has been realigned to immediately below the eastern hillside whilst its original alignment appears to have been through lower land nearer the centre of the fairways. This means that should the man made channel overtop, flow would quickly run to the lower land and urbanisation would be put at risk. This area will need particular design input as part of any land development.

Although stormwater off roads and roofs enters Duck Creek at numerous points, and in various quantities, it is possible to identify some of the more significant points at which major quantities enter the stream. It is difficult to calculate amounts precisely and at each outfall the relative quantities of water collected from roads and roofs versus green space is obviously variable. However, estimates are helpful in gaining an understanding of the relative significance of the key outfalls. Key outfalls in lower Duck Creek are listed in Appendix 2.

### **New Subdivision**

Whitby Coastal Estates Ltd has indicated an intention to subdivide the remainder of their landholdings, shown as some 94 ha in their March 2003 indicative plan. This plan provides for some 6 ha of reserves and 4.5 ha of walkways. In areas where indigenous bush remnants remain the lots are larger to accommodate retention. Based on this plan, if approved, some 15-20 ha of impermeable surface would be added to the lower Duck Creek Catchment, a 35-40% addition. This would take the proportion of impermeable surface in the catchment to some 16-21%, a low percentage and fairly consistent with current percentages for Whitby as a whole.

To the south of the Whitby Estates land is Silverwood Forest, currently being logged, and zoned for eventual residential development. Areas along the ridge of the forest area are zoned within the "Landscape Protection" within the current District Plan and so have minimum lot size constraints aimed at ensuring continuing open space and provision.



There should be strict controls on any approved subdivision in terms of both vegetation removal and the management of sediment. Under both the proposed lower Duck Creek subdivision plan and the eventual Silverwood forest subdivision, water quality and stormwater flows should be managed by a range of methods as noted under "Planning and Strategic Initiatives". The design philosophy for such features is to provide major benefit in storm events up to perhaps 5 year return period and a reducing benefit in more major storms when flows and silt loads are much higher and not realistically manageable.

In addition it is strongly recommended that in lower Duck Creek some ponding be retained (or new ponds designed), on the flat lower lands to settle silt, and at least, some other contaminants before flows enter the inlet. From the analysis in Appendix 4 the most advantageous area appears to be a portion of the extensive 1 year ARI flood prone area below the end of Shackle Lane, that could serve as a wetland and an area of periodic inundation where the filtering of stormwater can occur during peak flows. In the event of residential subdivision of the portion of Duck Creek above Discovery Drive, a similar provision would be desirable to the east of Adventure Park.

All of the grassed riparian portions of Duck Creek require restoration and better management for stormwater management and natural habitat maintenance (see below). All of the areas subject to 1 year ARI floods should be planted in low growing native riparian grasses and shrubs, and kept free of structures. Areas subject to the Mean Annual Flood should also be dominantly vegetated but there need be no height restriction; shade will not be an issue away from the immediate stream and debris will not be an issue in shallow water away from faster flows.

If esplanade reserves on lower Duck Creek are required as conditions on subdivision, it would be desirable from an ecological perspective for these reserves not to be of uniform width. In some areas the requirement may be less than 20 metres (the default esplanade reserve requirement under the Resource Management Act) while still providing sufficient width for riparian protection, access and bank stability. In other areas it would be desirable to have more than 20 metres to enable restoration of adjacent riparian and forest habitats, or to make provision for ponding areas.

### **Natural Character & Biodiversity**

The former Duck Creek golf course, as well as its invaluable function in buffering flooding, is central to the generous patterns of open space through Whitby. The high visual value of expansive grass areas is particularly important for residents in adjoining areas. However, the dominant former recreational use for golfing has created a disincentive to plant riparian vegetation other than grass. On steeper sections of the stream the riparian vegetation is substantial, with dense ground cover and shrubs.

Indigenous remnants, dominantly Kanuka/Manuka with regenerating native shrubs, are common but very fragmented in the main Duck Creek catchment. There are small areas of remnant native forest containing such species as tawa and titoki with the odd podocarp. Many of the remnants are associated with walkway reserves and so are narrow and elongated, while some other patches have been subject to neglect and clearance or fragmentation. Nevertheless



these fragments provide threads of connection and cohesion along water ways and across steeper scarps. They are ecologically and visually important.

Most of the planting since Whitby's early development has been of exotics, in reserves as well as on private properties. The oldest and dominant trees are all macrocarpa, from the farming period, but with subdivision there have been mass plantings of Alders, Birches, Eucalypts, Acacias and pines with a diversity of English hardwoods planted as specimen trees. Such plantings are visually pleasant and very suitable where an open park like character is desired. In waterways however they are inclined to create excessive shade so that ground cover is often limited or non existent.

The eastern tributaries of Pauatahanui Stream retain some natural cover of riparian vegetation, although this is highly fragmented in current subdivision and construction.

Current riparian vegetation in the Lower Duck Creek catchment is for the most part inappropriate or inadequate for natural habitat. A stable stream bed is supported by native grasses and a dense cover of indigenous shrubs in the upper section of the former golf course but lower down cover is limited to introduced grasses with some sections of the stream bank exposed with eroding earth. In the tributaries, notably the eastern Endeavour Park tributary, the stream moves through pipes and constructed drains with exotic canopy trees and little ground cover. At the bottom end, the portion of the stream flowing through Duck Creek Reserve represents the only authentic section of the stream and the only area of estuarine vegetation along the southern side of the inlet. Lower Duck Creek is an important location regionally for native freshwater fish and this habitat should be enhanced.

All indigenous remnants, and especially significant ecological sites, need to be afforded greater protection and there is a need for selective restoration of these. There are sites within reserves where native trees could be planted.

### **Recreation and Access**

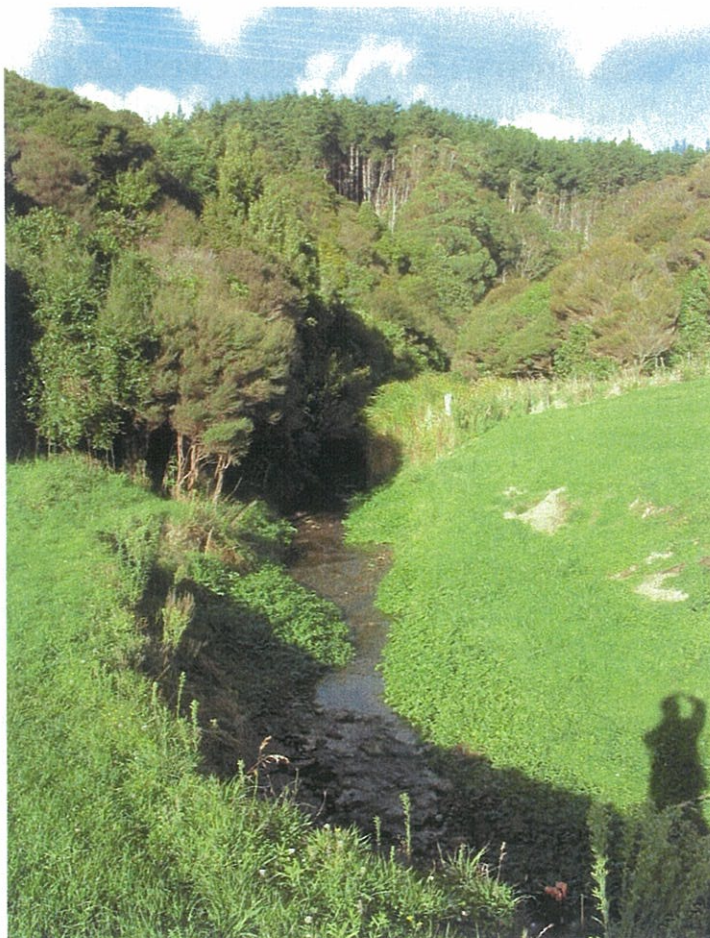
Existing pathways tend to follow the outer edges of the former golf course and most, but not all, are within reserves. This provision should be extended. Potentially the former Duck Creek golf course offers attractive low-gradient routes both upstream through the current Silverwood Forest area into the upper Duck Creek catchment and into Belmont Regional Park, and downstream to link Whitby directly to the Pauatahanui Inlet. The loss of views onto open space for walkers moving up existing walkways will be compromised by residential development. Higher up the creek views tend to be across the valley so that the retention of vegetation on higher ground and the planting of vegetation in riparian and inundation areas should ensure that the sense of coherence which open space confers is retained.



### **Summary : Lower Duck Creek and Pauatahanui Tributaries Action Points**

- Afford greater protection to all indigenous remnants, and especially Sites of Ecological Significance, and undertake restoration as required.
- Implement strict controls on any approved subdivision in terms of both vegetation removal and the management of sediment.
- Consider ways in which any approved development can reduce impermeable surfaces and increase the management of stormwater with natural rather than engineered systems.
- Plant all areas subject to 1 year floods in low growing native riparian grasses and shrubs, and kept these free of structures.
- In the event of development of lower Duck Creek for residential development, set aside a portion of the extensive 1 year ARI flood prone area below the end of Shackle Lane at the bottom end of Duck Creek to serve as a wetland and an area of periodic inundation where the filtering of stormwater can occur during peak flows. In the event of residential subdivision of the portion of Duck Creek above Discovery Drive, a similar provision would be desirable to the east of Adventure Park.
- Investigate the extension of walkway routes along Duck Creek between Pauatahanui Inlet and the upper Duck Creek catchment, as part of any esplanade reserve requirements in the event of development of lower Duck Creek for residential development.
- Investigate the possibility of extending the effective saltmarsh area within and immediately above the current Duck Creek Saltmarsh Reserve.





**Riparian vegetation at the top of the former golf course**



**Bank erosion at the bottom end of Duck Creek**



## Other Specific Issues

### The Pauatahanui Inlet pathway

When implemented, the pathway will become a generic issue for restoration around most of the Inlet edge. In this report an attempt is made to give particular emphasis to the need to contain cultural impacts and to concentrate recreation activities in well designed corridors. The pathway will comply with this objective and should become a wonderful asset bringing the public into much closer contact with the special qualities of the inlet. Restoration initiatives along the pathway will enhance the visitor's experience while informing the visitor.

The planning, design, and implementation of the pathway is already underway and subject to a separate comprehensive and inclusive consultation process. From the perspective of restoration the significant challenges will include:

- The minimisation of physical and visual intrusion into the estuarine environment.
- Avoiding bird brooding sites and avoiding wildlife habitat generally.
- Directing users and hardening surfaces where containment is needed.
- Ensuring that there are no toxic substances associated with any structures and their treatment, e.g. timber or metal preservatives.
- Placement and design of toilet facilities.
- Using parking to control access and the intensity of use in specific areas.
- Environmental effects resulting from greater access – e.g. litter, foot traffic damage, ability to wander off pathways and cause damage.

In conjunction with planning for the proposed pathway, and the general need for enhanced environmental awareness discussed in an earlier section, the publication of a illustrated guideline on 'Protecting the Edge' should be considered. The aim of this would be to raise awareness of and promote greater resident involvement in protecting the special character of the inlet, at the same time as promoting the values that could be accessed through the pathway. The guideline would stress the importance of the relationships between vegetation cover, structures, ecological processes and the general wellbeing of both people and their environment.

### Road Reserve Management

The integration of road maintenance with the management of water movement and vegetation on both the landward and seaward sides of the road has the potential to greatly enhance the ecological values of the Inlet, improve the experience for motorists, and lower the long term costs of maintenance. In practical terms, road reserve management is synonymous with management of the edge of the Inlet.

If agreed to, the current discussion about trialling filters on SH1 to 'clean' water before it enters the Inlet at Dolly Varden Beach is a positive first step in a move towards an improved



understanding of contamination and its management. If successful, this should be rapidly followed by installation of sump filters at key outlets on SH58.

### **Road Maintenance Regimes**

The two key objectives in road maintenance are keeping water off the road and keeping sight lines open for motorists. Transit operational manuals require that any vegetation overhanging the road must be at least 4.5 metres above the tarmac. Keeping swales and culverts clear requires the regular, usually annual, cutting back of woody vegetation and chemical spraying to control exotic grasses, fescue in particular.

Erosion off steep banks within the road reserve on SH 58 affects the integrity of the unique vegetation communities on the escarpment and detracts from the attractiveness of the Inlet edge. It should be addressed jointly by Transit, Porirua City Council (who manage adjacent reserves), and landowners on reserve boundaries.

Establishing vegetation on steep clay banks without retaining structures can be difficult. Canopy trees such as Kowhai planted on the tops of, or well up, banks will buffer the impacts of rain and shelter natural regeneration. Plants in water tables can filter stormwater and reduce contaminants. Well integrated planting will enhance the natural character and quality of the coastal edge and improve the amenity of private properties. Work to protect and better manage Significant Ecological Sites along the coastal edges is a priority within the general need of SES discussed above.

### **Car Parking**

The PIRP Stage 1 report established the principle of limiting parking to specific nodes and thereby directing people to less vulnerable places. The size of parking areas also controls the number of people and can be related to 'carrying capacity'. This principle has been used successfully for some recent events; for example the recent organised walk around the Inlet attracted over 500 entries, the cars for most of which were accommodated at Motukaraka Point, one of the northern edge nodes. The same principles adopted for Stage 1 should apply to the Stage 2 area, particularly along SH 58. In fact there are limited opportunities to develop further parking areas here but as discussed for management sector 5, additional parking should only be provided on the inland side of the road, not on the Inlet edge. Car parking issues should be considered in detail in planning for the proposed Inlet Pathway project, anticipating a possible significant increase in demand.



### **Summary: Other Action Points**

- Monitor progress with the proposal for a 'pathway' along the edge of the inlet and associated with SH 58. Ensure that the visual and ecological impacts are not in contrary to the restoration initiatives being promoted and that appropriate connections are made with existing recreational networks.
- Consider car parking issues in detail in planning for the proposed Inlet Pathway project, anticipating a possible significant increase in demand.
- Publish an illustrated guideline on 'Protecting the Edge' to raise awareness of and promote greater resident involvement in protecting the special character of the inlet.



## Action Priorities

The above lists of actions are, in the judgement of the consultants, *all* important in a restoration plan for the southern and western parts of the Pauatahanui Inlet and catchment. However, the following list of actions has been chosen by the consultants as their recommended top priorities from among the individual lists. These are the actions thought to be able to contribute the most to the aims set out in the previous chapter, arranged according to the outcomes they are principally aimed at achieving. They include at least one priority project for each management sector, as well as some generic actions.

This list was guided by priorities nominated by participants in the second consultation meeting in July 2003, but the final selection of priorities was made by the consultants, further guided by comments on the draft report (Appendix 8). In this way, and because the list of priorities specifically includes actions aimed at each management sector and all communities of interest, as well as all outcomes, the process of selecting priorities for the PIRP is complementary to the processes that will be required for Long-Term Community Council Plans that affect the Pauatahanui Inlet and catchment.

This priority list comprises a mixture of generic and location specific projects which range from very large to modest. They do not have any order of priority attached to them, but are divided into those that should be implemented in the next three years, and those that will take longer to achieve. *It is important to note that this division is not a further priority ranking; the actions ranked '2' are no less important than those ranked '1' but will take longer to implement.*

In the table, for each priority action the desired outcome(s) they are principally aimed at are shown. The fact that many priority actions address more than one outcome (in some cases all four), shows how closely linked the outcomes are, principally around the over-riding concern for water quality in the Inlet. In the Executive Summary, the actions are arranged according to the outcomes and the relevance of these to the maintenance of water quality is further emphasised.



**Table - Recommended Priority Actions for the Pauatahanui Inlet Restoration Project, Stage 2**

PRIORITY ACTION	OUTCOME	URGENCY
Monitor the quality of storm water entering the Inlet from SH1 before and after the installation of filters in sumps.	WQ ER	1
Limit all vehicle access to the inter-tidal area to the cars of residents, and for essential Council maintenance, and where possible assist owners with alternative access and parking away from the estuary edge.	WQ ER	1
Undertake a detailed survey of public and private land along the southern escarpment to identify areas where the vegetation cover is inadequate and/or deteriorating. Differentiate between those areas that can be left to regenerate naturally and those where active planting is to be undertaken.	BNCA	1
Undertake a detailed site specific expert evaluation of options for eel grass restoration within the whole estuary, possibly in conjunction with dredging built up sediment from the Inlet bottom in priority localities.	BNCA ER	1
Develop, implement and monitor effective controls on subdivision in terms of both vegetation removal and the management of sediment, especially within all Significant Ecological Sites.	BCNA ER WQ	1
Set aside the extensive flood prone area at the bottom end of Duck Creek out from Shackle Lane as a wetland, or as an area of periodic inundation where the filtering of stormwater can occur during peak flows. A similar provision would be desirable to the east of Adventure Park.	SW BCNA	1
Investigate the possibility of extending Duck Creek Saltmarsh Reserve.	BCNA SW WQ ER	1
Explore options with owners of larger landholdings to secure the long term protection of indigenous vegetation across Whitby's western slopes.	BNCA	1



Ensure the maintenance of a dense vegetation cover along the edges of waterways passing through Camborne and crossing the escarpment.	WQ ER	2
Develop and implement a strategic animal pest and weed control strategy for the whole Pauatahanui Inlet and catchment, within an overall Porirua City animal pest and weed control strategy.	BNCA	2
Explore options for enhanced filtering of stormwater off SH1 and SH58, in association with planting around drainage areas, before it enters the Inlet.	WQ	2
Complete restoration planting on the sand dune along the foreshore between Pascoe Avenue and the first section of Camborne walkway.	BNCA	2
Investigate the possibility of zoning Golden Gate as a 'Special Character Area' with appropriate planning provisions supported by a design guideline. The provision would recognise the contribution the special character of the peninsula makes to the Inlet as a whole, especially as seen from SH1.	BNCA	2
Establish a full vegetation cover, woody if possible, on all slopes over 35°, whether in private or public tenure, and with special attention to the southern escarpment.	BNCA	2
Ensure that the integrity of existing indigenous vegetation in the upper part of the Brown's Bay catchment (especially riparian areas) is protected through council reserves or other means of protection.	ENCA ER	2
Plan and implement a re-vegetation programme for the upper reaches of Duck Creek catchment. Aim to re-establish a cover of woody vegetation over approximately a third of the total area, on steeper slopes and in riparian areas, and within the Landscape Protection Zone, with the objective of reducing sedimentation and flooding.	BNCA WQ SW ER	2



Investigate the possibility of re-contouring the Duck Creek tributary in the recreation reserve below The Yardarm to create a retention area to filter stormwater off Spinnaker Drive before it enters the main Duck Creek.	SW BCNA	2
Develop a comprehensive non-statutory package targeting all landowners who manage areas of indigenous vegetation, especially Sites of Ecological Significance and areas of riparian vegetation.	BCNA WQ ER	2
Consider ways in which development can reduce impermeable surfaces and increase the management of stormwater with natural rather than engineered systems.	SW	2
Plant all areas subject to 1 year ARI floods in lower Duck Creek in low growing native riparian grasses and shrubs, and kept these free of structures.	SW	2

#### Key to 'OUTCOMES' (see Outcomes and Objectives section)

- WQ = Water Quality outcome  
 SW = Stormwater outcome  
 BCNA = Biodiversity, natural character and amenity outcome  
 ER = Environmental resilience outcome

#### Key to 'URGENCY'

- 1 = priority to be fully planned and implemented by 2006-7 year  
 2 = priority to be fully planned and substantially implemented by 2009-10

#### Implementation of the action programme

To provide a full implementation programme is beyond the scope of this project. Once this report is accepted by Porirua City and Greater Wellington councils, it is intended that it become a non-statutory guideline plan that will guide the planning and prioritisation of council projects. It is hoped that the report will also form a useful resource for community groups who wish to influence such planning. It is recommended that the Porirua City and Greater Wellington councils undertake further work on implementation of the Action programme laid out in this report. This work should include monitoring of achievement of the programme, and also should involve community groups (especially the Pauatahanui Inlet Community Trust) and other government organisations and stakeholders.







## **APPENDIX 1**

### **Some highlights of Pauatahanui Inlet projects, 2002-3**

#### **A catalogue of Community and Agency Achievement**

- Completion of Stage I of the Pauatahanui Inlet Restoration Plan and significant public feedback on the proposals within the plan;
- Steps towards implementation of some proposals, such as investigation of restoration options at the Pauatahanui Wildlife reserve, and redevelopment and landscaping work at Motukaraka Point;
- Regional stormwater, stormwater contaminant and sedimentation studies, including in the Whitby area;
- Publication of erosion and sediment control guidelines for the Wellington region and some progress in implementing these guidelines in residential subdivision in Whitby;
- Continuing ecological restoration work in the southern Pauatahanui catchments, mainly in the Pauatahanui Wildlife Reserve and adjacent areas, and in the nearby Cannons Creek area of Belmont Regional Park (Maara Roa);
- Acquisition of an extension to the Pauatahanui Wildlife Reserve enabling the better incorporation of riparian habitat into the Reserve;
- Monitoring of bird populations on the Inlet by the Ornithological Society;
- Significant progress by Porirua City Council in validating and implementing the 2001 report on Significant Ecological Sites in the City, including a series of very positive clinics with landowners;
- Perhaps most significantly, the formation and initial work of the Pauatahanui Inlet Community Trust as a community-led vehicle for sustainable development in the catchment. In its first year the Trust has initiated and carried out several significant projects, including scoping of a roading strategy and a two-day workshop on research needs for the Inlet and catchment.



## APPENDIX 2

### Summary of Methodology Used for Preparation of this Report

- Review existing information, identify issues and opportunities for restoration, site inspections. (April-May 2003)  
↓
- First meeting with the community and key stakeholders: verify issues, identify options and further sources of information and expertise. (June 2003)  
↓
- Further informal meetings with key individuals, and staff of councils, complete site inspections. (June 2003)  
↓
- Second meeting with the community and stakeholders to confirm objectives and refine restoration options and priorities. (July 2003)  
↓
- Preparation of first draft material for comment from council officers. (July – September 2003)  
↓
- Review of draft by council officers and PICT members. Revision of drafts, meetings to discuss issues, addition of maps and photographs. (September 2003 – January 2004)  
↓
- Draft available for public comment. (January – February 2004)  
↓
- Final revision following public comment. (February – March 2004)

Although these steps are shown as sequential, they were in fact iterative, and the consultants frequently went back to review previous steps in the process. In particular, discussion with individuals and groups took place throughout the process, as did field inspection to verify or illustrate restoration options. This enabled the consultants to consult informally more thoroughly than just through two meetings.



## APPENDIX 3

### Background Information on Individual Management Sectors

Information sources for this section are mainly Boffa Miskell 2000 and Boffa Miskell 2001a, as well as the consultants' observations and information from Porirua City Council officers.

#### 1. Camborne escarpment

**Description and location:** The northernmost outlier of the study area. Part of the north-western edge of Pauatahanui Inlet, adjacent to the Mana foreshore. Also contains a narrow foreshore area occupied by the Mana boatsheds.

**Landscape and ecological features:** A xxm-tall bush-covered escarpment. Attractive visual backdrop to the western Pauatahanui Inlet, the bush being framed by houses at the top and boatsheds at the base, neither of which unduly dominate the vegetation at present. The vegetation is mainly regenerating mahoe-dominated forest, with some sizeable titoki, ngaio, kowhai and ribbonwood trees emerging from the canopy. The native bush has been significantly fragmented and planted into, with some tall poplar trees adding to the visual diversity.

**Vehicle and human traffic:** No roads. Camborne Walkway at base of escarpment, and small footpath linking to Mana View Rd

**Tenure:** Predominantly PCC reserve.

**SES:** Camborne Inlet Scarp (#17, 13.36 ha, part area only)

**Linkages:** Direct link to rest of Camborne scarp to the north. Similar visual character to the Paremata and Golden Gate escarpments, interrupted by the Mana foreshore and Pauatahanui Inlet entrance.

**Current ecological management:** Some weed control and recent planting by PCC at the base of the scarp.

#### 2. Mana Foreshore and Inlet entrance

**Description and location:** The Pauatahanui Inlet edges on the north and south sides of the Inlet entrance, together with adjacent flat areas of the eastern side of the Mana Sandspit (East of State Highway 1). The sector also includes Ivey Bay and the narrow foreshore on the southern side of the Inlet between SH1 and Ivey Bay.

**Landscape and ecological features:** This management sector is unique in the whole Inlet. The Inlet here includes extensive tidal sandbanks and cockle beds east of the Mana Sandspit. This is one of the largest intertidal zones in the whole Inlet, and has very large populations of cockles and associated fauna (e.g. meiopods) and provides feeding grounds for many of the birds using the Inlet. The sector also contains some



important remaining eelgrass beds in the vicinity of Ivey Bay and the SH1 and rail bridges. These latter areas are very disturbed, with a boat launching ramp on the northern side and current bridge construction activity. The relatively deep Inlet entrance is vital for tidal flushing of the whole Inlet. The Mana shore edge, although highly modified, contains the only remaining sand dunes in a short section just south of the Camborne escarpment, with a few native elements in its vegetation.

**Vehicle and human traffic:** Contains SHI on the Mana esplanade and the Mana bridge, and the westernmost section of SH58 – together the busiest arterial routes in Porirua City. Also some short cul-de-sacs leading from Mana Esplanade to the Inlet edge. Heavy foot traffic along the Mana foreshore and around the Ivey Bay boatsheds and kindergarten.

**Tenure:** All the sector is public road and beach reserve.

**SES:** Contains part of the Pauatahanui Inlet, not included in the SES survey (which had a terrestrial focus) but acknowledged as the key ecological resource in the City.

**Linkages:** Provides the link between the Camborne, Paremata and Golden Gate escarpments.

**Current ecological management:** Recent native planting by PCC on the southern end of the Mana foreshore, adjacent to the Camborne Scarp walkway.

### 3. Golden Gate

**Description and location:** A small peninsula (Shearers Point) of consolidated Quaternary sediments, protruding into the southern Pauatahanui Inlet between Ivey and Browns Bay. Steep-sided edges to the sea, and adjoins the Paremata escarpment at the junction of Seaview and Bayview Roads.

**Landscape and ecological features:** Visually prominent from many western parts of the Inlet. Visually attractive tree-filled suburban landscape, although housing development comes close to the water's edge in many parts. There is virtually no sandy edge. Many native trees are growing in gardens and there is limited regeneration in a few undeveloped parts of the escarpments, but there are no significant natural areas.

**Vehicle and human traffic:** Seaview Road. No footpaths

**Tenure:** All private residential land apart from the foreshore reserve.

**SES:** None

**Linkages:** The Paremata – southern Inlet escarpment. Intertidal fringe links to the corresponding fringes in the Mana and southern Inlet management sectors.

**Current ecological management:** Little



#### 4. Paremata and the Southern Inlet Escarpment

**Description and location:** A narrow coastal escarpment extending along the southern edge of the Pauatahanui Inlet (immediately inland of SH58) for 4 km from the western to the eastern edges of the study are between SH1 and the Pauatahanui roundabout. It is broken by the mouths of the Browns Bay and Duck Creek streams. The escarpment is nowhere more than about 100m deep. It rises to about 100m high in the west and slopes lower to the east.

**Landscape and ecological features:** This management sector is the visually dominant part of the whole study area as seen from the Inlet, and for road travellers along SH1 and SH58. It is partly vegetated but also intensively developed for housing in some parts, including new subdivisions in eastern Whitby.

The Quaternary sediments have a cover of distinctive red sandy soil. Vegetation is native in some parts, including mahoe regeneration and distinctive hardwood forest remnants containing mature ngaio, titoki and kowhai trees. There are sections of mature pine trees, mainly adjacent to lower Duck Creek.

**Vehicle and human traffic:** Oak Avenue and Spinnaker Drive cross the escarpment.

**Tenure:** A mixture of PCC reserve, Transit New Zealand road reserve, and private residential land.

**SES:** Browns Bay Escarpment Bush (#204, 0.95 ha)  
Bradeys Bay Escarpment Bush (#213, 0.60 ha)  
Ivey Bay Bush (#214, 2.56 ha)

**Linkages:** Link between the lower Duck Creek and Browns Bay catchments and the Inlet for the whole of its length.

**Current ecological management:** Exotic tree replacement and weed control in some reserves.

#### 5. Southern Inlet

**Description and location:** The southern Pauatahanui Inlet edge (SH58 and all land seaward of it) and southern Inlet, between Shearers Point (Golden Gate) and the Pauatahanui Wildlife Reserve.

**Landscape and ecological features:** Land areas restricted to the SH58 roadway, very small rocky beach outcrops between the road and the shore, and a narrow foreshore and inter-tidal strip. The foreshore has been hardened as part of the road edge in many places.

**Vehicle and human traffic:** SH58 runs along the whole length of the management sector.

**Tenure:** All public land, either road or foreshore reserve.



**SES:** Contains part of the Pauatahanui Inlet, not included in the SES survey (which had a terrestrial focus) but acknowledged as the key ecological resource in the City.  
**Linkages:** Borders the southern escarpment sector along its whole length.

**Current ecological management:** Annual cockle count.

## 6. Browns Bay Catchment

**Description and location:** Most of the Browns Bay catchment, except for the front escarpment. The highest point is the western ridge between No 2 trig at Paremata and Ascot Park, which rises up to 157m. The eastern boundary runs behind the houses on Leeward Drive. Goes down to Pauatahanui Inlet at Browns Bay.

**Landscape and ecological features:** A mixture of built up areas in the central and eastern parts of the management sector, pine trees, regrowth vegetation in the western part and grassy open space around Postdate Park and Postgate School, and Browns Bay Reserve. The regrowth on the western hills is dominated by kanuka and mahoe, but there are emergent treeferns and shrub hardwoods, and small areas of riparian vegetation with *Carex* species in the gully behind Postgate Park. The regrowth bush also contains kowhai and ribbonwood seedlings and reasonable bird populations including records of bellbirds, but is also infested with old man's beard.

**Vehicle and human traffic:** Postgate Drive is the main thoroughfare, and there are some footpaths.

**Tenure:** Predominantly private, a mixture of residential and rural residential (western part), with PCC reserve running below Kahu Rd.

**SES:** Ascot Park Bush (#126, 19.70 ha, part of area only)

**Linkages:** A link between Whitby (lower Duck Creek catchment and the western Whitby hills) and the Porirua Harbour catchment. Also joins to Golden Gate.

**Current ecological management:** Routine reserves management.

## 7. Western Duck Creek

**Description and location:** The western part of the lower Duck Creek catchment. Runs between Browns Bay, northern Whitby, lower Duck Creek in the vicinity of Discovery Drive, and Whitby Village.

**Landscape and ecological features:** This is the least built up part of lower Duck Creek. Hills form the western backdrop to Whitby, with a mixture of houses, regenerating kanuka and manuka dominated bush, small areas of more advanced regeneration with shrub hardwoods, and some grassed open space. There are small remnants of mature bush on the lower hill slopes around Latitude Close and Furneaux Grove, containing mature tawa and podocarp trees, but the SES are all fragmented.



**Vehicle and human traffic:** Discovery Drive and Exploration Way run around the eastern edge of the hills, and there are a few footpaths. Both roads and paths have comparatively light traffic.

**Tenure:** Predominantly private. Residential around the streets and rural residential on the hills. Narrow PCC reserves.

**SES:** Latitude Close (# 17, 1.05 ha)  
Whitby West Bush (#155, 29.1 ha)  
Exploration Drive Kanuka Forest (#190, 8.02 ha)

**Linkages:** Main ecological linkage between lower Whitby and Browns Bay hills and the upper Duck Creek catchment.

**Current ecological management:** Routine reserves management. Footpath between Adventure Drive and The Mainsail has been recently upgraded.

## 8. Upper Duck Creek

**Description and location:** Southernmost and largest management sector of the study area, consisting of the upper part of the Duck Creek catchment from the southern end of the former golf course and the two reservoirs on the southern hills of Whitby, up to the top of the catchment at Round Knob (410 m a.s.l.). Hourglass shape, thinnest in mid section south of Tideman trig.

**Landscape and ecological features:** Steep hill country, with shallow soils, rocky outcrops and a somewhat incised stream. Almost all in pine forest or pasture, except for small mahoe-dominated regenerating forest close to the stream bottoms, gorse-dominated regeneration on the eastern fringes. Some of the pine areas have been logged and are bare, awaiting sowing in pasture, while other afforested areas south of Exploration Way include gum and acacia plantations. The main upper Duck Creek stream as well as several major tributaries contain native fish populations and much of the stream length has reasonable riparian vegetation.

**Vehicle and human traffic:** Farm roads only. Several walking tracks within Belmont Regional Park.

**Tenure:** Public land includes DOC, WRC and PCC reserves. Private land owned by Landcorp (Waitangirua Farm) and Silverwood Forest. Most of the public land is managed by Landcorp as a farm park, in conjunction with Belmont Regional Park.

The Duck Creek Catchment covers 1050 ha, with 363ha in Whitby (200 ha in housing and the remainder open space), and the remaining above the former golf course. Most of this upper catchment is in pasture; woody vegetation is limited to scattered indigenous remnants and plantations of Radiata Pine. Plantations are currently being logged. All of Silverwood Forest to the east of Duck Creek, 108 ha, will be logged by 2006. The remaining 40 ha of radiata pine planted in 1981-82 on the western side of Duck Creek will be logged within 15 years. At present there is no intention of



logging the mixed eucalypts and acacia and Indigenous regrowth is being carefully protected from logging damage. so that following logging areas are being sown in pasture grasses rather than replanted in forest trees.

**SES:** None

**Linkages:** Apart from the boundary with lower Duck Creek, most of the management sector borders the Porirua and Hutt catchments.

**Current ecological management:** Native planting in selected tributary junctions as part of catchment protection measures ahead of the Transmission Gully project. Stream monitoring by Guardians of Pauatahanui Inlet.

## 9. Northern Duck Creek Hills

**Description and location:** The western part of lower Duck Creek, between Whitby Village, Spinnaker and Ayton Drives and the Pauatahanui Inlet escarpment. Rises to 71 m at Bradeys Lookout.

**Landscape and ecological features:** Moderately steep hills with a mixture of housing and reserved areas with a variety of vegetation cover. Vegetation includes mature pines below Ayton Drive, regenerating scrubby vegetation with pampas prominent after logging in Spinnaker Reserve, and areas of remnant native mature forest and native regeneration. The regenerating native scrub is dominated by kanuka, while the small forest remnants in each of the PCC reserves are dominated by hardwoods such as tawa and titoki, but also have distinctive species such as kohekohe, wharangi and podocarps. Yardarm Bush has good bird populations including kereru observed. They are all highly significant but are threatened by weed invasion.

**Vehicle and human traffic:** A few small suburban streets but no major through roads. Several footpaths (mainly to lookouts).

**Tenure:** Mixture of private residential and PCC reserves.

**SES:** Duck Creek Bush (#16, 9.32 ha)  
Yardarm Bush (#151, 6.15 ha)  
Leeward Drive Bush (Spinnaker Reserve) (#161, 0.82 ha)

**Linkages:** Central in the Lower Duck Creek area. Bordered by the Pauatahanui Inlet escarpment, Browns Bay, Western Whitby and lower Duck Creek.

**Current ecological management:** Some native planting in Spinnaker Reserve



## 10. Lower Duck Creek and Pauatahanui tributaries

**Description and location:** Lower-lying parts of the Duck Creek catchment, from the top of the former golf course in the south, including eastern Whitby, and the northern end of Silverwood Forest. Also includes the lower western tributaries of the Pauatahanui Stream which lie within eastern Whitby. Mainly <40 m a.s.l but rises to about 100 m a.s.l. at the eastern end.

**Landscape and ecological features:** Centred around the lower Duck Creek valley, most of the sector has an enclosed valley feel to it, with the hills of northern and western Whitby and the Upper Duck Creek catchment around. More hilly in the east. The sector has a mixture of housing development of different age and density, together with the large currently open space of the former golf course and the logged parts of Silverwood Forest, both zoned for residential development. Contains several small areas of remnant and nature forest, mainly dominated by tawa and titoki, with a few podocarps present. Mainly kanuka and manuka regrowth, tall in places and with native regeneration. Most native vegetation areas are continuing to be fragmented by clearance and weed invasion. However, bird populations appear to be reasonable, including kereru. Duck Creek, as the largest stream in the study area, is an important ecological feature, with several native fish species including galaxids. The lower end of Duck Creek, with open saltmarsh vegetation dominated by shore ribbonwood, oioi and sea rush, fulfils an important ecological as the last "sink" for stormwater and sediment before discharge to the estuary, and is also is a distinctive visual counterpart to the rest of the study area.

**Vehicle and human traffic:** Several through roads including Discover, James Cook, Navigation and Joseph Banks Drives. Also several footpaths.

**Tenure:** predominantly private. PCC reserves east of James Cook Drive and along the Pauatahanui tributaries.

**SES:**

- Navigation Drive Kanuka Bush (#21, 4.43 ha)
- Duck Creek Saltmarsh (#22, 1.18 ha)
- James Cook Drive Bush (#33, 13.0 ha)
- Samwell Drive Bush (#68, 0.83 ha)
- (Endeavour Park Bush remnant (#69, 1.15 ha)
- Scorseby Grove Kanuka Forest (#70, 7.42 ha)

**Linkages:** Bordered by the other lower Whitby management sectors, upper Duck Creek and also links the study area into the rest of the Pauatahanui Stream catchment.

**Current ecological management:** Riparian values appear to have been maintained during the recent logging in Silverwood Forest. Stream monitoring by Guardians of Pauatahanui Inlet.



## APPENDIX 4

### History of Recent Development in the Whitby District

The western and southern sections of the Pauatahanui Inlet could be used as a case study in the historical development of New Zealand's coastal environment, and Whitby as a model of late 1960's residential development.

Before the end of the 1960's any residential settlement was largely confined to Mana Esplanade and Golden Gate, although there was a long tradition of baches and boatsheds around the edges of the Inlet on either side of the entrance. The remainder of the Inlet catchments were farmed. Gradually, with increasing numbers of people choosing to live around the Inlet substantial residential dwellings began to assume dominance over modest baches and boat sheds.

The Whitby Consortium was formed in 1967 to work with local authorities and come up with a viable settlement scheme. Most of the 3180 acres purchased in 1967 came from the Bradey family. The consortium, made up of Huapai Properties (Fletcher and Mainline Corporations), Jubilee Investments (Todd), and National Mutual, employed planner Peter Bagnall to develop an overall strategy. Bagnall had recently returned from the UK where he had been studying New Town Development. Howard Hunter and Phil Callendar, also part of the design team, visited British Columbia, the USA and Canberra to gather ideas.

Of particular interest in the *Whitby Plan* of 1971 is the generous allocation of open space and the focus on tree planting. One of the key objectives of the plan was stated as being to "*Conserve and develop the qualities of the natural landscape so that they become part of an attractive urban environment.*" In the outline of the concept for the village it is stated that:

*"The village plan is intended to introduce a broader element of choice into the life style of the community. Identifiable neighbourhoods of individual character provide a choice of residential environment; the contrasting attractions of the high and low level open space system provide a wide choice in recreation; the separate provisions for pedestrian and vehicle journeys make the choice between walking and driving equally appealing, safe, and convenient. The object of the plan is an environment to serve the needs of people, not to dominate them"*

In the same year the plan was published a nursery was established and each household given \$10 worth of free plants.

The first 9 holes of the golf course were set up in 1972. In the same year *The New Community*, a local residents' newspaper, announced that 500 ha of land was to be planted with mixed exotic trees including eucalypts. A Farm Forestry Grant had been taken out by the consortium. The forest was to provide for public access and recreation:

*"Eventual felling in 25- 30 years time will be carried out in such a way that, with revegetation and replanting, the area will not lose its appeal either as a recreational area or as a place of visual beauty."*



In a 1973 edition of *The New Community* it was noted that 70 hectares of scrub had been underplanted with Red and Silver Beech from the consortium's nursery. Also noted was the production of 3500- 4000 exotic amenity trees, and 500 natives for the same purpose. The second year of plantation planting is also noted with 70,000 pines and 10,000 Eucalypts being established.

Although establishment was completed by the consortium the forest was eventually sold. Locals continued to have access for recreation however, at least up until the recent commencement of logging. Pines and macrocarpa planted in isolated pockets through the residential area were vested in the council in 1979-80. *The Kapi- Mana News* reported growing concerns about scenery and safety in relation to the Whitby pines in April 1985. These areas have been progressively felled by council.

The vision of the 1971 Whitby Plan was very much focused on the recreational and visual values of open space and associated plantings. The establishment of vegetation was clearly important, and existing native vegetation was largely retained, but consideration for ecological connections and the indigenous dimension of fresh water and riparian values were not of concern beyond soil and water management needs. Waterways were a part of public open space because of an association with recreation, golf and walkways, rather than for their ecological values. In fact many of the streams were relocated and/or culverted. Planting along waterways was often of canopied exotics such as alders with very little ground cover.

Whitby is at the beginning of a new cycle. The exotic plantations are all but gone and the privately-owned plantation land is zoned for eventual residential development. The golf course also is proposed for subdivision. It is perhaps an appropriate time to be developing a new vision to revise or replace the old one within the context of the changes that have occurred. A vision which is somewhat more responsive to the ecological needs of Whitby is likely to assist in sustaining the wider Pauatahanui environment including the Inlet. This vision to put vegetation back where it is needed must extend beyond residential Whitby into the wider project area.



## APPENDIX 5

### Natural Values Of The PIRP Stage 2 Area

#### Ecodomains and Natural Vegetation

Most of the areas immediately associated with the Pauatahanui Inlet are part of the ecodomain described as the 'mild, humid, nikau belt.' The species most representative of this ecodomain and still reasonably common are manuka and kanuka. Associated with these are kohekohe, kaikomako, kawakawa, with ngaio on the spurs. On damper southerly faces tawa would be expected.

On the lower river flats there would once have been extensive areas of kahikatea and pukatea with sedges, toetoe, rushes, swamp flax, manuka, and five finger. Moving up river and into the higher basins there would have been rangiora, mahoe, five finger, hangehange, and rewarewa.

The principal wetland vegetation in estuarine salt marshes such as Duck Creek and the Pauatahanui Wildlife Reserve include flax, raupo, reeds, rushes, glasswort, sea primrose, New Zealand spinach and wild celery. Three species colonise the open tidal flats: glasswort, shore primrose and sea rush. Jointed rush occurs at higher elevations.

#### Inlet Values

The Mana sandbank is one of the richest habitats in the Inlet and in particular is one of the key habitats for the large populations of polychaete worms and copepods, the latter providing a food source for flatfish. This part of the Inlet has the highest recorded copepod density of any Inlet in the world (Dickison 1992; Hicks 1986). A further significant and related feature is the high density of cockles compared with other New Zealand estuaries. Cockles are an important food source for several bird and fish species, and filter approximately half the Inlet's volume of water each tidal cycle.

Perhaps the most characteristic estuarine species of all is the tuarangi or New Zealand cockle (*Austrovenus stutchburyi*). A huge biomass of up to 5000 tonnes, corresponding to a total population of 550 million or 80% of the total biomass in the Inlet, was estimated at the time of the PEP. It is the decline in the numbers of cockles over much of the last 30 years, by as much as half, which is a pivotal focus of concern for the ecological health of the Inlet. Explanations for the decline in the cockle population are unclear. Populations of cockles are known to fluctuate naturally so that the recent fall could be part of a natural cycle. The 2001 survey suggest that numbers have remained reasonably stable over most of the last decade (Grange & Tovey 2002). If there is a human induced reason the most likely one is the ongoing sedimentation of the inlet.



## **APPENDIX 6**

### **Management Issues**

#### **Coastal Erosion**

A recent report on coastal erosion in Porirua City (BECA and Coastal Consultants Ltd, 2003) makes recommendations for the management of erosion at two sites. The first of these is along the eastern edge of the main channel into Porirua Harbour, on the seaward edge of Ngati Toa Domain, and the second, within the study area, is along the Dolly Varden Beach Shoreline. This report picks up on proposals for dune reconstruction, re-vegetation, and the stabilisation of the dune toes at the high tide mark with rock works. This proposal was discussed with representatives of the residents association.

#### **Water, Nutrient and Sediment Management**

First impressions might suggest that the study area is dominated by urban development and that most water is captured within a developed infrastructure of pipes and drains. In fact residential development exists within a broader context of open space, natural areas, and rural land so that stormwater entering the inlet is of mixed origins. There is a need to understand the capture and movement of water through both engineered and natural waterways. Only with this understanding can sediment, nutrients, and pollutants ending up in the Inlet be properly managed.

The most comprehensive overview of the broader context is provided by Healy, 1980. The 450 ha of Inlet is served by catchments covering 10,550 ha. Catchments in the southern and eastern areas are relatively small. The main catchment in the study area is Duck Creek and this constitutes only 10% of the area draining to the inlet. The Duck Creek Catchment is some 1050 ha in extent, about one third of it occupied by the residential area of Whitby. The remainder, the upper catchment, is farmed by Landcorp and managed as part of the Belmont Regional Park. The only other significant catchment in the study area is Browns Bay, some 100 hectares in extent, most of which is residential.

Approximately 40% of the overall study area is structured residential development and the remainder open space. Open space includes farmed land as well as reserves and undeveloped residential land.

Healy reports that a vegetation survey carried out in 1980 showed that across the 10,800ha of land making up the catchments of the Inlet an estimated 642 ha of indigenous vegetation remained. Some 2,500 hectares of regenerating scrub were also recorded. It is generally agreed by later observers, notably Fuller in his evidence on Transmission Gully (1995) and the Porirua Ecological Sites survey (2001), that since 1980 both rural and urban indigenous vegetation cover within the Pauatahanui Catchments has been reduced by clearance for pasture development, plantation forestry, and residential development. How much reversion there has been to offset these losses is unknown.



Duck Creek catchment, although having a higher amount of residential area than the northern and eastern catchments, is reasonably typical in terms of vegetation cover and change. Apart from the loss of indigenous vegetation to residential development, land uses have remained fairly constant between the late 1970s and the late 1990s. Major changes in the last 5 years include the continued residential development in eastern Whitby and the clearance of a major area of Silverwood Forest in 2002-3, now destined for residential development.

### **Suspended Sediments**

Suspended sediments are soil and organic particles entrained in stormwater flows. They can be silt sized or smaller. Sediments reduce light transmission through water, clog fish gills, affect filter-feeding shellfish, smother benthic organisms, change benthic habitats, and fill up estuaries. Larger soil particles above silt sized are also contaminants but typically exhibit different physical characteristics and settle more quickly. These particles are sometimes called bed load sediments.

The three largest streams entering the estuary, Pauatahanui, Horokiri, and Kakaho, have well defined deltas indicating a steady advance over the last 2-3000 years. Sediments washed into the Inlet over the past 1000 years have raised the bed by an estimated 2m, or 2mm per year. Although the rate has been fairly constant over this time the more recent annual rate is thought to be around 2.9mm. Rates for estuaries around the country vary between 1 and 5 mm per year. Specific sites in Auckland's estuaries can receive up to 9mm per year (Boffa Miskell 2000).

The adverse effects of excessive sedimentation can be summarised as follows:

- Lethal and sub-lethal effects on stream plants and animals with smothering and decreased light penetration, fewer stream insects and fish, and shifting food availability for fish. Extensive beds of eelgrass are thought to have been smothered over the last 25 years.
- A deterioration in water clarity and aesthetic value.
- Reduced suitability for horticultural irrigation, rural water supplies, stock watering, and recreation.
- Generally reduced life supporting capacity and increased rating costs to residents; there is a public interest in keeping water quality high.

Most of the study area is Land Use Capability Class VI. This classification indicates moderate to low soil fertility and suitability for extensive pastoralism with a potential for soil slip and sheet erosion. North and west facing slopes are noted by Healy (1980) as particularly vulnerable, but erosion is not seen as a critical issue.

Healy provided a comprehensive overview of catchment behaviour based on sediment and hydrological data recorded over two years (see table below). It is interesting to note that the Browns Bay catchment contributed disproportionately high inputs during periods of high flows and disproportionately low inputs during low flow periods. This is due to the very high percentage of the catchment in hard surface as a consequence of residential development. Sediment yield is generally proportional to the area of the catchments but Duck Creek contributes a slightly higher proportion than its area would indicate: 1,650 tonnes per annum or 12% of that carried into the Inlet. This sediment presumably derives from sheet erosion in the upper catchment, with minor stream bank erosion. Very high levels of sedimentation



have been recorded during urban development at both Browns Bay and Duck Creek but only as transient, albeit undesirable, phenomena.

### Water Yields: June 1975 - June 1977 (Healy, 1980)

Catchment	Annual Yield				Maximums	
	% total area	Discharge (millions of m <sup>3</sup> )	Discharge (millions of m <sup>3</sup> per km <sup>2</sup> )	% total Annual yield	Water Discharge (l/sec.)	Sediment Discharge Tonnes/day (mean Kg/day)
Pauatahanui	41	29.61	0.68	39	25800	3360 (295)
Horokiwi	31	26.73	0.81	35	19100	1780 (331)
<b>Duck</b>	<b>10</b>	<b>7.31</b>	<b>0.70</b>	<b>10</b>	<b>5890</b>	<b>924 (430)</b>
Kahao	11	7.38	0.65	10	5860	727 (279)
Ration	6	3.98	0.65	5	4550	278 (210)
<b>Browns</b>	<b>1</b>	<b>0.29</b>	<b>0.24</b>	<b>&lt;1</b>	<b>2060</b>	<b>2020(3200)</b>
Total	100	75.30		100	63260	9090

Most of the water and sediment entering the Inlet is contributed by floods. During the recording period reported by Healy one storm event, likely to occur once a year, produced 13% of the mean annual water yield and 63% of the mean annual sediment yield in just four days. Reducing flooding, or lowering peak flows, will clearly result in a reduction in the amount of sediment entering the Inlet.

Recently hydrological information for Duck Creek has been supplemented by hydraulic modelling of the catchment and stream based on surveyed stream sections (BECA 2003). Modelling of a 1 year flood and mean annual flood event, as well as of 10-year and 50-year return events. Three land use scenarios were modelled: existing land use based on aerial photos; full urbanisation based on current District Plan zoning, and full urbanisation of the entire catchment. The extent of flooding for the different return period floods is shown in detailed maps, and as would be expected there is a progressive increase in valley flooding with increased return periods. Under existing contouring in the lower catchment, large areas adjacent to lower Duck Creek are prone to shallow flooding in flood events.

### Water Quality- Nutrients

Healy reports the results of monitoring for both reactive nitrogen and reactive phosphorus. About 75% of the annual input of each occurs during winter months when rainfall is high and plant growth in the catchments is low. Reactive nitrogen levels are therefore high in winter and low in spring and summer. Inputs of reactive phosphorous tend to be more even throughout the year, with some depletion in spring. Phosphorous levels tend to be similar in fresh and salt water so that it is the elevated levels of nitrogen, notably in winter months, which should be the cause for concern. Healy notes records of 200-400 milligrams of nitrogen per cubic metre of water in winter but summer concentrations which are barely detectable at 5 milligrams per cubic metre.



Healy concludes that although nutrient enrichment from farming is evident, tidal flushing tends to reduce build up in the Inlet so that adverse effects are limited. Healy concludes that sediment rather than nutrients should be the focus of concern.

Kathryn Hooper (Hooper 2002) sampled water on 5 occasions at 8 freshwater and 6 marine sites during March and April of 2001. Hooper's work was conducted as part of a masters thesis in Environmental Studies and sponsored by Greater Wellington. While acknowledging the limits of her 'point in time' sampling, and accepting variations in nutrient outfalls with rainfall, Hooper concluded that levels of both nitrogen and phosphorous can be excessive for biological health (measured in accordance with accepted NZ guidelines<sup>8</sup>). Levels of nitrogen in Browns Bay were as high as those recorded in Horokiwi Stream and exceeded the guidelines acceptable levels on all occasions. In upper Duck Creek, at the top end of urbanisation, guideline levels were exceeded on 3 occasions. Hooper notes that nitrogen was up to 3 times the guideline level.

As with nitrogen, Hooper notes that phosphorous levels were exceeded on a number of occasions at both freshwater and marine sites. Phosphorous levels were particularly high during periods of turbidity. Levels were always above the acceptable limit except at the outlet where water flushing was occurring.

Interim results from the current Greater Wellington stormwater study<sup>9</sup> are consistent with Hooper's results. Concentrations of various nitrogen and phosphorus nutrients were 1.5 - 3.8 times their respective ANZECC "trigger values" for lowland streams.

Water quality at Brown's Bay sometimes does not meet bathing water standards because of excessive *E.coli* levels.

Nutrient levels above those recommended can promote the excessive growth of plants and algae which then creates shade and generates an overabundance of decaying material. In particular, weeds can be favoured by excessive nutrients. IN the Inlet the growth of various algal species (*Ulva*, *Enteromorpha*, *Cladophora* and *Gracilaria* spp) reflect high nutrient levels.

There is little doubt that there are specific times and places when nutrient loadings are excessive and of concern. It is difficult to judge, however, the mitigating effect of tidal flushing, at least within the marine environment.

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<sup>8</sup> ANZECC (2000) guidelines

<sup>9</sup> Gary Stephenson, Greater Wellington Regional Council, pers. Comm. February 2004



## **Water Quality - Heavy Metal and other Contaminants**

**Heavy metals**, hydrocarbons and oils, and polynuclear aromatic hydrocarbons (PAH's) are perhaps the most insidious contaminants because, unlike sediments they can't be seen. They are also difficult to measure. Heavy metals include a variety of trace metal compounds which are carried in stormwater in both solid and dissolved forms. The most commonly measured metals of concern are zinc, lead, copper, and chromium. Lead comes from car emissions, copper and zinc from vehicle component wear. Zinc is also relatively common on roads as it is used as an anti-corrosive agent. A certain amount of zinc is also washed from roofs. The cessation of the use of lead in petrol and in roofing systems is seeing its decline. Lead can still be found in heavy concentrations in sediments however. Metals are persistent; they don't decompose and they accumulate in sediments and in plant and filter feeding animals such as shellfish. Although not biologically available, during heavy rain high concentrations of zinc and copper can be found. Elevated levels of heavy metals cause public health issues and an avoidance of the affected habitat area. This then leads to a reduction in both the number of species and their diversity. At very high levels of contamination inter generational tumours and deformities may occur.

**Hydrocarbons and oils** are generally associated with vehicle use. They may be in the form of free slicks, oil droplets and oil emulsion, in solution or absorbed onto sediments. Most, however, are thought to be relatively innocuous in the aquatic environment. Soluble aromatic hydrocarbons, thought to be the most toxic, tend to evaporate off the road. Microbes in the aquatic environment are thought to degrade organic chemicals, although such activity will be constrained by high levels of heavy metals.

**Polynuclear aromatic hydrocarbons** are a group of over 100 different chemicals formed during the incomplete burning of gas, oil, and coal. These can be major contaminants in urban stormwater and effect aquatic feeding animals. PAH's derive from the partial combustion of fuels, wood fires and vehicles, and the spillage of engine oils into drains can be a particularly significant source.

**Organo- chlorine pesticides** such as dieldrin, lindane, and heptachlor constitute another main class of toxic organics and are generally associated with sprays used in association with agriculture and horticulture to control.

It must also be noted that stormwater discharges off roads can have significant effects on the temperature, pH, dissolved oxygen, alkalinity, hardness, and the conductivity of the receiving waters.

Levels of contamination from a catchment depend on the areas of the collecting surfaces, the contribution of the surface itself (zinc off a roof), and for vehicle contaminants, the volumes of traffic and the way vehicles are driven.

**For the purposes of this project an estimate was made of the areas of hard surface for each of the catchments.** The area of hard surface was not calculated for Camborne as most of the stormwater drains out to the main channel of Porirua Inlet; any water draining to the inlet passes through reserves with riparian vegetation. Stormwater from Mana Esplanade does drain to the inlet and although the area of hard surface is relatively limited the traffic



volumes are high. For Whitby the areas of hard surface have been calculated for each of the catchments.

**Table: Whitby Stormwater Capture**

Hard surfaces	Browns Bay Catchment (hectares)	S.H.58 & Escarpement (hectares)	Duck Creek Catchment (hectares)	Pauatahanui Stream (hectares)
Major Roads	2.10	7.20	8.80	
Minor Roads	9.48	3.12	10.05	3.34
<b>Total roads</b>	<b>11.58</b>	<b>10.32</b>	<b>18.85</b>	<b>3.34</b>
Roofs etc	13.22	5.100	28.28	2.40
<b>Total All</b>	<b>24.80</b>	<b>15.42</b>	<b>47.11</b>	<b>5.74</b>
<b>Percentage of Whitby total</b>	<b>27%</b>	<b>16%</b>	<b>51%</b>	<b>6%</b>

**Assumptions:**

Roofs etc -200 m<sup>2</sup> per residential site; includes house roof, sheds, Garages, paths, drives.  
Major Roads 20 metres wide. (District Plan Standard)  
Minor Roads 13 metres wide. (District Plan Standard)

The area of hard surface on residential sites was similar to the area of roads; 48.98 hectares and 44.09 hectares respectively. At present hard surface covers about 16% of Whitby (93 of the 559 hectares). This is an extremely low percentage for an urban area; the more usual coverage is 25-35%. Whitby is however very generously provided for with reserves and considerable areas remain undeveloped. For the developed area only (excluding reserve areas and undeveloped areas within the residential zone) the hard surface cover becomes 26%, which is still relatively low for a residential area.

Although these figures are very approximate they do help to provide an overview and to establish the likely relative significance of areas in terms of contaminants. For example it is very easy to assume that most of the contaminants will be coming off SH 58. In fact major roads internal to Whitby carry traffic volumes similar to SH 58 and cover a greater area. Duck Creek is not only by far the largest catchment in the study area but also contains the largest area of hard surface.

Given the significance of Duck Creek for stormwater management a more detailed evaluation of the capture and movement of stormwater was made by the consultants. Key outfalls into Lower Duck Creek include:

**1. Endeavour Park Outfall**

This outfall picks up all of the stormwater from the eastern tributary of Duck Creek, some of which remains relatively 'natural' while other sections are piped. Water from the stream through Endeavour Park passes under James Cook Drive to an outlet at the



bottom of Duck Creek. (Immediately above Duck Creek Reserve.) This outfall currently picks up stormwater from some 9 ha of impermeable surface, about 18% of the total for Duck Creek.

**2. Shackle Lane Area**

Stormwater from the shackle lane area enters Duck Creek at a number of points in relatively small quantities. The total amount of impermeable surface being collected from is about 5 ha, some 10% of the total.

**3. Western Duck Creek**

This tributary picks up stormwater from the Northern Duck Creek Hills and the Western Duck Creek Area; approximately 7ha of impermeable surface for each area. This 14 ha constitutes some 30% of the total entering the creek.

**4. Picket Boat Lane - Sailmaker Close.**

The reserve running from Discovery Drive and down between Picket Boat Lane and Sailmaker Close to the Village Walkway (which runs along the edge of the former golf course) collects stormwater from some 3.5 ha of impermeable surface, some 7% of the total.

**5. Eastern Exploration Way**

Stormwater from the eastern side of exploration way passes through Adventure Park to enter the main stream just above Discovery Drive. There are some 3ha of hard surface, 6% of the total.

Water from the remaining 30% of impermeable surfaces is discharged directly or indirectly in smaller and less aggregated quantities along the stream. At least 80% of stormwater from impermeable surfaces enters Duck Creek at or below Discovery Drive.

This pattern of capture and discharge to the main Duck Creek has implications for any future stormwater management initiatives. For example, retention areas are going to be more effective below Discovery Drive. Such a location could capture water from Western Duck Creek, although a retention area at the lower end of this branch would also be desirable.

The eastern tributaries of Pauatahanui Stream pick up only minor quantities of storm water from Whitby (from approximately 6 ha of impermeable surface) and this water is discharged into streams retaining some natural, although highly fragmented, riparian vegetation.

**Traffic volumes** for all of the main roads were available from PCC monitoring. It was advised that these were point in time samples and so, like the hard surface calculations, need to be seen as valid in terms of relative significance but questionable for judging absolute effects.



Table: Traffic volumes in relation to the areas of main roads ( capture surfaces).

Main Roads	Vehicles per day (2001)	Est. Capture Surface (hectares)
SH 1-Mana Esplanade	28,000	2.40
SH 58	6-7,000	7.20
Grays Road	14,000	8.00
Main Roads within Whitby:		
-Postgate Drive (Browns Bay Catchment)	6,000	2.10
-Spinnaker-Discovery-James Cook.	6,000	6.80

The amount of contaminant ending up in the Inlet will depend on a number of factors including traffic volumes, the areas of hard surface, how stormwater reaches the inlet, and patterns of rainfall (infrequent downpours or constant showers.) What the figures indicate is that Whitby roads are likely to contribute as much contaminant as either SH 58 or even SH1. If minor roads, for which traffic numbers are not available, were added, and given the likely speed variations in Whitby, it is likely that contamination sources from roads are greatest in Whitby.

### Heavy Metal Contamination in Pauatahanui Inlet

The evidence of contamination is scant and variable. The most up to date information is provided by Kathryn Hooper's 2002 study. For the purpose of comparison she notes that the Inlet is far less polluted with heavy metals than either Waiwhetu Stream or Wellington Harbour.

**Water samples** taken by Hooper showed **zinc levels** exceeding the NZ standards in three water samples, all from Browns Bay Stream, and all following heavy rain. Although zinc levels in sediment samples taken at the outlet of Duck Creek were twice those at other sites sampled, the 69mg per kg recorded as a maximum was well within the NZ guidelines maximum permissible level of 200 mg per kg.

**Lead levels** exceeded the standard once, at the site at the top of urban development on Duck Creek, and again following rain. **Manganese** was detected on all sampling occasions in Browns Bay and the Pauatahanui Stream, also in Lower Duck Creek. **Copper** exceeded the NZ guidelines standard once, in Browns Bay following rain.

**Sediment Cores** were analysed at 4 sites. Levels of Zinc, lead, and copper were highest at a site to the west of the outlet from Duck Creek, twice the levels recorded at the other 3 sites.

The findings of Hooper are in line with those of Glasby *et al.* (1990). The Glasby study also found that the levels of Zn were highest at the mouth of Duck Creek. Glasby *et al.* noted that the levels of contamination were not excessive and this tends to be confirmed by Hooper. A WRC/PCC sponsored study undertaken in 1997 (Berry *et al* 1997) came to similar



conclusions. In addition to sampling sediments this study sampled shellfish. In none of the samples were the guideline levels for cadmium and copper exceeded.

From more general research copper and zinc are noted as the most significant pollutants, copper from car brake linings and zinc from tyres. Sediment samples taken at various depths at the mouth of Duck Creek would seem to confirm the claimed trending down in lead. Copper was generally within limits for marine sediment samples.

Most recent (interim) results for Duck and Browns Creeks come from the Greater Wellington stormwater study.<sup>10</sup> At Duck Creek, levels of cadmium, silver, zinc and possibly mercury were above the ISQ high guidelines values and levels of copper and lead between high and low values. At Browns Bay, levels of silver, mercury and possibly cadmium were above ISQ high guideline values and levels of lead and zinc between high and low values.

### How significant are the levels of heavy metals?

It is extremely difficult to make meaningful comparisons with other places if only because the approaches to sampling vary so widely. The Christchurch City *Waterways, Wetlands, and Drainage Guide* does however provide some data from around the country for each of copper, lead, and zinc, and this can be compared with the findings of Hooper (2002) and Glasby *et al.*(1990).

**Table: Heavy Metal in Sediments as averages of sample sites.  
(mg/kg dry weight.)**

	<i>Copper</i>	<i>Lead</i>	<i>Zinc</i>
Duck Creek West <sup>1</sup>	7.0 (9.1)	22.4 (37.0)	59.6 (69.0)
Duck Creek East <sup>1</sup>	3.3 (4.8)	10.3 (16.0)	34.2 (47.0)
Horokiwi West <sup>1</sup>	4.4 (5.1)	8.4 (11.0)	39.2 (48.0)
Horokiwi East <sup>1</sup>	3.5 (3.9)	7.5 (9.4)	34.7 (41.0)
Glasby <i>et al.</i> <sup>2</sup>	29.0 (66.0)	36.0 (47.0)	133.0 (241.0)
Christchurch Residential <sup>3</sup>	49.0	270.0	785.0
Hamilton Rural/Residential <sup>3</sup>	45.0	109.0	780.0
Auckland Residential <sup>3</sup>	42.0	62.0	438.0
ISQG Low <sup>4</sup>	65.0	50.0	200.0
ISQG High <sup>4</sup>	270.0	220.0	410.0

<sup>1</sup> Hooper, 2002. (Figures in brackets are the maximums recorded.)

<sup>2</sup> Glasby averages

<sup>3</sup> *Christchurch Waterways, Wetlands and drainage Guidelines-2.7*

<sup>4</sup> NZ Interim Sediment Quality Guideline. High indicates a potentially high ecological impact. Low suggests a need to monitor.

<sup>10</sup> Gary Stephenson, Greater Wellington, pers. comm., February 2004.



Although there are specific sites recording moderately high readings the levels of heavy metals are generally well below sites for which measurements are available in Auckland and Christchurch and in some cases well below guideline levels. The available information is however extremely limited and there is a need to continue monitoring the levels of contamination at key outfalls, particularly from Mana Esplanade, Browns Bay, and Duck Creek.

The 1997 WRC/PCC study (Berry *et al* 1997) sampled for **Polycyclic Aromatic Hydrocarbons** (PAH's) and organochlorins. Levels were not excessive for samples within the current project area. Levels of organochlorines were high at the Pauatahanui Stream outlet, probably due to farming activities.

In the Greater Wellington stormwater study interim results, low levels of various organochlorides, chlorophenols, PAH's and PCBs were detected.

The WRC/PCC study also sampled for **faecal coliform levels**. These were highest at the Ivey Bay site. Enterococci levels at Ivey Bay were also amongst the highest. Guidelines on acceptable coliform levels suggest that shellfish at the Ivey Bay site are not fit for human consumption. Guidelines for enterococci are not available. Explanations for the levels of contamination are varied and often conflicting but the common claim is that septic tanks are malfunctioning.

The 1997 WRC/PCC study recommended that further sampling at Ivy Bay was needed.

Residential catchments yield high levels of heavy metals. Tom Snelder (NIWA 1995) estimated that in urban catchments vehicles contributed 40% of zinc in stormwater, 100% of the lead, 50% of the copper and 50% of the suspended solids. The research available would suggest that Zinc is probably of greatest concern. Zinc is noticeably higher on the residential side of the inlet and both Duck Creek and Browns Stream would appear to carry significant, although not critical, amounts following rain.

There is a need for further research to better understand the source and loadings of heavy metals in storm water.

### **Summary Observations on Sediment and Water**

Sedimentation from the study area has an historical association with farming and, more recently, residential development. Logging in the middle reaches of Duck Creek during the 2003 winter does not appear to have resulted in noticeable sedimentation and tends to be a short term activity. Residential development can generate large amounts of sediment if not well managed, but over a time scale of decades is not a permanent contributor of sediment, especially if the proportion of hard surface is low as is the case in Whitby. The most pervasive management issues are probably associated with farming, and Healy notes the disproportionately high sediment yields from the Duck Creek Catchment. There is also soil disturbance and bank erosion in residential areas and this may be particularly significant along the scarp above SH58.



Like sedimentation, high yields of nitrogen and phosphorous tend to be associated with high rainfall and flood events during the winter. High levels of Nitrogen entering the Inlet from the study area during warmer periods, notably from Upper Duck Creek, must continue as a concern.

### **The Main Channel**

The Inlet is subject to natural and powerful processes which are well beyond our control. The health of the Inlet can be controlled to some extent by controlling what gets washed into the Inlet. A second and major determinant of health is the functioning of the main channel. The channel has been subject to major cultural disturbance.

The Plimmerton Residents Association has concerns about the narrowing of the channel as a result of structures associated with the former ferry terminal and the recently constructed walkway running under the new bridge. In both instances constructed gabions are obstructing the flow of water. This is creating 'slow water' with deposition. Their contention is that setting structures on piles and removing gabions would see the flow restored along the northern edge with a reduction in unwanted deposition. A particular concern is the deposition on the outer corner of the marina breakwater. The complexity of this issue is appreciated by the community; the BECA-Coastal Consultants 2003 report notes that sand movement southwards has been occurring since the 1960's. This has necessitated regular dredging to maintain access to the marina. Also of concern to the community is the management of stormwater outflows to the channel and more general issues associated with recreational access such as the proposed new boat launching area, and signage.

Transit has applied for consent to remove gabions. Transit also has a contract to complete a programme of mitigation once the main construction work is completed and this includes removing the former ferry terminal structure.

At this time it will be important to ensure that all of the issues associated with the channel are considered together. The critical issue for the Mana Foreshore area is the stabilisation of the edge, primarily with dune restoration, and the monitoring of stormwater entering the Inlet from the Mana Esplanade. There may also be issues related to sand movement and deposition associated with structural works on the edges of the main channel.

### **Visual Landscape**

The unique character of the inlet derives from the relationship between the landform, the sea, the vegetation, and the scale and distribution of buildings and roads. The vegetation, both in type and distribution, is critical in defining the character of the Inlet and tends to be the attribute over which people have greatest control, both in the public and private domains. The vegetation cover is also vital to the ecological health of both the waterways entering the Inlet and the estuary itself.



In their 1992 landscape evaluations Boffa Miskell observe that:

*“The Inlet must first be acknowledged as an ecological entity rather than simply as a recreational resource. Recreation has to be a secondary consideration and permitted only if it does not conflict with the biophysical processes and values”.*

Specifically, this means that a catchment wide approach to the planning and management of the inlet must occur. All of the events and developments that take place in the catchment impinge in some way on the inlet. The key is to ensure that all such events and developments are considered, both long and short term, in relation to the inlet with control of the changes that will inevitably occur so that effects on the inlet are minimised.”

In terms of the landscape and sustaining its high visual values the Boffa Miskell investigations and subsequent recommendations were clearly focused on the need to protect critical vegetation, prevent further fragmentation, and to reconnect areas of vegetation and to restore ecological connections, particularly along waterways.

In their ‘Inventory of Ecological Sites in Porirua City’ of July 2001 (Boffa Miskell 2001) the authors say,

*“The most significant losses [in the whole of Porirua City] have been losses of relatively extensive areas of regenerating kanuka-dominated bush to urban expansion and subdivision in the Papakowhai and Whitby areas, and the loss of a few small remnants associated with exotic forestry establishment and life style block subdivision in the Pauatahanui area.”*

The Landscape of the study area continues to be very much threatened by ongoing fragmentation and the loss of its important and unique indigenous character, especially along the edges of the Inlet where larger houses, and more of them, are beginning to dominate. Development back from the edges threatens vegetation on visually important faces and within Whitby the sense of containment is being eroded by vegetation removal and residential development. As the number of structures increases relative to the amount of vegetation cover there is an inevitable loss of natural character.

### **Wildlife Issues**

A recent histological study of the tuangi and the deposit-feeding bivalve (*Macomona liliana*) revealed a severe degree of inflammation and renal mineral deposition in bivalve tissue in about 20% of the Pauatahanui Inlet sample (Hine, in press). This was a surprising and disturbing result as the Pauatahanui Inlet cockles were thought to be representing uncontaminated waters (compared to Porirua Harbour and Manukau Harbour samples). Hine considered that as the Inlet is ringed by busy roads, possible contamination of the Inlet by runoff from roads, particularly PAHs, had to be considered, although a conclusive link was not possible.

It is not known what if any effects this pollution may be having on other estuarine wildlife. However, because of the decline in quantity of catchable fish in the Inlet and the reluctance



of some to eat fish from the Inlet because of pollution concerns, the 1970s assertion of the Inlet as a major fish nursery can no longer be assumed and should be re-examined.

Along sections of the lower tributaries of Duck Creek shading from exotic trees, notably macrocarpa along Spinnaker drive and Alders east of James Cook Drive, is excessive so that the ground cover of vegetation is minimal or absent. Without a vegetation cover stream banks are vulnerable to erosion when floods occur. The habitat for freshwater fish such as galaxids is also poorer.

## **Pest and Weed Issues**

Pest and weed issues for individual areas are summarised in the previous chapter. Serious well-established weeds include boneseed, pampas, blackberry, ragwort, Himalayan and Japanese honeysuckle, broom, Spanish heath, hawthorn, wandering willie, and wilding pines.

There is little information about animal pests. Possums are likely to be present in bush and plantation areas over most of the study area, although they are not known to be a major problem. Rats would also be pervasive, while stoats and feral cats will also be present, and all these pests predate remaining native bird populations. In the marine environment, the invasive seaweed *Undaria* is known to be widespread around close to the Inlet entrance and the western end.

Overall, pest and weed problems are of some concern for the ecological health of the study area, if only because they are poorly known and not significantly addressed. Our best knowledge is for PCC reserves, especially those captured by the survey of ecological sites (Boffa Miskell 2001a). For some of these there is a degree of control of known weeds during routine management activities. Even these do not have systematic survey or management however. There are no Key Native Ecosystem sites receiving pest control by Greater Wellington Council.

## **Vegetation Removal**

The patterns of vegetation across the study area have undergone substantial and continuing change since European settlement, from 1840. In the Duck Creek catchment, which would once have been completely forested, our estimates suggest that about 6% of the area retains an indigenous cover. The conversion to pasture was largely responsible for the loss but residential development has caused the demise and fragmentation of many remnants. Residential development has not been entirely unsympathetic however so that some remnants are captured in reserves while others are retained on more extensive residential properties, especially along the western hills of Whitby. On these larger and steeper lots retention is a desirable option for owners. Remnants on flatter land are few, and generally in a process of rapid decline for lack of active management.

The vegetation along almost all of the Inlet edge within the study area has been heavily modified. Roading, residential development, boatsheds, walking access, sewer pipes, retaining walls, and weeds have virtually destroyed the original cover. Planting, in road reserves and along private frontages has been almost entirely with exotic species.



Continuing threats to vegetation around the western and southern inlet edges are:

- The ongoing fragmentation of vegetation along edges and scarps as a result of inadequate vegetation management and continued residential development. With attrition the remaining remnants are exposed to increasing natural and cultural pressures; there is a gradual eating away from the edges of remnants.
- Road maintenance (cutting, spraying) knocks back or kills vegetation in the vicinity of the road. The need to keep vegetation low to preserve sightlines for traffic exacerbates sedimentation; steep clay banks are exposed to erosion. Observations suggest that a high canopy of trees can reduce the impact of rain and improve bank stability.
- Further residential development in the Duck Creek Catchment has the potential to further fragment remnant vegetation and add to sedimentation, smothering estuarine vegetation, eel grass in particular. In the longer term increased road runoff poses additional threats to the estuarine environment.

### **Recreational Use**

Increasing recreational use is very much focused on the estuarine edge. Although individual impacts are low, and locals tend to respect their environment, the Inlet is gaining a wider and regional popularity. Use may increase substantially if the proposed pathway around the inlet goes ahead.

Existing walkways within the study area are closely aligned with water courses and open space generally. The walkways incorporate spectacular lookout points along the hills above the Inlet edge. For the most part the existing open space network is used by locals and there are excellent and well used walkways between shops, schools, and other local amenities. (Playing fields are regarded as a city wide or even regional resource.)

The Porirua City Council Leisure and Recreation Plan, 2004-2014, recognises the significance the community places on the sustainable management and use of natural resources and access to the outdoors, the coastal environment in particular. Community surveys are in support of the proposed coastal walkway. Many community groups, including the Guardians of Pauatahanui Inlet, support such a pathway, subject to the protection of the natural character of the coastal environment.

Whether the coastal pathway is developed or not it is likely that the increased interest in the coastal environment, both for subdivision and recreational use, will continue so that pressures on ecological values will increase. The issues arising both from the literature and community meetings held during the course of this and the Stage 1 project include:

- The need for walking linkages from the coast into the Whitby environment, onto lookout sites on the northern hills in particular.
- The need for a sensitive approach to any pathway development along the coast. Existing consents for the restoration and/or establishment of stone walls along the coastal edge in association with SH 58 recognise the requirement to protect natural character and make provision for walking.



- The management of dogs. It is no longer appropriate for dogs to have an absolute freedom of access to coastal areas. The numbers now demand that access become limited to specific areas and that stricter controls on dogs be observed. Dogs interfere with and threaten wildlife. Droppings need to be collected by dog owners and the council needs to provide bins.
- Although clearly beyond the scope of this project there is an ongoing need to endorse and expand the councils policies for integrated networks in order that the coast and the hinterland are managed as a whole and that the ecological and recreational values are dealt with together.

### **Sub-division**

The council has policies in its District Plan setting the context for subdivision. These policies are selective in their concerns; those for the rural zone tend to be more sympathetic to ecological values while urban policies focus on infrastructural needs.

Policy C 4.1.3 states a requirement

*To ensure that activities within the Rural Zone do not detract from the character or quality of the rural environment.*

Policy C 9.1.15 is quite specific in requiring a developer

*To recognise, protect and enhance the existing ecological and landscape features in the Whitby Landscape Protection Area, including Duck Creek and Resolution Ridge, through subdivision design, location, roads, low residential densities, allotment size and the management of earthworks and vegetation clearance.*

By contrast the policies for residential areas are amenity and infrastructure focused. Policy C3.2.1 requires a developer

*To protect and enhance the amenity and character of the residential resource by defining standards for the bulk and location of buildings, and the nature and scale of activities., and*

Policy C 6.1.4 requires development

*To ensure continuity of transport, road links, open space, walk ways, cycle routes, sewer lines, water mains and other infrastructure services through proposed new areas of development and subdivision.*

There is a need to ensure that policies are consistent across all lands administered by the council. Similarly with rules; vegetation clearance should be treated the same in all zones. The clearance of vegetation on sites of ecological significance should be limited to that required by the built structures.

For all new subdivision the council should develop policies and rules that aim to achieve zero change in water quantities and quality. To achieve this the council needs to review infrastructural requirements to reduce hard surfaces and to minimise pipes; the objective must be to use natural swales, ponds, and retention arise so that water can be cleaned and released slowly into the estuarine environment. Both Auckland and Christchurch cities have excellent guidelines on stormwater management. Porirua City needs to review these guidelines and develop standards appropriate to its own circumstances, possibly in consultation with developers.



## APPENDIX 7

### **Aims of individual sessions at the October 2003 “De-Stressing Estuaries” workshop**

To broadly overview planning and management issues facing communities and agencies in their attempts to sustainably manage sensitive estuarine systems, and the role that science has to play.

1. To provide an introduction to and overview of: issues relating to the sustainable management of estuarine systems; the environmental, economic and cultural significance of estuarine environments; and the physical and ecological processes at work within estuaries and the stresses to which these are exposed by activities (both within the estuary, and within any supporting catchment and adjacent coastal areas). This overview will broadly introduce efforts that are being made to further understand these systems and their dynamics and in this context the efforts that are being made to sustainably manage these environments.
2. To raise awareness and understanding of the new science being developed and applied to an integrated approach to managing estuaries and their catchments to meet the sustainable management tests of the Resource Management Act 1991.
3. To highlight key threats to estuarine systems, the role and place of science in understanding and assisting in responding to these threats, and issue specific management approaches that can be employed to address threats.
4. To raise awareness and understanding of a further approach being advanced in New Zealand to sustainably manage estuarine systems, including ‘whole’ catchment areas, in an integrated fashion.
5. To cover the role of science and the community, including Tangata Whenua, in setting informed, achievable and agreed targets for restoration and management initiatives, and how this is best facilitated.
6. To explore community roles in restoration and management initiatives, and how these can be facilitated.
7. To explore generic and Pauatahanui-specific solutions (interactive session).



## **APPENDIX 8**

### **WRITTEN COMMENTS ON DRAFT REPORT**

A full draft of the report was publicly notified in January 2004 and written comments invited. Comments were received from the following groups and individuals:

Burton Consultants on behalf of Transpower New Zealand Ltd  
Claire and Ross Giblin  
Dr Margaret Bailey  
Guardians of Pauatahanui Inlet  
Howard Saunders  
Karen Moses and Eve Treggerthan  
Pauatahanui Inlet Community Trust  
Transit New Zealand  
Victoria Froude and Chris Richmond

These comments, along with feedback obtained from a public meeting held to discuss the draft report in February 2004 and other received verbal comments, have all been considered in the preparation of this final report.

A summary of all written comments, and notes from the public meeting, together with responses from the consultants, is available from the Strategic Policy Group at Porirua City Council.



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## GLOSSARY

**ARI:** Average recurrence interval. Refers to the expected frequency of a given level of flooding, e.g. 1 year ARI flood = the flow which is expected on average once a year.

**Copepod:** An order of crustacean animals.

**Ecodomain:** An area of similar environmental factors.

**Ecosystem:** A functioning community of organisms together with their physical environment.

**Ecosystem services:** A wide range of conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfil human life.

**Estuarine:** Used of organisms that inhabit estuaries or environmental conditions occurring in estuaries.

**Estuary:** A semi-enclosed coastal waterbody receiving relatively high inflows of fresh water.

**Galaxid:** A suborder of small freshwater fish. One of the most important groups of native New Zealand freshwater fish, including whitebait species.

**MAF:** Mean annual flood = the arithmetic mean of annual maximum flood flows of a river.

**PAHs:** Polycyclic aromatic hydrocarbons, a group of organic chemicals which can be significant environmental contaminants.

**PEP:** Pauatahanui Environmental Project, a comprehensive environmental investigation undertaken by the former Department of Scientific and Industrial Research in the mid 1970s (Healy 1980).

**PIRP:** Pauatahanui Inlet Restoration Project.

**Riparian:** Part of a watershed immediately adjacent to the stream channel; pertaining to or living on the banks of rivers and streams.

**SES:** Significant Ecological Site ( as identified in the Inventory of Ecological Sites in Porirua City (Boffa Miskell 2001a).

**Stormwater:** Surface water resulting from heavy falls of rain. In urban areas stormwater need to managed by drainage or percolation systems.





**Map 2- Open Space  
Reserves & Sites of Ecological Significance**

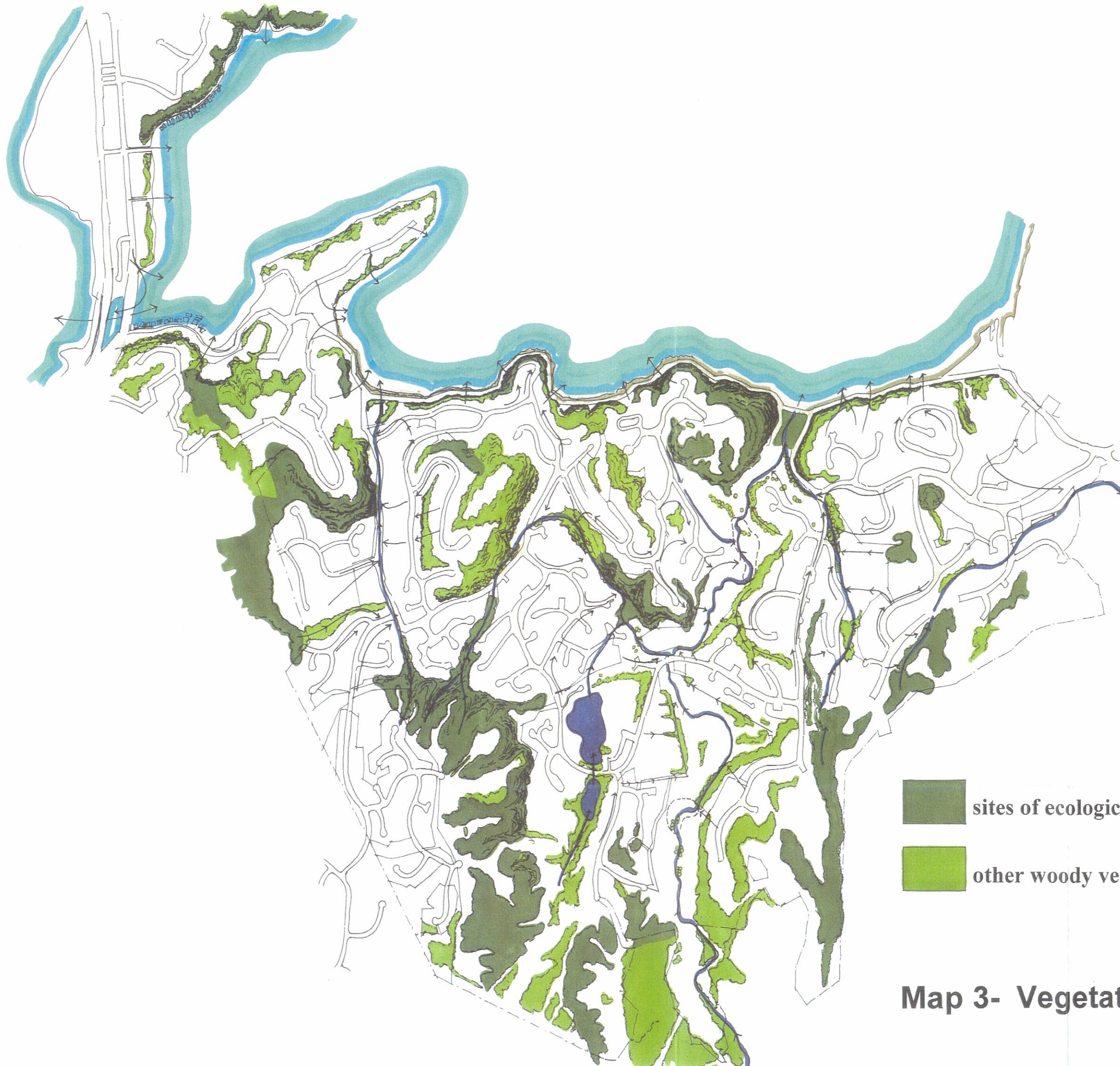




**Reserves**  
**Sites of Ecological Significance**

Whitby Reserves, Walkways and Ecosites

Digital map data supplied by Sinclair Knight Merz. The information displayed in the GIS has been taken from Porirua City Council's databases and maps. Sourced from Land Information New Zealand. Crown Copyright. RESERVE. If the information is relied on in support of a resource consent it should be verified independently.





-  sites of ecological significance
-  other woody vegetation

**Map 3- Vegetation & Drainage**

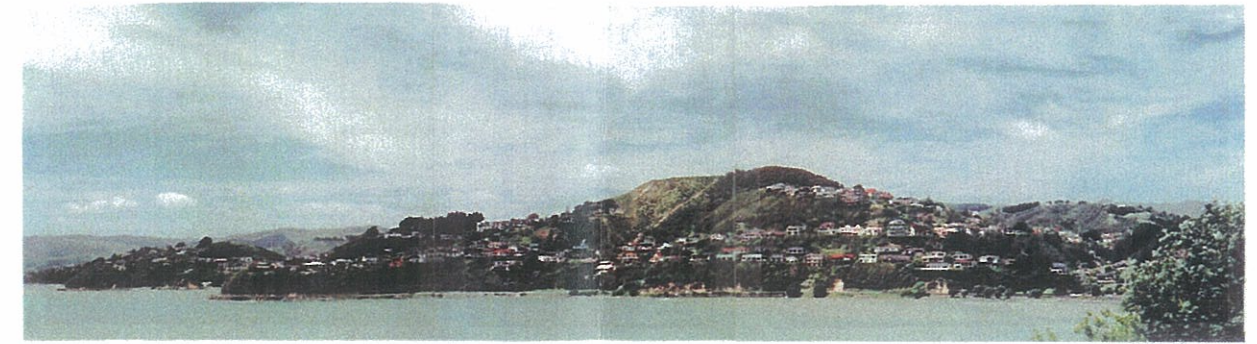


## 2. Mana, the Inlet Entrance and Edge

- Monitor the quality of stormwater entering the estuary from SH1 before and after the installation of filters in sumps.
- Monitor tidal flow and deposition patterns at the channel opening to Pauatahanui Inlet.
- Discourage vehicle access on the inter-tidal areas accessed from Ivey Bay.
- Complete restoration/ stabilisation planting on the sand dune at the entrance to Camborne walkway.
- Liaise with property owners along the Mana foreshore when planning restoration/ dune toe stabilisation work and consider extending planting onto private land.

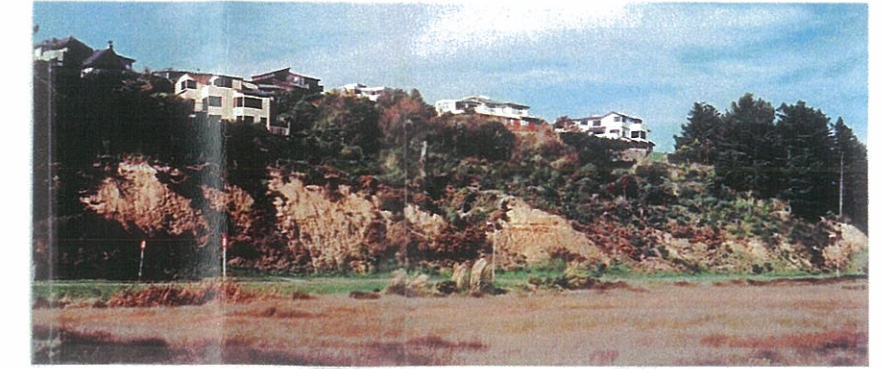
## 1. Camborne Escarpment

- Ensure the maintenance of a dense vegetation cover along the edges of waterways passing through Camborne and crossing the escarpment.
- Give priority to weed control along the escarpment because of its ecological and visual importance.
- Plant groups of native shrubs in gaps created by weed control.
- Progressively plant indigenous hardwood trees to replace current exotic dominants in the escarpment canopy.



## 3. Golden Gate

- Implement a restoration programme at Shell Point to demonstrate the wider restoration potentials.
- Ensure that heavy vehicles are kept off the intertidal areas; control access from Trevor Terrace.
- Limit vehicle access in inter-tidal area to the cars of residents; assist owners with alternative access.
- Place conditions on resource consents & building permits to minimise silt runoff associated with construction; provide information to landowners.
- Investigate zoning Golden Gate a 'Special Character Area' with planning provisions & a design guideline. This would recognise the contribution the peninsula makes to the visual quality and character of the Inlet as a whole, especially as seen from SH1.
- Develop a restoration guideline for residents of the peninsula; highlight visual and ecological values.
- Investigate the need for increased storage capacity at the pump station off Golden Gate.

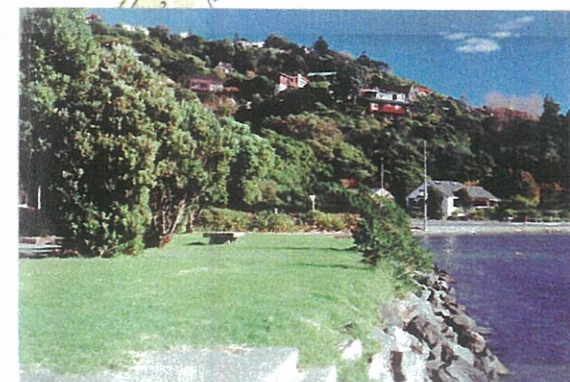


## 5. Southern Edge and Inlet

- Continue monitoring the cockle populations and their health.
- Undertake a detailed site-specific expert evaluation of options for eel grass restoration within the whole estuary.
- Explore options for filtering stormwater off SH58 before it enters the estuary.
- Continue monitoring environmental conditions in the inlet and undertake research on determining limiting factors for key estuarine species.
- Produce an updated hydrological model for the Inlet.

## 4. Paremata & Southern Inlet Escarpment

- Undertake a survey of public and private land along the escarpment to identify areas where the vegetation cover is inadequate. Differentiate between areas that will regenerate naturally and those requiring planting.
- Establish trial plantings as a joint venture between the council and landowners. Consider nurse crops of exotic species as shelter for the natural regeneration of natives.
- Assist existing and future property owners in recognising the value of native and exotic vegetation; promote protection and restoration.
- Ensure that any future pathway along SH58 has linkages into the Whitby area, particularly to lookout points along the Northern Hills.
- Ensure the protection and/or establishment of a vegetation cover on all slopes over 35°.
- Ensure that areas of the escarpment onto which stormwater is discharged are stable with a good vegetation cover.



Map 4 Inlet Edge







9. Northern Duck Creek Hills

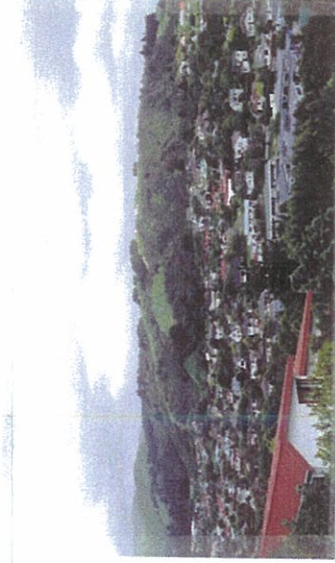
- Along open and less entrenched sections of the stream plant indigenous species to establish a dense, low, ground cover. Keep canopy species back from the stream to ensure sufficient light is available for ground cover species.
- Maintain Spinnaker Reserve as a mixture of exotic and indigenous species.
- Undertake weed control in reserves as part of the overall strategy for the inlet. Pampas grass poses a significant threat.
- Lightly thin macrocarpa on the faces above Spinnaker Drive and along the stream to provide sufficient light for natives to regenerate. Remove naturally regenerated pines.
- Investigate the possibility of re-contouring the stream in the recreation reserve below the Yardarm to create a storm-water retention area.
- In sheltered and damper areas of Yardarm and Duck Creek Reserves inter-plant existing native shrubs with native canopy trees.
- To assist a shift to indigenous vegetation establish areas of natives as seed sources.

6. Browns Bay Catchment

- Ensure that the integrity of existing indigenous vegetation in the upper part of the catchment (especially in riparian areas) is protected.
- Investigate options to formally protect areas previously designated for roading where they traverse tributaries of the catchment.
- Develop an education campaign to stop the dumping of rubbish, weeds in particular, in areas of indigenous vegetation.
- Undertake an investigation to establish the levels of contamination in stormwater picked up off Postgate Drive. Consider cleaning devices such as those being investigated for the Mana Esplanade.

7. Western Duck Creek

- Explore options with owners of larger holdings to secure the long term protection of indigenous vegetation across Whitby's western slopes.
- Thin out the canopy of exotic species in council reserves, macrocarpa and alders in particular, so that there is sufficient light to enable indigenous regrowth.

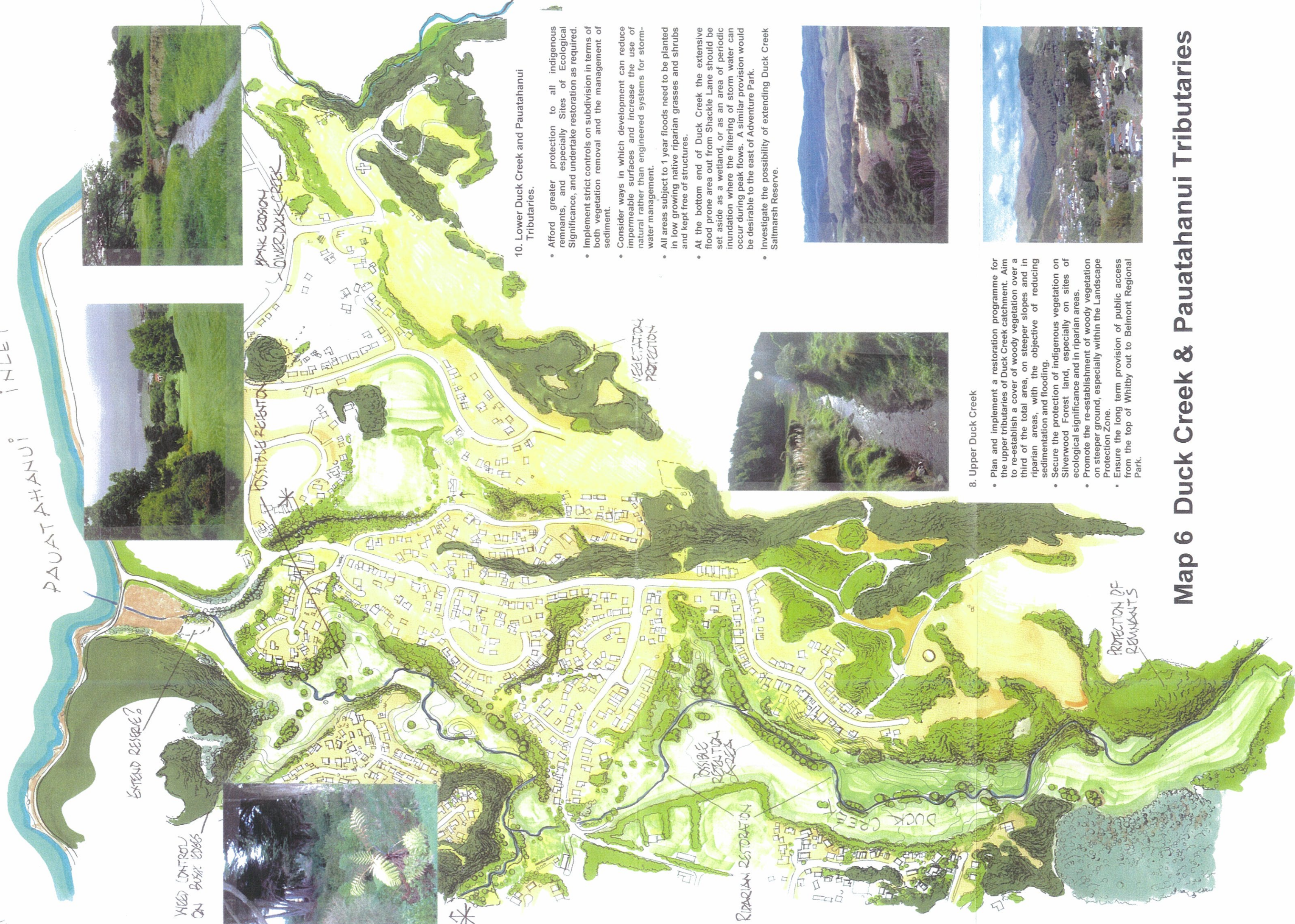


Map 5 Browns Bay & Western

Duck Creek Catchments



# PAUATAHANUI INLET



## 10. Lower Duck Creek and Pauatahanui Tributaries.

- Afford greater protection to all indigenous remnants, and especially Sites of Ecological Significance, and undertake restoration as required.
- Implement strict controls on subdivision in terms of both vegetation removal and the management of sediment.
- Consider ways in which development can reduce impermeable surfaces and increase the use of natural rather than engineered systems for storm-water management.
- All areas subject to 1 year floods need to be planted in low growing native riparian grasses and shrubs and kept free of structures.
- At the bottom end of Duck Creek the extensive flood prone area out from Shackle Lane should be set aside as a wetland, or as an area of periodic inundation where the filtering of storm water can occur during peak flows. A similar provision would be desirable to the east of Adventure Park.
- Investigate the possibility of extending Duck Creek Saltmarsh Reserve.

## 8. Upper Duck Creek

- Plan and implement a restoration programme for the upper tributaries of Duck Creek catchment. Aim to re-establish a cover of woody vegetation over a third of the total area, on steeper slopes and in riparian areas, with the objective of reducing sedimentation and flooding.
- Secure the protection of indigenous vegetation on Silverwood Forest land, especially on sites of ecological significance and in riparian areas.
- Promote the re-establishment of woody vegetation on steeper ground, especially within the Landscape Protection Zone.
- Ensure the long term provision of public access from the top of Whitby out to Belmont Regional Park.

# Map 6 Duck Creek & Pauatahanui Tributaries



**Pauatahanui Inlet Restoration Programme: Stage II  
Summary of written comments on public draft,  
with responses  
Paul Blaschke, March 2004**

**Comments received and incorporated into final text**

Burton Consultants on behalf of Transpower New Zealand Ltd  
 Claire and Ross Giblin  
 Dr Margaret Bailey  
 Guardians of Pauatahanui Inlet  
 Howard Saunders  
 Karen Moses and Eve Tregathan  
 Pauatahanui Inlet Community Trust  
 Transit New Zealand  
 Victoria Froude and Chris Richmond

**Claire and Ross Giblin,**

<b>Comment</b>	<b>Response from consultants</b>
There are only a handful of residents whose only vehicle access to their houses is along the beach. We can now only drive a vehicle on to the beach with resource consent and as part of that must prove that no harm will be inflicted.	Recommended action modified to allow limited use by residents that does minimal damage to shore.
We would also like to note that recreational users are encouraged to drive their cars on the beach to launch their boats with expanded facilities between the bridges at Paremata, with no restrictions. There are also regularly vehicles along the Mana Esplanade beach front.	Noted that council should be even-handed with users.

**Howard Saunders**

I know of two occurrences this year of sewage overflow from the manhole beside SH1 between the Mana bridge and Mobil service station. On the second occasion on 16 February 2004 the volume of sewage flowing out of the manhole was significant.	Noted and brought to attention of PCC.
Also, there is a low level of sewage contamination occurring more often if not continuously from the sewer pipe along the foreshore on so called Golden Gate caused by breakdown of one or other of the pumps.	Noted and brought to attention of PCC. PCC suggest contamination may be caused by rotting vegetation. Rec. action calls for continued monitoring and attention where necessary.



## Margaret L Bailey (Dr)

<p>The house I live in is directly affected by this work. It lies between Spinnaker Drive and State Highway 58 directly overlooking Bradey's Bay and close to the Reserve.</p>	
<p>My particular concern relates to the land immediately below the houses which is partly in private ownership and partly road reserve. There used to be a row of macrocarpa and pine trees along the top of the cliff, but in July 1999 these were felled by Transit NZ because they were a danger to road users. No planting has been done to replace the trees. This has led to the upsurge of noxious plants and weeds, both on the private property and on the road reserve and cliff.</p>	<p>Rec. action modified to include need for replanting of felled vegetation</p>
<p>However, slips continue to occur from the cliff face, and during the last week of heavy rain, two trees and soil came down on the road from neighbouring properties. Therefore, I fully support the action points on page 44 of the Plan. I would be willing to help with the survey of the vegetation on my property and the adjacent Transit NZ road reserve and to help with trial plantings.</p>	<p>Noted. Rec. action modified to include voluntary action by residents</p>
<p>I would also like to see home owners in this area provided with information about the importance of removing noxious plants and weeds and with information about suitable plants to replace them with.</p>	<p>Agreed. Rec. action modified</p>

## Transit New Zealand

<p>It is my understanding that there are three sumps on the road and four on the old and new bridges which discharge stormwater into the Inlet. The current proposal is that these sumps are being fitted with a siphon system. It would be useful if the existing monitoring programme could be adapted to monitor what impact the road runoff from State Highway 1 may have.</p>	<p>Noted</p>
<p>We would be willing to investigate the practicality and feasibility of carrying out additional planting on any identified areas.</p>	<p>Noted and included in Rec. action</p>



## Victoria Froude & Chris Richmond

Without measurable outcome goals there is a real risk that progress will be measured by activities rather than real results. Clearly identified goals are needed to assess the comprehensiveness and relevance of the policies and actions proposed and to measure progress over time.	Consultants feel that goals are clearly expressed but are not fully quantifiable within this project. Goals rewritten to make more specific where possible.
The "ecological health balance sheet" is superficial. The separation into land and water is confusing. Freshwater does not seem to be covered.	Balance sheet redrafted to specifically include freshwater
Browns Bay regularly fails to meet the standards for bathing beaches and in mid January E.coli levels were more than 71 times higher than the maximum allowable levels for swimming	Nutrient pollution is noted as an issue. PCC has questioned accuracy of E. coli results; did not have time to check.
Various algal species ( <i>Ulva</i> , <i>Enteromorpha</i> , <i>Cladophora</i> and <i>Gracilaria</i> ) reflect high nutrient levels.	Noted in Appendix 6.
The overall catchment restoration and enhancement action programme is supported. More active steps to address stormwater management will be needed.	Noted. Stormwater management noted as one of major restoration themes. Agree to need for active stormwater management.
The decline in the diversity and abundance of marsh birds has not been reversed by recent repair programmes.	Noted. Several biodiversity actions may help habitat of marsh birds, but not as much of an emphasis as in Stage I.
There needs to be priority actions to significantly reduce the amounts of sediment, nutrients and contaminants reaching the Harbour from stormwater, tributary streams, the sewage system and roading.	Agree. Feel this is very adequately covered by several priority actions.
While we support eel grass restoration, we consider the first action is to improve the habitat quality (especially water clarity) so that existing eel grass beds are able to survive, thrive and expand.	Noted. Recommended action in this area has been modified and dropped from priority list.



## Pauatahanui Inlet Community Trust

We are still firmly committed to the view that the aim of the Restoration Plan is to enhance the ecological health of the estuarine environment of the Inlet. The primary focus must therefore be on means of improving the quality of the estuarine water – or at the very least, preventing further deterioration.	Noted with agreement. Outcomes introduction has been strengthened to further emphasise water quality focus and actions.
Emphasise strongly that achieving these aims will require very high quality of monitoring of compliance with conditions in resource consents.	Agreed. Monitoring section of Rec. Priorities strengthened.
Changes to the regulatory regime (e.g. District Plan, Code of Urban Development, provision of incentives to developers and land owners) to facilitate more environmentally sensitive urban and rural development and assist the conservation of natural features.	Totally supported but felt that points adequately covered in generic action points.
<b>Map 2</b> should be amended to include the western boundary of the Wildlife Refuge.	Map 1 amended to show this. Also mentioned in text.
Marine pests and weeds are not mentioned in the paragraph on p. 93 especially devoted to “Pest and weed issues”.	They have been mentioned (p94). Pest and weed control section strengthened to emphasise this further.
<b>Hydrological modeling:</b> The Trust gives strong support to the concerns expressed on p. 92 (“The Main Channel”)	Further emphasised in revised Action Plan.
<b>Executive Summary:</b> Assessment of the Plan by Councillors, Council Officers and the public would be assisted by the provision of a short Executive Summary.	Agreed. Executive Summary has been added.
We also believe that this some issues raised in Stage 2 are so serious and urgent that they require to be addressed before Stage 3 is completed, or even contemplated.	This is outside the scope of consultants’ brief.

## Burton Consultants on behalf of Transpower New Zealand Ltd

Action points relating to protection of indigenous vegetation and planting and implementation of restoration programmes are supported but any planting undertaken within Management sectors traversed by high voltage transmission lines should not have the potential to adversely affect these existing assets.	Text has been modified to take account of comment (p55)
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Planting should be in accordance with the Electricity (Hazards from Trees) Regulations 2003 (schedule of relevant growth limit zones attached). Controls on vegetation clearance should not impose unreasonable constraints on Transpower's ability to undertake trimming and removal activities without additional restrictions or require obtaining of resource consents for such work.	Point noted (p28)
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## Guardians of Pauatahanui Inlet

Suggest provision of Executive Summary	Agreed. Executive Summary has been added.
The process of supplying only an unranked list of short-term and long-term priorities is totally inadequate. Should unequivocally identify and rank those actions that are absolutely critical to restoration. Recommendations on the implementation process and timetable are also required.	All priorities are regarded as very important if not critical. They have been grouped by outcome to emphasise their relationships, and ranked by urgency. Beyond this a detailed implementation plan is beyond consultants' brief but some notes on implementation programme are included.
Should stress the importance of monitoring indicators of the health of the Inlet and mention current Guardians stream monitoring.	Covered in action plan for southern inlet. Guardians monitoring is mentioned (p30)
Porirua City Council and Greater Wellington should formulate an integrated programme and associated database that includes all key indicators.	Agree. Noted under discussion of implementation programme.
Production of a hydrological model for the inlet should be a high priority and must precede any decision of the construction of boat ramps and other such facilities, or of the formulation of any plan for dredging, within the Inlet and its approaches.	Agree. This is provided for in new action point.
Agree with actions to minimise erosion, especially hydroseeding of bare banks above SH 58.	Noted
Want increased emphasis on better mandatory provision of state-of-the-art stormwater and riparian management systems by developers, road builders and landowners, in order to maximise water quality.	Feel this is adequately covered in priority actions in the action plan
Agree with protection and enhancement of delicate habitat such as eelgrass beds and salt marsh. However have severe doubts about the efficacy and practicability of eelgrass restoration that is not based on natural regeneration and growth, i.e. require the abatement of causal factors of sedimentation.	Recommended action has been changed to accommodate this comment.
Support emphasis on weed control.	Noted



Support public awareness measures, especially planting guidelines and signage, but do not see need for staffed information centre.	Noted that this suggestion was not included as specific action point. Text modified to accommodate this point.
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**Karen Moses and Eve Tregathan**

Strongly object to the prohibition on the use of vehicles on the foreshore of Golden Gate.	Related points noted. Rec. action modified to allow for regulated local use by light vehicles.
Suggest that each local household be permitted up to 4 vehicle access times per year.	



## Comments received too late to be incorporated into final text

### Whitby Residents' Association

Comment	Consultants' response
Report generally weak on detailed proposed actions or remedies.	Not possible within limits of brief to provide level of detailed for implementation of actions for all areas
No further development should be permitted until it is proven that there would be no adverse environmental effects.	This would be contrary to the RMA which allows for avoidance, remedying or mitigation of adverse effects.
Areas required for flood control, filtering or regulation of stormwater should be specifically declared unsuitable for residential development and recommended for Council purchase at non-residential land values.	Feel that recommendation for flood control or stormwater regulation clearly implies unsuitability for residential development of that site but this does not necessarily preclude them being within residential precincts. Report did not deal with land ownership issues.
Esplanade reserve is of very high amenity value and should not be encroached on by any development. Parts of it should not be traded for low value areas.	Noted. Report only notes that from an ecological point of view the esplanade reserve need not be of uniform width. Any trading off under such a recommendation should be for areas that are ecologically more valuable, not less valuable.
Should require a total development plan for any residential development in Duck Creek or Silverwood areas to allow overall assessment of environmental effects and identification of areas important to protection and restoration. No piecemeal development plan should be accepted.	See comment below regarding Duck Creek management plan.
Recommendation that DP Policy C9.1.15 is a retrograde step which does not provide protection of environmental and neighbourhood protection values.	Consultants' understanding of the policy is different, notably that it is valid to use <i>management</i> of earthworks and vegetation clearance as a mechanism for recognition, protection and enhancement of ecological and landscape features. Feel that Action Plan recommendations (p32, eg. review of planning provisions related to vegetation clearance and development controls) attempt to provide for protection and enhancement of the environment.
Restoration Plan should be used to trigger amendments to the DP.	Consultants' understanding is that the Restoration Plan is a guideline plan, as are most non-statutory plans. Noted that some recommendations of the RP



	would lead to review of DP provisions.
There is a requirement for a Duck Creek River Management Plan (jointly between PCC and WRC)	Consultants believe that this recommendation has merit. The current restoration plan goes some way towards such a plan.
Much stronger commitment by local bodies required to adopt the RP and incorporate objectives and recommendations into LTCCP, District and Regional Plans and Annual Plans.	See above comments on guideline plan.

### Paremata Residents Assn

Comment	Consultants' response
Heath and Balham 1884 should read <u>1994</u>	Noted
The traffic volume figures quoted in the table on p98 are clearly incorrect. This may affect the conclusion that "contamination sources from roads are greatest in Whitby" which seems to ignore things like the level of heavy vehicles on SH1 and SH58, the degree of congestion on Mana Esplanade and at Paremata Roundabout, distance from the Inlet, etc.	Traffic volumes are correct. Consultants acknowledge however that there is insufficient information on exact sources of pollution but are principally arguing for the recognition of Whitby as a potentially significant source of contaminants. Traffic volumes are not the only factor.
Plimmerton Res Assn should read <u>Paremata Res Assn</u>	Noted. Apologies for the mistake
Note confusion about the obstructions under the Mana road and rail bridges (p92). Suggest a number of changes to clarify the situation.	Noted, unfortunately not able to incorporate these suggestions.
Summary of planning and strategic initiative does not include filling information gaps noted earlier in report. This is necessary for setting priorities and a strategic directions	Agreed. Section was revised to include this need.
We have some reservations about the statement that "there should be no construction of vehicle lay-bys on the seaward side of the road [SH58]". At present there are several small areas where people can park and watch activities (eg. yacht racing) on the harbour. If these can be retained (or even enhanced) in conjunction with any future pathway construction or road calming measures, this should not be ruled out	Consultants agree that some present small areas are acceptable but contend that no new such areas should be built. Areas in this sector not essential for roading should preferentially be used for environmental enhancement.
Suggest that the continued use of Transit's seawall method around SH58 should be reviewed. It is very visually obtrusive,	Consultants believe that this recommendation has merit, in conjunction with design work on the



extends significantly onto the foreshore and is very hostile for recreational users.	pathway proposal.
<i>Priority Actions:</i> Even very limited erosion control measures along the Dolly Varden foreshore would be of much greater benefit (both to the Inlet and the adjacent reserve) than further "restoration planting on the sand dune" at the northern end.	Both are recommended actions but consultants believe that erosion control in this area may not be cost effective and should only be considered if other measures are unsuccessful. Restoration planting of the sand dunes was recommended as a priority because of their distinctiveness.
<i>Priority Actions:</i> Immediate removal of tidal obstructions under the rail bridge is of much greater urgency than "limiting all vehicle access to the inter-tidal area", as the potential damage is much greater.	Consultants understand that tidal obstructions are being dealt with and that vehicle access is an important issue for intertidal management.
<i>Priority Actions:</i> Production of a hydrological model for the harbour seems essential if restoration initiatives are to be undertaken in an effective and informed way	Agree.