



OTAKI FLOODPLAIN
MANAGEMENT PLAN
for the Otaki River
and its environment

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Otaki Floodplain Management Plan
The Community's Plan for the Otaki River and its environment

June 1998

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This Plan is the result of much hard work and commitment by people who live on, or have a connection with, the Otaki River and its floodplain.

I would like to take this opportunity, on behalf of the Regional Council, to thank all of these people for their input into the Plan, whether it was through attendance at community meetings or as a member of one of the groups involved in bringing the Plan together.

In a community effort such as this, every contribution is valued. The Otaki Floodplain Management Plan has been over six years in the making, and has benefited from community involvement at every step. From defining the flood problem, selecting the preferred options, looking at the environmental and economic impacts, through to preparing the Plan, the Otaki Community has been fully involved and now has a stake in it.

However, the Plan, is a living document. It will change and be further developed over time. We can never be too prepared for a flood, and the landscape continues to change in response to far greater powers than ours. We must never let ourselves believe that we are able to control the mighty forces of a river in flood. This is why your continuing involvement in the implementation of the Plan will keep it alive and will reflect the changing needs of the community as well as keeping you informed and prepared.

From here, we can now look to the outcomes of the Plan being implemented and the benefits being realised of a prepared community.

Foreword



STUART MACASKILL
Chairperson
Wellington Regional Council

Acknowledgements

Major contributors to this Plan have been:

- Staff and elected representatives of the Wellington Regional Council
- Various consultants
- Staff and elected representatives of the Kapiti Coast District Council
- Members of the Officials Liaison Group
- The people of Ngati Raukawa
- Members of the interested and responsible community who have made their contribution to the Kapiti Floodplain Management Committee and the Otaki Resource Group.

The Wellington Regional Council thanks them all, past and present, and offers special acknowledgement to those who have passed on since the project began.

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The artwork on the cover and the border design on the foreword page were designed by and are the property of Tippy Bevan (Ngati Raukawa, Ngati Toa). They are used with his permission. The cover image represents the interaction between the Iwi, the community, the Regional Council and the landscape on the Otaki floodplain.

| | |
|--|-----------|
| Foreword | iii |
| Executive Summary | 1 |
| How do I find my way around the Plan? | 5 |
| 1. Introduction | 7 |
| 1.1 Why Should I Read This Plan? | 8 |
| 1.2 Some Frequently Asked Questions | 8 |
| 1.3 Who Is Responsible For Making The Plan Happen? | 10 |
| 2. Background | 11 |
| 2.1 The Otaki River Catchment | 11 |
| 2.2 The Flood Problem | 11 |
| 2.3 Flooding and People | 15 |
| 2.4 Who will be most at risk? | 16 |
| 2.5 Why undertake Floodplain Management Planning? | 17 |
| 2.6 Preparing an FMP for Otaki | 17 |
| 2.7 The Community Objectives for the FMP | 18 |
| 2.8 Iwi | 18 |
| 2.9 Consultation undertaken during the Floodplain Management Planning Process | 19 |
| 3. Outcomes of the FMP Process | 21 |
| 3.1 Methods | 21 |
| 3.2 Implementation | 22 |
| 3.3 Non-Structural Methods | 22 |

Contents

| | | | |
|---|-----------|---|------------|
| 3.4 Structural Methods | 32 | 7.2 Elements to be Monitored | 72 |
| 3.5 River Management | 35 | 7.3 Elements to be Reviewed | 72 |
| 3.6 Environmental Outcomes | 41 | 7.4 Future Role of the Otaki Community | 72 |
| 3.7 Ongoing Consultation | 43 | 8. Cross Boundary Issues | 74 |
| 4. Considerations | 44 | 8.1 Issues | 74 |
| 4.1 Introduction | 44 | 8.2 Objectives | 75 |
| 4.2 The Physical Environment | 44 | 8.3 Policies | 75 |
| 4.3 The Human Environment | 49 | 8.4 Methods | 75 |
| 4.4 Maori | 54 | 9. Plan Changes | 76 |
| 4.5 Ecology | 56 | Glossary | 77 |
| 4.6 Recreation/Landscape/Heritage Values | 58 | Bibliography | 84 |
| 4.7 Planning and Land Use | 63 | Otaki FMP Reports | 84 |
| 5. Environmental Results Anticipated | 66 | Other References | 86 |
| 5.1 The Human Environment | 66 | Relevant Legislation | 87 |
| 5.2 Maori | 66 | Appendices | 88 |
| 5.3 The Physical Environment | 66 | A Legislative Framework | 89 |
| 5.4 Ecology | 67 | B Phases of Floodplain Management Planning | 94 |
| 5.5 Recreation/Landscape/Heritage Values | 67 | C Regional Civil Defence Operations | 95 |
| 5.6 Planning and Land Use | 67 | D Kapiti Coast Disaster Response Procedures | 98 |
| 6. Implementation and Funding | 68 | E National Recovery Plan | 101 |
| 6.1 Introduction | 68 | F Flood Warning System | 103 |
| 6.2 Current Council Policy for Flood Protection | 68 | Index | 105 |
| 6.3 What the Council Will Fund | 69 | | |
| 7. Monitoring and Review | 72 | | |
| 7.1 Why Monitor and Review? | 72 | | |

List of Figures

| | |
|--|-----|
| Figure 1: Present extent of flooding in a 100-year flood | 2 |
| Figure 2: The Otaki catchment | 13 |
| Figure 3: Present extent of flooding in a 100-year flood | 14 |
| Figure 4: Consultation organisational structure | 20 |
| Figure 5: Non-Structural methods | 22 |
| Figure 6: Hazards related to flood depth and velocity | 23 |
| Figure 7: Flood hazard categories included in the KCDC District Plan | 24 |
| Figure 8: Extent of flooding in an event greater than the design standard (1.5 times the 100-year) | 29 |
| Figure 9: River corridor land ownership | 30 |
| Figure 10: Location of structural methods | 33 |
| Figure 11: Channel alignment and river management methods | 38 |
| Figure 12: Process for implementing environmental outcomes | 42 |
| Figure 13: Sites of Maori significance | 57 |
| Figure 14: Sites of ecological significance | 59 |
| Figure 15: Sites of heritage value | 61 |
| Figure 16: Where FMPs fit in relation to other Plans | 92 |
| Figure 17: Civil defence emergency procedures in a flood | 101 |
| Figure 18: Overview of the Flood Warning System | 104 |

List of Tables

| | |
|--|----|
| Table 1: Otaki Floodplain Management Planning—Phases 1–5 | 4 |
| Table 2: Summary of Guidelines for Future Development | 26 |
| Table 3: Proposed Structural Methods in Priority Order | 36 |
| Table 4: Programmed Works | 37 |
| Table 5: Council Funding Policy (updated 1 July 1997) | 69 |
| Table 6: Criteria for Priority List | 71 |
| Table 7: Elements to be Monitored | 73 |
| Table 8: Elements to be Reviewed | 73 |
| Table 9: Civil Emergency Support Organisations | 99 |

List of Photographs

| | | | | | |
|-----|--|----|-----|--|----|
| 1: | <i>In 1931 Otaki township and the Railway Station were extensively flooded</i> | 8 | 14: | <i>Whare Runanga Raukawa is the third meeting house built on this site. The original house was opened in 1853, rebuilt in 1885, and then again in 1936. It is an outstanding example of revived Maori decorative art</i> | 55 |
| 2: | <i>View upstream to the Tararua Ranges, September 1997</i> | 12 | 15: | <i>Native planting by participants of the Council's Community Task Force and Kapiti Community Development and Training Trust, November 1994</i> | 60 |
| 3: | <i>Flooding at Riverslea, November 1993</i> | 15 | 16: | <i>Native Planting (in similar location), May 1998</i> | 60 |
| 4: | <i>The Otaki River in moderate flood, 11 December 1982, passing under the North Island Main Trunk railway bridge</i> | 16 | 17: | <i>Lower Otaki River landscape, 1992</i> | 62 |
| 5: | <i>Aerial View of the Otaki River from just below the Gorge with the River Corridor marked</i> | 27 | 18: | <i>Fishing for Whitebait at the Otaki River mouth, August 1997</i> | 63 |
| 6: | <i>Undermining of the State Highway 1 bridge pier, left bank, June 1997</i> | 35 | 19: | <i>More Whitebait fishing, August 1997</i> | 63 |
| 7: | <i>Further undermining of the State Highway 1 bridge pier, April 1998</i> | 35 | | | |
| 8: | <i>Chrystalls Bend, March 1998</i> | 39 | | | |
| 9: | <i>Otaki River mouth looking upstream, showing the river mouth cut, 1994</i> | 40 | | | |
| 10: | <i>Erosion on the left bank of the Otaki River, upstream of State Highway 1 bridge, March 1996</i> | 45 | | | |
| 11: | <i>In 1946 the Tower Dredge began a massive task on the lower Otaki River (below State Highway 1), excavating thousands of cubic metres of river gravel that now constitutes the right stopbank that protects Otaki township (the river bed was lowered by about 2 metres)</i> | 47 | | | |
| 12: | <i>Chrystalls Bend, March 1998—north-west view of Otaki floodplain showing Otaki township on the right bank of the river. A breach of the stopbanks around Chrystalls Bend could result in extensive flooding within Otaki.</i> | 50 | | | |
| 13: | <i>Gravel extraction operation, upstream of the railway bridge, September 1997</i> | 52 | | | |

Executive Summary

A major flood in the Otaki River could cause millions of dollars worth of damage to property and community assets in the Otaki area. The social and psychological costs, although difficult to quantify, add considerably to the devastating effect of such an event.

The Otaki Floodplain Management Plan (FMP) is the result of six years of work by the Otaki Community, Ngati Raukawa, the Wellington Regional Council (the Council) and the Kapiti Coast District Council (KCDC). Essentially, the Plan provides a blueprint for management of the river and floodplain over the next 40 years.

Human influences on the floodplain, such as forest clearance, urban settlement and some river management practices, have resulted in significant changes to the landscape. These changes, combined with natural floods, have created a flood hazard. Even with the protection that was put in place between 1945 and 1955, following a series of floods during the 1920s and 1930s small to medium sized floods continue to cause damage. This problem has been made worse by recent settlement, which has been located in areas susceptible to flooding.

The question uppermost in everyone's minds is whether or not they live in a flood-prone area. Figure 1 on page 2 shows the extent of flooding that can be expected on the Otaki floodplain as a result of a '100-year' flood in the Otaki River. This is a major flood event estimated to have a 1% chance of being equalled or exceeded in any one year.

What is Going to be Done?

As a result of examining various options for dealing with the flood problem, the Otaki Community has developed a set of 'outcomes'. These are the tangible and practical results of the six-year planning process which will be put in place under the new FMP. Complete implementation of the outcomes may take many years, depending on the Regional and/or District community's preparedness to pay.

There are three main types of outcome—non-structural, structural and river management methods.

Non-Structural Methods

These methods address land use, building construction, community preparedness and emergency procedures. They are the most cost-effective

OTAKI FLOODPLAIN MANAGEMENT PLAN: June 1998

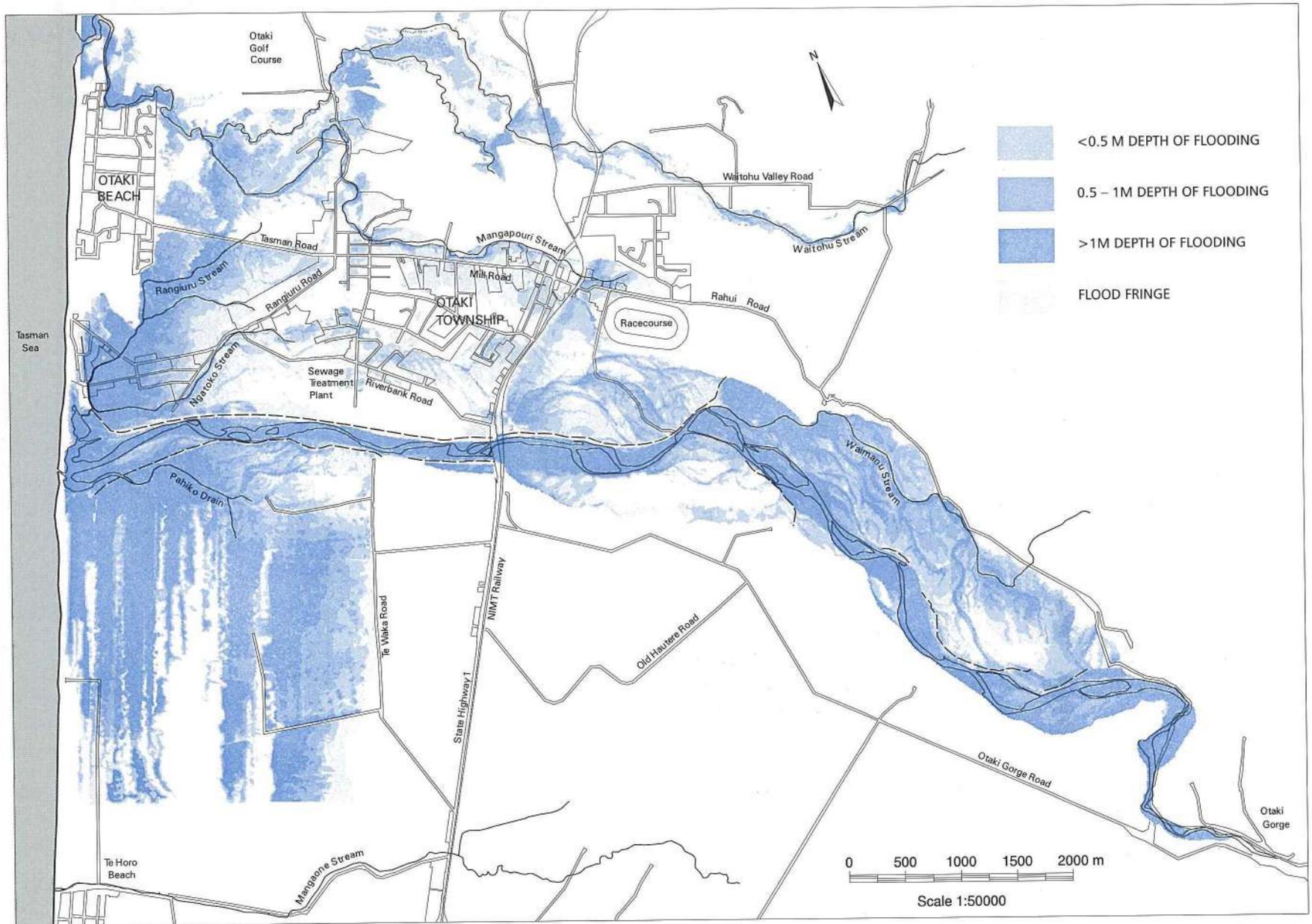


FIGURE 1: PRESENT EXTENT OF FLOODING IN A 100-YEAR FLOOD

methods of floodplain management, reducing the cost of flood damage and guiding future development on the floodplain. Non-Structural methods include the following:

Flood Hazard Categories

Five flood hazard categories have been defined and are included in the KCDC District Plan, with appropriate land uses defined for each. The Council will advise KCDC on subdivision and land use applications to ensure that any new development or activity is appropriate to the flood hazard in that area.

Public Ownership of the River Corridor

The River Corridor is the area most susceptible to flooding. One of the ultimate aims of the Plan is for the whole of the River Corridor to be held in public ownership for both safety and environmental reasons.

Community Preparedness

Flood hazard information The Council will continue to provide up-to-date hazard information to Civil Defence agencies and work to enhance co-operation between the various agencies involved.

Public education The Council will support and assist KCDC in its education programmes to improve flood awareness.

Insurance Individuals will be encouraged to take out adequate insurance against flood damage.

Flood warning The Council will consider ways of improving the current system.

Civil defence The Council will assist KCDC in updating its civil defence plan as required.

Disaster recovery Although KCDC would take the lead role, the Council will assist with recovery where appropriate.

Structural Methods

Structural methods are physical works such as stopbanks and floodgates.

They protect existing development from floods. Agreed structural methods include the following:

Stopbanks

These are generally designed to protect homes and properties from a 100-year flood. Rural land is protected from lesser events. Annual surveys will determine maintenance and budget requirements. Stopbanks are designed for a 40-year lifetime and allow for a 5mm/year sea level rise as a result of climate change. The following stopbanks are included in the Plan:

Chrystalls Extended Will provide protection for Otaki township.

South Waitohu Will provide protection for properties in Rangioru.

North bank Maintenance to the main stopbank downstream of the bridges which protects Otaki township. Minor reconstruction is also required.

Chrystalls Existing stopbank will be reconstructed to give a better standard of protection. It currently has a high probability of failing in a major flood event.

Seaward Extension An extension to the existing stopbank to protect properties in Rangioru.

Old Coach Rd A stopbank will be built across rural land at Mangapouri in conjunction with raising the bridge to provide protection for properties and land.

Hughes/Lutz Rural stopbank providing protection for horticultural and pastoral land.

Harpers Rural stopbank providing protection for horticultural and pastoral land.

South bank Rural stopbank providing protection for horticultural and pastoral land.

House Raising

This applies to existing properties on flood-prone land. It will be funded by the Council according to the funding policy at the time of the work. Individual owners will organise the work and be responsible for ongoing maintenance. There are 41 houses to be raised to the 100-year level, in Rangioru, Mangapouri, Lethbridge and South Waitohu.

| Phase | Description | Current Status |
|-------|--|--|
| One | Definition of the flood problem | Completed April 1993 |
| Two | Evaluation and selection of preferred options | Completed March 1995 |
| Three | Refinement of preferred options, environmental impact assessment and economic evaluation | Completed June 1996 |
| Four | Writing of the Otaki FMP | Consultation draft completed February 1998 |
| Five | Implementation of the Otaki FMP and Environmental Strategy | Under way Reviewed every 10 years |

TABLE 1: OTAKI FLOODPLAIN MANAGEMENT PLANNING—PHASES 1–5

Bridge Raising

The Old Coach Road Bridge on the Waitohu Stream causes a severe flow constriction and will be raised by 1.2 m. Associated works to the abutments and road approaches and construction of a debris arrestor will assist in improving the performance of the bridge. This option also includes the construction of a deflector stopbank. Costs will be subject to cost-sharing between the Council and KCDC.

Services

The aim is to reduce the number of locations where river crossings are required. The Council will facilitate utility service groups where appropriate.

River Management Methods

These methods include both day-to-day activities and major works. They are intended to maintain the river in the preferred channel alignment and protect and maintain existing flood mitigation structures.

Gravel extraction

An annual average of 50,000 m³ (reviewed every five years) will be extracted from the Otaki River in locations that provide the maximum benefit for river management purposes.

River mouth management

The river mouth will be periodically cut when trigger points are reached.

Channel maintenance

The river will be kept to the preferred alignment by regular channel maintenance activities, which include repairing and constructing bank protection (groynes and rip-rap), vegetation planting and berm maintenance.

Monitoring

Monitoring will assess the effectiveness of river management activities, river bed levels, conditions after floods and other natural hazards, and the impacts of climate change. Annual reports will be produced and the accumulated knowledge applied to future assessments.

Development of the Otaki FMP

Each step of the process is represented by a planning phase shown in Table 1. At all stages in the development of the Plan, the Otaki Community has had a vital role in determining its content and will continue to be crucial to the implementation of the Plan.

Environmental Outcomes

The River Corridor is a significant landscape and ecological feature of Otaki. Some of the methods in the Plan have the potential to adversely affect the environment, as do the activities of many other agencies in the Kapiti region.

For this reason the Plan includes Environmental Principles, and proposes the preparation of an Environmental Strategy. This will identify areas for special attention and provide an overall framework of environmental objectives for agencies and individuals involved in activities in the River Corridor.

How do I find my way around the Plan?

The thumbnail sketch on page 6 gives a quick description of what is contained in each section of the Plan.

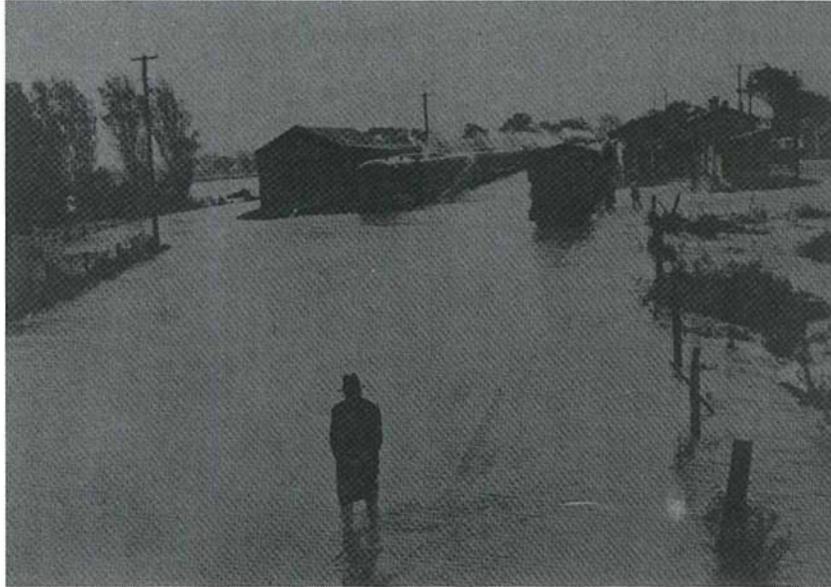
| | |
|--------------------------------------|--|
| 1. Introduction | Section 1 explains why you should read this Plan and how to find your way around it. |
| 2. Background | This 'sets the scene'. The geographical and geological features of the Otaki floodplain are briefly described. The flood problem and the importance of floodplain management planning are explained. The various processes involved in managing the floodplain are outlined. |
| 3. Outcomes | What is going to be done and how. This section explains what methods the Council will use to effectively manage the floodplain. These methods have been chosen by the community. There are three main categories of methods—non-structural, structural and river management (see section 3). Each category is discussed in some detail. Also included are environmental outcomes and an outline of consultation processes. |
| 4. Considerations | How we got there. This looks at the issues, objectives and policies that have led to the methods identified in section 3. It explains why certain approaches were chosen, and it will give you an idea of the decision making processes the community went through. |
| 5. Environmental Results Anticipated | The good news for the environment. This section lists the benefits to the natural environment and the community if the Plan is successfully implemented. |
| 6. Implementation and Funding | How the work will be funded and carried out. |
| 7. Monitoring and Review | How the Council and the community will make sure the Plan stays effective and can meet the region's changing needs. |
| 8. Cross Boundary Issues | This sets out the different responsibilities of the various authorities, and outlines how the Council will co-ordinate these different interests. |
| 9. Plan Changes | This section is reserved for future Plan changes. |
| Glossary | Some of the more technical terms and concepts used in the Plan are defined here. |
| Bibliography | A list of the reports written in earlier phases of the floodplain management planning process, which provide background for this Plan. |
| Appendices | More detailed information relating to some of the issues discussed in the text. |
| Index | Helps direct you to locations in the Plan where specific issues or subjects are dealt with. |

THUMBNAIL SKETCH OF THE OTAKI FMP

1. Introduction

The Otaki River has played a dominant role in the formation of the floodplain and continues to have a significant influence on the Otaki Community. Particularly in its middle and upper reaches, it is an important natural and scenic resource which is valued by the community. In the lower reaches below the gorge, farming, market gardening and horticulture provide a typically New Zealand character. The importance of these activities to Otaki's economy helps to explain the historical emphasis placed on restricting the river to the minimum area required to control flooding, and minimising encroachment onto adjacent land uses. As a result, the community generally has a greater acceptance of the need for flood protection measures.

As with all rivers there are times when the Otaki River can flood with the potential to cause considerable damage at great cost to the community. This Plan is all about how to minimise the adverse effects and costs of damage from flooding. It also provides an opportunity to incorporate environmental values into future activities to enhance the river environment.



PHOTOGRAPH 1: IN 1931 OTAKI TOWNSHIP AND THE RAILWAY STATION WERE EXTENSIVELY FLOODED

1.1 Why Should I Read This Plan?

To find out how to protect your assets from a flood:

A major flood in the Otaki River could cause millions of dollars worth of damage to property and community assets in the Otaki area.

If you own assets or have an interest in the area it is important that you read this Plan. It contains information about the river and the floodplain, the risk of flooding and what has been done to minimise its impact so far. It also sets out what the Council is intending to do in the future.

It tells you what you can do to minimise your losses in the event of a flood.

Helpful hints for flood preparedness:

- have emergency water and food for at least 3 days
- know how to turn off electricity, gas and water
- keep a 3 day supply of essential and prescribed medicines
- have a first aid kit
- have a transistor radio and batteries

To be informed about managing the Otaki floodplain:

This Plan sets out the outcomes that the Otaki River Community has chosen to manage the flood problem. See section 3 for details.

If you were involved in this process, you will want to know that the decisions made are reflected in this document.

If you were not involved, you will want to know which outcomes were chosen and why. This Plan will give you the background (section 2), what will be undertaken in the future to protect you from flooding (section 3), and help you understand why particular outcomes were favoured (section 4).

1.2 Some Frequently Asked Questions

You will probably have questions about flooding and flood protection. Some examples of the most commonly asked questions are listed here. For further information, please look up specific subjects in the index.

Do I live in a potentially flood-prone area?

For a map of potentially flood-prone areas, see Figure 3.

What should I do if there is a flood?

Firstly, stay where you are, and if necessary, climb higher. Do not attempt to escape. Some more helpful hints in case of a flood are given on page 8. You should also follow the directions for dealing with emergencies in the back of the Yellow Pages. Figure 6 gives an indication of the effects of the depth and velocity of water on your ability to escape.

Also see section 3.3.2 for ways in which the Council, KCDC and the community plan to increase public awareness so people are informed about the best way to remain prepared for a flood.

Am I in danger now?

Some of the existing flood defences are capable of dealing with a 100-year flood, while others would fail in lesser events. The community has agreed that it wants better protection than this. For details of the current situation, see section 2.2.

What is being done about the flood risk?

A range of outcomes have been chosen by the community to minimise the impact of flooding. The outcomes of the floodplain management planning process are outlined in section 3.

Can I build a house here?

If you own a section of bare land you are generally entitled to build one house on the section, provided you take certain precautionary measures such as building the house above the 50-year (2%) flood level (defined in the Building Act). For more detailed information, refer to the KCDC District Plan which sets minimum standards for new buildings and provides for exemptions for non-habitable buildings and minor extensions to existing rooms.

Can I subdivide in this area?

Generally, new subdivisions in flood-prone areas are not allowed under the Kapiti Coast District Plan unless each lot has a building site above the 1% flood level.

What land uses are compatible with the risk of flooding on my land?

Flood hazard categories have been identified which show flood risks in different parts of the floodplain. Figure 7 shows where these flood hazard categories occur. Some of the effects of these are detailed in section 3.3.1.2.

Who manages and implements the Plan?

The Council is responsible for management and implementation of the Plan in partnership with KCDC and the community. The Council achieves this through its Long-Term Financial Strategy and Annual Plan process.

Who will pay for the works?

Ultimately the community will pay, although a significant proportion of the costs are borne by the wider Wellington region. Section 6 gives more details.

What has been done already?

Because of the urgency placed on some structural flood mitigation works, and the timing of the production of the KCDC District Plan, some of the outcomes of this floodplain management plan have either been implemented or are currently being proposed. For example, the Chrystalls Bend protection works were completed in 1995 and design of Chrystalls stopbank will commence in 1999.

The flood hazard map (see Figure 7), River Corridor Zone and appropriate rules and standards are contained in the KCDC District Plan (see section 3.3.1.3). Implementation of these works is discussed in section 6.

The remaining structural methods are given in Table 3, and the criteria used to determine the order of priority are described in Table 6.

What will happen next?

When the Plan has been accepted by the community and formally adopted by the Council, work will begin on implementing the remainder of the outcomes. Section 6 sets out the details on how they will be put in place. The Plan will provide the basis for all future work but will be reviewed at regular intervals (see section 2 for details).

1.3 Who Is Responsible For Making The Plan Happen?

Three principal groups will be responsible for implementing the Plan. The roles to be played by these groups are described below:

1. Otaki Community

The Council acknowledges the vital role of the Otaki Community. They have had a significant role in determining what appears in the Plan. Likewise, they also have a crucial ongoing role in maintaining public awareness of the risks and potential impacts of flooding. The community has a role in:

- Education
- Preparedness
- Funding
- Monitoring and review
- Ensuring private developments are compatible with the Plan

2. Kapiti Coast District Council

KCDC has a role in:

- Controlling land uses through the District Plan
- Bridge raising
- Funding some outcomes through local KCDC rates
- Emergency management

3. Wellington Regional Council

The Council has a role in:

- Regional Plan controls
- Funding through special purpose and regional rates
- River management
- Flood mitigation
- Flood warning
- Emergency management

Other agencies (listed in more detail in Table 9) are also involved in emergency management activities—these are broadly grouped as health, welfare, relief, law and order, and utilities (e.g. gas and electricity supplies).

This Plan has no statutory status. Instead, Regional Plans (such as the Freshwater, Soil, Coastal, Discharges to Land, Landscape, and Air Quality Plans) and the KCDC District Plan will be used to implement the objectives of the FMP. Appendix A discusses this in more detail.

2. Background

2.1 The Otaki River Catchment

In a country like New Zealand, where flat land is at a premium, settlement of floodplains was inevitable. This has permanently affected natural river processes, resulting in irreversible changes to the character of rivers and their setting.

The Otaki catchment drains over 400km² of the western slopes of the Tararua Ranges, and extends from Mt. Aston in the south, along the southern ridge line of the Tararuas to Mt Pukematawai in the north (see Figure 2). Much of the upper catchment is managed by the Department of Conservation (DOC) within the Tararua Forest Park.

The Otaki river rises in the sharply peaked and steeply sided western slopes of the Tararua Ranges and flows down through the foothills cutting deep valleys and gorges. It is joined at the Otaki Forks by two major tributaries, the Waitatapia and the Waitotauru, and shortly downstream by the Pukeatua (Roaring Meg). On leaving the gorge the river meanders over a coastal plain, first within a floodplain defined by terraces and then through an area of open pastoral land (see Photograph 2).

Over the last 100 years the landscape has changed dramatically. This is mainly due to extensive lowland native forest clearance on the surrounding hills and coastal plain between 1886 and the 1930s.

As a direct consequence of this, the river began to erode its unprotected banks and reverted to its pre-forestation braided channel morphology. A severe storm in 1936 seriously damaged the remaining forest cover, and many slips developed, with a lot of material accumulating in the catchment waterways. Severe storms also occurred in 1955. Since then, there has been progressive improvement in the forest cover and the catchment waterways are generally free from accumulations of erosion material.

For the purposes of this Plan, the Otaki catchment includes the Waitohu and Mangapouri Streams where they interact with flood flows from the Otaki River. In the case of the Waitohu Stream this covers the reach between the mouth and the State Highway 1 bridge.

Waitohu

2.2 The Flood Problem

Natural floods combined with human uses of the floodplain have created a flood hazard. Early settlement was generally in areas only marginally



PHOTOGRAPH 2: VIEW UPSTREAM TO THE TARARUA RANGES, SEPTEMBER 1997

affected by floods, thereby minimising the hazard. Maori tended to move from settlements affected by flooding when the river shifted its course, and early European settlers selected sites that did not flood using local knowledge.

More recent development has not been so well located. Most flood-free sites were settled long ago and new development has had to use the more marginal sites. Modern settlements are not easily moved and are dependent on structural methods such as stopbanks for protection. Now a major flood could cause millions of dollars worth of damage.

Notable early flooding occurred in 1854, 1904, 1906, 1920, 1925, 1926, 1931 (on four separate occasions), 1936 and 1940 (see Photograph 1).

The initial response to these floods was to construct isolated stopbanks and river control works. When these failed and flooding continued, the existing flood control scheme was built in two parts between 1945 and 1955. The scheme works included stopbanks, drainage and erosion control, and channel alignment works.

Despite the construction and maintenance of this scheme since 1955, small to medium sized floods (5–20 year) continue to cause damage. Figure 3 shows the estimated extent of flooding in a 100-year event.

What is a 100-year flood?

The chance of a flood occurring is defined in the same way as any other statistical event. A 100-year return period flood is one that is predicted to be equalled or exceeded, on average, once in a 100 years. However, this does not mean that if such a flood occurs, it will not re-occur for another 100 years. Another way of explaining it is to say it has a 1% (one in 100) chance of being equalled or exceeded in any one year. To take another example, a 20-year flood is one that has a 5% (one in 20) chance of being equalled or exceeded in any one year.

In 1955 the Chrystalls Bend stopbank was overtopped by a medium-sized flood, with approximately a 30-year return period, and it was fortunate that the short duration of the peak flow prevented serious problems.

In 1990 Rangiuuru was flooded by a comparatively minor event (5-year

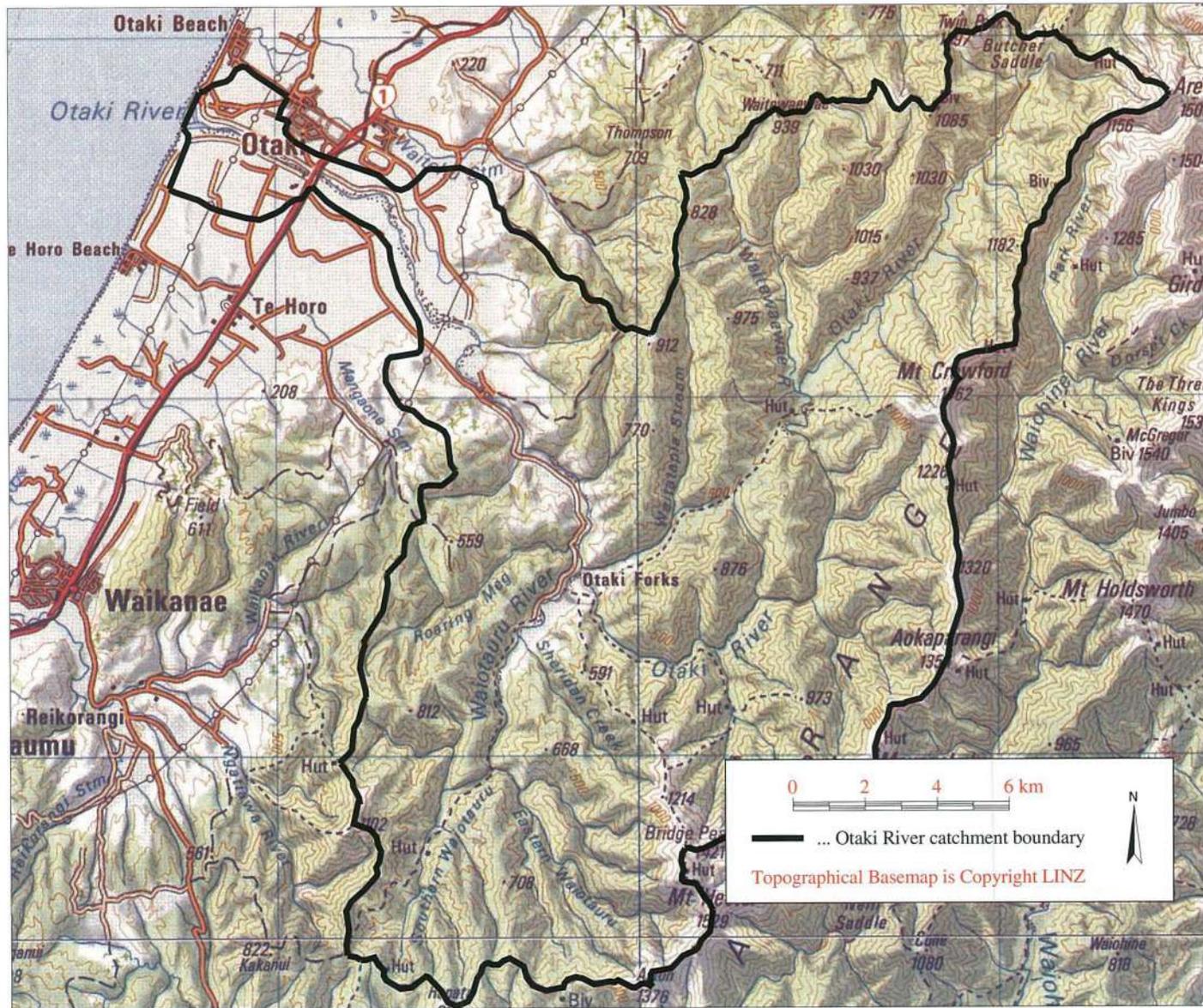


FIGURE 2: THE OTAKI CATCHMENT

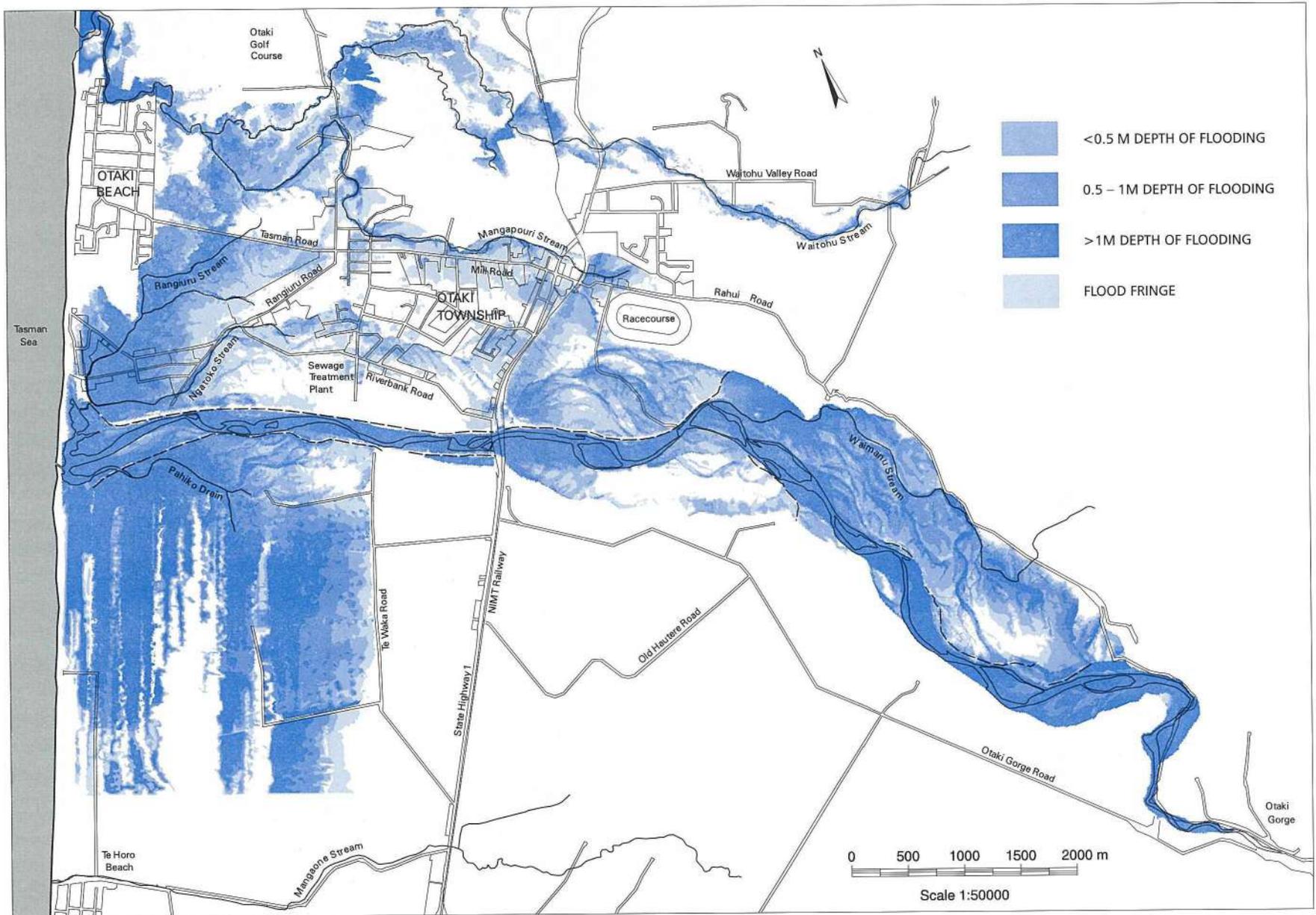


FIGURE 3: PRESENT EXTENT OF FLOODING IN A 100-YEAR FLOOD

return period), and the flood waters entered two houses. The most significant floods in recent years have caused substantial erosion and flood damage to rural properties at Riverslea (1991/92/93—see Photograph 3) and on the north bank upstream of Chrystalls Bend (1993/94). The most recent flood damage occurred in November 1994 with two breaches of the stopbank at Taylor's, and overtopping of the south bank at the gas crossing and 150 m further downstream.

Flooding continues to cause severe erosion problems along the river, increasing the potential to undermine stopbanks in a large flood event. With the large amount of residential, rural and horticultural development on the floodplain, damage from a large flood would be substantial and the costs enormous. Consequently, the whole issue of flooding must once again be addressed.

Annualised flood damages are estimated to be \$1.9 million per year (see Bibliography reference 43) and would remain at this level if no further flood mitigation methods were put in place. In addition to the financial costs of floods there are intangible impacts such as social and environmental costs.

In order to analyse these various costs, we have to consider a number of factors, including how often floods occur, how quickly they develop, and their extent.

Human use of the floodplain can also alter the impact of a flood. These uses are related to the community's understanding of the flood risk, and how well they are organised and prepared for a flood.

2.3 Flooding and People

The social and psychological impacts of a major flood in an urban area can be wide-ranging and last for many years. They can result from damage to homes, places of employment, community facilities and essential services. Flooding in Otaki could also cause injury or loss of life, and the psychological impacts that result from that. Recovery is likely to be slow and costs are likely to be high. In dollar terms, social and psychological impacts are estimated to cost at least as much as tangible losses.

A real risk to life exists immediately following a breach of a stopbank as waters rush out of the River Corridor, along overflow paths at high velocities, and into ponding areas. Ponds could be deep enough to endanger



PHOTOGRAPH 3: FLOODING AT RIVERSLEA, NOVEMBER 1993



PHOTOGRAPH 4: THE OTAKI RIVER IN MODERATE FLOOD, 11 DECEMBER 1982, PASSING UNDER THE NORTH ISLAND MAIN TRUNK RAILWAY BRIDGE

anyone attempting to swim or wade to safety. Water as shallow as 0.5 m high can be life-threatening. Data from the United States shows that over half of all flood-related deaths occur when people drive into low-lying flooded areas (Bibliography reference 59).

For most people, the loss of home and property is likely to be the most traumatic experience. Flooding results in considerable stress, especially when associated with financial concerns, and can have implications for human health. An example of these effects is the 1984 Invercargill floods. These events have been linked to both a high incidence of marital breakdown, and increased birth rates, due to the traumatic effects of the flooding. Overseas studies, assessing the impact of flooding, found increases in mortality of up to 50% in the year following a disaster (Bibliography reference 49).

The loss of vital services, which are a major part of modern daily life, can be a major source of stress. The breakdown of services can also pose a serious threat to health. In Otaki, flood waters and debris could make roads impassable and could disrupt rail, telephone, electricity and gas services (see Photograph 4).

2.4 Who will be most at risk?

The groups who will be most vulnerable to flooding are likely to come from one or more of the following categories:

- the elderly
- the disabled
- those on low incomes
- those in rental housing
- ethnic minorities for whom English is a second language
- children

In general, the more categories a person fits into, the more at risk they are likely to be during a major flood.

Key factors will influence how well a person will cope in a flood, as described below:

- the person's physical and mental health before the flood
- the strength of their social networks

- the soundness of their financial situation, including insurance cover, cash reserves, and access to compensation provisions
- the speed with which they can restore their homes
- their ability to take quick action to save possessions and evacuate

All of the disadvantaged groups share one important element—their limited access to the decision-making process. This may well mean that those most at risk could be in danger of being overlooked. Therefore, the Council has been careful to involve at-risk groups in all phases of the decision-making process.

2.5 Why undertake Floodplain Management Planning?

Floodplain management planning is a process or philosophy that emphasises the need to keep people away from floodwaters. Conversely, it better prepares them for coping with a flood when it occurs. The process aims to ensure that any future development of the floodplain takes flood risk into account.

Floodplain management planning also attempts to match in a cost-effective way the public acceptance of flood risk against the dollars they wish to spend to alleviate that risk.

The outcome of the planning process is the FMP. This Plan describes how a particular area of land and river channel should be managed to achieve the following objectives:

- minimising risks to life, health and safety
- reducing the severity of flood damage
- promoting the sustainable use of flood-prone land

These objectives are generally achieved in two ways:

- using planning and community preparedness methods to ensure that flood-prone land is used appropriately in relation to the flood risk (non-structural methods)
- constructing flood and erosion mitigation works where development has already taken place to keep floodwaters away from people and their assets (structural methods)

The Plan provides a blueprint for how the Otaki Community and the Council have agreed to manage the river and floodplain over the next 40 years. It will also provide guidance to others involved in making decisions about the management of the river and floodplain.

Under the Resource Management Act 1991 (RMA), the Council's responsibility is to promote the sustainable management of natural and physical resources. The definition of sustainable management includes '... managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being, and for their health and safety ...' (section 5, RMA). Under section 65 of the RMA the Council can prepare plans dealing with the mitigation of natural flooding and erosion hazard. Other responsibilities are detailed in Appendix A.

2.6 Preparing an FMP for Otaki

The formulation and implementation of this Plan have been carried out in five phases, as described below. One of the principal challenges was to develop a process to reconcile two opposing demands:

- the demand for flat land
- the demand for areas secure from flooding (Figure 3 shows how much of the lower catchment is either directly or indirectly affected by floods)

The Plan is a living document that must adapt to the changing needs of successive generations of people who live on the floodplain. Therefore, to be successful, the community needs to take ownership of the Plan.

The community response to flooding between the 1920s and the 1950s is typical of how flood problems were dealt with in the past. The Manawatu Catchment Board came up with a scheme which focused on keeping floodwaters away from people using stopbanks and river realignments.

Subsequent events have shown that this approach needs reviewing. Hence, the current Plan has been prepared in five phases.

Phase One defined the flood problem, including physical, social and environmental issues. The investigations were compiled in the Phase One Summary Report in 1993.

Phase Two reported on the evaluation and selection of preferred options for managing the flood problem. This was completed in March 1995.

Phase Three refined the chosen options, taking into consideration an environmental impact assessment. Economic evaluations of structural, non-structural and river management methods were included in the report. This was completed in 1996.

Phase Four included the drafting of the Otaki Floodplain Management Plan. The Plan contains the outcomes of the process along with the issues that were considered in deciding the outcomes. This will be completed with the final printing of this Plan.

Phase Five will be the implementation of the outcomes. The major structural and river management works have been prioritised. The actual rate of implementation will depend on a number of factors and how they fit in with the Council's Long-Term Financial Strategy, Facing the Future, and the Flood Protection Group's Business Plan. The Otaki FMP itself has no statutory status, but will guide Regional Plans and the KCDC District Plan in implementing the outcomes.

A more detailed description of these phases is included in Appendix B. Reports prepared at each phase are referenced in the Bibliography.

2.7 The Community Objectives for the FMP

The FMP process was overseen by the Kapiti Floodplain Management Committee (KFMC). The KFMC is made up of local, district and regional representatives. Further information about the KFMC and where they fit in is given in section 2.9. The objectives for the Plan agreed by the community are:

- to develop and implement an FMP for the Otaki River that is acceptable and considered affordable by the community (section 2.6)
- to ensure the FMP satisfies legislative requirements, particularly those of the RMA (Appendix A)
- to ensure the traditional, spiritual and cultural values of the tangata whenua are adequately recognised in accordance with the principles of the Treaty of Waitangi (section 4.4)
- to ensure flood mitigation options for the specific parts of the floodplain

or catchment be considered in terms of their effects on the entire floodplain (section 2.6)

- to ensure methods included in the FMP preserve or enhance the environmental character of the river and floodplain (section 4.5)
- to ensure public access to the river is maintained so as to enhance its amenity value and use for recreational purposes (section 4.6)
- to ensure land use and activities on the floodplain are compatible with the potential level of risk from a flood (section 3.3.1)
- to ensure the cost effectiveness of preferred FMP methods are acceptable to the Council (section 6)
- to ensure occupiers of the floodplain are made aware of the residual risk of flooding (section 3.3.2)
- to ensure the residual risks are acceptable to the community. (section 2.6)
- to ensure development on the floodplain is not unduly delayed or subject to unreasonable conditions (section 3.3.1)

Not all of the objectives have been fully met. However, through a process of consultation, negotiation and compromise, an agreed balance has been achieved.

2.8 Iwi

Maori settlement of the Otaki area dates back several centuries to the early moa hunters. Since then much change and development has occurred. Ngati Raukawa (the present tangata whenua) arrived in a number of Heke beginning in the 1820s. They came from Waikato under an invitation from their Ngati Toa kinsman Te Rauparaha. Today they are represented by five hapu, with Raukawa Marae (in the centre of the Otaki township) as the primary focus for their activity.

The Council commissioned Ngati Raukawa to prepare the Tikanga Maori investigation and report (see Bibliography reference 23). This recognised the considerable importance of Maori on the floodplain, and the importance of Maori issues in the past, present and in the future.

The Tikanga Maori report contains:

- a description of iwi/hapu with interests in this area including a short

- descriptive history and details of sub-tribal domains and important sites
- Maori environmental management philosophies, including pollution, water quality, water conservation, river development and flooding
- details of Crown land management and the effects on the Otaki River and Maori interests
- a description of the importance of the Treaty of Waitangi
- recommendations for future management of the Otaki floodplain

The RMA provides for the recognition of tangata whenua values in the management of New Zealand's natural resources:

- to promote sustainable management of the natural and physical resources so people and their communities can provide for their social, economic and cultural well-being, and their health and safety (section 5, RMA)
- to recognise and provide for the relationship of Maori and their culture and traditions with their ancestral lands, waters, sites, waahi tapu and taonga (section 6e, RMA)
- to have particular regard to kaitiakitanga (section 7a, RMA)
- to take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi) (section 8, RMA)

Recognition of the values of tangata whenua requires an understanding of these values, and consideration of how they are to be included in the decision-making process. The Council and Iwi have developed the Te Tutohinga O Te Whakaaetanga (Charter of Understanding). This Charter sets out the consultation procedures and practices to ensure there is recognition of these values and the Iwi right of inclusion in decision making. Ngati Raukawa is one of seven signatories to the Charter.

2.9 Consultation undertaken during the Floodplain Management Planning Process

From the outset, the Council recognised that public involvement was critical in the development and implementation of the Plan. People living on the floodplain have had a large amount of information on flooding made available to them. After taking advice from public meetings, community

groups, KCDC and the Otaki Community Board, a network of contacts was developed with the potential to provide input to the process.

This potential was realised in 1992 with the formation of two Resource Groups. These are the Residents Resource Group, representing floodplain dwellers on a geographic basis, and the Users Resource Group, representing floodplain users. The two groups merged into the Otaki Resource Group in 1993. The group is directly represented on the KFMC.

The Council has maintained consultation with interested and affected agencies, and the community, throughout the process. The structure is shown in Figure 4. Through the Resource Group and selected representatives at district and regional level, the community has guided the process.

The tangata whenua have been accorded appropriate status in the process. The Council works with the Marae committee as a whole and its appointed representatives. Ngati Raukawa have two representatives on the KFMC.

Interested agencies, government departments and departments of the Council and KCDC are represented on the Officials Liaison Group that operates in parallel with the Resource Groups. The Officials Liaison Group gives advice to the Flood Protection Group of the Council and its inputs are reflected in Project Manager's reports to the KFMC.

The KFMC is a special-purpose committee that considers what has to be done in the floodplain management planning process. They make recommendations to the Council's Landcare Committee but are not involved in their implementation. The KFMC was established as a subcommittee of the Landcare Committee. Meetings were publicly advertised.

The KFMC consists of three members from the Council, two from KCDC, one each from the Otaki and Waikanae Community Boards, two representatives from each of the Otaki and Waikanae Resource Groups, and two representatives from each of Ngati Raukawa and Ati Awa ki Whakarongotai (the Waikanae Iwi). It is chaired by an independent person appointed by the Council.

The Council's Landcare Committee is responsible for floodplain management. Recommendations made by the KFMC are considered from the regional perspective by the Landcare Committee, and consequent recommendations are made to the Council.



FIGURE 4: CONSULTATION ORGANISATIONAL STRUCTURE

KCDC has been continuously involved in discussions with staff and councillors through the Officials Liaison Group and the KFMC.

All of the methods for sustainable management of the floodplain, which are described in sections 3.3–3.6, have been agreed with the community during the consultation process. Section 3.7 describes the ongoing consultation process that will be a critical part of this Plan’s implementation.

This section describes the outcomes of the Otaki FMP process. This is essentially what we are going to do to reduce the flood hazard.

3.1 Methods

We have chosen a combination of the following methods:

- **Non-Structural Methods** are those that control the way land is used and buildings are constructed, and also those that relate to issues of community awareness and preparedness, and emergency procedures. They focus on keeping people away from floodwaters and helping the community cope when flooding occurs. They are the most cost-effective method of flood mitigation and their principles can be applied to both minor and major flooding. However, because some flood-prone areas have already been developed, planning controls alone are insufficient. In this Plan, planning controls will tend to be used primarily to set parameters for future development. Bibliography reference 48 gives a detailed report on the non-structural options.
- **Structural Methods** are physical structures or works designed to protect people and assets from flooding up to a specific standard. They keep floodwaters away from existing development. Non-Structural methods may also be required in some areas in case the structural methods fail, or the flood event exceeds the design standard of the works. Bibliography reference 47 gives a detailed report on the design and location of the structural options.
- **River Management Methods** are the day-to-day activities that maintain flood mitigation structures, the preferred channel alignment and identified river alignment improvements. Examples include constructing minor bank edge protection works and maintaining existing stopbanks. Bibliography reference 42 gives a detailed description of the river management options considered and the estimates of costs.

Each of these methods are described in more detail in sections 3.3–3.5.

The implementation of some structural and river management methods are constrained by certain **Environmental Outcomes** (see section 3.6). These outcomes include **Environmental Principles** and an **Environmental Strategy** for the Otaki River.

3. Outcomes of the FMP Process

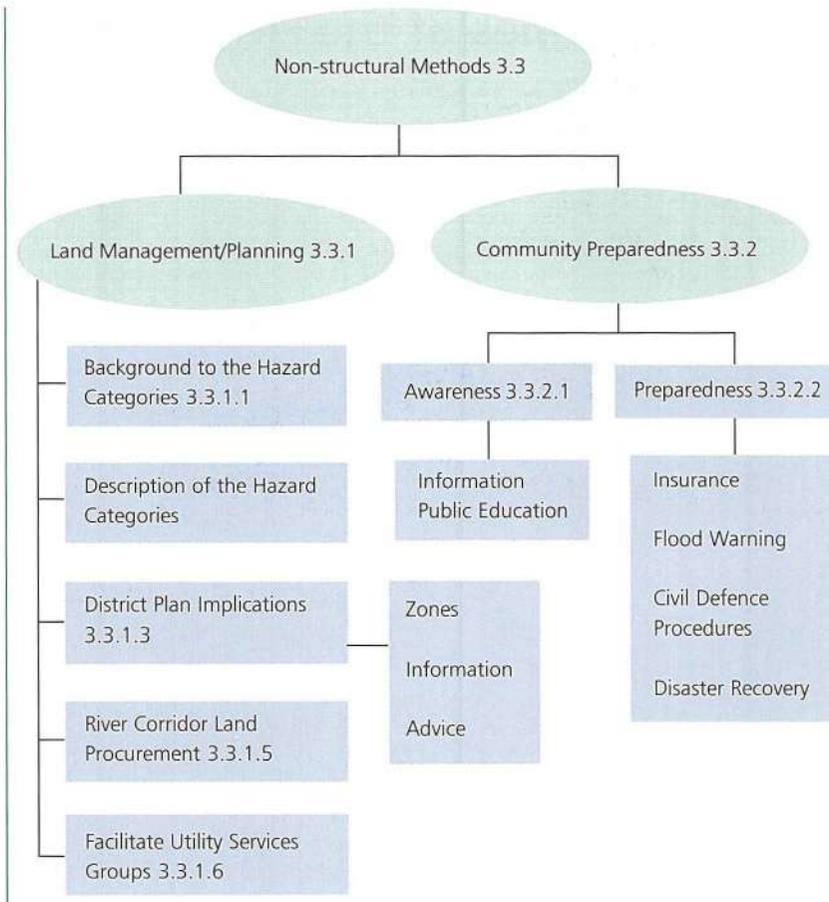


FIGURE 5: NON-STRUCTURAL METHODS

Environmental principles have been devised for situations where flood mitigation methods have potentially adverse effects, especially on ecology, landscape, recreation and heritage issues (described in section 4). The Environmental Strategy will identify opportunities for environmental enhancement within the Otaki River environment (see section 3.6).

The Environmental Principles and Strategy will work in conjunction with a Code of Practice, providing environmental standards for river works carried out anywhere in the Wellington Region.

Consultation has played, and will continue to play, a critical part in the management of the Otaki River and floodplain. Section 3.7 outlines the consultation process that the Council will undertake to ensure that all the methods and environmental outcomes detailed in this Plan are carried out.

3.2 Implementation

Implementation of the selected methods may take at least 30 years. Further details of implementation and funding will be established as time passes, although some interim methods are outlined in section 6. The very nature of funding processes for territorial local government means that the time-frame for implementation and funding policies will be constantly reviewed. This document identifies what needs to be done and their desired priorities.

3.3 Non-Structural Methods

Non-Structural methods are those which ensure that land uses within flood-prone areas are appropriate and serve to increase community awareness and preparedness. Figure 5 lists the different ways of keeping people away from floodwaters and prepared for a flood, and the section that deals with each method in the subsequent text.

For undeveloped land, management and planning methods are based upon the design standard of a 100-year event in urban areas in the same way as the structural and river management methods. The community has selected this as the most appropriate event to plan for.

The community preparedness methods recognise that floods more severe than a 100-year event can occur, and that flood mitigation structures such as stopbanks can fail or breach, i.e. that there is a residual risk of flooding.

3.3.1 Land Use in Flood-Prone Areas

3.3.1.1 Background to the Hazard Categories

Five Flood Hazard Categories have been identified on the Otaki floodplain for incorporation into the KCDC District Plan: River Corridor, Overflow Path, Ponding Area, Fringe¹ and Cliff Top Erosion.

These flood hazard categories were determined by taking the following factors into account:

- threat to life
- depth and velocity of floodwaters
- difficulty and danger of evacuating people and their property
- residual risk from flooding
- potential for damage to property and social disruption

Figure 6 shows the depths and velocities of flood waters that can cause varying degrees of threat to life and property (Bibliography reference 60).

The land uses appropriate to each flood hazard category will vary. For example, buildings and services that may be required in an emergency, e.g. hospitals, schools, community halls, and police and fire stations (vital services), should not be sited in flood-prone land. Obviously, other developments and land uses will be compatible with particular flood hazards. Whatever the case, any development within the floodplain should not adversely affect the existing flood risk.

Figure 7² shows the flood hazard categories on the Otaki floodplain which are included in KCDC's District Plan. These categories are described in more detail in section 3.3.1.2. Guidelines for future development in each flood hazard category are given in Table 2.

3.3.1.2 Description of Hazard Categories for the Otaki Floodplain

a) River Corridor

The River Corridor comprises the river bed and adjacent floodway (see Photograph 5). It is the minimum area necessary to manage a 'major' flood

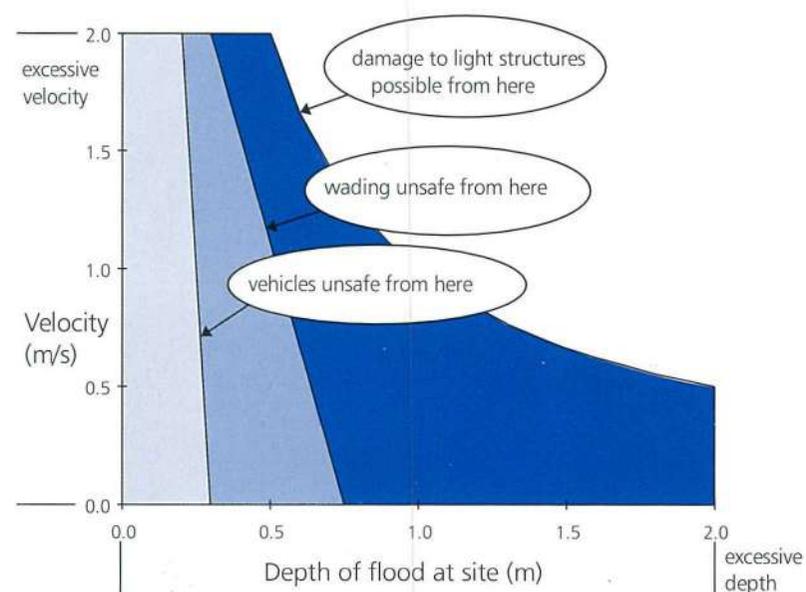


FIGURE 6: HAZARDS RELATED TO FLOOD DEPTH AND VELOCITY

¹ KCDC's planning maps identify overflow fringe and ponding fringe separately.

² Figure 7 shows hazard categories as modelled in 1995 (for the 100-year event) and included in KCDC's District Plan. New information has produced a more accurate representation of the 100-year flood extent. This is shown on Figure 3 and all subsequent figures where the 100-year extent is shown.

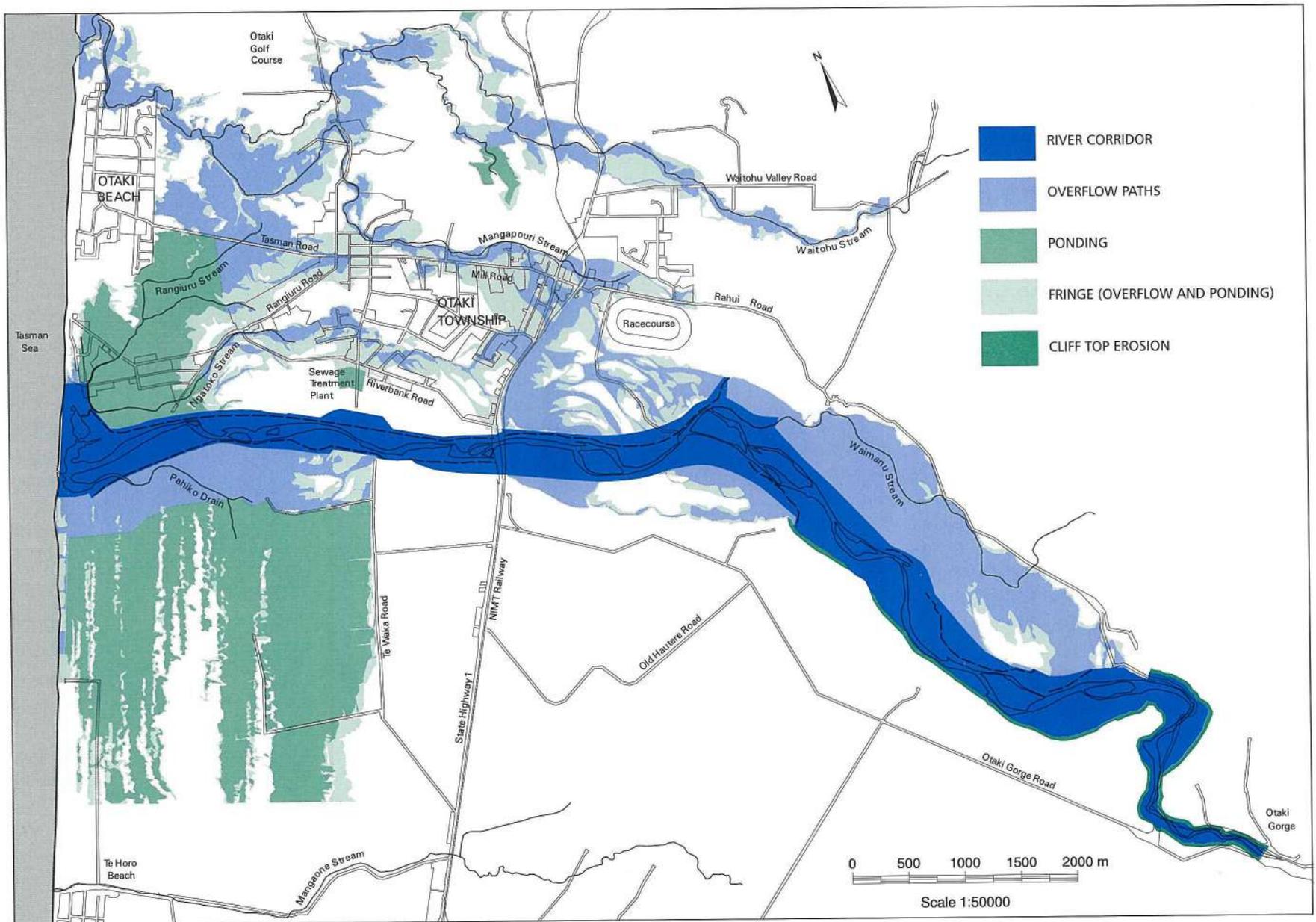


FIGURE 7: FLOOD HAZARD CATEGORIES INCLUDED IN THE KCDC DISTRICT PLAN

and allow floodwaters to pass safely to the sea. In a flood, the depth and speed of waters in the River Corridor are such that any development is likely to sustain major damage, and the evacuation of people and their possessions would be extremely difficult. The rise of floodwaters may be rapid. There could be danger to life and social disruption and financial loss may be very high.

Almost any development in the River Corridor would worsen the impact of flooding, either directly on nearby properties or indirectly through cumulative effects. This is an area that, if only partially blocked, would cause a significant redistribution of flood flow. Therefore, appropriate land uses and development potential are extremely limited.

b) Overflow Paths

Overflow paths are land areas (often immediately adjacent to the River Corridor) that would be inundated rapidly during a major flood. Usually, these paths lead fast-flowing water away from the River Corridor and across the floodplain.

The depth and speed of floodwaters means development could sustain major damage. Floodwater may rise rapidly. Evacuation of people and their possessions would be dangerous and difficult. There may be danger to life. Social disruption and financial loss could be high. If an overflow path was blocked, floodwaters could flow over other areas of the floodplain.

Generally, overflow paths are unsuitable for development unless adequate flood avoidance and/or mitigation provisions are made.

c) Ponding Areas

Ponding areas are where waters settle either during or after a major flood. They provide storage for floodwaters—if a ponding area is filled it may cause flooding elsewhere on the floodplain. During a flood there is little or no flow within ponding areas, although floodwaters could reach substantial depths and levels, and could rise rapidly.

Hazards in ponding areas are different to those in overflow paths. Evacuation of people and possessions may be difficult, especially on foot, and may need to be by boat. There is a potential danger to life and social disruption could be high.

d) Fringe Areas

Fringe areas are adjacent to overflow paths and ponding areas and could potentially be affected in a flood. Water depths are likely to be less than 0.5 m deep with little or no flow. If needed, four-wheel drive vehicles would be used to move people and their possessions. Able-bodied adults would have little difficulty in wading to safe areas, and damage is likely to be low.

Development and subdivision within fringe areas are generally more acceptable than in overflow paths and ponding areas, provided the floors of habitable rooms are relatively flood-free.

e) Cliff Top Erosion

The Cliff Top Erosion area extends from the road suspension bridge through the lower gorge, and down to Barrett's stopbank on the left bank of the River. Within this area there is active erosion occurring. Generally this area would be unsuitable for new development.

3.3.1.3 KCDC Implications

The KCDC District Plan is one of the key tools for implementing the non-structural methods described in section 3.3. The preparation of the District Plan before the completion of the Otaki FMP has meant that KCDC, in consultation with the Council, have already included a number of the intended outcomes from the FMP in their District Plan.

In particular the District Plan includes:

- a River Corridor Zone
- a Cliff Top Erosion hazard category
- resource management zones, rules and standards that take into account the flood hazard categories for the 100-year flood
- maps identifying Cliff Top erosion and flood hazard categories (see Figure 7)

In the future, it is likely that the extent and type of hazard identified in the District Plan will change, to reflect the improving situation as flood mitigation works are undertaken (see section 3.4). The Council will implement these improvements through changes to the District Plan as structural works are completed.

| | <i>River Corridor</i> | <i>Overflow Paths</i> | <i>Ponding Areas</i> | <i>Fringe Areas</i> | <i>Cliff Top Erosion</i> |
|---|--|---|---|---|---|
| Development in Existing Residential Areas and Additions | Minor additions may be appropriate if there is little or no adverse effect on the flood hazard, and may be exempt from development conditions. Each case to be considered on its merits. | Development in existing residential areas and major additions may be appropriate, subject to development conditions (see below). Minor development and additions that have little or no adverse effects on the flood hazard may be exempt from such conditions. Each case to be considered on its merits. | Development in existing residential areas and major additions may be appropriate, subject to development conditions (see below). Minor additions that have little or no adverse effect on the flood hazard may be exempt from development conditions. Each case to be considered on its merits. | Development and additions will generally be appropriate if there is little or no adverse effect on the flood hazard, and may be exempt from development conditions. Each case to be considered on its merits. | Minor additions may be appropriate if there is little or no adverse effects. Each case to be considered on its merits. |
| Greenfield Development | Generally not compatible. Boundary changes only are appropriate. Where development is proposed, conditions should apply (see below). Reserve contributions should be taken. | Generally not compatible unless adequate flood avoidance/mitigation provisions are made. Subdivision of areas previously zoned rural or large vacant residential areas would need to be considered on their merits. Habitable rooms should be effectively flood-free. | Generally unsuitable unless adequate flood avoidance/mitigation provisions are made. Subdivision of areas previously zoned rural or large vacant residential areas may be appropriate, each case to be considered on its merits. Habitable rooms should be effectively flood-free. | Generally acceptable, subject to conditions. Subdivision may be appropriate, each case being considered on its merits. Habitable rooms should be effectively flood-free. | Generally not compatible. Boundary changes only are appropriate. |
| Compatible Land Use | Open space/recreation, pastoral, rural. Fencing should allow stock access to higher ground. | Open space/recreation, pastoral, rural. Fencing should allow stock access to higher ground. | Open space/recreation, pastoral, rural. Fencing should allow stock access to higher ground. | Open space/recreation, pastoral, rural, some residential. | Open space/recreation, pastoral, rural. |
| Incompatible Land Uses | Residential, industrial, commercial, vital services ¹ , forestry, some horticulture ² , hazardous substance storage, caravan sites and camping grounds. | Residential, industrial, commercial, vital services ³ , some horticulture ² , forestry, hazardous substance storage, caravan sites and camping grounds. | Vital services ¹ , some horticulture ² , hazardous substance storage, caravan sites and camping grounds. | Vital services ¹ , industrial, hazardous substance storage, caravan sites and camping grounds. | Residential, industrial, commercial and intensive rural uses, vital services, forestry, hazardous substance storage, caravan sites and camping grounds. |

- Development Conditions**
- a) Any approved development should not adversely affect existing flood mitigation structures.
 - b) Structures that are permitted should be constructed to withstand the force of flood waters and debris or recognise that they will fail with no adverse consequences to the flood risk.
 - c) Where development is proposed, the applicant is required to demonstrate to the consent authority that the development will not increase the flood hazard or damage to other properties or adversely affect flood behaviour.
 - d) Building sites should be above the 100-year flood level and capable of withstanding floodwaters and debris.
 - e) Further subdivision will not generally be allowed where there is not a building site above the 100-year flood level, under the KCDC District Plan.

¹ Vital services include hospitals, schools, community halls, fire and police stations.

² Some horticultural crops such as lettuce and squash cannot withstand inundation. Each landowner will need to assess the flood risk. Other horticultural activities that either trap silt or debris (such as vine fruits) or alter flood flows (such as shelter belts) should be restricted.

TABLE 2: SUMMARY OF GUIDELINES FOR FUTURE DEVELOPMENT



PHOTOGRAPH 5: AERIAL VIEW OF THE OTAKI RIVER FROM JUST BELOW THE GORGE WITH THE RIVER CORRIDOR MARKED

(i) **Encourage KCDC to Protect the Upper and Middle Catchment**

The protection of the upper and middle catchment from clearance, and the encouragement of reforestation, is valuable in reducing the flood hazard and controlling sediment input into the river system. A forested area produces a more controlled environment. Both the Council and KCDC can influence this through their Regional and District Plans. In relation to the District Plan, the Council will encourage KCDC to:

- preserve and protect areas of importance for flood mitigation and stabilisation
- discourage subdivision that involves further clearance of the upper catchment, which would have a destabilising effect upon the area
- encourage the regeneration and planting of native bush in the upper catchment
- encourage riparian management

(ii) **Advise KCDC on Subdivision and Land Use Consent Applications**

When subdivision and land use applications are referred, the Council will advise KCDC of conditions that could be applied. This will help to ensure that any new development or activity is appropriate to the flood hazard in that area. The Council will also provide levels for the 50-year (2%) and 100-year (1%) flood events.

3.3.1.4 Floods Greater Than The Design Standard

Despite the protection afforded by structural methods, e.g. stopbanks, there is still a risk of flooding. This is because breaches or overtopping of stopbanks, or failure of drainage outlets, could occur. This is most likely in flood events greater than the design standard (100-year) for the flood protection works.

In order to ensure essential services are appropriately sited, and the risk is taken into account, hazard maps depicting the possible extend of flooding in an event larger than 100-years have been produced (Figure 8).

For the purposes of producing Figure 8, a flood flow 1.5 times the 100-year event has been arbitrarily selected and is consistent with the level used elsewhere in the region for the same purpose on other major rivers. Figure 8 shows the likely extent of flooding and includes the effects of possible stopbank breaches.

The models used to predict flooding up to the 100-year level are accurate based on current technology. However, in the case of flood events greater than the design standard (100-year), the accuracy of the information is limited. Therefore the flood extent on Figure 8 is described for information and education purposes only. There are no controls, or statutory requirements associated with this map.

3.3.1.5 River Corridor Land Procurement

In the long term it is proposed that the remaining privately owned land in the River Corridor, 85 hectares, be brought into public ownership. Figure 9 shows the land currently in private ownership. There are a number of opportunities available for procuring this land, which include:

- land swap
- reserve contribution—as part of adjacent subdivisions
- reserve contribution—funding from pool
- purchase—by the Crown, the Council or KCDC
- vesting

Purchase of River Corridor land will be considered as a last resort. At this stage, none of the public agencies are able to commit to the funding for land purchase, though they agree with the long-term strategy. Individual cases will have to be considered on their merits when the opportunities arise.

In the first instance, land occupied by structural flood mitigation methods that is not already in public ownership will generally be purchased by the Council. However, there may be some isolated instances where easements over private property, for construction and maintenance, will be sufficient.

As funding does become available, the preferred guidelines for the purchase of land, where part of the lot falls within the River Corridor, are:

- (a) the lot will not be purchased if the area of the lot encroaching onto the River Corridor is less than 0.2 hectares
- (b) the lot would normally be purchased if more than 30% of the area is in the River Corridor, subject to (a) above
- (c) the lot would normally be purchased if the major assets on the lot are within the River Corridor

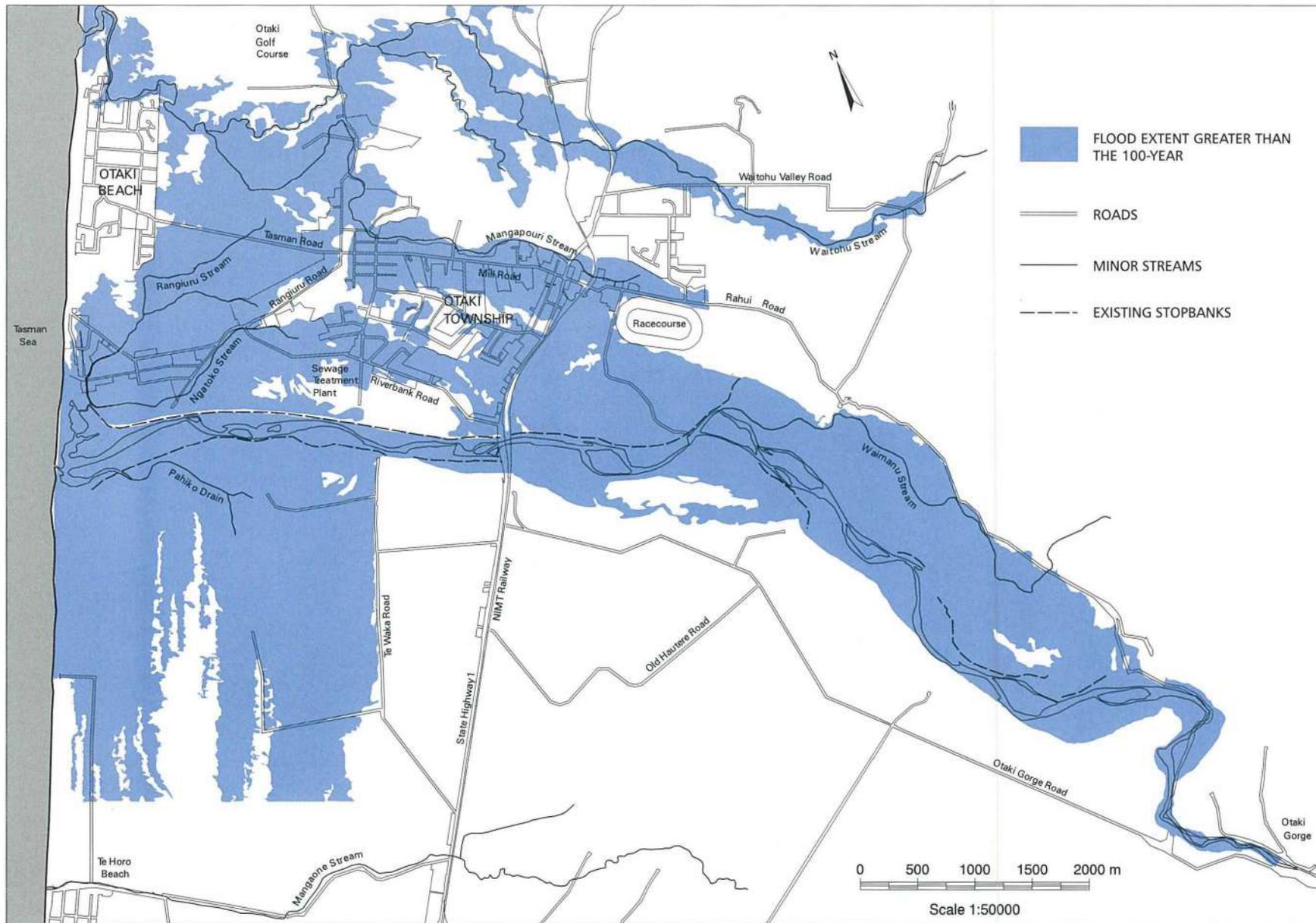


FIGURE 8: EXTENT OF FLOODING IN AN EVENT GREATER THAN THE DESIGN STANDARD (1.5 TIMES THE 100-YEAR)

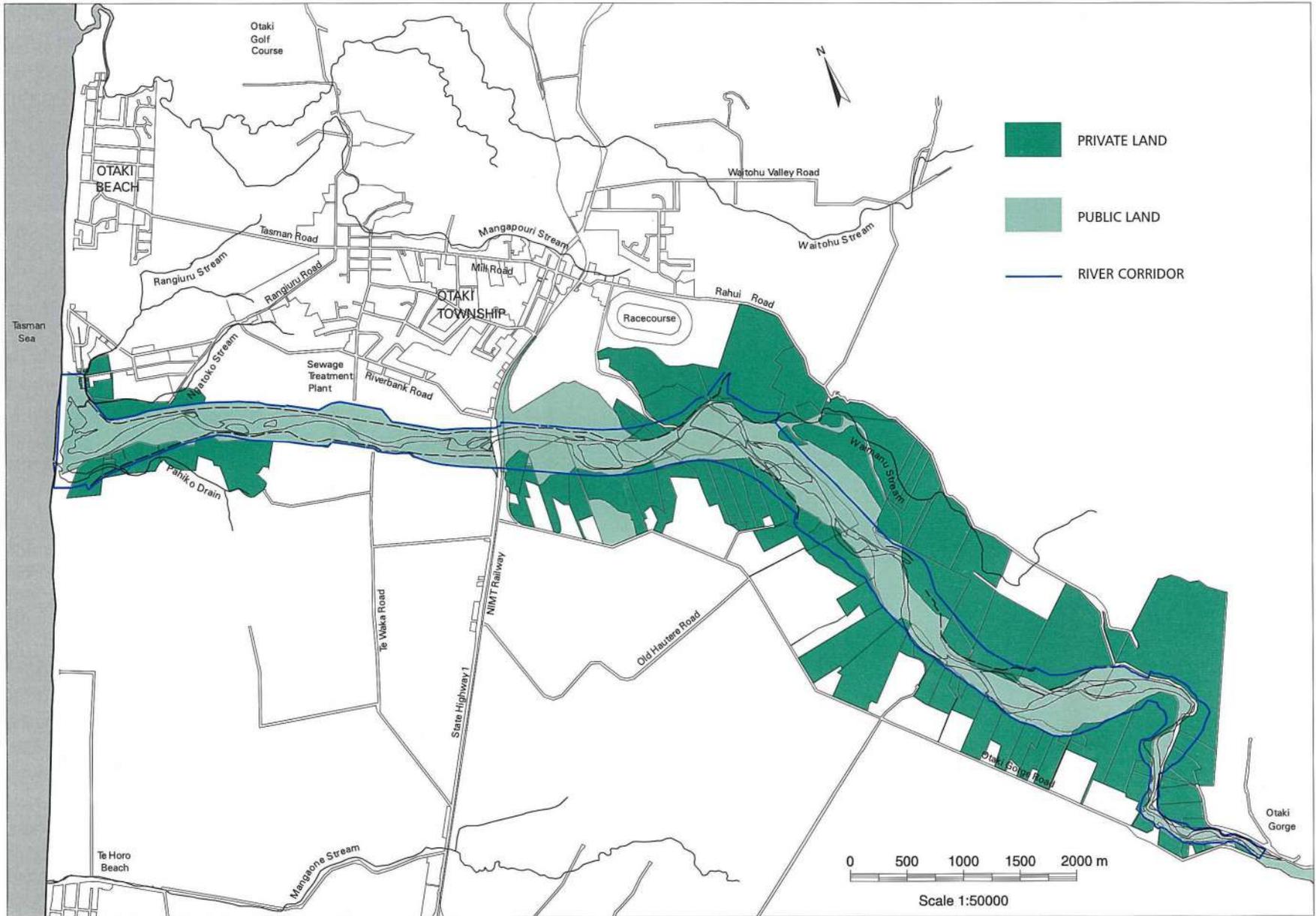


FIGURE 9: RIVER CORRIDOR LAND OWNERSHIP

3.3.1.6 Facilitate Utility Services Groups

The Council will facilitate utility services groups when required to co-ordinate and rationalise utility services within the River Corridor.

This group would be funded by those utility operators with services in the River Corridor. It is anticipated that the group would include representatives from Transpower NZ Ltd, Natural Gas Corporation Ltd, Tranz Rail Ltd, Transit NZ, Electra, CLEAR Communications Ltd, Telecom NZ Ltd, KCDC, and the Council.

3.3.2 Community Preparedness

Effective community preparedness reduces the social disruption and damage caused by flood events. Community preparedness is dependent upon both flood awareness (section 3.3.2.1) and flood preparedness (section 3.3.2.2). Options for increasing community preparedness include:

- providing public information
- public education
- insurance on home and contents
- flood warning
- disaster response planning
- disaster recovery planning

Awareness is the first step in community preparedness. A major factor in determining the degree of community awareness of flooding is recent personal experience of floods. Awareness is the acknowledgement that flooding can occur and an understanding of the consequences of flooding. Not surprisingly, people living near the river, who have experienced recent flooding, are more aware of the flood risk than others who lack recent personal experience. Education can also increase awareness.

Flood preparedness is the next step. It should be noted that while preparedness requires awareness, awareness does not necessarily mean preparedness. A conscious effort must be made to educate people on how to prepare for a flood. Preparedness involves having a predetermined plan to deal with a flood and includes knowing what to do, where to go, and what to take.

Those people who are better prepared will respond more effectively to flood warnings.

Flood warning systems are an important component of community preparedness. Early prediction of a potential flood enables information to be distributed to those who could be affected. The community is then better prepared—able to remove key possessions, animals, and people who may be affected. Thus, damage and social disruption are reduced.

3.3.2.1 The Council's Role in Flood Awareness

(i) Provide Up-to-Date Information

The Council will ensure that the most up-to-date information is readily available to all agencies involved in civil defence emergencies, and to those communities affected by flooding.

The Council will organise an annual meeting with KCDC civil defence staff to ensure continued co-operation and discussions and effective distribution of information.

(ii) Assist KCDC in Public Education Programmes

KCDC already have a public education programme involving radio shows and mail-outs. The Council will assist KCDC by preparing information on the flood risk. This could take the form of booklets describing the flood risks and advising what to do in a flood.

Helpful Flood Hints

- avoid floodwater
- climb higher rather than try to escape
- plan an escape route

Sections 1.1 and 1.2 give some other hints on what to do in a flood.

Education programmes will include information on routine civil defence procedures, survival kits, storage of valuable assets above flood waters, obtaining communication updates, rehearsals for floods and appropriate action.

3.3.2.2 Flood Preparedness

(i) Insurance Against Flood Loss and Damage

The Council will encourage individuals, and assist other agencies to encourage people, to take out adequate house and contents insurance against

flood loss. This will be done by including information and discussions in public education campaigns such as leaflets targeted at flood-prone areas and talkback radio shows.

(ii) Flood Warning

The Council has an established flood warning system. A summary of the procedures to be followed in a flood is shown in Appendix F.

The Council will maintain and improve the flood warning system by:

- implementing a real-time flood forecasting model
- monitoring and, if necessary, changing alarm settings
- installing a back-up rain gauge system
- recommending to KCDC that more severe events are planned for (i.e. more severe than a 100-year flood)
- supporting other agencies in investigating ways in which forecasting can be improved

(iii) The KCDC Civil Defence Plan

During an emergency, KCDC is responsible for co-ordinating disaster relief and planning on the Otaki floodplain. Appendix D gives details of the existing procedures. To maintain and improve disaster response, the Council will assist KCDC in updating the Civil Defence Plan whenever necessary, to provide for pre-disaster mitigation, warning and emergency operations.

(iv) Disaster Recovery (After the Flood)

The Council will assist KCDC in the improvement of disaster recovery procedures. See Appendix D for details of existing procedures.

3.4 Structural Methods

Structural methods have been selected to protect existing development from floods (Bibliography reference 44). The 100-year event is generally the design standard for structures in urban areas. The structural methods selected are described in sections 3.4.1–3.4.8, and summarised in Table 3. Figure 10 shows the location of the proposed works.

3.4.1 Culverts and Stream Channel Improvements

The eleven existing crossings over the Mangapouri Stream, between Bennetts

Road West and downstream of State Highway 1, will be progressively upgraded by KCDC. Each crossing will be replaced by twin 1.5 × 1.5 m concrete box culverts. KCDC began the culvert replacement programme in the 1997/98 financial year. However, it is not expected to be completed until 2003.

The Council will be responsible for upgrading 3.8 km of the Mangapouri Stream channel. This includes minor channel realignments, re-grading, and general lowering of the bed by 0.5 m. Some low stopbank work may also be necessary along short reaches of the channel.

The 20-year flood event has been used as the design standard for these works. These improvements in channel capacity combined with the detention dam effect of the railway embankment will effectively provide a 100-year level of protection. When the channel improvements have been completed the Council intends to transfer responsibility for the Mangapouri Stream to KCDC.

3.4.2 Floodgates

Floodgates will be located at Rangiuuru and Katihiku.

The existing Rangiuuru floodgates will remain in place. New floodgates, consisting of twin 1.2 m culverts, associated inlet and outlet structures, and flap gates, will be installed next to the existing ones. These are designed to provide further protection to the Rangiuuru area from high seas or storm conditions.

The existing Katihiku floodgates will be demolished and replaced with twin 2 m culverts, associated inlet and outlet structures, and flap gates, constructed on the existing alignment. They are designed to prevent the Otaki River entering the Katihiku drainage scheme during a flood event and then to allow water out after the event.

3.4.3 Stopbanks

New stopbanks have been designed to protect homes and properties from a 100-year flood. Existing stopbanks, or those protecting rural areas, may be designed to different standards. The alignment has been agreed in principle with the community through the floodplain management planning process. Stopbank locations are shown on Figure 10.

Stopbanks will be a minimum of 4 m wide at the top, will have 3.5:1 batters,

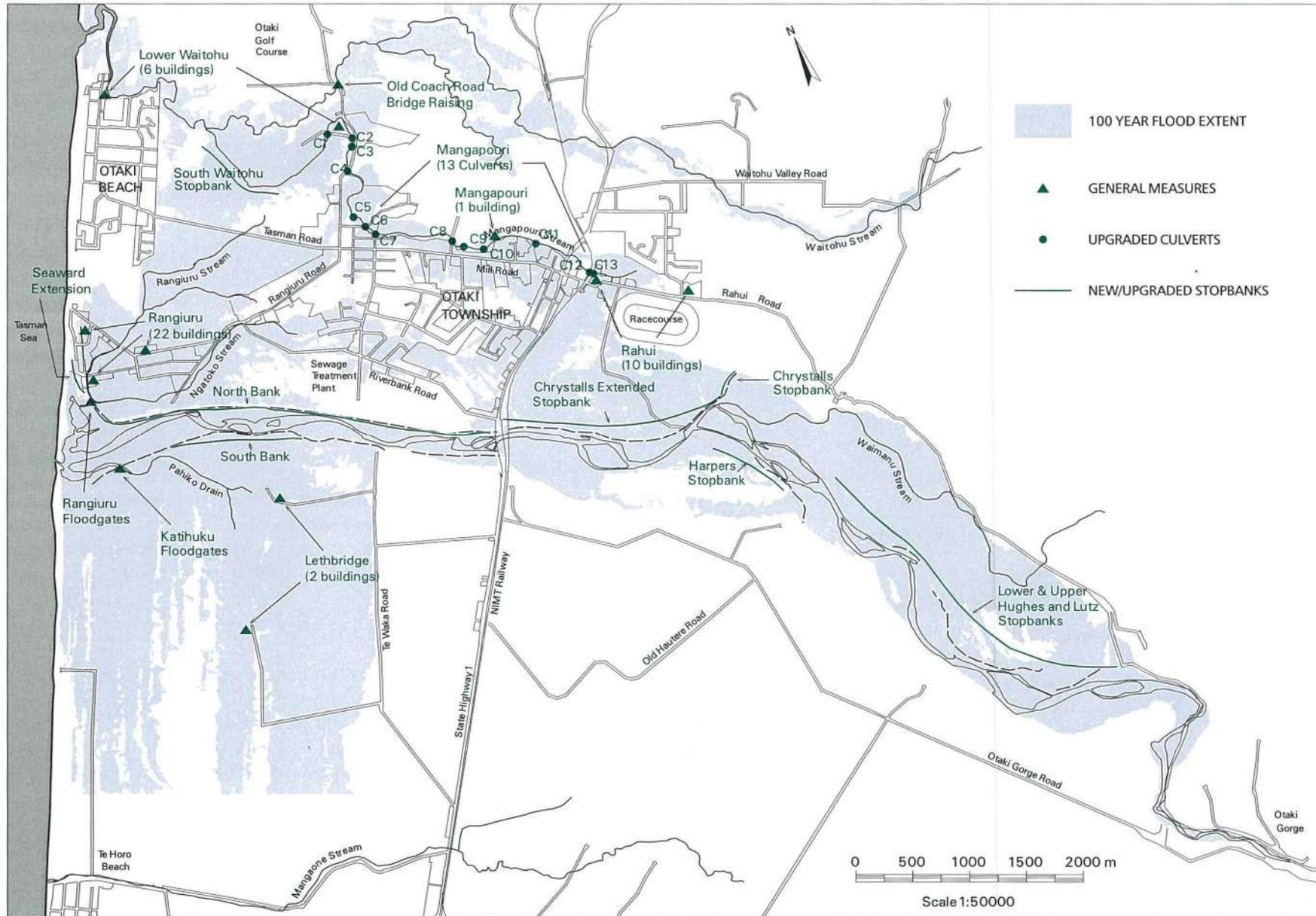


FIGURE 10: LOCATION OF STRUCTURAL METHODS

and will have a 5 m access strip on either side. Where appropriate, stopbanks could be designed with less steep batters to fit in with the existing environment. A well maintained grass cover will be established over the stopbank and access way. A paved walkway may need to be constructed along the crest if recreational use of the stopbank causes excessive damage to grass cover. New stopbanks are to be constructed at South Waitohu, Harpers, lower and upper Hughes, and Lutz. Stopbanks to be upgraded are Chrystalls and Chrystalls Extended. Deferred maintenance is planned for the north and south stopbanks downstream of the State Highway 1 bridge.

Stopbank maintenance and associated works will be undertaken as part of river management activities. An annual walk-over will determine maintenance works and budget requirements for the following year. All fences and gates will be maintained. Stopbanks that are currently maintained by the Council are:

- Rangiuru outlet
- Otaki—north bank
- Otaki—south bank
- Chrystalls
- Barretts

Stopbank design will allow for a sea level rise of 5 mm/year, due to climate change.

3.4.4 Bridge Raising and Deflection Stopbank

The Old Coach Road Bridge, across Waitohu Stream, has a very narrow opening and needs to be raised by 1.2 m. Details of the hydraulic characteristics of the raised bridge will be specified by the Council. Improvements need to be made to the bridge's abutments and road approaches, and a debris arrestor needs to be constructed upstream of the bridge. A deflector stopbank will be constructed on the left bank to prevent the flooding of houses adjacent to Convent Road.

3.4.5 House Raising

House raising involves raising the sub-floor framing, at the underside of bearers, to the 100-year flood level, securing the building to withstand the forces of floodwater, and sealing any services. Standards will be deter-

mined by KCDC and the Council. The Council has given a commitment to provide funding for house raising in accordance with the funding policy in place at the time. The work will be undertaken with the agreement of the landowner on a voluntary basis. Ensuring the work and maintenance are done will be the responsibility of the individual owner.

This approach applies to those existing properties that have been identified as flood-prone, and to areas where raising was selected by the community as the preferred approach for flood mitigation.

For those properties unable to be raised, alternatives will be encouraged, including flood-proofing and insurance. New houses built in flood-prone areas, following the identification of houses that require raising as part of the Plan process in 1995, will not be eligible for any funding from the Council.

3.4.6 Priority of Works

The structural methods listed in Table 3 are listed in order of priority, as agreed by the KFMC and the community. The criteria used for the priority of works are detailed in section 6, Table 6.

3.4.7 Construction

Generally, construction of structural methods will be undertaken either by the Council or by private contractors on behalf of the Council. House raising would be undertaken by contractors engaged by the individual, to standards specified by the Council and KCDC. Bridge raising will be specified and carried out by KCDC.

3.4.8 Services

Installation of new services across or along a stopbank will be controlled by the Council, either through giving approval as landowner, or through the consent process. Applications for additional services will have to include justification for the service and how it relates to the area. The need for placing the service through the River Corridor, the rationalisation of services, and construction standards, are of primary concern to the Council. Photographs 6 and 7 show undermining of the southernmost State Highway 1 bridge pier, caused by scour and bank erosion during flooding.

Construction of new services must not adversely affect the security of flood mitigation structures. Services through stopbanks, including culverts, will

be maintained to the specified standard by the authority or individual responsible for that service (see section 3.3.1.6).

3.5 River Management

3.5.1 Introduction

River Management Methods are day-to-day activities undertaken by the Council to maintain the river within its preferred alignment. River management activities include identified river alignment improvements, and protecting and maintaining existing flood mitigation structures. Overall, these methods aim to ensure that long-term maintenance of the river channel is undertaken efficiently. The Council is responsible for maintaining the reach of river from the mouth to the Otaki Gorge. Individual landowners are responsible for protecting land from erosion in the river beyond this point.

Three outcomes have been agreed with the community.

(1) Preferred Channel Alignment

The Council will maintain the river within the preferred channel alignment, shown in Figure 11 (see section 3.5.2 and Bibliography reference 42).

(2) River Training Methods

The Council will continue to use current training methods, recognising that additional programmed major works will be required at the locations specified in Table 4. In addition to channel maintenance works, a number of other specific activities are needed (see section 3.5.3).

(3) Expenditure

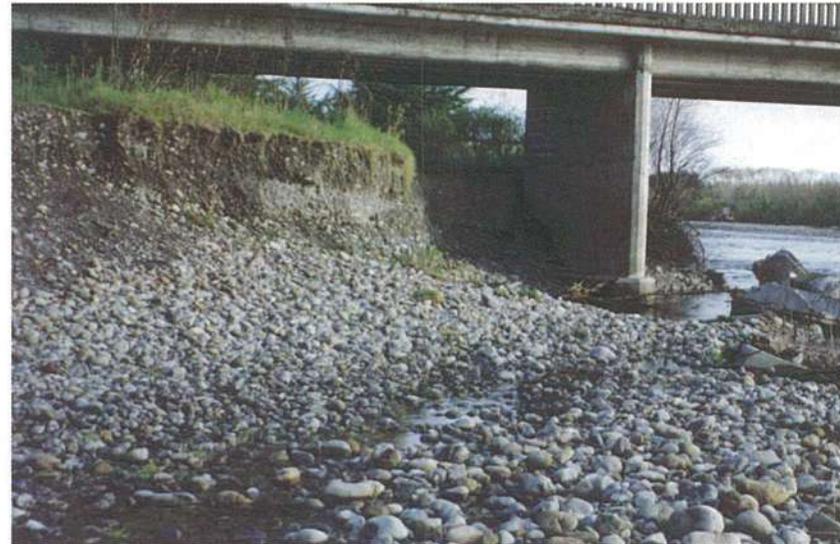
The Council will continue the current level of annual operations expenditure (see section 3.5.4).

3.5.2 Preferred Channel Alignment

The channel alignment is based upon the dominant flow regime and will have sufficient width to allow the threshold of motion regime channels to meander evenly within it as part of the sediment transport processes. It also provides an appropriate channel to convey flood flows.

The river will be trained to the preferred alignment as follows:

- River mouth to rail bridge: Dominant Flow Channel 150 m wide with 40 m berms



PHOTOGRAPH 6: UNDERMINING OF THE STATE HIGHWAY 1 BRIDGE PIER, LEFT BANK, JUNE 1997



PHOTOGRAPH 7: FURTHER UNDERMINING OF THE STATE HIGHWAY 1 BRIDGE PIER, APRIL 1998

| Name/Location | Structural Method | Cost 1997 (\$) |
|--------------------------------|--|-------------------------------|
| 1- Chrystalls | Stopbank RB—6 km upstream of mouth | 331,000 |
| 2- Rangiuuru | Floodgates—Kapiti Lane | 120,000 |
| 3 South Waitohu | Stopbank—Tasman Road | 433,000 |
| 4 Chrystalls Extended | Stopbank RB 4–6 km upstream of mouth | 1,026,000 |
| 5 North bank | Stopbank (minor reconstruction) RB—4 km upstream of mouth | 25,000 |
| 6 North bank | Stopbank (deferred maintenance ²) RB—4 km upstream of mouth | 135,000 ³ |
| 7 Seaward Extension—north bank | Stopbank RB—end of Atkinson Avenue, mouth | 13,000 |
| 8 Rangiuuru | House raising—7 in Atkinson Ave, 12 in Rangiuuru Rd and 3 in The Avenue | 646,000 |
| 9 Lethbridge | House raising—1 in Swamp Rd and 1 in Lethbridge | 54,500 |
| 10 South bank | Stopbank and deferred maintenance to existing stopbank LB—1.3–2 km upstream of mouth | 603,000 ⁴ |
| 11 Mangapouri | House Raising—1 house County Rd, 1 in Freemans Rd, 1 in Mill Rd, and 8 in Rahui Rd | 320,000 ⁵ |
| 12 Mangapouri Stream | 11 Culverts ⁶ and Stream Channel Works | 1,073,000 |
| 13 South Waitohu | House raising—1 in Bennetts Rd, 2 in Convent Rd, 2 in Kowhai Rd, and 1 in Moana Rd | 148,500 |
| 14 Harpers | Stopbank LB 6–7km upstream of mouth | 273,000 |
| 15 Lower Lutz and Upper Hughes | Stopbank ⁷ RB 7–11 km upstream of mouth | 810,000 |
| 16 Katihiku | Floodgates LB—400 m upstream of the mouth | 170,000 |
| 17 Old Coach Rd | Bridge raising and deflector stopbank | 396,000 |
| TOTAL | | 6,577,000 ⁸ |

RB true right bank, looking downstream

LB true left bank, looking downstream

¹ The criteria used for determining the priority of the structural methods are given in Table 6.

² For detailed information refer to Bibliography reference 36.

³ \$10,000 worth of deferred maintenance has been deleted from this figure and included in the south bank maintenance.

⁴ This figure includes \$10,000 for deferred maintenance to the existing stopbank.

⁵ This is based on figures contained in Bibliography reference 47.

⁶ KCDC is currently starting on the replacement of these culverts.

⁷ Part of this project is currently being constructed due to funding being provided by affected land-owners.

⁸ Total includes the cost of land purchase.

TABLE 3: PROPOSED STRUCTURAL METHODS IN PRIORITY ORDER¹

- Rail bridge to Chrystalls: Modified Dominant Flow Channel 180 m wide with 80 m berms
- Chrystalls to Otaki Gorge: Fairway Channel 255 m wide with 80 m berms

The preferred alignment takes into account the existing geographical features and alignment, and the location of existing development on the floodplain. Details on the determination of alignment and the alternatives considered are contained in Bibliography reference 42.

If the river meanders outside the preferred alignment, regular channel maintenance activities will be used to put the river back into this alignment.

3.5.3 River Training Methods

A summary of river training methods is outlined below:

(1) Construction of Impermeable Erosion Protection Structures

- rock groynes
- mass concrete block groynes
- gabion baskets
- rock rip-rap/toe rock linings
- mass concrete block linings
- driven rail iron and mesh gabion walls
- driven rail iron and willow fascine fences

(2) Construction of Permeable Erosion Protection Structures

- debris fences
- permeable rail iron groynes

(3) Development of Vegetative Bank Protection

- tree planting (including native species)
- layering and tethering of willows
- tree groynes
- impermeable rock snub groynes
- berm maintenance

(4) Maintenance of Existing Structures

- maintenance, repair, replacement, extension, addition to, or alteration of, any existing lawful structure

(5) Channel Maintenance Activities

- beach clearing/ripping
- clearance of flood debris
- tree removal
- vegetation control by spraying

(6) Channel Shaping Activities

- bed and beach re-contouring
- gravel extraction
- flood relief cuts

3.5.4 Expenditure**3.5.4.1 Maintenance and Programmed Works**

In addition to day-to-day maintenance activities, a number of other works are required to achieve and maintain the preferred channel alignment. There are nine reaches of the River where works have been programmed. The locations of these reaches are shown on Figure 11 and estimated expenditure for each area is listed in Table 4. These works are indicative only, and changes could be made at the detailed design stage before work starts. A major flood event may also influence the timing and extent of these works.

3.5.4.2 Extent of Programmed Works

The extent of programmed works is described below, by reach (see also Figure 11):

(1) Katihiku (River Mouth to 1,300 m upstream)

Clearing and removal of Mangahanene Island is a high priority for this reach. The rapid build-up of the Island is increasing erosion pressures on the adjacent river banks.

Berm recovery and placement of rock rip-rap on the right bank is also a high priority, especially where there is no existing rock lining. Protection

| Number on Figure 11 | Reach (m) ¹ | Programmed Works ² | Estimated Cost 1997 \$ ³ |
|---------------------|------------------------|-------------------------------|-------------------------------------|
| 1 | 0–1,300 | Katihiku | 532,900 |
| 2 | 1,300–2,400 | Gas Line | 594,900 |
| 3 | 2,400–3,900 | Batching/Campbell | 505,200 |
| 4 | 3,900–3,980 | Bridges | 57,900 |
| 5 | 3,980–5,500 | Ballast/Tracey | 1,416,400 |
| 6 | 5,500–6,600 | Chrystalls Bend | 105,500 |
| 7 | 6,600–8,000 | Hughes | 277,300 |
| 8 | 8,000–9,650 | Hughes/Lutz | 598,300 |
| 9 | 9,650–11,300 | Taylor/Mansell | 173,200 |
| 10 | 11,300–13,500 | Lower Gorge | No Major Works |
| | | Sub Total | 4,261,600 |
| | | Other Costs ⁴ | 1,133,800 |
| | | TOTAL | 5,395,400 |

¹ Works are listed in order of increasing distance upstream.

² See Bibliography reference 42 for details of the works.

³ Costs of land purchase are not included in these figures.

⁴ The total includes the cost of design and supervision, resource consents, environmental enhancement, and contingency.

TABLE 4: PROGRAMMED WORKS

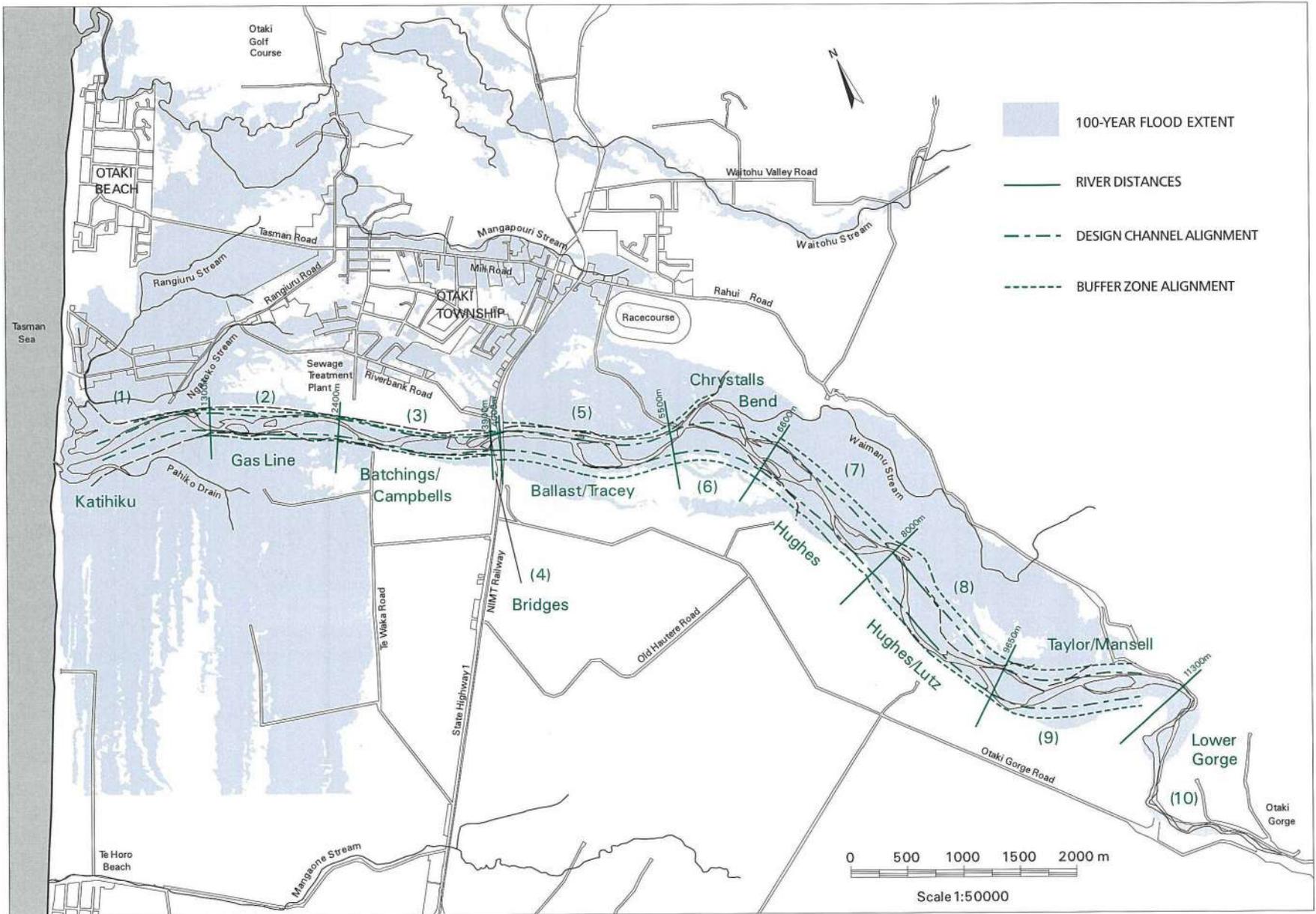


FIGURE 11: CHANNEL ALIGNMENT AND RIVER MANAGEMENT METHODS

planting is also proposed for most of the right bank.

- (2) Gas Line (1,300–2,400 m upstream)
- (3) Batching/Campbell (2,400–3,900 m upstream)

The design strategy for reaches (2) and (3) is to maintain the river between the existing stopbanks. A higher standard of protection will be provided for the stopbank on the right bank, which protects the residential and commercial areas of Otaki.

High priority works include clearing and recovery of berms and rock rip-rap placement on the right bank. A lower priority is toe rock on the left bank. Protection planting on both banks is also proposed.

- (4) Bridges (3,900–3,980 m upstream)

Protection planting will continue in this reach with toe rock proposed for the right bank.

- (5) Ballast/Tracy (4,000–5,500 m upstream)

The strategy for this reach is to provide protection for the stopbank on the right bank, which protects Otaki township. The right bank will be protected with a combination of toe rock, rail iron groynes, and planted buffer zones. Tree groynes and vegetation will be used on the left bank.

- (6) Chrystalls Bend (5,500–6,600 m upstream)

The river was realigned through this reach in 1994 and the protection works have been completed (see Photograph 8). Additional rock rip-rap and protection planting is proposed for the right bank to maximise the security of the realignment. Planting is also proposed for the left bank.

- (7) Hughes (6,600–8,000 m upstream)
- (8) Hughes/Lutz (8,000–9,650 m upstream)
- (9) Taylor/Mansell (9,650–11,300 m upstream)

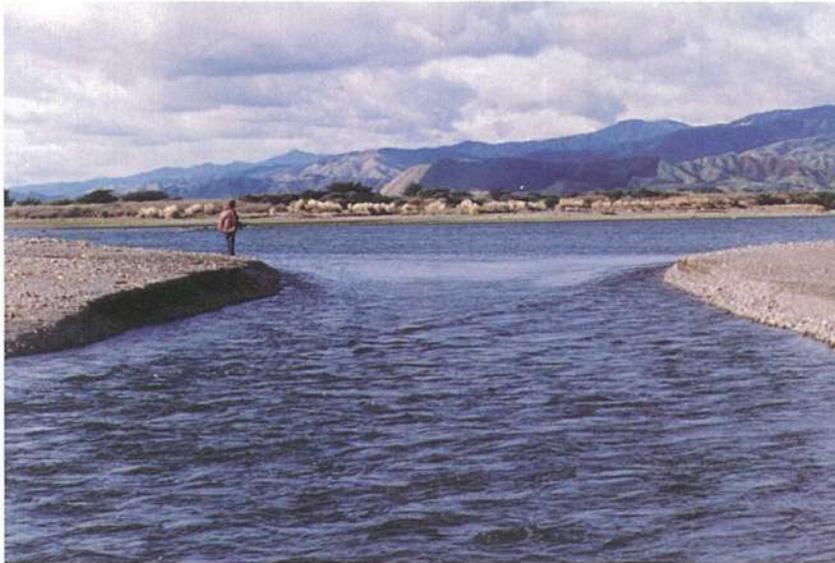
The design strategy for reaches (7)–(9) is to implement the fairway channel. This fits the existing channel fairly well. However, land on both banks will be required to achieve the new alignment. The principal protection will be provided by rail iron groynes and planting.

- (10) Lower Gorge (11,300–13,500 m upstream)

No major works are required in this area.



PHOTOGRAPH 8: CHRYSTALLS BEND, MARCH 1998



PHOTOGRAPH 9: OTAKI RIVER MOUTH LOOKING UPSTREAM, SHOWING THE RIVER MOUTH CUT, 1994

3.5.5 River Mouth Management

The following activities will be undertaken:

- Periodically cut the mouth (see Photograph 9). Trigger points for cutting the mouth are set in the Regional Coastal Plan. Generally, it should be cut when the exit to the sea has migrated more than 300 m either side of the centre line of the river, as measured 700 m upstream of the mouth (refer to the Regional Coastal Plan for further information).
- Monitor the mouth and its reaction to the works on an ongoing basis.
- Allow for a 5 mm/year rise in mean sea level in all design work affected by the tides.

3.5.6 Gravel Extraction

Gravel extraction is a key river management tool on the Otaki River. Specific guidelines will be used for future work.

- Allow an average of 50,000 m³ of gravel to be extracted annually from the river until 2001/02. Extraction locations should be chosen to provide the maximum benefits to the river channel management, through consents applied for by the Council. Private individuals or companies will undertake the extraction.
- Defer extraction in the 1.5 km reach of the river above Chrystalls Bend until bed levels have recovered.
- Review the volume of gravel available for annual extraction. This will be decided on the basis of the five-yearly bed level analysis and inspection of river condition. The aim is to ensure that the total gravel balance below the Gorge is maintained at present levels.
- Identify and discuss, with affected parties, sites for gravel extraction.
- Charge a gravel-use fee for any material extracted from land owned or managed by the Council. Fees would go towards Flood Protection Group monitoring (see section 3.5.7 below) and resource consent costs.
- Manage gravel extraction to ensure that potential benefits for river management are maximised.

3.5.7 Monitoring of River Processes

The following monitoring activities will be undertaken:

- take vertical aerial photographs of the Otaki River, annually, using a standard 35 mm camera
- make major reviews of river management practices at 15-year intervals
- perform bed level surveys every five years, or after a 20-year flood or greater
- analyse the survey data and update estimates of aggradation, degradation and river mouth movement. Recommend an annual extraction volume
- take high-level aerial photographs (rectified image or orthophotography) at five-yearly intervals, or after a 20-year flood or greater
- inspect flood protection structures and monitor catchment and channel conditions after major earthquakes
- monitor (with surveys if necessary) the location of the river mouth and the level of sand build-up at the fore-dune annually
- prepare detailed annual reports recording all work done, including a record of how these works perform during subsequent floods. (These reports, which will be part of the asset management process, will provide information for future decision making.)
- review current knowledge on climate change every five years, and revise figures used for flood mitigation methods if appropriate
- assess the effect of increased knowledge gained from monitoring and determine any implications for the flood hazard on the Otaki floodplain
- review the effectiveness of flood mitigation works in light of information collected during monitoring
- produce an annual schedule which identifies actions to be continued and audited

3.6 Environmental Outcomes

The floodplain management planning process has highlighted the need to protect and enhance the environmental values of the Otaki River (see sections 4.5–4.6). This section identifies four general environmental principles that the Council will follow when implementing the primary outcomes

described in sections 3.3–3.5. It also sets out the process for implementing those principles (see Figure 12).

3.6.1 Environmental Principles

- Minimise any adverse effects of flood mitigation works on the community including landscape, heritage, ecological, or recreational values.
- Identify opportunities to enhance landscape, recreational and ecological values as part of river management and flood mitigation works, or other development within the River Corridor.
- When designing works within the river environment ensure a diverse range of habitats remain, providing for native fish, plants, birds and invertebrates, and trout.
- Retain and enhance public access to and along the river, where possible.

3.6.2 Process for Implementing Environmental Principles

These principles will be implemented through an **Environmental Strategy** and an **Environmental Code of Practice** (both currently being developed).

The Council is preparing the Environmental Strategy as part of the Otaki FMP. Initially it is intended to provide a draft document for discussion between all those parties who are responsible for, or involved in, the management of the River Corridor and its environs.

The Strategy will provide a structure and framework for enhancing the environmental values of the River Corridor from the gorge to the river mouth. It will guide Council's structural and river maintenance works, non-structural methods, and the management activities of other parties involved in the River Corridor (see Figure 12). It will identify areas where particular management or action is needed, and provide an overall framework for individual actions. It is intended for use by agencies and individuals involved in environmental management. They will use it to link their core functions and management plans into a joint management approach for the Otaki River Corridor and its environs.

Appropriate management of the river directed by the Strategy, should result in enhanced environmental values.

The Council will implement its responsibilities contained in the Environmental Strategy after discussions with other agencies involved in the man-

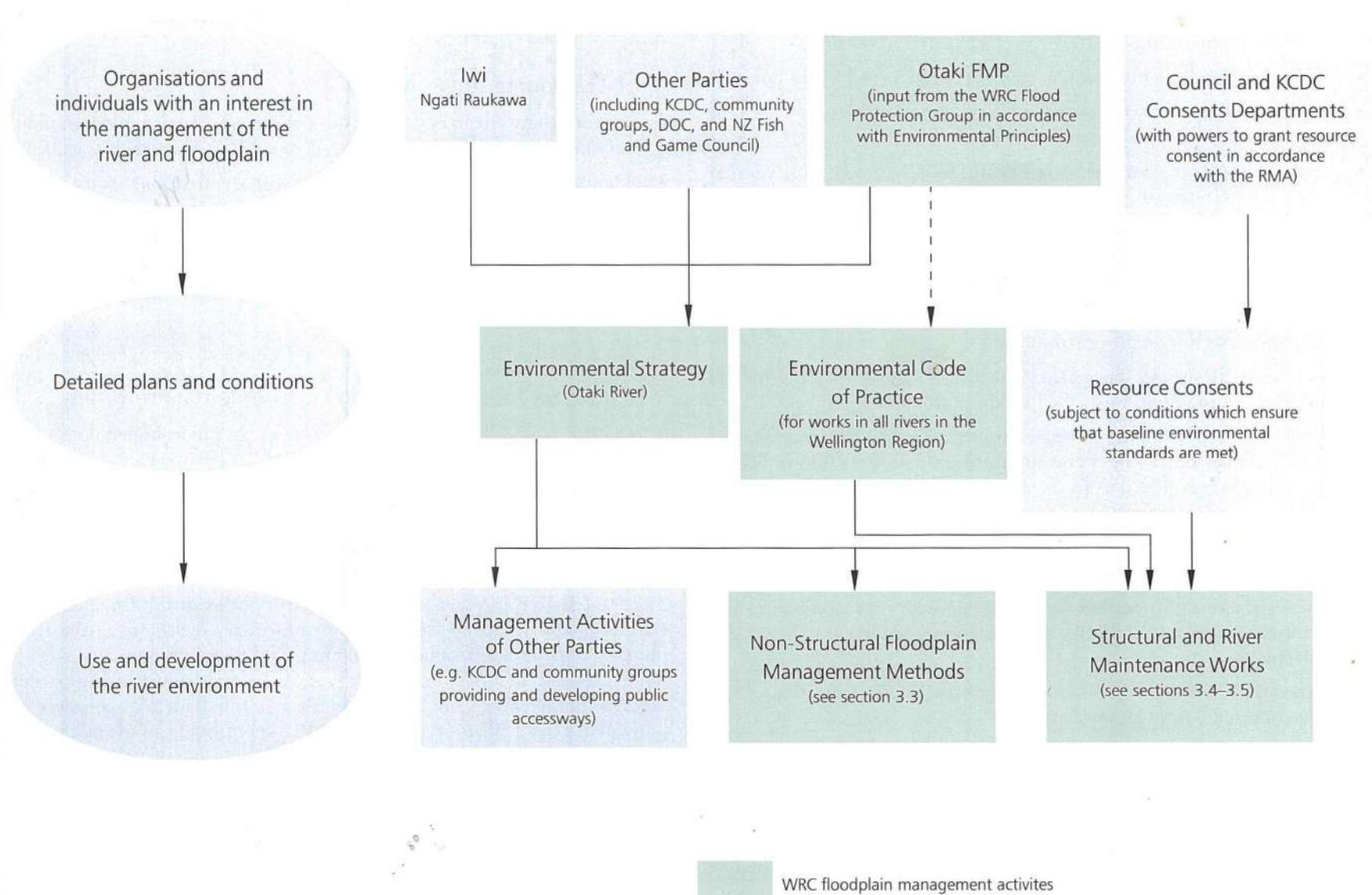


FIGURE 12: PROCESS FOR IMPLEMENTING ENVIRONMENTAL OUTCOMES

agement of the River Corridor. This will help to ensure that other agencies 'buy into' the Strategy and use the document when they undertake their own work.

The Code of Practice will set out the Council's environmental standards for all river maintenance and structural works. Because good work practices are generally the same for all rivers, the Code of Practice will be applied regionally.

Environmental controls on river works and enhancement features are already included as conditions of resource consents granted by the Council and KDCDC Consents Departments. The Code of Practice will differ from these conditions in that it will contain greater detail and may be more restrictive. The conditions of consent for current river maintenance activities are set out in Appendix C.

3.7 Ongoing Consultation

3.7.1 Consultation with the Community

Consultation will occur as the flood mitigation works are implemented through the normal statutory processes, including those for resource consents and the Council's Long-Term Financial Strategy and Annual Plan processes. The Flood Protection Group will:

- meet annually with members of the DOC, Fish & Game Council, Iwi, and interested members of the Otaki Community (see section 7.4) to make an inspection of the Otaki River, (this ensures everyone is thoroughly informed about any proposed works, and has enough time to air and discuss their concerns)
- consult at the initial planning stage, with individuals who will be directly affected by major works

3.7.2 Consultation with Tangata Whenua

In accordance with the Treaty of Waitangi and Te Tutohinga O Te Whakaaetanga (Charter of Understanding) the Council has developed a relationship with tangata whenua in the Region. For Otaki this relationship is with Ngati Raukawa, who hold mana whenua over the Otaki area. Through consultation the Council has involved Ngati Raukawa in the

floodplain management planning process since 1991, in keeping with its Treaty responsibilities.

Understanding the Treaty is an ongoing process, as is understanding its principles. The need to incorporate these principles into the process for assessing and carrying out flood mitigation works is recognised in the Plan.

Meaningful consultation is an important aspect of partnership and ongoing communication. The process of consultation enables recognition of the local knowledge, values and experience of the tangata whenua. It provides for the identification and protection of sites of special value to tangata whenua, and enables their cultural values to be recognised and provided for when assessing flood mitigation options.

To achieve this:

- the Council will undertake consultation through its established practices—the resource consent process and Te Tutohinga O Te Whakaaetanga, as well as through informal discussions over ongoing issues.
- Ngati Raukawa is represented on the KFMC and this level of representation should be reflective of the Treaty of Waitangi
- the Council will maintain ongoing consultation with tangata whenua to ensure that sites of spiritual and historic importance are noted and evaluated in the assessment of options for flood mitigation works and other development
- the Council will ensure that lists and plans of identified significant sites are updated when they are next reviewed.

4. Considerations

4.1 Introduction

This section looks at the rationale for choosing the outcomes listed in section 3. The physical environment, the human environment, Maori concerns, ecology, landscape/recreation/heritage values, and planning and land use, have been considered separately. Each section explains the specific issues, lists the related objectives and policies, and identifies the relevant methods in section 3.

The objectives set out what the Council is trying to achieve on the Otaki River and floodplain. Policies describe how the Council is going to achieve the long-term sustainable management of the floodplain. Each policy relates to an objective. The methods for resolving the issues and achieving the objectives and policies are, in most cases, described in section 3. These methods describe actions which will help reduce the flood hazard within the Otaki area.

For the ecology and recreation/landscape/heritage sections, the objectives and policies are to be met by applying the Environmental Principles, Environmental Strategy and Environmental Code of Practice described in section 3.6. These have been devised to minimise adverse effects and provide for long-term environmental enhancement of the floodplain.

4.2 The Physical Environment

4.2.1 Flood Mitigation

4.2.1.1 Issues

- **Flooding is a natural process which only becomes a problem when inappropriate development and use of the floodplain occurs, and subsequently requires protection.**

The Otaki floodplain has been used and developed by its community. To facilitate this process much of the Otaki River has been modified and restricted to a narrow channel and stopbanks have been constructed to restrict flood flows. The community subsequently relies upon these works for a high degree of protection from flooding. However, flood mitigation works can never completely eliminate the flood hazard.

Historically, flooding across the floodplain has occurred via a series of old river channels and drainage paths. Channel works and stopbanks have modi-

fied these river channels considerably. Much of the floodplain is now at high risk of being inundated during a 100-year flood, as shown on Figure 3.

- **Flood mitigation methods have the potential to adversely affect the physical environment.**

Stopbanks cutting across overflow paths can retain flood flows in the main river channel and increase flood levels downstream. Of the proposed stopbank works, Hughes/Lutz, Chrystalls, Chrystalls Extended, Harpers and South stopbanks may do this. Computer modelling has shown that the increase in flood levels, mainly in the surrounding area, is approximately 100–200 mm in a 100-year flood (an amount considered minor given the value of the proposed structural options).

Furthermore, there is general agreement that the minor negative impacts are far outweighed by the positive effects. In practice, the increase in flood level has been taken into account when setting the house-raising levels described in section 3.4.5.

4.2.1.2 Objectives

- To ensure existing flood mitigation works operate effectively.

4.2.1.3 Policies

- (1) To maintain existing flood mitigation works, including vegetation, to the standards necessary to allow them to perform as designed.
- (2) To periodically review information collected from monitoring, and re-view and revise the Otaki FMP as appropriate.

4.2.1.4 Methods

Methods for achieving these policies are detailed in sections 3.4 and 3.5.

4.2.2 River Processes

4.2.2.1 Issues

- **The Otaki River is continually migrating laterally.**

Formation of a floodplain is a natural occurrence resulting from a variety of geomorphologic processes, and the river forms an integral part of this. These processes are continuous, but the river can radically change during a single major event.



PHOTOGRAPH 10: EROSION ON THE LEFT BANK OF THE OTAKI RIVER, UPSTREAM OF THE STATE HIGHWAY 1 BRIDGE, MARCH 1996

The river channel will generally occupy a constant area of land. However, this area may move, crossing land ownership boundaries. This creates gains and losses between individual owners due to erosion and accretion, and the short-term loss of productive land along the river banks. Today's community finds this meandering across boundaries unacceptable. However, they must accept that constraining these natural processes will have a cost.

- There is limited understanding of the complex natural processes occurring in the Otaki River.

Rivers respond unpredictably to natural events and to human intervention. The lack of historical records makes it difficult to assess its responses to mitigation works. Developing a greater understanding of the long-term natural processes will assist in managing the river.

- The threat of erosion along the Otaki River is severe.

Land adjacent to the Otaki River is highly vulnerable to erosion due to frequent flooding, the steep grade of the river bed, high volumes of gravel transport, and significant gravel extraction in the past (see Photograph 10).

- The Otaki River has been confined to a narrow channel, which has been considerably modified by river management activities.

Historical river management has dramatically altered the river's natural character in an attempt to contain floodwaters and control flooding.

River works have been undertaken on the Otaki River over a long period. Records show stone gabion groynes and stopbank works being constructed in the 1920s and 1930s. The original scheme works, carried out between 1945 and 1955, substantially modified the river. Downstream of the State Highway 1 bridge the river was excavated to a uniform straight channel and stopbanks were built. Upstream of the bridge a less expensive river training scheme was implemented, but the intention remained to confine the river to a narrow single-thread channel.

In recent years river management techniques have changed and the upstream part of the river is no longer confined to a narrow channel.

4.2.2.2 Objectives

- To continue to minimise the Otaki River's ability to meander across the floodplain.

- To gain a better understanding of the natural processes of the river and its response to physical works.

4.2.2.3 Policies

- (1) To manage the Otaki River within a preferred channel alignment.
- (2) To set up systems that accurately monitor changes in the river, both as a result of natural events and physical works.
- (3) To encourage conservation forestry in erosion-prone areas of the Otaki catchment through the KCDC District Plan.
- (4) To encourage landowners and other users to minimise lateral erosion of river banks.

4.2.2.4 Methods

Methods for achieving these policies are detailed in sections 3.5.2 and 3.5.7.

4.2.3 Gravel Management

4.2.3.1 Issues

- Significant degradation of the Otaki River bed has occurred.

Large quantities of gravel have been extracted from the bed of the Otaki River over the last 150 years. The rate of extraction was greater than the natural rate of supply, artificially lowering the bed level, and causing erosion and adversely affecting the natural character and habitat of the river (see Photograph 11). Bed levels are now being monitored to determine sustainable gravel extraction rates. In recent years, extraction has been reduced, allowing a recovery in bed levels from the mouth to Chrystalls Bend. Upstream of Mangahanene Island there has been significant aggradation. However, degradation has continued upstream of Chrystalls Bend.

This process of gravel movement and aggradation can be managed but it cannot be stopped. The rate of aggradation is influenced by catchment conditions, river channel conditions, and the nature and occurrence of floods. Aggradation reduces channel capacity and increases the tendency for the river to migrate. Neither effect is acceptable to the community. Their concern is primarily due to developments close to the river, and insufficient berm widths.

The best way to deal with aggradation and degradation is to allow the river

sufficient room to meander and transport or deposit gravel. Given the existing level of development, there is only limited opportunity for this to occur.

4.2.3.2 Objectives

- To maintain optimum bed levels and prevent river misalignments.

4.2.3.3 Policies

- (1) To extract gravel at a rate of 50,000 m³ per year until 2001/02.
- (2) To ensure extraction occurs at locations that reduce the flood and erosion risk.
- (3) To defer extraction in the 1.5 km reach of the river above Chrystalls Bend.
- (4) To use other gravel management options, including cross-blading.
- (5) To review this extraction policy after 2001/02 and reduce extraction rates if necessary.

4.2.3.4 Methods

Gravel management is discussed in section 3.5.6.

4.2.4 River Mouth and Coastal Environment

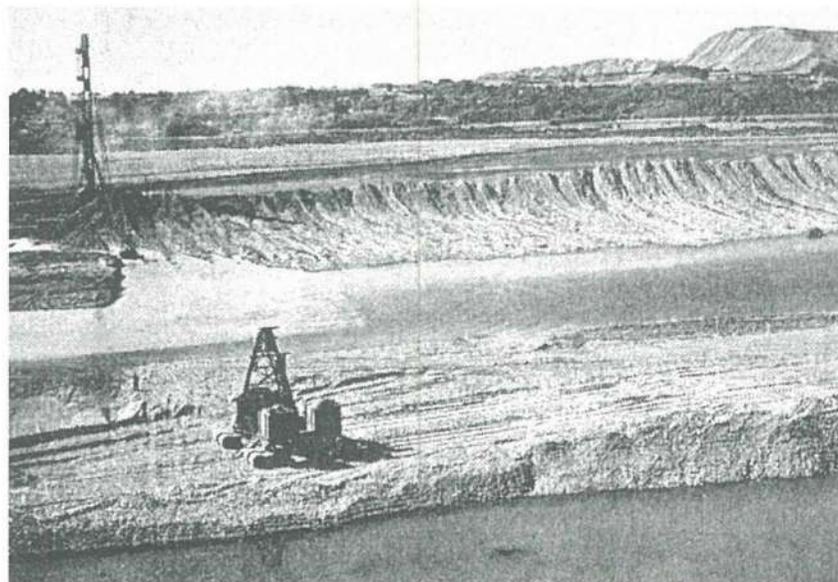
4.2.4.1 Issues

- The Otaki River mouth is a particularly dynamic and sensitive area which could be adversely affected by flood mitigation measures. Conversely, the migration of the river mouth may have adverse effects on adjacent land uses or flood mitigation measures upstream.

The Otaki River mouth has the tendency to migrate to the south under the prevailing littoral drift and the current alignment of the estuarine reach of the river.

Migration of the mouth too far southwards results in erosion of the left bank sand dunes and Maori land. Migration of the mouth too far north would alter the current estuary configuration, compromise the wetland habitat, and eventually threaten stopbanks to the north.

Consideration of options for stabilising the mouth must take the natural river and coastal processes into account. These processes are extremely complex, and the ways of assessing them are through computational or



PHOTOGRAPH 11: IN 1946 THE TOWER DREDGE BEGAN A MASSIVE TASK ON THE LOWER OTAKI RIVER (BELOW STATE HIGHWAY 1), EXCAVATING THOUSANDS OF CUBIC METRES OF RIVER GRAVEL THAT NOW CONSTITUTES THE RIGHT STOPBANK THAT PROTECTS OTAKI TOWNSHIP (THE RIVER BED WAS LOWERED BY ABOUT 2 M)

physical model studies. Currently, neither the financial resources nor the required data are available for this type of study. This in turn means that management strategies selected now must be modified as further information on river mouth processes comes to hand. Information suitable for modelling should be collected now.

4.2.4.2 Objectives

- To provide a sustainable management regime at the Otaki River mouth.

4.2.4.3 Policies

- (1) To gain a better understanding of the river mouth migration, enabling more informed decision-making.
- (2) To continue to cut the Otaki River mouth when its position is likely to result in adverse effects.

4.2.4.4 Methods

River mouth management methods are described in section 3.5.5.

4.2.5 Climate

4.2.5.1 Issues

- **Changes in climate, rainfall patterns, and sea level may have a significant effect on the Otaki floodplain.**

Evidence indicates that global sea level has risen by between 100 and 150 mm in the last 100 years. While there are no indications at present that this rise is accelerating due to global warming, the local relative sea level rise at Wellington has recently increased from 1.6 mm/year to 2.3 mm/year. It is estimated that the rate of sea level rise will accelerate by a factor of 3–6 times next century as a result of the greenhouse effect. Although low when compared with early estimates, a rise in sea level of this magnitude may significantly affect the Kapiti region. The most likely effects include:

- increased coastal erosion
- increased coastal inundation
- salt water intrusion into coastal ground water
- salt water intrusion into ecologically important wetlands and river mouths

Changes to the rainfall patterns of the Kapiti area due to the greenhouse

effect could cause increased summer dryness and increased flooding, due to:

- increased frequency of high intensity rainfall—each 1°C rise in temperature moves the cyclone belt 500 km south, so tropical cyclones could become more frequent
- higher rainfall in the ranges—increased erosion and sediment supply may lead to increased aggradation

The frequency and magnitude of natural rainfall events in the Wellington region may alter due to climate change. Warmer global temperatures may increase the region's exposure to tropical cyclones such as the Wahine storm.

Predictions concerning the impact of long-term climate change are limited by the short period over which climate records have been collected. Nonetheless, some changes seem to be occurring which river management planning must take into account.

Over the next 100 years, global temperatures are likely to increase. This will allow species from warmer climates in the north to spread further south. The effects of this are unclear—it may allow increased regeneration of floodplain forest, but it may also facilitate the spread of weeds now confined to more northerly locations, e.g. Manchurian wild rice. Such aquatic weeds could cause a flood hazard by constricting the channel, and increasing flood levels.

4.2.5.2 Objectives

- To plan for the effects of climate change.

4.2.5.3 Policies

- (1) To gain an increased understanding of how climate change will effect rainfall patterns, and therefore the nature of floods, to enable informed planning decisions to be made.
- (2) To remain up-to-date with research by others on the effect of climate change on rainfall patterns and sea level rise.
- (3) To accommodate the latest estimates of sea level rise in all flood mitigation methods.

4.2.5.4 Methods

Sections 3.5.5 and 3.5.7 describe the methods chosen for addressing the effects of climate change.

4.3 The Human Environment

4.3.1 The Community

4.3.1.1 Issues

- **The risk of damage and social disruption to the Otaki Community from a flood event is significant.**

In 1996 the Otaki floodplain had a population of around 7,000 (from the 1996 Census records). The majority of these people live within Otaki township and the Otaki Beach settlements with the remainder spread throughout the surrounding rural area.

In a 100-year flood at least one-third of the residential area (including the southern part of the Otaki Beach settlement) and all of the commercial centre of Otaki township would be inundated (see Photograph 12). The northern Otaki Beach settlement and the Otaki gorge area are not threatened by inundation.

This flooding would cause significant disruption and trauma to the community. Those not located within flood prone areas would be affected by the impacts on public facilities, and utility and transport networks.

There are a number of factors which are likely to influence the nature and extent of this social impact:

- the Otaki Community has a very high proportion of elderly residents and a per capita income below the national average
- a relatively high proportion of the population is not in the active paid labour force or seeking work
- almost a quarter of the population of Otaki is Maori

These factors have implications for the impact of a flood in the Otaki area because the elderly, low income earners, and ethnic minorities are among the groups that suffer most from the effects of serious floods (see Bibliography reference 59).

- **The extent of, and damage due to a significant flood event in the Otaki River is not well recognised.**

There have been several floods in the area in the last 20 years and this has helped to raise the awareness of residents to flood vulnerability. This level

of awareness is much higher than in Waikanae.

However, previous experience of flooding can limit people's perceptions of the degree of risk because people find it hard to imagine events larger than those previously experienced. A community survey (Boffa Miskell Partners, 1992) found that a large proportion of people living within the flood-prone area believed that they were at no risk or only a slight risk from flooding. The existing flood control scheme offers a level of protection which many of the community regard as adequate.

Regular public education is essential to maintain community awareness and preparedness. This should focus on the things people can do to maximise safety and reduce flood damage.

Public education campaigns can have a number of benefits:

- people gain an understanding of the flood hazard which can potentially reduce the emotional, physical and sociological impacts of flooding
- people learn techniques to save their belongings
- people become better acquainted with their local authorities and tend to have greater confidence in their advice

Information reinforced regularly is more likely to reach a wide cross-section of the community.

- **Community preparedness for a significant flood event is mixed.**

Otaki has a good civil defence organisation which networks with other community organisations to ensure that rescue and welfare support services can be quickly activated.

However, this higher level of preparedness only appears to exist in a small portion of the community. Surveys have revealed a low level of preparedness for a major flood in many areas. A lack of preparedness among the population living in flood-prone areas is a significant hindrance in reducing the impact of a major flood.

In a community with good flood preparedness, response to flood warnings is likely to be prompt. Ideally, residents and property owners should have evacuation plans and be able to implement them rapidly when they receive a flood warning.

Because flooding depends on rainfall, the frequency and extent of flooding



PHOTOGRAPH 12: NORTH-WEST VIEW OF OTAKI FLOODPLAIN SHOWING OTAKI TOWNSHIP ON THE RIGHT BANK OF THE RIVER, MARCH 1998. A BREACH OF THE STOPBANKS AROUND CHRYSTALLS BEND COULD RESULT IN EXTENSIVE FLOODING WITHIN OTAKI.

can be extreme and variable. A lack of historical data makes it even harder to predict floods. Due to Otaki's geography, the warning time is probably going to be quite short.

- **Stopbanks, although an efficient method of flood protection, can give a false sense of security because they could be overtopped or fail in a flood.**

An understanding of how much protection a stopbank provides is a difficult concept to get across to the community. This is because a stopbank's level of protection can change over time (due to river aggradation, meander patterns, and an increasing amount of rainfall information). Poor understanding may lead people to make poor choices, and could actually worsen the impact of flooding.

- **Some residents consider that public awareness of the flood risk in Otaki is having a depressive effect on the town.**

The impact of flood awareness and building restrictions on development within the Otaki area is a matter of concern to some residents. The level of building in Otaki has declined dramatically since 1990. While possibly not the sole cause, it seems likely that the greater awareness of the flood risk in the area and restrictions on building and subdivision within flood-prone areas has been a contributing factor to this decline (see Bibliography reference 39).

- **The basis on which decisions have been made in the floodplain management process is not widely understood by the community.**

This has given rise to concerns that floodplain management is not being properly controlled, and that the community's opinions and knowledge have not been adequately considered in the consultation process.

A clear example of this is the widely held view that the removal of more shingle would reduce the risk of flooding from the river. The reasons behind the reduction in the amount of shingle removed over the past 20 years is not understood by the community.

- **There is uncertainty about the responsibilities of KCDC and the Council with regard to flood preparedness and response.**

Presently, KCDC organises disaster response and recovery as part of the Civil Defence Plan (Appendix D). The Council is responsible for flood

warning (Appendix F). This has led to community concern about a possible lack of co-ordination between agencies, and confusion about which agency is responsible for the various aspects of flooding.

- **House raising as an alternative method of flood mitigation in an area is not an option that can necessarily be undertaken by all those property owners in that area.**

Some people require ground floor access to living areas while other houses are already two storeys and cannot be easily modified to shift living areas upstairs.

4.3.1.2 Objectives

- To minimise the risk to life, health and safety from a flood.
- To minimise the degree of damage resulting from a flood event.
- To minimise the disturbance to the community during river management activities, the construction of flood mitigation works, and other associated development.
- To achieve a consensus of opinion amongst the whole community regarding the future management of the floodplain and the level of flood protection to be provided.
- To maintain a high level of public awareness of the flood hazard.
- To ensure the community is aware of the responsibilities of KCDC and the Council with regard to flood preparedness and recovery.

4.3.1.3 Policies

- (1) To prepare a management strategy for the Otaki floodplain that will minimise the risk to life and property resulting from a flood, and ensure that the floodplain is used in a wise and rational way.
- (2) To ensure the community recognises that flooding is a natural process that cannot always be prevented or controlled.
- (3) To ensure careful planning and consultation with the community takes place before implementing flood mitigation methods.
- (4) To reduce or avoid the adverse effects of flooding through careful management and timing of flood mitigation methods, minimising any resulting inconvenience to the community.

- (5) To maintain awareness of the flood hazard throughout all sectors of the community, enabling people to better cope in a flood.
- (6) To ensure the community is given adequate warning of an impending flood event, and that an adequate back-up system is in place.
- (7) To ensure the community has a clear flood response plan.
- (8) To reduce social disruption and damage caused by flood events by improving and maintaining community preparedness.

4.3.1.4 Methods

These policies will be achieved through the flood mitigation methods described in section 3 (particularly 3.3.2 and 3.7).

4.3.2 Industrial/Commercial

4.3.2.1 Issues

- **There is a commercial demand for gravel extraction from the Otaki River.**

Gravel from the river is of a very high quality, making it suitable for roading and as a concrete aggregate. It has also been used substantially as ballast for railway lines. The commercial demand is variable and focused on localities with ready access. Within the constraint of achieving optimum bed levels there are still suitable sources on the river (see Photograph 13). Any substantial reductions in the permitted gravel extraction rate will adversely affect the gravel industry.

- **Flooding could cause disturbance and damage to the commercial sector.**

Otaki is an industrial and retail centre for the surrounding rural area. Some industries also serve a wider regional and national market. Flood loss or damage to places of employment are stressful for both owners and employees of businesses. There would be some economic impact and possible unemployment.

4.3.2.2 Objectives

- To ensure a continued supply of gravel for the industrial sector within the constraint of achieving optimum bed levels.
- To ensure minimal disturbance and damage to the commercial sector



PHOTOGRAPH 13: GRAVEL EXTRACTION OPERATION, UPSTREAM OF THE RAILWAY BRIDGE, SEPTEMBER 1997

due to flooding or flood mitigation methods.

4.3.2.3 Policies

- (1) Take account of the industrial reliance on gravel from the Otaki River when reviewing gravel extraction rates.
- (2) Provide adequate warning of substantial changes in gravel extraction rates to allow industry time to adjust.
- (3) To ensure the commercial sector is adequately protected from or prepared for flooding, whether by structural or non-structural methods.

4.3.2.4 Methods

The policies above will be achieved through the flood mitigation methods in section 3 (particularly section 3.5.6).

4.3.3 Infrastructure/Services

4.3.3.1 Issues

- **Impacts of flooding on utility services crossing the River Corridor.**

There are a number of utility services within the River Corridor. While they are not considered a major problem, some are threatened by the effects of flooding. For instance, transmission lines cross the river 2.7 km upstream of the railway bridge. The pylon on the right bank is located within the buffer zone and very close to the main channel. Erosion problems at the foundation have occurred in the past and it continues to be vulnerable. There are also concerns at the shallowness of a gas pipeline crossing the river 1 km from the mouth, which would be vulnerable to damage if the river bed was to degrade.

In the event of a 100-year flood it is likely that both the main trunk railway line and the State Highway would be impassable for some time. This would disrupt the passage of goods, commuters and other travel.

- **There is the potential for flooding to cause disturbance and damage to the infrastructure and services of Otaki township.**

The loss of services regarded as an integral part of people's daily lives can be a major source of stress. It can also seriously threaten public health. In a 100-year flood the Waitohu Stream bridges are expected to be severely damaged and total replacement is envisaged. Major damage is also ex-

pected to the Water Treatment Plant (Waitohu Valley) from the Waitohu Stream, and potentially Tasman Road Water Pumping Station. The sewerage system would be inoperable for the duration of the flood. Depending on the extent of damage, it could take a significant amount of time to re-commission the sewerage plant.

- **River management benefits utility services within the River Corridor.**

Maintaining channel alignment, and controlling bank erosion and bed levels, all provide protection for utility services within the River Corridor. It has been suggested that utility service operators should be made to pay for this benefit. However, at present no mechanism exists to allow this to happen.

4.3.3.2 Objectives

- To locate new services so they have little or no impact on the management of the Otaki River channel.
- To minimise disturbance and damage to the infrastructure from flooding or flood mitigation methods.
- To recover some form of financial support from utility operators, e.g. Telecom and Electra, when river management works have to be designed around or protect services.

4.3.3.3 Policies

- (1) To ensure that essential services are located outside flood-prone areas.
- (2) To ensure services located in flood-prone areas are designed to withstand the effects of flooding.
- (3) To ensure that any new service crossings recognise the requirements of the FMP and the objectives of the River Corridor zone.
- (4) To ensure that existing services are moved to more appropriate locations when they are upgraded.
- (5) To keep the number of new service crossings to a minimum and reduce the number of existing service crossings.
- (6) To encourage utility operators to take a more co-ordinated approach to the location and standard of installation of new services as well as upgrading the existing services.

- (7) To ensure that protection of existing services and infrastructure is provided for when considering future flood mitigation methods.
- (8) To maintain a dialogue with utility and service providers to ensure efficient and effective protection of services.

4.3.3.4 Methods

The above policies will be achieved through methods described in section 3.4.8. The co-ordination of these methods, and any prioritising that needs to be done, will be the responsibility of the utility service operators (section 3.3.1.6).

4.3.4 Economics

4.3.4.1 Issues

- **There is a lack of adequate insurance cover against loss or damage due to floods held by residents within the Otaki floodplain.**

Insurance is often perceived as a high-cost option for lessening the impact of a flood. Few insurance companies appear to promote insurance against flooding in flood-prone areas. Yet, this is a relatively low cost pre-flood method that spreads loss amongst all policy holders. Insurance can be crucial in alleviating the financial costs of flooding, and can provide a relatively cost-effective way for property owners and occupiers to protect themselves against risk of flood damage.

The Council itself cannot take insurance cover as an option as it has no insurable interest in the property of its ratepayers. It is the responsibility of the individual property owner to obtain insurance against floods for their assets.

- **Structural methods generally have a high cost.**

The cost of constructing structural methods is generally high. However, the alternatives for protecting existing development are limited and can have other unacceptable costs. The impact on rates and details of how the costs of flood mitigation methods are divided between the local community and the wider region are in line with the policies set out in section 6. The benefits and costs of the methods also vary depending on what perspective is being taken—be it national, regional, local, or individual. Differing perspectives will also affect priority.

- River management has significant ongoing costs.

Management of the Otaki River will always be a difficult and at times costly task. It is not possible, without major adverse effects, to fix a reach of river channel 'once and for all' and allowance must be made for ongoing works.

4.3.4.2 Objectives

- To ensure individuals have sufficient insurance cover against loss or damage by flood.
- To ensure that the costs of flood mitigation methods undertaken are within those that the community is prepared to pay (see section 2.7).

4.3.4.3 Policies

- (1) To encourage individuals to take out insurance cover against loss or damage by flood.
- (2) To ensure that flood mitigation and river management works are undertaken within the budgets agreed in this Plan and through the Annual Plan process.
- (3) To test the community's preparedness to pay for flood mitigation and river management works at each Plan review.

4.3.4.4 Methods

The above policies will be achieved through the flood preparedness methods described in section 3.3.2.2, and by completing flood mitigation methods within budget.

4.4 Maori

4.4.1 Issues

- The Council must ensure that the principles of the Treaty of Waitangi are taken into account in any evaluation and selection of flood mitigation options.

Under the RMA, the Council is obliged to take the principles of the Treaty of Waitangi into account in the management of the natural and physical resources of the region. These principles include:

- partnership
- active protection of Maori rights and interests
- each partner acting in the utmost good faith towards each other

Ngati Raukawa hold mana whenua over the Otaki area. Through consultation the Council has involved Ngati Raukawa in the floodplain management planning process since 1991, in keeping with its Treaty responsibilities. This has included:

- representation at regional level as well as on the KFMC
- discussions held with the Iwi on their involvement in the FMP
- a presentation made to the Marae Committee in July 1991
- representations made in October 1992
- hui to present the Iwi perspective on resource management held in June 1993
- discussions about the aspirations and preferences of the Iwi held in July 1993

There has also been extensive consultation regarding the Draft Regional Freshwater Plan for the Kapiti area. The relationship between this FMP and the Regional Freshwater Plan is discussed in Appendix A.

- **What is the role of Tangata Whenua in the management of the Otaki River and floodplain.**

Since the signing of the Treaty of Waitangi Ngati Raukawa have been progressively marginalised and consistently excluded from the management of the Otaki floodplain. This is despite the guarantees of the Treaty. Their ownership status has never been effectively recognised.

Tangata whenua remain concerned that their role of kaitiakitanga over water bodies is not adequately recognised and that there are few opportunities to manage water bodies according to Tikanga Maori. Tangata whenua have therefore indicated their desire to be involved in the decision-making process regarding the region's watercourses.

- **Maori have concerns about the environmental degradation of the Otaki River and floodplain.**

Water is a very significant resource to Maori and plays a central role in

both their spiritual and secular worlds. Water is an essential element to all life and expresses all dimensions: taha wairua (spiritual significance), taha hinengaro (intellectual dimensions), taha tinana (physical dimensions), and taha whanaunga (the social aspect).

Ngati Raukawa have witnessed a progressive degradation of the floodplain, including its waterways. They have noted the disappearance of certain species of flora and fauna, and they have lamented over the drying up of certain streams and springs. They have cried over the destruction of certain habitats and have been exasperated at the amount of pollution and gravel that has caused havoc in the river.

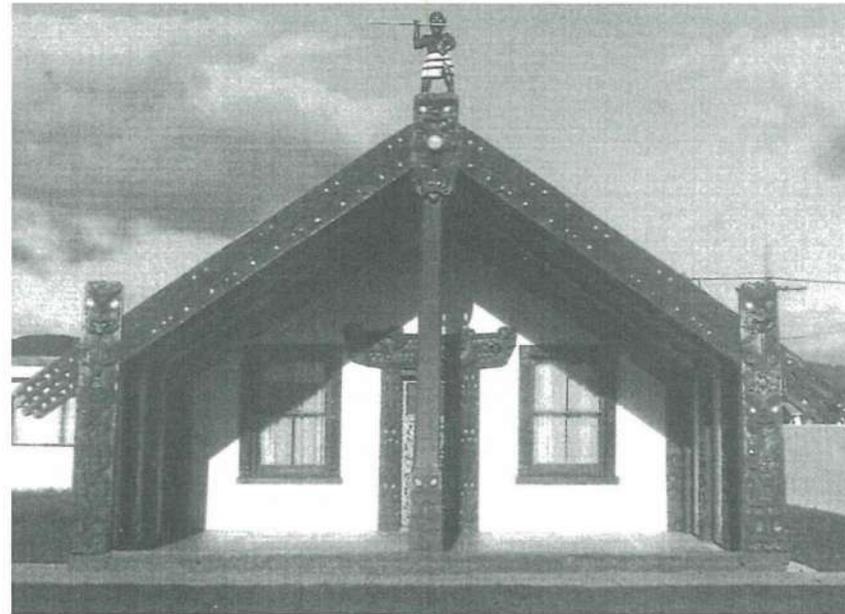
Fitting into your environment, rather than attempting to fit the environment into human activities, is a notion traditional to Maori. Present day Iwi members feel that the problems arising from the stopbanks on the river (such as a rise in gravel and prevalent flooding) have vindicated this traditional philosophy. Many feel that in the short-term the stopbanks may have helped solve the problem, but in the long-term flooding is more of a problem now. Planning of Otaki township has exacerbated the problem because, again, there is no real attempt to create a town in keeping with features of the landscape. Instead a design showing little harmony with the topography, such as floodplain and waterways, was imposed upon the geography. Flooding is more of a problem now because of this.

Tangata whenua are also concerned that flood mitigation activities within watercourses will adversely affect the mauri of water bodies. The mauri, or life essence, is adversely affected in many ways. Examples of particular relevance to flood mitigation include the following:

- damming, diverting or mixing water from one water body into the catchment or watercourses of another
- otherwise altering the natural flows and fluctuations of water bodies
- There are sites of special value to Tangata Whenua on the floodplain.

Sites of special spiritual, historic, or cultural value include waahi tapu, mahinga kai, and areas where pure water was used for ritual purposes. Important values include the mana of Iwi, hapu and whanau, and the ability of the tangata whenua to provide manaakitanga (see Photograph 14).

These sites may be adversely affected by flood mitigation works. In some cases, sites may have been destroyed or be no longer visible. Nevertheless,



PHOTOGRAPH 14: WHARE RUNANGA RAUKAWA IS THE THIRD MEETING HOUSE BUILT ON THIS SITE. THE ORIGINAL HOUSE WAS OPENED IN 1853, REBUILT IN 1885, AND THEN AGAIN IN 1936. IT IS AN OUTSTANDING EXAMPLE OF REVIVED MAORI DECORATIVE ART

tangata whenua still consider them to be waahi tapu. Therefore, it is important that the values and concerns of tangata whenua are included when working through the options for flood mitigation works. The Council needs to be aware of the importance of Iwi feelings when identifying tapu sites and make sure that appropriate consultation occurs. Identified sites of importance are shown on Figure 13 (this notes the existence of silent files).

- **Tangata Whenua have become angry at the creation of a gravel industry on the Otaki River which adversely effects the river environment and provides no rewards to Ngati Raukawa.**

Ngati Raukawa have lost control of many of their natural resources as a result of the European presence in Otaki. The gravel industry is seen as yet another example of this infringement of their rights.

- **The Council needs to look at recognising Rahui (protections or restrictions) supporting the procedures for making the public aware of such sites, and being aware of the significance of a Rahui.**

Rahui is an important aspect of Maori lore and should be given due respect.

4.4.2 Objectives

- To take the principles of the Treaty of Waitangi into account when managing the Otaki River.
- To undertake ongoing active consultation.
- To recognise the relationship of Maori, and their culture and traditions, with freshwater, ancestral sites, waahi tapu, and other taonga within the beds of rivers and lakes, and provide for these in the assessment of flood mitigation options.

4.4.3 Policies

- (1) To identify, in conjunction with the tangata whenua, sites of significant value to the tangata whenua in watercourses.
- (2) To recognise the significance of sites currently identified by the tangata whenua as being of special value.
- (3) To consult with tangata whenua in order to identify any silent files that may exist before working in the Otaki River.
- (4) To discuss protection of sites and access to sites with the Iwi of the

region when evaluating options for flood mitigation.

- (5) To have regard for the values, aspirations and customary knowledge of the tangata whenua when evaluating options for flood mitigation works.

4.4.4 Methods

The above policies will be achieved through the methods described in section 3, in particular sections 3.6 and 3.7. Protection of sites of importance to Maori is also provided through the KCDC District Plan.

4.5 Ecology

4.5.1 Issues

- **The natural character of the Otaki River is protected by the RMA.**

The preservation of the natural character (including the ecology) of rivers and their margins is included as a matter of national importance in the RMA. The RMA also protects the habitat of trout and salmon (sections 6(a) and 7(h)).

- **The Otaki River is vital to the natural ecology of its whole floodplain.**

The Otaki River carries water and fresh nutrients from the rocks and soils of the catchment and deposits them downstream, both within the river channel and, during floods, on the surrounding floodplain. Restricting the river to a defined channel alignment limits the natural deposition of nutrient-bearing silts and sands to the river channel except in very rare flood events.

- **The natural ecosystems of the Otaki floodplain have been extensively modified as a result of human habitation.**

The original mosaic of wetlands, open water, raupo swamp, flax and swamp forest have been largely drained and cleared to make way for farms, market gardens, orchards, and the Otaki township. The originally meandering, changing watercourse has now been largely confined into a single channel, and the ecosystem is now dominated by introduced species. The river mouth is the only remaining area of ecological significance in the lower reaches of the river (see Figure 14).

- **There is the potential for river management activities, flood mitigation works, and other developments within the flood plain to adversely effect the sensitive riverine habitat.**

Any disturbance to the river can have a negative impact upon its ecology, the extent and severity depending upon the particular activity and the sensitivity of the environment. Generally, river management works have minor temporary impacts when compared to other works taking place in the River Corridor. However, river management occurs daily and can have significant cumulative effects.

Construction works within the River Corridor, whether part of flood mitigation works or other developments, may have significant adverse effects upon the ecology of the floodplain. However, adverse effects can be mitigated with careful planning.

In many instances, adverse effects that may result from river management or any other works within the floodplain can be avoided or mitigated. Sensitive design, identification and avoidance of particularly valuable or rare habitats and species, and careful implementation of works can achieve this.

Significant improvements and enhancements can be made to the existing river environment during developments within the River Corridor. These could include the creation of new habitats, the extension and more appropriate management of existing ones, and the use of more native species in planting schemes (see Photographs 15 and 16). Opportunities such as these are identified in the Environmental Strategy (see section 3.6).

Non-Structural options have little immediate effect on the ecology of the floodplain. The wise and rational use of flood-prone land is promoted and should prevent further habitat loss and deterioration in water quality.

The River Corridor will provide a wildlife corridor linking the Tararua Ranges to the coast across what is becoming an increasingly urbanised floodplain.

4.5.2 Objectives

- The restoration of the diversity of the Otaki floodplain ecosystem where practicable.

4.5.3 Policies

- (1) To protect the remaining natural habitats of the Otaki River.
- (2) To maintain habitat diversity and value.
- (3) To minimise the disturbance and damage to habitats and species dur-

ing river management activities, the construction of flood mitigation methods, and other developments.

- (4) To restore and re-create natural ecosystems where possible.

4.5.4 Methods

The above policies will be achieved through the methods described in section 3.6.

4.6 Recreation/Landscape/Heritage Values

4.6.1 Issues

- **River management activities and flood mitigation works could adversely affect the river's recreation, landscape and heritage values.**

River management and flood mitigation activities can disrupt and disturb the community's enjoyment of recreational opportunities, landscape, and heritage. The impacts of such works can be either long-term or limited to the construction period. Examples are:

- restricted or altered access to the river or its banks for recreation
- visual intrusion of construction activities onto, or permanent alteration of, the landscape
- destruction or disturbance of sites or buildings of historic value

The heritage value of the Otaki floodplain reflects its rich physical, cultural and spiritual history, both European and Maori. Figure 15 shows the location of sites of heritage value. Heritage is not only about precious buildings and artefacts but also about living heritage—natural and cultural.

No known heritage sites will be directly affected by the proposed flood mitigation activities. Conversely, certain structural works will add security to those sites adjacent to the river by stabilising the river channel.

- **Human efforts to restrict the course of the lower and middle reaches of the Otaki River and the Waitohu Stream have undermined their visual quality.**

The Otaki River and Waitohu Stream are important components in the character of the Otaki floodplain. Unfortunately, like similar rivers through-

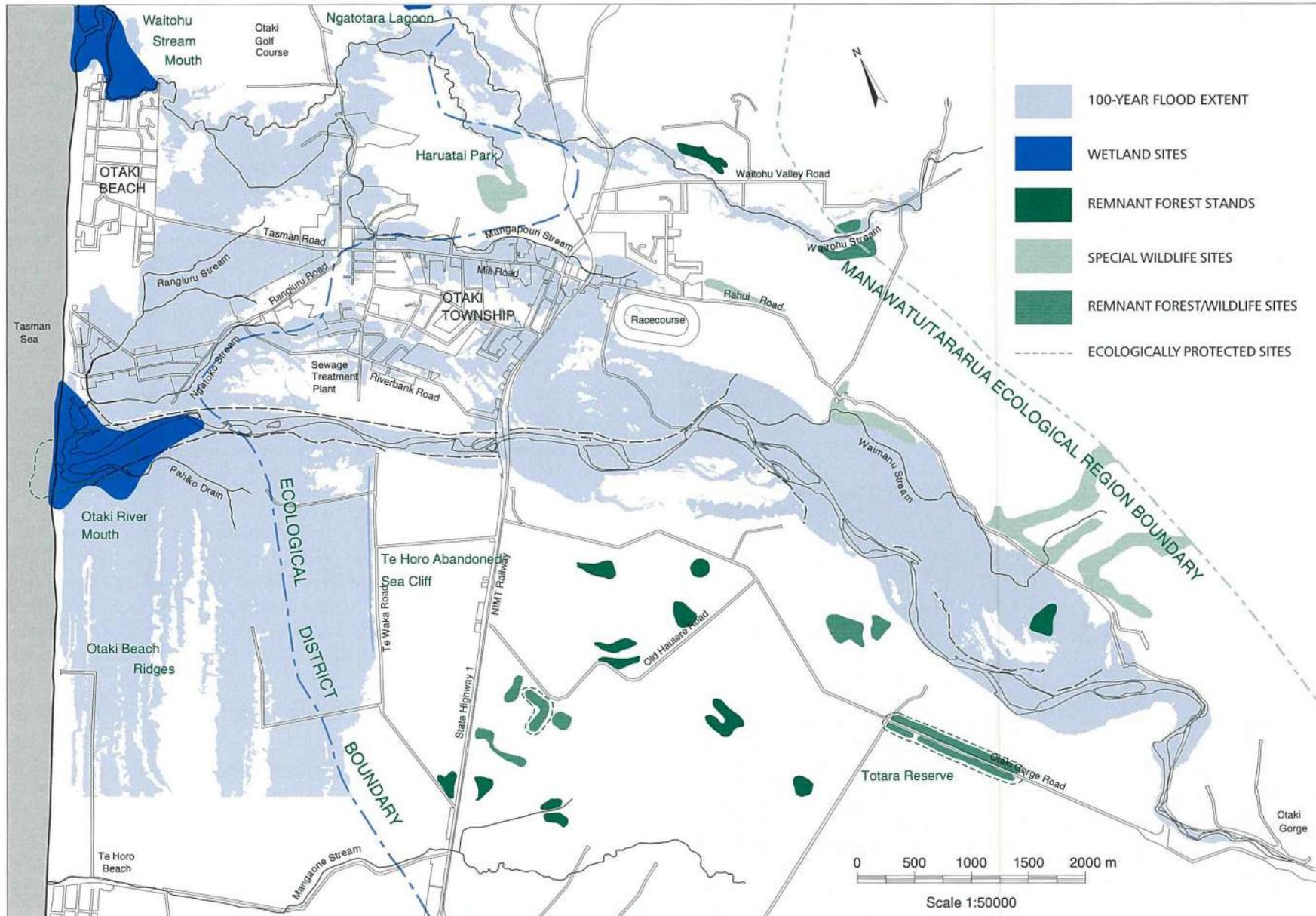


FIGURE 14: SITES OF ECOLOGICAL SIGNIFICANCE



PHOTOGRAPH 15: NATIVE PLANTING BY PARTICIPANTS OF THE COUNCIL'S COMMUNITY TASK FORCE AND KAPITI COMMUNITY DEVELOPMENT AND TRAINING TRUST, NOVEMBER 1994



PHOTOGRAPH 16: NATIVE PLANTING (IN SIMILAR LOCATION), MAY 1998

out New Zealand, the middle to lower reaches of these waterways have been perceived as a threat to productivity and economic viability. Since the beginning of European settlement, attempts have been made to control them by restricting the channel width to the minimum area required to control flooding. These efforts have dramatically altered the visual character of the lower reaches.

Stopbanks, dense willow plantings rock rip-rap on river banks, debris fences, gravel extraction and cross-blading have all, in visual terms, effectively eliminated the Otaki River from its surrounding landscape. From outside the River Corridor, the presence of the river is distinguished by continuous bands of exotic vegetation, mostly willows, on both sides stretching from the foothills to the sea. Within the corridor itself the surrounding coastal plain landscape is almost totally obliterated and the river character is one of sameness (see Photograph 17).

In contrast, the significant scenic and recreational values of the upper and middle reaches of the Otaki River remain unmodified, partly because the area has never been considered suitable for farming.

- **Landscape and recreational values of the middle and lower reaches of the Otaki River have been affected by the need for flood protection works.**

To residents living and working on the floodplain there has been, and continues to be, an acceptance of the need for effective flood control to protect lives and livelihoods. The middle and lower reaches of the Otaki River, unlike the Waikanae to the south, appears never to have been recognised as having intrinsic landscape and recreation values worth protecting. However, the upper reaches of the Otaki are regarded as having high intrinsic values.

- **The recreational value of the Otaki River is affected by the lack of natural character.**

Recreation is closely linked to the setting in which it takes place. The low to average landscape quality that exists along much of the Otaki River Corridor has a direct effect on people's perception and level of recreational use. Increasing the visual quality by eliminating those activities that have a high visual impact, such as gravel extraction and industry, and using more 'natural' river control measures, such as a greater range of riparian species

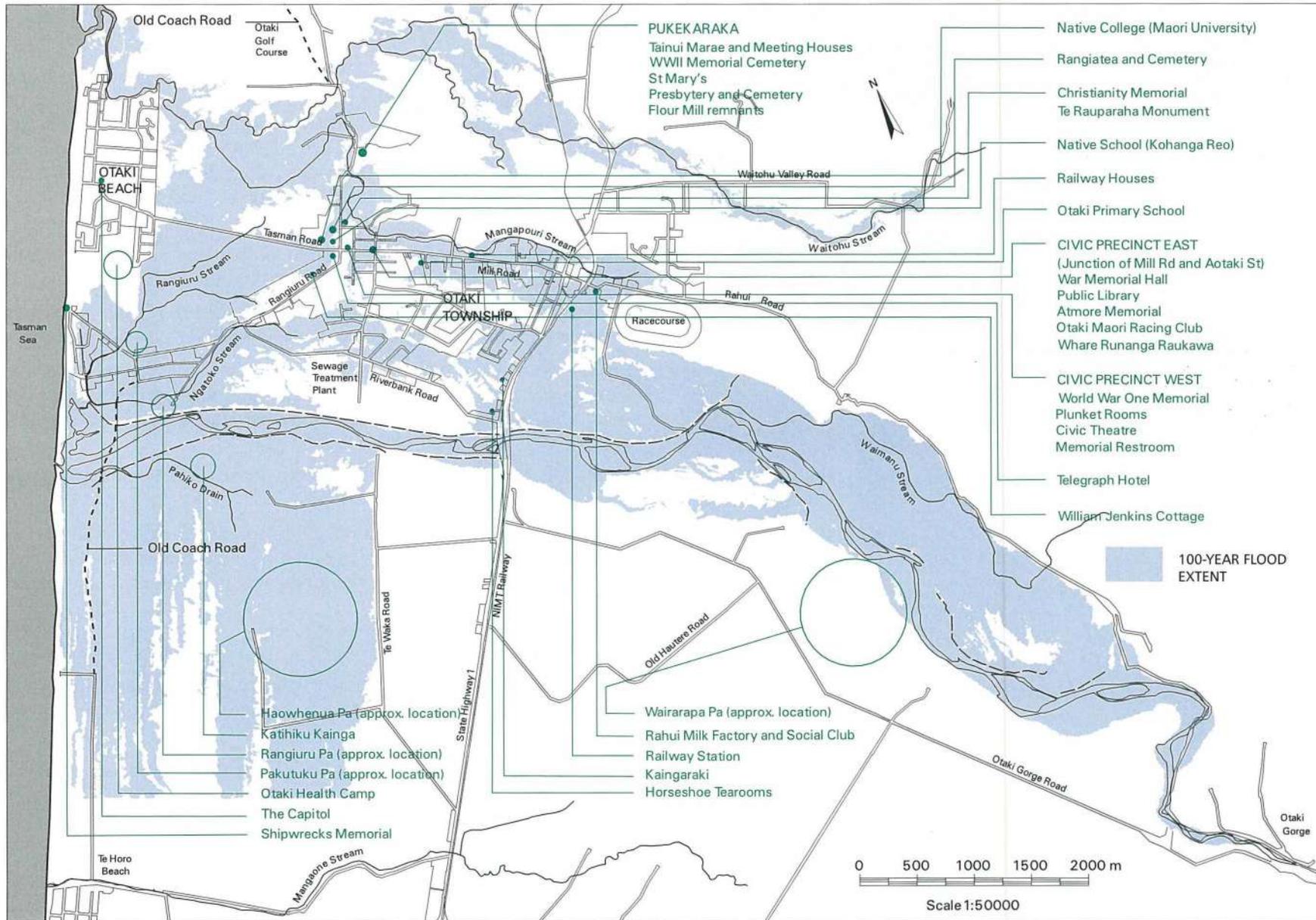


FIGURE 15: SITES OF HERITAGE VALUE



PHOTOGRAPH 17: LOWER OTAKI RIVER LANDSCAPE, 1992

and creating wetlands, would lead to a greater range and level of recreational use.

Given the importance of the Otaki River as a trout fishery, both the existing flood control measures and those used in the future need to consider the effects on trout habitat. The Otaki River mouth and estuary also support a whitebait and flounder fishery and provide habitats for marine and freshwater species including kawhai, snapper, dogfish, red cod, gurnard and yellow eyed mullet (herring). (See Photographs 18 and 19.)

Another important consideration in relation to recreation and bank-edge protection is the desirability of avoiding obstructions, such as steel reinforcing rods protruding from concrete blocks and debris fences.

- **Floodplain management provides opportunities to redress some of the impacts of flood mitigation methods on the river's landscape values.**

This can be achieved by incorporating environmental enhancement works as an integral part of flood mitigation and river management works. This should enhance peoples' recreational and environmental appreciation of the river.

- **Floods could cause damage to, or destruction of, recreation, landscape, and heritage resources.**

Floods themselves affect recreation, landscape, and heritage values on the floodplain. Serious flood events can limit the recreational use of the river and its banks. They can alter the landscape and may cause damage to historic sites and buildings.

4.6.2 Objectives

- To maintain a river environment where the recreational, landscape, and heritage values are protected, enhanced, and recognised by the community.

4.6.3 Policies

- (1) To identify and protect features and areas of significant landscape value.
- (2) To identify and protect recreational resources of significant value.
- (3) To minimise disturbance and damage to the recreational and landscape resources of the floodplain.

- (4) To enhance the recreational and landscape values of the floodplain wherever possible.
- (5) To maintain adequate knowledge of sites of historical importance to the local community.
- (6) To consider the protection of historic sites when evaluating flood mitigation options and other developments within the floodplain.

4.6.4 Methods

The above policies will be achieved through the methods described in sections 3.3.1.5 and 3.6.

4.7 Planning and Land Use

4.7.1 Issues

- Existing developments within the River Corridor and on the floodplain are at risk, and will continue to be at risk, from flooding.

Existing development is already at risk of flooding. Correct siting and design can reduce risks to future development.

- The flood hazard and potential costs of damage are largely determined by the types of land use in flood-prone areas. Planning for appropriate land use in these areas is one of the most effective ways of reducing flood damage.

Land use planning is a non-structural mitigation method which seeks to promote wise use of flood-prone land (section 3.3). Land use on the Otaki floodplain is controlled by KCDC in accordance with its District Plan.

During the development of the District Plan in 1995, the opportunity was taken to identify the River Corridor Zone and the 100-year flood extent on the planning maps and incorporate suitable land use controls within these areas.

- Stopbanks encourage further development behind them, and increase potential damages in the event of overtopping or failure.

It is essential that non-structural methods are used in conjunction with structural methods and are supported by an increased level of awareness of the residual flood risk. This helps ensure stopbanks and river manage-



PHOTOGRAPH 18: FISHING FOR WHITEBAIT AT THE OTAKI RIVER MOUTH, AUGUST 1997



PHOTOGRAPH 19: MORE WHITEBAIT FISHING, AUGUST 1997

ment methods are not construed as making Otaki a completely flood-free area. Likewise, awareness will help ensure that structures and river management programmes are not placed at risk through ad hoc development.

- **New development and inappropriate activities within the River Corridor and on the floodplain may increase the risk of flooding to the surrounding environment.**

The risk of flooding will increase when inappropriate structures and/or activities are located within the River Corridor or on the floodplain. Inappropriate use may change the shape and distribution of material across the river bed and floodplain, and change hydraulic processes. This may cause instability of the river banks and a diversion of flood flows to other areas of the floodplain. The flood hazard or risk of flood damage to other properties may increase. Avoiding such development reduces social disruption and damage from floods.

Public ownership of the River Corridor allows it to be protected from inappropriate development. Reserve contributions, esplanade reserves, or River Corridor land purchase may be required along the river.

- **Development and use of the River Corridor and floodplain may have an adverse effect on flood mitigation structures.**

Any adverse effect on structural flood mitigation methods could lead to increased flood damage. Allowing development that might affect these structures could place the surrounding environment at risk.

- **The intentions of private landowners within the River Corridor can be in conflict with floodplain management objectives. Public ownership is a way of overcoming this conflict.**

The River Corridor covers 525 hectares, of which 440 hectares are publicly owned (by the Crown, the Council and KCDC). The remaining 85 hectares are privately owned, principally in large blocks along the south bank and above the bridges on the north bank of the river. Private ownership inevitably makes public access to the River Corridor and its environs more difficult. Figure 9 shows the existing ownership of land in the River Corridor.

The most successful method of controlling land uses within the River Corridor is for the land to be in public ownership. This concept is a key component of the Plan. It will ensure effective land use control within the River

Corridor, in an area where the adjacent land is under development pressure and where there is a significant flood hazard.

- **Deforestation in the upper catchment can have a significant adverse effect upon aggradation and flows (both flood peaks and low flows).**

Deforestation of the catchment area exposes a large portion of otherwise covered steep land to the elements. Rain falling onto an exposed area results in increased erosion, run-off and high flow velocities.

4.7.2 Objectives

- That the overall flood hazard on the floodplain is minimised by reducing flood risks to existing development and communities to an appropriate level.
- That implementation of structural flood mitigation methods does not encourage further inappropriate development in the areas protected by those methods.
- That new development on the floodplain is appropriately located and/or compatible with the flood hazard.
- That both the existing community and future developers are aware of the potential flood hazard.
- That flood mitigation structures are protected from damage.
- That a co-ordinated approach to flood mitigation is taken at a regional, district and individual level.

4.7.3 Policies

- (1) To encourage riparian management. Where land subdivision occurs, any land within the River Corridor should be included within any proposed reserve contributions or esplanade strips.
- (2) To discourage subdivision involving further clearance of the upper catchment, which may destabilise the area.
- (3) To encourage reforestation of the upper and middle catchment through District and Regional Plans.
- (4) To only use structural methods to protect existing development, and then only if they are compatible with environmental objectives.

- (5) To maintain uses of flood-prone land that are appropriate to the hazard and costs associated with flooding.
- (6) To implement long-term means of land use planning to reduce the flood hazard and limit future increase in potential flood damages.
- (7) To prevent the inappropriate development of the River Corridor and Overflow Paths.
- (8) To ensure that development does not adversely affect flood mitigation structures.

4.7.4 Methods

The above policies will be achieved through the river management, structural, and non-structural methods described in section 3 and through the KCDC District Plan.

5. Environmental Results Anticipated

5.1 The Human Environment

- The risk of injury or death resulting from a flood is decreased.
- Potential social disruption from a flood is mitigated or avoided.
- Damage resulting from a flood is reduced or avoided.
- People in the Otaki Community can cope better with a flood.
- People in the Otaki Community are aware of the flood risk and consider this risk when making decisions regarding development or activities on the floodplain.
- Where existing development is at risk, methods are implemented to mitigate the effects of the natural hazard.

5.2 Maori

- The relationship of the Maori and their culture and traditions with freshwater is recognised and provided for.
- Maori involvement in the management of the Otaki River is increased.

5.3 The Physical Environment

- Adverse environmental effects arising from floods are minimised as far as possible.
- Action taken to avoid or mitigate flood and erosion hazards recognises the natural physical processes acting in the area.
- The physical environment is protected through land use methods such as riparian management.
- An increased understanding is gained of how global climate changes could affect a flood.
- An increased understanding is gained of the natural river environment and how it is affected by human intervention, floods, and coastal processes.
- The financial cost of flood damages is reduced.

5.4 Ecology

- Action taken to avoid or mitigate any natural hazard recognises and enhances the ecological habitats in the area.
- Planning for the ecological environment is included within the process for evaluating flood mitigation options.
- Areas of particular ecological significance are protected.
- Effects of flood mitigation methods on the natural environment are minimised.
- Where possible, the natural environment is enhanced.

5.5 Recreation/Landscape/Heritage Values

- Action is taken to mitigate the effects of natural hazards on community amenity values.
- Action is taken to preserve sites with historical and cultural significance to the community from natural hazards.

5.6 Planning and Land Use

- The risks to existing and planned development are identified and, where appropriate, mitigation methods implemented.
- Future development, where possible, avoids natural hazards.
- The value of the wise use of flood-prone land is recognised and promoted throughout the community.
- New development does not increase the flood hazard.

6. Implementation and Funding

6.1 Introduction

There will be a variety of flood mitigation methods implemented as part of the FMP. They will be carried out by a number of different authorities and individuals, and it is anticipated that implementation costs will generally remain where they fall. Most costs will be incurred through methods implemented by the Council and these will be funded by the Council through rates of various types or direct contributions. KCDC will also fund a significant share of the non-structural methods proposed in the KCDC District Plan.

6.2 Current Council Policy for Flood Protection

The Council's Long-Term Financial Strategy 'Facing the Future' is very clear about what the Council is going to do for the next ten years and the reasons why. The current policy for flood protection works is summarised below:

- The problem facing communities has always been how to protect themselves and their possessions against the risk and effects of flooding, given the limited resources available.
- For the Council, deciding what flood protection works should be done involves balancing the benefits to those at risk against the benefits for the region as a whole.
- Funding is now the critical determinant of the nature and level of flood management in the community. The Council is committed to maintaining existing assets. However, all new work is subject to satisfactory funding arrangements.

For Otaki this means that between 1998 and 2007 \$3,200,000 will be spent on maintenance and management of the river. Over the next two years \$566,000 will be spent upgrading the Chrystalls stopbank and \$534,000 (Council share \$160,000) on the Rahui stopbank and bank-edge protection works.

Implementation of the remainder of the Plan's outcomes will depend on their inclusion as part of the Council's review of its overall Long-Term Financial Strategy, which is completed every three years.

6.3 What the Council Will Fund

The Council, through its rating powers, will provide funding for implementing parts of the Otaki FMP. The source of rates will depend on Council policy at the time. The current Council policy on funding is summarised below, although this may be reviewed at any time.

6.3.1 Flood Contingency Fund and Reserve Policy

The purpose of the Fund and Reserves is to provide a contingency fund in the event of significant unforeseen flood damage to the Council's flood protection assets.

One flood contingency fund has been established for the whole region. An annual contribution of \$200,000 is currently made to this fund from the Council general rate.

A sum of \$50,000 (approximately) is put into local area reserves annually. When money is drawn from Kapiti's local area reserve to repair flood damage, Kapiti community is rated for the cost of flood damage in the following year in order to reimburse the reserve.

Money is currently drawn in equal proportions from the region fund and local area reserve.

6.3.2 Asset Management

The Council has adopted the following principles for asset management:

- maintaining existing works will normally have a higher priority than construction of new capital works
- adequate funding provision will be incorporated into the Council's business and annual plans, to achieve appropriate and timely maintenance as set out in Asset Management Plans
- the Council's Flood Contingency Policy will be recognised in the Asset Management Plan, and its adequacy addressed as part of the plan development process
- planned and contingent maintenance will be subject to annual reporting
- river management and flood protection will be subject to peer review (at present this includes annual reciprocal reviews undertaken by registered engineers from the Wairarapa Division)

| Category | Regional Component | Community Component (River rate) | Budget in 1997 Business Plan |
|--|------------------------|----------------------------------|---|
| 1. Investigation, planning and monitoring | 100% | 0 | \$59,000/year |
| 2. Capital works within the scheme for structural works | Up to 50% ² | Not less than 50% ³ | \$565,000 in the next 10 years. \$6,206,000 beyond next 10 years. |
| 3. Ongoing maintenance works and programmed major river works within the Otaki River | 50% | 50% | \$461,315 for 1998/99 (this includes \$160,000 for Rahui works) and an average of \$318,000/year thereafter |

¹ Funding will be in line with the Local Government Amendment Act 1996 and Council policy at the time. This Act states that the users of services provided by local authorities shall, as far as possible, pay for those services in line with the benefits they receive.

² The regional component of capital works will be funded from the Council's general rate.

³ The community component of capital works will be funded through a Council works and services rate over the Kapiti Coast District, or a separate rate within a defined area of benefit (this would include a direct contribution).

TABLE 5: COUNCIL FUNDING POLICY (UPDATED 1 JULY 1997¹)

- annual reports will be prepared which will document the financial expenditure for the year and the condition of the assets

The Otaki Asset Management Plan is being prepared in line with the outcomes of the FMP. It forms the basis of all ongoing maintenance and replacement of assets. The Landcare Division has allocated \$261,000, over the 10 years commencing in 1997, to prepare and monitor all of its Asset Management Plans.

6.3.3 River Management

The Council has programmed to spend an average of \$318,000 per year until 2007 on maintenance and working toward implementation of the preferred channel alignment.

Major works and land purchase which are not programmed will remain on hold until funding is allocated. Certain programmes may be brought forward if more financial input is available from the community.

6.3.4 Structural

Structural works, including part of the Hughes/Lutz stopbank and the Mangapouri Stream culverts, are going ahead due to funding provided by landowners and KCDC respectively. The design of the Chrystalls Bend stopbank is due to start in the 1998/99 financial year. The remaining structural works will remain on hold until Council funding is available, or a greater financial contribution is made from the community.

6.3.5 Priority of Works

A priority list of outstanding structural works has been created and is shown in Table 6. This takes into account various attributes and the weightings which were developed after consultation with the community.

6.3.6 Non-Structural

The Council input for non-structural methods will be funded from within the programmed budgets. The main input required so far has been supporting KCDC in preparing its District Plan. In the future the main input will be maintaining community preparedness through regional and local civil defence.

The opportunity was taken to put interim planning methods in place during production of the KCDC District Plan in 1995. Ultimately, land use controls and flood hazard categories will reflect the improved situation after construction of all the identified structural methods, but they will also recognise the residual risk. These 'ultimate' flood hazard categories and land use controls are discussed in section 3.3.1.3.

6.3.7 Ongoing Consultation

The cost of consultation with the community will remain where it falls, i.e. the Council will not fund individuals for their input into consultation. However, the Council will cover costs of providing printed material and venues for meetings with Resource Groups and other interested community groups related to this Plan.

These latter costs will be funded through existing Flood Protection Group budgets and within the works budget for major projects.

| Priority | Location/Structural Method | Construction Cost (1997 \$) | Average Annual Flood Damages Saved ¹ | Financial Benefit– Cost Ratio | W V ² (60%) | Present Level of Protection (return period, years) | W V (10%) | Number of People Directly Affected ^P | Area Affected (Ha) | W V (10%) | Social Benefits (%) | W V (10%) | Ecological, Recreational, & Landscape Benefits (%) | W V (10%) | Total Point Value (100%) |
|----------|--|-----------------------------|---|-------------------------------|------------------------|--|-----------|---|--------------------|-----------|---------------------|-----------|--|-----------|--------------------------|
| 1 | Chrystalls—upgrade | \$331,000 | \$425,000 | 20.0 | 0.60 | 50 | 0.04 | 2,000 | 280 | 0.10 | 100 | 0.10 | 4 | 0.01 | 0.85 |
| 2 | Rangiuru—floodgates | \$120,000 | \$80,000 | 10.0 | 0.45 | 20 | 0.07 | 400 | 80 | 0.08 | 52 | 0.05 | 68 | 0.07 | 0.72 |
| 3 | South Waitohu stopbank | \$433,000 | \$120,000 | 4.2 | 0.30 | 10 | 0.10 | 320 | 120 | 0.06 | 68 | 0.07 | 4 | 0.01 | 0.55 |
| 4 | Chrystalls Extended | \$1,026,000 | \$150,000 | 2.2 | 0.20 | 20 | 0.05 | 800 | 150 | 0.07 | 84 | 0.08 | 100 | 0.10 | 0.52 |
| 5 | North bank—minor works | \$25,000 | \$5,000 | 3 | 0.25 | 5,000 | 0.01 | 120 | 35 | 0.04 | 84 | 0.08 | 36 | 0.04 | 0.42 |
| 6 | North bank maintenance | \$135,000 | \$10,000 | 1.2 | 0.15 | 5,000 | 0.01 | 120 | 45 | 0.04 | 84 | 0.08 | 68 | 0.07 | 0.35 |
| 7 | Seaward Extension bank | \$13,000 | \$1,000 | 1.2 | 0.13 | 20 | 0.03 | 40 | 2 | 0.02 | 68 | 0.07 | 20 | 0.02 | 0.27 |
| 8 | Rangiuru—raise floodable houses | \$646,000 | \$25,000 | 0.6 | 0.07 | 5–50 | 0.07 | 88 | 2.2 | 0.03 | 50 | 0.07 | 0 | 0.01 | 0.25 |
| 9 | Lethbridge—raise floodable houses | \$54,500 | \$3,500 | 0.9 | 0.10 | 5–50 | 0.07 | 8 | 0.2 | 0.01 | 45 | 0.05 | 0 | 0.01 | 0.24 |
| 10 | South bank | \$603,000 | \$35,000 ⁴ | 1.0 | 0.11 | 20 | 0.01 | 12 | 40 | 0.02 | 36 | 0.04 | 52 | 0.05 | 0.23 |
| 11 | Mangapouri—raise floodable houses | \$320,000 | \$15,000 | 0.7 | 0.08 | 5–50 | 0.07 | 44 | 1.1 | 0.02 | 52 | 0.05 | 0 | 0.01 | 0.23 |
| 12 | Mangapouri—culverts and stream works | \$1,073,000 | \$10,000 | 0.2 | 0.02 | 1–5 | 0.08 | 120 | 20 | 0.03 | 68 | 0.05 | 52 | 0.05 | 0.23 |
| 13 | South Waitohu—raise floodable houses | \$148,500 | \$7,000 | 0.8 | 0.08 | 5–50 | 0.07 | 24 | 0.6 | 0.02 | 36 | 0.04 | 0 | 0.01 | 0.22 |
| 14 | Harpers stopbank | \$273,000 | \$20,000 ⁵ | 1.0 | 0.08 | 10 | 0.01 | 4 | 25 | 0.01 | 25 | 0.02 | 84 | 0.08 | 0.20 |
| 15 | Hughes/Lutz stopbank | \$810,000 | \$30,000 ¹ | 0.7 | 0.07 | 10 | 0.03 | 20 | 150 | 0.02 | 32 | 0.03 | 84 | 0.04 | 0.19 |
| 16 | Katihiku—floodgates | \$170,000 | \$2,000 | 0.2 | 0.02 | 10 | 0.05 | 8 | 25 | 0.01 | 36 | 0.04 | 20 | 0.02 | 0.14 |
| 17 | Old Coach Rd—bridge raising and stopbank | \$396,000 | \$3,000 | 0.1 | 0.01 | 10–20 | 0.05 | 8 | 5 | 0.01 | 36 | 0.04 | 20 | 0.02 | 0.13 |

¹ Discount rate = 5%.

² W V = Weighted Value.

³ This number is based on the number of people affected by flooding to house or property, restricted access, and damage to services.

⁴ This figure includes maintenance costs saved.

⁵ This figure includes horticultural and pastoral flood damages saved.

TABLE 6: CRITERIA FOR PRIORITY LIST

7. Monitoring and Review

7.1 Why Monitor and Review?

Monitoring will be ongoing, and will enable the Plan to be reviewed in terms of desired outcomes. Regular reviews mean that the floodplain management planning process can be updated and changed as necessary. Monitoring and review of the Otaki FMP will be consistent with the intent of the RMA and will consist of two parts:

- the operational effectiveness of flood mitigation options in decreasing the flood hazard risk
- the effectiveness of the FMP in meeting its overall purpose

7.2 Elements to be Monitored

The items listed in Table 7 will be monitored through the Otaki Asset Management Plan, except where indicated.

7.3 Elements to be Reviewed

The FMP will be reviewed every 10 years or when the flood hazard is significantly altered. Table 8 summarises what will be reviewed and when. It is anticipated that a new Plan will be produced after 40 years, or earlier if required.

7.4 Future Role of the Otaki Community

There will be a future role for the Otaki Community in monitoring the achievement of the Plan.

An informal community group (Friends of the River) with links to the Council and KCDC will be set up. Flood Protection Group staff will be responsible for co-ordinating the group, with meetings to be held as agreed.

The purpose of the group will be to monitor implementation of the FMP. The role of the group will be purely advisory and will also be used for the spread of information between the community and the Council.

The first group will be drawn from members of the existing Resource Group and KFMC to take advantage of their knowledge and experience. The group will be reviewed and re-established every three years.

A chairperson will be elected from within the group every year, with additional members being co-opted at the discretion of the group. The first group will be phased in after formal adoption of the Otaki FMP by the Council.

| <i>Element</i> | <i>Time-frame</i> |
|--|---|
| Community awareness | Ongoing |
| Readiness of disaster agencies to respond | Part of Flood Protection Group's ongoing role |
| Storm surge magnitude | Ongoing |
| River bed levels | 5-yearly |
| Environmental quality | The Council's Consents Management Department's ongoing monitoring |
| New development in flood-prone areas | Annually |
| Sea level rise | Part of Flood Protection Group's ongoing role |
| Natural river and coastal processes and the effect of physical works | 5-yearly |
| Percentage of implementation complete | Annually |
| Estimated value of assets at risk from a 100-year flood | Annually |
| Effectiveness of the methods | Annually |
| Priority of works | Annually |

TABLE 7: ELEMENTS TO BE MONITORED

| <i>Time-frame</i> | <i>Elements to be Reviewed</i> |
|--|---|
| When the flood hazard is significantly altered by completion of a major structural work, or after a major flood, or prior to the approval of District and Regional Plans | Land use control methods Flood hazard maps Advice given to KCDC |
| Every year (in line with the Flood Protection Group's Annual Plan) | Programme by walkover survey Priority of the works |
| Every 10 years | Hydrology Hydraulics Processes monitored Work methodology Non-Structural methods Potential damages and effectiveness of all methods Capital and Operational expenditure budgets |

TABLE 8: ELEMENTS TO BE REVIEWED

8. Cross Boundary Issues

Cross boundary issues arise as a result of the administrative division of the floodplain, estuary and river. Under the RMA, KCDC is responsible for controlling the effects of land use and DOC is responsible for the coastal marine area. The Council is responsible for controlling the bed of the river upstream of the coastal marine area for a number of purposes including the avoidance and mitigation of natural hazards.

Natural processes, including those associated with the Otaki River, continue regardless of these managerial distinctions. The river is constantly altering its course and can threaten properties and infrastructure with erosion or flood damage. Equally, human activities on the floodplain can affect the natural processes, e.g. development that changes flow patterns in a way that increases the flood risk. The interrelationship between the floodplain, estuary and river must be recognised by all those involved in their management.

This FMP is itself a response by the Council to cross boundary issues raised in the Regional Freshwater Plan (Bibliography reference 68). The completion of the Environment Strategy will also help to provide a framework for discussion.

8.1 Issues

8.1.1 Issues Between the Council and KCDC

- Activities or processes occurring in or beside the river and above mean high water springs can adversely affect the way the river reacts in a flood.
- Natural processes of the river are continuously altering the floodplain environment, e.g. erosion, deposition and flooding.
- The implementation of flood mitigation methods may take place in areas or relate to functions outside the Council's jurisdiction, such as on the floodplain.
- Consistency must be achieved between the FMP and the KCDC District Plan.

8.1.2 Issues Between the Council and DOC

- Natural processes of the river and human activity are continuously altering the estuarine and coastal environment.

- There is a need to achieve a consistent approach to the management of the river to ensure the respective management objectives are met.

8.2 Objectives

- To avoid the adverse effects of activities that cross the boundary between the river and the estuary.
- To maintain a process sufficiently flexible for both KCDC and the Council to administer their functions under the RMA and to react to the changing requirements of the river.
- To maintain communication on issues involving the jurisdiction of various bodies, i.e. DOC, KCDC, the Council, and service authorities.

8.3 Policies

- (1) When considering resource consent applications for activities located on the floodplain, to take into account any provisions of this Plan, the KCDC District Plan, the Regional Policy Statement, and the Regional Freshwater Plan, as they relate to flooding and flood risk.
- (2) To provide input to the other agencies preparing management plans that cover areas of the floodplain.
- (3) To maintain communication and co-ordination with DOC regarding management of areas within the Department's jurisdiction as it affects the Otaki River.

8.4 Methods

8.4.1 Consistency of Approach

- Seek a consistent approach between plans dealing with the control of activities where the activities themselves, or their effects, span boundaries or functions.
- Identify issues that cross district and regional boundaries or functions, and formulate joint responses between KCDC and the Council.

In terms of environmental enhancement the Environmental Strategy aims to do this.

8.4.2 Ongoing Consultation

- Use joint hearings where resource consents concern the Otaki River, and are required from both KCDC and the Council.
- Identify issues that impinge on both the Regional Freshwater Plan and the FMP. Liaise with other Council departments to ensure a consistent approach between plans dealing with activities (and their effects) that span boundaries.
- Encourage effective consultation between KCDC and DOC regarding common interests and proposed works.
- Involve DOC early in the planning of any works that will affect an area under its management. This refers especially to the Coastal Marine Area.

9. Plan Changes

As reviews of the Otaki FMP are undertaken, aspects and details may change to reflect the changing needs and desires of the community. Any changes will be issued as addenda and inserted into this section as and when they are approved.

Changes to the Plan will be by Council resolution and can be promoted in accordance with standard Council procedures.

Glossary

100-year flood a 100-year flood event has a 1% (one in 100) chance of being equalled or exceeded in any one year. On average, this is expected to occur once in 100 years, based on past flood records, though in reality it could happen at any time.

aggradation the build-up of gravels and other materials deposited by water action in the bed and along the banks of a river.

amenity values those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

annualised flood damages the amount of flood damages expected to occur on average each year due to floods occurring over a long period.

Asset Management Plans these are plans which assist with physical and financial management of the Council's assets.

batter the side slope of a stopbank or stream bank edge.

beach clearing this may involve removal of flood debris, spraying of weed growth on beaches, cutting and removing excess willow growth, or mechanical scalping and stripping of gravel beaches.

The aim is to prevent build-up of vegetation and, consequently, gravel. This can deflect flood flows, causing possible migration of the river channel and resulting in lateral erosion to the opposite bank. Beach clearing is undertaken above water level, so any disturbance to the channel and flowing water is minimal.

bed and beach re-contouring the moving of gravel that has built up on the inside of bends in the river to the outer eroding edge. This is a short-term cost-effective method of channel alignment. It is usually undertaken to support willow plantings or as a temporary emergency method. The river bed and banks are disturbed with a temporary loss of habitat and water quality.

The normal management practice is to undertake this work when adverse effects will be minimised, i.e. outside fish spawning and migration periods.

berms low-lying flat land adjacent to the river bank. Berms are a natural extension to the main channel and carry water during floods.

bund a ridge of material, usually gravel, placed parallel to the river bank, behind which works are undertaken. It acts as a buffer or filter to mini-

mise any potential discharges of sediments released to the flowing water during the works.

catchment the area drained by a watercourse. It always relates to a particular location and may include the catchments of tributary streams as well as the main river.

channel morphology the geology of the river channel. It includes the size and type of bed material, and the slope of the channel.

Cliff Top Erosion the areas at the top of very high river banks which are actively eroding.

contingency works works necessary to protect permanent dwellings, utilities, and bank protection structures from an imminent threat of erosion. These include the repair of any bank protection works and the re-contouring of the bed of the river

cumec an abbreviation for cubic metres per second, (m³/s), used as a measurement of discharge.

degradation the lowering of a land surface (including river beds) by erosion.

design standard flood mitigation methods are designed to contain a flood of a certain size. In urban areas the design standard for the Otaki River is generally the 100-year event, which equates to 1860 cumecs at the mouth.

Floods greater than the design standard

These events can and do occur. For the Otaki River an event 1.5 × the 100-year flow has been modelled for illustrative and educational purposes only.

development erecting a building, carrying out work, using land or a building, or subdividing land. Infill development refers to developing vacant blocks of land that are generally surrounded by developed properties. Greenfield development refers to development of a completely different nature, e.g. the urban subdivision of an area previously used for rural purposes.

dominant flow regime this is a theory based on the premise that the 2-year return period flow is the significant flow in shaping the river channel.

esplanade reserve or strip a reserve within the meaning of the Reserves Act 1977. That is either:

- a) a local purpose reserve within the meaning of section 23 of that Act, if vested in the territorial authority under section 239
- b) a reserve vested in the Crown or a regional council under section 237D; and which is vested in the territorial authority, regional council or the Crown for a purpose or purposes set out in section 229

An esplanade reserve or esplanade strip has one or more purposes:

- a) To contribute to the protection of conservation values by, in particular:
 - (i) maintaining or enhancing the natural functioning of the adjacent sea, river or lake; or
 - (ii) maintaining or enhancing water quality; or
 - (iii) maintaining or enhancing aquatic habitats; or
 - (iv) protecting the natural values associated with the esplanade reserve or strip; or
 - (v) mitigating natural hazards; or
- b) To enable public access to or along any sea, river or lake; or
- c) To enable public recreational use of the esplanade reserve or esplanade strip and adjacent sea, river or lake, where the use is compatible with conservation values.

fascine fence this is used to protect the riverbank by constructing a fascine of willows or poplars laid horizontally and cabled together to anchor blocks underneath. In front of the willows rail irons are driven and these are cabled back to an anchor block located 10 m back on the riverbank. Vertical willow poles are also installed.

flood a relatively high stream flow that overtops the natural or artificial banks in any part of a stream or river.

flood awareness an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures. It ensures that the community has the ability to cope with a flood event. People who are prepared will respond more appropriately to flood warnings.

flood hazard the potential for damage to property or persons due to flooding.

floodplain the portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows during large floods.

flood-prone a term describing the land likely to be inundated during a 100-year flood.

Flood Warning the process used to warn the community of an impending flood.

floodway the area where most of the water flows during a flood. It is often aligned with obvious naturally defined channels. If even partially blocked, floodways would cause a significant redistribution of flood flow, which could adversely affect other areas.

They are often areas of deeper or swifter flow. The floodway includes land adjacent to the riverbed, required to maintain an adequate corridor for the controlled passage of floodwater.

Fringe the fringe includes areas adjacent to overflow and ponding areas that may be affected by a flood. Water depths would be less than 0.5 m deep. If necessary, people and possessions can be evacuated by four-wheel drive vehicles. Able-bodied adults would have little difficulty in wading to safe areas. Damage potential would be low. Development within fringe areas, resulting in minor or no adverse effect upon the flood hazard (and meeting certain requirements) could be undertaken as a controlled activity.

geomorphology the physical processes which result in the land form and landscape of a particular place.

gravel extraction the selective removal of surplus gravel from the river bed. This has two main purposes. Firstly, to maintain bed levels within an optimum range, and secondly, to correct misalignments and ease pressure against eroding banks. Extraction occurs on the beaches in the river bed and, excluding river crossings, does not involve work in flowing water.

greenfield development see 'development'.

greenhouse effect a warming near the earth's surface that results when the earth's atmosphere traps the sun's heat. The atmosphere allows most of the sunlight that reaches it to pass through and heat the earth's surface.

The earth sends the heat energy back into the atmosphere, but much of this heat doesn't pass freely back into space—because certain gases in the atmosphere absorb it. These gases grow warm and send heat energy back

toward the earth, adding to its surface warming.

groynes structures built perpendicular to the river bank to push the fast-flowing water away from the bank edge. They are intended to halt erosion and maintain river alignment.

- Impermeable rock snub groynes

These consist of rocks which jut into the river at a sharp angle to the flow, in order to deflect the flow away from the bank. Snub Groynes are more appropriate on straight reaches of a river. However, they are less cost-effective than rock rip-rap. To date they have not been used on the Otaki, but they may be considered for future protection works.

- Permeable rail iron groynes

These give a lower strength form of erosion protection than rock rip-rap. However, they are considerably cheaper and, depending on their location and design, quite effective. They consist of rows of railway irons cabled together in herringbone form and pointing between 45 and 60 degrees downstream from the riverbank. The groynes reduce flood velocities and trap silt, resulting in progressive vegetation and sediment build-up around them. Rail iron groynes will be used where possible on the Otaki River.

- Tree groynes

These are used on the Otaki River to provide a moderate, cost-effective level of protection, where the river has meandered outside the design channel alignment but there are no significant assets at immediate risk. Existing tree groynes will be maintained where they remain effective. However, the use and location of tree groynes requires careful evaluation.

habitat the place or type of site where an organism or population normally occurs.

hapu sub-tribe.

heke tribal migration, march to new territory.

hazard this is created when there is an interaction between a natural event and the human use and development in that area.

hui a meeting, or meetings.

infill development see 'development'.

infrastructure networks, links and parts of facility systems, e.g. transport infrastructure (roads, rail, parking, etc.) or water system infrastructure (pipes, pumps and treatment works, etc.).

interophones automated phone messages updating river levels every 15 minutes.

iwi a tribe or people.

kaitiakitanga the exercise of guardianship. In relation to a resource this includes the ethic of stewardship based on the nature of the resource itself.

land this item includes land covered by water and the air space above the land.

layering layering is when willows are partially cut through, then felled towards the river in a downstream direction. The tree may be wired to its stump or to buried anchors to prevent breaking during a flood.

The intent is to allow the willows to sucker from the branches lying on the ground that become covered in silt and gravel, and rebuild the bank edge.

littoral drift the transport of beach material along a coast by wave action.

m³/s a measurement of discharge. The volume of water (measured in cubic metres) that flows past a given point in one second (also referred to as a cumec).

major additions refers to the major ground floor extension of an existing building.

mahinga kai an area where food is traditionally harvested.

manaakitanga the practice of caring for others.

mana whenua the customary or traditional right to the management of the resources of an area or the people who hold this right.

Management Plan a document including, as appropriate, both written and diagrammatic information describing how a particular asset or area of land is to be managed to achieve defined objectives. It may also include descriptions and discussion of various issues, problems, special features and values of the area, the specific management methods that are to apply and the means and timing by which the plan will be implemented.

marae traditionally, the central area of a village used for gatherings, councils, etc.

mauri the life-force present in all things.

meander the natural wave-like pattern of a river across its bed and over the floodplain.

minor additions refers to swimming pools, fencing, storage areas, sheds, carports, domestic garages, repair of an existing structure, or minor one-off additions to buildings.

mitigation the act of moderating or reducing the effects of an event, in this case a flood.

native (plants) produced in or naturally belonging to a particular region or area.

Ngati Raukawa tangata whenua and iwi of the Otaki area.

Overflow Path an overflow path includes areas adjacent to the River Corridor where a large volume of water would flow over a floodplain during a major event. They are often areas of land which lead fast-flowing water away from the River Corridor and over the floodplain. The depth and speed of floodwaters are such that development could sustain major damage. The rise of flood water may be rapid. Evacuation of people and their possessions would be dangerous and difficult. There may be potential danger to life. Social disruption and financial loss could be high. If an overflow path were blocked this could potentially cause a significant redistribution of flood flows to other areas of the floodplain. Overflow paths are generally not suitable for development, unless adequate flood avoidance and/or mitigation provisions are made.

Overflow paths are generally not suitable for development because of the depth and speed of flood water. However:

- Additions to existing development may be acceptable subject to rules, e.g. the same standards as specified for the River Corridor. Where possible, a recommendation to establish a flood-free site above the 100-year flood level should be made.
- Land uses should not adversely affect flood flows. Examples of land uses generally compatible with the flood hazard include rural uses and open space/recreational development. Where proposed developments include club houses, fences, etc. there is a need to consider the effects on the flood behaviour.
- Where stock are grazed, fencing arrangements should enable stock to escape to higher ground.

- Low-density subdivision in existing residential and rural areas may be allowed. Each case is considered on its merits. Each subdivision lot should include a house site and access above the 100-year flood level.

pa a fortified village.

planting river management relies heavily on willow planting to maintain stable bank edges. Branch growth reduces flood velocities on berms and the willow's dense root mass binds the bank edge soils.

Planting consists of willow poles being placed in furrows in the ground. Locations for planting are carefully chosen, with consideration given to the surrounding environment. Hybrid willows that are less susceptible to spreading are used. The willow stands along the banks are maintained by replanting areas where bank erosion has occurred, and periodically cutting and layering mature trees (this thickens stands and promotes new growth).

Ponding Area ponding areas are those where flood waters would pond either during or after a major flood event. Reduced ponding areas may result in adverse effects elsewhere on the floodplain.

Water moves slowly in ponds. However, water levels could rise rapidly. Evacuation of people and their possessions may be difficult, especially on foot, and may need to be by boat. There could be danger to life. Social disruption may be high. Generally, ponding areas are unsuitable for development, unless adequate avoidance and mitigation provisions are made.

rahui a temporary protection or restriction placed upon anything.

real time flood forecasting model this is a computer model that uses rainfall data collected as it falls, to predict flood flows in the river before the flows occur.

residual risk this is the risk of flooding, despite the protection afforded by flood mitigation structures, due to possible breaches of stopbanks and overtopping by flood events greater than that for which the structures have been designed.

return period the frequency in which an event is expected to occur. For example, a 100-year return period is expected to occur once every 100 years, on average.

riparian management this is management of the riparian zone. The ripar-

ian zone consists of the berms and the floodway. This is an important ecological link between the river and land-based ecosystems. Good riparian management is essential to minimise bank erosion, maintain healthy ecosystems, and ensure good water quality.

rip-rap large boulders placed directly below the river bank to prevent the river eroding the bank and bed below scour depth in the active channel. Disturbance to the environment is minimised by separating the river flows from the work area with bunds (bund construction involves machinery working in flowing water for a short time).

Typical maintenance of rip-rap involves topping up and tidying the structure. Additional rock may be required, and is usually sourced from the same quarry as the original material. The repair work is usually able to be undertaken without diversion of the river flow.

river bed this is defined in the RMA . . . In relation to any river, the space of land which the waters of the river cover at its fullest flow without overtopping the banks.

River Corridor the River Corridor comprises the river bed and adjacent floodway. It is the minimum area able to contain a major flood and allow the water to pass safely to the sea. The outer limit of the River Corridor, where not adjacent to a ponding area or overflow path, is generally the extent of a 1% flood (including freeboard).

In areas adjacent to ponding areas or overflow paths, the boundary between the River Corridor and the adjacent area is defined by geographical features that control the flow, or at the point where the flow direction changes from downstream to across the floodplain.

The depth and speed of flood waters are such that existing development in the corridor could sustain major damage. Water may rise rapidly. Evacuation of people and their possessions would be extremely difficult. There is potential danger to life. Social disruption and financial loss could be very high. Most types of development would worsen the impact of flooding on other properties in the vicinity. Even a partially blocked River Corridor would cause a significant redistribution of flood flow, which is likely to adversely affect other areas. Appropriate land uses and development are as follows:

- Open space, recreational and rural land uses such as pastoral farming

are compatible. However, where developments include structures, fences, etc., their effect on the flood flow or behaviour needs to be considered. Where stock are grazed, the fencing arrangements should allow stock to escape to higher ground.

- Where development is proposed, the applicant must demonstrate to the consent authority that there will be no increase in the flood hazard or flood damage to other properties, or that flood behaviour would not be adversely effected.
- There should be no subdivision within the River Corridor except for boundary changes, unless lots including a portion of River Corridor have access or a house site in the portion that is outside the River Corridor.
- Where subdivision occurs, land within the River Corridor should be included in any proposed reserve contributions or esplanade reserve.
- Minor additions to existing structures may be compatible if no increases in flooding or changes to the flooding pattern occur elsewhere as a result. Habitable floors should be above the 100-year flood level.
- Any such development should withstand both flood flows and debris, or should recognise that they will fail with no adverse consequences to the flood risk.
- Residential, commercial and industrial development, forestry, caravan sites, and camping grounds are not compatible. Some types of horticulture that either cannot withstand inundation, or which trap silt or debris or alter flood flows, may not be appropriate either.

run-off the amount of rainfall that ends up as flow in a river or stream.

silent file a restricted access file containing or referring to information that is of significant cultural, historical or spiritual importance to the tangata whenua. Disclosure of such information to the general public is likely to cause offence or degradation of the importance of the sites referred to.

sustainable management this is defined in the RMA as

... managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being, and for their health and safety while:

- a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.

tangata whenua the iwi or hapu (sub-tribe) that holds customary authority over a particular area.

taonga highly regarded physical or spiritual treasures or property.

tapu temporary restriction or ban on use.

telemetry automatic recording of rainfall and river level data linked to the Council Flood Base via a radio network.

territorial authority a city council or district council, in this case KCDC.

tethering where significant erosion has occurred, willows are often re-established by tethering large willow trees with wire rope against the eroding bank and partially covering them with gravel. Anchors, such as driven railway irons and concrete blocks are frequently used to hold the trees in place. This technique enhances bank stability and is a very good way to re-establish willows.

Te Tutohinga O Te Whakaaetanga the Charter of Understanding between the Council and the Iwi in its area.

threshold of motion regime the flow at which sediment transport commences.

Tikanga Maori Maori customary values and practices.

tino rangatiratanga chieftainship, chiefly authority, or full authority.

urupa a burial ground.

waahi tapu a sacred site, as defined by a hapu or iwi. Some waahi tapu are recognised and respected generally. These are principally urupa, which are seldom interfered with, but this does not automatically occur, particularly if commercial interests clash with preservation.

If the waahi tapu in question is not urupa, but has other spiritual significance, recognition of its value is more difficult to establish. Not all restric-

tions are permanent. A tapu or rahui can be imposed for a period of time—following a death, for example.

wetland this includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals adapted to wet conditions.

zone/zoning the use of land use zones is not intended to unjustifiably restrict development within the floodplain. They are based on an objective assessment of flood hazard, environmental and other factors, such as:

- whether the land is in an area of high risk
- whether there is the potential for future development to have an adverse effect on flood behaviour, and therefore on existing development
- whether adequate house sites and access are available during floods
- whether certain activities should be excluded because of risk to users, e.g. hospitals, schools, accommodation for the elderly, etc.

Bibliography

All the reports referred to in this Plan are available from the Council's Information Services Department.

Otaki FMP Reports

Phase 1 Reports

1. Adams M, Gilliland B W and Watson J D (c. 1988), Manawatu Catchment Board, **The Water Resources of the Otaki Catchment**. (Unpublished Report.)
2. Blackwood P L (1992), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase One, Investigations: Summary Report**.
3. Borrie N (1992), Agricultural Engineering Institute, **Otaki River Floodplain Management Plan: Assessment of Potential Flood Damage Costs**.
4. Brougham G G (1976), Manawatu Catchment Board and Regional Water Board, **Environmental Assessment of the Otaki River Scheme and Shingle Resources**.
5. Brougham G G (1976), Manawatu Catchment Board and Regional Water Board, **Shingle Management Report on the Otaki River**.
6. Brougham G G and Brown D M (1978), Manawatu Catchment Board and Regional Water Board, **Otaki Scheme Review 1948–1978**.
7. Brougham G G and Brown D M (1983), Manawatu Catchment Board and Regional Water Board, Report No. 51, **Otaki Scheme Review 1978–1982 and Proposed Works 1983–88**.
8. Brougham G G and Gestro B L (1986), Manawatu Catchment Board, Report No. 69, **The Kapiti–Waikanae Catchment Control Scheme and Proposed Works 1987–1992**.
9. Brougham G G and McLennan N R (1983), Manawatu Catchment Board and Regional Water Board, Report No. 59, **Otaki River Channel Change and Gravel Resources**.
10. Brougham G G And McLennan N R (1984), Manawatu Catchment Board and Regional Water Board, **An Economic Appraisal of the Otaki River Scheme 1983–88**.

11. Climo N A (1993), Consulting Engineer, **Otaki River Floodplain Management Plan: Structural and Geotechnical Assessment of Stopbanks, Stability Assessment.**
 12. Dick G R (1992), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Structural and Geotechnical Assessment of Stopbanks—Qualitative Assessment.**
 13. Dominic Holdings application/Planning Tribunal case (1992).
 14. Easther J (1991), Catchment Engineering Limited, **A History of the Management of the Otaki River and Flood Control Scheme.**
 15. Evans B (1992), Boffa Miskell Partners, **Otaki River Floodplain Management Plan: Environmental Investigations.**
 16. Evans P G (1948), Manawatu Catchment Board, **Report on Proposed River Control and Drainage Scheme—Otaki Area.**
 17. Evans P G (7 March 1955), Manawatu Catchment Board, **Report to the Chairman, Flood Damage Report.**
 18. Kapiti Coast District Council (1992), **Otaki River, Flood Damage Assessment, 100-year event.**
 19. Leenards A G (1976), Manawatu Catchment Board and Regional Water Board, **Report on the Otaki River Scheme, Bed Survey and Shingle Resources.**
 20. Macky G H (1992), Hydrology Centre, DSIR, **Otaki River: Assessment of 1955 Floods.**
 21. McKerchar A I (1991), Hydrology Centre, DSIR, **Kapiti Coast Floodplain Management: Hydrology and Climatology.**
 22. Robb C A (1992), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: River and Floodplain Hydraulics Report.**
 23. Royal C (1992), Te Rununga o Raukawa Marae Committee, **Otaki Floodplain Management Plan: Tikanga Maori.**
 24. Stanton B (1992), Marine and Freshwater, DSIR, **Kapiti Coast Floodplain Management Plans: Review of Design Storm Surge Levels.**
 25. Williams G J (1992), G and E Williams Consultants, **Otaki River Floodplain Management Plan: Channel Management.**
 26. Williams G J (1992), G and E Williams Consultants, **Otaki River Floodplain Management Plan: River Characteristics and Sedimentation.**
 27. Wilshere D S (1992), Rivers Department, Wellington Regional Council, Report No. 92.73, **Kapiti Coast Floodplain Management Plans: Proposal for Public Involvement Procedures.**
 28. Wood R (1992), Wairarapa Division, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase One Investigations: Catchment Condition Survey (Headwaters Catchment).**
 29. Wright W R and Holland M K (1984), Manawatu Catchment Board and Regional Water Board, **Otaki Scheme Classification.**
- Phase 2 Reports**
30. Berghan T L (1994), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Two Investigations: Description of Non-Structural Options for Discussion.**
 31. Blackwood P L (1993), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Scope of Phase Two Investigations: Development and Evaluation of Flood Mitigation Options.**
 32. Blackwood P L (1994), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Two Investigations: River Management and Protection Works Options.**
 33. Blackwood P L (1994), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Two Investigations: Combinations of Options: Volume One, Discussion Document; Volume Two, Background Appendices.**
 34. Blackwood P L and Robb C A (1993), Rivers Department, Wellington Regional Council, **Chrystalls Bend Options Design Report.**
 35. Boffa Miskell Ltd (1994), **Otaki River Floodplain Management Plan: Phase Two Investigations: Preliminary Assessment of Environmental Effects.**

36. Manssen S R (1994), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Two Investigations: Stopbank Options.**
37. Manssen S R (1997), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Two and Three Investigations: Hydraulic Modelling.**
38. Tonkin and Taylor Ltd (1994), **Otaki River Floodplain Management: Structural Flood Mitigation Investigations Phase Two.**

Phase 3 Reports

39. Barwick H (1996), Brown, Copeland and Co. Ltd, **Analysis of Statistics Describing the Social and Economic Development of Otaki.**
40. Blackwood P L and S R Manssen (1996), Rivers Department, Wellington Regional Council, **Otaki Floodplain Management Plan: Phase Three Investigations: Confirmed Flood Mitigation Measures.**
41. Blackwood P L (1995), Rivers Department, Wellington Regional Council, **Otaki Floodplain Management Plan: Scope of Phase Three Investigations: Detailed Evaluation of Preferred Flood Mitigation Options.**
42. Blackwood P L (1996), Rivers Department, Wellington Regional Council, **Otaki Floodplain Management Plan: Phase Three Investigations: River Management and Protection Works.**
43. Blackwood P L (1996), Rivers Department, Wellington Regional Council, **Otaki Floodplain Management Plan: Phase Three Investigations: Risk Analysis and Economic Evaluation of the Recommended Flood Mitigation Measures.**
44. Blackwood P L and Oppatt G H (1996), Rivers Department, Wellington Regional Council, **Otaki Floodplain Management Plan: Otaki River Gravel Analysis 1991–1996.**
45. Boffa Miskell Ltd (1996), **Otaki Floodplain Management Plan: Phase Three Investigations: Environmental Evaluation.**
46. Brown, Copeland & Co. Ltd (1996), **Estimation of Benefits and Cost-Benefit Analysis of Rural Stopbanks on the North Side of the Otaki River.**
47. Connell Wagner Ltd (1996), **Otaki River Floodplain Management Plan:**

Phase Three Investigations: Volume One, Stopbanks, Floodgates and Rangioru Pump Station; Volume Two, House Raising Works.

48. Knight C (1996), Rivers Department, Wellington Regional Council, **Otaki River Floodplain Management Plan: Phase Three Investigations: Non-Structural Options Report.**
49. Wilshere D S (1998), Flood Protection Group, Wellington Regional Council, **Otaki River Floodplain Management Plan Public Involvement Strategy: Phase 1–3: A Resume.**

Other References

49. Erickson, N J (1986), NWSCA Report No. 61, **Creating Flood Disasters?**
50. Extract from Report of the Controller and Auditor-General (1996), **Funding the Restoration of Essential Community Services Following Natural Disasters**, TEPHRA Vol.15 No.1 p. 36–39.
51. Helm P. (1995), **The Role of Central Government in Recovery in Sustainable River Schemes—Funding Issues Seminar 9 & 10 May 1995.**
52. Hutt City Council (1996), **Community Emergency Response Training Programme.**
53. Kapiti Coast District Council (1993), **Civil Defence Plan.**
54. Kapiti Coast District Council (1993), **Civil Defence Standard Procedures Instruction Manual.**
55. Kapiti Coast District Council (1994), **Tararua—the Story of a Mountain**, Whitcombe Press.
56. Maclean C & J (1988) **Otaki Past and Present**, Whitcombe Press.
57. Mitchell, C (1996), Wairarapa Division, Wellington Regional Council, **Effect of River Control Works on Aquatic and Riparian Communities in the Upper Ruamahanga River.**
58. **The National Civil Defence Plan: Parts I and II (1992).**
59. **Natural Hazards Observer**, Vol. XX No.5 (page 23), (1996).

60. New South Wales Government (1986), **Floodplain Development Manual.**
61. Parker D J, Green C H & Thompson P M (1987), **Urban Flood Protection Benefits: a project appraisal guide**, Gower Technical Press.
62. Wellington Regional Council (1991), **Transitional Regional Plan.**
63. Wellington Regional Council (1996), **Beacon Hill Standard Response Procedures.**
64. Wellington Regional Council (1996), **Civil Defence Response Plan.**
65. Wellington Regional Council (1996), **Duty Officer Standard Response Procedures.**
66. Wellington Regional Council (1996), **Draft Regional Landscape Plan.**
67. Wellington Regional Council (1996), **Response Sub Plan For a Major Flooding Event in the Wellington Region: Sub Plan One.**
68. Wellington Regional Council (1997), **Proposed Regional Freshwater Plan.**
69. Wellington Regional Council and Boffa Miskell Ltd (1993), **Otaki River Floodplain Management Plan: Assessment of Effects on the Environment, Chrystalls Bend Channel Realignment.**
70. Wellington Regional Council (1997), **Waikanae Floodplain Management Plan.**
71. Williams G J (1992), G and E Williams Consultants, **Otaki River: Chrystalls Bend Channel Realignment Works Final Design Report.**

Relevant Legislation

- The Civil Defence Act 1983.
- The Resource Management Act 1991.
- The Soil Conservation and Rivers Control Act 1941.
- The Water and Soil Conservation Act 1967.
- The Building Act 1991.
- The Local Government Amendment Act 1996.

Appendices

- A Legislative Framework
- B Phases of Floodplain Management Planning
- C Regional Civil Defence Operations
- D Kapiti Coast Disaster Response Procedures
- E National Recovery Plan
- F Flood Warning System

Appendix A: Legislative Framework

Resource Management Act 1991

The primary statute under which the natural and physical resources of the region are managed is the RMA. The RMA provides for the preparation of regional plans to assist the Council in carrying out any of its functions in order to achieve the purposes of the RMA. Regional Plans are to be prepared in a manner set out in the First Schedule of the RMA.

The Council and KCDC both have the avoidance or mitigation of natural hazards as a function under the RMA.

The Council has numerous responsibilities under section 30 of the RMA including:

- a) The establishment, implementation and review of objectives, policies and methods to achieve integrated management of the natural and physical resources of the region.
- b) The preparation of objectives and policies in relation to any actual or potential effects of the use, development, or protection of land which are of regional significance.
- c) The control of the use of land for the purpose of—
 - (iv) The avoidance or mitigation of natural hazards.

KCDC has responsibility under section 31 of the RMA for:

- a) The establishment, implementation and review of objectives, policies and methods to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district.
- b) The control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards . . .

DOC and the Council both have jurisdiction over the Coastal Marine Area. DOC, the Council and KCDC have jurisdiction over Local Purpose Reserves. The management of the areas must occur through a co-ordinated approach by all bodies with the interest of the particular environment at the centre of any decision.

Natural hazards are those naturally occurring events that threaten human

life, property or other aspects of the environment. Section 2 of the RMA defines natural hazards as:

any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property or other aspects of the environment.

The RMA provides the framework for the management of the region by integrated management and management of effects.

Integrated management is the shared vision of how the nation's resources should be managed between and within agencies responsible for those natural resources. This management practice is in response to the recognition of the holistic nature of natural resources.

Managing effects, or potential effects, requires identifying activities having a significant effect on the environment. Activities that have an effect are those which have the potential to disturb the natural environment.

Part II contains a number of specific provisions that must be taken into account when considering the use, development or protection of the region's water bodies and associated floodplains.

Section 5 states the purpose of the RMA as . . . to promote sustainable management of natural and physical resources.

Section 6 identifies a number of matters of national importance that the Council must recognise and provide for in managing the use, development and protection of natural and physical resources. Included is the protection of the natural character of wetlands, lakes and rivers and their margins.

Section 7 identifies a number of additional matters the Council must have particular regard to in managing the use, development and protection of natural and physical resources. Included is the maintenance and enhancement of amenity values and intrinsic values of the ecosystems.

Section 32 requires councils to be objective in preparing Regional Plans. In particular, when determining objectives, policies and methods, they must have regard to alternatives that may be available and the reasons for and against options, including their costs and benefits. In the preparation of this Plan, the various options have been discussed with members of the

community, and the approach in the Plan is that preferred by the community as a whole.

Soil Conservation and Rivers Control Act 1941

This Act includes provisions . . . for the prevention of damage by erosion . . . and . . . the protection of property from damage by floods. Within the general powers (section 126) of this Act the principal function of every Catchment Board is to minimise and prevent damage within its district by floods and by erosion. These Catchment Boards, whose powers have now been assumed by Regional Councils, have wide powers in relation to watercourses for the purpose of their functions.

Section 126: General Powers of Catchment Boards:

2. Each Board shall have all such powers, rights and privileges as may reasonably be necessary or expedient to enable it to carry out its functions, and in particular each Board shall have power to construct, reconstruct, alter, repair, and maintain all such works and do and execute all such other acts and deeds, including the breaching of any stopbank, as may in the opinion of the Board be necessary and expedient for:
 - a) (repealed)
 - b) controlling or regulating the flow of water in and from watercourses
 - c) preventing or lessening any likelihood of the overflow or breaking of the banks of any watercourse
 - d) preventing or lessening any damage which may be occasioned by any such overflow or breaking of the banks
 - e) preventing or lessening erosion or the likelihood of erosion
 - f) promoting soil conservation

Building Act 1991

The Building Act 1991 and Building Regulations 1992 provide a performance-based building control system that applies to the construction, alteration, demolition and maintenance of most structures within the Otaki area. The controls within the Building Act assist in ensuring development is compatible with the prevailing flood hazard, and that the overall level of flood damage will not be increased significantly. Types of controls available through the Building Act are, for example, setting of floor levels and filling of sites.

Recent case law has ruled that in certain instances the RMA can override the Building Act.

Relationship of Floodplain Management Plans to the Regional Policy Statement and Regional Plans

The Council made the decision that the region's FMPs would not be statutory documents in themselves. The approach was taken that Regional and District Plans would be used to ensure that the non-structural methods are achieved, and the Flood Protection Group Annual and Business Plans would be used for the structural and river management methods.

Figure 16 summarises the roles of the various Council Plans in implementing the FMP outcomes:

Regional Policy Statement

The Regional Policy Statement provides an overview of resource management issues and sets the policies and methods by which the Council seeks to achieve integrated management of the natural and physical resources of the region. The Regional Policy Statement became operative on 15 May 1995. It contains objectives, policies and methods covering a wide range of resource management issues, including the mitigation of natural hazards and the management of fresh water. Method 14 in the Natural Hazards chapter requires the Council to implement natural hazards policies through Regional Plans.

Facing the Future

Facing the Future is the Council's Long-Term Financial Strategy. It outlines:

- what the Council plans to do between 1997–2007
- why the Council is going to do it
- what it will cost, particularly the impact on rates
- how the community will benefit
- what challenges the Council will face

Regarding flood protection, the 10-year action programme includes:

- the preparation of FMPs
- flood hazard assessments and scheme reviews

- the management and improvement of River Corridors, stopbanks and associated flood protection assets

Flood Protection Group Business Plan

The Business Plan identifies the objectives, financial matters, performance targets, and standards for 1995–2005. The objectives of the Flood Protection Group are:

- to promote integrated and sustainable management of rivers and floodplains and the mitigation of flood hazards
- to ensure the ongoing maintenance and effectiveness of waterways, land and assets
- to develop policies for effective river management and flood mitigation
- to implement FMPs and reduce flood risks
- to enable the community to respond to flood risk
- to provide timely flood warning and response
- to manage the Group cost-effectively

The performance targets in the long-term are:

- FMPs completed for all the major western rivers by 2001
- flood hazard assessments completed for significant secondary streams by 2002
- flood hazards reduced to acceptable levels
- effectiveness of river assets maintained
- quality of riverside environments perceived by the community to have improved
- flood warning and response improved

Annual Plan

Preparation of the Annual Plan is required by the Local Government Amendment Act 1996. All local authorities must prepare an Annual Plan. It must outline the nature and scope of activities undertaken by the organisation over the financial year, along with the funds required to undertake these activities.

Floodplain Management Plans

Presently, the Council has resolved that FMPs should have no formal statutory basis. Instead they should be used as working guidance documents with respect to carrying out floodplain management, evaluating the options, and establishing the overall desired outcomes. Therefore, these Plans are non-statutory documents prepared in consultation with the community. In comparison to Regional Plans (that cover a diverse range of issues), the Otaki FMP specifically deals with management of the river and providing flood protection measures. At the same time the Plan provides the framework for guiding land use and development on the floodplain.

Regional Plans

The Proposed Regional Freshwater Plan includes objectives, policies and methods to promote the sustainable management of fresh water in the region. The issue of flood mitigation is raised in Part 3 of the Plan and addresses two aspects of flood hazard:

- the actual and potential adverse effects of flooding as a natural hazard on human life, property or other aspects of the environment
- the actual and potential adverse effects that the use of the river and lake beds and the subdivision, use and development of land can have on flood flows

Methods to overcome these aspects are based around the preparation of FMPs. Policies and methods are to be implemented through these Plans. They will be used as the basis for the Council's approach to floodplain management.

Part 2 of section 3 of the Proposed Regional Freshwater Plan also addresses the relationship of Maori with freshwater in the Kapiti Coast District. The specific activities and areas of concern are addressed in Part IV of the Freshwater Plan.

The Proposed Regional Coastal Plan deals with most aspects of managing the coastal marine area in the Wellington region. It indicates how the Council seeks to achieve sustainable management of the coastal marine area. For that purpose it details a number of activities which Council considers could occur within the area, and addresses whether these activities are appropriate for sustainable management. Several activities discussed are those which

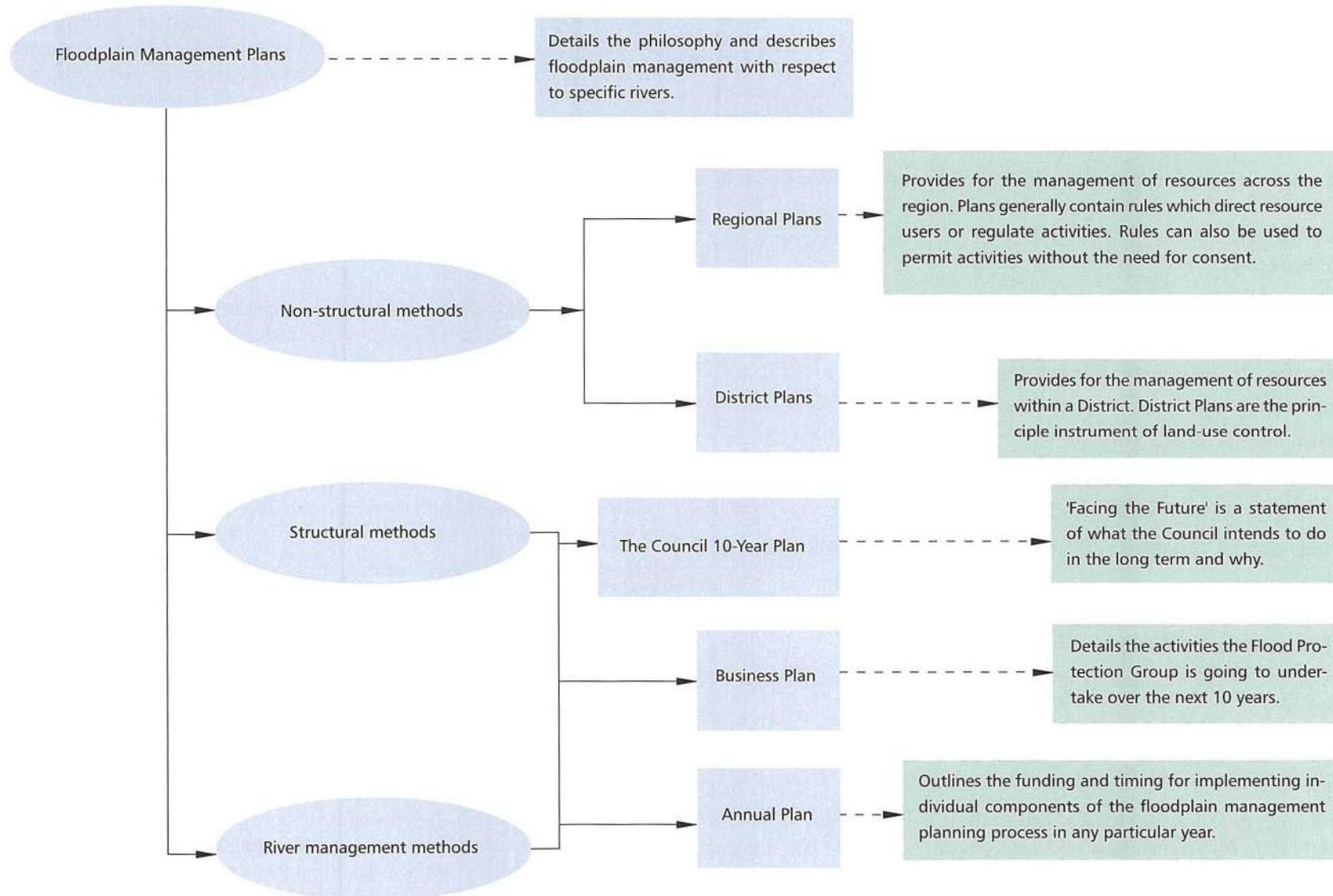


FIGURE 16: WHERE FMPs FIT IN RELATION TO OTHER PLANS

are undertaken by the Council for flood mitigation purposes and are therefore discussed in this Plan.

The Draft Regional Landscape Plan addresses landscapes of regional significance, and is concerned with the effects of human activities on these highly valued areas. It contains objectives and policies for managing the effects of use and development on these landscapes. The management of regionally significant landscapes is addressed and includes the Otaki River.

The Regional Discharges to Land Plan and Regional Air Quality Management Plan are intended to work in a complementary manner. Discharges to land, water and air may be used in the mitigation of floods. However, activities that would involve such a discharge are not included.

District Plans

Regard must be given to the extent to which the FMPs must be consistent with the KCDC District Plan. As the RMA stipulates flood hazard mitigation to be a responsibility of both the Council and KCDC, the Plans must reflect a co-ordinated approach to mitigating the flood hazard.

In this regard the KCDC District Plan includes restrictions and land use controls, in particular relating to building and subdivision, and maps and zones showing flood hazards. All of these assist in the avoidance and mitigation of the flood hazard.

Appendix B: Phases of Floodplain Management Planning

Phase One

Phase One covers the definition of the flood problem. The nature, extent and severity of flood hazards were determined, and the sociological values of the community, development, and the area's environmental issues were recognised. Outcomes are reported in the Phase One summary document (Bibliography reference 2). This document draws together the findings of the detailed reports prepared as part of the Phase One investigations.

Phase Two

Phase Two concerns the evaluation of the effectiveness of all flood mitigation options. Evaluation included initial selection of some options (or a combination) and used technical, social and environmental databases established in Phase One. Factors considered included physical flood conditions, land requirements, costs, benefits and economic efficiency, visual impact, development pressure, and social/community values regarding perceived risk and level of protection. Mitigation methods are those that:

1. modify the flood event—stopbanks, detention dams, channel improvements
2. modify damage susceptibility—zoning and building permit restrictions, flood proofing, flood warning and community preparedness
3. modify the flood loss burden—insurance, disaster relief

Options are described in the Phase Two Scoping Report (Bibliography reference 31). These options were then grouped into combinations of options in a further document (Bibliography reference 33). This report formed the basis for the consultative process, enabling selection and recommendation of the preferred flood mitigation methods.

Phase Three

Phase Three includes refinement of the chosen options, taking into consideration an environmental impact assessment. Three reports were prepared which described the detailed investigations into the recommended River Management, Structural and Non-Structural methods (Bibliography references 42, 47 and 48). An environmental and economic evaluation of these

methods was then undertaken (see Bibliography reference 45).

Phase Four

Phase Four is the drafting of the Otaki FMP.

Phase Five

Phase Five is the Plan's implementation. Theoretically, implementation will occur when the Plan is completed. In reality, the rate of implementation will depend on many factors including the Council's rolling 10-Year Plan and the Flood Protection Group's Business Plan.

Certain aspects, such as some of the land use methods, have already been incorporated into the KCDC District Plan. Preparation of the District Plan was undertaken before the Plan's completion. However, Phase Three investigations had identified land use methods as appropriate, and missing this opportunity would have caused considerable delay in implementing any of the methods. Chrystalls Bend improvement works were also completed in 1995 ahead of this Plan. Both stopbanks and land use methods have been identified as being particularly urgent, because of the high risk to a large section of the community.

Appendix C: Regional Civil Defence Operations

Roles and Responsibilities

The National Civil Defence Act 1983 requires the Council to maintain a civil defence organisation for the region together with units and services necessary or desirable to enable an effective response to be carried out during a civil defence emergency. If there is a major flood, a regional headquarters will be activated. This will support local response operations in the Wellington region. Headquarters will have the following purposes:

- to provide a central co-ordination point for regional response efforts in support of local government operations
- to co-ordinate dissemination of public information
- to provide a focal point for collecting operational intelligence and damage assessment information regarding the event

The Regional Civil Defence Headquarters will be activated when it is clear a major flood event is about to or has actually happened, and it will serve as the primary direction and control facility for co-ordinating the regional response to the affected area.

In a flood disaster, the Headquarters will provide the following services for the affected area:

- collect, process and display operational information about the flood
- analyse the disaster situation
- serve as the primary centre for receiving requests for national assistance
- establish regional response priorities and allocate resources within the affected area
- request necessary resources from within the region and, where resources are not available, draw up resource requests for the Ministry of Civil Defence
- provide a location for primary interaction with Central Government
- co-ordinate Council operations within the region
- function as a central point for collecting and co-ordinating emergency public information

- co-ordinate the use and deployment of helicopters and planes

Organisational Concept

A large number of functions, organisations and departments will operate during a major disaster

The National Civil Defence Plans identify a number of essential functions:

- operations
- intelligence
- emergency public information
- transport
- welfare
- communication
- rescue
- medical
- public health
- energy
- supply
- warning systems
- law and order

Civil Defence operations are designed to clearly establish priorities for response, and to meet local government requirements for support in the most effective manner possible.

Some government agencies/organisations already have functioning emergency management systems and emergency operating centres. Others may elect to operate some of their co-ordination functions from their own facilities. However, because of the problems caused by a major flood, the involvement of many organisations, and the need to address many policy and priority issues and maximise co-ordination, it is vital to have all major emergency management functions at one location. The Regional Civil Defence Headquarters satisfies that function.

Priority Setting and Resource Allocation Decisions

A major flood in the Wellington region would require resources to be used as effectively as possible. The potentially widespread effects of the flood may require prioritisation of resources to meet the most critical needs, so it may be some time before local operations are fully resourced.

The Regional Controller and Situations Manager (assisted by the Liaison Advisory Team), will continually evaluate and establish response priorities and when necessary, determine local allocations. Allocation decisions about incoming resources and supplies will be made on the basis of the highest priority lifesaving needs. A 'first come, first served' philosophy will NOT be followed.

Regional Action Planning

The Regional Controller, Situations Manager and Liaison Advisory Team should meet periodically for situation briefing, action planning, and setting of overall response priorities.

At the end of each planning meeting a time-frame for subsequent meetings and assigned tasks should be established.

Planning sessions should start with a brief situation summary from the Situations Manager. Major problems requiring regional support should be identified and response priorities established. Resource needs over and above those currently planned should be determined and persons/organisations allocated to secure those resources.

Disaster Intelligence and Situation Analysis

The Regional Headquarters is the primary point for receiving and analysing all incoming Disaster Reports from local Civil Defence Headquarters, Liaison/Advisory Team members, and other reporting sources. Current information will be displayed in the operational area and reports will be prepared as required. Headquarters will summarise situation information on available committed resources.

Forecasts and projections will be developed to cover future requirements as determined by the Controller and the Planner.

Communications

How well the Regional Headquarters fulfils its mission depends on how

well it communicates with its sub-area Headquarters and local Civil Defence organisations within the affected area.

In a very serious flood emergency some communication systems may be damaged or overloaded.

Regional communications will immediately be activated and begin the process of establishing functional communications utilising whatever means available.

The Regional Controller in conjunction with Telecom will draw up restoration priorities for non-operational systems.

Regional Headquarters Organisation and Staffing

The initial staff responding to and activating Regional Headquarters will consist of:

Council staff available during the flood.

A staff roster system will be implemented as soon as is possible. Additional personnel to augment the Regional Headquarters may be requested by the Controller, using the Commissioner support team system.

Public Information

The Media Liaison Officer reports to the Situations Manager and co-ordinates all aspects of the public information—to ensure the release of consistent and non-conflicting information. A joint information centre may be activated in co-operation with the Ministry of Civil Defence. Other public information activities may take place in the affected area.

Flood Protection Group

The Flood Protection Group will liaise with the Controller on the current situation and the relevant management strategies of the Flood Protection Group.

The Flood Protection Group will:

- provide regular updates of current situation
- brief the Controller, Advisory/Liaison staff, and media as requested
- work with the Public Information Officer

Purchase and Supply

The Purchase and Supply Section, staffed by Council personnel, is responsible for obtaining resources that are not available from within those organisations/ government departments assisting with the emergency. These would include, but are not limited to, bulk food supplies, petroleum fuels, heavy equipment, and consumable supplies. This section is also responsible for maintaining records of purchase/title.

Summary of Liaison/Advisory Support Organisations

Table 9 provides a summary of liaison/advisory support organisations.

Appendix D: Kapiti Coast Disaster Response Procedures

Civil Defence Plan

The objective of the Kapiti Coast Civil Defence Plan is

... to set out the prior arrangements to be made and the responsibilities to be exercised by or on behalf of the Kapiti Coast District during a state of National, Regional or District Civil Defence Emergency ...

The plan deals specifically with those actions necessary to

... reduce the loss of human life, to care for the injured and to help those in distress as a result of a disaster whilst a state of emergency continues ...

It identifies personnel authorised to declare a state of emergency, and the Civil Defence Controllers and their respective authorities and roles.

Civil Defence also gives information on:

- warning systems
- law and order
- the fire service
- medical and public health
- public information
- welfare
- transportation
- communications
- energy—gas and electricity
- supply
- requisition of property
- rescue procedures

Civil Defence Standard Procedures Instruction Manual

This manual outlines the procedures for the Kapiti Coast Civil Defence Headquarters. It details the following:

- organisation

- activation procedures
- operational responsibilities
- communication facilities
- information management systems

The functions of the District Civil Defence Headquarters are

... the collection and dissemination of information on the nature and extent of the emergency, and the co-ordination of the use of the local resources of government departments, other government agencies, liaison services and assistance from any other quarter in meeting a situation beyond local civil defence capabilities ...

The manual identifies and details the roles of all those council staff, staff from other agencies, and volunteers, who may be called upon during a Civil Defence emergency. Instructions on the procedures to be followed cover:

- casualty
- rescue
- Controller support
- chemical/dangerous goods
- tsunami warnings
- people and their animals
- neighbourhood support
- flooding and heavy rainfall warnings
- public information
- supply
- transport
- Commissioner's support teams
- finance and emergency expenditure
- evacuation principles and considerations

Existing Civil Defence Procedures in the Event of a Flood

Disaster response and planning is currently organised on a geographical

| <i>Agency</i> | <i>Primary Task</i> |
|--|--|
| Capital Coast Health | <ol style="list-style-type: none"> 1) Board Office: regional co-ordination of resources, Medical Officer of Health, Public Health, publicity and information to public, co-ordination with Regional Civil Defence. 2) West Coast: care for staff and patients in hospitals, co-ordinate and maintain medical and surgical services, prepare for reception of casualties or patients relocated from other hospitals, maintain public health, co-ordinate with District Civil Defence. |
| Electric Power Liaison | Make infrastructure safe and restore supply. |
| Flood Protection Group | LEAD AGENCY. Assess available information, make predictions, provide warnings to appropriate agencies. |
| Gas Liaison | Make infrastructure safe and restore supply. |
| GNS | Advise on seismology, earth deformation, and land stability. |
| Harbours Department, the Council | Make available a float rescue craft. |
| Housing New Zealand | Control housing of displaced persons. |
| Insurance Council of New Zealand | Bring the insurance emergency service plan into operation. |
| Inter-church Trade & Industry Mission | Look after the welfare needs of Headquarters staff. |
| Landcare and Utility Services Divisions, the Council | Bulk water, rural fire, flood protection, forestry. |
| Land Safety Transport Authority | Protect motorists and other road users; define alternative routes; control entry into affected areas. |
| Life Flight Trust, WestpacTrust Helicopter | Heavy lifting, rescue, and reconnaissance. |
| New Zealand Fire Service | Standard Fire Service procedure. |
| New Zealand Police | Standard Police Procedure. |
| NZ Red Cross | Supply emergency clothing/blankets. Provide a team of people trained in light rescue, first aid, emergency welfare and catering. |
| Plunket | Give advice to the caregivers of children under 5 years. |
| Public Information/Media Liaison | Activate and run emergency Public Information Section. |
| Resource Investigations Department, the Council | Assess pollution of natural waters. |
| Salvation Army | Provide catering services to civil defence personnel, displaced people, workers in the field, and welfare centres. |
| SPCA | Co-ordinate the rescue of ALL animal and bird life and supply the necessary holding facilities. |
| Telecom | Provide public telecommunications services. |
| Transit New Zealand | Assist Controller and determining priority order for restoration of highways. |
| Wellington Free Ambulance | Organise pre-hospital care and transport for sick and injured. |

TABLE 9: CIVIL EMERGENCY SUPPORT ORGANISATIONS

basis, with different groups operating in Otaki Beach, Otaki township, and rural areas. This separation is for a number of reasons: physical separation of the floodplain caused by the river, separate communities of interest, and differing networks that operate in each area.

The Police have set up a network of 90 neighbourhood support groups, with one designated person from each group responsible for contacting the other members of the group in an emergency. The Civil Defence Network uses this local network to help co-ordinate responses to all types of disasters, and has methods in place to provide disaster response in the event of a flood (Figure 17).

Sirens are also located at Otaki Beach, Otaki Township, and State Highway 1 shopping complex. A fourth siren is proposed for the Waitohu Store. These sirens are for use in any civil emergency.

The Council has a responsibility under the Civil Defence Act (1983) to co-ordinate and prioritise the use of resources and personnel made available from emergency services, government departments, private industry, and territorial authorities not involved in the emergency. This role is undertaken by the Civil Defence Controller.

The Council is responsible for co-ordinating the processing of disaster intelligence and the release of public information. A more detailed explanation of the roles, responsibilities and procedures is given in Appendix C.

In a flood, the success of the disaster response methods depends greatly on the level of community support and awareness. Direct community involvement is therefore encouraged. To this end, KCDC has enlisted the support of the existing network of community or neighbourhood support groups.

Disaster Recovery

Part Two of the Civil Defence Plan addresses the issues related to recovery. The priorities for disaster recovery are:

- safety of people
- social restoration
- economic restoration
- physical restoration

In line with the National Civil Defence Plan guidelines, KCDC is establish-

ing a Kapiti Coast Emergency Relief Fund that is . . . designed to act as the central focus for contributions made by the public to assist the victims of an emergency. KCDC is also a member of the Local Authority Protection Plan (LAPP), a mutual scheme for local authorities providing disaster funds for recovery and emergency financial relief.

Appendix E: National Recovery Plan

Role of Central Government in Disaster Recovery

The purpose of the National Recovery Plan, 'Natural Disasters and Emergencies within New Zealand', is to help communities resume their normal activities. The role of central government is to supplement that of the regional and territorial authorities, and is the minimum assistance required to restore the community capacity for self help (Bibliography reference 58).

Principles of the National Recovery Plan

The emphasis of the Recovery Plan is that of Risk Management. Regional and territorial authorities are encouraged to undertake risk assessments, asset management and to have financial provision in the event of natural disasters. The Government's financial assistance policy is primarily . . . a mechanism for reimbursing and subsidising disaster recovery costs after the event . . . (Bibliography references 50 and 58). The main principles of the Recovery Plan are:

- initial and primary responsibility rests with the local community
- individuals, businesses and local authorities must insure themselves and minimise the risk
- Government has a role after major events
- Government helps restore community capacity for self help
- Government encourages proper management practices
 - insurance (community and individual assets)
 - reserve funds (businesses and local authorities)
 - mitigation methods

The role of local authorities is stressed, namely:

- minimising the chance of an adverse event occurring, where possible, especially where natural disasters might trigger subsequent effects
- mitigating the consequences of an event, should it occur, through sound engineering and construction, and careful maintenance

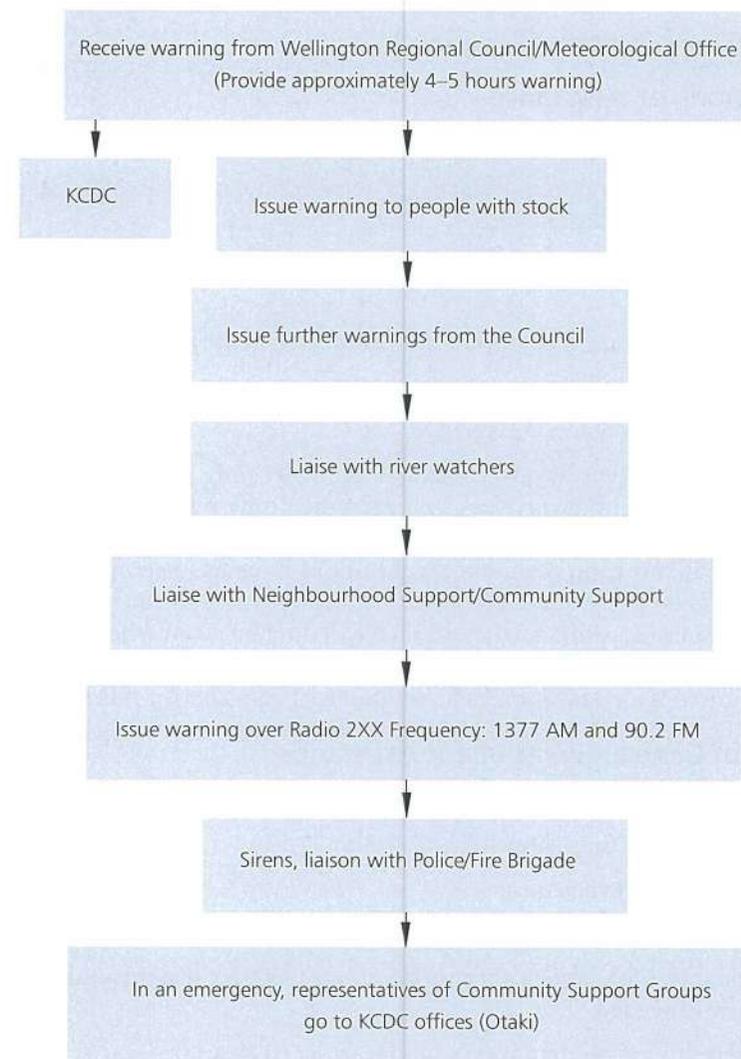


FIGURE 17: CIVIL DEFENCE EMERGENCY PROCEDURES IN A FLOOD

- managing the risk with appropriate financial and operational provisions (Bibliography references 51 and 58)

Conditions of Assistance

Central government assistance will only be provided where:

- there is a statutory requirement for action or a need to invoke a statute to achieve the desired ends
- recovery procedures cannot be carried out without Government assistance
- Central government help will aid co-ordination of the process significantly
- there are advantages of economies of scale

(Bibliography references 51 and 58)

Assistance from central government is generally only given for the reinstatement of 'essential services', and even then only when it is not financially viable to insure those services. In these cases, central government will meet 60% of the costs once a threshold limit has been passed. The threshold is 0.002% of the equalised net capital value of the services and assets. In summary, financial assistance will only be given where it is considered appropriate that the taxpayers of New Zealand as a whole should contribute to the restoration of a community's capacity for self help.

Types of Central Government Assistance

Central government assistance normally takes the form of:

- emergency feeding, housing and welfare
- transport for evacuation
- restoration of government services and facilities
- assistance with some other services and facilities if uninsurable or if urgently needed
- expert advice and temporary labour to speed clean-up
- co-ordination of response from central government and appointment of the Recovery Co-ordinator

Appendix F: Flood Warning System

Summary of Existing Flood Warning System

Figure 18 provides an overview of the flood warning system which is summarised below. The Data Collection Network records data in the field and transmits it to the flood base, at the Regional Council Centre, for flood forecasting. Forecasting begins before the flood and continues for its duration.

In a significant flood event, the Flood Manager disseminates information directly to the regional and local civil defence organisations. Other information pathways include radio, television, telephone and other public organisations who, after receiving a flood forecast, disseminate flood warnings to people potentially affected.

Those who receive flood warnings then determine the degree of response needed, and the actions and responses required.

Public warnings are issued by:

- Meteorological Office (heavy rain forecast)
- Flood Protection Group, the Council (Flood Warning)
- KCDC (surface flooding, stormwater, slips, etc.)
- Police (road closure, delays etc.)

Flood Detection

Flood Detection starts with the detection of heavy rainfall capable of leading to an increase in river levels. Several methods are available to predict if and how river levels may react to a heavy rainfall event, such as manual estimations, computer modelling, and past experience. The Council currently uses telemetered river level recorders and telemetered rainfall information to provide the necessary data to predict river levels and hence a flood. The Council is in the process of implementing a real time flood forecasting model. Once this model has been validated it will provide more accurate computer-generated estimates.

Flood Warning Time

The warning time is how long a person subject to a flood has to react. The

warning is determined by a combination of flood detection and recognition, plus the time taken to issue warnings and take action. The warning time in Otaki is generally short (about four to five hours from when the alarms activate until flooding hits the Railway Station, and about an hour longer at Rangiuru).

Improving Warning Times is difficult due to the nature of the Otaki River catchment. Consideration could be given to basing alarm settings on rainfalls over one hour's duration. Alarm settings are based on 30 mm in 2 hours at Oriwa, McIntosh, and Taungata gauges, and 20 mm in 2 hours at Kapakapanui gauge. Changing alarm settings is currently being looked at by the Resource Investigations Department and Flood Protection Group.

Back-up Systems

Currently, three separate sensor devices operate at the Otaki River water level recorder, Pukehinau. One is via telemetry and two are via interophones. The possibility exists that both interophones may malfunction simultaneously (for example, by lightning strike).

The telemetry at Pukehinau operates from the same repeater (Kapakapanui) as the four high altitude rain gauge stations. In the worst case scenario, if the repeater, telemetry, and gauges failed, no rainfall information or alarms would be received. A flood alarm would still operate at Pukehinau through an auto dialler.

External staff gauges exist at the Pukehinau site and at the Otaki swing bridge. If no information is available, the only option is manual reading at half hour to 1 hour intervals.

Installing a back-up rain gauge system is recommended although costs may be prohibitive.

Current forecasting is based on New Zealand Meteorological Service special weather bulletins, information from the Oriwa, McIntosh, Taungata and Kapakapanui rain gauges, and monitoring of water levels at the Pukehinau recorder. The Council then advises KCDC of the situation. These procedures currently work satisfactorily. However, planning for more severe events is recommended.

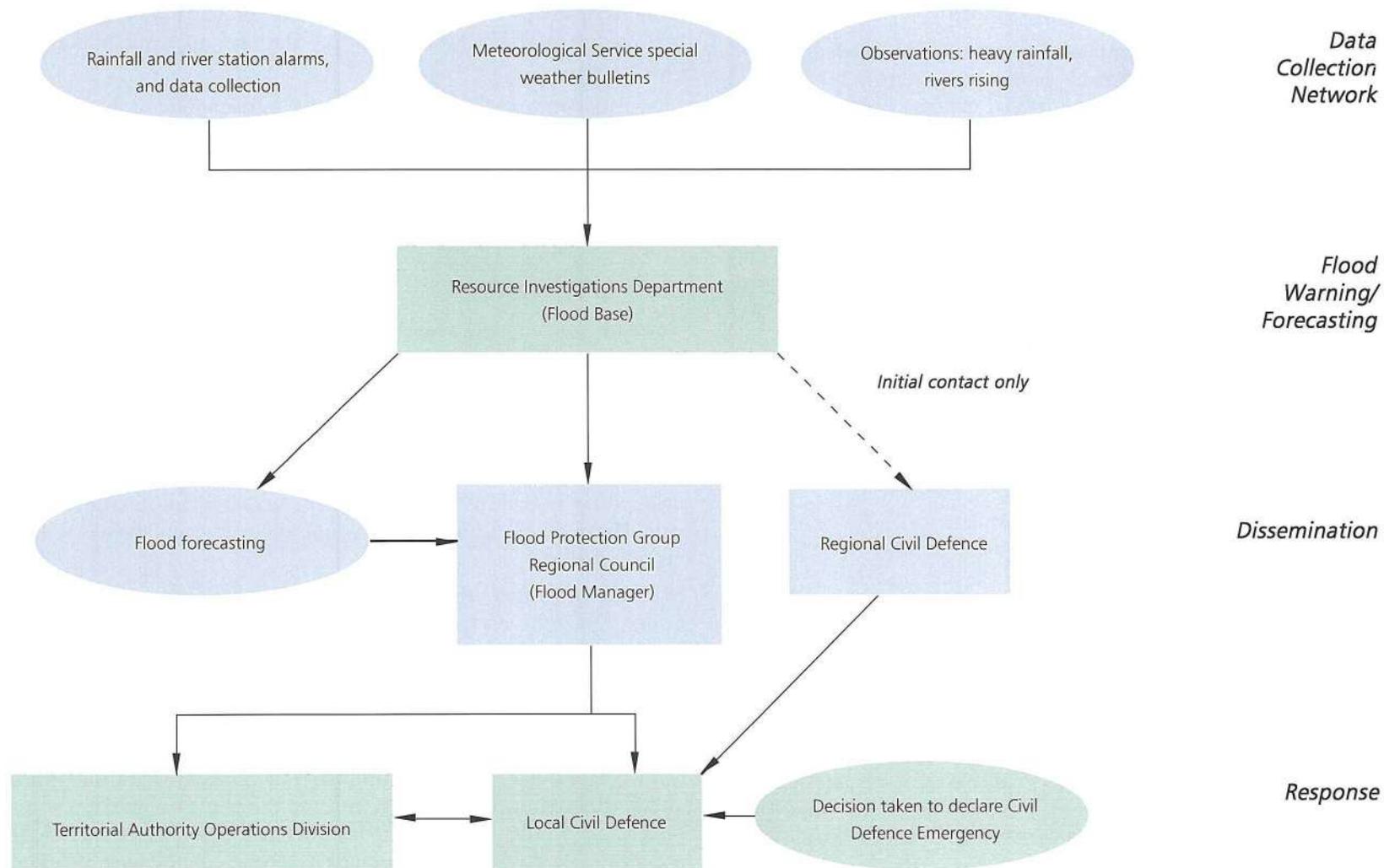


FIGURE 18: OVERVIEW OF THE FLOOD WARNING SYSTEM

Index

Symbols

100-year flood 1, 12, 49

A

aggradation 41, 46, 48, 64
 Annual Plan 91
 annual surveys 3
 asset management 69
 assistance 102
 at-risk groups 16

B

Ballast/Tracy 39
 Barretts 25, 34, 36
 Batching/Campbell 39
 bed levels 46
 breaches 15, 28, 81
 bridge raising 4, 34
 bridges 39
 Building Act 1991 90
 Building Regulations 1992 90
 Business Plan 18, 91

C

catchment 11, 28, 64
 Catchment Boards 90
 channel alignment 4, 12, 21, 35, 37, 53, 56, 70
 channel maintenance 4
 Charter of Understanding 19
 Chrystalls 3, 9, 12, 36, 70
 Chrystalls Bend 9, 15, 40
 Civil Defence 3, 50, 98
 Civil Defence Plan 98
 Civil Defence, Regional Operations 95
 Cliff Top Erosion 25
 climate change 48

| | | | |
|---|--|--------------------|--|
| coastal environment | 47 | | |
| Code of Practice | 22, 43 | | |
| commerce | 52 | | |
| community awareness | 31, 49 | | |
| Community Objectives | 18 | | |
| community preparedness | 1, 3, 31, 49 | | |
| computer modelling | 45 | | |
| consultation | 18, 19, 20, 22, 25, 43 | | |
| consultation with Tangata Whenua | 43 | | |
| cost-effectiveness | 1, 17, 18 | | |
| cross boundary issues | 74 | | |
| cross-blading | 47, 60 | | |
| D | | | |
| deflection stopbank | 34 | | |
| deforestation | 64 | | |
| degradation | 41, 46, 54 | | |
| Department of Conservation | 11, 74, 89 | | |
| design standard | 21, 22, 28, 32 | | |
| development | 12, 64 | | |
| disaster recovery | 3, 32, 100, 101 | | |
| disaster relief | 32 | | |
| District Plans | 25, 28, 93 | | |
| E | | | |
| ecology | 56, 67 | | |
| economics | 53 | | |
| ecosystems | 56 | | |
| emergency procedures | 1 | | |
| environment | 5, 7, 41, 44, 47, 49, 55, 56, 58, 67, 74 | | |
| Environmental Code of Practice | 41 | | |
| Environmental Outcomes | 5, 21, 41 | | |
| Environmental Principles | 5, 21, 22, 41, 44 | | |
| Environmental Results | 66 | | |
| Environmental Strategy | 5, 22, 41 | | |
| erosion | 11, 15, 46 | | |
| esplanade reserve | | 64, 78 | |
| estuary | | 74 | |
| evacuation | | 25, 49 | |
| expenditure | | 37 | |
| F | | | |
| Facing the Future | | 18, 90 | |
| financial costs | | 15 | |
| Financial Strategy | | 68 | |
| flood awareness | | 31, 49 | |
| Flood Contingency Fund | | 69 | |
| flood control scheme | | 12 | |
| flood damage | | 15 | |
| flood defences | | 9 | |
| flood detection | | 103 | |
| flood hazard categories | | 3, 9, 23 | |
| flood mitigation | | 44, 64, 68 | |
| flood preparedness | | 8, 31, 49 | |
| Flood Protection Group | | 19, 96 | |
| Flood Protection Group Business Plan | | 91 | |
| flood protection policy | | 68 | |
| flood warning | | 3, 31, 32, 49, 103 | |
| Flood Warning System | | 32, 103 | |
| flood-prone areas | | 1, 3, 9, 23 | |
| flood-proofing | | 34 | |
| floodgates | | 32 | |
| floodplain management | | 3, 17 | |
| Floodplain Management Plan (FMP) | | 1, 9, 18, 91 | |
| floods greater than the design standard | | 28, 78 | |
| floodwaters | | 23 | |
| floodway | | 23, 79 | |
| forest clearance | | 1, 11 | |
| Frequently Asked Questions | | 8 | |
| Friends of the River | | 72 | |
| Fringe Areas | | 25 | |
| funding | | 68, 69 | |

G

| | |
|-----------------------------------|---------------|
| gas crossing | 15 |
| gravel extraction | 4, 40, 46, 52 |
| gravel management | 46 |
| greenhouse effect | 48 |
| guidelines for future development | 23 |

H

| | |
|----------------------|--------------------|
| habitats | 41, 55, 58, 62, 67 |
| hapu | 18 |
| Harpers | 3, 36 |
| Helpful Flood Hints | 8, 31 |
| heritage | 58, 67 |
| house raising | 3, 34, 51 |
| Hughes | 39 |
| Hughes/Lutz | 3, 39 |
| Hughes/Lutz stopbank | 36, 70 |
| human environment | 66 |

I

| | |
|----------------------------|---------------|
| implementation of the Plan | 22, 68 |
| Industry | 51 |
| information distribution | 31 |
| infrastructure | 52 |
| insurance | 3, 31, 34, 53 |
| Integrated Management | 89 |
| iwi | 18 |

K

| | |
|---|--------|
| kaitiakitanga | 54 |
| Kapiti Coast Disaster Response Procedures | 101 |
| Kapiti Floodplain Management Committee | 18, 19 |
| Katihiku | 32, 36 |
| KCDC Civil Defence Plan | 32 |

L

| | |
|------------------------------|------------------------------|
| land ownership | 64 |
| land procurement | 28 |
| land use | 1, 9, 18, 23, 28, 63, 64, 67 |
| land use applications | 3 |
| Landcare Committee | 19 |
| landscape | 1, 58, 60, 67 |
| Lethbridge | 3, 36 |
| Long-Term Financial Strategy | 68 |
| Lower Gorge | 39 |

M

| | |
|-------------------------------|---------------|
| maintenance | 37 |
| major works | 4, 35, 43, 70 |
| mana whenua | 43, 54 |
| Mangahanene Island | 37 |
| Mangapouri Stream | 32, 36, 70 |
| Maori | 54, 66 |
| Maori settlement | 18 |
| Marae committee | 19 |
| mauri | 55 |
| meander | 46 |
| monitoring | 4, 72 |
| monitoring of river processes | 40 |

N

| | |
|------------------------|---------------|
| National Recovery Plan | 101 |
| natural habitats | 56 |
| natural hazards | 89 |
| Ngati Raukawa | 1, 18, 19, 54 |
| Non-Structural methods | 1, 21, 22, 70 |
| North bank | 3, 36 |

O

| | |
|-----------------------------|---------------|
| Officials Liaison Group | 19 |
| Old Coach Rd | 3, 36 |
| Old Coach Road Bridge | 4, 34 |
| ongoing consultation | 70, 75 |
| Otaki Community | 1, 10, 49, 72 |
| Otaki Resource Group | 19 |
| Outcomes of the FMP Process | 1, 21 |
| Overflow Paths | 15, 25 |

P

| | |
|-----------------------------|-----------|
| peer review | 69 |
| Phases, planning | 5, 17, 94 |
| physical environment | 66 |
| Plan changes | 76 |
| Plan implementation | 9, 10 |
| planning | 63, 67 |
| planting schemes | 58 |
| Ponding Areas | 15, 25 |
| preferred channel alignment | 35 |
| priority list | 70 |
| private land | 64 |
| programmed works | 37 |
| psychological impacts | 15 |
| public access | 18 |
| public education | 3, 31 |

R

| | |
|---------------------------|---------------|
| Rahui | 56 |
| Rangiuru | 3, 12, 32, 36 |
| Raukawa Marae | 18 |
| recreation | 58, 60, 67 |
| reforestation | 28, 64 |
| Regional Plans | 10, 91 |
| Regional Policy Statement | 90 |
| Residents Resource Group | 19 |

| | |
|---------------------------------|----------------------------|
| residual risk | 18, 22, 23, 70 |
| Resource Management Act | 17, 18, 19, 54, 56, 74, 89 |
| Review of the Plan | 72 |
| rip-rap | 4, 36, 37, 39, 60, 79 |
| riparian management | 28, 64, 66 |
| risk to life | 15, 23 |
| River Corridor | 3, 5, 23, 63 |
| River Corridor Land Procurement | 28 |
| river management | 1, 70 |
| river management methods | 1, 4, 21, 35 |
| river mouth | 37, 47, 48 |
| river mouth management | 4, 40 |
| river mouth migration | 47 |
| river processes | 45 |
| river training methods | 35, 36 |
| Riverslea | 15 |
| rules and standards | 9, 25 |

S

| | |
|---|----------------------|
| salt water intrusion | 48 |
| sea level rise | 3, 34, 48 |
| Seaward Extension | 3, 36 |
| services | 16, 34, 52 |
| silent files | 56 |
| social costs | 15 |
| Soil Conservation and Rivers Control Act 1941 | 90 |
| South bank | 3, 36 |
| South Waitohu | 3, 36 |
| statutory status | 10 |
| stopbanks | 3, 32, 45, 63 |
| Stream Channel Improvements | 32 |
| stress | 16 |
| Structural methods | 1, 3, 21, 32, 34, 70 |
| subdivision | 3, 9, 28 |
| summary of Plan | 5 |
| sustainable management | 17 |

T

| | |
|---|------------|
| tangata whenua | 18, 19, 54 |
| tapu | 56 |
| Taylor/Mansell | 39 |
| Taylor's | 15 |
| Te Tutohinga O Te Whakaaetanga | 19 |
| Tikanga Maori | 18, 54 |
| Treaty of Waitangi (Te Tiriti o Waitangi) | 18, 19, 54 |
| trout habitat | 62 |

U

| | |
|---------------------------|-----------|
| urban settlement | 1 |
| Users Resource Group | 19 |
| utility services (groups) | 4, 31, 52 |

W

| | |
|----------------|--------|
| Waitohu Stream | 4 |
| willows | 36, 60 |

Z

| | |
|-------|------------|
| zones | 25, 39, 83 |
|-------|------------|



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