

Waitakere's Green Network, a 10-year anniversary — the challenges and successes of implementing a biodiversity programme begun in 1993

Chris Ferkins¹

Waitakere City Council
Private Bag 93-109, Henderson, Waitakere City, New Zealand
chris.ferkins@waitakere.govt.nz

ABSTRACT

In 1993 Waitakere City Council joined a group of some 2000 cities world-wide in taking the path to becoming sustainable cities — a direction that considers the impact our decisions today have on future generations and on the environment the city inhabits; a direction recommended to communities world-wide by The Earth Summit held in Rio de Janeiro in 1992, through Agenda 21.

When Waitakere City agreed to these recommendations they became the first city in New Zealand to begin realigning to a sustainable objective. The eco city was born and a concept called the Green Network was developed. The Green Network is not just about enhancing biodiversity, but is a 'healthy habitat for a city' concept. The key element besides biodiversity is ecosystem services, and both have capacity to enhance the healthy functioning of biological and physical processes, to the benefit of all living things within the city environment.

Waitakere City faces similar challenges to the retention of biological diversity as other large New Zealand cities including land use intensification, the spread of environmentally invasive weeds and the loss of vegetation and habitat. Waitakere however, has also retained significant biodiversity helped by the mix of features that give variety to the landscape including coast, ranges (a large and recovering area of rainforest if somewhat frayed at the edges and in the vicinity of roadways), lowlands (containing fragmented remnant bush and wetland areas) and streams (retaining perhaps surprising levels of biodiversity).

The Green Network is a concept and planning tool that uses both regulatory and voluntary mechanisms to attain a physical presence (the development and retention of habitat connections from the ranges to the coasts). But the Green Network must also connect the community and have a clear purpose if it is to succeed and persist. Crucially, Waitakere City Council has a clear vision, supported and encouraged by the community. Attitudes of integration and innovation are also strong.

This paper marks the anniversary of a decade of work in furthering the Green Network and the eco city in Waitakere, and focuses on a few key examples of the progress made and lessons learnt:

1. Asset Management — Roadsides

Waitakere has 1500 km of roadsides within Road Reserves, including that in the Waitakere Ranges. Management changes have seen substantial improvement in the asset, its ecological health, its impact on surrounding natural areas, and expected future savings on the cost of road maintenance

2. Regulation — Riparian Margins

One key inclusion in the District Plan was the creation of a riparian zone that set a specific set of rules for the land beside streams, and in so doing provides a positive message about the values of that land

3. Community and Partnership — Green Network Community Assistance Programme

As the tool by which local communities express their wishes and guide their development, Councils

¹ Note: the contents of this paper are the opinions and the copyright of the author. They do not necessarily represent the opinions of Waitakere City Council.

Section 2: Nature Friendly Environments — Communities Making it Happen

have a role in both supporting and encouraging communities. The massive potential of a supportive community, taking both individual and group action in working towards a vision should not be underestimated. Although some do support these initiatives just for their environmental gains, much broader engagement is gained through also acknowledging and incorporating the economic, cultural and social objectives of community members. Non-regulatory programmes of support for community involvement including private landowners are also discussed

4. Stormwater and ecological restoration in the heart of the city — Project Twin Streams

This project aims to improve water quality, improve ecological function and health, and create wildlife corridors through the heart of urban Waitakere.

INTRODUCTION

In 1993 Waitakere City Council joined a group of some 2000 cities world-wide in taking the path to becoming sustainable cities — a direction that considers the impact our decisions today have on future generations and on the environment the city inhabits. This direction was recommended to communities world-wide by the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in 1992. This conference, also called The Earth Summit, was the largest gathering of world leaders in history, and made the recommendations in a signed agreement called Agenda 21 that outlined global strategies for cleaning up the environment and encouraging environmentally sound development.

Thus, in 1993 Waitakere City agreed to these recommendations and became the first city in New Zealand to begin realigning to a sustainable objective. The eco city was born, and an early step was the development of a concept called the Green Network. The eco city vision gave direction but where to start? And how could the Green Network be managed to serve those economic, cultural and social outcomes as well as the environment? These were among the first practical challenges that we needed to resolve to translate the eco city and Green Network concepts into reality.

Interestingly, the Green Network was never just about biodiversity, but about fostering a 'healthy habitat for a city'. (See Appendix 1 for a definition of 'Biodiversity'). The key element fostered besides biodiversity is ecosystem services (Appendix 2). Both of

these overlapping but complementary elements (Fig. 1) have capacity to impact on the healthy functioning of biological and physical processes, and their enhancement can benefit all inhabitants of the city (human and non-human) with improved environmental quality — as well as enhanced cultural, social and economic functioning.

Now, 10 years later, Waitakere is celebrating a decade of work on furthering the Green Network and the eco city.

This paper focuses on examples of Waitakere City Councils experiences in four key facets of operation:

1. Asset Management — Roadsides
2. Regulation — Riparian Margins
3. Community and Partnership — Green Network Community Assistance Programme
4. Stormwater Management — Project Twin Streams.

THE BACKGROUND — BIODIVERSITY THREATS AND OPPORTUNITIES IN WAITAKERE

Landscape features

Waitakere City is bounded on three sides by coast (Fig. 2) — looking east to the Auckland harbour bridge across the Waitemata Harbour; south to Manukau across the Manukau Harbour, and west to the Tasman Sea. Running in a dog-leg north to south is the central divide of the rainforest covered Waitakere Ranges (Waitakere Ecological District). There are some settlements west of the divide and some housing along the rural roads. Urban Waitakere

occupies the lower eastern foothills and lowlands, and the foothills beside the Manukau Harbour (Tamaki Ecological District). An area of peri-urban agriculture lies to the north (also largely Tamaki Ecological District with one valley that is in the Rodney Ecological District).

Three elements help summarise the threat to biodiversity:

1. Land use intensification and urbanisation (Waitakere is New Zealand's fifth largest city)
2. Environmentally invasive weeds — location (proximity to a major international seaport and airport), climatic influences (sub-tropical vigour) and disturbances to the landscape (current and historical) have resulted in the wider Auckland city, of which Waitakere is a part, having an exceedingly large naturalised flora, a diversity apparently unmatched in any other city in the world, resulting in it being arguably the weediest city in the world (Esler 1987)
3. Historical and current loss of vegetation and habitat (including disturbance to 98% of what is now the more vegetatively 'intact' parts of the city).

Despite this, other factors including the regenerative power of native ecosystems mean Waitakere now has significant biodiversity, and the layout of the land has endowed Waitakere with multiple small and several medium sized streams that flow between the bush covered foothills and the coast, through the middle of the urban landscape. This is the base of biodiversity and ecosystem services available for the development of the Green Network and a sustainable city.

Biodiversity features

Lowlands — urban and peri-urban (Tamaki Ecological District; e.g., Fig. 3):

- 30% of the existing lowland vegetation was lost between 1993 and 2000. While some loss resulted from subdivision, most is the net effect of many people removing a few trees each over time
- 9% of the area is now occupied by remnant vegetation, most of this being in gullies and beside streams and is highly fragmented

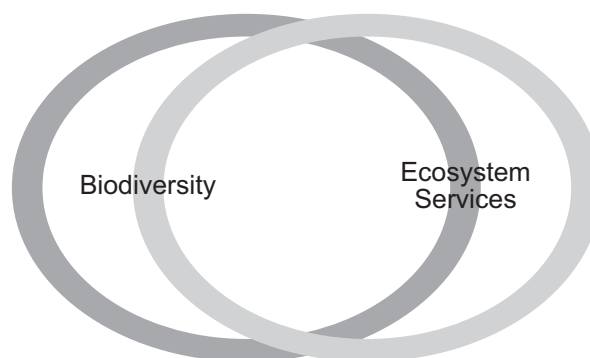


Fig. 1 The relationship between Biodiversity and Ecosystem Services.

- Despite cumulative, historical habitat loss, a surprising amount of native aquatic and some significant riparian wildlife is still present (Fig. 4A,B).

Waitakere Ranges and west coast (Waitakere Ecological District):

- 98% of the Waitakere Ranges and west coast has suffered historical disturbance (especially from fire and logging)
- 90% of the area has returned to native bush (regenerating rainforest) but the vegetation patterns have changed
- The area is still rich in species diversity — 20% of New Zealand native angiosperm species and 60% of New Zealand fern species are represented (542 species in total). However, of these plant species, 21 are threatened, and 6 are endemic
- 700 species of beetles and 100 land snails were identified in a survey of one bush area near Te Henga (Bethells Beach) on the west coast
- 5 species of native lizards and the endangered Hochstetter's frog (*Leiopelma hochstetteri*) are present
- The loss or survival of the other components of biodiversity is poorly known — the genetic diversity within species (especially as this may be affected by the loss of distinct populations), and ecosystem diversity.

Marine areas:

- A small number of marine mammals are present including seals and the world's smallest and rarest marine dolphin, the

Maui's dolphin (*Cephalorhynchus hectori maui*)

- Mangrove colonies are intact providing valuable refugia for juvenile marine life, but the mangroves are spreading with the increasing siltation of estuarine areas due to activities on land.

City-wide (within the Waitakere City Council boundaries):

- About 200 species of invasive plants are currently recognised as present or threatening to Waitakere (WCC 2002a)
- 12 species of native fish including shortjaw kōkopu (*Galaxias postvectis*). Most species have a continuing presence in those lowland streams now part of the urban area, but in low numbers
- Recent monitoring indicates that bird populations are now increasing in the Waitakere Ranges but are still decreasing in the lowlands
- Long-tailed bats (*Chalinolobus tuberculatus*) are making nocturnal incursions into urban areas following corridors of well-established vegetation.

And people?

- 168 750 people and 56 170 households — these numbers are expected to grow 40% by the year 2050
- 367 km² land area within the Council boundaries
- 23% of the Council land area is urbanised (within the metropolitan urban limit of the city)
- 52% of respondents to an annual telephone survey want more Green Network activities and support
- 542 Parks.

The above data on biodiversity features is from the *State of the city report* (WCC 2002b).

THE GREEN NETWORK — WAITAKERE'S 'HEALTHY HABITAT FOR A CITY' CONCEPT

Ever walked into a patch of bush and thought 'where are all the birds?'
Many New Zealand birds and other wildlife cannot move across open space!
Therefore wildlife in that bush is isolated too and life in the bush slowly dies away.

*But link it by **passageways of cover** to other bush? You get interconnecting passageways of green ... a backbone for the **Green Network**.*

The Green Network can be defined physically as (see Fig. 5):

- A *framework* (or 'backbone') of green space dedicated to habitat creation. These 'fingers of green' (corridors) include bush and riparian areas on both public and private land, and stretch from the Waitakere Ranges to the coasts. They create connections with remnant bush, wetland, coastal edges and other natural features. The plotting of areas of existing and proposed vegetation (Fig. 5) highlighted those areas that if restored, would create continuous connections for the length of the catchment
- And a *matrix* — mixed use areas that complement and give body to the framework such as areas of stormwater management (planted ponds, swales, rain gardens), agricultural (hedgerows, orchards, rank grass), residential (gardens, street trees) and commercial yards, all of which contain vegetation or habitat features that can be occupied by some species.

The Green Network can also be defined by:

- *Team* — comprising all those people who share an interest, management role or impact on the health of the natural features of the City including:
 - Private landowners and occupiers, community groups
 - Cross-council teams who meet monthly to exchange information and coordinate activities (including Parks, Transport Assets, Resource Management, Consents Services, Ecowater Solutions, Cleaner Production, community coordinators, and Strategic Development)
 - Interagency interests including for example Waitakere City Council, Auckland Regional Council, Water Care Services, DOC, power companies, Transit, Tranzrail, QEII National Trust
- *Purpose* — the aims of the Green Network are to:
 - Enhance the natural environment — including health, self-sustaining capacity, and diversity

Section 2: Nature Friendly Environments — Communities Making it Happen

- Enhance the capacity of nature (natural and managed environments combined) to maximise beneficial ecosystem services to Waitakere City
- Increase people's enjoyment of (e.g., recreation), valuing of, and participation in management of the City's environment.

All three components (physical, team and purpose) are essential for the Green Network to be effective in the context of a modern, urbanised society living with and benefiting from nature.

The progress in developing the Green Network is cumulative with a large number of tasks and programmes undertaken. There are three factors that have resulted in substantial momentum in Waitakere. These are:

1. The work is part of a vision that has broad Council and community support
2. Strong efforts are made to integrate the vision across Council, which helps to avoid the potential for staff in separate departments to be isolated, or to undermine each others progress
3. Council have a policy of being an innovative 'learning organisation', which mandates a willingness to experiment and an attitude of innovation.

Collectively these three factors have generated a substantial momentum, both in addressing biodiversity and ecosystem services (Fig. 6), including focussing on in-stream and riparian areas (Fig. 7). Additionally, these initiatives provide a strongly motivational and rewarding environment for staff and community participants alike.

There are too many activities here to explore them all in this paper. I have chosen four key examples, representing different facets of Council operation.

CASE STUDY 1. ASSET MANAGEMENT — ROADSIDES

Waitakere has 1500 km of roadsides including those through the Waitakere Ranges. Management changes have seen substantial improvement in the asset, its ecological health,

and that of the surrounding natural areas. Future impacts are expected including a relative reduction in the maintenance costs of both the roads and the roadsides.

Task description:

- Identify and manage threats to the asset (i.e., threats to both the constructed and natural features)
- Identify and manage threats being effected on the environment surrounding the asset (e.g., impacts on bush, wetland and stream habitats)
- Maximise the potential benefits of the asset to Waitakere City
- Reduce the long-term costs (including financial, environmental and human health) attributed to use of the asset, and of managing the asset
- Consider the enhancement of natural health and ecosystem services such that they help achieve outcomes currently achieved by more costly and/or damaging intervention practices
- Ensure no loss of safety to carriageway users.

Issues and challenges:

Unfortunately, roadsides are regularly treated by society as 'highly managed wastelands'. This results in high levels of disturbance, dismissive attitudes, damaging behaviours, and significant threats and damage to ecological values and functions, all of which increase the costs of managing and maintaining the roadside asset of the city.

Roadsides and roadside vegetation also:

- Are home to threatened species
- Provide important habitat
- Have a major role in silt reduction and water quality improvement to local streams
- Provide edge protection and buffer for neighbouring native bush
- Add ground stability for roads.

Roads are a major means of distribution for weeds due to effects such as wind funnelling, water channelling, movement of people and machinery, and removal of vegetation and dumping. Land and vegetation disturbance including road and roadside works means there is traditionally a lot of habitat available for weeds to establish on roadsides.



Fig. 2 Aerial depiction of Waitakere City and surrounds.



Fig. 3 Henderson Creek working its way through urban Waitakere, flanked by industrial sites, backyards and open green spaces — all components of either the framework or the matrix of the Green Network.



Fig. 4 A, coastal wetland in Waitakere looking across the Waitemata Harbour to central Auckland; **B**, resident fernbirds.

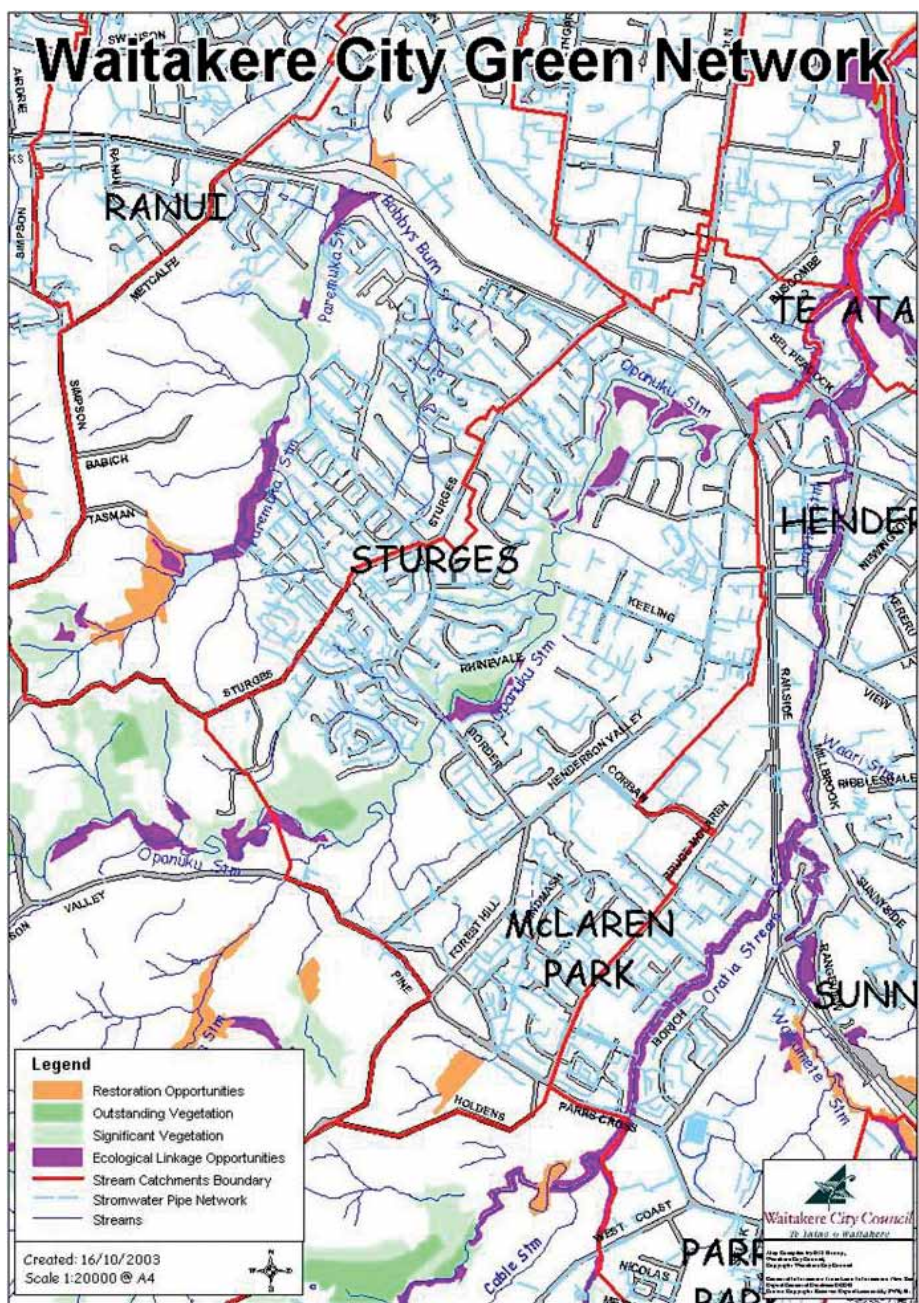


Fig. 5 Map showing part of Waitakere’s Green Network.

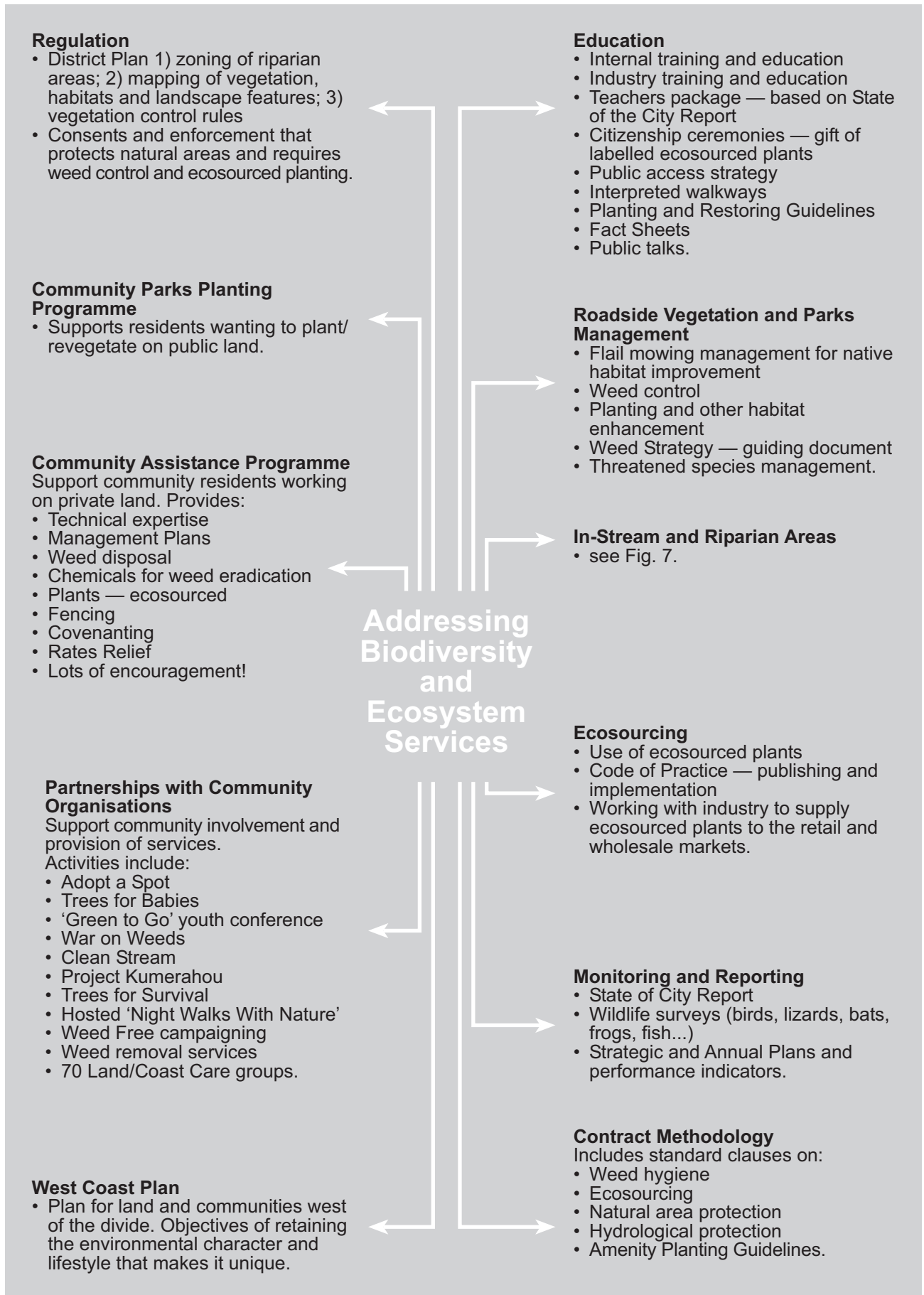


Fig. 6 A decade of work — general activities.

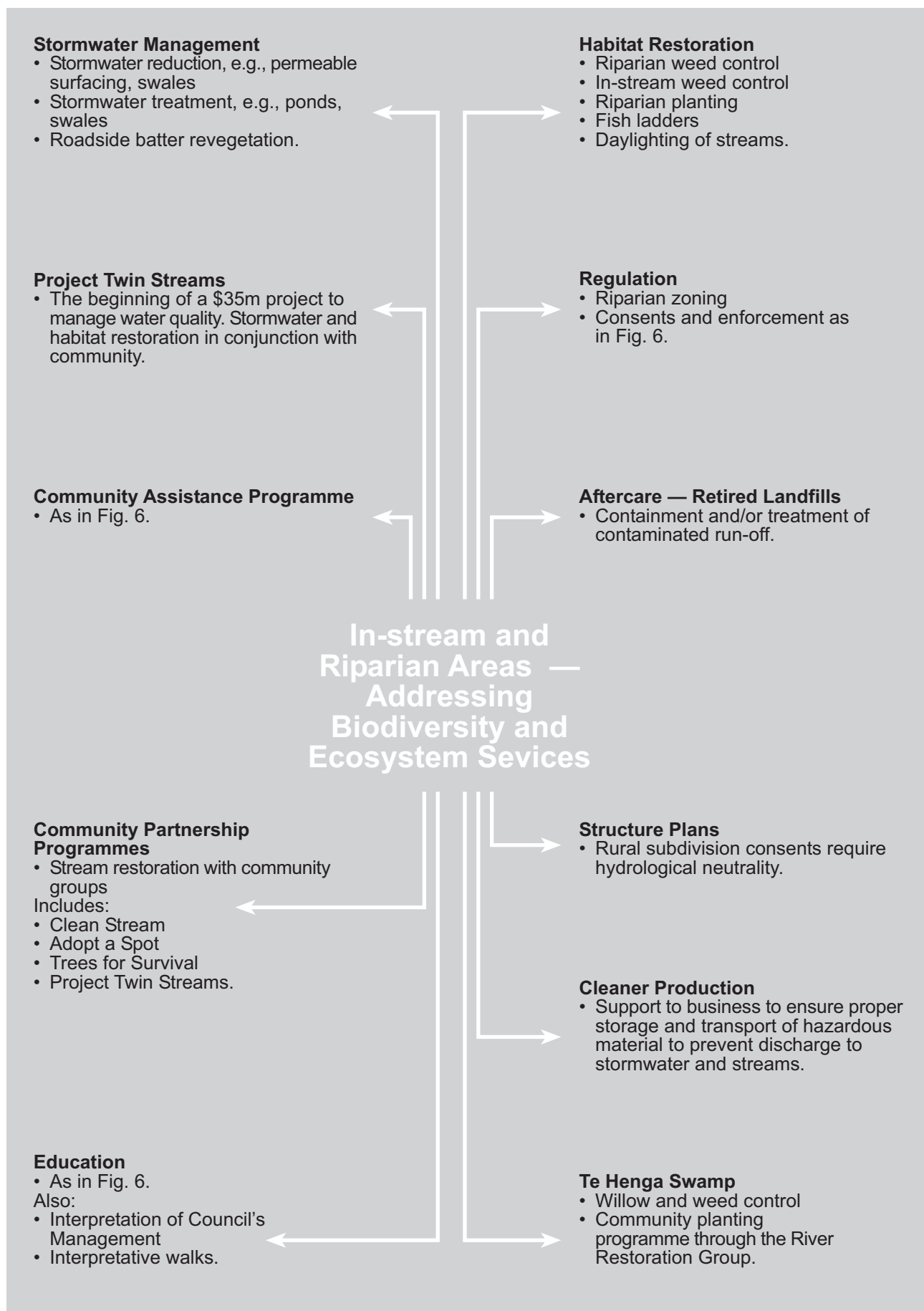


Fig. 7 A decade of work — activities on streams.

Herbicide use and reduction is an issue for human and environmental health that can be improved by appropriate selection of control techniques.

Vegetation management objectives for road reserves:

There are nine objectives, five of which require *vegetation control*:

1. Safety (maintaining sight lines for drivers and preventing overhanging plants)
2. Protection of the asset (preventing plants from causing damage to the seal, footpaths, kerb and other features or furniture of the road edge or berm; or preventing erosion from undermining such features)
3. Flood mitigation (preventing stormwater blockages and damage)
4. Control of environmental weeds
5. Fire risk reduction.

The four remaining objectives require *vegetation enhancement*:

6. Water quality improvements for local streams (reducing the quantity of silt and pollution carried by stormwater washing from roads, roadside banks and ditches)
7. Stability enhancement (i.e., reducing slips through revegetation and moderation of water saturation and drought levels in soil)
8. Threatened species protection (roadsides provide a well-defined seral habitat suited to some species)
9. Bush edge protection (achieved by maintaining good 'edge' structure for bush areas growing on neighbouring land). Intact edge vegetation has significant benefits for the health of the adjoining bush and other natural areas.

Processes:

- A weed management strategy for Waitakere City was prepared (Flynn & Buddenhagen 2000) followed by a weed management planning exercise for roadsides
- A systemic examination of management practices and options was made to determine their efficacy
- Running of trials for refining weed control and herbicide reduction

- Explore weed hygiene — for example, is the operation inadvertently contributing to the spreading of weeds?
- Contract specifications modified especially for flail mowing and weed control (the two major tools for managing roadside vegetation) to increase positive effects and minimise effects contrary to the management objectives.

Biodiversity lessons and achievements:

The overarching lesson is to use a systems-based management regime. When well thought through this will both accommodate causes and effects and use them in helping achieve a positive direction that supports the objectives. This makes the approach very powerful as it enlists natural processes in achieving management objectives, and thus in the medium term is also likely to result in relative cost reductions and improved outcomes. The causes and effects considered must include both human (including management) and ecologically related ones. Causes and effects related to the baring of soil and to weed invasion have proven to be the biggest threats to the objectives. Changes made to roadside vegetation management as a result of this approach have included:

- Raising the height of flail mowing (minimum height of 300 mm on batters). Result: ground coverage on batters by native plants (when combined with spot spraying for invasive weeds). Outcomes: minimised bare ground, increased stability, minimised new weed invasion, maximised ecological benefits
- Go beyond legal requirements for weed control and include all invasive species (build up to this progressively starting with the most threatening species)
- Giving equal priority to environmental and agricultural weed control — each has its imperative in certain circumstances. While many invasive species may not currently be subject to legal controls (listed in Regional Pest Management Strategies or in the National Pest Plant Accord), there is potential they will be in the future. Controlling smaller populations now will reduce substantially the cost of future control — and of course limit environmental damage

Section 2: Nature Friendly Environments — Communities Making it Happen

- Limiting the weed habitat available — achieved through the management regime. For example, by adjusting the height of flail mowing, adopting weed hygiene requirements for contractors, and limiting the by-kill from weed control
- Preparedness to retain gorse (*Ulex europaeus*) at some sites as a temporary tool to suppress other more threatening weeds, and to encourage native regeneration. A close observation of gorse highlighted its ability to establish on dry banks that are otherwise difficult to vegetate and prone to erosion. The established gorse is stabilising batters and causing moisture to be retained in the soil. This is assisting native seedling germination that after five years is now suppressing the gorse
- Management regime designed to focus on limiting population distribution, not just the killing of weeds. This will be most effective in reducing population size
- Programme includes responsiveness to weed areas of public concern (i.e., empowering public participation in weed management)
- Prioritising — targeting weed outliers before targeting large colonies, most threatening species before lesser threatening species, areas of high ecological value before lesser valuable areas. Result: 967% increase over four years in the number of species for which outliers are controlled in the non kerb and channel areas of roadside (i.e., rural and wilderness roadsides). 600% increase over four years in the number of species controlled in urban roadsides. Some species received priority control throughout the whole asset from the start, while others were targeted in groups over time. Concurrently, incremental control of large population clusters was begun, focussing first on areas of greatest ecological value.
- Number of weed species being controlled in the Waitakere Ranges have increased from 6 to 58
- Significant stretches of roadside are now weed free, naturally regenerating, and more stable — requiring only base-level maintenance
- Increasing public recognition of positive change most commonly expressed in a sense of hope that it is possible to make a difference. This is resulting in increasing participation as more people take actions to control weeds and restore areas, both on ‘their’ berm (road reserve) and within their properties. (A small number of people have objected to the selective retention of gorse as described below.)

Notably, during this period there was no increase in allocated funds. Note also that aspects of the above are reported on in *Roadside vegetation monitoring, Waitakere City* (WCC 2004).

It is expected that the trends towards the objectives will continue and consolidate, and that costs associated with current road maintenance (e.g., slips, drains) will begin to decrease (Fig. 8). By 2014 (the 15-year mark) it is expected that savings on road maintenance costs associated with roadside ground stability will have reached their maximum potential and that the roadsides of Waitakere City will be substantially free of invasive weed plants. Roadside vegetation management costs will continue but at a reduced level as the lengths of roads needing flail mowing will be reduced, and noxious weed control will be restricted to the control of small new invasions.

Fig. 9A illustrates a slightly extreme example of traditional roadside vegetation control. The lower area is scalped by the flail mower (tractor with a mower on a movable arm), and the upper area is blanket sprayed for gorse. The majority of vegetation has been removed including those that would have begun the rehabilitation of the site. Exposed soil with high light levels provides great habitat for the establishment of further crops of weeds.

Thus to date (five years into the programme):

- Substantial passive regeneration of native vegetation (no planting cost) has resulted
- Some native species previously in decline, for example, kūmarahou (*Pomaderris kumeraho*), are now regenerating strongly

Fig. 9B illustrates changed management practices and a newly regenerating site. Flail mowing has ceased and weed control is by spot spraying only of all invasive species. Flail mowing will restart should this vegetation grow to within 1.2 m of the road.

Fig. 9C illustrates the same site, six months later. The plants will soon reach canopy closure (no bare soil and the plants will exclude direct sunlight on the bank), removing the potential habitat for most weeds. Therefore no further spraying is required.

Fig. 9D illustrates fully re-established vegetation in a moist habitat on a shady bank. The site is now meeting all objectives, with minimal maintenance and cost now required. These plants are unlikely to grow any bigger and the closed canopy means that weed invasion is also unlikely. Although species composition will differ, regeneration also occurs on dry, sunny sites (Fig. 10A). Once a site has been substantially restored and is weed free, there is minimal maintenance or cost (Fig. 10B).

Although it may seem surprising to some, gorse is probably the least ecologically damaging invasive plant in Waitakere. On drier sites, away from productive or residential land (e.g., Fig. 11), gorse establishes where other plants fail. This effectively creates all the benefits of the vegetation in Fig. 9D. In addition, through soil moisture retention and shade, conditions are created that allow native plants to now colonise. More than 20 species of native plants are now present in the site illustrated in Fig. 9D. Once

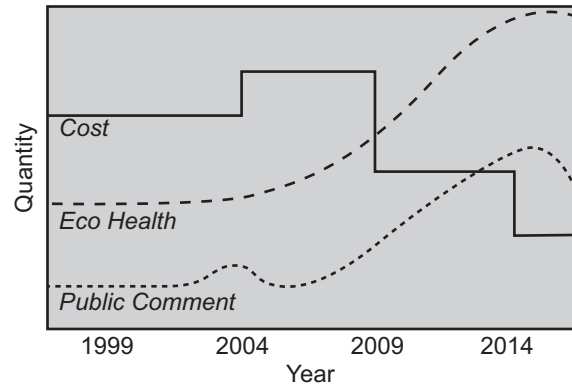


Fig. 8 Current and expected trends resulting from management changes to roadside vegetation.

these native plants are sufficiently established, they will either remain when the gorse is selectively controlled, or will outgrow and cause dieback of the gorse.

CASE STUDY 2. REGULATION — RIPARIAN MARGINS

One key inclusion in the District Plan is the creation of a Riparian Margin. This applies a set of rules to a designated land area beside streams. The very presence of these rules gives a positive message about the values of this riparian land.

Task description:

- To provide a tool for the regulation of activities within this sensitive riparian area
- Maximise the ongoing potential of the riparian area to sustain biological diversity (both in the aquatic and riparian environment)
- Maximise the ongoing potential of the riparian area (and associated aquatic environment) to provide stormwater quality and other ecosystem services of economic, recreational and ecological value to the City.

ENVIRONMENTALLY INVASIVE WEEDS

To clarify what is meant by ‘environmentally invasive weed’, please note that for management purposes, weed plants are acknowledged according to the nature of their impact. Some weeds have a horticultural impact, e.g., oxalis; some have agricultural impacts, e.g., ragwort and gorse; while others have environmental impacts. Some plants may have impacts in more than one area. Environmentally invasive weeds are those that can be judged to impede or over-ride the natural processes of nature, such that the self-maintaining abilities, natural succession or regenerative capacities of native habitat(s) is inhibited. The inhibition of seedling germination caused by dense stands of ginger within forests of the Waitakere Ranges would be a good example. Ecological, agricultural, and horticultural weed species require different management practices and methodologies in effecting their control.

Result:

All waterways in Waitakere City of 1 m or more in width have a designated Riparian Margin (Fig. 12). The margin starts at the waters edge and moves with any movement in the stream bed, and margin widths range from 5 m to 20 m. Note that the designation of a Riparian Margin does not change ownership of the land — it just applies a specific set of rules to that land.

Issues and challenges:

- To gain sufficient information on which to base decisions about the appropriate widths of Riparian Margins. Actions:
 1. Research information on widths needed to achieve the objectives
 2. Conduct team walks critically assessing features that help determine Riparian Margin widths for each stream reach. A formula was devised and used to ensure consistency.
- Communication on issues with the public.

Process and milestones:

- Riparian Margin widths are incorporated in the District Plan. A set of rules regulate activities in the margin
- The District Plan became operative in 2002.

Biodiversity lessons and achievements:

- Changing attitudes to and treatment of the riparian area is substantial (Fig. 13A,B). This is observed across a range of people from individual householders to developers. It is now seven years since Riparian Margins were first proposed for the District Plan
- Acting upon their own initiative, developers often now present their plans with the Riparian Margin intact — and are often using it to advantage for stormwater mitigation, landscape enhancement, and amenity
- Streams and riparian areas are now more likely to be perceived as an asset by the community at large
- Riparian areas make a major contribution to ecological linkages — connecting up the Green Network
- New piping or culverting of streams is now very rare. Some projects undertake work to ‘daylight’ previously piped streams.

CASE STUDY 3. COMMUNITY AND PARTNERSHIP — GREEN NETWORK COMMUNITY ASSISTANCE PROGRAMME

People may be reluctant to change their perceptions and actions, but try making a lasting difference in an urban environment without addressing the cause of an issue — or without harnessing the massive potential of a supportive community! Then ask yourself — ‘What drives that support?’ Often social (e.g., team building, altruism, community service), cultural (e.g., artistic materials) or economic interests (e.g., reducing business costs, increasing property values) are the principle drivers, and create a ‘win-win’ situation when ‘helping the environment’ at the same time. When those responsible for environmental projects acknowledge other objectives of their community they gain a formula for broad engagement.

Task description:

- Encourage adoption of the Green Network as a community tool (landowners and occupiers, business, community groups), not just a Council tool
- Provide a system to enable and encourage strong community participation in generating and managing the Green Network (much of it self-driven)
- Encourage the development of a community endorsed ethic of care — for the urban environment and environmental values on private land
- Maximise the potential for residents to contribute to biodiversity and ecosystem services through appropriate management of private land
- Enable the generation of understanding and skill development in the community, to facilitate the implementation of best practice.

Results:

- A non-regulatory system of support providing a range of services from the easy-to-implement to more in-depth programmes. Supportive measures include:
 - Access to technical expertise
 - Free native ecosourced plants
 - Weed bins for safe disposal of invasive weeds

Section 2: Nature Friendly Environments — Communities Making it Happen

- Free bags and dumping at the Transfer Station for kahili and yellow ginger (*Hedychium gardnerianum* and *H. flavescens*)
- Subsidised contractor assistance for the more difficult weed jobs
- Subsidised fencing for excluding stock from natural areas
- A covenanting programme with biennially updated management plans
- Rates relief for property owners with Green Network or QEII National Trust covenants with active management
- Ongoing experimentation and collation of best practice information — for both Council and community use
- A developing attitude of ‘we’re in this together’ between community sectors and Council (Fig. 14; 15A,B).

Issues and challenges:

- Supporting those with regulatory requirements — people with consent requirements can access the non-regulatory programme for technical guidance. Other support becomes available for activities that go beyond the requirements of the consent
- Helping individuals or groups overcome obstacles that might otherwise prevent them from getting on with the task. It is common to hear someone say ‘I’ve been trying to do this for years but I didn’t know where to start / couldn’t get it to work’
- Uptake of the programme has been rapid and continually growing. This makes resourcing the major limiting factor.

Processes and milestones:

- Development of application forms and information sheets
- Public speaking engagements
- Knowledge within the community of the support and services available
- Developing interest in environmental care, followed by developing skill base.

Understanding the process whereby individuals and community take up new ideas and opportunities has been important. A useful tool is a model of change-over-time as it relates to knowledge, attitudes and behaviours towards

environmental issues (Fig. 16). This model facilitates identification of an individual’s or group’s current needs.

Attitude behaviour education model

The stages of knowledge, attitude and behaviour development include:

- **Gloom** — a cause, or crisis, is recognised (by some) and a message of ‘look at all the damage we are doing’ is given. The desire is to *draw attention* to the issue. It is a ‘dramatic’ response to surrounding ignorance / poor awareness or lack of engagement. The response to the message is often one of feeling surprised by the new concept — and debate begins.

Note: At each stage in the model there will be those individuals that fall by the way, through either lack of understanding of the issue or its significance, or through choice (choosing to give other issues or values greater priority). None of these people are lost to the model as further information, re-evaluation, market pressures or other means may see them engage at a later time. If the issue has merit, debate will begin, or if dropped, the issue will come back with a greater imperative at a later time.

- **Acceptance** — wide acceptance that *there are environmental problems* that we (society) need to address. The response has two stages:
 1. Oh yes, but it’s out ‘there’, too big, or, ‘nothing to do with me’; and later
 2. Oh yes, and ‘I am part of it’. Thus ...

Milestone 1

Belief or feeling that what I do can make some difference. If my current decisions are contributing to a negative consequence, what alternatives are there?

- Information *seeking* — people start looking for information. Response (by those advocating the issue): provision of *guidance* on how to address the problems (i.e., providing practical options as *solutions*).
- Application — *uptake* of solutions (experimenting to see what suits and what works — for me / our household / our organisation). This may be as a:

Section 2: Nature Friendly Environments — Communities Making it Happen

- *Participant* (self — on own or with group)
- *Advocate* (tell others); or
- *Organiser* (organise for others to participate).

Usually these stages are progressive and cumulative.

- Effectiveness
 - Suitable (convenient) and *workable techniques are discovered*
 - Begin to repeat — using most convenient and effective techniques
 - Common strategies, methods, tools used.

Milestone 2

- Normalisation — Changed behaviour and attitudes have become normalised (*habitual*).

Note: The stages from Information seeking to Normalisation can be cyclical. The formation of ‘habit’ means less energy or concentration is needed to support the action. Now energy can be concentrated on the next change.

- Effort, Inconvenience — this stage includes *feelings of commitment* and involves a willingness to put yourself out to do the ‘right thing’ because of what you believe (belief often forms after the first cycle and will fuel following cycles.) It is also now, after one or more cycles that ‘Advocate’ and ‘Organiser’ are most likely to happen. It is also at this point that what may have been an individual but concurrent journey may become coordinated, i.e., supported in a growing number of instances by groups forming (e.g., within workplaces, clubs, or neighbourhoods) to plan and assist collective responses.

Milestone 3

- System — a *societal* response. That is, enough people are prepared to put themselves out that there is now enough demand to set up a system. Systems are important (e.g., kerbside recycling) because they reduce effort and inconvenience allowing effort to be transferred to the next step and allowing wider uptake. Without a system, the development process as detailed above stagnates. With the timely creation of systems the process is one of continual improvement.

Importantly, the whole continual improvement process can be sped up significantly or short circuited if the system is provided early on, that is, leadership is given by a forward looking and innovative system provider, e.g., community organization, business, local authority, etc. This requires several attributes on the part of the system provider:

- Open and listening, thus able to perceive the issue and need
- Responsive
- Trusting and capable of working with the community
- Innovative and solution orientated
- Proactive and willing to follow a vision
- Give advocacy at a practical and political level. This is the provision of leadership.

Lessons and achievements for biodiversity and community:

- Escalating enhancement of biodiversity on both private and public land
- Escalating knowledge and application of skills
- The community has huge potential — acknowledging this energy and commitment is creating wonderful opportunities
- The programme was initially intended to engage individual property owners. It has been surprising to observe the proliferation of groups keen to contribute to biodiversity, many of whom are neighbours acting cooperatively, church groups, youth groups, and so forth
- From 1998 to 2003 there has been a 930% increase in the number of groups (known to Council) getting involved in environmental activity
- ‘The environment’ is becoming a common topic of conversation. Earlier reticence to discuss environmental matters is now much reduced
- Multiple objectives: Participation has not been limited to so-called ‘conservation groups’. The community includes a large number of potential groups, most of whom have other primary objectives — sports groups wanting a fitness exercise, businesses wanting a team building exercise, church groups wanting a community service exercise, youth groups wanting to contribute to the community. Such

groups can achieve their own objectives whilst at the same time participating in a Green Network project. In this way new people gain exposure to environmental activities, perhaps for the first time

- Sustainability is also about strong (sustainable) structures within the community. Working with the community on a 'multiple objectives' basis enhances the viability and respect for those people and groups, serving as valuable community development
- Separation of project control (decision making), and accountability (of staff regarding Council policies and public funds etc). This is a whole paper in itself, but essentially allowing community groups to take on the decision making role is hugely empowering and motivating. Doing so substantially enhances community engagement and community/Council relations.

CASE STUDY 4. STORMWATER MANAGEMENT — PROJECT TWIN STREAMS

Focussing on stormwater management with associated habitat restoration in the urban heart of Waitakere City, Project Twin Streams aims to improve water quality in the local urban streams and associated harbour and gulf. A major tool in achieving this is the improvement of ecological function and health, including riparian restoration and the creation of wildlife corridors through the urban lowland of Waitakere City. Project Twin Streams intends to facilitate substantial community participation in achieving the project and to leverage community development from this and the significant finances committed to the project.

Task description:

- A comprehensive project of stormwater quality management for the major streams that run through urban Waitakere
- Maximise the effectiveness of biological and physical processes (as assisted by biodiversity and ecosystem services) in the riparian and aquatic environment that contribute to stormwater quality
- Support and encourage community engagement in generating and managing the Green Network

- Maximise the potential benefits of the project and the streams to the economic, social, cultural and environmental life of the city.

Result:

Stage 1 — A NZ\$40–50 million programme is just beginning, of riparian restoration covering two streams and four significant tributaries through industrial and residential areas of lowland Waitakere.

Stage 2 — An intended programme to build upon the foundation of Stage 1, including extending the catchment approach and retrofitting stormwater management devices. For example, devices such as planted swales and rain gardens offer a suite of benefits. Swales are broad shallow channels that allow good vegetation and soil contact, and rain gardens are planted sand traps. Both are used to filter surface water runoff (stormwater) especially from contaminated areas such as carparks, through vegetation and to allow time for the water to soak through soil or sand — instead of going directly into pipes. This enables plant, microbial and physical processes (ecosystem services) to treat the stormwater before it reaches the local stream. As well, these techniques offer ground water replenishment, habitat, and can be used as part of the landscape and amenity of the city environment. This will thus complement the riparian restoration of Stage 1.

Issues, actions, and challenges:

This project is resulting in substantial re-evaluations of many practices and processes. A selection of best practice guidelines and other tools are being incorporated or produced, for example the *Ecosourcing code of practice and ethics* (Ferkins 2001), *Riparian restoration guidelines* (WCC, undated 1) and *Weed management — a community tool for action* (WCC, undated 2).

Waitakere City Council is seeking to implement all that has been learnt so far into one large Biodiversity / Ecosystem Services project.

Significant actions and challenges include:

- Identification of the floodplain and the

purchase of a number of properties within the 100-year flood zone

- Geotech studies — it is expected that earthworks will account for only NZ\$150 000. Bioengineering techniques are expected to be implemented in the majority of situations requiring erosion control and stabilisation
- Generation of planting and weed control plans
- Plant supply — including the collection of ecosourced seed
- Establishment of mechanisms for large scale community engagement
- Monitoring
- The sourcing of funding
- The size of the project — 110 km of streamside.

Achievements

Although the project is only beginning, Project Twin Streams is definitely building the capacity of Waitakere to:

- Be an eco city
- Work together for better social, cultural, economic and environmental outcomes for our children, our grandchildren and yes, ourselves.

SUMMARY COMMENT

It is stating the obvious to say that it takes a lot to change the direction of a city, but that does not make the statement any less true.

The eco city was launched in 1993. Ten years later the accumulation of change is substantial. Is it visible to residents of the City? That depends partly on their observance of environmental activity. Is it making a difference to the biodiversity within the City? Yes. Several large projects coming to fruition including Project Twin Streams will provide renewed impetus and greater visibility. Like many of my colleagues, I enjoy the challenge, the innovation and the satisfaction of being part of making a difference, of finding new and effective ways to value what is 'us' — the biodiversity of Waitakere and New Zealand. The eco city is as much a journey as a destination.

REFERENCES

- Daily, G. C.; Alexander, S.; Ehrlich, P. R.; Goulder, L.; Lubchenco, J.; Matson, P. A.; Mooney, H. A.; Postel, S.; Schneider, S. H.; Tilman, D.; Woodwell, G. M. 1997: Ecosystem Services: benefits supplied to human societies by natural ecosystems. *Issues in Ecology 2*: 1–16.
- Department of Conservation (DOC) and the Ministry for the Environment (MfE) 2000: The New Zealand biodiversity strategy: our chance to turn the tide. Wellington, Department of Conservation and Ministry for the Environment. 144 p. Available at <http://www.biodiversity.govt.nz/picture/doing/nzbs/contents.html>.
- Esler, A. E. 1987: The naturalisation of plants in urban Auckland, New Zealand. 1. The introduction and spread of alien plants. *New Zealand Journal of Botany 25*: 511–522.
- Ferkins, C. 2001: Ecosourcing code of practice and ethics. Waitakere City Council, Henderson, Waitakere City. 129 p.
- Flynn, S.; Buddenhagen, C. 2000: Waitakere City weed strategy. Kingett Mitchell & Associates. (For Waitakere City Council). 34 p.
- Waitakere City Council (WCC) 2002a: Invasive or environmental weeds of Waitakere. Waitakere City Council, Henderson, Waitakere City. April 2002, 8 p. Available at <http://www.waitakere.govt.nz/CnlSer/pw/plantweed/pdf/weedlist-env-inv.pdf>.
- Waitakere City Council (WCC) 2002b: State of the city report: Waitakere City. Waitakere City Council, Henderson, Waitakere City. 212 p. Available at <http://www.waitakere.govt.nz/AbtCit/ps/socreport.asp>.
- Waitakere City Council (WCC) 2004: Roadside vegetation monitoring, Waitakere City. Waitakere City Council, Henderson, Waitakere City. 23 p. & appendices.
- Waitakere City Council (WCC, undated 1): Riparian restoration guidelines. Twin Streams Project, Lower Oratia Catchment, Waitakere City. Waitakere City Council, Henderson, Waitakere City. 18 p.
- Waitakere City Council (WCC, undated 2): Weed management — a community tool for action. Waitakere City Council, Henderson, Waitakere City. 12 p. Available at <http://www.waitakere.govt.nz/CnlSer/pw/plantweed/pdf/weedmngmnt.pdf>.

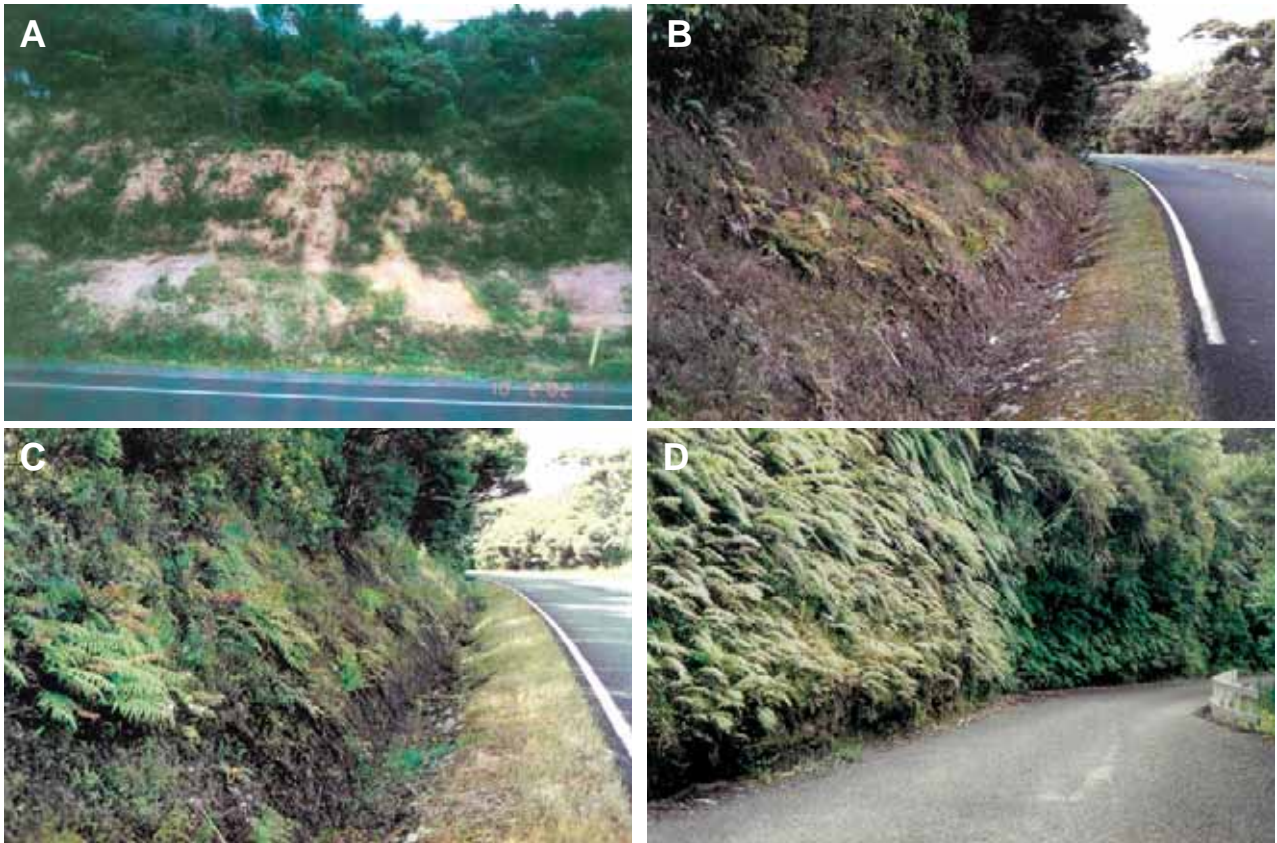


Fig. 9 **A**, a common effect of traditional vegetation control of roadsides. (Photo: C. Ferkins); **B**, a newly regenerating site. (Photo: M. Tyrrell); **C**, the same site as Fig. 9B, six months later. (Photo: M. Tyrrell); **D**, fully re-established vegetation on a shady site. (Photo: C. Ferkins).



Fig. 10 **A**, regeneration beginning on a sunny, dry site; **B**, substantially restored and weed free site. (Photos: C. Ferkins).



Fig. 11 Gorse — a traditional enemies strengths used to benefit roadside vegetation management. (Photos: C. Ferkins).



Fig. 14 Motivated people, new skills — Green Network Community Assistance staff discussing restoration of a private stream. Meeting convened by property owners who invited neighbouring stream owners and Council. (Photo: C. Ferkins).



Fig. 15 Green Network community management **A**, rural; **B**, urban. (Photos: C. Ferkins).

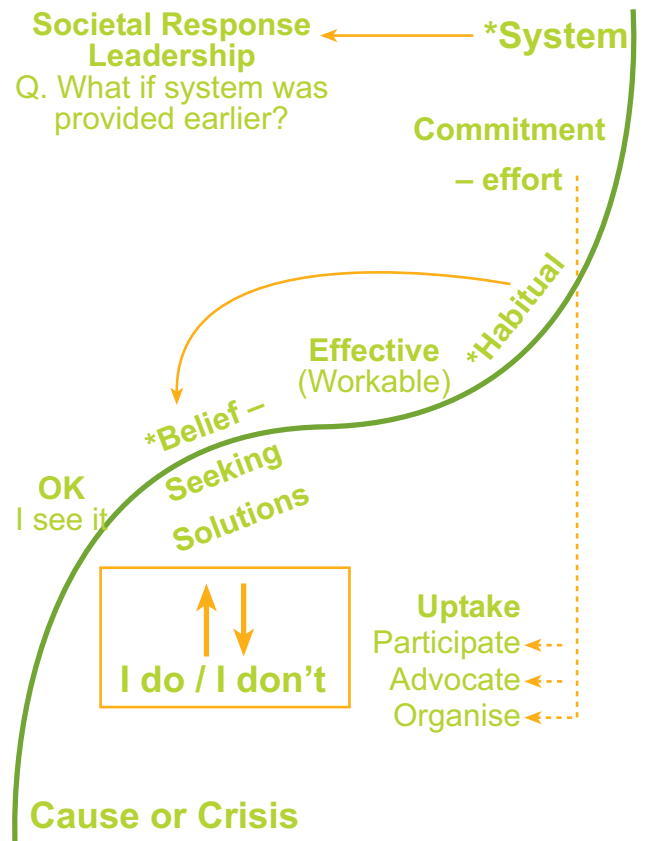


Fig. 16 Model of change in knowledge, attitudes, and behaviours in response to environmental issues.

Section 2: Nature Friendly Environments — Communities Making it Happen

Eco city – the journey continues...



Managing for biodiversity?



'Think on it ... unless we change direction ...



... we will end up where we are headed.'



APPENDIX 1: GLOSSARY

Adapted from *The New Zealand biodiversity strategy: our chance to turn the tide* (DOC & MfE 2000)

<p>Biodiversity (Biological Diversity):</p>	<p>The variability among living organisms from all sources including ... terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species (<i>genetic diversity</i>), between species (<i>species diversity</i>) and of ecosystems (<i>ecological diversity</i>). Biodiversity is a global concept contributed to by each population, species and ecosystem within its native range. Biodiversity is therefore best managed locally.</p>
<p>Genetic Diversity:</p>	<p>The variability in the genetic makeup among individuals within a population.</p>
<p>Species Diversity:</p>	<p>The range of species native to a particular geographical area. A species is a group of organisms that have evolved distinct inheritable features and occupy a unique geographic area. Species are usually unable to interbreed with other species due to such factors as genetic divergence, different behaviour and biological needs, and separate geographic location. However several plant species readily cross-pollinate and produce hybrids. Natural barriers help to isolate populations. These barriers include historical (remnant patches of vegetation); climatic or microclimatic (valley bottoms and swamps versus ridge-tops); substrate (volcanic soils bordering alluvial areas) and topographical barriers (islands isolated by surrounding water and ridge-lines that cause seed transporting water to flow in one direction or another). Such barriers are a significant factor in the development and maintenance of diversity in the New Zealand landscape.</p>
<p>Ecological (ecosystem) Diversity:</p>	<p>The variety of ecosystem types (e.g., forests, deserts, grasslands, streams, lakes, wetlands and oceans) and their biological communities that interact with one another and their non-living environments. An ecosystem is an interacting system of living and non-living components such as sunlight, air, water, minerals and nutrients. Ecosystems can be small and short-lived, for example, water-filled tree holes or rotting logs on a forest floor, or large and long-lived such as forests or lakes.</p>

APPENDIX 2: ECOSYSTEM SERVICES: BENEFITS SUPPLIED TO HUMAN SOCIETIES BY NATURAL ECOSYSTEMS

(Summary reproduced from Daily et al. 1997)

Human societies derive many essential goods from natural ecosystems, including seafood, game animals, fodder, fuelwood, timber, and pharmaceutical products. These goods represent important and familiar parts of the economy. What has been less appreciated until recently is that natural ecosystems also perform fundamental life-support services without which human civilizations would cease to thrive. These include the purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and production and maintenance of biodiversity, from which key ingredients of our agricultural, pharmaceutical, and industrial enterprises are derived. This array of services is generated by a complex interplay of natural cycles powered by solar energy and operating across a wide range of space and time scales. The process of waste disposal, for example, involves the life cycles of bacteria as well as the planet-wide cycles of major chemical elements such as carbon and nitrogen. Such processes are worth many trillions of dollars annually. Yet because most of these benefits are not traded in economic markets, they carry no price tags that could alert society to changes in their supply or deterioration of underlying ecological systems that generate them. Because threats to these systems are increasing, there is a critical need for identification and monitoring of ecosystem services both locally and globally, and for the incorporation of their value into decision making processes.

Historically, the nature and value of Earth's life support systems have largely been ignored until their disruption or loss highlighted their importance. For example, deforestation has belatedly revealed the critical role forests serve in regulating the water cycle — in particular, in mitigating floods, droughts, the erosive forces of wind and rain, and silting of dams and irrigation canals. Today, escalating impacts of human activities on forests, wetlands, and

other natural ecosystems imperil the delivery of such services. The primary threats are land use changes that cause losses in biodiversity as well as disruption of carbon, nitrogen, and other biogeochemical cycles; human-caused invasions of exotic species; releases of toxic substances; possible rapid climate change; and depletion of stratospheric ozone.

Based on available scientific evidence, we are certain that:

- Ecosystem services are essential to civilization
- Ecosystem services operate on such a grand scale and in such intricate and little-explored ways that most could not be replaced by technology
- Human activities are already impairing the flow of ecosystem services on a large scale
- If current trends continue, humanity will dramatically alter virtually all of Earth's remaining natural ecosystems within a few decades.

In addition, based on current scientific evidence, we are confident that:

- Many of the human activities that modify or destroy natural ecosystems may cause deterioration of ecological services whose value, in the long term, dwarfs the short-term economic benefits society gains from those activities
- Considered globally, very large numbers of species and populations are required to sustain ecosystem services
- The functioning of many ecosystems could be restored if appropriate actions were taken in time.

We believe that land use and development policies should strive to achieve a balance between sustaining vital ecosystem services and pursuing the worthy short-term goals of economic development.