Auckland **Regional** Council

State of the Auckland Region Report 1999

Chairman's Message

State of the Auckland Region 1999

To make the best of the future, we must first understand where we are now, and where we have been. This principle forms the foundation of this ***State of the Auckland Region Report.***

This report is the initiative of the Auckland Regional Council, the umbrella environmental organisation for New Zealand's most intensely developed, most populous region. For the first time, the state of our region has been assessed in one easy-to-read publication. The work of our best scientists, geographers, researchers, planners and heritage managers has been compiled to provide a comprehensive 'snapshot' of our region at the end of the millennium. Future versions of this report will show our successes, and point to those areas we might need to focus on.

This report shows that the Auckland Region has many good qualities: a diverse community, a strong economy, and a generally good quality environment. The report also shows that the Auckland Region faces some challenges, such as accommodating urban growth, traffic congestion, and maintaining the environmental qualities enjoyed by the region's population.

A special feature of this ***State of the Auckland Region Report*** is the guidance on how you and I, personally, can contribute to a healthier environment – one which can be sustained, and which in turn, will sustain us. This information can be found at the end of the sections in the Climate and Air, Land and Fresh Water, and Coast and Seas Chapters.

The ***State of the Auckland Region Report*** goes a long way towards empowering us all to make a positive difference. We have a special region, and with your help, our children will inherit a region that they also can be proud of.

Philip Warren QSO JP

CHAIRMAN

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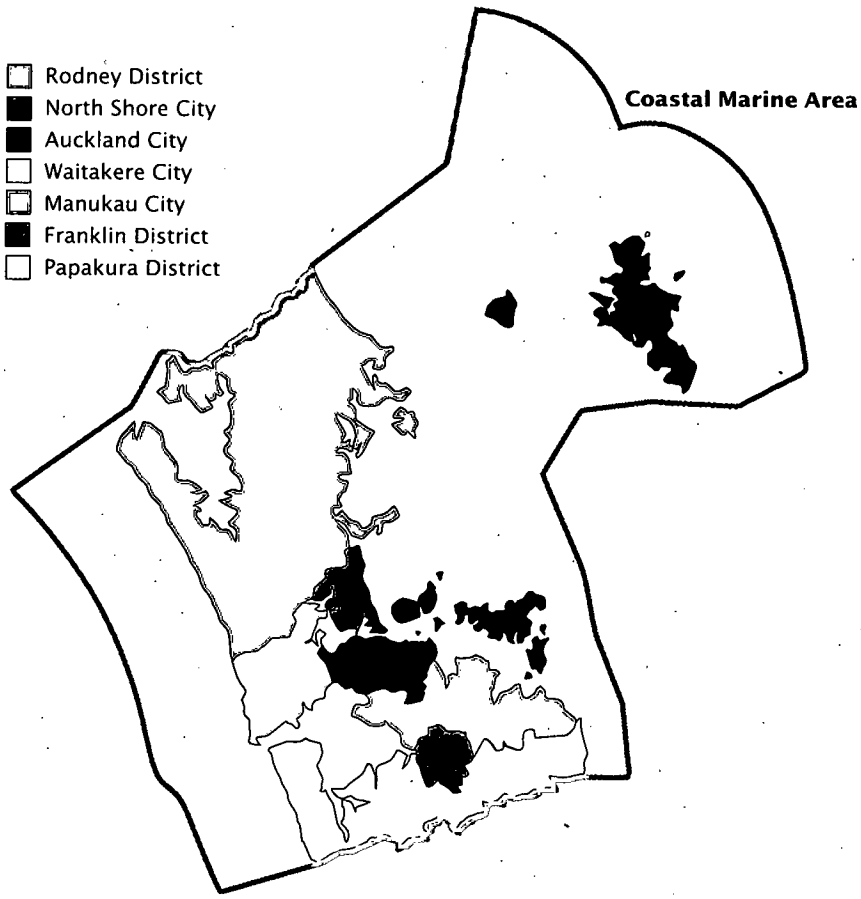
FIGURE 1: THE AUCKLAND REGION



Between 140 and 250 million years ago the base greywacke rocks of the Auckland Region accumulated at the bottom of the sea off the coast of the ancient super-continent Gondwanaland. Through millions of years a series of geological events shaped what would one day become the Auckland Region. The Tasman Sea opened up between 55 and 80 million years ago, the Waitakere and Kaipara volcanoes erupted 15-22 million years ago, and the land of the Auckland area was raised from the sea about 15-16 million years ago.

The present geology is heavily influenced by relatively recent events, particularly the Franklin volcanoes which erupted 1.5 million years ago, and the Auckland Isthmus volcanoes which erupted between 150,000 years and just 600 years ago: The present coastline formed about 6,500 years ago, when the sea level rose to approximately its present level following the last ice age.

Humans are a relatively recent arrival in the region. The Maori have been here for about the 1,000 years, and Europeans a little over 200 years.[1]

The Auckland Region Today

The Auckland Region is located at latitude 37° south, and longitude 174° east. Seventy per cent of the total area of the Auckland Region is in the coastal marine area. The mainland area of the region covers 16,140 square kilometres and has 1,613 kilometres of coastline. It is comprised of three districts (Rodney, Papakura and Franklin) and four cities (North Shore, Waitakere, Auckland and Manukau).

The landscape of the Auckland Region is extremely diverse, ranging from native forests and freshwater wetlands, to coastal seas and urban areas. The Auckland Region is home to over 20,000 species of plants and animals.

The Auckland Region makes up just 2 per cent of New Zealand's total land area, but has 30 per cent of the population and generates 34 per cent of the economic activity. The Auckland Region is now home to approximately 1.17 million people (in June 1999) from a wide range of cultures and ethnicities.

The size and diversity of the population of the Auckland Region offers many possibilities, a wide variety of jobs, educational opportunities, shopping, nightlife, festivals and cultural diversity.

The natural environment is particularly valuable to the people of the Auckland region — we enjoy going to the beach in the summer, sailing, fishing and even just looking out at the harbours on stormy winter days. We enjoy being able to go to the top of Mount Wellington or One Tree Hill without the view being obstructed by air pollution. We enjoy going to parks such as the Auckland Domain or the Hunua Ranges to get away from the city and relax, or to do some tramping or mountain biking.

The environment is also valuable to our region's economy — it provides favourable conditions for our primary sector industries such as pastoral farming, horticulture, forestry and fisheries. Other industries, such as manufacturing and the service sector, benefit from the close proximity to the biggest population base and markets in New Zealand, and also from access to other markets through the ports at Auckland and Onehunga, and the Auckland domestic and international airports.

But while we enjoy the Auckland Region's environment, we need to understand that our actions often have an effect on the environment, which ultimately impacts back on us.

In fact, virtually every action we take has a variety of consequences, both positive and negative. The following pages show some examples of how everyday activities result in a variety of effects.

Driving a Car

Carbon dioxide emitted per person in 1993 from land transport activities w

The average length of journey to work was [13.9 km in 1996], up 29 per cent over 1991.

Total vehicle kilometres travelled was [8.4 billion in 1996], up from 6.8 billion in 1991.

Total vehicles per 1000 people [increased from 594] in 1991 to [615] in 1996.

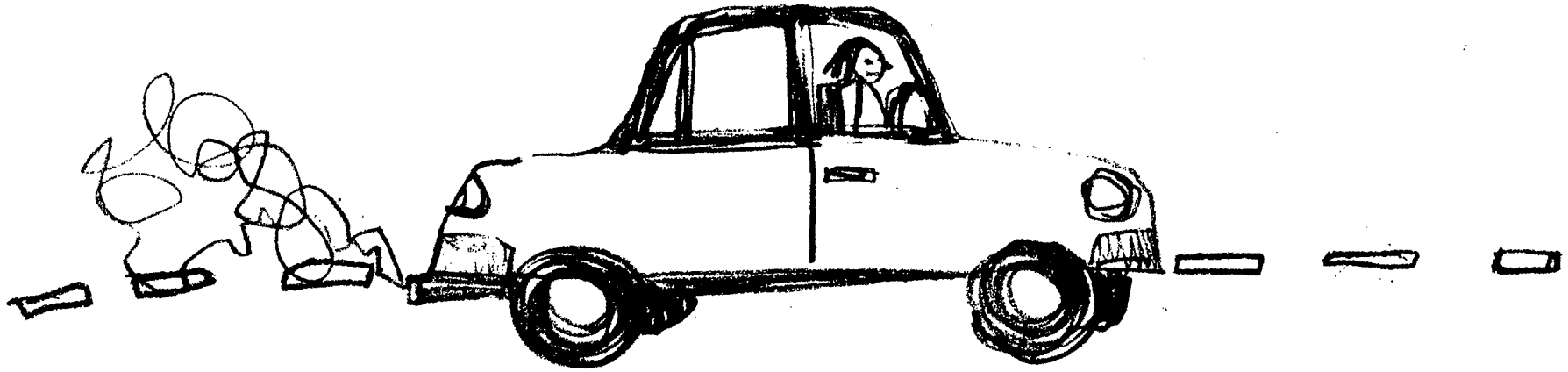
It is estimated that [944 million litres of petrol] and [393 million litres of diesel] was used on Auckland roads in 98/99.

Number of transport-related fatalities per 100,000 people in 1996 was [9.7] down from [11.4] in 1991.

2.496 kg The cost of all reported motor vehicle crashes in the Auckland region is estimated at more than $750 million per year

Transport air pollutant emissions per person in 1993:

[Volatile Organic Compounds] 43.9 kg [Nitrogen Oxides] 32.9 kg [Carbon Monoxide] 329.1 kg [Sulphur Dioxide] 0.4 kg [Total Suspended Particulates] 0.9 kg



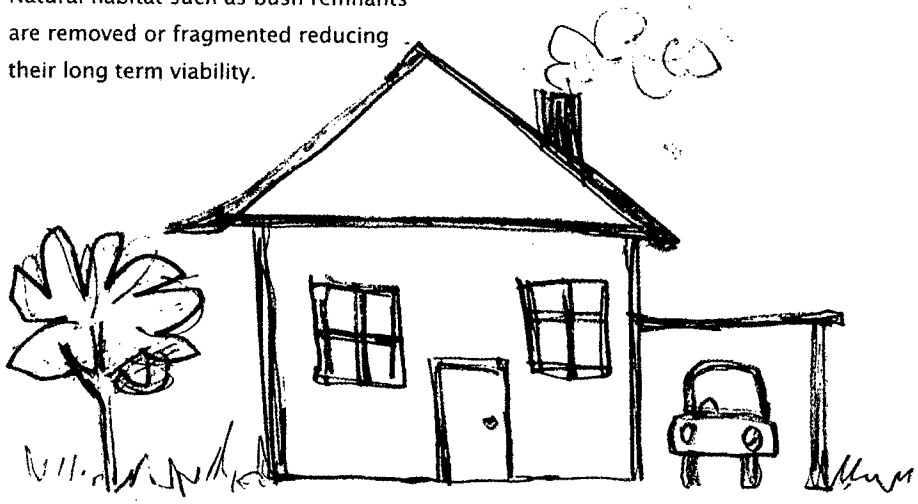
Transport pollutants deposited on roads, and eventually in waterways from tyre wear, engine wear, brake linings etc:

[Zinc] 0.7 mg/km travelled [Copper] 0.16 mg/km travelled [Cadmium] 17.6 µg/km travelled [Nickel] 0.045 mg/km travelled [Chromium] 0.1 mg/km travelled [Hydrocarbons] 15 µg/km travelled

Developing Land

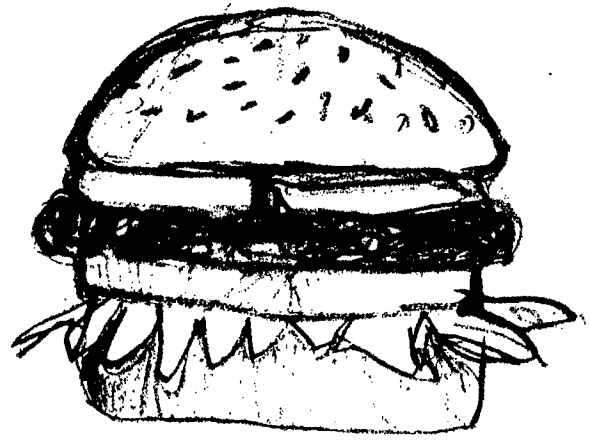
The appearance and landscape value of land changes, from natural or rural to suburban/urban environments.

Natural habitat such as bush remnants are removed or fragmented reducing their long term viability.



The impervious (hard surfaces where water runs off rather than soaking in) area of a catchment increases, changing how streams flow within that area. This in turn affects the aquatic life that lives there and can lead to flooding problems and bank erosion downstream. Urban pollutants land on these hard surfaces and are washed into streams and eventually harbours and estuaries each time it rains. Soil is eroded from earthworked land: up to 2,000 times more sediment erodes from land under construction than land under forest. This sediment then enters streams, which causes changes to the habitat type, reduces water clarity, smothers aquatic plants and other organisms, and may promote flooding.

Buying a Hamburger



Getting there: If you drive, you are using resources such as petrol and emitting pollutants into the atmosphere and waterways.

- Manufacture and application of **fertilisers** to grow wheat used to make buns, tomato and lettuce.
- **Land**, **energy** and **water** are needed to raise the cows and process meat into patties.
- **Heat** and **light** at the takeaway store, possibly from electricity generated at hydro-electric dams, geothermal or thermal power stations.
- **Paper** packaging from forestry pulp. Sometimes this paper is **bleached** with chlorine, which also impacts on the environment.

Our People

issue:

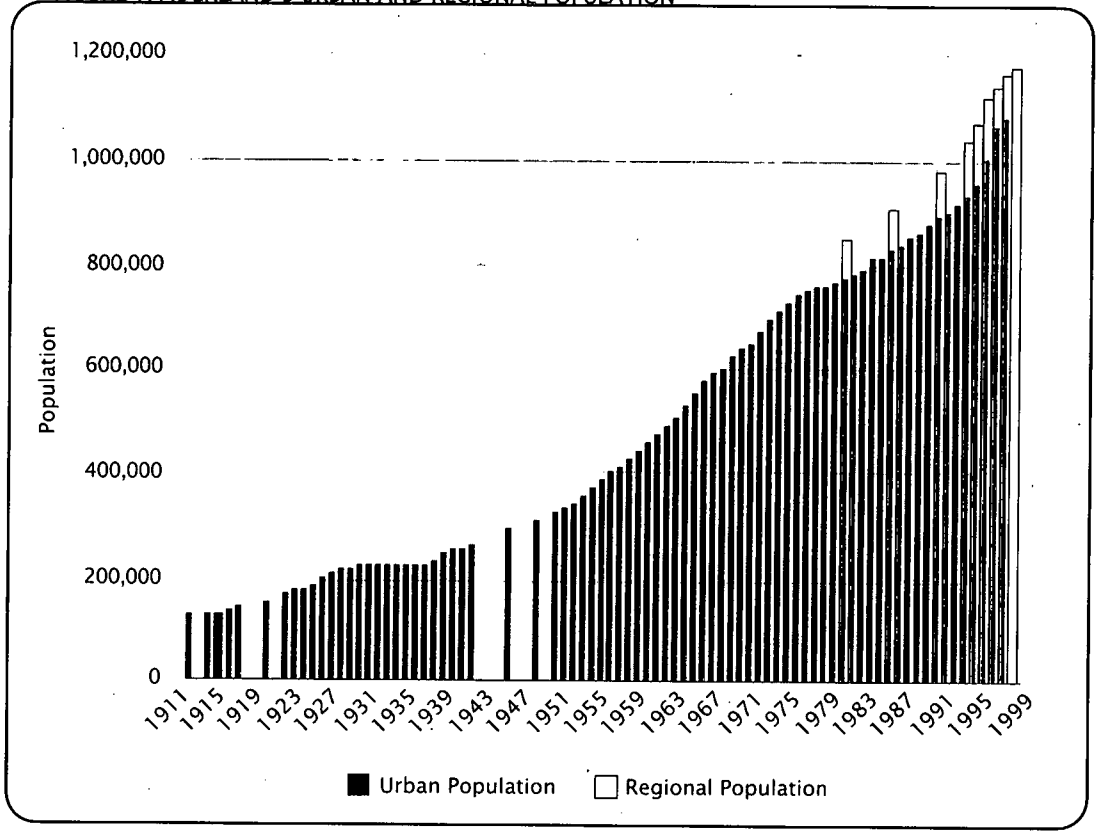
Population

People are our best resource and the source of greatest pressure on services and the environment.

The region's population growth offers benefits and challenges.

How is it now?

FIGURE 1: AUCKLAND'S URBAN AND REGIONAL POPULATION[1, 2, 3]



Auckland's population has grown every year since at least 1911. This feat is unmatched by any other region in New Zealand or the nation as a whole.

The population for the Auckland urban area, which makes up approximately 90 per cent of the region's population, is illustrated in Figure 1 from 1911, when the population numbered just 120,000. By 1996, the population of the Auckland Region numbered 1,109,100, and in June 1999 the regional population was estimated at 1,173,400.

A growth spurt between 1991 and 1996 saw the Auckland Region's population increase by over 123,000 — nearly 25,000 people a year. This is nearly the same as the population of Dunedin arriving in Auckland every four years.

The rate of growth of the population has varied widely, reaching 6 per cent increase per year in the 1920s (as high as the boom years of the 1990s), but also dropping below 1 per cent on several occasions. The growth of the Auckland Region has almost always been higher than that of New Zealand.

With our population growing on average at twice the national rate, Auckland's proportion of the national population is also expanding. In 1911, 11 per cent of the nation's population lived in Auckland. By 1996 this was over 30 per cent and rising.

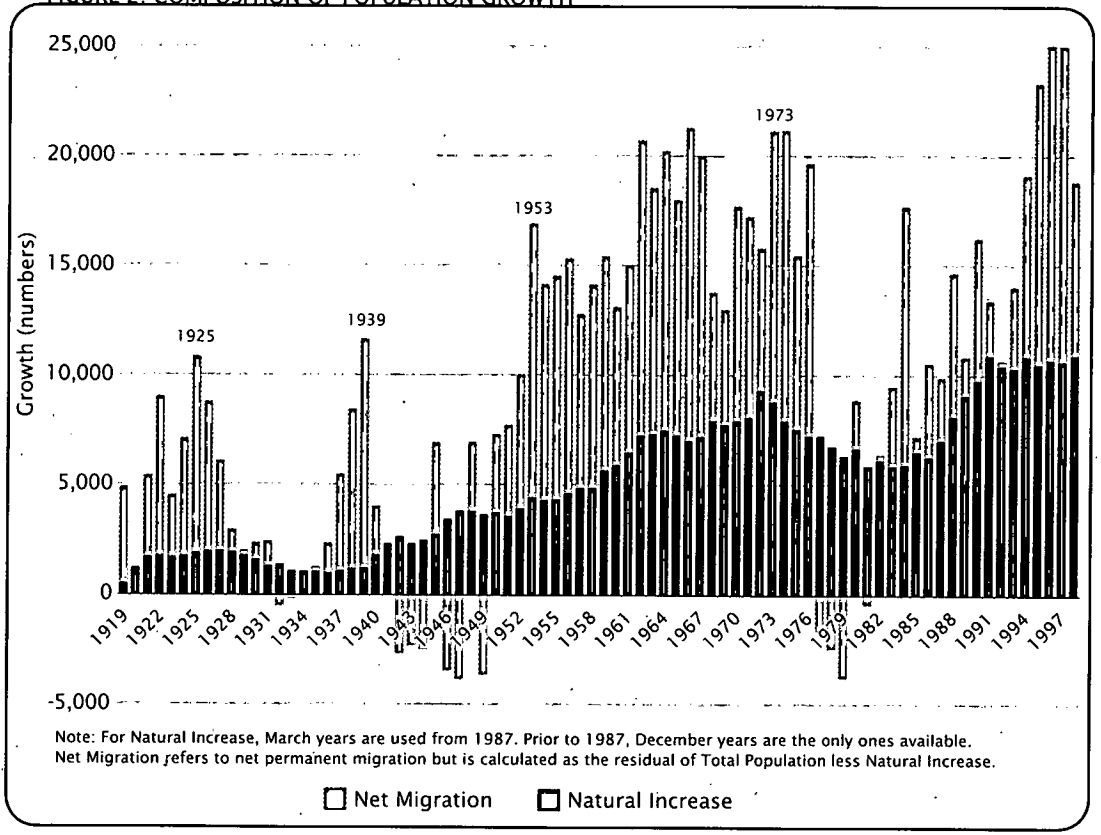
All of the region is growing, especially Rodney District, which is the second-fastest growing city or district in the country. Rodney's population grew by nearly 47 per cent between 1986 and 1996 and is expected to do the same again over the next 10 years. Slowest growing is Auckland City, though its 18 per cent increase between 1986 and 1996 well exceeds the comparable national increase of 11 per cent.

TABLE 1: PERCENTAGE SHARE OF NEW ZEALAND'S POPULATION [2, 3]

Region	1998 (estimated)	2016 (projected)	2041 (projected)
Northland	4%	4%	5%
Auckland	***30%***	***33%***	***39%***
Waikato	10%	10%	12%
Bay of Plenty	6%	7%	8%
Wellington	11%	10%	9%
Canterbury	13%	12%	13%
Otago	5%	5%	4%
Southland	3%	2%	1%

Population

FIGURE 2: COMPOSITION OF POPULATION GROWTH[2]



Note: For Natural Increase, March years are used from 1987. Prior to 1987, December years are the only ones available.
Net Migration refers to net permanent migration but is calculated as the residual of Total Population less Natural Increase.

Most of the Auckland Region's population growth (50-60 per cent) is from natural increase — more births than deaths. A further 30-35 per cent is from international migration (up to 70 per cent of overseas immigrants settle in Auckland where they are more likely to get jobs or live close to family or friends), while the remaining 10 per cent of growth is people migrating from other parts of the country.

Auckland City is home to over a third of the region's population. Manukau City is the next most populous, with nearly a quarter of the regional population, followed by the urban cities of North Shore and Waitakere. The three more rural local authorities (Papakura, Rodney and Franklin) together house the balance of the region's people.

The regional population is expected to reach 2 million in around 50 years: by then Auckland City will have reached 600,000 people and Manukau 480,000, though growth will become less rapid as the population ages.

What could happen?

TABLE 2: USUALLY RESIDENT POPULATION[1, 3]

	1986	1991	1996	2016	2041
Rodney District	45,868	55,784	67,261	105,862	149,850
North Shore City	144,153	152,134	171,494	225,255	268,929
Waitakere City	122,598	136,716	154,386	206,757	258,345
Auckland City	301,435	315,668	354,532	450,366	560,300
Manukau City	206,754	226,147	254,603	343,630	442,178
Papakura District	32,816	36,553	39,298	47,536	54,067
Franklin District	37,283	42,193	48,285	67,149	88,675
Auckland Region	**881,019**	**953,980**	**1,077,205**	**1,418,965**	**1,766,006**
Wellington Region	395,609	402,892	416,019	435,000	not available
Canterbury Region	436,571	446,114	478,912	500,300	not available
New Zealand	3,307,084	3,434,950	3,681,546	4,256,000	4,530,000

Our growing population has brought many benefits: more work and business opportunities, a diverse and vibrant cultural scene and the potential for better services such as public transport. The Auckland Region's growth has been largely self-perpetuating: a healthy economy attracts more people, increasing the size of the economy still more.

Added attractions include the Auckland Region's mild climate, its northern location, ports and natural environment, all of which are likely to contribute to future growth.

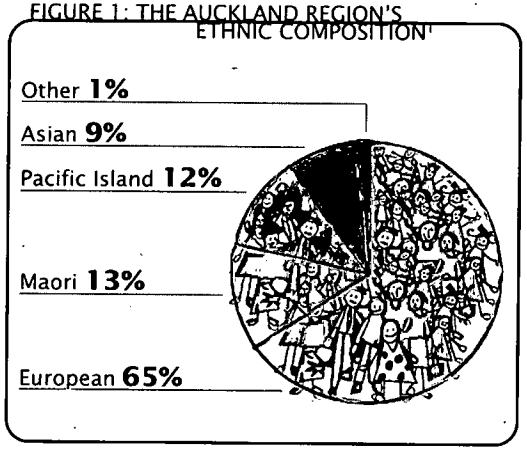
The downside is the pressure that growth puts on services like roads, water supplies and wastewater treatment. Much of Auckland's infrastructure is at capacity or the end of its life, or needs to meet higher environmental standards. Upgrading services is often expensive, but properly managed population growth can make better infrastructure more affordable.

Issue: Ethnicity

Different peoples and cultures make our region vibrant. This mix dramatically influences growth patterns and community needs.

How is it now?

FIGURE 1: THE AUCKLAND REGION'S ETHNIC COMPOSITION[1]



The Auckland Region has an increasingly diverse community. Figure 1 shows the Auckland Region's current ethnic composition.

The world's largest Pacific Island community lives in Auckland and it has been steadily growing as a proportion of the regional population. Since the large migrations of the 1970s and 1980s, growth has mainly been from natural increase. There are now almost as many Pacific Islanders in Auckland as there are New Zealand Maori.

Though small in numbers, the most rapidly growing ethnic group is from Asia. Growth in this population is almost entirely from migration, with relatively low rates of natural increase. Asian migrants are from many countries including mainland China, India, Taiwan, Japan, Korea, Philippines, Singapore, Hong Kong, Malaysia and Thailand.

Because Auckland is the main port of entry for most overseas immigrants and has the largest job market, 50 per cent to 70 per cent of migrants decide to stay here, increasing Auckland's share of New Zealand's migrant communities.

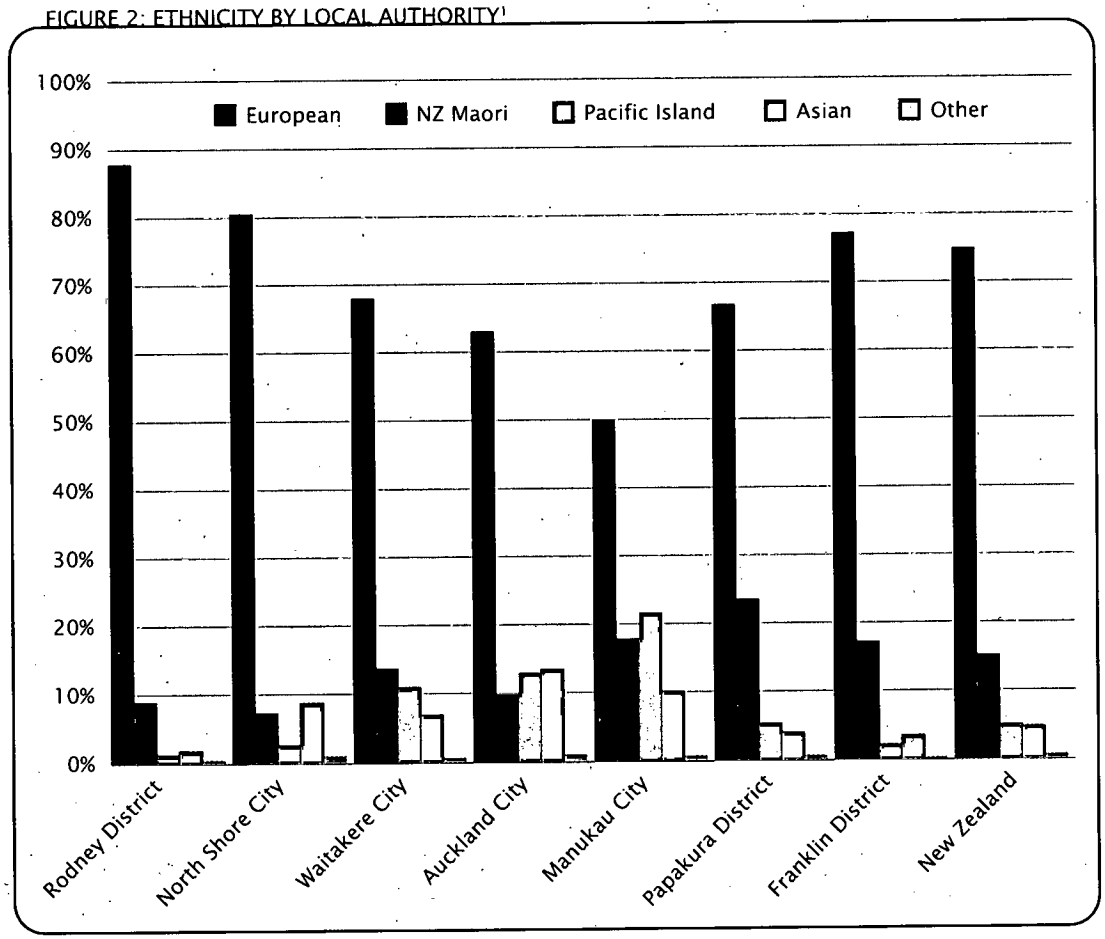
People from various ethnic communities often live near each other, probably to be near others of their culture, language, values, religion or appearance. Support structures often develop within these communities to help new migrants adjust to their new homeland more easily. These include community groups and education assistance, language classes, shopping and other services.

Ethnic groups vary widely across the region. 80 per cent of people of Pacific Island descent live in Manukau or Auckland City: in Manukau City they outnumber all other ethnic groups except Europeans by a wide margin. Very few Pacific Islanders live in the region's more rural areas.

Manukau City also has a significant proportion of New Zealand Maori who, together with Pacific Islanders, make up over 39 per cent of Manukau's population. Maori are also well represented in Papakura, where they make up 24 per cent of the population, and are least represented in North Shore City at 7 per cent.

Asians outnumber both New Zealand Maori and Pacific Islanders in Auckland City and are also well represented in North Shore City and Manukau City.

FIGURE 2: ETHNICITY BY LOCAL AUTHORITY[1]



What could happen?

Immigration has been a subject of widespread debate in New Zealand over the last few decades. Immigration policy is determined by government and is not easily influenced by regional, city and district councils.

Changes in the number and location of different ethnic groups have dramatically influenced the housing types, recreation needs, education and support services in some areas.

Ethnic diversity has implications in terms of the way Auckland will develop in the future, such as the likely demand for residential land and regional facilities and differing transport needs. The media, fashions, arts and sports of Auckland will also change as a result of a new ethnic mix.

Issue:

Age and Gender

Age influences things such as whether we go to school or work, drive a car, what we earn, our health and housing needs, and the resources we consume. Understanding the age structure enables us to plan to meet the needs of our population.

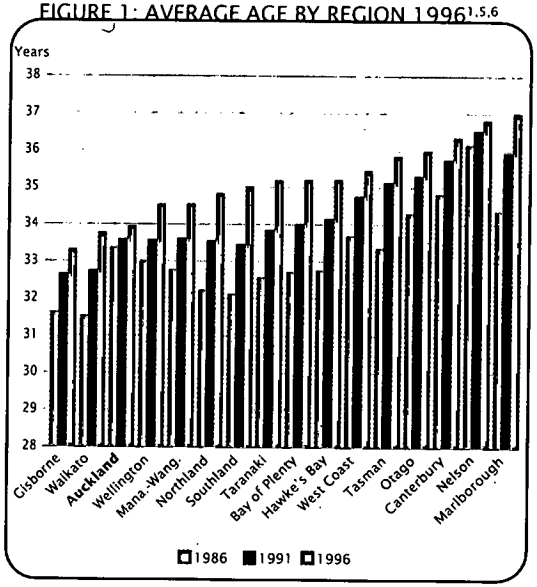
How is it now?

Aucklanders are relatively young on average compared with people in other parts of New Zealand. Although the average age is increasing all round the country, Auckland's is increasing more slowly than most.

Within a few years Auckland could be the youngest region in New Zealand: in 1996, our average age was 33.9, up from 33.4 in 1986. Only Gisborne and Waikato have a lower average age.

Aucklanders also live longer on average than other New Zealanders, living to an average 76.5 years of age (79.2 years for females and 73.2 years for males), compared with the national average lifespan of 75.7 years (78.7 for women and 72.8 for men). The difference is largely due to the influx of younger people looking for work and the outflow of older people looking for places to retire, which raises Aucklanders' life expectancy and lowers our average age.

FIGURE 1: AVERAGE AGE BY REGION 1996[1,5,6]



What Could happen?

The age of the population affects things such as the number of babies being born, the medical and educational facilities needed, the type of housing and infrastructure that needs to be provided and the nature of the labour force.

Age-sex pyramids like those following help with this planning. A classic pyramid shape with a broad base and narrow top indicates a young, growing population, while a narrowing base and widening middle indicates slow growth and an ageing population.

If we know how the age structure of the population will change, we can plan for the right kind of housing. We can also plan for the infrastructure these houses will need, such as, roads, public transport and power, water supplies, sewage and stormwater services. Providing these services usually involves forming partnerships with other organisations and companies. Co-ordinated planning for these needs makes good sense.

Our average age is expected to continue increasing into the next century, but relatively slowly. The age-sex pyramids show a smaller proportion of people aged under 10 in 20 years' time. On the

FIGURES 2 & 3: AGE-SEX STRUCTURE AUCKLAND REGION[1,3]

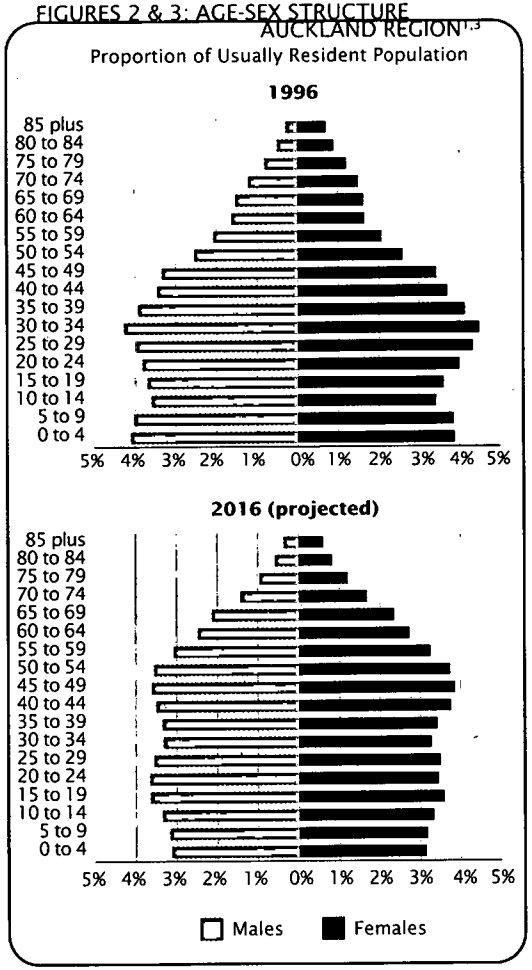
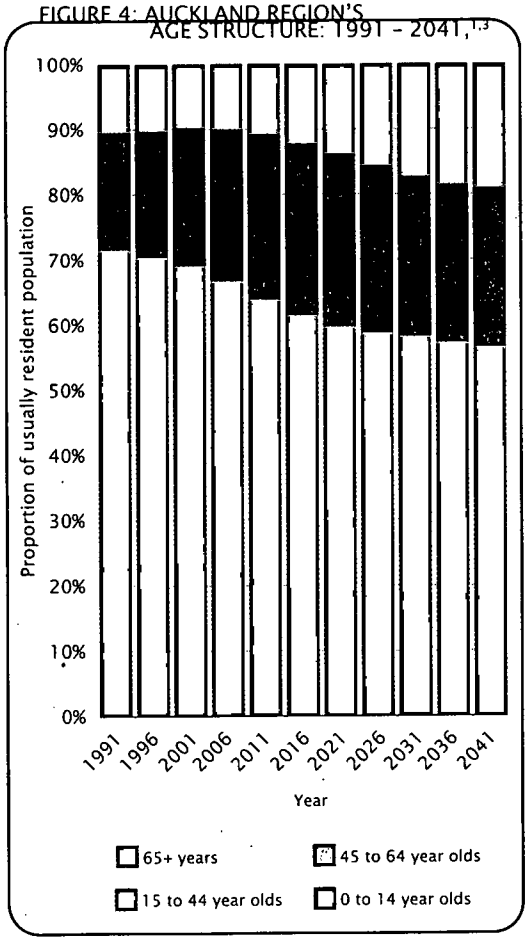


FIGURE 4: AUCKLAND REGION'S AGE STRUCTURE: 1991 - 2041,[1,3]



other hand, there will be a greater proportion of people in older age groups, particularly working-aged people in the 45-64 age group.

The age-sex pyramids also show the higher proportions of females at older ages. One thousand and fifteen males are born for every 1,000 females in New Zealand, but death rates for males are higher for all age groups (including those not yet born). There are more males than females in the Auckland population until age 19, when females become predominant.

Beyond 2016, retired people will rapidly expand in number - both males and females. Eventually, there will be as many people aged over 65 as there are under 15. Without careful financial management, this could put serious strain on New Zealand's ability to support these older people. We may see more older people staying in employment or starting their own businesses.

Issue:

Tangata Whenua

Tangata whenua (the Maori 'people of the land') have long-standing links with resources which establish their mana whenua, or customary authority, over an area. The Treaty of Waitangi created a unique relationship with Maori in 1840, and since then various laws have incorporated Treaty principles, which must be taken into account in all our dealings with Maori people, the land and it's resources.

How is it now?

Seven tribes are represented in the Auckland Region in the 1996 Census. Because the diagram below records people who identify with more than one iwi or whose mana whenua falls outside the Auckland Region, it may slightly over-estimate the numbers of tangata whenua in the region. It does not include all New Zealand Maori in the Auckland region.

Tangata whenua of Auckland are involved in resource management issues at all levels from whanau, marae and hapu-based groups through to wider iwi groups.

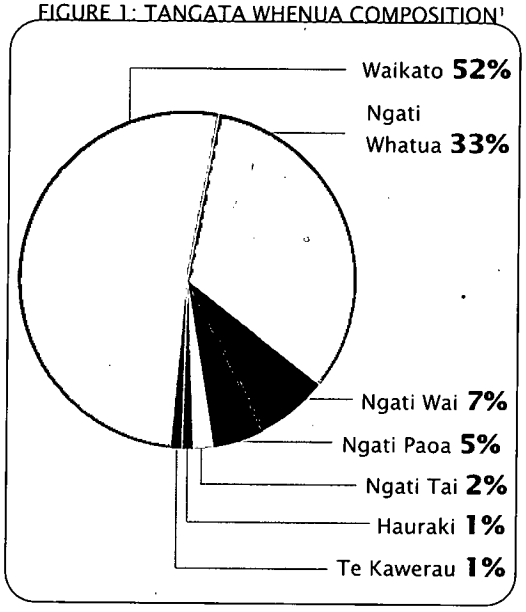
At the regional level tangata whenua are represented by tribal trust boards and iwi resource management units. The recognised bodies are the Ngati Wai Trust Board, Te Hao o Ngati Whatua, Te Rito o Ngati Whatua and Ngati Whatua o Orakei, Te Kawerau a Maki Trust, Ngai Tai ki Tamaki Tribal Trust, Ngati Paoa Whanau Trust, Hauraki Maori Trust Board, Huakina Development Trust representing Waikato hapu, and Awaroa Environment representing Ngati Te Ata.

There are 16 tangata whenua marae in active use in the region today. They belong to the people of Ngati Whatua, Ngati Wai, Ngati Paoa, Ngati Te Ata and the northern hapu of the Waikato iwi.

Tangata whenua have become more active in local government issues as they have become more familiar with decision-making processes and as agencies have developed a better understanding of the issues of significance to Tangata Whenua.

Tangata whenua now work with resource consent applications, help councils prepare policy statements and plans, and promote practical kaitiakitanga (guardianship) initiatives.

FIGURE 1: TANGATA WHENUA COMPOSITION[1]



What could happen?

Tangata whenua view the environment as a living entity which shares a common origin with people. Environmental resources are the taonga (treasured gifts) of Papatuanuku (earth mother) handed down through the generations. The traditional concept of kaitiakitanga is the driving force behind the growing involvement of tangata whenua in resource management. The Auckland Region's growth and development puts significant pressures on the region's resources, which hold special value to tangata whenua.

To meet the challenges posed by the law and the obligations of kaitiakitanga, local government and tangata whenua must strengthen their present relationship. These challenges will only be met successfully with the support of the entire community, and so continuing education for everyone involved will be an important tool in the future.

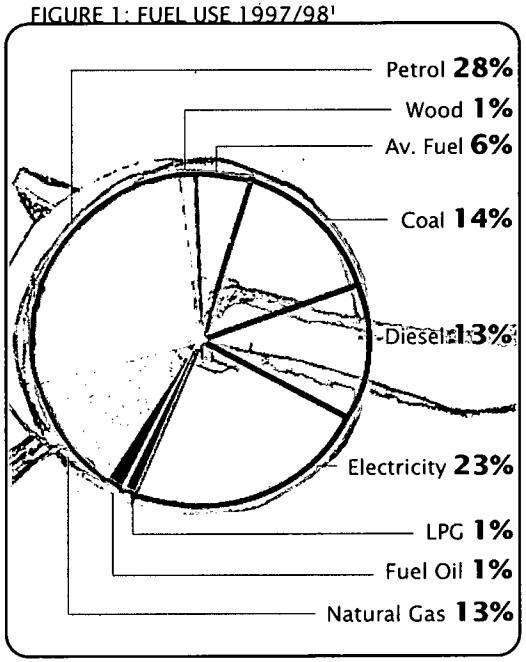
Issue:

Petrol, diesel, electricity, water and countless goods and materials keep everyday life going, but wastes from their use threaten human and environmental health. Efficient use of resources and reducing waste has much to offer the region's economy and environment.

Resource Use and Waste

How is it now?

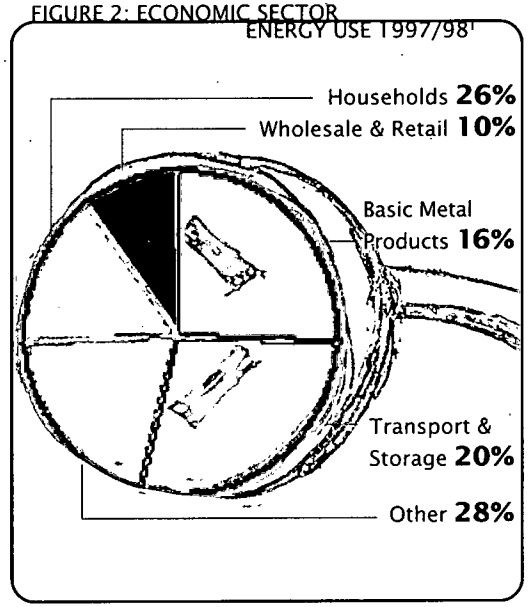
FIGURE 1: FUEL USE 1997/98[1]



ENERGY

Oil-based fuels contribute almost half of the energy delivered to end users in the Auckland region, with electricity, coal and natural gas also widely used. As some electricity in New Zealand is generated from fossil fuels, Figure 1 understates the importance of these fuels to a small degree.

FIGURE 2: ECONOMIC SECTOR ENERGY USE 1997/98[1]



Four economic sectors consume almost three-quarters of energy used in the Auckland region: households, transport and storage, basic metal products and the wholesale and retail trade. Twenty economic sectors, including the food and beverage, petroleum and chemical manufacture, and Construction industries make up the 'other' category, and together consume the remaining 28 per cent of energy used in the Auckland Region.

Over half the energy used by the household sector is for private transport, with the remainder used in the home for hot water heating, cooking, space heating and lighting.

Almost two-thirds of energy used by transport and storage is petrol and diesel, mainly for road transport such as buses and trucks. Most of the rest - a quarter of the total - is aviation fuel, reflecting Auckland domestic and international airports, energy use.

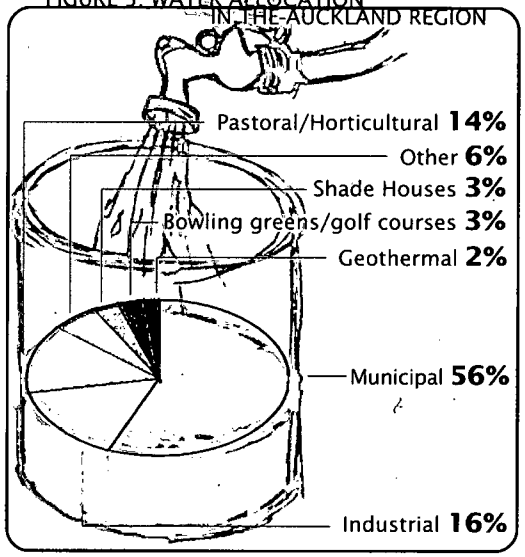
Over half the energy used by the wholesale and retail trade is petrol, again reflecting the importance of transport to this sector.

Most of the energy used by the basic metal products sector is coal used at the Glenbrook Steel Mill.

Around half Auckland's energy is used for transporting people or goods, with the rest either used in manufacturing or in buildings for heating, lighting and other building services.

Household energy use increased by 14 per cent from 1994/95 to 1997/98, almost twice the rate of population growth. It is likely that most of this increase is due to increasing car use.

FIGURE 3: WATER ALLOCATION IN THE AUCKLAND REGION

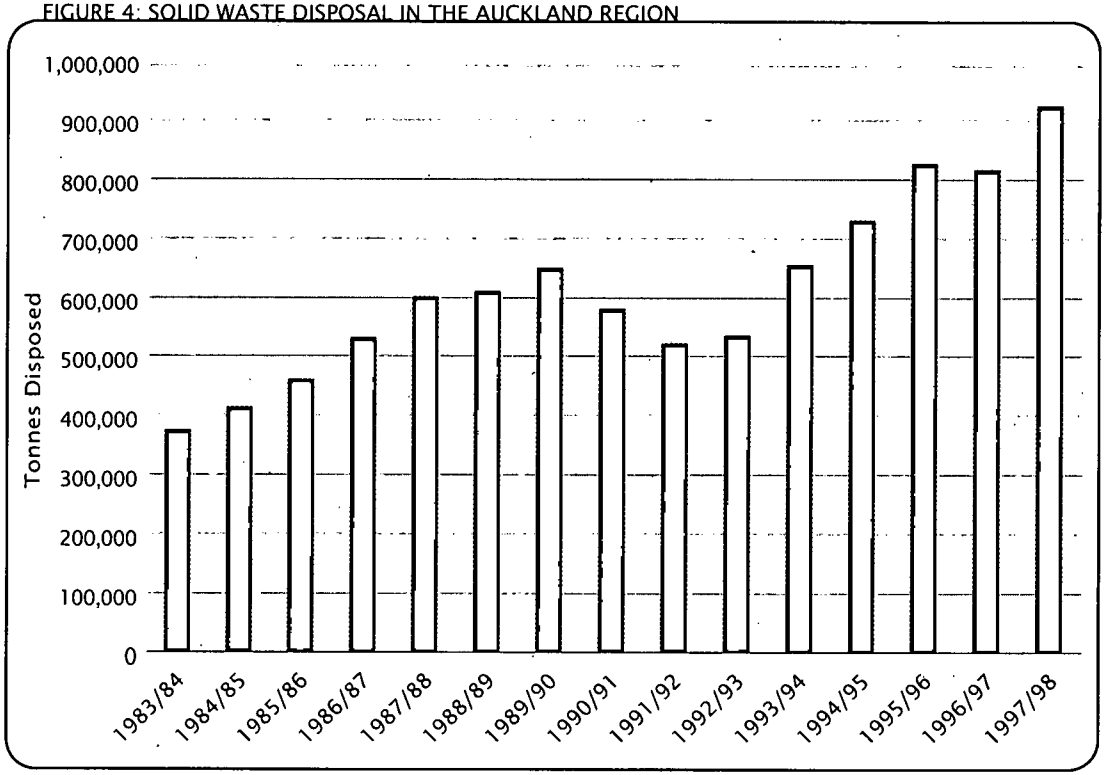


WATER

Figure 3 shows that most of the water used in the Auckland Region is allocated to municipal supply, with industrial and pastoral activities also consuming significant amounts. The 'other' category of water allocation includes domestic, stock and emergency water use.

Average reticulated residential water consumption in the four cities (Auckland, Waitakere, North Shore and Manukau) is 182 litres per person per day.

FIGURE 4: SOLID WASTE DISPOSAL IN THE AUCKLAND REGION



SOLID WASTE

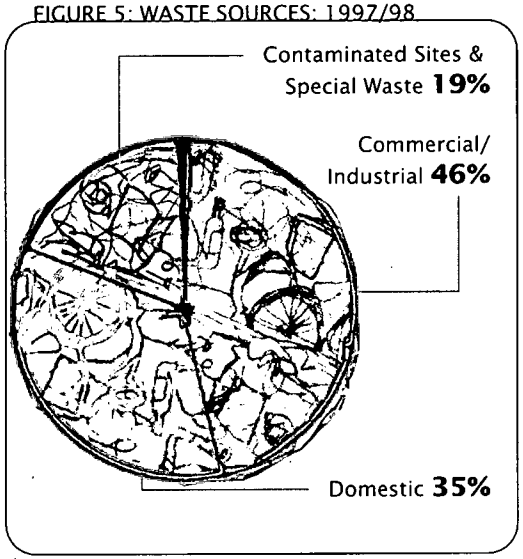
The commercial/industrial sector is the largest source of solid waste. Households contribute another third, with the remainder of waste coming from contaminated sites and other special waste.

Total waste disposed in landfills increased by 11 per cent from 1995/96 to 1997/98. The increase was mostly due to waste generated by the cleaning up of contaminated sites.

Resource Use and Waste

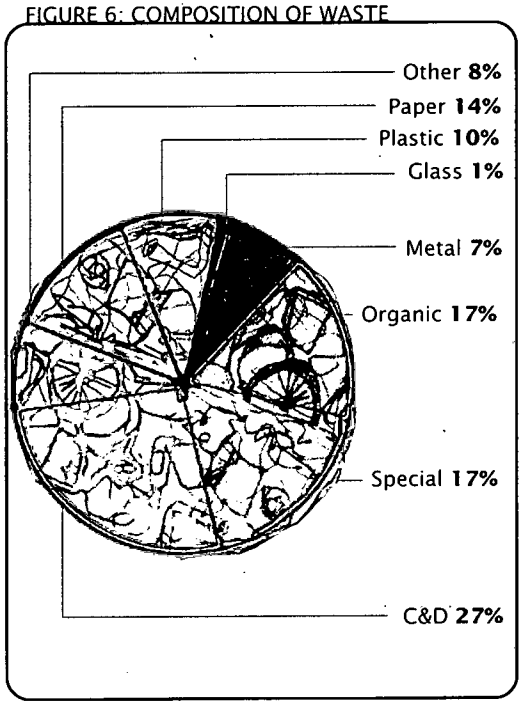
In 1997/98 the largest components of the Auckland Region's waste stream were organic materials (food and garden wastes), construction and demolition wastes, and paper.

FIGURE 5: WASTE SOURCES: 1997/98



Most household waste is organic and paper, which can be easily recycled. Commercial and industrial wastes have high levels of construction and demolition waste, and organic materials.

FIGURE 6: COMPOSITION OF WASTE



Waste generation has more than doubled in the 15 years to 1997/98, and increased by about 50 per cent over the last decade. There are many factors which influence this, including population (which grew by 22 per cent in the decade to 1996), and the economy (regional GDP increased by 31 per cent in the decade to 1997).

What could happen?

The Auckland Region uses large amounts of resources, many of which are finite and non-renewable. The use of resources and the disposal of waste materials have environmental consequences.

For example, the region's high dependence on non-renewable energy sources has environmental implications: burning fossil fuels releases CO_2 into the atmosphere, thought to cause global warming (see ***Global Atmospheric Issues***). The transport sector which consumes a large proportion of the energy in the region also creates serious air pollution from vehicle emissions (see ***Travel Patterns***). Motor vehicles are also a major contributor to water pollution in the region, with stormwater from roads containing oils, organic contaminants and metals which are accumulating in our streams and harbours (see ***Earthworks***).

Many of the environmental effects of Auckland's energy use are felt outside the region, with electricity coming from dams all over New Zealand and thermal power stations such as Huntly. Recently however, electricity generation capacity in the Auckland Region has been increased, with new or upgraded facilities at Southdown and Otahuhu.

To become a more sustainable society, we must use resources more efficiently and reduce waste.

Issue: Housing

As well as the traditional quarter-acre, Aucklanders' housing choices now includes high-rise apartments, townhouses, terrace and cluster housing, and 1 hectare lifestyle blocks. Changes in occupancy rates, age and family structures and ethnic composition can all have dramatic effects on the demand for housing, and in turn the demand for residential land.

How is it now?

By 1996, there were 355,000 private dwellings in the Auckland Region, up from 320,000 in 1991 and 288,000 in 1986.

The growth in the number of houses in Auckland has mirrored our population growth — but the type of housing varies widely. The overwhelming majority (77 per cent) of private homes are separate houses on their own sections. Although section sizes have been decreasing over the last decade, this housing has been the standard accommodation for several generations. However, the proportion of multiple dwellings has been slowly increasing.

The proportion of houses in multiple units, like apartments or blocks of flats, varies around the region. The regional average is 23 per cent, but the greatest proportion by far is in highly urban areas such as Auckland City, where 34 per cent of the housing is multiple units. By contrast, the more rural Franklin District has just 9 per cent of its housing in multiple units.

This variation is due to many factors, including land price and availability, demand for housing, ethnic and socio-economic composition, and the history of development in the area.

FIGURE 1: HOUSING TYPES IN THE AUCKLAND REGION[1]

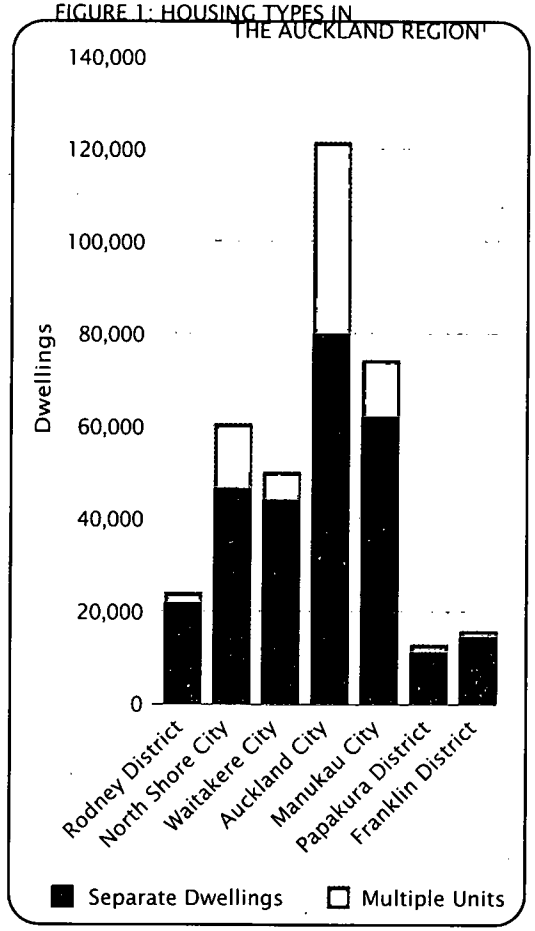
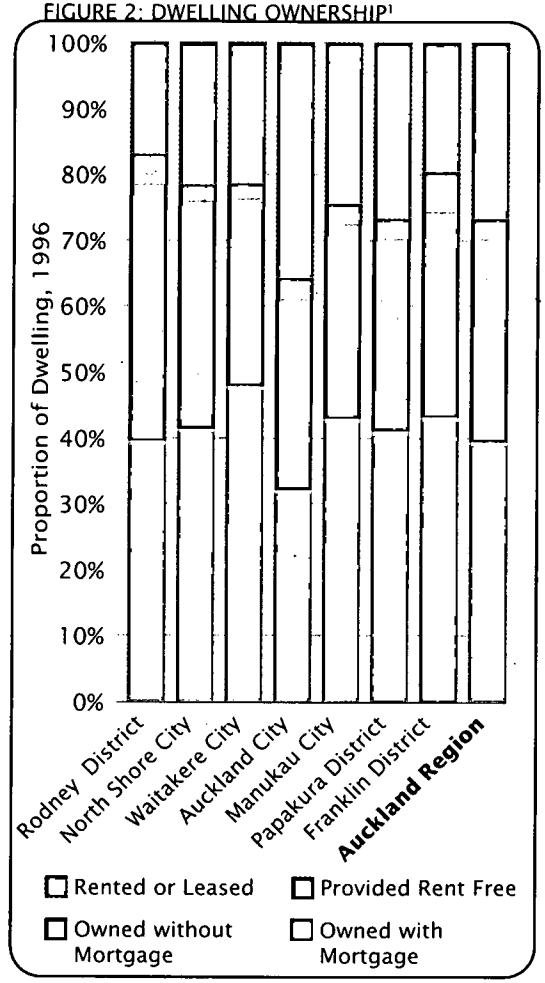


FIGURE 2: DWELLING OWNERSHIP[1]



Home ownership is becoming less common, although it is still high by international standards. In 1996, 66 per cent of Auckland homes were owned either with or without a mortgage, down from 71 per cent in 1991 and 73 per cent in 1986.

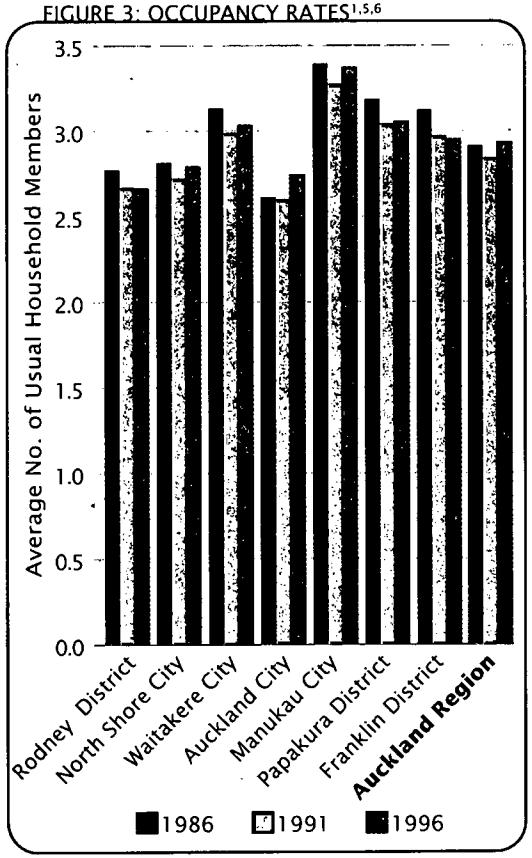
Renting has become correspondingly more common. Of the 98,000 rented houses in the region, 56 per cent are rented from private individuals, 19 per cent from Housing New Zealand and 10 per cent are provided rent free. The remaining 15 per cent are rented from a mix of central government, local authorities and businesses.

People's preferences for renting or owning vary depending on affordability, how often they move residence, and changing attitudes to home ownership.

The average number of people living in each home (home occupancy) reveals much about the family structure of the population and potential housing demand.

Falling home occupancy for some years was thought to reflect an ageing population, the trend towards independent living, delayed childbearing and more childless couples. The 1996 census however, revealed that Auckland's average occupancy rate rose from 1991, in contrast to the national figure which continues to fall.

FIGURE 3: OCCUPANCY RATES[1,5,6]



The average home occupancy rate in the Auckland Region is 2.93 people per household, up from 2.84 in 1991. Even such a small increase can make a big difference: it means that the region's population of 1,173,400 can be accommodated in 12,700 fewer houses.

Widely varying occupancy rates across the region reflect variations in the type and size of houses, affordability, ethnicity, age and family structures. For example, detached dwellings on their own section are generally larger than flats or high-rise apartments, and therefore have a higher average occupancy rate, but with fewer detached houses in Auckland City, its occupancy rate is lower than the regional average. On the other hand, Manukau City's larger proportion of Pacific Island households pushes up that City's average occupancy rate because these households often include extended family members.

Housing

Building consents are a good indicator of the supply of new houses as well as of house size and construction cost. In the March 1999 year, 8,500 residential consents were issued, well down on the 11,250 the year before. The mid-1990s building boom is clearly noticeable in Figure 4, and though it seems to have cooled in 1998/99, it has only dropped to 1996 levels.

In 1999, 1.3 million m² was potentially added to the regional housing stock (not all building consents are acted on). This is down from the 1.7 million m² the previous year, but an Auckland Regional Council survey in early 1998 revealed that 97.5 per cent of buildings for which consents had been issued since 1995 were actually built. This is well up from the 70 per cent of building consents that became houses in the late 1980s.

In 1999, the average size of new houses was 153m², down from the 155m² the previous year and down still further from the 171m² in 1996. This may reflect the increasing numbers of apartments and high-rise accommodation being built, especially in the central city, because their average floor area is much smaller than that of traditional detached houses.

FIGURE 4: NEW DWELLINGS[7]

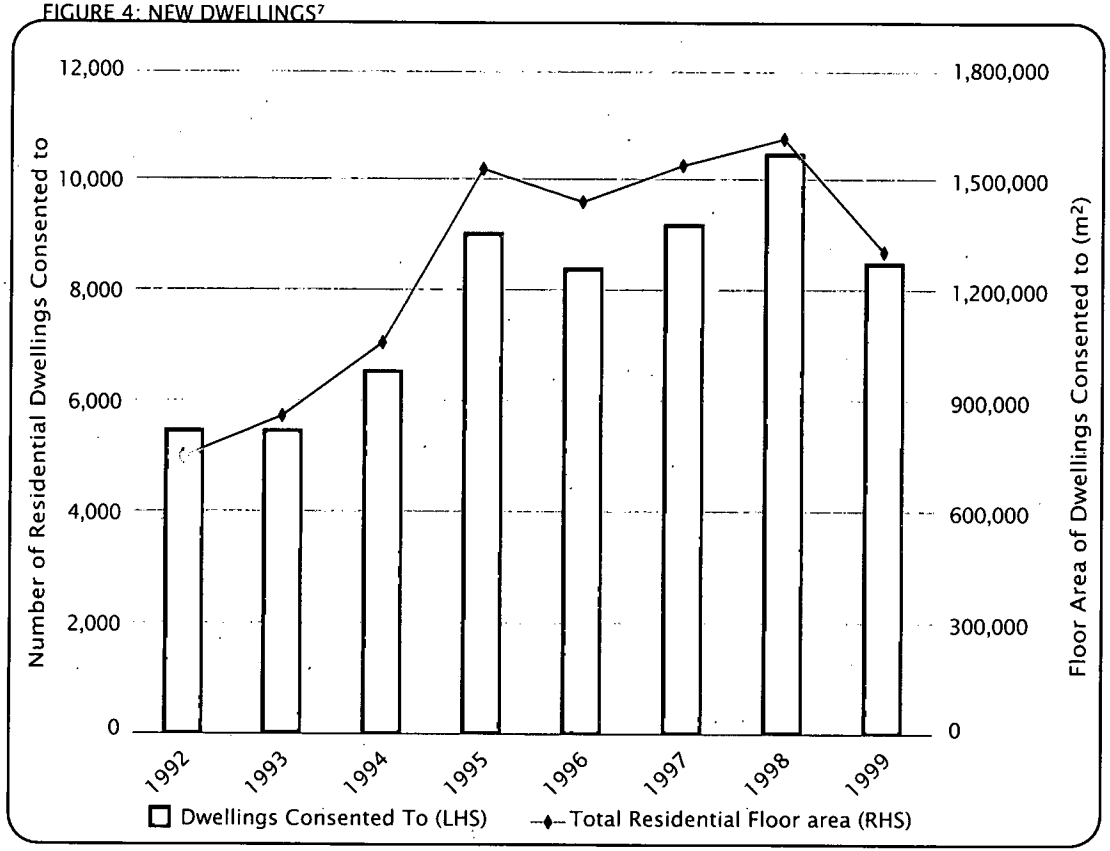


TABLE 1: DWELLING FLOOR AREA AND VALUE[1]

March Year	Dwellings	Total Floor Area	Average Floor Area (m^2)	Total Value ($)
1992	5,471	747,687	137	572,538,752
1993	5,473	856,830	157	610,126,677
1994	6,543	1,054,693	161	793,511,432
1995	9,026	1,524,444	169	1,189,261,777
1996	8,402	1,435,380	171	1,174,498,903
1997	9,188	1,535,040	167	1,278,425,081
1998	11,249	1,739,538	155	1,500,152,032
1999	8,482	1,300,781	153	1,140,985,571

Housing demand is likely to keep pace with expected population growth. Different growth scenarios put the number of houses at 623,000 to 800,000 by 2050. This demand will put more pressure on available land, potentially causing land prices to rise. However, more intensive forms of housing will become more common. While this will reduce how much land is required for development, less private open space (such as private back yards) will need more compensating public open space, such as parks.

Demand for higher density living seems likely to increase in the future, although demand for more traditional housing will persist. The central city has experienced a dramatic increase in the number of medium and high density apartments and more are planned, while these developments are now seen in the suburbs as well.

There is at present 15-20 years, supply of land left within present urban limits to build new houses on. It is intended to retain such a supply of land for urban development for the foreseeable future as a reduction could create pressure on housing patterns and affordability.

Issue:

Households

Our living arrangements affect the number and type of housing we need – whether we live alone, with friends or a partner, with our children or extended family.

How is it now?

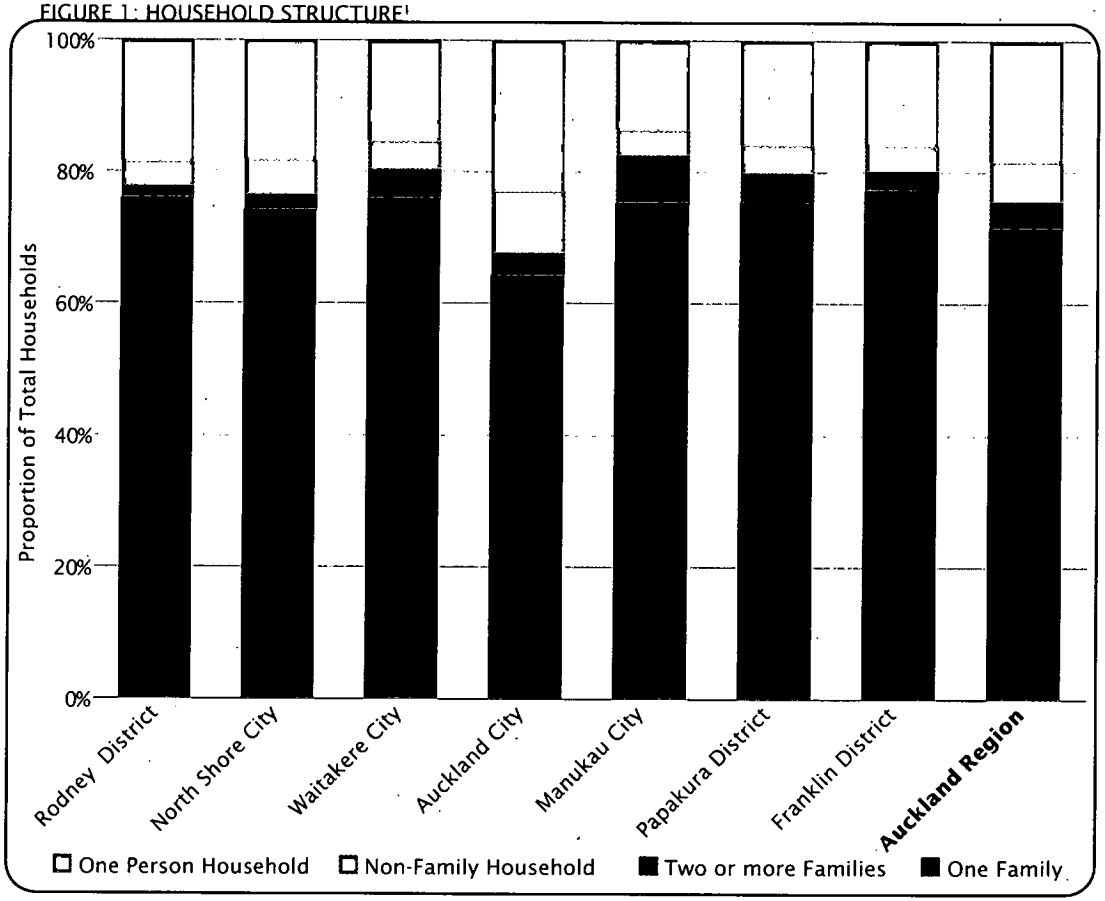
Along with Northland, the Auckland Region has the nation's largest average household size. Most Auckland households (71 per cent) are just one family. One-person households are the next most common living situation (18 per cent). Two or more families living together account for 4 per cent, while the remaining 6 per cent of households are non-family households, for example people flatting together.

These figures vary around the region, reflecting the types and cost of housing available, age structure, available facilities and perceptions about the desirability of different areas. Auckland City has the most one-person households and non-family households because of its educational institutions and the attractions of the central city generally, as well as its relatively high proportion of older people.

The proportion of people living in the traditional family has been declining in recent years. Single parent families and couples without children are increasingly common for many reasons, such as the increasing divorce rate and changing attitudes towards marriage, living together and childbearing.

While two-parent families are still the most common family arrangement, they comprise just 47 per cent of all families. Increasingly common is the one-parent family (18 per cent) and couples without children (34 per cent).

FIGURE 1: HOUSEHOLD STRUCTURE[1]

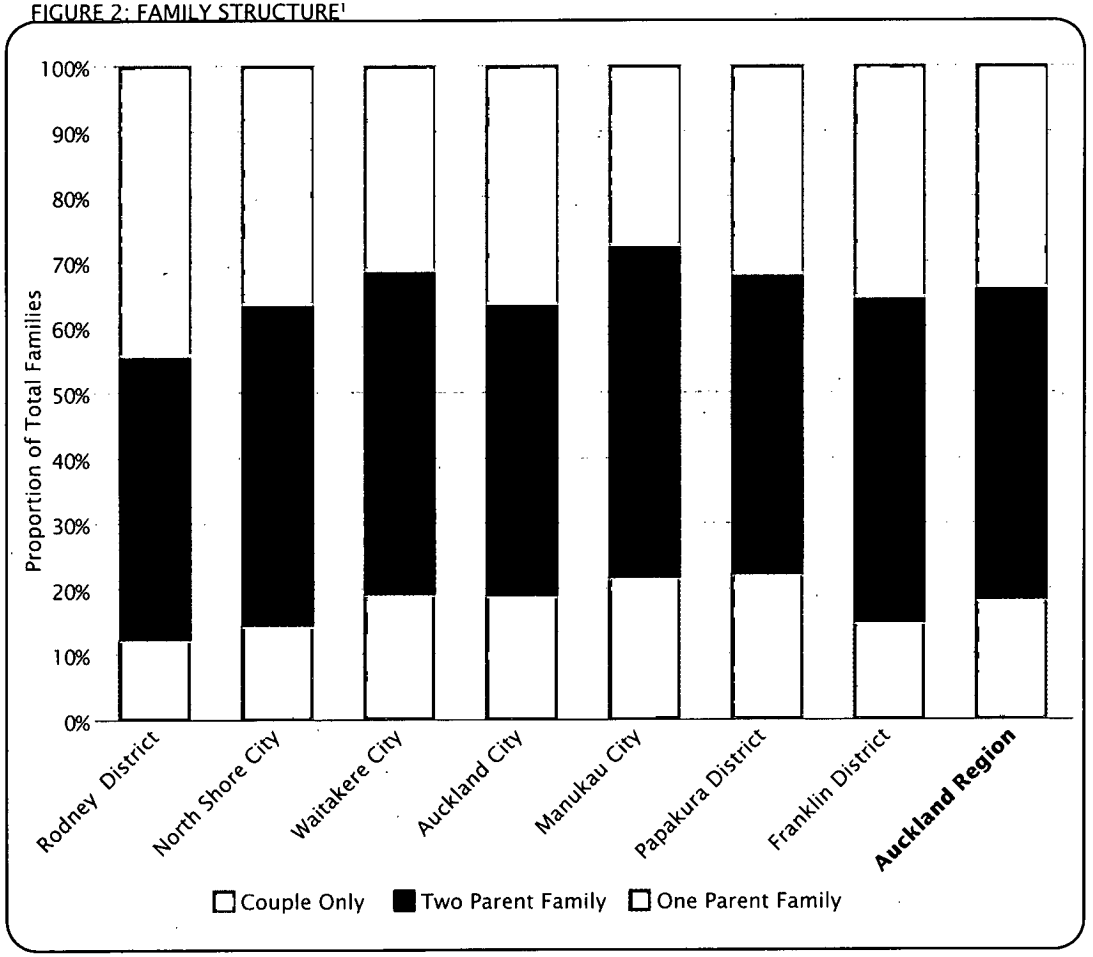


What could happen?

Household and family structure affect the type of housing demanded. Families prefer family homes. But non-traditional households often prefer non-traditional housing, and the available housing stock may not be suitable to meet these needs.

Other implications result from the greater transcience of non-traditional households, their relatively greater mobility and higher car ownership and the changing demand for social infrastructure such as medical facilities, schools, entertainment and after hours shopping facilities. These changes affect transport infrastructure deman and can sometimes cause conflict between different types of land use.

FIGURE 2: FAMILY STRUCTURE[1]



Issue:

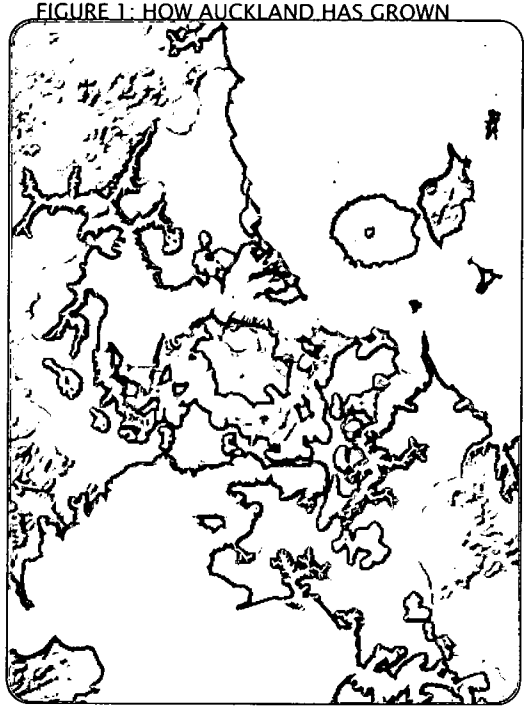
Urban Growth

Growth is Auckland's hallmark. It has long been the subject of intense local and national debate, yet with most growth from new births in the region, growth and its accompanying development are here to stay, with all their implications.

How is it now?

Auckland has been New Zealand's largest urban area since 1896 when it overtook Dunedin. Almost all new urban growth has been accommodated by expanding into rural land. From its beginnings as a town in central Auckland, Freemans Bay and Parnell, the city moved outwards for the next 150 years, swallowing up smaller isolated settlements such as Onehunga, Henderson, Otahuhu and Howick.

FIGURE 1: HOW AUCKLAND HAS GROWN

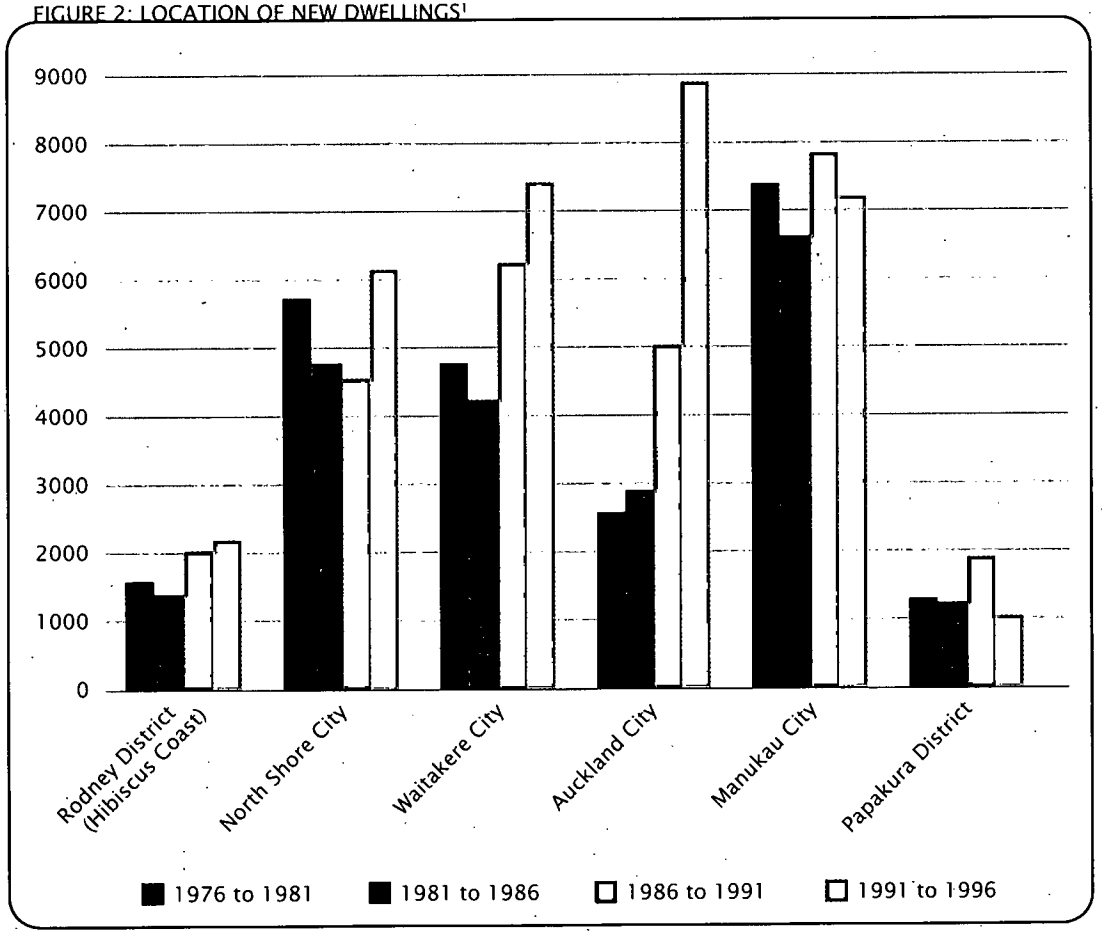


Since 1990, the Auckland urban area has continued its historical expansion, but is now also experiencing a sustained period of consolidation. Apartments, terrace housing, town housing and infill housing are being built in greater numbers throughout metropolitan Auckland. Most obvious on the Auckland Isthmus, they are also found in places as far afield as Albany and Botany Downs, and reflect an increasing desire to trade traditional housing for more compact housing: being closer to work, cafés, beaches and other amenities. Suburban houses on large sections are no longer everyone's first choice of housing.

Figure 2 shows just how many new dwellings have recently been built in central areas instead of on the city fringe. Auckland City now has the region's biggest growth in new dwellings, while 20 years ago it had one of the smallest.

The urban area is now home to about 1.1 million people, and covers approximately 50,000 hectares. We inhabit one of the largest cities in the world for our population size.

FIGURE 2: LOCATION OF NEW DWELLINGS[1]



Urban Growth

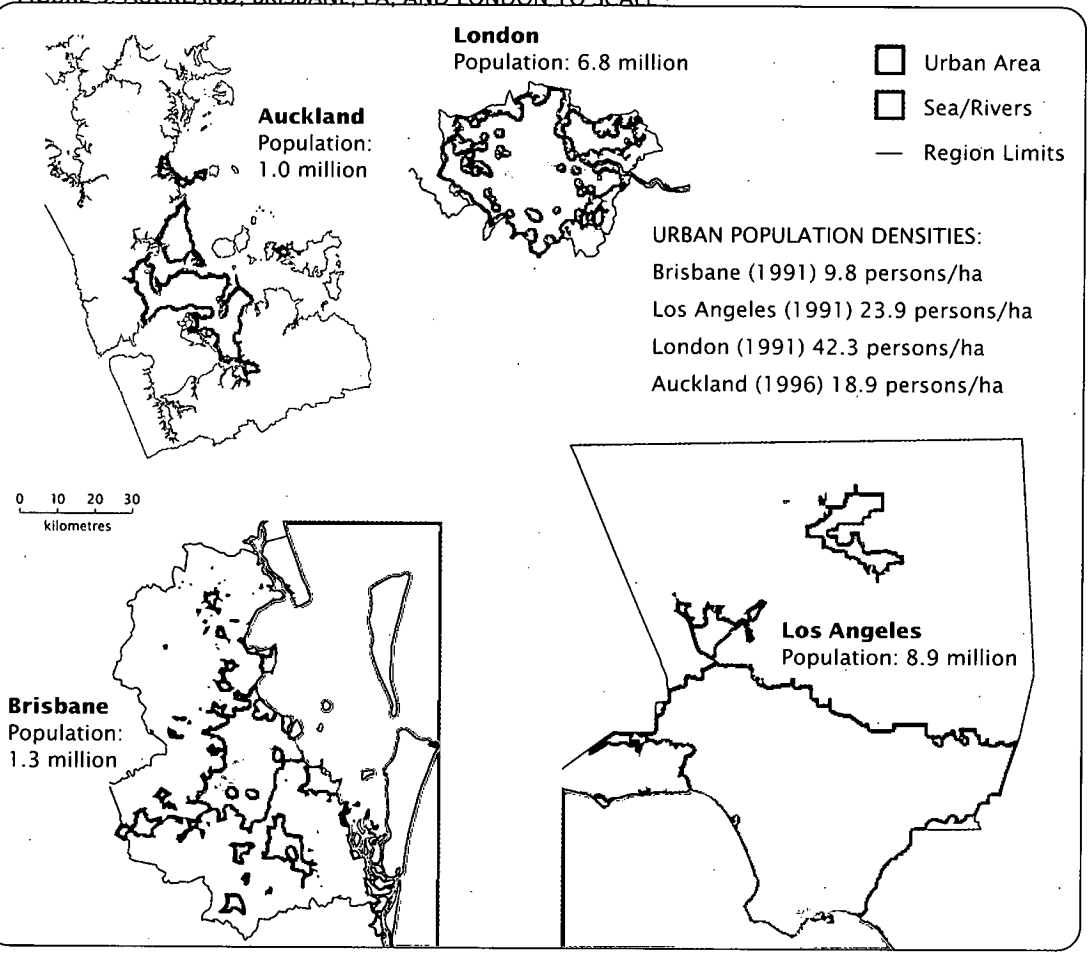
What could happen?

Auckland is growing faster then any other Australasian city. In 1999 Auckland overtook Adelaide to become Australasia's fifth largest city. By the year 2050 Auckland could have 2 million inhabitants and cover around 60,000 hectares (see ***Population***).

Developing new areas for urban land use affects the natural and physical environment and how the existing urban area functions. Effects range from removal of natural areas and sediment discharged from new subdivisions (see ***Earthworks***) to congestion on previously uncrowded transport routes.

While these concerns are still being managed at the city fringes, more and more development in Auckland is redevelopment of already urbanised areas. In these cases, issues that need to be addressed include providing new, denser communities with adequate social and physical infrastructure such as schools, passenger transport and additional stormwater capacity.

FIGURE 3: AUCKLAND, BRISBANE, LA, AND LONDON TO SCALE[8, 21]



Issue:

Travel Patterns

The mobility provided in the past by a relatively good road system and high car ownership has led to a diverse pattern of land uses and trips. This is now resulting in increasing congestion, particularly in the central area, which is difficult to handle cost effectively with passenger transport.

How is it now?

The dispersed nature of trips is the main feature of transport in the region. The Auckland metropolitan area has a relatively low density, with households and employment spread widely. The trend towards decentralisation is continuing, with only 11 per cent of employment located in the Central Business District in 1996 compared with 15 per cent in 1986[1].

Trip lengths are increasing over time, with the average length of a work trip increasing by 6 per cent from 1986 to 1996 to 13.9 kilometres. Most trips are much shorter than this, with the median trip length in 1996 being 9.5 km, up by 3 per cent since 1986. In 1992, 27 per cent of all trips were less than 3 km long.

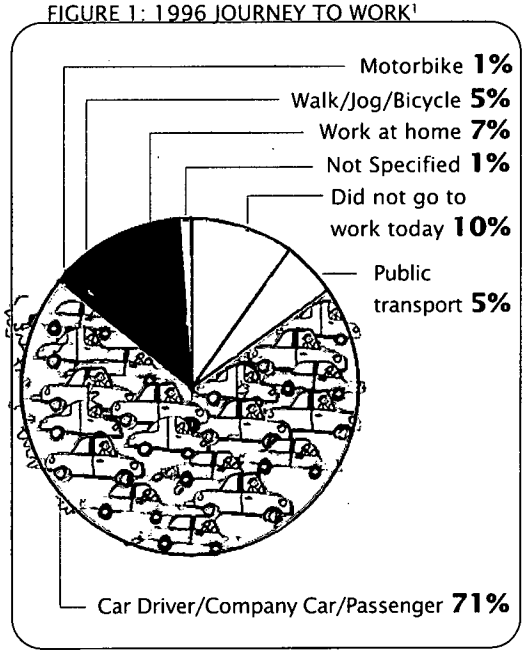
Aucklanders are also making more trips per person than ever before and more of these trips are in cars. Current trends would see the use of cars double in the next 20 years. These trends are exacerbated by low car occupancy, with a peak period average of only 1.2 people per car.

The region has a high and growing level of car ownership — increasing from 1.38 per household in 1986 to 1.55 in 1996[1]. There are now some 560,000 cars and 92,000 heavy motor vehicles registered in the region[9]. With one car for every two Aucklanders, the region has one of the world's highest car ownership rates, comparable to the United States, Canada and Australia.

Our motorways demonstrate Auckland's traffic usage: on average, approximately 150,000 vehicles cross the Auckland Harbour Bridge every day, and 200,000 vehicles per day use the Southern Motorway between Gillies Ave and Khyber Pass[10]. Traffic growth in the region over 66 monitored sites has averaged approximately 4 per cent a year over the last six years. Traffic volumes also change throughout the year, with congestion generally reducing during school holidays.

Use of passenger transport has declined as a proportion of total trips. In 1986, 15 per cent of people travelling to work used passenger transport. By 1996 this had dropped to just 7 per cent, relatively low by international standards. While the number of trips to work by car increased between 1986 and 1996 by 21 per cent, the number of work trips by passenger transport users decreased by 50 per cent[1].

FIGURE 1: 1996 JOURNEY TO WORK[1]



Travel Patterns

What could happen?

Factors affecting passenger transport usage include increased car ownership, decentralised development, long-standing under-investment in passenger transport infrastructure and reduced motoring costs. Car use has also been encouraged because motorists do not pay the full cost of their use of roads.

Recent surveys have indicated more use of passenger transport, with small but consistent increases in the proportion of morning peak hour trips on passenger transport observed at a number of monitored sites.

New Zealand's fatality rate is relatively high among developed countries. Every year in the Auckland region approximately 100 people die and around 5,000 people are injured in road crashes. Pedestrians account for about 20 per cent of road fatalities. The cost is an estimated $750 million a year.

Motor vehicles are the biggest source of metropolitan air pollution, affecting public health, welfare and property (see ***Ambient Air Quality***).

The impacts of contaminated runoff from roads are concentrated in the sensitive waters next to the most densely urbanised parts of the isthmus — the Tamaki Estuary, Manukau and Waitemata Harbours. Treatment of all existing and future urban stormwater discharges into the Waitemata Harbour and Hauraki Gulf would cost an estimated $1.8 billion to $2.3 billion (see ***Coastal Waters***).

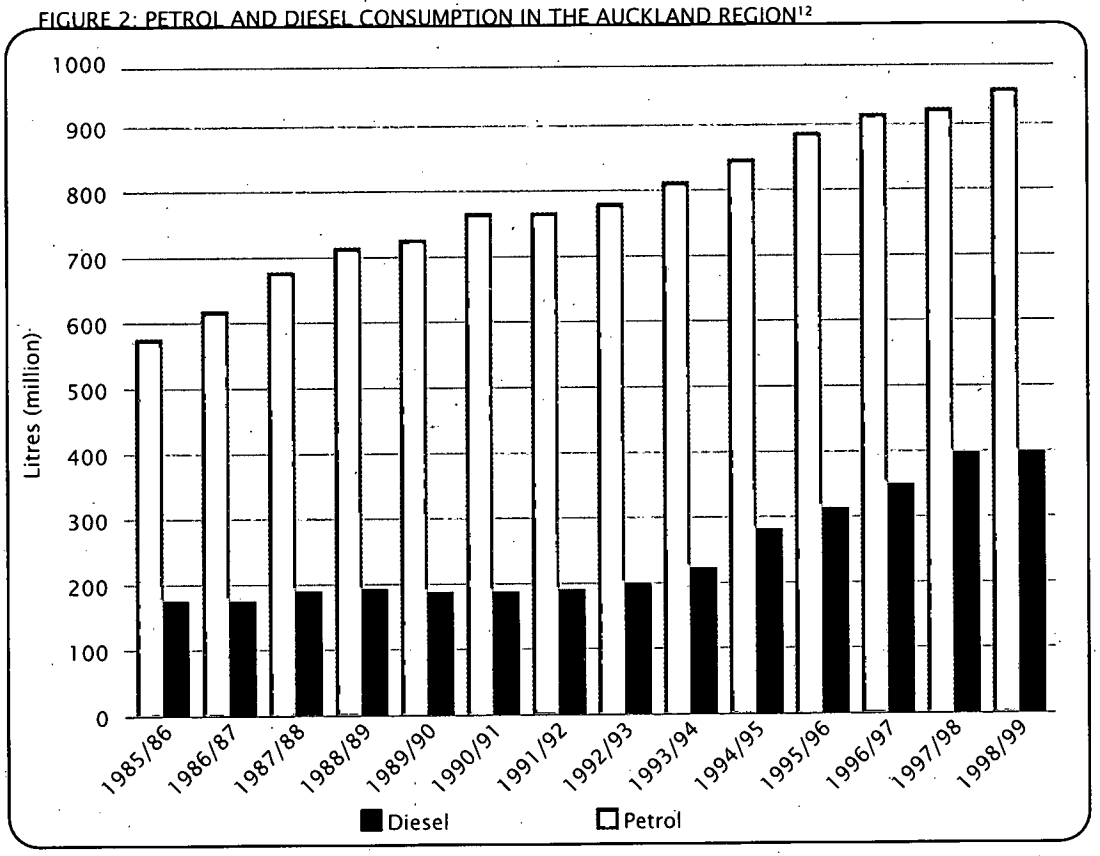
The transport system is a big energy user and consumes non-renewable resources, both fuel and land. There has been strong growth in transport fuel use in the last 10 years, with the consumption of diesel doubling and the consumption of petrol increasing by 30 per cent[12], while in the same period the region's population increased by only 14 per cent.

The Auckland Region's relatively low density growth has encouraged us to rely on car travel. This has lead to a road network that has become overloaded, especially in the central area where there are few acceptable options for expansion. Allied with concerns over the environmental effects of continued urban sprawl, this has encouraged proposals for more compact, mixed-use communities in the future. These generally need to be supported by a high-quality passenger transport system operating on its own right-of-way and linked to major activity centres.

Auckland's current passenger transport is mostly buses sharing arterial roads with other traffic, a limited number of ferry services and a passenger rail system which occupies important corridors but which does not connect directly to the CBD around Queen Street. A major thrust of transport planning in Auckland is to develop a series of exclusive passenger transport corridors connected to the CBD, to continue to expand the system of bus priority measures on main roads, and to increase the frequency of services. These measures will make public transport more attractive.

More growth will be accommodated in higher density areas and passenger transport use is expected to increase, but use of the car will remain high and a need to expand the roading network will remain.

FIGURE 2: PETROL AND DIESEL CONSUMPTION IN THE AUCKLAND REGION[12]



Issue:

Ease of Travel

Most complaints about travel in the region are about traffic congestion. This is mainly in peak periods, but some areas are also becoming congested throughout the day.

How is it now?

Morning and evening peak travel times for cars between the outer suburbs and Auckland City increase every year as traffic volumes grow. Roads leading to the motorway system are heavily congested during these peak periods, affecting other vehicles wishing to use the rest of the street network for local trips. As traffic volumes increase, the waiting period lengthens, creating further delays.

On the motorways, long queues occur. On the Harbour Bridge approaches 8 km queues often extend north beyond the Sunnynook Road overbridge in the morning, and 6 km queues build up south of the Newmarket Viaduct in the evening peak.

In the 1998 morning peak period, it took on average 28 minutes to travel from Greville Road to Auckland City on the Northern Motorway, a distance of 15 km. During uncongested traffic conditions this trip would take 9-11 minutes (at 80-100 km per hr), but on a bad day can take more than 45 minutes — an average travel speed of 20 km per hour.

Average travel times in 1998 from Hobsonville Road to Auckland City on the North-Western Motorway was 21 minutes (average speed 46 km per hr for the 16km trip) and on a bad day was 35 minutes (at an average speed of 27 km per hr).

From Papakura to Auckland City on the Southern Motorway, a distance of 30 km, the average travel time during the morning peak period was 37 minutes (average speed 49 km per hr). This time increased to 57 minutes on bad days (32 km per hr), though in uncongested conditions it takes 22 minutes (82 km per hr).

Bus priority measures have been introduced on some important passenger transport routes. More are planned, including priority turns, priority at traffic signals, use of motorway shoulders and exclusive bus lanes. This leads to significant savings in travel times for bus passengers, with little or no effect on other road users while offering a more reliable service. Shorter travel times allow more trips to be run with the same number of buses.

What could happen?

Travel times continue to increase on the major roads to and from Auckland's central areas as a result of more cars on the road. The economic cost of congestion to the manufacturing and distribution sectors in the Auckland region has been estimated at around $185 million per year and the total annual cost of congestion to the region at $755 million[13]. Public transport and bus priority measures are provided to alleviate this congestion.

Growing vehicle use disadvantages those without cars, especially the young, elderly, disabled, and those from low socio-economic groups. This is because the car's growing dominance of the transport system makes it more and more difficult to provide comprehensive, cost effective passenger transport. This particularly affects the approximately 40,000 households in the region (11 per cent of the total) with no access to a car[1].

Roads also affect the communities they pass through. Busy roads are difficult to cross, severing local communities and can create environmental problems such as air, water and noise pollution, while heavily used roads are an unpleasant and sometimes unsafe environment for pedestrians and cyclists.

Issue:

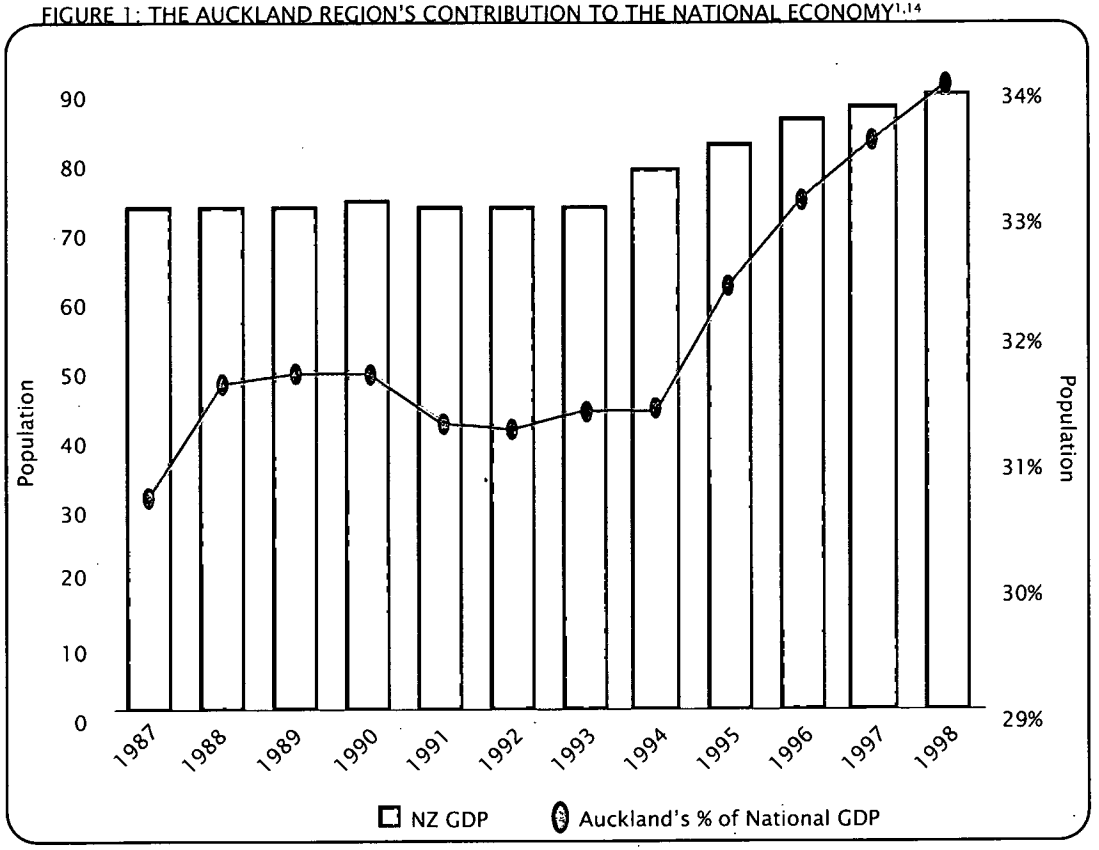
How we make a living affects how the region functions and what it is like to live in. Like everything else in Auckland, this too is changing, in line with international trends and pressures.

Economy and Industry

How is it now?

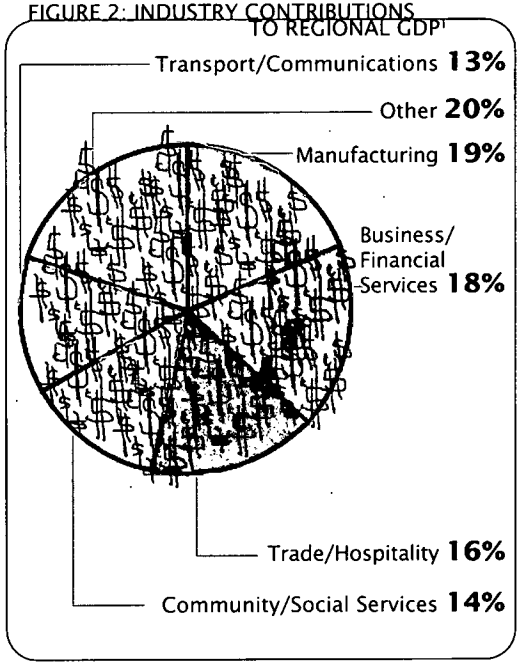
Auckland has New Zealand's largest regional economy, with a 34 per cent share of total output in 1998. The average Aucklander's economic output is higher than other New Zealanders' (GDP per capita in 1998 for Auckland is $26,178, while the New Zealand average is $23,530).

FIGURE 1: THE AUCKLAND REGION'S CONTRIBUTION TO THE NATIONAL ECONOMY[1,14]



All of the sectors except Agriculture/Forestry, Mining/Quarrying (which together with Construction and Utilities make up the 'other' category) and Community/Social and Personal services, play a bigger role in the Auckland Region's economy than elsewhere in New Zealand.

FIGURE 2: INDUSTRY CONTRIBUTIONS TO REGIONAL GDP[1]



Economy and Industry

What could happen?

Auckland's role as the major distribution point for goods and services flowing in and out of the country has seen continued growth in the retail, wholesale and transportation sectors. The strong New Zealand dollar in the mid 1990s and high levels of international immigration have encouraged growth in the trade sectors.

Echoing world trends, manufacturing has lost its share of employment and output to growth in the service and trade sectors. Decreasing commodity prices world wide and removal of protectionist trade barriers have seen a move from large commodity processing operations towards more value-added manufacturing production in Auckland. There are relatively fewer government jobs, but population growth has led to rapid development of population-based services such as health and education. Skill levels have risen in the trade, hospitality, finance, business and service sectors. This service sector growth also reflects uptake of new technologies, overseas immigration, rapidly improving communications and the availability of a skilled workforce.

Changes in occupational structures mean more service, administrative and professional jobs but fewer jobs in manual and low-skilled production occupations. Traditionally male dominated low and semi-skilled jobs in particular have reduced, as all sectors - even the manufacturing industry — require higher skilled and more service-orientated jobs.

With industrial restructuring, employment regulation and changes in technology, low and semi-skilled manual occupations have not grown to the extent seen elsewhere in New Zealand, while changes in technology, employment regulation and in the wider economy have led to an increase in part-time work as jobs become more specialised, more flexible and less regulated.

As in the rest of the country, small and medium-sized enterprises dominate Auckland's economy and are growing in importance. New technology and continually improving communications allow more people to work from home and in areas where a variety of industries and residences operate side by side.

Reflecting these trends, distribution patterns of industry are changing, with the CBD and southern industrial edge still dominant, but smaller centres growing faster.

The region's changing industrial structure needs people who can use and develop new technologies and operate in a service-oriented climate, rather than carry out lower skilled, hard physical production jobs. This in turn must be reflected in curricula at all levels, from schools to tertiary institutions and training providers in all fields.

People no longer expect to be in a 'job for life' and may change employer and profession many times during their working career. People are also less likely to be working in one full-time job: more are working shorter hours or doing more than one job.

There is less gender distinction between jobs, as the new service jobs are not dominated by either sex.

All these changes will create very different patterns of work in Auckland compared with the pre-restructuring 80s and 90s: more people will travel to work in many different locations and work spaces, and more will work from home.

The Auckland Region's economy is recovering from nationwide recession. While our economy was in deeper recession than the rest of New Zealand, once the recovery accelerates the Auckland economy is likely to out-perform the rest of the country, as in the 1991-2 cycle.

Issue:

Age, ethnicity and gender all affect our work and income: whether or not we have a job, the hours we work, the skills we have and the options open to us.

Work and Income

How is it now?

TABLE 1: REGIONAL INCOMES[1]

	Mean Household Income 1996	Median Household Income	Median Personal Income	Mean Personal Income
Northland	35,330	27,843	13,225	18,497
Auckland	**50,600**	**42,163**	**17,818**	**23,688**
Waikato	42,381	34,149	15,235	21,436
Bay Of Plenty	39,119	30,897	14,470	20,280
Gisborne	36,458	29,058	13,602	18,559
Hawke's Bay	36,887	29,667	14,235	19,183
Taranaki	40,207	31,898	15,121	21,448
Manawatu-Wanganui	37,293	29,804	14,219	19,150
Wellington	49,929	41,296	19,006	24,995
West Coast	33,905	27,566	13,323	18,323
Canterbury	39,671	32,172	14,786	20,202
Otago Region	37,295	29,979	13,687	18,772
Southland	38,999	31,975	14,884	20,458
Tasman	36,302	29,363	14,097	18,833
Nelson	38,725	31,279	15,068	20,277
Marlborough	36,699	30,112	14,712	19,243

INCOME

Auckland has the highest median and mean household incomes of any region in New Zealand, though the nation's highest personal incomes are in Wellington region. The poorest regions are West Coast and Northland.

Gross Domestic Product (GDP) in the Auckland region grew slightly faster than in the rest of New Zealand between 1991 and 1996, mostly because of population growth. (see ***Economy and Industry***) However per capita GDP also grew during this period.

On average, men earn more than women and Europeans earn more than other ethnic groups. Income distribution has become more unequal, probably at a faster rate than other comparable countries: the top 10 per cent of income earners have earned more, whereas the lower 90 per cent have a static or declining share. Most of the households in the lowest-earning 20 per cent are older people living alone and single-parent households.

Work and Income

THE SIZE OF THE WORKFORCE

From a high of 481,500 in 1987, the region's labour force dropped to a low of 463,800 in 1993 at the worst of the recession. This artificially low estimate reflects changes in the definitions used to calculate the labour force, making it much harder to be counted as unemployed. The unemployed workforce grew from 14,000 in 1987 to a peak of 55,000 in 1992, and a great number of people also gave up looking for work and dropped out of the labour force during this period. Between 1993 and 1998 the region's labour force grew to 563,700, of whom 41,000 people (7 per cent of the region's labour force) were unemployed.

PARTICIPATION IN WORK

A slightly higher proportion of working-age people are in employment in the Auckland Region (67 per cent in 1999) than in the rest of New Zealand (65.2%).

Overall, participation rates (the proportion of the working-age population of 16 years of age and older in the labour force) have grown steadily since 1992, although not evenly across all age groups and more rapidly for women. Younger (under 20) age groups participate in the labour force less than in the past. Europeans continue to participate in the labour force more than other ethnic groups. Other ethnic groups (including Asians, recent immigrants, refugees, and those whose first language is not English) have consistently lower participation rates than larger ethnic groups.

AGE AND EMPLOYMENT

More young people are in tertiary education or still at school, so they now form a smaller proportion of the labour force than in the past. However, those who are in the labour force have much higher unemployment rates than older age groups: 15.6 per cent of 15-19 year olds and 10.2 per cent of 20-24 year olds were unemployed in the year to 1999. During this time, however, the make-up of youth employment in Auckland changed as male (15-20) unemployment dropped, but young female unemployment rates increased. In the 20-24 year-old-age group male unemployment remained higher, perhaps as women in this age group were more likely to have left the labour force to have children.

ETHNIC GROUPS AND EMPLOYMENT

The ethnic mix of the region's labour force — both employed and unemployed — is changing: Europeans made up 82.8 per cent in 1989 but only 73 per cent of those employed a decade later. This reflects the growth of "other" ethnic groups from 4.7 per cent of the labour force in 1989 to nearly 10.2 per cent now as a result of high levels of immigration during the 90s from Asia. Pacific Island and Maori also increased substantially over the last decade as a proportion of the labour force.

There are significant differences between the ethnic groups in terms of their participation in the occupational and industrial areas. European men dominate managerial and administrative occupations while Maori and Pacific Island groups are over-represented in the manufacturing and production (and, for Maori, the construction) sectors and under-represented in managerial, professional and technical occupations.

The "other" ethnic group, which includes Asian, African and some European groups, is well represented in the managerial occupations and in the trade and industrial sectors, reflecting immigration trends and policies.

Maori, Pacific Island and "other" ethnic groups were significantly over-represented in the unemployed group, with 14.2 per cent of Maori, 14.3 per cent of Pacific Islanders and 15.0 per cent of "other" ethnic groups unemployed, while Europeans had an unemployment rate of only 4 per cent.

The gap between European and non-European labour force participation and unemployment rates has not changed significantly over the last six years, since the peak of the recession in 1992. Growth in new jobs has been in areas where Maori and Pacific Island people have yet to develop a significant presence.

For young non-European people, particularly males, the labour market offers fewer opportunities for participation than in the past, more so given the decline in the traditional sectors where Maori and Pacific Island people depend for employment. There is no evidence that this situation has improved since the early 90s.

GENDER AND EMPLOYMENT AND THE NATURE OF WORK

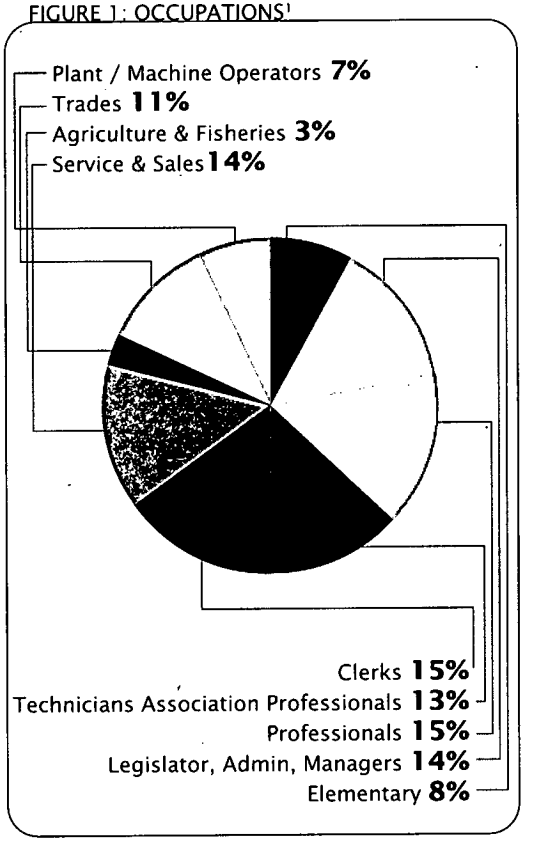
In 1999, 262,260 women made up 46 per cent of the region's labour force, compared with 43 per cent a decade earlier. In 1999, almost 60 per cent of women were working, compared with around 57 per cent in the late 80s. That many more women are now participating in paid employment echoes international trends. In Auckland, the availability of service sector jobs, increasing numbers of women in professional occupations, and the need for multiple incomes to service living costs add to this trend.

The high-status occupational categories, particularly the managerial and administrative groups, are dominated almost exclusively by European men, although women make up an increasing proportion of professional (53 per cent) and technical groups (47 per cent). Although they make up 24 per cent of the total labour force, non-European ethnic groups accounted for less than 15 per cent of the three higher-status occupation categories (managers, professionals, and technical groups).

The average working week was 38.3 hours in 1990, 44.4 for full-time and 14.6 for part-time workers.

Women are much more likely to be working part-time than men, working an average of 33.2 hours per week compared with 42.7 for men.

FIGURE 1: OCCUPATIONS[1]



Work and Income

What could happen?

The male-dominated occupations, such as managers, worked longer than other occupational groups, averaging 46.4 hours a week, followed by trades and machine operators, averaging 42.9. Those working in the manufacturing, construction and transport industries worked the longest hours.

People working part-time made up 20.3 per cent of the 1999 labour force compared with 17.6 per cent in 1991. Part time workers are concentrated in the service and trade industries and in the clerical and service and sales occupations.

The shift to occupations in service industries has seen manufacturing slip to third in providing employment, while the wholesale and retail trades and community and personal services sectors each employ more people.

Substantial growth in professional, technical, clerical and sales and service groups between 1991 and 1999 has been at the expense of declining jobs in the trade, plant and machine operators and elementary (unskilled) occupations. While men still dominate in the elementary, production and managerial occupations, women dominate in sales and service, clerical and professional occupations.

Substantial growth and change in the region's labour force echo the region's population pressure dynamics — for example, the large increases in traffic seen at peak hours in the past decade can be largely attributed to increased numbers of people going to and from work.

At work in the late 1990s, your colleagues are more likely to be non-European, female and in their middle years than 10 years ago. As the make-up of the labour force changes, so will the support services needed in areas such as childcare, public transport and recreation.

The smaller proportion of younger people in the paid work force diverts them into other activities, for example, raising the school leaving age has meant that more young people stay longer at school and in further education.

In the medium and long term, the proportion of the total population in paid employment is likely to fall as a result of the effects of an ageing population. Young people are now entering the paid workforce later, more older people are retiring earlier and, with increasing average life expectancy, many people are spending a greater proportion of their lifetime in retirement.

Maori and Pacific Island groups, especially young people and young men most of all, represent a major proportion of unemployed and jobless in the region. This has not changed over the last decade.

issue:

Education

Access to education reinforces our ability to make best use of the living, working and recreational opportunities available in the region.

How is it now?

Educational opportunities are provided at pre-school, primary, intermediate, secondary, and tertiary levels. Also, many people continue to learn through work-based training and community-based programmes throughout their lifetimes.

EARLY CHILDHOOD EDUCATION

An increasing proportion of children under five participate in early childhood education (57 per cent nationally in 1996 compared to 48 per cent in 1992). However, there are significant differences between regions and ethnic groups. The Auckland Region has a relatively low participation rate (52 per cent). This is due to the relatively low participation rates of Pacific Island (37 per cent) and Maori (31 per cent) children.

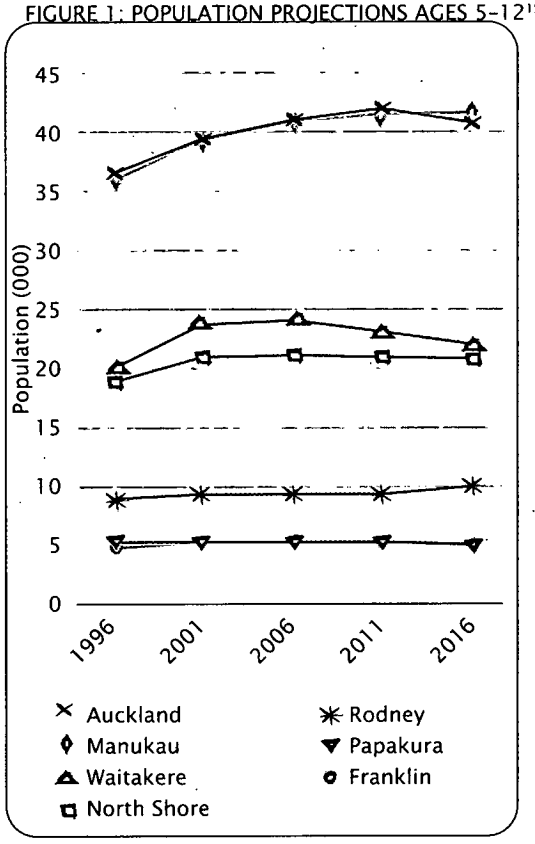
The Early Childhood Development Unit has identified the need to provide culturally appropriate early childhood facilities in its research project "Participation Trends in Early Childhood Education, 1999". This is a response to the link between the availability of Te Kohanga Reo and Pacific Island Language Groups and participation rates of young Maori and Pacific Island children.

PRIMARY, INTERMEDIATE & SECONDARY SCHOOLS

During the last decade primary school rolls have been increasing faster than at any time in several decades. The number of school students in the Auckland Region, after showing a net decrease in 1990, has grown rapidly ever since. This has been caused by the entrance of 'echo baby boomers' - children of baby boomers born in the late 1980s and early 1990s and into primary schools migration to the region from elsewhere in New Zealand and abroad. Between 1991 - 1998 total primary/intermediate school rolls increased by 30,808 (27 per cent).

Enrolments in primary/intermediate schools will peak in 2002 at 495,000, and then steadily decline by approximately 62,100 to the year 2016. Growth in school rolls has not been even throughout the region The Ministry of Education population projections for ages 5-12 show that the 'echo baby boomers', will peak later in Manukau and Auckland than in the other cities, while North Shore shows least variation in numbers overall.

FIGURE 1: POPULATION PROJECTIONS AGES 5-12[15]

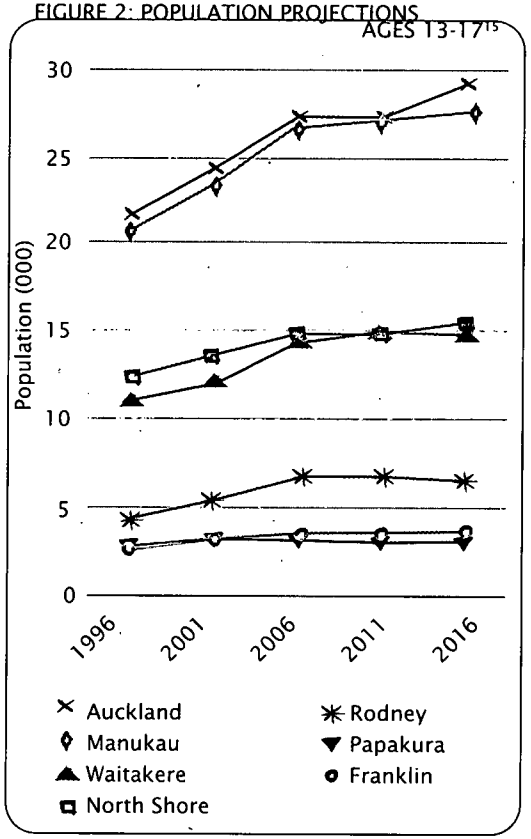


Education

At secondary school level, rolls were static until 1995, and then started to increase. This was despite dropping numbers of secondary school aged children in the region and was due to more people staying longer at school as a result of the rise in the school leaving age and the relatively few jobs available for school leavers. The rise in the number of secondary school pupils since 1995 is largely due to the entry of the first of the 'echo boomers' into secondary education, buoyed by high migration.

Secondary school enrolments will peak in 2007 with a total of 298,200 and then slowly decline by 23,000 in 2016. The pattern of future secondary enrolments shows the impact of the echo boom progressing into the age 13-17 age group. Again, this age group reaches its peak in Manukau and Auckland City after 2016, later than the other cities, which peak around 2006.

FIGURE 2: POPULATION PROJECTIONS AGES 13-17[15]



TERTIARY EDUCATION

There were 55,400 students at the region's tertiary institutions in 1998, up from 50,300 in 1994. This low rate of growth reflects the low growth in the tertiary age group in the region's population and is likely to move upwards as the echo boom moves into the tertiary education age groups early in the new century.

Currently, the region's public tertiary institutions include two universities, three polytechnics and a teacher's college. These are scattered throughout the region, but are concentrated in central Auckland and noticeably absent from the West.

Table 1 shows the numbers of students at the various tertiary institutions in the Auckland Region.

While more than half of the polytechnic students study part-time, three-quarters of university students are in full-time study. Women make up slightly more than half (54 per cent) of the region's tertiary student population, and a larger proportion of polytechnic students (57 per cent). Although supporting figures are not currently available, this may be partly due to more males taking up training opportunities in trade and work-based training.

TABLE 1: TERTIARY ENROLMENTS[16]

	1994	1995	1996	1997	1998
Auckland Institute of Technology	9,327	10,387	10,039	11,207	10,628
Manukau Institute of Technology	6,469	7,513	9,299	6,832	8,887
UNITEC	7,090	7,605	7,406	8,441	8,202
Auckland College of Education	2,965	3,207	2,867	2,531	2,875
Massey University	900	1,750	2,200	2,750	3,300
Auckland University	23,514	24,201	23,824	23,572	23,487
Total	50,265	54,663	55,635	55,333	57,379

EDUCATIONAL ACHIEVEMENT

Long-term assessments of educational achievement in the region are difficult to make due to changes' in definition. However, census data shows that the proportion of people with university qualifications in the region grew from 7 to 11 per cent between 1986 and 1996. A further 27 per cent had a qualification from a non university tertiary institution in 1996, down from 31 per cent in 1991 and up from 25 per cent in 1986. At the other end of the spectrum, 31 per cent of the region's population reported having no school qualifications in 1996, down 8 per cent from 1986. Most of the improvement was in the second half of the decade.

Overall, people appear to be achieving higher school qualifications, due in part to raising the school leaving age, changes in the system to allow more people to achieve a school qualification and increased requirements and competition for entry into tertiary institutions and employment. The proportion of people in employment achieving University Bursary/scholarship level has increased from 7.5 percent to 11.3 percent between 1986 and 1998.

Education

What could happen?

The wave of 'echo baby boomers' progressing through the primary/intermediate school system will make demands on secondary and tertiary education for the next 25 years. Thirty four new schools opened in the region between 1991 and 1999: 13 state primary/intermediate, five integrated primary/intermediate, five integrated secondary and 10 private secondary. Resources will be focused on secondary and tertiary education provision as the 'baby blip' moves through the teenage and young adult population. Like other elements of social infrastructure, there will be a need to site education facilities close to growing communities, such as in higher-density urban areas.

There are 10 Kura Kaupapa Maori schools in the region, with growth strongest in the younger age groups. Growing ethnic diversity and demand-led education provision is likely to mean the emergence of more specialised facilities in future, focused around cultural, religious and curriculum-based themes.

Full participation in the labour market and in tertiary education is becoming more dependent on achievement at school. OECD Education Indicators (1998) show that access to formal education in early years is important to be able to make use of opportunities to learn later in life.

Household Labour Force Survey figures suggest that people with no school qualifications are more likely to be unemployed. As proportionally more people participate in education after the school leaving age, this will create more pressure on education providers to allow for life-long learning opportunities.

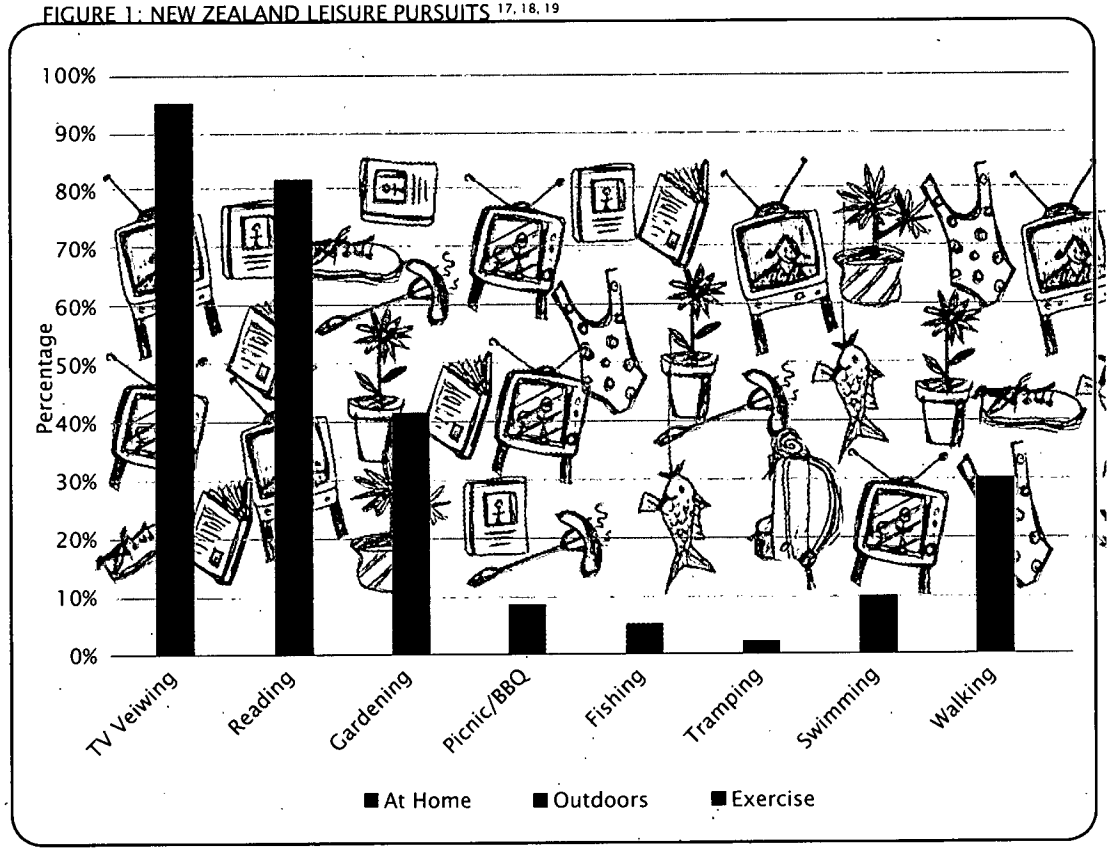
Issue:

The region needs to be able to accommodate the leisure-time needs of its growing population, with growing pressure on outdoor recreational resources placing demands on the quality of these environments.How is it now?

Leisure Patterns

How is it Now?

FIGURE 1: NEW ZEALAND LEISURE PURSUITS [17, 18, 19]



Sedentary home-based activities are the most frequently reported leisure pursuits: 96 per cent of respondents had watched TV, 82 per cent read for pleasure and 41 per cent gardened for pleasure in the previous four weeks. Outdoors, 9 per cent of respondents had been picnicking or barbecuing, 5 per cent fishing and 2 per cent tramping.

The main leisure settings (for people to have visited in the last four weeks) are: shopping centres (56 per cent); restaurants (52 per cent), beaches/rivers/lakes (50 per cent) and walking tracks (23 per cent). The most common activities in New Zealand's parks include sightseeing, viewing scenery, relaxing and short walks.

A 1995 review of outdoor recreation in New Zealand found the most popular activities of walks, picnics, and driving for pleasure have remained stable over time, with emerging activities including mountain biking, wind surfing and parapenting. People are attempting more short-lived activities, seeking a variety of experiences from any location. This has made it harder to label people who may be a tramper one day and mountain biker the next. The activities are also becoming more specialised. For example, distinctions are now made between sea,

Leisure Patterns

white-water or flat-water kayaking. Outdoor activities are also becoming less structured and more individual[20].

Active outdoor pursuits tend to attract younger people, while more passive activity appealed across all age groups. Outdoor recreationists are generally more highly educated, some studies indicating as much as 50 per cent having full or some tertiary qualification.

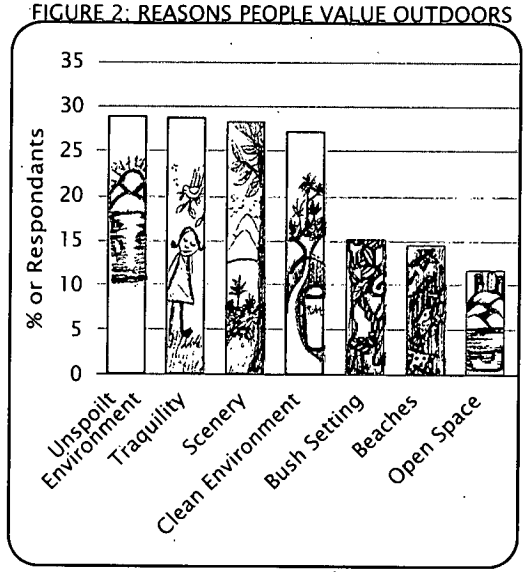
Men tend to prefer more active outdoor pursuits like hunting, fishing or kayaking and females tend towards more passive outdoor pursuits like picnicking. Age also affects park use: studies of non-users of parks found higher proportions of non-European, disabled, older and low socio-economic groups.

AUCKLAND TRENDS

People in the Auckland region most value, in order of importance, a natural unspoiled environment, peace and quiet, scenery, an unpolluted and clean environment, bush settings, beaches/sea water and open space. Our parks are used for a wide range of activities.

Walking and swimming have universal appeal, though notably, fishing appealed particularly to Maori (27 per cent of Maori visitors). There is also an increasing desire for unstructured, non-competitive, non-gender-specific recreational opportunities.

FIGURE 2: REASONS PEOPLE VALUE OUTDOORS



What could happen?

Our leisure patterns influence the type of facilities that need to be provided. Increasing growth and development of urban areas mean greater opportunities for urban leisure experiences such as in shopping malls and restaurants. However, greater population also means more pressure on non-urban leisure settings, and potentially having to go further and to different places for experiences such as remote bush walks and fishing.

Issue:

Open Space

Open space serves a variety of needs in society, including providing a setting for active and passive recreation, contributing to our social and psychological well-being, and containing examples of natural and cultural heritage.

How is it now?

The region's public open space totals 76,192 ha — 15% of the total land area. It's made up of city, district, and regional council land and Department of Conservation (DoC) reserves. Although a standard of 4 ha per 1,000 people is often used to provide neighbourhood parks and sports fields in new suburbs, there are no recognised standards for larger district parks, sub-regional or regional park systems, or for other areas like esplanade reserves and ecological corridors which fulfil both conservation and recreational roles.

Regional parkland and DOC land were purchased to protect valued natural and cultural features, so West and South Auckland benefit from the major bush-covered ranges of the Waitakeres and the Hunuas, while Auckland City benefits from its jurisdiction over the Hauraki Gulf Islands.

As a result of this geography and the fact that people living in one area will travel to another area in order to reach their preferred experience, there can be no ideal regional distribution of natural parkland. Patterns of visitors to regional parks confirm this. However, visitor patterns indicate that open space is presently slightly under-represented in the northern sector of the region.

TABLE 1: PUBLIC OPEN SPACE IN THE AUCKLAND REGION

	Public Open Space (ha)	Regional Parks (ha)	DoC Estate (ha)	Ha per TA	Population
Rodney	864	1,740	8,635	11,239	67,261
North Shore	1,341	113	52	1,506	171,494
Waitakere	1,089	16,259	101	17,449	154,386
Auckland	2,179	295	21,864	24,338	354,532
Manukau	1,557	3,780	573	5,910	254,603
Papakura	172	0	18	190	39,298
Franklin	347	14,913	301	15,561	48,285
Total	7,549	37,100	31,543	76,192	1,077,205

NOTE:

1. Territorial authority areas contain only those areas assessed to be currently used for recreation and conservation purposes
2. Auckland City Council area includes 21,317 ha of land managed by the Department of Conservation on Great and Little Barrier Islands

Open Space

What could happen?

Auckland's maritime setting means its harbours and the Hauraki Gulf play a major role in meeting the region's overall recreational needs. There are approximately 82,000 recreational boats in the region.

There is no simple formula for determining how much parkland will satisfy the needs and wishes of the region's people. While the level of formal recreational space provided in the future is likely to grow with population, the protection of significant heritage features is determined by the value placed on them by the regional community and the level of threat to them.

Growing urban intensification will make new parks more expensive and make existing open space more precious. Better use may need to be made of space in areas such as schools, while others may need enhancement to provide high quality open space.

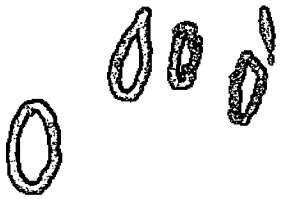
The key to ensuring the cost-effective provision of parkland lies in systematic monitoring of use and people's level of satisfaction and thoughtful promotion to ensure its best use. Accompanying this is the need for systematic assessment of valued heritage features and monitoring of threats to these.

By comparison with elsewhere in New Zealand and overseas, the Auckland region is not over-endowed with parkland, even when DOC land is included.

The need for more land for recreation depends on how well the existing areas satisfy the range and quality of experience expected from parkland. Remote or wilderness areas are especially vulnerable, as increased use can reduce or destroy the quality of experience people are seeking. This may mean that further land should be purchased before existing holdings are fully utilised.

Popular areas of the harbours and gulf may come under more pressure as boat numbers grow apace with population and tourism, while demand will grow for a range of coastal services, including boat ramps, moorings, shore-based recreation, water, fuel and provisioning and solid and liquid waste disposal.

Our Air and Climate



Issue:

The Weather

What is Happening?

FIGURE 1: THE AUCKLAND REGION'S WEATHER[1, 7]

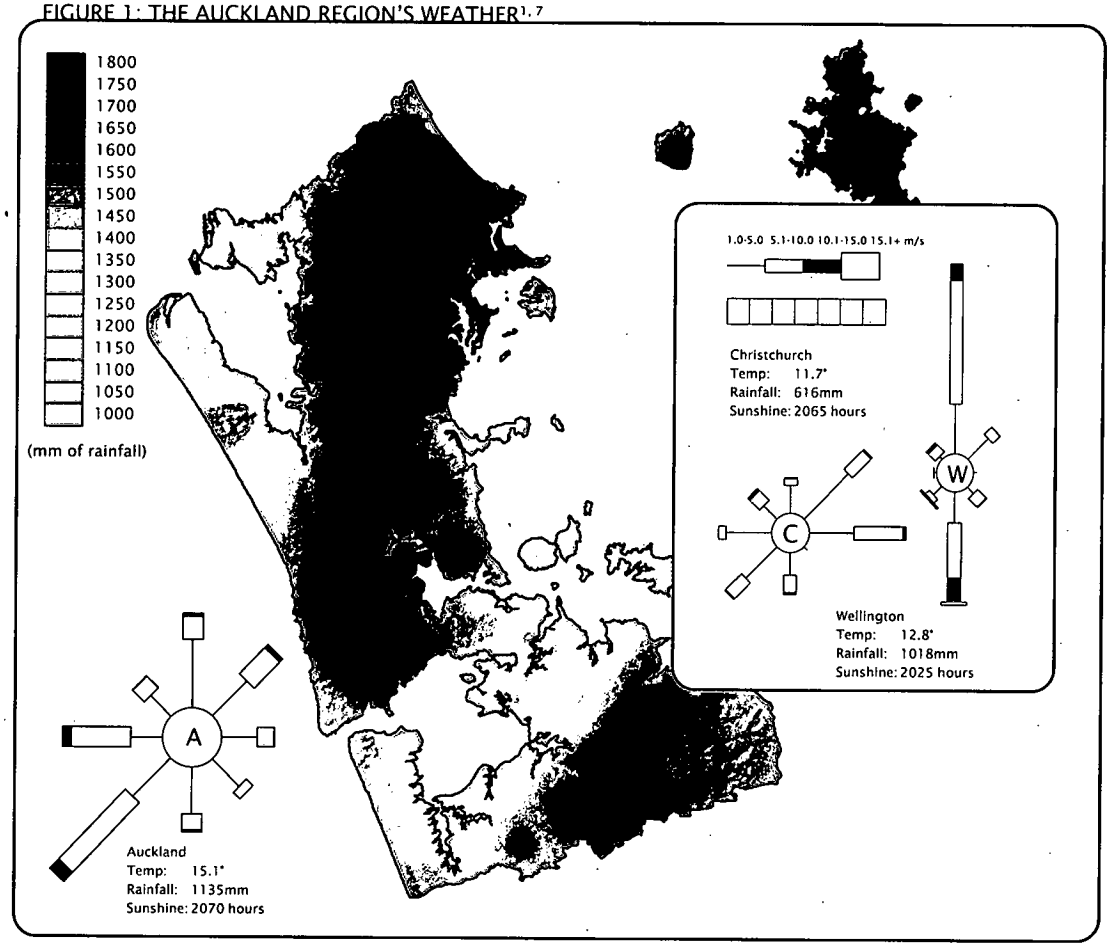


Figure 1 illustrates the average rainfall (and variation in rainfall across the Auckland Region — darker colours on the map show higher annual rainfall), the average direction and strength of wind, and the average temperature in Auckland, compared with Wellington and Christchurch.

How is it Happening?

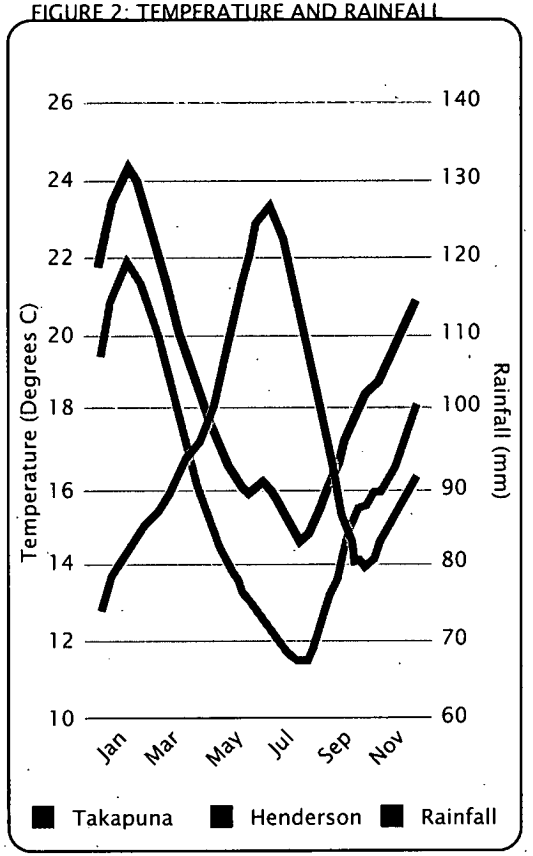
The winds affecting the Auckland region are predominantly from the south-west and west, and the strongest winds are also typically from these directions. Rainfall is determined to a large degree by the wind direction, and the general pattern across the region is more rainfall in higher areas such as the Waitakere Ranges.

Figure 2 illustrates the variation in the amount of rainfall and temperature throughout the year. As expected, this shows that rainfall is much higher during winter months (July has 1.7 times the amount of rainfall that January does), while the average temperature is much lower during this time.

The temperature of the Auckland region is determined by its northerly latitude (compared to Wellington and Christchurch) and its marine setting. The temperature also varies significantly across the region, with the Takapuna monitoring station (illustrated in Figure 2) having the highest mean temperature in The temperature of the Auckland region is determined by its northerly latitude (compared to Wellington and Christchurch) and its marine setting. The temperature also varies significantly across the region, with the Takapuna monitoring station (illustrated in Figure 2) having the highest mean temperature in the region and other monitoring sites recording mean annual temperatures up to 3.7° C less. This may be due to the 'heat island' effect which occurs in built-up urban areas, with increased temperatures due to nearby concrete, motorways and buildings.

As most areas in Auckland are near the sea or a harbour, the annual temperature variation in Auckland is quite small. This is because the sea moderates the temperatures. Sea breezes reduce the daytime maximum temperatures, and the warmth of the sea water at night prevents very cool night-time temperatures and decreases the likelihood of frosts. The maximum temperature in Auckland in 1998 was 31°C measured at Takapuna and the minimum was 0°C measured at Wiri.

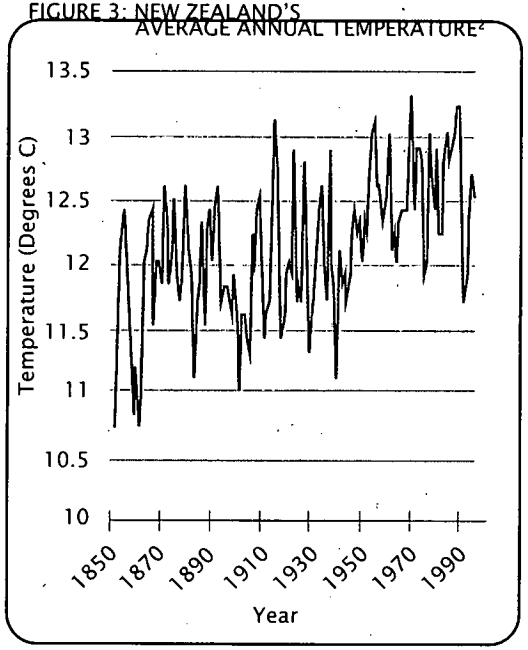
FIGURE 2: TEMPERATURE AND RAINFALL



The Weather

Figure 3 shows New Zealand's annual average temperature since 1853, and reveals a wide variation and potentially a trend of increasing average temperature since the mid 1800s.

FIGURE 3: NEW ZEALAND'S AVERAGE ANNUAL TEMPERATURE[2]



Why is this Important?

The weather affects a lot of our activities, such as beach outings in summer. It also determines to a large extent the effect of our activities on the environment. For example, cold, still winter days without much wind can lead to a build-up of air pollution in urban areas (see ***Ambient Air Quality***). A lack of rainfall can lead to a reduction in the amount of ground and surface water available for use (see ***Groundwater*** and ***Surface Water***), while too much rain in a short time can lead to flooding (see ***Natural Hazards***).

What is the ARC doing?

The ARC is monitoring various aspects of the weather to help in managing its effects on human activities.

issue:

Global Atmospheric Issues

What is Happening?

Greenhouse gases provide insulation to maintain the earth's climate within a relatively stable temperature range. Greenhouse gases include water vapour, carbon dioxide and methane. Carbon dioxide (CO_2) levels in the atmosphere are higher than they have been for millions of years. Figure 1 shows the increase in the levels of CO_2 in the atmosphere measured at Baring Head (near Wellington) since 1970. Since pre-industrial times, CO_2 levels in the atmosphere have risen about 30 per cent. Methane levels in the atmosphere have also risen dramatically, almost doubling over the last 400 years.

The ozone layer in the stratosphere protects us from the sun's ultraviolet radiation. Ozone concentrations in the upper atmosphere have been significantly depleted over the past 20 years by manufactured gases that contain chlorine, such as chlorofluorocarbons (CFCs). Figure 2 shows the size of the ozone hole over the Antarctic, which has appeared every spring since the 1980s. Depletion of ozone in the upper atmosphere has resulted in increased levels of ultraviolet radiation (UV). In New Zealand UV-B levels have increased by 6-9 per cent since the 1970s.

FIGURE 1: ATMOSPHERIC CARBON DIOXIDE AT BARING HEAD[1]

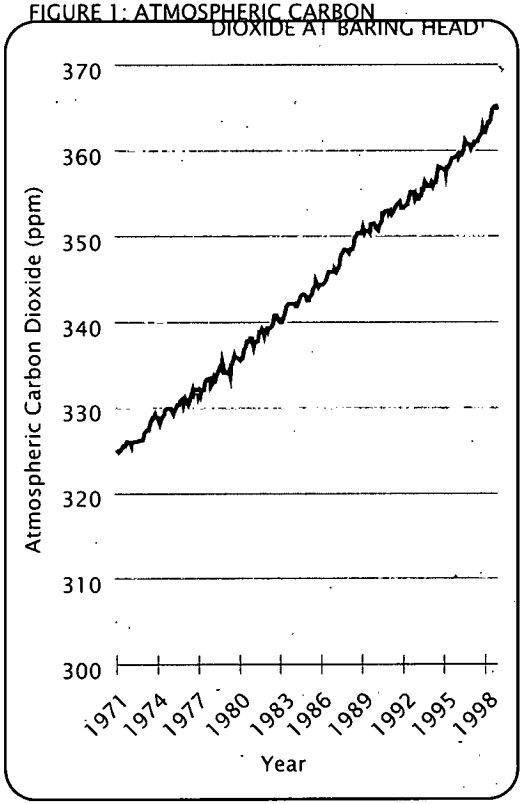
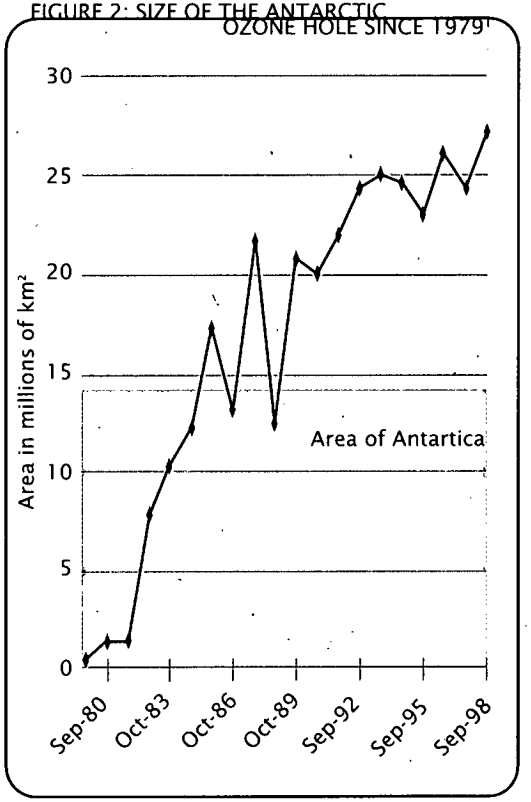


FIGURE 2: SIZE OF THE ANTARCTIC OZONE HOLE SINCE 1979[1]



Global Atmospheric Issues

How Is It Happening?

The rise in CO_2 levels in the atmosphere results from the burning of fossil fuels and the global reduction in forests which act as carbon sinks. Methane levels have increased due to more intensive farming methods and increased waste generation with the growth of the world's population. Methane is produced primarily by livestock and decomposing waste in landfills and sewage treatment plants.

Current predictions indicate that in the absence of further policy measures, New Zealand's net greenhouse gas emissions will be 34 million tonnes more than the 1990 level by 2012. The largest growth in New Zealand's CO_2 emissions has come through the increase in fossil fuel usage for transport and electricity generation.

Since pre-industrial times, the total concentration of chlorine in the atmosphere has risen by more than 600 per cent from 0.6 parts per billion to 4 parts per billion. However, since international agreements were signed in 1989, the emission of ozone-depleting substances has reduced globally, and it is expected that the concentration of chlorine in the atmosphere will begin to decline from now onwards. In New Zealand for example, the import and manufacture of most ozone-depleting substances has been banned. Even with these measures in place it will still take at least 100 years before the amount of chlorine in the atmosphere returns to near its natural level because of the long life of ozone-depleting substances.

Why is this Important?

Life on Earth depends on the protective properties of the ozone layer and the greenhouse gases in the upper atmosphere. The ozone layer filters harmful radiation while greenhouse gases keep global temperatures within a liveable range.

Scientists now believe that the release of greenhouse gases from human activities is causing global temperatures to rise and weather patterns to change. In New Zealand, our average temperature has risen 1.1°C and our sea level has risen by 15cm in the past century. These changes still fall within the range of natural variability, but scientists believe that human activities have and will influence global climate.

The potential problems arising from climate changes include: more frequent floods and droughts; land encroachment and coastal erosion from rising seas; more frequent invasions by tropical pests and infectious diseases; and the disappearance of some types of ecosystems. In New Zealand, patterns of agriculture could be changed by different weather patterns and some fisheries may be affected.

Ozone depletion leads to more UV radiation passing through the Earth's atmosphere. In turn, increased levels of UV could lead to effects on plant life (including possible crop size reductions) along with eye and skin problems.

What Can I Do?

- Reduce your CO_2 emissions by reducing your energy use — insulate your house, join a carpool, walk, bike or use public transport instead of driving your car when you can.
- Don't discharge CFCs into the air. Buy ozone-friendly aerosols and fridges and ensure your car air-conditioners are serviced by a company that collects the gases.

What is the ARC Doing ?

- Global atmospheric issues such as greenhouse gas levels and ozone-depleting substances are monitored and managed at the national level, by the Ministry for the Environment for greenhouse gases, and the Ministry of Commerce for ozone-depleting substances.
- The ARC is working with central government towards an effective national framework for the management of greenhouse gases.
- The ARC has in place many strategies which have as a by-product the effect of reducing CO_2 production. These strategies include encouraging voluntary industry agreements, considering energy efficiency with respect to consent applications, and strategies for providing more energy-efficient transport.

Issue:

Ambient Air Quality

Despite its importance, clean air is often taken for granted but air pollution has become a major problem in many countries and is a growing problem in Auckland. Unpleasant smells, hazy days, damage to people's health and damage to plants, buildings and property can all be caused by air pollutants.

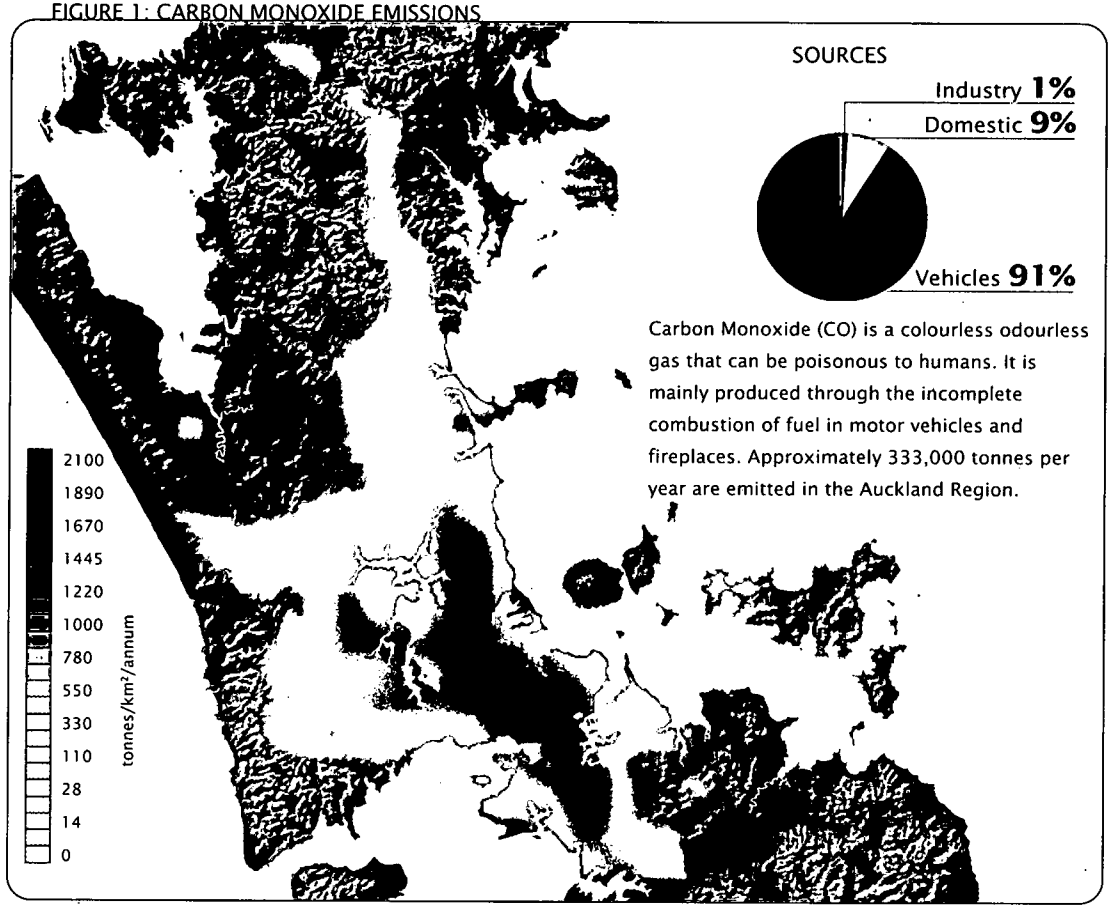
What is Happening?

Ambient air quality depends on the amount of pollutants created by both human and natural activities as well as the wind and the weather, and chemical reactions between various pollutants. Figure 1 illustrates the pattern of emissions and sources of carbon monoxide in the Auckland Region.

Key pollutants are monitored because they are indicators of the main types of air pollution found in urban areas. For instance, carbon monoxide and nitrogen oxides are produced mainly by motor vehicles, so if there are high concentrations of these pollutants in the air, there will also be other motor vehicle pollutants in the air, such as volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs).

Key pollutants are monitored at representative sites to illustrate the state of local air quality. The peak traffic and central business district (CBD) sites are 2 to 3 metres from road sides, where pedestrians and people working close to busy roads would be exposed. Residential monitoring sites are in suburban areas at least 10 metres from any road,

FIGURE 1: CARBON MONOXIDE EMISSIONS



Carbon Monoxide (CO) is a colourless odourless gas that can be poisonous to humans. It is mainly produced through the incomplete combustion of fuel in motor vehicles and fireplaces. Approximately 333,000 tonnes per year are emitted in the Auckland Region.

representing areas where people live. The remote sites are away from the city and any significant roads in areas that are not heavily populated but are still affected by pollution from central Auckland.

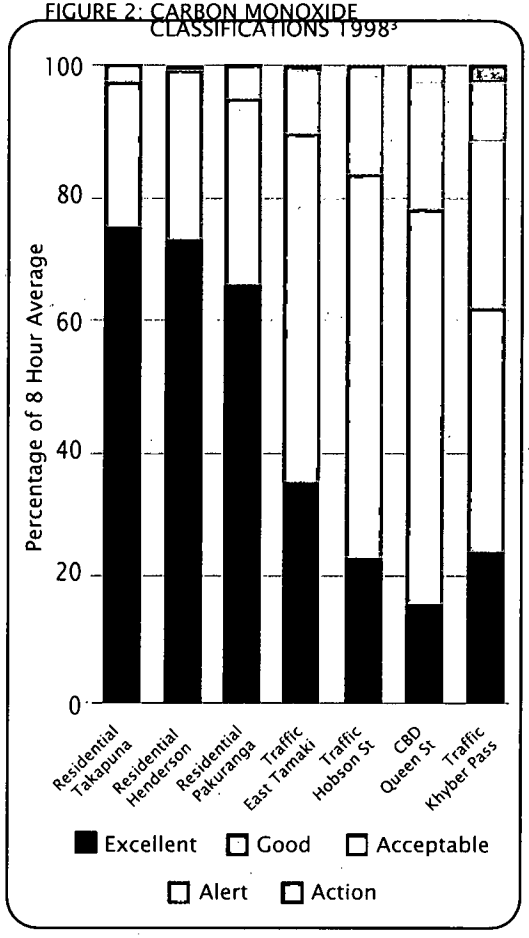
The pollution levels that are measured at these representative sites across the region can then be compared to the Environmental Performance Indicators (EPI) developed by the Ministry for the Environment which have been developed to avoid adverse effects. The categories are detailed in the following table and figures.

TABLE 1: EPI CLASSIFICATIONS FOR AIR QUALITY

Category	Measured value	What does it mean?
Action	higher than the guideline	unacceptable by national and international standards
Alert	66-100% of guideline	a warning level which can lead to excesses if trends are not curbed
Acceptable	33-66% of guideline	maximum values may be of concern in some sensitive locations, but are generally at a level which does not warrant dramatic action
Good	10-33% of guideline	peak measurements in this range are unlikely to impact air quality
Excellent	<10% of guideline	of little concern

Ambient Air Quality

FIGURE 2: CARBON MONOXIDE CLASSIFICATIONS 1998[3]



CARBON MONOXIDE

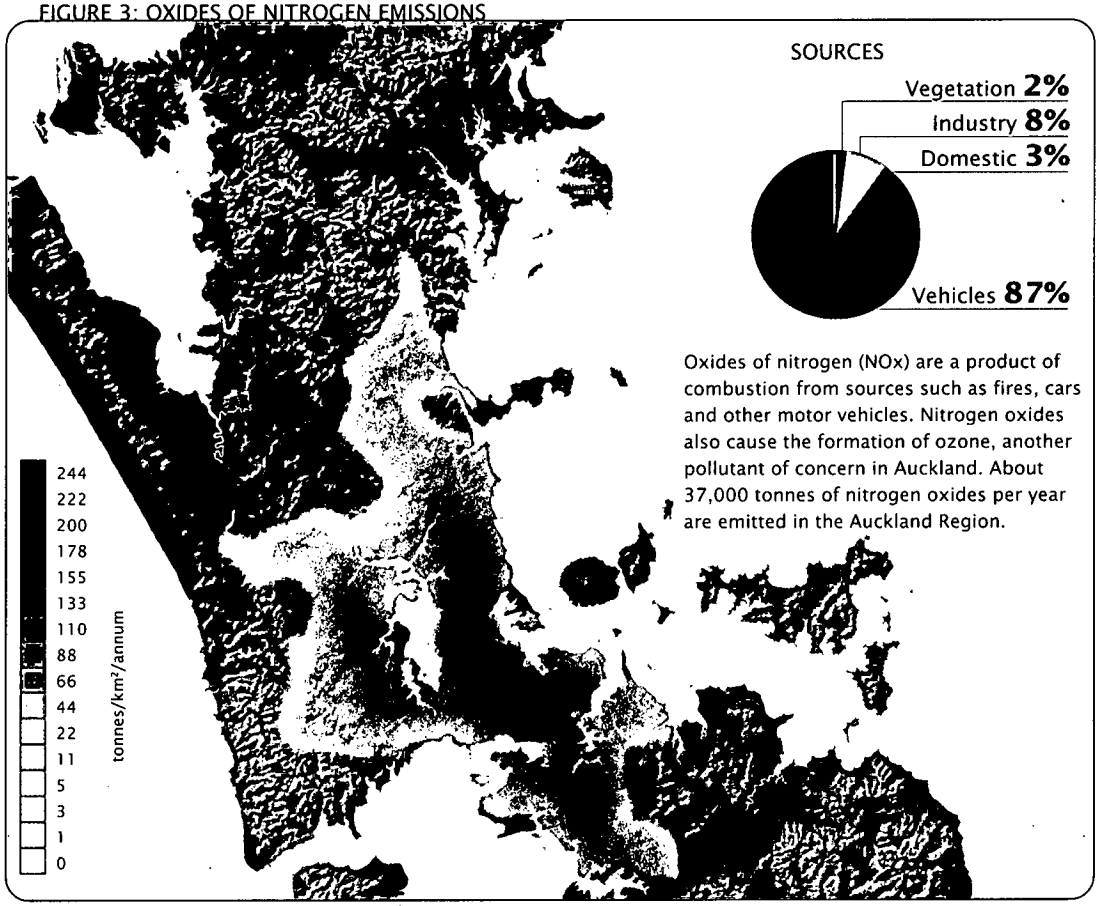
Carbon monoxide interferes with the blood's ability to absorb and circulate oxygen. High CO levels can affect people with heart conditions such as angina and can impair coordination and attention. Monitoring of CO has been carried out at various sites in the Auckland Region since 1991, and the eight hour guideline of eight ppm of CO is based primarily on potential health effects.

Figure 2 shows that the CO levels in residential areas are mostly excellent. However, at the Pakuranga site 0.3 per cent of the results were in the alert category. Alert levels are also being reached at all peak traffic sites and the Queen Street site.

At the Khyber Pass traffic site levels in excess of the guideline were recorded 2.5 per cent of the time in 1998 and 2.6 per cent of the time in 1997. Exceedences of the guideline have also been recorded in the Queen Street site every year from 1991 to 1996, and at a short-term traffic site in Dominion Road for both years of operation in 1994 and 1995.

The results of monitoring indicate that CO levels in the air are usually within acceptable limits, but sometimes the guideline is exceeded near busy roads and in street canyons such as Queen Street. This may have potential health effects for vulnerable groups, such as those with heart disease, who spend long periods of time in these areas.

FIGURE 3: OXIDES OF NITROGEN EMISSIONS

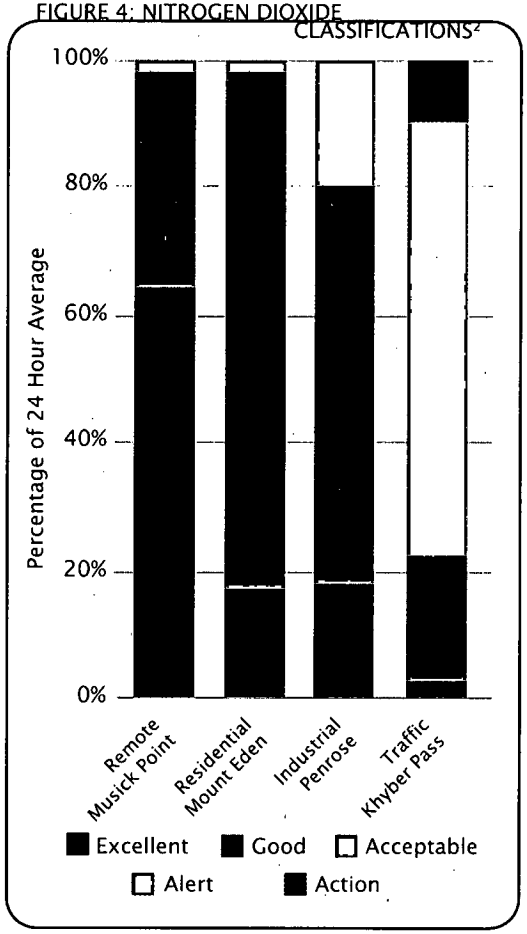


Nitrogen oxide (NO) and nitrogen dioxide (NO_2) are together referred to as nitrogen oxides (NO_x). NO reacts with ozone in the atmosphere to produce NO_2 and under certain conditions the reverse reaction can occur forming NO and ozone. NO_2 can irritate the lungs, increase susceptibility and severity of asthma, and lower resistance to colds and flu. NO_2 can also affect plant growth and health and can significantly degrade visibility as it contributes to the formation of brown hazes and smog. The guideline level of 100 micrograms (mg)/m^3 averaged over 24 hours is based on potential human health effects.

NO_x has been monitored at various sites around the region since 1986. At the peak traffic site levels in excess of the 24-hour guideline were recorded 9 per cent of the time in 1998, and the annual average guideline was also exceeded. At all other sites, the levels were mostly good, but exceedences of the guideline were recorded at the temporary Dominion Road site in 1994. The results of monitoring indicate that levels in excess of the NO_2 guideline

Ambient Air Quality

FIGURE 4: NITROGEN DIOXIDE CLASSIFICATIONS[2]



Note: Khyber Pass and Musick Point figures are not based on a full year of data.

may occur near busy roads, which could affect people's health, especially asthmatics and people with respiratory diseases who spend long periods of time in these areas. Levels away from busy roads and intersections are within acceptable limits.

OZONE

Although Ozone (O_3) is a vital component of the upper atmosphere, at ground level it is an unwanted toxic gas. Ozone can affect the growth of sensitive plants and affects human health, causing runny eyes, nose and throat irritation and breathing difficulties.

Ozone levels in the air are measured at 3 remote sites and at the top of the Sky Tower. These represent peak ozone sites, because the high levels of nitrogen oxides in air react to form ozone as polluted air moves away from sources in the city. Alert levels are being reached at all four sites. This means that, if nitrogen oxide emissions from the city increase, ozone levels in remote areas may reach levels that can cause health and vegetation effects, and there will be an increased chance of smog over the Auckland Region.

FIGURE 5: OZONE CLASSIFICATIONS

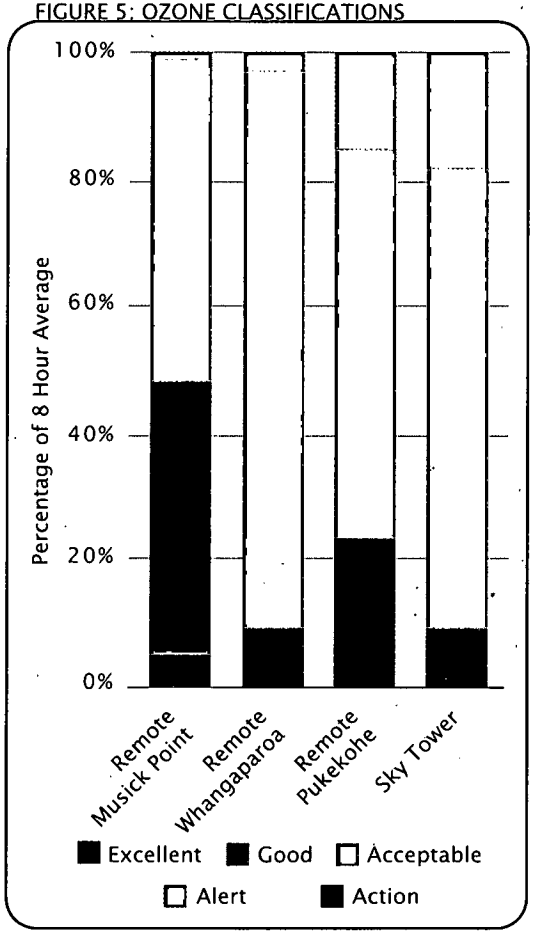
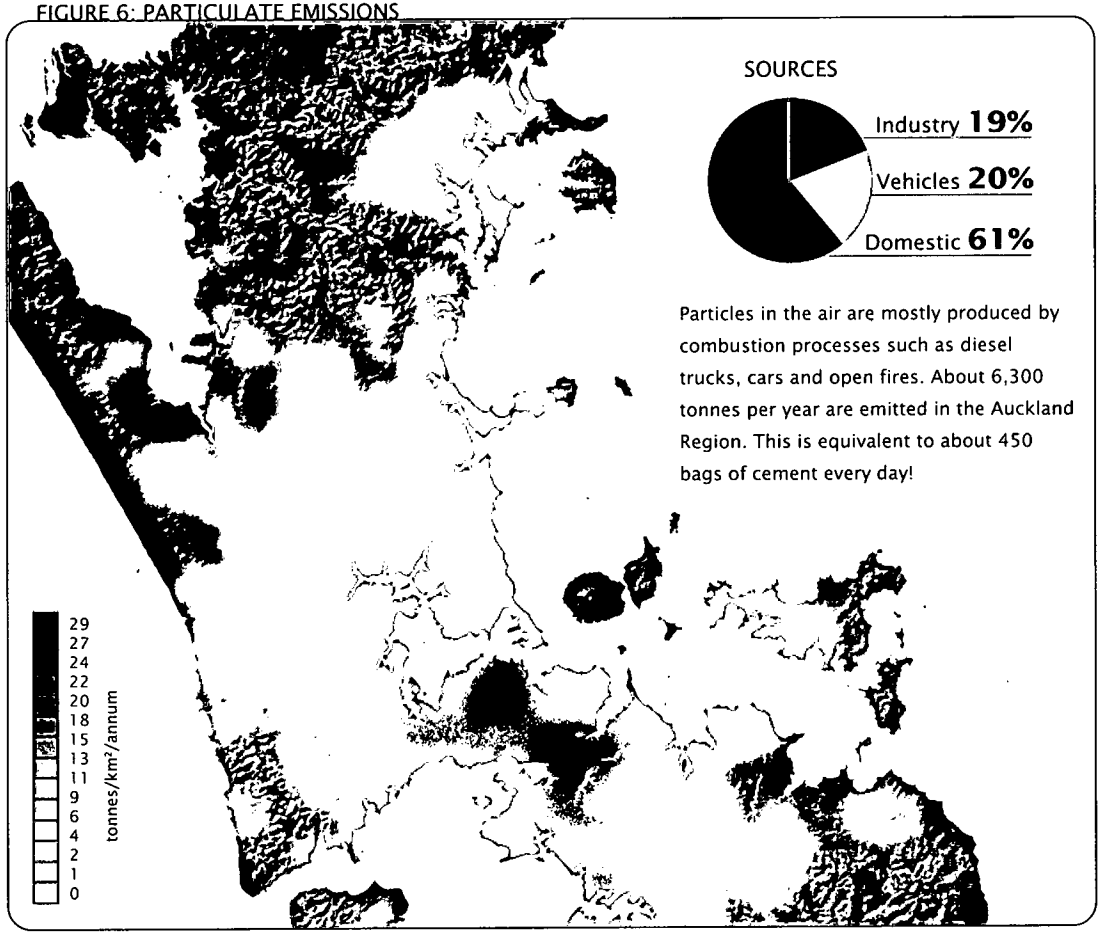


FIGURE 6: PARTICULATE EMISSIONS



SOURCES

Particles in the air are mostly produced by combustion processes such as diesel trucks, cars and open fires. About 6,300 tonnes per year are emitted in the Auckland Region. This is equivalent to about 450 bags of cement every day!

Ambient Air Quality

PARTICULATE MATTER

Fine particulate (PM_{10}) describes suspended particles in air which have a diameter of less than 10 micrometres. They aren't visible to the human eye but they do create a visible haze in the air. Particles of this size can be inhaled and can seriously effect human health, especially in asthmatics and people with heart or lung disease. The guideline level of 50mg/m³ is designed to avoid health effects, although recent research suggests that health effects may occur below this level in susceptible people.

Monitoring of PM_{10} in the Auckland Region began in 1995. Levels in excess of the guideline were recorded 2 per cent of the time in 1998 at the traffic site in Khyber Pass. Exceedences of the guideline were also recorded at the Penrose industrial/traffic site during 1995 and 1997, and at the Takapuna residential site during 1997. Alert levels are being reached at all sites.

The monitoring results indicate that while particulate levels are usually acceptable, levels in excess of the guideline for fine particulate occur sometimes near busy roads and in residential areas, which is a cause for concern.

FIGURE 7: FINE PARTICULATE MATTER EPI CLASSIFICATIONS

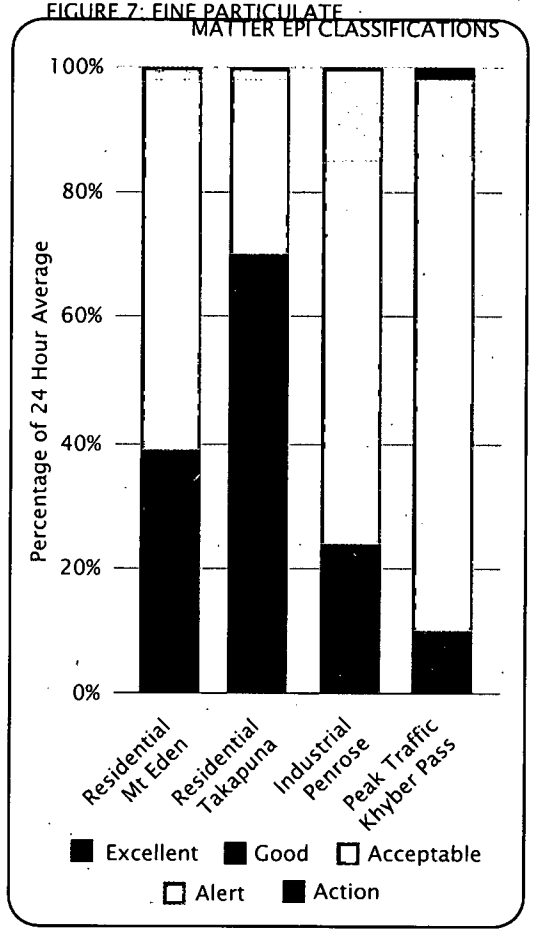
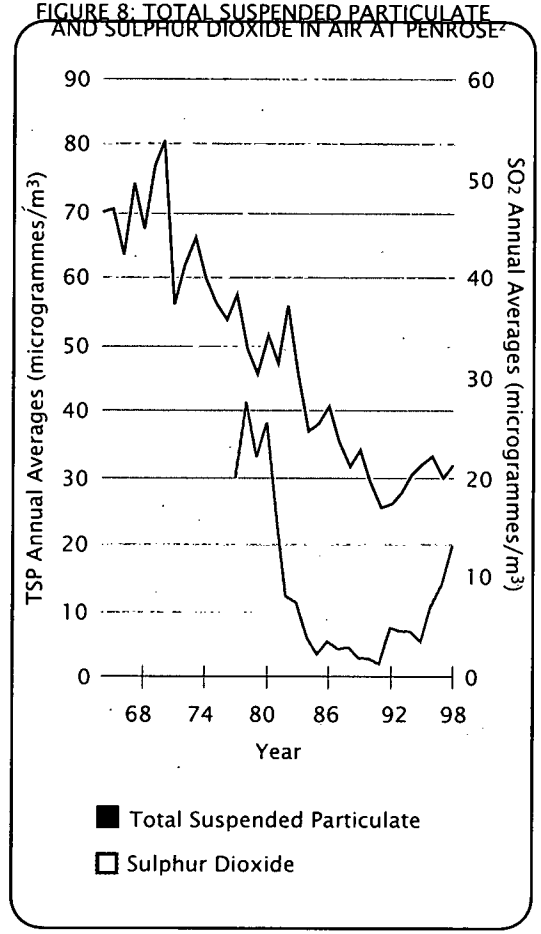


FIGURE 8: TOTAL SUSPENDED PARTICULATE AND SULPHUR DIOXIDE IN AIR AT PENROSE[2]



How is it happening?

Total Suspended Particulate (TSP) is the name given to all particles that remain suspended or 'float' in the air. Fine particles (PM_{10}) make up a portion of TSP, but this varies depending on where the particles are coming from. The particles that are larger than the PM_{10} are of less concern because they are not inhaled deeply into the lungs. Our monitoring has shown that approximately three-quarters of the TSP measured at the Mt Eden residential site is fine particulate, and at the Penrose industrial/traffic site approximately half of the TSP is fine particulate.

The TSP monitoring results show a clear long-term downward trend. However an increase has been seen over the past few years at some sites, indicating that levels of fine particulate in the air may also be increasing.

Similarly, Figure 8 shows a clear downward trend in the level of Sulphur Dioxide (SO_2) since the early 80s because of the decrease in usage of coal and heavy fuel as industrial fuels, but there has been a significant increase over the past few years. Recent results are still well below the guideline level of 50mg/m³ as an annual average (or 30mg/m³ to protect sensitive plant species).

Air quality depends on the amount of pollution produced, and the rate at which the pollution disperses. Poor air quality generally only occurs when winds are very light, and the contaminants aren't blown away. Monitoring shows that the worst pollution occurs on virtually calm days, and during cold winter days when contaminants are trapped close to the ground by an inversion layer when pollution can sometimes be seen accumulating in valleys and downwind of hills.

Air pollution levels are also affected by landscape. For instance, in the central business district contaminants aren't blown away as easily because of the high buildings.

The ARC has prepared an inventory of emissions showing where the pollution in our air is coming from. The main emissions are from motor vehicles and domestic fireplaces.

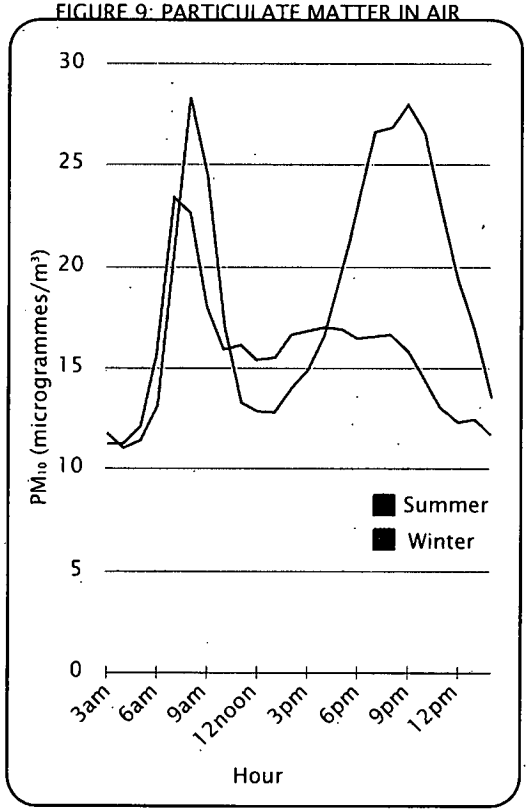
DOMESTIC POLLUTION

The main contributor to fine particulate in air during winter is home fireplaces. Figure 9 shows the effect that our fireplaces have on the levels of particulate in the air at a residential site where levels in the evening are much higher during winter. In the Auckland Region 20 tonnes of fine particles, 140 tonnes of CO, and 60 tonnes of hydrocarbons pour out of our chimneys on an average winter day. Smoke from fireplaces can also contain formaldehyde, volatile organic compounds and polycyclic aromatic hydrocarbons. These compounds can adhere to the fine particles that are inhaled deep into our lungs and some are thought to pose a cancer risk with prolonged exposure.

Bonfires and incinerators are the other major source of domestic air pollution. Every year more than 110 tonnes of fine particles, 600 tonnes of carbon monoxide and 200 tonnes of hydrocarbons pour into the air from rubbish fires. As well as producing harmful pollutants these fires can also be a nuisance to neighbours. More than 2,000 complaints about open burning are received by local councils every year in the Auckland Region.

Ambient Air Quality

FIGURE 9: PARTICULATE MATTER IN AIR



MOTOR VEHICLES

The most significant source of CO is the motor vehicle. The amount of CO produced by our cars increases when the engine isn't working efficiently or is idling, so congested traffic produces much more CO pollution than free-flowing traffic.

Figure 9 shows how the concentration of carbon monoxide varies in a typical day at a peak traffic site, and illustrates the effect of the rush hours in the morning and evening. CO dissipates fairly quickly in the atmosphere so is generally only at high levels close to busy roadways or in areas where traffic emissions accumulate.

Nitrogen oxides are also a product of fuel combustion and again motor vehicles are the main source. The main industrial sources of nitrogen oxides are primarily the gas-fired power stations, and industrial energy and heat-raising plants.

Ozone is produced when nitrogen oxide and hydrocarbons react in the air. As polluted air moves away from urban areas ozone levels increase. Therefore, at remote sites like Musick Point, nitrogen oxide levels are generally low, but ozone levels are quite high. Ozone is only formed in the lower atmosphere in the presence of sunlight, so levels are highest during summer.

The amount of particulate produced by motor vehicles, in particular diesels is increasing. The sale of diesel in the region has more than doubled over the last 10 years and is increasing at a much greater rate than the sale of petrol (see ***Travel Patterns***). Diesel engines produce high levels of particulate and sulphur dioxide, especially if they're not properly tuned. This increased rate of diesel consumption is thought to be the reason for the increase in the amount of SO_2 and total suspended particulate measured over the past few years.

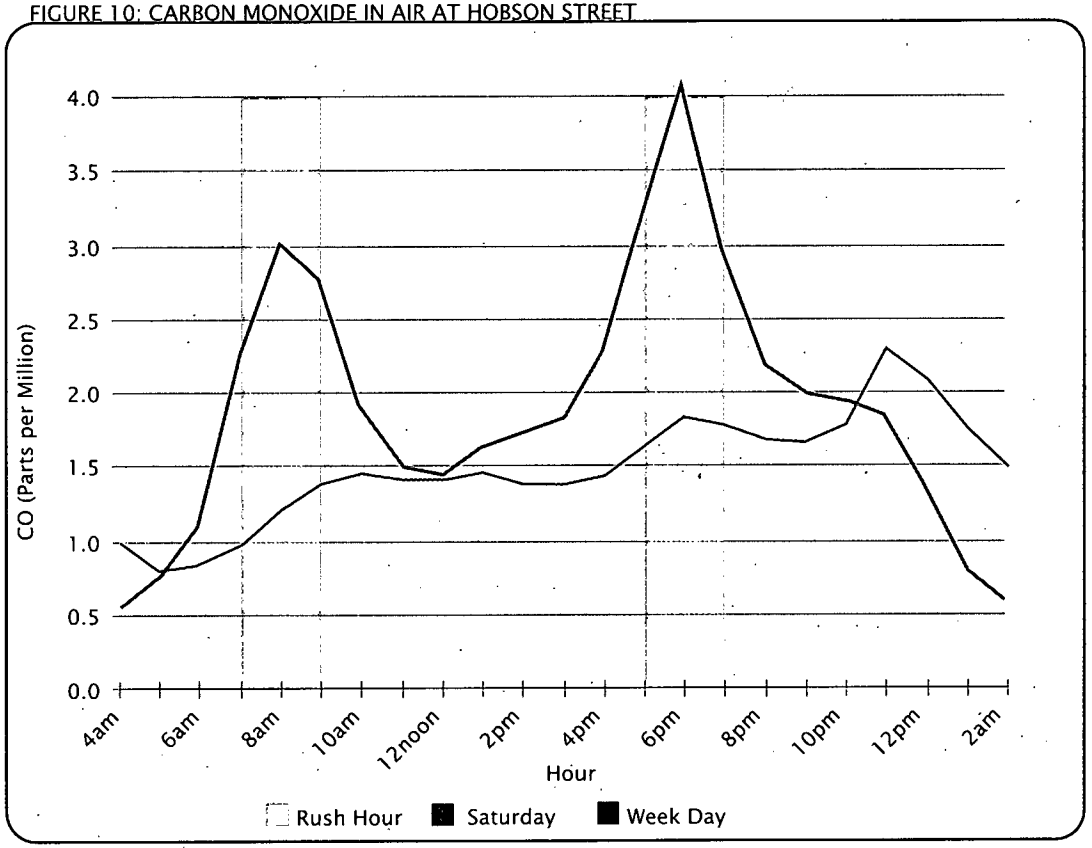
Over the past 13 years petrol and diesel sales have increased by 70 per cent. This means that emissions from cars have also risen by 70 per cent since 1985. If fuel consumption continues to increase at this rate, the air quality in Auckland will get worse, even with the introduction of better engines and/or pollution controls such as catalytic converters.

INDUSTRY

Overall, industry is responsible for about 3 per cent of air pollution in the Auckland Region. However, some industries have the potential to cause significant pollution, and are carefully controlled for this reason. These include power stations and large boilers, chemical processes, landfills, rendering, large mines and mineral processing, metal production and industries with significant hydrocarbon discharges.

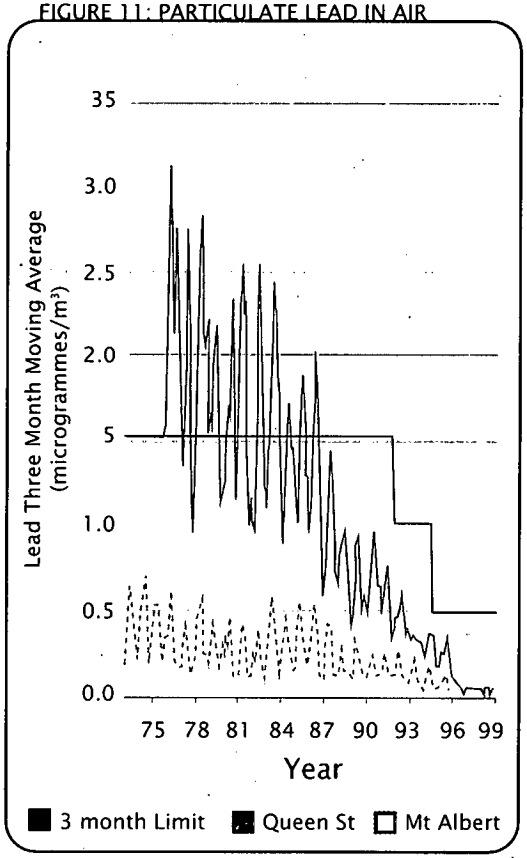
About 11 per cent of public complaints about air quality in the Auckland Region are about industry, and are usually related to odour. An increasing problem in the Auckland Region is the encroachment of sensitive land uses such as residential areas on industrial areas. Although industrial emissions are generally well controlled, there is potential for problems such as occasional smells or accidental discharges which cannot be eliminated. The only way to ensure that industrial emissions do not have an adverse effect is to maintain adequate separation distances between industrial and sensitive areas.

FIGURE 10: CARBON MONOXIDE IN AIR AT HOBSON STREET



Ambient Air Quality

FIGURE 11: PARTICULATE LEAD IN AIR



Why is it Important?

Air quality is important to everybody. We can choose not to swim in polluted water, to eat organic food, and to purify our drinking water, but we can't choose not to breathe.

Poor air quality can seriously affect our health. This is a major concern in the Auckland Region because of the prevalence of respiratory and heart disease. The Auckland Region has one of the highest asthma rates in the world. Between 12 and 23 per cent of adults in the Region are asthmatic, and asthma is the fourth highest cause of hospitalisation in the region. Overall, New Zealand has the fifth highest rate of chronic obstructive respiratory disease (CORD) in the world, and as a group, Maori have the highest rate of CORD in the world. The highest cause of death in the region is coronary heart disease.

Air pollution can also cause degraded visibility, brown hazes and smog which could seriously affect our 'clean green' image, potentially affecting tourism and export earnings. If vehicle usage continues to increase smog could form on clear sunny days, affecting our beautiful vistas, people's health and possibly the productivity of our farms.

We can make a Difference!

The amount of lead in total suspended particulate has been measured in Auckland since 1973. Lead is a heavy metal which is of concern because of the serious health effects it can cause.

The long-term monitoring results show that the concentration of lead in air has reduced to levels that are well below the Ministry for the Environment guidelines ever since the reduction of lead levels in petrol began in 1986, and was completely phased out in 1996. Figure 11 shows that efforts to reduce lead in petrol have been successful in reducing the amount of lead in the air.

What Can I Do?


Drive your car less — walk, bike, bus, or car pool, especially during congested periods, and combine many chores with each car trip — for example, do the shopping, post the mail, and drop the kids off at school in one trip rather than three. (see ***Travel Patterns***)


Tune engines regularly to reduce particulate emissions and save costs (especially diesel engines).


Make sure your new car has a catalytic converter, and don't remove it!


Check the chimney to make sure your fire doesn't smoke too much (if it does this wastes fuel as well as polluting the air). Don't burn anything other than dry, seasoned wood, and use kindling and paper to start your fire. Don't bank the fire up and let it smoulder overnight — this releases higher levels of pollution. Make sure you chimney is cleaned every year, is well insulated, is high enough to let smoke and gases disperse and does not have a 'hat', which deflects the smoke downwards.


Don't burn rubbish — call the ARC on 0800 REDUCE or 0800 733 823 for advice on where to recycle or safely dispose of non-recyclable wastes.


If you decide to burn rubbish then call your local council first as it may be prohibited, or if not you will probably need a fire permit. Don't burn plastics, rubber, paint or poisons, painted wood, treated timber, dust, food scraps, wet material, fabrics, green grass or foliage, tins or glass as these materials may produce large quantities of toxic smoke. Make sure that your incinerator is at least 3m from your boundary and 12m from any building, there is air circulating through the fire, and that the wind isn't blowing towards your neighbours washing or through their windows.

What is the ARC doing?


Continually monitoring key pollutants around the Auckland Region, along with the Ministry of Health and Manukau City Council.


Analysing and monitoring programmes to develop regional models for assessing overall air quality and prediction of future levels.


Because vehicles cross regional boundaries, lobbying for stronger government initiatives to control vehicle air pollution.


Developing and implementing strategies to encourage Aucklanders to reduce vehicle usage and to manage travel demand.


Developing and implementing strategies to encourage Aucklanders to reduce emissions from fireplaces, open burning and rubbish incineration.

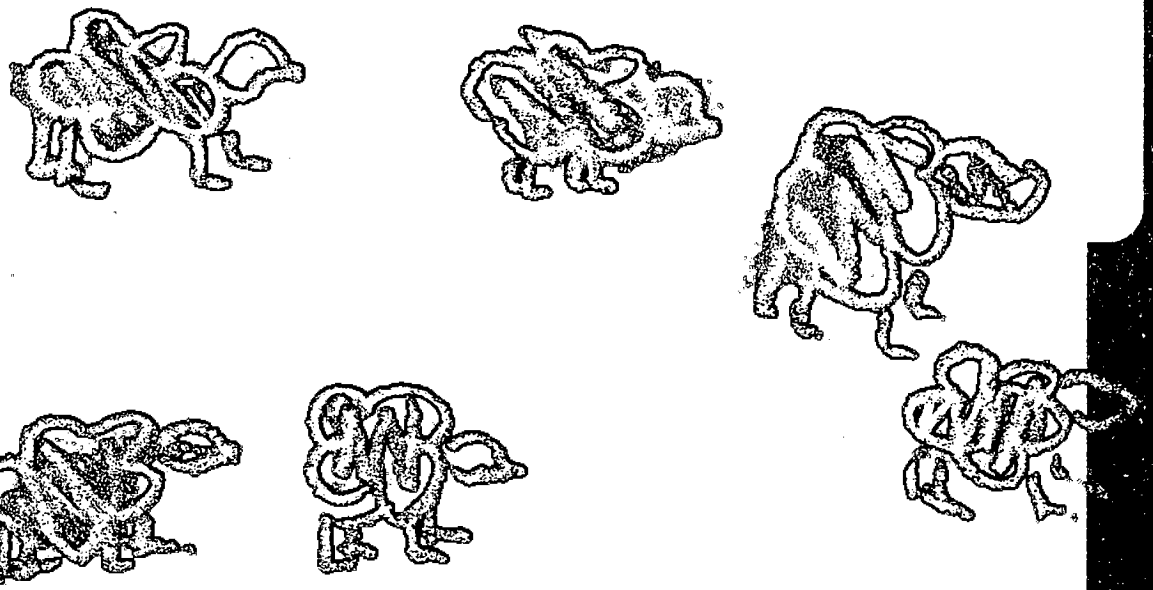

Developing a Regional Air Quality Plan to control various air emissions.


Working with city and district councils to ensure that adequate separation distances between industry and sensitive land uses are maintained.


Providing an ongoing education programme.


Controlling industrial emissions and monitoring compliance.


Working with city and district councils to ensure that public complaints about air quality are responded to effectively.



Our Land and Fresh Water

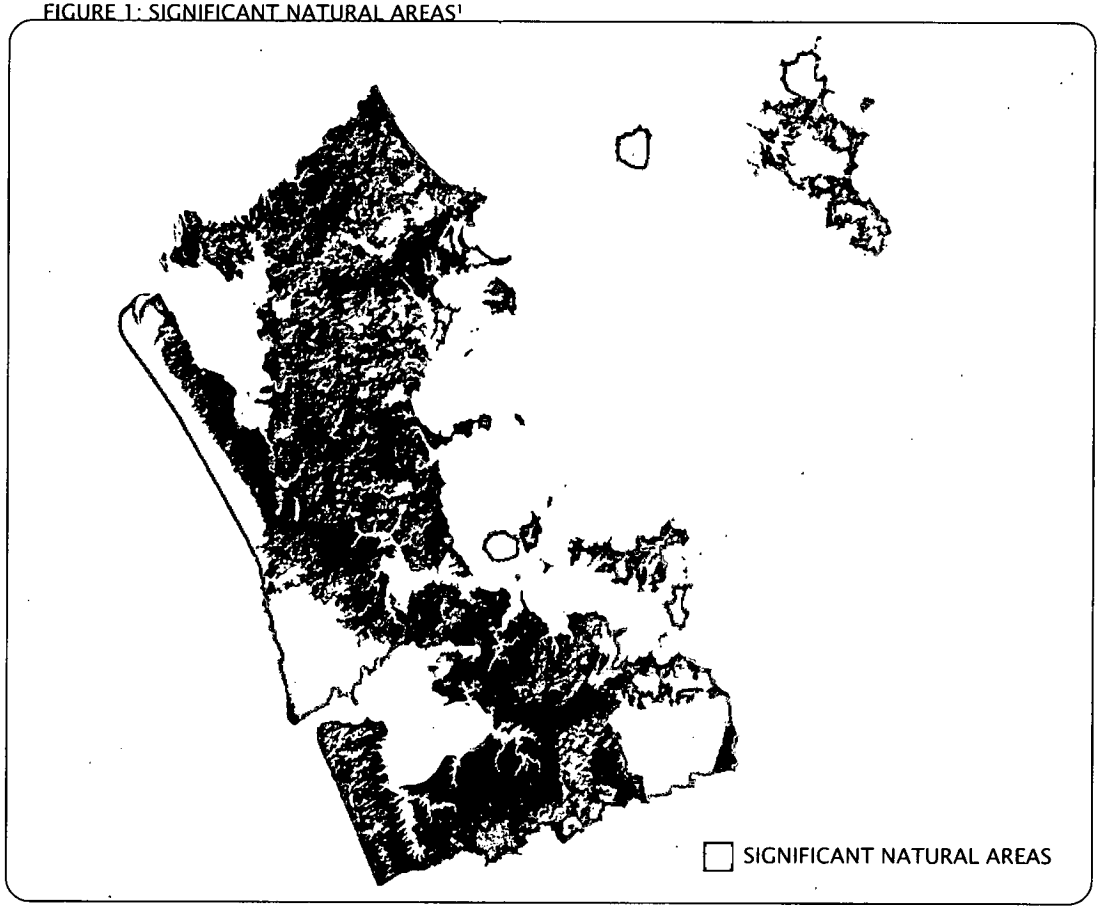
issue:

Our native forests, plants and animals make the Auckland Region unique. The coastal pohutukawa forests, the rain forest of the Waitakeres and the pockets of lowland forest in urban and rural areas of the region – with kauri, taraire, kereru and tui – all are special.

Terrestrial Ecosystems

What is happening?

FIGURE 1: SIGNIFICANT NATURAL AREAS[1]



The Auckland Region's natural environment and indigenous biodiversity have been extensively modified and reduced from its original state. Of the total land area of the region, only 12 per cent remains as indigenous forest and 18 per cent as regenerating native scrub. The remaining significant natural areas in the Auckland Region are illustrated in Figure 1.

Originally the region would have been almost entirely covered in native forest (with kauri, rimu, taraire, tawa and pohutukawa in the canopy) and with wetlands and swamp forest in the low-lying areas. At the coast the forest would have given way to saltmarsh and mangrove forest in tidal inlets and estuaries with pingao and Spinifex on the sand dunes[2].

Today, most of the remaining native forest in the Auckland region has been modified and is regenerating from clearance and milling at the time of European settlement. These regenerating forests

are highly diverse. They are characterised by regenerating kauri and broad-leaved forest, coastal forest with pohutukawa, and areas of regenerating forest and scrub dominated by manuka and kanuka.

The largest areas of native forest remaining in the region occur in the Waitakere and Hunua Ranges, and on islands such as Little Barrier and Great Barrier. In the coastal and lowland areas of the region, where urban and rural development has been intensive, only fragments of native vegetation remain.

An estimated 14 per cent of the Auckland Region is in protected natural areas, including Department of Conservation reserves, local authority reserves and regional parks.

A significant amount of natural heritage resources are protected and managed in ARC's extensive regional parks network (37,320ha), which includes regionally and nationally significant heritage resources such as the Hunua and Waitakere Ranges.

TABLE 1: PROTECTED LAND IN THE AUCKLAND REGION

Ecological District	Land in Protected Natural Areas (ha)	Percentage of land Protected
Rodney	5780.0	3.2
Kaipara	3704.0	4.7
Tamaki	1225.3	1.8
Waitakere	16393.6	51.1
Hunua	23223.6	22.0
Manukau	367.2	0.5
Awhitu	328.7	1.1
Rangitoto	2332.9	100.0
Inner Gulf	2729.0	13.8
Great Barrier	14641.1	51.9
Little Barrier	2817.0	100.0
Total	***73542.5***	***14.0***

Terrestrial Ecosystems

How is it happening?

Loss of habitats and ecosystems cause native species to become lost or threatened. The numbers of nationally threatened plant and animal species in the Auckland Region are shown in Table 2. Also shown is the number of species which have been identified as a priority for conservation effort in the region.

Auckland forest ecosystems provide a habitat for a number of nationally threatened species, including a native frog, geckos and skinks, both native species of bats and the endangered North Island kokako. Approximately half the region's threatened plants occur in shrubland habitats and regenerating forest ecosystems, and a significant number of plants (102) have also been identified as regionally threatened.

TABLE 2: THREATENED SPECIES IN THE AUCKLAND REGION

	Number of Nationally Threatened Species	Priority for Conservation Effort
Birds	35	72
Plants	66	100
Mammals (bats)	2	2
Reptiles (geckos, skinks and tuatara)	9	4
Amphibians (frogs)	1	1
Invertebrates	unknown	3
Total	***113***	***182***

The natural forest vegetation of the region was largely burnt and destroyed over the last 500 years, firstly during many centuries of Maori occupation, and then intensifying after European settlement. Regenerating manuka and kanuka scrub, along with forest remnants in gullies were widespread in the region when Europeans settled in Auckland in 1840. Visitors wrote of the widespread occurrence of bracken and gumlands of low-growing manuka and umbrella ferns. Large areas of regenerating native scrub in the region were cleared by Europeans for farming when they settled in the region after 1840. As land was cleared more of the native vegetation disappeared and there was an influx of weeds.

Changes in land use and urban growth and development is the principal factor affecting indigenous biodiversity today. Vegetation clearance causes loss of habitats, loss of species and invasion by weed and pest species (see ***Plant and Animal Pests***). It is often small scale but the cumulative effects of this clearance impacts on the quality of waterways and estuaries and the general health of the environment. In the Rodney Ecological District surveys

Why is it important?

have shown that over 80 per cent of forest remnants are 10ha or less in size[3]. Many forest and wetland remnants in the lowland areas of the region are small, fragmented and isolated from one another. For example, in the Manukau Ecological District the remaining native vegetation is made up of at least 296 fragments of forest, scrub and wetland, with the majority of sites (85 per cent) less than 5ha in size.[3]

The biological diversity and ecological viability of such small remnants is often severely reduced. A study of forest remnants has shown that environmental factors such as light, humidity and temperature are different at the edge of a forest remnant compared to the forest interior ('edge effects'). The edges of forest remnants are more susceptible to stock damage and pests and weeds and the establishment of wind and light-tolerant plant species different to those adapted to forest interior conditions. In remnants smaller than 10ha, these effects can be significant throughout the forest[5].

The terrestrial ecosystems of the Auckland Region are diverse and distinctive. This diversity is represented in the range of lowland and coastal forest, shrubland and duneland vegetation found in the Auckland Region and in their plant and animal species.

Over a third of New Zealand's 2,200 native vascular plants (approximately 800 species) have been recorded in the Auckland Region[6]. The Department of Conservation has recorded 127 species of native birds (over half of New Zealand's bird species)[1], 16 species of native frogs and reptiles (skinks, geckos and tuatara) and two species of native bats in the region[1]. New Zealand's native frogs, reptiles and bats are found nowhere else in the world.

Some indigenous species are unique to the Auckland Region including the Chevron skink found only on Great and Little Barrier Islands, and flowering plant species such as the Waitakere rock hebe and the Great Barrier Island kanuka[1].

Native forest areas enable forest regeneration, nutrient recycling, breeding of native species and are vital to the well being of our native plants and animals, most of which are found nowhere else in the world. Many native species cannot survive in modified environments. The extensive regenerating manuka, kanuka and tree fern forests and scrublands of the region also provide habitats for many important species, and act as a nursery for other native trees (such as kauri) to grow. Other species fostered by the scrublands include native shrubs, ferns, orchids, fungi, lichens, geckos and birds.

Islands are an important feature of the region. Many are refuges for native plants and animals. Great Barrier Island contains the most extensive northern forests free from possum damage, and from mustelids. The island contains the largest remaining population of brown teal in New Zealand, and provides a habitat for one of the most rich and diverse reptile fauna in New Zealand (13 species). Little Barrier Island contains the largest remaining area of relatively unmodified northern North Island forest, while Rangitoto Island has unique characteristics, with its association of pohutukawa and rata forest growing on lava and scoria, and wide diversity of native plant species[1].

With urban growth and development the terrestrial ecosystems of the Auckland Region are under increasing pressure through destruction of habitats and the threat of weeds and pests. What is left of our indigenous biodiversity needs to be safeguarded, protected and restored.

Terrestrial Ecosystems

What can I do?

- Protect native forest and scrub remnants on private land — control pests, fence bush from stock, avoid fragmenting areas of native forest, avoid vegetation clearance, use locally-sourced native plants for restoration. To date, approximately 360 landowners in the Auckland region have protected forest and wetland remnants as bush lot covenants. In addition, approximately 1178ha is protected through QE II National Trust covenants in the region.
- Join your local LandCare or CoastCare or community restoration group. The ARC currently works with 13 care groups in the region, including seven LandCare groups and six CoastCare Groups. Over the past four years approximately 28,000 native plants have been planted at Te Henga by the CoastCare Group, while the Awhitu LandCare Group produces up to 10,000 trees per year for restoration planting.
- Plant native plants to create buffers to existing native forest, to create corridors for movement of native birds or distribution of plant seeds and to protect stream margins. Use locally sourced plants and seed.

What is the ARC doing?

- Monitoring and undertaking ecological surveys to identify significant natural resources.
- Managing the extensive regional parks network (37,320ha). The network contains regionally and nationally significant heritage resources, such as the Waitakere Ranges, and coastal forests at Tawharanui, Wenderholm and Shakespear Regional Parks.
- Participating in joint wildlife management projects, including the release of North Island robins at Wenderholm, and the kokako management programme in the Hunua Ranges. (By the end of 1998-99 season, the population had increased to three breeding pairs, and since 1994, nine young have fledged.)
- Managing existing Mainland Islands at Wenderholm Regional Park (80ha) and in the Hunua Ranges in the kokako management area (500ha). Mainland Islands are proposed at Tawharanui and Shakespear Regional Parks.
- Undertaking pest control in high conservation value areas.
- Developing education programmes.
- Managing the revegetation of ARC parks. In 1998 about 60,000 native trees were planted in regional parks as part of a network-wide habitat restoration programme.
- Co-ordinating the Trees For Survival programme. Approximately 25,000 native plants are planted each year on erosion-prone land in the Auckland Region.

Our streams and wetlands provide a habitat for a diverse range of plants, animals, and insects.

Issue:

Freshwater Ecology

What is happening?

Forest once covered large areas of the Auckland Region. Associated with this forest was an extensive network of small streams, of which more than 80 per cent were small upper catchment streams. Freshwater wetlands and swamp forests (with kahikatea, cabbage tree, pukatea and swamp maire) would have once covered large stretches of the low-lying land.

Today, the vast majority of Auckland's streams (about 2,900 km), have been modified for rural uses, flood control or urban development. The channel characteristics and flows have been modified, and much of the associated riparian (or streamside) vegetation has been destroyed or severely degraded. Mostly these modifications have been accompanied by varying degrees of water quality degradation ranging from moderate to severe. Of the total length, approximately 2,600 km are small streams that you can step or jump over.

In addition, many of the region's wetlands have been drained or irretrievably modified for farmland, flood control, or urban development. Table 1 illustrates the remaining wetlands in the various ecological districts of the Auckland Region, with estimates of the land area which was originally in wetlands illustrated in brackets.

Nationally, it is estimated that 90 per cent of the original area of wetlands has been lost[1]. In the Auckland Region, approximately 0.5 per cent of the total land cover is in wetlands, compared with an estimated 5-10 per cent of the total land cover in pre-human times.

TABLE 1: REMAINING WETLAND AREAS IN THE AUCKLAND REGION[1]

Ecological District	% of land remaining as wetlands
Rodney	0.1%
Kaipara	1.2%
Waitakere	0.7%
Rangitoto	0.0%
Tamaki	0.03%
Inner Gulf	0.1%
Manukau	0.1%
Awhitu	0.1%
Hunua	0.1%
Little Barrier Island	0.0%
Great Barrier Island	2.3%

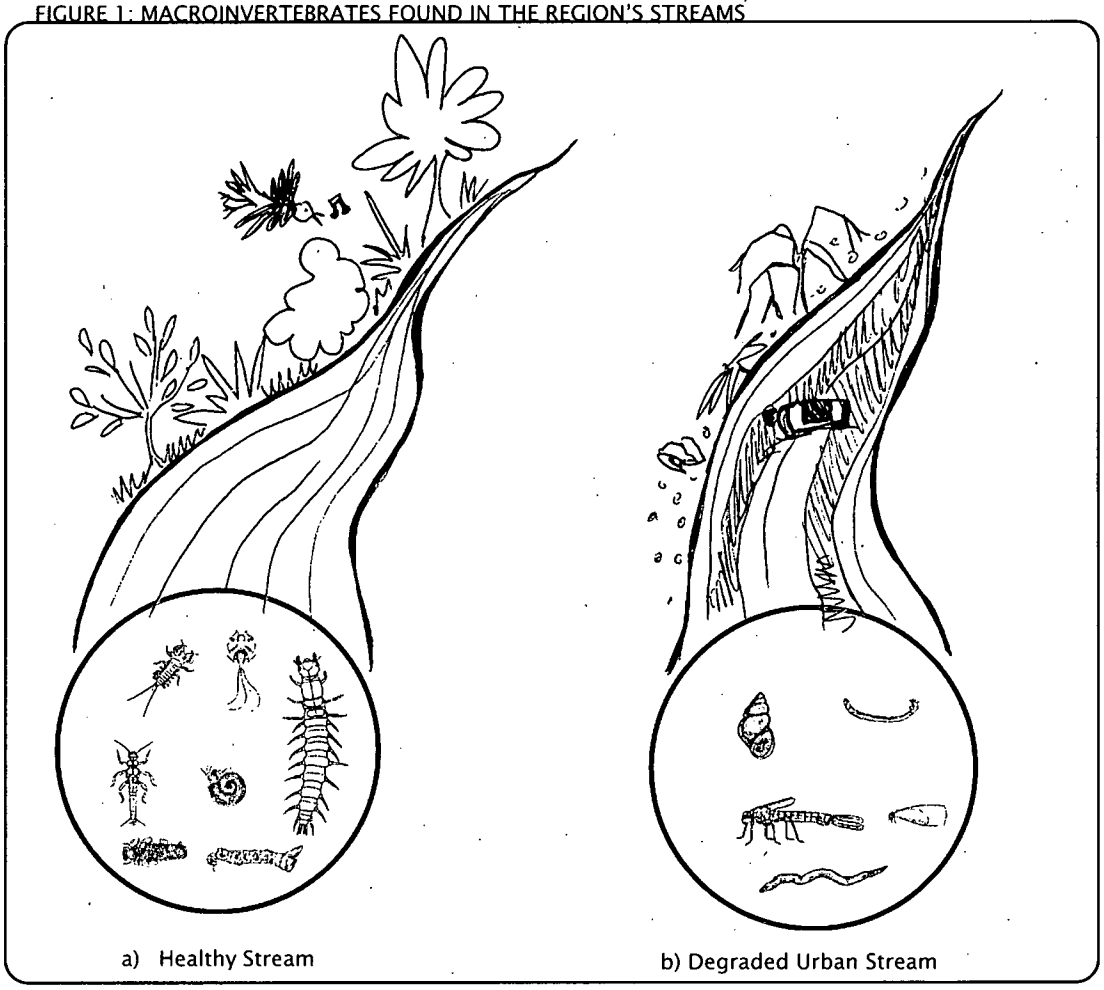
Freshwater Ecology

Significant freshwater wetlands remaining in the Auckland Region include:

- Te Henga wetland (the largest freshwater wetland in the mainland of the region).
- The internationally significant Kaitoke swamp on Great Barrier Island.
- The dune lakes of the Awhitu and Kaipara peninsulas, and the numerous smaller remnants of flax, raupo, cabbage tree and rush swamps which occur in many parts of the region.

Aquatic macroinvertebrates include insects, snails and worms that live on the bed of rivers and streams. They show varying degrees of sensitivity to organic enrichment and pollution. The species present and the overall diversity changes as a result of water pollution and habitat changes. Figure 1 illustrates some macroinvertebrates commonly found in a healthy forested stream and a degraded urban stream. A typical macroinvertebrate community index (MCI — which is used to illustrate the health of stream ecology) for these types of ecosystems is also shown.

FIGURE 1: MACROINVERTEBRATES FOUND IN THE REGION'S STREAMS



a) Healthy Stream

b) Degraded Urban Stream

How is it happening?

Each habitat is characterised by its own unique macroinvertebrate community. Healthy muddy-bottomed coastal streams typically contain snails, shrimps, damselflies, mayflies and caddisflies. High-quality rocky-bottomed streams with good riparian vegetation are typically dominated by a greater number of mayflies, caddisflies, stoneflies and dobson flies. As streams are degraded, as often occurs in urban environments, the sensitive taxa such as mayflies and stoneflies gradually disappear. The most impacted streams have macroinvertebrate communities dominated by snails, midges and worms.

The diversity of fish can also be an indicator of stream health. A high-quality, soft-substrate coastal stream would be expected to have around nine native fish species present whereas a similar but degraded stream may have only one or two species. Similar results could be expected from other stream types.

Urban and rural development results in the removal of native vegetation, which changes the quantity and quality of water entering streams and wetlands. In many instances streams and wetlands are channelled, piped or culverted, which remove the natural habitat of many freshwater organisms. Various land uses result in reduced riparian vegetation cover, loss of the instream habitat and changes to the flows of streams, which in turn results in changes to the ecology of these areas.

Most freshwater species require certain minimum stream flows and good riparian cover to survive. As a result of pressures on freshwater habitats and the effects of introduced species, pests and weeds, many freshwater species have a significantly restricted distribution.

Aquatic plants and macroinvertebrates play a key role in the structure and function of river ecosystems. Native plants provide important cover and habitat for fish and macroinvertebrates. In turn, many macroinvertebrates eat algae and decomposing leaf matter and are a food source for fish and birds.

Because most of the recorded species of fish require access to and from the sea to complete their life cycles, the presence of instream barriers such as weirs, dams, culverts, waterfalls and concrete channels can result in the total elimination of such species from areas upstream of the barrier.

Freshwater Ecology

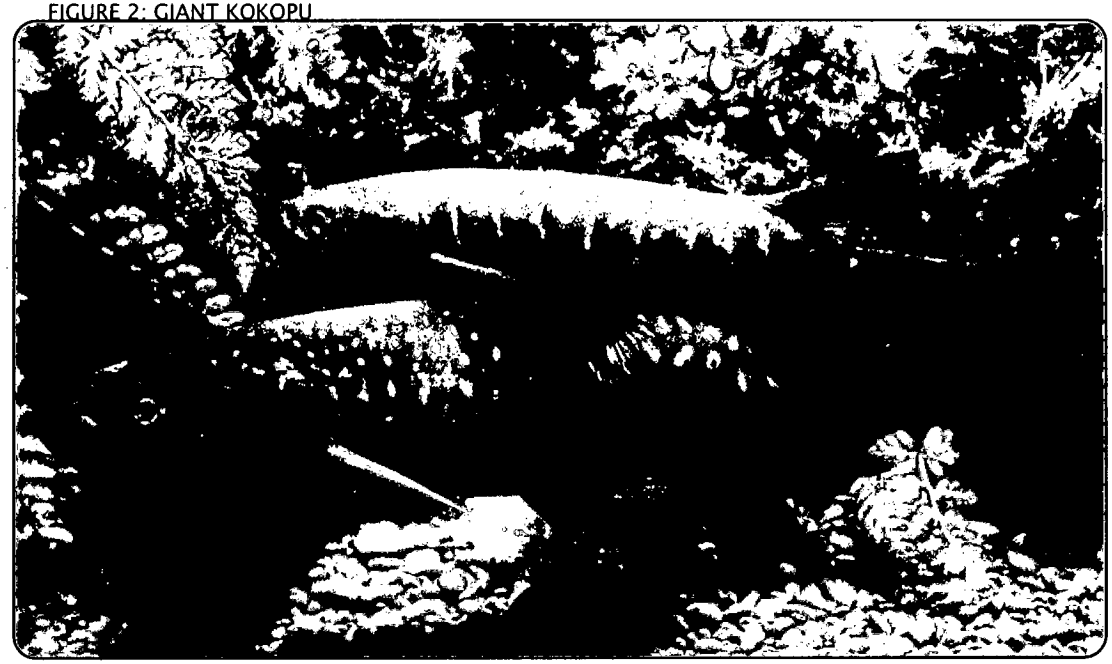
Why is it important?

Auckland's small streams and wetlands are of a very high value because of the aquatic and terrestrial biodiversity they maintain. Wetlands provide an important habitat for bird life. Freshwater wetlands support a diversity of native plants and animals, most of which are endemic and unique to New Zealand. Many of these species are threatened because of loss and modification of their habitat. At least 15 species of native freshwater fish have been recorded in the region, while nationally one-third of all native New Zealand fish are threatened. Three species of fish are listed as threatened in the Auckland Region, and four species are identified as being a priority for conservation effort.[2]

Loss of habitat for native fish is a nationally important issue because the majority of species are only found in New Zealand. A wide variety of aquatic macroinvertebrates and native plants are also unique to New Zealand freshwater environments.

Streams are intimately linked with the downstream estuaries and harbours, both hydrologically and biologically. Many migratory species move between these systems. Land use in the catchment can lead to sediment build-up in our estuaries and bays.

FIGURE 2: GIANT KOKOPU



What can I do?

- Adopt your local stream and establish a Care Group to act as 'Minders'.
- Don't remove, and where possible restore, riparian vegetation along water courses.
- Help protect and restore wetland ecosystems by controlling weeds and pests, fencing the area from stock damage, and planting a buffer zone around the wetland margins.
- Don't tip household wastes such as paint, oil and grass clippings into stormwater drains or water courses.
- Report 'spills' or water quality problems to the ***ARC Pollution Hotline on (09) 377-3107.***
- Get involved through the submission process in land use changes that may affect streams and water bodies in your area.

What is the ARC doing?

- Establishing a regional freshwater ecology monitoring network.
- Requiring land use, stream modification and waste discharge applications to avoid, remedy or mitigate any adverse effects of their proposals.
- Supporting land and stream care initiatives.
- Developing guidelines for various activities to minimise their effects on freshwater ecosystems.
- Restoring and protecting freshwater wetlands on regional parks, including Awhitu, Shakespear and Tawharanui.

issue:

Plant and Animal Pests

Plant and animal pests can have serious adverse impacts on our regional environment, in particular our natural ecosystems, agricultural resources and health and enjoyment.

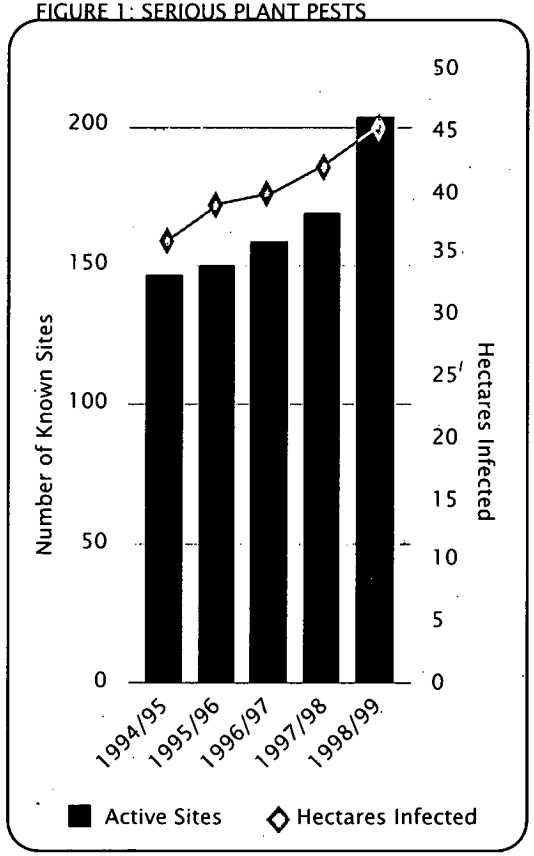
What is happening?

Monitoring over the past five years has shown that the number and density of serious plant and animal pests within the Auckland Region, as well as the cumulative adverse effects they are having on the environment, has increased steadily.

The Auckland Museum Herbarium estimates that 655 exotic plant species became naturalised within the Auckland Region between 1840 and 1995. That's an average of four new exotic species becoming established in the wild every year. Not all of these naturalised plants prove to be pests, but in 1995, 40 of these naturalised species were considered to be serious pests (under the Biosecurity Act), and in 1999 this number had increased to 43 species.

Infestations of these serious plant pests gradually spread in size and distribution throughout the region. Figure 1 illustrates the increase in the number of known sites of 14 representative species of these serious plant pests, as well as an increase in the total area of infestation over the past five years.

FIGURE 1: SERIOUS PLANT PESTS

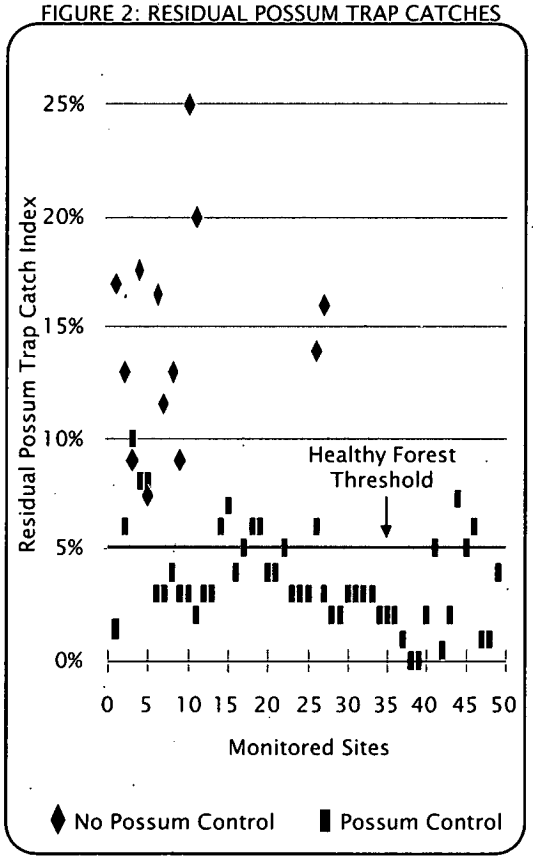


The number of new mammal pest species has not increased in the region during the last five years. However, new insect and bird species are continuing to increase steadily.

In many parts of the region endemic animal pests — such as possums, feral goats, feral deer, rats and mustelids — are at levels above those where natural ecosystems remain in a healthy state.

Figure 2 shows that possum numbers, in all of the randomly selected 'high regional conservation value' areas (which have not had any possum control in the preceding three years) are well above the 5 per cent residual trap catch index level that is considered to be the threshold for a healthy forest ecosystem. This also shows that the majority of areas where control operations have been carried out now have possum numbers at or below the threshold level for a healthy forest.

FIGURE 2: RESIDUAL POSSUM TRAP CATCHES



How is it happening?

Many of the serious plant pest species found growing in the wild, are plants which have escaped from cultivation or have arrived here accidentally from overseas. These plants then spread through natural means such as wind, water, birds and animals. Humans also distribute them on machinery, recreational gear and clothing and in topsoil and illegally dumped garden waste. Some of these plants are even being sold and planted by uninformed people.

Some animal pests have been illegally or accidentally liberated by humans. However, in areas of the region where control operations have not been initiated, animal pests populations are generally spreading and increasing in size through natural means. Their only natural limitations are topography, suitable habitat and availability of food. Nearly all of the serious animal pest species breed successfully in New Zealand and are very mobile.

Why it is important?

Over the past 160 years, Auckland's natural environment has been modified such that less than 30 per cent of the region's indigenous terrestrial habitats remain (see ***Terrestrial Ecosystems***). Many of these remaining areas have a wide range of unique endemic species which contribute greatly to the region's biodiversity or biological wealth. For example, there are more endemic species on six Hauraki Gulf islands than there are in the whole of Britain. Pests are one of the greatest threats to the long-term survival of these areas, and to the wide range of species found within them.

Animal pests are seriously affecting our native ecosystems. They are eating or damaging large amounts of native vegetation and some are predating on native animal, insect and bird species.

Plant pests also are permanently altering the structure and composition of natural ecosystems by suppressing, out-competing and replacing native plant species. In the long term, this leads to a permanent change in the structure and composition of our native bush areas. We all enjoy these

Plant and Animal Pests

beautiful native ecosystems, as do tourists, and it is important that future generations are able to enjoy these areas too.

A significant proportion of wealth generated in rural Auckland comes from farming and forestry. Once plant pests become widespread they can affect production by competing with, smothering, suppressing or degrading crops.

Possums and mustelids can spread and transfer bovine Tb to cattle and deer herds. Possums and rabbits also cause localised damage to horticultural and forestry plantings as they find these crops particularly palatable.

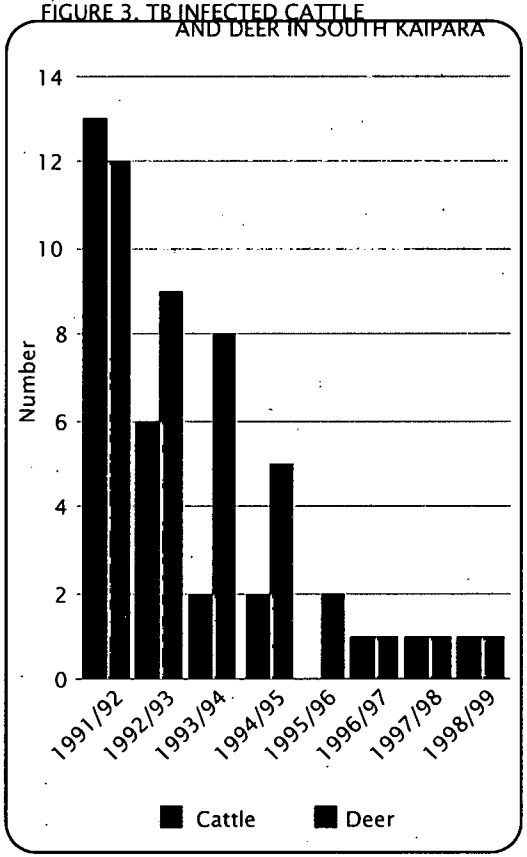
Human health and enjoyment are also being affected by plant pests. Some are poisonous or irritating if touched and others have pollens which aggravate respiratory ailments. Some are also obstructive to recreational activities.

Similarly, none of us want to be stung, bitten, scratched, poisoned, irritated or infected with disease by pest species either.

We can make a difference!

Figure 3 shows the decline in the number of cattle and deer herds within the South Kaipara "vector risk area" which are infected with bovine Tb.

FIGURE 3. TB INFECTED CATTLE AND DEER IN SOUTH KAIPARA



What is the ARC doing?

- Controlling possums, feral goats and mustelids in high conservation value areas.
- Carrying out Animal Health Board pest management contracts.
- Controlling serious plant pest infestations and getting land occupiers to control widespread plant pest species.
- Carrying out a programme of systematic pest surveillance inspections.
- Implementing controls on the sale of 110 plant pest species and the movement of animal pests to the Hauraki Gulf.
- Educating people on the need to control pests and how to go about it.
- Rearing and releasing biological control agents for plant pests.

What can I do?

- Become aware of the pest species and your obligations in regard to controlling them.
- Report sightings of potential new pest species to the Auckland Regional Council — phone ***ENVIROLINE 0800 80 60 40***.
- Control plant pests on your property and replace with friendly alternatives.
- Control animal and insect pests which may be on your land.
- Do not sell or distribute any plant or animal pests.
- Do not dump garden waste or aquatic plants — take them to an authorised refuse collection/ disposal site.
- Do not release any animals into the wild.
- Be aware of cattle and deer movement restrictions — contact the Auckland Regional Council or the Animal Health Board.

Issue:

Earthworks

The development of land for new urban areas and associated infrastructure involves the disturbance of land to form desirable contours.

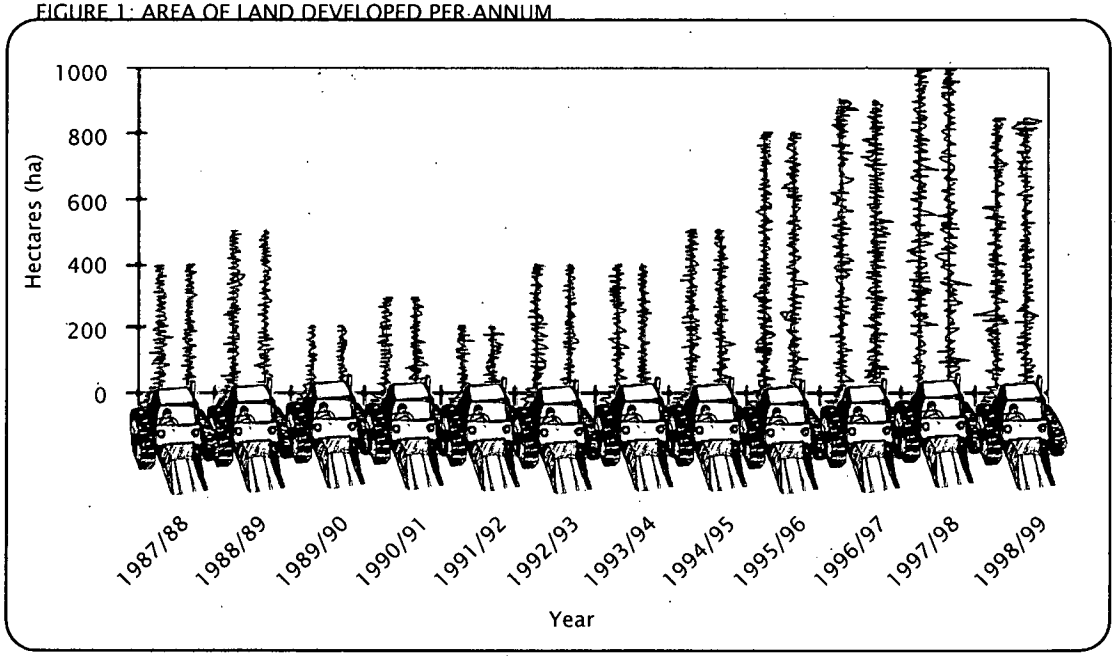
What is happening?

Despite a small downturn in 1998/99, the last five years have seen a steady increase in the amount of earthworks undertaken in the Auckland Region. These earthworks are undertaken for a range of reasons centering around industrial, commercial and residential development to keep up with the region's growth. (see ***Urban Growth***)

The 1998/1999 financial year saw a total of approximately 850ha of "bulk" earthworks undertaken in addition to significant streamworks activities. Assuming these have appropriate erosion and sediment control practices in place, the disturbed area equates to approximately 72,000 tonnes of sediment discharged, resulting from runoff during rainfall, into the streams, estuaries and harbours. A similar amount of sediment is retained on earthworks sites by sediment control measures such as sediment retention ponds, and even more earth is protected from eroding in the first place by erosion control measures.

Figure 1 illustrates the amount of large-scale land development over the last 12 years in the Auckland Region.

FIGURE 1: AREA OF LAND DEVELOPED PER ANNUM



How is it happening ?

Following land development, impervious surfaces are created — such as roads, footpaths and roofs. These increase the amount and speed of the flow of rainwater runoff, compared to a natural bush or rural area where much of the rainfall will settle on trees, or soak into the ground. These increased flows can lead to potential downstream flooding and streambank erosion problems.

Urban stormwater typically carries a range of contaminants such as suspended solids, heavy metals, polynuclear aromatic hydrocarbons and bacteria which reduce the overall water quality of receiving environments such as groundwater, surface water and marine areas. (see ***Groundwater, Surface Water***, and ***Coastal Waters***)

Population increases ultimately lead to more land being required for residential areas, businesses and roading systems.

The process of construction of these areas involves numerous stages. Firstly, bulk earthworks, where land is subject to major earthworks to achieve desirable land contours which are suitable for subdivisions. Small site establishment then occurs, involving small earthworks operations such as individual house site construction. Cumulatively, these processes expose large areas of land.

Why is it important?

Sediment discharges to our streams, estuaries and harbours in the Auckland Region are shown to have an adverse effect on both freshwater systems and the eventual estuarine and marine environments. Effects range from lethal through to impacts on the food chain, smothering of stream bottoms and habitat areas.

There may also be aesthetic impacts and impacts on downstream water users. Receiving environments such as streams, estuaries and harbours have a range of natural, cultural and economic values. Uncontrolled sediment discharges can destroy these values. The receiving environments may take a very long time to recover.

By protecting streams and undertaking earthworks only where land sensitivity is taken into account, soil resources will be protected and sediment discharges will be minimised. Areas of native vegetation will be enhanced, protecting important ecological areas and steep slopes from long-term future erosion.

Earthworks

What can I do?

- If you see a major sediment discharge call Auckland Regional Council's 24-hour Pollution Hotline (09) 377-3107.
- If you are associated with any land disturbance proposals, ensure you comply with all the requirements. Ask for the ARC Erosion and Sediment Control Guidelines and comply with them. Install and maintain all erosion and sediment controls necessary to protect downstream environments.
- If in any doubt talk to the Auckland Regional Council about impacts, solutions and options that may exist.

What is the ARC doing?

- Regulating and Enforcing — we require, through resource consents, that land development minimises damage to downstream environments. We respond to all complaints.
- Educating development consultants and contractors about the issues and solutions associated with sediment discharge. We run industry training sessions on how to minimise sediment generation and discharge.
- Developing policy and input into a range of statutory and non statutory documents, which often involves working closely with city and district councils.
- Investigating and researching the efficiency of both erosion and sediment controls and gaining a better understanding of the impacts of sediment on receiving environments. Continuing to improve implementation of appropriate controls, including a range of mitigation measures to offset the impacts of sediment discharge.

issue:

Cultural Heritage Sites

Cultural heritage resources are those aspects of both the natural and cultural environment which are associated with past human activity. The cultural heritage of the Auckland Region is unique and is central to individual and community identity.

What is happening?

Auckland has a unique and distinctive physical setting and natural environment, which have attracted human settlement for approximately 1,000 years. Throughout this period the natural environment has been extensively modified by human activities, and thus the natural and cultural resources of the region are inextricably linked. The Auckland Region's heritage is a dynamic resource which changes spatially and over time as natural systems evolve and humans impact on the environment.

The natural and cultural heritage associated with the coastal environment in particular has always been central to creating the sense of place that is Auckland. The entire coastal marine area is overlaid by places of cultural and historic significance to both tangata whenua and Europeans.

The ARC has records of approximately 11,800 historic places and sites recorded in the Auckland Region, the largest percentage of which are archaeological sites. However, an estimated 90 per cent of the Auckland Region has yet to be systematically surveyed and assessed for cultural heritage resources.

Currently we know of:

- over 8,000 recorded archaeological sites;
- 1,000 sites with historic maritime associations within the coastal marine area;
- 1,500 historic buildings and structures of significance to the local and regional community;
- about 500 botanical heritage sites.

Table 1 shows the condition of known archaeological sites in the Auckland Region.

To date there is no comprehensive evaluation of the state of the regions' cultural heritage. We do know that in the Auckland metropolitan area over 50 per cent of pa have been extensively modified or destroyed. In addition, of the original 8,000 ha of stonefield areas, less than 200 ha are still in existence.

TABLE 1: CONDITION OF ARCHAEOLOGICAL SITES[8, 9]

	Intact	Damaged	Destroyed	No Info.	Total
Auckland	635	1,385	183	184	2,387
Franklin	100	624	44	247	1,015
Manukau	282	629	86	111	1,108
North Shore	27	105	24	30	186
Papakura	7	21	6	6	40
Rodney	537	1,989	149	97	2,772
Waitakere	15	432	100	34	581
Total	*1,603*	*5,185*	*592*	*709*	*8,089*

Cultural Heritage Sites

Between 1979 and 1995, 395 archaeological sites within the Auckland region were destroyed or modified (approximately 6 per cent of known sites). Over 40 buildings listed with the New Zealand Historic Places Trust in Wellington as being places of historical and cultural significance have been destroyed in the last 10 years.

How is it happening?

Auckland imposes special pressures on its heritage resources because it is the largest and fastest growing urban area in New Zealand. In particular, much of the cultural heritage of the coastal environment has been modified or destroyed through the gradual and cumulative effects of development. Urban development contributes markedly to the loss of, or damage to, cultural heritage resources. Similarly, rural horticulture and farming practices can incur significant adverse effects upon archaeological sites. Erosion, slumping and natural vegetation re-growth also have significant impacts.

The built heritage of the region is being increasingly valued and adapted for re-use. There are a number of buildings and structures throughout Auckland that are being highlighted for their heritage attributes.

Many significant historic places have been protected by local authorities through purchase and restoration. Most recently, for example, the Warkworth Lime and Cement Works (Rodney District), Falls Hotel, Henderson (Waitakere City), Otuataua Stonefields (Manukau City), the Commemorative Seawall, Devonport restoration (North Shore City), and the Town Hall and Civic Theatre restoration (Auckland City).

Why is this important?

Cultural heritage resources are the products and remnants of people and communities and are valued from many different perspectives. For example, a place or area can be valued for its historical, archaeological, architectural, technological, aesthetic, scientific, spiritual, social or traditional significance.

Cultural heritage is a dynamic resource which changes as natural systems evolve and humans impact upon the environment. It is part of a continuum that extends from the first human occupation of the region to the present and is recorded as a series of migrations, occupations and conquests. It consists of a series of layers that form a cultural grid over the landscape. Cultural heritage can be viewed as a resource of both national and regional significance, yet it can also be local, tribal and personal in scale.

Cultural heritage is important because it is central to individual and community identity, it is unique, it links people and place, it enables better understanding of cultural differences and it promotes the appreciation of both the past and the present and our place in history, and because it has amenity values — aesthetic, cultural, educational and recreational.

What can I do?

- Learn more about the historic places and areas around you.
- Take an interest or get involved with their management through local authorities, historical societies or volunteer programmes.
- Submit on local and regional authorities district and annual plans for the protection and preservation of historic places and areas that are important to you and your community.
- Think of other ways to appropriately utilise heritage places. For example — re-using historic buildings, highlighting their values, instead of knocking them down to build new structures.

What is the ARC doing?

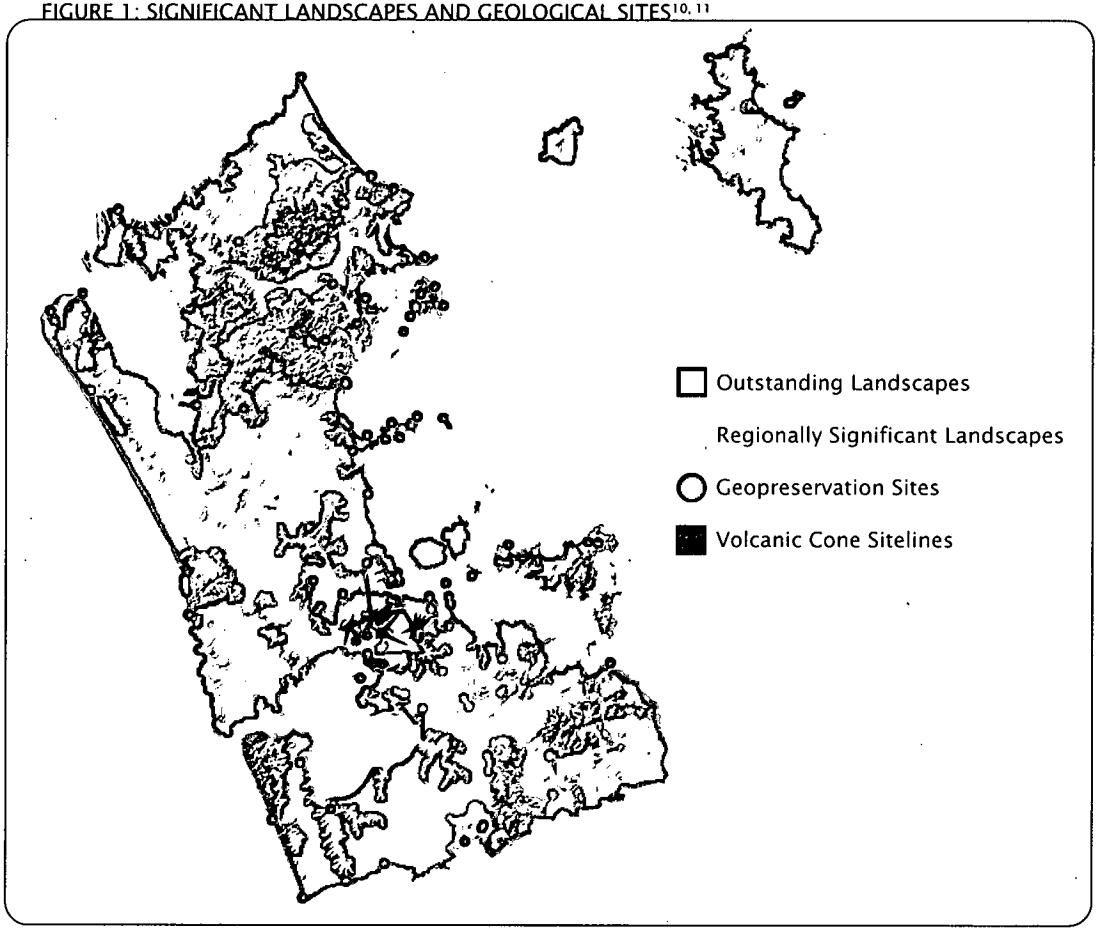
- Researching and monitoring cultural heritage resources in the Auckland region, particularly within the coastal marine area.
- Educating and advocating through the production of posters, leaflets and evaluation guidelines.
- Providing information for, and ongoing development of, the Cultural Heritage Inventory (CHI).
- Protecting and preserving the cultural heritage sites on regional parks and in the coastal marine area where appropriate.
- Working with local authorities to achieve appropriate levels of protection for historic resources of district and regional significance.
- Working with iwi on the conservation of places of Maori significance.
- Increasing the protection of cultural heritage resources through land acquisitions (new regional parks) and financial contributions (for example, Otuataua Stonefields).

The Auckland Region contains a wealth of landscapes, geological features and landforms that are significant for their scientific, educational and aesthetic importance. Landscapes in particular contribute to the identity and character of our region.

Landscapes and Geological Sites

What is happening?

FIGURE 1: SIGNIFICANT LANDSCAPES AND GEOLOGICAL SITES[10, 11]



The presence of attractive features like indigenous vegetation, prominent landforms and combinations of land and water contribute to the value of important landscapes. Usually, a relative absence of human development or structures also contributes to landscape values. However, some of the landscape icons of the region are urban, such as the Auckland Harbour Bridge, Tamaki Drive and the sweep of East Coast beaches. Here the visual appeal arises from a mix of natural and urban features. Landscapes with heritage features are becoming increasingly recognised and valued.

Our important landscapes encompass much of the coast, the islands of the Hauraki Gulf, or the large areas of remaining native forest on the mainland such as the Waitakere and Hunua Ranges. There are also areas of rural land; particularly in Rodney District which form regionally significant landscapes. The coastline is particularly important to the character of the Auckland Region.

Many of the Auckland Region's significant landscapes also include geological features that are noted for their scientific, educational and aesthetic importance. The volcanic cones are perhaps the

How is it happening?

most widely recognised of these. There are many others ranging in size from the active dune fields of South Kaipara Head (which cover hundreds of hectares), to traces of a special volcanic mineral at Brown's Island.

The volcanic cones are visually dominant and impart a character that is distinctively Auckland. Many are prominent icons in the region, such as Rangitoto, Mt Eden or Mt Victoria at Devonport. Many views of the cones are tied into the image of the Auckland urban area.

Nearly 190 of the geological features in the Auckland Region have been identified in the Geopreservation Inventory[11] as 'geopreservation sites' of regional, national or international significance. Many of these are little-known geological marvels that most people never notice. These sites are indicated in Figure 1. Such features form part of the geological record that helps us to understand the events and changes that have shaped the land in the past, and the risks, such as volcanic eruptions, that may face us in future.

Threats to geological and landscape features include quarrying, land development, structures and activities such as road construction. Parts of both Mt Wellington and Mt Roskill are presently within designated road corridors and are potentially threatened by earthworks. Natural erosion also affects some features, while others are threatened by recreational overuse.

While many of the geological features and landscapes are at least partly protected in regional parks, DoC land and local reserves, others have little or no protection. An unknown number on private property have some protection from covenants, while others have limited protection from regional and district planning rules. The Auckland Regional Policy Statement identifies 47 significant geological sites.

The unique landscape areas which contribute to the character and identity of the Auckland Region are becoming fewer. Development results in more and more landscapes looking the same.

The increasing uniformity in the region's landscapes is the result of the expansion of urban and coastal settlements into rural areas and increasing rural residential subdivision — particularly along our coastlines. Rural residential subdivision has resulted in increasing densities of houses in some rural and coastal locations, while in other areas there are houses where previously the landscape was characterised by an absence of built structures. Changes in rural activities have reduced pastoral farming, with its more open landscape character, and lead towards more intensive and enclosed landscapes associated with horticulture, viticulture and the spread of commercial forestry.

Significant geological features are threatened by general development pressures, but quarrying poses a more direct threat to many of these sites. Used in construction and road-making, much of this rock comes from landforms such as south Auckland volcanoes. As Auckland grows, and sources close to the city are used up, significant geological features further afield are coming under threat of quarrying.

Landscapes and Geological Sites

In reserves, threats to geological features include erosion through over use (for example, by mountain bikes and pedestrians) and conflicting management requirements.

Natural erosion threatens some landscape and geologically significant features, while in other cases natural processes of erosion and accretion are an integral part of the interest of the landform, as at the Whatipu coastal flats, and Whakatiwai gravel ridges. Ironically, coastal landscape and geological features around Auckland are commonly damaged by artificial structures erected to reduce coastal erosion.

Why is this important?

People identify with, and are inspired by, the prominent landforms in their area such as Auckland's volcanoes, the Pukekohe East explosion crater, East Coast headlands and beaches, and Waitakere's wild west coast cliffs. Maori especially have a long association with the region's landforms. Many of the region's maunga and other places of cultural significance are also significant geological features.

Significant geological features have scientific, educational and scenic values. They tell us about the origins of the land, it's geological history and the potential future changes we can expect such as sea level changes, future volcanic activity and the risk of erosion or mass land movement. Geological features and landforms are an important part of the region's natural character — they're part of what makes the region's landscape attractive and distinctive.

Landscape change is often viewed as a matter of personal perception. Urban expansion, rural residential development and changes in rural land uses can be undertaken in ways and in locations which work with, rather than against the landscape.

What can I do?

- Find out more about the important landscape values and geological sites in your area or even on your own land.
- Take an interest or get involved in their management. Have your say when local authorities are developing district and regional plans. Tell your council about areas which you think are important landscapes that need protection.
- Be aware of the threats that your activities pose to geopreservation sites and landscape values. Use professional advice on appropriate building design and location when developing in visually sensitive areas.
- If you or your business is a user of rock materials, consider the source and ways to reduce your usage. Some sources are less significant or sensitive to damage than others.

What is the ARC doing?

- Developing policy for the identification and protection of important landscapes and significant geological features (Regional Policy Statement and Regional Plan: Coastal).
- Preserving important landscape features in the Regional Parks Estate.
- Monitoring the state of geopreservation sites in partnership with city and district councils.
- Undertaking a review of significant volcanic cone sightlines in partnership with city and district councils.
- Providing information and educational material to interested parties.

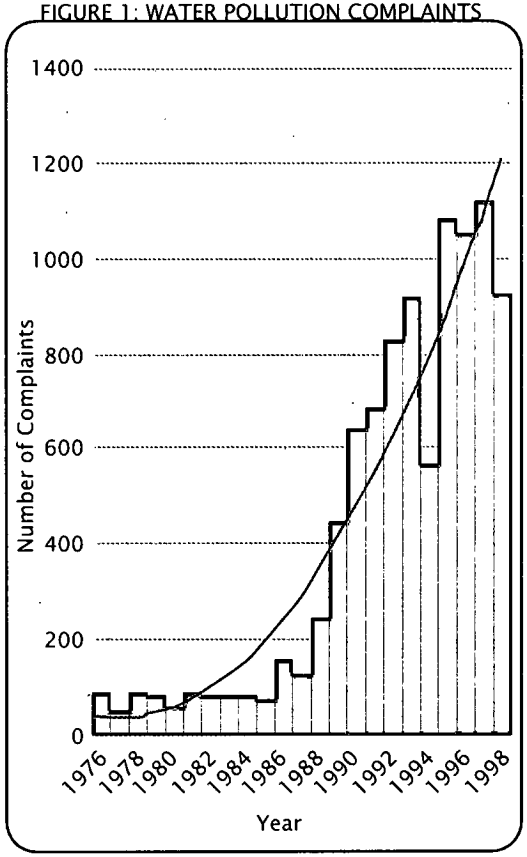
issue:

When pollution enters the water, it can affect overall water quality, the health of the organisms which live there, and human health and enjoyment.

Water Pollution Events

What is happening?

FIGURE 1: WATER POLLUTION COMPLAINTS



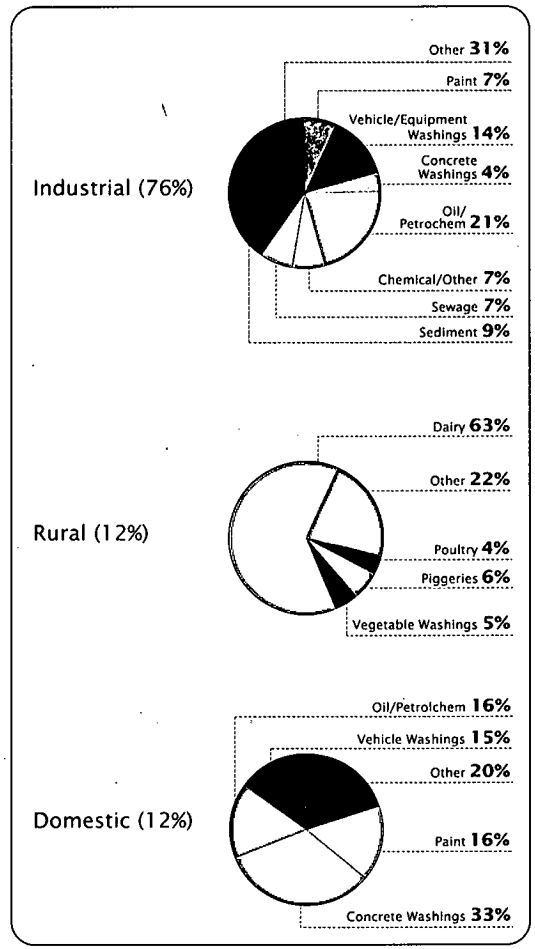
A seemingly inevitable consequence of land development and use throughout history has been the inappropriate disposal of the waste materials generated by people. The Auckland Regional Council has pursued a primarily reactive pollution control programme for more than 20 years, dealing with discharges of waste materials to land and water.

The numbers of complaints received annually by the council has risen steadily from several hundred in the late 70s and early 80s to around 1,000 by 1998.

It is likely that this increase reflects greater awareness of environmental issues and knowledge about ARC services, rather than an increasing disregard for the environment.

How is it happening?

FIGURES 2, 3, AND 4: POLLUTION EVENT SOURCES



Why is this important?

Most people view "waste discharges" as being something which comes from industrial or commercial sources rather than derived from households.

But around 12 per cent of all the complaints received by the ARC have domestic origins. Of these, the most common categories a re vehicle washing, waste oil, concrete wastes, cleaning chemicals and paint.

The predominant reason for pollution problems occurring in the domestic context is lack of understanding of the consequences of what are apparently harmless activities.

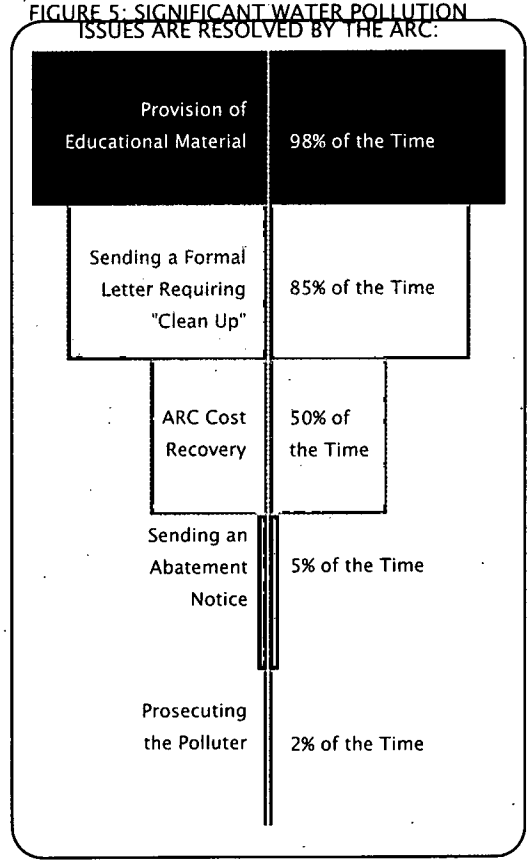
In rural areas complaints generally relate to intensive agricultural activities — predominantly dairy, piggery and poultry wastes and vegetable wash water.

Complaints about industrial or commercial activities reveal that discharges of petrochemical products and washing of vehicles, equipment or materials into the stormwater system are the main problems.

Everyone has a duty to ensure that our own activities (or those of people working for us) do not lead to waste discharges to the environment. Even seemingly harmless actions can cause environmental damage. Remember, even small stormwater drains eventually end up in natural streams, estuaries, and harbours.

The ARC relies heavily on the public to be our eyes and ears and noses, with regard to notifying us of pollution events. It is very important that everyone reports pollution events as soon as possible to the ARC's Water Pollution Hotline. The sooner we get the call the more likely we can prevent, or at least minimise, environmental damage, start the clean-up operation and identify the responsible parties.

FIGURE 5: SIGNIFICANT WATER POLLUTION ISSUES ARE RESOLVED BY THE ARC:



Water Pollution Events

What can I do?

- Make sure that you aren't responsible for contaminants such as paint, oil, detergents and grass clippings entering drains or water courses.
- Report any spills or water quality problems to the ***ARC Water Pollution Hotline on (09) 377-3107.***
- Adopt your local stream and get a care group set up to act as minders for the stream.

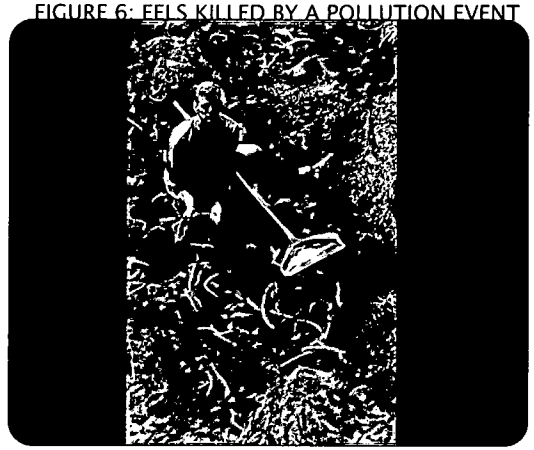
What is the ARC doing?

- Operating a 24-hour pollution response service (the ARC Water Pollution Hotline).
- Undertaking proactive site investigations to detect potential and actual pollution problems.
- Undertaking target catchment surveys of proven problem areas and area blitzes.
- Running Target Industry Projects which concentrate on particular industries that have potential to illegally discharge contaminants in to our water courses.
- Educating about the effects of various pollutants on the environment through the provision of general and specific information.
- We prosecute offenders as a last resort.

All site investigations, whether resulting from a complaint or initiated as part of the Council's proactive programmes, are dealt with in the same way, as is illustrated in Figure 5.

Higher levels of water pollution response by the ARC are initiated as a result of the severity of the pollution event, the attitude and past history of the culprit, and the amount of ARC time required to resolve the situation.

FIGURE 6: EELS KILLED BY A POLLUTION EVENT



issue:

Groundwater

Groundwater is contained in rock formations called aquifers located below the ground surface. High-quality ground water is in short supply and vulnerable to pollution in both the city and countryside.

What is happening?

The Auckland Region is short of fresh water. Our geography and complex geology mean that surface water stream catchments and groundwater resources are generally small. Some locations on the Auckland Isthmus and in Franklin have good groundwater supplies though. With less access to surface water, groundwater becomes the alternative. Though the total volume allocated is less, there are approximately three times as many resource consents issued by the ARC to take groundwater than to take surface water.

Aquifers are essentially a storage facility which captures rainwater and releases it as springs or when accessed with bores. This water is used for many purposes, from drinking water in both cities and rural towns, to providing essential supplies to industry and horticulture. The variety of uses and their respective proportion of the total groundwater allocation within the Auckland region is presented as a pie chart in Figure 1.

Aquifers are susceptible to over-pumping where demand for water exceeds availability. Water levels in aquifers fluctuate seasonally, mainly in response to changes in rainfall. They are also affected by the pumping of water from bores.

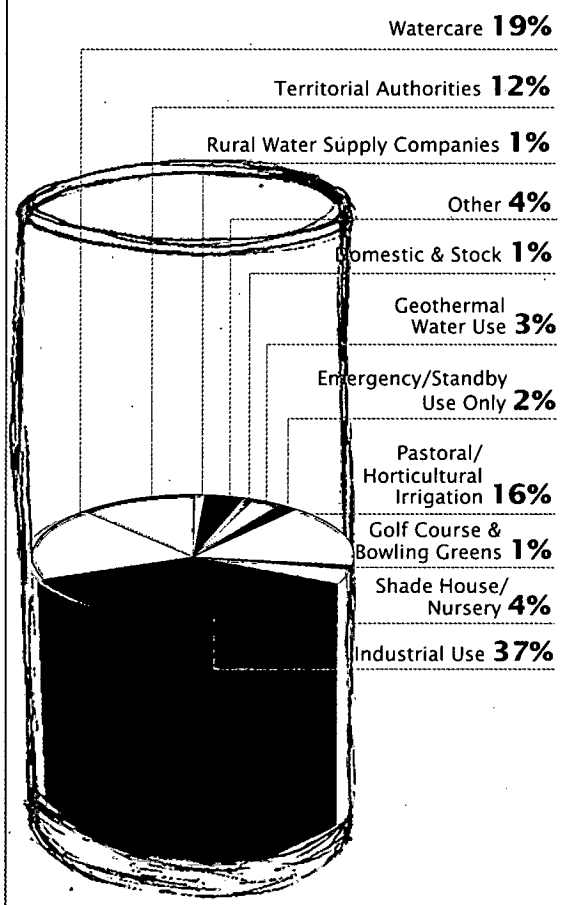
This seasonal fluctuation is illustrated in Figure 2, which features the water level record from a bore in the Pukekohe volcanic aquifer. The water level peaks are the result of winter rainfall replenishment, and should not decline in the long term if the aquifer is used in a sustainable way. The sustainable quantity of groundwater which can be taken from an aquifer is termed its availability.

In the short term, low rainfall periods can cause dramatic effects as is seen in 1993/94.

Groundwater availability for new users is limited in the following locations, as noted in Figure 3:

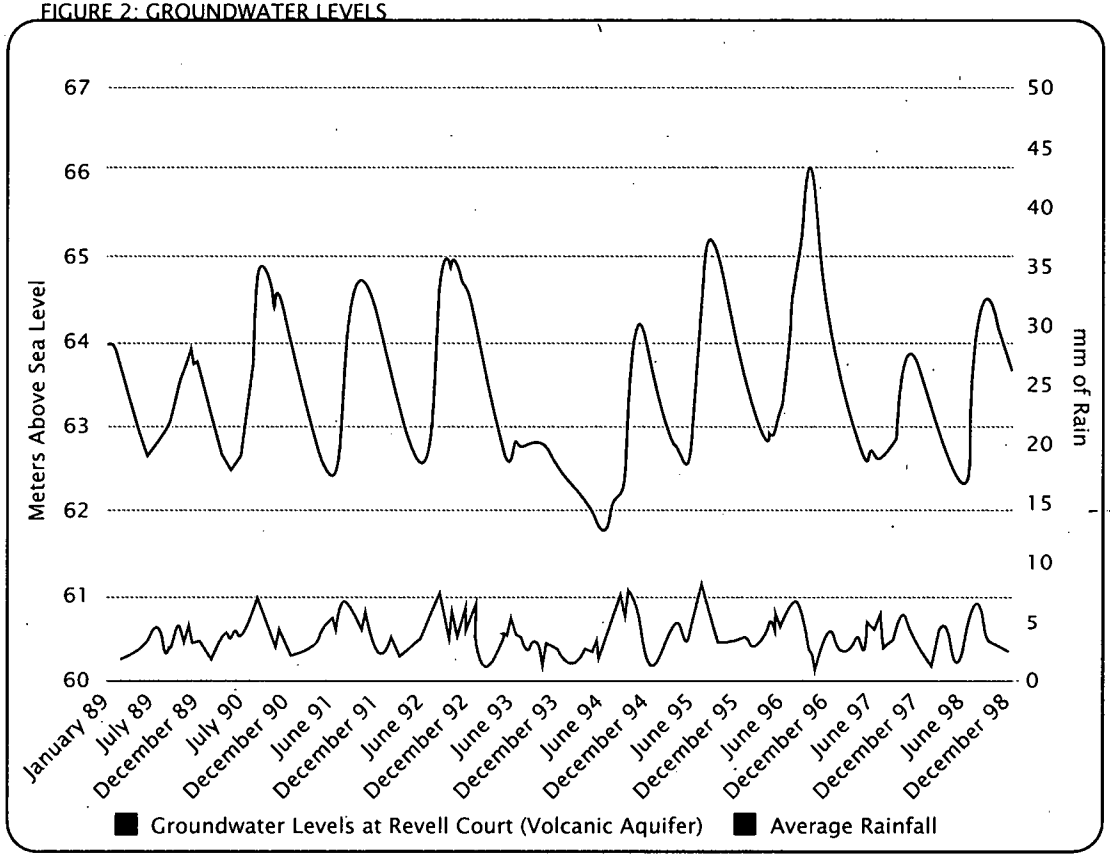
- ***Auckland Isthmus/Onehunga:*** urban water supply
- ***Pukekohe:*** irrigation for market gardening
- ***Waiwera/Parakai:*** thermal water for recreation
- ***Kumeu/Riverhead***: irrigation for horticulture
- ***Omaha:*** both horticultural irrigation and residential supply
- ***Drury:*** horticultural irrigation

FIGURE 1: USE OF GROUNDWATER



Groundwater

FIGURE 2: GROUNDWATER LEVELS



As groundwater moves through an aquifer it dissolves minerals from the surrounding rock. The chemistry of the groundwater varies naturally, depending on the water, age and depth in the aquifer, and on the type of rock that the aquifer is composed of. In Franklin District for example, spring water from shallow volcanic aquifers has a much lower total concentration of dissolved minerals than groundwater from 300m deep sandstone aquifer bores in Karaka. Typical chemical analyses of some representative groundwaters are presented in Table 1.

Compared to the Kaawa formation shell aquifer water, groundwater from the shallow volcanic aquifer has low (more acidic) pH, and higher nitrate derived from fertiliser application. Groundwater from the deep sandstone aquifer on the other hand has high pH (less acidic), very low calcium and magnesium (low hardness) and low silica.

FIGURE 3: GROUNDWATER AVAILABILITY

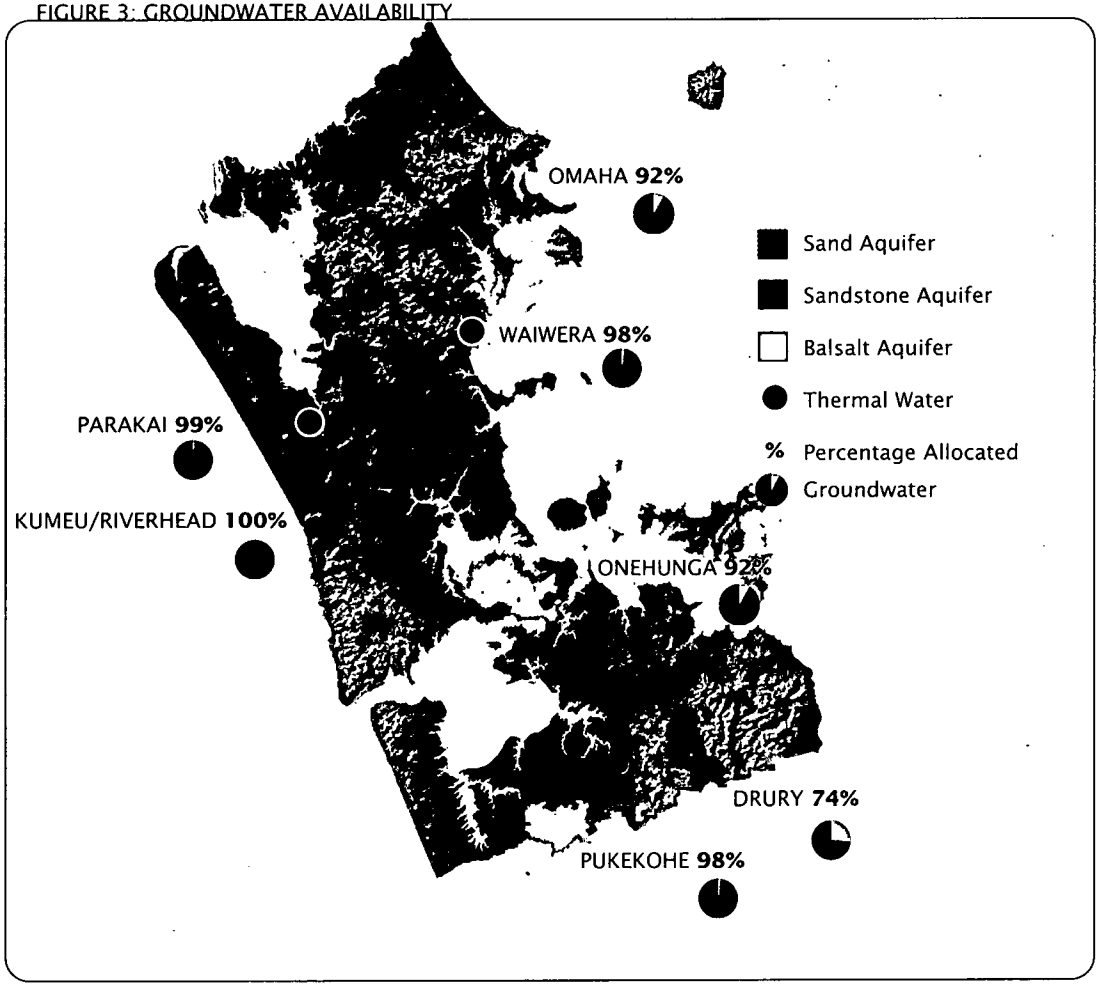


TABLE 1: CHEMICAL COMPOSITION OF GROUNDWATER

Aquifer	Kaawa Shell	Shallow Volcanic	Deep Sandstone
pH	8.0	6.4	9.0
Potassium	4.0	1.4	2.5
Sodium	29.0	24.4	168.0
Calcium	32.0	5.4	2.2
Magnesium	7.0	6.5	0.7
Bicarbonate	165.0	33.0	434.0
Chloride	27.0	40.0	21.0
Sulphate	3.2	4.0	0
Silica	52.0	30.0	11.7
Nitrate	0	4.0	0

Note: concentrations in parts per million.

Groundwater

How is it happening?

High concentrations of sodium and boron which occur naturally in some deep sandstone bores can be toxic to sensitive plants. Groundwater with a low pH can be corrosive to plumbing while groundwater high in iron (usually associated with shallow bores) can leave staining and clog irrigation nozzles.

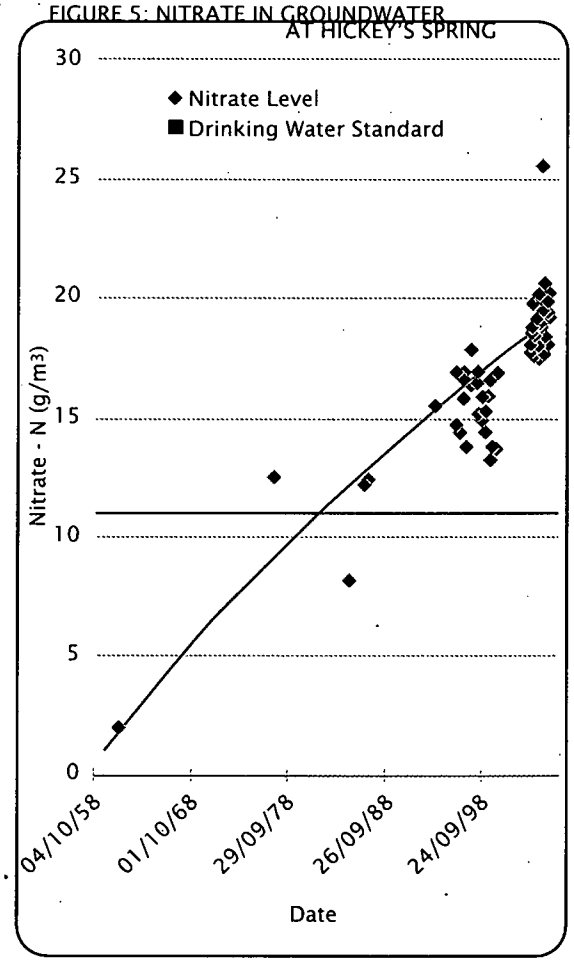
Human activities can also lead to adverse effects on groundwater quality. Figure 4 illustrates the main aquifers in which ground water quality has been impacted by rural or urban activities, as well as those about which little is known or which are presently unimpacted. Many of our modern land uses deposit substances onto the land which are subsequently washed into groundwater aquifers.

Each aquifer is different in terms of its size and the amount of water it can provide. The volcanic rock aquifers of Pukekohe, for example, hold large quantities of water and can release it to bores at relatively high rates.

The Kaawa Formation aquifer, also in Franklin District, is similar in its capacity to supply water, while groundwater from the volcanic aquifers of the Auckland Isthmus will soon supply 20 per cent of Auckland's daily drinking water. Other areas are not so lucky, with the majority of the region underlain by low-yielding sandstone rocks. Areas like Albany have very low-yielding aquifers.

Only part of the total rainfall which annually replenishes an aquifer is available to be pumped out using bores. Though there are often considerable volumes of water stored in aquifers, pumping out more than the annual rainfall input will cause groundwater levels to decline.

FIGURE 5: NITRATE IN GROUNDWATER AT HICKEY'S SPRING



Why is this important?

In the urban areas of the Auckland Isthmus stormwater disposal to ground soakage and leaching of contaminants from contaminated sites are the main sources of pollutants. Typical contaminants in urban stormwater are heavy metals and hydrocarbons which also make their way into groundwater aquifers (see ***Earthworks***). Key pollutants which have been found in groundwater downstream of contaminated sites include metals, nutrients and organic compounds.

In rural areas agrichemicals and fertilisers are at least partially implicated as sources of contamination of groundwater. Some areas of South Auckland have increasing nitrate levels in groundwater, and exceed the New Zealand Drinking Water Standard[7]. This is illustrated in Figure 5 from samples taken at Pukekohe's Hickey Spring, which is fed directly from groundwater from the volcanic aquifer.

The long-term sustainability of groundwater supplies is essential to water-demanding activities like horticulture, as well as provision of drinking water. Auckland and Pukekohe take municipal supply from aquifers, while Kumeu, Omaha, Franklin and Bombay depend on groundwater to sustain their vibrant horticultural industries.

When supplies become limited, water availability can constrain further development of towns and cities which are dependent on groundwater. Land which could otherwise be productive is of little use for horticulture or industry. Any long-term reductions in groundwater supplies can also reduce stream flows, where aquifers are the source of these streams. In other words, over-pumping an aquifer can effect those who take water from a stream kilometres away.

Quantity and quality can be affected by over-pumping. A proportion of the annual rainfall that recharges aquifers is essentially held in reserve, ensuring an outflow of groundwater is maintained at the coast to prevent sea water being drawn into aquifers. Salt water contaminates aquifers, reducing their value for subsequent use.

Once it has become contaminated by salt water or human pollutants, ground water can take decades to clean itself. Contaminants must be flushed from the aquifer, and this won't always happen. If a certain water quality is required for horticultural or municipal purposes, alternative supplies may be required in the interim. For example, raised levels of nitrates can render the water unsuitable for domestic consumption.

Another often unnoticed effect of groundwater contamination is its potential impact on sensitive environments around the aquifer. Contaminated groundwater discharging into a sensitive stream, estuary or even another aquifer can result in adverse effects on sensitive organisms (such as nitrogen-intolerant aquatic native plants) and a gradual degradation of these environments.

Groundwater

What can I do?

- Know where your water supplies come from and determine if reduced groundwater quality could affect your uses of the water.
- Consider where your wastes (such as car wash water) are going, and determine what impacts you, or your neighbours, could be having on groundwater resources.
- Test the quality of your own groundwater supply. The ARC, Ministry of Health and your testing laboratory can all advise you on what the testing results mean, and whether your water is suitable for your use.
- Practice conservation and efficiency in your use of water.

What is the ARC doing?

- Determining sustainable groundwater availability from aquifers.
- Monitoring the quantity and quality of groundwater in aquifers.

  Investigating when actual or potential groundwater effects are identified.
- Applying the Urban and Rural Pollution Abatement Programmes, which aim to prevent groundwater contamination.
- Educating as to where aquifers are, how they may be (or already have become) contaminated, and means of protecting groundwater quality and preserving groundwater quantity for everyone's benefit.
- Promoting water conservation.
- Allocating groundwater at a level which is both appropriate for the activity to operate efficiently and within the availability for the aquifer. Allocation guidelines are developed from metered water use records and scientific data on water requirements for particular uses.

Issue:

Surface Water

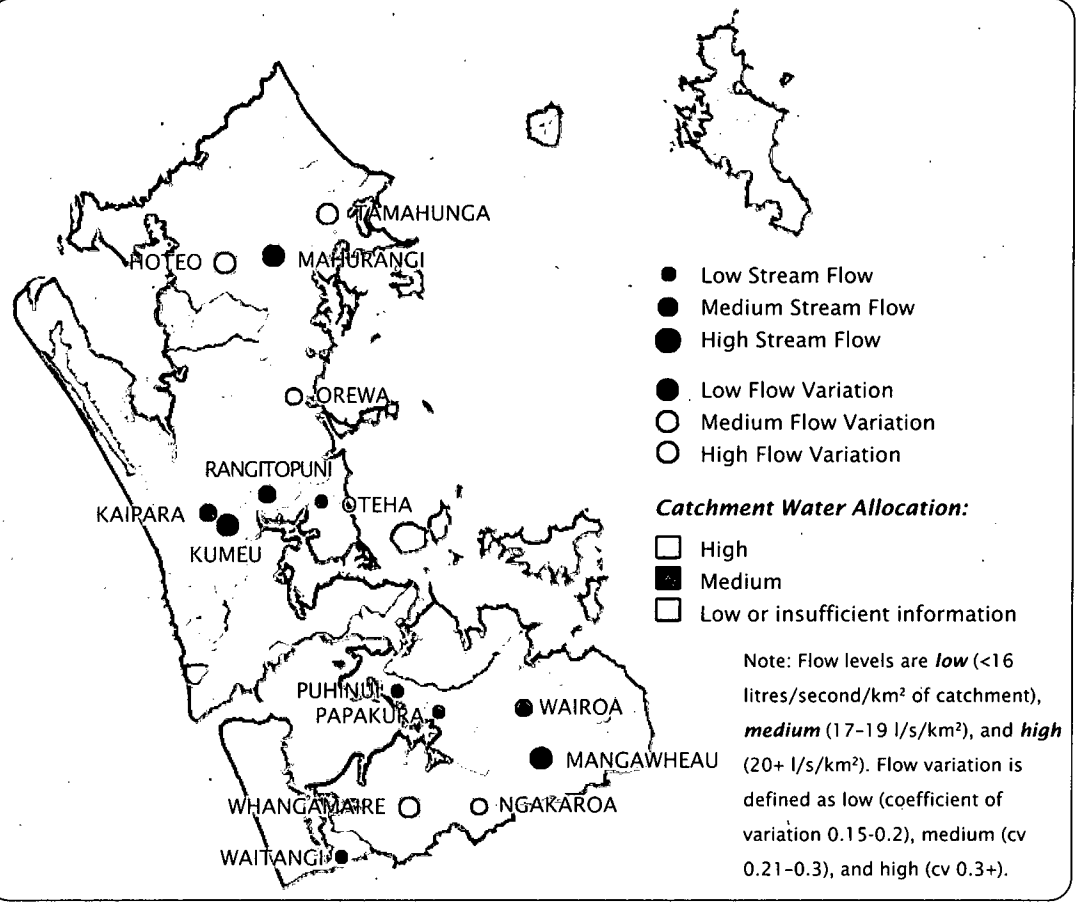
Adequate flows of good quality surface waters are critical to sustain rich freshwater ecologies. They directly affect a range of social, economic, and cultural values.

What is happening?

Figure 1 illustrates the level and variability of flows in rivers at various sites around the region. The amount of water in streams and rivers varies in response to climate, topography, land use and geology. In addition to these natural influences, surface water levels vary in response to water use. Unfortunately, the greatest demand for surface water resources often occurs during the period of least availability or lowest annual flows, resulting in dams or storage reservoirs becoming a common feature of rural areas to meet summer water demand.

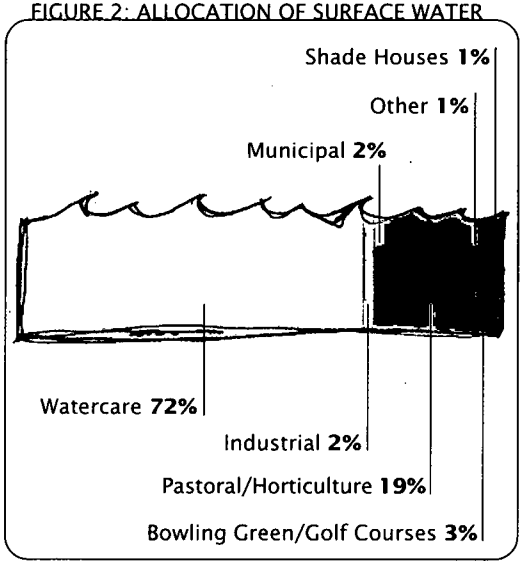
The use, damming and diversion of surface waters, whilst having many economic benefits, can adversely affect streams, lakes and wetlands, particularly during dry periods.

FIGURE 1: SURFACE FRESHWATER FLOWS IN THE AUCKLAND REGION



Surface Water

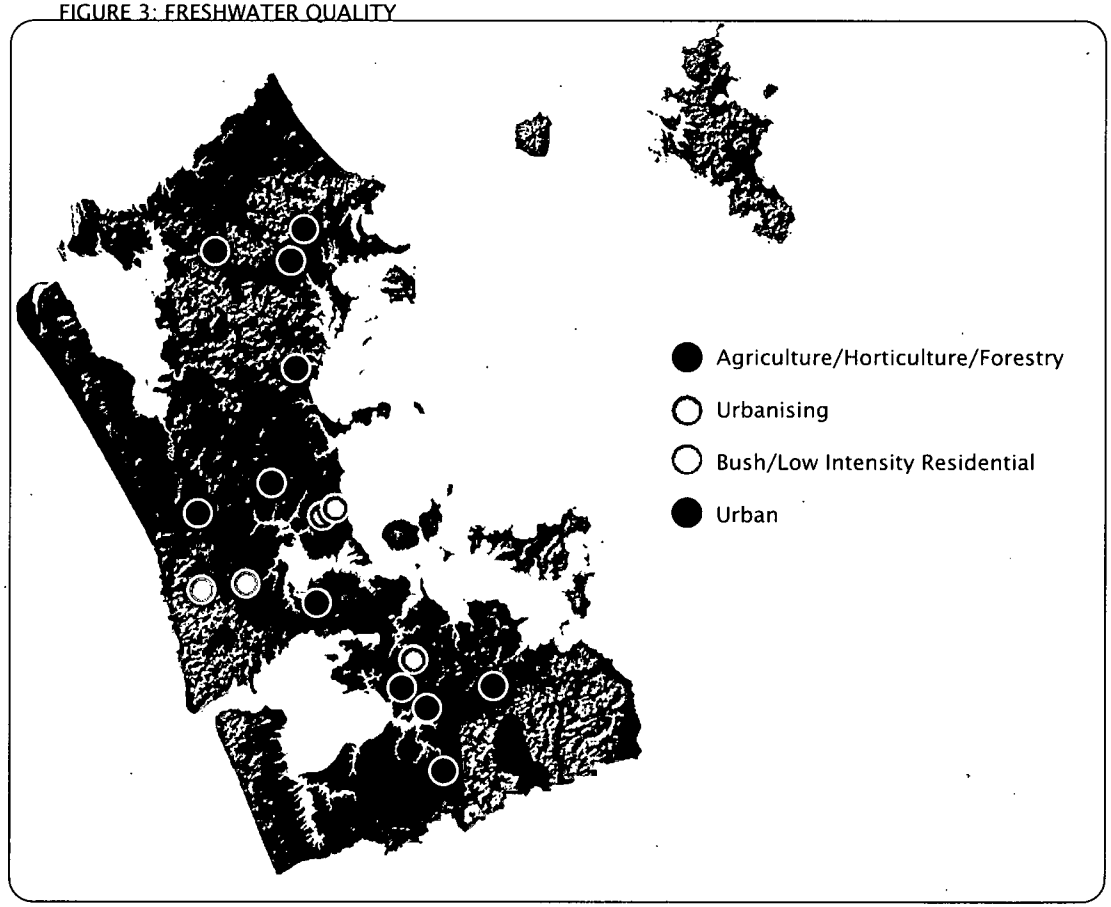
FIGURE 2: ALLOCATION OF SURFACE WATER



Our use of land has effects on the quality of water in streams and rivers. Figure 3 illustrates the effects of land uses on the surface water quality at monitored sites across the region.

Up to 13 years of monitoring data at stream sites throughout the region tells us that the quality of our stream waters are generally good. There are some notable exceptions in the urban, peri-urban and rural areas.

FIGURE 3: FRESHWATER QUALITY



How is it happening?

The stream sites illustrated in Figure 3 have been chosen to be representative of particular land use types, and the water quality in turn shows the effects of these land uses. The data provides a benchmark by which we can compare the water quality from similarly developed catchments. This data also allows us to make sensible conclusions about the:

- range of water quality which can be expected from particular land uses
- seasonal patterns where they exist
- trends of improvement or degradation over time
- effects on water quality from pollution events
- the effectiveness of the ARCs water quality protection activities and policies.

The data provides an essential link between the causes of water quality degradation and its effects. The contaminants of concern and the levels at which they occur vary between the rural, peri-urban and urban land use types.

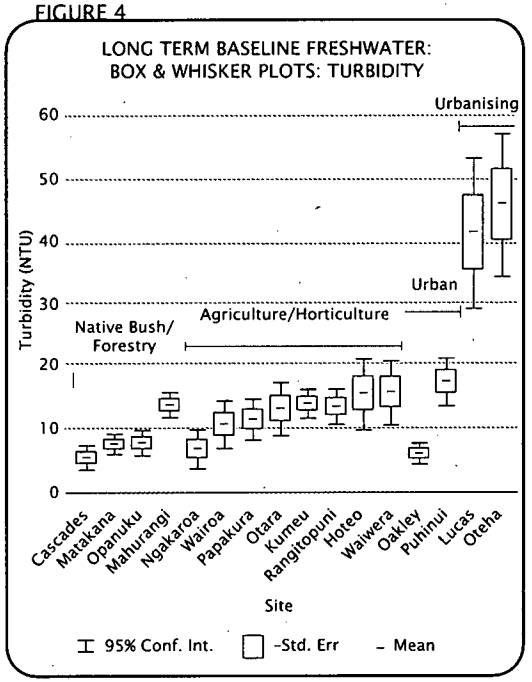
The greatest demand for surface water is from urban land uses, although horticultural use in areas such as South Auckland, Kaipara and the Hoteo is also significant. A trend in recent years has been for large allocation from surface (and groundwater) irrigation, related to dairy farming and for golf courses.

The extensive construction of small dams in peri-urban and rural catchments is considered to have significantly altered the flows of streams. For example, over 600 dams were identified in a recent survey of the Kaipara catchment.

The Hunua and Waitakere Ranges, areas of relatively high water yield, stand out in Figure 1 as being highly utilised for supply to the Auckland metropolitan area. On average 317,900 cubic metres of water is supplied to Auckland each day and 116 million cubic metres/annum from water supply dams in these catchments. Water demand source planning by Watercare Services suggests demand will increase to 400,000 cubic metres per day in 10 years.

The variety of uses and proportions of that use is presented in Figure 2. Pressures on surface water resources are arising from high growth in urban areas and an intensification of use for agriculture in peri-urban areas. Land use change can also affect the flow regime in streams by changing the vegetation type or by developing large areas for urbanisation. These effects are often further confounded by climate variations.

FIGURE 4



Surface Water

Surface water quality is similarly affected by land uses in the catchment. The impacts attributable to such land uses and the likely causes can be summarised as follows:

1. **The urbanisation process** (see *Earthworks*) leads to large areas of disturbed soil due to earthworks. Despite current sediment control strategies, catchments where development is occurring have markedly poorer water clarity as indicated by high levels of suspended solids, turbidity and low black disk transparency (a measure of visual water clarity).
2. **Land development for rural or urban purposes** has often led to removal of riparian vegetation around stream margins. Those catchments which have retained substantial areas of native or exotic vegetation shading the stream have cooler water temperatures. Lower stream temperatures are also generally linked to high levels of dissolved oxygen vital to the wellbeing of aquatic organisms which rely upon the water for oxygen transfer (such as breathing).
3. **Rural land uses such as intensive stock farming and horticulture** result in considerably higher nutrient levels, particularly nitrate. This can also happen in urbanised catchments where failure of sewage infrastructure leads to elevated nutrients.
4. **Both urban and rural** land uses lead to elevated bacteria.
5. **Urbanised land uses** lead to elevated levels of trace metals, primarily generated in stormwater runoff from impervious surfaces such as roads. Industrial and commercial areas have higher contaminant levels than residential catchments.

The monitoring information also reveals patterns over time such as changing temperature, dissolved oxygen, turbidity and nitrate as a result of the changing seasons. Longer-term patterns such as the influence of La Nina and El Nino on water temperature are also evident.

A number of sites exhibit trends of either improving of decreasing water quality, however these tend to be one-off or stepwise changes relating to a specific event, rather than slow changes over time. Exceptions occur in the catchments which are undergoing urbanisation where the transition from greenfields development (and bulk earthworks) through to full urbanisation leads to progressive reduction in water clarity. Once full urbanisation is attained the water clarity generally improves and in fact may surpass rural water quality.

Why is this important?

Surface water is used for municipal drinking water, industrial uses and horticulture. These water bodies also support a wide and diverse ecosystem (see ***Freshwater Ecology***). The various human uses and natural ecosystems depend on adequate quantities of good quality water, which can be adversely affected by over-use, human activity and land use.

What can I do?

- Conserve water.
- Make sure that you don't allow contaminants such as paint, oil, detergents and grass clippings to enter stormwater drains or water courses.
- Report any 'spills' or water quality problems to the ARC Water Pollution Hotline on (09) 377-3107.
- Get involved through the submission process in land use changes that may affect streams and other water bodies in your areas.

What is the ARC doing?

- Monitoring water levels, stream flows and water quality.
- Working with bulk water suppliers (Watercare) and city and district councils to promote water conservation and to reduce water losses from unaccounted sources.
- Developing methods to assess irrigation needs in areas of the region which currently have high allocations.
- Working with the community to develop water management plans.

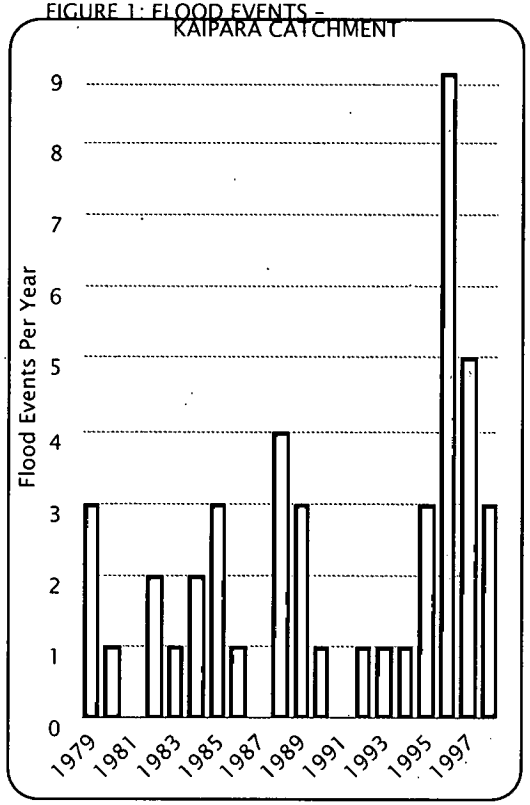
Issue:

Natural Hazards

A variety of natural hazards in the Auckland Region pose threats to human safety and wellbeing, and to the environment.

What is happening?

FIGURE 1: FLOOD EVENTS – KAIPARA CATCHMENT



The most commonly occurring natural hazards in the Auckland Region are flooding and land instability. Less frequent, but potentially more damaging, natural hazards include volcanic eruptions and earthquakes.

Flooding occurs when the amount of rainfall exceeds the capacity of streams and rivers to carry it. When the size of the stream flow is greater than the capacity of the stream banks, out-of-bank flows, or flooding events occur.

Figure 1 illustrates the frequency of out-of-bank flows, or flood events, in the Kaipara catchment. This shows that flood events have tended to happen on an almost annual basis, and appear to have increased in frequency and size recently, possibly as a result of climatic effects or a changing catchment hydrology.

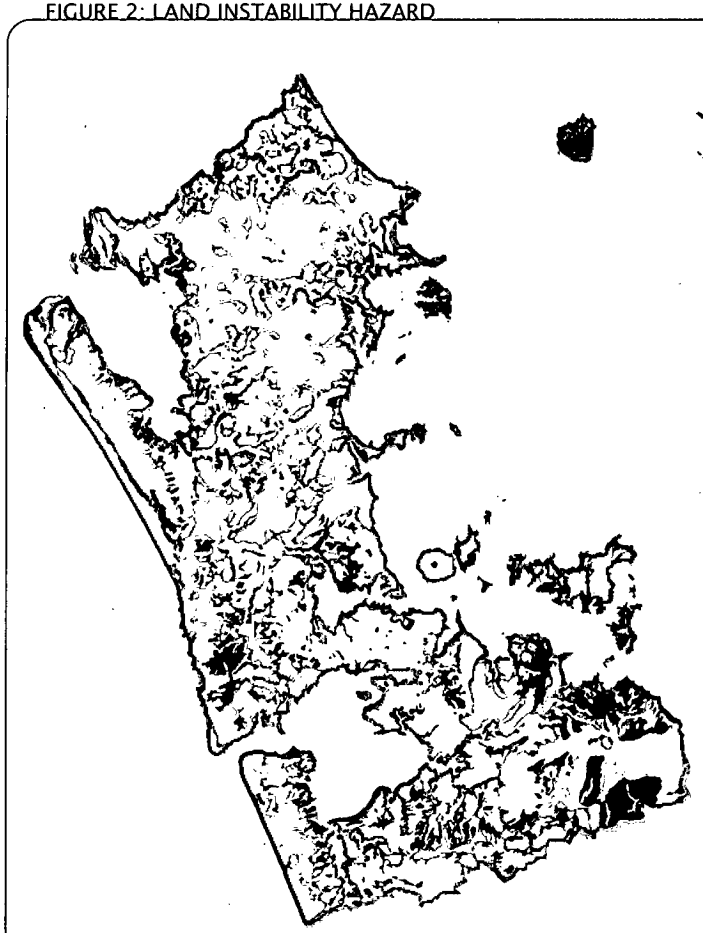
Figure 2 shows the extent to which land instability is a potential hazard for various areas of the Auckland Region.

Much of metropolitan Auckland is built on a recently active volcanic field, although it is unlikely that any of the existing volcanic vents will erupt again. The lack of surface activity in Auckland can lead to the false impression that the field is extinct. However, the hot spot of molten rock deep below the city remains active and it will almost certainly send up more magma some time in the future. When and where that eruption will take place is unknown.

In addition to being at risk from an eruption in the Auckland Volcanic Field, Auckland is vulnerable to eruptions elsewhere in the North Island. An eruption at Mt Ruapehu, Taupo or Mt Taranaki could cause ash deposits from a few millimetres thick to almost one metre thick. In fact, Auckland is more likely to be affected by ash from a distant eruption than from an eruption in the Auckland Volcanic Field. Table 1 shows the relative probabilities of the different events.

The Auckland Region lies in one of the lowest earthquake activity regions of New Zealand. Only one earthquake over the last 150 years (Port Waikato, 1891) is known to have caused significant damage in the Auckland Region. However, 150 years is a short time in geological terms and the possibility of future damaging earthquakes is very real. Figure 3 shows the number of historical earthquakes in or near the region over the last 150 years. Despite low earthquake activity, the

FIGURE 2: LAND INSTABILITY HAZARD



- ○ ***Low Hazard***
- ○ ***Medium Hazard:*** slope will be dependant on local factors such as depth of weathering and degree of saturation
- ● ***High Hazard:*** slopes potentially unstable

Note: This map has been compiled at a regional scale. It is not suitable for site specific assessments.

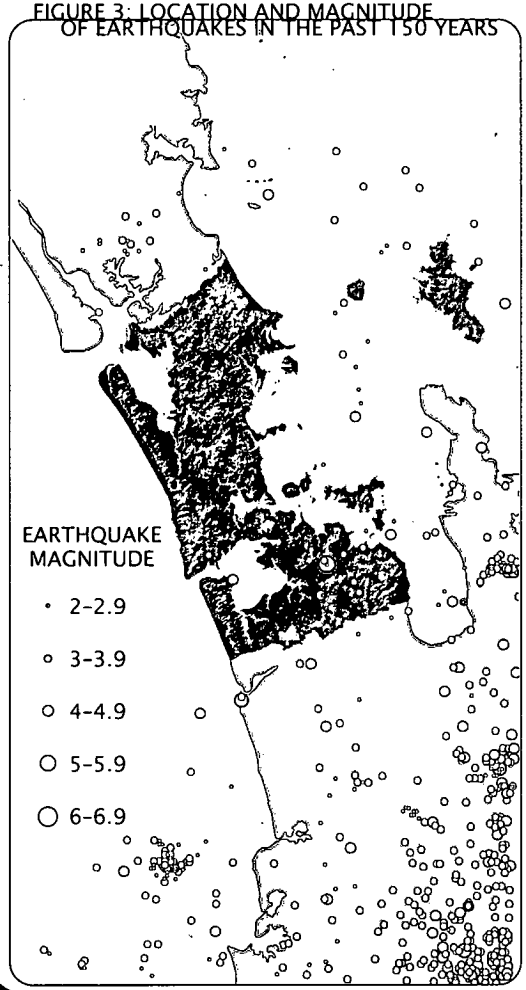
TABLE 1: PROBABILITIES OF VOLCANIC/DAMAGING EARTHQUAKE EVENTS AFFECTING AUCKLAND

Volcanic Event	Return Period (years)	Probability of occurring in the next 50 years
Auckland Volcanic Field	1000	5%
North Island and site cones such as Mt Ruapehu, Mt Taranaki	50-300	15-63%
North Island rhyolite calderas such as Taupo	1000-2000	3-5%
Earthquake	500-2000	3-10%

Natural Hazards

How is it happening?

FIGURE 3: LOCATION AND MAGNITUDE OF EARTHQUAKES IN THE PAST 150 YEARS



earthquake ***risk*** (risk is measured in terms of the consequences and likelihood) for the Auckland Region is relatively high because of its large population and high population density.

The predominant hazard resulting from earthquakes is ground shaking. Locations further away from an earthquake source generally feel a lower level of shaking than locations near the source, while some ground conditions amplify the shaking. Thus different levels of shaking may be felt from the same earthquake within even quite a small area.

In general, rock sites record the lowest levels of shaking during an earthquake. It's usually the combined effect of shaking and associated secondary ground damage that causes the main damage to structures during earthquakes. Buildings, roads and services on soft ground suffer more damage than those on firm rock. In areas such as Orewa, Helensville and near Takanini where sand, silts and estuarine muds make up the soil, ground shaking will be worse. Ground shaking will also be greater on reclaimed land such as parts of downtown Auckland.

Increasing growth and urban development has put more pressure on land previously considered unsuitable for development, such as steep land and land adjacent to streams. The Auckland region is prone to a range of land instability hazards such as slips on steep land, coastal and stream erosion, and weak and swampy ground. The factors that contribute to land instability are many and include the geology (type of soil and rock and degree of weathering), the steepness of the ground, extent of vegetation cover, and degree of saturation (how wet the ground is).

Development usually results in the disruption or removal of the vegetation cover, which in many areas exacerbates instability and accelerates erosion. Vegetation, particularly along stream margins, also plays a key role in slowing down the rate of water entering streams in upper areas of catchments, meaning that lower areas of the catchment are less prone to flooding. The change of the landscape from natural vegetation to rural and urban use, and from trees to grassland and impervious surfaces such as concrete, speeds up and increases the flow of water into streams, making downstream areas more prone to flooding effects.

Why is this important to me?

Twenty-five small local earthquakes have been recorded by the region's seismic monitoring network between December 1994 and December 1998. None of these relate to volcanic activity, but instead are associated with normal stress and strain releases in the earth's crust. The majority of these earthquakes have occurred to the south and east of the region, which reflects where the areas of major faulting are.

As Auckland grows, so to do the effects of earthquakes and volcanic eruptions. While each hazard has its own characteristic effects, they also disrupt lifeline services (for example, power and water supplies) or cause structural damage to buildings. By working to reduce the vulnerability of our communities, we can work towards reducing disruption and damage.

Although land instability doesn't normally result in the large-scale disruption that earthquakes or volcanic eruptions can cause, its consequences can be severe and lead to injury or damage to property. Similarly, flooding events can lead to significant damage to property and danger to human safety.

Even a small, brief volcanic eruption would have a major impact on Auckland. The level of destruction and disruption would depend on the size and location of the eruption, type of activity, warning time, wind direction and preparedness.

We need to collectively work towards reducing our vulnerability to natural hazards by:

- Improving our understanding of the hazard, its consequences, and what we can do to reduce the impacts.
- Public education of the consequences of natural hazards and what to do.
- Developing contingency plans.
- Monitoring these hazards so we can provide an early warning of when and where such hazards might occur.

Reducing risk to hazards is as much an individual responsibility as it is a community one. Everyone needs to take more responsibility for their preparedness if we are to create a community that is resilient to the consequences of hazard events.

Natural Hazards

What can I do?

- Find out more about natural hazards and how they might affect you by contacting ***ENVIRO-LINE*** ph 0800-80-60-40.
- Find out more about what you can do to be better prepared by contacting your Civil Defence advisor on ph 0800-22-22-00, and by familiarising yourself with the information at the back of the Yellow Pages.
- Find out about any other hazards likely to affect you and your property by asking your local council.

What is the ARC doing?

- Continuing to monitor natural hazards in the Auckland Region and increasing our understanding about them to help make decisions about the best ways of reducing risk.
- Working with city and district councils to establish an awareness and education strategy to increase understanding about what to do (Civil Defence Public Education Strategy).
- Continuing to work with lifeline service providers to reduce vulnerability to hazards and improving their response to and recovery from hazard events (Auckland Engineering Lifelines Project).
- Working with district and city councils to improve the way information about hazards is managed (Hazards Guidelines Project).
- Working with district and city councils, emergency services, public health, lifelines and others to improve regional emergency management (Emergency Management Group).
- Applying our knowledge of consequences and community vulnerabilities to other types of hazards, such as technological hazards, so we can effectively manage ***all*** hazards.

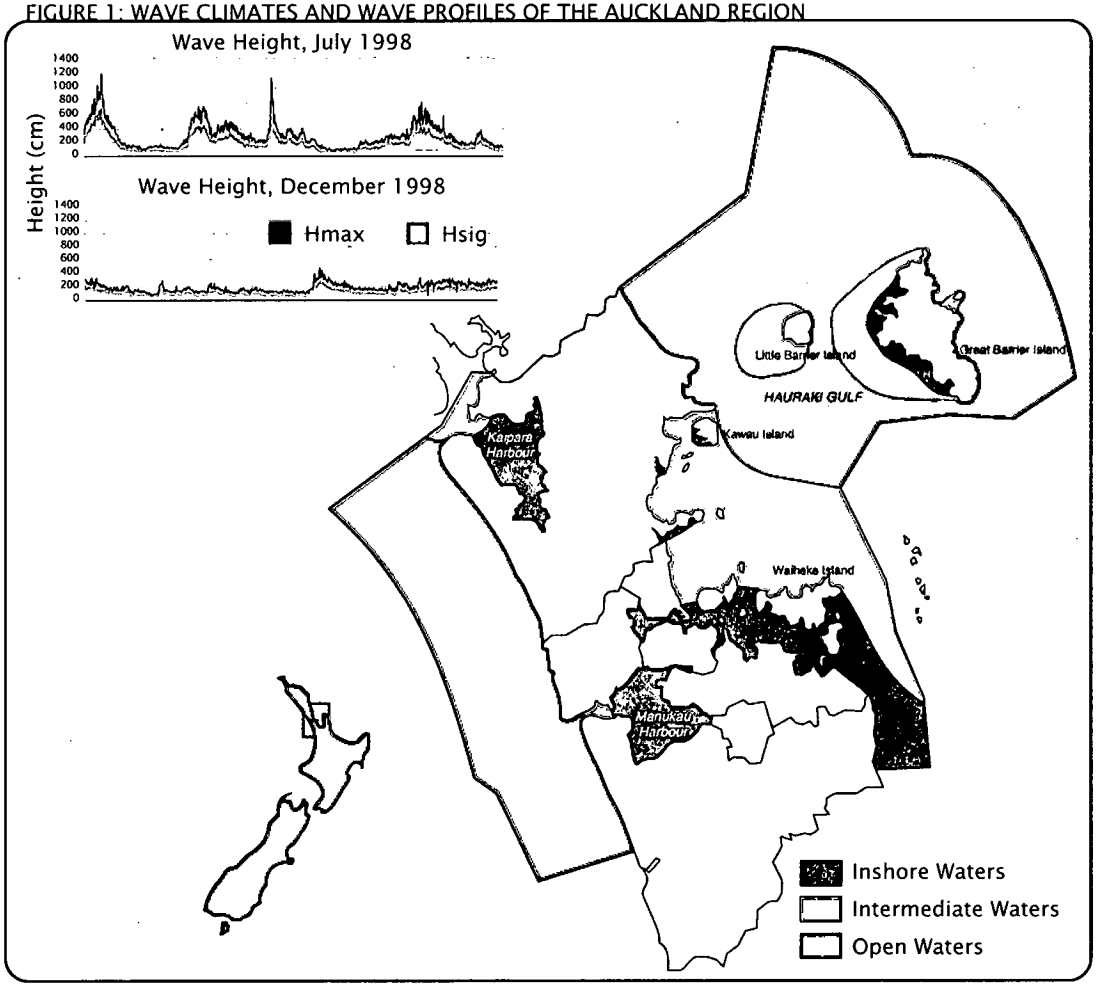
Our Coast and Seas

The endless energy of the sea provides a rhythmic texture to the lives of the people of the Auckland Region.

Issue: Waves and Tides

What is Happening?

FIGURE 1: WAVE CLIMATES AND WAVE PROFILES OF THE AUCKLAND REGION



The east coast of the Auckland Region is a lee-energy coastline, which means it is it is generally sheltered from the predominant west to south-west winds. Wave heights are therefore generally low to moderate in the middle to outer Hauraki Gulf, and low to very low in the inner gulf and harbours. Occasional easterly storms do affect the east coast, and these can produce storm waves in the outer gulf higher than 10m. When these waves reach the shore they can lead to significant coastal erosion and flooding.

The west coast is a high-energy exposed environment where significant wave height averages 2-3m most of the year. The Manukau Harbour provides a more sheltered tidal environment, however the shorelines of the harbour are susceptible to fetch limited waves and storm surges which occur on average 1-2 times per year.

Figure 1 illustrates the various wave environments for the Auckland Region, and wave information for July 1998. Several depressions passed over the region in this period, with particularly severe conditions early in the month when maximum wave heights exceeded 12m, and significant wave heights were 6-7m.

This can be compared to the chart for December 1998. Wave height is very much lower, which is due to lower wind speeds. This is more typical of summer conditions, but this can be affected by El Nino (generally lower winds and wave) and La Nina (generally higher winds and waves) conditions.

Relative to wave processes, tides and currents are less significant, with the exception of storm surges. These cause a rise in water levels due to a reduction in atmospheric pressure (called the 'inverse barometric effect') and movement of water over the continental shelf due to wind. The response of mean sea level to pressure changes is relatively slow, taking about 2-12 hours, while the response to wind stress is faster. From eight years of monitoring, it is estimated that there is a 1 per cent chance (the 1 per cent Annual Exceedence Probability Event) that a storm surge of 3.204m above mean sea level will occur in any given year.

Another type of wave that could affect our coastline is a tsunami, a Japanese word meaning 'harbour wave'. It is commonly used to describe the series of waves formed when the sea floor is disturbed usually due to an earthquake. The events which trigger a tsunami can happen far away, such as the west coast of South America, with the waves travelling almost undetected until they reach land.

Of the 32 recorded tsunami to reach New Zealand between 1840 and 1995, 12 have been detected within Auckland waters. Although information about many of these is sketchy, all were small (less than 2m) and if any damage occurred it would have been very minor. However more extreme events may have happened in the past.

There is about a 50 per cent chance within the next 50 years that Auckland will be affected by a tsunami originating from a large earthquake off the west coast of South America. Wave heights of up to 4m could occur in the outer Hauraki Gulf. This is the most likely damaging tsunami for Auckland. The effects of tsunami can vary along the same coastline depending on the shape of the coast and the water depth, making it difficult to determine what might happen.

An earthquake in the outer Hauraki Gulf or Firth of Thames could generate a larger tsunami but the probability of this occurring in the next 50 years is less than 1 per cent.

Ocean and coastal waves are primarily the result of wind stresses upon the surface of the ocean. In the open ocean they are the result of winds blowing over very large distances. These winds cause chaotic ripples on the water surface, which if given sufficient area of "fetch" to blow over, will form regular wave forms. These open ocean waves are often referred to as "swell". Open water swell affects much of the coast of Auckland, but especially its west coast, and more exposed east coast areas.

The east coast is typical of a drowned river valley system, and is consequently highly variable, indented and complex. Variations occur due to changes in exposure, from the moderate energy beaches of Pakiri, Tawharanui and Omaha, to the sheltered estuaries in inner harbours such as Tamaki Estuary, Upper Waitemata Harbour and the Wairoa.

Waves and Tides

Why is this Important?

In terms of physical coastal processes this leads to great diversity in the levels of wave, tidal and current energies that shape and affect the coast and the rates of coastal erosion and accretion. Consequently, levels and degrees of coastal hazards which inhabitants face are similarly diverse.

In more sheltered situations such as estuaries and harbours, there is less fetch available for the development of swell. In addition, the shallow nature of these areas prevents the waves from developing beyond the typical "chop" which can be seen in the Waitemata or Manukau Harbour most of the time.

Waves are the most important agent of change on the coastal environment of the Auckland Region. Virtually every coastal landform in the region has either been created by waves (such as beaches), or modified by wave processes to a greater or lesser extent (cliffs, shore platforms and other erosional features). (See ***Beach Dynamics)***

Most of our settlements are close to the coast. Therefore there is a degree of hazard to many communities, developments and public resources in the coastal environment.

The pattern and type of development in the Auckland Region has tended to take place within sheltered harbours and estuaries (such as the Waitemata and Manukau) where the direct effect of many coastal hazard processes are less significant. However in these locations, coastal hazards are still present including:

- flooding of low-lying areas during storm surges;
- erosion of cliffs, especially Waitemata sandstone/mudstone cliff faces;
- loss of foreshore sediment due to foreshore structures (seawalls, groynes etc), stormwater disposal, sand extraction, loss of sediment supply and other factors;
- modification and destruction of buffering features such as dunes, coastal vegetation and areas to accommodate short-term fluctuations in shoreline position;
- infilling and reclamation of estuarine areas leading to changed hydraulic and sedimentary conditions which can cause hazards.

Numerical modelling of a selected tsunami event from Chile (Figure 2) shows the variability in wave heights that could be expected on the east coast of the region. Preliminary work indicates that areas likely to be at greatest risk from inundation from distantly generated tsunami are around Omaha, Pakiri, the northern shores of the inner Gulf islands, between Howick and Maraetai, and between Little and Great Barrier islands.

FIGURE 2: SEA LEVELS DURING A TSUNAMI FROM CHILE

(Darker colours indicates maximum levels.)

What Can I do?

- Find out more about what to do in the event of a tsunami or storm surge. Contact your local Civil Defence advisor on ***0800-22-22-00*** and make sure you are familiar with the information in the back of the Yellow Pages.

What is the ARC doing?

- Monitoring to better understand the nature of coastal waves (the Wave Climate Strategy).
- Providing guidance to landowners on how best to manage areas of the coast affected or potentially affected by the influences of waves, tides, storm surges and tsunami (see also ***Beach Dynamics***).
- Working to better understand the likelihood of tsunami, the consequences and areas most likely to be affected.

Issue:

Beach Dynamics

Coastal processes gradually modify the shape of our beaches and coastline.

What is happening?

Several beaches in the Auckland Region have been periodically surveyed to find out what parts of our coastline are prograding (building out towards the sea), eroding (retreating landwards) or are dynamically stable. The beaches surveyed are Rangitira (north Muriwai), Muriwai, Piha, Pakiri, Omaha and Long Bay. Our data illustrates that most of these beaches have been dynamically stable over the period that they have been monitored, though at some sites the beach is prograding and at others it is eroding.

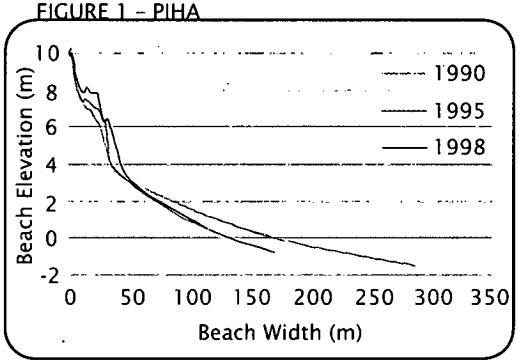
On the West Coast, Rangitira and Piha have been dynamically stable (fluctuated in position and volume, but not significantly built up or eroded) over the surveyed period. This is illustrated in Figure 1, where it can be seen that though beach levels below the 3.5m contour (represents upper beach area for this beach) are highly variable and subject to large fluctuations, in the order of 310-450m³/m of beach, the beach has not significantly prograded or eroded. It can also be seen that above the 3.5m contour the frontal dune is stable.

At Muriwai, there is a net trend of erosion. Figure 2 illustrates this, where it can be seen that the upper dune area (7.5m contour) has eroded by approximately 20m since 1981, and the upper beach area (3.5m contour) by 25m.

The east coast beaches have generally been dynamically stable over the surveyed period, with much larger fluctuations in the position of the shoreline and sand storage in the foredune and beach at the more exposed Pakiri Beach compared to Omaha and Long Bay respectively. Figures 3 and 4 illustrate this trend. In Figure 3 it can be seen that an initial erosion trend (between 1965 and 1978) was followed by a period of accretion, and Figure 4 illustrates upper beach accretion with a dynamically stable lower beach area.

Much of our cliffed coastline is retreating, with erosion rates for the Waitemata Harbour and Hauraki Gulf varying between 0.04-0.35m/yr[1]. Mean erosion rates are highest in the open coastal environments and lowest in the more sheltered areas.

FIGURE 1 - PIHA



How is this happening?

Fluctuations in the position of the coastline (advance, retreat or dynamic equilibrium) and the volume of sand stored in beaches is a normal and expected process on all parts of the region's coastline. While human activities and natural processes shape our coastline (with varying intensity and duration), it is waves and currents which mostly cause change on our beaches (see ***Waves and Tides***) and winds which build our sand dunes.

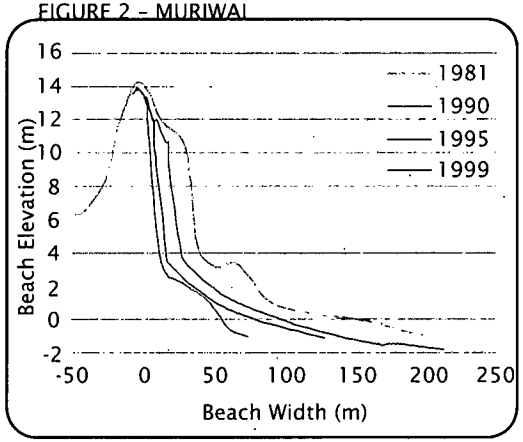
Beaches adjust their profiles to most efficiently dissipate incoming wave energy. This is best seen during and after storms. Strong winds generate high, steep waves which frequently result in the seaward transport of beach material to an area where the reduced water velocities allow sediment to settle. Following a storm, with relatively lower wave energy, waves move sand from offshore back to the beach. The winds may then dry and transport the sand landwards to rebuild the foredune.

Generally the rebuilding process takes much longer than storm-related erosion, and sometimes the beach does not have sufficient time to rebuild between storms. Sometimes full recovery of the beach does not occur because the eroded sand has been lost from that part of the beach system.

Why is this important?

Beaches and the coastal environment are a key component of the Auckland Region and play a major part in how people spend and enjoy their recreation time. Erosion and accretion processes gradually modify the shape and contours of the coastal environment. Where human property is placed in these dynamic areas there is the potential for property to be damaged and human safety to be put at risk.

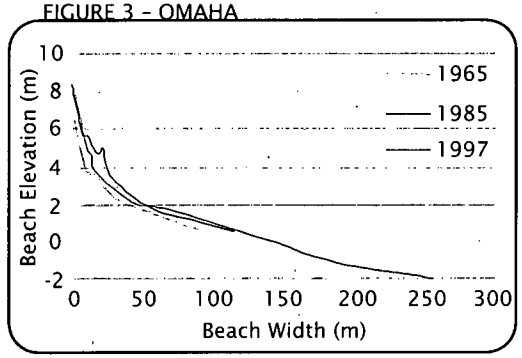
FIGURE 2 - MURIWAI



What can I do?

- Allow a buffer for the natural processes of erosion and accretion if you own coastal property or are about to develop some coastal land.
- If you do suffer severe or chronic coastal erosion that does cause a coastal hazard, consult the ARC before deciding upon any proposed erosion management techniques.
- Avoid removing native coastal vegetation, especially from dunes and cliffs and avoid placing fill or other materials near cliff edges where they might accelerate coastal erosion.
- Avoid walking or trampling and driving vehicles on sensitive coastal dunes and other areas.
- Encourage communities to form CoastCare groups to act as guardians for coastal systems.

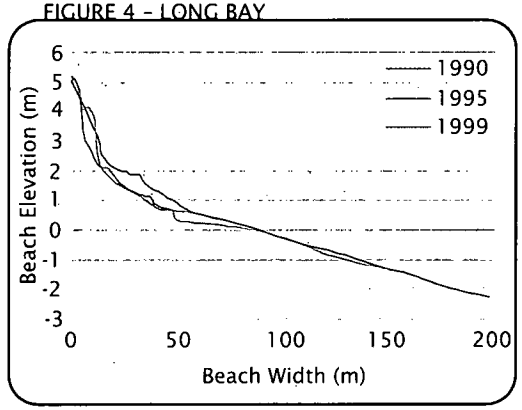
FIGURE 3 - OMAHA



What is the ARC doing?

- Developing a region-wide representative monitoring programme.
- Providing input to TA Plans and subdivision developments which may impact on, or be impacted on by, natural beach processes.
- Directly regulating structures in the coastal marine area which may worsen coastal erosion.

FIGURE 4 - LONG BAY



Issue:

Coastal Waters

The sea defines our region. We share these ecosystems with a wide range of plants and animals. Their health and our enjoyment can be harmed by pollution from our land and water uses.

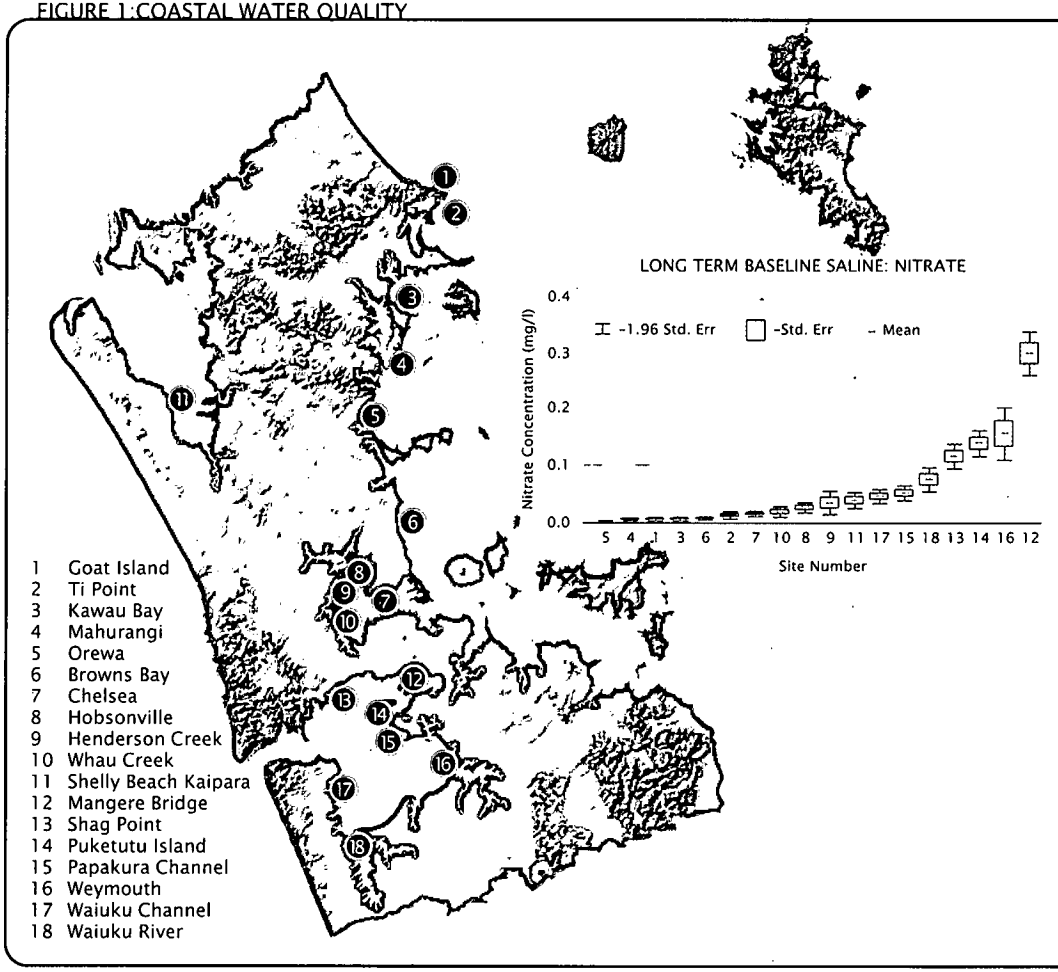
What is happening?

Twelve years of monitoring tells us the overall quality of our coastal waters is very good, but that the further up our sheltered harbours and estuaries we go, particularly following storms and in places close to our cities, the poorer the water quality can become. Figure 1 shows the coastal water quality at various sites around the Auckland Region.

Saline water quality at all sites along the Hauraki Gulf's open coast shows similar characteristics of high quality with their open coastal situation. By comparison, the sites in the sheltered waters of the Kaipara, Waitemata and Manukau Harbours show more variable water quality, with considerably higher levels of particles in the water flushed off from the land or re-suspended from the harbour bed. This is to be expected due to their more sheltered location, larger catchments and more diverse land uses.

Within these harbours the waters in the main channels may be of better quality than in shallower waters and stream mouths. Sites in the north-eastern Manukau Harbour showed greatest levels of nutrients, bacteria and oxygen-demanding materials, indicating the effect of the present discharge from the Mangere sewage treatment plant.

FIGURE 1:COASTAL WATER QUALITY



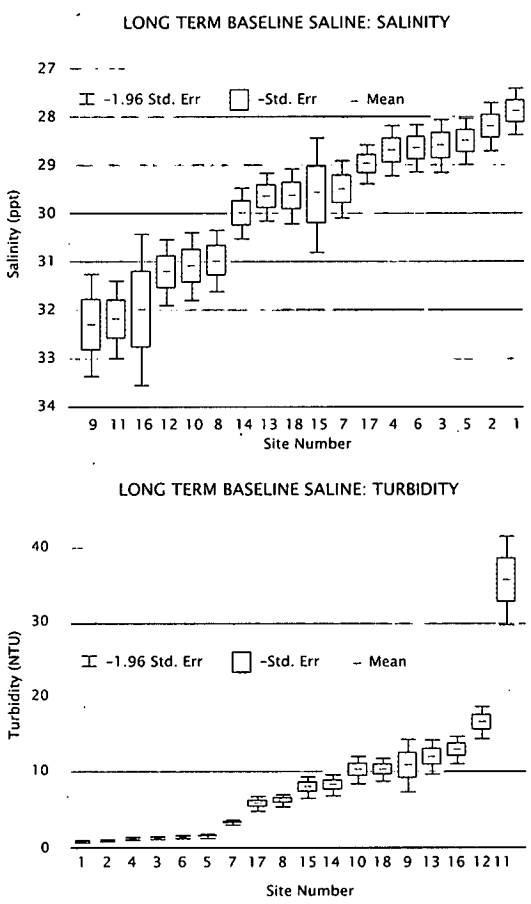
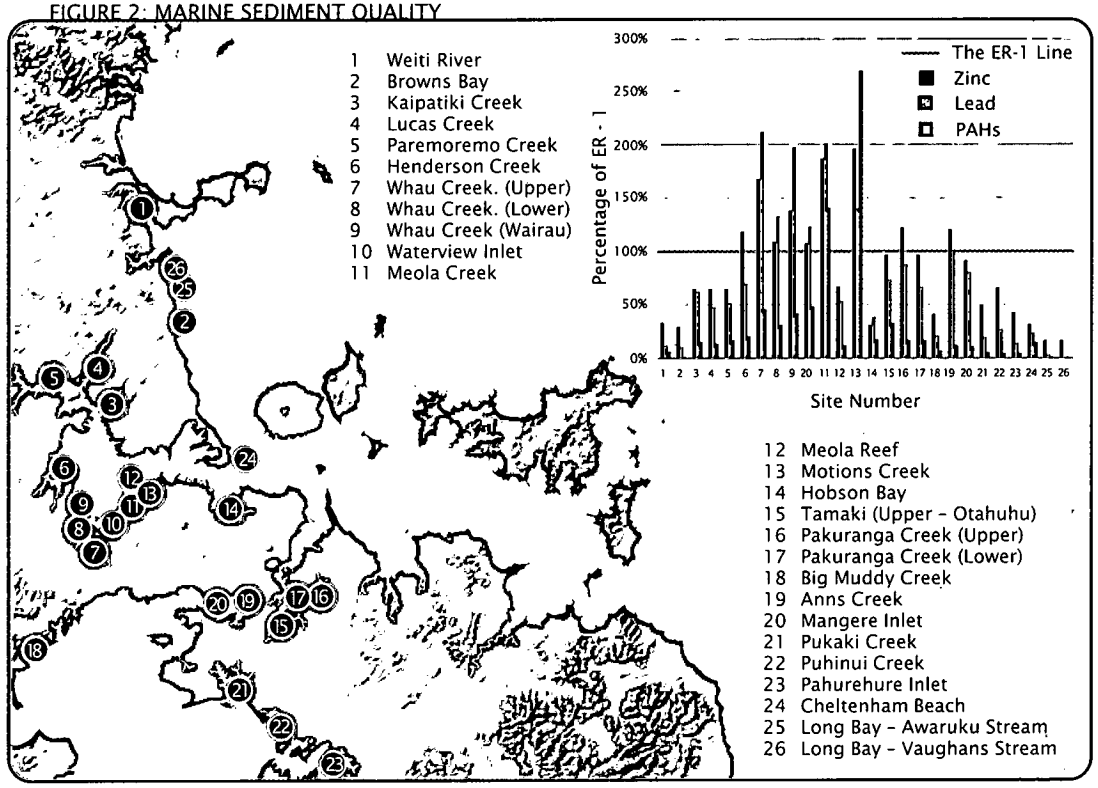


FIGURE 2: MARINE SEDIMENT QUALITY

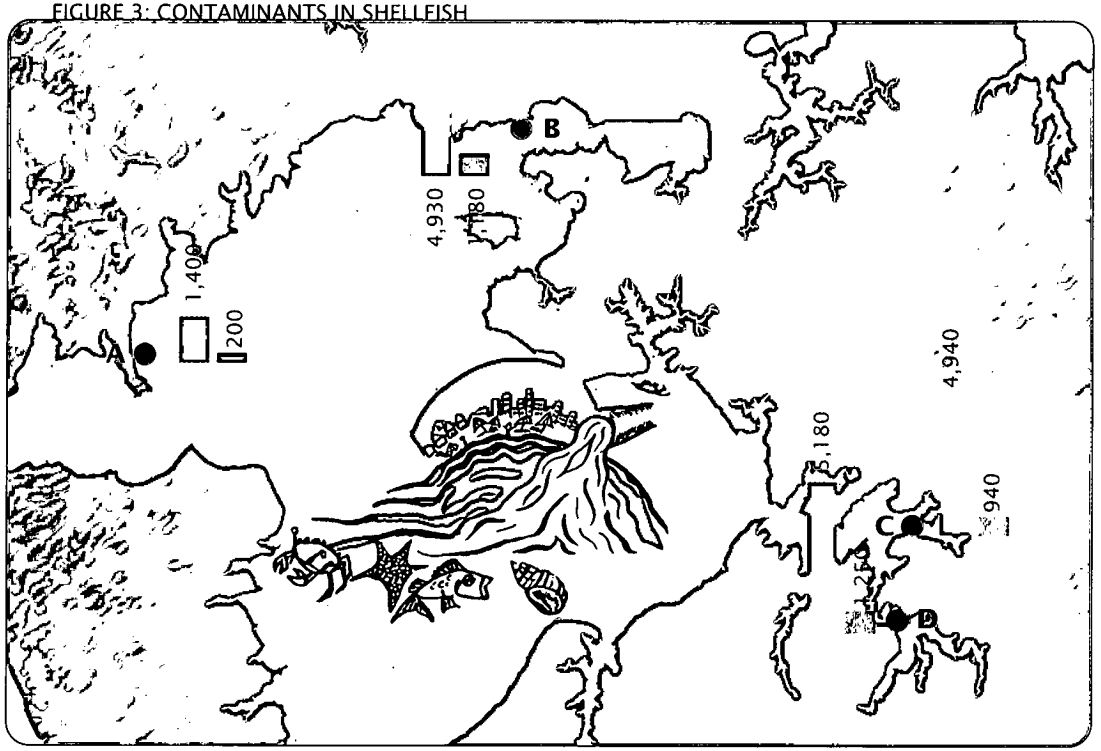


Water quality may change quickly as tide and weather conditions change. The quality of sediments and shellfish gives us a longer-term measure of the average water quality. Figure 2 illustrates the levels of three important stormwater contaminants in coastal sediments and shows that for some areas, particularly in muddy sediments near to the main urban areas, contaminants are at levels where they might have some toxic effects (the ER-1 line) on sensitive marine organisms such as shellfish and marine worms.

Coastal Waters

How is it Happening?

FIGURE 3: CONTAMINANTS IN SHELLFISH



● Sampling Sites

■ Zinc

□ Copper

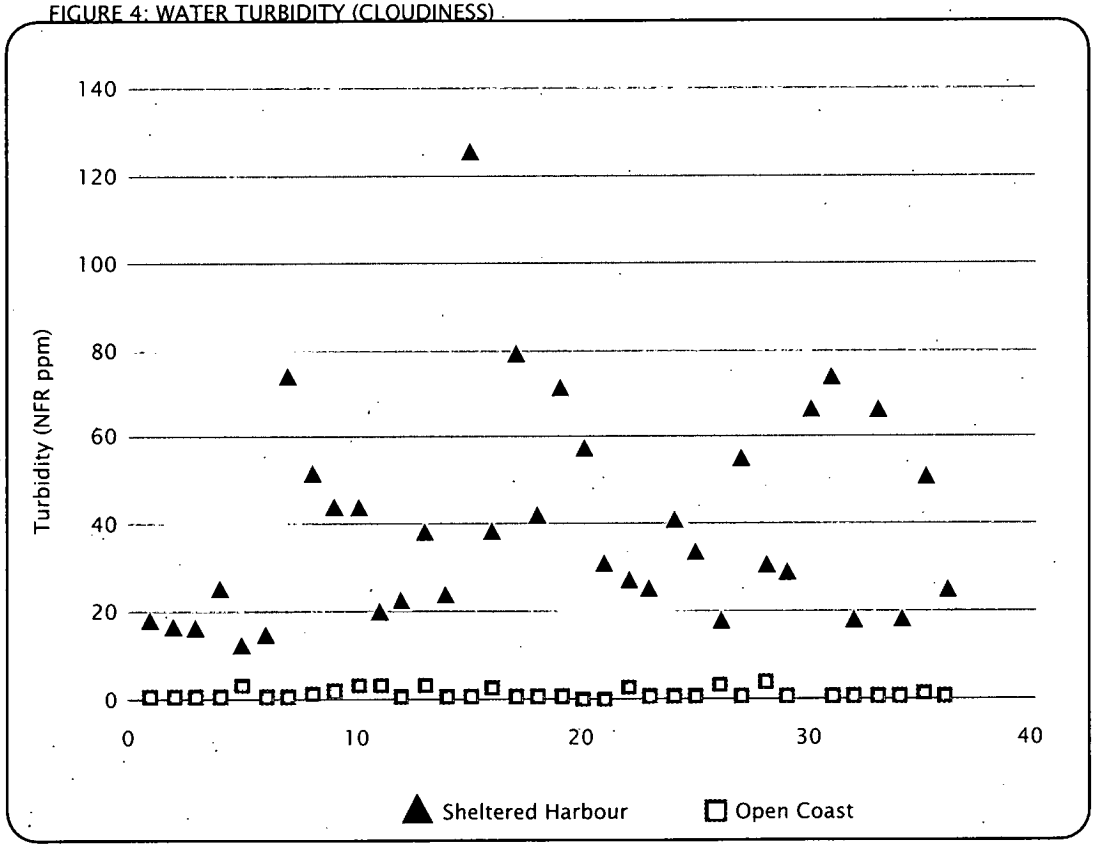
(concentrations in parts per million)

Figure 3 illustrates the levels of zinc and copper in oysters in the Manukau Harbour and shows that shellfish near the urban areas (sites B, C and D) have higher levels of these contaminants than those from areas in the outer harbour (site A).

Our monitoring illustrates the joint role of land use and tidal flushing in determining pollution levels in water, shellfish and sediments. The more sheltered the water the more the contaminants stay around, and the more road traffic and industry there is close by, the more contaminants run off in stormwater. Harbours are more sheltered than the open coast so sediment and contaminants tend to accumulate there, rather than being dispersed and diluted as on the open coast.

Figure 4 illustrates the turbidity (or cloudiness) of water at an open coastal location and in a sheltered harbour site. The open coastal site has far lower turbidity due to distance from the sources of land runoff and greater tidal flushing. This also holds true for other contaminants where overall water quality depends on the location (sheltered harbour or coastal) along with how close the area is to sources of pollution such as stormwater runoff, sewage overflows, and both short and long-term pollution events.

FIGURE 4: WATER TURBIDITY (CLOUDINESS)



Short-term pollution events include illegal industrial discharges into the stormwater system (see ***Water Pollution Events***), sediment running off new subdivisions (see ***Earthworks***) and sewage overflows (see ***Beach Water Quality***).

Consistently poor quality in our inner harbour areas is caused by long-term deterioration over many years. This comes from traffic depositing oils, metals and rubber on the roads, which are swept into our coastal waters every time it rains (see ***Travel Patterns***). Spills and waste disposal into stormwater systems from businesses and households also contributes.

Seasonal changes affect coastal water quality. Wetter winter weather contributes to stormwater washing pollutants off streets, industrial areas and farms, and more frequent sewage overflows. Strong winds and waves stir up bottom sediments, and there are also 'natural' seasonal changes such as in temperature and salinity etc.

Coastal Waters

Why is this important?

Our region includes two of New Zealand's largest harbours. These, and more open coastal waters like the Hauraki Gulf, are the home of our inshore and offshore fisheries, which are of huge commercial, cultural and recreational importance. The habitat of fish like mullet, mackerel, snapper or flounder, and shellfish like pipis, cockles and mussels in our harbours and estuaries can be easily damaged by pollution.

The country's biggest population lives next to some of its nicest beaches, but discharges its stormwater onto them. Contaminants like heavy metals and petroleum compounds accumulate in our harbours, causing long-term deterioration in water quality and ecosystem health.

Our 'clean, green' image is an international drawcard, with tourism now our country's biggest single overseas income earner. Overseas experience shows us that tourist markets are notoriously sensitive to environmental concerns.

What can I do?

- Make sure that you don't allow contaminants such as paint, oil, detergents and grass clippings to enter stormwater drains or water courses. Remember that stormwater drains lead to streams which lead to our estuaries and harbours.
- Report any 'spills' or water quality problems to the ARC Water Pollution Hotline on (09) 377-3107.
- Get involved through the submission process in land use changes that may affect streams, estuaries and other water bodies in your area.

What is the ARC doing?

- Monitoring coastal water quality and ecology to detect any changes in the coastal and marine environment.
- Working with city and district councils to reduce the effects of stormwater-based contaminants (Auckland Regional Stormwater Strategy, Auckland Regional Discharge Performance Standards).
- Inspecting industrial areas and educating industries about preventing pollution (Pollution Control Programme).
- Promoting good maintenance of sewerage infrastructure to reduce sewage overflows.

We Can Make a Difference!

Figure 4 shows the decline in the level of chlordane in a sample of oysters from the outer Manukau Harbour. Chlordane, a pesticide, was identified as accumulating in sediments and shellfish and was banned. This graph shows how the environment in this area is gradually cleaning itself.

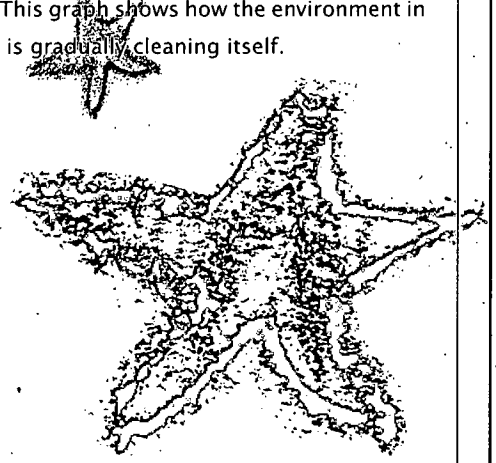
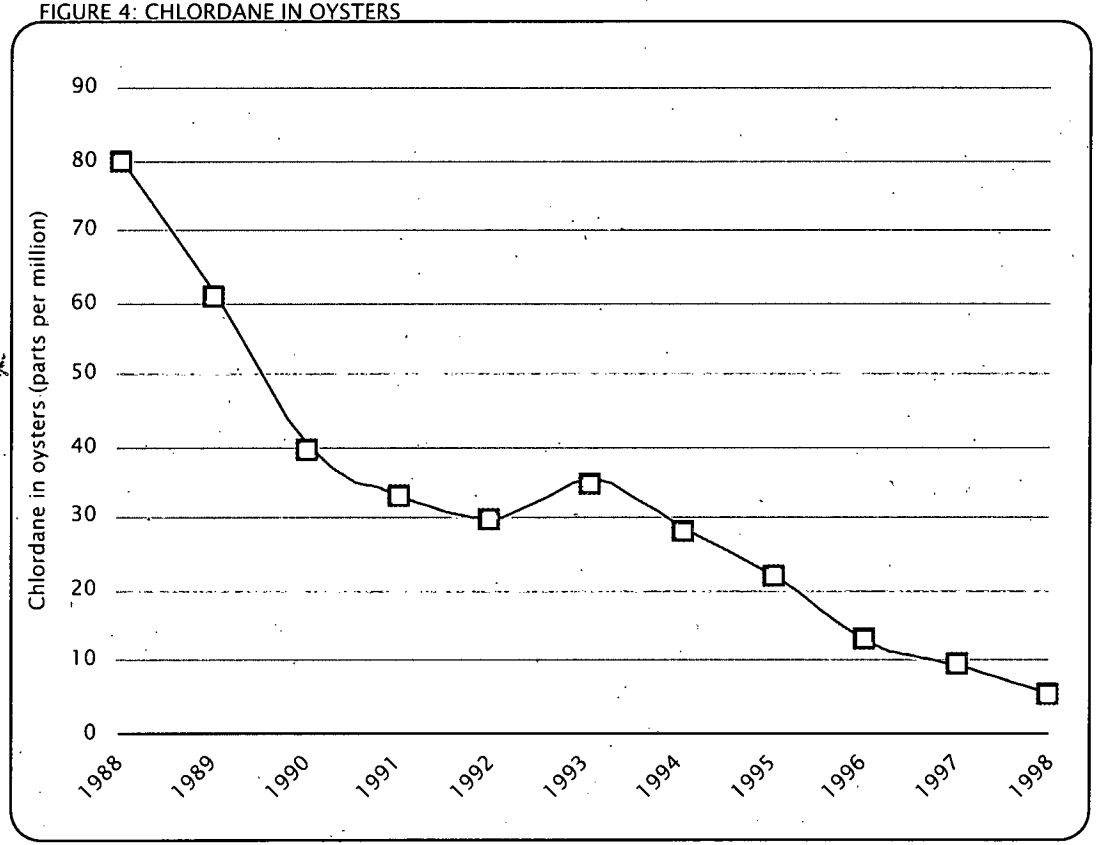


FIGURE 4: CHLORDANE IN OYSTERS



Issue:

Beaches are Auckland's playground, we expect the waters around our beaches to be clean and safe to swim in. So what's the real story?

Beach Water Quality

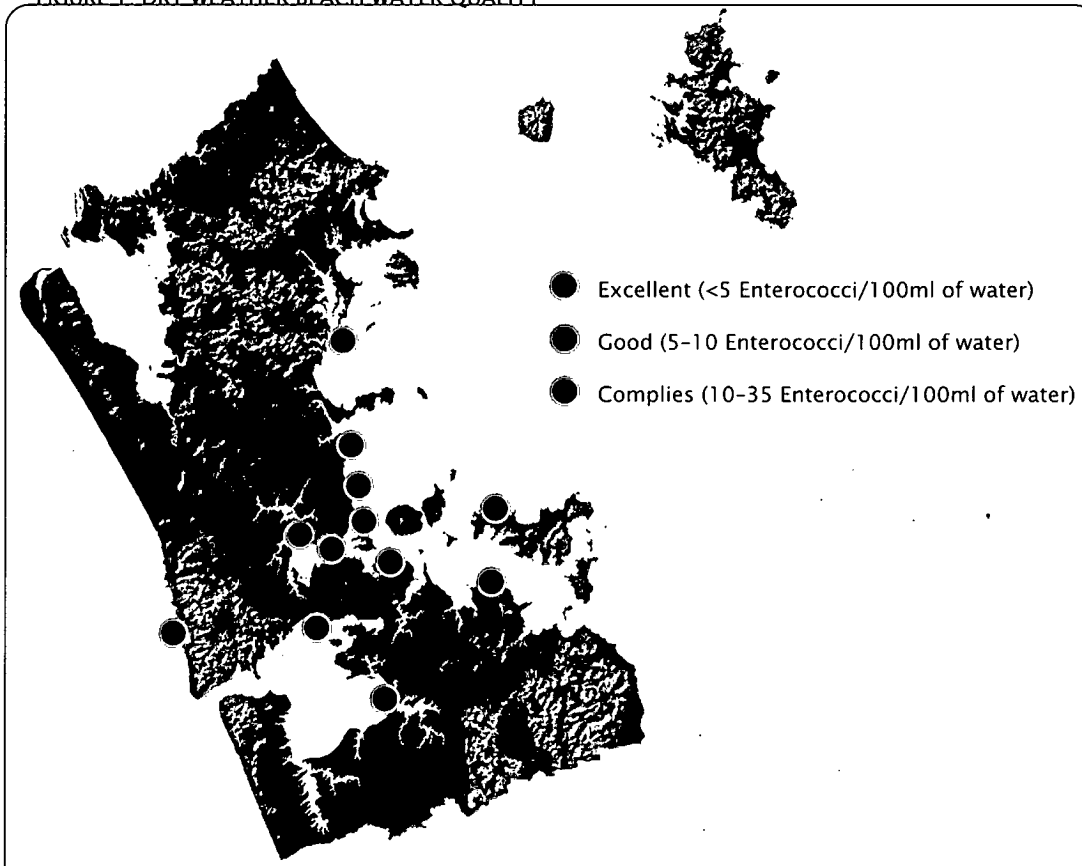
What is happening?

Usually when pollution occurs it impacts on the environment and the animals that live in it long before humans become affected or even concerned. With marine water pollution however, humans can be the first species to be affected. We can become sick from swimming in waters receiving bacterial pollution from normal rural and urban runoff, and from sewage overflows. Also, if marine water is polluted, so too are the shellfish which live and feed in it, and humans can get sick from eating these.

The bacterial quality of our beach/coastal water is generally very good in dry weather. We know this because almost all beaches meet the Ministry of Health's long-term guideline for safety. The ministry also has a measure for short-term (daily) quality, and our data suggests there are sometimes potential health issues.

Figure 1 shows the long-term results for the beach water quality of some representative sites. All beaches sampled complied with the Ministry of Health's whole season median guideline value for marine bathing waters (35 enterococci per 100 ml of water). Remember that these illustrate results

FIGURE 1: DRY WEATHER BEACH WATER QUALITY



Ministry of Health Guideline Value: 35 Entercocci/100ml of water (whole season median)

How is this Happening?

for dry weather only. At the time when this sampling was done, there was no tool available to assess wet weather marine water quality.

High bacterial counts in seawater can be from sewage. Often however, no sewer overflows or obvious reasons for high counts are found. A thorough investigation of the beach and surrounding land is often undertaken by local council health officers in an attempt to identify the source of the high bacterial count.

There have been no health standards available to really determine the wet weather situation. We know that sewage systems become overloaded in heavy rain. Stormwater from hard surfaces, such as roadsides and roofs, pours into drains or streams and ends up at the beach. The threat to public health from this is presently not really known, but could be high, so health authorities are suitably cautious in their advice.

In urban areas, bacterial contamination can come from many sources. The pipes which collect sewage and the pumping stations which send it to treatment plants are obvious possible sources. Pipes may simply leak or be overloaded. The collection systems in older areas can be a 'combined type', where stormwater from hard surfaces flows into the sewers until they overflow. In newer areas, the systems are designed specially to avoid rainwater inputs but illegal connections of roof water still mean that sewers or pump stations overflow. All overflows end up in the streams or stormwater pipes and are delivered to the nearest beach.

Even stormwater which falls as clean rain can pick up bacterial contaminants from roads, driveways and other areas. All streams in urban areas receive such stormwater and they themselves may be bacterially polluted. Where connections of sewage are wrongly directed to stormwater systems (and therefore to the beach) there is a major pollution factor and health risk.

Sewage outfalls from wastewater treatment plants are usually situated away from swimming areas. But dilute plumes of their treated effluent do move around in harbours. Generally, this is more of a threat to public health via shellfish quality than to bathers directly. Where a threat of exposure exists, local councils will warn the public by erecting signs.

In rural areas, stormwater can become contaminated from farm run-off and poorly-performing septic tank systems. Estuaries generally receive all these inputs and, depending on their extent of tidal flushing, can record high levels of bacterial pollution.

At the beach, bacteria can either be swept away by tidal currents or linger in the bathing area. They are also re-suspended from sediments and other sources. This often makes determining the actual source of pollution a complex task for local health officers.

Beach Water Quality

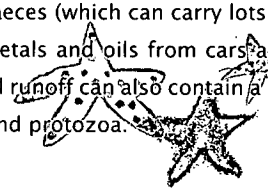
Why is this Important?

The following information is provided by the Medical Officer of Health[2].

Most people enjoy going to the beach in summer and having a swim. If the water is polluted, either from sewer overflows, stormwater drains or some other source, then people swimming in that water may get ill.

There are a number of different illnesses people can get from such pollution. These include stomach upsets, skin rashes and eye, nose and throat infections.

The viruses and bacteria that can cause these illnesses can come from several sources. Among these are domestic sewage, road runoff or from rural areas such as farms. Domestic sewage can flow into the water either from combined sewer overflows which are purposefully designed to overflow into the sea when there has been a lot of rain or when there has been a pump breakdown. Road runoff, which is washed down during heavy rain, can contain animal faeces (which can carry lots of pathogens), heavy metals and oils from cars and from industries. Rural runoff can also contain a lot of viruses, bacteria and protozoa.



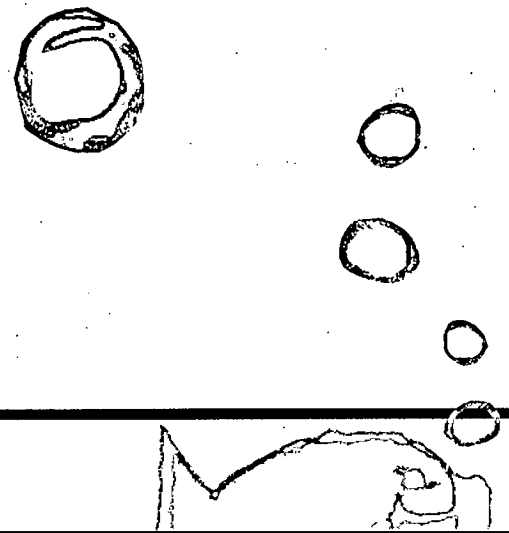
Once these organisms enter the marine water most will start to die or, because they are heavier than water, they will settle out of the water column. However, if you go swimming immediately after they have entered the water you may be exposed to live organisms by swallowing water, or from getting some in your eyes or up your nose. Your skin may also have a scratch which the micro organisms can enter. Once these organisms get into your body they may make you ill; especially if you are very young, elderly or if you have some other illness which has lowered your immune defences. Most of the illnesses are only minor; you might have a sore throat, itchy eyes, a rash on your skin or diarrhoea.[1]

What can I do?

- Because bacteria have the ability to make people ill, it is very important that you carefully choose where to swim. Your local council will be able to tell you whether a beach is polluted or not. If you are concerned, ring your local council. If there is any pollution a sign will be placed somewhere prominent at the beach advising you not to swim — take notice of it!
- Because so much pollution enters the water after rain it makes sense to not go swimming until the pathogens have died or floated away. Public Health Protection advise people not to go swimming for at least 48 hours after a heavy rainfall (such as 10mm in 24 hours). This gives the tide time to wash the pollution away.
- If you do get ill and think that the water may be to blame, see your family doctor, or phone your local Public Health Office (09) 262-1855.
- Check around your house for stormwater connections to the sewer, or worse still, sewage connections to stormwater.
- Report any 'spills' or water quality problems to the ***ARC Water Pollution Hotline*** on (09) 377-3107.

What is the ARC Doing?

- Working with city and district councils to reduce the effects of stormwater-based contaminants (Auckland Regional Discharge Performance Standards, Auckland Regional Stormwater Strategy, and with North Shore City Council on 'PROJECT CARE').
- Promoting good maintenance of sewerage infrastructure to reduce sewage overflows.



Issue:

Marine Ecology

Our seabed marine ecosystems are home to an abundant and diverse range of organisms. They are beautiful and fascinating but also provide food for people, fish and seabirds. Our region's coastline is dominated by the presence of large shallow harbours and numerous small estuarine inlets. A mosaic of rocky shore types is also found in more exposed areas.

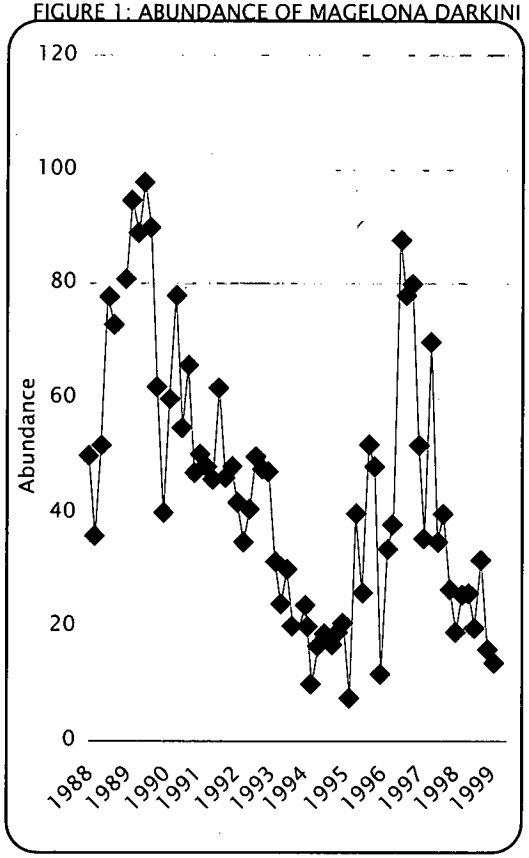
What is Happening?

A desirable coastal environment has both good water quality and supports a healthy plant and animal community. Much of our concern over water quality is directed at protection of plants and animals from pollution. Studying the ecology of areas exposed to pollution such as the broad intertidal sand flats of the Manukau Harbour gives us a measure of the health of the marine environment and allows us to detect effects at an early enough stage to take appropriate actions.

In general, the health of the sand flat ecology is good. It has not suffered any significant decrease in abundance over the long term of the monitoring period. Animals monitored include bivalve shellfish and snails, crabs, sea lice and sand hoppers, marine worms, anemones and sea cucumbers. We have found consistent patterns of change in abundance across the whole harbour. In other words, the sand flats have been acting as one ecological unit.

Most trends in abundance have now been identified as being part of longer-term cyclical patterns. These cyclical patterns of abundance and recruitment range from annual seasonal patterns to cycles of many years duration (as shown in Figure 1).

FIGURE 1: ABUNDANCE OF MACELONA DARKINI



Settlement of young shellfish (recruitment) has been variable with extended periods of low recruitment and occasional peaks (as illustrated by Macomona liliana in Figure 2 which has relatively consistent abundance despite variable recruitment). However this has not resulted in changes in the adult population.

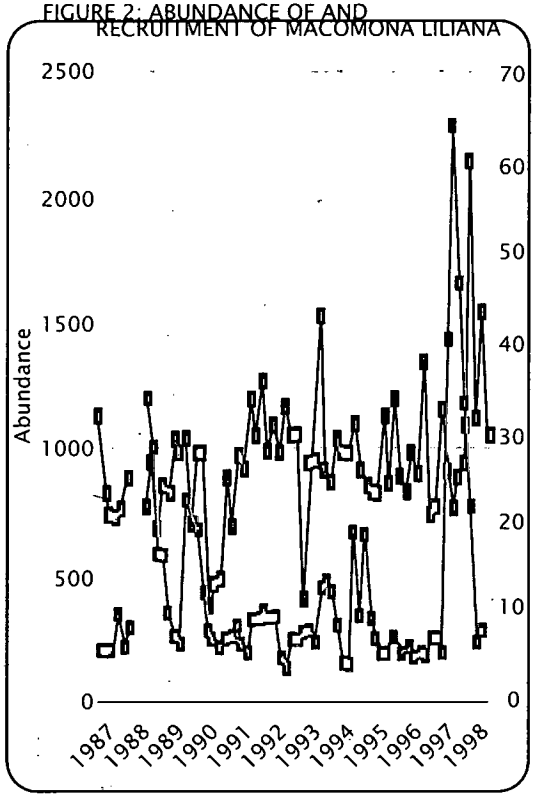
These results match up well with the results of saline water quality, shellfish quality and sediment chemistry monitoring which show good water quality across the broad expanse of the harbour. Poor water quality is largely limited to the more sheltered muddy areas close to sources of urban runoff (see ***Coastal Waters***).

One change in Manukau Harbour sand flat ecology that may prove to be significant is a reduction in the abundance of a marine worm species sensitive to fine sediment (mud) and the increase of more mud-tolerant species.

A similar monitoring program was started in the Mahurangi Harbour in 1994, but a wider range of ecosystems is monitored including both muddy and sandy intertidal ecosystems, and subtidal sites. A worrying decrease in the numbers of horse mussels in the subtidal channel has been detected which, like the changes in the Manukau, has also been linked to an increase in the sediment load in the water derived from sources on land.

How is it Happening?

FIGURE 2: ABUNDANCE OF AND RECRUITMENT OF MACOMONA LILIANA



Pollution of marine ecosystems are mostly derived from activities on land. The land area in the Auckland Region has undergone major changes over the last several hundred years (see ***Urban Growth***). Felling of native bush and development of farm land over the last 150 years has resulted in erosion and the release of sediment into the marine environment. Recent improvements in sediment control (see ***Earthworks***) have helped reduce the impacts of earlier further development of farm land to suburban residential housing areas and urban centres.

Effects of sediment on marine plants and animals include:

- direct smothering and oxygen starvation;
- clogging of breathing or feeding surfaces;
- reduction in light transmission necessary for photosynthesis in plants;
- less visibility makes feeding harder for predators.

Large sediment deposits in sandy areas may cause localised extermination of sensitive species which may take months or years to re-colonise. In some cases the new sediment deposit stabilises and the ecosystem shifts from a sandy habitat to a muddier one.

Many activities on land generate pollution. These range from drips of oil and the release of trace metals from our vehicles onto the road through to spills of chemicals (see ***Water Pollution Events***). These contaminants are carried through the stormwater system into our rivers and streams and out into the marine environment.

Contaminants carried in runoff from the land cause reduced water quality in the estuaries and embayments into which they discharge. These contaminants can accumulate in the sediment and tissues of marine organisms, like shellfish, crabs and marine worms (see ***Coastal Waters***).

Usually the build-up of contaminants in the marine environment is accompanied by a loss of the more sensitive species, and their replacement by more pollution-tolerant species. This simplification of the biological community amounts to a loss of diversity and reduces the value of the area to people and other organisms that would have fed there, such as fish and birds.

Marine Ecology

Why is it important?

The heath of the plants and animals that live in the coastal marine area reflects the quality of the coastal environment. In New Zealand we are fortunate with the availability of open spaces, access to clean beaches and relatively uncontaminated coastal areas.

We can marvel at the fascinating complexity of life in a rock pool, swim without fear of infection, and we can collect seafood and catch fish from an abundant supply and eat them without fear of poisoning. Healthy and abundant marine life requires uncontaminated water and unpolluted environments to be able to filter food from the water or hunt for food, and to effectively breed.

What can I do?

- Support local initiatives to protect the freshwater and marine environment.
- Be aware of pollution. Carefully select options that you know to have a low potential for causing problems to water quality and flow-on impacts upon marine ecosystems.
- Respect and appreciate the value of the marine ecosystems you use and try to pass on this respect and appreciation to other people.
- Remember that many pollution problems are caused by numerous small events that by themselves seem trivial and unimportant. The next time you wash out your paint brush, throw away your rubbish, or clean down your concrete driveway, ask yourself, "where is this waste going, what problems might it cause, and what can I do to avoid this happening?".

What is the ARC doing?

- Monitoring the state of marine ecology.
- Controlling pollution to minimise damage from human sources.
- Controlling land use to reduce its effects on marine ecology, particularly in sensitive areas (such as through the Auckland Regional Growth Forum).
- Improving stormwater and sediment management.

Issue:

Fish Stocks

The abundant fisheries resources found in our coastal waters are highly valued by Maori, commercial, and recreational harvesters. Fish stocks have come under increasing pressure as more and more people compete for the same limited resources using technology that has improved their ability to locate and capture fish, and as our activities damage the marine environment

What is Happening?

The Ministry of Fisheries (MFish) has the responsibility for management of fish stocks. The following summary information is based on their information.

WEST COAST FISHERY

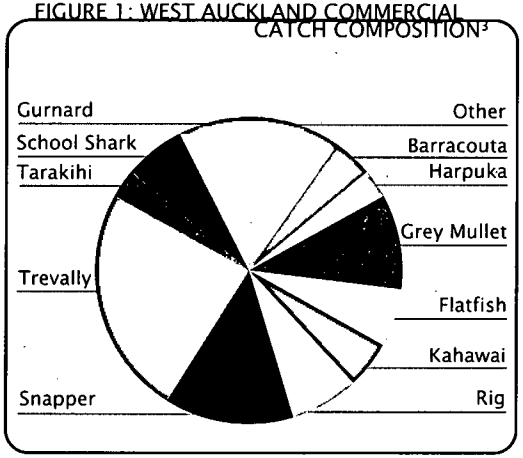
Fishing Activities:

Before the 1950s commercial fishing off the open west coast was very limited. Trawling developed during the 1950s, and markedly increased during the 1970s. Initially trawlers mostly fished for snapper and tarakihi, but now other species such as trevally, barracouta, kahawai, and gurnard are also caught.

Commercial fishers use set nets to catch species such as school shark, rig, flounder, grey mullet, yellow eyed mullet, kahawai, snapper and trevally, especially in more sheltered locations, such as the Manukau and Kaipara Harbours. The Kaipara Harbour also supports a small dredge fishery for tuatua.

Surfcasting for species such as snapper and trevally is the most popular non-commercial fishing activity on west coast beaches such as Muriwai, while

FIGURE 1: WEST AUCKLAND COMMERCIAL CATCH COMPOSITION[3]



the collection of mussels and tuatua is also popular. Within the harbours, line fishing and netting for snapper, flounder and grey mullet and gathering of pipis, cockles, scallops, mussels and oysters is common. Upwards of 400 recreational boats have been recorded in the Manukau Harbour during peak summer periods. Many of these will carry recreational fishers who line fish or lay nets in the harbour.

West Coast Fish Stocks

Many of the species of fish and shellfish found on the west coast are less abundant than they were several decades ago, due to the combined effects of fishing and environmental changes. However, since 1986, when limits were imposed on commercial catches of species including snapper, flounder, mullet and trevally, populations generally appear to be rebuilding. Populations of some short-lived species, such as flounder, fluctuate naturally from year to year.

Recently recreational fishing pressure has been blamed for a marked decrease in abundance of shellfish and other marine life in areas such as Piha Beach. However it is not yet clear how much environmental changes might be to blame instead, as shellfish abundance has not increased markedly in areas where recreational harvesting has been restricted or banned.

EAST COAST (HAURAKI GULF) FISHERY

Fishing Activities

The commercial snapper fishery of the Hauraki Gulf is the mainstay of the domestic fishing industry in the North Island and is the most important species in terms of tonnage landed and value of catch. The main snapper fishing methods are trawling and Danish Seining in the outer Gulf and longlining in

Fish Stocks

the inner and mid Gulf. Set-netting in the mid and inner Gulf for flounder and a range of other species is the other main fishery. Flounder, kahawai, gurnard, trevally, john dory, grey mullet and other minor species make up just over a quarter of the commercial catch with the remainder being snapper.

There is commercial dredging for scallops in the Hauraki Gulf. However, catches have fallen during the 1990's due to declines in the scallop populations in the main commercially harvested beds off Waiheke Island. Natural causes are thought to be responsible for these declines. The Hauraki Gulf supports a relatively small commercial crayfish fishery with potting taking place at locations around the coast and several of the Hauraki Gulf Islands.

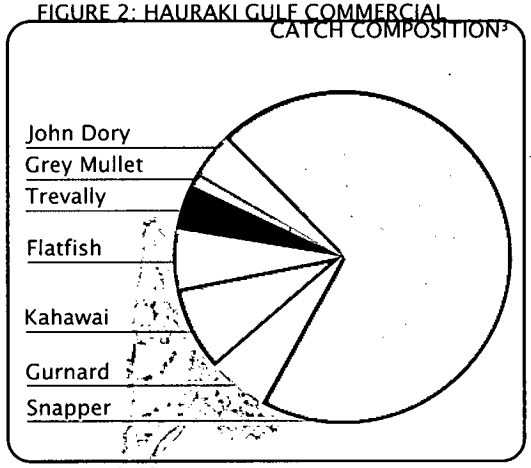
The Hauraki Gulf is the most popular recreational fishing area in New Zealand. Several hundred thousand people are estimated to recreationally fish the Gulf each year. MFish estimates of the current annual recreational take of snapper from the Gulf area is around 1100 tonnes, around 50 per cent of the total recreational catch from the east coast of the North Island down to East Cape. Most fishing is over the summer months using rod and reel or hand lines from small boats, while fishing from the shore, netting and longlining accounts for less than 10% of the recreational snapper catch.

Other popular recreational fishing activities include surf casting from beaches, line fishing from the shore, trolling, drop lining and long lining from boats, set netting, beach seining, shellfish dredging, diving, spearing and hand collection. Species commonly taken include flounder, grey mullet, yellow eyed mullet, snapper, trevally, kahawai, king fish, various reef fish, crayfish, mussels, oysters, cockles, scallops, pipi, kina, and tuatua.

Hauraki Gulf Fish Stocks

Like the west coast, many of the species of fish and shellfish found in the Hauraki Gulf are less abundant than they were several decades ago, due to the combined effects of fishing and environmental changes. However, here too, most fish populations, including snapper, now generally appear to be rebuilding.

FIGURE 2: HAURAKI GULF COMMERCIAL CATCH COMPOSITION[3]



MFish monitoring of shellfish abundance on a number of Auckland's east coast beaches has shown that in recent years cockles have decreased in abundance at the Cheltenham, Cornwallis, Eastern, Wenderholm and Howick Beaches. This effect can not be linked to harvesting alone since several of the beaches are closed to all forms of shellfish collection. Recruitment of young cockles has been patchy on these beaches with Cheltenham beach not having successful recruitment over the three year monitoring period. At present the reason for the decline in cockle abundance is not known.

How is it Happening?

Fisheries resources exist in a state of balance that may be upset by natural events or human activities. Healthy and abundant coastal fisheries require breeding stocks of adults to produce the recruits that replace fish that die or are harvested. To produce juvenile recruits the adult population must have a healthy environment with unpolluted waters and abundant food supplies, and must be protected from over fishing.

Many fish species release their eggs and developing juveniles into the sea where they drift in the plankton. These sensitive life stages can be greatly affected by changes in weather patterns, water temperature, algal blooms, and so on. As they grow, many are eaten by other fish and birds. They must also compete for food with their own and other species.

Our activities on land or in the coastal area can pollute or destroy areas important to fish. For example reclaiming wetlands and mangrove areas and construction of structures such as seawalls and wharf's can modify the coastal processes that shape the seabed. Water quality has been reduced by increased erosion and stormwater pollutants (see ***Earthworks***, ***Coastal Waters***), and exotic and invasive species have been introduced which have put pressure on marine ecosystems. (see ***Coastal Pests***)

Some species are more vulnerable than others; for example because they have a slow reproductive rate (like rig or carpet sharks), a limited habitat were they can live (like reef fish), or a habitat that is under great stress because of our development of the land (like sandy intertidal areas in estuarine systems). Other more common and widespread species are still vulnerable because of the level of fishing pressure they attract (such as snapper).

Why is it Important?

Like most New Zealanders, Aucklanders take pride in the abundant fishery resources of their coastal waters. Many consider it a birth right or natural legacy that they and their children will be able to go fishing and collect fish and shellfish from the waters around us. Many consider that recreational fishing and the good chance of catching a decent feed of fresh fish is the best form of recreation available. For Maori this special love of local kai moana is of tremendous cultural significance.

Tourists and visitors to Auckland will often be attracted here by the chance of enjoying the coastal waters, the fishing, and the seafood. Even those who aren't keen fishers often enjoy seafood and depend on local commercial fishing operations to supply this. Fisheries are economically important and many peoples livelihoods are dependant upon the various industries associated with commercial and recreational fishing.

Fish Stocks

We need to manage our fisheries carefully to ensure that the various pressures acting upon them do not damage or destroy them. If this were to happen we would loose a great deal of what we value and enjoy about the Auckland region. Most Aucklanders want to be able to continue to have access to fresh fish, or to enjoy a day fishing with friends, visitors, or relatives.

What can I do?

- Make sure you don't let pollution enter water (see ***Water Pollution Events***).
- If you are thinking about building structures in the coastal marine area, talk to the Auckland Regional Council, who will advise whether you need a resource consent and ways to minimise any potential damage on coastal processes.
- Make sure you obey all catch limits and other controls on fishing set by MFish, and if you see someone else breaking the rules, notify your nearest MFish Office.

MFish have numerous management processes aimed at sustainable management of fish stocks for both commercial and non-commercial fishing activities. Further information on the details of these controls is available from Ministry of Fisheries - Auckland: Phone (09) 379 4700.

What is the ARC Doing?

- Managing the coastal marine areas to minimise damage to areas where fish live and breed.
- Reducing water pollution and the effects of human land uses on overall water quality (see ***Surface Waters***, ***Coastal Waters***).

MFish has responsibility for managing fishing activities. The main ways it does this are by:

- Operating the Quota Management System, which involves setting sustainable limits on the commercial catch of all species within this system, while making an allowance for non-commercial catches.

- Developing and enforcing a range of rules aimed at reducing the by-catch of non-target species, preventing the capture of fish before they have a chance to reproduce, reducing the impact of fishing on vulnerable areas, limiting the amount of fish taken by recreational fishers while still allowing a reasonable catch, and controlling the way certain fishing methods are used.
- Monitoring fish stocks and numbers of fish caught to ensure that catch limits maintain populations at sustainable levels. Research is also carried out into fish biology and life histories to better understand how they interact with the environment.

As with the land, the coastal marine area is under threat from invasion of exotic species.

Issue: Coastal Pests

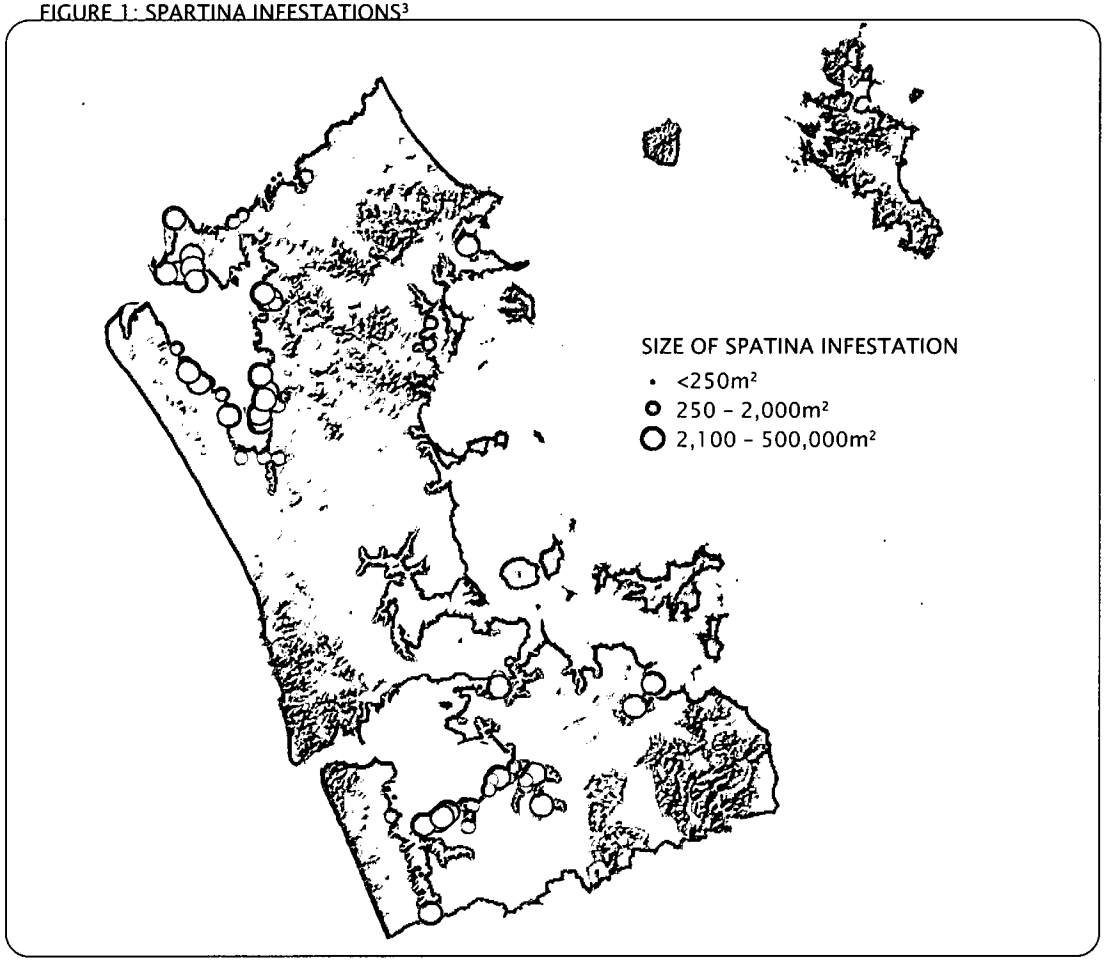
What is happening?

With the colonisation of New Zealand by Europeans, their desire to "naturalise" the country resulted in a number of species of fish being introduced. The majority of these animal species did not survive, although a number of salmon species did establish in the South Island.

In addition three species of the genus ***Spartina*** were introduced to New Zealand. ***Spartina*** is a northern hemisphere plant which rapidly colonises intertidal areas. It was initially introduced to reclaim land, provide protection from coastal erosion, and for use as an alternative fodder crop for cattle. ***Spartina anglica***, ***S. Alterniflora***, and ***S. x townsendii*** are now present in the Auckland Region.

Spartina can rapidly colonise intertidal areas. Research on ***S. alterniflora*** in the Manukau Harbour shows an annual spread of 2m. Since its introduction, ***Spartina*** has colonised significant areas in the region.

FIGURE 1: SPARTINA INFESTATIONS[3]



From 1984 to 1994 ***Spartina*** cover in the Auckland Region rose from 103ha to 125ha. Figure 1 illustrates the extent of ***Spartina*** infestations around the region[4].

More recently, concern has been expressed at the potential for ballast water and ship hulls to introduce species to New Zealand. These introductions are haphazard and could have significant adverse effects on the ecology of the region. The introduction of 53 species nationally and 38 species in the Waitemata Harbour have been attributed to introductions through hull attachments or ballast water.

How is it happening?

Historically the spread of ***Spartina*** has been a combination of planting and natural spread. More recently people are becoming more aware of the adverse effects of ***Spartina***, and natural spread is the dominant method of recolonisation, although some planting may still occur.

Ballast water is a significant method of entry for the introduction of plants and animals. Exotic plants and animals are taken into ships whilst they are taking on ballast water and discharged at ports when cargo is loaded. Other species simply attached themselves to boat hulls as they would do to any hard surface, and are transported from port to port where they may become dislodged or reproduce to colonise new locations.

Most species that enter a country this way will die, but some do establish. The Auckland Region is vulnerable to this kind of colonisation due to the location New Zealand largest port, the Port of Auckland, in the Waitemata Harbour.

Why is it important?

The main harbours of the region are internationally important for migrating wading bird species and support significant fisheries.

Spartina's ability to rapidly colonise large areas of the coastal marine area is a concern. ***Spartina*** can trap tonnes of sediment and slowly reclaim areas of the sea. Coupled with these changes are changes in interstitial species composition and loss of species diversity. These may in turn result in changes in the use and value of the area to intertidal wading bird species, fish and humans.

Introduction of species via ballast water and hull attachment is haphazard and uncontrolled. New species may upset the ecological balance of the marine environment through species competition, displacement or disease. They may affect human health, or have significant economic implications through impact on fisheries, recreation or tourism.

Coastal Pests

Of the exotic species currently established in the region, the Asian date mussel smothers benthic fauna, and the Pacific oyster, although of significant commercial value, poses a significant threat to human activities in some areas. But for many species (such as 15 species of Bryozoans, sea anemone and sea weeds) little is known of their impacts. Overseas experience has shown that some species may become a considerable threat to the values and activities undertaken in the sea.

What can I do?

- Do not plant or disturb colonies of ***Spartina.***
- Contact the ARC when controlling ***Spartina.*** The council has expertise in ***Spartina*** control and will provide advice on resource consent requirements, herbicide use and application.
- Keep samples of strange plants or animals you find in the sea. Identify them either through the ARC, the Auckland Museum, university, or Ministry of Fisheries.

What is the ARC doing?

- Controlling ***Spartina,*** particularly in the Whangateau Harbour, Puhoi Estuary, Waitemata Harbour, Umupuia Estuary and Waiuku Estuary.
- Rules governing the cleaning of vessels are contained in the Proposed Regional Plan: Coastal.
- Participating in national discussion on the development of national policy and rules for ballast water and hull attachments.
- Participating in the National Marine Surveillance System.

Conclusion

The snapshot has been taken. The film has been processed and the pictures printed.

But it is not a case of 'Oh well, that's it then'. This report is the starting point of the future monitoring of the state of the Auckland Region. In editions to come, we will be able to directly compare the state of our society, the quality of our air, water and natural ecosystems, and see how our region is changing and how well we are doing.

That is the value of these reports, they stand as a benchmark, a community report card on our society, and on how our actions affect the environment and our long term sustainability.

This report shows us that the Auckland Region has a lot going for it: a vibrant and diverse population, a strong economy, and a wide range of natural resources and environmental qualities. It also shows that we have some challenges to address, including traffic congestion, pressures on air and water quality, and on natural ecosystems.

In future editions of the State of the Auckland Region Report we would very much like to be able to comment on:

- better air quality throughout the region;
- well protected and preserved natural terrestrial ecosystems;
- decreased waste output per person;
- reduced numbers of pollution events;
- good water quality and healthy aquatic ecosystems.

These are some of our visions. But these can only be accomplished by all of us, the people of the Auckland Region. Throughout this report, we have outlined practical things you can do to help improve the environment. You will also find references to care groups and volunteer organisations that help with looking after the environment. Join one. Get involved. The Auckland Region is a valid concern for all of us!

Want to find out more?

The Auckland Regional Council has other information on most of the issues raised in this document including a number of technical publications, reports from the Regional Growth Forum, copies of the ARC newspaper RegionWide, and general information on a range of topics which may interest you. Examples of the range of publications is shown below. If you would like any more information then please contact Enviroline on 0800 80 60 40.

Fact sheets covering topics such as:

- transport facts;
- pest (plants and animals) facts;
- land facts;
- cultural heritage facts;
- water facts;
- farm facts;
- pollution facts;
- waste facts;
- hazard facts;
- coastal facts;
- harbour facts.

Technical publications covering topics such as:

- water allocation and management plans for ground and surface water resources;
- guidelines for topics such as erosion and sediment controls for land disturbing activities, large lot stormwater management, and the design of stormwater treatment devices;
- results of monitoring programmes such as saline ecology, water quality, cultural heritage, and demographic and social change;
- natural hazards;
- research into the effects of various activities such as the impacts of urbanisation, and increased erosion and sedimentation;
- stormwater quality and treatment;
- water quality.

A variety of operative and proposed statutory documents such as:

- The Auckland Regional Policy Statement;
- The Auckland Regional Land Transport Strategy;
- The Proposed Regional Plan: Coastal;
- Regional Plan: Farm Dairy Discharges;
- Auckland Regional Animal Pest Management Strategy.

We also have a range of reports associated with the Regional Growth Forum including topics such as:

- history of planning in Auckland;
- techniques for managing growth;
- natural and physical constraints;
- the capacity for Auckland to accommodate further growth;
- opinion surveys of businesses and environmental organisations;
- rural values;
- social needs;
- employment location;
- The Auckland Regional Growth Strategy.

And much much more, so please contact Enviroline on 0800 80 60 40 for more information.

Want more copies of this report?

Copies of the full State of the Auckland Region 1999 Report are $15, and copies of the summary document are free. Please contact the Assistant Librarian - phone (09) 366 2000 extension 8338, fax (09) 366 2154 or email library@arc.govt.nz.

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