WAIPA 2050
Value our Past - Champion our Future

Physical Environment Profile Statement

Waipa DISTRICT COUNCIL

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1 Introduction

1.1 Purpose and Scope

The purpose of this profile statement to profile the physical environment including physical features, soils/soil productivity, water quality and quantity, ecology, air quality and the acoustic environment of the Waipa district. This statement provides a 'snap shot' of potential constraints and opportunities for growth and development to assist in the development of the Waipa District Growth Strategy and subsequent District Plan Review.

Available information on the physical environment has been collated and reported. On the basis of the review the Profile Statement identifies implications for future strategic planning, including future needs and opportunities.

It is worth noting that the other profile statements to be produced as part of the Waipa District Plan Review and Growth Strategy include the following:demographics, infrastructure (incorporating roading/transportation, water, wastewater, stormwater, and services (power, waste management)), urban growth, economic development, tourism, natural character / landscape, cultural / historic and social services.

There is potential for some overlap to occur between profile statements, for example regarding natural character and landscapes, and infrastructure with regard to water quality and quantity. In an effort to avoid duplication other profile statements have been referred to throughout the document.

1.2 Abbreviations

ED Ecological District

EW Environment Waikato

HAIL Hazardous Activities and Industries List

LGA Local Government Act

MfE Ministry for the Environment

NES National Environmental Standard

RMA Resource Management Act 1991

RPS Regional Policy Statement

1.3 Definitions

The physical environment for the purposes of this paper includes the geology, topography soil characteristics, water quality, air quality, and acoustic environment.

1.4 Limitations

This report has been prepared using existing published information provided predominantly by Environment Waikato, Waipa District Council and the Department of Conservation. No specific consultation has been undertaken as part of this report preparation.

2 Current Profile

2.1 Geology

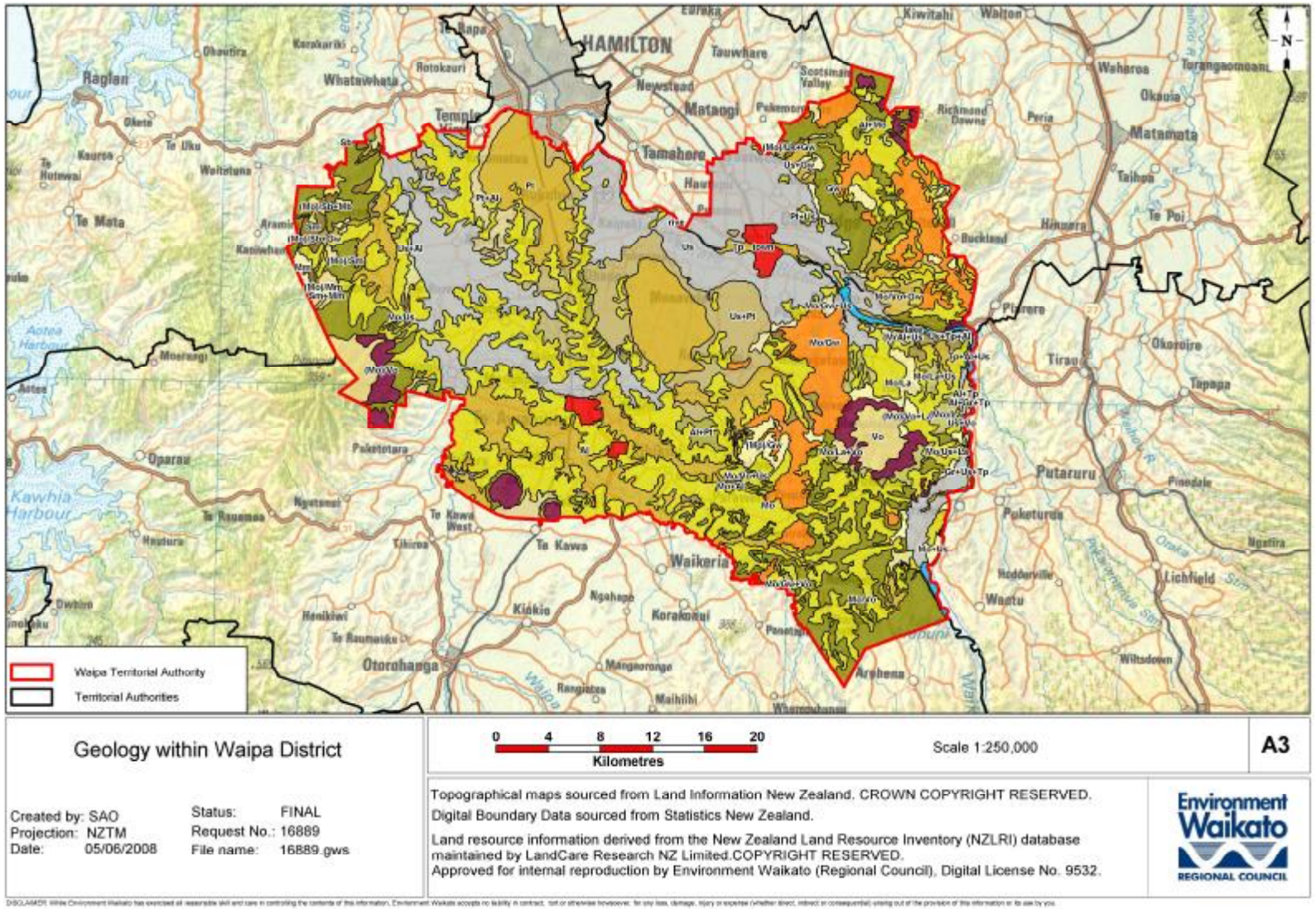
The predominant geology of the area is volcanic material including tephra. Volcanic events such as eruptions from the Taupo region have impacted in the Waipa district with large volumes of alluvial material being deposited. Volcanic features such as Pirongia Mountain - a basaltic-andesite volcanic cone; Maungatautari and Kakepuku dot the landscape (Wildland Consultants, 2007). Approximately one fifth of the area is made up of alluvial and unconsolidated sediments. Sandstone/mudstone/limestone, and Greywacke or Agillite are also present (Environment Waikato internal report, 2008). Figure 1 below illustrates the complex geology within the Waipa district.

Flooding events and subsequent drainage have also impacted on the form of the district, particularly the channels carved out by the Waikato and Waipa rivers.

There are also a number of geological sites which are regarded as being of regional or international significance as follows:

- Karamu cave (regionally significant);
- Tomac Tomo (regionally significant);
- Piarere turnoff alluvial terraces – one of the world's best examples of alluvial terraces, also good outcrops of ignimbrites, and small alluvial fans (internationally significant);
- Bald spur volcanic breccia, Mount Pirongia (regionally significant);
- Ahura ignimbrite section – section though intensely welded ignimbrite with 'inverse' cooling gradient, erupted from Mangakino volcano (regionally significant); and,
- Te Kawa olivine basalt quarry (excellent exposures of thick olivine basalt (ankaramite) lavas (regionally significant) (Wildland Consultants, 2007).

Figure 1: Geology within the Waipa District (Source: Environment Waikato)



2.2 Topography

The Waipa district is predominantly flat and basin-like with some rolling hills and mountainous areas formed by volcanoes at Mount Pirongia, Maungatautari, and a smaller mountain at Kakepuku, as illustrated on the topographic map contained in Appendix A. Figure 2 (Special Features Map) below also illustrates vast tracts of "unstable land" running in a north-south direction north of Pirongia in the west of the District, and north-south around Mt Maungatautari and Maungakawa in the eastern quarter of the District. Unstable land is defined by Waipa District Council as land with a slope between 16 and 35 degrees (Waipa District Council map). The district is entirely land bound with various streams and rivers including the Waikato and the Waipa rivers run through the district.

2.3 Land Cover

The Waipa District is predominantly covered in pastoral land. Patches of native vegetation are also scattered for example at Maungatautari and small pockets to the north of Cambridge (Te Miro Scenic Reserve and Maungakawa Scenic Reserve) and large areas scattered to west of Te Awamutu associated with Mount Pirongia and Kakepuku. A few scattered areas of planted forest and horticulture also exist in the Waipa District as well as some inland water bodies. One small inland wetland is located west of Cambridge at Moanatuatua Reserve. The main areas of urban settlement are at Cambridge, Te Awamutu, Kihikihi and Pirongia (Environment Waikato website – Land Cover).

2.4 Soil Productivity and Land Use Capability

Soils in the Waipa district tend to be highly productive, as the land use capability map in Figure 3 sets out. However, there are also a number of areas where soil productivity or land use capability is not productive. Such areas include:

- Soil erosion prone areas in the district;
- Areas where Environment Waikato is involved in soil conservation and catchment management projects; and
- Areas where contaminated land is an issue following historic land use practices.

2.4.1 Land Use Capability

Soil type data (along with other information) can be used to determine Land Use Capability (LUC), which assesses an area's capacity for sustained productive use, taking into account physical limitations, management requirements and soil conservation needs. The assessment is based on an interpretation of the physical information in the Land Resource Inventory as well as additional information on climate, etc. Figure 3 below illustrates the land use capability in the Waipa District.

Land use capability classes as recognised in the New Zealand Land Resource Inventory are listed below:

I = Land with virtually no limitations for arable use and suitable for cultivated crops, pasture or forestry.

II = Land with slight limitations for arable use and suitable for cultivated crops, pasture or forestry.

III = Land with moderate limitations for arable use, but suitable for cultivated crops, pasture or forestry

IV = Land with severe limitations for arable use and suitable for occasional cropping, pasture or forestry.

V = Highly producing land unsuitable for arable use, but with only slight limitations for pastoral or forestry use.

VI = Non-arable lands with moderate limitations for use under perennial vegetation such as pasture or forest.

VII = Non-arable lands with severe limitations for use under perennial vegetation such as pasture or forest.

VIII = Land with very severe to extreme limitations or hazards that make it unsuitable for cropping, pasture or forestry use.

As the Land Use Capability map illustrates, much of the Waipa area has soils classified as Class I and II (yellow and orange areas). These areas are very well suited to productive activities such as agriculture rather than residential growth and development.

A reasonable proportion of the District (in the east and west) is classified as Class VI soils meaning that it has a 'medium' level of suitability for general pastoral and production forestry use. The cream areas (Class VII) represent land that is unsuitable for arable use and has severe limitations or hazards under perennial vegetation. With few exceptions, it is usually not suited for grazing and can only support erosion control forestry. There are very few Class VIII soils (illustrated by the grey areas). Class VIII land mainly comprises high, mountainous country (e.g. Maungatautari) although it may include very steep slopes and also highly erodible areas at lower altitudes. Both of these areas (especially Class VIII) will generally not be suitable for major residential growth and development, due to extreme actual or potential erosion, or topographical constraints.

Figure 2: Special Features Map (Source: Waipa District Council)

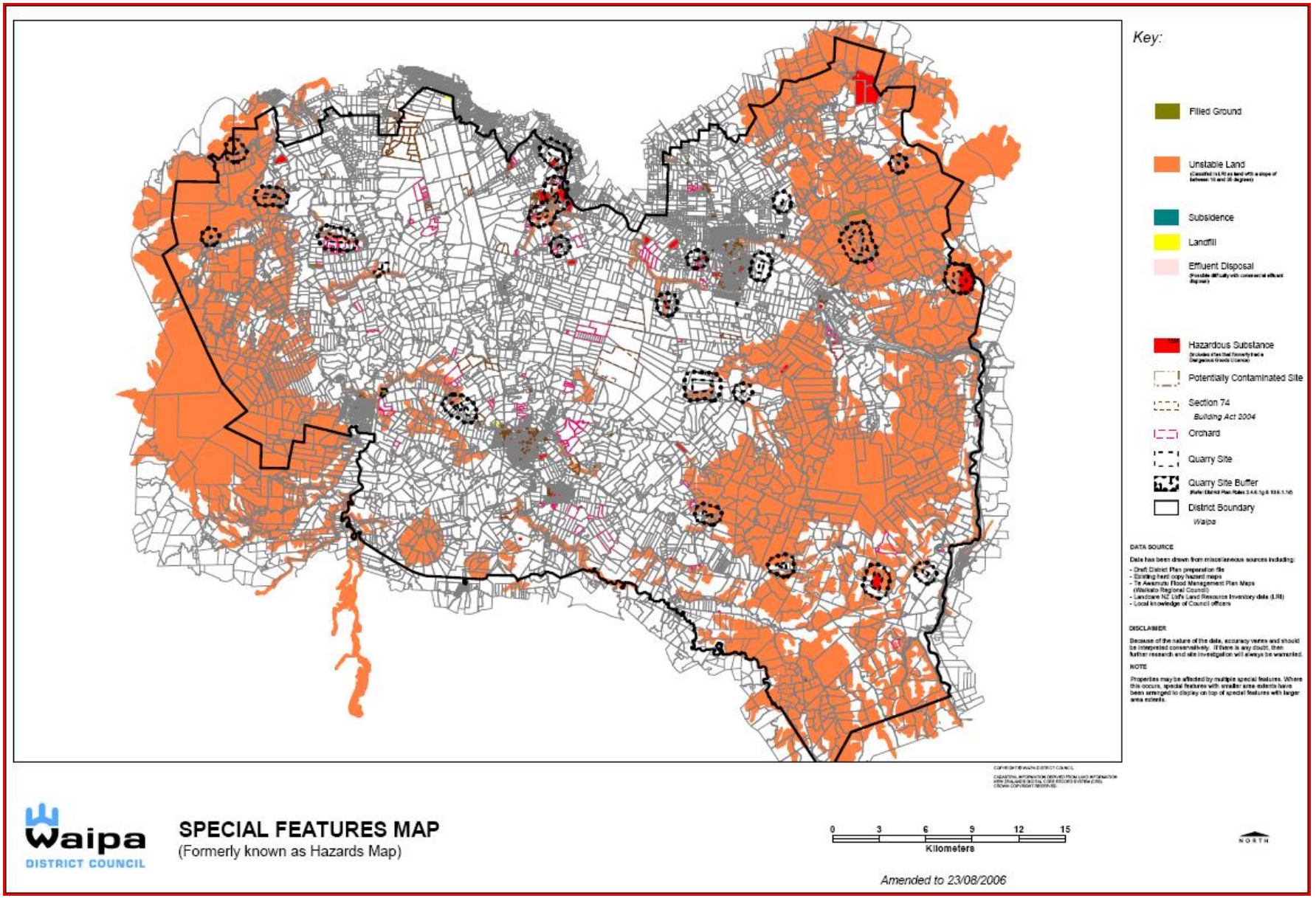
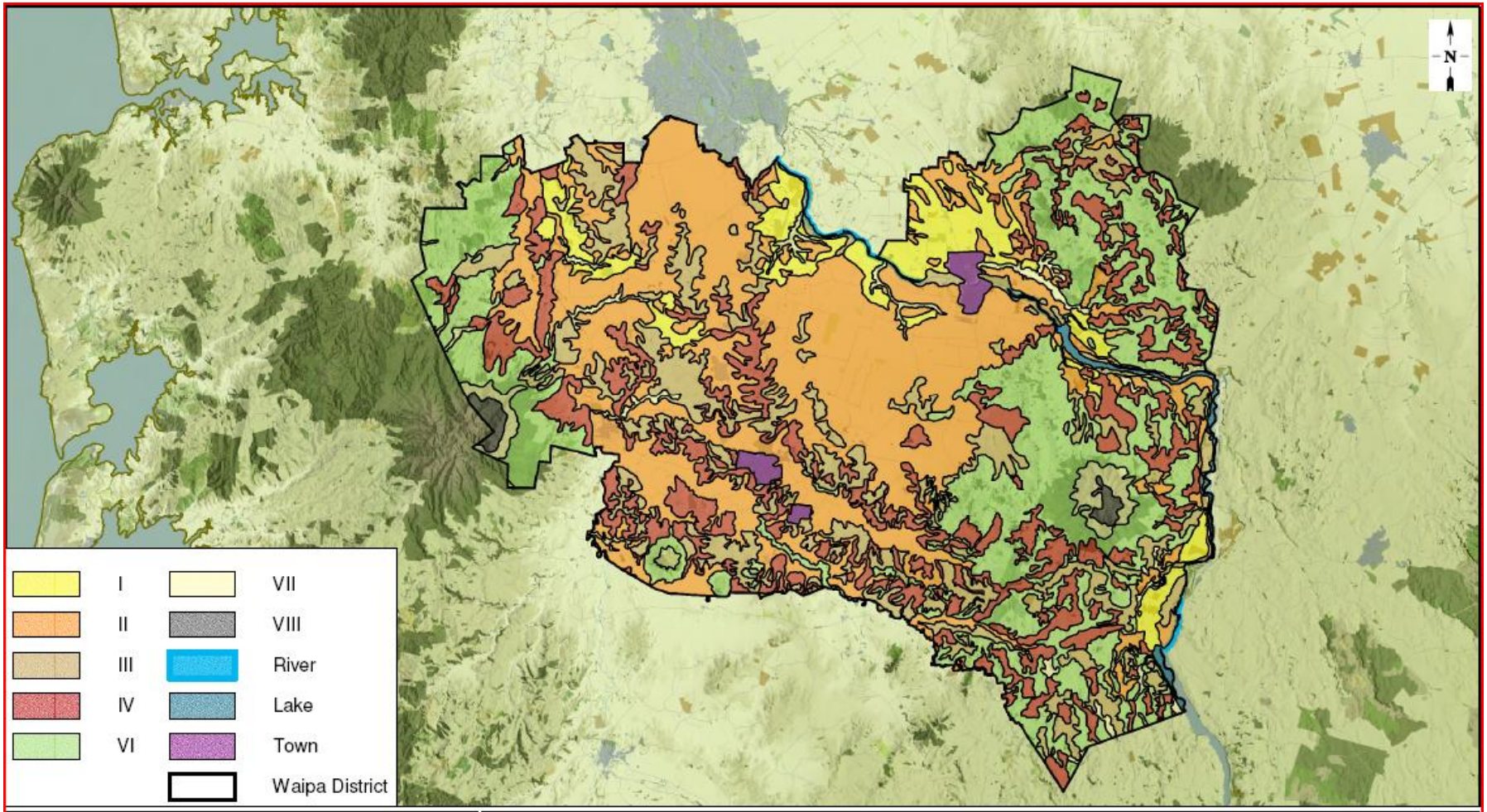


Figure 3: Land Use Capability (Source: Environment Waikato)



Landuse in the Waipa District

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2.4.2 Soil Erosion and Conservation / Catchment Management

Environment Waikato focuses on two types of erosion risk in their soil conservation programmes – stream-bank erosion and 'hill-country type erosion'. The Waipa District has scattered areas of soil prone to erosion and areas with low to medium erosion potential.

In terms of Environment Waikato's catchment management programme, the Waikato Region is divided into a number of catchments. The Waipa District is predominantly in the 'Waipa' catchment zone which includes much of the Pirongia, Kakepuku, and Te Awamutu wards. The rest of the District including the Cambridge and Maungatautari wards and a portion of the Pirongia ward are part of the 'Lower Waikato' zone. Catchment Management projects are predominantly undertaken and funded jointly by Environment Waikato in partnership with landowners. The Waipa zone has a long history of soil conservation with extensive catchment schemes in place. Works have involved fencing, riparian planting, hillside plantings and retirement of land.

For the purposes of this report, catchment management has been discussed within the soils section of this report. However, it is important to note that catchment management involves a holistic approach and that catchment management projects involve flood control mitigation outcomes and positively impact on water quality. In addition, the importance of undertaking biosecurity / pest control projects in tandem with catchment management is becoming increasingly recognised and employed where possible.

In the Mangapiko River and Catchment, Environment Waikato is focusing on reducing the impacts of flooding, bank erosion and improving water quality in the lower catchment, and hill country erosion in the upper catchment. In the Pirongia Streams, Maungatautari Streams, Part of the Punui, Mangaotama, Mangaonua, Karapiro/Waiarumu, Mangawhero, Mangahanene, Waione and Pairere catchments works being undertaken by Environment Waikato are addressing hill country erosion, water quality issues throughout the catchments, biodiversity protection and enhancement projects (Desmond, *pers. comm*. 2008).

Table 1 below provides a summary of priority catchments in the Waipa district as identified by Environment Waikato. The table also provides details regarding the land area assessed as being at risk from hill country erosion, and the lengths of riparian margins associated with the waterways.

Table 1: Integrated Catchment Management Works in the Waipa District

	Piarere	Karapiro / Waiarumu	Mangahanene	Waione	Mangawhero	Mangaotama	Mangapiko	Punui
Total catchment (ha)	679	9075	1003	1346	7345	7538	28430	55675 (part of Punui catchment is in Waipa)
Area of severe erosion (ha)	0	418	0	52	210	112	854	2412
Area to be treated (ha)	0	41.8	0	5.2	21	17	129	362
Riparian bank length (km)	2.8	44	4.8	6.4	9.2	112	708	1786
Length treated (km)	0.7	10	1.1	1.5	2.1	21	131	329

Source: Environment Waikato (2001)

2.4.3 General Soil Issues

Fragmentation of Rural Land

Fragmentation of rural land by urban expansion is an issue in the Waipa district especially around Cambridge and onto very productive/high class land. Such urban expansion takes productive land that could be used for cropping and other agricultural activities and limits future land use options. Soils around Cambridge and Hamilton are regarded as particularly versatile soils[1]. Loss of rural land as a result of subdivision can result in a number of adverse consequences, including: loss of valuable topsoils during road construction and earthworks; greater concentration of septic tank discharges which increases the risk of contamination of ground water; loss and fragmentation of habitat for native plants and animals; and the introduction of domestic animals, which can cause problems for native animals (Taylor, M. *pers comm*., 2008).

Soil compaction

Animal and vehicular traffic can compact soils, crushing the pores where soil organisms like worms live, reducing aeration and infiltration. Without air, plant roots struggle to live. Reduced infiltration means more water runs off over the soil when it rains. This runoff picks up sediment (sheet erosion), nutrients, agrichemicals and animal manure, and can carry them to waterways. In addition, the water runs off more quickly leading to increased flood peaks in streams and rivers. These flood peaks are high energy so are able to cause more stream bank erosion and resulting in more sedimentation in estuaries (Taylor, M. *pers comm*., 2008; Environment Waikato website – Pugging and Compaction).

Nutrients

Soils in the Waipa district are generally naturally low in nutrients and require fertilisation for farming. However, application of fertilisers can have adverse effects on waterways downstream due to eutrophication leading to algae blooms. Phosphorus attaches to soil particles and is transferred to waterways when soil is eroded or mobilised in runoff. Only a tiny amount of phosphorus is required for algae to grow. Nitrogen does not attach to soil so is washed out of the soil to groundwater by drainage. Ground water may take days to years to millennia to travel to waterways so impacts can be greatly delayed (Taylor, M. *pers comm.,* 2008; Environment Waikato website – Managing Farm Nutrients; Environment Waikato website - Cultivation).

Nutrient runoff is also a significant issue affecting peat lakes. This issue needs to be addressed within the district plan in order that tighter regulations are put in place to better manage current land use practices and their associated effects on water quality. As land use, land management and nutrient runoff are issues dealt with by both the Regional and District Council, and it would be beneficial to develop a joint management strategy between Waipa District Council and Environment Waikato in order to manage Waipa's peat environments in an integrated way.

2.4.4 Contaminated Land

Another issue facing the Waipa District is contaminated land. The presence of a number of different contaminants within the soil can place constraints on growth and development as contaminated sites may require further investigation or remedial works prior to development, and may preclude some types of development (e.g. schools, childcare facilities, or residences). While the presence or potential presence of contaminants is not desirable for residential or other development, such sites are not necessarily precluded from development altogether. The Ministry for the Environment (MfE) has produced best practice guidelines which set out the processes by which potentially contaminated land should be investigated, and if necessary,

[1] Soil versatility is a measure of what uses a soil is best suited to. Very versatile soils are suited to a wide range of uses – including cultivation and cropping which are very demanding on soil. Soil versatility considers: the potential rooting depth of plants; how well the soil can withstand traffic (both vehicles and animals); the potential loss of nutrients from the soil; the potential risk of erosion; the water deficit – whether there is enough water in the soil for plants; and soil drainage.

remedial works undertaken. Contaminated land site investigations are often required by councils as part of the development conditions to ensure that soils being excavated and moved are managed appropriately.

Environmental Effects

A site is considered contaminated when a hazardous substance (or mixture of substances) is present in the site soil, groundwater or surface water at concentrations above guideline levels, or that pose a threat to human health or the environment. Because many hazardous substances do not break down, or take many years to start to break down, contamination can have occurred in the past without present owners being aware of it.

People, animals and the environment can be exposed to hazardous substances on contaminated land in a number of ways, including direct contact with contaminated soil, swallowing food or water from contaminated environments and breathing vapours or contaminated dust. Exposure to hazardous substances can have significant adverse effects on human health and on soil, surface water, groundwater and ecosystems. As well as endangering health, these substances can limit the use of land, cause corrosion that may threaten building structures, and reduce land value. Contamination is not always limited to a specific site as hazardous substances may seep through the soil into groundwater, or be carried to nearby land and waterways in rainwater or on dust particles (MfE – Contaminated Land, 2008).

Hazardous Substances and Industries

The MfE has developed a Hazardous Activities and Industries List (HAIL). This list is a compilation of activities and industries that are considered likely to cause land contamination resulting from hazardous substance use, storage or disposal. Examples of sites that can be contaminated are service stations, sheep dips, paint factories, timber treatment sites, gasworks, landfills, scrap yards, orchards (MfE, 2003).

Environment Waikato HAIL Records

Environment Waikato records identify 348 properties in the Waipa district as being used (either formerly or currently) for a HAIL activity. Environment Waikato has categorised these properties as follows:

Table 2. Environment Waikato HAIL Activities

Status	Number of Properties in Waipa District
Confirmed contaminated	7
Sites not yet investigated or land use verified (i.e. where activities listed in the HAIL may have taken place, or are taking place, but this has not yet been independently verified)	310
Land use verified (i.e. sites where activities listed in the HAIL have taken place, or are taking place)	6
Properties deemed suitable for the current land use	10
Remediated sites	6
Currently under investigation	9

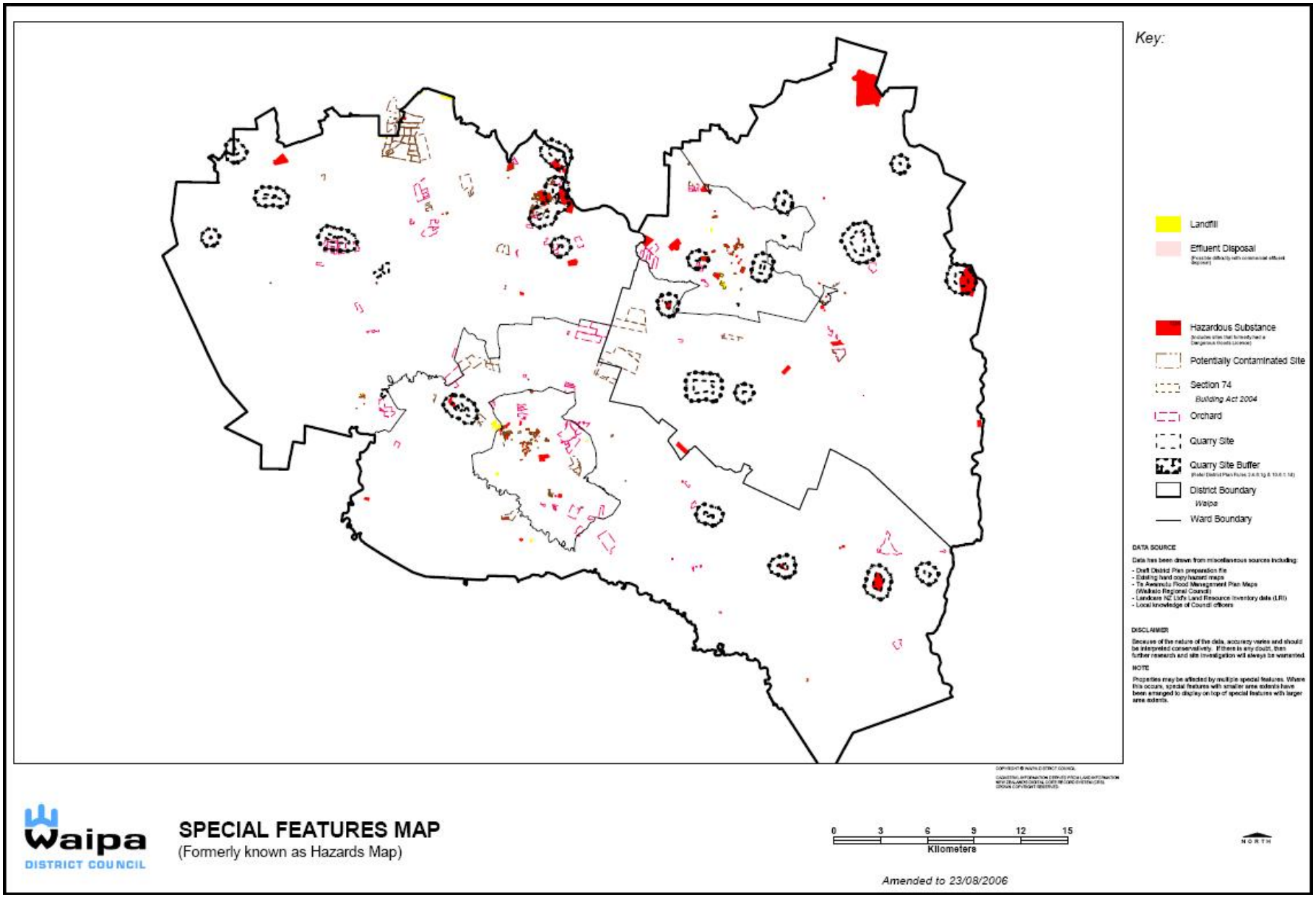
The seven contaminated sites (from Environment Waikato records) consist of four landfills, one gasworks, and two service stations. These sites are located in Cambridge, Te Awamutu, Pirongia and Kihikihi.

Table 2 demonstrates that the majority of sites have not been investigated or the HAIL activity verified. It is important to note that both Waipa District Council and Environment Waikato records are under development and therefore incomplete, and that these authorities records regarding contaminated sites in the Waipa District have not been integrated at this point (Begbie, M. pers comm., 2008).

Types of Contaminated Sites

Figure 4 below shows the general location of hazardous substances and potentially and confirmed contaminated sites within the Waipa District, from both Waipa District records and Environment Waikato records. However, it is noted that there may be many more sites within the District that are potentially or actually contaminated, and as a result of different types of activities.

Figure 4: Special Features Map -Contaminated Land and Hazardous Substances (Source: Waipa District Council)



a. Landfills

Former landfills have the potential to contaminate the soil, groundwater and surface water, through leachate and landfill gas. The types and magnitude of contamination will vary depending on the range of materials present within the landfill, the 'design' of the landfill and the amount of leachate. Older and informal landfill sites (e.g. old quarry sites used as rubbish tips) often have the greatest potential for contamination, as they were often not specifically designed for that purpose, and there was little or no control over the materials dumped. Such sites are therefore generally not lined, and contain a variety of contaminative materials. Hazardous substances within a landfill site are dependent on the original waste composition but may include hydrocarbons, BTEX, PAH's, metals, organic acids, landfill gas and ammonia (MfE, 2003). Figure 4 shows the location of 10 landfill sites in the Waipa District.

b. Gasworks

When a national natural gas reticulation system was set up during the 1970s and 1980s, gasworks (involving the manufacture of town gas from coal or oil feedstocks) in New Zealand were gradually closed. Gasworks can contain hazardous substances such as PAHs, phenolics, BTEX, metals (particularly arsenic, lead, copper, and chromium), cyanide compounds, sulphides and sulphates, thiocyanates, ammonia, nitrates and coke. The manufacturing process generated a number of by-products and wastes, such as coal tar, spent oxide, purifier waste, ash and clinker, many of which were disposed of both on and off-site. These wastes contain substances that are potentially hazardous to human health. When many of the sites were closed, underground structures containing many of these contaminants were left. The processes affecting the fate and transport of contaminants associated with gasworks sites depend heavily on their chemical and physical properties, and the soil and groundwater characteristics of each site. According to Environment Waikato records, there is at least one gasworks site confirmed contaminated in the Waipa District. The MfE has published guidelines for assessing and managing contaminated gasworks sites in New Zealand (MfE, 1997; MfE, 2003).

c. Service Stations

Service stations can contain hazardous substances such as hydrocarbons, lead and copper. There are a number of sites within the Waipa District where services stations have been previously located and it is unclear whether these have been properly decontaminated. EW has confirmed two contaminated service station sites however it is likely there are more potentially contaminated sites due to service station activities. The MfE has produced guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE, 2003).

d. Orchards

Land contamination on historical horticultural sites is due to routine activities such as spraying pesticides and herbicides. Sprays were generally applied or used over the entire site; however, specific areas may have highly elevated levels of contaminants. Areas of concern include glasshouses, spray storage sheds, spray equipment washdown areas, bulk storage areas and areas of uncontrolled dumping or landfilling of chemical containers. Contaminants of concern on historic horticultural land include DDT, DDD, DDE, lindane and dieldrin, as well as metals such as cadmium, arsenic, nickel, copper, lead, zinc and chromium (Ministry for the Environment, 2003). It is expected that a number of properties in the Waipa District may have contaminated soils due to previous horticultural use. Figure 4 demonstrates the large number of current and historical orchards in the Waipa District.

e. Timber Treatment Sites

Chemical treatment has been used for many years throughout New Zealand for the preservation of timbers, particularly softwoods. Chemicals used as part of the process and of concern are PCPI copper, chromium, arsenic (CCA), boron organo-tim, PAHS and phenolics (creosote), organoclorine pesticides and

pentachlorophenol (PCP). These contaminates are found in residue in soils and groundwater (Ministry for the Environment, 2003).

f. Scrap Yards

Scrap yards (automotive dismantling, wrecking yards, and scrap metal yards) can contain hazardous substances such as metals, hydrocarbons, and solvents. It is important that these historical sites are identified and the effects of these uses on the soils investigated.

g. Cowsheds/Sheep Dips

Livestock dips could be a major contributor of contaminated sites in the Waipa District, due to the land use history of the District. Livestock dips can contain hazardous chemicals including arsenic, organochlorine and organophosphates, carbamates, and synthetic pyrethroids. Although these sites are not identified on the map or confirmed in Environment Waikato records, the potential for these sites should be considered at any detailed investigation stage.

While the above addresses the key issues in the Waipa District, a more complete list of activities and industries which may be associated with contaminants is available on the Ministry for the Environment website.

2.5 Water Quantity and Quality

The following briefly describes the quality and quality of water in the Waipa District as it relates to growth and development. Water quantity in terms of flooding has been discussed in the natural hazards sections. Further details of the current water supply sources and water treatment and implications for growth are provided in the Infrastructure Profile statement.

Water quality with respect to ecological health and for contact recreation is discussed in this section. As there are no coastal waters pertaining to the Waipa District the following discussion relates solely to freshwater.

2.5.1 Water Supply

Figure 5 below illustrates the extensive network of rivers, streams and lakes present in the Waipa District, including the aquifers which underlay the area.

The most significant surface water feature in the Waipa District is the Waikato River in the east of the district, with the Waipa River forging its way in the west. A large number of streams and lakes also criss-cross the district. Lake Ngaroto is the largest of the Waipa peat lakes and located between Te Awamutu and Hamilton. Lake Karapiro in the east of the district provides an important recreational feature to the population beyond the Waipa District. Lake Arapuni in the south east of the district also provides for recreation in the form of trout fishing and other water sports. Lake Karapiro and Lake Arapuni, both manmade lakes, are also significant as they are the largest lakes in the Waikato hydro system.

Areas of current and potential future water supply may be susceptible to potential contamination by growth and development. Figure 6 below shows the location of water take permits in the district. Fifty-three water take permits currently exist in the Waipa district. Many of the water take permits are located along the Waikato River or Lake Karapiro. Twenty-nine water permits are for ground water takes with the remaining twenty-four for surface water takes.

The vast majority of water permits are for irrigation purposes associated with horticulture and some associated with agriculture, for example stock watering and dairy shed cleaning. Three water take permits are for irrigating golf courses. Eight factory or industry water takes also exist and are associated with dust suppression and quarry/mining related activities. Two water takes are also associated with airport activities (industrial and domestic). Two water take permits are for domestic purposes, and a number of consents are for water supply

to towns (Cambridge, Karapiro, Kihikihi are specifically listed). A full list of details of these water take permits is provided in Appendix B.

The Proposed Waikato Regional Plan Proposed Variation No. 6 – Water Allocation includes new objectives to ensure that water is available to meet the needs of communities, continued water is available for renewable energy generation and that water for instream requirements during water shortages is available. Policies are included which establish allocable and environmental flows from surface water and establish sustainable yields from groundwater. These policies state, among other matters, that particular regard will be had to the maintenance and enhancement of water quality, instream ecological values, renewable energy generation, and avoidance of depletion of ground water. New policies state how ground and surface water will be allocated.

The town of Cambridge receives its water from Lake Karapiro, whilst Te Awamutu receives water supply from the Maungauika Stream catchment on Mount Pirongia. Refer to the infrastructure report for more information on water supply.

Figure 5: Aquifers and Water Bodies in the Waipa District (Source: Environment Waikato)

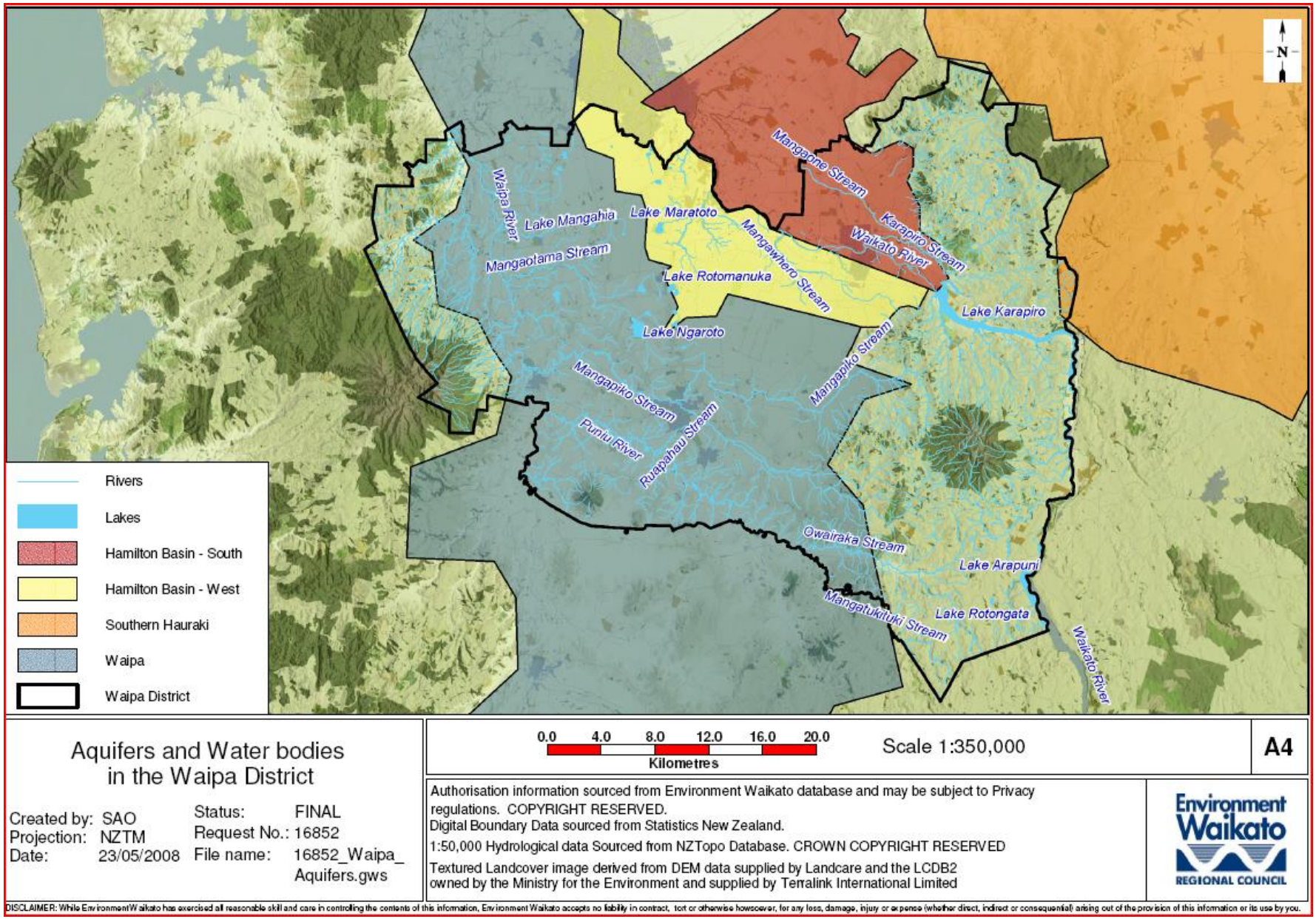
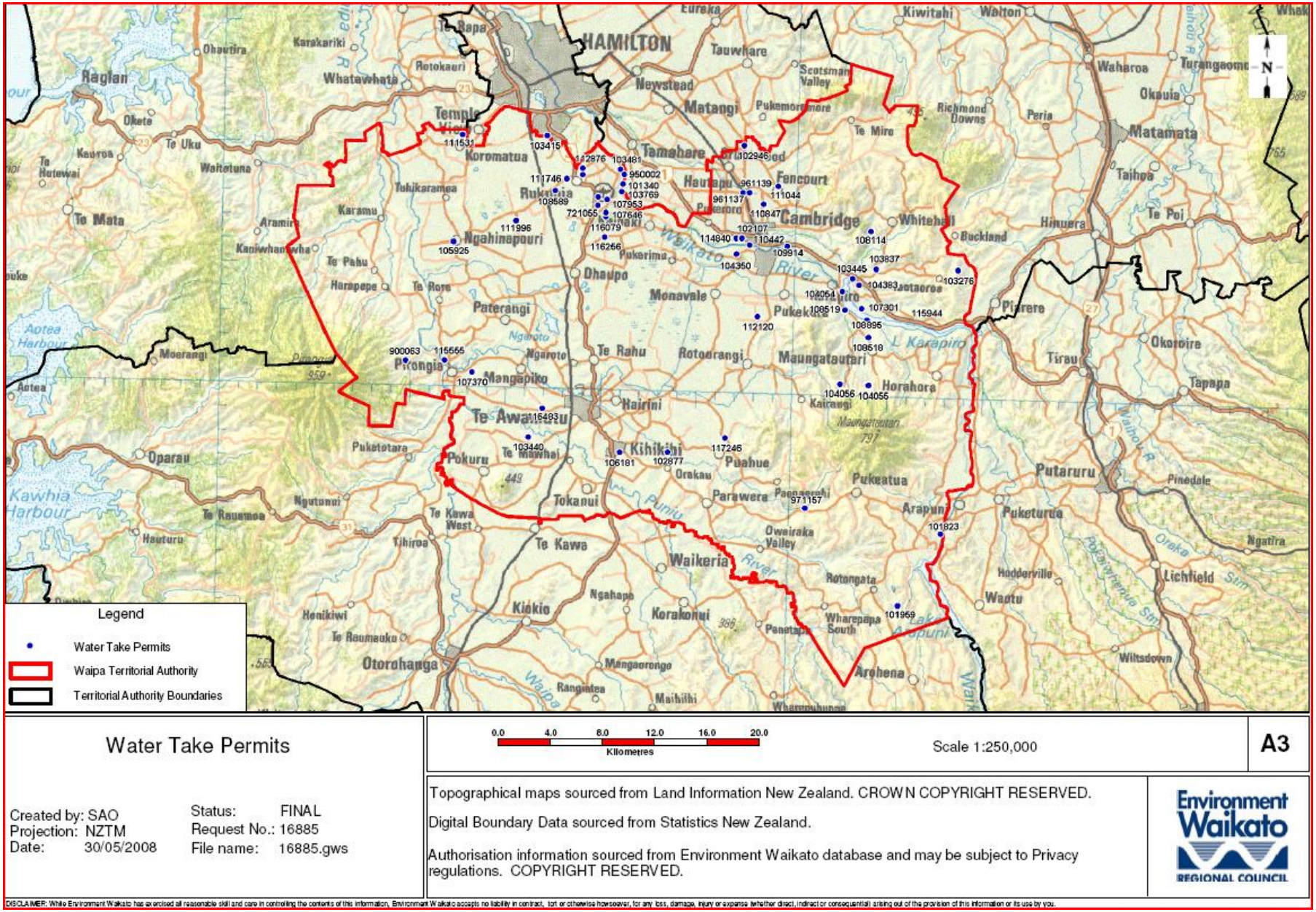


Figure 6: Water Take Permit Locations (Source: Environment Waikato)



Water Take Permits

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Projection: NZTM
Date: 30/05/2008

Status: FINAL
Request No.: 16885
File name: 16885.gws

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2.5.2 Water quality

The Waikato Region has over 16,000 kilometres of rivers and streams. Rivers and streams provide:

- a place to play, swim, fish, water-ski, kayak
- a home for aquatic plants and animals
- a source of food such as koura, inanga, eels (tuna)
- water for drinking, industry and agriculture
- hydro-electricity
- wastewater treatment
- a source of spiritual renewal
- a focus for community and cultural events.

However, all such uses are affected by the quality of the water. Clean water is important both for ecosystems and for the economy. In a 2000 survey, Waikato people thought that water pollution was one of the most important environmental issues facing the region (Environment Waikato website – Rivers, Lakes and Wetlands).

Rivers and streams in the Waipa district have been altered dramatically since European settlement through damming, diversion, water takes and discharges. Exotic plants and animals have also been introduced, and land adjacent to water bodies has been cleared for agriculture, forestry and urban development. These activities increase the amount of runoff entering rivers and streams and can also lead to the introduction of nutrient-rich products and contaminants which affect the quality of the water (Environment Waikato website - Rivers, Lakes and Wetlands; Kessels Associates Limited 2006).

For example, the Mangapiko Stream, in Te Awamutu has been extensively altered by the intensive agriculture surrounding the stream. The water quality is poor with high levels of bacterial contamination resulting from the wastewater treatment plant effluent; dairy factory effluent from Fonterra, and urban stormwater discharges from the Te Awamutu township. Pollution impacts have affected the stream ecology leading to pollution-sensitive species being absent in more contaminated parts of the stream (Kessels & Associates, 2006).

Environment Waikato measures water quality at 100 sites in the region of which nine are in the Waipa district. Water quality is also measured with respect to ecology (river biology) at 125 sites across the Waikato region, of which 26 are in the Waipa district. Refer to Appendix C for location maps of the water quality monitoring site locations.

Ecological Water Quality

Ecological water quality is measured to determine its suitability for aquatic plants and animals. Chemical and temperature characteristics are measured including the following variables for the following reasons:

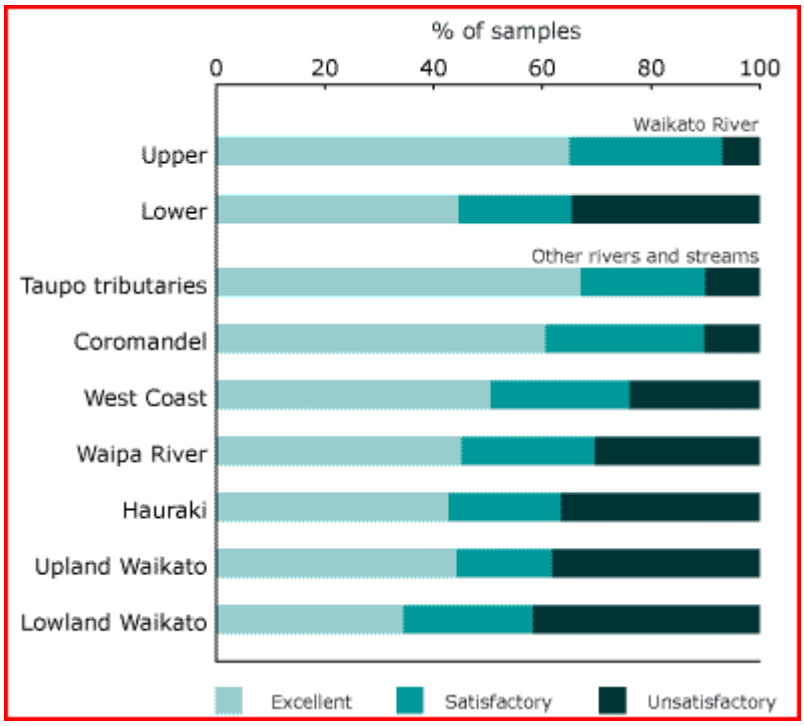
Table 3: Water Quality Indicators Monitored

Variable	Reason for monitoring
Dissolved oxygen	Oxygen for aquatic animals to breathe
pH	Can affect plants and fish
Turbidity	Can restrict plant growth
Ammonia	Toxic to fish
Temperature	Fish spawning: May-Sep Fish health: Oct-Apr
Nitrogen	Causes nuisance plant growth
Phosphorus	Causes nuisance plant growth

Source: Environment Waikato website – River Quality

Figure 7 below refers to the physical and chemical characteristics of rivers and streams in the Waikato Region and how suitable these water bodies are for freshwater plants and animals. The graph illustrates the percentage of rivers and streams meeting Environment Waikato guidelines for river water quality for ecological health according the levels of the variables above. As the graph shows, the Lower Waikato River, the Waipa River, and the Lowland Waikato rivers and streams all have average water quality with a reasonable proportion showing unsatisfactory results of water quality tests.

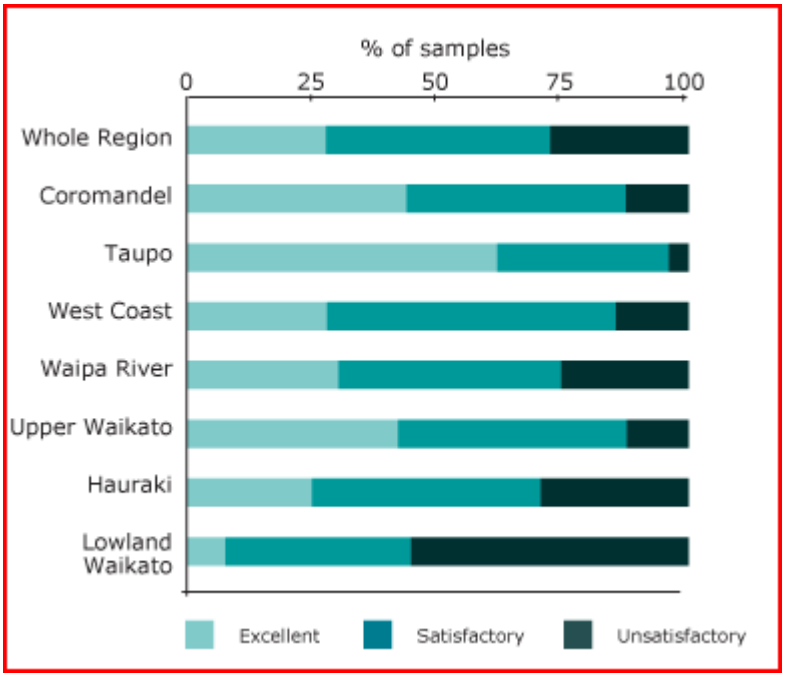
Figure 7: River Quality for Ecological Health, Waikato Region



Source: Environment Waikato website – River Water Quality

Similarly Figure 8 below illustrates the ecological health of streams and rivers in the Waikato Region. The results for both the 'Waipa River' and 'Lowland Waikato' are relevant to the Waipa District. As illustrated above, the streams and rivers in the Waipa have an average level of ecological health. More than half of the samples taken in the 'Lowland Waikato' region indicated that the water quality was unsatisfactory for ecological health. Water quality tends to be worse in areas with intensive land use due to the reduced riparian forest cover, such factors may also lead to an increase in stream erosion as a result of development (Environment Waikato website – River Biology).

Figure 8: Ecological Health of Streams and Rivers in the Waikato Region



Source: Environment Waikato website – River Biology

The clearing of vegetation has also made stream temperatures more variable (as less shade is now provided by forest cover), and therefore less suitable for many native aquatic animals and plants. Freshwater ecological systems have also been affected by other aspects of development including:

- barriers to fish passage
- reduced water quality
- changes to flow regimes
- habitat loss (due to drainage and changes in land use).
- introduced species competing with or eat our native fish and thereby becoming pests (Environment Waikato website – Stream and River Life).

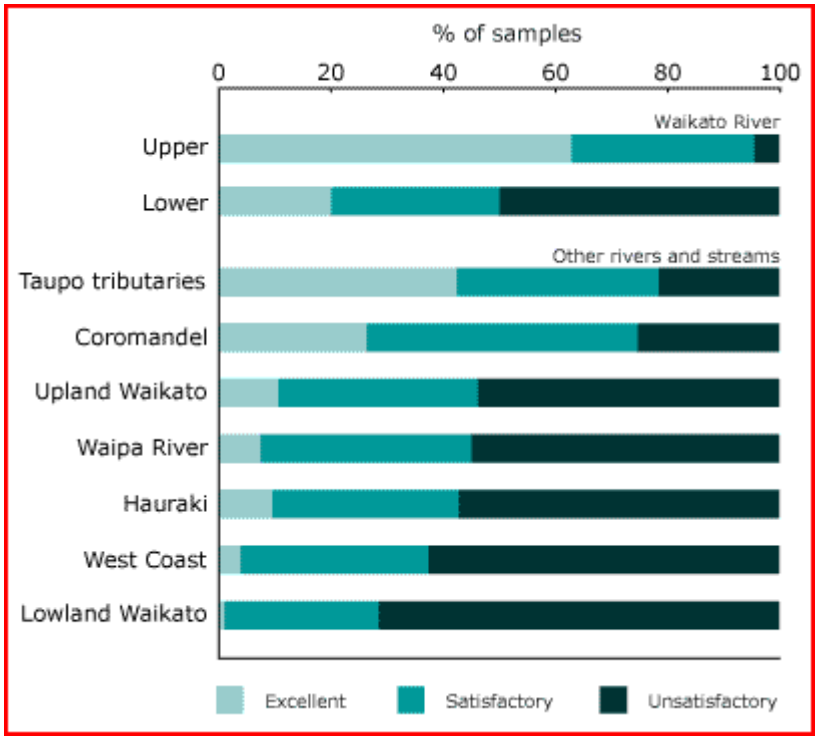
River Quality for Contact Recreation

Environment Waikato monitors water quality for contact recreation, for example swimming, kayaking and water-skiing. The two main indicators are water clarity and levels of *E. coli* bacteria (derived from excreta).

Water quality is an issue for contact recreation as water may be swallowed or come into contact with nasal passages, ears, or cuts in the skin. Usually the health effects of poor water quality though unpleasant are short-lived and involve gastro-enteritis, or respiratory problems. However sometimes more long-term effects may result including Hepatitis A, giardiasis, cryptosporidiosis, campylobacteriosis and salmonellosis (Ministry for the Environment, 2003).

Figure 9 below illustrates the percentage of samples meeting Environment Waikato's guidelines for water quality for contact recreation. Rivers and streams in the Waipa district are included in the results for Lower Waikato River, Waipa River and Lowland Waikato and tend to have poorer water quality and are frequently assessed as unsatisfactory for contact recreation. This is as a result of the district having relatively intensive development.

Figure 9: Water Quality for Contact Recreation, Waikato Region



Source: Environment Waikato website – River quality for contact recreation

2.5.3 Lake Water Quality

Lakes in the Waikato Region have experienced significant changes to surrounding land uses and as a result lake quality has been impacted upon. The three main factors causing decline in ecological health in the Waikato include:

- declining water quality – conversion of forested lake catchments to agriculture; drainage of wetlands; removal of lake-margin vegetation; fertiliser application leading to nutrient enrichment and siltation;
- invasive fish species – introduction of non-native species contribute to deterioration in water quality and decline in submerged vegetation; and,
- invasive plant species – displacing indigenous submerged vegetation which often leads to vegetation collapse. Devegetated lakes have high biomass algae growth or re-suspicions of bottom sediments reducing water clarity and leading to inability of plant species to re-establish (Environment Waikato website – Rivers, Lakes and Wetlands).

Lake ecology in the Waipa District has also been affected by growth and development. An assessment of the water quality of ten lakes across the Waikato Region studied three peat lakes in the Waipa district – Lake Koromatua, Lake Mangahia and Lake Serpentine. Dune and riverine lakes in the region were also monitored in this study but only the aforementioned peat lakes were in the Waipa district. Zooplankton levels and species were monitored as an indicator for the eutrophication levels in the Waikato lakes (Duggan 2007).

The study found that Lake Koromatua was hypertrophic; Lake Mangahia was supertrophic and Lake Serpentine was mesotrophic. The peat lakes tended to have higher trophic levels than the riverine and dune lakes (Duggan, 2007) with the exception of Lake Serpentine. This is a result of their location in modified landscapes where the lakes are receiving runoff from agricultural land. Lake Serpentine, conversely is in a predominantly pristine location surrounded by a regenerated area of native forest and therefore had significantly better results for water quality.

Edwards *et al* (2007) conducted a study to assess the condition of 41 lakes in the Waikato region based on condition and composition of aquatic plants. Eleven of the lakes studied were Waipa peat lakes. The study used submerged plant indicators (SPI) to assess and report on lake condition: pre-impact; historical condition (using historical data); and present day indices were used. The indicator assesses both the make up of native plants and the prevalence of non-native invasive species which tend to be an indicator for poor lake health (Edwards *et al*, 2007). All lakes showed deterioration from the pre 1900 'pristine state' indices, however, more of the peat and riverine lakes had deteriorated, and 78% of those lakes were de-vegetated altogether. Lake Mangakaware was one exception and gained a 'satisfactory' score as it contained some vegetation despite the presence of invasive weed species (*Egeria* and *Elodea canadensis*). The three Lake Serpentine lakes were also notable as they scored best overall, and were considered to be in an 'excellent' condition. This is due to the lake being one of the few to remain un-impacted by invasive plant species and is contains well-developed solely native vegetation. However, the study also found that even Lake Serpentine was exhibiting signs of stress indicated by the high abundance of algal growth attached to plants surfaces which could lead to a rapid decline in plant cover. Herbivorous rudd was also found in the lakes and a fish removal programme has been implemented by management agencies health (Edwards *et al*, 2007).

2.6 Ecology and Biodiversity

The Waipa District's alluvial flats, low rolling hills, volcanic peaks, peat swamps, lakes, river and river terraces contain a number of areas of ecological significance and biodiversity value. The Waipa District comprises seven different ecological districts (EDs), the location and extent of which are shown in Appendix D.

In March 2007, Wildland Consultants produced a report entitled *Natural Heritage of Waipa District* to assist Waipa District Council in managing areas of indigenous vegetation and habitat for indigenous species. This report, and a report entitled 'Promoting the Protection of Natural Heritage within Waipa District' have been used as the basis for this section of the Profile Statement.

2.6.1 Forests

Waipa's most significant forests are currently located on:

- Pirongia Mountain (12,000ha)
- Maungatautari Mountain (3,500ha);
- The central uplands of Maungakawa and Te Miro (Te Tapui is within Matamata-Piako District but forested areas are adjacent to the Waipa district); and
- The western uplands beyond the Waipa River from Kupumahanga Range south to Kaniwhaniwha.

Other forests are associated with isolated Scenic Reserves like Horahora on the western shores of Lake Karapiro, Te Reti at Paepaerahi south west of Maungatautari and Mt Kakepuku south of Te Awamutu. Around 10,912ha of indigenous forest and scrubland remain within the district. These are predominantly podocarp–hardwood forests, a forest type which covered much of the lowlands in the central North Island. For example, the lower slopes of Pirongia Mountain are covered in podocarp/broadleaved forest (scattered emergent rimu and northern rata over a tawa-dominated canopy). Sub-canopy species include rimu, northern rata, tawa, wheki, ponga and nikau. Pigeonwood, hinau, pukatea, supplejack, mahoe, hangehange, kanono and toropapa are also present. At higher altitudes, these species are replaced by kamahi, tawari, Hall's totara, tawheowheo, and horopito, and kaikawaka near the summit (Waipa District Council, N.D.).

Forest Fragments

In the Waipa District, approximately 20% of native forest occurs in fragments less than 25ha in area, with the largest remnant being Yarndley's Bush at 14.5ha.

Forest fragments are important for a number of reasons, including:

- Some forest types (such as kahikatea stands) now only occur as fragments.
- Fragment vegetation helps prevent soil erosion and maintain water quality.
- Birds can use them as 'stepping stones' to move between the larger forest areas.
- They can be core areas for habitat restoration or sources of plant material for restoration.
- They provide a source of native seeds that birds or wind can carry across the landscape to other natural areas.
- Their native insects may help pollinate nearby crops or control pests.

Kahikatea stands make up a very small percentage of forest fragments overall. Nonetheless, kahikatea is the dominant tree of these stands, with varying contributions of matai, totara and rimu depending on the influence of drainage. Most kahikatea stands in the Waikato lowlands are relatively young forest fragments, and it is unlikely many new areas of kahikatea stands will develop in the Waikato (as flood events are now controlled). The sub-canopy and under storey trees can include pukatea, tawa, pate, mahoe, titoki, cabbage tree and very occasionally swamp maire. Characteristic small leaved trees and shrubs include the milk tree/turepo, smalled-flowered mahoe, Coprosma areolata, and the round-leafed coprosma. Ground cover is largely ferns and spleenworts (Environment Waikato website – Forest Fragments).

Fauna of Forests and Scrublands

The larger forests such as Maungatautari provide habitat for native bird fauna, including (Wildland Consultants, 2007):

- North Island Brown Kiwi
- Australasian harrier
- New Zealand bush falcon (Karearea)
- Pukeko
- Wood pigeon (Kererū)
- Shining and long tailed cuckoo
- Morepork
- New Zealand Kingfisher
- Welcome swallow
- Grey Warbler (Riroriro)
- North Island fantail (Piwakawaka)
- North Island Tomtit (Miromiro)
- Silvereye
- New Zealand Bellbird (Korimako)
- Tui

Many of the bird species are mobile and will utilise a range of habitats as food becomes seasonally available, while others are 'residents' at a site or cluster of sites (Waipa District Council, N.D.).

Herpetofauna in Waipa forests include the copper skink, common gecko, forest gecko, and the threatened Pacific gecko, Hochstetter's frog, Auckland green gecko and speckled skink. Pekapeka and the long-tailed bats, are endangered mammals. Many of these species are more likely to occur in the larger and more intact forests, as small, isolated pockets of native forest are often too small to support some native plants or animals (Waipa District Council, N.D.; Wildland Consultants, 2007).

The Maungatautari Ecological Island Trust has been established to lead a community project to restore the ecology of Maungatautari. The vision of this Trust is to remove introduced mammalian pests and predators from Maungatautari, and restore to the forest a healthy diversity of endangered flora and fauna species which have been lost from the area, such as the tuatara, kiwi, kakariki, saddleback, stitchbirds. Pests have been removed from the mountain and in 2007 the pest-proof fence around the forest perimeter was completed. At present, kiwi, takahe and kaka live on the mountain as well as the native bird species listed above. Maungatautari Mountain is also home to a large number of native beetles, and Hochstetter's frog (Maungatautari Ecological Island Trust website).

Pirongia and Kakepuka Mountains also have active restoration groups.

2.6.2 Wetlands

Wetlands are permanently or temporarily wet areas that support plants and animals adapted to wet conditions. The Waikato peat lakes are nationally significant and represent the largest collection of this type of wetland in New Zealand. A significant area of the Waikato's peat lands are found in the Waipa district, as illustrated in Figure 10 below.

As well as being important areas for recreation, wetlands support a number of species which are rare and endangered and have adapted to living in the conditions provided by the peat lakes and adjacent wetlands. Wetlands are now some of New Zealand's rarest and most at-risk ecosystems: about 5% of the Waikato Region used to be covered by wetlands, but today only they only cover 1%. Seventeen of the remaining Waikato peat lakes are in the Waipa district and these lakes support a diverse range of bird species, native fish, invertebrates, and native plants adapted to the wet and peaty conditions (Waipa District Council *et al,* N.D.). The Moanatuatua Scientific Reserve, north east of Te Awamutu is one of the few sites in New Zealand where the rare giant cane rush occurs (Environment Waikato website – *where are our wetlands*).

Wetlands also provide a number of advantages to their surrounding environments including:

- storage of floodwaters as they soak up excess flood water and slowly release it;
- improving water quality as wetland plants trap sediment suspended in water and bacteria living in wetland soils absorb and break down nitrogen from farm run-off and leaching;
- reducing erosion as in riparian areas, their roots hold riverbank soil together; and,
- healthy peat wetlands operate as carbon sinks thereby reducing the climate change emissions (Environment Waikato website – Freshwater Wetlands).

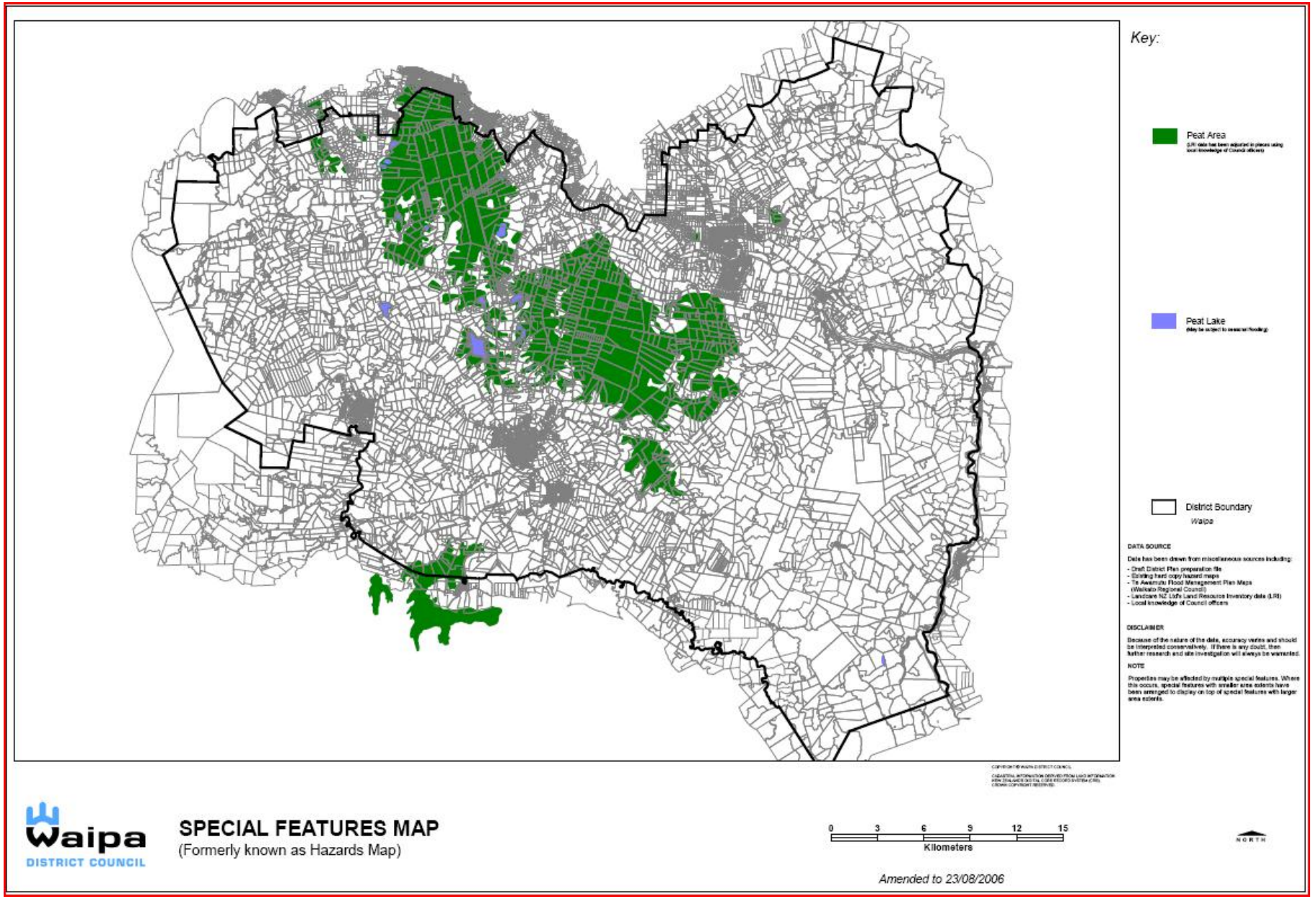
Peat Lakes - Peat lakes are productive systems that support complex biological communities. The greatest diversity of plants and animals is found in the lakes with relatively clear water and higher pH, however those with dark peat stained water, also support interesting species (whirligig beetles, water mites (recorded for the first time in NZ from Lake Maratoto) freshwater jellyfish, leeches and communities of copepods). Most lakes support beds of submerged exotic plants which have largely replaced the native communities. Lake Serpentine (Rotopiko) is the only lake that supports beds of submerged native plants; tall emergent reeds such as spike rush and raupo grow around the edges of the open water. Behind these reeds are floating rushes, sedges, grasses, ferns and mosses, and an outer fringe of peat tolerant woody species. Threatened plant species include swamp helmit orchid, bog club moss, stout water milfoil, bamboo rush, giant wire rush, yellow bladderwort, and bladderwort (Waipa District Council, N.D).

Peat Bogs - The only remaining peat bog in the Waipa District is the Moanatuatua Scientific Reserve located east of Ohaupo. Once a 14,900 hectare area of peat bog, today it measures just 114ha area. This Reserve supports a natural cover of peat forming restaid vegetation such as the threatened giant cane rush (one of three sites where this plant occurs in NZ), and wire rush and tangle fern. Bog communities do not support abundant fauna. Resident species include the North Island fernbird, Australasian harrier, and the fantail, grey warbler and welcome swallow (Waipa District Council, N.D).

Fauna of Peat Lakes

These peat lakes provide habitat for a variety of resident and frequenting native water birds. Grey duck, grey teal, shoveler duck, black swan, little black shag, black shag, and occasionally NZ scaup and New Zealand dabchick frequent the open water areas. White-faced heron, pied stilt, and Australasian bittern, can be found wading within the swampy margins of these lakes. Marsh crake has recently been recorded on the southern shores of Lake Ngaroto, and banded rail has been recorded at Lake Koromatua, potentially in response to predator control around the lake. The vegetated margin also provides habitat for fantail, grey warbler, welcome swallow, North Island fernbird and numerous introduced finches, thrushes, magpies and pheasants. Threatened fish species in the Waipa District include the longfin eel and giant kokopu (Waipa District Council, N.D; Wildland Consultants, 2007). However, fauna numbers tend to be low and the lakes no longer represent a habitat containing a significant indigenous fishery owing to the effects of the surrounding agricultural land use.

Figure 10: Location of Peat Lakes and Wetlands (Source: Waipa District Council)



Waipa River Margins

A very small part of Tokoroa ED is within the Waipa District (2ha). This area consists of grasslands, margins of the Waikato River and open water. Water birds are common along the Waikato River and its margins, or example the grey duck. Other indigenous species include the welcome swallow, kingfisher, pied stilt, mallard, spur-wing plower, white-faced heron and pukeko. Rainbow trout, bulleys, lamprey, and long and short-finned eels are present within the Waikato River (Wildland Consultants, 2007).

2.6.3 Threatened Environments and Species

In 1840 the vegetation of Waipa District was estimated to be as follows:

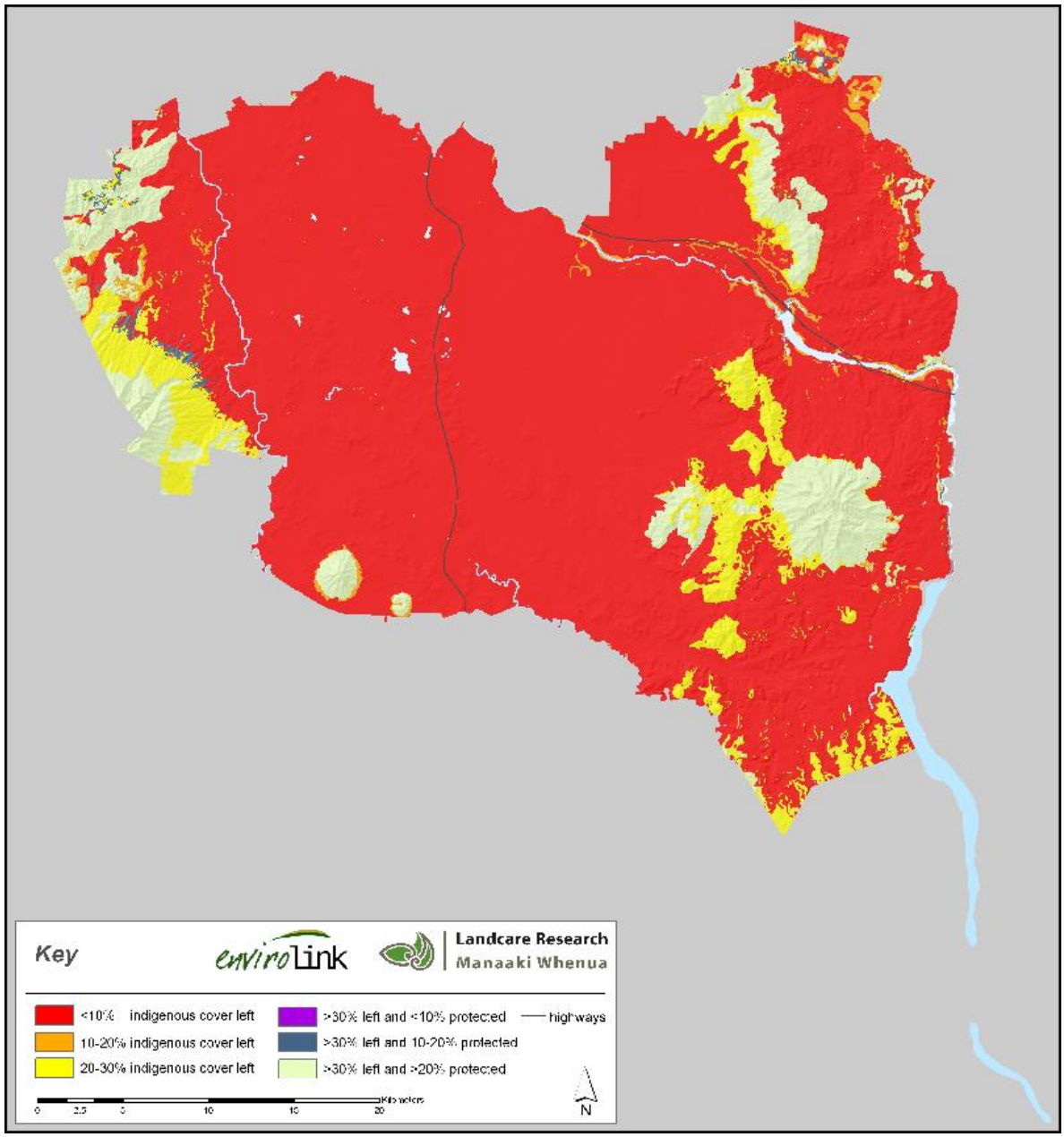
- 45% primary indigenous forest
- 43% secondary indigenous forest and scrub
- 11% wetlands.

Today, the predominant groundcover in Waipa District is exotic grassland (87% cover), while only 10,900 ha (7%) of Waipa District remains in indigenous vegetation which is mostly made up of forest (Wildland Consultants, 2007).

Figure 11 below demonstrates the loss of indigenous vegetation in the Waipa District: the red area indicates that the vast majority of the District has less than 10% indigenous cover remaining. The yellow and green areas show small areas that have greater than 20% indigenous cover left, some of which is protected. Protected areas in the Waipa District are discussed below.

Fifty-two threatened species have been recorded in Waipa District. This includes 22 vascular plant species, 18 bird species, two mammal species, five fish species, one frog and three lizard species, and one threatened invertebrate (Wildland Consultants, 2007). These species are listed, along with their ‘threat classification’ in Appendix E.

Figure 11: Threatened Environments



Source: Action Bio-community website

2.6.4 Protected Areas

Areas of biodiversity/ecological value in the Waipa District are managed and protected by different agencies from inappropriate use and development, as shown in Figure 12. These areas cover approximately 5,880 ha (4%), including 2,740ha of land administered by the Department of Conservation (DOC), 300ha of QEII Trust covenants, and the Maungatautari Mountain Scenic Reserve (2,400ha, administered by Council), which is the largest protected area within the Waipa District.

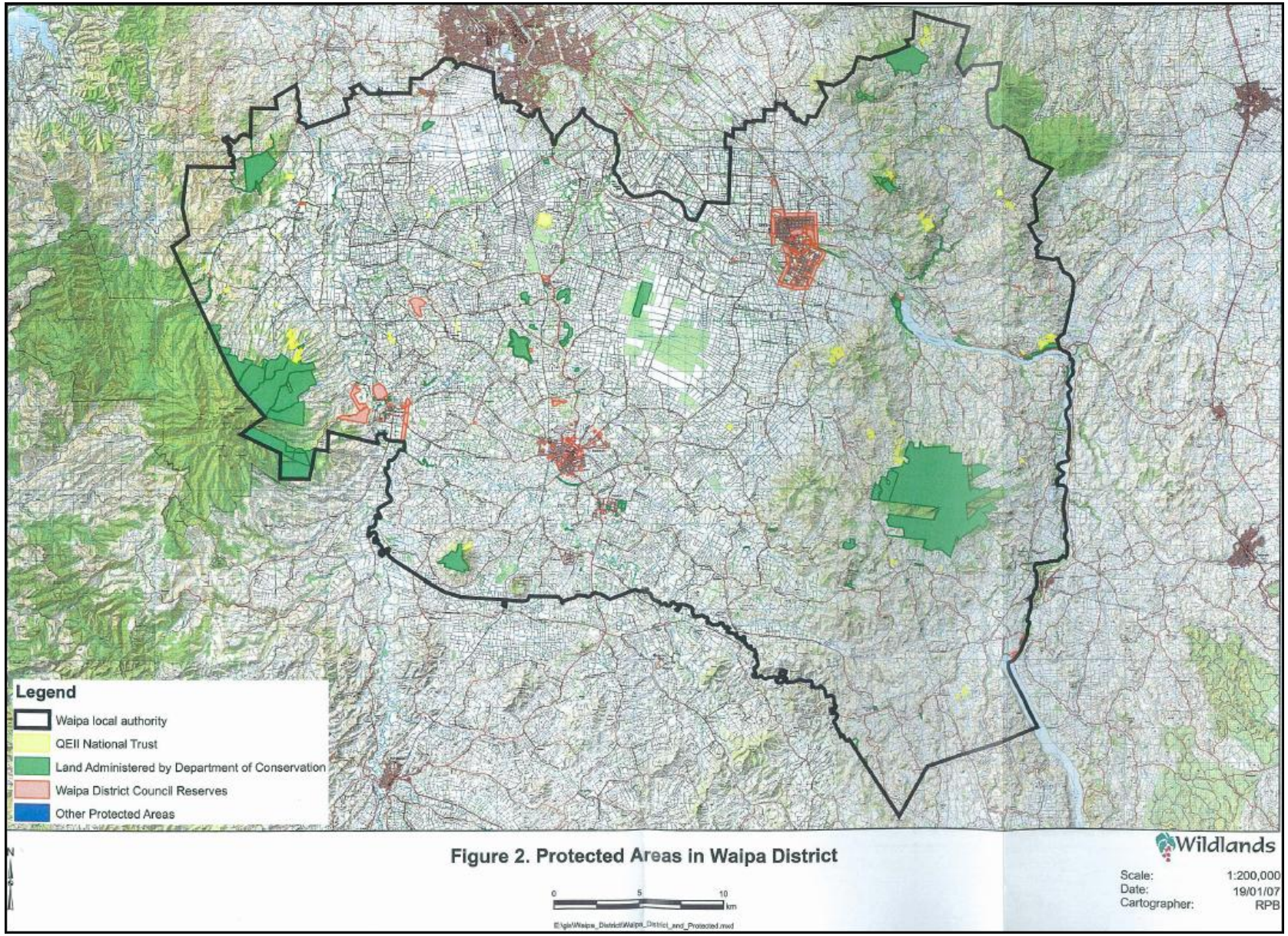
Other protected areas include nationally significant peat lakes, and a raised oligotrophic peat bog (Moanatuatua Peat Scenic Reserve). Approximately 78% percent of the area which is legally protected in Waipa District comprises indigenous forest (including 'broadleaved indigenous hardwoods' and 'manuka and/or kanuka'). A further 281ha comprises 'herbaceous freshwater vegetation', 'river', and 'land and pond' (Wildland

Consultants, 2007). Table 4 below outlines each of the protected areas in the Waipa District managed by Council and DOC.

Table 4: Waipa Protected Areas (Wildland Consultants, 2007)

Site	Features
Hamilton Ecological District	
Administered by DOC	
Maratoto QEII	Deep bog but difficult to maintain bog vegetation.
Lake Koromatua Wildlife Management Reserve	Common wetland and wading birds.
Lake Rotomanuka Wildlife Management Reserve	Large number of waterfowl and waders. High quality wetland habitat.
Lake Serpentine Wildlife Management Reserve	Pa site and important wildlife habitat.
Mangakawa Scenic Reserve	Part of reserve in Maungatautari ED. Secondary indigenous forest.
Moanatuatua Peat Scenic Reserve	Last remnant of a former 14,000 hectare peatland. Restored bog.
Administered by Waipa District Council	
Lake Mangakaware Recreation Reserve	Swamp and pa site. High numbers of water fowl. High restoration potential.
Lake Ngaroto	One of the largest peat lakes in the Waikato and the largest lake in Waipa District. Restoration programme. Good wildlife populations.
Yarndley's Bush	One of the largest remaining alluvial kahikatea forests for the Waikato Region.
Lake Cameron	A small but ecologically significant lake, surrounded on two sides by residential subdivision. It is a true peat lake with deep peat on the west and south. It is home to waterfowl and waders.
Kawhia Ecological District	
Administered by DOC	
Pirongia State Forest (in part)	Volcanic cone. Provides outstanding habitat value; podocarp hardwood forest; part of the largest tract of unbroken native forest left in the Waikato Region; Outstanding forested site.
Rolley Road Scenic Reserve	On moderately steep and rolling limestone hillslopes. Tawa-pukatea-rewarewa forest and bracken fernland.
Maungatautari Ecological District	
Administered by DOC	
Maungakawa Scenic Reserve	Secondary indigenous forest located partly in Hamilton ED.
Te Miro Scenic Reserve	Volcanic cone. Primary and secondary highland forest.
Te Reti Road Scenic Reserve	Rolling to steep hill country; broadleaf, podocarp forest.
Administered by Waipa District Council	
Maungatautari Mountain Scenic Reserve	Largest protected area in the Waipa District.
Raglan Ecological District	
Administered by DOC	
Kaniwhaniwha Scenic Reserve	Located in the Kapamahunga Range. Common forest animals and plants; tawa-pukatea/mamaku-mahoe forest; mangeao forest.
Waipa Ecological District	
Administered by DOC	
Kakepuku Mountain Historic Reserve	Basaltic cone. Accounts for over one third of the logged tawa that remains in Waipa ED.

Figure 12 Areas of Biological/Ecological Value and Management Bodies (Source: Wildland Consultants, 2007)



2.6.5 Issues and Threats

Forests and Forest Fragments

A number of factors and land use practices threaten Waipa's forests, bush stands and the species these habitats support. The primary threats to such areas are as follows:

a. Stock grazing

Stock will eat native plants and trample seedlings, effectively wiping out the next generation. Mammal grazing and browsing and to a lesser extent trampling of root systems, can severely modify the composition of forests and lead eventually to the collapse of the tiered forest structure with subsequent loss in species diversity (Waipa District Council, N.D.).

b. Introduced species

Browsing by introduced mammals (brush tailed possums, goat and deer) and predation from introduced mammals (mustelids, rats, cats, stoats, possums, hedgehogs and mice) are a threat to forest biodiversity. New Zealand's endemic species evolved in the absence of mammalian pests and are highly susceptible to competing and predatory pressures exerted by introduced predatory mammals. Approximately eight of every 10 eggs laid, or chicks hatched by a native bird, are killed by these predators.

Plant pests, while not a major threat to most healthy forests, will displace, out-compete and change the structure of many native plant communities, especially when those communities are under stress. Perennial plants like privet (both small-leaved and large-leaved species), ornamental cherry, ivy, and wandering dew, pose a serious threat unless they are removed. Aggressively colonising woody species include Chinese privet, Cotoneaster and hawthorn (Waipa District Council, N.D.).

c. Habitat fragmentation

Fragmentation of forests and bush stands as result of intensification of surrounding land use, is a highly detrimental and ongoing issue for the Waipa District (Environment Waikato website – Forest Fragments).

d. Land drainage

Draining wet kahikatea stands results in detrimental effects on forest ecosystems. Plant species commonly found in kahikatea stands may not survive, weeds are more likely to invade and broadleaved trees such as tawa and titoki will replace the kahikatea over time (Environment Waikato website – Forest Fragments).

e. Adjoining land use

Activities on adjoining land may affect the health of a forest. Fertiliser drift or enriched runoff may encourage weeds or change the composition of native species (Environment Waikato website – Forest Fragments).

Peat Lakes

The two threats to Waipa's peat lakes include adjoining land use and invasive species, as outlined below:

a. Adjoining land use

The natural hydrological regime of many lakes has been altered through drainage activities deemed necessary to accommodate settlement of adjoining farmed peat. Peat shrinks as it oxidises and the rate of shrinkage accelerates with tillage and the addition of fertilisers and nutrients.

All the lakes have been impacted to a greater or lesser degree by the runoff of nutrients from adjoining agricultural land. This accelerates the growth of aquatic plants and algal communities and creates conditions more suitable for pest plants like crack and grey willow, blackberry and gorse. Catchment modification, earthworks and surface tillage cause sediments to be mobilized and washed into the lakes under high rain fall events. This reduces water depth, contributes to reduced water clarity through the suspension of inorganic

colloidal particles and transports nutrients commonly bound to soil particles, such as phosphorous directly into the lake (Waipa District Council, N.D.).

Agricultural land use in peat areas has also resulted in further adverse effects including:

- The application of fertilisers which has detrimental effects as it increases the nutrient levels in the lakes making them unsuitable for many of the native species;
- Plant and animal pests have also been introduced to peat areas adversely affecting native flora and fauna;
- Wetlands can also be susceptible to stock grazing in wet areas causing pugging or grazing on vegetation next to the lake edge;
- Changes in water quality and flow regimes resulting in a reduced area of habitat.

All these activities have had detrimental effects on native species and their habitats (Waipa District Council *et al*, N.D.).

b. Invasive species

Willows, alder and pasture weeds have invaded the margins of many Waipa lakes. Lakecare groups and administering agencies have been controlling pest plants, and a range of natives trees like kahikatea, cabbage tree, Manuka, Coprosma sp. and flax have been planted on the drier margins of several lakes, notably Ngaroto, Serpentine (Rotopiko), Cameron and Koromatua.

The artificial connection of many lakes to larger streams and rivers has enabled introduced fish species like European carp; rudd; mosquito fish; bullhead catfish and goldfish to colonise. Introduced fish are now common in many of the larger lakes. They are generally more tolerant of environmental change and displace and outcompete most native fish (Waipa District Council, N.D.).

2.7 Natural Hazards

Under the Civil Defence Emergency Management (CDEM) Act 2002, Civil Defence emergency management (CDEM) is a function and responsibility of regional, district and city councils. Consequently, all local authorities throughout New Zealand have joined together on a regional basis to form Civil Defence Emergency Management Groups (CDEM Groups). These groups, in partnership with emergency services and other organisations, are responsible for emergency management locally. The Waipa district is included in the Waikato Valley Civil Defence Emergency Management Group.

The main natural hazard of concern in the Waipa District is flooding: on average the Waikato Region as a whole can expect to experience a significant flood event every two to three years. The region's topography and geology makes it susceptible to heavy rainfall and high river events, and climate change is likely to further exacerbate such hazards (Civil Defence Emergency Management Group 2007). Waipa's flood risk is discussed further in Section 2.7.1 below. Waipa's exposure to other natural hazards, such as seismic, volcanic, and instability, is fairly limited. However, parts of the Waipa district could face liquefaction in large earthquakes (Waikato Civil Defence Emergency Management Group 2007). In addition, the Waikato region provides water and energy supply to surrounding regions, such as Auckland, and this could be compromised if the Waikato experiences a serious natural disaster.

Hazards in Waipa District were assessed in the Waikato Civic Defence Management Plan. Impacts included: human, economic, social, infrastructure, and geographic and each impact was given a score out of five for each type of hazard, five being the greatest impact (so the overall score is out of 25) The following table illustrates the relative level of impact for each risk category in comparison to other districts in the Waikato Valley Emergency Operating Area which include: Waipa, Waitomo, Otorohanga, Waikato, and Hamilton City. As the table shows Waipa is not significantly more 'at risk' in any category than the other districts except in relation to river/lake control structure failure, severe storm events, electricity failure and major transportation accident (air) due to the location of Hamilton airport within the Waipa District.

Table 2: Hazard Types and Level of Impact, Waikato Valley Emergency Operating Area

	Relative Level of Impact					
Hazard Type - Waikato Valley EOA	**Waipa DC**	**Oto DC**	**Waitomo DC**	**Waikato DC**	**Hamilton CC**	**Total**
River/Stream Flooding and Ponding	11	17	13	11	13	65
Subsidence (Karst solutioning)	12	8	12	0	0	32
Landslip	13	12	10	0	9	44
Earthquake	12	0	5	10	14	41
Shoreline Erosion	0	14	10	0	0	24
Ashfall - Ruapehu (or others)	11	0	5	10	12	38
Auckland Volcanic Field	0	0	0	10	12	22
Severe Storm Events	13	0	0	9	0	22
Fire (Rural)	7	9	0	0	0	16
Heatwave	0	0	0	0	4	4
Services/Infrastructure Failure	0	0	0	9	0	9
Electricity Failure	13	0	0	13	0	26
Hazardous Substances Spill	9	0	0	0	0	9
Major Transportation Accident (Air)	12	0	0	0	0	12
Terrorism	2	2	2	2	2	10
River/Lake Control Structure Failure	21	0	0	13	0	34
Human Pandemic	0	0	0	11	11	22
Animal Epidemic	0	0	0	11	0	11
MLE's identified by this EOA are:	River flooding; EQ-induced banks down following a 1/500 year event					
	Fault rupture:	Kerepehi				
		Wairoa North				
	Volcanic (not specifically within this EOA)					
	River/Lake control structure failure (following EQ)					
		* assumes repeat of 1891 Wairoa fault EQ				
	Electricity Failure (check redundancy with Lifelines Group)					
Events of National Significance:	Terrorism					
	SARs					
	Foot and Mouth					

Source: Emergency Management Office, 2005

Other development issues which need to be planned for in order to reduce risk include:

- Movement from rural to urban areas will make rural areas more isolated. This is an issue as rural communities have the potential to become more isolated in an emergency because of their remoteness and accessibility issues (for example gravel roads) and geography.
- Urban areas and urban activities will continue to encroach into rural areas increasing the rural fire risk.
- Hazardous substances transported on the Region's road and rail networks at times in close proximity to residential areas.
- Traffic congestion on arterial routes surrounding Hamilton could pose a problem in an evacuation situation.

The Waikato Civil Defence Emergency Management Group (2007) aims to increase community resilience in Civil Defence Emergency Management; reduce the risk from hazards; and to provide effective and efficient response and recovery capability. A key element in ensuring resilience in the community is in planning and avoiding hazard risks.

Territorial authorities can employ the following regulatory and non-regulatory tools to manage natural hazards:

- Subdivision and building consents (through the RMA and Building Act 2004);
- The district plan (through identifying natural hazards, educating people as to the risks, provision of financial incentives, land use controls, and engineering works);
- The implementation and maintenance of hazard registers; and
- Resource consent applications (Saunders *et al*, 2007).

Saunders *(et al, 2007)* also state that reviews of Regional Policy Statements provide an opportunity to strengthen linkages between Civil Defence Emergency Management measures and planning practice. For example, Queenstown Lakes District Council has abandoned a number of physical work schemes to deal with flooding in the town, and is now adopting a new flood strategy which emphasises citizen responsibility and learning to live with flooding. As part of this the Council is developing better public guidelines about the risks and recommended actions.

2.7.1 Flood Hazards in the Waipa District

As the draft River Flood Risk Management Strategy 2007 (Environment Waikato 2007) states "river flooding is a significant hazard, being the most widespread and frequently occurring hazard within the Waikato Region". River modification has had many benefits, but in some areas has encouraged the intensification of urban development in flood prone areas, and it is likely that development in marginal areas such as flood plains will continue to occur (Waikato Civil Defence Emergency Management Group 2007).

The draft River Flood Risk Management Strategy sets out an Action Plan for minimising risk and mitigating the adverse effects of flooding. Regional and district plans are key documents for strengthening the risk management approach by providing a clear and integrated policy approach to reducing flood risk hazards (Environment Waikato 2007). An increase in population coupled with changing economic uses of land will exacerbate the risk to communities from flood hazards.

The vision of the River Flood Risk Management Strategy is sustainable communities that understand rivers as natural systems within a whole catchment context; recognise the level of flood risk and residual risk that may affect them; and manage existing risks and seeks to avoid increasing the risks (Environment Waikato 2007).

The Action Plan associated with the Strategy includes goals to ensure that land use decisions are made on the best possible information available and thereby ensuring that LiDAR (Light Detection and Ranging) land information is available for all key flood risk hazard areas – this will require collaboration between the district and regional council to identify the match between population growth areas and flood risk areas and collaboration to ensure appropriate land use decisions (policies, rules and consents) are made in these areas. The Strategy identifies river bank stability setback lines of between 25 and 150 metres along the Waikato River

downstream of the Karapiro Dam. These setbacks indicate areas where the risks need to be further assessed before development is allowed to proceed and should be considered as part of the District Plan Review.

Figure 13 below illustrates the 1:50,000 scale flood hazard map data from Environment Waikato. This map provides an overview of river flood hazards in the Waikato Region is based on anecdotal evidence. The background information for each flood hazard ID number is provided in Appendix F. Unfortunately the data does not explain what flood hazard level each flood risk area is. Similarly the Waipa District Council has produced a map showing flood risk areas as illustrated in Figure 14 below. Both maps indicate a corridor from the north east of the district to the south of the district is more prone to flooding than areas in the north and west, such as Cambridge. Notably, the urban area of Te Awamutu appears to be a flood hazard area, as is a proportion of Pirongia.

More detailed studies have been carried out regarding flood risk in Te Awamutu and have shown that the township is prone to flooding from the Mangapiko and Mangaohoi Streams (Waikato Regional Council, 1993). The study concludes that the most significant mitigation measure for the Te Awamutu township is stream channel maintenance. Maps provided in Appendix G also illustrate land which is located below the probable maximum flood level according to the Waikato Regional Council (1993) (this document is the most recent finalised flood management plan for Te Awamutu).

As mentioned in Section 2.4.2 integrated catchment management activities which have a significant role in retaining sediment and slowing run-off of flood waters through retention of stable land and vegetation cover should be carried out. Such activities include soil conservation; riparian management; land retirement; clean streams programme; and biosecurity controls (in order to protect trees) (Environment Waikato, 2007).

A High Flood Management Plan is also being developed by Environment Waikato and Mighty River Power. This document sets down the procedures for the management of significant flood events in the Waikato River. While it does not contain flood hazard maps, it does outline how river flood events will be managed through towns such as Cambridge, for example how dams will be managed in a flood event to minimise downstream effects.

Environment Waikato also holds data regarding Waikato and Waipa River design and high flood levels. This information has recently been incorporated into the Waikato District Plan. There is the opportunity to incorporate these into the Waipa District Plan at the review stage.

2.7.2 Peat Subsidence and Localised Flooding

Peat subsidence is also a hazard leading to localised flooding in Waipa's lowland areas. Peat subsidence occurs as a result of localised land drainage – as peat is drained and the water table lowered, the natural process of accumulating organic matter stops. The surface of the land then starts to subside as the organic matter shrinks and decomposes as a result of exposure to air (oxidation) and compaction due to agricultural practices (Environment Waikato 2006; Schipper and McLeod 2002).

In a study of subsidence rates and carbon loss in peat soils following conversion to pasture near the Moanatuatua peat bog, subsidence of 137cm over 40 years was observed (about 3.4cm per year). Of this approximately 50cm was attributed to carbon loss with the remaining 87cm of subsidence attributed to shrinkage from dewatering and consolidation (Schipper and McLeod 2002).

However, peat subsidence rates vary and when measured at two other locations in the Waikato Region, results were as follows:

- Hauraki Plains – 1.8 cm/year (average annual subsidence)
- Rukuhia – 2.5 mm/year (average annual subsidence) (Environment Waikato 2006).

Such variance is based on a number of factors including: drain depth and spacing affecting water tables (the deeper and more closely spaced the drains, the quicker the peat will subside); thickness of the original peat; mineral content of the peat; and, compaction rates (Environment Waikato 2006).

Careful management is therefore recommended in such areas. Managing water tables is the best way for farmers to slow peat shrinkage, and this is particularly important during summer as studies show that subsidence rates are highest where water tables are lowest. Where peat soils are over-drained it is likely that

some areas of peat land will ‘sink’ below current water levels, increasing the need for stopbanking and pumping stations. Continuous cultivation also accelerates the rate of shrinkage to more than twice that of peat soil under permanent pasture (Environment Waikato 2006).

Loss of peat is also an issue in terms of climate change emissions, as when peat bogs are in a healthy state they absorb carbon acting as a carbon sink. Conversely when peat bogs shrink they release carbon into the atmosphere which has implications for national carbon budgets (Schipper and McLeod 2006).

Figure 13: Flood Hazard Map – Environment Waikato (Source: Environment Waikato)

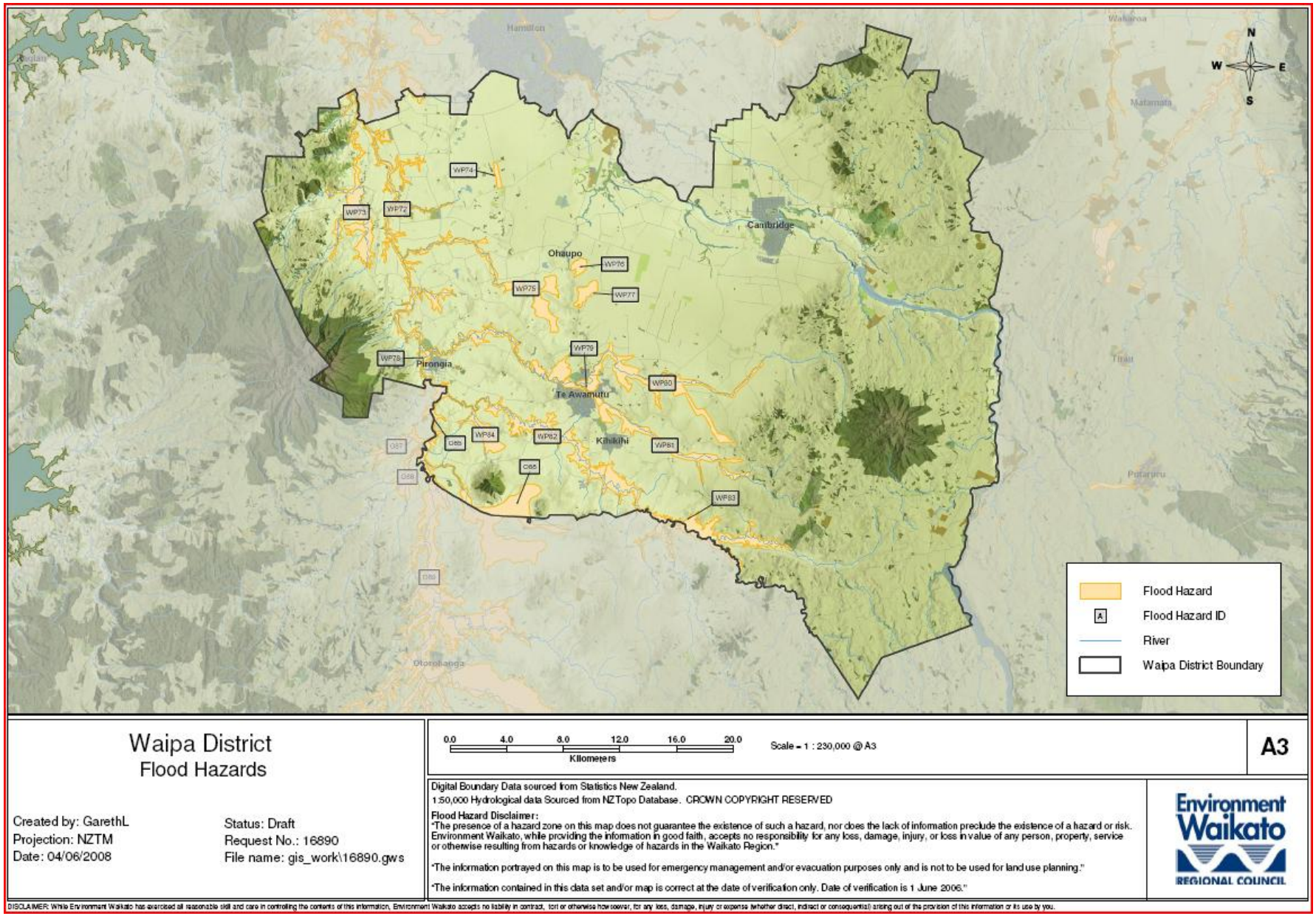
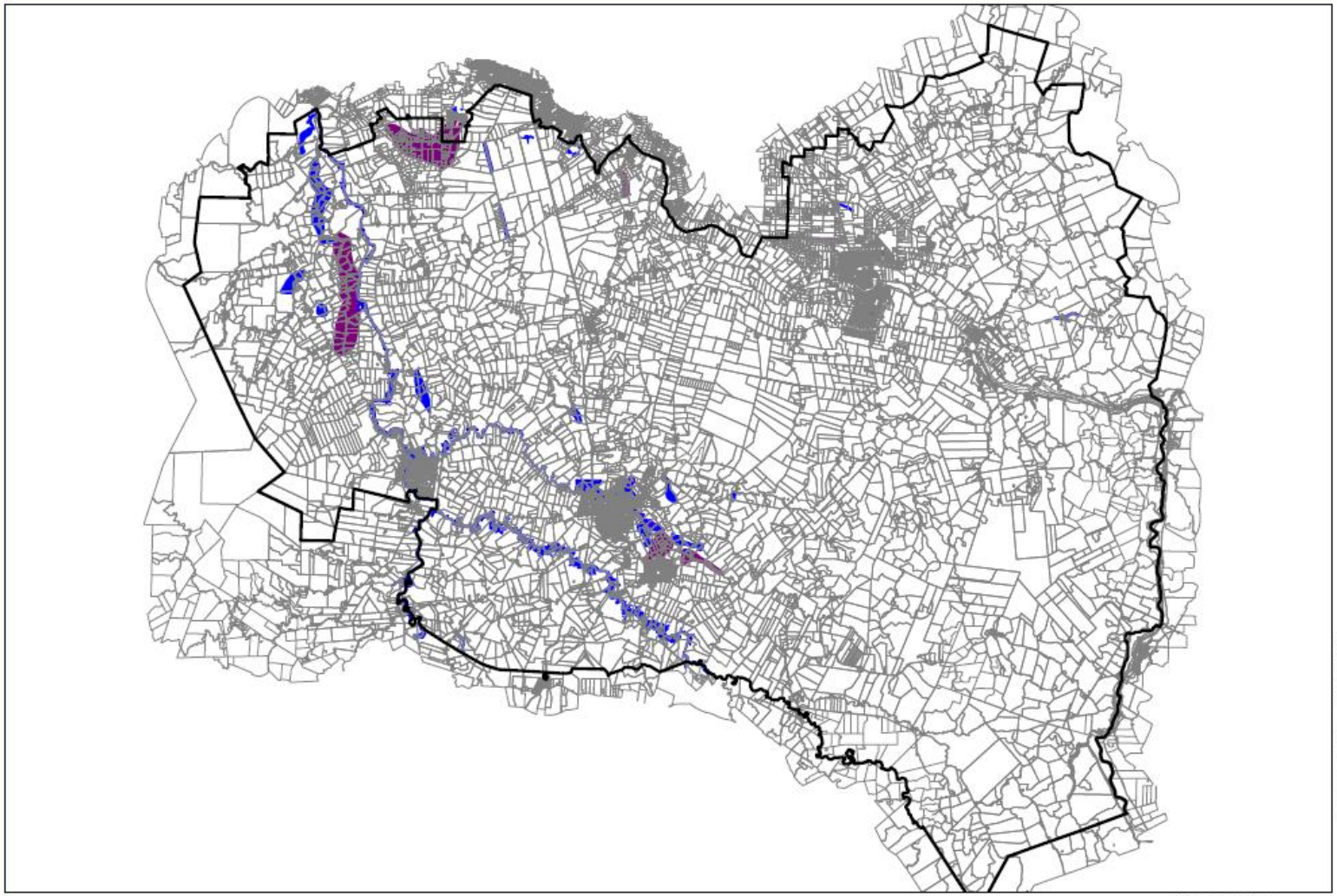


Figure 14: Flood Hazard Map – Waipa District Council (Source: Waipa District Council)



Key:

- Flooding
- Flood Levels
- Poor Soakage
- Secondary Flow Flood Path
- District Boundary
  Waipa

DATA SOURCE

Data has been drawn from miscellaneous sources including:

- Draft District Plan preparation file
- Existing hard copy hazard maps
- Te Awamutu Flood Management Plan Maps (Waikato Regional Council)
- Landcare NZ LUN Land Resource Inventory data (LRI)
- Local knowledge of Council officers

DISCLAIMER

Because of the nature of the data, accuracy varies and should be interpreted conservatively. If there is any doubt, then further research and site investigation will always be warranted.

NOTE

Properties may be affected by multiple special features. Where this occurs, special features with smaller area extents have been arranged to display on top of special features with larger area extents.

Waipa DISTRICT COUNCIL

SPECIAL FEATURES MAP

(Formerly known as Hazards Map)

0 3 6 9 12 15
Kilometers

NORTH

Amended to 23/08/2006

2.8 Air Quality

Different weather patterns, landscapes and activities can affect air quality. In the Waipa District the main features of the airshed include two main areas of relatively high population density, meaning more home fires and more vehicles affecting visibility and health. There is also a high level of industrial activity in some areas, and sources of contaminants from agricultural activities. Certain agricultural and industrial activities also have the potential to produce unpleasant odours. Methane and other greenhouse gases are released from farming, peat fires, and other sources such as vehicles (Environment Waikato website – Air around the Region).

For the Waipa District, the major influencing factors in terms of air quality include domestic home heating. This in particular affects air quality in urban air sheds during colder winter months. The main air contaminant of concern in the Waikato Region is 'suspended particles'/airborne particulate matter[2] (PM_{10}).

The World Health Organisation (2005) states that exposure to PM_{10} indicates that there is a public health risk. However this risk depends on people's general health and age and therefore no 'safe' threshold has been determined at which there are no adverse health effects. The guidelines set by the WHO and adopted by New Zealand are 50 µg/m3 (24-hour average) and 20 µg/m3 (annual average) (Ministry for the Environment and Ministry of Health, 2002). Adverse health effects resulting from exposure to PM_{10} include:

- increased mortality
- aggravation of existing respiratory and cardiovascular disease
- hospital admissions and emergency department visits
- school absences
- lost work days
- restricted activity days (Ministry for the Environment and Ministry of Health, 2002).

People most susceptible to the effects of particles include the elderly; those with existing respiratory disease such as asthma, chronic obstructive pulmonary disease and bronchitis; those with cardiovascular disease; those with infections such as pneumonia; and children (MfE and Ministry of Health, 2002).

Amenity impacts of PM_{10} in New Zealand include visibility degradation, smoke and odour nuisance associated with combustion activities and dust nuisance. The nuisance impacts associated with smoke, odour and dust include soiling, a reduced enjoyment of the environment, odour nuisance and eye, nose and throat irritation. More severe health impacts may also be associated with localised discharges (Environet, 2003).

Complaint registers held by Regional Councils indicate that complaints regarding smoke and dust are common (Environet, 2003). In 2000 and 2001 Environment Waikato received the following complaints associated with various activities across the Waikato Region.

- Dust – 118 complaints;
- Domestic burning – 26 complaints;
- Rural burning - 38 complaints; and,
- Industrial burning - 118 complaints.

Environment Waikato currently monitors air quality within the region at sites in Hamilton, Tokoroa, Te Kuiti, Taupo and Matamata. None of the existing monitoring sites are located within the Waipa District but Hamilton and Matamata represent the closest sites. EW plans to extend the current monitoring programme to Cambridge and Te Awamutu but the timeframe for carrying this out is unknown (Kim, pers.comm 2008).

In September 2004, the Ministry for the Environment introduced a National Environmental Standard (NES) for suspended particles of 50µg m^{-3} (24-hour average) with one allowable exceedence each year. The NES is effective from September 2005. The NES requires regional councils to identify specific areas (called airsheds) where air quality standards are (or may be) breached. By 2013 PM_{10} levels must be below the safe levels or councils will not be able to grant resource consents for the discharges of PM_{10}.

Air quality within the identified airsheds (as well as elsewhere within the District) is likely to be largely influenced by domestic home heating, outdoor burning, traffic emissions and industrial activities. Future

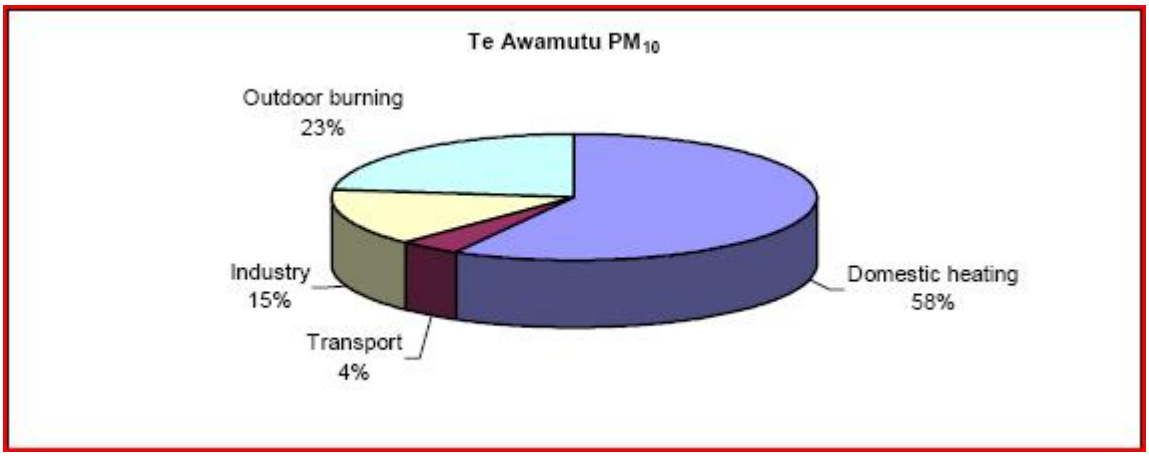
[2] The term 'suspended particles' or PM_{10} refers to small particles in the air which are less than 10 microns in diameter.

residential and industrial growth in the District has the potential to decrease air quality within the identified airsheds, and also to result in other areas of the District being identified as airsheds where air quality standards are (or may be) breached. Increased traffic volumes may also influence air quality in proximity to main routes.

It is unknown how many dwellings within the Waipa District contain higher emission fire places (e.g. open fires, coal burners, multi-fuel burners, older wood burners, etc). However, an air emission inventory study has been done for Te Awamutu which is likely to be indicative for the rest of the District and therefore some conclusions can be drawn (Ngaruawahia and Turangi were also part of this study). The study focused on emissions of PM_{10} as these are the only contaminant in breach of the NES in the Waikato Region (Wilton and Environet 2006).

Overall less than half a tonne of PM_{10} is discharged to air in Te Awamutu on an average winter's day. Figure 15 below illustrates the relative contribution of different sources to daily winter PM_{10} emissions. As illustrated, in Te Awamutu the main source PM_{10} emissions during the winter was from domestic home heating, and this accounts for of 59% of total emissions. Other significant contributors included outdoor burning (23%) and industry (15%) (Wilton and Environet 2006).

Figure 15: relative contribution of sources to daily winter PM_{10} levels in Te Awamutu



Source: Wilton and Environet 2006

Approximately 11 kilograms of PM_{10} is emitted per day from vehicles in Te Awamutu. This figure is based on the estimated vehicle kilometres travelled in Te Awamutu and assuming that traffic is relatively free flowing (as opposed to congested or semi-congested).

Around 63 kilograms of PM_{10} are estimated to be emitted from industrial or commercial activities in Te Awamutu during the winter months. This figure increases to 306 kilograms during the summer months. The main source of industrial PM_{10} emission in Te Awamutu is from the burning of gas (25%) and coal (75%). These emissions are predominantly derived from the milk powder emissions from Fonterra's gas co-generation plan and coal-fired boiler, and the milk powder drying facilities in the same plant. Industry is also estimated to contribute 700 kilograms of NOx and over 500 kilograms of SOx per day in the winter and 3.8 tonnes of NOx and 2.5 tonnes of SOx in the summer. It is however worth noting that the industrial contribution to contaminant concentrations is likely to be much less that the contribution to emissions because industrial discharge is via high stacks that promote more effective dispersion of contaminants.

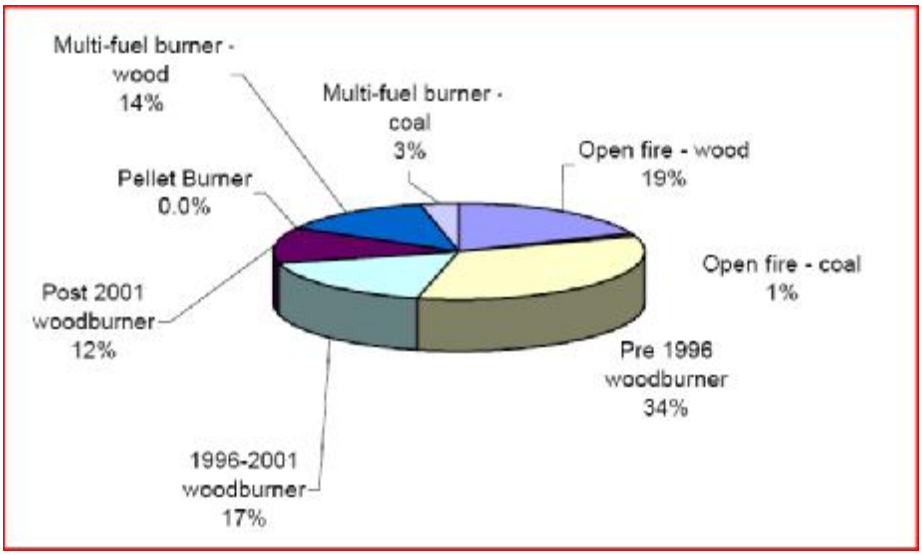
During the winter approximately 97 kilograms of PM_{10} are emitted from outdoor burning in Te Awamutu. Outdoor burning also produces around 325 kilograms of carbon monoxide and around 11 tonnes of carbon dioxide per day.

Overall it is interesting to note that compared to other areas of the Waikato there is a relatively small difference between Te Awamutu's winter and summer emissions: emissions during the summer are estimated to be 90%

of winter emissions, compared to around 8% in Turangi for example. This anomaly in Te Awamutu is attributed to the presence of the Fonterra factory and the increased production in the summer months.

As domestic home heating is the most significant contributor of PM10 in Te Awamutu, it is interesting to note the relative contribution of different heating methods to average daily PM_{10} from domestic heating - this is illustrated in Figure 16 below, and shows an average winter day based on results extrapolated from those taken in July.

Figure 16: Contribution of different heating methods to daily PM_{10} emissions in Te Awamutu.



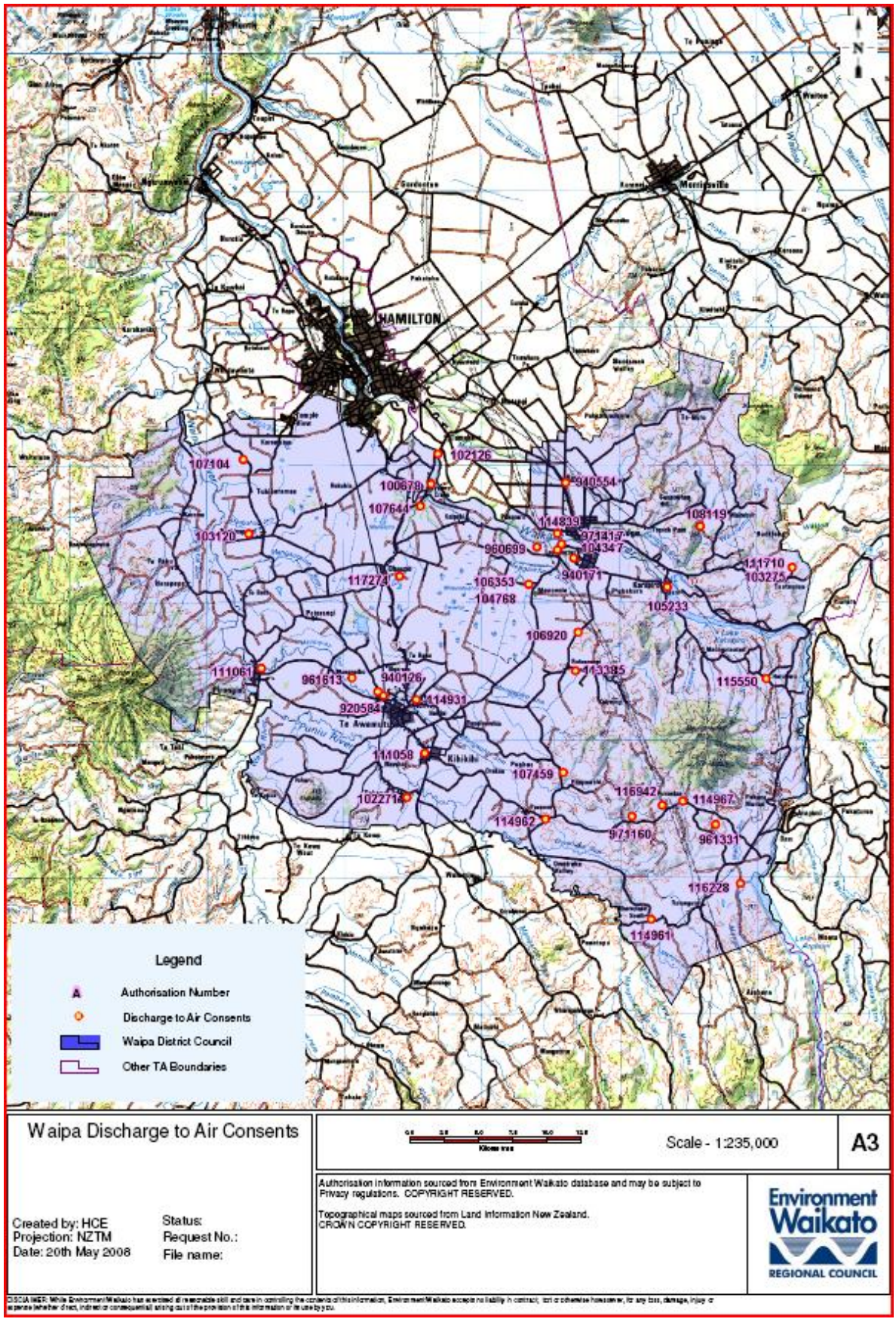
Source: Wilton and Environet 2006

2.8.1 Air Discharge Permits

Air discharges are, and will continue to be, a necessary part of the healthy economic functioning of the Waipa District and therefore air discharge permits are consented if their effects are not going to cause a more than a minor adverse effect on the surrounding environment. Figure 17 below illustrates the location of the existing resource consents held for air discharges within the Waipa District. Appendix H contains the details about each consent.

There are 36 resource consents altogether, with many concentrated around Cambridge and Te Awamutu. One third of these consents relate to discharges of dust and other contaminants as a result of quarrying and some sand mining operations; a large number of the consents relate to agricultural practices including discharges of contaminants and odour from poultry processing; piggery operations; compost manufacturing and mushroom cultivation purposes. Three consents relate to discharges of contaminants to air from school incinerators (Wharepapa, Pukeatua, Parawera); and a further five consents relate to municipal works such as discharges of contaminants from closed landfill sites (Kihikihi, Pirongia, Te Awamutu, Cambridge) and sewage treatment facilities (Cambridge). Other consents also relate to discharge of herbicide by the Regional Council, and discharges from a fertilizer processing plant in Te Awamutu.

Figure 17: Discharge to Air Consents in Waipa District (Source: Environment Waikato)



2.9 Acoustic Environment

The Waipa District Plan contains noise standards that set out anticipated maximum noise levels for different zones within the district. A number of activities are undertaken within the district which generate noise. These include:

- Events at the Mystery Creek Events Centre (such as Fieldays and the Parachute Festival);
- Hamilton Airport;
- Rural activities such as dairy sheds, motorbikes and animals;
- Recreational activities such as jet-skiing, scenic flights, public events;
- Residential/urban activities such as lawnmowers, traffic, stereos;
- Economic activities such as construction, industry, forestry, quarrying, mining etc; and,
- Highway noise.

Future growth and development in the District, if not located and / or designed appropriately, may adversely affect the operation of existing noise generating activities leading to reverse sensitivity effects. This is especially the case due to the rural nature (and therefore anticipated tranquillity) of much of the District. However, given that the Waipa District is a key dairy farming area, important to both the regional and the national economy, associated agricultural noise is to be expected. Rural activities should be protected from reverse sensitivity effects, whilst at the same time emerging rural-residential areas needed to be accorded some protection against unreasonable noise.

Highway noise is a key noise-generator which must be managed effectively. Local authorities do not have any control over traffic noise under the District Plan, therefore careful consideration of the location of dwellings, and the road materials used, needs to occur (Faris, 2007; Waipa District Council, 2004).

For example, the State highway 1 Cambridge bypass and proposed growth cells in Cambridge North must be considered carefully to ensure that residents do not receive noise above the levels specified by the World Health Organisation: 55dBA (Leq) in outside living areas; 35dBA inside at night; no maximum levels above 55dBA as a result of outside noise sources; and no dwellings should be within areas that exceeds traffic noise 65dB(Leq).

2.9.1 Recommendations - District Plan Noise Issues

A study of noise in the Waipa was prompted by the need to update The District's policies and rules to comply with the updated New Zealand Measurement of Sound standard[3]. The study assessed the performance on noise rules in the district and the following key recommendations were made by Council staff:

- General Zone – contains mixed uses such as residential, professional offices, commercial and light industrial. Noise complaints are reasonably infrequent and mainly relate to night time activities particularly those associated with licensed premises which provide musical entertainment. The noise climate in the zone is controlled by traffic noise and the background level is high. Therefore noise in the general zone should be less restrictive and it is proposed that night time noise standards are increased from 35dBA(L10) to 40dBA(L10).

- Industrial Zone – two unique industrial environments exist in the Waipa District including the two dairy factories (Hautapu and Te Awamutu) and the airport. The dairy factories often exceed noise standards. As a result of this and due to their economic importance within the region a memorandum of understanding

[3] NZS6801:1991 Measurement of Sound and NZS6802:1991 Assessment of Environmental Sound were replaced with NZS6801:1999 Measurement of Sound and NZS6802:1999 Assessment of Environmental Noise as a number of defects and improvements were indentified by acoustic practioners. These changes to noise standards therefore needed to be reflected in the Waipa District Plan. This Standard has once again been updated in 2008 but implications of the new standard for the District Plan's noise rules and Waipa's acoustic environment are as yet unclear.

(MOU) has been signed with the Council. The MOU sets out existing levels as monitored at various points around each site and states that these existing levels will not be exceeded. It is further agreed that any new plant or major upgrade will be designed and installed to meet the night time level of 45dBA (L10). The intention is that both factories will eventually meet the District Plan levels. Faris (2007) recommends that the MOU is incorporated into the district plan.

- The airport receives a number of noise complaints each year as a result of engine testing, however, noise standards specified in the district plan are being met and therefore there is a recommendation for standards to remain as they are (Faris 2007). It is also worth noting that Plan Change 57 to rezone 117 hectares of rural land to an 'Airport Business Zone' is being considered by Council currently. Noise standards proposed as part of the plan change do not differ from those in the current District Plan and it is considered that such rules have been reasonable for managing noise associated with airport operations (Faris 2007).

- Rural Zone – some activities which are now common are not specified in the current district plan but have prompted noise complaints: standards addressing the use of frost fans are proposed. Additionally, motor bikes – regardless of whether they are being used for farm or recreational purposes are also currently excluded from the noise standards. However, as a number of complaints are received regarding their use for recreational purposes it is proposed that the Plan should make it clear that the recreational use of motor bikes is subject to noise standards. In addition it is considered that large packing houses which are currently excluded from noise rules should be subject to general rural zone noise rules as well (Faris 2007).

- Mystery Creek Exhibition Centre Zone – three key noise generating activities take place on this site: Mystery Creek Events Centre site which hosts the yearly Fieldays event; Hamilton Kart Club and Hamilton piston club. The activities on the Events Centre site have increased since the operative District Plan has been adopted and a Resource Consent was granted in 2003 to hold the Parachute Music Festival on the site for five years. This consent specifies noise conditions to control noise form the event. Other events are generally within the noise limits prescribed in the District Plan and do not generate complaints. However, events such as the Fieldays cannot meet the normal levels specified in the District Plan for rural zones. As these events are for a short duration of a few hours to a four day event for the Fieldays themselves and are mostly held on an annual basis the operative District Plan provides for exceedence of the normal daytime levels on a number of specified days per year called activity days. A memorandum of understanding (MOU) has been drafted between the New Zealand National Fieldays Society and Waipa District Council and it is recommended that this MOU (although currently in draft form) is adopted by the revised District Plan (Faris 2007). Some complaints are also received regarding activities at the kart club. It is recommended that the noise standards for the Mystery Creek Exhibition Centre Zone be redrafted to provide separate rules for activity days at both the Mystery Creek Events Centre and at the Hamilton kart club, as well as normal activities within the zone (Faris 2007).

Consideration of several specific new noise rules and/or zones was suggested by Council staff in the noise assessment report (Faris 2007). These suggestions will be considered as part of the District Plan Review to be undertaken 2009/2010, and include:

- Karapiro Domain Reserve – A new 'Lakeside Reserve Zone' covering the Karapiro Domain and adjacent reserves is being proposed as part of Plan Change 61 (under development, to be notified in March/April 2009).

- Recreation Zone – The noise assessment report suggests that establishing a Reserves or Recreation Zone be considered as part of the District Plan Review. Such a zone could be established to enable controls to be placed on temporary recreational uses on land owned by Council and which is not covered by of the Council's Reserve Management plans. The new zone could include rules relating to the number of consecutive days an event can take places; total number of days per year; hours in which it can take places; restrictions on fireworks and loud speakers; and noise level limits.

- Rural-Residential Zone – The establishment of specific noise performance rules in these policy areas to provide protection against effects of noise within the areas as well as noise generated in rural zones and

received in rural residential policy areas should be considered. It is reasonable to provide a similar level of protection between sites within this zone as is provided for within the residential zone except specifying the compliance monitoring position to be within the notional boundary instead of the actual boundary as in a residential zone.

3 Trends and Growth

As the population of the Waipa district increases and residents in other areas, including the large urban centre of Hamilton, desire to live in a more rural-residential environment, additional pressure will be placed on the physical environment of the Waipa District. This trend leads to a conflict between urban expansion and the need to preserve highly productive soils. Entwined in this issue are reverse sensitivity effects and the need to balance existing economic activities, such as agricultural production and industry, with the needs of the expanding residential areas which may occur in close proximity to such economic activities. New residential developments are likely to be acoustically sensitive to existing industries. Residential expansion may also affect the landscape and amenity of the Waipa district and this needs to be carefully managed. This is discussed further in Sections 4 and 5 of this report.

Another widespread trend (which is not unique to the Waipa District) is the ongoing use of 'minimum' lot sizes as opposed to 'maximum', regardless of the sites location. This does not promote densification of development, which could potentially be more sustainable by limiting urban sprawl.

4 Management of the Physical Environment

This section outlines the various statutory and non-statutory mechanisms available for the management of the physical environment within the Waipa District and wider Waikato region. The way in which these physical environment factors are managed is an important part of the 'profile' of the Waipa District.

4.1 Local Government Act 2002

4.1.1 Regional LTCCP

Under the Local Government Act 2002 (LGA), Environment Waikato has prepared a Long Term Council Community Plan (the Regional LTCCP). The Regional LTCCP incorporates in one document all the work intended to implement other key planning documents, such as the Regional Plan and Regional Coastal Plan.

The Regional LTCCP for 2006-2016 reiterates a number of desired community outcomes, grouped under the theme of sustainable environment that relate to the physical environment. These include:

- *1(B) Our natural environment is protected and respected. Its ecological balance is restored, its air, soil, and water quality is improved and its native biodiversity is enhanced.*
- *1(E) Our coastal and waterway environments are restored and preserved and access to them is maintained.*
- *1(F) Our region's waterways have consistently high water quality*
- *1(G) We use land management practices that protect and sustain our soil and land*
- *1(H) We reduce our reliance on non-renewable energy*
- *1(I) Waste reduction, recycling, energy conservation and energy efficiency are promoted and are part of how we live.*

In attempting to help achieve these desired community outcomes; the Regional LTCCP identifies groups of activities and objectives (which are supported by specific activities) for the regional council. These include:

- Air

  The overall objectives relating to air quality activities are based around meeting National Environment Standards (NES) for air quality, protecting air quality where it is high, enhancing air quality where it is degraded and maintaining air quality elsewhere.

- Inland waters

  The overall objectives relating to inland water activities include for water to be used more efficiently (there is enough for human and ecological uses), for people to have clean water for recreation, cultural and commercial uses, and for people to have access to water bodies (for both recreational and cultural purposes). Environment Waikato also has the objective of a net improvement in water quality across the region.

- Land and soil

  Activities identified in the Regional LTCCP in relation to land and soil aim to ensure that:

  - people have soil and land that remains versatile for productive uses;

- soil will be managed more efficiently and will remain in a condition that can support future generations; and
- levels of contaminants in water that come from land uses will be minimised as far as is practicable so that water quality is acceptable to the community.

- River and catchment systems

  The objective of activities relating to river and catchment is to *"create stable and healthy river and stream systems, protect communities, maintain the productive potential of land and enhance the public amenity and environmental values of rivers and streams throughout the region."*

- Waste, pollution prevention and contaminated land.

  The objective of activities relating to pollution prevention and contaminated land is to manage the disposal and reduce the amount of waste being generated in the region, including minimising the adverse environmental affects from activities that produce waste.

4.1.2 District LTCCP

The Waipa District Council LTCCP for 2006-2016, prepared under the LGA, sets out community outcomes for the District, and identifies associated activities, actions and budgets for achieving these outcomes.

Waipa District Council's LTCCP mission statement is to promote the wellbeing of the people of the Waipa District. Goals which fall under this and relate to the physical environment include:

- To recognise, and foster awareness and the enhancement of, the unique cultural, historic, environmental and recreational character and strengths of the District;
- To ensure prudent stewardship of the natural and physical resources of the District; and,
- To act as an advocate to promote the social, economic, cultural and environmental well-being of residents and communities of the District.

Waipa community identified a broad range of outcomes through the LTCCP process. Those related to the physical environment come under the 'Sustainable Waipa' umbrella and include the following:

- Clean air, water and land;
- Minimal waste and effective waste management;
- Efficient and effective utility services;
- A well-managed environment; and,
- Protection of natural environment.

In achieving these it is acknowledged that growth and development need to be carefully managed and monitored in order to prevent potential negative effects on the physical environment.

The Waipa LTCCP identifies the following tools and activities to help the Council maintain the physical environment:

- The District Plan – discussed further in Section 4.2.3 of this paper. The LTCCP indicates that this is a base document for Council in its guidance of development in the District in compliance with the Resource Management Act 1991.
- Asset Management Plans – these have been developed over a number of years in the main areas of physical service provision by Council i.e. water supply, stormwater, wastewater treatment and disposal, transport management.

- Reserve Management Plans – Council has developed several plans over the last few years in line with the Reserves Act 1977.

A number of indicators have been development to monitor the community outcomes associated with the physical environment. These include:

- Lake/River water quality
- Air quality at selected sites
- Soil quality at selected sites
- Volume and composition of waste going to landfills as a proportion of total
- Quantity of waste diverted from landfill
- Community satisfaction with recycling services
- Area of vacant land available for development for residential, commercial, industrial and rural residential uses
- Extent of urban/rural residential areas
- Efficient and effective utility services Satisfaction with Council services/facilities
- Quality of public water supply
- People's environmental attitudes
- People's personal environmental actions
- Area of land subject to environmental protection by type.

The next review of the LTCCP (2009-2019) is anticipated to be notified in March/April 2009.

4.2 Resource Management Act 1991

4.2.1 Regional Policy Statement

The Regional Policy Statement (RPS) provides an overview of the significant resource management issues of the Waikato Region and sets out objectives, policies and methods to achieve integrated management of the natural and physical resources of the whole Region.

A significant resource management issue is accelerated erosion of soil resources which *"..is leading to:*

i. *loss of soil productivity, capability and versatility;*

ii. *downstream sedimentation resulting in degradation of water quality, aquatic ecosystems and water supply systems and increased flooding potential;*

iii. *adverse effects on the aesthetic, scientific and cultural values associated with land."*

Net reduction in the effects of accelerated erosion and those effects avoided where practicable is therefore an objective throughout the Region.

Similarly, contamination of soils may lead to reduced soil versatility and productivity, and has been identified as a significant resource management issue, as these contaminants can be leached from the soils and contaminate surface and groundwater resources. Avoiding, remedying or mitigating soil contamination is a policy of the RPS. Also, management of contaminated sites is another policy of the RPS, so that no significant risk of adverse effects on human health or the wider environment results from existing contaminated sites.

The RPS also recognises the presence of wetlands and peat soils which have value for agricultural; scientific and flood control purposes. The RPS states that "*while much of this land has been drained and protected from flooding, and these schemes require effective and efficient management, water levels need to be managed to limit oxidation of the peat*".

Significant water resource management issues for the Waikato Region have been identified as; water quality, flow regimes, efficient use of water, wetlands.

The RPS states *"the quality of the Region's waterways is generally high in upper catchments but degrades downstream, particularly in intensively used catchments."*

Net improvement of water quality across the Region is an objective of the RPS, with protection of outstanding water bodies and riparian management being relevant policies.

Wetlands are recognised as vital ecosystems which contain a rich variety of flora and fauna. They are also an integral component of the Region's water resources. Wetlands are an important but diminishing resource in the Waikato, so an increase in the quantity and quality of the Region's wetlands is an objective of the RPS.

In the majority of areas in the Region, air quality is perceived to be high. Yet the RPS has recognised that this air quality can be adversely affected by point source or cumulative discharges to air, which may in turn produce adverse effects such as decreased personal and public amenity, decreased health of humans, flora and fauna. Therefore regional and local air quality is a significant resource management issue, with the following related RPS policies: protection of high air quality; enhancement of degraded air quality; maintaining other air quality; avoiding adverse effects on human health; and avoiding adverse effects on the health of flora and fauna.

Resource management issues related to energy and efficient energy use and production are also key to the RPS. Energy production, distribution and use produces adverse environmental effects. Reducing energy consumption through increased efficiency will minimise these adverse environmental effects (e.g. the production of greenhouse gases when burning fossil fuels, or the flooding of productive land for a hydro dam). Inefficient energy production and use uses natural resources at a greater rate than is needed and results in unnecessary adverse effects on natural and physical resources. Therefore one objective in the RPS is efficiency use of energy within the Waikato Region.

Rapid and increasing consumption of resources contributes to many waste disposal problems. In the short term, the volumes of waste generated create problems relating to safe disposal and the availability of disposal facilities, especially with respect to hazardous wastes. In the long term, wasteful consumption of resources can deplete critical and non-renewable resources. It is therefore necessary to reduce the quantity of wastes produced and the adverse effects associated with the generation and disposal of these wastes. An objective of the RPS is "*the efficient use of resources and a reduction in the quantities of wastes requiring disposal in the Waikato Region, and the adverse effects associated with their generation and disposal*".

The RPS is presently under review and the proposed RPS is anticipated to be notified July 2010.

4.2.2 Regional Plan

A number of issues, objectives and policies are identified in the Regional Plan that relate to the physical environment. These relate to water resources, damming and diverting water, drilling, river and lake bed structures/disturbances, accelerated erosion, contaminated land, regional and local air management, and the discharge of agrichemicals into air.

Issues relate to:

- Deterioration in water quality and values through point source discharges, the cumulative effects of non-point source discharges and modification of flow regimes.
- Deep groundwater takes may affect other users or reduce the sustainable yield, through drawdown effects. Shallow takes may adversely affect surface water base flows, quality and water levels.
- Contamination of groundwater or soils, mixing of aquifers or loss of pressure through drilling below the water table.
- Structures in, on, under or over the beds of rivers and lakes may adversely affect bed stability, water quality, and flow regimes of river and lake beds.
- Activities that alter the beds or banks of rivers and lakes can create bank erosion or destabilise bed material, leading to decreased water quality.
- Deliberate introduction of any plant in, on, or under the beds or banks of rivers or lakes can redirect river flows resulting in localized erosion of river bed or bank, or on adjacent land, decreasing water quality.

- The clearance of vegetation from the bed or bank of a river or lake can result in adverse effects, including increasing the level of contaminants carried over land into streams.
- Livestock access to the banks and rivers, lakes and wetlands can decrease water quality through trampling and defecation, create bank instability effects, and cause deposition of faecal material in a place where it can enter the water body causing adverse effects on water quality.
- Some land use activities can create a high risk of accelerated erosion of soil resources; which may result in loss of soil productivity, reductions in water quality due to high suspended sediment loads, increased sedimentation in streams, estuaries and harbours, or discharge of particulate matter to air.
- Discharge of wastes and hazardous substances into or onto land can cause contamination of soils*, surface water and ground water (through processes such as surface run-off, acid drainage, leaching and ground water percolation)*, adverse effects on air quality, and increased downstream sedimentation in streams.
- Discharge of contaminants from contaminated land can cause degradation of water quality.
- Air quality can be degraded by individual site sources and/or by cumulative discharges from diffuse sources, including odour, particulate matter, combustion products and/or hazardous air pollutants.
- Discharge of herbicides, insecticides and fungicides into the air can result in off target drift of these agrichemicals. Decay of vegetation as a consequence of weed control using agrichemicals can decrease water quality through decreased dissolved oxygen levels.

The objectives and policies of the Regional Plan in relation to the physical environment reflect the above issues, and seek to avoid, remedy or mitigate adverse effects.

4.2.3 District Plan

The Waipa District Plan, contains a number of issues, objectives and policies that relate to the physical environment and are therefore of relevance to this Profile Statement. The Plan outlines three significant resource management issues:

- **Rural land subdivision and development and the protection of prime agricultural land –**Subdivision can facilitate intensive productive use but it can also reduce the range of future production options. There is a need to balance subdivision and rural-residential development against concern for the protection of land resources in the longer term.
- **Landscape protection –** Outstanding natural features and landscapes throughout the District are worthy of some sort of policy protection in order to prevent adverse effects of development activities. Other localised areas in the District also provide significant amenity values which could be prejudiced by inappropriate development.
- **Urban development -** The different potentials and constraints within Cambridge and Te Awamutu need to be recognised and development opportunities provided for within both, commensurate with such opportunities in other parts of the Region and Hamilton City. Environmental improvements, commercial trends, and traffic issues also need to be considered.

The objectives and policies of the District Plan in relation to the physical environment reflect the above issues, and seek to avoid, remedy or mitigate adverse effects. The Waipa District Plan contains a range of methods including rules and non-regulatory methods to achieve the objectives and policies in relation to the physical environment, including the use of zones providing different standards for activities.

4.3 Other Management Tools

4.3.1 The Conservation Management Strategy – Waikato Conservancy, 1996

The Conservation Management Strategy for the Waikato Conservancy (currently under review) is a 10 year statutory document that describes how and where DOC will manage public conservation lands and waters for the purposes of conservation, recreation and tourism.

The Strategy outlines a number of objectives and implementation methods for the Waikato sub-region. These objectives and methods largely focus on the protection of natural values, ecosystems, habitats and biodiversity,

and are therefore of relevance to water quality and quantity and to a lesser degree air quality and soil characteristics.

The Department of Conservation administers some land within the Waipa District, including some of the Waikato forest land such as Pirongia, and Waipa peat lakes such as Lake Serpentine - regarded as being of international significance. DOC is also one of the signatories to the Waipa Peat Lake and Wetland Accord (Department of Conservation 2008).

4.4 Summary

The planning framework described in preceding sections seeks to protect features of the physical environment, such as air and water quality, significant ecological areas and landscapes, from the effects of growth and development. Elements of the physical environment can be a direct constraint or limitation to growth and development (e.g. erosive soils or contaminated land) or they can be limiting indirectly through the need for protection (e.g. water quality, air quality, highly productive soils, and landscapes).

5 Key Opportunities and Constraints

The following section outlines the key opportunities and constraints for growth management in relation to the physical environment of the Waipa District. These opportunities and constraints will help inform the District Plan review and growth strategy.

5.1 Opportunities

Physical Features

- The topography of the district makes it a desirable place to visit and live. Residents and visitors alike appreciate the rural character, quality of air, and picturesque water and land features present there. The importance of the physical environment to industries associated with tourism and recreation as well as agriculture is a driver for protection of these features from the impacts of growth and development.
- Geological features are generally resilient to changes in the use of land surfaces, but the character of some sites and the visibility of geological features, can be influenced by human induced changes like - the removal of native vegetation and planting of exotic species; the proximity of earthworks like roading and quarrying; and the erection of tall structures like pylons and towers.

Water Quality and Quantity

- Water features such as Arapuni and Karapiro lakes and the peat lakes are an asset to the Waipa District and represent important economic and recreational opportunities.
- Opportunities to improve water quality exist and should be pursued.

Ecology

- Areas of ecological significance (which also tend to have landscape values) such as the peat lakes and wetlands, Mount Pirongia and Maungatautari are an asset to the district and represent economic and marketing opportunities for tourism, as well as research, education and recreation.
- Other, lesser-known' areas in the District would also benefit from local ecological restoration and protection. Ecological corridors can be created and the Waipa community (for example community groups and farmers) should be encouraged to be engaged in this.
- There are vast areas of land with little or no ecological/biodiversity value, that may be potentially suitable for growth and development.
- Land-use 'buffers' between intensive agriculture and protected ecological sites could be created in the form of forestry, for example.

Natural Hazards

- Natural hazards information is key to determining appropriate options for growth, that is, avoiding growth in locations which are likely to be subject to natural hazards.
- The District Plan review provides an opportunity to focus on resilience to hazards, Territorial authorities have a crucial role to play through equipping communities with knowledge of natural hazards and what they need to do to be prepared.

Air Quality

- As the most significant causes of poor air quality are from domestic home heating, the District Plan can combat this by providing stringent insulation and energy efficiency standards, ensuring new wood burners

installed in houses are clean-burning and efficient, and promoting low carbon technologies / renewable energy.

5.2 Constraints

Physical Features

- The eastern and western edges of the district are classified as “unstable land” by Waipa District Council as they have a slope between 15 and 35 degrees, therefore such areas are characterised by challenging topography for growth and development. It is likely that such areas could be developed upon if engineering solutions were employed. However, given their distance from existing centres and therefore from services, and the rural character of the surrounding area, these areas do not lend themselves to intensive development.

Soil

- A key conflict arises in the Waipa district between land use for agricultural purposes and land for urban development and growth. Areas desirable because of their physical form correspond to highly productive land and versatile soil. Few brownfield sites exist for redevelopment/regeneration.
- Some contaminated sites have been identified in the district. However, the data held by Waipa District Council differs in some cases from that held by Environment Waikato. It is therefore important that further investigation and dovetailing of the information occurs. Remedial works will also be needed, particularly if such land is to be used for future brownfield development.

Water Quality and Quantity

- Increased growth and development may adversely affect ground and surface water quality. Care must be taken to ensure development is located appropriately and so that erosion and sediment runoff do not lead to increased turbidity/nutrient-enrichment thereby adversely affecting the water quality of the District’s waterways. This may mean that more reticulated systems are required so that the Council can carefully monitor wastewater systems. This is particularly important in the peat areas as discussed in Section 5.4.

Ecology

- Careful management of peri-urban development is needed particularly in the ecologically sensitive environments such as the peat wetlands. Particular care must be taken to ensure that the impacts of earthworks and activities associated with the establishment of lifestyle blocks do not adversely impact on peat lands through increase sedimentation and nutrient-enrichment. Establishment of buffer zones, such as forestry and riparian zones, may be appropriate in some areas.
- Additionally care must be taken to ensure that growth occurring in close proximity to important ecological areas, such as Pirongia and Maungatautari, is appropriately managed in order that introduced species such as cats and dogs to not have detrimental effects on the native flora and fauna species within those areas (for example, through the use of conditions).

Natural Hazards

- Flooding is the main natural hazard that the Waipa district is subject to. Ensuring that flood prone areas are either not developed upon, or that streams which may cause flooding in extreme weather conditions are carefully managed (weeds and debris removed) is crucial to mitigate the effects of flooding. Areas of Te Awamutu have experienced a number of historical flooding events therefore useful data exists regarding flood prone areas in the township. The District Council must consider flood hazards when deciding on subdivision proposals and building permits. Information from the Te Awamutu study has been incorporated into the Waipa District Plan subdivision rules as assessment criteria to which regard should be had, including: that any allotment, unless not relevant to its likely development or use, contain a sufficient area of land capable of accommodating any foreseeable building and associated development which is above the 100 year flood level or any flood level identified on the 1% probability flood level as described in the Draft Te Awamutu Flood Management Plan prepared by Waikato Regional Council (1993).

- Peat subsidence and localised flooding issues are also constraints which need to be managed through appropriate land management practices.

Air Quality

- Increasing residential populations will lead to increased discharges to air from domestic home heating, and to a lesser extent from vehicle emissions and outdoor burning. Economic growth may lead to air discharges from industrial or other activities. Currently nowhere in the Waipa District is considered to have poor air quality but there is the potential for this to worsen with increasing population and industry growth.

Acoustic Environment

- Increased growth and development may adversely impact on the tranquil nature of the environment. Reverse sensitivity impacts of residential development in close proximity to existing rural and /or industrial activities could adversely impact on such rural / industrial activities if noise complaints etc are received.
- Careful location and design of new residential areas is needed to ensure that residents are not adversely affected by highway noise.

6 Base Case Conclusions

- The Waipa District is fortunate to have predominantly versatile and high class soils. Unfortunately inherent in this characteristic of the District is conflict between the desire for peri-urban development and urban expansion, and the resultant loss of productive soils.
- The central belt of the district contains flat land which is better suited to development than the more hilly / “unstable areas” to the west and east of the district. However, the central area also contains significant ecological areas such as peat lakes and wetlands, which require careful management; therefore development in such locations is likely to conflict with other aims within the district. Conflicts will require management.
- Flooding is the major natural hazard facing the Waipa District and development. Te Awamutu in particular has experienced a number of flooding events associated with the Mangapiko Stream. Peat subsidence will also cause localised flooding issues. Therefore, future development in flood prone areas needs to be carefully designed and located, and appropriate land management practices encouraged.
- There are few known contaminated sites in the District, however, an unknown number of additional sites may be potentially or actually contaminated due to historical or current uses. Any identification of future growth areas will require further investigation and remediation of these areas and may preclude some kinds of development, for example schools.
- The District is generally well supplied with water though water quality varies between catchments (refer to the Infrastructure Profile Statement). Agricultural practices, stormwater need to be managed appropriately in order to minimise eutrophication and sedimentation of the District’s waterways and the subsequent effects on water supply, ecology and contact recreation.
- The Waipa District contains ecological values and biodiversity of regional and national significance. The peat lakes and native flora and fauna, such as Mount Pirongia and Mount Maungatautari, must be protected from the adverse effects of growth and development.
- Air quality in the District is generally high and tends to be affected on a localised scale mainly by domestic home heating during winter, as well as vehicle emissions, outdoor burning and industry to a lesser extent. Future development should encourage cleaner domestic heating, and future urban areas should be designed to reduce reliance on private motor cars. Industrial burning has the potential to decrease air quality over a larger area, therefore airsheds will need to be considered in light of industrial growth or expansion.
- Future residential development must be designed to avoid reverse sensitivity effects (such as noise, emissions) as a result of existing industries such as agriculture and industry, as otherwise reverse sensitivity may became a hindrance to economic growth in some areas.
- In locating future growth cells, consideration must be had to the location of highways and future bypass routes to ensure that residential areas are not adversely affected by highway noise.
- The Waipa district contains landscapes of regional and national significance and the protection of such landscapes may conflict with future growth and development (refer to the Natural Character and Landscapes Profile Statement).

7 Recommendations for Further Work

On the basis of the profile provided in this paper, the following further work recommendations are made to assist in this and future strategic planning projects:

- Preparation of a Hazard Mitigation Plan would be a worthwhile way to guide the growth strategy as it could highlight specific hazard areas such as flood zones. Further assessment is needed to assess the location and extent of flood prone areas and areas where ponding occurs- collaboration will be needed between the district and regional council to identify the match between population growth areas and flood risk areas and to ensure appropriate land use decisions (policies, rules and consents) are made in these areas.
- A review of the Regional Policy Statement provides an opportunity to strengthen linkages with Civil Defence Emergency Management so that such measures can be incorporated into planning practice.
- Potentially contaminated sites need to be investigated and those in which contamination is confirmed require remediation.
- Air quality monitoring sites should be established within the Waipa District to monitor that airshed.
- Natural heritage landscape plans should be prepared to integrate urban areas, historical features, productive land and the indigenous landscape (eg native vegetation) in order to reflect Waipa's history – both natural and cultural. Linkages between different environments could be strengthened and adjacent land-uses protected through the use of buffer strips in the form of forestry, for example, and riparian protection, where appropriate.

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