Southland's Air / Ngā Hau o Murihiku

State of the Environment Report

Te Ao Marama Inc.

environment SOUTHLAND
Te Taiao Tonga

Whakatauki

The source of the air of the world

Na te Pō, Ko te Ao	From the night
Na te Ao, Ko te Aomārama	Came the day
Na Rangi, ka noho i a Pokoharuatēpo	From the day came the world of light Rangi coupled with Pokoharuatēpo,
Ka puta ko Te Hānuioraki me ngā hau katoa.	and Te Hānuioraki came forth, then all the winds.

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Foreword

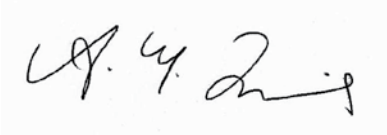
Air is essential to life, but most of us take it for granted. So, it's not until the air around us becomes compromised that we give it any thought, whether it's a smoking chimney or unpleasant odour.

As a regional council, it is Environment Southland's job to manage Southland's air using the Resource Management Act. We have a responsibility to meet the Government's National Environmental Standards for Air Quality (NES). We are also required to have a regional air plan that reflects current laws and the community's health values. Our scientists monitor air quality, we set policy, issue consents, have a proactive pollution prevention programme and respond to any complaints about poor air quality.

This is our first State of the Environment Report on air. It is written in partnership with Te Ao Mārama Incorporated and draws together what we know about our air. Environment Southland has provided the technical information, however, this is not a technical report; more a report about air designed for the community to read and understand.

In most of Southland we have very good air quality, but in Invercargill and Gore air pollution is an issue during winter, mostly due to the burning of coal and wood in home fires. We know it can cause health problems, but people also need to keep warm, which is what makes this a difficult problem to tackle. And, in rural areas how burn-offs are managed and what is being burnt are important in reducing their impact.

Addressing issues of poor air quality will take time. Understanding the issues is a first step; working together and taking responsibility, the second. No matter where we live in Southland, each of us can act to reduce air pollution leading to health benefits, an enhanced sense of wellbeing and a more amenable outdoor environment.



Ali Timms
Environment Southland Chairman

Air is a taonga (treasure) to protect; supporting so much of the life of our planet. It contributes to our health, the functioning of our environment and how we interact with our cultural landscapes. The protection of this taonga is a kaitiaki responsibility for Māori, and of high importance to all Southlanders.

Poor air quality can directly affect our health, through inhalation of tiny particles and contaminants that get lodged in our lungs. Health effects can manifest from coughing and wheezing, impaired activities, increasing need for medical treatment, reduced life expectancy and death. It disproportionately affects the most vulnerable in our community, including the very young, the elderly, pregnant women, the poor and those with respiratory and heart conditions. Māori have also been identified as particularly susceptible to the health effects of air pollution.

Ngāi Tahu whānui health and wellbeing depends on our linkages and interaction with landscapes and environment. As such we consider that air pollution includes odour, visual and noise pollution and that it is linked to the issue of climate change. All these issues can impact on the way we experience and protect the places and treasures of our ancestors, and pass on knowledge to our next generations.

Compared to heavily industrialised countries, our air is generally clean. We are not reduced to wearing face masks and having to stop community events because of the condition of the air. However, there are times when Southland's urban air quality exceeds national health standards. Poor air quality comes at a high social cost to our region and community – it has been recently estimated that human-induced air pollution costs New Zealand $4.28 billion per year. The cost of watching a whanau or community member suffer is too high at any price, and together we need to work to ensure such suffering does not continue.

Mō tātou, ā, mō kā uri ā muri ake nei
(For us and those after us).

Gail Thompson
Te Ao Mārama Incorporated Chair

Photo by: Emma Moran

Acknowledgements

This report is a result of a collaborative partnership between Environment Southland and Te Ao Mārama Incorporated.

Neither the report nor the partnership would have been possible without the patience, commitment and vision of the councillors, chairpersons and staff within those organisations.

The authors acknowledge all those who have contributed to its completion.

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At a glance

This is the first state of the environment report on air for Southland/Murihiku. *Southland's Air /Ngā Hau o Murihiku: State of the Environment Report 2014* takes a wide perspective bringing together both technical and cultural aspects to explain what we know about the condition of our air, the impacts of changes to it and what we are doing about them.

This section lists a summary of the key points made in the main text. The terms and concepts here are spelled out in much more detail in the text (and there's a glossary too).

Overall, air quality in New Zealand, measured against international and national standards, is generally good. In the Southland region, air quality can at times fall below those standards, particularly in winter in the urban centres of Invercargill and Gore.

The main issue is PM_{10}, the microscopic particles that are carried in the air. The key source of these in our region is coal and wood fires. This is a pollution cause we as a community can do something about. We are already working to reduce PM_{10}, but more needs to happen.

Air pollution levels have changed little since monitoring in Southland began in 2003. At the same time, the national system for judging when air is healthy or not has changed, and there are now Ministry for the Environment deadlines for our compliance with the new standards. The next major step is for our region to update the Regional Air Quality Plan for Southland, with rules for home heating.

Who manages Southland's air quality?

- Air quality is managed according to global and national health standards.
- Under the Resource Management Act 1991, Environment Southland as the regional council is required to manage the environmental effects of pollutants in the air, including particulate matter less than 10 microns in diameter (PM_{10}), odour, dust, dioxins and other gaseous pollutants from human-generated sources.
- Environment Southland works under national environmental standards administered by the Ministry for the Environment. These standards have set deadlines for compliance with the required pollutant limits.
- Te Ao Mārama Incorporated looks after manawhenua interests in resource management and is involved in the protection of spiritual and cultural values of the region.
- Local councils have a role in managing air quality and are responsible for authorising consents for domestic fires.
- Health agencies and the Southland Warm Homes Trust also have an indirect involvement in managing the effects of the region's air quality.

Why care about air?

- Air is one of the basic elements supporting life on earth; the quality of air is critical for human health and wellbeing, as well as the health of the natural environment.
- Air quality in New Zealand is generally clean and healthy. It is an important indicator of environmental health that contributes to the quality of life we enjoy.
- For Māori, air is taonga derived from Ranginui, whose many offspring include the various winds that are so critical for influencing our climate and the quality of our air. Maintaining the mauri, or life-supporting capacity, of air for future generations and ensuring the domain of Ranginui is treated with respect are key concerns for tangata whenua.
- Discharges to air from a range of sources have the potential to affect human health, as well as affecting valued flora and fauna and our climate.
- In winter our air can become polluted, especially in the urban centres of Invercargill and Gore where PM_{10} levels regularly exceed the national standards designed to protect our health.
- Exposure to PM_{10} is detrimental to human health especially for elderly people, children and those who have existing respiratory conditions. Symptoms can range from minor irritations to chronic physiological changes.
- PM_{10} is so tiny it is invisible to the naked eye and easily inhaled as we go about our day.
- PM_{10} is a particular issue in Southland, especially in the urban centres of Invercargill and Gore during winter. It is largely a result of the burning of coal and wood in domestic fires, which means we can do something about it by changing how we heat our homes.

What contributes to poor air quality?

- Natural sources include volcanic ash, sand storms, bush fires.
- Human activities are the main contributors in our region. The burning of coal and wood in domestic fires accounts for 92% of all the human-generated PM_{10} pollution in urban Invercargill and 96% in urban Gore.
- The practice of 'banking' and 'dampening down' of fires creates more PM_{10} as does burning poor quality fuel (eg wet and unseasoned wood).
- While Southland has some big industries, which are monitored through the resource consent process, industrial activities cause very little PM_{10} – Invercargill 6%, Gore 1%. Motor vehicles contribute 2% and 1% respectively.
- Outdoor burning contributes relatively little PM_{10} in urban centres, but the burning of wet vegetation creates significant smoke and pollution, and the burning of other types of waste (such as baleage wrap and agrichemical containers) can create potentially toxic fumes.
- Each of the sources of air pollution mentioned above may also contribute to the concentrations of dioxins and other gaseous pollutants in the atmosphere, but their specific contributions in Southland is not known.

What is poor air quality?

- New Zealand air quality standards and guidelines cover 15 contaminants.
- Particulate matter less than 10 microns (PM_{10}) is the only contaminant that Environment Southland monitors. Research has shown it is the primary contaminant of concern in the region.
- Airsheds that exceed a 24-hour average of 50 $\mu g/m^3$ of PM_{10} more than once a year are in breach of the national standard.

What is Southland's air quality like?

- Like most New Zealand towns, Invercargill and Gore have more air pollution during the winter months when people are lighting their fires and the weather is calm and cold.
- Air quality in the urban airsheds of Invercargill and Gore regularly exceeds the national standard for PM_{10} during winter.
- Other Southland towns are monitored for short periods from time to time and show relatively low levels of PM_{10}.
- Air quality has been monitored in Invercargill since 2003 and in Gore since 2006 and analysis shows that the situation has neither improved nor worsened.
- Of the 43 airsheds nationally, Invercargill ranked 10th and Gore ranked 23rd for the number of exceedances in 2011.

What are we doing about air quality?

- Environment Southland provides information and advice to the community, organisations and industries to encourage best practice and reduce discharges to air.
- Our current focus is on reviewing the Regional Air Plan for Southland (1999) to reflect current legislation and standards, and to develop good management tools to address areas of poor air quality.
- The air plan review is already underway – it will cover domestic heating, outdoor burning, agrichemical use and fertiliser use. A later review will address industrial and trade discharges to air. The current review will almost certainly require changes to the way people in the Invercargill and Gore airsheds heat their homes, and to how farmers dispose of baleage wrap and agrichemical containers.
- Any new rules in the air plan will strive to balance the deadlines applied by the Ministry for the Environment with the time the community needs to adjust to the necessary changes.

What we don't know

- It would be useful to do some research to identify what proportion of particulate matter comes from human sources versus natural sources.
- There is currently no information on indoor air quality so we don't know if outdoor pollution is entering into our homes.
- While we know poor air quality has a negative impact on human health, little is known about the extent of long-term effects on Southland communities or on the natural environment.

What help is there?

- There are central government subsidies available through the Southland Warm Homes Trust project to help low income households insulate their homes.
- An Eco Design Advisor is available at the Invercargill City Council to offer free advice to Invercargill residents.
- Information about sustainable energy options is available on the Ministry for the Environment website: www.mfe.govt.nz
- Links and information are available at www.BreatheEasySouthland.co.nz

What is PM_{10}?

PM_{10} is a mix of liquid droplets and solid particulate matter less than 10 microns (µm) in diameter – a pollutant too small to see with the naked eye that can affect human health.

PM_{10} is formed through the combustion of fuels (burning), natural processes (sea spray/ volcanic eruptions etc) and mechanical processes including crushing, grinding and abrasion. It can also be formed through reactions between gases and particles in the atmosphere.

The main human-generated sources of PM_{10} in urban areas are:

- burning fuels such as wood and coal for home heating
- vehicle exhaust emissions
- industrial discharges.

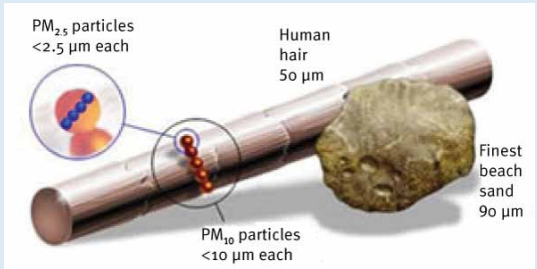
An emission inventory undertaken for Invercargill and Gore in 2011 found that home heating was *"the main source of PM_{10} emissions, accounting for 92% in Invercargill and 96% in Gore"*.[1]

What are the health effects of PM_{10}?

Research shows that breathing in PM_{10} is harmful to human health. Coarse PM_{10} (between 2.5 and 10 µm) accumulates in the upper airways, and fine PM_{10} (less than 2.5 µm) accumulates in the small airways deep in the lungs (Figure 1).[2]

Health effects include irritation to eyes, nose and throat, increased risk of colds and influenza, asthma attacks, and deterioration in chronic heart and lung conditions. Healthy people experience mainly nuisance health effects but children, asthmatics and people with other respiratory problems can experience serious health effects.[3]

Figure 1: Size of PM_{10} particles in comparison to human hair and beach sand



Source: Ministry for the Environment

1 Wilton, 2011. **2** Ministry for the Environment, 2011. **3** Fisher et al., 2007.

Photo by: © Stephen Voss

Introduction – the air we breathe

Air is essential for life and the quality of the air directly impacts on the quality of lives – our health and wellbeing, and that of the environment.

Air, air quality and the atmosphere are taonga (treasured) and part of the kaitiaki (guardian) responsibility for Māori. This realm of Rakinui[4] contributes to our health, quality of life, the functioning of the natural environment and our interaction with it, as well as the connections with our wāhi tapu (sacred places) and wāhi taonga (places of importance).

The legal system in New Zealand recognises the importance of air quality, in particular through the Resource Management Act 1991. Environment Southland as a regional council has legal responsibility for reporting on and managing air quality in the region, under this Act.

Air in New Zealand is generally clean and healthy relative to heavily industrialised countries.[5] Yet there are times when some indicators of air quality exceed national health standards[6] in urban areas where most of our population lives, including in the Southland airsheds of Invercargill and Gore.

This report addresses the importance of air quality in Southland/Murihiku. Created in partnership between Environment Southland and Te Ao Mārama Incorporated, it considers how we are looking after the issues in our region – within the context of state of the environment reporting, and the manawhenua (customary authority) interests in resource management for the Ngāi Tahu whānui.

4 Rakinui is the Kai Tahu dialect of Ranginui (sky father). **5** Ministry for the Environment, 2007. **6** These regulations are the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (amended 1 June 2011).

Our place our people

Hokia ki nga maunga kia purea koe e nga hau o Tawhirimatea

Return to the mountains to be purified by the winds of Tawhirimatea

Southland is the second largest region in New Zealand. It covers an area of 34,000 sq km (12.5% of New Zealand's landmass). Its coastal boundary extends from Awarua Point (Fiordland) on the west coast, to Waiparau Head (Catlins) on the fringe of the east coast, and includes Stewart Island/Rakiura.

In all, 53% of Southland's land area is managed as public conservation land. Farms occupy 85% of the remaining land.

Climate

Southland lies deep within the southern hemisphere's westerly wind belt.

Wet westerly winds drop most of their moisture on the western side of the partial barrier formed by the Fiordland mountain ranges (5,000–10,000 mm/yr); rainfall on the eastern or lee side is much lower, although still reasonably common (700–1,500 mm/yr).

Coastal Southland near Foveaux Strait can experience periods of strong and persistent westerly winds, combined with regular rainfall (1,000–1,200 mm/yr). Average wind speeds in Invercargill are around 18 km/h, while the average annual temperatures in the city are around 9.9°C[7].

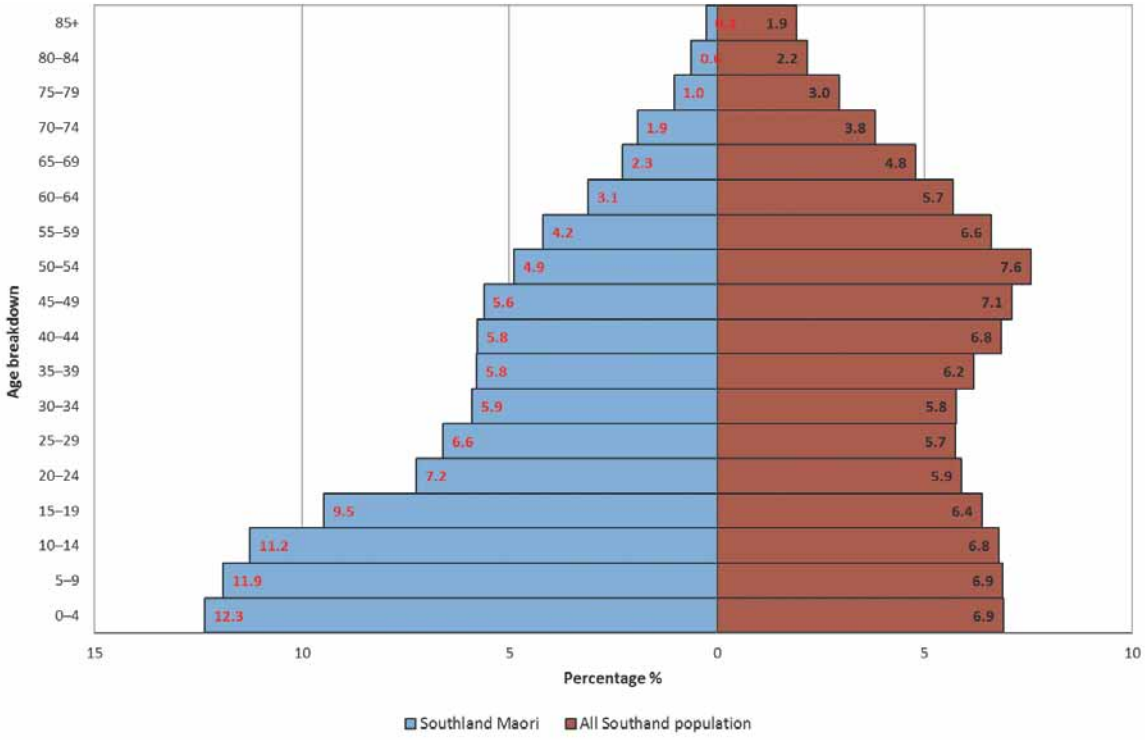
Across Southland, the temperatures generally range from a high of 30°C in the summer months to a low of -8°C in the winter.

Population and ethnicity

In the 2013 Census the population of Southland was 93,339, making up 2.2% of New Zealand's population. In terms of ethnicity, 85.4% of Southlanders identify as being of European descent, 12.4% as Māori, 3.0% as Asian, 2.1% as Pacific people and 2.2% as another ethnicity (you can identify with more than one ethnicity).

The age distribution for Southland for Māori is predominantly youthful (35.4% are in the 0–14 years categories) and steadily diminishes with age. This contrasts with the total Southland population which has a higher proportion of the population in the 40–60 years categories (28.1%) (Figure 2).[8]

Figure 2: Age distribution of Southland by Māori and total population



Source: Statistics New Zealand, 2014

7 NIWA, n.d. 8 Statistics New Zealand, 2014.

Manawhenua

Māori have a long history in Southland/Murihiku, with a major settlement on Ruapuke Island and other settlements along the Southland coast at Waikawa, Bluff, and Riverton/Aparima.

Manawhenua refers to the iwi or hapū that holds the traditional/customary authority over resources within a particular area.

In Southland/Murihiku (Figure 3) there are four Ngāi Tahu papatipu rūnanga (traditional local Māori councils) whose members hold manawhenua status within the region:

Figure 3: Map of Murihiku boundaries *(light shading)*

Source: Ngāi Tahu ki Murihiku, 2008

- Te Rūnaka o Waihōpai: centered on Waihōpai/Invercargill
- Te Rūnanga o Awarua: centered on Awarua/Bluff
- Te Rūnanga o Ōraka/Aparima: centered on Colac Bay/Ōraka
- Te Rūnanga o Hokonui: centered on Gore.

Where we live

Southland's main urban centre is Invercargill with 51,693 people. Other significant population areas are Gore (7,353), Winton (2,211), Te Anau (1,911) and Mataura (1,509). The proportion of the region's population living in rural areas is approximately twice the national average.

Home ownership in Southland is above the national average, with 70% of households living in homes owned by themselves or a family trust. There are 37,449 households in Southland, with an average of 2.4 persons in each. Approximately 86% of households were constructed pre-1980, indicating that many households do not have adequate insulation.

Southlanders heat their homes using a variety of methods and many households use more than one type of heating in their main living area. As an example, a household may have a heat pump and a wood burner in their main living area. The main choices in Southland are electricity (78%), wood (54%) and coal (34%). The percentage of households using coal is the second highest in the country; only the West Coast region is higher.[9]

What we do

Economy and employment

Agriculture, primary production and manufacturing are the main contributors to Southland's economy. The agriculture, forestry and fishing industries employ 20% of the workforce, while manufacturing employs 13%. The retail trade (9.6%), health care (9.2%) and construction (7.1.%) round out the top five. The average household income in Southland is $57,400.

Play and recreation

Southlanders enjoy outdoor recreation. Our most popular sporting and recreational activities include walking, gardening, fishing and jogging. Hunting is also a major activity for Southland males, with 19.5% participating.

Southland seasons are often described in terms of what can be hunted or gathered (mahinga kai) in the environment at that time of year. Such seasonal harvests include whitebait, trout, duck, kanakana (lamprey), tītī (mutton bird) and deer (eg the stag hunts of the 'roar', the 'rut' and the 'bugle').

Southlanders are also involved in the year-round recreational and customary harvests of flounder, crayfish, blue cod and pāua.

9 Statistics New Zealand, 2014.

What is the purpose of this report?

This report has been written to:

- raise awareness and understanding of our region's air resource
- explain how activities are influencing air quality
- help us plan and set priorities for the future
- help people and organisations to make informed decisions to protect what they value in the environment
- inspire community action.

State of the environment reporting

State of the environment (SOE) reporting conveys knowledge about the current state of the environment or a particular component of it. This report presents the current state of air quality in Southland, evaluates trends, identifies pressures on air quality, and presents our response to those pressures.

SOE reports summarise a large amount of technical information, but are not generally themselves a technical document. This particular report draws on over 10 years of monitoring and analysis information to evaluate air quality against an established set of standards and environmental indicators. These standards and indicators enable us to identify areas that need improvement if we are to protect the air resource.

Regional councils are required by section 35(2)(a) of the Resource Management Act 1991 to monitor the environment and take appropriate action where it is shown to be necessary. Regional councils are also required by the Resource Management Act and other legislation (including the Local Government Act 2002 and the Ngāi Tahu Claims Settlement Act 1998) to work in partnership with iwi authorities on resource management issues.

This SOE report is the first completed by Environment Southland on air quality since that legislation was introduced. It is the third SOE report completed in partnership with iwi.

How we developed this report?

This report is the result of the partnership between Environment Southland and Te Ao Mārama Incorporated (see the following section, 'Who manages Southland's air quality' for a description of the two organisations). Environment Southland and Te Ao Mārama Incorporated have worked together to ensure that the content of the report is relevant to the population of Southland and answers the questions important to them.

The report preparation combined two processes. Environment Southland drew on its scientific monitoring, policy expertise and its relationships and work with organisations and individuals in the community, plus feedback from a public questionnaire distributed in the early stages of the review of the regional air plan in 2013.

Te Ao Mārama Incorporated held interviews and discussion with various members of the Ngāi Tahu whānui, and carried out a literature review. This was written up as a free-standing report *Hā Nui o Raki (2013)*, before it was combined with material prepared by Environment Southland, to form this full report.

The content of the report is guided both by measures of cultural health as outlined in Hā Nui o Raki, and by the legislated air quality standards that Environment Southland is required to report to. It is important to note that the regional council now works to air quality standards set at a national level, which have replaced the guidelines that formed the basis of the 1999 *Regional Air Quality Plan for Southland*. Environment Southland is in the process of reviewing this regional air quality plan and it is hoped that this SOE report will provide the community with some context for that review (see 'Air plan review' in a later section).

More detail on Environment Southland's SOE reporting can be found on the website:

www.es.govt.nz/environment/monitoring-and-reporting/state-of-the-environment

Tracking changes over time

Monitoring of environmental trends requires a number of samples to be collected over a period of time. In air quality monitoring, a period of five years is generally considered to be the minimum for trend analysis. This period allows the influence of year-to-year climate variations to be minimised and trends to be identified. Trend analyses ideally occur over as long a period as possible. As an example, climatic trends are generally assessed using periods of 30 years or greater. One of the limitations associated with the five-year period used in this report is that it may not take into account longer term climatic cycles and their influence on air pollution meteorology.

Scope of the report

This report combines research and other analysis to present a snapshot of the state of air quality in Southland, from both the regional council and iwi perspectives. It utilises monitoring data collected in the region since 2003 and other information, such as emission inventories, trends analyses and management options' reports. It incorporates analysis that recognises the cultural impact of air quality, in terms of effects on people's overall wellbeing.

The report focuses on outdoor (ambient) air quality, in particular on particulate matter smaller than 10 microns (PM_{10}), which Environment Southland is required by legislation to monitor. There is also a brief discussion of indoor air quality – while this is generally addressed through health and building legislation, and as such is outside of the regional council's monitoring programme. However, it is included here as an issue of particular importance to Ngāi Tahu whānui. So also are odour, and climate change resulting from greenhouse gas emissions, which are also discussed briefly but are outside of the technical scope of this report. Environment Southland holds little data on the effects of climate change and greenhouse gas emissions, so these topics have not been included in the scope of this report.

Photo by: www.southernexposures.co.nz

Who manages Southland's air quality?

This section sets out the purpose and relative role of agencies involved in preparing this report on our region's air quality.

Environment Southland

Environment Southland is the brand name of the Southland Regional Council, whose 12 elected councillors are responsible for the governance and management of Southland's natural and physical resources: air, land, water and coast.

Under the Resource Management Act 1991 (the RMA), Environment Southland is responsible for managing air quality, ensuring the national air quality standards are met and also for reporting on the state of the environment in terms of air quality.

This RMA requirement includes managing effects on cultural health and wellbeing, as well as physical and environmental health.

Environment Southland's role in managing air quality covers a broad scope. Table 1 provides a broad indication of where the main air quality issues fit in terms of management responsibility, divided into international, national, regional and territorial authorities (TAs).

Environment Southland, as the regional council, manages the environmental effects of particulate matter less than 10 microns (PM_{10}), nitrogen oxides (NOx), carbon monoxide (CO), sulphur dioxide (SO_2) odour, dust and dioxins.

The 'outcomes' that Environment Southland aims for in its management of air quality are the community expectations set out within the Regional Policy Statement and the Regional Air Quality Plan for Southland (1999) ('the air plan'). The air plan is under review, to match the new National Environmental Standards for Air Quality (NESAQ). These national standards were introduced by the Government in 2004, and set minimum requirements for outdoor air quality to protect human health and the health of the environment. The NESAQ also set a design and thermal efficiency standard for new wood burners. (See 'Air plan review' section.)

Table 1 : Management responsibility of air quality issues

	International	National	Regional	TAs
Greenhouse gases	✓	✓		
Ozone	✓	✓		
Particulate matter (PM_{10}), NOx, CO and SO_2		✓	✓	✓
Odour			✓	✓
Dust			✓	✓
Dioxins		✓	✓	

Source: Environment Southland, 2013

Te Ao Mārama Incorporated

Te Ao Mārama Incorporated looks after manawhenua interests in resource management and other aspects related to local government in Southland. It is authorised to represent the four Ngāi Tahu papatipu rūnanga in Murihiku/Southland on certain resource management matters – in particular those relating to the management of natural resources under the Resource Management Act 1991. It is involved in the protection of the spiritual and cultural values of the region, including wāhi tapu (sacred places), mahinga kai (gathering food and resources) and other natural resources.

Kaitiakitanga (guardianship) is a central traditional principle behind Ngāi Tahu's management of the environment.

Manawhenua values and perspectives on natural resource and management issues are consolidated in *Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan: Te Tangi a Tauira* (2008). This planning document assists Ngāi Tahu ki Murihiku in carrying out kaitiaki roles and responsibilities. *Te Tangi a Tauira* also recognises the role of communities in achieving good environmental outcomes and healthy environments, and therefore is designed to assist others in understanding manawhenua values and policy.

Sharing a vision for air quality in Southland

The 2013 air quality report prepared by Te Ao Mārama Incorporated, Hā Nui o Raki, sets out in detail the Ngāi Tahu ki Murihiku vision of Southland's air quality. It also reports the areas of concern about air and atmosphere issues as expressed in *Te Tangi a Tauira*.

Environment Southland's *Regional Air Quality Plan for Southland* similarly sets out a community view of air quality goals. However this 1999 document is in the process of being updated, in line with the national standards for air quality introduced since its publication. It is expected the revised air plan will reflect the findings of this SOE report.

Other agencies

There are a number of other agencies who have a role in managing air quality in Southland. The three territorial authorities have a responsibility to manage PM_{10}, odour and dust issues in the region. The Invercargill City, Gore District and Southland District Councils authorise building consents for the installation of domestic fires under the Building Act 2004; domestic fires are a major contributor to air pollution in Southland so the consenting system has a direct effect on changing air quality here. It is at the building consent stage of the process that new wood burners are checked for compliance with the NESAQ design and efficiency standards.

In addition, the health effects associated with air quality issues mean agencies such as Public Health South, the Southern District Health Board and the Southland Warm Homes Trust are indirectly involved in managing air quality in Southland/Murihiku.

Photo by: Adrienne Henderson

Photo by: Boi Rickertsen

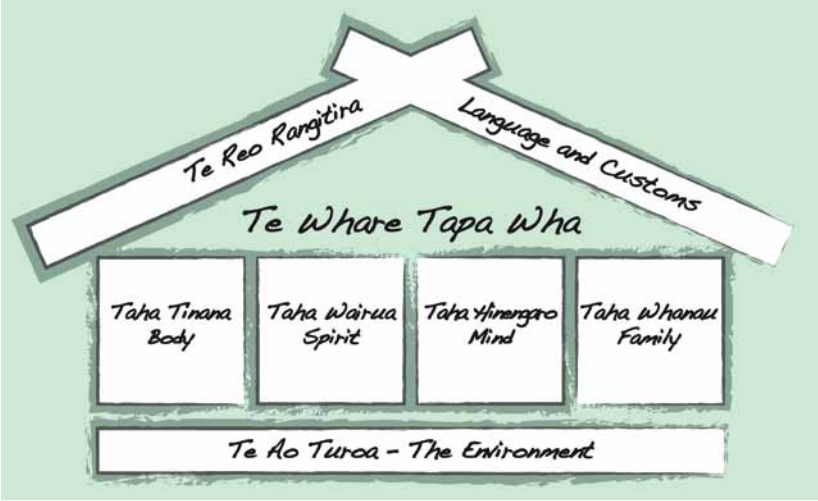
Why care about air?

This section focuses on the values our community attaches to clean air, which have formed the basis of our systems of measuring and managing air quality. The section starts with a description of Ngāi Tahu whānui concepts of air and atmosphere, and continues with a scientific examination of the connections between air quality and physical health. They combine to represent in broad terms the links between air and cultural health and wellbeing, environmental health and physical human health.

Health, cultural health and wellbeing

The World Health Organization defines health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity".[10]

Figure 4: Te Whare Tapa Wha Māori Health Model



Source: Durie, 1994

For Māori, the environment provides the foundations for the four pillars of wellbeing (Figure 4):[11] Hinengaro (mind), Wairua (spirit), Tinana (body), and Whānau (family).

Issues with air and air quality can not only affect people's physical health, but can also impact on the connection with whenua (land), te reo (language), te ao tūroa (environment) and whanaungatanga (relationships, kinships, whakapapa and whānau), which are central to Māori culture, health and wellbeing.[12]

Whakapapa establishes links that maintain relationships between our people, language and their environment. All things whether animate or inanimate are connected and have Mauri, a life force. Therefore the welfare of any part of our environment determines the welfare of our people. [13]

O Te Pū Hau – Ngāi Tahu and Air

Air and the surrounding atmosphere are considered by Ngāi Tahu whānui to be derived from Rakinui (the sky father). Following the separation of Rakinui and Papatūānuku (the earth mother), one of their many children Tāwhirimatea fled with Rakinui to his new home in the sky.

From there Tāwhirimatea controls the wind and elements. Rakinui is adorned by celestial bodies such as the moon and the stars, and is associated with light and life (see Figure 5).

Figure 5: Depiction of Tāwhirimatea

Source: E Kitson, 2013

Air is viewed as a taonga and valued for its life-supporting capacity for all things.

A central component of the Māori perspective on the environment is the recognition, protection and enhancement of mauri or the life force present in all things, animate and inanimate. Air, forests, waters, the life supported by them, together with natural phenomenon such as mist, wind and rocks, possess mauri. Mauri is required to be maintained and protected – and where it is degraded, enhanced – and to be passed on to the next generation in a healthy state.

10 Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19–22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. The definition has not been amended since 1948. **11** Durie, 1994. **12** Kai Tahu Ki Otago Ltd et al., 2010. **13** Ngāi Tahu ki Murihiku, 2008.

Air pollution can degrade and lessen the mauri or life force of this taonga. It also affects the mauri of other taonga, for example plants and animals, as all living things need air and all things share the same air. It is important to Māori to exercise kaitiakitanga to protect and maintain the mauri of taonga.

Degradation of mauri occurs if it no longer supports the traditional uses and values. Mauri can be desecrated by improper resource management activities. There are tangible and intangible measures of mauri. The tangible measures include:[14]

- aesthetic qualities, eg natural character and indigenous flora and fauna
- life-supporting capacity and ecosystem robustness
- fitness for cultural use
- productive capacity.

Kaitiakitanga is the exercise of guardianship/stewardship by tangata whenua of their area and resources in accordance with tikanga Māori (rules and customs). Kaitiakitanga governs the way humans interact with the environment, with the concept of maintaining balance and reciprocity underpinning cultural uses and practices. Kaitiaki are the interface between the natural and spiritual realm of resource management.

The Māori concept of the environment is holistic. Ngāi Tahu whānui use 'ki uta ki tai' (from mountains to the sea) as an overall approach to resource management.

Ki uta ki tai encompasses the wider creation traditions and kaitiaki status of tangata whenua.

The application of ki uta ki tai requires co-ordinated and holistic management of the interrelated elements of a catchment, from the air to water, the land and coast.[15]

For instance, it is easy to see the direct link of poor air quality on human and ecosystem health. At the same time, air as wind is also the medium by which seeds are dispersed to enable propagation and regeneration of native plants (and unfortunately pest plants). Plants and forests also have a role in keeping air clean. In this way air is linked to the environment, biodiversity, taonga species, biodiversity and customary resources, such as mahinga kai, rongoa, weaving and art materials.[16] Resource management around air also links to cultural identity and cultural amenity values, including celestial darkness and visibility, linkages to landmarks, wāhi tapu/wāhi taonga, and place names.

Air is also viewed as having a range of interwoven spatial scales, from inside homes, to marae, to towns, to the region, the nation and at a global level.

Climate change is also viewed as a key aspect to consider when discussing air and atmosphere, due to its interwoven nature with air quality and activities affecting it.[17]

Direct health effects of air pollution

As well as managing air quality to meet community goals, Environment Southland is responsible for managing air quality to national standards that focus on the direct health effects of air pollution on people. These standards are outlined in the following section 'What is poor air quality'.

Air pollution is a complex combination of contaminants. We generally divide the pollutants into two main categories: particulate matter (small airborne particles of various sizes and compositions) and gases (which are often colourless and odourless, but can still have adverse health effects).

Particulates are solid and liquid matter carried in very fine form in the air. They can deposit in people's airways or lungs, and in their smallest form, can be carried around the body in blood. Particulate matter can vary in size from less than 0.1 micron (µm) in diameter, to over 100 microns in diameter. To give an example – the size of a human hair is about 50 microns in diameter.

The size we focus on in environmental monitoring is particulate matter less than 10 microns (PM_{10}), including the particles less than 2.5 microns in diameter (fine particles), and those smaller than 0.1 micron in diameter (ultrafine particles). These are generally not visible to the naked eye. Their ability to travel down airways and deposit deep in the lungs makes them harmful to human health, especially for susceptible groups such as elderly people, young children, asthmatics, and people with existing respiratory and cardiovascular disease.[18] The smaller particles are able to penetrate further into the airways and certain chemical elements are more damaging than others.[19]

Human-generated sources of PM_{10} include burning coal, oil, wood, petrol and diesel in domestic fires, motor vehicles and industrial processes. Natural sources of PM_{10} include sea spray, crustal matter (soil), pollens, volcanic activity and earthquakes (liquefaction dust).

14 Te Rūnanga o Ngāi Tahu, 1999. **15** Kai Tahu Ki Otago Ltd, 2007. **16** Jolly & Ngā Papatipu Rūnanga Working Group, 2013; Ngāi Tahu ki Murihiku, 2008; Kai Tahu Ki Otago Ltd, 2005.
17 Ngāi Tahu ki. Murihiku, 2008. **18** Fisher et al., 2007. **19** Russell & Brunekreef, 2009.

In most places in New Zealand, levels of PM_{10} in the air are highest during winter months, due to the higher frequency of calm conditions and increased wood and coal burning for home heating.[20]

Gaseous pollutants such as carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NOx), Ozone (O_3) and volatile organic compounds (VOCs) can all have adverse effects on human health. These adverse effects include increasing cancer rates, organ and tissue damage, respiratory and cardiovascular disease, and increased mortality rates.[21]

How are we exposed?

Humans are exposed to air pollution as they go about their daily routine. A walk outside to collect the morning paper can expose us to smoke from fires, while the commute to work can expose us to vehicle emissions. Research shows the exposure for people cycling or running on road edges is not significantly different to those travelling by bus.

However, because breathing rates increase while exercising, the volume of air pollution inhaled is significantly higher.[22]

The principal way we get exposed to air contaminants is through respiration; the contaminants are inhaled as we breathe. We can also be exposed to air pollution through food and water.[23] The contaminants settle out on fruit and vegetables that we eat, and on water that we drink (and water can have its chemical properties altered if the air-borne pollutants are soluble). We can also be exposed through direct contact with our skin and eyes.[24]

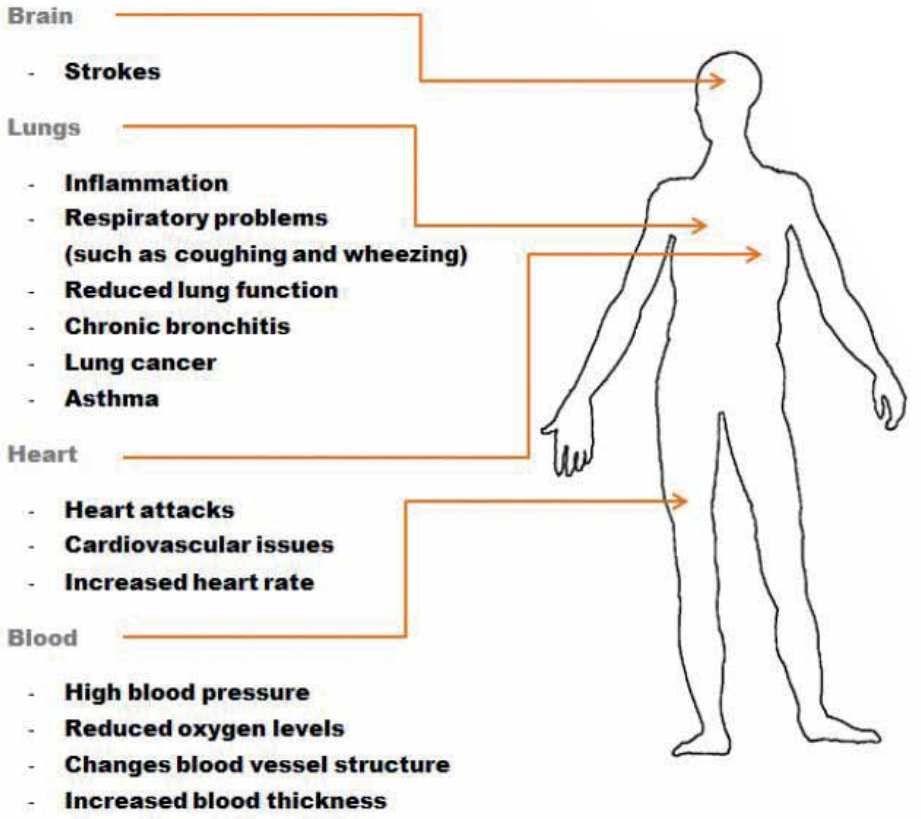
How does air pollution affect us?

Air pollution affects humans by interfering with our breathing and lung function. The effect on our lungs in turn places stress on our cardiovascular system. Larger particles (between 2.5 and 10 µm) are mostly caught in the upper airways, such as the nose and throat. Smaller particles can penetrate deeper into the lungs and ultrafine particles may even enter the blood through the alveoli, which allow gases to pass into the bloodstream. Air pollution can also cause irritation to our eyes, nose and skin.

The type of contaminant influences the effect on the human body, eg the gas carbon monoxide (CO) binds to the haemoglobin in blood and reduces its ability to transfer oxygen.[25]

The effects of particulate matter are diverse and include lung and systemic inflammation, which can affect blood coagulation and lead to the obstruction of cardiac blood vessels (see Figure 6).

Figure 6: Health effects caused by PM_{10} exposure



Source: Aphekom, 2011, as adapted by Ministry for the Environment, 2011

20 Kuschel et al., 2012a. **21** Fisher et al., 2007. **22** Dirks et al., 2012. **23** Thron, 1996. **24** Kampa & Castanas, 2008. **25** Badman & Jaffe, 1996.

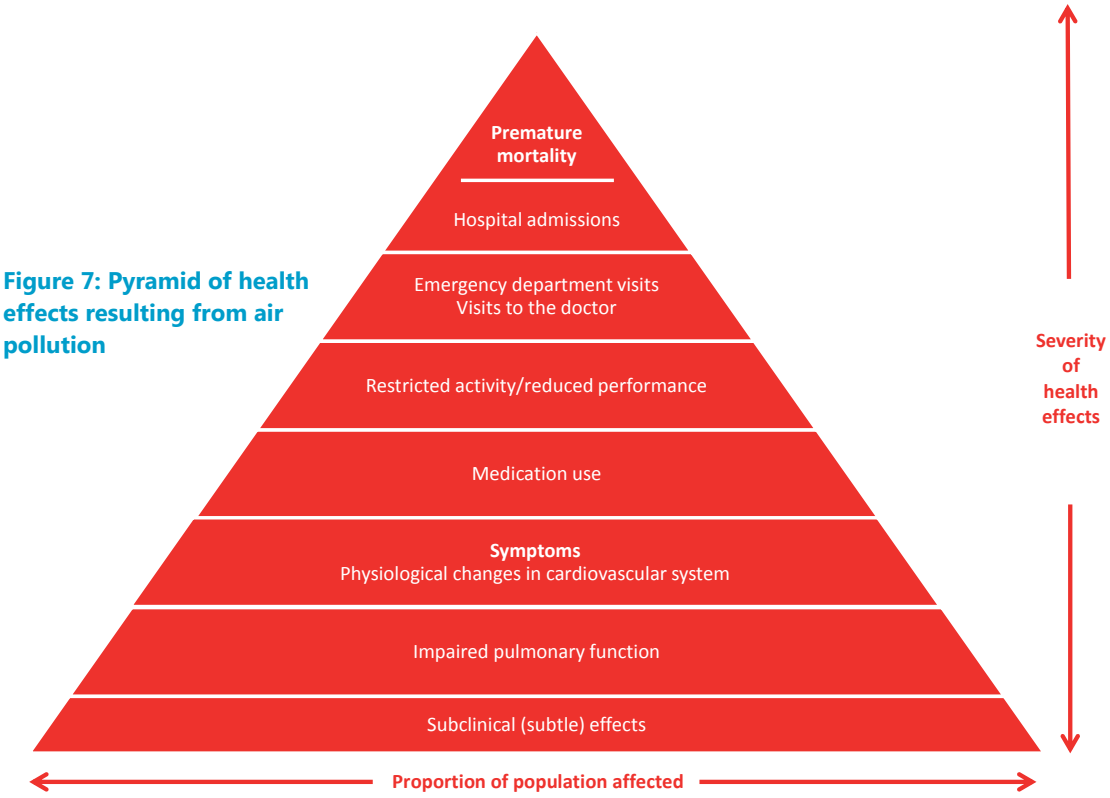
In addition to having a direct effect on our lungs, air pollution can also impact the nervous system, urinary system and digestive system. Exposure to air pollution, particularly heavy metals, during pregnancy has also been shown to have adverse effects on the developing foetus.[26]

Most people who are affected suffer the less severe health effects. While there are a large number of acute and/or transitory health effects due to air pollution, the fewer chronic impacts incur a much greater social cost (Figure 7).[27]

How does air pollution affect society?

Air pollution can have a profound effect on human society. It is often an accumulative effect of relatively minor impacts on individuals' ability to function, which limits what they do (such as work or attend school) and drives them to seek medical assistance. Sometimes the impacts are dramatic, such as the 1952 London coal smog which lasted four days and killed about 4,000 people.[28]

Figure 7: Pyramid of health effects resulting from air pollution



Source: World Health Organization – Regional Office for Europe, 2006

The Health and Air Pollution in New Zealand (HAPINZ) study published in 2007 was the first major study to estimate the countrywide impacts of air pollution.[29] A 2012 update estimated that human-generated air pollution results in 1,175 premature deaths and 1.49 million restricted activity days in New Zealand each year. A restricted activity day is defined as a day on which people cannot do the things they might otherwise have done if the air pollution was not present. The total social costs for the country were estimated to be $4.28 billion per year, or $1,061 per person.[30] The study also noted that Māori were disproportionately represented in the adult premature mortality figures, making up 18.3% of all deaths, but only 8.7% of the adult population.

In Southland, it was estimated that human-generated air pollution resulted in 27 premature deaths per year in adults aged over 30. The total social costs for all air pollution related health effects were estimated to be $201.2 million per year.[31]

The HAPINZ study used location-specific monitoring data, where it was available, but also had to make some assumptions and involved averaging data over long periods. Such a study in Southland would greatly improve our understanding of the local health effects of PM_{10}, but such local studies are difficult to undertake and generally do not result in the same statistical robustness.

In addition to the direct effects on our health, air pollution can also affect our lives in other ways. For example, black carbon pollution in the atmosphere can absorb the sun's light, reducing the amount that reaches the earth's surface.

26 Kampa & Castanas, 2008. **27** WHO, 2006. **28** Greater London Authority, 1952. **29** Fisher et al., 2007. **30** Kuschel et al., 2012a. **31** Kuschel et al., 2012a.

This interaction warms the atmosphere and contributes to global warming, but can also affect the growth of plants on the earth's surface.

Air pollution can also affect our quality of life in other ways, such as affecting visibility in urban areas. The effects on visibility are sometimes as obvious as a layer of smog, but can also be as subtle as a slight brown haze on the horizon. The haze occurs because the air pollution absorbs and scatters the sun's light.

Does air pollution affect some groups in society more?

Air pollution affects some groups of society more than the total population generally. These groups include elderly people, children, people with pre-existing heart or lung disease, people with respiratory conditions, asthmatics, diabetics, pregnant women, and Māori.

Research has also shown that lower socio-economic parts of the population are particularly sensitive to air pollution. As well as possibly reflecting higher exposure, it may also relate to limited access to health care as well as other risk factors.[32]

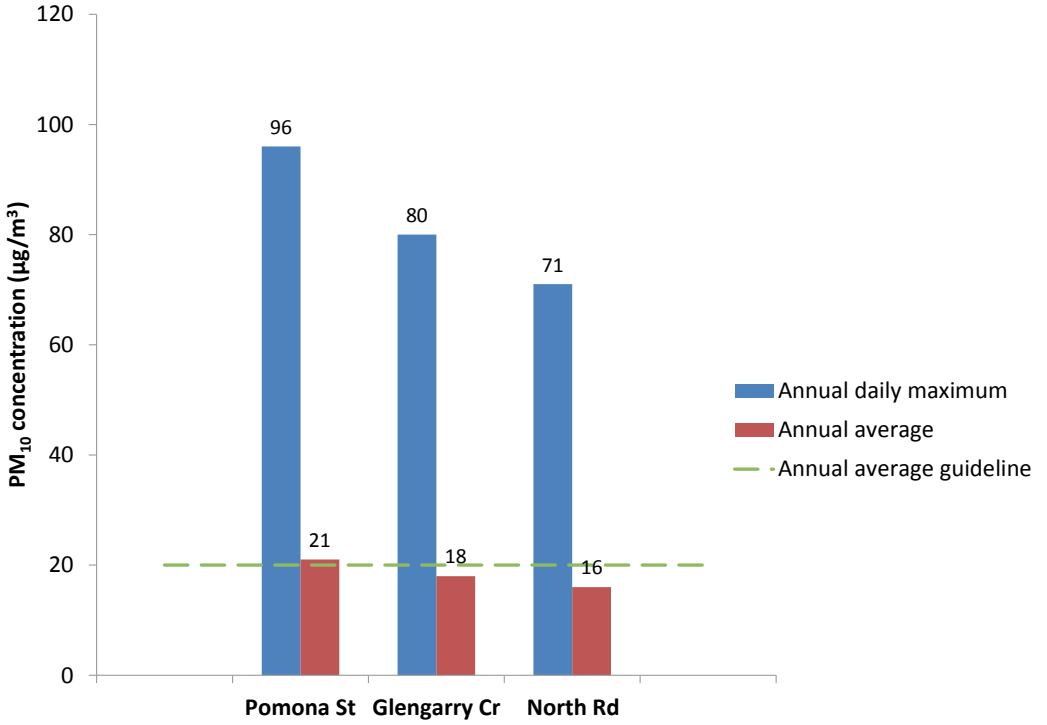
In 2009, Environment Southland conducted PM_{10} monitoring at three different sites across Invercargill. This year is the only year that we have monitoring data across all three sites concurrently. Those sites covered northern (North Road), central (Glengarry Crescent), and southern (Pomona Street) locations in the city.

The monitoring showed that the southern site measured the highest PM_{10} concentrations (Figure 8). Of the three locations, the southern one recorded the highest level of deprivation with a deprivation index of 9.[33]

Poor air quality is often found in areas with higher deprivation because the people living in those areas are least able to afford solutions to the problem. Without assistance, upgrading to clean heating options is impossible for many on low incomes. Landlords may also be reluctant to make the necessary upgrades. Rental properties are also often poorly insulated and colder, requiring more heating of any type to keep them warm.

As domestic home heating is the primary cause of air pollution in Southland, the ability of lower socio-economic households to afford cleaner heating options and insulation is a key area for action (see 'Case study: Awarua Synergy – Warming up Southland homes').

Figure 8: Annual daily maximum and annual average PM_{10} concentrations at three sites in Invercargill, 2009



Source: Environment Southland

32 Pope & Dockery, 2006. **33** The New Zealand deprivation index is a measure of socio-economic deprivation for small geographical areas based on socio-economic variables measured in the 2006 Census. The index combines a number of factors to assess the degree of deprivation in an area, with 1 being the least deprived and 10 being the most deprived.

Māori are recognised as a sector of the community particularly susceptible to direct health effects linked to poor air quality.[34] Issues for Māori identified by the Ministry for the Environment and Ministry of Health[35] include:

- Māori are more likely than non-Māori to be hospitalised for asthma
- cancer is one of the leading causes of death in Māori and non-Māori, but the incidence remains higher in Māori
- Māori experience far more cases of respiratory illnesses and heart disease than non-Māori.

According to the New Zealand deprivation index a greater proportion of Māori in Southland lived in higher deprivation areas than non-Māori.[36] Forty-two percent of Māori were living within areas of the three highest deprivation scores (10, 9 and 8) compared to 20% for non-Māori.

Health effects of indoor air pollution

A related issue of particular importance to Ngāi Tahu whānui is indoor air quality.[37] Cold and damp homes with insufficient insulation and circulation can cause a health risk to residents.[38] This is a significant health issue as New Zealanders spend about 70% of their time in the indoor home environment.[39]

The main indoor air quality issues are moisture and contaminants. Moisture sources can be activities such as cooking, washing, occupants' breathing and unflued gas heaters. Common sources of contaminants include smoking, building materials giving off volatile organic compounds (VOCs), and combustion of fuels used for cooking and heating (gas, oil, coal or wood). Air can sometimes be contaminated by bio-contaminants such as mould and fungi spores.[40] (See 'Case study: Awarua Synergy – Warming up Southland homes'.)

Health effects of odour

Unpleasant odours can cause stress and annoyance as well as potentially cause health symptoms depending on the type of odour, such as irritation or toxicological effects and alteration of mood and behavioural responses.[41]

Odour can not only directly influence physical health, but also the overall cultural health and wellbeing of Ngāi Tahu whānui by impacting on how they use outdoor areas and the experiences they have.

Cultural impacts of poor air quality

Cultural health and wellbeing can also be affected by poor air quality. The Resource Management Act 1991 also requires these effects to be taken into account in the management of air quality.

Indigenous people's health and wellbeing can depend on the interactions of people, place and nature–culture relationships.[42] For Māori such interactions are iwi/hapū/whānau specific, and the culture–environment connection interlinks with the biophysical and spiritual dimensions of cultural identity. Tribal land can be viewed as an extension of a sense of self and collective being.[43]

Ngāi Tahu used visual markers in the landscape to identify their trails, and peaks and hills were given names that remembered ancestors, which helped preserve stories and traditions down the generations. If reduced air clarity results in such markers being obscured, this impact affects wāhi tapu, wāhi taonga and cultural landscapes and identity. For example, signal fires were used to communicate between different kainga. Tūrakanui a Rua, the long flat hill behind Greenpoint about 5kms from Bluff, is one such area where signal fires were lit to signal Aparima, Ōraka, Pahia, Hokonui, Tuturau and Rakiura.[44]

Maunga play an important role in the spiritual and cultural beliefs of Ngāi Tahu, particularly as they are the gateways to the atua (gods). In Murihiku these include the Takitimu mountain range, Hokonui Hills, Bluff Hill/Motupōhue, and Mount Anglem/Hananui. Obscuring the view and interactions (through noise and odour) with these maunga would diminish the mauri of these areas.

34 Hales et al., 2010; Kuschel et al., 2012a. **35** Ministry for the Environment, 2002. **36** Southern District Health Board, 2011. **37** Kai Tahu Ki Otago Ltd et al., 2010; Beaton, n.d. **38** Howden-Chapman et al., 2007; Howden-Chapman, 2004; Level, n.d. **39** Baker et al., 2007. **40** Level, n.d.-b; NIWA, 2012. **41** Fiedler et al., 2005; Schiffman & Williams, 2005; Shusterman, 2001. **42** Panelli & Tipa, 2009. **43** Panelli & Tipa, 2007. **44** Ashwell, 2002.

Similarly, the stars and moon aid in navigation and finding fishing grounds, and loss of visual clarity would affect their value.

Some wāhi ingoa (place names) denote an aspect of air or quality of air of the area, eg the name of Lake Hauroko relates to the sound of the wind, Stewart Island/Rakiura is named after its glowing skies, and Rakahouka (Rakahauka or Rakauhaunga) refers to the smell of the area.

Important sites such as rock art can be impacted by poor air quality. Wind-borne dust can abrade and erode the pigments and supporting rock. The settled dust can be washed down in rain seepage and cover the art from view. Evaporation of moisture in hair-line cracks is impeded by dust and thereby could help cause instability of the rock, potentially causing loss of the art. Soil-filled cracks could also support vegetation.[45]

All physical landscapes are inseparable from tīpuna (ancestors), events, occupations and cultural practices. These dimensions remain critical to cultural identity and to the maintenance of a Māori sense of place. The fabric of the Māori cultural landscape includes all physical and spiritual dimensions of whānau, hapu and iwi as expressed in our living environments – our whenua, kainga, whare and public spaces.[46]

Climate change

The strong links between Māori economic, social and cultural systems and the environment can make Māori vulnerable to climatic changes.[47] As such, climate change is viewed as a major issue by Ngāi Tahu ki Murihiku.[48] Climate change has the potential to change taonga and mahinga kai species, including tītī (muttonbird) and tio (oysters).[49]

Consequences of climate change such as increased erosion and flooding can impact on sites such as wāhi tapu/taonga sites (through erosion and flooding) and tohu/indicators used for harvesting customary resource, and this in turn can affect mātauranga (Māori knowledge) and the ability to pass it on to the next generations.

Included within climate change and ozone depletion are direct impacts such as melanoma, disease, and impacts from extreme weather events on our health, the safety of our community and important infrastructure.

There are concerns expressed that communities need to be able to plan and respond to climate change and its possible impacts and that some communities and sectors of society are more sensitive to such impacts. The Ngāi Tahu ki Murihiku Iwi management plan Te Tangi a Tauira[50] has a climate change section. As yet there are no regional policies on how to minimise greenhouse gas emissions and adapt to the effects of climate change in Murihiku.

What is poor air quality?

This section sets out how we define and measure air quality, which is fundamental to understanding the state of our air quality and acting to protect it. It includes a description of the limits that are applied at different levels (internationally and nationally), and discusses the difference between guidelines and standards.

This section also includes a description of traditional indicators of air quality important to Ngāi Tahu whānui – which are often indicators of cultural health as much as of physical health.

International and national limits

The air quality guidelines relevant to New Zealand include the World Health Organization's (WHO)[51] Air Quality Guidelines and New Zealand's Ministry for the Environment's (MfE) Ambient Air Quality Guidelines (AAQG)[52]. The legislated standards relevant to New Zealand are the New Zealand government's National Environmental Standards for Air Quality (NESAQ).[53]

Many countries around the world have set their own limits for air quality, but the WHO's air quality guidelines provide universal guidance on reducing the impacts of air pollution on human health. They were first established in 1987 and most recently updated in 2005. The WHO guidelines recommend limits for particulate matter less than 10 microns (PM_{10}), ozone, nitrogen dioxide and sulphur dioxide.

The Ministry for the Environment's ambient air quality guidelines were first developed in 1994 with the purpose of promoting sustainable management of the air resource of New Zealand.[54]

A revision of the guidelines in 2002 introduced new priority contaminants that recent research had shown to be of concern. The guidelines now cover 15 contaminants including carbon monoxide, PM_{10}, nitrogen dioxide, sulphur dioxide, ozone, hydrogen sulphide, lead, bezene, 1,3-Butadiene, formaldehyde, acetaldehyde, benzo(a)pyrene, mercury, chromium, and arsenic (Table 2).

While the WHO and MfE guidelines provide guidance, they have limited enforcement opportunities. The NESAQ differ in that they contain regulations that regional councils are required to enforce. These are the limits that have the most impact on communities and individuals.

Table 2: Selected air contaminants and their limits

Contaminant	Averaging time	Threshold limit		Permissible exceedances in a 12-month period
PM_{10}	24-hour	50 µg/m^3	Standard	1
	Annual	20 µg/m^3	Guideline	-
Carbon monoxide	1-hour	30 µg/m^3	Guideline	-
	8-hour	10 µg/m^3	Standard	1
Nitrogen dioxide	1-hour	200 µg/m^3	Standard	9
	24-hour	100 µg/m^3	Guideline	-
Ozone	1-hour	150 µg/m^3	Standard	0
	8-hour	100 µg/m^3	Guideline	-
Sulphur dioxide	1-hour	350 µg/m^3	Standard	9
	1-hour	570 µg/m^3	Standard	0
	24-hour	120 µg/m^3	Guideline	-
Hydrogen sulphide	1-hour	7 µg/m^3	Guideline	-
Lead	3-month moving average calculated monthly	0.2 µg/m^3	Guideline	-
Benzene (2010 on)	Annual	3.6 µg/m^3	Guideline	-
Formaldehyde	30-minutes	100 µg/m^3	Guideline	-
Acetaldehyde	Annual	30 µg/m^3	Guideline	-
Benzo(a)pyrene	Annual	0.0003 µg/m^3	Guideline	-
Arsenic (inorganic)	Annual	0.0055 µg/m^3	Guideline	-

Source: Standards are from NESAQ, guidelines from AAQG

51 World Health Organization – Regional Office for Europe, 2006. **52** Ministry for the Environment, 2002. **53** New Zealand Government, 2011. **54** Ministry for the Environment, 2002.

The Government developed the NESAQ in 2004 in response to the poor air quality found in New Zealand's urban areas. The national standards provide limits for five contaminants: carbon monoxide, nitrogen dioxide, ozone, PM_{10} and sulphur dioxide.

When a concentration above the limit is recorded, it is considered to be an 'exceedance of the standard'. Each contaminant is permitted a certain number of exceedances (Table 2). For example, there can be one exceedance of the PM_{10} limit concentration before an airshed is considered to be in breach of the national standards.

A recent review of the scientific information associated with the adverse health effects of particulate matter supports the conclusions of the WHO's air quality guidelines. In particular, the review indicates that adverse health effects can occur at pollution concentrations lower than those identified in the guidelines.[55] Given that New Zealand's national standards are in line with the WHO's air quality guidelines, this indicates the NESAQ limits provide some protection but do not remove the risk completely.

What does Environment Southland measure?

Environment Southland currently measures particulate matter (PM_{10}) at sites in Southland.

Research has shown that PM_{10} is the primary contaminant of concern in Southland and it is the sole focus of Environment Southland's current monitoring programmes.[56] Additional contaminants and urban areas are expected to be monitored in future. Sulphur dioxide and benzo(a)pyrene have both been identified as contaminants that may be elevated in Southland. Emission density assessments have also identified urban areas in Southland that may experience elevated PM_{10} concentrations.

In addition to the contaminants mentioned earlier, odour also contributes to poor air quality. Odour is caused by odorous chemicals and contaminants in the air. Whether an odour is pleasant or objectionable is determined by our brain's response to the smell. Unlike the contaminants previously mentioned, odour is difficult to measure and it is often hard to determine its source.

Environment Southland does not measure odour or dust as part of its air quality monitoring programme. Instead, these are monitored through a complaints process, when a council officer visits a site to assess the discharge. (See case studies: 'Keeping the dust down' and 'Catching more than a whiff'.)

Ngā tohu o Te Pū Hau – Ngāi Tahu indicators of air quality

Historically, Māori used (and still use today) tohu/signs from the environment. Māori use environmental indicators to forecast local weather and climate[57] and to determine the best time for seasonal activities such as mahinga kai.[58] This knowledge has been gathered by interacting with biophysical processes over time.

The moon, stars and rainbows are also important in Māori mythology and as environmental signals. The air needs to be clean in order for these signs to be visible and usable. These signs can be obscured by air pollution and by light pollution (which can mask the stars). Similarly, human–environmental interactions are potentially affected by noise pollution and odour.

Ngāi Tahu whānui tohu/indicators associated with air and atmosphere include:

- visibility
- view of specific landmarks
- celestial darkness
- darkness (unimpeded by light)
- natural quiet
- ability for sound to carry naturally
- ability to hear the sea
- ability to smell the sea
- purity of the air (smell, taste)
- clean rain.[59]

55 WHO, 2013. **56** Wilton, 2013a. **57** King et al., 2005. **58** Tau, 2008; Beattie, 1994. **59** Te Rūnanga o Kaikōura, 2009.

Matariki

Matariki or the rising of Pleiades and/or of Puanga/Rigel in late May or early June is taken as the beginning of the Māori new year.

For Ngāi Tahu the Māori new year begins with the rising of the star Puanga (Rigel in Orion, Figure 9). Puanga can be seen in Te Waipounamu, the South Island, at the same time as Matariki appears further north. A sighting of Puanga heralds the onset of winter.

In ancient times Matariki arrived at the end of the harvest. It symbolises the start of a new phase of life. Traditionally this was a time of subdued activity and a time of reflection and a time to remember the dead. It was also a time of abundance, with plenty of food stored, so it was a time of feasting.

The first appearance of Puanga can denote whether the upcoming season will be a year of plenty or a lean season for food.[60]

Weather and climate forecasting

The visibility of certain landmarks and features has been used by Ngāi Tahu whānui to forecast the weather. The knowledge was used to help determine safety for going out to sea or other activities. These indicators include:

From Bluff if you can see:

- The trees on Stewart Island/Rakiura you know that the wind is about to blow.
- Takitimu Range the wind is coming.

Rainbows/Kahukura:

- The appearance of rainbows means that clear weather is coming.

Lightning/Uira:

- With lightning flickering above the horizon, the side the flashes are strongest on indicates the direction the wind will come from.

Moon/Marama:

- A complete ring around the moon indicates the coming of a heavy fog (or cold weather).
- A new moon lying on its back indicates rainfall or bad weather.

Sun/Ra:

- A vivid halo encircling the sun indicates a storm is approaching.
- A pale and dim halo indicates a storm is far away.

Stars/Nga whetu:

- In fine weather if the stars are twinkling up north and not down south this means a light northerly is likely the next day.
- Atutahi/Canopus (star in the southern constellation of Carina):
- Atutahi standing far away from the Milky Way in about October indicates a dry summer will follow
- Atutahi shining brightly on one side but dim on the other indicates the wind will blow hard from the bright side (top of photo).

Mahinga kai

Mahinga kai is a culturally defining activity for Ngāi Tahu whānui. It connects tangata whenua with their ancestors, waters, whenua (land), and associated landscapes, as well as the future generations. Mahinga kai is an extremely important activity that contributes to the overall wellbeing of Ngāi Tahu.

Figure 9: Puanga, the bright top star in the Orion constellation

Source: As found in Kitson, 2013

60 Best, 1922; Beattie, 1990; Beattie, 1994; Cormack & Orwin, 1997 in King et al., 2005; King et al., 2005.

These tohu (environmental indicators) are intrinsically linked to mahinga kai. They help define when harvesting and processing can occur, eg foods cannot be left out to dry in the full moon and darkness is required for harvesting some species due to animal behaviour, such as during the tuna heke (eel migration) and tītī/muttonbird harvesting. Light pollution could impact such mahinga kai practices.

Plants and animals require clean and healthy air. Poor air quality could result in impacts on mahinga kai resources as well as other customary resources such as rongoa and weaving and art materials. An example of such an impact can be found in dioxins, which are known to bio-accumulate in plant and animal life that may then be collected and eaten.

Photo by: Dave Taylor

Photo by: Michele Poole

What contributes to poor air quality?

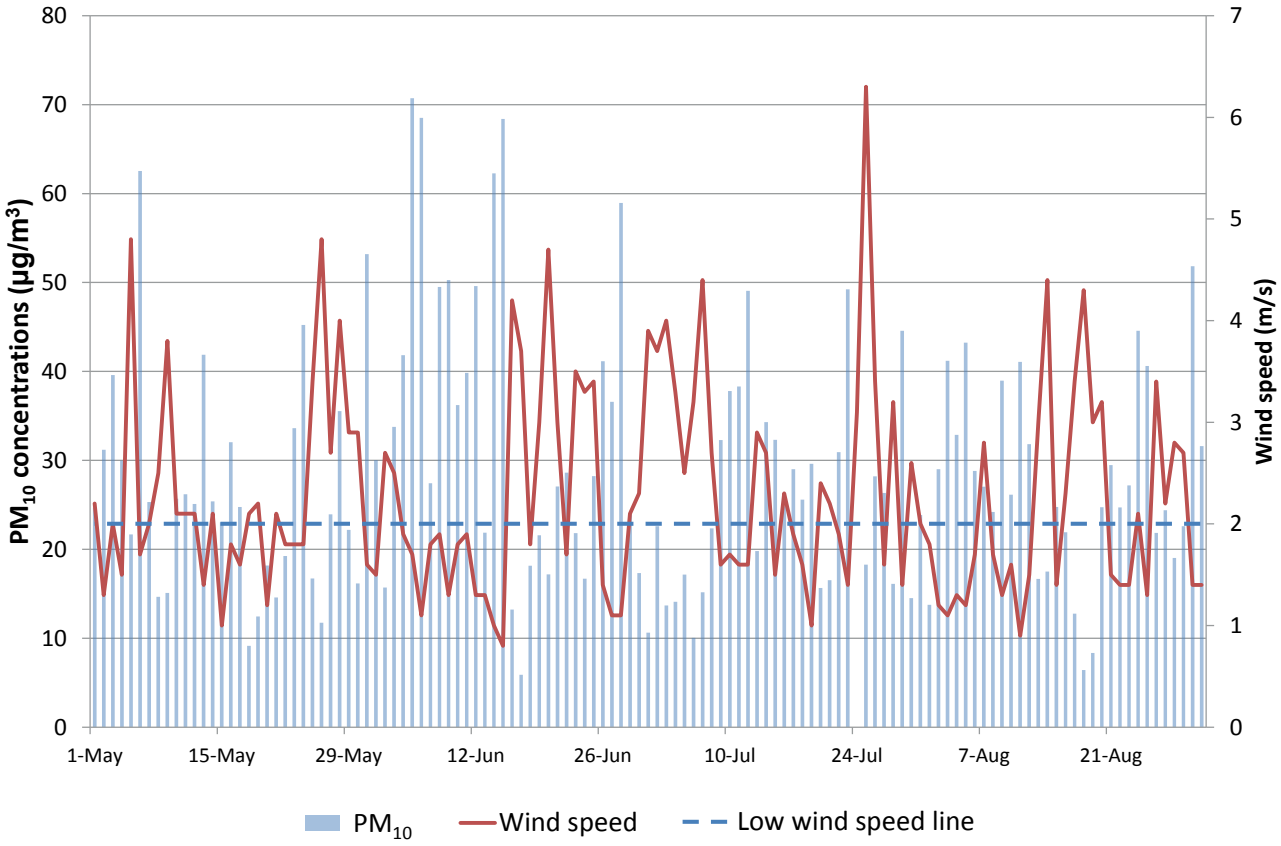
This section discusses the main sources of air pollution and describes how the weather conditions can contribute to bad air pollution days.

Air pollution and the weather

Poor air quality in Southland is primarily caused by smoke from home fires, but the weather systems that pass over the country have an influence on the accumulation of those emissions. These systems provide large-scale controls on air pollution and their effect can cover tens of kilometres. In New Zealand, low pressure systems bring an unstable atmosphere and increased wind speeds. High pressure systems or anticyclones are responsible for calm, stable atmospheric conditions. During winter, anticyclones mean low wind speeds and clear, frosty evenings.

Wind has a significant influence on the dispersion of air pollution and higher wind speeds provide greater dilution of the pollution in the air. Air pollution episodes in Southland mostly occur when wind speeds are low (less than two metres per second), and pollutant emissions are high (Figure 10).

Figure 10: Wintertime daily average wind speed and PM_{10} concentrations in Invercargill at Pomona Street site, 2013



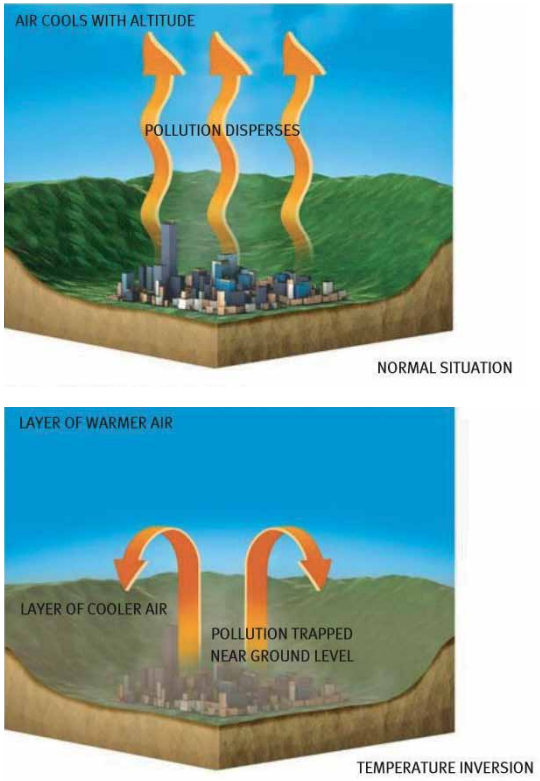
Source: Environment Southland

In Southland, poor air quality is a seasonal problem that mostly occurs during the winter months. The cooler temperatures in winter prompt households to heat their homes. The most common heating method, behind electricity, is the use of solid fuel burners.[61] The emissions from these burners contribute to air pollution, which is made worse when wind speeds are low.

Topography also influences the occurrence of air pollution episodes. Valleys and basins which are sheltered from large-scale weather systems can experience high pollution episodes. Wind speeds tend to be lower in those locations and pollutants are often trapped. An example of such a feature in Southland is the Mataura Valley.

A variety of atmospheric processes can influence the accumulation of air pollution near the earth's surface, but perhaps the most common and influential process is a temperature inversion. Normally, air temperature decreases with height above the earth's surface. During a temperature inversion, the air at the earth's surface becomes cooler than the air above. The warm air above then forms a cap, which restricts air circulation and keeps the polluted air near the surface (Figure 11). Temperature inversions in Southland are mostly nocturnal radiation inversions[62], which form overnight. Temperature inversions can vary in height above the ground from tens of metres to heights over 100 metres.

Figure 11: Formation of a temperature inversion



Source: Ministry for the Environment

Where the pollutants come from?

Air pollution can come from human and natural sources. Human sources include domestic heating, industry, motor vehicles and outdoor burning. Natural sources include sea spray, soil, pollen, wild fires and volcanoes. Air quality management practices generally focus on the human sources, as they can be controlled, unlike natural sources. Human sources are also the primary driver of exceedances of national guidelines and standards. With the exception of volcanoes, natural sources alone rarely cause standards to be exceeded.

Natural sources

While human-generated air pollution generally decreases with height in the atmosphere, natural sources such as volcanic ash are found high in the atmosphere. Volcanic eruptions occur with such power and violence that pollutants are ejected into the upper atmosphere, and once there can be caught in jetstream winds which can transport them for hundreds of kilometres, sometimes more.

Similarly, pollutants from sand storms have been recorded over 1,000 kilometres from their source[63]. Such events do not normally show up on the monitoring equipment in Southland, but if they do recent changes to the National Environmental Standards for Air Quality (see next section) mean that regional councils can now apply for an exemption, if they result in an exceedance of the standards.

61 Wilton, 2011. **62** Nocturnal radiation inversions often occur on clear sky nights, when the earth's surface cools at a faster rate than the air above. The clear sky means that the heat energy absorbed by the earth during the day is rapidly lost into the atmosphere. **63** Radhi et al., 2010.

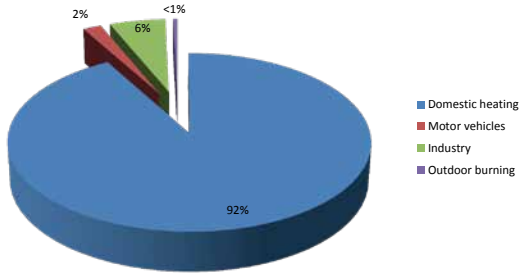
Domestic heating

Domestic heating is the primary cause of wintertime PM_{10} pollution episodes throughout most of New Zealand.[64] Home heating methods such as open fires, wood burners, multi-fuel burners and pellet burners all contribute to the air pollution problem. In saying that, some methods are 'cleaner' than others, producing less PM_{10}. For example, a pellet burner will produce approximately 2 grams of PM_{10} per kilogram of pellets burnt, while an open fire burning coal will produce approximately 21 grams of PM_{10} per kilogram of fuel.[65] Solid fuel quality can also influence the amount of PM_{10} produced. For example, wet wood produces more PM_{10} as the heat energy is used to evaporate moisture from the wood, rather than enable complete combustion.

A 2011 phone survey of Invercargill households showed the most commonly used solid fuel type is wood. Approximately 32% of households burn this fuel and about 102 tonnes of wood are burnt on an average winter's night. Coal is used by 19% of all households and an estimated 50 tonnes is burnt on an average winter's night.[66]

In Southland, the primary cause of wintertime urban air pollution is domestic heating, which accounts for 92% of all human-generated PM_{10} emissions in Invercargill (Figure 12) and 96% in Gore. Industrial and commercial activities accounted for 6% of PM_{10} emissions in Invercargill, and only 1% of PM_{10} emissions in Gore. Motor vehicles contributed 2% and 1%, respectively. Outdoor burning is responsible for less than 1% in Invercargill and 1% in Gore.[67]

Figure 12: Wintertime PM_{10} contributions by source in Invercargill



Source: Wilton, 2011

Emission inventories completed for Invercargill and Gore show that multi-fuel burners burning coal account for 50% of Invercargill's wintertime daily average PM_{10}, and 65% of Gore's. Coal burning in open fires contributes a further 5% and 2% respectively[68].

Te Ao Mārama Incorporated also reports concerns among Ngāi Tahu whānui about the poor quality of the coal available on the domestic market, and the associated increased negative health effects: "*…We are being forced to use dirt coal, full of sulphur, only thing on the market and people have still got to keep warm so of course they will go and buy it, forced to use low grade fuel.*"[69]

The effect that domestic heating has on air pollution is also dependent on household burning behaviour. Damping and banking of fires restricts the airflow to the combustion zone, causing incomplete combustion and more smoke. Burning wet or unseasoned wood can also cause more smoke to be produced by the burner. Wood should be stored in a dry place for 12–18 months prior to its use in the fire.

Outdoor burning

Outdoor burning also contributes to poor air quality, although in Southland it is a relatively minor contributor to total PM_{10} emissions (Figure 12). Generally, outdoor burning is a result of people burning green waste, such as leaves and hedge trimmings. Significant smoke and pollution problems occur when this green waste hasn't been allowed to dry before burning. Macrocarpa hedge trimmings are commonly burned, but can take a few months before they are dry enough. Freshly cut green waste contains higher moisture levels, which produces more smoke when burned. Dioxins and furans are also likely contaminants in outdoor burning due to the lower burning temperatures.

Unfortunately, inappropriate materials are also often burnt in outdoor fires. These materials include plastics, oils, treated and painted timber, tyres and polystyrene (Figure 13). In addition to high levels of PM_{10} these materials emit toxic gases (such as chlorine, aldehydes, nitrous oxides and volatile organic compounds) when burnt.

Figure 13: Outdoor burning causing poor air quality in Southland

Source: Environment Southland

64 Wilton et al., 2010. **65** Wilton, 2011. **66** Wilton, 2011. **67** Wilton, 2011. **68** Wilton, 2011. **69** Kai Tahu Ki Otago Ltd et al., 2010.

Plastics such as baleage wrap often get burnt on farms, but there are now options available for recycling the wrap. Such recycling schemes help to avoid the harmful emissions produced by burning the wrap (eg www.plasback.co.nz).

Motor vehicles

Vehicle emissions also contribute to poor air quality in urban areas. While the majority of the particles result from vehicle exhaust emissions, they are also released from tyres, brakes and mechanical wearing of the road surface. In addition to particulate matter, vehicle emissions are often high in carbon monoxide and nitrogen oxides. Diesel vehicles typically emit disproportionately more air pollution than petrol vehicles and, likewise, older vehicles produce more pollution than newer vehicles. Motor vehicles are not a significant contributor to PM_{10} concentrations in Invercargill or Gore[70].

Secondary pollutants

Although pollutants are emitted from specific sources or processes, they can also form in the atmosphere. This process is known as secondary formation and generally results from gaseous emissions interacting with each other in the atmosphere. For example nitrogen oxide, nitrogen dioxide and volatile organic compounds can chemically react in the presence of sunlight to form ozone. Such processes have not been studied in Southland, but given the relatively cool climate and lower emission densities, they are not likely to be a significant contributor to air pollution in the region.

Industry

There are a number of significant industrial activities in Southland that have the potential to impact on air quality, such as plants processing the region's milk, meat and wood products. The medium density fibreboard (MDF) plant near Mataura, the aluminium smelter at Tiwai Point and the nearby port at Bluff are the more recognisable examples. Smaller scale industrial discharges from coal, diesel and wood chip boilers are also found in many of the towns.

Industrial discharges are closely monitored by Environment Southland and generally contribute minimal amounts of PM_{10} to the airsheds[71] (Figure 12). Each new industrial discharge is assessed against the Regional Air Quality Plan for Southland and where a resource consent is required, conditions are imposed to ensure that pollutant emissions are minimised.

The Tiwai aluminium smelter has been in operation since 1971. Typical air pollutants that are emitted from aluminium smelters include gaseous and particulate fluorides, alumina and carbon dust, and gaseous sulphur dioxide, carbon monoxide and carbon dioxide. Of these, the fluorides represent the greatest health risk to humans, plant and animal life.[72]

The main mechanism for removal of dust particles and fluoride gases from the smelter's emissions is by the 'dry scrubbing' process.[73] Scrubbers at the smelter were upgraded in 1995/96, reducing the fluoride emissions from the site.[74] [75]

Greenhouse gases (GHGs) are a by-product of aluminium manufacturing. In 2011, 669,000 tonnes of CO_2 was emitted as part of the Tiwai smelter operation.[76] Since the 1990s the Tiwai aluminium smelter has reduced GHG production by nearly 42%.[77]

Port operations can potentially impact on air quality, through the release of diesel/petrol exhaust, particulate matter (PM), volatile organic compounds (VOCs), nitrogen oxides (NOx), ozone (O_3), and sulphur oxides (SOx). Other potential air pollutants from port operations are carbon monoxide (CO), formaldehyde, heavy metals, dioxins, and pesticides used to fumigate produce.[78]

Air quality incidents

Environment Southland operates a pollution response hotline that is available 24 hours a day, seven days a week (phone 0800 76 88 45). Each year, we attend a large number of incidents related to air quality (Figure 14). These incidents are recorded in the following categories:

- burning materials
- burning vegetation
- odour
- particulate deposition
- spray drift
- general air emissions

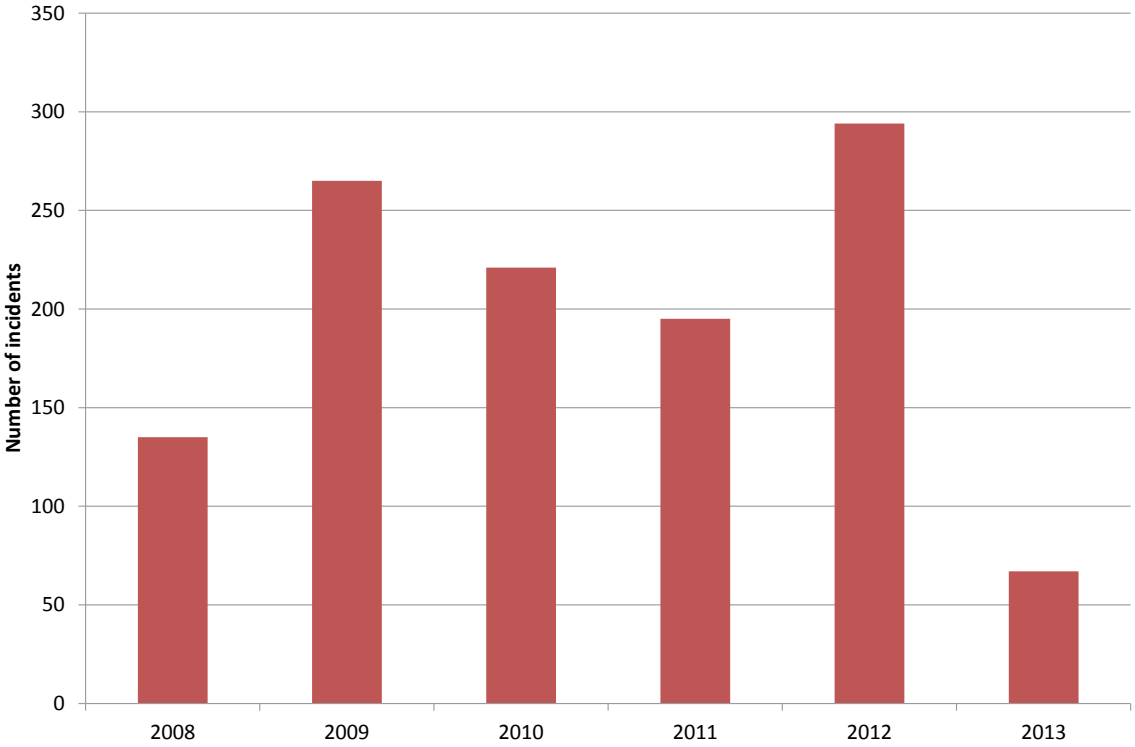
70 Wilton, 2011. **71** Wilton, 2011. **72** New Zealand Institute of Chemistry, 2002. **73** New Zealand Aluminium Smelters Ltd, 2010. **74** Placer Investments Limited, n.d.
75 Torbed, n.d. **76** New Zealand Aluminium Smelters Ltd, 2011. **77** Rio Tinto Alcan, 2014. **78** Bailey & Solomon, 2004.

Figure 15 shows the percentage of incidents in each category. Odour is the most commonly reported, followed closely by burning materials. The burning materials category includes anything that isn't vegetation, such as construction waste, plastics and metals.

Where people or businesses are found to be undertaking burning activity that isn't permitted, Environment Southland prefers to take an educational approach, promoting best practice to remedy the situation. For example, the Pollution Prevention team provides advice to businesses on alternative disposal and recycling methods. If the problem persists, Environment Southland has the ability to issue an abatement notice, an infringement notice or take a prosecution.

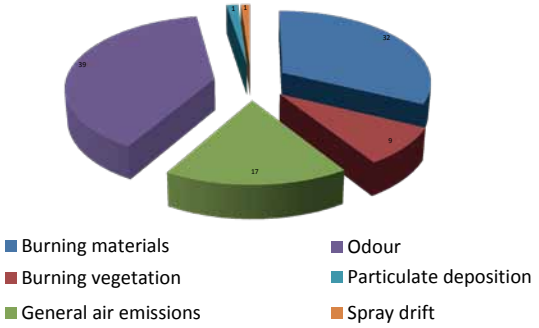
Air quality incidents may also be reported to the territorial authorities in Southland (Invercargill City Council, Gore District Council and Southland District Council). The information presented here represents only those incidents reported directly to Environment Southland.

Figure 14: Number of air quality incidents responded to by Environment Southland, 2008–2013



Source: Environment Southland

Figure 15: Air quality incidents investigated by Environment Southland by percentage, 2008–2013



Source: Environment Southland

How do we find out what's in the air?

How we monitor air quality

Environment Southland is required to monitor air quality in our environment. For Southland, the main contaminant is particulate matter less than 10 microns in diameter (PM_{10}).

Figure 16: High Volume Sampler

Source: Environment Southland

What equipment is used?

We use two types of monitoring equipment: the High Volume Sampler (HiVol) and the continuous Beta Attenuation Monitor (BAM).

The BAM records PM_{10} data continuously up to the minute, which means we know exactly what the air quality is like right now. It records 10-minute average concentrations which are then combined up to 1-hour and 24-hour averages.

The HiVol operates for a 24-hour period every second day in winter and every sixth day in summer (Figure 16). For that to happen, we need to manually change a glass filter and set the computer to begin recording when we need it to. This involves a visit to the site to carry out the filter changes – even on the weekends. The HiVol only records 24-hour average concentrations.

How does it work?

Each type of monitoring equipment draws in air from its surroundings using a pump. Air is sucked into the machine at a calibrated rate of about 16 litres per minute for the BAM and over 1,000 litres per minute for the HiVol.

The HiVol uses a specially designed inlet to separate the particles in the sampled air by size, allowing only the PM_{10} to deposit onto a glass filter paper. The glass filter paper is weighed before and after the sampling period to calculate the 24-hour average concentration of PM_{10} (Figure 17). Some of our filters end up very dirty!

The BAM also collects material on filters. However, instead of calculating the PM_{10} concentration from the mass collected (as in the HiVol) the BAM calculates the concentration using changes in beta radiation. Beta rays (otherwise known as electrons) get absorbed by particles, with the change being dependent on the mass of material. A beta ray passes

through a clean filter and measures a zero value. As the PM_{10} builds up on the filter the beta ray does not pass through as easily and so the value it records increases. These recorded values are then sent into our database and soon after this data is uploaded to our website for you to view: www.es.govt.nz/rivers-and-rainfall/?data=airquality

Can we monitor for other pollutants?

Yes we could. Other contaminants such as carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone and heavy metals can be monitored by using different types of equipment, as they are in other areas of New Zealand – particularly where air quality is impacted by other sources such as motor vehicles. However, monitoring for a range of pollutants in addition to PM_{10} is more expensive and needs to be justified.

Environment Southland has reviewed air quality monitoring undertaken throughout the country and it is unlikely that concentrations of contaminants other than PM_{10} would be in breach of the national standards in Southland, so they are not part of our current monitoring schedule.

Results – the good and the bad

Invercargill recorded a 24-hour average PM_{10} concentration of 198 micrograms per cubic metre ($\mu g/m^3$) on 18 July 2008, nearly four times the national standard (50 $\mu g/m^3$).

Southland experiences its best air quality at the windiest and warmest times during the year. When it is windy pollutants are literally blown away; when it is hot people don't light their fires!

Figure 17: A fresh air filter (white) is compared with one that had been in use for two days during the winter of 2012 at the Glengarry Crescent air monitoring site in Invercargill.

Source: Environment Southland

Photo by: i-Fly Aerial Photography

What is Southland's air quality like?

This section focuses on particulate matter smaller than 10 microns in diameter (PM_{10}) and reports on the air quality in Southland's main urban areas, identifying the trends observed in our analysis.

Cultural aspects of air quality are not covered in this section. Assessments of cultural impacts tend to be conducted as part of assessments of particular proposed activities or developments, and as such cannot give an overall assessment of the impact of Southland's air on people's overall wellbeing.

Where do we monitor air quality?

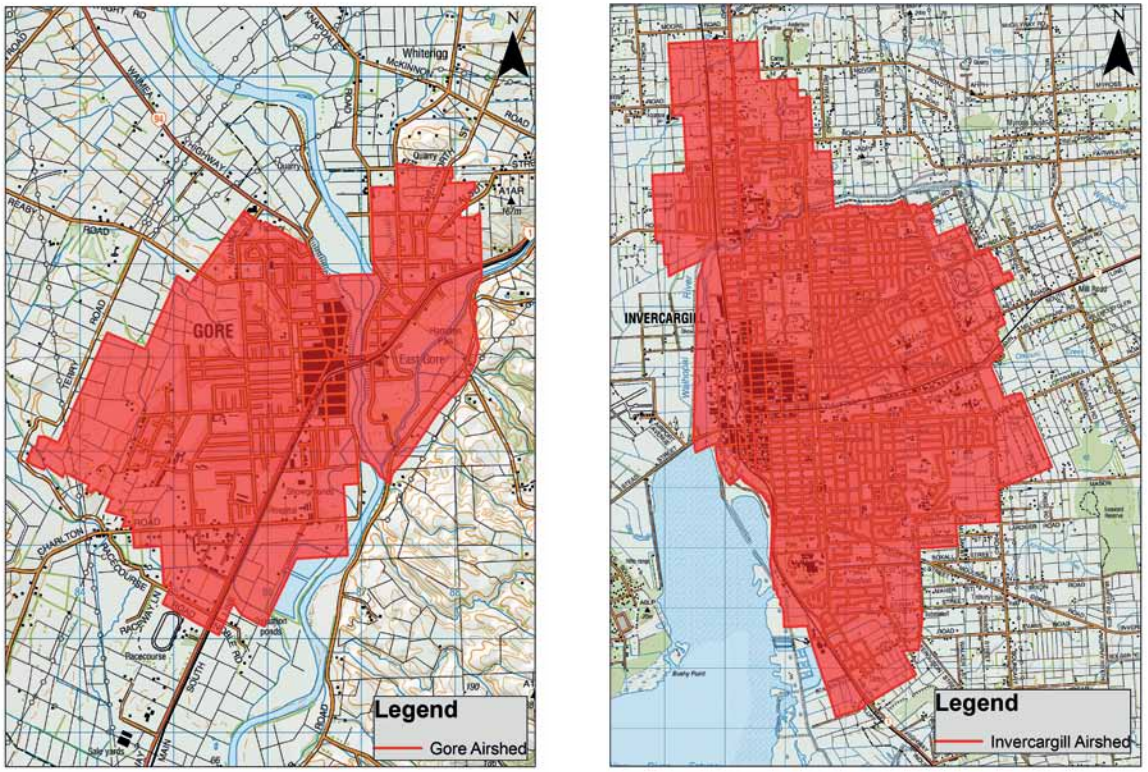
Environment Southland currently monitors air quality in Invercargill, Gore and Winton, by monitoring PM_{10} levels. Some smaller urban centres have also been monitored for short periods, including Mataura, Bluff, Riverton, Edendale, Te Anau and Wallacetown. These were the urban areas identified in the region's first air quality monitoring strategy (2003), as most at risk of poor air quality on the basis of emission densities.[79] It is recognised there are other urban areas in Southland that have not yet been monitored. Some of these will be monitored in the future, while others are considered to be at low risk of poor air quality due to their low emission densities. The monitoring strategy was recently updated in 2013 and another review will take place within the next five years.

Environment Southland's primary focus is to measure PM_{10} in its two airsheds, the Invercargill airshed and the Gore airshed (Figure 18).

An airshed is similar in concept to a catchment and is an area designated by a regional council for the purpose of managing air quality. Airsheds are gazetted by the Minister for the Environment.

Since 2003 when formal air quality monitoring began in Southland, Environment Southland has been able to build an understanding of the state of the region's air quality, and how it is changing over time. Our air quality monitoring strategy determines our monitoring locations and is regularly updated, as new information and research becomes available.

Figure 18: Invercargill and Gore airshed boundaries as gazetted by the Minister for the Environment



Source: Environment Southland

79 Wilton, 2003.

Current state of our air quality

Southland's air quality is assessed using PM_{10} concentrations, which provide an indication of the level of contamination in the air. If PM_{10} concentrations are high, it is quite likely that other airborne contaminants (eg Carbon Monoxide, Nitrogen Oxides and Volatile Organic Compounds) will also be elevated.

Annual variations

The annual average PM_{10} concentrations are a useful starting point, despite their limitations, as they allow us to determine whether a town is likely to have poor air quality. Annual averages provide information on long-term population exposure, but can hide very poor seasonal air quality (eg wintertime exceedances of the PM_{10} 24-hour standard). Table 3 shows the annual average PM_{10} concentrations for all sites monitored by Environment Southland for the period 2003–2012.

It is noticeable that Invercargill and Gore have both recorded annual average PM_{10} concentrations above the WHO (2006) and Ambient Air Quality Guidelines (2002) limit of 20 µg/m^3. At the other end of the spectrum, Te Anau consistently records an annual average of 6 µg/m^3, indicating that the air quality is generally very good in the town. As a comparison, PM_{10} from natural sources alone has been estimated at 6.8 µg/m^3 in many parts of the country.[81]

Table 3: Annual average PM_{10} concentrations in Southland in µg/m^3 (exceedances in bold)

Testing site	Calendar year									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Invercargill at Miller St	18*	19*	20*	15*	14	14				
Invercargill at Pomona St						22*	**22**	**24**	**22**	**24**
Invercargill at Glengarry Cr							18			
Invercargill at North Road							16			
Gore			21*	22*	18	20	18	**22**	**21**	**23**
Mataura			15*	15*						
Winton					11*	15*	11*	13*		
Te Anau								6*	6	6
Edendale				10*						
Riverton									10*	11*
Bluff					6*					
Wallacetown								12*		

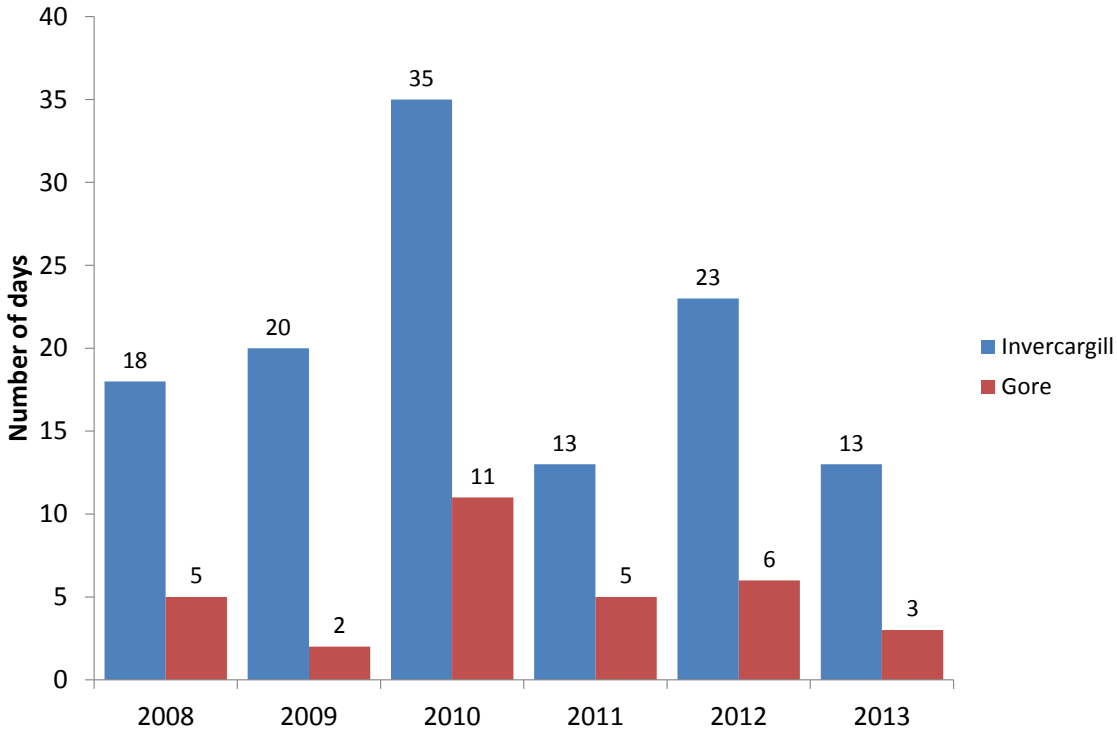
Note: * = less than 75% data available as recommended by MfE (2009)[80]

Source: Environment Southland

80 Ministry for the Environment, 2009. **81** Kuschel et al., 2012b.

Another important indicator of air quality is the 24-hour average PM_{10} limit of 50 µg/m^3 – this is the limit required by the National Environmental Standards for Air Quality (NESAQ). An exceedance of the standard occurs when daily levels are higher than the established limit. In Southland, the 24-hour average PM_{10} standard is regularly exceeded during the winter months. Figure 19 shows the number of exceedances recorded in Invercargill and Gore since monitoring began in those urban areas. It is important to note the monitoring methods and sites have changed over time, so long-term trends cannot be assumed from this graph. Climatic variations between years have also not been taken into account.

Figure 19: Number of days the NESAQ 24-hour average PM_{10} limit (50 µg/m3) was exceeded, 2008–2013



Source: Environment Southland

Table 4: Environmental Performance Indicator (EPI) programme air quality categories

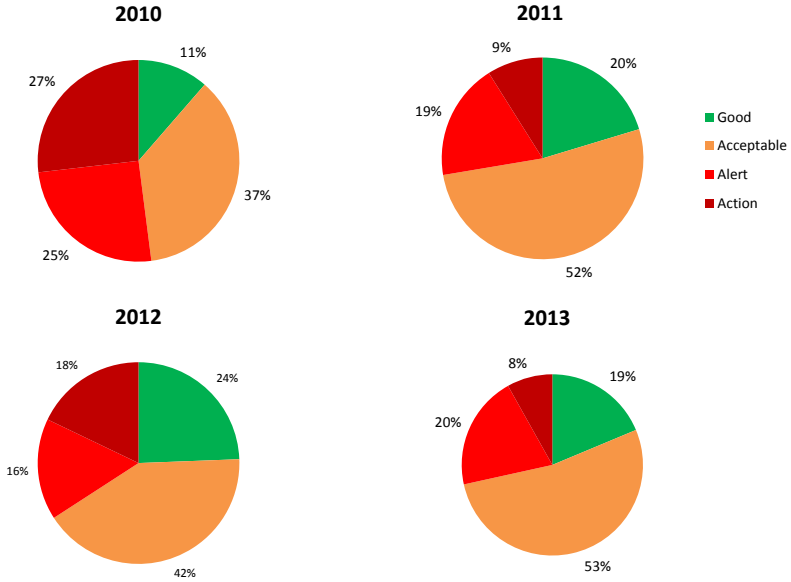
Category	Measured value	Comment
Action	Exceeds the guideline value	Exceedances of the guideline are a cause for concern and warrant action, particularly if they occur on a regular basis.
Alert	Between 66% and 100% of the guideline value	This is a warning level, which can lead to exceedances if trends are not curbed.
Acceptable	Between 33% and 66% of the guideline value	Peak measurements in this range are unlikely to affect air quality.
Good	Between 10% and 33% of the guideline value	Peak measurements in this range are unlikely to affect air quality.

Source: Ministry for the Environment, 2002

The Ministry for the Environment's Environmental Performance Indicator (EPI) criteria (Table 4) provide a useful way of categorising air quality results in Invercargill and Gore.

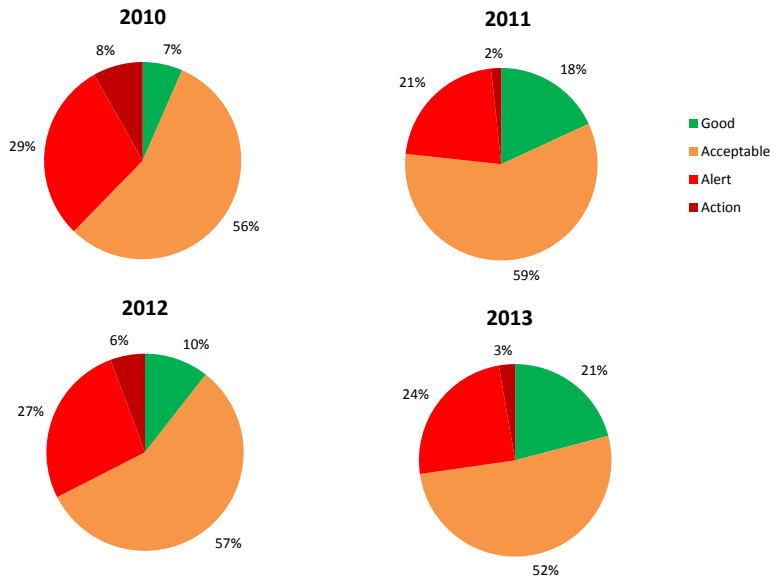
Figure 20 and Figure 21 show the winter daily average monitoring results over the period 2010–2013. The winter monitoring period is 1 May to 31 August. Exceedances of the NESAQ 50 µg/m^3 limit generally occur between these dates. As the figures show, air quality in Invercargill and Gore during winter is 'Good' on less than 30% of the days.

Figure 20: Winter daily average PM_{10} in Invercargill by EPI category, 2010–2013



Source: Ministry for the Environment, 2002

Figure 21: Winter daily average PM_{10} in Gore by EPI category, 2010–2013



Source: Ministry for the Environment, 2002

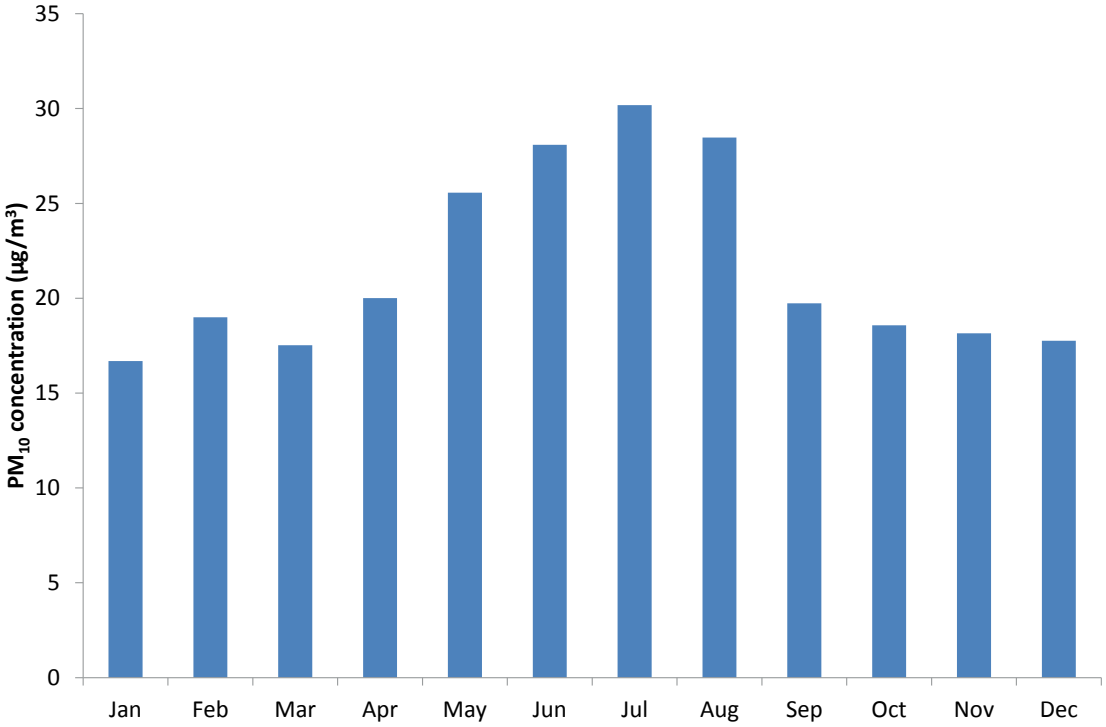
Like most New Zealand towns, Invercargill and Gore demonstrate distinct air quality patterns depending on the season and the time of day. PM_{10} levels are generally highest during the winter months and lowest during the summer, as shown in Figure 22. Burning solid fuel (wood and coal) for domestic heating is widespread in our region during the winter and the effects of those emissions can be observed in the winter peaks. The concentrations during the summer months are much lower, when only industrial, motor vehicles, outdoor burning and natural sources contribute to air pollution.

Hourly/daily variations

Changes in PM_{10} concentrations through the day in Invercargill and Gore are very similar to those observed in other towns in New Zealand. The first peak occurs in the morning around 9 am as people rise for the day and start their fires (Figure 23). Motor vehicle emissions are also likely to contribute to this early morning peak, as people drive to work or drop children at school. Wind speeds are generally low during the morning also, which means the pollution is not rapidly blown away. Concentrations are lowered as the wind increases into the afternoon, then around 5 pm they start to increase again. The likely causes are the same: end-of-day traffic and domestic heating. The concentrations build throughout the evening and peak around midnight.

The distribution of PM_{10} across Invercargill has also been analysed, both by Environment Southland and independently. In 2007, mobile monitoring was conducted across the city and around its immediate boundaries by an Otago University honours student. That study concluded concentrations of PM_{10} were generally the highest in the southern residential suburbs, moderate in the CBD and lowest just outside the city boundaries.[82]

Figure 22: Monthly average concentrations of PM_{10} in Invercargill (Pomona Street), 2010–2013



Source: Environment Southland

Are there trends in our air quality?

Invercargill and Gore have both been monitored for over five years, which enables an analysis of longer term air quality trends. The trends addressed here relate to wintertime (May–August) PM_{10} concentrations only. Many of the smaller urban areas in Southland have not been monitored for an extended length of time, so analysis of trends in those areas is not currently possible.

Because PM_{10} concentrations are affected by year-to-year variation in climate conditions, it is not appropriate to look at the concentrations alone to determine trends. The raw PM_{10} data must first be 'normalised', which involves accounting for variability in meteorology (ie climate) to minimise the impact on the PM_{10} concentrations data. Regression tree analysis was used to determine the meteorological conditions with the greatest potential to result in elevated concentrations of PM_{10}.

PM_{10} concentrations were first monitored in Invercargill at a site on Miller Street, between 2003

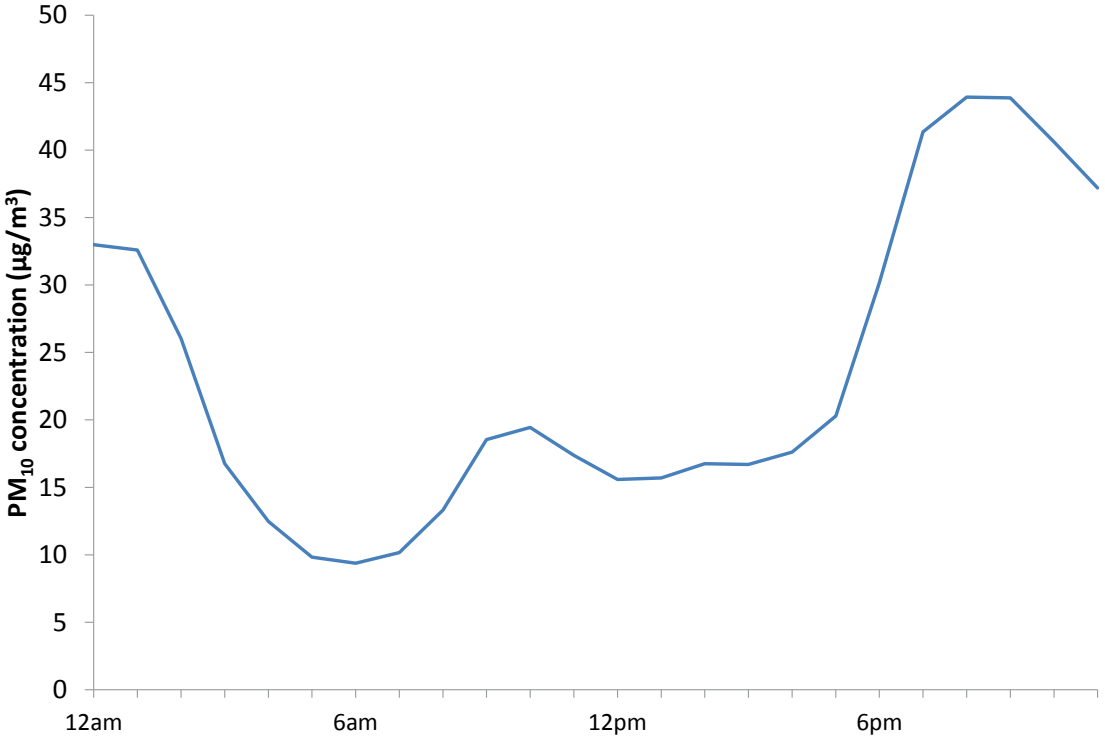
82 Conway et al., 2007.

and 2008. The monitoring site then moved to Pomona Street, where it has been since April 2009. Past and present air quality monitoring sites are shown in Figure 24. The change in site makes it difficult to assess the trends in Invercargill over the entire monitoring period. Instead, trend analysis for Invercargill has been done for two separate periods, 2003–2008 and 2009–2012.

The assessment for the first period suggests there was a significant reduction in PM_{10} concentrations at the Miller Street site between 2003 and 2008.[83] It is possible that observed reduction resulted from changes in home heating behaviour in the area, although that has not been quantified. Another possible explanation for the reduction is that during this timeframe, the monitoring period was changed to a midnight to midnight period from a midday to midday period. Given that some of PM_{10} monitoring during the study timeframe was conducted using a HiVol sampler, it has not been possible to recalculate daily averages to test this theory. The same statistical methodology was used to assess the 2009–2012 Pomona Street data, which showed no downward trend in emissions over that period (Figure 25). The latter result is expected given there has been no change in regulation to initiate reductions in PM_{10}. The meteorological variables found to have the greatest impact on PM_{10} concentrations at Pomona Street (2009–2012) were wind speed and temperature.

The current results suggest that there has been no improvement in air quality in Invercargill, but also that the air quality doesn't appear to be getting any worse. Environment Southland will continue to assess these trends as it implements PM_{10} reduction measures through a review of its Regional Air Quality Plan for Southland.

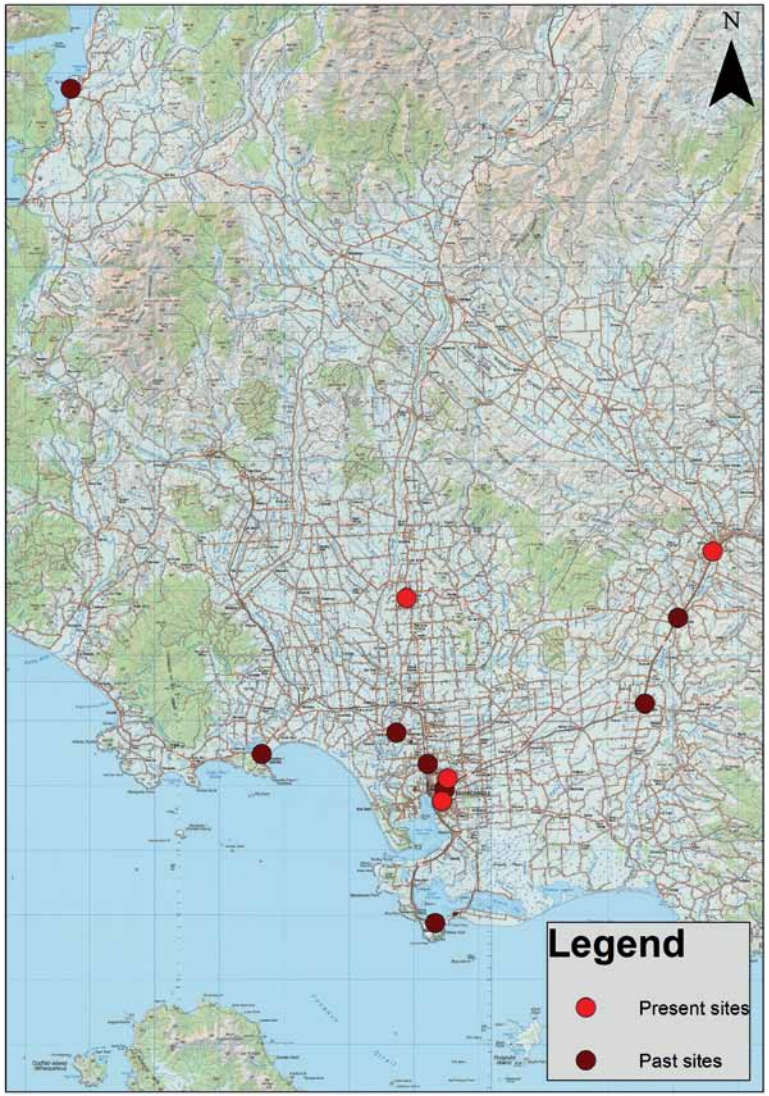
Figure 23: Average hourly concentrations of PM_{10} during winter in Invercargill (Pomona Street), 2010–2013



Source: Environment Southland

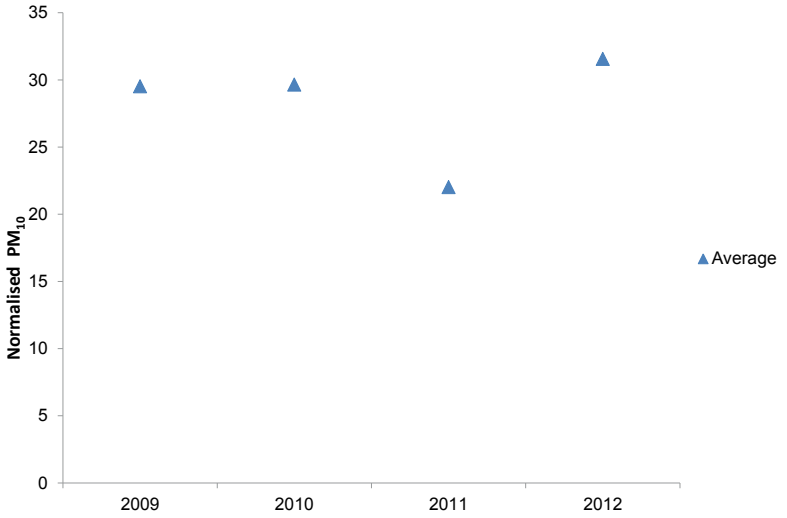
83 Wilton et al., 2009.

Figure 24: Past and present air quality monitoring sites in Southland



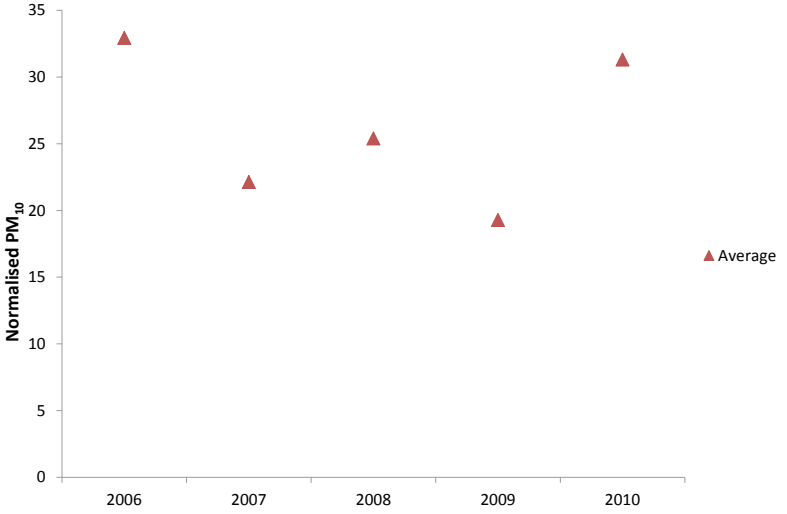
Source: Environment Southland

Figure 25: Normalised daily average wintertime PM_{10} concentrations for Invercargill at Pomona Street, 2009–2012



Source: Environment Southland

Figure 26: Normalised daily average wintertime PM_{10} concentrations for Gore at Main Street, 2006–2010



Source: Environment Southland

How does Southland's air compare?

We can see how our region's air quality compares with the rest of the country by contrasting it to data provided by the Ministry for the Environment (MfE).

The Ministry data gives a nationwide snapshot of the 2011 year, based on the annual average PM_{10} concentrations for each airshed (Figure 27). Invercargill and Gore were among the nine airsheds that exceeded the annual average guideline. Annual average concentrations are a measure of long-term exposure to elevated PM_{10} concentrations. These results indicate Invercargill and Gore are among those airsheds in the country where long-term exposure to poor quality air is a concern.

If we look at the data across all of Southland, we see the highest annual average PM_{10} concentrations are in the largest urban areas – Invercargill and Gore. The smaller urban areas in our region have much lower annual and daily concentrations of PM_{10} and have not yet breached the NESAQ, meaning the air quality is better (Table 3). The larger urban areas have a much greater number of solid fuel burners which are responsible for the high concentrations (see 'What contributes to poor air quality'). They are also the areas where industry and traffic are likely to play a greater role.

The air quality measure that receives the most publicity in New Zealand is the number of exceedances of the national standard in a particular airshed. Of the 43 airsheds listed (Figure 28), Invercargill ranked 10th and Gore 21st for the number of exceedances recorded during 2011. These results show the difference between the two measures. Although Gore's annual average PM_{10} concentration for 2011 is above the recommended guideline, there are relatively few exceedances recorded in the town. The results suggest the PM_{10} concentrations in Gore remain at elevated levels throughout the entire year, rather than being affected by occasional very high spikes during the winter. Further investigation is required to understand why this pattern is present.

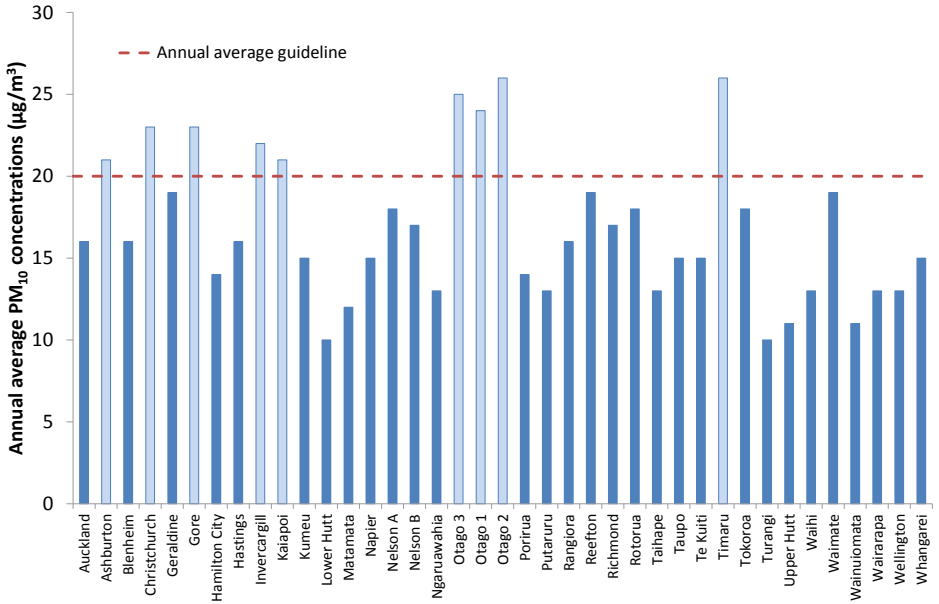
Although exceedances are regularly recorded in the Invercargill airshed, there are fewer exceedances in Invercargill than in many other New Zealand towns and cities (Figure 28).

On a global level, Southland's air quality is much better than in many parts of the world. While Invercargill and Gore both record annual average PM_{10} concentrations above 20 $\mu g/m^3$, which is the WHO guideline level (Figure 27), in comparison some cities in Iran, Pakistan and India record concentrations that are up to 10 times greater.[84]

Photo by: Boi Rickertsen

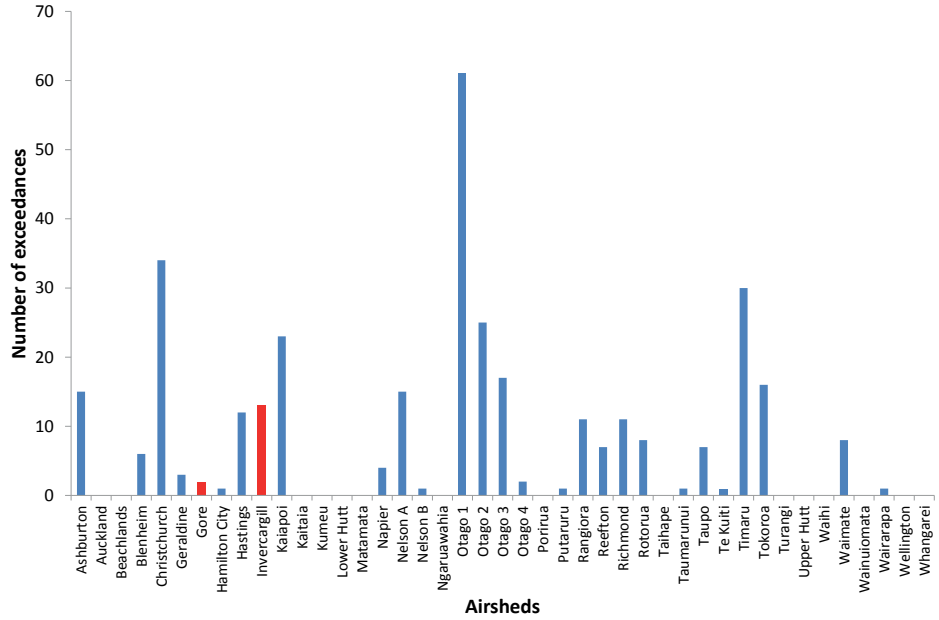
84 WHO, 2011.

Figure 27: Annual average PM_{10} concentrations across New Zealand in 2011 (top nine in light blue)



Source: Ministry for the Environment

Figure 28: Exceedances by airshed across New Zealand in 2011 (Invercargill and Gore in red)



Source: Ministry for the Environment

Explanatory note:

The Otago airsheds are each comprised of multiple urban areas.

Otago 1
(Alexandra, Arrowtown, Clyde and Cromwell)

Otago 2
(Mosgiel and Milton)

Otago 3
(Central Dunedin and Oamaru)

Photo by: Gail Jefferies

What are we doing about air quality?

This section reports on responses we are making to identified air quality issues as a community.

Environment Southland's action in this area is focused on reviewing the Regional Air Quality Plan for Southland (1999). This is likely to result in changes that will affect the regulation of home heating systems and outdoor burning in our region.

Other responses to air quality issues are shown as case studies. These cover Environment Southland's day-to-day and one-off education work, as well as community initiatives such as the upgrade of the heating system at the Southland Aquatic Centre – Splash Palace and Awarua Synergy's project work.

Air plan review

The aim is to address areas of poor air quality, and to provide effective management for the future, while also reflecting recent law changes, eg the National Environmental Standards for Air Quality (NESAQ).

The focus will be on domestic heating in the Invercargill and Gore airsheds, outdoor burning, agrichemical and fertiliser use. The domestic heating and outdoor burning focus will help us achieve the NESAQ PM_{10} standard, while agrichemical and fertiliser drift is an issue faced by our pollution response team.

The exact nature of the changes have yet to be determined and the community still has an opportunity to be involved in the decision-making through the air quality plan review process.

Why do we need an air plan review?

The regional air quality plan adopted in 1999 doesn't provide effective means to address areas of poor air quality, nor does it meet recent legal requirements such as the national standards (NESAQ).

Good air quality is an important natural resource and necessary for the sustainable future of the region. If discharges of contaminants to air are not managed appropriately they can have adverse effects on human physical health, cultural health and on the environment.

Environment Southland produced a summary document about the air plan review in 2013. It discussed a range of issues, options and recommendations to manage air quality in Southland. Community input was sought on how we could better manage air quality, in particular, home heating options. The results are available online at: www.es.govt.nz/environment/air/breathe-easy-and-the-air-plan-review

What will the reviewed air plan look like?

Any changes around home heating will have to focus on reducing PM_{10} concentrations in the Invercargill and Gore airsheds to improve air quality and meet the requirements of the national air quality standards.

Specifically, changes for home heating are likely to lead to restrictions on open fires and new solid fuel burners in favour of those that meet specific emission and efficiency standards, and the phasing out of older solid fuel burners.

The focus of changes to do with outdoor burning will need to be two-fold: minimise localised health and nuisance effects across the region; and reduce the contribution of outdoor burning to PM_{10} concentrations in the Invercargill and Gore airsheds.

Changes for agrichemical spray drift and applying fertiliser will be aimed at minimising localised adverse impacts outside the areas being targeted in that activity.

How long will it take for air quality to improve?

We have a real opportunity right now, to take steps to improve the quality of the air we breathe. The poor air quality during winter months in our main urban centres is predominantly caused by domestic heating emissions – smoke from fires. Reducing home heating emissions will mean effective improvements in the quality of the air.

The length of time it will take will depend on the strength of the reduction measures we opt to use to reduce those emissions. Some of the suggested reduction measures include restricting the installation of new multi-fuel burners, banning open fires and phasing out old solid fuel burners. It will take more than just a change of rules; a mix of education and regulation will be necessary.

The timeframes set by the National Environmental Standards for Air Quality (NESAQ) for achieving the PM_{10} national standard are: 1 September 2016 for Gore and 1 September 2020 for Invercargill, with an interim target of no more than three exceedances by 1 September 2016.

Any changes to the rules in the air plan will aim to achieve a balance between the need to meet the required deadlines, and the time the community needs to make the necessary changes.

Photo by: Libby Vermunt

Case study: The Southland Aquatic Centre – Splash Palace

Reducing Emissions

Many Southland businesses are playing their part to reduce their impact on our region's air quality. The Southland Aquatic Centre – Splash Palace is one of them.

The Olympic-sized facility operated by the Invercargill City Council is reaping the benefits of a new state-of-the-art wood-fired burner, which produces substantially reduced and less toxic emissions compared to its previous lignite boilers. Not only is it cheaper to run and better for the environment, but the woodchip fuel is a renewable source of energy and is locally supplied.

The boiler replacement began as a response to high maintenance costs for the two old lignite boilers. It has become much more, with diverse benefits for the operators and the community.

Often referred to as brown coal, lignite releases toxic gases on burning that are proven to cause harm to both the environment and human health.

This is in stark contrast to the woodchips burned by the new boiler, which have a 30% moisture content and do not release gaseous toxic emissions.

The new boiler is custom-fit to the precise requirements of the facility. Its specifications meet world-class emission level standards and are accepted for installation into problem airsheds around the world. This meant it automatically met requirements for use in Invercargill.

Staff are also appreciating its ease of use. Maintenance supervisor Stephen Cook remembers what it was like to run the old lignite boiler, when fireproof overalls were a necessity. Now the Splash Palace boiler room is very different. The system is fully automated and a touch screen monitor displays an overview of the boiler's operations. Parameters are easily adjusted and even accessed remotely from a PC, tablet or smartphone.

Facility manager Pete Thompson talks about the benefits of the system. "The pool is now one degree warmer, emissions to air are now virtually invisible and the lignite smell that lingered around the facility has completely disappeared."

The 97% reduction in ash generation has led to $15,000 in savings and less time is spent in the boiler room itself, allowing for more time to be spent on other jobs. Maintenance costs for the facility are also at an all-time low and there's now no Emissions Trading Scheme cost.

This system is a real-world example of how engineering, technology and environmental considerations have been taken into account to improve a community facility, with great outcomes all round, particularly outside.

Case study: Keeping the dust down

The role of a pollution prevention officer

Leonie Grace regards air pollution as one of the most obvious types of pollution, because you can usually see it or smell it. She would know, in her job as a pollution prevention officer for Environment Southland.

Leonie works with all sorts of pollution issues, helping people to understand the issues caused by pollutants and offering them viable, useful alternatives. Often there's a win–win fix that returns a good gain to the individual household or business, while reducing negatives in the wider environment.

But there's one air pollutant she meets all the time with no easy fix – dust from unsealed roads.

Dusty roads are a common problem throughout Southland. Dust is whipped up by vehicles on unsealed roads and by windy weather. It's an environmental issue that can be hazardous for the people who live close by. Dust lands on roofs and contaminates drinking water, covers gardens and household property, adds sediment into stormwater, causes health problems for people with breathing disorders, impairs drivers' visibility, and is generally unpleasant and a nuisance.

Of all the pollution issues Leonie deals with, it is one of the trickiest. Suppressing dust is fraught with complications and long-term solutions are often expensive and problematic. But there are still some useful things people can do, she says.

In the first instance she advises people to plant trees on their properties to screen their homes from the road. This helps by acting as something of a dust absorption buffer.

Various agents can be used to dampen down road dust. However, a variety of rules apply, a permit is required from your local council and it is recommended that the work be done by an approved contractor.

Used engine oil is still applied on gravel roads in Southland, but most regions have taken steps to discourage this practice because it poses its own risks to human and environmental health. The toxic substances in used engine oil are known to cause a variety of illnesses in people including cancer, and can impact on animal fertility, and plant foliage and growth. When the surface of an oiled road breaks down, polycyclic aromatic hydrocarbons (PAHs) become mobile with the dust.

Other dampening agents such as bitumen emulsions and bitumen seal treatments are considered safer, but cost more. Water is the cheapest option, but is really only a short-term solution, effective for 30 minutes to 12 hours. Regular, light watering is more effective than less frequent, heavy watering.

Leonie says dust on areas such as driveways to homes, and trade and industrial sites can be managed in a variety of ways including regular cleaning and sweeping, using water sprinklers, planting out exposed surfaces, and making surface improvements such as applying gravel, concrete or asphalt.

She finds new commercial developments which have built dust mitigation into the design of their sites have the most success. This can include shelterbelts, screens and making the most of natural land features, or creating artificial features such as bunds, to provide a degree of wind protection. Other measures include limiting vehicle speeds and loads, covering loads, and installing wheel- and truck-wash facilities to stop the tracking of sediment off site.

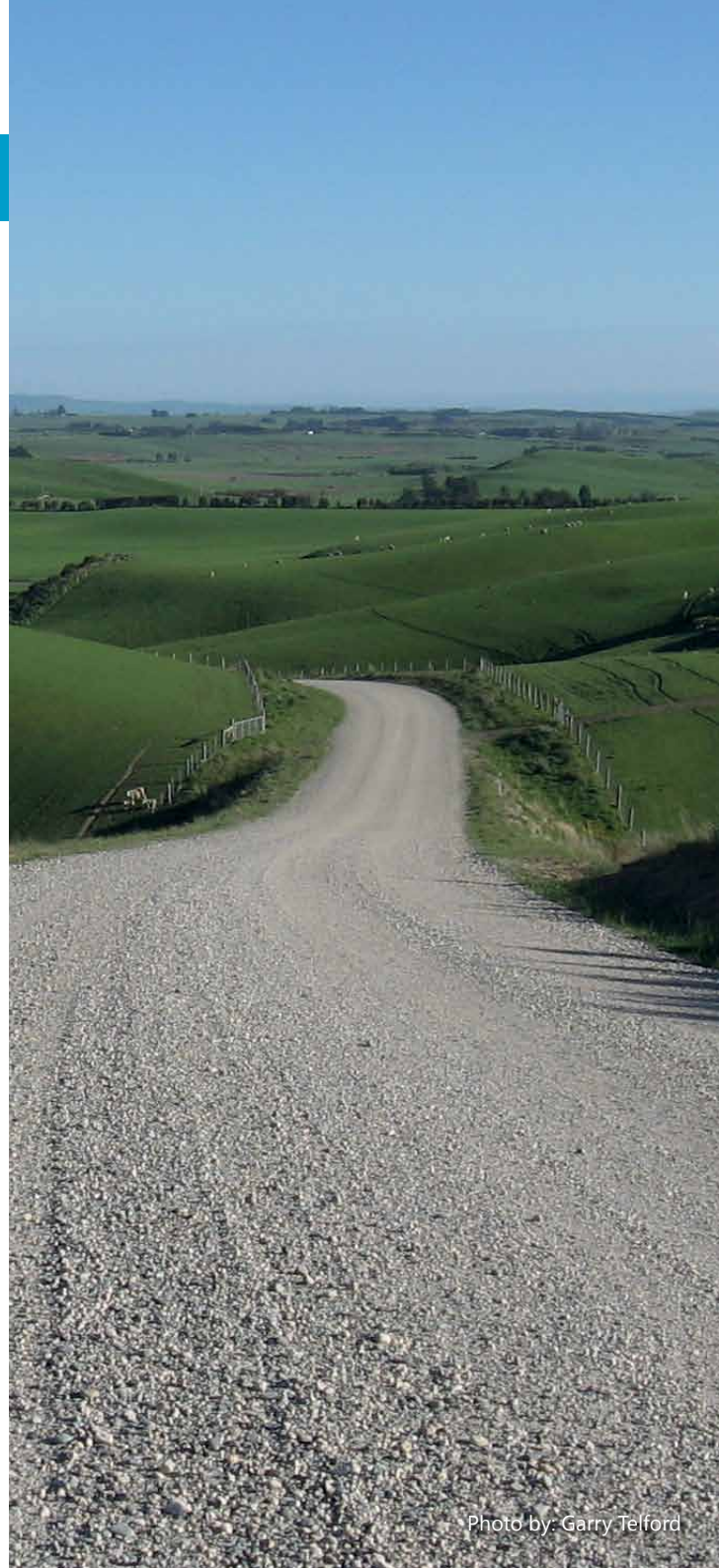


Photo by: Garry Telford

Case study: Catching more than a whiff

Responding to odour complaints

Twenty-four hours a day, seven days a week, Environment Southland compliance staff are on the job monitoring the 24-hour pollution hotline.

Occasionally calls come in from members of the public, complaining of unsavoury odour. These incidents are responded to immediately, with trained staff sent to investigate.

Odour incidents can arise from various activities. The most common ones are industrial processing and the spreading of farm effluent.

The compounds that cause odour are air contaminants and their discharge is controlled under section 15 of the Resource Management Act 1991. The key legal requirement is that an objectionable or offensive odour should not cause adverse effects at or beyond the boundary of its site.

The process of investigating odour incidents involves arriving at the complainant's address (or somewhere nearby if they have phoned anonymously), and assessing if there is any odour. Sometimes the odour is found in the place described by the complainant, sometimes it's not.

Senior Technical Officer Graeme McKenzie has found that odour can be very fickle, continually changing intensity and direction. Odour incidents are more common in the warmer months on still days, or in autumn on days with higher winds. There are usually fewer calls about odour during the winter, as the rain tends to suppress it.

A rigorous process is used to assess odour incidents. Staff drive in a full circle from the initial point of complaint, to note wind speed (using a hand-held wind speed monitor), wind direction and odour character and intensity at all points. There are five factors used to assess the odour: frequency, intensity, duration, offensiveness and location (FIDOL).

There is currently no technical replacement for the human nose; it's the best tool in the staff member's toolkit when attending an odour incident.

Graeme says it's important to know each staff member's ability to detect odour. For example, if someone has a bland sense of smell but can still detect the odour a complainant had phoned in about, then there's no doubt it's a strong smell.

If an odour is detected, the next step is pinpointing where it originates from. Sometimes it's obvious, but sometimes it's near impossible. If the odour can be traced, staff will then visit the premises emitting the odour, discuss the situation with the people there and try to work out a solution.

Photo by: www.southernexposures.co.nz

Photo by: Boi Rickertsen

Case study: Taking Care

School Caretakers' Workshop

School caretakers are essential cogs in the smooth, efficient running of schools, and as Environment Southland's first caretakers' workshop showed, many also want to make a difference environmentally. It turns out that can include improving air quality.

Environment Southland has a long history of working with schools to deliver environmental education to staff and students. Along the way, its Environmental Education team had identified caretakers as some of the key people within a school to make a difference when it comes to environmental practices and projects.

In 2013 the team began developing a workshop especially for school caretakers. Environmental Education Officer Mark Oster wanted it to be "hands on, boots on, and useful". He'd worked with teachers a lot in the past, but this needed a different approach.

Mark began calling a few caretakers to see what they would be most interested in learning at a workshop designed to improve their environmental understanding, knowledge and skills.

There was a common theme: caretakers wanted to know how to get the best out of their boilers, how to run them efficiently within their financial budgets and how to minimise negative environmental impacts.

The one-day School Caretakers' Workshop was held in August 2013 at the Southland Community Nursery in Otatara and the Otago College of Education on Nelson Street and included a visit to the campus' boiler room.

The workshop attracted more than 20 caretakers from schools across Southland. It included a range of sessions on topics such as dealing with green waste, weeds and disposing of chemicals, but the strongest focus was on boilers.

Air Quality Scientist Owen West was invited to give some context on Southland's air quality. Experts from the Ministry of Education and the Otago University property teams in Invercargill and Dunedin delivered a hands-on boiler session.

Topics such as boiler maintenance, tuning the boilers to juggle the air and fuel ratios to get the 'right' sort of flames, blends of coals, visual analysis, gas analysis and pellets were discussed with the experts. Some of the more experienced school caretakers provided guidance to those who were newer in their roles.

Southland schools have a range of boilers: many are older and many burn coal. The emphasis of the session was to give the caretakers skills they could take away to adjust and tune their boilers to get the best out of their existing systems.

Mark said caretakers often feel they work in isolation. Environment Southland's workshop gave local school caretakers a rare opportunity to network and to learn from one another. This has continued since the workshop with some caretakers contacting one another to discuss various aspects of boiler efficiency and care.

Mark received lots of positive comments about the day, including this one: "The information on boilers was very informative" and this: "Always thinking about the environment and how we can do better."

Case study: Awarua Synergy

Warming up Southland homes

The aim of Awarua Synergy is to make Southland homes warmer, drier and healthier.

Originally set up in 2005 as a local response to a real need for better living conditions for Bluff people, this charitable company is now delivering improvements to homes inside and out – with real gains for air quality as the dependence on burning cheap fuels reduces.

Awarua Synergy provides a range of energy-efficient services and products to Southland homeowners and businesses. This includes comprehensive energy assessments, sales and installation of insulation, clean heating appliances, hot water cylinder heat pumps and solar panels, access to subsidies, public education, and the monitoring of outcomes.

The organisation started in a small way, growing out of General Manager Sumaria Beaton's prior work at Awarua Research & Development at Te Rau Aroha Marae in Bluff. Its first focus was on delivering a three-year, government-subsidised Bluff Healthy Homes insulation project.

That first project was a roaring success: by the end every household in Bluff had participated in a one-on-one energy efficiency and heating education programme, and more than half of the community's homes were insulated. Since then Awarua Synergy has insulated a further 5,500 homes throughout Southland through the Southland Warm Homes Project.

General Manager Sumaria and her team believe there's more to be done though, with a total of 39,000 houses in Southland and some of the oldest housing stock in New Zealand.

Until 2013 Awarua Synergy's projects were funded by government subsidies aimed at improving people's health and reducing hospital admissions.

Sumaria says the subsidies definitely helped people to make choices that benefited air quality. Once people have insulated their homes, they use their fires less, she says, and they often go on to replace their open fires with Ministry for the Environment approved wood burners or heat pumps. Of the heating appliances Awarua Synergy installed during the 2012/13 year, 17% were wood burners and 83% were heat pumps.

In 2013 the Government substantially reduced its funding and Awarua Synergy had to reinvent itself. It has shifted to a charitable company model, offering all Southlanders a wider range of products and services.

The revised service specialises in helping people make the best long-term choices to ensure the best return on their investment. It includes whole-of-house assessments, and access to a locally created independent solar photo voltaic calculator to assess the return on different energy solutions.

Sumaria says many of the people they deal with are aware of air quality issues around home fires, but are less conscious of the health effects of moisture and mould inside their homes.

Awarua Synergy gets a lot of positive feedback from customers. Sumaria says they commonly talk about lower power bills, improvements in their children's asthma, and just how much warmer and drier their homes are. "Some people are so pleased they walk in and hug us."

Awarua Synergy Charitable Company

Awarua Synergy is a subsidiary of Te Rūnanga o Awarua – one of Ngāi Tahu's four Southland rūnanga. It evolved out of Awarua Research & Development at Te Rau Aroha Marae in Bluff, to lead the government-subsidised Bluff Healthy Homes project (2005–2008).

In 2008, the Southland Warm Homes Trust was formed to facilitate subsidised insulation and heating assessments and refits for homes throughout Southland, in association with the Energy Efficiency and Conservation Authority (EECA). Awarua Synergy was contracted to install the insulation.

In 2011 Awarua Synergy became the project manager for the trust and now offers a wide range of energy-efficient services and products to Southland homeowners and businesses. Subsidies continue to be available, thanks to government funding and third-party local funders via the Southland Warm Homes Trust, and are subject to certain criteria. The subsidies are now focused at those on lower incomes.

PowerNet provides administration and financial reporting services for the trust, while many organisations have contributed to the project in other ways. They include Environment Southland, the Invercargill City Council, the Gore District Council, the Southland District Council, the Invercargill Licensing Trust, the ILT Foundation, the Community Trust of Southland and Southland Primary Health Organisations. The Southland Times and Work and Income New Zealand have provided indirect support.

What we don't know and what we could do better

What we don't know

- Environment Southland's work to manage air quality in the region would benefit from further research into the composition of the particulate matter (PM) measured in the Invercargill and Gore airsheds. Research to show the sources of the PM would allow us to confirm the relative proportions of human-generated and natural sources in PM_{10} emissions. It would also provide information on heavy metals, such as arsenic. Similar research in Masterton found elevated arsenic concentrations in the air, which were suspected to come from the burning of treated timber in home fires.
- Fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is not currently measured in Southland, but it has been identified as an emerging issue in New Zealand. There is not yet a standard for $PM_{2.5}$ in New Zealand, so Environment Southland has not begun monitoring for it.
- There are still small towns in Southland (such as Makerewa, Balfour, Oban, Tuatapere, Otatara, Lumsden and Riversdale) where the air quality has never been monitored. The risk of poor air quality in these towns is generally low. However, without monitoring we cannot be completely sure.
- Contaminants such as carbon monoxide and nitrogen dioxide are not monitored by Environment Southland. A risk assessment has indicated that concentrations of those contaminants are unlikely to be elevated above the guideline limits.[85] As with the small towns, however, we cannot be completely sure without testing.
- Environment Southland's Air Quality Monitoring Strategy (2013) identified sulphur dioxide (SO_2) and benzo(a) pyrene (BaP) as contaminants that warrant further investigation. BaP has been strongly correlated with PM_{10}[86] so it is likely that BaP concentrations will be elevated in Southland's two airsheds.
- We don't know how airborne contaminants are affecting food production and activities such as mahinga kai.
- We also have no information on indoor air quality in Southland. Although it is not Environment Southland's responsibility to collect and report such information, it is information that would be useful. For example, we don't know how much of the outdoor air pollution is making its way into homes through poorly sealed windows and doors. There may be potential in the future to collaborate with Crown Research Institutes and other research providers to investigate indoor air quality in Southland, and Environment Southland would take an active interest in those opportunities.
- Poor air quality is known to adversely affect human health; further research on the Southland population could be carried out to investigate this. However, as noted earlier in this document, such small scale studies are often expensive and struggle to achieve the necessary statistical robustness.

Environment Southland's Air Quality Monitoring Strategy (2013) maps out a research programme to help us gain some of the information identified above. We are also working with external research providers to help us with the necessary projects. We have established a project with GNS Science to research the composition of particulate matter in Invercargill, as mentioned in the first bullet point.

What we could do better

We are actively working to ensure that the public is better informed about air quality issues in Southland. This report is a key step in conveying the message that there are still improvements that need to be made.

85 Wilton, 2013a. **86** Gunatilaka, 2002.

Photo by: Boi Rickertsen

What can you do?

Good air quality (clean, clear, unpolluted air) is important for maintaining human health and life. Air quality is poor when concentrations of pollutants reach high enough levels to endanger human physical health, our cultural health, or the environment. Everyday choices such as driving a car or lighting a fire can have a significant impact on air quality.

Many people assume air quality refers only to the quality of air outside, but the quality of the air we breathe indoors is also very important. New Zealanders spend about 75% of their time indoors, and children, elderly people and those who are unwell spend as much as 90% of their time at home – yet many of our houses are old and cold.

How can I improve the quality of air indoors?

- Make your home a non-smoking zone.
- Keep a healthy level of humidity. A good indoor humidity level is between 30–40% during winter and below 50% in summer. A humidity level below 30% is considered too dry, while humidity above 65% may cause mould growth and dust mites.
- Clean and vacuum regularly to remove dust, dirt, and particulates that build up indoors.
- Use materials and furnishings that are non-toxic for things such as wall finishes, caulks, adhesives, upholstered furniture, and carpeting.
- Use cleaning products that contain no volatile organic compounds or toxic chemicals.
- Invest in good High Efficiency Particulate Air (HEPA) air filters to help purify the air in your home, and be sure to change filters often. A true HEPA filter is able to remove 99.7% of the particles as small as 0.3 microns from the air.
- Remove your shoes at the door to prevent dirt, dust and other particles from spreading throughout your house.
- Check air and heat pump filters at least every two months, and replace or clean regularly.
- Take steps to ensure that your home remains mould-free.
- Ventilate.
- Insulate.
- Stop the draughts.

How can I improve the quality of air outdoors?

- Switch from solid fuels (wood, coal) to cleaner and more efficient fuels and energy technologies.
- Burn only dry seasoned firewood (eg less than 20% moisture content and not ‘green’).
- Do not damp down your fire overnight or overload it with fuel.
- Keep your fire burning brightly.
- Maintain your fireplace – remove ash and sweep the chimney regularly.
- Look outside – check whether your chimney is releasing lots of smoke.
- Do not burn rubbish, treated wood or any other waste materials in your fire.
- Insulate your home. An insulated home requires less heating to stay warm.
- Minimise the use of braziers and outdoor ovens during the winter months.
- Use alternative forms of transport to your car, such as a bike, or public transport.
- Pave or seal dusty driveways and keep them washed down and clean.

Photo by: Boi Rickertsen

What help is out there and where can you get it?

Outdoor air pollutants can be kept to a minimum by using energy efficient home heating options. Not only will insulation retain the heat within your home for longer and so reduce your energy costs, but it can also decrease the effects of condensation and mould. Warm, comfy environments are vital in maintaining the wellbeing of elderly people, children and those with poor health.

There is government assistance available to help low income households insulate their homes. In 2013 the Government allocated $100 million of operating funding over three years to the Warm Up New Zealand: Healthy Homes programme. The Southland Warm Homes Trust project is part of this scheme and has been working in association with the Energy Efficiency and Conservation Authority (EECA) to help warm up Southland homes since 2008.

The Southland Warm Homes Trust project aims to insulate about 340 Southland houses by July 2014, when funding will be reviewed. The project is aimed at people with a community services card who are at high health risk from conditions relating to cold, damp housing.

Free, independent advice on sustainable building practice – and on cutting energy consumption – is available from the Invercargill City Council's Eco Design Advisor. The Eco Design Advisor service provides free advice on how to best use energy, water and materials on home building and renovation projects, to ensure better use is made of resources.

This service is an initiative of BRANZ Ltd – the independent research, testing, consultancy and information resource for the building and construction industry.

New Zealand's Home Heating Association (NZHHA) has played an active role in the development of appliance and installation standards both nationally and internationally. It also plays a major role in the development and promotion of clean air standards, and energy and resource conservation. It runs a certification system for installer and retailer members to help ensure that the appropriate standards are maintained at all levels within the industry. The NZHHA is affiliated with similar trade groups and organisations throughout the world.

Further details on sustainable energy options and on improving air quality can be found at the Ministry for the Environment website: www.mfe.govt.nz

Invercargill City Council's Eco Design Advisor can be contacted on (03) 211 1777.

For information about air quality in Southland please visit:

BreatheEasySouthland.co.nz

Photo by: Joel C Ryan, Bluff

Glossary

AAQG

Ambient Air Quality Guidelines

Airshed

An area designated by a regional council for the purposed of managing air quality and gazetted by the Minister for the Environment.

Atua

A god

BaP

Benzo(a)pyrene

Breach

First exceedance of an ambient standard above the number of permissible exceedances in any 12-month period.

CO

Carbon monoxide

CO_2

Carbon dioxide

Deprivation index

A measure of socio-economic deprivation for small geographical areas based on socio-economic variables measured in the 2006 Census. The index combines a number of factors to assess the degree of deprivation in an area, with 1 being the least deprived and 10 being the most deprived.

Dioxin

A general term that describes groups of hundreds of chemicals that are highly persistent in the environment.

Domestic fire

A combustion appliance used for heating space, water, or for cooking which has a chimney and which is intended primarily for use in a residential dwelling house.

Exceedance

An instance where a contaminant exceeds its threshold concentration (defined in Schedule 1 of the NESAQ Regulations) in an airshed.

Furans

An aromatic ether of molecular formula C4H4O, or a molecule containing this structure.

Gaseous pollutant

A pollutant that is present in the atmosphere in a gas form, such as carbon monoxide or ozone.

Hinengaro

Mind, thought, intellect, consciousness, awareness.

Kainga

Dwelling places

Kaitiaki

Guardians

Kaitiakitanga

The exercise of guardianship/stewardship by the tangata whenua of an area and resources in accordance with tikanga Māori.

Mahinga kai

Food, and places for obtaining natural foods, methods and cultural activities involved.

Manawhenua

Traditional/customary authority or title over land, and the rights of ownership and control of usage on the land, forests, rivers etc.

Matariki

Māori name for the cluster of stars known as Pleiades. It rises once a year in mid-winter and marks the beginning of the Māori new year.

Mātauranga

Education, knowledge, wisdom, understanding, skill.

Maunga

Mountains

Mauri

Spiritual essence, life-force

Micron

A unit of length equal to one thousandth of a millimetre.

Multi-fuel burner

Similar to a wood burner but is designed to burn both wood and/or coal and has over fuel and under fuel combustion air supply with separate controls, a grate in the base of the firebox and an ash pan.

NESAQ

National Environmental Standards for Air Quality

Ngāi Tahu whānui

The collective of the individuals who descend from the primary hapū of Waitaha, Ngāti Mamoe, and Ngāi Tahu, namely Kāti Kurī, Katī Irakehu, Kāti Huirapa, Ngāi Tūāhuriri, and Kai Te Ruahikihiki.

NO_2

Nitrogen dioxide

NOx

Nitrogen oxides

Nocturnal radiation inversion

Nocturnal radiation inversions occur on clear sky nights, when the earth's surface cools at a faster rate than the air above. The clear sky means that the heat energy absorbed by the earth during the day is rapidly lost into the atmosphere.

Pellet burner

A wood burner with metal firebox and a door on the front. The wood is in the form of small pellets that are fed continuously into the fire.

PM_{10}

Particulate matter less than 10 microns in diameter, generally consisting of tiny solid or liquid particles of soot, dust, aerosols, fumes, and mists suspended in the atmosphere.

Regression tree analysis

A data-analysis method that recursively partitions data into sets of each which are modelled using regression methods.

Rongoa

Traditional medicines

Rūnanga Papatipu

The Rūnanga Papatipu of Ngāi Tahu Whānui, referred to in the Te Rūnanga o Ngāi Tahu Act 1996, including Te Rūnanga o Waihōpai, Te Rūnanga o Awarua, Te Rūnanga o Ōraka Aparima and Te Rūnanga o Hokonui.

Secondary pollutant

A secondary pollutant is not directly emitted, but formed when other pollutants react in the atmosphere.

SO_2

Sulphr dioxide

SOx

Sulphur oxides

Solid fuel

Coal or wood (including wood pellets).

Solid fuel burner

A burner that uses solid fuel to generate heat, such as a wood burner, a multi-fuel burner and a pellet burner.

Source apportionment research

Research to identify the emission sources of pollutants, eg whether they are human generated or natural.

Takiwā

Area

Tangata whenua

People of the land, local owner occupier, original inhabitant, the people that hold the tūrangawaewae and the manawhenua in an area, according to tribal and hapū custom.

Taonga

Treasured possession, material or abstract (eg language); Māori interest in these is protected by the Treaty of Waitangi and New Zealand statute and common law/ lore.

Te reo

Māori language

Temperature inversion

A layer of the atmosphere in which air temperature increases with height.

Territorial authorities

A type of local authority. They are either district or city councils. Territorial authorities are responsible for the provision of local infrastructure.

Tikanga

Māori rules and customs

Tinana

The body or main part of anything

Tīpuna

Ancestors, grandparents

Tītī

Muttonbird, sooty shearwater

Tohu

A sign, mark, symbol, emblem, token, qualification, cue, symptom, proof, directions.

Tuna heke

Eel migration

VOC

Volatile organic compound

Wāhi taonga

Places of sacred or extreme importance

Wāhi tapu

Sacred places

Wairua

Spirit, soul, quintessence.

Whakapapa

Genealogy, lineage, descent.

Whakatauki

To utter a proverb.

Whānau

Extended family, family group.

Whanaungatanga

Relationship, kinship, sense of family connection.

Whare

House, building, residence, dwelling.

Whenua

Country, land, nation, state.

WHO

World Health Organization

Wood burner

A fully enclosed metal firebox only designed to burn wood (and paper) with a door and two air controls to allow for the efficient burning of wood within the combustion chamber.

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