

93401R



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2010 Geography

2.00 pm Saturday 27 November 2010

RESOURCE BOOKLET

Refer to this booklet to answer the questions for Scholarship Geography 93401.

Check that this booklet has pages 2–22 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

CONTENTS

INTRODUCTION	3
PART A: CAUSES OF POLLUTION	5
PART B: EFFECTS OF POLLUTION	8
PART C: CASE STUDIES	
Sarnia, Ontario, Canada	14
Mercury pollution in Canada	16
Pollution in Ecuador	17
Love Canal, Niagara Falls, New York, USA	18

"We do not inherit the earth from our ancestors, we borrow it from our children."

Native American Proverb

"For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death."

Rachel Carson, *Silent Spring*, 1962

"If the world does not learn now to show respect to nature, what kind of future will the new generations have?"

Rigoberta Menchú Tum, 1992

INTRODUCTION

Pollution is the introduction of contaminants into an environment that causes instability, disorder, harm, or discomfort to the ecosystem. Pollution can take the form of chemical substances, or energy, such as noise, heat, or light. Pollutants can be foreign substances or energies, or occur naturally.

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Figure 1: Industrial pollution

The costs of pollution are widespread and include death, decreased levels of health, declining water resources, reduced soil quality, and poor air quality. These have a significant effect upon people's quality of life.

Growing evidence of local and global pollution and the public having become increasingly informed over time have given rise to environmentalism and the environmental movement, which generally seek to limit human impact on the environment.

Supernova
by Liquid Blue

Population overload, treading in a fragile zone
Ozone layer disappearing, predictions that the end is nearing ...

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... Pollution in our lakes and streams, pollution is in everything
Gotta catch a ship to Mars or somewhere out beyond the star.

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**Figure 2: Smog in cities
causing pollution**

PART A: CAUSES OF POLLUTION

Motor vehicle emissions are one of the leading causes of pollution, with China, the United States, Russia, Mexico, and Japan, leading the world in air pollution emissions.

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Figure 3: Cartogram showing global carbon emissions

In 2005 there were almost 23 billion tonnes of **carbon dioxide** (CO₂) emitted worldwide. Of this, 28 per cent came from North American territories; 0.09 per cent came from Central African territories. Emissions of carbon dioxide vary hugely between places, due to differences in lifestyle and ways of producing energy. In 2007, China took over from the United States as the world's biggest producer of CO₂.

Other pollution sources include chemical plants, coal-fired power plants, oil refineries, petrochemical plants, nuclear waste disposal activity, incinerators, large livestock farms (dairy cows, pigs, poultry, etc), PVC factories, metals production factories, plastics factories, and other heavy industry. Agricultural air pollution comes from practices that include clear-felling and burning of natural vegetation, as well as spraying of pesticides and herbicides.

The destruction of rainforests or farmland to produce ethanol, or for palm oil production, has also been a significant contributor to pollution.

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Figure 4: Ethanol production reduces pollution

About 400 million metric tons of **hazardous wastes** are generated each year. The United States alone produces about 250 million metric tons. Americans constitute less than 5 per cent of the world's population, but produce roughly 25 per cent of the world's CO₂, and generate approximately 30 per cent of the world's waste.

Pollution normally increases with **population growth** and **economic development**. The graph (see **Figure 5 below**), shows a model of air quality and levels of economic development. Less economically developed countries (LEDCs), such as Bangladesh and Ecuador, have weaker economies and when industrialisation began there, it was generally fast. These countries favoured cheap and inefficient energy sources such as low-grade coal. Investment in pollution control is minimal. More economically developed countries (MEDCs), such as the United States and the United Kingdom, have tended to put controls on pollution earlier than LEDCs as they began industrialisation much earlier.



Figure 5: Model of pollution and economic development

The recent **industrialisation** of China and India poses a significant threat to the world's environment. Both countries generate pollution and have large proportions of their populations with very low incomes. This means there is very little public support for reduction of pollution unless imposed through external pressure, such as in China during the 2008 Beijing Olympics.

There is a level of **living standard** at which populations will begin to make substantial demands of political systems to reduce pollution. As living standards continue to rise, the demand for cleaner environments inevitably becomes stronger as people reach the point of having satisfied other desires. Among industrialised countries, living standards had some influence on which countries developed environmental movements first. The United States, with a higher per capita GDP than Europe, adopted many environmental regulations before European countries did, and, for example, banned the use of lead in petrol many years before most European countries did. However, many years after leaded petrol was banned in the United States, it continued to be used in Mexico. Mexicans were poorer and were more concerned about getting cheaper gas and cheaper cars than in getting cleaner air.

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Figure 6: Stages of water pollution

PART B: EFFECTS OF POLLUTION

Pollution affects many aspects of our environment:

- visual qualities
 - vegetation
 - water quality
 - soils
 - natural and artificial structures
 - human health.
- Air pollution discolours the atmosphere and reduces **visibility**. For example, in cities such as Mexico City, visibility is at times so affected that it is now on average only 1.5 km, compared with 100 km in the 1940s.

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Figure 7: Mexico City air pollution

- **Vegetation**, such as forests, has been affected by acid rain across the globe. Acid rain is caused by emissions of compounds of ammonium, carbon, nitrogen, and sulphur, which react with the water molecules in the atmosphere to produce acids. Studies in Germany have shown that many acres of trees in Bavaria have been destroyed by acid rain.

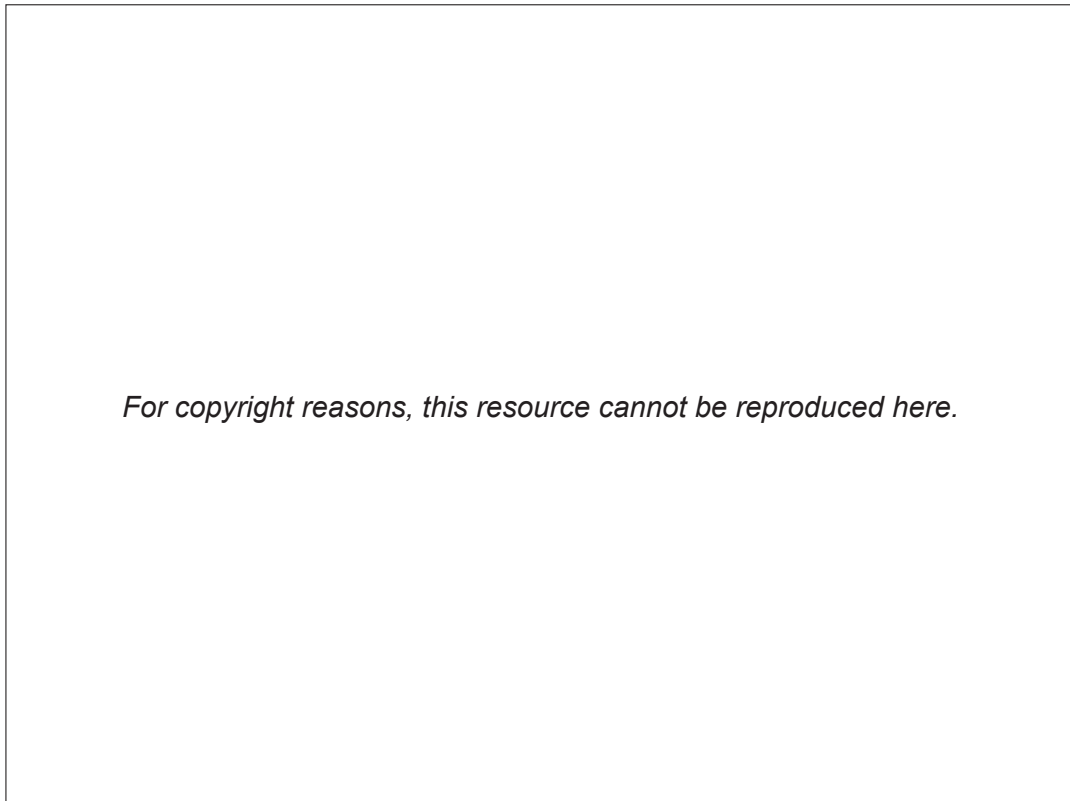


Figure 8: Trees destroyed by acid rain

- **Lakes and waterways** have been affected by pollution when chemicals or effluent have been dumped, purposely or accidentally, into streams, or rivers, or lakes. In New Zealand, many lakes in the central North Island are clogged with weeds fed by nitrogen run-off from farms and industry. Toxins in the water can cause illness in the liver and nervous system, as well as skin rashes, hay fever, and asthma attacks.

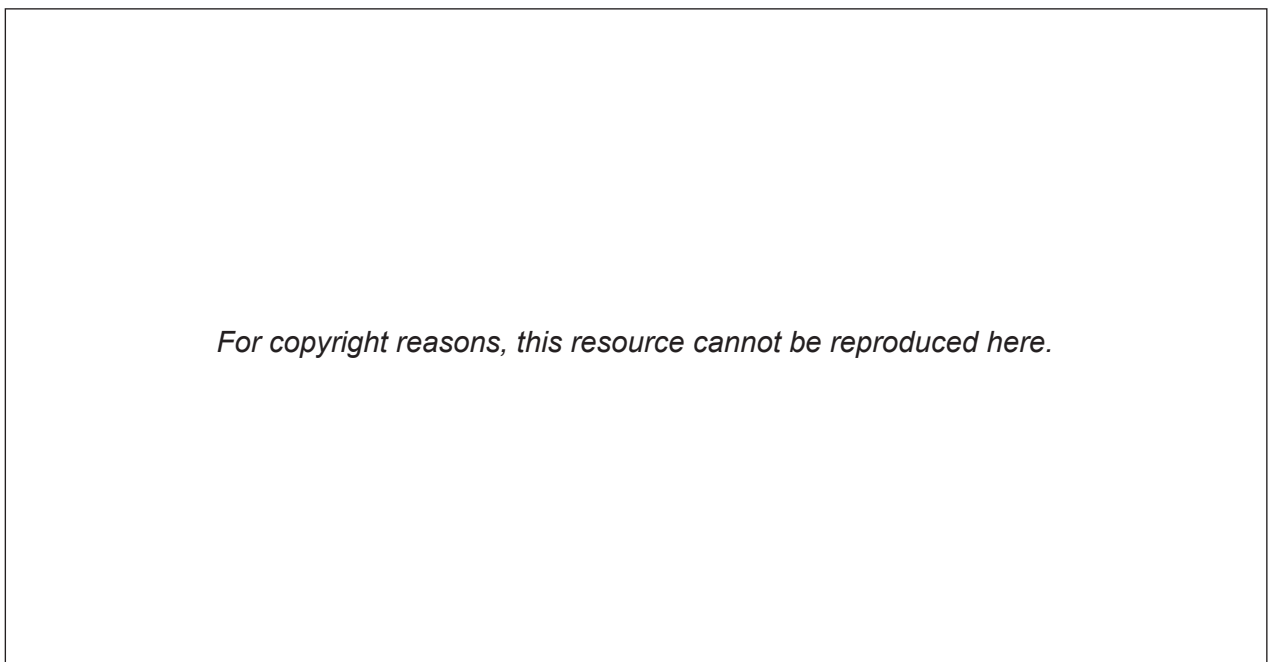


Figure 9: Pollution pathways

- **Soil** pollution is caused by the presence of chemicals or other alteration in the natural environment. This type of contamination typically arises from the rupture of underground storage tanks, application of pesticides, percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills, or direct discharge of industrial wastes to the soil.
- Pollution can also have a major impact on human-made **structures**, such as the Acropolis in Athens. The Acropolis shows considerable decay that has been accelerated in the twentieth and twenty-first centuries. The problem has grown to the extent that buildings have required restoration, and many important statues in Greece (and in many other countries) have had to be removed from their original standing place and placed in glass containers, with replicas standing in the former outdoor location for tourists to view.

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Figure 10: An engineer using laser beams to remove the black crust caused by pollution from decorations on the Acropolis

- Pollution can also affect **human health** in many ways with both *short-term* and *long-term* effects. The extent to which an individual is harmed by pollution usually depends on the total exposure to the damaging chemicals. Some individuals are much more sensitive to pollutants than are others. Young children and elderly people often suffer more from the effects of air pollution than others. People with health problems such as asthma, or heart and lung disease, may also suffer more when the air is polluted.
Examples of short-term effects include irritation to the eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia. Symptoms can include headaches, nausea, and allergic reactions. Short-term air pollution can aggravate the medical conditions of individuals with asthma and emphysema. In the great “Smog Disaster” in London in 1952, four thousand people died in a few days due to the high concentrations of pollution.
Long-term health effects can include chronic respiratory disease, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys. Continual exposure to pollution affects the lungs of growing children, and may aggravate or complicate medical conditions in the elderly.

Oil spills can cause skin irritations and rashes. Noise pollution induces hearing loss, high blood pressure, stress, and sleep disturbance. Mercury has been linked to developmental deficits in children. Lead and other heavy metals have been shown to cause neurological problems. Chemical and radioactive substances can cause cancer, as well as birth defects. Researchers have linked air pollution exposure before birth with lower IQ scores in childhood, bolstering evidence that smog may harm the developing brain.

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Figure 11: Effects of major pollutants on human beings

“Indigenous peoples remain on the margins of society: they are poorer, less educated, die at a younger age, are much more likely to commit suicide, and are generally in worse health than the rest of the population.”

International Working Group on Indigenous Affairs (IWGIA)

The impact of pollution is thought to be more serious on indigenous people than on other groups. There are an estimated 370 million indigenous peoples living in more than 70 countries worldwide. They represent a rich diversity of cultures, religions, traditions, languages, and histories, yet continue to be among the world’s most marginalised population groups. The health status of indigenous peoples varies significantly from that of non-indigenous population groups in countries all over the world. Safe water and food, proper sewage and refuse disposal, adequate living space and sanitary facilities, provision of power, and vector control, are all critical determinants of health in any community. Poverty and lack of services and education lead to increased vulnerability.

In Australia, there is a large discrepancy between the health of indigenous and non-indigenous people. There is a significant difference in life expectancy of nearly 20 years between indigenous and non-indigenous people. Diabetes, cardiovascular disease, respiratory diseases, and enteric and parasitic diseases, claim a huge toll on Australia’s indigenous people.

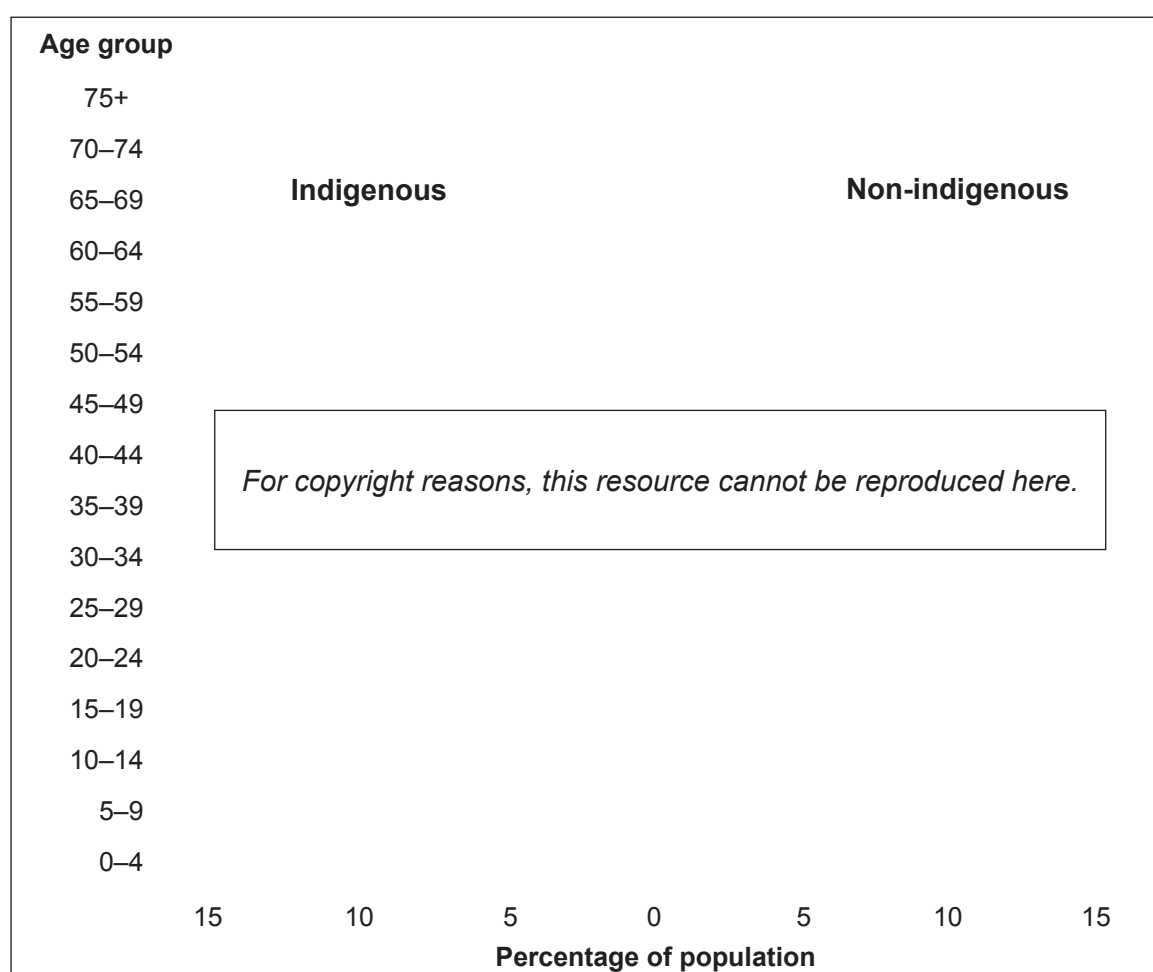
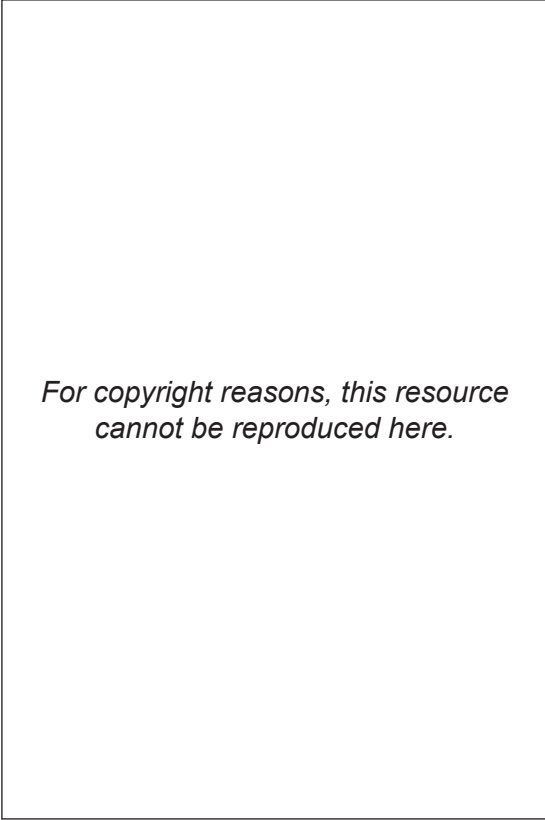
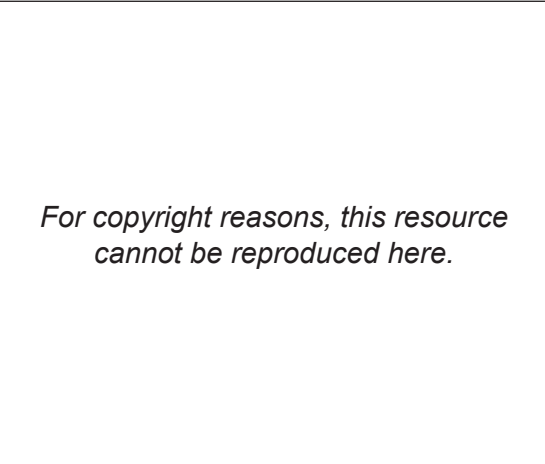


Figure 12: Age-sex pyramid for indigenous and non-indigenous population(s) in Australia



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Figure 13: Water pollution causes serious risks to people's health



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"I used to play here as a kid, but of course, that was before humans built that sewer pipe ..."

Figure 14: Water pollution causes serious risks to animals' health

PART C: CASE STUDIES

1. Sarnia, Ontario, Canada

The city of Sarnia (population 71 000), is situated at the south end of Lake Huron on the east side of the St Clair River, Ontario, Canada (see **Figure 15 below**). The local Indian reserve known as the Aamjiwnaang First Nation is adjacent to the south end of Sarnia. The Aamjiwnaang reserve is home to about 850 people, about one-quarter of whom are children.



Figure 15: Location of North American Case Studies

Aamjiwnaang (ahm-ji-nong), is the name of both a place and the people who live in that place. The name Aamjiwnaang, more fully vocalised as Aamjiwanaang, means “at the spawning stream”.

The Aamjiwnaang are members of the Ojibwe tribe, and have lived on the St Clair River for more than 6 000 years.

Their land originally covered large parts of south-western Ontario. From the mid-1700s, when the first permanent European settlers arrived, and over the next two centuries, a series of government rulings alienated the Aamjiwnaang from their culture and language through enforced attendance at residential mission schools, and appropriated control over their land. By the 1950s, the reserve had shrunk to its current size of 2 700 acres.

The world’s first **oil** strike was in 1857, in Black Creek, Ontario. The city of Sarnia, located on the nearby St Clair River, and on the border with the United States, became a major refining and trans-shipment site. During World War II, the Canadian government built a **synthetic rubber** plant in Sarnia to supply the Allied war effort. After the war, industries flocked to Sarnia to take advantage of the new “petrochemical revolution”. With access to raw materials, a network of pipelines, a prime location, and exploding consumer demand, Sarnia became an economic powerhouse.

Today, Sarnia is the site of 40 per cent of Canada's **petrochemical industry**, with 62 large industrial facilities stretching along the St Clair River waterfront. Approximately 40 per cent of Canada's **chemical industry** is clustered near Sarnia in an area known as "Chemical Valley".

Immediately to the south of Sarnia's "Chemical Valley", is the Aamjiwnaang First Nations reserve. Residents of Sarnia and the Aamjiwnaang First Nation face a grave air pollution problem. The area has become one of the most polluted hot spots in Canada. Other sources of pollution in the area include the significant exhaust output from cars and trucks travelling the area's numerous highways. Trucks are often idling for hours as their drivers wait in line to cross the nearby Canada-US border.

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Figure 16: Some of the 62 industrial plants in Sarnia

In 2006, the Aamjiwnaang Environment Committee interviewed locals about the impacts of pollutants on their lives. Members of the Aamjiwnaang reserve identified releases of chemicals and incidents such as spills as their primary concern. They also noted that these chemicals and related incidents have significant impacts on their cultural life, including hunting, fishing, medicine gathering, and ceremonial activities. Health impacts included asthma, reproductive effects, learning disabilities, and cancer. Asthma is common on the reserve – about 17 per cent of adults surveyed have asthma, as well as about 22 per cent of children surveyed. Canada's national rate of asthma is 8.4 per cent. The most common reported impact, however, was fear. People on the reserve feared the outdoors, the warning sirens, and unreported incidents.

The Aamjiwnaang community also expressed concern regarding its proximity to chemical plants in the area. Birth rates in the area deviate from the normal ratio of close to 50 per cent boys, 50 per cent girls. The ratio (between 1999 and 2003) was roughly 33 per cent boys, and 67 per cent girls. The First Nation is concerned that this abnormal trend is due to exposure to the effluent and emissions of the nearby chemical plants. This is also the first place in the world to have two girls to every boy. In addition, 39 per cent of the women at Aamjiwnaang over the age of 18 have had at least one miscarriage or stillbirth. This compares to 25 per cent in the general population in Canada. Other health effects reported by those surveyed included high blood pressure, chronic headaches, skin rashes, and kidney problems.

2. Mercury pollution in Canada

In another part of Ontario, in 1970, the government of Canada informed commercial fishermen and tourist lodge owners along the English–Wabigoon River system in Ontario that the fish were testing for extremely high levels of mercury and that the rivers were poisoned.

Soon after the announcement, the source of contamination was discovered: Dryden Chemicals Limited had been dumping untreated mercury wastewater into the river. All told, the company released more than 9071 kg of mercury-contaminated wastewater between 1962 and 1970. Between 1971 and 1996, 17 671 indigenous people in another part of Ontario were found to have dangerous levels of mercury in their blood.

After the warning was made public, the Ontario government told the First Nations communities to stop eating the fish – their main food source – and further advised the township of Grassy Narrows (**see Figure 15 on page 14**), to shut down its commercial fishery.

The economies were devastated. In Grassy Narrows alone, the employment rate dropped from 90 per cent to 10 per cent. In addition, residents had to find different food sources and many were already suffering from mercury poisoning. Mercury poisoning causes eye problems, loss of coordination, numbness in the hands and feet, loss of memory, loss of strength, severe birth defects, “insanity”, neurological disorders, and death. People in Grassy Narrows and other towns nearby all showed all these symptoms of poisoning.

In 1985, the Federal and Provincial Government, along with Dryden Chemical’s parent company Reed Inc. and Great Lakes Forest Products, paid the communities of Grassy Narrows a little over \$16 million in compensation. The mercury, however, was never removed from the water.

Studies in 2002 and 2008 indicated that there were still high concentrations of mercury in the local populations of pike, walleye, and otters, and people within the region were still suffering from symptoms of mercury poisoning and other health issues.

3. Pollution in Ecuador – a less economically developed country (LEDC)

When René Arévalo draws water from his well, it is brown and gummy, requiring him to run it through a makeshift filtering system outside his wood-plank home in the jungle. Like thousands of other people, he suspects the water was fouled by the waste an American oil company dumped across miles of Amazonia in its 20 years of operations. After all, he and his five children live across from a separation plant once operated by a Texaco affiliate, their house built on a mound of dirt that covered a pit where wastewater was dumped.

“If you dig here just a metre deep, you hit oil,” Mr Arévalo said, moments after probing into the dirt outside his house to show visitors the gooey slime. “The water is contaminated, very contaminated. But we drink it. What else can we do?”

Painting a picture of water pollution in the Amazon region, a recent report said the fault lay with the Texaco Petroleum Company and Petroecuador, the nation’s state oil company. From 1972, the year commercial oil production started in Ecuador’s Amazon (**see Figure 17 above**), until 1992, the two companies were responsible for 88 per cent of oil production in the region.

“Residents are [still] exposed to levels of oil-related contaminants significantly exceeding internationally recognised safety limits,” the report concluded, referring to Ecuador’s Amazon. “Dermatoses and other skin problems apparently related to oil contamination were observed in residents near oil facilities. Those exposed to the oil had a higher occurrence of abortion, elevated rates of fungal infection, dermatitis, headache, and nausea.”

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Figure 17: Location of Ecuador

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Figure 18: Dirty and dangerous—workers who clean up oil spills often suffer neurological and digestive problems. Cancer rates are higher in areas close to oil activity than in the rest of Ecuador.

4. **Love Canal, Niagara Falls, New York, USA – a more economically developed country (MEDC)**

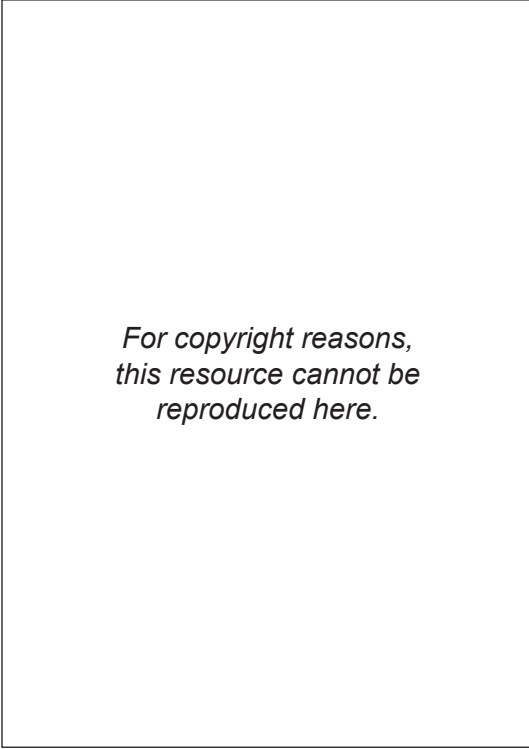
Love Canal is a neighbourhood in Niagara Falls, New York, USA (see **Figure 15 on page 14**), which became the subject of national and international attention, controversy, and eventual environmental notoriety following the discovery of 21 000 tons of toxic waste that had been buried beneath the neighbourhood by the Hooker Electrochemical Company.

Love Canal was named after William T. Love, who in the early 1890s, envisioned a canal connecting the two levels of the Niagara River that were separated by the Niagara Falls. He prepared a plan that called for the construction of a vast community of beautiful parks and homes along Lake Ontario. Unfortunately for Love, his plan was never realised. He was barely able to start digging the canal and build a few streets and homes before his money ran out. Only 1.6 km of the canal, about 15 m wide and 3 m to 12 m deep, stretching northward from the Niagara River, was ever dug.

With the project abandoned, the canal gradually filled with water. The local children swam there in the summer and skated in the winter. At some time in the 1920s, the canal became a dumping site for the city of Niagara Falls. By the 1940s, a company by the name of Hooker Electrochemical Company began a search for a dump to store the increasing amount of chemical waste it was producing. The local council allowed the company to dump its wastes in the Love Canal. This dumpsite was in operation until 1952 when 21 000 tons of chemicals such as caustics, alkalines, fatty acids and chlorinated hydrocarbons from the manufacturing of dyes, perfumes, solvents for rubber and synthetic resins were added. These chemicals were buried at a depth of between 5 and 10 metres. After 1952, the canal was covered with dirt, and vegetation such as grass began to grow on top of the dumpsite.

At the time of the dump's closure, Niagara Falls' population began to expand dramatically. The local school board purchased the land that had been used for the dumpsite for a school. Four hundred children attended the school upon its completion in 1955.

A survey conducted by the Love Canal Homeowners Association found that 56 per cent of the children born between 1974 and 1978 had a birth defect. In 1976, a protest group was formed by women whose children had a number of birth defects all associated with the exposure to the leaking chemical waste. The women wanted the school closed and compensation for their children's health problems. The families were upset later to learn that their neighbourhood sat on top of 21 000 tons of buried chemical waste. Love Canal can now be added to a growing list of environmental disasters involving toxins, ranging from industrial workers stricken by nervous disorders and cancers, to the discovery of toxic materials in the milk of nursing mothers.



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Figure 19: Love Canal demonstrations

"I visited the canal area at that time. Corroding waste-disposal drums could be seen breaking up through the grounds of backyards. Trees and gardens were turning black and dying. One entire swimming pool had been popped up from its foundation, afloat now on a small sea of chemicals. Puddles of noxious substances were pointed out to me by the residents. Some of these puddles were in their yards, some were in their basements, others yet were on the school grounds. Everywhere the air had a faint, choking smell. Children returned from play with burns on their hands and faces."

Today, houses in the residential areas on the east and west sides of the canal have been demolished. All that is left on the west side are abandoned residential streets. Some older east-side residents, whose houses stand alone in the demolished neighbourhood, chose to stay. It was estimated that less than 10 per cent of the original 900 families opted to remain. These were willing to remain as long as they were guaranteed that their homes were in a relatively safe area.

**Pollution
by Tom Lehrer**

**If you visit American city,
You will find it very pretty. ...**

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reproduced here.*

**... Like lambs to the slaughter,
They're drinking the water
And breathing (cough) the air.**

Acknowledgements

Text–information used in this examination was adapted from the following sources:

D. Botkin and E. Keller, *Environmental Science: Earth as a Living Planet*.

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<http://en.wikipedia.org/wiki/Pollution#Environment>

http://en.wikipedia.org/wiki/Soil_contamination

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Images – visuals used in this examination came from the following sources:

- Figure 1 <http://www.enviroblog.org/2009/02/>
- Figure 2 <http://www.onestepbehind.com/twostep.html>
- Figure 3 <http://www.worldmapper.org/images/largepng/295.png>
- Figure 4 http://www.treehugger.com/files/2006/07/is_e85_ethanol.php
- Figure 5 P. Guinness and G. Nagle, *Advanced Geography – Concepts and Cases Revised Edition* (London: Hodder Education, 1999), p 483.
- Figure 6 *Ibid.*, p 505.
- Figure 7 <http://www.tropical-rainforest-animals.com/air-pollution.html>
- Figure 8 <http://www.supergreenme.com/go-green-environment-eco:Acid-Rain>
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- Figure 10 <http://io9.com/5065540/visit-the-acropolis-now-clean-in-all-light-wavelengths>
- Figure 11 http://commons.wikimedia.org/wiki/File:Health_effects_of_pollution.svg
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- Figure 14 www.cartoonstock.com
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