Abstract annual report on the federal-provincial agreements,

ABSTRACTThis report involves a well description on acid rain as well as a focus on acid rain in eastern Canada. This report contains a very helpful basic background on acid rain as well as a questionnaire. It involves an annual report on the Federal-Provincial Agreements, sulphur dioxide emissions in the seven most eastern provinces, trends in acid deposition in the Atlantic provinces from 1980-1994, as well as acid precipitation in Kejimkujik, Nova Scotia. It also includes data tables, graphs and interesting facts concerning acid rain.

INTRODUCTIONThis report is on acid rain and identifies the harmful effect it has on almost everything such as aquatic ecosystems, forests, farming, and even human health. It shows the sulphur dioxide emissions in the seven most eastern provinces along with their limits and how much sulphur dioxide they emitted in 1980, 1990, 1994, 1995, and 1996. It also contains sulphur emissions from major sources from four Canadian provinces as well as sulphur dioxide emissions from electric power generators in three Canadian provinces.

There are also some interesting questions and answers and facts are included also. This information was organized from various websites. It also contains information from a newspaper article about a new monitoring site for acid rain in Irish Cove located in Cape Breton, Nova Scotia.

ACID RAINThe atmosphere, unpolluted, is the means of life on earth. It is a thin layer of gases which surrounds our planet. It is known that without the atmosphere our planet would be inhabitable, but we continue to put numerous amounts of toxic waste into it.

The burning of fossils fuels, produces gases that cause acid rain. Acid rain is harmful to forests, lakes, rivers, and any wildlife that is located in these areas. High standards of living, which developed countries are accustomed to, depends upon fossil fuels to withhold these standards.

Therefore, they cause the pollutants that cause acid rain. THE MEANING OF ACID RAINAcid rain comes in all forms of precipitation. Besides rain, it can be mist, snow, and dry deposition. Pollutants deposited on the environment before they are absorbed by the moisture in the atmosphere is called dry deposition. MEASURING ACIDITYIn measuring acid rain, the pH scale is used. This scale measures the acidity of acid rain. A measurement of seven is neutral, less than seven is acidic, and more than seven is basic.

HOW THE RAIN BECOMES ACIDCarbon dioxide in the atmosphere causes rain to become naturally acidic because it absorbs the carbon dioxide and makes a weak carbonic acid with a pH between five and six. Burning of fossil fuels causes sulphur dioxide and nitrogen, which happens to be the major causes of acid rain. These gases are emitted into the atmosphere where they are absorbed by the moisture and become weak sulphuric and nitric acids, with a pH of around three. Natural gas contains little or no sulphur and does not cause much pollution. THE MAIN SOURCES OF POLLUTIONSulphur dioxide is produced by coal fired power stations. Vehicles, especially cars, are the major producers of the nitrogen oxides in the atmosphere. Some oxides come from the vehicle exhaust alone, but others form when the exhaust gases react with the air. Exhaust gases also react with strong sunlight to produce poisonous ozone gas that damages plant growth and in some cases, human health.

Sulphur is one of the chemical elements that make up the earth. It can come from volcanic eruptions, sea spray, and tiny sea creatures called plankton. In the world as a whole almost 50 percent of sulphur dioxide in the air comes from natural sources of sulphur, like the ones previously mentioned. ENVIRONMENTAL DAMAGE CAUSED BY ACID RAINThe Built EnvironmentAcid rain corrodes metal and stone work.

It causes major threats to older historical buildings. FarmingThe more acidic the land becomes, the less likely the land can be used for growing crops and yields. Trees and ForestsSulphur dioxide interferes with the process of photo synthesis. Coniferous trees are at risk from acid rain because they do not shed the needles at the end of each year. The needles on a tree that has been affected by acid rain often last only two or three years, while healthy tree needles last up to seven years.

Young trees in soils affected by acid rain often show abnormally rapid growth. The nitrogen from the acid rain acts as a fertilizer. The root systems, however, are not developed as well as trees that have to collect their nutrients from a larger area and the trees are more easily blown over. Also, they are short of other essential nutrients and the wood can be very soft making. When the soil becomes acid, toxic minerals like aluminum and cadmium are washed out by water passing through the soil. These minerals are taken by the trees causing their growth to suffer. Water Courses and LakesWater courses and lakes are affected by the acid rain that falls directly into them and from water that runs into them.

The problem is worst in spring when snow melts. The pollution build up over the winter period is suddenly released as an “ acid surge” just at the time when many young fish and insects are most vulnerable. A healthy lake has a pH of about 6. 5 and supports a rich variety of wildlife. As a lake becomes more acidified, the fish population declines along with the birds that feed on the fish.

They are all dependent, upon one another in a complex food web, for a while, there is an increase in the number of insects in the lake they are not eaten by fish. The number of species declines as the acidity of the lake increases. The lake becomes dead when the pH reaches a level of about 4. 5. Other Factors Contributing to Acidification of the EnvironmentFarming and forestry can also increase acidification. When plants grow they take nutrients from the soil that causes the soil to become more acidic, but when they die and rot back into the soil the nutrients are replaced and the soil becomes less acidic.

The removal of a whole tree can be equivalent to about 60 years of acid rain because it does not get a chance to rot and replenish the nutrients. When the trunk is only taken it is equivalent to about 20 years of acid rain. Areas that are prepared for forestry are often drained and deep ploughed which allows more oxygen into the soil, therefore the minerals become oxidized and the soil becomes acidic. QUESTIONS AND ANSWERS1) Explain dry acid deposition. Sometimes the acids can be transformed chemically into sulphur dioxide gases into sulphur and nitrogen salts in which they are dry in this form.

They cause the same damage as when they land dissolved in rain or snow. In this form they can also do internal damage to plants as they are taken up from the soil. 2) Is acid deposition always wet? No. The acids can be transformed chemically into sulphur dioxide gas or into sulphur and nitrogen salts.

In this form they are deposited “ dry”, causing the same damage as when they land dissolved in rain or snow. In this form they can also do internal damage to plants as they are taken up from the soil. 3) How does acid deposition affect aquatic ecosystems? The interactions between living organisms and the chemistry of their aquatic habitats are extremely complex. If the number of one species or group of species changes in response to acidification, then the ecosystem of the entire water body is likely to be affected through the predator-prey relationships of the food web. At first, the effects of acid deposition may be almost imperceptible, but as acidity increases, more and more species of plants and animals decline or disappear. As the water pH approaches 6. 0, crustaceans, insects, and some plankton species begin to disappear.

As pH approaches 5. 0, major changes in the makeup of the plankton community occur, less desirable species of mosses and the progressive loss of some fish populations is likely, with the more highly valued species being generally the least tolerant of acidity. Below pH of 5. 0, the water is largely devoid of fish, the bottom is covered with undecayed material, and the nearshore areas may be dominated by mosses. Terrestrial animals dependent on aquatic ecosystems are also affected.

Waterfowl, for example, depend on aquatic organisms for nourishment and nutrients. As these food sources are reduced or eliminated, the quality of habitat declines and the reproductive success of the birds is affected. 4) How does acid deposition affect terrestrial plant life? Both natural vegetation and crops can be affected. It can alter the protective waxy surface of leaves, lowering disease resistance. It may inhibit plant germination and reproduction. It accelerates soil weathering and removal of nutrients. It makes some toxic elements, such as aluminum, more soluble.

High aluminum concentrations in soil can prevent the uptake and use of nutrients by plants. 5) How does acid deposition affect animal life? The effects on terrestrial wildlife are hard to assess. As a result of pollution induced alteration of habitat or food resources, acid deposition may cause population decline through stress (because of decreases in available resources) and lower reproductive success. 6) How does acid deposition affect human health? We eat food, drink water, and breathe air that has come in contact with acid deposition. Canadian and U.

S. studies indicate that there is a link between this pollution and respiratory problems in sensitive populations such as children and asthmatics. Acid deposition can increase the levels of toxic metals such as aluminum, copper, and mercury in untreated drinking water supplies. 7) Is acid deposition occuring to the same extent across Canada? No. Sulphur emissions tend to be concentrated in relatively few locations, while the sources of nitrogen emissions are widely distributed; however, where they are deposited depends on more than just where they are produced.

Airborne acidic pollutants are often transported by large scale weather systems thousands of kilometers from their point of origin before being deposited. In eastern North America, weather systems generally travel from southwest to northeast. Thus, pollutants emitted from sources in the industrial heartland of the midwestern states and central Canada regularly fall on the more rural and comparatively pristine areas of the northeastern U.

S. and south eastern Canada. ANNUAL REPORT ON THE FEDERAL-PROVINCIAL AGREEMENTS FOR THE EASTERN CANADAACID RAIN PROGRAM, 1996The Eastern Canada Acid Rain Program provides us with the 1996 emissions of sulfur dioxide (SO2) in the seven most eastern provinces and compares them to the emissions targets in the program. The program is intended to protect moderately sensitive ecosystems from acid deposition. The purpose of the program was to limit sulphur dioxide emissions at 2, 300 kilotonnes in Eastern Canada by 1994 until the year 2000, which is a 40 percent reduction from the 1980 emissions. Every eastern province met their emission goals in 1994.

In 1996, each eastern province except Newfoundland accomplished their goal by being 24 percent under the limit of 2, 300 kilotonnes, which was down slightly from 1995. Newfoundland is now taking steps to reduce their emissions. Quebec was 30 percent below their limit, New Brunswick 40 percent, and Ontario 25 percent. Manitoba had a slight increase but still managed to settle at 20 percent below the limit. In 1996, smelter’s accounted for 52 percent of sulphur dioxide emissions in Eastern Canada while fossil fueled-power plants accounted for another 16 percent.

The recent emission rates and provincial targets are shown in Table 1. Table 2 provides emissions data for the major sources. Table 2: Mineral Extraction and Smelting: Major sulphur dioxide sources. (kilotonnes) 198019901994199519961LimitManitobaInco (Thompson) 215247194195195220Hbms (Flin Flon)248253194162184220OntarioInco (Copper Cliff)81261716223623626 5Falconbridge (Sudbury)12370544553100Algoma (Wawa, Iron Ore)15542344440125QuebecNoranda (Horne) 552146156174147.

5272Noranda (Murdochville)9143434336. 565New BrunswickNoranda (Belledune)156141313-Electric Power Generation: Major sulphur dioxide sources (kilotonnes)198019901994199519961LimitOntario Hydro 3961951067285175New Brunswick Power123141906752123Nova Scotia Power125143133134130145TRENDS IN ACID RAIN IN THE ATLANTIC PROVINCES (1980-1994)Temporal TrendsThere are five sites in the Atlantic provinces that are monitored by Environment Canada. Environment Canada is part of the nation-wide Canadian Air and Precipitation Monitoring Network (CAPMoN). The United States and Canadian sulphur dioxide emissions are declining. They dropped by 16.

5 percent from 1980 to 1992. At the four CAPMoN sites located in New Brunswick, Nova Scotia, and Newfoundland, have recorded significant decreases of 28 to 40 percent in precipitation sulphate (See Fig. 1, Fig. 2, Fig. 3). A decrease of 25 percent has occurred at site in Labrador. No significant trends in hydrogen ion concentration were detected.

Spatial TrendsSince the late 1970’s the federal and provincial governments have been monitoring acid rain in the Atlantic provinces. The National Atmospheric Chemistry Data Base, which is maintained by Environment Canada, stored most of the data collected. The data which met the quality criteria of the Unified Deposition Data Base Committee was used to conduct annual maps of precipitation-weighed average sulphate deposition in the Atlantic provinces from 1980 to 1993. The deposition of acidifying sulfate has decreased since the 1980’s, when most of the region received sulfate deposition greater than 12 kilograms per hectare a year. In recent years, most of the region has received less than 12 kilograms per hectare a year.

ProjectionsThe majority of the aquatic ecosystems of the Atlantic provinces are very sensitive to acid deposition. The critical load for much of the region is less than 8 kilograms per hectare a year. Projected deposition fields for future years were produced from an atmospheric model using estimated future emissions.

The areas that will still be receiving sulfate deposition greater than their critical loads were declined. Many of the Atlantic provinces will likely continue to receive deposition greater than the critical load even after legislated emissions reductions in the United States. ISLAND HOME TO INTERNATIONAL ENVIRONMENTAL MONITORING SITEIrish Cove has been added to the list of international sites being used as monitoring ground for changes in the environment in Cape Breton. Irish Cove is the second site selected by Environment Canada in Nova Scotia, the first one selected was established in Kejimkujik National Park. Ms. Pixie Williams, a research associate with the Provincial Museum of Natural History, said the job is to

compile a complete inventory of all organisms living on the site. The plan is to monitor changes within temperate and boreal forests to aid in determining harmful environmental effects. She also went on to say that the decay of certain mosses and lichens indicate an acid rain problem.

World leaders vowed to begin cleaning up the environment and limiting the harmful effects of chemicals and other manmade substances. Dr. Patricia Roberts-Pichette, who is the executive secretary of the Canada/Man and Biosphere said the work at Irish Cove will be completed mainly by biology students under the watchful eye of members of the Biodiversity Research Associates. ACID PRECIPITATION DURING 1992 AT KEJIMKUJIK, NOVA SCOTIAAt Kejimkujik National Park in southeastern Nova Scotia the average precipitation- weighed pH for 1992 was 4. 57, which was equal to the average pH over the 13 years of record (1980-1992). The most acidic event of the year with a pH of 3. 04 was 269 times more acidic than the least acidic event with a pH of 5.

47. Wet deposition of excess sulphate and nitrate during 1992 at Kejimkujik was 10. 8 kilograms per hectare a year and 9. 4 kilograms per hectare a year respectively, which was less than the 13 year average of 15 and 10 kilograms per hectare a year respectively. In 1992 on June 15, 0. 6 kilograms per hectare a year of excess sulphate and 0. 09 kilograms per hectare a year of nitrate was deposited which was the largest daily deposition.

A comparison of the average was made between sulphate and nitrate for the first five years in which the average annual excess sulphate deposition decreased by over 10 percent whereas the average annual nitrate deposition

increased by over 33 percent. FACTSIt has been estimated that acid rain causes $1 billion worth of damage in Canada every year. Thousands of lakes have been damaged; a large part of the salmon habitat in the Maritimes has been lost; a significant proportion of eastern Canada’s forests has been affected; and considerable damage to buildings and monuments has been documented. More than 89% of all Canadians live in areas with high acid rain-related pollution.

It has been estimated that about 50% of the sulphate deposited in Canada is derived from sources in the U. S. About 40% of nitrogen oxides come from transportation (cars, trucks, buses, trains), about 25% from thermoelectric stations, and the balance from other industrial, commercial, and residential combustion processes. Scientists have estimated that a cut of 80-90% of sulphur emissions is required to prevent further damage to the Swedish environment. Pollution from car vehicle exhausts can be reduced if catalytic converters are fitted. These devices are fitted into the exhaust system of the car and change the harmful nitrogen oxides and other pollutants into less polluting carbon dioxide, nitrogen and water. However they will only work with lead free petrol.

Buses and trains make more efficient use of fuel then private cars. One litre of fuel will carry a person: 6 kilometers in a large car (driver only), 9 kilometers in a small car (driver only), 50 kilometers in a bus with 40 passengers and 55 kilometers in a train with 300 passengers. CONCLUSIONWe have looked at acid rain in various forms and how it contributes to be very harmful and destructive. Some action has been taken

to reduce sulphur dioxide emissions in the seven most eastern provinces that is a first step in the right direction.

There are other ways to reduce the amount of sulphur dioxide getting into the atmosphere such as, sources of coal and oil naturally low in sulphur can be used. Sulphur can be removed before the fuel is burnt. Smoke can be washed with a slurry of lime.

Everyone can do something to reduce pollution. We can save energy by not wasting hot water, turning off lights when they are not needed, reducing central heating thermostat by a couple of degrees, using cars when it is really necessary, taking cans, paper and bottles for recycling, making sure washing machines are used only when there is a full load. If we continue to ignore acid rain as a series problem and do nothing about it, as a result more fish well die, more trees will die, water will become contaminated, it will affect animal life, as well as human health.