THE DISTRIBUTION OF AIR POLLUTION IN CANADA: EXPLORING INJUSTICES

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ABSTRACT

The environmental justice movement initiated an interest amongst academics to explore this topic empirically. Researchers attempted to determine if harms attributed to pollution and toxic wastes were disproportionately distributed to poor minority groups. This thesis explores air pollution exposure and its relationship to socioeconomic status in a Canadian context. A brief discussion on current social, economic, and political factors and its relationship to corporate violence and environmental victimization is also included. This study asked two questions: Who are the victims of environmental injustices and does current Canadian policy have any effect on the distribution of air pollution. Using exploratory spatial data analysis and multiple regression, environmental injustices were not found. However, data shortcomings prevent certainty to such conclusions. The power that corporations have on agenda setting influences current data quality. Therefore, further research is needed.

Keywords:

Environmental Justice, Canadian Environmental Policy, Corporate Violence, Offences Against the Environment, and Distribution of Air pollution.

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INTRODUCTION

Millions of people around the world are affected by pollution and environmental degradation. It is suspected that pollution attributed-human injury, including death, far exceed the number of injuries and death caused by violent crime (Burns & Lynch, 2004). After ten years of dumping "more than 20,000 tons of toxic chemical waste onto the Love Canal near Niagara Falls, New York" there is evidence to suggests that the company responsible, Hooker Chemical, "knew of the problem as far back as 1958 but chose not to warn local health officials of any potential problems" (Simon, 2002: 10). A clean up cost in excess of 50 million dollars justified the suppression of this information (ibid: 10). Not only did the people in the area suffer financial strain due to low property values, but they also suffered major health related harms, such as birth defects (ibid: 10-12). According to Burns and Lynch (2004), this type of victimization occurs around the world and occurs more frequently than we might imagine (3).

Research has shown that this harm, in many cases, is spatially correlated with low socioeconomic neighbourhoods (Cutter, Hodgson, & Dow, 2001: 29). In addition, the "lower" socioeconomic segments of society are exposed to more traditional types of crimes compared to those "higher" on the socioeconomic scale (Morenoff, Sampson, & Raudenbush, 2001). Thus, the poor are not only subjected to socioeconomic privation but also are more susceptible to the consequences of both environmental and traditional crimes. The main purpose of this study is to explore the demographics of people victimized by environmental harms within a Canadian context.

Implicit in recent federal government environmental policy discourse is an attempt to identify and ensure that the distribution of environmental harms is not a discriminatory practice based on class or race. The 1999 amendments to the *Canadian Environmental Protection Act* (CEPA) have included some elements to ensure that those of lower socioeconomic status are not unfairly burdened with pollution exposure. Thus, this study will address both the prevalence of environmental injustices, and will explore the impact the CEPA amendments to sustainable development policy have had on environmental victims.

Injustices and Criminology

Today's socio-political and global economic structure facilitates industries to produce and distribute harmful pollution. However, attempts to develop global, uniform tax regulation and environmental laws, and the drive to maximize profits, challenge the highly valued notions of national sovereignty and democracy. National policies to address pollution thus are at a disadvantage in an era of globalization, in which everything affects everything else (Strong, 2000: 33). Unrestrained corporate and government activities can exacerbate the deliberate contamination of our land, water, and air by (ibid: 33). Canada is not immune from such activity.

Unregulated and/or poorly enforced regulation of toxic substances contributes to environmental harms. These "substances...are highly resistant to natural processes of degradation... as they disperse through" our physical environment (Benidickson, 2002: 233). The pollutants percolate through the food chain causing permanent ecological change, which in turn disrupts and cripples the benefits of biodiversity. This transformation creates an unstable environment where the current quality of human life

will not be sustainable. Despite the mass destruction pollution and toxic substances pose to human life, criminologists have largely ignored the relationship between environmental harm, social segregation and the development of policy.

Environmental harms are often not identified as crimes seriously addressed by government, media, law enforcement agencies, or the public, despite the devastation they might cause. From a criminological standpoint, it is necessary to explore the relationship between harm and socioeconomic status to appreciate the impact that social climate has on the definition of crime and the continuous victimization (regardless of its source) towards those of lower socioeconomic status. It is also important to understand current legislation on these environmental and social matters and to determine if the amendments of the 1999 *Canadian Environmental Protection Act* (CEPA) affect environmental victimization. Without policy addressing these important issues, how can Canada promote an equitable, safe, and sustainable environment?

Although criminal sanctions concerning pollution do exist (Benidickson, 2002; Paehlke, 1995), there appears to be reluctance on the part of many criminologists to explore these events (Lynch, Stretesky, & McGurrin, 2002: 109). One possibility for this reluctance is partly due to the debate surrounding the definition of crime. The scope of crime in its traditional discourse typically includes only behaviours considered a "true crime". Additionally, polluting is not seen as wrong in itself (malum in se) but rather it is seen as an act that is simply prohibited (malum prohibitum). As such, some criminologists would rather accept the traditional view of crime and leave the study of environmental harms to other academic disciplines. The premise set for this thesis

suggests that crime is socially defined and that environmental harm and its subsequent victimization must be included within the criminology paradigm.

Chapter One provides an overview of the history of environmental justice and key concepts associated with injustices. Chapter one will also provide a brief review of social structure and its relationship to environmental justice and issues surrounding corporate violence and environmental victimization.

Chapter Two reviews current literature concerned with the empirical study of environmental justice. An examination of the methodological issues presented in previously completed research on environmental justice will also be discussed.

Chapter Three provides the framework for understanding environmental policies that relate to environmental justice initiatives. These policies include government's attempt to create sustainable development initiatives. More specifically an examination of Canadian policies throughout time, in addition to the recent amendments to the *Canadian Environmental Protection Act*, will be thoroughly discussed. Lastly, the relationship between corporate power and agenda setting will be revealed.

Chapter Four describes the methods used to explain the research question. Included in the methods chapter, a description of variables used, data gathering techniques and statistical measures is explained. Chapter Five systematically identifies the results of the thesis, while Chapter Six discusses the results. In addition, Chapter Six will outline the limitations of the study and where future research should focus. Finally, the Conclusion will reflect on the entire thesis and discuss pertinent issues that this study was able to identify.

CHAPTER ONE:
ENVIOMENTAL VICTIMIZATION

Conceptualizing Environmental Justice

A basic understanding of justice could include terms such as equality and fairness (Nagel, 2002: 95). Thus, to understand the idea of environmental justice one should consider the concepts of equality and fairness. Environmental justice incorporates a holistic prospective which looks at all disadvantaged groups who lack the power to change current conditions. Initially the concept of environmental justice was narrow in scope but today it encompasses a variety of initiatives (Draper & Mitchell, 2001: 93-94). The concept of environmental justice, "includes the equal distribution of environmental benefits which includes the provision of access [to decision making and] is....seen not only as being about stopping 'bads', but about promoting 'goods' and being able to experience quality environments and environmental quality," (Bullard, 2002: 34). The Environmental Protection Agency in the United Sates has defined environmental justice as:

> Fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including racial, ethnic, or socio-economic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies (Bullard, 2002: 37-38).

Within the environmental justice frame, there are two additional concepts that should be considered. Environmental racism reflects the ideas that discrimination occurs

in the decision making process related to the siting of waste facilities and pollution causing industries (Draper & Mitchell, 2001: 94). This discrimination is based on a community's racial composition with nonwhite individuals being exposed to more pollutants and toxic wastes than white individuals. Environmental equity is a term used to describe the fair and "equal treatment and protection for various racial, ethnic, and income groups under environmental statutes, regulations and practices" (Draper & Mitchell, 2001: 94). This equity must be seen in the procedures of environmental policy, regulation, and enforcement. The various forms of environmental equity include: procedural, geographic, and social equity (Bullard, 2002; Draper & Mitchell, 2001; Jerrett, Eyles, Cole, & Reader, 1997).

Ensuring that environmental regulations and rules are uniformly applied to all groups of people is the essence of procedural equity (Bullard, 2002: 38). This term reflects the need for all groups to receive equal protection from environmental injustices (ibid: 38). Geographic equity ensures that land used for pollution causing industry and toxic waste facilities are not based on discriminatory practices (ibid: 38). Lastly, social equity looks at sociological factors associated with the decision making process of land use, environmental law enforcement, and policy development (ibid"38). Thus, social equity suggests that those of lower socioeconomic status should enjoy equal access to safe working environments and clean living environments (ibid: 38). It is important to note that much of the environmental justice literature looks at equity as analogous to equality. In other words these concepts are used interchangeably (Jerrett et al., 1997: 1781).

The History of the Environmental Justice Movement

The environmental justice movement has emerged as a dominant force in revolutionizing policy throughout the last few decades (Dawson, 2000: 28-29). The strategy, which combined the civil rights initiatives with environmental issues, gave the movement great appeal at the grassroots level (ibid: 29). This enabled a resilient grassroots force to emerge resulting in a policy transformation that addresses inequalities relating to toxic exposure (ibid: 29). The environmental justice movement can be linked to the 1982 Warren County civil rights group which protested against a hazardous waste facility in a predominantly African American neighbourhood in North Carolina (Dawson, 2000; Sexton, Olden, & Johnson, 1993; Stephens, 1996; Szasz & Meuser, 1997). The people in this community rose-up against the government's plans to build a toxic dump site in their community in which its location would be just feet away from a major water source (Rosen, 1994: 214-215). This political mobilization and protest began the environmental justice movement.

Environmental justice issues were also being raised beyond the United States. The public's exposure to the injustices that were occurring around the world increased the commitment to this movement. A tragic example of injustice occurred in Bhopal, India in 1984. A leak from a pesticide plant in Bhopal killed four thousand people and injured many others (Pearce & Tombs, 1993: 192). "In their desperate struggle for foreign investment and technology" it is argued that India allowed corporations to ignore environmental regulations just to have capital come to their countries (Pearce & Tombs, 1993: 206). This incident caused great concern for many of those in the world living near

similar toxic sites. Bhopal and Warren County are only a two examples of environmental exisits

> Politically, the frame rests on the idea that environmental allocations often result from processes where different groups have unequal power. Groups with less power, as measured by resources and knowledge, have less influence on the policy process that allocates pollution over space than wealthier and better educated groups. Socially, the frame tries to deal with preventing anyone from becoming a 'second-class' citizen by having to live in a contaminated community. Economically, the frame highlights how poorly defined property rights allow individuals and firms to transfer costs, unpriced, through common property environmental media. Geographically, the frame taps into an older tradition of assessing the economic and behavioral factors that influence the location of noxious facilities, which can be defined as those facilities needed within a region, but generally unwanted by the residents of a particular site. In essence the frame covers most aspects of society, including cultural norms and values, rules, regulations, behaviors, policies, and decisions in support of sustainable communities (Jerrett et al., 1997: 1781).

In addition, this framework looks beyond the medicalization of the effects of environmental degradation, and takes into account the overall structure of society, its morals and values, including the principles of democracy (Loh & Surgerman-Brozan, 2002: 112). In other words, it looks at harms not just as a health issue but also as a social issue. The frame also incorporates sustainable development (J. Agyeman, Bullard, & Evans, 2002; Fritz, 1999). Thus, it recognizes the economic, political, and social challenges to sustainable development and attempts to address these challenges in a fair way that promotes sustainability for all global citizens (Fritz, 1999: 185). However, the ultimate goal of the environmental justice frame is to change the current power structure of society in order to foster a more equitable approach to the distribution of power (Loh & Surgerman-Brozan, 2002: 114).

One underlying theory of why environmental inequalities exist lies in the political and economic disparities present in society. Health problems, that occur due to environmental degradation and pollution exposure, may result from "deeply rooted social injustices based on race and class" (Loh & Surgerman-Brozan, 2002: 111). Loh and Sugerman-Brozan (2002) emphasize that:

> By connecting environmental struggles to racism and poverty, the movement has brought the environment onto a broader social justice perspective. By addressing root causes, the movement seeks not to distribute pollution equally but to fundamentally transform the way that we produce, consume, and govern (113).

These inequalities in pollution distribution are the result of the "complex web of social relations" and not from one single factor (Buzzelli, Jerrett, Burnett, & Finklestein, 2003: 558). The dynamic interface between social, economic, and political life creates a challenge in determining culpability in environmental harms and environmental justice. However, environmental harms do constitute a serious and criminal matter. Sections 272 to 286 of the Canadian Environmental Protection Act describe the punishments for those that contravene any part of the Act including a provision specifically addressing corporate accountability. With pollution exposure predominantly initiated by industry and corporate officials, considering the issue of corporate violence is relevant when examining environmental injustice.

Corporate Violence and Environmental Victimization

Corporate Violence

While this thesis does not attempt to empirically test the relationship between corporate violence and environmental victimization, the inherent relationship between

pollution exposure and corporate behaviour warrants a brief discussion surrounding this issue. In general, violence as described by Stretesky and Lynch (1999), is a consequence of the "unjust use of power" which will lead to "physical injury, disease or disability" (168). Violence can be categorical, reflecting the different outcomes of harms. Violence can be direct, indirect, repressive, and/or alienating (Salmi, 2004: 56-59). Violence in relation to environmental harms and injustices can be distinguished as an indirect form of violence. This is illustrated as either violence by omission or mediated violence (ibid: 57-58). Violence by omission can comprise the "lack of protection from physical and[/or] social violence" by corporate bodies (ibid: 57-58). This violence, while indirect, suggests that corporations do not prevent the harmful consequences of certain actions. Mediated violence describes a premeditated action resulting in negative consequences injuring "the natural or social environment" (Salmi, 2004: 58). Salmi (2004) further explains that the harmful consequences of mediated violence are "indirect and often delayed" (ibid: 58). Mediated violence could describe an event where air pollutants are released in such a way (i.e. not abiding by regulatory guidelines) that will inevitably cause harm. Since industry by proxy of their very existence contributes significantly to environmental harms corporate violence and environmental injustice do share a relationship. Even though this relationship is debated, understanding its potential existence provides a framework for further study. As such, criminology should pay close attention to the victims and perpetrators of such environmental harms and with this, the environmental justice perspective provides a good "conceptual starting point" (South, 1998: 217).

Environmental Victimization

In order to have a victim there must be a cause and effect relationship (Williams, 1996a). Environmental victimization is caused by "a presence or absence of chemical, physical, micro-biological, or psycho-social environmental factors, resulting from individual or collective human act[s] or omission[s], over any time-scale, of which the consequence is human injury" (ibid: 23). In addition to looking at the cause and effect relationship, "environmental victims...must...be distinguished from environment[al] casualties" (ibid: 19). A casualty implies some sort of 'chance,' whereas a 'victim' represents a consequence of a deliberate act or omission that causes some form of suffering (ibid: 19).

The term 'environment' in the context of victimization is comprised of four components: the chemical makeup, the physical layout, the micro-biological composition and/or the psychosocial structure (Williams, 1996a: 19-22). Environmental victims, thus can be defined as:

> Those of past, present, or future generations who are injured as a consequence of change to the chemical, physical, microbiological, or psychosocial environment, brought about by deliberate or reckless, individual or collective, human act or act of omission (ibid: 21).

While the consequences of chemical, physical and microbiological environment change are important, understanding the changes to the psychosocial environment is significant when discussing power and victimization. The transformation of the psychosocial environment can in part be attributed to the manipulation and abuse of power which corporations exert when engaging in environmentally harmful activities

(Williams, 1996a: 30). The consequences of such psychosocial environmental harms can include:

> ...family disruption; alienation...reduced marriage and employment prospects...a perception that life has no future; social apathy; community and personal abandonment; loss of confidence in social institutions; 'denial' of the victimization; false norms; economic dislocation; local and domestic conflict; skills deficit; migration; increased criminality...; and a breakdown of traditional structures for community management (Williams, 1996b: 30).

Humans, unfortunately, may be seen as an exploited commodity in the name of growth and prosperity (South, 1998). The conditions in society that reflect an overemphasis on production and profit will result in neglected environments. The contamination of the land, air and water generate a changed environment. This transformed environment, through the decay of biodiversity and the exposure of harmful pollutants, will ultimately cause human injury and victimization.

Estimates of the harm done by air pollution suggest that each year between 50,000 and 60,000 deaths in the United States occur as a result of "particulate pollution from manufacturing plants" (Potter & Miller, 2002: 21). Unfortunately, as indicated within the definition of mediated violence, much of the harm is gradually incurred, and as such the victims of such harm are not immediately identifiable. In addition, the social reality of such harms does not permit the true devastation caused by such behaviour to be adequately evaluated.

It also has been argued that violence towards the polluters and/or towards fellow community members in the form of environmental terrorism, can also be a consequence of environmental victimization. The case of Wiebo Ludwig provides a compelling example of the deadly violence injustices can create (Nikiforuk, 2002). Although there is

no empirically tested relationship between environmental victimization and retributive violence towards the offenders, understanding such behaviour may provide insight into why some extremists retaliate and fight environmental injustices by perpetrating violence.

Besides psychosocial harms and environmental terrorism, environmental injury can take other forms, most notably human illness. Human health is exposed to the dangers of cancer causing agents through air, water, and land pollution. The degree of causation between pollution exposure and illness is far from concrete; however, with the changing physical, chemical, and microbiological environment, there seems to be a strong correlation between pollution and adverse human health effects. Pollution can cause not only illness related health concerns, it can also create negative behavioural consequences. Some studies have found that neurological damage due to pollution exposure can perpetuate violence and criminal behaviour (Denno, 1990; Edwards, Edwards, & Fields, 1996; Hays, Esler, & Hays, 1996; Masters, 2001; Stretesky & Lynch, 2001). Exposure to certain heavy metals can damage the parts of the brain responsible for impulse control, thus creating increased impulsivity in exposed individuals, which can consequently restrict their ability to control aggression and violence (Denno, 1990: 5). A cycle of violence within the disadvantaged neighbourhoods may therefore be perpetuated.

Other forms of harm can take the appearance of 'environmental blackmail' (Bullard, 2002; Simon & Hagan, 1999; White, 2003). This term suggests that those communities with limited economic opportunities are blackmailed into having pollutant-emitting factories in their neighbourhoods in exchange for the economic incentives such factories generate. Thus, residents must make a choice: a clean environment or economic

survival. The acceptance of environmental blackmail and other associated harms suggests a "loss of trust and confidence in business leaders and politicians [which] further erodes democratic free enterprise systems, and feeds cynicism and apathy" (Snider, 1991: 210). Such indifference can erode the cohesiveness of a community and nation, which in turn can influence further social degradation.

Environmental harm has been argued to be the result of current power differentials and socioeconomic disadvantages with the victimization being socially patterned (Simon, 2002; Simon & Hagan, 1999: 36; White, 2003). In other words "the dynamics of environmental harm cannot be understood apart from consideration of who has the power to make decisions, the kinds of decisions that are made, in whose interests they are made, and how social practices based on these decisions are materially organized" (White, 2003: 496). As a result, those with less power will likely be the targets of environmental harms, while those with the power will be the creators of such harms (Burns & Lynch, 2004; Simon, 2002). Because power is arguably linked to the quantity and quality of resources afforded to an individual or group of individuals, it may be asserted that those with less power will only have access to lower quality education, health care, and other vital social services. As Simon and Hagan (1999) illustrate, "the victims of hazardous toxic-waste scandals are [also] those with the least access to sanitation, health education, and health care" (37).

It is the socially disadvantaged that are the victims of environmental injury (Bullard, 2002; Burns & Lynch, 2004; Krieg, 1998; Pellow, 2002; Simon & Hagan, 1999; White, 2003). Those who have little power, fewer resources, lack strong financial support, and are of non-white origin, may be more exposed to environmental harms than

those in higher socioeconomic position. These populations already suffer from social adversity, inadequate nutrition, economic strain, and workplace pollution; thus, the victimization from environmental harms is yet another burden that the less powerful and economically underprivileged have to confront (Jerrett et al., 2001: 957). However, if First World nations continue to consume the majority of the world's resources, and with this consumption continue to mass produce, pollutants will eventually travel into the affluent, elite, and middle-class white communities where they will also have to confront environmental contamination of their homes, neighbourhoods, and workplaces (Jerrett et al., 1997; Pellow, 2002; Seis, 1999)

CHAPTER TWO:
ENVIRONMENTAL JUSTICE - A REVIEW OF EVIDENCE

Three studies emerged from the 1982 Warren County protest, which sparked an entirely new field of interest combining environmentalism and human rights. These three important studies[1] confirmed the presence of "environmental inequality" which focused on, "race as the main, if not only, inequality of real interest" (Szasz & Meuser, 1997: 101). These studies, however, were not the first of their kind, as a small number of economists in the 1970s wanted to see "if there [was] a relationship between economic status and exposure to polluted air" (ibid: 101). These earlier studies concluded that income, not race, was found to be the significant factor in patterns of air pollution and exposure (ibid). Thus, the poorer you were the more likely you would experience a greater share of air pollution. More recent literature maintains that there are four general factors that influence pollution exposure and the consequential injuries: ethnicity and race, class, political mobilization, and exogenous factors (Lester, Allen, & Hill, 2001: 3).

Methodological Issues

It has been argued that much of the environmental research, at least until recently, has suffered severe methodological flaws (Bowman, 1997; Jerrett et al., 2001; Szasz & Meuser, 1997). Most studies only look at one temporal component and reflect little on

[1] US General Accounting Office (1983). Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities. Washington, DC.; United Church of Christ Commission for Racial Justice (1987) Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites. & Bullard, R. (1983) *Solid Waste Sites and the Black Houston Community.* Sociological Inquiry, 53(spring/summer) 273-288.

how such inequalities happen (Lester et al., 2001; Szasz & Meuser, 1997). Also, most research only looks at one dependant variable, such as waste facilities or pollution emissions, to address the prevalence of environmental injustices (Lester et al., 2001: 18). It is also suggested that the majority of current research only utilizes one unit of analysis[2] (Lester et al., 2001: 18). These issues can question the reliability of the research and limit the study's generalizability (Bowman, 1997: 169).

In addition to methodological flaws, there is discrepancy amongst the research as to the prevalence of environmental injustices, and if injustices do exist, there is disparity concerning which factors (i.e. race, income, political mobilization, market dynamics, and/or occupation) are associated with increased exposure. The differences in the research continue to develop as more advanced methodological techniques are applied (Bowman, 1997: 168-169). For example Bowman (1997) suggests that during the 1970s, before the environmental justice movement was established, "there was analytical evidence [to support] the disproportionate impact of environmental bads" (Bowman, 1997: 163). As research methods improved during the 1980s, studies began to demonstrated that "[d]ensity affects the impact of a [pollution causing] facility even in areas with the same proportional characteristics" (Bowman, 1997: 164). However, these earlier demonstrations of injustices also concluded that minority populations were "the 'best' explanation" for toxic waste sites and exposure (Bowman, 1997: 166). Most of this early research was based on case studies and even though such studies are invaluable for exploratory research they cannot be generalized to the population as a whole (Lester et al., 2001: 14). As research methods started to incorporate sophisticated software and

[2] For example, research tends to focus on either zip code areas or census tracts within a county or state. It is suggested by Lester et al. (2001) that research must include both zip code areas and census tracts in relation to states, counties, and cities.

statistical tools, the 1990's research displayed varied conclusions of environmental injustice and race and/or income. Studies during this time started to see other variables, such as occupation, as having a strong relationship with pollution exposure (Bowman, 1997:168).

Lastly, establishing a direct causal relationship between toxins and injury is complex and typically inconclusive (Sexton et al., 1993: 695). It is difficult for such research to make causal links because, "the well known fact [is] that poor minorities are generally in poorer health - because of poor nutrition, lack of access to health care, high social stress and other factors related to poverty," (Szasz & Meuser, 1997: 112) thus maintaining that pollution may not be the sole cause for the human injury. In addition, the old cliché, *which comes first the chicken or the egg*, applies. In other words, is industry attracted to low income areas, or are low-income populations attracted to areas with inexpensive land due to the presence of pollution causing industry. This quandary is further hindered by the lack of data (Sexton et al., 1993: 717). Consequently, caution should be used when examining the empirical evidence. However, regardless of these challenges, there is enough empirical evidence to suggest that socioeconomic status, injury, and exposure to pollutants are negatively related (Sexton et al., 1993: 722).

The Research

The majority of the research suggests that environmental injustices are occurring in North America and there is evidence that such injustices are occurring to non-white individuals. It is also argued that these injustices can further segregate racial and ethnic minorities in addition to generating further social and economic disadvantages (Stretesky & Lynch, 2002: 554). Stretesky and Lynch (2002) contend, "serious environmental

hazards influence neighbourhood disadvantage over time, increasing both racial and ethnic segregation and poverty" (554). In addition to the environmental injustices that may be present in poorer communities, if these injustices are also associated with schools located in these communities this may bring about community disorganization (ibid: 554-555). As a result, crime, drug use, and other issues associated with poverty will emerge (ibid: 554). They theorized that, "schools near environmental hazards will become increasingly non-white over time [and] if this is the case, environmental hazards may be the 'trigger' for a series of social events that perpetuate school segregation and racial inequality" (ibid: 554). The study analyzed environmental hazards and school locations in Hillsborough County, Florida from the years 1987-1999. Using cross sectional and multivariate analysis, the study found that "schools more proximate to hazards are becoming more black segregated over time while schools that are less proximate to environmental hazards are becoming increasingly white segregated" (ibid: 568). The same conclusion was also found with the Hispanic populations, thus, providing evidence that race is correlated with environmental harms.

Krieg (1998) also found a relationship between race and pollution exposure. By incorporating a historical view into the research design Krieg (1998) assessed the association between race, income, and "the percentage of each town's tax base comprised of commercial and industrial taxes," with overall exposure to toxic pollutants via pollution causing facilities (12). The population sampled was Boston and the surrounding region. The findings suggest that "toxic waste sites are most likely to be found in communities that collect a large percentage of their total tax base from commercial and industrial sources, regardless of which region they are located" (Krieg,

1998: 16). However, after controlling for the tax variable, "race [produced] the strongest association with a partial correlation of .57 ($p = .02$) " (ibid: 15-16). Even though sitings of industrial facilities may have much to do with tax issues, this study demonstrates that nonwhites are exposed to pollution more than their white counterparts.

Lester, Allen & Hill (2001), in their book *Environmental injustice in the United States: myths and realities,* try to correct many of the methodological concerns presented in previous environmental justice research. As a result, they use a multidimensional analysis, including various units of analysis over time and space, in addition to utilizing more than one exposure variable (ibid: 2-5). Their analysis also concludes that race is positively correlated with environmental injustices. With 86 percent of the race based analyses, the study found that Blacks were more likely to be exposed to injustices in some form or another (Lester et al., 2001: 152). With respect to the Hispanic population, only in 50 percent of the results was this population correlated to environmental injustices (ibid: 154). However, it was also found that "in poorer Western counties with low fiscal capacity, Hispanics are [more] likely [than Blacks,] to be confronted with incidences of environmental injustice" (ibid: 154).

When looking at health risk, pollution exposure, and race, there is evidence to suggest that race and ethnicity are positively correlated with cancer prevalence. An analysis of cancer risk and outdoor air pollution was conducted on 1990 data in Southern California (Morello-Frosch, Pastor, & Sadd, 2001). This study found that cancer risk was greater amongst ethnic and racial minorities (ibid: 562). "Given that air toxics are predominantly urban problems, it is not surprising that the variables most highly correlated with lifetime cancer risk is population density" (ibid: 565) and since a large

proportion of African Americans, Latinos and Asians live in urban centres, it is predictable that these populations are at a greater risk of developing cancer. Conversely, "Anglos are more dispersed, with significant numbers living in less urban areas, [therefore their] risks are lower" (ibid: 562). This emphasizes the underlying premise of environmental justice, signifying that injustices are related to the wider socio-political and economic structures.

Been and Gupta (1997) attempt to address two issues previously discussed in the environmental justice literature regarding injustices and the siting of pollution causing facilities in non-white communities. The first issue they address is whether waste facilities are "placed deliberately in minority neighborhoods" (Been & Gupta, 1997: 4). Second, if they are not deliberately sited in those neighbourhoods, then do waste facilities contribute to making the neighbourhood more desirable for minorities, due to economic incentives (ibid: 7). No evidence was demonstrated that siting was motivated by the presence or absence of minority populations. However, there was a statistically significant positive correlation between siting of waste facilities and working class and lower class populations. With respect to their second question, there were no substantial changes in the socioeconomic makeup of the community nor did the ethnic or racial composition change. However, the study did show that "the areas surrounding TSDFs [(commercial hazardous waste treatment storage and disposal facilities)] currently are disproportionately populated by African Americans and Hispanics" (ibid: 9).

Rather than pollution-causing facilities or toxic waste sites as the dependant variable, a study conducted by Stretesky, Johnston & Arney (2003) examined large scale hog farm operations and their proximities to the American Black and Hispanic

populations. It is suggested that with the expansion of the farming industry into large scale operations, adverse health effects, specifically within the Hog farming sector, are becoming apparent (Stretesky, Johnston, & Arney, 2003: 234). Stretesky et al. (2003) hypothesized that, "[s]ince power relations among counties impact the distribution of industrial development, a county's racial, ethnic, and economic makeup are likely to play a role in the location of large-scale hog operations" (235). The study found evidence that a "disproportionate placement of large-scale hog operations in Black communities [occurred] during the 1980s and the 1990s, but only in states where large-scale hog production is dramatically expanding" (ibid: 244). Therefore, it can be inferred that there is a relationship between race and the siting of large scale Hog operations in the United States, especially in areas that Hog farming is expanding at exponential rates.

Lastly, using a GIS-based analysis Chakraborty's (2001) study identifies which social factors are associated with high levels of pollution exposure in Hillsborough County, Florida. Unlike other studies done in the environmental justice area, this study looks at "worst case risk surfaces" and the relationship between poverty and race (Chakraborty, 2001). In other words, in the event that there was an accidental release of toxins from legal waste facilities, what population of people are more likely to be exposed to the harmful effects of such an incident? Chakraborty (2001) utilizes dispersion models to study the spatial connection of chemical exposure and socioeconomic status at the census block level. The study found that, at the 0.01 level of significance, a positive and significant correlation with exposure of accidental pollution release and race did exist.

While there is empirical evidence to suggest that race plays a significant role in determining one's likelihood of becoming a victim of environmental harm, other socioeconomic factors also play a significant role. In particular, low income families tend to be exposed to pollution more so than middle and upper class families. For example in addition to race, Chakraborty (2001) also found a positive significant correlation with "the degree of worst case exposure and the relative proportion of impoverished residents" (892).

A study conducted by Asch and Seneca (1978), also found environmental inequalities in the United States. The analysis used census tract data and air quality to determine, from a sample of states, if environmental injustices were prevalent. The results of this study showed "that lower income individuals generally are exposed to poorer air quality conditions" (Asch & Seneca, 1978: 281). In addition, the poor were overrepresented in areas that did not comply with air pollution standards. There was also evidence to suggest "[e]xposure to particulate matter is relatively higher in cities with low-income characteristics, whether measured by income level, income distribution, or the poverty tail of the distribution" (Asch & Seneca, 1978: 282). Other variables, such as low education levels and highly dense populations, which may be associated with income level, were also correlated with lower air quality (ibid: 283). A similar finding was discovered by Morello-Frosch, Pastor & Sadd (2001). They found a negative relationship with home ownership and cancer risk instigated by outdoor air pollution (Morello-Frosch et al., 2001: 565).

Cutter, Hodgson, and Dow (2001) expand on traditional environmental justice variables to include public housing as a possible correlate with pollution exposure. Public

and assisted housing is also a variable related to income level. Analyzing "Public and Indian Housing projects" of eight metropolitan areas in the United Sates, the study concludes that those people living in assisted housing, compared to their low-income counter parts that do not live in assisted housing, are more likely to be exposed to toxic facilities (Cutter et al., 2001: 32). By utilizing spatial and temporal methodologies in "five of the eight study areas...[t]he mean cumulative proximal exposure (CPE) of the HUD [(assisted housing)] families is statistically greater (at the $p>.01$ level) than the mean of non-HUD poor" (ibid: 36). In suggesting that not all poor communities, in the same state, county or city, are exposed to the same level of disproportionality calls into question the extent that the macro socio-political and economic context of society plays in environmental justice. Further analysis as to why such differences between similar populations exist needs to be undertaken.

Only a few studies on environmental justice have been conducted in the Canadian context. One of these studies examined air pollution in Hamilton, Ontario and its relationship with socioeconomic factors. Utilizing spatial statistics, the study found that the most significantly correlated variable to exposure of air pollution was dwelling value (Jerrett et al., 2001: 969). The relationship was not only significant but it was also an inverse relationship. Thus, as dwelling value decreases air pollution increases. Two other variables that were also significant were low income and unemployment; however, "these results varied depending on whether the model took spatial autocorrelation into account" (ibid: 969). The authors conclude, that the results demonstrate that groups in lower socioeconomic position "experience higher exposure to environmental pollutants" (ibid: 970).

A second Canadian study looked at air pollution and income in the Province of Ontario. The study's premise was if "lower wages attracted more polluting firms, pollution would continue to increase until the point where it began to exert significant welfare losses on individuals" (Jerrett et al., 1997: 1793). When these welfare losses start to materialize demands for higher wages will increase. There will be a point where industry will refuse to pay the increases and move out of those higher income areas to lower income areas. Therefore, air pollution may be related to modest income levels and not the low income areas per se. This "represents a kind of market-driven compensation for lower environmental quality" (ibid: 1793). The study found "that location of polluting facilities is determined slightly more from a general pattern of urban and industrial development than from discrimination against poor groups" (ibid: 1794). However, the study also found that dwelling value was negatively associated with air pollution exposure. It is suggested that the dwelling value does indeed "support the inequality hypothesis" (ibid: 1794). Dwelling value arguably represents someone's actual permanent income as opposed to fluctuations represented in yearly census income data. Dwelling value, thus "represents a capital investment based on the ability to pay over the long term" which can be argued as a measure of "lifetime average income" (ibid: 1794). Based on this hypothesis it can be argued that as permanent income decreases, pollution increases. Thus, environmental injustice was found to occur in relation to poorer communities in Ontario.

In addition to race and income, the premise behind the environmental justice frame is that those without power and resources are likely to be victims of pollution. As a result, it is argued that the more a community is actively involved in decision making,

the less likely they will be exposed to environmental harms and injustices, regardless of other socioeconomic factors. However, little empirical research has paid attention to this variable. Lester et al. (2001), in their multidimensional analysis, found that political mobilization and exposure to pollutants were not correlated (149). In other words, regardless of how politically mobilized a community is towards environmental justice issues, it does not affect the rate of exposure. However, before a conclusive link can be supported or negated more research needs to analyze this variable.

There has also been empirical evidence that environmental injustices are not present in North American societies, or if they are present, the variables correlated with such injustices are debated. For instance a study conducted by Anderton, Anderson, Oakes, and Fraser (1994) found no evidence of environmental injustice in the United States. The study was concerned with the dumping of toxic waste in relation to demographic factors, namely ethnicity/race, income, and occupation. This study uses census tract data for the unit of analysis to avoid aggregation errors. To identify the dumping sites, a database was constructed using commercial waste facilities defined as, "one which is privately owned and operated and which receives waste from firms of different ownership" (Anderton, Anderson, Oakes, & Fraser, 1994: 232). This definition is consistent with previous research. The variables used were: black persons, Hispanic persons, families living below the poverty line, households receiving public assistance, males in the civilian labour force, employment in manufacturing and industry, and the value of housing. These variables were chosen in order to be consistent with prior research. Employing t-tests and Wilcoxon rank-sum tests no statistical difference was found except for the labour force variable. Logit regression analysis was also conducted

to control for the labour variable. The results indicate no change from the study's initial findings, that ethnicity/race and income are not related to toxic waste exposure.

Using spatial and temporal analysis and applying ArcView and S-Plus software, a study conducted by Buzzelli, Jerrett, Burnett, and Finklestein (2003) found imperceptible relationships between income and exposure to air pollution. The study used variables associated with socioeconomic status and air pollution data to illustrate the prevalence of environment injustices in a Canadian city. The results indicated that environmental injustices were present in Hamilton, Ontario (R^2 .60). However, only one variable, dwelling value, was significantly correlated with air pollution exposure. This relationship grew weaker with time (Buzzelli et al., 2003: 566-568). Thus, in the 1980s (when their first temporal analysis begins) the statistical significance for dwelling value and exposure to air pollution was great; however, during the study's last temporal stage (in the mid 1990s) the statistical significance weakened. Thus, over time injustices based on socio-economic status became less evident.

A quasi–meta analysis conducted by Bowen (2002) suggests that all American high quality studies demonstrate that no statistical significance has been found between race or ethnicity and exposure to harmful toxins (11). However, there are regional studies that suggest income is a more likely indicator of exposure to pollutants. The conclusions are based on reviewed empirical evidence surrounding the occurrence of environmental justice. He categorizes the studies into three levels of quality; high, medium, and poor (Bowen, 2002: 6-9). Each study is rated based on methodology and scientific grounding in addition to the study's ability to contribute to policy formation. High quality research is such that its methods, including design and documentation,

enable accurate research to be generalized to the broader population. Medium quality research is categorized as such because of its substantial methodological flaws, regardless of the plausibility that the information may be accurate, that would cause speculation regarding the generalizablity and thus policy potential of such studies. Poor quality research was seen as only serving a political agenda and based on false or suppositional claims. Poor methodologies or documentation could be to blame for the inability of many of these studies to provide reliable and valid results. However, Bowen (2002) acknowledges that more high quality environmental justice research needs to be undertaken. Therefore, generating unsubstantiated conclusions from current research should be cautioned (12-13).

With the emergence of the environmental justice movement, the United States has seen a proliferation of environmental justice research, while Canada, until recently, has largely ignored such issues (Jerrett et al., 2001; Szasz & Meuser, 1997). While many empirical studies have shown that environmental victimization exists more commonly amongst already disadvantaged groups (see Stretesky & Lynch, 2002; Krieg, 1998; Lester, Allen Hill, 2001; Chakraborty, 2001; Asch & Seneca, 1978 and Jerrett, Burnett, Kaoaroglou, Eyles, Finkelstein, Giovis, 2001) the body of empirical studies on this issue are still inconclusive. While some studies suggest that race is the predominate factor associated to pollution exposure other studies suggest that income or political mobilization, not race, has a more significant relationship with pollution exposure. The review of the literature clearly demonstrates that there is no consensus on weather environmental injustices do exist. In addition, if there is consensus on the existence of

environmental injustices there is disagreement concerning what variables are associated to such injustices.

CHAPTER THREE:
A POLICY REVIEW: ENVIRONMENTAL JUSTICE AND SUSTAINABLE DEVELOPMENT

Before exploring the world of policy, pollution and environmental injustice, it is important to review the basic terms associated with such issues. Environmental justice and its relationship to equality and fairness are described in both the process of decision making and the outcomes of environmental harms. Environmental justice, as iterated throughout this thesis, identifies disadvantaged groups as lacking the power to change current conditions. This is largely based on socioeconomic position and the influence such standing has on law and policy. More specifically, these groups lack the influence to change any policy and corresponding law that may affect trade relations and market growth. Trade and economic prosperity are two major concerns when talking about sustainability and environmental protection.

The concept of environmental justice is about "being able to experience quality environments and environmental quality" (Bullard, 2002: 34) across all socioeconomic groups. Unlike Canada, the United States has fully endorsed this line of thinking within its environmental protection mandate. The United States' Environmental Protection Agency has clearly set environmental justice within its agenda and has made it policy to protect disadvantaged citizens from disproportionate exposure to environmental harms (Bullard, 2002: 37-38). Further, the American Environmental Protection Agency has adopted environmental justice policy and formulated into law to ensure justice is

maintained. As will be further explored, Canada lacks this recognition, specifically with respect to environmental policy and sustainability.

Sustainable Development

Environmental policy typically revolves around the idea of sustainable development. The convergence between environmental justice and environmental protection is seen in their overlapping dedication to sustainable development. The term 'sustainable development' spread rapidly since its construction at the World Commission on Environment and Development (WCED) in 1987 (Benidickson, 2002: 18). Sustainable development has since become an objective that the world is aiming to achieve (ibid: 18). Sustainable development involves meeting the needs of *all* humans by asserting that these needs must be met without risking the needs of future generations (ibid: 18). In addition to this, it must take into account economic progression (ibid: 18). Thus, a balance must be made between environmental stability and economic development.

There have been three theories regarding sustainable development and its incorporation into the policy process (Vos, 1997: 4). All three approaches have emerged due to the historical relationship between the empirical study of the environment and the greater political and economic agenda. The "neoclassical economist" perspective signifies the first school of thought (ibid: 5). This perspective views the environment as a resource for economic growth. The view suggests that sustainable development is primarily concerned with economic growth resulting in a cost benefit analysis of environmental protection (ibid: 7-10). Thus, by adequately pricing the environmental cost in relation to the free market, sustainable development will be ensured (ibid: 7-10). For instance, as resources become more expensive due to limited surplus, the market will

demand that alternatives be explored. The high price of current resources will invoke demands for alternative sources, thus ceasing current high rate of depletion. This approach may also be classified as a "soft" discourse of sustainable development (Agyeman et al., 2002: 81). The "soft" approach argues that the depletion of resources is acceptable so long as technology at some point in the future can provide substitutes for those resources (ibid: 81). This would suggest that the market is responsible for, and will encourage technological advances, ensuring continued economic growth. This neoclassical economist interpretation of sustainable development has been the primary interpretation successfully adopted by "Agenda 21" at the Earth Summit in Rio de Janerio in 1992[3] (Vos, 1997: 7). Sustainable development policy using a market driven approach to solve environmental problems is predominately advocated within the right of centre approach, and neither criminalization nor regulatory accountability is the preferred action (Paehlke, 1995: 309)

The second supposition of sustainable development is approached from an "ecological-science" model (Vos, 1997: 5). Unlike the neoclassical economist perspective, this paradigm suggests that the environment has limits and as such, there are calculable rates at which degradation can and will occur (ibid: 5). Thus, sustainable development would include identifying these rates and determining how natural resources can be obtained without threatening the ecosystems that ensure human survival (ibid: 6). Also differing from the neoclassical economist approach, the ecological-science model reflects a "hard" sustainability. This approach suggests that resources should not be taken from the environment faster than they can be replaced (Agyeman et al., 2002: 81).

[3] The Earth Summit and Agenda 21 are discussed later in this thesis at page 43.

The last theory identified by Vos (1997) is the "deep-ecological" perspective (6). This approach to policy development emphasizes the need to address the relationship between nature and the human race. This ideology looks at the ethical and moral issues related to environmental exploitation. The belief suggests that sustainable development requires social structural change. This change would reflect a new appreciation, respect and value to nature (Vos, 1997: 16-17). Policy guided by this thought would initate an acceptance of providing rights to all organisms. This understanding suggests that we have a moral obligation to the environment to protect it from destruction. This philosophy is based on the idea of interconnectedness and the influence each action has on every thing in life. Thus, this view looks beyond human harms and injustices and values harms to the environment with as much significance. As a response to policy based on these ideals, the deep-ecology perspective may advocate for more criminalization of environmental harms (Paehlke, 1995: 320).

While none of these perspectives addresses environmental justice specifically their underlying premise will dictate the acceptable level of *risk*, whether it is financial damage or physical harm. These approaches are not exclusive and a balance may be struck if one considered a centrist approach to environmental harms and sustainability. This view recognizes that a few economic elites (industry leaders) are primarily accountable for the current environmental distress[4] and environmental injustices. A centrist approach also acknowledges the responsibility each human has in the contributing to the harm (Paehlke, 1995: 310) This view may pave a way to justifying a more egalitarian approach to sustainable development policies. This perspective would

[4] As in the deep-ecological approach.

use both the market as a tool for compliance but also recognize that regulation (ibid: 310), even criminalization, are necessary to ensure environmental protection. This approach does not deny accountability but accepts our responsibility without rejecting a market society. Hence a centrist perspective provides a viable solution in a capitalist world. However sustainable development is achieved (i.e. maintaining biodiversity, protecting the intrinsic value of nature via providing rights to nature, or even just to protect the "critical natural capital"), sustainable development is a universal realism (Dobson, 1998: 39). With regularly attended conferences on issues of the environment and sustainability, sustainable development is arguably a universally accepted and necessary goal and is currently embedded in Canadian policy

However, sustainable development has been very broadly defined and, as a result, it has evolved to include an array of "social, economic, and environmental concerns" (Dobson, 1998: 19). It is within this dynamic of social, economic and environmental interdependence that the nexus between environmental justice and sustainability is realized and it is this relationship, in which environmental justice and sustainability are constructed within policy. Environmental injustice is a symptom of the greater need to protect the environment and ensure sustainability. It may also be a catalyst to the current environmental predicament. Over an extended period, an "unjust society is unlikely to be sustainable in environmental or economic terms" (Agyeman et al., 2002: 84). For instance, it is known that corporate bodies seek out inexpensive production costs and by so doing the poorer nations will sacrifice environmental standards for corporate capital. Thus, the poor communities will not only feel the disproportionate affects of environmental destruction but will also prevent sustainable initiatives. For poor

communities to compete, the market encourages lax regulations in turn ensuring that inequality will continue to be felt. Those communities that can afford environmental protection can benefit from both economic prosperity and environmental health while the poor will have to sacrifice environmental protection and sustainability for present economic gain. Thus, the fight becomes about current economic prosperity rather than economic and environmental sustainability. By incorporating social equity within the broader economic concerns, sustainable development has a greater chance of success.

Canada and Sustainable Development Policy (prior to 1999)

There are a few important concepts addressed within Canadian policy on environmental matters. First, conservation can be used synonymously with prevention, and is a way in which sustainability can be achieved (Benidickson, 2002: 16). Second, the ecosystem is an interconnected network of beings. This network cannot survive with out the complete "integration and interaction among living and non-living elements" (Benidickson, 2002: 17). In other words, one species cannot exist without the other. Two other relevant concepts identified in the Canadian environmental discourse of policy is the "polluter pay" and "precautionary principles" (Benidickson, 2002: 21). First, the polluter pays principle reflects the idea that those that pollute are deemed accountable for the harms. Second, the precautionary principle suggests that substances need to be scrutinized until science[5] declares (Markowitz & Rosner, 2002: 163) otherwise rather than the reverse. These principles have strong implications on how Canada views the seriousness of environmental destruction. However, Canada's attempt to utilize these

[5] Science is also largely dictated by corporations. The funds that they allocate to research even in the public sector (i.e. research grants); can create biases that have favourable outcomes for the corporations.

concepts to effectively achieve sustainable development goals is debated (Benidickson, 2002: 24).

Historically, talk of the environment has not been in relation to development. Rather environment and development have been discussed as a 'one or another' perspective (Sanger, 1993: 154). Even with the implementation of the Brundtland Commission, which was the first attempt in Canada to address sustainable development as a national issue, the struggle to see environment and development as interrelated issues was evident. The Brundtland Report includes as its summation that "'inequality is the planet's main environmental problem" (Dobson, 1998: 14). The report also exemplified environmental problems by showing that while the GDP (Gross Domestic Product) was on the rise, environmental degradation was enormous in scope and economic growth was not going to be sustainable (Hoffman, 2000: 282). The Brundtland Commission also failed to meet the objectives of sustainable development (Sanger, 1993: 158).

In addition to the Brundtland Commission, the 1980's saw many other environmental policies emerging in Canada (Dobson, 1998: 14) The Canadian International Development Agency (CIDA) was able to enact sustainable development policies, which included all the customary issues needed to address environmental concerns and economic growth (Sanger, 1993: 158). The CIDA is primarily concerned with global sustainable development initiatives (n.a., 2004) and the factors that they aim to incorporate within their policy include: economic, political, environmental, social, and cultural issues (Sanger, 1993: 158). Agencies such as the CIDA recognized that environmental concerns were indeed part of a country's economic growth and thus development and environment were no longer autonomous. To enforce policies

concerning development and the environment a global attempt was seen in the Law of the Sea Accord. This United Nations Convention, signed by Canada in 1982, was an attempt to balance economic growth with environmental degradation. While the policy was maintained, the law to support such initiatives failed (Sanger, 1993: 158). Many countries only "implemented those parts of the convention that suited their needs" (Sanger, 1993: 158).

The Earth Summit of 1992 in Rio has been suggested to be the "true" starting point in which sustainable development become a priority in government and business operations (Sanger, 1993: 160-164). It wasn't until 1992, the same year as the Earth Summit, that Canada's policy required environmental stability when development is proposed (Sanger, 1993: 162). Since the establishment of Agenda 21[6], and the events at the Earth Summit, CIDA has contributed millions of dollars to meet the objectives set forth by those events (ibid: 162). Since 1992, Canada has become much more accepting of non-government organizations (NGO's) and their involvement in the policy process (ibid: 166). However, little evidence is present that may suggest these groups indeed make change within environmental policy (ibid: 167-168).

However, evidence seems to suggest that Canada has not really "[shifted] towards [a] regulatory-integration and pollution-prevention theme endorsed by the Brundltland Commission" (Rabe, 1997: 416). It also suggests that Canada has made little progress in the area of sustainable development (ibid: 417). Reducing the nation's debt has proceeded to have an impact on sustainable development initiatives. Many budgetary cuts have weakened enforcement measures and have depleted testing facilities and human

[6] Agenda 21 is a "Declaration of Principles" generated from the Earth Summit talks (Strong, 2000: 193). These principles are aimed at ensuring social, economic and environmental sustainability in the face of development (n.a., n.d.).

resources, elements that are necessary for sustainable development policies to be effective (Draper & Mitchell, 2001: 95). Canada's inclination to maintain the status quo, consisting of a fragmented state with pollution control, and not pollution prevention, at the forefront of environmental policies, hinders policy implementation (Rabe, 1997: 515, 517-518). Ever since the Brundtland Commission "actual" policy improvement and change have been on the back burner; yet talk concerning sustainability has continued to receive great attention by government (ibid: 417). The United States has had more innovative policy strategies, which has enabled them to make greater strides towards preventing pollutants from entering the environment than Canada's (ibid: 431).

As already mentioned, the fragmentation in Canada, between the provinces and the federal government, immobilizes an effective implementation of environmental policy (Rabe, 1997: 417). Another weakness in Canadian federalism is that, unlike its American neighbours, Canadian federal policy has less authoritative power over the provinces to ensure sustainable development initiatives are being met. In addition, Canada's lack of public access to information and data concerning pollution, which has been one of the chief influences in fundamental policy change both in the United States and in some parts of Europe, has hindered valid policy mobilization (Boyd, 2003; Rabe, 1997: 419). Canada has only recently started ensuring reliable measures regarding toxic emissions and environmental quality. The federal government has made a strong argument suggesting its commitment to sustainable development, but there is no evidence to suggest that any substantial policy change has occurred (Rabe, 1997: 429). The federal government's actions, if any, are seen as symbolic.

It appears that both on a provincial and federal level, economic concerns are at the forefront of policy initiatives whereas environmental concerns are not a priority (Rabe, 1997: 416-417). This in large part is due to the state of the economy and its direct correlation with a politician's success (Boyd, 2003: 265). Canada's resistance to change is also evident when compared to our Southern neighbours. Canada's reluctance to regulate practices involving environmental concerns which would support environmental policy, and the lack of access that the multiple stakeholders have to the policy arena prevent great strides in sustainable development (Rabe, 1997: 432-433).

Canada and Sustainable Development Policy (After 1999)

Canada's current sustainable development policy reflects many concerns (see Figure 1). These concerns include equity, global responsibility, health, equality of life, and natural resource maintenance. When discussing environmental justice issues, what is of importance is Canada's acknowledgement of equity issues in sustainable development policy. What does it mean to promote equity? (Government of Canada, 2002). A two-dimensional commitment to equity comprises both the relationship, "between the current generation and those that will follow and between the poor and the more affluent" (Government of Canada, 2002: ¶1). One of the current goals within Canada's sustainable development policy is to ensure a fair distribution of sustainable development outcomes. The Government of Canada (2002) states, "domestically, the principal challenge is to extend the benefits of our economic prosperity and high quality of life to a broader segment of the population while maintaining the fundamental integrity of our ecosystems" (¶3). Addressing such factors as gender, poverty, provincial impacts,

and First Nations people are just a few of the variables Canada is trying to incorporate in sustainable development policies (Government of Canada, 2002).

Figure 1: Canada's Sustainable Development Objectives

Canada's Sustainable Development Objectives	=	• Promoting equity • Improving Quality of Life and Well-being • Sustaining Our Natural Resources – Sustainable Jobs, Communities and Industries • Protecting the Health of Canadians and of Ecosystems • Meeting Our International Obligations

(Government of Canada, 2003)

Environmental Protection Act (1999)

Sustainable development policy in Canada is represented in "environmental statutes or Bill of Rights [and through the appointment of] Environmental Commissioners or Ombudspersons (Draper & Mitchell, 2001: 94). After Rio, sustainable development became an issue government could not ignore. With that, it was necessary to amend the 1988 *Canadian Environmental Protection Act,* one of the fundamental legal works for implementing sustainable development policy into law. It is Canada's mission to ensure that our environment is sustained for future generations and this mission claims to understand that social, economic, and environmental issues are all inter-connected (Environment Canada, 2004b). As a result, the primary piece of legislation that promotes sustainable development is the amended *Canadian Environmental Protection Act*, 1999 (CEPA) (see Appendix A).

When reading the CEPA's preamble, the incorporation of sustainable development issues and environmental justice issues are evident in its policy. The

preamble states that, "cooperation with provinces, territories and aboriginal peoples, [are needed] to achieve the highest level of environmental quality [for] **all** Canadians [which will] ultimately contribute to sustainability..." (*Canadian Environmental Protection Act*: 2). This statement reflects the need to ensure that **all** people receive a high level of environmental quality. In addition to the aforementioned statement, the preamble also discusses the required application of scientific and traditional knowledge in the decision-making process and an emphasis on the interdependency of social and economic factors is relevant and necessary (E. Canada, 2004a). Thus, socio-economic issues are important when decisions are made in relation to the protection of the environment and human health. Canada's position on sustainable development policy seems to recognize, as do environmental justice advocates, the relationship between social factors, economic factors, and environmental protection. However, Canadian policy and the resulting laws to enforce that policy have not adopted an explicit commitment to environmental justice concerns at the national level. The CEPA only implies such issues as a component of sustainable development policy.

Upon further examination of the CEPA, 1999, environmental justice is not a priority within the Act's mandate. Not once is environmental justice addressed in the CEPA's annual report[7]. There is some mention of public participation and consultation with respect to environmental concerns, but its obvious lack of importance is reflected in only three pages reporting on public participation of 72. In addition, concerning the prevention of environmental damage/pollution, neither socio-economic concerns nor distribution of harms is mentioned in the report. Human health is of concern, but it is

[7] Environment Canada (2004a). *Canadian Environmental Protection Act, 1999 annual report: April 2002 to March 2003*: Government of Canada.

clear that this concern is only general in nature. The report states, "The Act allows the Minister to require any persons to prepare and implement a pollution prevention...plan to avoid or minimize pollution and wastes and to reduce the *overall* risk of the environment or human health" (E. Canada, 2004a: 23). In addition, there are still roughly 23, 000 substances that Canadians are exposed to, which have not been "assessed for the risks that they pose to human health or the environment" (E. Canada, 2004a: 29). While these substances are identified, it is evident that the precautionary principle is inadequately emphasized. This lag in understanding the consequences of potentially deadly substances suggests that the damaging effects are largely under represented. If these effects are felt disproportionately by the less privileged, the harm could be even greater than currently identified.

The final example of Canada's lack of sufficient commitment to sustainable development policy within the CEPA is the lack of enforcement power. The CEPA (1999) allows the federal government to take many actions against violators including prosecutorial measures (Benidickson, 2002; Boyd, 2003; Environment Canada, 2004a: 61). Regardless of such actions, Boyd (2003) claims that "enforcement agencies are more likely to prosecute small companies or individuals despite the fact that their levels of pollution pale in comparison to major industrial polluters" (238). In addition to enforcement issues, some of the standards set are only "guidelines and[/or] codes of practice" (E. Canada, 2004a: 5). Measures set forth by the CEPA, 1999 can also be null and void if "by Order in Council...a province, a territory or area under jurisdiction of an Aboriginal government" has equivalent measures in place (E. Canada, 2004a: 8). This

allowance removes a federally standardized enforcement strategy, which could ultimately diminish the effectiveness of Canada's sustainable development policy.

Protecting the environment is a challenge for many nations. Within a federal state such as Canada, this challenge is a result of the conflict surrounding jurisdictional responsibility (Alvazzi del Frate & Norberry, 1993: 7). However, compared to our southern counterparts, it is evident that the federal government has given great freedom for provincial ownership in the regulation of their own environmental matters (Rabe, 1997: 419). There are three reasons why Canada likely allows such freedom to exist (Boyd, 2003: 262). First, is the fear of the separatist movement in Quebec. The more the federal government can stay out of Quebec's affairs the better. Second, the fear of impeding economic prowess amongst provinces provides pressure on the federal government to stay out of the management of each province's natural resources (ibid: 262). Lastly, the top agenda item for the federal government is the national deficit. All of these factors restrict the federal government's ability and/or willingness to address environmental matters seriously (ibid: 262). In addition, there is substantial duplication of environmental authorities and law thus abating sustainable development policies. In order to address these concerns, the federal government has passed the responsibility to the provinces by introducing environmental harmonization agreements (ibid: 241 & 262). These agreements have lessened the role that the federal government plays in ensuring environmental protection, again subjecting sustainable development polices to inadequate application and enforcement (ibid: 242).

Power and Agenda Setting

While environmental degradation may be a reflection on the consumer society, with all of us to blame, it still needs to be identified that large corporate bodies and industry leaders provide great influence on what matters are deemed important. It is also essential to understand that these groups ultimately dictate what products are available to us, thus directly impacting the country's ability to meet policy objectives. Seis (1999) argues that free trade agreements are in favor of profit gain by corporations even if democracy is at stake (293-295). The General Agreement of Tariffs and Trade (GATT), The North American Free Trade Agreement (NAFTA), and the World Trade Organization (WTO) ensures that governments trying to disallow trade, even if it is for the protection of consumers and/or the environment, can be victims of a lawsuit indicating "violations of free trade" (Seis, 1999: 295). The WTO, an executive branch comprised of corporate and government elites, maintains enforcement power over rules of free trade (Seis, 1999: 295:296). The goal is to allow trade, unhindered, to flow freely between nations (Seis, 1999: 296). This necessitates that transnational corporations need to have unbridled access to the market, thus maximizing their profits even in the face of undemocratic and harmful results. The reality of the WTO's power is exemplified in cases where governments, in the best interests of their citizens, have been financially "blackmailed" into allowing dangerous pollutants to enter their nations. These free trade agreements largely dictated and enforced by the powerful elites, deteriorate sustainable development policy.

Canada's stance on MMT[8] is an international example of how NAFTA and other corporate regulated groups can undermine local environmental policy. By banning this substance for import, a lawsuit against Canada from an American firm that made MMT, was brought forward (Boyd, 2003: 258). Ethyl Corp sued for financial damages the ban initiated. As a result the ban on MMT, which was placed because of the dangers it could pose to human health, was removed (ibid: 258). As indicated previously, the power transnational corporations possess helps to define a global world.

Within Canada, corporate bodies and industry leaders have enormous control over environmental policy and regulation. For instance, in Canada, Boyd (2003) argues that the Canadian Council of Chief Executives (CCCE) are the most influential group on "environmental law and policy" (253). This CCCE is made up of "150 CEOs from Canada's largest corporations" (ibid 253). Boyd also argues that it was this group that mandated revisions that weakened the 1999 amendments to the CEPA (254). The power these groups hold over sustainable development initiatives is supported by looking at the National Pollution Release Inventory Working Committee (NPRIWC) designed to address what pollutants are monitored. Public participation in determining what chemicals are to be reported is limited to sending in a request for review to the NPRIWC.

The working committee is principally made up of industry leaders, government officials and NGOs (non-government organizations). However the role of the NGOs is primarily for observation purposes only (n.a., 2005e: 5). The ultimate deciders on what chemicals are deemed important enough for reporting are government and industry. In the 2004 report, it was decided not to include a known carcinogen, RCFs, to the NPRIs

[8] A manganese based additive to gasoline.

list of reported substances. Despite the fact that this substance is a track II substance[9] and there is expressed disappointment from the NGOs, the "onerous" costs to business to monitor the release was deemed too exorbitant, thus RCFs was not included on the NPRI substance list (n.a., 2005e: 8 & 10). Obviously, the substances are viewed in light of any economic hardship placed on the company. This example is a reflection of the federal government's inability to not only enforce the polluter pays principle but also the precautionary principle. The influence that Industry has on government will diminish the effectiveness of policy aimed to address sustainable development. At the provincial level this influence is even greater (Boyd, 2003: 255). Provinces take corporate concerns very seriously because they depend heavily on capital generated from industry (ibid: 255).

Environmental Policy: Justice and Sustainable

If the markets are left to ensure sustainable development policies are effective, the inequality of pollution distribution and unhindered development will flourish. Many agree that allowing the markets to "solve our problems" is insufficient (Hoffman, 2000: 283). Thus regulation and even criminal sanctions need not only to be incorporated into law but also need to be strictly enforced (Hoffman, 2000: 283) to ensure sustainable development objectives set forth by policy are met. It is not enough to suggest to companies that they have a moral obligation to protect the environment, rather it needs to benefit the corporation and their shareholders in a financial way (Friedman, 2000: 286). By government "hitting the companies over the head with...regulations and...tax

[9] Track II substances are one of two primary concerns of the CEPA, 1999. These substances, even though they are not up for total elimination, are seen as toxic to human or environmental health or may have the potential to be harmful to human or environmental health. It is acknowledge by the CEPA that it is essential to track these substances "throughout their entire lifecycle, to prevent or minimize their releases to the environment" (Environment Canada, 2003: section 4.1.2)

incentives to be green, and with the SEC telling companies they have to start accurately portraying their environmental liabilities to shareholders – such as where they are being sued for dumping and what cleanup could cost" a change in corporate operations could be evident (Friedman, 2000: 286-287). This is exemplified in a comment made to CBC's Fifth Estate (2005) by Brian Parkinson from the International Chambers of Shipping. Parkinson assures the viewers that ship breaking[10] is a purely profit driven industry and if the harm caused by ship breaking was important, government would pass laws to prevent such harms (2005). According to him, this is not a priority of government and only with the establishment of prohibitive laws would it indicate a strong governmental stance on the ship breaking industry and the harm it causes. Unfortunately, the harms associated with ship breaking tend to affect the more impoverished peoples of the world such as India and Bangladesh. It is also interesting to note that North America's largest ship breaking companies are located in Laneville Texas, an area with a high population of poor Mexican peoples (2005).

While environmental degradation is accepted as an issue of sustainability, as exemplified in the Fifth Estate Report, justice is also an issue of sustainability. Furthermore, some argue that understanding environmental injustices is a function of addressing sustainable development concerns (Agyeman & Evans, 2004: 160). First, sustainability is both a social and environmental matter (ibid: 160). Understanding social justice as a cause of environmental instability will enhance sustainability measures (ibid: 160). Thus, sustainability is more about environmental protection which speaks to the political milieu. (ibid: 160). Inequality inhibits sustainable measures to be fully embraced

[10] Ship Breaking is the recycling of old out of service ships. Most of these ships contain toxic pollutants including large quantities of heavy metals (Burke, 2005).

as it prevents a collective ability to achieve sustainable development goals (ibid: 160-161). In addition environmental justice initiatives give more power to the populace in making their environment clean and safe. Consequently, without employing human agency in the formation of policy, it is unlikely that sustainable development will be able to be maintained (Hoffman, 2000: 281). Environmental injustices, thus are undeniably associated to both environmental protection and sustainable development.

CHAPTER FOUR: METHODS

Issues of Study

This study follows in a similar fashion as previously conducted empirical examinations of environmental injustices. Data from the Western provinces of Alberta and British Columbia are analyzed to explore the relationship between pollution exposure and socioeconomic status. Two main questions are addressed by this study. First, are those of lower socioeconomic position exposed more frequently to pollution causing industry than those of higher socioeconomic status? Second, did the amendments of the 1999 CEPA have any effect on the spatial dispersion of pollution causing industry and subsequently the population being harmed by such facilities? Since the Act promotes sustainable development rhetoric and the auxiliary issue of equity, any injustices that occurred during 1996 should decrease in the 2001 data. Related questions answered include:

- Are there provincial differences between exposure and socioeconomic status?
- What, if any, policy implications do the results have?

There are two parts to this study's methodology. Part I, Who Are the Victims?, reflects the analysis concerned with victimization and pollution exposure. Part II, The Effectiveness of CEPA Policy Objectives, identifies the research design associated with

the policy analysis portion of this study. The parts are interdependent and as such cannot necessarily be analyzed separately.

Part I: Who Are The Victims?

Examining two time points, 1996 and 2001, and incorporating spatial analysis, a cross-sectional method explores the relationship between socioeconomic status and pollution in order to address the first question in this study. Spatial representation allows visual depiction of the data, while statistical analyses provide a quantitative description of possible relationships. The spatial analysis provides a visual interpretation by displaying the information on maps and spatially dependent graphs. This interpretation of the data reveals if the pattern of pollution facilities is clustered or dispersed. Geographical Information Software (ArcView 9.0) assists in visually mapping the point (pollution facilities) data. SPSS software is utilized to run the statistical analyses.

Variables

Dependent variable

In keeping with current environmental justice literature, the dependent variable is pollution exposure. The hypothesis is that pollution exposure is dependent on socioeconomic status and those that are in a lower socioeconomic group will be exposed more frequently to pollution than other socioeconomic groups. Much of the literature utilizes only one measure for pollution exposure and within the Canadian context, the

measure has consisted primarily of air pollution.[11] In keeping with previous research, pollution exposure is measured using on-site air releases of pollutants. These data were generated through the Canadian National Pollution Inventory (NPRI). Rather than using pollution levels, this study uses pollution sites as a proximity based measure for pollution exposure. Proximity based methods assume that the population sited around a pollution causing facility will be exposed to the same degree of pollution as all those that are in the pre-defined geographical boundary situated near the facilities (Jerrett et al., 1997).

Independent Variable(s)

The independent variables, which are those describing demographic information, were acquired through the Canadian Census of 1996 and 2001. Socioeconomic status is defined by variables consistent with previous research and include 1) rate of low income, 2) average household income, 3) highest level of education completed, 4) rate of aboriginal peoples, 5) dwelling value, 6) unemployment rate and 7) rate of visible minority population (see Appendix B). The data were provided through the database, E-Stat via Simon Fraser University's online subscription. In order to standardize the data the variables, in some cases, had to be converted to rates (See Appendix C).

Controlled variable(s)

One variable, population size, is controlled to limit erroneous conclusions. Since census division's geographical boundaries are based on relatively arbitrary criteria and

[11] See Jerrett, M., Burnett, R., Kaoaroglou, P., Eyles, J., Finkelstein, N., CGiovis, C., et al. (2001). A GIS environmental justice analysis of particulate air pollution in Hamilton, Canada. *Environment and Planning A, 33*(6), 955-973; Jerrett, M., Eyles, J., Cole, D., & Reader, S. (1997). Environmental equity in Canada: an empirical investigation into the income distribution of pollution in Ontario. *Environment and Planning A, 29*(10), 1777-1800. & Buzzelli, M., Jerrett, M., Burnett, R., & Finklestein, N. (2003). Spatiotemporal perspectives on air pollution and environmental justice in Hamilton, Canada, 1985-1996. *Annals of the Association of American Geographers, 93*(3), 557-573.

are not bound by population size it is important to reduce fallacious conclusions by standardizing for population size. The population data were standardized to form the rate of facilities per unit area. The formula to calculate this is:

(n facility per unit area/ total population per unit area) × 100,000 = rate per unit area

This eliminated the need to control such data within the regression model.

The Data

National Pollution Release Inventory

The data for the dependent variable were collected through the NPRI, publicly available via the World Wide Web. The NPRI maintains a database tracking the release of pollutants into Canada's environment. The database was developed in 1992 and has since become a feature of the *Canadian Environmental Protection Act*, 1999 (n.a., 2005b). Each year the substances reported to the NPRI change depending on current technological advances and scientific information regarding toxicity and dangerousness of such substance. Chemicals that may be of concern are put forward to a "multistakeholder working group" for assessment. The chemicals included are typically those that have been agreed upon by government and industry leaders (n.a., 2005c: 7-8). In other words, substances deemed to threaten the environment, human health and/or sustainable development initiatives are monitored. This means that the NPRI only includes a portion of chemicals released into Canada's environment. Things such as greenhouse gases and some pesticides are not currently reported to the NPRI. In addition,

"[o]nly facilities that meet established reporting criteria[12] are required to report to the NPRI (ibid, ¶4). Thus, this data do not include all possible harmful pollutants and does not include all possible releases of such pollutants. However, companies meeting the required criteria are legally bound to report their pollution releases and transfers as per the *Canadian Environmental Protection Act* of 1999 (n.a., 2005b).

The dependent variable, represented by air polluting facilities, is publicly available through the database set forth by the (NPRI). The NPRI data contain information concerning where the pollutants are released and how they are released. For example, the data will indicate if the pollution is released at the location of the facility or if it is transported to another location for disposal. The data also describes the pathway in which the pollution is released. The pathways of release include air, land, and/or water.

Two criteria had to be met before a facility was included in the data. Only those facilities that emit pollutants on-site via **air pathways** in the provinces of Alberta and British Columbia were observed (n = 479). Thus, if pollutants were released in any other manner, i.e. on the land, they were not included[13]. In addition, only those facilities that reported latitudinal and longitudinal coordinates for their location were included in the total sample (n = 441). In other words, the data had to contain a geographic reference in order to be mapped correctly using GIS based software. To explore relationships between socioeconomic status, pollution exposure and policy influence, data were gathered from 1996, 1999 and 2001. The two time points, 1996 and 2001, are consistent with Canadian

[12] Those companies that manufacture, process or otherwise use any of the substances listed on the NPRI are required (as of 1999) to report to Environment Canada. However, only those companies that meet a set parameter of employee hours worked and met a set parameter concerning the quantity of a substance based on substance type need to report. These parameters change depending on the substance the companies uses, manufactures or processes (n.a. 2005b).

[13] Air pollution was used to maintain consistency between this study and other Canadian studies.

census data periods. Prior census years would be beneficial for inclusion; however, the NPRI has only recorded data since 1996. The facility data from 1999 was also obtained to capture the distribution of air pollution during the period of the CEPA amendments.

Canadian Census Data

The data that reflect the socio-economic status of the population being studied were obtained from the Canadian Census. Census data were gathered based on the levels of analysis examined in this study (Census Divisions) and are available to Simon Fraser University Students through a subscription to E-Stat data services. Aggregated population characteristics, by census divisions, for Alberta and British Columbia were obtained through the ESTAT database. Census data allow researchers to examine data across both time and space because the boundaries specified and questions asked by the census are relatively consistent. Census data also "provide an accurate account of the population" (Dale, Fieldhouse, & Holdsworth, 2000).

Research Design

In order to address some of the identified methodological flaws with current environmental justice research two time points and one unit of analysis (census divisions[14]) were examined[15] (Lester et al., 2001; Szasz & Meuser, 1997). Census divisions are a clustering of municipalities for the purpose of service administration and regional development (n.a., 2005a). This larger unit of analysis describes regional disparities within provinces, as opposed to neighbourhood differences within urban

[14] British Columbia uses the term regional districts and regions rather then census divisions.
[15] It was also the intent to examine Census Tracts as a second unit of analysis. However, once the data were examined, the significant lack of data points (facilities) at the census tract level, made it impossible for this level of analysis to be used.

centres. Census divisions are relatively stable and the boundary definitions have not changed for the 1996 or 2001 data[16] (n.a., 2003a). By using standard government-designed geographical boundaries, reliability can be ensured.

The facility identification includes accessing the NPRI website and conducting a data search. The data includes all British Columbia and Alberta facilities reporting to the Canadian National Pollution Inventory for the years of 1996 and 2001. Each industry reporting for the years 1996 and 2001 are systematically inspected to determine if:

a) They have reported on-site releases,

b) Those releases were released via the air, and;

c) The facilities report a latitudinal and longitudinal coordinate for their location.

The facility's geographical information was entered into an Excel spreadsheet for easy exportation into mapping and statistical software. Once all facilities latitudinal and longitudinal coordinates were transformed to degrees, the information was imported into ArcView 9.0 to interpret the data using Geographical Information Systems.

The demographic information was retrieved from Census Canada. The information was entered into an Excel spreadsheet, with each year given their own dataset. Once the data were imported and redefined (see section on the Independent variables), the data excel spreadsheets were converted into dbf files for easy importation into the ArcView 9.0 software.

The provinces of Alberta and British Columbia were chosen for two reasons. First, Alberta, similar to Ontario, has "dense point patterns of polluters" (Jerrett et al.,

[16] Some boundary definitions have changed between the years; however, the areas this thesis concerns itself with do not have any changes.

1997: 1785). Comparing a province (Alberta) with densely saturated industrial facilities to a province (British Columbia) with less saturation provides valuable information regarding the reality of pollution exposure and socioeconomic status. Looking at the differences and/or similarities between two distinct provinces will ascertain if injustice are present regardless of facility saturation. In other words, do injustices differ across two fundamentally different spaces? Additionally, the examination may provide insight into why disparities between the provinces do/do not exist. Second, current Canadian research in the area of environmental justice has been reserved for eastern provinces. An explication of environmental justice issues including western provinces will further piece together a holistic representation of the problem within Canada. The inclusion of Western Canada can help to either support or reject the thesis that environmental inequality is present within Canadian society.

The Analysis

The research design utilizes both visual and statistical techniques in analyzing and interpreting the data (see Appendix D). A spatial representation of air pollution causing facilities was generated using visual exploration of the relationship between air pollution facilities and census areas. Utilizing mapping software easily identifies emerging visual clusters and patterns. By incorporating a spatial design, variables are assumed to be "dependent in some way on the locations of the objects being analyzed" (Goodchild & Janelle, 2004: 5). Thus, when analyzing the relationship of facility locations and socio-economic status, the mapping of such incidents provides invaluable assistance. The statistical portion refers to understanding the relationship with socioeconomic factors and pollution exposure. In keeping with previous research (Lester et al., 2001: 70) and thus

ensuring construct validity (Miller & Whitehead, 1996: 185), this study utilizes Ordinary Least Squares Regression analysis to explore this relationship.

Descriptive Statistics

Spatial statistics should be viewed not as a separate tool for analyses but should be utilized in conjunction with classical statistics (Haining, 1990: 4). The two methods, of analysis, spatial and classical, when appropriate should complement each other. As such, this study bridges the two forms of analysis to improve the description of the data. An Exploratory Spatial Data Analysis (ESDA), which is derived "from conventional descriptive statistics"(Haining, 1990: 4) is utilized to describe the data. This method is beneficial for two reasons. First, it puts into context the local features of data, and second this method is not as affected by extreme values compared to classical statistics (ibid: 4). ESDA represents the "data summaries in numerous graphical or pictorial forms" (Haining, 1990: 4).

The visual display of pollution causing facilities, as points on a map, within a predefined geographical region[17] is the primary ESDA tool this research utilizes. Analyzing the distribution of points (in this case facility locations) throughout space is one way to explore the data. While the visual depiction of the facilities will provide some descriptors of where pollution is distributed, it is limited. Thus, to better understand the distribution of the facilities, this study identifies areas that contain a higher concentration of facilities. This is also known as density (see Appendix E). More specifically, this study utilized a Kernel Density calculation. Kernel Density weights the points depending on their proximity to one another. In other words, rather than simply counting the number of

[17] Alberta and British Columbia

points within a cell, points that are concentrated more closely together within a cell are identified as being more spatially dense (Hick, Bair, Fritz, & Helms, 2004: 333).

In addition to the distribution of facilities and the density of those points, a map of facility locations where population was controlled[18] was also produced. Rather then calculating each point's relationship to one another within a given geographic area, Choropleth maps[19] were made to show shaded areas "according to their data values, by either rate or frequency" (Harries, 1999: 115). The maps used natural breaks[20] (also known as Jenks) to define the intervals used. These intervals distinguish areas containing high, medium, or low rates of pollution causing facilities. A table was constructed, based on the Choropleth mapping that describes the socio-economic makeup of each census division as it is categorized having a low, medium, or high rate of pollution causing facilities. The table reports the mean of each independent variable for each rate category (low, medium or high). This spatial exploration of the data determines if further analysis is necessary.

Two drawbacks of ESDA, and more specifically point pattern analysis, need to be considered (Arlinghaus, 1996:129-130). First, is that the relationship only determines clustering of points, without understanding the heterogeneous nature of the geographic area (ibid: 129). Second, the pattern is sensitive to the geographical size (ibid: 130). If the area increases or deceases with no new events (i.e. facility locations) occurring, the

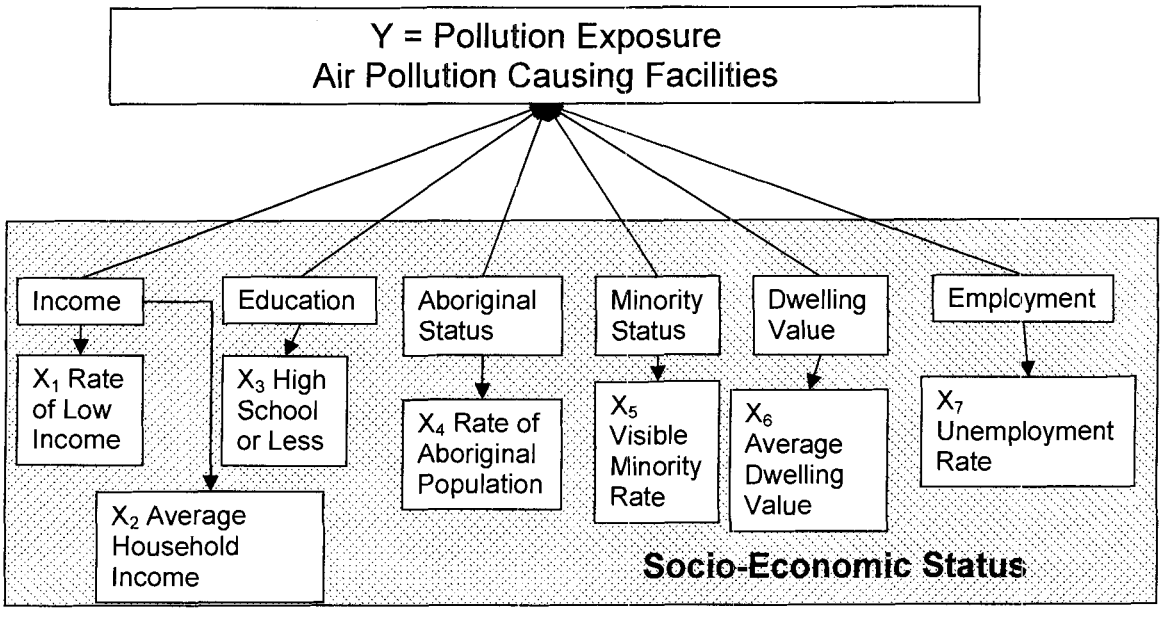
[18] Since census division have very little similarity with respect to geographical size or population size, population was used to standardize the dependent variable.
[19] Maps display quantifiable or themed data aggregated by some predefined geographic boundaries, in this case census divisions.
[20] Natural breaks identify naturally occurring clusters and/or gaps in the data (Hick et al., ; Ormsby, Napoleon, Burke, Groessl, & Feaster, 2001: 136).

results will change (ibid: 130). While the drawbacks of ESDA are inescapable, utilizing classical statistics will not incur the same "geographic" hindrances.

Multivariate Regression

Using Ordinary Least Squares Multiple Regression (Appendix F), the study will identify what socio-economic variables share a relationship with the distribution of air pollution. The regression model used for this thesis is conceptualized below:

Figure 2: Regression Model



Regression Assumptions

A linear regression model measures the change in one unit of the independent variable when the dependent variable also changes one unit. For this to be modelled adequately, there are central assumptions the regression equation makes. These assumptions are critical to any multiple regression application and need to be reviewed in detail before reporting any results of such an analysis. First, the relationship should be

linear. For instance, "the dependent variable is assumed to be a function of one or more independent variables" (Crown, 1998; Garson, 2005a; Pepinsky & Tobin, 2003: 4). Second, variables that should be in the model should not be excluded from the model. However, in social sciences this selection is not always possible. As long as the researcher is aware of the possible biases that could result from excluded variables and ensures all important variables are added to the model (Crown, 1998: 48-49), this assumption can be relaxed. Third, the error value should be "constant for all the values of the independent(s)" (Crown, 1998; Garson, 2005a: 17). This is also known as homoscedastic. The variance should thus be equal across all the error terms. Lastly, the explanatory variables must not share perfectly collinearity. If the independent variables do resemble perfect intercorrelation the model is deemed un-unique. This "makes it impossible for the regression model to decompose the variation of the dependent variable that is due to one variable versus another" (Crown, 1998: 49). In other words, the model cannot differentiate the "the covariation in which the value of the dependent variable is proportional to the value of the independent variable" (Bohrnstedt & Knoke, 1994: 193).

The existence of outliers in a data set can affect the linearity of a relationship. Outliers will skew the data, which ultimately could distort the results and the analysis could thus derive erroneous conclusions. In regression modelling outliers are also known to violate homoscedasticity (Garson, 2005a: 17). This will not drastically affect the regression estimates but may create erroneous conclusions with respect to the t statistic (Crown, 1998: 50) (Garson, 2005a: 17). SPSS offers a casewise diagnostic to identify outliers in a data set, which will be included in the regression output generated by SPSS. Outliers can significantly affect the results of any statistical analysis using measures of

central tendency. Thus, it is exceptionally important to understanding the possible biases when using parametric statistics.

There are a few options available to deal with outliers. The solution to heteroscedasticity caused by extreme values will depend on why the cases exist. Outliers can be removed, transformed, or left in the analysis (Osborne & Overbay, 2004). In the event that the data were uncooperative, an examination of the data at the analysis stage will determine the appropriate action.

In addition to outliers, mullticollinearity is another issue that needs to be addressed before running any regression analysis. Mullticollinearity is a result of the independent variables being highly correlated to each other. The more the independents are intercorrelated the more likely the regression models assumptions of non-collinearity will be violated. Thus, it will disallow the model to understand the uniqueness of each variable and their individual contribution to the explanation of the dependant variable. To test the multicollinearity of the variables SPSS was requested to produce Tolerance and Variance-inflation factor (VIF) statistics. Tolerance suggests that the "higher the intercorrelation of the independents the more the tolerance will approach zero (11)(Olson). If the tolerance is less than .20, the general rule suggests that multicollinearity is a problem (11). The VIF statistic suggests the opposite (Garson, 2005a: 11; Olson, n.d.) in that VIF of more than 4 suggests that "75% of the variance in the independent variables is shared", indicating a multicollinearity problem (Garson, 2005a; Olson, n.d. : 3). The most desirable solution to a multicollinearity problem is to increase sample size; however, this is not always possible (Crown, 1998: 75). The most common way to deal with intercorrelations is to remove variables from the model that are

highly intercorrelated. However, this approach can create an even greater error. The regression model should be a design based on theory and as such, when variables are dropped from the model, the model will be weak. The weakness is created because it is leaving out necessary variables as indicated by theory (ibid: 75). However, if some of the variables are a suggestion of the same idea, it may be reasonable to remove the highly correlated variables. The idea is that one or more of the included variables explains the removed variables inherently (ibid: 75). This thesis uses variables relating to socioeconomic status, so it is expected that some variables may be intercorrelated. The VIF value will be used to determine such correlations and depending on the appropriateness, the variable may be removed from the model.

Part II: The Effectiveness of CEPA Policy Objectives

Research Design

To answer the second issue of this study[21], the policy implications of the 1999 amendments to the CEPA were examined by employing a time-series research design. The results produced by the ESDA for part one of this study are used to explore the legislative effects on pollution exposure and socio-economic status. The point pattern analysis identified by the density maps is used as one measure of change through time. In addition to the 1996 and 2001 data, the facilities reported for 1999 were compiled. The data were mapped and density was calculated. The physical landscape of the environment during the year of the CEPA (1999) amendments provides the frame of reference for a pre and post analyses. The data for pollution facilities of 1999 were generated from the

[21] Did the amendments of the 1999 CEPA have any effect on the spatial dispersion of pollution causing industry and subsequently the population being harmed by such facilities?

National Pollution Release Inventory by the same systematic approach utilized for the first part of the study. To demonstrate if there was any change in the spatial pattern of air polluting facilities, all ESDA techniques are compared between the three years.

ESDA techniques only summarize one aspect of the data. They demonstrate the congruency of pollution causing facilities throughout time yet have no implications for socioeconomic status. Further analysis must take place. This step was done to examine the regression model and Person r statistics to reveal if the CEPA amendments have had any effect on socioeconomic status as it relates to pollution exposure. Even if the locations of pollution causing facilities remain constant, the areas in which they are located may present different attributes over time. The amendments to the CEPA in part may explain any changes that are determined through the time-series analysis.

CHAPTER FIVE:
RESULTS

Part I: Who are the Victims?

1996

Descriptive Statistics

The initial stage in understanding the distribution of the facilities is how they are geographically dispersed. By plotting the x y coordinates of each facility, it is easy to see that many points tend to cluster (See Appendix G). As the kernel density map demonstrates (Figure 3), facilities tend to cluster around major urban centres, specifically Edmonton, Calgary and the Greater Vancouver area.

However, clustering does not tell us the attributes of those areas exposed to air pollution. Actually, once population is controlled for, and the facilities are mapped according to their rate of distribution (Figure 4), the clustered areas are no longer of significant concern. Rather, the areas with a high rate of pollution facilities are not the metropolitan centres. This may suggest that exposure to air polluting facilities may be associated to something other than population size. Rate of pollution causing facilities, and thus pollution exposure, is an important factor to consider as opposed to the count per unit area as it controls for population and assumedly workforce availability.

Figure 3: Density Map: 1996

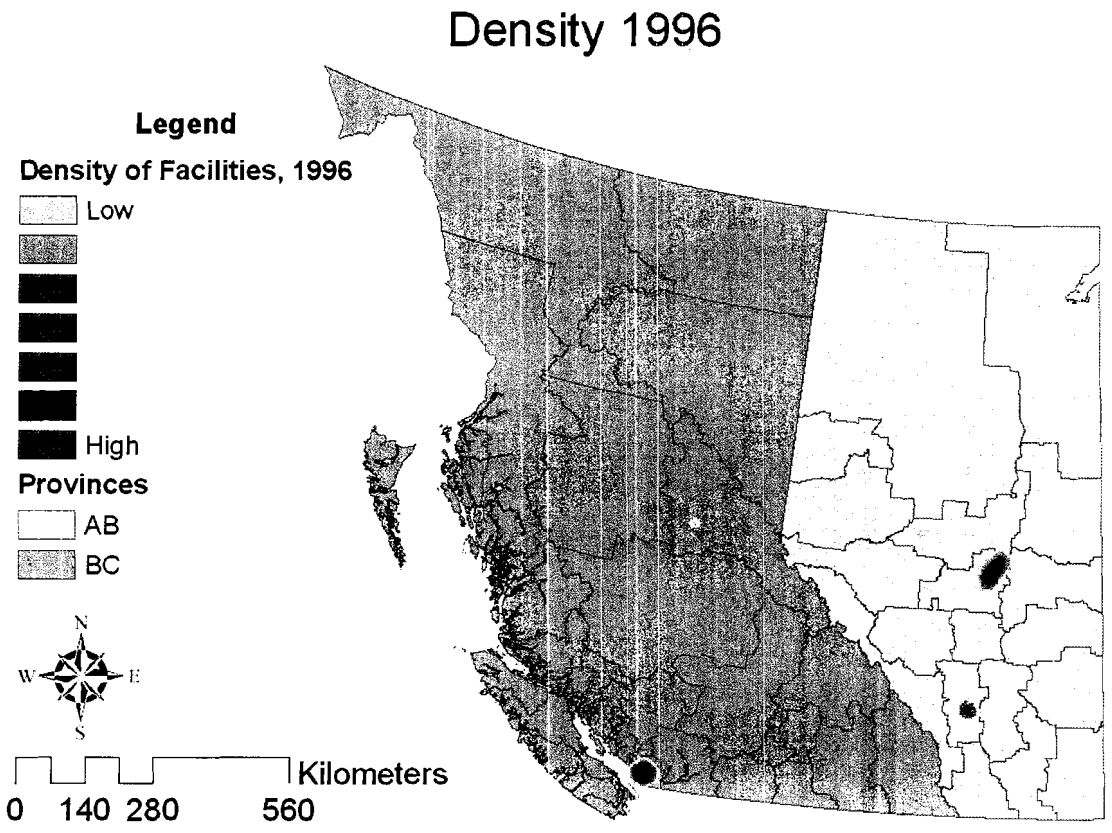
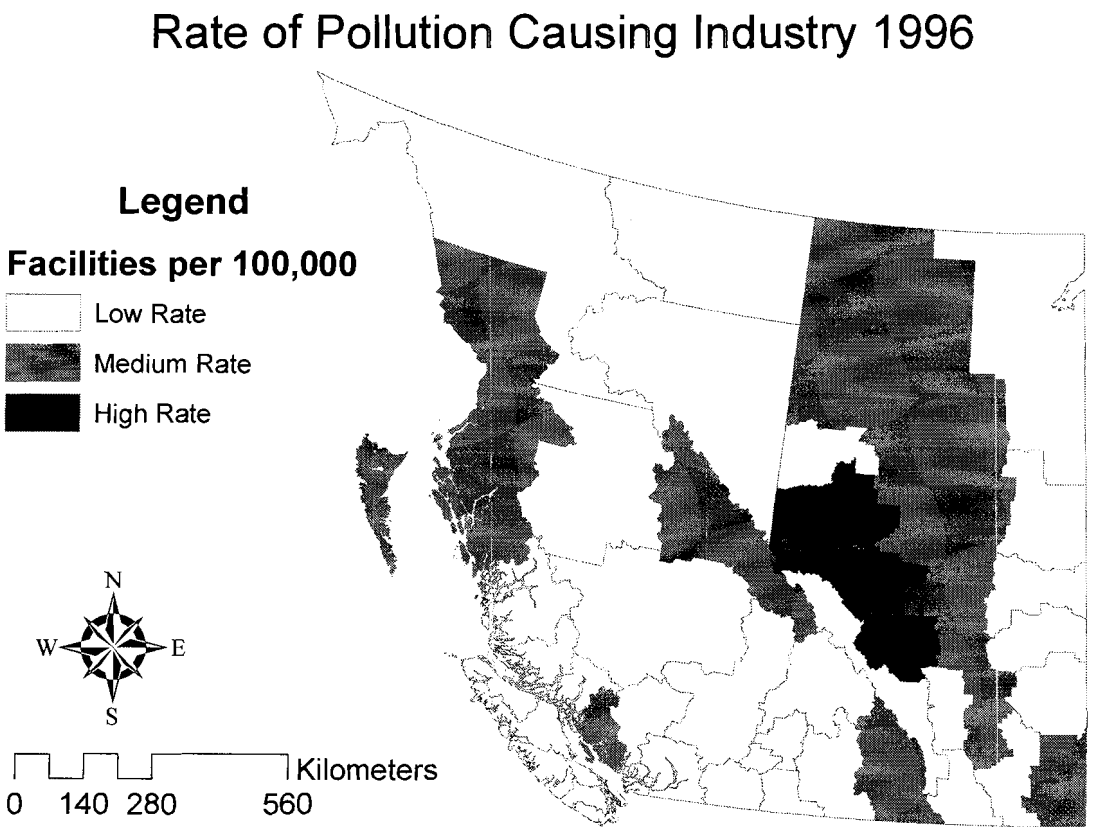


Figure 4: Distribution of Pollution Facilities by Rate: 1996



To describe the areas that contain a high rate of facilities, a ranking order was determined. The areas are determined to have a low, medium, or a high rate of pollution causing facilities. This ranking order, defined by "natural breaks,"[22] provides for an observable description of what census divisions have higher rates of facilities. The ranked areas are displayed in Figure 4. The map depicts that Central Western Alberta consists of all the areas with higher rates.

[22] Natural breaks identify clusters in the data and make classifications based on those clusters (Ormsby et al. 2001: 136).

Table 1 reflects the socio economic characteristics by rate. Areas with higher rates are denoted as three and lower rate areas as one. The values of each division, by rate category, were summed then averaged to determine the values within each ranked area. Interestingly, areas considered as having a higher rate have a lower rate of visible minority populations but also have a higher rate of aboriginal population. Dwelling value and education also decreases as rate increases. All other variables are relatively constant.

Table 1: Descriptions by Rate, 1996

RATE[23]	Low Income	X Household Income	Aboriginal Pop	Minority Pop	Dwelling Value	Unemployment Rate	Education[24]
1	15	47589	9.6	5	145456	9.5	49.3
2	15.1	48434	8.3	4.1	127241	9.6	51.2
3	15.3	48533	15.9	1.4	87831	8.7	53.6

Values are the averages within groups. 1996

Based on rate, population characteristics suggest that environmental injustices do exist. However, by collapsing data into categorical values, the strength of statistical tools decreases. Categorical data lose the unique characteristics offered by each geographic location and thus it loses the ability of the individual characteristics to be accounted for within an analysis. A regression model benefits dramatically when using interval (thus un-collapsed) data. The strength and accuracy of the results is greatly improved.

Before running the regression model, it is essential to look at the data distribution to see if any outliers exist. Further exploration of the data reveals the mean number of facilities, per census division, in 1996 is 3.55. The median is one while also having

[23] 1 = Rate of <3.78. 2 = Rate of 3.77<>16.46, and 3 = Rate of 16.45<

[24] Rate of population with high school or less as highest level of education completed.

multiple modes. Below is a frequency distribution concerning the number of pollution causing facilities in each geographic area. Table 2 shows that 59.6% of the areas contain either zero or one facility. When the standardized data was examined a similar pattern emerges. Looking at the rate of pollution causing facilities, 4.58 is the average with a median value of 2.04. The most common occurring rate is zero. These values suggest a positively skewed distribution. Since OLS regression is fairly robust, a slight skew from the normal distribution should not bias the results significantly (Garson, 2005b: 10).

Table 2: Frequency of Total Number of Facilities by Census Division, 1996

Number of Facilities

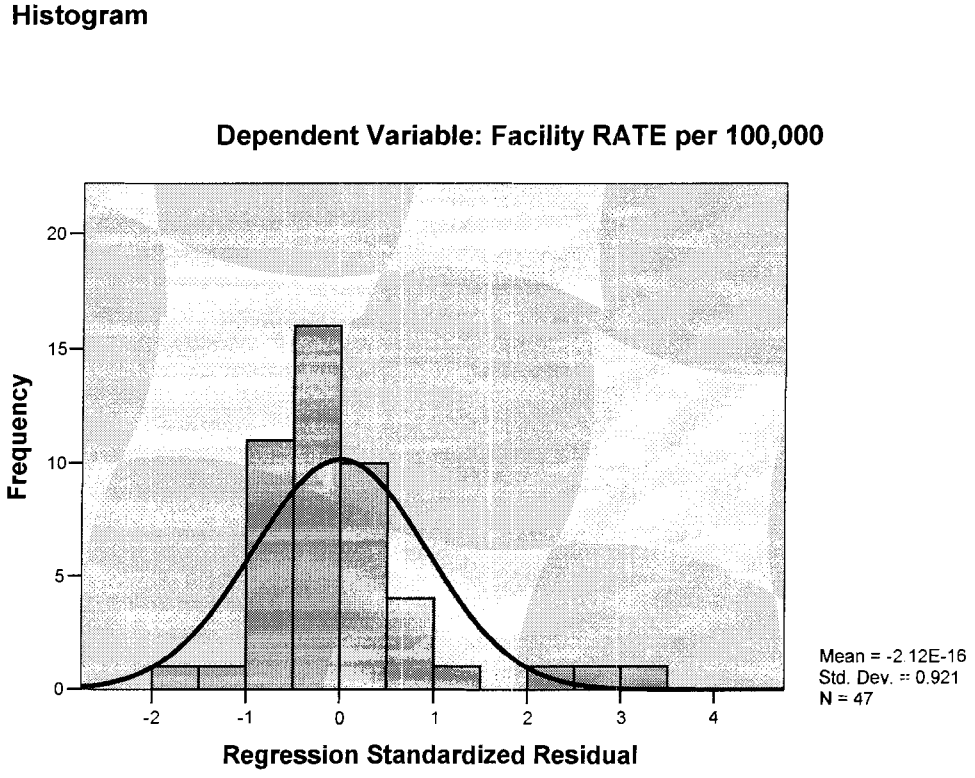
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	14	29.8	29.8	29.8
	1	14	29.8	29.8	59.6
	2	4	8.5	8.5	68.1
	3	2	4.3	4.3	72.3
	4	3	6.4	6.4	78.7
	5	1	2.1	2.1	80.9
	6	4	8.5	8.5	89.4
	7	1	2.1	2.1	91.5
	9	1	2.1	2.1	93.6
	18	1	2.1	2.1	95.7
	27	1	2.1	2.1	97.9
	37	1	2.1	2.1	100.0
	Total	47	100.0	100.0	

However, a mean value of 4.58 and a standard deviation value of 8.2262 demonstrate that these values are significantly impacting the measures of central tendency. In addition, the histogram of the distribution of the regression[25] residuals also

[25] A preliminary regression analysis was conducted to discover any data concerns that may affect the analysis. This preliminary test used untransformed data and included all variables noted within the model.

indicates the likelihood of some outliers in the data set (see Figure 5). As a result, heteroscedasiticity in the dependent variable is evident.

Figure 5: Distribution of facility Rate Residuals, 1996



These extreme values are not due to mathematical or imputation error, rather the values are present in the raw data. This suggests that the values are a true representation of the data and thus removing the value would create a specification error that would jeopardize the validity of the analysis. To limit the biases outliers would have, the regression model was tested with transformed data. While transforming data is not a highly desired approach in dealing with outliers, it was determined that keeping the outliers would severely affect the measures of central tendency and thus significantly devaluing the

outcome of the t-tests. The effects of the outliers were mediated by the transformation of the data.

There are three methods commonly applied when transforming data (Osborne, 2002: 2). One way is to take the inverse of the value ($1/X$) (Osborne, 2002: 4). The second approach is to take the logarithm ($\log_{10}$) of the values (Osborne, 2002: 3). While both of these methods are excellent ways to ensure that the data integrity is kept, both conversions require that the original data do not contain zeros. Since there are numerous census divisions in the current data set that do not contain any facilities, it is not mathematically possible to transform this data set with either of these two approaches. The last approach, which is feasible to use when zeros are present, is to take the square root of the values. This method, even with its own biases, forces the outliers into the data set normalizing the distribution (Osborne, 2002: 5). By weighing the biases of transformation with the biases in keeping the outliers in the data, the outliers caused too much distortion in the measure of central tendency and affecting normality, that transformation was preferred. The relative distance between the values are maintained and the mean and standard deviation is within logical limits (see Table 3)

Table 3: Measures of Central Tendency and Variation, 1996

Statistics, 1996

		Facility Rate per 100,000
	Valid	47
	Missing	0
Mean		4.581
Median		2.040
Mode		.0
Std. Deviation		8.2262
		Rate Transformed
	Valid	47
	Missing	0
Mean		1.5423
Median		1.4283
Mode		.0
Std. Deviation		1.50011

The last preliminary step before conducting the regression analysis is to check if there are collinearity problems. In other words, the explanatory variables must not share high inter-correlations. Utilizing the Tolerance and VIF test (see Appendix H), none of the variables meet the cut off value (.20 and 4.0 respectively) indicating collinearity problems.

The Model

The regression model was applied using SPSS. The model utilized the "enter" technique, which included all variables indicated by the environmental justice theory. The enter method, unlike other procedures such as stepwise, should be used when the researchers have theory to support variable inclusion. Because the stepwise procedure is more of an exploratory method, it may exclude variables that should be entered into the model (Garson, 2005a: 12). It also lacks reliability as sample size or slight data

modifications can result in different variables being included in the model (Fox, 1997: 356).

The adjusted R^2 value for the model is .18. In other words, the model explains roughly 18% of facility locations over all variance (Table 4). The F statistic (2.891) ensures that these results are unlikely due to chance at the .05 level (Table 5). Eighteen percent is not a strong explanation of the dependent variable.

Table 4: Model Summary, 1996

Model Summary (b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.552(a)	.304	.180	1.35873	.304	2.439	7	39	.036

a Predictors: (Constant), Unemployment Rate, Rate of Minority Pop, Average Household Income, High School or Less, Rate of Aboriginal Pop, Incidence of Low Income, Average Dwelling Value,
b Dependent Variable: Rate Transformed

Table 5: ANOVA of Regression, 1996

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.516	7	4.502	2.439	.036(a)
	Residual	72.000	39	1.846		
	Total	103.515	46			

a Predictors: (Constant), Unemployment Rate, Rate of Minority Pop, Average Household Income, High School or Less, Rate of Aboriginal Pop, Incidence of Low Income, Average Dwelling Value,
b Dependent Variable: Rate Transformed

The coefficients that accounted for the most influence on facility rate is incidence of low income. The relationship, as indicated by the t statistic, is positive, thus as incidence of low-income increases in a neighbourhood so does the rate of pollution

causing facilities (Table 6). The B value suggests that for every one-unit increase in facility rate, the incidence of low income increases by .318 (Table 6).

Table 6: Regression Coefficients, 1996

Regression Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-9.643	5.009		-1.925	.062
	Incidence Of Low Income	.318	.112	.649	2.837	.007
	Average Household Income	9.88E-005	.000	.375	2.128	.040
	High School or Less	.079	.051	.302	1.552	.129
	Rate of Minority Pop	-.120	.077	-.397	-1.552	.129
	Rate of Aboriginal Pop	.039	.028	.294	1.399	.170
	Average Dwelling Value	-2.38E-006	.000	-.082	-.336	.739
	Unemployment Rate	-.191	.105	-.369	-1.827	.075

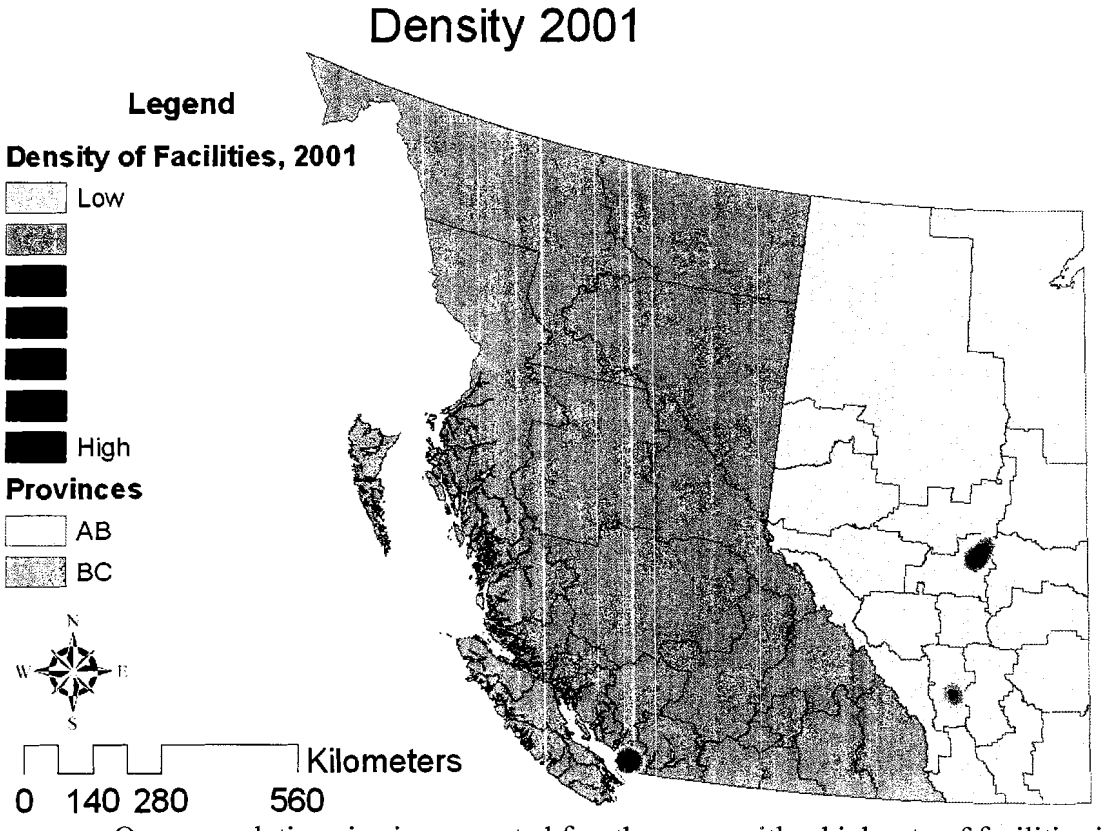
The only other variable that has a significant relationship with facility location is average household income (Beta .375, $p<.05$). The absence of a negative sign indicates that this too is a positive relationship. However, it only explains a small portion of the variance of facility locations. Incidence of low income and average household income share the most significant contribution to the model. The results suggest that the areas that have higher rates of facilities contain both higher income households and high incidences of low income. This may reflect the global trend in the increasing gap between rich and poor. As will be explained later, this also may be reflective of the job market and the types of employment available in industries that distribute air pollution. Overall, the results are inconclusive with respect to the environmental justice theory. Rather, some contradictory findings (incidence of low income and average household income) suggest that further analysis needs to be done to understand the population characteristics of those frequently subjected to environmental injustices.

2001

Descriptive Statistics

As in the 1996 data, the facility locations in 2001 also seem to cluster around certain areas (see Appendix I). The kernel density calculation indicates that the urban centres contain numerous facilities within close proximity of each other (Figure 6).

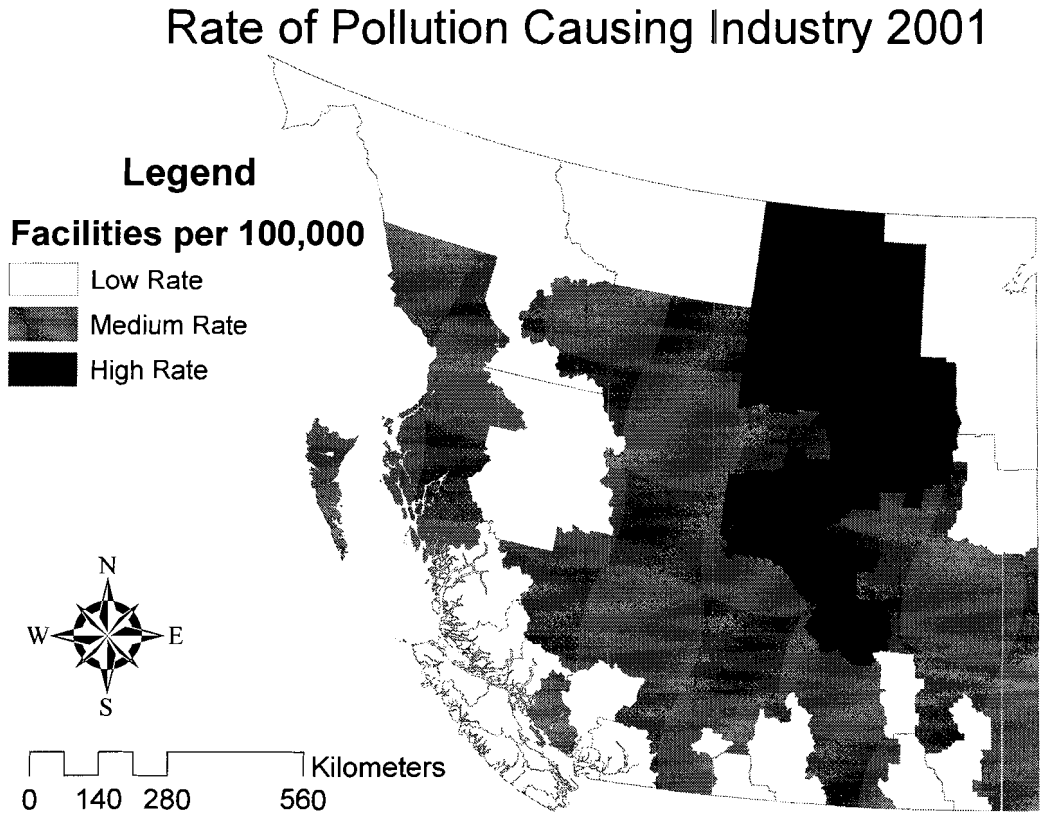
Figure 6: Density Map: 2001



Once population size is accounted for, the areas with a high rate of facilities is markedly different from those that are densely saturated with facilities. The areas with higher rates suggest that something other than an available workforce is contributing to the facility siting. In keeping with the same cut off points calculated by a "natural break"

determination from the 1996 data, areas are classified as either low, medium, or high rate. The areas described by rate of pollution causing facilities are displayed in Figure 7. There are four "high" rate areas and they are all located in Central Western Alberta.

Figure 7: Distribution of Facilities by Rate, 2001



The socio-economic characteristics for the areas categorical defined based on rate are described in Table 7. Visible minority populations are not as common in areas that have a higher rate of pollution causing facilities. While this may lend itself to the finding that race/ethnicity is not a factor in pollution exposure, it in part may be reflective of Alberta's low rate of minority population but it may also suggest that injustices are more likely an issue for the Aboriginal population. The unemployment rate seems to decrease

as rate increase while level of education decreases as rate increases. As will be discussed later, this is result may be consistent with an employment sector in which high paying jobs are available without having much education. Dwelling value also is lower in areas with a higher rate of pollution of causing industry. A market driven approach would suggest that land near areas with pollution causing facilities would be more affordable, thus the average housing prices would be lower.

Table 7: Descriptions by Rate, 2001

RATE[26]	Low Income	X Household Income	Aboriginal Pop	Minority Pop	Dwelling Value	Unemployment Rate	Education[27]
1	13.3	55602	13.2	6.4	163157	9.7	40.7
2	13.2	53299	8.4	3.8	137453	8.3	44.7
3	11.1	57512	18.5	1.7	109923	6.9	52.3

Values are the averages within groups. 2001

One last finding is that the average household income in high-rate areas is actually greater than in any of the other areas. On the surface, this suggests the opposite hypothesis dictated by environmental justice theorists. However, it also may speak to the shortcomings of conducting a macro level analysis.

Classic descriptive statistics indicates that the mean number of facilities is 5.83 in census divisions while the median is 3. The most common occurring number of facilities, the mode, is one. Table 8 describes the frequency of the number of facilities per census division.

[26] 1 = Rate of <3.78. 2 = Rate of 3.77<>16.46, and 3 = Rate of 16.45<

[27] Rate of population with high school or less as highest level of education completed.

Table 8: Frequency of Total Number of Facilitates by Census Division, 2001

Number of Facilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	12.8	12.8	12.8
	1	12	25.5	25.5	38.3
	2	4	8.5	8.5	46.8
	3	5	10.6	10.6	57.4
	4	2	4.3	4.3	61.7
	5	5	10.6	10.6	72.3
	6	3	6.4	6.4	78.7
	7	2	4.3	4.3	83.0
	8	2	4.3	4.3	87.2
	9	1	2.1	2.1	89.4
	12	1	2.1	2.1	91.5
	18	1	2.1	2.1	93.6
	27	1	2.1	2.1	95.7
	38	1	2.1	2.1	97.9
	54	1	2.1	2.1	100.0
	Total	47	100.0	100.0	

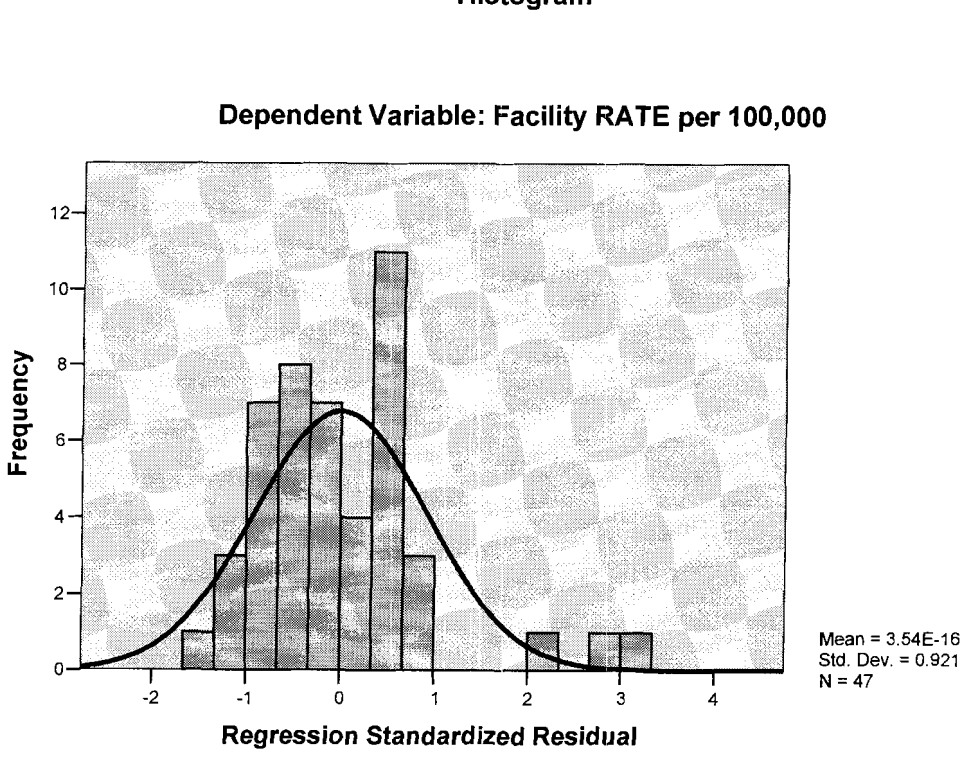
It appears that most of the areas (57.4%) contain three or fewer facilities. The table shows that only a few areas contain a large number of facilities. This agrees with the spatial descriptive statistics, that a large numbers of facilities tend to cluster in a few geographical areas. With a large amount of census divisions having only a few facilities, the 2001 data also suggest a positively skewed distribution.

By understanding the measure of central tendency for facility rate, it is determined that outliers are present. It is also determined that these outliers severely influence the measures of central tendency. The mean of 7.75 with a standard deviation of 11.178 suggests that some areas could considerably have a negative value, which is specious. In addition to looking at the distribution of the rate data, it can also be seen that the histogram of the regression model[28] residuals suggests outliers. This obviously

[28] A preliminary regression analysis was conducted to discover any data concerns that may affect the analysis. This preliminary test used untransformed data and included all variables noted within the model.

violates the normality assumption of regression (Figure 8). This distribution of residuals depicts the skewed error terms, which could affect the t- statistic.

Figure 8: Distribution of Facility Rate Residuals, 2001



To solve this issue the data need to be transformed. As with the 1996 data, the data was transformed utilizing the square root method previously discussed.

In addition to meeting the assumption of normality, it is also wise to consider the assumption of no perfect collinearity. To test if the independent variables share high inter-correlations, it is necessary to look at the Tolerance and VIF scores included in the regression output (Table 9). With a VIF value of 4.128, Dwelling value shares a high

collinearity with the other independent variables. As a result, dwelling value was excluded from the model.

Table 9: Collinearity Diagnostics, 2001

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Incidence of Low Income	.290	3.446
	Average Household Income	.380	2.630
	High School or Less	.308	3.250
	Rate of Minority Pop	.289	3.461
	Rate of Aboriginal Pop	.427	2.343
	Average Dwelling Value	.242	4.128
	Unemployment Rate	.341	2.935

a Dependent Variable: Rate Transformed

The Model

The Adjusted R^2 value suggests that the model is able to predict 38% of the depended variable's variance (Appendix J). The F statistics (5.706) also ensures that this result is unlikely due to chance at the 0.05 level (Appendix J). Table 10 shows the significance each coefficient has on the dependent variable when controlling for all other variables in the model.

Table 10: Regression Coefficients, 2001

Regression Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-10.382	3.962		-2.620	.012
	Incidence of Low Income	.188	.128	.317	1.470	.149
	Average Household Income	7.28E-005	.000	.380	2.044	.048
	High School or Less	.175	.041	.644	4.267	.000
	Rate of Minority Pop	-.046	.055	-.166	-.839	.406
	Rate of Aboriginal Pop	.002	.024	.016	.090	.929
	Unemployment Rate	-.139	.081	-.342	-1.722	.093

a Dependent Variable: Rate Transformed

The coefficient contributing the most to the model is the education variable. This is identified with a Standardized Beta coefficient of .644 and a significant t-test value of 4.267. This is a positive relationship. In other words, as the rate of those only having high school or less increases so does the rate of pollution causing facilities. In addition, as one unit of facility rate increases the rate of having high school or less increase by .175 (Table 10). Also of significance, the average household income results contribute the next highest amount of the variation explained (Beta .380). Similarly, as with the 1996 regression results, this is a positive relationship. This suggests that as household income increases so does the rate of pollution causing facilities.

Part II: The Effectiveness of CEPA Policy Objectives

To understand how the data changed or did not change with the implementation of the 1999 CEPA amendments, a comparison of the spatial distribution of the data was examined for each time period. Analyzing the point maps (Figure 9, Figure 10 & Figure 11) for the 1996, 1999, and 2001 data, there is virtually no change. In addition, looking at

the Choropleth maps only a slight change is noticed with respect to high-rate areas (see Appendix K).

Figure 9: Facility Locations, 1996

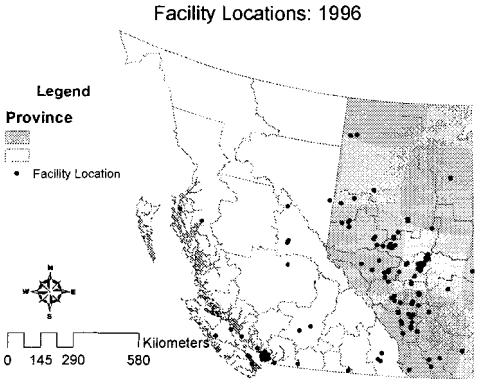


Figure 10: Facility Locations, 1999

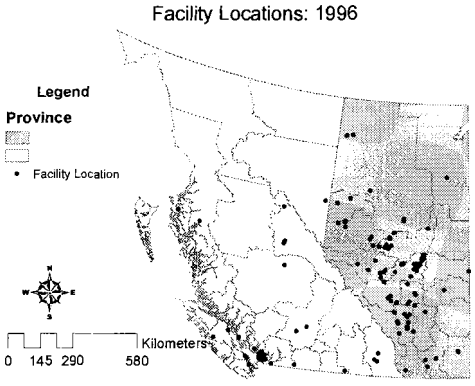
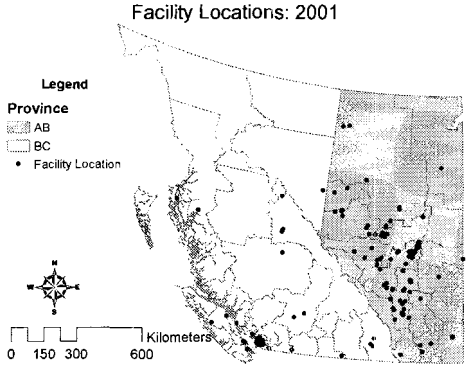


Figure 11: Facility Locations, 2001



The only noticeable impact that the CEPA may have had is an increase in reporting. That is the number of facilities reporting to the NPRI increased steadily each year (n = 169, n = 229, n = 277 respectively). Household income was consistently significant in both models (t-test >2). In the 1996 data, the incidence of low income was the most prevalent factor affecting the dependent variable's variance (Beta .649), while in 2001 low income

no longer played a significant role (Beta .317), but was replaced by level of education as providing the most influence on the dependent variable (Beta .644). It should also be noted that the model explained more of the variance in the 2001 facility rate than it did in the 1996 data (R^2 .38 and .18 respectively). This may be explained by an increase in the number of facilities and thus providing a more accurate representation of the overall population. The study would suggest that the variable that consistently influences facility rates is average household income. This relationship is positive, thus there is a temptation to conclude that environmental injustices amongst lower socio-economic populations is not present in western Canada. The model utilizing 2001 data provided a better explainer for facility rate. Since the mandatory reporting requirement established by the 1999 amendments of the CEPA, it is argued that the 1996 data underreported the number of facilities present.

Regardless of these differences, it is difficult to generate a concrete answer to the second thesis question, "does the CEPA have any effect?" The thesis contends that there is insufficient data to conclude any significant change after the amendments to the CEPA. However, it may be too soon to see the effects of the 1999 CEPA amendments. Since the amendments came into effect in 1999 and the data used was 2001, it is unlikely that within the short 2-year time span that any significant differences would be seen. However, it is also likely that no change will ever be seen since the mandate of the CEPA is concerned little with environmental justice issues, regardless of the sustainable development rhetoric.

CHAPTER SIX:
DISCUSSION

Who Are the Victims?

The Exploratory Spatial Data Analysis suggests that facilities are densely concentrated. It is certain that the areas with large numbers of facilities are located in highly populated areas, such as Edmonton, Calgary, and Greater Vancouver. Once population is factored in, the result changes. Those areas that experience a high rate of pollution causing facilities do not contain large populations. This suggests that human resources alone do not affect the locations of facilities. Pollution exposure thus is not necessarily a consequence of urbanization or population size. Other than these variables, what factors explain pollution exposure using facility siting as the dependent variable?

When the variables are categorized by level of rate, there is evidence to suggest that high aboriginal populations characterize communities with a high rate of pollution causing industry. This presence of aboriginal populations exposed to a higher rate of pollution causing facilities is consistent with environmental justice theory. Interestingly, minority populations resided in areas with lower rates of facilities. Unlike the United States, Canada does not experience the same racial divide between the Blacks and the whites. In addition, Canada does not contain a large Black population. However, Canada does experience similar inequalities between the Native peoples and White Canadians. Given the similarities between Canada's aboriginals and the African Americans, it is logical to conclude that aboriginal populations would be exposed to a higher rate of

pollution causing facilities than any other visible minority. Higher rate areas also seem to contain populations with lower education and less expensive housing values. Exploring the rate of pollution exposure, using proximity based methods, supports the need for further exploration into environmental injustices in Canada.

Using the classical statistical technique, multiple regression, favours the rejection of environmental justice assumptions. The OLS regression analysis is more powerful then ESDA; however, because of insufficient data and a small sample size (n = 47), the regression analysis should be interpreted cautiously. Regardless, the regression analysis seems to support an opposite view of environmental injustice. For instance, in both samples (1996 and 2001) those living in areas with a higher rate of facilities have a higher household income. It should be noted that the household income coefficient only increases marginally as the rate of pollution increases (B values of ~.000099 & ~.000073). In other words, with one unit increase in rate of pollution exposure, average household income increases by less than .0001. Hoffman (2000) suggests that "[i]ncome, commonly used in studies of crime, may fail to measure economic well-being because it does not include entitlements" (281). Other measures of economic wealth, such as access to public services (Hoffman, 2000: 281), should also be conceptualized in future regression models.

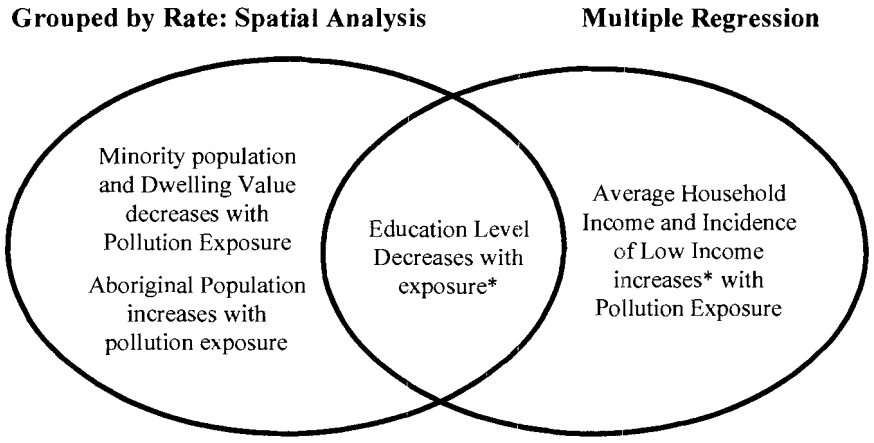
A suspicious finding in the 2001 results suggests that those making more money also have lower education. Both variables (average household income and education) significantly contributed to the 2001 regression results. This contradiction, can in part, be explained by the labour value specifically in the oil and gas sector. Working on oil and gas sites does not necessarily require higher education and as such, the education variable

may accurately reflect the workforce of the industry. It could mean that these jobs may be considered high risk (risk to health) with salary reflecting this cost. Those with lower education will be drawn to the higher income because few opportunities exist to make such substantial wages. As Bullard (2002) argues, this may still be indicative of environmental injustice. Bullard (2002) would argue that these individuals are victims of Environmental Blackmail[29] (ibid: 40). A Well Driller is an example of this labour value. Well Drillers in Alberta make on average $55,018[30] per year (n.a., 2005f). In addition, a high school diploma is all that is needed in most cases[31]. The income made by Well Workers is actually one standard deviation above the 2001 mean household income.

The rate of aboriginal populations was not a significant contributor in the regression model in either year. However, when the data were collapsed into groups by rate, it was obvious that aboriginal populations were concentrated in areas that had a higher rate of pollution causing facilities. The disjuncture between the results of the spatial categorization of rate and the classical regression model demonstrates the need for further research (see Figure 12).

[29] See Environmental Victimization discussed on page 14
[30] Based on 2003 data.
[31] This is changing; in fact starting in 2008 a post secondary component in the form of a Journey classification will be implemented for all Well Drillers (n.a. 2005g).

Figure 12: Comparison of the Two Analyses



*Low income was only significant in the 1996 data, while education was only significant in the 2001 data.

The difference between the Regression Model results of the two periods is evident. The 1996 data only explained roughly 18 percent of the dependent variables variance. Thus, 82% of the variance is explained by other factors, making this a weak model. The 2001 regression results suggest that the same variables explain 38% of the dependent variable's variance. The 1996 regression results suggest that incidence of low income is the greatest explainer of pollution exposure, with average household income following a distant second. In addition, high school education was the most significant contributor in explaining pollution exposure. Again, average household income also explained a small portion of the variance. The reason for the difference could be the result of increased reporting of pollution emissions. With the mandatory reporting requirements introduced by the 1999 CEPA amendments, the 2001 facility locations would be a more accurate reflection of pollution exposure. The number of facilities would change the rate of pollution exposure and thus the model would generate different results between years.

The Effectiveness of CEPA Policy Objectives

It is evident from the Exploratory Spatial Data Analysis techniques, that the CEPA amendments of 1999 may have only changed the reporting frequency. It would be unfair to suggest that the CEPA makes no efforts to address sustainable development policies, which in turn reflect equality amongst all human beings. Utilizing 2001 data may not provide for a significant amount of time to elapse from the CEPA implementation for results to be fully evident.

Canada's inability to meet sustainable development policies can be reflective in both its application of the policy into law and the enforcement of the policy. It is unlikely that any significant impact will ever be made because of the CEPA's lack of dedication to environmental justice issues in its mission statement. While Canada preaches on its dedication to sustainable development and the equity needed to ensure the policy's success, the CEPA amendments aimed at meeting such objectives do little to ensure the equity issues are met. In addition to the lack of concern over environmental justice issues, it is also evident within the data reporting process that industry will continue to dominate environmental law and thus policy effectiveness. Therefore, injury from environmental harms may never be taken seriously. The only way industry leaders will implement 'green' policies "is to demonstrate that their profits and share prices will increase if they adopt environmentally sound production methods" (Friedman, 2000: 286).

It is essential to recognize the importance of tracking toxic substances. Sustainable development initiatives rely on the accuracies of what substances are entering the environment, as well as how those releases affect the economic and social spheres of life. The results of this analysis demonstrate that greater strides are being made to ensure

reporting is complete. However, it is also certain that industry still plays a large role in determining what substances are to be reported thus insulting the precautionary and polluter pays principles. In turn, this influence will influence how environmental harms are distributed.

Lastly, the difference between Alberta and British Columbia with respect to pollution causing facilities is noticeable. All of the higher rate areas are contained within Alberta's border. In addition, two of the three highly dense industry locations (Edmonton and Calgary) also fall within the boundaries of Alberta. The difference could be due to the type of industry each province primarily relies on. British Columbia sustains a large Forestry Sector while Alberta primarily manufactures Oil and Gas products. The amount of pollution and the type of release method various between industries. For instance, most pollutants released by the forestry sector are not isolated substances released into the air as a result of processing. Rather, "sediment is the most common pollutant" in the forestry sector (n.a., 2005d). The eroded soil and subsequently any pesticide or other toxin present in the soil, can end up in the earth's waterways (n.a., 2005d). Thus, air pollution may not adequately capture the toxins released by industry in British Columbia.

Limitations

A few limitations should be noted with these two study questions. First, by utilizing only one measure for the dependent variable, air pollution, the results cannot be generalized to all forms of pollution exposure; i.e. water, traffic or noise pollution. Thus, this study is limited to the exploration of air pollution and its relationship with socioeconomic factors. It is important to note that this is an exploratory study, and consequently, the purpose of the findings is to provide a framework for future research.

Second, using proximity methods to operationalize air pollution exposure, as opposed to actual dispersion methods, can produce error. Therefore, the results could over estimate the number of victims present in a given area. It could also under-represent the number of people exposed to air pollution. Proximity based methods assume that the population sited around a pollution causing facility will be exposed to the same degree as all those that are in a pre-defined geographical boundary (Jerrett et al., 1997). Thus if facilities are located near a boundary of any geographic area, people situated in the adjacent area, even though they may be nearer to the facility, will not be considered. Conversely, if a geographic area is large and all the facilities are located on one side of the area, those individuals residing at the other end are weighted with the same risk as those closer to the facility. However, the limited data on exposure pathways permits the proximity method to be the most practical for the proposed study. Proximity based method also is the most time and cost efficient.

It is not possible to explore all plausible explanations. Due to resource constraints, it is not viable to control for all conceivable variables. As such, and with most analysis within the social sciences, "any model or theory...will fail to account perfectly for the phenomena that it describes" (Goodchild & Janelle, 2004: 9).

Using self-report data such as the Census questionnaire can produce inaccurate results (Dale et al., 2000). Low-response rate, incomplete questionnaires and misinterpretation of questions plague self-report questioners (Miller & Whitehead, 1996; Palys, 2003). It is up to the respondents to mail the completed questions back to the data collection service. This onus usually results in a low response rate (Miller & Whitehead, 1996; Palys, 2003). Without the presence of a researcher, questions may be overlooked or

purposely missed and an incomplete survey results (Miller & Whitehead, 1996). Lastly, misinterpretation of either the question and/or answer may result in fallacious conclusions. Without the presence of a researcher, the misunderstanding of the material being presented is likely (Miller & Whitehead, 1996; Palys, 2003).

The overall regression model may be inhibited by using census division as the unit of analysis. The larger the area of study, the less variability between areas. Thus, each geographic census division is more homogenous. This poses a challenge to identifying low, medium and high socio-economic areas. It could be argued that utilizing a large scale of analysis (census division) does not capture the unique qualities that smaller units such as neighbourhoods, would include. By using a smaller unit of analysis, it may be more likely to notice these variances. By identifying greater differences between neighbourhoods, areas may be more easily defined as low, medium or high socio-economic areas thus containing more of one population group than another. The larger the unit of analysis the less variance between groups and the more each area will resemble the entire population. Therefore, identifying 'areas' characterized as having a low socioeconomic make-up and their relationship to pollution will be less visible. If the heterogeneity between geographic areas is apparent, it is more likely that environmental injustices will be seen. Unfortunately, the data were insufficient for an analysis at a smaller level of analysis.

Even if these limitations were negated, the extent to which injury and violence are caused by environmental crime would still be a challenge to measure. Due to scientific uncertainty, the complexity of the issue, and inconclusive links of causality, there is an *under-representation* of the true extent of harm (Benidickson, 2002; Loh & Surgerman-

Brozan, 2002: 111; Sexton et al., 1993). Thus, it is an inevitable that any study looking at environmental harms will never fully be able to conceptualize the true relationship between pollution exposure and socioeconomic status.

The results of the second part of the analysis, understanding the CEPA 1999 and its effects, are also very limited with the available data. Since changes in legislation may have an impact prior to its implementation, it is possible that the effects of the CEPA would already be taking shape in the 1996 data. Conversely, if the effects of the legislation are lagging, it is possible that the 2001 will not encompass changes the CEPA have initiated. Such scenarios could produce Type One or Type Two errors. In addition to this, a federal nation such as Canada reflects a duality in its conception and implementation of environmental policies. Controlling for provincial policies, which may impeded or excel environmental justice initiatives, is difficult under the most pristine of circumstances. As such, an assessment of the effectiveness of the CEPA will be very limited. However, for the purpose of this study, the results will provide a framework for further policy analysis on the CEPA and Canada's Sustainable Development policies in general.

Future Research

Since this research was the first of its kind in Western Canada, its purpose was to explore environmental justice theory and sustainable development policy. Thus, the need for future research is this area is inevitable. There are many recommendations this thesis provides. Rather than concluding the environmental injustices are not an issue in Western Canada, this thesis explicitly demonstrates that data issues inherently disallow any such concrete conclusion to be made. Thus, the first thing any future research needs to

address is the quality and quantity of the data. Canada has attempted to provide publicly obtainable data on pollution exposure, but it is only in its infancy. The NPRI is an evolving database that continues to be modified. Second, these data were not entirely reliable due to the restrictions on who does/does not have to report and NPRI limits its reporting on only chosen substances. As identified in the Policy Discussion, these substances are chosen in large part by corporate interests. Thus, the results are inherently biased. One way to address the data problem is to include various kinds of releases (air, land and water).

Utilizing facility siting should also be replaced and/or combined with other measures of exposure. One measure would be derived from dispersion modelling. This measure would reflect how pollution moves through space (Chakraborty, 2001: 887). Its variables would include things such as wind direction and water flow. Another measure would be to identify who would be at the most risk of toxic 'accidents'. Chakraborty (2001) describes this as

> the release of the largest possible quantity of the substance from a vessel or process line failure that travels the greatest distance in any direction to a specified end point, before dissipating enough to become non-toxic (887).

A third measure would be proximity to main thoroughfares and arteries to capture pollutants such as car exhaust (Morello-Frosch et al., 2001: 565).

If data issues cannot be resolved or if the data dictate other wise, more advanced statistical methods need to be considered. Rather than forcing the data to meet the assumptions of an OLS regression model, non-parametric tests could be used. These statistical methods are able to analyze data that either does not fit a normal distribution, has a small sample size, and/or have problems concerning measurement (n.a., 2003b).

For example, other ways to avoid data transformation/normalization would be to collapse the data into categorical values and utilize Ordinal Logistic Regression methods. Logistic Regression is used when the data have been categorized into a 'low – high' scale (n.a., 2003b). While the alternatives are very useful when dealing with uncooperative data, this exploratory study maintained its reliability by keeping consistency with other studies.

Including other levels of analysis, such as census tracts, also needs to be incorporated into future research. This study, due to data inadequacy, could not feasibly utilize census tracts, but this is vital to understand the true existence of environmental harms and the subsequent victimization. Census tracts serve two functions. First, using a smaller level of analysis would more accurately capture a difference within metropolitan areas and other smaller geographical areas where clustering of facilities are most dense. Census tracts also will reflect more diversity between areas with respect to population characteristics. This variability would capture the significance that each level of socioeconomic status has in relation to pollution exposure.

To address policy, corporate deviance, and environmental victimization, a discourse analysis is recommended to uncover the agenda setting process. Analyzing the process in which ideas become policy will provide valuable insight into how harms are truly viewed in light of sustainable development. Second, the effectiveness of sustainable development initiatives, specifically the equality component, needs to be conducted. This is envisioned by conducting a time series design that utilizes various measures including environmental victimization and various policies aimed at addressing sustainable development at multiple levels of government. In the absence of any significant results

describing the victims of environmental injustices, it is the researcher's belief that these issues will continue to go largely ignored.

Lastly, it is essential environmental victimization in relation to the broader political and economic context. Victims of environmental harms may not "describe or see the issues in strict environmental terms" (White, 2003: 494). This understanding creates a subjective dimension of environmental victimization by requiring victims to identify and define their own levels of harm (ibid: 494). Thus, it can be argued that harm, more specifically criminal harm, is defined by the social context. In today's global economic and political climate, with corporate bodies invading many aspects of the social enterprise, a critical analysis of perpetrators of harm and the resulting victims should be further explored.

CONCLUSION

It has been suggested that the causes of environmental injustices are due to the inherent power differentials in society. However, it remains unclear as to the extent to which such injustices occur and if victimization is disproportionately distributed. What is certain is that the inequality present in today's world suggests an increased gap between the rich and the poor (Pellow, 2002: 169). The competitive drive for resources, power, and money has made individuals, cities, and nations fight for a share of the globe's wealth (Pellow, 2002: 169). This guarantees that corporate violence will continue and harms will be the burden of the world's poor.

In addition to understanding the power structure inherent in society, more evaluation that is empirical needs to be conducted. The research needs to emphasize a multidimensional approach to the environmental justice analysis by incorporating multiple sources of environmental injury, different units of analysis, and to ensure multiple time dimensions are included. We must also analyze the value we as society place on the environment and to what extent we are willing to sacrifice human health and environmental degradation for the sake of our current notion of prosperity and capital gain. Understanding our relationship to nature "has considerable significance for official attitudes towards resource development, sustainability, and the level of compensation" for environmental harms (Benidickson, 2002: 183).

It is also important to look at human injury as something that is not necessarily immediate; rather harms can be incurred through gradual and cumulative exposure to

environmental degradation via land, water, and air pollution. These harms must also be looked at beyond a compensatory model. In essence, harms are not always about weighing the costs and assigning a value to environmental injuries. In understanding the interdependency humans have with nature and vice versa, it is revealed that this idea needs to be incorporated into policies addressing environmental sustainability.

It is necessary to explore the occurrence of violence as a reaction to government's inadequate response to environmental injustices. From victim to victimizer, the behaviour of individuals who, in the name of justice, engage in criminal behaviour is an important element in understanding environmental concerns. Understanding the reasons behind this violent behaviour will assist for better policy development and enforcement of environmental legislation.

Criminologists should take an active role in environmental victimization research. The discipline of criminology can help address the problems that arise when harmful behaviour is purposeful, but economic and/or political concerns negate the impact such harm causes. Criminology can critically evaluate this behaviour by understanding the social construction of crime and deviance and the subsequent reaction of law and policy. The discoveries made will ultimately add to our current understanding of crime, victimization, and deviant behaviour. White (2003) argues that "[t]he quest for environmental and ecological justice requires reacting against undemocratic decision making locally and globally, as well as against the imposition of global capitalist economic agenda" (501). It is "[b]y rethinking how new global relationships can diagnose, deter, prevent - and indeed, sometimes criminalize - ongoing environmental harms" that criminology can make a difference in the study of environmental harms

(White, 2003: 503). Understanding societal structure based on power differentials and economic incentives can enhance our knowledge of human behaviour. These understandings will ultimately enable a proactive approach in our efforts to address victimization and all forms of harmful behaviour.

The world is changing, in large part from our own actions; it is inevitable that all of humanity will eventually feel harms, regardless of who feels them now. As Friedman (2000) appropriately imparts, "if we cannot learn to do more using less stuff, we are going to burn up, heat up, pave up, junk up, franchise up and smoke up our pristine areas, forests, rivers and wetlands at a pace never seen before in human history" (254).

APPENDICES

Appendix A: Environmental Protection Act, 1999 – Preamble[32]

Canadian Environmental Protection Act, 1999

1999, c. 33

An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development

[*Assented to 14th September, 1999*]

Declaration

It is hereby declared that the protection of the environment is essential to the well-being of Canadians and that the primary purpose of this Act is to contribute to sustainable development through pollution prevention.

Preamble

Whereas the Government of Canada seeks to achieve sustainable development that is based on an ecologically efficient use of natural, social and economic resources and acknowledges the need to integrate environmental, economic and social factors in the making of all decisions by government and private entities;

Whereas the Government of Canada is committed to implementing pollution prevention as a national goal and as the priority approach to environmental protection;

Whereas the Government of Canada acknowledges the need to virtually eliminate the most persistent and bioaccumulative toxic substances and the need to control and manage pollutants and wastes if their release into the environment cannot be prevented;

Whereas the Government of Canada recognizes the importance of an ecosystem approach;

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[32] n.a. (1999). *Canadian Environmental Protection Act*, 1999. Environment Canada. Retrieved November 1, 2005, http://www.ec.gc.ca/CEPARegistry/the_act/

Whereas the Government of Canada will continue to demonstrate national leadership in establishing environmental standards, ecosystem objectives and environmental quality guidelines and codes of practice;

Whereas the Government of Canada is committed to implementing the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;

Whereas the Government of Canada recognizes that all governments in Canada have authority that enables them to protect the environment and recognizes that all governments face environmental problems that can benefit from cooperative resolution;

Whereas the Government of Canada recognizes the importance of endeavouring, in cooperation with provinces, territories and aboriginal peoples, to achieve the highest level of environmental quality for all Canadians and ultimately contribute to sustainable development;

Whereas the Government of Canada recognizes that the risk of toxic substances in the environment is a matter of national concern and that toxic substances, once introduced into the environment, cannot always be contained within geographic boundaries;

Whereas the Government of Canada recognizes the integral role of science, as well as the role of traditional aboriginal knowledge, in the process of making decisions relating to the protection of the environment and human health and that environmental or health risks and social, economic and technical matters are to be considered in that process;

Whereas the Government of Canada recognizes the responsibility of users and producers in relation to toxic substances and pollutants and wastes, and has adopted the "polluter pays" principle;

Whereas the Government of Canada is committed to ensuring that its operations and activities on federal and aboriginal lands are carried out in a manner that is consistent with the principles of pollution prevention and the protection of the environment and human health;

Whereas the Government of Canada will endeavour to remove threats to biological diversity through pollution prevention, the control and management of the risk of any adverse effects of the use and release of toxic substances, pollutants and wastes, and the virtual elimination of persistent and bioaccumulative toxic substances;

Whereas the Government of Canada recognizes the need to protect the environment, including its biological diversity, and human health, by ensuring the safe and effective use of biotechnology;

And whereas the Government of Canada must be able to fulfil its international obligations in respect of the environment;

Now, therefore, Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:

Appendix B: Census Data

Variable	Definition as per Census
Incidence of Low Income	"Percentage of economic families or unattached individuals who spend 20% more than average on food, shelter and clothing"
Average Household Income	Sum of the total household income – 20% of sample
Level of Education: High School or Less	"Total population 20* years and over by highest level of schooling – 20% sample data" - Aggregated two census variables: less then grade 9 and grade 9 to 13
Aboriginal	Total aboriginal population – 20% of sample
Minority	"Total population by visible minority"
Average value of Dwelling	Mean value of owned dwelling – 20% of sample
Unemployment Rate	Expressed as percent of labour force – 20% of sample

* A change was made in this census question from the 1996 to 2001 questionnaire. The 1996 included persons 15 years and over while the 2001 data included only those person 20 years and over.

Source: n.a. (2005h). *2001 Census of Canada. Statistics Canada.* Retrieved March 8, 2005 http://www12.statcan.ca.proxy.lib.sfu.ca/english/census01/home/index.cfm

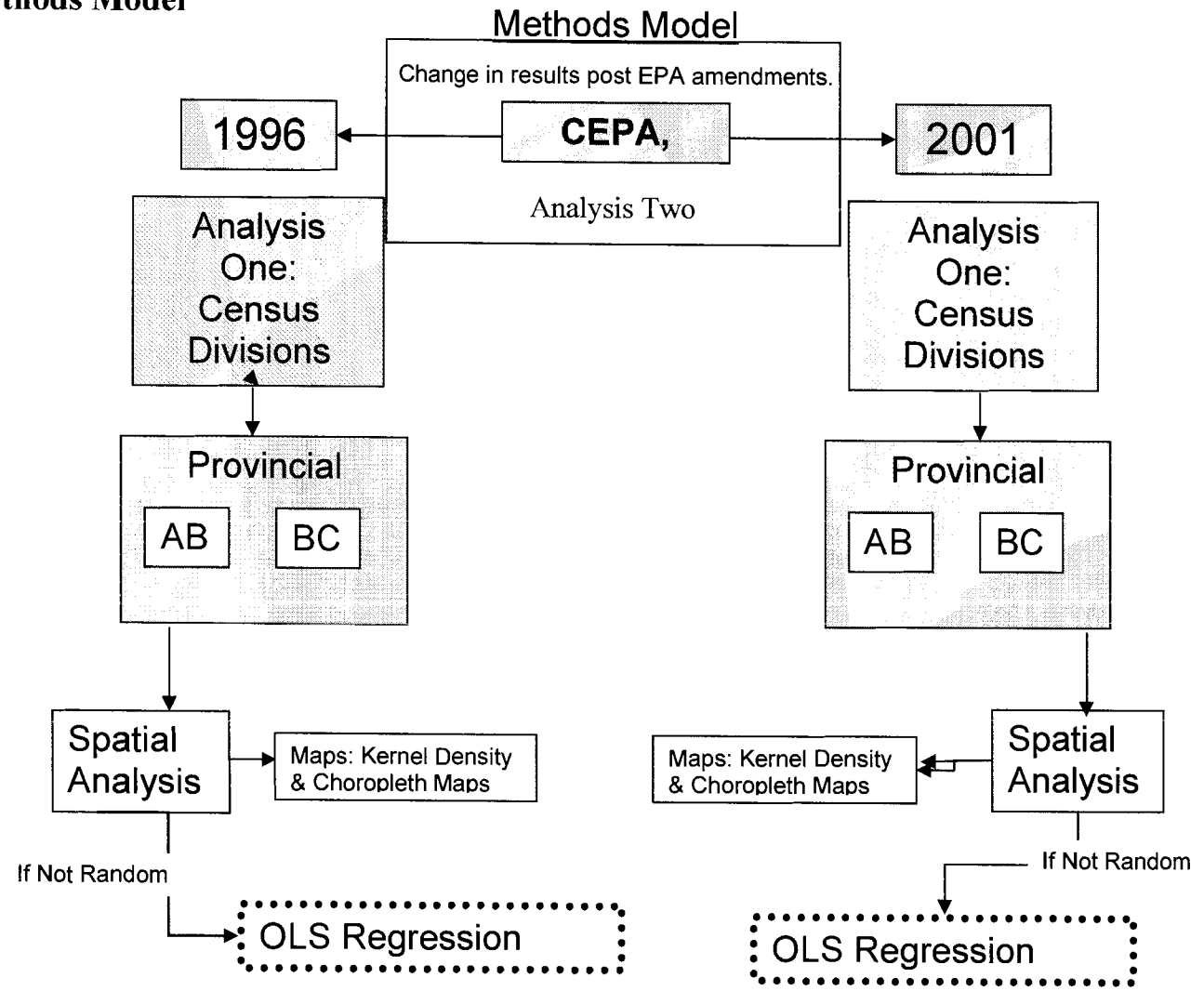
Appendix C: Data Transformation

Variable*	Original Form	Conversion into Rates**
Pollution Facilities	Count per Census Division	Rate per 100,000
Level of Education: High School or Less	Amalgamated raw numbers for less then high school population with High School population to generate a raw number for High School or Less	Rate per 100
Aboriginal Population	Count per Census Division	Rate per 100
Minority Population	Count per Census Division	Rate per 100

* All other variables were unchanged from original census information.

** The differences between rates were due to the sample size provided by the census data. The number of respondents for each question varied resulting in the inadequacy in using the same rate count. Utilizing too large of a population would provide for too many decimal places diminishing the aesthetic appeal of the data.

Appendix D: Methods Model



Appendix E: Exploratory Spatial Data Analysis - Density

Density, described as quadrant analysis, looks at "points per area" (Lee & Wong, 2000: 72). Density is calculated by determining how the points are patterned through space (ibid: 62). The pattern can be random, clustered or dispersed. Clustered and dispersed patterns reflect a distribution that is caused by something other then chance. Clustering occurs if points lie closer together than chance would predict while dispersed distributions resembles patterns in which the points are further apart than chance would allow. One way to understand density is to describe the observed pattern with an expected pattern, or theoretically construed random pattern (ibid: 62). It involves overlaying the geographical area with a grid to determine the frequency of points within each grid unit (ibid: 62). The visual representation of density shows the areas where points lie within a grid based on this observed and expected pattern. Calculating density requires a summation of the "points found in a specified search radius and divided by the area of the circle" (Hick et al., 2004: 333). This calculation provides a visual interpretation of patterning among the points.

Appendix F: Multiple Regression

A multiple regression analysis can be defined as "a statistical technique for estimating the relationship between a continuous dependent variable and two or more continuous or discrete independent, or predictor variables" (Bohrnstedt & Knoke, 1994: 263). However, regressing two or more coefficients will not likely produce a perfect prediction model; thus, errors will be present. The errors are the "difference between the actual values for Y and the predicted values $\hat{Y}$ " (Crown, 1998: 28) (Bohrnstedt & Knoke, 1994: 195). In order to limit the errors, an ordinary least squares multiple regression analysis can determine a linear relationship by regressing the dependent variable on the independent variable while also limiting the error sum of squares (Bohrnstedt & Knoke, 1994; Crown, 1998; Garson, 2005a). A regression equation looks at how well a prediction equation reflects the regression model. Fortunately, the regression model allows for some deviation from a perfect liner relationship (Bohrnstedt & Knoke, 1994: 195). Ordinary least squares (OLS) estimates the population regression intercept and the population size for each variable in such a manner that reduces the sum of errors squared. In other words, this model will reduce the error (or residuals) occurring in the regression equation (ibid: 197). By reducing the residuals, the model more accurately describes how much the independent variable(s) explains the dependent variable. The lower the residual the better the model is at predicting y from x.

The prediction and regression equations are presented below:

$$\hat{Y}_i = \alpha + b_1 X_{1i} + b_2 X_2 \quad \textit{Prediction}$$

$$Y_i = \alpha + b_1 X_{1i} + b_2 X_{2i} + e_i \quad \textit{regression}$$

Where:

$\hat{Y}$ = The excepted value of Y
Y = Dependent Variable
α = Population regression intercept
b = Population regression coefficient
X_i = Independent variables at the nth
e = error or residual

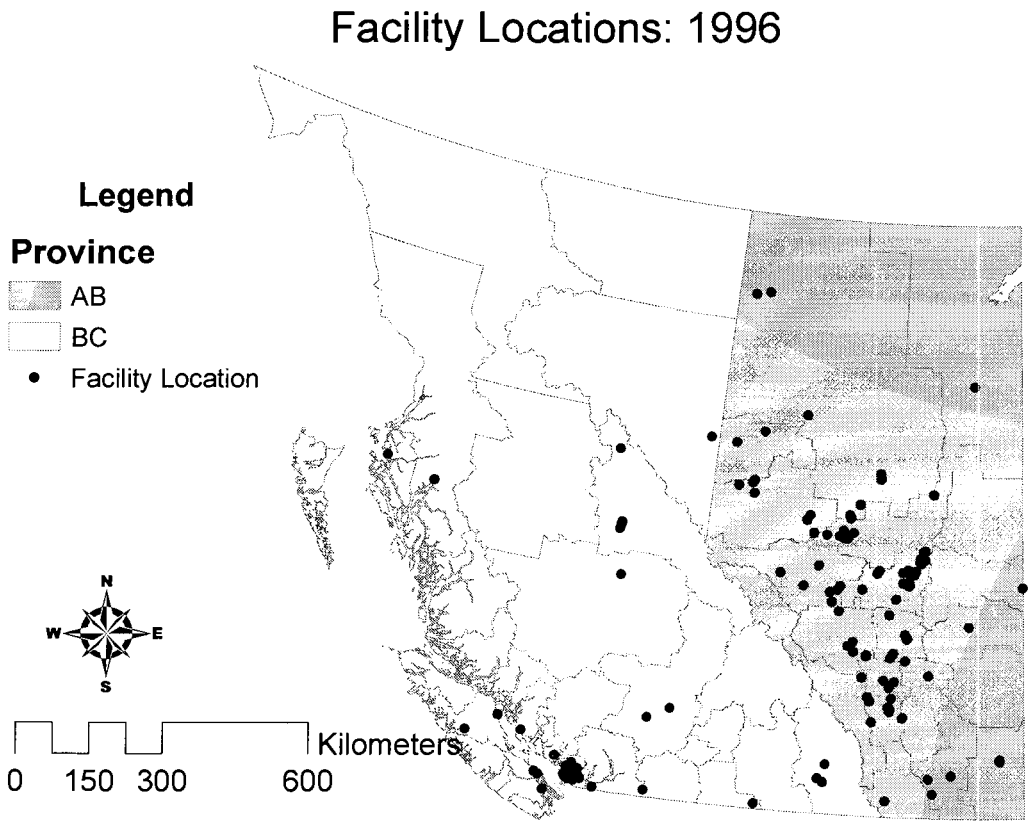
(Bohrnstedt & Knoke, 1994: 269)

In the multiple regression model the regression coefficient for each variable is calculated while controlling for other variables (Crown, 1998: 38).

The measure associated to understanding "how well the model as a whole describes the variation in the dependent variable" (Crown, 1998: 31)is the R^2 value, also known as the "coefficient of multiple determination" (Garson, 2005a: 5). This is calculated by "the total deviation of a particular observation of the dependent variable from its mean" (Crown, 1998: 31). The R^2 of the regression analysis indicates what variables contribute in what proportion to the variance of "Y around its mean" (Crown, 1998: 32). The closer the R^2 value is to 1 the high the proportion of variance is explained by the independent variable(s) (Crown, 1998: 32). It is best, however when using aggregated data, to examine the Adjusted R^2 value, as it reduces the amount of "chance" estimates that may be included to explain the dependent variable (Crown, 1998; Garson, 2005a: 6). In addition to the R^2 statistic, calculating the F statistic will see if the regression model is statistically significant. In other words, "if (f) <.05, the model is considered significantly better than would be expected by chance" (Garson, 2005a: 8). Other statistics relevant to any regression model is the standardized Beta Coefficients.

The beta describes each variable's "relative importance in predicting" the *Y* or dependent variable (Garson, 2005b: 5). Also calculated is the statistic for each coefficient in the model. This value will determine "the significance of each b coefficient" (Garson, 2005b: 5).

Appendix G: Facility Locations 1996

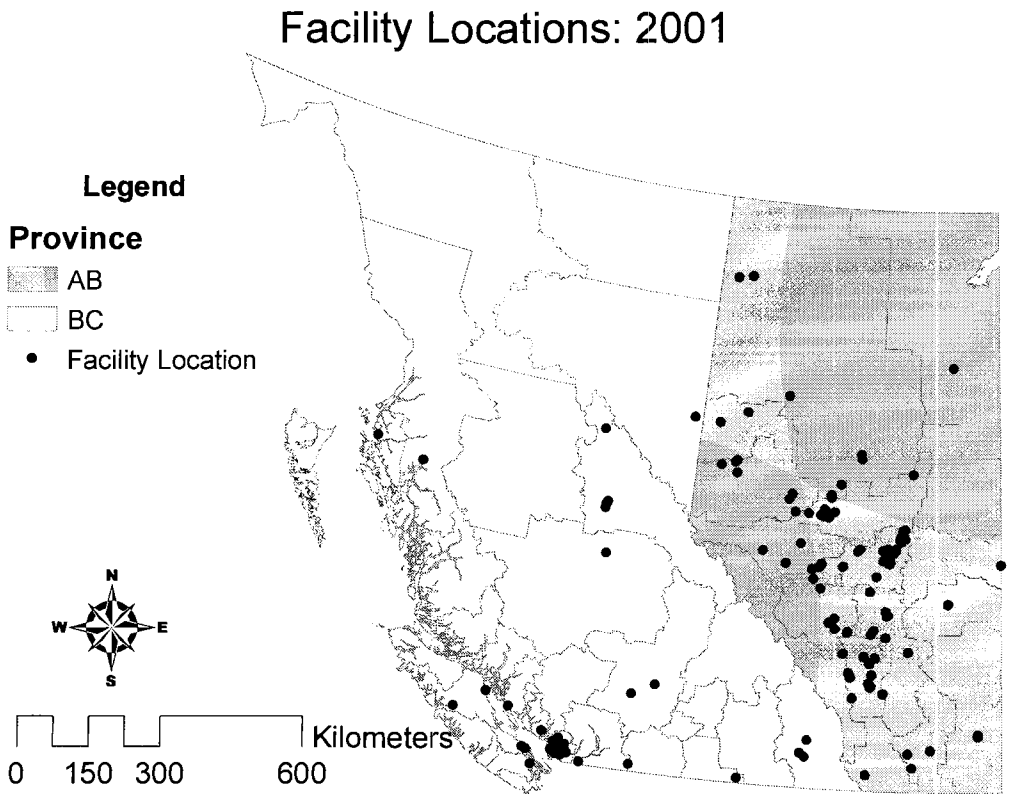


Appendix H: Tolerance and VIF scores, 1996

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Incidence of Low Income	.341	2.936
	Average Household Income	.575	1.738
	High School or Less	.471	2.124
	Rate of Minority Pop	.272	3.676
	Rate of Aboriginal Pop	.404	2.478
	Average Dwelling Value	.299	3.348
	Unemployment Rate	.437	2.288

a Dependent Variable: Rate Transformed

Appendix I: Facility Locations 2001



Appendix J: Regression Summary and ANOVA Table, 2001

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.679(a)	.461	.380	1.29054	.461	5.706	6	40	.000

a Predictors: (Constant), Unemployment Rate, Rate High School or Less, Incidence of Low Income, Average Household Income, Rate of Aboriginal Pop, Rate of Minority Pop

b Dependent Variable: Rate Transformed

ANOVA (b)

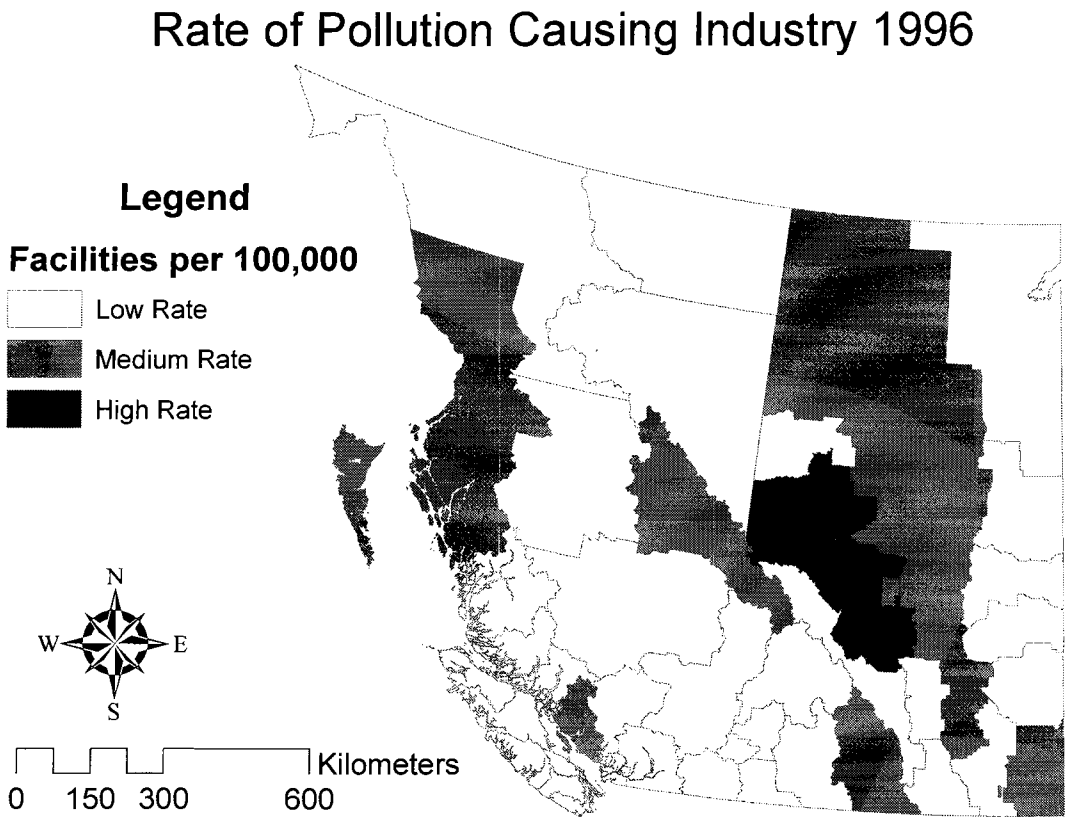
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	57.019	6	9.503	5.706	.000(a)
	Residual	66.620	40	1.665		
	Total	123.638	46			

a Predictors: (Constant), Unemployment Rate, Rate High School or Less, Incidence of Low Income, Average Household Income, Rate of Aboriginal Pop, Rate of Minority Pop

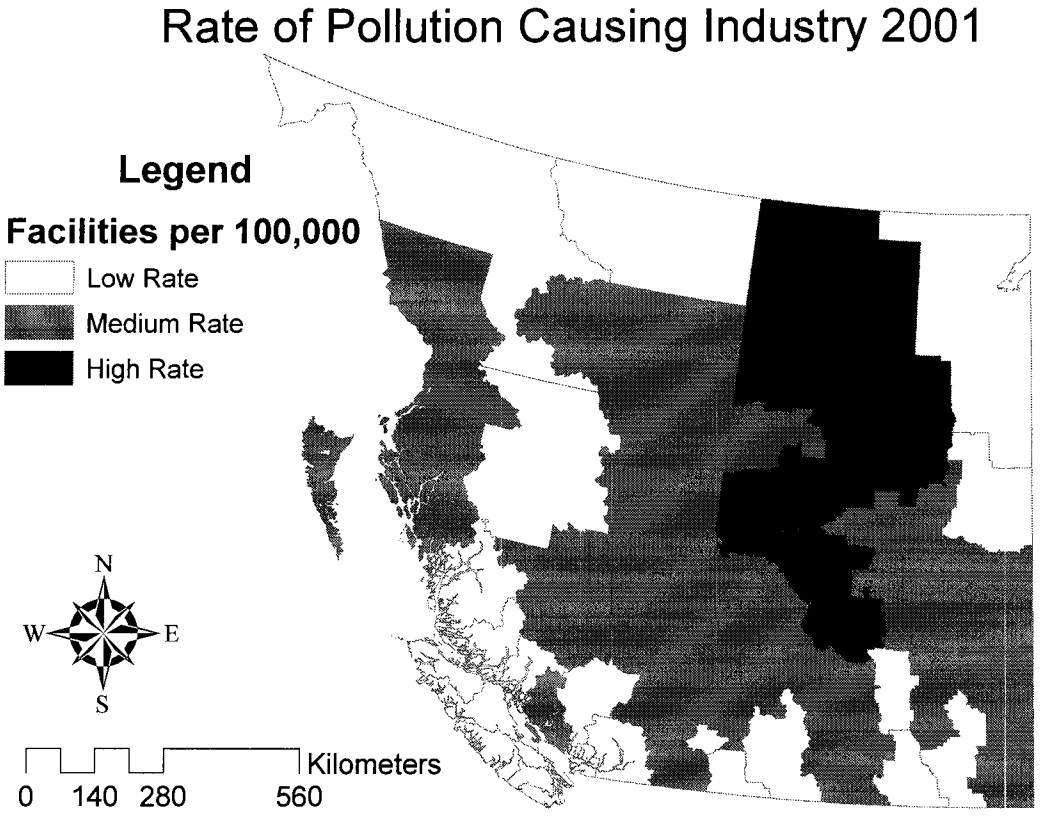
b Dependent Variable: Rate Transformed

Appendix K: Choropleth Maps

Choropleth Map, 1996



Choropleth Map, 2001



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