HEALTH POLICY APPROACHES TO CHILDREN’S ENVIRONMENTAL HEALTH

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A RESEARCH REPORT TO HEALTH CANADA

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The views expressed herein do not necessarily represent the official policy of Health Canada

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PREFACE

This report is in response to the Request for Proposal, “RFP 017-3: Request for Proposals for Synthesis Research Health Policy Approaches to Children’s Environmental Health”.

Dr. Daniel Krewski and Professor Jamie Benidickson served as Co-Principal Investigators. Dr. Krewski had responsibility for overall direction of the study, with Professor Benidickson assuming responsibility for the legal and regulatory research, including the supervision of legal research assistants, and in writing related aspects of the final report.

Three scientific advisors (Dr. Vic Armstrong, Dr. Don Wigle and Mr. John Harrison) served as an internal Scientific Advisory Panel and helped to guide the project. Co-investigators on the project (Dr. Michael Tyshenko, Ms. Michelle Turner, Ms. Connie Berry, and Ms. Lorraine Craig) carried out literature reviews, content analysis, expert interviews, and were involved in writing of the final report. The team met monthly to complete objectives and milestones set out in the report.

Report findings were disseminated to the Vulnerable Populations Division, Healthy Environments and Consumer Safety Branch, Health Canada and other stakeholders in a workshop hosted by the McLaughlin Centre for Population Health Risk Assessment. Following the workshop, the draft report, workshop presentations, and rapporteur’s report (Appendix 1) were available for comment from the McLaughlin Centre website at the University of Ottawa (www.mclaughlincentre.ca). The work will be disseminated according to the plan given in Appendix 2.
EXECUTIVE SUMMARY

It has been established that children have greater vulnerability to some substances in the natural and built environments. The Canadian Environmental Protection Act (CEPA, 1999) was enacted with its main mandate being the prevention and management of risks posed by harmful substances in the environment. A review of current policy for children’s environmental health in Canada summarizes a number of different Acts and legislation at the federal level. Provincial and Municipal legislative frameworks are also reviewed. After establishing the context of current legal and policy frameworks in Canada a comparative analysis of children’s environmental health was undertaken by analysis of expert and non-expert content to uncover governance and non-governance instruments. Expert opinion from different jurisdictions (Canada, United States and the European Union) was also solicited to determine key legislative tools and practices used. Experts were asked about facilitators, barriers and instrument choice. Interviews from external experts revealed a number of common themes as well as novel approaches for improving children’s environmental health. From the review of legislation, policy and practices from other jurisdictions instrument choice, criteria and implementation of instruments were compared. A number of relevant case studies were reviewed as examples to understand legislative instruments and results in a Canadian context.

Finally the research synthesis is used to provide recommendations and conclusions. In Canada the implicit designation of children in legislation and the cross cutting nature of children’s environmental health issues makes it difficult to manage. The ability to improve children’s environmental health can be strengthened in two main areas: organizationally (clear mandates, explicit responsibility for children’s environmental health, and effective coordination of risk management responsibilities) and operationally (increased research, improved surveillance
or longitudinal studies, and effective enforcement of existing standards). The recommendations made in this report are designed to enhance the basis for children’s environmental health risk management decision-making.
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1 BACKGROUND AND INTRODUCTION

1.1 Overview of CEPA, 1999

The Canadian Environmental Protection Act was first passed into law in June, 1988; this Act replaced the Environmental Contaminants Act and subsumed other Canadian environmental protection statutes (and their regulations) such as the Clean Air Act, the Ocean Dumping Control Act and part of the Canada Water Act. CEPA, 1988 was superseded by a new and further expanded Canadian Environmental Protection Act, (CEPA, 1999) which received royal assent in September 1999.

The current legislation, which resulted from a mandatory parliamentary review of CEPA, 1988, continues the mandate of prevention and management of risks posed by harmful substances in the environment. Under CEPA, 1999 substances encompass a broad collection of environmental pollutants as well as existing and new hazardous substances. The definition of substances under CEPA also includes products of biotechnology, water contaminants, anthropogenic chemicals, chemical spills, emissions (from combustion sources), fuels and hazardous wastes. CEPA, 1999 provides for the assessment and management of the environmental and human health impacts resulting from this broad range of substances.

CEPA, 1999 is complemented by several other federal Acts for protecting humans and the environment; for example the Fisheries Act, the Food and Drugs Act, Hazardous Products Act, the Canada Water Act, the Species at Risk Act, the Canada Wildlife Act, and the Canadian Environmental Assessment Act. Additional specialized Acts are also used to regulate chemicals.
(pesticides, fertilizers and the introduction of biotechnology products) to reduce the risks to the environment and human health (Environment Canada, 2005a).

Canada is one of the few countries in the world to take a very comprehensive legislative approach to hazardous substances in the environment by requiring under CEPA, 1999, an examination of all commercial substances. In order to oversee and enforce this consolidated legislation on protecting the environment CEPA, 1999 added many new Ministerial authorities and obligations, including: Requirements for environmental quality research; more emphasis on risk assessment and risk management of toxic substances and their handling, increasing risk management of new technologies like genetic engineering, pollution prevention, new enforcement tools, such as Environmental Protection Compliance Orders (EPCOs); and strengthening authorities for environmental action governing federal departments and agencies (CCME, 2005a).

There are many challenges with respect to the implementation of CEPA including the requirement to categorize 23,000 existing chemicals and as a way to prioritize these for screening assessments. Assessments of substances must be conducted to ascertain whether substance poses a risk to health or the environment; thus under subsection 64 of the Act a substance is "CEPA Toxic" if “….. it is entering or may enter the environment in a quantity or under conditions that a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; b) constitute or may constitute a danger to the environment on which life depends; or c) constitute or may constitute a danger in Canada to human life or health.”

1.2 Proposals for Legislative Reform to CEPA, 1999 (five-year review)
CEPA, 1999 received royal assent on September 14, 1999 replacing the original Act, which had been in effect since June 30, 1988. CEPA, 1999 came into force on March 31, 2000. The proposed CEPA, 1999 was subject to at least 250 amendments before being proclaimed.

CEPA, 1999, Section 343, requires that the Act be reviewed every 5 years after coming into effect (which, in the case of CEPA, 1999 was March 31, 2000). The purpose of the review is to examine the provisions and operation of the Act and to make recommendations that would improve its effectiveness in protecting the environment and human health. By March 31, 2005, the Ministers of the Environment and Health advised Parliament that this review was required. The review is assigned to a Parliamentary Committee that conducts a review and prepares a report within one year.

The Parliamentary Committee Review provides recommendations to the Government of Canada pertaining to revisions of CEPA on pollution prevention, sustainable development and federal/provincial/territorial cooperation. The Parliamentary Committee Review provides the opportunity for feedback from the public on how well they feel the Act is protecting the environment and human health.

Previously participants reporting on amendments to CEPA, 1999 emphasized that CEPA should unambiguously require that risk assessments take into account susceptible populations, including pregnant women, infants, children, people with environmental sensitivities, individuals with allergies and individuals with pre-existing respiratory ailments (Environment Canada, 2005b).
1.3 Children’s Health and Environmental Hazards Designated by Health
Canada as a Component of the Legislative Agenda

It has been established that children have greater vulnerability following exposures to high levels of some substances such as lead, methylmercury and PCBs in the natural and built environments. Research has also indicated that deleterious health impacts may result from low-level exposures to some environmental toxicants. Increased risks for a variety of different health outcomes, respiratory conditions, neurodevelopmental delays, developmental impairment, cancer, immune system effects, reproductive effects and developmental alterations have been associated with exposure to various environmental contaminants. However, data on such effects among children in Canada are currently very limited.

1.4 Purpose and Scope of Report

CEPA and its administration must be reviewed every five years. As of March 31, 2005, CEPA, 1999 was referred for Parliamentary Review and, in April 2006, the work of the CEPA 1999, review was referred to two Parliamentary Committees, one from each House of Parliament:

- on April 25, 2006, a motion was passed in the House of Commons ordering that the Standing Committee on Environment and Sustainable Development be the committee for the purposes of Section 343 of the Canadian Environmental Protection Act.
• on April 27, 2006, a motion was passed in the Senate ordering that the Standing Committee on Energy, the Environment and Natural Resources be authorized to undertake a review of CEPA 1999 pursuant to Section 343(1) of the said Act.

The information presented in this report is intended to assist policy makers at Health Canada in utilizing the experience of other jurisdictions to develop and implement legislative and other measures to safeguard children’s health from environmental hazards in the context of the upcoming revisions to CEPA, 1999 and to the proposed Canada Health Protection Act (CHPA).

Content analysis of newspaper, internet grey literature and peer-review articles (including legal databases) will be used to help select case study examples, provide a short list of names of pertinent Acts and regulations, determine a list of children’s environmental health issues and validate expert opinion interviews.

Expert opinion was solicited through interviews targeted to various areas where individuals have experience with governance and non-governance instruments. Analysis using the experiences of other jurisdictions (notably the United States and members of the European Union, and selected international agencies eg. World Health Organization) compared to Canada allowed for the determination of risk issues, barriers, facilitators and proven strategies for improving children’s environmental health based on governance and non-governance instruments.

This research collectively identifies elements of a children’s environmental health protection and illustrate variations that have been adopted elsewhere providing much needed context for Canadian policy makers seeking guidance on revisions for protecting vulnerable groups under CEPA, 1999. The research attempts to incorporate ideas of precaution, addressing
uncertainties in the state of the science, focusing on critical windows of childhood development and addressing multi-media exposures throughout the report.
2 CHILDREN’S ENVIRONMENTAL HEALTH AS A FOCUS FOR LEGISLATIVE ACTION: THE SCIENTIFIC EVIDENCE

2.1 Introduction

Health as defined by the World Health Organization is “… a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO, 1948). The health of a population is influenced by a broad array of determinants. Although population health frameworks have proposed a variety of specific determinants, broadly, they can be seen as encompassed by the following categories: biology and genetics, environment and occupational, and social and behavioural (Figure 2.1). Health determinants may be considered in isolation or perhaps more relevantly, in combination, as interactions between any of the determinants may produce synergistic or antagonistic effects on health status. The concept of the environment in relation to health status tends to be quite broad in perspective and usually includes such components as the natural environment (ex. air, water, and soil), the built environment (ex. housing, infrastructure) as well as consumer products (ex. household products, children’s toys) (Hertz-Picciotto, 1998).

The influence of the environment on health status in general has long been recognized (Hertz-Picciotto, 1998). The field of children’s environmental health however, has only begun to emerge more recently (Wigle, 2003). Indeed, a major stimulus for investments in research into the area was the publication of the National Academy’s *Pesticides in the Diets of Infants and Children* in 1993 (National Research Council, 1993; Charnley and Putzrath, 2001). The report highlighted that compared to adults, children may experience higher levels of exposure to
pesticide residues in food and greater susceptibility to the toxicity of pesticides. It also proposed a variety of regulatory changes in order to better protect children’s health.

Children’s environmental health issues can range from those for which the weight of the evidence is substantive to others where the scientific basis for an association is limited or inadequate (Wigle, 2003). For example it is well established that environmental exposure to high levels of lead in childhood may result in serious permanent effects on cognitive function (Toscano et al., 2005) while recent longitudinal studies have shown convincing evidence of cognitive deficits at lower blood lead levels that were previously considered not to be of concern (Lanphear et al., 2005). In contrast, the association between residential proximity to radiofrequency fields and childhood leukemia remains unclear (Kheifets and Shimkhada, 2005). There are many other childhood diseases where environmental links are suspected (Wigle, 2003). Researchers are also only beginning to describe the nature of interactions between the environment and other health determinants, which may modify the environment-health outcome association such as genetics or social factors (Suk and Collman, 1998; Chaudhuri, 2004).

Various studies have estimated the economic and societal costs associated with children’s environmental health disorders to be substantial, in part, due to disruption of normal development with potential serious and irreversible consequences (Muir and Zegarac, 2001; Landrigan et al., 2002). For example, annual direct and indirect costs associated with the environmental component of childhood lead poisoning, asthma, cancer, and neurobehavioral disorders in the US were estimated at nearly $55 billion (range $49-65 billion) for 1997 (Landrigan et al., 2002).

Among the leading causes of morbidity and mortality among infants and children, there exist many causes with fractions attributable to environmental factors (Wigle, 2003; Commission
Increasing trends in the incidence of a number of such diseases in children including allergy and asthma as well as certain cancers have also been reported (Wigle, 2003; Commission for Environmental Cooperation, 2006). In addition, of the thousands of chemicals produced each year, very few have been tested for developmental toxicity (Landrigan et al., 2002; Goldman and Koduru, 2000).

This Section describes the rationale for considering distinctive policy responses for children by reviewing the unique characteristics of children and children’s environmental health issues, variations within the population of children, other vulnerable child populations, and the scope of risks to children’s health. The Section does not provide a complete review of the existing literature, but through the illustration of specific examples highlights the main considerations for policy response in this area.
Figure 2.1. University of Ottawa, Centre for Population Health Risk Assessment

(unpublished)
2.2 Distinctive Characteristics of Children’s Health Challenges

Risk may be defined as a function of the probability of occurrence and the nature of the consequences (Presidential/Congressional Commission on Risk Assessment and Risk Management, 1997). The potential consequences of environmental agents on children’s health may range from subtle reversible effects to potential serious permanent long-term effects and even death (Wigle, 2003). The probability of the occurrence of adverse children’s environmental health effects for a given agent may depend on factors affecting exposure, susceptibility, and toxicity of the agent (Faustman et al., 2000).

This section of the report describes how children may be unique with respect to the probability and consequences (of exposure); these are primarily scientific considerations. The influence of public’s perception of risks is a potentially important modifier of the risk equation and a critical input for effective risk issue management, which must also be considered (Leiss, 2001); this aspect is addressed in Section 3.

2.2.1 Probability

The probability of the occurrence of an adverse children’s environmental health outcome is influenced by the pattern and level of exposure (timing, intensity, duration), the susceptibility of the child to the exposure (genetic factors, age, nutritional status, other health conditions), and the toxicological properties of the environmental agent.

2.2.1.1 Exposure
Children may be exposed to potentially hazardous environmental agents through various pathways including ingestion, inhalation, and dermal exposure pathways while the developing fetus is exposed transplacentally to the mother’s body burden of contaminants (Health Canada, 1998). Examples of the types of exposures that may be experienced through each of the following media include: food (e.g. PCBs, methylmercury, pesticide residues), drinking water (e.g. chlorination disinfection by-products, waterborne infectious agents), breast milk (e.g. PCBs and other persistent organochlorine compounds), air (e.g. environmental tobacco smoke, ambient air pollutants), soil (lead, arsenic), consumer products (e.g. phthalates in plastics, lead in imported jewellery), built environments (e.g. radon, volatile organic compounds, molds), radiation-emitting devices (e.g. ionizing radiation, radiofrequency radiation, power-emitting electromagnetic fields) etc.

Children’s exposures to environmental agents (adjusted for body weight) may exceed those of adults, thereby increasing the likelihood of adverse health effects (Faustman et al., 2000; Moya et al., 2004). A combination of physiological and behavioural factors in children may combine to result in increased levels of exposure to environmental contaminants. Large differences in consumption of certain foods and water per unit body weight are observed. As summarized by Selevan et al. (2000), it is estimated for example that infants less than 1 year of age consume 43.5 mL/kg/day of drinking water compared to 35.5 mL/kg/day in children and only 19.9 mL/kg/day in adults (Snodgrass, 1992). It is also estimated that infants consume 12.9 g/kg/day of fruits (minus citrus fruits) compared to 5.8 g/kg/day in children and only 1.3 g/kg/day in adults (U.S. Environmental Protection Agency, 1997).
In addition, children below age 3 years crawl, play on the ground, and display high amounts of hand-to-mouth contact thus increasing the potential for elevated contaminant exposures through ingestion, dermal, and inhalation pathways (Faustman et al., 2000). Indeed, levels of indoor housedust ingested have been estimated at 60 mg/day in children aged 2.5 years compared to only 0.4 mg/day among adults (Snodgrass, 1992; Selevan et al., 2000). Children may also receive additional environmental exposures as a consequence of their location of residence and parental behaviours as elevated exposure to industrial chemicals may be experienced due to airborne emissions and contamination of ground water, soil, and local garden produce as well as direct transfer from clothing worn by parents at work (Faustman et al., 2000).

The nature of certain children’s environmental exposures is also unique. For example, in utero environmental exposures are experienced by the fetus not only as a result of present maternal experience, but also as a result of stored chemicals released by fat and bone tissue during pregnancy (Makri et al., 2004). For instance, maternal blood lead levels increase during late pregnancy, especially among older mothers and those with low dietary calcium intake (Hertz-Picciotto et al., 2000; Gomaa et al., 2002). Additionally, in infancy, infant products, breast milk, and formula constitute large proportions of the diet (Lawrie, 1998; Faustman et al., 2000). The preferential introduction of other foods over the first months and years of life eventually replaces all early food sources and may lead to enhanced exposures to other toxicants such as pesticides (National Research Council, 1993; Makri et al., 2004). Breast milk remains a unique and important early food source of concern as detectable levels of contaminants ranging from flame retardants (PBDEs, a family of chemicals with toxicities and other properties similar to PCBs) to pesticides to plasticizers to methylmercury and therapeutic drugs were detected in
the breast milk of women throughout the world (Latini et al., 2004; Kalantzi et al., 2004; Fitzgerald et al., 2001; Howard and Lawrence, 1998; Abadin et al., 1997; Faustman et al., 2000).

Overall, although it is found or suspected that children’s exposure to a variety of environmental toxicants may be elevated compared to adults, a difficulty in terms of health policy however, may arise due to the fact that there exists a lack of information on children’s environmental exposures in Canada as no national biomonitoring is currently performed (Commission for Environmental Cooperation, 2006). Lead is the only environmental contaminant ever measured at the national level in Canada (using blood samples collected during the 1978-79 Canada Health Survey) and, even then, it was only measured in persons age 6 years or older, thus excluding the most important at-risk population subgroups (the fetus and preschool child are at greatest risk of cognitive deficits from lead).

2.2.1.2 Susceptibility

From conception through to adulthood, the developing fetus and child undergo complex patterns of growth and development. Indeed, the development of organ systems at differential rates during pregnancy and throughout childhood (including adolescence) creates critical exposure time windows with unique potentials for adverse health effects (below). In general, differences in the uptake, distribution, metabolism, and elimination of exogenous environmental agents due to immature systems in children may play important roles in increasing the susceptibility of infants and children to the occurrence of an adverse health effect. Additionally, exposures to toxic environmental agents early in life may allow for an extended time period for the manifestation of delayed adverse health effects, particularly cancer. For instance the risk of
adult breast cancer was substantially elevated for persons exposed to ionizing radiation during adolescence (American Academy of Pediatrics Committee on Environmental Health, 1998).

Scheuplein et al. (2002) and Makri et al. (2004) summarize many of the physiological changes which may impact chemical sensitivity in infants and children. Although development continues throughout childhood and adolescence, generally, it is believed that the fetal and infant periods may represent particularly enhanced periods of sensitivity to chemical exposures. Indeed, a large host of physiological changes manifest during pregnancy that may impact internal dose received, and as mentioned above, may reflect both current and previous (stored) exposure. Chemicals of certain properties may also be easily transferred across the placenta, distributed throughout the body, and some (e.g. lipophilic chemicals such as methylmercury) may accumulate in the brain. Little capacity for detoxification of certain chemical toxicants by the fetus is also an important consideration.

In general, a wide variety of factors impact toxicokinetics in children potentially leading to elevated or prolonged dose received for certain chemical exposures. Ingestion is thought to represent a particularly important route of exposure during the first year of life due to the incomplete maturation of GI-related toxicokinetic factors with other routes of exposure becoming subsequently more important. Elevated gastric absorption of inorganic elements is observed in infants and preschool aged children compared to adults. Other factors leading to differential gastric absorption include differences in gastric pH, gastric secretions, digestive enzyme activity, gastric emptying time, GI motility, as well as differences in intestinal flora and bile acid metabolism in infants and children compared to adults. Dermal and inhalation absorption of environmental chemicals may also be enhanced in the infant due to greater skin surface area and increased ventilation rates. Distribution of an exogenous chemical agent in the
infant and child body may be affected by reduced protein binding, increased extracellular water, and increased body fat. The ability to metabolize certain exogenous chemicals in the newborn also tends to be reduced in comparison to the adult. More specifically, infants have lower levels of key enzymes involved in detoxification including P450 enzymes, B-glucuronidase, and glutathione-S-transferase. Reduced renal function may influence the ability of the infant to eliminate chemical compounds from the body; however, reaches double that of adult capacity per body weight by age six months.

2.2.1.2.1 Critical Exposure Time Windows

As stated above, human development does not occur uniformly across each organ system, but rather, each organ system undergoes a series of stages of rapid development occurring at precise time intervals (Scheuplein et al., 2002). It is precisely during these critical time periods of development where the individual may be more highly susceptible to the occurrence of certain permanent adverse health effects from exposure to environmental agents that may range from death to various structural or functional abnormalities (Selevan et al., 2000; Makri et al., 2004; Anderson et al., 2000).

The prenatal period and childhood may be subdivided into specific critical windows based on developmental period and potential susceptibility to environmental agents (Scheuplein et al., 2002). The subgroups considered here include the preconceptual period, prenatal period, infancy, childhood, and adolescence. It is important to recognize however, that scientists are only beginning to understand the influence of exposures during certain periods of development.
and their specific health effects (Selevan et al., 2000). The depth of knowledge also varies greatly by developmental stage (Selevan et al., 2000).

**Preconceptual Period**

There is growing evidence that preconceptual maternal and paternal exposures may disrupt fetal and child development. Preconceptual paternal occupational exposures to certain toxicants (e.g., pesticides, ionizing radiation) have been linked to fetal death and childhood cancer (Feychting et al., 2001; Shu et al., 1994). This is an emerging field of epidemiologic research that urgently needs increased support.

**Prenatal Period**

During the prenatal period, the developing child undergoes rapid cell division, differentiation, and growth, to transform from a single fertilized ovum to a viable fetus with most organ systems largely formed by birth (Scheuplein et al., 2002). Some of the unique features related to susceptibility during this time period are described above. Organ specific time windows for unique susceptibility to teratogens have long been recognized (Moore and Persaud 1973). The embryonic period (week 2-8 post-fertilization) is a particularly sensitive time period to the effects of teratogens as this is a key period of formation of many organs (Moore and Persaud 1973; Scheuplein et al., 2002). Anatomical birth defects can only be caused by disruption of fetal development during the 1st trimester. During later pregnancy, the fetus is vulnerable to functional as opposed to anatomical abnormalities (Moore and Persaud 1973; Scheuplein et al., 2002). It is indeed the concept of the timing of exposure, that is a major determining factor to the nature and type of adverse effect that may be expressed (Makri et al., 2004). Indeed more extreme adverse effects tend to be manifested with earlier prenatal exposures experienced (Makri et al., 2004; Moore and Persaud 1973).
Recently the timing for potential adverse health effects for a variety of systems was highlighted (Selevan et al., 2000). Some exposure-response relationships however, have been more precisely characterized than others. Although limited human data exist, the prenatal and early postnatal (below) periods may represent critical time windows for immunotoxicant exposures including pesticides, heavy metals, PCBs and PAHs potentially resulting in reduced immune capacity or the development of hypersensitivity or autoimmune disorders (Holladay and Smialowicz, 2000).

Weeks 3-8 of gestation were described as a critical time window for heart and endocrine glands abnormalities with a second period of susceptibility for certain organs in the early or late fetal period arising due to cell differentiation (Sadler et al., 2000).

Prenatal maternal exposure to ionizing radiation and diethylstilbestrol (DES), respectively, are well-established risk factors for childhood leukemia and clear-cell adenocarcinoma of the vagina in young women (Anderson et al., 2000; Olshan et al., 2000). A range of other prenatal exposures are suspected carcinogens however, the evidence remains controversial (Anderson et al., 2000). Prenatal maternal environmental tobacco smoke exposure is a suspected risk factor for chromosomal abnormalities (Neri et al., 2006) and childhood cancer but epidemiologic evidence to date is limited, precluding firm conclusions. Also, perinatal HBV infection as opposed to infection in infancy or early childhood increases substantially the risk of becoming a chronic HBV carrier, a significant risk factor for hepatocellular carcinoma (Anderson et al., 2000).

The nervous system develops from the embryonic period through puberty, and as such remains vulnerable to developmental effects of chemical exposures for an extended period of time (Rice et al., 2000; Adams et al., 2000). As summarized by Adams et al. (2000) however,
some specific time windows in the prenatal period have been reported. For PCBs and methylmercury, prenatal exposure appears to be most important for causing neurotoxicity (Schantz et al., 2003). By comparison, both prenatal and early childhood lead exposures can cause cognitive deficits even at very low exposure levels with no apparent threshold (Lanphear et al., 2005; Emory et al., 2003).

Adverse respiratory system effects from environmental chemical exposures are also thought to depend on timing of exposure (Pinkerton and Joad, 2000). For example, the prenatal and neonatal periods are thought to represent critical periods for adverse structural, functional, and growth abnormalities as well as hypersensitivity and cancer development. Although little specific evidence exists, prenatal maternal exposures are hypothesized to be somewhat important in the development of atopy (Peden et al., 2000).

The reproductive system continues to develop from the neonatal to adolescent periods thus increasing the number or length of critical windows of exposure (Lemasters et al., 2000; Pryor et al., 2000). Although little human data exists, prenatally, the embryonic and early fetal period whereby gonadal differentiation, urogenital system development, and mammary bud formation occurs may represent critical time periods where environmental exposures, especially hormonally active chemicals, may be particularly important (Lemasters et al., 2000; Pryor et al., 2000). The prenatal period may also represent a critical exposure time period in females, as all oocytes are established at this time (Pryor et al., 2000).

*Neonatal Period*

The neonatal period encompasses the time from birth to one month of age (Makri et al., 2004). As described by Makri et al. (2004) and above, the neonatal period may represent a time period of heightened sensitivity to chemical exposures, particularly through the GI route. Small
lipophilic chemicals, basic substances, and heavy metals present in breast milk are easily absorbed by the developing GI tract. Lipophilic compounds are not easily metabolized and excreted by the neonate due to immature detoxification systems and are preferentially stored in the brain.

The prenatal and early postnatal periods may represent a critical time window for exposures to immunotoxic agents, certain infectious viruses, and for effects on the respiratory system including structural, functional, and growth abnormalities as well as development of hypersensitivity and cancer. The neonatal and early infant periods may also represent a critical window for testis and mammary gland development (Lemasters et al., 2000; Pryor et al., 2000).

**Infancy**

The period of infancy ranges from age 1 month to about 2 years (Makri et al., 2004; Scheuplein et al., 2002); during this time, maturity of various toxicokinetic factors and GI function occurs. However, absorption of inorganics, blood distribution and preferential storage of lipids in the brain remain elevated (Makri et al., 2004; Scheuplein et al., 2002). This time period is also characterized by breast milk consumption, as well as the introduction of other foods thereby possibly increasing the range of chemical exposures (Makri et al., 2004). Various behavioral factors may also increase exposure to a variety of environmental agents. Infancy and childhood also represents an important time period of brain development and continued lung development (Adams et al., 2000; Scheuplein et al., 2002). Indeed, the first year of life is thought to represent a critical period of exposure to environmental agents such as allergens and the development of asthma or atopy (Peden et al., 2000). The early infant period may also represent a critical window for testis and mammary gland development.

**Children**
Since children ranging in age from about 2 years to 12 years of age have relatively mature GI function, other exposures including dermal and pulmonary as well as age-specific unique behavioural patterns may become more important determinants of chemical exposures (Makri et al., 2004). Brain and lung development continues during childhood.

Late childhood and adolescence represents an important window for maturation of reproductive organ function again where exposure to hormonally active agents may have the potential to negatively impact reproductive function (Lemasters et al., 2000; Pryor et al., 2000). Certain infections which may occur during early childhood may increase cancer risks later in life, e.g. Helicobacter pylorus and hepatitis B infection, respectively, increase the risks of stomach and liver cancers as compared to infection later in life (Rowland and Drumm, 1998; Anderson et al., 2000).

Adolescents

Adolescence from age 12 to 18 years represents the time period of lung, brain, and reproductive tract maturation as well as the potential introduction of new chemical exposures such as smoking, recreational drugs, and occupational exposures (Makri et al., 2004). Although little is known about the adverse effects of exposures to the adolescent brain, it is recognized as an important area of research due to the occurrence of significant brain development and results from animal studies suggesting the consequences of external exposures in adolescence for later behaviour and physiology (Adams et al., 2000). Adolescence is also suspected as a critical period of development in males due to the significant increase in germ cell production and genital growth (Pryor et al., 2000). Exposure to ionizing radiation during childhood or adolescence increases the risk of adult breast cancer, thyroid cancer, leukemia and other cancers.
2.2.1.3 **Toxicity of Children’s Environmental Exposures**

The effects of children’s exposures to environmental substances is influenced their physical chemical properties and the dose-response relationship. Physical/chemical properties include factors such as solubility and biological reactivity. The dose-response function of environmental chemical exposures may exhibit a threshold, or may display linear, sublinear, supralinear or U-shaped properties. The dose-response relationship of lead is discussed in Section 8. A challenge certainly exists in the field of children’s environmental health as the majority of established relationships in human population studies are those with high levels of exposure received (Wigle, 2003). A major challenge for regulators remains the lack of knowledge surrounding chronic low-dose exposure for which the majority of the population is likely exposed. Indeed, human health effects from chronic low-dose environmental exposures are particularly difficult to characterize in epidemiological studies and tend to result in much scientific uncertainty.

Although Scheuplein et al. (2002) state that low level environmental exposures are less likely to overwhelm developing systems than high level exposures, seemingly subtle effects from low level exposure can be associated with large life-time or population consequences (as is the case for lead, see below and Section 8) (Rice and Barone Jr., 2000; Landrigan et al., 2002; Toscano and Guilarte, 2005). There is little information on the developmental toxicity of most chemicals currently in production (Landrigan et al., 2002; Goldman and Koduru, 2000). Increased research and the establishment of national biomonitoring programs are critical to inform the knowledge gap and to inform children’s environmental health policy (National Research Council, 2006a; McLaughlin Centre, 2006).
2.2.2 Consequences

The consequences associated with children’s environmental health exposures, as previously mentioned, may be very broad in scope and range from the most severe, death, to other less severe functional consequences. In addition, there are a number of unique factors that may influence the nature of the consequences for adverse environmental health outcomes in children including the potential for permanent effects due to developing systems, and due to exposures very early in life, the potential for a lifetime of morbidity or years lost.

As noted above, the economic and societal costs associated with children’s environmental health disorders have been estimated to be substantial (Muir and Zegarac, 2001; Landrigan et al., 2002). For example, small shifts in IQ due to environmental lead exposure, as small as a 1 IQ point reduction, have enormous estimated personal and societal economic consequences (Landrigan et al., 2002; Rice and Barone Jr., 2000; Toscano and Builarte, 2005). Costs associated with other environmentally related diseases are far reaching with direct and indirect medical and morbidity costs ranging into the billions of dollars for U.S. estimates alone (Landrigan et al., 2002).

2.2.3 Other Vulnerable Child Populations

There may also exist subgroups of children in Canada that may experience much greater levels of environmental exposures compared to average or may be more highly susceptible to the
effects of environmental exposures. Although it is possible to illustrate this with many examples only the influence of genetics, socioeconomic and Aboriginal status will be described here.

2.2.3.1 Genetics

Genetics plays an important role in determining health status (Figure 2.1). Indeed a variety of childhood diseases have established genetic links (Suk and Collman, 1998). Although research into the determination of gene-environment interactions in relation to children’s health is at an early stage, there are a number of suspected links. For example, polymorphisms in genes related to metabolic enzyme activity, growth factor regulators and homeobox genes may increase susceptibility to environmental chemical exposures (National Research Council, 1993; Faustman et al., 2000). The high degree of variation in gene expression throughout the stages of development also relates to the existence of critical time windows of exposure to environmental agents (Faustman et al., 2000). It is clear that further research to improve understanding of gene-environment interactions is needed (Suk and Collman, 1998).

2.2.3.2 Socioeconomic Status

Level of income has long been recognized as a significant determinant of health status for a variety of reasons (Mustard and Frank, 1991; Federal, Provincial and Territorial Advisory Committee on Population Health, 1999; Marmot and Wilkinson, 1999). For example, among the disadvantaged, poor housing and neighbourhood quality may lead to increased exposure to a range of chemical and biological contaminants and unsafe conditions leading to a range of
adverse health effects including injury, respiratory disease, deficiencies in emotional
development and mental health, cardiovascular disease later in life, and mortality (Chaudhuri,
2004; Xue et al., 2005; Shenassa, et al., 2004; Evans and Kantrowitz, 2002; Cummins et al.,
2001). The disadvantaged may experience greater levels of exposure to a variety of exposures
including air pollution, tobacco smoke, lead, certain allergens as well as experience greater
disease severity and increased hospitalization rates (Moralez et al., 2005; CDC, 1997; Almqvist
et al., 2005; Litonjua et al., 1999; Perera et al., 2002; Shapiro et al., 2002). Disadvantaged
children are also more likely to have a poorer nutritional and health status, increasing
susceptibility to environmental exposures (National Research Council, 1993). In 1995, it was
estimated that approximately one quarter of all children in Canada lived in low-income
households, decreasing to 15.6% in 2001 (Federal, Provincial and Territorial Advisory
Committee on Population Health, 1999; Commission for Environmental Cooperation, 2006).
The unique vulnerability of homeless children to environmental exposures has also been
recognized (WHO/IPCS, 2006).

2.2.3.3 Aboriginal Children

The health of the Aboriginal population in general has long been recognized as requiring
significant investment and improvement in order to more closely reflect that of the overall
Canadian population (Canada. Royal Commission on Aboriginal Peoples, 1996). For example,
infant mortality rates and rates of hospitalization among Aboriginal children remain significantly
elevated compared to the overall child population (Canada. Royal Commission on Aboriginal
Peoples, 1996). With respect to environmental exposures, Aboriginal children, for a variety of
factors which may include poverty, housing conditions, or other social or cultural factors, may represent a subpopulation that experiences much higher levels of certain exposures (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999; Indian and Northern Affairs Canada, 2003; Canada. Royal Commission on Aboriginal Peoples, 1996).

In 1991, the Northern Contaminants Program http://www.ainc-inac.gc.ca/ncp/index_e.html) was established in Canada with the focus of determining the extent of environmental and human exposures to contaminants in the Canadian Arctic and their resulting impact on human health (Indian and Northern Affairs Canada, 2003). Most health risk uncertainty related to the presence of contaminants in the Arctic food chain is due to methylmercury and persistent organic pollutants (POPs). Inuit mothers have been found to have levels of oxychlordane, trans-nonachlor, PCBs, HCB, mirex, toxaphene, and mercury for example, in blood much higher compared to other Aboriginal groups or Caucasians in the Arctic (Indian and Northern Affairs Canada, 2003). In some cases, levels of contaminants among the Inuit were also found to exceed guideline values. For example, the level of concern for maternal blood level of PCBs as Aroclor 1260 (range from >5 - < 100 ug/L) was found to be exceeded in 43% of the samples from Inuit mothers, with much lower proportions of samples exceeding the level of concern found among mothers of other Aboriginal groups or Caucasians (Indian and Northern Affairs Canada, 2003). The action level (100ug/L) was however, not found to be exceeded in any sample (Indian and Northern Affairs Canada, 2003). Similarly, Inuit mothers were the only maternal group found to exceed the ‘increasing risk’ level for blood mercury concentration (range from >20 -<100 ug/L), with even larger proportions of Inuit mothers found to exceed a recent maternal blood guideline developed in the US of 5.8 ug/L (Indian and
Again, no sample was found however, to exceed the ‘at-risk’ level for mercury of 100 ug/L (Indian and Northern Affairs Canada, 2003).

One of the research priorities of the Northern Contaminants Program is to study prenatal exposure to environmental chemicals and adverse developmental effects on immune system and nervous system function early in life. Neurobehavioural and immune function effects of prenatal exposure to environmental chemicals are being studied in prospective longitudinal cohort studies starting during pregnancy (Commission for Environmental Cooperation, 2006).

Aboriginal children may also experience differential levels of exposure to a variety of other agents due in part to comparatively poorer housing conditions, inadequate sanitation practices, as well as crowded dwellings leading to elevated exposures from infectious agents, allergens, as well as unsafe physical structures (Canada. Royal Commission on Aboriginal Peoples, 1996). Aboriginal children may also experience greater levels of exposure to environmental tobacco smoke as a recent report found aboriginal children in British Columbia were nearly twice as likely to be exposed to environmental tobacco smoke in the home compared to non-aboriginal children (BC Ministry of Health and Heart and Stroke Foundation of BC and Yukon, 1997). A detailed review of the health of the First Nations in Canada is available from Health Canada (2003a).

2.3 Professional and Research Initiatives

Some research activities relevant to children’s environmental health have been noted in the foregoing (e.g., the Northern Contaminants Program). Described below are some additional ongoing studies.
The Allergy, Genes and Environment Network (http://www.allergen-nce.ca/default.htm), one of the Networks of Centres of Excellence in Canada, was launched in 2004 to radically improve the quality of life for asthma and immune disease sufferers. Comprised of more than 100 researchers at 20 universities and research facilities plus over 70 Canadian and international partners, Allergen supports research, multi-disciplined scientific and health networking, commercialization and capacity building among experts in medicine, genetics, molecular biology (genomics and proteomics); environmental, occupational and population health; epidemiology; health economics, and health policy; ethics, psychology, sociology, and medical geography and anthropology. AllerGen research cuts across the following five broad themes to promote multi-disciplinary scientific/partner collaboration and network-based results: Genes and Early Life Determinants examines the interaction of early life events and environmental exposures with the genes that may impart susceptibility to allergies; Environments Populations and Society focuses on food, water, and air — and its effects on mothers and their infants, families and special Canadian populations, including our Aboriginal communities; Mechanisms and Biomarkers investigate biological mechanisms to aid the development of new diagnostic aids; Therapeutics and Drug Discovery contribute to unique therapeutic and drug discovery programs, partnering with the biopharmaceutical and biotechnological industries; and Prevention Control and Public Policy integrates knowledge of allergies, especially in schools and the workplace, towards the development of specific preventive and control measures, leading to significant public policy debate and change. One of AllerGen's key objectives is to double the number of clinical and
research trainees produced in Canada each year, while increasing the country's capacity to train allergic-immune disease specialists by 25% per year. A two-year, $110,000 AllerGen/BAYER/CAAIF Immunodeficiency and Immunomodulation of Allergic Inflammation Clinician-Scientist Research Fellowship has been created to encourage an increasing number of clinicians to train as scientists in the field of allergy.

2.3.2 Health Canada/Environment Canada/USEPA- Children’s Air Pollution

Health Effects Research

In support of this pilot project under the Canada-United States Border Air Quality Strategy, Health Canada is working with Environment Canada, the United States Environmental Protection Agency and partners from other levels of government, local businesses and communities to examine the impacts of air pollution on the health of children and other vulnerable populations, such as pregnant women and diabetics, in the Great Lakes Basin region. A cross-sectional study using a questionnaire survey and objective measures of lung function will identify any associations between respiratory symptoms and air pollution in elementary school children living in Windsor. Another study will examine the adverse effects of air pollution on the cardiovascular and immune systems of pregnant women, and on the birth weight of those infants. A personal exposure study of asthmatic children will assess the contribution of ambient sources of air pollution to asthmatic children’s personal and indoor exposures and determine the impact of ambient sources of air pollution on asthmatic children’s lung health.

Health Canada is also working with the British Columbia Centre for Disease Control and the Universities of British Columbia, Victoria and Washington to follow children's health from
before they are born (called a birth cohort) to determine the incidence of childhood respiratory disorders relative to air pollution exposure in the Georgia Basin Airshed. Another study will examine the relationship between adverse birth outcomes and exposure to air pollutants in the Greater Vancouver Regional District.

2.4 Conclusion

The unique vulnerabilities of children in terms of both the probability and consequences of adverse environmental health effects are clear. Although research into children’s environmental health issues has begun to emerge, there remain gaps in our knowledge and substantial scientific uncertainties. Further research is required in a number of areas. For example, the developmental toxicity testing of chemicals is inadequate; further epidemiological studies are required to improve our understanding of critical exposure time windows, genetic and social/behavioural – environment interactions, the influence of preconceptual exposures, multimedia exposures, and low-dose effects; a national biomonitoring program is required in order to understand current levels of exposure of children to environmental toxicants and to establish their trends over time (National Research Council, 2006a; McLaughlin Centre, 2006).
3. CHILDREN’S HEALTH AS A FOCUS FOR LEGISLATIVE ACTION: 
PUBLIC PERCEPTION OF THE RISKS

3.1 Introduction

Policy decisions are influenced to some degree by the public’s perception of an issue and, in the case of children’s environmental health, how the risks of environmental toxicants are perceived is an important modifier of an estimation of risk based on strictly scientific criteria. Uncertainties surrounding many environmental health issues, which tends to heighten the public’s concern about issues, has evoked considerable debate about what course of health protection and regulatory action should be taken including the appropriate use of the precautionary principle (United Nations, 1992). Public perception is therefore a critical component for effective decision-making in managing risks and should therefore be taken into consideration (Krewski et al., 1987; Krewski, 1993; Slovic, 1999). In this section, studies of risk perception are presented. The extent to which coverage given by the media may also be a factor that influences the public’s perception of risks and hence have a bearing on decision-making. Results of a search of newspaper coverage of children’s environmental health issues are also presented.

3.2 Risk Perception

Studies of risk perception support the notion that perceptions of children’s environmental health issues may be elevated both in terms of the nature of the issue as well as the population in
question. In addition, there is a perception that high levels of health risk result from exposures to a variety of chemicals exposures (Krewski et al., 1995b; 2005; 2006). This may be due, in part, to the uncertainty about exposure to chemical contaminants; that surrounds them as hazards that are less familiar, for which less scientific information exists, that are involuntary, and for which have less obvious the benefits are unclear, tend to be perceived as posing higher greater in risks (Whyte and Burton, 1982; Slovic et al., 1982).

Studies of risk perception carried out in Canada have found high levels of environmental concern (Krewski et al., 1995a; 2005). Findings from the most recent national survey conducted in 2004 revealed that over 84% of respondents agreed with the statement that “the land, air, and water around us are, in general, more contaminated now than ever before” (Krewski et al., 2005). Chemicals in the form of air pollution and pesticides were also perceived as posing a higher risk to the health of Canadians compared to chemicals used for medical purposes (including prescription drugs and natural health products) (Krewski et al., 2005; Krewski et al., 2006). Similarly, nuclear power plants, as an industrial form of radiation, were perceived as posing a higher risk to the health of Canadians than x-rays, a medical form of radiation (Krewski et al., 2005; Krewski et al., 2006).

As summarized by Wigle (2003), it is interesting to note that both outdoor and indoor air pollution and pesticides were identified by many large national and international organizations as important environmental health issues in general and for children. Although both infectious and chemical contaminants in water were also identified by many organizations, public risk perception of the risks associated with tap water in Canada tended to be very low (Wigle, 2003; Krewski et al., 2005). Chemical risks in children’s environments were also found to predominate in our analysis of Canadian newspaper and magazine reporting (see below).
Although, the Canadian national risk perception survey did not gather perceptions about health risks to children specifically, other research may help to inform this gap. For example, there exist a variety of factors with a known influence on risk perceptions (Whyte and Burton, 1998; Slovic et al., 1982). Perceptions of risk may be heightened if the hazard is less familiar, is involuntary, and for which less scientific information exists. Perceptions are also known to be elevated when children or future generations are at risk. Therefore, although environmental health risks tend to be perceived as important health risks to Canadians, it is likely that children’s environmental health risks in specific may tend to be perceived as even greater health risks.

It is also interesting to note that Canadians tended to display fairly high levels of trust in regulators as the majority of respondents agreed with the statements that “when there is a really serious health problem, the government will regulate it” (57.7% in agreement), “experts are able to make accurate estimates of health risks” (74.2% in agreement), and “government agencies are well qualified to regulate health risks” (56.4% in agreement) (Krewski et al., 2005). Agreement with the statement “when there is a really serious health problem, the government will regulate it” was also seen to increase greatly from the previous national survey conducted in 1992, where only 20.3% of respondents were in agreement (Krewski et al., 1995b). Lastly, Canadians also tended to transfer some degree of control over health risks to professionals where it was reported that 56.6% of respondents agreed that “decisions about health risks should be left to the experts”, a nearly 20% increase since 1992, and that “government agencies are responsible for controlling my exposure to health risks” (53.9% in agreement) (Krewski et al., 2005; Krewski et al., 1995b). Therefore, it might be expected that the public may expect government to display a high level of proficiency in protecting Canadians, and Canadian children from environmental exposures.
Also of interest were the preferred sources of information about health risks and associated degree of confidence. Respondents indicated that the news media, medical doctors, and the Internet were the information sources most frequently turned to whereas industry, government, and public interest groups the least (Krewski et al., 2005). In terms of confidence in information sources, respondents reported the greatest level of confidence in medical doctors, university scientists/scientific journals, and health brochures whereas the remaining sources ranked comparatively lower. Due to the large amount of variation observed, it is therefore important in terms of the design of any government communication program to consider factors such as mode of delivery, target audience, and perceived origins of information in order to improve the potential for success.

3.3 Newspaper Coverage

A measure of public interest in environmental issues can be gleaned from coverage given by the news media. A search of the content of major national and regional daily newspapers in Canada between 1985 and 2005 returned a total of 1,196 articles pertaining to children’s environmental health (Figure 3.1).

Stages of infant and child which are more generic terms and returned the most newspaper articles. Specific names of legislation, Acts, regulations were not mentioned within the articles. News articles pertaining to children’s environmental health dealt with only a limited number of stories with the majority discussing the hazard for specific stages, product recalls and health concerns as a way to inform and raise awareness of the risk issue.
A breakdown of the newspaper search by hazard category indicated that the fetal stage newspaper articles were concerned mostly with chemical and radiation risks and effects on development. The post-natal stage showed relatively few news articles with the highest number of results for physical hazards focused on the effects of exercise and drugs on newborn health. Articles for infants and children were similar with the hazards reflecting the stage behaviour. Both infants and children interact more with their environments with infants prone to putting objects into their mouth. As a result the most articles for these two groups centered on water contamination, chemical exposure and air quality. Finally adolescents showed the highest number of news articles pertaining to physical hazards reflecting their mobility. News articles for this group focused on mortality and morbidity from various physical activities (smoking, drug use, driving, cycling, diet, skateboarding and other sports related injuries).

Figures 3.2 to 3.6 illustrate the numbers of Canadian newspaper articles published with various environmental health determinants at different stages of development (fetal, post natal, child and adolescent). Children and infants as stages returned the majority of results for the keyword searches. When all articles were ranked for hazard issue and frequency of the hazard keyword the top 16 issues revealed a predominance of chemicals as the major hazard group. The top issues included direct or indirect links to chemicals: water quality and chemical contamination of water, lead (from various sources including paint), pesticides (in food, water), chemicals, mercury (from fish consumption and environmental exposure), chemicals released for toys (phthalates) and PCBs (Figure 3.7). Besides chemicals other broad categories were identified as top issues including pollution (indoor and outdoor air), smoking (and second hand smoke) and radiation.
Figure 3.1. Number of news articles published from 1985-2005 in major Canadian newspaper dailies concerning environmental health issues for children at various stages of development.
Figure 3.2. Number of Canadian newspaper articles published with various environmental health determinants concerning the fetal stage.
Figure 3.3. Number of Canadian newspaper articles published with various environmental health determinants concerning the post-natal stage.
Figure 3.4. Number of Canadian newspaper articles published with various environmental health determinants concerning the infant stage.
Figure 3.5. Number of Canadian newspaper articles published with various environmental health determinants concerning the child stage.
Figure 3.6. Number of Canadian newspaper articles published with various environmental health determinants concerning the adolescent stage.
Figure 3.7. Top 16 issues for children’s environmental health found in major Canadian newspapers between 1985-2005 shown by frequency of keyword and number of news articles.
The majority of cited children’s environmental health risk issues involved chemical hazards. Issues of chemical contaminated water, lead, pesticides (in the environment, food and water), smoking, radiation (cell phones), hazardous toys, air pollution and other chemicals predominated in the ranking.

Risk issues that have a large degree of negative perception have usually undergone a process of “social amplification of risk”. Intense news media coverage and controversial triggers (victims, controversy, inequity) can occur in news media and this would be uncovered by the content analysis as risk issues that may provide insight for management (Kasperson et al., 1988). Although a number of environmental hazards received a substantial amount of media coverage, the current analysis of newspaper and news magazine content indicates little evidence for social amplification of risk, with the possible exception of bacterial contamination of water and the Walkerton tragedy. Social amplification of risk usually occurs with issues receiving extremely intense media coverage usually with controversial triggers (victims, controversy, inequity). The Walkerton water case was unique and had some of the essential features for risk amplification by the media: involuntary exposure to the hazard, harm to children, questions of blame and accountability, recognizable villains and dupes in the local water management, heroes in the form of the medical officer (Hill, 2005). Television media, a significant information source, and other media forms were not analyzed.

Many of the news media articles were prescriptive and either attempted to raise awareness of certain environmental hazards or acted as one-way communication to inform individuals about risks from everyday hazards (for example lead in paints, phthalates in toys, lawn chemicals, second hand smoke).
3.4 Conclusions

Studies designed to elicit information on risk perception show that children’s environmental health risks are likely viewed with high levels of concern by the public. A search of Canadian newspaper and popular magazine content identified coverage of a number of issues pertaining to children’s environmental health. Risk issues related to pesticides, air pollution, and chemicals in general were found to predominate in both studies. Risk issues that have a large degree of negative perception have usually undergone a process of “social amplification of risk”. Although little direct evidence of worry by the public that these environmental hazards were being poorly managed by the government was found in the newspaper and magazine analysis, the high levels of risk perceived over environmental chemicals found in repeatedly in surveys of the Canadian public suggests that environmental health hazards will likely remain an important risk issue requiring careful and ongoing risk management and communication efforts by the government.
4. CHILDREN’S ENVIRONMENTAL HEALTH IN CANADA: CURRENT POLICY

Responsibility for population health and environmental protection in Canada is shared between the federal, provincial and territorial governments. Actions to protect public health are also undertaken at the municipal level. In this Section the salient regulatory and other initiatives undertaken by the two levels of government, independently and cooperatively, are reviewed.

4.1 Children’s Environmental Health in Federal Legislation

In this section, existing legislative arrangements that offer opportunities to address children’s environmental health with particular attention to CEPA, 1999 are examined together with references to other federal statutes and initiatives).

4.1.1 Canadian Environmental Protection Act, R.S.C. 1999, c.33

CEPA, 1999 is the principal federal legislation for managing toxic substances in Canada. The declared primary purpose of this Act is “to contribute to sustainable development through pollution prevention.” The legislation nevertheless contains numerous direct references to human health, if not specifically to the health of children. One of many examples is the definition of “air pollution” which “means a condition of the air, arising wholly or partly from the presence in the air of any substance, that directly or indirectly (a) endangers the health, safety or welfare of humans…” (Section 3(1)). More fundamentally, the overall administration of the Act is to be guided by section 2(1) which sets out in paragraph (a) the duty on the federal government to
“exercise its powers in a manner that protects the environment and human health, applies the precautionary principle that, where there are threats of serious or irreversible harm, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

The remaining paragraphs of section 2 broadly describe other protective approaches to be applied by the government, such as informing the public of environmental issues, cooperating with other levels of government and implementing an ecosystem approach. Paragraph 2 (1)(j) specifically calls upon the Government of Canada to “protect the environment, including… human health, from the risk of any adverse effects of the use and release of toxic substances, pollutants and wastes.” Each of these objectives, strategies or administrative duties – together with many specific powers and programs authorized by the legislation - encompasses opportunities to address children’s environmental health.

In view of the scope of the subject matter addressed in CEPA, 1999 the following summary is necessarily selective.1

Toxic Substances (Part 5)

As set out in s 64, a substance is toxic if “…..it enters or may enter the environment in a quantity or concentration, or under conditions that

(a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity;

(b) constitute or may constitute a danger to the environment on which life depends; or

(c) constitute or may constitute a danger in Canada to human life or health.”

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1 For a recent overview of the Act, see Meinhard Doelle, Canadian Environmental Protection Act and Commentary (LexisNexis Canada, 2005)
The regime dealing with toxic substances is oriented around a system of substance classifications each associated with different implications for management and control. It is noteworthy in connection with toxicity assessments and the selection of control options that wide-ranging investigations around human and environmental health are authorized. These may include investigations concerning the effects of short-term exposure, the potential for exposure including exposure via multiple pathways, delayed or latent effects, or impacts on metabolic or reproductive functions, or trans-generational effects.²

Under section 66, the Minister of Environment shall establish a list of Domestic Substances which reflects whether at least 100 kg annually of the substance was manufactured or imported into Canada between 1984 and 1986, or was used in for Canadian commercial manufacturing. The Act imposes a reporting obligation on persons commercially involved with a substance, who obtain information reasonably supporting the conclusion that the substance is or is capable of becoming toxic. Furthermore, if the Ministers “have reason to suspect” that a substance is or may become toxic, they may require a person engaged in any activity with the importation or manufacturing of the substance to carry out scientific tests and submit the results to the Minister.

Within seven years of the date of Royal Assent to the Act, the Ministers must categorize all the substances on the Domestic Substances List³ to identify the substances that, “may present, to individuals in Canada, the greatest potential for exposure” or that are persistent or bio-accumulative, and inherently toxic, as set out in s. 73(1)(a) and (b) respectively.⁴ In categorizing, the Ministers shall determine whether an amendment should be made to the List that the

² CEPA, 1999 section 68
³ This means that the approximately 23,000 substances on the Domestic Substances List must be categorized by Sept. 14, 2006.
⁴ The precise parameters of persistence and bioaccumulation are set in the Persistence and Bioaccumulation Regulations, SOR/2000-107.
substance cannot be used, processed or manufactured for a “significant new activity” unless the Minister is provided with the prescribed information and fee.\(^5\) A screening assessment is required for those substances identified as described above (in paragraphs 73(1)(a) or (b)), as well as substances that have been added to the Domestic Substances List under section 105 which deals with living organisms\(^6\), to determine if they are toxic or capable of becoming so.

The Priority Substances List, established pursuant to subsection 76(1), specifies the substances for which the Ministers are satisfied priority should be given in assessing their potential toxicity. As set out in subsection 76(5), the List may be amended to add substances where the Ministers become satisfied priority should be given to their assessment. That decision may flow from a screening assessment, consultation, an individual request, or any other reason.\(^7\)

Any person may request that a substance be added to the Priority Substance List, and the Minister must consider the request and provide reasons for the decision on how to deal with it. Another possible basis for an amendment to the List comes from the required screening assessment following another jurisdiction’s decision to legislatively prohibit or substantially restrict a substance for health or environmental reasons. The Ministers are required to review that decision to determine if the substance is toxic or capable of becoming toxic.\(^8\) If a substance has

\(^5\) A “significant new activity” means an activity that results or may result in the entry or release into the environment of a quantity or concentration that is significantly greater, in the Minister’s opinion, than the previous quantity or concentration entering the environment, or in a manner or circumstances that are significantly different that the previous manner or circumstances. See section 80.

\(^6\) Section 105 requires that living organisms imported into or manufactured in Canada and released into the environment without being subject to conditions under this or any other Act of Parliament or legislature be added to the Domestic Substances List.

\(^7\) The consultation element refers to the requirement that the Minister offer to consult with provincial governments and the aboriginal representatives on the National Advisory Committee, and may consult with government departments or agencies, aboriginal people, municipal authorities and industry and labour, or with “persons interested in the quality of the environment or the preservation and improvement of public health.” See subsection 76(2).

\(^8\) Unless the substance is already regulated under another Act of Parliament that provides for health and environmental protection. See subsection 75(3).
been on the Priority Substances List for five years without being assessed for toxicity, any person may file an objection requesting that the matter go to a Board of Review under section 333.

When conducting a screening assessment, review of a foreign decision or evaluation of toxicity, the Minister is to apply a weight of evidence approach and the precautionary principle. Where the substance is found to be toxic or capable of becoming toxic, and the Ministers are satisfied that

(a) the substance may have a long-term harmful effect on the environment and is

(i) persistent and bioaccumulative in accordance with the regulations, and

(ii) inherently toxic to human beings or non-human organisms, as determined by laboratory or other studies, and

(b) the presence of the substance in the environment results primarily from human activity,

the Ministers shall recommend to the Governor in Council that the substance be added to the List of Toxic Substances. The substance shall also be recommended for “virtual elimination” if it is not a naturally occurring radionuclide or inorganic substance. The Governor in Council may, if satisfied that a substance is toxic, make an order adding it to the List of Toxic Substances, which permits the prescription of preventive or control actions. In addition to the regulation-making

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9 As set out in s. 65, the Minister is to compile a list of toxic substances known as the Virtual Elimination List. “Virtual elimination” means the ultimate reduction of the quantity or concentration of the substance below the “level of quantification” specified by the Minister. Section 65.1 elaborates that “level of quantification” means “the lowest concentration that can be accurately measured using sensitive but routine sampling and analytical methods”. From that starting point, the Minister must then prescribe the quantity or concentration of the substance that may be released into the environment either alone or in combination with any other substance. The Minister shall “take into account any factor or information provided for in section 91, including, but not limited to, environmental or health risks and any other relevant social, economic or technical matters.”

10 Under section 93, the Prohibition of Certain Toxic Substances Regulations, SOR/2003-99 were prescribed. The Regulations ban the manufacture, use, sale, and import of specified toxic substances, except for laboratory research and limited permitted uses.
power, the Ministers may issue interim orders where the Ministers believe that immediate action is necessary to deal with a significant danger to the environment or human health.\(^{11}\)

There are a number of regulations dealing with specific substances, many of them first prescribed under the original 1988 version of the *Canadian Environmental Protection Act*\(^ {12}\). So, for instance, the *Chlor-Akali Mercury Release Regulations*, SOR/90-130 sets the amount of mercury, which a plant can release into the ambient air. The *Chlorobiphenyls Regulations*, SOR/91-152 prohibits the manufacture, use, sale, or importing of chlorobiphenyls for specified uses, and sets the concentration limits allowed in products and for the release of liquids. The *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*, SOR/92-267 bars the release of “measurable concentrations” of specific chemical forms of dioxins and furans. More generally, the *Ozone-depleting Substances Regulations*, SOR/99-2 sets up the permitting regime governing substances under the Montreal Protocol on Substances that Deplete the Ozone Layer.

**Pollution Prevention (Part 4)**

Under section 56, the Minister may at any time publish a notice requiring any person or class of persons to prepare and implement a pollution prevention plan in respect of substances on

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\(^{11}\) Interim orders are authorized by section 94 of CEPA, 1999 where the Ministers believe that a substance on the List of Toxic Substances is not being adequately dealt with, or where the Ministers believe that a substance not on the list is toxic or capable of becoming toxic. Section 94 corresponds with section 35 of the previous version of CEPA which was constitutionally upheld in *R. v Hydro-Québec* [1997] 3 S.C.R. 213. See also, Edward A. Fitzgerald, « The Constitutionality of Toxic Substances Regulation Under the Canadian Environmental Protection Act » (1996), 30 U.B.C. Law Review 55

\(^{12}\) When the original *CEPA* came into effect, a number of pre-existing regulations applicable to substances associated with a range of children’s environmental health concerns were either re-enacted or carried over under the new legislation. By way of example, the *Asbestos Mines and Mills Release Regulations*, SOR/90-341, replaced the Asbestos Mining and Milling National Emission Standards Regulations, C.R.C., c. 405 originally promulgated under the *Clean Air Act*. The *Chlor-Alkali Mercury Release Regulations*, SOR/90-130 replaced the Chlor-Alkali Mercury National Emission Standards Regulations, C.R.C., c. 406 also originally promulgated under the *Clean Air Act*. The *Chlorobiphenyls Regulations*, SOR/91-152 consolidated three previous regulations, enacted under the *Environmental Containments Act*, S.C. 1974-75-76, c. 72. The *Gasoline Regulations*, SOR/90-247 replaced the Lead-Free Gasoline Regulations, C.R.C., c. 408; and the Leaded Gasoline Regulations, C.R.C., c. 409, both originally promulgated under the *Clean Air Act*. The *Secondary Lead Smelter Release Regulations*, SOR/91-155 replaced the Secondary Lead Smelter National Emission Standards Regulations, C.R.C., c. 412 also originally promulgated under the *Clean Air Act*. 
the List of Toxic Substances or to which subsection 166(1) or 176(1) applies. Those subsections, as discussed below, deal with substances contributing to international air and water pollution respectively.

Controlling Pollution and Managing Waste (Part 7)

In a series of divisions, this Part of the legislation addresses several distinct environmental issues with potential implications for health. These include Nutrients, Disposal at Sea, International Marine Pollution, Fuels and the Movement of Hazardous Waste. Threats to human health are referred to in passing, as for instance, in one of the strands in the definition of “marine pollution”:

175. In this Division, "water pollution" means a condition of water, arising wholly or partly from the presence in water of any substance, that directly or indirectly (a) endangers the health, safety or welfare of humans…

Given its focus on transboundary considerations and transportation issues, the relationship between this Part of CEPA, 1999 and children’s environmental health is not always direct. Nevertheless, there are important linkages and implications. Since air pollution is among the major threats to children’s environmental health as illustrated in case studies noted elsewhere in this report, some reference to the divisions on fuels, vehicle emissions and international air pollution is warranted.

Fuels:

Fuels produced, imported or sold in Canada are required to meet prescribed standards. The Gasoline Regulations, SOR/90-247 set the maximum concentrations for lead and

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13 Section 166(1) refers to substance released from a source in Canada that the Minister has reason to believe contributes to air pollution in a country other than Canada, or to air pollution inside Canada that violates an international agreement concerning pollution which is binding on Canada. Section 176 (1) has the same arrangement as regards water pollution.
phosphorus permitted in gasoline. There are, however, a number of exceptions from the general prescription that lead be limited to 5 mg/L. Aircraft and competition vehicles are wholly exempted, while tractors and other farming machinery, boats, and trucks exceeding 3,856 kg are permitted to use gasoline with a maximum lead concentration of 30 mg/L. In addition, the *Sulphur in Gasoline Regulations*, SOR/99-236 sets the allowable concentration of sulphur in gasoline. In the event of a contravention, the Minister may require a producer, processor, importer, retailer or distributor to give public notice of the fuel characteristics and of any danger to human health or the environment that might be threatened.

**Vehicle, Engine and Equipment Emissions:**

No company shall transport within Canada a prescribed vehicle unless a national emissions mark is applied to it, and the national emission mark can only be applied to a vehicle if certain requirements are satisfied. The general provision is that no vehicle, engine or equipment to which a national emissions mark has been applied to can be imported or sold by a company without abiding by the various documentation, labeling and information submission requirements set out in subsection 153(1). However, there are various exceptions, such as for vehicles in Canada for less than a year and solely for exhibition purposes, or if the vehicle is merely in transit across Canada. In addition, companies can apply for time-limited exemptions from the standards for a vehicle; to be granted where the Governor in Council is of the opinion that conforming with the standard would impose serious financial hardship on the company, or would impede the development of new technology.15

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14 The effects of lead on children’s health are described in a case study elsewhere in this report.
15 Exemptions are not available for financial hardship where the company produces more than 10,000 vehicles worldwide, or where it manufactures in or imports into Canada more than 1000. The reference to new technology covers new safety features and emission controls, as well as new models of vehicles, engines or systems or components of either. However, exemptions are also not available for the development of a new model where the exemption would substantially diminish the control over emissions from it, or where the company cannot demonstrate that it attempted in good faith to conform. See section 156.
Under section 162, the Act authorizes the prescription of an emission credits-based scheme, in which credits would be obtained by vehicles, engines and equipment whose emissions “more than meet” the prescribed standards, or by a payment based on the emissions. Credits would then be transferred between companies “in the prescribed manner.” However, no such credit-based scheme has been prescribed.

The On-Road Vehicle and Engine Emission Regulations, SOR/2003-2 establishes emission limits for hydrocarbons, carbon monoxide, and particulate matter, among other substances. It also aligns emission standards and testing procedures with the U.S. EPA.

International Air Pollution

The situation in which the Minister is expected to take action against international air pollution is described below:

166. (1) Subject to subsection (4), the Minister shall act under subsections (2) and (3) only if the Ministers have reason to believe that a substance released from a source in Canada into the air creates, or may reasonably be anticipated to contribute to

(a) air pollution in a country other than Canada; or

(b) air pollution that violates, or is likely to violate, an international agreement binding on Canada in relation to the prevention, control or correction of pollution.

As part of an attempt to avoid constitutional challenges to federal action in relation to air pollution, the Minister must first consult with the government responsible for the area in which the source is located, and offer that government the opportunity to prevent, control or correct the air pollution. If the source of air pollution is federal, or if the other government cannot or does not act, the Minister is required to take at least one of the following steps:
(a) on approval by the Governor in Council, publish a notice under subsection 56(1)\textsuperscript{16}; or
(b) recommend regulations to the Governor in Council for the purpose of preventing, controlling or correcting the air pollution.

Included as specific examples of regulations authorized for this purpose are the prescription of the quantity or concentration that may be released into the air, and the manner in which and conditions under which a substance may be released, alone or in combination with any other substance.

Where it is likely that there will be an unauthorized release of a substance, the Act imposes obligations on persons responsible either for the substance or the release to notify an enforcement officer and:

169 (1)(b) take all reasonable measures consistent with the protection of the environment and public safety to prevent the release or, if it cannot be prevented, to remedy any dangerous condition or reduce or mitigate any danger to the environment or to human life or health that results from the release of the substance or may reasonably be expected to result if the substance is released; and

(c) make a reasonable effort to notify any member of the public who may be adversely affected by the release or likely release.

A similar regime is set up for international water pollution. There is also a passing reference to human health in the provisions relating to the transport of hazardous waste, stating that the Minister may refuse to issue a permit even if the relevant authorities have done so where of the opinion that the waste or material will not be managed in a manner that will protect the environment and human health from the adverse effects that may result from that waste or material.

\textsuperscript{16} Subsection 56(1) deals with pollution prevention plans.
Information Gathering (Part 3)

In addition to the subjects of health-related investigation noted in connection with toxic substances, CEPA 1999 calls upon the Ministries of Environment and Health to carry out scientific research and monitoring. The subject areas for the Minister of the Environment are described as follows:

s.44 (1) The Minister shall…

…

(b) conduct research and studies relating to pollution prevention, the nature, transportation, dispersion, effects, control and abatement of pollution and the effects of pollution on environmental quality, and provide advisory and technical services and information related to that research and those studies;

(c) conduct research and studies relating to

(i) environmental contamination arising from disturbances of ecosystems by human activity,

(ii) changes in the normal geochemical cycling of toxic substances that are naturally present in the environment, and

(iii) detection and damage to ecosystems

On the other hand, the Minister of Health is required by s. 45 to:

(a) conduct research and studies relating to the role of substances in illnesses or in health problems;

(b) collect, process, correlate and publish on a periodic basis data from any research or studies done under paragraph (a); and

(c) distribute available information to inform the public about the effects of substances on human health.
Thus, the legislative responsibility for researching the health effects on humans of environmental pollutants falls on the Ministry of Health.

As part of the research process, the Minister is empowered under section 46 to require information from any person who would be reasonably expected to have possession or access to it. That person must submit the required information, but may request that it be treated as confidential as a trade secret or because its publication would cause material financial loss to the person. The Minister may deny such a request if the disclosure is in the interest of the environment, public health or safety, but that denial is reviewable by the Federal Court.

Although information may be submitted with a request that it be treated as confidential, the Minister is not always bound to respect that request:

315. (1) The Minister may disclose information, other than information in respect of which section 318 applies, where

(a) the disclosure is in the interest of public health, public safety or the protection of the environment; and

(b) the public interest in the disclosure clearly outweighs in importance

(i) any material financial loss or prejudice to the competitive position of the person who provided the information or on whose behalf it was provided, and

(ii) any damage to the privacy, reputation or human dignity of any individual that may result from the disclosure.

In addition, the Minister may disclose information where the Minister determines that it would not be prohibited under the *Access to Information Act*. Section 316 also provides generally that information may be disclosed where it is necessary for the purposes of the administration or enforcement of the *Act*. The only absolute bar to the Minister’s disclosure is set out in section
318, and deals with where an exemption has been granted under section 19 of the *Hazardous Materials Information Review Act*. This section provides that an exemption from disclosure exists until the claim has been disposed of, and for three years following a final disposition concluding that the claim was valid.

### 4.1.2 *Canadian Environmental Assessment Act, S.C. 1992, c. 37*

This legislation, like its provincial counterparts, provides mechanisms to encourage prior consideration of the potential environmental impacts of various types and categories of human activity. For purposes of the legislation, environmental effects are defined as “any change that the project may cause in the environment, including any effect of any such change on health and socio-economic conditions…..” While referring to the protection of the environment and human health in connection with the exercise of environmental assessment powers under the *Act*, CEAA does not directly address children’s environmental health. Nor is children’s health a consideration articulated in the 1999 Cabinet directive on strategic environmental assessment of policy.17 Indeed, it has been observed that health impacts receive limited attention within the federal environmental assessment regime. According to one estimate, more than 90 per cent of environmental assessments either neglect or deal inadequately with health. Opportunities to minimize adverse health effects through mitigation measures may be lost, and the potential to enhance the beneficial health implications of a project will not be effectively pursued.18

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18 Katherine Davies and Barry Sadler, “Environmental Assessment and Human Health: Perspectives, Approaches and Future Directions: A Background Report for the International Study of the Effectiveness of Environmental Assessment” (Health Canada, May 1997)
4.1.3  *Canada Water Act, R.S.C. 1985, c. C-11*

The *Canada Water Act* authorizes agreements with provincial officials in order to establish inter-governmental committees on a national, provincial, regional or lake or river-basin oriented basis for the purpose of advising on the development and implementation of water management initiatives. Within the context of such programs, monitoring and research activities may be undertaken along with projects relating to the conservation, development and utilization of the relevant waters. Where a significant national interest exists in a water area, provision is made for federal authorities to undertake water management programs.

This legislation contains one of the earliest proposals for the use of economic incentives to limit pollution in the interests of water quality. In keeping with the general understanding of water as a natural resource and given the *Canada Water Act’s* goal of ensuring “the optimum use of those resources for the benefit of all Canadians” neither public health nor children’s environmental health figure directly in the statute.

4.1.4  *Feeds Act, R.S.C. 1985, c. F-9*

This legislation and accompanying regulations\(^\text{19}\) establish the federal framework for the manufacture, importation and sale of animal feeds while setting out a general prohibition against animal feeds which “may adversely affect animal or human health.”\(^\text{20}\)

The release of a novel feed requires prior notification to and authorization from the responsible Minister whose decision involves consideration of relevant factors and an evaluation.

\(^{19}\) Feeds Regulations, 1983 SOR/83-593

\(^{20}\) Feeds Act s. 3(3)
of “the potential impact on and risk to the environment, including the potential impact on and risk to human and animal health.”\textsuperscript{21} Authorization may be refused in the case of “unacceptable” risks, a set of considerations that includes the possibility that a novel feed might be toxic according to the same criteria as those set out in \textit{CEPA, 1999}. Requirements concerning the disclosure of new information on environmental, (including human health) risks, as well as conditions respecting labelling, sampling and testing are also included in the legislation. Where feeds contain a medicating ingredient, a warning statement on human health hazards must be provided.

\textbf{4.1.5 \textit{Fertilizers Act, R.S.C.1985, c. F-10}}

This legislation governs the sale and importation of fertilizers subject to a regime of registration, standards and labelling requirements. Regulations respecting fertilizers and supplements address health considerations in several contexts, without, however specifically directing attention to children’s health. For example, section 11 of the Fertilizer Regulations\textsuperscript{22} provides that:

“A fertilizer or supplement shall not contain (a) any substance in quantities likely to be generally detrimental or seriously injurious to vegetation (except weeds,) domestic animals, public health or the environment when used according to direction; or (b) any substance that would, when applied in amounts commonly used or as specified in the directions for use, leave in the tissues of a plant a residue or a poisonous or harmful substance…”

\textsuperscript{21} s. 4.3(1)
\textsuperscript{22} Fertilizer Regulations, C.R.C., c. 666
Information relating to “the risk to human health” is included in the data requirements applicable to anyone seeking registration of a novel supplement. In determining whether to authorize the release of a novel supplement the Minister is instructed to consider “the potential impact on and risk to human health” and may refuse authorization where risk to human health and the environment is unacceptable, a determination that involves toxicity assessment along the lines established under CEPA, 1999.

4.1.6 Food and Drugs Act, R.S.C. 1985, c. F-27

General provisions indicate the intention of this longstanding legislation to safeguard consumers against food that:

(a) has in it or on it any poisonous or harmful substance;

(b) is unfit for human consumption;

(c) consists in whole or in part of any filthy, putrid, disgusting, rotten decomposed or diseased animal or vegetable substance;

(d) is adulterated; or

(e) was manufactured, prepared, preserved, packaged or stored under unsanitary conditions.

The general thrust of this provision confirms that the focus of this legislation is on food directly, rather than on environmental contaminants. However, food standards may be prescribed by regulation, including regulations “respecting the assessment of the effect on the environment or

23 Fertilizer Regulations, s. 23.2
24 Food and Drugs Act, s. 4
on human life and health of the release into the environment of any food, drug, cosmetic or
device, and the measures to take before importing or selling any such food, drug, cosmetic or
device.” Regulations under the act provide that food containing pesticides or agricultural
chemicals above prescribed residue levels are not in compliance, although a mechanism to
provide for an exemption is available. In addition, the presence of either of two substances of
environmental origin (ethylene thiourea and chlorinated-p-dioxins) constitutes adulteration under
the regime. (Section B.01.046) Drugs, cosmetics and devices are defined in the legislation, in
certain cases with direct reference to considerations relating to children’s health and safety.
Some regulatory details also address children’s issues in relation to product rather than
environmental safety, child resistant packaging, for example.

4.1.7 **Hazardous Products Act, R.S.C. 1985, c. H-3**

There is evidence that consumer products can be a major source of, or contributor to,
exposures to certain hazardous chemicals. Examples include lead in jewellery,
perfluorochemicals in non-stick surfaces of cookware, PBDEs in electronics and home
furnishings, phthalates in children’s toys, Bisphenol A in dyes, and nonylphenol in detergents.
However, the **Hazardous Products Act** is reactive in that there is no pre-market assessment for
these products and regulates on a product-by-product basis.

Pursuant to the **Hazardous Products Act**, certain products may be prohibited, while others
may be designated as restricted. The circumstances in which a product may be prohibited and
thereby listed in Part I of a Schedule to the legislation are as follows:

26 s. 30 (1) (1.1
27 Food and Drug Regulations C.R.C., c. 870, Part C, C.01.031(1)
“(a) any product, material or substance that is or contains a poisonous, toxic, flammable, explosive, corrosive, infectious, oxidizing or reactive product, material or substance or other product, material or substance of a similar nature that the Governor in Council is satisfied is or is likely to be a danger to the health or safety of the public; or

(b) any product designed for household, garden or personal use, for use in sports or recreational activities, as life-saving equipment or as a toy, plaything or equipment for use by children that the Governor in Council is satisfied is or is likely to be a danger to the health or safety of the public by reason of its design, construction or contents.”28

Regulations under the **Hazardous Products Act** provide some indication of the manner in which the distinctive interests of children might be addressed in that several products – pacifiers, toys and nipples on infants’ feeding bottles – have been singled out for detailed attention. The **Hazardous Products (Toys) Regulations**, C.R.C., c. 931 deals with a range of hazards including those of an electrical, mechanical and toxicological nature. With regard to toxicological threats, (other than absolute prohibitions against certain listed toxic substances.) the regulation imposes a series of requirements:

(a) the product, by reason of its nature, physical form, size or any other characteristic, shall be such that the toxic substance or the substance or part containing the toxic substance cannot be ingested, inhaled or absorbed through the skin;

(b) the total quantity of the available toxic substance shall not exceed one-hundredth of the acute oral or dermal median lethal dose, whichever is the lesser, calculated for a child having a body weight of 10 kg; or

(c) the toxicity of the toxic substance does not exceed (prescribed limits) (s. 10).

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28 **Hazardous Products Act**, s. 6(1)
The extensive potential of this legislation to safeguard children is achievable by means of product-oriented regulations rather than by means of general environmental protection measures.29

4.1.8 Pest Control Products Act

An important piece of federal legislation for children’s environmental health is the Pest Control Products Act (PCPA), which governs the regulation of pesticides in Canada. Legislation currently in force dates from the 1960s, although administrative arrangements involving the creation of the Pest Management Regulatory Agency and the re-location of responsibility for the PCPA from Agriculture to Health are now about a decade old. The PCPA itself establishes a registration scheme whose operational dimensions have been elaborated in regulations.30

The basic content of an application for registration is specified in section 7 of the regulation which calls for the names and addresses of the applicants, manufacturers and agents to be provided. Section 9(1) states that in addition to the information required by section 7, the applicant shall provide such further information as will allow the Minister to make a determination as to the control product’s safety, merit and value. Subsection 2(a) elaborates that for devices and chemicals not previously assessed, the further information includes the results of scientific research. The following topics of research are specified in subsection 9(2), without limiting the generality of the requirement: its effectiveness, its occupational safety, safety as

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30 Pest Control Products Regulations, C.R.C. c.1253
regards the animal or plant to which it is applied, the effects on non-target organisms in the vicinity, the degree of its persistence and movement, suitable methods of its analysis, disposal and neutralization, its stability and compatibility with other control products with which it is likely to be mixed. Where the pest control product is intended for use on living plants or animals, or where the ultimate products are intended for human consumption, the applicant is required to provide research on the following:

(i) the effects of the control product or its residues when administered to test animals for the purposes of assessing any risk to humans or animals, and

(ii) the effects of storing and processing food or feed, in relation to which the control product was used, on the dissipation or degradation of the control product and any of its residues.

Section 13 states that, where the Minister receives an application for registration, s/he shall, subject to section 18, register the pest control product. The grounds listed in section 18 on which the Minister shall refuse to register the product include:

(b) the information provided to the Minister on the application is insufficient to enable the control product to be assessed or evaluated;

(c) the applicant fails to establish that the control product has merit or value for the purposes claimed when the control product is used in accordance with its label directions;

(d) the use of the control product would lead to an unacceptable risk of harm to

(i) things on or in relation to which the control product is intended to be used, or

(ii) public health, plants, animals or the environment;

During the period of registration, the registrant is required by section 19 to be able to satisfy the Minister on demand that the availability of the product will not lead to an unacceptable risk of harm to things on or in relation to which it is used, or public health, plants,
animals or the environment. If the Minister decides at any point based on current information that the safety, merit or value of the product is no longer acceptable, s/he may cancel, suspend or specify the registration (s.20). That decision may be appealed to a Review Board, consisting of at least three persons, who will hold a hearing and make recommendations to the Minister.

Much of the remainder of the regulations deals with the specifics of the labeling, and packaging. Interestingly, however, section 42 provides as follows:

Where the physical properties of a control product are such that the presence of the control product may not be recognized when it is used and is likely to expose a person or domestic animal to a severe health risk, the control product shall be denatured by means of colour, odour or such other means as the Minister may approve to provide a signal or warning as to its presence. The Regulations thus clearly contemplate the acceptability of a product, which could pose a “severe health risk” to a person or animal.

Critics of the established arrangements identified a number of shortcomings, some of which were addressed in legislative reform. Amendments to the PCPA enacted in December 2002, and not yet in force, introduced a number of important changes, including some specifically directed towards the interests of children. Amongst provisions of significance from the perspective of children’s environmental health, section 7 is particularly noteworthy. Here, in making certain assessments or determinations under the legislation, the Minister is directed to consider considerations relating to the distinctive circumstances of children:

“7. (7) (b) (ii) apply appropriate margins of safety to take into account, among other relevant factors, the use of animal experimentation data and the different sensitivities to pest control

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products of major identifiable subgroups, including pregnant women, infants, children, women and seniors, and

(iii) in the case of a threshold effect, if the product is proposed for use in or around homes or schools apply a margin of safety that it ten times greater than the margin of safety that would otherwise be applicable … in respect of that threshold effect, to take into account potential pre- and post-natal toxicity and completeness of data with respect to the exposure of, and toxicity to, infants and children unless, on the basis of reliable scientific data, the Minister has determined that a different margin of safety would be appropriate.”

Determinations respecting maximum residue levels must address similar considerations respecting the distinctive sensitivities of sub-populations such as children and may impose increased margins of safety. The cumulative effects of pesticides with similar modes of action, and potential effects of aggregate exposures from residues on foods and domestic uses must also be considered. These changes give legal force to what has been a customary procedure in recent years, and applies a more precautionary approach to regulating pesticides (CELA, 2002). The health-protective revisions to this law were largely due to concerns about pesticide risks in children. The new legislation also provides more systematically than its predecessor for the re-evaluation of registered pest control products.

The involvement of provincial and, more recently, municipal governments in determinations concerning the use of federally registered pesticides provides additional opportunities to consider potential impacts on children’s environmental health.32

4.1.9 Radiation Emitting Devices Act, R.S. 1985, c. 34 (1st Supp.)

32 Jamie Benidickson, Environmental Law (Irwin Law, 2002), 249-252
A radiation emitting device may not be sold, imported or leased if it fails to comply with prescribed standards, or if it:

s. 4 (b) creates a risk to any person of genetic or personal injury, impairment of health or death from radiation by reason that it

(i) does not perform as per claimed performance characteristics;

(ii) does not accomplish claimed purpose; or

(iii) emits radiation not necessary to accomplish claimed purpose.

Manufacturers and importers who become aware after a device has left their premises that it fails to comply with prescribed standards or that it creates a risk as described, are required to notify the Minister immediately.

Regulation making under the legislation is intended “for the purpose of protecting persons.” (s. 13) Technical standards for the design, construction and operation of such devices as televisions, X-Ray and microwave equipment are set out in schedules which do not disclose either the level of protection aimed at or other considerations that may have been involved in establishing them.33

4.1.10 Tobacco Act, 1997, c.13

The federal Tobacco Act, successor to the Tobacco Products Control Act,34 is, together with complementary provincial measures, relevant in the context of this report to the issue variously known as passive or involuntary smoking, second-hand smoke or environmental tobacco smoke.

33 Radiation Emitting Devices Regulations, C.R.C. c. 1370
34 The constitutionality of this legislation was considered in RJR-Macdonald Inc. v Canada (Attorney-General), [1995] 3 S.C.R. 199
Federal tobacco legislation endeavours to discourage the demand for tobacco products using a variety of instruments, including taxation and pricing. The legislation also prohibits the sale of tobacco products unless the packaging contains information prescribed by regulation about the product, its emissions, health hazards and effects. One of the specific warnings, as required by the Tobacco Products Information Regulation, is that “Tobacco Smoke Hurts Children.” The sale of tobacco products to persons under 18 is prohibited.

4.1.11 Unsuccessful Legislative Initiatives at the Federal Level

Although not enacted, it is noteworthy that a number of legislative initiatives with possible implications for children’s health have been put forward by individual members of parliament in recent years.

C-236: An Act to prohibit the use of chemical pesticides for non-essential purposes

The proposed Act would have created a moratorium on the use of pesticides in domestic and recreational settings by means of an amendment to the Pest Control Product Act. The preamble recognized that such use is particularly hazardous to the residents and users of the recreational facilities, “who may include children, pregnant women and others who may be particularly sensitive”. This Act was introduced by Mr. Clifford Lincoln in the 37th Parliament, 2nd Session and received a First Reading on Oct. 22, 2002. A previous version of the Act had been introduced in the 1st Session by Ms. Jennings.

S-18: An Act to amend the Food and Drug Act (clean drinking water)

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36 Tobacco Products Information Regulation, SOR/2000-272
This would have designated water from community water systems (serving at least 25 people for more than 30 days a year) as a food, thereby making it subject to federal regulation and approval. It would also have authorized the inspection of lands forming part of the watershed, and the inspection of any place from which contaminants might escape into the drinking water. This Senate Bill was introduced by Senator Grafstein in the 37th Parliament, 1st Session and received a First Reading on February 20, 2001. A related initiative entitled: An Act to ensure safe drinking water throughout Canada has been introduced in several Parliamentary sessions. Mr. Herron introduced the Act in the 37th Parliament, 1st and 2nd Sessions, and Mr. Stoffer has introduced it in the 38th Parliament, 1st Session where it received a First Reading on October 15, 2004.

C-514: An Act to protect human health and the environment by reducing automotive pollution. The proposed Act was explicitly based on the precautionary principle. It would have prohibited gasoline containing methylcyclopentadienyl manganese tricarbonyl, as well as requiring a specified level of oxygenation in gasoline diesel fuels. The Act was introduced by Mr. Clifford Lincoln in the 36th Parliament, 1st Session and received a First Reading on May 27, 1999. In the 37th Parliament, 1st and 2nd Sessions, this idea was re-introduced by Mr. Lincoln under the title: An Act to protect human health and the environment by oxygenating automotive fuels.

C-522: An Act respecting the replacement of agricultural pest control products

This proposed legislation, in contrast with measures intended to shift the regulatory balance towards the protection of human health, would have provided that pesticides could only be banned or restricted if an equally effective alternative was found, or if the threat was “real” and outweighs the agricultural interests.

4.1.12 Conclusion
This section of the report has reviewed federal legislation relating to environmental health with particular reference to existing provisions of *CEPA, 1999*. The arrangements in place provide a range of opportunities for measures to be taken to safeguard children’s environmental health, although the extent to which such measures have been taken with this objective in mind is not addressed here. It may be observed that explicit references to children’s environmental health are rare in Canadian federal legislation and regulation. Certain regulations under the *Hazardous Products Act* and recent amendments to the PCPA – while not yet in force - are notable exceptions.

4.2 Other Federal Initiatives Related to Children’s Health

4.2.1 (Former) Office of Children’s Environmental Health (OCEH)

Health Canada’s Office of Children’s Environmental Health (OCEH) was established in 2003, with a mandate to advance the protection of children's health in Canada from environmental risks by collaborating with various government agencies, nongovernmental organizations, academics and the community. Recently the OCEH was subsumed by the Vulnerable Populations and Climate Change Office, Health Impacts Bureau, Health Canada. This office now serves as the designated lead for coordinating activities on children’s environmental health and has a stated objective to “catalyze action to manage environmental

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37 Further discussion of legislative and policy responses to specific concerns surrounding children’s environmental health is found in a series of case studies elsewhere in this report.
risks to child health” (Health Canada, 2005a); it is the counterpart in the US EPA’s Office of Children’s Health Protection.

### 4.3 Provincial Legislative Framework: Children’s Environmental Health Protection Measures in Provincial Legislation

The provinces and territories have various laws and programs for regulating industrial emissions to air and water, or to control transport and disposal of wastes. For example, provincial laws may include standards for contaminant levels in surface waters, drinking water and in sector-specific effluent emissions to waterways. Standards are also established for air pollutants, either as emission limits from stationary or mobile sources, or as ambient air quality standards around industrial facilities. There are also provincial laws and regulations controlling the transfer and disposal of hazardous wastes, municipal waste, and guidelines governing the clean up and redevelopment of contaminated land. Pesticides are regulated by the federal government in terms of the evaluation process, registration for use in Canada, product labeling and maximum residue levels (MRLs) on foods. Provincial jurisdiction focuses on regulating the conditions of pesticide use including sales and availability to consumers.

Provincial environmental and health protection policies are generally designed to protect all population subgroups, including children and other sensitive groups. Examples of provincial policy measures are described below with respect to the air and drinking water routes of exposure.

### 4.3.1 Air Quality
The Canadian Council of Ministers of the Environment (CCME), which is comprised of provincial, territorial and federal government environment ministers, has established Canada-wide Standards (CWS) for fine particulates, ground level ozone, benzene, mercury and dioxins from specific sources. These standards commit provincial governments to significantly reduce emissions and establish implementation plans describing comprehensive actions being taken within each jurisdiction to achieve the Standards by the specified target date.

Particulate matter and ozone are linked to serious health impacts, including chronic bronchitis, asthma, and premature deaths. PM$_{10}$ and its precursors as well as ozone and its precursors have all been declared toxic under Schedule 1 of CEPA, 1999. In June of 2000, the federal, provincial and territorial governments (except Quebec) signed the Canada-wide Standards for Particulate Matter (PM) and Ozone. The Canada-wide Standard for PM$_{2.5}$ is 30 µg/m$^3$ averaged over 24 hours using 3 years of data, to be achieved by 2010. The Canada-wide Standard for ozone is 65 ppb averaged over 8 hours using 3 years of data, to be achieved by 2010. A wide range of actions to reduce emissions from vehicles, products and industry will have to be implemented to meet the standards. Initiatives such as vehicle and fuel emission standards will be carried out by the federal government, while other actions such as emission reductions from certain existing industrial sources, will be undertaken by provinces and territories.

4.3.2 Drinking Water Quality
Outside of the areas of federal jurisdiction (drinking water quality and quantity on federal lands and in areas that fall under federal jurisdiction, such as First Nations lands (shared responsibility), on-board common carriers (e.g., ships, airplanes), and in national parks), regulatory oversight of drinking water quality is a provincial and territorial government responsibility. Some provincial and territorial governments reference drinking water quality criteria directly to regulations. As a result of the experiences at Walkerton, Ontario and North Battleford, Saskatchewan all provincial and territorial governments have revisited their respective drinking water programs and have implemented or identified improvements. Most provinces and territories have established legislation and regulations for: i) protecting water resources; ii) approving the design, construction, operation, and maintenance of water treatment and distribution systems; iii) establishing drinking water quality criteria; and iv) setting monitoring, remediation, and enforcement activities.

While no program specifically targets children, the federal, provincial and territorial health and environment departments have developed a comprehensive source-to-tap approach to protecting water quality, which includes watershed management. A key component of provincial and territorial drinking water programs is setting compliance and performance monitoring requirements. Compliance monitoring requirements addresses drinking water quality, while performance monitoring ensures treatment and distribution systems are functioning optimally. Provincial and territorial responsibilities include ensuring that the appropriate legal instruments are in place to require operators to be properly trained and certified.

All Canadian jurisdictions have established guidelines, objectives or standards for drinking, recreational and ambient water quality. Guidelines are recommended benchmarks against which water quality can be assessed, but are not legally enforceable. These guidelines are
developed at the provincial/territorial and/or the federal level. As described previously, the provincial and territorial governments are responsible for implementing the guidelines through their respective drinking water quality and public health programs. The federal government uses the guidelines as the benchmark against which the quality of drinking water supplied on federal lands and at federal facilities is measured.

The Guidelines for Canadian Drinking Water Quality are developed by the Federal-Provincial-Territorial Committee on Drinking Water (CDW), a standing Committee reporting to the Federal-Provincial-Territorial Committee on Health and the Environment (CHE). Provinces and territories establish their drinking water quality requirements using these guidelines or other more stringent ones.

Provincial governments have developed a substantial range of policies, regulations, strategies and frameworks to enhance the safety of drinking water supplies. As a result of the North Battleford inquiry, Saskatchewan has drafted a Water Management Framework to address measures for the protection of provincial water resources. This framework emphasizes the protection of water and wetlands, the management and development of water resources, and the inclusion of public involvement in decision-making processes. The planned Saskatchewan Watershed Authority Act will govern the Saskatchewan Watershed Authority in watershed planning, aquifer protection measures, management of surface and groundwater supplies and monitoring. Existing legislation includes the Environmental Management and Protection Act, which regulates water pollution control measures, industrial effluent, and reservoir land use, and the Environmental Assessment Act, which requires proponents of development projects to receive Ministerial approval before proceeding with a development. Saskatchewan's Rural Water Quality Advisory Program provides information and services to people in rural areas regarding water
quality collection and testing, and surface and groundwater protection. The Prairie Farm Rehabilitation Association uses its expertise in the biological, geological, and engineering disciplines to develop secure water supplies, high water quality, and wastewater infrastructure in the prairies through programs such as the Rural Water Development Program and the Sustainable Well Water Initiative.

The Ontario government is continuing to implement recommendations from the Walkerton inquiry. In April 2003, the Advisory Committee on Watershed-based Source Protection Planning released its report - Protecting Ontario’s Drinking Water: Toward a Watershed-based Source Protection Planning Framework. Its 55 recommendations set out a comprehensive framework that addresses: roles and responsibilities, the planning process, resources, timing and legislation. Guidelines for surface and groundwater Water Quality Objectives are also in place. There is an ongoing process of GIS-based mapping of surface and groundwater resources. Groundwater monitoring programs are underway. The *Environmental Protection Act* prohibits contaminant discharges into the natural environment. The *Nutrient Management Act* includes regulations for the protection of areas surrounding wellheads.

There are many issues shared by all jurisdictions in Canada that benefit from collaborative approaches. For example, the multiple-barrier approach to protecting drinking water encompasses all components of a drinking water system and identifies safeguards needed to provide safe drinking water. The components include source water protection, drinking water treatment and distribution systems. The safeguards include management, monitoring, research, science and technology development, guidelines, standards and objectives, legislative and policy frameworks, and public involvement and awareness. The elements of a successful drinking water program can include state-of-the-art facilities, operation certification, an effective compliance
assurance program with emergency response protocols and measures to ensure public confidence. The protection of source water is the critical first barrier in the multiple-barrier approach to protecting drinking water. This extends beyond controlling individual sources of contamination to address problems and solutions on a regional or watershed basis. Watershed-based source protection was a key recommendation of the Walkerton Inquiry. Ontario and other provincial and territorial jurisdictions, as well as local governments, have adopted watershed approaches to water quality management.

4.3.3 Other Provincial Initiatives

A number of province-wide initiatives serve to enhance children’s environment health promotion and protection. As an example, the Best Start Resource Centre (Ontario’s Maternal, Newborn and Early Childhood Development Resource Centre) is a provincially funded. The Centre attempts to increase the capacity of service providers to implement effective health promotion programs for expectant and new parents (including both men and women), newborns and young children (The Ministry of Health and Long-Term Care, 2005).

4.3 Municipal Legislation

Municipalities are increasingly taking a lead role in making communities safer places to live, work and play and have developed a variety of initiatives, some in partnership with other groups, to protect the health of children from harmful toxic substances. Second-hand smoke by-
laws and pesticide by-laws are examples of municipal legislation aimed at protecting children from contaminant exposures.

4.3.1 Second Hand Smoke By-laws

Dr. Robert Cushman, Ottawa’s former Medical Officer of Health, advocates that “smoke-free by-laws are currently the single most important public health initiative available at the municipal level to protect the well-being of our citizens.” (City of Ottawa, 2002). Such by-laws are based on the conclusive scientific evidence that both short and long-term exposure to second-hand smoke produces significant adverse health outcomes. Most often, municipal smoke-free by-laws are more restrictive and provide residents with better protection from second hand smoke than is afforded by existing provincial/territorial legislation, regulations or policy. More than 100 municipalities in Ontario have passed smoke-free laws, and the provincial government has passed the *Smoke-free Ontario Act*, that will prohibit smoking in all public places and workplaces across the province by May 31, 2006. The Act also gives shopkeepers until 2008 to remove large behind-the-counter displays of cigarettes. The new law will be the strictest anti-tobacco legislation in North America and would override the current patchwork of municipal by-laws on smoking.

4.3.2 Pesticide By-laws

In June 2001, a Supreme Court of Canada decision confirmed that Hudson, Quebec had the power to pass a municipal by-law that banned the cosmetic use of pesticides within
municipal boundaries, including on private property. A precautionary approach was endorsed by the Supreme Court in the Hudson decision as an appropriate course of action on the part of municipalities. Several municipalities have now passed by-laws similar to Hudson’s Quebec’s or are engaging in public consultations to control use of pesticides in their communities. More than 69 municipal pesticide by-laws have been enacted across Canada (Christie, 2005). Under the revised *Ontario Municipal Act*, municipalities have powers to regulate matters for purposes related to the health, safety and well being of the inhabitants of the municipality.

4.3.3 Drinking Water

Both municipalities and non-municipal system owners are responsible for providing clean, safe and reliable drinking water to consumers. Typically, a municipality's roles and responsibilities are defined in provincial or territorial regulations. Municipalities can impact watersheds/aquifers through road construction and maintenance; winter control (including salting, sanding and snow removal); and waste management including the placement and management of landfills. For this reason, municipalities are encouraged to examine ways they can reduce their impacts on watersheds/aquifers. At the organizational level, this can include engaging in the development of a corporate environmental management plan such as ISO14001, EMAS, and other variations. These plans provide a consistent and transparent examination of the activities of each department and provide a management tool for identifying environmental risks and establishing priorities for action.

The maintenance and improvement of source water quality is an investment that more municipalities will be taking in the future as the onus on municipal politicians and staff increases
under the legal changes foreshadowed, for example in Ontario. The concept of ‘statutory standard of care’ increases the obligations of municipal councillors to ensure effective oversight of the operation of municipal waterworks. The Federation of Canadian Municipalities (FCM) has produced a document entitled *Municipal Governments and the Protection of Water Sources*. The document outlines the type of actions that municipal governments can take immediately to protect watersheds and water sources.

4.4 Intergovernmental Initiatives

4.4.1 Committee on Health and Environment (CHE) (2003)

For some key areas of environmental or health regulation, the federal, provincial and territorial governments co-ordinate activities within the terms of various accords signed by the Canadian Council of Ministers of the Environment. The Federal-Provincial-Territorial Committee on Health and Environment (CHE) was established in 2003 by the Deputy Ministers of Health and Environment; this Committee is the principal FPT forum for advice and joint-action on health and environmental issues of national interest. The CHE is a Liaison Committee to the FPT Advisory Committee on Population Health and Health Security and reports to the Canadian Council of Ministers of the Environment’s Environmental Planning and Protection Committee. The CHE supports the work of these committees by addressing significant policy, regulatory, guideline and programme issues related to the impact of the environment on human health. The Committee has been charged with:
increasing capacity in Canada to address issues related to the impact of the environment on health within a population health approach; and;

- facilitating the integration of health and environmental issues at the national level.

(Green, 2006).

At its first meeting in 2004, the CHE identified children’s health and the environment as one of three priority themes for action. The Children’s Task Group (CTG) of this Committee is pursuing three projects. These include: 1) an inventory of children’s health and environment initiatives in governments and other organizations in Canada, 2) an inventory of blood lead level studies and review of the recent science for the blood lead intervention level and strategies, and 3) development of indicators to address the status of children’s environmental health in Canada.

4.4.2 Committee on Health and Environment Children’s Task Group

In January 2004, the Federal-Provincial-Territorial Committee on Health and Environment established a Children’s Task Group (CTG) to develop and assist in a collaborative federal-provincial-territorial agenda to reduce the risk to children’s health from key hazards in the physical environment. A number of projects are underway to i) develop a comprehensive inventory of federal, provincial, and territorial initiatives on children’s health and the environment; ii) create a national database of blood lead level studies in Canada and review the current blood lead intervention level; iii) develop a proposed set of national environmental health indicators to determine the status of children’s environmental health in Canada; iv) develop a federal-provincial-territorial child health and environment strategy; and v) assess the availability
and importance of biomonitoring data to the protection of children’s environmental health in Canada.

Although the CEC is quite evidently more than a domestic inter-governmental mechanism, the information exchange, collaborative research, discussion and policy-development initiatives it has promoted have encouraged the type of inter-governmental co-operation – domestic and international - that is essential to strengthen protection for children’s environmental health. The dialogue on children’s environmental health fostered by the CEC has also facilitated participation by professional organizations, non-governmental bodies and industry.

The Commission for Environmental Cooperation, established through the North American Agreement on Environmental Cooperation in 1994, conducts a range of programs and activities intended to facilitate cooperative effort involving Canada, Mexico and the United States to protect the North American environment. Within the context of a major program area designated generally as Pollutants and Health, the CEC Secretariat - the organization’s administrative body – established an initiative specifically intended to address Children’s Health and the Environment.

In launching its initiative on Children’s Health and the Environment in 1999, the CEC affirmed the view that coordinated efforts across North America were required in order to reduce threats posed by environmental contaminants to the vulnerable population of children. When the CEC Council consisting of environment ministers from Canada, Mexico and the United States endorsed the initiative the following year, the three countries undertook “to develop a
cooperative agenda to protect children from environmental threats with the overall objective of reduction of human-made pressures on children’s health.”

The CEC’s work in the field of children’s environmental health has combined workshops, participatory gatherings and reporting with the efforts of expert advisors. An Expert Advisory Board was first convened in October 2001, to advise the Council in the development of a Cooperative Agenda for Children’s Health and Environment in North America. A draft Agenda was subsequently examined at a workshop involving health and environment representatives from the three countries, as well as the Expert Advisory Board and the NAFTA Technical Working Group on Pesticides.

In the foreword to a CEC report in 2002 entitled *Making the Environment Healthier for Our Kids*, the chair of the Board outlined the challenges of children’s environmental health:

> While there is abundant literature on the acute toxicity of many chemicals, we have scant information on the effects of chronic, low-dose exposures or on how various chemicals act in combination. We need to promote scientific and clinical research to help regulators make evidence-based decisions. But we also need to find the courage to take precautionary action while awaiting further data.

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The report provided an overview of then-known information on children’s vulnerabilities and the main environmental threats to children’s health, with “a view to stimulating dialogue among interested individuals and groups throughout civil society”.41

A Co-Operative Agenda for Children’s Health and Environment in North America was finalized and adopted by the CEC Council through Council Resolution 02-06 in June 2002. The CEC’s primary focus in Children’s Health and the Environment was then directed towards a series of specific health concerns. Asthma and other respiratory diseases, lead poisoning, exposure to other toxic substances, and water-borne diseases were identified as the immediate priorities. In each case, work was conducted to improve the knowledge base, to provide strengthened resources, and to pursue preventive efforts within the context of other CEC programs, notably, programs for the Sound Management of Chemicals and the Pollutant Release and Transfer Registry.

The CEC children’s environmental health initiative encompassed three additional measures: risk assessment on children’s health; children’s environmental health indicators; and professional training or capacity building.

Risk Assessment

For the purpose of encouraging a common understanding of risk assessment terms and approaches as a step towards enhanced collaboration, the Agenda included a trilateral workshop on risk assessment and children’s health.42 There are several aspects to the risk assessment issue. First, the simpler one of developing a common understanding and approaches (harmonization) that allows for work sharing between the countries. Ideally, this deepens and broadens the risk assessment, while simultaneously reducing the demand for resources from each country. The

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41 Ibid. at 1.
42 Cooperative Agenda, supra at Item 4.3
quality of the resulting risk assessment is likely to improve by expanding the research base across countries. The more complicated issue is one of improving risk assessment itself as regards children’s health issues, by enhancing the role of precaution and the transparency of the process.43

CEC’s Expert Advisory Board submitted its official advice to the Council on the issue of risk assessment and children’s environmental health. It suggested that epidemiological data needs to be collected more often, and given more weight. To support such data collection, the Board suggested that the CEC Secretariat create an inventory of such studies currently in existence. A number of recommendations dealt with capacity-building, training and community outreach. Great weight was placed on expanding the numbers of persons trained in risk assessment, toxicology and epidemiology, and on improving the training vis-à-vis children’s environmental health. The board’s final observation was that:

industry produces and manages data vital to risk assessment and should be encouraged to make these data and related information accessible to those engaged in the work of risk assessment and risk communication.44

Children’s Environmental Health Indicators

In accordance with the Cooperative Agenda the CEC has also developed a set of children’s environmental health indicators. A report detailing their design and significance recently appeared as Children’s Health and the Environment in North America: A First Report

on Available Indicators and Measures (2006). This publication makes North America the first region to publish children’s environmental health indicators as part of a global initiative on environmental health indicators, launched at the Johannesburg summit under the leadership of the World Health Organization. On the basis of thirteen indicators, the CEC project addressed three general areas: asthma and respiratory diseases, lead and other toxics (including pesticides), and waterborne diseases.

The indicators are briefly described, organized by issue area:

**Asthma & Respiratory Diseases**
1. Percentage of children living in areas where air pollution exceeds air quality standards
2. Measure of children exposed to environmental tobacco smoke or the burning of biomass
3. Prevalence of asthma in children

**Effects of Lead and Other Toxics**
4. Body burden measurements of lead in children
5. Children living in homes with a potential source of lead
6. Pollutant Release and Transfer Register (PRTR) data on industrial releases of lead
7. PRTR data on industrial releases of 155 chemicals
8. Pesticide residues on foods

**Waterborne Diseases**
9. Percentage of children without access to treated water

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46 Ibid. at 2. There is a further subdivision into eleven themes, including outdoor air pollution, indoor air pollution, lead in the home, and sanitation.
10. Percentage of children with access to water in violation of local standards
11. Percentage of children that are not served with sanitary sewers
12. Number of childhood illnesses attributed to waterborne diseases
13. Number of childhood deaths attributed to waterborne diseases

**Health Care Professionals**

Health care professionals represent the front-line in children’s environmental health. They are the first to see affected children and must be able to recognize, diagnose and treat environmental illnesses, as well as to inform parents and communities of potential risks. Even in the 1980s, the U.S. Institute for Medicine stated that “at a minimum, all primary care physicians should be able to identify possible occupationally or environmentally induced conditions and make the appropriate referrals for follow-up.” Increasing the level of knowledge and capability of healthcare workers is therefore a primary vehicle for the communication, education, prevention and remediation of environmental hazards to children.

The core medical training in all three NAFTA countries was found to lack basic education on children’s environmental health. This is starting to change, to some degree, in the United States. There are definitely opportunities to specialize in CEH, and to work in the recently established pediatric environmental health specialty units and CEH research centres, and add to the growing collection of information resources. However, all of these initiatives maintain the voluntary status of CEH training. More promisingly, there are some programs in the U.S. which have incorporated environmental health elements as a required competency for a pediatric specialization, and the American Academy of Pediatrics plans to distribute its 2003

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49 Ibid at 3-4; 7.
Handbook of Children’s Environmental Health to all pediatricians.\textsuperscript{50} The existence of the American innovations may make it easier for Canadian institutions to follow suit.

\textbf{4.4.3 Pan-Canadian Public Health Network}

The Pan-Canadian Public Health Network was announced in April, 2005 in response to recommendations of the National Advisory Committee on SARS and Public Health and the Senate Standing Committee on Public Health calling for mechanisms to improve co-ordination and decision making among federal, provincial and territorial governments on public health issues and especially, public health emergencies. This formal network links all 13 provincial/territorial governments with the Public Health Agency of Canada and reports to the Conference of Federal/Provincial/Territorial (F/P/T) Deputy Ministers of Health. The Public Health Network serves as a forum for multilateral intergovernmental collaboration on public health issues, while respecting jurisdictional responsibilities in public health.

The Network is mandated to i) facilitate information sharing among all jurisdictions; ii) disseminate information regarding best-practices in public health; iii) support jurisdictions during emergencies (both public health emergencies and emergencies with public health implications); and, iv) provide advice and regular reporting to F/P/T Deputy Ministers of Health on public health matters and the activities of the Network.

Leadership for the Public Health Network is provided by a Council, consisting of representatives of each province and territory and the federal government. The Council is be co-chaired by a provincial/territorial member, serving as co-chair on a two-year rotational basis, and by the Chief Public Health Officer of Canada.

\textsuperscript{50} Ibid. at 4.
The activities of the Network are undertaken by an initial series of Expert Groups addressing the following six issues:

1. Communicable Disease Control;
2. Emergency Preparedness and Response;
3. Canadian Public Health Laboratory;
4. Surveillance and Information;
5. Non-Communicable Disease and Injury Prevention and Control; and,
6. Health Promotion.

The Council also creates project-oriented Task Groups to assist and advise on emerging issues or to undertake specific work when an existing Expert Group is not appropriate. For example, one of the first task groups convened through the Network was to establish implementation principles for the *Agreement on Mutual Aid During an Emergency* and to develop an agreement on public health information sharing.

**4.4.4 Canadian Health Network (CHN)**

The Canadian Health Network (CHN) is a national, web-based bilingual health promotion initiative available at www.canadian-health-network.ca. The CHN's goal is to promote healthy choices among Canadians by disseminating information on health promotion and disease and injury prevention through a network of expert organizations. All content is quality-assured to ensure that the information is timely, accurate, and relevant. The network of health information providers includes the Public Health Agency of Canada, Health Canada and
national and provincial/territorial non-profit organizations, as well as universities, hospitals, libraries and community organizations. The Network provides access to more than 20,000 Canadian web-based resources, including links to plain language primers addressing a variety of environmental threats to children’s health prepared by organizations such as the Canadian Partnership for Children’s Health and Environment (CPCHE), Toronto Public Health and Canadian Environmental Law Association. The Network serves as a mechanism to enable Canadians to better understand the risks to children’s health associated with environmental exposures and make informed decisions on protective actions to reduce such exposures.
5 ENVIRONMENTAL HEALTH INITIATIVES OUTSIDE OF CANADA

5.1 Introduction

The literature search methodology described in this Section is intended to assist policy makers at Health Canada utilize the experience of other jurisdictions (United States, members of the European Union, and selected international agencies) in developing and implementing legislative and other policy measures aimed at safeguarding children’s health from environmental hazards. Content analysis consisted of searching newspapers (using the Newsstand database), Internet (using the Google search engine, grey literature (using the Google scholar search engine) and peer reviewed journal articles (non-legal, using the OVID database). The search methodology is described in Appendix 4.

5.2 Results

Canada, United States and the European Union all have regulatory, non-regulatory and other initiatives for safeguarding, improving and addressing children’s environmental health. Relevant Canadian initiatives were identified by the described approach to content analysis; since these are described in Section 4 of the report, the results of the search strategies are presented only in summary form in this Section.

It was found that the United States has mentioned the protection of children explicitly in only a few legislative Acts (TOSCA, FIFRA) but has created an overarching department with
wide latitude for overseeing children’s environmental health. The European Union has
introduced several Acts, which have the force of legislation in all member states.

5.2.1 International Initiatives

There are numerous international agreements to which Canada is signatory recognizing
the vulnerability of children and committing to policies to address these risks. The 1989 United
Nations Convention on the Rights of the Child laid a strong foundation for a series of further
international commitments towards protecting children from environmental harm. The 1997 G8
summit led to the “Miami Declaration on Children’s Environmental Health” to promote research
into children's unique vulnerability to environmental hazards and the development of protective
policies to prevent adverse health effects from known and emerging environmental pollutants.

In June of 2000, the North American Commission for Economic Cooperation
environment ministers of US, Mexico and Canada signed a Resolution on Children's
Environmental Health, putting into motion an ambitious cooperative agenda for the three
countries which includes work on asthma, lead poisoning, risk assessment, indicators
development and economic valuation (U.S. Environmental Protection Agency, 2006a).

Additional international commitments have been signed by Canada concerning
children's environmental health as well as targeting specific issues such as lead pollution. Non-
governmental organization alliances have drawn up similar declarations (CPCHE, 2006).

Canada has also signed The Stockholm Convention on Persistent Organic Pollutants
(POPs), an international treaty initiated in 2001 and ratified in 2004. The Stockholm Convention
seeks to implement plans to phase-out and ban a group of 12 persistent toxic substances (dioxins,
furans, PCBs, hexachlorobenzene, and eight organochlorine pesticides including mirex, aldrin, DDT, chlordane, dieldrin, endrin, heptachlor and toxaphene). Increasing evidence suggests that a number of other persistent toxic substances should also be considered for this international phase-out. For example, PBDEs are similar to PCBs in terms of both environmental persistence and toxic effects (Birnbaum and Staskal, 2004) but are not currently included in the Stockholm Convention (McKweon, 2005).

5.2.2 United States

5.2.2.1 US EPA’s Office of Children’s Health Protection (OCHP) (1997)

The United States Environmental Protection Agency’s (US EPA) Office of Children’s Health Protection (OCHP), established in May 1997, supports the EPA as it implements both President Clinton's 1997 Executive Order on the Protection of Children from Environmental Health Risks and Safety Risks as well as the National Agenda to Protect Children's Health from Environmental Threats. The Executive Order requires all federal agencies to place a high priority to addressing health and safety risks to children. The OCHP is a dedicated office, which has institutionalized child health protection within the US federal government. It works with internal and external partners to improve scientific understanding of children's environmental health issues. Its contribution to children’s health protection in the US is substantial in the areas of research, regulation, outreach and education. The OCHP has established 12 Centers for Children’s Environmental Health and Disease Prevention Research and reviews and develops health-based standards that specifically address impacts on children’s health. The OCHP has also
supported the development of Pediatric Health Fellowships and Pediatric Environmental Health Specialty Units (PEHSUs) (USEPA, 2006).

5.2.2.2 National Children’ Longitudinal Study

One initiative with long term impacts is currently being undertaken by several United States federal agencies who are initiating the National Children’ Study, a longitudinal cohort study that will track the health of 100,000 American children from in utero to adulthood (Branum et al, 2003). Planned as a 21-year undertaking (estimated to cost 2.7 billion dollars US) the study will provide base line data and lay the groundwork for further studies that will help answer many questions on how exposures at different times affect child health and health later in life. Data will be collected relevant to describing exposures from pre-pregnancy and in early pregnancy. Biological samples from the mother and child, as well as from air, water, dirt, and dust in the child's environment will be collected and tested. The study will also gather information on the children’s genetics. The study intends to examine the possible impacts from exposures together with consideration of how environment and genes interact with each other (Check, 2004).

5.2.3 European Union

Content analysis (Google, Google Scholar) provided a number of initiatives currently underway in various countries in Europe with many coordinated by European Union activity. Over the last forty years the European Union has generated more than five hundred different
Directives, Regulations, Decisions and Recommendations relating to chemicals and consumer protection, occupational health, environmental protection, process and transport safety, and substance management; several of these initiatives pertain specifically to children’s environmental health. Each of the initiatives is described briefly with information on how the plan pertains to children’s environmental health.

5.2.3.1 WHO/Europe AIQ Air Quality Programme (October 2005)

A variety of outdoor and indoor sources can contribute to the health risks of children, and the hazardous properties of many common pollutants are still being investigated. Since outdoor air pollution can travel beyond boundaries international information exchange and collaborations are needed to evaluate the risks and promote the most efficient ways to prevent, eliminate or reduce air borne contaminants integrating health issues with sustainable development. To this end the WHO/Europe AIQ program’s mission is to contribute to the information base on health protection and harm caused by air pollution. As part of the global WHO strategy on air quality and health, AIQ provides knowledge on the disease burden of air pollution as a basis for making environmental policy; reviews scientific evidence on health effects of air pollution; and provides guidance to countries for capacity building to improve health risk management from air pollution (World Health Organization, 2005).

5.2.3.2 EU Restrictions for Phthalates and Mercury (October 2005)
There was much content in Europe calling for strong action on phthalates and mercury - two substances known to impact children’s health. Restrictions on the marketing and the use of dangerous substances, to which new-born babies, children, pregnant women, elderly persons and workers are heavily exposed, were recommended as safer alternatives become available. Six phthalates (di(2-ethylhexyl) phthalate (DEHP), di-iso-nonyl phthalate (DINP), dibutyl phthalate (DBP), di-iso-decyl phthalate (DIDP), di-n-octyl phthalate (DNOP), and butylbenzyl phthalate (BBP)) used in domestic products and in medical devices were targeted for reduction, except where such a restriction would have a negative impact on medical treatment. The use of other chemicals: mercury used in dental amalgams and in non-electrical or non-electronic measuring devices, chlorinated solvents, and a small number of organophosphate pesticides (chlorpyriphos, diazinon and malathion) and an organochlorine pesticide (endosulfan) were also restricted (Health Care Without Harm, 2006).

5.2.3.3 The Stockholm Initiative (October 2005)

Pharmaceuticals have been found in the environment at levels that are known to cause long-term toxic effects, yet for most pharmaceutical substances there is little or no data on exposure data or on the long-term effects of exposure to human health or the environment. Stockholm County Council has developed a system for environmental classification of pharmaceutical substances. The system operates by assessing the environmental hazard of the pharmaceutical substance in the aquatic environment in terms of its persistence, its potential to bioaccumulation and its eco-toxicity (PBT). Over 159 active substances have been classified on their PBT potential (Health Care Without Harm, 2006).
5.2.3.4 SCALE Initiative (July 2004)

The European Commission environmental health strategy called 'SCALE' is an acronym for Science, Children, Awareness, Legislation and Evaluation. The priority is on the following child disease areas: childhood respiratory diseases, asthma, allergies; neuro-developmental disorders; childhood cancer; and endocrine disrupting effects. These illnesses are linked to environmental factors such as indoor and outdoor air quality, dioxins, heavy metals, endocrine disrupters, electromagnetic fields and the urban environment. SCALE uses a science-based approach to look at the complex interactions between different pollutants and the body using research focusing on children’s health. The program aims to raise awareness of stakeholders and the general public and reduce the disease burden of children caused by environmental factors in Europe (EurActiv, 2006).

5.2.3.5 WHO Children's Environment and Health Action Plan for Europe (CEHAPE) (2004)

The CEHAPE is a document for policy makers addressing the environmental risk factors that most affect the health of European children. It was developed at the request of Member States and adopted by European Ministers at the Fourth Ministerial Conference on Environment and Health (2004) on "The future for our children". The plan highlights the main commitments on children's health and environment and focuses on four regional priority goals for Europe: safe
water and adequate sanitation; injury protection and adequate physical activity; clean outdoor and indoor air; and reduction of chemicals in the environment.

5.2.3.6 European Union Chemicals Policy Review (REACH) (October 2003)

On October 29 2003, the European Commission presented a proposal for a complete and major review of the European Union's chemical substances policy. The proposal sets up a comprehensive system for the Registration, Evaluation, Authorization of Chemicals known as REACH (Europa, 2006a).

5.2.3.7 EU Tobacco Legislation (December 2002)

The European Union is very active in combating smoking and the impacts of smoking and second hand smoke on children. EU governments have agreed to ban most forms of tobacco advertising and event sponsorship by tobacco companies no later than August 1 2005. Under EU rules there are already limits to the use of additives and addictive substances, compulsory health warnings, prohibitions to prevent misleading claims, and maximum levels for cigarette tar, carbon monoxide and nicotine. The EU has put forward a non-binding policy statement from the Council to the member states, covering issues that are not regulated at EU level, including retailing, vending machines, passive smoking, indirect advertising and disclosure of marketing budgets. A previous European Commission directive to ban tobacco advertising 98/43/EC was overturned by a European Court of Justice ruling (Case C-376/98) when it was legally challenged (Europa, 2006b).
5.2.3.8 Environment and Health Action Plan 2004-2010

There was need to develop an action plan to reduce diseases caused by a polluted environment in the EU. The plan would develop an EU system integrating information on the state of the environment, the ecosystem and human health. It identifies 13 actions, which include initiatives on how to better understand the environment-health link and establish how environmental exposure leads to epidemiological effects (Europa, 2004a).

5.2.3.9 CAFE Initiative (May 2001)

In May 2001, the European Union launched a program aimed at reducing air pollution and its effects on human health and the environment. The program called CAFE (Clean Air for Europe) is a collaborative effort between the European Commission, Member States, industry and Non-Governmental organizations (NGOs) to identify measures that need to be taken to improve air quality in Europe. Although mentioned as being an at risk group, specific additional targets to protect children are not included in CAFE’s mandate (Europa, 2005a).

5.2.3.10 EU Pesticide-Free Baby Foods Directives (June 1999)

The European Commission implemented new rules in the Commission Directives on infant formula and on cereal-based and other baby foods for infants and young children (96/5/EC) under which baby foods may not contain any demonstrable residues of pesticides.
Certain pesticides are to be banned in farm products intended for use in baby foods. Baby foods will not be allowed to contain more than 0.01% mg/kg of pesticide residues. The Commission has based its decision on the rules applied by Belgium, Germany, Luxembourg and Austria. In the past, free trade has suffered disruptions because of discrepancies between the rules applied by different Member States (EU Business, 1999a).

Each of the initiatives for children’s environmental health was derived from a transdisciplinary movement. Bogart (2005) suggests that for children’s environmental health we can look to the successful examples from those who have greatly helped to catalyze policy change in this area. She cites two examples, the US Environmental Protection Agency (EPA) and the Canadian Policy Research Networks (CPRN). As a model the EPA used an information campaign with political support focusing on scientific evidence using an incremental policy approach that used and built on pre-existing programs. The approach was transdisciplinary and integrated leading to the creation of a dedicated office with staff that “Institutionalized” the issue.

5.3 Newsstand Database Review

The Canadian newsstand database consists of the main Canadian Newsstand newspapers. Included are national and leading regional papers such as National Post, Calgary Herald, Edmonton Journal, Montreal Gazette, Ottawa Citizen, Regina Leader Post, Vancouver Sun, and the Victoria Times-Colonist with coverage from 1985-2005.
An initial search of newspaper articles used a broad approach with the keyword terms “legislation”, “health”, “hazard” and stage (either “fetus”, “post-natal”, “infant”, “child” or “adolescent”) but surprisingly returned only 4 article (see Table 5.1).

Table 5.1. Results on an initial search of newspaper content using keywords, “legislation”, “health”, “hazard” and “stage” (fetus, post-natal, infant, child or adolescent).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Newsstand Database Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetus</td>
<td>0</td>
</tr>
<tr>
<td>Post-natal</td>
<td>0</td>
</tr>
<tr>
<td>Infant</td>
<td>0</td>
</tr>
<tr>
<td>Child</td>
<td>4</td>
</tr>
<tr>
<td>Adolescent</td>
<td>0</td>
</tr>
</tbody>
</table>

the issue by loosely referencing legislation as a call to reduce childhood drownings: “Tougher public health legislation is one step in the right direction”. The second article names the *Ontario Tobacco Act* and defends the position preventing the sale of tobacco in Ontario pharmacies to protect children’s health. The third article discusses the hypocrisy of banning smoking in public places while allowing a nearby incinerator to operate in the same municipality.

Given the paucity of newspaper articles concerning children’s environmental health with regards to legislation, a more “relaxed” keyword search was undertaken to determine which issues were being raised and of concern to the general public. For children’s environmental health issues a search using keywords: “health”, “hazard”, and stage (either “fetus”, “post-natal”, “infant”, “child” or “adolescent”) was performed without the keyword “legislation” included. This second Newsstand database search returned a total of 1,196 newspaper articles published in major Canadian newspaper dailies from 1985-2005. The results of this search are presented in Section 3 and provide a measure of media interest in and hence, perhaps, risk perception of, issues pertaining to children’s environmental health.

### 5.4 Grey Literature Content Analysis Review (Google Scholar)

Grey literature was obtained and analyzed using Google Scholar an Internet database that catalogues peer-reviewed papers, policy documents, white papers, theses, books, preprints, abstracts and technical reports. Google scholar database can be assessed on the Internet at: [http://scholar.google.com/](http://scholar.google.com/). Google Scholar content analysis used a method for recovering and analyzing downloaded technical documents, white papers and reports in adobe acrobat (PDF) format. In short PDF files were downloaded if they matched keyword criteria, converted to
Microsoft word and searched en masse for the keyword which dumped the text line to a new file for by eye analysis of content. The methodology employed is described in Appendix 5.

5.4.1 Legislation Identified

The results of the grey literature content and keyword searches are shown in Figures 5.1 to 5.4 for each of the types of instruments: “legislation”, “regulation”, “voluntary code” and “initiative, incentive, program, plan and warning”.

Figure 5.1. Result of Grey Literature Keyword Search: Legislation

Legend:
- Protecting fetus health
- Protecting post-natal health
- Protecting infant health
- Protecting child health
- Protecting adolescent health
- Hazard environment
- Legislation
- Canada
- United States
- European Union
- World Health Organization
Figure 5.2. Result of Grey Literature Keyword Search: Regulation
Figure 5.3. Result of Grey Literature Keyword Search: Voluntary Codes
Figure 5.4. Result of Grey Literature Keyword Search: Initiative, Incentive, Program, Plan and Warning
The searches revealed that the United States as a jurisdiction had more grey literature documents available concerning children’s health than all other jurisdictions for all five child stages and for the four governance categories used. Canada as a jurisdiction had slightly higher numbers than the European Union and the World Health Organization for the governance tools and had a number of documents for legislation and regulation. As a jurisdiction, the European Union with a large collection of member countries had the fewest number of documents concerning health hazards to the fetal stage for all governance tools listed. The main collection of documents from the European Union focused on post-natal, infant and child stages for the governance instruments. Further searches were then carried out on the files retrieved using the keywords to find the name of Acts, legislation, regulations or initiatives using the method described in Appendix 5.

With the identification and retrieval of hundreds of grey literature documents searching the documents from the 80 separate searches for named Acts and regulations revealed the majority of citations for legislation referred generically to the subject of “legislation” without naming specific titles. In addition some of the names when given referred to legislation that was not specific for children’s environmental health. Regardless of this a small number of Acts, regulations and legislation were identified by name. A short list of legislation for Canada, United States and the European Union was created. A list for the World Health Organization showed it to be very Euro-centric and as a non-governmental group without true jurisdictional powers it largely referred to existing legislation in various European countries and European Union directives.

5.4.1.1 Canada
Legislation

- Canadian Environmental Protection Act (CEPA)
- Pest Control Products Act (PCPA),
- Food and Drugs Act (FDA),
- The Tobacco Act
- Radiation Emitting Devices Act (RED Act),
- Hazardous Products Act (HPA),
- Quarantine Act,

Guidelines, Workshops, Inquiries

- Walkerton Inquiry,
- Meat Inspection Inquiry,

Notable Project Groups and Workshops

- Children’s Environmental Health Project (Canadian Association of Physicians for the Environment-CAPE),
- Canadian Children's Environmental Health Research Workshop (2002)
5.4.1.2 United States

Legislation

- *Toxic Substances Control Act* (TOSCA)
- *Food Quality Protection Act* (FQPA)
- *U.S. Food and Drug Administration* (FDA)
- *The Clean Air Act* (CAA)
- *The Clean Water Act* (CWA)

Guidelines, Workshops, Inquiries

- Microbial/Disinfection Byproducts Rules
- National Research Council’s Acute Exposure Guideline Levels (AEGLs) for hazardous substances
- Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens (U.S. EPA)

Notable Project Groups and Workshops

- The Office of Children’s Health Protection (OCHP) and “Children’s Health Protection Advisory Committee”
- “America's Children and the Environment: A First View of Available Measures” National Centre for Environmental Economics

5.4.1.3 **International (European Union and World Health Organization)**

Guidelines, Workshops, Inquiries

- 1997 Declaration of the Environmental Leaders of the Eight on Children’s Environmental Health
- National Environment and Health Action Plan (NEHAP)
- European Union Council Recommendation on electromagnetic fields
- Workshop to Develop a Framework for Assessing Risks to Children from Exposures to Environmental Agents- ILSI27.
- International Conference on Environmental Threats to the Health of Children: Hazards and Vulnerability (Bangkok, 2002)
- Making a Difference: Indicators to Improve Children's Environmental Health (WHO)
5.5 Internet Database Review

A general Internet search engine, Google: [http://www.google.ca](http://www.google.ca) was used to search web pages for keywords employing a Boolean strategy following the search strategy. Google contains 8,058,044,651 available, catalogued web pages. Internet web pages were catalogued according to child stage (group) and environmental hazard category (env. hazard) in order to find concentration areas and a general inventory of content for different child developmental windows. Fetus, post-natal and infants when searched with keywords “health” and “hazard” in conjunction with environmental hazards revealed that categories of “soil”, “consumer products”, “built environment” and “radiation (emitting devices)” returned fewer results than “air”, “water”, “chemical” and “physical hazards”. The youngest age categories are largely immobile and routes of exposure to chemicals come primarily from air (indoor and outdoor air quality, second hand smoke, off-gassing of materials) and water (chemical contamination) used for drinking and preparation of infant formula. Radiation exposure as a hazard returned very few results regardless of child developmental stage as children are unlikely to expose themselves to radiation sources (microwaves, radioisotopes). One emerging area is the use of cellular telephones by adolescents as an electromagnetic radiation hazard but the web search revealed this was not a hazard of great concern when compared to chemical, built environment and physical hazards. Adolescents are much more mobile and are susceptible to injury in the built environment. Children as a group returned the largest number of results for all categories due to the fact that the keyword term is a “catch-all” used loosely sometimes referring to several developmental stages. Results for the general content analysis keyword search are shown in Table 5.2.
Table 5.2. Keyword search for content analysis: INTERNET (Google: http://www.google.com) using stage (either fetus, post-natal, infant, children or adolescent); environmental hazard (air, water, soil consumer products, built environment radiation emitting device, chemical, physical or biological agent); combined with keywords “health” and “hazard”.

<table>
<thead>
<tr>
<th>Group</th>
<th>Fetus</th>
<th>Post-natal</th>
<th>Infants</th>
<th>Children</th>
<th>Adolescent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Env.Hazard</strong> Air</td>
<td>21,800</td>
<td>6,640</td>
<td>64,300</td>
<td>377,000</td>
<td>24,200</td>
</tr>
<tr>
<td>Water</td>
<td>25,300</td>
<td>9,000</td>
<td>59,400</td>
<td>386,000</td>
<td>15,500</td>
</tr>
<tr>
<td>Soil</td>
<td>8,730</td>
<td>3,800</td>
<td>31,900</td>
<td>165,000</td>
<td>8,490</td>
</tr>
<tr>
<td>Consumer products Built environment</td>
<td>8,040</td>
<td>2,710</td>
<td>44,400</td>
<td>178,000</td>
<td>16,600</td>
</tr>
<tr>
<td>Radiation (emitting devices)</td>
<td>7,370</td>
<td>1,780</td>
<td>51,400</td>
<td>195,000</td>
<td>28,700</td>
</tr>
<tr>
<td>Chemical</td>
<td>2,850</td>
<td>440</td>
<td>5,310</td>
<td>19,500</td>
<td>2,290</td>
</tr>
<tr>
<td>Physical hazards Biological agents</td>
<td>45,400</td>
<td>8,240</td>
<td>82,900</td>
<td>423,000</td>
<td>56,400</td>
</tr>
<tr>
<td></td>
<td>40,000</td>
<td>7,790</td>
<td>86,600</td>
<td>456,000</td>
<td>72,400</td>
</tr>
<tr>
<td></td>
<td>9,910</td>
<td>3,730</td>
<td>22,300</td>
<td>69,700</td>
<td>9,560</td>
</tr>
</tbody>
</table>

Restricting the first keyword search to include the search term “legislation” returned significantly fewer results for all categories revealing much less public domain information is available. Results show a similar pattern to the initial search with the keyword “children” resulting in the most web pages (Table 5.3). The search for keywords in other jurisdictions (the United States, the European Union, and the World Health Organization) shows more webpage content dealing with legislation exists for the United States than other jurisdictions.
Environmental hazards of air and water mainly related to pollution and contamination resulted in the largest numbers of web pages (Table 5.4).

Table 5.3. Keyword search for content analysis: INTERNET (Google: www.google.com) using stage (either fetus, post-natal, infant, children or adolescent); environmental hazard (air, water, soil consumer products, built environment radiation emitting device, chemical, physical or biological agent); combined with keywords “health”, “hazard” and “legislation” (ie. search Table 5.2 results with keyword “legislation” added).

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Env. Hazard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>2,970</td>
<td>1,580</td>
<td>10,600</td>
<td>82,400</td>
<td>4,850</td>
</tr>
<tr>
<td>Water</td>
<td>3,160</td>
<td>1,880</td>
<td>12,600</td>
<td>96,400</td>
<td>5,400</td>
</tr>
<tr>
<td>Soil</td>
<td>1,570</td>
<td>556</td>
<td>5,920</td>
<td>34,600</td>
<td>1,670</td>
</tr>
<tr>
<td>Consumer products</td>
<td>1,960</td>
<td>679</td>
<td>7,690</td>
<td>41,000</td>
<td>3,320</td>
</tr>
<tr>
<td>Built environment</td>
<td>756</td>
<td>532</td>
<td>4,970</td>
<td>42,000</td>
<td>2,640</td>
</tr>
<tr>
<td>Radiation</td>
<td>400</td>
<td>119</td>
<td>650</td>
<td>5,180</td>
<td>372</td>
</tr>
<tr>
<td>Chemical</td>
<td>2,940</td>
<td>1,510</td>
<td>9,310</td>
<td>55,800</td>
<td>3,120</td>
</tr>
<tr>
<td>Physical hazards</td>
<td>3,120</td>
<td>2,000</td>
<td>10,900</td>
<td>80,000</td>
<td>6,680</td>
</tr>
<tr>
<td>Biological agents</td>
<td>1,510</td>
<td>580</td>
<td>4,040</td>
<td>16,700</td>
<td>1,660</td>
</tr>
</tbody>
</table>
Table 5.4. Keyword search for content analysis: INTERNET (Google: [www.google.com](http://www.google.com)) using jurisdiction (either Canada, United States, European Union or the World Health Organization); stage (either fetus, post-natal, infant, children or adolescent); environmental hazard (air, water, soil consumer products, built environment radiation emitting device, chemical, physical or biological agent); combined with keywords “health”, “hazard” and “legislation”.

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td><em>2,810</em> (USA)</td>
<td>2,580</td>
<td>13,700</td>
<td>70,600</td>
<td>7,570</td>
<td></td>
</tr>
<tr>
<td></td>
<td>638 (EU)</td>
<td>907</td>
<td>5,420</td>
<td>24,600</td>
<td>2,260</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,530 (CAN)</td>
<td>926</td>
<td>6,390</td>
<td>29,000</td>
<td>3,360</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,950 (WHO)</td>
<td>2,190</td>
<td>9,900</td>
<td>43,400</td>
<td>5,610</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,010</td>
<td>3,260</td>
<td>15,500</td>
<td>81,100</td>
<td>8,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>777</td>
<td>1,740</td>
<td>6,190</td>
<td>28,400</td>
<td>2,380</td>
<td></td>
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<tr>
<td></td>
<td>1,510</td>
<td>1,680</td>
<td>7,250</td>
<td>32,100</td>
<td>3,460</td>
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<tr>
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<td>1,560</td>
<td>1,570</td>
<td>7,270</td>
<td>32,000</td>
<td>2,710</td>
<td></td>
</tr>
<tr>
<td></td>
<td>467</td>
<td>603</td>
<td>3,300</td>
<td>13,200</td>
<td>613</td>
<td></td>
</tr>
<tr>
<td></td>
<td>557</td>
<td>553</td>
<td>3,430</td>
<td>14,400</td>
<td>719</td>
<td></td>
</tr>
<tr>
<td></td>
<td>213</td>
<td>601</td>
<td>2,100</td>
<td>8,970</td>
<td>415</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,070</td>
<td>1,370</td>
<td>10,400</td>
<td>41,500</td>
<td>5,130</td>
<td></td>
</tr>
<tr>
<td></td>
<td>589</td>
<td>810</td>
<td>4,870</td>
<td>19,900</td>
<td>1,720</td>
<td></td>
</tr>
<tr>
<td></td>
<td>753</td>
<td>744</td>
<td>5,170</td>
<td>19,700</td>
<td>2,420</td>
<td></td>
</tr>
<tr>
<td></td>
<td>234</td>
<td>681</td>
<td>2,840</td>
<td>12,300</td>
<td>694</td>
<td></td>
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<tr>
<td></td>
<td>753</td>
<td>1,760</td>
<td>7,050</td>
<td>37,400</td>
<td>4,300</td>
<td></td>
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<td></td>
<td>326</td>
<td>714</td>
<td>3,110</td>
<td>16,500</td>
<td>958</td>
<td></td>
</tr>
<tr>
<td></td>
<td>423</td>
<td>713</td>
<td>3,440</td>
<td>17,400</td>
<td>1,910</td>
<td></td>
</tr>
<tr>
<td></td>
<td>132</td>
<td>697</td>
<td>2,440</td>
<td>13,300</td>
<td>672</td>
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<td></td>
<td>940</td>
<td>526</td>
<td>4,650</td>
<td>17,400</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>364</td>
<td>282</td>
<td>2,020</td>
<td>8,180</td>
<td>671</td>
<td></td>
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<tr>
<td></td>
<td>564</td>
<td>275</td>
<td>2,380</td>
<td>8,590</td>
<td>694</td>
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<td></td>
<td>2,780</td>
<td>962</td>
<td>11,500</td>
<td>48,200</td>
<td>4,880</td>
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<tr>
<td></td>
<td>667</td>
<td>653</td>
<td>5,200</td>
<td>20,600</td>
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<tr>
<td></td>
<td>990</td>
<td>588</td>
<td>5,600</td>
<td>21,800</td>
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<tr>
<td></td>
<td>329</td>
<td>471</td>
<td>3,140</td>
<td>13,100</td>
<td>592</td>
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<tr>
<td></td>
<td>2,920</td>
<td>1,820</td>
<td>13,500</td>
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<td></td>
<td>675</td>
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<td></td>
<td>963</td>
<td>581</td>
<td>6,020</td>
<td>26,400</td>
<td>3,700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>344</td>
<td>607</td>
<td>3,740</td>
<td>18,000</td>
<td>1,710</td>
<td></td>
</tr>
</tbody>
</table>
Several similar listings of children’s environmental health issues were found on educational websites during the initial search. A list of issues as keywords was searched in combination with keywords “child”, “environment” and “health”. Results are shown in Table 5.5 (by number of webpages). The top issues for children’s environmental health issues were: Transportation, Communicable Disease, Chemicals, Smoking, Global Climate Change and Pollution (general). These are all very broad categories for children’s environmental health encompassing many related issues. Specific chemicals or pollutants returned fewer results. Over half of the issues (42 out of 76) dealt with chemical contaminants (chemical compounds, heavy metals, and chemical pollution).


<table>
<thead>
<tr>
<th>Biological agents</th>
<th>2,130</th>
<th>2,120</th>
<th>5,940</th>
<th>30,500</th>
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<tr>
<td></td>
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<td></td>
<td>797</td>
<td>808</td>
<td>2,960</td>
<td>14,600</td>
<td>720</td>
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<tr>
<td></td>
<td>299</td>
<td>673</td>
<td>1,680</td>
<td>9,300</td>
<td>374</td>
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</tbody>
</table>
Table 5.5. List of Child Environmental Health Issues and numbers of Google webpages. Issues sorted by descending number of resulting Google webpages. Issues also assigned to the main hazard categories of: air, biological, chemical, consumer product, environment (natural or built), physical, radiation, soil and water. Internet Google database accessed July 1-20 2005. Results sorted by number of webpages. Initial issue list used for google search modified from: Children's Environmental Health Network, Washington D.C., online:


<table>
<thead>
<tr>
<th>ISSUE</th>
<th>NUMBER</th>
<th>CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>16,500,000</td>
<td>Environment, Air, Physical</td>
</tr>
<tr>
<td>Communicable Disease</td>
<td>12,300,000</td>
<td>Environment, Biological</td>
</tr>
<tr>
<td>Chemicals</td>
<td>11,300,000</td>
<td>Chemical, Environment, Soil, Water</td>
</tr>
<tr>
<td>Smoking</td>
<td>6,640,000</td>
<td>Environment, Air, Consumer product</td>
</tr>
<tr>
<td>Global Climate Change</td>
<td>6,300,000</td>
<td>Environment, Air, Water, Soil</td>
</tr>
<tr>
<td>Pollution (general)</td>
<td>6,270,000</td>
<td>All categories</td>
</tr>
<tr>
<td>Alcohol</td>
<td>5,880,000</td>
<td>Consumer product, biological</td>
</tr>
<tr>
<td>Water (drinking)</td>
<td>4,960,000</td>
<td>Environment</td>
</tr>
<tr>
<td>Agricultural Exposure (chemicals)</td>
<td>4,200,000</td>
<td>Environment</td>
</tr>
<tr>
<td>Viruses</td>
<td>4,100,000</td>
<td>Biological</td>
</tr>
<tr>
<td>Medical Waste</td>
<td>3,920,000</td>
<td>Chemical, Environment, Soil</td>
</tr>
<tr>
<td>Soil</td>
<td>3,760,000</td>
<td>Soil, Environment</td>
</tr>
<tr>
<td>Asthma (air quality)</td>
<td>3,270,000</td>
<td>Biological, environment</td>
</tr>
<tr>
<td>Water (recreational)</td>
<td>3,180,000</td>
<td>Water, Environment</td>
</tr>
<tr>
<td>Radiation</td>
<td>2,890,000</td>
<td>Radiation</td>
</tr>
<tr>
<td>Pesticides</td>
<td>2,350,000</td>
<td>Chemical, Environment, Water, Soil</td>
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<tr>
<td>Respiratory Diseases</td>
<td>2,340,000</td>
<td>Environment (built), Biological</td>
</tr>
<tr>
<td>Bacteria</td>
<td>2,280,000</td>
<td>Biological</td>
</tr>
<tr>
<td>Issue</td>
<td>Value</td>
<td>Category</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hazardous Waste</td>
<td>2,180,000</td>
<td>Chemical, Environment (built)</td>
</tr>
<tr>
<td>Paint</td>
<td>1,910,000</td>
<td>Chemical, Environment (built)</td>
</tr>
<tr>
<td>Reproductive Disorders</td>
<td>1,890,000</td>
<td>Chemical, Biological</td>
</tr>
<tr>
<td>Food (pesticides)</td>
<td>1,620,000</td>
<td>Chemical, Consumer product</td>
</tr>
<tr>
<td>Lead and Lead Poisoning</td>
<td>1,610,000</td>
<td>Chemical, Environment (built), Soil</td>
</tr>
<tr>
<td>Outdoor Air Quality</td>
<td>1,410,000</td>
<td>Air, Chemical, Biological, Environment</td>
</tr>
<tr>
<td>Heavy Metals</td>
<td>1,300,000</td>
<td>Chemical, Soil</td>
</tr>
<tr>
<td>Mercury, Methylmercury</td>
<td>1,270,000</td>
<td>Chemical, Soil</td>
</tr>
<tr>
<td>Air Pollution (automobile)</td>
<td>1,150,000</td>
<td>Air, Chemical, Biological, Environment</td>
</tr>
<tr>
<td>Ozone</td>
<td>923,000</td>
<td>Air, Chemical</td>
</tr>
<tr>
<td>Cleaning Products (Household)</td>
<td>902,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Mold</td>
<td>866,000</td>
<td>Environment (built and natural)</td>
</tr>
<tr>
<td>Indoor Air Quality</td>
<td>851,000</td>
<td>Biological, Environment (built)</td>
</tr>
<tr>
<td>Fungi</td>
<td>767,000</td>
<td>Environment (built and natural)</td>
</tr>
<tr>
<td>Uranium</td>
<td>740,000</td>
<td>Radiation</td>
</tr>
<tr>
<td>Fish (Mercury)</td>
<td>665,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Tobacco Smoke (second hand)</td>
<td>664,000</td>
<td>Air, Environment (built)</td>
</tr>
<tr>
<td>Biological Contaminants</td>
<td>596,000</td>
<td>Chemical, Biological</td>
</tr>
<tr>
<td>Chlorine</td>
<td>595,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Aluminum</td>
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</tr>
<tr>
<td>Arsenic</td>
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<tr>
<td>Chromium</td>
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</tr>
<tr>
<td>Microorganisms</td>
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<td>Biological</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>430,000</td>
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</tr>
<tr>
<td>Electric and Magnetic Fields</td>
<td>411,000</td>
<td>Radiation</td>
</tr>
<tr>
<td>Sudden Infant Death Syndrome</td>
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</tr>
<tr>
<td>Radon</td>
<td>329,000</td>
<td>Radiation</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>294,000</td>
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</tr>
<tr>
<td>Substance</td>
<td>Quantity</td>
<td>Category</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Carcinogens</td>
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<tr>
<td>Volatile Organic Compounds</td>
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</tr>
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<td>Toys (hazardous)</td>
<td>215,000</td>
<td>Consumer products</td>
</tr>
<tr>
<td>PCBs</td>
<td>204,000</td>
<td>Chemical, Environment</td>
</tr>
<tr>
<td>Dioxin</td>
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<td>Chemical</td>
</tr>
<tr>
<td>Cadmium</td>
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<td>Chemical</td>
</tr>
<tr>
<td>DDT</td>
<td>169,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Wood Smoke (wood stoves)</td>
<td>166,000</td>
<td>Air, Consumer product</td>
</tr>
<tr>
<td>Selenium</td>
<td>160,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Endocrine Disruptors</td>
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</tr>
<tr>
<td>Benzene</td>
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</tr>
<tr>
<td>UV Radiation</td>
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<td>Radiation</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>134,000</td>
<td>Chemical</td>
</tr>
<tr>
<td>Urban Exposures (chemicals)</td>
<td>133,000</td>
<td>Chemical, Environment (natural)</td>
</tr>
<tr>
<td>Incinerators (pollution)</td>
<td>115,000</td>
<td>Air, Environment</td>
</tr>
<tr>
<td>Nitrates</td>
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<tr>
<td>Radium</td>
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<td>Radiation</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>72,200</td>
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</tr>
<tr>
<td>X-ray Radiation (x-rays)</td>
<td>61,500</td>
<td>Radiation</td>
</tr>
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<td>Teratology</td>
<td>54,700</td>
<td>Chemical, Biological, Environment</td>
</tr>
<tr>
<td>Thalidomide</td>
<td>54,700</td>
<td>Chemical</td>
</tr>
<tr>
<td>Methyl Bromide</td>
<td>52,900</td>
<td>Chemical</td>
</tr>
<tr>
<td>Prenatal Exposures (chemical)</td>
<td>49,100</td>
<td>Biological, Chemical</td>
</tr>
<tr>
<td>Bioaccumulation (referring to chemicals)</td>
<td>47,000</td>
<td>Biological, Chemical</td>
</tr>
<tr>
<td>Phthalates</td>
<td>43,800</td>
<td>Chemical</td>
</tr>
<tr>
<td>Organochlorine Compounds</td>
<td>43,700</td>
<td>Chemical</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>41,200</td>
<td>Chemical</td>
</tr>
</tbody>
</table>
Organophosphates  36,700 Chemical
Sulfates  28,300 Chemical
Neurotoxicants (neurotoxins)  28,200 Chemical

5.6 Conclusions from Content Analysis

Grey literature revealed a number of regulations, Acts and initiatives for the three jurisdictions surveyed. The broad approach showed that for legislation the majority of references in grey literature were generic references to “the legislation” without naming specific Acts. In addition, some identified Acts were not pertinent for children’s environmental health protection even though specific key words for environmental health were used. Despite the disadvantages the approach provided a broad canvassing of available grey literature and policy documents. The approach did allow for the identification and creation of short lists of pertinent legislation and regulatory initiatives. From this short list individual pieces of legislation were analyzed as governance tools for children’s health protection.
6. GENERAL LESSONS FOR HEALTH CANADA FROM THE EXPERIENCE OF OTHER JURISDICTIONS

Expert opinion is characterized, for authors in the peer reviewed literature, by a specific mode of thinking which has evolved from the merger of knowledge, skill and experience (Benner and Tanner, 1987; Field, 1987). This specialized mode of thought appears to enable experts to develop “heuristics” or a usable catalogue of “expert rules of thumb” that allow for situational response without having recourse to obvious diagnostic principles (Nyiri, 1988). The use of intuition (Benner and Tanner, 1987), expert quality (Field, 1987), know how (Gatley, 1992), artistry (Meerabeau, 1992) or term association (Broudy et al., 1964) in decision making for experts is framed in terms of perceptual awareness.

Thompson et al. (1990) suggest that attempts to find exact definitions of “expertise” as a way to rank experts are fruitless in that the definitions will not provide any measurable phenomena required as a selection criteria. Schvaneveldt et al. (1985) agrees that defining an expert by quantifiable measures is extremely difficult. Characteristics of expertise are not being able to understand more complex structure and details, but rather, experts tend to identify the important, critical information and associations. This ability by experts allows them to simplify complex information to its salient and essential points.

Specialized domains of knowledge such as science, medicine, law, and government policy have gradually taken over as the basis on which many of our rational decisions are made. For risk assessment of population health issues there is a significant use of expert analysis and understanding. Statistics, epidemiology and other population based quantitative methods are
routinely used to inform risk management decisions. Consequently, expert opinion in these areas has become a powerful type of argument based on highly technical information (Walton, 1997).

A review of current literature shows that expert opinion is used in a number of domains. The majority of expert opinion use occurs in several fields including finance, law, medicine and public policy (Shiller, 2001; Underwager and Wakefield, 1993; Strom, 2004; Dur and Swank, 2005) but the two main fields where expert opinion is formalized as a transparent process to inform society in a normative way is law and medicine. Much expert opinion is used in business (finance, insurance and investment) but the proprietary nature of the sector restricts the benefits as a public good to individuals or corporate entities. In law individuals called as expert witnesses can give advice on a number of subjects. Medical reviews of competing treatment alternatives are assessed by clinical evidence and medical experts who give their opinion on which treatment they believe are the most effective.

Thus, based on this review we can define an expert as anyone with expert knowledge or experience of a particular field or discipline beyond that expected of a layman. An expert witness is an expert who makes this knowledge and experience available to a court (or other judicial and quasi-judicial bodies, e.g. tribunals, arbitrations, adjudications, select committees and official inquiries) to help it understand the issues of a case and thereby reach a sound and just decision. In law, it is a matter for the court to decide whether or not a witness is an expert. Academic or professional qualifications are not a prerequisite. Practical experience and the relevance of the expert's evidence to the issues of the case count for much more (Pamplin, 2000).

The role of expert opinion in decision making is important as experts help policy makers to make informed decisions about complex issues that revolve around knowledge they do not possess. Policy makers should not expect certainty as experts may disagree when presented with
the same information or data. Special interests and stakeholders may produce their own experts to support their position, their analysis, and reasons for championing certain policy options. The experts especially on a panel may have differing opinions but they need to reach consensus at some level to offer recommendations.

Risk assessment and risk management frameworks consist of a number of steps as an effective way to deal with decision making under uncertainty. Health Canada (2000) uses a six stage decision making framework that identifies the issue and context, determines the risks and benefits, identifies and analyzes options, selects a strategy, implements the strategy and evaluates the results. Expert opinion and expert panels are usually brought together and follow this framework strategy to yield an informed consensus, a set of policy options, guidelines, recommendations or an integrated-transdisciplinary overview of the issue. The effectiveness of any experts and the resulting synthesis of ideas and proposed solutions depend upon the experts chosen for the evaluation. Thus much can be learned in the area of children’s environmental health protection by looking to experts from different sectors (government, industry, non-governmental organizations and university researchers) and experts residing in other jurisdictions for guidance.

For identification of governance tools (legislations, regulations, policy) and non-governance tools a number of individuals with expertise in children’s environmental health were contacted and interviewed. Based on the knowledge that experts and expertise can be found is several areas we adopted a broad transdisciplinary approach contacting experts in government, non-governmental organizations, university researchers, consultants and industry. Including experts outside of government we felt was important especially when asking for information on non-governance instruments. A short survey was administered consisting of 10 questions,
conducted over the phone or in person. Individuals were asked to complete a consent form prior to participation (see Appendix 6 for survey questions and consent forms). Questions were asked to uncover barriers, facilitators, experience based initiatives, and methods of evaluating child health initiatives, policy and legislation. Interviews were conducted in three main jurisdictions: Canada, the United States and member countries of the European Union (England, Sweden, Denmark, Austria and Germany) (see Appendix 7 for a listing of experts interviewed). The expert interviews will provide much information to determine what approaches, arguments, strategies, types of governance or non-governance tools have been used in other countries. Moreover experts were asked about the effectiveness of using such instruments and how these governance tools have been monitored and evaluated for protecting children’s environmental health. The aim was to solicit expert opinion from a variety of areas to obtain knowledge of both explicit and implicit tools related to children’s environmental health.

6.1 Canada – Expert Opinion Interview Results

Respondents from Canada comprised experts from four domains: industry, university researchers, non-governmental organizations and government committee/consultants (n=12) (Figure 6.1).
Each of thee respondents were asked to identify by name legislation or Acts identified (excluding CEPA) as protecting children’s environmental health, non-regulatory instruments and information based strategies. No distinction between implicit and explicit use was indicated in our line of questioning. Experts from each sector were able to name at least two of each instrument type. Some respondents found the question pertaining to naming legislation difficult stating that there were many Acts and legislation that they could name that “implicitly” were used to protect children’s health. Experts in non-governmental organizations with strong advocacy and communications areas were able to name more Acts, non-governance tools and communications strategies than other experts. Respondents from industry and consultants appeared equally knowledgable while University researchers were least aware of legislation,
other tools and communications strategies for children’s environmental health (Figure 6.2).

Some experts identified CEPA itself clearly indicating that they believed that it already implicitly applied to the protection of children. The list of legislation named by experts is given in Table 6.1 and the list of non-legislative instruments is given in Table 6.2.

Figure 6.2: Identification of governance instruments. Blue: Average number of legislation or Acts identified (excluding CEPA); Red: Average number of non-regulatory instruments identified; and Yellow: Average number of information based strategies identified.
Table 6.1: Responses from experts in Canada identifying legislation by name when asked.

**Respondents Canada: Identifying legislation that protects children’s environmental health.**
- CEPA
- Pest Control Products Act
- Canadian Health Acts (general)
- Hazardous Products Act
- Food and Drugs Act
- Radiation Protection Act
- Canada Water Act
- No true child specific legislation in Canada
- Pesticide by-laws
- Provincial air/water quality legislation
- Don’t know

Table 6.2: Responses from experts in Canada identifying non-legislative tools by name when asked.

**Respondents Canada: Identifying non-legislative tools that protect children’s environmental health.**
- Educational initiatives for smoking, water, pesticides (Health Canada, Provincial and municipal)
- NGO actions (internet based)
- Action of child health advocates (CICH, CAPE, CEH networks)
- Multi-stake holder meetings (industry with NGOs)
- Voluntary initiatives for reduction of chemicals by industry
- Responsible care initiatives (CCPA, ARET, Env. Performance Agreements)
- Radon abatement initiatives (B.C. schools)
- Fact sheets
- Guidance documents
- Not aware of any non-legislative instruments

Having identified these governance and non-governance instruments we were then interested in knowing how experts evaluated the effectiveness of these instruments. Almost all experts were in agreement that the evaluation of instruments used is an extremely difficult undertaking.
Respondents were also asked to identify effective actions for children’s environmental health that they were aware of (Table 6.3). There were many identified needs including: Improving evaluation, biomonitoring, information uptake, longitudinal studies. This question was matched by asking experts based on their own first hand experience what are the most effective ways to improve children’s environmental health (Table 6.4). Despite the fact that the evaluation of these tools was previous identified as lacking or weak legislation and local bylaws, education and monitoring were named as tools most effective based on personal experience.

Table 6.3: Expert opinion on effective children’s environmental health actions.

<table>
<thead>
<tr>
<th>Expert group</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>• Biomonitoring</td>
</tr>
<tr>
<td></td>
<td>• Longitudinal studies</td>
</tr>
<tr>
<td></td>
<td>• Better monitoring of child health trends</td>
</tr>
<tr>
<td>NGOs</td>
<td>• Evaluate health outcomes to see if actions have reduced incidence</td>
</tr>
<tr>
<td></td>
<td>(biomonitoring)</td>
</tr>
<tr>
<td>University Research</td>
<td>• Biomonitoring</td>
</tr>
<tr>
<td></td>
<td>• Surveys and sampling for contaminants</td>
</tr>
<tr>
<td></td>
<td>• Measure uptake of education campaigns (surveys)</td>
</tr>
<tr>
<td>Consultants</td>
<td>• Measure morbidity and mortality, establish baseline data</td>
</tr>
<tr>
<td></td>
<td>• Biomonitoring</td>
</tr>
<tr>
<td></td>
<td>• Health outcome surveillance</td>
</tr>
<tr>
<td></td>
<td>• Issue state of health report</td>
</tr>
<tr>
<td></td>
<td>• Communicate funding and outcomes</td>
</tr>
<tr>
<td></td>
<td>• Improve data sharing</td>
</tr>
<tr>
<td></td>
<td>• Increase applied research</td>
</tr>
</tbody>
</table>
Table 6.4. Expert opinion of the most effective children’s environmental health actions based on personal experience.

**Most effective children’s environmental health actions based on personal experience.**

- Public educational campaigns
- Local bylaws
- Current legislation at all levels
- Evidence based risk assessments using biomonitoring data (cited most often)
- Policy processes that use broad consultation, includes all stakeholders and is transparent
- Initiatives or programs that can establish consensus early during the process

Respondents were asked to identify approaches they would like to see implemented given the absence of barriers. Increasing research capacity into child specific issues was the most often cited answer but a number of other approaches were indicated (listed below).

- Increase research and research capacity
- Recognition of different child groups (windows of vulnerability)
- Increase education
- Increase regulation in the area of children’s environmental health
- Better communication
- Improve hazard detection, monitoring and risk evaluation
- Better prioritize risk management efforts to target the greatest burden of children’s diseases

Experts were then asked for ways to operationalize approaches that consider children’s environmental health. A number of innovative answers were received including:
1. Issue a “State of Health” report much like the state of the environment report. Such reports could be targeted to various developmental windows.

2. Increase transparency by communicating dollar amounts spent and committed for various child environmental health initiatives and programs. Could subdivide allocation by the different determinants of health.

3. Canada needs to establish its own capacity for biomonitoring, we rely heavily on American data extrapolating from their surveillance. Creation of a National Canadian Database on children’s health.

4. Need to include vulnerable subpopulations and critical windows of development for biomonitoring.

5. Establishment of a children’s environmental health ombudsman or Children’s Minister of Health to oversee children’s health issues.

Limitations and barriers to implementing children’s environmental health strategies exist and experts were also asked to identify these. Table 6.5 shows that experts believed the lack research funding, the lack of biomonitoring data and the lack of knowledge along with its poor dissemination were the largest encountered barriers. Changing personal behaviours, self interest by industry and advocacy groups, lack of a database to track child health and lack of information for decision making were given as weak barriers encountered by experts.
Table 6.5. Barriers to implementing effective children’s environmental health policies identified by Canadian experts.

<table>
<thead>
<tr>
<th>BARRIERS</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of funding for research</td>
<td>30.4</td>
</tr>
<tr>
<td>Lack of knowledge and knowledge transfer</td>
<td>17.3</td>
</tr>
<tr>
<td>Low awareness or child health seen as a low priority</td>
<td>17.3</td>
</tr>
<tr>
<td>Lack of biomonitoring data</td>
<td>13.0</td>
</tr>
<tr>
<td>Lack of information for decision making</td>
<td>8.6</td>
</tr>
<tr>
<td>Difficulty changing behaviours</td>
<td>4.4</td>
</tr>
<tr>
<td>Self interest by activists and industry</td>
<td>4.4</td>
</tr>
<tr>
<td>Lack of national child health database</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Finally, Canadian experts were asked if, in their opinion, CEPA adequately protected children’s environmental health (Figure 6.3). Half the respondents felt that this legislation was inadequate.

Figure 6.3. Canadian respondents asked if CEPA adequately protects children’s environmental health (respondent answers: yes, no or don’t know).
6.2 United States – Expert Opinion Interview Results

Respondents from United States comprised experts from four domains: industry, university researchers, non-governmental organizations and government officials (n=11) (Figure 6.4). Each of these respondents were asked to identify, by name, legislation or Acts identified in their jurisdiction as protecting children’s environmental health, non-regulatory instruments and information based strategies. No distinction between implicit and explicit use was indicated in our line of questioning but expert respondents from government clearly indicated and named explicit legislation only and indicated that they were aware of many pieces of legislation that implicitly named children; other groups (industry, university researchers and non-governmental respondents) did not qualify their answer when naming legislation. Experts from each sector were able to name, on average, at least one of each instrument type. Some respondents found the questions naming specific non-regulatory instruments and communication strategies difficult stating that there were many available despite the fact that they could not name the exact State or community instruments. Experts from university research laboratories named the fewest numbers of legislation, non-legislative instruments and communication based strategies. Government experts were able to name more non-governance tools and communications strategies than other experts (Figure 6.5). The list of legislation named by experts is given in Table 6.5 and the list of non-legislative instruments is given in Table 6.6.
Figure 6.4 Composition of expert respondents (Research, Government, non-governmental organization and industry) from the United States (n=11).
Figure 6.5. Identification of governance instruments by experts from the United States. Blue: Avg. no. of legislation or Acts identified; Red: Avg no. of non-regulatory instruments identified; and Yellow: Avg. no. of information based strategies identified.

Table 6.5. Responses from United States experts identifying legislation by name when asked.

**Respondents United States: Identifying legislation that protects children’s environmental health.**
- **Food Quality Protection Act** (children named explicitly)
- **Safe Drinking Water Act** (children named explicitly)
- **Federal Hazardous Substances Act** (FHSA) (children named explicitly)
- Lead regulations (implicitly name children)
- Various state statutes and standards (implicitly name children)
- Various state legislation eg. school child health act
- **Consumer products Act**
- **Toxic substances Act**
- **Federal Insecticide, Fungicide, and Rodenticide Act** (child safety closures)
- **Clean Air Act**
- Not aware of any legislative acts or regulations
Respondents identified a number of governance and non-governance instruments. When asked how these should be evaluated for effectiveness a number of answers were given. Almost all experts stated that this was a difficult question to answer and that that evaluation of children’s environmental health was a difficult task. Evaluation included acquiring baseline data, having independent peer review of data and risk assessment evaluation. Evaluation of schools, school children, their parents and the general public was also suggested as a way to evaluate knowledge uptake and the effectiveness of educational campaigns. Surveys were also suggested as a way to determine how well legislation and compliance was working. Evaluation also was indicated through surveillance and monitoring for compliance by industry but also monitoring of child health endpoints as a way to measure the effectiveness of instruments for reduction (Table 6.7). The question about evaluation was matched by asking experts to identify their own first hand experience of what they have found to be the most effective ways to improve children’s environmental health (Table 6.8). While evaluation of governance and non-governance

Table 6.6. Responses from experts in the United States identifying non-legislative tools by name when asked.

**Respondents United States: Identifying non-legislative tools that protect children’s environmental health.**

- Educational
- NGO actions (internet based)
- NGO educational campaigns
- Multi-stake holder meetings (industry with NGOs)
- Voluntary initiatives for reduction of chemicals by industry
- Integrated Pest Management in schools
- Action of child health advocates
- Voluntary Children's Chemical Evaluation Program (VCCEP)
- Longitudinal child health study
- Many community, city, state child health initiatives eg. lead reduction
- Not aware of any non-legislative instruments

Respondents identified a number of governance and non-governance instruments. When asked how these should be evaluated for effectiveness a number of answers were given. Almost all experts stated that this was a difficult question to answer and that evaluation of children’s environmental health was a difficult task. Evaluation included acquiring baseline data, having independent peer review of data and risk assessment evaluation. Evaluation of schools, school children, their parents and the general public was also suggested as a way to evaluate knowledge uptake and the effectiveness of educational campaigns. Surveys were also suggested as a way to determine how well legislation and compliance was working. Evaluation also was indicated through surveillance and monitoring for compliance by industry but also monitoring of child health endpoints as a way to measure the effectiveness of instruments for reduction (Table 6.7). The question about evaluation was matched by asking experts to identify their own first hand experience of what they have found to be the most effective ways to improve children’s environmental health (Table 6.8). While evaluation of governance and non-governance
instruments was indicated as an extremely difficult area experts were able to describe tools that had been effective in their expert opinion.

Table 6.7. United States Expert opinion on effective children’s environmental health actions.

<table>
<thead>
<tr>
<th>Expert group</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>• Biomonitoring</td>
</tr>
<tr>
<td></td>
<td>• Independent peer review of child health data</td>
</tr>
<tr>
<td></td>
<td>• Systematic review of child risk assessments</td>
</tr>
<tr>
<td></td>
<td>• Better monitoring of child health trends</td>
</tr>
<tr>
<td>NGOs</td>
<td>• Evaluate health outcomes to see if actions have reduced incidence (biomonitoring) and safe environmental doses have been achieved</td>
</tr>
<tr>
<td></td>
<td>• Surveillance and sampling for contaminants</td>
</tr>
<tr>
<td></td>
<td>• Survey doctors, public for uptake of education campaigns</td>
</tr>
<tr>
<td>University Research</td>
<td>• Biomonitoring, measure child health indicators</td>
</tr>
<tr>
<td></td>
<td>• Surveys of public, schools, consumers for knowledge uptake and labeling initiatives</td>
</tr>
<tr>
<td>Government</td>
<td>• Biomonitoring, measure child health indicators</td>
</tr>
<tr>
<td></td>
<td>• Surveys of contaminants to evaluate legislation</td>
</tr>
<tr>
<td></td>
<td>• Survey of public to evaluate education campaigns</td>
</tr>
</tbody>
</table>
Table 6.8. Expert opinion, United States: The most effective children’s environmental health actions based on personal experience.

**Most effective children’s environmental health actions based on personal experience.**
- Public educational campaigns and consumer awareness
- Initiatives or programs that are inclusive involving all stakeholders
- Current legislation, monitoring and enforcement for compliance
- Evidence based risk assessments using a good data set
- Policy processes that are flexible and use a balanced approach considering risks and benefits of all available options
- Adequate research to provide basic information for risk assessments

Respondents were also asked a normative question to identify approaches they would like to see implemented as a way to improve children’s environmental health. Increasing monitoring capacity into children’s environmental health was the most often cited response but a number of other approaches were indicated (listed below):

- Improve risk assessments
- Increase research and research capacity
- Increase biomonitoring
- Monitoring of specific child developmental “windows”, allocate resources appropriately
- Increase monitoring of the environment for contaminants
- Better education and communication to the public about child health issues
- More emphasis on prevention and reduction of environmental hazards.
Experts were then asked for methods that they would use to operationalize approaches that consider children’s environmental health. A number of answers were received including:

1. Use a combination of strategies to improve children’s environmental health, different stakeholders focus on different outcomes making a single endpoint or outcome as a measure difficult for consensus.
2. Increase education, there is a great need to increase the awareness of children’s environmental health in the general public
3. Improve biomonitoring, this requires the acquisition of good data to improve evaluation and risk assessments of children
4. Use existing databases creatively to improve risk assessments for children’s environmental health.
5. Regulate children’s environmental health using the Precautionary Principle instead of a case-by-case basis for environmental contaminants.

Experts identified a number of barriers to their work in children’s environmental health. Table 6.9 shows that experts believed the low awareness or child health seen as a low priority, and the lack of funding for research were the two biggest barriers to children’s environmental health. The phrase “lack of political will” was repeated several times by various experts when discussing barriers. Gaps in risk communication, knowledge transfer, education and lack of good data were also identified as problematic. Self interest by industry and bias against industry were also cited as lack of consensus barriers. Despite naming biomonitoring as one of the most effective ways to measure and evaluate children’s environmental health the lack of biomonitoring data was not seen as a major barrier for children’s environmental health.
Table 6.9. Barriers to implementing effective children’s environmental health policies identified by United States experts.

<table>
<thead>
<tr>
<th>BARRIERS</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low awareness or child health seen as a low priority</td>
<td>19.2</td>
</tr>
<tr>
<td>Lack of funding for research</td>
<td>19.2</td>
</tr>
<tr>
<td>Lack of risk communication and knowledge transfer</td>
<td>15.4</td>
</tr>
<tr>
<td>Lack of adequate data for policy</td>
<td>15.4</td>
</tr>
<tr>
<td>Lack of consensus on issues</td>
<td>11.5</td>
</tr>
<tr>
<td>Lack of education</td>
<td>7.7</td>
</tr>
<tr>
<td>Lack of biomonitoring data</td>
<td>7.7</td>
</tr>
<tr>
<td>Language barrier</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Finally, experts from the United States were asked if in their opinion if legislation adequately protected children’s environmental health (Figure 6.6). Half the respondents felt that legislation was inadequate. All industry respondents felt current legislation was adequate while all those doing university research felt it was not. Non-governmental organization experts and government experts split between agreeing and disagreeing that legislation in the United States was adequate to protect children’s environmental health.
Figure 6.6. United States respondents asked if legislation adequately protects children’s environmental health in their country (respondent answers: yes, no or don’t know).

6.3 European Union – Expert Opinion Interview Results

Experts interviewed from the European Union consisted of four groups: industry, university researchers, non-governmental organizations and government officials (n=11) (Figure 6.7). All of the experts worked in the area of children’s environmental health. Each of these respondents was asked to identify by name legislation used to protect children’s environmental health, non-regulatory instruments and information based strategies. No distinction between implicit and explicit use when naming legislation was indicated prior to answering. Experts from each sector were able to name at least one of each instrument type. Respondents from various European countries, much like those in Canada and the United States, found naming exact legislation difficult and believed that there was much legislation that “implicitly” protected
children’s environmental health. Experts in non-governmental organizations with strong advocacy and communications areas were able to name more non-governance tools and communications strategies than other experts (Figure 6.8). Almost all of the respondents from European countries were aware of European Union directives that provided another set of regulations (in some areas) to protect children’s environmental health, in addition to country specific governance tools. The list of legislation named by experts is given in Table 6.10, and the list of non-legislative instruments is given in Table 6.11.

Figure 6.7. Composition of expert respondents (University research, Government, Non-governmental organization and Industry) from the European Union (n=11).
Figure 6.8. Identification of governance instruments by experts from European Union member countries (Sweden, England, Austria, Germany and Denmark). Blue: Avg. no. of legislation or Acts identified; Red: Avg no. of non-regulatory instruments identified; and Yellow: Avg. no. of information based strategies identified.
Table 6.10. Responses from European Union experts identifying legislation by name when asked.

**Respondents European Union: Identifying legislation that protects children’s environmental health.**
- Gefahrstoffverordnung (Dangerous materials regulation) - Germany
- Gerätesicherheitsgesetz (Law over technical media, equipment safety law) - Germany
- Regulation for the protection from damage by x-rays (Electromagnetic fields and pregnant women) - Germany
- Federal Emission Control Act (Protection from air pollution, noise, vibration and similar phenomena) - Germany
- Building Law (Sustainable urban development) - Germany
- Industrial Pollution Control Order (1997) - England
- Environmental Protection Act 1990 - England
- EU mercury strategy (European Union)
- REACH (Registration, Evaluation and Authorisation of Chemicals) (European Union)
- No special legislation exists specifically for children (England, Austria)
- Not aware of any legislative acts or regulations (Netherlands, Denmark)

Table 6.11. Responses from experts from the European Union identifying non-legislative tools by name when asked.

**Respondents from the European Union: Identifying non-legislative tools that protect children’s environmental health.**
- Educational (many programs initiated in schools)
- NGO actions (educational, committees and communications outreach)
- CEHAPE- Children’s Environment and Health Action Plan for Europe to reduce children’s exposure to air pollution
- Carbon-dioxide monitors (air quality monitoring) in schools (Netherlands)
- Voluntary initiatives for reduction of environmental chemicals by industry
- Many community child health initiatives
- Not aware of any community based initiatives
Experts from European Union countries identified a number of governance and non-governance instruments. When asked how these should be evaluated for effectiveness a number of answers were given but many struggled with this question stating that evaluation was a difficult task; this answer was similar to the responses given by North American respondents. Evaluation included acquiring improved baseline data with improved biomonitoring. Monitoring was suggested not only of children but also monitoring of the environment, including air, soil and water. Evaluation of knowledge uptake and education was also thought to be important to European Union respondents and this could be done by surveys of school children but also their parents. Surveys were also suggested as a way to determine how well legislation and compliance was working as an evaluation tool. All expert groups from the European Union (industry, government, non-governmental groups and university researchers) mentioned monitoring and surveys as effective ways to evaluate the actions taken for children’s environmental health. (Table 6.12). The question about effective evaluation strategies was matched by asking experts to identify personal experience that they found to be the most effective way to improve children’s environmental health (Table 6.13). While evaluation of governance and non-governance instruments was indicated as an extremely difficult area the experts were able to describe tools that had been effective. The most effective governance tool was specific children’s environmental health legislation and the most effective non-governance instrument was education and communication strategies.
Table 6.12. European Union respondent’s opinions on effective children’s environmental health actions.

<table>
<thead>
<tr>
<th>Expert group</th>
<th>Action</th>
</tr>
</thead>
</table>
| Industry         | • Biomonitoring and monitoring  
                      • Establish better baseline data  
                      • Prioritize actions for children’s environmental health  
                      • Use an integrated approach (include education, communication, science, risk assessments and evidence based decision making) |
| NGOs             | • Monitoring of children and environment  
                      • Survey of institutions to see what they are doing, evaluate actions  
                      • Surveys parents and public for knowledge uptake on important child health issues  
                      • Include children in planning and decision making |
| University Research | • Biomonitoring, measure child health indicators  
                          • Surveys of public for knowledge uptake  
                          • Use national longitudinal study  
                          • Need to link monitoring efforts to reduction and legislation to evaluate what is effective |
| Government       | • Biomonitoring, measure child health indicators but this is a multifactorial problem making evaluation difficult  
                          • National longitudinal study  
                          • Better enforcement of WHO standards for children’s environmental health. |
Table 6.13. Expert opinion, European Union: The most effective children’s environmental health actions based on personal experience

**Most effective children’s environmental health actions based on personal experience.**
Legislation and regulations
Public educational campaigns that increase awareness and support
Use of mass media for dissemination of information and to increase awareness
Strategies that improve information to pediatric groups
Monitoring and biomonitoring of children’s environmental health endpoints and outcomes
Actions of organizations and committees such as the EU, WHO

Respondents were also asked to identify approaches they would like to see implemented as a way to improve children’s environmental health. Increasing public awareness, public education, and monitoring capacity were the most often cited responses.

Experts were then asked for methods that they would use to operationalize approaches that consider children’s environmental health. A number of answers were received including:

1. Improve education of key groups that deal with children, this would include teachers, nurses, midwives, pediatricians and professional groups.
2. Increase spending on children’s environmental health research
3. Improve biomonitoring and environmental monitoring
4. Need to identify the most important risks to children and prioritize them. Each country should develop a children’s environmental health strategy.
5. Set up new scientific advisory committees that include all stakeholders and those that hold opposite views or alternatives for promoting children’s environmental health
health. There would be a need to fund alternative expert opinion and ensure transparency of reporting of advisory committees.

6. Children’s environmental health is segmented and compartmentalized. Need to merge environment and health departments in government to create a department dealing with cross-cutting issues like children’s environmental health.

7. Need a minister or ombudsmen specifically assigned to children’s environmental health with responsibility and the authority to enforce and deal with issues related to children’s health.

8. Need to improve data confidentiality and use of existing data for epidemiology and monitoring studies.

Experts were also asked to identify barriers that they had encountered in their work on children’s environmental health. Table 6.14 shows that experts believed the lack of organization with no single department responsible for children’s environmental health, due to cross-cutting of this issue, the lack of funding for research and the overall lack of political will were the biggest barriers to children’s environmental health protection. Gaps in public awareness, poor education and poor use of existing scientific data were also identified as barriers. Self interest by industry and an inherent organizational bias when formulating children’s health policy were also cited as barriers. Experts had named surveillance and enforcement as some of the most effective ways to measure and evaluate children’s environmental health but these were not seen as major barriers for children’s environmental health.
Table 6.14. Barriers to implementing effective children’s environmental health policies identified by experts from the European Union.

<table>
<thead>
<tr>
<th>BARRIERS</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of organization, no single department responsible for children due to cross-cutting nature of issue</td>
<td>25.0</td>
</tr>
<tr>
<td>Lack of funding for research</td>
<td>20.0</td>
</tr>
<tr>
<td>Lack of political will</td>
<td>20.0</td>
</tr>
<tr>
<td>Lack of transparency in decision making with bias from stakeholder groups</td>
<td>10.0</td>
</tr>
<tr>
<td>Absence of adequate planning, misuse of resources</td>
<td>10.0</td>
</tr>
<tr>
<td>Lack of communication and education to the public on children’s environmental health issues</td>
<td>5.0</td>
</tr>
<tr>
<td>Lack of adequate data sets for policy</td>
<td>5.0</td>
</tr>
<tr>
<td>Poor use and misuse of science data</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Finally, experts from the European Union countries were asked if, in their opinion, legislation adequately protected children’s environmental health in their country (Figure 6.9). The majority of experts felt that legislation was inadequate (45.5%) while just over one third agreed that children’s environmental health was protected in their country (36.3%). One respondent answered that legislation may or may not protect children depending on the issue, the outcome being analysed and the endpoints being used, that is to say the issue is very complicated with multifactor variables that needed to be assessed on a case by case basis. One respondent declined to answer the question. Industry respondents felt current legislation was adequate but could be improved by using a holistic integrated approach combined with better biomonitoring and prioritizing of child health issues. Non-governmental organization experts and government experts split between agreeing and disagreeing that legislation was adequate to protect children’s environmental health. Respondents from the European Union identified a number of issues they
believed to be most pressing for children’s environmental health, issues included: indoor environments (a need to regulate building materials), indoor air quality (secondhand smoke, off-gassing of materials), traffic near schools (noise, pollution, traffic accidents), outdoor air quality, lead reduction (in localized areas) and chemical exposures.

Figure 6.9. European Union respondents asked if legislation adequately protects children’s environmental health in their country (respondent answers: yes, no, don’t know or no response).

6.4 Conclusions – Comparison of Expert Opinion from Different Jurisdictions

When discussing children’s environmental health most of the experts regardless of jurisdiction were in agreement that areas of uncertainty existed and that in some areas there is simply no information for many chemical environmental hazards. Experts in children’s
environmental health policy pointed to the lack of research funding and lack of political will to invest funds into research, biomonitoring, database management and program building despite the concern from the public to reduce some specific hazards for children.

Experts were aware of legislation, non-legislative tools and communication based strategies for children’s environmental health. Experts in all jurisdictions believed that in order to quantify the scope of the problem and to better understand environmental health outcomes linked to exposure levels that biomonitoring is needed.

Children’s environmental health issues and priorities were shown to be different depending on the jurisdiction. For example experts in Canada pointed to issues of smoking, environmental chemicals while respondents in the United States focused on issues of air pollution and chemicals. European Union respondents tended to focus on air pollution, improving city planning and chemicals.

Different jurisdictions identified similar barriers to children’s environmental health. In Canada and the United States lack of funding, low awareness and poor issue communication were the foremost barriers. European Union countries also identified lack of funding and low awareness as top barriers along with lack of political will.

Respondents from all jurisdictions identified interesting and novel ways to improve children’s environmental health. Improvements fell largely into main groups: first the need for improved data, data collection, biomonitoring and surveillance with associated issues of data sharing, confidentiality and knowledge transfer. Second the need for an integrated approach and a formal organization to strengthen the area of children’s environmental health by assigning a government group with responsibility for children’s environmental health. The United States and Canada have created specific offices for children’s environmental health while the European
Union respondents identified the lack of political will and voice as a main barrier for children’s environmental health issues. Clearly much work remains in the area of children’s environmental health to improve biomonitoring, surveillance, program evaluation and organizational strengthening of departments responsible for children’s environmental health issues.
7 FROM INSTRUMENT CHOICE TO IMPLEMENTATION

7.1 Introduction

7.1.1 Children’s Health and the Environment: Defining Objectives

The desire to better children’s health and life prospects is widespread and supported, (as noted elsewhere in this report), on grounds ranging from ethical to empirical. Thus, as a generalized objective of public policy, protecting children’s health enjoys the same status as the proverbial apple pie: it is difficult, (subject to the residual presence of contaminants,) to be against it. But although improved children’s health may be a universally-acclaimed objective, it is still desirable to inquire what advocates wish to accomplish, in particular what they wish to accomplish in relation to children’s health and the environment, and, how they propose to accomplish it. Some definition of goals is helpful from a range of perspectives: it may assist in the choice of instruments and approaches selected to pursue them; it may assist in the assessment and evaluation of such measures once implemented; and, it may contribute more generally to the effectiveness of processes of accountability that allow citizens to determine whether social goals and objectives are being adequately met.

Yet to suggest the importance of goals for children’s environmental health does not make the precise determination of those goals an easy task. Better children’s health in relation to the environment might mean one or more of a number of things:

- Directing attention towards controlling, reducing, or eliminating those environmental health risks to which children are particularly or uniquely vulnerable; that is, emphasize
environmental health risks that might be over-looked or neglected in programs aimed at environmental health protection for the general adult population. [Do not authorize the use of a pest control product which poses particular risks to children] Indeed, this objective might be further refined, for example, in relation to environmental health risks facing aboriginal children.

- Directing attention to children’s exposure to environmental health risks; that is focus on separating children from those risks, whether or not the environmental risks themselves to the general adult population are actually reduced. [Do not authorize the use of a pest control product which poses particular risks to children in settings where children are ordinarily found (playgrounds, parks, school yards). Or, perhaps, design initiatives to meet the circumstances of sub-populations of children who are believed to be distinctively subject to harmful exposures (workers in the agriculture or forestry sectors.)]

- Directing attention to particularly severe children’s environmental health risks whether severity might be understood in terms of impacts that are highly detrimental to a small number of individuals or in terms of impacts that affect a broad segment of the population, albeit moderately.

- Directing attention toward the overall reduction of environmental health risk with the intention that children will thereby benefit anyway as members of the general population. [Reduce the use of pest control products generally]

The manner in which an objective might be selected from amongst general alternatives of the kind noted, (assuming sufficient knowledge to do so,) here may well engender intense debate. It is of course important to direct resources towards the protection of children from environmental risks to which they are in some sense uniquely vulnerable. On the other hand it
may be possible with those same resources to achieve a greater overall improvement in children’s health by addressing more general forms of environmental health risk. There will also be those whose efforts to improve children’s environmental health will focus on cures and remedial interventions that will reduce the effects of illness or injury without necessarily lessening the incidence of such suffering.

It is unnecessary here to explore the alternative formulations fully. Sufficient general guidance exists in the form of policy statements to confirm a general orientation toward controlling exposures in the first instance:

“We affirm that prevention of exposure is the single most effective means of protecting children against environmental threats. We seek to improve levels of protection for children, and we reaffirm the priority of children’s environmental health in our own countries…” 51

However a more refined objective is determined, there may also be variations in the manner in which results are to be evaluated or the degree of success is to be assessed.

- Fewer incidents attributable to environmental conditions
- Fewer severe incidents attributable to environmental conditions
- Slower rate of increase in incidents attributable to environmental conditions
- Improved performance relative to some benchmark country or comparative standard

Once an overall outcome or objective and a means for measuring results have been identified, attention turns to the manner in which progress might best be pursued, sometimes described as the question of instrument choice.

7.1.2 Criteria for Instrument Choice

51 “1997 Declaration of the Environment Leaders of the Eight on Children’s Environmental Health” (Miami, Florida, May 5-6, 1997)
The selection of instruments is generally understood to flow from a process of assessment of alternatives against a set of factors including efficiency criteria, procedural criteria and legal criteria. A somewhat more elaborate description of the process of instrument-choice assessment in the context of children’s environmental health will involve consideration of the distinctive characteristics of this policy field and some determination of the particular goals that are to be achieved. Elsewhere in this report we have outlined characteristics of children’s environmental health and in the introduction to this section we have noted possible variations in the objectives that might be selected as representing advances in children’s environmental health.

It should also be noted that in the development of the proposal for this research, the applicants identified a further set of criteria that may be considered particularly relevant to effective environmental health policy. These are noted here briefly for convenience:

- Critical Windows of Development
- Susceptible Populations
- Multi-media Exposure
- Uncertainty and the State of the Science
- Precautionary Principle
- Knowledge Transfer
- Post-market surveillance

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These considerations it is assumed will figure alongside more generalized criteria for instrument choice in guiding the selection of approaches best suited to safeguarding children’s environmental health.

7.2 Instrument Choice: A Basic Inventory

Although selection, design and application of tools and instruments to promote the objectives of government present ongoing challenges, the general categories are well recognized.

- Law-making in one of a range for forms
- Economic incentives such as taxation, grants or subsidies
- Information-based strategies
- Direct provision of public services\(^\text{53}\)

This general classification corresponds to other formulations incorporating the categories of regulatory, economic, advisory, community-based and technical instruments.\(^\text{54}\)

7.2.1 Law-making and Regulation

The forms of law-making which are of most significance here include:

- primary legislation or statutes
- delegated or subordinate legislation, ordinarily known as regulation

\(^{53}\) This report makes no attempt to survey this option in the present context.

- quasi-legislation such as policy statements or guidelines produced by administrative authorities
- incorporation by reference of standards or codes of conduct giving the force of law to otherwise unofficial or non-binding norms

Les Pal of the School of Policy and Administration at Carleton University provides a helpful discussion of some of the distinguishing features of these legal instruments. Distinctions can be made among these, he notes, from the perspective of their legal effect and in relation to the procedures used to formulate them. With reference to legal effect two characteristics are of particular significance: first, generality of application, or the number of people towards whom the instrument is directed; and, second, the degree of compulsion, ordinarily involving the imposition of some threat or sanction. Statutes ordinarily affect large numbers of people and are understood to be binding. This is equally the case for secondary legislation whose legal authority is clearly established. Decisions, in contrast, are specific rather than general instruments that apply rather than make law. Quasi-legislation, as described by Pal, “has no binding legal effect generally – but bulletins etc. interpreting the meaning of legislation can have practical effect and can be authoritative to the degree that they are accepted by the courts.” Finally, incorporation by reference constitutes a powerful and flexible form of rule-making because it “can combine instruments that would otherwise stand separate and give them the force of law.” This can occur, for example, when a statute incorporates a regulatory code of conduct developed by an industry association. Such incorporation by reference, may even take on a dynamic quality where drafters provide that any subsequent amendments made to the code are also automatically reflected in the
legal instrument. “The law without the code is one instrument, and the code without the law is another. Combined, they form a hybrid that is more than the sum of its parts.”55

Where regulation is adopted, it can take a variety of forms. As described by PCO, several forms of regulation are available.56 These include:

1. Direct Product Controls:

   Such controls may take the form of restrictions on pricing or quantity of production and are generally intended to control profits in situations resembling a monopoly. Regulatory controls on product attributes (size, appearance, purity, durability, composition etc) are more typical in environmental regulation, and are quintessential “command-and-control” regulations.57 PCO acknowledges possible negative effects associated with such standards, including the possibility of increased costs, restraints on innovation, limited consumer choice. It is also sometimes suggested that a diminished sense of personal responsibility may result from dependence on government regulation for quality assurance.

   Standards can vary widely in terms of complexity, and in relation to their impact on the manner of compliance, or how expected results are to be achieved. Technical standards consist of an exact prescription of compliance, whether by giving the exact wording required on food labels, or by specifying the technology to be employed in an activity. By clearly defining what constitutes compliance, such standards provide considerable certainty: monitoring can often be accomplished merely by determining whether the required technology is present and functioning.

56 PCO, Assessing Regulatory Alternatives, 63-94
57 For recent commentary and assessment of command and control regulation in the environmental context, see Ben Richardson and Stepan Wood, Environmental Law for Sustainability (Hart Publishing, 2006)
On the other hand, businesses may complain that it stifles innovation and limits consumer choice.

In contrast with technical specifications, performance standards are understood to focus on setting the outcome or objective to be achieved. The differentiating characteristic between performance and technical standards is that with performance standards the regulated organizations may select the process by which to achieve with the target result (sometimes, though not necessarily, from a series of suggested alternatives.) Governments face more onerous monitoring challenges in relation to performance standards, since it is necessary to determine whether the regulatory outcome has been achieved. The monitoring burden may be alleviated by means of independent third-party performance review, through a program of ongoing re-certification, for example.

2. **Supplier Entry and Exit Controls**

These types of controls regulate who is allowed to supply a good or service. Having established control over the identity of the suppliers makes it administratively easier to impose other standards. First, there are a limited number of already identified and regulated persons, and second, the government may impose qualification standards or other restrictions as a condition of entering and remaining in the market. Examples of such controls are licences and permits as employed in a wide range of settings from resource use to telecommunications and transportation.

3. **Production Process Controls**

These standards relate to the inputs used or outputs generated during production, or to aspects of the processes themselves. For instance, effluent standards are intended to address the water quality impacts of certain production activities. Like product controls, they can take the
form of technical or performance standards. Technical standards have been used in the transport of dangerous goods, and in marine and air transport safety. Performance standards often take the form of specifying the maximum allowable concentration of a substance that can be used or produced, and allowing the company to select how to achieve that level.

As noted previously in connection with a survey of existing federal legislative provisions relevant to children’s environmental health, CEPA, 1999 already contains authority relating to this range of instruments. However, some discussion has been directed to the possibility of underlining the importance of children’s environmental health in legislation.

7.2.1.1 Adding Children’s Environmental Health to CEPA

It is at least possible to imagine amendments at the legislative level to enhance the profile of children’s environmental health within the formal statutory framework. By way of example, the list of administrative duties specified for the Government of Canada in section 2(1) contains frequent reference to human health:

(a) exercise its powers in a manner that protects the environment and human health …

(j) protect the environment, including its biological diversity, and human health, from the risk of any adverse effects of the use and release of toxic substances, pollutants and wastes;

(j.1) protect the environment, including its biological diversity, and human health, by ensuring the safe and effective use of biotechnology;

…
(k) endeavour to act expeditiously and diligently to assess whether existing substances or those new to Canada are toxic or capable of becoming toxic and assess the risk that such substances pose to the environment and human life and health

…

(m) ensure…that all areas of federal regulation for the protection of the environment and human health are addressed in a complementary manner in order to avoid duplication and to provide effective and comprehensive protection.

For the sake of exposition one might imagine exercises interpreting the scope of human health that is subject to the protective administrative duties set out here. Certainly we are dealing with the health of Canadians, at least primarily, for the specified administrative duties are to be fulfilled “having regard to the Constitution and laws of Canada.” (s. 2(1)) Yet in so far as CEPA, 1999 is responsive to Canada’s international obligations respecting, for example, the export of hazardous wastes (Part 7, Division 8), or in so far as the legislation addresses international air and water pollution (Part 7, Divisions 6 and 7) the Government of Canada is exercising its authority in relation to the human health of those other than Canadians. In connection with international air pollution, this concern with human health beyond that of Canadian human health is signalled by reference to “air pollution in a country other than Canada” (s. 166 (a)) with air pollution defined elsewhere to mean “a condition of the air … that directly or indirectly (a) endangers the health, safety or welfare of humans” (s. 3(1)). Water pollution is similarly treated and defined within the specific context of a set of provisions dealing with international water pollution. (Part 7, Division 7). We may also, without hesitation, conclude that human health encompasses the health of men and women equally, making reference to the Charter of Rights or general interpretative legislation.
Does the human health which the Government of Canada has administrative duties to protect under CEPA, 1999 also encompass the health of children? Subject to debate about the relationship of ‘children’ to ‘unborn children’ in legislation that already acknowledges the interest of future generations through the notion of sustainable development, children’s health has a pretty comfortable position under the human health umbrella. One might note, by way of re-enforcement of that impression reference in section 2(1)(j) to “any adverse affects” and in section 2(1)(m) to “comprehensive protection.”

Nevertheless, for greater certainty or in order to aim the spotlight, one might contemplate a preambular addition or an amendment to various references to human health in the legislation that would read, “including children’s health.” Amendments along these lines might serve to provide increased general prominence to the children’s health agenda. In addition, specific cases may continue to arise in which explicit child-oriented provisions may be considered desirable as in the case of the recent revision to Pest Products Control legislation.

7.2.2 Economic Instruments

Economic instruments or incentives have attracted increased attention among policy makers, and on the basis of growing experience with implementation, discussion of their merits and utility is shifting from the theoretical to the applied context. The Privy Council surveyed

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economic instruments in its review of federal regulatory alternatives.\textsuperscript{59} Principal examples are briefly noted here.

1. \textbf{Taxation}

In addition to its contribution to revenue raising, taxation can advance the government’s agenda by altering the economic consequences of particular forms of behaviour. Environmental taxes may take the form of deductions or credits (for engaging or refraining in the target behaviour) that reduce the taxes otherwise owing, or charges such as environmental emissions fees. Specific taxation examples that might contribute positively to the protection of children’s environmental health include an accelerated write-off of Capital Cost Allowance for pollution abatement equipment, and taxes on pesticides or fuels.

2. \textbf{Expenditures:}

Expenditures are transfers of benefits by government to persons in the private sector or to other levels of government. These typically consist of monetary grants but could also potentially be of material, information, or skilled personnel. Like taxation, expenditures influence behaviour by changing the economic costs and consequences, and thus are most effective when economic factors determine whether or not to engage in the target behaviour. One example of the use of expenditures for environmental objectives would be giving grants to environmental groups that perform monitoring, educational or advocacy functions.

3. \textbf{Loans/Loan Guarantees}

Another type of financial incentive, involves government transfers of assets or guarantees for a third-party loan, with attached contractual terms setting out the required behaviour change.

\textsuperscript{59} Privy Council Office, \textit{Assessing Regulatory Alternatives} (1994), online: http://www.pco-bcp.gc.ca/raojcs-srdd/docs/publications/assessing_reg_alternatives_e.pdf. The alternatives to regulation are set out pages 23-63. The examples given here are those provided by the Privy Council Office.
Such measures might be used to defray initial costs of technology and updating equipment to meet new standards.

4. **User Charges**

User charges are fees imposed for the use of collective resources, facilities or services, and have been used extensively in environmental regulation. The idea, consistent with the polluter pay principle, is that the charges should reflect the true value or cost. User charges have been applied in situations where there is a monopoly, such as water consumption, or with a regulatory regime supporting the use of the chosen suppliers. An example of the latter situation is the municipal sewage services and garbage collection. Although there are alternatives (installing a septic tank, dumping the garbage at night in a park), they are controlled by regulation and thus perceived as more expensive and burdensome.

5. **Insurance**

The federal government may establish or promote insurance schemes that protect persons from certain risks. As an element of a regulatory regime, the government can also require that businesses carry insurance for specified risks. One benefit of an insurance scheme is that the government is relieved of the detailed assessment and monitoring responsibilities of traditional command-and-control regulation. Instead, businesses are motivated to reduce the risks, and insurance companies may involve themselves in monitoring to assess the risks associated with the individual businesses. Common types of insurance schemes include performance bonds or restorations funds in which suppliers contribute through premiums to a fund which automatically pays out for specified harm. One example would be a performance bond or restoration fund for harm suffered by pesticide usage.

6. **Marketable Rights**
A regime of this kind may be established when government creates and distributes marketable rights to, for instance, use a limited natural resource or engage in certain activity. Following the initial allocation, market forces largely influence the transfer and re-distribution of the rights. This type of regime has been proposed in a variety of situations, ranging from controlling air and water pollution to fishing quotas.

The use of economic instruments, notably tradeable units and deposit-refund schemes is already authorized under *CEPA, 1999*. It is specifically provided in s. 323 (1) that in exercising authority to employ market-based approaches or economic instruments, the Minister “shall offer to consult …with persons interested in quality of the environment or the preservation and improvement of public health.”

### 7.2.3 Information-based Strategies

The collection and dissemination of environmental information and an understanding of associated health consequences is frequently regarded, in and of itself, as a potentially significant influence upon the behaviour of those responsible for and those subject to such impacts. Organizations and individuals whose activities expose others to environmental health risk become more accountable to governments, to the public, and - in the case of corporate polluters - to shareholders and investors. On the other hand, victims or potential victims, once alerted to

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60 ss. 322, 323, 326, 327

61 Reduction in both on-site inventories and toxic chemical releases have been attributed to compulsory TRI disclosures under the US Emergency Planning and Community Right to Know Act, 1986. Shameek Konar and Mark Cohen, “Information as Regulation: The Effect of Community Right-to-Know Laws on Toxic Emission,” (1997) 32 *Journal of Environmental Economics and Management* 109. This example illustrates a combination of instruments in that regulatory authority forms the basis for the disclosure of information to the public.
the potential for harmful exposure may be in a position to take certain protective measures on their own behalf.

Information-based strategies, as analysed by Richard Stewart, may vary significantly as to source, type and quantity of information, or as to the degree of complexity and interpretative support required, and in relation to the intended audience.62 Styles may vary as between negative messages oriented around the disclosure of health risks and positive information extolling some form of environmentally beneficial characteristic of a product or its process of manufacture. One thinks here of the contrast between a tobacco warning that signals danger to health and an eco-label affirming some form of endorsement or approval.63 Alternatively, information strategies may be largely neutral, simply requiring disclosure without necessarily attaching a positive or negative connotation. Certain forms of environmental assessment may fall within this realm.

Notwithstanding the beneficial potential of environmental health information, limitations must be acknowledged. Assuming that information is actually available and that it can be effectively disseminated to reach the intended audience, appropriate interpretation by members of that audience requires some level of understanding and a willingness to take measures to safeguard themselves or those for whom they are responsible. As Richard Stewart sums up the situation, “People have limited time, energy and attention.”64

Opportunities to pursue information-based strategies to protect children’s environmental health already exist in legislation.65 **CEPA, 1999** Part 2, dealing generally with public participation, provides for an Environmental Registry (ss. 12, 13). Part 3 addresses information

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63 For a recent assessment of eco-labelling in Canada, see Kathryn Harrison, “Promoting Environmental Protection Through Eco-Labelling: An Evaluation of Canada’s Environmental Choice Program” in Kernaghan Webb, ed. Voluntary Codes: Private Governance, the Public Interest and Innovation (Carleton University, 2004) 273
64 Stewart, 141
65 The ongoing debate over the extent of compulsory reporting that should be required and the extent to which confidentiality provisions might restrict access to certain forms of information is not addressed here.
gathering and research. Sections of this Part authorize arrangements, including cooperative arrangements with other persons and institutions to monitor environmental quality (s. 44) and permit the Minister to require those in possession of information on a range of environmental matters to provide such information (s. 46). Certain responsibilities are specifically assigned to the Minister of Health who shall (s. 45):

(a) conduct research and studies relating to the role of substances in illnesses or in health problems;

(b) collect, process, correlate and publish on a periodic basis data from any research or studies done under paragraph (a); and

(c) distribute available information to inform the public about the effects of substances on human health.

Perhaps to increase accessibility, those responsible for circulating information will favour simplification. Yet this approach, as much as commitment to complex detail, may limit the utility or effectiveness of information. How information will eventually be understood, and whether it will in fact be acted upon are additional factors requiring attention. Donald Buckingham has recently reviewed Canadian experience with food labelling in the context of a comprehensive analysis of the rationales offered for labelling requirements and an examination of the legal dimensions of such regimes.\(^6\) Undoubtedly experience with new food labelling requirements introduced to the Canadian marketplace in 2005 will be instructive. Important considerations may involve the accessibility of this information to a multi-lingual population with a significant immigrant component. It will also be of interest to observe whether increased labelling information has any discernable impact on children and youth as direct purchasers/consumers of

food products. Clearly on the basis of experience in relation to smoking, or to nutrition and diet, the significance of social circumstances as a factor influencing the effectiveness of information-based measures must be anticipated.

7.2.3.1 Pollutant Release and Transfer Systems

In the environmental context, the most prominent example of an information-based strategy is perhaps the Taking Stock initiative of the Commission for Environmental Cooperation, a program consolidating information from U.S Toxics Release Inventory and Canada’s National Pollutants Release Inventory. Comparable information from Mexican authorities in the form of the Registro de Emisiones y Transferencia de Contaminantes is expected to become publicly available in 2006.

The NPRI consists of a database of information maintained by Environment Canada as required by CEPA, 1999. Each year, companies which employ ten or more full-time employees are required to report the releases of the specified toxic substances. The amount of the substance which must be used, manufactured or processed by the company to trigger a reporting obligation varies. For instance, the core set of 231 NPRI substances relates to use in excess of 10 tonnes (and at 1% concentration) during the year. Releases of lead and arsenic can be made up to 50 kg (at .1% concentration) before NPRI obligations are triggered, while the reporting obligation for dioxins and furans is based the type of activity involved. The NPRI may be particularly valuable as a tool to identify the most problematic sectors, individual facilities and chemicals.

67 www.cec.org/takingstock. The NPRI has been established pursuant to CEPA, 1999 s. 46
The NPRI has continued to expand its list of substances, with the 2004 report covering 320 chemicals. These chemicals include carcinogens, developmental toxicants and neurotoxicants. The comprehensiveness of the NPRI is subject to certain limitations. For example, it excludes mobile sources of pollutants such as automobiles, ships, trains and airplanes. A major criticism of the NPRI was its initial failure to include common air pollutants such as carbon dioxide, but this limitation is being remedied. The lack of NPRI data on so-called “Criteria Air Contaminants” was also of considerable concern. Seven common air pollutants have been identified as “Criteria Air contaminants” (CACs) which when they interact tend to produce effects such as smog and acid rain. The CACs are: total particulate matter, fine and coarse particulate matter, carbon monoxide, nitrogen oxide, sulphur dioxide, and volatile organic compounds. They are produced in large volume in Canada, and were added by CEPA, 1999 to the National Pollutant Release Inventory (NPRI) as of 2002. The first data on CAC emissions was reported to the NPRI in 2004. The 2004 report includes the releases of criteria air pollutants (CACs) in excess of 20 tonnes. This means that the NPRI reports as of 2002 have data far more reflective of air quality.

The CEC’s essential aspiration in connection with the dissemination, through its Taking Stock project, of pollutant release and transfer information provided by the NAFTA parties has

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69 Environment Canada, “Glossary: Criteria Air Contaminants”, online: (last modified 30 December 2004) [http://www.ec.gc.ca/pdb/cae/gloss_e.cfm](http://www.ec.gc.ca/pdb/cae/gloss_e.cfm)

70 Prior to that, data on selected CACs had been collected through a patchwork of voluntary and mandatory data gathering mechanisms every 5 years since the 1970s. See Environment Canada, “Criteria Air Contaminants”, online: [http://www.ec.gc.ca/pdb/cae/gloss_e.cfm](http://www.ec.gc.ca/pdb/cae/gloss_e.cfm)


72 Ibid.
been described as follows: “The primary goal of the project is to stimulate reductions in pollutant releases and transfers from industrial activities.”

_Taking Stock_ reports list the emissions of the most polluting individual facilities, by name, for key pollutants of concern. It analyses the data, yielding statistics such as the industrial sectors and geographical regions producing and emitting the greatest volume of a particular pollutant, or the disproportionate percentage of total emissions produced by the top 10% most polluting facilities. Since the reporting occurs on an annual basis, it is also possible to compare current results with previous years, and to note increases, decreases and general trends in the pattern of emissions.

Part of the CEC’s work is directed towards improving the comparability of the national databases, one aspect of which involves comparability in the points or thresholds where the reporting requirement is triggered. Reporting thresholds can be activity-based (volume of a chemical that is manufactured, processed or otherwise used) or defined in terms of the amount released or transferred for disposal (primarily used for by-product chemicals), or even no thresholds at all for some chemicals. Canada’s NPRI, uses a mixture of the three types of threshold, following the addition of new chemicals to the NPRI in 2000, and the Mexican database also has relied on release thresholds. In 2002, the Council agreed to expand the use of

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76 Ibid.
77 Ibid., Reporting Threshold Issue Paper, at 3.
activity-based thresholds. Other identified discrepancies include the national treatment of confidential business information.

Pollutant release information constitutes an important source of data for the management of dangerous chemicals. For instance, the US and Canadian Pollution Release and Transfer Reports (PRTRs) require the reporting of releases and transfers of mercury, lead, dioxins, furans and hexachlorobenze – all of which are the subject of initiatives under North American Regional Action Plans (NARAP). PRTRs can be used to gauge progress under the NARAP. They also serve to identify to the public, regulatory officials, and industry itself those sectors or facilities where pollution-reduction activities should be instituted. In turn, experience with chemicals management may serve to indicate other chemicals which should be added to the PRTR, or to suggest the desirability of altering reporting requirements.

Linkages between pollutant releases and children’s health were specifically addressed in a special draft version of Taking Stock issued in 2004. The authors’ attitude towards the scientific basis of such linkages can be implied from the following:

Our lack of knowledge about the risks posed by toxic chemicals makes it difficult to quantify the extent to which environmental contaminants may contribute to many of the leading causes of illness, hospitalization and death of children. Particularly, we lack understanding about the long-term health effects of simultaneous, cumulative exposure to multiple, low-level, toxic contaminants. What we do know is this: toxic chemicals are a largely preventable factor in many of these childhood diseases. [emphasis in original]

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78 Ibid. at 6.
80 NARAPs address priority chemical pollution issues of regional concern in North America. Supra note 67, SMOC-PRTR Linkages, at 6-7.
81 Ibid. at 8.
82 Taking Stock, at p. x. (executive summary)
The report provided two types of analysis of PRTR data. First, it considered the top twenty-five pollutants (by volume of emissions) known or suspected to be carcinogenic, developmental toxicants, or neurotoxicants. Second, it focused on key pollutants of public concern, such as lead, mercury, dioxins and PCBs. The public comment period revealed the controversial nature of the draft report and underlined the significance of an information-based environmental protection strategy.

The Canadian Partnership for Children’s Health and the Environment (CPCHE), a partnership of non-governmental organizations, welcomed the 2004 draft Taking Stock report as “an excellent first step towards providing another valuable contribution to the public understanding of environmental health issues in North America.” More generally, the comment underlined the value of the Taking Stock series as “a crucial component of public right-to-know” in the NAFTA context. On the other hand, comments from industry, and from agricultural and chemical organizations, questioned the linkage of chemicals to health effects. For its part, the American Chemistry Council, (ACC) expressed disappointment “that time and resources have been expended to create this draft report that ignores basic tenets of risk assessment, and relies on emotional statements and implications of disease causation not grounded in a balanced view of peer reviewed science.”

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83 Another constellation of health effects, asthma/respiratory diseases, was excluded because many of the major chemicals thought to be associated with such effects (particulates, SO2 and NOx) were not then included in PRTR reporting requirements.


85 Ibid. at 2.

The ACC response challenged the science underlying the *Taking Stock* discussion of health effects of chemicals, claiming that the unnamed authors’ demonstrated bias in their selective review and overstatement of the scientific evidence. The following comments are representative of the ACC’s view:

“By implication, the draft report seeks to associate chemicals reported in TRI and NPRI databases with the induction of cancer in children. This is highly misleading and not consistent with recognized authoritative sources.”

“While some have postulated that other chemicals, such as pesticides, PCBs, solvents and hormonally active agents may cause neuro-developmental effects in children, these hypotheses are far from being proven.”

The reference to the neglect of risk assessment principles refers to the failure of the report to acknowledge that “for any and all chemical substances” exposure levels below a reference dose are not expected to pose “any significant degree of health risk.” In the ACC’s view, the report impliedly makes the unsupported allegation that children are at risk from “normal uses” of products in and around the home where it would have been more appropriate to indicate that it is excessive exposure rather than *any* exposure that is harmful.

In the ACC’s view, the CEC report made three crucial errors. First, it adopts the assumption that the releases listed in PRTRs can be equated to children’s exposures, and, second, that any exposure leads to some risk to human health. Finally the ACC faulted the report for using “lists of substances developed by activist organizations rather than by an objective authoritative body.” Its conclusion was as follows:

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87 Ibid., ACC comments, at 14.
88 Ibid. at 16.
89 Ibid. at p.8.
90 Ibid. at 11.
91 Ibid. at 25.
“[T]he approach taken in the draft 2004 *Taking Stock* report goes well beyond the reports of prior years and purports to establish a direct link between children’s health and reported emissions. We believe this undertaking is not grounded in science and this approach should be abandoned.”92

The controversy is indicative of the inter-relationship between the availability of data and the assessment of consequences. The mere availability of increased data required by reporting systems will facilitate ongoing research around the causes of illness and disease. However, where uncertainty remains as to the adverse effects of exposures, the procedures for setting emission standards and making related regulatory decisions, including the manner in which the precautionary principle might be applied, remain crucial.93

Work associated with the PRTR project extends beyond the *Taking Stock* series. For instance, in 2002 it commenced an annual analysis of pollutant releases from the electricity-generating sector. The general utility of such a sectorally oriented emissions inventory was explained as follows:

Policymakers who are responsible for protecting human health and the environment rely on air emissions inventories to identify opportunities for reducing pollution and to evaluate alternative policy scenarios. Companies rely on emissions data to assess their performance relative to others in their sector and to evaluate their progress in reducing emissions. Public health researchers use emissions inventories when trying to link observed health effects to air pollution sources. The public relies on emissions inventories to understand the sources of air pollution in its communities. Electricity suppliers, in some cases, rely on emissions inventory data to assess and

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93 As the present report was being completed, the CEC published an additional study in this area, Toxic Chemicals and *Children’s Health in North America: A Call for Efforts to Determine the Sources, Levels of Exposure and Risks that Industrial Chemicals Pose to Children’s Health* http://www.cec.org/files/PDF/POLLUTANTS/CHE_Toxics_en.pdf
report to their customers on the emissions attributable to the electricity they sell. The investment community can use the data to assess the environmental liabilities faced by a company.\(^{94}\)

The analysis is complicated by the fact that, as previously noted, Canada, Mexico and the United States have implemented different reporting requirements, rendering direct comparisons difficult. 2002 was the first year that data was available from individual power plants in both Canada and the United States, and even then Canada did not require reporting of greenhouse gas emissions from facilities. However, CO\(_2\) reporting will be required under *CEPA, 1999* for the calendar year 2004 for all facilities emitting more than 100 thousand metric tons.\(^{95}\)

This suggests no obvious need for new instruments. The challenge rather is to take advantage of the range of instruments currently available for the purpose of enhancing children’s environmental health, bearing in mind the availability of alternative strategies – as noted above – for advancing this objective.

### 7.3 Implementing Chosen Instruments: Institutions, Enforcement and Capacity

The effectiveness of measures to safeguard children’s environmental health will ultimately depend upon the manner in which policies are implemented, for in the absence of implementation even well intentioned and well-designed instruments will not achieve success. It is accordingly worth closing a discussion of instrument choice with some reference to conditions underlying effective implementation. While an extremely elaborate list of conditions affecting

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\(^{95}\) *Ibid.* at 83.
implementation might be formulated, it will suffice here to consider only three: institutional structures, enforcement arrangements and capacity.

### 7.3.1 Institutions

Institutional design might well be considered independently as an instrument of policy. Without embarking upon that level of analysis here it may simply be observed that the ability of government to promote and enhance children’s environmental health is dependent to some degree upon the availability of institutions charged with or responsible for such a mandate. This is true in relation to institutions at all levels – departmental, inter-departmental, federal-provincial or inter-governmental, and international. A brief description of some of the existing arrangements will illustrate the general importance of institutions while serving further to demonstrate that some may be re-configured and enhanced without legislative change, that some although executive in nature require the operational collaboration of other participants, and that the creation of others may well depend upon formal negotiations and international agreement.

#### 7.3.1.1 Departmental Arrangements

Like all federal departments, Health Canada and Environment Canada are subject to internal reorganizations intended to align operations with current practices and priorities. Branches are regularly established and dissolved with these ends in mind, and in illustrating
operational initiatives relevant to children’s environmental health, no attempt is made here to provide a detailed understanding of the most-up-to-date configuration.96

Although the Health Policy Branch is not explicitly mandated to pursue children’s environmental health issues, it plays the lead role in setting policies and priorities for Health Canada. So, for instance, the Women’s Health Bureau found within it, is responsible for “ensuring women’s health concerns receive the appropriate attention and concern within Health Canada.”97

According to its website, the mandate of the Healthy Environments and Consumer Safety Branch of Health Canada is the promotion of “safe living, working and recreational environments.” HECS programs include product safety, sustainable development, and - most immediately relevant - “safe environments,” a cluster of responsibilities encompassing radiation, air quality, toxics, water quality and health impacts generally. The former Office of Children’s Environmental Health of the Safe Environments Program, is now part of the Vulnerable Populations and Climate Change Office Health Impacts Bureau. This Office was set up to “catalyze,” lead, and coordinate action on children’s environmental health, improve understanding of the environment’s role in children’s health threats, and advise Health Canada decision-makers.98

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96 Branches as listed in March 2005 were: Corporate Services Branch, First Nations and Inuit Health Branch, Healthy Environments and Consumer Safety Branch, Health Policy Branch, Health Products and Food Branch, Information, Analysis and Connectivity Branch. Health Canada Website, (last modified 23 March 2005) http://www.hc-sc.gc.ca/english/about/org.html. Please note that the institutional framework has changed since the CELA chapter on standard-setting, infra at note 2.


98 Office of Children’s Environmental Health, (last modified 29 April 2005) online: http://www.hc-sc.gc.ca/hecs-sesc/oeeh/index.htm. As this report was being finalized no direct references to environment appear under the heading “Children and Youth” on the index to Health Canada’s website. Some discussion of environmental concerns relating to children may be found in connection with references to vulnerable populations.
The Products Safety Programme encompasses consumer products, hazardous workplace materials, new substances and radiation protection. Consumer Product Safety applies the *Hazardous Products Act* to those products listed in the schedules, the *Food and Drugs Act* to cosmetics, and considers it bears an implicit duty of care for unregulated products. Consumer Product Safety considers the flammability, chemical and mechanical dangers posed by products. Threats to children figure prominently, considering the volume of child-related regulations and safety messages posted on the website, dealing with threats such as toys, strollers, cribs, high chairs, change tables, car seats, infant carriers, bunk beds, safety gates, playpens, pacifiers, hook-on chairs, and children's clothing.99

Departmental responsibilities relating to the *Pest Control Products Act* have been assumed by the Pest Management Regulatory Agency (PMRA), which was created by the federal executive in 1995 to consolidate federal regulatory activity dealing with pesticides, notably the registration process. The PMRA reports directly to the Minister of Health.100

The PMRA registration process consists of three steps: screening, reviews and decisions.101 In the course of its work, the PMRA is involved in extensive liaison and collaboration with other federal and provincial departments, including the Canadian Food Inspection Agency, which monitors the pesticide residues in food at the point of sale to ensure they do not exceed the limits set by the PMRA. The PMRA is advised by committees, namely the Federal/Provincial/Territorial Committee on Pest Management and Pesticides, the manufacturer/user- based Economic Management Advisory Committee and the multi-

stakeholder Pest Management Advisory Committee. The PMRA is also involved in Integrated Pest Management, supporting voluntary programs of sustainable pest management in collaboration with partners such as Agriculture and Agri-Food Canada (AAFC) and the Federal/Provincial/Territorial Committee on Pest Management and Pesticides.

Environment Canada, prior to recent re-organization, operated five Services: Environmental Protection, Environmental Conservation, Meteorological, Human Resources and Innovation, and Policy. It also has a number of Regional offices and Business Lines that cut across this organization. The most relevant one is that the pollution prevention-oriented Clean Environment. The Environmental Protection Service encompasses responsibilities over Air Pollution Prevention, Pollution Prevention, Environmental Technology, Risk Management and Strategic Priorities. Environment Canada works closely with Health Canada/PMRA, Industry Canada, Agriculture and Agri-Food, and Natural Resources Canada to implement CEPA, 1999.

The National Guidelines and Standards Office of Environment Canada develops national guidelines, standards and objectives, as mandated by CEPA, 1999 and under various federal-provincial agreements. The NGSO works cooperatively with Environment Canada Regional offices, as well as other federal departments and the Canadian Council of Ministers of the Environment, discussed in more detail below. The NGSO’s website states that its primary focus is the development of standards for water, sediment, soil quality and aquatic tissue residue.

7.3.1.2 Interdepartmental Arrangements

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The nature of issues associated with children’s environmental health, and the allocation of decision-making authority established by CEPA, 1999 itself, call for significant degree of inter-departmental collaboration, some of which has already been noted.

The federal government has taken several initiatives specifically aimed at children’s environmental health.104 An Interbranch Working Group on Child Health is comprised of representatives from Environment Canada and Health Canada, including the PMRA. This is expected to meet regularly to exchange information, coordinate positions on emerging issues, and to identify gaps in government policy. The federal Memorandum of Understanding on Science and Technology for Sustainable Development established the Working Group on Children’s Environmental Health to ensure that consideration of children’s vulnerability is incorporated into the environmental protection regime administered by the five natural resources departments.

Within the context of the ongoing Smart Regulation initiative, there are also inter-departmental activities with some relevance to children’s environmental health.105 Smart regulation is intended to promote domestic and international coordination, increased transparency and timeliness, “integration of social, economic and environmental considerations at all stages of policy and decision-making”, and an “enhanced ability to identify, manage and mitigate unintended impacts of regulation.”106

To ensure a “whole-of-government” approach of greater governmental coherence, five themes have been identified: A Healthy Canada; Environmental Sustainability; Safety and Security; Innovation, Productivity and Business Environment; Aboriginal Prosperity and

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106 Ibid. at 7.
Northern Development. Interdepartmental theme tables meet regularly to coordinate agendas and jointly establish priorities. Participants at the Healthy Canada theme table are: Health Canada, the Public Health Agency of Canada, the Canadian Food Inspection Agency, the Pest Management Regulatory Agency, Industry Canada, Agriculture and Agri-Food Canada, and International Trade Canada. Twice every year, there will be a plenary meeting of all the theme tables.

Under the Healthy Canada theme, a Memorandum of Understanding relating to the establishment of Maximum Residue Levels (MRLs) for pesticides in foods was signed in February 2005. This launched a 30 month pilot project to streamline the prepublication regulation requirements, so that industry will be able to sell new products faster. The report then adds that “growers [will] get access to new and safer pesticides.” Should the initiative achieve the latter objective, children will figure among the beneficiaries.

Within the Environmental Sustainability theme, there has been an initiative dealing with chemicals. Environment Canada and Health Canada are currently carrying out a pilot project on a “parallel notification process” to streamline the chemical approval process within OECD countries. Businesses will only have to fulfill the requirements of one application process to gain access to multiple markets. The report describes the benefits of the initiative as follows: OECD countries will understand and accept one another’s results, which will facilitate better protection of human health and the environment.

Assuming that “better protection” of health may result from increased opportunities for information sharing to support the scientific foundations of decision-making, again, children’s environmental health may experience enhanced safeguards.

7.3.1.3 Federal-Provincial Institutions and Co-operative Initiatives

The constitutional division of responsibilities for health and environment is such that an extensive framework for federal-provincial interaction has evolved. Certain arrangements provide over-arching mechanisms for ongoing consultation and collaboration respecting an open-ended range of issues, while other mechanisms have been designed to pursue specific functions.

*Canadian Council of Ministers of the Environment*

The CCME is comprised of the 14 environment ministers from the federal, provincial and territorial governments who work jointly to promote coordination and to encourage national approaches. Ultimately, however, it is up to each jurisdiction to decide whether to adopt proposals emanating from the CCME process. In 1998, all of the Ministers of the Environment except Quebec signed the Canada-wide Accord on Environmental Harmonization, a document with significant implications for environmental standard setting.

The Accord sets out a number of objectives, such as the clear delineation of the respective roles and responsibilities of the governments with the intention that only one level of government will undertake each. Another stated goal is to work cooperatively towards consistent environmental measures (standards, policies, objectives and regulation) across the country. The governments also agree in the Accord to base their environmental activities on a number of foundational principles, such as the polluter-pays and precautionary principles. In addition,

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108 The institutional framework of the CCME consists of the council of ministers, above a number of committees. The Environmental Planning and Protection Committee, reporting to the Deputy Ministers Committees, sits over working groups dealing with specific sub-topics, including one on Canada-Wide Standards. Other task groups include those concerned with hazardous waste, water quality, and “health and the environment”. Committees dealing with air issues, including ozone depleting substances, hazardous air pollutants, and emissions, work in cooperation with the Council of Energy Ministers.
environmental measures are to be “performance-based, results-based and science-based,” and developed for flexibility in national implementation to reflect local variation.

The Accord provides for multi-lateral sub-agreements on specific environmental issues in order to implement the broad commitments. It also authorizes regional or bilateral sub-agreements on regional or local issues. Three of these multilateral sub-agreements were signed in 1998 along with the Accord: the Canada-wide Environmental Standards Sub-agreement, Canada-wide Environmental Inspections Sub-agreement, and the Sub-agreement on Environmental Assessment.

The Environmental Standards Sub-agreement focuses on the development of ambient standards, in accordance with the principles set out in the Accord. Within the CCME framework, Ministers are expected to determine priorities for the development of standards. The governments will identify existing and emerging threats to human health and environment, and jointly agree on an appropriate course of action. Standards developed under the Sub-agreement will be submitted to the CCME for the approval of the Ministers. Where the issues are primarily associated with intra-provincial effects, the implementation measures will be left to the discretion of the governments concerned. On the other hand, where the effects are primarily inter-provincial or where an integrated national approach is necessary, governments are expected to seek agreement on implementation measures including a suitable timeframe.

The Agreement sets out that the role of the federal government consists primarily of the following:

- providing scientific and technical support to the process outlined in this Sub-Agreement;
- implementing measures at international borders;

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109 In addition to regulatory standards, the Environmental Standards Sub-Agreement lists codes of practice, guidelines, memoranda of understanding, voluntary initiatives, economic instruments and pollution prevention planning among possible implementation measures.
implementing measures on federal lands;

representing Canada internationally, advocating the adoption of Canada-wide standards at the international level and promoting actions necessary at the international level to achieve Canada-wide Environmental Standards domestically; and

implementing Canada-wide Environmental Standards that require a product/substance approach.

**Federal-ProvincialTerritorial Committee on Drinking Water (CDW)**

One of the more long-standing inter-governmental mechanisms contributes to the formation of national drinking water quality guidelines, which have been implemented in varying degrees by individual provinces. The Drinking Water Section of the Safe Environments Directorate of HECS (Health Canada) serves as the Secretariat for the Committee on Drinking Water (CDW). The Committee’s parent committee is the Federal-Provincial-Territorial Committee on Health and the Environment (CHE). The CDW makes recommendations to the CHE, which when approved are published as the non-binding *Guidelines for Canadian Drinking Water Quality*. The DWS has 14 voting members, one for each jurisdiction in Canada (10 provinces, three territories, and the federal government). These members represent the authority responsible for drinking water quality in their respective jurisdiction, usually either the department of health or the environment. Non-voting members include representatives from the CHE, Environment Canada, and the Canadian Advisory Council on Plumbing (http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/fpt/index_e.html as of 2006-09-19)

7.3.1.4 International Initiatives
In addition to the inter-departmental and inter-governmental relations noted previously, the PMRA has extensive links with the U.S. EPA. In 1996, the PMRA and the U.S. EPA established a joint review program for reduced risk pesticides, and that has continued to be expanded. Generally speaking, it allows the countries to review different sections of the submissions and exchange their analysis, thus leading to a reduced processing time. Also at the international level, PMRA is associated with the NAFTA Technical Working Group on Pesticides (NAFTA TWG) and the Pesticide Program of the Organization for Economic Cooperation and Development. Indeed, with the standardization of format by using the OECD model, the possibilities of work sharing are expanded to other countries.\footnote{110}{Pest Management Regulatory Agency, Progress Report 1998-2003 (online) \url{http://www.pmra-arla.gc.ca/english/pgd/plansandreports/pmra_progressreport2003-e.pdf} at 10 (date accessed Feb. 21, 2005).} The OECD manages a database of country reviews of pesticide submissions.

The steps taken in the area of international cooperation ranged from the establishment of a working group to develop a Framework for International Regulatory Cooperation to the release of a Joint Statement on a New Partnership in North America.\footnote{111}{Ibid. at 21. In addition, a Framework on Canada-EU Regulatory Cooperation has already been adopted. See p. 24 of the Report.} On November 30, 2004, the leaders of Canada and the United States pledged to deepen their coordination, with an agenda to increase their citizens’ security, prosperity and quality of life.\footnote{112}{“Joint Statement by Canada and the United States on common security, common prosperity: A new partnership in North America”, online: Office of the Prime Minister (last modified 30 November 2004), \url{http://www.pm.gc.ca/eng/news.asp?id=341}.} After the publication of the report, a further announcement was made of a trilateral North American partnership. The leaders of Canada, the United States and Mexico committed to the “development of new avenues of cooperation that will make our open societies safer and more secure, our businesses more competitive and our economies more resilient”.\footnote{113}{“Security and Prosperity Partnership of North America Established”, online: Office of the Prime Minister (last modified 23 March 2005) \url{http://pm.gc.ca/eng/news.asp?id=443}.}
7.3.2 Capacity

When instruments, including approaches designed to protect children’s environmental health, have been chosen and institutions configured with a view to contributing effectively to implementation, it is nevertheless true that the availability of resources – from qualified personnel to financial support – will affect results and performance. An assessment of the adequacy of existing resources or of the capacity of established institutions to pursue children’s environmental health vigorously falls well outside the scope of the present report. It may be noted, nonetheless, that commentaries, advisory reports, and numerous other studies repeatedly draw attention to requirements for increased and secure funding to conduct research, whether in the form of epidemiological investigations or a biometric program of data compilation.

The availability of resources or system capacity affects children’s environmental health independent of the selection or availability of policy tools. This is true not only in relation to research, to the development of detailed regulations, to the dissemination of relevant information and so on, but also in relation to monitoring and enforcement initiatives which are a further dimension of the instrument choice process.

7.3.3 Monitoring, Enforcement and Compliance

The range of activity encompassed within the scope of enforcement and compliance is significantly broader than the common or popular perception of prosecution. It certainly includes reporting, monitoring, inspection and audit activities among the measures necessary to determine
whether or not existing expectations and obligations are being met. Indeed the *CEPA, 1999* compliance and enforcement policy is explicit in its indication that compliance or conformity with the law is to be pursued through the use of promotional activity as well as enforcement. Efforts to promote compliance include educational and informational initiatives alongside consultation programs and authority to develop environmental quality objectives, codes of conduct or guidelines. This authority provides opportunities to safeguard children’s health. For example, the Minister of Environment may act in relation to pollution prevention or in order to reduce the release of substances into the environment, (CEPA, 1999 s. 54 (2)) while the mandate of the Minister of Health contemplates objectives, guidelines and code of practice that address environmental matters “that may affect the life and health of the people of Canada.” (CEPA, 1999 s. 55(1))

In the case of non-compliance with legal requirements under *CEPA, 1999*, several forms of enforcement intervention are available. The enforcement measures contemplated by the legislation range from warnings, through directions, to ticketing for certain offences, administrative orders, injunctions and prosecution. In addition, the statute provides for a series of measures other than judicial proceedings that may be used in dealing with a person alleged to have committed certain offences. Among the specific considerations that must be addressed when the use of environmental protection alternative measures is being contemplated, the Attorney General must be satisfied that such measures would be appropriate, having regard to factors including “the protection of the environment and of human life and health and other interests of society.” (CEPA, 1999, s. 296 (1)(d)(i))

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114 For further discussion, see *Compliance and Enforcement Policy for the Canadian Environmental Protection Act, 1999 (CEPA, 1999)* (March 2001)
In the case of administrative agencies, John Laskin has provided a useful overview of enforcement powers.¹¹⁵ These derive from several sources of authority and influence of which the governing statute itself, accompanying regulations, and whatever ancillary authority exists on the basis of necessary implication are fundamental. In addition, agencies may take advantage of more informal opportunities to outline their preferences or to exert their influence through policy statements and guidelines or simply as a consequence of the ongoing relationship between regulator and regulatee that can foster a process of cooperation. As Laskin further observes, more specific enforcement mechanisms will be applicable in the context of distinctive stages of agency operations. At the investigative stage, for example, enforcement powers may take the form of the decision to initiate an investigation, the conduct of inspections or spot audits, orders to provide documentation or to produce witnesses for examination. These measures may be re-enforced on the basis of interim orders or even prosecution where non-compliance constitutes obstruction of the agency in the fulfilment of its responsibilities. At the hearing and post-hearing stage, other enforcement powers may be applicable. These include possible orders concerning compensation or costs or might involve negotiations leading to settlement action. Agency orders themselves may ultimately be the subject of enforcement action, typically in conjunction with the exercise of judicial authority where appropriately registered agency orders have not been complied with directly. These general considerations may apply equally to the environmental context.

CASE STUDIES

The following case studies illustrate the concepts discussed in earlier sections by reviewing six known environmental health hazards that particularly pertain to children’s health. Each case study includes a background and description of the known and possible health effects of each hazard, which is followed by a discussion of how selected governments and international bodies have developed and defined their risk management strategies.

Each case study also includes an accompanying Table that analyzes legislative risk management approaches for certain selected exposures relevant to children’s health. Each Table classifies116 the type of risk management approach used in selected jurisdictions, assesses barriers and facilitators to implementation117, then evaluates the implementation strategy with respect to its implementation process, consensus policy development, whether policies are science-based, and the role of information-based strategies.

The exposures or characteristic selected for detailed review for each hazard are listed below:

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>CHILDREN’S ROUTE OF EXPOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>➢ Public drinking water systems</td>
</tr>
<tr>
<td></td>
<td>➢ Interior paint</td>
</tr>
<tr>
<td>Mercury</td>
<td>➢ Food sources (fish)</td>
</tr>
<tr>
<td></td>
<td>➢ Dental amalgam</td>
</tr>
<tr>
<td>Pesticides</td>
<td>➢ Food sources</td>
</tr>
<tr>
<td></td>
<td>➢ Consumer products</td>
</tr>
</tbody>
</table>

116 See classifications described in 7.1 and 7.2
117 See background information in 7.3 and expert opinions discussed in Chapter 6.
Endocrine Disrupters ➢ International policy approaches
Indoor Air Pollution ➢ Environmental Tobacco Smoke (ETS)
Outdoor Air Pollution ➢ Motor vehicle fuels and vehicle emissions

The jurisdictions and governance bodies selected for comparative purposes include the United States and at least one European government or inter-governmental body such as the European Commission (EC) of the European Union, the Organization for Economic Co-operation and Development (OECD), and the World Health Organization (WHO) as applicable. The Tables are intended to be illustrative, not exhaustive, of the types of risk management approaches adopted to address the exposure to the hazard in question.

8.1 Lead

8.1.1 Introduction

Abdominal colic among men engaged in lead smelting was recognized about 370 BC and among consumers of lead-contaminated cider in England in 1767 while childhood lead poisoning was first recognized in Australia in 1892 (Gibson, 1892). Acute childhood lead poisoning is now rare in developed countries. Most of our knowledge on lead exposure comes from the USA, the first country in the world to conduct nation-wide biomonitoring (even today, Germany is the only other country that does so). Average childhood blood lead levels in U.S. children have declined dramatically since 1976, mainly because of the introduction of lead-free gasoline.
(Annest et al., 1983; Billick et al., 1980) and the introduction of lead-free solder for sealing food and drink cans (Pirkle et al., 1994).

A pooled analysis of twelve studies found that the major source of lead exposure for children with blood lead levels of 10-25 µg/dL was house dust (Lanphear et al., 1998). Ingested In the early 1980’s, about 95% of house dust lead in newer housing and at least 50% in older housing originated in leaded gasoline (Fergusson and Schroeder, 1985). Emissions from point sources (especially lead smelters, battery manufacturers) are now the major sources of airborne lead emissions. Soil lead concentrations in urban core regions, where high traffic volumes occurred during the leaded gasoline era, may reach several hundred µg/g. Young children engage in hand-mouth behaviour and activities at floor or ground level, greatly increasing their chance of exposure to lead-contaminated dust and soil (Lanphear and Roghmann, 1997). Ingested lead-based paint chips were an important cause of substantial blood lead elevations, particularly among African-American children living in deteriorating pre-1950 housing (McElvaine et al., 1992). Other sources included foods packaged in lead-soldered cans and drinking water contaminated by lead or lead alloy plumbing materials. Vinyl miniblinds were an unusual but important source of lead contaminated house dust and have never been subjected to a product recall (Norman et al., 1997). Lead pipes are still present in many older communities and can cause substantial contamination, especially when water is soft and acidic. Tap water lead levels above the EPA standard (15 µg/L) occurred in 5% of standing samples in a U.S. survey. Among German children, blood lead levels were related to lead concentrations in drinking water and house dust (Seifert et al., 2000). Data from U.S. and German national biomonitoring systems indicate that lead exposure continues at levels known to cause cognitive and other neuropsychologic deficits after early childhood exposure.
8.1.2 **Known and Possible Health Effects**

Research before about 1980 showed that moderate to high level lead exposure during childhood (blood lead levels exceeding about 50 µg/dL) caused clinically overt neurotoxicity, abdominal colic, anemia and renal tubular damage (Agency for Toxic Substances and Disease Registry, 2005). Subsequent research has demonstrated subtle adverse health effects among children even at blood lead levels below 10 µg/dL. There is also suggestive evidence linking prenatal maternal lead exposure to adverse pregnancy outcomes and childhood neuropsychologic deficits.

8.1.2.1 **Cognitive Function**

Although neurotoxicity is not clinically overt among children with blood lead levels below about 50 µg/dL, severe effects including delirium, convulsions, paralysis, coma and death may occur at levels exceeding 100 µg/dL. The first convincing evidence of neurotoxicity at relatively low lead exposure levels came from a study of middle-class children in Boston showing that tooth dentine lead concentrations were associated with deficits in full-scale IQ, verbal IQ subscale, attention and auditory processing and with classroom problem behaviours (Needleman et al., 1979).

Subsequently, several large and well-conducted cross-sectional and longitudinal birth cohort studies confirmed and extended Needleman’s observations. Most epidemiological studies of childhood cognitive function and lead exposure have statistically controlled for potential
confounders such as sex, age, school grade, parental education level, HOME scores\textsuperscript{118}, maternal IQ, parental smoking habits and birth weight. Recent reviews of such studies found strong evidence for cognitive deficits among school-age children at blood lead levels below 10 µg/dL (Bellinger, 2004; Koller et al., 2004; Lidsky and Schneider, 2003). For instance, among children whose blood lead concentrations never exceeded 10 µg/dL, there were inverse dose-response relationships between cognitive function scores and blood lead concentration in two longitudinal studies (Bellinger and Needleman, 2003; Canfield et al., 2003a). Even low to moderate early childhood lead exposure is associated with cognitive deficits that persist after exposure levels decline (Tong, 1998).

At low exposure levels, there may be greater cognitive deficits per unit increase in blood lead concentration. In a pooled analysis of seven longitudinal studies, the average IQ deficit over the blood lead range <1 to 10 µg/dL was about 3-fold greater than over the range 10-20 µg/dL (Lanphear et al., 2005). Most studies in this field have measured childhood blood lead levels but transplacental lead exposure is also important. Cognitive function scores among young children were inversely related to prenatal maternal or cord blood lead levels (Bellinger et al., 1988; Gomaa et al., 2002; Shen et al., 1998; Tang et al., 1999), even among infants of women with prenatal blood lead levels below 5 µg/dL (Emory et al., 2003). The predicted impact of an increment in peak childhood blood lead concentration from 2.4 to 10 µg/dL during early childhood is about 4 points (Lanphear et al., 2005). An IQ deficit of 5 points would reduce the proportion of very gifted people (IQ \geq 130) in a population by at least half and would double the proportion of mentally retarded persons (IQ < 70) (Weiss, 1990).

\textsuperscript{118}Home Observation for Measurement of the Environment (an inventory designed to measure the quality and quantity of stimulation and support available to a child in the home environment).
Prenatal or childhood lead exposure is associated with other neuropsychologic deficits including fine motor function (Altmann et al., 1997; Ris et al., 2004; Wasserman et al., 2000), reading (Fergusson et al., 1997; Lanphear et al., 2000), arithmetic (Lanphear et al., 2000; Wang et al., 2002), hearing acuity (Schwartz and Otto, 1987; Osman et al., 1999), central auditory processing (Rothenberg et al., 1994; Rothenberg et al., 2000), attention (Canfield et al., 2003b) and visual-motor integration and problem behaviours (Needleman et al., 1996; Chiodo et al., 2004).

Studies of monkeys exposed only prenatally or postnatally found learning and memory deficits at blood lead levels as low as 10 µg/dL that persisted years after exposure ceased (Rice, 1992). Even at low levels, lead binds almost irreversibly to zinc-dependent proteins including gene transcription factors, membrane ion-transport enzymes, intracellular signaling enzymes and δ-aminolevulinic acid dehydratase (ALAD)119. Lead impairs synapse formation by disrupting neuronal cell adhesion molecule function, dendrite formation and N-methyl-D-aspartate receptor function. Lead also disrupts calcium-dependent ion channels, intracellular signaling enzymes such as protein kinase C.

8.1.2.2 Adverse Pregnancy Outcomes

Transplacental lead exposure is associated with early fetal death (Hertz-Picciotto, 2000) and preterm birth (McMichael et al., 1986; Torres-Sanchez et al., 1999). A recent study of early fetal deaths found a strong dose-response relationship with 1st trimester maternal blood lead levels with elevated risks at concentrations as low as 5-9 µg/dL (Borja-Aburto et al., 1999).

119 ALAD is an enzyme essential for heme synthesis; reduced heme synthesis can cause anemia and impaired oxygen transport and storage and reduced mitochondrial energy production.
Maternal bone lead appears to be mobilized during pregnancy and lactation, particularly among women who do not take calcium supplements (Gulson et al., 1998).

### 8.1.2.3 Other Health Outcomes

Three large well-conducted studies found inverse dose-response relationships between height during childhood or adolescence and current blood lead levels extending below 10 µg/dL, with no evidence of a threshold (Ballew et al., 1999; Schwartz et al., 1986; Selevan et al., 2003). Several studies have found strong dose-response relationships between childhood urinary protein levels (indicative of renal tubular damage) and childhood lead exposure indices (Bernard et al., 1995; Factor-Litvak et al., 1999; Fels et al., 1998; Staessen et al., 2001; Verberk et al., 1996). Limited evidence supports associations between low-level childhood lead exposure and dental caries (Gemmell et al., 2002) and delayed onset of menarche and pubic hair growth in females (Wu et al., 2003; Selevan et al., 2003). Childhood neuroblastoma has been linked to paternal occupational lead exposure (De Roos et al., 2001) but the role of childhood lead exposure remains unexplored.

### 8.1.3 International Context

#### 8.1.3.1 Organisation for Economic Co-operation and Development (OECD)

The OECD published a Lead Monograph in 1993 that contained National Position Statements summarizing participating countries’ rationales for any lead risk management strategies undertaken. By this initiative the OECD sought to encourage harmonization of
approaches given the importance of international trade. Lead was one of five risks chosen as pilot cooperative projects in risk reduction. The monograph represents the international best practices of the era, and provides a foundation for analysis of the relative effectiveness of risk reduction strategies (Organisation for Economic Co-operation and Development, 1993).

In 1996, Environment Ministers from the OECD member countries issued a Declaration that recognized the particular health risks to children arising from lead exposures. The Declaration included a seven point risk management strategy and schedule for followup action:

- make efforts to reduce risks from exposure to lead;
- prioritize the risk of exposure from food and beverages, water, air, occupational exposure and other potential pathways;
- review lead levels in the environment and exposure to sensitive and high risk populations;
- promote recycling;
- cooperate in sharing and disseminating risk and risk management information;
- encourage the lead producing and using industries to share their expertise;
- and work with the industry to develop voluntary action programmes to reduce exposure to lead.

In 2000, both the member countries and industry stakeholders were surveyed on their actions taken for the 1993-1998 period to assess the need for further action. Twenty-three member countries and the European Commission responded (Organisation for Economic Co-operation and Development, 2000).

### 8.1.3.2 WHO Children's Environment and Health Action Plan for Europe (CEHAPE)

WHO (CEHAPE) recommended that a number of specific actions be taken to control children’s health risk from lead exposure:
- Enact legislation on the content of lead in petrol and building materials, to protect children from exposure to lead.
- Develop and enforce regulations to minimize risks from hazardous building materials (including lead).
- Carry out biomonitoring of lead, etc in at-risk infants and mothers.
- Enact/enforce legislation to protect children from exposure to hazardous chemicals in toys and other products used by children.
- Ensure safe collection, storage, transportation, recovery, disposal and destruction of non-hazardous and hazardous, in particular, toxic waste.
- Raise awareness/educate caregivers about preventing children from playing around waste sites.
- Enact/enforce legislation on the composition labeling, and information to the public on "do-it-yourself" products and materials taking into account the risks to children's health (World Health Organisation, 2004).

8.1.3.3 Canada

The Canadian Lead Risk Management Strategy (Health Canada, 2002a) is designed to address health risks to children and control the use of lead in and on a wide range of consumer products accessible to children, including toys, furniture, ceramics, and other household goods. This report will not repeat the extensive strategy detailed therein but will look to other jurisdictions for examples of alternative approaches. It is noted, however, that the Canadian
strategy acknowledges a regulatory gap in failing to control importation of lead-containing consumer products.

8.1.3.4 United States (US)

The US lead risk assessment strategy includes a specific exposure monitoring system for children under seven years old. The four main components of the child-specific exposure monitoring system are: “(1) an exposure model that relates environmental lead concentrations to age-dependent intake of lead into the gastrointestinal tract; (2) an absorption model that relates lead intake into the gastrointestinal tract and lead uptake into the blood; (3) a biokinetic model that relates lead uptake in the blood to the concentrations of lead in several organ and tissue compartments; and (4) a model for uncertainty in exposure and for population variability in absorption and biokinetics.” (U.S. Environmental Protection Agency, 1994)

8.1.4 Detailed Study of Specific Exposure Pathways: Lead

Table A8.1 and A8.2 in Appendix 8 analyzes selected countries’ approaches to lead risk management for two exposure pathways that are still of active concern: lead-based paint in residences, and leaching of lead into public drinking water supplies. The following text provides additional commentary to the information provided in the Table. Earlier important sources of lead exposure, namely the use of leaded fuels in motor vehicles and the use of lead solder in food cans, have been largely eliminated so were not selected for detailed examination.

8.1.4.1 Lead Exposure Pathway: Public Drinking Water Systems
The Canadian approach sets water quality targets consistent with international norms and sets standards for lead control in water delivery systems. The US and UK systems have devised ways to integrate risk identification to set priorities for remediation efforts as well, and embed specific priorities for schools and other subpopulations including young children. Perhaps the relatively aggressive US measures were motivated by the findings of lead monitoring surveys in 1995 indicating that over 20% of the American population was drinking water from systems that exceeded the action level of 15 ppb at least once (Organisation for Economic Co-operation and Development, 2000).

The UK has also incorporated creative incentives for consumers to invest in remediation of their own homes, by making such investments trigger parallel action by their water supplier. Consider whether owners of older rental properties should be required to, or receive economic incentives for, water quality testing and pipe replacement costs if warranted. There appear to be few federally supported economic incentives for consumers to do water testing. However, as water is primarily a matter of provincial jurisdiction, federal support should be directed through those channels if those governments do not already provide such incentives.

Basic risk communication information is available online for consumers, but seems to be passively delivered. Public surveys to measure the penetration of this information and behavioural habits may be warranted, particularly given the need for active consumer participation in risk reduction by flushing out standing water from the taps. Investment in public education and incentives would seem warranted, particularly in light of the significant risks to children’s health associated with exposure to lead.
8.1.4.2  Lead Exposure Pathway: Leaded Paint in Older Buildings

Both the Canadian and US strategies have implemented controls over new paints and painted articles that could come within reach of children. While Canada has produced risk communication information and advice to address the risk of exposure during renovation activities, the US has mandated such controls through regulation. The US approach prioritizes action in homes occupied by young children, mandates distribution of warning materials to the building occupants prior to renovation, trains renovators on safe practices, and provides economic incentives to encourage implementation at the state level.

In keeping with Canada’s voluntary dissemination of information approach, consider developing risk communication outreach programs to appropriate segments of the construction industry as well as consumers by disseminating risk information through retailers of home renovation supplies.

8.2  Mercury

8.2.1  Introduction

There are four principal categories of sources of mercury in the environment: natural sources, such as volcanic eruption; anthropogenic sources from incidental release of mercury from impurities in raw materials, such as coal fuels; anthropogenic sources from intentional use in products and known byproducts of processes, such as mercury from plants that produce
At high exposure levels, elemental mercury and inorganic and organic mercury compounds all have neurotoxic and other adverse health effects. Human exposure to inorganic mercury came mainly from historical uses in drugs (e.g., analgesic teething powders for infants) and disinfectants (e.g., in diaper washes). However, naturally occurring inorganic mercury is transformed by microorganisms to methylmercury, a potent neurotoxin that bioaccumulates in aquatic food chains. Consumption of predatory fish and fish-eating mammals is the main current source of methylmercury exposure. Various synthetic organic mercury compounds have been used as biocides in vaccines (thimerosal), other medicines, paints and seed grain. Elemental mercury has many industrial uses including electrolysis, gold extraction, dental amalgam, thermometers, barometers, lights and electrical switches.

8.2.2 Known and Possible Health Effects

8.2.2.1 Methylmercury

8.2.2.1.1 Neuropsychologic Function

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120 Phenylmercuric acetate was used in interior latex paints until about 1990; only two proven cases of childhood mercury poisoning from this source were reported but there must have been millions of children with lower levels of mercury exposure from this source.
High-level transplacental methylmercury exposure (maternal hair mercury $\geq 100 \mu g/g$) in Minamata (Japan) and Iraq$^{121}$ caused severe neurotoxicity including delayed developmental milestones, mental retardation, cerebral palsy, blindness and deafness (Amin-Zaki et al., 1979; Harada, 1977). Mothers of some severely affected infants reported no symptoms or only transitory paresthesiae, showing the greater neurotoxicity of transplacental compared to adult methylmercury exposure. Postnatally exposed Iraqi children developed ataxia, weakness and visual and other sensory deficits.

Epidemiologic research in fish-eating populations has produced inconsistent evidence of neuropsychologic deficits. In major birth cohort studies conducted in the Faroe Islands and Seychelles Islands, maternal hair mercury levels were, respectively, 4.3 $\mu g/g$ (geometric mean) (Grandjean et al., 1997) and 6.8 $\mu g/g$ (arithmetic mean) (Davidson et al., 1998). However, Faroese intermittently eat pilot whale meat that contains relatively high methylmercury levels, likely causing spiking of blood methylmercury concentrations. Expert panel reviews of findings from these and other studies of fish-eating populations found limited evidence, mainly from the Faroe Islands study, for associations between maternal hair mercury levels of 15-30 $\mu g/g$ and memory, language and attention deficits during infancy and childhood (National Research Council, 2000a; United Nations Environment Programme, 2002a).

In a recent U.S. birth cohort study, the average maternal hair mercury concentration was only 0.55 $\mu g/g$ (Oken et al., 2005). Nevertheless, there was a significant inverse association between visual recognition memory scores at age 6 months and 3$^{rd}$ trimester maternal hair mercury levels. However, a large U.K. birth cohort study found no association between

$^{121}$ Exposure sources in Minamata and Iraq were, respectively, marine fish/shellfish contaminated by effluent from an acetaldehyde production factory (mercuric oxide, used as a catalyst during acetaldehyde production, was released into coastal waters where it was biotransformed to methylmercury and accumulated in the aquatic foodchain) and bread made from methylmercury-treated seed grain.
neuropsychologic development scores at age 15-18 months and umbilical cord tissue mercury levels (average maternal hair mercury level was 1.6 µg/g) (Daniels et al., 2004).

Relatively low-level transplacental or postnatal methylmercury exposure causes central auditory processing deficits (Newland, 2002). A recent study found an association between central auditory processing deficits at age 14 years and current hair mercury levels as low as 5 µg/g (Murata et al., 2004). Combined analysis of studies in the Faroe Islands and Madeira yielded a benchmark dose for prenatal maternal hair mercury of 9.5 µg/g for doubling of a 5% prevalence of abnormal auditory-evoked potential latencies (Murata et al., 2002). Based on analyses of attention, language and verbal memory for children age seven in the Faroe Islands study, the U.S. National Research Council recommended a benchmark dose lower limit of 58 µg/L for cord blood and 11 µg/g for maternal hair (National Research Council, 2000a). These concentrations correspond to a maternal oral methylmercury intake of about 1 µg/kg body weight/day; application of a 10-fold uncertainty factor yielded an RfD for dietary methylmercury of 0.1µg/kg body weight/day. The Academy noted that the smaller Seychelles Islands cohort had a statistical power of only 50% to detect the effects found in the Faroe Islands study (National Research Council, 2000a).

No single molecular mechanism underlying methylmercury neurotoxicity has been identified. Methylmercury disrupts several molecular processes, including microtubule formation, and inhibits neuronal cell division and migration in the developing brain (Counter and Buchanan, 2004). At nanomolar concentrations in vitro, methylmercury reduces sodium and calcium ion currents and inhibits neurite growth in pheochromocytoma cells (Shafer et al., 2002; Parran et al., 2003).
8.2.2.1.2 Other Health Outcomes

There is limited evidence for associations between transplacental methylmercury exposure (at maternal hair mercury levels < 10 µg/g) and reduced heart rate variability (Grandjean et al., 2004) and elevated blood pressure at age 7 (Sorensen et al., 1999).

8.2.2.2 Elemental and Inorganic Mercury

About 70-80% of inhaled elemental mercury is absorbed and disseminated in blood, readily crossing blood-brain and placental barriers and entering tissues where it is rapidly oxidized to inorganic mercury. Dental amalgam\(^{122}\) and fish consumption are the major sources of mercury exposure in the general population (Becker et al., 2002b).

8.2.2.2.1 Neuropsychologic Function

Children acutely exposed to high levels of elemental mercury may experience dizziness, insomnia, hallucinations, tremors, irritability and peripheral neuropathy (Counter and Buchanan, 2004). There have been no adequately conducted epidemiologic studies of potential health effects from childhood use of dental amalgam. In animal studies, inhaled elemental mercury accumulates in the CNS causing neuron loss, especially in the cerebellum (Counter and Buchanan, 2004). Elemental mercury is oxidized in the CNS to inorganic mercury that disrupts structural proteins, enzymes and neurotransmitters.

\(^{122}\) Most dental amalgams contain elemental mercury plus other metals such as silver, tin, copper and zinc.
8.2.2.2 Other Health Outcomes

Health effects in children acutely exposed to high levels of airborne elemental mercury include cough and respiratory distress (Counter and Buchanan, 2004). High-level exposure to inorganic mercury during infancy or childhood produces acrodynia and renal tubular damage (Clarkson, 1997).

8.2.3 International Context

8.2.3.1 United National Environment Programme (UNEP)

The Mercury Programme of the UNEP aims to reduce uses and anthropogenic releases of mercury and mercury compounds by offering technical and capacity-building support. In 2002, it completed a Global Mercury Assessment Report that compiled information on mercury risk management initiatives collected from governments, non-governmental organizations and others around the world (United Nations Environment Programme, 2002b).

The global report found that regulatory approaches to risk management have focused on reducing mercury release through anthropogenic sources by reducing consumption, developing alternative materials or processes, applying “end of pipe” controls, and improving recycling and recovery. While local mercury reduction initiatives are important to minimize local risks, air and marine currents transmit mercury long distances so a global approach is considered appropriate. Despite its risks, mercury continues to be used in both industrial as well as consumer
applications such as pharmaceuticals, cosmetics, florescent lamps, and dental fillings (United Nations Environment Programme, 2002a).

8.2.3.2 Aarhus Protocol on Heavy Metals, 1998 (in force 2003)

In 1998, 27 states party to the Convention on Long-Range Transboundary Air Pollution (LRTAP) - including Canada, the US, UK, and the European Community - adopted the Aarhus Protocol on Heavy Metals. The Protocol recommends that, given the presence of mercury in listed products (including manufactured products and dental amalgam), “where satisfied of the need to take precautionary measures” signatories should consider using alternative products, add warnings and handling information on product labels, and implement waste management programs (United Nations Economic Commission for Europe, 1998).

8.2.3.3 Canada

The Canadian government has incorporated limits on mercury emissions into air, effluent, consumer products, pesticides, and other sources through existing mechanisms that address other hazards. In 2000, the Canadian Council of Ministers of the Environment developed Canada-wide Standards (CWS) for Mercury Emissions, including specific standards for dental amalgam waste (CCME, 2005b).

8.2.3.4 USA
At the federal level, mercury product regulation has focused on elimination of mercury from products, including the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) and the *Federal Food, Drug, and Cosmetic Act* (FFDCA) regulations. Some U.S. States have instituted notification and labelling requirements; prohibitions on the sale of certain products for which alternatives are available; concentration limits for products such as batteries; restrictions on product disposal; and state-sponsored collection programs for specific items such as fever thermometers, and products found in schools. Since 2000, those who release even small amounts (5kg) of mercury-containing materials into the environment have to report to the U.S. Toxics Release Inventory (United Nations Environment Programme, 2002a).

8.2.3.5 **North America**

Given the dispersion of mercury releases into continental and global air and water supplies, governments have taken a number of regional initiatives to limit contamination of ambient air and water. Some of particular note for mercury include a North American Regional Action Plan (NARAP) for mercury, by Canada, Mexico and the United States; a Great Lakes Water Quality Agreement (GLWQA), by Canada and the United States; and the related Great Lakes Binational Toxics Strategy for the virtual elimination of persistent toxic substances in the Great Lakes (Health Canada, 2006a). The latter Strategy encourages voluntary mercury reduction commitments and conducts workshops on reduction opportunities for electric utilities, local communities, and schools.

The New England Governors/Eastern Canada Premiers Mercury Action Plan specifically included initiatives to develop recommendations for completing mercury clean-outs in all middle...
and high schools in the region, as well as outreach and education about mercury in the schools (Conference of New England Governors and Eastern Canadian Premiers, 2002).

8.2.4  Detailed Study of Specific Exposure Pathways: Mercury

Few exposures to mercury occur due to actions taken in or around the home. Mercury is still used in the manufacture of certain household products, but is generally not accessible to children or others in a normal home environment. For example, fluorescent lights and batteries are found in many households, but their mercury content is not exposed under normal use. However, mercury is still used in dental work, resulting in measurable emission of mercury vapours representing a significant single source of mercury exposure for the person affected (Richardson, 1995). Another primary route of human exposure to mercury is from eating fish. Due to the contamination of aquatic habitats, mercury bioaccumulates in fish which can then be ingested by children.

For the above reasons, dental amalgam and fish food sources were selected for detailed review for this hazard in Table A8.3 and Table A8.4 (Appendix 8). The following text provides additional commentary to supplement the information provided in the Table.

8.2.4.1  Mercury Exposure Pathway: Dental Amalgam

Initiatives related to dental amalgam deal with a few distinct issues: health risks to dental patients, occupational health risks to dental practitioners (not covered here), and preventing downstream contamination by appropriate waste management in dental offices.
Regarding the human health aspects, in 1997 the World Health Organisation issued a Consensus Statement on Dental Amalgam concluding that dental amalgam was considered safe for patients, though it occasionally caused local side effects. No contraindications other than allergy were indicated, though it recognized that some patients would request removal due to health concerns (World Health Organisation, 1997).

However, the divergent approaches subsequently taken by different countries suggest that any consensus on potential health risks to dental patients was tenuous at best. Sweden exemplifies a precautionary approach, having successfully phased out virtually all use of mercury-containing dental amalgam by 2005. It focused on children’s health as a priority and stopped using it for children at an early phase. At the other end of the spectrum, the US continues to hold firm to the assurances of safety in the WHO Consensus Statement, and recommends active continued use for all patients except those with an allergy to mercury. Public demand and health concerns have, however, kept the issue on the US government and the dental profession’s agenda, resulting in ongoing studies, reviews, and justifications.

In this instance, Canada seems to have successfully navigated the controversial issue by adopting a precautionary yet consensus-based approach. Despite the long history of successful use of dental amalgam and the lack of epidemiological evidence of adverse effects, Canada developed a position statement that recommends avoiding the use of dental amalgams in pregnant women and young children. The successful collaboration with the dental profession on the usage issue seemed to carry through into collaboration and voluntary compliance with dental waste management targets, which are more stringent than the voluntary standards set for the US dental practitioners.
8.2.4.2 Mercury Exposure Pathway: Consumption of Fish

There appears to be more consistency in approach regarding how the countries under review moderate mercury intake through fish consumption. In general, countries regulate a maximum tolerance for mercury concentration in fish sold commercially, and implement monitoring and testing programs for domestic fish that do not enter the commercial market such as sport and subsistence fishing.

One common feature of all approaches reviewed is a two-tier tolerance approach. Tolerance levels for mercury concentrations differ, allowing predator fish to be sold despite routinely higher mercury levels. Predator fish would generally not be able to pass the more stringent tests. The higher risk is considered acceptable because it is believed to have been mitigated by information-based strategies: public advisories of caution that certain vulnerable populations (e.g. children) should not eat those species too frequently, if at all. From a risk management perspective, the inherent weaknesses of the advisory system could be considered disproportionately weak and insufficient to ensure that those at risk are notified and suitably informed. Canada could therefore consider revisiting its risk communication approach, and whether incorporating advisory information into existing regulatory systems for food warning labels or other point of sale communications could be justified.

Differences in approach emerge at the more detailed level regarding the scope of populations considered to be at risk, and the appropriate limit on dose (consumption frequency). The United Kingdom is more precautionary than either the US or Canada on both counts. The UK warning includes all children under 16, compared to “young children” in Canada and US.
The UK also recommends that vulnerable populations do not eat the higher risk species at all, rather than suggest they limit consumption to one meal per month.

It could be argued that the more restrictive UK approach to dose limits is consistent with the bioaccumulating characteristics of mercury. Although the half-life of methylmercury in blood is the order of weeks to months, methylmercury is converted in the brain to inorganic mercury that is much more persistent (Rice, 1989). Thus a weekly/monthly dose control system is inconsistent with maintaining the accumulation of mercury within the brain within tolerable limits. Canada should consider adopting the more precautionary UK approach to its advisories to ensure that prenatal and child accumulations of mercury, particularly those in brain, are kept to a minimum. Special attention is required to address the issue of Northern diets, as explained in section 2.2.3.3.

8.3 Pesticides

8.3.1 Introduction

Conventional pesticides comprise a diverse group of substances ranging from broad-spectrum biocides to relatively selective agents used to control microbes, insects, plants and animals. Public concern about pesticides increased after discovery during the 1960’s of toxic effects among wildlife attributed to bioaccumulation of DDT/DDE and other organochlorines in food chains. The landmark report *Pesticides in the Diets of Infants and Children* concluded that children are vulnerable to pesticides because of their exposure levels, metabolic characteristics and the potential for disruption of developmental processes during relatively short time windows
(National Research Council, 1993). This report noted that tests conducted by manufacturers usually involved sexually mature animals and did not assess neurobehavioural, immunologic or endocrine effects of prenatal and early-life pesticide exposures.

The US EPA has registered about 900 active pesticide ingredients and 1,600 formulants\textsuperscript{123} (U.S. Environmental Protection Agency, 1999a; 2001a). A 1998 review found evidence that 165 pesticidal active ingredients were known, probable or possible human carcinogens; all or most uses of 39 of these pesticides had been eliminated and reviews of the food uses of others were planned (Goldman, 1998). The EPA also lists eight inert ingredients (pesticide product ingredients not claimed to be pesticidally active) still in use for which it has significant concern about carcinogenicity, reproductive toxicity, developmental toxicity or neurotoxicity (U.S. Environmental Protection Agency, 2004a). Organophosphate insecticides have acute neurotoxicity at high doses in humans and appear to be neurotoxic at relatively low doses during the prenatal and early postnatal periods in experimental animals (Choi et al., 2004; Jamal et al., 2002; Slotkin, 2004; Vidair, 2004).

Limited population-based biomonitoring data from the United States and Germany show that blood or urine samples from most children and reproductive-age adults contain detectable levels of multiple pesticides (or their metabolites) (Barr et al., 2004; 2005; Becker et al., 2002a; Wilhelm et al., 2003). In the US survey, few persons had urinary organophosphate metabolite levels exceeding reference doses (Mage et al., 2004).

DDT and other persistent organochlorine pesticides were widely used by about 1950 while organophosphate insecticides, highly toxic but less persistent compounds, were introduced during 1960-1980. Natural plant pyrethrins and synthetic pyrethroids, non-persistent insecticides effective at low doses with relatively low toxicity, have been used since the 1980’s. Genetically

\textsuperscript{123} The corresponding numbers for Canada were not found on PMRA’s website.
modified plants, pesticide-resistant crops and relatively non-toxic biopesticides (microbials, plant pesticides, pheromones) were introduced during the 1990’s.

Young children may be exposed to pesticides through inhalation, dermal absorption or ingestion. Exposure is enhanced by hand-mouth behaviour and playing barefoot indoors and outdoors. Despite heavy use of herbicides early in the growing season, food residues of insecticides and fungicides are generally higher because these are applied directly to food closer to or after its harvest. Foods frequently consumed by children include apples, other fruits and vegetables that may contain pesticide residues in the ppb range.

Personal air sampling has shown that exposure from indoor air may exceed dietary doses for pesticides used mainly in the home. Pesticide products are used indoors in over 90% of U.S. households, the main types being insecticide bombs, broadcast applications, crack and crevice treatments, no-pest strips, pet shampoos and flea collars. Pesticide use was reported in over 70% of households with pregnant women or infants age less than age six months. The most frequently detected pesticides in dust and surface wipe samples from U.S. homes were chlorpyrifos, atrazine, malathion, chlordane, DDT/DDE, methoxychlor, propoxur, carbaryl, permethrin, o-phenylphenol, PCP and 2,4-D. Tracking of pesticide-contaminated soil and dust into homes by pets and people is a major source of 2,4-D and other pesticide residues in house dust (Nishioka et al., 2001; U.S. Environmental Protection Agency, 1999b). In agricultural areas, children may be more exposed to pesticides because of higher environmental levels in their indoor and outdoor environments and maternal breast milk.

There have been few studies of pesticide contamination in school environments. In its first statewide survey of pesticide use in public schools, New York found that 87% of schools used pesticides and usually took few precautions (Attorney General of New York, 1996). In the
USA, automatic insecticide dispensers are registered by the EPA for use in restaurants, schools, supermarkets, hospitals, day-care centres and other facilities to control indoor flying insects in food service or work areas (Centers for Disease Control and Prevention, 2000). Drinking water is a minor source of pesticide exposure for children or adults in the general population but may be important for subgroups such as farm families. Unlike the USA and Germany, Canada has not conducted biomonitoring to assess population exposure to pesticides. Such monitoring is essential to adequately assess population exposure levels and potential health risks.

8.3.2 Known and Possible Health Effects

The following discussion of potential links between adverse pregnancy outcomes and childhood illnesses is not meant to comprise a comprehensive review of the literature. The literature cited is mainly recent literature reviews and subsequently published studies. Inherent weaknesses in epidemiologic study designs have hindered the ability to obtain clear answers about the existence and extent of a causal link between exposure and particular health effects. While the immediate effects of acute pesticide poisoning may be identified and monitored, delayed effects of acute exposure or low-level chronic exposure are much more difficult to trace. Since humans are exposed to multiple pesticides through a wide array of exposure pathways, it is rarely possible to know conclusively whether one or more pesticides actually caused a subsequent health effect. (Sanborn et al., 2004)

8.3.2.1 Fetal Deaths
Reviewers found limited epidemiologic evidence that early fetal deaths may be caused by preconceptual or early gestational parental pesticide exposure (Sever et al., 1997). An Ontario farm family study found suggestive associations between early fetal deaths and preconceptual phenoxy herbicide or fungicide use (mainly paternal) (Arbuckle and Sever, 1998; Arbuckle et al., 1999; 2001). A study of Chinese textile workers and a US nation-wide study found dose-response relationships between early fetal death and prenatal maternal serum DDE levels (Korrick et al., 2001; Venners et al., 2005; Longnecker et al., 2005).

Late fetal deaths have been linked to prenatal maternal occupational pesticide use or indoor use of insecticides at home (Pastore et al., 1997), documented agricultural use of restricted pesticides within 1.6 km of maternal residence during the 2nd trimester (associations observed for organophosphates, organochlorines, pyrethroids and carbamates) (Bell et al., 2001a; 2001b) and prenatal maternal serum DDE levels (Longnecker et al., 2005). The Ontario study found no association between 2nd trimester fetal deaths and preconceptual or 1st trimester parental (mainly paternal) phenoxy herbicide exposure (Arbuckle et al., 1999).

### 8.3.2.2 Small for Gestational Age (SGA)

Limited evidence supports associations between SGA\textsuperscript{124} and prenatal maternal residence in municipalities with drinking water supplies contaminated by atrazine, metolachlor or cyanazine (Munger et al., 1997), maternal prenatal serum DDE levels (including a dose-response relationship) (Longnecker et al., 2001), self-reported maternal prenatal pesticide exposure or reduced cord blood AChE levels (Levario-Carrillo et al., 2004) and third tertile cord plasma organophosphate pesticide levels (chlorpyrifos, diazinon) (Whyatt et al., 2004).

\textsuperscript{124} Defined here as low birth weight at term or adjusted for gestation length.
Ontario farm families found a borderline association between SGA and paternal periconceptual use of yard herbicides without protective equipment (Savitz et al., 1997), other studies found no associations with paternal occupational exposure to chlorophenate wood preservatives (Dimich-Ward et al., 1996), occupation in farming (Kristensen et al., 1997a), serum TCDD concentrations among male Vietnam veterans exposed to Agent Orange (a 50:50 mixture of 2,4-D and 2,4,5-T) (Michalek et al., 1998) or county-specific wheat production (a proxy for use of chlorophenoxy herbicides) (Schreinemachers, 2003).

8.3.2.3  Preterm Birth

There is limited evidence that preterm birth is associated with prenatal maternal or cord serum DDE concentrations (Longnecker et al., 2001; Ribas-Fito et al., 2002; Torres-Arreola et al., 2003) or maternal serum β-HCH levels (Torres-Arreola et al., 2003). A longitudinal cohort study in New York found no association between gestation length and self-reported household pesticide use or 3rd trimester maternal urinary concentrations of chlorpyrifos, pyrethroids or pentachlorophenol (or their metabolites) (Berkowitz et al., 2004). Although the Ontario study reported associations between preterm birth and paternal periconceptual use of several specific herbicides (Savitz et al., 1997), other studies found no association with occupational exposure to chlorophenate wood preservatives (Dimich-Ward et al., 1996) or serum TCDD levels among male Vietnam veterans (Michalek et al., 1998).

8.3.2.4  Birth Defects
Specific types of birth defects are relatively rare and epidemiological studies have often assessed their overall risk in relation to pesticide exposure. Given the heterogeneity of birth defects, such studies may obscure true relationships and discussion here is thus limited to the most common specific types of birth defects. Neural tube (NTD), orofacial, limb reduction and cardiac birth defects have been linked to maternal or paternal pesticide exposure indices (Nurminen, 1995; Sever et al., 1997; Loffredo, 2000).

8.3.2.5 Neural Tube Birth Defects (NTDs)

A reviewer concluded found limited epidemiologic evidence that NTDs are linked to maternal or paternal occupational pesticide exposure (Sever et al., 1997). NTDs may also be associated with maternal residential pesticide exposure (Shaw et al., 1999), paternal preconceptual exposure to chlorophenate wood preservatives (Dimich-Ward et al., 1996), pesticide use in orchards or greenhouses (Kristensen et al., 1997b) or parental residence in regions with high agriculture use of chlorophenoxy herbicides and fungicides (Garry et al., 1996). Other studies found no association between NTDs and paternal occupational pesticide exposure (Shaw et al., 1999; Brender et al., 2002).

8.3.2.6 Cardiac Birth Defects

A reviewer found inconsistent epidemiologic evidence for an association between cardiac birth defects and prenatal maternal pesticide exposure (Loffredo, 2000). Elevated risks of cardiac birth defects have been linked to maternal periconceptual exposure to insecticides,
herbicides or rodenticides (Loffredo et al., 2001), parental residence in regions with high agricultural use of chlorophenoxy herbicides and fungicides (Garry et al., 1996; Schreinemachers, 2003), maternal periconceptual occupational insecticide exposure (Shaw et al., 2003) and periconceptual maternal exposure to garden pesticides or insect repellents (Shaw et al., 1999). Cardiorespiratory birth defects were linked to paternal employment as licensed pesticide applicators (Garry et al., 1996) but not with preconceptual paternal occupational pesticide exposure (Shaw et al., 1999).

8.3.2.7 Limb Reduction Birth Defects

Two reviews found limited epidemiologic evidence for associations between limb reduction birth defects and maternal or paternal occupational pesticide exposure (Nurminen, 1995; Sever et al., 1997). Findings include associations with maternal residence in counties with high agricultural pesticide use (Schwartz and LoGerfo, 1988), maternal residence in regions sprayed with malathion (Thomas et al., 1992), paternal occupational exposure to fungicides or herbicides (Lin et al., 1994), farm expenditures on pesticides for grain production (Kristensen et al., 1997b) and maternal employment in agriculture (Engel et al., 2000). Other studies found no associations with self-reported maternal pesticide exposure or farm residence (Kristensen et al., 1997b; Lin et al., 1994; Shaw et al., 1999).

8.3.2.8 Other Birth Defects
Orofacial birth defects have also been linked to maternal employment in agriculture (Nurminen et al., 1995), professional use of a garden pesticides or insect fogger at the maternal residence and to paternal occupational pesticide exposure (Shaw et al., 1999). See also discussion of reproductive tract birth defects in the case study on endocrine disruptors. Urinary tract birth defects have been linked to agricultural use of pesticides in orchards or greenhouses (Kristensen et al., 1997b), serum TCDD levels in male Vietnam veterans (Wolfe et al., 1995) and paternal employment as licensed pesticide applicators (Garry et al., 1996).

8.3.2.9 Childhood Cancer

Childhood brain cancer, leukemia, Wilm’s tumour, neuroblastoma and Ewing’s sarcoma of bone have been linked to parental or childhood pesticide exposure indices (Daniels et al., 1997; Daniels et al., 2001; Linet et al., 2003; Zahm and Ward, 1998). A U.S. cohort study of children of licensed agricultural pesticide applicators found an overall increased risk of childhood cancer compared to the general population and a greater risk among children whose fathers did not use protective gloves (Flower et al., 2004).

8.3.2.9.1 Childhood Leukemia

Most of the 17 case-control studies and one cohort study in a recent review found elevated leukemia risks among children of parents who reported occupational or residential pesticide exposure (Zahm and Ward, 1998). There was also fairly consistent evidence for associations between childhood leukemia and use of no-pest strips, pet pesticides and other home
pesticides (Daniels et al., 1997). Subsequent studies have found links between childhood leukemia and prenatal maternal use of herbicides, plant insecticides or tree pesticides in or around the home (Infante-Rivard et al., 1999), maternal or paternal occupational pesticide exposure and household pesticide use (Alexander et al., 2001; Meinert et al., 2000) and household professional pesticide applications and household insecticide use (Ma et al., 2002). Other recent studies found weak or no association between childhood leukemia and paternal pesticide exposure inferred from death certificate occupation information (Fear et al., 1998), paternal occupational exposure to chlorophenate wood preservatives (only five case fathers had high exposure) (Heacock et al., 2000), paternal pesticide exposure inferred from occupation on census records (Feychting et al., 2001), paternal employment as pesticide applicators (only 8 cases were observed) (Rodvall et al., 2003) or maternal or paternal periconceptual occupational exposure to agrochemicals (McKinney et al., 2003). Childhood leukemia has also been linked to childhood exposure to insecticides or insect repellents (Infante-Rivard et al., 1999), household professional pesticide applications and household insecticide use during the year before birth and the first three years of life (Ma et al., 2002) and agricultural propargite use in the immediate region of the subject’s residence (Reynolds et al., 2002). Given that childhood leukemias appear to be initiated in utero (Taub and Ge, 2004), preconceptual and transplacental pesticide exposure indices may be the most relevant.

8.3.2.9.2 Childhood Lymphomas

A review of the few available epidemiologic studies of childhood non-Hodgkin’s lymphoma (NHL) and pesticide exposure (four case-control studies and one cohort study) noted
that all had few exposed cases or case parents (Zahm and Ward, 1998). Nevertheless, the authors found some evidence that NHL was associated with parental occupational or residential pesticide exposure and with postnatal residential pesticide use. Subsequent studies found links between childhood NHL and prenatal maternal or paternal occupational pesticide exposure (Meinert et al., 2000) and dose-response relationships between NHL and frequency of prenatal maternal or professional indoor insecticide applications (Buckley et al., 2000). Children of farm pesticide applicators had increased risks of Hodgkin’s disease and total lymphomas (Flower et al., 2004). Subsequent studies found a link between total lymphomas and household pesticide use (Meinert et al., 2000) and a dose-response relationship between NHL and frequency of childhood pesticide exposure (Buckley et al., 2000).

8.3.2.9.3 Childhood Brain Cancer

Reviewers found suggestive evidence for associations between childhood brain cancer and preconceptual paternal or periconceptual maternal pesticide exposure (Daniels et al., 1997; Zahm et al., 1997). There was also limited evidence for an association with residential use of no-pest strips, pet pesticides and other indoor pesticide use. Subsequent studies have reported links between childhood brain cancer and paternal employment in agriculture or other occupations likely to have pesticide exposure (Cordier et al., 1997; Cordier et al., 2001; Feychting et al., 2001), paternal occupational herbicide exposure (associated with primitive neuroectodermal tumours) (van Wijngaarden et al., 2003), prenatal maternal agricultural pesticide exposure and farm residence before age 6 months (Holly et al., 1998), maternal occupational pesticide exposure (Meinert et al., 2000) and parental employment as agricultural pesticide applicators.
(Flower et al., 2004). Other studies found no association between childhood brain cancer and potential paternal exposure inferred from occupations recorded on death certificates (Fear et al., 1998), paternal occupational exposure to chlorophenate wood preservatives (Heacock et al., 2000) or paternal employment as pesticide applicators (only 17 cases in cohort) (Rodvall et al., 2003), maternal or paternal periconceptual occupational exposure to agrochemicals (McKinney et al., 2003) or intensity of agricultural pesticide use near the residence at diagnosis (Reynolds et al., 2002). A recent review noted growing evidence for an association between childhood brain cancer and paternal occupational pesticide exposure (Olshan and van Wijngaarden, 2003).

8.3.2.9.4 Other Childhood Cancers

There have been relatively few epidemiologic studies of other childhood cancers. Some studies found links between parental pesticide exposure indices and neuroblastoma (Olshan et al., 1999; Daniels et al., 2001), Wilms’ tumour of kidney (Fear et al., 1998; Kristensen et al., 1996; Sharpe et al., 1995; Tsai et al., 2006), Ewing’s sarcoma of bone (Valery et al., 2005) and germ cell tumours (Shu et al., 1995).

8.3.2.10 Neuropsychologic Function

Animal studies have found adverse neurodevelopmental effects from relatively low-level transplacental or early-life insecticide exposure (Eskenazi et al., 1999) but the few available epidemiologic studies are inadequate to assess childhood risks at background exposure levels. Studies have found links between abnormal neonatal reflexes and breast milk DDE levels
(Rogan et al., 1986) and prenatal maternal urinary organophosphate metabolite levels (Young et al., 2005). Other studies found no association between neonatal neuropsychologic indices and maternal serum or breast milk DDE levels (Steuerwald et al., 2000) or cord blood DDE or hexachlorobenzene levels (Stewart et al., 2000). Neuropsychologic indices at ages 6-24 months were not associated with transplacental or lactational DDE exposure indices (Longnecker et al., 1997; Darvill et al., 2000). A longitudinal study found an inverse association between head circumference and maternal urinary chlorpyrifos metabolite levels among infants of women with low blood PON1 levels (an enzyme involved in metabolism of organophosphate pesticides) (Berkowitz et al., 2004).

Among persons poisoned as children by hexachlorobenzene, half had weakness, paresthesiae and myotonia and/or cogwheeling when examined at an average age of 36 (Gocmen et al., 1989). There was an association between attention deficit hyperactivity disorder and use of the herbicide glyphosate among children of male licensed pesticide applicators (Garry, 2002). There have been sporadic case reports of severe childhood neurotoxicity (including coma, seizures and death) after ingestion or excessive dermal exposure to DEET, a widely used insect repellent (Briassoulis et al., 2001).

The report *Pesticides in the Diets of Infants and Children* recommended that toxicologic evaluations of pesticides include developmental neurotoxicity data and noted that only adult neurotoxicity test data were available for most of the pesticide active ingredients in use. The EPA recently requested developmental neurotoxicity data from manufacturers on about 140 pesticides considered to be neurotoxic.

### 8.3.2.11 Other Health Effects
Limited evidence supports an association between early childhood ear infections and biomarkers of perinatal organochlorine pesticide exposures (DDE, hexachlorobenzene) (Dallaire et al., 2004; Dewailly et al., 2000; Karmaus et al., 2001). Potential effects of pesticides on pubertal sexual development in humans remain largely unexplored. Ages at menarche and breast development and male genital development were not related to biomarkers of transplacental or lactational DDE exposure (Gladen et al., 2000). A study of male youth living near cashew plantations aerially sprayed with endosulfan found delayed Tanner stage pubertal development compared to a comparison group from a village remote from the plantations (Saiyed et al., 2003).

There are about 3,000 moderate to severe childhood pesticide poisonings annually in the USA, mainly from organophosphates, pyrethrins, herbicides and carbamates (Watson et al., 2003). Children poisoned by hexachlorobenzene in Turkey developed severe disease characterized by hyperpigmentation, large skin bullae in skin areas exposed to sun (caused by the photosensitizing effect of high circulating porphyrin levels), hypertrichosis and porphyrinuria; follow-up at an average age of 36 years showed that 65% still had hyperpigmentation, 84% had severe scarring of skin and 70% had small hands and arthritis (Gocmen et al., 1989). Surveillance of childhood pesticide poisonings revealed 2,593 children with acute pesticide-related illnesses associated with exposure at schools in the United States during 1998-2002 (there are no similar data available for Canada) (Alarcon et al., 2005). These included 3 severe and 275 moderately severe cases. Most were associated with insecticides (35%), disinfectants (32%), repellents (13%) or herbicides (11%). The sources of pesticide exposure included uses by schools per se (69%) and drift from adjacent farms (31%).
8.3.3 International Context

8.3.3.1 OECD

The OECD produced a vision statement about agricultural pesticides that describes certain goals to be achieved by 2014, including the reduction of levels of risk to man, animal, and the environment from pesticide exposure “to the extent possible” and harmonization of pesticide regulations to better share risk assessment information (Organisation for Economic Co-operation and Development, 2004). Both Canada and the US signed on to this vision in 2005 (Organisation for Economic Co-operation and Development, 2005).

8.3.3.2 Stockholm Convention on Persistent Organic Pollutants (POPs) (2001)

In 2001, over 90 countries and the European Community signed the Stockholm Convention committing to reduce or eliminate the production, use, and/or release of twelve key POPs including nine pesticides. Provisions were also included in order to provide assistance to developing countries to implement the treaty requirements.

8.3.3.3 United States

The major statutory authorities governing pesticide regulation in the United States consist of the Section 408 of the Federal Food, Drug, and Cosmetic Act (FFDCA), as well as the major regulatory programs for pesticides. The Federal Insecticide, Fungicide, and Rodenticide Act
(FIFRA) requires the U.S. EPA to regulate the sale and use of pesticides in the United States through registration and labelling of pesticide products including the reregistration of older pesticides based on new data as it becomes available. Section 408 authorizes the EPA to establish levels of allowable residue levels for food. Foods in non-compliance or with no established tolerance are not permitted to be imported or sold in interstate commerce.

8.3.3.4 Canada

The new Pest Control Products Act, 2002 (in force June 2006) includes measures designed to embed precautionary risk management for children, including a ten-fold safety factor for risk assessment, where warranted, consideration of aggregate exposures from food, water and environment, and consideration of cumulative effects of like pesticides.

8.3.4 Detailed Study of Special Exposure Pathways

Children may be exposed to pesticides by ingesting their residues on commercially purchased food and in public drinking water. Pesticides are also readily available for domestic use in the home and garden. Even if all recommended precautions are followed, residues will remain in the air and on treated surfaces. Similarly, pesticides applied to community spaces such as parks, sports fields and schoolyards can be additional sources of exposure and can be brought indoors on footwear and transferred to carpets and floors (Sanborn et al., 2004; Fortmann and Tulve, 2002).
Section 4.3.2 of this report has already described the recent momentum in Canadian cities towards adopting municipal bylaws controlling cosmetic use of pesticides. This case study has selected two other exposure pathways common to children in and around the home: pesticide residues on children’s food sources and pesticides designed for indoor home use. Tables A8.5 and A8.6 (Appendix 8) review specific legislation on those two topics. The following text provides additional commentary to supplement the information provided in the Tables.

8.3.4.1 Pesticide Exposure Pathway: Food Sources

The US government formally recognized children’s special vulnerabilities in the US *Food Quality Protection Act 1996* in which a ten-fold extra safety factor is to be applied to risks that could affect children, based on scientific risk assessment results. The Canadian government followed suit with a similar approach in its *Pest Control Products Act 2002* enacted in 2006.

In contrast, the European Commission adopted a different approach, by setting more stringent (zero) pesticide residue tolerance limits for foods designed for infants and weaning children. While the simplicity of this approach has some appeal, its limitations become apparent upon consideration of the time- and product- limited aspects of such a system. Not all parents rely on commercially prepared baby food for their infant children, and in any event the children soon graduate to eating food from the family larder. The North American approach, though complex, embeds precautionary aspects directed at children, and prioritizes products consumed by children, but ensures that the benefits of that extra safety margin are shared by all.

8.3.4.2 Pesticide Exposure Pathway: Household Products

125 See also 5.2.3.10
While many people think primarily of their food supply when considering pesticide risks, there are many household uses that could expose children to pesticides in the air or on surfaces that can be transferred to their skin or inadvertently ingested, such as organophosphate pesticides used in pet flea collars.

Risk controls for such consumer products involve setting technical standards and limits on the product characteristics, and then transmitting product information about any residual hazards or handling requirements to the consumer via product labelling, packaging, or other means.

It is of interest that the US Food Quality Protection Act requirement to assess aggregate exposures to children brought to light the unexpected finding of high exposures from pet flea collars (U.S. Environmental Protection Agency, 2001b). The Canadian and US regulatory approaches rely on labelling and packaging controls. While that type of control addresses the risk of acute direct exposure, it may not fully address the residual inadvertent exposures resulting from using the product for its intended purpose in and around the home.

8.4 Endocrine Disrupters

8.4.1 Introduction

The endocrine system produces multiple hormones that coordinate bodily functions during gestation and postnatal life. Hormone-producing tissues include the pituitary, thyroid, parathyroid and adrenal glands, pancreatic islets, testicles and ovaries. When activated by a
hormone, receptors on or within target cells trigger a cascade of intracellular reactions that amplify and translate the hormone “signal”.

Endocrine disruptors (EDs) interfere with the synthesis, secretion, transport, binding, action or elimination of natural hormones and may cause adverse effects at the level of an organism, progeny or populations. The ability of DDT/DDE to inhibit testicular and secondary sexual development in roosters was recognized long before public interest in EDs became prevalent (Burlington and Lindeman, 1950). Experience with the drug diethylstilbestrol (DES) showed that transplacental exposure to an exogenous hormonally active agent could disrupt development in both sexes and cause cancer in exposed daughters. Wildlife and experimental animal studies have shown important adverse effects of EDs on reproductive system development, sexual behaviour, fertility and immune function (Vos et al., 2000). For instance, transplacental exposure to the pesticides DDT/DDE, vinclozolin, procymidone or linuron can cause hypospadias, cryptorchidism and other abnormalities in experimental animals (Gray et al., 2001).

Although not proven to cause adverse health effects in humans, several compounds known to be EDs in experimental animals are widespread in the environment. High concentrations of nonylphenol ethoxylates and their degradation products occur in municipal wastewater treatment plant effluents and sewage sludges. The latter may be applied to agricultural lands, thereby contaminating groundwater. Other EDs potentially present in water include the natural hormones estradiol and estrone and the synthetic oral contraceptive hormone 17α-ethyl estradiol (from municipal waste water discharges) (Yin et al., 2002), organotin compounds (may leach from PVC pipes) (van Dokkum and Huwer, 2005) and atrazine (Rohr et al., 2001).

126 Nonylphenol ethoxylates and related compounds have been used for over 40 years as detergents and emulsifiers in consumer and industrial products (e.g., textiles, pulp and paper, paints, pesticides, cosmetics).
Foods are potential sources of exposure to EDs including natural phytoestrogens, hormones used in beef production, phthalates, dioxins, PCBs and certain pesticides. Hormones allowed for use in Canadian beef production include the natural hormones estradiol, progesterone and testosterone and synthetic products including zeranol, melengestrol and trenbolone. Zeranol has potency similar to DES and estradiol in inducing estrogen-dependent gene expression in human MCF7 cells in vitro (Leffers et al., 2001).

Large amounts of phthalates are used annually to produce flexible polyvinyl chloride products; smaller amounts are used in consumer products including soaps, insect repellants, lotions, perfumes and other cosmetics. Migration of phthalates from polyvinyl chloride food packaging into foods is increased by heat and fat content. For instance, U.K. dairy products contained average total phthalate levels of up to 56 mg/kg in butter and 114 mg/kg in cheese (Sharman et al., 1994). After Denmark banned use of DEHP-plasticized milk tubing, average DEHP levels in whole milk fell to less than 50 µg/L within six months (Petersen 1991).

Infants and toddlers may be exposed to relatively high DEHP levels from mouthing plastic toys and objects (National Institute of Environmental Health Sciences, 2000). DINP replaced DEHP as the main phthalate used in plastic toys and other children's products until restricted in 1998 because of evidence of carcinogenicity in rodents. Seriously ill infants or children receiving parenteral fluids may have high DEHP exposures because of leaching from plastic medical devices (Calafat et al., 2004). The U.S. biomonitoring program found unexpectedly high urinary phthalate metabolite levels in children, especially MBP, MBzP and MEHP\textsuperscript{127} (Silva et al., 2004). It is unknown whether these findings represent differences between children and adults with regard to exposure (dose per unit body weight) or pharmacokinetics (Centers for Disease Control and Prevention, 2005).

\textsuperscript{127} Monobutyl phthalate (MBP), monobenzyl phthalate (MBzP), mono-(2-ethylhexyl) phthalate (MEHP)
Bisphenol A is used in production of polycarbonate plastics used in baby bottles, household appliances, food and drink containers and many other products and has been detected in human breast milk and urine (Ye et al., 2005; Ye et al., 2006). Bisphenol A diglycidyl ether (BADGE) is used in organosol lacquers used to treat the interior surface of cans used for food packaging and can migrate into foods, especially fatty products. Bisphenol A has been found in the liquid phase of preserved vegetables in lacquer-coated cans at levels capable of inducing proliferation of MCF-7 human breast cancer cells \textit{in vitro}. Several sunscreens had estrogen agonist activity in bioassays (Klann et al., 2005; Schlumpf et al., 2001). See other case studies for information on exposure to pesticides and lead.

\textbf{8.4.2 Potential Health Effects}

\textbf{8.4.2.1 Male Reproductive Tract Birth Defects}

Several studies have reported increased incidence rates of cryptorchidism (undescended testicles) and hypospadias (a birth defect of the penis) during recent decades but the significance of these trends is uncertain (Toppari et al., 2001). Reported cryptorchidism incidence rates vary considerably between countries and irregularly over time within countries (Paulozzi, 1999). The reporting of cryptorchidism cases is influenced by diagnostic efficiency and age at examination (in 70\% of affected neonates, testicles spontaneously descend by age three months).

Similarly, incidence rates of hypospadias vary substantially between countries. Even in countries with high reported rates, 30-40\% of cases may not be detected or reported (Kallen et al., 1986). Hypospadias incidence rates approximately doubled in United States during 1968-
1993; the annual incidence rate of severe hypospadias and the ratio of severe to mild cases both increased, findings suggestive of real upward trends (Paulozzi et al., 1997). Increases have been reported by surveillance systems in Alberta, Norway, and Israel but not in several other developed countries including Finland (where all children are examined at birth by a pediatrician) (Aho et al., 2000) and Scotland (Ahmed et al., 2004).

8.4.2.2 Cryptorchidism

Testicular descent appears to require a prenatal testosterone surge, suggesting that exposure to exogenous antiandrogens could cause cryptorchidism but only a few epidemiologic studies have assessed environmental exposures. Observed environmental links to cryptorchidism include periconceptual maternal use of exogenous estrogens (Depue, 1984), parental use of pesticides on field vegetables (Kristensen et al., 1997b), maternal occupation in gardening (Weidner et al., 1998), paternal occupational exposure to chlorophenate wood preservatives (Dimich-Ward et al., 1996), infant adipose tissue heptachlor-epoxide and hexachlorobenzene levels (Hosie et al., 2000), maternal serum DDT/DDE and hexachlorobenzene levels (Waliszewski et al., 2005) and self-reported paternal occupational pesticide exposure (Pierik et al., 2004; Wang and Wang, 2002). German and U.S. studies found borderline associations with infant adipose tissue or prenatal maternal serum DDE levels (Hosie et al., 2000; Longnecker et al., 2002). A second U.S. study, with about one-third of the case number in the Longnecker study, found no association with prenatal maternal serum DDT or DDE levels (Bhatia et al., 2005). The National Research Council concluded that there is insufficient toxicologic and
epidemiologic evidence to attribute increased risks of cryptorchidism to environmental EDs (National Research Council, 1999).

### 8.4.2.3 Hypospadias

Hypospadias has been linked to proximity of maternal residence to landfill sites (Dolk et al., 1998; Elliott et al., 2001), prenatal maternal DES use (Beral and Colwell, 1981), 1st trimester maternal progestin use (Carmichael et al., 2005), prenatal maternal grandmother DES use (an apparent transgenerational effect) (Klip et al., 2002), farm expenditures on tractor spraying equipment for grain production (Kristensen et al., 1997b) and paternal occupational solvent exposure (Pierik et al., 2004). Other studies found no association with maternal or paternal occupation in farming or gardening (Weidner et al., 1998), maternal serum DDE levels (Bhatia et al., 2005; Flores-Luevano et al., 2003; Longnecker et al., 2002) or maternal occupational exposure to pesticides or to any of several suspected EDs\(^{128}\) (Vrijheid et al., 2003). The National Research Council concluded that there is insufficient toxicologic and epidemiologic evidence to attribute increased risks of hypospadias to environmental EDs (National Research Council, 1999).

### 8.4.2.4 Feminization of Male Infants

A U.S. cohort study found a borderline association between accessory nipples in male infants and prenatal maternal serum DDE concentrations (Longnecker et al., 2002). This study took advantage of prenatal maternal serum samples collected during 1959-1966, a period when

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\(^{128}\) Pesticides, PCBs, phthalates, alkylphenolics, biphenolics, cadmium, lead, mercury, other specified compounds
serum DDE levels were substantially higher than those today. A recent U.S. epidemiologic study found an inverse dose-response relationship between anogenital index\textsuperscript{129} and prenatal maternal urinary phthalate metabolite concentrations (Swan et al., 2005).

Although there have been only two reported epidemiologic studies of this relationship, evidence from animal studies indicates a need to substantially expand epidemiologic research to address this knowledge gap. For instance, developmental abnormalities among male rodents prenatally exposed to AR antagonists (vinclozolin, procymidone, linuron, DDE and several phthalates) include feminization (reduced anogenital distance, retained nipples/areolas), reproductive tract birth defects (agenesis of sex accessory tissues, cryptorchidism, hypospadias) and sexual dysfunction (inability after puberty to mate with sexually receptive females) (Agency for Toxic Substances and Disease Registry, 2000; Gray et al., 2001). Transplacental TCDD exposure produced reduced ventral prostate weight and reduced anogenital distance in rats and cryptorchidism and reduced testicular germ cell populations in swine (Barthold et al., 1999).

8.4.2.5 Sexual Maturation

8.4.2.5.1 Females

The average age at menarche may have decreased during recent decades (de Muinck Keizer and Mul, 2001). Breastfed daughters of women with high serum polybrominated biphenyl (PBB) levels had earlier onset of menarche compared to daughters of women with low serum PBB levels or formula-fed girls (Blanck et al., 2000). Delayed menarche and pubic hair development were associated with blood lead levels in the range below 10 µg/dL in at two of the

\textsuperscript{129} Anogenital distance (mm) divided by weight (kg) at examination
three major ethnic subgroups studied (Selevan et al., 2003; Wu et al., 2003). Other studies found no association between age at female pubertal stage attainment and prenatal or lactational PCB exposure (Blanck et al., 2000; Gladen et al., 2000) or current serum TCDD activity or PCB levels (Den Hond et al., 2002; Staessen et al., 2001).

In the Belgian study, delayed breast development in girls was associated with serum TCDD activity but not with serum PCB levels (Den Hond et al., 2002; Staessen et al., 2001). In a U.S. birth cohort study, delayed breast development was not associated with prenatal maternal serum PBB levels (Blanck et al., 2000). A small study of Puerto Rican girls found associations between premature breast development and serum phthalate and phthalate metabolite levels, a finding that needs verification (Colon et al., 2000).

8.4.2.5.2 Males

Delayed male genital development was associated with current serum PCBs or TCDD-like activity levels (Den Hond et al., 2002; Staessen et al., 2001). Other studies found no association between age at pubertal stage attainment and prenatal or lactational PCB exposure in males (Gladen et al., 2000; Mol et al., 2002) or between serum testosterone level at age 20 and prenatal maternal serum DDE levels (Gladen et al., 2004). A small birth cohort study found normal testicular volume, penis length and serum testosterone levels among adolescent boys neonatally exposed to DEHP (estimated doses were 42-140 mg/kg/bw) during extracorporeal membrane oxygenation (Rais-Bahrami et al., 2004).

8.4.2.6 Testicular Cancer
Incidence rates of testicular cancer, the most common cancer among young men in most
developed countries, have increased in Canada and many other countries (Liu et al., 1999; Power
et al., 2001). Cryptorchidism is a risk factor for testicular cancer but correction of
cryptorchidism early in life does not reduce the risk of testicular cancer and men with unilateral
cryptorchidism have increased risks of contralateral testicular cancer (Moller et al., 1996; Prener
et al., 1996). These findings suggest that cryptorchidism and testicular cancer may share a
common cause. Given the strong animal evidence that environmental AR antagonists can cause
cryptorchidism, it is possible that some human testicular cancers may be attributable to such
agents.

Testicular cancer has been linked to occupations potentially exposed to pesticides (Guo et
al., 2005), employment as licensed pesticide applicators (Fleming et al., 1999; Wiklund et al.,
1989), parental employment in farming (early-onset testicular cancer) (Hardell et al., 1998;
Kristensen et al., 1996), insect repellent use and occupational exposure to plastics (Hardell et al.,
1998; Ohlson and Hardell, 2000), plasma hexachlorobenzene and DDE levels of subjects and
plasma hexachlorobenzene levels of their mothers (Hardell et al., 2003), prenatal maternal
exogenous hormone therapy (Weir et al., 2000) and early onset of puberty (Weir et al., 1998;
Coupland et al., 1999). An expert panel concluded that testicular cancer was not associated with
occupational or environmental phenoxy herbicide exposure (National Research Council, 2005).
The U.S. Agricultural Health Study, a large cohort study of pesticide applicators, found no
overall increased risk of testicular cancer but lacked statistical power to assess associations
between testicular cancer and specific types of pesticides (Alavanja et al., 2005). Several case-
control studies found no associations with occupations potentially exposed to pesticides but were
non-informative due to low statistical power.

8.4.2.7 Thyroid Function

The fetal brain has thyroid hormone receptors before the fetus is able to synthesize
thyroid hormones, creating a dependence on maternal thyroid hormones. Thyroid hormones are
essential for normal brain development during gestation and early childhood, including neuronal
migration, dendritic and axonal growth, synapse formation and myelination. Inadequate prenatal
maternal and infant thyroid hormone levels can cause major cognitive deficits and other
abnormalities.

A reviewer found limited epidemiologic evidence for associations between reduced
prenatal maternal plasma thyroid hormone levels and PCB exposure levels (Longnecker et al.,
1997). Reduced cord plasma thyroid hormone levels (free or total) have been linked to breast
milk PCB and total dioxin-TEQ levels (Sauer et al., 1994), cord serum PCB levels (Steuerwald et
al., 2000) and cord plasma pentachlorophenol and hydroxylated PCB levels (Sandau et al. 2002).
Another study found no associations between cord serum thyroid hormone and breast milk PCB
levels (Longnecker et al., 2000). Among older children, reduced serum thyroid hormone levels
were associated with serum PCB and blood cadmium levels (Osius et al., 1999). Hydroxylated
PCB metabolites bind to human transthyretin (a blood protein that binds thyroid hormone),
thereby increasing hepatic T4 metabolism (Cheek et al., 1999). Prenatal and lactational exposure
to PCBs, PCDDs or PCDFs produces severely reduced fetal and neonatal brain T4 levels in
experimental animals.
8.4.3 International Context

While specific jurisdictions have articulated national policy platforms and approaches, the breadth and gravity of the issue has prompted governments and other stakeholders to consider a global approach. In some ways, the concern about endocrine disruption has precipitated and provided an impetus to revisit the effectiveness of the chemical risk management system generally. Endocrine disruption issues have thus become integrated into the larger context of concerns over potential adverse effects of chemical exposure.

8.4.3.1 United States

The 1996 Food Quality Protection Act (FQPA) and amendments to the Safe Drinking Water Act (SDWA) mandated the development of a screening and testing strategy for endocrine disrupters, to be incorporated into the existing regulatory frameworks for pesticides and other toxic substances (US EPA July 1999). In 1998, the EPA issued a draft policy platform describing its proposed approach to a screening program, as discussed in the accompanying Table.

In 1999, the Endocrine Disrupter Screening and Testing Advisory Committee (EDSTAC) submitted a report reviewing the proposed program. It expressed concern about the lack of ongoing program evaluation and optimization, suggesting that public support would be lost unless learnings were promptly integrated into the process. Regarding the burdensome issue of screening and testing chemical mixtures, the Committee supported the need to focus on single
compounds first, and suggested that existing methodologies for Whole Effluent Testing (WET) and Toxicity Identification Evaluation (TIE) be applied to the Endocrine Disruptor Screening Program. Regarding the handling of risks to specific subpopulations such as infants and children, the Committee prefers the approach of using subpopulations as a criterion within existing compartments rather than as a stand-alone compartment (U.S. Environmental Protection Agency, 1999c).

It is also of note that in the context of examining the effects of environmental influences on children’s health, the National Children’s Study identified endocrine disrupters as a priority topic for research (U.S. National Institute of Child Health and Human Development, 2000).

### 8.4.3.2 International Conference on Chemicals Management

The Strategic Approach to International Chemicals Management (SAICM) (United Nations Environment Programme, 2006) was adopted by the International Conference on Chemicals Management (ICCM) in February 2006. SAICM includes a political commitment by states, civil society and industry actors, a policy framework, and an action plan. It admits a number of weaknesses in the status quo systems, and declares a need to improve risk reduction for children and fertile populations and public access to chemical risk and safety information. Specific action items to reduce children’s risk of chemical exposure include the development of guidance materials to assess and prioritize children’s environmental health concerns, risk assessment research infrastructure, and information dissemination mechanisms. Action items to address knowledge and information related to children and chemical safety include promotion of safety education and training, development of indicators, consideration of children’s special
exposures and vulnerabilities when setting tolerance limits, and development of child and family-centric strategies.

### 8.4.3.3 European Commission

In early 2005, the European Commission’s Research Directorate-General hosted a Workshop entitled “Enhanced International Collaboration in the Field of Endocrine Disrupters: How to Do It in Practice?” (Europa, 2005b). Workshop participants expressed a number of regulatory needs and preferred approaches, including a desire to promote product substitutions and define the scope of endocrine disrupters. The screening and testing process should first study single ingredients before studying the mixtures, yet also develop techniques to assess the additive and interactive effect of multiple exposures. It was recommended that regulators base their actions on evidence of adverse effects, while keeping the precautionary principle in mind. Finally, the need to improve communication of risks and policy approaches to public audiences was acknowledged.

### 8.4.4 Detailed Review

Endocrine disruption is unlike the other case study topics, as it does not refer to a particular type or class of material (e.g. lead, pesticides) nor a specific type of exposure (e.g. air pollution). Rather, the concern relates to a belated realization that an unanticipated class of new adverse effects was potentially emerging as a result of exposure to chemicals and substances that were already found in a wide range of products and sources of exposure. While in many cases
the potential for endocrine disrupting effect merely adds a layer of severity to known hazards caught by existing regulatory control mechanisms, other cases may raise new concern about products previously believed to be safe. It should also be recognized that this concern is relatively new, so the regulatory risk management frameworks are still in a relatively immature policy development stage.

Therefore, rather than describe how risks arising from particular exposure pathways are managed, this section will provide a sampling and discussion of international approaches to the issue. Table A8.7 (Appendix 8) describes the policy approaches in selected jurisdictions, notably the US and the EU. The following text provides additional commentary to supplement the information provided in the Table.

In brief, the European Commission has grappled with the very practical issue of overwhelming volumes of chemicals requiring review by proposing prioritization on the basis of the number of tons of the chemical produced or distributed. The US policy statement follows a more conventional risk assessment approach that will set priorities based on risk information already on file – presumably an arduous task in itself.

While the EC approach to prioritization may appear relatively arbitrary, product volumes do have some relationship to the potential breadth of exposure: extensive tonnage of a moderately toxic chemical could affect more people than a small volume of a highly toxic substance. While the EC approach includes a “safety net” for special cases of concern, that aspect presumes the availability of relative risk information about the effect of long-term exposure. In so doing, it indirectly triggers an extra step in the review of existing chemicals, which may defeat the purpose of its prioritization strategy.
This report has not investigated whether alternative high-level policy approaches were considered to address the prioritization issue. For example, consider whether priority screens could have been based on whether children and other vulnerable populations were exposed to them, particularly those substances that were not yet subject to high levels of regulatory control and monitoring. Further consideration of how the EC General Product Safety requirement does or should influence the development of EC policy on EDCs would also be worthwhile.

8.5 Indoor Air Pollution

8.5.1 Introduction

Children under age twelve in Canada spend about 90% of their time indoors with the remainder divided roughly equally between outdoors and motor vehicles (Leech et al., 1996). Indoor air pollution is a major public health problem (Samet and Spengler, 2003). Children inhale relatively high amounts of air per unit body weight per day and are susceptible to airborne toxicants that can disrupt normal lung function and growth during early childhood. Potential health effects include lung function deficits (reduced capacity and air flow rates) and respiratory diseases such as bronchitis, pneumonia, asthma and middle ear infections. Emerging evidence suggests that prenatal maternal environmental tobacco smoke (ETS) exposure may cause adverse pregnancy outcomes including fetal death, preterm birth and intrauterine growth restriction.

Major indoor air contaminants include gases and particles ranging from those that are small and respirable particles to large, transiently suspended particles. Sources of indoor air
contaminants include smoking\textsuperscript{130}, volatilization of chemicals from water, building materials, household cleaners and other consumer products, pet dander, insects, molds, house dust (including dried soil tracked indoors), inadequately ventilated cooking and heating devices and influx of outdoor air pollutants. Economically disadvantaged children may be more exposed to indoor air hazards because of higher prevalence of household smokers and conditions that favour proliferation of molds, mites and cockroaches.

\textbf{8.5.2 Known and Possible Health Effects}

Discussion of adverse health effects of indoor air is limited to ETS, aeroallergens and carbon monoxide poisoning since there is inadequate epidemiologic evidence for child health effects of other contaminants (apart from lead and mercury that are discussed in other case studies).

\textbf{8.5.2.1 Environmental Tobacco Smoke}

\textbf{8.5.2.1.1 Adverse Pregnancy Outcomes}

Reviewers and an expert panel recently concluded that there is limited evidence for associations between maternal prenatal ETS exposure (among non-smoking women) and early fetal death and intrauterine growth restriction and strong evidence that such exposure increases the risk of preterm birth (California Environmental Protection Agency, 2005; DiFranza et al., 2004; Jaakkola and Jaakkola, 2002; Lindbohm et al., 2002). Polymorphisms of CYP1A1 and

\textsuperscript{130} The major source of airborne fine particulate matter (PM$_{2.5}$) in homes with smokers
GSTT1 have been linked to birth weight deficits among infants of active smokers but their role in birth weight of infants of ETS-exposed non-smoking women is unknown (Wang et al., 2002).

8.5.2.1.2 Respiratory Disease

The prevalence of physician-diagnosed childhood asthma increased from 2.5% to 11.2% in Canada during 1978-1995 (Millar and Hill, 1998) but may have stabilized during recent years (Senthilselvan et al., 2003). There is sufficient epidemiologic evidence that ETS exposure during infancy and early childhood can produce incident asthma, increased asthma severity, lower respiratory tract infections and acute and recurrent middle ear infections (Jaakkola and Jaakkola, 2002; DiFranza et al., 2004; California Environmental Protection Agency, 2005). Many of the epidemiological studies of respiratory outcomes were based on parent-reported household ETS exposure but there were also associations with children’s cotinine levels.

8.5.2.1.3 Cancer

The onset of childhood leukemia appears to occur in utero (Taub and Ge, 2004), consistent with a role for preconceptual or gestational carcinogenic exposures. Parental smoking has been linked to childhood brain tumours, leukemia and lymphoma (California Environmental Protection Agency, 2005). For instance, paternal smoking during the five years before conceptions was associated with leukemia, lymphoma and brain cancer (Ji et al., 1997). Childhood ETS exposure has been linked to childhood brain cancer and to adult breast, nasopharyngeal and lung cancers (California Environmental Protection Agency, 2005).
8.5.2.1.4 Other Health Effects

There is strong evidence that postnatal ETS exposure can cause sudden infant death syndrome (SIDS), independent of prenatal maternal active smoking (Anderson and Cook, 1997; California Environmental Protection Agency, 2005). Childhood cognitive deficits, problem behaviours and learning difficulties have been linked to prenatal maternal and postnatal ETS exposure\(^{131}\) (California Environmental Protection Agency, 2005; Rauh et al., 2004; Yolton et al., 2005). Childhood ETS exposure has also been associated with lung function growth deficits (California Environmental Protection Agency, 2005; Jaakkola and Jaakkola, 2002) and dental caries\(^{132}\) (Aligne et al., 2003; Shenkin et al., 2004).

8.5.2.2 Other Indoor Air Contaminants

An expert panel concluded that new onset asthma can be caused by house dust mite allergen and, possibly, cockroach allergen exposure (National Research Council, 2000b). Among established asthmatics, attacks can be triggered by cat, cockroach and house dust mite allergens and, possibly, by dog allergens, molds and high NO\(_2\) concentrations. The panel’s conclusions are consistent with findings in subsequent original research. For instance, a large U.S. study found strong associations between physician-diagnosed asthma among preschool-age children and pet allergy, ETS exposure, use of a gas stove or oven for heat\(^{133}\) and family history

\(^{131}\) Prenatal maternal active smoking is a known cause of childhood learning difficulties (World Health Organization 1999).

\(^{132}\) ETS can cause nasal obstruction and mouth breathing; the latter contributes to oral growth of cariogenic bacteria.

\(^{133}\) Inadequately ventilated gas appliances are a major source of indoor NO\(_2\).
of allergies (Lanphear et al., 2001). There were about 1,800 reports of moderate, severe, or fatal carbon monoxide poisonings among U.S. children during the year 2000\textsuperscript{134} (Litovitz et al., 2001).

### 8.5.3 International Context

It is fitting that the case studies on indoor and outdoor air pollution be discussed last, as in some senses they represent the sum of all previous issues. Air quality suffers from the release of contaminants of heavy metals, particulates, and chemicals, as well as the potentially unexpected adverse effects caused when the above substances are combined. Managing these cumulative risks is therefore a proportionately massive and complex challenge.

Other sections of this paper\textsuperscript{135} have already discussed a number of joint international initiatives addressing both indoor and outdoor air qualities, which will not be repeated here. Instead, this section will mention a few additional initiatives that focus on indoor air quality, followed by a detailed review of one of the biggest sources of indoor air particulate matter – environmental tobacco smoke.

#### 8.5.3.1 Canada

The 1987 Canadian Residential Indoor Air Quality Guidelines developed by the Federal/Provincial Advisory Committee on Environmental and Occupational Health (CEOH) include a number of technical standards for a range of chemicals. In addition, the guidelines

\textsuperscript{134} Comparable data are not available for Canada (because there is no national childhood poisoning reporting system).

\textsuperscript{135} See 2.3.2 and 5.2.3.1
provide practical qualitative advice on how to control the level of exposures to the various classes of substances of concern (Health Canada, 1987).

The Healthy Indoors Partnership is a multi-sectoral, not-for-profit organization created to foster cooperation and communication among organizations and individuals who want to improve indoor air quality for Canadians. Partners include federal government departments, non-government organizations, academics, industry, and consumer groups (Healthy Indoors Partnership, 2006). Another noteworthy Canadian initiative is the Indoor Air Quality Tools for Schools Action Kit designed to help school principals and administrators identify and address indoor air quality problems (Health Canada, 2003b).

8.5.3.2 United States

Although no U.S. federal law or agency specifically protects indoor air environments, a range of other legislation addresses specific hazards and together help control the risks. For example, the *Superfund Amendments and Reauthorization Act, 1986* (SARA) and the *Safe Drinking Water Act, 1974* (SDWA), refer to indoor air in the context of radon, while other specific substances are regulated pursuant to the *Toxic Substances Control Act* (TSCA).

The US EPA has also implemented a program on Indoor Air Quality and Tools for Schools (U.S. Environmental Protection Agency, 2006b) to help communities and professionals integrate good indoor air quality practices into the design, construction, renovation, and operation and maintenance of school facilities.
8.5.4 Indoor Air Pollution Exposure Pathway: Environmental Tobacco Smoke (ETS)

Other sections of this report\(^\text{136}\) made reference to the provisions of the Canadian Tobacco Act, Canadian municipal smoke-free bylaws, and the European Commission tobacco control legislation. The Non-smokers’ Health Act R.S., 1985, c. 15 (4th Supp.) is also worthy of mention in passing, as it regulated smoking in the federal workplace and on common carriers.

The rest of this case study on indoor air pollution will focus on a single document: the WHO Framework Convention on Tobacco Control (the “Convention”). Its historic significance as the first treaty negotiated through the auspices of the WHO, as well as its legally binding nature, justify this special attention. It is destined to shape the future development of ETS risk management programs internationally (World Health Organisation, 2003). See Table A8.8 for an analysis of the Convention. The following text provides additional commentary to supplement the information provided in the Table.

The WHO treaty came into effect in 2005 and is legally binding on Canada as one of its ratifying parties. Its first guiding principle incorporates two fundamental pillars: every person should be informed of the risks of exposure to tobacco smoke, and public authorities at all levels should act to protect all persons from exposure to tobacco smoke. It should be noted that the Convention mentions the need to restrict children’s direct use of tobacco and specifies that gender-specific risks should be taken into account (e.g. pregnant women). However, the Convention is silent as to any special risks to children from exposure to environmental tobacco smoke.

\(^{136}\) See 4.1.10, 4.3.1, 5.2.3.7
While the US government has been criticized (American Lung Association, 2005) for not having ratified the Convention, it has supported environmental tobacco smoke reduction in other ways. The Centers for Disease Control and Prevention provide an online guide to Best Practices for Comprehensive Tobacco Control Programs that offers detailed advice on programming options at the state or local level (Centers for Disease Control and Prevention, 1999).

Meanwhile, the US EPA has initiated a Smoke-Free Homes campaign, urging parents to protect their children’s health by keeping their homes smoke-free (U.S. Environmental Protection Agency, 2006c).

While public health advocates may be optimistic that they will soon win the war against tobacco, it is sobering to remember that the battles began back in 1964 with the release of the landmark Surgeon General’s report – almost forty years prior to the signing of this Convention (Centers for Disease Control and Prevention, 2004). While there may have been legitimate debate over the health risk assessments in those early years, the weight of evidence soon grew overwhelming as to the myriad of adverse health effects caused by smoking, and - more recently – ETS. And yet, though the situation passed the threshold for instituting precautionary measures many years ago, effective risk control is still on the agenda. This history does not bode well for the time horizons we should expect before we effectively grapple with new and emerging grave risks, such as endocrine disrupting chemicals, for which we have just begun to scratch the surface of understanding.

8.6 Outdoor Air Pollution

8.6.1 Introduction
Most people in developed countries are chronically exposed to outdoor air pollutants from fossil fuel combustion, mainly vehicular and industrial emissions. During the severe 1952 London smog episode\textsuperscript{137}, most of the 4,000 excess deaths involved elderly persons but death rates doubled among young children. This incident led to the 1956 U.K. \textit{Clean Air Act} while concern over urban smog led to the 1970 U.S. \textit{Clean Air Act}.

The U.S. EPA defined two major outdoor air pollutant categories:

- \textbf{Criteria air pollutants} – carbon monoxide (CO), nitrogen dioxide (NO\textsubscript{2}), sulphur dioxide (SO\textsubscript{2}), particulate matter (PM), lead and ozone. These are all clearly recognized human health threats.

- \textbf{Hazardous air pollutants}\textsuperscript{138} – this group comprises 188 substances reasonably expected to cause serious health effects and under review for establishment of emission standards.

Motor vehicles produce most of the CO, NO\textsubscript{2} and VOCs in ambient urban air. In general, diesel fuel and coal combustion, respectively, are the major sources of ambient air PM\textsubscript{2.5} and SO\textsubscript{2}. Photochemical smog comprises pollutants formed when atmospheric nitrogen oxides and VOCs undergo photochemical reactions in sunlight, creating a brown haze. Smog pollutants include ozone, NO\textsubscript{2}, peroxyacetyl nitrate, aldehydes\textsuperscript{139} and other toxicants.

Smog-forming reactions can take place while polluted air masses move long distances, sometimes creating more severe smog at sites remote from the sources of precursor air pollutants. During calm summer weather, with warm air trapped near the ground by colder overlying air (temperature inversions), smog severity can increase over periods of several days to

\textsuperscript{137} Caused mainly by widespread use of low-grade coal for home heating and weather conditions (inversion).
\textsuperscript{138} Hazardous air pollutants include VOCs (e.g., benzene, perchlorethylene, methylene chloride, benzene, toluene) and other toxicants (e.g., dioxin, asbestos, cadmium, mercury, chromium).
\textsuperscript{139} Peroxyacetyl nitrate and aldehydes contribute to eye and respiratory tract irritation.
levels exceeding health-based air standards. Although VOC emissions per vehicle-mile have decreased substantially because of technologic advances (engine efficiency, catalytic converters, fuel oxidants), total VOC emissions have increased mainly because of greatly increased numbers of vehicles.

Compared to adults, children breathe more air per unit body weight at rest and may spend more time outdoors\(^{140}\) and have greater activity levels, especially during summer afternoon hours when ozone concentrations are highest. In 2002, almost 150 million Americans lived in areas that did not meet national primary or secondary ambient air quality standards for at least one criteria air pollutant (ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, lead)\(^{141}\) (U.S. Environmental Protection Agency, 2003).

### 8.6.2 Known and Possible Health Effects

Although concentrations of individual toxic chemicals in ambient air are highly correlated, impressive evidence links each of the major air pollutants to respiratory and other health effects in children who are vulnerable because lung growth and development continues through childhood to adolescence (California Environmental Protection Agency 2000; Shannon et al., 2004; Leech et al., 1996).

#### 8.6.2.1 Adverse Pregnancy Outcomes

\(^{140}\) Adults spend more time in motor vehicles than do children.

\(^{141}\) Comparable Canadian data are not available.
Preterm birth and SGA have been linked to prenatal maternal exposure to ambient air pollutants (Binkova et al., 2004; Glinianaia et al., 2004a). Exposure indices included measurements of gaseous or particulate contaminants in maternal personal air\textsuperscript{142} or ambient air samples near the maternal residence during pregnancy. Two studies have reported links between cardiac birth defects and CO, PM, SO$_2$ or ozone levels near the maternal residence during the 1$^{st}$ trimester (Gilboa et al., 2005; Ritz et al., 2002).

8.6.2.2 Respiratory Outcomes

Known effects of air pollution episodes or controlled short-term exposure to air toxicants include transient lung function deficits, increased asthma severity and lower respiratory infections including postneonatal respiratory deaths (Binkova et al., 2004; Teague and Bayer, 2001; Ward and Ayres, 2004). Chronic exposure to ambient air pollution during childhood can produce lung function growth deficits (Binkova et al., 2004). Childhood air pollution exposure has also been linked to incident asthma (Binkova et al., 2004; Schwartz, 2004; Shannon et al., 2004) and to middle ear infections (Heinrich and Raghuyamshi, 2004). At concentrations below the EPA air standard (80 ppb), ozone may cause short-term lung function deficits and increased risk of respiratory illnesses including asthma episodes severe enough to require medical attention (Binkova et al., 2004). Chronic ozone exposure during early childhood may cause reduced lung function growth (Shannon et al., 2004).

8.6.2.3 Cancer

\textsuperscript{142} Measured using personal dosimeters
The few epidemiologic studies of childhood cancer and ambient air pollution have generally been small and used crude exposure measures. In three recent studies, childhood leukemia was associated with hazardous air pollutant scores (based on carcinogenicity of 25 air contaminants), estimated benzene levels in ambient air near children’s homes or duration of childhood residence on properties adjacent to gasoline stations or car repair facilities (Crosignani et al., 2004; Reynolds et al., 2003; Steffen et al., 2004). Childhood leukemia/lymphoma has also been linked to paternal occupational exposure to motor vehicles emissions and solvents (Olshan and van Wijngaarden, 2003).

8.6.2.4 Other Health Effects

Reviewers found limited evidence for a link between sudden infant death syndrome (SIDS) and postnatal exposure to outdoor air pollution (Glinianaia et al., 2004b). A recent study found an association between SIDS and average annual PM$_{10}$ levels exceeding 12 µg/m$^3$ near the maternal residence (Kaiser et al., 2004).

8.6.3 International Context

As mentioned above with respect to indoor air pollution, outdoor air pollution can be considered relevant to virtually all the other case studies that largely focused on distinct hazards rather than the cumulative effect of many in one media.

Earlier sections canvassed several governance and policy documents from the national and international landscape that grapple with air pollution generally, including the Minister’s
powers under CEPA to take action against international air pollution, the Health Canada/Environment Canada/USEPA Children’s Air Pollution Health Effects Research program, the WHO/Europe AIQ Air Quality Programme, National Pollutant Release Inventory, the CAFE Initiative, and others. The following lists additional instruments that pertain to outdoor air quality.

**8.6.3.1 Convention on Long-Range Transboundary Air Pollution (LRTAP)**

The 1979 Convention on Long-Range Transboundary Air Pollution (LRTAP) has been adopted by fifty States, including Canada. It has been extended by a subsequent series of eight protocols that describe specific actions recommended to cut specific types of emissions such as heavy metals, persistant organic pollutants, and volatile organic compounds (United Nations Economic Commission for Europe, 1979).

**8.6.3.2 European Union**

The European Commission’s Directive 96/61/EC (Europa, 1996) provides an integrated pollution prevention and control (IPPC) strategy designed to address air, water, and land pollution. Its approach is to assess the environmental performance of an industrial plant as a whole to ensure a high level of protection.

**8.6.3.3 United States**
The U.S. *Clean Air Act* regulates air emissions from area, stationary, and mobile sources and authorized the U.S. EPA to establish National Ambient Air Quality Standards (NAAQS). In 1990, the *Clean Air Act* was amended to address air pollution problems such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics. Provisions were included for interstate commissions on air pollution control to develop regional air pollution strategies and reduce interstate as well as international air pollution. A permit program for large releases was introduced and realistic deadlines for pollution reduction were set (U.S. Environmental Protection Agency, 2006d).

8.6.3.4 Canada

In Canada, National Ambient Air Quality Objectives (NAAQOs) identify benchmark levels of protection and guide federal/provincial/territorial and regional governments in making risk management decisions related to air quality. NAAQOs are mainly effects-based but also consider technological, economic and societal information. As provincial governments have primary jurisdiction over many aspects of air pollution control, they are largely voluntary, not mandatory (Health Canada, 1994).

8.6.4 Detailed Review of Exposure Pathway

8.6.4.1 *Outdoor Air Pollution Exposure Pathway: Motor Vehicle Fuels and Emissions*
Both fuel properties and vehicular properties affect the type and extent of release of airborne pollutants from motor vehicle operation. Canada’s regulations on fuel and vehicle emissions were outlined in an earlier section. Given the importance of this source contributor to air pollution, combined with the importance of consumer market behaviour, those regulations were the subject of further examination in Table A8.9 (Appendix 8). The following text provides additional commentary to supplement the information provided in the Table.

As the US regulations for vehicle emission standards and fuel standards are now comparable to Canadian standards, they have not been examined during this review. The “convergence” rather than harmonization approach used with respect to US/Canada fuel regulation seems to be welcome as a means of achieving comparable standards that are still adaptable to each particular national context (Environment Canada, 2003).

The international movement to phase out lead from gasoline can be declared a public health victory from which important lessons could be gleaned for action on other pollutants. Post-hoc reviews of the lead phase-out have identified a number of effective techniques, including collaboration with industry, ensuring appropriate economic incentives at the consumer level occur during the phaseout period, and a short phaseout period to minimize the burden of a dual-track system. Timing of implementation, however, may be limited by the industry’s ability to institute any technical changes required, such as adding catalytic converters to new vehicles (Organisation for Economic Co-operation and Development, 1999a).

Part of the challenge is the continued presence of older vehicles on the road that do not conform to the newer, more fuel-efficient norms. Mechanisms employed to address this issue include inspection and maintenance, retrofit, accelerated retirement (scrapage), import restrictions, and alternative fuel conversions. However, such programs require careful design
and implementation to be successful (Organisation for Economic Co-operation and Development, 1999b).

Until January 1, 2008, the use of leaded gasoline is still permitted for “competition vehicles” in Canada, being vehicles or boats used exclusively in competition at identifiable events or locations. However, the potential for children to suffer exposures to vehicle emissions at competition locations does not seem to be taken into account nor controlled. Consideration should be given to mandating restrictions or warnings of health risks to children at vehicle competition venues. Indoor venues should be of particular concern regardless of fuel type, as air quality monitoring tests show that carbon monoxide levels can well exceed tolerable limits (Lévesque et al., 2000). Consider also whether sufficient incentives and targets are in place to ensure that boat, truck and agricultural machinery manufacturers are working to develop engines that are not lead-dependent as soon as possible.

Canada has not yet taken advantage of its statutory authority to develop an emissions credit scheme to encourage manufacturers to strive for better-than-minimum emission standards. While it would appear that public demand for better environmental performance may provide some economic reward through market activity, formal incentives could accelerate both the adoption and development of even better technologies.

On October 19, 2006, the Canadian government announced its intent to enact a new Clean Air Act, but that recent development is beyond the scope of this paper.

8.7 Lessons Learned from the Case Studies
Earlier subsections of this section have identified a few specific opportunities to reconsider Canada’s approach to the management of certain hazards, particularly as they pertain to children’s health. This section draws together a number of those examples to comment on the risk management approaches used in a more general way.

8.7.1 Risk Communication

Several suggestions for improvement related to the issue of risk communication, and specifically Canada’s seemingly heavy reliance on communicating with the general public rather than communicating specific risks to specific audiences in an as-and-when-needed approach. For example, governments could require or encourage predator fish vendors to include mercury risk information on consumer package labels rather than assume that the public advisory would have come to the attention of, and be remembered by, the family grocery shopper when it is time to plan dinner. Similarly, governments could warn home renovators of lead paint risks in a timely way by communicating the risks to them at the home renovation supply shop, yet this does not appear to be part of the risk communication strategy. It may well be that this generalized communication approach is a consequence of jurisdictional aspects of these issues, but such hurdles could be overcome by vertical integration of communication strategies.

Better risk communication at the consumer level can result in collateral benefits, since fully informed buyers may well honour ‘buyer beware’ advice and opt for lower risk alternatives. Although industry may fiercely resist mandatory warnings of a precautionary nature, once instituted the warnings could increase consumer demand for lower-risk products thus motivating industry to quickly adapt to serve that new demand. For example, if the recent surge in consumer
demand for organic foods was driven in part by consumers’ concerns about health risks of pesticide residues, then better public or point-of-sale education on other products could inspire a shift in consumer demand, and a more rapid response from industry, than a regulatory approach alone.

### 8.7.2 Remediation and Remobilization of Hazardous Substances

Several exposure pathways of concern result from releases or use of hazardous substances that occurred in years past. Such situations raise inherent weaknesses, as they are beyond the reach of ordinary pre-market control mechanisms and often beyond identification of the contributing sources be they a specific product, company, or even the industry group. Even if the originator(s) of the hazard could be identified, they may have little current incentive to remediate the situation since their involvement in the sale/emission has long since past. Although mechanisms that ensure manufacturers remain responsible throughout a product’s life cycle are useful where practicable, governments should also consider opportunities to control the remediation/remobilization activities themselves, as the US did when regulating the renovation of homes with leaded paint.

### 8.7.3 Separate the Children from the Exposures

In some instances, precautionary measures have involved the establishment of barriers to keep children away from the risk of exposure, such as the recommendation that dentists avoid using mercury-containing fillings for young children. This could take the form of ensuring that
children are kept away from high-risk areas (e.g. indoor motor vehicle competition venues), or ensuring that children’s environments are closely protected and monitored (e.g. schools). In that regard, while some regulations take that approach with respect to the school environment, it is not clear whether the now-extensive network of government, nonprofit, and private day care facilities are subject to the same level of scrutiny and protection.

8.7.4 Stakeholder Engagement

The most striking example of the benefits of building a consensus approach with industry is seen when comparing the Canadian and US approaches to the dental amalgam question. Canada developed a consensus position that did not appear to generate much controversy, yet results in improved environmental measures and precautionary health measures. In contrast, the US dental profession’s resistance to yield to public concerns seems to have simply extended and inflamed the debate. It is impossible to draw conclusions about the consensus-building issues on either side without knowing their respective political and economic contexts. However, one could speculate that by now, all the costs borne by the US in being “right” (conducting study after study to justify why they uphold the WHO consensus position) might outweigh the presumed benefits gained.

While it may be impossible to develop a consensus position with industry in some cases (e.g. tobacco), in most cases it should be possible to find areas of common ground.

8.7.5 Precaution, in Hindsight
It should be recognized that several of the hazards of ongoing concern for children’s health result from hindsight appreciation of the considerable risks posed by products and emissions from products and activities from the past. Hindsight regrets might include the widespread use of lead and mercury, the under-appreciation of the potential adverse health effects from pesticides and other chemicals, and the inability to control or predict the cumulative health and environmental consequences of our combined activities. Further research could deepen our understanding of how and when the precautionary principle should be applied by comparing the original benefits, adverse effects, and remediation costs of an ‘old’ hazard with a hypothetical calculation of what might have happened if a more precautionary approach had been applied to that hazard at the outset.
9 EVALUATION AND ASSESSMENT

9.1 Evaluation of Instruments

The evaluation of instruments for environmental protection, however fundamental the need for such a process, is a challenging, controversial and comparatively new form of analysis. The introduction of children’s health to the mix adds a further level of complexity.

While this report has documented the particular vulnerability of children to adverse environmental health impacts, and has surveyed some of the possible responses – both domestic and with reference to other jurisdictions – it does not identify an ideal instrument. Indeed, as indicated in the discussion of instrument choice, there is an increasing tendency within the policy-making constituency to acknowledge the importance of an appropriate mix of instruments to further or achieve the relevant policy goal. Generally, but with some exceptions, the policy goal is environmental protection overall, rather than children’s environmental health, although the latter may serve as an important motivating consideration.

Pathways of environmental exposure for children, as the case studies indicate, may be various and cumulative. In addition, impacts may be affected by a range of “development windows.” For these reasons, responses to children’s environmental health risks presents challenges that differ substantially from efforts that might be directed at the environmental protection of workers whose exposures are understood to occur in the more confined circumstances of their place of employment. The fact that children’s environmental health is generally safeguarded through the regular mix of environmental policy instruments operating in a given jurisdiction (perhaps with some adjustments for their distinctive vulnerabilities) means
that whatever evaluation of those general instruments is available largely serves as proxy or surrogate for evaluating their effectiveness from a children’s environmental health perspective.

The evaluation of environmental protection instruments should ordinarily be carried out with reference to the purpose or goal which they were intended to serve, and with reference to relevant and available evidence of their effectiveness. It is often the case, however, that environmental instruments – especially of a constitutional or legislative nature, are intended to fulfill only loosely defined objectives such as the betterment of the environment, environmental quality, or sustainability.

For some time, the effort to evaluate environmental protection measures against such general standards has been limited. Instead, the effectiveness of environmental instruments and the agencies that administer them has been evaluated from the perspective of “outputs.” Conventional reporting has typically included data on numbers of inspections, warnings, prosecutions, and convictions, for example. These, it will be seen, offer insights into levels of compliance and enforcement activity without reference to the environmental consequences or effects of that activity. The emerging objective, however, is for such agencies to move closer to a set of environmental indicators that resemble substantive “outcomes” rather than agency “outputs.” Total reduction in contaminant emissions, or air quality records are among representative “output” measures. While understood to be more useful and valuable, there is still much to be accomplished in terms of “outcomes” data.

143 This has not, however, precluded litigation intended to enforce such standards. See, for example, Carl Bruch, Wole Coker, and Chris VanArsdale, “Constitutional Environmental Law: Giving Force to Fundamental Principles in Africa,” (2001) 26 Columbia Journal of Environmental Law 131.
144 Annual reports on the operations of CEPA, 1999 and corresponding provincial legislation typically provide such indicators.
Even where a more precisely formulated instrument is under consideration, a regulation calling for reduction in the discharge to water of a particular substance, for example, evaluation of the instrument is not straightforward. Generally, evaluation has focused on some measurable factors. From an administrative perspective, these might include levels of compliance. How many, or what percentage, of those subject to the regulation comply with the behaviour called for by the instrument. For some time, this form of assessment has served as a surrogate for underlying, but more difficult to measure goals.

To the extent that the Canadian regulatory experience broadly mirrors a recent synthesis of regulatory evolution within the OECD community, it is appropriate to observe that:

“In the 1990s the focus of regulatory reform at OECD has turned from deregulation to regulatory quality management – improving the efficiency, flexibility, simplicity and effectiveness of individual regulations and non-regulatory instruments. Regulatory reform is now entering a third phase – the management of regulation – to improve the total impact of regulatory systems in achieving their social and economic goals.”

This objective ultimately rests on the capacity of the regulatory framework to encourage compliance or behaviour that conforms with regulatory expectations. Insistence on the importance of behaviour and compliance is now central to regulatory decision-making and the choice of governing instrument. An OECD study entitled “Reducing the Risk of Policy Failure: Challenges for Regulatory Compliance,” asserts firmly:

“The traditional regulatory approach of establishing standards of behaviour and legal enforcement mechanisms is not the sole means for governments to influence the behaviour of citizens and enterprises and may not be the most effective. In order to achieve regulatory objectives, regulatory policymakers need a clear understanding of the nature of different policy...

instruments, of the habits of the regulated target group, and of the regulatory context, to achieve regulatory objectives.”¹⁴⁷

An important and influential analysis for the Dutch Ministry of Justice further underlines the centrality of behavioural and compliance objectives in a range of settings rather than in relation to environment or health:

“The government wants to make changes to society by influencing the behaviour of citizens and businesses. One of the policy tools, which the government can use to achieve this, is legislation. … Legislation, however, also assumes some level of compliance with it by the target group. Non-compliance decreases the chance of realizing the policy objective.”¹⁴⁸

As a field of specialized inquiry regulatory compliance is substantially broader in scope than the associated subject of enforcement discussed further below. Many factors influence compliance under regulatory schemes. Compliance rates may be as adversely affected by a confusing legislative mandate as by poor enforcement practices—or by any number of socio-psychological, sociological or criminological factors across the entire spectrum of regulatory activity. From preliminary consultations, through draft legislation to program implementation, compliance promotion, monitoring, inspection and eventual enforcement actions, consideration must be given to at least this range of influences on the effectiveness of regulation.

The current view of the pre-conditions and components of a successful regulatory compliance and enforcement program is the product of numerous multi-disciplinary studies, supplemented by general views and practical experience in the field of law enforcement. Despite many different formulations of the accumulated wisdom by modern regulators in western democratic countries, there is a surprising degree of unanimity on the key factors. It is important,

¹⁴⁷ Ibid., 5
¹⁴⁸ The Table of Eleven (November 2004) 4
for example, to identify viable means of promoting compliance on a voluntary basis. Monitoring, inspection and surveillance procedures are also needed, as well as the capacity to respond systematically and appropriately to non-compliant behaviour.

Designing an effective regulatory regime including an effective compliance and enforcement program, necessarily involves several steps, including the need to:
- identify the compliance problem or regulatory objective to be achieved.
- determine the underlying causes of the problem to be addressed including the reasons for real or anticipated non-compliance.
- evaluate the responses (including the range of legal instruments) available to address objective to be achieved.
- select and design (according to relevant criteria) the regulatory instruments or programs to be pursued
- implement and refine as necessary the instrument or instruments selected on the basis of sound management principles.

The Dutch Ministry of Justice, in a document known as the “Table of Eleven,” has elaborated upon factors that affect compliance with legislation along the following lines.
1. Knowledge: the selected instrument or instruments must be understood with sufficient clarity to minimize unintentional non-compliance.
2. Cost-Benefit: the group targeted for regulatory compliance must be encouraged to do so on the basis of such considerations as time, money, resources and reputational impacts.
3. Level of Acceptance of the Regulatory Scheme: the objective and the form of law, regulation or policy instrument must be recognized as reasonable so as to promote wide acceptance on the part of the target group.
4. Loyalty and Obedience of the Target Group: this can be encouraged by assuring those willing to comply that poor performers will be dealt with effectively by regulatory officials.

5. Social Controls / Peer Pressure: these forces can promote compliance where it is understood that regulatory objectives are consistent with community standards and values, and where competitors will accordingly be willing to exert informal controls.

6. Informal Reporting of Violations: opportunities for external verification or third party reporting independent of government authority can also enhance compliance.

7. Likelihood of Detection: compliance is encouraged by the likelihood, or perceived likelihood that violations will be detected.

8. Probability of Official Response: The expectation that non-compliance will be the subject of follow-up action by authorities increases compliance levels.

9. Selectivity: Regulatory targeting of those likely to violate the rules addresses a disinclination on their part to comply.

10. Probability of Sanction: Where violations of regulatory norms are likely to be met with administrative, civil or criminal sanctions, compliance is promoted.

11. Severity of Sanction: a graduated scheme of sanctions appropriately linking the severity of violations to the level of sanctions and further accounting for repeat offenders may enhance compliance rates.

This inventory of factors affecting compliance serves to provide some explanation for behaviour that conforms to regulatory expectations. Sometimes compliance results from good citizenship; sometimes from elements of self-interest (a desire to avoid reputational losses for being off-side); or from fear of liability or prosecution. This latter consideration is linked directly to the matter of enforcement: what measures are in place to promote or compel compliance
through sanctions, penalties or other incentives. This matter is of fundamental importance to the
evaluation of any given instrument. If it is simply “law on the books” rather than law in practice
or law put into operation, the instrument itself cannot be directly evaluated for the simple reason
that it has not actually been put to the test.

Forms of enforcement are themselves subject to evaluation and debate. In some
jurisdictions this is associated with direct enforcement initiatives on the part of regulatory
officials. Elsewhere, with the United States as a principal example, public interest litigation plays
a central role. Citizen enforcement might involve litigation directed against individuals or
organizations who may have violated regulatory standards, or it may in some circumstances be
channelled through actions against government officials that are intended to increase the
regulatory enforcement effort itself.149

Whether a “satisfactory” level of compliance – however it is achieved - results in other
desired effects being demonstrated depends on several additional considerations. In the case of
environmental protection measures expected to safeguard children’s health a number of factors
are directly relevant. Have regulators, for example, appropriately assessed and responded to risks
from exposure to a particular substance? Where they have failed to do so, it is possible that the
intended level of environmental protection will have been achieved while vulnerability persists.
Has reliable baseline information been assembled such that adverse effects before and after the
introduction of a regulatory response may be compared with confidence? If reliable baseline data
are unavailable, or if standards of detection increase significantly over time, one may face
difficulty in evaluating its performance150. Or where domestic sources and transboundary sources

149 Barton H. Thompson, Jr. “Symposium: Innovations in Environmental Policy: The Continuing Innovation of
150 It is to be acknowledged that detection of changes in the incidence of effects in human populations may not
always be possible, for example, where restrictions have been imposed on new chemicals prior to their introduction
of some relevant contaminant operate simultaneously, a very effective domestic instrument may not produce the necessary or desired level of environmental health protection. Such considerations may provide some insight into the observations of experts interviewed in the course of this report that data are lacking and an integrated effort is essential to address children’s environmental health.

To consider the utility in Canada of legal instruments and initiatives from other jurisdictions such as Europe and the United States calls for an understanding of the context within which those instruments operate. In the European Union, where children’s health has encouraged the formulation of a number of initiatives as noted in case studies and elsewhere in this report, directives and regulations have distinctive status. Even if we were confident that some particular instrument operating in the European context was proving to be effective in achieving a given objective, it by no means follows that such an instrument or its language would be equally effective in the entirely different constitutional, legal and institutional context of Canada.

Thus, an effective path forward for protecting children’s environmental health would appear to require an approach involving a mix of instruments that takes into account the distinct characteristics of Canada’s administrative frameworks and environmental factors. However, it should perhaps also be borne in mind that considerations of economics and trade are leading countries, notably member states of the Organization for Economic Cooperation and Development, to strive towards harmonizing approaches for addressing environmental pollution and controlling toxic chemicals thereby impacting on how regulatory instruments are to be

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into the market place, or where controls have been imposed based on effects detected in laboratory testing regimes. This is not to say that attempts to find ways to monitor progress or effectiveness should not be undertaken in such instances.
crafted and implemented. Ways are needed to ensure that instruments developed are assessed for effectiveness on an ongoing basis that lends themselves to adaptation, modification, upgrading or abandonment as indications of effectiveness become more reliable.

9.2 Assessment

This report has assembled a range of information associated with policy development in the field of children’s environmental health. It includes, in particular, a review of scientific materials summarizing and documenting current knowledge of the distinctive impacts of environmental exposures on children at various stages of development. The report also presents the findings of an extensive process of literature review, documentary analysis and interviewing intended to illuminate aspects of popular and professional attitudes towards and understanding of children’s environmental health issues and the policy instruments, including regulatory measures available to respond. The primary legislative and regulatory measures of potential relevance to children’s environmental health were surveyed, and case studies illustrating the state of knowledge concerning selected children’s environmental health risks and the policy responses in place to address them was presented. In addition, the report provides an overview of instrument choice in the children’s environmental health field, including reference to matters of implementation, inter-governmental and inter-departmental organization, and capacity. Comparative reference was made to the experience of other jurisdictions with children’s environmental health protection.

In so far as the legal perspective is concerned, it is clear that explicit references to children’s environmental health are rare in Canadian federal legislation and regulation. Certain
regulations under the *Hazardous Products Act* and recent amendments to the *Pest Control Products Act* – while not yet in force – are notable exceptions. Other jurisdictions, by comparison, have demonstrated more direct support for children’s environmental health in legislative arrangements, with the U.S. *FQPA* the most prominent of these examples.

Explicit reference to children’s environmental health is by no means a precondition to programs, policies and other initiatives. This is clear from the range of such measures and institutional arrangements that have been undertaken in a range of settings. The POPs Convention and the CEC’s children’s environmental health initiative are example at the international level. The Working Group on Children’s Environmental Health involving PMRA alongside representatives of federal natural resource departments illustrates the possibility of inter-departmental measures, while the variety of steps taken to pursue research on children’s environmental health as discussed in case studies makes clear that this focus is not precluded by the absence of a specific mandate or direction embodied in legislative authority.

The present report has made no systematic attempt to assess the comparative effectiveness of systems in which children’s environmental health has been legislatively designated for priority and those in which the basis of related initiatives must be found in professional concern and public awareness. Nevertheless, one may note expressions of frustration on the part of those concerned with health and environment in Canada generally, and children’s environmental health in particular to the effect that the importance of children’s environmental health is not as clearly affirmed as one would wish. The concern for priorities is reflected, for example, in the mission of the Canadian Partnership for Children’s Health and the Environment, which is, “to protect children’s health from environmental exposures by moving children’s environmental health issues into the minds of decision-makers, caregivers and the
public.” A consortium of non-governmental organizations has drawn attention to the desirability of directing more explicit attention to the problems arising from the exposure of children to environmental risk by asking in a recent submission how CEPA, 1999 “can… effectively protect children’s environmental health and other vulnerable communities.”

In addition to measures available to emphasize the particular environmental risks to which children may be exposed as a result of environmental contamination, it is also essential to remind ourselves that by strengthening a series of existing strategies and approaches much can be done to safeguard children alongside the general population. Pollution prevention is a vital strategy in this regard, and might well be re-enforced on the basis of its capacity to reduce childhood exposures and the distinctive risks these entail for future generations of Canadians. Precautionary decision-making, too, is at the heart of a fundamental commitment on the part of Canadian decision-makers to sustainable development, which equally promises a more environmentally safe and secure future for our children. More mundane, perhaps, and often troublesome from the perspective of financial responsibility, is the question of remediation of environments that are already contaminated and which continue to present risks to neighbouring and more distant communities, including children. None of these measures – prevention, precaution, and remediation – is statutorily precluded by existing legislative arrangements. But a renewed and enhanced commitment to each of these offers opportunities to safeguard children’s environmental health alongside certain further initiatives which are noted in the conclusion to this report.

Experts when interviewed regardless of background usually identified the need for increased monitoring to establish base-line levels of environmental toxicants in children.
Currently, biomonitoring data of various samples all show trace indications of exposure to environmental contaminants for children.

Heavy metals in the environment such as lead and mercury, indoor and outdoor air pollutants, some pesticides, organic solvents, and persistent organic pollutants (such as dioxins, PCBs and PBDEs and phthalates) have all been found in the bodies of children in areas when tested. The long-term impacts either individually or synergistically of these chemical exposures to children is currently unknown (Toronto Public Health, 2005).

There was strong agreement from experts in all jurisdictions that evaluation of previous and ongoing children’s environmental health instruments, whether legislation, regulations, voluntary codes, education or other communications based strategies were difficult to assess. Experts were in consensus that the lack of biomonitoring makes evaluating any intervention or implemented policy initially put in place to improve children’s environmental health nearly an impossible task. Without such an evidence based evaluation for a children’s environmental health the risk issues that have characteristics of occurring over a long time period, and are multi-factorial turns decision making largely a normative or arbitrary exercise.

Similarly, respondents indicated that educational programs could be evaluated by surveys that attempt to measure information uptake by the public. Surveys could be employed to measure communications based strategies to measure behavioural changes.

Whatever new policy approach is adopted it must be applied to the enormous number of substances in commercial use, or from industrial emissions that have never been fully evaluated for toxicity during prenatal and childhood life stages. A high degree of uncertainty, multiple confounding factors and long-term impacts complicate policy evaluation. While children’s environmental health is included in many risk assessments they should be placed in the center of
the risk assessment process, if scientific evidence supports children as a vulnerable group levels should be set for them shifting the existing risk assessment paradigms to become child-focused.

Great gaps in basic knowledge and data about children exist. Experts consistently emphasized that there should be increased funding for biomonitoring, longitudinal studies, research and data collection. A need to establish comprehensive surveillance programs to better understand exposure trends and health risks, and expand public education and outreach are needed. Future research and study needs must focus on several areas. Children may be exposed to toxicants in greater amounts depending on their developmental window. There is a need to gather additional and better basic information on what substances children are exposed to and the extent of their exposure. The best way to evaluate children's increased susceptibility to toxicants developmentally is to use longitudinal studies of children that include epidemiological and clinical studies (Children's Environmental Health Network, 1997; Stroebel, 1998).

Reviewing chosen policy decisions by evaluation is an important tool that can help governmental policy makers improve efficacy for children's environmental health programs. Reiterative policy and evaluation could improve children’s environmental health. There is a need for a reiterative process in decision-making involving highly technical policy decisions.

A limitation that confronts policy makers is decision making in the face of uncertainty and using incomplete science risk assessment on which to base policy decisions. Advocates for changing traditional approaches to environmental hazards call for a precautionary approach. In particular, the Privy Council Office has supported the application of a precautionary approach to risk management in Canada. Following the preparation of “A Canadian Perspective on the Precautionary Approach/Principle" (September 2001) the Privy Council Office developed” A
The use of a precautionary approach to risk management decision-making was discussed in detail at a Workshop on *Guiding Public Health Policy in Areas of Scientific Uncertainty* held in Ottawa from July 11-13, 2005, sponsored by the McLaughlin Centre and the World Health Organization. A summary of the workshop proceedings is available at [http://www.who.int/peh-emf/meetings/ottawa_june05/en/index.html](http://www.who.int/peh-emf/meetings/ottawa_june05/en/index.html).

Precaution if needed can be guided by setting priorities for different environmental hazards and comparing them. CEPA requires government to apply the “precautionary principle” such 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. Despite efforts to define and operationalize the precautionary principle in Canada, it has not been fully implemented in important areas of policy and regulation.

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10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Introduction

Several Canadian experts held the position that the health of children in Canada disproportionately is at risk from environmental contaminants with some stages more vulnerable than others. Differential risk is thought to occur at several stages or “windows” during development. The developing fetus, infants and young children up to age three can experience greater exposure and greater vulnerability than adults to substances in the environment. Multiple exposures of uncertain risk occur during pregnancy and continue throughout the course of development and may have a deleterious effect. This opinion was held by experts in other jurisdictions as well.

Scientific evidence does exist for a positive association between environmental hazards and negative child health outcomes including cancer, learning disabilities, behavioural problems, developmental effects, low birth weight and birth defects. There are also indications of additional, equally serious, health effects such as impaired functioning of the immune system and interference with the hormones of the endocrine system from environmental endocrine disrupters. Hundreds of environmental contaminants are suspected of contributing to serious health outcomes in children although only a small number of these contaminants have been fully evaluated for their effects on prenatal and child development. Experts in all jurisdictions surveyed believed that biomonitoring is needed in order to quantify the scope of the problem and to better understand environmental health outcomes linked to exposure levels. Data acquired from biomonitoring should also be available as a shared public resource for researchers,
epidemiologists and others interested in children’s health trends. Currently, not only is the information base about environmental exposures limited, but ongoing testing to establish baseline contamination levels is not in place.

A second area cited mainly by researchers was the lack of adequate funding to pursue research related to children’s environmental health. Experts in children’s environmental health policy also pointed to the lack of political will to invest in research, biomonitoring, database management, longitudinal studies and child-specific program-building despite the need expressed by the public to reduce hazards to children.

All of the experts were in agreement that areas of uncertainty existed and that in some areas there is simply no information to assess many chemical environmental hazards. The vulnerability of the developing fetus, infants and young children stems from a fairly small number of well-studied substances. Older children and adolescents who are much more mobile experience different environmental hazards including smoking, second hand smoke and lifestyle hazards from the built and natural environment.

Difficulties in evaluation of governance and non-governance tools were also indicated. Almost all of the experts indicated that evaluation was a difficult task due to the multivariate nature, longer term and potential synergistic effects that may confound attempts at evaluation. However, in some cases correlations for evaluation were believed to be possible. For example some chemical hazards that are well characterized appeared to lend themselves to evaluation through monitoring programs.

Studies designed to elicit information on risk perception show that children’s environmental health risks are likely viewed with high levels of concern by the public. Such individuals typically mobilize at a municipal level for action on these exposures, through
policies, by-laws, with educational activities and other measures that protect environmental quality. This local action to improve environmental health is reflected by the lack of content linking federal legislation to children’s health as an issue of concern. A search of Canadian newspaper and popular magazine content identified coverage of a number of issues pertaining to children’s environmental health. Risk issues related to pesticides, air pollution, and chemicals in general were found to predominate in both studies. Risk issues that have a large degree of negative perception have usually undergone a process of “social amplification of risk”. Although little direct evidence of worry by the public that these environmental hazards were being poorly managed by the government was found in the newspaper and magazine analysis, the high levels of risk perceived over environmental chemicals found in repeatedly in surveys of the Canadian public suggests that environmental health hazards will likely remain an important risk issue requiring careful and ongoing risk management and communication efforts by the government.

10.2 Recommendations

The U.S. National Research Council (NRC) has reviewed toxicity testing of commercial chemicals and identified major needs to improve developmental and reproductive toxicity testing in order to provide a stronger scientific basis for risk assessment of toxicants that may disrupt pregnancy and child development (National Research Council, 2000; 2001; 2006b). Observations included:
Mechanisms of developmental toxicity: NRC noted that partial knowledge of such mechanisms is available for only a few chemical toxicants and full explanation is available for none.

Few of the major advances in human genomics and developmental biology have been integrated into developmental toxicity testing.

The NRC called for research in developmental toxicology and developmental biology including measures to (1) evaluate chemicals for developmental toxicity, (2) identify mechanisms of developmental toxicity, (3) address several key areas of uncertainty about cross-species extrapolation of toxicity testing information from animals to humans, and, (4) explore gene-environment interactions that may underlie a large fraction of developmental defects and explain human variability in response to environmental agents.

The U.S. EPA recently asked the U.S. National Research Council (NRC) to conduct an independent review of toxicity testing done to meet the needs of federal regulatory agencies and to develop a long-range vision and strategy for such testing (National Research Council, 2006b). The review panel recommended that, (1) all new and existing environmental agents should be evaluated (the intensity and depth of testing should depend on the use of the chemical, the likelihood of human exposure and scientific knowledge gaps), (2) criteria for deciding priorities for testing should include production volumes, exposure patterns and environmental persistence/bioaccumulation, and, (3) tiered testing be considered as it has the advantage of reducing the time needed to meet regulatory needs.

The new European REACH (Registration, Evaluation and Authorization of Chemicals) program may also serve as a model for Canada to consider. The REACH proposal gives greater responsibility to industry to manage the risks from chemicals and to provide safety information
on the substances. Manufacturers and importers will be required to gather information on the properties of their substances, which will help them manage them safely, and to register the information in a central database. A Chemicals Agency will act as the central point in the REACH system: it will run the databases necessary to operate the system, co-ordinate the in-depth evaluation of suspicious chemicals and run a public database in which consumers and professionals can find hazard information. Final adoption of the program is expected by the end of the year 2006.

10.2.1 Research Recommendations

- Whereas there are major knowledge gaps in our understanding of the many relationships between environmental toxicants and human pregnancy and child health outcomes, and,
- Whereas Canada has no system to monitor the exposure of children and reproductive-age adults to environmental contaminants, and,
- Whereas Canada has no national institute for environmental health research, and,
- Whereas Canada had no national capacity for independent toxicity testing of environmental chemicals, and,
- Whereas such knowledge is needed to plan, implement and evaluate intervention programs aimed at reducing harmful exposures and prevention of adverse health effects, and,
- Whereas there is an urgent need for adequate and ongoing support for such research,
It is recommended that a mechanism be established to ensure ongoing support for a national research program\textsuperscript{152} on child health and the environment including:

i. Epidemiology: Infrastructure and major research programs on the relationship between environmental exposures and adverse pregnancy and child health outcomes.

ii. Toxicology: Infrastructure and major research programs on the toxicity of high-priority environmental contaminants on fetal and child health growth and development.

iii. Biomonitoring: Infrastructure for an ongoing national biomonitoring system that includes adults, newborns and children.

\textbf{10.2.2 Operational Recommendations}

There is a need for improved coordination of government activities at the federal level (Environment Canada and Health Canada) and provincial level (Long-Term Care, and Children and Youth Services). There is an urgent need for strong political leadership and clear accountability and resources for children's environmental health at both the federal and provincial level. There must be greater integration across departments where policies and programs can minimize exposure to environmental hazards.

Many European Union child health directives and initiatives apply a public health approach to improve children’s environmental health that is based on a precautionary approach in the absence of evidence of harm. Some municipalities in Canada have also applied the precautionary principle to known environmental health risk issues by passing bylaws to control

\textsuperscript{152} The Toxic Substances Research Initiative (TSRI) can be cited as an example of such a funding mechanism.
cosmetic pesticide use. The level of precaution needed can be guided by setting priorities for
different environmental hazards and comparing them. Exposure risks for hazards may be
preventable requiring a cost to reduction benefit analysis. More serious risks may have the
potential to affect large numbers of children and be associated with serious or irreversible health
effects with long-term consequences. While the precautionary principle already appears in some
Canadian legislation (including CEPA, 1999 and the proposed new Pest Control Products Act),
practical guidance is needed in Canada to assist risk managers in deciding i) when to use
precautionary principle in decision-making; ii) how to build greater public participation in
environmental decision-making; iii) how precautionary decisions should be; and iv) how to
justify the costs associated with precautionary decisions.

Experts consulted during the course of this work suggested moving towards
institutionalizing children’s environmental health at the federal level by establishing a
comprehensive Children's Environmental Health Program to oversee federal resources, research,
biomonitoring initiatives, and to ensure that new policies and regulations for hazards explicitly
consider impacts on children.

Increase funding for biomonitoring, longitudinal studies, and research and data collection
were cited most often as important for improving monitoring. Concomitant with biomonitoring is
the need to establish comprehensive surveillance programs to better understand exposure trends
and health risks, and expand public education and outreach programs for children’s health.

Educational campaigns may be needed to address domestic and school environment
indoor air quality problems. It may also be necessary to disseminate educational resources
through key organizations involved in promoting the health of children including school-based
parent groups, environmental and local community groups and health-care practitioners and organizations (Toronto Public Health, 2005).

Some progress has occurred in terms of revising federal and provincial regulatory approaches to take children’s health into account. These new approaches must be applied to the enormous number of substances in commercial use, or that result from industrial emissions, that have never been fully evaluated for toxicity during prenatal and childhood life stages. Children’s exposure to toxic substances used in consumer products (one of the main exposure sources) should be minimized and labeling and disclosure of ingredients in consumer products are improved. This would require incorporation of precautionary action into the *Hazardous Products Act* and the *Pest Control Products Act*.

Advocates for changing traditional approaches to environmental hazards call for a precautionary approach. This approach speaks directly to the reality of never having absolutely definitive or conclusive evidence of harm. It denotes a duty, on all members of society, to prevent harm, when it is within our power to do so, even when the evidence is uncertain or not readily attainable.

In the same way that children are particularly vulnerable to certain environmental exposures, as this report has demonstrated, children’s environmental health interests are vulnerable to neglect. In order to ensure continuing attention to children’s environmental health in the context of successor legislation to *CEPA, 1999* we recommend:

a. An amendment to the preamble of CEPA that would explicitly recognize children’s distinctive vulnerability to environmental contamination. Such an amendment might take the following form:
“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 including the distinctive risks faced by children (and other vulnerable populations) and social, economic and technical matters are to be considered in that process.”

b. Measures to enhance the status and re-enforce the organizational support for children’s environmental health within Health Canada. The head of this office should hold a position at a level not below that of an executive. As an initial responsibility this agency should carry out an inquiry into the best means to establish a national office of children’s environmental health along the lines of such agencies existing in other jurisdictions. As an additional responsibility, this office should co-ordinate an inquiry across federal legislation to identify and assess areas where an additional margin of safety should be explicitly added to regulatory decision-making in the interests of children.

c. Re-enforcement of inter-departmental mechanisms to maintain a focus on children’s environmental health within an overall program to reduce the exposure of Canadians to environmental contaminants. In addition, we wish to highlight the importance of communication and co-ordination across departments in relation to the range of environmental risks to which children’s health is vulnerable, including risks associated with products containing toxic and hazardous substances whether those products are manufactured domestically or imported.

d. A commitment to ensure stable and ongoing funding and other elements of capacity necessary to pursue research requirements and policy implementation.
A national research program on children’s environmental health could make an important contribution to health protection. One major element of such a research program would be a biomonitoring program associated with risk assessment requirements, both existing and prospective. The importance of biomonitoring was noted several times in the opinions solicited from experts (See, for example, Section 6). Also, the U.S. Committee on Human Biomonitoring for Environmental Toxicants has recently stated that biomonitoring is a tool with great potential, having been “…of value in identifying human exposures to chemicals that pose potential harm to human health, in understanding exposure status and trends, in fostering public health interventions, and in validating environmental-health policies.” (National Research Council, 2006a). While paragraph 45(a) of CEPA-1999 requires, in general terms, the Minister of Health to “conduct research and studies relating to the role of substances in illness or in health problems”, incorporation of a provision requiring the conduct of biomonitoring studies specifically would add impetus to their implementation. It is to be noted, in this context, that the preceeding subsection 44 (1) requires the Ministers to “…conduct research or studies related to hormone disrupting substances, methods related to their detection, methods to determine their actual or likely short-term or long –term effect on the environment and health,………….”

Mechanisms are required to ensure that the research results generated by such a program meet children’s environmental health risk assessment needs and are incorporated within future risk management decisions. Whatever risk management strategies are adopted, their effectiveness should be subject to periodic audit and assessment. Communication and education strategies should also be reviewed and evaluated periodically to ensure their continued effectiveness.
With regard to the toxic substance provisions of CEPA and in relation to biotechnology, consideration should be given to the incorporation of an additional ten-fold margin of safety for environmental agents to which children or pregnant women may be exposed. Such an additional margin of safety is presently included in the US FQPA, 1996, and the PCPA, 2002 currently awaiting implementation. This additional margin of safety would be applied as a default in the absence of evidence to the contrary, showing that extra protection for children’s health is not warranted.

In order to ensure accountability for children’s environmental health protection in Canada, Annual Reporting to parliament should include specific reference to measures taken in relation to children’s environmental health.

Although this report was directed at CEPA and children’s environmental health our investigations have raised concerns about other risks to children such as those posed by the importation of products containing dangerous materials. Nothing in this report should be understood to suggest that such risks are adequately addressed at present. Special measures may be required.
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APPENDIX 1

PROCEEDINGS OF THE WORKSHOP

“HEALTH POLICY APPROACHES TO CHILDREN’S ENVIRONMENTAL HEALTH”
WORKSHOP PROCEEDINGS

Health Policy Approaches to Children’s Environmental Health

Sponsored by

The Faculty of Law and
The McLaughlin Centre for Population Health Risk Assessment

March 31st, 2006
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EXECUTIVE SUMMARY

On March 31st, 2006, the Faculty of Law and The McLaughlin Centre for Population Health Risk Assessment hosted a one-day roundtable workshop entitled Health Policy Approaches to Children’s Environmental Health. Thirty-five people attended including representatives from academia, government, and non-governmental organizations (NGOs). The purpose of the workshop was to: (1) provide an overview of the research approach; (2) engage multiple stakeholders in discussions on children’s environmental health; and (3) to help guide the research team in developing recommendations for Health Canada.

The project objectives are:

- To use international evidence and information on policy options to develop recommendations for the revision and implementation of the Canadian Environmental Protection Act (CEPA), 1999 and the proposed Canada Health Protection Act.
- To use the results of this research to enable policy makers at Health Canada to develop legislation designed to safeguard and protect children from the health impacts of environmental hazards.

The workshop was divided into two sessions. The morning session provided an overview of the research approach and an opportunity for participants to provide input into the scientific approach taken by the research team. The afternoon session provided a forum to discuss policy options for Children’s Health in the context of the Canadian Environmental Protection Act (CEPA), 1999 and the proposed Canada Health Protection Act (CHPA).

At the end of the sessions a summation and provisional conclusion was provided. The focus of the provisional conclusion was the issue of whether it would be appropriate in a legislative forum to articulate explicitly the importance of environmental health of children. The conclusion was – it may not be necessary – it absolutely will not be sufficient – but it very well might be useful. It might be useful in helping to integrate or coordinate or strengthen the wide range of activity that is underway that we have been talking about today whether it is policy making or conducting research or inter-governmental communication. In strengthening that current activity we are giving ourselves a neon sign to point to. It is the neon sign that has great virtue and tie in to the very last comment from our participants today – that neon sign is the key to accountability in the Canadian system of government – which is a combination of law making and allocation of resources to fulfill the objectives of law.
PROJECT OVERVIEW – Dr. Daniel Krewski, The McLaughlin Centre for Population Health Risk Assessment

The goal of the proposed research is to utilize international evidence and information on policy options to develop recommendations for the revision and implementation of the Canadian Environmental Health Act (CEPA), 1999 and the proposed Canada Health Protection Act (CHPA). The results of this research will enable policy makers at Health Canada to develop legislation designed to safeguard and protect children from the health impacts of environmental hazards. International legislation, policy options and risk communication programs will be evaluated to determine how environmental health legislation address both current and potential environmental hazards, how legislation is effectively implemented to protect children’s health and how the precautionary principle is used to guide legislative decisions.

The Project Team was introduced and a brief outline of the research approach was provided.

The Project Team members include:

- **PRINCIPAL INVESTIGATORS**
  - Jamie Benidickson
  - Dr. Daniel Krewski

- **TEAM MEMBERS**
  - Dr. Michael Tyshenko
  - Lorraine Craig
  - Michelle Turner

- **EXPERT PANEL**
  - Dr. Don Wigle
  - Dr. Vic Armstrong
  - John Harrison

PURPOSE AND SCOPE OF THE PROJECT

The proposed research is intended to assist policy makers at Health Canada in utilizing the experience of other jurisdictions to develop and implement legislative and other measures to safeguard children’s health from environmental hazards in the context of revisions to the Canadian Environmental Protection Act (CEPA), 1999 and the proposed Canada Health Protection Act (CHPA). Content analysis of newspapers, internet grey literature and peer-review articles (including legal databases) were used to help select case study examples, provide a short list of names of pertinent Acts and regulations, determine a list of children’s environmental health issues and validate expert opinion interviews. Expert opinion was solicited through interviews targeted to various areas where individuals have experience with governance and non-governance instruments. Analysis using the experiences of other jurisdictions (notably the United States and members of the European Union, and selected international agencies, i.e., World Health Organization) compared to Canada allowed for the determination of risk issues, barriers, facilitators and proven strategies for improving children’s environmental health based on governance and non-governance instruments. This research collectively identified elements of a children’s environmental health protection approach and illustrated variations that have been adopted elsewhere providing a context for Canadian policy makers seeking guidance on revisions for protecting vulnerable groups under CEPA 1999.
THE POLICY PROBLEM: EMERGENCE OF CHILDREN’S HEALTH AS A FOCUS FOR LEGISLATIVE ACTION – Michelle Turner, McLaughlin Centre for Population Health Risk Assessment

The influence of the environment on health status in general has long been recognized. The field of children’s environmental health however, has only begun to emerge more recently. A major stimulus for investments in research into the area was the publication of the National Academy’s *Pesticides in the Diets of Infants and Children* in 1993. The report highlighted that children and adults may experience differential levels of exposure to pesticide residues in food, differential levels of toxicity of pesticides, and proposed a variety of regulatory changes in order to better protect children’s health.

Children’s environmental health issues can range from those for which the weight of the evidence is substantive to others where the scientific basis for an association is limited. Researchers are only beginning to describe the nature of interactions between the environment and other health determinants which may modify the environment-health outcome association such as genetics or social factors. Various studies have estimated the economic and societal costs associated with children’s environmental health disorders to be substantial, in part, due to the interference of normal development with potential serious and irreversible consequences. For example, annual costs associated with the environmental component of childhood lead poisoning, asthma, cancer, and neurobehavioral disorders in the U.S. were estimated at nearly $55 billion. There may also exist a climate of increased concern surrounding environmental exposures and children’s health. Among the leading causes of morbidity and mortality among infants and children, there exist many with fractions attributable to environmental factors. Increasing trends in a number of childhood diseases including allergy and asthma as well as certain childhood cancers have been recently reported. There exists thousands of chemicals produced each year, for which very few have undergone testing for developmental toxicity.

The following framework illustrates the population health approach taken by the project team to examine evidence and information on policy options to safeguard and protect children from the health impacts of environmental hazards (Figure 1).
Figure 1: Population Health Framework (Krewski et al., unpublished)

Distinctive Characteristics of Children’s Health Challenges

The potential consequences of environmental agents on children’s health may range from subtle reversible effects to potential serious permanent long-term effects and even death. The probability of the occurrence of adverse children’s environmental health effects for a given agent may depend on factors affecting the exposure, the level of susceptibility, as well as the toxicity of the agent. The influence of public perception of risk as a potentially important modifier of the risk equation and a critical driver for effective risk issue management must be considered. It is the concept of the timing of exposure, that is a major determining factor to the nature and type of adverse effect that may be expressed, and such defines the concept of critical exposure time window.

The Scope of ‘Risk’ to Children’s Health

A general discussion of risk was provided – perceived versus actual (popular versus professional perspectives); risks that are distinctive to children; general risks with distinctive impacts on children; general risks with no distinctive impacts on children was presented. Risk pathways: food (and drinking water); environmental media; air, water, soil. Other environmental hazards: consumer products, built environments, radiation-emitting devices, chemical, physical and biological.

Environmental Health Risks to Children

Risk = Probability x \{Consequences\}^p

- Probability \sim\ nature, level, and timing of exposure, as well as factors influencing susceptibility such as immature detoxification systems.
• Consequences ~ serious permanent long-term effects and even death.

The WHO framework was used to demonstrate the unique and broad nature of environmental exposures to children from the environments to the media to the circumstances.

Building on the WHO framework a chart was presented that describes some of the specific differences between children and adults. The consumption of foods can vary greatly over the lifespan. You can see very high levels of consumption for certain foods during the first few years of life such as apple juice and tomatoes reducing to much lower levels during later childhood and adulthood. This again may play a role in the type and amount of chemical exposures received.

Timing of exposures may impact on the nature of adverse health impacts. An example describing the critical periods of development for the reproductive system was presented. There are many critical periods during the fetal period, as well as others following birth and into adolescence depending on the structure or function of interest.

The health outcome consequences can include quality of life issues such as a lifelong reduction in IQ and lifetime reduction in earnings.

Another important issue addressed in this presentation concerns the concept of perceptions of risk. Thirty hazards to the health of Canadians were ordered in terms of percent high health risk response. Items perceived as posing the lowest risk were natural health products and laser eye surgery. Chemicals in the form of air pollution and pesticides ranked relatively high as compared to chemicals in the form of prescription drugs or natural health products. Industrial sources of radiation such as nuclear power plants ranked higher compared to radiation for medical purposes such as x-rays (Figure 2).
Figure 2: Perceived Health Risk to Canadian Public (source Krewski et al., 2005)
The final component of this presentation focused on the general perception of trust in regulators. Respondents tended to agree that when there was a really serious health problem, the government would regulate it. Experts were able to make accurate estimates of health risks – and that government agencies were well qualified to regulate health risks. In addition to trusting regulators, respondents also tended to give them control. So overall, the results indicated that the Canadian public may demonstrate high levels of environmental concern with a tendency to trust and depend on regulators to guard them from health risks.

Although this research did not ask specifically about children’s environmental health, there are a number of well described factors that can influence public perceptions of risks that may help us to better understand public perceptions. Many children’s environmental health relationships are new and are associated with many scientific uncertainties. Many associations are better understood at high exposure levels but may have greater levels of uncertainty at lower level exposures. Children’s environmental health exposures may be involuntary, and have a delayed impact. Risk reduction may also be difficult for some environmental hazards and it may also be difficult to understand population or individual levels of exposure to many environmental hazards.

These are a few highlighted examples of the presentation on the policy problem.

**QUESTION AND ANSWER FORUM**

Don Spady from the University of Alberta – Did you look at the actual risk that has been published to see if there is a relationship between perceived and real risk?

Answer: was conducted in the 2004 risk assessment protocol but not in this project. Mike Tyshenko – University of Ottawa – there are a number of logarithmic scales used for interpreting risk – sometimes people will qualify risk as being “low” or “really low” or “minimal”, or “zero”. They are descriptive and thus have different meanings for different people. The UK defines a logarithmic scale for interpreting risk. Health Canada has given safety factors for dosing and identifies brief exposure levels at 1:1,000,000 risk level. The perception of risk by the public is sometimes different than the perception of risk from the experts.

Don Spady – the perception of risk is not consistent.

Mike Tyshenko – the perception of risk varies by issue. Some issues, for example Walkelton water – contaminated water resulted in public perception that this was very dangerous and something needed to be done. Overall water quality in Canada is quite good and is regulated very well. The experts would rank that risk much lower than the actual perception by the public after that specific event. It really depends upon the context of the issue.

Question: Don Mattison – NIH – perception of risk in humans we can compare or express the perception of risk to the actual risk only over a relatively narrow range of risks and at very high levels human perception levels off and at very low levels of risk human perception of risk levels off. How do you handle those two extremes needs in the function or in the approach that you are thinking about? Are you talking about that?

Answer: Michelle Turner – Thinking of risk perception for children’s environmental health issues in comparison to other environmental health issues which many only affect adults or everybody and not just children. What we wanted to point out in the risk equation was that we are looking at the perception of children’s risk may be more elevated compared to other population groups.
That would link to expectations by the public of certain policy responses or education campaigns by governments or other groups.

Dan Krewski: I just wanted to follow-up on your question about experts versus public perceptions. We have completed another project for Health Canada that focuses on risk assessment and assessibilities and goes into a number of areas that you where touching on. We do have in addition to the public survey that we showed another survey of experts and our previous work showed that experts typically almost universally see the risk as being lower than the public. The original question was can we relate the perception to reality. One of the problems is that we often don’t know what the actual risk is because they are hard to gauge. There is a paper in 1979 ‘Baruch Fischhoff that looked at judging frequency of lethal events which is probably the best that can be stated in that regard and there are people who tend to overestimate risks that they are not familiar with and underestimate risks that they are familiar with such as motor vehicle fatalities. But the project that we did goes into how risk perception should be factored into the system. Look at different ways of expressing this, risk thermometer, which helps you get benchmarks or a base, how can people interpret information, particularly at small doses we face in the environment. Don’t want to put words into your mouth Michelle, just want to get us thinking about perceived risk as far as how it pertains to child health.

Question: Robin Moore Orr – CICH – A question about the Risk Assessment Study. Did you specifically look or ask about how these risks were perceived from the point of view of children? For instance, I remember top ones, tobacco smoke, unprotected sex and obesity, all relate very much to public health information and education programs, and to the media, generally perceived as risks for adults not for children. Do you have any information on how adults perceive the risks of these things for their children?

Answer: Michelle Turner – No, unfortunately not in this survey. The respondents were asked to identify the hazards posed to Canadians in general. In a smaller subset we also asked them to tell us how much that risk would pose as a risk to themselves or the individual. Only adults were asked that question. Hopefully by considering information on factors that influence risk perception that might help us bridge the gap between the questions in the survey and the topic of discussion today.

Question: __________ -- Health Canada – I was just wondering in terms of kind of information that is requested in the survey – the broader context of this, the government action. Also there is a public demand for services and programs, elements, products, varying degrees of putting public at risk, so is there an understanding of this – is it contextualized in the sense of how we understand and use risk perception to develop preventive action?

Answer: Michelle Turner – Not so much in the survey but in another recent survey that we did that looked at terrorism risk. Questions were focused on and related to actual action by a number of different groups such as the government, first responders or other groups. People were asked about perceived level of preparedness from a variety of groups, how confident they were that the different groups would be able to act to a threat or an actual attack. Another part of the survey that I didn’t show here sources of information that people can turn to when they sought information about health risks. The media came first, followed by medical doctors I think, the government came right near the bottom with industry. The levels of confidence with the information sources were similar.

Question: Brian Ladd – University Alberta – more of a comment – the bar charts you were showing about agreement or disagreement about confidence in things like the government’s
ability to recognize risks, to estimate them for instance, to regulate them, interesting to me that people seem to have in the survey, most confidence in the government’s ability to estimate those risks. Why do they believe that? Because looking at these risks, for example, complex chemical use are extremely difficult to estimate, people seem to believe that the government has a good capacity to estimate in that regard compared to some of the other functions. Something to consider at the roundtable as we look at policy approaches.

Answer: Michelle Turner – we must also keep in mind that the question asked about the general ability of experts to estimate health risks and it remains unclear to what degree of precision or certainty is expected. Also related to the type of information reported in the news media, it can be very confusing as results of conflicting studies can cause a lot of problems in understanding the current state of science and understanding where the information is coming from.

Question: Robin Moore Orr – CICH – I noticed that you questioned outdoor air did I miss indoor air? I didn’t see it and that is obviously a very important consideration in the health of children since they spend so much time in school and so on.

Michelle Turner – Hazards were selected to be representative of the broad determinants of health. We wanted to make sure that we had a few examples from each category, like environmental risk, social risk, behavioural risks. There is air pollution but not stated specifically if outdoor or indoor air pollution.
LEGAL FRAMEWORK FOR CHILDREN’S ENVIRONMENTAL HEALTH IN CANADA
– Jamie Benidickson, Faculty of Law

Jamie Benidickson prefaced his remarks by indicating that he is a lawyer with environmental and regulatory interests, not specifically child health. Terminology – such as enshrining in legislation; encouraging practices; strengthening policy and regulatory approaches set the stage for his discussion on regulatory approaches to children’s environmental health.

Regulatory approaches are varied and our challenge will be to identify specific regulatory approaches that will be most useful, appropriate, and productive in relation to the challenges presented by children’s environmental health. Direct references to children’s environmental health are comparatively rare, virtually non-existent. There are many program policy initiatives oriented around children’s environmental health, sponsored or authorized by the existing legislative framework. There is some degree of concern about children’s environmental health at all levels – international, federal, provincial, local. One international example is the 1997 Declaration of the Environment Leaders of the Eight on Children’s Environmental Health – following President Clinton’s initiative. One example of the Canadian contribution is the Northern Contaminants Program.

In Canadian legislation children’s environmental health appears as an unarticulated sub-element of human health, public health, population health. For example, in CEPA human health was incorporated as an important element of the legislative scheme but without explicit reference to children’s health. Are children included or excluded by a reference to human health? Some elements of regulatory scheme almost appear to exclude children. Some of the decision making is formal rule making, are addressed to people other than children or operate on assumptions that children have been excluded from the equation.

In the regulatory regime in Canada there are specific areas that could be attributed to children. I have not pulled together provincial legislation that relates to children’s environmental health – Lorraine Craig, has been developing an inventory of provincial initiatives. At the provincial and inter-governmental level many activities are underway – organizational, consultory, advisory and is carried out on the basis of legislative authority.

Initiatives of a formal and informal sense are underway at municipal levels in Canada.

Jurisdictions around the world have addressed the interests of children and have been explicitly articulated and incorporated directly in the language of the law.

I have not undertaken any attempt to compare children’s environmental health quality in jurisdictions that would be distinguished by explicitly or implicitly incorporated children’s environmental health in legislation. There are jurisdictions where children are recognized as a subset of human health and jurisdictions where children’s environmental health is explicitly articulated at the statutory level. I am simply reporting a descriptive finding at this point. On a comparative basis different jurisdictions in different parts of the world have approached this question differently.

In the U.S. there have been state level initiatives directed at children’s environmental health. As a follow-up on Robin’s question, statutes on lead-based paint regulation is one example.
In Canada, our priorities are not always as clearly established as one might like. Often this means that the commentator disagrees with the agreed perception of the priorities but in the last decade or so we have seen a number of calls for government to address competing challenges, to please articulate more explicitly the ranking, priorities of those different government objectives. When the Auditor General makes such an observation into the relation to federal legislation that is a call for increased transparency and accountability on the part of decision making authorities.

On occasion public commentators concerned about the legislative or regulatory framework will make recommendations. On the screen you will see an observation of Justice O’Connor, from the Walkerton Inquiry in which he is making an indirect reference to vulnerable populations in relation to water quality and inviting those responsible to give it greater attention. The terms of reference of this provincial inquiry did not invite him to discuss federal and inter-governmental issues of quality water guidelines in Canada.

On the issue of risk and risk perception he did take it upon himself to address a chapter on water requirements of aboriginal communities in Ontario. Walkerton was not an aboriginal community and it may very well be that the quality of Canadian water systems overall is something of which we should be proud. Secondary benefit in terms of legislative and policy initiatives were shared with a wider community (Walkerton), the aboriginal community who have been lagging behind the norm in terms of water quality systems in part because of legislative gaps.

At the international level there are several large initiatives including the CEC.

Summarizing his thoughts, Jamie described where we are as the basis for discussion as to where we may like to go next. His provisional findings at the level of describing what is going on currently would be to say that Canadian legislation primarily federal legislation treats children’s environmental health implicitly rather than explicitly.

Secondly, in so far, as the priority is also a legislative question, intent to achieve a wide range of purposes and so when he referred to priorities he made this comment in the content of his reading of formal legislation, statement of policy goals of legislation. Priorities tend not to be clearly articulated, whether priorities between health and economy, or human health and children’s health more specifically.

As an observation of the legislative and regulatory process, generally he found a significant volume and level of activity taking place at the operational or institutional level or inter-governmental level, or advisory level. An indication that it is a correct description of what is going on, and that many people are taken with the importance of children’s environmental health and are taking advantage of the avenues available to them to advance and bring to prominence the issues of children’s environmental health – the kinds of things that Michelle outlined.

The challenge from the perspective of CEPA reform or transition would be to ask in the operational sense has the current language of CEPA inhibited some of the working relationships in children’s environmental health that Canadians would like to accomplish. If there are some obstacles embedded in that legislation can they be addressed or removed. If indeed there are positive legislative and regulatory measures to be put forward what specifically might they be?
This discussion set the foundation for the afternoon discussion on measures that can be taken and are most appropriate in relation to children’s environmental health.

QUESTION AND ANSWER FORUM

Question: Don Mattison – NIH – In your review, with the exception of assumptions that children may participate, the example that you identified where the law states assumption of reading and understanding to write sections of product use you find no specific restrictions or did you look for specific restrictions that would not allow attention to children’s health.

Answer – Jamie Benidickson – We did not systematically attempt to identify restrictions as restrictions that are directed at children. One notes in reviewing the general legal literature on CEPA and comparable legislation concerns about limitations in the reporting requirements for example, users of chemicals for manufacturing or other purposes some of those limitations might relate to questions of business confidentiality, or other matters of general policy importance. There is an inventory of such limitations but those are in a sense limited to the availability of information and might be of general utility to researchers whether they would be concerned with children’s health or human health generally.

Claire Franklin – The McLaughlin Centre for Population Health Risk Assessment – With regard to implicit versus explicit certainly the fact that there is a responsibility in law to protection of human health includes children there is no question. I don’t think there is any legislation that excludes children because they were not explicitly mentioned. There has been a tendency and I guess I am more familiar with the pesticide legislation, with the implementation of FDA in 1996, to explicitly state it. It doesn’t mean that the practice of doing the evaluation or assessment of risk was in any way any different than what was already been done but it made it perhaps more visible for those who might read the legislation who were not really familiar with the practices that were in place. Certainly in my experience there won’t be any less attention paid to the health effects for children because it doesn’t happen to be specifically mentioned. That is not to say that there aren’t differences in the way risk assessment is done for everybody under different pieces of legislation. Do I think we really need to differentiate? There is no question that CEPA has a very different approach for commercial chemicals than other pieces of legislation do – for pharmaceuticals or pesticides and that type of thing. I have one additional question, which was when you speak about priorities and you talk about health versus economic what specifically are you considering the weighing of one against the other under law or the resourcing of it?

Answer: Jamie Benidickson – Perhaps the immediate focus would be under law.

Claire Franklin – Well, very specifically and actually stated in the pesticide legislation benefits do not trump nor ever have trumped. Very clear under U.S. legislation under EPA that was a modification from FIPRA where in fact the benefits could trump if there were real needs. One could way that but that is clear in US legislation for that. The only area where it becomes a little challenging is to way the risks and the benefits is when you are talking about vector control and malaria and product use that are the ones that you really bump up against. How do you way the risks and the benefits when the end effect in both cases is protecting humans? For economic benefit they do not trump.

Answer: Jamie Benidickson – That kind of issue or statute like that basis remains sufficiently unclear to people making generalized observations. The issue continues to arise. It arises more generally in the international setting when we as Canadians might for internal purposes have
made a particular finding in relation to risk and measures that we would like to take to avoid that risk but one of our trading partners invoking the international legal system might reach the conclusion that a protective measure that Canadians have adopted for themselves is indefensible at law within the context of world trading arrangements. So, although there are examples of priorities that does not make them universally defensible. Comment on the fact that the US has used explicit language and Canada has not doesn't make a practical difference in terms of the manner in which risk is analysed and assessed. That is precisely the question I was not getting into, precisely the question that I do not offer any experience with or expertise. I am merely describing that two different countries have taken two different approaches and if were to be a matter of reflection, how can one advance children’s environmental health agenda, someone said it should be made explicit in the legislation I would assume that policy makers would then want to be able to do an empirical comparison dealing precisely with the kind of observation that your experience allows you to make. But that is not part of anything that I have done here.

Claire Franklin – I would just like to set the record straight. FQPA, the Canadian pesticide legislation specifically deals with these issues. The attitude is such that it helps the public understand that children are being looked at and we recognize that there are differences. There is no harm in putting it into the legislation. I think that this is something that law makers might take into consideration. It really helps without having to read through decisions to understand that children are not considered to be just small adults. There is no harm in it and it does not mean that when it is not there that it is not being done.

Question: Vic Armstrong -- The McLaughlin Centre for Population Health Risk Assessment – I would like to comment in following up on what Claire said and maybe on your comment about the absence of wording in the legislation possibly excluding certain things being done under an Act. I would just like to point out that, under CEPA, children have explicitly been taken into account in carrying out risk assessments both of existing chemicals, and of new chemicals for which manufacturers and importers are required to submit data. I would agree with Claire that it wouldn’t hurt to make the language more explicit but in terms of current legislation it has been done. In fact, Canada may have been a pioneer in recognizing different age groups and, with respect to some chemicals new to Canada, control measures have been taken because of the attention given to assessing risks to very young children.

As a question, I think I heard you say - and the point that Claire made – that if there isn’t explicit reference to children then they could be excluded from a legal point of view in addressing public health? Is this correct? Also, did you look at any developments in the European Union? It is possible that provisions for children’s health are being contemplated in its proposals for new chemicals legislation.

Jamie Benidickson – My observation in relation to this would be that it would be very difficult to treat children other than human. All I was doing was describing the language that exists in Canadian legislation and I was doing so in part for laying the foundation for possible law reform. I do so because I read repeatably that there is a constituency that is well represented here, who want it understood that children are something other than just small humans. There are distinctive issues. I then hear and said that I did not examine empirical practices that children are currently being looked at but I do read for example studies of the role of health impact under assessments conducted in connection with Canadian Environmental Assessment Act and I read the findings of others who say that health impacts are not generally given the attention and consideration that they ought to receive. I conclude that in the context of environmental assessment if health impacts are not sufficiently attended to perhaps children’s health impacts
are not sufficiently attended to in that same context. I don’t make that assertion I just report what I have read. Children’s health issues are being taken in a practical operational way, leads to the question – is the current level of attention adequate? If more is to be done, can the legislative or regulatory process make some contribution? If more is to be done, is it simply a question of resourcing capacity?

Question: Manju Sah – Health Canada – Address some of the challenges of extending some of the regulatory framework or objectives at the local level in the sense that assessment and all those kinds of things city planning for example, environment assessments are done, roadways and things like that, but urban density, urban planning, doesn’t require any environmental assessments, so you get all kinds of contaminants based on how safe it is, so this will always be an ongoing challenge, because of the fragmentation of how protective works of some of these things get into the building codes, there is no specific framework in which all these things happen. The ultimate objective is at the local level how is it possible to make a difference with the federal regulatory framework? Do you think this is a step in your work in terms of how these objectives can be achieved? Legal and policy frameworks together.

Answer: Jamie Benidickson – If I were George Brown or John A. MacDonald in 1867 and if I knew then what we know now, would the rules of federalism and governmental relations and the status of municipalities be different. The question is clearly related to the effectiveness of inter-governmental federal, provincial and federal, municipal communication in consultation processes and so on. If there were ways to encourage flow of information and understanding I am sure it would be valuable but that is not anything really falling within my territory here.

Question: Manju Sah – Health Canada – referring back to initial discussion about codes, what would be the best way to make the objectives achievable? Is it really by putting it into legislation, or are we not going far enough in terms of placement in legislation, are we relying on voluntary practices to achieve action? So is this a weakness that we should be looking at?

Answer: Jamie Benidickson – I think that almost a central question for the afternoon is very much the kind of thing that Dan will be leading a discussion on after lunch.

Dan Krewski – 1993 NRC report on pesticides in diets of infants and children – Don Mattison and I worked on that report for 5 years. 1996 was the US Food Quality Protection Act, Claire, the Canadian Pest Control Products Act 2004, decade where we have seen this transition where there is a very explicit requirement for certain aspects of children’s environmental health. The 1993 NRC report recommended an additional ten fold margin of safety applied to the protection of children. The 1996 FQPA took up that recommendation and required that the additional margin of safety be applied unless you could show evidence that it was not necessary. Prior to the 1996, FQPA I would expect that regulators in both Canada and US would have looked at children’s issues and would have applied additional margin of safety if there was concern. The burden of proof had shifted with that statute to that thou shall use that extra margin unless identified as unnecessary. I just wanted to clarify that the intent of the 2002 FQPA was the same. The pieces of legislation are identical.

Two important issues to take away from the workshop are:

1. The burden of proof had shifted from you got to apply the extra margin unless deemed unnecessary versus apply the extra margin to the past practice when it is necessary.
2. This is an example of Canadian legislation in which we do have a very explicit provision for children’s environmental health perhaps the only one that is really clearly spelled out in black and white.

We are waiting for the law. Not promulgated yet?
COMPARATIVE APPROACHES TO CHILDREN’S HEALTH AND THE ENVIRONMENT – Dr. Michael Tyshenko, McLaughlin Centre for Population Health Risk Assessment

In this session, an overview of the comparative approaches to children’s health and the environment was presented. The intent of the research was to assist policy makers at Health Canada in utilizing the experience of other jurisdictions to develop and implement legislative and other policy measures to safeguard children’s health from environmental hazards in the context of revisions to the Canadian Environmental Protection Act (CEPA) 1999 and the proposed Canada Health Protection Act (CHPA).

Recognizing that knowledge and expertise can be found in several areas, a broad transdisciplinary approach was adopted. Experts were contacted in multiple sectors including representatives from government, non-governmental organizations (NGOs), university researchers, consultants and industry. Questions were asked to uncover barriers, facilitators, experience based initiatives and methods of evaluating child health initiatives, policy and legislation. Interviews were conducted in three main jurisdictions: Canada, the United States and member countries of the European Union (England, Sweden, Denmark, Austria and Germany).

Content analysis of newspapers, internet grey literature and peer-review articles (including legal databases) were used to help select case study examples, provide a short list of names of pertinent Acts and regulations, determine a list of children’s environmental health issues and validate expert opinion interviews. Expert opinion was solicited through interviews targeted to various areas where individuals have experience with governance and non-governance instruments.

Analysis using the experiences of other jurisdictions (notably the United States and members of the European Union, and selected international agencies, i.e., World Health Organization) compared to Canada allowed for the determination of risk issues, barriers, facilitators and proven strategies for improving children’s environmental health based on governance and non-governance instruments.

Content analysis of Canadian newspapers and popular magazines showed that while several environmental hazards received quite a bit of coverage there was little worry by the public that these hazards were being poorly managed by government.

The expert interviews provided much information to determine what approaches, arguments, strategies, types of governance or non-governance tools have been used in other countries. Experts were asked about the effectiveness of using such instruments and how these governance tools have been monitored and evaluated for protecting children’s environmental health. The aim was to solicit expert opinion from a variety of areas to obtain knowledge of both explicit and implicit tools related to children’s environmental health.

When discussing children’s environmental health most of the experts regardless of jurisdiction were in agreement that areas of uncertainty existed and that in some areas there is simply no information for many chemical environmental hazards. Experts in children’s environmental health policy pointed to the lack of research funding and lack of political will to invest funds into research, biomonitoring, database management and program building despite the concern from the public to reduce some specific hazards for children.
Experts were aware of legislation, non-legislative tools and communication based strategies for children’s environmental health. Experts in all jurisdictions believed that in order to quantify the scope of the problem and to better understand environmental health outcomes linked to exposure levels that biomonitoring is needed.

Children’s environmental health issues and priorities were shown to be different depending on the jurisdiction. For example, experts in Canada pointed to issues of smoking, environmental chemicals while respondents in the United States focused on issues of air pollution and chemicals. European Union respondents tended to focus on air pollution, improving city planning and chemicals.

Different jurisdictions identified similar barriers to children’s environmental health. In Canada and the United States lack of funding, low awareness and poor issue communication were the foremost barriers. European Union countries also identified lack of funding and low awareness as top barriers along with lack of political will.

Respondents from all jurisdictions identified interesting and novel ways to improve children’s environmental health. Improvements fell largely into main groups: first the need for improved data, data collection, biomonitoring and surveillance with associated issues of data sharing, confidentiality and knowledge transfer. Second the need for an integrated approach and a formal organization to strengthen the area of children’s environmental health by assigning a government group with responsibility for children’s environmental health.

The United States and Canada have created specific offices for children’s environmental health while the European Union respondents identified the lack of political will and voice as a main barrier for children’s environmental health issues.

Clearly, much work remains in the area of children’s environmental health to improve biomonitoring, surveillance, program evaluation and organizational strengthening of departments responsible for children’s environmental health.

**QUESTION AND ANSWER FORUM**

**Question:** Fatma Maged, Environment Canada – We don’t have a Canadian policy on environmental health and most of OECD countries have the same problem. This is lacking and there is no general law and thus children are left out. My question if we begin by focusing on the vulnerability of children, we can get to having children specifically and especially their stages mentioned in the legislation because for example the child who died from swallowing a charm from a bracelet because of lead poisoning, if these parents were to look for somebody to blame they would not be able to use any of these legislations to specifically say that this was dangerous. Because if you or I swallowed the charm it probably would not have harmed us as much, but was capable of killing a child. This is the kind of thing from a legal perspective that is lacking. It needs to be there and in human health we do assessment but no legal mechanism to stop the use of lead in these bracelets and thus kill a child.

**Mike Tyshenko** – This is a very good point. I think Pat Rasmussen when we had the Children’s environmental health meeting in B.C., there was a discussion at the international level about issues surrounding importation of products and toys from other countries such as China, high
lead and other heavy metals, cadmium – no provision or legislation to stop the sale of these products. No mechanism to allow Canada to warn consumers.

-------------- I am not an expert in the area but I am familiar with the Hazardous Product Act there are loop holes or gaps, legislative reform is attempting to address these issues. It may not mention bracelets specifically but lead content is included. So we can act on that.

Question: Sheryl Bartlett – Health Canada – how did you do the study with the expert opinion. How many people were you able to enlist – how did you frame the population?

Mike Tyshenko – We initially used the content analysis to look on the internet to identify people who had published in the area of children’s environmental health. Child health experts were solicited from industry, university research, government and non-governmental groups. We contacted and interviewed 14 experts in Canada, 13 experts in the United States and 11 from the European Union. For the subgroup that we contacted the response rate was less than 10%, depending upon area, jurisdiction. In the UK it was difficult to get industry respondents. In Canada few NGOs would participate, we contacted over 200 NGOs. For the analysis we aggregated survey results into graphs.

___________ Health Canada -- a little more specific on the group of people you surveyed particularly in Canada – the number of groups of people who responded and see the stats, specifically looking at the government category would those include public health officials at the local and regional levels, health practitioners, and if so where did they fall in the category?

Mike Tyshenko – we did have health practitioners, for example Mark Walker, from OHRI, who works on endocrine toxicant for specific child health windows. When you are doing a survey like this beggars can’t be choosers. We identified a list and contacted people, if they responded we were grateful and carried out the survey. We didn’t have a lot of control over who was responding to the survey but we tried to cast our net widely by contacting key people from industry, university researchers, government officials at provincial level, NGOs.

__________, Health Canada. I understand that when you do a survey you take what you get but in your final report it might be interesting to have a little more detail on the make up of those groups. Interested in breakdown on government wide range of responsibilities and views that may vary and if there are enough numbers there to give us some truly accurate insights of the opinions of those groups it would be useful.

My second question relates to your conclusion at the end, content analysis you talked about your newspaper ranking to the little worry bit – based on ranking of risk – little worry by the public that hazards were being poorly managed by the government. Woo, from a government perspective, that sounds really great, but I am a little bit surprised by the jump from your survey to that particular conclusion so can you walk me through the process? Was there another analysis or did you just make that conclusion?

Mike Tyshenko – when we did the key word searches we were searching the issues and then went and used words like legislation, Act or regulation, and if there was a large glut of group articles highlighting the issue as a risk with the need for legislation it would suggest public concerns that something must be done to protect children – we would have picked it up in the news articles but we did not see that in the new articles that were downloaded using these combined key words. So the conclusion is a result of negation, the lack of concern for specific
issues suggests that it is not a pressing issue for the public for children’s environmental health and legislation.

Potential questions to address for the afternoon session.

1. In light of the CEPA 1999 reform process, what are the most promising avenues (regulatory, advisory, community based, other) to address children’s environmental health in Canada?

2. Based on your awareness of other jurisdictions (such as the United States and the European Union), are there any specific elements that you would recommend Canada consider adopting?

3. Based on your knowledge of current scientific and medical issues related to children’s environmental health, are there any specific research requirements necessary to support children’s environmental health legislation in Canada?

4. To advance a children’s environmental health agenda, what are the strongest available policy arguments to move this agenda forward?

5. Given that children’s environmental health plays some role in Canadian initiatives at the international, federal, provincial/territorial, and municipal levels, what are the most promising opportunities to strengthen and coordinate activities at these different levels?

6. Children’s environmental health is largely implicitly embedded in Canadian legislation at present – should this be made more explicit?
PANEL DISCUSSION ON POLICY OPTIONS FOR CHILDREN’S HEALTH IN THE CONTEXT OF CEPA, 1999 AND THE PROPOSED CANADA HEALTH PROTECTION ACT

Panel members included:

Leader: Dr. Daniel Krewski

Members:  Dr. Don Wigle, McLaughlin Center for Population Health Risk Assessment  
Dr. Don Mattison, National Institutes of Health  
Dr. Robin Moore-Orr, Canadian Institute of Child Health  
Annie Bérubé, Health Canada  
Donald Spady, University of Alberta  
Brian Ladd, University of Alberta

Dan Krewski called the afternoon session to order. Each panelist was asked to provide a five minute opening statement. A general discussion followed the opening comments.

Brian Ladd, University of Alberta – I have been working with Don Spady and a number of other people on a project similar to what the teams at the University of Ottawa and the University of British Columbia – looking at environmental health government instruments in OECD countries and evaluating those looking for lessons that we could learn – basically lessons from other countries that may be put into the Canadian context to inform Health Canada in an advisory role in federal government. I think Don Spady is going to speak a little bit to the methods and detail on just what we did and what we found. I am going to cover a few areas that maybe a bit different from what some of the other groups have looked at but are still relevant to children’s environmental health. One of the things that we did in our project we decided we would take a look at constitutions – foundational documents in OECD countries usually lay out their powers of different branches of government and rights of citizens, constitutions contain bills of rights. We want to see if there are any constitutions in any OECD countries that contain language that either explicitly includes children’s rights to environmental health or could be construed to have that implication. We did not find much at all. We did find that in some of the countries in Europe and Mexico there is language in those constitutional documents that refers to a clean environment or environmental health and sometimes they talk about government responsibility, government and citizen responsibility to work together or play a role in the environment but it is very general language and children are not mentioned. One of the reasons the OECD countries don’t contain this kind of language is because they are quite old and the kinds of environmental issues we take for granted as being important today weren’t around in the founding of the United States or older British documents. You might ask why we looked at this although it was not directly in our mandate. We did think that because constitutions ideally can set the direction for society they become the value reference points for further legislation and more specific to be developed and we thought it might be worth seeing if some hints in the constitutions that could be used as arguments to create more specific children’s environmental health legislation or guidelines. What we also decided to do, we had a good personal contact in South Africa was to look at the new South African constitution which is only about 10 years old and is written in plain language – quite pioneering in that way – but included is the Bill of Rights that does provide for children’s specific rights to environmental health. We are really interested to see where that goes and what the courts decide when cases are brought forward that deal with this provision in the Bill of Rights. So far the public is not aware of what it means that they can really bring those issues before the courts based on section 24-28 Bill of Rights. It is a model and we are really
interested in seeing if it does lean towards a really proactive prudence of court decisions around children’s environmental health. We also wanted to look more at the definition of the child and rights of the child that are enshrined in supernatural conventions such as the UN Convention on the Rights of Child, European Convention on Human Rights, American Convention on Human Rights – partly again because we realize the international nature of children’s environmental health—transgenic—pollutants and vast global trade where products come into another jurisdiction. We were concerned about the definition of the child – birth to 18 years – might narrow our vision about what we might look at as the determinants of child health and adult health as well. We are learning more and more about the vulnerabilities of the child in utero and even what it means when parents prior to conceiving a child are exposed to harmful substances that can damage the reproductive systems or create epigenetic effects that may be passed on through generations, these sort of things. We did look a little bit at the legal status of the child in OECD countries and with the exception of the American Convention on Human Rights, some indication that children include the fetus. Legally define children from birth to 18-19 years. Does that legal status affect the levels of protection that are offered children, does it perhaps influence governments in whether or the extent to which they are looking at prenatal influences on environmental health?

Donald Spady, University of Alberta – Amazing how Health Canada can give three different groups the same mandate and have three completely different approaches. Give Health Canada a bit more food for thought. We defined governance systems as well as regulations and guidelines. Searched the legal databases in Canada, United States, selected states, and contracted with the WHO in Europe to look for the environmental health laws in European Union countries and belonged to the OECD and non-OECD countries such as Norway, and in the appropriate languages which was an asset which we did not have at the time. We were able to obtain laws in most of the countries in the EU plus the EU itself. In doing so, we found approximately 700 different documents related to children’s environmental health in some way or other. Similar to the documents that Michael showed earlier in the day. In going through those laws, we found four laws, two laws actually, concept laws, or regulations or guidelines, Executive Order signed by Bill Clinton, Maryland House Bill 313, only laws that stated that in every instance there is a possibility that children’s environmental health will be affected by a law that we institute then we have to consider the affects on children of that law. Gives children a primacy which we just didn’t see elsewhere. Out of that came FQPA which was mentioned this morning which also directly looked at the law in the context of the uniqueness of children and was beautifully demonstrated by Michelle in her presentation. The other law that we found that documented the uniqueness of children as a preamble California State Bill 25 of the Children’s Environmental Act – dealing largely with air pollution but it was done with the idea that we are doing this for children because children are special people. There just were no other laws that explicitly looked at children because they were children and they had some unique characteristics. There are some laws that are related to children, like the pesticide law in infant fruits is directed to children but they were not necessarily discussing rights that were unique, they were directed to children because that is who eats infant food. Packaging laws, safety packaging, radiation, labeling laws, the biggest thing that came out of our project is that children are special and different. They should be considered specially and differently in the creation of laws, it does not have to be present in each law but when making law should think of context of children. Draws an analog to medicine, where prior to the development of pediatrics treated children as little adults not special beings in their own. Pediatrics came along and we realized that the child was a special individual and had special needs and characteristics and that they varied from conception, to birth, to first year of life, to up to age 18. They are different beings and must be considered differently. If we just considered them as adults as small adults we would not be doing them a service. The same thing applies in law. If we just consider them as
part of the whole and not as a separate grouping we are not going to serve them well. What might work in an adult for example some toxicology it has to be a certain level, it has to be 10 times or 100 times below the level that is least likely to cause disorder, doesn’t apply to kids because sometimes it is a million times below that affects the child. You have to consider children separately and specially.

Dr. Don Mattison – NIH – Three specific explicit laws and reporting requirements; education and communication; and practices and health services implications. Explicit laws reflect on two that we are engaged in – one is FQPA; second a law passed in the US in 2002 Best Pharmaceutical for Children’s Act. Both of these attest to the value of the explicit attention in legal documents to children. The FQPA and its requirements that children’s risks be considered or developmental risks be considered and unless there is specific indication that demonstrates biologic exposure is clearly no more hazardous to a child than an adult an extra safety factor be put in. The Best Pharmaceutical for Children’s Act notes that for the use of medication in the US once a drug is licensed for distribution or available to be marketed it can be used by any practitioner for any indication in any age group. There is no formal recognition of the need for appropriate information on pharmacokinetics, safety or ethical considerations within those various age groups. So the Best Pharmaceutical for Children’s Act specifically draws attention to this and requires that drugs be reviewed on an annual basis that the gap between adults and children, and appropriate use for use in children, studies be put in place to diminish that gap. The other thing that I think that is of value in the context of explicit laws are regular reporting requirements – tailored to the kind of information that will drive health protection on a population basis.

Education and communication – reporting requirements play a very useful role because they continuously reinforce in the public’s mind and in the minds of decision makers – what we have achieved and what needs to be achieved in these areas of child health.

Practice and health services implications – in the area of environmental health, practitioners can get tangled in trying to understand exposure outcome relations to a particular child and family. At least in the US this is not a reimbursement expense. It can consume huge amounts of time and no obvious source of structure for dealing with it. With respect to the use of pharmaceuticals less of an issue, but we are finding that practitioners need tools to help them guide practice. Probably truer with respect to environmental health – these issues are becoming a smaller part of the educational component of medicine. As a result they are less able to make informed decisions about environmental exposures in health, or the appropriate use of medication in children.

It seems to me that in each of these areas, there seems to be substantial benefit to explicit language in laws, draws attention to children’s health. There is substantial benefit derived from reporting requirements – requires the executive agency to go back on a regular basis and report to parliament or legislative body how well it is doing in implementing these activities and is reflective in what practitioners and health services are available in the communities.

Annie Bérubé – Health Canada – Similar meeting in Vancouver – part of the reason we issued the Request for Proposal at Health Canada is revisiting two pieces of legislation CEPA and consultation on several pieces of health protection legislation. The challenge that we had when we began the discussion for legislative renewal convincing our senior management and several funding agencies that it was indeed a regulatory legal gap in those pieces of legislation. We are looking forward to having concrete findings so that we can put these findings before them so that we can see what other jurisdictions are doing and determine what are the best practices abroad are and will be extremely useful in those debates.
I will briefly summarize children’s environmental health policy at the federal level. I think recognition of children’s environmental health in the federal government probably began in the late 1990s. First went for a request for money in 2001 asking for coordinated programs among children’s environmental health in the federal government and then September 11th happened and we never got the funding. Recently, we have attempted to obtain funding again and when you are given the opportunity to go before funding agencies and say that there is a gap in our program and you would like to address children’s environmental health you have to conduct a huge consultation in government. We have reached a good consensus on what data needs, research needs, program needs in the federal government. We need to improve our risk assessment methodologies, and they are evolving rapidly to account for children’s special vulnerabilities. We need to keep incorporating these changes in the methodology in all of our regulatory programs. Health Canada in terms of risk assessment and contaminants – wide range of programs, water, contaminants, etc. The new risk assessment is a very different way – critical need for exposure data. All of our risk assessment to date, relies mostly on exposure modeling, provides estimates of children, pregnant women and the rest of the population exposures might exceed. We have only begun at Health Canada to use biomarking data to support our risk assessment. This is a huge technological advance. We need to incorporate. Ten years ago we did not have biomarkers to chemical exposure. Biomonitoring program for children’s environmental health has huge implications from a public health perspective in terms of knowing when to publish what an exposure is but it also has implications to how you do risk assessment. We have to start incorporating into our risk assessment methodology and there is call from our risk assessors to have exposure measurements to use as opposed to exposure modeling.

Some of the work that we have been doing is following what is happening in the US National Children’s Study, Longitudinal Cohort Study, should we participate or should we not and how will it look, should we partner with the US – develop a business case for Canadian Longitudinal Cohort Study – begin to determine what a sampling strategy would be like – what an actual Canadian Cohort Study would be so that when we are ready to go to central funding to ask for money we have a strong case – this is a Canadian made approach for a Longitudinal Cohort Study in Children.

Finally, I want to briefly touch on the research agenda. There is a huge gap in terms of the impact of environmental exposure on children’s health. In the absence of an Institute at CIHR dedicated to Children’s Environmental Health or Environmental Health for that matter, a huge gap in terms of funding Canadian research. We use to have in the federal government a toxic substances research initiative that was cancelled about 2-3 years ago. Since then there is no federal program to support Canadian researchers in academic or medical institutions to that kind of research. This is a huge gap. Children’s environmental health in the federal government unfortunately still remains in a policy development stage and that we don’t have a coordinated funded program – something similar to the United States nor do we have a federal research agenda. But I think because we have been doing this consultation over recent years, we have a good consensus and a good assessment of what our research needs are and our approach – when the opportunity arises we are ready to make a case for a program.

Dr. Don Wigle – McLaughlin Centre – My role in the project is to focus on the six case studies – lead, mercury, endocrine disruptors, indoor air, outdoor air and pesticides. My part is to synthesize the epidemiologic knowledge on what we know about the links between those specific environmental exposures and adverse pregnancy or child health outcomes. The
second part of the case studies is being put together by John Harrison, i.e., a history of regulatory approaches to those six hazards. Hopefully information from the case studies will give us some insight into what we can learn from the past and maybe improve in the future. In terms of CEPA, I see some needs from an epidemiologic perspective and have a question of how they could be addressed in legislation. When epidemiologists are faced with very complex issues, they try to step back and simplify things. How well are we doing in the pre-market toxicity testing of new products? How well are we doing at going after the grandfathered products? How well are we doing in developmental toxicity testing? In epidemiologic studies we try to assess the biologic plausibility of whatever exposure/outcome relationship we are studying. Epidemiologists get frustrated when they look at the toxicological studies as they may be very small. Similarly, toxicologists note that most epidemiologic studies are observational studies, not experimental studies. From an epidemiologic perspective, we need to improve both epidemiologic and toxicological study methodologies and to improve working relationships between the two disciplines.

We need more and larger cohort (aka longitudinal) studies to greatly improve research on environmental exposures and health outcomes. We also need ongoing population biomonitoring surveys to assess trends in exposures to environmental contaminants. At present, only the US and Germany do national biomonitoring of their population. The USA has by far the best established program, having conducted national health surveys since 1960 that included blood and urine sampling. Without the U.S. blood lead data from the late 1970’s, we would not know the dramatic role of leaded gasoline in population-wide lead exposure. In epidemiologic research on the relationship between exposures and outcomes, we have some major problems. The best recognized problem related to obtaining valid exposure data but we also have problems with health outcome data. Even at a preliminary stage where you are trying to develop hypotheses for a grant application in Canada, there is the assumption that with our universal health care system, that we probably know a lot more about health outcomes than we do. There are a few outcomes that we measure very well, notably cancer incidence (new diagnoses of cancer). For deaths, we know who has died and we usually have fairly good information on the cause of death but we do not validate any information on death certificates. For birth defects, Canada has fair data but they are not adequate to assess issues such as male reproductive tract birth defects. We can not say with any confidence whether the risk of such birth defects is increasing or not in Canada. In Finland, every newborn has to be examined for birth defects by a pediatrician, making Finnish birth defect data among the most reliable in the world.

Where is the money? We need more research on environmental exposures and pregnancy and child health outcomes. We were very disappointed a few years ago when the new CIHR was formed and there was no Institute for Environmental and Occupational Health. In Canada we have no dedicated source of funding for environmental health research. For a while Health Canada and Environment Canada had a wonderful program called the Toxic Substances Research Initiative (TSRI) but it has been cancelled.

New CEPA legislation should address the need for human exposure assessment and biomonitoring in hand with other authorities. Health Canada should be actively involved perhaps under the authority of its planned new Health Protection Act or some other formal agreement between the two departments. Let’s not have a standoff between Environment Canada and Health Canada in terms of making CEPA more relevant.

Dr. Robin Moore-Orr – Canadian Institute of Child Health – we have been involved with children’s environmental health as a priority for the last few years. We have been working in this
area as part of the Voluntary Sector Initiative funded by Environment Canada -- five papers were part of that project – water quality, pesticides, indoor and outdoor air, and heavy metals. These papers were produced by a variety of organizations – areas of expertise in those topics. The institute has always worked with consortia or cooperatively with other organizations. We have been involved with the CEC – the trilateral initiative between Canada, US and Mexico on environmental indicators. We were represented on the SMART legislation health initiative with Health Canada – concerns for and barriers to promoting children’s environmental health were identified and were very similar to results reported this morning. Co-chaired the International Conference on Children’s Environmental Health in Washington on September 11th, 2001.

We have advocated on behalf of children’s environmental health for a number of years. In 1999, we presented to the Standing Committee on Environmental Sustainable Development, 2002 made presentations again.

Our particular interest and emphasis on children’s environmental health came with the preparation of the Third Edition of the Health of Canada’s Children: A CICH Profile 2000. In each edition, new chapters on emerging issues were included. In the third edition the two new chapters dealt with children’s mental health and children’s environmental health. We have been strong proponents of the precautionary principle.

As a result of the chapter on children’s environmental health we have been involved in a CIDA funded project in Argentina and it points to and supports a number of points that were made this morning – a survey of pediatricians was undertaken as part of this project 12-14 thousand pediatricians in Argentina and was done in conjunction with the Argentina Pediatrics Society – response rate was 6% -- bias sample – very few included any environmental issues in their medical history, clearly there is a serious problem. We are conducting two studies, one on lead and one on pesticide exposures – considered such a success is now being funded by US EPA – Paraguay, Chile, Uruguay. This one will include a component in Canada. I agree with Don Wigle, where is the money. The profile has always been developed addressing issues of children’s developmental problems. One of the issues we have strongly supported is an office of Children’s Environmental Health, a proposal for a children’s bureau which died during deficit reductions.

The promotion of health in general – an office of children’s health with components of various areas would be beneficial.

QUESTIONS FROM THE FLOOR:

Question: Claire Franklin – McLaughlin Centre – Having spent a career in regulation in many different things I would like to perhaps put something on the table that will hopefully provoke a little discussion. The situation that we have in CEPA at this point in time despite that it was toted as bringing in major reform in 1999, it still is a piece of legislation that results in a very data poor situation. We only get data on volume triggers, we tended collectively to respond to that in interesting ways. The call for biomonitoring is very necessary as the government must show need in order to generate the data that they should have had any way. Biomonitoring is very helpful – show that you are picking this up in people’s bodies there has to be something going on. Doesn’t necessarily say that it is causing the health effect but it is at least a little piece of evidence not a smoking gun. Those two pieces -- the lack of information and reverse onus driven us into doing some pretty creative things – trying to get the type of information to prove that we are really protected.
The precautionary principle is another piece of that – the idea being that we shouldn’t have to wait to take action – try to close the gap dealing with what you actually have and being protected.

What I would like to throw out to the panel is the issue and the activity that is going on in Europe – REACH. Pre-market information for chemicals – can do an appropriate risk assessment and keep something off the market before it causes a problem and then you have to go and take it off the market because it is already out there. What are your views on that and is this a major policy change that should be put to Health Canada as to why are you not addressing this? One might utilize it and the US is going to be faced with the same thing – there will be huge trade implications because Europe will simply not allow products into Europe that haven’t met the bench mark – their own data that they will be measuring their own chemicals by.

I would be interested in your views and whether you would even entertain putting something like this to Health Canada and Environment Canada ultimately.

Answer: Don Mattison – NIH – Yes, it always seems to me to be a public health failure, to require the demonstration of human disease when there is host of ways to think about it in advance. We have a comparable piece of legislation that how our FDA regulates nutritional products. There the requirement is the FDA can only take action against those particular products that are demonstrated to be harmful. It puts the regulatory body in an extremely difficult situation where the data may clearly demonstrate biologic plausibility for harm but there is no reasonable human data collected and sometimes the collection of human data can be extremely difficult. I would argue for pre-market detail evaluation of chemicals.

Answer: Don Spady – you asked if any of us would put in as a recommendation – yes, we did, for each of our case studies we have lessons for Health Canada. When we discuss chemicals we have to come up with recommendations – the onus really shouldn’t be on society to do the work of industry, it should be the other way around and perhaps how that happens – I don’t see how it couldn’t be done by an independent agency funded by industry but research done for specific chemicals and compounds, be done through this independent agency rather than the government – something at arms length.

Various acts in the US the Data Quality Act demonstrates that the other way around it does not work – can cripple almost any kind of research to demonstrate the harm of a chemical and it is a dead end and it is not going to work. I think the European REACH isn’t exactly what the environmentalists wanted in Europe it is a big step forward and will force the Americans and Canadians to change their approach.

Answer: Don Wigle – McLaughlin Centre – One thing that caught my attention lately in terms of this issue of pre-market testing is an article that is published in this month’s (March 2006) issue of Environmental Health Perspectives. It is the report of a lifetime carcinogenicity study of aspartame in rats. It showed that aspartame is a multi-site carcinogen even though pre-market tests conducted by industry were interpreted as negative for carcinogenicity. The new study was much larger than the earlier studies and followed the animals over their natural lifespan (up to 3 years), as opposed to the conventional 2-year study required by regulatory authorities. Basically Canada largely takes a free ride on this issue – as a country we rely on premarket toxicity testing conducted mainly by industry. Only a few commercial chemicals are tested in government laboratories, mainly in the USA. In Canada, since the funding cuts to the former
Health Protection Branch during the mid-1990’s, there has been little or no independent toxicity testing done.

Claire Franklin – No or little pre-market testing – what about the national toxicology program in the US – it is done but not nearly enough for all pre-market product testing. I think that if one thinks there is a need to validate or keep industry honest by having a watch dog then, I am not against that but we really need to be aware of the fact that the burden for government to be doing all of the pre-market testing for everything is insurmountable. Between the kinds of reviews that are done and GLP there certainly is every effort to make certain that the quality of testing done by industry is good. But you are right, very little is done in Canada at the government level similar to what is being done in the US. We the world relies very heavily on the work that is done in the US in these various areas.

Don Wigle, I did not mean that government would take over toxicity testing – Canada is getting a total free ride which I think is wrong and we should have independent expertise. We need to have individuals with the expertise who can look at the private sector. How would you audit a private sector study if you didn’t have the independent expertise to do the audit? All you need to do is look at the historic examples of industry not doing what is in the public interest.

Dan Krewski – pre-market testing by government – March 9th, 1977 – Canada and FDA – a band on saccharin – last study ever done in Canada of that type in terms of pre-market testing.

Annie Bérubé – A quick note on the precautionary principle it has a very long history of being implemented to various other jurisdictions – first time in Canada CEPA 1999 – preamble government turned around and said that we are stuck with this principle, how are we going to implement it and how is it going to affect our regulatory risk assessment and risk management – consultation process began – government had a discussion paper which would tell all the affected programs – this precautionary principle affects this legislation and this is how you are suppose to implement in your program. As far as I know this was never concluded never a final discussion or decision on the level that the precautionary principle should be incorporated into the day to day risk assessment and risk management decision and I might be wrong but I can’t think of any regulatory decision at the federal level that hasn’t invoked the precautionary principle for taking a specific decision so the precautionary principle is intended to help risk assessment and risk management deal with the uncertainty with regard to children’s environmental health and so I think it is high time to determine how best to implement this principle that is in our legislation.

Dan Krewski – Annie you brought up the precautionary principle that is part of the preamble of CEPA -- the McLaughlin Centre is WHO collaborating centre as of last year, in population health risk assessment – first major event with WHO was to host an international meeting here last July 2005 purpose was to peer-review WHO’s precautionary principle framework. Policy document and how we should exercise precaution in the face of scientific uncertainty. We had the workshop to review the framework and we had a number of case studies discussed at that workshop and we are now working with WHO to finalize the framework and publish the framework and the associated presentations as a proceedings volume in the Journal of Toxicology and Environmental Health Sciences. That may give you some guidance along the lines of what you are looking for or some suggested policy options to think about.

Question: Mary Ellen Starodub – I am a toxicologist and a consultant on risk assessment in health and environment with more than 15 years experience working with levels of government and industry and with the children’s health institute and their voluntary program. It is a great
discussion but it is really focusing on products and our focus here is children’s environmental and mental health. My role is to bring it back to the environment. But I don’t want to loss the opportunity to draw on what we have heard this morning about public perception and the public perception that natural health products or the natural origins is not a problem and it is a big problem and there is a big gap in the legislation. If we are looking at legislation discussion of products and children and mental health, we need to be aiming at that and there are many examples and most of those natural health products have a pharmacological component to them and there should be at least labeling. That is the minimal amount of legislation that could be done. We can look at California. Going back to the environment and children, we have industry, we have lifestyle choices, city planning, and all sorts of things that affect children’s environmental health and I am wondering if this panel and the members working on this project and if you will be looking at the issues and how legislation currently provides support to communities, to actual home owners and their families when it comes to contamination that is moved off site such as a product as lead paint in a household itself or whether from historical occurrence emissions from industry. It has been my experience that there is a burden on the homeowners themselves. I am wondering if there is some sort of mechanism that we can build into our legislative framework that provides the support that is needed for us as individuals and our communities to adjust to solving these very difficult problems.

Answer: Brian Ladd – We are focusing our discussion narrowly on CEPA and to some extend the developing Canadian Health Protection Act. Your question on how these set of initiatives are needful could be incorporated into that legislation or we could imagine new kinds of instruments or initiatives that could deal with this outside of these two big acts.

Mary Ellen Starodub – I am looking to you as experts in legislation but the other side of the coin – do we have a framework that will protect us, the community – I will give you an example of a situation where we have mining communities and have high levels of metal contaminants – arsenic, the concern is that poses a risk to children. Is the migration of drinking water from the soil itself, this is something that needs to be addressed. So there is no industry accountable we want to go and clean them up but then where does that burden of responsibility lie? Who is going to pay for it? Because we have situations where members of the community say you can come onto our property and sample because we need to know whether or a sense of the contamination but now those people cannot get a mortgage on their property and sell it because CNHC people are so risk adverse – I am wondering if under this legislative umbrella that there is some way that we can provide source or mechanism assistance to communities that want to improve their situation for future generations. We can do this in a way that will elevate the impediment that we face right now.

Answer: Brian Ladd – I know that one of the guiding principles – to make a case and to what extent because it seems like maybe some of those concerns if you are looking to damage to the environment that is immediately affecting a specific community that kind of thinking ought to be included in decisions what the political environment – whether historical or current are responsible for but I know it is very difficult to track down all the contributors to problems that are not immediate or don’t have a short history. I don’t know it is such a good question.

Mary Ellen Starodub – I am wondering if in the US it is different, if there is any sort of provision for similar concerns.

Don Mattison – Yes, we have an agency that is a part of CDC, Agency for Toxic Substances Disease Registry (ATSDR) and they provide some recourse – they do community consultations, they look at exposures, potential health hazards, and can place sites and communities on the
superfund list which makes them available for some resources for cleanup. I don’t know if it is always comfortable or appropriate for the communities, I know that in the US some communities strongly oppose that activity. The town in Colorado called Leadville which is a mining community and they have been at odds with the ATSDR about the cleanup. There are some litigation opportunities available, I don’t know if those are always the best.

Annie Bérubé – Health Canada – I think that the US program has triggered some very important and interesting epidemiologic research in those contaminated sites – as far as I know there is no equivalence in Canada. We do have a contaminated sites program where certain sites that are contaminated fall under federal jurisdiction and then that would trigger human health assessment. Canadian program is much narrower program than the superfund program in the US. I think it is a huge gap and it has to be addressed. I think consistently exposures in home indoor air quality is a huge regulatory gap that we are still struggling with and given the capacity to communicate, Health Canada has a specific concern about the exposure scenario that they would like investigated and I think it is a huge gap and I can’t think of any federal legislation that covers that at the moment.

Robin Moore-Orr – CICH – The report of the contaminated blood from the Argentine study – one of the strong recommendations was that there would be a no fault insurance largely directed at medical procedures and medical products but the problem that you raise is really very important if you know something then it can have very adverse social effects – you can’t sell your house, is very similar to the sort of problem that we had with HIV testing because most insurance companies consider either that if you make an appointment and don’t keep it or you are tested and your test results return negative, are you a non-insurable risk?. Some occupational employment considerations because of the responsibility of the company of their health coverage and so on. But perhaps something along those lines which would provide protection for people because we do want to know about these things. You cannot improve them if you don’t know about them. I wanted to raise one question, perhaps you have already looked at this, but it seems like one of our emerging problems is that appearance in water of pharmaceutical products – many that are endocrine disruptors – very negative to developing resistance – I don’t know where – is that covered somewhere, I think that water is a separate act Annie. Clearly it is becoming a serious environmental problem.

Annie Bérubé – Health Canada – this was a challenged that was identified 2-3 years ago, when we started to do a little bit of monitoring in Canada and found traces of pharmaceuticals but not in drinking water sources but in waste water affluence. So as far as I know it hasn’t been found in drinking water maybe because it is not monitored but it is in waste water affluence for sure. Then it was discovered that it was a regulatory gap between the Food and Drug Act and Canadian Environmental Protection Act whereby we assess the safety of drugs and pharmaceuticals for their intended use but we don’t assess their fate into the environment and the second exposure that might occur at the population level. So there are environmental assessments regulations that are about to be published if they have not as yet been published to address that regulatory gap and I believe that they are coming into force under CEPA – authorize the regulation and use and better monitoring of pharmaceuticals. I think we are just starting to tackle this huge issue.

Question: Manji Sah – Health Canada – I am wondering by listening to the discussion and concentrating on CEPA and the Canadian Health Protection Act, have we not narrowed the focus – identified the areas of greatest concern – i.e., substances and products, because there is a whole range of things out there that affect children’s health outside the range of the Minister of the Environment and Minister of Health. We need to bring another perspective. Have we
narrowed it down too much? Are we dealing with the pathways of exposure which would require a whole range of different side measures to do something about or are we just focusing on the quality of the products which can be federally handled? We can establish guidelines, levels, how many parts per million are acceptable – to me coming from a policy world that is quite a different kind of an approach. Under CEPA we have the polluted problems and we can go after the companies and contaminated sites and such but what kind of latitude does CEPA have when the environmental health policy is something like the toxic mould issue that happened in British Columbia when the homeowner got completely stuck and had run from one level government to another and there was no help and in the meantime people are exposed to the toxic mould and face the environmental health consequences. You can have guidelines under CEPA but guidelines do not have the weight of law so would the panel consider that since guidelines don’t work we should regulate everything and if we say that we have to acknowledge that a large effectiveness is dependent on government’s ability to monitor and enforce, and currently we are going less down that path of monitoring, enforcing, with voluntary industry standards. So there are several questions and issues that I am raising – I invite the panel to speak on any or all of these aspects.

Answer: Annie Bérubé – Health Canada – Why are we focusing so much on CEPA and the Canadian Health Protection Act – mainly because that is how the request for proposal was written. I agree that there are other pieces of legislation and guidelines that address the environmental hazards to children. The three research teams were specifically asked to focus on those two pieces of legislation.

Don Wigle – Should we be focusing on testing the quality of products or would some integrated measure of exposure like monitoring do?

Manji Sah – Health Canada – Pathways of exposure rather than the quality of the product – scientific evidence we can build a case for the quality of the product but if we are looking at pathways of exposure that requires partnerships with a wide range of people which would be outside the federal government and that is what we ought to be concentrating on.

Don Wigle – I don’t think that biomonitoring is the answer to all our problems but for high priority issues and those for which you have a valid biomarker, it seems to me that a biomonitoring approach might be better than a whole lot of regulation. One of the arguments for biomonitoring is that it helps you focus on the main problems. If we had an appropriately robust biomonitoring policy under CEPA, then, governments could track population exposures and more readily detect any problems that come up. Take for example, the increased levels of PCDEs in breast milk. Instead of waiting for some program to decide that they are going to look at it, proactive biomonitoring would likely have gained several years lead time in detecting this problem. If we were doing that type of biomonitoring more systematically as soon as a new product is released, or whatever scientifically makes sense, you could track populations to see if they are exposed (i.e., the new chemical is found in human biosamples). If this happens, governments would then be alerted to the need to identify the most important exposure pathways and to implement targeted interventions. All of this is to say that biomonitoring would help us focus on real exposure problems instead of trying to regulate everything.

Question: Sheryl Bartlett – Health Canada – addressing question #3 – we can agree that there are specific requirements, but how do we make the decision to do that research in Canada – how do we get the resources in Canada to address these issues. Do we need to in your opinion enshrine this in legislation?
Annie Bérubé – Health Canada – CEPA 1999 review we ended up with this clause that required research on endocrine disruptors and it is really rare that you have something that prescriptive in legislation. You must undertake research on one specific issue. I think that most of that research was done through the Toxic Substance Research Initiative. So one has to wonder if you didn’t have the legal requirements to do that research would the federal government have funded such a program. So, I think that there is some merit in terms of having prescriptive requirements for research in legislation because then it does trigger funding and research programming that goes with it. The disadvantage of that is that there will always be new emerging issues so if you make your legislation very prescriptive you might not be able to keep up with the new emerging issues. So I think it is a balance that I don’t see why we can’t have legal requirements to conduct research that is broadly defined so that it allows you to address issues as outlined in US executive order is actually what mandated US government to launch a longitudinal cohort study. So there you have an executive order that is a legal requirement to launch a huge research project. So I think that there are examples in other jurisdictions where legislation has been used to mandate research.

Brian Ladd – University of Alberta – I wonder about the absence of mandated research and explicit goal setting in certain environmental quality objectives in CEPA. If there are explicit environmental goals embedded in the act that need to be mapped or move forward to measure, because of the grand guiding principles of CEPA need to be questioned about moving towards goals that are tangible – sustainable development language when we look at gross measures in a nation’s ecological footprint. Canada at something like 8 hectares per person bio-productive land that is required to sustain our lifestyle and we recon that the earth can given our current population can support people at about 2 hectares of bio-productive land per person. So we have this huge gap and there is always going to be differences between nations. I would like to see in CEPA clarification around meaning of the guiding principles and to see some actual measurable objectives that gives some meaning to those principles in legislation so that people can understand and can measure progress against.

Don Mattison – NIH – The one thing that Don mentioned earlier relates to biomonitoring I think that is one area that clearly describes the value of biomonitoring data for understanding and setting goals and for determining potential environmental and human impacts. The other thing that we haven’t talked about but it does relate indirectly to children’s health is no reason to presume that other organisms developing in the environment may not be adversely affected. So one of questions would be is there any value in tying the developmental health of humans to the development of health of other species in the context of ecological consequences. I don’t know what CEPA says about ecological health.

Annie Bérubé – Health Canada – there are requirements in CEPA for environmental monitoring for affects on wildlife and some of the research funding is triggered by some of the research done on wildlife. The effect of PCB was first seen in wildlife. There are requirements in CEPA for that kind of research – endocrine toxicants.

Claire Franklin – McLaughlin Centre – I just wanted to make a comment on the issue of putting requirements in legislation for doing research. Sometimes things get into pieces of legislation because of the chair of the committee not necessarily because of any constitutional right to be there. Generally speaking I know with the pesticide act when there was any suggestion by any of the opposition members to put something in that would force government’s hand to spend money in a prescribed way it was never considered. The legislation with the health committee you get the authority to do things within the legislation you do not prescribe the mechanism whereby one does it. But it doesn’t mean that it couldn’t happen because it really seems to
depend upon the committee and the strength of the legislation. When CEPA went back into the House had over 400 amendments.

Don Wigle – Would like to see legislated funding for environmental and occupational health research. We need a National Institute of Environmental and Occupational Health that is appropriately funded at US standards, i.e., at least $100 million a year for environmental health research.

Robin Moore-Orr – CICH – where there are specific areas where we do need research – paid attention to our aboriginal and northern communities with good reason but an enormous area now I believe is inner city – low socio-economic immigrant children and we need to be looking at all children – another potential area of high risk group which has not had the same attention as our northern areas have had.

Dan Krewski – Why do we focus just on children as a potential susceptible sub-population? I can define many vulnerable sub-populations based genetics, age? What makes children unique?

Annie Bérubé – Health Canada – we are just beginning to tackle mature adults and seniors vulnerability to environmental contaminants and some of the research is going to happen in the context of climate change and vulnerability to heat waves and extreme weather and certainly for environmental contaminants as we are just starting with pregnant women and children’s environmental health but I think eventually would want to extend into other vulnerable populations.

Dan Krewski – even before we had special provisions for children’s health we still took into account potential health risks to children in risk assessment and risk management actions. I am just trying to say that it is good to focus on children because there are some specific characteristics but I think that the notion is starting to emerge – US national research council that I chair is trying to define how we should do toxicity testing in 10-20 years down the road really looking at changing the way we think about these issues and we are looking at life stages, vulnerabilities, we have a paradigm unveiled this fall – move us in a totally different direction but it doesn’t really focus necessarily on any population subgroup but tries to take up a much broader perspective.

Annie Bérubé – Health Canada – I think that some of the very interesting research that is coming up in environmental exposure and new emerging diseases such as Parkinson’s Disease probably should be focusing more on those health end points which we have neglected in our risk assessment.

Robin Moore-Orr – CICH – could we justify children as a very special group? Yes, we can because we have a moral obligation; children and particularly very young children have no control over their exposures unlike adults so we have a moral obligation to be particularly careful of them; obesity in children there are very distinct environmental concerns – obesity research suggests this and issues surrounding asthma – it is going to cost us a lot of money in medical care and lost productivity – the resource for the future.

Fatma Maged – Environment Canada – I was looking at models outside of Canada in terms of the governance of this policy – falls between the cracks because there is no accountability – no governing accountability. We separate, Environment Canada looks at the protection, Health Canada looks at the remedy and looks at the research at what are the causes. So one of the
things I have seen in Europe and Australia is that they begin with a charter or an agreement between all stakeholders and they define entitlements or responsibilities and the entitlements are for whatever, children, groups, aboriginals, and then they develop a governing council or a body in Australia it is the National Council in EU Council of Ministers which governs – oversee whatever strategy is enacted. We need to have a charter for children’s environmental health. Who could be capable of championing this need? Where should it start? The government has five priorities and will act on that if the pressure is not coming from outside. The government is going to continue to have those five priorities.

Don Spagy – University of Alberta – must come from the public such as an NGO such as CICH or equivalent it really has to be drawn out of the populous of our society for it to have any credence. Governments can mandate it but I don’t think that necessarily that is going to have the same effect as if people in general want to have it.
**SUMMATION** – Jamie Benidickson, Faculty of Law

Michelle Turner – a lot of questions about accessing information today – circulate PDF of all the presentations on Monday to the participants of the workshop and then within a few weeks time we should have our draft report and workshop report up on our web site and we will send everyone a link to that web site so that you can provide us with comments that you may have.

Jamie Benideckson – This is unbelievably exciting because all afternoon people have been asking does CEPA say this, does CEPA say that, is there anything about this in CEPA, I brought it along so I thought we could start reading it. We have been taking about the preamble but we start before the preamble back with the declaration so that we are oriented. The declaration in CEPA states: 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.

Let me if I can try and quickly go through some highlights of the day.

Michelle’s presentation I think clearly establishes that children face distinctive environmental health risks. It seems that failure to respond to risks of children given that we now know about them is no longer an option. To fail to address children’s environmental health would be to fail to address human health. But how do we do this?

Mike’s presentation took us through a literature search, an opinion survey, and produced a number of intriguing findings. Among the things that were striking to me – something that stood out – 50% of people more or less expert or non-expert Canadian, European, American, do not believe that law adequately protects children’s environmental health. But I did not see i.e., on the initiatives to be taken what should we do next -- any reference to legislative or regulatory reform. I saw instead references to more research, education, biomonitoring, efforts to protect the rights of children, threats to children’s environmental health. But again, I am from the law school and I have to tell my Dean that I spent the day doing law. So excuse me for reverting to that theme.

Let me say a few things about the stimulating remarks of the panelists.

I was encouraged to hear from Brian Ladd and Don Spady about their report that is due shortly. Brian spoke about the evaluation of governing instruments, The evaluation of governing instruments triggers in my mind a number of thoughts – what are the criteria for evaluating a governing instrument? I can certainly imagine legal criteria, but I think what was intended in Brian’s remarks, and what most people around the round would understand is another question: is this legislation – is the regulatory framework effective or useful to us in accomplishing the goals we seek to achieve – that is improve children’s environmental health? That task assessing legislation against that criterion is going to be difficult.

The Commission for Environmental Cooperation has only recently produced a set of indicators after considerable thought that this will do something for us. All day long we have heard from people talking about the need for more funding to promote research and I take it that that research will in some measure be used to provide baseline or bench marks against which to assess how well we are doing now and in the future. This seems to be central to assessing or evaluating governing instruments.
Don Spady boiled down 700 documents into a core recommendation. As we go about the law making process we should think about the distinctive characteristics of children because they are distinctive. That is a proposition associated with the intrinsic importance of children’s environmental health about their entitlement to have public institutions respond to those needs. Children are nothing more or nothing less than a sub-category of the human diversity that we celebrate in so many ways and will in some point include the older person that Dan Krewski is on the way to becoming.

From the remarks of Don Mattision and Annie Bérubé I took a joint message. Annie in her opening comments said that Health Canada was looking for best practices from elsewhere. Don spoke about reporting requirements as well as about the importance of education and communication. Here is what I thought was the linkage – both are talking in some way about an information based strategy for doing better. Both are addressing the issues of the dynamic nature, the dynamic element, of moving the children’s environmental health agenda forward. We are seeking better tools to allow us to improve performance over time. Now if information is one driver of improvement Don Wigle highlighted another driver of improvement.

Now if information is one driver of improvement Don Wigle highlighted another driver of improvement. Funding for epidemiological research and other research is essential to generate data, to analyse that data and lay the foundations of effective public policy. If I had not had that sad experience with the Senators game on Tuesday night and lost much of my voice, I would put Don’s comment in the words of Tom Cruise from Jerry McGuire, ‘show me the money’.

If you will pardon a little diversion here, I just finished writing a legal history of sewage. What struck me as I was listening to the discussion today, in terms of research that I have done, the learning I think I have accomplished, wondering about the last couple of centuries about sewage is that of course the work of Dr. John Snow was hugely influential. I in fact end up arguing that the foundations of much of the modern regulatory state from public health to water works through municipal financing and so on can be traced to the sense of community and interaction between the environment in which we live and the well-being of our society that was really focused by Snow’s research. So this research is actually an inquiry into the well-being of humans.

How many humans might benefit from better research supporting improved public policy? This I think is the question that Robin Moore-Orr answered in her reference to a discussion of comparative and collaborative research in countries of Latin America. All populations of the world might well benefit from this kind of inquiry. We are talking about a project that has some global potential.

Let me offer a provisional conclusion – on at least one issue that I have been thinking about – the issue of whether it would be appropriate in a legislative forum to articulate explicitly the importance of environmental health of children. Here is my provisional conclusion – it may not be necessary – it absolutely will not be sufficient – but it very well might be useful – it might be useful in helping to integrate or coordinate or strengthen the wide range of activity that is underway that we have been talking about today whether it is policy making or conducting research or inter-governmental communication. And in strengthening that current activity we are giving ourselves a neon sign to point to. It is the neon sign that has great virtue and tie in to the very last comment from our participants today – that neon sign is the key to accountability in the Canadian system of government – which is a combination of law making and allocation of resources to fulfill the objectives of law.
In any event, let me close by thanking on behalf of our research team, Dan Krewski, Mike, Michelle, and others who are not here, thanks to the panel covering a huge water front, putting things into a wider context and sharing experiences. Thank you for spending your day here and helping us better understand how this project will further unfold.
APPENDICES

Appendix A: Agenda

Appendix B: List of participants
## APPENDIX A

The Faculty of Law and  
The McLaughlin Centre for  
Population Health Risk Assessment  
present a workshop on:  

### HEALTH POLICY APPROACHES TO  
CHILDREN’S ENVIRONMENTAL HEALTH

### AGENDA

Friday, March 31, 2006  
University of Ottawa  
Senate Room, Tabaret Hall

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>9:30am</td>
<td>Registration and Coffee</td>
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<tr>
<td>10:00am</td>
<td><strong>Introductory Remarks and Project Overview</strong> – Dr. Daniel Krewski, McLaughlin Centre for Population Health Risk Assessment</td>
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<td>10:15am</td>
<td><strong>The Policy Problem: Emergence of Children’s Health as a Focus for Legislative Action</strong> – Michelle Turner, McLaughlin Centre for Population Health Risk Assessment</td>
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<td>10:30am</td>
<td><strong>Legal Framework for Children’s Environmental Health in Canada</strong> – Jamie Benidickson, Faculty of Law</td>
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<td>11:15am</td>
<td><strong>Comparative Approaches to Children’s Health and the Environment</strong> – Dr. Michael Tyshenko, McLaughlin Centre for Population Health Risk Assessment</td>
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<td>12:00pm</td>
<td>Lunch Break</td>
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1:00pm  **Panel Discussion on Policy Options for Children’s Health in the Context of CEPA, 1999 and the Proposed Canada Health Protection Act**

**Leader:** Dr. Daniel Krewski

**Members:**
- Dr. Don Wigle, McLaughlin Centre
- Dr. Don Mattison, National Institutes of Health
- Dr. Robin Moore-Orr, Canadian Institute of Child Health
- Annie Bérubé, Health Canada
- Donald Spady, University of Alberta
- Brian Ladd, University of Alberta

1:30pm  **General Discussion**

3:00pm  **Break**

3:15pm  **Summary and Wrap-up** – Jamie Benidickson, Faculty of Law
## APPENDIX B

### LIST OF PARTICIPANTS

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
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<tbody>
<tr>
<td>Dan Krewski</td>
<td>University of Ottawa</td>
<td>Speaker</td>
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<tr>
<td>Jamie Benidickson</td>
<td>University of Ottawa</td>
<td>Speaker</td>
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<tr>
<td>Michael Tyshenko</td>
<td>University of Ottawa</td>
<td>Speaker</td>
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<tr>
<td>Michelle Turner</td>
<td>University of Ottawa</td>
<td>Speaker</td>
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<td>Don Wigle</td>
<td>University of Ottawa</td>
<td>Panelist</td>
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<td>Vic Armstrong</td>
<td>University of Ottawa</td>
<td>Participant</td>
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<tr>
<td>Miriam Levitt</td>
<td>University of Ottawa</td>
<td>Participant</td>
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<tr>
<td>Jacinthe Seguin</td>
<td>Health Canada</td>
<td>Participant</td>
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<td>Annie Berube</td>
<td>Health Canada</td>
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<td>Manju Sah</td>
<td>Health Canada</td>
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<td>Jessi Mahon</td>
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<td>Marcia Armstrong</td>
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<td>Pat Rasmussen</td>
<td>Health Canada</td>
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<td>Donald Spady</td>
<td>University of Alberta</td>
<td>Panelist</td>
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<td>Brian Ladd</td>
<td>University of Alberta</td>
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<td>Don Mattison</td>
<td>National Institutes of Health</td>
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<td>Elizabeth Everhardus</td>
<td>Pollution Probe</td>
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<td>Sheryl Bartlett</td>
<td>Health Canada</td>
<td>Participant</td>
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<tr>
<td>Seema Nagpal</td>
<td>Canadian Medical Association</td>
<td>Participant</td>
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<td>Tubao Yang</td>
<td>University of Ottawa</td>
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<td>Quiying Yang</td>
<td>University of Ottawa</td>
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<tr>
<td>Cheryl Chaffey</td>
<td>PMRA, Health Canada</td>
<td>Participant</td>
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<td>Martha Robinson</td>
<td>City of Ottawa</td>
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<td>Esther Moghadam</td>
<td>City of Ottawa</td>
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<td>Regina De La Campa</td>
<td>Canadian Institute of Child Health</td>
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<td>Robin Moore-Orr</td>
<td>Canadian Institute of Child Health</td>
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<td>Anne-Marie Pelletier</td>
<td>Environment Canada</td>
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<td>Fatma Maged</td>
<td>Environment Canada</td>
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<td>Claire Franklin</td>
<td>University of Ottawa</td>
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<td>Lyle Fairbairn</td>
<td>University of Ottawa</td>
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<td>Jennifer Maxwell</td>
<td>Government of British Columbia</td>
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<td>Sharon Moss</td>
<td>Government of British Columbia</td>
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<td>Mary Ellen Starodub</td>
<td>Government of Ontario</td>
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<td>Krista Kreling</td>
<td>City of Ottawa</td>
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<tr>
<td>Tara Kelly</td>
<td>Government of Newfoundland</td>
<td>Participant</td>
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<tr>
<td>Elaine Easson</td>
<td>Health Canada</td>
<td>Participant</td>
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APPENDIX 2

DISSEMINATION PLAN

As part of the Research Report the work undertaken will be disseminated under the following plan:

1) Preliminary analysis of work was presented at the University of British Columbia, Vancouver on January 13th 2006. Seminar presented: “Health Policy Approaches to Children’s Environmental Health: Structured content analysis, legal database review, case studies and interviews for identification of governance and non-governance tools.” Dr. Michael Tyshenko acted as the McLaughlin Centre team representative and participated in workshop discussions and policy recommendations for improving children’s environmental health.

2) Report findings were disseminated to the Vulnerable Populations Division, Healthy Environments and Consumer Safety Branch, Health Canada and other stakeholders in a workshop hosted by the McLaughlin Centre for Population Health Risk Assessment on March 31, 2006. The workshop was held at the University of Ottawa.

3) Following the workshop on March 31, 2006 the draft report, workshop presentations, and rapporteur’s report were available for comment from the McLaughlin Centre website at the University of Ottawa (www.mclaughlincentre.ca) (Appendix 1).
4) The final report will be disseminated to all respondents who were interviewed. Many respondents who participated requested that the final document be sent to them once available.


7) Final Project Report will be posted and available via the Internet at:

www.mclaughlincentre.ca.

8) The following manuscripts derived from this work are currently in preparation:

- Case studies in Children’s Environmental Health
- Improving Children’s Environmental Health in Canada by Utilizing Experiences from Other Jurisdictions
- Risk Communication, Public Perception and Prioritizing Children’s Environmental Health Issues in Canada
- Recommendations and Policy Options for Improving Children’s Environmental Health in Canada
APPENDIX 3

GOOGLE SCHOLAR KEYWORD SEARCH LISTS (80)

1) Governance Tool = Legislation

Keywords:

protecting fetus health hazard environment legislation Canada
protecting fetus health hazard environment legislation United States
protecting fetus health hazard environment legislation European Union
protecting fetus health hazard environment legislation World Health Organization

protecting post-natal health hazard environment legislation Canada
protecting post-natal health hazard environment legislation United States
protecting post-natal health hazard environment legislation European Union
protecting post-natal health hazard environment legislation World Health Organization

protecting infant health hazard environment legislation Canada
protecting infant health hazard environment legislation United States
protecting infant health hazard environment legislation European Union
protecting infant health hazard environment legislation World Health Organization

protecting child health hazard environment legislation Canada
protecting child health hazard environment legislation United States
protecting child health hazard environment legislation European Union
protecting child health hazard environment legislation World Health Organization
2) Governance Tool = Regulation

Keywords:

- protecting fetus health hazard environment regulation Canada
- protecting fetus health hazard environment regulation United States
- protecting fetus health hazard environment regulation European Union
- protecting fetus health hazard environment regulation World Health Organization

- protecting post-natal health hazard environment regulation Canada
- protecting post-natal health hazard environment regulation United States
- protecting post-natal health hazard environment regulation European Union
- protecting post-natal health hazard environment regulation World Health Organization

- protecting infant health hazard environment regulation Canada
- protecting infant health hazard environment regulation United States
- protecting infant health hazard environment regulation European Union
- protecting infant health hazard environment regulation World Health Organization
protecting child health hazard environment regulation Canada
protecting child health hazard environment regulation United States
protecting child health hazard environment regulation European Union
protecting child health hazard environment regulation World Health Organization

protecting adolescent health hazard environment regulation Canada
protecting adolescent health hazard environment regulation United States
protecting adolescent health hazard environment regulation European Union
protecting adolescent health hazard environment regulation World Health Organization

3) Governance Tool = Voluntary codes

Keywords:
protecting fetus health hazard environment voluntary codes Canada
protecting fetus health hazard environment voluntary codes United States
protecting fetus health hazard environment voluntary codes European Union
protecting fetus health hazard environment voluntary codes World Health Organization

protecting post-natal health hazard environment voluntary codes Canada
protecting post-natal health hazard environment voluntary codes United States
protecting post-natal health hazard environment voluntary codes European Union
protecting post-natal health hazard environment voluntary codes World Health Organization

protecting infant health hazard environment voluntary codes Canada
4) Governance Tool = Guidelines, recommendations, incentives

Keywords:

protecting fetus health hazard environment guidelines recommendations Canada
protecting fetus health hazard environment guidelines recommendations United States
protecting fetus health hazard environment guidelines recommendations European Union
protecting fetus health hazard environment guidelines recommendations World Health Organization

protecting post-natal health hazard environment guidelines recommendations Canada
protecting post-natal health hazard environment guidelines recommendations United States
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protecting child health hazard environment guidelines recommendations World Health Organization

protecting adolescent health hazard environment guidelines recommendations Canada
protecting adolescent health hazard environment guidelines recommendations United States
protecting adolescent health hazard environment guidelines recommendations European Union
protecting adolescent health hazard environment guidelines recommendations World Health Organization
APPENDIX 4 SEARCH METHODOLOGY FOR CONTENT ANALYSIS

For content analysis searches for the keyword “Children” was conducted, in some cases this term was subdivided into 5 discrete groups defined to include stages representing children from the fetus to persons aged 18:

- fetal period
- post-natal period
- infants
- children
- adolescents

When searching the term “Hazard” was used, for searches of large databases hazards were expanded to include multiple media search terms:

- air
- water
- soil
- food
- consumer products
- built environments
- radiation emitting devices
- chemical
- physical hazards
- biological agents
Content was analysed for various “Governance instruments” and four main areas were used were include:

- legislation
- regulations
- voluntary codes
- incentives (programs, plans, warnings)

Finally, content was searched for 4 different jurisdictions:

- Canada
- United States
- European Union
- World Health Organization

Keyword search strings were carried out using these different combinations. The total number of searches conducted for Internet and grey literature (Internet sources) was 80: 5 stages (fetus, post-natal, infant, child, adolescent) x 4 governance instrument (legislation, regulation, voluntary codes and incentives) x 4 regional groups (Canada, United States, European Union and the World Health Organization) (see also Appendix 3). The strategy is summarized in Figure A4.1.
Content was taken from four main sources: newspapers, internet (webpages), internet (grey literature) and peer reviewed journals. Content used is summarized in Figure A4.2. Note that newspaper content obtained from the internet database as html files were converted to Microsoft word (.doc) format for searching. Grey literature adobe acrobat PDF files were converted to Microsoft word format for searching. The goal of content analysis is to identify legislation and initiatives for further analysis and legal interpretation in the context of children’s environmental health.
Figure A4.2. Summary of the four content areas used to determine a short list of legislation and initiatives in the four jurisdictions.
APPENDIX 5 SEARCH METHODOLOGY FOR GREY LITERATURE CONTENT

Searches were carried out initially using a series of keywords: “protecting”, “health”, “hazard” combined with stage of development (fetus, post-natal, infant, child adolescent), governance tool (either legislation, regulation, voluntary code or initiative) and jurisdiction (Canada, United States, European Union or World Health Organization).

Further searches were subsequently carried out on the files retrieved using the keywords to find the name of Acts, legislation, regulations or initiatives using the following method:

1) PDF Files Downloaded from Google scholar using keyword search criteria using internet web spider utility (Software used: A Great Grabber v. 1.0)

2) Retrieved files were converted from Adobe PDF format to MS Word Documents (BATCH) (Software used: Solid Converter PDF)

3) Keyword searches of the MS Word files were performed (BATCH) (Software used: AJC Grep)

4) The text surrounding the keyword (1-2 lines) were captured and copied to a separate MS Word text file. (Hex dump of context line to separate MS Word text file using software: AJC Grep).

5) Analysis of text dump files and creation of a short list of legislation/governance tools by eye. (Software used: Microsoft word).
APPENDIX 6

EXPERT INTERVIEW SURVEY QUESTIONS AND CONSENT FORMS

Health Policy Approaches to Children’s Environmental Health Survey

Objective:

Our objectives are to identify and evaluate governance instruments from various jurisdictions designed to protect children’s health from exposures to environmental hazards. We hope to identify challenges, barriers and facilitators to implementation of these governance instruments and the effectiveness of such implementation. The proposed research is intended to assist policy makers in government by utilizing the experience of other jurisdictions to develop and implement legislative and other measures to safeguard children’s health from environmental hazards in the context of revisions to Canadian Environmental Protection Act (CEPA), 1999 and the proposed Canada Health Protection Act (CHPA).

10 survey questions to be asked of experts for CEPA children’s health:

1) Briefly describe your organization’s role in children’s environmental health protection.

2) Briefly describe your personal background and experience in children’s environmental health protection.

3) What regulatory statutes are used to protect children’s environmental health in your country?

4) What non-regulatory instruments for children’s environmental health protection are used (including public consultation, community-based initiatives, and voluntary codes)?

5) Are you aware of any information or communications-based strategies for children’s environmental health protection (such as labeling, warnings, or educational programs)?

6) How should the effectiveness of actions taken to protect children’s environmental health be evaluated?
7) In your experience, what are the most effective regulatory or other strategies to protect children’s environmental health?

8) Please describe any barriers that you have encountered in your work in children’s environmental health protection.

9) What improvements do you think could be made in current children’s environmental health risk management practices?

CANADIAN RESPONDENTS ONLY

10) Does the current Canadian Environmental Protection Act adequately protect children’s environmental health?

If not, how could it be improved?

FOREIGN RESPONDENTS ONLY

10) Does current legislation in your country adequately protect children’s environmental health?

If not, how could it be improved?

(WE WOULD APPRECIATE YOUR ASSISTANCE IN IDENTIFYING OTHER EXPERT INDIVIDUALS WHO SHOULD BE CONTACTED FOR AN INTERVIEW ON THIS TOPIC).
CONSENT FORM - ENGLISH

May 11, 2005

Dear __________:

The McLaughlin Centre for Population Health Risk Assessment at the University of Ottawa is conducting a project entitled “Health Policy Approaches to Children’s Environmental Health”. This purpose of the project is to assist policy makers at Health Canada in utilizing the experience of other jurisdictions to develop and implement legislative and other policy measures to safeguard children’s health from environmental hazards in the context of revisions to Canadian Environmental Protection Act (CEPA), 1999 and the proposed Canada Health Protection Act (CHPA).

As part of this project we are conducting interviews of international experts in the field of children’s environmental health in order to discuss children’s environmental health issues and the challenges, facilitators and barriers of implementation of children’s environmental health legislation in their respective jurisdictions. The telephone interview will be conducted in English by Dr. Michael Tyshenko at the McLaughlin Centre, and is anticipated to take approximately 30 minutes.

Please see the enclosed consent form for additional details of this study. If you have any questions please feel free to contact Dr. Tyshenko at (613) 562-5800 ext. 2311 (phone) or mtyshenk@uottawa.ca (email).

If you are able to participate, please sign the enclosed consent form and return it to us in the enclosed envelope. You will then be contacted to set-up an interview time.

Sincerely,

Daniel Krewski, PhD, MHA
Professor and Director
McLaughlin Centre for Population Health Risk Assessment
Consent Form (English)

Principal Investigators:
Dr. Dan Krewski, University of Ottawa, Faculty of Medicine, 613-562-5381
Prof. Jamie Benidickson, University of Ottawa, Faculty of Law, 613-562-5800 ext. 3287
Dr. Robert Clarke, University of Ottawa, Faculty of Medicine, 613-562-5280

Research Team:
Dr. Michael Tyshenko, McLaughlin Centre for Population Health Risk Assessment
Michelle Turner, McLaughlin Centre for Population Health Risk Assessment
Melanie Mallet, Legal Associate
Dr. Donald Wigle, McLaughlin Centre for Population Health Risk Assessment
Dr. Vic Armstrong, Consultant
John R. Harrison, President, JRHToxicology
Lorraine Craig, Institute of Risk Research

About the study:
The goal of the proposed research is to utilize international evidence and information on policy options to develop recommendations for the revision and implementation of the Canadian Environmental Protection Act, 1999 and the proposed Canada Health Protection Act. The results of this research will enable policy makers at Health Canada to develop legislation designed to safeguard and protect children from the health impacts of environmental hazards. International legislation, policy options and risk communication programs will be evaluated to determine how environmental health legislation address both current and potential environmental hazards, how legislation is effectively implemented to protect children’s health and how the precautionary principle is used to guide legislative decisions.

Personal interviews of experts in the field of children’s environmental health are being conducted as part of this project in order to discuss children’s environmental health issues and the challenges, facilitators and barriers of implementation of children’s environmental health legislation in their respective jurisdictions. This study is funded by Health Canada’s Health Policy Research Program.

If you agree to participate: It will take approximately 30 minutes of your time to complete a series of 10 questions during the English telephone interview. Please read over the rest of this page carefully.

Anonymity and confidentiality: Anonymity can not be guaranteed through participation in this project as the purpose of the interview is to seek expert opinion on children’s environmental health legislation in your jurisdiction. Interviews will be recorded and quotations may be used in the final research report and publications. Participants will be given the opportunity to look over their transcripts prior to publication. The contents of the interview will be analyzed by members of the research team and recommendations for the revision and implementation of the Canadian Environmental Protection Act, 1999 and the proposed Canada Health Protection Act will be drawn. Data will be securely stored at the McLaughlin Centre for a period of 5 years.
Completion of the survey is voluntary: You are free to withdraw from the project at any time and may refuse to participate or answer questions for any reason.

Questions or comments?

If you have any questions about the research project, you may contact Dr. Michael Tyshenko, at the McLaughlin Centre for Population Health Risk Assessment at (613) 562-5800 ext. 2311 (phone) or mtyshenk@uottawa.ca (email). The results of the study can also be made available to you upon request through the above contacts.

Any information about your rights as a research participant may be addressed to Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 159, Ottawa, ON K1N 6N5, tel.: (613) 562-5841 or ethics@uottawa.ca.

Statement of Consent:
I have read this consent form. I have had the opportunity to discuss this research study with one or more of the investigators. The risks and benefits have been described to me. I understand that I will keep one copy of the consent form after signing it and will return the other to the study team. I understand that my participation in this study is voluntary and that I may choose to withdraw at any time. I freely agree to participate in this research study.

Participant Signature: ____________________________            Date: _____________
Participant Printed Name: ____________________________

I, the undersigned, have fully presented the relevant details of this research study to the participant named above and believe the participant has understood and has knowingly given her/his consent.

Printed Name: ____________________________            Date: _____________
Signature: ____________________________
Role in the study: ____________________________

*Form can be faxed to: (613) 562-5380
CONSENT FORM – FRENCH

Le 11 mai 2005

Madame, Monsieur,

Le Centre McLaughlin d’évaluation du risque pour la santé des populations de l’Université d’Ottawa mène un projet intitulé Health Policy Approaches to Children’s Environmental Health (approches en matière de politiques de santé environnementale des enfants). L’objectif du projet est de permettre aux responsables de l’élaboration des politiques à Santé Canada de profiter de l’expérience d’autres pays pour élaborer et mettre en œuvre des mesures législatives et d’autres mesures stratégiques en vue de protéger les enfants des menaces environnementales pour la santé. Ce projet s’inscrit dans le cadre des révisions de la Loi canadienne sur la protection de l’environnement (LCPE) et de la proposition d’une nouvelle Loi sur la protection de la santé du Canada (LPSC).

Dans le cadre de ce projet, nous prévoyons interviewer des experts internationaux en santé environnementale des enfants pour discuter des problèmes et des défis propres à ce domaine ainsi que des éléments qui favorisent ou qui empêchent la mise en œuvre d’une législation sur la santé environnementale des enfants dans leurs pays respectifs. L’entrevue téléphonique sera menée en anglais par Dr Michael Tyshenko, au Centre McLaughlin d’évaluation du risque pour la santé des populations, et devrait durer environ 30 minutes.

Je vous invite à consulter le formulaire de consentement ci-joint pour obtenir de plus amples détails sur l’étude. Si vous avez des questions, n’hésitez pas à communiquer avec Dr Tyshenko, par téléphone, au (613) 562-5800 poste 2311 ou par courriel à l’adresse mtyshenk@uottawa.ca. Si vous souhaitez participer à l’étude, veuillez signer le formulaire de consentement ci-joint dans l’enveloppe-retour. Par la suite, on communiquera avec vous pour fixer l’horaire de l’entrevue.

Veuillez agréer, Madame, Monsieur, l’expression de mes sentiments distingués.

Le professeur et directeur,

Daniel Krewski, PhD, MHA
Centre McLaughlin d’évaluation du risque pour la santé des populations
Université d’Ottawa
Formulaire de consentement

Chercheurs principaux :
Dr Dan Krewski, Université d’Ottawa, Faculté de médecine (613) 562-5381
Prof. Jamie Benidickson, Université d’Ottawa, Faculté de droit (613) 562-5800 poste 3287
Dr Robert Clarke, Université d’Ottawa, Faculté de médecine (613) 562-5280

Équipe de recherche :
Dr Michael Tyshenko, Centre McLaughlin d’évaluation du risque pour la santé des populations
Michelle Turner, Centre McLaughlin d’évaluation du risque pour la santé des populations
Melanie Mallet, avocate associée
Dr Donald Wigle, Centre McLaughlin d’évaluation du risque pour la santé des populations
Dr Vic Armstrong, consultant
John R. Harrison, président, JRHToxicology
Lorraine Craig, Institute of Risk Research

À propos de l’étude :
L’objectif de la recherche proposée est d’utiliser les faits et les renseignements recueillis sur la scène internationale relativement aux options de politiques, en vue d’élaborer des recommandations pour la révision et la mise en œuvre de la Loi canadienne sur la protection de l’environnement (1999) et de la proposition d’une nouvelle Loi sur la protection de la santé du Canada. Les résultats de cette recherche permettront aux responsables de l’élaboration des politiques à Santé Canada d’élaborer une législation qui protège les enfants des risques environnementaux sur leur santé. La législation internationale, les options de politiques ainsi que les programmes de communication des risques seront évalués pour déterminer comment la législation sur la santé environnementale permet de réduire et de prévenir les menaces environnementales actuelles et potentielles, dans quelle mesure sa mise en œuvre protège effectivement la santé des enfants et à quel point les décisions législatives sont fondées sur le principe de précaution.

Les entrevues individuelles des experts en santé environnementale des enfants menées pour les fins de cette recherche visent à discuter des problèmes et des défis propres à ce domaine et des éléments qui favorisent ou qui empêchent la mise en œuvre d’une législation sur la santé environnementale des enfants dans leurs pays respectifs. Cette recherche est subventionnée par le Programme de recherche sur les politiques en matière de santé (PRPS) de Santé Canada.

Si vous acceptez de participer : Veuillez prévoir environ 30 minutes de votre temps pour répondre à une série de 10 questions durant l’entrevue téléphonique en anglais. Veuillez également lire attentivement les renseignements qui suivent.

Anonymat et confidentialité : L’anonymat des participants au projet ne peut pas être garanti puisque l’objectif de l’entrevue est d’obtenir un avis d’expert sur la législation sur la santé environnementale des enfants dans votre pays. Les entrevues seront enregistrées, et des citations pourraient être utilisées dans le rapport de recherche final et publications. Les participants auront

**La participation à l’étude est volontaire** : Vous êtes libre de vous retirer du projet en tout temps et vous pouvez refuser de participer ou de répondre à des questions pour quelque raison que ce soit.

**Questions ou commentaires ?** Si vous avez des questions sur le projet de recherche, vous pouvez communiquer avec Dr Michael Tyshenko, au Centre McLaughlin d’évaluation du risque pour la santé des populations, par téléphone au (613) 562-5800 poste 2311 ou par courriel à l’adresse mtyshenk@uottawa.ca. Vous pourrez connaître les résultats de l’étude en faisant la demande aux personnes susmentionnées. Pour toute information concernant vos droits à titre de participant à une recherche, adressez-vous à un Responsable de l’éthique en recherche, Université d’Ottawa, Pavillon Tabaret, 550 rue Cumberland, pièce 159, Ottawa, ON K1N 6N5, tél. : (613) 562-5841, courriel : ethics@uottawa.ca.

**Énoncé de consentement :**
J’ai lu le présent formulaire de consentement. J’ai eu l’occasion de discuter de l’étude avec un ou plusieurs chercheurs. On m’a décrit les risques et les avantages de celle-ci. Je comprends que je dois conserver une copie du formulaire de consentement signé et retourner l’autre copie à l’équipe de recherche. Je comprends également que ma participation à l’étude est volontaire et que je peux choisir de me retirer en tout temps. J’accepte librement de participer à ce projet de recherche.

**Signature du participant :** ____________________________    **Date :** _____________

**Nom du participant en lettres moulées :** ____________________________

Je, soussigné, ai présenté en détails les renseignements pertinents du projet de recherche au participant susmentionné et je crois que le participant a compris et a donné sciemment son consentement.

**Nom en lettres moulées :** ____________________________    **Date :** _____________

**Signature :** ____________________________

**Rôle dans l’étude :** ____________________________

*Ce formulaire peut-être envoyé par télecopieur au (613)-562-5380.*
APPENDIX 7

INTERVIEW LIST

CANADA

Miriam Levitt, Ph.D.
Representative: Canadian Institute of Children's Health
Department of Epidemiology and Community Medicine
University of Ottawa
ML Health and Social Policy Consulting

Mandy Weselak
Registered Nurse/Epidemiologist
Early embryo development

Bruce Caswell
Senior Manager, Environment, Health & Safety
Canadian Chemical Producers’ Association

Ray Copes
Representative: CEH British Columbia
Medical Director, Environmental Health, BCCDC and Clinical Associate Professor, Health Care and Epidemiology, University of British Columbia
Vancouver, British Columbia

Blain Ganong
Representative: CEH Saskatchewan
Director of Air and Land Section
Environmental Protection Branch
Saskatchewan Environment

Fred Ruf
Representative: CEH Ontario,
Head, Environmental Health & Toxicology Unit (Acting) - ENVIRONMENTAL HEALTH AND TOXICOLOGY UNIT

Geoff Granville
Shell Canada Ltd.

Don A Hames
EHICG Coordinator

Don Wigle MD, PhD, MPH,
Affiliate Scientist
McLaughlin Centre for Population Health Risk Assessment;  
Adjunct Professor, Department of Epidemiology and Community Medicine, Faculty of Medicine, University of Ottawa

Warren G. Foster, Ph.D.,  
CIHR/Ontario Women's Health Council Scholar  
Professor & Director,  
In Vitro Fertilization and Reproductive Biology,  
Centre for Reproductive Care  
Department of Obstetrics & Gynecology  
McMaster University

Karen Phillips  
Assistant Professor, Faculty of Health Sciences,  

Mark Walker  
MD, FRCSC, Assistant Professor, Department of Obstetrics and Gynecology,  
Faculty of Medicine, University of Ottawa.  
Perinatologist and Clinical Epidemiologist  
Ottawa Health Research Institute

UNITED STATES

Martha Berger  
Office of Children's Health Protection  
US Environmental Protection Agency

Dr. Carole Kimmel,  
Senior Scientist, National Center for Environmental Assessment/ Washington, DC

Lee Salamone  
Director, Public Health and Science Policy Issue Group  
American Chemistry Council

George Daston, Ph.D.  
Procter & Gamble  
Miami Valley Labs

Dan Goldstein, MD  
Director, Medical Toxicology  
Monsanto

Katherine Shea, MD MPH  
American Academy of Pediatrics
Chris Portier  
Associate director of the National Toxicology Program  
National Institute of Environmental Health Sciences, Research Triangle Park, N.C.

Mike Dourson, Ph.D.  
Director  
Toxicology Excellence for Risk Assessment

Brenda Foos  
Office of Children's Health Protection  
US Environmental Protection Agency

Cheston M. Berlin, Jr., MD  
Department of Pediatrics, Children’s Hospital  
Milton S. Hershey Medical Center  
Pennsylvania State University College of Medicine

Ruth A. Lawrence, MD  
Professor of Pediatrics, Obstetrics & Gynecology  
Director, Newborn Nursery, Children's Hospital at Strong  
Director, Breastfeeding and Human Lactation Study Center  
University of Rochester  
Neonatology

Linda Pugh PhD, RNC, FAAN  
Associate Professor  
Director, Baccalaureate Program  
Johns Hopkins University School of Nursing

EUROPE

Dr. Chris Birt  
Cheshire and Merseyside Public Health Network (Champs)  
Liverpool, UK

Richard Parish  
Chief Executive  
The Royal Society for the Promotion of Health  
London, UK

Dr. Chris Busby  
University of Liverpool and Green Audit  
Department of Human Anatomy and Cell Biology  
Ceredigion, UK
Dr. Hanns Moshammer,
University of Vienna, Department Environmental Health
Venna, Austria

Stephan Boese-O'Reilly
Pediatrician, Master of Public Health post.grad. , Environmental health specialist,
German Network C-H-E
Munich, Germany

Dr. David Russel
UK Health Protection Branch
Health Protection Agency, Chemical Hazards and Poisons Division (Cardiff),
and Deputy Director of the WHO Collaborating Centre for Chemical Incidents.

Ms Ann Thuvander
Senior Administrative Officer
Ministry of Agriculture Food and Fisheries
Stockholm, Sweden

Dr. Lisbeth E. Knudsen, Ph.D.
University of Copenhagen
Lust. Public Health
Copenhagen, Denmark

Gerhard Winneke
Medical Institute of Environmental Hygiene
Düsseldorf, Germany

Tom van Teunenbroek
Senior Expert, Environment and Health
DG-Environment/Chemicals, Waste Radiation Directorate, IPC 645
Ministry of Housing, Spatial Planning and the Environment (VROM)
Netherlands

Jan M van der Eijk
Shell Chemicals Europe
APPENDIX 8 SUMMARY TABLES FOR SECTION 8 “CASE STUDIES”
<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES / BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANADA –</td>
<td>Reduces exposure to general population</td>
<td>P/Ts have primary jurisdiction for both drinking water and property so cannot enforce either nationally</td>
<td>International support for lead risk reduction strategies</td>
<td>Implementation process:</td>
</tr>
<tr>
<td>National Guidelines for Canadian Drinking Water Quality (Health Canada, 2006b) include maximum acceptable concentration of 0.010 mg/L for lead was set in 1992.</td>
<td>Direct product controls: Intensity-based standards on water purity</td>
<td>Does not address methods for remediation: removal of existing leaded plumbing</td>
<td>Municipal urban water pipes are controlled by local public authorities; so dependent on their resources and capacity</td>
<td>Consumer compliance (with risk reduction recommendations) hard to monitor</td>
</tr>
<tr>
<td>National Plumbing Code of Canada 1995 prohibits the use of lead pipe and lead solders and fluxes in potable water systems. Most provinces and territories have adopted the National Plumbing Code.</td>
<td>Performance standards determine the characteristics of the end product, while the Code technical standards limits processes.</td>
<td>Challenge to measure compliance as leachate occurs during delivery</td>
<td>Enforcement at P/T level</td>
<td>Biomonitoring system for children not in place</td>
</tr>
<tr>
<td>“Lead in Older Homes – Fact Sheet” (Canada Mortgage and Housing Corporation, 2006) alerts occupants of pre-1990 buildings to risk of leaded plumbing and suggests sample testing, sometimes free from municipality. See also “It’s Your Health – Lead-based Paint” (Health Canada, 2005b)</td>
<td>National Code has no legal effect, requires adoption by P/Ts.</td>
<td>Lack of data for authorities and consumers on where leaded plumbing installations exist (lack of risk communication)</td>
<td>Defining best practices (model Code) approach</td>
<td>Remediation incentives less developed than elsewhere</td>
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<td></td>
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<td>0.01 standard assumes consumers flush their taps before use (limited public education)</td>
<td>Commission for Environmental Cooperation (CEC)’s child health indicators include: “body burden measurements of lead in children”, and “percentage of children with access to water in violation of local standards”</td>
<td>Consensus policy development:</td>
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<tr>
<td></td>
<td></td>
<td>no tools to target at-risk populations or neighbourhoods</td>
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<td>Consensus approach to standards development</td>
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<tr>
<td></td>
<td></td>
<td>Dosage could exceed standard if consumers do not flush their pipes of standing water</td>
<td></td>
<td>Successful acceptance of national Code by most P/Ts</td>
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<td></td>
<td></td>
<td>Exposures may vary on a micro-level (house to house), which should affect sample size for compliance monitoring</td>
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<td>Science-based policy:</td>
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<td>Health risk of lead exposure well-established</td>
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<td>Tolerance levels are arguably not precautionary when adverse effects are measurable even at low exposure levels</td>
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<td>Information-based aspects of implementation (education/KT):</td>
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<td>Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system</td>
</tr>
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</table>
**UNITED KINGDOM –**

*Water Supply (Water Quality) Regulations 2000 (England) and 2001 (Wales) (UK Drinking Water Inspectorate, 2006)*

England and Wales have adopted increasingly stringent drinking water quality limits for lead content. The maximum of 50 µg/l in any sample from a consumer drinking water tap was reduced to 25 µg/l (2003) and ultimately a final standard of 10 µg/l (2013). These standards were combined with operational requirements for industry to strategically replace lead pipes to prioritize the highest exposures and highest risk populations, and treat water to reduce its plumbosolvency. Furthermore, consumers have certain power: water companies must replace their part of a lead service pipe if a consumer replaces his lead pipe.

Contextual note: Water pipes that lead from main watermains to individual buildings are owned by private companies, not local governments.

<table>
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<tr>
<th>Action</th>
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<tbody>
<tr>
<td>Reduces exposure to general population (phase-out slower than other jurisdictions)</td>
</tr>
<tr>
<td>Drinking water delivery infrastructure in private hands, with many parties involved</td>
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<tr>
<td>Direct product controls: Intensity-based standards on water purity</td>
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<tr>
<td>Performance standards determine the characteristics of the end product</td>
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<tr>
<td>Mandatory process controls defined to reduce leachate.</td>
</tr>
<tr>
<td>Actively target remediation efforts at high risk populations and neighbourhoods</td>
</tr>
<tr>
<td>Consumer incentive favours those with financial means</td>
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<tr>
<td>Slower phase-out not combined with stronger risk communication to consumers</td>
</tr>
</tbody>
</table>

**Implementation process:**
- Consumer compliance (with risk reduction recommendations) hard to monitor
- Progressive compliance targets set; still in progress
- Creative remediation incentives used

**Consensus policy development:**
- Challenging context of privatized water delivery

**Science-based policy:**
- Health risk of lead exposure well-established
- Tolerance levels are arguably not precautionary when adverse effects are measurable even at low exposure levels

**Information-based aspects of implementation (education/KT):**
- Less aggressive risk communication efforts than in US

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**USA –**

42 USC —CH 6A—SUBCH XII—Part B—Public Water Systems Sec. 300g–1.

*Safe Drinking Water Act –*

Since lead leaches into drinking water during the distribution and delivery process, the US system of controls includes the evaluation of the pipes used in delivery, as well as the ages and types of housing that they serve. Sampling requirements target the points that are vulnerable to lead contamination, including bathroom and kitchen taps.

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<tr>
<td>Reduces exposure to general population</td>
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<tr>
<td>Implemented by individual States, without centralized reporting of data to U.S. EPA.</td>
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<tr>
<td>Direct product controls: Intensity-based standards on water purity</td>
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<tr>
<td>Embeds ongoing monitoring, relative to lead levels in initial monitoring results.</td>
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<tr>
<td>Performance standards determine the characteristics of the end product</td>
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<tr>
<td>Water system owners may bear more than their share of replacement cost.</td>
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<tr>
<td>Actively targets remediation efforts based on lead level test results</td>
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</tbody>
</table>

**Implementation process:**
- Prioritizes remediation efforts based on level of health risk
- Includes mandatory mitigation efforts (corrosion control or replacement)

**Consensus policy development:**
- Dependent on implementation at state
Where high lead levels are found, public authorities must implement corrosion control measures to reduce the leaching effect, and assess the source water lead levels. (U.S. Environmental Protection Agency, 2006e)

If corrosion control is not sufficient, water system owners must replace their lead service lines and offer to replace the privately owned portion(s) as well. Timeframes for completion apply (Organisation for Economic Co-operation and Development, 2000).

Sec. 300j-24. Lead contamination in school drinking water

These guidance documents assist states and schools in testing school water coolers and fixing or removing those coolers with unacceptable test results. Sections 300j-22 & 23 deal with identification, banning, and recall of lead-lined drinking water coolers.

Its 2006-2011 Strategic Targets for compliance with drinking water standards differentiate between targets for Indian lands and other public drinking water sources, recognizing that current levels of compliance differ. Support will be offered to low-compliance communities. (U.S. Environmental Protection Agency, 2006f)
<table>
<thead>
<tr>
<th>AUTHORITY</th>
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<tbody>
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<td>CANADA –</td>
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<td></td>
<td><strong>Hazardous Products Act R.S., 1985, c. H-3</strong></td>
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<td></td>
<td>Hazardous Products include scheduled Prohibited, Restricted, and Controlled Products. Prohibited Products may not be sold or imported, and include: 2. Furniture and other articles for children that are painted with a surface coating material that contains lead compounds of which the total lead content is more than 600 mg/kg.</td>
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<tr>
<td></td>
<td><strong>Hazardous Products (Liquid Coating Materials) Regulations, S.O.R./91-262</strong></td>
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<tr>
<td></td>
<td>3. Sale or import of leaded paint (or other hazardous coating material) must either include a warning label “Caution: Contains lead. Do not apply to surfaces that children may chew” or the product is to be used in a place unlikely to be frequented by children. “Lead in Older Homes – Fact Sheet” (Canada Mortgage and Housing Corporation, 2006) refers to risk of paint chips/dust from homes built before 1960. Suggests risk controls during renovation and post-renovation dust testing.</td>
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<td></td>
<td>➢ Product controls include limits, not bans, on lead content</td>
<td>➢ Limited ability to control lead content in imported goods</td>
<td>➢ Active prioritization of controlling exposures to children by identifying products used by them</td>
<td>Implementation process:</td>
</tr>
<tr>
<td></td>
<td>➢ Product controls tied to product purpose</td>
<td>➢ Relies on consumers using the products only for their intended purpose</td>
<td>➢ Consistent with international approach, facilitating product trade and compliance</td>
<td>➢ Consumer compliance (with risk reduction recommendations) hard to monitor</td>
</tr>
<tr>
<td></td>
<td>➢ Reduces exposure to children specifically, as well as general population</td>
<td>➢ Fact sheet assumes phase-out complete by 1960</td>
<td>➢ Does not address remediation/re-mobilization of lead-painted objects already in children’s environments</td>
<td>➢ Does not address remediation/re-mobilization of lead-painted objects already in children’s environments</td>
</tr>
<tr>
<td></td>
<td>➢ Performance standards determine the characteristics of the end product</td>
<td>➢ Cosmetic renovation of homes (e.g. painted surfaces) not licensed or controlled</td>
<td>➢ Consensus policy development:</td>
<td>Consensus policy development:</td>
</tr>
<tr>
<td></td>
<td>➢ Does not regulate exposures released from pre-existing products</td>
<td>➢ Building renovation exposures would be acute rather than chronic, so hard to measure</td>
<td>➢ Consistent with international approach</td>
<td>➢ Consistent with international approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Science-based policy:</td>
</tr>
<tr>
<td>USA –</td>
<td>➢ Product controls in place for housing within federal</td>
<td>➢ Cosmetic renovation of homes (e.g. painted surfaces) not licensed or controlled</td>
<td>➢ Active exposure management during renovation process by multi-layered approach</td>
<td>Information-based aspects of implementation (education/KT):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>➢ Outreach to consumers long post-purchase (at time of renovation) a challenge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>➢ Less aggressive risk communication efforts than in US</td>
</tr>
</tbody>
</table>

395
Toxic Substances Control Act (TSCA), as amended by the Residential Lead-Based Paint Hazard Reduction Act of 1992—Title X, Public Law 102-550

102nd Congress -- 2nd Session [H.R. 5334] and related regulations

[leaded paint phased out by 1980 for housing under federal jurisdiction]


Objective is to protect children living in pre-1978 Homes from exposure to dust/debris from lead paint. Applies to property owners and risk assessors. Federal grants made available to state/municipal governments for programs to contain/remove the hazard from priority homes (with children < 6 years)

40 CFR Part 745, Lead; Requirements for Hazard Education Before Renovation of Target Housing
Requires renovators to distribute a warning pamphlet to building occupants before renovations begin.

The objective of the Lead Safe Work Requirements to Protect Children During Renovation, Repair and Painting Activities (U.S. Environmental Protection Agency 2006g) is to train and accredit individuals engaged in renovation and remodeling activities on homes built before 1978 to properly handle and control the hazards they will create. Presently in public consultation phase.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Building renovation exposures would be acute rather than chronic, so hard to measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandates remediation efforts including prioritizing children’s exposures, risk communication, and supplier entry controls</td>
<td>Note the significant differences in risk periods: 1978 vs 1960 (Canada). Unless the Canada/US paint trade was strictly controlled for lead during those decades, risk periods should be reconciled.</td>
</tr>
</tbody>
</table>

Recommendations hard to monitor
Ensures action on remediation

Consensus policy development:
Extent of consultation and consensus of renovator community unclear, though essential to success

Science-based policy:
Health risk of lead exposure well-established
Recognition of special risk to young children integrated into policy approach

Information-based aspects of implementation (education/KT):
Creative risk communication used to protect and reach residents during renovation
**TABLE A8.3 MERCURY - EXPOSURE PATHWAY: DENTAL AMALGAMS**

<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES / BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANADA –</td>
<td></td>
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</tr>
<tr>
<td>Dental amalgam use - In 1996, Health Canada issued a formal position statement on the safety of dental amalgams, which included recommendations for physicians and dentists. Use was contraindicated for people allergic to mercury, those with impaired kidney function, or for use in contact with existing metal devices (braces), pregnant women, and the primary teeth of children. Dentists are to inform their patients of options available regarding the material used to fill their teeth. (Health Canada, 1996)</td>
<td>Waste management controls reflect voluntary compliance with production processes. Risk reduction targets are absolute, not intensity-based, providing incentive to actively implement significant management measures. Health Canada statement provides recommendations, not requirements, that dentists avoid use on young children Dentists are assigned task of risk communication to patients</td>
<td>Dual motivation for use reduction (health and environment) could complicate risk communication messaging Practice recommendation does not trigger followup to assess takup by dentists and public acceptance of program Unclear whether cost or perceived health risk has dissuaded consumers from getting proper dental treatment Long history of presumed safe use make it hard to measure any incremental increase in safety factor Goes beyond WHO Consensus Statement (though so do other countries)</td>
<td>Consensus approach to achievement of standards Clear and ambitious targets set for waste reduction Precautionary approach to child safety accepted by dental profession and public (no apparent public debate as in US) Waste reduction targets and use restrictions complement each other</td>
<td>Implementation process: Complementary aspects of health-focused initiative (patient care) and environment-focused initiative (waste management) Combines both intensity-based and absolute targets Sets ambitious yet achievable timeframes Consensus policy development: Industry cooperation critical factor to success F/P/T cooperation required due to shared jurisdiction More precautionary than international policy position Distinct from US position Science-based policy: Precautionary approach adopted in favour of children’s health Information-based aspects of implementation (education/KT): Surveys of dental practices could assess degree of implementation of both patient care and waste management</td>
</tr>
<tr>
<td>Dental amalgam waste – The Canada-wide Standard defines best management practices (end-of-pipe trap and waste management: recycling, hazardous waste landfill or stabilization) to achieve a 95% national reduction in mercury releases from dental amalgam waste discharges by 2005, from a base year of 2000. Environment Canada signed an MOU with the Canadian Dental Association in 2002 to collaborate towards achievement of the standards (Environment Canada, 2002). By the end of 2003, 27% of dental practices had installed the end-of-pipe trap (CCME, 2005b).</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>USA –</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dental amalgam use – The American Dental Association (ADA) official position statement is that the only contraindication to amalgam use is a mercury allergy, though it acknowledges that small mercury releases occur (American Dental</td>
<td>Dental profession activities focus on risk assessment and risk communication Production process controls to reduce release of mercury into the environment rely on</td>
<td>Lack of consensus on health effects and consequent best practices for dentists Clear discrepancy between public perception of risk and</td>
<td>Consistent with WHO consensus statement and risk assessment Materials suggest threat of regulation was used to motivate voluntary compliance Both WHO and US government</td>
<td>Implementation process: Complementary aspects of health-focused initiative (patient care) and environment-focused initiative (waste management)</td>
</tr>
</tbody>
</table>
Other ADA materials reflect a vigorous ongoing public debate about whether human health risks of mercury-containing dental work justifies use of alternative products. As recently as Sept 2006, the ADA defended its continued use to a panel of the U.S. Food and Drug Administration. (American Dental Association, 2006).

The US Public Health Service believes it is “inappropriate …to recommend any restrictions” in use, because of lack of evidence of risk and that alternatives would be safer. (Centers for Disease Control and Prevention, 2001)

The Food and Drug Administration (FDA) regulates dental amalgam under FFDCA. Dental mercury and dental amalgam alloy are classified as Class I and Class II medical devices respectively. Dental amalgam waste – The ADA issued Best Practices for Amalgam Waste in 2004, urging members to comply voluntarily to avoid regulatory action. No absolute reduction target is included. (American Dental Association, 2004).

**SWEDEN –**
In contrast, by 2005 Sweden had effectively phased out the use of dental amalgams, having switched over to acceptable alternative materials. Mechanisms included government withdrawal of insurance support for amalgam procedures to achieve cost-neutrality. Motivating factors included environmental and health risks, with early agreement to phase-out use in children. (Swedish Chemicals Inspectorate, 2005)

<table>
<thead>
<tr>
<th>voluntary compliance</th>
<th>scientific proof of harm</th>
<th>materials justify continued use of dental amalgam based on significantly higher cost of alternative materials</th>
<th>Worth study as a risk communication failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Economic incentives employed by government</td>
<td>✓ Lost opportunity to apply the precautionary principle, particularly given the direct environmental consequences of continued use</td>
<td>✓ The public perceived that the risk management measures were taken to reflect human health risks rather than environmental risks, exacerbating the confusion</td>
<td>Consensus policy development:</td>
</tr>
<tr>
<td>✓ Other details of implementation mechanisms unavailable</td>
<td>✓ Does not follow WHO Consensus Statement</td>
<td>✓ Aggressively precautionary approach presumably reflects public opinion and expectation</td>
<td>✓ Policy platform derived from international policy position</td>
</tr>
<tr>
<td></td>
<td>✓ Possibility exists that alternative materials will cause unanticipated health consequences vs ‘tried and true’ amalgam (as per US position)</td>
<td>✓ Economic mechanism to achieve cost-neutrality</td>
<td>✓ Strong industry opposition has tempered government position</td>
</tr>
<tr>
<td></td>
<td>✓ Aggressively precautionary approach presumably reflects economic mechanism to achieve cost-neutrality</td>
<td></td>
<td>Science-based policy:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Failure to win public support results in ongoing defensive approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Information-based aspects of implementation (education/KT):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Economic mechanism to achieve cost-neutrality</td>
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<tr>
<td></td>
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<td>Economic incentives employed by government</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Industry cooperation critical factor to success</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Considerably more</td>
</tr>
</tbody>
</table>

Implementation process:
- Complementary aspects of health-focused initiative (patient care) and environment-focused initiative (waste management)
| precautionary than international policy position |
| Science-based policy: |
| ➢ Precautionary approach adopted in favour of children’s health and environment |
| Information-based aspects of implementation (education/KCT): |
| ➢ Unclear whether public support led or followed this initiative |
## Table A8.4: Mercury - Exposure Pathway: Fish Consumption

<table>
<thead>
<tr>
<th>Authority</th>
<th>Objective / Approach</th>
<th>Challenges / Barriers</th>
<th>Facilitators</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canada</strong> – Food and Drugs Act / Food and Drug Regulations (FDA/FDR) and the Consumer Packaging and Labelling Act and Regulations (CPLA/CPLR) prescribe labelling details such as the need to state the colour of tuna meat, but there is no requirement to incorporate the Advisory information for the higher-risk species.</td>
<td>➢ Mandatory – but inconsistent - product control standards: level of safety varies with fish species &lt;br&gt;➢ Dependent on information-based strategies to mitigate some risks, though not integrated into product labelling</td>
<td>➢ Lack of integrated standards, practices, and communications within and across jurisdictions &lt;br&gt;➢ Challenge in effectively reaching prospective consumers of certain fish species for risk communication purposes. &lt;br&gt;➢ Challenge in monitoring mercury levels in non-commercial (sport / subsistence) fish &lt;br&gt;➢ Complexity of mixed messaging: “fish is good for you – but risky too” &lt;br&gt;➢ Fish testing and risk communication capacity issues in remote areas, even though those fish populations may have high concentration levels &lt;br&gt;➢ Consider issue of high consumption rates of fish, including predator fish, in traditional diets of Aboriginal populations</td>
<td>➢ Ability to integrate risk communication messaging to pregnant women with other prenatal health messaging &lt;br&gt;➢ Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>Implementation process: &lt;br&gt;➢ Consumer compliance (with consumption recommendations) hard to monitor &lt;br&gt;➢ Northern populations require special attention &lt;br&gt;➢ Biomonitoring challenges noted Consensus policy development: &lt;br&gt;➢ Lacking consensus within F/P/T/M authorities &lt;br&gt;➢ While international risk assessors agree that predator species pose higher risks to consumers, risk control policies differ Science-based policy: &lt;br&gt;➢ Quantitative levels of risk are assessed for fish species groups based on science. Policy choice is less precautionary than other countries. Information-based aspects of implementation (education/KT): &lt;br&gt;➢ Lack of effective communication regarding wildlife advisories &lt;br&gt;➢ Effectiveness of advisory system for commercial fish consumer unclear &lt;br&gt;➢ Surveys to assess consumer uptake of information and behaviour change could assess</td>
</tr>
</tbody>
</table>
USA -
The Food and Drug Administration (FDA) sets an action level of 1ppm methylmercury for commercial fish.

Tissue Residue Criterion is 0.3 mg methylmercury/kg fish, (U.S. Environmental Protection Agency, 2001f)

The US EPA national Fish Advisory distinguishes low from high risk fish species, like Canada, but applies more stringent recommended limits on who should eat it and how often, i.e. women who might become pregnant and young children are advised to avoid the high risk species altogether (U.S. Environmental Protection Agency, 2004b).

The EPA also provides a searchable online database of local Fish Advisory information, including Canadian information (U.S. Environmental Protection Agency, 2006h).

The EPA also offers Guidance documents for local authorities in implementing their local fish testing and advisory programs.

<table>
<thead>
<tr>
<th>USA -</th>
<th>United Kingdom (applying European Union) –</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory – but inconsistent - product control standards: level of safety varies with fish species</td>
<td>Mandatory – but inconsistent - product</td>
</tr>
<tr>
<td>Challenge in effectively communicating risk to prospective consumers of certain fish species</td>
<td>Challenge in effectively communicating risk to prospective</td>
</tr>
<tr>
<td>Challenge in monitoring mercury levels in non-commercial (sport / subsistence) fish</td>
<td>Challenge in effectively communicating risk to prospective</td>
</tr>
<tr>
<td>Complexity of mixed messaging: “fish is good for you – but risky too”</td>
<td>Challenge in effectively communicating risk to prospective</td>
</tr>
<tr>
<td>Fish testing and risk communication capacity issues in remote areas, even though those fish populations may have high concentration levels</td>
<td>Consistency in effectively communicating risk to prospective</td>
</tr>
<tr>
<td>Consider issue of high consumption rates of fish, including predator fish, in traditional diets of Aboriginal populations</td>
<td>Consistency in effectively communicating risk to prospective</td>
</tr>
<tr>
<td>Ability to integrate risk communication messaging to pregnant women with other prenatal health messaging</td>
<td>Consistency with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>Centralized resources and reporting, despite decentralized implementation and enforcement structure</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>Simpler risk messaging for high risk species: “do not eat” rather than “eat less often”</td>
</tr>
<tr>
<td>Centralized resources and reporting, despite decentralized implementation and enforcement structure</td>
<td>Implementation process:</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>– Consumer compliance (with consumption recommendations) hard to monitor</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>– Northern populations require special attention</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>– Biomonitoring challenges noted</td>
</tr>
<tr>
<td>Consistent with Global Mercury Assessment approach of setting maximum acceptable mercury concentration for fish</td>
<td>Consensus policy development:</td>
</tr>
<tr>
<td>Consistent with EC approach</td>
<td>– Consistent with EC approach</td>
</tr>
<tr>
<td>While international risk assessors agree that predator species are at higher risk, risk control policies differ</td>
<td>While international risk assessors agree that predator species are at higher risk, risk control policies differ</td>
</tr>
<tr>
<td>Science-based policy:</td>
<td>– Quantitative levels of risk are assessed for fish species groups based on science. Policy choice is more precautionary than Canada.</td>
</tr>
<tr>
<td>– Seemingly effective communication regarding wildlife advisories</td>
<td>Information-based aspects of implementation (education/KT):</td>
</tr>
<tr>
<td>– Risk messaging for high-risk species simpler than Canada’s.</td>
<td>– Seemingly effective communication regarding wildlife advisories</td>
</tr>
<tr>
<td>– Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system</td>
<td>– Risk messaging for high-risk species simpler than Canada’s.</td>
</tr>
<tr>
<td>– Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system</td>
<td>– Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system</td>
</tr>
</tbody>
</table>

Implementation process:
- Consumer compliance (with consumption recommendations) hard to monitor
- Northern populations require special attention
- Biomonitoring challenges noted

Consensus policy development:
- Consistent with EC approach
- While international risk assessors agree that predator species are at higher risk, risk control policies differ

Science-based policy:
- Quantitative levels of risk are assessed for fish species groups based on science. Policy choice is more precautionary than Canada.

Information-based aspects of implementation (education/KT):
- Seemingly effective communication regarding wildlife advisories
- Risk messaging for high-risk species simpler than Canada’s.
- Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system.
women who might become pregnant, and children under 16 years of age to avoid eating swordfish, shark and marlin and moderate their levels of tuna because of high mercury levels.

**COMMISSION REGULATION (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs**

A maximum level of 0.5 mg/kg wet weight is set for mercury in fishery products, with the exception of several fish species, including halibut, tuna, shark, and marlin, for which a separate maximum level of 1 mg/kg wet weight applies.

<table>
<thead>
<tr>
<th>control standards: level of safety varies with fish species</th>
<th>consumers of certain fish species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent on information-based strategies to mitigate some risks</td>
<td>Complexity of mixed messaging: “fish is good for you – but risky too”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>approach of setting maximum acceptable mercury concentration for fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simpler risk messaging for high risk species: “do not eat” rather than “eat less often”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>consumption recommendations) hard to monitor</th>
</tr>
</thead>
</table>

**Consensus policy development:**
- Consistent with US approach

**Science-based policy:**
- Quantitative levels of risk are assessed for fish species groups based on science. Policy choice is more precautionary than Canada’s.

**Information-based aspects of implementation (education/KT):**
- Risk messaging for high-risk species simpler than Canada’s.
- Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of advisory system
### TABLE A8.5 PESTICIDES – EXPOSURE PATHWAY: RESIDUES ON CHILDREN’S FOOD SOURCES

<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES / BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
</table>
| **European Union /European Commission (EC)** – | ➢ Regulatory measures for product control  
            ➢ Differential MRLs for different classes of end user  
            ➢ Production process controls applied to growers of crops for baby food | ➢ Challenge in harmonization, given the importance of international trade in food  
            ➢ Limits farmers’ market opportunities if specialty market sales need to be planned in advance  
            ➢ Does not address risk of infant food that is not commercially processed as such  
            ➢ Challenge in monitoring compliance given high product turnover and import/export trade | ➢ Clear differentiation of product lines  
            ➢ Centralized standards may facilitate region’s import/export and internal trade | Implementation process:  
            ➢ Focus on child-specific products facilitates implementation.  
            ➢ Compliance and biomonitoring challenges noted  
            ➢ Consensus policy development:  
            ➢ Industry cooperation desirable, but here did not research whether incentives were offered  
            ➢ Science-based policy:  
            ➢ Precautionary approach adopted for children  
            ➢ Quantitative standards will be science-based.  
            ➢ Information-based aspects of implementation (education/KT):  
            ➢ Product line differentiation facilitates public messaging  
            ➢ Challenge to communicate to diverse nature of agricultural industry | |
| **USA –** | **Food Quality Protection Act, 1996 21 U.S.C. 346a**  
             **CHAPTER 9 – IV FOOD**  
             **Sec. 346a.** Pesticide residue tolerance limits on food are based on “reasonable certainty of no harm”, and consideration of the aggregate effect of all exposures. Special risks to children are assessed by taking into account their consumption patterns, special biological vulnerabilities, and cumulative effects. Surveillance monitoring of children and their food consumption habits is required. An extra ten-fold margin of | ➢ Standard of care is precautionary in nature  
            ➢ Multilayered child protection strategy affects standard-setting methodology and monitoring efforts.  
            ➢ Aggregate exposures given weight in assessment  
            ➢ Includes information- | ➢ Lack of biomonitoring data  
            ➢ Product in question consumed by whole population, so difficult to segregate special risk groups  
            ➢ Lack of reliable information for decision making  
            ➢ Challenge in conveying child health protection aspects to public, given complexity | ➢ Public support for child-protective actions  
            ➢ Better monitoring of child health trends  
            ➢ Uses an integrated approach  
            ➢ CEC lists pesticide residues on foods as a proposed children’s health indicator | Implementation process:  
            ➢ New features, such as aggregate exposure measurement, are complex and burdensome.  
            ➢ Application of child protection safety factor unclear  
            ➢ Compliance and biomonitoring challenges noted  
            ➢ Consensus policy development:  
            ➢ Industry cooperation desirable, but | |
safety is required to protect children unless risk assessment data indicates otherwise. Relevant factors when setting pesticide residue tolerances include consideration of aggregate exposure levels other than occupational exposures, and vulnerabilities of subpopulations.

This Act also mandates consumer education about the risks of pesticide residue on food.

21 C.F.R. 109.6
PART 109 – AN UNAVOIDABLE CONTAMINANTS IN FOOD FOR HUMAN CONSUMPTION AND FOOD-PACKAGING MATERIAL
109.3(a) Poison tolerance limits are set, in part, by considering whether industry practices can feasibly avoid them.

40 C.F.R. 180
PART 180_TOLERANCES AND EXEMPTIONS FROM TOLERANCES FOR PESTICIDE CHEMICALS IN FOOD Sec. 180.5 A zero tolerance for a pesticide chemical in or on a raw agricultural commodity may be established where a safe level has not been reliably determined, among other reasons.

<table>
<thead>
<tr>
<th>Standard of care is precautionary in nature</th>
<th>Lack of biomonitoring data</th>
<th>Public support for child-protective actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilayered child protection strategy affects standard-setting methodology and monitoring efforts.</td>
<td>Product in question consumed by whole population, so difficult to segregate special risk groups</td>
<td>Uses an integrated approach</td>
</tr>
<tr>
<td>Aggregate exposures given weight in assessment</td>
<td>Lack of reliable information for decision making</td>
<td>Challenge in conveying child health protection aspects to public, given complexity</td>
</tr>
<tr>
<td>Includes information-based risk communication components</td>
<td>Challenge in conveying child health protection aspects to public, given complexity</td>
<td>CEC lists pesticide residues on foods as a proposed children’s health indicator</td>
</tr>
</tbody>
</table>

CANADA –
The new Pest Control Products Act, 2002 (c. 28, in force June 2006) includes measures designed to embed precautionary risk management for children, including a ten-fold safety factor for risk assessment, where warranted, consideration of aggregate exposures from food, water and environment, and consideration of cumulative effects of like pesticides. Associated regulations prescribe labelling details.

<table>
<thead>
<tr>
<th>Standard of care is precautionary in nature</th>
<th>Lack of biomonitoring data</th>
<th>Public support for child-protective actions</th>
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<tbody>
<tr>
<td>Multilayered child protection strategy affects standard-setting methodology and monitoring efforts.</td>
<td>Product in question consumed by whole population, so difficult to segregate special risk groups</td>
<td>Uses an integrated approach</td>
</tr>
<tr>
<td>Aggregate exposures given weight in assessment</td>
<td>Lack of reliable information for decision making</td>
<td>Challenge in conveying child health protection aspects to public, given complexity</td>
</tr>
<tr>
<td>Includes information-based risk communication components</td>
<td>Challenge in conveying child health protection aspects to public, given complexity</td>
<td>CEC lists pesticide residues on foods as a proposed children’s health indicator</td>
</tr>
</tbody>
</table>

quantitative standards will be science-based
➢ Canada has followed US approach

Science-based policy:
➢ Approach designed to ensure evidentiary basis for risk assessment.
➢ Approach takes circumstances of exposure into account
➢ Quantitative standards will be science-based, with precautionary approach regarding children

Information-based aspects of implementation (education/KT):
➢ Complex assessment system a challenge to convey to public
➢ Horizontal communications across governments
➢ Challenge to communicate to diverse nature of agricultural industry

Implementation process:
➢ New features, such as aggregate exposure measurement, are complex and burdensome.
➢ Application of child protection safety factor unclear
➢ Compliance and biomonitoring challenges noted

Consensus policy development:
➢ Industry cooperation desirable, but quantitative standards will be science-based
➢ Canada has followed US approach

Science-based policy:
- Approach designed to ensure evidentiary basis for risk assessment.
- Approach takes circumstances of exposure into account
- Quantitative standards will be science-based, with precautionary approach regarding children

Information-based aspects of implementation (education/KT):
- Complex assessment system a challenge to convey to public
- Horizontal communications across governments
- Challenge to communicate to diverse nature of agricultural industry
<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES / BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA –</td>
<td>Product controls define the allowable active ingredients and concentrations</td>
<td>Lack of exposure and biomonitoring data</td>
<td>Benefits from FQPA monitoring of aggregate exposures</td>
<td>Implementation process:</td>
</tr>
<tr>
<td>(MRL levels are regulated by the pest control products Acts set out above)</td>
<td>Risk to children is moderated by child-resistant packaging for certain toxic products</td>
<td>Labelling and packaging controls mitigate acute, but not chronic, exposures</td>
<td>Builds on evaluations and control systems developed for commercial use products</td>
<td>Collateral benefits seen from interplay with FQPA</td>
</tr>
<tr>
<td>40 C.F.R.156</td>
<td>Labelling regulations convey basic handling requirements and warning of risk to children</td>
<td>Dependent on consumer compliance with handling instructions</td>
<td></td>
<td>Consumer compliance (with handling recommendations) hard to monitor</td>
</tr>
<tr>
<td>PART 156. LABELING REQUIREMENTS FOR PESTICIDES AND DEVICES</td>
<td>Challenge to distinguish source of exposure when several sources exist</td>
<td></td>
<td></td>
<td>Biomonitoring challenges noted</td>
</tr>
<tr>
<td>Subpart D. Human Hazard and Precautionary Statements Sec. 156.66 (a) Each pesticide product must bear on the front panel of the label the statement “Keep Out of Reach of Children”, but that requirement may be waived if the likelihood of exposure of children to the pesticide during distribution, marketing, storage or use is remote (i.e.industrial)</td>
<td></td>
<td></td>
<td>Consensus policy development:</td>
<td></td>
</tr>
<tr>
<td>40 C.F.R.157</td>
<td></td>
<td></td>
<td></td>
<td>Industry cooperation may be motivated in part by desire to avoid consumer lawsuits from acute incidents</td>
</tr>
<tr>
<td>Subpart B--Child-Resistant Packaging - Special child-resistant packaging is required for consumer products that are of specified levels of toxicity.</td>
<td>CHAPTER 39A--SPECIAL PACKAGING OF HOUSEHOLD SUBSTANCES FOR PROTECTION OF CHILDREN Sec. 1472. Special packaging standards may apply to any household substance if required to protect children from serious personal injury or illness resulting from handling, using, or ingesting such substance, based on the degree or nature of the hazard to children.</td>
<td></td>
<td></td>
<td>Relies on other regulatory chemical hazard control systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Warning labels may not take all circumstances of exposure into account</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Information-based aspects of implementation (education/KT):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surveys to assess consumer uptake of information and behaviour change could assess effectiveness of warning system</td>
</tr>
<tr>
<td>CANADA –</td>
<td>Product controls define the allowable active ingredients and</td>
<td>Lack of exposure and biomonitoring data</td>
<td>Benefits from FQPA monitoring of aggregate exposures</td>
<td>Implementation process:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Labelling and packaging controls</td>
<td></td>
<td>Consumer compliance (with handling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE A8.6 PESTICIDES – EXPOSURE PATHWAY: HOUSEHOLD PRODUCTS**
**Consumer Chemicals and Containers Regulations, 2001**  
**SOR/2001-269**  
These regulations classify products by the nature of the hazard (toxic, flammable, etc) then restrict advertising, sale, or import unless certain conditions are followed about risk assessment, prescribed warning labels, and child-resistant packaging.

**Pest Control Products Regulations, 2006**  
**SOR/2006-124**  
s.26 requires that pest control products for domestic (home) use must include the warning “keep out of reach of children”

- Concentrations
  - Risk to children is moderated by child-resistant packaging for certain toxic products
  - Labelling regulations convey basic handling requirements and warning of risk to children

- Mitigate acute, but not chronic, exposures
  - Dependent on consumer compliance with handling instructions
  - Challenge to distinguish source of exposure when several sources exist

- Builds on evaluations and control systems developed for commercial use products

**European Union** –

**European Commission Directive 2001/95/EC**  
**General Product Safety Requirement** - This Directive provides an overarching standard that products sold to consumers be safe for reasonably foreseeable use, taking the risk to children into account in particular. Compliance with formal standards, voluntary standards, and reasonable consumer expectation may be taken into account when determining appropriate level of safety. Producers are required to provide consumers with risk information relevant throughout the normal or reasonably foreseen lifespan of product.

- Acts as “catch-all” for products not specifically regulated
  - Describes a standard of care rather than a technical or performance standard
  - Demands foresight by producers throughout lifespan of product
  - Requires active risk communication to consumer

- Challenge for producers to comply when specifics are not provided
  - Challenge to monitor compliance with a qualitative, not quantitative, standard
  - Feasibility of effective and timely risk communication for post-purchase lifespan of product
  - Challenge for producers to foresee and predict product lifespan and children’s risks

- Takes interests of all stakeholders into account in setting standard of care
  - Reflects standards of care that have evolved through civil liability systems

**Implementation process:**
- High level nature and lack of measurable indicators make implementation unclear
- Consensus policy development:
  - Industry cooperation may be motivated in part by desire to avoid consumer lawsuits

**Science-based policy:**
- Relies on other regulatory chemical hazard control systems
- Warning labels may not take all circumstances of exposure into account
- Information-based aspects of implementation (education/RT):
  - Surveys to assess consumer uptake of information and behavior change could assess effectiveness of warning system

**Consensus policy development:**
- Industry cooperation may be motivated in part by desire to avoid consumer lawsuits
foreseeable period of the product use, where such risks are not immediately obvious without adequate warnings, and to take precautions against those risks (Europa, 2001a).

- Drawn from evolution of legal standards for product safety

Information-based aspects of implementation (education/KT):
- Challenge for producers to anticipate and communicate throughout lifespan of product.
<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES / BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANADA – CEPA, 1999</td>
<td>Information- (research-) based approach to assess the effectiveness of current regulatory controls over the products and releases in question</td>
<td>➢ Overwhelming volume of chemicals requiring review</td>
<td>➢ Issue can be integrated into existing regulatory controls for many classes of chemicals of concern</td>
<td>(Example given deals with research only)implementation process: ➢ Timeliness is issue of concern, given volume of risk assessments required for chemicals already in marketplace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Challenge in assessment of multiple exposures</td>
<td>➢ International harmonization of regulatory controls already in progress</td>
<td>Consensus policy development: ➢ Industry cooperation desirable, but quantitative standards will be science-based</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Complexity of assessing, or predicting, effect of innumerable mixtures</td>
<td>➢ Inter-governmental fora to discuss chemical regulatory systems already in place</td>
<td>Science-based policy: ➢ Approach designed to ensure evidentiary basis for risk assessment. ➢ Approach takes circumstances of exposure into account ➢ Quantitative standards will be science-based.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Volume of work and length of animal studies cause inevitable time delays</td>
<td></td>
<td>Information-based aspects of implementation (education/KT): ➢ Complex horizontal communications across governments ➢ Complex vertical communications across industry</td>
</tr>
</tbody>
</table>
### USA –

The core elements of the US EPA approach include sorting, priority setting, Tier 1 screening, and Tier 2 testing. Priority setting will be done with reference to existing information and preliminary test results. Tier 1 involves an assessment and identification of substances that have the potential to interact with the endocrine system. Tier 2 then determines whether the substance causes adverse effects in humans, animals, or the environment, taking life stages, routes of exposure, and dose into account. Tier 2 tests identify the adverse effects and assess the dose response relationship. Tier 2 results determine whether a substance will be considered an endocrine disruptor for regulatory purposes. The concern about endocrine disrupting potential applies to more than 87,000 chemical substances, including chemicals used in pesticides, cosmetics, food additives, and certain mixtures. (U.S. Environmental Protection Agency, 1998)

<table>
<thead>
<tr>
<th>USA –</th>
<th>European Union –</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envisages comprehensive risk assessment system</td>
<td>Prioritization of action based primarily on production volumes</td>
</tr>
<tr>
<td>Standard-setting would involve quantitative and qualitative aspects</td>
<td>Standard-setting would involve quantitative and qualitative aspects</td>
</tr>
<tr>
<td>Expected to lead to regulatory product controls and production process controls</td>
<td>Indirect influence over supplier entry and exit</td>
</tr>
<tr>
<td>Overwhelming volume of chemicals requiring review</td>
<td>Possibility that producers would moderate volume output or modify corporate structures to stay ‘under the radar’</td>
</tr>
<tr>
<td>Challenge in assessment of multiple exposures</td>
<td>Still dependent on access to risk assessment data on effects of long-term exposure</td>
</tr>
<tr>
<td>Complexity of assessing, or predicting, effect of innumerable mixtures</td>
<td>Issue can be integrated into existing regulatory controls for many classes of chemicals of concern</td>
</tr>
<tr>
<td>Volume of work and length of animal studies cause inevitable time delays</td>
<td>Implicitly recognizes that a system that is both timely and comprehensive is impossible to achieve, so focuses on practical and achievable goals.</td>
</tr>
<tr>
<td>Concern over number of animals required for testing purposes</td>
<td>International consensus could facilitate national implementation</td>
</tr>
<tr>
<td></td>
<td>EC context includes General Product Safety Requirement</td>
</tr>
</tbody>
</table>

### Implementation process:

- Timeliness is issue of concern, given volume of risk assessments required for chemicals already in marketplace
- Consensus policy development:
  - Industry cooperation desirable, but quantitative standards will be science-based
  - Implementation approach consistent with that taken by the EC
- Science-based policy:
  - Approach designed to ensure evidentiary basis for risk assessment.
  - Approach takes circumstances of exposure into account
  - Quantitative standards will be science-based.
- Information-based aspects of implementation (education/KT):
  - Complex horizontal communications across governments
  - Complex vertical communications across industry

### European Union –

The European Commission’s Community Strategy for Endocrine Disrupters sets out an action plan to research, monitor, and develop policy and risk management approaches to the risk of EDC. (Europa, 1999)

The European Commission’s Strategy for a future Chemicals Policy (Europa, 2001b) outlines the REACH approach, which is designed to help authorities cope with the overwhelming volume of chemicals that need review (for various regulatory tests and controls, broader than endocrine disrupting concerns alone):

<table>
<thead>
<tr>
<th>European Union –</th>
<th>USA –</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envisages comprehensive risk assessment system</td>
<td>Prioritization of action based primarily on production volumes</td>
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<td>International consensus could facilitate national implementation</td>
</tr>
<tr>
<td></td>
<td>EC context includes General Product Safety Requirement</td>
</tr>
</tbody>
</table>

### Implementation process:

- Volume-based priority-setting used to expedite otherwise insurmountable volume of risk assessments required
- Consensus policy development:
  - Industry cooperation desirable, but quantitative standards will be science-based
  - Implementation approach inconsistent with that taken by USFDA
- Science-based policy:
  - Approach balances practical and time
Registration – of basic information about high production volume substances; Evaluation – of the registered information about the highest volume substances (top 15%) and lower volume substances if long-term exposure concerns warrant; Authorization – requiring case-by-case review and approval for specified uses for those substances of very high concern.

Quantitative standards will be science-based.

Information-based aspects of implementation (education/KT):
- Complex horizontal communications across governments
- Complex vertical communications across industry

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>This Directive provides an overarching standard that products sold to consumers be safe for reasonably foreseeable use, taking the risk to children into account in particular. Compliance with formal standards, voluntary standards, and reasonable consumer expectation may be taken into account when determining appropriate level of safety. Producers are required to provide consumers with risk information relevant throughout the normal or reasonably foreseeable period of the product use, where such risks are not immediately obvious without adequate warnings, and to take precautions against those risks.</td>
</tr>
<tr>
<td>Acts as “catch-all” for products not specifically regulated</td>
</tr>
<tr>
<td>Describes a standard of care rather than a technical or performance standard</td>
</tr>
<tr>
<td>Demands foresight by producers through lifespan of product</td>
</tr>
<tr>
<td>Requires active risk communication to consumer</td>
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<tr>
<td>Challenge for producers to comply when specifics are not provided</td>
</tr>
<tr>
<td>Challenge to monitor compliance with a qualitative, not quantitative, standard</td>
</tr>
<tr>
<td>Feasibility of effective and timely risk communication for post-purchase lifespan of product</td>
</tr>
<tr>
<td>Challenge for producers to foresee and predict product lifespan and children’s risks</td>
</tr>
<tr>
<td>Takes interests of all stakeholders into account in setting standard of care</td>
</tr>
<tr>
<td>Reflects standards of care that have evolved through civil liability systems</td>
</tr>
</tbody>
</table>

Pressures with desire to assemble evidentiary basis for risk assessment.
**TABLE A8.8 INDOOR AIR POLLUTION - EXPOSURE PATHWAY: ENVIRONMENTAL TOBACCO SMOKE**

<table>
<thead>
<tr>
<th>AUTHORITY</th>
<th>OBJECTIVE / APPROACH</th>
<th>CHALLENGES/ BARRIERS</th>
<th>FACILITATORS</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framework Convention on Tobacco Control (World Health Organisation, 2003)</td>
<td>This comprehensive and integrated strategy includes product controls, economic measures, trade and sale restrictions as well as a range of information-based measures.</td>
<td>Powerful tobacco lobby, particularly in tobacco-growing jurisdictions</td>
<td>Convention is legally binding on States party. Monitoring of tobacco sales and production could be used as indicator of progress</td>
<td>Implementation process: Though binding, no concrete timeframes set Development of civil society allies essential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Though legally binding at national level, some aspects are controlled at other jurisdictional levels so have persuasive power only</td>
<td>Alleviation of financial health care burden (cost of tobacco-related illness) could motivate jurisdictions to comply</td>
<td>Consensus policy development: Significance of broad-based international binding instrument F/P/T/M cooperation required due to shared jurisdiction In direct conflict with industry interests so collaboration limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effects of fractured jurisdiction: uneven implementation, decentralized information</td>
<td>Convention presumes active involvement of civil society in implementation, and many civil society allies exist</td>
<td>Science-based policy: Science related to severity and breadth of health effects is well established</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Governments may have financial conflict of interest (tobacco sales taxes)</td>
<td>Multi-faceted strategy allows for great flexibility, adaptability, and redundancy of approaches</td>
<td>Information-based aspects of implementation (education/KT): Public education and risk communication are important components, as success depends largely on consumer behaviour change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Challenge to enforce sales to minor provisions (point of purchase)</td>
<td>Related children’s health indicators (as proposed by the CEC): “measure of children exposed to environmental tobacco smoke” and “prevalence of asthma in children”</td>
<td>Depends on active involvement of civil society organizations in information-based initiatives</td>
</tr>
</tbody>
</table>

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* Article 8 states: “2. Each Party shall adopt and implement …measures providing for protection from exposure to tobacco smoke in indoor workplaces, public transport, indoor public places and, as appropriate, other public places.”

** Article 16 urges restrictions on sales to minors, sales by less-than-packet quantities (affordable to minors), and sales by vending machines.
### Table A8.9 Outdoor Air Pollution - Exposure Pathway: Fuel and Vehicle Emissions

<table>
<thead>
<tr>
<th>Authority: CANADA – CEPA, 1999</th>
<th>Objective / Approach</th>
<th>Challenges / Barriers</th>
<th>Facilitators</th>
<th>Evaluation</th>
</tr>
</thead>
</table>
| Gasoline Regulations, SOR/90-247 set maximum concentrations for certain substances in gasoline. However, limits vary depending on use, with favourable treatment for aircraft, competition vehicles, farm machinery, boats, and large trucks. | Product control by setting technical standards | Federal jurisdiction does not extend to vehicle standards and licensing | Quantitative standards are relatively easy to test and monitor | Implementation process:  
- Lead phase-out successful  
- Short-as-possible transitions are best |
| Sulphur in Gasoline Regulations, SOR/99-236 set the allowable concentration of sulphur in gasoline. Noncompliance may oblige the offender to give public notice of the fuel characteristics and of any danger to human health or the environment that might be threatened. | Lower standards apply in some cases, dependent on use/type of vehicle | High mobility of vehicles across P/T boundaries | Phase-in approach provides time for industry to adapt and develop technologies | Consensus policy development:  
- F/P/T cooperation required due to shared jurisdiction  
- Industry cooperation required to ensure economically and technologically feasible |
| Gasoline and Gasoline Blend Dispensing Flow Rate Regulations (SOR/2000-43) set a maximum flow rate of 38 litres per minute to dispense the fuel into on-road vehicles. The limit does not apply to nozzles dedicated to refuelling heavy-duty vehicles. The objective is to minimize vapour emissions and overflow at the pump when flow rates exceed the vehicles’ flow rate capacity. (Environment Canada, 2006) | Flow rate restrictions control distribution process to minimize unintended release | Flow rate control does not require post-implementation monitoring, as physical barriers ensure minimal release. | Flow rate control does not require post-implementation monitoring, as physical barriers ensure minimal release. | Consistent with international policy development |
| Contaminated Fuel Regulations (SOR/91-486) prohibit the import of contaminated fuel except for the purpose of destruction, disposal and recycling in accordance with applicable federal or provincial law. Export is also forbidden, unless permitted by the appropriate authority of that country. | Emission control regulations | Cumbbersome to issue separate regulations for different components of the same product | Regulation of the input (fuel) and output (emissions) indirectly ensures efficient technology development for the vehicles themselves. | Consistent with US approach facilitates trade and mobility |
| On-Road Vehicle and Engine Emission Regulation SOR/2003-2 establishes emission limits for hydrocarbons, carbon monoxide, and particulate matter, among other substances. It also aligns emission standards and testing procedures with the U.S. EPA. | Requires collaboration and coordination of many aspects of the auto manufacturing and supply chain | Requires collaboration and coordination of many aspects of the auto manufacturing and supply chain | History of measurable success of lead phase-out program paves way for additional risk control measures | Science-based policy:  
- Quantitative standards based on scientific grounds |

**Information-based aspects of implementation (education/KT):**  
- Price differentials during phase-out require information to public  
- Regulations are invisible to consumer after phase-out  
- Complex horizontal communications across governments  
- Complex vertical communications across industry
<table>
<thead>
<tr>
<th>CEPA, 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. 153 Mandates the use of a national emissions mark on all vehicles to certify compliance with standards, achieved by prohibiting transport of vehicles without the mark. Some exemptions apply.</td>
</tr>
<tr>
<td>s. 162 authorizes the creation of an emission credits-based scheme to reward companies with payment or a transferable credits for vehicles, engines and equipment whose emissions “more than meet” the prescribed standards. [not yet given effect by regulation]</td>
</tr>
</tbody>
</table>