The Canadian Society for
Civil Engineering

"Entrusted to Our Care"
Guidelines for Sustainable Development

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Abstract: This document presents the draft CSCE Guidelines for Sustainable Development, updated in 2006, in response to changing issues and Civil Engineering needs. These revised guidelines are intended to assist today's Civil Engineering community to practice their profession in the most sustainable manner possible. The main focus is to instil the concepts of sustainability and life cycle assessment into the planning, design and operation of civil infrastructure, and in this way promote the development of new technologies and management practices for minimizing the use of energy, non-renewable resources, and the production of waste materials.

1. LEGACY

The Civil Engineering profession has contributed much to human development and quality of life through the provision of basic water supply, pollution control, transportation, industrial/commercial, and urban infrastructure. Some notable Civil Engineering achievements since 1800 include:

- ***The Bell Rock Lighthouse (Robert Stevenson – 1807);*** Submerged at high tide, the Bell Rock Reef at the entrance to the Firth of Forth had terrorized shipping for centuries and was responsible for hundreds of shipwrecks and thousands of lives lost. Many earlier attempts to build a lighthouse on it had failed. Stephenson's work still stands as the oldest operating lighthouse in the world.
- ***The Stockton and Darlington Railway (George Stephenson – 1829);*** The first steam railway linking cities and towns with comfortable travel at a time when a hard day's journey covered 15 miles and most people never travelled more than a few miles from their birthplace. This represented unimaginable freedom.
- ***The Great Eastern (I.K. Brunel – 1853);*** Over 700 feet long, the Great Eastern ushered in the age of iron ships, reduced transatlantic crossing times, and laid the first submarine cable linking Europe and North America. Our interconnected world today owes much to the Great Eastern.
- ***The London Sewers (Sir Joseph Bazalgette – 1858);*** More than 1,000 miles of sewers were laid to replace some 200,000 cesspools at a time when regular cholera epidemics left as many as 35,000 dead at a time, and almost 60% of children from poor families never reached the age of 5 years. The benefits were immediate and widely acclaimed.
- ***The Victoria Bridge (Robert Stephenson – 1859);*** The first crossing of the St. Lawrence river helped unite Upper and Lower Canada through trade with the New England colonies, thus providing an efficient means for goods, supplies and immigrants to develop Canada and the western territories.
- ***The Canadian Pacific Railway (Sir Sandford Fleming – 1877);*** More than 46,000 miles of surveys on foot and canoe through the most arduous conditions and unknowns, finding a route for the transcontinental railway that helped unite the new Dominion of Canada after Confederation.
- ***The Panama Canal (Ferdinand de Lesseps – 1894, and George Goethals – 1904);*** Linking the Atlantic and Pacific oceans, cutting months off the passage from the east coast to the west, hence stimulating trade, immigration and travel in the Americas.
- ***The St. Lawrence Seaway (1957);*** Enabling ocean-going ships to reach Thunder Bay, and bring minerals from the Canadian Shield and wheat from the Prairies to markets in North America and Europe.
- ***The Confederation Bridge (1997);*** A magnificent span of the Northumberland Strait, linking Prince Edward Island with the mainland, reducing travel time and stimulating economic development.

Each of these Civil Engineering works, in its own way, made life more comfortable, convenient, accessible, healthy and longer - not only for the local populations, but ultimately for us all.

But now that same infrastructure, and the economies and standard of living that it supports, is contributing to environmental degradation due to the sheer size and scale of its effects. There are ubiquitous signs that the human population is now impacting the global environment, thus threatening our life-support systems.

Human society worldwide has continued, during the past decade, on a path that is clearly not sustainable. By the year 2050, fewer resources (than we are now relying on) will have to support nearly 9 billion people, each requiring food, clothing, shelter and modern amenities of life. As rapidly developing nations with large populations increase their use of resources, at some point this demand will simply exceed the earth's resources, with drastic consequences for human life and the environment on the planet.

Civil engineers are faced with an increasingly complex and interrelated world; a world that is growing rapidly in population, and becoming more urbanized and economically developed. Infrastructure development can no longer be done in a microcosm on a project level – a more holistic inclusion of the complex interactions of human society and the environment upon which it depends, is needed.

Sustainable Development can be taken to mean development that meets the needs of the present without compromising the needs of future generations to meet their own needs. Sustainability is thus a social concept (inter-generational), an environmental concept (conservation and protection), and an economic concept (living on the earth's interest). From this perspective arises the "Triple Bottom Line" – social, environmental and economic criteria for decision making. These criteria, coupled with consideration of the full life cycle of the Civil Engineering projects embarked upon, represents the way forward for Civil Engineering.

The CSCE adopted its first *Guidelines for Civil Engineering Practice, Our Commitment to a Sustainable Future* in 1993. These guidelines were the Society's first attempt to establish sustainability concepts within Canadian Civil Engineering practice in a manner consistent with the report of the Bruntland Commission and other relevant forums. The CSCE's 1993 guidelines were instrumental in helping to promote national and international progress in the field. For example, the China Civil Engineering Society used the CSCE's guidelines as a model for their own set of protocols. Recently, the World Engineers Convention was held in Shanghai (WFEO 2004) and resulted in the Shanghai Declaration on sustainable development in engineering. The CSCE has recently signed an international protocol for "Engineering a Sustainable Future for the Planet" (July 2006) with the American Society of Civil Engineers and the Institution of Civil Engineers (UK) - a major commitment to sustainability on the part of Civil Engineering.

As more is learned about the vulnerability of the environment and the challenges of development, the need to update the CSCE's Sustainable Development guidelines became apparent. Important new issues have emerged, such as climate change, preservation and enhancement of the environment, human health effects, loss of biodiversity, and the consequences of fossil fuel shortages in the future. The civil engineer's role in guiding the development process towards sustainability is now more important than ever.

2. NEWLY EMERGENT ISSUES

Since the CSCE's 1993 guidelines were prepared, several sustainable development issues that affect Civil Engineering practices have gained prominence:

- ***climate change:*** its potential impacts upon civil infrastructure; changes in extreme hydrological and meteorological events; and the growing efforts to reduce greenhouse gas emissions, as well as adaptation requirements;
- ***peak oil:*** depleting oil and natural gas reserves with potentially very serious repercussions unless major shifts in societal priorities and policies are implemented; these include energy conservation and efficiency, alternative renewable sources, and strategies to reduce waste;
- ***sustainable transportation:*** renewed emphasis on pedestrian amenities; mass transit; and energy conservation in transportation systems;

- ***environmental restoration:*** reconstruction of natural features, and fish habitat in rivers and streams; the control of sediment runoff; the removal of dams and tidal barriers, and cleanup and/or redevelopment of contaminated sites;
- ***ecosystem disruption:*** loss of biodiversity; genetically modified products; and modified environmental vectors that may indirectly impact Civil Engineering;
- ***ethics & equity:*** transparency and equity in providing basic human services to disadvantaged people; contributing to poverty reduction, human health and public welfare; and,
- ***infrastructure operations & maintenance:*** infrastructure must be operated and maintained as effectively and efficiently as possible if the intended service benefits are to be obtained.

The concepts of sustainability should guide the civil engineer: to recognize the full life cycle of a project or system; to ensure follow-up by the designer during the operational phase of works; to use performance indicators in post-implementation monitoring of projects; and to balance the environment, social and economic objectives over the entire life of the project – the "Triple Bottom Line" – in infrastructure development.

Globally, there is the need to ensure civil infrastructure contributes to poverty alleviation, protects human health and ecosystem integrity, and offers the widest possible access to basic human services. Transparency, social equity and fairness must all be factored into civil projects.

Throughout all of these changes, the role of public participation in project planning and environmental assessment has been increasing. Civil engineers must learn to communicate the importance, function and impacts of civil infrastructure in daily life, and in sustainability terms, in order to assume a greater leadership role.

The ***CSCE Guidelines for Civil Engineering Practice – "Entrusted to Our Care"*** is the Society's effort to promulgate these concepts to members of the Civil Engineering profession, to other professions, to all levels of government and to the public. Sustainable development is now being incorporated into university curricula in Civil Engineering, and more opportunities for professional development with respect to sustainable development are being provided. The practising civil engineer must be made aware of the CSCE's guidelines and the importance of implementing them in professional practice.

2.1. UNCED and Agenda 21

These important international initiatives established sustainable development as an urgent operating need for all agencies.

The 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, resulted in the adoption of three key documents: (1) Agenda 21, a program to guide national and international environmental and development efforts into the 21st century; (2) the Rio Declaration, a statement of principles regarding the environment and development, and (3) a statement of principles for the conservation and sustainable use of forests and a convention to combat desertification. The United Nations has now established a Commission on Sustainable Development (CSD) to monitor implementation of Agenda 21 recommendations. Further implementation of Agenda 21 and the commitments to the Rio principles, were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa in September 2002.

A Framework Convention on Climate Change culminated in an agreement that received more than 150 head of state signatures at UNCED in June 1992; the convention entered into force in 1994. The climate change convention places an obligation upon industrialized countries to develop action plans to limit emissions of greenhouse gases and enhance forests and other greenhouse gas sinks. The First Conference of the Parties to review the climate change convention was held in Berlin, Germany, in 1995, and the 11th in Montreal in December 2005.

2.2. Climate Change

While there are uncertainties over the magnitude of climate change, scientific evidence is growing that global warming is occurring and is expected to continue during the 21st century. Climate change can affect both our natural and built environments, and challenge our ability as civil engineers to design and construct infrastructure that can protect people from harm and maintain acceptable standards of economic well-being. To respond to these challenges, proactive efforts are needed to reduce greenhouse gas emissions (mitigation) and to incorporate the effects of climate change on infrastructure design and the natural environment (adaptation).

2.3. Transportation

To a nation as large as Canada, transportation is an important issue. Throughout much of the 20th century, the major focus was on private motorized vehicles dependent on fossil fuels and a complex array of roads and highways for personal, commercial and industrial transportation. It is evident that the impacts of modern transportation in terms of urban sprawl, inefficient use of energy, high air pollution levels and greenhouse gas emissions, and an unacceptably large ecological footprint, are not sustainable. For example, the transportation sector accounts for about one quarter of Canada's greenhouse gas emissions and is a major contributor to smog in urban areas. A shift to sustainable forms of transportation is timely and essential. Civil engineers play such a major role in the planning, design, construction and operation of transportation systems that leadership must come from the Civil Engineering profession.

2.4. Environmental Restoration

During the 1990s, large development projects have been questioned and further efforts were directed at not only remediation of contaminated sites but also restoration of heavily damaged environments. For example, systematic approaches to remediate contaminated sites were introduced in 1980s with the establishment of the Superfund in the USA; and elsewhere the World Commission on Dams stated that, despite significant benefits to humankind from dams and reservoirs, in too many cases the price paid to secure those benefits in social and environmental terms has been too high (and, more importantly, could have been avoided). Civil engineers must become increasingly engaged with the restoration of natural habitat in conjunction with civil infrastructure projects.

2.5. Equity and Ethics

The welfare of the world's population can be improved, and a better quality of life achieved, through sustainable Civil Engineering projects that help eliminate poverty, provide basic services, protect human health, and contribute to equitable economic development among the world's poor. Lack of transparency reduces the effectiveness of costly development projects. The CSCE, in cooperation with several other engineering societies, has begun to work on a set of principles of professional conduct that will help improve practices in the engineering and construction industry. Openness and transparency in the procurement and delivery of global engineering and construction services, efficiently allocated for their intended purpose, will result in additional financial resources being available for poverty reduction and optimizing societal benefits by employing the "Triple Bottom Line" approach.

2.6. Infrastructure Operations and Maintenance

Civil engineers need to be involved with the operational phases of their works, especially with buildings, structures, water supply and wastewater treatment works. The design process cannot be divorced from operations and maintenance aspects of project implementation, yet this is often the case. Civil engineers should be advocating that contractual arrangements for the design of infrastructure include an obligation to evaluate subsequent operations. The first principle of sustainable development should be that existing infrastructure must be operated and maintained as efficiently and effectively as possible, before undertaking new projects relying on non-renewable resources, high energy use, and generating additional waste.

3. THE CSCE GUIDELINES FOR CIVIL ENGINEERING PRACTICE

3.1. Vision/Mission/Values.

Civil Engineering offers needed solutions to global society and the environment in an *increasingly populated and technology-dependant world.* There is no going back! Civil engineers can participate fully in the development process, becoming more aware of social, health, environmental and economic issues, and better advocating for sustainable development in the true sense of the word. Civil Engineering is in a position to make a tremendous difference. By exercising a leadership role, individual civil engineers can help to solve the most challenging and threatening problems that have ever faced humankind. One of the most important aspects of this role will be to continue to research and develop new technologies for resource utilization, basic human services, energy conservation and waste minimization. Another important aspect will be to apply sound management thinking to develop sustainable projects that are appropriate to community needs. This is truly the challenge of our generation.

3.2. Natural Environment.

The CSCE recognizes the imperative of protection of the environment, minimization of the environmental impacts of Civil Engineering works, minimization of waste and efficient energy use. The need is not simply for protection of the environment, but its enhancement through measures that improve the functioning of ecosystems and life-support systems on which we all depend.

The civil engineer should endeavour to:

- Recognize that the interdependence and diversity of our natural ecosystems form the very basis of our continued existence;
- Recognize the finite capacity of the environment to assimilate changes due to human activities, and incorporate consideration of adaptive capacity into project planning and design;
- Identify and act to minimize potential environmental effects of engineering activities;
- Study thoroughly the environment that will be affected, assess all the impacts that may arise, and select the best alternative for a sustainable project;
- Include consideration of environmental effects in all phases of planning and implementation of engineering activities;
- Promote a clear understanding of the actions required in Civil Engineering practice to sustain and restore the natural environment; and,
- Encourage the enhancement, not simply the protection, of the environment.

3.3. Financial and Economic Sustainability.

The CSCE recognizes the need for financial and economic sustainability in the provision of infrastructure. This would include considering the true life cycle costs, both direct and indirect, such as the increased cost of water treatment required *(direct)* when water quality buffers such as wetlands are destroyed, and the loss of habitat for waterfowl and aquatic species *(indirect)*. Other important considerations are operations and maintenance, repair and rehabilitation costs, demolition and disposal costs, as well as the appropriate level of service required taking into account the current level of economic development and the ability of users and consumers to pay. The closing of the gap between rich and poor has been identified by international aid organizations as integral to economic sustainability.

The civil engineer should endeavour to:

- Adopt a life cycle approach to project financing and implementation in which the construction, operation and maintenance, demolition and disposal costs are all adequately considered;

- Include costs and benefits related to environmental quality in economic evaluations of engineering activities;
- Recognize all actual, potential or perceived conflicts of interest in relation to engineering activities, and ensure clarity and transparency in dealing with them;
- Recognize that compromising environmental quality or standards in Civil Engineering activities is an inappropriate means of reducing cost, and may only achieve short-term gains at the expense of long-term sustainability and human welfare;
- Disclose environmental implications and uncertainties, and the entirety of external costs of Civil Engineering activities, taking into account the often inadequate and uncertain nature of environmental data;
- Promote economic approaches that recognize natural resources and the environment as capital assets; and,
- Consider the cost of environmental protection for the entire project life.

3.4. Green Construction.

The CSCE endorses "Green Construction" - construction that achieves the beneficial objectives of engineering work with the lowest possible consumption of raw materials and energy, both during and after construction. Every decision should aim to minimize environmental burdens under five global consequences: resource depletion, energy depletion, climate change, biodiversity, and human health. Best practices for eco-efficiency, such as increased energy/water efficiency, the minimization of waste and resource consumption, the employment of "clean" technologies should be employed. The use of performance based standards and guidelines identifying the outcome required as opposed to a prescriptive path that must be followed enables designers to achieve improved end results.

The civil engineer should endeavour to:

- Promote the wise use of non-renewable resources, waste minimization and recycling in engineering activities and the development of alternatives to the use of non-renewable resources;
- Select materials and systems with low embodied energy and easy reuse;
- Promote the principles of conservation and energy efficiency;
- Rigorously examine the basic functions and purposes behind a project to recognize options and alternatives that will increase sustainability;
- Identify appropriate technology for sustainable development, recognizing that may mean low-tech solutions;
- Choose a built form and orientation that contribute to environmental economies and future adaptability, flexibility of use and reuse;
- Select construction methods that minimize the effects of construction and demolition in terms of land take, waste and pollution;
- Aim to reduce natural, accidental and wilful hazards;
- Consider individual and cumulative social, economic and environmental impacts (the Triple Bottom Line) including long-term and indirect impacts; and,
- Adopt practices, policies and design goals that focus on efficiency, conservation of materials and energy, and waste minimization.

3.5. Human Resources.

The CSCE recognizes the need for continuing education and professional development of human resources as integral to sustainable development. Civil Engineering education and learned societies like the CSCE must promote the requirement for engineers to educate themselves on environmental issues and the full consequences of development actions, stay aware of the issues, and practice continuous

improvement. Educational programs must be strengthened and broadened to foster the capacity for the creation of Civil Engineering solutions required to deal with the complexity of sustainable development. Internationally, the need for capacity building in development organizations and at the community level is also acknowledged.

The civil engineer should endeavour to:

- Keep informed about environmental trends and issues;
- Promote a clear understanding of the actions required in Civil Engineering practice to sustain and restore the natural environment;
- Support and participate in environmental education and public consultation activities;
- Promote continuing improvement in the sustainability of design, construction and maintenance of the built and natural environments;
- Be aware of the potential impacts of professional activities on the environment, and maintain a working knowledge of environmental issues and solutions; and,
- Not rely on ignorance of environmental problems to justify activities that may cause significant damage to the environment.

3.6. Social, Regulatory, and Health Concerns.

The CSCE recognizes the need to go beyond the minimum regulatory requirements; the importance of basic human services and poverty reduction through rule of law, transparency, and accountability in Civil Engineering activities is paramount. The CSCE advocates voluntary compliance as preferable to legislation, such as through performance based standards and guidelines. The CSCE recognizes that equity and meeting basic human needs is fundamental to sustainability and the practice of Civil Engineering, and that no generation should increase its wealth to the detriment of others.

The civil engineer should endeavour to:

- Meet basic human needs with a focus on social equity;
- Recognize the rights of future generations;
- Report conditions affecting public safety and the environment;
- Comply with legislation and consider additional environmental protection where feasible; and,
- Consider evidence of cumulative, persistent and synergistic effects where these may not be addressed in legislation.

3.7. Ethics.

The CSCE recognizes that the public welfare is the prime responsibility of the civil engineer. This inherently includes the well-being of the environment. As such, the civil engineer should advocate for the principles of sustainable development in both their work and in their workplace, and urge clients and employers to incorporate environmental objectives, conservation and energy efficiency into design criteria, in order to prevent or minimize the adverse environmental effects of engineering activities.

The civil engineer should endeavour to:

- Adopt practices that contribute to the goal of sustainable development;
- Suggest alternatives to clients, if the proposed engineering activity is likely to create unavoidable environmental risks;
- Urge clients to incorporate the monitoring of environmental changes into projects, and to adjust operations as a result of that monitoring;

- Provide information to clients, employers, the public and government about ways of improving the sustainability of Civil Engineering solutions;
- Decline to associate with engineering activities if the client or employer is unwilling to support adequate efforts to evaluate and/or mitigate environmental problems;
- Employ the precautionary principle – always err on the side of caution with respect to environmental consequences, since the response of biological systems to human activities is frequently difficult to predict;
- Provide leadership in the development of codes of practice for sustainable development within the workplace;
- Reaffirm their commitment to regard the physical, economic and environmental well being of the public as the prime responsibility of their work; and,
- Decline to be associated with engineering activities if the client or employer is unwilling to comply with environmental requirements.

3.8. Participation.

The CSCE recognizes the interdisciplinary nature of the issues and therefore the need for participation, by government, public agencies, institutions and societies, the public, employees, and other professionals. Civil engineers have a role as leaders to set an example and support actions leading to sustainable development.

The civil engineer should endeavour to:

- Recognize that the expertise required for a specific engineering activity may not be sufficient for judging the environmental implications of that activity;
- Involve specialists in environmental engineering and other professions in determining the environmental implications of engineering activities;
- Recognize individual limitations in assessing environmental effects, and consider other opinions, professional and otherwise;
- Recognize the rights of the community to be involved in project formulation and development, and actively encourage such involvement;
- Maintain dialogue about sustainable development with other professions, with the public, and with environmental groups;
- Ensure active community participation in engineering decisions/discussions;
- Assist and advise other engineers, where necessary, in the application and use of the principles of sustainable development set out in this document;
- Work to harmonize the activities of public and private sectors, non-governmental and intergovernmental organizations; and,
- Support initiatives of other recognized professionals to implement the principles of sustainable development.

3.9. Implementation.

The CSCE recognizes the importance of operations and maintenance in infrastructure projects, and the monitoring, reporting, and periodic evaluation and review of civil projects and programs leading to continuous improvement.

The civil engineer should endeavour to:

- Establish operational goals and targets aimed at energy and resource conservation, minimization of waste, protection of surface and ground water, and the abatement of air emissions;

- Promote and follow performance based standards and guidelines;
- Incorporate appropriate monitoring of environmental change into all operations and processes, and adjust the systems based on the results;
- Ensure close liaison between the design and operational phases of projects; and,
- Advocate for sustainable funding for O&M during the entire life cycle of each project.

4. CONCLUDING REMARKS

It is clear that in recent years, additional clarity has evolved in terms of sustainability as a concept and how it relates to institutional and societal values, and that significant progress has occurred in translating these goals into at least short-term programming for many agencies, and sometimes long-term programs as well.

Viewed both globally and locally, humanity is very much technology dependent. New and more innovative technologies must play a key role in preserving and enhancing the environment, including the human environment – technologies based on research and development, alternative design and service standards, and large scale behavioural and social changes.

The role and benefits of Civil Engineering must be communicated effectively to the public, other stakeholders, regulatory agencies, infrastructure owners and developers, and politicians so that the serious, urgent and growing problems faced by the world's burgeoning population can be effectively addressed.

Civil Engineering will continue to be a vital profession – a profession that supports food production, health and security, basic human services (water, wastewater, energy, transportation), and environmental protection and enhancement for the burgeoning global population that will increase markedly under growing economic and social stimuli. Therefore, civil engineers need to strive to incorporate sustainability in all aspects of their work if humankind is to adapt and survive into the next millennium.

Anthropologist Margaret Meade once noted, "Never doubt that a small group of thoughtful, committed citizens can change the world". Civil engineers, through the practice of their profession, can join that group and act as part of these necessary agents of change.

The CSCE's Guidelines for Sustainable Development will hopefully play an important role in this process.

5. ACKNOWLEDGEMENTS

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References

American Society of Civil Engineers (ASCE). 2004. The Role of Civil Engineer in Sustainable Development (ASCE Policy Statement 418). Available on the ASCE website: www.asce.org

Asian Development Bank (ADB). 2005. The Asian Development Bank Website: http:/www.adb.org.
CSCE / ICE / ASCE Protocol for Engineering – A Sustainable Future for the Planet. The Canadian Society for Civil Engineering, Montreal, Quebec, Canada, July, 2006.

Berton, P. 1971. *The Last Spike: The Great Railway, 1881-1885*. McClelland & Stewart, Toronto, Ontario.

Borris B., Cochrane, R., Culver, K., Dunn, R., Hopper, D., Leech, R., McIntyre, E., Morris, V., Rankin, N. and Shikaze, K. .1998. Environmental Guidelines of Professional Engineering in Ontario, Toronto.

Bruntland, G (ed). 1987. Our Common Future: The World Commission on Environment and Development, Oxford: Oxford University Press.

Canadian International Agency (CIDA) (The) .2005.The Canadian International Development Agency, Ottawa.

Canadian Society for Civil Engineering (CSCE) .1993. CSCE Guidelines for Civil Engineering Practice with a Commitment to Sustainable Future.

Carroll, W.J. .1993. World Engineering Partnership for Sustainable Development, Journal of Professional Issues in Engineering Education and Practice, 119 (3): 238-240.

China Civil Engineering Society (CCES). 1998. CCES Guidelines for Sustainable Development of Civil Engineering. CCES Research Group on Sustainable Development for Civil Engineering Practice. China Architecture and Building Press.

CIWEM website. 2005. Principles for Managing the Environment_ March 1988, Fact sheet: Sustainable Development, 2003; Policy statement: The Environment, June 2001; Policy statement: Water Use Efficiency, June 2003; Policy Statement: Environmental Economics, Paul McMahon & Derek Giles, January 2001. Available at www.ciwem.org (Accessed December 2005).

CSCE. 1993. The Canadian Society for Civil Engineering Guidelines for Civil Engineering Practice, Our Commitment to a Sustainable Future.

Government of Canada. 2002. Climate Change Plan for Canada. ISBN: En56-183/2002E. Available at www.climatechange.gc.ca (Accessed December 29, 2005).

HKIE. 2005. Hong Kong Institution of Engineers, Hong Kong, China. HKIE www.hkie.org.hk.

IEM. 2003. Website. Institution of Engineers, Malaysia (IEM), Petaling Jaya, Selangor Darul Ehsan, Malaysia. www.iem.org.my (Accessed November 2005).

IES. 2005. Institution of Engineers, Malaysia (IEM). Singapore. www.ies.org.sg (Accessed November 2005).

Institute of Transportation Engineers (ITE), Policies of the Institute of Transportation Engineers, posted on ITE website (Revised October 2003).

Institution of Civil Engineers (ICE). 2003. The ICE Sustainability Charter, June 2003, London, United Kingdom. www.ice.org.uk/about_ice/aboutice_sustainability.asp (Accessed December 2005).

Institution of Structural Engineers (ISE) 1999. Building for a sustainable future: construction without depletion, London, United Kingdom.

IPCC. 2001. Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. [Watson, R.T. and the Core Writing Team (eds.)], Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

Jamaica Institute of Engineers (JIE), Jamaica Institute of Environmental Professionals (JIEP) and Jamaica Sustainable Development Networking (JSDN) Program, websites read in 2005.

Johnson, C.D., Korol, R.M. and Perks, A. 1994. "CSCE Guidelines in the Context of Sustainable Development". *Canadian Civil Engineer*, August issue, pp1-10.

Postel, S.L. 2000. Water and the World Population, Journal of the American Water Works Association, 92 (4): 131-138.

The Centre for Sustainable Transportation. 2002. Definition and Vision of Sustainable Transportation October 2002. Mississauga, Ontario, Canada. www.cstctd.org.

Transport 2000 Canada. 2004. Freight Transport and Greenhouse Gases: Rail versus Road. Transport 2000 Atlantic, October 2004, Available at www.transport2000.ca/atlantic/railvsroad.html (Accessed December 29, 2005).

Transportation Association of Canada (TAC). 2005, Transportation Association of Canada Environmental Policy and Environmental Code of Ethics, Ottawa.

United Nations. 1992. [RIO] Declaration of Principles. United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992.

United Nations. 2002. The World Summit on Sustainable Development, Johannesburgh, South Africa, 2-4 September 2004.

Washington Post (Oct. 27, 2005) "Canada Evacuates Indian Reserve Over Contaminated Water Supply", The Washington Post Company, Washington, DC, USA.

WFEO. 2004. The Shanghai Declaration on Engineering and the Sustainable Future. World Engineers' Convention, Shanghai, 5 November 2004. The World Federation of Engineering Organizations, Maison de l'UNESCO, Paris, France. www.unesco.org/wfeo/wecdeclaration.pdf (Accessed December 2005). Also see Engineering for Sustainable Development, WFEO website 2005.

World Bank (The). 2005. Environmentally and Socially Sustainable Development Reference (Guide 1), Washington, D.C.

World Commission on Dams. 2000. Dams and Development: a new framework for decision-making. Earthscan Publications Ltd., London, United Kingdom.

World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.