CRANFIELD UNIVERSITY

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MSc Thesis

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Application of e^2DPSIR for analysis of soil protection issues and an assessment of British Columbia's soil protection legislation

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Abstract

This thesis evaluates the Driver-Pressure-State-Impact-Responses (DPSIR) framework as a tool for analysis of soil protection issues and illustrate its application, assesses British Columbia's (BC) legislative framework to determine if it adequately addresses threats to soils, recommends whether a BC strategic soil protection framework, or additional soil protection measures are required.

The DPSIR framework was evaluated and an enhanced model developed. The e^2DPSIR model addresses short-comings identified by various authors with a sub-system covering human, societal, sector, economic and socio-political drivers and factors. This allows potential effects of targeted responses on environmental factors and human well-being to be assessed. The use of symbology (directional, weighted arrows and colour) aids visualization of relationships and effects. The e^2DPSIR model was used to assess the potential effects on soil organic matter and soil carbon stores of two current policy initiatives linked to a mountain pine beetle epidemic which has devastated 13.5 million hectares of forests in BC, namely the Mountain Pine Beetle Action Plan and the BC Bioenergy Strategy. Implementation of these initiatives must balance biomass supply for bioenergy with biomass retention to prevent potential degradation of soil productivity and soil carbon stores in the long term. The accelerated emission of biomass carbon as CO_2 through 'burning' for bioenergy (versus natural decay) may offset emissions from hydrocarbon sources due to substitution. Further application and evaluation of the e^2DPSIR model is recommended.

BC soil legislation was found to be quite comprehensive and to adequately address the major threats to BC soils, with few minor gaps. Recommendations are for a) a strategic soil protection framework to integrate existing legislation and raise awareness of soil protection issues, b) measures to prevent soil organic matter decline and protect urban soils, and c) a soil monitoring program.

Acknowledgements

This MSc thesis was completed while the author was on Education Leave from the British Columbia Ministry of Environment. This support is gratefully acknowledged.

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Notation

ALC	Agricultural Land Commission (BC) (also used in citations)
ALR	Agriculture Land Reserve (BC) (also used in citations)
BC	British Columbia
BCGovt	Government of British Columbia (used in citations)
BCMoE	BC Ministry of Environment (used in citations)
BCMoF	BC Ministry of Forests (used in citations)
BCMoFR	BC Ministry of Forests and Range (used in citations)
BCSRB	BC Ministry of Small Business and Revenue (used in citations)
BDt	Bone-dry tonnes (of wood) (BC term)
beetlewood	BC term for wood of pine trees that have been killed due to infestation by mountain pine beetle.
Bioenergy	BC term for energy from biomass
CBC	Canadian Broadcasting Corporation
Central Node	A factor in the causal network diagram which affects or is affected by multiple other factors (See Figure 7)
CFS	Canadian Forest Service (used in citations)
CoE	Council of Europe (used in citations)
Crown land	Provincially owned land (BC)
cutblock	BC term for the block or area to be cut(logged) or that has been logged.
CSA	Canadian Standards Association
Defra	Department of Environment, Food, and Rural Affairs (United Kingdom) (used in citations)
DPSIR	Driver-Pressure-State-Impact-Response framework
DSS	Decision support system
e^2DPSIR	Further enhanced DPSIR model
e-DPSIR	Enhanced DPSIR model
EC	European Commission (used in citations)
EEA	European Environment Agency (used in citations)
element	A components of DPSIR (e.g. Driver) (See Section 5.1) (in discussion of models)
end-of-chain node	A factor in the causal network diagram representing a 'end result' of the cause-effect relationships in the diagram (See Figure 7)
EnvCan	Environment Canada (Department of) (used in citations)
EPD	Environmental Political Dynamics model
EPP	Environmental Protection Process model
EU	European Union

factor	An behavior, environmental or human characteristic, entity, policy, or event which affects or is affected by other linked factors within the causal network of the DPSIR framework (e.g. soil organic matter)
FREP	Forest and Range Evaluation Program (BC)
FRPA	Forest and Range Practices Act (BC)
FSC	Forest Stewardship Council
gasoline	Canadian term for petrol (liquid hydrocarbon product for powering vehicles)
GHG	Greenhouse gas(es)
Govt of Canada	Government of Canada (used in citations)
HaBC	Hectares BC – a web-based publically accessible grid-based spatial analysis tool which provides tools for overlay and analysis of BC geographic data, including land cover, soils, topographic and ecosystem data. See: http://www.hectaresbc.org:22080/trac
LIMB	Integrated Land Management Bureau (BC) (used in citations)
MCA	Multiple criteria analysis
MEA	Millennium Ecosystem Assessment (used in citations)
node	A characterization of a factor due to the nature of its linkages to other factors (e.g. root node, central node)
NRCan	Natural Resources Canada (used in citations)
NRTEE	National Round Table on Environment and the Economy (Canada) (used in citations)
OECD	Organization for Economic Cooperation and Development (used in citations)
OPS	Okanagan Partnership Society (BC) (used in citations)
PSR	Pressure-State-Response framework
PWC	Price Waterhouse Coopers
QPN	Qualitative Probabilistic Network model
range	BC term for ranching or grazing lands on forest tenures
root node	A factor in the causal network diagram which starts a cause-effect chain (See Figure 7)
SFI	Sustainable Forestry Initiative
symbology	Term for a defined set of symbols (used in context of GIS, mapping and graphics)

1 Introduction

Environmental management and degradation issues have been recognized for quite some time in Europe. This has lead to the development of analytical frameworks or models for applicable to environmental or sustainable development issues, and to the development of thematic strategies and directives for environmental protection. One such analytical framework is the Driver-Pressure-State-Impact-Response (DPSIR) model which was developed for the European Environmental Agency (Smeets 1999). Strategies or directives include, for example, the European Union (EU) Thematic Strategy on Air Pollution, the Water Framework Directive, the Thematic Strategy for Soil Protection and the (draft) Soil Framework Directive.

The question arises: Are these analytical frameworks, strategies and directives potentially more broadly useful to aid other jurisdiction in their environmental management and protection efforts? Could other jurisdictions learn from the work by the EU or adapt these vehicles to support their own environmental management legislative or policy initiatives? In response to these questions, this thesis evaluates the applicability of the DPSIR framework to analysis of soil protection issues, and assesses whether British Columbia could benefit from application of a similar strategic level soil protection framework. This latter involves assessing the current state of BC's legislation and policies for protection soils against potential threats.

The objectives of this thesis are to:

- Evaluate the Driver-Pressure-State-Impact-Response (DPSIR) framework as a tool for analysing soil protection issues and potential responses.
- Assess British Columbia's legislative framework to determine how well it addresses the protection of soils from soil threats
- Recommend whether an overarching soil protection framework similar to the European Thematic Strategy for Soil Protection and the draft European Soil Framework Directive is needed in British Columbia (BC)
- Identify whether any significant threats to BC soils are not being addressed adequately at present and provide recommendations for next steps.
- Apply a DPSIR framework to assess the effects of selected drivers, pressures and responses on soils in BC as an illustrative exercise

The chapters within this thesis are outlined in the Table of Contents. A brief description of the chapters in this thesis follows, to provide the reader with an understanding of the flow of topics addressed.

This thesis starts by providing introductory information on thesis methodology, the importance of soil in providing ecosystem services which support human well-being, and the European strategy for soil protection. It then discusses the

DPSIR framework model, its uses, identified short-comings, and briefly reviews other authors' modifications to DPSIR and related models, leading to proposed further enhancements to DPSIR. A modified version is proposed, named 'e^2DPSIR'.

A summary of the geography, land use and socio-economic environment of BC sets the context for later discussions about BC legislation and soil threats for the reader, as is it assumed that some readers will not be familiar with BC. There follows an analysis and discussion about existing BC soil protection legislation and policy, the extent or magnitude of the various threats to soil on BC's total land base or specific to forest lands, agricultural lands or urban areas.

The e^2DPSIR model is then applied to illustrate the potential effects of climate change and two BC initiatives, namely the Mountain Pine Beetle Plan and the BC Bioenergy Strategy, on soil organic matter content and soil carbon stores in the areas affected by the mountain pine beetle epidemic.

The final chapters provide a summary of the key findings, conclusions, and recommendations.

This thesis is submitted to Cranfield University, as one of the requirements for the Master of Science Degree in Land Management (Soil Management Option).

The intended and potential audiences for this thesis include the examiners of this thesis, management and policy staff within the BC Ministry of Environment, policy analysts or technical staff in other government departments, and the wider scientific community or members of the public who may find these analyses and discussions of interest. The author welcomes feedback.

2 Methodology

Information requirements for this thesis pertained to the following broad topics:

- A theoretical legislative/policy analytical framework or model
- European soil management legislation and policy
- British Columbia soil management legislation and soil threats

For all of the above topics, research was conducted by review of published or publicly available sources, including articles in scientific journals, on-line (internet) journals, research papers, technical reports, consultant's reports, books and other documents, and information published on websites (See Bibliography)).

The Scopus electronic database of scientific journal articles (available via the Cranfield Library) was the primary database search tool used to access articles. In cases where Cranfield Library's license arrangements did not allow access to specific, relevant articles, these were accessed via the BC Ministry of Forests Library licence arrangements (available to the author as a public service employee (on education leave)).

Scientific journals were the primary sources for information on DPSIR and other analytical models. The European Commission's websites were the primary sources for European Communications, Directives and related documents.

The DPSIR model had been identified as a potential theoretical framework for this thesis. The author conducted enquiries within the BC government to determine whether there were any legislative or policy analysis frameworks already in use by environmental policy makers in BC, as potential alternative models. (Contacts included staff in the BC Ministry of Environment - Strategic Policy Branch, the BC Environmental Assessment Office, the BC Ministry of Labour and Citizen's Services - Corporate Library and Knowledge Management Services section, and the Office of the Chief Information Officer - Cross Government Research Policy and Practice section). No policy frameworks were identified by any of the contacts.

British Columbia's Statutes and Regulations were reviewed for content related to soil protection in order to identify and extract this text for further analysis. These excerpts (including reference to the source Act or Regulation) are catalogued by soil threat and applicable land class and are available in Appendix 1. (This same data is also available from the author in a spreadsheet format upon request.).

The official BC legislative documents were accessed via the web-based QP Legaleze database. QP Legaleze is produced by the BC Legislative Assembly and the Ministry of Attorney General, and provides access to current BC legislation and regulations. The QP Legaleze database was accessed at:

http://www.qplegaleze.ca/default.htm, utilizing the BC Ministry of Environment's subscription package.

Legislation addressing soil-related topics were identified by searching QP Legaleze for key words including (but not limited to) 'soil', 'erosion', 'contamination', 'landslide', 'compaction', 'organic matter', 'sealing', and 'salinisation'.

Should the reader wish to review any materials beyond what has been compiled in Appendix 1, BC's statutes and regulations are also freely, publically available from the Queen's Printer at: http://www.qp.gov.bc.ca/statreg/, though these may not be current. Public access to QP Legaleze is available at BC public libraries, government agent offices or at BC Courthouse libraries.

The British Columbia government provides public access to an extensive collection of research publications and reports, policy and planning documents, strategic plans, ministry business plans, ministry programs, etc. via its websites. A comprehensive set of geographic data and mapping is also available via multiple web-based mapping tools. These resources were used extensively.

A raster-based spatial analysis tool called 'Hectares BC' was used for many spatial queries.

3 Ecosystem Services

The discussion (below) about ecosystem services is provided to illustrate the importance of protecting soil so that it can continue to support human well-being. It will be important for readers and potential users of the e^2DPSIR framework to understand the concept of ecosystem services, as one of the modifications to the DPSIR framework was the inclusion of ecosystem services with links to human well-being.

3.1 Natural Capital and Ecosystem Services

Human well-being is dependant on the capital stock on the earth which generates a flow of goods and services to support human welfare. This capital stock exists in the form of natural capital, manufactured capital, human capital and social capital (institutional rules, norms) (Costanza et al 1997a). Natural capital includes the lithosphere, hydrosphere, atmosphere and biosphere, and within the most biologically active zones within soils – the detritusphere (zone of decaying detritus), the porosphere (the pores and channels between aggregates containing water films), the aggregatusphere (the tiny pores and channels within macroaggregates), the drilosphere (earthworm burrows) and the rhizosphere (the rooted zone) (Barrios 2007).

The value of the earth's natural capital, in total, is infinite, as it forms the human life-support system. (Constanza et al 1997b)

'Ecosystem services' are the services provided by this natural capital to support human well-being. The provision of ecosystem services is dependent on the availability of an adequate level of natural capital, though to a certain and limited extent, if natural capital is depleted or degraded, it is possible to provide some substitute services through the use of manufactured (or perhaps human) capital (Constanza et al 1997b). For example, if groundwater quality is degraded due to the leaching of fertilizers and pesticides in quantities which exceed plant usage and the ability of soils to filter, assimilate, chemically degrade/neutralize or otherwise regulate these contaminants, water purification plants can be built to purify the water prior to human consumption.

Loss or degradation of our natural capital results in a decrease in human well-being as economic expenditures are required to provide the substitutes for an ecosystem service which had been essentially a free public good. As many ecosystem services have no viable or feasible substitutes (e.g. the influence of the atmosphere on climate regulation and the hydrologic cycle), as the demand for these services approaches the available supply (which is fixed or constant) or the supply approaches a minimum level for survival, the price or value of these non-substitutable services rises dramatically towards infinity (due to a near vertical marginal supply curve)(Costanza et al 1997b).

Ecosystem services can be categorized as:

- Supporting services – those that support ecosystem function and all other ecosystem services. Examples include: photosynthesis, primary production, formation of soil, nutrient cycling, water cycling.

- Provisioning services - those that provide products, for example: food, fibre, raw materials, fuel, genetic resources, fresh water.

- Regulatory services – those that regulate processes within the ecosystem such as climate regulation, water purification and regulation, erosion control, natural hazard regulation, pollutant filtration/detoxification, disease regulation

- Cultural services - those that provide non-material benefits to people, including recreation, aesthetic and spiritual experiences, preservation of artefacts. (MEA, 2005c, Defra 2006))

Linkages between ecosystem services and human well-being are illustrated in Figure 1. The 'potential for mediation by socio-economic factors' or the potential for substitution is shown by coloured arrows (e.g. a water purification plant can replace natural water filtration/purification processes.)

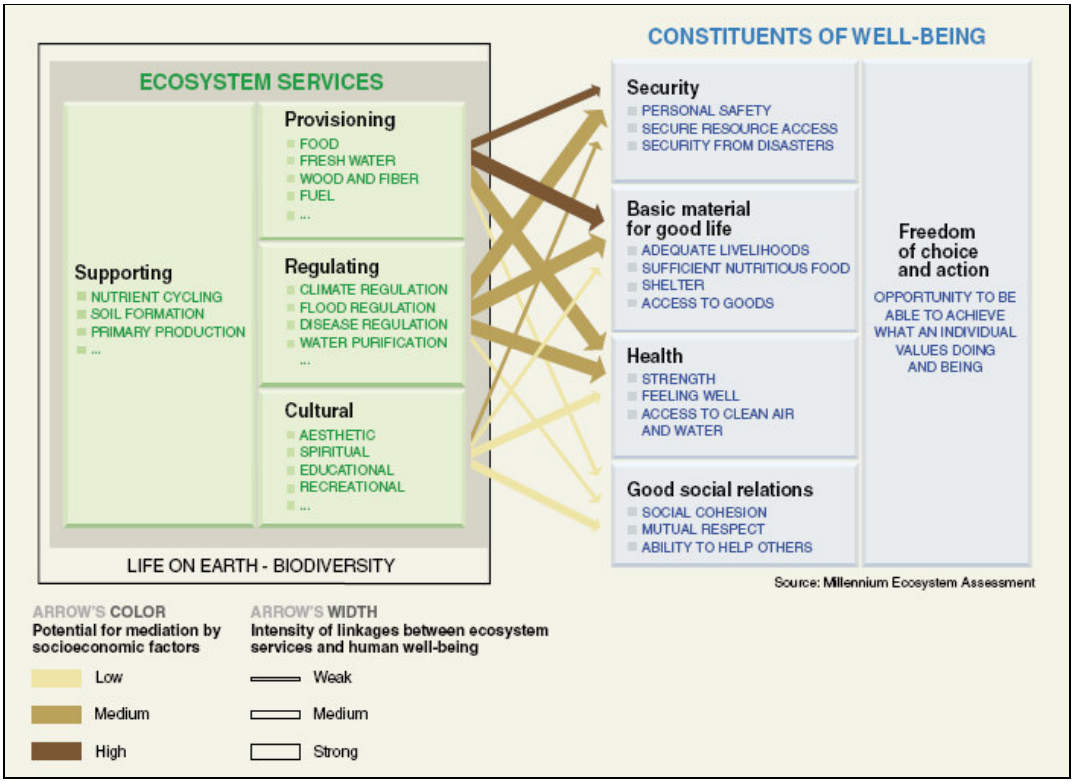

Figure 1 Linkages between Ecosystem services and human well-being (MEA 2005c)

3.2 Ecosystem services provided by soil

Soil is the foundation of all terrestrial ecosystems and the agricultural and forestry provisioning services, as well as being the structural medium for supporting the terrestrial biosphere and human infrastructure. The ecosystem services provided by soil are linked to its key functions. These functions include:

- Production of biomass
- Storage, filtration and transformation of nutrients, substances and water
- Provision of habitat, species and genetic biodiversity
- Provision of the physical and cultural environment for humans and their activities
- Provision of raw materials
- Carbon storage and cycling
- Protection of archaeological heritage (EC 2006)

Soil condition and type determine its ability to function and to provide ecosystem services. Degradation may be reflected by declines in soil fertility, soil organic matter and organic carbon content, loss of biodiversity, loss of water retention capacity, disruption of water, nutrient and gas cycles, and reduced capacity to degrade contaminants (Toth et al 2007). Soil degradation reduces its ability to provide ecosystem services.

Examples of ecosystem services provided by soil are listed in Table 1.

Table 1 Examples of ecosystem services provided by soil (continued on next page)

Ecosystem Service	Functional process(es)	Contributing or limiting factors
Water purification and soil contaminant reduction	Atmospheric deposits, applied fertilizers, pesticides or other contaminants are adsorbed into soil aggregates, by clay particles and organic matter, and degraded (chemically altered) by soil biota	Soil texture (primarily silt and clay content), soil structure, organic matter content, genetic and functional biodiversity of soil biota, (e.g. specific organisms are most efficient in degrading petroleum products)
Flood regulation	Rainfall infiltration and storage in soils reduces the rates of surface run-off, reducing and delaying peak flows, and reducing flood risk. Decreased surface run-off also results in lower rates of erosion, reducing sediment load in flood waters (reducing their volume)	Soil texture and structure, and organic matter content affect infiltration rate, erosion potential and storage capacity.
Source of bio-chemicals and pharmaceuticals	Bio-diverse soil biota could be a source of new pharmaceuticals (e.g. penicillin is a soil bacteria)	Soil structure and organic matter content affect moisture content gaseous exchange and nutrient availability.

Table 1 Continued

	Functional process(es)	Contributing or limiting factors
	Soil biota break down and recycle dead vegetative matter and organic waste products releasing nutrients available for plants and other biota and soil invertebrates physically mix soil and break down organic matter.	Recycling efficiency and effectiveness is a function of temperature, biodiversity of the soil biota, carbon-nitrogen ratios, molecular complexity, availability of water and oxygen, pH, and levels of any toxins.
Carbon Sequestration	Carbon in short-lived to more stable forms of soil organic matter (SOM) is stored (and recycled). SOM is approximately 58% organic carbon.	Carbon storage capacity is a function of soil texture, structure, moisture regime, nutrient regime (e.g. N availability), temperature, level of biotic activity, associated vegetation and soil disturbance regime.
Basis of all terrestrial ecosystems – life support	Soil (horizon) development and disturbance regime controls ecosystem development	Soil and associated ecosystem development is a function of time, underlying surficial materials, topography/elevation, climate, rainfall, temperature, aspect, and evolved moisture and nutrient regimes and vegetation development and succession. .
Nutrient cycling to support plant growth (primary production) including food and fibre production	Soil biota recycle dead organic matter into a mineralized form usable by plants and required for vegetative cell formation and growth	Nutrient availability from organic matter is a function of biological activity levels. Chemical fertilizer availability is a function of the dissolved (aqueous) nutrient concentration, adsorption by clays and OM. Prevalence of roots and mycorrhizal fungi and other soil biota.
Foundation for human infrastructure	Most human infrastructure is supported within or on top of soil and surficial materials or on bedrock.	Soil strength is a function of bulk density (compaction), texture, structure, moisture content and void space.
Regulation of greenhouse gasses	Soil biota affect fluxes of CO_2, CH_4 and N_2O.	Soil moisture regime (saturation), nutrients (organic matter), temperature, microbial activity levels.
Remediation of soil contaminated by diffuse airborne pollution	Soil biota metabolize contaminants through oxidative or reductive processes	Microorganisms require nutrients (mainly C, N, P, and others in minor or trace amounts), moisture (generally at 40-60% field capacity), and appropriate pH (5.5-8.5, best at 7.0) and appropriate temperature (15-45°C), plus oxygen for the oxidative processes. Processes will not proceed if too many inhibiting or toxic compounds are present.

(Daily 1997, MEA 2005a, MEA 2005b, MEA 2005c, Rockne 2003)

A very large proportion of the ecosystem services provided by soils are actually provided by the soils biotic community. This biotic activity tends to be concentrated in the rhizosphere, the hydrosphere associated with arbuscular mycorrhizal fungi, within soil aggregates and within soil carbon pools and detritus (organic matter) (Barrios 2008). Soil biodiversity is critical to ecosystem functioning and sustainable land management, with soil functional diversity rather than genetic diversity being a key factor. Species richness is much greater than functional diversity, indicating functional redundancy, however the effects of loss of genetic diversity and potential thresholds for sustaining ecosystem function and ecosystem services requires additional research (Barrios 2008). Important soil biota functional groups and the processes they influence are illustrated in Figure 2.

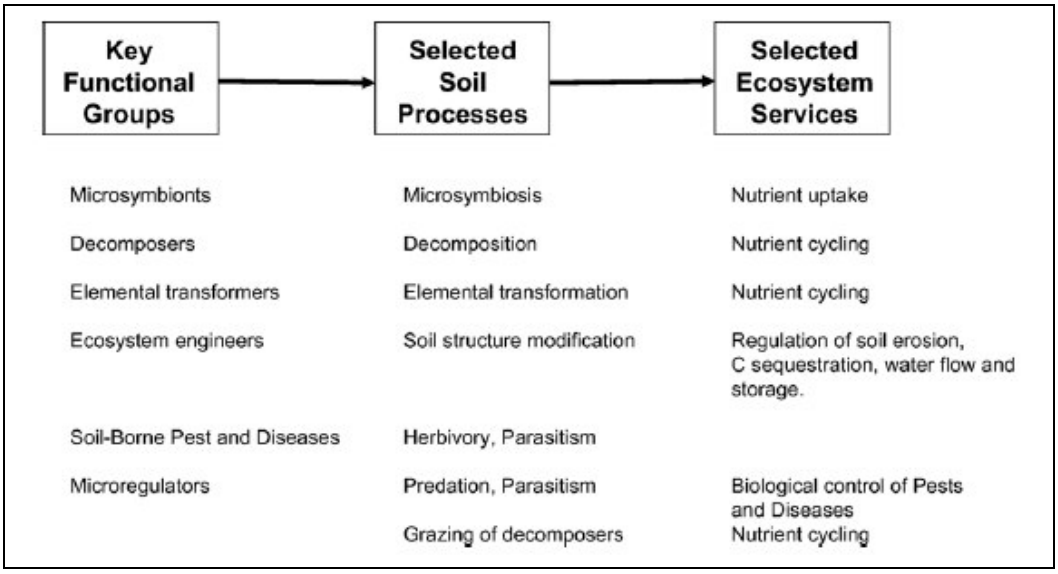

Figure 2 Functional groups of soil biota (in an agricultural landscape), the soil processes they influence, and the ecosystem services they provide (from Barrios 2007)

Naturally bio-diverse populations of soil biota and/or artificial inoculation of the soil with specific antagonistic bacteria, fungi and nematodes are known to effectively control a variety of pests and diseases. Biological control mechanisms include direct control, increased competition for substrate (food), parasitisation, spore removal or interference with spore germination, alteration or protection of plant or root tissues reducing colonization by pathogens, production of antifungal antibiotics, interference with fungal pathogenicity factors, induction of systemic resistance in plants, provision of increased nutrients to support plant health and strengthen natural resistance, and competitive exclusion of pathogenic species (Barrios 2007, Jacometti 2007).

Within many of the agricultural systems of the world, degradation of the soil has resulted in a loss of organic matter and a decrease in the natural nutrient cycling and nutrient provision services provided by soil and soil biota. Substitution of these nutrient provision services with chemical fertilizers had maintained or improved agricultural production levels, however, the associated soil degradation has caused other consequences. Loss of organic matter has affected soil structure and aggregate formation, decreased water and nutrient holding capacity, reduced infiltration rates, and reduced contaminant filtration and degradation capability (due to decreased biotic activity), resulting in leaching or runoff of fertilizers, pesticides and other contaminants into the groundwater, pollution and siltation of surface water bodies, increased soil susceptibility to wind and water erosion, and loss of valuable topsoil as the growing media for crops.

Relationships between soil biota and ecosystem services in agricultural systems are illustrated in Figure 3.

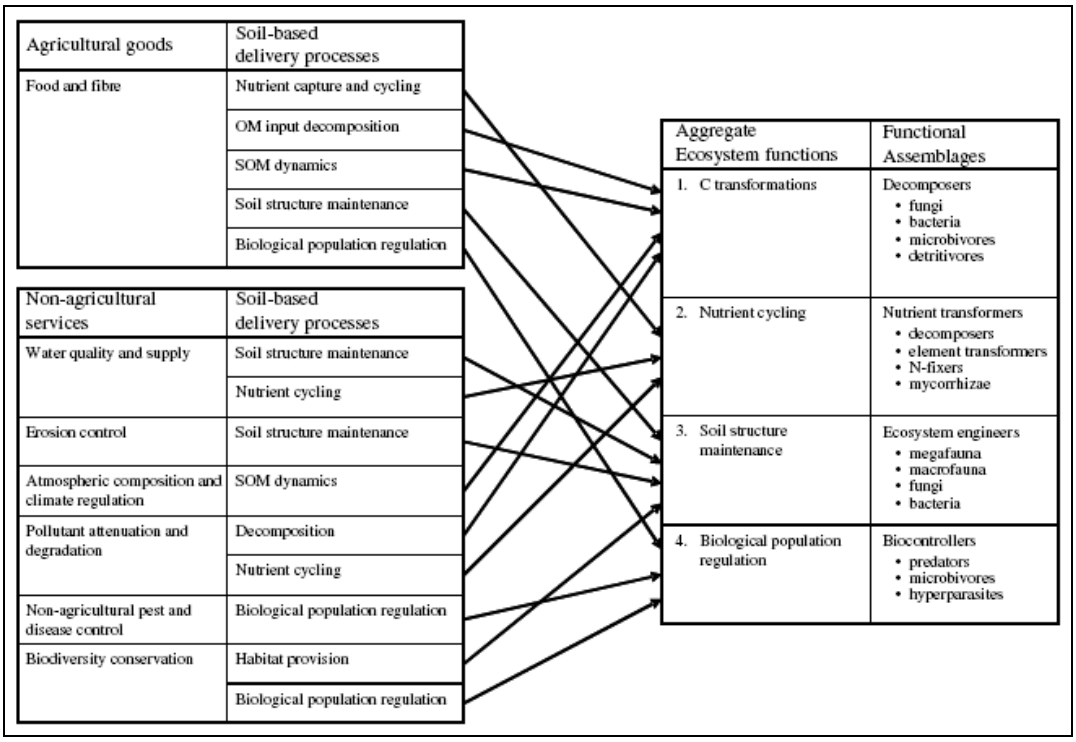

Figure 3 Relationships between soil biota and a range of ecosystem services in agricultural soils (SOM = soil organic matter, OM = orgnaic matter)(Kibblewhite at al 2007)

Current rising prices for chemical fertilizers and pesticides may result in a return to increased reliance on the soil food web to maintain and enhance crop productivity through nitrogen, phosphorous and other macro- and micro-nutrient cycling, and pest and disease control. However, due to past tillage, fertilization

and pesticide application practises which have disrupted or suppressed soil biotic communities and biodiversity, altered or destroyed soil structure and reduced organic matter levels, this conversion will take time and concerted effort in rebuilding healthy, diverse soil food webs.

3.3 Valuation of soil ecosystem services

As ecosystem services are generally not valued within the commercial or economic market, the impacts of degradation of natural capital tend to be born by the public rather than the factor, sector, organization or individual responsible for the degradation.

De Groot et al (2002) defines three types of values of ecosystem services:

- Ecological value
- Socio-cultural value
- Economic value

Ecological value reflects the integrity of the supporting and regulatory services. Sustainable use of natural capital is determined by the integrity, resilience and resistance of the ecosystem or natural capital resource. Socio-cultural value reflects the value of the cultural services, and economic value - the direct or indirect monetary value (assuming this can be determined or estimated).

As few ecosystem services are 'traded' in commercial or economic markets, a variety of valuation methods are needed in order to estimate the economic value for these services. Valuation methods may include:

- Direct market valuation (e.g. the price of agricultural products or bottled spring water)
- Indirect valuation:
    - avoided cost (e.g. waste treatment by wetlands)
    - replacement cost (e.g. cost of a sewage or water treatment plant)
    - factor income (income from an associate product that relies on the ecosystem service; e.g. increased value of a fishery due to improved water quality)
    - travel cost (e.g. willingness to pay an increased price to visit a natural area)
    - hedonic pricing (e.g. incremental house price for a scenic viewscape)
- Contingent valuation (e.g. using a survey to measure willingness to pay)
- Group valuation (e.g. using group deliberations to determine value) (De Groot, 2002)

Valuation methods for ecosystem services provided by soils include mainly direct valuation, avoided cost, replacement cost, or factor income methods. Some examples of potential valuation methods for soil's ecosystem services are provided in Table 2.

Table 2 Examples of valuation of ecosystem services provided by soil

Ecosystem Service	Valuation method	Example
Nutrient cycling and crop protection by soil food web	Direct market valuation	Premiums paid for organic produce
Groundwater protection by soil filtration of fertilizers and pesticides	Avoided cost	Cost of construction and operation of water purification plant to treat contaminated groundwater prior to human consumption
Water storage and cycling in soils and by vegetation	Avoided cost	Cost of flood control measures and remediation of effects if flooding occurs
Nutrient cycling by soil food web	Replacement cost	Cost of substitution with chemical fertilizers and pesticides
Erosion control	Avoided cost	Cost of dredging rivers or lakes
Erosion control	Hedonic pricing	Value of protecting sensitive fisheries for biodiversity and recreational fishing (by minimizing sedimentation of spawning beds and maintaining water quality)

(De Groot et al 2002)

In general, the majority of individuals and organizations within society are aware of and value soils' provisioning services (production of food, fibre, etc.), however, the value of soils' other ecosystem services tends not to be appreciated due in large part to the invisible nature of these services and to the services' nature as 'public goods'.

4 EU Soil Protection initiatives and Soil Threats

This chapter describes the development of soil protection initiatives in Europe, and the objectives and mechanisms for implementation of the Thematic Strategy for Soil Protection (the Strategy). The list of threats to soil that are identified in the Strategy, as well as some additional threats, provide a structure for analysis of BC's legislation and the evaluation of threats to BC soils in later chapters.

4.1 History of soil policy in the EU

Due to the long history of development and population growth in Europe, soil management and degradation issues have been recognized for quite some time.

The European Soil Charter (1972) agreed by the Council of Europe recognized "the increasing biological deterioration of soil **...** especially that used for agriculture and forestry ... which suffers the damaging effects of pollution, erosion and sometimes ill-chosen techniques". In the Charter, the Council proposed that land managers should to consider the role of soil in landscapes and vegetation, and in the scientific, aesthetic and cultural interests of man, in addition to considering its role in meeting the immediate needs of society for agriculture, industry, urbanization and tourism (CoE 1972).

In 2002 the European Commission (EC) adopted the Communication 'Towards a Thematic Strategy for Soil Protection' (EC 2002), and in 2006, the 'Thematic Strategy for Soil Protection' Communication (EC 2006a). The EC then drafted the Soil Framework Directive (Defra 2005, EC 2006b). The aim of the Directive is to raise soil protection to the same level as air and water protection. The European Parliament adopted its first reading opinion of the Directive on 13 November 2007**,** however full adoption of the Soil Framework Directive also requires support from a qualified majority of member states. The necessary support by EU Environment Ministers was not attained during the December 2007 Council meeting, and this Directive remains 'on the table' pending further discussions among member states to resolve outstanding issues and potential agreement of the Council at a future EC meeting (EurActiv 2008, Europa 2008d). (Status reported as of July 2008.)

The Thematic Strategy for Soil Protection (EC 2002) proposes 4 areas of focus: 1) development of framework legislation for protection and sustainable use of soil, 2) integration of soil protection into EU and national policies, 3) closing the knowledge gaps, and 4) increasing public awareness. The Strategy identifies the following key threats to soil:

1. erosion
2. organic matter decline
3. contamination
4. sealing

5. compaction
6. decline in biodiversity
7. salinisation
8. floods and landslides

As the risks for erosion, organic matter decline, salinisation, compaction and landslides vary with geographic and climate factors, the Strategy proposes that risk areas be identified and established for these threats. The process proposed is illustrated in Figure 4. The Directive further requires that targets be established and a program of measures developed to address these threats. For each threat, definitions, methods of inventory and data requirements for assessing threats are provided in 'Common Criteria for Risk Area Identification according to Soil Threats' (Europa 2008a). To assist in determining and monitoring sol organic matter decline, a soil sampling methodology is provided in 'Soil Sampling Protocol to Certify the Changes of Organic Carbon Stock in Mineral Soils of European Union (Version 2)' (Stolbovoy et al 2007).

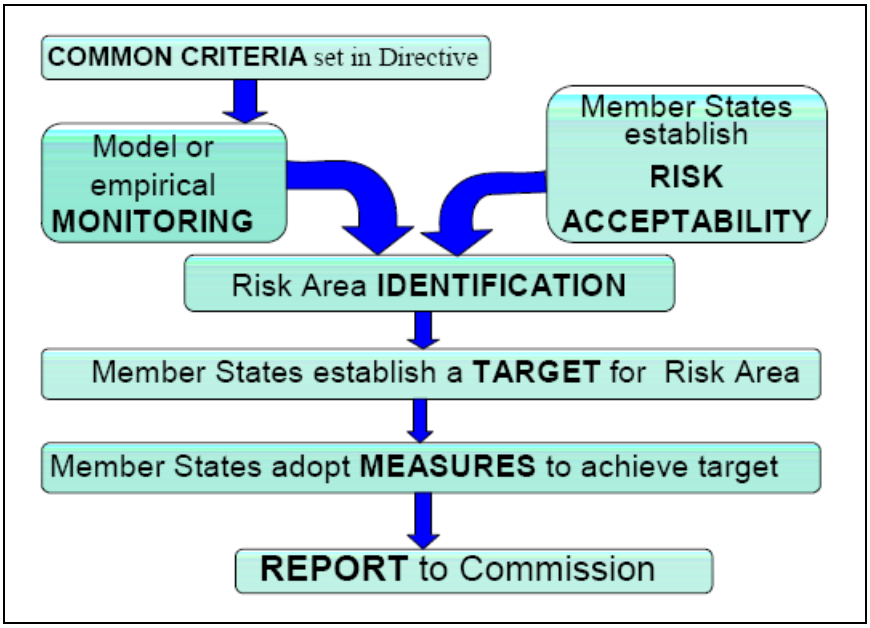

Figure 4 Process for addressing erosion, organic matter decline, salinisation, compaction and landslides in the EU (from EC 2002)

To address contaminated sites, the European Commission's Strategy proposed that member states develop an inventory of contaminated sites as well as a strategy for addressing 'orphaned' sites following the model illustrated in Figure 5.

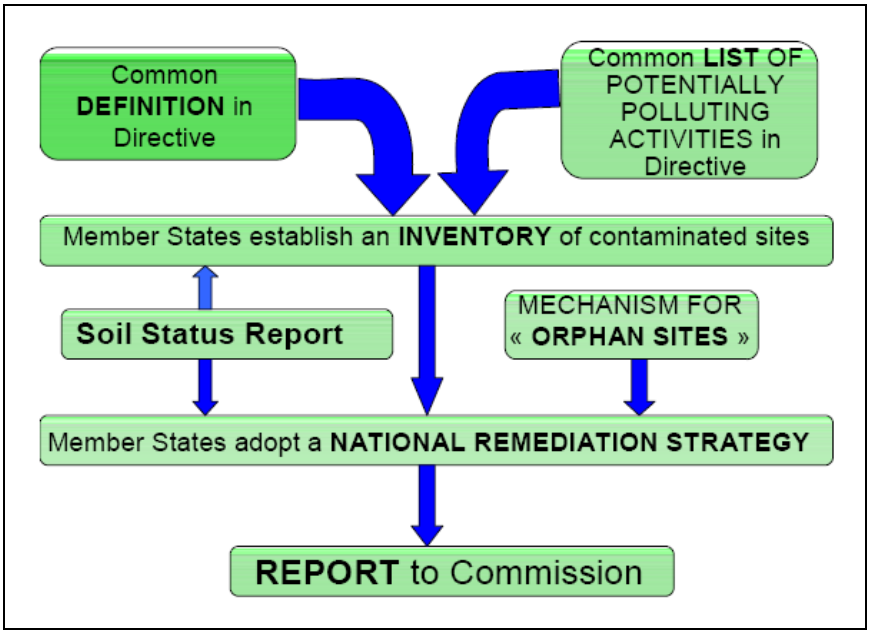

Figure 5 Recommended EU process for addressing contaminated sites (from EC 2002)

The Strategy proposes that member states take measures to limit soil sealing and to use applicable construction techniques to minimize negative impacts on soil function.

The Strategy does not address loss of biodiversity directly, but assumes that actions taken to mitigate the other threats will have a positive influence on biodiversity. Flooding is not addressed in the Strategy as it is covered under other EU initiatives (EC 2006a).

The draft Soil Framework Directive defines the framework and soil protection objectives and requires that member states implement laws and other measures appropriate to their needs, consistent with the principles of subsidiarity and proportionality. The principle of subsidiarity is intended to ensure that within the EU, actions are taken at the lowest effective level of government (unless the issue is within the exclusive competence of a higher level) (Europa 2008b). The principle of proportionality is intended to ensure that the European Union's involvement is limited to what is necessary, giving member states and individuals the greatest freedom possible (Europa 2008b).

There are several other European directives and other initiatives which directly or indirectly address soil protection issues. Examples are listed in Table 3 (below).

The recently completed ENVASSO (Environmental Assessment of Soil for Monitoring) project describes a proposed soil monitoring program for Europe. The project reports on: a) Criteria and Indicators, b) Inventory and Monitoring, c) Database Design and Selection, d) Procedures and Protocols, and e)

Prototype Evaluation. The ENVASSO project addresses monitoring of the 8 threats listed above, plus desertification. This monitoring system can be used to assess the current and future states of soils and to support sustainable soil management (ENVASSO 2008). The results of the ENVASSO project have potential for application elsewhere, including in BC.

Table 3 Other European initiatives which consider soil protection issues

Directive	Issues addressed
Water Framework Directive	Surface water quality and contamination
Nitrates Directive	Good farming practices with respect to manure and fertilizer use within nitrate vulnerable zones
Air Quality Framework, Directive on National Emissions Ceilings, and CAGE(Clean Air for Europe)	Deposition of heavy metals and other materials potentially contributing to contamination, acidification and eutrophication
Sewage Sludge Directive and Urban Wastewater Directive	Disposal and spreading of sewage sludge on land.
Habitat Directive	Defines rare habitats dependant on specific soil characteristics (e.g. dunes, peat lands, calcareous grasslands, wet meadows)
Transportation Policy	Land take for transportation infrastructure, fragmentation of habitats/ecosystems, effects on soils quality due to water runoff from roads, persistent herbicide use on railway corridors, disturbance of surface and groundwater flows and contamination risk (from dangerous goods spills)
Common Agricultural Policy	Good farming practices, including setting maximum livestock carrying capacities, banning burning of field residues, agri-environmental measures – organic farming, integrated crop management, reduced pesticide use
Research Policy	On contaminated land rehabilitation, global climate change and vulnerable ecosystems, new farming systems to prevent/control erosion & salinisation, and support for the European Soil Bureau Commission's Joint Research Centre (JRC)

(EC 2002)

4.2 Beyond the Strategy and Framework Directive

In addition to the main threats to soil identified in the Strategy for Soil Protection, several other threats could be added to the list. These may be specific to certain sectors or regions.

The ENVASSO project addressed an additional threat - desertification - not included in the Soil Strategy (ENVASSO 2008, EC 2006a).

Another additional threat important in northern or alpine regions (including parts of BC) is the threat of loss of permafrost and loss or degradation of cryosolic soils. Cryosols are very high in organic matter content and degradation of these

soils has implications regarding release of CO_2 and climate change. The distribution of cryosols in the Northern Hemisphere is shown in Figure 6.

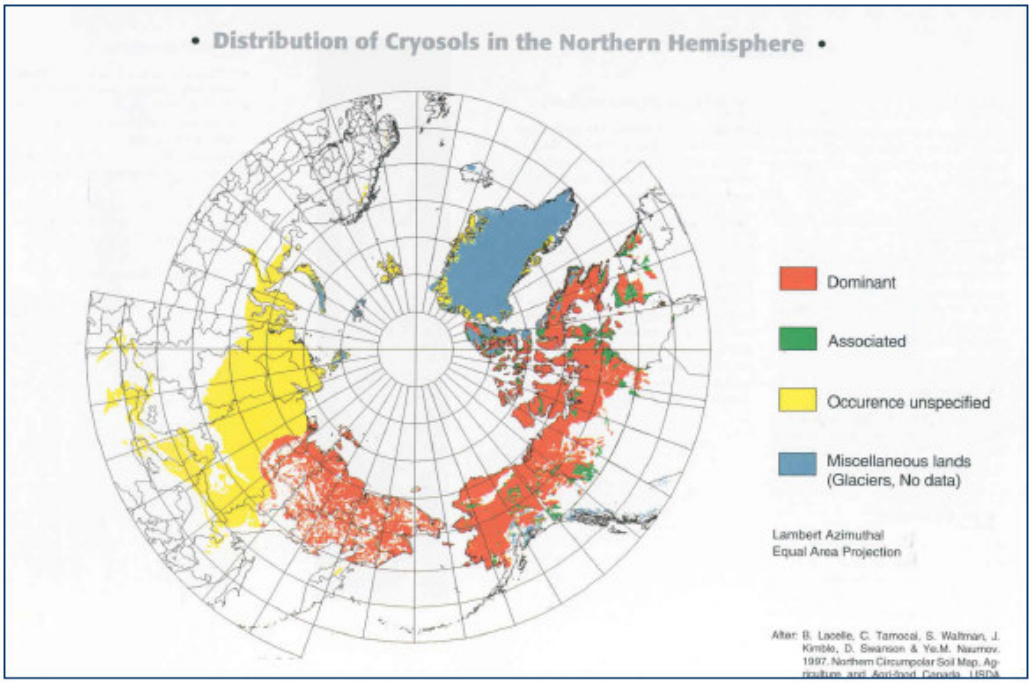

Figure 6 Distribution of Cryosols in the Northern Hemisphere (from Spaargaren 2005) (Note: Map does not show cryosols in British Columbia, though they are present (Valentine & Kavkulich 1978))

Soil loss due to crop harvest (e.g. with root crops if they are not washed on site and soil recovered) is potentially a threat to agricultural soils. Some soil may also be lost if it is stripped and stored or disposed of (e.g. by burial) in a manner that prevents restoration of soil functions. Situations where this may occur include during urban development, infrastructure construction, mining development, or flooding of lands for creation of dams.

The Thematic Strategy for Soil Protection and the draft Soil Framework Directive give consideration to threats to soil biodiversity but do not specifically consider the issue of conservation or preservation of rare or endangered soils (for example, those associated with rare and endangered ecosystems). The Habitat Directive may partially address this issue, but is limited to the identified habitats. Conservation of rare soil ecosystems would help to preserve soil biodiversity and protect potentially important currently unknown biochemical or pharmaceutical resources or soil biotic communities which may become important as global climate changes.

The list of soils threats could therefore be expanded to include all of the following:

1. erosion
2. organic matter decline

3. contamination
4. sealing
5. compaction
6. decline in biodiversity
7. salinisation
8. landslides
9. desertification
10. loss of permafrost soils
11. soil loss due to harvest or removal/burial
12. loss of rare soils (and ecosystems)

This expanded list of soil threats is addressed in this thesis.

5 The Driver-Pressure-State-Impact-Response (DPSIR) framework

The DPSIR framework, widely in use in Europe, was suggested as a potential theoretical analytical framework to support the evaluation of soil protection issues. As BC soil legislation and policy is a focus of this thesis, the author sought to identify theoretical policy frameworks used by BC environmental policy makers (see Chapter 1). No such framework was found, so the DPSIR framework was adopted and evaluated for application in this thesis.

5.1 The evaluation

The scientific and environmental policy literature was reviewed for applications and critiques of the DPSIR framework. Previous author's modifications, and other analytical models were evaluated, and select components adopted to further develop the DPSIR framework. As these additional customizations build upon other authors' work, the modified framework developed here is named the 'e^{2}DPSIR' framework, following the lead of Niemeijer and DeGroot (2008) who named their enhancement 'eDPSIR' ('e' for enhanced).

In order to ensure consistency in the use of terminology when describing various models or frameworks below, the terms element, node, factor and relationship or influence are used. Elements are the Driver, Pressure, State, Impact and Response components of the DPSIR model. Nodes refers to the factors under consideration for the scenario being analysed in the DPSIR model framework, and the arrows represent the links or relationships between factors or the influence of one factor on another (as illustrated in Figure 7 (next page)) .

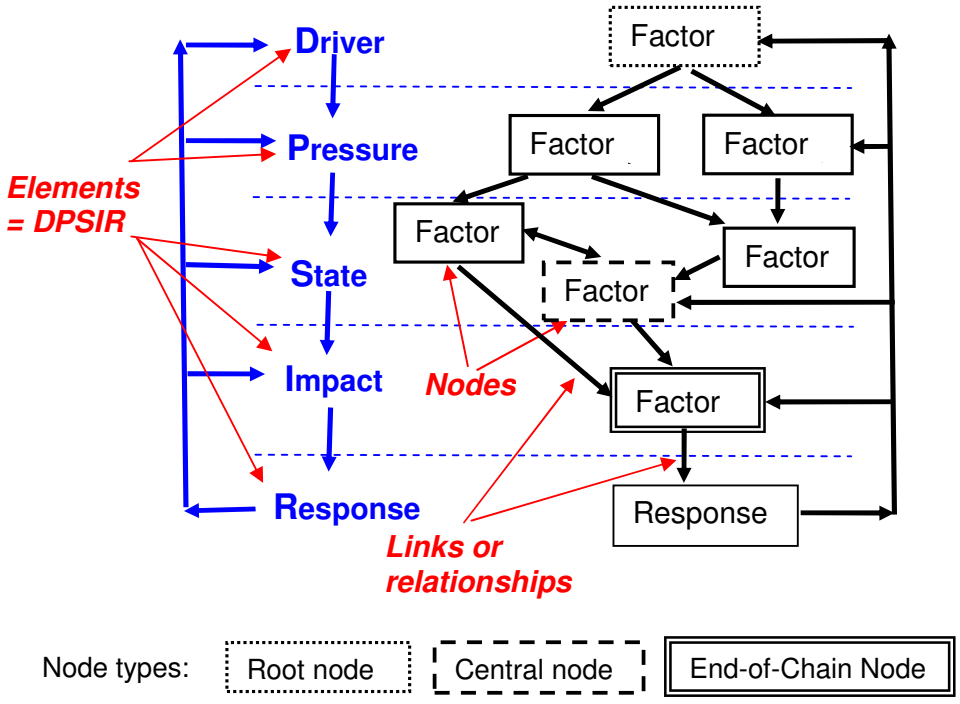

Figure 7 Illustration of terminology used in describing the framework models

5.2 The DPSIR framework

The DPSIR framework was developed for the European Environment Agency (EEA) (Smeets & Weterings 1999), building on the Pressure-State-Response (PSR) model of the Organization for Economic Cooperation and Development (OECD 1993). The DPSIR framework describes cause-effect relationships with social or environmental **D**rivers putting **P**ressure on the environment, changing its **S**tate and causing **I**mpacts to human well-being or ecosystem services, in turn soliciting a societal **R**esponse. Response measures may be directed at any of the Drivers, Pressures, the State or the Impacts. The most commonly used DPSIR diagram is shown in Figure 8. The linkages between the elements of this model are also important. In their original work for EEA, Smeets and Weterings (1999) describe some of the indicators or types of information which link the elements of DPSIR (Figure 9).

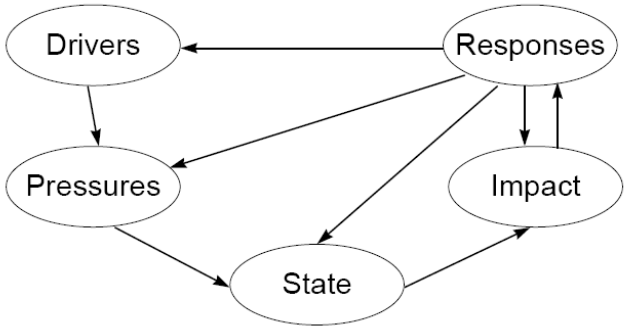

Figure 8 The commonly used DPSIR diagram (from Smeets & Weterings 1999)

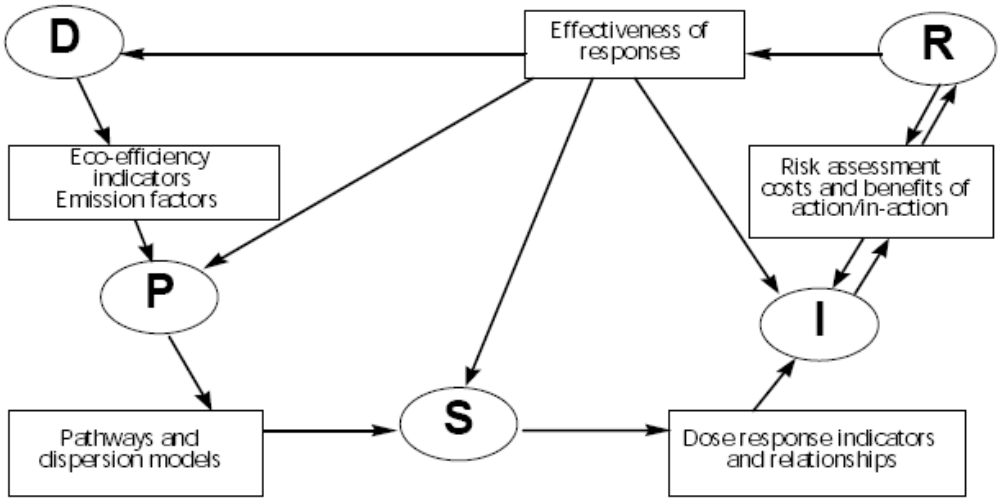

Figure 9 Indicators and information linking DPSIR elements (from Smeets & Weterings1999)

The DPSIR framework has been widely used by researchers of various disciplines and policy makers have used it for organizing information about the causal relationships between society and the environment to support inter- and intra-disciplinary and stakeholder communication (Tapio & Williamo 2008; Svarsted et al 2008).

The DPSIR model has been used for environmental assessment, (e.g. Luiten 1999), environmental sustainability (e.g. Borja et al 2006; Zalidis et al 2004), and analyses of land and resource management options in a variety of ecosystems or sectors (e.g. Pirroni et al 2005, Karageorgis et al 2006, Elliott 2002 (catchment/coastal zone/offshore), Fassio et al 2005 (agricultural pollution), Vasik et al 2006; Wolfstehner & Vacik 2008 (forest development)). The broad definition of criteria for categorizing the factors or influences which

may be selected for each element (driver, pressure, state, impact or response) has resulted in variability in application and use of the framework. Various authors have made comments, often contradictory, about the strengths and weaknesses of the DPSIR as an analytical or communications tool. A sample of these comments follows:

The DPSIR framework:

- can show cause-effect relationships for alternative possible measures, to support decision-making (Fassio et al 2005)
- fails to capture and evaluate different management options (Vacik et al 2006)
- is just a way of categorizing and disseminating information (Carr et al 2007)
- suggests linearity in the cause-effect relationships between human activities and the environment (Vacik et al 2006)
- has some rigidity and limitations in dealing with dynamic or complex socio-economic interactions (Fassio et al 2005).
- Is flexible in allowing impacts to be defined at a different scale (or for a different spatial boundary) than the Drivers and Responses (Svarsted et al 2008)
- cannot account for changing dynamics within the system being analysed (Rekolainen et al 2003)
- cannot capture trends over time expect by repeating the study over regular intervals (Rekolainen et al 2003)
- fails to take into account individual (and their potential cumulative) influences on the state of the environment (Carr et al 2007)
- does not allow for identification of specific actors in the chain (Gobin et al 2004)
- treats society as one entity, failing to consider individuals actions, not differentiating between human actions and societal factors (Tapio & Williamo 2008)
- fails to distinguish between anthropogenic and natural factors, assuming that these can indeed be separated (Tapio & Williamo 2008)
- does not separate environmental protection objectives from measures (Tapio & Williamo 2008)
- is not a neutral analytical tool, as it tends to bring into it the biases of the analyst (Svarsted et al 2008)
- tends to best support the 'Preservationist' discourse type, and can accommodate the 'Win-Win' type with a conscious effort to include the social aspects, but does not readily incorporate the 'Traditionalist' or 'Promethean' discourse type (Svarsted et al 2008). (See Table 4 for information about the values considered important in each of the discourse types)
- has shortcomings as a communications tool where the above discourse-type biases result in failure to address the perspectives of stakeholders and policy makers (who may be approaching the

issue from the socio-economic rather then environmental protection perspective) (Svasted et al 2008).

Table 4 The relative importance of different values in the Preservationist, Win-Win, Traditionalist and Promethean discourse types (from Svarsted et al 2008)

	Conservation Important?	Needs and interests of local people important?	Partnerships with local/external groups positive?
Preservationist discourse type	Yes	Yes	No
Win-Win discourse type	Yes	Yes as means	Yes
Traditionalist discourse type	Yes in terms of sustainable use	Yes	No
Promethean discourse type	No	Yes	Not Relevant

(Explanatory note: A Promethean is only concerned with the well-being of the local people, ignoring conservation of environmental values and relationships with external organizations.)

The lack of rigorous definition of the DPSIR model has been identified as one of its weaknesses, however, this is perhaps also one of its strengths. The flexibility of the model allows it to be adapted to suit the unique requirements of a wide variety of analyses and scenarios, and allows customization and integration with other models or tools.

5.3 Integrating DPSIR with MCA

The DPSIR model has been used in conjunction with multiple criteria analysis (MCA) in a decision support system (DSS), to evaluate the suitability or preference for policy options (Fassio 2005). **Error! Reference source not found.** shows the process or phases of analysis utilized within the DSS.

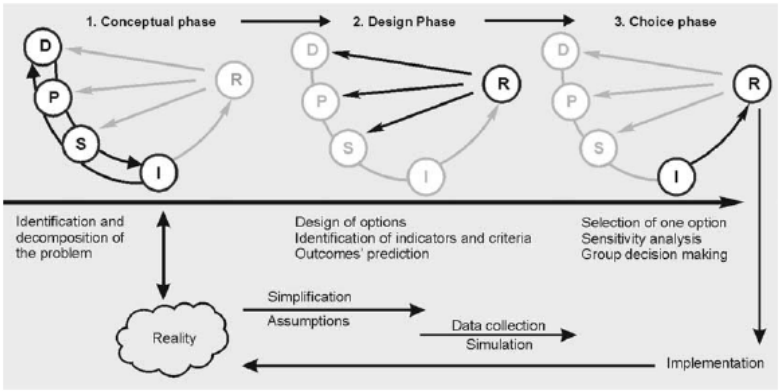

Figure 10 Phases of analysis in a decision support system based on the DPSIR framework (from Fassio et al 2005)

Phase 1 involves understanding the relationships between the DPSI elements, phase 2 identifies options for potential responses and phase 3 determines the effects of implementing these responses on the DPSI elements. Multiple scenarios could be analysed.

Figure 11 illustrates how a multi criteria analyses can be integrated in the DSS to help normalize or weight options in order to optimise the response in terms of impacts on various factors. Similarly, sensitivity analyses could be conducted.

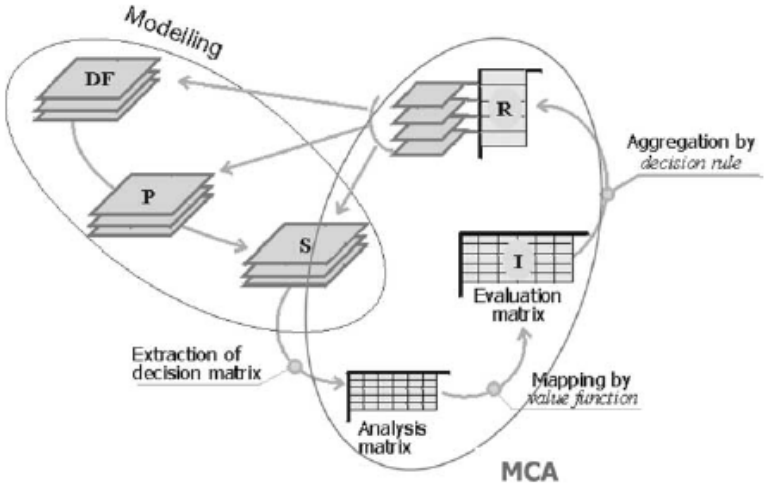

Figure 11 Integration of Multi-Criteria Analysis (MCA) with the DPSIR framework (from Fassio et al 2005)

5.4 The EPD Model

Scholl and Staerdahl (2001) describe an Environmental Political Dynamics (EPD) model. This model contains a parallel Society-Impact-Environment-Effects stream of elements which mimic the DPSI elements, except that Drivers and Pressures appear to include only anthropogenic factors, (and 'Industry' and 'Agriculture' are not Drivers *per se*). The lower row of elements - Priority-Targets-Environmental Policy-Sector Policy - could easily be categorized as parts of a modified 'Response' element in a DPSIR framework. Their model is dissimilar from DPSIR as it restricts responses to policy options directed at only the Drivers and Pressures. Their flow diagram (modified by overprinting with the DPSIR terminology – in blue) is illustrated in Figure 12.

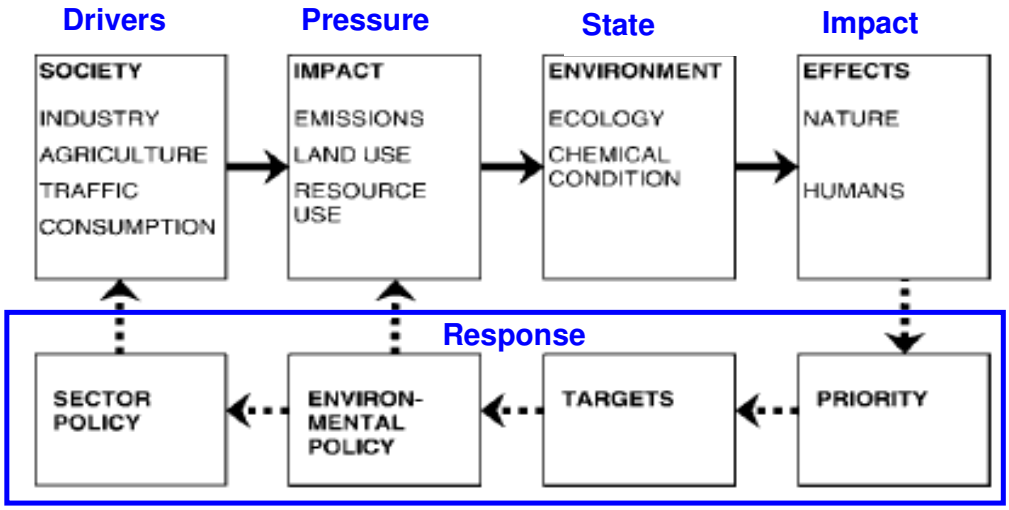

Figure 12 The Environmental Political Dynamics (EPD) Framework overprinted with the DPSIR elements (in blue) (modified from Schroll & Staerdahl 2001)

Scholl & Staerdahl (2001) in their EPD model consider possible responses to environmental impacts by first having society prioritize which negative effects require mitigation or an alternate response. The response is also clearly linked with a defined acceptable target for the environmental effect being addressed (e.g. an acceptable concentration of a nitrate in groundwater). The acceptable target is presumably determined by a defined process such as a risk analysis. The definition of a target allows the responses to be focussed on addressing the pressures though the use of environmental policy measures or on addressing the drivers through sector-specific measures. Setting of targets also allows monitoring of the effectiveness of the actions.

The EPP framework does not identify options for measures to directly address an environmental condition or its effects on the nature or humans. An argument could be made that direct action to alter the state of the environment or to mitigate its effects on nature or humans could still be valid responses within such a model (though perhaps outsider the strict realm of 'policy'). An example of a direct action is liming of acidic lakes, rather than implementing a policy to cause reduction of emissions which cause the acidification.)

5.5 The e-DPSIR model

Niemeijer & DeGroot (2008) build upon the DPSIR framework by integrating a causal network. This causal network may contain multiple interlinked factors within each element of the DPSIR framework (see Figure 13). This framework has been named the enhanced DPSIR or e-DPSIR.

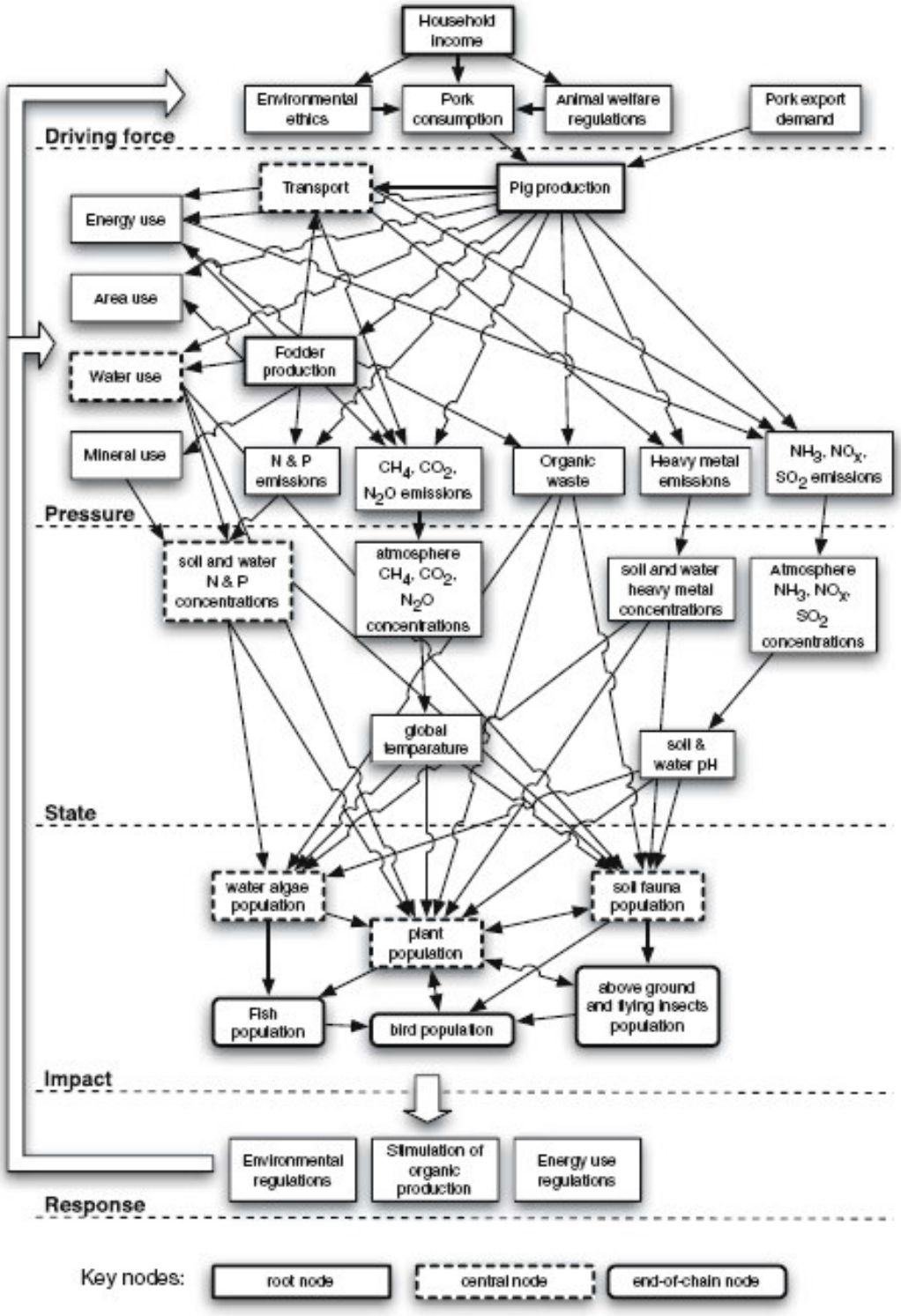

Figure 13 A simplified DPSIR causal network centred on pork production (from Mieneijer & De Groot 2008)

The e-DPSIR framework contains the following:

- causal networks rather than causal chains
- multiple nodes and links within each DPSIR element
- many-to-one, one-to-many and many-to-many relationships between nodes
- 'key nodes' of three types:
  1) root nodes
  2) central nodes
  3) end-of-chain nodes.

Root nodes are those which are the cause of the environmental problems, occurring at the start of the network. Central nodes have many incoming or outgoing links, so are affected by multiple factors and/or affect multiple other factors. End-of-chain nodes are at the ends of interlinked causal chains, often where the direct and indirect effects of many factors become visible as environmental problems.

This classification of key nodes is potentially very useful for targeting responses and measures towards drivers and pressures (at root nodes), or towards the most influenced and influential environmental factors or indicators (at central nodes). The indicators at the central or end-of-chain nodes may be good indicators to monitor, as they should respond to effective actions altering the factors or indicators within in the network of chains.

5.6 The QPN Model

van Koewen 2008 has described the qualitative probabilistic network (QPN) model which attempts to straddle the gap between causal loop diagrams and cognitive maps used by policy makers and simulation models used by researchers and scientists.

In environmental policy-making, an important task of the modelling is to identify policy measures that will address a specific problem (van Kouwen 2008). Where quantitative relationships are not known, qualitative probabilistic relationships could be used. This implies adding an expected or probable direction (positive or negative) to the influence and possibly a magnitude of the influence to the arrows linking nodes (or factors) in the causal network (e.g. an increase in rainfall intensity could be expected to increase erosion of vulnerable soils). This does not imply that numerical probabilities can be assigned, though in some cases, dose-response relationships may be known for specific factor to factor relationships. Probable relationships can be illustrated by the use of symbols (e.g. different types of arrow-heads).

The QPN model itself is a (computer) simulation model which propagates the positive, negative, zero or ambiguous qualitative influences on adjacent active nodes and across and around the network to predict probable ultimate impacts on the nodes of interest.

Figure 15 illustrates the probable impact of increased use of 'common' resources by the one or both individuals (A or B). In this 'tragedy of the commons' example, it is not known whether it is A's or B's or both A and B's levels of activity (these factors are ambiguous) which ultimately impact the gain from the resource, yet the effect can be expected to be negative. (See Figure 14)

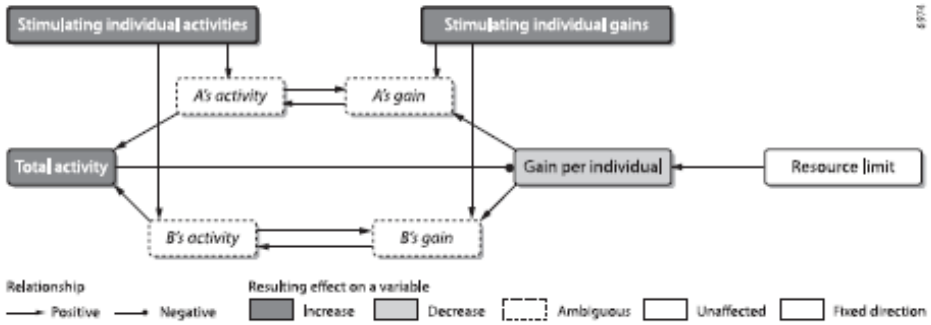

Figure 14 QPN model symbology - Analysis of the ''tragedy of the commons'' in the long term (from van Kouwen 2008)

In some situations, analysts using a DPSIR model may wish to define rules for propagation of negative, positive and other relationships between factors and utilize a QPN simulation model to more rigorously test the effects of response measures on factors of interest. Simulation modelling is beyond the scope of this thesis, however, integration of the concept of positive, negative, zero or ambiguous probable influences could potentially enhance scenario analyses within the DPSIR model.

5.7 The EPP Model

Williamo (in Williamo 2005 and Tapio & Williamo 2008) has also presented a modified DPSIR model, in this case splitting the causal chain of the DPSIR model into a causal network with two parallel and interlinked systems – a human environment system and an ecological environment system. This Environmental Protection Process (EPP) model further elaborates on the DPSIR elements subdividing these into phases or duplicating elements and phases within the two streams. The EPP model also distinguishes between societal factors and individual factors and filters their influences through an infrastructure lens in the human-environment system. The EPP model also draws from the EPD model, incorporating the concepts of prioritization (as **Problem** identification), and **Target** setting for identifying response measures. Measures may be targeted against any factor within the framework (See Figure 9).

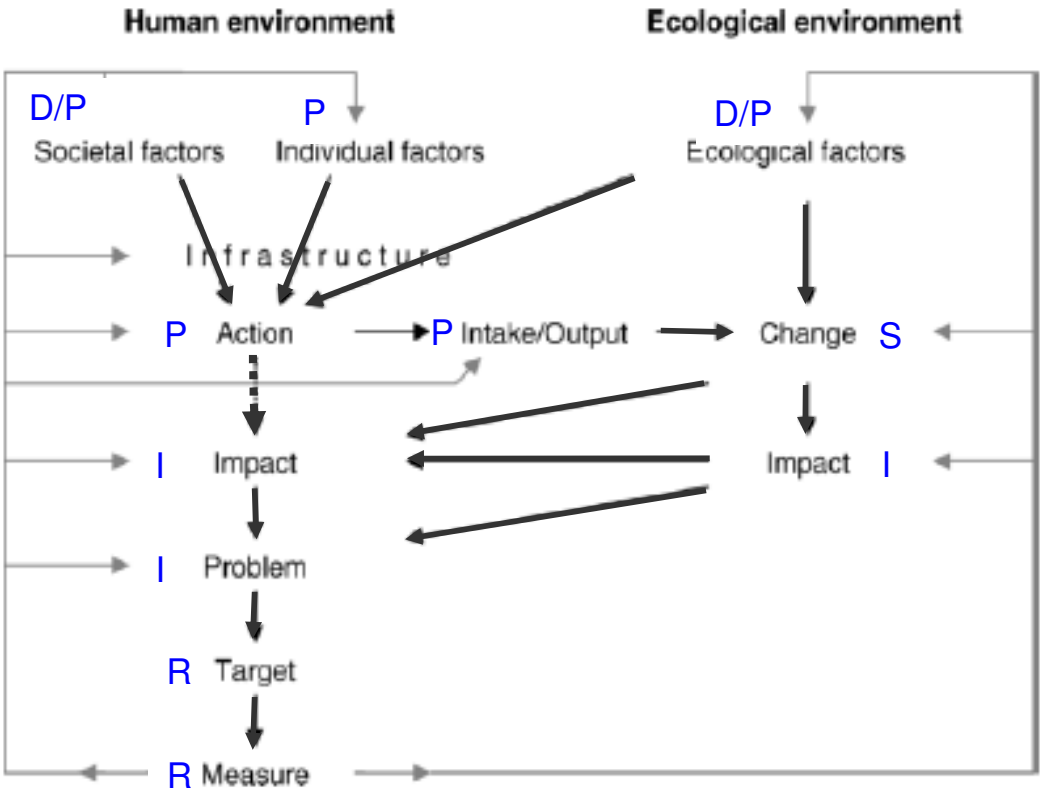

Figure 15 The EPP Framework (modified by overprinting DPSIR elements in blue) (from Williamo 2005 and Tapio 2008)

The EPP Framework in Figure 15 "illustrates the process (black arrows) through which environmental problems are created and also that (grey arrows) different parts of this process can be affected by different environmental protection measures. Between ecological factors, action, intake/output, change and impact interactions, the cause and effect –relationship has an important meaning. Other arrows show the relationship where human decisions are in the essential role. The dashed line adds to the human dimension of sustainable development representing those impacts that human actions have on cultural, social and economical environment" (Caption from Willamo 2005 as translated from Finnish by Tuomas Oula.)

This division of EPP framework into these two separate systems brings in the social/socioeconomic perspective, potentially providing the means to address some of the issues identified by Carr (2007), Tapio (2008) and possibly Svarsted (2008).

As measures could be applied to all of the elements and phases within the EPP model, Tapio & Williamo 2008 go on to classify the types of measures that can be used to respond to the environmental problems.

The types of measures include the following (in order of DPSIR elements and the EPP phases):

- Measures affecting societal factors
- Measures affecting individual factors
- Measures affecting ecological factors
- Measures affecting infrastructure
- Measures affecting human action
- Measures affecting intake/output
- Measures affecting change (environmental)
- Measures affecting the impact (environmental and/or human)
- Measures neglecting the problem (deliberate non-action)

This classification of types of measures could potentially also fit well or be modified by the concepts of root, central and end-of chain nodes (van Kouwen, 2008) to allow comparative assessment of measures most likely to result in the desired outcome (or target). .

5.8 The e^2-DPSIR model

A new enhanced DPSIR model - e^2-DPSIR - is proposed, primarily incorporating and modifying the EPP model further, but also utilizing various components from other models discussed above.

The components of e^2-DPSIR consist of the following:

- Addition of a socio-economic subsystem to the human system in the EPP model – containing 'sectors' and other economic or socio-economic factors with a 'barriers to change' filter (similar to the infrastructure filter).
- Addition of 'ecosystem services' factors to help clarify the link between the impacts on ecological factors and the impact on the human well-being
- Addition of a 'risk assessment' process or sub-model (node) at the link between the Problem and Target
- Addition of definition of 'objectives' prior to the identification of 'measures'
- Restructuring of the model as a causal network with multi-directional links and root nodes, central nodes and end-of-chain nodes (following the format of the e-DPSIR (Neimeijer & De Groot, 2008))
- Incorporation of probabilistic quantitative links (positive, negative, zero or ambiguous links) (following van Kouwen, 2008)

See Figure 16.

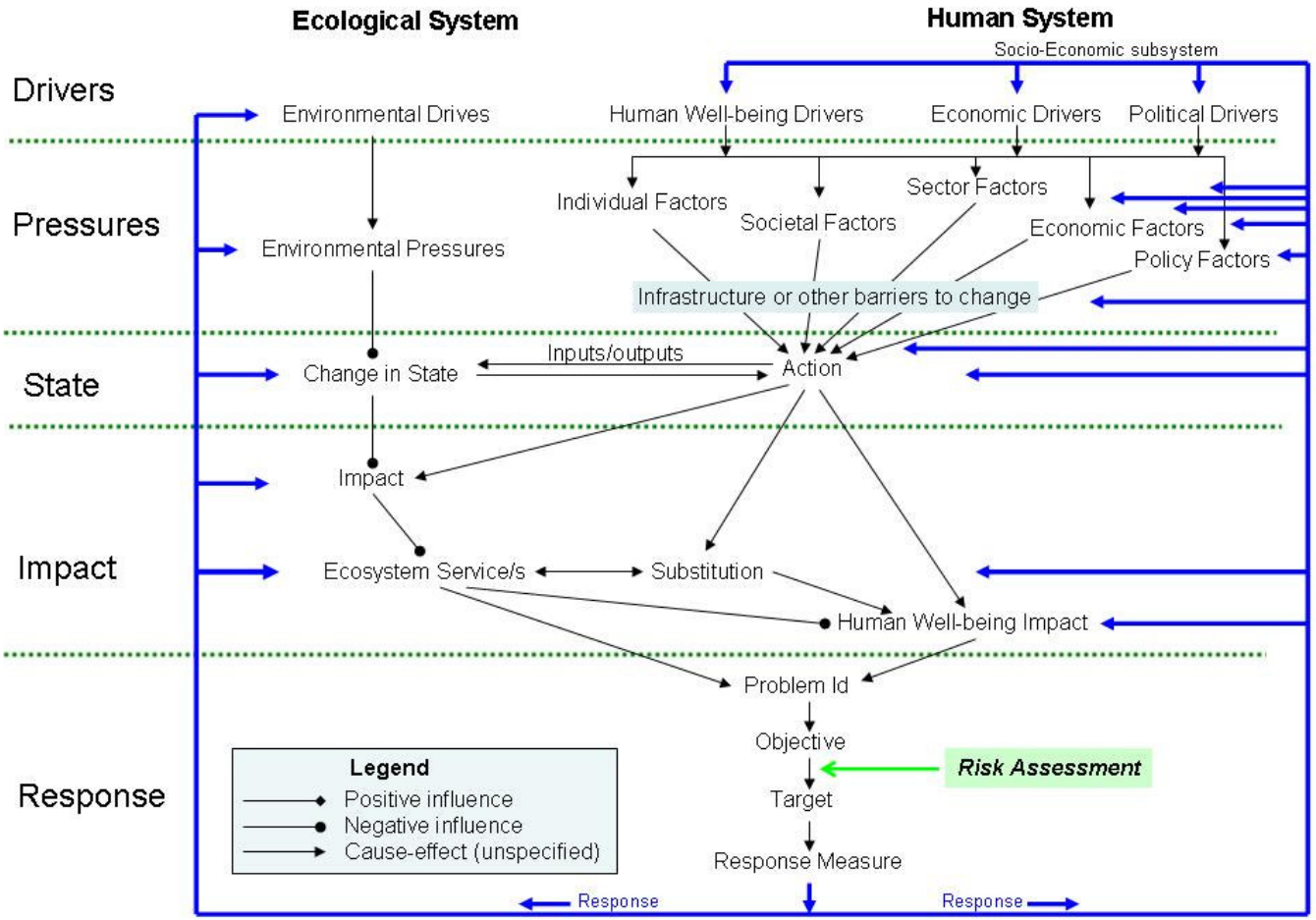

Figure 16 The e^{2}DPSIR Framework

Splitting out the social-economic subsystem from the Human Environment system of Williamo (2005) provides a defined system for specifically addressing 1) sector, 2) economic, 3) socio-economic, 4) socio-political and 5) policy factors, especially when evaluating potential response measures. Corresponding examples of each of these types of factors are: 1) the forestry sector, 2) availability of capital ($), 3) a community's dependence on a manufacturing plant for employment and a tax base, 4) a ruling political party's philosophy, and 5) an environmental policy or regulation.

These factors could be critical in understanding and evaluating response measured directed at specific factors by allowing consideration of effects on a variety of stakeholders including external stakeholders. The filter in this stream – the 'barrier' – documents economic, social or political considerations which may prevent, impede or otherwise influence implementation or effectiveness of a proposed measure.

The inclusion 'ecosystem services' helps to clarify the biophysical – human well-being linkages between these factors. This also potentially opens opportunities to consider the value of these ecosystem services and to possibly draw on work on classifying and valuing these services. This information could be useful to policy analysts in identifying cost/benefit trade-offs between proposed measures. For example, a question might be whether it is better to retain or restore an ecosystem service (e.g. by restoring the soil's water filtration capacity) or to substitute for these services by installing a water treatment plant to treat the polluted groundwater.

In using the e^2-DPSIR, due to its added complexity over the original DPSIR model, it is suggested that analysis and modelling be undertaken in several stages.

1. Problem characterization, identification of elements, factors and causal links considering the DPS elements of the e^2-DPSIR framework to understand the origin of the issue. The initial focus might be on the biophysical relationships in order to understand the workings of the ecological system

2. Identification of ecosystem services affected by the ecological factors and identification of human well-being impacts. Identification, assessment of presence and magnitude of the 'problem' to be addressed. (One cannot assume that every change of 'environmental state is negative.) Once a problem is identified, the objective for 'improvement' can also be identified and a formal or informal risk assessment can be undertaken to set a target or acceptable level(s) for the factor of interest (or indicator used to measure its state) (e.g. concentration of a pesticide in soil)

3. Identification of potential response measures. In most cases many possible measures could be undertaken. Efficiencies could be gained by

considering measures directed at applicable root nodes or central nodes first.

4. Identification of the positive, negative or other influences between factors, and propagation of the linked effects through the e^2DPSIR causal network model. In some cases there may be a simple unidirectional cause-effect chain. In most cases, however, complex relationships between factors are more likely, and here utilizing the arrow styles and weighting may aid in visualizing the effects on downstream factors. This should permit assessment of the effects on the central nodes or end-of-chain nodes which are possibly good indicators of whether the response measure was effective.

This staged approach also allows the analysis to conduct multiple passes through the model to evaluation several response measures or to assess tradeoffs that may be necessary to meet multiple objectives.

The models could also be simplified by retaining only the dominant factors and relationship, if the model is to be used as a communications tool.

It is hoped that the e^2DPSIR model will be useful in supporting a variety of analyses and communication within and between the social, economic and, environmental spheres including the bio-, litho-, atmo- and aqua- spheres, and the scientist-public-politician realms. As with DPSIR, the e^2DPSIR model could also be integrated with other analytical models or tools (e.g. multiple criteria analysis or sensitivity analysis). See Chapter 1 for an example of application of this model.

6 Backgound about BC

The purpose of this chapter is to provide selected background information about the geography of British Columbia to provide a context for the analyses and discussions presented later in this thesis.

6.1 Information about BC

British Columbia is the western-most province in Canada. It is approximately 1200 by 1050 kilometres north to south and east to west, the majority extending from latitude 49º N to 60º N, with the southern tip of Vancouver Island extending south to 48.3º N. The province is approximately 94.7 million ha in size, and 75% is mountainous, with mountain ranges trending NNW to SSE (see Figure 17). The province has 25,000 kilometres of coastline and its longest river – the Fraser - is 1368 kilometres long (BCGovt 2007c, 2007d).

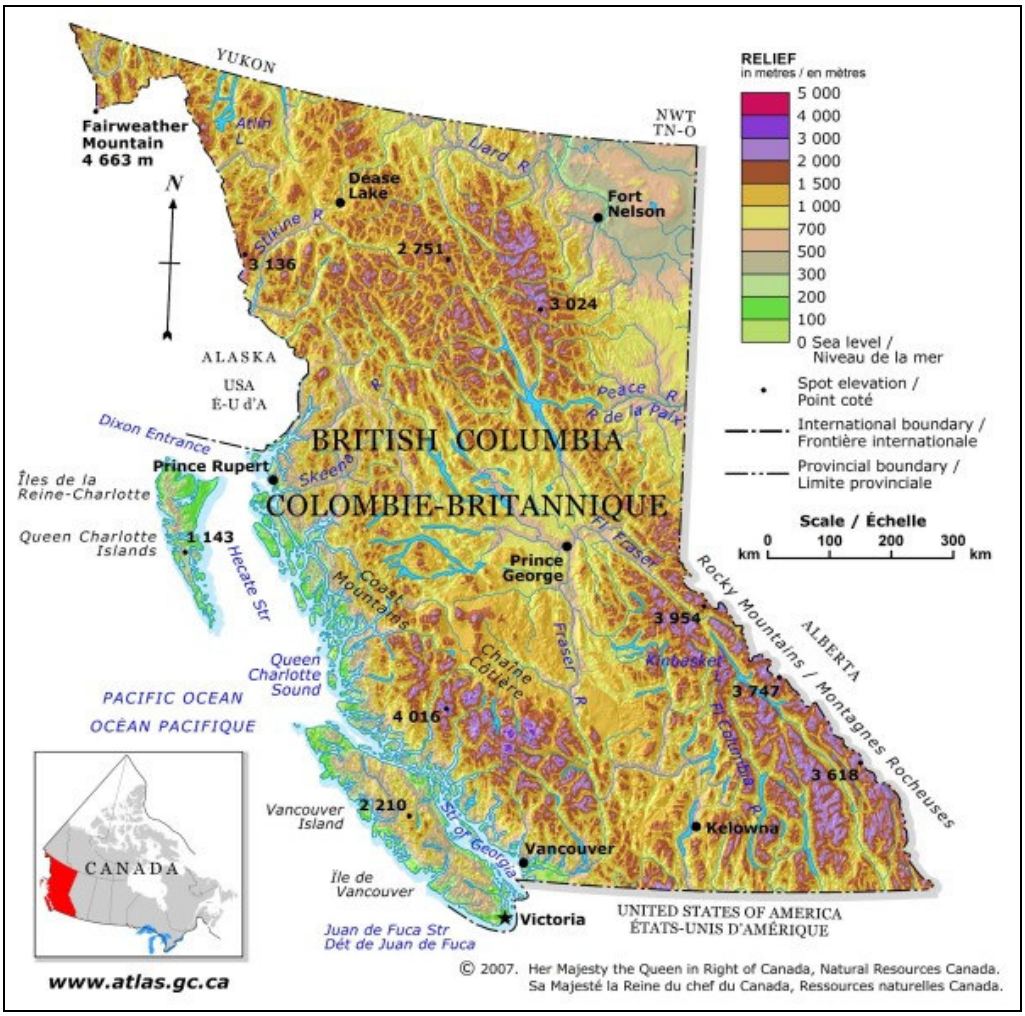

Figure 17 BC Relief Map (from NRCan 2007)

British Columbia has a population of approximately 4.4 million (BC Stats 2008), with 2.25 million people located in the Greater Vancouver area and 340,000 in the Capital region (Victoria and adjacent municipalities) (BC Stats 2007b). These are the 2 largest urban centres, both located in south western BC. The First Nations (aboriginals) number approximately 200,000, many in very remote communities. BC has a total labour force of 2.2 million workers, with 36,200 in agriculture and 24,300 in forestry (BC Stats 2007a). Forestry is the largest contributor to GDP, contributing approximately 15% (BCMoFR 2006b).

Approximately 60 million ha of BC are forested, of which 25.3 million ha is productive forest in the timber harvesting land base. Agriculture occupies 4.7 million ha (BCGovt 2007d, BCMoFR 2006b). (See Figure 18).

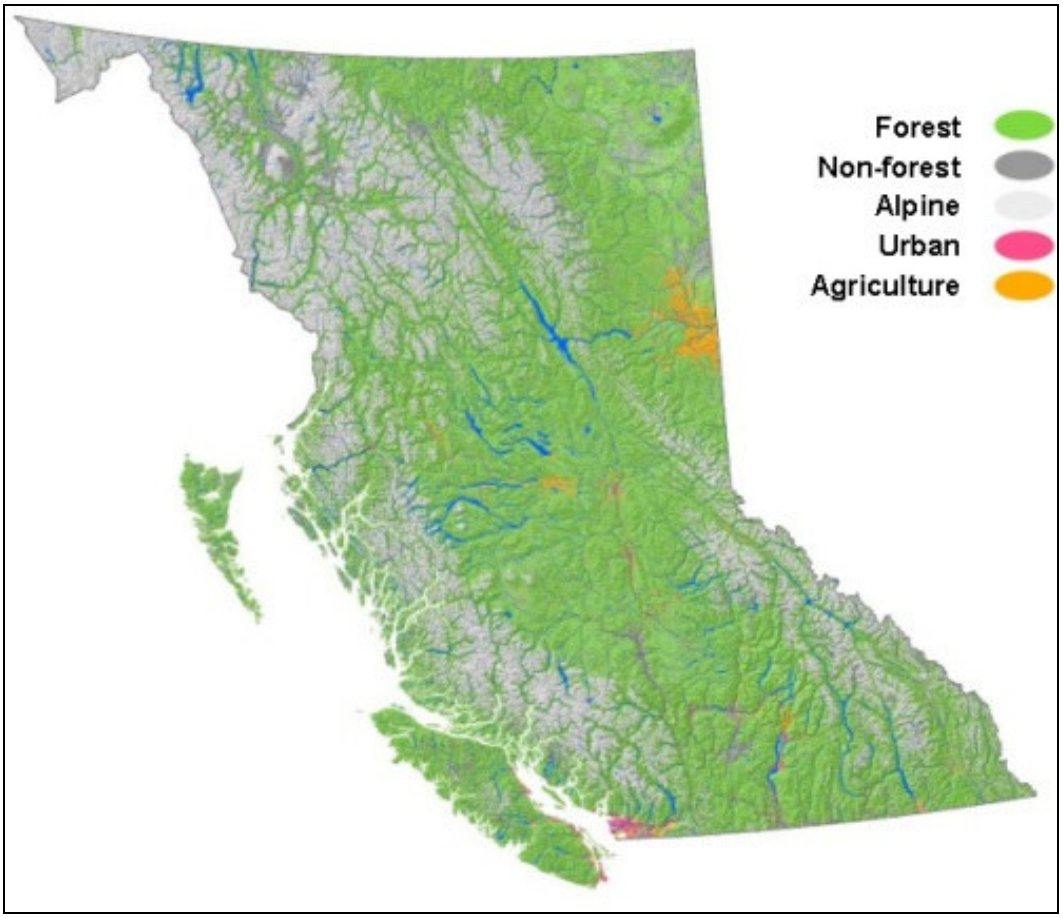

Figure 18 Forest Lands in BC (from BCMoFR 2006b)

The vast majority (95%) of the land base of BC is Crown (provincially) owned.

Approximately 13.4 % of the province has been legally designated as protected area, with an additional 0.6% in the process, plus another 0.6% in announced new conservancies (private land conservation trusts) (BCMoE 2007d).

The Terrestrial Ecozones of BC and Canada are shown in Figure 19. These ecozones are further subdivided into biogeoclimatic (BEC) zones which are shown in Figure 20. (BEC zones are zones of uniform climate, broken down further based on vegetation, soils and topography) (BCMoFR 2008b). More detailed (e.g. 1:50,000, or 1:20,000 scale) ecosystem and soil or terrain (surficial materials) mapping covering perhaps 50% of the province is also available (though not all in digital GIS format) (BCMoE 2007a, 2007c).

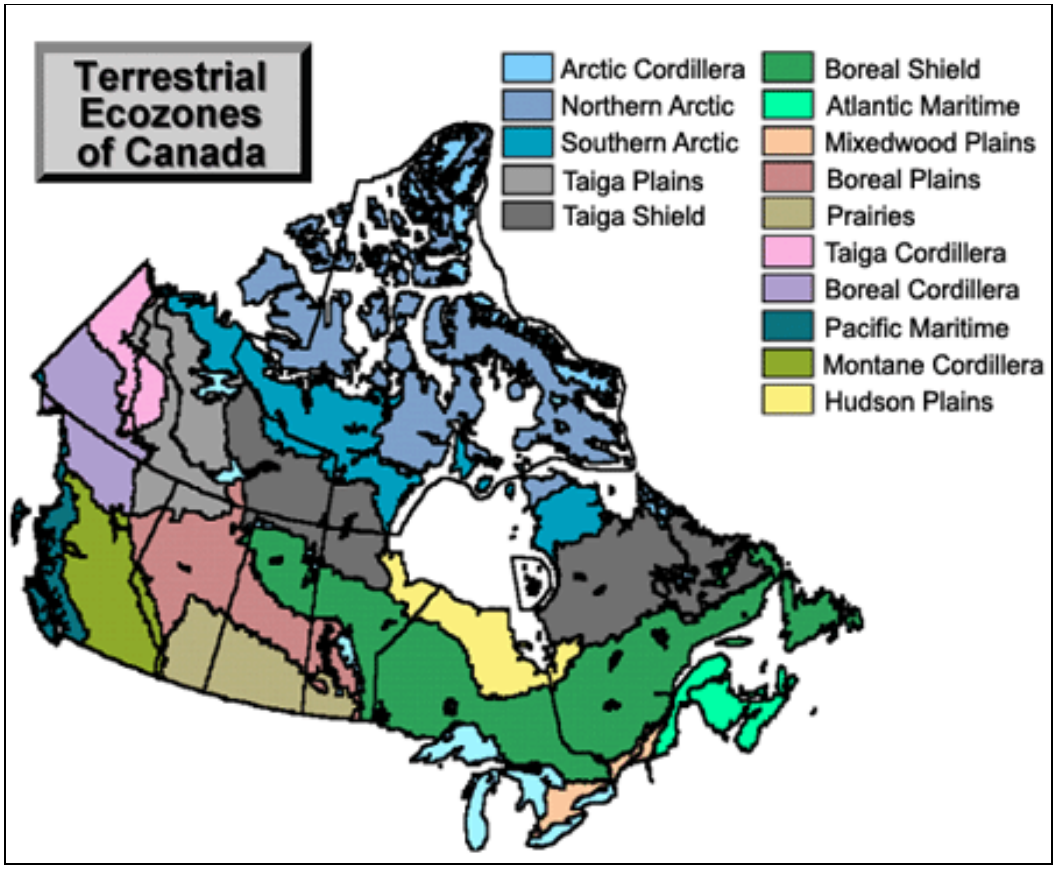

Figure 19 Terrestrial Ecozones of BC and Canada (from EnvCan 2005b)

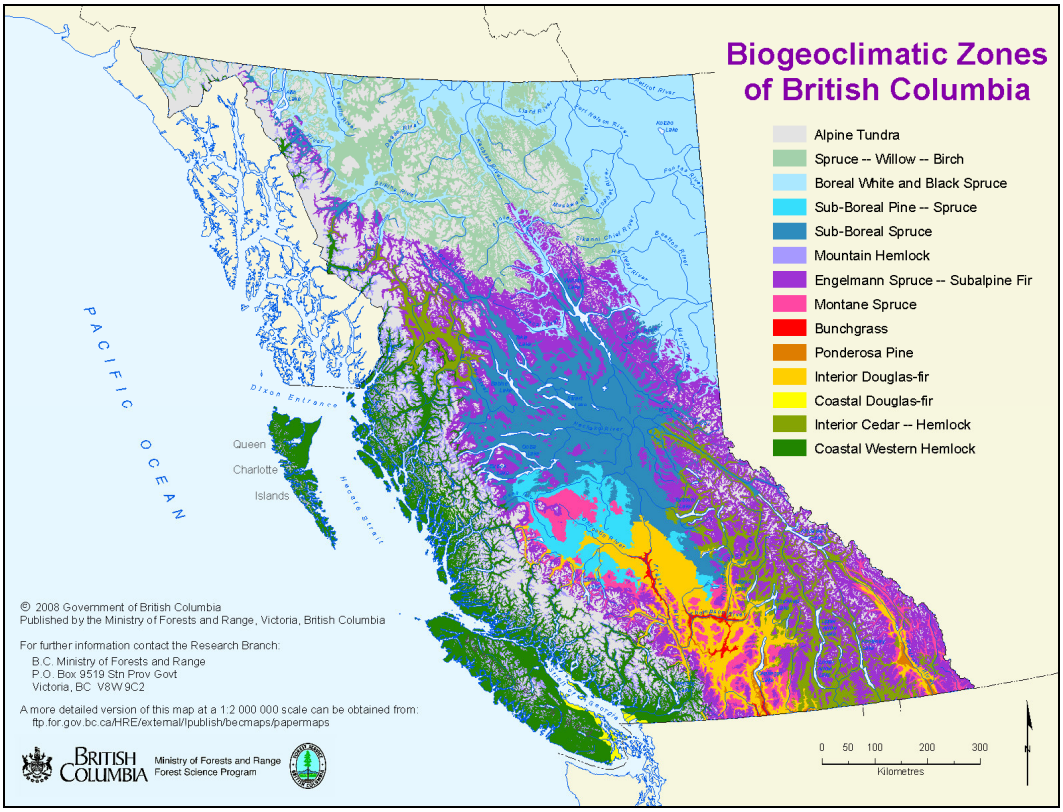

Figure 20 Biogeoclimatic Zones of BC (from BCMoFR 2008b)

Figure 21 (next page) illustrates the soil landscapes of British Columbia (at 1:5,000,000 scale). Note the similarity between the BEC zones and soils. Variations may be explained by the availability of newer, more detailed data supporting the BEC mapping. .

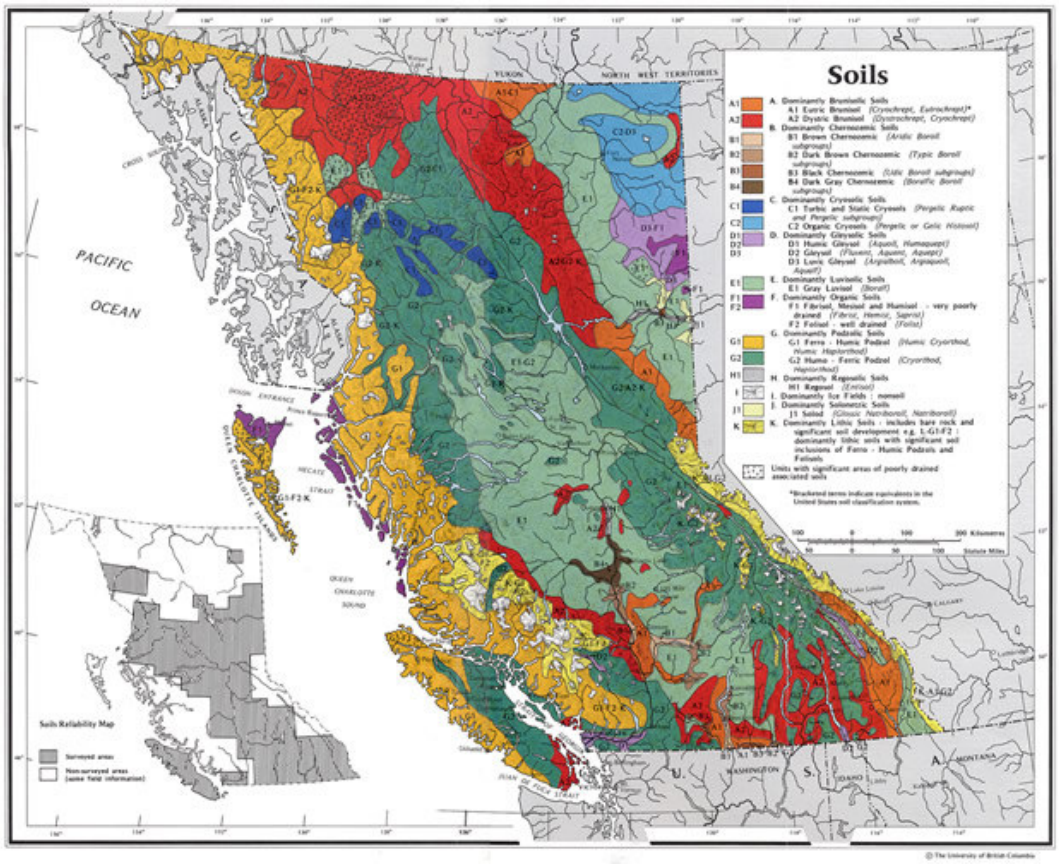

Figure 21 Soil Landscapes of British Columbia (from Valentine & Lavkulich 1978)

(A zoom-able .pdf file of the above map is available at: http://www.env.gov.bc.ca/soils/landscape/figures/fig321.html .

6.2 Governance of BC

There are three levels of government with jurisdiction in British Columbia: federal, provincial and municipal. The national Parliament is responsible for peace, order and good government of Canada, and has joint responsibility with the province over agriculture, immigration and certain aspects of natural resource management. The province is responsible for taxation for provincial purposes, natural resources (subject to above), hospitals/health care, municipal institutions, property and civil rights, and much more (Govt of Canada 2005). Municipalities are responsible for local services, such as policing, fire protection, libraries, recreation, and city streets, and deliver, with the Regional Districts, water, sewage and garbage collection services. (BCGovt 2007d)

The province has a legislative assembly which is elected every 4 years. The BC Liberal Party has been in power since the summer of 2001 (almost 2 terms). The next election is scheduled for May 2009.

The current BC government is 'results-oriented'. Its general approach is to provide tools and information to support individuals and sectors in taking responsibility for their actions (e.g. the Forest and Range Practices Act (BCMoF 2004), ActNow BC or LiveSmart BC initiatives) (BCGovt 2008b)). Its managerial principles include: being open and transparent, having an innovative, goal-oriented, focussed and efficient public service, and having high standards of accountability, consultation and ethics (BCGovt 2002). Monitoring and reporting are part of the Ministries' service planning processes, and the province publishes state of the environment and state of the forests reports (see http://www.env.gov.bc.ca/soe/ and http://www.for.gov.bc.ca/hfp/sof/).

The government has set out a strategic plan for the province, with five 'Golden Goals'. (BCGovt 2008a)

Great Goals for a Golden Decade

1. Make British Columbia the best-educated, most literate jurisdiction on the continent.
2. Lead the way in North America in healthy living and physical fitness.
3. Build the best system of support in Canada for persons with disabilities, those with special needs, children at risk, and seniors.
4. Lead the world in sustainable environmental management, with the best air and water quality, and the best fisheries management, bar none.
5. Create more jobs per capita than anywhere else in Canada.

Figure 22 Great Goals for a Golden Decade (from BCGovt 2008a)

The province has a tradition of consultation with its citizens, business and resource sectors (BCMoFR 2006b). Consensus-based regional land use plans were developed starting in the 1990's with 85% of the province now having strategic land use plans (Figure 23). Consultation is continuing 'tradition' as evidenced by the recent 'Conversation on Health' (BCGovt 2007b) and the Forestry Roundtable (BCMoFR 2008e).

Figure 23 Current status of regional level strategic land and resource planning (ILMB 2008)

Government action plans, new policy initiatives and ministry level 3-year service plans, are all readily available via the BC government's websites. The BC government has also made geographic and resource data freely and readily available to the public via its GeoBC portal (at http://www.geobc.gov.bc.ca/) and other websites. This ready access to legislation, government policy and data has facilitated much of the research for this thesis.

6.3 Climate Change and BC

The impacts of climate change are evident in British Columbia.

Climate Change and past fire suppression activities are believed to be major factors in development of unprecedented extent of the a mountain pine beetle epidemic which has impacted 13.5 million ha of pine forests in the interior of British Columba to date (Figure 24). (See also Section 9.1 for more discussion). These forests will release an estimated net 990 million tonnes of carbon dioxide (or equivalent) over 21 years to the atmosphere (from the total 37 million ha expected to be impacted). This is equivalent to 5 years of total Canadian transportation emissions (based on2005 values) (Kurz et al 2008).

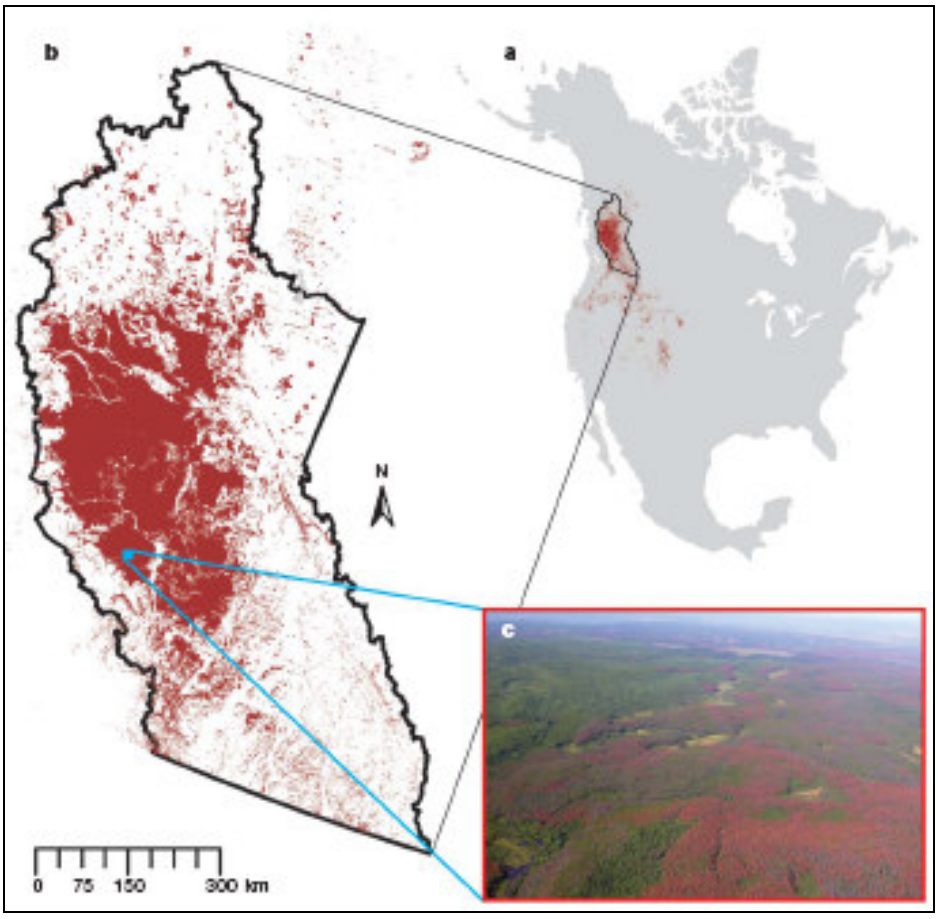

Figure 24 Geographic extent of the mountain pine beetle outbreak in North America (Area 'a'). Area 'b' is Kurz's study area. (from Kurz et al 2008)

Mean annual temperature for BC during the past 3 decades is shown in Figure 25, along with the predicted mean temperatures for the 2020s, 2050s and 2080s decades. (These predictions, and those for ecosystems (below), are based on the six ensemble averages generated by six global circulation models (Wang et al 2006)):

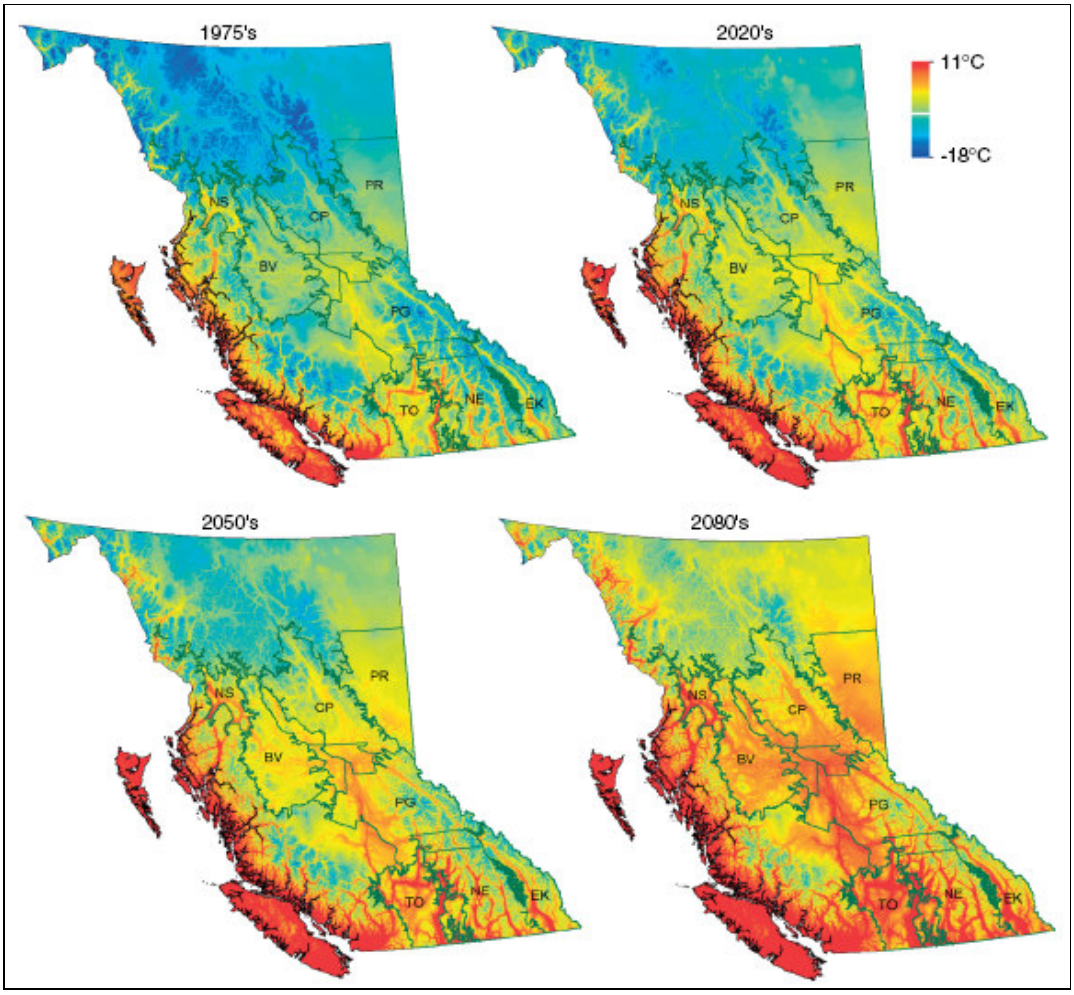

Figure 25 Mean annual temperatures for BC for the 1975s (average for period 1961–1990), 2020s, 2050s and 2080s (from Wang et al 2006)

The changing climate regimes are expected to cause significant pressures on existing ecosystems as their climate ranges are expected to shift dramatically. See Figure 26.

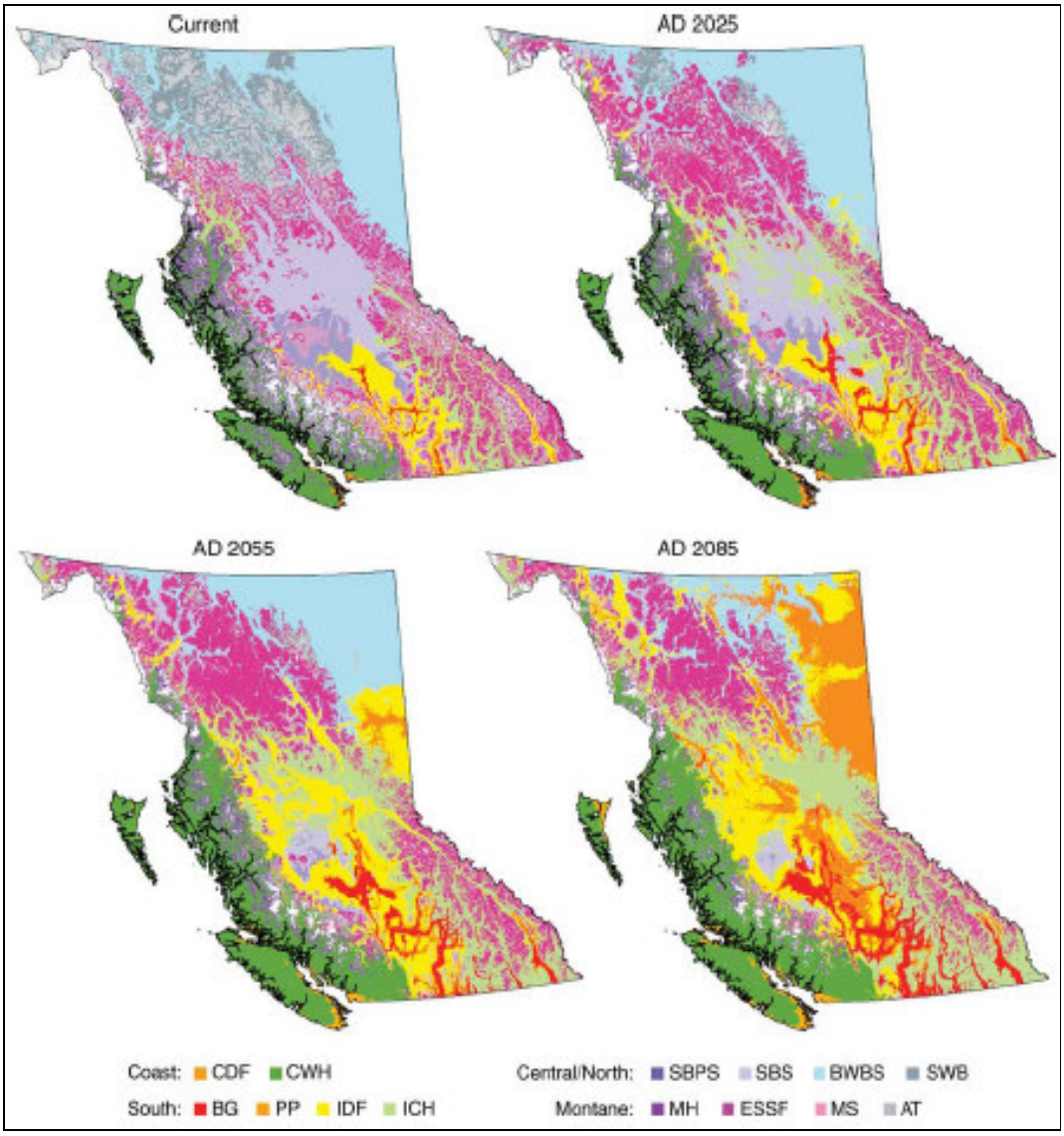

Figure 26 Predicted shifts in climate envelopes of ecosystem zones (based on simulations) (from Hannan & Wang, 2006) The ecological zones are: CDF - Coastal Douglas-fir; CWH - Coastal Western Hemlock; BG - Bunchgrass; PP - Ponderosa Pine; IDF- Interior Douglas-fir; ICH - Interior Cedar–Hemlock; SBPS - Subboreal Pine and Spruce; SBS - Sub-boreal Spruce; BWBS - Boreal White and Back Spruce; MH - Mountain Hemlock; ESSF -Engelmann Spruce–Subapline Fir; MS - Montane Spruce; SWB - Spruce–Willow–Birch; AT - Alpine Tundra.

Recent and ongoing research on the potential impacts of climate change on BC's forest resources and mitigation options is available via the Ministry of Forests publications website (at: http://www.for.gov.bc.ca/hre/) and FORREX (at : www.forrex.com).

The BC government has undertaken several initiatives to address climate change, including the Climate Action Plan, the BC Carbon Tax, the BC Bioenergy Strategy, the Energy Efficient Buildings Plan, the Climate Action Secretariat and the Pacific Institute for Climate Solutions, among others (see BCGovt 2008b, 2007a).

Additional background information is provided in the following chapters where required to support those discussions.

7 BC Soils-related Statutes and Regulation

The analysis and discussion about BC's soil-related legislation is organized by the following topics: forest lands, agricultural lands, urban lands and contaminated sites. Legislative responsibilities are split along similar ministry lines in the BC government.

7.1 Forest Lands

The Ministry of Forests has primary responsibility for management of Crown (provincially-owned) forested lands and limited responsibility for management of private forest lands.

On Crown forest lands, timber development and grazing (range) rights are held by licensees, whose activities are governed by the Forest and Range Practices Act (FRPA) and its associated regulations (referenced cumulatively as FRPA). FRPA is a 'results-based regulation' which came into effect in January 2004, replacing the more prescriptive Forest Practices Code which was 'legendary for the sheer volume and complexity of its regulations' (Fitzsimmons 2004). FRPA reduced regulatory requirements by 55%.

The change to results-based legislation was driven by the following factors:

- A change in government (political parties) in 2001, which also lead to:
    - a promise by this new government to shift to results-based management, to reduce red tape and streamline regulations (by one third) (BCMoF 2002, Fitzsimmons 2004)
    - dramatic rationalization (down-sizing) of the public service (Ministry of Forests' budget was to drop from $538 Million Cdn in fiscal 2001/2002 to $350 Million Cdn in 2004/05, and full time equivalent staff from 4061 to 2628 – both seeing a 35% reduction (BCMoF 2002)

Within the results-based framework, government sets the resource management and environmental objectives, and licensees are required to submit forest stewardship (or similar) plans consistent with these objectives. FRPA defines the requirements for planning, logging, reforestation, road building and grazing (BCMoFR 2006c) but companies are free to undertake innovative approaches to forest development. Non-compliance is however subject to higher penalties than under the previous regulations (BCMoF 2004). The Ministry of Forests and Range conducts approximately 16,000 compliance inspections a year (as of 2005/06)(MoFR 2006b). Additional information on compliance and enforcement is available in the BC State of the Forest's report at: http://www.for.gov.bc.ca/hfp/sof/. (See Table 5 below for examples of government objectives for soil and other excerpts from forest lands legislation.)

On privately owned forest lands (located predominantly on Vancouver Island), forest development is governed by the Private Managed Forest Land Act. As this Act applies to activities on private lands, where the Ministry has more limited jurisdiction, the majority of the soil-related regulations are focussed on the following:

- objectives to protect soil productivity by minimizing areas occupied by roads, trails and landings
- protecting fish habitat and water quality in streams by controlling soil and stream bank erosion.

Consistent with the results-based framework, the forest soil-related regulations define soil management or soil protection objectives. Examples follow in Table 5:

Table 5 Excerpts from forest sector legislation (Table continues on the next pages)

Legislation:	Excerpts related to soil management
Forest and Range Practices Act Forest Planning and Practices Regulation B.C. Reg. 14/2004 O.C. 17/2004 [includes amendments up to B.C. Reg. 267/2007, July 26, 2007]	6 The objectives set by government for soils are as follows: (a) protect soil properties; (b) minimize erosion and compaction; (c) minimize undesirable disturbance to soils; (d) maintain a vigorous and diverse cover of desirable plant species with a variety of root depths sufficient to protect the soil ; (e) re-establish ecologically suitable vegetation after disturbance occurs; (f) maintain ground cover, including sufficient litter and residual dry matter accumulation to protect soil ; (g) minimize accelerated soil erosion; (h) minimize sealing of the soil surface.
Forest and Range Practices Act Fort St. John Pilot Project Regulation "B.C. Reg. 278/2001 O.C. 1033/2001 [includes amendments up to B.C. Reg. 360/2006, December 15/2006]	28 (1) A participant or holder of a minor timber sale licence who carries out a forest practice on an area must ensure that the forest practice (e) conserves the soil by (i) maintaining slope stability, (ii) maintaining surface drainage patterns, and (iii) minimizing surface soil erosion, (f) protects the productive capacity of harvested areas, by (i) sustaining soil productivity, (ii) rehabilitating compacted areas, and (iii) rehabilitating areas occupied by access structures if the rehabilitation is necessary to sustain soil productivity,

Legislation:	Excerpts related to soil management
Private Managed Forest Land Act [SBC 2003] CHAPTER 80	Soil conservation 12 The forest management objective for private managed forest land with respect to conservation of soil for areas where harvesting has been carried out is to protect soil productivity on those areas by minimizing the amount of area occupied by permanent roads, landings and excavated or bladed trails.
Private Managed Forest Land Act "Private Managed Forest Land Council Regulation, 2007" "B.C. Reg. 182/2007 Council Regulation "	Sediment transport or deposition 15 An owner carrying out a primary forest activity must not cause sediment or other material to be transported to, or deposited in, a stream if that sediment or material will have a material adverse effect on (a) fish habitat, or (b) water that is diverted by a licensed waterworks intake. Measures respecting exposed soils 19 If, during road construction or deactivation, an owner exposes soil on an area (a) that is outside of the running surface of the road, and (b) where it is reasonably foreseeable that the surface erosion of the soil would cause a material adverse effect on fish habitat or water that is diverted by a licensed waterworks intake, the owner must, within two years of the completion of the road construction or deactivation activity, revegetate the area or carry out other measures that will materially reduce the likelihood of surface soil erosion from the area. Notification of landslides and debris flows 26 An owner must notify the council, within 24 hours of becoming aware that a landslide or debris flow has occurred on the owner's land, if the owner knows that the landslide or debris flow has deposited debris or sediment into a class A, B, C, D or E stream.
Forest Practices Code of BC Act Stillwater Pilot Project Regulation "B.C. Reg. 96/2001 O.C. 427/2001 " [includes amendments up to B.C. Reg. 209/2007, June 21, 2007]	9 For purposes of Part 7 the following are the resource value goals for the Stillwater area (c) to minimize impacts on the soil resource by managing soil disturbance from forestry operations with the goals of conserving and protecting the soil and maintaining soil quality, quantity and function; 18 (1) Before making a Stillwater pilot forest stewardship plan available for review under this Part, the licensee must complete the following *as if the Stillwater pilot forest stewardship plan were a forest development plan:* (a) a terrain stability hazard map and soil erosion potential map for that part of the Stillwater pilot forest stewardship plan that is within the community watershed in accordance with section 12 of the Operational and Site Planning Regulation *(Italics are the current author's)*

Note that the last excerpt is an update of the Forest Practices Code of BC Act (FPC) (still in force), illustrating the more prescriptive language of the precursor to the results-based FRPA. That regulation specifies that two maps must be provided as part of the stewardship plan 'as if it were a forest development plan' (the precursor type of plan), and but does not define how this

information is to be used. The Forest Practices Board has found that the terrain stability maps completed to meet FPC requirements had not always been used in development planning, nor were the findings of site specific terrain stability field assessments always incorporated (Chatwin 2005)

The soil protection objectives of the Forest and Range Practices Act, and its predecessor, the Forest Practices Code, both aim to:

- minimize loss of productive soils to permanent access roads and other related features (landings, pits, quarries, trails)

- limit/minimize detrimental soil disturbance (compaction, organic matter loss, soil erosion and sediment delivery to streams, and landslides).

The Forest Practices Code guidebooks which outline acceptable practices and impacts, though no longer part of the FRPA regulations, continue to define requirements. On all cutblocks, operators are to minimize the area occupied by permanent access roads and related features, and to ensure detrimental soil disturbance is limited to 5% or less of the Net Area for Reforestation (NAR). (BCMoF 2008, 2001a, 2001b, 1999). The Forest Practices Board, which oversees

The Forest and Range Evaluation Program (FREP) is a monitoring program, complete with defined indicators, field protocols, field forms (BCMoF 2007d, BCMoF/MoE 2008). The Protocol for Soil Resource Stewardship Monitoring: Cutblock Level (Curran 2008) describes protocols for quantifying and describing:

- areas lost to permanent access structures

- the amount and effects of detrimental soil disturbance on natural drainage, erosion and potential for landslides

- retention of dead wood, organic matter and green trees (the latter for sustaining mycorrhizae, biodiversity and wildlife)

In order to ensure that government's objectives under FRPA are met, an effectiveness monitoring program – the Forest and Range Practices Act Resource Evaluation Program (FREP) is being implemented (Niemann 2006). The Ministry of Forest has provided web resources including guidebooks on hazard ratings for erosion, compaction and displacement (landslides), pre-harvest data collection, disturbance measurement and limits, and soil rehabilitation (BCMoF 2001a, BCMoF 2001b, BCMoF 1999, BCMoF 1997, Curran et al 2000). These guidebooks define best management practices and field data collection protocols. To access the guidebooks see http://www.for.gov.bc.ca/hfp/frep/values/soils.htm.

A key component of sustainable forest management (and FRPA and FREP) is the development of key criteria and indicators for monitoring whether objectives have are being met. An initiative originally spearheaded by the forest development companies, and expanded to include government and industry association was undertaken to develop a common set of criteria and indicators for use in BC. This work builds on previous work by the Canadian Council of Forest Ministers, the Montreal Process, the Canadian Standards Association certification and other groups (Niemann 2006). Criteria and indicators developed under the Common Indicators initiative for soil and water are available in Hickey & Innes 2005 at: http://www.forrex.org/publications/forrexSeries/fs17.pdf.

The Ministry of Forests has developed field protocols and key indicators for soil conservation monitoring under FREP. These indicators are:

1. Lost productivity due to access construction
2. Landslides, erosion, and drainage diversion
3. Dispersed soil disturbance in the net area to be reforested
4. Green tree retention (to support beneficial soil biota such as mycorrhizae)
5. Organic matter retention (BCMoF 2008d).

In addition to FRPA / FREP, sustainable forest certification is a very significant driver encouraging forest companies to conserve soil values and practice sustainable forestry. Standards address environmental, social and economic aspects of sustainable forest management. Third party verification gives wood product buyers assurance that the products come from well-managed forests, and puts pressures on forest companies to become certified in order to maintain market access (BCMoFR 2006b).

The area under forest certification plans increased significantly from 2001 on, commencing prior to implementation of FRPA in 2004 (See Figure 27).

The Canadian Standards Association's Sustainable Forest Management Standard (CSA), the Sustainable Forestry Initiative (SFI), and the Forest Stewardship Council (FSC) are globally recognized programs used in Canada (MetaFore 2007a). There are 39 companies with 80 certified locations in BC, and certified operations account for two thirds of the timber harvested from BC (MetaFore 2007b, Niemann 2006).

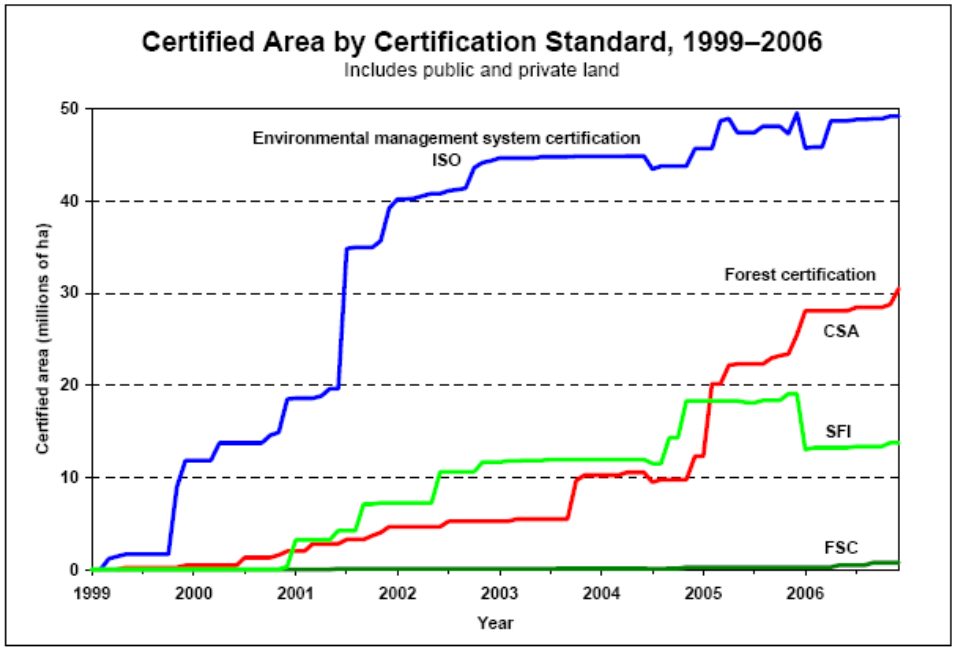

Figure 27 Forest Area in BC under a Forest Certification Standard (BCMoFR 2006b)

7.2 Agricultural Lands

The majority of agricultural lands in BC are privately owned and are located within the Agricultural Land Reserve (ALR), with the exception of range (ranching/grazing) tenures on Crown lands (managed under the Forest and Range Practices Act). The ALR contains 4.7 million hectares, or approximately 5% of the provincial land base. See Figure 28 for a map showing the location of the ALR in BC.

The province introduced the Agricultural Land Commission Act in 1973, in response to the loss of approximately 6000 hectares of prime agricultural land to urban development and other land uses. The Agricultural Land Reserve was established in cooperation with regional districts and municipalities and with public input during the period 1974-1976 (ALC 2002). The Agricultural Land Commission is responsible for land management within the Agricultural Land Reserve. (See the Agricultural Land Commission Act in Appendix 1).

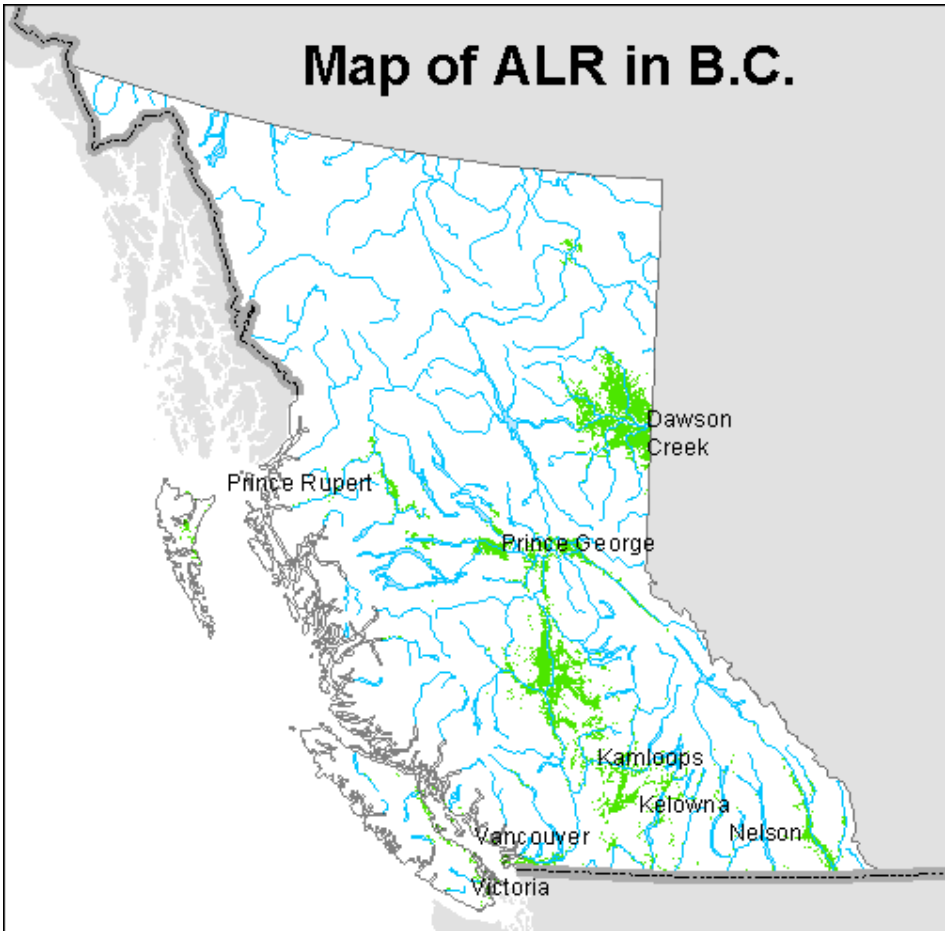

Figure 28 Distribution of Agricultural Land Reserve in BC (ALC 2002)

The primary responsibilities of the Commission with respect to soil protection include:

- Controlling land use on the ALR to prevent or limit non-agricultural uses
- Controlling non-agricultural uses on ALR lands (e.g. agro-tourism, composting operations for non-farm use) through permitting or policy.
- Controlling soil deposition and removal

The Ministry of Environment, under the Environmental Management Act is responsible for:

- Managing waste disposal, use of soil amendments (e.g. wood waste) and organic matter recycling (facilities) on agricultural lands. (See Appendix 1)

The ALC's responsibility is not for soil protection legislation as such, but includes protecting agricultural lands and their soils from urban development and non-agricultural use. The ALC has been successful in maintaining the area of the ALR over time, as losses mainly due to urbanization or recreational pressures (e.g., Greater Vancouver, Nanaimo, Okanagan Shuswap) have been offset by the addition of lands in other regional districts (See Table 5.) The largest proportional losses in agricultural lands are in the districts on Vancouver Island, the Lower Mainland and the Okanagan/Shuswap, three populated areas experiencing significant growth. The net change in agricultural capability of the lands added or removed from the ALR from 1974 to 2000 is shown in Table 6.

Table 6 Area Included and Excluded from the ALR by Regional District, in hectares (for the period from 1974 to March 31, 2001 (ALC 2008)

Regional	Area at Designation	% of provinicial ALR	Inclusions	Total Exclusions (due to private and	Area as of Mar. 31, 2008	% total area added	% total area excluded due to government	% net change
Bulkley Nechako	297,611	6.3%	70,500	2,172	365,939	23.7%	0.6%	23.0%
Fraser Fort George	349,636	7.4%	42,425	11,613	380,448	12.1%	2.9%	8.8%
Kitimat Stikine	64,170	1.4%	3,146	838	66,478	4.9%	0.7%	3.6%
Peace River	1,453,434	30.8%	26,641	2,461	1,477,614	1.8%	0.0%	1.7%
Cariboo	925,506	19.6%	18,405	18,400	925,510	2.0%	1.5%	0.0%
Skeena-Queen Charlotte	43,887	0.9%	80	187	43,780	0.2%	0.0%	-0.2%
Central Coast	4,453	0.1%	53	65	4,442	1.2%	0.0%	-0.2%
Thompson Nicola	568,705	12.1%	2,134	4,250	566,588	0.4%	0.2%	-0.4%
Northern Rockies	45,554	1.0%	603	981	45,176	1.3%	1.7%	-0.8%
East Kootenay	272,510	5.8%	346	7,452	265,404	0.1%	0.3%	-2.6%
Alberni Clayoquot	7,935	0.2%	805	1,041	7,699	10.1%	12.1%	-3.0%
Kootenay Boundary	55,061	1.2%	291	1,973	53,379	0.5%	2.0%	-3.1%
Okanagan Similkameen	86,478	1.8%	2,165	4,892	83,750	2.5%	2.2%	-3.2%
Mount Waddington	1,741	0.0%	17	120	1,638	1.0%	0.0%	-5.9%
North Okanagan	70,283	1.5%	1,536	5,946	65,873	2.2%	6.7%	-6.3%
Fraser Valley	76,803	1.6%	415	5,389	71,829	0.5%	5.0%	-6.5%
Squamish Lillooet	27,126	0.6%	939	2,923	25,141	3.5%	9.7%	-7.3%
Comox Strathcona	43,725	0.9%	4,778	8,192	40,310	10.9%	15.0%	-7.8%
Greater Vancouver	66,839	1.4%	233	6,158	60,914	0.3%	5.6%	-8.9%
Central Kootenay	71,539	1.5%	799	8,388	63,949	1.1%	10.2%	-10.6%
Nanaimo	21,053	0.4%	1,880	4,460	18,473	8.9%	14.8%	-12.3%
Capital	19,595	0.4%	289	2,819	17,065	1.5%	3.4%	-12.9%
Cowichan Valley	21,984	0.5%	443	4,680	17,747	2.0%	16.5%	-19.3%
Central Okanagan	33,077	0.7%	210	7,207	26,079	0.6%	13.6%	-21.2%
Columbia Shuswap	67,409	1.4%	1,364	17,905	50,868	2.0%	22.9%	-24.5%
Powell River	14,130	0.3%	502	5,086	9,546	3.6%	34.9%	-32.4%
Sunshine Coast	6,275	0.1%	17	2,249	4,044	0.3%	29.1%	-35.6%
Total	**4,716,516**		**181,011**	**137,846**	**4,759,682**	**3.8%**	**2.0%**	**0.9%**

Notes:
All figures are cumulative and rounded off.
The areas of ALR for FVRD and GVRD have been adjusted to reflect the changes in jurisdictional boundaries involving Central Fraser Valley, Dewdney Alouette, the original Greater Vancouver and Fraser Valley

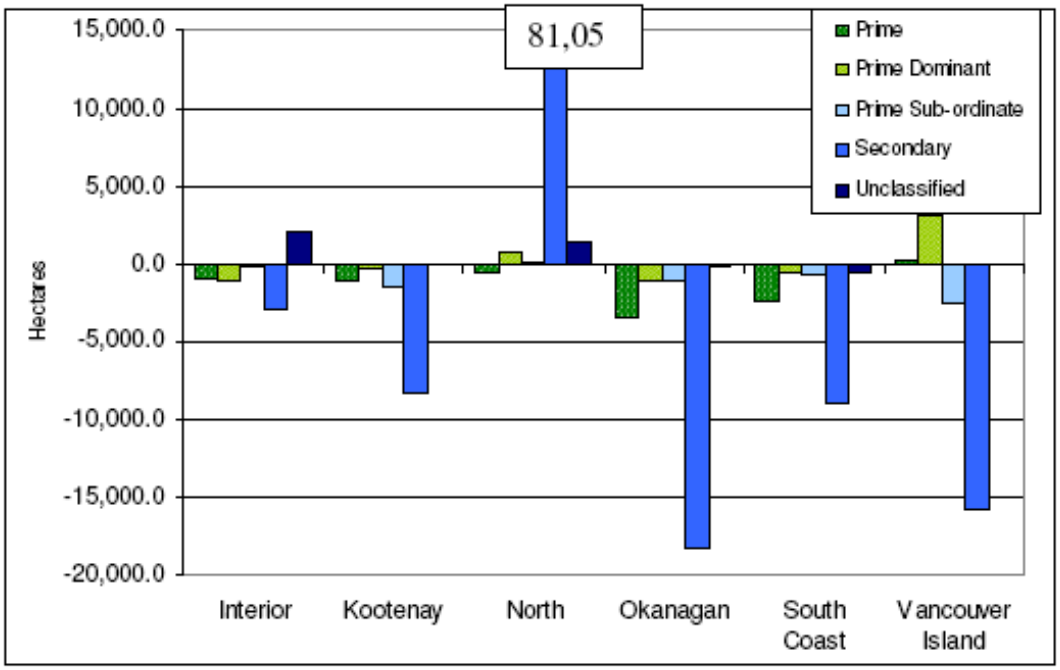

Figure 29 Net change in agricultural capability category in the ALR, by Region, from 1974 to March 2000 (from MoE 2007d)

A comprehensive listing of ALC's legislation, decisions (orders in force) and policies on permitted uses is available at:
http://www.alc.gov.bc.ca/legislation/legislation_main.htm#orders

The Ministry of Environment's Environmental Management Act addresses issues related to contaminated sights and waste disposal by various sectors (sewage, oil and gas, industrial and agriculture)(See Section 8.4.1). Of the latter, the Agricultural Waste Control Regulation 131/192 applies specifically to agricultural lands (for agricultural waste, wood waste and mortalities), and the Organic Matter Recycling Regulation 18/2002 (for biosolids and composts) and Code of Practice for Soil Amendment 470/2007 are widely applicable. (These are regulations under both the Environmental Management Act and Health Act (see Appendix 1)).

In the Agricultural Waste Control Regulation, 'agricultural waste' is defined as used mushroom medium, agricultural vegetation waste and manure. This regulation defines storage, handling and disposal requirements in order to prevent pollution of watercourses or water sources, and specifies that this waste may be applied to only as a soil conditioner or fertilizer, but not if the waste may run off or escape and pollute a watercourse or groundwater (due to soil, meteorological or topographic conditions, or application rate). Pollution 'means

the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment'.

Due to the high live-stock to land base ratios, manure volumes in the Fraser Valley are causing environmental pressures and methane generation is also a climate change related concern (BCMAL 2008a).

The Organic Matter Recycling regulation deals with compost facility construction and operation, and production, storage, distribution, sale and use or land application of compost and biosolids. (Backyard compost and agricultural waste are excluded from these regulations.) Two classes are defined for each of compost and biosolids. These materials may be applied to agricultural and forest reserve lands and application must be consistent with good agricultural practice, however, land application of Class A and B biosolids or Class B compost requires submission of details regarding land conditions and application rates, including estimates of accumulated heavy metals and other contaminants over time, and issuance of a permit.

Beyond the above regulations regarding permitted land uses and soil and waste deposition or removals, environmental and soil protection on agricultural lands seems to rely on agricultural sector's application of good farming practices.

The Ministry of Agriculture and Lands (BCMAL) provides a supportive role to the agricultural sector, more than a regulatory role. BCMAL's mandate includes promoting economic development and environmental sustainability of the agriculture and food sectors and supporting these sectors in delivering high quality, safe and healthy food. Jurisdiction for agriculture and food production is shared between the provincial and federal levels of government under an array of collaborative agreements. BCMAL also works in partnership with the Agricultural Land Commission, the B.C. Farm Industry Review Board (a quasi-judicial tribunal dealing with complaints about farm practices), other ministries, First Nations, the British Columbia Investment Agriculture Foundation, the B.C. Agriculture Council and other sector associations (BCMAL 2008a).

The Ministry provides a web-based 'INFOBASKET' which provides access to information on regulations and legislation, marketing, market data, statistics, finance and business management, production and processing and links to directories and contacts, for wide variety of agricultural products or product groups (e.g. beef, berries, bioproducts, field vegetables, greenhouse vegetables, grapes, game birds, bison, organics, grains and other field crops) (BCMAL 2007). More information is available at: InfoBasket Home .

The InfoBasket site also contains links to a lot of information regarding crop production and land management practices. BCMAL has provided and extensive list of resources under most topics. For example, the subfolders for access to information on 'Soil & Water' for the Grains, Oilseeds, Pulses and Forage Seeds product group are shown in Table 7. (If reading this thesis in digital format, follow the hyperlinks in the table below, to view the reference lists.)

Table 7 InfoBasket Soil & Water Sub-folders

Subfolders in 1.5 Soil & Water	
1.5.1 Drainage	1.5.5 Soil Fertility
1.5.2 Irrigation	1.5.6 Water Conservation
1.5.3 Soil Amendments	1.5.7 Water Quality
1.5.4 Soil Conservation	

(From BCMAL 2007)

BCMAL also provides additional information on soil amendment, conservation, and fertilization at: http://www.al.gov.bc.ca/resmgmt/publist/Soil.htm .

The Environmental Farm Planning program provides financial incentives for farmers to assess environmental stewardship opportunities and risks on their lands and to be better stewards of the land. See http://www.bcac.bc.ca/efp_programs.htm for more information.

The BC government has also recently announced the British Columbia Agriculture Plan: Growing a healthy future for BC families. The aims of this plan are to produce local food, meet environmental and climate challenges, build innovative and profitable family farm businesses and First Nations agricultural capability, and bridge the urban/agricultural divide. Twenty three strategies have been identified. Table 8 lists the Strategies and related initiative which have potential implications for soil management.

Table 8 BC Agricultural Plan strategies with potential implications for soil management (BCAML 2008e)

Strategy 2	**Implement initiatives to strengthen community food systems.** Includies supporting direct farm sales, community gardens (urban), local food delivery services,
Strategy 5	**Implement initiatives to improve environmental management in the agriculture and agri-food sectors**. Includes promoting adoption of Environmental Farm Planing, soil nutirent studies and options for nutrient management, and value added from processing plants
Strategy 6	**Implement approaches for farmers to receive benefits for ecological goods and services (EG&S)**. Includes implementing a new Provincial Agriculture Zone Wildlife Program, enhancing provision of ecological goods and services on agricultural lands, and participating in a Western carbon credit market.
Strategy 7	**Address climate change and reduction of greenhouse gas emissions from food production and processing**. Includes agricultural industry initiatives to reduce greenhouse gas emissions (currently 4% of BC's total GHG emissions), facilitate adoption of anaerobic digestion technologies (for reducing GHS emissions from manures),
Strategy 8	**Integrate needs of agriculture in provincial water management policies and programs**. Includes developing an agriculture sector water policy on water licensing to meet "crop and soil needs"
Strategy 9	**Optimize forage production for livestock grazing on rangeland.** Includes integrating silvopasture into tenures on rangeland.
Strategy 10	**Enhance and coordinate province-wide, invasive plant management**. Includes decision-support tools for invasive plant management, regional intitatives and plant removal crews.
Strategy 15	**Strengthen current extension services.**
Strategy 21	**Preservation of agricultural land for future generations of farm and ranch families.**

7.3 Urban Lands (lands under local government jurisdiction)

The Local Government Act authorizes local governments (municipalities and regional districts) to regulate or prohibit soil removal and deposit, to require tree cutting permits in designated areas subject to flooding, erosion or landslides, and to regulate or prohibit development on lands subject or potentially subject to flooding, erosion, mud or debris flows, landslides or other natural hazards. Under the same act, local government may also construct works to reclaim or protect lands from erosion by the sea or streams, including, under the Community Charter, appropriating the necessary lands in the stream channel or bed for these works in streams.

In addition to the above measures which may protect soil, the government of BC has developed the 'Develop with Care: Environmental Guidelines for Urban

and Rural Land Development in British Columbia' (BCMoE 2006). This document includes mention of ecosystem services provided by soil, including regulation of the hydrologic cycle, groundwater recharge, water catchment, top soil formation, storage and recycling of nutrients and organic matter, soil fertility maintenance, and assimilation, storage and recycling of waste, and highlights the value of urban forests in carbon sequestration, erosion control and water retention.. Additional information is provided on good management practises which can protect soil, such as choosing the timing of site clearing to avoid the 'rainy season' to reduce erosion and runoff, minimizing vehicular traffic on site to minimize compaction and retaining soils for reuse.

Public awareness and general Interest in environmental management in urban areas, including maintenance of healthy soils has grown recently, particularly in south western BC. Here pocket markets sell food grown organically on urban plots (see: FoodRoots at http://www.foodroots.ca/ and City Harvest at http://www.cityharvest.ca/). South western BC is also the 'head office' of the Society for Organic Urban Landcare (SOUL), which promotes sustainable soil management in urban horticulture (see http://www.organiclandcare.org/).

7.4 Contaminated Sites

The Environmental Management Act (under the jurisdiction of the Ministry of Environment) defines contaminated sites, controls contaminated soil movement and specifies remediation standards (see Appendix 1).

In BC, there are an estimated 2000 contaminated sites on provincial crowns lands, an estimated 4000 sites on private lands, and 4088 on federal lands (mainly Department of National Defence, 'Indian Reserves' or national park lands)(BCMAL 2008c).

Remediation of contaminated sites on private lands is the responsibility of the land owner, and on federal sites, the responsibility of the applicable federal agency. Responsibility for cleanup of (historical) contaminated sites on Crown lands rests with the Ministry of Agriculture and Lands, Crown Land Restoration Branch. According to the 'state of the environment report' of 2007. of the 6,800 contaminated sites registered in the provincial database, approximately 41% (or 2817 sites) have been remediated and 30% (or 2022 sites) are in some stage of the process (BCMoE 2007d), while the status on the remaining 2010 sites is unknown. BCMAL reports that over the last two years progress has been made on 51 sites (BCMAL 2008d, Brown 2008).

BCMAL has recently announced a BC Brownfield Renewal Strategy to remediate sites which have potential for urban or industrial development (BCMAL 2008b).

Mineral exploration and development sites across the province may also be contaminated. There are currently 20 operating metal and coal mines in BC (BCMEMPR 2008c), and 5.8 million ha of new claims were staked in 2007 (PWC 2008). Approximately $416 Million (Cdn) was spent on exploration and development activities in the province in 2007 (PWC 2008).

Contamination may be due to past exploration and development practices (e.g. exposure of sulphide bearing minerals to oxidation causing 'acid rock drainage' issues), or contamination by leachates or other materials.

In order to not discourage or prevent mineral exploration activity in BC (due to its importance to the provincial economy), current tenure holders are exempt from liability to clean up historical contamination (See Environmental Management Act – Part 5 in Appendix 1). (Companies are responsible for cleanup of 'spills'). Due to boom and bust cycles in mineral exploration (due to globally fluctuating commodity prices and international demand), mineral exploration activity and tenures tend to be very fluid, and exploration may occur in waves separated by many years of inactivity on any particular piece of land.

Petroleum exploration and development companies are responsible for cleanup of any contamination and reclamation of well sites upon completion of operations and abandonment of boreholes. In some cases, wells may have been 'suspended' (for future use as disposal or possibly production wells) and tenures allowed to expire, or abandoned wells may not have been properly abandoned, and these become 'orphaned'. A significant number of these orphaned wells were identified as potential sources of current or future contamination in the 1990's, and remediation was proposed. In 2006, the Oil and Gas Commission Act was amended to add an additional tax onto the existing levy to generate revenue for the 'Orphan Site Reclamation Fund'. The purpose of this fund is to pay the costs of abandonment and restoration of orphaned wells or other oil and gas facilities and to compensate the landowner for any delinquent surface lease payments (BCSRB 2007).

Other contaminated sites are related to past pulp and paper production or other industrial activities.

7.5 Summary of the analysis

BC legislation and regulations do not consistently address all of the soil threats identified in the EU Soil Framework Directive or EU Soil Strategy, across all land use sectors, nor do they directly address preservation of rare soils ecosystems. However, all the major threats are addressed for the lands or sectors where impacts are observed and relevant.

As a summary, Table 9 (below) identifies which soils threats or issues are considered in BC legislation, organized by the land use sector to which the

legislation applies, reflecting the division of responsibilities of BC Ministries and agencies along major land use/sector lines. The legislation applicable to Crown Forest Lands is the most comprehensive in term of addressing a variety of soil threats. References to salinisation or desertification are absent from any legislation.

Table 9 Issues considered in legislation by land use sector

Sector: / Threat:	Crown Forest	Private Forest	Agricultural (ALR)	Local Government	Petroleum & Natural Gas / Mining	All Lands
Soil Erosion	Y	Y		Y	Y	
Erosion (Streams)	Y	Y		Y	Y	Y
Soil Contamination					Y	Y
Contaminated Sites					Y	Y
Compacton / degradation of soil structure	Y	Y				
Soil disturbance	Y	Y				
Organic Matter	Y		Y *			
Blodiversity	Y					
Land Use Change / Permitted land uses			Y	Y		
Soil Productivity	Y	Y				
Soil Sealing	Y	Y	Y			
Soil Deposit & Removal			Y	Y		Y **
Flooding				Y		Y
Landslides	Y	Y		Y		Y
Salinization						
Desertification						

* Applies to composting
** Applies to contaminated soils

See Appendix 1 for details regarding legislation applicable to each land use sector.

The majority of the BC legislation addressing soil issues can be classified into the following main categories (see Appendix 1):

- soil protection objectives related to forest development activities (focusing on erosion, compaction, sealing, soil disturbance, and landslides)
- permitted land uses and activities on lands in the Agricultural Land Reserve (focussed on protecting agricultural lands from urbanization, controlling soil deposition and removal, and managing organic matter, soil amendment and waste applications to land),
- contaminated site identification and remediation (and soil relocation)

- local government responsibilities for permitting of urban developments (mainly to related to areas at risk from natural hazards -erosion, landslides, flooding,

- water and fish habitat management which addresses erosion of stream banks and water quality throughout the province

- 'administrative' legislation which mainly defines roles and responsibilities for various agencies or authorized persons.

Most of the Statutes and Regulations also contain definitions of the terms used.

Contrasting approaches to land and soil management were observed, notably between soil-related legislation applicable to forested lands and that applicable to agricultural lands. Activities on forest lands are generally governed by results-based regulations (with some exceptions) and the legislation defines the government's soil management objectives. On the Agricultural Land Reserve (ALR), regulations focus predominantly on permitted uses (to prevent loss of lands for agricultural uses) and deposition and removal of soil, wastes or amendments.

8 Status and Threats to BC Soils:

The discussion in this chapter addresses the current status of soils or quantifies the spatial extent of soils impacted by the various threats, where data is available.

8.1 Estimates of impacts on Forest Soils

The total impact on forest soils due to sealing under permanent roads and total soil disturbance due to logging could be substantial, given the area of forested lands in BC and the extent of recent (and historical) logging. An analysis of the potential status of forested BC soils for sealing (permanent access roads), soil disturbance (erosion, organic matter decline, fire impacts), and potential biodiversity loss is provided below.

8.1.1 Forest soils lost to sealing

The Ministry of Forests has mapped road density in the province and changes between the 1980s and 1990s. See Figure 30.

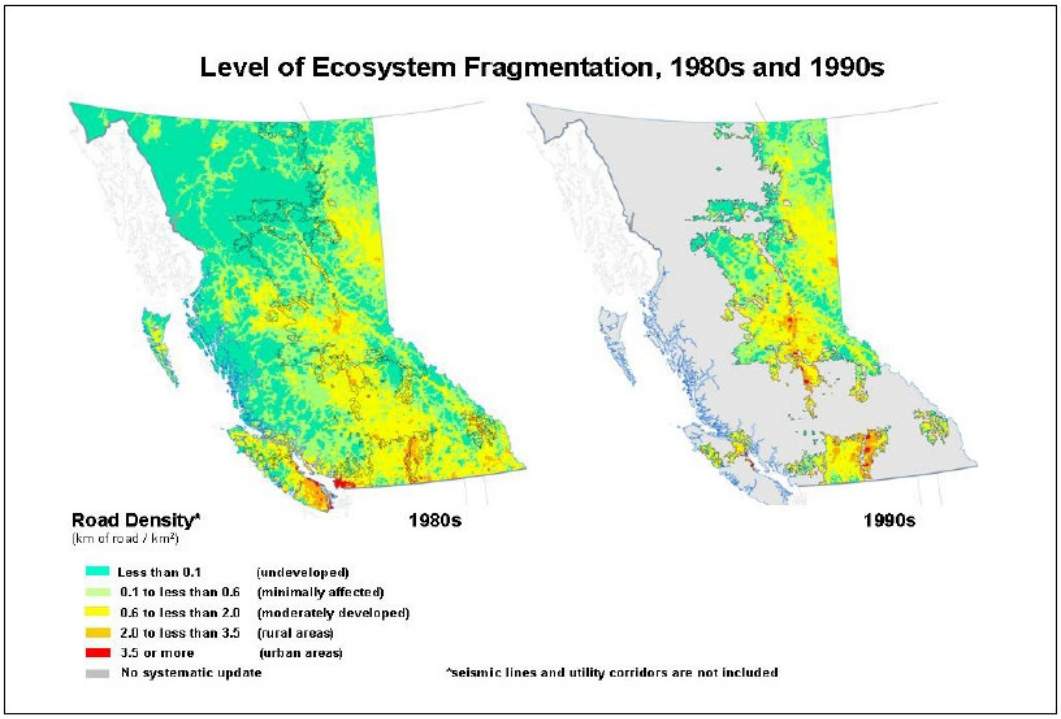

Figure 30 Road Density in the 1980s and 1990s (from BCMOFR 2006b)

The results of an analysis of forest land lost to roads are shown in Table 10. This and further analyses used the Hectares BC (HaBC) grid-based spatial

analysis tools available on-line. See: http://www.hectaresbc.org:22080/trac (BiodiversityBC 2008b))

Table 10 Average Forest Land area lost to access roads (data from HaBC)

	Total Area (hectares)	Total Road Length (m)	Area lost to 20 m wide roads (ha)	Percent of Area lost to 20 m wide roads	Area lost to 15 m wide roads (ha)	Percent of Area lost to 15 m wide roads	Average Distance to Road (m)
Old Forest	25,868,000	63,365,000	127,000	0.5%	95,000	0.4%	6397
Recently Burned **	1,401,000	3,744,000	7,000	0.5%	6,000	0.4%	6985
Recently Logged	5,161,000	161,465,000	323,000	6.3%	242,000	4.7%	207
Selectively Logged	688,000	20,495,000	41,000	6.0%	31,000	4.5%	157
Young Forest	28,554,000	195,752,000	392,000	1.4%	294,000	1.0%	2511
SUB-TOTAL	**61,672,000**	**444,821,000**	**890,000**	**1.4%**	**668,000**	**1.1%**	
Range Lands	788,000	11,777,000	24,000	3.0%	18,000	2.2%	1878
TOTAL	**62,460,000**	**456,598,000**	**914,000**	**1.5%**	**686,000**	**1.1%**	

*** average road width of 20 m (63 feet) after Guthrie 2002.**

**** though the load date for this dataset is 2006, the large fires of 2003 and subsequent years are not included in this dataset (total burned area ~625,000 ha). Therefore the total area Recently Burned should be more than 2,026,000 ha. (See Table 3 below).**

Two road widths were used in the analysis above. Guthrie (2002) uses 20 meters in his work on landslide frequency, and this may represent the major haul road widths, however, many roads are narrower (from the author's experience driving on these roads), so a 15 meter width was also used for comparison.

The area occupied by roads in old forests and burned forests (which were probably mature at the time of burning) is quite low at approximately a half a percent (0.5%) of the land base. The area occupied by roads in recently logged and selectively logged areas is approximately 4.7 to 6.3 %, or a total of 270,000 to 360,000 ha. One would expect a similar road density in the young forest, though the analysis results are much lower. This could be explained in one of two ways: 1) more roads have been rehabilitated in these areas, or the mapping of the road network is not as current as the forest class data. The latter is the more likely explanation. Range (grazing) lands have been included in the above table as they contain open forest and are managed under forest tenures.

In total, is its estimated that 1.1 – 1.5% of the forest soils of British Columbia have been sealed under permanent access roads, though the total area sealed

may be slightly higher if permanent landings and other related areas are included.

8.1.2 Extent of Forest Soil Disturbance

The dominant types of soil disturbance caused by forest operations include: 1) compaction, 2) erosion and potential delivery of sediment to streams, 3) loss of organic matter, and 4) landslides.

The FRPA soils objectives state that the area of soil disturbance which could impact on future forest productivity should be kept to less than 5% of the net area to be reforested. This implies that potentially 1.7 million ha of forest soils could have been detrimentally disturbed (see Table 11). It can be expected, however, that changes in soil biota and soil organic matter (usually a decrease in soil biomass and diversity in soil biotic communities) will have occurred over the complete area harvested (approximately 34 million ha) due to increased temperature and moisture fluctuations caused by the loss of the shading over-storey, loss of thickness of forest floor litter due to decay and oxidation resulting from disturbance of the materials and exposure to increased sunlight and winds), and changes in the nutrient supply and necessary biotic symbionts due to loss of living vegetation (Smith et al 2008).

Table 11 Potential area of forest soils disturbed by logging operations (data from HaBC)

	Total Area (hectares)	5% of area (hectares)
Recently Logged	5,161,000	258,050
Selectively Logged	688,000	34,400
Young Forest	28,554,000	1,427,700
TOTAL	**34,403,000**	**1,720,150**

Recent practices of retaining forest debris and large woody debris on site, plus the retention of green trees to support mychorryzae, biodiversity and wildlife will tend to promote maintenance of soil organic matter and support soil microbial communities.

8.1.3 Soil affected by wildfires

Significant areas of forest and forest soils in BC can be affected by wildfires. See Table 12 for a summary of area burned during the 1997-2007 period, including information of the cost of fighting these fires.

Table 12 Forest Fire History in BC 1997-2007 (from BCMoFR 2008c)

Year	Total Fires	Total Hectares	Total Cost ($Millions)	Ave. Ha per fire	People Caused	Percent People Caused	Lightening Caused	Percent Lightening Caused
2007	1604	29,404	$98.8	18.3	685	42.7%	919	57.3%
2006	2570	139,265	$158.7	54.2	1034	40.2%	1536	59.8%
2005	976	34,588	$47.2	35.4	591	60.6%	385	39.4%
2004	2394	220,518	$164.6	92.1	681	28.4%	1713	71.6%
2003	2473	265,053	$371.9	107.2	959	38.8%	1514	61.2%
2002	1783	8,539	$37.5	4.8	911	51.1%	872	48.9%
2001	1266	9,677	$53.8	7.6	787	62.2%	479	37.8%
2000	1539	17,673	$52.7	11.5	697	45.3%	842	54.7%
1999	1208	11,581	$21.1	9.6	609	50.4%	599	49.6%
1998	2665	76,574	$153.9	28.7	910	34.1%	1755	65.9%
10-yr Aver-age	1848	81287.2	$116	36.94	786.4	0.4538	1061.4	0.5462

In 2003, during the very dry and hot summer in the southern part of the province, 25,912 ha and 239 homes were burned in the Okanagan Park fire causing the evacuation of 30,000 people from suburbs of the city of Kelowna. See Figure 31. (Note the environmental impacts (including impacts to soils) listed and mitigation strategies identified to address the soil damage caused by the wildfire.)

In addition to burning trees and other vegetation, forest fires can cause extensive loss of the forest litter layer and soil organic matter, and may cause significant changes to soil biotic communities and soil structure. Soil pH also commonly increases due to release and deposition of basic cations, also increasing the availability of phosphorous, calcium, potassium and magnesium (Smith et al 2008).

Smith et al (2008) also found that 1 year after a burn the microbial biomass in a soil was 74% less than in an unburned soil (the control), and it was 54% lower than the control in a burned soil where salvage operations had returned organic matter from tree residue to the surface of the soil.

Fire intensity (amount and rate of energy release) and fire severity (level of consumption) affect the amount of change to soil properties. Severe fires occurring under extremely dry conditions in areas with high fuel loads are likely to be intense and severe, and consume most of the available fuels including the ground-covering forest litter. In these situations, soil temperatures may be high enough to burn organic matter within the soil matrix, resulting in an 'ashed' soil which has lost its soil structure and natural cohesiveness and becomes highly erodible. High soil temperatures can also volatize soil organic compounds which subsequently condense in deeper horizons or at the surface, creating hydrophobic layers which affect water infiltration. Poor infiltration alters subsurface recharge, speeds delivery of water to streams and increases the potential for surface erosion of the soils and channels. (Soil hydrophobicity is

most pronounced in areas that experienced the most intense and severe burns, and decreases with time.) (Scott & Pike 2003)

Figure 31 Okanagan Mountain Fire 2003 - City of Kelowna Display (from City of Kelowna 2005)

Soil vulnerability to erosion post-fire is influenced by:

- the amount of forest floor litter (duff) remaining after the fire (duff would have insulated the soil from heating during the fire, and protects against erosion post-fire)
- the severity of heating (affecting organic matter content and structure)
- the presence of hydrophobic layers or surface water repellency (Scott 2005).

Prescribed burning for forest management is usually conducted under moist conditions, permitting retention of some ground-cover litter and not damaging the soils significantly. (Scott & Pike 2003).

The loss of trees and other vegetation and changes in soil infiltration and moisture holding capacity (due to hydrophobicity and loss of organic matter) caused by forest fires can cause significant changes in watershed hydrology. Increased surface flows (due to hydrophobic layers) can cause significant erosion (sheet flow, rills, gullies) and landslides on steep terrain, and increased peak flows in streams may result in flash floods and debris flows. Figure 32 illustrates the relationship between runoff and erosion (sedimentation), as measured by Jordan et al (2008).

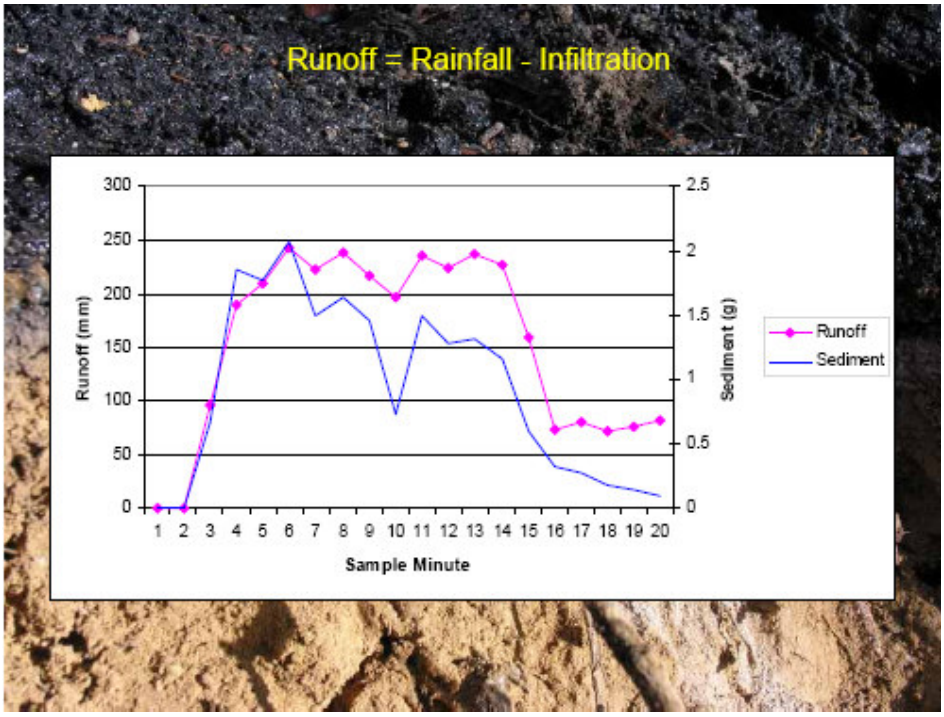

Figure 32 Relationship between runoff, erosion (sedimentation) and infiltration in hydrophobic soils (from Jordan et al 2008)

Two authors have measured erosion rates of 0.65 to 0.9 tonnes/ha in burned area plots under light rain conditions in southern BC (Covert et al 2007; Jordan et al 2008). Rates could be significantly higher under intense rain conditions as are common during localized summer thunderstorms in the region. (These storms may have rainfall intensities of 10 mm/hour for 30 minutes (Jordan et al 2008)).

Maps of forest fire burn intensities for recent fires in southern BC indicate that approximately 20-30% of the areas show high fire intensity with potentially significant alteration of soils. If the measured erosion rates were applied to a quarter of the burned area of the Okanagan Park fire, 4,200 to 5,800 tonnes of soil could have been lost.

Given these erosion rates and estimates of areas of severe burns potential soil loss due to post-wildfire erosion is estimated at 132,000 to 183,000 tonnes from the 813,000 ha burned in BC in the last 10 years (1997-2007).

A severe erosion event in Kelowna following the 2003 Okanagan Mountain fire resulted in a debris flow which damaged one house (see Figure 33). Debris flows originating from the Kuskanook burned area destroyed 2 homes, damaged others, and closed a highway at 2 locations (see Figure 34) (Jordan et al 2008).

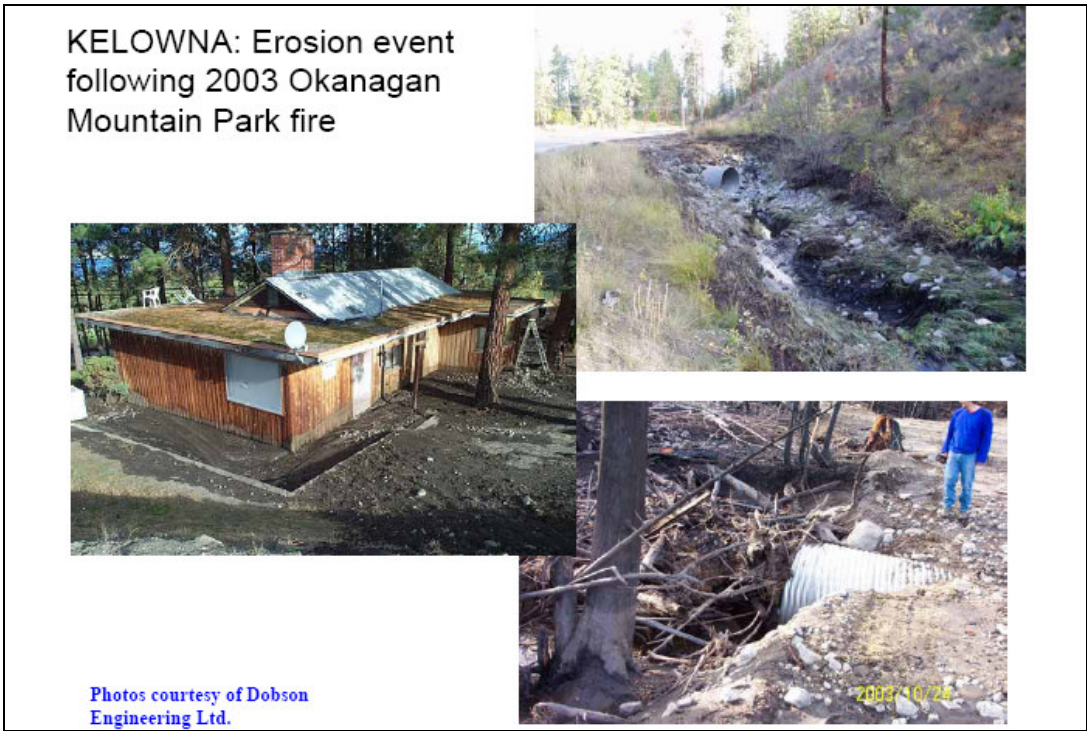

Figure 33 Erosion event at Kelowna following the 2003 Okanagan Mountain Park fire and severe (localized) summer storm event (from Jordan et al 2008)

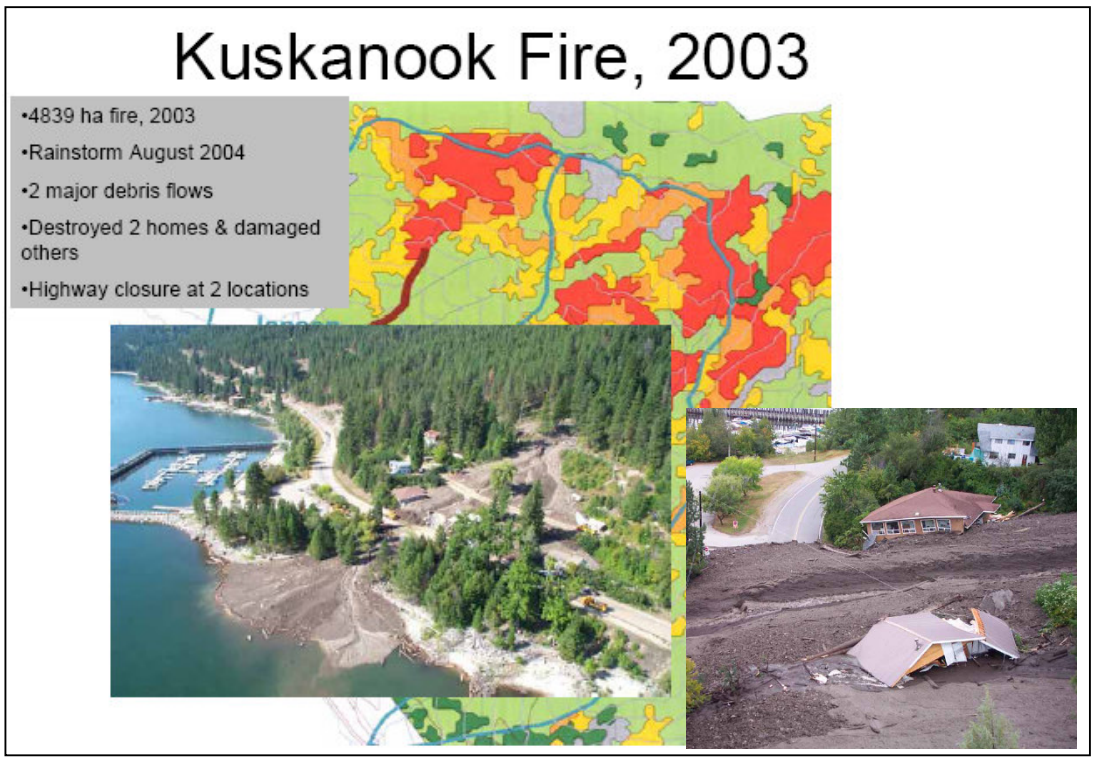

Figure 34 Debris flow in 2004 following Kuskanook Fire (2003) (from Jordan et al 2008)

In total, there were 10 significant erosion, landslide or debris flow events during the 2003 to 2005 period related to the 2003 wildfire events. (These are: Okanagan Park in 2003, Cedar Hills, Strawberry Hills, Kuskanook, Lamb Creek, and Vaseau in 2004 and McLure and McGillivray in 2005(Jordon et al 2008)).

These debris flows, erosion events and landslides led the Ministry of Forests and Range (Southern Interior Region) to develop a risk assessment procedure to screen all wildfires greater than 100 ha in size in potentially high risk areas such as near residences or in interface areas, highway/industrial corridors, and community watersheds. Ministry staff assess burn severity, test soils and identify areas with high potential for landslides, debris flows or flood hazard, inspect elements (highway culverts/bridges, homes on alluvial fans, etc.) potentially at risk, and identify options for mitigation treatments (see Figure 35 and Figure 36).

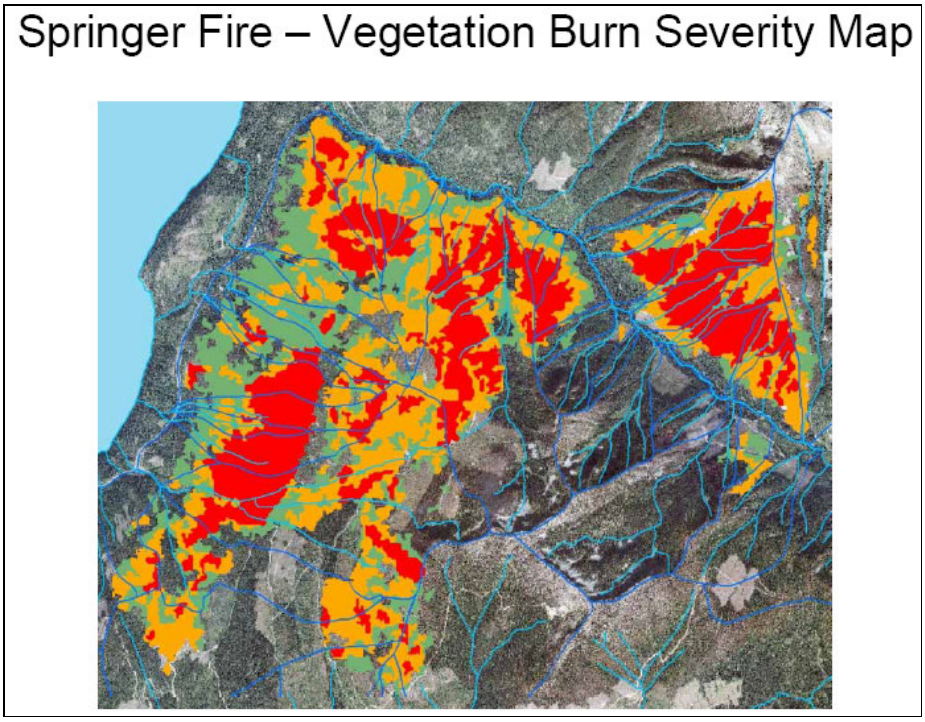

Figure 35 Springer Fire Vegetation Burn Severity Map (red = high severity) (from Jordan et al 2008)

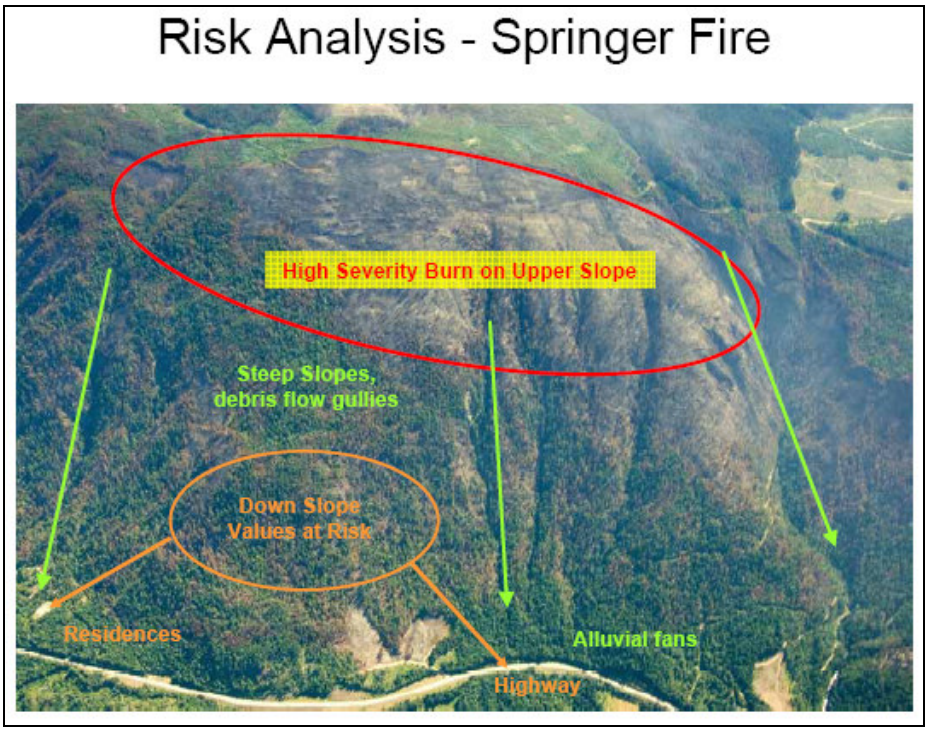

Figure 36 Example of a risk analysis (from Jordan et al 2008)

Where high risks are identified, the Provincial Emergency Program gets involved, informing stakeholders and making recommendations for defensive work. Development of the risk analysis procedure and related aspects are documented in Jordan et al 2006.

Post-wildfire mitigation measures may include defensive structures in gullies, channels and on fans, engineering treatments (e.g. upgrading creek crossings, cross-drain culverts), straw or other material mulching, contour log felling or installation of bioengineering features, grass seeding or reforestation (tree planting).

Wildfire damaged soils, depending on the level of damage, will be limited in terms of their ability to provide ecosystem services. The loss of soil organic matter may also limit the rate of recovery of ecosystems and ecosystem function (Curtis & Wei, 2005). Return of organic matter in the form of mulches or slash from salvage logging (Smith et al 2008), will increase soil organic matter content.

Hot dry weather in southern BC during the summer of 2008 has already resulted in new wildfires which may result in erosion, debris flow and landslide hazards and risks in the coming years (See Figure 37).

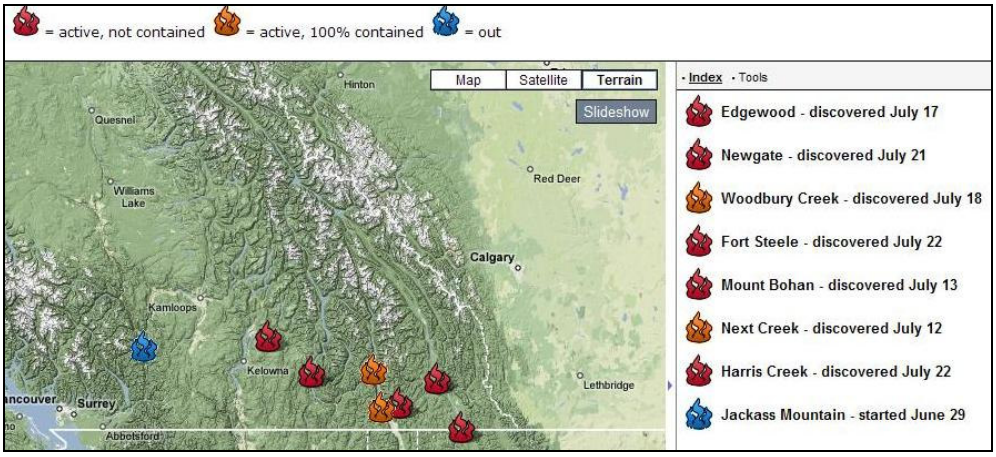

Figure 37 Wildfires in southern BC as of July 23, 2008 (from CBC 2008)

With the predicted climate change, wildfire related threats to soils in BC can be expected to increase as higher temperatures and drier summers (Spittlehouse 2008) increasing the probability and frequency of intense and severe wildfires which in turn will result in increased likelihood of significant soil damage, and resulting erosion, debris flows and landslides. The vast tracts of mountain pine beetle killed forests are at risk of very severe and intense wildfires due to the volume of fuel. These hazards also result in increased risk to human life, infrastructure and property (Spittlehouse 2008)

8.1.4 Landslides

Landslides, both natural and those caused by human activities on the land base, are a significant threat to the soils of British Columbia due to the large area of mountainous terrain. See Figure 17 (p.35).

Approximately 9 million hectares have an average slope greater than 35 degrees, and 18.7 million hectares have an average slope between 15 and 35 degrees. (This estimate is based on data available from the HaBC analysis tool (BC Biodiversity 2008b). In this case the data used was the average slope class of each one hectare grid cell in BC).

Approximately 6% of the forested land hectare grid cells have an average slope steepness greater than 35% and with 30% of the cells having slopes between 15 and 35 degrees. (See Table 13 for details regarding the distribution of land cover by slope class)

The majority of landslides on forested hill slopes in BC are triggered by unusual rainfall events (intense or prolonged rainstorms, sudden changes in temperature or rain-on-snow events (Fannin 2007, Eggington 2007, Jakob 2008)). Shallow landslides (debris slides, debris flows, and debris avalanches) are usually influenced by groundwater flow convergence controlled by topography, and are a function of soil depth, ground slope, angle of shearing resistance, soil cohesion and apparent cohesion from root networks, and soil saturation and groundwater flow. Following landslide initiation, travel distance is influenced by the properties of the material, characteristics of the flow path, and the volume of additional material entrained (Fannin 2007).

Table 13 Distribution of land cover categories by average slope class per ha (data from HaBC analysis)

		Average Slope Class (in degrees)(of 1 ha cells)				
Land Cover Category		**Total area in BC (hectares)**	**Flat (0 - 3)**	**Moderately Flat (3 - 15)**	**Moderately Steep (15 - 35)**	**Steep (35+)**
Mountains, Rock and Ice	Area (ha)	22,738,000	765,000	4,575,000	11,741,000	5,657,000
	% of Area	24.0%	3.4%	20.1%	51.6%	24.9%
Wetlands and Estuaries	Area (ha)	3,907,000	3,073,000	748,000	79,000	7,600
	% of Area	4.1%	78.6%	19.1%	2.0%	0.2%
Water	Area (ha)	2,231,000	2,041,000	144,000	41,000	4,400
	% of Area	2.4%	91.5%	6.5%	1.8%	0.2%
Shrubs	Area (ha)	1,604,000	410,000	855,000	310,000	28,900
	% of Area	1.7%	25.6%	53.3%	19.3%	1.8%
Forest and Range	Area (ha)	62,460,000	13,319,000	26,862,000	18,695,000	3,583,000
	% of Area	65.9%	21.3%	43.0%	29.9%	5.7%
Agriculture	Area (ha)	1,366,000	920,000	415,000	30,000	1,100
	% of Area	1.4%	67.3%	30.4%	2.2%	0.1%
Urban	Area (ha)	381,000	209,000	153,000	18,000	700
	% of Area	0.4%	54.9%	40.2%	4.7%	0.2%
Other Human Use	Area (ha)	86,000	21,000	41,000	23,000	2,000
	% of Area	0.1%	23.8%	47.0%	26.8%	2.3%
Total Area by Slope Class		94,773,000	20,758,000	33,793,000	30,937,000	9,285,000
Percent of BC in each Slope Class			21.9%	35.7%	32.6%	9.8%
Data from HaBC analysis of average slope in each 1 ha grid by land cover category						

Geertsema et al (2006b) noted an apparent increase in the number of large natural landslides in northern BC, perhaps related to climate change. Some of these slides are triggered by a rock fall or other event in a steeper portion of the slope, which triggers a large earthflows, channelized debris flows or debris avalanches on lower gradients. See Figure 38. At least one of the slides studied is believed to have been triggered by melting of permafrost at its head. (Geertsema et al 2006a).

Recent work by Geertsema (2007) indicates that as landslides act as agents of change, altering site conditions, they can contribute significantly to biodiversity.

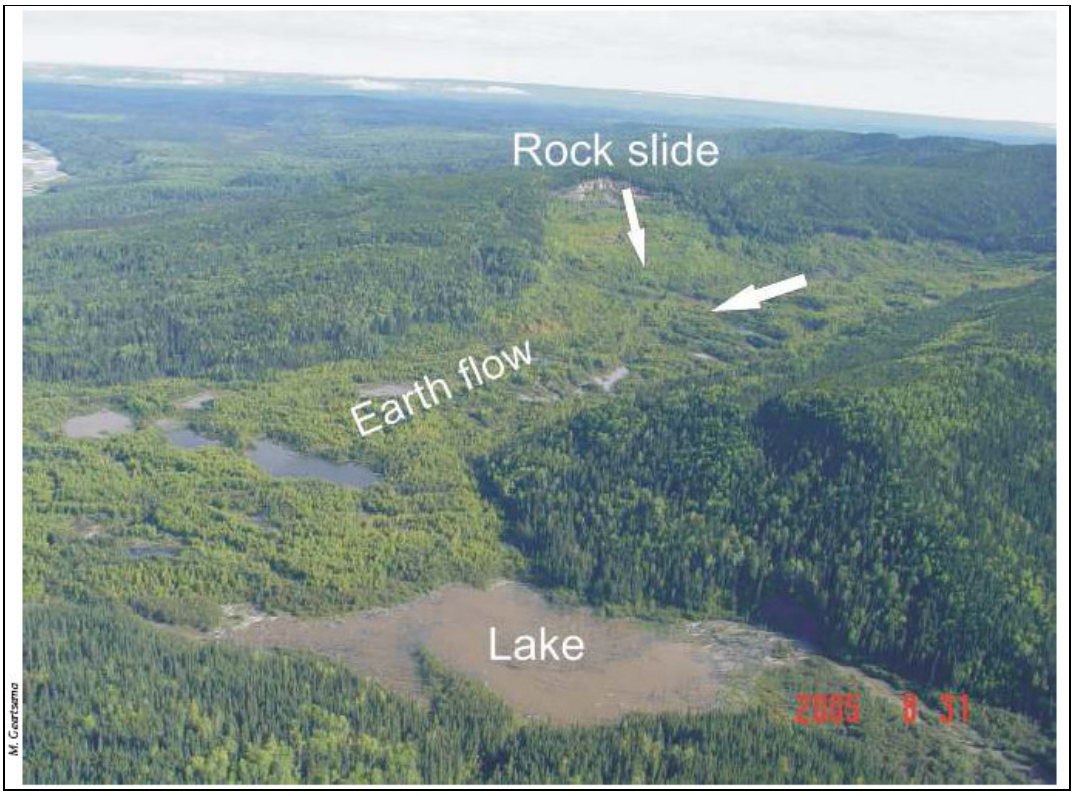

Figure 38 The 1979 Muskwa rock slide-earthflow in clayey diamicton on a 3 degree slope. The distance from the crown to the tip is 3.25 km. (from Geertsema 2006a)

With climate change and the predicted increases in rainfall during the winter period and drier summers with more intense storms, natural landslide frequencies and human activity caused landslides could be expected to increase (Geertsema 2006a, Spittlehouse 2008).

8.1.5 Landslides related to forest harvest activities

Forest removal increases the amount of rainfall hitting the soil (due to loss of vegetation layer causing interference), and higher initial (pre-rainfall) soil moisture contents (due to loss of evapotranspirative processes). Logging and road building activities can also alter the soil properties, while loss of live trees affects root network influenced cohesion and the modified water infiltration, surface runoff and groundwater flow patterns, potentially concentrate groundwater flows and trigger landslides (Fannin 2007, Spittlehouse 2008).

The effects of forest development road building, especially poor drainage design or failure to maintain road drainage structures, are considered to be the dominant reason for accelerated slope failures (Slaymaker 2000).

Guthrie (2002) mapped landslides in three watersheds on Vancouver Island pre and post logging, and found that landslide frequencies had increased 3 to 16 times and frequencies related to roads increased 12 to 94 times. Precipitation in these watersheds ranged from 2000 to 4000 mm/year.

In studies of sediments in lakes, sediment accumulation rates 10 times greater than background rates were observed for 5 to 7 years following forest road construction, especially where this was on erodible soils within 100 meters of streams (Slaymaker 2000).

The Forest Practices Board conducted an evaluation of landslide activity in 3 study areas across the province. They found 46 road and cutblock landslides in 455 steep slope cutblocks – representing on average 1 landslide per 14 square kilometres of steep cutblock. Approximately 60% of these landslides had a materially adverse effect on a forest value (e.g. loss of soil, impact on a stream). The Forest Practised Board did however find that landslide frequency, though still higher on cutblocks than on undisturbed terrain, has been significantly reduced after the Forest Practices Code came into effect (1995) The number of landslides initiated on roads had also declined. Post-code landslides impacted 0.3% of the watersheds (Chatwin 2005).

Under the current FPRA framework, the licensee is required to ensure forest practices do not cause a landslide leading to a materially adverse effect. This also represents a shift from hazard-based to risk-based forest management (Chatwin 2005).

8.2 Agricultural Lands:

The discussion in this section addresses identified threats to soils on BC's agricultural lands. Arable lands are located primarily in the ALR and grazing and ranching (range) may also occur on private land grasslands or on range tenures on forest lands. (See Figure 28 (p. 53) for map of the distribution of the ALR)

Based on consultations with representatives from local, provincial and federal agencies and agricultural producer groups at workshops at various locations in BC in early 2003, environmental risks and priorities related to soil, water quality, water quantity, air, and biodiversity were identified for each major agricultural region in BC (Golder 2003). The results of these consultations on soil management and soil protection are summarized in Table 14. (In the table, soil threats have been associated with water quality issues.) The agricultural regions referenced in the Table 14 are shown in Figure 39.

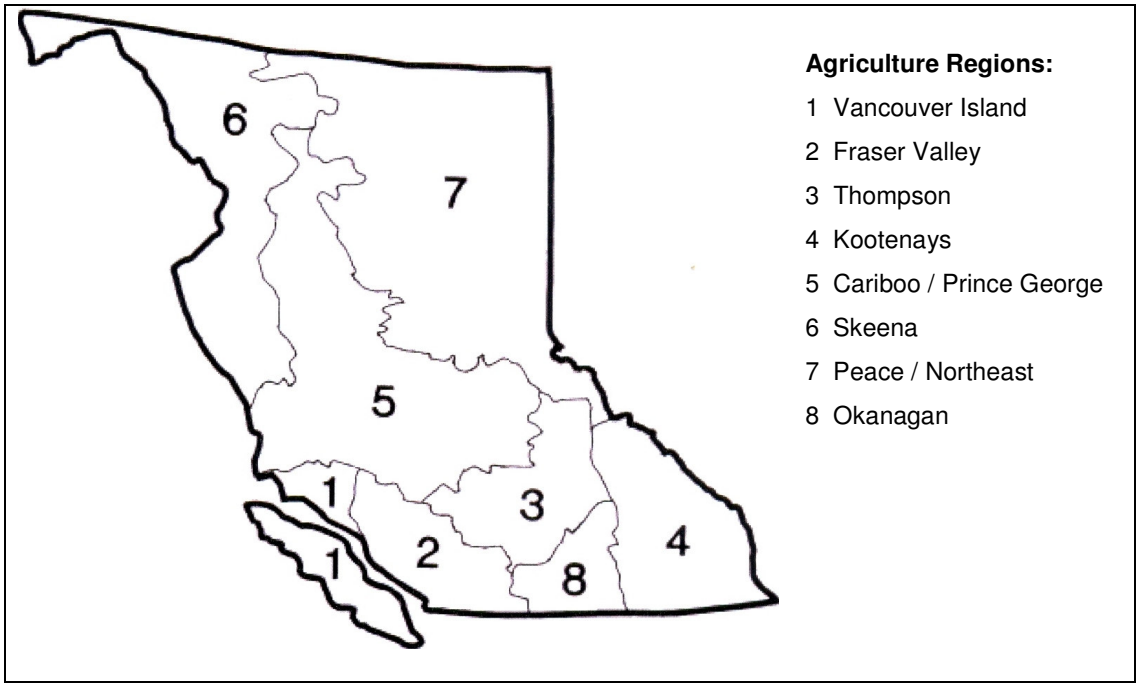

Figure 39 Agricultural Regions of BC (from Golder 2003)

Table 14 Agricultural Soil Threats in BC

Soil Threat	Issue Identified and management practices proposed	Vancouver Island	Fraser Valley	Thompson	Kootenays	Cariboo / Prince George	Peace	Okanagan
	Water Quality:							
Erosion/Runoff	Loss of Riparian function	Y	Y	Y	Y	Y	Y	Y
Erosion/Runoff	Nutrients in surface water (mainly N, P)	Y	Y	Y	Y	Y	Y	Y
Erosion/Runoff	Pesticides in surface waters		Y					
Erosion/Runoff	Pathogens in surface waters	Y	Y	Y	Y			
Erosion/Runoff	Petroleum products in surface water						Y	Y
OM Decline	Nitrates in groundwater	Y	Y	Y	Y			
OM Decline	Pesticides in ground water		Y	Y	Y			
Erosion/Runoff	Sedimentation in surface waters	Y	Y	Y	Y	Y		Y
	Water Quantity							
Erosion/Runoff	Storrmwater management	Y	Y					
OM Decline	Water conservation	Y	Y	Y	Y	Y	Y	Y
	Soil							
OM Decline	Soil organic matter decline	Y	Y			Y		Y
Contamination, Salinisation	High potassium in soil (dairy)	Y	Y	Y				
Contamination	High nitrates in soil	Y						
OM Decline	Organic soil management		Y					
Compaction, OM Decline	Soil Structure (incl. trafficabilty, compaction - liverstock / machinery)	Y	Y	Y	Y			
Erosion	Field erosion (due to ack of cover, steepness, over-irrigation, &/or storm runoff)	Y	Y	Y	Y	Y	Y	Y
Erosion	Streambank erosion	Y		Y	Y	Y	Y	
Soil Loss	Soil loss during harvest (turf, nursery)	Y	Y					
Contamination	Acidification		Y					Y
Compaction	Drainage	Y	Y					
Flooding	Flood Control		Y	Y		Y		
Contamination	Pesticide accumulation		Y					Y
OM Decline	Soil fertility						Y	
Salinization	Salinization - partly natural					*Y*		*Y*
Contamination	Waste disposal (on farm dumps, undergound tanks)		Y					
Soil Loss / Sealing	Land Loss to Urbanization	Y	Y					Y
Sealing	Soil sealling under greenhouses	*Y*	*Y*					
	Air							
OM Decline	Burning of residues	Y			Y	Y		Y
Erosion (wind)	Dust						Y	Y
Contamination	Spray drift							Y
OM Decline	Greenhouse Gases	Y	Y					
Contamination	Industrial/urban diffuse pollution		Y			Y	Y	Y
	Biodiversity							
Contamination	Pesticides		Y					Y
Loss of rare soils/ecosystems	Loss of grassland habitat (to orchards or forest encroachment)			Y	Y	Y	Y	Y
Loss of rare soils/ecosystems	Loss of wetlands	Y	Y	Y	Y	Y	Y	Y
Loss of rare soils/ecosystems	Species at Risk	Y		Y	Y	Y	Y	Y
Count of Ys		21	26	15	14	14	12	19
	Y - Data from Golder 2003 ***Y - Data from other sources***	(Valentine & Lavkulich 1978, BCMAFF 2003)						

The majority of the differences between the soil threats seen as important by the workshop participants in the Golder study are related to the types of agricultural production occurring in each region. See Table 15 for a summary of the distribution of BC's agricultural sectors by region.

The majority of the 618,000 ha in crops is concentrated in the valley bottoms all over BC or on flatter lands on the east coast of Vancouver Island or in the Peace region. The province has over 1.4 million hectares in pasture or grazing on private lands, with an additional approximately 8.5 million ha of open or forested grazing land on Crown land tenures used by the ranching industry (BCMAL 2004). The distribution of arable and pasture/grazing lands is reflected by the regional distribution of the agricultural sectors. See Table 15.

Table 15 Regional distribution of BC's agricultural sectors

Regional Distribution of Agricultural Sectors	Vancouver Island	Fraser Valley	Thompson	Kootenays	Cariboo / Prince George	Peace	Okanagan
Livestock and Related:							
Dairy	Y	Y	Y		y	y	
Cattle (including ranching)	y	y	Y	Y	Y	Y	y
Hog	Y	Y					
Poultry	Y	Y					
Other (sheep, bees (honey), game products, other related)	y	y	y	y	y	y	y
Fruit, Vegetables and Field Crops:							
Tree Fruit							Y
Grapes	y						Y
Berries	y	Y					
Vegetables & Potatos	y	Y					
Floriculture	Y	Y					
Greenhouse crops, nursery products, mushrooms, specialty crops	y	Y	y				y
Grain				y		Y	
Oilseeds				y		Y	
Forage crops				y		Y	
Number of Identified Sectors	10	9	4	5	3	6	5

Y = concentration of operations in the sector
y = number of operations
* small operations in each sector may occur in any region
(MAL 2004)

Note: In addition to the above noted agricultural crops, between 168-416 metric tonnes of marijuana (*cannabis nativa)* (export value of $2 Billion Cdn (£1 Billion)) was produced in BC in 2000), concentrated in grow-op operation in the Lower Mainland (Fraser Valley) (RCMP2005, Fraser Institute 2004). In 2008, it is claimed that marijuana production was second place after forestry in contributing to BC's Gross Domestic Product (The marijuana industry was valued at $7.5 Billion Cdn (£3.5 Billion),'employing' 250,000 people)(Bainas 2008). Some grow-ups are located in more remote forested regions of southern BC and on Vancouver Island (where the climate is suitable), however, as the land area impacted is likely not very large, related soil protection issues will not be addressed here.

As a result of the many agricultural sectors active on Vancouver Island, soils in that region are under a wide variety of threats, including erosion, organic matter decline, agricultural contamination and sealing. The eastern lowlands of Vancouver Island are dominated by arable agricultural and urban/rural

residential uses, bordered by forests in the uplands to the west. A wide variety of products are produced on Vancouver Island mostly from small to medium size farms. The east coast of Vancouver Island has a mild climate (average monthly temperatures ranging from 4 – 19 ºC, and rainfall ranging from 18 mm/month in the summer to upwards of 120 mm/month in winter)(TVI 2008), Brunisolic soils, (Valentine & Kavkulich 1978), high population pressures and high land prices.

The Fraser valley of British Columbia is an area of intensive agricultural production with the highest livestock/ha concentrations in Canada (BCMAL 2008b), a growing greenhouse sector, and significant berry production. The valley has the largest number of soil threats identified (see Table 14), including issues of soil, surface and groundwater nutrient and pesticide contamination, diffuse urban/industrial contamination, sealing, erosion and organic matter decline. (The valley is surrounded by high mountains and is downwind of the major urban centre of Greater Vancouver, and frequently experiences very poor air quality (EnvCan 2005)). Agricultural lands are also under continuing pressure from urbanization and the threat of further removals of lands from the ALR (See Table 6 (p.54) for information on loss of lands from agricultural use). In 2001, approximately 2188 hectares was under glass houses for vegetable production, with greenhouse sized ranging from 0.2 to 18 ha in size (BCMAFF 2003). Soils are also under threat of additional sealing due to this expanding industry.

The grazing and ranching sectors are the dominant agricultural sectors in the Thompson, Cariboo / Prince George and Kootenay regions. Stream bank erosion due to livestock access to water was identified during the workshops in these regions as a important environmental issue (Golder 2003).

In the Okanagan, the tree fruit orchards and vineyards are the dominant agricultural sectors. This is a semi-arid region with very dry summers and irrigation is key for these industries. Recently the administrators in the region have become concerned about future water supplies (from surface water and groundwater sources) due to proposed urban expansion and vineyard expansion pressures (OPS 2004).

8.3 Urban Lands

Soils in urban areas are threatened primarily by soil sealing, contamination (contaminated sites, inappropriate waste disposal and diffuse contamination), and soil disturbance due to land development practises, as well as by compaction, erosion and potential loss of soil organic matter.

Impervious surfaces in urban areas may range from low to 100% of the land area (in parts of city centres). (Data for BC cities is not readily available). The higher the amount of impervious surface and buildings, the greater the ‘urban heat island’ effect, and the poorer the air quality, as soil and vegetation are not present to shade buildings and the concrete/asphalt surfaces, provide moisture

to the air through evapotranspiration, or to absorb air pollution or filter and retain rainfall in the soil and on the plants. A recent study found that 29% of the carbon in tissues of grasses growing on the verges adjacent to a busy urban road consisted of carbon derived from fossil-fuel carbon dioxide (using ^{13}C analysis) (Licthfouse et al 2003). The presence of soil and vegetation can provide a significant level of environmental services in urban areas. Schaefer et al (2004) estimates that a 200 square meter area in an urban yard could provide an array of benefits from savings on heating and cooling, to reductions in air pollution and other benefits. See Table 16.

Table 16 Air pollution reduction and other annual benefits from a 200 square meter yard with various vegetation types ($1 US = ~ £0.50) (from Schaefer et al 2004)

	One yard all grass	One yard all shrubs	One yard all trees	Ideal yard	Realistic yard
Energy					
Cooling KWh savings	1072	2144	2680	2224.4	1474
Heating Mbtu savings	44.267	88.533	110.667	91.853	60.867
PM10 (kg)	5.04	10.08	12.6	10.458	6.93
Ozone (kg)	1.584	3.168	3.96	3.2868	2.178
Nitrogen dioxide (kg)	1.704	3.408	4.26	3.5358	2.343
Sulfur dioxide (kg)	4.296	8.592	10.74	8.9142	5.907
Carbon monoxide (kg)	0.384	0.768	0.96	0.7968	0.528
Carbon dioxide (kg)	876	1752	2190	1817.7	1204.5
Hydrology (litre)	6003.36	12006.72	15008.4	12456.972	8254.62
Other Benefits $US	1247.04	2494.08	3117.6	2587.608	1714.68

Previous industrial sites and 'gas stations' (gasoline (petrol) retail sites) in BC urban areas may contain contaminated soils which must be removed, remediated, or potentially sealed in place, prior to reuse of these sites for other purposes. The majority of the contaminated sites listed in Table 17 are located within or near large urban centres, small cities or towns. See Section 8.4.1 (p. 82) for more information on contaminated sites.

Table 17 Contaminated sites overseen by the Ministry of Environment, Land Remediation Section (from BCMoE 2007e)

Site Number	Site Name	Location	Origin of Contamination
9195	18th and Dunbar	Vancouver	Drycleaner
10247, 10258, 10259, 10260	41st and Collingwood	Vancouver	Service station
1397	9250 Oak Street	Vancouver	Wood preservation
1733	Bamberton	Mill Bay	Cement plant
451	Bell Pole	Lumby	Pole treatment and storage
6137	Brilliant	Nelson	Metal concentrate spill
436	Britannia	Britannia Beach	Copper mine
2167	Bullmoose/Quintette	Tumbler Ridge	Coal mines
4084	Cordova Bay Shell	Victoria	Service station
1759	Country Club Mall	Nanaimo	Service station
71	Canada Cedar Pole	Kootenays	Wood preservation
5716455	CPR Revelstoke/Exeter Offsite	Revelstoke	Rail yard
1540	Domtar	Coquitlam	Wood preservation
9465, 9466, 9467	Dockside Lands	Victoria	Mixed industrial
2643	Grand Forks Chevron	Grand Forks	Service station
2203	Koppers	Burnaby	Lumber treatment
6670	Malahat Soil	Malahat	Soil stockpile
445	Mitchell Island	Vancouver	Steel manufacturing
3141	Nexen	Squamish	Chlor-alkali plant
9680	Quathiaski Cove	Quadra Island	BC Packers Cannery
4188	Quesnel Legion Drive	Quesnel	City works, bulk fuel storage, rail yard
354	Rock Bay	Victoria	Coal gasification plant
13	Southeast False Creek	Vancouver	Mixed industrial
3120	Sixth and Cambie	Vancouver	Rail yard
3730, 4119	Smithers Bulk Plants	Smithers	Bulk fuel storage
2421	Skeena Cellulose	Smithers	Pulp mill
7091	Suburban Motors	Victoria	Service station
5819	Sullivan Mine	Kimberley	Lead-zinc mine
3232	Taylor	Taylor	Gas refinery
3250	Trail Smelter	Trail	Lead smelter
4291	Union Bay coal pile	Union Bay	Coal waste
9404, 9405, 9406	United Auto lands	Vancouver	Fill of unknown origin
9	Vancouver Wharves	Vancouver	Industrial shipping
1419	Versatile Shipyard	Vancouver	Shipbuilding, wood preservation
9930	Woodfibre	Squamish	Pulp mill
5184	Your Family Food Mart	Victoria	Service station

During urban development, topsoil is usually stripped from the site and stockpiled for re-spreading later. Soil scrapers and other heavy equipment can cause extensive compaction, impeding water infiltration in the short and long term, as this compaction is usually not loosened post-construction. A significant proportion of the soil organisms present in the soil are likely to be killed during the disturbance, movement and stockpiling process. Soil stored in heaps may become anoxic (due to lack of oxygen), and the resulting anaerobic decomposition can release methane and raise levels of ammonia in the soil, change pH and make the environment toxic to any remaining soil biota.

When these soils are put back in the landscape, post-construction, they will have poor structure, low organic matter, and possibly low porosity (due to compaction), and so conditions for re-establishment of vegetation will be poor. These soils will, with good management (alleviation of compaction, addition or organic matter and lack of further disturbance) and time, eventually be restored and will be again able to provide the ecosystem services (filtration, water storage, gaseous exchange, support for health vegetation, etc.)

8.4 Soil status and threats on other lands

8.4.1 Contaminated Sites:

There are approximately 8000 contaminated sites in British Columbia (MoE 2007e). The regional distribution of these is shown in Figure 40. The frequency of the 'suspect land uses' which caused the contamination is shown in Figure 41

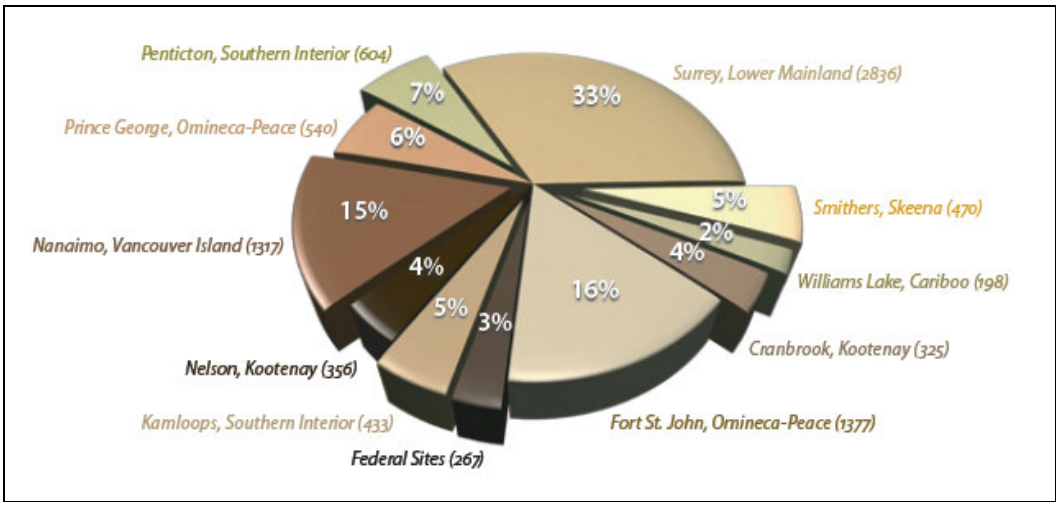

Figure 40 Number and percentage of contaminated sites by region (from BCMoE 2007e)

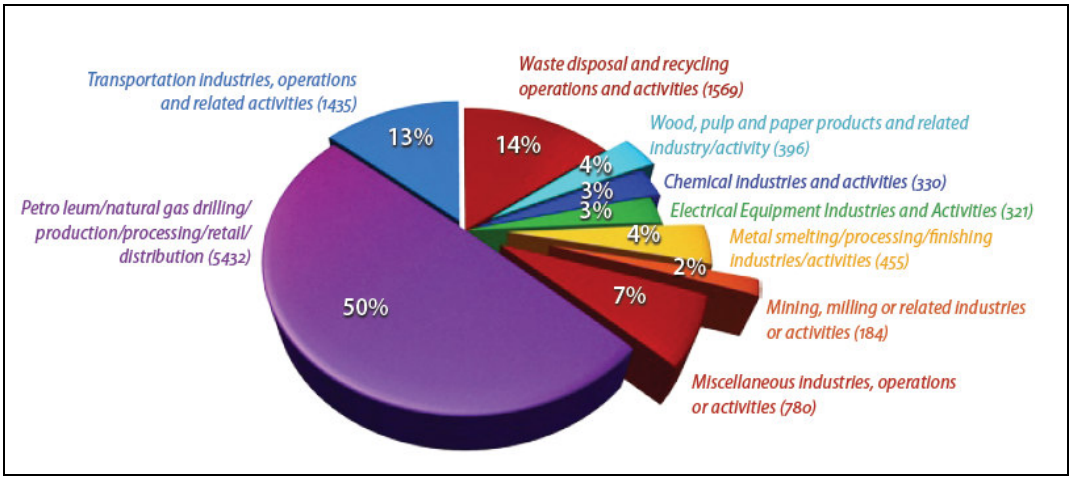

Figure 41 Number and percentage of contaminated sites by 'suspect land use', as of March 2007 (from BCMoE 2007e)

The Land Remediation Section of the Ministry of Environment and the National Round Table on Environment and the Economy have both identified initiatives to support redevelopment of brownfield sites (BCMoE 2007b, NRTEE 2007).

8.4.2 Permafrost soils

The province of BC has sporadic and discontinuous permafrost areas with cryosolic soils (see Figure 42). Areas of sporadic permafrost are present on some of the highest mountain peaks and on northern mountains in the province. Discontinuous permafrost is present in the north-eastern region of the province (Fort Nelson Area) (see Figure 43).

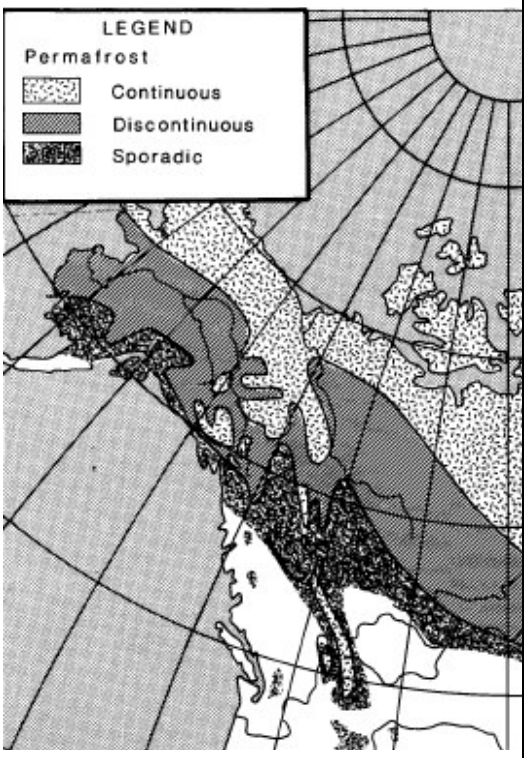

Figure 42 Distribution of Permafrost in NW North America (from Harris 1986)

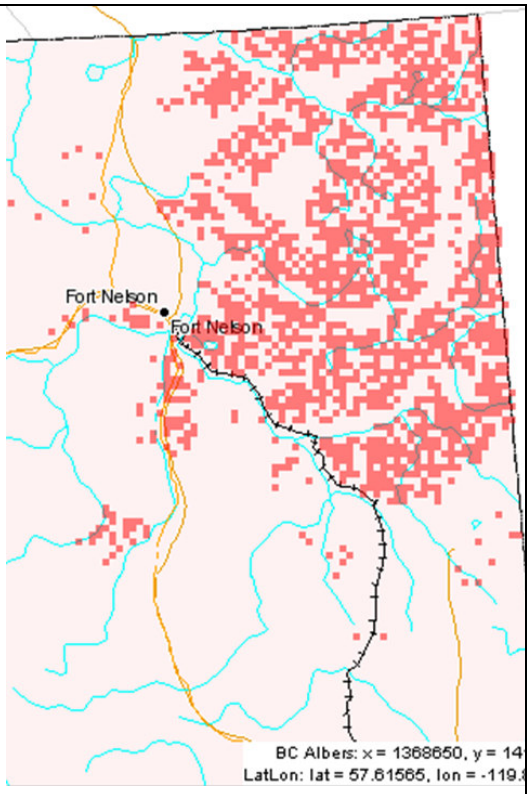

Figure 43 Distribution of Organic Crysols in NE BC (1 pixel = 1024 ha) (map and data from HaBC)

The organic crysols in Figure 43 are in the wetlands on the 'plains' of north eastern BC. This is an area of muskeg, with low timber or agricultural values, but the subsurface does contain potential oil and gas reserves. In the past, access for drilling and pipeline construction would have been almost exclusively in winter when the ground is frozen, however over the last decade or so, 'freeze up' periods have shortened, and geotextile mats are now being used for access construction to permit access year round in many parts of north eastern BC. The soils of this region are estimated to hold 246 tC ha^{-1} (Wilson & Hebda 2008). Potential disturbance of the organic cryosolic soils may speed melting of the permafrost and degradation of the stored organic matter, potentially releasing significant volumes of carbon dioxide to the atmosphere.

The permafrost on the mountains in northern BC may already be melting, triggering landslides (Geertsema 2006a) (see Section 8.1.4 (p. 73)).

Climate change can be expected to put the larger areas of permafrost areas in northern BC at risk of melting, with degradation of the cryosolic soils and release of carbon dioxide as the organic matter is degraded by increased biotic activity during periods of thaw.

9 Applying e^{2}DPSIR

This chapter illustrates one application of the e^{2}DPSIR model to analysis of the potential impacts of two current provincial government initiatives on soil. The objectives of these two initiatives range from sustaining communities to maximizing financial benefits and renewing forest ecosystems. The variety in the strategies (or response measures) identified allows analysis of both the environmental and human systems (and socio-economic subsystem) using the e^{2}DPSIR model.

The e^{2}DPSIR model is applied (below) to analyse the potential impacts on soil organic matter (and soil organic carbon) of the BC Bioenergy Strategy and the Mountain Pine Beetle Action Plan.

The e^{2}DPSIR model (described in Section 5.8 (p. 30)) is applied in two stages or scenarios. Scenario 1 illustrates the influences on soil organic matter in beetle killed pine forest stands primarily within the 'environmental system' (of the e^{2}DPSIR model) and identifies impacts to human well-being. Scenario 2 assesses the influences on soil organic matter in beetle-killed pine forest stands subject to logging and removal of 'biomass residuals' for bioenergy, and looks at the environmental and human factors, as they are influenced by existing drivers and pressures and the strategies of the two policy initiatives. In analysing these scenarios, the e^{2}DPSIR model will also be assessed for its functionality and usability.

Scenario 1) involves an assessment of the relationships within the environmental system. Once this analysis is complete, the second stage (Scenario 2) adds the human and socio-economic influences.

9.1 Potential impacts of the BC Bioenergy Strategy and the Mountain Pine Beetle Action Plan on soils

The BC Bioenergy Strategy proposes to utilize BC's biomass resources for production of heat, electricity, liquid fuels and other forms of 'green' energy, in large or small-scale, community-based production systems, anaerobic digesters, wood-fired electricity generation plants, or for wood-pellet or liquid biofuel production or wood-gasification (BCMEMPR 2008a). Bioenergy is seen as 'clean' or 'carbon neutral' as its use releases only the carbon recently stored in the biomass material during its growth, with no 'net' increase in atmospheric CO_2 (BCMEMPR 2008b).

The relative proportions of the forest, agricultural and other biomass resources in BC are shown in Figure 44. Estimates of potential resource volumes are given in Table 18.

The removal of biomass from forest lands (i.e. the woody logging residues and mountain pine beetle-killed wood) and agricultural lands (agricultural crop

residues and animal manures) could be expected to impact the organic matter content of soils and amount of carbon sequestered by these soils. Removal of crop or organic residues may disrupt nutrient cycling, causing a decline in the activity levels of soil biotic communities (micro- to macro- fauna and flora), a decrease soil biodiversity, depletion of soil organic matter (and the soil carbon pool), reduction in water retention, and by leaving the surface of the soil unprotected, it may increase erosion hazard (Lal 2008).

Removal of logging debris, beetle-wood, agricultural crop residues and animal manures should be considered alongside requirements for adequate biomass retention to maintain soil organic matter content, which in turn affects soil productivity and soil ecosystem service provision and carbon stores, if incremental greenhouse gases are not to be released to the atmosphere due to cycling of currently-stored carbon. (See Chapter 3 for a discussion on the importance of soil biotic communities and soil organic matter.)

The BC Bioenergy Strategy does mention making use of 'unused biomass' – that is not required for maintenance of soil health or ecosystem restoration, for bioenergy (BCMEMPR 2008b). BC's big challenge will be maintaining the appropriate balance between retention of biomass for maintaining or building of soil organic matter (and carbon stores) in the forest and agricultural soil ecosystems and removal of any 'excess' for bioenergy production.

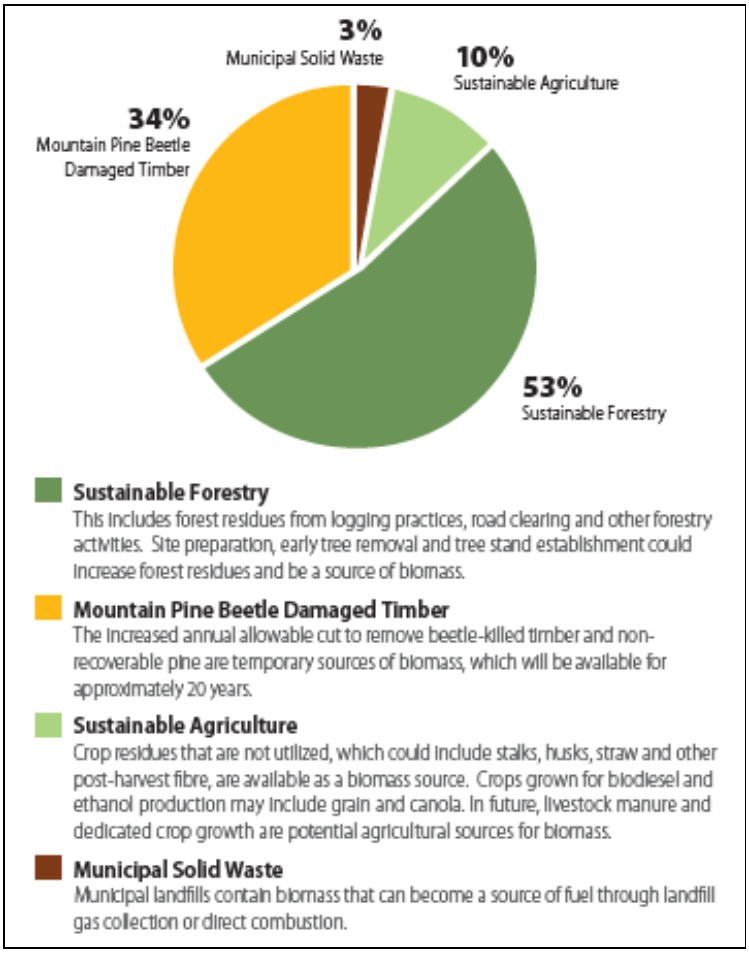

Figure 44 Types of biomass resources in BC (from BCMEMPR 2008b)

Table 18 Volumes of biomass resources potentially available for bioenergy production (from BCMEMPR 2008b)

Sector	Product	Estimated resource
Forestry	Sawmill residues	1.2 million bone-dry tonnes(BDt) currently burned in beehive burners with no energy recovery
Forestry	Woody residues from logging	7 million BDt from the central interior of BC, plus amounts from other regions (no estimates available)
Forestry	Mountain pine beetle killed wood	estimated 400 million – 1 billion BDt of wood not recoverable as merchantable timber
Agriculture	Agriculture crop residues	(no estimate available)
Agriculture	Animal manures	(no estimate available)
Agriculture	Production of feed stocks for biofuels	(no estimate available)
Municipal	Municipal wastes	(no estimate available)

British Columbia's pine forests are currently experiencing an attack by mountain pine beetles (*Dendroctonus ponderosae*) in unprecedented numbers. The mountain pine beetle is a native beetle whose population was in the past kept in check by very cold winters which would kill the eggs, pupae and larvae. Recent winters have been warmer, probably reflecting climate change. The epidemic was worsened by the availability of vast areas of even-aged mature trees due to successful fire suppression over the last 30 years. (The beetle prefers mature pine (>80 years old)). These trees are also further stressed by drier, warmer summers (again, due to climate change), making them more susceptible to attack (BCMoFR 2007c, 2008a). Killed pine forests initially turn red, while the dead pine needles remain on the tree, and then turn grey as these needles drop (see Figure 45 and Figure 46).

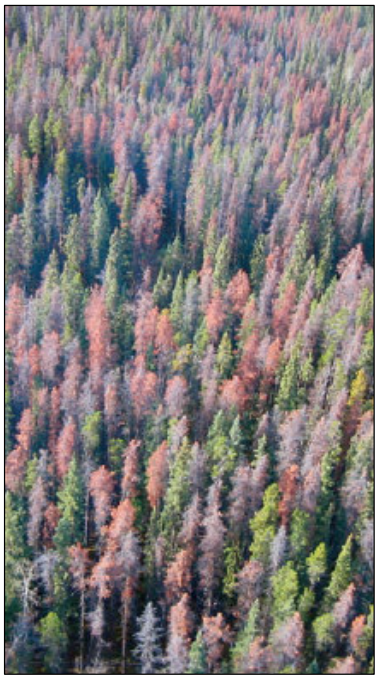

Figure 45 Red and grey beetle-killed pine trees (from BCMoFR 2006a)

Figure 46 Beetle killed forest stands (from Kurz et al 2008

The outbreak of the beetle started in the mid 1990's and has now affected 13.5 million hectares (see Figure 47).

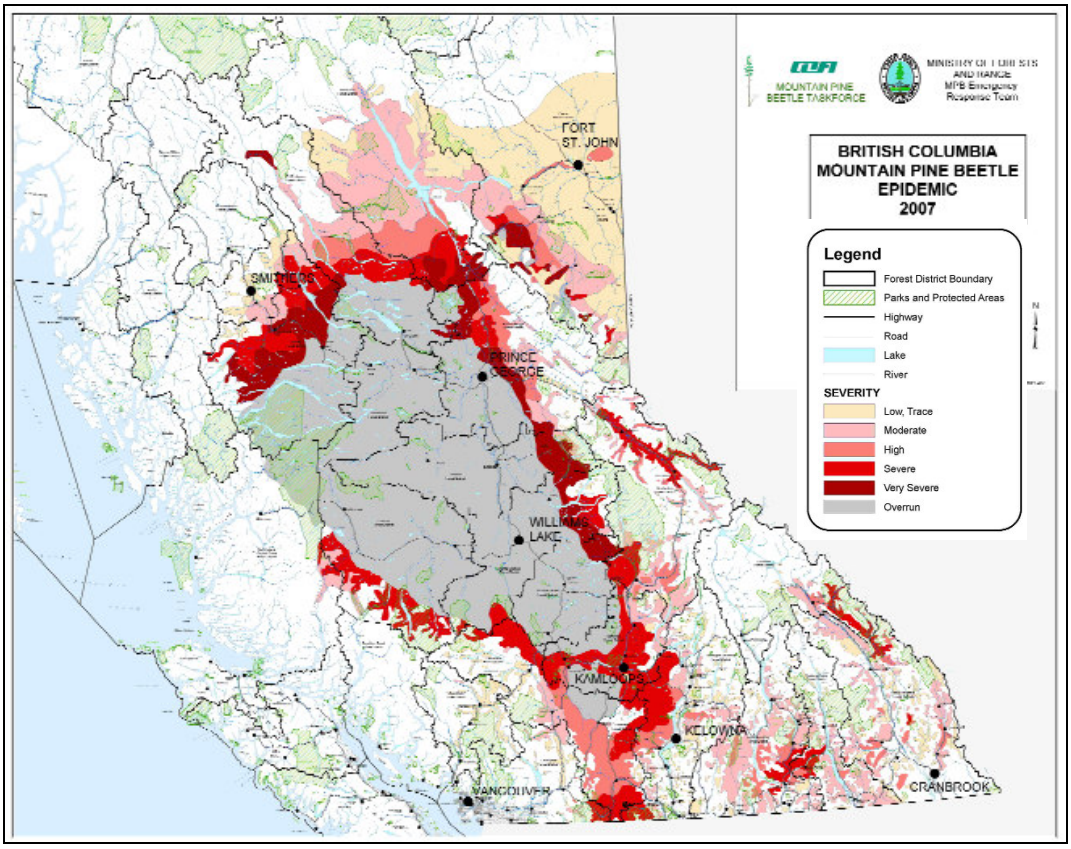

Figure 47 Severity of the Mountain Pine Beetle Attack (from BCMoFR 2007b)

The scale of the epidemic poses risks to hydrologic functioning, biodiversity, wildlife and fisheries.

Though pine dominates many of the forest stands in the BC Interior, the forest area within a watershed would generally not be all pine. Other species are present particularly in riparian zones, other wetter ecosystems, and at higher elevations. See Table 19 for a comparison of the provincial average % pine killed versus % forest killed by slope class. Mountainous or steep areas where a high proportion of the forest has been killed may present a higher erosion hazard.

Table 19 Provincial average percent pine or forest killed by slope class (data from HaBC)

Mountain Pine Beetle Impact	Average % Pine Killed, 1999 to 2006 :	Average % Forest Killed, 1999 to 2006 :
Flat (0 - 3) : Slope Class	57.5	32.3
Moderately Flat (3 - 15) : Slope Class :	53.7	26.2
Moderately Steep (15 - 35) : Slope Class :	42.4	13.6
Steep (35+) : Slope Class :	41.0	8.5

9.2 Scenario 1:

In order to assess the potential impact on soil organic matter (the focus of the Scenario 1 analysis) the environmental system acting on soils in watersheds affected by the mountain pine beetle epidemic, with no logging or other human interventions is modelled. The following relationships are considered and illustrated using the model:

- Even though pine is killed, other trees and vegetation in mixed stands, or where present separately, are assumed to be unaffected
- Dead trees do not evapo-transpire, so soils tend to remain moist for longer periods in killed stands and in some areas, groundwater levels have risen (Uunila et al 2006)
- Dead and fallen trees intercept less snow resulting in deeper snow packs, and these provide less shade resulting in more rapid melting of snow in spring and earlier and higher peak flows, especially following rain-on-snow events. (Boon 2007).
- Watersheds with killed trees have increased annual total and peak flows, and lower minimum flows than intact watersheds (BCMoFR 2007a).
- The increased total and peak flows result in increased flood hazard downstream, potentially putting lives, property and infrastructure at risk.
- The increased runoff increases erosion hazard.
- Dead trees do not provide root exudates or other nutrients to support the soil microbial communities, including mycorrhizae.
- Dead trees loose branches and eventually topple, becoming woody debris (forest litter), and if left in place will break down over time, providing food for soil organisms and contributing to soil organic matter content and carbon stores. (Quantifying the relationship between forest litter volumes and ultimate carbon stores is beyond the scope of this thesis).
- Forest fire behaviour is expected to be more severe in stands of dead trees or in areas with large amounts of woody debris, putting nearby communities at greater risk. (BCMoFR 2007c)
- Depending on the intensity of a wildfire (or prescribed burn) fire will consume some or all forest litter and may destroy soil organic matter and affect soil structure. Erosion hazard can be expected to increase following a fire.
- Soil biota cycle soil organic matter (and soil C which accounts for 72% of soil organic matter). Nutrients are released as C decays due to biotic activity. Accumulation or decline of the carbon stored in the soil is a function of the relative rates of biomass addition versus decay (See Figure 48)

- Increased temperatures and soil disturbance tend to increase biological activity levels, assuming suitable moisture
- If vegetation or other organisms do not take up nutrients released due to organic matter decay, they may be leached from the soil into surface or ground water.

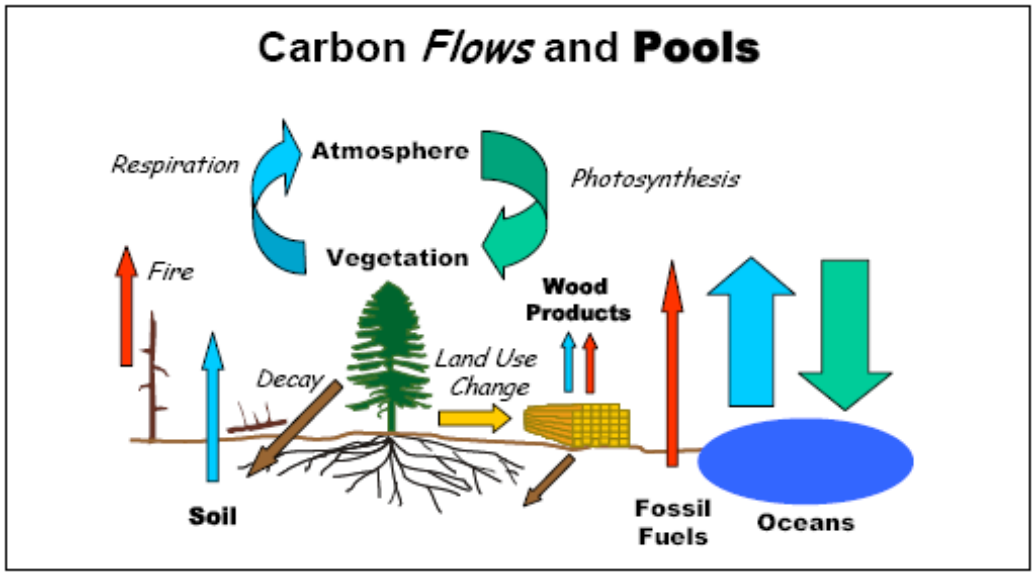

Figure 48 The Carbon Cycle (from BCMoFR 2006b)

The risks to humans from two significant natural hazards increase due to the presence of vast tracts of dead forest. These are wildfire risk and flood risk.

The factors noted above and the relationships between them are illustrated in the e^2DPSIR model in Figure 49.

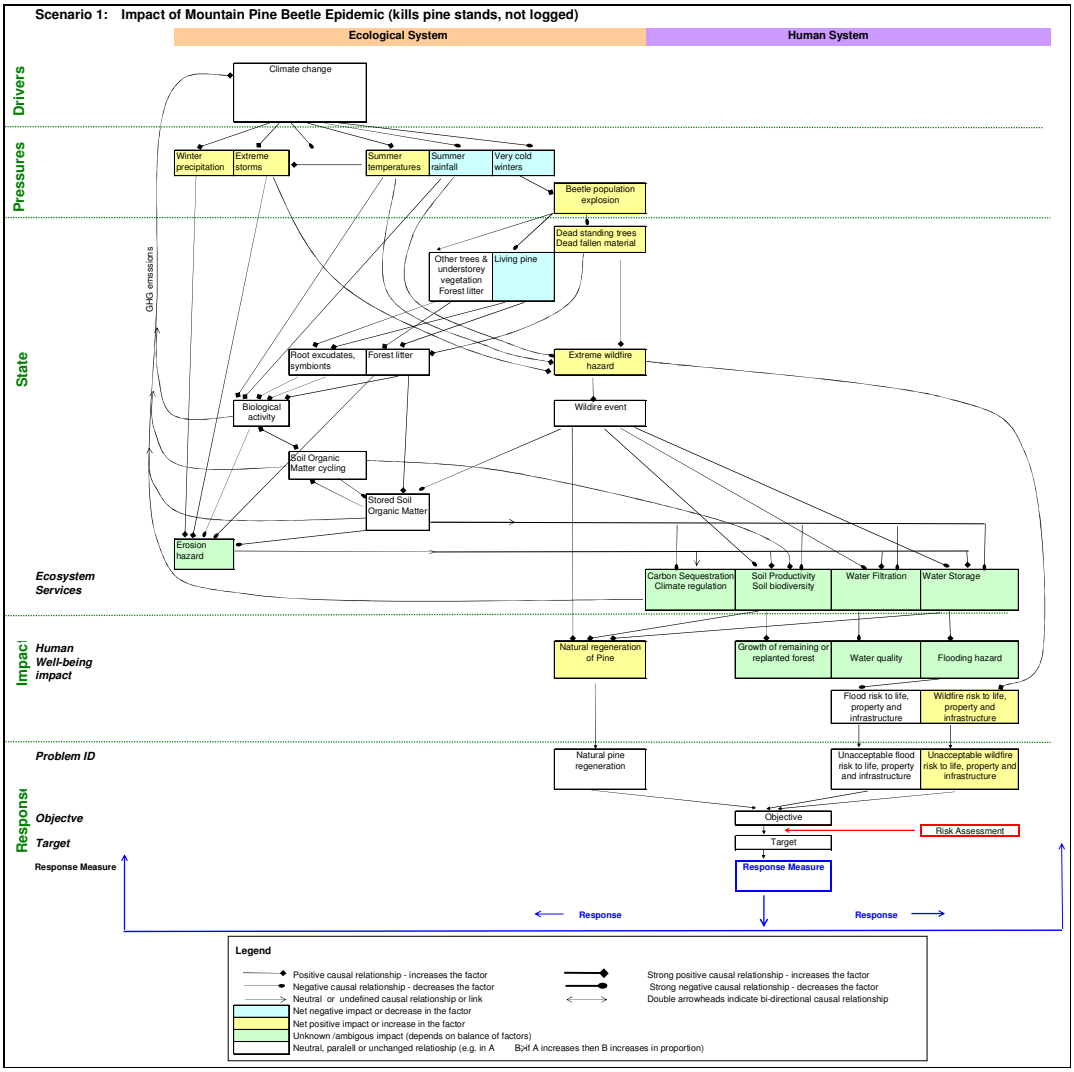

Figure 49 Scenario 1: Applying e2DPSIR to assess the potential impacts on soil organic matter due to the mountain pine beetle epidemic (with no logging)

In this scenario, the majority of the dead beetle-wood can be expected to become forest floor litter, and a significant portion of this will decay releasing CO_2 to the atmosphere, with a small portion becoming soil organic matter, and of this only a very small amount being converted to 'slow' carbon pools and stored in the soil horizon. Kurz et al (2008) estimate that as a result of the pine beetle epidemic, the forests will release an average 17.6 million tonnes of carbon per year (Mt C yr^{-1}) from 2003 to 2020 (totalling 270 Mt C). These same forests were a small carbon sink prior to the beetle epidemic. The estimate includes emissions from decomposition and forest fires (average annual estimate). The model used to generate this estimate is illustrated in Figure 50.

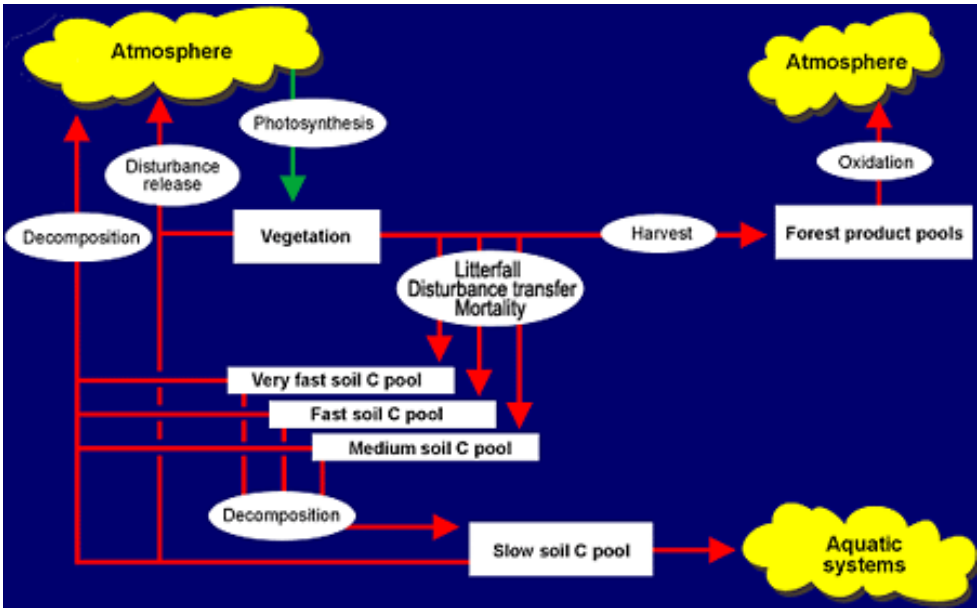

Figure 50 Carbon pools and carbon transfers in the CBM-CFS2 model (from CFS 2006)

Wilson and Hebda (2008) have estimated carbon storage by ecozone (see Figure 51. Refer to Figure 19 (p. 37) for a map of ecozones). The majority of the mountain pine beetle epidemic is concentrated in the Montane Cordillera Ecozone. Based on their estimates, 73% or 236 tC ha^{-1} are stored in the soils within this region.

Ecozone	Area	Carbon density	Total Carbon stored (million tonnes C)		
	million ha	tonnes C/ha	biomass	soil	ecosystem
Taiga Plains	5.8	266	104	1,436	1,540
Boreal Plains	3.1	171	101	429	530
Boreal Cordillera	7.2	256	502	1,329	1,832
Pacific Maritime	10.8	375	1,542	2,504	4,046
Montane Cordillera	31.1	324	2,717	7,340	10,057
Total	**57.9**		**4,966**	**13,040**	**18,005**
Average Carbon (tonnes C/ha)			86	225	311

Figure 51 Estimates of forest carbon storage in BC by Ecozone (from Wilson & Hebda 2008)

9.3 Scenario 2:

The second stage in this modelling integrates the human and socio-economic drivers, and pressures on the land base, forests and soil, and so that the potential impacts and relationships resulting from the current policy proposals (e.g. the BC Bioenergy Strategy, the Mountain Pine Beetle Action Plan) can be evaluated. The environmental system, the human and the socio-economic subsystem are part of this analysis.

Human and socio-political factors considered in this scenario reflect the following objectives from the Mountain Pine Beetle Action Plan and the BC Bioenergy Strategy.

Objectives of the Mountain Pine Beetle Action Plan (BCMoFR 2006a) are:

- Economic sustainability for communities (intermediate and long term)
- Ensure worker and public health and safety
- Maximize the value obtained from dead timber before it decays or burns (in wildfires), while respecting other forest values
- Control or minimize damage from the spread of the pine beetle to other susceptible areas
- Restore the forest resources in impacted areas
- Ensure effective and coordinated mitigation measure planning and implementation.

Objectives of the BC Bioenergy Strategy (BCMEMPR 2008b, BCGovt 2007a) (relating to forest biomass) include:

- Help meet BC's needs for clean renewable energy, offset non-renewable energy resources, and meet BC's target of a 30% reduction in greenhouse gas emissions by 2020 (compared to 2007 levels)
- Utilize waste wood (from logging and sawmill operations (diverting sawmill wastes from beehive burners) for bioenergy
- Maximize the value recovered from 'beetlewood' (mountain pine beetle-killed wood) before it decays and has no (commercial) value
- Help diversify communities, including creating bioenergy opportunities for First Nations
- Advance bioenergy research, and develop, deploy and export BC's clean and alternative fuel technologies

Policy changes and activities on the forest land base arising from the above objectives (which have a potential impact on soil resources) include:

- Accelerated harvest levels above 'annual allowable cut' sustainable forestry levels. (At 2006 harvest rates (of 48 million $m^3 yr^{-1}$) available pine

would be harvested by 2014, though BCMoFR is reported to be planning to slow this rate (BIOCAP & ENVINT 2008).

- Financing of road building and road improvements (for harvest and worker health and safety)

- Preservation of large tracts of (mixed or killed) forest for conservation of other values (biodiversity and habitat, water quality and quantity, visual aesthetics), and preservation of mixed stands for (later) mid-term harvest (BCMEMPR 2008b).

The relationships between these objectives (drivers, pressures) and factors (influences and activities on the land base), and their effects on soils are illustrated in Figure 52. The relationships between the factors are illustrated using different arrowheads for positive, negative and ambiguous or unspecified relationships. The most influential relationships are shown with heavier lines. Where the cumulative effect of incoming influences is believed to be negative (net), the value of the factor declines and the factor box is coloured blue. Where the net effect is believed to be positive (increasing value), the factor box is yellow, and where the net effect is unknown (because influences have not been quantified), the box is green. As this is an illustrative model, the relationships and net effects are not based on rigorous criteria.

The relationships between factors can be uni-directional or bi-directional. As examples, an increase in temperature will increase biological activity, (but not vice versa), and an increase in soil biological activity would generally correspond to an increase in soil organic matter cycling, and vice versa.

In some instances, factors were duplicated within the network diagram in order to minimize the complexity of the mesh of arrows or to demonstrate the influences on or of these factors within both the environmental and human systems.

The model also illustrates the key relationships between human and socio-political factors and environmental factors and their influence on ecosystem services and human well-being, as affected by the response measures identified as strategies in the Mountain Pine Beetle Action Plan and BC Bioenergy Strategy.

To analyse the impacts of adoption of each response measure (individually), one would follow the links or relationships through the network, changing the arrow type and factor box colours to reflect the magnitudes and positive/negative influences and net effects according to the details of the scenario being analysed. Ultimately this allows the analyst to estimate the resultant positive or negative effects on the factor or factors of most concern (whether in the human or environmental system). By altering the types, number or magnitude of the response measures, trade-offs can be understood.

Note that response measures may be directed at factors anywhere in the e^2DPSIR network, for example: at the barriers (e.g. transportation costs), human well-being factors (risk to life), policy initiatives (or activities on the land base). See Figure 52.

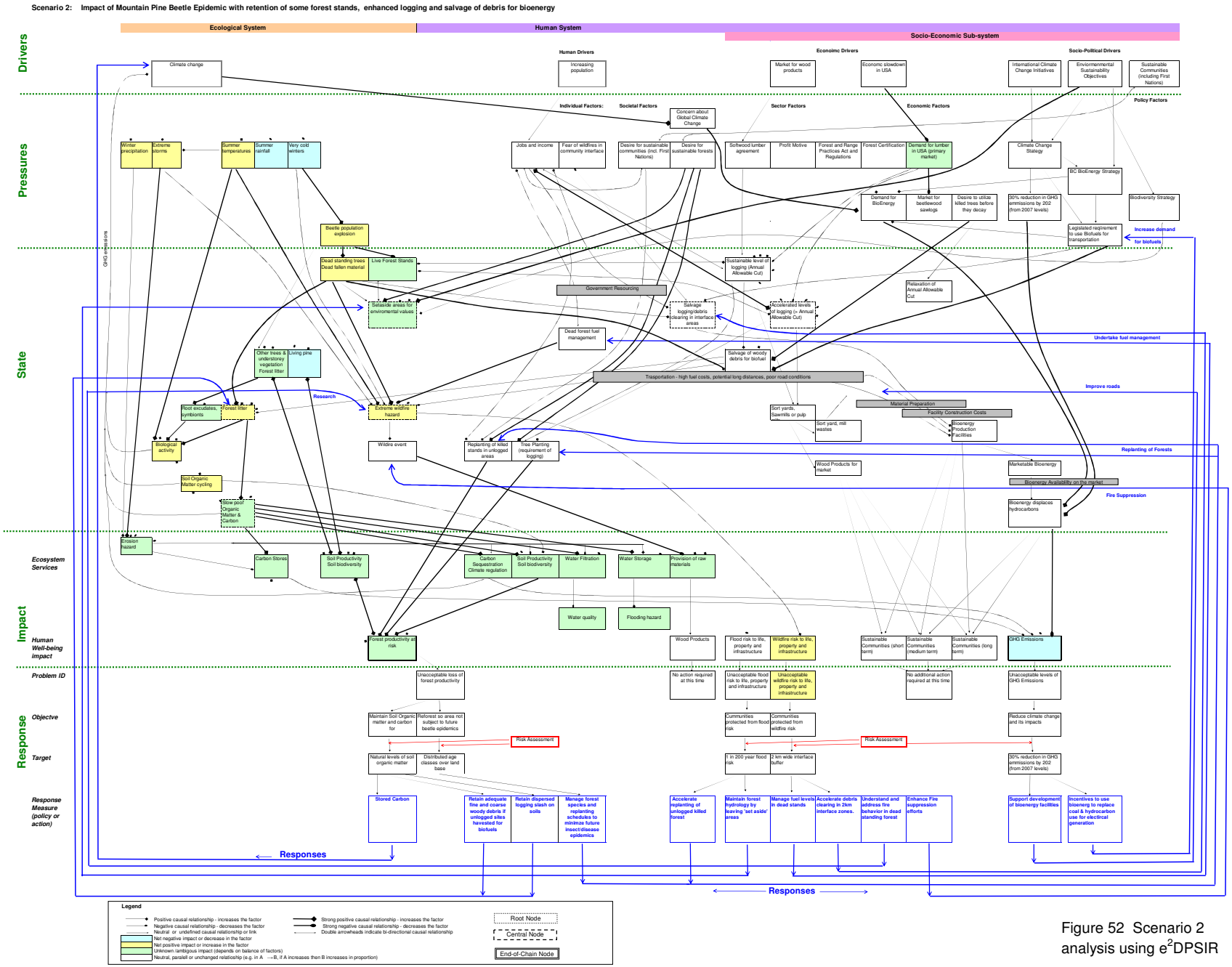

Figure 52 Scenario 2 analysis using e^{2}DPSIR

Back of figure

The Scenario 2 model illustrates the positive and negative effects of climate change on soil organic matter and potential carbon storage including potential human influences. There is insufficient information (in this scenario) on the proportion of dead timber and debris staying on-site versus that being removed for bioenergy, and on the proportion of killed pine forest debris that is subsequently retained as the 'slow pool' carbon to predict whether the ultimate carbon store will increase or decrease.

From a greenhouse gas (GHG) emissions and soil productivity perspective, the key relationships in this scenario are:

- the loss of living trees causing reduction in atmospheric CO_2 cycling for production of new biomass and reduction of organic matter inputs to the soil (exudates, roots, supply of fresh forest litter)

- the volume of wood left to decay on-site (with slow release of CO_2 to the atmosphere with a portion of the wood contributing to maintaining soil organic matter and soil carbon pools)

- the volume of wood removed from the site for bioenergy and 'burned' in the short term (with an associated 'fast' release of CO_2).

The key question is: how much biomass can be removed for bioenergy production while maintaining long-term soil organic matter, carbon stores and soil and forest productivity? A definitive answer cannot be reached without quantifying the relationships.

MacDonald (2006) investigated the cost and availability of mountain pine beetle killed wood and logging debris for biofuel production. Beetle wood has a shelf-life as sawlogs of approximately 5 years after mortality (a reason for the accelerated levels of Annual Allowable Cut seen in Scenario 2), and value as fuelwood for bioenergy for approximately 15 years . The decay rate is a function of biogeoclimatic zone – wood on warmer and wetter sites decays faster than on colder, drier sites.

Dead timber and debris (for bioenergy production) could be of three types:

- dead standing trees (initially sawlogs, then potential fuelwood until commercially worthless)
- road-side residuals - (tops, buts and limbs) left over from conventional harvesting, piled at the sides of access roads or scattered on the ground.
- dispersed residuals (branches, limbs or large woody debris) dispersed over the cutblock following conventional harvesting.

With conventional live-stand harvesting, the roadside residues (in piles) are typically burned (with an immediate release of CO_2), and the scattered debris left to decay (resulting in slow release of CO_2 , with a portion of the biomas potentially contributing to maintaining soil organic matter and stored carbon levels).

These road-side residues and dead standing trees were seen as the primary feedstock for bioenergy production. Recovery of the dispersed residues for biofuel production was determined to be uneconomic. (MacDonald 2006)

If one assumes that levels of dispersed residues left behind during current logging practices are sufficient to maintain the long term soil productivity and soil carbon pools, then use of the other residues for bioenergy should have minimal incremental effect (as compared to conventional past logging practices.) This assumption may however not be true. Also, increasing temperatures will alter nutrient cycling, negating past relationships.

If one assumes no loss to future soil productivity or carbon stores, then the primary impact of utilization of wood and debris for bioenergy is accelerated release of CO_2 the atmosphere caused by its use for bioenergy, compared to a very slow release due to the natural decay process. If this bioenergy offsets hydrocarbon usage, then net GHG effects should be neutral (ignoring material transportation energy costs and fuel efficiency differences).

Figure 52 illustrates just one example of a limited application of the e^2DPSIR model. The same figure could be used for multiple scenario analyses as noted above. If this model were to be used as a communications tool, depending on the audience, simplification to key relationships may be required. .

In this illustrative example, relationships and effects have been assumed. In an analysis for policy-making or another decision-support purpose, additional rigor may be necessary. This rigor may include quantification of relationships where possible, estimation of probabilities, and/or propagation of relationships through the chain based on defined rules. Sensitivity analyses may also be required.

It is hoped that others will find the e^2DPSIR model useful for their particular application.

10 Key Findings and Conclusions

This chapter provides a summary of key findings organized by the main topic areas: 1) DPSIR and e^{2}DPSiR, 2) Summary of the effects of the Mountain Pine Beetle Action Plan and the BC Bioenergy Strategy, 3) BC's soil protection legislative framework and soil threats.

10.1 Key Findings - DPSIR and e^{2}DPSiR

The following observations were made during the application of the e^{2}DPSiR model to Scenario 1 and 2:

- The drawing of the model diagrams was time-consuming and at times frustrating as it seemed that boxes and links needed to be moved around numerous times in order to make space in the figure for new factors and relationships to be added. (This process may be aided by different software tools than those readily available to the author (MSExcel was used)).
- It was useful to conduct the analysis in stages to allow isolation of the environmental system, prior to considering effects of the human system.
- Natural hazards were incorporated in the analysis. (Natural hazards had not been identified as a type of factor in the e^{2}DPSiR template, however, the model is flexible enough to allow new 'themes' to be added as needed.)
- Substitutes for ecosystem services were not of key relevance in the scenarios as the factors of interest were soil organic matter and soil carbon pools and risks to human well-being. If analysing response measures directed at alleviating risk to humans and property related to flooding, then dams or dikes may be substitutes for the ecosystem service of water storage provided by soils in upstream watersheds.
- Addition of the suite of human, societal, sector, economic and socio-political factors and all their relationships and factors resulted in a complex causal network, resulting in a loss of easy comprehension and analysis using the model. (However, it is for the very reason of complexity that a modelling process is needed.) This complexity was required in order to capture all key cause-effect relationships. In a later stage, when evaluating the effects of one response measure, the diagram could be simplified by removing peripheral or minor factors and links.
- To use the model for analysis of the effects of response measures contemplated, the cause-effect relationships would be propagated through the model network for each response measure individually, creating several different versions of the model diagram. The resulting models can then be compared in order to identify trade-offs and the

sensitivity of factors to various effects. This process is potentially time-consuming, and may discourage some users. (Use of network analysis software may be helpful.)

- In propagating cause-effects through the network, the symbology for type of influence (positive, negative, unknown), level of influence (small or large), and net effects on factors was quite useful, providing a visual aid to understanding the overall effects on the factors of most interest.
- Application of more rigorous rules, expert concensus opinion, or probability functions to the cause-effect linkages, and sensitivity analyses would help to formalize the analysis process.
- In order to quantify potential impacts on soil carbon stores in Scenario 2, good quality mass balance data would be required. (This data may be available from the Canadian Forest Service Carbon Budget model (CFS 2006) or from work by Kurz et al 2008).
- The impacts to factors in both the environmental system and the human system could be assessed simultaneously, and trade-offs identified (e.g. balancing forest debris for soil carbon stores vs. biofuel production).
- Different viewpoints or discourse types (of Svasted et al 2008) and stakeholder perspectives could be incorporated into the human system in the e^2DPSIR framework as individual or societal pressures that support actions which positively influence the human well-being factors, while ignoring or negative effecting the environmental factors.
- In many situations the intensity of effect or relative importance of different complimentary or contradictory factors on their downstream factor may not be well understood. These uncertainties could be addressed in a number of ways (for example by use of assumptions or probablilty estimation tools, gathering additional information or conducting new research). The appropriate course of action will depend on the level of influence or significance of this decision on the impact being evaluated, or on the severity of consequences arising from decisions to be made based on the model results. Sensitivity analyses may be advised.
- To utilize a elaborated model as a communications tool (and depending on the audience), the model diagrams may need to be simplified (e.g. by removing the smaller influences or intermediate factors in cause-effect chains.)
- The visual identification of root nodes, central nodes and end-or-chain nodes tended to be subconscious initially, but formally identifying these was useful in providing focal point for potential response measures. This classification could also be useful for identifying factors useful for baseline assessment and future monitoring.

10.2 Conclusions – e^{2}DPSIR

The objectives of this thesis were to evaluate the DPSIR model as a tool for analysing soil protection issues and to apply the model in an illustrative example. These objectives have been met.

The DPSIR framework was evaluated and enhanced, incorporating ideas and aspects of other models and authors.

In the proposed e^{2}DPSIR model, enhancements to DPSIR and its derivative EPP model (Williamo 2005) were intended to address short-comings identified by various authors. The e^{2}DPSIR model was then assessed by applying it to an analysis the potential impacts of two current initiatives in BC on soil organic matter and soil carbon stores.

The addition of the socio-economic subsystem (including economic and socio-political drivers) to the human system addresses the concerns identified by Vacik (2006), Fassio (2005), Carr (2007), Gobin (2004) and Svarsted et al (2008), by allowing the full range of individual, aggregated human, societal, economic and socio-political factors to be incorporated and impacts on both the environmental and human systems to be assessed.

The e^{2}DPSIR is in some aspects, a formalization of many of the concepts presented in the original DPSIR model by Smeets & Weterings (1999), but lost along the way, as others utilized the basic form of their model. Perhaps, this enhanced model with its clearly defined range of factors will act as a useful framework to remind analysts of all the factor types to consider.

The use of directional, weighted arrows (for relationships and links) and colors to indicate net effects on factors, supports the exercise of propagating cause-effect relationships throughout the model network by providing a means of keeping track of the effects. Also, the net effect of the response measure on factors of importance can be made visually clear in the final diagram, making this a useful communications tool.

The addition of more rigor to the qualitative or, where applicable, quantitative cause-effect relationships would help to formalize the analytical process, helping to remove biases of the analyst. Sensitivity analyses may also be useful.

The e^{2}DPSIR maintains the flexibility of the DPSIR model for use in a wide variety of qualitative analyses and scenarios over a range of spatial scales. The framework also supports added rigor and more quantitative assessments (for those components for which data are available).

Testing of the e^{2}DPSIR model was limited to one illustrative (though quite complex) example. Application and critique of this model by other authors on a wider range of scenarios would further test the robustness and usefulness of this model.

10.3 Key findings - Effects of the Mountain Pine Beetle Plan and the BC Bioenergy Strategy

Use of the e^2DPSIR model to assess the potential effects of the Mountain Pine Beetle Plan and BC Bioenergy Strategy on soil organic matter and soil carbon storage and on human well-being, revealed the following:

- The response measures recommended by government in these initiatives are consistent with their outlined objectives, comprehensive and address logical targets.

- The protection of soil and the fate of organic matter and soil carbon, do not, however, appear to have been given any priority in these two initiatives.

- There are important linkages between potential volume and spatial distribution of forest biomass to be removed for bioenergy and potential degradation of soil organic matter pools and soil carbon stores over the intermediate and long term. It was beyond the scope of this thesis to explore these relationships in sufficient depth to quantify what proportion of biomass should be retained to maintain soil carbon stores and soil productivity in the long term.

- Potential longer term degradation of soil carbon pools and soil productivity may occur if the soil organic matter cycling equilibrium is not maintained due to removal of excess amounts of biomass. This soil degradation has implications for sustainable forest productivity.

- As dispersed biomass left on site by current and past harvesting practices is not economic to recover for bioenergy (MacDonald 2008), it is assumed that this level will not change in future with removal of piled biomass for bioenergy. If the current volume dispersed of biomass, plus the prescribed volumes of coarse woody debris (as per FRPA), are sufficient to maintain soil productivity, and these volumes continue to be retained, then bioenergy production should not significantly worsen soil productivity. The assumption that current levels are adequate may not be valid.

- The primary potential environmental impact of using beetle-killed biomass for bioenergy is the acceleration of release of the CO_2 from this material, as compared to its slow release through natural decay. If this bioenergy displaces hydrocarbon fuels, the net change in GHG emmissions should be slightly positive (accounting for emissions from material preparation and transportation, and energy efficiency differeces between biomass and hydrocarbons).

- Utilization of agricultural crop residues and manures for bioenergy will similarly affect soils on agricultural lands. The potential effects of the bioenerygy strategy on soil organic matter and carbon must also be understood, to ensure soil degradation is avoided.

10.4 Conclusions - Potential impacts on soil of the Mountain Pine Beetle Plan and the BC Bioenergy Strategy

Carbon cannot be created or destroyed, only cycled between reservoirs (such as the oceans, atmosphere, biomass, and soils)

Accelerated harvest of mountain pine beetle killed trees and removal of logging debris for bioenergy production results in an accelerated release of stored biomass carbon into the atmosphere as CO_2. However, if this energy displaces hydrocarbon fuels, the net impact on total emissions can be expected to be positive but small (to account for emissions due to material preparation and transportation, and differences in energy efficiency between materials.

Removal of large quantities of biomass for biofuel production must consider potential impacts on soil organic matter, carbon pools, and maintenance of soil productivity to support forest and agricultural productivity.

There is potential longer-term degradation of soil carbon stores, if too much biomass is removed. It would appear that as current levels of dispersed biomass and coarse woody debris will not change (due to economic factors), that soil productivity can be maintained (assuming it is under current practices).

Additional information, possibly including new research, may be required in order to understand the carbon mass balance relationships and potential impacts of beetle-killed biomass removal on soil carbon pools

Failure to maintain the carbon pool in soils in the mountain pine beetle epidemic areas could potentially result in disturbance of the nutrient cycling equilibrium and release of significant quantities of CO_2 over the long term from 'slow' carbon stores. (An estimated 236 tC ha^{-1} are stored in the soil in the region (Wilson & Hebda 2008))

Soil protection and maintenance of soil carbon pools (which are huge reservoirs of carbon) are of vital importance to minimizing incremental GHG emissions in the global climate change challenge.

10.5 Key Findings - Soil protection policy and legislation in BC

The most serious threats to soils in BC have been addressed directly or indirectly through existing legislation, policy or other related initiatives. These related initiatives may include formal programs (e.g. Environmental Farm Planning program), or informal measures such as outreach, education or information services (see Table 20).

Soil (and water) contamination and contaminated sites are addressed by regulations under the Environmental Management Act.

The BC government has defined soil protection objectives on its Crown forest lands (the most extensive land use category in the province) under comprehensive results-based forest management legislation. These objectives seek to minimize the area of land permanently sealed under access roads and related infrastructure, and to minimize disturbance and maintain soil productivity across the remaining forest lands. Tenure holders are responsible for meeting these objectives. A monitoring program is in place to ensure objectives are met and continual improvements can be made where problems are identified.

Approximately 5% of the land base in BC is agricultural, and the vast majority of operations are of small to medium size. Legislation is focussed primarily on preventing removal of lands from the Agricultural Land Reserve, on restricting land use to permitted uses, and on managing soil removal and deposits. Nutrient management (potential soil and water contamination) are addressed under the Environmental Management Act (as noted above). Environmental protection is supported by the Environmental Farm Plan program, and soil protection and good management practises are promoted by the Ministry of Agriculture and Lands through extensive provision of information and outreach.

In urban areas, the majority of the soil related legislation addresses soil removal/deposit, and development permitting in areas subject to flooding, erosion, mud or debris flows, landslides or other natural hazards. Soil sealing is considered by bylaws limiting building footprints to a specified portion of the lot, and the Develop with Care best management practises provide guidance for soil management during development. Increased public awareness of the ecosystem services provided by soil and 'best management' practices for urban horticulture may help protect urban soils from degradation.

Table 20 provides a summary presence/absence and type of mechanism addressing soil threats for all lands or specifically forest, agricultural or urban lands. Where data is available, information on the area of land at risk or affected by the threat is also provided.

Table 20 Summary of soil threats addressed through existing BC legislation or policy

Sector: / Threat:	All Lands	Crown Forest	Private Forest	Agricultural (ALR)	Local Government	Provincial significance
Soil Erosion		Y	Y	P	Y	Approximatly 75% of BC is mountainous, though erosion can also occur on disturbed soils on low slopes.
Erosion (Streams)	Y	Y	Y	P	Y	Any human or livestock caused soil disturbances near or in streams increase the risk of erosion
Soil Contamination	Y					Human activities and atmospheric pollution may cause contamination. Vigilence is required.
Contaminated Sites	Y					There are approximately 8000 contaminated sites in BC, the majority located in or near urban centers, small cities or towns.
Compacton / degradation of soil structure		Y	Y	P		Soil disturbance, (including tillage), and compaction by off-road vehicular traffic could cause degradation. Compacted soils have higher erosion hazard.
Soil disturbance		Y	Y	O		Up to 1.7 million ha of forest soils may have been degraded by logging activities
Organic Matter		Y		Y, O		Soil organic matter is key to soil health and productivity.
Biodiversity		Y		P		Soil organic matter is key to soil biodiversity which is the foundation of all ecosystems.
Land Use Change / Permitted land uses	L	L	L	Y	Y	Changes in land use from forest to agricultural to urban usually result in a loss of soil organic matter, releasing GHGs.
Soil Productivity		Y	Y	O		Maintenance of soil productivity is fundemental for sustaining the environment, forestry agriculture, and communities.
Soil Sealing		Y	Y	Y		Up to 900,000 ha or 1-1.5% of forest lands may have been lost to permanent access roads and related infrastructure
Soil Deposit & Removal	Y	L		Y	Y	No estimates are available regarding volumes of soil removed or deposited in BC.
Flooding	Y				Y	Changes in watershed hydrology in the mountain pine beetle epidemic area may increase flood hazards downstream.
Landslides	Y	Y	Y		Y	Landslide frequency on forest cutblocks, though higher than on undisturbed terrain, has been significantly reduced since the Forest Practices Code came into effect (in 1995). (No information is available post-Forest and Range Practices Act).
Salinization						saline soils) and some risk in the Okanagan region.
Desertification						Potentially some risk in the Okanagan region, particularly with climate change
Wildfire impacts on soils						Approximately 813,000 ha of BC's forests have burned in the last 10 years. One fifth to one thirds of this area may have experiences fire intensity and severity to significantly alter soil properties, making this soil extremely vulnerable to severe erosi
Potential climate change impacts to permafrost soils						Are seeing evidence of melting permafrost causing landslides in northern BC and shorting of winter 'freeze-up'. These are organic soils whose degradation could release significant levels of CO_2.
Conservation of rare soil ecosystems	P?					Rare soil ecosystems are likely to benefit from conservation efforts for rare species and terrestiral ecosystems.

Legend:
Y - addressed in soil protection legislation
L - addressed in other legislation or policy
P - addressed by other mechanisms (e.g. Environmental Farm Planning)
O - addressed through outreach or education

Soil erosion, contamination, compaction are well addressed on the majority of BC's land base. Legislation does consider soil organic matter and biodiversity, however, not extensively. As soil organic matter is a key factor in soil productivity and provision of numerous ecosystem services, and degradation of the soil carbon stores has serious implications for GHG emissions and global climate change. Therefore, explicit mechanisms to protect and maintain soil organic matter levels and a monitoring program are required.

BC's legislation and policies do not specifically address conservation of rare soil ecosystems, however, there are a number of other initiatives in place for preservation or conservation of representative samples of terrestrial ecosystems or rare ecosystems. Approximately 13.4 % of the province has been legally designated as protected area, with an additional 1.2 in the process or announced (BCMoE 2007d). Organizations such as Biodiversity BC (Biodiversity BC 2008a), the Grasslands Conservation Council of British Columbia, and numerous other conservation group and land trusts are also working to conserve other environmentally or socially important areas. No program specifically seeks to identify or conserve rare soils.

Salinisation, desertification, wildfire impacts, potential impacts to permafrost soils, and loss of rare soil ecosystems are not addressed in legislation.

The spatial extent of areas at risk of salinisation and desertification is probably quite small and primarily concentrated in the Okanagan region. It is however, possible that areas at risk may expand due to expansion of intensive agriculture in the Okanagan, increasing demands on limited water resources and climate change.

Wildfire impacts cannot be legislated against. Fuel management strategies may however reduce the frequency and areal extent of intense and severe wildfires, thereby reducing soil structural damage, hydrophobicity, and erosion risk. The Ministry of Forests and Range has developed a risk analysis procedure for identifying areas in burns with high erosion, landslide, debris flow or flood potential which may endanger lives or infrastructure, enabling remedial actions to be taken to protect people and property and remediate damaged soil to reduce the hazard. Other jurisdictions, such as those of the southern Mediterranean which have recently experienced extensive wildfires, may benefit from review of the work completed in BC in identification and mitigation of these wildfire effects, should similar risks exist in these regions.

Climate change (especially the fact that warming is more pronounced in northern latitudes) can be expected to gradually melt BC's sporadic and discontinuous permafrost, potentially triggering landslides. The most significant impact however, is likely to be degradation of the organic soils (cryosols) of north eastern BC, resulting in CO_2 release to the atmosphere. Minimizing trafficking and disturbance may help to slow melting, plus maintaining high and uniform moisture levels may help to slow organic matter degradation by inhibiting biological activity.

10.6 Conclusions – BC Soil Protection Legislation:

BC's soil protection legislation and policies are quite comprehensive and address most of the main threats to soils, utilizing legislation, policy measures or other initiatives consistent with the strategic, economic and operation factors affecting the relevant sector, the size of its land base and its potential impact on the environment. Legislation for soil protection on Forest lands is the most comprehensive.

Legislation peripherally considers soil organic matter but appears insufficiently focussed to protect against organic matter decline in soils. Such decline reduces soil productivity and biodiversity, negatively impacts the ecosystem services provided by soil and releases CO_2 to the atmosphere due to degradation of soil carbon stores. Soils with higher levels of organic matter are most at risk.

Threats such as salinisation and desertification which may potentially affect small land areas (e.g. the Okanagan region) are not currently addressed. Monitoring of soil in areas at risk could help identify any potential problems as they are developing.

No consideration has been given in soil related legislation to identifying and conserving rare soil ecosystems, though some may be unintentionally conserved as a by-product of terrestrial conservation initiatives and activities. Research and mapping would be required to identify potentially rare soils.

Contamination and to a limited extent, erosion of urban soils is addressed. However, given the concentration of BC's population in urban areas and value of ecosystem services provided by soils (and the vegetation it supports) to human well-being, additional soil protection measures would be beneficial.

11 Recommendations:

The British Columbia government should consider implementation of a soil protection framework, similar to the European Thematic Strategy for Soil Protection to:

- Provide an integrating strategic-level framework for soil protection applicable across the whole land base
- Raise soil protection to the same level of importance as air and water protection,
- Raise awareness of the importance of soil and the ecosystem services it provides to support human well-being
- Act as a checklist for policy makers and decision-makers across the public and private sectors, to ensure soil protection issues are included in their viewscape.

The British Columbia government should also consider the following:

- Strengthening legislation or adopting measures to:
    - Protect urban soils from mis-management and minimize sealing
    - Prevent soil organic matter decline
    - Identify and conserve rare soil ecosystems
    - Respond to threats identified through monitoring.
- Implementation of a soil monitoring program to:
    - Monitor the status of soil contaminant levels and soil organic matter levels (paying especial attention to area hit by the mountain pine beetle epidemic for the latter)
    - Monitor soils at risk of salinisation and desertification (primarily in the Okanagan region)
    - Monitor soil erosion levels and landslide frequency in areas with high hazard or high risk to the environmental values or humans
- Continue to support and further enhance research on soil carbon cycling, soil productivity and soil protection issues related to resource activities on the land base and arising from the mountain pine beetle epidemic and climate change.
- Consider a ‘Soil Smart’ or similar initiative that ties in with the themes of LiveSmart, Living Water Smart, BC Air Action Plan and the Climate Action Plan.

The e^2DPSIR model should be made more widely available in order that it can be evaluated by a broad audience for usefulness and usability and its robustness tested further. This model should also be evaluated by BC ministry strategic policy staff as a potential tool, as no theoretical analytical framework appears to be in use across government.

European nations with extensive forest resources should evaluate BC's results based legislative framework for forest management and the extensive research that has been conducted in BC on forest ecology and management, as this work may be support their own legislative or research requirements. (Much of this research is available via http://www.for.gov.bc.ca/ and http://www.forrex.org/).

European and other nations which have recently experienced extensive wildfires should review BC's work on wildfire effects on soil properties and erosion and mass movement risks, and its procedures for assessment of post-wildfire risk to humans and infrastructure.

12 Summary:

The Driver-Pressure-State-Impact- Response (DPSIR) model has been evaluated and an enhanced version developed. This e2DPSIR has been applied to assess the potential impacts of two current BC government initiatives (The Mountain Pine Beetle Action Plan and the BC Bioenergy Strategy) on soil organic matter and soil carbon stores. It is recommended that this model be made widely available to support further application and testing. It is hoped that it will provide a useful and usable framework for analysis of issues which affect both the ecological and human systems.

British Columbia's soil protection legislation and related initiatives were found to be quite comprehensive in giving consideration to the major threats of BC soils. As much of the legislation is resource sector based, it is recommended that the BC government consider implementing an overarching soil protection framework to integrate this legislation, to raise awareness of the importance of soil to human well-being, and to raise soil protection to the same level as air and water protection. It is also recommended that BC implement a soil monitoring program and strengthen a few soil protection measures. These initiatives are especially important given the potential impacts of climate change on ecosystem services provided by soils.

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Appendix 1 Compendium of BC Legislation (extracts) addressing soil protection

Legislation in this compendium is sorted in alphabetic order by name of the Act (firstly) and name of the regulation(secondly).

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Addresses the following:	Administrative issues / Permitted land uses / Sealing
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; purpose is preservation fo agricltural land
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Purposes of the commission
Section Number:	6

Purposes of the commission - 6 The following are the purposes of the commission:

(a) to preserve agricultural land;

(b) to encourage farming on agricultural land in collaboration with other communities of interest;

(c) to encourage local governments, first nations, the government and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws and policies.

Addresses the following:	Adrmistrative issues / Data collection
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; powers for monitoring
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Inspections
Section Number:	49 (1) (2)

49 (1) For the purposes of administering this Act or of ensuring compliance with this Act, the regulations or an order of the commission, a member of the commission or an official may do one or more of the following:

(a) enter any land, other than a dwelling house;

(b) make any surveys, analyses, inspections, examinations or soil tests that are necessary to determine any of the following:

(i) the current use of the land;

(ii) the suitability of the land for farm use;

(iii) the potential impact of proposed changes to the use of the land on land in an agricultural land reserve;

(c) remove soil samples for the purposes of conducting the analyses and tests referred to in paragraph (b);

(d) make any inspection of records, things or activities reasonably related to the purpose of the inspection;

(e) make copies of any records or documents reasonably related to the purpose of the inspection.

(2) A person who hinders, obstructs, impedes or otherwise interferes with a person exercising a power under subsection (1) commits an offence.

Addresses the following:	Definitions
General Intent:	Enabling legislation and mandate for Agricultural Land Commission
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Definitions
Section Number:	1

"soil " includes the entire mantle of unconsolidated material above bedrock other than minerals as defined in the Mineral Tenure Act;

"agricultural land" means land designated as agricultural land under this Act and includes agricultural land under a former Act;

"agricultural land reserve" means agricultural land designated as an agricultural land reserve under this Act and includes an agricultural land reserve under a former Act;

"compost" means a product that is

(a) a stabilized earthy matter having the properties and structure of humus,

(b) beneficial to plant growth when used as a soil amendment,

(c) produced by composting, and

(d) derived only from organic matter ;

"fill" means any material brought on land in an agricultural land reserve other than materials exempted by regulation;

"farm use" means an occupation or use of land for farm purposes, including farming of land, plants and animals and any other similar activity designated as farm use by regulation, and includes a farm operation as defined in the Farm Practices Protection (Right to Farm) Act;

"managed organic matter " means Class A or Class B biosolids or Class B compost as those things are defined in the Organic Matter Recycling Regulation, B.C. Reg. 18/2002;

Addresses the following:	Definitions
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; consideration of 'community issues'
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Dispute resolution on community issues
Section Number:	13 (1) thru (6)

13 (1) In this section, "community issue" means a matter concerning one or more of the following:

(a) an application for a use of agricultural land for a school, hospital, publicly funded institution or public utility, or another purpose prescribed by regulation;

(b) a regional growth strategy under the Local Government Act;

(c) the form and content of the official community plan of a local government;

(d) an agreement under section 26 (1);

(e) the form and content of a first nation government's plan that has the same or similar purposes as an official community plan of a local government.

(2) If a dispute arises on a community issue, the commission and the local government or the first nation government, as applicable, may agree to attempt to resolve the dispute by a method of facilitated dispute resolution.

(3) If an agreement is made under subsection (2), the commission and the local government or the first nation government, as applicable, may appoint a facilitator.

(4) In making a recommendation to resolve a dispute, a facilitator must give weight to the following values in descending order of priority:

(a) agricultural values, including the preservation of agricultural land and the promotion of agriculture;

(b) environmental, economic, social and heritage values, but only if

(i) those values cannot be replaced or relocated to land other than agricultural land, and

(ii) giving weight to those values results in no net loss to the agricultural capabilities of the area.

(5) Each party must pay its own costs under this section.

(6) The provisions of this section do not restrict or limit the provisions of section 2, 3 or 46.

Addresses the following:	Permitted land uses / Soil Deposit & Removal
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; conditions re:removal/placement of soil or fill
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Use of Agricultural Land
Section Number:	20 (4) thru (6)

(4) A person who intends to use agricultural land for a prescribed use that involves soil removal or placement of fill must give notice of that intention to the commission in the prescribed form at least 60 days before engaging in the intended use.

(5) In response to a notice under subsection (4) or if a person engages in a use specified in subsection (4) without giving the required notice, the chief executive officer, by written order, may

(a) if the owner of the land agrees to restrictions on the use, specify terms and conditions for the conduct of that use of the agricultural land, or

(b) order that an application to the commission under subsection (3) is required for permission to engage in the use and may include as a term in the order that the person cease or not engage in the use until the application is determined.

(6) If the chief executive officer does not respond to a notice under subsection (4) within 30 days by making an order under subsection (5), the owner of the land may engage in the intended use.

Deals with the following:	Permitted land uses / Sealing
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; limits to uses on ALR lands
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Rules for use and subdivision of agricultural land reserve
Section Number:	18

18 Unless permitted under this Act,

(a) a local government, a first nation government or an authority, or a board or other agency established by a local government, a first nation government or an authority, or a person or agency that enters into an agreement under the Local Services Act may not

(i) permit non-farm use of agricultural land or permit a building to be erected on the land except for farm use, or

(ii) approve more than one residence on a parcel of land unless the additional residences are necessary for farm use, and

(b) an approving officer under the Land Title Act, the Local Government Act or the Strata Property Act or a person who exercises the powers of an approving officer under any other Act may not approve a subdivision of agricultural land.

Addresses the following:	Permitted land uses / Sealing
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; limits to uses on ALR lands
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Use of Agricultural Land
Section Number:	20 (1),(2)

20 (1) A person must not use agricultural land for a non-farm use unless permitted under this Act. (2) For the purposes of subsection (1), except as provided in the regulations, the removal of soil and the placement of fill are non-farm uses.

Addresses the following:	Permitted land uses / Sealing
General Intent:	Enabling legislation and mandate for Agricultural Land Commission; conditions for subdivision
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 36,
Date:	Assented to May 30, 2002
Applicable Section:	Subdivision of agricultural land reserve
Section Number:	21 (1) (2)

21 (1) A person must not subdivide agricultural land unless permitted under this Act.
(2) An owner of agricultural land may apply to the commission to subdivide agricultural land.

Addresses the following:	Definitions
General Intent:	Conditions for subdivision (urbanization)
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	**Agricultural Land Reserve Use, Subdivision and Procedure Regulation**
	B.C. Reg. 171/2002
	O.C. 571/2002
Details:	[includes amendments up to B.C. Reg. 546/2004, December 31, 2004]
Date:	Deposited July 5, 2002, effective November 1, 2002
Applicable Section:	Definitions
Section Number:	

" soil amendment" means compost, manure, mulches, fertilizer and soil conditioners;

Addresses the following:	Permitted land uses /Soil Deposit & Removal
General Intent:	Permitted uses and conditions for subdivision (urbanization)
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	**Agricultural Land Reserve Use, Subdivision and Procedure Regulation**
	B.C. Reg. 171/2002
	O.C. 571/2002
Details:	[includes amendments up to B.C. Reg. 546/2004, December 31, 2004]
Date:	Deposited July 5, 2002, effective November 1, 2002
Applicable Section:	Part 2 — Permitted Uses - Activities designated as farm use
Section Number:	2

(2) The following activities are designated as farm use for the purposes of the Act and may be regulated but must not be prohibited by any local government bylaw except a bylaw under section 917 of the Local Government Act or, if the activity is undertaken on treaty settlement lands, by a law of the applicable treaty first nation government: (4) Unless permitted under the Water Act or the Waste Management Act, any use specified in subsection (2) includes soil removal or placement of fill necessary for that use as long as it does not

(a) cause danger on or to adjacent land, structures or rights of way, or

(b) foul, obstruct or impede the flow of any waterway.

(5) The removal of soil or placement of fill as part of a use designated in subsection (2) must be considered to be a designated farm use and does not require notification except under section 4.

[am. B.C. Reg. 339/2004, s. 2.]

Addresses the following:	Permitted land uses /Soil Deposit & Removal
General Intent:	Permitted uses and conditions for subdivision (urbanization)
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	**Agricultural Land Reserve Use, Subdivision and Procedure Regulation**
	B.C. Reg. 171/2002
	O.C. 571/2002
Details:	[includes amendments up to B.C. Reg. 546/2004, December 31, 2004]
Date:	Deposited July 5, 2002, effective November 1, 2002
Applicable Section:	Part 2 — Permitted Uses Permitted uses for land in an agricultural land reserve
Section Number:	3 (1) (6)

3 (1) The following land uses are permitted in an agricultural land reserve unless otherwise prohibited by a local government bylaw or, for lands located in an agricultural land reserve that are treaty settlement lands, by a law of the applicable treaty first nation government: (k) aggregate extraction if the total volume of materials removed from the parcel is less than 500 m3, as long as the cultivatable surface layer of soil is salvaged, stored on the parcel and available to reclaim the disturbed area; (6) Unless permitted under the Water Act or the Waste Management Act, any use specified in subsection (1) or (4) includes soil removal or placement of fill necessary for that use as long as the soil removal or placement of fill does not

(a) cause danger on or to adjacent land, structures or rights of way, or

(b) foul, obstruct or impede the flow of any waterway.

[am. B.C. Regs. 339/2004, s. 3; 546/2004, App. s. 1.]

Addresses the following:	Permitted land uses /Soil Deposit & Removal
General Intent:	Permitted uses; and conditions for removal/placement of soil
Applicability:	Agricultural Lands
Name of Act:	**Agricultural Land Commission Act**
Name of Regulation:	**Agricultural Land Reserve Use, Subdivision and Procedure Regulation**
	B.C. Reg. 171/2002
	O.C. 571/2002
Details:	[includes amendments up to B.C. Reg. 546/2004, December 31, 2004]
Date:	Deposited July 5, 2002, effective November 1, 2002
Applicable Section:	Part 3 — Soil Removal and Placement of Fill
Section Number:	5 (1)

Notification requirements for specified non-farm uses 5 (1) The removal of soil and placement of fill are exempt from the requirement to file an application under section 20 of the Act as long as the requirements in subsections (2), (3) and (4) are met and the removal or placement is for one or more of the following uses:

(a) aggregate extraction if the total volume of material removed is more than 500 m3;

(b) peat extraction;

(c) placer works including the exploration, development and production of placer minerals as defined in the Mineral Tenure Act;

(d) the construction, maintenance and operation of a composting facility for the production of managed organic matter.

Addresses the following:	Definitions
General Intent:	Defines basis for forest land valuation
Applicability:	Forest Lands (Private)
Name of Act:	**Assessment Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 20,
Date:	
Applicable Section:	Classification and valuation of forest land
Section Number:	24 (6)

6) The actual value of managed forest land must be determined on the basis of its topography, accessibility, soil quality, parcel size and location.

Addresses the following:	Definitions
General Intent:	Defines basis for agriclutural land valuation using soil capability classifications
Applicability:	Agricultural Lands
Name of Act:	**Assessment Act**
Name of Regulation:	**Land Values for Farm Land Regulation**
	B.C. Reg. 276/84 Assessment Commissioner
Details:	[includes amendments up to B.C. Reg. 290/2006, November 1, 2006], Schedules [am. B.C. Regs. 389/88; 228/91; 364/92; 506/92; 298/93, ss. 2 and 3; 454/94; 469/94; 407/95; 381/96; 323/97; 391/98; 486/2003; 290/2006.]
Date:	Deposited August 30, 1984
Applicable Section:	
Section Number:	1

1 In these schedules,

(a) where the land use indicated is "orchards-vineyards", land is rated by number according to the productivity of the soil type for tree fruits, on a scale of 0-100 with 100 being the highest degree of productivity,

(a.1) where the land use indicated is "aquaculture", land is rated by number according to the production potential of the site for aquaculture, on a scale of 10-50 with 50 being the highest degree of productivity,

(b) where the land use is other than "orchards-vineyards" or "aquaculture", land is rated according to a number appearing in a "land capability" or " soil capability" column, and the numbers 1 to 7 in either of those columns refer respectively to soil capability classes 1 to 7 of the " Soil Capability Classification for Agriculture" contained in The Land Inventory Report No. 2-1965 published by the Department of Forestry, Canada; which soil capability classes may be summarized as follows:

Class 1 — Soils with no significant limitations in use for crops;

Class 2 — Soils with moderate limitations that restrict the range of crops or require moderate conservation practices;

Class 3 — Soils with moderately severe limitations that restrict the range of crops or require special conservation practices;

Class 4 — Soils with severe limitations that restrict the range of crops or require special conservation practices or both;

Class 5 — Soils with very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible;

Class 6 — Soils capable only of producing perennial forage crops, and improvement practices are not feasible;

Class 7 — Soils with no capability for arable culture or permanent pasture,

and the numbers 8 and 0 refer respectively to land comprising the farmstead curtilage; and

(c) the "rate code" or "rating" column is for office use only.

Schedules 1-1 to 27-1 were enacted by B.C. Reg. 486/2003 but are not included in this consolidation. They are published in the British Columbia Gazette, Part II, Volume 46, Number 26, pages 781 to 921.

Note: see also section 10 of B.C. Reg. 799/74 — Assessment Act Regulations

Addresses the following:	Definitions
General Intent:	Defines basis for forest land valuation, including soil quality and classes of slopes
Applicability:	Forest Lands (Private)
Name of Act:	**Assessment Act**
Name of Regulation:	**Managed Forest Land and Cut Timber Values Regulation**
	B.C. Reg. 90/2000
	Assessment Commissioner 1
Details:	[includes amendments up to B.C. Reg. 413/2007, December 21, 2007]
Date:	Deposited March 15, 2000
effective April 1, 2000	
Applicable Section:	Interpretation
Section Number:	1 (2)

(2) The references in Schedule B to

(a) "good", "medium" and "poor", in relation to soil quality, are references to the classification in the "site index equations and curves for the major tree species in British Columbia" — Forest Inventory Report No. 1 of the Ministry of Forests revised September, 1981,

(b) "nonproductive"and "inoperable", in relation to soil quality, mean

(i) for nonproductive, the classification as low site in the report referred to in paragraph (a), and land which is physically incapable of growing commercial tree species, and

(ii) for inoperable, land which is productive of commercial tree species but is of such physical nature as to prevent harvesting by currently accepted methods, and

(c) "class 1", "class 2" and "class 3", in relation to topography of land, mean

(i) for class 1, all land that is generally flat to gently rolling, or has slopes, on average over the whole property, of less than 40%,

(ii) for class 2, all land that has slopes, on average over the whole property, of between 40% and 60%, and

(iii) for class 3, all land that is generally rocky, broken and with severe limitations to logging caused by rock outcrops, and has slopes, on average over the whole property, greater than 60%.

Addresses the following:	Administrative issues / Soil Deposit & Removal
General Intent:	Defines revenue collection provisions for Municipalities re: soil removal/placement
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 26,
Date:	Assented to May 29, 2003
Applicable Section:	Division 2 Part 7 - Municipal Revenue - Fees
Section Number:	195 (1) thru (3)

Fees in relation to soil removal and deposit

195 (1) A council may, by bylaw, do one or both of the following:

(a) impose rates or levels of fees for a permit required under a municipal bylaw for

(i) the removal of soil from, or

(ii) the deposit of soil or other material on

any land in the municipality or in any area of the municipality;

(b) impose rates or levels of fees for the activities referred to in paragraph (a).

(2) Without limiting section 12 (1) [variation authority], fees under subsection (1) may vary according to the quantity of soil removed or the quantity of soil or other material deposited and may be different for different areas of the municipality.

(3) A bylaw under subsection (1) has no effect until it is approved by the minister.

Addresses the following:	Definitions
General Intent:	Defines jurisdiction for roads and underlysing/adjacent soil in municipalities
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 26,
Date:	Assented to May 29, 2003
Applicable Section:	Division 5 — Highways

Ownership and possession of highways

Section Number: 35 (1)

35 (1) Subject to this section,

(a) the soil and freehold of every highway in a municipality is vested in the municipality, and

(b) in the case of a highway in a municipality that is not vested under paragraph (a), the right of possession of the highway is vested in the municipality.

Addresses the following:	Definitions
General Intent:	Definition of Soil
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 26,
Date:	Assented to May 29, 2003
Applicable Section:	Schedule

Definitions and Rules of Interpretation - Definitions

Section Number: 1

"soil " includes sand, gravel, rock and other substances of which land is composed;

Addresses the following:	Definitions
General Intent:	Requires inspection and decision on potentially hazardous lands by 'qualified professional' prior to approval of building permits
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 26, This Act is Current to June 18, 2008.

This Act has "Not in Force" sections. See the Table of Legislative Changes.

Date:	Assented to May 29, 2003
Applicable Section:	Part 3 — Additional Powers and Limits on Powers

Division 4 — Expropriation and Compensation

Requirement for geotechnical report

Section Number: 56 (2), (3)

"qualified professional" means

(a) a professional engineer, or

(b) a professional geoscientist

with experience or training in geotechnical study and geohazard assessments.

(2) If

(a) a bylaw regulating the construction of buildings or other structures is in effect, and

(b) a building inspector considers that construction would be on land that is subject to or is likely to be subject to flooding, mud flows, debris flows, debris torrents, erosion , land slip, rockfalls, subsidence or avalanche,

the building inspector may require the owner of land to provide the building inspector with a report certified by a qualified professional that the land may be used safely for the use intended.

(3) If a qualified professional determines that the land may not be used safely for the use intended, a building inspector must not issue a building permit.

Addresses the following:	Erosion (streams)
General Intent:	Allows a municipality to expropriate lands in order to address erosion issues along waterways or the ocean
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 26, This Act is Current to June 18, 2008.

This Act has "Not in Force" sections. See the Table of Legislative Changes.

Date:	Assented to May 29, 2003
Applicable Section:	Part 3 — Additional Powers and Limits on Powers

Division 4 — Expropriation and Compensation

Appropriation of stream channel or bed without compensation

Section Number: 34 (1)

Appropriation of stream channel or bed without compensation

34 (1) A council may appropriate the land constituting the channel or bed of a stream that passes through the municipality, without compensation to the owner, for the purpose of constructing one or more of the following:

(a) dikes;

(b) works to maintain the proper flow of water in a stream, ditch, drain or sewer in the municipality;

(c) works to reclaim or to protect part of the land mass of the municipality from erosion by action of the sea or a stream or by any other cause;

(d) works to protect all or part of the banks of the stream from erosion or damage;

(e) works to make a watercourse part of the municipal drainage system, whether the watercourse is on municipal land, private land or a highway;

(f) works through, under or over land adjoining a highway to protect the highway from damage by water.

Addresses the following: Erosion (streams)

General Intent: Allows a municipality to expropriate lands in order to address erosion issues along waterways or the ocean

Applicability: Lands under Local Government Jurisdiction

Name of Act: **Community Charter**

Name of Regulation:

Details: [SBC 2003] CHAPTER 26, This Act is Current to June 18, 2008.

This Act has "Not in Force" sections. See the Table of Legislative Changes.

Date:

Applicable Section: Part 3 — Additional Powers and Limits on Powers

Division 11 — Other Powers

Specific authority in relation to drainage, sewage and dikes

Section Number: 69

Specific authority in relation to drainage, sewage and dikes

69 A council may, by bylaw, do one or more of the following:

(a) in relation to drainage and sewerage works provided by persons other than the municipality,

(i) regulate their design and installation, and

(ii) require property owners to connect their buildings and structures to the works in the manner specified in the bylaw;

(b) impose requirements on persons undertaking the construction of works to

(i) maintain the proper flow of water in a stream, ditch, drain or sewer in the municipality, or

(ii) reclaim or protect part of the land mass of the municipality from erosion by any cause;

(c) impose requirements on the owners of dikes or persons undertaking the construction of dikes;

(d) make a watercourse part of the municipal drainage system, whether the watercourse is on municipal land, private land or a highway.

Addresses the following:	Administrative issues / Soil Deposit & Removal
General Intent:	Defines Provincial Agencies responsible for various bylaws related to soil removal or deposit
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Community Charter**
Name of Regulation:	**Responsible Minister Regulation**
	B.C. Reg. 330/2003
	O.C. 861/2003
Details:	,
Date:	Deposited September 5, 2003 effective on the coming into force of sections 8, 9 and 282 of the Community Charter

Applicable Section:

Section Number:

Responsible Minister -
- Matter

Minister of Community, Aboriginal and Women's Services
-Bylaws under section 8 (3) (l) [buildings and other structures] of the Act that establish standards that may be dealt with under the Provincial building regulations

Minister of Energy and Mines
-Bylaws under section 8 (3) (m) [removal and deposit of soil and other material] of the Act that prohibit soil removal

Minister of Health Services
-Bylaws under section 8 (3) (i) [public health] of the Act

Minister of Water, Land and Air Protection
- Bylaws under section 8 (3) (j) [protection of the natural environment] of the Act
-Bylaws under section 8 (3) (k) [animals] of the Act in relation to wildlife
-Bylaws under section 8 (3) (m) [removal and deposit of soil and other material] of the Act that prohibit the deposit of soil or other material by reference to the quality of the soil or material or to contamination

[Provisions of the Community Charter, S.B.C. 2003, c. 26, relevant to the enactment of this regulation: section 282 (2) (b)]

Addresses the following:	Definitions
General Intent:	Defines ecosystem to include the soil
Applicability:	Ecological Reserves
Name of Act:	**Ecological Reserve Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 103,
Date:	This Act is current to June 11, 2008
Applicable Section:	Definitions
Section Number:	1

"ecosystem" means a complete system composed of human beings, other animals and plants in a defined area, and with the soil and climate comprising their habitat in that area;

Addresses the following:	Adrmistrative issues / Data collection
General Intent:	Identifies allowable uses/activities in an Ecological Reserve
Applicability:	Ecological Reserves
Name of Act:	**Ecological Reserve Act**
Name of Regulation:	**Ecological Reserve Regulations**
	B.C. Reg. 335/75
	O.C. 1456/75
Details:	,
Date:	Filed April 28, 1975
Applicable Section:	Conditons of permit
Section Number:	3

Conditions of permit

3 The administrator of ecological reserves may, by permit, authorize the use of an ecological reserve for research or educational purposes. The administrator shall include in each permit issued under this section conditions that, in his opinion, are adequate to protect the reserve and any ongoing research from disruption; provided however that minimally disruptive procedures, such as collection of some plant and animal specimens, soil samples, and the like, may be specifically permitted.

Addresses the following:	Administrative issues / Erosion / Erosion (streams)
General Intent:	Supports remediation of erosion control structures on waterbody banks, and topsoils losses on agricultural fields following an environmental emergency (e.g. flood), by authorizing repayment of remediation expenses
Applicability:	All lands
Name of Act:	**Emergency Program Act**
Name of Regulation:	**Compensation and Disaster Financial Assistance Regulation** **B.C. Reg. 124/95** **O.C. 310/95**
Details:	[includes amendments up to B. C. Reg. 201/2006, July 13, 2006]
Date:	Deposited March 31, 1995
Applicable Section:	Schedules 1, 2, 3, 4, & 5 - for types of eligible expenses
Section Number:	Schedule 1, 2, 3, 4, 5 - items 1

Schedules for "eligible personal expenses", "eligible small business expenses", "eligible farm operation expenses", "eligible charitable or volunteer expenses", and "eligible local government body expenses" :

1 For the purposes of section 10 (1) (b) "eligible small business expenses" means eligible costs incurred or required for

(a) structural repair to or replacement of eligible business structures including

(i) foundations, footings, seals, slab floors, pilings, structural walls and attached garages,

(ii) framing, roofing, doors, windows, materials, wall coverings, mouldings, fixtures and finishings,

(iii) filling and levelling to restore essential access,

(iv) parking areas, pumps, services and connections and space and water heating equipment,

(v) retaining walls that form part of an eligible business structure or that are essential to sustain land that is immediately adjacent to and critical to an eligible business structure, and

(vi) existing protective works designed to protect banks from erosion ,

Addresses the following:	Administrative issues / Erosion / Flooding / Landslides
General Intent:	Defines minister responsible for taking the lead role due to environmental emergencies
Applicability:	All lands
Name of Act:	**Emergency Program Act**
Name of Regulation:	**Emergency Program Management Regulation**
	B.C. Reg. 477/94
	O.C. 1498/94
Details:	[includes amendments up to B.C. Reg. 200/98]
Date:	Deposited December 16, 1994
Applicable Section:	Schedule 1 Ministers Responsible for Coordinating Government Response to Specified Hazards
Section Number:	Schedule 1

Key Ministers Responsible by hazard:

HAZARD GROUPS - HAZARD - KEY MINISTERS

Geological - • debris avalanches and debris flows - Environment, Lands and Parks

- • landslides:
  - — highways - Transportation and Highways
  - — other - Attorney General

Hydrologic - • erosion and accretion - Environment, Lands and Parks

• flooding - Transportation and Highways

Addresses the following:	Contamination
General Intent:	Define conditions for waste disposal
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 2 — Prohibitions and Authorizations Waste disposal
Section Number:	6 (2) and (5) (5 continued in next column)

6 (1) For the purposes of this section, "the conduct of a prescribed industry, trade or business" includes the operation by any person of facilities or vehicles for the collection, storage, treatment, handling, transportation, discharge, destruction or other disposal of waste in relation to the prescribed industry, trade or business.

(2) Subject to subsection (5), a person must not introduce or cause or allow waste to be introduced into the environment in the course of conducting a prescribed industry, trade or business.

(5) Nothing in this section or in a regulation made under subsection (2) or (3) prohibits any of the following:

(a) the disposition of waste in compliance with this Act and with all of the following that are required or apply in respect of the disposition:

(i) a valid and subsisting permit;

(ii) a valid and subsisting approval;

(iii) a valid and subsisting order;

(iv) a regulation;

(v) a waste management plan approved by the minister;

(b) the discharge into the air of an air contaminant from an incinerator operated under an authority, licence or permit of a municipality;

(c) the disposition of human remains in crematoria in compliance with the Cremation, Interment and Funeral Services Act;

(d) the discharge of air contaminants authorized by a bylaw made under section 31 (3) (d) [control of air contaminants in Greater Vancouver];

(e) the burning of leaves, foliage, weeds, crops or stubble for domestic or agricultural purposes or in compliance with the Weed Control Act;

(f) the use of pesticides or biocides for agricultural, domestic or forestry purposes in compliance with the Integrated Pest Management Act, the Pest Control Products Act (Canada) and any other Act and regulation governing their use;

(g) fires set or controlled by a person

(i) acting under an order of a local assistant, as defined in the Fire Services Act, if the local assistant orders the fires for training purposes,

(ii) carrying out fire control under section 9 of the Wildfire Act, or

(iii) if the fires are resource management open fires under the Wildfire Act and are lit, fuelled or used in accordance with that Act and the regulations under that Act;

Addresses the following:	Contamination
General Intent:	Specifies conditions for movement of contaminated soil
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Division 4 — Implementation of Remediation Contaminated soil relocation
Section Number:	55 (1) (2)

55 (1) Subject to subsection (5), a person must not relocate contaminated soil from a contaminated site unless

(a) the person enters into a contaminated soil relocation agreement, and

(b) complies with terms and conditions of the contaminated soil relocation agreement.

(2) If, in the opinion of a director, after giving consideration to

(a) the suitability of the receiving site,

(b) the quality of the contaminated soil to be relocated, and

(c) the existing and future uses of the receiving site,

the relocation of the contaminated soil will not cause a significant potential for adverse effects on human health or for pollution of the environment, the director may enter into a contaminated soil relocation agreement with

(d) the owner or operator of the site proposed to receive contaminated soil , and

(e) a responsible person for the contaminated site from which the contaminated soil is proposed to be removed.

(3) The contaminated soil relocation agreement must provide that prescribed standards and procedures apply in respect of the relocation and deposit and that

(a) the quality of the soil at the receiving site is suitable for the use intended based on prescribed standards, or

(b) the conditions at the receiving site are suitable for the use intended as documented by a risk assessment conducted in accordance with the regulations and to the satisfaction of the director.

(4) A director may require, as a condition of entering into a contaminated soil relocation agreement, that the person requesting the agreement provide

(a) information pertaining to the source site, the receiving site and the quantity and quality of material being relocated, and any other prescribed information, and

(b) security, which may include real and personal property, in the amount and form and subject to conditions the director specifies.

(5) Nothing in this Part prevents a person from depositing soil from a contaminated site at another site if the deposit is authorized by

(a) a valid and subsisting permit or approval,

(b) an order,

(c) a waste management plan approved by the minister, and its associated operational certificate, or

(d) the regulations.

(6) A municipality, including its employees or elected officials, does not incur any liability and must not be considered a responsible person under this Act as a result of any bylaw, permit, licence, approval or other document adopted or issued under the Community Charter, the Islands Trust Act, the Local Government Act or the Vancouver Charter that authorizes the removal or deposit of contaminated soil in the municipality.

(7) Despite section 37 (5) [conflicts between this Act and bylaws, permits, etc. issued by a municipality], subsection (6) of this section does not apply if

(a) a bylaw of a municipality, or

(b) a permit, licence, approval or other document issued under the authority of a municipal bylaw

establishes standards or procedures for testing, excavating, storing, removing, relocating or depositing contaminated soil that conflict with this Act, the regulations, a permit, approval, order, contaminated soil relocation agreement or an approved waste management plan.

(8) Subsection (6) does not give immunity to any municipality from obligations the municipality may have under this Act with respect to

(a) a contaminated site owned by the municipality,

(b) contaminated soil that originated from property owned by the municipality, or

(c) activities of the municipality, other than regulatory activities, that caused or contributed to property becoming a contaminated site.

(9) If a director enters into a contaminated soil relocation agreement, the director must provide notice of the agreement to the municipality from which the soil is removed and to the municipality in which the receiving site is located.

Addresses the following:	Contamination
General Intent:	Specified conditions for transfer of tenures
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 5 — Remediation of Mineral Exploration Sites and Mines - Definitions and interpretation
Section Number:	65 (1) In this Part:

"transfer agreement" means a written agreement between the Chief Inspector of Mines under the Mines Act and a director under this Act regarding the transfer of a Mines Act permit.

(2) This Part does not restrict the powers of a director to issue and enforce a permit or approval for a discharge to air, land or water associated with an advanced exploration site or producing or past producing mine site.

(3) This Part does not apply to exploration, mine development or the production of placer minerals, marl, earth, soil , peat, sand, gravel, dimension stone, rock or any natural substance that is used for a construction purpose on land.

(4) If there is a conflict between anything in Part 4 [Contaminated Site Remediation] or sections 81 [pollution prevention orders] and 83 [pollution abatement orders] that are otherwise provided for in this Part, the provisions of this Part prevail.

(5) Despite sections 66 (5) [exploration sites], 67 (4) [advanced exploration sites] and 68 (4) [producing or past producing mine sites], a person who requests a director to issue an approval in principle or a certificate of compliance under section 53 [approvals in principle and certificates of compliance] or to provide any other services in relation to a contaminated site must pay the fees prescribed in the regulations for those services.

Addresses the following:	Contamination
General Intent:	Define conditions for waste disposal
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 2 — Prohibitions and Authorizations Waste disposal
Section Number:	6 (5) (continued from previous page)

(h) emissions from steam powered or internal combustion engines in compliance, if applicable, with the Motor Vehicle Act and regulations;

(i) emission into the air of soil particles or grit in the course of agriculture or horticulture;

(j) the disposal of waste by a person other than a municipality

(i) by means of a system of waste disposal lawfully operated by a municipality or other public authority, and

(ii) in compliance with the rules and regulations that apply to that system;

(k) emission of an air contaminant from combustion of wood or fossil fuels used solely for the purpose of comfort heating of domestic, institutional or commercial buildings;

(l) emission of an air contaminant from food preparation in

(i) residential premises, or

(ii) retail food outlets;

(m) an owner, agent or manager, as those terms are defined in the Mines Act, from carrying out an activity related to mineral and coal exploration if that activity is exempted under section 10 (2.1) of that Act.

(6) Nothing in subsection (5) (b) or (k) authorizes the use of an incinerator or domestic, institutional or commercial heating equipment for the purpose of destroying hazardous waste by means of combustion.

Addresses the following:	Contamination
General Intent:	Defines responsibility for previous contanimation of mineral exploration/development sites
Applicability:	Mineral tenures/past mineral tenures
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 5 — Remediation of Mineral Exploration Sites and Mines
Section Number:	66 thru 69

Exploration sites

66 (1) Despite section 45 [persons responsible for remediation of contaminated sites], the following persons who carried out mineral or coal exploration activities at an exploration site are not responsible for remediation of the site:

(a) a previous owner or operator;

(b) a current owner or operator who holds a valid and subsisting bond for the exploration site under the Mines Act.

(2) A director may not issue a remediation order under section 48 [remediation orders] to a current or previous owner or operator of an exploration site.

(3) A director may not issue a pollution prevention order under section 81 [pollution prevention orders] or a pollution abatement order under section 83 [pollution abatement orders] to a previous owner or operator of an exploration site in respect of the exploration site.

(4) A director may not require or accept security under this Act for remediation of an exploration site.

(5) Fees prescribed under this Act for the purposes of Part 4 [Contaminated Site Remediation] in relation to an exploration site are payable only with respect to the remediation of spills of substances.

Similar applies also to: Advanced exploration sites 67, Producing or past producing mine sites 68, Historic mine sites 69

Addresses the following:	Contamination / Soil Deposit & Removal
General Intent:	Set conditions for contaminated soil relocation
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53
Date:	Assented to October 23, 2003. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Division 4 — Implementation of Remediation Contaminated soil relocation
Section Number:	55 (1) thru (5) (continued in next column)

55 (1) Subject to subsection (5), a person must not relocate contaminated soil from a contaminated site unless

(a) the person enters into a contaminated soil relocation agreement, and

(b) complies with terms and conditions of the contaminated soil relocation agreement.

(2) If, in the opinion of a director, after giving consideration to

(a) the suitability of the receiving site,

(b) the quality of the contaminated soil to be relocated, and

(c) the existing and future uses of the receiving site,

the relocation of the contaminated soil will not cause a significant potential for adverse effects on human health or for pollution of the environment, the director may enter into a contaminated soil relocation agreement with

(d) the owner or operator of the site proposed to receive contaminated soil , and

(e) a responsible person for the contaminated site from which the contaminated soil is proposed to be removed.

(3) The contaminated soil relocation agreement must provide that prescribed standards and procedures apply in respect of the relocation and deposit and that

(a) the quality of the soil at the receiving site is suitable for the use intended based on prescribed standards, or

(b) the conditions at the receiving site are suitable for the use intended as documented by a risk assessment conducted in accordance with the regulations and to the satisfaction of the director.

(4) A director may require, as a condition of entering into a contaminated soil relocation agreement, that the person requesting the agreement provide

(a) information pertaining to the source site, the receiving site and the quantity and quality of material being relocated, and any other prescribed information, and

(b) security, which may include real and personal property, in the amount and form and subject to conditions the director specifies.

(5) Nothing in this Part prevents a person from depositing soil from a contaminated site at another site if the deposit is authorized by

(a) a valid and subsisting permit or approval,

(b) an order,

(c) a waste management plan approved by the minister, and its associated operational certificate, or

(d) the regulations.

Addresses the following:	Contamination / Soil Deposit & Removal
General Intent:	Set conditions for contaminated soil relocation
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53
Date:	Assented to October 23, 2003. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Division 4 — Implementation of Remediation Contaminated soil relocation
Section Number:	55 (6) thru (9) (continued from previous page)

(6) A municipality, including its employees or elected officials, does not incur any liability and must not be considered a responsible person under this Act as a result of any bylaw, permit, licence, approval or other document adopted or issued under the Community Charter, the Islands Trust Act, the Local Government Act or the Vancouver Charter that authorizes the removal or deposit of contaminated soil in the municipality.

(7) Despite section 37 (5) [conflicts between this Act and bylaws, permits, etc. issued by a municipality], subsection (6) of this section does not apply if

(a) a bylaw of a municipality, or

(b) a permit, licence, approval or other document issued under the authority of a municipal bylaw

establishes standards or procedures for testing, excavating, storing, removing, relocating or depositing contaminated soil that conflict with this Act, the regulations, a permit, approval, order, contaminated soil relocation agreement or an approved waste management plan.

(8) Subsection (6) does not give immunity to any municipality from obligations the municipality may have under this Act with respect to

(a) a contaminated site owned by the municipality,

(b) contaminated soil that originated from property owned by the municipality, or

(c) activities of the municipality, other than regulatory activities, that caused or contributed to property becoming a contaminated site.

(9) If a director enters into a contaminated soil relocation agreement, the director must provide notice of the agreement to the municipality from which the soil is removed and to the municipality in which the receiving site is located.

Addresses the following:	Definitions
General Intent:	Specifies conditions for movement of contaminated soil
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 4 — Contaminated Site Remediation - Division 1 — Interpretation - Definitions and interpretation
Section Number:	39 (1)

(h) emissions from steam powered or internal combustion engines in compliance, if applicable, with the Motor Vehicle Act and regulations;

(i) emission into the air of soil particles or grit in the course of agriculture or horticulture;

(j) the disposal of waste by a person other than a municipality

(i) by means of a system of waste disposal lawfully operated by a municipality or other public authority, and

(ii) in compliance with the rules and regulations that apply to that system;

(k) emission of an air contaminant from combustion of wood or fossil fuels used solely for the purpose of comfort heating of domestic, institutional or commercial buildings;

(l) emission of an air contaminant from food preparation in

(i) residential premises, or

(ii) retail food outlets;

(m) an owner, agent or manager, as those terms are defined in the Mines Act, from carrying out an activity related to mineral and coal exploration if that activity is exempted under section 10 (2.1) of that Act.

(6) Nothing in subsection (5) (b) or (k) authorizes the use of an incinerator or domestic, institutional or commercial heating equipment for the purpose of destroying hazardous waste by means of combustion.

Addresses the following:	Definitions
General Intent:	Define conditions for waste disposal
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 53,
Date:	This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 1 — Introductory Provisions Defiitions
Section Number:	1 (1)

"remediation" means action to eliminate, limit, correct, counteract, mitigate or remove any contaminant or the adverse effects on the environment or human health of any contaminant, and includes, but is not limited to, the following:

(a) preliminary site investigations, detailed site investigations, analysis and interpretation, including tests, sampling, surveys, data evaluation, risk assessment and environmental impact assessment;

(b) evaluation of alternative methods of remediation;

(c) preparation of a remediation plan, including a plan for any consequential or associated removal of soil or soil relocation from the site;

(d) implementation of a remediation plan;

(e) monitoring, verification and confirmation of whether the remediation complies with the remediation plan, applicable standards and requirements imposed by a director;

(f) other activities prescribed by the minister;

Addresses the following:	Erosion (streams)
General Intent:	Prevent erosion of streams and impairment of ecological function
Applicability:	Petroluem & Natural Gas Tenures (Coal Bed Methane)
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations** **B.C. Reg. 156/2005** **M74/2005**
Details:	
Date:	Deposited March 21, 2005, effective July 1, 2005
Applicable Section:	Part 2 — Discharge of Produced Water - Discharge of produced water into perrenial or seasonal streams
Section Number:	4 (1) thru (3), 5 (1) thru (3)

Discharge of produced water into perennial streams

4 (1) Produced water may be discharged into a perennial stream only if

(a) the flow of the perennial stream directly upstream from the point of discharge is sufficient, at all times, to provide a minimum of 10:1 dilution for the total produced water discharged by the discharger into that perennial stream, and

(b) the requirements of this code and the standards specified in Schedule 1 are met.

(2) Produced water may not be discharged into a perennial stream in a manner or quantity that impairs the proper ecological function of the perennial stream or otherwise causes excessive erosion .

(3) A discharger must ensure that a discharge of produced water into a perennial stream is treated, if necessary, to remove iron and manganese precipitates so that discoloration in the perennial stream is minimized.

Discharge of produced water into seasonal streams

5 (1) Produced water may be discharged into a seasonal stream only if

(a) the seasonal stream, when flowing, flows directly into a perennial stream,

(b) the flow of the perennial stream at its confluence with the seasonal stream is sufficient at all times to provide a 10:1 dilution of all the produced water discharged to the seasonal stream, and

(c) the requirements of this code and the standards specified in Schedule 2 are met.

(2) Produced water may not be discharged into a seasonal stream in a manner or quantity that impairs the proper ecological function or otherwise causes excessive erosion of

(a) the seasonal stream, or

(b) the perennial stream into which the discharge of produced water is or will be conveyed.

(3) A discharger must ensure that a discharge of produced water into a seasonal stream is treated, if necessary, to remove iron and manganese precipitates so that discoloration in the seasonal stream is minimized.

Addresses the following:	Definitions
General Intent:	Define contaminated sites and remediation requirements
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Contaminated Sites Regulation**
	B.C. Reg. 375/96
	O.C. 1480/96
Details:	[includes amendments up to B.C. Reg. 239/2007, July 1, 2007]
Date:	Deposited December 16, 1996, effective April 1, 1997
Applicable Section:	Part 1 — Interpretation - Definitions
Section Number:	1

"agricultural land use" means the use of land for the primary purpose of producing agricultural products for human or animal consumption including, without limitation, livestock raising operations, croplands, orchards, pastures, greenhouses, plant nurseries and farms;

"environmental media" means soil, sediments, surface water, groundwater, air, animals and plants;

"generic numerical sediment criterion" means the concentration of a substance specified in Schedule 9 for a particular sediment use;

"generic numerical soil standard" means the concentration of a substance in soil specified for a particular land use in Schedule 4 or Schedule 10;

"industrial land use" means the use of land for the primary purpose of conducting industrial manufacturing and assembling processes and their ancillary uses including, without limitation, factories, metal foundries, wood treatment facilities, mines, refineries, hydroelectric dams, metal smelters, automotive assembly plants, rail car or locomotive maintenance facilities, railyards, non-retail breweries and bakeries, roads and highways, wastewater and sewage treatment plants, electrical transformer stations and salvage yards;

"residential land use" means the use of land for the primary purpose of

(a) a residence by persons on a permanent, temporary or seasonal basis, including, without limitation, single family dwellings, cabins, apartments, condominiums or townhouses, or

(b) institutional facilities, including, without limitation, schools, hospitals, daycare operations, prisons, correctional centres and community centres;

"soil" includes

(a) unconsolidated mineral or organic material,

(b) rock,

(c) fill, and

(d) sediment deposited on land,

but does not include the following, which are applied to land for a beneficial purpose in compliance with the Organic Matter Recycling Regulation or an authorization given under the Act:

(e) sewage sludge;

(f) composted organic materials;

(g) products derived from the materials described in paragraph (e) or (f);

Addresses the following:	Definitions
General Intent:	Define contaminated sites and remediation requirements
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Contaminated Sites Regulation**
	B.C. Reg. 375/96
	O.C. 1480/96
Details:	[includes amendments up to B.C. Reg. 239/2007, July 1, 2007]
Date:	Deposited December 16, 1996, effective April 1, 1997
Applicable Section:	Part 5 — Contaminated Site Definition and Determination - Definition of contaminated site
Section Number:	11 (1)

Definition of contaminated site

11 (1) Subject to section 12 and subsections (2), (3) and (4) of this section, the following substances, standards and conditions are prescribed for the purposes of the definition of "contaminated site" in section 39 of the Act:

(a) the land use of the site is agricultural, commercial, industrial, urban park or residential and the concentration of any substance in the soil is greater than

(i) the applicable generic numerical soil standard, or

0(ii) the lowest value of the applicable matrix numerical soil standards;

(4) Subsection (1) does not apply to a site in relation to a substance in the soil if

(a) the site has been used for the application of

(i) managed organic matter , as defined in the Organic Matter Recycling Regulation, B.C. Reg. 18/2002,

(ii) retail-grade organic matter , as defined in the Organic Matter Recycling Regulation, or

(iii) products derived from the materials described in subparagraphs (i) or (ii)

in a manner consistent with the Organic Matter Recycling Regulation or an authorization given under the Act, and

(b) the site has not been used for a commercial or industrial activity listed in Schedule 2.

[en. B.C. Regs. 322/2004 and 324/2004, s. 11.]

Addresses the following:	Contamination / Erosion
General Intent:	Prevent erosion due to spillage from water impoundments
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Municipal Sewage Regulation**
	B.C. Reg. 129/99
	O.C. 507/99
Details:	[includes amendments up to B.C. Reg. 305/2007, October 5, 2007
Date:	Deposited April 23, 1999, effective July 15, 1999
Applicable Section:	Appendix 3 to Schedule 7 - Health and Safety Criteria for use of Reclaimed Water - 1 Construction Criteria
Section Number:	Appendix 3 to Schedule 7 - 1

(7) Impoundments must be designed, operated and maintained to minimize fluid leakage. Any leakage must not aggravate or produce soil or bedrock instability or erosion elsewhere or impact ground or surface water quality.

Addresses the following:	Contamination
General Intent:	Management of discharges to land from Oil and Gas drilling operations
Applicability:	Petroluem & Natural Gas Tenures
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Oil and Gas Waste Regulation**
	B.C. Reg. 254/2005
	O.C. 541/2005
Details:	[includes amendments up to B.C. Reg. 220/2006, July 21, 2006]
Date:	Deposited July 28, 2005
Applicable Section:	Requirements for discharges from specific operations 7 (2) (e)

Section Number:

(vi) the discharge does not cause erosion or result in measurable downward and outward movement of soil , rocks, snow, ice, mud or debris, and

(vii) the discharge is on to a stable slope.

See also details under seperate cover.

Addresses the following:	Contamination / Organic matter
General Intent:	Management of industrial wood waste; Soil protection
Applicability:	All lands
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Waste Discharge Regulation**
	B.C. Reg. 320/2004
	O.C. 723/2004
Details:	[includes amendments up to B.C. Reg. 329/2007, March 1, 2008]
Date:	Deposited July 8, 2004, effective July 8, 2004
Applicable Section:	Operations exempt from the Act (Application of industrial wood residue)
Section Number:	3 (3) thru (6.1)

(3) Repealed. [B.C. Reg. 132/2006, s. 5.]

(3.1) In subsections (4), (5), (6) and (6.1), "industrial wood residue" does not include the residue of wood treated with glue, paint, a preservative or another substance harmful to plants or animals.

(4) The use of industrial wood residue for foundation material at construction sites is exempt from section 6 (2) and 6 (3) of the Act if the material is applied under the direction of a professional engineer.

(5) The use of industrial wood residue

(a) as plant mulch or in residential gardens,

(b) as foundation material for animal bedding, and

(c) in sports areas

is exempt from section 6 (2) and 6 (3) of the Act.

(6) The use of industrial wood residue as a soil conditioner or ground cover in non-agricultural operations is exempt from section 6 (2) and 6 (3) of the Act if

(a) less than 100 m3/year is spread on a single property, and

(b) it is applied in accordance with good agronomic practices.

(6.1) The limitation in subsection (6) (a) does not apply if the industrial wood residue is applied as a soil conditioner or ground cover to land used for forestry.

Addresses the following:	Contamination / Erosion
General Intent:	Manage the discharge of various fluids used in oil and gas drilling operations
Applicability:	Petroluem & Natural Gas Tenures
Name of Act:	**Environmental Management Act**
Name of Regulation:	**Oil and Gas Waste Regulation** **B.C. Reg. 254/2005** **O.C. 541/2005**
Details:	[includes amendments up to B.C. Reg. 220/2006, July 21, 2006]
Date:	Deposited July 28, 2005
Applicable Section:	Requirements for discharges from specific operations 7 (2) (e) (v)
Section Number:	7 (2) (e) (v)

(v) the liquid is discharged at a rate at which there is no accumulation of effluent on the surface of the ground,

(vi) the discharge does not cause erosion or result in measurable downward and outward movement of soil, rocks, snow, ice, mud or debris, and

(vii) the discharge is on to a stable slope.

Addresses the following:	Contamination / Organic matter
General Intent:	Waste management on Agriclutural Land (see printed Act)
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Agricultural Waste Control Regulation**
	B.C. Reg. 131/92
	O.C. 557/92
Details:	[includes amendments up to B.C. Reg. 321/2004], Code of Agricultural Practice for Waste Management
Date:	Deposited April 9, 1992
Applicable Section:	Part 1 to 4 (see next for part 5 on)
Section Number:	1 to 10

1 The purpose of this Code is to describe practices for using, storing and managing agricultural waste that will result in agricultural waste being handled in an environmentally

sound manner.

3 Agricultural wastes, wood waste and mortalities must be collected, stored, handled, used and disposed of in accordance with this Code and in a manner that prevents pollution.

4 Agricultural waste may be stored on a farm only if the waste is produced or used on that farm.

5 When agricultural waste is stored, it must be stored

(a) in a storage facility, (b) as field storage, or (c) in the case of waste from fur bearing animals, under their outdoor pens.

6 A storage facility must (a) be of sufficient capacity to store all the agricultural waste produced or used on the farm for the period of time needed to allow for (i) the application of agricultural waste as a fertilizer or soil conditioner, or (ii) the removal of agricultural waste, (b) prevent the escape of any agricultural waste that causes pollution, and (c) be maintained in a manner to prevent pollution.

7 (1) A storage facility must be located at least 15 m from any watercourse and 30 m from any source of water for domestic purposes. (2) Subsection (1) does not apply to a storage facility existing prior to April 1, 1992 provided that a report (a) demonstrating to the satisfaction of a director that no pollution of any watercourse or domestic water supply is occurring from the storage facility, and (b) produced by (i) a person with professional qualifications in the field of environmental assessment and licensed to practice in British Columbia, or (ii) staff of the ministry of the minister charged with the administration of the Farm Practices Protection (Right to Farm) Act under a Best Agricultural Waste Management Plan is made available to the director within 12 months of his or her request.

8 (1) Solid agricultural waste may be stored on a field for 2 weeks or less if the agricultural waste is (a) used within 2 weeks, and (b) stored in a manner that prevents the escape of agricultural waste that causes pollution. (2) Solid agricultural waste may be stored on a field for more than 2 weeks if the agricultural waste is (a) stored for no longer than 9 months, (b) located at least 30 m from any watercourse or any source of water used for domestic purposes, and (c) stored in a manner that prevents the escape of agricultural aste that causes pollution. (3) Berms or other works must be constructed around a field storage area if this is necessary to prevent the escape of agricultural waste that causes pollution.

9 In areas of the Province, including the Fraser Valley and Vancouver Island, that receive a total average precipitation greater than 600 mm (24 in) during the months of October to April inclusive, field stored solid agricultural wastes, except agricultural vegetation waste, must be

covered from October 1 to April 1 inclusive to prevent the escape of agricultural waste that causes pollution.

10 (1) Agricultural waste from fur bearing animals may be stored under their outdoor pens for up to 9 months if the storage area under the pens (a) prevents the escape of any agricultural wastes that causes pollution, and (b) is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes. (2) Subsection (1) (b) does not apply to a pen constructed prior to April 1, 1992 provided that a report (a) demonstrating to the satisfaction of a director that no pollution of any watercourse or domestic water supply is occurring from the under pen storage facility, and (b) produced by (i) a person with professional qualifications in the field of environmental assessment and licensed to practice in British Columbia, or (ii) staff of the ministry of the minister charged with the administration of the Farm Practices Protection (Right to Farm) Act under a Best Agricultural Waste Management Plan is made available to the director within 12 months of his or her request.

Addresses the following:	Contamination / Organic matter
General Intent:	Waste management on Agriclutural Land (see printed Act)
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Agricultural Waste Control Regulation**
	B.C. Reg. 131/92
	O.C. 557/92
Details:	[includes amendments up to B.C. Reg. 321/2004], Code of Agricultural Practice for Waste Management
Date:	Deposited April 9, 1992
Applicable Section:	Part 5 to 8
Section Number:	11 to 16, 20-22, 24

11 Agricultural waste must not be directly discharged into a watercourse or groundwater.

12 Agricultural waste must be applied to land only as a fertilizer or a soil conditioner.

13 Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater.

14 Agricultural wastes must not be applied (a) on frozen land, (b) in diverting winds, (c) on areas having standing water, (d) on saturated soils, or (e) at rates of application that exceed the amount required for crop growth, if runoff or escape of agricultural waste causes pollution of a watercourse or groundwater, or goes beyond the farm boundary.

15 Agricultural waste may be composted on a farm if (a) the agricultural waste being composted consists only of agricultural waste (i) produced on that farm, or (ii) produced elsewhere but being composted for use on that farm only, (b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and (c) the agricultural waste is composted in a manner that does not cause pollution.

16 (1) Composting agricultural waste for the production of mushroom medium on a farm is allowed if (a) the mushroom medium produced is used only on that farm, (b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and (c) the medium is composted in a manner that does not cause pollution. (2) Subsection (1) (a) and (b) does not apply to a composting operation and site existing prior to April 1, 1992 provided that a report (a) demonstrating to the satisfaction of a director that no pollution of any watercourse or domestic water supply is occurring from the composting operation and site, and (b) produced by (i) a person with professional qualifications in the field of environmental assessment and licensed to practice in British Columbia, or (ii) staff of the ministry of the minister charged with the administration of the Farm Practices Protection (Right to Farm) Act under a Best Agricultural Waste Management Plan is completed by April 1, 1993 and is made available to the director at his or her request.

20 Wood waste may only be used for (a) plant mulch, soil conditioner, ground cover, on-farm access ways, livestock bedding and areas where livestock, poultry or farmed game are confined or exercised, (b) berms for cranberry production, or (c) fuel for wood fired boilers.

21 Wood waste stored and used on a farm must be handled so as to prevent any escape of (a) particulate or solid matter from the wood waste into the air, or (b) particulate or solid matter or leachate from the wood waste into any watercourse or groundwater that causes pollution.

22 Wood waste used on the farm must not be used (a) for landfill, and (b) on sites within 30 m of any source of water used for domestic purposes with the exception of existing sites under use prior to April 1, 1992, provided that this use is not causing pollution.

24 Mortalities may be composted on-farm if (a) the mortalities are composted on the farm where they died, (b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and (c) the composting does not cause pollution.

Addresses the following:	Contamination / Organic matter
General Intent:	Waste management on Agriclutural Land (see printed Act)
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Agricultural Waste Control Regulation**
	B.C. Reg. 131/92
	O.C. 557/92
Details:	[includes amendments up to B.C. Reg. 321/2004], Code of Agricultural Practice for Waste Management
Date:	Deposited April 9, 1992
Applicable Section:	Part 9
Section Number:	25 to 31

25 Livestock, poultry or farmed game feeding within a grazing area may have access to watercourses, provided that the agricultural waste produced by that livestock, poultry or farmed game does not cause pollution.

26 (1) A seasonal feeding area for livestock, poultry or farmed game must (a) be operated in a way that does not cause pollution, and (b) have berms where necessary to prevent agricultural waste runoff from causing pollution. (2) Locations for feeding livestock, poultry or farmed game within a seasonal feeding area, including locations for movable feed bunks, must (a) be at least 30 m from a high tide watermark, a watercourse or the bank of a watercourse, unless written permission has been obtained from a director for a closer location, and (b) be distributed throughout the area to ensure that manure from the feeding of livestock, poultry or farmed game is spread as a fertilizer or soil conditioner and that no accumulation of manure causes pollution. (3) Where permanent feed bunks are used within a seasonal feeding area, written permission for the location of the bunks must be obtained from a director.

27 Livestock, poultry or farmed game in a seasonal feeding area may have access to watercourses provided that (a) the feeding of livestock, poultry or farmed game is in accordance with section 26, and (b) the access is located and maintained as necessary to prevent pollution.

28 Livestock, poultry or farmed game in a confined livestock area may not have access to a watercourse, with the exception of a holding area on rangeland where (a) livestock is held no longer than 72 hours, (b) the watercourse is not a source of water used for domestic purposes at any location downstream from the confined livestock area, and (c) the access is located and maintained as necessary to prevent pollution.

29 (1) Confined livestock areas must be operated in a way that does not cause pollution. (2) If there are more than 10 agricultural units in a confined livestock area or areas within the same drainage basin then the area or areas must be located at least 30 m from a high tide watermark, a watercourse, the bank of a watercourse or any source of water used for domestic purposes. (3) Subsection (2) does not apply to a permanent confined livestock area constructed prior to April 1, 1992 provided that a report (a) demonstrating to the satisfaction of a director that no pollution of any watercourse or domestic water supply is occurring from the permanent confined livestock area, and

(b) produced by (i) a person with professional qualifications in the field of environmental assessment and licensed to practice in British Columbia, or (ii) staff of the ministry of the minister charged with the administration of the Farm Practices Protection (Right to Farm) Act under a Best Agricultural Waste Management Plan is completed by April 1, 1993 and is made available to the director at his or her request.

30 Agricultural products such as livestock, poultry, farmed game, fur bearing animals, animal and poultry feeds, forage silage, forage crops, vegetables and chemical fertilizers must be

managed, used and stored in a manner that prevents the escape of agricultural waste that causes pollution.

31 Raw materials for making products such as mushroom medium or soilless medium must be used and stored in a manner that prevents the escape of agricultural waste that causes pollution.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 1 – Definitions (Part 2 follows)
Section Number:	1

Definitions
1 (1) In this regulation :
"Act" means the *Environmental Management Act*;
"agricultural land reserve" means land designated as agricultural land and established as an agricultural land reserve under section 11 of the *Agricultural Land Commission Act*;
"agricultural waste" means agricultural waste that is subject to the Code attached to the Agricultural Waste Control Regulation , B.C. Reg. 131/92, but does not include
(a) human or animal food waste that is diverted from residential, commercial or institutional sources,
(b) waste materials derived from non-agricultural operations, or
(c) wood waste derived from land clearing, construction or demolition;
"biosolids" means stabilized municipal sewage sludge resulting from a municipal waste water treatment process or septage treatment process which has been sufficiently treated to reduce pathogen densities and vector attraction to allow the sludge to be beneficially recycled in accordance with the requirements of this regulation ;
"biosolids growing medium" means biosolids that meet the requirements of section 10;
"Class A biosolids" means biosolids that meet the requirements of section 6;
"Class B biosolids" means biosolids that meet the requirements of section 8;
"Class A compost" means compost that meets the requirements of section 12;
"Class B compost" means compost that meets the requirements of section 14;
"compost" means a product which is
(a) a stabilized earthy matter having the properties and structure of humus,
(b) beneficial to plant growth when used as a soil amendment,
(c) produced by composting, and
(d) only derived from organic matter ;
"composting" means the controlled biological oxidation and decomposition of organic matter in accordance with the time and temperature requirements specified in Schedule 1;
"composting facility" means a facility that processes organic matter to produce compost;
"discharger" means any of the following responsible persons:
(a) an owner of a composting facility;
(b) an owner of a facility that produces managed organic matter for land application;
(c) a registered owner of the land where managed organic matter is applied;
"fertilizer" means an organic or inorganic material of natural or synthetic origin, other than liming material, that is added to a soil to supply one or more plant nutrients;
"foreign matter " means a contaminant that is not readily decomposed during the composting process, and includes demolition waste, metal, glass, plastic, rubber and leather, but does not include silt, sand, rocks or stones, or gravel less than 2.5 centimetres in diameter, or other similar mineral materials naturally found in soil;

"forest reserve land" means land designated as forest reserve land under section 10, 11 or 12 of the *Forest Land Reserve Act*;
"land application" means the application to land, after biosolids treatment or composting, of managed organic matter ;
"land application plan" means a plan for the land application of managed organic matter , prepared in accordance with section 5;
"Land Reserve Commission" means the commission established under the *Land Reserve Commission Act*;
"leachate" means
(a) effluent originating from organic matter being received, processed, composted, cured or stored at a composting facility,
(b) effluent originating from managed organic matter being stored or applied to land, or
(c) precipitation, storm water, equipment wash water or other water which has come into contact with, or mixed with, organic matter or managed organic matter being received, processed, composted, cured or stored;
"managed organic matter " means Class A biosolids, Class B biosolids or Class B compost;
" organic matter " means those materials set out in Schedule 12 that are suitable for composting;
"pathogen" means an organism capable of causing disease in humans, animals or plants;
"qualified professional" means a person who
(a) is registered in British Columbia with his or her appropriate professional association, acts under that professional association's code of ethics, and is subject to disciplinary action by that professional association, and
(b) through suitable education, experience, accreditation and knowledge may be reasonably relied on to provide advice within his or her area of expertise as it relates to this regulation ;
"retail-grade organic matter " means biosolids growing medium or Class A compost;
"soil conditioner" means
(a) managed organic matter that measurably improves specific chemical or physical characteristics of soil or chemical or physical processes for a given use, or
(b) a plant growth medium;
"vector" means a carrier organism that is capable of transmitting a pathogen from one facility, waste source, product or organism to another facility, waste source, product or organism;
"yard waste" means
(a) clean and untreated wood waste, or
(b) non-food vegetative matter resulting from gardening operations, landscaping and land clearing,
but does not include wood waste derived from construction or demolition.
(2) For greater certainty, neither
(a) human or animal food waste that is diverted from residential, commercial or institutional sources, nor
(b) manure, is yard waste.
[am. B.C. Reg. 321/2004, s. 19 (a) to (c).]

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 2 — Application and Exemption (Part 3 follows)
Section Number:	2 to 4

Part 2 — Application and Exemption
General application
2 (1) For the purposes of the Act, compostable materials and recyclable materials continue to be a waste until dealt with in accordance with this regulation .
(2) A person who produces or uses biosolids or compost is exempt from section 6 (2) and (3) of the Act if the person produces and uses the biosolids or compost only in accordance with this regulation .
(3) This regulation applies in British Columbia to
(a) the construction and operation of composting facilities, and
(b) the production, distribution, storage, sale and use or land application of biosolids and compost.
(4) The land application of retail-grade organic matter or managed organic matter , and the construction and operation of composting facilities, on an agricultural land reserve or on forest reserve land must
(a) be in compliance with all applicable legislation of British Columbia including, without limitation, the *Agricultural Land Commission Act* and the *Forest Land Reserve Act*, and all applicable regulations under those enactments, and
(b) be done in accordance with good agricultural practice.
(5) Any discharge of waste into the environment, not otherwise authorized by this regulation , must be in compliance with the Act.
[am. B.C. Reg. 321/2004, s. 19 (d) and (e).]
General exemptions
3 (1) In this section:
"agricultural waste composting" means the composting of agricultural waste in accordance with Part 5 of the Code made under the Agricultural Waste Control Regulation , B.C. Reg. 131/92;
"backyard composting" means the composting of food waste or yard waste, or both, at a site where
(a) the food waste or yard waste is generated by the residents of a residential dwelling unit, and
(b) the annual production of compost does not exceed 20 cubic metres.
(2) This regulation does not apply to any of the following:
(a) composting facilities
(i) authorized by a permit, approval or operational certificate, or
(ii) required by an order issued under the Act;
(b) the land application of managed organic matter
(i) authorized by a permit, approval or operational certificate, or
(ii) in accordance with an order issued under the Act;
(c) agricultural waste composting;

(d) backyard composting;
(e) demonstration gardens for the composting of yard waste in quantities not exceeding 100 cubic metres per year.

Contaminated sites

4 A site is not a contaminated site with respect to a substance in the soil if
(a) the site has been used in accordance with this regulation for the application of managed organic matter or retail-grade organic matter ,
(b) the site has not been used for any commercial or industrial purpose or activity listed in Schedule 2 of the Contaminated Sites Regulation , B.C. Reg. 375/96, and
(c) the site, before application of managed organic matter or retail-grade organic matter , was not a contaminated site as defined in section 11 (1) to (4) of the Contaminated Sites Regulation , B.C. Reg. 375/96.
[am. B.C. Reg. 321/2004, s. 19 (f).]

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 3 — Land Application and Distribution Requirements, (Part 4 follows)
Section Number:	5 to 15

Part 3 — Land Application and Distribution Requirements
Division 1 — Land Application Plan
Requirement for a land application plan
5 (1) A discharger must have a qualified professional
(a) prepare a land application plan for
(i) each site where managed organic matter is land applied, and
(ii) each occurrence that managed organic matter is land applied, and
(b) sign the land application plan before its implementation.
(2) The land application plan required by subsection (1) must provide the information specified in Schedule 7.
(3) After land application of managed organic matter at any site, the discharger must obtain written certification from a qualified professional that the land application was done in accordance with the land application plan required by subsection (1).
(4) The land application plan must be provided to the registered owner of the land and be made available, upon request, both before and after its implementation, to
(a) a director, or
(b) an official designated under the *Agricultural Land Commission Act*.
[am. B.C. Reg. 321/2004, s. 19 (g) and (h).]
Division 2 — Class A Biosolids
Process and quality criteria
6 Biosolids that meet the requirements of all of the following are Class A biosolids:
(a) Schedule 1, Pathogen Reduction Processes;
(b) Schedule 2, Vector Attraction Reduction;
(c) Schedule 3, Pathogen Reduction Limits;
(d) Section 3 of Schedule 4, Quality Criteria;
(e) Schedule 5, Sampling and Analyses — Protocols and Frequency;
(f) Schedule 6, Record-keeping.
Land application and distribution
7 (1) Class A biosolids may be applied to land in accordance with subsection (2) or distributed in accordance with subsection (4).
(2) When applied to land in quantities greater than 5 cubic metres per year per parcel of land, Class A biosolids must only be applied in accordance with
(a) a land application plan for Class A biosolids, and
(b) the soil substance concentrations specified in Schedules 9 and 10.
(3) The land application plan must, before land application of Class A biosolids, be made available to the registered owner of the land.
(4) Class A biosolids must only be distributed as follows:
(a) in volumes that do not exceed 5 cubic metres per vehicle per day;

(b) in sealed bags for retail purposes, each not to exceed 5 cubic metres, with no restrictions on the number of bags distributed per vehicle per day;
(c) in volumes greater than 5 cubic metres to composting facilities or biosolids growing medium facilities.

Division 3 — Class B Biosolids

Process and quality criteria

8 Biosolids that meet the requirements of all of the following are Class B biosolids:
(a) Schedule 1, Pathogen Reduction Processes;
(b) Schedule 2, Vector Attraction Reduction;
(c) Schedule 3, Pathogen Reduction Limits;
(d) Column 3 of Schedule 4, Quality Criteria;
(e) Schedule 5, Sampling and Analyses — Protocols and Frequency;
(f) Schedule 6, Record-keeping.

Land application and distribution

9 (1) Class B biosolids may be applied to land in accordance with subsection (2) or distributed in accordance with subsection (4).
(2) Class B biosolids must only be applied to land in accordance with
(a) a land application plan for Class B biosolids,
(b) the methodology specified in Schedule 8, and
(c) the soil substance concentrations specified in Schedules 9 and 10, or the site-specific criteria approved by a director.
(3) The land application plan must, before land application, be made available to the registered owner of the land.
(4) Class B biosolids may be distributed to composting facilities with no volume restriction.
(5) Class B biosolids that meet the pathogen reduction and vector attraction requirements for Class A biosolids specified in Schedules 1, 2 and 3 may be distributed to a biosolids growing medium facility with no volume restriction.
(6) Class B biosolids must not be land applied in a watershed used as a permitted water supply under the Drinking Water Protection Regulation , B.C. Reg. 200/2003.
[am. B.C. Reg. 321/2004, s. 19 (g) and (i).]

Division 4 — Biosolids Growing Medium

Process and quality criteria

10 Biosolids that meet the requirements of all of the following are biosolids growing medium:
(a) Column 2 of Schedule 4, Quality Criteria;
(b) Schedule 5, Sampling and Analyses — Protocols and Frequency;
(c) Schedule 6, Record-keeping;
(d) Schedule 11, Requirements for Biosolids Growing Medium.

Distribution

11 Biosolids growing medium may be distributed with no volume restriction.

Division 5 — Class A Compost

Process and quality criteria

12 (1) In this section, **"untreated and unprocessed wood residuals"** means clean wood from lumber manufacturing, and includes shavings, sawdust, chips, hog fuel, ground mill ends and land clearing waste which has been ground with the majority of the greenery removed and no soil present.
(2) Compost that is produced solely from yard waste or untreated and unprocessed wood residuals, or from both, and that meets the requirements of all of the following, is Class A compost:
(a) Schedule 1, Pathogen Reduction Processes;
(b) Schedule 2, Vector Attraction Reduction;
(c) Column 1 of Schedule 4, Quality Criteria.
(3) Compost that is not solely produced from yard waste or from untreated and unprocessed wood residuals and that meets the requirements of all of the following is Class A compost:
(a) the requirements of subsection (2) (a) to (c);
(b) Schedule 3, Pathogen Reduction Limits;
(c) Schedule 5, Sampling and Analyses — Protocols and Frequency;
(d) Schedule 6, Record-keeping.
(4) Class A compost must be derived only from organic matter .

(5) Biosolids used as feedstock for the production of Class A compost must not exceed the standards for Class B biosolids set out in Column 3 of Schedule 4.

Distribution

13 Class A compost may be distributed with no volume restriction.

Division 6 — Class B Compost

Process and quality criteria

14 (1) Compost that meets the requirements of all of the following is Class B compost:

(a) Schedule 1, Pathogen Reduction Processes;

(b) Schedule 2, Vector Attraction Reduction;

(c) Schedule 3, Pathogen Reduction Limits;

(d) Column 3 of Schedule 4, Quality Criteria;

(e) Schedule 5, Sampling and Analyses — Protocols and Frequency;

(f) Schedule 6, Record-keeping.

(2) Class B compost must be derived only from organic matter .

Land application

15 (1) Class B compost must only be applied to land in accordance with

(a) a land application plan for Class B compost,

(b) the methodology specified in Schedule 8, and

(c) the soil substance concentrations specified in Schedules 9 and 10, or the site-specific numeric soil standards approved by a director.

(2) The land application plan must, before land application, be made available to the registered owner of the land.

(3) Class B compost must not be land applied in a watershed used as a permitted water supply under the Drinking Water Protection Regulation , B.C. Reg. 200/2003.

[am. B.C. Reg. 321/2004, s. 19 (g) and (i).]

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 4 — Storage and Land Application Requirements (Part 5 follows)
Section Number:	16 to 22

Part 4 — Storage and Land Application Requirements
Division 1 — Storage at a Land Application Site
Definitions
16 In this Division:
"precipitation" means precipitation as determined by the Canadian Atmospheric Environmental Service Reports of Environment Canada;
"storage facility" means a structure for containing managed organic matter before its use under a land application plan, and includes a reservoir, lagoon, cistern, gutter, tank or bermed area but does not include a vehicle or any mobile equipment used for the transportation of managed organic matter ;
"storage site" means a site for storing a temporary stock of managed organic matter which is ready to be drawn upon for use as a fertilizer or soil conditioner under a land application plan.
Storage methods
17 (1) If managed organic matter , which is to be applied to land under a land application plan, is stored on a farm or at some other site, it must be stored
(a) in a storage facility in accordance with the requirements of section 18, or
(b) at a storage site in accordance with the requirements of section 19.
(2) Managed organic matter must only be stored on a farm if all of the managed organic matter is used on that farm.
Storage facility
18 A storage facility must
(a) be of sufficient capacity to store all the managed organic matter to be used on the land application site for the period of time needed for its application as a fertilizer or soil conditioner,
(b) be located at least 15 metres from any watercourse and 30 metres from any source of water for domestic purposes, and
(c) be maintained in such a manner as to prevent the escape of managed organic matter .
Storage site
19 (1) Managed organic matter may only be stored at a storage site as follows:
(a) for not more than 2 weeks if it is
(i) used within 2 weeks, and
(ii) stored in a manner that prevents the escape of managed organic matter ;
(b) for more than 2 weeks if it is
(i) stored for no longer than 9 months,
(ii) located at least 30 metres from any watercourse or any source of water used for domestic purposes, and
(iii) stored in a manner that prevents the escape of managed organic matter .
(2) Berms or other works must be constructed around the storage site if necessary to prevent the escape of managed organic matter .

Rainy season storage using a storage site
20 (1) This section applies to
(a) Vancouver Island,
(b) the Fraser Valley, and
(c) any other area of British Columbia that receives a total average precipitation greater than 600 mm (24 inches) during the months of October to March inclusive.
(2) Managed organic matter that
(a) is to be applied to land under a land application plan,
(b) is stored at the land application site, and
(c) is not stored in a storage facility,
must be covered from October 1 to March 31 of the next year to prevent the escape of managed organic matter .
Division 2 — Notification of Land Application of Managed Organic Matter
Definition
21 In this Division:
"medical health officer" has the meaning given to it in section 1 of the *Health Act*;
"watershed" means a watershed used as a permitted water supply under the Drinking Water Protection Regulation , B.C. Reg. 200/2003.
[am. B.C. Reg. 321/2004, s. 19 (j).]
Discharger to give notice
22 (1) A discharger must, using the standardized form provided in Schedule 13, give notification of any proposed land application of managed organic matter in volumes greater than 5 cubic metres, as follows:
(a) to a director at least 30 calendar days before the land application of managed organic matter ;
(b) to the medical health officer having jurisdiction at least 30 calendar days before the land application of managed organic matter to agricultural land or in a watershed;
(c) to the Land Reserve Commission at least 30 calendar days before the land application of managed organic matter within an agricultural land reserve or forest reserve land.
(2) The director may, within 30 days after receipt of the information required by subsection (1) (a), request additional information.
(3) If the information required by subsection (1) (a) or (2) indicates the need for site-specific standards or management practices respecting the land application of managed organic matter in order to protect human health and the environment, the director may, within 30 days after receipt of the information, require the discharger to meet the site-specific standards or management practices specified by the director.
(4) The medical health officer having jurisdiction may, within 30 days after receipt of the information required by subsection (1) (b), provide written directions to the discharger that the application of managed organic matter
(a) must not proceed, or
(b) may only proceed subject to conditions specified by the medical health officer.
(5) If there is agreement between the discharger and the director and, in the case of land application to agricultural land or in a watershed, the medical health officer having jurisdiction, the parties may agree to amend the time limit under subsection (3) or (4).
[am. B.C. Reg. 321/2004, s. 19 (g) and (k).]

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 5 — Composting Facility Requirements (Part 6 follows)
Section Number:	23 to 26

Part 5 — Composting Facility Requirements
Division 1 — Requirements for Composting Facilities
1.1.1.1 Environmental impact study and report
23 (1) This section applies, on and after the coming into force of this regulation , to a composting facility proposed to be
(a) constructed with an existing or proposed annual production capacity of 20 000 tonnes or more,
(b) expanded beyond an existing annual production capacity of 20 000 tonnes or more resulting in an increase in production capacity of more than 10 percent, or
(c) expanded beyond an existing annual production capacity of less than 20 000 tonnes resulting in an annual production capacity of more than 20 000 tonnes.
(2) A discharger must ensure that no organic matter is collected at, and no compost is distributed from, a composting facility unless a qualified professional conducts and completes an environmental impact study and produces an environmental impact study report acceptable to a director which includes, but is not limited to,
(a) design of the composting facilities including buildings, works and other appurtances,
(b) odour and leachate collection and treatment systems, and
(c) site preparation for the composting facilities, buffer zones and plans to minimize the impact on adjacent lands.
(3) A copy of the environmental impact study report required by subsection (2) must be submitted to the director at least 90 days before commencement of construction of a new composting facility or the modification of an existing composting facility.
(4) The discharger must retain a copy of the completed environmental impact study report for inspection.
(5) The director may request additional information with respect to the environmental impact study that he or she considers necessary for the protection of human health and the environment, and may specify particular concerns or questions that the impact study must address.
[am. B.C. Reg. 321/2004, s. 19 (g), (k) and (l).]
Division 2 — Construction and Operation of Composting Facilities
1.1.1.2 Plans and specifications
24 (1) A discharger must have a qualified professional prepare plans and specifications for
(a) the construction and operation of a new composting facility, or
(b) any modification of an existing composting facility that results in an increase in the annual production capacity of more than 10 percent or more than 20 000 cubic metres.
(2) The plans and specifications required by subsection (1) must include, but are not limited to, all of the following:
(a) all works to be constructed on the site;

(b) design capacity of the composting facility;
(c) a leachate management plan which stipulates how leachate generated from any and all stages of the composting process will be minimized, managed, treated or disposed;
(d) an odour management plan which stipulates how air contaminants from the composting facility will be discharged in a manner that does not cause pollution;
(e) an operating and closure plan for the composting facility.
(3) The discharger must ensure that
(a) the qualified professional
(i) affixes his or her professional seal or signature, or both, to the plans and specifications for the composting facility, and
(ii) makes a signed statement certifying that the composting facility has been constructed in accordance with the plans and specifications,
(b) a copy of the plans and specifications for the composting facility are kept at the composting facility at all times, and are available for inspection at any time,
(c) the plans and specifications are submitted to a director upon request, and
(d) the composting facility is operated in compliance with the plans and specifications required by subsection (1).
(4) The director may request additional information with respect to the plans and specifications that he or she considers necessary for the protection of human health and the environment, and may specify particular concerns or questions that the plans and specifications must address.
[am. B.C. Reg. 321/2004, s. 19 (g), (k) and (m).]

1.1.1.3 Notification of operation

25 (1) The discharger must, at least 90 days before beginning the operation of a composting facility, give notice in writing to
(a) a director, and
(b) the Land Reserve Commission if the composting facility is in an agricultural land reserve or forest reserve land.
(2) The notification required by subsection (1) must include
(a) the composting facility location and design capacity, name of a contact person, type of waste received, and intended distribution of compost, and
(b) a copy of a personnel training program plan that addresses the specific training needed to operate the composting facility in compliance with this regulation .
[am. B.C. Reg. 321/2004, s. 19 (g).]

Division 3 — Leachate Management for Composting Facilities

1.1.1.4 Composting facility requirements

26 (1) In this section, **"curing area"** means an area where organic matter which has undergone the rapid initial stage of composting is further matured into a humus-like material.
(2) The receiving, storage, processing and curing areas of a composting facility must comply with all of the following:
(a) be located on asphalt, concrete or another similar impermeable surface that is capable of withstanding wear and tear from normal operations and that will prevent the release of leachate into the environment;
(b) have a roof or cover, or a prepared surface, designed to prevent
(i) the surface collection of water around the base of organic matter and compost, and
(ii) run-off water from entering the receiving, storage, processing and curing areas;
(c) have a leachate collection system designed, constructed, maintained and operated to reuse leachate, or to remove leachate, from the receiving, storage, processing and curing areas.
(3) Leachate that is not collected and reused in the composting process must not be discharged into the environment unless authorized under the Act.
(4) Despite subsections (2) and (3), an impermeable surface, roof, cover, prepared surface or leachate collection system is not necessary if a qualified professional can demonstrate through an environmental impact assessment that the environment will be protected and appropriate water quality criteria satisfied through the use of alternative leachate management processes.
(5) A director may request additional information with respect to the environmental impact assessment that he or she considers necessary for the protection of human health and the environment, and may specify particular concerns, questions, standards or monitoring that the assessment must address.
[am. B.C. Reg. 321/2004, s. 19 (n).]

Division 4 — Capacity of Composting Facilities

1.1.1.5 Capacity for organic matter

27 The amount of organic matter in a composting facility must not at any time exceed the total design capacity of the facility.

1.1.1.6 Capacity for compost

28 At least half of the compost stored at a composting facility must be removed annually from the facility beginning in the third year after facility start-up.

1.1.1.7 Capacity for residuals

29 (1) Residuals from the composting process must

(a) be stored so as to prevent vector attraction, and

(b) be disposed of on a regular basis in accordance with the Act.

(2) Residuals that are stored at a composting facility must not at any time exceed 15 cubic metres in total.

1.1.1.8 Closure of a composting facility

30 Before the closure of a composting facility,

(a) all compost must be applied or distributed in accordance with this regulation , and

(b) all unprocessed organic matter must be removed from the facility and dealt with in accordance with the Act.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Part 6 — General (Schedules follow)
Section Number:	31, 32

Part 6 — General
Offence and penalty
31 (1) A person who contravenes a provision of this regulation , other than as set out in subsection (2), commits an offence and is liable on conviction to a fine not exceeding $10 000.
(2) A person who contravenes section 5 (1), 7 (2) or (4), 9 (2), 12 (4) or (5), 14 (2), 15 (1), 17 (1) or (2), 20 (2), 22 (1), 23 (2) or (3), 24 (1), 25 (1), 26 (2) or (3), 27, 28, 29 (1) or (2) or 30 commits an offence and is liable on conviction to a fine not exceeding $200 000.
Review of organic matter provisions
32 The Ministry of Water, Land and Air Protection will evaluate the management of this regulation within 3 years of this regulation coming into force to determine if any modifications are appropriate based on advances in science, law and the management of organic matter

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Schedule 1 - Pathogen Reduction Processes - (Schedule 2 follows)
Section Number:	Schedule 1

Schedule 1

Pathogen Reduction Processes

1 The pathogen reduction requirements listed in section 2 (a) to (g) of this Schedule must be met before or at the same time as the vector attraction reduction requirements set out in sections 1 to 3 of Schedule 2.

2 One of the following pathogen reduction methods is required for Class A biosolids or biosolids used to produce biosolids growing medium:

(a) the thermophilic aerobic digestion method consisting of an aerobic process whereby liquid biosolids are agitated with air or oxygen under a temperature of not less than 55° Celsius for 30 minutes or longer, and the temperature and time period are determined using the equation in paragraph (f). The process is to be configured (batch, plug flow, staged) to maintain sufficient retention time to ensure that pathogen and volatile solids destruction is reliably achieved;

(b) the thermophilic anaerobic digestion method consisting of a process whereby liquid biosolids are agitated in the absence of free oxygen (under negative Redox potential) at a temperature of not less than 50° Celsius for at least 10 consecutive days. The process must be configured (batch, plug flow, staged) to maintain sufficient retention time to ensure that pathogen and volatile solids destruction is reliably achieved;

(c) the heat treatment method such that when the percent solids of the biosolids is 7 percent or higher,

(i) the temperature of the biosolids must be 50° Celsius or higher,

(ii) the time period must be 20 minutes or longer, and

(iii) the minimum required time period must be determined using the following equation, except when small particles of biosolids are heated by either warmed gases or an immiscible liquid:

D = 131 700 000/ 100.1400t

where:

D = time in days

t = temperatures in °Celsius;

(d) the heat treatment method such that when the percent solids of the biosolids is 7 percent or higher and small particles of biosolids are heated by either warmed gases or an immiscible liquid,

(i) the temperature of the biosolids must be 50° Celsius or higher,

(ii) the time period must be 15 seconds or longer, and

(iii) the minimum required time period must be determined using the equation in paragraph (c);

(e) the heat treatment method such that when the percent solids of the biosolids is less than 7 percent,

(i) the time period must be at least 15 seconds but less than 30 minutes, and

(ii) the minimum required time period must be determined using the equation in paragraph (c);

(f) the heat treatment method such that when the percent solids of the biosolids is less than 7 percent,

(i) the temperature of the biosolids must be 50° Celsius or higher, and

(ii) the time period must be 30 minutes or longer, and

(iii) the minimum required time period must be determined using the following equation:

D = 50 070 000/100.1400t

where:

D = time in days

t = temperatures in °Celsius;

(g) the alkaline stabilization method consisting of maintaining the pH within the biosolids at above 12 for 72 hours with a temperature during the 72 hour period greater than 52º Celsius for 12 hours. After 72 hours at pH above 12, the biosolids must be air-dried to greater than 50 percent total solids.

3 The pathogen reduction requirements for Class A compost listed in section 4 (a) to (c) of this Schedule must be met before the vector attraction reduction requirements listed in section 2 (a) and (b) of Schedule 2.

4 One of the following pathogen reduction processes specified in paragraphs (a) to (c) is required to produce Class A compost:

(a) the windrow composting method whereby organic matter is processed in a windrow involving periodic aeration and mixing of the windrow, with a temperature of not less than 55º Celsius maintained for at least 15 days and not fewer than 5 turnings of the windrow made during the high temperature period to promote uniform exposure of the compost to thermophilic temperatures;

(b) the static aerated pile composting method consisting of a compost process involving mechanical aeration of the compost pile, with the compost pile insulated and a temperature of not less than 55º Celsius maintained throughout the compost pile for at least 3 consecutive days;

(c) the enclosed vessel method consisting of a confined compost process involving mechanical aeration of compost under controlled environmental conditions, with a temperature of not less than 55º Celsius maintained for at least 3 days during the composting process.

5 To produce Class A compost from yard waste alone, a turning process can be used whereby the pile is turned on a periodic basis to aerate the yard waste, maintain optimum temperatures, and reduce pathogens.

6 The director may provide approval for an alternative process on a specific basis if the director is satisfied that the alternative process in that case will provide a Class A compost equivalent in quality as that produced by the process described by section 4 (a) to (c).

7 For Class B biosolids and Class B compost a biosolids treatment or composting process must be used whereby fecal coliform are reduced to levels < 2 000 000 MPN per gram of total solids (dry weight basis), or one of the following processes must be used:

(a) the aerobic digestion process whereby Class B biosolids are agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature must be between 40 days at 20º Celsius and 60 days at 15° Celsius;

(b) the air-drying process whereby Class B biosolids are dried on sand beds or on paved or unpaved basins. The biosolids must dry for a minimum of 3 months. During 2 of the 3 months, the ambient average daily temperature must be above 0° Celsius;

(c) the anaerobic digestion process whereby Class B biosolids are treated in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell time

and temperature must be between 15 days at 35° Celsius to 55° Celsius and 60 days at 20° Celsius;

(d) the compost process using either within-vessel, static aerated pile or windrow-composting methods whereby the temperature of the Class B compost is raised to 40° Celsius or higher and maintained for 5 days. For 4 hours during the 5-day period, the temperature in the compost pile must exceed 55° Celsius;

(e) the lime stabilization process whereby sufficient lime is added to the Class B biosolids to raise the pH of the biosolids to 12 after 2 hours of contact.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 2 - Vector Attraction Reduction (Schedule 3 follows)
Section Number:	Schedule 2

Schedule 2

Vector Attraction Reduction

1 One of the following vector attraction reduction processes is required for Class A biosolids or Class B biosolids used to produce biosolids growing medium:

(a) a digestion process (aerobic or anaerobic) resulting in the mass of volatile solids of the biosolids being reduced by more than 38 percent;

(b) when the 38 percent volatile solids reduction requirement in paragraph (a) cannot be met for an aerobically digested biosolids, vector attraction reduction can be demonstrated by digesting a portion of the previously digested biosolids that has a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20° Celsius. When, at the end of the 30 days, the volatile solids in the biosolids at the beginning of that period is reduced by less than 15 percent, vector attraction reduction is achieved;

(c) when the 38 percent volatile solids reduction requirement in paragraph (a) cannot be met for an anaerobically digested biosolids, vector attraction reduction can be demonstrated by digesting a portion of the previously digested biosolids anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30° and 37° Celsius. When, at the end of the 40 days, the volatile solids in the biosolids at the beginning of that period is reduced by less than 17 percent, vector attraction reduction is achieved;

(d) the specific oxygen uptake rate (SOUR) for biosolids treated in an aerobic process shall be less than or equal to 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20° Celsius;

(e) the pH of biosolids shall be raised to 12 or higher by alkali addition and, without the addition of more alkali, shall remain at 12 or higher for two hours and then at 11.5 or higher for an additional 22 hours;

(f) the percent solids of biosolids generated in a wastewater treatment process must be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials. The biosolids must thereafter be managed in such a way that the moisture content of the biosolids does not increase such that compliance with the 90 percent solids requirement is maintained until such time as the biosolids is land applied in accordance with section 7 (2) or distributed in accordance with 7 (4) of this regulation .

2 One of the following vector attraction reduction processes are required for Class A compost:

(a) Class A compost must be treated in an aerobic process for 14 days or longer. During that time, the temperature of the compost must be higher than 40° Celsius and the average temperature of the compost must be higher than 45° Celsius. After the vector attraction

reduction process is completed the carbon to nitrogen ratio of the compost must be greater than or equal to 15:1 and less than or equal to 35:1;

(b) Class A compost must be retained in curing piles for at least 21 days. After the 21 day period, the carbon to nitrogen ratio of the Class A compost must be greater than or equal to 15:1 and less than or equal to 35:1 and must not re-heat, upon standing, under the following conditions:

(i) compost is aerated and formed into a pile no smaller than 3 metres in diameter and 2 metres high with compost having a moisture content between 35 percent and 60 percent;

(ii) the pile must be formed in a location where the ambient temperature remains in the range of 5° to 30° Celsius;

(iii) 3 days after the pile has been formed, the temperature of the compost is measured at a depth of 60 cm into the pile from the outside surface of the pile;

(iv) the compost must not re-heat upon standing to greater than 20° Celsius above ambient temperature.

3 If one of the above vector attraction reduction methods cannot be met, then a test method or treatment process specified in protocols approved by the director, may be used as an alternative means of showing that vector attraction reduction has been achieved.

4 Class B biosolids must meet the vector attraction reduction processes specified in section 1 of this Schedule or meet one of the following alternatives:

(a) if Class B biosolids, with fecal coliform levels determined to be < 2 000 000 MPN per gram of total solids, are injected into the soil, then the biosolids must be injected below the land surface within 8 hours after being discharged from the pathogen treatment process and no significant amount of biosolids must remain on the soil surface 1 hour after application;

(b) if Class B biosolids, with fecal coliform levels determined to be < 2 000 000 MPN per gram of total solids, are incorporated by tillage, then the biosolids must be incorporated within 8 hours after being discharged from the pathogen treatment process and no significant amount of biosolids must remain on the soil surface 6 hours after application.

5 If Class B compost does not meet the vector attraction reduction processes specified in section 1 of this Schedule, and Class B compost is incorporated by tillage, then no significant amount of Class B compost must remain on the soil surface 6 hours after application.

6 If Class B biosolids or Class B compost is applied to soil using other technologies, practices or methods, Class B biosolids or Class B compost must be applied in accordance with best management practices described in the most recent edition of the organic matter recycling guidelines approved by the director.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 3 - Pathogen Reduction Limits (Schedule 4 follows)
Section Number:	Schedule 3

Schedule 3

Pathogen Reduction Limits

1 Fecal coliform levels must be determined to be < 1 000 MPN per gram of total solids (dry weight basis) for

(a) Class A biosolids, and

(b) Class A compost (not produced from yard waste alone).

2 Determination of fecal coliform levels is not required for Class A compost produced from yard waste alone.

3 For Class A biosolids or Class A compost (not produced from yard waste alone), 7 representative samples must be taken

(a) from every 1 000 tonnes dry weight, or

(b) once per year,

whichever occurs first.

4 The required fecal coliform levels must be met in all 7 representative samples.

5 Fecal coliform levels for Class A biosolids and Class A compost (not produced from yard waste alone) must be met either before, or at the same time as, the vector attraction reduction requirements are met.

6 Fecal coliform levels must be met and vector attraction reduction methods must be complete before

(a) Class A biosolids are used for land application,

(b) Class A biosolids in quantities less than 5 cubic metres and Class A compost are prepared for distribution, and

(c) Class A biosolids and Class B biosolids are used to prepare biosolids growing medium.

7 For Class B biosolids and Class B compost,

(a) the biosolids or compost must be treated through one of the process options listed in section 7 (a) to (e) of Schedule 1,

(b) fecal coliform levels must be determined to be < 2 000 000 MPN per gram of total solids (dry weight basis), and

(c) fecal coliform levels must be determined to be < 1 000 MPN per gram of total solids (dry weight basis) if the land application methods stated in section 2 of Schedule 8 apply.

8 The required fecal coliform levels for Class B biosolids and Class B compost must be met for the geometric mean of 7 discrete samples analyzed at intervals of

(a) at least every 1 000 tonnes dry weight, or (b) once per year, whichever comes first.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 4 - Quality Criteria (Schedule 5 follows)
Section Number:	Schedule 4

Schedule 4 - Quality Criteria

1 Substance concentrations, expressed in µg/g dry weight must not exceed the limits set out in the following table:

	Column 1	Column 2	Column 3
Substance	**Class A compost**	**Biosolids growing medium**	**Class B biosolids Class B compost**
Arsenic	13	13	75
Cadmium	3	1.5	20
Chromium	100	100	1 060
Cobalt	34	34	150
Copper	400	150	2 200
Lead	150	150	500
Mercury	2	0.8	15
Molybdenum	5	5	20
Nickel	62	62	180
Selenium	2	2	14
Zinc	500	150	1 850

2 Retail-grade organic matter and managed organic matter must have

(a) foreign matter content less than or equal to 1 percent dry weight, and

(b) no sharp foreign matter , such as glass or metal shards, in a size and shape that can cause injury.

3 Class A biosolids must not contain elements at concentrations above those specified in Trade Memorandum T-4-93 (September 1997), Standards for Metals in Fertilizers and Supplements, as amended from time to time, as adopted by Agriculture and Agri-Food Canada under the Fertilizers Act (Canada) and regulations.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Schedule 5 - Sampling and Analyses — Protocols and Frequency (Schedule 6 follows)
Section Number:	Schedule 5

Schedule 5

[am. B.C. Reg. 321/2004, s. 19 (n) and (o).]

Sampling and Analyses — Protocols and Frequency

1 All required analyses for

(a) Class A biosolids and Class B biosolids,

(b) biosolids growing medium,

(c) Class A compost that is not solely produced from yard waste, and

(d) Class B compost,

must be carried out at intervals of

(e) at least every 1 000 tonnes dry weight of organic matter , or

(f) once per year,

whichever occurs first.

2 A director may increase the frequency of sampling required based on provincial organic matter sampling guidelines.

3 Analyses must be in accordance with the procedures described in "British Columbia Laboratory Methods Manual: 2003 — for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples", (2003, Ministry of Water, Land and Air Protection), or by suitable alternate procedures authorized by a director.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 6 - Record-keeping (Schedule 7 follows)
Section Number:	Schedule 6

Schedule 6

[am. B.C. Reg. 321/2004, s. 19 (g) and (n).]

Record-keeping

1 Temperatures and retention times must be monitored and recorded each working day during the production of

(a) Class A biosolids, and

(b) Class A compost (not produced from yard waste alone) and Class B compost.

2 Temperature and retention time records must be kept at the facility for at least 36 months and must be made available for inspection by an officer, or sent to a director or an inspector or officer authorized under the Agricultural Land Reserve Act, the Soil Conservation Act or the Forest Land Reserve Act, upon request.

3 The results of analysis required by this regulation must be kept at the facility for at least 36 months after the production of

(a) Class A biosolids and Class B biosolids,

(b) biosolids growing medium,

(c) Class A compost (not solely produced from yard waste), and

(d) Class B compost.

4 The results of analysis must be made available for inspection by an officer or sent to a director or an inspector or officer authorized under the Agricultural Land Reserve Act, the Soil Conservation Act or the Forest Land Reserve Act, upon request.

5 The land application plan signed by a qualified professional as required by Division 1 of Part 3 of the regulation must be kept at the facility, or kept by the registered owner of the land application site, for at least 36 months after application and must be made available for inspection by an officer, or sent to a director or an inspector or officer authorized under the Agricultural Land Reserve Act, the Soil Conservation Act or the Forest Land Reserve Act, upon request.

6 A director may request a sampling report from the facility operators or the registered owner of the land for at least 36 months after application of managed organic matter .

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 7 - Land Application Plan for Managed Organic Matter (Schedule 8 follows)
Section Number:	Schedule 7

Schedule 7

[am. B.C. Reg. 321/2004, s. 19 (g).]

Land Application Plan for Managed Organic Matter

1 The land application plan for managed organic matter must provide all of the following:

(a) the full legal name and address of the facilities where the managed organic matter is produced;

(b) the name of the local contact, local address, and telephone number for the discharger of managed organic matter ;

(c) the name and address of the qualified professional producing the land application plan;

(d) the name of the registered owner of the land upon which the land application of managed organic matter will take place;

(e) the street address and legal description of the land application site;

(f) the location and boundaries of the land application site, and provide map or plan;

(g) written authorization of registered owner(s) or his or her agent(s) for the land application of managed organic matter ;

(h) the intended commencement date and subsequent dates for land application;

(i) storage and leachate management requirements for managed organic matter at the application site;

(j) a physical description of the constituents, including foreign matter , of the managed organic matter to be applied.

2 In addition to the requirements of section 1, the land application plan for managed organic matter must provide the following:

(a) fecal coliform densities;

(b) vector attraction reduction process or management method;

(c) the moisture content of the managed organic matter ;

(d) Total Kjeldahl Nitrogen (TKN) (µg/g) dry weight basis;

(e) ammonia plus ammonium and nitrate nitrogen (µg/g) dry weight basis;

(f) plant available phosphorus and potassium (µg/g) dry weight basis;

(g) calculation of soil conditioner and/or crop nutrient requirements;

(h) soil concentrations (µg/g) of substances set out in Schedule 4 before application under the plan;

(i) pH and electrical conductivity in the soil where the managed organic matter is to be applied;

(j) substance concentrations set out in Schedule 4 in the managed organic matter to be applied;

(k) pH and electrical conductivity in the managed organic matter to be applied.

3 In addition to the requirements of section 1, the land application plan must provide the following:

(a) projected concentrations in soil of substances set out in Schedule 4 at the location of land application for each year after application;

(b) methods to measure soil concentrations of substances set out in Schedule 4 after each year's application;

(c) management methods for specific conditions for each site described within the plan or as specified by a director;

(d) special procedures if the plan is to land apply Class B biosolids with fecal coliform levels greater than or equal to 1 000 MPN per gram of total solids;

(e) special procedures if the plan is to land apply Class B biosolids that do not meet the vector attraction reduction process requirements specified in this regulation ;

(f) special procedures if the plan is to land apply Class B compost that does not meet the maturity requirements specified in this regulation ;

(g) application rate in dry tonnes per hectare for each year of the plan that provides the desired fertilizer nutrient levels and/or soil conditioner levels required to establish and/or sustain the vegetation or crops on the land application site, while at the same time minimizing the potential for adverse environmental impacts;

(h) a post-application monitoring plan if the proposed application rates exceed the annual crop nutrient requirement, including potential changes in soil and vegetation quality.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) Schedule 8 - Land Application Methods for Managed Organic Matter (Schedule 9 follows)
Section Number:	Schedule 8

Schedule 8
Land Application Methods for Managed Organic Matter

1 Class B biosolids and Class B compost with fecal coliform levels greater than or equal to 1 000 MPN per gram of total solids, or that have not been processed to reduce vector attraction, must comply with all of the following:

(a) be applied only to land application sites with restricted public access or use;

(b) not be applied to land where the groundwater table at the time of application is within one metre of the surface;

(c) be applied only if

(i) domestic animal grazing is restricted for 60 days and food crops for human consumption with harvested parts above the surface of the land are not to be grown for 18 months, and

(ii) food crops for human consumption with harvested parts below the surface of the land are not to be grown for 38 months;

(d) be applied with the following minimum distances:

(i) 30 metres to potable water sources and irrigation wells, lakes, rivers, streams, farm dwellings and off-property occupied dwellings or boundaries of property zoned for residences or recreation;

(ii) 20 metres to major arterial roads or highways;

(iii) 10 metres to minor public roads excluding logging roads;

(e) have visible signage, for 38 months after the most recent application each road or path to the land application site and for 38 months after the most recent application;

(f) have signage that clearly indicates:

(i) that the biosolids derived from a wastewater treatment plant have been applied to the land application site;

(ii) that the public should avoid ingesting plant material from the site with harvested parts above the surface until the end of the 18 month moratorium;

(iii) that the public should avoid ingesting plant material from the site with harvested parts below the surface until the end of the 38 month moratorium;

(iv) the domestic animal restrictions specified in paragraph (c) of this section;

(v) a name and telephone number for additional information.

2 Class B biosolids and Class B compost with fecal coliform levels less than 1 000 MPN per gram of total solids that meet the requirements for vector attraction reduction for Class B biosolids and Class B compost specified in Schedule 2 must

(a) be applied with the following minimum distances:

(i) 30 metres to potable water sources and irrigation wells, lakes, rivers, streams, farm dwellings and off-property occupied dwellings or boundaries of property zoned for residences or recreation;

(ii) 20 metres to major arterial roads or highways;

(iii) 10 metres to minor public roads excluding logging roads, and
(b) not be applied to land where the groundwater table at the time of application is within one metre of the surface.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 9 - Land Application Plan for Managed Organic Matter (Schedule 8 follows)
Section Number:	Schedule 7

Schedule 9
Generic Soil Standards for Cobalt, Molybdenum, Nickel and Selenium Where Managed Organic Matter Has Been Applied

1 Site-specific numeric soil standards for a land application plan for managed organic matter may be developed using protocols approved by the director.

2 The following soil standards, expressed in µg/g dry weight, must not be exceeded in soil to which managed organic matter has been applied in accordance with a land application plan that does not include site-specific standards:

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Substance	**Agricultural Land (AL)**	**Urban Park Land (UPL)**	**Residential Land (RL)**	**Commercial Land (CL)**	**Industrial Land (IL)**
Cobalt	40	50	50	300	300
Molybdenum	5	10	10	40	40
Nickel	150	100	100	500	500
Selenium	2	3	3	10	10

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation** **B.C. Reg. 18/2002** **O.C. 84/2002**
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 10 - Matrix Soil Standards for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury (Inorganic) and Zinc Where Managed Organic Matter Has Been Applied (Schedule 11 follows)
Section Number:	Schedule 10

Schedule 10 -
Matrix Soil Standards for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury (Inorganic) and Zinc Where Managed Organic Matter Has Been Applied

1 Site-specific numeric soil standards for a land application plan for managed organic matter may be developed using protocols approved by the director.

2 Soil standards, expressed in µg/g dry weight in the following tables, must not be exceeded in soil to which managed organic matter has been applied in accordance with a land application plan that does not include site-specific standards.

Consult director for further advice.

Tables and Notes follow:

Table 1 — Soil Standards: Arsenic [1]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[2]
Human Health Protection						
Intake of contaminated soil	100	100	100	300		[3], [4]
Groundwater used for drinking water	15	15	15	15	15	[5]

Environmental Protection						
Toxicity to soil invertebrates and plants	50	50	50	100	100	
Livestock ingesting soil and fodder	25					
Major microbial functional impairment	NS					6
Groundwater flow to surface water used by aquatic life						
Freshwater	20	20	20	20	20	5
Marine	25	25	25	25	25	5
Groundwater used for live stock watering	15					5
Groundwater used for irrigation watering	25	25	25			5

Notes to Table 1

1. All values are in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
2. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
3. Standard has been derived based on results of clinical studies at sites. Standard represents the rounded sum of the toxicologically-based value plus the soil ingestion clinical study factor. For AL, PL and RL the soil ingestion clinical study factor is 80 µg/g. For CL soil ingestion the clinical study factor is 240 µg/g.
4. Intake pathway of exposure modeled is inadvertent ingestion of soil.
5. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 14.9 µg/g.
6. NS - no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

Table 2 — Soil Standards: Cadmium [7]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[8]
Human Health Protection						
Intake of contaminated soil	3 or 35	3 or 35	3 or 35	100		[9], [10], [11]
Groundwater used for drinking water						
pH < 6.5	1.5	1.5	1.5	1.5	1.5	[12], [13]
pH 6.5 - < 7.0	3	3	3	3	3	[12], [13]
pH 7.0 - < 7.5	15	15	15	15	15	[12], [13]
pH 7.5 - < 8.0	200	200	200	200	200	[12], [13]
pH ≥ 8.0	1 000	1 000	1 000	1 000	1 000	[12], [13]
Environmental Protection						
Toxicity to soil invertebrates and plants	70	70	70	500	500	
Livestock ingesting soil and fodder	9					
Major microbial functional impairment	NS					[14]
Groundwater flow to surface water used by						

aquatic life Freshwater						
pH < 7.0	2	2	2	2	2	[12], [13]
pH 7.0 - < 7.5	2.5	2.5	2.5	2.5	2.5	[12], [13]
pH 7.5 - < 8.0	25	25	25	25	25	[12], [13]
pH ≥ 8.0	150	150	150	150	150	[12], [13]
Groundwater flow to surface water used by aquatic life Marine						
pH < 7.0	2	2	2	2	2	[12], [13]
pH 7.0 - < 7.5	3.5	3.5	3.5	3.5	3.5	[12], [13]
pH 7.5 - < 8.0	35	35	35	35	35	[12], [13]
pH ≥ 8.0	200	200	200	200	200	[12], [13]
Groundwater used for livestock watering						
pH < 6.0	2.5					[12], [13]
pH 6.0 - < 6.5	6					[12], [13]
pH 6.5 - < 7.0	30					[12], [13]
pH 7.0 - < 7.5	200					[12], [13]

pH 7.5 - < 8.0	3 000					12, 13
pH ≥ 8.0	20 000					12, 13
Groundwater used for irrigation watering						
pH < 6.5	2	2	2			12, 13
pH 6.5 - < 7.0	3	3	3			12, 13
pH 7.0 - < 7.5	15	15	15			12, 13
pH 7.5 - < 8.0	200	200	200			12, 13
pH ≥ 8.0	1 000	1 000	1 000			12, 13

Notes to Table 2

7. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
8. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
9. If land is used to grow produce for human consumption, the standard is 3 µg/g; if not, the standard is 35 µg/g.
10. The 3 µg/g standard has been derived based on results of clinical studies at sites. It represents the rounded remainder of the toxicologically-based value, 35 µg/g, minus the soil ingestion clinical study factor, 32 µg/g.
11. Intake pathway of exposure modeled is inadvertent ingestion of soil.
12. The pH is the pH of the soil at a site.
13. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 1.3 µg/g.
14. NS - no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

Table 3 — Soil Standards: Chromium [15]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	**16**
Human Health Protection						
Intake of contaminated soil	100	100	100	300		17, 18
Groundwater used for drinking water	60	60	60	60	60	19, 20
Environmental Protection						
Toxicity to soil invertebrates and plants	300	300	300	700	700	19
Livestock ingesting soil and fodder	150 50					18 21
Major microbial functional impairment	50					19, 22
Groundwater flow to surface water used by aquatic life						
Freshwater	60 65	60 65	60 65	60 65	60 65	18, 22 20, 21
Marine	60 95	60 95	60 95	60 95	60 95	18, 20 20, 21
Groundwater used for	60					23

livestock watering						
Groundwater used for irrigation watering	60	60	60			[23]

Notes to Table 3

15. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
16. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
17. Intake pathway of exposure modeled is inadvertent ingestion of soil.
18. Standard is for chromium+6.
19. Standard is for chromium (total).
20. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 58.9 µg/g.
21. Standard is for chromium+3.
22. Standard is set equal to the Canadian Council of Ministers of the Environment, 1999 - Nutrient and energy cycling check value.
23. Standard is applicable to both chromium+3 and chromium+6.

Table 4 — Soil Standards: Copper [24]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[25]
Human Health Protection						
Intake of contaminated soil	15 000	15 000	15 000	50 000		[26]
Groundwater used for drinking water						
pH < 5.0	250	250	250	250	250	[27] [28],
pH 5.0 - < 5.5	400	400	400	400	400	[27] [28],
pH 5.5 - < 6.0	1 500	1 500	1 500	1 500	1 500	[27] [28],
pH 6.0 - < 6.5	15 000	15 000	15 000	15 000	15 000	[27] [28],
pH ≥ 6.5	350 000	350 000	350 000	350 000	350 000	[27] [28],
Environmental Protection						
Toxicity to soil invertebrates and plants	150	150	150	250	250	
Livestock ingesting soil and fodder	150					[29]
Major microbial functional impairment	NS					[30]

Groundwater flow to surface water used by aquatic life						
pH < 5.0	90	90	90	90	90	[27] [28],
pH 5.0 - < 5.5	100	100	100	100	100	[27] [28],
pH 5.5 - < 6.0	200	200	200	200	200	[27] [28],
pH 6.0 - < 6.5	1 500	1 500	1 500	1 500	1 500	[27] [28],
pH ≥ 6.5	30 000	30 000	30 000	30 000	30 000	[27] [28],
Groundwater used for livestock watering						
pH < 5.0	100					[27] [28],
pH 5.0 - < 5.5	150					[27] [28],
pH 5.5 - < 6.0	500					[27] [28],
pH 6.0 - < 6.5	5 000					[27] [28],
pH ≥ 6.5	90 000					[27] [28],
Groundwater used for irrigation watering						
pH < 5.0	100	100	100			[27] [28],
pH 5.0 - < 5.5	150	150	150			[27],

						[28]
pH 5.5 - < 6.0	350	350	350			[27], [28]
pH 6.0 - < 6.5	3 500	3 500	3 500			[27], [28]
pH ≥ 6.5	75 000	75 000	75 000			[27], [28]

Notes to Table 4

24. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
25. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
26. Intake pathway of exposure modeled is inadvertent ingestion of soil.
27. The pH is the pH of the soil at a site.
28. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 74.0 µg/g.
29. Standard is applicable to livestock other than sheep. Consult director for further advice.
30. NS - no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

49. Standard varies with receiving water hardness (H). H = 100 - < 200 mg/L as $CaCO_3$ is assumed.

Table 5 — Soil Standards: Lead [31]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[32]
Human Health Protection						
Intake of contaminated soil	500	500	500	1 000		[33] [34],
Groundwater used for drinking water						
pH < 6.0	100	100	100	100	100	[35] [36],
pH 6.0 - < 6.5	250	250	250	250	250	[35] [36],
pH ≥ 6.5	4 000	4 000	4 000	4 000	4 000	[35] [36],
Environmental Protection						
Toxicity to soil invertebrates and plants	1 000	1 000	1 000	2 000	2 000	
Livestock ingesting soil and fodder	350					
Major microbial functional impairment	NS					[37]
Groundwater flow to surface water used by aquatic life						
pH < 5.5	150	150	150	150	150	[35],

						[36]
pH 5.5 - < 6.0	250	250	250	250	250	[35] [36],
pH 6.0 - < 6.5	2 000	2 000	2 000	2 000	2 000	[35] [36],
pH ≥ 6.5	40 000	40 000	40 000	40 000	40 000	[35] [36],
Groundwater used for livestock watering						
pH < 5.5	150					[35] [36],
pH 5.5 - < 6.0	250					[35] [36],
pH 6.0 - < 6.5	1 500					[35] [36],
pH ≥ 6.5	30 000					[35] [36],
Groundwater used for irrigation watering						
pH < 5.5	150	150	150			[35] [36],
pH 5.5 - < 6.0	400	400	400			[35] [36],
pH 6.0 - < 6.5	3 500	3 500	3 500			[35] [36],
pH ≥ 6.5	100 000	100 000	100 000			[35] [36],

Notes to Table 5

31. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
32. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
33. Intake pathway of exposure modeled is inadvertent ingestion of soil.
34. Standard has been derived based on clinical studies at sites. Standard represents the rounded sum of the toxicologically-based value, 115 µg/g, plus the soil ingestion clinical study factor, 385 µg/g. For CL soil ingestion the clinical study factor is 650 µg/g.
35. The pH is the pH of the soil at a site.
36. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concen-tration is 108.6 µg/g.
37. NS - no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

Table 6 — Soil Standards: Mercury (inorganic) [38]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[39]
Human Health Protection						
Intake of contaminated soil	15	15	15	40		[40]
Groundwater used for drinking water	NS	NS	NS	NS	NS	[41]
Environmental Protection						
Toxicity to soil invertebrates and plants	100	100	100	150	150	
Livestock ingesting soil and fodder	0.6					
Major microbial functional impairment	20					[42]
Groundwater flow to surface water used by aquatic life Freshwater or Marine	NS	NS	NS	NS	NS	[41]
Groundwater used for livestock watering	NS					[41]
Groundwater used for irrigation	NS	NS	NS			[41]

watering						

Notes to Table 6

38. All values are in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.

39. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.

40. Intake pathway of exposure modeled is inadvertent ingestion of soil.

41. NS - no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

42. Standard is set equal to the Canadian Council of Ministers of the Environment, 1999 - Nutrient and energy cycling check value

Table 7 — - Soil Standards: Zinc [43]

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Note
Site-specific Factor	**Agricultural Land(AL)**	**Urban Park Land(UPL)**	**Residential Land(RL)**	**Commercial Land(CL)**	**Industrial Land(IL)**	[44]
Human Health Protection						
Intake of contaminated soil	10 000	10 000	10 000	30 000		[45]
Groundwater used for drinking water						
pH < 5.0	150	150	150	150	150	[46] [47],
pH 5.0 - < 5.5	200	200	200	200	200	[46] [47],
pH 5.5 - < 6.0	300	300	300	300	300	[46] [47],
pH 6.0 - < 6.5	1 000	1 000	1 000	1 000	1 000	[46] [47],
pH 6.5 - < 7.0	7 500	7 500	7 500	7 500	7 500	[46] [47],
pH ≥ 7.0	15 000	15 000	15 000	15 000	15 000	[46] [47],
Environmental Protection						
Toxicity to soil invertebrates and plants	450	450	450	600	600	
Livestock ingesting soil and fodder	200					
Major microbial functional	320					[48]

impairment						
Groundwater flow to surface water used by aquatic life Freshwater						
pH < 6.0	150	150	150	150	150	[46], [47], [49],
pH 6.0 - < 6.5	300	300	300	300	300	[46], [47], [49],
pH 6.5 - < 7.0	1 500	1 500	1 500	1 500	1 500	[46], [47], [49],
pH ≥ 7.0	3 000	3 000	3 000	3 000	3 000	[46], [47], [49],
Groundwater flow to surface water used by aquatic life Marine						
pH < 6.5	150	150	150	150	150	[46], [47], [49],
pH 6.5 - < 7.0	300	300	300	300	300	[46], [47], [49],
pH 7.0 - < 7.5	2 000	2 000	2 000	2 000	2 000	[46], [47], [49],
pH ≥ 7.5	35 000	35 000	35 000	35 000	35 000	[46], [47], [49],
Groundwater used for livestock						

watering						
pH < 5.5	150					46, 47
pH 5.5 - < 6.0	200					46, 47
pH 6.0 - < 6.5	500					46, 47
pH 6.5 - < 7.0	3 000					46, 47
pH ≥ 7.0	7 000					46, 47
Groundwater used for irrigation watering						
pH < 6.0	150	150	150			46, 47
pH 6.0 - < 6.5	500	500	500			46, 47
pH 6.5 - < 7.0	3 000	3 000	3 000			46, 47
pH ≥ 7.0	15 000	15 000	15 000			46, 47

Notes to Table 7

43. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 of the Contaminated Sites Regulation , B.C. Reg. 375/96, or alternate methods acceptable to the director.
44. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
45. Intake pathway of exposure modeled is inadvertent ingestion of soil.
46. The pH is the pH of the soil at a site.
47. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 138.1 µg/g.
48. Standard is set equal to the Canadian Council of Ministers of the Environment, 1999 - Nutrient and energy cycling check value.

Consult director for further advice.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 11 - Requirements for Biosolids Growing Medium (Schedule 12 follows)
Section Number:	Schedule 11

Schedule 11
Requirements for Biosolids Growing Medium

1 Biosolids growing medium must be derived from either Class A biosolids or Class B biosolids that meet the pathogen and vector attraction reduction requirements for Class A biosolids specified in Schedules 1, 2, and 3.

2 The following standards for biosolids growing medium must be met:

(a) substance concentrations, listed in Schedule 4, Column 2;

(b) Total Kjeldahl Nitrogen (TKN) < 0.6 percent by weight;

(c) carbon to nitrogen ratio, (C:N) ratio must be > 15:1;

(d) organic matter content must not exceed 15 percent dry weight.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 12 - Organic Matter Suitable for Composting (Schedule 13 follows)
Section Number:	Schedule 12

Schedule 12

Organic Matter Suitable for Composting

[am. B.C. Reg. 198/2007, s. (a).]

1 Only the organic matter in the following table may be composted into Class A compost or Class B compost:

Table — Organic Matter Used for Compost

Column 1 — Organic Matter	Column 2 — Constituents of Organic Matter
animal bedding	animal bedding derived from straw, paper, hog fuel, wood chips, bark, shavings or sawdust.
biosolids	stabilized municipal sewage sludge resulting from a municipal waste water treatment process or septage treatment process which has been sufficiently treated to reduce pathogen densities and vector attraction to allow the sludge to be beneficially recycled in accordance with the requirements of this regulation .
brewery waste/winery waste	used or diverted grain, malt, hop flowers, berries, fruit, leaves and twigs and yeast resulting from brewing or wine making process.
domestic septic tank sludge	sludge removed from a septic tank used for receiving, treating and settling domestic sewage.
fish wastes	fish carcasses and parts from harvested wild stocks, commercial aquaculture operations and fish processing facilities. This would include offal, viscera and mortalities from fish and shellfish. It would also include faeces captured from commercial aquaculture net pens.
food waste	recyclable food for humans that has been diverted from residential, commercial or institutional sources.

hatchery waste	broken or unhatched eggs, unhatched chicks, membranes, embryonic fluids and eggshell.
manure	animal excreta from pets, animals in zoological facilities, fish held in commercial aquaculture or aquarium facilities, livestock, farmed game or poultry, this does not include the management of animal excreta (manure) on farms as defined as agricultural waste in B.C. Reg. 131/92 but does include animal excreta (manure) not included within the scope of B.C. Reg. 131/92.
milk processing waste	sludge or biomass from treatment of milk or fluid milk which has been diverted from human food consumption.
plant matter derived from processing plants	fruit, vegetable and vegetative material derived from fruit and vegetable processing plants, these are materials which have been removed from an agricultural operation and no longer fit within the definition of agricultural waste (agricultural vegetation waste) as defined in B.C. Reg. 131/92.
poultry carcasses	carcasses of domestic fowls, such as chickens, turkeys, ducks or geese, raised for meat or eggs. This would include offal and viscera as well as mortalities from fowl which died from reported "Federally Reported Diseases".
red-meat waste	carcasses of red-meat animals such as cattle, swine, sheep, fallow deer, farmed game and farmed bison.
untreated and unprocessed wood residuals	clean (non-contaminated and untreated) wood from lumber manufacture, e.g. shavings, sawdust, chips, hog fuel, ground mill ends and land clearing waste which has been ground with the majority of the greenery removed and no soil present but does not include construction and demolition debris.
whey	the serum or watery part of milk that remains after the manufacture of cheese.
yard waste	clean and untreated wood waste or non-food vegetative matter resulting from gardening operations, landscaping, and land clearing; yard waste does not include wood waste derived from construction or demolition. Neither human or animal food waste that is diverted from residential, commercial or institutional sources, nor manure, is yard waste.

Addresses the following:	Contamination / Organic matter
General Intent:	Manage Organic Matter recycling
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act, Health Act**
Name of Regulation:	**Organic Matter Recycling Regulation**
	B.C. Reg. 18/2002
	O.C. 84/2002
Details:	[includes amendments up to B.C. Reg. 198/2007, June 30, 2007]
Date:	Deposited February 5, 2002
Applicable Section:	(All) - Schedule 13 – Notification
Section Number:	Schedule 13

Schedule 13
[am. B.C. Reg. 321/2004, s. 19 (g).]
Notification

1 The discharger must submit the following information to a director at least 30 calendar days before the intended land application:
(a) full legal name and address of the discharger.....
(b) name of the local contact and local address for the discharger of managed organic matter .....
(c) street address and legal description of the land application.....
(d) registered owner of the land upon which the land application of managed organic matter will take place..... ..
(e) land upon which the land application of managed organic matter will take place is
(i) in the Agricultural Land Reserve (ALR)? Yes ..... No .....
(ii) Forest Land Reserve (FLR)? Yes ..... No .....
(iii) a watershed used for a permitted water supply under B.C. Reg. 230/92, the Safe Drinking Water Regulation ? Yes ..... No .....
(iv) Agricultural land? Yes ..... No .....
(f) If ALR or agricultural land, will it be used
(i) to grow edible crops with harvested parts above ground?
Yes ..... No .....
(ii) to grow edible crops with harvested parts below ground?
Yes ..... No .....
(iii) for tree crops? Yes ..... No .....
(iv) for livestock grazing? Yes ..... No .....
(v) for forage crops? Yes ..... No .....
(g) any previous waste management permit number, if known.....
(h) description of the managed organic matter to be applied.....
(i) intended date(s) for land application for that year.....
(j) application rate(s).....
(k) cumulative additions for that year of substances listed in Schedule 4.....

(l) pre-approved, site-specific numeric soil standards, if applicable.....
(m) attached map and/or plan identifying the bounds of the land application site.
(n) written authorization by registered owner or lessee for the land application of managed organic matter attached.

Note: this regulation replaces B.C. Reg. 334/93.

[Provisions of the Environmental Management Act, S.B.C. 2003, c. 53, relevant to the enactment of this regulation : sections 21 and 138]

Addresses the following:	Contamination / Organic matter
General Intent:	Applicaton of Soil Amendments (printed)
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act; Health Act**
Name of Regulation:	**Code of Practice for Soil Amendments**
	B.C. Reg. 210/2007
	O.C. 470/2007 and M169/2007
Details:	
Date:	Deposited June 21 and 26, 2007, effective September 1, 2007
Applicable Section:	(All) Part 1 to Part 3 (Schedule 1 follows)
Section Number:	1 to 12

Part 1 — Definitions

Definitions

1 In this regulation:

"application site" means a parcel of land, or 2 or more contiguous parcels of land, to which soil amendments are, or are intended to be, applied under a land application plan;

"average precipitation", for an area, means the most recently available average monthly precipitation figures published for the area by Environment Canada;

"discharger", in relation to the application of soil amendments to an application site, means,

(a) if the owner of the facility that produced the soil amendments applies the soil amendments under contract with the registered owner of the application site, the facility owner, and

(b) otherwise, the registered owner of the application site;

"domestic sewage" has the same meaning as in the Municipal Sewage Regulation;

"foreign matter" means a contaminant that does not readily decompose, including, without limiting this, demolition waste, metal, glass, plastic, rubber, and leather, but does not include silt, sand, rocks, stones, or gravel, in pieces smaller than 2.5 centimetres in diameter, and other similar-sized minerals naturally occurring in soil ;

"land application plan" means a plan that complies with section 8;

"MPN" means an estimate of the most probable number of living organisms in a sample, determined using the applicable method described in the British Columbia Environmental Laboratory Manual: 2005 — for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples, as amended from time to time (Victoria, 2005), published by the minister;

"qualified professional", in relation to a duty or function under this code , means an individual ho

(a) is registered in British Columbia with a professional organization, is acting under that organization's code of ethics, and is subject to disciplinary action by that organization, and

(b) through suitable education, experience, accreditation and knowledge, may reasonably be relied on to provide advice within his or her area of expertise, which area of expertise is applicable to the duty or function;

" soil amendment " means

(a) fly ash derived from the burning of wood, other than wood that has been immersed in marine waters,

(b) residuals from the primary or secondary treatment of liquid waste produced after 1995 from a pulp or paper mill, including domestic sewage if it is mixed with those residual solids,

(c) lime mud derived from pulp or paper mill processes or waste lime,

(d) residuals from the treatment of water for domestic use or use in industrial processes, or

(e) industrial residue of wood that has not been treated with glue, paint, a preservative or another substance harmful to humans, animals or plants;

"storage facility" means a storage facility described in section 3;

"storage site" means a site described in section 4;

"vector" means a carrier organism that is capable of transmitting a pathogen from one facility, waste source, product or organism to another facility, waste source, product or organism.

Part 2 — Soil Amendments Storage

Storage methods

2 (1) If soil amendments described in paragraph (a), (b) or (d) of the definition in section 1 are stored before being applied to land under a land application plan, they must be stored

(a) in a storage facility in accordance with the requirements of section 3, or

(b) at a storage site in accordance with the requirements of section 4.

(2) Soil amendments may be stored on a farm only if all of the soil amendments are scheduled to be used on that farm under a land application plan.

Storage facility

3 (1) Except for the period during which soil amendments may be stored at a storage site in accordance with section 4, soil amendments must be stored in a structure, including, without limiting this, a reservoir, lagoon, cistern, gutter, tank or bermed area, that

(a) is located at least 15 metres from any watercourse and 30 metres from any source of water used for domestic purposes, and

(b) has sufficient capacity to prevent, and is maintained in a manner that prevents, the escape of the soil amendments.

(2) For the purposes of subsection (1), "structure" does not include a vehicle or any mobile equipment used for the transportation of soil amendments.

Storage site

4 (1) Soil amendments may be stored temporarily at a storage site in order to be ready to be drawn upon for use as a fertilizer or soil conditioner, if the storage site is maintained in a manner that prevents the escape of the soil amendments.

(2) Soil amendments may be stored under subsection (1) only for the following periods:

(a) if the storage site is at least 30 metres from any watercourse or any source of water used for domestic purposes, not more than 9 months, and

(b) otherwise, not more than 2 weeks.

Rainy season storage using a storage site

5 (1) This section applies

(a) on Vancouver Island,

(b) in the Greater Vancouver Regional District,

(c) in the Fraser Valley Regional District, and

(d) in any other area of British Columbia for which the sum of the average precipitation for the months October to March inclusive exceeds 600 millimetres (24 inches).

(2) Soil amendments described in paragraphs (a), (b) and (d) of the definition in section 1 that are stored at a storage site must be covered from October 1 to March 31 so that the rain is kept out.

Part 3 — Application of Soil Amendments to Land

Application of soil amendments

6 (1) Soil amendments must not be applied to an application site if the soil amendments contain

(a) more than 1% foreign matter by dry weight,

(b) any sharp foreign matter, including glass or metal shards, in a size or shape that could cause injury,

(c) a substance set out in Column 1 of the table below in a concentration, expressed in µg/g of dry weight, exceeding the concentration set out opposite in Column 2.

Column 1 **Substance**	Column 2 **Concentration (µg/g dry weight)**
arsenic	75
cadmium	20
chromium	1 060
cobalt	150
copper	2 200
lead	500
mercury	5
molybdenum	20
nickel	180
selenium	14
zinc	1 850

(2) Soil amendments must not be applied to an application site if the application is likely to cause the site to become a contaminated site.

(3) Soil amendments must not be applied to an application site if the application site is a contaminated site and the application is likely to exacerbate the contamination of the site.

(4) Soil amendments must be applied to an application site in a manner that prevents leachate or runoff escaping from the application site.

If soil amendments contain domestic sewage

7 (1) Soil amendments that are described in paragraph (b) of the definition in section 1 and include domestic sewage must not be applied to land unless the groundwater table at the time of application is at least 1 metre below the surface of the land.

(2) Soil amendments referred to in subsection (1) must not be applied within

(a) 30 metres from a drinking water source, irrigation well, lake, river, stream, dwelling or boundary with land zoned for residential or recreation uses,

(b) 20 metres from a major public road, and

(c) 10 metres from a minor public road, other than a logging road.

(3) If soil amendments referred to in subsection (1) having a fecal coliform density greater than or equal to 1 000 MPN per gram by dry weight of total solids are applied to an application site,

(a) the land owner must not allow planting on the application site of food crops of which only the parts growing above ground are harvested for human consumption for at least 18 months after the application,

(b) the land owner must not allow planting on the application site of food crops of which parts growing below ground are harvested for human consumption for at least 38 months after the application, and

(c) the discharger must ensure that a sign, at least 1 m2 in size and legible to a person approaching the application site at each point of access, is posted for 38 months after the application of the soil amendments.

(4) A sign required under subsection (3) (c) must set out all the following:

(a) a description of the application site;

(b) that residuals from the primary or secondary treatment of pulp or paper mill liquid waste with a fecal coliform density greater than or equal to 1 000 MPN per gram of total solids dry weight basis have been applied to the site and the date of that application;

(c) that the public should avoid

(i) entering the application site for 38 months after the application,

(ii) ingesting plant material grown on the application site within 18 months after the application if the part of the plant ingested grows above the surface of the land, and

(iii) ingesting plant material grown on the application site within 38 months after the application if the part of the plant ingested grows below the surface of the land;

(e) that domestic animals should not be permitted to graze on the application site for 60 days after the application;

(f) the name and telephone number of a person who may be contacted for additional information.

Requirement for a land application plan

8 (1) If more than 5 m3 of soil amendments will be applied to an application site in a year, before applying the soil amendments the discharger must have a plan prepared in accordance with this section.

(2) A plan required under subsection (1) must

(a) be prepared and signed by a qualified professional, and

(b) provide all the following information:

(i) the full name and address of the facility where the soil amendments are produced;

(ii) the name, address and telephone number of an individual who is located at or near the application site and is the local contact for the discharger;

(iii) the full name and address of the qualified professional preparing the plan;

(iv) the name of the registered owner of the application site and the written authorization of that registered owner, or the agent of that registered owner, for that application of the soil amendments;

(v) the street address and legal description of the application site;

(vi) the latitude and longitude, and a description of the boundaries, of the application site;

(vii) a map or plan showing the location of the application site;

(viii) the intended dates for each application of soil amendments to the application site in the year;

(ix) conditions, specific to the application site, that may adversely impact the effective application or storage of the soil amendments or the beneficial use of the soil amendments, including, without limiting this, the gradient, drainage issues and type of groundcover;

(x) a physical description of the constituents, including foreign matter, of the soil amendments;

(xi) the street address and legal description of each storage facility and storage site where soil amendments intended to be applied to the application site will be stored;

(xii) a map or plan showing the location of those storage facilities and storage sites.

(3) A plan required under subsection (1) must provide

(a) the following information in relation to the soil amendments to be applied:

(i) moisture content expressed as a percentage of total weight;

(ii) the concentration of each substance set out in the table in section 6 expressed in µg/g of dry weight;

(iii) Total Kjeldahl Nitrogen (TKN) expressed in µg/g of dry weight;

(iv) ammonia plus ammonium and nitrate nitrogen expressed in µg/g of dry weight;

(v) plant-available phosphorus and potassium expressed in µg/g of dry weight;

(vi) if the soil amendments are those described in paragraph (b) of the definition in section 1 and include domestic sewage, the fecal coliform density expressed as MPN per gram by dry weight of total solids;

(vii) pH and electrical conductivity;

(viii) the application rate for the year, in dry tonnes per hectare, required to obtain the necessary fertilizer nutrient levels or soil conditioner levels to establish or sustain the intended crops or other vegetation on the land and minimize the potential for adverse environmental impacts, and

(b) the following information about the soil at the application site:

(i) a calculation of soil conditioner or crop nutrient requirements:

(ii) the pH and electrical conductivity before the first application of soil amendments and the projected pH and electrical conductivity before each subsequent application of soil amendments;

(iii) the concentration of each substance set out in the table in section 6, expressed in µg/g of dry weight, before the first application of the soil amendments and the projected concentrations, expressed in µg/g of dry weight, of each of those substances before each subsequent application of soil amendments.

(4) A plan required under subsection (1) must set out the following management methods or processes:

(a) management methods or processes to reduce or prevent the transmission of pathogens by vectors;

(b) the management methods that will be implemented at the storage facilities and storage sites at which the soil conditioners are stored to prevent the formation of leachate;

(c) if the fecal coliform density reported under subsection (3) (a) (i) is greater than or equal to 1 000 MPN per gram by dry weight of total solids, the management processes that will be implemented to prevent the spread of disease;

(d) the management methods or processes that will be implemented to address specific site conditions identified under subsection (2) (b) (ix);

(e) if the proposed application rates exceed the annual soil conditioning or crop nutrient requirements,

(i) a process for monitoring the composition of the soil on land to which soil amendments have been applied, and

(ii) a statement of the potential changes in the soil and vegetation quality the proposed application rates will cause.

Notice of application of soil amendments

9 (1) In this section:

"drinking water source" has the same meaning as in section 1 of the Drinking Water Protection Act;

"medical health officer", in relation to land, means the medical health officer appointed under the Health Act for the area in which the land is located;

"watershed" means a watershed from which water flows into a drinking water source.

(2) At least 30 days before a proposed application to land of more than 5 m3 of soil amendments, the discharger must give notice

(a) to a director,

(b) if the land has an agricultural land use as defined in the Contaminated Sites Regulation, or is in a watershed, to the medical health officer, and

(c) if the land is within an agricultural land reserve as defined in the Agricultural Land Commission Act, to the Provincial Agricultural Land Commission.

(3) Notice under subsection (2) must be given in the form set out in Schedule 1 and contain all the information required by that form.

(4) If within 30 days of receiving notice under subsection (2) (a) the director requests from the discharger additional information, the discharger

(a) must provide that additional information to the director and the medical health officer, and

(b) must not apply the soil amendments to the application site for at least 30 days after providing that additional information.

(5) If the information provided to the director under subsection (2) (a) or (4) satisfies the director that site-specific standards or management practices respecting the application of the soil amendments to the application site are necessary to protect human health or the environment, within 30 days after the later of receiving notice under subsection (2) (a) and receiving information under subsection (4), the director may require the discharger to comply with site-specific standards or management practices specified by the director.

(6) Within 30 days after receiving a notice under subsection (2) (b) or additional information under subsection (4) (a), if applicable, the medical health officer may provide written directions to the discharger

(a) prohibiting the application of the soil amendments to the application site, or

(b) imposing conditions on the application of the soil amendments to the application site.

(7) The time limits in subsections (5) and (6) may be amended by agreement between the director and the discharger or the director, the discharger and the medical health officer, as applicable.

Certification of qualified professional

10 After each application of soil amendments to an application site, the discharger must obtain the certification of a qualified professional that the application was carried out in accordance with the land application plan.

Sampling and analysis

11 (1) A discharger must ensure that sampling and analysis of soil amendments described in paragraphs (a) and (b) of the definition in section 1 are carried out by a qualified professional when the earlier of the following occurs:

(a) 1 000 tonnes dry weight of soil amendments are produced at the facility, or

(b) one year has passed since the facility started to produce the soil amendments or 1 year has passed since the last sampling and analysis, as applicable.

(2) A director may require more frequent sampling and analysis than is required under subsection (1) if the director considers this necessary or advisable in the circumstances.

(3) An analysis under this section must be made in accordance with the British Columbia Environmental Laboratory Manual: 2005 — for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples, as amended from time to time (Victoria, 2005), published by the minister, or by suitable alternative procedures authorized by a director.

Record keeping

12 (1) A discharger must

(a) retain the results of the sampling and analysis required under section 11 for 36 months after production of the soil amendments,

(b) make those results available for inspection by an officer, and

(c) on request, provide a copy of those results to a director or an official under the Agricultural Land Commission Act.

(2) A discharger must

(a) retain a land application plan, and each certification obtained under section 10 in relation to the application plan, for 36 months after the application of soil amendments under it,

(b) make the land application plan and certifications available for inspection by an officer, and

(c) on request, provide a copy of the plan and certifications to a director or an official under the Agricultural Land Commission Act.

Addresses the following:	Contamination / Organic matter
General Intent:	Applicaton of Soil Amendments (printed)
Applicability:	Agricultural Lands
Name of Act:	**Environmental Management Act; Health Act**
Name of Regulation:	**Code of Practice for Soil Amendments**
	B.C. Reg. 210/2007
	O.C. 470/2007 and M169/2007
Details:	
Date:	Deposited June 21 and 26, 2007, effective September 1, 2007
Applicable Section:	(All) Part 1 to Part 3 (Schedule 1 follows)
Section Number:	1 to 12

Schedule 1

Notification of Application of Soil Amendments to Land

[section 9 (2)]

(a) full legal name and address of the discharger (or if discharger is the land owner, name and address of facility)

.....

.....

(b) name of the local contact and local address for the discharger

.....

.....

(c) street address and legal description of the application site

.....

.....

(d) registered owner of the application site

.....

.....

(e) name of the qualified professional who prepared the land application plan

.....

.....

(f) application site is

(i) in the Agricultural Land Reserve (ALR)? Yes …….. No ……..

(ii) in a watershed of a drinking water source under the Drinking Water Protection Regulation, B.C. Reg. 200/2003? Yes …….. No ……..

(iii) Agricultural land? Yes …… No ……

(g) If ALR or agricultural land, will it be used

(i) to grow edible crops of which only the parts growing above ground are harvested?

Yes …… No ……

(ii) to grow edible crops of which the parts growing below ground are harvested?

Yes …… No ……

(iii) for tree crops? Yes …… No ……

(iv) for livestock grazing? Yes …….. No ……

(v) for forage crops? Yes …… No ……

(h) any previous waste management permit number for applying soil amendments to the same application site, if known

.....

(i) number of years that soil amendments have been applied to the application site

.....

(j) description of the soil amendment to be applied (sample analysis and amount)

.....

(k) intended dates for each application to the application site in the year to which the land application plan relates:

.....

(l) application rate

.....

(m) the concentration in the receiving soil of each substance set out in the table in section 6

.....

.....

(n) attached map and/or plan identifying the bounds of the application site.

(o) attached written authorization of the registered owner or lessee of the application site for the application of the soil amendments.

I certify that the information provided in this form is correct and complete.

.....

Print name

.....

Signature

.....

Telephone number

.....

Date

[Provisions relevant to the enactment of this regulation: Environmental Management Act, S.B.C. 2003, c. 53, sections 22 and 139] and Health Act, R.S.B.C. 1996, c. 179, sections 8 (1) and 33 (2)

Addresses the following:	Definitions
General Intent:	
Applicability:	All lands
Name of Act:	**Fish Protection A**
Name of Regulation:	**Riparian Areas Regulation**
	B.C. Reg. 376/2004
	O.C. 837/2004
Details:	[includes amendments up to B.C. Reg. 148/2006, May 19, 2006]
Date:	Deposited July 27, 2004, effective March 31, 2005
Applicable Section:	Definitions and interpretation
Section Number:	1 (1)

"natural features, functions and conditions" include but are not limited to the following:

(a) large organic debris that falls into the stream or streamside area, including logs, snags and root wads;

(b) areas for channel migration, including active floodplains;

(c) side channels, intermittent streams, seasonally wetted contiguous areas and floodplains;

(d) the multicanopied forest and ground cover adjacent to streams that

(i) moderates water temperatures,

(ii) provides a source of food, nutrients and organic matter to streams,

(iii) establishes root matrices that stabilize soils and stream banks, thereby minimizing erosion , and

(iv) buffers streams from sedimentation and pollution in surface runoff;

(e) a natural source of stream bed substrates;

(f) permeable surfaces that permit infiltration to moderate water volume, timing and velocity and maintain sustained water flows in streams, especially during low flow periods;

Addresses the following:	Biodiversity / Contamination / Erosion / Fish Protection / Riparian Buffers
General Intent:	Manage riparian areas as a buffer for fish protection
Applicability:	All lands
Name of Act:	**Fish Protection Act**
Name of Regulation:	**Riparian Areas Regulation**
	B.C. Reg. 376/2004
	O.C. 837/2004
Details:	[includes amendments up to B.C. Reg. 148/2006, May 19, 2006]
Date:	Deposited July 27, 2004, effective March 31, 2005
Applicable Section:	Purposes of this regulation
Section Number:	2

The purposes of this regulation are

(a) to establish directives to protect riparian areas from development so that the areas can provide natural features, functions and conditions that support fish life processes, and

(b) to facilitate an intergovernmental cooperation agreement between the ministry, Fisheries and Oceans Canada and the Union of British Columbia Municipalities including the ability for individual intergovernmental cooperation agreements with local governments for any of the following:

(i) the implementation of this regulation;

(ii) the confirmation of regionally significant fish by the ministry;

(iii) providing, sharing or confirming information on fish habitat conditions;

(iv) describing roles and responsibilities with reference to applicable and appropriate use of authority and program mandates;

(v) dispute resolution;

(vi) a compliance strategy, including education, training, monitoring, reporting, enforcement and auditing.

[am. B.C. Reg. 148/2006, s. 1.]

Addresses the following:	Definitions
General Intent:	Manage riparian areas as a buffer for fish protection
Applicability:	All lands
Name of Act:	**Fish Protection Act**
Name of Regulation:	**Riparian Areas Regulation**
	B.C. Reg. 376/2004
	O.C. 837/2004
Details:	[includes amendments up to B.C. Reg. 148/2006, May 19, 2006]
Date:	Deposited July 27, 2004, effective March 31, 2005
Applicable Section:	Definitions
Section Number:	1

"floodplain plant species" means plant species that are typical of an area of inundated or saturated soil conditions and that are distinct from plant species on freely drained adjacent upland sites;

"high water mark" means the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself, and includes the active floodplain;

"qualified environmental professional" means an applied scientist or technologist, acting alone or together with another qualified environmental professional, if

(a) the individual is registered and in good standing in British Columbia with an appropriate professional organization constituted under an Act, acting under that association's code of ethics and subject to disciplinary action by that association,

(b) the individual's area of expertise is recognized in the assessment methods as one that is acceptable for the purpose of providing all or part of an assessment report in respect of that development proposal, and

(c) the individual is acting within that individual's area of expertise;

Addresses the following:	Compliance / Soil disturbance
General Intent:	Allows Chief Forester to reduce annual allowable cut if approved planned 'soil disturbance' was exceeded
Applicability:	Forest lands (Crown)
Name of Act:	**Forest Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 157
Date:	This Act is current to May 28, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 4 General Tenure Provisions - Reductions in allowable annual cut
Section Number:	70 (1) thru (5)

Reductions in allowable annual cut

70 (1) In this section, "soil disturbance" has the same meaning as it has under the Forest and Range Practices Act.

(2) In a notice served on the holder of a major licence, community forest agreement or a woodlot licence, the chief forester, subject to subsection (3), may reduce the allowable annual cut

(a) available to the holder of the licence, if it is a tree farm licence, or

(b) for the licence, if other than a tree farm licence, or for the agreement

by an amount not exceeding the volume of timber that the chief forester determines was on an area authorized for harvest under a cutting permit issued under the licence or agreement.

(3) The chief forester may not make a reduction under subsection (2) unless he or she determines that the holder of the licence or agreement, on the area authorized for harvest, caused or allowed soil disturbance in excess of the limits specified in an operational plan that pertains to the cutting permit referred to in subsection (2).

(4) In a notice served on the holder of a major licence a community forest agreement or a woodlot licence the regional manager, subject to subsection (5), must reduce the allowable annual cut

(a) available to the holder of the licence, if it is a tree farm licence, or

(b) for the licence, if other than a tree farm licence, or for the agreement

by an amount not exceeding 5% of the volume of timber that the regional manager determines was on an area authorized for harvest under a cutting permit issued under the licence or agreement.

(5) The regional manager may not make a reduction under subsection (4) unless he or she determines that the holder of the agreement did not establish a free growing stand as required under the Forest and Range Practices Act.

Addresses the following:	Definitions / Biodiversity / Organic Matter
General Intent:	Manage for wildlife habitat, biodiversity and soil organc matter (Wildlife trees, coarse woody debris)
Applicability:	Forest lands (Crown)
Name of Act:	**Forest Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 157
Date:	This Act is current to May 28, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 3 Division 7.2 - Interpretation
Section Number:	43.6

Interpretation

43.6 In this Division and in section 47.3, "qualifying timber" means Crown timber, whether standing, felled or fallen, that is

(a) left on the site of a logging operation after that operation has concluded, other than timber left to fulfill a forest management function, such as

(i) a seed tree,

(ii) a wildlife tree, or

(iii) a log or stump that provides habitat for plants or animals or is a source of nutrients for soil development,

(b) dead, damaged, diseased, infested or windthrown, or

(c) removed in accordance with a community salvage licence to provide access to timber described in paragraph (a) or (b) or to ensure the safety of a person harvesting that timber.

Addresses the following:	Administrative issues / Biodiversity / Soil Productivity
General Intent:	Management of innovative forestry practices
Applicability:	Forest lands (Crown)
Name of Act:	**Forest Act**
Name of Regulation:	**Innovative Forestry Practices Regulation**
	B.C. Reg. 197/97
	O.C. 694/97
Details:	[includes amendments up to B.C Reg. 292/2003]
Date:	Deposited June 18, 1997
Applicable Section:	Schedule E, Section 2 - Authorized innovative forestry practices and activities
Section Number:	Schedule E, Section 2

Authorized innovative forestry practices and activities

2 The innovative forestry practices and other activities that may be the subject of an agreement under section 59.1 (1) of the Act are the following:

(a) the implementation of harvesting methods or silvicultural systems that may

(i) increase the total amount of timber available to harvest in the timber supply area over the amount available under standard practices, or

(ii) reduce the loss of productivity associated with permanent access structures from the loss of productivity under standard practices for similar terrain and timber types in the timber supply area;

(b) activities that result in the establishment of free-growing stands on

(i) previously unforested areas,

(ii) areas that are below stocking requirements and are not part of the holder's free-growing responsibilities under sections 69.1 (3) and 70 (3) of the Forest Practices Code of British Columbia Act, or

(iii) areas that

(A) have stands of timber with repressed growth or that contain brush or species that are not commercially valuable, and

(B) are not part of the holder's free-growing responsibilities under sections 69.1 (3) and 70 (3) of the Forest Practices Code of British Columbia Act;

(c) silviculture treatments on free-growing stands;

(d) silviculture treatments on sites that are not free growing in order to produce stands that exceed current growth performance or standards achieved using standard practices for the timber supply area;

(e) the collection and analysis of new data, in accordance with the specifications of the chief forester, to provide a more accurate representation of the forest composition and its expected rate of growth compared to the rate existing when the forest plan is submitted or at any other time determined by the regional manager;

(f) activities that will enhance and protect other resource values, including, but not limited to, water, fisheries, wildlife, biological diversity, soil productivity and stability, forage production, grazing and recreation values.

[am. B.C. Reg. 292/2003, Sch. E, s. 2.]

Addresses the following:	Administrative issues / Compaction / Erosion / Landslides
General Intent:	Management for terrain stability and soil disturbance (erosion, compaction)
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	
Details:	[SBC 2002] CHAPTER 69,.
Date:	Assented to November 21, 2002. This Act is current to June 11, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes
Applicable Section:	Part 9 — Regulations And Standards - 159 Terrain stability and soil disturbance
Section Number:	159

Terrain stability and soil disturbance

159 The Lieutenant Governor in Council may make regulations respecting terrain stability and soil disturbance.

Addresses the following:	Administrative issues / Soil disturbance
General Intent:	Defines requirements for site plans
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 3 — Site Plans
Section Number:	34

Content of site plans

34 (1) A person who prepares a site plan for an area referred to in section 29 (1) or (2) [free growing stands] of the Act must ensure that the plan identifies

(a) the standards units for the area, and

(b) the stocking standards and soil disturbance limits that apply to those standards units.

(2) A holder of a site plan must retain the plan until the holder

(a) has met the requirements in respect of the area to which the plan relates, or

(b) has been relieved under section 108 [government may fund extra expense or waive obligations] of the Act of the requirements in respect of the area to which the plan relates.

Addresses the following:	Biodiversity / Organic matter
General Intent:	Defines requirements for retention of coarse woody debris for biodiversity objectives
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 4 Practice Requirements - Division 5 — Biodiversity
Section Number:	68 (1) (2)

Coarse woody debris

68 (1) An agreement holder who carries out timber harvesting must retain at least the following logs on a cutblock:

(a) if the area is on the Coast, a minimum of 4 logs per hectare, each being a minimum of 5 m in length and 30 cm in diameter at one end;

(b) if the area is in the Interior, a minimum of 4 logs per hectare, each being a minimum of 2 m in length and 7.5 cm in diameter at one end.

(2) An agreement holder is exempt from subsection (1) if

(a) the holder's agreement or an enactment requires the holder to act in a manner contrary to that set out in subsection (1), or

(b) the holder carries out on the cutblock a controlled burn that is authorized under an enactment.

[en. B.C. Reg. 580/2004, s. 45.]

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Defines permitted levels of soil distrubance, compaction, road construction, and defines remediation requirements
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004. effective January 31, 2004
Applicable Section:	Part 4 - Division 1 – Soils - Soil Disturbance Limits
Section Number:	35 (1) thru (7)

Soil disturbance limits

35 (1) In this section:

"roadside work area" means the area adjacent to a road where one or both of the following are carried out:

(a) decking, processing or loading timber;

(b) piling or disposing of logging debris;

"sensitive soils" means soils that, because of their slope gradient, texture class, moisture regime, or organic matter content have the following risk of displacement, surface erosion or compaction:

(a) for the Interior, a very high hazard;

(b) for the Coast, a high or very high hazard.

(2) Repealed. [B.C. Reg. 580/2004, s. 30 (a).]

(3) An agreement holder other than a holder of a minor tenure who is carrying out timber harvesting must not cause the amount of soil disturbance on the net area to be reforested to exceed the following limits:

(a) if the standards unit is predominantly comprised of sensitive soils, 5% of the area covered by the standards unit, excluding any area covered by a roadside work area;

(b) if the standards unit not is not predominantly comprised of sensitive soils, 10% of the area covered by the standards unit, excluding any area covered by a roadside work area;

(c) 25% of the area covered by a roadside work area.

(4) An agreement holder may cause soil disturbance that exceeds the limits specified in subsection (3) if the holder

(a) is removing infected stumps or salvaging windthrow and the additional disturbance is the minimum necessary, or

(b) is constructing a temporary access structure and both of the following apply:

(i) the limit set out in subsection (3) (a) or (b), as applicable, is not exceeded by more than 5% of the area covered by the standards unit, excluding the area covered by a roadside work area;

(ii) before the regeneration date, a sufficient amount of the area within the standards unit is rehabilitated such that the agreement holder is in compliance with the limits set out in subsection (3).

(5) The minister may require an agreement holder to rehabilitate an area of compacted soil if all of the following apply:

(a) the area of compacted soil

(i) was created by activities of the holder,

(ii) is within the net area to be reforested, and

(iii) is a minimum of 1 ha in size;

(b) the holder has not exceeded the limits described in subsection (3);

(c) rehabilitation would, in the opinion of the minister,

(i) materially improve the productivity and the hydrologic function of the soil within the area, and

(ii) not create an unacceptable risk of further damage or harm to, or impairment of, forest resource values related to one or more of the subjects listed in section 149 (1) of the Act.

(6) An agreement holder who rehabilitates an area under subsection (4) or (5) must

(a) remove or redistribute woody materials that are exposed on the surface of the area and are concentrating subsurface moisture, to the extent necessary to limit the concentration of subsurface moisture on the area,

(b) de-compact compacted soils, and

(c) return displaced surface soils, retrievable side-cast and berm materials.

(7) If an agreement holder rehabilitates an area under subsection (4) or (5) and erosion of exposed soil from the area would cause sediment to enter a stream, wetland or lake, or a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act, the agreement holder, unless placing debris or revegetation would not materially reduce the likelihood of erosion , must

(a) place woody debris on the exposed soils, or

(b) revegetate the exposed mineral soils.

[am. B.C. Reg. 580/2004, s. 30.]

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Defines factors to be considered in setting objectives for soil during forest operations
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Schedule 1 [am. B.C. Regs. 580/2004, s. 69; 62/2005, s. 18; 223/2006, s. 4.]. Factors [sections 12, 16, 24, 25, 26]. - Factors relating to objective set by government for soils 1
Section Number:	Schedule 1 - Factors - 1

Factors relating to objective set by government for soils

1 The following factors apply to a result or strategy for the objective set out in section 5 [objectives set by government for soils] of the regulation:

(a) the amount of productive forest land base that will be occupied by permanent access structures;

(b) the amount of soil disturbance within the net area to be reforested, having regard to

(i) the classification of soils based on their biological, physical and chemical properties, including their sensitivity to displacement, surface erosion and compaction,

(ii) the kinds of disturbance that are detrimental to productivity and hydrological function,

(iii) the amount of detrimental disturbance that can occur without unduly compromising productivity or hydrological function, and

(iv) the extent to which rehabilitation efforts can mitigate the effects of detrimental disturbance.

Addresses the following:	Compaction / Productivity / Sealing
General Intent:	Minimize soil disturbance, erosion, compaction, landslides and other mass movements
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 2 — Forest Stewardship Plans - Division 1 — Content (Objectives)
Section Number:	5

Objectives set by government for soils

5 The objective set by government for soils is, without unduly reducing the supply of timber from British Columbia's forests, to conserve the productivity and the hydrologic function of soils.

Addresses the following:	Definitions
General Intent:	Minimize soil disturbance, erosion, compaction, landslides and other mass movements
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 1 — Interpretation - Definitions
Section Number:	1

"excavated or bladed trail" means a constructed trail that has

(a) an excavated or bladed width greater than 1.5 m, and

(b) a mineral soil cutbank height greater than 30 cm;

"fan destabilization" means one or more of the following that occur beyond the naturally occurring range of variability:

(a) an increase in the depth of a channel within an alluvial or colluvial fan;

(b) water and sediment that overflows the banks of a channel within an alluvial or colluvial fan and spreads out across the surface of the fan;

(c) the creation of a new channel within an alluvial or colluvial fan;

"forest health factors" means biotic and abiotic influences on a forest that have an adverse effect on the health of trees and other plants;

"gully process" means

(a) a rapid erosion of sediment that creates a channel or increases the depth of an existing channel, or

(b) a debris flood;

" soil disturbance" means disturbance to the soil in the net area to be reforested in a cutblock because of

(a) temporary access structures,

(b) gouges, ruts and scalps, or

(c) compacted areas,

but does not include the effect on the soil of rehabilitating an area in accordance with section 35;

"standards unit" means one or more parts of a cutblock for which part or parts there is only one of each of the following:

(a) soil disturbance limit;

(b) regeneration date;

(c) stocking standard;

(d) free growing date;

(e) free growing height for each species that contributes to establishing a free growing stand on the cutblock;

Addresses the following:	Definitions
General Intent:	Defines 'damage to the environment' in terms of soil disturbance, landslides and water contamination.
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 1 — Interpretation - Damage to the environment
Section Number:	3

3 (1) For the purpose of section 46 (1) and (1.1) [protection of the environment] of the Act, "damage" means any of the following that adversely alters an ecosystem:

(a) a landslide;

(b) a gully process on the Coast;

(c) a fan destabilization on the Coast;

(d) soil disturbance;

(e) the deposit into a stream, wetland or lake of

(i) a petroleum product,

(ii) a fluid used to service industrial equipment, or

(iii) any other similar harmful substance;

(f) a debris torrent that enters a fish stream;

(g) changes to soil .

Addresses the following:	Erosion / Landslides
General Intent:	Defines permitted levels of soil distrubance, compaction, road construction, and defines remediation requirements
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Forest Planning and Practices Regulation**
	B.C. Reg. 14/2004
	O.C. 17/2004
Details:	[SBC 2002] CHAPTER 69[includes amendments up to B.C. Reg. 104/2008, May 16, 2008]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 4 - Division 1 – Soils - Soil Disturbance Limits
Section Number:	37, 38, 39, 40

Landslides

37 An authorized person who carries out a primary forest activity must ensure that the primary forest activity does not cause a landslide that has a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act.

[en. B.C. Reg. 580/2004, s. 31.]

Gully processes

38 An authorized person who carries out a primary forest activity on the Coast must ensure that the primary forest activity does not cause a gully process that has a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act.

[en. B.C. Reg. 580/2004, s. 31.]

Natural surface drainage patterns

39 (1) If an authorized person constructs a road, a temporary access structure or a permanent access structure on an area, the person must maintain natural surface drainage patterns on the area both during and after construction.

(2) Despite subsection (1), if it is not practicable for an authorized person to maintain natural surface drainage patterns during the construction of a road, a temporary access structure or permanent access structure, the person must ensure that the altered surface drainage pattern is compatible with the original natural surface drainage pattern by the earlier of

(a) the end of the construction, and

(b) the next freshet.

[en. B.C. Reg. 580/2004, s. 31; am. B.C. Reg. 102/2005, s. 2.]

Revegetation

40 An authorized person who constructs or deactivates a road must ensure that soil exposed by the construction or deactivation is revegetated within two years after the construction or deactivation is completed if it is reasonably foreseeable that

(a) the erosion of the soil would cause

(i) sediment to enter a stream, wetland or lake, or

(ii) a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act, and

(b) revegetation would materially reduce the likelihood of erosion . [en. B.C. Reg. 580/2004, s. 31.]

Addresses the following:	Compaction / Erosion / Landslides / Productivity / Sealing
General Intent:	
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Fort St. John Pilot Project Regulation**
	B.C. Reg. 278/2001
	O.C. 1033/2001
Details:	[includes amendments up to B.C. Reg. 360/2006, December 15/2006]
Date:	Deposited November 30, 2001, effective December 1, 2001
Applicable Section:	General constraints on forest practices
Section Number:	28 (1) (2) (3)

General constraints on forest practices

28 (1) A participant or holder of a minor timber sale licence who carries out a forest practice on an area must ensure that the forest practice

(a) is consistent with any sustainable forest management plan, forest development plan and site level plan,

(b) does not result in any of the following:

(i) the felling or modifying of trees in an area that is

(A) a riparian reserve zone except at a stream crossing for a road, or

(B) a reserve identified in a site level plan;

(ii) damage to any resource feature;

(iii) equipment fueling and servicing fluids damaging forest resources;

(iv) the harvesting of areas adjacent to areas that are not greened-up except as permitted under Schedule E,

(c) if the area is a known scenic area, is consistent with any established visual quality objectives for the area,

(d) if the area is a known wildlife habitat area, is consistent with known general wildlife measures that are

(i) established for application in the wildlife habitat area, and

(ii) made available to the participant by the district manager or designated environmental official at the time the wildlife habitat area is made known,

(e) conserves the soil by

(i) maintaining slope stability,

(ii) maintaining surface drainage patterns, and

(iii) minimizing surface soil erosion,

(f) protects the productive capacity of harvested areas, by

(i) sustaining soil productivity,

(ii) rehabilitating compacted areas, and

(iii) rehabilitating areas occupied by access structures if the rehabilitation is necessary to sustain soil productivity, and

(g) protects water quality, water quantity, fish and fish habitat by

(i) maintaining shade over known temperature sensitive streams,

(ii) providing for safe passage of fish in streams for the purposes of spawning, rearing or migration,

(iii) maintaining fisheries-sensitive zones,

(iv) complying with any timing windows and measures established by a designated environmental official to adequately manage and conserve aquatic resources that apply to forest practices in and around streams, unless relieved of that requirement by the designated environmental official,

(v) protecting stream bank and stream channel stability, including minimizing or mitigating stream bank and stream channel disturbances at any crossing or immediately upstream or downstream from that crossing,

(vi) minimizing sediment entering into streams, and

(vii) protecting the structural integrity of any associated road and drainage structures.

(2) A participant or holder of a minor timber sale licence who

(a) carries out a forest practice, and

(b) knows that the carrying out of that forest practice contravenes subsection (1)

must take reasonable measures to mitigate any damage to the environment resulting directly or indirectly from that contravention.

(3) Subsection (1) (f) (i) does not apply to an area to which section 30.1 pertains.

[am. B.C. Reg. 292/2003, Sch. D, s. 14.]

Addresses the following:	Compaction / Disturbance / Erosion / Sealing / Soil productivity
General Intent:	Set soil protection objectives
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Range Planning and Practices Regulation**
	B.C. Reg. 19/2004
	O.C. 22/2004
Details:	[includes amendments up to B.C. Reg. 267/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Division 2 — Objectives
Section Number:	6

Division 2 — Objectives

Objectives set by government generally

5 The objectives set by government for the purposes of section 33 (1) (e) [content of range use plan for grazing], 34 (1) (e) [content of range use plan for hay cutting] and 35 (1) (d) [content of range stewardship plan] of the Act are set out in sections 6 to 11.

Objectives set by government for soils

6 The objectives set by government for soils are as follows:

(a) protect soil properties;

(b) minimize erosion and compaction;

(c) minimize undesirable disturbance to soils;

(d) maintain a vigorous and diverse cover of desirable plant species with a variety of root depths sufficient to protect the soil ;

(e) re-establish ecologically suitable vegetation after disturbance occurs;

(f) maintain ground cover, including sufficient litter and residual dry matter accumulation to protect soil ;

(g) minimize accelerated soil erosion;

(h) minimize sealing of the soil surface.

Addresses the following:	Buffers / Compaction / Erosion / Erosion (streams) / Landslides
General Intent:	
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Range Planning and Practices Regulation**
	B.C. Reg. 19/2004
	O.C. 22/2004
Details:	[includes amendments up to B.C. Reg. 267/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 2 Plans - Division 2 — Riparian and Upland Areas
Section Number:	

Riparian areas

30 A range agreement holder must not carry out a range practice if it would result in a material adverse affect on the ability of the riparian area to

(a) withstand normal peak flow events without accelerated soil loss, channel movement or bank movement,

(b) filter runoff,

(c) store and safely release water, and

(d) conserve wildlife habitat values in the area.

[am. B.C. Reg. 225/2006.]

Upland areas

31 A range agreement holder must not carry out a range practice on an upland area if the range practice would result in a material adverse affect on the upland area by substantially

(a) accelerating the rate of soil loss from the area,

(b) diminishing infiltration of water on the area,

(c) reducing moisture storage on the area, or

(d) decreasing stability of the area.

Addresses the following:	Compaction / Disturbance / Erosion / Organic Matter / Sealing / Soil Productivity
General Intent:	Sets objectives for soil protection
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Range Planning and Practices Regulation**
	B.C. Reg. 19/2004
	O.C. 22/2004
Details:	[includes amendments up to B.C. Reg. 267/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 2 Plans - Division 2 Objectives
Section Number:	6

Objectives set by government for soils

6 The objectives set by government for soils are as follows:

(a) protect soil properties;

(b) minimize erosion and compaction;

(c) minimize undesirable disturbance to soils;

(d) maintain a vigorous and diverse cover of desirable plant species with a variety of root depths sufficient to protect the soil ;

(e) re-establish ecologically suitable vegetation after disturbance occurs;

(f) maintain ground cover, including sufficient litter and residual dry matter accumulation to protect soil ;

(g) minimize accelerated soil erosion;

(h) minimize sealing of the soil surface.

Objectives set by government for water

8 The objectives set by government for water are as follows:

(a) maintain or improve water resources;

(b) maintain or promote healthy riparian and upland areas;

(c) maintain or promote riparian vegetation that provides sufficient shade to maintain stream temperature within the natural range of variability;

(d) maintain or promote desired riparian plant communities.

Addresses the following:	Administrative issues / Compaction / Erosion / Landslides / Sealing
General Intent:	Allows operators to vary from standard requirments re: minimum areas for soil disturbance, riparian buffers.
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Woodlot Licence Planning and Practices Regulation**
	B.C. Reg. 21/2004
	O.C. 24/2004
Details:	[includes amendments up to B.C. Reg. 268/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 2 — Woodlot Licence Plans,Division 2 — Woodlot Licence Plan Content - Alternative performance requirements
Section Number:	13 (1)

13 (1) A woodlot licence holder may propose in a woodlot licence plan an alternative performance requirement that specifies in relation to the plan

(a) an amount of soil disturbance for the purposes of section 24 (1) (a),

(b) an area for occupation by permanent access structures for the purposes of sections 25 (1) (a), (2) (a) or (3) (a),

(c) the stocking standards, regeneration date and free growing date for the purposes of section 35 (1) (a),

(d) the minimum riparian management area width, riparian reserve zone width and riparian management zone width for the purposes of one or more of section 36 (4) (a), 37 (3) (a) or 38 (2) (a),

(e) the circumstances in which cutting, modification or removal of trees may occur in a riparian reserve zone for the purposes of section 39 (1),

(f) the circumstances in which road construction may occur in a riparian management zone for the purposes of section 40 (1) (a),

(g) the proportion of the woodlot licence area that may consist of wildlife tree retention areas for the purposes of section 52 (1) (b),

(h) the quantity of logs to be retained for the purposes of section 54 (1) (a), and

(i) the measures that relate to resource features for the purposes of section 56 (1) (a).

Addresses the following:	Compaction / Erosion / Landslides / Sealing
General Intent:	Defines permitted levels of soil distrubance, compaction, road construction, and defines remediation requirements
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Woodlot Licence Planning and Practices Regulation**
	B.C. Reg. 21/2004
	O.C. 24/2004
Details:	[includes amendments up to B.C. Reg. 268/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 3 — Practice Requirements - Division 1 — Soils
Section Number:	24 thru 29

Soil disturbance limits

24 (1) A woodlot licence holder must not cause the amount of soil disturbance on the net area to be reforested to exceed

(a) the amount specified in the holder's woodlot licence plan, or

(b) 8%, if there is no amount specified in paragraph (a).

(2) A woodlot licence holder must not cause soil disturbance on any portion of the net area to be reforested to be concentrated in a manner that would be inconsistent with the objective set out in section 9 (1) (b) [established objectives].

(3) A woodlot licence holder may exceed the limit set out in subsection (1), if

(a) the holder is removing infected stumps or salvaging windthrow, and

(b) the additional disturbance is the minimum necessary.

Permanent access structure limits

25 (1) A woodlot licence holder must ensure that the maximum amount of the total area within a cutblock that is 5 ha or greater in size that is occupied by permanent access structures is

(a) the amount specified in the holder's woodlot licence plan, or

(b) 7%, if there is no amount specified in paragraph (a).

(2) A woodlot licence holder must ensure that the maximum amount of the total area within a cutblock that is less than 5 ha in size that is occupied by permanent access structures is

(a) the amount specified in the holder's woodlot licence plan, or

(b) 10%, if there is no amount specified in paragraph (a).

(3) Without limiting subsections (1) and (2), a woodlot licence holder must ensure that the maximum amount of the woodlot licence area that is occupied by permanent access structures is

(a) the amount specified in the holder's woodlot licence plan, or

(b) 7%, if there is no amount specified in paragraph (a).

Landslides

26 A woodlot licence holder who carries out a primary forest activity must ensure that the primary forest activity does not cause a landslide that has a material adverse effect on a matter referred to in section 149 (1) [objectives set by government] of the Act.

Gully processes

27 A woodlot licence holder who carries out a primary forest activity on the Coast must ensure that the primary forest activity does not cause a gully process that has a material adverse effect on a matter referred to in section 149 (1) [objectives set by government] of the Act.

Natural surface drainage patterns

28 (1) If a woodlot licence holder constructs a temporary access structure or a permanent access structure on an area, the holder must maintain natural surface drainage patterns on the area both during and after construction.

(2) Despite subsection (1), if it is not practicable for a woodlot licence holder to maintain natural surface drainage patterns during the construction of a temporary access structure or permanent access structure, the holder must ensure the altered surface drainage pattern is compatible with the original natural surface drainage pattern by the earlier of

(a) the end of the construction, and

(b) the next freshet.

Revegetation

29 A woodlot licence holder who constructs or deactivates a road must ensure that soil exposed by the construction or deactivation is revegetated within two years after the construction or deactivation is completed if it is reasonably foreseeable that

(a) the erosion of the soil would cause

(i) sediment to enter a stream, wetland or lake, or

(ii) a material adverse effect on a matter referred to in section 149 (1) [objectives set by government] of the Act, and

(b) revegetation would materially reduce the likelihood of erosion.

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Defines factors to be considered in setting objectives for soil during forest operations
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Woodlot Licence Planning and Practices Regulation**
	B.C. Reg. 21/2004
	O.C. 24/2004
Details:	[includes amendments up to B.C. Reg. 268/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Schedule 1 [am. B.C. Regs. 585/2004, s. 22; 106/2005, s. 13.]. Factors [sections 9, 11 and 12]. Factors relating to objective set by government for soils 3
Section Number:	Schedule 1 - Factors - 3

Factors relating to objective set by government for soils

3 The following factors may be used to determine if a woodlot licence plan is consistent with the objective set out in section 9 (1) (b) [established objectives]:

(a) the amount of productive forest land base that will be occupied by permanent access structures;

(b) the amount of soil disturbance within the net area to be reforested, having regard to

(i) the classification of soils based on their biological, physical and chemical properties, including their sensitivity to displacement, surface erosion and compaction,

(ii) the kinds of disturbance that are detrimental to productivity and hydrological function,

(iii) the amount of detrimental disturbance that can occur without unduly compromising productivity or hydrological function, and

(iv) the extent to which rehabilitation efforts can mitigate the effects of detrimental disturbance.

Addresses the following:	Definitions
General Intent:	
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Woodlot Licence Planning and Practices Regulation**
	B.C. Reg. 21/2004
	O.C. 24/2004
Details:	[includes amendments up to B.C. Reg. 268/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 1 — Interpretation - Damage to the environment
Section Number:	3 (1)

Damage to the environment

3 (1) For the purpose of section 46 (1) and (1.1) [protection of the environment] of the Act, "damage" means any of the following that adversely alters an ecosystem:

(a) a landslide;

(b) a gully process on the Coast;

(c) a fan destabilization on the Coast;

(d) soil disturbance;

(e) the deposit into a stream, wetland or lake of

(i) a petroleum product,

(ii) a fluid used to service industrial equipment, or

(iii) any other similar harmful substance;

(f) a debris torrent that enters a fish stream.

(g) changes to soil .

(2) A person who is carrying out fire control or suppression in accordance with an enactment is exempt from section 46 of the Act.

[am. B.C. Reg. 268/2007, s. (b).]

Addresses the following:	Definitions
General Intent:	
Applicability:	Forest lands (Crown)
Name of Act:	**Forest and Range Practices Act**
Name of Regulation:	**Woodlot Licence Planning and Practices Regulation**
	B.C. Reg. 21/2004
	O.C. 24/2004
Details:	[includes amendments up to B.C. Reg. 268/2007, July 26, 2007]
Date:	Deposited January 23, 2004, effective January 31, 2004
Applicable Section:	Part 1 — Interpretation - Definitions
Section Number:	1 (2)

"sensitive soil " means an area with one or both of the following:

(a) a slope of greater than 60%;

(b) indicators of potential slope instability;

" soil disturbance" means an area within a cutblock that is occupied by one or more of the following:

(a) an unrehabilitated temporary access structure;

(b) gouges, ruts or scalps that are outside of a temporary access structure;

(c) a compacted area;

Addresses the following:	Administrative issues / Erosion / Landslides
General Intent:	Protect community water quality by requiring the slope stability and erosion potential are mapped in community watersheds prior to logging activities.
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest Practices Code of British Columbia Act**
Name of Regulation:	**Stillwater Pilot Project Regulation**
	B.C. Reg. 96/2001
	O.C. 427/2001
Details:	[includes amendments up to B.C. Reg. 209/2007, June 21, 2007]
Date:	Deposited April 5, 2001
Applicable Section:	Assessments and mapping required by the Act and regulations
Section Number:	18 (1)

Assessments and mapping required by the Act and regulations

18 (1) Before making a Stillwater pilot forest stewardship plan available for review under this Part, the licensee must complete the following as if the Stillwater pilot forest stewardship plan were a forest development plan:

(a) a terrain stability hazard map and soil erosion potential map for that part of the Stillwater pilot forest stewardship plan that is within the community watershed in accordance with section 12 of the Operational and Site Planning Regulation

(b) forest health evaluation and assessment in accordance with section 13 of the Operational and Site Planning Regulation;

(c) a watershed assessment within the previous 3 years of the submission date for areas under the Stillwater pilot forest stewardship plan provided for and in accordance with section 14 of the Operational and Site Planning Regulation.

Addresses the following:	Compaction / Disturbance / Erosion / Productivity / Sealing
General Intent:	Define soil resource management goals for forestry operations in this project area
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest Practices Code of British Columbia Act**
Name of Regulation:	**Stillwater Pilot Project Regulation**
	B.C. Reg. 96/2001
	O.C. 427/2001
Details:	[includes amendments up to B.C. Reg. 209/2007, June 21, 2007]
Date:	Deposited April 5, 2001
Applicable Section:	Part 2 — Balancing Competing Values and Interests - Division 1 — Resource Value Goals - Resource value goals
Section Number:	Part 2 - Division 1: 9

Resource value goals

9 For purposes of Part 7 the following are the resource value goals for the Stillwater area:

(a) to minimize impacts on the water resource from forestry operations with the goal of maintaining or improving water quality and quantity including maintenance of natural stream flow rates and patterns;

(b) to maintain and improve physical access for domestic, fisheries, recreational, wildlife and industrial water users in the course of planning forestry operations;

(c) to minimize impacts on the soil resource by managing soil disturbance from forestry operations with the goals of conserving and protecting the soil and maintaining soil quality, quantity and function;

(d) to conserve, protect and restore biological diversity of forest and aquatic ecosystems and plant and animal species by planning and managing forest practices;

(e) to protect, maintain and improve the forest's natural ability to grow timber;

(f) to practise sustainable and economic utilization of the timber resource profile;

(g) to protect forest productivity by minimizing losses to fire, flood, insects, disease, windthrow, erosion, and other damaging agents, keeping levels within socially and economically acceptable thresholds;

(h) in cooperation with appropriate interest groups, federal and provincial agencies, to identify, manage and protect wildlife habitat, especially with regard to rare and endangered species;

(i) to identify and protect existing recreation features;

(j) to develop and manage for recreational opportunities in cooperation with government and local citizens;

(k) to manage the visual impact of harvesting and road construction activities at the landscape and the stand level;

(l) to identify and manage cultural heritage resources;

(m) to manage for the access needs of industry, recreation groups, the general public, government and first nations while managing productive land base losses to roads and trails;

(n) to minimize aquatic resource impacts from forestry operations with the goal of conserving, protecting and maintaining the biological productivity of all anadromous and resident fish waters;

(o) to manage wetlands, streams and lakeshore areas to minimize harmful impacts from forestry operations with the goal of protecting water quality, stream bank stability, fish habitat and wildlife habitat, and to provide for biological diversity;

(p) to carry out forest planning so that it will identify known tourism opportunities, incorporate protection measures that minimize harmful forestry impacts, and enhance access concurrent with harvesting development;

(q) to support energy and mineral exploration while taking into account development impacts on the forest land base;

(r) to carry out forest planning so that, for botanical forest products, it will minimize harmful forestry impacts, and manage for sustainable use;

(s) to promote sustainable development of natural resources on the land base that result in multiple benefits to the community;

(t) to invite, encourage and provide a forum for public participation in the planning process for the Stillwater area;

(u) to make it a priority to develop a system to ensure that a sustainable log supply from the licensee's production of appropriate grade timber is available in a timely manner, at fair market price, and for purchase by local small businesses;

(v) to strive to develop or find practical alternatives of brush control other than herbicides;

(w) to promote opportunities to educate and learn from the public, government agencies and first nations.

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Defines requirements for setting strategies and targets for soil and other value management
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest Practices Code of British Columbia Act**
Name of Regulation:	**Stillwater Pilot Project Regulation**
	B.C. Reg. 96/2001
	O.C. 427/2001
Details:	[includes amendments up to B.C. Reg. 209/2007, June 21, 2007]
Date:	Deposited April 5, 2001
Applicable Section:	Part 7 — Stillwater Pilot Forest Stewardship Plan Content - Division 1 — Management Strategies and Measurable Targets - Management strategies and measurable targets for achieving equivalent protection,
Section Number:	61 (1) (2)

Management strategies and measurable targets for achieving equivalent protection

61 (1) In addition to the strategies and targets required in section 59, the Stillwater pilot forest stewardship plan must establish strategies and measurable targets to ensure a level of protection at least equal to the level required under the Act and regulations for all of the following forest resources and resource features:

(a) soil ;

(b) water;

(c) biological diversity;

(d) fish and wildlife;

(e) recreation;

(f) cultural heritage resources;

(g) forest health;

(h) timber.

(2) The strategies and measurable targets established under subsection (1) must include the following:

(a) for soil :

(i) targets for maximum allowable site loss due to permanent access structures;

(ii) targets for maximum allowable soil disturbance within any portion of the net area to be reforested;

(iii) targets for the extent to which soil disturbance limits may be temporarily exceeded to construct temporary access structures;

(iv) targets for the maximum allowable time to complete the rehabilitation of temporary access structures;

(v) a statement that, where soil compaction has occurred during harvesting, the site will be rehabilitated before regeneration;

(vi) targets for the maximum allowable time to re-vegetate erodable soil surfaces during harvesting and road construction and deactivation;

(vii) targets for the minimum allowable time to re-vegetate operationally induced landslides;

(b) for water:

(i) strategies to maintain natural stream flow patterns;

(ii) strategies for yarding, according to stream class;

(iii) the minimum range of basal area retention for each riparian class of stream, wetland and lake;

(iv) strategies to maintain stream bank stability;

(v) strategies for addressing the licensee's operations within community watersheds;

(c) for biological diversity:

(i) harvesting strategies, including the silvicultural system to be employed, consistent with desired future forest condition for each forest stewardship zone;

(ii) regeneration strategies consistent with management emphasis and desired future forest condition for each forest stewardship zone;

(iii) the timeline to achieve 100% minimum variable retention or other partial harvesting system targets;

(iv) minimum retention targets for coarse woody debris in stands of old growth timber and second growth timber;

(d) for fish and wildlife:

(i) timing windows for helicopter harvesting within specified distances from mountain goat winter ranges, marbled murrelet nests and heron rookeries and any other fish or wildlife that are identified under Part 10 of the Operational and Site Planning Regulation;

(ii) timing windows and measures for harvesting and road construction, modification and deactivation activities in and around fish streams and fish stream crossings;

(iii) access management strategies;

(e) for recreation:

(i) strategies to identify recreation features and opportunities;

(ii) access management strategies;

(iii) strategies for permanent and temporary deactivation;

(f) for cultural heritage, necessary strategies to identify, document and manage cultural heritage resources;

(g) for forest health, management strategies for fire prevention and suppression, insects, disease and windthrow;

(h) for timber:

(i) minimum utilization standards for alder;

(ii) strategies for minor salvage;

(iii) strategies for reforestation;

(iv) stand management strategies;

(v) targets for maximum cutblock size and adjacency requirements;

(vi) targets consistent with the adoption of Vancouver Forest Region Free Growing Stocking Standards for

(A) species selection,

(B) stocking standards,

(C) regeneration dates, and

(D) free growing standards.

[am. B.C. Regs. 292/2003, Sch. H, s. 2; 209/2007, s. 1.]

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Defines requirements for setting strategies and targets for soil and other value management
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest Practices Code of British Columbia Act**
Name of Regulation:	**Stillwater Pilot Project Regulation**
	B.C. Reg. 96/2001
	O.C. 427/2001
Details:	[includes amendments up to B.C. Reg. 209/2007, June 21, 2007]
Date:	Deposited April 5, 2001
Applicable Section:	Part 7 — Stillwater Pilot Forest Stewardship Plan Content - Division 1 — Management Strategies and Measurable Targets - Requirements with respect to road activities
Section Number:	62

Requirements with respect to road activities

62 The Stillwater pilot forest stewardship plan must establish the following with respect to road construction, modification and deactivation activities to ensure a level of protection for forest resources and resource features at least equal to the level required under the Act and regulations:

(a) requirements for selecting and locating access structures including strategies to protect and conserve the soil and water resources, specifically addressing timing windows and construction measures in and about streams and fish and wildlife habitat;

(b) road layout and design specifications;

(c) drainage design objectives;

(d) requirements for design of bridges and culverts;

(e) objectives for revegetation of exposed mineral soil subject to erosion ;

(f) strategies for inspection, evaluation and maintenance of roads, bridges and major culverts;

(g) deactivation objectives and standards;

(h) measures to ensure that crossings of fish streams will provide safe passage for fish.

[am. B.C. Reg. 209/2007, s. 1.]

Addresses the following:	Erosion
General Intent:	Requires mapping of erosion potential in community watersheds prior to logging.
Applicability:	Forest Lands (Crown) - Defined Area
Name of Act:	**Forest Practices Code of British Columbia Act**
Name of Regulation:	**Stillwater Pilot Project Regulation**
	B.C. Reg. 96/2001
	O.C. 427/2001
Details:	[includes amendments up to B.C. Reg. 209/2007, June 21, 2007]
Date:	Deposited April 5, 2001
Applicable Section:	Division 2 — Map and Information Requirements - Map requirements for a Stillwater pilot forest stewardship plan
Section Number:	63 (1)

Map requirements for a Stillwater pilot forest stewardship plan

63 (1) The licensee must ensure that a Stillwater pilot forest stewardship plan includes the following information:

(i) if mapping is required under section 18 (1), the location of areas within a community watershed that have a high or very high soil erosion potential.

Addresses the following:	Administrative issues
General Intent:	Ensures persons installing sewerage systems (seepage fields) have necessary qualifications.
Applicability:	All lands
Name of Act:	**Health Act**
Name of Regulation:	**Sewerage System Regulation**
	B.C. Reg. 326/2004
	O.C. 701/2004
Details:	[includes amendments up to B.C. Reg. 372/2007, November 23, 2007]
Date:	Deposited July 8, 2004, effective May 31, 2005
Applicable Section:	Part 3 — Sewerage Systems - Authorized persons
Section Number:	7 (1)

Authorized persons

7 (1) A person is qualified to act as a registered practitioner if the person

(a) has successfully completed a post-secondary training program through

(i) the West Coast Onsite Wastewater Training Centre, administered by the British Columbia Onsite Sewage Association, or

(ii) through an institution that

(A) is designated, registered or accredited under an enactment of Canada or any province, except British Columbia, to offer post secondary education, and

(B) includes, as part of its curriculum, training in soil analysis and sewerage system construction and maintenance, and

(b) holds a registration certificate.

Addresses the following:	Administrative issues / Contamination
General Intent:	Ensure sewerage systems (seepage fields) are constructed in suitable soils
Applicability:	All lands
Name of Act:	**Health Act**
Name of Regulation:	**Sewerage System Regulation**
	B.C. Reg. 326/2004
	O.C. 701/2004
Details:	[includes amendments up to B.C. Reg. 372/2007, November 23, 2007]
Date:	Deposited July 8, 2004, effective May 31, 2005
Applicable Section:	Part 3 — Sewerage Systems - Filing
Section Number:	8 (2)

(2) Before construction of a sewerage system, an authorized person must file with the health authority, in a form acceptable to the health authority,

(a) information respecting

(i) the name, address and telephone number of the owner for whom the sewerage system is being constructed,

(ii) the type of structure the sewerage system will serve, and

(iii) the type, depth and porosity of the soil at the site of the sewerage system,

Addresses the following:	Contamination / Erosion / Landslides
General Intent:	To protect saturated and agricultural soils from inappropriate pesticide use and to prevent removal of vegation which prevents soil erosion or stabilizes a slope.
Applicability:	All lands
Name of Act:	**Integrated Pest Management Act**
Name of Regulation:	**Integrated Pest Management Regulation**
	B.C. Reg. 604/2004
	M422/2004 and M423/2004
Details:	[includes amendments up to B.C. Reg. 267/2006, October 1, 2006]
Date:	Deposited December 29, 2004
Applicable Section:	Division 7 — Standards for Use, Containment, Transport, Storage or Sale of Pesticide - Use requirements — all users
Section Number:	71 (2), (9) (10)

71 (2) A person described in subsection (1) must ensure that the following precautions are taken in carrying out the pesticide use:

(a) precautions to prevent unprotected human exposure to pesticide;

(b) precautions to ensure that domestic water sources, agricultural water sources and soil used for agricultural crop production are protected for their intended use;

(c) except as provided under subsection (12), precautions to avoid the use of pesticide over vertebrate wildlife or domestic animals that are visible to the user.

(9) A person described in subsection (1) must not

(a) use a residual pesticide on water-saturated soil , during heavy rainfall or if heavy rainfall is imminent, or

(b) spray a pesticide on foliage covered by ice or frost or if water is flowing on the foliage.

(10) A person described in subsection (1) must ensure that a use of herbicide does not remove vegetation that is necessary to

(a) prevent erosion of a stream bank

(b) prevent debris that would cause an unreasonable adverse effect from entering a stream, or

(c) maintain slope stability in areas where landslides have occurred.

Addresses the following:	Permitted land uses / Erosion / Flooding / Landslides
General Intent:	Authorizes an approving officer to refuse subdivision of lands subject ot natural hazards (flooding, erosion, landslides)
Applicability:	All lands
Name of Act:	**Land Title Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 250,
Date:	
Applicable Section:	
Section Number:	86 (1) (a) thru (d)

86 (1) Without limiting section 85 (3), in considering an application for subdivision approval, the approving officer may

(a) at the cost of the subdivider, personally examine or have an examination and report made on the subdivision,

(b) hear from all persons who, in the approving officer's opinion, are affected by the subdivision,

(c) refuse to approve the subdivision plan, if the approving officer considers that

(v) the land is subject, or could reasonably be expected to be subject, to flooding, erosion , land slip or avalanche,

(d) if the approving officer considers that the land is, or could reasonably be expected to be, subject to flooding, erosion , land slip or avalanche, the approving officer may require, as a condition of consent to an application for subdivision approval, that the subdivider do either or both of the following:

(i) provide the approving officer with a report certified by a professional engineer or geoscientist experienced in geotechnical engineering that the land may be used safely for the use intended;

(ii) enter into one or more covenants under section 219 in respect of any of the parcels that are being created by the subdivision.

Addresses the following:	Administrative issues / Erosion
General Intent:	Ensure adequate lands are acquired for Dams to take into account the effects of erosion
Applicability:	Defined Area
Name of Act:	**Libby Dam Reservoir Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 262,
Date:	Ths Act is Current to June 18, 2008.
Applicable Section:	2 Ministry or agency to acquire land
Section Number:	2

Ministry or agency to acquire land

2 The Lieutenant Governor in Council, by an order published in the Gazette, may appoint a ministry or a statutory agency of the government to acquire, on behalf and in the name of the government, all land in British Columbia necessary or convenient for

(a) the creation of a storage reservoir in accordance with the obligation undertaken by British Columbia under section 3 (c) of the agreement,

(b) works, undertakings, ways or water or conservation systems incidental to it, or which may, with advantage, be combined with it, and

(c) providing a reserve of land against the effects of erosion .

Addresses the following:	Administrative issues / Soil Deposit & Removal
General Intent:	Allows local government to manage soil removal and deposition and charge fees.
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 323
Date:	Act is current to June 18, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 22 — Miscellaneous Powers - Division 3 — Sundry Powers - Removal and deposit of sand, gravel and other soil
Section Number:	723 (1) thru (7)

Removal and deposit of sand, gravel and other soil

723 (1) This section applies to a regional district only if the regional district provides a service referred to in section 797.1 (1) (c).

(2) The board may, by bylaw, regulate or prohibit

(a) the removal of soil from, and

(b) the deposit of soil or other material on

any land in the regional district or in any area of the regional district.

(3) A bylaw under subsection (2) may make different regulations and prohibitions for different areas.

(4) Section 9 [spheres of concurrent authority] of the Community Charter applies to a provision in a bylaw under subsection (2) that

(a) prohibits the removal of soil , or

(b) prohibits the deposit of soil or other material and that makes reference to quality of the soil or material or to contamination.

(5) The board may, by bylaw, do one or more of the following:

(a) require the holding of a permit for

(i) the removal of soil from, or

(ii) the deposit of soil or other material on

any land in the regional district or in any area of the regional district;

(b) impose rates or levels of fees for a permit referred to in paragraph (a);

(c) impose rates or levels of fees for the activities referred to in paragraph (a).

(6) Fees under subsection (5) (b) or (c) may vary according to the quantity of soil removed or the quantity of soil or other material deposited, and the rates or levels of fees may be different for different areas of the regional district.

(7) A bylaw under subsection (5) (b) or (c) has no effect until it is approved by the minister

Addresses the following:	Administrative issues / Erosion / Flooding
General Intent:	Allow local government to prohibit removal of trees if this will cause erosion or flooding
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 323
Date:	Act is current to June 18, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Division 7 — Zoning and Other Development Regulation - Tree cutting permits
Section Number:	923

Tree cutting permits

923 (1) A board may, by bylaw, designate areas of land that it considers may be subject to flooding, erosion , land slip or avalanche as tree cutting permit areas.

(2) A bylaw may, in respect of an area designated under subsection (1),

(a) regulate or prohibit the cutting down of trees, and

(b) require an owner to obtain, on payment of a fee set by the bylaw, a permit before cutting down a tree.

(3) The bylaw may allow the board, at its discretion, to require an applicant to provide at the applicant's expense, a report certified by a qualified person, agreed upon by both parties, that the proposed cutting of trees will not create a danger from flooding or erosion .

Addresses the following:	Administrative issues / Erosion / Flooding / Landslides
General Intent:	Allow local government to prohibit develoment fo lands subject to natural hazaards.
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 323
Date:	Act is current to June 18, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 26 — Planning and Land Use Management - Division 9 — Permits and Fees - Designation of development permit areas - Development permits
Section Number:	919.1, 920 (7) (7.1)

Designation of development permit areas

919.1 (1) An official community plan may designate development permit areas for one or more of the following purposes:

(a) protection of the natural environment, its ecosystems and biological diversity;

(b) protection of development from hazardous conditions;

(c) protection of farming;

(h) establishment of objectives to promote energy conservation;

(i) establishment of objectives to promote water conservation;

(j) establishment of objectives to promote the reduction of greenhouse gas emissions.

Development permits 920

(7.1) For land designated under section 919.1 (1) (b), a development permit may do one or more of the following:

(a) specify areas of land that may be subject to flooding, mud flows, torrents of debris, erosion, land slip, rock falls, subsidence, tsunami, avalanche or wildfire, or to another hazard if this other hazard is specified under section 919.1 (1) (b), as areas that must remain free of development, except in accordance with any conditions contained in the permit;

(b) require, in an area that the permit designates as containing unstable soil or water which is subject to degradation, that no septic tank, drainage and deposit fields or irrigation or water systems be constructed;

(c) in relation to wildfire hazard, include requirements respecting the character of the development, including landscaping, and the siting, form, exterior design and finish of buildings and other structures;

(d) in relation to wildfire hazard, establish restrictions on the type and placement of trees and other vegetation in proximity to the development.

Addresses the following:	Erosion (streams)
General Intent:	Gives local goverment power to require remediation of erosion along banks, or power to appropriate lands to conduct the remediation
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 323
Date:	Act is current to June 18, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 15 - Division 6 - Sewers, Storm Drains and Drainage - Requirements respecting drainage works - Appropriation of stream channel or bed
Section Number:	542, 543

Requirements respecting drainage works

542 (1) In this section and section 543, "stream" means a stream as defined in the Water Act.

(2) A board may, by bylaw,

(a) establish requirements that must be met by persons undertaking the construction of

(i) dikes,

(ii) works to maintain the proper flow of water in a stream, ditch, drain or sewer in the regional district, or

(iii) works to reclaim or to protect part of the land mass of the regional district from erosion by action of the sea or a stream, or any other cause, and

(b) establish requirements that must be met by owners of dikes.

Appropriation of stream channel or bed

543 (1) For the purpose of constructing works referred to in subsection (2), a board may appropriate the land that constitutes the channel or bed of a stream that passes through the regional district, without compensation to the owner.

(2) The power under subsection (1) may be exercised in relation to one or more of the following:

(a) dikes;

(b) works to maintain the proper flow of water in a stream, ditch, drain or sewer in the regional district;

(c) works to reclaim or to protect part of the land mass of the regional district from erosion by action of the sea or a stream, or any other cause;

(d) works to protect all or part of the banks of the stream from erosion or damage;

(e) works to make a watercourse part of the regional district drainage system, whether the watercourse is on a highway or regional district or private land;

(f) works through, under or over land adjoining a highway to protect the highway from damage by water.

(3) Before exercising the power under subsection (1), the board must, by bylaw, define the channel or bed of the stream.

(4) A certified copy of every bylaw under subsection (3), together with a plan showing the channel or bed of the stream as defined in the bylaw, must be filed in the land title office of the district in which the land affected is located.

Addresses the following:	Erosion (streams)
General Intent:	Gives local goverment power to conduct remediation of erosion along banks
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 323
Date:	Act is current to June 18, 2008. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 15 - Division 8 – Miscellaneous - Authority subject to Water Act 555
Section Number:	555 (2)

(2) In addition, the following authorities of a regional district are subject to the applicable provisions of the Water Act:

(a) the authority to acquire, manage, extend and remove

(i) works to maintain the proper flow of water in a stream as defined in the Water Act, ditch, drain or sewer in the regional district,

(ii) dikes, or

(iii) works to reclaim or to protect part of the land mass of the regional district from erosion by action of the sea or a stream as defined in the Water Act, or any other cause;

Addresses the following:	Administrative issues / Erosion / Flooding
General Intent:	Gives this Regional District power to manage for erosion and flooding
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Government Act**
Name of Regulation:	**Peace River Regional District Regulation** **B.C. Reg. 109/90** **O.C. 465/90**
Details:	[includes amendments up to B.C. Reg. 418/99]
Date:	Deposited March 26, 1990
Applicable Section:	Erosion and flooding management
Section Number:	2

Erosion and flooding management

2 The Peace River Regional District is granted the additional power to manage erosion and flooding, including, without limitation, the powers of a district municipality under sections 552 and 553 of the Municipal Act 1 , as an extended service.

[en. B.C. Reg. 421/90.]

Addresses the following:	Administrative issues / Flooding / Landslides / Soil productivity
General Intent:	2.01 The purpose of these regulations is to assist in assuring the safe, healthful, equitable, efficient, economical and attractive subdivision of land for the benefit of the community as a whole.
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Services Act**
Name of Regulation:	**Subdivision Regulations**
	B.C. Reg. 262/70
	Regulation of the Minister
Details:	[includes amendments up to B.C. Reg. 555/2004, December 31, 2004]
Date:	
Applicable Section:	General - Information Required
Section Number:	4.06

Information required

4.06 In order that any proposed subdivision may be properly considered by the approving officer, the owner of any land being subdivided may be required to provide any of the following:

(a) topographic survey where the terrain is steep, irregular or otherwise difficult to appraise in respect of the subdivision suiting the configuration of the land being subdivided;

(b) spot elevations;

(c) a professional engineer's report on

(i) the effect on soil stability of disturbing natural grades or natural growth, or changing the moisture content of the soil by developing, using or occupying the land;

(ii) groundwater levels and conditions for as much of the year as is considered necessary;

(iii) the depth and extent of flooding and the likely frequency of its occurring.

Addresses the following:	Definitions
General Intent:	Purpose – "2.01 The purpose of these regulations is to assist in assuring the safe, healthful, equitable, efficient, economical and attractive subdivision of land for the benefit of the community as a whole."
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Services Act**
Name of Regulation:	**Subdivision Regulations**
	B.C. Reg. 262/70
	Regulation of the Minister
Details:	[includes amendments up to B.C. Reg. 555/2004, December 31, 2004]
Date:	
Applicable Section:	Definitions
Section Number:	3.01

"slip" means the downward and outward movement of slope forming materials composed of natural rock, soils, artificial fills, or combinations of these materials, which movement may proceed by any one of 3 principal types of movement — falling, sliding or flowing — or by their combinations;

Addresses the following:	Permitted land uses / Erosion / Flooding / Landslides
General Intent:	Purpose – "2.01 The purpose of these regulations is to assist in assuring the safe, healthful, equitable, efficient, economical and attractive subdivision of land for the benefit of the community as a whole."
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Local Services Act**
Name of Regulation:	**Subdivision Regulations**
	B.C. Reg. 262/70
	Regulation of the Minister
Details:	[includes amendments up to B.C. Reg. 555/2004, December 31, 2004]
Date:	
Applicable Section:	General - Characteristics not approvable
Section Number:	4.04

Characteristics not approvable

4.04 Without limiting the generality of section 4.01, approval of any subdivision may be refused if it

(a) contains

(i) land which is subject to erosion , or

(ii) a parcel which is divided by land subject to erosion into areas not suited to the use to which it is intended,

(b) contains land which

(i) may slip when developed, used or occupied,

(ii) when developed, used or occupied may cause land on an adjacent parcel to slip, or

(iii) may be inundated by a land slip if land above on another parcel slips,

(c) contains land which is subject to flooding so as to render it unsuitable for the use to which it is intended, or

(d) contains land which because of inadequate drainage is not suitable for the use to which it is intended.

Addresses the following:	Contamination
General Intent:	Prevent contamination of soil due to escape of drilling fluids from their containment
Applicability:	Petroluem & Natural Gas Tenures
Name of Act:	**Petroleum and Natural Gas Act**
Name of Regulation:	**Drilling and Production Regulation**
	B.C. Reg. 362/98
	Oil and Gas Commission
Details:	[includes amendments up to B.C. Reg. 390/2004, August 13, 2004]
Date:	Deposited October 23, 1998, effective October 23, 1998
Applicable Section:	Part 4 — Well Operations - Division 2 — Blowout Prevention During Drilling - Ancillary equipment requirements
Section Number:	21 (4)

(4) The earthen pit referred to in subsection (1) (e) must

(a) be excavated to a depth of not less than 2 m,

(b) have side and back walls rising not less than 2 m above ground level,

(c) be constructed to resist the erosion of a high pressure flow of gas or liquid, and

(d) be shaped to contain any liquids.

Addresses the following:	Contamination
General Intent:	Prevent spread of nematode species
Applicability:	Defined Area
Name of Act:	**Plant Protection Act**
Name of Regulation:	**Golden Nematode Regulation**
	B.C. Reg. 253/79
	O.C. 1517/79
Details:	
Date:	Filed June 5, 1979
Applicable Section:	1 Interpretation, 2 Transportation of soil and plants, 3 Transportation of farm equipment and machinery
Section Number:	1, 2, 3

1 "gold nematode" means any specimen of the species of Globodera rostochiensis (Wollenweber) or Globodera pallida (Stone);

Transportation of soil and plants

2 (1) Unless authorized by the minister, no person shall convey plants, soil or plant parts with soil from

(a) the municipality of Central Saanich to a place outside that municipality, or

(b) a place within the municipality of Central Saanich to another place in that municipality.

(2) The minister may authorize the transportation or movement of soil , plants or plant parts under subsection (1) where soil , plants or plant parts with soil , as the case may be, do not contain any golden nematodes.

Transportation of farm equipment and machinery

3 No person shall convey machinery or equipment that is infested or likely to be infested with golden nematodes from

(a) the municipality of Central Saanich to a place outside that municipality, or

(b) a place within the municipality of Central Saanich to another place in that municipality

unless the farm machinery or farm equipment is disinfected in the manner required by an inspector.

Addresses the following:	Compaction / Erosion / Sealing
General Intent:	Prevent loss of productive land (soil) to roads or trails, and protect fish habitat
Applicability:	Forest Lands (Private)
Name of Act:	**Private Managed Forest Land Act**
Name of Regulation:	
Details:	[SBC 2003] CHAPTER 80
Date:	Assented to November 17, 2003. This Act is Current to June 18, 2008
Applicable Section:	Part 3 — Forest Management - Division 1 — Management Objectives on Private Managed Forest Land - 12 Soil conservation
Section Number:	12, 14

Soil conservation

12 The forest management objective for private managed forest land with respect to conservation of soil for areas where harvesting has been carried out is to protect soil productivity on those areas by minimizing the amount of area occupied by permanent roads, landings and excavated or bladed trails.

Fish habitat

14 (1) The forest management objective for private managed forest land with respect to the protection of fish habitat, both during and after harvesting, is to retain sufficient streamside mature trees and understory vegetation to protect all of the following:

(a) a natural variation in water temperatures;

(b) sufficient cover for fish;

(c) a continual source of large woody debris for stream channel stability purposes;

(d) a vigorous mass of roots capable of controlling stream bank erosion ;

(e) a filter to prevent the transport of sediment into stream channels;

(f) woody debris sufficient for in-stream habitat;

(g) a source of nutrients to the stream through litter fall.

(2) Nothing in subsection (1) requires an owner to retain additional streamside trees or additional understory vegetation to address problems with fish habitat that originate outside of the owner's private managed forest land.

Addresses the following:	Compaction / Sealing
General Intent:	Prevent loss of productive land (soil) to roads or trails
Applicability:	Forest Lands (Private)
Name of Act:	**Private Managed Forest Land Act**
Name of Regulation:	**Private Managed Forest Land Council Regulation, 2007** **B.C. Reg. 182/2007** **Council Regulation**
Details:	
Date:	Deposited June 20, 2007, effective September 1, 2007
Applicable Section:	Division 2 — Soil Conservation Part 3 — Owner Requirements - 13 Limits on areas that may be occupied by roads, 14 Limits on areas that may be occupied by logging trails
Section Number:	13, 14

Limits on areas that may be occupied by roads

13 An owner who carries out timber harvesting in a cutblock must restrict the amount of productive forest land within the cutblock that is converted to roads to the minimum necessary for the safe and efficient conduct of timber harvesting operations.

Limits on areas that may be occupied by logging trails

14 (1) An owner who carries out timber harvesting in a cutblock must restrict the amount of productive forest land within the cutblock that is converted to logging trails to the minimum necessary for the safe and efficient conduct of the timber harvesting operations.

(2) Subject to subsection (3), an owner who constructs logging trails when carrying out timber harvesting in a cutblock must rehabilitate the logging trails to the extent necessary to meet any reforestation requirements under section 31 for the cutblock.

(3) Subsection (2) does not apply to logging trails that, at the time of the construction of the logging trail, are reasonably expected to provide access for timber harvesting and other activities that are not wholly contained in the cutblock.

Addresses the following:	Erosion / Landslides
General Intent:	Require land owners to prevent erosion from causing damage to fish habitat, and to report landslides or debris flows.
Applicability:	Forest Lands (Private)
Name of Act:	**Private Managed Forest Land Act**
Name of Regulation:	**Private Managed Forest Land Council Regulation, 2007** **B.C. Reg. 182/2007** **Council Regulation**
Details:	
Date:	Deposited June 20, 2007, effective September 1, 2007
Applicable Section:	Division 3 — Protecting Water Quality and Fish Habitat - 15 Sediment transport or deposition, 19 Measures respecting exposed soils, 26 Notification of landslides and debris flows
Section Number:	15, 19, 26

Sediment transport or deposition

15 An owner carrying out a primary forest activity must not cause sediment or other material to be transported to, or deposited in, a stream if that sediment or material will have a material adverse effect on

(a) fish habitat, or

(b) water that is diverted by a licensed waterworks intake.

Measures respecting exposed soils

19 If, during road construction or deactivation, an owner exposes soil on an area

(a) that is outside of the running surface of the road, and

(b) where it is reasonably foreseeable that the surface erosion of the soil would cause a material adverse effect on fish habitat or water that is diverted by a licensed waterworks intake,

the owner must, within two years of the completion of the road construction or deactivation activity, revegetate the area or carry out other measures that will materially reduce the likelihood of surface soil erosion from the area.

Notification of landslides and debris flows

26 An owner must notify the council, within 24 hours of becoming aware that a landslide or debris flow has occurred on the owner's land, if the owner knows that the landslide or debris flow has deposited debris or sediment into a class A, B, C, D or E stream.

Addresses the following:	Permitted land uses / Erosion / Flooding / Landslides
General Intent:	Prevent development of land at risk of landslides, erosion, saturated soils.
Applicability:	Lands under Local Government Jurisdiction
Name of Act:	**Strata Property Act**
Name of Regulation:	**Bare Land Strata Regulations**
	B.C. Reg. 75/78
	O.C. 418/78
Details:	[includes amendments up to B.C. Reg. 546/2004, December 31, 2004]
Date:	Filed February 17, 1978
Applicable Section:	General - Requirements for approval
Section Number:	3 (1) (e)

Requirements for approval

3 (1) In considering an application for the approval of a bare land strata plan, the approving officer may

(e) refuse to approve the bare land strata plan, if he considers that

(v) it contains land that because of inadequate drainage is not suitable for the intended use or any other prospective use the approving officer considers likely,

(vi) the land is subject or could reasonably be expected to be subject to flooding, erosion , land slip or avalanche,

Addresses the following:	Definitions
General Intent:	Prevent erosion and sedimentation of streams
Applicability:	All lands
Name of Act:	**Water Act**
Name of Regulation:	**Water Regulation**
	B.C. Reg. 204/88
	O.C. 889/88
Details:	[includes amendments up to B.C. Reg. 390/2007, January 1, 2008]
Date:	Deposited May 13, 1988, effective June 1, 1988
Applicable Section:	Definitions
Section Number:	

" erosion " means the wearing away, by water, of the banks or bed of a stream or of the materials used in any works;

Addresses the following:	Erosion (streams)
General Intent:	Prevent erosion and sedimentation of streams
Applicability:	All lands
Name of Act:	**Water Act**
Name of Regulation:	**Water Regulation**
	B.C. Reg. 204/88
	O.C. 889/88
Details:	[includes amendments up to B.C. Reg. 390/2007, January 1, 2008]
Date:	Deposited May 13, 1988, effective June 1, 1988
Applicable Section:	Authorization for changes in and about a stream
Section Number:	44

Authorization for changes in and about a stream

44 (1) For the purposes of section 9 (2) of the Water Act, the following changes in and about a stream may be made without obtaining an approval or licence for that change, provided that the change is made in accordance with this regulation and in accordance with the terms and conditions, described in section 42, specified by a habitat officer:

(a) the installation, maintenance or removal of a stream culvert for crossing a stream for the purposes of a road, trail or footpath, provided that

(iii) the culvert inlet and outlet incorporate measures to protect the structure and the stream channel against erosion and scour,

(iv) if debris cannot safely pass, provision is made to prevent the entrance of debris into the culvert,

(v) the installation, maintenance or removal does not destabilize the stream channel,

(k) the repair or maintenance of existing dikes or existing erosion protection works to their original state, provided that the dikes or works were functional during the previous year;

(l) the construction or maintenance of storm sewer outfalls, provided that the storm sewer outfall is designed by a professional engineer, and constructed, maintained and used so as not to obstruct the flow of water in the stream or to cause erosion or scour in the stream;

(o) the construction or placement of erosion protection works or flood protection works during a flood emergency, but not including restoration works, declared under the Emergency Program Act, under the direction of the Crown in right of British Columbia, or its agents, or by a municipality;

(v) the removal of a beaver dam under section 9 of the Wildlife Act, provided that the removal is carried out in such a manner that downstream flooding and erosion do not occur;

(w) the construction of a temporary ford across a stream, provided that

(i) the construction occurs at a time in the year during which the construction can occur without causing harm to fish, wildlife or habitat,

(ii) the 1 in 10 year maximum daily flow over the ford is accommodated without the loss of the ford and without scouring the stream,

(iii) a stream culvert, if used, is designed and installed to pass the average low flow during the period of use,

(iv) the channel is protected against any anticipated erosion

(A) during the period of construction and use of the ford, and

(B) after the ford crossing is removed,

(v) sediment from approach ditches does not enter the stream,

(vi) the driveable running surface is erosion -free,
(vii) the stream remains in its channel and cannot be diverted down the road,

Addresses the following:	Erosion / Erosion (streams)
General Intent:	Requirements for rehabilitation of soil disturbance cause during forest fire control activities.
Applicability:	All lands
Name of Act:	**Wildfire Act**
Name of Regulation:	**Wildfire Regulation**
	B.C. Reg. 38/2005
	O.C. 94/2005
Details:	[includes amendments up to B.C. Reg. 215/2006, July 14, 2006]
Date:	Deposited February 11, 2005, effective March 31, 2005
Applicable Section:	Part 3 — Fire Control - 16 Rehabilitation if a person carries out fire control, 17 Rehabilitation if government carries out fire control
Section Number:	16, 17

Rehabilitation if a person carries out fire control

16 For the purposes of section 6 (3) (d) of the Act, on Crown land the prescribed requirements are that the person carrying out the industrial activity, as soon as practicable, must

(a) conduct a fire hazard assessment, ensuring that the fire hazard assessment includes an assessment of the fuel hazard and its associated risk of a fire starting or spreading,

(b) prepare and submit to an official for approval a site rehabilitation plan that specifies measures for

(i) minimizing any fuel hazard created as a result of fire control operations, and

(ii) maintaining natural drainage patterns for all of the fire control works to minimize surface soil erosion by

(A) stabilizing and re-vegetating soil disturbed or exposed by heavy equipment,

(B) stabilizing the stream channel and stream bed at stream crossings, and

(C) stabilizing sump and dam locations that were created for the purpose of carrying out fire control, and

(c) implement the measures specified in the approved site rehabilitation plan.

Rehabilitation if government carries out fire control

17 For the purposes of section 9 (6) of the Act, the prescribed requirements, applicable if the government exercises the discretion under that subsection to rehabilitate land, are that, as soon as practicable,

(a) a fire hazard assessment must be carried out,

(b) a site rehabilitation plan must be prepared that specifies measures for

(i) minimizing any fuel hazard created as a result of fire control operations, and

(ii) maintaining natural drainage patterns for all of the fire control works to minimize surface soil erosion by

(A) stabilizing and re-vegetating soil disturbed or exposed by heavy equipment,

(B) stabilizing the stream channel and stream bed at stream crossings, and

(C) stabilizing sump and dam locations that were created for the purpose of carrying out fire control, and

(c) the measures specified in the site rehabilitation plan must be implemented.

[am. B.C. Reg. 206/2005, s. 8.]

Addresses the following:	Definitions
General Intent:	
Applicability:	All lands
Name of Act:	**Wildlife Act**
Name of Regulation:	
Details:	[RSBC 1996] CHAPTER 488
Date:	This Act is Current to June 18, 2006. This Act has "Not in Force" sections. See the Table of Legislative Changes.
Applicable Section:	Part 1 — General Provisions - 1 Definitions and interpretation
Section Number:	1 (1)

"habitat" or "wildlife habitat" means the air, soil , water, food and cover components of the environment on which wildlife depend directly or indirectly in order to carry out their life processes;