



Ministry of
Environment

BC Contaminated Sites Regulation Update

North East British Columbia

Producer's Group

November 14, 2007

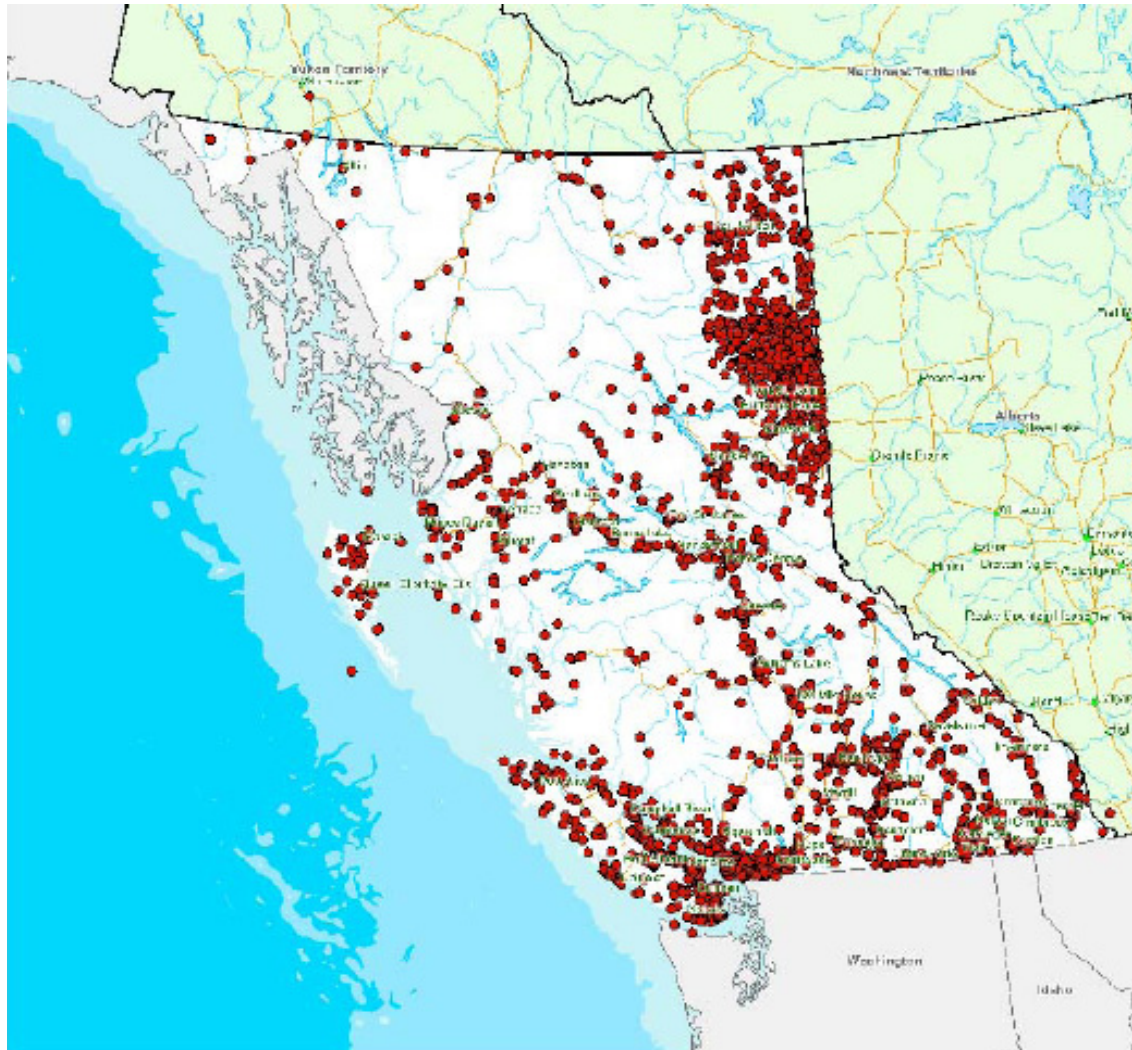
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Contaminated Sites in BC

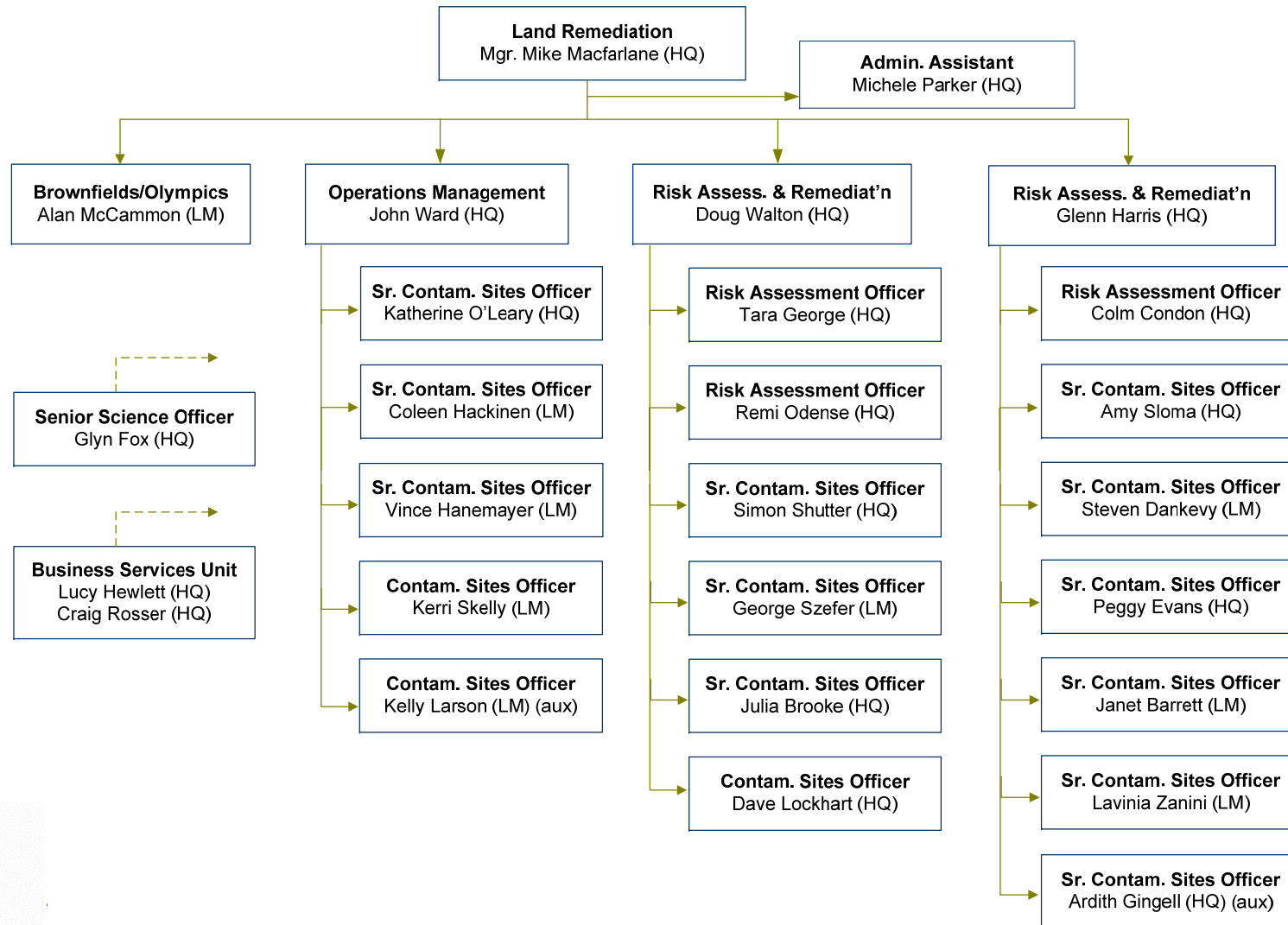
November, 2007



- Land Remediation Section
- Contaminated Sites Regulatory Process
- Contaminated Sites Approved Professionals
- Regulatory Developments
 - Protocol 6
 - Barium and Salt Standards
 - Interim Guidance – Vapours
 - Wildland Standards
 - Site Classification System (Protocol 12)
 - Screening Level Risk Assessment (Protocol 13)
- 2008 Priorities

Land Remediation Section Organization

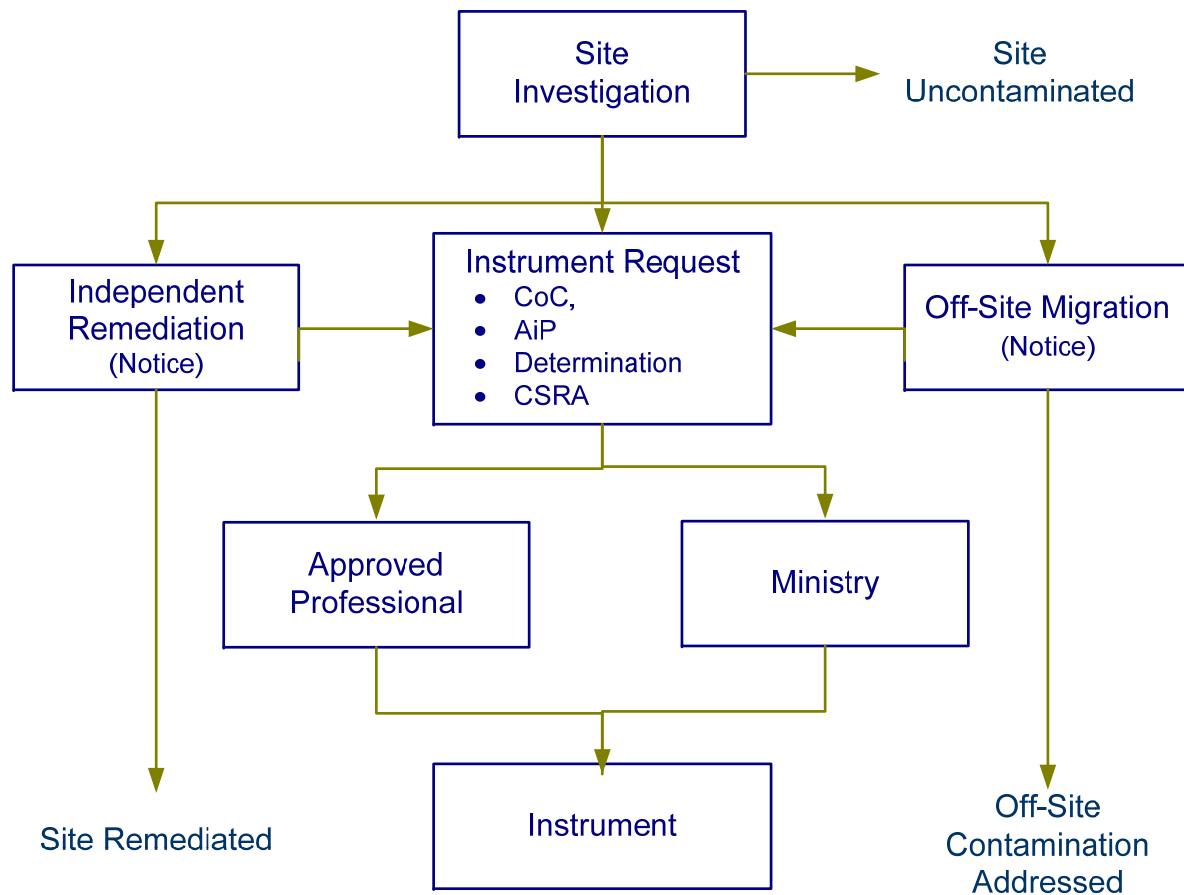
November, 2007



- *Environmental Management Act (Part 4)*
- Contaminated Sites Regulation
 - Standards
 - Procedures
 - Administrative process
 - Authorizations (Instruments)
 - Enforcement tools
- Hazardous Waste Regulation
- Waste Discharge Regulation
- Oil and Gas Waste Regulation (O&G Handbook)
- Spill Reporting Regulation

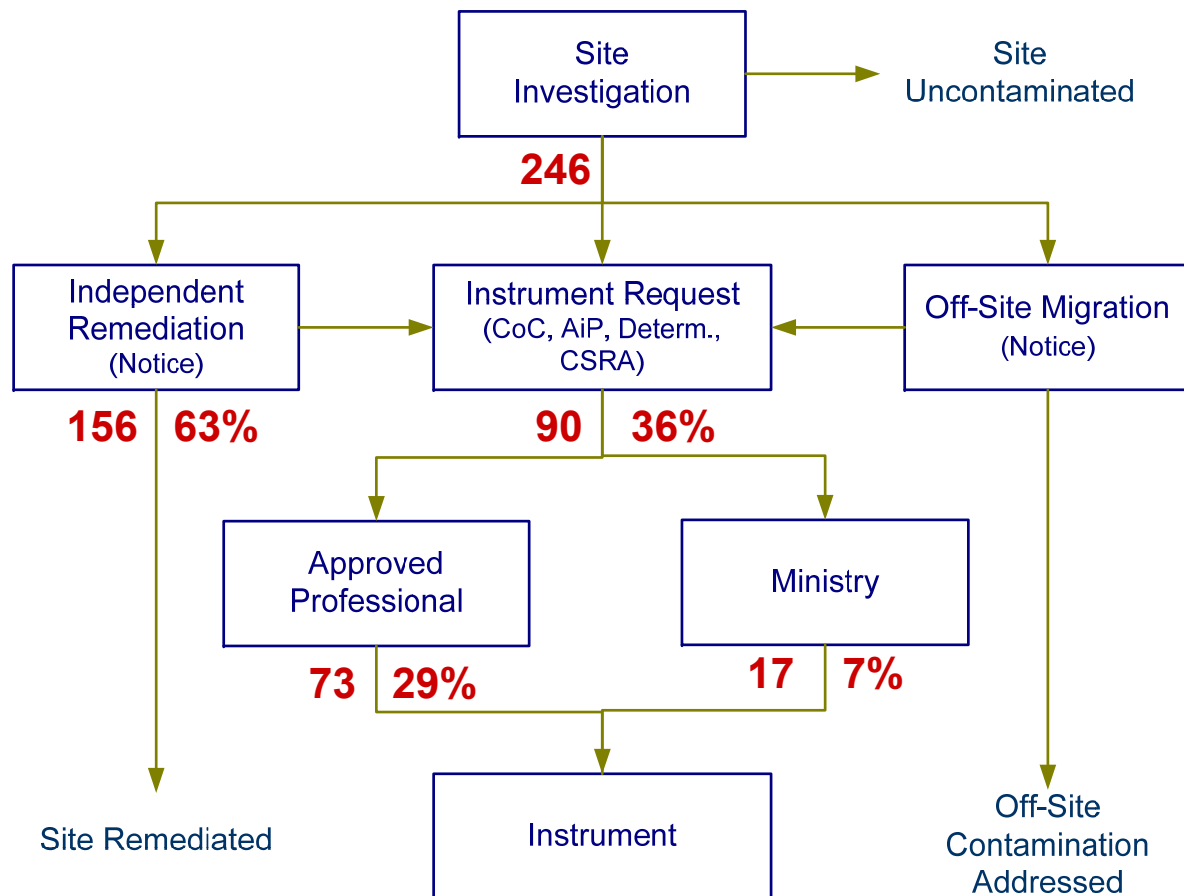
Investigation/Remediation Process

November, 2007



Investigation/Remediation Process

November, 2007



Established 1999

- Roster of Approved Professionals
(now Contaminated Sites Approved Professionals)
- Appointed by Director

Scope of Service

- Review reports and recommend instruments for “low and moderate risk” sites
- Authority outlined in Protocol 6
- Two types of experts:
 - Numerical standards professionals
 - Risk-based standards professionals
- Ministry issues instruments

CSAP Society – Registered 2007

- Board (10 members), committees, fee schedule, practice guidelines & disciplinary guidelines
- Self-regulating
- Self-funded

Membership

- 80 members (68 numeric, 12 risk-based)
- 10 to 20 new members per year

Qualifications

- Member of BCAPEG, BCIA, CAB
- 10 years related experience
- Entrance exam

Protocol 6 – amended Sept./07 to expand CSAP services:

- Screening Level Risk Assessment
- On-site Detailed Risk Assessment
- On-site Risk Management
 - CSAP performance verification
 - Owner promise to implement
- Instrument Amendments

Summary of Site Conditions

- Supporting documentation for CSAP recommendations
- Basis for Director's approval

Working Groups

- Risk Assessment
- Groundwater Policy
- Oil and Gas Sector Capacity

Draft Documents – Dec. 2006

November, 2007

- Protocol 12: *Classifying Site Risk Levels* (Mar 2008)
- Protocol 13: *Screening Level Risk Assessment* (Dec 2007)
- *Director's Interim Air Concentration Criteria* (2008)
- Tech Guidance 4: *Soil Vapour Investigation* (Dec 2007)
- Tech Guidance 7: *Supplemental Guidance for Risk Assessments* (July 2007)
- *Procedures for Site Profile Processing* (Mar 2008)
- *Procedures for Defining the Boundaries of a Site* (Mar 2008)



BC Upstream Petroleum Environmental Committee

Mandate

- Identify gaps and obstacles to the remediation of upstream oil and gas sites.
- Conduct facts-gathering, background research and knowledge sharing around solutions.
- Prepare recommendations for regulatory changes that promote high standards of environmental stewardship.

Members

- Ministry of Environment
- Ministry of Energy, Mines & Petroleum Resources
- Ministry of Agriculture & Lands
- Integrated Land Management Bureau
- Oil & Gas Commission
- Canadian Association of Petroleum Producers



BC Upstream Petroleum Environmental Committee

2007/08 Priorities

- Barite & salt standards
- Land use standards for closed oil & gas sites
- NORMs
- Wildland/Muskeg standards
- Integration of CoC-CoR requirements

Schedule 5 Soil Standards - Barium

November, 2007

Current Status

- Posted for public comment Nov. 5, 2007 (ends Dec. 14/07)

Draft Schedule 5 matrix standards

- Current science
- CSST derivation protocol (*Contaminated Sites Soils Taskgroup*)

Two analytical methods authorized:

- Weakly soluble extraction method (CaCl)
- Strong Acid Leach Method (SALM)

Application Procedures

- Barite source: eligible for CaCl method
- Other barium sources: SALM
- Draft for public comment – target release Dec. 2007



**SCHEDULE 5
MATRIX NUMERICAL SOIL STANDARDS¹
BARIUM (CAS# 7440-39-3)**

November, 2007

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI	Note
Site-specific Factor	SOIL STANDARD FOR PROTECTION OF SITE-SPECIFIC FACTOR					2
	Agricultural (AL)	Urban Park (PL)	Residential (RL)	Commercial (CL)	Industrial (IL)	
HUMAN HEALTH PROTECTION						
Intake of contaminated soil	6 500	6 500	6 500	20 000		3
Groundwater used for drinking water	400	400	400	400	400	4,5
ENVIRONMENTAL PROTECTION						
Toxicity to soil invertebrates and plants	1 000	1 000	1 000	1 500	1 500	
Livestock ingesting soil and fodder	400					5
Major microbial functional impairment	NS					6
Groundwater flow to surface water used by aquatic life						
Freshwater	3 500	3 500	3 500	3 500	3 500	4
Marine	1 500	1 500	1 500	1 500	1 500	4
Groundwater used for livestock watering	NS					7
Groundwater used for irrigation	NS	NS	NS			7

Schedule 5 Soil Standards - Barium

November, 2007

Notes

1. All values in ug/g unless otherwise stated. Substances must be analyzed using methods specified in a director's protocol 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. Intake pathway of exposure modeled is inadvertent ingestion of soil.
4. Assumes barium $K_d = 100$ L/kg.
5. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the reference provincial background soil concentration.
For all land uses, the reference provincial background soil concentration is 412 ug/g.
6. NS – no standard. Insufficient acceptable scientific data exists, so no standard is calculated.
7. NS – no standard. No appropriate standard, guideline of criterion exists to use to develop a soil quality standard.



Schedule 5 Soil Standards – Salt

November, 2007

Current Status

- Posted for public comment Nov. 5, 2007 (*ends Dec. 14/07*)

Draft Schedule 5 matrix standards – Sodium & Chloride

- Current science (2002 Draft Standards updated)
- CSST derivation protocol
- New ambient water quality guidelines – chloride 150 mg/L
- Collapsing chloride Kd series to single value (0.0 to 0.1)

New analytical method

- Saturated paste extraction method



**SCHEDULE 5
MATRIX NUMERICAL SOIL STANDARDS¹
SODIUM Ion (Na⁺)**

November, 2007

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI	Note
Site-specific Factor	SOIL STANDARD FOR PROTECTION OF SITE-SPECIFIC FACTOR					2
	Agricultural (AL)	Urban Park (PL)	Residential (RL)	Commercial (CL)	Industrial (IL)	
HUMAN HEALTH PROTECTION Intake of contaminated soil	> 1 000 mg/g	> 1 000 mg/g	> 1 000 mg/g	> 1 000 mg/g		3
Groundwater used for drinking water	15 000	15 000	15 000	15 000	15 000	
ENVIRONMENTAL PROTECTION Toxicity to soil invertebrates and plants	200	200	200	1 000	1 000	
Livestock ingesting soil and fodder	NS	NS	NS	NS	NS	4
Major microbial functional impairment	NS	NS	NS			4
Groundwater flow to surface water used by aquatic life	NS					5
Groundwater used for livestock watering	NS					5
Groundwater used for irrigation	NS					5

Schedule 5 Soil Standards – Sodium

November, 2007

Notes

1. All values in ug/g unless otherwise stated. Substances must be analyzed using methods specified in protocols approved under section 53 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. Intake pathway of exposure modeled is inadvertent ingestion of soil.
4. NS – no standard. Insufficient acceptable scientific data exists, so no standard is calculated.
5. NS – no standard. No appropriate standard, guideline of criterion exists to use to develop a soil quality standard.

**SCHEDULE 5
MATRIX NUMERICAL SOIL STANDARDS¹
CHLORIDE Ion (Cl-) (CAS # 7647-14-5)**

November, 2007

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI	Note
Site-specific Factor	SOIL STANDARD FOR PROTECTION OF SITE-SPECIFIC FACTOR					2
	Agricultural (AL)	Urban Park (PL)	Residential (RL)	Commercial (CL)	Industrial (IL)	
HUMAN HEALTH PROTECTION Intake of contaminated soil	> 1 000 mg/g	> 1 000 mg/g	> 1 000 mg/g	> 1 000 mg/g		3, 4
Groundwater used for drinking water	90	90	90	90	90	5
ENVIRONMENTAL PROTECTION Toxicity to soil invertebrates and plants	350	350	350	2 500	2 500	
Livestock ingesting soil and fodder	NS					6
Major microbial functional impairment	NS					7
Groundwater flow to surface water used by aquatic life	550	550	550	550	550	5, 8
Groundwater used for livestock watering	200					5
Groundwater used for irrigation	35	35	35			5

Schedule 5 Soil Standards – Chloride

November, 2007

Notes

1. All values in ug/g unless otherwise stated. Substances must be analyzed using methods specified in a director's protocol 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.
2. Intake pathway of exposure modeled is inadvertent ingestion of soil.
3. Standard established based on toxic reference dose (Tolerable Daily Intake) derived for NaCl. Toxicity attributed primarily to cation (Na⁺) not anion (Cl⁻).
4. Standard varies with K_d for Chloride ion in the soil of a site. Standard is appropriate to a chloride:soil K_d range of 0 to 0.1 mL/g. Consult Director for further advice.
5. NS – no standard. No appropriate standard, guideline of criterion exists to use to develop a soil quality standard.
6. NS – no standard. Insufficient acceptable scientific data exists, so no standard is calculated.
7. Standard to protect freshwater aquatic life.

Director's Interim Air Concentration Criteria

Draft Director's Interim ACC - December 2006

- Human health based
- Strict application for contaminated sites
- Application guidance in Technical Guidance 4
 - Soil Vapour Investigations

Current Status

- Definition of “volatile” under review;
- Need approved analytical methods
- **Target release - 2008**

Technical Guidance 4 – Vapour Assessment

Interim Guidance – Vapour Assessment

- Procedure for risk assessment of vapour exposure pathway in absence of numeric criteria.
- **Target release Dec. 2007**

Two Approaches:

- Predictive – based on partitioning from soil and groundwater and vapour attenuation using defensible vapour intrusion models; or
- Measurement – based on applying prescribed attenuation factors to measured soil vapour concentrations to predict indoor/outdoor air concentrations.

Interim Vapour Guidance – Application Rules

- Defensible, documented professional judgement
- Volatile substances are
 - in the Dec./06 Draft Director's Interim ACC
- Defensible vapour intrusion models are
 - Health Canada 2007 guidance
 - Johnson and Ettinger 1991
- Conservative site-specific parameter values
- Vapour sampling guidance
 - Science Advisory Board 2006 guidance
 - Health Canada 2007 guidance
- Technical Guidance 7 for reference concentrations (RfCs)
- Low soil and groundwater detection limits

Interim Vapour Guidance – Transition Process

Existing Approval in Principle:

- Complete remediation as approved, including timelines.

Completed Investigations

- Applications received before Dec. 2007 exempt from Interim Guidance
- Applications received after Dec. 2007 subject to Interim Guidance

Sites under Investigation

- Investigations subject to Interim Guidance

Supplemental Risk Assessment Guidance

- **Issued July 2007**
- Reference document to support risk assessment reviews by CSAPs
- Hierarchy of application guidance & toxicological reference data

Numeric Soil Standards – Wildlands

Framework for the deriving “wildland” standards

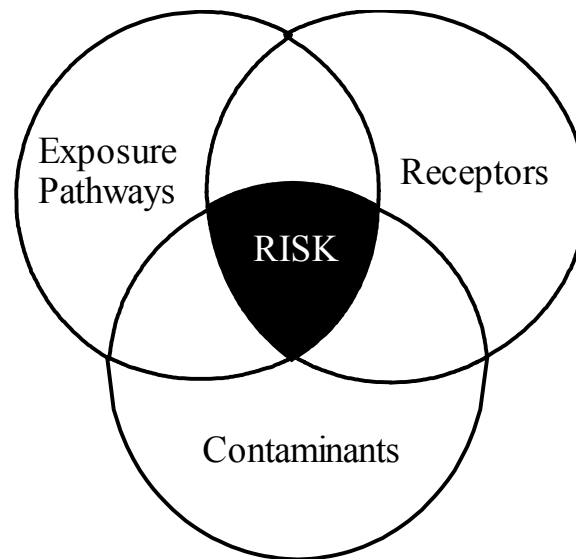
- Under development by Simon Fraser University
- Conceptual model for exposure pathways and receptors
- Range of wildland settings
- **Due March 2008**

Elements

- Multiple pathways
- Multiple toxicological data
- Resident and migratory species
- Different trophic levels
- Cumulative impacts
- Generic and site-specific procedures
- Adaptive to new science

Protocol 12: Classifying Site Risk Levels November, 2007

- Simple, facts-based assessment
- Establishes upper limits for primary risk contributors
- Upper limits occurring in combination constitute “high risk”



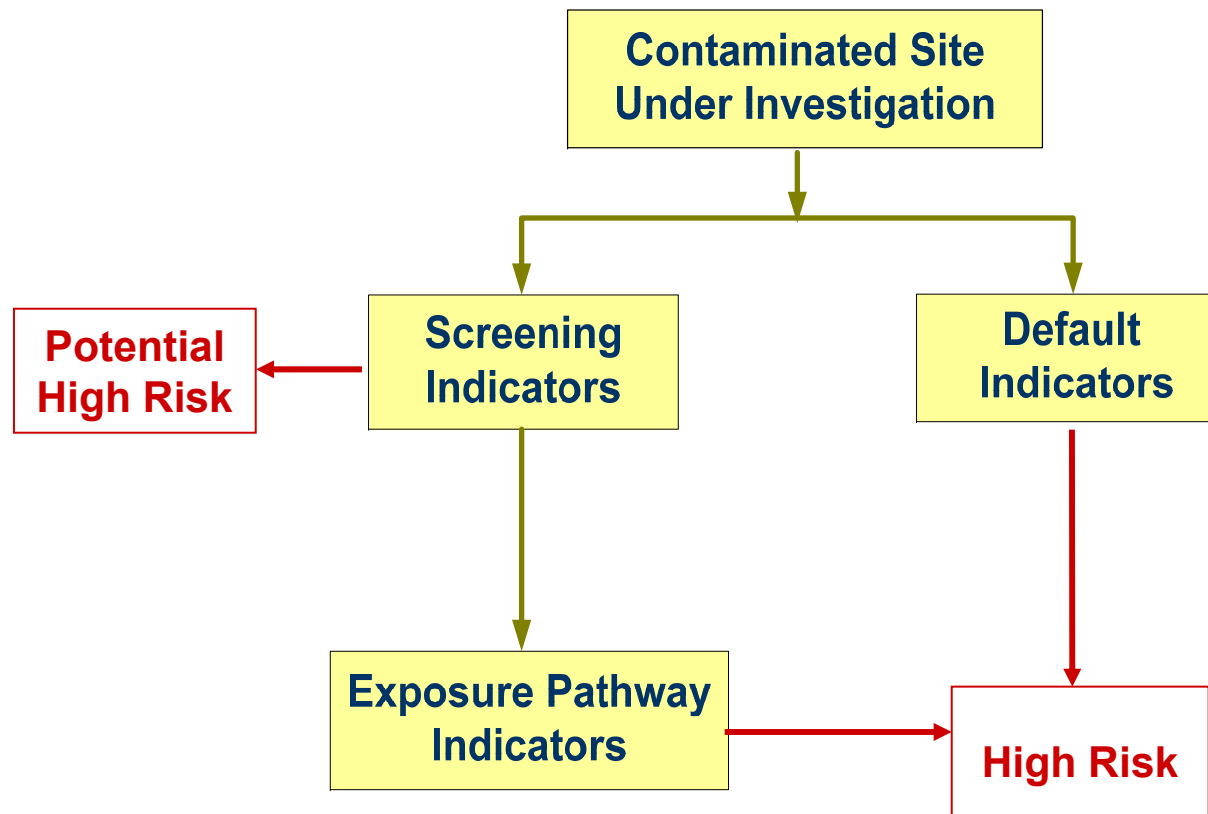
Protocol 12: Classifying Site Risk Levels November, 2007

Purpose

- Ensure high standard of care in the assessment and remediation of high risk sites
- Distinguish sites eligible for CSAP oversight and those requiring Ministry oversight.

Protocol 12: Assessment Process

November, 2007



Protocol 12: Screening Indicators

November, 2007

- Presence of Upper Cap concentrations
- Official reports and declarations of human health or environmental impacts caused by site contamination

Protocol 12: Screening Indicators

November, 2007

Upper Cap Concentrations

Media and Pathway	CSR Stds/Criteria	UC Multiplier
Human Health Protection		
Soil	Sched. 4 Sched. 5 & 10	App. 3 10
Vapour	Air Conc. Criteria	10
Water	Sched. 6	10 (except for VH6-10 and EPH10-19)
Environmental Health Protection		
Terrestrial soil	Sched. 4 Sched. 5	App. 3 10
Aquatic life water	Sched. 6	10
Livestock & Irrigation water	Sched. 6	10
Aquatic life sediment	Sched. 9	10

Official Reports & Declarations

- Report of Health Official documenting adverse effects on human health...
- Declaration by Health Official that a groundwater or surface water source is unsafe for human consumption...
- Report of Ministry of Environment Official documenting adverse effects on sensitive species or sensitive habitats...
- Declaration by Official of Ministries of Environment or Agriculture and Lands that a groundwater or surface water source is unsafe for livestock watering, irrigation, or use by aquatic life...

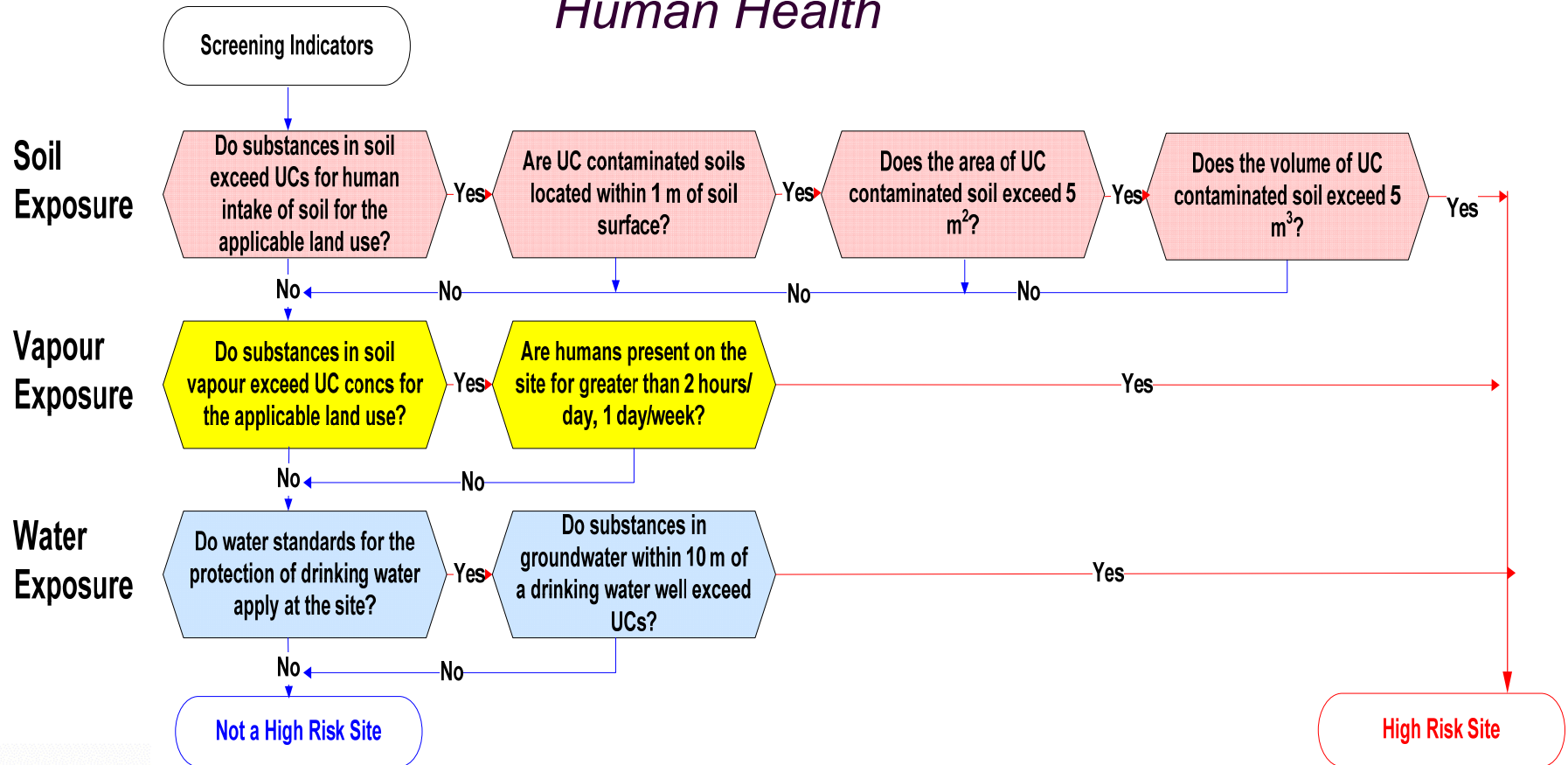
... caused by contamination at or from a site.

Offsite Migration and Mobile NAPL

- Off-site migration of contaminants in soil, soil vapour, and groundwater at > “applicable” human health UCs.
- Presence of mobile LNAPL or mobile DNAPL.
 - Mobile LNAPL: considered present when
 - thickness of free liquid in monitoring wells increases with time.
 - Advance in free liquid plume across monitoring wells over time.
 - thickness, product, media relationship is exceeded (under devel.)
 - Mobile DNAPL: considered present when individual DNAPL substances are detected in water at concentrations exceeding 10% of their theoretical solubility limit.

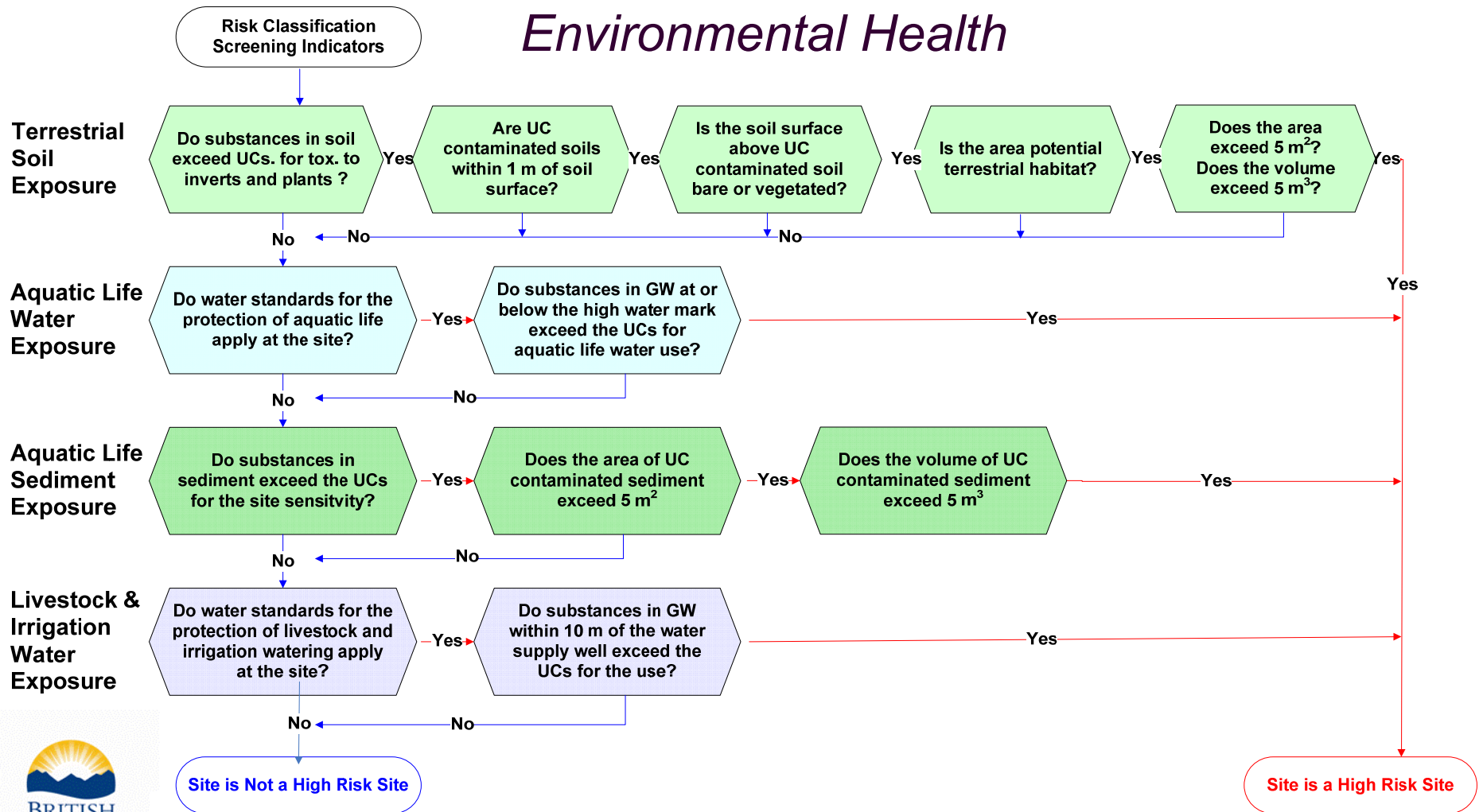
Protocol 12: Exposure Pathway Indicators November, 2007

Human Health



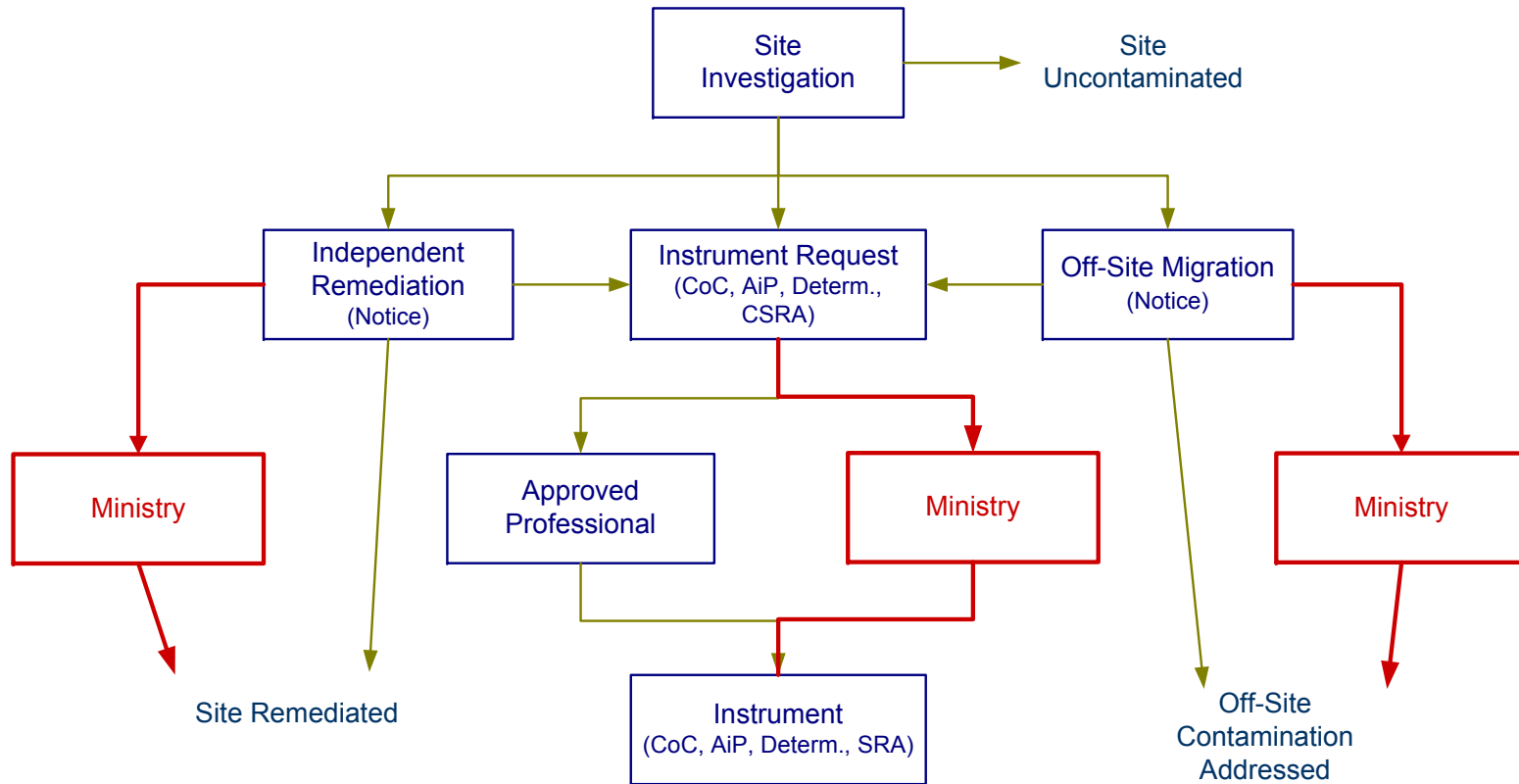
Protocol 12: Exposure Pathway Indicators November, 2007

Environmental Health



Protocol 12: Process

November, 2007

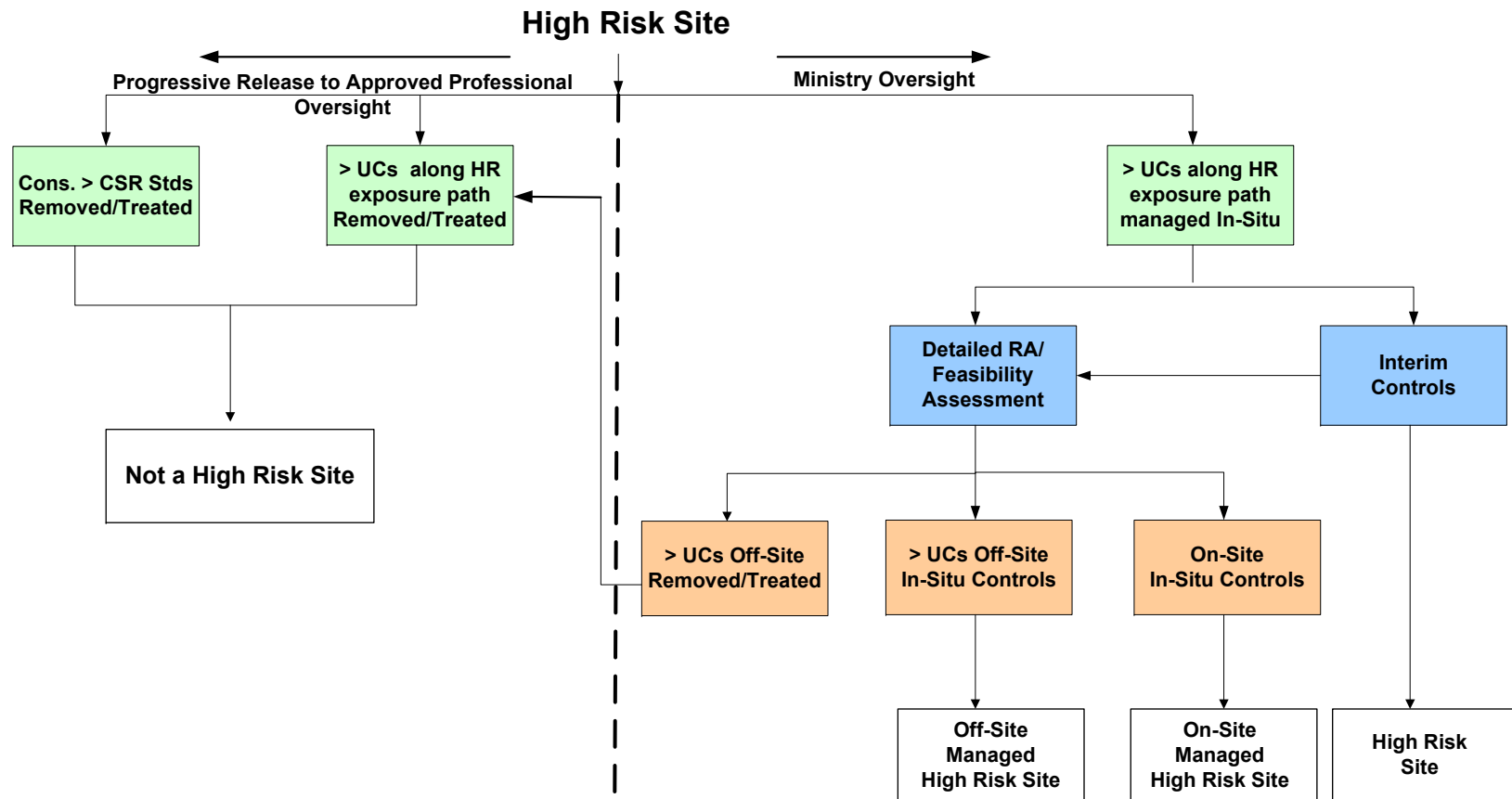


Protocol 12: Reporting

November, 2007

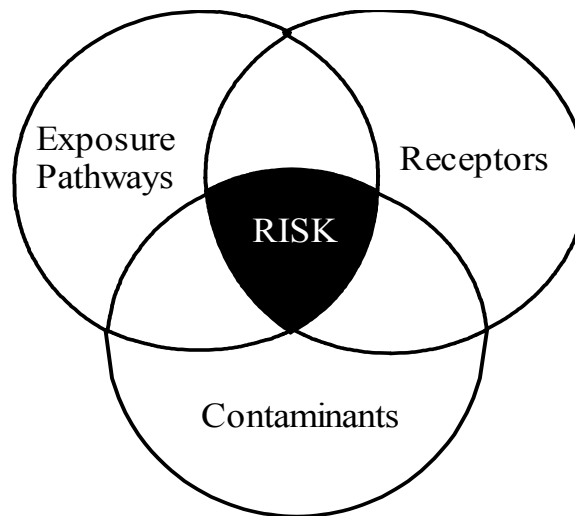
Notice	Not a High-Risk Site	Potential High-Risk Site	High-Risk Site
Independent Remediation	X		X
Off-Site Migration	X	X	X
Service Applications for Non-HR sites (Protocol 6)	X		
Service Applications for HR sites			X

Protocol 12: Remediation/Reclassification November, 2007



Protocol 13: Screening Level Risk Assessment

- Simple, constrained risk assessment
- Evaluates whether exposure pathways are operative and/or receptors present
- Assesses whether contamination at a site poses acceptable or unacceptable risks.
- Can be applied before or after remediation.



Protocol 13: Practitioner Restrictions

November, 2007

- Any contaminated sites practitioner may complete SLRA, except, Professional Biologist required for signoff on Habitat and Receptor Assessment.
- However, SLRA report may only be submitted to the ministry by a Contaminated Sites Approved Professional.

Protocol 13: Process

November, 2007

1. Problem formulation.
2. Check for exemptions/precluding conditions.
3. Evaluate exposure scenarios.
4. Determine risk.
5. Reporting.

Protocol 13: Precluding Conditions

November, 2007

- Not a High Risk site.
- A long term source of contamination.
 - Presence of LNAPL or DNAPL.
- Contamination adjacent to surface water.
 - In sediments or surface water.
- Deep rooting plants.
 - Edible fruit-bearing trees whose root structures extend below 1 m depth.
- Vapour contamination.
 - Volatile and toxic contaminants exceeding ACC in upper 1 m of soil.
- Potential for bioaccumulation.
 - Bioaccumulative substances in upper 1 m of soil.

Presence of LNAPL or DNAPL

- LNAPL is considered present when free liquid is found in monitoring wells (apparent thickness greater than 2 mm).
- DNAPL is considered present when free liquid is found in monitoring wells (apparent thickness greater than 2 mm) or when individual DNAPL substances are detected in water at concentrations exceeding 1% of their theoretical solubility limit.

STEP 1: Problem formulation

- Review existing PSI and DSI data.
- Develop a conceptual model of site conditions.
 - Provide a graphical conceptual model.

Protocol 13: Exemptions/Precluding Conditions

STEP 2: Check for Exemptions/Precluding Conditions

- Beneficial use exemption.
 - Galvanized materials.
 - Copper piping.
 - Wood preservatives.
- Precluding conditions.

STEP 3: Evaluate Exposure Scenarios

- Eight exposure scenarios to be considered.
- Complete SLRA Questionnaire.
- Complete Forms as necessary.
 - Groundwater transport assessment (Appendix A).
 - Receptor/habitat assessment (Appendix B).

Protocol 13: Exposure Scenarios

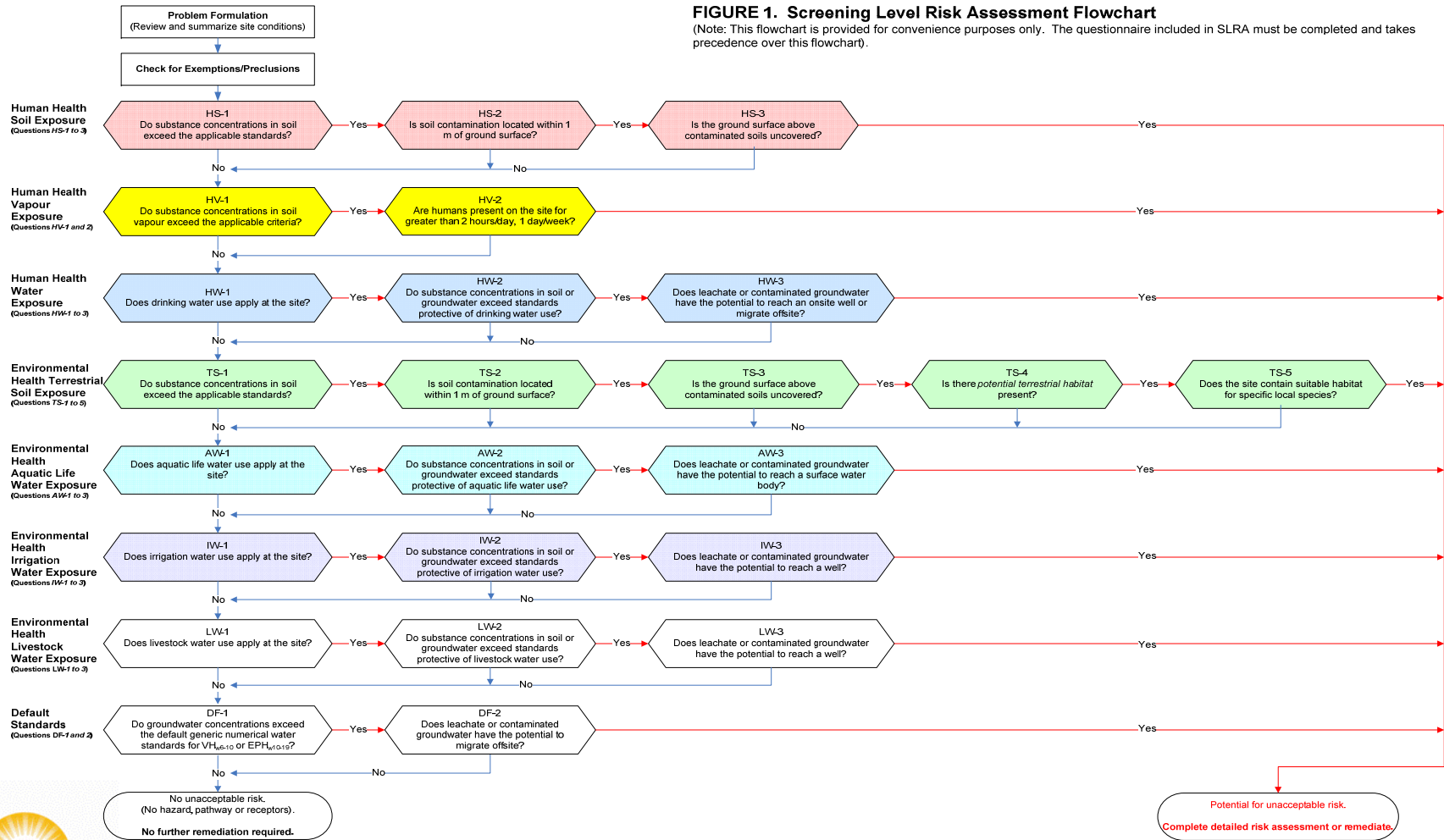
November, 2007

- Consider potential for exposure to:
 - Contaminated soil
 - Contaminated groundwater
 - Contaminant vapours

- Receptors include:
 - Humans
 - Terrestrial biota (soil invertebrates, livestock ingesting soil and fodder, soil microbes)
 - Aquatic biota
 - Livestock (watering)
 - Crops (irrigation)

Protocol 13: Exposure Scenarios

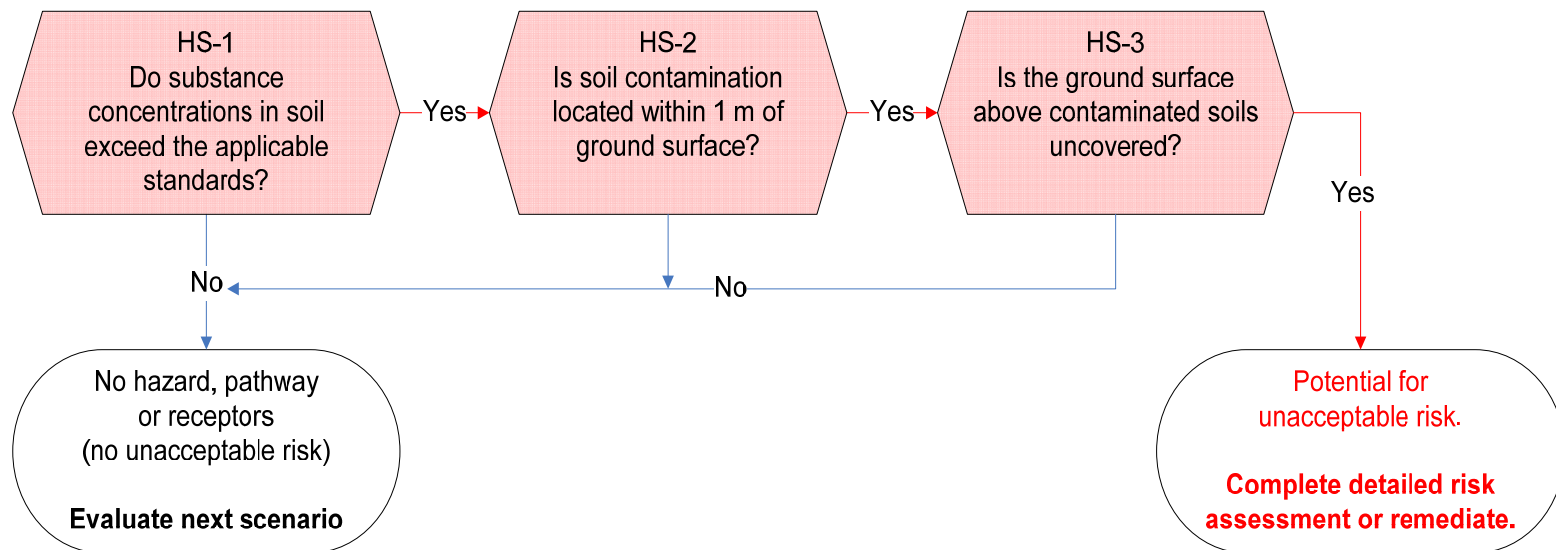
November, 2007



Protocol 13: Exposure Scenarios

November, 2007

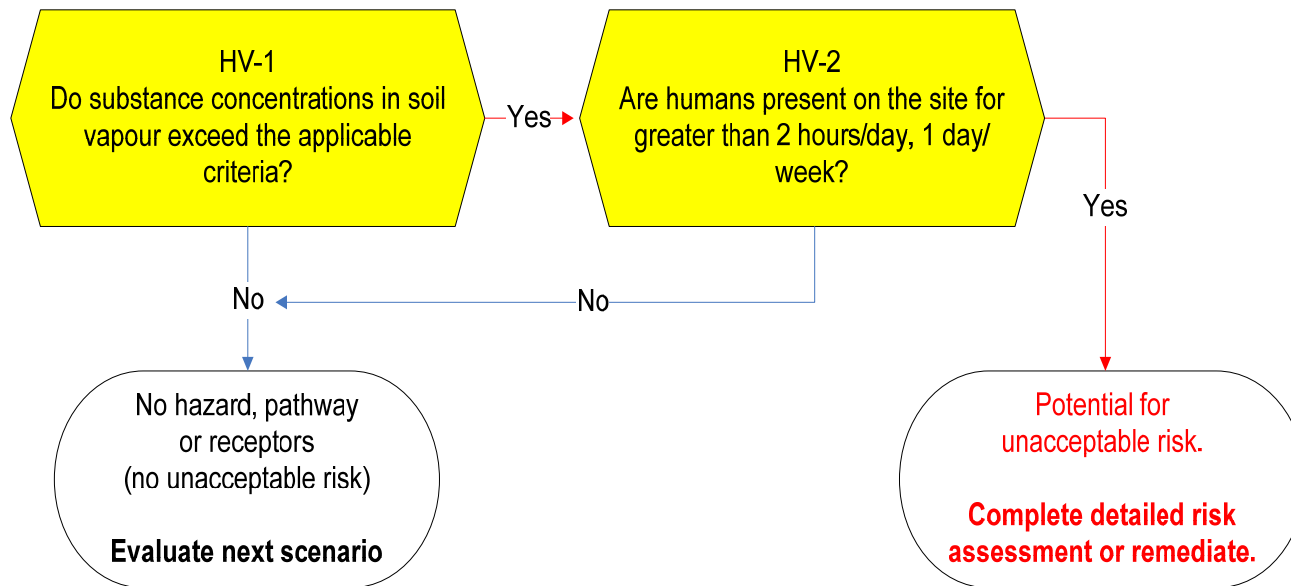
Potential exposure of humans to contaminated soil



Protocol 13: Exposure Scenarios

November, 2007

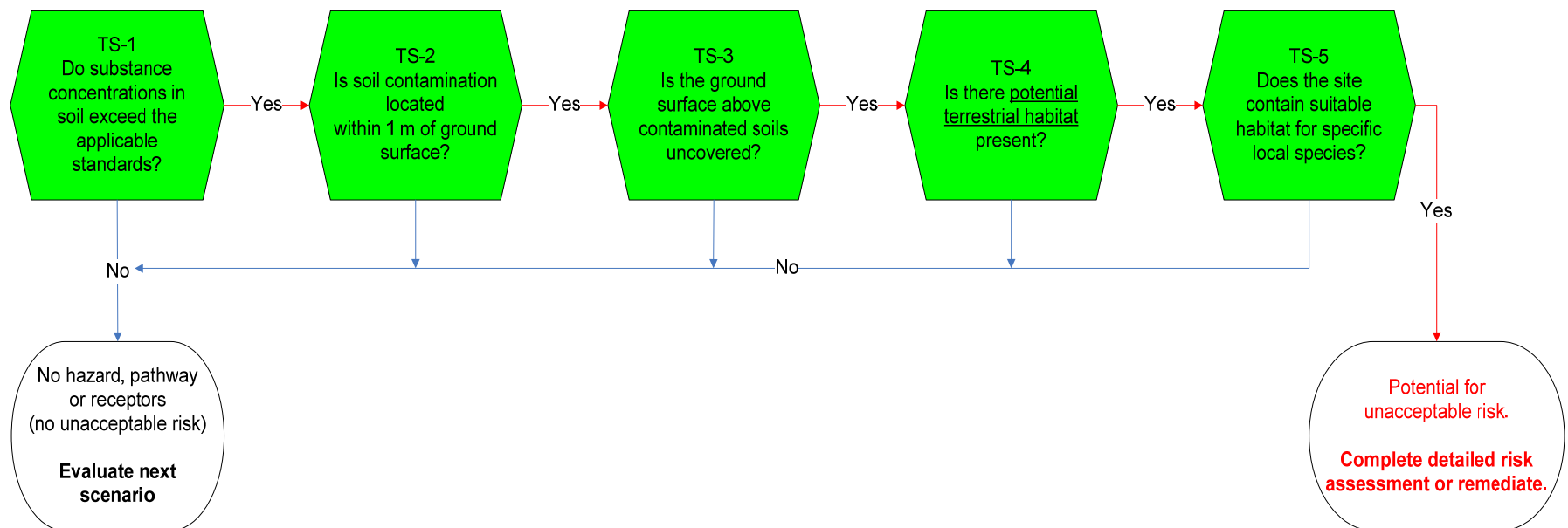
Potential exposure of humans to vapours



Protocol 13: Exposure Scenarios

November, 2007

Potential exposure of terrestrial biota to contaminated soils



STEP 4: Determination of Risk

→ Unacceptable Risk(s)

- “Yes” responses to all questions within a series.
- Implement further remediation or detailed risk assessment.

→ No Unacceptable Risk(s)

- at least one “no” response within each series of questions
- No further remediation required
- Site eligible for a certificate of compliance (remediation to risk-based standards).

STEP 5: Reporting

- Summary of site conditions and investigations.
- Forms:
 - SLRA Questionnaire
 - Groundwater transport assessment
 - Habitat/receptor assessment
- Supporting figures
 - Conceptual model
- Conclusions.

2008 Priorities

November, 2007

- Complete 2006 Draft Documents MOE
- *Review of British Columbia CSST Standards Derivation Protocol* SAB
- *Guidance for Detailed Ecological Risk Assessments (DERA) in BC* SAB
- Groundwater Policy
 - Investigation Guidance Golder
 - Determination of Groundwater Use (Tech Guide 6) MOE
- Authorized Remediation Methods MOE
 - Biocells
 - Dig & Dump
 - Product Recovery



BC Upstream Petroleum Environmental Committee

- End land use MAL
- Review of Muskeg CAPP/AENV
- Sector-specific guidance CAPP/MOE
- Integration and clarification of CoR/CoC OGC/MOE
- Oil and Gas Handbook Review OGC/MOE

Land Remediation Section Website

November, 2007

The screenshot shows the website interface for the Land Remediation Section of the British Columbia Ministry of Environment. At the top left is the British Columbia logo with the slogan "The Best Place on Earth". To the right is a search bar with a "Go" button and radio buttons for "All B.C. Government" and "Land Remediation". Further right are links for "Main Index", "Contact Us", and "Help". Below the search bar is a breadcrumb trail: "B.C. Home » Environment » Environmental Protection » Land Remediation Home". A "Text Size" control and a "Printer Version" icon are also present.

The left sidebar contains a navigation menu with the following sections:

- B.C. Home**
- Environment**
- Environmental Protection**
- Land Remediation**
 - ▶ [About Us](#)
 - ▶ [What's New](#)
 - ▶ [Contaminated Sites 101](#)
 - ▶ [CS e-Link Mailing List](#)
 - ▶ [Related Links](#)
 - ▶ [Contact Us](#)
- Resources**
 - [Key Topics](#)
 - [Acronyms](#)
 - [Fact Sheets](#)
 - [Forms](#)
 - [Policies, Protocols, and Procedures](#)
 - [Guidance](#)
 - [Discussion Papers and Reports](#)
 - [Standards and Criteria](#)
 - [Analytical Methods](#)
- Legislation & Regulations**
 - [Environmental Management Act \(EMA\)](#)
 - [Contaminated Sites Regulation \(CSR\)](#)
 - [Legal Decisions](#)

The main content area features a banner for the "Ministry of Environment" with images of a fish, a dog, and a ram. Below this is the "Land Remediation" heading and a "Welcome" message. A large photograph shows a waterfront promenade with a railing and a building in the background. The caption reads: "Pacific Place on the north shore of False Creek was once the industrial heart of Vancouver." Below the photo, the text states: "The Land Remediation Section administers the provisions for the investigation and remediation of contaminated sites in British Columbia under the *Environmental Management Act* and Contaminated Sites Regulation. Our section focuses on the remediation of brownfields, orphan sites and complex, high risk contaminated sites, and facilitates the remediation of low and medium risk sites. We also manage the Site Registry, provide operational and procedural contaminated sites guidance, and administer the site screening process using site

The right sidebar contains two sections:

- What's New?**
 - » [Recent CS e-Link Messages](#)
 - » [Draft Documents](#)
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 - » [Extension of Time Period for EPH Equivalency](#)
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At the bottom of the right sidebar is a "Key Topics" section with a list of links:

- » [Information on Sites](#)
- » [Roster of Approved Professionals](#)
- » [Brownfields and Brownfield Redevelopment](#)
- » [High-Profile Sites](#)
- » [Site Profiles](#)
- » [Independent Remediation](#)
- » [Offsite Migration](#)



CS-elink

- notifies subscribers of ministry contaminated sites information, on-line documents, news and other announcements.

http://www.env.gov.bc.ca/epd/epdpa/contam_sites/