



## EXAMINATION GUIDE FOR EXAM CANDIDATES

### ROSTER OF APPROVED PROFESSIONALS EXAMINATION TECHNICAL -- RISK ASSESSMENT

#### Roster Qualifications and Functions

The Roster of Approved Professionals (the Roster) is a roster of individuals who have proven, through examination and experience, their expert knowledge in contaminated site assessment, management, and remediation.

Members of the Roster are authorized, under section 49(1) of the Contaminated Sites Regulation (CSR), to recommend to the British Columbia Ministry of Environment (MOE) issuance of Approvals in Principle, Certificates of Compliance, Determinations that a site is or is not contaminated, Contaminated Soil Relocation Agreements and approval of background release exemptions (based on Table 1 of Protocol 4) for low to moderate risk sites.

There are two categories of Approved Professionals: Standards Assessment Specialists, whose recommendations are based on application of the numerical standards of the CSR; and Risk Assessment Specialists, whose recommendations are based on application of the risk based standards of the CSR.

The qualifying examination is offered in three parts: Technical – Standards Assessment, Technical – Risk Assessment, and Regulatory. To be appointed to the Roster, candidates must achieve a pass in both the regulatory part and the technical part associated with the category in which they seek appointment. Candidates must satisfy all minimum requirements in the year of appointment.

More information on the Roster is available at [www.csapsociety.bc.ca](http://www.csapsociety.bc.ca).

#### Examination Format

**The examination is offered in a computer-based format and is held in a computer lab.** The Technical – Risk Assessment part of the examination consists of approximately **70 multiple-choice questions** worth 1 point each. Candidates will be given **5 hours** to complete the Technical – Risk Assessment part of the examination. A basic, non-programmable calculator (Texas Instruments TI-30Xa Solar), a #2 mechanical pencil, an eraser, and a package of page markers (eg *Post-it Brand* flags) will be provided to, and retrieved from, candidates with their examination paper. Candidates will not be permitted to use their own calculator or writing instruments.

A reference binder will **NOT** be supplied for the examination. Candidates will be provided with a list of reference materials (*see Attachment 2*) to help prepare for the examination. Candidates are expected to prepare their own reference material which can be brought into and used during the examination. The examination is not limited to testing knowledge of only those materials in the reference list.

### **Objectives of the Technical - Risk Assessment Part of the Exam**

The objectives of the Technical – Risk Assessment part of the examination include the testing of the understanding and application of combined aspects of ecology, toxicology and environmental chemistry for the review of human health and ecological risk assessments. Candidates are also expected to have a general understanding of related areas such as, for example, basic contaminant transport in various media.

### **Examination Content and Guide to Preparation**

This Guide to Examination Candidates is intended to give candidates guidance in their preparation for the exam. The information contained in this document and its attachments is to assist only and is subject to change. Areas and materials not specifically mentioned may also be examined.

### **Information useful in preparing for the exam is included in the following attachments**

1. Syllabus
2. List of Reference Materials

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## **ATTACHMENT 1 – SYLLABUS**

Candidates should read the Guide to Examination Candidates – Roster of Approved Professionals Examination – Technical – Risk Assessment before reading this syllabus. The percentage in brackets indicates the approximate percentage of the examination that will cover each major content area. While the ½ percentage weightings appear to be quite specific; they are, in fact, approximate only. Particularly important areas of knowledge include:

### **ECOLOGICAL RISK ASSESSMENT**

#### **1. Problem Formulation (17.5%)**

- a. Risk Assessment Planning
- b. Integration of Available Information
- c. Identification of stressors
- d. Potentially Exposed Receptors
- e. Selecting Assessment and Measurement Endpoints
- f. Conceptual Models
- g. Data Gap Analysis
- h. Sampling and Analysis Plan

#### **2. Exposure Assessment (12.5%)**

- a. Characterization of Exposure
- b. Evaluating Data and Models for Analysis
  - i. Strengths and Limitations of Different Types of Data
  - ii. Literature Data – relevant species, study conditions
  - iii. Site Data/Observations - measurement and assessment endpoints; species diversity, richness, abundance
- c. Measurement and/or Modeling Studies

#### **3. Effects Assessment (12.5%)**

- a. Quantitative and Qualitative Site Observations
  - i. Terrestrial Receptors
  - ii. Aquatic Receptors
- b. Bioassays
  - i. Field studies
  - ii. Laboratory toxicity tests
- c. Toxicity Reference Values
  - i. Selection
  - ii. Derivation
- d. Ecosystem – context of scale relative to contaminated sites
- e. Ecological Responses
  - i. Stressor-Response Analysis
  - ii. Establishing Cause-and-Effect Relationships
  - iii. Linking Measures of Effect to Assessment Endpoints

#### **4. Risk Characterization (5%)**

- a. Quotient Method
- b. Observation Method
- c. Weight of Evidence
- d. Reporting Risks

## **SYLLABUS CONT'D**

### **5. Uncertainty Analysis (2.5%)**

- a. Identifying Major Types of Uncertainty
- b. Use of Uncertainty Factors
- c. Sensitivity Analysis

## **HUMAN HEALTH RISK ASSESSMENT**

### **1. Problem Formulation (17.5%)**

- a. Data Collection
  - i. Background Information Useful for Data Collection
  - ii. Review of Available Site Information
  - iii. Addressing Modeling Parameter Needs
  - iv. Preliminary Identification of Potential Human Exposure
  - v. Strategy for Sample Collection
  - vi. QA/QC Measures
- b. Data Evaluation
  - i. Combining Data Available from Site Investigations
  - ii. Evaluation of Analytical Methods
  - iii. Evaluation of Quantitation Limits
- c. Chemicals of Potential Concern
  - i. Comparison of Samples with Criteria/Guidelines
  - ii. Comparison of Samples with Standards
- d. Potentially Exposed Receptors
- e. Potential Exposure Pathways
- f. Conceptual Model
- g. Data Gap Analysis

### **2. Exposure Assessment (17.5%)**

- a. Characterization of Exposure Setting
  - i. Characterize Physical Setting
  - ii. Characterize Exposed Receptors
  - iii. Identification of Exposure Routes
  - iv. Identification of Reasonable Maximum Exposure
- b. Quantification of Exposure: Determining Exposure Concentrations
  - i. Estimation of Chemical Intakes
  - ii. Exposure Concentrations in Various Media
  - iii. Combining Chemical Intakes Across Pathways

### **3. Toxicity Assessment (7.5%)**

- a. Types of Toxicological Information Considered in Toxicity Assessment
- b. Toxicity Assessment for Noncarcinogenic Effects
- c. Toxicity Assessment for Carcinogenic Effects
- d. Identifying Appropriate Toxicity Values for Site Risk Assessment
- e. Evaluating Chemicals for which no Regulatory Toxicity Values are Available

## **SYLLABUS CONT'D**

### **4. Risk Characterization (5%)**

- a. Quantifying Risks
  - i. Risks for Individual Substances
  - ii. Risks for Multiple Substances
- b. Combining Risks Across Exposure Pathways
- c. Consideration of Site-Specific Human Studies
- d. Risk Characterization Results

### **5. Uncertainty Analysis (2.5%)**

- a. Identifying Major Types of Uncertainty
- b. Use of Uncertainty Factors
- c. Sensitivity Analysis

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## ATTACHMENT 2 – LIST OF REFERENCE MATERIALS

Candidates should read the **Guide to Examination Candidates – Roster of Approved Professionals Examination – Technical – Risk Assessment** before reading this attachment. This list of reference materials includes materials upon which some, but not all, of the exam questions have been developed. Other questions are drawn from the general principles to be tested and, in some instances, what is considered to be general knowledge. In addition to relevant portions of those materials listed here, candidates should study generally accepted, up-to-date texts in the subject matter to be tested.

- BCMELP (British Columbia Ministry of Environment, Lands and Parks). January 1998. Recommended Guidance and Checklist for Tier 1 Ecological Risk Assessment of Contaminated Sites in British Columbia. Protocol 1 of Contaminated Sites Regulation. Prepared by the Ecological Risk Assessment Guidance Team [W.G. Landis, A.J. Markiewicz, and V. Wilson, Western Washington University; A. Fairbrother, Ecological Planning and Toxicology, Inc.; and G. Mann, EVS Environment Consultants]  
[www.env.gov.bc.ca/epd/remediation/policy\\_procedure\\_protocol/index.htm](http://www.env.gov.bc.ca/epd/remediation/policy_procedure_protocol/index.htm)
- BCMELP (2002). A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater, Estuarine and Marine Ecosystems, Volume 1 May 2002
- BCMOE (British Columbia Ministry of Environment). Effective August 1, 2008. Protocol 13 For Contaminated Sites. Screening Level Risk Assessment.  
[www.env.gov.bc.ca/epd/remediation/policy\\_procedure\\_protocol/index.htm](http://www.env.gov.bc.ca/epd/remediation/policy_procedure_protocol/index.htm)
- BCMOE (British Columbia Ministry of Environment). July 9, 2007. Technical Guidance 7 on Contaminated Sites. Supplemental Guidance for Risk Assessments.  
[www.env.gov.bc.ca/epd/remediation/guidance/index.htm](http://www.env.gov.bc.ca/epd/remediation/guidance/index.htm)
- BC Ministry of Environment- Technical Guidance Document 4 (2009) Vapour Investigation and Remediation – DRAFT Q&As for Draft Guidance for Vapour Investigation and remediation  
<http://www.env.gov.bc.ca/epd/remediation/guidance/index.htm>
- BCMOE (British Columbia Ministry of Environment). August, 2005. Technical Guidance 19 on Contaminated Sites. Assessing and Managing Contaminated Sediments.  
[www.env.gov.bc.ca/epd/remediation/guidance/index.htm](http://www.env.gov.bc.ca/epd/remediation/guidance/index.htm)
- BCMELP (British Columbia Ministry of Environment, Lands and Parks). 2000. Tier 1 Ecological Risk Assessment Policy Decision Summary. Prepared by the Ecological Risk Assessment Guidance Team for BC Ministry of Environment. Last updated November 15, 2000.  
[www.env.gov.bc.ca/epd/remediation/policy\\_procedure\\_protocol/index.htm](http://www.env.gov.bc.ca/epd/remediation/policy_procedure_protocol/index.htm)
- BCMWLAP (British Columbia Ministry of Water, Land and Air Protection). 2004. Criteria for Managing Contaminated Sediment in British Columbia, Technical Appendix.  
[www.env.gov.bc.ca/epd/remediation/standards\\_criteria/index.htm](http://www.env.gov.bc.ca/epd/remediation/standards_criteria/index.htm)
- BC Ministry of Environment- Protocol 6- Eligibility of Applications for Review by Approved Professionals  
[http://www.env.gov.bc.ca/epd/remediation/policy\\_procedure\\_protocol/](http://www.env.gov.bc.ca/epd/remediation/policy_procedure_protocol/)

BC Ministry of Environment- Protocol 13- Screening Level Risk Assessment

[http://www.env.gov.bc.ca/epd/remediation/policy\\_procedure\\_protocol/protocols/pdf/protocol\\_13.pdf](http://www.env.gov.bc.ca/epd/remediation/policy_procedure_protocol/protocols/pdf/protocol_13.pdf)

BC Ministry of Environment- Soil Vapour FAQs <http://www.env.gov.bc.ca/epd/remediation/faq/index.htm#10>

CCME (Canadian Council of Ministers of Environment). 1996. A Framework for Ecological Risk Assessment: General Guidance. Prepared by the CCME Subcommittee on Environmental Quality for Contaminated Sites for the National Contaminated Sites Remediation Program. March 1996. [www.ccme.ca/publications/](http://www.ccme.ca/publications/)

CCME (Canadian Council of Ministers of Environment). 1997. A Framework for Ecological Risk Assessment: Technical Appendices. Prepared by the CCME Subcommittee on Environmental Quality for Contaminated Sites for the National Contaminated Sites Remediation Program. March 1997. [www.ccme.ca/publications/](http://www.ccme.ca/publications/)

CCME (Canadian Council of Ministers of Environment). Environmental Quality Guidelines. [www.ccme.ca/publications/](http://www.ccme.ca/publications/)

CCME (Canadian Council of Ministers of Environment). 2006: A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. [www.ccme.ca/publications/](http://www.ccme.ca/publications/)

EC (Environment Canada). 1992. Biological Test Method: Test of Larval Growth and Survival using Fathead Minnows. Environment Canada, Environmental Protection, Conservation and Protection. EC-EPS 1/RM/22, Ottawa, Canada.

EC (Environment Canada). 1994. A Framework for Ecological Risk Assessment at Contaminated Sites in Canada: Review and Recommendations. Prepared by C. Gaudet, EVS Environment Consultants, and Environmental and Social Systems Analysts for the National Contaminated Sites Remediation Program. Scientific Series No. 199.

HC (Health Canada). 2004. Federal Contaminated Site Risk Assessment in Canada. Part 1: Guidance on Human Health Preliminary Quantitative Risk Assessment. Prepared by Environmental Health Assessment Services Safe Environment Programme. [www.hc-sc.gc.ca/ewh-semt/contamsite/risk-risque-eng.php](http://www.hc-sc.gc.ca/ewh-semt/contamsite/risk-risque-eng.php)

HC (Health Canada). 2004. Federal Contaminated Site Risk Assessment in Canada. Part 2: Health Canada Toxicological Reference Values. Prepared by Environmental Health Assessment Services Safe Environment Programme. [www.hc-sc.gc.ca/ewh-semt/contamsite/risk-risque-eng.php](http://www.hc-sc.gc.ca/ewh-semt/contamsite/risk-risque-eng.php)

Province of BC. 2004. *Environmental Management Act* [SBC 2003] Chapter 53. Queen's Printer, Victoria BC. [www.env.gov.bc.ca/epd/remediation/leg\\_regs/ema.htm](http://www.env.gov.bc.ca/epd/remediation/leg_regs/ema.htm)

Province of BC. 2007. Contaminated Sites Regulation. Queen's Printer, Victoria BC. [www.env.gov.bc.ca/epd/remediation/leg\\_regs/csr.htm](http://www.env.gov.bc.ca/epd/remediation/leg_regs/csr.htm)

Suter, G. W., II. 1993. Ecological Risk Assessment. Ann Arbor, MI: Lewis Publishers.

Toxicology Excellence for Risk Assessment (TERA). <http://www.tera.org/>

US Department of Energy Oak Ridge Operations Publications and on-line Risk Assessment Information System (RAIS). <http://risk.lsd.ornl.gov/>

- USEPA. 1989. United States Environmental Protection Agency, Office of Emergency and Remedial Response, December 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002. [www.epa.gov/oswer/riskassessment/ragsa/index.htm](http://www.epa.gov/oswer/riskassessment/ragsa/index.htm)
- USEPA. 1989. United States Environmental Protection Agency, Office of Emergency and Remedial Response, December 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim. EPA/540/R/99/005. [www.epa.gov/oswer/riskassessment/ragse/index.htm](http://www.epa.gov/oswer/riskassessment/ragse/index.htm)
- USEPA (United States Environmental Protection Agency). June 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA 540-R-97-006 [www.epa.gov/oswer/riskassessment/ecorisk/ecorisk.htm](http://www.epa.gov/oswer/riskassessment/ecorisk/ecorisk.htm)
- USEPA (United States Environmental Protection Agency). April 1998. Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12460#Download>
- USEPA. 1999. Risk Assessment Guidance for Superfund, Volume 3 Process for Conducting Probabilistic Risk Assessment. [www.epa.gov/oswer/riskassessment/rags3adt/index.htm](http://www.epa.gov/oswer/riskassessment/rags3adt/index.htm)
- USEPA (United States Environmental Protection Agency). August 1997. Exposure Factors Handbook. (Volume I – General Factors; Volume II – Food Ingestion Factors; Volume III – Activity Factors). EPA/600/P-95/002Fa,Fb,Fc <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12464>  
USEPA, March 2001 Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, page E-6, Appendix E
- USEPA. Integrated Risk Information System (IRIS) Guidance Documents. [www.epa.gov/iris/index.html](http://www.epa.gov/iris/index.html)
- Health Canada (2008). Final Draft Guidance Manual for Environmental Site Characterization in Support of Human Health Risk Assessment. Volume 1 Technical Guidance. To obtain a copy of this document, send a request to the following e-mail address: [cs-sc@hc-sc.gc.ca](mailto:cs-sc@hc-sc.gc.ca)
- Science Advisory Board for Contaminated Sites in British Columbia (February 2006). Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings <http://www.sabcs.chem.uvic.ca/guidance%20on%20site%20characterization%20for%20evaluation%20of%20soil%20vapour%20intrusion%20into%20buildings.pdf>
- Health Canada (2008). Federal Contaminated Risk Assessment in Canada: Guidance on Human Health Risk Assessment of Soil Vapour Intrusion to the Indoor Environment. To obtain a copy of this document, send a request to the following e-mail address: [cs-sc@hc-sc.gc.ca](mailto:cs-sc@hc-sc.gc.ca)
- Health Canada (2008). Federal Contaminated Risk Assessment in Canada Part IV: Spreadsheet Tool for Human Health Preliminary Quantitative Risk Assessment (PQRA). To obtain a copy of this model, send a request to the following e-mail address: [cs-sc@hc-sc.gc.ca](mailto:cs-sc@hc-sc.gc.ca)
- Johnson PC, Ettinger R (1991). Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapours into Buildings. Environmental Science and Technology 25(8):1445–1452. [http://www.epa.gov/oswer/riskassessment/airmodel/johnson\\_ettinger.htm](http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm)

Golder Associates (200) Guidance for Detailed Risk Assessment (DERA) in British Columbia submitted for the Science Advisory Board for Contaminated Sites in British Columbia

[http://www.sabcs.chem.uvic.ca/FINAL%20rpt-0330\\_06%20SAB-DEA%20Guidance%20Manual.pdf](http://www.sabcs.chem.uvic.ca/FINAL%20rpt-0330_06%20SAB-DEA%20Guidance%20Manual.pdf)

USEPA Integrated Risk Information System (IRIS). <http://www.epa.gov/iris/index.html>

USEPA, 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187

Klaassen, C. D. (1995). Casarett and Doull's Toxicology: The basic science of poisons (5th ed.) McGraw-Hill, New York.

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