



## 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 BC Ministry of Environment and Climate Change Strategy (BC ENV) 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 (as per Table 1 and Table 2 of Protocol 6 - Eligibility of Applications for Review by Approved Professionals).

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). Please email [admin@csapsociety.bc.ca](mailto:admin@csapsociety.bc.ca) for the Approved Professional Roster Pack.

#### 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 **4 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 **printed** reference materials which can be brought into and used during the examination. Laptops or electronic materials are **NOT** permitted. 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

## 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 (15%)

- a. Risk Assessment Planning
- b. Integration of Available Information
- c. Identification of stressors
- d. Potentially Exposed Receptors
  - i. Complete and incomplete pathways
  - ii. Risk controls
- 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 (7.5%)

- 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 (12.5%)

- 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
  - i. Complete and incomplete pathways
  - ii. Risk controls
- f. Conceptual Model
- g. Data Gap Analysis

### 2. Exposure Assessment (15%)

- 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 (10%)

- 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 (10%)**

- 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
- e. Risk controls

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

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

## 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. (Note: BC ENV = BC Ministry of Environment and Climate Change Strategy; USEPA = United States Environmental Protection Agency)

1. BC ENV. Administrative Guidance on Contaminated Sites Documents. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/administrative-guidance>
2. BC ENV. Technical Guidance on Contaminated Sites Documents. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/technical-guidance>
3. BC ENV. Protocol for Contaminated Sites Documents. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/legislation-and-protocols>
4. BC ENV. Procedure Documents. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/procedures>
5. BC ENV. Policies and Standards Documents. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/policies-standards>
6. BC ENV. Questions & Answers (PDF), October 16, 2015. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/contaminated-sites/cs\\_q-a.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/contaminated-sites/cs_q-a.pdf)
7. BC ENV. Performance Verification Plans. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/performance-verification-plans>
8. BC ENV. Protocol 1 Detailed Risk Assessment. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p1\\_may\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p1_may_2021_revisions_final_signed.pdf)
9. BC ENV. Protocol 4 Establishing Local Background Concentrations in Soil. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p4\\_may\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p4_may_2021_revisions_final_signed.pdf)
10. BC ENV. Protocol 6 Applications with Approved Professional Recommendations and Preapprovals. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p6\\_jan\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p6_jan_2021_revisions_final_signed.pdf)
11. BC ENV. Protocol 13 Screening Level Risk Assessment. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p13\\_combined\\_may\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p13_combined_may_2021_revisions_final_signed.pdf)
12. BC ENV. Protocol 20 Detailed Ecological Risk Assessment Requirements. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol\\_20\\_may\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol_20_may_2021_revisions_final_signed.pdf)

13. BC ENV. Protocol 22 Application of Vapour Attenuation Factors to Characterize Vapour Contamination  
[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol\\_22.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol_22.pdf)
14. BC ENV. Protocol 28 2016 Standards Derivation Methods.  
[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p28\\_jan\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p28_jan_2021_revisions_final_signed.pdf)
15. BC ENV. Protocol 30 Classifying Substances as Carcinogenic.  
[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol\\_30.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol_30.pdf)
16. BC ENV. CSR OMNIBUS UPDATING: Protocol Summary - Amendments to Schedule 5 Environmental Protection, Matrix Soil Standards. February, 2016 [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/policies-and-standards/amendments\\_sch\\_5\\_eh.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/policies-and-standards/amendments_sch_5_eh.pdf)
17. BC ENV. Technical Guidance 4 Vapour Investigation and Remediation. Version 2, effective date: November 1, 2017. <https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg04.pdf>
18. BC ENV. Technical Guidance 15 Concentration Limits for Protection of the Aquatic Receiving Environments. Version 2.0, November 1, 2017.  
<https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg15.pdf>
19. BC ENV. Technical Guidance 19 Assessing and Managing Contaminated Sediments. August 2005.  
<https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg19.pdf>
20. BC ENV. Procedure 3 Ministry Procedures for the Roster of Approved Professionals. November 12, 2009.  
[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/procedures/pr03\\_procedures\\_for\\_the\\_roster\\_v5\\_final\\_numbered.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/procedures/pr03_procedures_for_the_roster_v5_final_numbered.pdf)
21. BC ENV. Procedure 8 Definitions for Contaminated Sites. April 1, 2021.  
<https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/procedures/procedure08.pdf>
22. BCMELP (British Columbia Ministry of Environment, Lands and Parks). Undated. Tier 1 Ecological Risk Assessment Policy Decision Summary. Prepared by the Ecological Risk Assessment Guidance Team for BC Ministry of Environment. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/policies-and-standards/tier\\_1\\_ecological\\_risk\\_assessment\\_policy\\_decision\\_summary.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/policies-and-standards/tier_1_ecological_risk_assessment_policy_decision_summary.pdf)
23. BC ENV. Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbons (PAHs). February 1993. <https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/pahs-tech.pdf>

24. 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. [http://www.ccme.ca/assets/pdf/pn\\_1195\\_e.pdf](http://www.ccme.ca/assets/pdf/pn_1195_e.pdf)
25. 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. [http://www.ccme.ca/assets/pdf/pn\\_1274\\_e.pdf](http://www.ccme.ca/assets/pdf/pn_1274_e.pdf)
26. CCME (Canadian Council of Ministers of Environment). 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. [http://www.ccme.ca/assets/pdf/sg\\_protocol\\_1332\\_e.pdf](http://www.ccme.ca/assets/pdf/sg_protocol_1332_e.pdf)
27. CCME (Canadian Council of Ministers of Environment). 2020. Ecological Risk Assessment Guidance Document. PN1585. [https://ccme.ca/en/res/eraguidance\\_e.pdf](https://ccme.ca/en/res/eraguidance_e.pdf)
28. Society of Contaminated Sites Approved Professionals of British Columbia (CSAP). Practice Guidelines and Detailed Ecological Risk Assessment Policy Summary Documents. <https://csapsociety.bc.ca/members/practice-guidelines/>
29. Society of Contaminated Sites Approved Professionals. 2016. Risk Management Decision Framework for BC Contaminated Sites Phase 2 – Guiding Principles for Applying Risk-based Standards to Ecological Receptors <https://csapsociety.bc.ca/members/professional-development/technical-studies/>
30. Society of Contaminated Sites Approved Professionals of British Columbia (CSAP). Fall 2017 Members Update. <https://csapsociety.bc.ca/members/members-updates/>
31. Environment Canada. 2013. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance. March 2012. Prepared for Environment Canada by Azimuth Consulting Group.
32. Environment Canada. Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows. EPS 1/RM/22 Second Edition, February 2011. [http://publications.gc.ca/collections/collection\\_2011/ec/En49-7-1-22-eng.pdf](http://publications.gc.ca/collections/collection_2011/ec/En49-7-1-22-eng.pdf)
33. Health Canada. 2010, Revised 2012. Federal Contaminated Site Risk Assessment in Canada. Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Prepared by Contaminated Sites Division, Safe Environments Directorate, Health Canada.
34. Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada. Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0. Prepared by Contaminated Sites Division, Safe Environments Directorate, Health Canada.
35. Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada. Part V: Guidance on Human Health Detailed Quantitative Risk Assessment (DQRA<sub>CHEM</sub>). Prepared by Contaminated Sites Division, Safe Environments Directorate, Health Canada.
36. Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada. Part VII: Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites. Prepared by Contaminated Sites Division, Safe Environments Directorate, Health Canada.



37. Health Canada. 2013. Federal Contaminated Sites Risk Assessment in Canada. Interim Guidance on Human Health Risk Assessment of Short-Term Exposure to Carcinogens at Contaminated Sites.
38. Health Canada. 2017. Federal Contaminated Site Risk Assessment in Canada. Supplemental Guidance on Human Health Risk Assessment of Contaminated Sediments: Direct Contact Pathways. Prepared by Contaminated Sites Division, Safe Environments Directorate, Health Canada.
39. Health Canada. March 2021. Federal Contaminated Site Risk Assessment in Canada. Preliminary Quantitative Risk Assessment (PQRA). Version 3.0.
40. Health Canada. March 2021. Federal Contaminated Site Risk Assessment in Canada. Toxicological Reference Values (TRVs). Version 3.0.
41. Province of BC. 2004. *Environmental Management Act* [SBC 2003] Chapter 53. Queen's Printer, Victoria BC. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/legislation-and-protocols>
42. Province of BC. Contaminated Sites Regulation. Queen's Printer, Victoria BC. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/legislation-and-protocols>
43. Science Advisory Board for Contaminated Sites in British Columbia (2008). Detailed Ecological Risk Assessment (DERA) in British Columbia, Technical Guidance. <https://secureservercdn.net/198.71.233.31/j90.518.myftpupload.com/wp-content/uploads/2019/09/DERA2008.pdf>
44. Science Advisory Board for Contaminated Sites (2010). Guidance for a Weight of Evidence Approach in Conducting Detailed Ecological Risk Assessments (DERA) in British Columbia. <https://secureservercdn.net/198.71.233.31/j90.518.myftpupload.com/wp-content/uploads/2019/09/a-December-5-2011-Discussion-January-2011-Posting-copy-Weight-of-Evidence-Final-.pdf>
45. Suter, G. W., II. 1993. *Ecological Risk Assessment*. Ann Arbor, MI: Lewis Publishers.
46. Suter, G.W. II. 2007. *Ecological Risk Assessment, Second Edition*. Boca Raton, FL. CRC Press,
47. Suter, G.W., II, R.A. Efrogmson, B.E. Sample, and D.S. Jones. 2000. *Ecological Risk Assessment for Contaminated Sites*. Lewis Publishers.
48. 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.
49. 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.
50. 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

51. USEPA (United States Environmental Protection Agency). April 1998. Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F. EPA – You may look for Publication Number EPA 540-R-97-006
52. USEPA. 1999. Risk Assessment Guidance for Superfund, Volume 3 Process for Conducting Probabilistic Risk Assessment. EPA 540-R-02-002
53. USEPA Integrated Risk Information System (IRIS). <https://www.epa.gov/iris>
54. USEPA (United States Environmental Protection Agency). November 2003, revised March 2005. Guidance for Developing Ecological Screening Levels. OSWER Directive 9285.7-55.
55. USEPA (United States Environmental Protection Agency). March 2005. Guidelines for Carcinogen Risk Assessment. EPA/630/P-05/001F
56. USEPA (United States Environmental Protection Agency). January 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). EPA-540-R-070-002.
57. USEPA December (1993) Wildlife Exposure Factors Handbook, EPA/600/R-93/187

NOTE:

Health Canada documents may be ordered by request to Health Canada at:

<http://www.hc-sc.gc.ca/ewh-semt/contamsite/docs/index-eng.php>

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