



EXAMINATION GUIDE FOR EXAM CANDIDATES

ROSTER OF APPROVED PROFESSIONALS EXAMINATION TECHNICAL – NUMERICAL STANDARDS 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 & 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. Please email 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 – Standards 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 – Standards Assessment part of the examination. A formula sheet containing some required formulas will be provided by email previous to the exam. A basic, non-programmable calculator (Texas Instruments TI-30Xa Solar), a #2 mechanical pencil, an eraser, writing papers and a package of page markers (e.g. *Post-it Brand* flags) will also be provided to, and retrieved from, candidates with their examination paper. Candidates will not be permitted to use their own calculator or writing instruments. Laptops or electronic materials are **NOT** permitted.

Candidates will be provided with a list of reference materials (*see Attachment 2*) to help prepare for the examination. The examination is not limited to testing knowledge of only those materials in the reference list.

A detailed list of the documents available in the exam's Reference Library will be sent to you. In general, you will have available the electronic version of the following documents:

From Ministry website: Administrative Guidance, Technical Guidance, External Guidance, Protocols, Procedures, Forms, Fact Sheets, Analytical and Field Methods, Discussion Papers and reports, and other Guidelines and Regulations.

From CSAP website: CSAP Membership Guidelines, Bylaws, PA Guidelines, Numerical practice Guidelines, Risk Assessment Practice Guidelines, Rules, Submissions Checklist, Screening Guidance and others.

Please take note that CSAP still encourages the examinees to bring hard copies of these documents to the exam.

Candidates are also expected to prepare their own printed reference materials which can be brought into and used during the examination.

Objectives of the Technical - Standards Assessment Exam

The objectives of the Technical – Standards Assessment examination include the testing of knowledge in the combined aspects of soil science, environmental engineering, hydrogeology, environmental chemistry, basic risk assessment principles; and assessment of the candidates' ability to apply this knowledge in the review of contaminated site investigation and remediation.

While candidates are expected to be familiar with risk assessment principles (particularly with respect to exposure pathways as this is an integral part of the screening assessment protocol) detailed risk assessment review is carried out by Roster members qualified as Risk Assessment Specialists and is the subject of a separate test.

Examination Content and Guide for 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 – Standards Assessment Part before reading this syllabus. This syllabus has been divided into the common stages of contaminated site investigation and remediation work and provides an indication of what level of knowledge is expected (i.e., what the Approved Professional should be capable of doing). The percentage in brackets indicates the approximate percentage of the examination that will cover each major content area. Particularly important areas of knowledge include:

A. Historical and Visual Site Information (5%)

1. APEC and PCOC: Identify all applicable potential APEC and PCOC based on review of existing information from various sources and based on assessment of site conditions observed during a site reconnaissance.

B. Assessment of Affected Media and Migration Pathway (20%)

1. Soil: Interpret site geology and soil stratigraphy.
2. Hydrogeology: Assess groundwater flow and contaminant transport (dissolved and Non-aqueous phase liquids - NAPL).
3. Surface hydrology: Interpret significance of precipitation on a contaminated site in terms of contaminant transport (surface water, groundwater, soil and sediment).
4. Sediment: Interpret sediment characteristics and its significance for contaminant distribution and release.
5. Soil vapour: Understand soil vapour concentrations and migration.
6. Air: Understand impact on indoor and outdoor air quality by dust and vapours from site contamination.
7. Biota: Understand significance of food-chain transfers and the significance of observations such as stressed vegetation and effects on aquatic life.

C. Contaminant Characteristics (17%)

1. Chemistry and biochemistry: Interpret physical, chemical and biological properties of contaminants and their significance on fate, transport, treatment and relative human health and ecological risks.
2. Chemical composition of mixtures: Understand the significance of chemical compositions of common types of contamination substances including but not limited to: fuels, lubricants, solvents, paints, wood preservatives, coal tar, metal plating, and landfill leachate.
3. Sources of Contamination: Be familiar with common residential, commercial and industrial activities that may result in site contamination including but not limited to: Fuel storage and handling, metal fabrication, wood preservation, solvent cleaning, coal gasification, and landfilling.

D. Investigation Approach and Methods (17%)

1. Sampling rationale: Interpret available information to develop a defensible sampling rationale that will satisfy the investigation objectives.
2. Sampling plans: Assess sampling plans to determine whether they are consistent with the investigation objectives and sampling rationale.
3. Sampling techniques: Understand the significance of the use of proper equipment and methods for sampling of soil, sediment, groundwater, surface water and soil vapour.
4. Field observations and records: Assess field records in terms of adequacy for data interpretation included but not limited to: Borehole logs, well installation details, visual/olfactory signs of contamination, sampling details, etc.

SYLLABUS CONT'D

5. Laboratory testing methods: Understand applicability and limitations of common laboratory sampling methods including but not limited to: Gas chromatography, gas chromatography/mass spectroscopy, infrared spectroscopy, petroleum analytical methods (e.g., LEPH/HEPH vs. EPH).
6. Field screening techniques: Understand applicability and limitations of common laboratory sampling methods including but not limited to: soil vapour headspace, immunoassay, colorimetric, pH/conductivity/temperature, X-ray fluorescence.
7. QA/QC practices: Assess field and laboratory work in terms of acceptable QA/QC methods and interpretation.

E. Data Synthesis and Interpretation (17%)

1. Data integration and presentation: Assess the investigation data in terms of adequate presentation in tables and figures.
2. Adequacy of testing: Review sampling programs to assess the adequacy of the testing performed (number, type and location of samples).
3. Nature and extent of contamination: Assess APEC and AEC: number, types, characteristics, PCOC, delineation.
4. Nature and extent of migration pathways: Assess migration pathways: types, characteristics, preferential routes, relative importance.
5. Background conditions: Assess regional and local background conditions.

F. Risk Assessment Principles and Screening (7%)

1. Problem formulation: Identify/screen sources, exposure pathways, receptors
2. Acceptable risk: Carcinogens Non-carcinogens.
3. Exposure scenarios: Interpret current and future site uses.
4. High risk: Recognize imminent and high risk to human health and environment, and immediate risks to public welfare (e.g., explosion hazard, etc.).

G. Remediation Design, Implementation and Confirmation (17%)

1. Remediation techniques: Be familiar with common soil, sediment, groundwater, water and soil vapour remediation methods.
2. Remedial design: Understand technical, regulatory and cost aspects of common remediation methods, and be able to evaluate the selection of appropriate alternatives.
3. Remediation implementation: Understand health and safety standards, construction techniques/constraints, monitoring requirements, and requirements associated with off-site transport and disposal of contamination and record keeping.
4. Remediation Confirmation: Assess confirmatory sampling program and results in terms of adequacy to demonstrate the site meets the applicable requirements of a remediated site.

ATTACHMENT 2 – LIST OF REFERENCE MATERIALS

Candidates should read the **Guide to Examination Candidates – Roster of Professional Experts Examination – Technical – Standards Assessment Part** 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 those materials listed here, candidates should study generally accepted, up-to-date texts in the subject matter areas to be tested.

1. ALS Laboratory Group. *CCME Hydrocarbon Reference Library*: https://www.academia.edu/31351034/CANADA_CCME_Hydrocarbon_Reference_Library_|_Cam_Quach_-_Academia.edu or <https://alsglobal.com>
2. BC ENV. *Administrative Guidance* on Contaminated Sites Documents - up to and including November 1, 2017. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/administrative-guidance>
 - i) Administrative Guidance 10: Site Risk Classification
 - ii) Administrative Guidance 22: Application of Wildlands Land Use
3. BC ENV. *Facts* on Contaminated Sites – up to and including August 31, 2020. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/fact-sheets>
4. BC ENV. *Procedure* Documents – up to and including April 1, 2021. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/procedures>
 - i) Procedure 6: Establishing the Boundaries of a Site
 - ii) Procedure 8: Definitions and Acronyms for Contaminated Sites
5. BC ENV. *Protocol* for Contaminated Sites Documents - up to and including May 13, 2021. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/protocols>
 - i) Protocol 1: Guidance and Checklist for Tier 1 Ecological Risk Assessment of Contaminated Sites in British Columbia
 - ii) Protocol 2: Site-Specific Numerical Soil Standards
 - iii) Protocol 3: Blending, Mixing, or Dilution as a Remediation Approach
 - iv) Protocol 4: Determining Background Soil Quality
 - v) Protocol 6: Eligibility of Applications for Review by Approved Professionals
 - vi) Protocol 8: Security for Contaminated Sites
 - vii) Protocol 9: Determining Background Groundwater Quality
 - viii) Protocol 10: Hardness Dependent Site-Specific Freshwater Water Quality Standard for Zinc
 - ix) Protocol 11: Upper Cap Concentrations of Substances
 - x) Protocol 12: Site Risk Classification System, Reclassification and Reporting
 - xi) Protocol 13: Screening Level Risk Assessment
 - xii) Protocol 14: Requirements for Determining Barite Sites
 - xiii) Protocol 15: Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil
 - xiv) Protocol 16: Determining the Presence and Mobility of Nonaqueous Phase Liquids and Odorous Substances
 - xv) Protocol 17: Requirements for Notifications of Independent Remediation and Offsite Migration
 - xvi) Protocol 18: Criteria for Establishing Multiple Land Uses at Sites
 - xvii) Protocol 20: Detailed Ecological Risk Assessment Requirements
 - xviii) Protocol 21: Water Use Determinations
 - xix) Protocol 22: Application of Vapour Attenuation Factors to Characterize Vapour Contamination
 - xx) Protocol 27: Soil Leachate Tests for Use in Deriving Site-Specific Numerical Soil Standards
 - xxi) Protocol 28: Standard Derivation Methods 2016 - Chapter 4
 - xxii) Protocol 30: Classifying Substances as Carcinogenic
6. BC ENV. *Technical Guidance* on Contaminated Sites Documents - up to and including January 5, 2021. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/technical-guidance>
 - i) TG1: Site Characterization and Confirmation Testing

- ii) TG2: Statistical Criteria for Characterizing a Volume of Contaminated Material
 - iii) TG4: Vapour Investigation and Remediation
 - iv) TG5: Sampling and Determining Soil pH at Soil Relocation Receiving Sites
 - v) TG6: Assessment of Hydraulic Properties for Water Use Determinations
 - vi) TG8: Groundwater Investigation and Characterization
 - vii) TG9: Chlorophenol Aquatic Life Water Quality Standards
 - viii) TG10: Guidance for a Stage 1 Preliminary Site Investigation
 - ix) TG11: Guidance for a Stage 2 Preliminary Site Investigation and Detailed Site Investigation
 - x) TG12: Statistics for Contaminated Sites
 - xi) TG13: Groundwater Protection Model - (Version 2 – Eff date Nov 1, 2017)
 - xii) TG14: Operations of Soil Treatment Facilities for the Bioremediation of Hydrocarbon Contaminated Soil
 - xiii) TG15: Concentration Limits for the Protection of Aquatic Receiving Environments
 - xiv) TG20: Applicability of Sodium (Na+) and Chloride (Cl-) Soil Relocation Standards to Marine and Estuarine Dredge Materials
 - xv) TG22: Use of Monitored Natural Attenuation for Groundwater Remediation DRAFT
 - xvi) TG24: Site Specific Numerical Soil Standards Model Parameters
7. BC Ministry of Environment (2001). *Analytical Method 7 for Contaminated Sites: Aliphatic/Aromatic Separation of Extractable Petroleum Hydrocarbons in Solids or Water by Silica gel Fractionation. Version 2.1.*
 8. BC Ministry of Environment, *British Columbia Environmental Laboratory Manual* (April 2020 version). Environmental Monitoring, Reporting & Economics Section, Knowledge Management Branch, B.C., Ministry of Environment, including the BC ENV Sample Preservation & Holding Time Requirements table.
 9. BC Ministry of Environment, BC Field Sampling Manual. (2013 - 2020 versions) *Note: Field Sampling Manual is in the process of being revised and section version dates vary.
 10. BC Ministry of Environment, Guidance and Resources, Performance Verification Plan webpage: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/performance-verification-plans>
 11. BC Ministry of Environment, Background Concentrations in Soil webpage: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/investigating-sites/background-concentrations/background-concentrations-in-soil>
 12. ASTM E1943-98: Standard Guide for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites (Reapproved 2010).
 13. Butler, James J. (1998). *The Design, Performance and Analysis of Slug Tests*. Boca Raton, Florida, CRC Press LLC.
 14. CCME (Canadian Council of Ministers of the Environment), (2010). *Canadian Soil Quality Guidelines: Carcinogenic and Other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) Scientific Criteria Document (Revised)*.
 15. CCME (Canadian Council of Ministers of the Environment), (2016). *Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment*.
 16. Canadian Standards Association (R2016). *Phase I Environmental Site Assessment. CSA Z768-01*.
 17. Cedergren, H. R. (1989). *Seepage, Drainage and Flow Nets*. New York, John Wiley and Sons, Inc.
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 19. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2009). *Soil Vapour Advice and Practice Guidelines*.
 20. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2015). *Numerical Practice Guidelines*.

21. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2018). *Potential Contaminants of Concern at Select Commercial and Industrial Land Uses*, prepared by PGL Environmental Consultants; <https://csapsociety.bc.ca/wp-content/uploads/r-PCOC-Guidance-June-2018-V1.0-002.pdf>
22. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2015). *Bioaccumulation Research Project*, prepared by SLR Consulting (Canada) Ltd.
23. Contaminated Sites Approved Professionals of British Columbia (CSAP), Technical Review Committee, (June 10, 2020). Petroleum Hydrocarbon PCOC Data Review, Soil and Groundwater, prepared by SLR Consulting (Canada) Ltd.
24. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2019). *Guidance for the Assessment and Remediation of Per- and Polyfluoroalkyl Substances in British Columbia*, prepared by SLR Consulting (Canada) Ltd.
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27. Domenico, P. A., & Schwartz, R. W. (1998). *Physical and Chemical Hydrogeology*. New York, John Wiley and Sons.
28. Drever, James (2002). *The Geochemistry of Natural Waters: Surface and Groundwater Environments*. Third Ed. Prentice-Hall, Inc., New Jersey.
29. Federal Remediation Technology Roundtable (FRTR), (2002). *Remediation Technologies Screening Matrix and Reference Guide*, Version 4.0. http://www.frtr.gov/matrix2/top_page.html
30. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0 (2010) Revised 2012.
31. Federal Contaminated Sites Action Plan (FCSAP), Ecological Risk Assessment Guidance, Module 2: Development of Site-specific Toxicity Reference Values, March 2010.
32. Fetter, C.W. (2008). *Contaminant Hydrogeology* (2nd Ed). Reissued by Waveland Press Inc., Long Grove, Illinois.
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38. Handbook of Environmental Data on Organic Chemicals, Van Nostrand Reinhold. 1983.
39. Health Canada (2012). *Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRACHEM)* (2010), revised 2012.
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45. ITRC (2005), *Permeable Reactive Barriers: Lessons Learned/New Directions*. PRB-4. Washington, D.C.
46. IPCS Inchem, International Programme on Chemical Safety (IPCS), *Environmental Health Criteria No.116*, World Health Organization, 1990.
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50. Moffitt, F. H. (1987). *Surveying* (8th Ed). New York: Harper and Row, p. 124.
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52. Morrison, R. and Murphy, B. (2006). *Environmental Forensics*. Elsevier Academic Press.
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55. Nyer, E.K., D.F. Kidd, P.L. Palmer, T.L. Crossman, S. Fam, F.J. Johns II, G. Boettchera, and S.S. Suthersan (1996). *In Situ Treatment Technology*. Geraghty and Miller, Lewis publishers.
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57. OSHA Training manual, HAZWOPPER (April 2022)
58. Pankow, J.F. and J.A. Cherry (eds.) (1996). *Dense Chlorinated Solvents and Other DNAPLs in Groundwater*.
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60. Province of British Columbia (2016). *Groundwater Protection Regulation (GWPR)*, B.C. Reg. 39/2016, including amendments up to B.C. Reg. 152/2016, March 11, 2021.
61. Province of British Columbia (2017). *Hazardous Waste Regulation (HWR)*, B.C. Reg. 63/88, including amendments up to B.C. Reg. 243/2016, March 11, 2021.
62. Province of British Columbia (2021), BC Approved Water Quality Guidelines and BC Working Water Quality Guidelines: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines>
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70. US EPA. Drinking Water Treatability Database. (Per- and polyfluorinated substances). <https://iaspub.epa.gov/tdb/pages/contaminant/contaminantOverview.do>
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81. US National Centre for Biotechnology Information Pubchem Compound Summary: [https://pubchem.ncbi.nlm.nih.gov/compound/Carbon-tetrachloride_CSR_Schedules_3.1, 3.2, and 3.3 \(up to Stage 13 amendment, 2021\)](https://pubchem.ncbi.nlm.nih.gov/compound/Carbon-tetrachloride_CSR_Schedules_3.1,_3.2,_and_3.3_(up_to_Stage_13_amendment,_2021))
82. Well Protection Toolkit (2004), joint project of BC Environment, Ministry of Health, Ministry of Municipal Affairs, Environment Canada and BC Groundwater Association. Issued by Water Stewardship Division, ISBN 0-7726-5566-9
83. Work Safe BC (2019). *Workers Compensation Act, Occupational Health and Safety Regulation (OHSR)*, B.C. Reg. 296/97, includes amendments up to B.C. Reg. 14/2019, January 1, 2021.
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