



Professional Engineers
Ontario

Environmental Site Assessment, Remediation and Management Guideline

• July 2020 •



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CONTENTS

1. INTRODUCTION	3
1.1 Purpose.....	3
1.2 Responsibilities.....	3
1.2.1 Engineers.....	3
1.2.2 The Client and/or Property Owner.....	3
1.3 Sealing Requirements.....	4
1.4 Qualifications.....	4
1.5 Conflict of Interest.....	4
1.6 Duty to Report.....	4
1.7 Professional Liability Insurance and Certificate of Authorization.....	5
1.8 Reliance.....	5
1.8.1 Extending Reliance to Others.....	5
1.8.2 Relying on third party documents or information (with and/or without reliance).....	5
2. PHASE I ENVIRONMENTAL SITE ASSESSMENTS.....	5
2.1 Objective	5
2.2 Study Considerations.....	6
3. PHASE II ENVIRONMENTAL SITE ASSESSMENTS.....	6
3.1 Objective	6
3.2 Study Considerations.....	7
3.2.1 Inherent Limitations	7
3.3 Phase II ESA Practices.....	7
3.3.1 Investigation and Sampling Work Plan	7
3.3.2 Undertaking Site Investigations.....	8
3.3.3 Interpretation and Reporting of Sampling Results.....	8
4. LIMITED SCOPE INVESTIGATION	8
5. CONTAMINATION MANAGEMENT	8
5.1 Evaluation of Options.....	9
5.2 Risk Assessment.....	9
5.3 Risk Management Measures	9
5.4 Site Remediation.....	10
5.4.1 Objectives	10
5.4.2 Remediation Targets.....	10
5.4.3 Identification and Evaluation of Remedial Alternatives	10
5.4.4 Remedial Action Plans	10
5.4.5 Implementation of Remedial Action Plan	11
5.5 Verification and Documentation	12
6. EXCESS SOIL	12
7. QUALITY ASSURANCE / QUALITY CONTROL.....	12
7.1 Field Quality Assurance	13
7.2 Laboratory Data Quality Assurance.....	13
7.3 Document Control	13
8. SPECIAL SERVICES	14
8.1 Expert Testimony	14
8.2 Presentation at Public Meetings.....	14
8.3 Advisory/Peer Review Services	14
Appendix 1–Definitions	14
Appendix 2–References	15
Appendix 3–Acronyms	16

INTRODUCTION

1.1 Purpose

This document is a guideline for Ontario professional engineers providing environmental site assessments (ESA), site remediation, and environmental risk assessment and management services. Its purpose is to highlight the professional and ethical responsibilities and to provide a benchmark to evaluate the level of professional practice and quality of work required of a professional engineer practicing in this field.

The guideline recognizes the multidisciplinary nature of such work, and that other professionals may be involved to provide complementary skills and knowledge as required for certain sites and/or stages in the remediation work.

This guideline is intended to assist engineers but does not replace existing legislation, regulations, policies or other guidelines, nor does it obviate the need for required appropriate education, training and experience.

For more information on the purpose of practice guidelines, the guideline development and maintenance processes, including the Professional Engineers Ontario (PEO) standard form for proposing revisions to guidelines, please read our document: <https://www.peo.on.ca/sites/default/files/2019-08/GUIDELINE%20DEVELOPMENT%20AND%20MAINTENANCE%20PROCESSES%20terms%20of%20reference.pdf> To view a list of the PEO guidelines, please visit the Publications section of the PEO website: <https://peo.on.ca/index.php/knowledge-centre/practice-advice-resources-and-guidelines/practice-guidelines>

1.2 Responsibilities

1.2.1 Engineers

Engineers owe a legal duty to exercise reasonable diligence and skill to persons other than their own clients. Canadian courts will recognize such a duty (known as a “duty of care”) where it is foreseeable that the engineer’s conduct could cause harm to a specific person and that person is not in a proximal relationship with the engineer, *Cooper v. Hobart*, 2001 SCC 79. Such duties of care can extend to third parties who merely rely on the reported findings and conclusions of engineers in certain circumstances. Where an engineer fails to meet the standard of care, the engineer could be found liable for any damages that are directly caused by that failure.

Notice: The Professional Standards Committee has a policy of reviewing guidelines every five years to determine if they are still viable and adequate. However, practice bulletins may be issued from time to time to clarify statements made herein or to add information useful to those professional engineers engaged in this area of practice. Users of this guideline who have questions, comments or suggestions for future amendments and revisions are invited to submit these to PEO using the “Guideline Amendment and Revision” form available at: <https://www.peo.on.ca/sites/default/files/2020-01/Guideline%20Amendment%20and%20Revision%20Form%20%28FINAL%29.pdf>.

Engineers involved in ESAs and remediation should be familiar with federal, provincial and municipal legislation, regulations, policies and guidelines that apply to their projects, sites, contaminants of concern, and to their particular area of practice.

Permitting processes, approval requirements and compliance issues will vary depending on the site location and proposed work plan. With the client’s consent, it is advisable that the engineer leading a project interact with the applicable regulator(s)/stakeholder(s) early in the planning stages and throughout the project to satisfy themselves that the method and interpretation of the regulator’s policy, guidelines and acts are consistent and clear to all parties. Differences or concerns raised by the regulator should be clarified.

Beyond these responsibilities, engineers are also required to conduct themselves in a manner consistent with the Professional Engineers Act including, among other things, the duty to protect the public and the duty to conduct their work to the appropriate standard of care.

Where a multi-disciplinary team structure or oversight of others is required on a project, the engineer’s responsibilities will vary depending on their role. For example:

- The role of engineers who are undertaking a specific portion of a project should be clearly defined in the agreement. Any limitations in the scope of work should be identified;
- Engineers overseeing the work of others, who may or may not be members of a professional organization, and who will ultimately sign off on the final report(s), should provide overall guidance and review of the results of others’ work.

For more information, refer to the PEO guidelines, *Supervising and Assuming Responsibility for Engineering Work and Use of the Professional Engineer’s Seal*.

1.2.2 The Client and/or Property Owner

To achieve the desired goal and implement a reliable ESA, remediation and/or risk assessment, the engineer should consider undertaking the following activities with the client/property owner:

- Define the objectives, scope of work, limitations and deliverables with the client/property owner;
- Clarify the roles and responsibilities of the various professionals and contractors that the client/property owner has retained and are involved with the project;
- Enter into a signed written agreement with the client/property owner prior to commencing work. The agreement should be prepared in consultation with legal counsel. The agreement should outline the scope of work, the compensation,

terms and conditions, insurance requirements, schedule for the services and any other details on the project that were agreed upon or that of which the client/property owner should be made aware;

- Obtain all relevant documentation from the client/property owner that would benefit the undertaking of the ESA or risk assessment/remediation such as, utility maps, previous ESA reports and historical uses of the site including, where applicable, providing letters of reliance as detailed in section 1.8;
- Require that the client/property owner grants unimpeded access to the project site or document the site access limitations;
- Advise the client of potential regulatory requirements or schedule implications as a result of regulatory reviews and approvals;
- Recommend that the client/property owner obtain legal advice when appropriate; and
- Maintain communication with the client/property owner on the progress of the project and deviations or changes to the project. Changes to the scope of work or the terms of the written agreement should be documented and signed off by both parties to avoid conflicts or misunderstandings.

1.3 Sealing Requirements

Use of the seal is governed by section 53, O. Reg. 941, under the Professional Engineers Act.

The use of an engineer's seal is a matter of professionalism and not an independent source of civil liability. The failure to abide by section 53 of O. Reg. 941, constitutes professional misconduct under section 72(2)(g) of O. Reg. 941. Consequently, if in doubt, engineers are better off affixing the seal than withholding it. Affixing the seal avoids an allegation of professional misconduct and there is no downside of civil liability or professional misconduct in affixing the seal.

Engineers should decide whether a document needs to be sealed based on the policies and procedures that are outlined in the Use of the Professional Engineer's Seal guideline.

1.4 Qualifications

An engineer shall possess a combination of formal education, skill, experience and training appropriate to provide technically sound:

- Phased ESAs;
- Remedial options analysis;
- Site remediation design;
- Risk assessment; and/or
- Environmental risk management design.

A qualified engineer practising in this field should also be knowledgeable of the federal, provincial and municipal government legislation, regulations and guidelines, and approval-specific requirements that apply to site investigations, risk assessment and/or remediation. Applicable codes, bylaws, statutes and rules in connection with work being undertaken should be followed. For

more information on some of the applicable regulations, guidelines and industry standards, refer to Appendix 2.

To comply with their professional obligations, engineers should only perform or take responsibility for work in which they are certain they are competent. Section 72(2)(h) of Regulation 941/90 states: "Professional misconduct means undertaking work the practitioner is not competent to perform by virtue of the practitioner's training and experience."

In addition to the above, engineers should:

- Be aware of the role and contributions of engineering, geoscience, and other disciplines required to assess and remediate a site;
- Be able to identify when additional specialized knowledge not already included in the project team is required;
- Recognize the value of team skills including project management, shared goals, team make-up, team operations, shared knowledge of accountability, and limitations of other team members; and
- Consider including a summary of their relevant work experience in the proposals, terms of reference, engineering agreements and/or reports.

Finally, engineers practicing in Ontario should be aware that a phased ESA completed to support the filing of a record of site condition (RSC) shall be conducted or supervised by a "qualified person" (QP), as defined under Ontario Regulation (O. Reg.)153/04. An engineer can be a QP if they hold a licence, limited licence or temporary licence under the Professional Engineers Act.

1.5 Conflict of Interest

O. Reg. 941/90 made under the Professional Engineers Act describes the circumstances that create a conflict of interest. Section 72(2)(i) states that "failure to make prompt, voluntary and complete disclosure of an interest, direct or indirect, that might in any way be, or be construed as, prejudicial to the professional judgment of the practitioner in rendering service to the public, to an employer or to a client" shall constitute professional misconduct. To know when disclosure is appropriate, a clear understanding of what causes a conflict of interest is needed.

The simplest and most effective way to deal with potential conflicts of interest is to be forthright and communicate with the appropriate parties about any circumstances that could reasonably lead those parties to question the engineer's judgment.

For more information on conflict of interest, refer to PEO's Professional Engineering Practice guideline.

1.6 Duty to Report

The duty to report is an essential component of an engineer's commitment to professionalism. Each engineer "shall regard the practitioner's duty to protect the public welfare as paramount" (section 77(2).i, O. Reg. 941/90). For more information on an

engineer's duty to report, refer to the Professional Engineering Practice guideline.

1.7 Professional Liability Insurance and Certificate of Authorization

Engineers who offer services to the public or engage in the business of providing services to the public within the practice of professional engineering shall hold a certificate of authorization and carry liability insurance in accordance with the provisions in section 74(1) of Regulation 941/90 and other applicable acts and regulations.

1.8 Reliance

There may be situations when undertaking phased ESAs, risk assessments and/or remediation work where reliance on reports and data prepared by others for consideration and incorporation into one's own project may be warranted. As well, for a variety of purposes, the final report(s) prepared for the client/property owner may also be used and distributed to other third parties who may seek reliance on the use of the report(s).

The merits for extending or requesting reliance on another professional's work/report should be considered on a case-by-case basis, evaluating the circumstances and the risks involved such as the legal liability, cost considerations and timing constraints, as these and other factors can all weigh in on the decision.

1.8.1 Extending Reliance to Others

In situations where an engineer has prepared a report and a third-party other than the client/property owner is seeking/requesting a letter of reliance to rely on the engineer's report, the following should be considered:

- Engineers should consult their employer's legal counsel to decide on whether to provide a letter of reliance based on factors that may include but not limited to: the age of the report and the conditions on the site and adjacent site that may have changed in the intervening time; objective of the request; conflict of interest; business relationships with the client/property owner and recipient; and, the legal consideration; and
- If a letter of reliance should be provided, engineers should seek the advice of the legal counsel to assist in preparing a letter of reliance.

1.8.2 Relying on third party documents or information (with and/or without reliance)

In situations where engineers should rely on information or reports prepared by others, the engineer should carefully review data and results from a third party to satisfy themselves that they are relevant and consistent with professional industry and regulatory standards and that no systematic or intentional bias exists with the data.

It would be prudent to identify the fact that some information has been provided by others and provide representations, disclaimers, limitation and qualifications in their reports that make the allocation of professional responsibility clear to the reader. Engineers

relying on information prepared by others may need to consult their insurance companies since coverage may be denied by an insurer where the insured professional completes work outside of the covered area of expertise.

2.

PHASE I ENVIRONMENTAL SITE ASSESSMENTS

In general, a Phase I ESA identifies potential contaminating activities and areas of potential environmental concern on a property through desktop study review of background documents and maps, interviews and site reconnaissance.

Specific requirements of a Phase I ESA may vary depending on federal, provincial and/or municipal regulations pertaining to the site as well as client-specific requirements. The engineer should consider these factors when developing an approach to a Phase I ESA.

In Ontario, the Phase I ESA process often falls into one of two categories:

- Phase I ESAs completed for due-diligence purposes; and
- Phase One ESAs completed to support the filing of a Ministry of the Environment, Conservation and Parks (MECP) RSC under O. Reg. 153/04.

For the purposes of this document, the term "Phase I ESA" will be used to describe both Phase I ESA and Phase One ESA.

2.1 Objective

The objectives of a Phase I ESA are to determine:

- If the property is subject to actual contamination or potential sources of contamination;
- If there are potential off-site sources of contamination to the property;
- The locations on the property where contaminants are potentially present;
- If additional assessment, such as a Phase II ESA, is recommended or required; and
- Under O. Reg.153/04, the specific objectives of:
 - o Identifying potentially contaminating activities (PCA) (as defined under O. Reg.153/04) on the property or off-site within the defined study area; and
 - o Identifying areas of potential environmental concern (APEC) on the property as a result of the PCA.

A Phase I ESA may be completed to:

- Develop a conceptual site model;
- Establish the basis for further investigative work;
- Identify potential environmental risks or environmental liabilities;
- Assist in meeting regulatory, legislative or policy requirements;

- Assist in making informed decisions about property transactions or financing;
- Assist in identifying baseline conditions;
- Support legal action or defense;
- Serve as an initial step in the preparation of a site remediation;
- Support the completion of a risk assessment; and/or
- Support the filing of a RSC.

The type of report that is being prepared should be determined at the beginning of the ESA process and meet the overall project or study objectives.

2.2 Study Considerations

The specific requirements, methods and practices for a Phase I ESA are more fully described in Canadian Standards Association (CSA) Standard Z768-01. The mandatory requirements for a Phase I ESA to support the filing of a RSC are outlined in Part VII of O. Reg. 153/04.

The scope of work for a Phase I ESA should consider the following:

- A project study area is defined for the collection of off-site information;
- Access agreement or permits are in place;
- Reasonably attainable information is collected for the project site and properties within the scope of the project study;
- Reasonable steps are taken to obtain interviews with persons knowledgeable about the project site; and
- Site reconnaissance is conducted by an individual with the appropriate level of knowledge, skill and experience.

Sufficient information should be obtained, evaluated and presented to support the engineer's conclusions. Engineers are required to use sound judgment and avoid speculation when identifying on-site and off-site environmental concerns and consider the relative degree of uncertainty associated with historical information, data gaps and conflicting information.



PHASE II ENVIRONMENTAL SITE ASSESSMENTS

In general, a Phase II ESA involves intrusive investigations (e.g. boreholes/monitoring wells, test pits) and assessment through sampling, monitoring and chemical analysis of applicable media (i.e. soil, groundwater, sediment, and/or vapours) on areas of the property identified in the Phase I ESA where contaminants are potentially present.

Specific requirements of a Phase II ESA may vary depending on federal, provincial and/or municipal regulations pertaining to the site as well as client-specific requirements. The engineer should consider these factors when developing an approach to a Phase II ESA.

In Ontario, the Phase II ESA process often falls into one of two categories:

1. Phase II ESAs completed for due-diligence purposes; and
2. Phase Two ESAs completed to support the filing of a MECRP RSC under O. Reg. 153/04.

For the purposes of this document, the term “Phase II ESA” will be used to describe both Phase II ESA and Phase Two ESA.

3.1 Objective

The objectives of a Phase II ESA may include:

1. Determining the location and concentration of contaminants in the land, sediment and/or water on, in or under a specific property;
2. Determining if applicable standards for contaminants on, in or under the property have been met;
3. Collecting data to inform other decisions such as data supporting the evaluation and design of remediation programs and supporting the development and/or completion of a risk assessment; and
4. Delineating the extent of contamination.

Additional objectives under O. Reg. 153/04, include:

- Investigating APECs on the property identified in the Phase I ESA as a result of the on-site and/or off-site PCAs; and
- Confirming that the concentration of identified contaminants in the land and/or water on, in or under a specific property meet the applicable site condition standards or property specific standards.

A Phase II ESA may be completed to:

- Develop or update a conceptual site model;
- Assist in determining potential environmental risks or environmental liabilities;
- Assist in meeting regulatory, legislative or policy requirements;
- Assist in making informed decisions about property transactions or financing;
- Assist in identifying baseline conditions;
- Support legal action or defense;
- Assist in site remediation plan preparation;
- Support the completion of a risk assessment; and/or
- Support the filing of a RSC.

During the development of the scope of service, consultation with other professionals such as risk assessors and professional geoscientists, may be beneficial.

The type of report that is being prepared should be determined at the beginning of the ESA process and meet the overall project or study objectives.

It is the engineer's responsibility to plan and execute a detailed intrusive site investigation and to prepare a report that includes the review and evaluation of information gathered during the site investigation. Within the approved scope, the site investigation

should identify, characterize and/or delineate the nature and extent of contamination on, in or under the property.

3.2 Study Considerations

The components of a Phase II ESA should include:

- Developing investigation and sampling work plans based on APECs (as identified by the owner, client and/or previous ESAs conducted for the site);
- Developing data quality objectives;
- Retaining licensed and/or qualified contractors such as utility locators, drillers and excavators to conduct intrusive investigations as required;
- Undertaking investigations and inspections when they can be done safely (e.g. utility locates, overhead clearance, traffic control, etc.);
- Recovering representative soil, groundwater, surface water, sediment and/or soil vapour samples to characterize property conditions;
- Retaining an appropriately accredited analytical laboratory to conduct laboratory analysis of samples collected;
- Selecting the appropriate regulatory standards to compare the collected analytical data;
- Interpreting and reporting sampling results to the client/property owner of the property;
- Identifying if the study objectives have been met; and
- Providing recommendations for additional work.

The specific requirements, methods and practices for a Phase II ESA are more fully described in CSA Z769-00. The mandatory requirements for a Phase II ESA to support the filing of a RSC are outlined in part VIII of O. Reg. 153/04.

A Phase II ESA should be as detailed as necessary for the purpose of the study. It should be guided by such information as:

- The types of activities, processes and practices that have occurred on the site and on neighbouring sites that have resulted in APECs for the property;
- Legislation and published guidelines that apply to the property;
- The amount and quality of pre-existing information on the site's potential contamination;
- Such site-specific conditions as soil type, soil vapour, hydrogeological conditions, groundwater quality, surface water quality, sediment quality and depth to bedrock;
- The type and quantity of information required for delineation or to design an appropriate remediation and/or risk management program; and
- The potential presence of designated substances, solid, liquid or hazardous wastes, raw materials, products and other dangerous goods.

3.2.1 Inherent Limitations

The client/property owner and other stakeholders should be apprised of the limitations of the Phase II ESA which may include:

- Uncertainty of subsurface conditions between sampling points;
- Inadequate background information;

- Errors by third parties;
- Limitations of use of the report in its entirety by the client/property owner;
- Limitations of third-party reliance on the report;
- Unknown off-site environmental concerns;
- Detection/delineation limitations due to budget, access and/or time;
- The site's nature and constraints at the time of the investigation; and
- Other considerations, such as environmentally sensitive areas, access control, safety concerns and operational limitations.

3.3 Phase II ESA Practices

When preparing, undertaking and completing a Phase II ESA, the engineer should consider the following subsections to meet the objectives of the investigation.

3.3.1 Investigation and Sampling Work Plan

The engineer should develop a work plan detailing the investigation, sampling and handling procedures, monitoring and applicable health and safety considerations to be conducted during a Phase II ESA.

When developing the work plan, the following should be considered:

- Site limitations;
- The objectives of the investigation or sampling effort;
- The types and locations of field measurements;
- The number of samples to be collected, analyzed and the location of each sample;
- Anticipated site conditions such as soil, groundwater, surface water, sediment and/or soil vapour conditions) based on background review;
- Avoiding adverse impact on the environment, including creating preferential pathways for contaminants to migrate. In particular, special consideration should be given to well-head protection areas or other designations identified by a regulatory authority for the protection of groundwater and/or source water protection areas;
- Specific sampling or measuring methods, the number of samples or measurements to be taken, the parameters being sampled or measured, a description of the objectives for each sampling or measuring activity, and details of the methods to be used for sample or measurement collection, preservation, transportation and analysis;
- A field and laboratory QA/QC program including data quality objectives;
- Management of investigation-derived waste; and
- Maintenance and/or decommissioning monitoring wells in accordance with Regulation 903.

The sampling methods used will be influenced by the types and concentrations of contaminants encountered or suspected to be present, and by the environmental media to be sampled. Specific methods can range from non-intrusive field screening to more complex, intrusive media sampling.

Since the nature and extent of potential contamination may not be identified from file review and site observation, field screening techniques may provide an indication of the presence or absence of contaminants. The objective of field screening is not to quantify the magnitude and define the extent of contamination precisely, but rather to assist in identifying sampling methods, analytical parameters, and the selection of samples for analysis.

Established regulatory requirements, published guidelines, and relevant technical literature should be referenced where possible/applicable to assist in the development of the sampling work plan.

3.3.2 Undertaking Site Investigations

The Occupational Health and Safety Act requires all site work be conducted with appropriate regard for the health and safety of the individuals and workers at the site and the public in the vicinity. It is best practice to prepare and implement a site-specific health and safety plan.

Environmentally-sensitive features should be identified and appropriately addressed before any physical work is undertaken with due consideration for applicable regulatory requirements.

The site investigation should be documented using appropriate methods, including but not limited to, field logbooks or forms, photographs and/or videos. Logbooks, forms and records can be in hardcopy or electronic format. Electronic documents should have secure back-up copies.

During a site investigation, conditions may be discovered that require deviations from the sampling plan. The deviation and its rationale should be documented. Discussions with the client/property owner and regulatory agencies may be necessary to decide how to respond to deviations.

Collection, transportation and analysis of samples in a manner consistent with the investigation's requirements and applicable regulations, standards and guidelines are ultimately the engineer's responsibility.

3.3.3 Interpretation and Reporting of Sampling Results

The engineer should evaluate the information obtained during site investigation and present it in a manner designed to help the client/property owner understand its significance. To do this, the engineer should:

- Compare analytical data with the applicable standards;
- Summarize data and describe general trends or patterns;
- Use figures to show spatial patterns of contamination and soil/bedrock stratigraphy;
- Draw attention to data that indicate conditions of concern;
- Point out possible inconsistencies or anomalies in the data;
- Indicate the relative degree of uncertainty associated with evidence of contamination, and/or if the data are statistically reliable; and

- Identify any limiting conditions that arose during the investigation.

The engineer may also:

- Identify further investigation, sampling, or inspection to delineate the extent of contamination or to develop a proper remedial action plan; and
- Provide a preliminary scope of work and cost estimate for possible remedial activities.

Recommendations could be included in the Phase II ESA report or documented in a separate communication.

4.

LIMITED SCOPE INVESTIGATION

A limited scope environmental investigation may be sufficient to meet a project or client/property owner's objectives. A limited scope investigation is often conducted to evaluate a specific potential environmental concern or to evaluate one or more concerns identified by a Phase I ESA that are considered to have a higher potential to result in site contamination. The limited investigation should have a clearly defined scope of work, and the limitations to the work should be communicated to the client/property owner.

Examples of limited scope environmental investigations include:

- Historical document review (in lieu of a Phase I ESA);
- Client/property owner designed pre-screening study or form (in lieu of a Phase I ESA);
- Limited scope Phase II ESA involving the investigation of a specific medium, stratigraphy, or location;
- Environmental baseline study;
- Groundwater sampling/monitoring report;
- Excess soil and fill investigations;
- Spill response sampling; and
- Storage tank investigations.

The use of industry accepted methods for Phase I ESA and/or Phase II ESA will provide the engineer with a framework for quality when completing limited scope environmental investigations.

5.

CONTAMINATION MANAGEMENT

Means by which identified contamination may be addressed are highly dependant on site-specific conditions. Common approaches to contamination management include risk assessment (and

subsequent management as required) and remediation of the site or a combination thereof.

5.1 Evaluation of Options

Management and/or remediation approaches or a combination thereof are typically selected for evaluation. A preferred approach is selected by weighing the advantages and disadvantages of the various alternatives, the trade-offs among alternatives, and the client/property owner risk tolerance. This often involves striking a balance between a number of factors, including but not limited to:

- Probability or certainty of success to reach remediation/management objectives;
- Timeframe and cost constraints;
- Regulatory constraints and/or approvals;
- Accessibility limitations;
- Potential for off-site impacts;
- Public safety;
- Sustainability; and
- Stakeholder consultation.

The results of the Phase II ESA or limited scope investigation outlined in sections 3 and 4, respectively, may be sufficient to provide a representative description of the media/materials requiring remediation and/or management (by defining the contamination's nature, and preliminary quantity, area, vertical distribution and location). The investigation data and results should be thoroughly reviewed and evaluated for quality and completeness to determine adequacy in supporting management of the contamination. Additional investigations may be necessary to develop a fuller understanding of the contaminant's three-dimensional distribution to support the evaluation and design of remediation and/or management options.

5.2 Risk Assessment

A risk assessment is a scientific process used to evaluate the potential for adverse impact to human health or the health of ecological receptors.

A risk assessment approach to managing site contamination may be the preferred option when:

- Full remediation to applicable criteria is not financially feasible or is not technically practical or warranted;
- Remediation is required over a longer period of time and risk assessment is required to protect health and safety of users of the site during the interim; or
- It supports sustainable practices (such as reducing the need for the transportation and disposal of soil).

The risk assessment should consider the following but not be limited to:

- Evaluation of the potential risks to human health or ecological receptors based on site-specific contaminants and exposure pathways;
- The current use and/or proposed future use;

- Development of site-specific criteria for a contaminant (which may or may not have a published criteria);
- Development of risk-based remediation targets;
- Prioritization of remediation efforts;
- Reduction in quantity of excess soils generated during redevelopment; and
- Determination of appropriate risk management measures (RMM).

Similar to ESAs, risk assessments can be completed for due-diligence purposes or to support the filing of a RSC under O. Reg.153/04. Risk assessments completed to support the filing of a RSC shall be completed following the specific requirements outlined in O. Reg.153/04.

Risk assessments can develop site specific standards, which consider specific information (such as geology, hydrogeology, site physical characteristics, exposure pathways and receptors) that may be more relevant to the site than the assumptions used to develop applicable generic standards. The application of site specific standards may be contingent on the implementation of RMMs.

5.3 Risk Management Measures

RMMs can be implemented to control potential contaminant exposure pathways. RMMs are designed to achieve the same target level of risk as the applicable generic criteria and may include administrative and/or engineered solutions.

Examples of administrative RMMs include:

- Land uses restrictions;
- Groundwater use restrictions;
- Building restrictions and building use restrictions;
- Soil and groundwater management plans; and
- Worker health and safety plans.

Examples of engineered RMMs include:

- Physical barriers to eliminate contact with contaminated media;
- Vapour intrusion mitigation systems; and
- Control of contaminated groundwater flow.

Engineers recommending and designing engineered RMMs require an appropriate level of education and experience, and familiarity with applicable regulations and codes.

RMM designs should:

- Have appropriate and measurable performance objectives;
- Consider the level of uncertainty that may be inherent in the risk assessment;
- Have the appropriate means to measure that the objective has been achieved;
- Include provisions for the short- and long-term monitoring and maintenance of the RMM;
- Include contingency plans should the RMM fail to meet the performance objective; and

- Consider regulatory requirements, approvals and/or notifications that may be required.

5.4 Site Remediation

5.4.1 Objectives

The objective of remediation is most often to return an impacted property/site to an environmental condition that will sustain its intended reuse without the need for administrative or engineering RMMs. Alternatively, the objective can be to secure the site in a manner that mitigates or prevents future on-site or off-site impacts.

5.4.2 Remediation Targets

There are multiple approaches that can be used to determine the remediation level to be achieved during site remediation. Remediation targets may include:

- Remediation to background conditions;
- Remediation to published “generic” guidelines or standards; or
- Remediation to risk-based or site-specific standards.

In principle, remediation to background conditions can be used for any site. It is essentially a remedial strategy that restores the property to an environmental condition consistent with the ambient or background conditions. Background conditions can be defined by standards, surveys, studies or through the completion of a site-specific study.

Remediation standards have been developed by several government agencies to assist in establishing criteria that are protective of human health and/or the environment. “Generic” standards are most commonly developed for such media as soil, groundwater, surface water, air and sediment. “Generic” standards have been developed for a range of applications, including different land uses, land-use sensitivity, depth of contamination and surface water or groundwater use. The engineer should be aware of the limitations of “generic” standards, including the assumptions made in their development, and advise the client/property owner of the relative merits of this approach to site remediation.

Site remediation or site management targets for a particular site may also be developed based on risk assessment at that site (see section 5.2 above).

The selection of remediation targets will depend on a number of factors, including:

- Whether the remediation is voluntary or compliance-driven;
- Whether filing a RSC is an objective or a requirement; and
- The nature of contamination and feasibility of various remedial alternatives (refer to section 5.4).

The decision process and logic used to select remediation targets should be documented and form part of the remedial action plan.

5.4.3 Identification and Evaluation of Remedial Alternatives

Once remediation objectives and targets are established, the next step is to identify and select site remediation alternatives for review and consideration. Similar to determining the preferred approach to contamination management, various remediation alternatives are evaluated, often by striking a balance between the same factors outlined in section 5.1 above.

Remediation alternatives may involve one or more of the following activities:

1. Excavation and off site removal (e.g. approved waste disposal site, relocation to alternative suitable receiving site); and/or
2. Elimination, destruction, degradation or transformation of contaminants through in-situ or ex-situ methods.

Alternatives may need to be refined based on the results of further site characterization or pilot study or transitions to changing technology.

Bench-scale and pilot-scale testing of remediation technologies may be prudent but not necessary in the evaluation of remediation alternatives. The value of conducting these studies and pilot tests should be weighed against the available budget and time required. If significant cost savings can be achieved, or if uncertainties can be reduced to tolerable levels, then treatability studies and/or pilot studies would be warranted.

5.4.4 Remedial Action Plans

Once a preferred remediation method is selected, a remedial action plan (RAP) should be prepared, which:

- Provides a description of the project to the preliminary design stage;
- Defines the desired outcomes and appropriate remediation requirements and targets, including the decision-making process to develop the remediation targets;
- Describes the plans and defines the sequence of activities for implementing the selected remediation alternative that responds to stakeholder concerns;
- Identifies approaches to mitigate the off-site effects of the remediation program; and
- Establishes monitoring and confirmatory requirements.

The RAP also serves as the basis for discussing implementation of the remediation work with the client/property owner, government regulatory authorities and/or other stakeholders, such as adjacent property owners, community groups and Indigenous groups.

The RAP may include the following elements:

- Objectives and remediation targets, including any specific remediation standard to be achieved;
- Stakeholder concerns;
- Overview of the site contamination and site conditions affecting remediation, including soil and stratigraphy, soil vapour, surface water, groundwater and aquifers;
- Media/materials to be remediated;

- Management of excess soils, sediment and groundwater such as movement, disposal and quantities during remediation from source site to receiving sites in compliance with local guidelines and regulations;
- Review of options that appear to be best suited to remediate specific conditions;
- Remediation strategy and the sequence of activities for remediation, including specific reference to each area to be remediated in terms of lateral and vertical extents, overall surface area and overall volume, as well as volumes to be remediated with respect to each class of contamination typically based on soil or sediment standards;
- Requirements for a site-specific health and safety plan;
- Risk management plans;
- Issue resolution process with third party stakeholders;
- Types of pilot-scale tests to confirm the viability of specific options, including treatment equipment, if any;
- Government regulatory approval requirements;
- Communications plan;
- Mobilization and site preparation;
- Methods to manage accumulated water, dust, noise, odour and traffic;
- Management of by-products;
- Requirements for on- and off-site air quality/emission monitoring;
- Contingency plans;
- Identification of the fate of residual contaminants;
- Remediation verification and long-term monitoring plans;
- QA/QC plan;
- Site restoration and closure process including reporting and documentation requirements; and
- Closure and sign-off.

In cases where risk assessment becomes part of the remedial approach for a site, the description of risk management plans may be included in the RAP. For further details on risk assessment and RMMs, refer to sections 5.2 and 5.3.

In addition to the above, depending on project needs and complexity, detailed construction/remediation specifications and drawings are typically developed at this stage for implementing the project and potentially for government regulatory approvals. The plan may include applying for permits and approvals for decommissioning or demolition of building structures and/or equipment in addition to the remediation of solid, liquid or gaseous matrices.

The importance of contingency planning for site remediation cannot be overemphasized. There are many occasions where additional information not previously identified or obtained during the site assessment process is discovered during a site remediation activity, especially where excavation is part of the remedial activity. Contingency items may be needed to address:

- Site characterization uncertainties, including vertical and lateral delineation or previously unknown contaminants;

- The potential for unknown infrastructure, such as underground storage tanks; and
- The potential for off-site impacts.

The engineer should advise the client/property owner that contingency measures may be necessary to complete the remedial objective if unknown conditions are encountered. Reference to other potential contingencies in the plan may be useful in alleviating project delays or disputes.

5.4.5 Implementation of Remedial Action Plan

The engineer should consider several important factors during implementation of the RAP as discussed below.

5.4.5.1 Notifications, Permits and Approvals

Regulatory requirements shall be considered during implementation of the RAP. The engineer should allow adequate time to obtain required permits in the schedule for the RAP.

Due to the dynamic nature of site remediation, requirements for notifications, permits and/or approvals may deviate from the details provided in the RAP. The engineer overseeing the RAP implementation shall be knowledgeable of regulatory requirements so that any such deviations may be addressed. As a best practice, engineers should retain copies of any notifications, permits and/or approvals completed by the contractor.

5.4.5.2 Preparation of Specifications and Tender Documents, Contractor Selection

A wide range of strategies for contractor selection are available for remediation projects. The conventional approach involves the preparation of specifications and/or tender documents, issuing the tender for bid, review of bids and contractor selection.

Typically, specifications provide a thorough description of the remediation work to be performed. Specifications may be in the form of written instructions, engineering drawings or both; or other documentation models. The client/property owner may have their own standard operating procedures for procurement. Detailed specifications are used when the remediation method is well-defined and not open to alternatives developed by the remediation contractor. A performance specification is used when the end goal is well-defined but there are numerous ways to achieve the goal, any of which is considered acceptable to the client/property owner. Combinations of detailed and performance specifications can also be used as appropriate. The RAP, or components of the RAP, should form the basis for the development of the detailed technical or performance-based specifications.

Paramount importance must be given to selecting remediation contractors that fulfill regulatory approval, permit and certification requirements. Consideration should also be given to selecting a contractor with a demonstrated history of successful application of the remediation technology.

5.4.5.3 On-site Supervision

On-site supervision is essential during remediation operations to confirm the client/property owner's interests are addressed; that the contractor is executing the RAP as specified in the contract; and that remediation verification information is obtained (e.g. through confirmatory sampling and testing).

In some cases, the engineer may act as the client/property owner's representative to coordinate the implementation of the RAP. The role may include:

- Periodic or continuous supervision requiring various field methods (e.g. field screening techniques, progress sampling, conducting quality assurance/quality control activities, verification sampling of various waste streams, etc.);
- Advising the client/property owner if changing site conditions or situations deviate from the RAP or objectives and targets are not achieved;
- Documenting further approved or corrective actions;
- Compliance with applicable regulations;
- Compliance with the health and safety program;
- Monitoring/addressing issues that may arise during progression of remediation (e.g. previously unknown conditions, off site plume migration, air quality/odour issues, dust control, etc.). This may include implementing contingency measures as outlined in the RAP or developing and implementing additional contingency measures;
- Documenting the nature and progress of the remediation as it relates to the objectives; and
- Performing contract administration duties.

Consideration should be given to the risks in assuming responsibility for and/or supervising engineering work. For more information, refer to the Assuming Responsibility and Supervising Engineering Work practice guideline.

5.5 Verification and Documentation

Verification sampling of the remediated areas/materials should be carried out to monitor progress or completion of the RAP. The engineer shall follow relevant regulatory requirements and should follow established engineering and scientific practices in designing verification sampling and analysis programs. Key considerations include the following:

- The target media and contaminants of concern;
- An appropriate sampling and analysis plan, including interim sampling and analysis of impacted materials to verify/support that the remedial efforts were required and verification sampling and analysis to indicate that the remediation methods achieved the targets;
- A QA/QC plan as further discussed in section 7; and
- The potential for contaminant concentrations to rebound. This is particularly a concern for in-situ remediation methods, and pump and treat groundwater remediation.

Remediation activities, including results of the sampling and analysis program, should be thoroughly documented. Typically, a

remediation report is prepared and provided to the client/property owner. In preparing this report, the engineer should consider:

- Recommendations presented in section 3.3.3 of this guidance document for evaluating and reporting information obtained during a Phase II ESA, as they are highly applicable to contaminant remediation;
- Describing site remediation activities and status at the time of reporting, including sufficient documentation to demonstrate whether or not the remediation objectives were achieved;
- Describing and providing rationale for any deviations from the RAP;
- Providing recommendations for further monitoring and/or contaminant management actions as appropriate; and
- Fulfilling reporting requirements under a permit and/or regulatory authority, if they are within the scope of work.

6.

EXCESS SOIL

Excess soil is often generated during construction activities or through the course of ESA and remediation activities. Engineers are encouraged to consider the beneficial reuse of excess soil, where appropriate, in a manner promoting sustainability and protection of the environment. Soil conservation and management should be a consideration throughout a project where excess soil is expected to be generated.

When planning excess soil management activities, engineers should consider best practice guidelines and be aware of municipal requirements and provincial regulations that pertain to excess soil management.

7.

QUALITY ASSURANCE/QUALITY CONTROL

QA/QC programs are an essential part of the ESA and remediation processes. A QA/QC program provides a measurable standard of quality of engineering services and also provides a safeguard to public safety.

A site-specific QA/QC program may include, but is not limited to, the following:

- Assurance that data of sufficient quality is obtained to make proper decisions for the property and/or remediation design;
- Consideration for both field and laboratory data quality which may include the use of standard statistical methods;

- Establishment of data quality objectives (DQOs) and evaluating the data for conformance with DQOs;
- Monitoring staff and contractor performance;
- Verification of data quality relative to expectations of the regulatory agency;
- Use of standard field tests and assessment protocols, including the use of standard analytical tests by accredited laboratories; and
- Development of and adherence to standard operating procedures including, but not limited to:
 - o Borehole drilling;
 - o Test pitting;
 - o Excavating;
 - o Soil sampling;
 - o Field screening measurements and calibration procedures;
 - o Monitoring well installation, development, maintenance and closure;
 - o Field measurement of water quality indicators and calibration procedures;
 - o Sediment sampling; and
 - o Groundwater sampling.

DQOs are included as part of a good QA/QC program. DQOs outline the overall level of uncertainty that an engineer will accept when evaluating collected data. DQOs are set to assess precision, accuracy, representativeness, comparability and completeness for field and/or laboratory data, with each specifically defined as follows:

- Precision is the measure of reproducibility of a measurement;
- Accuracy is the measure of how close the measured result is to the true value;
- Representativeness is the degree to which the results are indicative of true site conditions;
- Comparability is the confidence to which one data set can be compared to another; and
- Completeness denotes the amount of data planned to be collected to the amount of data actually collected.

DQOs can be viewed as the overall project design constraints that determine if the project work completed is acceptable.

The engineer should have an active role in reviewing and validating all QA/QC for the project, including, but not limited to, field, laboratory, data and document control aspects of the QA/QC program.

7.1 Field Quality Assurance

A field QA/QC component should be included in the Phase II ESA and/or remediation sampling and analysis plan. The following, as a minimum, should be included in the field QA/QC:

- Specification on the minimum requirements for the number, type and frequency of field quality control measures including field blanks, trip blanks, equipment blanks and/or blind field duplicates and calibration checks on field instruments;
- A minimum of 10% of blind field duplicate samples should be collected and submitted for laboratory analysis in each me-

dium being sampled. Blind field duplicate labels should not be linked with the primary samples;

- Properly labelled and sealed samples in order to prevent lost, broken or exposure to conditions that may affect the sample's integrity;
- Samples submitted to laboratories for analysis shall be accompanied by a chain of custody form to document the transport of samples, communicate requested analyses for the appropriate parameters, receipt by the laboratory and analyses within the prescribed laboratory holding times;
- The chain of custody form, completed at the time of sampling, should contain at least the sample number, date and time of sampling, and the name of the sampler. Contact information should also be provided. The engineer should confirm that the chain of custody document be signed and dated when transferring the samples during shipment or upon relinquishing the samples to the analytical laboratory; and
- All non-dedicated sampling and monitoring equipment be decontaminated following each use.

7.2 Laboratory Data Quality Assurance

As discussed in section 8, DQOs set the acceptable level of uncertainty of collected data. The engineer should review and validate the laboratory certificates of analysis, including the laboratory supplied QA/QC data. Validation includes an evaluation of data for the following:

- Precision: Relative per cent difference between parent sample data to field duplicate data;
- Accuracy: Review of method blanks, spiked blanks, matrix spikes and surrogate recovery results;
- Representativeness: That the analytical results are consistent with field screening measurements and/or previous investigations;
- Comparability: Confirmation that sample integrity, sample preservation, holding times, etc. are consistent; and
- Completeness: That the certificate of analysis is in agreement with the chain of custody documentation.

It is the engineer's responsibility to use their professional judgement to analyze the QA/QC data in context of the DQOs for the investigation to determine their suitability for use in making decisions for the investigation and/or subsequent phases of the project.

7.3 Document Control

Engineers are responsible for the documents and records that they create. A document control process should also be part of the QA/QC program. The documents included as part of an ESA, remediation and/or risk assessment, such as field notes, records, meeting minutes, project specific correspondence and report deliverables, should be managed and archived in a system that allows for validation and traceability. Where it pertains to report deliverables that may be under regulatory or legal scrutiny, these controls are essential for technical review/senior approval, updates and documenting that changes have been conducted and adequately

recorded. The retention and disposal of these documents shall be in line with legislative requirements and best practices.

8.

SPECIAL SERVICES

8.1 Expert Testimony

The process of ESA, remediation and management sometimes requires the expert testimony of engineers at regulatory hearings, courts of law, inquest hearings and discoveries, through interrogatories, and before committees. The purpose of expert testimony is to provide unbiased, truthful information to assist the trier of fact, such as a judge, board, tribunal or jury in reaching a sound decision. Engineers should refer to PEO's guideline, The Professional Engineer as an Expert Witness, for further guidance on this subject.

8.2 Presentation at Public Meetings

The engineer requires a comprehensive understanding of the subject to present information in a manner the public can readily understand. Information shall be truthful and unbiased.

For complex or contentious public meetings, the engineer may consider a team approach, including other professionals such as lawyers, planners or media consultants.

8.3 Advisory/Peer Review Services

Engineers may be retained to provide advisory or peer review services to stakeholders objecting or seeking another professional opinion on an ESA, remediation, risk assessment or management project. Engineers shall be aware of their responsibilities under the Code of Ethics when reviewing another engineer's work and shall comply with these responsibilities. Other engineers may have similar responsibilities.

In cases where the advisory services or peer review is for a third party such as community groups, prospective property buyers, regulatory agencies or property owners, the engineer's role is to independently verify the work of other engineers and to provide an independent report to the client/property owner.

For more information on the peer review, refer to the Professional Engineers Reviewing Work Prepared by Another Professional Engineer guideline.

APPENDIX

Appendix 1–Definitions

Where such definitions conflict or differ from what is in applicable legislation, the regulatory definition replaces the one used in this guide. For the purposes of this guideline:

“Client” is the party who engages the engineer, coordinating engineer and/or in some cases, the contributing engineer(s) to provide the required professional services. The client may be the property owner, a potential buyer of the property or an affected third party that could include government.

“Conceptual site model” is a synthesis of all relevant information obtained from an environmental site assessment with interpretation as necessary, recognition of uncertainties, and identification of contaminant linkages that are, or might be, present.

“In-situ” is the management of contaminants in place without excavation or disturbance of the soil structure.

“Blind field duplicate” is used to assess field sampling precision by taking a second media sample and submitting with an identity not associated to the original sample in order to keep it unknown to the laboratory.

“Contaminant” for the purpose of this document means a substance of concern at a concentration above an appropriate pre-established criteria in soil, soil vapour, sediment, surface water, groundwater or air. As adapted from CSA Z768-01 (R2016).

“Contamination” for the purpose of this document means a substance of concern or a condition in concentrations above appropriate pre-established criteria in soil, soil vapour, sediment, surface water, groundwater or air. As adapted from CSA Z768-01 (R2016).

“Criteria” are established numerical limits, a risk-based limit, or narrative statement. Criteria may be adopted directly from generic values or formulated to account for site-specific conditions.

“Due diligence” is the care that a reasonable engineer exercises under the circumstances to avoid harm for their client, to other persons, property and the environment.

“Engineer” means an engineer who is registered as a member in good standing with Professional Engineers Ontario. References in this guideline to “engineers” apply equally to professional engineers, temporary licence holders, provisional licence holders and limited licence holders.

“Equipment blanks” are field blanks that are used to check for contamination from filtering equipment or any other equipment that is used in sample collection.

“Field blanks” are defined as matrices that are prepared by the analytical laboratory that have negligible amounts of the substance(s) or contaminant(s) of interest. They are prepared by transferring analyte free media from one vessel to another or by exposing the media to the sampling environment at the sampling site. Field blanks are used to test the purity of chemical preservatives, check for contamination of sample containers, detect contamination that occurs during sampling and detect other systematic and random errors that may occur during sampling.

“Monitoring” is the routine sampling of water, sediment soil or air samples at an appropriate frequency and location; the analyses of the samples for contaminants; and the collection or reporting of the methodology and interpretation of the results.

“Phased ESA” is the systematic environmental assessment process to determine whether a property is or may be subject to potential or actual contamination. A Phase I ESA generally involves desktop study review of background documents and maps, interviews and site reconnaissance. A Phase II ESA involves intrusive investigations (e.g. boreholes/monitoring wells, test pits) including monitoring, sampling and chemical analysis for applicable contaminants of concern.

“Project” is the total work contemplated.

“Property” comprises land, buildings, equipment and installations, and the improvement of any physical object with some degree of permanence.

“Property owner” includes a lessee, a person in charge, a person who has care and control, and a person who holds him or herself as having the powers and authority of ownership or who for the time being exercises the powers of ownership.

“Quality assurance” means evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

“Quality control” means monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory results.

“Remediation” means the development and application of a planned approach to treat, remove or destroy contaminants present in the soil and/or groundwater for the purpose of reducing their concentration or availability to acceptable levels.

“Risk” means the probability or threat of damage, injury, liability, loss or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action. For the purposes of this document, it generally refers to a measure of the severity of human health and/or ecological health effects arising from potential exposure to contamination and the probability of the occurrence.

“Risk assessment” scientifically examines the risk posed to humans and the natural environment from exposure to a contaminant. The purpose of a risk assessment is to develop property specific standards that will protect the uses that are being proposed to take place on the property.

“Risk management” means the actions implemented to eliminate or control potential contaminant exposure pathways.

“Stakeholder” means a person or organization who is directly involved with or affected by a project, product or activity thereby having an interest in it.

“Trip blanks” (also known as travel blanks) are field blanks that accompany sample bottles for the duration of the sample period and return to the laboratory without ever being opened.

Appendix 2–References

The following documents were used in the development of this guideline and provide additional information that can be referenced. Updates to these documents may occur over time. The most recent version should be referenced. This is not an exhaustive list. Other reference documents exist and may be helpful in environmental site assessment and remediation work. The engineer should determine the applicability of other such references.

- Canadian Council of Ministers of the Environment. [2016]. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 1 Guidance Manual.
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- Ministry of the Environment, Conservation and Parks. [current date 2019]. Ontario Regulation 406/19: On-Site and Excess Soil Management

Retrieved from the Government of Ontario website: <https://www.peo.on.ca/knowledge-centre/practice-advice-resources-and-guidelines/practice-guidelines>

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- Professional Engineers Ontario [October 2011]. Professional Engineers Reviewing Work Prepared by Another Professional Engineer guideline.
- Professional Engineers Ontario [February 2018]. Assuming Responsibility and Supervising Engineering Work guideline .
- Professional Engineers Ontario. [August 2017]. Professional Engineering Practice guideline.

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- Engineers Canada. [March 2018]. National guideline on site remediation for professional engineers.

Appendix 3—Acronyms

- APEC: Area of potential environmental concern
- CSA: Canadian Standards Association
- DQO: Data quality objectives
- ESA: Environmental site assessment
- MECP: Ministry of the Environment, Conservation and Parks
- PCA: Potentially contaminating activities
- QA/QC: Quality assurance/quality control
- QP: Qualified person
- RMM: Risk management measures
- RSC: Record of site condition
- RAP: Remedial action plan
- PEO: Professional Engineers Ontario



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