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CHWMD/HUL/NGT (1)
November 08, 2021

To
The National Green Tribunal (SZ)
South Zone
Chennai

Sub: Submission of clarifications on Original Application No. 161 of 2021 (SZ) & I.A. No.151 of 2021 (SZ)

Ref:

1. NGT (SZ) Order dated 08/10/2021
2. CSIR-NEERI study report titled "Site Assessment of Pambar Shola and Pambar River Kodaikanal, August 2021

Sir,

In compliance to NGT order mentioned under ref.1, on behalf of CSIR-NEERI, I hereby submit clarifications/comments with respect to objections/points raised by petitioners on the conclusions of the study report "Site Assessment of Pambar Shola and Pambar River in the Down Gradient Direction of the Mercury Contaminated Site of Hindustan Unilever Ltd. Closed Thermometer Factory, Kodaikanal".

Thanking you,

Yours faithfully,

ANV 08/11/2021

(A.N. Vaidya)

Response of CSIR-NEERI to the comments/objections raised by the intervening petitioner on the report "Site Assessment of Pambar Shola and Pambar River in the Down Gradient Direction of the Mercury Contaminated Site of Hindustan Unilever Ltd. Closed Thermometer Factory, Kodaikanal" dated August 2021

Ref:

1. NGT order dated 01/11/2018 on OA No. 211/2018
2. Impleading petition filed by Mr. Navroz Modi dated 06/10/2021
3. Note on submissions before the NGT dated 07/10/2021 – Pages 11 to 17.
4. NGT Order dated 08/10/2021 on Original Application No. 161 of 2021 (SZ) & I.A. No.151 of 2021 (SZ)

1. Scope of the CSIR-NEERI study report

The Principal Bench of the NGT in its order on OA No. 211/2018 dated 01 November 2018 directed Hindustan Unilever Ltd (HUL) to remediate the mercury-contaminated soil in the premises of the closed thermometer factory and its adjoining areas to the remediation target level of 20 mg/kg, and also to carry out offsite assessment study in Pambar Shola. The relevant portion of NGT order is reproduced verbatim.

> *"Considering the reported environmental impacts in Pambar Shola river in the downgradient direction of closed thermometer factory, it is proposed that a detailed site assessment be carried out to ascertain the extent of contamination and if required, an ecological risk assessment study also be carried out.*"

CSIR-NEERI has carried out the study and submitted the report as per the directive of NGT.

2. Petitioner's objections on the report and response of CSIR-NEERI:

The petitioner raised some objections to the screening standards used in the NEERI study report pertaining to Soil, Water, Sediment, and Moss.

The screening levels are generic concentrations of hazardous substances in soil and sediments, ground water and surface water at or below which potential risks to human health or environment are not likely to occur and where no further investigation and assessment is needed.

The MoEF&CC document "Guidance document for assessment and remediation of contaminated sites in India" provides screening values. Applicable portions of the document are given as Annexure I.

2.1. Soil

Petitioner's objection:

The screening criteria of 6.6 mg/kg is not correct. The use of the Parkland / residential standards for the adjacent wildlife sanctuary is wholly inappropriate.

CSIR-NEERI's response:

(i) The MoEF&CC guidance document recommends the use of Canadian soil quality guidelines of 6.6 mg/kg since no Indian guideline value is available. The MoEF & CC document clearly shows how to correlate the form of land use in India *vs* the Land use in Canadian Guidelines, in this case, for "Forest" land use in India the corresponding value of "residential / parkland" in Canadian Guidelines is to be used, which is 6.6 mg/kg. Also, the Canadian soil quality guideline for environmental health is 12 mg/kg. The relevant portion of the document is given as Annexure II.

(ii) Mercury content in all the 90 soil samples taken was in the range of "ND to 4.7 mg/kg" (average 0.154 mg/kg) and was below the screening value of 6.6 mg/kg.

2.2. Water:

Petitioner's objection:

(i) Canadian guideline value of 0.000026 mg/l for the protection of aquatic life needs to used, instead of BIS/MoEF&CC values that are meant for drinking and effluent discharge to surface water bodies.

(ii) The detection limit is above the most conservative of screening standards, and therefore there is no evidence to conclude that water is not contaminated and no such conclusion can be reached from the present report as all values less than LOQ have been reported as "Not detected (ND)". The LOQ of 0.003 mg/l used in the present report is 115 times higher than the appropriate screening value.

CSIR-NEERI's response :

(i) The screening Levels for assessing surface water impact from contaminated sites discharging wastewater to surface water bodies, the MoEF&CC guidance document recommends the use of the Indian standards: "The Environment (Protection) Rules, 1986 Schedule VI, General standards for discharge of environmental pollutants". The applicable screening value is 0.01 mg/l for surface water. The document clearly mentions that if there are no Indian standards for a specific compound, then only the Canadian Water Quality Guidelines for the protection of aquatic life will be used as Screening Levels. The relevant portion of the MoEF & CC document is given as Annexure III. Hence, 'Canadian Water Quality Guidelines for the Protection of Aquatic Life' is not applicable in this case.

(ii) Mercury content was 'Not Detected' in all the 46 water samples taken, compared to the screening value of is 0.01 mg/kg. We have used the most sensitive ICP-MS method for measurement of mercury with LOD of 0.0009 mg/l and LOQ of 0.003mg/l.

(iv) The Canadian value of 0.000026 mg/l is an ultra trace analysis, which require highly sophisticated instruments that are not generally available in India.

2.3 Sediment:

Petitioner's objection:

The interim sediment quality guideline (ISQG) is 0.17 mg/kg, and the Probable effect levels (PEL) is 0.486 mg/kg, and it is the former, not the latter that is the appropriate and most conservative screening criteria that ought to have been used for comparison. The fact that considerable biologically adverse effects will occur when sediment mercury levels are above 0.17 mg/kg is evident from the Canadian Guidelines which states that the incidence of biologically adverse effects is 34% when sediment mercury levels are between 0.17 mg/kg and 0.486 mg/kg. At levels above 0.486 mg/kg, the incidence of adverse effects increases marginally to 36%. I submit that this makes it clear that considerable biologically adverse effects are certain at the levels detected by NEERI in its study and that its interpretation and conclusion on the sediment quality being benign is deeply flawed.

CSIR-NEERI's response :

(i) For sediments quality assessment, there is no Indian guideline value available. As per the recommendation of MoEF&CC document, Canadian sediment quality guidelines are recommended for assessment to further risk assessment/intervention is required or not.

(ii) Canadian sediment quality guidelines mention interim sediment quality guidelines (ISQG), and probable effect levels (PEL), whose values are 0.17 and 0.486 mg/kg, respectively. ISQGs are derived when available data is limited and knowledge gap exist, whereas PELs are based on potential for developing adverse biological effects in aquatic organisms. In addition to the mercury levels, the adverse biological effects in sediment dwelling organisms depend on site specific conditions, bioavailability, sediment organic matter and the nature of aquatic species (Page 3, Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1995, Annexure IV).

(iii) Comparison of the results of the NEERI study with ISQG i.e. 0.17mg/kg, indicate out of the 44 sediment samples results, 41 samples (93%) were below the ISQG and 3 sample results (7%) were above of ISQC and below PEL. Comparison of the results of the NEERI study with PEL i.e. 0.486 mg/kg, indicate none of the 44 sediment samples results exceeded the PEL (i.e. the level above which adverse effects are more likely to be observed).

(iv) It is the PEL that is realistic and concentrations above this level would indicate adverse effects based on scientific data. The ISQGs are conservative, and exceedance of these concentrations does not warrant further action/intervention. As per the generic Canadian Guidelines, the National Classification System for Contaminated Sites (NCSCS) score is used to decide action required or not (Annexure V). As per the Canadian Guidelines, studies provide additional evidence that toxic levels of Hg in sediments are similar to, or greater than the PELs, confirming that adverse effects are more likely to be observed when concentrations of Hg exceed the PELs. Therefore, sediment mercury levels of the study were compared to the screening level (PEL) of 0.486 mg/kg.

2.4 Moss :

Petitioner's objection:

The mercury level of 6.36 mg/kg present in Moss collected at the HUL stream is 795 times higher than background levels (detection limit: 0.008 mg/kg) in NEERI's data set from other parts of the sanctuary. The high level of mercury suggests that the stream bed is an active *source of mercury. This is evidence that mercury is being discharged from the site into the sanctuary.*

CSIR-NEERI's response :

(i) There is no screening value available for vegetation in India or other countries. Lichens and Moss are widely used as biomarkers because of their ability to absorb and accumulate heavy metals, including mercury, from atmosphere. The scientific literature suggests limited possibility for uptake of mercury from lichen / moss by animals, birds or insects and hence it considered as low risk.

(ii) Elevated levels of mercury observed in bio-markers like lichen and moss are due to the ability to absorb and accumulate over time period. The highest level of 6.36 was observed in the moss sample collected from HUL factory stream discharge point.

(iii) The level of mercury in moss from the 45 samples taken is in the range of 'ND to 6.36 mg/kg' and average value is 0.232 mg/kg.

(iv) The detection limit of 0.008 mg/kg is the instruments capability to produce reliable results and does not represent "background value". Hence the statement "mercury in moss is 795 times higher than background levels" is incorrect.

2.5 Conclusion on the need for detailed risk assessment study:

Petitioner's objection:

It is submitted that NEERI in the latest report has rejected the need for an ecological risk assessment study based on a flawed interpretation of results as demonstrated above and it is a fact that contamination is found in the silt and in the stream leading from the HUL factory etc. There is a need to conduct an independent ecological risk assessment. It is submitted that the onus is on the actor carrying on the activity to prove that their actions do not cause *environmental harm and in the instant case, there is enough evidence to demonstrate otherwise.*

CSIR-NEERI's response :

As per MoEF&CC, USEPA, CCME, EU guidelines, Ecological risk assessment is carried out in phases *viz.* Tier I, Tier II and Tier III. The requirement of the successive phases of assessment/intervention is based on the result of the previous assessment, intended land use, screening value, and professional judgement among other factors.

In this study, Screening level based Ecological Risk Assessment (Tier 1) of soil, sediment and water indicated that no/negligible risk to flora and fauna, as the observed concentrations are far less than the screening levels. Based on the offsite field observations, sampling and analysis, Tier I Screening Level Risk Assessment, and review of the previous Risk Assessment studies, it is observed that HUL site do not pose any off-site ecological risks, particularly to the ecologically sensitive Pambar Shola forest area.

Considering all these factors, the conclusion "Detailed risk assessment of the Pambar Shola is not deemed necessary." is justified.

Annexure I

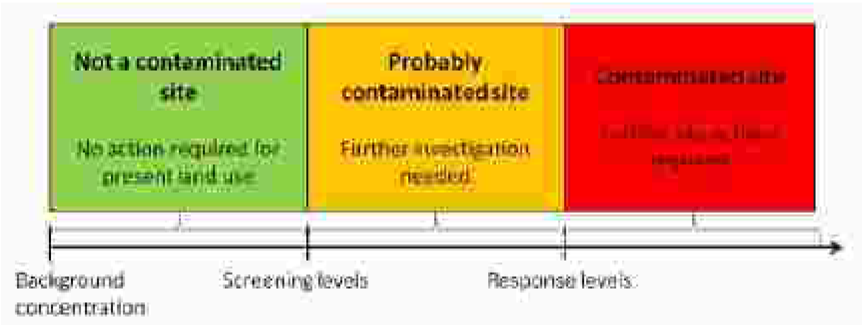
Volume II-2.1-b
Screening and Response levels

1 Introduction

This information is relevant for various Steps and Tasks in the assessment and remediation process.
Screening and Response levels are important to assess the level of contamination.

Screening levels are generic concentrations of hazardous substances in soil and sediments, groundwater and surface water at or below which potential risks to human health or the environment are not likely to occur and where no further investigation and assessment is needed. These Screening levels are distinguished for land use.

Response levels are generic concentrations of hazardous substances in soil and sediments at or above which it is very likely there is threat to human health or the environment, that may be imminent. At or above this level some form of response is required to provide an adequate level of safety to protect public health and/or the environment.



Note that that for certain contaminants such as Persistent Organic Pollutants, no background concentrations should be used, as there is no natural background for these substances.

2 Screening and Response levels

The table on next pages provides the Screening and Response levels.

ANNEXURE II

Appendix Figure 1 Overview of Screening and Response Levels related to risk and actions

Risk levels versus site categorization according to the definition is schematically shown in the figure below. The relation between the definitions of (probably) contaminated sites and the determination of specific Screening/Response Levels can be deducted as follows:

Risk levels and site categorization

Screening Levels

Assessing soil contamination

In India, there are no specific levels for assessing soil contamination. The Canadian CCME Environmental Quality Guidelines will be used as preliminary screening levels in the Indian situation. Four categories of land use are distinguished:

- Agricultural
- Residential/Parkland
- Industrial
- Commercial.

In the table below, we show how to correlate the form of land use from the Canadian Environmental Quality Guidelines with the land uses referred to by the MoEF.

Land use India (Referred to by the MoEF)	Land use in the Canadian Environemtal Quality Guidelines
Agricultural land	Agricultural (including water quality guidelines for agriculture)
Waste land	Industrial
Water bodies	For soil depending on land use
Forests	Residential/Parkland
Habitation settlements	Residential/Parkland
Industrial	Industrial, commercial
Mixed	Choose the most vulnerable land use
Other	Choose the most vulnerable land use

Background levels

In most cases, Screening Levels are well above the natural background levels. The natural background levels of metals and other inorganic chemicals can vary widely, and this should be taken into account when applying the assessment levels. Where it can be demonstrated that *natural* background concentrations are elevated (e.g. heavy metal concentrations in mineralised areas), it would be appropriate to develop less stringent assessment criteria. However, care needs to be taken when establishing the level of the natural background and its natural variation, as the local background level may be influenced by historic mining and/or waste disposal activities. Note that for certain contaminants such as Persistent Organic Pollutants, no background values should be used, as there is no natural background for these substances.

Assessing groundwater contamination

For groundwater, first the intended use (at present or in future) of the groundwater has to be established. Is it to be used for drinking water for humans, for drinking water for animals, for irrigation of crops, or for water in industrial processes? Depending on this, different screening levels can be set up. In India, there are no specific standards for groundwater levels beneath contaminated sites. However, there are specified standards for e.g. drinking water and water used for irrigation.

Groundwater used for drinking water

As Screening Levels for groundwater used for drinking water, the Indian drinking water values considered are as per IS 10500:2012 - (Second Revision) will be used. For contaminants not listed in this document, suggested screening values are taken from Canadian Standards. Where Canadian values are also unavailable, those from WHO are used.

Groundwater used for irrigation

As Screening Levels for groundwater used for irrigation, the current Indian Standard: "The Environment (Protection) Rules, 1986 Schedule VI General standards for discharge of environmental pollutants" will be used. If there are no Indian standards for a specific compound, the Canadian Water Quality Guidelines for the Protection of Agriculture will be used, see Appendix B.

Assessing surface water contamination

As Screening Levels for assessing surface water impact from contaminated sites discharging waste water to surface water bodies, the Indian standards: "The Environment (Protection) Rules, 1986 Schedule VI, General standards for discharge of environmental pollutants" will be used. The values are divided into 4 categories: 1) Inland/surface 2) Public sewers 3) Land for irrigation and 4) Marine coastal. In general, these values are very high compared to international standards e.g. the Canadian Water Quality Guidelines for the protection of Aquatic Life.

If there are no Indian standards for a specific compound, the Canadian Water Quality Guidelines for the Protection of Aquatic Life will be used as Screening Levels, see Appendix C.

ANNEXURE IV

GUIDING PRINCIPLES

The following guiding principles for the development of Canadian SQGs for the protection of aquatic life are based on those adopted by the Canadian Council of Ministers of the Environment (CCME 1991a) for the development of Canadian water quality guidelines.

- SQGs are numerical limits or narrative statements that are set with the intention to protect all forms of aquatic life and all aspects of their aquatic life cycles during an indefinite period of exposure to substances associated with bed sediments.
- In deriving SQGs for the protection of aquatic life, all components of the aquatic ecosystem (e.g., bacteria, algae, macrophytes, invertebrates, fish) are considered, if the data are available. However, evaluation of the available data should focus on ecologically relevant species.
- Interim SQGs (ISQGs) are derived when data are available but limited, and information gaps are explicitly outlined.
- Unless otherwise specified, SQGs refer to the total concentration of the substance in surficial sediments (i.e., the upper few centimetres) on a dry weight basis (mg•kg^{-1} dry weight). However, sediments represent a complex and dynamic matrix of biotic and abiotic components that may influence the bioavailability of sediment-associated chemicals. When sufficient information is available to define the influence of any factor on the toxicity of a specific substance (e.g., TOC for nonpolar organic substances [Swartz et al. 1990; Di Toro et al. 1991]), the guidelines will be developed to reflect this relationship. Considera-tion of these relationships will increase the applicability of guidelines to a wide variety of sediments throughout Canada.
- SQGs are refined as new and relevant scientific data become available. The refinement of these guidelines in the longer term will provide a means of ensuring their broader applicability.

OVERVIEW OF GUIDELINE DEVELOPMENT

The process for developing Canadian SQGs follows the general framework that has been established for the derivation of water quality guidelines (CCME 1991a). This process involves a comprehensive evaluation of the available scientific information on a particular substance to support the development of national SQGs (Fig. 1). This section gives a brief overview of this process, with details of the guideline derivation procedures described in the next section.

Literature Search and Evaluation

A comprehensive review of the scientific literature is performed for each substance for which guidelines are to be derived. Introductory information is briefly summarized on the substance's physical and chemical properties, its production and uses, and its sources to the aquatic environment. More detailed discussions are included with respect to concentrations of the chemical found in Canadian sediments (including natural background concentrations), the chemistry and fate of the chemical in sediments, and the available toxicological data for the sediment-associated chem-ical. Each toxicological study retrieved from the scientific literature is evaluated for its overall acceptability to ensure that high quality data are used in developing SQGs. Characteristics of the sediment and the overlying water column are reviewed if these factors have been measured, since this information is used to help interpret the corresponding toxicological data. Finally, a review of existing guidelines from other jurisdictions is provided. Data gaps are explicitly outlined to stimulate research that will generate the necessary data to support guideline development.

Background Concentrations of Natural Substances

Regional background concentrations of natural inorganic and organic substances occurring in sediments are also established, if possible, for freshwater and marine systems. This information should be considered during the implementation of SQGs since, in some cases, national guidelines (which are toxicologically based) may be lower than the respective concentrations of naturally occurring substances at a particular site (see Chap. 2 for general guidance on the use of SQGs with information on background concentrations). This information is also an important component in the development of site-specific sediment quality objectives.

An interpretive tool has been developed that provides an effective means of distinguishing the probable origin (i.e., natural vs. anthropogenic) of many metals in marine sediments (Loring 1990, 1991; Schropp and Windom 1988; Schropp et al. 1989; Schropp et al. 1990; Loring and Rantala 1992;

ANNEXURE V

2 International practices of dealing with contaminated sites

2.1 Introduction

For India, the assessment of contaminated sites is relatively new. In most western countries, structured assessment of contaminated sites has been dealt with since the eighties or nineties of the last century. Consequently, these countries have a vast amount of experience in dealing with the identification and assessment of contaminated sites. In working towards a standard procedure for the assessment of sites in India, the international experience is valuable.

In this chapter, we describe international practices for identifying contaminated sites. We discuss the advantages and disadvantages of several practices for the Indian situation and propose a practice that we think is the most suitable. Instead of making a broad outline for all countries, we have chosen to make a more detailed analysis of the practices in a few countries that most other countries look at and follow, i.e. USA, UK, Canada, the Netherlands and Australia.

In Section 2.2, we evaluate the practices for the USA, UK, Canada, the Netherlands and Australia (in accordance with the other two NPRPS assignments) on how contaminated sites are identified and on the relevance of these practices for India. Table 2.1 presents a summary of the results of this evaluation.

Given the industrial history and development of India, it is to be expected that there are many sites that will meet the definitions of a (probably) contaminated site. However, the capacity for carrying out the identification and assessment of probably contaminated sites in India is still being built up. The assessment of contaminated sites should therefore aim at fast results by using available time, money and resources to quickly identify the sites where the people and the environment are actually at risk. Given the scale of the operation, also instruments to manage this identification process are needed, like registration systems and priority setting. We will evaluate the relevance of the practices in the five countries for the Indian situation by answering the following questions:

under an assumption of no action). The baseline risk assessment contributes to the site characterization and subsequent development, evaluation, and selection of appropriate response alternatives. The results of the baseline risk assessment are used to help to determine whether additional response action is necessary at the site, modify preliminary remediation goals, help to support the selection of the "no-action" remedial alternative, where appropriate, and document the magnitude of risk at a site, and the primary causes of that risk.

Further investigation/ assessment, ecological risk

Superfund risk assessments help to determine a safe level for each potentially dangerous contaminant present. For ecological receptors, determining the level of risk is more complicated than for human health and is a function of the receptors of concern, the nature of the adverse effects caused by the contaminants, and the desired condition of the ecological resources. Several guidance documents are available on the ecological risk assessment process under the Superfund.

The document Ecological Risk Assessment Guidance for Superfund (ERAGS) provides guidance on the process of designing and conducting technically defensible ecological risk assessments for the Superfund Program.

Relevance to India

Structured process
In the USA, a clear structured process is used to identify (probably) contaminated sites and focuses on sites where imminent threats to human health and/or the environment occur. Many guidance documents are available for the different steps in the process and for carrying out a site-specific risk assessment. Only the guidance for identifying potentially polluting activities and land uses are limited.

Availability of generic criteria
Generic site screening levels (SSLs) are available for a wide range of contaminants for two forms of land use. The SSLs, however, are not determined to assist in the process of identifying contaminated sites. The generic screening levels are used in the remediation process to quickly distinguish between sites or defined areas within a site based on the need for response or further investigation

Instruments for the management of the identification process
CERCLIS and Hazard Ranking System (HRS) are good examples of a registration system and priority setting to help managing the process of identification of contaminated sites. These instruments require quit detailed input, but the HRS can be used for priority setting in the first stages of the identification process.

2.2.2 Canada

Identification process/Definition of contaminated sites

A contaminated site is defined as a site at which substances occur at concentrations:

(1) above background levels and pose or are likely to pose an immediate or long-term hazard to human health or the environment, or

(2) exceeding levels specified in policies and regulations.

Canada operates with a ten step process for identifying, investigating and remediating a contaminated site, see Figure 2-1.

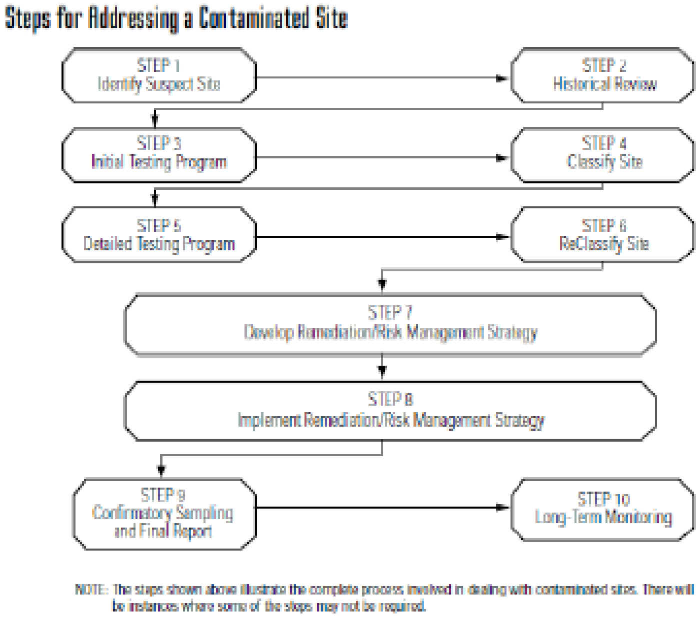


Figure 2-1 Steps for managing a contaminated site

Inventory/Potential polluting activities

For the most part, contaminated sites are typically associated with commercial, industrial and waste disposal activities and are commonly the result of improper chemical storage practices, spills, leaks and waste disposal. Some contaminated or potentially contaminated sites are obvious, such as sanitary landfills, while others may be innocuous, with the potential for hidden underground contamination. The Federal Contaminated Sites Inventory lists over 21,000 federal sites. This number includes confirmed contaminated sites, suspected contaminated sites, and about 9,000 "closed" sites where remediation was either completed or not required.

There are several different avenues by which potentially contaminated sites may be identified. The majority of these avenues are contingent upon previous investigations and/or reports that may have been generated for the site. As a preliminary overview, useful information regarding the site is obtained from the following sources:

- previous environmental record(s);
- internal environmental programs;
- complaints by citizens;
- off-site impacts;
- similarities to other known contaminated sites;
- visual or olfactory evidence of previous leaks, spills or discharges; and
- the nature of current or past activities at the site or adjacent properties.

Upon completion of the site identification, it will be possible to assess whether it is a suspect site. If the site is suspected of being contaminated, but additional historical and current information is required, it will be necessary to proceed with a Historical Review (Step 2).

Preliminary assessment

The objectives of the Historical Review, also known as a Phase 1 Environmental Site Assessment, are to assemble and review all available historical and current information pertaining to the site. The Historical Review activities may be undertaken to:

1 identify potential contaminants and environmental concerns at a site;

2 identify the need for further investigation, particularly at sites where little existing information is available; and/or

3 establish the preliminary site characteristics and develop a program or work plan for subsequent site investigations.

Following the identification of a suspected contaminated site in Step 1, the next step is to identify the necessary background information through the completion of a Historical Review. It may be necessary to conduct a Historical Review even if information documenting the site's environmental conditions already exist, depending upon the nature of that information. Examples of such instances would be:

› A previous environmental investigation was not representative of the entire site conditions.

› Previous site investigations were undertaken without the benefit of a Historical Review.

› An unknown element or uncertainty identified in Step 1 requires further qualification.

The Historical Review generally comprises three principal components:

1 a literature review;

2 a site visit or walk-through; and

3 interviews with specific persons.

For more information on conducting a Historical Review, the Canadian Standards Association (CSA) document CAN/CSA Z768 Phase 1 Environmental Site Assessment (CSA, 1994) outlines a standard approach to conducting a Historical Review, or Phase 1 Environmental Site Assessment. In addition, the Canadian Council of Ministers of the Environment (CCME) publication Guidance Document on the Management of Contaminated Sites in Canada (CCME, 1997b) outlines the phased approach to conducting environmental site assessments, including the elements to be addressed in the initial phase of an environmental site assessment.

Site Inspection (SI)/ preliminary investigation

An Initial Testing Program may be undertaken in one or more stages, depending upon site and contaminant characteristics, the specific objectives of the study and the Initial Testing findings.

The Initial Testing Program consists of six principal stages:

1. Planning;
   The work plan should be based on the findings and/or uncertainties identified in the Historical Review (Step 2). In developing the work plan, the Initial Testing Program should incorporate the use of technically sound sampling procedures, quality assurance/quality control procedures and laboratory analytical procedures.
2. Field investigation and sampling;
   The Initial Testing Program should include surface and subsurface soil sampling, groundwater sampling and surface water sampling using approved sampling procedures (e.g. CCME).
3. Sample analyses;
   On-site methods allow samples to be screened for a variety of suspect contaminants in a cost- and time effective manner. Samples with the highest contaminant concentration identified by the screening method should then be submitted to a laboratory for detailed analyses and confirmation of actual contaminant concentrations.
4. Data interpretation and evaluation;
   The Initial Testing Program will provide information on the nature and magnitude of contamination at the site, environmental quality guidelines can be used for the purpose of evaluating:
   - the degree of contamination at the site;
   - if further site investigations are required; and
   - if management actions are necessary.
5. Risk identification
   Undertaking a qualitative risk assessment as part of the Initial Testing Program establishes the three components of risk — contaminants, potential receptors, and exposure pathways — and focuses the data collection accordingly.
6. Conceptual model development.
   The three preliminary site characteristics (contamination, pathways and receptors), when viewed as a whole, constitute a conceptual site model. Both the Historical Review and Initial Testing Program must be thoroughly evaluated and documented to establish the preliminary site characteristics and determine the potential for site contamination.

Related documents/Guidance

1 CAN/CSA Z769 Phase II Environmental Site Assessment, Canadian Standards Association, 1998 (CSA)

2 Guidance Document on the Management of Contaminated Sites in Canada (CCME), 1997b

3 Subsurface Assessment Handbook for Contaminated Sites (CCME), 1994

4 Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites — Volume 1: Main Report (CCME), 1993

5 Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites — Volume II:

6 Analytical Method Summaries (CCME), 1993

7 Canadian Water Quality Guidelines (CCREM), 1987

8 A Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME), 1995

9 Recommended Canadian Soil Quality Guidelines (CCME), 1997c

10 Canadian Soil Quality Guidelines for Copper: Environmental and Human Health (CCME), 1997d

11 Canadian Soil Quality Guidelines for Pentachlorophenol: Environmental and Human Health (CCME), 1997e

12 Protocol for the Derivation of Canadian Tissue Residue Guidelines for the Protection of Wildlife that Consume Aquatic Biota (CCME), 1997f

13 Canadian Environmental Quality Guidelines (CCME), 1999.

Priority setting/ranking

The National Classification System for Contaminated Sites (NCSCS) was developed by the CCME to aid the evaluation of the level of concern and the development of management priorities for contaminated sites. Following the Initial Testing Program (Step 3), the environmental data and information accumulated so far may be sufficient to undertake classification of the site using the Detailed Evaluation Form.

The Detailed Evaluation Form consists of a series of questions related to three factors:

1 Contaminant Characteristics — the relative hazard of contaminants present at a site;

2 Exposure Pathways — the route a contaminant may follow to a receptor. There are three subcategories: (a) groundwater; (b) surface water; and (c) direct contact; and

3 Receptors — living beings or resources that may be exposed to and affected by contamination (e.g. humans, plants, animals, or environmental resources). There are two sub-categories: (a) human and animal; and (b) environment.

Under each of the three factor headings, there are evaluation factors that must be scored individually based on the specific site and contaminant characteristics. Based on the total score and total estimated score, the site can be classified. The

NCSCS is used for calculating a NCSCS score, and based on this score sites are assigned one of the following classes:

- Class 1: Action Required (Total NCSCS Score greater than 70)
- Class 2: Action Likely Required (Total NCSCS Score between 50 and 69.9)
- Class 3: Action May Be Required (Total NCSCS Score between 37 and 49.9)
- Class N: Action Not Likely Required (Total NCSCS Score less than 37)
- Class I: Insufficient Information (>15% of Responses are "Do Not Know")

Criteria and screening levels

Generic Interim Assessment criteria were first developed in 1991 and were used as general guidance for the protection, maintenance, and improvement of specific uses of soil and water. Assessment criteria are approximate background concentrations or approximate analytical detection limits for contaminants in soil or water.

A protocol for the derivation of soil quality guidelines that are scientifically defensible was originally developed in 1996 and has been updated since (last update 2006).

The protocol considers the effects of contaminated soil exposure on human and ecological receptors for given land uses. The pathways and receptors of contaminated soil considered in the derivation of soil quality guidelines were selected based on exposure scenarios for agricultural, residential/parkland, commercial, and industrial land uses.

Procedures for deriving environmental soil quality guidelines were developed to maintain important ecological functions that support activities associated with the identified land uses. Deriving human health based soil quality guidelines includes:

- assessing the hazard posed by a chemical;
- determining estimated daily intake (EDI) of that chemical unrelated to any specific contaminated site (i.e. normal "background" exposure);
- defining generic exposure scenarios appropriate to each land use.

Soil guidelines must ensure that total exposure to a contaminant (EDI + on-site exposure at the guideline concentration) will present negligible risk.

Generic soil quality guidelines are available based on the lowest value generated by the environmental and human health approaches for each of the four land uses: Agricultural, Residential/Parkland, Commercial, and Industrial.

Similar guidelines are available for water; water quality guidelines for the protection of aquatic life and water quality guidelines for the protection of agriculture (irrigation and livestock). These guidelines are used in addition to soil quality guidelines to assess the risk of the transport of groundwater contamination to surface water and the risks of groundwater contamination from agriculture.

Further investigation/ assessment

The objective of the Detailed Testing Program is to further define the nature of the site contamination and to address outstanding issues with respect to the development of an effective site management strategy.

The specific objectives of the Detailed Testing Program are:

1 to target and delineate the boundaries of identified contaminants;

2 to define, in greater detail, site conditions required to identify all contaminant pathways, particularly with respect to risk assessment;

3 to provide contaminant and other information necessary to finalize remediation guidelines or risk assessment; and

4 to provide all other information required to develop a Remediation Plan and input to specifications and tender documents.

These specific objectives will provide useful input in the implementation of (1) Step 6: Reclassify the Site Using CCME National Classification System; and (2) Step 7: Develop Remediation/Risk Management Strategy.

The nature and extent of the site contaminant conditions, including the horizontal and vertical distributions of contaminants, should be thoroughly established. A finalized conceptual site model that emphasizes the type and extent of the subsurface contamination should define the pathways for contaminant migration and identify potential receptors relative to human health and/or the environment. As a result, the nature of a contaminant, its transport mechanism and its impact on human health and/or the environment is combined with site geological, hydrogeological and topographical information to produce a comprehensive model of how contaminants may be disbursed from a source to a receptor.

Related documents/guidance:

1 1. Subsurface Assessment Handbook for Contaminated Sites (CCME), 1994

2 2. Guidance Document on the Management of Contaminated Sites in Canada (CCME), 1997b

Relevance to India

Structured process

Canada uses a clear structured process to identify (probably) contaminated sites and focuses on sites where imminent threats to human health and/or the environment occur. Many guidance documents are available for the different steps in the process and for deriving site-specific criteria.

Availability of generic criteria

Generic soil quality guidelines are available for four land uses: Agricultural, Residential/Parkland, Commercial, and Industrial. The guidelines take into account the effects of contaminated soil exposure on human and ecological receptors for given land uses. Soil guidelines must ensure that total exposure to a contaminant will present negligible risk. Similar guidelines are available for surface water and water for agricultural use which can be used to assess the risks of contaminated groundwater.

Instruments for the management of the identification process