

 DESIGN PRACTICES	SOLID WASTE MANAGEMENT AND SITE REMEDIATION GUIDELINES AND CONSIDERATIONS FOR SITE REMEDIATION	Section	Page
		XX-B	1 of 10
		February, 2004	

CONTENTS

Changes shown by ↕

Section	Page
SCOPE.....	2
REFERENCES	2
INTRODUCTION	3
INTEGRATED SITE REMEDIATION STRATEGY.....	3
SITE CHARACTERIZATION.....	5
INITIAL SITE ASSESSMENT	5
CONCEPTUAL MODEL	5
MORE DETAILED CHARACTERIZATION	6
CLEANUP LEVELS.....	7
REMEDIAL (RISK-BASED) DECISION MAKING	7
ENGINEERED SOLUTIONS	8
GROUND WATER MONITORING	8
CONTAINMENT, PUMP AND TREAT HYDRAULIC CONTROL, CAPS AND LINERS.....	8
ACTIVE REMEDIAL METHODS.....	9
Soil Remediation Technologies	9
Ground Water Remediation Technologies	9
Sludge Treatment Technologies.....	9
Free Product or NAPL (Non-Aqueous Phase Liquid) Recovery Technologies.....	10

FIGURES

Figure 1 Integrated Site Remediation Strategy.....	4
Figure 2 Relative Costs of Site Remediation	6

REVISION MEMO

02/04 Additional references.
 Use of field analytics.
 New active remedial methods

Section	Page	SOLID WASTE MANAGEMENT AND SITE REMEDIATION GUIDELINES AND CONSIDERATIONS FOR SITE REMEDIATION	 DESIGN PRACTICES
XX-B	2 of 10		
March, 2004			

SCOPE

This introduction to site remediation provides background information applicable to the remediation of contaminated sites. It takes the form of a general framework that describes the major components of site characterization and remediation.

Procedures and technologies used in the evaluation and remediation of a contaminated site are discussed in general terms. Detail can be found in the following [Sections XXB-1](#) through [B-6](#) and [C-1](#) through [C-3](#) or in other EMRE or third party publications (as referenced in the foregoing sections).

REFERENCES

1. Hensan, T. S., Landers, R. A., Stones, E. J., Ground water Containment and Cleanup Guide, EE.21E.94.
2. Archibald, B. B., Becker, P. W., Smith, H. A., Wilkinson, J.B., Site Remediation Technology Screening Studies, EE.3E.93.
3. Caramichael, L. G., Landers, R. A., Stones, E. J., Pauwels, S. J., Site Characterization Guide, EE.22E.94.
4. Becker, P. W., Madden, P. C., Serrapere, F. R., Smith, W., Marketing Site Characterization and Remediation Technology Selection Guide, EE.4M.95.
5. Battaglia, F. J., Wilkinson, J. B., Environmental Liability Assessment Guide for Non-Operating Marketing Sites, EE.1M.96.
6. Standard Guide for Remediation of Ground Water by Natural Attenuation at Petroleum Release Sites, ASTM-E 1943 (1998).
7. Racioppi, L., Application of Human Health Based Exposure/Risk Assessment to the Site Remediation Process, MAN.021.MR.
8. Pauwels, S. J., Data Needs for Human Health and Ecological Risk Assessment at Contaminated Sites, MR.4DO.95.
9. Smith, W., Field Analytic Technologies for Site Characterization and Remediation, EE.3M.95.
10. Sweed, H. G., Review of Multiphase Ground water Flow and Transport Models, EE.32E.95.
11. Becker, P. W., Site Characterization Tool Kit, 95 ECS4 061.
12. Marketing Engineering Services: Environmental Management and Site Remediation Procedures Manual; Section 6 - Site Remediation Protocols, Imperial Oil Ltd., Marketing Dept.
13. A Guide to the Assessment and Remediation of Underground Petroleum Releases; Section 4 - Site Assessment, API Publication 1628.
14. Environmental Engineering Guidelines for Soil and Water Protection; Section 8.0, 9.0, 10.0, Surface and Sub-surface Investigation, Exxon Company USA, Marketing Dept.
15. Site Remediation Experience Catalogue, TMEE 071.
16. Standard Practice for Environmental Site Assessment: Transaction Screen Process, ASTM E1528-93.
17. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, ASTM E1527-93.
18. Site Characterization Manual, TMEE 072.
19. A Framework for Ecological Risk Assessment to Support Site Remediation, MAN.3DO.94.
20. Wilkinson, J. B., Site Remediation Decision Framework, 96ECS4 42.
21. Standard Guide for Risk-Based Corrective Action (RBCA) Applied at Petroleum Release Sites, ASTM E1739-95.
22. European Oil Industry Guideline for Risk-Based Assessment of Contaminated Sites, CONCAWE Report No. 2/97.
23. Containment Technologies Application Guide, 95 ECSR 01.
24. Madden, P. C., Remediation by Natural Attenuation, 97 ECS4 009.
25. Madden, P. C., and Giuseppi-Elie, A., Natural Attenuation as a Cost-Effective Alternative to Active Ground Water Remediation, February 1997.

 DESIGN PRACTICES	SOLID WASTE MANAGEMENT AND SITE REMEDIATION GUIDELINES AND CONSIDERATIONS FOR SITE REMEDIATION	Section	Page
		XX-B	3 of 10
		March, 2004	

26. Natural Attenuation: A Practical Guide for Evaluating and Closing Petroleum Hydrocarbon Sites (Future Issue).
27. Provisional Standard for Risk-Based Corrective Action at Chemical Release Sites (RBCA II), ASTM PS 104-98.
28. Guidance Manual for Developing Site Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada, CCME, March, 1996.
29. Resources for Strategic Site Investigation and Monitoring, EPA 542-F-01-030b.
30. Current Perspectives in Site Remediation and Monitoring, EPA 542-R-01-016, October 2001.
31. Crumbling, D. M., J. Griffith, D. M. Powell, Improving Decision Quality: Making the Case for Adopting Next-Generation Site Characterization Practices, REMEDIATION Spring 2003, 91-111.
32. Field Analytic Technologies Encyclopedia (FATE), US EPA web site, <http://fate.clu-in.org>.
33. ExxonMobil Guide for Field Analytics, Remediation BestNet Library

INTRODUCTION

Several frameworks exist for defining the steps involved in evaluating and remediating a contaminated site. These frameworks include those developed by ASTM (American Society for Testing and Materials, **References 21 and 27**), the US EPA (Triad Approach for Site Investigation and Cleanup, **References 29-31**), CONCAWE (Oil Companies' European Organization for Environmental and Health Protection, **Reference 22**) and CCME (Canadian Council of Ministers of Environment, **Reference 28**) for Risk-Based Corrective Action (RBCA).

These frameworks tend to be regional, but they provide a great deal of useful information on site characterization techniques and risk assessment approaches. Rather than be prescriptive, this Design Practice provides a more general description of the key steps common to all remediation projects. It also serves as a road map to the other Design Practices sections related to site remediation.

INTEGRATED SITE REMEDIATION STRATEGY

The Integrated Site Remediation Strategy shown in [Figure 1](#) identifies activities that are applicable to many remediation projects. When these activities are optimized with respect to each other, the remediation project can be completed with the maximum efficiency and lowest overall cost. The process is typically iterative or tiered in its approach. For example, the initial pass through the framework might use low cost, available information, while additional iterations would incorporate more extensive data collection and more sophisticated analyses. While these higher tiers are more time consuming and costly, they reduce uncertainties and thereby allow less conservative and less costly solutions, without altering risk.