# Management & Remediation of Sites in the Petroleum Industry:

## *A Framework for the Developing World*

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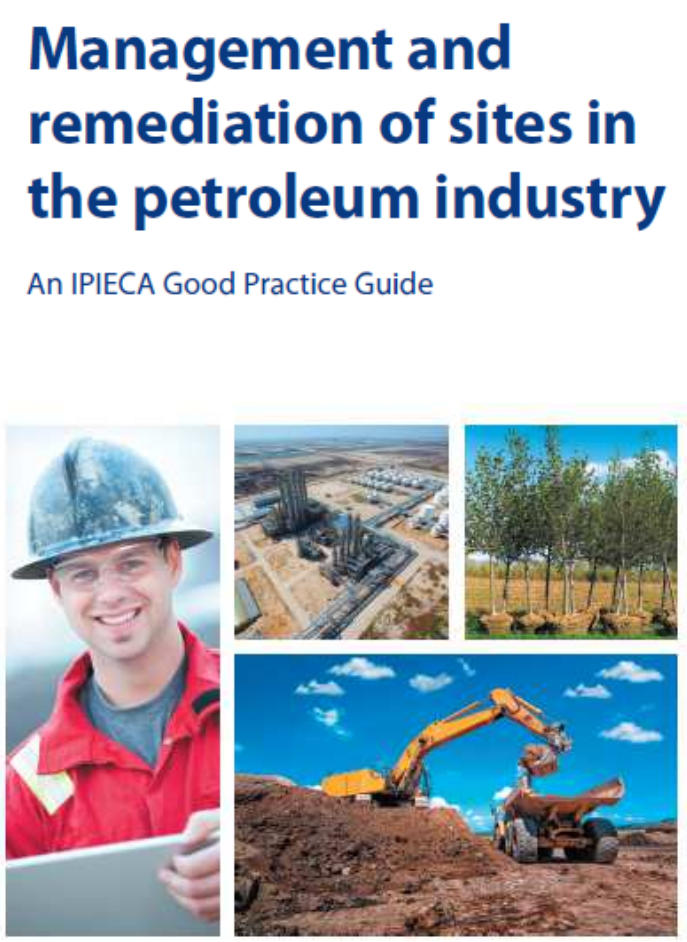
AECOM

# An IPIECA Good Practice Guide

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  - ExxonMobil
  - Shell
  - Other Committee Members

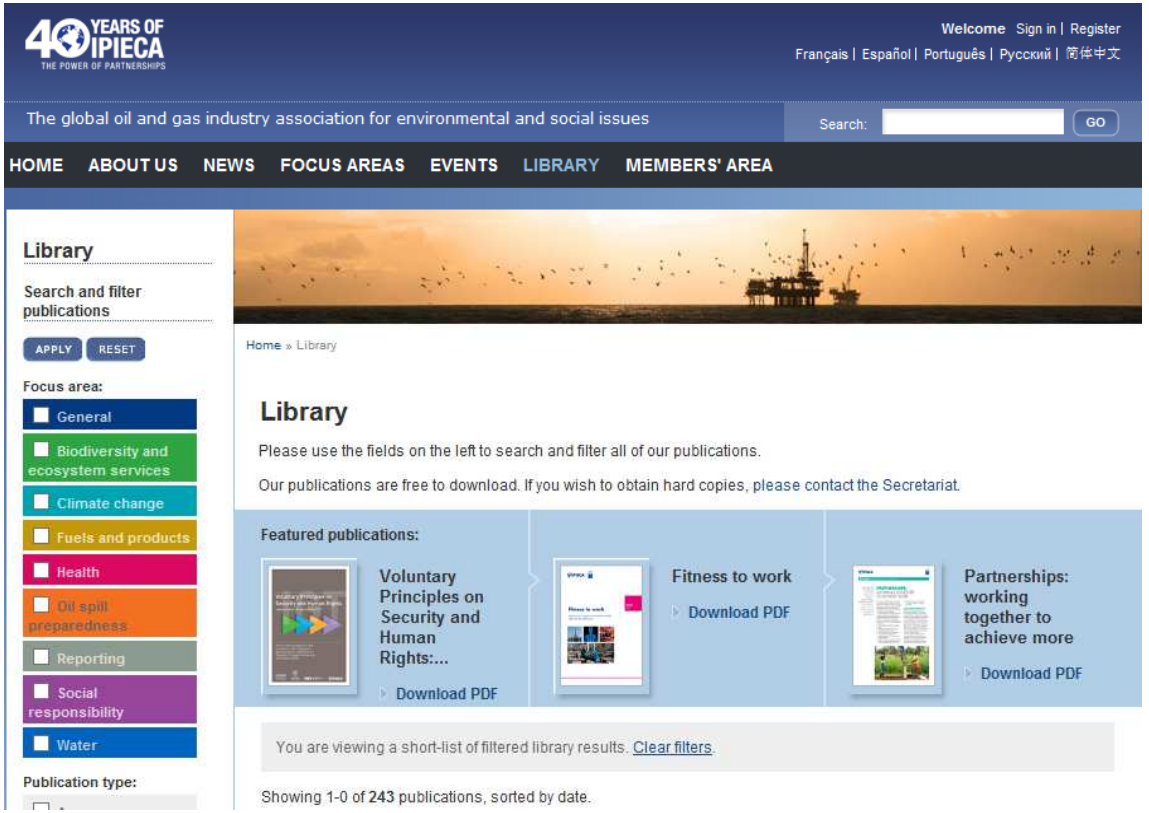
http://www.ipieca.org/publication/management-and-remediation-sites-petroleum-industry-ipieca-good-practice-guide

# IPIECA's Vision Drives Promotion of Good Practices

*To support the oil and gas industry efforts to improve its operations and products to meet society's expectations for environmental and social performance.*

IPIECA operates globally and seeks to achieve its Vision by:

- Developing, sharing and promoting sound practices and solutions
- Enhancing and communicating knowledge and understanding
- Engaging members and others in the industry
- Working in partnership with key stakeholders



# Content Focused to End-User in Developing World

*Generic, adaptable, and globally applicable risk-based framework for identifying and implementing corrective action techniques*

- Managing releases to soil and groundwater from petroleum refineries, terminals, gas stations and on-shore E&P facilities
- Summarizes commonly accepted principles and approaches – ASTM, US EPA, UK EA
- Targeted to environmental specialists working in countries where legislative procedures or guidance may be less developed or detailed

# Regulatory Framework in Developing Countries

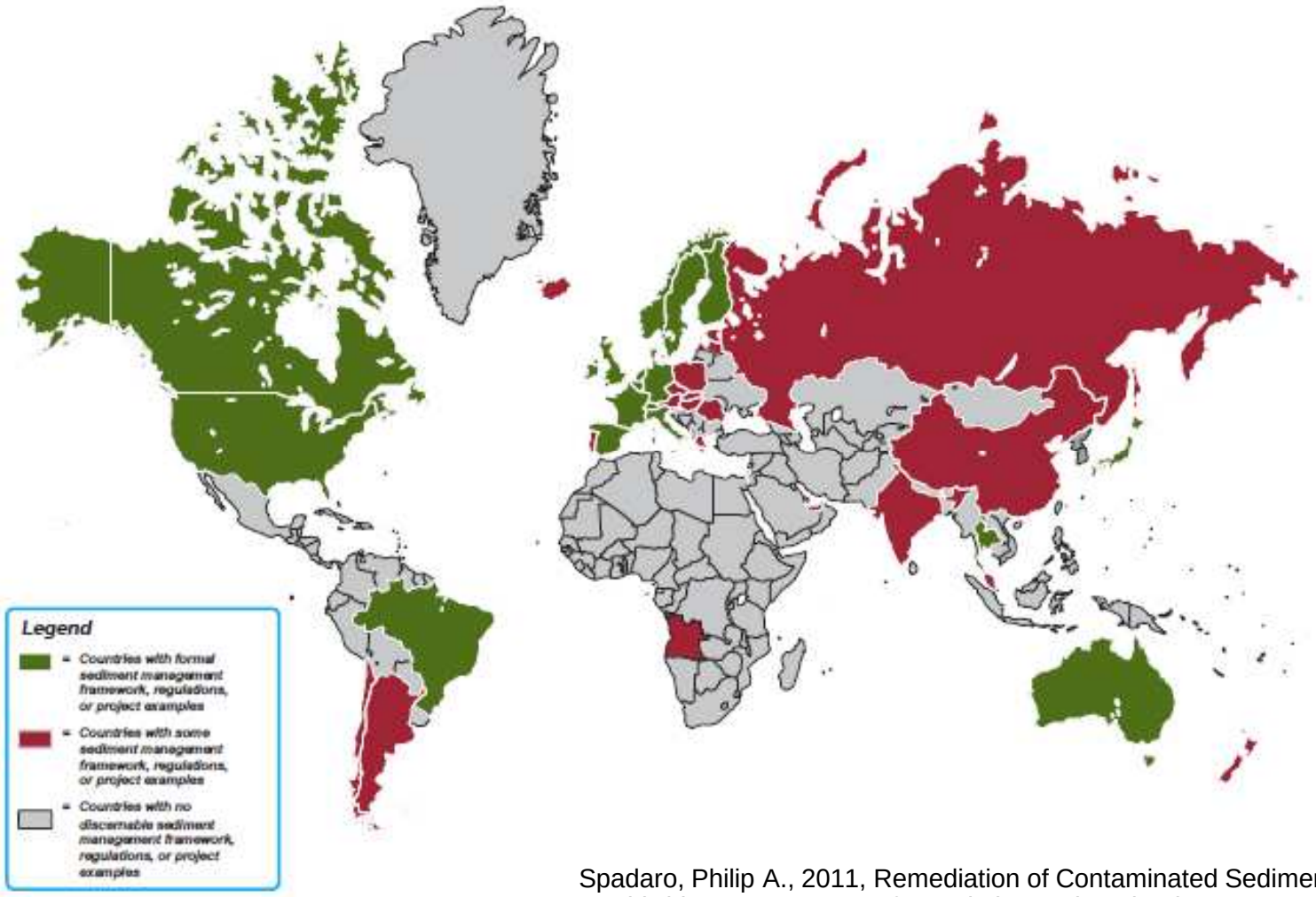



Figure 1. Global map identifying regulatory and technical findings.

Spadaro, Philip A., 2011, Remediation of Contaminated Sediment: A Worldwide Status Survey of Regulation and Technology, Terra et Aqua, No. 123, June 2011

# Good Practices Structure – a Practical Approach

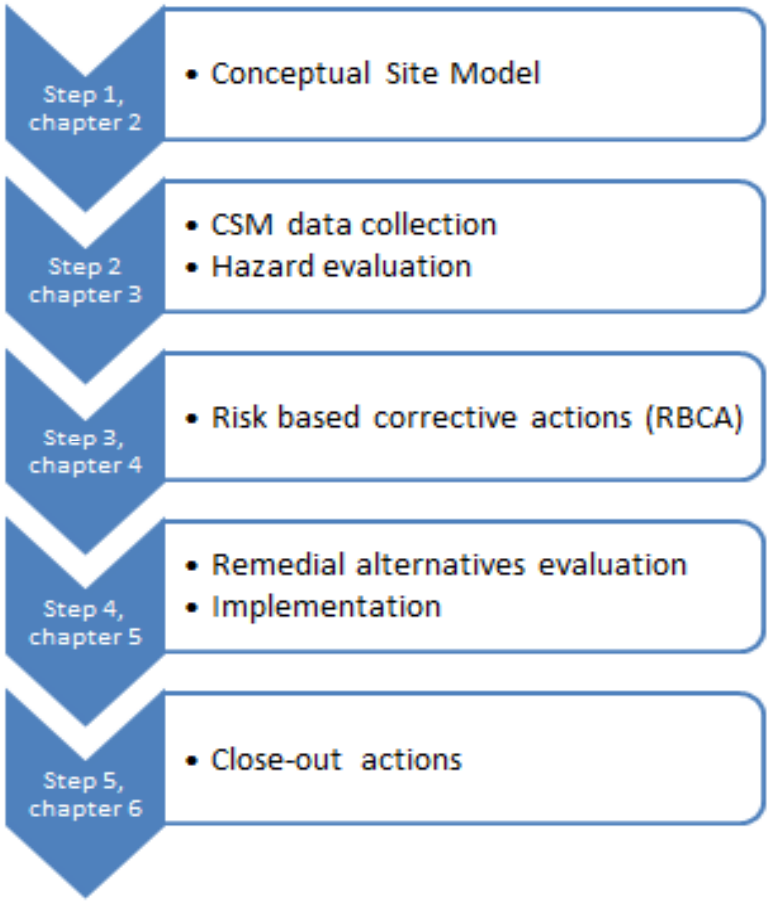
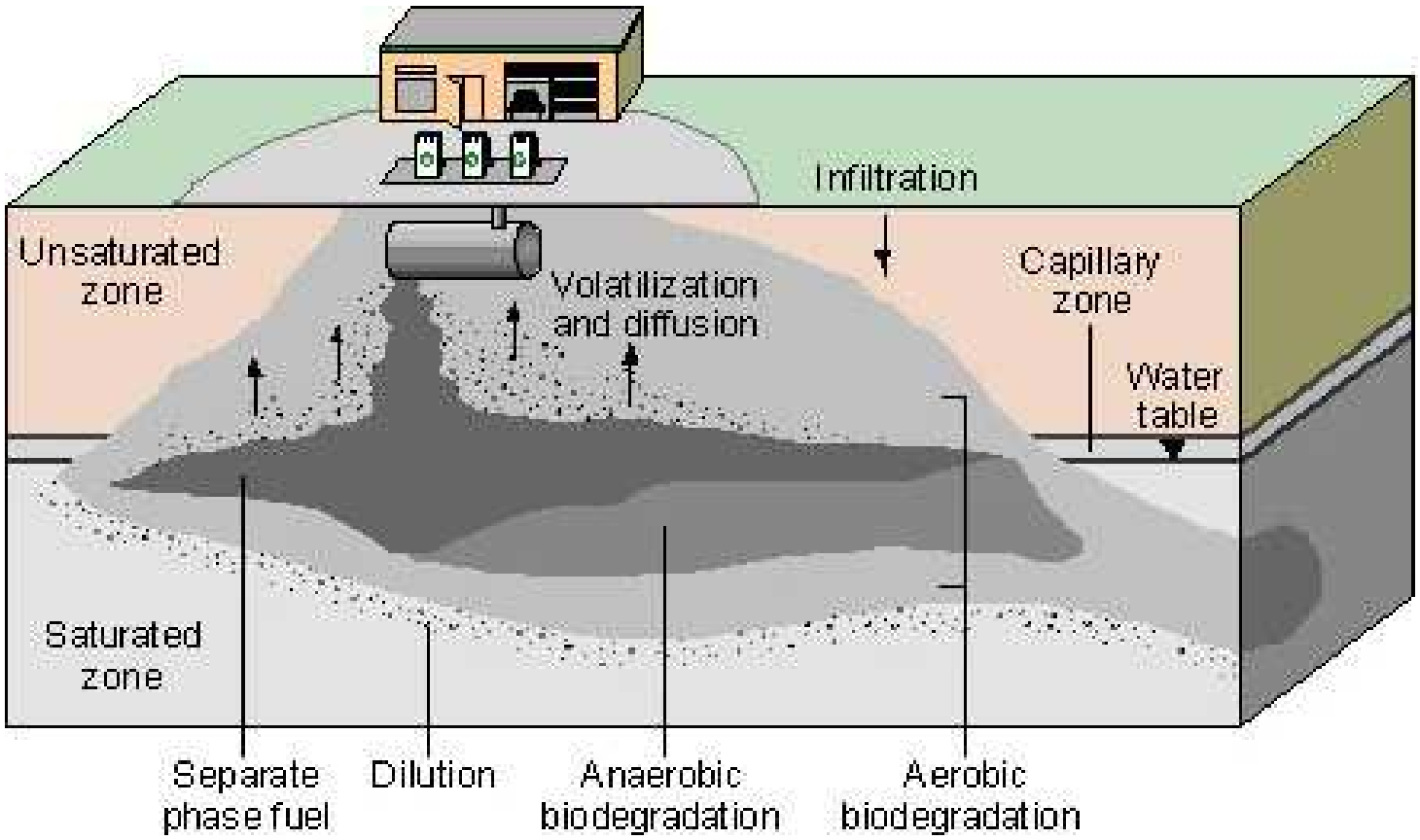



Figure 1: Good Practices Work Flow

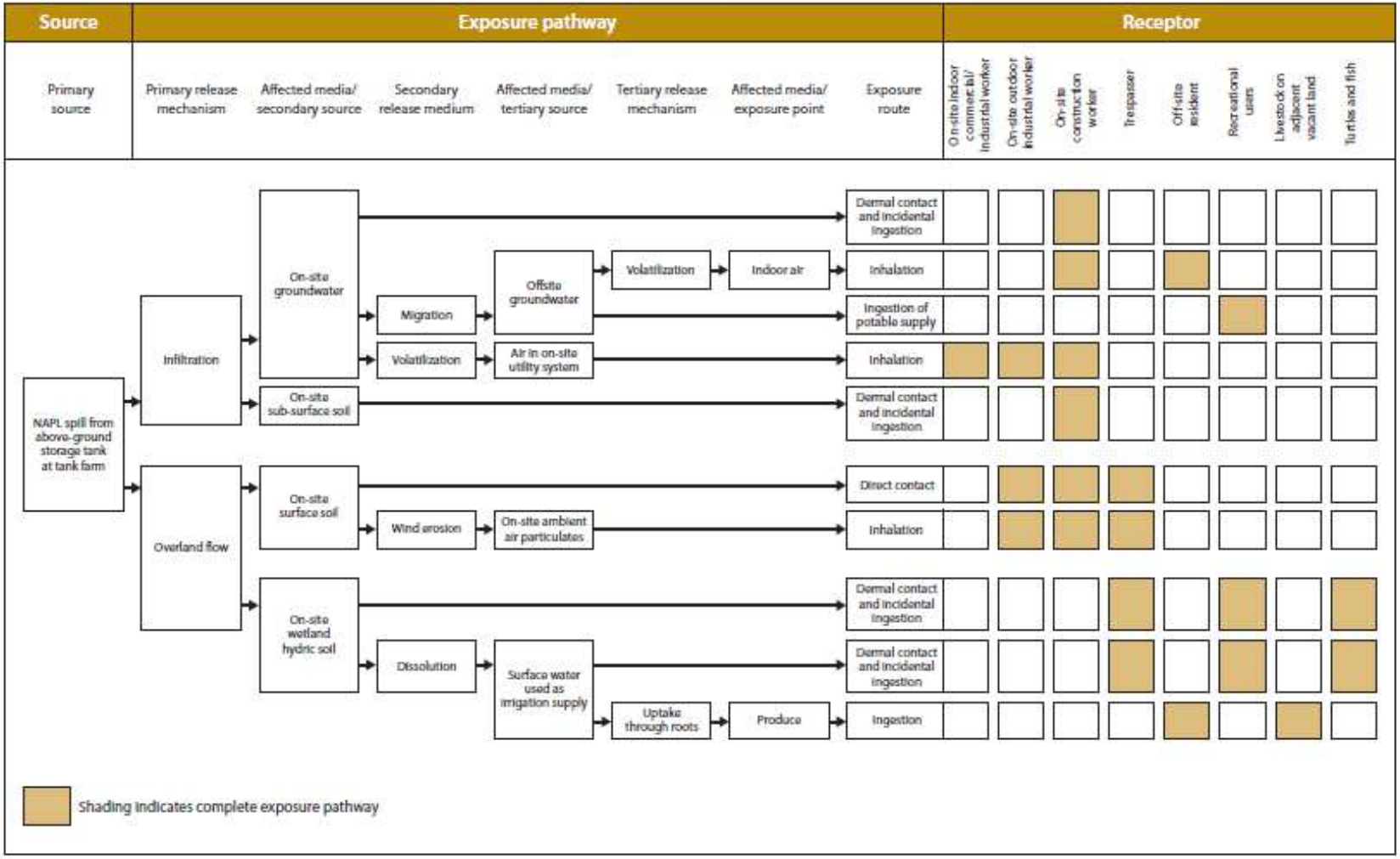
# CSM Is Foundation for Exposure Assessment

## Figure 2: CSM for Subsurface Petroleum Release

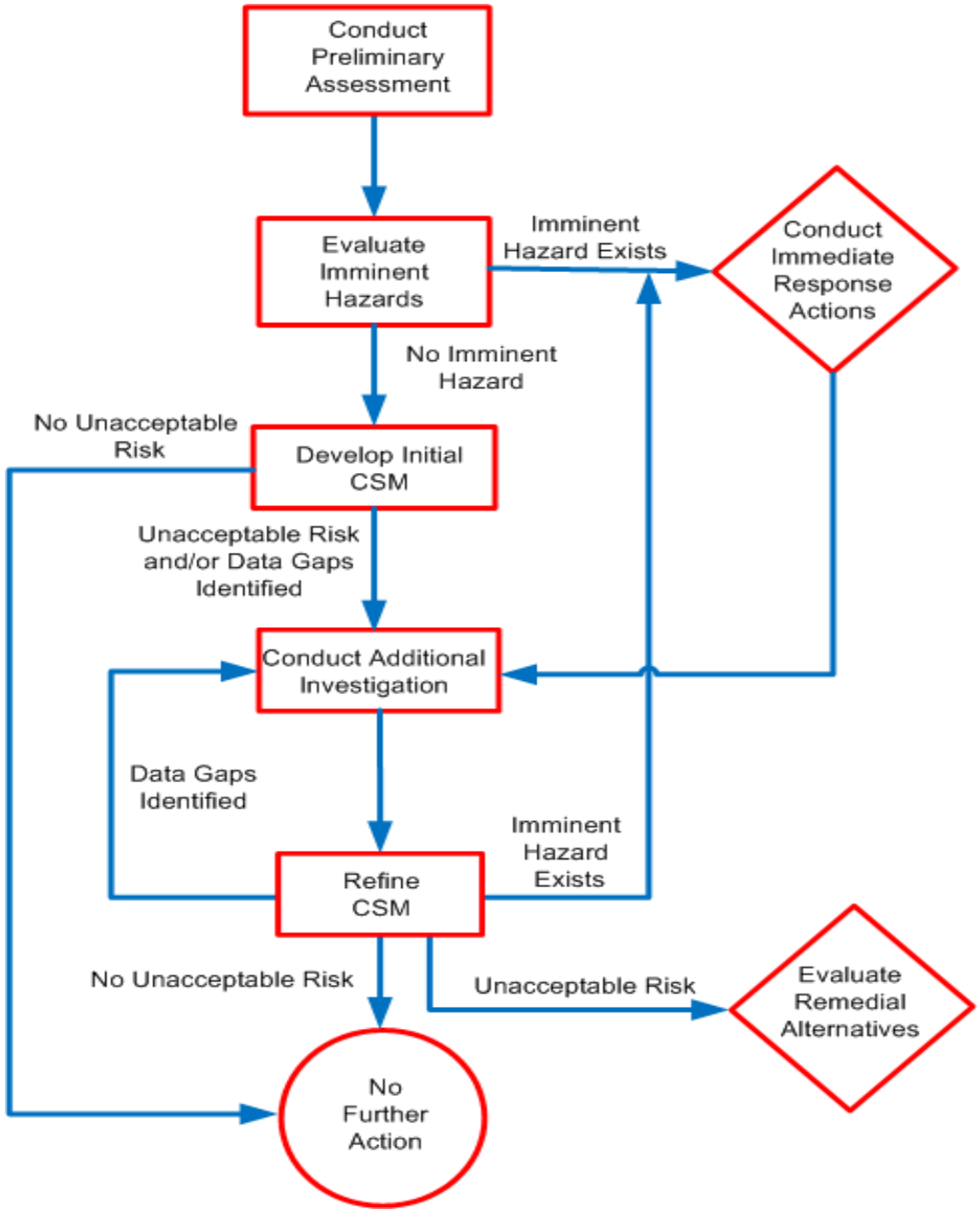


# Graphical CSM

**Figure 4** *Graphical CSM for petroleum release at above-ground storage tank farm*



# Investigation Data Input to CSM and Risk Evaluation



# Risk-Based Management Framework

Addresses impact(s) in the soil and/or groundwater on human health and environment by evaluating the linkage between:

- Release of a chemical from a source;
- The transport or exposure pathway; and
- The exposure to and uptake of the chemical contaminants by the receptor.

*A key difference from traditional regulatory approaches: Incomplete source-pathway-receptor linkage is used to show no risk exists, and that no active remediation is needed*

# Risk Assessment Following ASTM RBCA Process

The RBCA process uses a tiered approach involving increasingly sophisticated levels of data collection and analysis:

- RBCA Tier 1 Screening Level Risk Assessment
- RBCA Tier 2 Site Specific Risk Assessment and Target Levels
- RBCA Tier 3 Site Specific Risk Assessment and Risk Characterization
  - High Cost and Complex Sites

# Why RBCA?

It is a good fit for developing countries:

- Simplifies an otherwise complicated process
- Allows risk assessments to be tailored to the complexity of the site and contaminants
- Globally-accepted risk assessment framework that can be used where no standards or guidelines exist
- Wealth of guidance and software to aid in implementation

# Two Primary Remedial Approaches

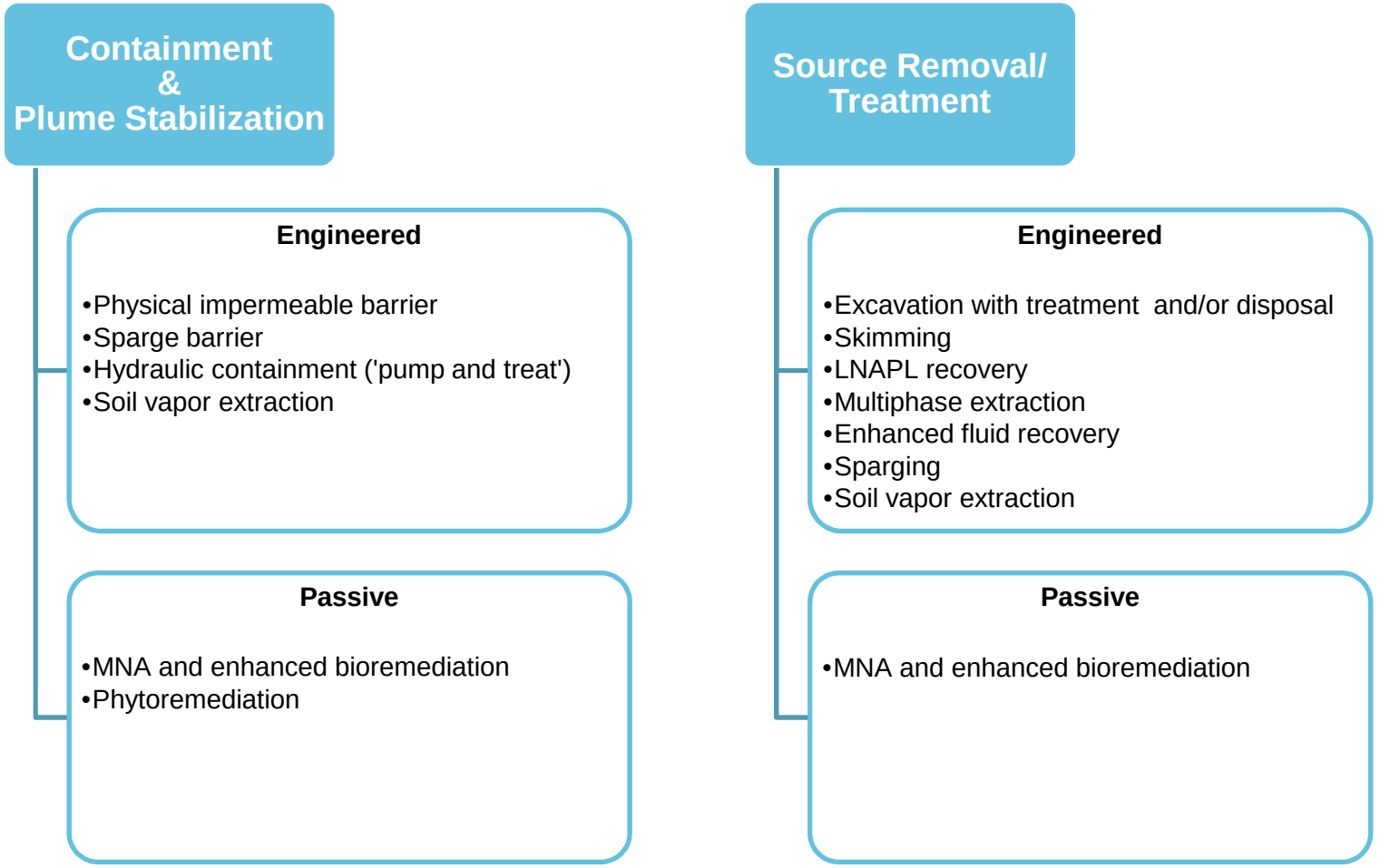



**Figure 12: Commonly used remedial technologies for petroleum hydrocarbon impacted sites**

# Sustainability

- Sustainability considerations incorporated into alternatives selection process
- Sustainable Remediation:

*The practice of demonstrating, in terms of environmental, economic, and social indicators, that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process* (CL:AIRE, 2010)

**Table 6** *Example sustainable remediation indicator categories (after SuRF-UK; CL:AIRE, 2011).*

| Environment | Society | Economy |
|---|---|---|
| Air | Human health and safety | Direct economic costs and benefits |
| Soil and ground conditions | Ethics and equality | Indirect economic costs and benefits |
| Groundwater and surface water | Neighbourhood and locality | Induced economic costs and benefits |
| Ecology | Communities and community involvement | Employment and employment capital |
| Natural resources & waste | Uncertainty and evidence | Project lifespan and flexibility |

# Framework Based on Proven Approaches

- API – American Petroleum Institute
- ASTM – ASTM International (formerly American Society for Testing and Materials)
- CL:AIRE – UK
- EA – Environmental Agency (UK)
- EPA – U.S. Environmental Protection Agency
- FRTR – U.S. Federal Remediation Technologies Roundtable
- ITRC – Interstate Technology and Regulatory Council
- NICOLE – Network of Industrially COntaminated Land in Europe
- SuRF – UK (Sustainable Remediation Forum)

# Additional Resources and Guidance

## Further reading and references

The following reports and publications provide additional references for understanding and managing impacts, and assessing corrective action techniques for releases to soil and groundwater from retail gas stations, petroleum refineries, terminals, and on-shore exploration and production facilities. These publications summarize commonly accepted global principles and approaches developed by API, ASTM, the United States EPA, EA-UK, and others. Each reference is followed by a brief description to inform the reader of the relevance, accuracy and quality of the sources cited.

API (1993). *Guide for Assessing and Remediating Petroleum Hydrocarbons in Soils.* API Publication 1629, October, 1993.

*This publication provides general information regarding the site and release characteristics relevant to, and methods for assessing and remediating, soils contaminated with petroleum hydrocarbons released from underground storage tank (UST) or above-ground storage tank (AST) systems and operations.*

API (1996). *A Guide to the Assessment and Remediation of Petroleum Releases, 3rd ed.* Washington, D.C.: API, Publication 1628.

*This document identifies and describes soil and groundwater remediation technologies specific to petroleum. This edition includes new technologies and improvements for the assessment and remediation of petroleum releases.*

API (1997). *Environmental Guidance Document: Waste Management in Exploration and Production Operations.* API E5, February 1997.

*The document specifically addresses community concerns about raw materials, products, and operations in the petroleum industry that could be potential sources of groundwater and soil impacts.*

## Appendix A: Standard and guidance references

API – American Petroleum Institute
ASTM – ASTM International (formerly American Society for Testing and Materials)
EPA – US Environmental Protection Agency
ITRC – Interstate Technology and Regulatory Council

| Standard / Guidance | Name / Description |
|---|---|
| **Soil Sampling** | |
| ASTM D2487 - 11 | *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)* |
| ASTM D2488 - 09a | *Standard Practice for Description and Identification of Soils (Visual Manual Procedure)* |
| ASTM D5633 - 04(2008) | *Standard Practice for Sampling with a Scoop* |
| ASTM D5831 - 09 | *Standard Test Method for Screening Fuels in Soils* |
| ASTM D6907 - 05(2010) | *Standard Practice for Sampling Soils and Contaminated Media with Hand-Operated Bucket Augers* |
| ASTM D1586 - 11 | *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* |
| ASTM D4700 - 91(2006) | *Standard Guide for Soil Sampling from the Vadose Zone* |
| ASTM D6418 - 09 | *Standard Practice for Using the Disposable En Core Sampler for Sampling and Storing Soil for Volatile Organic Analysis* |
| ASTM D6640 - 01(2010) | *Standard Practice for Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations* |
| **Drilling Methods** | |
| ASTM D6429-99(2011)e1 | *Standard Guide for Selection Geophysical Methods* |
| ASTM D6169 - 98(2005) | *Standard Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations* |

# Additional Resources and Guidance

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Soil (S), Bedrock (B), NAPL (N), Sludge (SL), Groundwater (G), Surface Water (SW), Soil Vapor (V), Leachate (L)

# Additional Resources and Guidance

Figure C-2 *Pneumatic skimmer in a single well (EPA, 2011b) (API, 1996)*

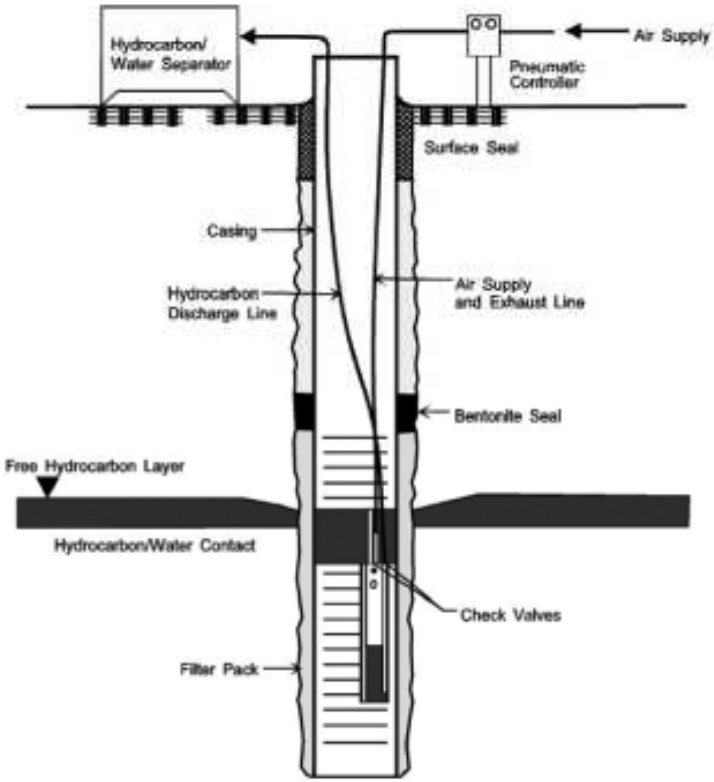
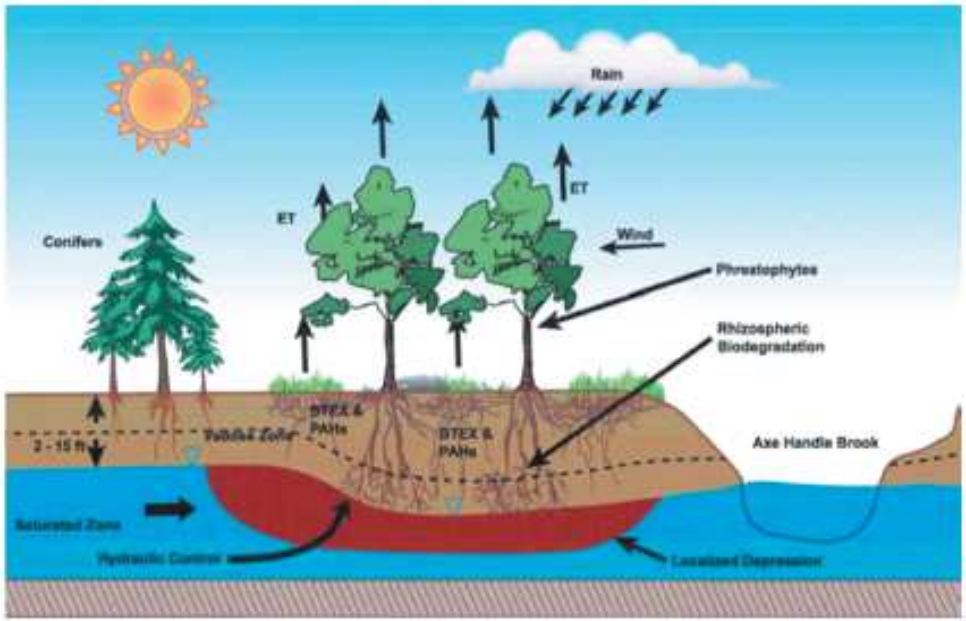



Figure C-8 *Conceptual phytoremediation processes (AECOM Technical Services, Inc.)*



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# Thank You

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