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Office of Solid Waste and
Emergency Response
(5201G)

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Superfund

EPA

Introductory Site Inspection Training

Student Manual

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Please refrain from any actions or comments, including jokes, which might make another class participant feel uncomfortable.

The Course Director is prepared to take appropriate action to ensure your full participation and benefit from our training. Please present your concerns to the Course Director or the U.S. EPA Project Officer, Bruce Potoka, at (513) 567-7537.

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PB95-963212

RECORD OF REVIEW

This manual is for reference use of students enrolled in scheduled training courses of the U.S. Environmental Protection Agency (EPA). While it will be useful to anyone who needs information on the subjects covered, it will have its greatest value as an adjunct to classroom presentations involving discussions among the students and the instructional staff.

This manual has been developed with a goal of providing the best available current information; however, individual instructors may provide additional material to cover special aspects of their presentation.

Because of the limited availability of the manual, it should not be cited in bibliographies or other publications.

References to products and manufacturers are for illustration only; they do not imply endorsement by EPA.

Constructive suggestions for improvement of the content and format of the manual are welcome.

INTRODUCTORY SITE INSPECTION TRAINING
2 DAYS

This course provides participants with an introduction to the Superfund site assessment process and the fundamentals of the site inspection phase of this process. The site assessment process is used to screen hazardous waste sites for inclusion on the U.S. Environmental Protection Agency's (EPA) National Priorities List and to prioritize sites for further investigation and remediation. Participants will receive the background necessary to evaluate preliminary assessments and to develop and implement site inspection strategies. The course is designed for individuals with little experience in the initial evaluation of hazardous waste sites.

The course format is based on the EPA document entitled *Guidance for Performing Site Inspections Under CERCLA*. The focus is on implementing EPA site inspection guidance rather than on emphasizing the mechanics of scoring sites using the Hazard Ranking System.

Topics to be discussed include an overview of the site assessment process; the fundamentals of the Hazard Ranking System; data collection strategies; site reconnaissance and documentation procedures; site, source, and waste characterization techniques; groundwater, surface water, air, and soil exposure pathway analyses; and reporting requirements.

After completing this course, participants will be able to:

- Describe how the outcome of the site assessment process affects the placement of a hazardous waste site on the National Priorities List.
- Define key phrases related to site inspections.
- Review a Preliminary Assessment document and develop a site reconnaissance plan.
- Develop site sampling strategies that will test preliminary assessment hypotheses and will provide adequate data for performing Hazard Ranking System calculations.

Note: Calculators are highly recommended.

Continuing Education Units: 1.35

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SECTION ONE

INTRODUCTORY SITE INSPECTION TRAINING

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SITE INSPECTION TRAINING

This course . . .

- Focuses on the role of the Site Inspection (SI) in the site assessment process
- Examines the relationship of the SI to the Preliminary Assessment
- Demonstrates that the SI process is flexible and dynamic

SITE INSPECTION TRAINING (cont.)

- Describes the activities necessary to develop pathway-specific sampling
- Emphasizes the importance of sampling smart
- Introduces the concept of "integrated assessments"

SITE INSPECTION TRAINING (cont.)

This course does not provide . . .

- Detailed SI standard operating guidelines or procedures
- Hazard Ranking system (HRS) training
- Region-specific policy, procedures, and sites

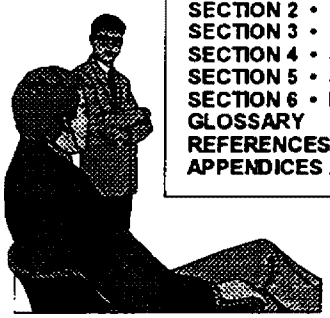
GUIDANCE GOALS

Assist SI investigators in:

- Conducting efficient, high-quality assessments
- Making correct site recommendations
- Achieving national consistency in performing SI's

SI Guidance, Chapter 1

SI GUIDANCE STRUCTURE



SECTION 1 • INTRODUCTION
SECTION 2 • SI APPROACHES
SECTION 3 • PLANNING
SECTION 4 • SAMPLING STRATEGIES
SECTION 5 • SI EVALUATION
SECTION 6 • REPORTING REQUIREMENT
GLOSSARY
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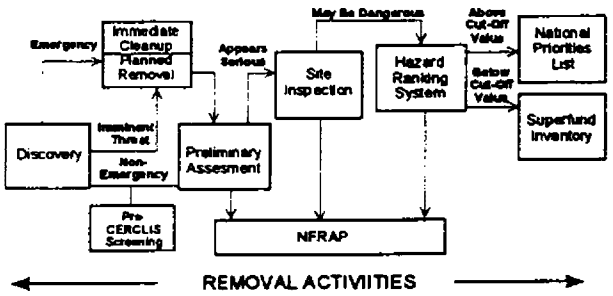
SI Guidance, Chapter 1

SUPERFUND TACKLES HAZARDOUS WASTE EMERGENCIES AND THE NATION'S MOST SERIOUS SITES

PRE-REMEDIAL SITE ASSESSMENT PORTION

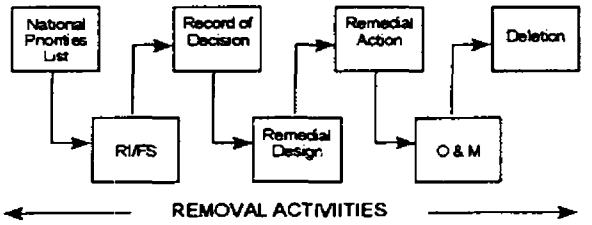
Site Discovery & Study: Finding the Most Serious Sites



SUPERFUND TACKLES HAZARDOUS WASTE EMERGENCIES AND THE NATION'S MOST SERIOUS SITES (cont.)

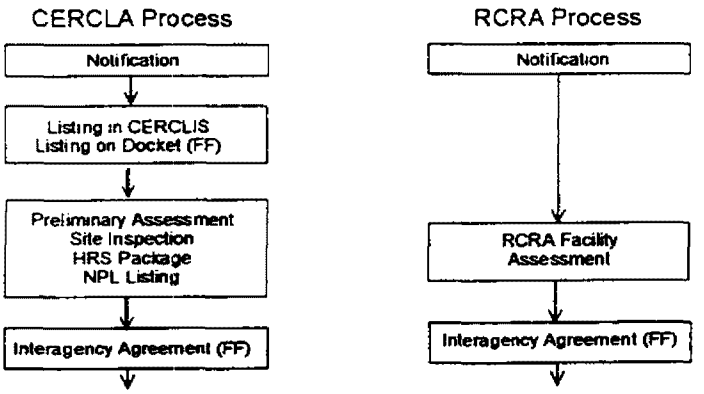
REMEDIAL PORTION

Long-Term Cleanup: Fixing the Most Serious Sites

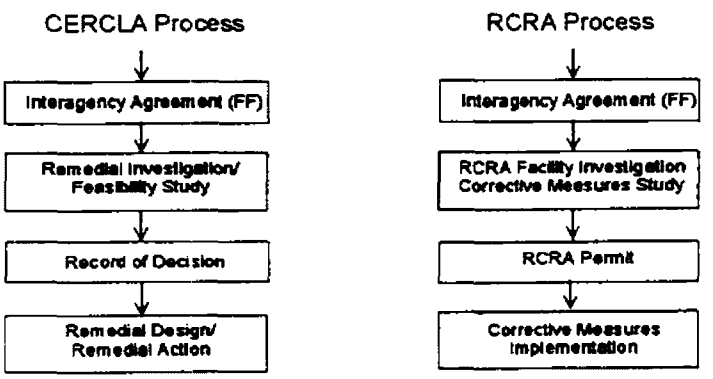


40 CFR 300.420

COMPARISON OF SUPERFUND PROCESS AND RCRA CORRECTIVE ACTION



COMPARISON OF SUPERFUND PROCESS AND RCRA CORRECTIVE ACTION (cont.)



CERCLA INFORMATION SYSTEM (CERCLIS)

- Database to record the track activities at discovered sites
- All site assessment activities stem from CERCLIS entry
- Data included in CERCLIS
  - Site name
  - EPA identification number
  - Discovery date
  - Superfund program status and event dates

Please see: www.epa.gov/superfund

PRELIMINARY ASSESSMENT (PA)

- First step to determine if site warrants further CERCLA action
  - Emergency response
  - Site inspection
- Low cost review of available information (120 hours)

PRELIMINARY ASSESSMENT (PA) (cont.)

- Data collection and documentation performed by federal agency responsible for site
- Data evaluation and decision-making by EPA
  - PA/HRS evaluation
  - Further Superfund action or NFRAP

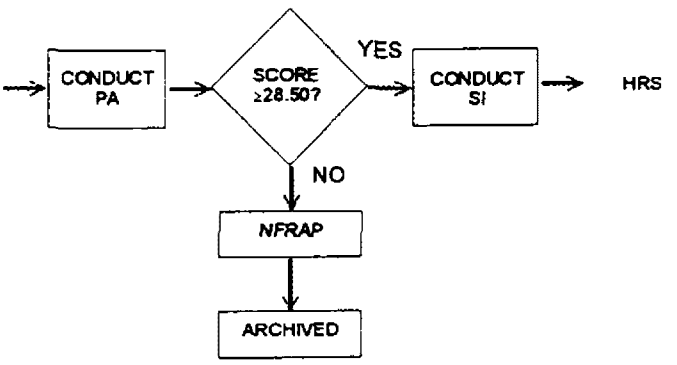
THE SITE ASSESSMENT PROCESS: PRELIMINARY ASSESSMENT (PA)

The PA identifies:

- Historical waste generation and disposal practices
- Hazardous substances associated with sources
- Potential sources of hazardous substances
- Important migration pathways and affected media
- A comprehensive survey of targets
- Critical sample locations for SI

SI Guidance, Section 1 1 1

SITE ASSESSMENT SUPERFUND



NO FURTHER REMEDIAL ACTION PLANNED (NFRAP)*

- Federal agencies not required to take further action under CERCLA
- Other authorities may require agencies to initiate further assessment and/or cleanup activities
  - States
  - Native American tribes
  - *Other federal regulations (e.g., RCRA corrective action)*

*Formerly known as Site Evaluation Accomplished (SEA)

NO FURTHER REMEDIAL ACTION PLANNED (NFRAP)* (cont.)

- Activities at facilities must be consistent with policy of responsible federal agency and all applicable federal and state environmental statutes (e.g., NEPA, CWA, SDWA and FFCA)

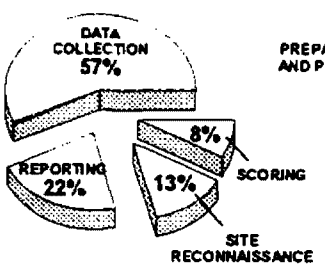
*Formerly known as Site Evaluation Accomplished (SEA)

WHY IS AN SI NECESSARY?

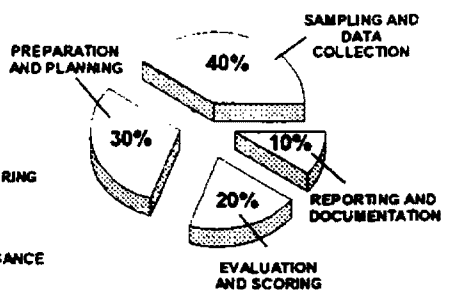
- Required by CERCLA/SARA for all federal facility sites not receiving NFRAP designation after PA
- HRS scoring requires analytical data
  - Analytical data usually not available or complete during PA
- Data collected during other site investigations may not address specific HRS requirements

THE SITE ASSESSMENT ACTIVITIES

PA ACTIVITIES



SI ACTIVITIES



THE SITE ASSESSMENT PROCESS:

Site Inspection (SI):

- Intended to test PA hypotheses
- Includes collection of environmental samples
- Involves more detailed data collection than a PA
- Results in a decision to recommend for HRS scoring or no further remedial action planned (NFRAP)

SI Guidance, Section 1.1.2

THE SITE ASSESSMENT PROCESS (cont.):

Primary SI objectives:

- Determine whether hazardous substances are likely to be released to the environment (LR)
- Identify substances present and their waste characteristics (WC)
- Determine whether hazardous substances have impacted or could impact specific targets (T)

SI Guidance, Section 1.1.2

THE SITE ASSESSMENT PROCESS (cont.):

Additional objectives:

- Support potential removal activities
- Support enforcement actions and identify potential responsible party (PRP Search)
- Collect data to support the remedial investigation/feasibility study (RI/FS)

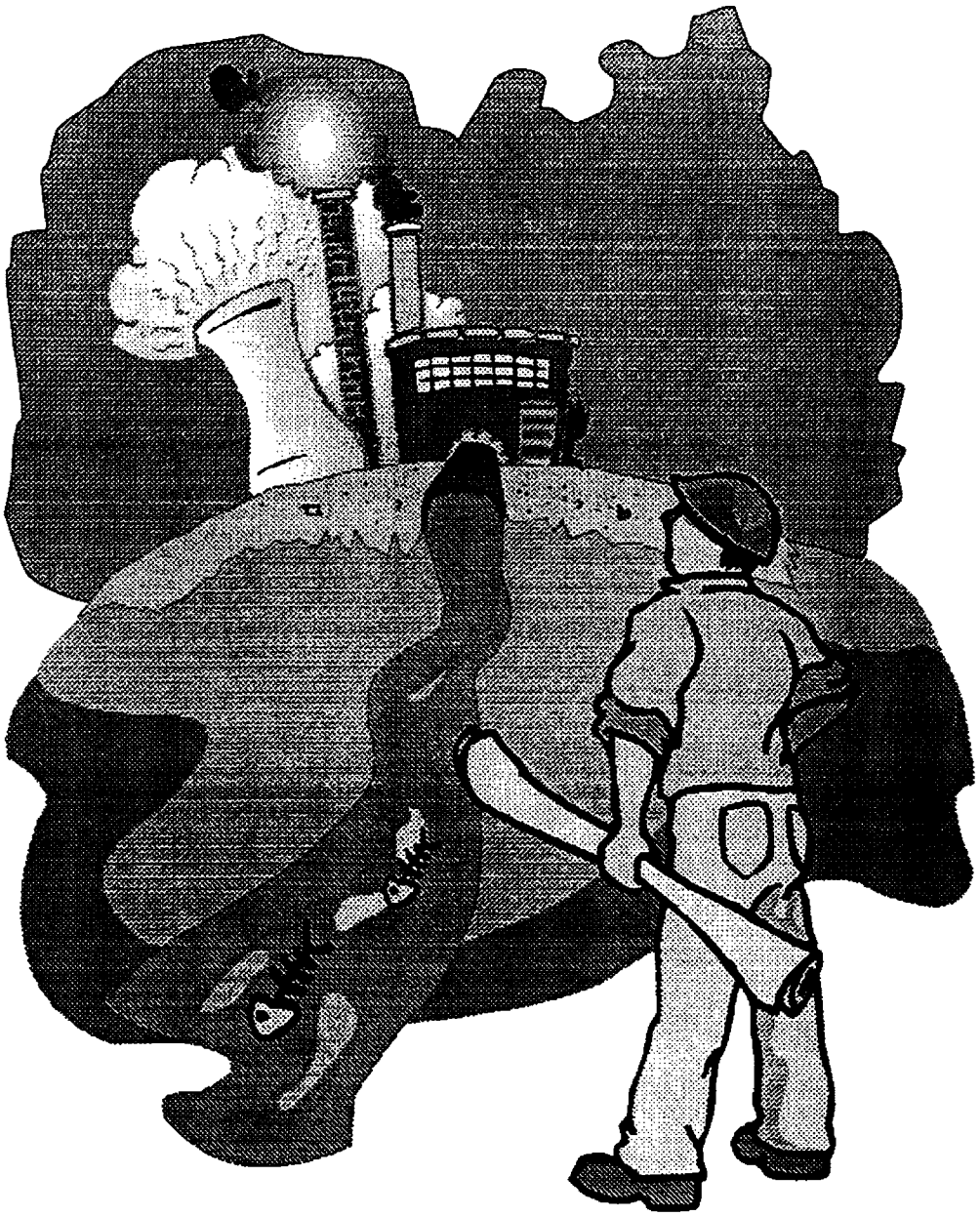
SI Guidance, Section 1.1.2

COMPARISON OF SI AND PA

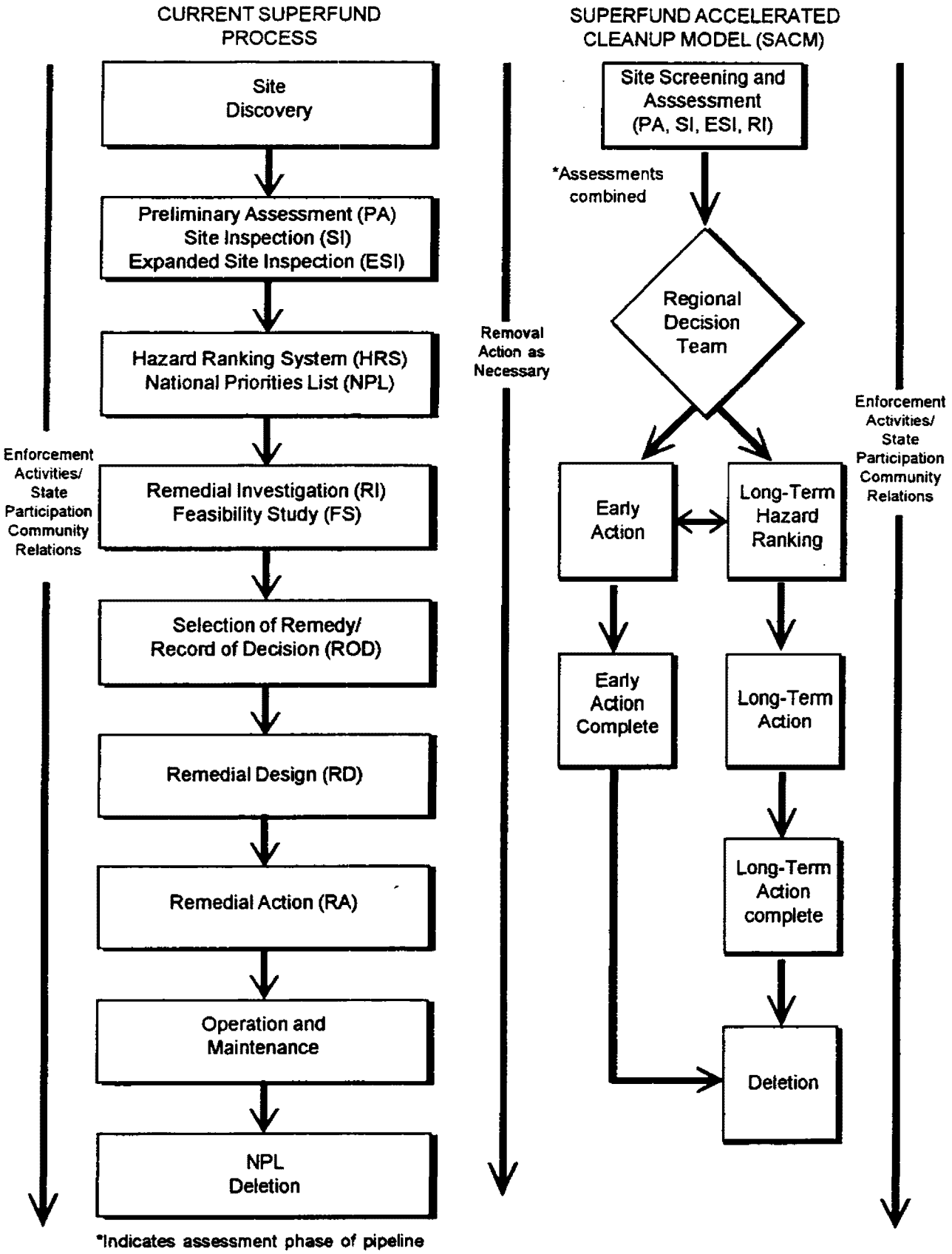
SI	PA
Limited scope	Limited scope
Biased sampling investigation	Nonsampling investigation
Flexible and dynamic evaluation	Step-by-step evaluation
Sampling strategy and data collection to satisfy HRS criteria	Comprehensive target survey
Additional information to test critical assumptions and hypotheses	Conservative assumptions and professional judgment

SECTION TWO

SI APPROACHES

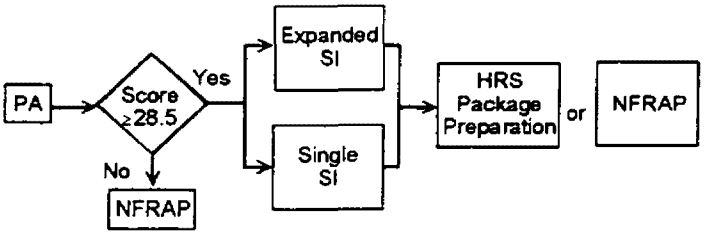


THE TRADITIONAL SUPERFUND PROCESS vs. THE SACM PROCESS



*Indicates assessment phase of pipeline

TRADITIONAL SI APPROACHES



SI Guidance, Chapter 2

EXPANDED SI: GOAL

". . . collect all data necessary to prepare an HRS scoring package to propose the site to the NPL."

SI Guidance, Section 2.2

EXPANDED SI: EMPHASIS

- Hypotheses or conclusions not adequately documented during the PA
- Collect samples necessary to attribute hazardous substance contamination to site operations
- Collect several samples to establish background/quality control

SI Guidance, Section 2.2

EXPANDED SI: EMPHASIS (cont.)

- Collect missing data for significant pathways not previously sampled
- Collect all remaining nonsampling data
- Establish thorough and defensible documentation

SI Guidance, Section 2.2

EXPANDED SI: SAMPLING

Design to support HRS requirements:

- "Observed release" of hazardous substances relative to background
- "Observed contamination"
- "Levels of contamination"

SI Guidance, Section 2.2

EXPANDED SI: SAMPLING (cont.)

May require special field activities:

- Monitoring well installation
- Air sampling
- Geophysical studies
- Drum/tank sampling
- Soil borings
- Background sampling studies

SI Guidance, Section 2.2

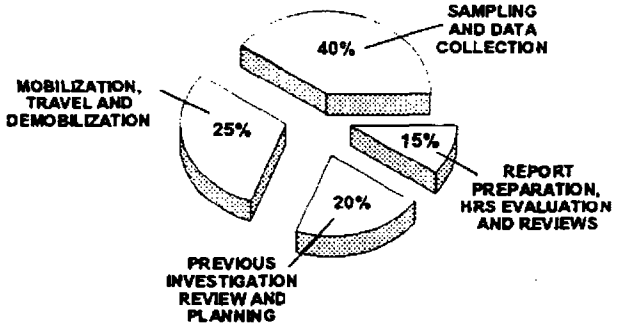
EXPANDED SI: SCOPE

- Average 600 hours; typically 550 to 650 hours
- Average 30 samples; typically 25 to 35 samples
- Adequate QA/QC and background samples
- Satisfy HRS requirements

Note: Hours are region specific

SI Guidance, Section 2.2

EXPANDED SITE ACTIVITIES



Total Expanded SI Hours: 620

SI Guidance, Section 2.2

SI APPROACH: TYPICAL DATA COLLECTION ACTIVITIES

ACTIVITY	EXPANDED AND SINGLE SI
Nonsampling data collection	✓
Target sampling	✓✓
Source sampling	✓✓
Release sampling	✓✓
Background sampling	✓✓
Attribution sampling	✓✓
QA/QC sampling	✓✓
Special data collection or sampling tasks	If necessary

SI Guidance, Section 2.2, Table 2-3

SINGLE SI

Eligibility for single SI:

- Sites with available analytical data
  - If previous analytical data are of sufficient quality and indicate site is a likely NPL candidate
- "Simple" sites
  - Well defined source, few targets, one pathway of concern

SI Guidance, Section 2.3

SINGLE SI (cont.)

Eligibility for single SI: (cont.)

- "Remote"
  - Only one mobilization feasible
- "Potential contamination" sites
  - Targets subject to significant contamination upon impact

SI Guidance, Section 2.3

SINGLE SI: ACTIVITIES

Scope varies:

- Collect data to satisfy HRS requirements
- Obtain adequate QA/QC and background samples
- Collect missing nonsampling information for significant pathways
- Document thoroughly

SI Guidance, Section 2.3

INTEGRATED ASSESSMENTS

- Integrating removal and remedial site assessment investigations to achieve increased efficiency and shorter response times

TRADITIONAL APPROACHES

- Removal assessments are traditionally based on whether site conditions meet National Contingency Plan (NCP) criteria for a removal action
- Remedial site assessments are focused on collecting data for HRS
- The need to integrate these programs is based on the assumption that there is duplication of effort between the programs

EPA Directive 9345 1-16FS (Fact Sheet), Integrating Removal and Remedial Site Assessment Investigations, September 1993

WHAT IS THE REMOVAL PROGRAM?

Federal response capability for releases or threatened releases of:

- Hazardous substances that present a threat to public health, welfare or the environment
- Oil spills into or on navigable waters and shorelines
- Petroleum releases from underground storage tanks

WHAT ARE THE REMOVAL PROGRAM AUTHORITIES?

Statutory

- Clean Water Act (CWA) as amended by the Oil Pollution Act of 1990
- Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)
- Superfund Amendments and Reauthorization Act (SARA)
- Oil Pollution Act

Regulatory

- NCP

INITIATING REMOVAL ACTIONS

Authority to approve a removal is generally based on estimated cost

- Less than $200K – Onscene Coordinator (OSC)
- $200K to $2M – Regional Administrator
- Over $2M – Assistant Administrator, OSWER

PRP search

- NCP requirement

Note: Cost criteria are subject to change.

INITIATING REMOVAL ACTIONS (cont.)

Action memorandum

- Criteria for qualifying site
- Proposed removal action
- Estimated cost

WHAT ARE REMOVAL ACTIONS?

Near-term response actions taken to prevent, minimize, or mitigate threats to public health, welfare, or the environment including, but not limited to:

- Collection and analysis of samples
- Provision of alternate water supplies
- On-site treatment
- Source control/stabilization
- Off-site storage, treatment, destruction, or disposal
- Temporary relocation of threatened individuals
- Installation of security fencing/guards

CLASSIFICATION OF REMOVAL ACTIONS

Classic emergency

- 33 percent of removal actions since 1985
- Immediate action required

Time critical

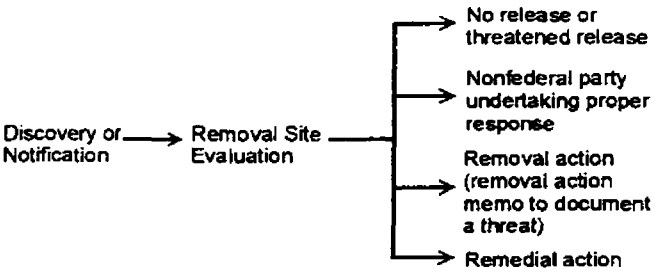
- Planning period of less than 6 months

CLASSIFICATION OF REMOVAL ACTIONS (cont.)

Non-time critical

- Planning period of greater than 6 months is available
- Agency conducts an engineering evaluation/cost analysis (EE/CA)

HOW IS THE APPROPRIATE RESPONSE SELECTED?



THE REMOVAL EVALUATION

Removal preliminary assessments and site inspections are conducted to determine and evaluate:

- Presence and magnitude of threat to health or environment
- Source and nature of the release
- Activities required to mitigate threat
- Ability of nonfederal party(ies) to undertake response
- Need for CERCLA-funded removal

REMOVAL CRITERIA

- Actual or potential human or animal food chain exposure
- Actual or potential drinking-water contamination
- Fire or explosion threat
- Hazardous substance in containers that pose a threat of release

REMOVAL CRITERIA (cont.)

- Highly contaminated soils at the surface that pose direct-contact threat
- Weather conditions that may cause substances to migrate
- Unavailability of other response or enforcement mechanisms

HOW ARE REMOVALS IMPLEMENTED?

Technical response support

- Superfund Response – contractor
- Superfund Assessment/Technical Assistance (SATA) – contractor
- U.S. Coast Guard (USCG)
- Environmental Response Team (ERT)

HOW ARE REMOVALS IMPLEMENTED? (cont.)

Mitigation/cleanup response

- Emergency Rapid Response Services (ERRS) – contractor
- Site – specific contracts

Cooperative agreements (CAs) with states

ERRS

- Analytical services
- Containment and countermeasures
- Cleanup, mitigation and disposal
- Site restoration

REMOVAL AND REMEDIAL ASSESSMENTS

Similarities in programs' goals

- Evaluate potential for human exposure to drinking water, soil, and airborne contaminants
- Evaluate threats to sensitive environments (e.g., wetlands)

Fact Sheet, Page 3

REMOVAL AND REMEDIAL ASSESSMENTS (cont.)

Similarities in activities

- Telephone and file investigations
- Site visits or PA recons
- Sampling visits

Fact Sheet, Page 3

INTEGRATED ASSESSMENT GOALS

- Eliminate duplication of effort
- Expedite the process
- Minimize the number of site visits and other steps in the process
- Collect only the data needed to assess the site appropriately

Fact Sheet, Page 3

INTEGRATED ASSESSMENT APPROACH

Important features:

- Combined notification/site discovery/screening function
- Single site visit for both programs
- Phased file searches
- Integrated sample planning and inspection

See Figure 2, Integrated Assessment, Integrating Removal and Remedial Site Assessment Investigations, Fact Sheet, EPA 540-F-93-038, September 1993

Fact Sheet, Page 4

INTEGRATED ASSESSMENT APPROACH (cont.)

Notification/site discovery/screening

- "One door" notification process
- All sites screened for emergency response
- Determine whether there is enough time for a file search before initial site visit

Classic emergency

- Respond immediately
- Little or no time for file search or telephone investigation

Fact Sheet, Page 3

INTEGRATED ASSESSMENT APPROACH (cont.)

File search:

- Includes all elements of a removal assessment file search
- Table 1: *File Search and Telephone Investigaton,* lists these elements
- Document all elements for both programs

Fact Sheet, Page 3

INTEGRATED ASSESSMENT APPROACH (cont.)

Initial field investigation/PA reconnaissance:

- Combines elements from removal field visit and remedial PA reconnaissance
- Documentation procedures for removal assessment may require revision to meet remedial assessment needs
- Would require on-site reconnaissance at all sites
- Table 2: *Data Elements of the Site Visit*, lists data needs for both programs

Fact Sheet, Page 5

INTEGRATED ASSESSMENT APPROACH (cont.)

Sample (optional)

- Should follow current removal assessment approach
- Should consider HRS data needs

Fact Sheet, Page 5

INTEGRATED ASSESSMENT APPROACH (cont.)

Review data and decide further action

- Both programs meet to decide next step(s)
- May continue removal assessment, PA, or both concurrently
- May expedite PA to determine whether remedial site assessment requirements should be included in sampling plans

Fact Sheet, Page 5

INTEGRATED ASSESSMENT APPROACH (cont.)

Complete the PA:

- Collect additional information needed to complete PA
- Calculate preliminary HRS score
- Prepare PA report
- Table 3: *Data Elements Needed to Complete the PA*, should be consulted
- Refer site to regional decision team if score is greater than or equal to 28.5

Fact Sheet, Pages 5 and 6

INTEGRATED ASSESSMENT APPROACH (cont.)

Integrated sampling plan:

- Combines screening level SI plans and remaining removal sampling activities
- For site going to NPL, remedial project manager (RPM) should be consulted
- Could include sampling for long-term objectives

See Table 4, Integrating Removal and Remedial Site Assessment Investigations, Fact Sheet, EPA 540-F-93-038, September 1993

Fact Sheet, Page 6

INTEGRATED ASSESSMENT APPROACH (cont.)

SI/removal assessment sampling:

- One event
- Meet needs of both programs

See Table 4, Integrating Removal and Remedial Site Assessment Investigations, Fact Sheet, EPA 540-F-93-038, September 1993

Fact Sheet, Page 6

INTEGRATED ASSESSMENT APPROACH (cont.)

Expanded Site Inspection/remedial investigation:

- Option allowing RI to start as soon as site appears to qualify for NPL
- NPL listing needs and RI needs can be incorporated into single sampling plan

Fact Sheet, Pages 6

FEDERAL FACILITIES

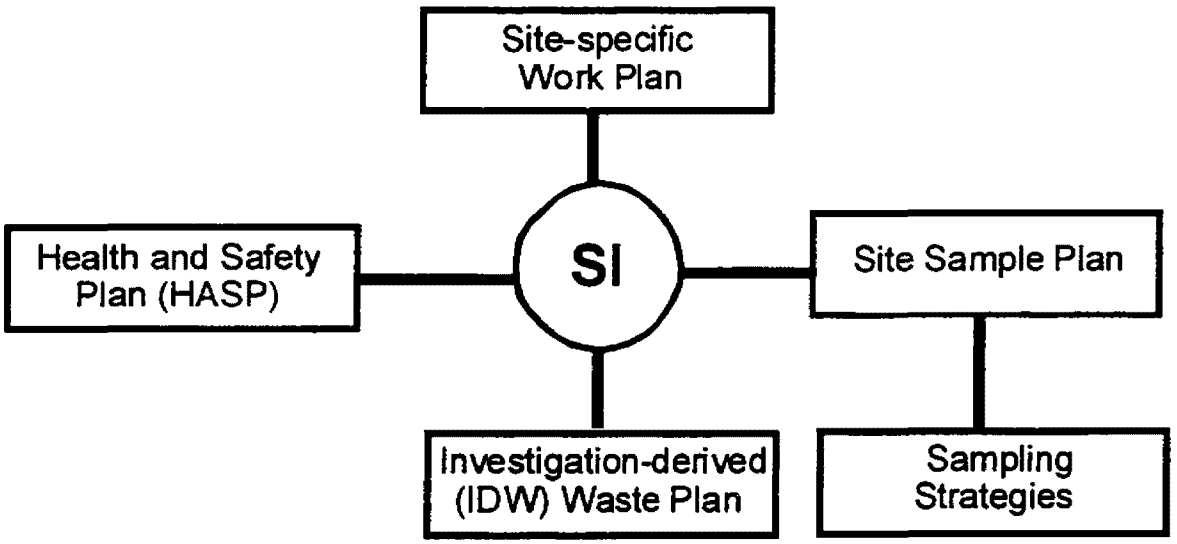
Integrated assessment at Federal Facilities:

- EPA Federal Facilities Enforcement Office (FFEO)
- U.S. Department of Defense (DOD)
- U.S. Department of Energy (DOE)

Memorandum: Guidance on Accelerating CERCLA Restoration of Federal Facilities, August 22, 1994

SECTION THREE

SITE PLANNING AND SAMPLING STRATEGIES (PART 1)



PLANNING – OVERVIEW

Four plans are needed to:

- Refine investigation objectives: Sampling Action Plan
- Ensure activities proceed efficiently: Work Plan
- Ensure safety: HASP
- Address investigation-derived waste (IDW)
- Negotiate site access

SI Guidance, Chapter 3, Pages 15 and 30

REVIEW INFORMATION FOR SI PLANNING

- Compile all relevant and available site data
- * – Hazardous waste sources completely described? (boundaries, location, containment, substances)
  - Migration pathways all evaluated?
  - Human and environmental targets identified?
  - Existing analytical data of CLP quality?

*See www.epa.gov/superfund/resources/chemicals.htm

SI Guidance, Section 3.5

REVIEW INFORMATION FOR SI PLANNING (cont.)

- Review PA reports
  - Examine hypotheses; are they feasible/logical?
  - Look for changes in site conditions over time since PA was conducted.

SI Guidance, Section 3.5

REVIEW INFORMATION FOR SI PLANNING (cont.)

Other sources of information:

- Previous investigations by other parties
- Investigations at nearby site – similar information
- Removal actions and reports
- EPA or other federal agencies
- State agencies

SI Guidance, Section 3.5

REVIEW INFORMATION FOR SI PLANNING (cont.)

Other sources of information (cont):

- Health departments
- Academic studies
- Owner/operator records
- Database vendors (facility audit reports)
  - www.edmet.com
  - www.ecesearchnet.com
  - www.vistacheck.com

SI Guidance, Section 3.5

EXISTING ANALYTICAL DATA REVIEW

- Use data to support design of sampling and analysis program
- Refer to SI Guidance, Table 3-7, Types of Analytical Data, for application of existing data

SI Guidance, Section 3.5.2

EXISTING ANALYTICAL DATA REVIEW (cont.)

- SI Guidance, Table 3-8, Review of Previous Analytical Data, provides a procedure for data review
- SI Guidance, Exhibit 3-1, Checklist for Usability of Previous Analytical Data, should be applied to existing data

SI Guidance, Section 3.5.2

WORK PLAN

Work plans should:

- Summarize site background and hazards present
- Identify SI objectives
- Set work schedule
- Identify personnel and training needs
- *• Determine equipment/laboratory requirements
- Include provisions to secure contract services

*See www.epa.gov/superfund/programs/clp/aboutsrv.htm

SI Guidance, Section 3.6.1

A SAMPLE PLAN INCLUDES:

- Field operations – sequence for conducting field activities
- Sample locations, rationale, and methodology – sample type, sample number, and sample location map

Refer to SI Guidance, Exhibit 3-2
SI Sample Plan Outline on the following pages

A SAMPLE PLAN INCLUDES (cont.):

- Analytical requirements and sample handling – sampling equipment, container types, preservation techniques, and filtering
- Sample delivery – laboratory locations, special storage, and transport requirements

Refer to SI Guidance, Exhibit 3-2
SI Sample Plan Outline on the following pages

EXHIBIT 3-2: SI SAMPLE PLAN OUTLINE

INTRODUCTION

- Briefly state the authority and purpose for conducting the SI and scope of the investigation. Discuss the objectives and goals of the SI.

SITE DESCRIPTION AND REGULATORY AND OPERATIONAL HISTORY

- Describe the site location. Identify the type of facility, whether it is active or inactive, and years of operation. Describe its physical characteristics and setting (e.g., local land use, climate, topography, geology, hydrology, hydrogeology). Include a map showing the location. Include a site plan or sketch showing features on and around the site.

- Describe historical site operation, including all past and current operations and conditions. Identify current and former owners/operators, types of site activities, wastes generated, and waste disposal practices. Identify all sources and source types. Provide the hazardous waste quantity disposed in each source, if possible, and provide volume or area of the sources. Identify hazardous substances associated with or detected in the sources. Describe source containment. Describe any spills that have occurred at the site.

- Specify whether any sources are regulated by RCRA. Describe past regulatory activities, including permits, permit violations, and inspections by local, state or federal agencies. If applicable, provide emergency response and waste removal information. Summarize analytical results of earlier investigations. Specify type of data (e.g., CLP, non-CLP, owner/operator).

COLLECTION OF NON-SAMPLING DATA

- Describe additional non-sampling information to be collected (e.g., aquifer boundaries, interconnections, and discontinuities; resources; drainage area; soil group; particulate migration factors); and the rationale for collecting this information. Discuss any field activities needed to obtain this information.

SAMPLING ACTIVITIES

- Discuss objectives of planned field activities. Describe procedures and necessary resources. Discuss the rationale for these tasks.

- Provide explicit instructions for all field activities, including field observations, sampling, environmental monitoring for health and safety purposes, and field QA/QC protocols. Reference appropriate Standard Operating Procedures (SOPs). Discuss purpose of both onsite and offsite reconnaissances and observations (e.g., to verify the selection of sample locations, to evaluate the degree of containment at site sources, to measure source dimensions, to verify distances to nearby targets, and to characterize additional sources of contamination not identified during previous investigations).

- Justify proposed sample locations. Discuss methods to more fully characterize wastes and sources. Identify specific targets to be sampled (e.g., drinking-water wells or intakes, fisheries, sensitive environments), or substantiate target contamination hypotheses. Describe sampling strategy to test or substantiate observed release hypotheses and presence of media contamination (e.g., soil, groundwater, sediment, air, surface water).

- Include a map or site sketch showing previous and proposed sample locations.

- Summarize sample plan in a table, identifying sample types, sample numbers, sample locations, and sample-selection criteria. Describe methods of sample collections and preservation, field measurements, and analytical methods. Refer to Standard Operating Guidelines (SOGs) or provide a table or checklist describing the SOGs.

- Describe investigation-derived wastes (IDW) that may result from field activities. Reference the IDW plan that describes the management approach for non-hazardous and hazardous IDW.

PROJECT MANAGEMENT

- Identify all people who will be involved in the field activities, and discuss their specific responsibilities. Identify all safety and sampling equipment and supplies. Describe any contractual services needed to accomplish field activities. Summarize all transportation and shipping information.
- Describe community relations plans and meetings.
- Provide information on SI costs (e.g., number of technical hours; number of CLP, field screening, or other samples; subcontracting costs). Provide schedule for SI activities and deliverables. Summarize any special requirements that impact the SI (e.g., special safety considerations, special analytical service, or special equipment).
- Reference the work plan.

ATTACHMENTS

- Sample summary table.
- Sample location sketch.
- List of references cited in this plan.
- Health and safety plan.
- Appropriate SOPs and SOGs.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

HEALTH AND SAFETY PLAN (HASP)

Goal: To establish requirements and procedures to protect the health and safety of investigative personnel and nearby public.

- Routine operations – describe hazards, list key safety personnel, levels of protection by task, designate work areas, security, environmental monitoring, training requirements, and weather-related problems.

SI Guidance, Section 3.6.3

HEALTH AND SAFETY PLAN (HASP) (cont.)

- Emergencies – communication alternatives, contact procedures for emergency response units, emergency equipment, map of route to hospital, transport vehicles, worker evacuation, and decontamination.

SI Guidance, Section 3.6.3

INVESTIGATION-DERIVED WASTES (IDW) MANAGEMENT PLAN

- Minimize quantity of wastes generated
- Remove wastes that pose an immediate threat to human health or the environment
- Must comply with applicable federal and state requirements

Refer to Directive 9345.3-02, Management of Investigation-Derived Wastes During Site Inspections

SI Guidance, Section 3.6.4

SITE ASSESSMENT TEAM

- Site Assessment Manager (SAM)
- Health and safety officer
- Field team
- Chemist/data evaluator
- Hydrogeologist
- Subcontracts officer/procurement officer

ON/OFF SITE RECONNAISSANCE

- Verify site conditions
- Verify sample locations (accessible?, obstructions?)
- Locate and identify all sources
- Determine physical state of wastes
- Evaluate source containment and migration

SI Guidance, Section 3.7

ON/OFF SITE RECONNAISSANCE (cont.)

- Identify overland flow paths (or subsurface storm water drainage system)
- Determine distance from sources to targets
- Refine site sketch
- Evaluate need for emergency response

SI Guidance, Section 3.7

SITE ACCESS

Legal access must be obtained from site owner before conducting an SI

- Voluntary entry – by notifying owner in writing of activities to be conducted (sample collection, photography)
- Conditional entry – consent to entry with restrictions (limit area of reconnaissance, employee interviews, records)

SI Guidance, Section 3.7.3

SITE ACCESS (cont.)

- Entry with a warrant – SI must be conducted in strict accordance with warrant
- Consult with EPA Office of Regional Counsel

SI Guidance, Section 3 7 3

COMMUNITY, NEIGHBORHOOD AND GOVERNMENT CONTACTS

- Contact local representatives in advance
- Explain purpose of SI
- Explain tasks to be performed
- Identify contact for further information: regional Site Assessment Manager (SAM)

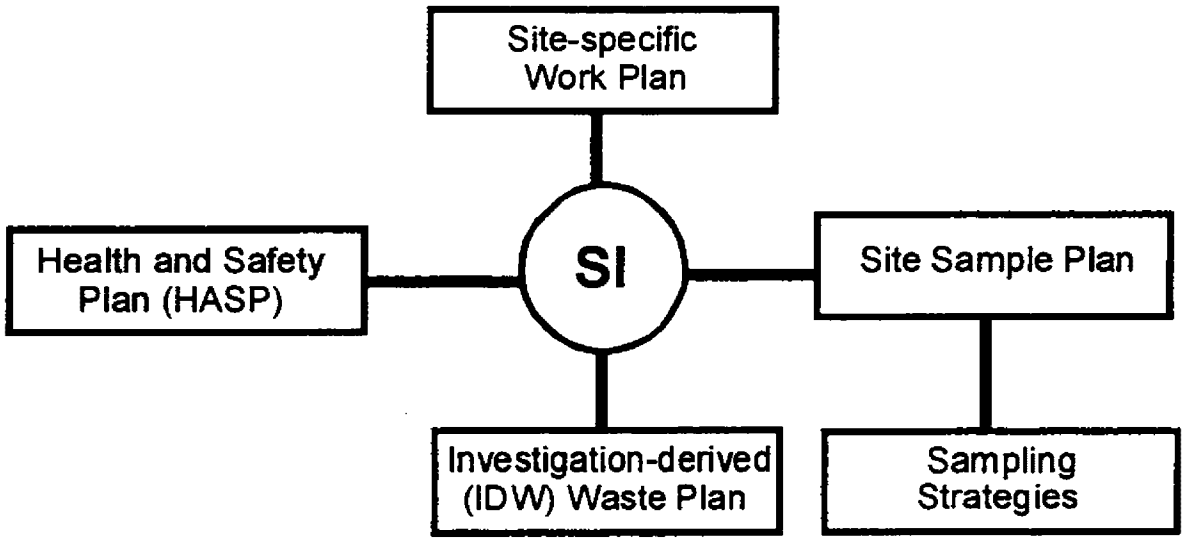
SI Guidance, Sections 3.7.4 and 3.7.5

COMMUNITY, NEIGHBORHOOD AND GOVERNMENT CONTACTS (cont.)

- Determine routing of SI results and other information
- Consult *Community Relations in Superfund: A Handbook*; Section 4.1, OSWER Directive 9230.0-03C, January 1992
- Contact appropriate municipal, county, state, and federal officials before SI

SI Guidance, Sections 3.7.4 and 3.7.5

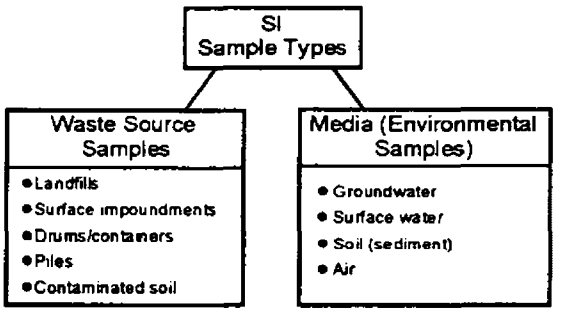
SITE PLANNING AND SAMPLING STRATEGIES (PART 2)



SAMPLE COLLECTION ISSUES

- Demonstrate that hazardous substances are present
- Determine whether they have migrated from their original locations to specific targets

SI Guidance, Section 3.12



Further discussion of sample types is found in Table 3-1, Types of Samples, Page 16 of the SI Guidance

SAMPLE VARIABILITY: FACTORS

- Sample collection and handling techniques
- Spatial variability
- Temporal variability
- Media variability

SI Guidance, Section 3.1.2, Pages 17-212

SAMPLE VARIABILITY: MEDIA-SPECIFIC SAMPLING

- Surface and groundwater
- Soil/sediment
- Air vapors or particulates
- Tissue
- Containerized materials

Turn to SI Guidance, Table 3-4, Sampling Issues Affecting Confidence in Analytical Results, Page 19, for media-specific sampling issues

SI Guidance, Section 3.1.2, Pages 17-212

SAMPLE ANALYSIS OPTIONS

*Contract Laboratory Program (CLP):**

- Standardized analytical services provided by laboratories under contract to U.S. Environmental Protection Agency (EPA)
  - Organics/inorganics
  - Water or solid samples

*See www.epa.gov/superfund/programs/clp/process.htm

SI Guidance, Section 3.4, Page 24

SAMPLE ANALYSIS OPTIONS (cont.)

Contract Laboratory Program (CLP) (cont.):

- Reliable, legally defensible data
  - Broad spectrum analysis
    - ✓ Target compound list (TCL)
    - ✓ Target analyte list (TAL)
- Validated data from other sources (state or PRP)

SI Guidance, Section 3.4, Page 24

SAMPLE ANALYSIS OPTIONS (cont.)

Non-CLP services:

- May provide data of similar quality to CLP
- Analytical protocols must be selected – method, detection levels, instrumentation, etc.

SI Guidance, Section 3.4, Page 25

SAMPLE ANALYSIS OPTIONS (cont.)

Field Analytical Screening Program (FASP):

- Use "portable" analytical instruments
- Allows for "intelligent" decision-making in the field

SI Guidance, Section 3.4, Page 25

SAMPLE ANALYSIS OPTIONS (cont.)

Field Analytical Screening Program (FASP) (cont.):

- Applications:
  - Screen many samples
  - Select sample locations
  - Design soil sampling
  - Reduce CLP costs
  - Fast turnaround time
  - Determine extent of waste migraton
  - Determine monitoring well locations
  - Estimate hazardous waste quantity (HWQ)

SI Guidance, Section 3.4, Page 25

FIELD QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) CONSIDERATIONS

- Help evaluate quality of analytical results and field methods
- QA/QC samples treated in same manner as site samples
- Consult EPA regional guidelines for number and type of QA/QC samples to be collected

SI Guidance, Section 3.2, Page 212

QA/QC SAMPLE TYPES

Co-located or Duplicates	Two samples collected at the same time and location.
Replicates or Splits	One sample that is divided and sent to the same or separate laboratories.
Field Blanks	Samples of contaminant-free medium that are either transferred from one container to another or are exposed to field conditions.
Trip Blanks	Samples prepared from contaminant-free medium and placed in sample containers prior to the SI. They are kept unopened with site samples throughout the investigation.
Field Rinsates (Equipment Blanks)	Deionized water flushed through sampling equipment after decontamination and before resampling to monitor decontamination procedures.
Field Matrix Spikes	Field samples prepared by adding a known amount of contaminants to selected site samples.

QA/QC SAMPLES

- Collected to confirm precision and accuracy of data
- QA/QC samples for SI's are limited
  - One aqueous trip blank per day
  - One equipment rinsate blank for each medium collected

Turn to SI Guidance, Table 4-6, Guidance for Minimum QA/QC Samples: Expanded SI or Single SI, Page 56, SI Guidance

SI Guidance, Chapter 4.3

QA/QC SAMPLES (cont.)

- Suggested QA/QC sample guidance for expanded and single SI's is found in Table 4-6 (Note: EPA regional guidance may differ)
- Refer to Qualified Data Fact Sheet, Appendix A

Turn to SI Guidance, Table 4-6, Guidance for Minimum QA/QC Samples: Expanded SI or Single SI, Page 56, SI Guidance

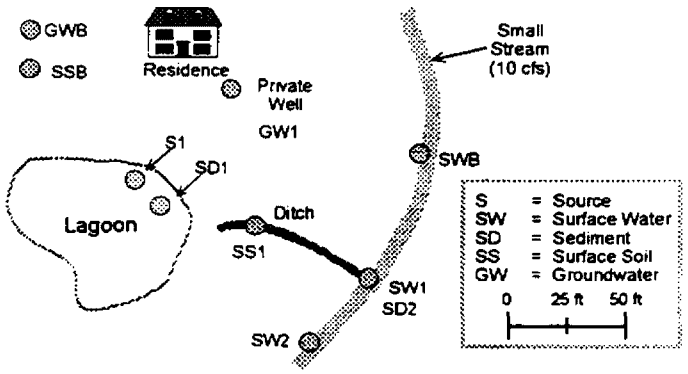
SI Guidance, Chapter 4.3

TABLE 4-6: GUIDELINES FOR MINIMUM QA/QC SAMPLES
EXPANDED SI OR SINGLE SI

MEDIUM	REPLICATES/ DUPLICATES	FIELD BLANKS	TRIP BLANKS
Aqueous	1 in 20	1 in 20	1/day of sampling
Soil and sediment	1 in 20	1 in 20	Usually not required
Air	1 in 20	Not applicable	1/day of sampling
Source material	1 in 20	Usually not required	Usually not required

Sample requirements should be developed on a site-specific basis. Laboratory blanks and spikes are method-specific and are not included in the table.

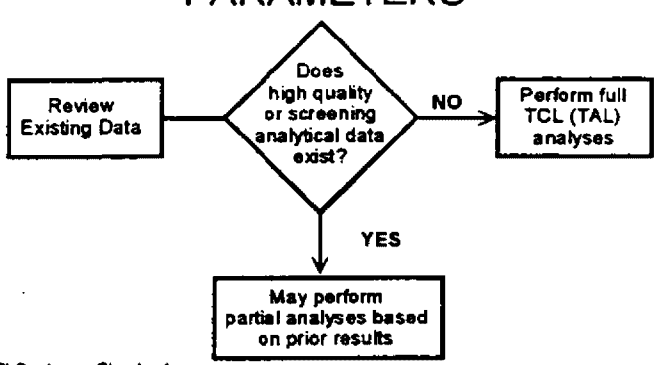
QA/QC SAMPLES: MINI EXERCISE
(NO DISPOSABLE EQUIPMENT)



QA/QC SAMPLES: MINI EXERCISE (cont.
(NO DISPOSABLE EQUIPMENT)

SAMPLING PLAN		QA/QC SAMPLES
Sampled	Rational	Expanded SI
SD1	Sediment from lagoon	
SD2	Sediment from probable point of entry (PPE)	
SS1	Surface soil from ditch	
SSB	Surface soil background	
SW1	Surface water at PPE	
SW2	Surface water downstream of PPE	
SWB	Surface water background	
S1	Source (aqueous)	
GW1	Groundwater from private well	
GWB	Groundwater background	

SELECTING ANALYTICAL PARAMETERS



SI Guidance, Chapter 4

HRS SAMPLING CONSIDERATIONS

Several HRS elements require sample data for:

- Site and source characterization list
  - Identify hazardous wastes/substances/source types
  - Determine hazardous waste quantity
  - Delineate source boundaries/containment

SI Guidance, Section 3.3, Pages 22-23

HRS SAMPLING CONSIDERATIONS(cont.)

Several HRS elements require sample data for:

- Observed release and areas of observed contamination
  - Provide direct evidence of an "observed release" to affected media
  - Demonstrate "significant" contamination
  - Estimate area of contamination
  - Demonstrate "attribution" to site activity/operations

SI Guidance, Section 3.3, Pages 22-23

HRS SAMPLING CONSIDERATIONS(cont.)

Additional HRS elements requiring sample data to determine:

- Levels of contamination at specific targets
  - Document "actual contamination"
  - Targets include drinking-water wells, surface water intakes, fisheries, workers, residential/school properties, and sensitive environments (wetlands)
  - Support "potential contamination"
  - Define levels of contamination

SI Guidance, Section 3.3

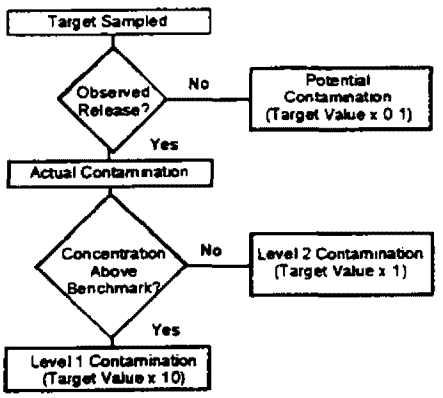
HRS SAMPLING CONSIDERATIONS(cont.)

Additional HRS elements requiring sample data to determine (cont.):

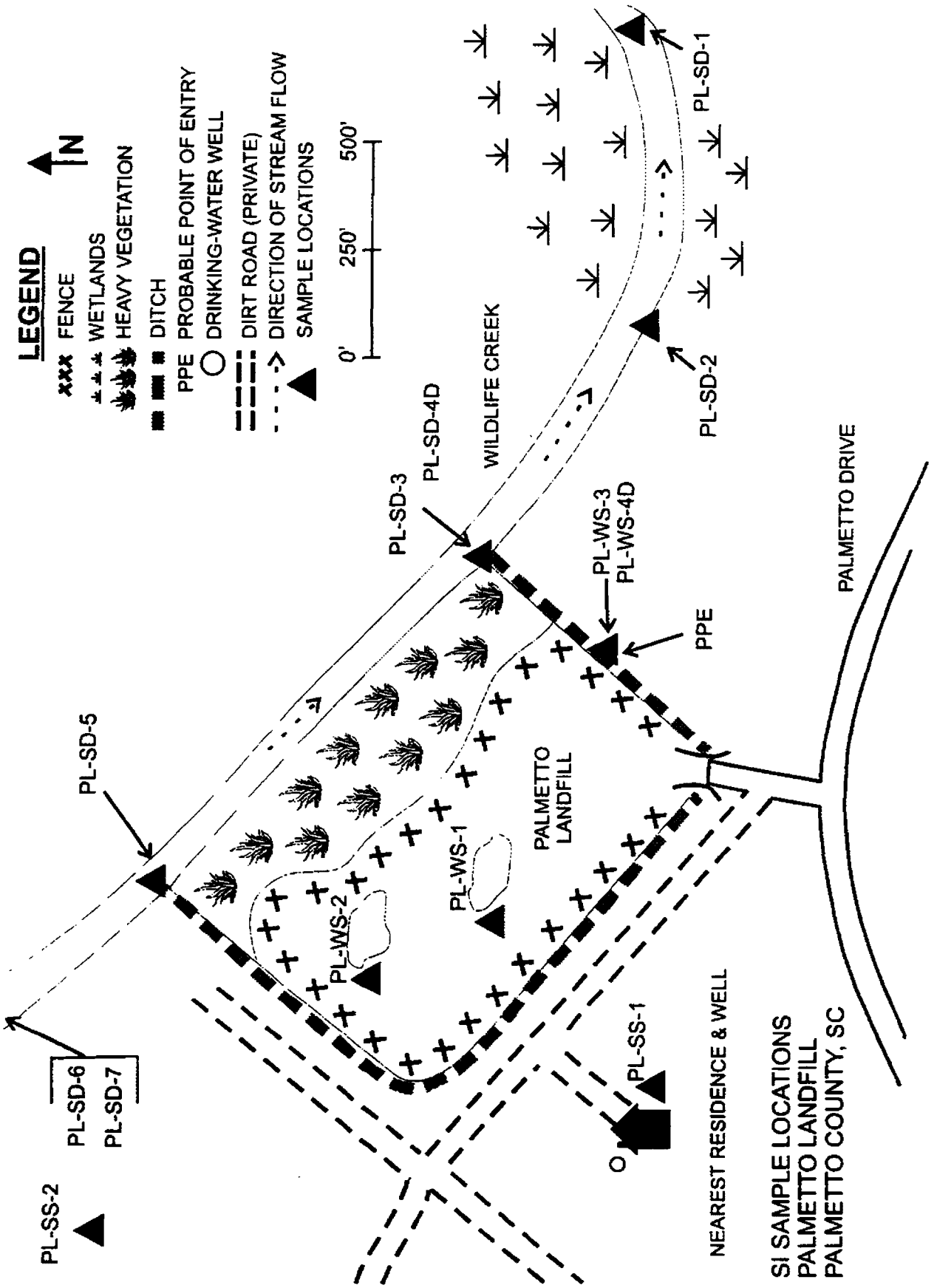
- Target distances
  - Establish target distance limits for each pathway

SI Guidance, Section 3.3

HRS SAMPLING CONSIDERATIONS: LEVELS OF CONTAMINATION



SI Guidance, Section 3.3


LEGEND
FENCE
WETLANDS
HEAVY VEGETATION
DITCH
PPE PROBABLE POINT OF ENTRY
DRINKING-WATER WELL
DIRT ROAD (PRIVATE)
DIRECTION OF STREAM FLOW
SAMPLE LOCATIONS
N
0' 250' 500'
PL-SD-1
PL-SD-2
PL-SD-3
PL-SD-4D
WILDLIFE CREEK
PL-WS-3
PL-WS-4D
PPE
PALMETTO DRIVE
PL-SD-5
PALMETTO LANDFILL
PL-WS-1
PL-WS-2
PL-SS-1
NEAREST RESIDENCE & WELL
PL-SD-6
PL-SD-7
PL-SS-2
SI SAMPLE LOCATIONS
PALMETTO LANDFILL
PALMETTO COUNTY, SC

DEMONSTRATING A RELEASE: HRS REQUIREMENTS

An observed release can be documented by:

- Direct observation
- Chemical analysis (preferred method)

SI Guidance, Chapter 4.41

DEMONSTRATING A RELEASE: LEVELS AND QUANTITATION LIMITS

Background Sample: A sample used in establishing a background level.

Contract Laboratory Program (CLP): Analytical program designed to provide legally defensible analytical results, supported by a high level of quality assurance and documentation.

HRS Manual, Page 57

DEMONSTRATING A RELEASE: LEVELS AND QUANTITATION LIMITS (cont.)

Contract-required Detection Limit (CRQL): The substance-specific level that a CLP laboratory must be able to routinely and reliably detect in specific sample matrices (the level that a CLP laboratory must reliably quantify).

Method Detection Limit (MDL): The lowest concentration of a hazardous substance that a *method* can detect reliably in either a sample or a blank.

HRS Manual, Page 57

DEMONSTRATING A RELEASE: LEVELS AND QUANTITATION LIMITS (cont.)

Sample Quantitation Limit (SQL): The quantity of a substance that can be reasonably quantified *given the limits of detection for the methods of analysis and sample characteristics* that may affect quantitation (e.g., dilution, concentration).

HRS Manual, Page 57

DEMONSTRATING A RELEASE BY SAMPLING

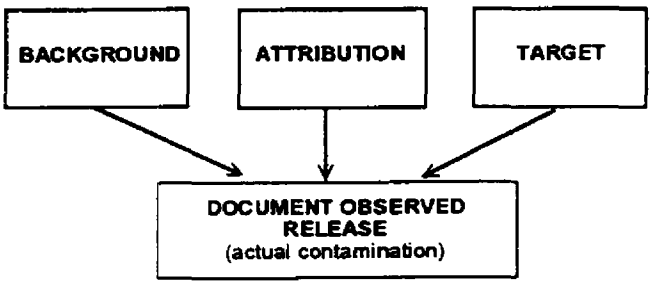
Key Factor:

To demonstrate a release by chemical analysis for a pathway, at least one sample must show contamination significantly above the background level for a hazardous substance at or above the SQL.

See SI Guidance, Page 59, for a discussion of the term "significance"

SI Guidance, Chapter 4.41

DEMONSTRATING A RELEASE BY SAMPLING (cont.)



SI Guidance, Chapter 4.41

DEMONSTRATING A RELEASE BY SAMPLING: BACKGROUND

Considerations:

- Naturally occurring vs. man-made concentrations
- Site-specific chemical analytical data vs. published data
- Comparability of background and release samples
- Background sampling locations

SI Guidance, Chapter 4.41

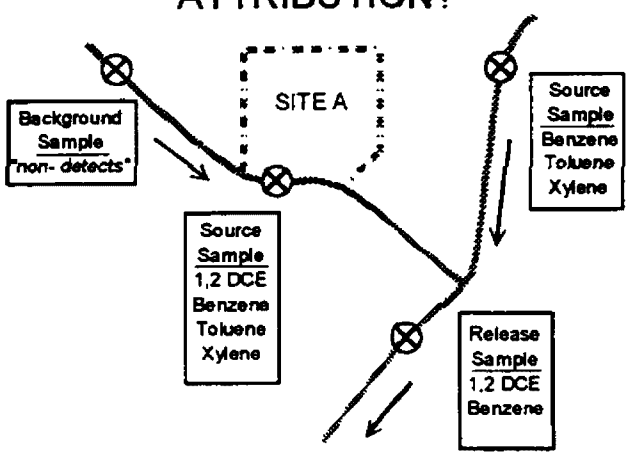
DEMONSTRATING A RELEASE BY SAMPLING: ATTRIBUTION

Considerations:

- *Some portion of the release must be* attributable to one or more sources
- Can use a unique hazardous substance from a site to differentiate it from other sites
- May be addressed by source characterization
- Age of site
- Transformation products

SI Guidance, Chapter 4.41

ATTRIBUTION?



DEMONSTRATING A RELEASE BY SAMPLING: TARGETS

Evaluate target factors:

- Nearest individual
- Population
- Sensitive environments, including wetlands

Evaluate on the basis of:

- Actual contamination (Primary Targets)
- Potential contamination (Secondary Targets)

SI Guidance, Chapter 4.4.1

DEMONSTRATING ACTUAL CONTAMINATION

- Must first demonstrate observed release
- Targets exposed to concentrations meeting observed release criteria are evaluated as actual contamination

(download from www.epa.gov/superfund/resources/scdm)

SI Guidance, Chapter 4.4.1

DEMONSTRATING ACTUAL CONTAMINATION (cont.)

- Two degrees of actual contamination
  - Level I = concentration ≥ applicable benchmark(s)*
  - Level II = concentration < applicable benchmark(s)*
- Use benchmark that provides highest score

* See Superfund Chemical Data Matrix (SCDM)

(download from www.epa.gov/superfund/resources/scdm)

SI Guidance, Chapter 4.4.1

ACTUAL CONTAMINATION?

CONCENTRATIONS (in μg/L)

ANALYTE	SITE	BACKGROUND	INTAKE	BENCHMARK
COMPOUND X	25	5U	20	15

U = nondetect

Numerical value is the method detection limit (MDL) in micrograms per liter (μg/L). Therefore, Compound X was not detected in the background sample at a concentration ≥ 5 μg/L.

HRS SAMPLING CONSIDERATIONS: WHAT ARE BENCHMARKS?

- Health or ecological-based reference concentrations that reflect relative risk (for example, cancer)
- Media and threat-specific
- Any threat may involve more than one benchmark

Benchmarks are presented in Table 3-6, Media-specific Benchmarks, SI Guidance, Page 23

SI Guidance, Section 3.3

HRS SAMPLING CONSIDERATIONS: WHAT ARE BENCHMARKS? (cont.)

- Found in look-up table (for example, Superfund Chemical Data Matrix {SCDM})
- Default to Level II if a sample meets observed release criteria, no benchmark applies

Benchmarks are presented in Table 3-6, Media-specific Benchmarks, SI Guidance, Page 23

SI Guidance, Section 3.3

TABLE 3-6: MEDIA-SPECIFIC BENCHMARKS

HRS PATHWAY/THREAT	BENCHMARKS[1]
Groundwater	Maximum Contaminant Levels Maximum Contaminant Level Goals Screening Concentrations[2,3]
Surface Water Drinking-water Threat	Maximum Contaminant Levels Maximum Contaminant Level Goals Screening Concentrations[2,3]
Drinking-water Threat	Food and Drug Administration Action Levels Screening Concentrations[2,3]
Environmental Threat	Ambient Water Quality Criteria Ambient Aquatic Life Advisory Concentrations
Groundwater	Screening Concentrations[2,3]
Air	National Ambient Air Quality Standards National Emmissions Standards for Hazardous Air Pollutants Screening Concentrations[2,3]

[1] See Superfund Chemical Data Matrix (SCDM)
[2] Screening concentrations for cancer corresponding to concentrations for the 10^{-6} individual cancer risk for oral exposure (inhalation exposure for the air pathway)
[3] Screening concentration for noncancer toxicological responses corresponding to RFDs for oral exposure (inhalation exposure for the air pathway)

* If more than one benchmark exists, use lower value.

SCDM--Download from: www.epa.gov/superfund/resources/scdm

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

SUPERFUND CHEMICAL DATA MATRIX (SCDM):

A source for *factor values and benchmark values* applied when evaluating potential National Priority List (NPL) sites using the Hazard Ranking System (HRS). Factor values are part of the HRS mathematical equation for determining the relative threat posed by a hazardous waste site and reflect hazardous substance characteristics such as:

- Toxicity
- Persistence
- Mobility
- Potential for Bioaccumulation

EPA web site:www.epa.gov/superfund/resources/scdm

SI SAMPLING PRINCIPLES

Collect analytical data to test PA hypotheses

- Identify hazardous substances present
- Determine waste quantity
- Determine whether a release has occurred
- Determine impact on targets

Determine need for further investigations

SI Guidance, Chapter 4.1.2

SI SAMPLING CONSIDERATIONS

- Concentrate on samples in major pathways that affect the score
- Use previous analytical data or published data*
- Limit collection of background and QA/QC samples

**Subject to data review and evaluation*

SI Guidance, Chapter 4 1 2

EXPANDED AND SINGLE SI SAMPLING PRINCIPLES

Collect fully documented data to prepare HRS package

- Document observed releases (GW, SW, Air)
- Document observed contamination (Soil exposure only)
- Determine waste quantity
- Document levels of target exposure

Collect field data for the RI when appropriate

Conduct field activities beyond the scope of focused SI

Turn to SI Guidance, Section 4.1.3, Page 49, for a list of expanded SI activities

SI Guidance, Chapter 4.1.3

EXPANDED AND SINGLE SI CONSIDERATIONS

- Collect samples to improve documentation for factors that significantly affect scoring
- Collect adequate background and QA/QC samples

SI Guidance, Chapter 4.1.3

TABLE 4-3: PRIORITIES FOR EXPANDED SI SAMPLES

SAMPLE CRITERIA	PRIORITIES
Number of pathways sampled	Sample pathways critical to site source. If multiple pathways are critical to site score, sample to fully document all remaining site hypotheses.
Number of targets sampled	Sample targets (e.g., drinking-water wells and intakes, residential and school properties, surface water sensitive environments, and wetlands) most likely to be exposed to site-related contamination. Resample targets where previous analytical results are questionable or where background concentrations are needed to document contamination of targets.
Number of sources sampled	Sample sources to attribute hazardous substances to site. Sample to more fully describe areas of observed surficial contamination. If multiple source types exist at site, at a minimum, sample each different source type.
Number of release samples	Sample to document a release for critical pathways. When possible, collect samples to document an observed release in conjunction with a target exposed to actual contamination. Limit number of release samples to critical pathways.
Number of background and QA/QC samples	Collect background and QA/QC samples necessary to confidently document site score.
Other criteria	Use previous analytical data to optimize sample locations. Do not resample at locations where reliable previous analytical data documented a hazardous substance or a release, unless samples are needed to pair those with background samples taken at the same time.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

SAMPLING STRATEGIES: CONCLUSIONS

The key to any successful SI: SAMPLE SMART

- Conserve resources
- Set sampling priorities
- Emphasize dual-purpose sampling
- Use previous analytical data to augment scope

SAMPLING STRATEGIES: CONCLUSIONS (cont.)

The key to any successful SI: SAMPLE SMART (cont.)

- Tailor sampling to meet SI objectives/use screening sample methods
- Consider HRS math when planning samples
  - Focus on major pathway(s)
  - Focus on critical HRS factors

SOURCE DEFINITION

An area where hazardous substances may have been deposited, stored, disposed of, or placed. Also, soil that may have become contaminated as a result of hazardous substance migration. But not volumes of air, groundwater, surface water, or sediment that have become contaminated through migration.

SI Guidance, Glossary, Page 121

BASIC PRINCIPLES

Sample to confirm or refute contamination at site

Sample to characterize sources

- Identify hazardous substances present
- Support determination of waste characteristics – waste quantity, toxicity, mobility
- Support attribution to site activities/operations

SI Guidance, Section 4.2

SOURCE CHARACTERIZATION GUIDELINES

Biased sampling:

- Sample where wastes are likely to collect or be concentrated
- Collect background sample for selected sources (for example, contaminated soil)
- Use composite samples carefully

SI Guidance, Chapter 4.1.3

MINI EXERCISE:

WHAT ARE THE SOURCES? WHAT KIND OF SAMPLES?

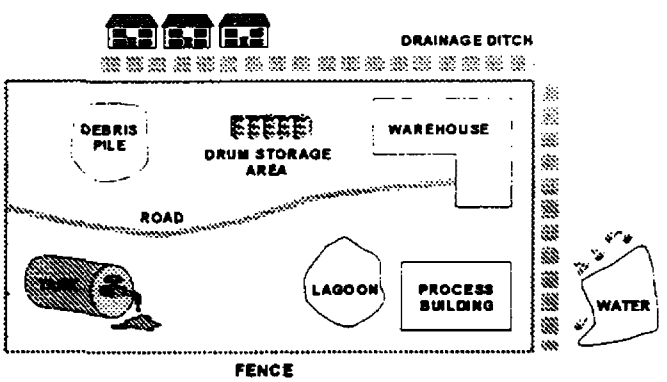


TABLE 4-4: SOURCE SAMPLING STRATEGIES

CRITERION	EXPANDED SI AND SINGLE SI
Primary objective	To verify inconclusive data collected during focused SI. In limited situations, to help quantify hazardous waste quantity.
Samples to help demonstrate observed contamination	Samples to further describe the area of observed contamination in the direction of targets for the soil exposure pathway.
Samples to help evaluate source containment or source type	Generally only collected when the containment factor value for a migration pathway is not 10; sometimes collected to demonstrate a biogas release if air pathway is significant pathway.
Samples to help describe source boundaries and estimate hazardous waste quantity	In certain situations, samples to estimate the depth of a source or to further describe the area of sources other than contaminated soil (e.g., landfill, land treatment, buried surface impoundment). In certain situations, samples to estimate hazardous constituent quantity or hazardous waste volume quantity.

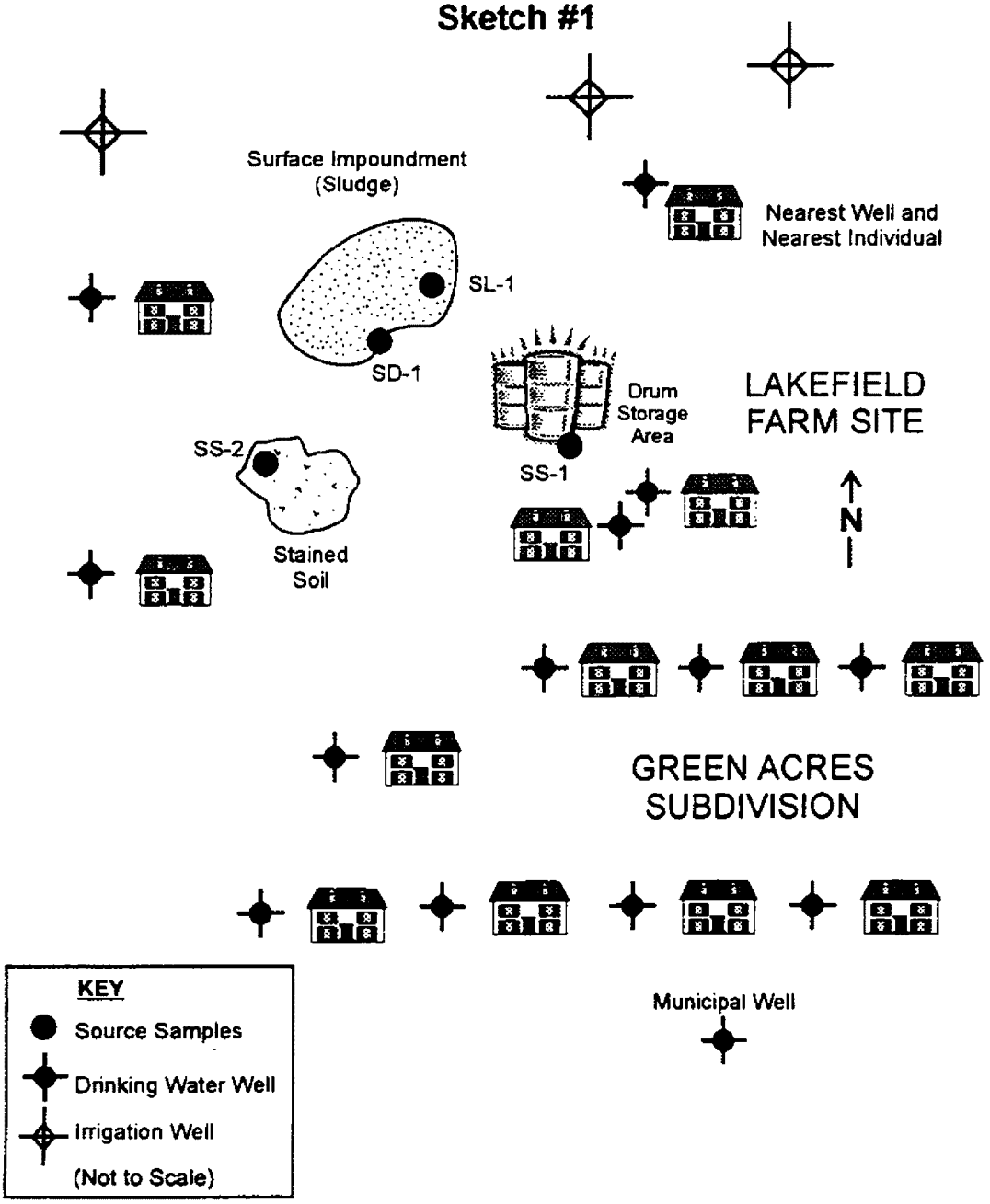
Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992 (modified)

CASE STUDY:

EXAMPLES OF SOURCE SAMPLING STRATEGY

Located near a town of 10,000 people, the Lakefield Farm Site is an abandoned strawberry farm that was used for various types of waste activities for an unknown period (see Lakefield Farm Site Sketch #1). During the preliminary assessment, three potential sources were identified: a wet surface impoundment with a volume of approximately 45,000 cubic feet of electroplating sludge; a drum storage area containing about 30 leaking drums (contents unknown) at the southeast corner of the site; and an area of stained soil near the site's western boundary.

LAKEFIELD FARM SITE
Sketch #1



SOURCE SAMPLING STRATEGY FOR EXAMPLE SITE

POTENTIAL WASTE SOURCE AREA	SI SAMPLING STRATEGY	HRS CONSIDERATIONS	NONSAMPLING DATA COLLECTION
Wet Surface Impoundment	Collect one composite source sample of impoundment sediments (SD-1) plus one sludge sample (SL-1) to evaluate hazardous substances present.	More than 675,000 cubic feet is needed to increase HWQ factor to next category value.	Obtain physical dimensions of source: evaluate containment, consider using aerial photographs.
Drum Storage Area	Collect one composite surficial soil sample (SS-1) adjacent to drums to determine hazardous substances present.	More than 1,000 drums are needed to increase HWQ factor value to next category value.	Verify number of drums, evaluate containment, look for container markings and examine area around drums.
Stained Soil	Collect one composite surficial soil sample (SS-2) to determine whether area is contaminated and to identify hazardous substances.	More than 78 acres of contaminated soil are needed to increase HWQ factor value to next category.	Obtain physical dimensions or area, evaluate containment.

SOURCE SAMPLING EXERCISE: ACME MANUFACTURING COMPANY

OBJECTIVE

Using available site information, develop a source sampling strategy, implementing procedures established in the SI guidance manual.

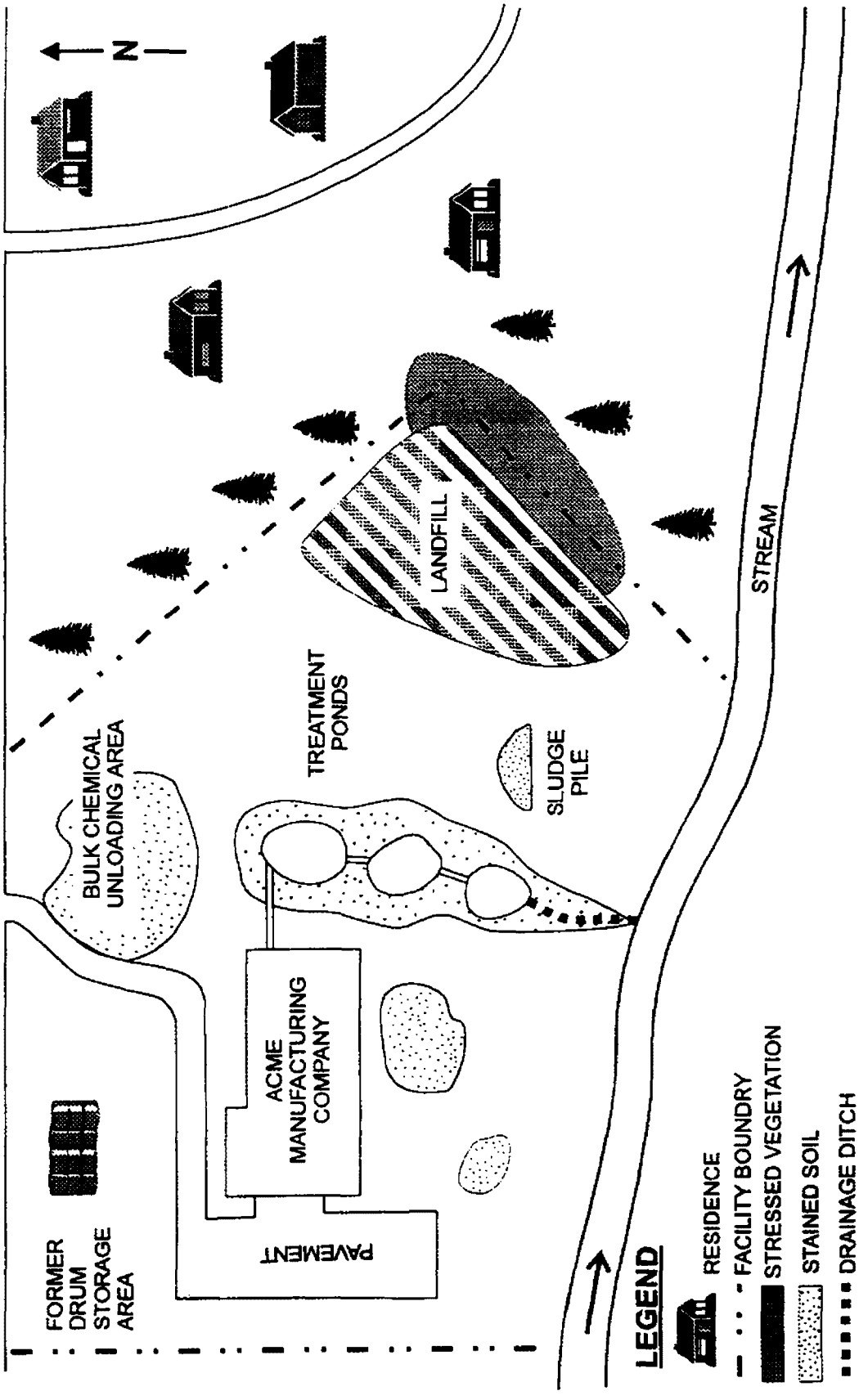
METHOD

1. Review the general site information provided below.
2. Identify site sources on the map.
3. Develop a source sampling strategy that includes source characterization, background determination, and collection of quality control samples. You are limited to 20 samples. You do not need to use all available samples.
4. Record your sampling strategy on the table provided.

GENERAL SITE INFORMATION:

- The ACME Manufacturing Company site is an inactive electroplating facility. The total acreage is about 10 acres (see site map).
- Rinse water from the electroplating process was discharged to treatment ponds from 1907 until 1995.
- Drums, which were located in the former drum storage area found on the northwestern corner of the facility property, are believed to have contained waste solvents. They were held there prior to offsite removal.
- Stained soil was observed adjacent to the bulk chemical unloading area and manufacturing building.
- The waste pile appears to be dried sludge from the treatment ponds.
- The landfill reportedly received "off-spec" products, spent solvents, and treatment pond sludge.
- Leachate seeps and stained soil were observed along the southeast corner of the landfill with stressed vegetation extending beyond the facility boundary.

SOURCE SAMPLING EXERCISE



SOURCE SAMPLING EXERCISE:
SITE NAME: ACME MANUFACTURING COMPANY

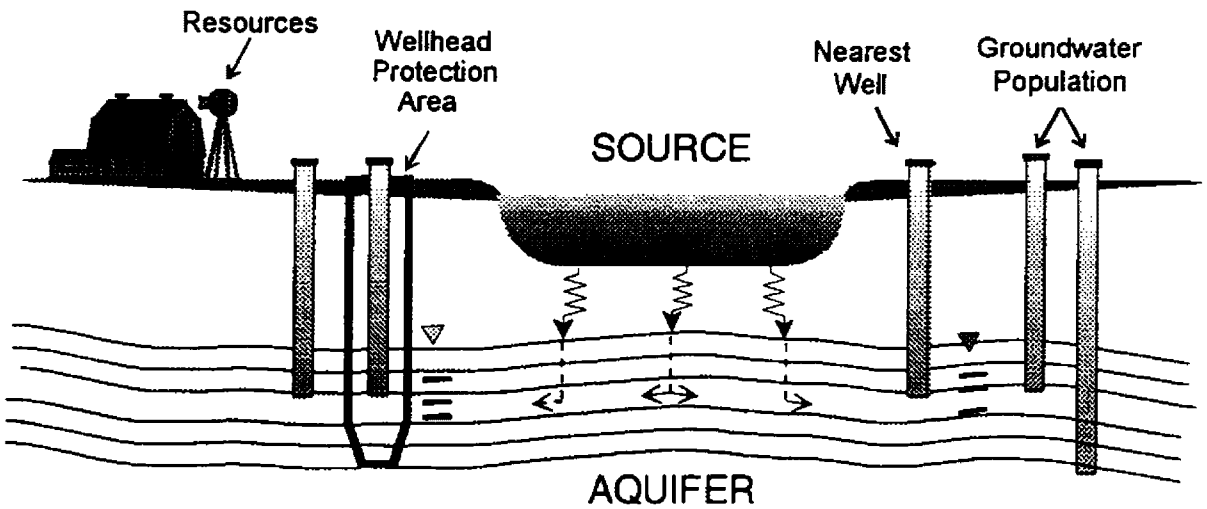
SAMPLE ID#	SAMPLE TYPE AQUEOUS//NON AQUEOUS	RATIONALE

Total Samples:

Special Sampling Considerations:

SECTION FOUR

GROUNDWATER PATHWAY



GROUNDWATER PATHWAY

Basis for pathway score

- Number of people served by drinking-water wells within aquifer(s) of concern
- Likelihood of release to each aquifer
- Likelihood that drinking-water wells are contaminated by site

SI Guidance, Section 4.5

GROUND WATER PATHWAY: REVIEW PA INFORMATION

Determine whether major pathway of concern is based on:

- Suspected release
- Primary targets
- Number of secondary targets
- Characteristics of waste

GROUNDWATER PATHWAY: REVIEW PA INFORMATION (cont.)

Has contamination already been demonstrated?

- Visual observation of the source
- Previous sampling
- Reports of suspected release
- Number of secondary targets

GROUNDWATER PATHWAY: REVIEW PA INFORMATION (cont.)

- Identify specific information concerning primary targets
  - Type of well/population served
  - Distance from outer boundaries of sources
  - Depth of screened interval

GROUNDWATER PATHWAY: REVIEW PA INFORMATION (cont.)

- Identify wellhead protection areas
- Identify relevant hydrogeological information
- Identify potentially affected resources
- Where do you expect hazardous substances to be found? Sinkers (DNAPLs) vs. floaters (LNAPLs).

DNAPL = Dense non-aqueous phase liquid (i.e., tetrachloroethene)
LNAPL = Light non-aqueous phase liquid (i.e., gasoline, #2 fuel oil)

GROUNDWATER PATHWAY

Compile existing analytical and nonsampling information

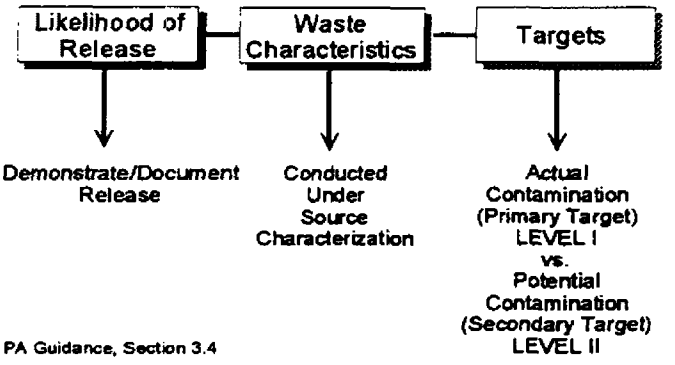
SI data summary document can be used to:

- Summarize existing information
- Identify factors not fully evaluated
- Focus additional data collection efforts

Go to SI Guidance, Appendix B, SI Data Summary, Page B-11 to B-11

SI Guidance, Appendix B

GROUNDWATER PATHWAY: HRS CONSIDERATIONS



PA Guidance, Section 3.4

GROUNDWATER PATHWAY: LIKELIHOOD OF RELEASE

Document an observed release by:

- Direct observation (injection well)
- Chemical analysis

Chemical analysis is preferred

SI Guidance, Section 4.5

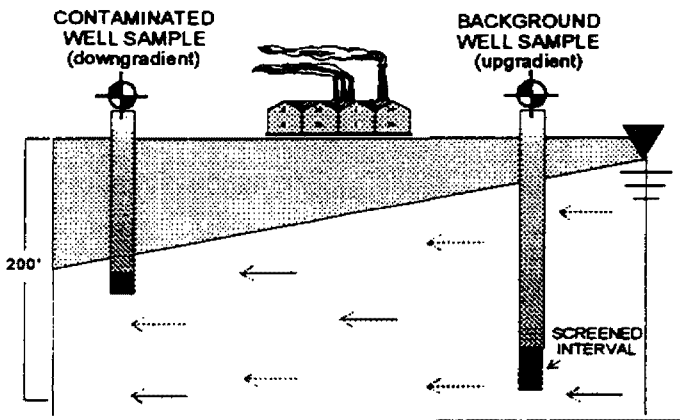
GROUNDWATER PATHWAY: LIKELIHOOD OF RELEASE (cont.)

- At least two groundwater samples are needed to document an observed release
  - Background sample (upgradient with respect to direction of groundwater flow and site sources)
  - Release sample (downgradient with respect to site sources, background sample, and groundwater flow direction)

GROUNDWATER PATHWAY: LIKELIHOOD OF RELEASE (cont.)

- Well samples should be from same aquifer and comparable screened intervals
- Wells should be of similar construction

GROUNDWATER PATHWAY: LIKELIHOOD OF RELEASE/OBSERVED RELEASE ?



GROUNDWATER PATHWAY: LIKELIHOOD OF RELEASE (cont.)

- Sample nearest well expected to be contaminated
- Background well should be out of influence of site and upgradient
- Sample both wells within the same sampling period (1-3 days)
- Samples should be similar
  - Sample analyses
  - Filtered or unfiltered

SI Guidance, Section 4.5

GROUNDWATER PATHWAY: TARGETS

- PA primary targets are sampled at SI to establish "actual contamination"
- PA secondary targets at SI become "potential contamination"

GROUNDWATER PATHWAY: TARGET DISTANCE LIMIT

- The Target Distance Limit (TDL) is 4 miles
- Can be extended if we have an Observed Release
- If a groundwater plume is the site source, begin measuring the 4-mile TDL from the center of the plume

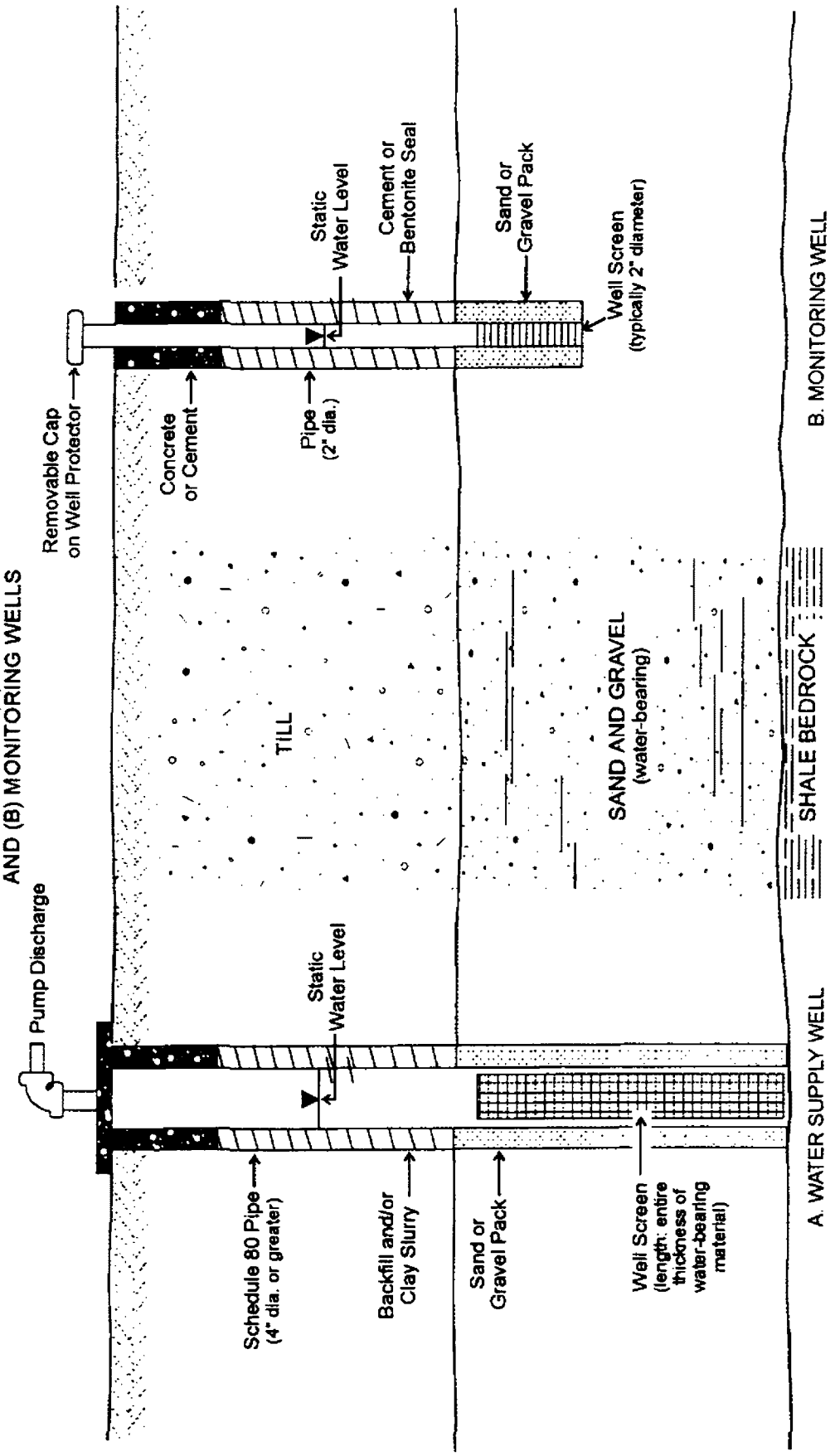
HRS Rule, Section 3.0.1.1, Page 51595

GROUNDWATER PATHWAY: AQUIFER EVALUATION

- Evaluate aquifers separately
- If aquifer interconnections occur within 4 miles of the source, you may combine aquifers
- If aquifer discontinuities exist within 4 miles, only score based on populations before the discontinuity
- The discontinuity must entirely transect the aquifer to be considered

HRS Rule, Section 3.0.1.2, Page 51595

EXHIBIT 8.5 -1
TYPICAL INSTALLATIONS OF (A) WATER SUPPLY WELLS AND (B) MONITORING WELLS



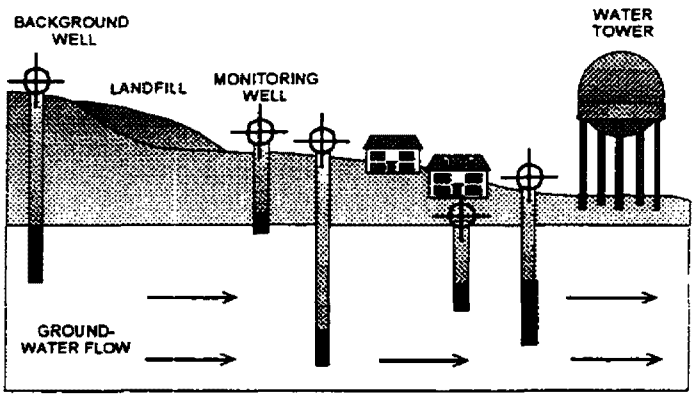
SOURCE: A Compendium of Superfund Field Operations Methods USEPA - OSWER Directive 9355.0 -14

GROUNDWATER PATHWAY: TARGETS

- Groundwater pathway targets
  - Municipal drinking-water wells
  - Private drinking-water wells
  - Public drinking-water wells
- Always sample nearest target well
- Attempt to sample all primary targets
- Cannot infer contamination between wells for actual contamination

SI Guidance, Section 4.5

GROUNDWATER PATHWAY: GROUNDWATER SAMPLING CONSIDERATIONS– WHAT ARE TARGETS?



GROUNDWATER SAMPLING

TYPE OF WELL	USE FOR BACKGROUND	GET AN OBSERVED RELEASE	ACTUAL CONTAMINATION
MONITORING			
PRIVATE			
MUNICIPAL			
INDUSTRIAL			
IRRIGATION			
STANDYBY *			

* Must be maintained, used once-a-year for a 24-hour period.

GROUNDWATER PATHWAY: SI STRATEGY–RELEASE

If PA hypothesized release to groundwater

- Sample to test hypotheses
- Sample nearest drinking-water well

SI Guidance, Section 4.5.1

GROUNDWATER PATHWAY: SI STRATEGY–RELEASE (cont.)

- Background wells may not be available
- Wells near source(s) may not exist
- Installing monitoring wells are an expanded SI activity

Can use other sources to establish background, if necessary

SI Guidance, Section 4.5.1

GROUNDWATER PATHWAY: SI STRATEGY–TARGETS

- Not every primary target well must be sampled
- Sample wells where detection of hazardous substances is likely
- Sample critical well locations with substantial populations
- Target well = drinking-water well
- Background well = any type of well
- Some wells can serve as their own background wells if continuous monitoring data are available

SI Guidance, Section 4.5.1

GROUNDWATER PATHWAY: SI STRATEGY– ACTUAL CONTAMINATION

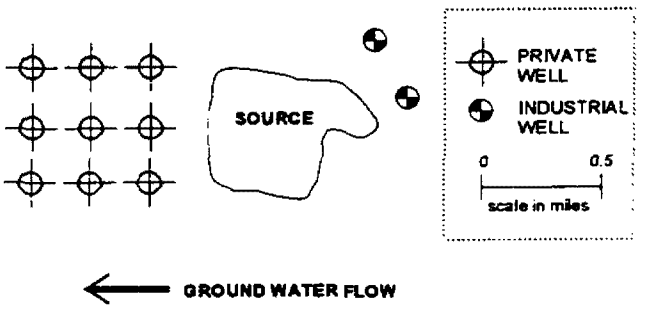
If "actual contamination" is hypothesized

- Drinking-water wells should be sampled
- *If all wells cannot be sampled, sample* nearby and municipal wells
- Sample remaining wells during expanded SI

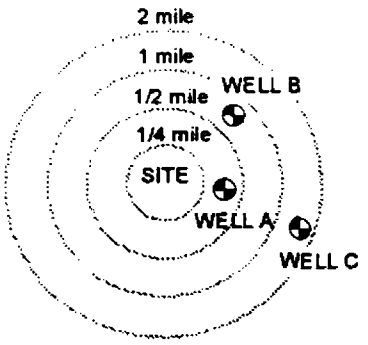
Can use samples from target wells to demonstrate observed release and actual contamination

SI Guidance, Section 4.5.1

WHICH WELLS SHOULD BE SAMPLED TO TEST FOR ACTUAL CONTAMINATION?



GROUNDWATER PATHWAY: SI STRATEGY – BLENDED SYSTEM



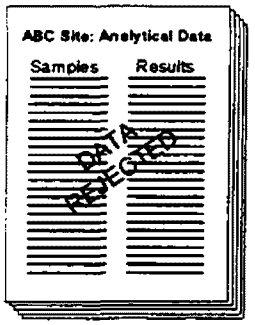
Wells A, B and C are part of a blended system. Which wells should be sampled?

SI Guidance, Section 4.5.1

EXPANDED SI AND SINGLE SI STRATEGY

Review existing analytical data from wells in the vicinity of the site

- Check for abnormalities
- Determine need for resampling
- Is data of CLP or comparable quality?



SI Guidance, Section 4.5.2

EXPANDED SI AND SINGLE SI ACTIVITY: DOCUMENT OBSERVED RELEASE

- Resample wells as needed
- Sample wells not tested during single SI
- Collect background samples
- Install monitoring wells
- Collect QA/QC samples

EXPANDED SI AND SINGLE SI ACTIVITY: GROUND WATER TARGET SAMPLING CONSIDERATIONS

- "Actual contamination" requires an observed release, attribution, and presence of hazardous substance at target
- Collect QA/QC samples
- Base well selection on ground water flow direction
- Background well should be upgradient or at least outside of the influence of sources
- Focus on targets

SI Guidance, Section 4.5.2

EXPANDED SI AND SINGLE SI ACTIVITY: MONITORING WELL INSTALLATION

- Done only on sites expected to score because of observed release
- May not be necessary if groundwater pathway is not critical to overall site score

SI Guidance, Section 4.5.2

GROUNDWATER PATHWAY

- After sampling and analysis have been completed, compile new information
- Complete SI data summary sheets pertaining to groundwater

Go to SI Guidance, Appendix B, SI Data Summary

TABLE 4-8: GROUNDWATER SAMPLING STRATEGIES

CRITERION	EXPANDED SI AND SINGLE SI
Primary objective	To demonstrate a release based on HRS documentation requirements. To demonstrate targets exposed to actual contamination and determine levels of exposure.
Average number of samples	0 to 14 based on HRS documentation requirements.
Types of activities	Resample existing wells if previous data did not conclusively demonstrate a release or targets exposed to actual contamination. Sample wells not yet sampled. Collect multiple samples from drinking-water wells where hazardous substance concentrations are likely to be near benchmarks. Install monitoring wells as needed.
Background samples	2 background per 3 release samples. Install background monitoring wells, if necessary. Generally should not rely on published data.
Attribution samples	Those necessary to attribute a share of a release to the site.
QA/QC samples	Those necessary to obtain precise and accurate data.

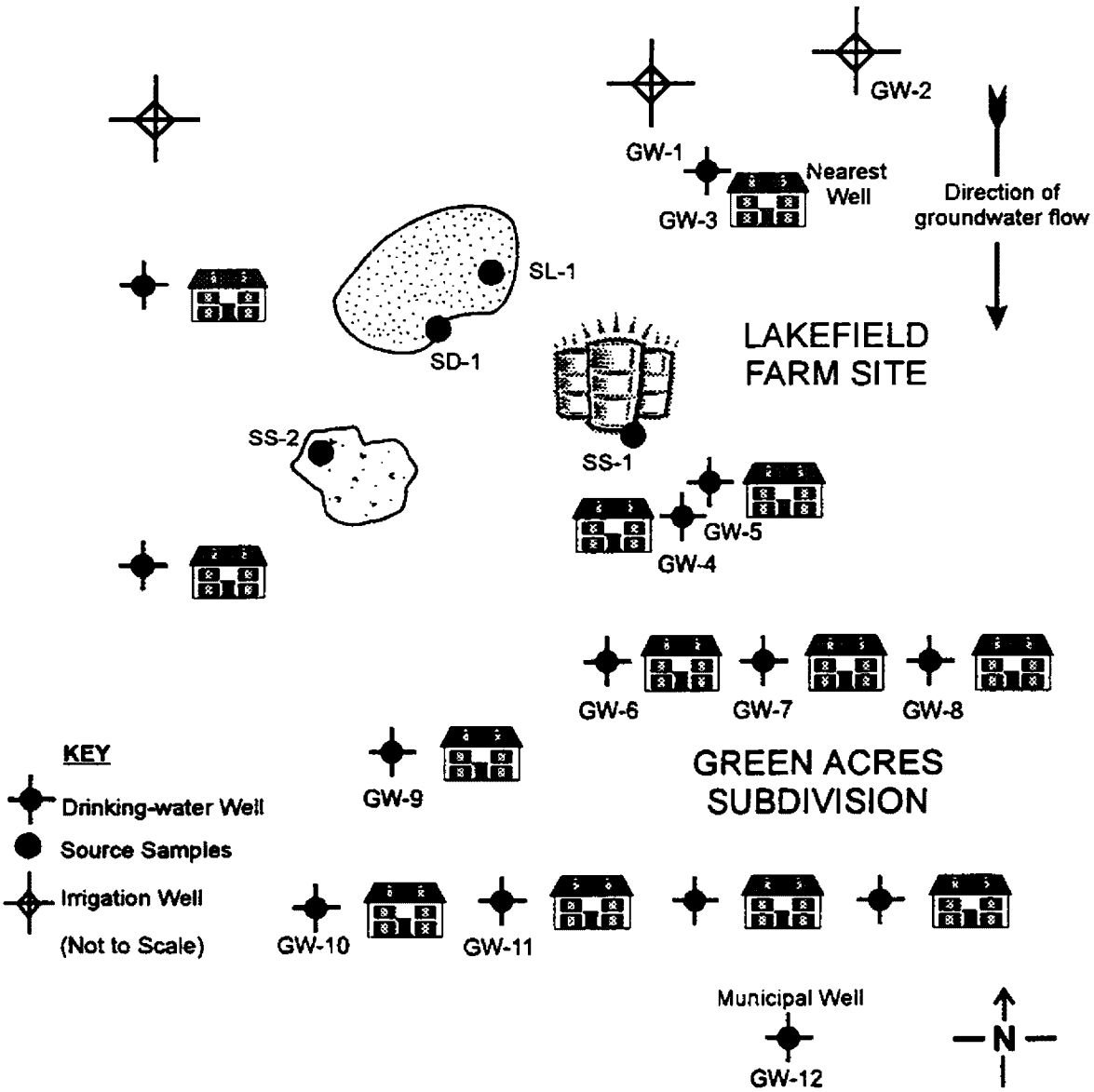
Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992 (modified)

CASE STUDY:

EXAMPLES OF SOURCE SAMPLING STRATEGY

During the PA it was determined that residents near the Lakefield Farm Site rely on shallow domestic wells for drinking water (see Lakefield Farm Site Sketch #2). A municipal well that provides drinking water to about 10,000 people is located 0.5 miles southeast of the site. The municipal well and several nearby irrigation wells are screened in the deep aquifer, which appears to be interconnected with the shallow aquifer. The PA identified the primary targets as all domestic wells within 0.25 miles of the site and the municipal well. The PA indicated groundwater flows to the south. Several domestic wells appear to be downgradient from the site.

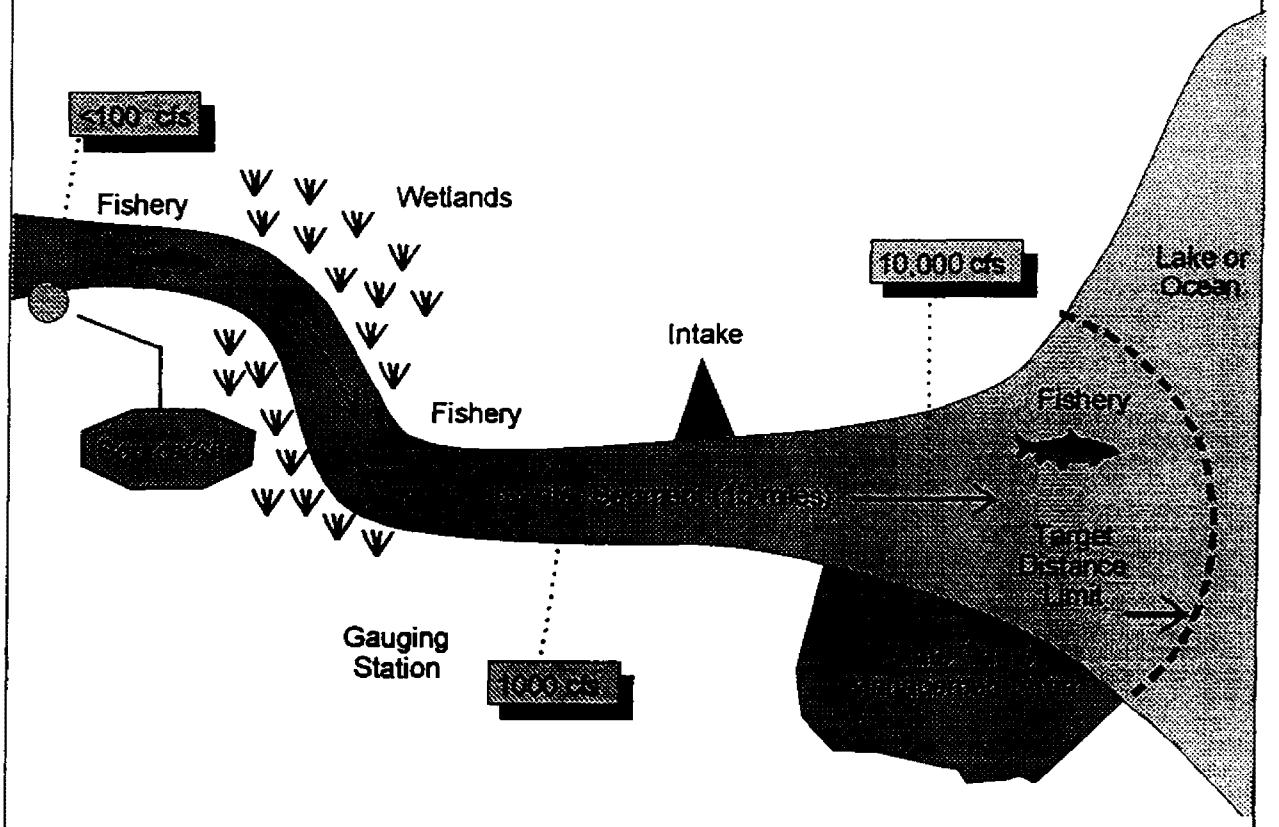
LAKEFIELD FARM SITE
Sketch #2



GROUND WATER SAMPLING STRATEGY FOR EXAMPLE SITE

SAMPLES	SAMPLING STRATEGY	HRS CONSIDERATIONS	NONSAMPLING DATA COLLECTION
Municipal well (GW-12)	Collect sample prior to treatment, sample to document contamination, identify hazardous substances, and determine level of contamination.	Determine municipal well contamination, which is critical to protecting public health and the screening decision.	Verify aquifer from which well draws; verify population served.
Domestic wells (GW-3, GW-4, GW-5, GW-6, GW-7, GW-8, GW-9, GW-10, GW-11	Sample nearest domestic drinking-water wells suspected of exposure to contamination.	Determine domestic well contamination, which is critical to protecting public health and the screening decision.	Verify aquifer from which wells draw; verify population served.
Background (GW-1, GW-2)	Sample drinking-water aquifer; limit number of background samples.	Sample to determine concentrations of hazardous substances.	Verify aquifer from which well draws.
Sources (SD-1, SL-1, SS-1, SS-2)	Collect grab or composite soil samples to identify hazardous substances present at site.	Do not sample to increase hazardous waste quantity (amounts are not close to HWQ factor value breakpoints).	Obtain physical dimensions of surface impoundment and estimate area of contaminated soil; verify number of drums and look for drum labels.
Sources (SD-1, SL-1, SS-1, SS-2)	Monitor sample collection and decontamination procedures; one rinsate and one field blank.		

SURFACE WATER PATHWAY



SURFACE WATER PATHWAY

- Likelihood of release to surface water body
- Likelihood that surface water body is contaminated by the site
- Number of people exposed to contaminated drinking water or contaminated food items
- Sensitive environments exposed to contaminated water
- Resources

SI Guidance, Section 4.6

SURFACE WATER PATHWAY (cont.)

Key Factor: If there are no surface waters within 2 miles of the site, the surface water pathway need not be evaluated.

SI Guidance, Section 4.6

SURFACE WATER PATHWAY CLASSIFICATIONS

- Rivers
  - Perennially flowing waters and man-made ditches, intermittent flowing water and man-made ditches in arid/semi arid areas (<20" mean annual precipitation)
- Lakes
  - Natural and man-made, static water channels or oxbow lakes and wetlands

See: //usgs.gov
See: HRS 4.0.2 Surface Water Catagories

SURFACE WATER PATHWAY CLASSIFICATIONS (cont.)

- Oceans
  - Territorial Sea; Great Lakes and contiguous wetlands
- Coastal Tidal Waters
  - Harbors, sounds, estuaries, lagoons, wetlands, etc.

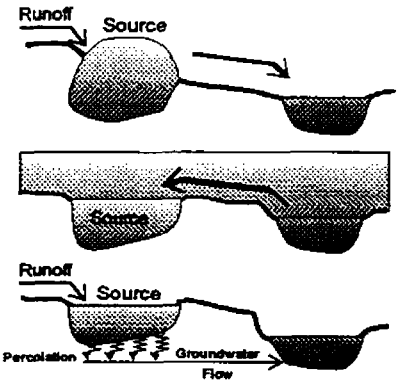
See: //usgs.gov
See: HRS 4.0.2 Surface Water Catagories

HOW CONTAMINANTS REACH SURFACE WATER

Overland flow

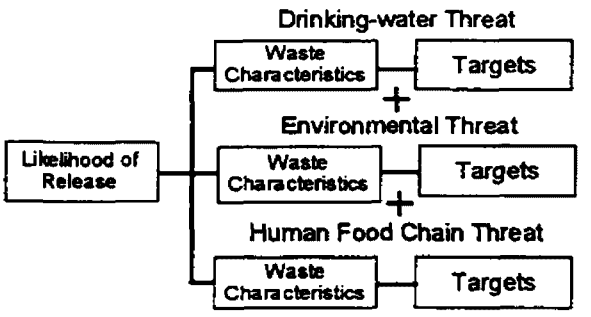
Flood

Groundwater discharge to surface water



SI Guidance, Section 4.6

SURFACE WATER ASSESSMENT



SURFACE WATER PATHWAY INVESTIGATION

Complete the SI Data Summary Surface Water section using available data

See SI Guidance, Appendix B, Surface Water Information Section, Pages B-12 through B-15

SI Guidance, Appendix B

REVIEW PA INFORMATION

Determine whether major pathway of concern is based on:

- Suspected release
- Primary targets exposed to hazardous substances
- Number of secondary targets not suspected to be exposed

SI Guidance, Section 4.6

REVIEW PA INFORMATION (cont.)

Identify physical characteristics of surface water migration route

- Is overland segment greater than 2 miles?
- Are there multiple watersheds?
- Location of Probable Points of Entry (PPE)
- Tidal influence
- Flow rate for each segment of migration path measured in cubic feet per second (cfs)

SI Guidance, Section 4.6

REVIEW PA INFORMATION (cont.)

Identify locations of primary targets on topographic map

- Drinking-water intakes
- Fisheries
- Wetlands and other sensitive environments
- Resources

See: www.fws.gov (U.S. Fish and Wildlife Service)
www.nwi.fws.gov (Wetland Inventory)

SI Guidance, Section 4.6

SURFACE WATER SAMPLING CONSIDERATIONS

- Are sources actively discharging contamination to surface water?
- How old is the site?
- What are surface water flow characteristics?
- What are the chemical properties of hazardous substances of concern (for example, persistence and bioaccumulation potential)?

See: //h2o.er.usgs.gov (Surface Water information)

SI Guidance, Section 4.6

SAMPLE TYPE CONSIDERATONS

Sediment, Aqueous, or Tissue

- Sediment samples typically detect contamination more often than other sample types
- Consider adding aqueous samples for intakes or sensitive environments (no benchmarks for sediments)
- Tissue samples are generally not recommended (use sessile benthic organisms)

SI Guidance, Section 4.6

LIKELIHOOD OF RELEASE: OBSERVED RELEASE BY DIRECT OBSERVATION

Hazardous substance seen entering or known to have been deposited into surface water bodies

- Sample effluent discharge, source runoff, or leachate (no background required)

or . . .

SI Guidance, Section 4.6

LIKELIHOOD OF RELEASE: OBSERVED RELEASE BY DIRECT OBSERVATION (cont.)

- Rely on existing analytical data indicating effluent contains hazardous substances prior to entering surface water
- Must sample discharge, runoff, or leachate to show they contain hazardous substance

SI Guidance, Section 4.6

LIKELIHOOD OF RELEASE: OBSERVED RELEASE BY DIRECT OBSERVATION (cont.)

Sources are flooded and sources are in direct contact with flood waters

- Must rely on historical "source" data and flood information
- No SI sampling necessary
- Use historical watermarks

See: www.fema.gov (Flood maps)

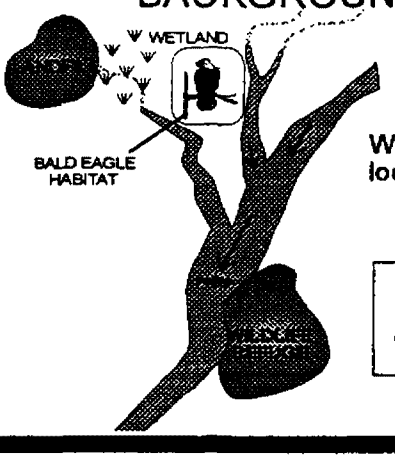
SI Guidance, Section 4.6

LIKELIHOOD OF RELEASE: OBSERVED RELEASE BY CHEMICAL ANALYSIS

- Minimum of two samples
  - One background sample upstream from PPE
  - Second sample at or reasonably close to PPE (downstream sample)
- If multiple PPEs present, sample each
- Background and release samples must be same type and from same or similar water body (same depth, sediment type)

SI Guidance, Section 4.6

SAMPLE TO ESTABLISH BACKGROUND



Where is the PPE; locate background samples

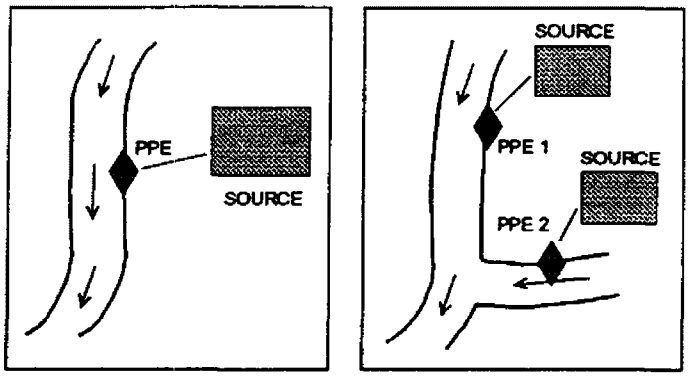
KEY
FLOW DIRECTION
INTERMITTENT STREA

LIKELIHOOD OF RELEASE: OBSERVED RELEASE BY CHEMICAL ANALYSIS (cont.)

- Comparable sampling and analytical procedures
- Collect most downstream samples first
- Collect aqueous samples before sediment samples at same location

SI Guidance, Section 4.6

SAMPLE TO TEST SUSPECTED RELEASE



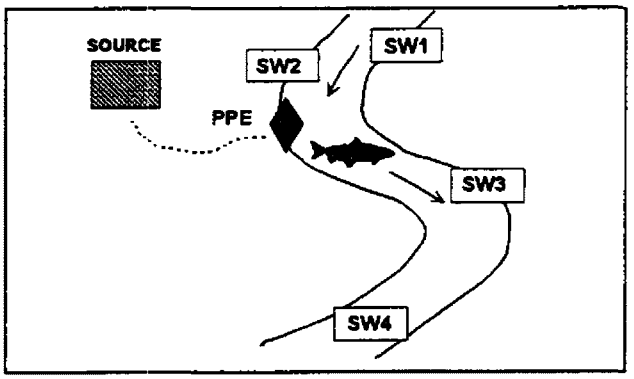
TARGETS

Sampling considerations for actual contamination

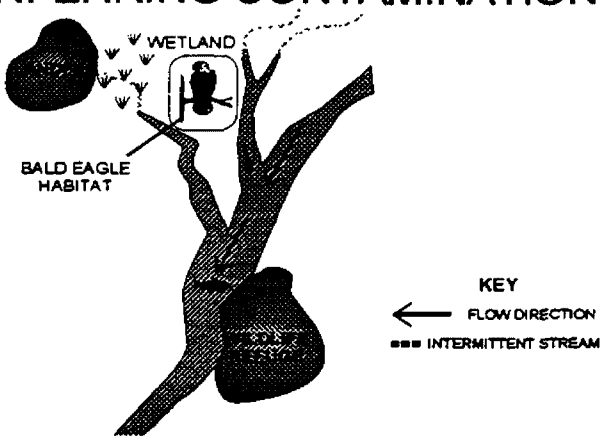
- Must establish observed release first
- Can infer contamination between "hits"
  - No need to sample each target
  - Can sample adjacent to or beyond (downstream of) target locations
- Sample for human health considerations, regardless of score
  - Always sample nearest drinking-water intake if contamination is suspected

SI Guidance, Section 4.6

TARGETS: INFERRING CONTAMINATION



INFERRING CONTAMINATION



TARGETS: DRINKING-WATER THREAT

To demonstrate actual contamination:

- Sample types to collect
  - Aqueous
  - Sediment
  - Sessile benthic
- Collect samples at or downstream of target (intake)
- Compare analytical results to benchmarks
- Only aqueous and tissue samples can be used to score Level I targets
- Level II can be established with any sample type

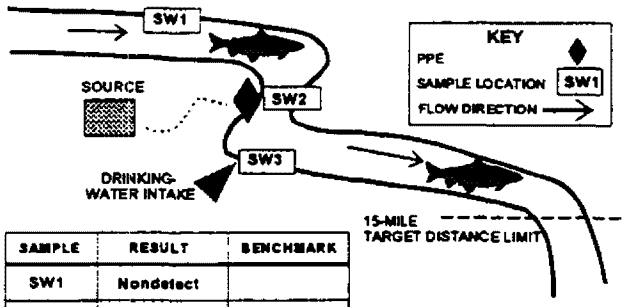
SI Guidance, Section 4.6

SURFACE WATER BENCHMARKS

SW THREAT	BENCHMARK	SAMPLE TYPE
DRINKING WATER	MCL MCLG Screening concentrations	Aqueous
ENVIRONMENTAL	AWQC AALAC	Aqueous
HUMAN FOOD CHAIN	FDAAL Screening concentrations	Tissue

SI Guidance, Section 4.6

ACTUAL CONTAMINATION? LEVEL OF CONTAMINATION?



SAMPLE	RESULT	BENCHMARK
SW1	Nondetect	
SW2	100 ppb	10 ppb
SW3	60 ppb	

TARGETS: HUMAN FOOD CHAIN THREAT

Demonstrate actual contamination

- Only attempt if this threat is essential to site score
- Use sediment samples (not organisms)
- Tissue sampling is expanded SI activity
- If fishery is closed for fishing, surface water sample can be used to establish threat
- Collect multiple samples to verify threat

TARGETS: HUMAN FOOD CHAIN THREAT (cont.)

Sampling considerations for actual contamination

- Observed release at target + bioaccumulation potential factor value (BPFV) considerations
- Sediment, aqueous, and effluent samples–require substance within BPFV≥500
- Tissue samples–no BPFV requirement
- Substance must be taken up by organism tissue

TARGETS: ENVIRONMENTAL THREAT

Determine actual contamination

- Only aqueous samples can be used to score Level I contamination
- Collect at or downstream of sensitive environment

SI Guidance, Section 4.6

TARGETS: ENVIRONMENTAL THREAT (cont.)

- For wetlands
  - Sample near PPE
  - Two samples from wetland (at least 0.1 miles apart, use wetland frontage)
- Collect unfiltered surface water for total metals

Sensitive environments for this pathway are found in PA Table 5 in the PA score sheets. Also see HRS Table 4-24 in 40 CFR Part 300, Appendix A.

SI Guidance, Section 4.6

PA TABLE 5: SURFACE WATER AND AIR PATHWAY SENSITIVE ENVIRONMENTS VALUES

Sensitive Environment	*Assigned Value*
Critical habitat for Federally designated endangered or threatened species Marine Sanctuary National Park Designated Federal Wilderness Area Ecologically important areas identified under the Coastal Zone Wilderness Act Sensitive Areas identified under the National Estuary Program or Near Coastal Water Program of the Clean Water Act Critical Areas identified under the Clean Lakes Program of the Clean Water Act (subareas in lakes or entire small lakes) National Monument (air pathway only) National Seashore Recreation Area National Lakeshore Recreation Area	100
Habitat known to be used by Federally designated or proposed endangered or threatened species National Preserve National or State Wildlife Refuge Unit of Coastal Barrier Resources System Federal land designated to the protection of natural ecosystems Administratively Proposed Federal Wilderness Area Spawning areas critical for the maintenance of fish/shellfish species within a river system, bay or estuary Migratory pathways and feeding areas critical for the maintenance of anadromous fish species in a river system Terrestrial areas utilized for breeding by large or dense aggregations of vertebrate animals (air pathway) or semiaquatic foragers (surface water pathway) National river reach designated as Recreational	75
Habitat known to be used by State designated endangered or threatened species Habitat known to be used by a species under review as to its Federal endangered or threatened status Coastal Barrier (partially developed) Federally designated Scenic or Wild River	50
State land designated for wildlife or game management State designated Scenic or Wild River State designated Natural Areas Particular areas, relatively small in size, important to maintenance of unique biotic communities	25
State designated areas for protection/maintenance of aquatic life under the Clean Water Act	5
Wetlands	See PA Table 6 (Surface Water Pathway) or PA Table 9 (Air Pathway)

PA TABLE 6: SURFACE WATER AND PATHWAY WETLAND FRONTAGE VALUES

Total Length of Wetlands	*Assigned Value*
Less than 0.1 mile	0
0.1 to 1 mile	25
Greater than 1 to 2 miles	50
Greater than 2 to 3 miles	75
Greater than 3 to 4 miles	100
Greater than 4 to 8 miles	150
Greater than 8 to 12 miles	250
Greater than 12 to 16 miles	350
Greater than 16 to 20 miles	450
Greater than 20 miles	500

EXPANDED AND SINGLE SI STRATEGY

- Determine whether aqueous samples are needed to demonstrate a release at intake or sensitive environment
- Collect surface water samples at targets that were not sampled earlier
- Sample to expand fishery and wetland boundaries if these are important

SI Guidance, Section 4.6

TABLE 4-10: SURFACE WATER SAMPLES TO SUPPORT A RELEASE AND TARGET CONTAMINATION

HRS Factors	Sediment[1]	Aqueous	Effluent[2]	Sessile Benthic Organisms	Non-sessile Benthic Organisms	Finfish Amphibians, and Reptiles
Observed release	Yes	Yes	Yes	Yes	No	No
Level I drinking water	No	Yes	No	No	No	No
Level II drinking water	Yes	Yes	Yes	Yes	No	No
Level I sensitive evironments	No	Yes	No	No	No	No
Level II sensitive evironments	Yes	Yes	Yes	Yes	No	No
Level I fisheries	No	No	No	Yes[3]	Yes[3,4]	Yes[3,4]
Level II fisheries	Yes[5]	Yes[5]	Yes[5]	Yes[3]	No	No

[1] No benchmarks available; evaluate as Level II contamination.
[2] Does not require comparison to background to document a release.
[3] Sample only tissues of edible species to evaluate human food chain level of contamination.
[4] Can be used to score Level I targets, but not an observed release; must be collected within boundaries of surface water contamination.
[5] Targets can be evaluated if hazardous substance has a bioaccumulation factor value of 500 or greater.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

SURFACE WATER SAMPLING STRATEGIES

Refer to:

- SI Guidance, Table 4-11, Surface Water Sampling Strategies, presents expanded and single SI sampling criteria and strategies
- Prior to sampling, carefully plot sample locations using information gathered during the site reconnaissance and the nonsampling investigation
- Photo document sample locations to aid in data evaluation and to resample locations if necessary

SI Guidance, Section 4.6.3; HRS Guidance Manual, Chapter 8

TABLE 4-11: SURFACE WATER SAMPLING STRATEGIES

CRITERION	EXPANDED SI AND SINGLE SI
Primary objective	To document a release based on HRS requirements. To document targets exposed to actual contamination and determine levels of exposure.
Average number of samples	0 to 14 based on HRS documentation requirements.
Types of activities	Resample surface water locations if previous data did not document a release or targets exposed to actual contamination. Sampled surface water targets not yet sampled, particularly sensitive environments and wetlands. Collect multiple aqueous samples from drinking-water intakes where hazardous substance concentrations are likely to be near surface water benchmarks.
Background samples	2 background per 3 release samples. Should not rely on published data.
Attribution samples	Those necessary to attribute a portion of a release to the site.
QA/QC samples	Those necessary to obtain precise and accurate data within the SI scope.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992 (modified)

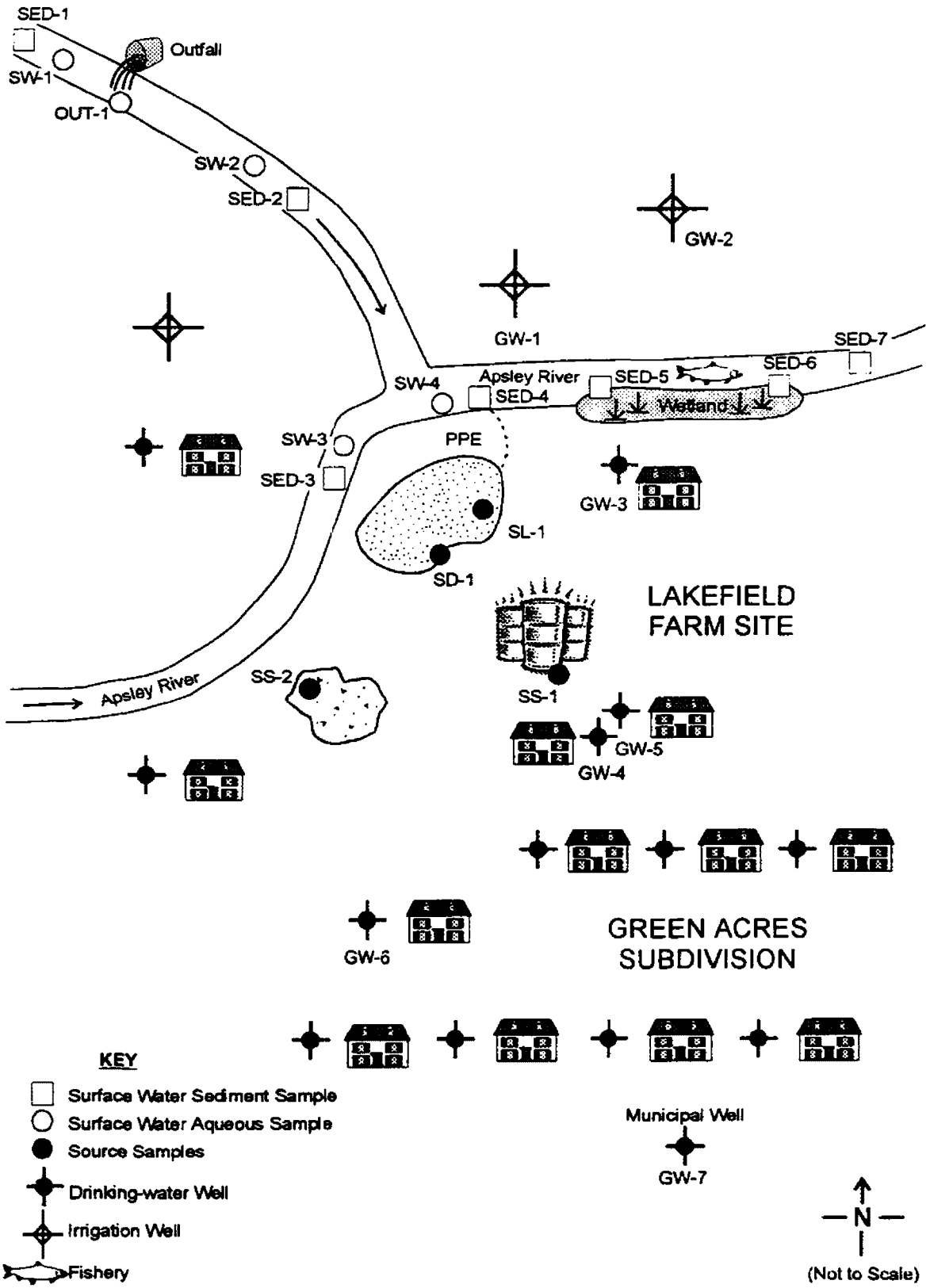
CASE STUDY:

EXAMPLES OF SURFACE WATER SAMPLING STRATEGY

Returning to the Lakefield Farm Site example, the site description now includes the Apsley River, a moderate-to-large water body (streamflow 900 cfs) approximately 200 feet north of the surface impoundment (see Lakefield Farm Site Sketch 3). A recreational fishery is located within the river, and a 10-acre wetland lies 1 mile downstream from the PPE. An unnamed creek flows into the Apsley River about 750 feet upstream of the PPE, and an outfall to this creek is 1 mile upstream of this confluence. During the PA, the investigator suspected a release to the Apsley River from the Lakefield Farm and a release to groundwater.

Because of significant threats to both groundwater and surface water and because attribution is a problem, an SI is planned with an expanded SI to be performed if necessary. SI sampling will test whether groundwater and surface water targets are exposed to contamination.

LAKEFIELD FARM SITE
Sketch #3



SURFACE AND GROUND WATER SAMPLING STRATEGY FOR EXAMPLE SITE

SAMPLES	APPROACH	RATIONALE	NONSAMPLING DATA COLLECTION
Municipal well (GW-7)	Sample drinking water prior to treatment; sample to document contamination, identify hazardous substances, and determine level of contamination.	Determining municipal well contamination, is critical to protecting public health and to the site screening decision.	Verify aquifer from which well draws; verify population served.
Domestic wells (GW-3 through GW-6)	Sample nearest domestic wells suspected of being exposed to actual contamination.	Determining municipal well contamination is critical to protecting public health and to the site screening decision.	Verify aquifer from which wells draw; verify population served.
Background for groundwater	Sample drinking-water aquifer; limit number of background samples.	Sample to determine concentrations of hazardous substances in ambient conditions.	Verify aquifer from which well draws.
Surface water target locations	Sample sediments to determine if contamination is present in the fishery (SED-4) or wetland (SED-5, SED-6).	Human food chain or sensitive environment contamination is vital to screening decision.	Verify linear footage of wetland exposed to actual contamination.
Background for surface water (SW-1, SED-1)	Limit number of background samples.	Sample to determine levels of hazardous substances.	Collect information about background sample location, including setting, flow, and physical characteristics (e.g., sediment grain size).
Sources (SD-1, SL-1, SS-1, SS-2)	Identify hazardous substances present at the site through composite samples.	Do not sample to increase hazardous waste quantity if amounts are not close to HWQ factor value breakpoints.	Obtain physical dimensions of surface impoundment and estimate area of contaminated soil; verify number of drums, and look for drum labels.
Quality control (Q-1 through Q-4) (Not shown)	Monitor collection and decontamination procedures; one rinsate for groundwater equipment, one rinsate for surface water equipment, one trip, and one field blank.		

SOURCE SAMPLING EXERCISE: R.R. ACME LANDFILL

OBJECTIVE

Using available site information, develop a single SI sampling strategy to test a PA hypothesis of suspected contamination of surface water.

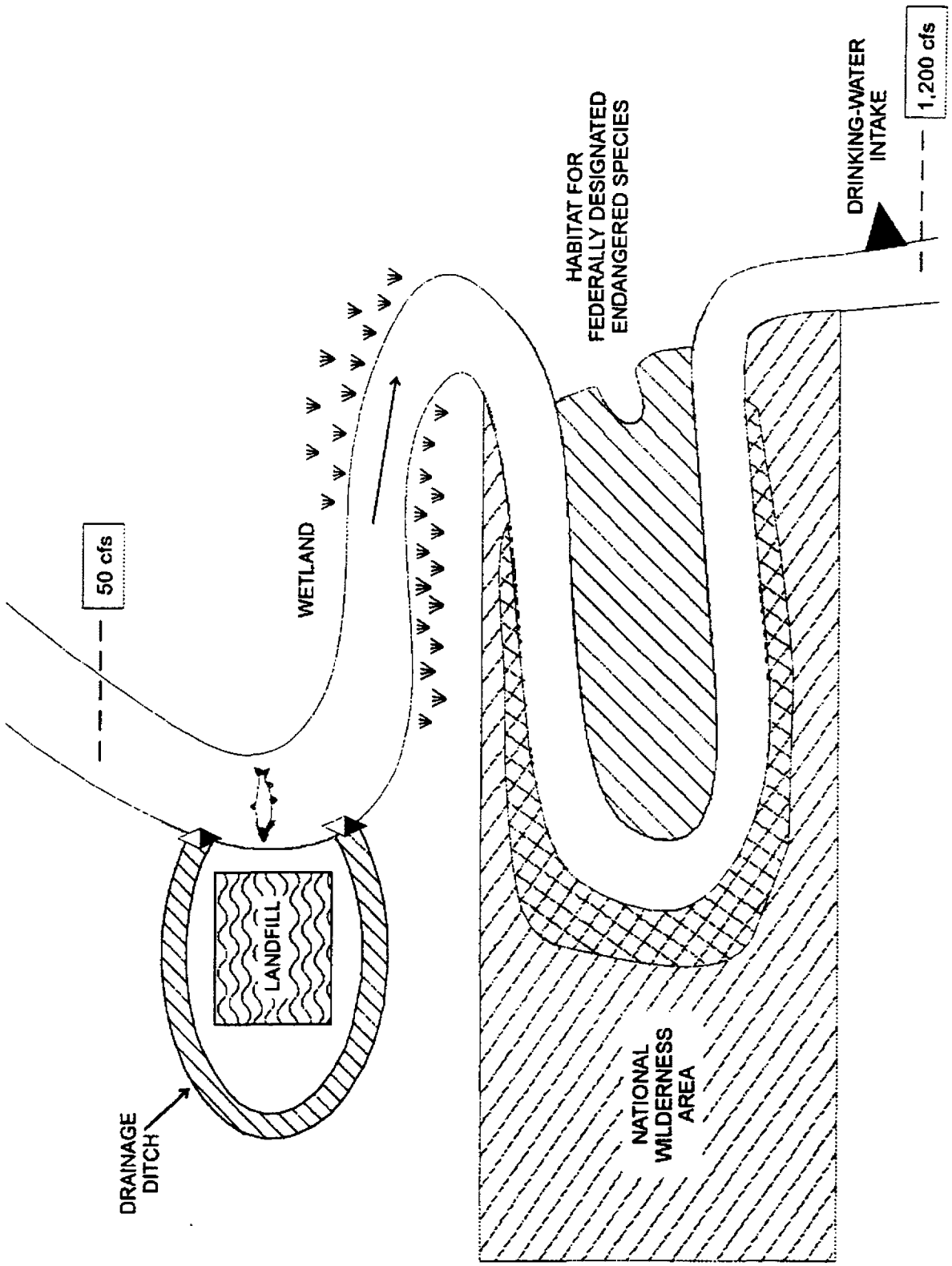
METHOD

1. Review the general site information and map.
2. Identify site sources on the map.
3. Identify probable points of entry (PPE).
4. Identify all targets.
5. Develop a sampling strategy to test the PA hypothesis of suspected release to surface water. You should use the procedures outlined in the SI guidance to demonstrate observed contamination. Because this is a single SI, all data must be sufficient to complete HRS scoring and documentation.
6. You are limited to 20 samples. You do not need to use all available samples.
7. Record your sampling strategy on the table provided.

GENERAL SITE INFORMATION:

- The R.R. Acme Landfill is a municipal landfill that was active between 1950 and 1980.
- The PA has determined that the surface water pathway is the major pathway of concern for this site.
- The PA has determined that the hazardous substances of concern are DDT, lead, and mercury.
- Critical distances:
  - PPE to wetland = 200 feet
  - PPE to wilderness area and habitat = 0.5 miles
  - PPE to intake = 5 miles

SAMPLE TO TEST SUSPECTED CONTAMINATION



SAMPLING STRATEGY

SITE NAME: R.R. ACME LANDFILL

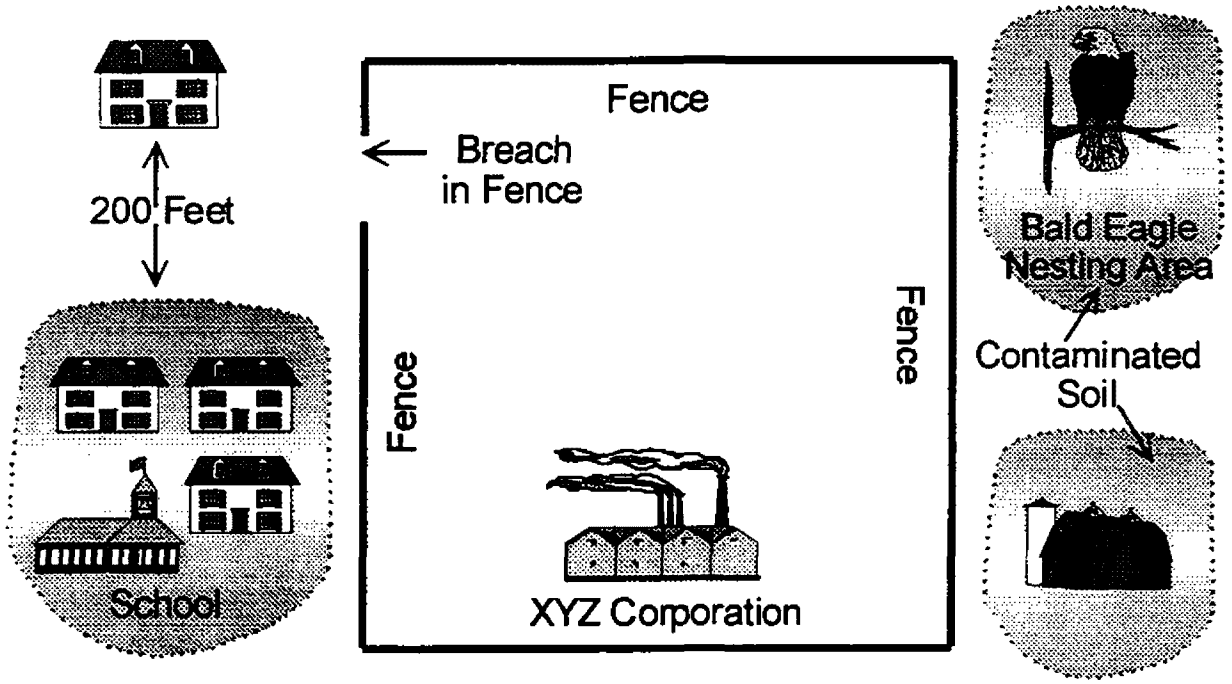
SAMPLE ID#	SAMPLE TYPE	RATIONALE

Total Samples:

Special Sampling Considerations:

Requested Analyses:

SOIL EXPOSURE PATHWAY



SOIL EXPOSURE PATHWAY

Pathway score based on:

- Likelihood that residential, school, or workplace properties are contaminated
- Likelihood that residents, students, or workers are exposed to site contaminants

SI Guidance, Section 4.7

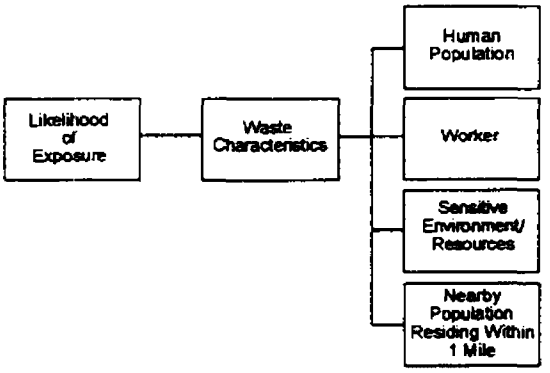
SOIL EXPOSURE PATHWAY (cont.)

Pathway score based on (cont.):

- Likelihood that federal or state designated terrestrial sensitive environments (National Parks, Wilderness Access, Critical Habitats, etc.), or unique biotic communities are contaminated
- Likelihood that commercial agriculture, silviculture and livestock production or grazing lands are contaminated

SI Guidance, Section 4.7

SOIL EXPOSURE: HRS CONSIDERATIONS



REVIEW PA INFORMATION

Determine whether a major pathway of concern is based on:

- Resident individuals (on-site residents, students
- Workers
- Terrestrial sensitive environments/resources
- Number and location of primary targets
- Areas of suspected surficial contamination
- Property boundaries
- If contamination has been demonstrated

SI Guidance, Section 4.7

SOIL EXPOSURE PATHWAY INVESTIGATION

Complete the SI Data Summary Soil section using available data

See SI Guidance, Appendix B, SI Data Summary, Pages B-16 through B-18

SI Guidance, Section 4.7

MOST IMPORTANT ANALYTICAL DATA

- Establishing observed contamination
- Establishing level of contamination
  - Level I (observed concentration > benchmark concentration
  - Level II (observed concentration ≤ benchmark concentration or no applicable benchmark)

SI Guidance, Section 4.7

ESTABLISHING OBSERVED CONTAMINATION

- Must use analytical evidence (no direct observation)
- Should demonstrate
  - Attribution
  - Contamination present at significant levels
- Need to collect two soil samples
- Background
- Area of contamination
- If observed contamination cannot be established, do not evaluate soil pathway

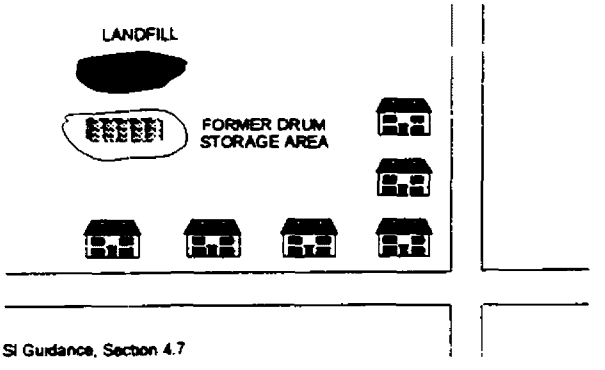
SI Guidance, Section 4.7

SAMPLING CRITERIA FOR OBSERVED CONTAMINATION

- Must meet criteria for observed contamination (similar to observed release for migration pathways), and samples must be collected within two feet of surface
- Cannot collect sample beneath impenetrable cover
- Can infer contamination within a source not between sources
- Multiple samples documenting observed contamination are required to establish an area of surficial contamination for the entire source

SI Guidance, Section 4.7

SAMPLE FOR OBSERVED CONTAMINATION (SOURCES)



SI Guidance, Section 4.7

SAMPLING CONSIDERATIONS

Sample to identify targets exposed to surficial contamination

- Resident individuals (most heavily weighted)
- Workers
- Terrestrial sensitive environment
- Resources (least heavily weighted)
- Nearby population
- Site accessibility

SI Guidance, Section 4.7

SAMPLING CONSIDERATIONS (cont.)

Sample in direction of targets only

- Do not sample to delineate total extent of surficial contamination

SI Guidance, Section 4.7

TARGET CONSIDERATIONS

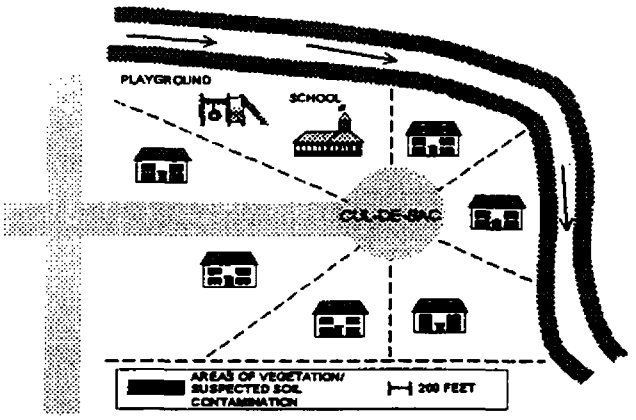
Resident individuals and workers

- Demonstrate contamination on the property and within 200 feet of residence, school, or workplace

Sensitive environments and resources

- Demonstrate contamination within boundary of resources and sensitive environments

SAMPLE TO DEFINE RESIDENT INDIVIDUALS



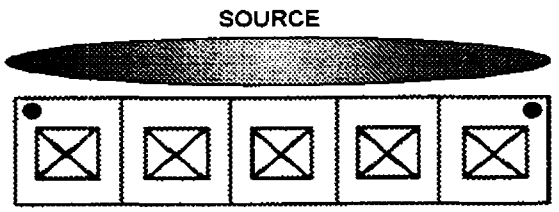
ESTIMATING AREAS OF OBSERVED CONTAMINATION

- Sample to identify resident population threat targets
- Three soil samples (minimum) needed
- Two soil samples for critical targets that lie along a line
- One nonsoil source sample can designate an entire source as area of observed contamination

SI Guidance, Section 4.7

AREA OF INFERRED CONTAMINATION

- Established between two points of observed contamination



0' 100' 200'

AERIAL VIEW

HOUSE
PROPERTY BOUNDAR
SOIL SAMPLE

SI Guidance, Section 4.7

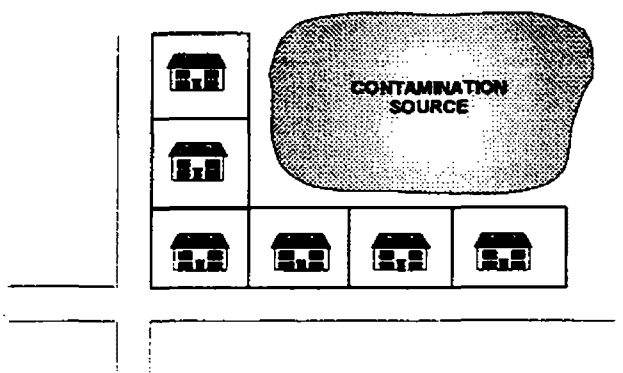
INFERRING CONTAMINATION CONSIDERATIONS

- Density of the soil
- Physiography
- Topography
- Operational history
- Transport and deposition patterns
- Means by which the substance migrates, such as wind dispersion
- Contamination in the downgradient portion of the migration route

INFERRING CONTAMINATION CONSIDERATIONS (cont.)

- Data from other investigations
- Soil staining
- Stressed vegetation
- Aerial and ground photography
- Infrared satellite imagery
- Use of composite samples/sample program design

INFERRING CONTAMINATION



EVALUATING LEVEL OF CONTAMINATION

- Analytical results are compared with soil benchmarks (milligrams/kilogram)
- Populations associated with areas of inferred contamination can only be evaluated as Level II resident threat targets

SI Guidance, Section 4.7

ADDITIONAL SAMPLING CONSIDERATONS

Soil samples collected for comparison should be similar

- Soil type
- Same soil horizon
- Mineralogy
- Composition

SI Guidance, Section 4.7

ADDITIONAL SAMPLING CONSIDERATONS (cont.)

For background, observed contamination, and metals analysis, the samples need to have similar:

- Texture
- Color
- Grain size

For HRS purposes, grab samples are preferred (not composite sample)

SI Guidance, Section 4.7

ESTABLISHING BACKGROUND

Background samples should:

- Represent uncontaminated conditions
- Be collected from undisturbed areas
- Not be collected from drainage channels
- Be collected within 1–3 days

SI Guidance, Section 4.7

SI STRATEGY

- Review PA hypotheses concerning suspected observed surficial contamination and exposed targets
- Establish areas of observed contamination
- Target resident individual exposures
- Can use inferred contamination areas

SI Guidance, Section 4.7.1

EXPANDED AND SINGLE SI STRATEGY

- Focus on documentation of target exposure
- Sample locations not sampled during earlier investigations
- Establish and document background
- Rigorous quality control

SI Guidance, Section 4.7.1

SOIL SAMPLING STRATEGY

SI Guidance, Table 4-14, Soil Sampling Strategies, compares criteria and activities associated with expanded and single SI's.

SI Guidance, Section 4.7.1.

TABLE 4-14: SOIL SAMPLING STRATEGIES

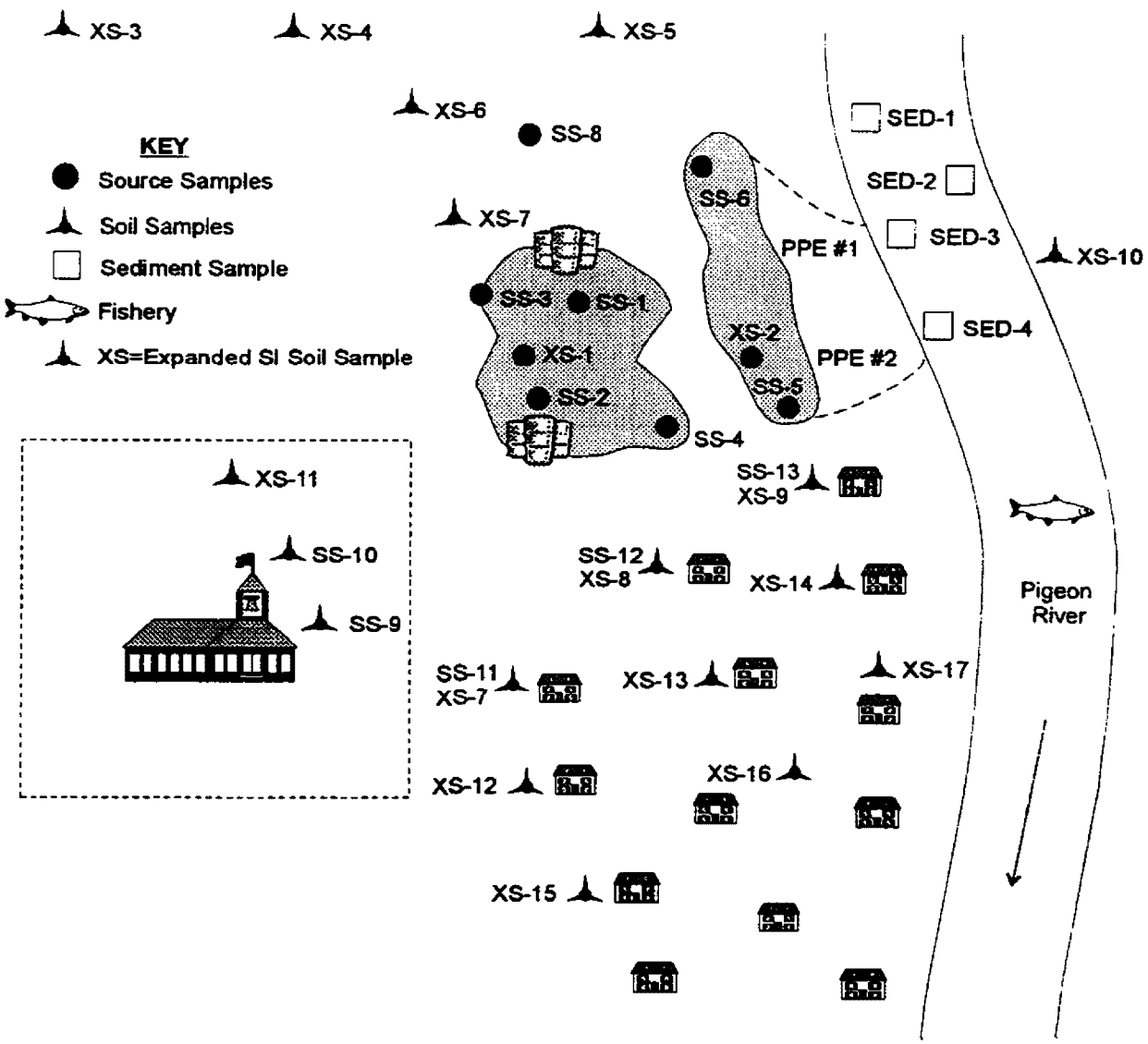
CRITERION	EXPANDED SI AND SINGLE SI
Primary objective	To document target exposure to hazardous substances related to site sources.
Average number of samples	0 to 20 based on HRS documentation requirements and number of sources and targets.
Types of activities	Resample locations if previous data did not demonstrate areas of observed contamination or targets exposed to actual contamination. Sample other resident target properties not yet sampled. Collect multiple samples on properties where hazardous substance concentrations are likely to be near benchmarks.
Background samples	As many as necessary; research natural soil concentrations as well as development history in the area to select critical background sample locations; use aerial photographs.
Attribution samples	Those necessary to attribute substances to the site being evaluated.
QA/QC samples	Minimum 1 split and 1 blank or per Regional guidelines.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992 (modified)

CASE STUDY:
EXAMPLES OF SOIL SAMPLING STRATEGY

The Carveth Landing site is a dump near a residential neighborhood and elementary school (see Carveth Landing site sketch). The PA reported that dumping occurred for an unknown period of time and allegedly included paints, organic and inorganic substances, and construction debris. The area is devoid of vegetation. Sources at the site include several piles of 5-gallon containers and two poorly defined areas of stained soil. Pigeon River, which flows at 1,600 cubic feet per second and is located 400 feet east of the site, has flooded twice in the past 7 years. Commercial and recreational oyster beds are downstream of two PPEs to surface water. The PA concluded the flooding may have carried hazardous substances into the surface water and onto adjacent school and residential properties. Hazardous substances associated with the site are not known, but could involve metals typically found in paints.

CARBETH LANDING SITE SKETCH

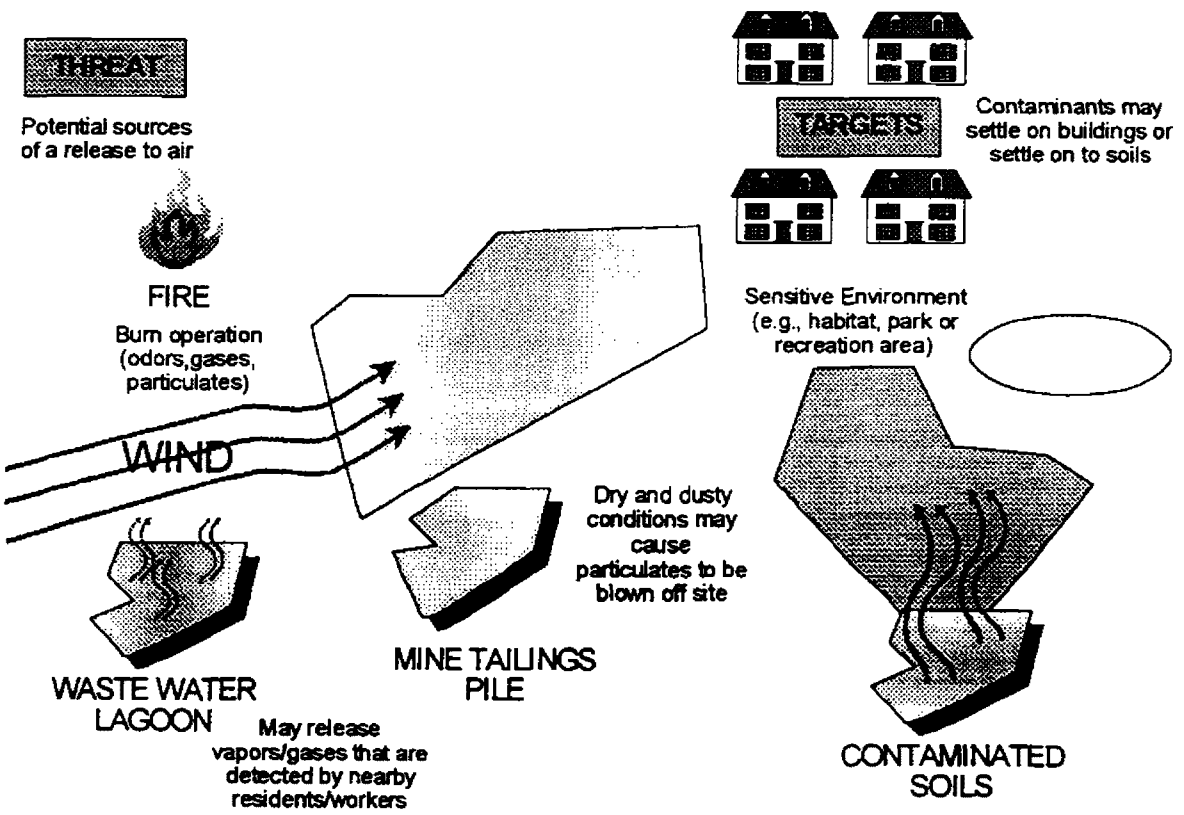


SOIL AND SURFACE AND WATER SAMPLING STRATEGY FOR EXAMPLE SITE

SAMPLES	APPROACH	RATIONALE	NONSAMPLING DATA COLLECTION
Surface water locations (SED-3, SED-4)	Sample sediments to demonstrate a release; determine if contamination is present and level of contamination.	Investigate release to surface water and determine if fishery is exposed to actual contamination.	Document use of river for fishing; estimate annual commercial food chain production for oysters.
Residential soil samples	Sample to determine if nearby residential properties (SS-11, SS-12, SS-13) and the school yard (SS-9, SS-10) are exposed to surficial contamination.	Investigate population exposure to hazardous substances.	Determine number of people per residence and number of students attending school.
Background soil (SS-7, SS-8)	Limited.	Sample to determine relative levels of hazardous substances under ambient conditions and to better define effects of flooding at site.	If available, obtain historical aerial photographs and FEMA maps; research natural background levels of metals.
Background surface water (SED-1, SED-2)	Collect sediment samples upstream of PPEs; ensure samples are beyond tidal influence of hazardous substance migration.	Sample to determine levels of hazardous substances under ambient conditions.	Research other potential sources of hazardous substances.
Sources (SS-1 through SS-6)	Identify hazardous substances present at the site; sample to test hypothesis of surficial contamination.	Do not sample to increase hazardous waste quantity because amounts are not close to HWQ factor value breakpoints.	Estimate physical dimensions of stained soil; count paint pails and look for drum labels.
Quality control (Q-1 through Q-3)	Monitor sample collection and decontamination procedures; two rinsates and one trip blank.		

U.S. EPA Headquarters Library
Mail code 3201
1200 Pennsylvania Avenue NW
Washington DC 20460

AIR PATHWAY


THREAT
Potential sources of a release to air
FIRE
Burn operation (odors,gases, particulates)
WIND
WASTE WATER LAGOON
May release vapors/gases that are detected by nearby residents/workers
MINE TAILINGS PILE
Dry and dusty conditions may cause particulates to be blown off site
TARGETS
Contaminants may settle on buildings or settle on to soils
Sensitive Environment (e.g., habitat, park or recreation area)
CONTAMINATED SOILS

AIR PATHWAY EVALUATION

Pathway score based on:

- Likelihood that airborne contaminants are migrating from site
- Likelihood of detecting contaminants at human and sensitive environment targets
- Characteristics of waste

SI Guidance, Section 4.8

REVIEW PA INFORMATION

- Was air pathway significant to preliminary score?
- Identify sources (source areas)
- Identify primary targets and primary target populations
- Identify most dispersible substances

SI Guidance, Section 4.8

AIR PATHWAY INVESTIGATION

Complete the SI Data Summary Air section using available data.

This information may help determine whether to evaluate the pathway.

See SI Guidance, Appendix B, SI Data Summary, Pages B-19 through B-21

SI Guidance, Section B

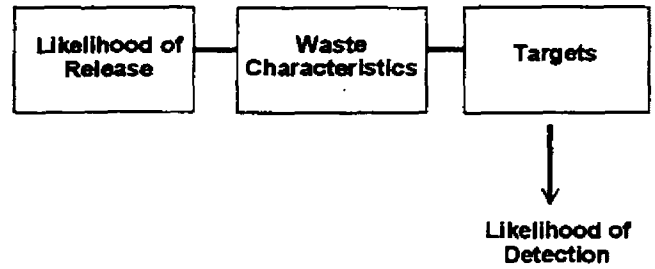
WHEN IS AIR MONITORING AND/OR SAMPLING APPROPRIATE?

Is air a significant pathway?

- Typically expanded or single SI activity
- Usually a unique event that must be understood prior to conducting fieldwork
- Are any health based levels potentially exceeded?

SI Guidance, Section 4.8

AIR PATHWAY: HRS CONSIDERATIONS



SI Guidance, Section 4.8

AIR PATHWAY: LIKELIHOOD OF RELEASE

Depends on nature of source

- Chemical properties
- Source type–gas/particulate
- Containment

Affected by atmosphere

- Wind direction and speed
- Temperature
- Precipitation

PA Guidance, Section 3.6.1

WASTE CHARACTERISTICS

Critical factors to consider:

- Contaminants' inhalation toxicity
- Contaminants' gaseous and/or particulate mobility
- Likelihood of detection

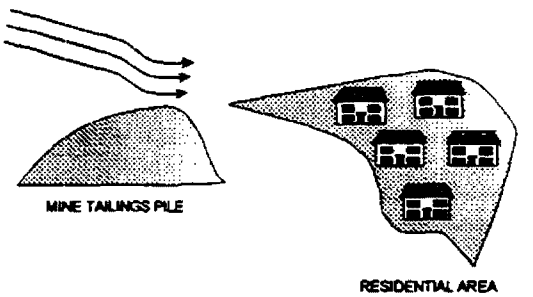
SI Guidance, Section 4.8

OBSERVED RELEASE BY DIRECT OBSERVATION

- Particulate or visible gaseous emission seen entering atmosphere directly
- Use photographs to document emissions
- Need information supporting that emission material contains hazardous substance
  - Existing analytical data
  - Manifests
  - Soil or source samples
- Sample source to document direct observation

Si Guidance, Section 4.8

OBSERVED RELEASE BY DIRECT OBSERVATION



OBSERVED RELEASE BY CHEMICAL ANALYSIS

Background and release samples should be similar

- Collection and analysis
- Same time frame
- Multiple contaminants may require method specific collection per contaminant
- Requires rigorous QA/QC

AIR PATHWAY: TARGETS

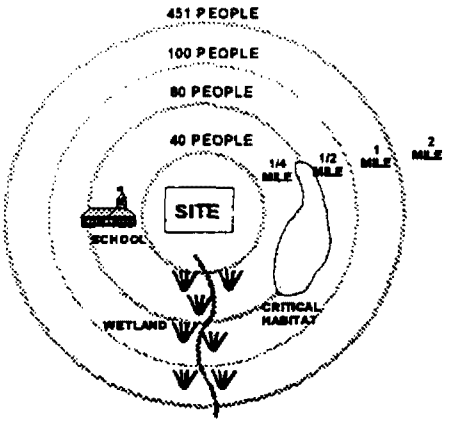
- Do not need to sample air targets directly
- Observed release can demonstrate actual contamination of targets within the distance category
- Emission models can be utilized to support exposure determinations

DATA REQUIREMENTS FOR EMISSION MODELS

			Soil Properties						Environ-mental			Physical/Chemical Properties								
	Source extent	Level of concentration	Density	Porosity	Moisture content	Organic content	Particle size distribution	Surface roughness	Temperature	Wind speed	Precipitation	Density	Molecular weight	Vapor pressure	Henry's Law constant	Diffusivity in air	Diffusivity in water	Water solubility	Octanol-water coefficient	Biorate constant
VOC Models																				
SEAMS Closed Landfill	●	●	●	●	●				●			●	●	●		●				
Hwang-Falco	●	●	●	●	●	●			●			●	●		●	●		●	●	
RTI Land Treatment	●	●	●	●	●				●	●		●	●	●	●	●		●	●	●
SEAMS Fresh Spill	●	●	●	●	●				●	●		●	●	●		●				
SIMS Aqueous Lagoons	●	●							●	●		●	●		●	●	●	●	●	●
SEAMS MSW Landfill	●	●																		
Scholl Canyon Model	●	●			●	●							●							
Particulate Models																				
Paved Road	●	●					●													
Unpaved Road	●	●					●				●									
MRI "Limited" Erosion	●	●					●	●		●										
MRI Storage Pile	●	●					●	●		●										
SCS Wind Erosion Model	●	●					●	●		●	●									

Source: Draft Emission Modeling Fact Sheet, March 1993

AIR TARGETS



AIR SAMPLING CONSIDERATIONS

- Sample targets within a 0.25 mile target distance limit
- Conduct air sampling before or after other sampling activities (not during)
- May require more than one sampling event
- Should not be conducted near facilities discharging into air
- Monitoring stations should be located near sources

SI Guidance, Section 4.8.3

EXPANDED AND SINGLE SI STRATEGY

- Single SI option is selected if air is the only pathway of concern
- Conduct sampling:
  - If air pathway is of concern
  - If public health is threatened
- Utilize method-specific sampling time to reduce variability
- Determine predominant wind direction
- Maintain rigorous quality control

SI Guidance, Section 4.8.3

EXPANDED AND SINGLE SINGLE SI STRATEGY: ESTABLISHING BACKGROUND

- Background sample locations should be outside influence of site to ensure attribution
- Necessary at this stage
- Upwind or cross-wind samples acceptable
- Multiple samples preferred
- Rigorous QA/QC required

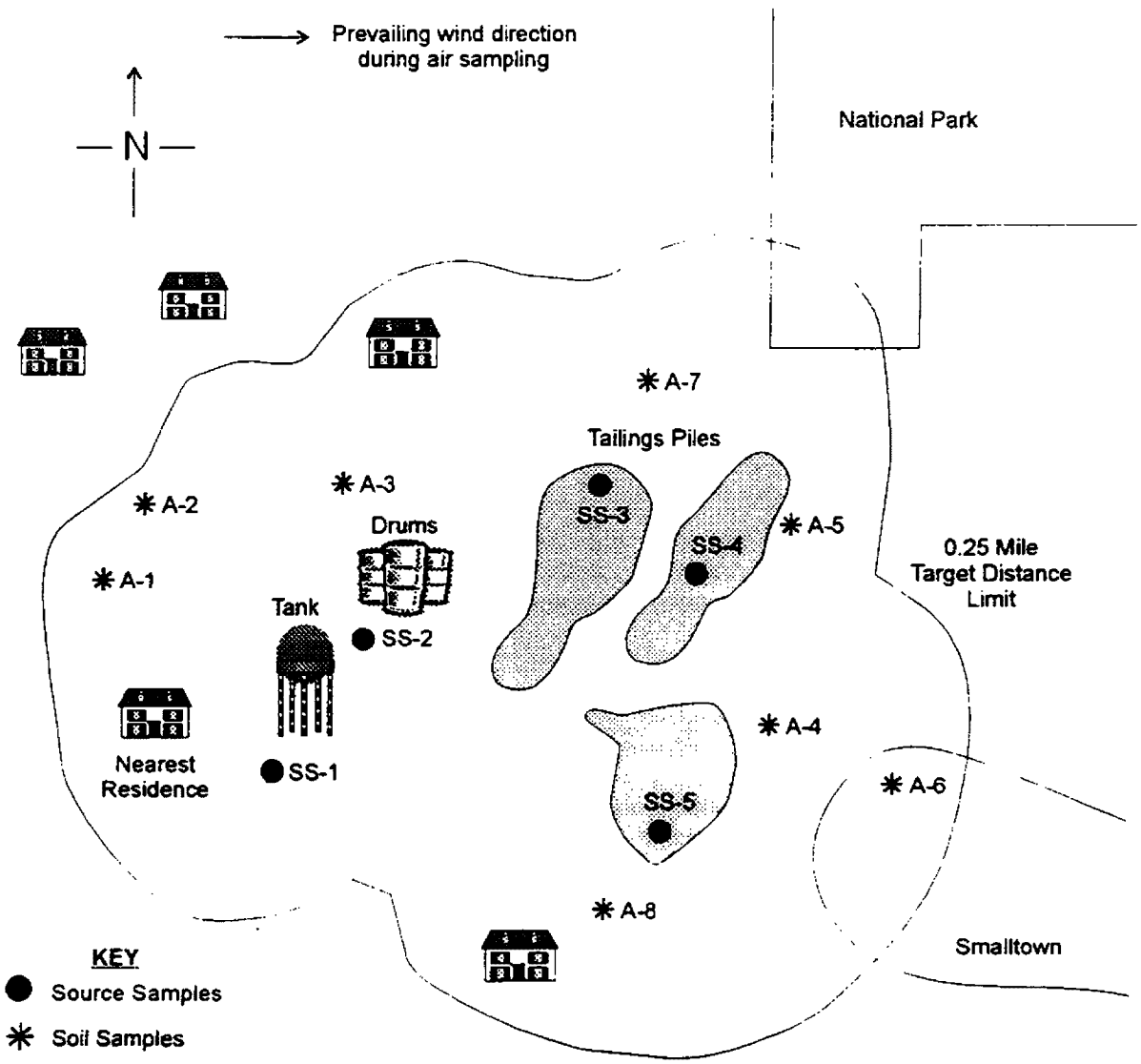
SI Guidance, Section 4.8.2

CASE STUDY:
EXAMPLES OF AIR SAMPLING STRATEGY

Vega Ore is a remote site near Smalltown where ore is processed for the extraction of lead, zinc, and silver (see Vega Ore site sketch). The site has been operating since 1930, and current activities are very limited. Waste sources include three tailings piles, a drum storage area for acids, and an above ground tank.

The nearest residence is 1,000 feet from a tailings pile. Smalltown relies on drinking water from an intake 3 miles away. A national park is located 900 feet from the site. A total of six ranches within 0.25 miles of the site rely on bottled water and cisterns for drinking water. Based on PA research, the significant threats posed by Vega Ore involve suspected migration of hazardous substances through air that may impact people and sensitive environments. No groundwater targets exist, and the nearest surface water body is more than 2 miles from the site.

VEGA ORE SITE SKETCH

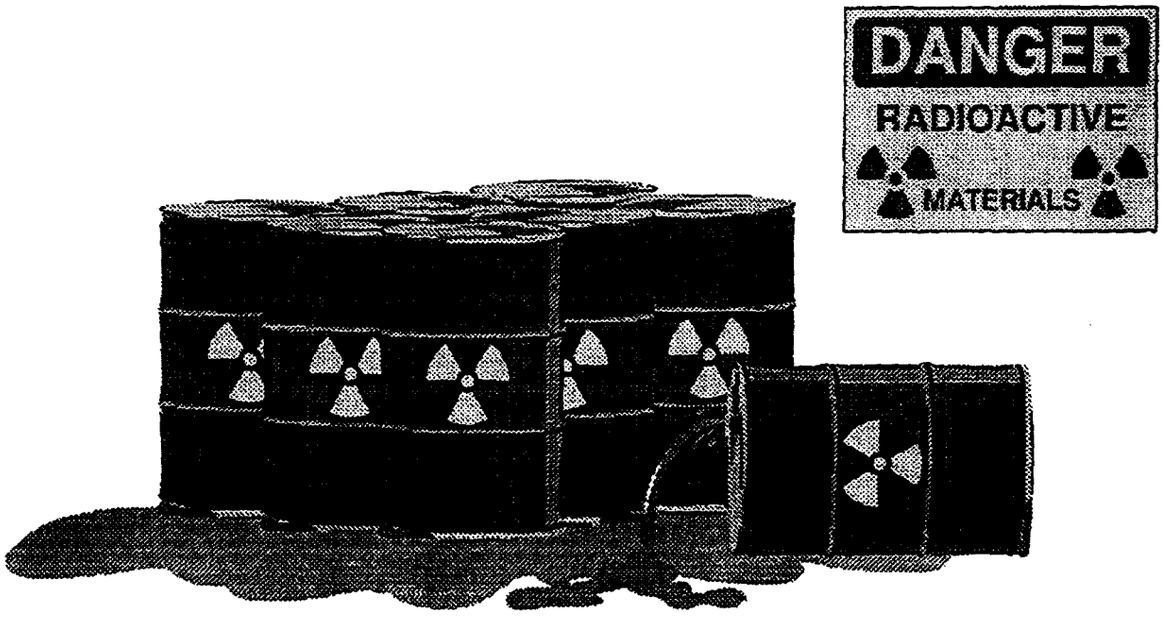


AIR SAMPLING STRATEGY FOR EXAMPLE SITE

SAMPLES	APPROACH	RATIONALE	NONSAMPLING DATA COLLECTION
Release and air targets (A-4 through A-6)	Sample to test if contamination is present and determine level of actual contamination. Monitor wind speed, direction, and other atmospheric conditions.	Determine whether the 0.25-mile target distance category is exposed to actual air contamination. This is vital to investigating the public health and the screening and listing decisions.	Determine population of Smalltown lying within the 0.25-mile target distance category from site sources. Determine number of workers at Vega Ore. Determine boundaries of national park.
Support for release and air targets (A-7, A-8)	*Sample to test if other sources* of air contamination exist in the site vicinity; or if wind direction changes during the sampling event, establish crosswind sample stations.	*Support determining* whether the 0.25-mile target distance category is exposed to actual contamination.	
Background (A-1 through A-3)	Sample to collect background levels of ambient air concentrations. Sample to determine background soil levels.	Sample to determine relative levels of particulate hazardous substances in ambient conditions. Ensure sufficient background samples for listing purposes.	Identify other sources of particulate emissions in area. Collect descriptive information for all background sample locations.
Sources (SS-1 through SS-5)	Identify hazardous substances present at the site through surficial soil samples and tailing samples.	Do not sample to increase hazardous waste quantity (amounts are not close to HWQ factor value breakpoints).	Obtain physical dimensions of tanks, drums, and tailings piles, and estimate area of contaminated soil; verify number of drums and look for drum labels.
Quality control (Q-1 through Q-4) (not shown)	Monitor sample collection and decontamination procedures; 2 trip blanks and 2 duplicates.	Ensure sufficient QA/QC samples for listing purposes.	

SECTION EIGHT

RADIATION



RADIATION: DEFINITIONS

1. RADIOACTIVE SUBSTANCE: Solid, liquid, or gas containing atoms of a single radionuclide or multiple radionuclides.
2. RADIONUCLIDE/RADIOISOTOPE: Isotope of an element exhibiting radioactivity. For HRS purposes, "radionuclide" and "radioisotope" are used synonymously.

HRS Final Rule, Section 1.1, Page 51586

RADIATION: DEFINITIONS (cont.)

3. RADIOACTIVITY: Property of those isotopes of elements that exhibit radioactive decay and emit radiation.
4. RADIATION: Particles (alpha, beta, neutrons) or photons (X- and gamma-rays) emitted by radionuclides.

HRS Final Rule, Section 1.1, Page 51586

RADIOACTIVE SUBSTANCES ARE:

- Hazardous substances under CERCLA and should be considered in HRS scoring
- Treated as additional wastes with special properties under the HRS

Special analytical data requirements apply

HRS Final Rule, Section 7.0, Page 51663

RADIATION: TYPES

1. IONIZING RADIATION: includes X-ray and gamma radiation. They are both forms of electromagnetic radiation which have sufficient energy to break chemical bonds and cause chemical reactions. Ionizing radiation also includes high speed subatomic particles such as alpha and beta particles, and neutrons.

RADIATION TYPES (cont.)

2. NON-IONIZING RADIATION: is electromagnetic radiation that does not have sufficient energy to break chemical bonds or cause chemical reactions. This includes radio waves, TV, microwaves, radar, visible light, and ultraviolet light.

RADIATION UNITS

1. RAD (Radiation Absorbed Dose): When ionizing radiation penetrates and interacts with a material, it imparts energy to the material. For a given mass of material this energy is called the absorbed dose. The unit that measures absorbed dose is the RAD.

RADIATION UNITS (cont.)

2. REM (Roentgen Equivalent Man): For an individual, the dose equivalent is obtained by multiplying the absorbed dose by a factor that varies with the type of radiation and takes into account these different affects.

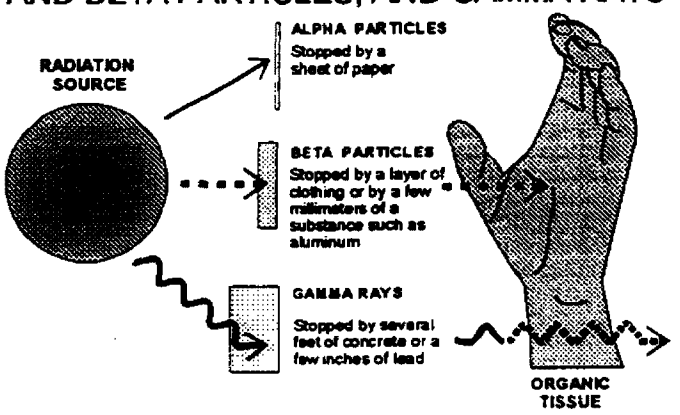
RADIATION UNITS (cont.)

1 Millirem = 1/1000 REM

New International Units:
1 Gray (gy) = 100 RAD
1 Sievert = 100 REM

1 Roentgen (R) = 2.58 x 10^{-4} Coulomb
1 R = 1 RAD = .01 gy

THE PENETRATING POWER OF ALPHA AND BETA PARTICLES, AND GAMMA RAYS



RADIATION: CHARACTERISTICS OF THE THREE MAJOR TYPES

SOURCE	SYMBOL	FORM	RELATIVE MASS (Charge)	# OF IONIZATIONS /CM IN AIR	PATH LENGTH IN AIR	HAZARD LOCATION OFSOURCE
ALPHA	α	Particle	4 (+2)	100,000's	<2.54 cm	Internal
BETA	β	Particle	0.00055 (+/-1)	100's	1 meter	internal/ external
GAMMA	γ	Electro-magnetic energy	0 (0)	1	Several meters to kilometers	internal/ external

TWO HRS GROUPS OF RADIONUCLIDES

1. Naturally occurring or ubiquitous in the environment.
2. Man-made radionuclides not ubiquitous in the environment (elements beyond atomic number 92: uranium).

HRS Final Rule, Section 7.1.1, Page 51663;
SI Guidance, Section 4.9.4, Page 89

RADIATION MEASUREMENT

Radiation is measured in activity units (Curies).

Curie (Ci): Measure used to quantify radioactivity. One Curie equals 37 billion nuclear transformations per second and one picocurie (pCi) equals 10^{-12} Ci.

MEDIA	UNIT MEASUREMENT
Soil	pCi/kg
Ground/surface water	pCi/l
Air	pCi/m^3

HRS Final Rule, Section 7.1.1, Page 51663

CERCLA EXCLUSIONS

Section 101(22) of CERCLA excludes a limited category of radioactive materials, making them ineligible for CERCLA response or the NPL.

1. Excludes releases of source uranium or thorium . . ., by-product or material made radioactive by exposure to radiation from the use or production or special nuclear material (plutonium, ^{233}U, enriched ^{233}U, ^{235}U) or any material that the NRC determines to be special nuclear material subject to Section 170 of the AEC Act.

HRS Guidance, Page 19

CERCLA EXCLUSIONS (cont.)

2. Any release of source, by-products, or special nuclear material from any processing site specifically designated under the Uranium Mill Tailings Radiation Control Act of 1978.
3. If facility has a current NRC license.

HRS Guidance, Page 19

POTENTIAL RADIOACTIVE WASTE SITES

- Pose special hazards for field investigators (gamma radiation)
- Less than 2 percent of CERCLA sites involve radioactive materials
- Detailed investigations and information are handled by EPA's Office of Air and Radiation Programs (OAR) or by an EPA Regional Health Physicist

PA Guidance, Section 2.7, Page 34

FACILITIES THAT CONTAIN RADIOACTIVE MATERIALS

- DOD/DOE research labs, university labs, contractors, and suppliers
- Public/private energy production and research labs
- Ore mining, milling, and processing industries
- Deep well injection sites

PA Guidance, Section 2.7, Page 34

FACILITIES THAT CONTAIN RADIOACTIVE MATERIALS (cont.)

- Aircraft, submarine, and shipbuilding companies
- Businesses that manufacture, use, store, or dispose of radio pharmaceuticals (hospitals)
- Industrial radiography (X-rays)

PA Guidance, Section 2.7, Page 34

EVIDENCE OF RADIOACTIVE MATERIALS

Presence of drums and containers with radiation symbols (trefoil)

- Permits, manifests, and records of radioactive materials
- Above-background reading on a radiation meter

EPA action guideline: readings ≥ 1mR/hr for gamma radiation – EVACUATE AREA!!

PA Guidance, Section 2.7, Page 34

RADIATION SAMPLING* GOALS

- Identify radionuclides and activity concentrations *in situ*, both onsite and offsite with radiation meter (background)
- Locate elevated radioactivity sources and external radiation exposure rates, consult Part B or SCDM
- Estimate areal extent of contamination and major migration pathways

*After consultation with a health physicist

SI Guidance, Section 4.9.1, Pages 86-88;
40 CFR Part 300, URS Final Rule 7.3.1

RADIATION SAMPLING* GOALS (cont.)

- Confirm radiation releases through sampling
- Document Level I and Level II contamination
- Support QA/QC requirements (samples require specialized CLP)

*After consultation with a health physicist

SI Guidance, Section 4.9.1, Pages 86-88;
40 CFR Part 300, HRS Final Rule 7 3 1

FACTORS THAT ARE EVALUATED DIFFERENTLY UNDER HRS IN ALL FOUR PATHWAYS

- Observed release
- Toxicity
- Persistance
- HWQ in tiers A and B only

Vary with isotope

Refer to 40 CFR Part 300, HRS Final Rule, Section 7 for specific information

HRS Final Rule, Table 7-1, Page 51663

OBSERVED RELEASE FOR α AND β

- Direct observation for each migration pathway except soil*
- Known radioactive source seen entering groundwater, surface water, or air; or known to have direct contact with media through deposition or flooding
- Measured concentration in activity units in all four pathways

*Soil exposure pathway must have a soil sample for analysis

SI Guidance, Section 4.9.1, Pages 86-88; 40 CFR Part 300, HRS Final Rule 7.3.1

OBSERVED RELEASE

1. Observed release for naturally occurring radionuclides
   - Concentrations that exceed upper limit of regional background for a specific nuclide and media type
   - Must be attributable to site

SI Guidance, Section 4.9.4, Pages 89-90

OBSERVED RELEASE (cont.)

2. Observed release for man-made radionuclide without ubiquitous background concentrations in the environment
   - Measure concentrations that equal or exceed the SQL* for that nuclide in a specific media
   - Must be attributable to site

*If CLP-generated date, use CRQL (Contract Required Quantitation Limit); if non-CLP-generated data, use IDL (Instrument Detection Level).

SI Guidance, Section 4.9.4, Pages 89-90

OBSERVED RELEASE OF α AND β FOR SOIL EXPOSURE PATHWAY

Radiation source

- Must be present at surface or covered by 2 feet or less of cover material
- Exceeds the upper-limit value of the range of regional background concentration values for that specific radionuclide in that type of sample
- Must be attributable to the site
- Excludes gamma radiation

SI Guidance Section 4.9.4, Page 89; HRS Final Rule 7.3.1

OBSERVED RELEASE IN SOIL EXPOSURE PATHWAY WITH GAMMA RADIATION

- Whose concentration equals or exceeds 2 times the site-specific background gamma radiation exposure rate
- Must be attributable to the site
- Does not have to be within 2 feet of the surface
- Must have external gamma radiation readings taken at no more than 1 meter above ground

HRS Final Rule, Section 7.1.1, Page 51664

TO CALCULATE HAZARDOUS WASTE QUANTITY (HWQ)

- Use activity units (curies) to evaluate sources
- Need source area and depth (volume in cubic yards or gallons)
- Need net activity concentration of each nuclide (after subtracting background concentration)

SI Guidance, Section 4.9.2, Pages 88-89

TO CALCULATE HAZARDOUS WASTE QUANTITY (HWQ)(cont.)

- Evaluate radionuclide constituent quantity (Tier A) or waste stream quantity (Tier B)
- Activity in curies is converted to equivalent pounds

SI Guidance, Section 4.9.2, Pages 88-89

HWQ

Tier A: Based on activity content. Convert from curies to equivalent pound of non-radioactive hazardous substances by multiplying the net activity estimate or area of observed contamination by 1,000. Assign the product as a constituent quantity value.

Select the higher value for HWQ

1 curie = same threat as 1,000 pounds of a hazardous chemical substance

HRS Final Rule, Section 7.2.5.7, Pages 5166-51666

HWQ (cont.)

Tier B: Based on activity content. Estimate total volume (cubic yards or gallons); divide cubic yards by 0.55 and gallons by 110 to obtain equivalent pounds of non-radioactive hazardous substances. Assign resulting value as radio nuclide quantity value.

Select the higher value for HWQ

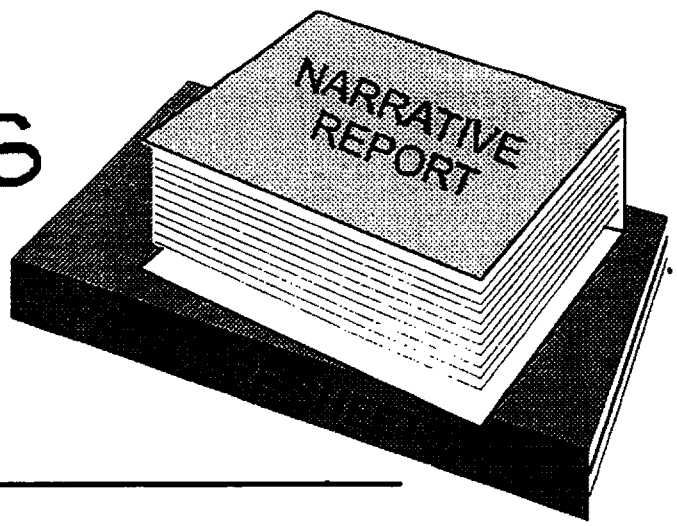
1 curie = same threat as 1,000 pounds of a hazardous chemical substance

HRS Final Rule, Section 7.2.5.7, Pages 5166-51666

SECTION NINE

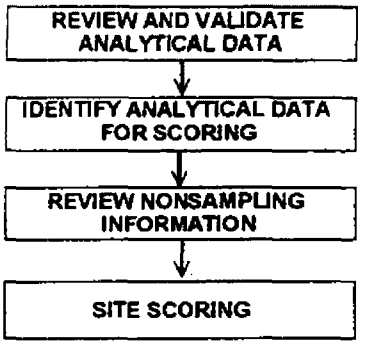
SITE INSPECTION EVALUATION AND REPORTING

$$\frac{WC \times LR \times T}{82{,}500} = S$$



$$\text{Site Score} = \sqrt{\frac{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}{4}}$$

SI EVALUATION OVERVIEW



SI Guidance, Chapter 5

SI EVALUATION: DATA REVIEW

- Compile all data
  - Existing
  - New SI data
- Include sampling and nonsampling information
- Evaluate existing analytical data using procedures outlined in Chapter 3 of the SI Guidance
- Evaluate new analytical data against performance criteria in SI work plan

SI Guidance, Section 5.1

SI EVALUATION: DATA REVIEW (cont.)

- All new analytical data should be independently validated before review
- Review should be conducted by the site investigator and project chemist
- SI Guidance, Table 5-1, provides data review considerations

SI Guidance, Section 5.1

TABLE 4-1: DATA REVIEW CONSIDERATIONS

- ☐ Review data reports for transcription and typographical errors (e.g., 0.5 v. .05; ppb v. ppm).
- ☐ Determine if sampling protocols were appropriate.
- ☐ Compare data against field and trip blanks to detect cross-contamination.
- ☐ Compare field replicate samples.
- ☐ Review laboratory QA/QC (e.g., laboratory blanks, method standards, spike recovery, duplicates).
- ☐ Summarize detection limits for non-detectable results.
- ☐ Review detection limits for positive but non-quantifiable data.
- ☐ Review sampling program design for assessing media variability.
- ☐ Review background concentrations to help identify site-specific contamination.
- Delete unusable data, attach qualifiers to usable data, and explain limitations of qualified data.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

SI EVALUATION: DATA REVIEW (cont.)

- Scope of data review reflects use requirements
- Problems with data packages should be resolved with laboratory

SI Guidance, Section 5.1

SI EVALUATION: IDENTIFY DATA FOR SCORING

HRS aspects that depend on analytical data

- Observed releases
- Observed contamination (soil pathway)
- Targets exposed to actual contamination
- Levels of target contamination
- Hazardous waste quantity

Can use CLP and non-CLP data deemed suitable for SI objectives

SI Guidance, Section 5.2

SI EVALUATION: IDENTIFY DATA FOR SCORING (cont.)

Criteria for establishing acceptable minimum data quality:

- Intended use of data
- Specific site hypothesis being tested
- Particular HRS factor being examined
- Levels of target contamination
- Hazardous waste quantity

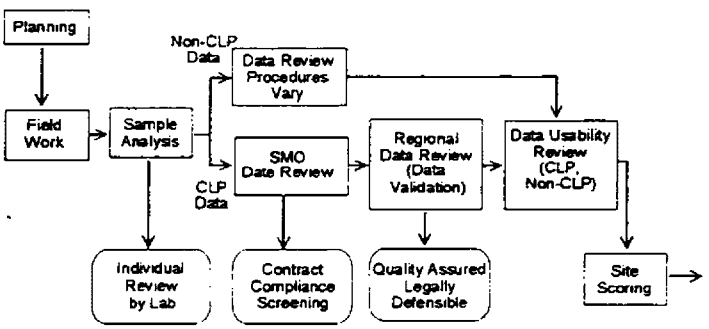
SI Guidance, Section 5.2

SI EVALUATION: IDENTIFY DATA FOR SCORING (cont.)

- Determine usability of qualified data
- Qualifiers are added to data during laboratory analysis or data validation

SI Guidance, Section 5.2

ANALYTICAL DATA REVIEW PROCESS



SI EVALUATION: IDENTIFY DATA FOR SCORING (cont.)

Qualified analytical data

- Data with attached letter code of "flag" indicates QA/QC problems or questions concerning chemical identity or concentration
- Flag assigned by analyzing laboratory or person validating data

SI EVALUATION: IDENTIFY DATA FOR SCORING (cont.)

Examples of Qualified Data

SAMPLES	1	2	3	4
Trichloroethylene	40J	160	120	30J
Tetrachloroethylene	25U	150J	100R	45
Phenol	330U	390	19,000J	490

Concentrations (ppb)

SI EVALUATION: IDENTIFY DATA FOR SCORING (cont.)

Common qualifiers in CLP data

- J-flag: Concentrations are estimated; identification of hazardous substances certain
- U-flag: Compound analyzed for but not detected
- R-flag: QA/QC indicates data are unusable
- Specific meaning of a qualifier may vary

SI EVALUATION: NONSAMPLING INFORMATION

- Review SI data sheets
- Update with new information if needed
  - Changes in site conditions (e.g., a removal)
  - Changes in targets
- Assess quality of nonsampling information

SI Guidance, Section 5.3

SI EVALUATION: SITE SCORE

General strategy

- Characterize sources
- Focus on significant pathways
- Document releases

SI Guidance, Section 5.4

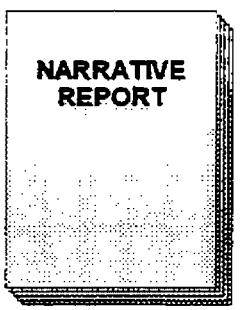
SI EVALUATION: SITE SCORE (cont.)

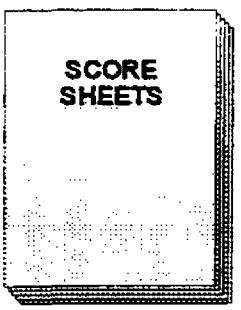
- SI worksheet
- PREscore software program
- HRS score sheets
- Other evaluation tools developed by EPA regional or state offices

See SI Guidance, Appendix C, Site Inspection Worksheets

SI Guidance, Section 5.4

SI REPORTING REQUIREMENT





SI REPORTING: NARRATIVE REPORT

Report should:

- Describe history and nature of waste handling at site
- Describe known hazardous substances
- Describe pathways of concern
- Identify and describe targets
- Present SI analytical results

SI Guidance, Section 6.1

SI REPORTING: NARRATIVE REPORT (cont.)

- Can be letter report or stand-alone document
- Factual statements should be supported by references
- References not generally available should be attached
- Structure and format should follow format in Exhibit 6-1, SI Narrative Report Form

SI Guidance, Section 6.1

EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT

INTRODUCTION

- State that an SI was performed, the name of the agency performing it, and the authority under which it was conducted (e.g., CERCLA as amended by SARA, and EPA contract or cooperative agreement).
- State the site name, CERCLIS identification number, and location (street address, city, county, State, latitude/longitude coordinates). If necessary, provide brief directions to the site.
- State the purpose, scope, and objectives of the SI.

SITE DESCRIPTION AND REGULATORY HISTORY

- Identify the type of site (e.g., plating facility, chemical plant, municipal landfill), whether it is active or inactive, and years of operation. Describe its physical setting (e.g., topography, local land uses). Include the appropriate portion of a USGS 7.5-minute topographic map locating the site and showing a 1-mile radius. On the map, identify the surface water drainage route; nearest well, drinking-water intake, and residence; and wetlands and other sensitive environments. Include a drafted sketch showing site layout, source areas, and features on and around the site.
- Briefly summarize dates and scope of previous investigations.
- Describe prior land use and past regulatory activities including the site's RCRA status, permits, permit violations, and inspections by local, state, or federal authorities. Discuss any citizen complaints.

OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

- Provide an operational history of the site. Identify current and former owners and operators, and describe site activities. Identify and describe wastes generated, waste disposal practices, waste source areas, waste source containment, and waste quantities. Indicate source areas on the site sketch.
- Discuss any previous sampling at the site; provide dates of sampling events and sample types. Summarize analytical results in a table. Include a site map of all previous sample locations.
- Discuss SI source sampling results. List in a table each waste source sample and summarize analytical results. Include a site map of all waste source and pathway sample locations.
- Identify hazardous substances associated with sources.
- Describe accessibility to source areas.

GROUNDWATER

- Describe the local geologic and hydrogeologic setting (e.g., stratigraphy, formations, aquifers, karst features, confining layers, depth and permeability to each aquifer).

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EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT (cont.)

GROUNDWATER (cont.)

- Discuss groundwater use within a 4-mile radius of the sources. Identify the nearest private and municipal drinking-water wells and state the distance from sources. Quantify drinking-water populations served by wells within 4 miles, differentiating between private and municipal wells and specifying aquifers. Identify any municipal wells that are part of a blended system; state number of wells, locations, pumping rafes, and aquifer from which water is drawn. Identify wells in karst aquifers.
- Identify designated wellhead protection areas (WHPA) and specify location.
- Discuss any previous groundwater sampling results; provide dates of sampling events and the depths and names of sampled aquifers.
- List in a table each well or spring sampled during the SI, provide the depth from which it draws drinking water and the screened interval, quantify the population associated with it, and identify its distance from site sources. Discuss SI groundwater sampling results. List in a table each sample, and summarize analytical results. Include a site map of sample locations. Identify drinking-water wells exposed to hazardous substances and quantify the drinking-water populations served by each.

SURFACE WATER

- Describe the local hydrologic setting, including site location with respect to floodplains, and the overland and in-water segments of the surface water migration path. State the distance from the site to the probable point of entry (PPE) into surface water. Identify the water bodies within the in-water segment, and state the length of reach and flow or depth characteristics of each; describe tidal influence. Include a drafted sketch of the surface water migration path. Describe upgradient drainage areas, onsite drainage (including storm drains, ditches, culverts, etc.), facility discharges into surface water, permits, and historical information, including floods, fish kills, fishery closures, and other events.
- Indicate whether surface water within the target distance limit supplies drinking water. Identify the location, and state the distance from the PPE to each drinking-water intake. Quantify the drinking-water population served by surface water and identify blended systems.
- Indicate whether surface water within the target distance limit contains fisheries. Identify and state the distance from the PPE to each fishery; briefly characterize each fishery.
- Indicate whether sensitive environments are present within or adjacent to the in-water segment. Identify and state the distance from the PPE to each sensitive environment. Describe each sensitive environment and state the frontage length of wetlands on surface water.
- Discuss any previous surface water sampling results, dates, locations, and types of samples.
- Discuss SI surface water sampling results. List in a table each sample and summarize analytical results. Identify surface water intakes exposed to hazardous substances and quantify the drinking-water populations served by each. Identify fisheries exposed to hazardous substances and quantify the food chain population associated with each. Identify sensitive environments and wetlands exposed to hazardous substances; quantify the frontage of exposed wetlands.

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EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT (cont.)

SOIL EXPOSURE

- State the number of workers on properties with site-related contamination.
- State then number of people who live on properties with site-related contamination and within 200 feet of an area of observed contamination. State the hazardous substance concentration and compare to health-based benchmarks.
- Identify schools and day care facilities within 200 feet from an area of observed contamination on the school property and state the number of attendees.
- Identify terrestrial sensitive environments and resources in an area of observed contamination.
- State the number of people who live within 1 mile travel distance of the site.
- Discuss any previous sampling results of sources of surficial materials, including dates and locations.
- Discuss SI surficial source samples. List each sample in a table and summarize analytical results.

AIR

- Identify the location of, and state the distance to, the nearest individual. State the population within 4 miles of the site, including students and workers. Identify sensitive environments on sources and within 4 miles.
- Discuss any previous air sampling results, including dated, locations, sampling procedures, and meteorological conditions.
- Discuss SI air sampling procedures and results. Identify sample locations on a map. List in a table each sample and summarize analytical results.

SUMMARY AND CONCLUSION

- Briefly summarize the major aspects of the site and its history and relate to the release or threatened release of hazardous substances and the exposure of targets. Briefly summarize principal pathways and targets of concern.
- Summarize sampling results, including substances detected in site sources and in environmental media.

PHOTODOCUMENTATION LOG

- As an attachment, provide photographs of the site taken during the SI depicting pertinent site features such as waste source areas, containment conditions, stained soil, stressed vegetation, drainage routes, and sample locations. Describe each photograph in captions or accompanying text. Key each photo to its location on the site sketch.

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT (cont.)

APPENDICES

- Analytical results reports
- QA Report
- Other attachments

REFERENCES

- List, in bibliographic citation format, all references cited in the SI report.
- Attach copies of references cited in the SI report. Include complete copies of site-specific references (e.g., USGS topographic maps, records of communication, drinking-water population apportionment and calculation worksheets, GEMS and other data base printouts, waste handling records or shipping manifests). Include only the title page and pertinent excerpts of publicly available references (e.g., geologic reports).

Guidance for Performing Site Inspections Under CERCLA, USEPA, September 1992

SI REPORTING: SCORE AND DOCUMENTATION

During SI scoring, investigator should:

- Start at beginning of package and work through systematically
- Document all assumptions
- Develop references

Evaluate SI Results:

- Use Table 6-1, Additional Evaluation of SI Results, to aid in decisions

SI Guidance, Section 6 1

SI REPORTING: REVIEWS

SI reports and score sheets undergo three separate reviews

- SI investigator conducts detailed review of SI report and score sheets for completeness and internal consistency
- Independent reviewer reviews analytical data and internal consistency
- EPA regional officials and state personnel review reasonableness and whether SI objectives were met

SI Guidance, Section 6 1

SI REPORTING: REFERENCES

Log books

- Source containment descriptions
- Sample descriptions (matrix, location, color, depth, etc.)
- Migration path descriptions
- Photograph descriptions
- Surrounding land use

SI REPORTING: REFERENCES (cont.)

Data sheets

- Field screening
- Borings and monitoring wells
- Chain of custody

SITE DISPOSITION DECISION

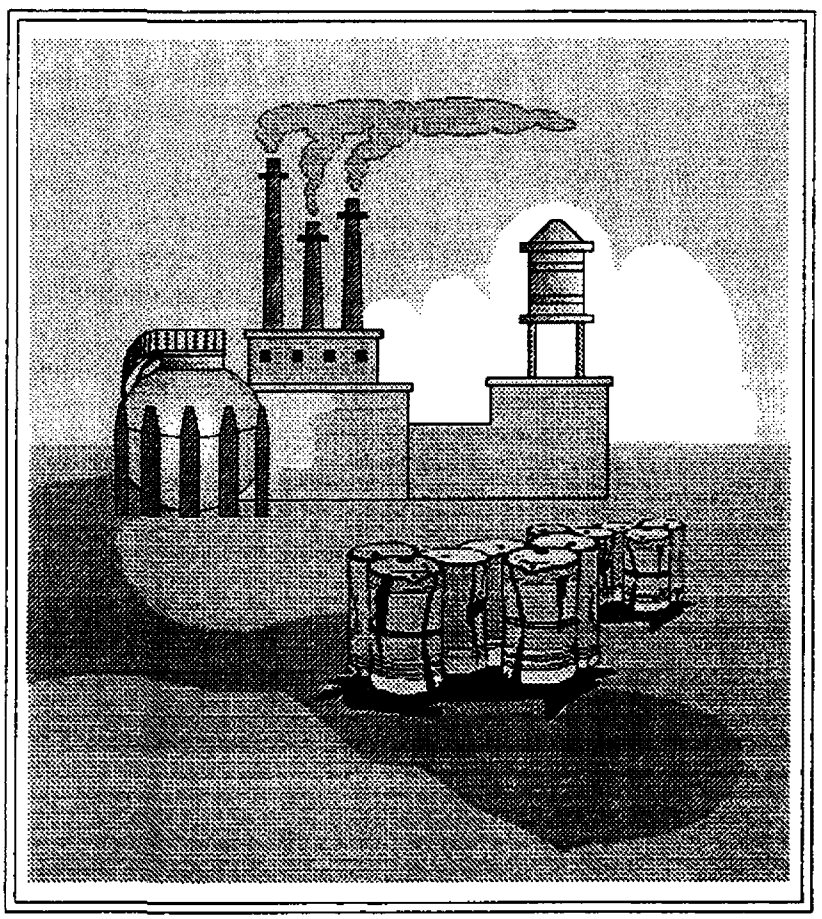
Recommendation based on site score

- No further remedial action planned (NFRAP)
- Expanded SI
- HRS package preparation

EPA makes final decision

SECTION TEN

CASE STUDY



CASE STUDY:
SI SAMPLING STRATEGY

OBJECTIVE

Using available site information for the Wolfram Industries site, develop a SI sampling strategy implementing procedures established in the SI guidance manual.

METHOD

1. Review the site information provided with this case study. The information is derived from the preliminary assessment (PA).
2. Identify the following elements and label them on the appropriate maps:
   - Sources
   - Targets
   - Areas of suspected contamination
   - PPE
   - In-water portion of the surface water pathway
3. Develop a list of objectives for an SI sampling plan.
4. Develop a sampling strategy to test the following PA hypotheses:
   - Suspected release to groundwater, surface water, and air
   - Suspected soil contamination
   - Exposure of targets to contaminated groundwater, surface water, soil, and air
5. Include the following elements in the sampling strategy:
   - Characterization of background
   - Demonstration of attribution
   - Quality control (minimal)
6. There is a limit of 20 samples for this exercise. You are not required to use all allocated samples.
7. Plot all sampling locations on the site map(s).
8. Complete the sampling strategy table.

SITE INSPECTION CASE STUDY: WOLFRAM INDUSTRIES

GENERAL SITE DESCRIPTION

Wolfram Industries is a 12-acre site located within an industrial area in Harbor Hill County, Fairlawn, New York. It consists of a laboratory, a warehouse, and a refinery. The site was active from 1941 to 1989 and has since been abandoned. The Mosquito River is located east of the site and flows south into Harbor Hill Bay. There are several small wetlands along the banks of the Mosquito River. A potato farm occupies a piece of land to the east of the river. Rainfall for this area is approximately 28 inches per year, according to the local weather station records.

The TIGER database provides the following population information for the region lying within 4 miles of the site.

DISTANCE FROM SITE	POPULATION
Onsite	0
0 -1/4 mile	250
1/4 - 1/2 mile	1,080
1/2 - 1 mile	4,520
1 - 2 miles	9,900
2 - 3 miles	35,400
3 - 4 miles	67,900

U.S. Census Bureau data for this region indicate an average 2.5 people per household.

OPERATIONAL HISTORY

A review of site records indicates that this facility processed tungsten ore into tungsten metal via crushing and hydrochloric acid extraction and precipitation reactions. Processed tungsten was used for making lighting filaments and other tungsten compounds. Waste products include acidic metallic slag that contains high concentrations of hexavalent chromium, lead, zinc, manganese, iron, copper, and cyanide.

Information obtained during the PA revealed several possible source areas on-site (see Figure 1, Wolfram Industries Site Map). The slag is stored in stacked 55-gallon drums throughout the site. The outdoor portions of the site are not paved. Two large piles of coarse-grained black ore tailings are adjacent to the refining facility. They are estimated to contain 375 cubic yards of waste within an estimated combined area of 416 square feet. A plastic-lined lagoon of unknown depth is found to the north of the refinery. It occupies an area of 2,000 square feet. The lagoon was reported to contain process waters and acidic solutions containing heavy metals and cyanide. Plants were observed growing out of a portion of the lagoon. Three monitoring wells that are 75 feet in depth are located around the lagoon. One down gradient monitoring well was reported to be vandalized and filled in with beer cans and gravel. The facility is fenced on three sides, but there is a large hole in the southern fence due to a recent automobile accident.

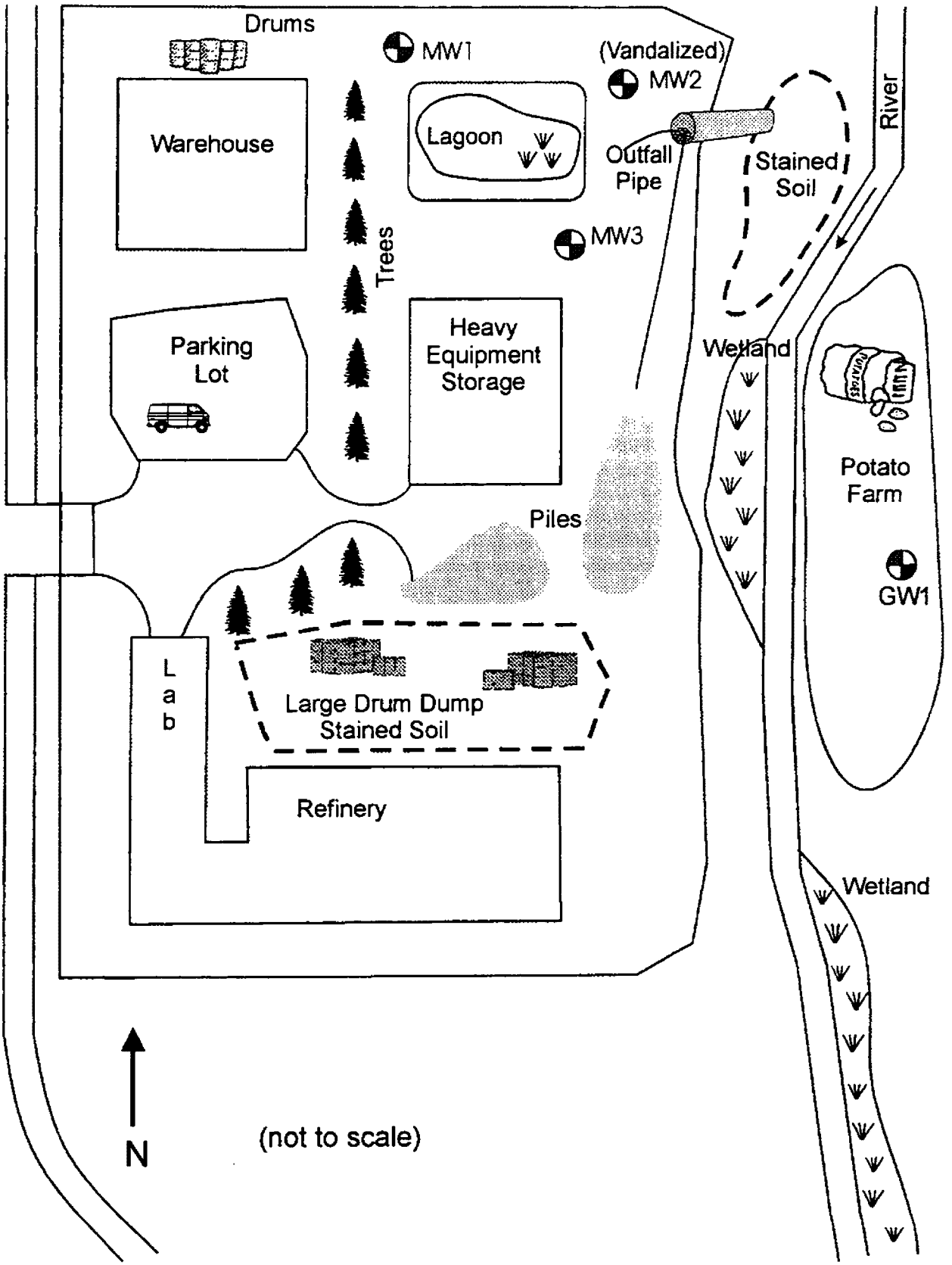
PROBABLE SUBSTANCES OF CONCERN

Based on observations made during the off-site reconnaissance for the PA, the 55-gallon drums of slag are badly deteriorated and the contents of several drums are spilling black, powdery slag onto the ground. Partially corroded drums were found on the north side of the warehouse; their contents are unknown. A topographic map of the area shows that the site slopes toward the northeast, and it is documented that runoff from the site is directed into the Mosquito River through an outfall pipe. The soil between the outfall pipe and the river was stained green and is devoid of vegetation. Aerial photographs of the site and information gathered during the PA indicate that there are 4,321 drums located outdoors. There is no containment, and these drums are in contact with the unpaved ground. The area of stained soil adjacent to the drums is estimated to be 400 feet by 600 feet. The area of contaminated soil near the outfall is estimated to be 100 feet long by 10 feet wide. The estimated depth of the contaminated soil for both areas is 0.5 feet.

GEOLOGY AND GROUNDWATER

Based on information gathered from a United States Geological Survey (USGS) publication, the native soil for the site and surrounding area is a thin (0 to 2 feet thick) cover of loamy soil. Beneath this soil lies a thick formation of sand and gravel that is part of the Atlantic Coastal Plain from the Cretaceous Period. A water table aquifer occurs at a depth of 60 feet below the surface, although perched water tables exist over small and discontinuous clay lenses at shallow depths (about 10 feet) throughout the area. Groundwater flow in the vicinity of the site is known to flow east-southeast or toward the Mosquito River.

FIGURE 1: WOLFRAM INDUSTRIES SITE MAP



GROUNDWATER PATHWAY

According to the municipal water authority, potable water for residents within 4 miles of the site comes from water reservoirs located 5 miles from the site. A wellhead protection area does not exist for this region. However, according to a USGS groundwater database, some residents have their own potable wells screened within a confined sand aquifer at a depth of 300 feet, but are located upgradient of the site. Groundwater from a shallow perched water table aquifer is used for the irrigation of Mr. Spuds 4.5-acre potato farm. There are eight homes located 0.3 miles from the site and 44 homes at 3.75 miles. This information was obtained from a USGS computer listing of wells within the county. No information is available on any well closures due to site contamination.

SURFACE WATER PATHWAY

The Mosquito River was identified on the topographic map as the closest surface water body to the site. It lies within 100 feet of the site. Based on information gathered during the off-site reconnaissance, an outfall pipe from the facility and its associated stained soil area lie adjacent to the river bank. The bank of this river is located several feet below the grade of the site. The Federal Emergency Management Agency (FEMA) indicates that the site is located on the 10-year flood plain. On average, the Mosquito River flows at 1,500 cubic feet per second, according to the USGS Water Resource Atlas for this region. The state fish and wildlife bureau has confirmed that portions of this river serve as a fishery for catfish and smallmouth bass and as a habitat for the state-designated endangered species known as the "long-eared sunfish." In addition, many sport saltwater fish are caught in Harbor Hill Bay located 13 miles to the south. One unmapped wetland (0.1 miles in length) was observed along the river closest to the site and another (0.4 miles in length) was identified from published wetlands maps. No known drinking-water intakes are located on the Mosquito River.

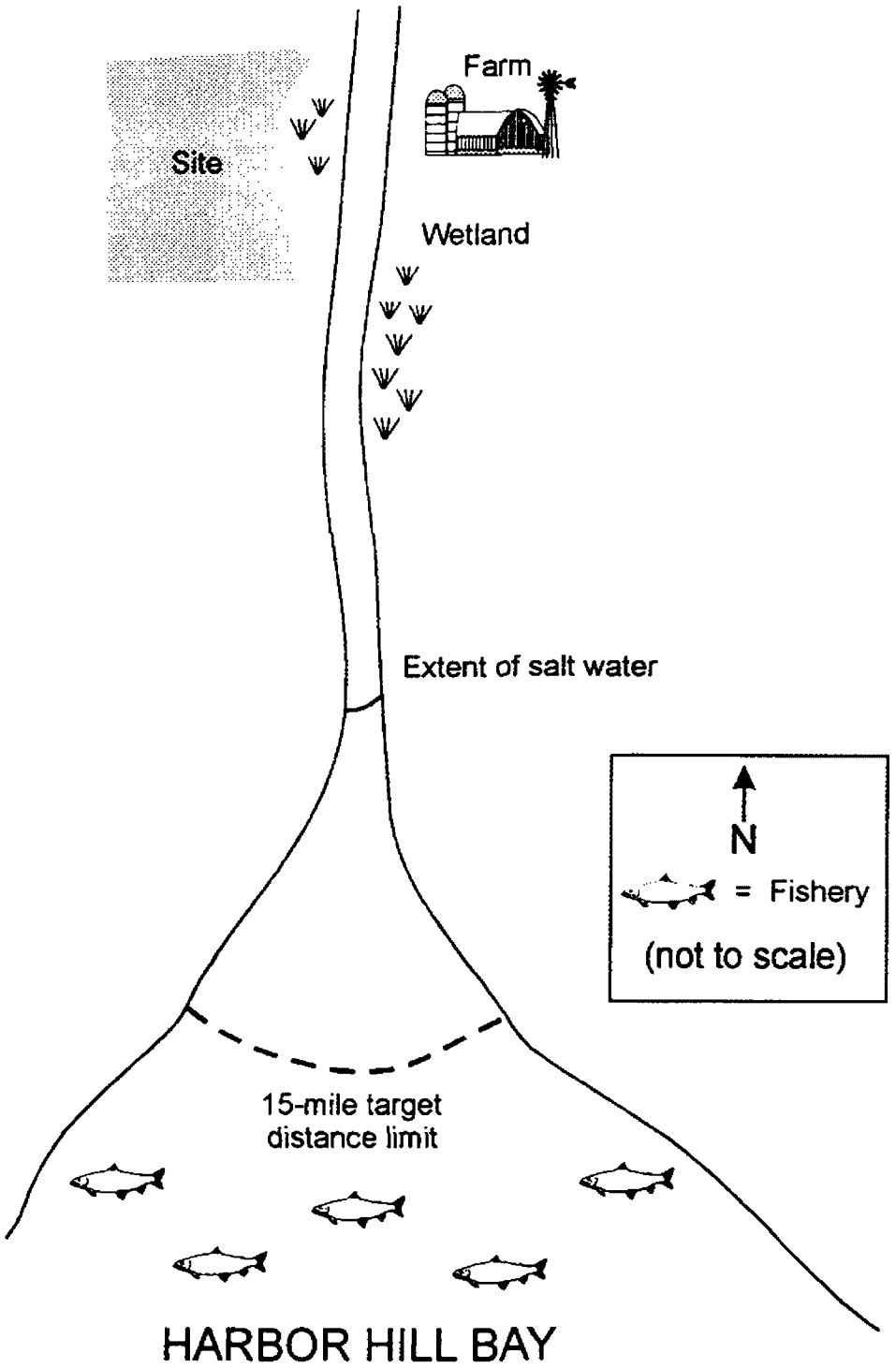
SOIL EXPOSURE PATHWAY

The PA states that there are no residents, schools, or day care centers located on or within 200 feet of an area of observed soil contamination. A hole in the fence of the facility allows unauthorized access by children or others. There are no terrestrial sensitive environments located on any areas of observed contamination. The total population within 1 mile of the site is 5,850 (based on TIGER data).

AIR MIGRATION PATHWAY

The nearest residence is located 0.24 miles west of the site and prevailing winds come from the west. No windbreak or covering is associated with the tailings piles.

FIGURE 2: SURFACE WATER PATHWAY MAP



SI SAMPLING STRATEGY

SAMPLE ID#	SAMPLE TYPE	RATIONALE

Total Samples:

Special Sampling Considerations:

Requested Analyses: