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National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN RESOURCES CONSERVATION AND ASSESSMENT
HAZARDOUS MATERIALS RESPONSE AND ASSESSMENT DIVISION
COASTAL RESOURCES COORDINATION BRANCH
c/o U.S. Environmental Protection Agency (H-1-2)
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May 28, 1992

Mr. Stephen Chao
Department of the Navy
Western Division
Naval Facilities Engineering Command
900 Commodore Way, Building 101
San Bruno, CA 94066-2402

Dear Mr. Chao:

The U.S. Department of Commerce/National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review the *Remedial Investigation Report, Operable Unit 2: Sites 3-11,13,14,16-19 Soils* for NAS Moffett Field, CA, submitted to EPA in April 1992.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Contingency Plan (NCP), NOAA is a designated Federal Natural Resources Trustee. As a natural resource trustee, NOAA is responsible for evaluating potential injury to NOAA trust resources that may be the result of releases of hazardous materials from CERCLIS sites. Through the Coastal Resource Coordination Branch, NOAA also provides technical advice throughout the site investigation and remediation process to aid in choosing appropriate analytical methodologies and protective remedies for NOAA resources.

This review concentrated primarily on Chapter 20, *Baseline Risk Assessment,* and Chapter 21, *Summary and Conclusions.* Information presented on exposure assessment and risk characterization/assessment were found to virtually ignore ecological concerns at the sites and center almost exclusively on human health concerns. This is particularly true for the risk assessment section (21.1 - 21.16) for each site in OU2.

Section 20.3.1.3, *Receptor Assessment - Environmental,* failed to clearly identify environmental receptors present at OU2 sites. A general description of flora and fauna was presented in the text but it did not appear that any field verification was conducted to determine which specific receptors were indeed present at the sites. Several of the sites in OU2 are either habitat or adjacent to habitat potentially utilized by species listed in the fauna section. The first step in conducting an ecological assessment is proper identification of the receptors potentially affected by activities at the sites.

The exposure assessment also failed to account for exposure pathways to environmental receptors. In section 20.3.2, *Identification of Potential Exposure Pathways,*

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there is virtually no description of potential pathways. Common pathways for environmental receptors can include soil ingestion, both direct and through the food chain, as well as dermal exposure. For example, the ground squirrel, a receptor included in the list of species found at Moffett Field, lives in the soil and may be burrowing in areas where contaminated soils may be present. It would be appropriate to explore a soil exposure pathway for this receptor as part of a complete ecological risk assessment.

The ecological risk portion of the RI for OU2 essentially does not exist. This section of the RI is deficient as a comprehensive assessment and does not satisfy the requirements of EPA guidelines for an RI/FS risk assessment. The full extent and magnitude of risk to environmental receptors cannot be evaluated based on the information presented in the receptor identification, exposure pathway identification, and risk assessment and characterization. It is unclear how a feasibility study will be written without first addressing the ecological impacts which may exist from activities at the OU2 sites.

Guidance is available to assist the PRP in developing a comprehensive and thorough ecological risk assessment. This guidance, which is available from EPA, was developed for the Superfund program by EPA with input from both NOAA and the US Fish and Wildlife Service. Please refer to the following document for guidance in structuring and executing an ecological assessment: *Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual (EPA/540/1-89/001), March 1989.*

I am also providing some additional guidance to supplement the above mentioned document. Please find attached the most recent ECO UPDATE entitled, *Developing a Work Scope for Ecological Assessments*. If you have any questions about these comments or require further explanation or elaboration, I will be happy to discuss them with you. I may be reached at (415) 744-3126.

Sincerely,

Denise M. Klimas

Denise M. Klimas
Coastal Resources Coordinator

Enclosure

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Developing A Work Scope For Ecological Assessments

This Bulletin is intended for Remedial Project Managers (RPMs), to help them plan and manage ecological assessments of sites as part of the Remedial Investigation and Feasibility Study (RI/FS) process.[1] As used here, the generic term **work scope** describes the process of specifying the work to be done for the ecological assessment, as part of the overall RI Work Plan. The term encompasses project scoping, development and approval of the Work Plan, and preparation of the Statement of Work (SOW) for contractors (at Fund-lead sites).

The outcome of a successfully executed work scope should be an ecological assessment that includes four essential components: problem formulation, exposure assessment, ecological effects assessment, and risk characterization.[2] A work scope should also provide for close oversight of individual tasks. This will ensure that the assessment accomplishes its objectives within reasonable budget and schedule limitations.

Need for Clarity, Specificity, and Completeness

SOWs and Work Plans should clearly state the studies needed at each phase of the assessment. In addition, they should include other parameters concerning an assessment, such as sample collection, data analysis, and reports. Specifically, SOWs and Work Plans should describe:

- Which studies should be conducted;
- Why they should be conducted;
- When and where they should be conducted;
- What data should be collected;
- How samples should be collected, handled, and analyzed;
- How data should be evaluated; and
- What reports should be produced.

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[1] Although the primary focus of this document is on the RI/FS process, On-Scene Coordinators may find much of the information useful in evaluating sites during the removal process.

[2] *Ecological Assessment of Superfund Sites: An Overview* (*ECO Update* Vol. 1, No. 2).

ECO Update is a Bulletin series on ecological assessment of Superfund sites. These Bulletins serve as supplements to Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual (EPA/540-1-89/001). The information presented is intended as guidance to EPA and other government employees. It does not constitute rulemaking by the Agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with these Bulletins.

Preparing a clear, specific, and thorough SOW will avoid such problems as the following:

- **Too much work,**
- **Too little work,**
- **Incorrect work, and**
- **Inadequate QA/QC.**

The work scope should also detail how decisions will be made about the need for additional studies.

Preparing a clear, specific, and thorough SOW will avoid such problems as the following:

- **Too much work.** In the absence of clear direction, a contractor may do considerably more work than is required to characterize the ecological risks at the site, wasting both time and money. The studies could be valid, well-designed, and complete, but unnecessary given the nature of the site and its contaminants.

- **Too little work.** An improperly designed study can result in inadequate attention to potentially important habitats or species associated with the site, too few sampling stations to characterize a habitat, or too few data points for meaningful statistical analysis. Such shortcomings could result in the need to conduct additional studies and cause delays in producing an acceptable RI/FS.

- **Incorrect work.** If the SOW is not specific enough as to what work is needed or what the objectives of the studies are, the contractor may conduct studies that fail to meet the needs of the RI/FS decision-making process. In this case, valuable time may be lost as the correct studies are rescheduled.

- **Inadequate QA/QC.** If the SOW does not specify data quality objectives (DQOs), the data may not meet the level of quality required to make decisions on risk or remedial actions. As above, a delay in the RI/FS process may result.

The Role Of The Biological Technical Assistance Group

Most EPA Regional Offices have established groups of biologists to advise site managers on ecological assessment in the RI/FS process from the Work Plan stage onward. These Biological Technical Assistance Groups (BTAGs)[3] provide valuable help in the development of a work scope.

RPMs should contact the Regional BTAG Coordinator as early in the process as possible, certainly before the Work Plan has been developed. The RPM should provide appropriate documentation on the site and its contaminants to BTAG members before the group meets to discuss the site. In addition, the BTAG may find a brief oral presentation on the site and its history helpful at this time. (A future *ECO Update* will provide guidance on how to provide the BTAG with useful information in this initial briefing.) Following this initial review of site data, the BTAG can make recommendations on the need for studies to characterize the ecological risks posed by the site. When the draft Work Plan has been developed, BTAG review may elicit further helpful comments.

The BTAG should also be consulted when interim products (reports, data summaries, etc.) are delivered. Based on the data in such a product, the BTAG may recommend modifications to the original work scope. Because this kind of "mid-course correction" can save a project time and money, the RPM is well advised to schedule time for such reviews in the Work Plan.

Points To Consider In Developing A Work Scope

Definition of Objectives

The work scope for the ecological assessment of a Superfund site requires an overall objective to provide the assessment with direction. When an assessment has a clear objective, the RPM can readily determine which studies will further the assessment. For example, at a site where chemicals from mine tailings contaminated the cold mountain streams that flow through the area, the work scope had for one of its objectives to determine whether resident fish had suffered adverse impact. Consequently, the work scope specified studies that concerned fish and their environment. These studies included aquatic toxicity tests, a

[3] These groups are sometimes known by different names, depending on the Region, and not all Regions have established BTAGs. Readers should check with the appropriate Superfund manager for the name of the BTAG coordinator or other sources of technical specialized facilities, and specialized equipment necessary to carry out the work. If not, qualified subcontractors should be sought for those tasks where their qualifications are needed.

fish survey, and **bioaccumulation**[4] studies using resident fish.

The overall assessment objective may be clear from the outset, based on data from previous studies or on an evaluation of the concentrations and known effects of site contaminants. More likely, some preliminary studies, including a site visit and collection of screening-level data, will be needed to identify and specify the objective of the ecological assessment. Where possible, these preliminary studies should incorporate the need for future work.

Just as an ecological assessment gains direction from having an overall objective, each study that the work scope specifies also should have a clear objective, such as filling a data gap or testing a hypothesis about the effects of the site's contaminants on resident organisms. By stating a study's objective, an RPM provides guidance for designing the study. For example, the work scope for the mining site described above called for aquatic toxicity testing to determine whether the water was toxic to freshwater fish that thrive at low temperatures. This study objective provided specific direction in planning the toxicity tests.

Assessment Design

The work scope lays out the design for an ecological assessment. Assessment designs vary tremendously from site to site depending on:

- The objective of the assessment;
- The size, location, and accessibility of the site;
- The site's ecology—what is already known and what needs to be known; and
- The site's contaminant history.

In an ecological assessment, the individual studies are the pivotal elements. If the overall objective gives an ecological assessment a purpose, the studies are the vehicles by which it attains its purpose. Studies can include chemical analyses of media or biota, toxicity testing of laboratory or resident organisms, biological field studies, and analyses of organisms' physiological or pathological condition. However, because a work scope indicates only those studies necessary for assessing a specific site, any one assessment need not include all of these types of studies. The assessment design specifies not only which studies to perform but also the level of effort for each. For example, the work scope developed for the mining site described above included toxicity testing, but only of one medium (surface water) and with only one type of test organism (fathead minnow). At another site, toxicity testing might include evaluation of soil, sediment, and surface water using several different organisms.

The complexity of an ecological assessment makes it essential that trained ecologists have responsibility for its design. The RPM can consult the BTAG for advice as to which media to analyze, which studies to perform, and at what level of effort. The RPM can include this information in the SOW. As discussed below, since the contractor has responsibility for developing the Work Plan from the SOW, the RPM needs to consider whether the contractor's staff has the required expertise. After a contractor has prepared the Work Plan, the BTAG can review it and advise the RPM whether or not to approve it.

The phased approach ensures that:

- **Only the necessary work will be done, and**
- **All the necessary work will be done.**

Phased Approach to Task Implementation

For most sites, a phased approach with expert review at each phase results in the most efficient use of resources. With the phased approach, data or observations from one phase determine whether further studies are needed to meet the assessment's objectives and, if so, what these studies are. At some sites, the phased approach might result in a low level of effort adequately characterizing ecological risks. At others, the phased approach might indicate that the assessment should be expanded to include studies of specific habitats or contaminants in order to evaluate the risks. At still other sites, the phased approach could identify areas originally not considered at

[4] Bioaccumulation is the accumulation of a substance in an organism's tissues as a result of respiration, absorption, or feeding.

risk. In this case, the RPM would want to expand the work scope to include an assessment of the newly identified area. Review of interim products, such as a report on the levels of contaminants of concern or a field survey of resident species, can contribute to the phased approach. Careful review of interim products can help to ensure that the assessment remains focused on those studies most important for evaluating the site's ecological effects.

To summarize, the phased approach ensures that:

- *Only* the necessary work will be done, and
- *All* the necessary work will be done.

The value of the phased approach can sometimes be outweighed by other factors. For example, seasonality affects when certain types of studies, such as floristics surveys, can occur. In some cases, budgetary restrictions and time constraints may be incompatible with the phased approach. RPMs may need to consider such factors when planning studies.

In practical terms, the phased approach requires an RPM to decide when a contractor should proceed from one task to the next and whether the contractor should proceed with one alternative task or another. In making these determinations, the RPM interprets information from completed studies. The BTAG can assist the RPM in identifying criteria appropriate for evaluating data. (See Figure 1.)

An ecological assessment should be designed to contribute to remedial decisions at the site.

As an example of the phased approach, consider the following hypothetical case. (See Figure 1.) An RPM has a field reconnaissance done in order to identify and map potentially exposed habitats at a site. The RPM then uses the results of this study to decide on the numbers and placement of sampling stations for initial chemistry data. After the first round of sampling for contaminant levels at these stations, the chemistry data indicate that contaminant levels are high enough in some areas of the site to warrant collection of biological data from the field, along with additional data on site chemistry. The field data collected indicate the advisability of toxicity testing at certain stations, but not at others. In other parts of the site, the low level of contaminants indicate that no further biological investigation is required. Thus, in this hypothetical example, use of the phased approach results in the areas most in need of study receiving the most attention.

An ecological assessment involves problem formulation, exposure assessment, ecological effects assessment, and risk characterization.

Relating Ecological Information to Remedial Decision-Making

While an ecological assessment of a Superfund site might extend our knowledge of the environment and the effects of contaminants on it, the assessment is not intended as a research project. Rather, it should be designed to contribute to remedial decisions at the site. Ecological assessments serve this function when they determine whether remediation is needed, indicate the conditions (if any exist) requiring remediation, suggest technologies for achieving remediation, and/or estimate the environmental effects of proposed remedial alternatives. At the earliest stages of Work Plan development, the RPM and BTAG should consider what types of ecological information will contribute to remedial decisions. For example, the site manager may need to know:

- If remediation goals are protective of environmental receptors,[5]
- If ecological risk considerations will affect the definition of the area to be remediated,
- If special measures need to be taken during remediation to protect natural habitats, and
- What monitoring will be needed to ensure protection of environmental receptors during and after remediation and to evaluate the effectiveness of remedial actions.

[5] Receptors are individuals, populations, or communities/habitats that may be exposed to a contaminant.

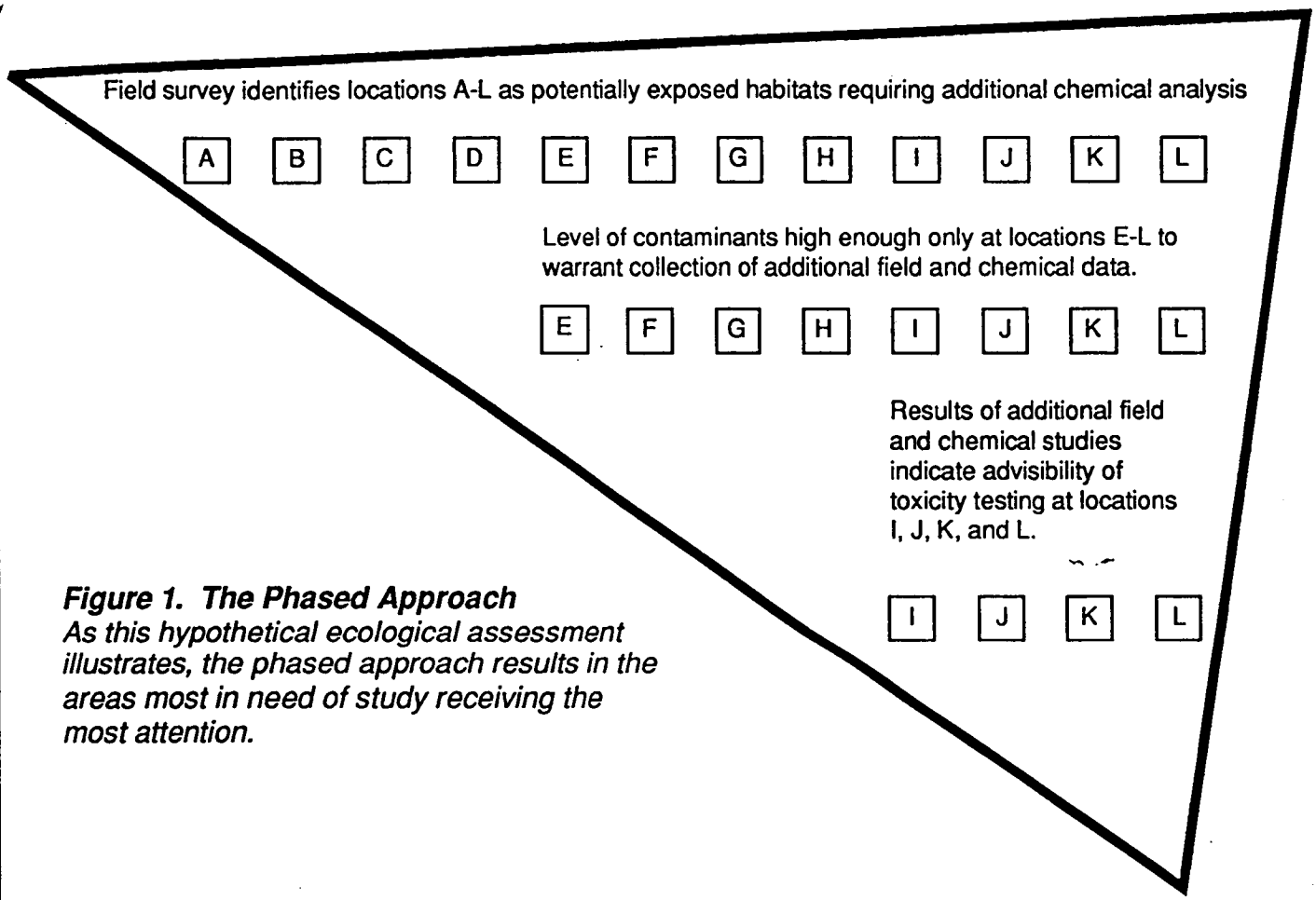


Figure 1. The Phased Approach
As this hypothetical ecological assessment illustrates, the phased approach results in the areas most in need of study receiving the most attention.

Questions such as these should form part of the initial scoping session, where the RPM and the BTAG select appropriate studies and study designs.

Elements Of An Ecological Assessment Work Scope

As described in *Ecological Assessment of Superfund Sites: An Overview* (*ECO Update* Vol. 1, No. 2) an ecological assessment involves problem formulation, exposure assessment, ecological effects assessment, and risk characterization. To ensure that an assessment fulfills its objectives, the work scope should use its elements to accomplish these tasks. In addition, the work scope should identify data quality indicators to ensure that established DQOs are met.

Problem Formulation

Problem formulation defines the assessment's objectives and also involves a thorough description of the site. This qualitative description must occur before deciding on any substantial quantitative work.

An initial site description should include citations from existing site literature (such as the Preliminary Assessment, Site Inspection, or any studies conducted in support of removal actions) relating to site history, physical features of the site, known or suspected contaminants, habitats on or near the site, species expected at or near the site, and known or anticipated effects of site contaminants on receptors. Investigators should determine whether threatened or endangered species are known or suspected to occur at or near the site. Descriptions of potentially affected habitats should include as much detail as possible. For instance, stream habitats vary considerably depending on stream depth and width, type of stream bottom, and types of vegetation in and adjacent to the stream. Information pertaining to these types of characteristics could affect both the kinds of studies required to evaluate possible effects and the level of effort needed to conduct the studies.

This qualitative description of the site helps to indicate whether further studies are needed and, if they are, what these studies should be. For example, if scientific

literature or databases indicate that a site's contaminant concentrations consistently fall below levels likely to cause adverse ecological effects, additional analyses may be unnecessary. On the other hand, if contaminant concentrations suggest a need for further investigation, the initial site description may identify potential exposure routes useful in targeting the additional studies to media and areas of greatest concern. Targeting studies makes the most efficient use of the time and money available for the ecological assessment.

A site visit should form part of the initial site description phase. In addition, the RPM may decide to characterize the site's ecology further by conducting limited field studies. These studies could include aerial photography, evaluation of habitats' suitability for wildlife, functional evaluation of wetlands,[6] qualitative or semi-quantitative examination of the environment for evidence of stress (e.g., stressed or dead vegetation, bare soil and erosion, dominance by pollution-tolerant species), and field verification of the presence or absence of key species. At some sites, the existence of site descriptions made prior to contamination may enable the RPM to assemble a "before and after" picture of the site.

Based on the information developed in this initial site description, the investigator (under the direction of the RPM and with BTAG consultation) should specify:

- The receptors (habitats and species) most likely to be exposed to site contaminants,
- The contaminants most likely to be of ecological concern,
- The ecological effects most likely to be important with regard to the site, and
- The studies needed to characterize actual or potential adverse effects associated with site contaminants and, where applicable, the hypothesis that the study will test.

Exposure Assessment

Since exposure assessment quantifies the actual or potential exposure of receptors to contaminants, the work scope must plan for studies that gather appropriate data on both receptors and contaminants. Evaluation of chemical and biological data will indicate which receptors and contaminants are appropriate subjects of study and how best to evaluate exposure at a particular site. And, as in all other decisions of this type, the RPM can consult the BTAG before committing resources.

The work scope can either specify receptors for exposure studies or set criteria for selecting receptors. Receptors studied in the exposure assessment could be chosen from among the site's biota, or surrogate species (e.g., standard test species) might be used. Resident species used as receptors can be selected from among those most likely to suffer adverse effects from site contaminants or those considered representative of or critical to the ecosystem. Alternatively, the work scope could specify receptors for further study because they are of concern for statutory or other reasons (e.g., those species protected under Federal law). When the RPM has satisfied these criteria for choosing receptors, he or she can then consider which of the species are most amenable to rapid and inexpensive field evaluation. Field, laboratory, and literature studies conducted in the Problem Formulation phase can also aid in selecting and characterizing receptors. The exposure assessment should include information on feeding habits, life history, and habitat preferences of receptors.

To study exposure to contaminants, the work scope might include additional chemical analyses and the measurement or estimation of exposure point concentrations. Chemical analysis of plant and animal tissues is one useful technique for determining whether exposure to contaminants has taken place. For contaminants known to bioaccumulate, analysis of tissues from organisms representing different trophic levels (e.g., plant, herbivore, carnivore) also permits measurement of dietary exposure for species that feed on contaminated organisms. Biochemical, physiological, and histological studies can also provide information about exposure of receptors to site contaminants.

The work scope could also specify studying exposure by means of fate-and-transport models. **Fate** concerns the ultimate chemical disposition of a contaminant, such as remaining stable, undergoing photodegradation, or combining with another substance. **Transport**, or migration, refers to the movement of a contaminant from one medium to another, from one location to another within the same medium, or into biota. Site characteristics, contaminants' physical and chemical properties, and

[6] A functional evaluation of a wetland determines the importance of the wetland for such values as wildlife habitat, pollution abatement, and flood control. This type of study helps to establish the value of a particular wetland as it relates to the need for remediation. Another type of study, a wetland delineation, defines the boundaries of a wetland based on soil type, vegetation, and hydrology. The delineation aids in the selection and evaluation of remedial alternatives. Site managers should consult with their BTAGs to determine which of these studies are appropriate, if at all, and when they should be conducted.

bioaccumulation studies provide information useful in predicting the fate and transport of site contaminants.

Ecological Effects Assessment

Ecological effects assessment links concentrations of contaminants to adverse effects in receptors. Literature reviews, field studies, and laboratory studies provide the information for making this link. However, the ecological assessment of a site may not require all three of these types of studies.

Field studies of populations and communities[7] support ecological effects assessment by providing information on the condition of populations of resident species and on any contaminant-related changes in ecological communities. In their focus on resident populations, field studies play a central role in identifying receptors. Such studies also can allow investigators to collect samples for laboratory analysis.

Field studies focus on natural environments, including freshwater, marine, or terrestrial environments. Aquatic field studies can include surveys of benthic (bottom-dwelling) organisms and surveys of organisms in the water column. Marine studies can also include surveys of coastal and tidal areas. In terrestrial environments, field studies may focus on vertebrates, invertebrates, or vegetation. An RPM also may need to conduct field studies in such human-managed environments as residential neighborhoods and other landscaped areas, since some wildlife species make use of these areas for all or part of their life cycle.

Generally, habitats that are potentially or actually exposed to contaminants require some field study. Consulting with the BTAG will enable the RPM to select the methods and level of effort appropriate to the site and its remedial objective. Whenever possible, the work scope should specify standard or commonly accepted field methods. A future *ECO Update* will provide information about field studies useful at Superfund sites.

Level of effort depends on the choice of qualitative, semi-quantitative, or quantitative studies. In some cases, qualitative studies will adequately describe the habitats and species at risk. However, most sites with suspected adverse effects will require some semi-quantitative or quantitative studies. For example, at one site a semi-quantitative approach for evaluating effects of stream pollution might sufficiently characterize differences in species composition between contaminated and uncontaminated areas of a stream. But another site might require a more detailed quantitative analysis to discern such differences.

An important task in preparing a work scope involves coordinating different types of studies. In an ecological effects assessment, simultaneous collection of site chemistry data and biological field data allows the analysis to show clearly whether a correlation exists between contaminant presence and ecological effects.

Toxicity tests (bioassays) constitute a major type of study used in assessing ecological effects at Superfund sites. Toxicity tests expose selected organisms to water, soil, or sediment from the site to determine whether the medium adversely affects the organisms. Most commonly, technicians perform these tests in laboratories using standard test organisms. However, toxicity tests also can occur on-site and can use resident organisms.

Especially for a site with only one or a few contaminants, toxicity tests can contribute to the weight of evidence linking the contaminants to biological effects. Specifically, while chemical analyses indicate the presence of contaminants, they do not indicate whether contaminants are **bioavailable**.[8] In order to have a toxic effect, a contaminant must be both bioavailable and toxic. The relationship between toxicity and site contaminants is less easily interpreted for sites with a more complicated contaminant picture.

The work scope should coordinate the collection of site chemistry data and toxicity data. When the work scope specifies that toxicity tests will occur in the laboratory, field scientists should collect samples for chemical analyses and toxicity tests at the same time and in the same place. When the work scope calls for *in situ* toxicity tests, chemical sampling should happen concurrently and at the same locations. In this way, analysis of the data can most clearly evaluate correlations between toxicity results and contaminant levels.

Consulting closely with the BTAG can help the RPM decide which tests are appropriate and the specific conditions under which to conduct the tests. A future *ECO Update* will focus on using toxicity tests in ecological assessments.

Risk Characterization

In ecological assessments, risk characterization evaluates the evidence linking site contaminants with adverse ecological effects. To characterize risk, the investiga-

[7] A population is a group of organisms belonging to the same species and inhabiting a contiguous area. A community consists of populations of different species living together.
[8] Bioavailability is the presence of a substance in a form that organisms can take up.

tor evaluates all of the chemical and biological data relating to the site, comparing the results of the exposure assessment with the results of the ecological effects assessment. In particular, fate and transport studies can provide evidence of links between site contaminants and observed or predicted effects.

Also relevant to risk characterization are the results of the chemical analyses of media, toxicity testing, and field studies. At some sites RPMs will have had these studies conducted along contaminant gradients. Where risk characterization establishes a link between contaminants and adverse effects, it should also describe the qualitative or quantitative ecological significance of these effects.

A successful work scope is one that correctly anticipates the types of studies that will provide the data needed for risk characterization.

The results of an ecological assessment support the remedial decision-making process only if the data are scientifically defensible.

Quality Assurance

The results of an ecological assessment support the remedial decision-making process only if the data are scientifically defensible. Usually, this means that the data should be (1) accurate and (2) amenable to statistical analyses (for quantitative studies). Data quality objectives are qualitative and quantitative statements of the overall level of uncertainty that a decision maker is willing to accept. Consequently, data quality objectives reflect the statistical design of the study and the level of significance needed to support any conclusion that might be drawn from the study. For example, the SOW should specify a sample size large enough to account for natural variability to ensure that DQOs are met. In reviewing the Work Plan, the RPM should ensure that minimum sample sizes are specified for statistically valid analyses, that significance criteria meet the needs for remedial decision making, and that quality control procedures are in place to ensure accuracy and precision.

Before approving a Work Plan, the RPM should make certain that the contractor has the trained personnel, specialized facilities, and specialized equipment necessary to carry out the work. If not, qualified subcontractors should be sought for those tasks where their qualifications are needed.

Quality assurance is the set of procedures that ensure that the quality of data meets the needs of the user. The Work Plan establishes quality assurance for field work and laboratory analyses by specifying criteria for such items as sample collection, sample handling, and numbers of replicate analyses. Selecting standard methods specified in EPA or other Federal agency manuals (subject to EPA approval), when these methods are appropriate, can provide confidence of a stated level of quality assurance because they have built-in quality control activities.

Laboratories that conduct standard toxicity tests, such as those required under the National Pollutant Discharge Elimination System (NPDES), have in place quality control procedures that are readily subject to review and audit. Contractors experienced in conducting field studies should also have standard procedures for ensuring accuracy and reproducibility in their work. As an example of quality control in a field study, a survey of benthic invertebrates could require an independent taxonomist to classify a randomly selected sub-set of the organisms identified by the study's field or laboratory staff.

When the work scope specifies clear and appropriate quality assurance procedures, the data collected should satisfy the specified data quality indicators of precision, accuracy, representativeness, completeness, and comparability.

Ensuring Contractor Capability To Do Work

Ecological studies require trained personnel, and some studies also require specialized facilities and equipment. Before approving a Work Plan, the RPM should be

satisfied that the contractor proposing to carry out the work can do so. If not, qualified subcontractors should be sought for those tasks where their qualifications are needed.

Personnel

In selecting a contractor, an RPM must look for a direct match between contractor qualifications and the scope of work. To this end, the RPM should request information on the specific training and experience of proposed individuals with respect to the specific tasks to be undertaken. For example, if a Work Plan calls for sampling benthic invertebrates in a stream, those conducting the study should:

- Be familiar with the types of equipment (e.g., Surber sampler, artificial substrates) appropriate to the study site;
- Know how and where to collect samples (e.g., what kinds of stream bottoms support which species);
- Know what kinds of environmental data to collect along with the biological and chemical samples (e.g., water temperature, pH, dissolved oxygen, hardness); and
- Have the requisite taxonomic expertise to identify the organisms (principally the larval stages of insects) collected.

On the other hand, these same individuals may lack qualifications for conducting other types of studies, such as wetland assessments or the collection of small mammals for tissue analysis. Although some experienced biologists have developed considerable expertise working in a wide variety of habitats and with a broad range of species, many others are specialists in their fields and do not know the details of conducting studies outside their specialty. Consequently, the RPM must ask for evidence of specific individuals' capabilities to carry out proposed tasks. This evidence can consist of results of similar studies conducted in the past. These results should demonstrate that the contractor performed studies correctly and that the resulting data served its intended purpose.

Facilities and Equipment

The RPM also should require a contractor to demonstrate capability in terms of any specialized facilities and equipment needed to conduct the studies selected for a particular site. For example, most of the toxicity tests used to evaluate aquatic systems are standard procedures developed for NPDES. Many States have certification programs for laboratories that conduct NPDES toxicity tests. If the work scope calls for such tests at a site, the RPM can ask that the contractor use a laboratory certified in at least one State (if possible, the State where the site is located), and that the laboratory show proof that it has conducted the same or similar tests in the recent past. Alternatively, where a State and its neighboring States have no certification program, the RPM can obtain the name of an appropriate laboratory from the State agency charged with regulating NPDES permittees. In the case of field sampling, the BTAG or Regional field biologists can evaluate a contractor's capabilities.

In all cases, contractors must possess both the appropriate equipment and staff trained on that equipment. For instance, a commonly used method for collecting fish involves electroshock equipment that stun the fish, causing them to float to the surface. Electroshock equipment ranges in size from small backpack units to large boat-mounted units. For both safety and efficacy, it is essential to use the right size of equipment manned by a crew familiar with its operation and safety requirements.

Review Of Interim And Final Products

In keeping with the suggested phased approach, the RPM should plan for BTAG review of interim products such as initial site descriptions, initial field surveys, and reports on specific studies such as toxicity test results or field data. Such reviews form the basis for revising the work scope to account for the new findings.

In addition to the interim products mentioned above, the RPM should have the BTAG review the draft Work Plan and the draft ecological assessment before the contractor proceeds with the final version. With regard to the draft ecological assessment, the RPM should particularly request the BTAG to comment on the quality of studies and the validity of their findings. The RPM will also want to know whether the data support any conclusions about proposed remedial actions at the site.

Sample Work Scope

The Appendix presents an example of the kinds of components likely to occur in a typical work scope. Of course, work scopes designed for particular sites will differ significantly from the general one in the Appendix. An RPM will find it necessary to tailor the work scope to the specific conditions and objectives at an individual site.

The example in the Appendix also demonstrates how BTAG review of interim products can alter the scope and level of effort for succeeding tasks. The example always states that products are subject to review and approval by the site manager, because the BTAG has no official authority to approve or disapprove contractor work. Nevertheless, wherever appropriate, the RPM should ask the BTAG for review and advice on each product. In scheduling a project, RPMs need to allow time for the review process. In fact, some Regional BTAGs require a minimum review period.

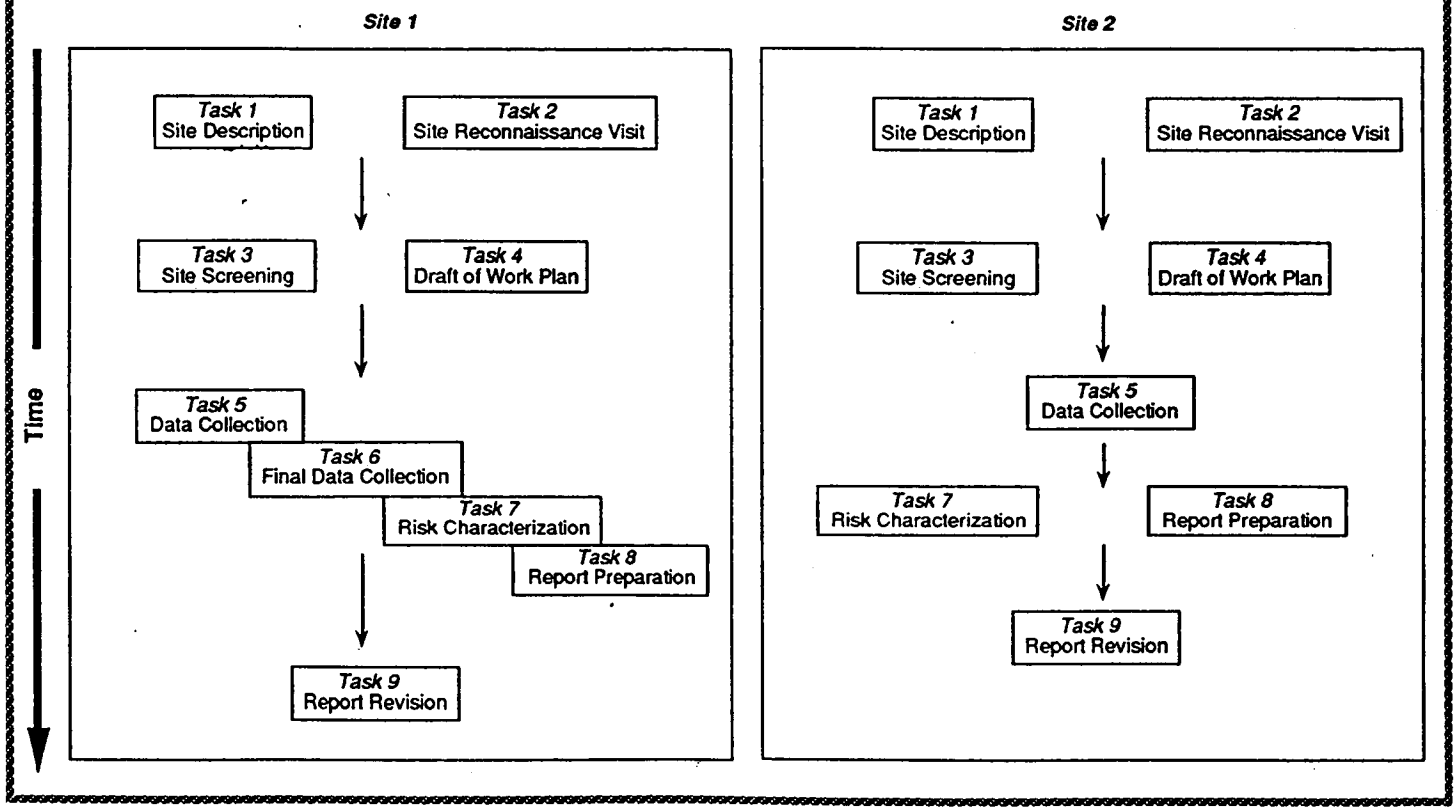
In addition to the general work scope in the Appendix, RPMs in several Regions have available to them generic work statements or other guidance material prepared by their BTAGs. RPMs should check with the BTAG coordinator in their Region to obtain any such guidance.

Conclusion

This Bulletin has summarized the issues an RPM needs to address in developing work scopes for the ecological assessment of Superfund sites. Because every site presents a unique combination of study problems, RPMs should consider the expert advice of BTAG members as an essential part of the planning process for these assessments. These specialists should be consulted as early as possible in the planning stages for a site, and should remain involved in the planning and oversight throughout the life of the project. By involving the BTAG in this way, the RPM can be assured that ecological as well as human health effects will receive the full attention called for in the law and in Agency policy directives.

Figure 2 Ordering Tasks in an Ecological Assessment

An investigator can conduct simultaneously some of the tasks that a Work Plan details for an ecological assessment. As indicated below, which tasks can occur simultaneously will vary somewhat with the site. Note that Site 2 does not require Task 6 (Final Data Collection), indicating that Task 5 gathered all the data necessary for an ecological assessment.



APPENDIX

SUGGESTED TASKS IN PLANNING AND EXECUTING AN ECOLOGICAL ASSESSMENT

The following tasks can help a contractor in assembling an acceptably detailed and focused ecological assessment. Wherever possible, these tasks should be coordinated with the human health assessment and any hydrogeologic investigations.

A site's ecological assessment may not require all of the tasks. For example, with site description (Task 1) and the reconnaissance visit (Task 2) complete, the RPM may decide that the Work Plan can be drafted (Task 4) without any further site characterization (Task 3).

Note also that an investigator can conduct certain tasks simultaneously rather than sequentially, greatly enhancing the efficiency of the process (Figure 2). Precisely which tasks can occur simultaneously and which the investigator must conduct sequentially depend upon the site.

Task 1. Site Description

Purpose: Preliminary screening of the extent of contamination and the potential for adverse effects

Description: Qualitatively describe site based on existing data from the Preliminary Assessment, Site Inspection, and other sources, including:

1. Physical description of the site and its surroundings, including photos and detailed maps
2. Nature and extent of contamination by medium and contaminant type
3. Site-associated habitats potentially exposed to contaminants
4. Initial toxicity assessment of site contaminants with respect to environmental receptors, including comparison to criteria and other benchmarks

Submit interim report to site manager for review.

Task 2. Site Reconnaissance Visit

Purpose: Gather first-hand expert opinion of site's condition and suggestions about what, if any, studies are needed

Description: If authorized by site manager, prepare plan for site reconnaissance, including:

1. Chemical and biological data needed for more complete initial site description
2. Methods to be used to collect necessary data
3. Criteria for deciding whether and what future studies might be necessary

Submit reconnaissance plan to site manager for review.

Task 3. Site Screening

Purpose: With limited studies, identify and characterize habitats and characterize exposure and ecological effects. [For some sites, information will suffice for risk characterization]

Description: If authorized by site manager, further characterize site based on field observations, including, as appropriate:

1. More detailed habitat identification and evaluation

   a. Suitability for wildlife, including an endangered species consultation with State and Federal agencies

   b. Ecosystem value and function (e.g., wetland functional analysis)

2. Qualitative and semi-quantitative surveys of flora and fauna

3. Toxicity tests

4. Additional chemical sampling

5. Identification of appropriate reference sites for comparison to each potentially exposed habitat

6. Simple modeling of transport and exposure

Submit interim report to site manager for review.

Task 4. Draft of Work Plan

Purpose: Develop a plan that will provide any additional information about exposure and ecological effects that is needed to characterize risk

Description: Draft detailed Work Plan for any further site investigations needed, including overall assessment objective and, as appropriate:

1. Qualitative, semi-quantitative, and quantitative surveys of flora and fauna in potentially exposed habitats and reference sites

2. Chemical sampling of media and biota in potentially exposed habitats and reference sites

3. Laboratory and *in situ* toxicity testing

4. Tissue analyses, enzyme studies, and bioaccumulation studies

5. Simple modeling of fate and transport

For each proposed study above, provide:

   a. Objectives of the study, effects to be measured, and relevance to overall risk assessment objectives at the site

   b. Proposed field or laboratory methods and their risk-based detection limits (where appropriate), with appropriate references to Agency guidelines or other source

   c. Criteria for determining sampling locations, expected sampling locations (including detailed maps), sampling dates, and sample sizes

   d. Benchmark, or background values, where appropriate

   e. Statistical methods to be used and data quality indicators to meet statistical significance criteria

   f. Quality assurance procedures and quality control techniques.

Submit Work Plan to site manager for review and approval. Revise per site manager's direction.

Task 5. Data Collection

Purpose: Gather necessary data regarding exposure and ecological effects

Description: Conduct those studies approved by site manager for immediate execution. Submit interim reports to site manager for review.

Task 6. Final Data Collection

Purpose: Based on findings of studies conducted, identify and collect any final data needed to assess exposure and ecological effects

Description: Revise Work Plan per site manager's direction. Conduct next phase of studies as approved by site manager. Submit interim reports to site manager for review. Repeat this step as needed. Task 6 is an iterative process that will lengthen or shorten, depending on the results of studies.

Task 7. Risk Characterization

Purpose: Validate the data and their interpretation, and characterize risk.

Description: Prepare the following for review by site manager:

1. Summary of biological and chemical data
2. Detailed outline of ecological assessment

Task 8. Report Preparation

Purpose: Prepare data for presentation.

Description: Prepare draft ecological assessment.

NOTE: Depending on the scope and level of effort decided on by the site manager, not all of the elements listed below may appear in a given assessment. For instance, not all sites will require toxicity testing or the full array of quantitative field studies. The following outline should be modified to account for the studies actually undertaken at the site with the approval of the site manager.

1. Initial site description and potential receptors (include detailed maps wherever appropriate)

   a. Physical description of the site

   b. Nature and extent of contamination by medium and contaminant type

   c. Potentially exposed habitats

      (i) Surface water habitats

      (ii) Wetlands

      (iii) Terrestrial habitats

      (iv) Sensitive or critical habitats

   d. Potentially exposed species

      (i) Vegetation

(ii) Invertebrates

(iii) Vertebrates

(iv) Special concern species

2. Selection of contaminants, species, and ecological effects of concern

   a. Contaminants of concern and rationale for selection

   b. Species of concern and rationale for selection

   c. Ecological effects of concern, acceptable and unacceptable levels of effects, temporal and spatial scales of concern, and rationale for selection

3. Exposure assessment

   a. Sources and exposure pathways of contaminants of concern

   b. Fate and transport analysis

   c. Exposure scenarios

   d. Estimated exposure point concentrations by habitat, species, and exposure scenario

   e. Uncertainty analysis

4. Ecological effects assessment

   a. Known effects of contaminants of concern (from literature)

   b. Site-specific toxicity tests—laboratory and *in situ*

   c. Existing toxicity-based criteria and standards

   d. Uncertainty analysis

5. Risk Characterization

   a. Observed adverse effects in potentially exposed habitats compared to reference sites

      (i) Mortality and morbidity

      (ii) Vegetation stress

      (iii) Habitat degradation

      (iv) Presence or absence of key species

      (v) Population assessment of key species

      (vi) Community indices

      (vii) Ecosystem function, such as decomposition or nutrient recycling

   b. Analysis of contaminant concentrations in relation to observed adverse effects

   c. Analysis of bioaccumulation studies

   d. Analysis of toxicity test results in relation to observed adverse effects

e. Comparison of estimated exposure point concentrations with criteria and standards

f. Comparison of estimated exposure point concentrations with toxicity data and/or toxicity values from literature, as appropriate

g. Likely ecological risks associated with present and future land use scenarios

h. Ecologically relevant ARARs

i. Ecological considerations in selecting remedial alternatives (including no action)

j. Uncertainty analysis

Submit draft ecological assessment to site manager for review.

Task 9. Report Revision

Purpose: Prepare final presentation of ecological assessment

Description: Revise draft ecological assessment per site manager's review comments and submit final ecological assessment for inclusion in RI/FS.