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NATURAL RESOURCE DAMAGE ASSESSMENT

This article provides an overview of the scope of natural resource damage case and site activity in the U.S., followed by the presentation of seven key guiding principles. For each of the guiding principles, general standards of practice are provided to indicate suggested ways practitioners can implement each principle. Further, case scenarios are presented to exemplify how each principle can be applied in practice. The author of the article concludes with recommendations on how practitioners can use this information with an eye to any modifications or expansions needed in the future.

Beyond the Headlines: Best Practices to Restore Natural Resources Injured by Long-Term Hazardous Waste Releases, Oil Spills and Transport and Other Accidents

By Barbara J. Goldsmith, et al.

This article summarizes best practices for natural resource damage assessment (NRDA) and related restoration of natural resources and the services (or uses) they provide to the public that may be injured as a result of a release of hazardous waste or an oil spill. Two sets of federal regulations set out a framework for assessing natural resource damages (NRD) and identifying corresponding restoration measures—one promulgated by the U.S. Department of the Interior under the Comprehensive Environmental Response, Compensation, and Liability Act, and one promulgated by the National Oceanic and Atmospheric Administration under the Oil Pollution Act of 1990.[1] Both sets of regulations provide for a sequential process of assessment and restoration, and both embed some very important principles. Among other issues, the regulations define the limits to liability, though use of the regulations is optional unless the government trustee (for natural resources) wishes the NRDA to have the force and effect of a rebuttable presumption.[2]

The guiding principles and best practices described in this article reflect the collective knowledge of the multi-stakeholder NRD practice community from 1980 through the present. The material herein is aimed at promoting reasonable consistency from site to site nationwide. Both the guiding principles and best practices recognize the need for common approaches but by the same token also are cognizant of site differences and related issues and needs.

[1] 43 C.F.R. Part 11 and 15 C.F.R. Part 990.

[2] 43 C.F.R. § 11.11.

The NRDA best practices are an outgrowth of the discussions at two symposia programs on natural resources[3] attended by representatives of federal and state government, industry, law and consulting firms, universities, research and conservation organizations and more. A multidisciplinary NRDA Best Practices Working Group was convened to prepare a written record of the collective thinking put forward and resulting from the symposia. The output of this activity is seven guiding principles for NRDA and restoration and accompanying suggested standards of practice and case example applications, all of which are detailed in this article.[4]

Overview of NRD Case/Site Activity

From 1980 to the present, a total of approximately 800 NRD claims have been filed by federal and state trustees.[5] Approximately 600 of these claims were brought under federal law or pursuant to a combination of federal and state law, and approximately 200 were brought under state law. At present, at least 100 federal NRD claims are pending—some of which were initiated in the early 1980s—and an even greater number of state NRD cases. Thousands of sites nationwide have the potential for natural resource claims under a variety of federal or state laws, including those on the EPA's National Priorities List of Superfund sites. Moreover, industrial accidents and accidental spills and releases can occur despite extensive preventative measures. Natural resources and the services they provide to the public may be affected by such events, thereby invoking the potential for NRD liability.

In this article, NRD ''cases'' are those situations in which an action has been filed by federal and/or state trustees for recovery of NRD. NRD ''sites'' are those where NRDA activity may be underway—or has the potential to begin—based on a site's history and characteristics, but a formal legal action hasn't been filed.

Over the course of the 30-year-plus timeline of NRD, over 800 settlements have resulted, some involving multiple settlements at single sites. Over the last decade or more, there has been a move to define settlements in terms of restoration projects versus dollar value of damages collected. However, it is noteworthy that over $3 billion have been recovered by federal and state trustees in settlements with potentially responsible parties that in turn have resulted in the restoration of tens of thousands of acres of land and miles of streams nationwide, extensive acreage donated or set aside for conservation easements and various educational and other projects.

Guiding Principles for NRDA and Restoration Practices

The following are seven guiding principles for natural resource damage assessment and restoration. The principles are intended to foster and encourage timely and cost-effective restoration of natural resources at federal and state sites nationwide.

Guiding Principle 1: The overall objective of NRDA and restoration is to achieve timely and cost-effective restoration of natural resource services to their baseline. ''Services'' include services provided by one natural resource to another natural resource resulting from their ecological functions and services provided by natural resources to humans. ''Baseline'' is the level of natural resource services that would have existed but for the release at issue.

Guiding Principle 2: Focus the assessment process on the earliest possible evaluation of restoration options.

Guiding Principle 3: Conduct NRDAs that follow the basic scientific and economic principles on which the federal NRDA regulations are based for the pertinent type of release—whether or not the parties are engaged in a process that specifically follows those regulations.

Guiding Principle 4: Consider that existence of injury doesn't always result in a loss of natural resource services to the ecosystem or people. A loss of services must be established and measured to scale restoration projects or determine damages. If a restoration-based settlement can be achieved by the parties, a rigorous quantification of lost services may not be necessary.

Guiding Principle 5: Quantify lost natural resource services as reductions in services compared with the baseline (i.e., the level of services that would have existed *but for* the release in question), taking into account the resource recovery period and recovery rate and omitting speculative services. To the extent possible, the baseline considers and adjusts for all external contributing factors, including those unrelated to the release, naturally occurring or otherwise.

Guiding Principle 6: Select and use assessment methods that are cost-effective given the circumstances of the site, using available data where feasible and focusing new studies on gathering information needed to determine injuries, quantify service losses and/or scale restoration projects.

Guiding Principle 7: Facilitate a collaborative, transparent and efficient NRDA process that offers opportunities for meaningful involvement of potentially responsible parties (PRPs) throughout the process.

Implicit in the above principles is the overarching need to establish front-end visions of the desired restoration endpoint, as well as have the NRDA process proceed in a manner that includes timeline and cost expectations and limits.

[3] These Natural Resources Symposia held in October 2011 and October 2013 were convened by the Ad-Hoc Industry Natural Resource Management Group (a group of multi-sector industrial companies focused on NRD and broader industrial operations/natural resource interface issues since 1988) in collaboration with The George Washington University. *See* www.nrdonline.org/symposium.

[4] This article is focused on seven guiding principles for NRDA and restoration. However, there are a number of other materials and resources that relate to and reinforce the principles. Recent examples include a compendium of cooperative assessment documents and a Restoration Project Catalog (both accessible at http://www.NRDARPracticeExchange.com) developed by the Ad-Hoc Industry Natural Resource Management Group, as well as ongoing oral and written communications within the industrial community and between industry and government on a variety of issues, including the relationship between remediation and restoration, the state of the science relative to NRDAs, how to address uncertainty in decision-making and the risk assessment in the context of NRDAs.

[5] Statistics in this article are drawn principally from a database established and maintained by the Ad-Hoc Industry Natural Resource Management Group since 1989, cataloging NRD case and site data and related laws, regulations, literature and additional information.

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Principles and Suggested Best Practices for NRDA and Restoration

This section examines further the seven guiding principles for NRDA and restoration and suggested standards of practice to implement each principle. Actual cases and/or sites exemplifying how the principle may be applied also are provided below.

Guiding Principle 1

The overall objective of NRDA and restoration is to achieve timely and cost-effective restoration of natural resource services to their baseline.

Suggested Standards of Practice for Guiding Principle 1

Peer-reviewed literature clearly establishes that the general public values natural resources for the flow of services they provide. Those services include direct uses of natural resources by the public (e.g., recreation uses), as well as indirect uses through the ecological functions of natural resources (e.g., pollination, water treatment and habitat services). If the release of a hazardous substance or oil causes a reduction in natural resource services, then the public experiences a loss for which trustees can recover natural resource damages. Actions that sufficiently increase comparable natural resource services (i.e., restoration actions) will compensate the public for the losses caused by the release. Restoration actions that are both timely and cost-effective are beneficial both to the public and PRPs because the public is compensated sooner at a relatively low cost to the PRPs.

The reduction in natural resource services caused by a release is the difference between post-release services and baseline services (i.e., the services that would have existed but for the release). As discussed in more detail under Guiding Principle 5, baseline services include trends and variations in services as a result of natural and anthropogenic factors that are unrelated to the release but may have a significant effect on services.

Case Site/Example: Palmer Barge Line Site, Texas

This example of NRDA was timely and cost-effective because it was possible to make a number of simplifying assumptions (including not adjusting for baseline). This was possible in context because it was a relatively small site where the impact of the conservative assumptions didn't create a huge increase in costs of the proposed projects. Other approaches may be necessary where greater costs are at issue (e.g., using ''reasonable'' rather than ''reasonably conservative'' assumptions or using sensitivity analysis to determine which assumptions to develop with more analysis). This assessment also is a good example of the application of the restoration selection criteria from the U.S. Department of the Interior (Interior) NRDA regulations.

Timely. The Chevron Palmer Barge Site was placed on the National Priorities List by the EPA in 2000, and its record of decision was released in September 2005. The restoration plan was developed and had trustee concurrence by January 2007.[6] This two-year time frame between the record of decision and finalization of the draft restoration plan can be considered timely in the context of the many other NRDA and restoration processes nationwide—particularly compared with those that may take decades to complete.

Focused on Restoration. Early in the process, the trustees determined that the preferred restoration would be estuarine marsh creation or enhancement. Thus, the results of the Habitat Equivalency Analysis, expressed in discounted service acre years (DSAYs) of open water injury, were converted to ''marsh equivalent DSAYs'' to help define the scope of potential compensatory projects. The trustees screened 11 potential projects and evaluated five of those in detail, using the restoration selection criteria of Interior NRDA regulations.[7]

Focused on Restoration of Resource Services. The NRDA focused on the ecological services provided by the benthos—organisms living at the bottom of a water body—and used benthic toxicity as an indicator of the levels of contamination at which services would be reduced.

Consideration of Baseline. One weakness of the assessment is that, other than the initial designation of ''assessment areas'' on the basis of both sediment testing and known physical constraints, it didn't adjust for baseline reductions in services caused by factors other than the release.

Guiding Principle 2

Focus the assessment process on the earliest possible evaluation of restoration options.

Suggested Standards of Practice for Guiding Principle 2

Injury assessment often is the primary focus early in the NRDA process, leaving restoration planning for much later. If restoration options are among the initial considerations and restoration ecologists are included early in the process, opportunities for cost-effective restoration can be identified. Identifying such opportunities early in the process can expedite the resolution of NRD claims and promote more rapid and efficient NRD compensation.

Practitioners aiming to compensate for lost or injured resources and services should consider incorporating restoration planning in the earliest possible phase of the NRDA process to identify the opportunities and constraints in selecting potential restoration alternatives. This allows practitioners to (1) establish baseline conditions at the site of injury, as well as restoration sites; (2) determine whether restoration can occur on-site or whether comparable off-site compensatory restoration will be required; (3) identify critical design elements for compensatory restoration alternatives; and (4) ensure the services associated with the NRD injury metrics align with the NRD compensatory restoration metrics.

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[6] Draft Restoration Plan and Environmental Assessment for the Palmer Barge Waste Site, Port Arthur, Jefferson County, Texas, January 12, 2007, prepared by the National Oceanic and Atmospheric Administration, Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, Texas General Land Office and U.S. Fish and Wildlife Service. http://www.gc.noaa.gov/gc-rp/palmer-rp-011207.pdf.

[7] 43 C.F.R. § 11.

Initiating discussion of restoration actions early in the NRDA process allows for an open dialogue between trustees and PRPs. An open dialogue can increase the success of restoration actions and decrease the obstacles to implementation by incorporating input from various groups, including regulators, public advocates and stakeholders. This approach also can help determine the feasibility of the restoration alternatives early on, allowing all parties to agree upon realistic restoration objectives and goals.

Seeking options for early restoration (i.e., planning restoration prior to the completion of the injury assessment) provides an opportunity for practitioners to implement existing restoration projects that are highly supported by stakeholder groups and allows for compensatory restoration to occur as early as possible, thereby increasing the total benefits generated by compensatory restoration actions.

Incorporating restoration design early in the NRDA process allows enough time to conduct pertinent site investigations to increase the success of restoration projects, satisfy stakeholder needs and concerns and ensure the appropriate services are restored as a result of restoration actions. Further, identifying restoration opportunities at an early stage allows NRD practitioners to implement synergistic compensatory restoration projects. The interaction of synergistic projects may prolong the lifespan of a habitat creation project, optimize the environmental conditions of an adjacent project (e.g., water quality) or provide recreational opportunities for human use. In addition to optimizing benefits, synergistic projects provide cost-savings to NRD participants by providing improvements to multiple services through a single restoration project, which limits the need to implement multiple restoration projects to compensate for these services.

Practitioners should strive to consider restoration planning in conjunction with planning for remedial activities and evaluations. When planning remedial and restoration activities simultaneously, the design team ideally would be a multidisciplinary team that includes both a remedial engineer and restoration ecologist. This allows practitioners to identify areas of overlap, providing potential cost savings and expediting compensation for natural resource damages. Remediation activities and the evaluations conducted during the remedial process can provide important information related to the injury assessment process, the establishment of baseline conditions and the identification of feasible compensatory restoration alternatives.

Although restoration design and remedial activities are separate legal processes, data collection can be streamlined by considering them simultaneously. Some of the data for site inventories, injury assessments, establishment of baseline conditions, ecological risk assessment and permit application and compliance can be collected at the same time, providing potential cost savings and decreasing the time until completion of restoration and remedial actions.

In some situations, planned and accepted remediation strategies can be expanded or modified to innovatively achieve compensatory restoration goals. For example, remedial strategies can be expanded to adjacent sites that require remediation or modified to maximize the ecological function of remediation sites (e.g., capture and treat contaminated groundwater to create a stormwater-fed wetland or use phytoremediation as a means to provide ecological services in conjunction with contamination removal). Restoration opportunities that build upon or augment remediation activities are most successful when both goals are considered simultaneously.

Case Example: Woodbridge Waterfront Park Redevelopment, N.J.

Consideration of Restoration in the Earliest Possible Phase of NRDA. El Paso Energy Corporation Polymers Inc. acquired a 185-acre former industrial site along the Raritan River in Woodbridge, N.J. EPEC Polymers engaged in a long-term evaluation of the entire site, which included coordination with the New Jersey Department of Environmental Protection (NJDEP) to develop a sitewide remedial plan to address on-site contamination and with the town of Woodbridge to develop a brownfield redevelopment program.

EPEC assembled an interdisciplinary team, including an ecological consulting firm and a remedial engineering firm. The interdisciplinary approach identified opportunities to decrease NRD liability by engaging state regulators early in the process to evaluate options on addressing NRD liability. The team simultaneously evaluated two approaches. The first approach set aside a portion of the site for compensatory restoration of tidal wetlands, which contributed to the mitigation required for remedial activities in anticipation of an NRD claim. This advance planning for on-site compensatory mitigation created a proactive NRD strategy for the client. The second approach considered removing three dams along the Raritan River to restore anadromous fish passage in New Jersey.

Working with the NJDEP, EPEC chose dam removal, which released them from liability for NRD of the Woodbridge Waterfront Park. EPEC's proactive approach to early restoration resulted in an innovative NRD strategy that integrated remediation and restoration, contributed to combined cleanup and restoration, reduced costs and increased cooperation with stakeholders, agencies and trustees. The approach satisfied the NJDEP regulatory guidelines.

This NRD restoration strategy can be applied to other contaminated sites. It features an interdisciplinary team, early evaluation of NRD alternatives prior to remediation and early engagement with all stakeholders. Using this approach, NRD liability was satisfied in a time- and cost-effective manner that benefitted all stakeholders.

Guiding Principle 3

Conduct NRDAs that follow the basic scientific and economic principles on which the federal NRDA regulations[8] are based for the pertinent type of release—whether or not the parties are engaged in a process that specifically follows those regulations.

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[8] *See* 43 C.F.R. Part 11 for the U.S. Department of the Interior regulations implementing CERCLA natural resource damage assessment and restoration activities conducted for releases of hazardous substances. *See* 15 C.F.R. Part 990 for the U.S. Department of Commerce/National Oceanic & Atmospheric Administration regulations implementing the Oil Pollution Act natural resource damage assessment and restoration activities conducted for discharges of oil.

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Suggested Standards of Practice for Guiding Principle 3

NRDA regulations promulgated by Interior[9] and NOAA[10] are based on fundamental biological, economic and legal principles relating to the existence of a compensable injury and the identification and determination of losses to the public. Following these principles is essential to establishing the public legitimacy and merit of an NRD claim and NRD restoration under federal or state statutory or common law, and will result in more prompt and efficient resolution of NRD claims and faster restoration of natural resource services to the public. Failing to follow these principles will result in illegitimate claims, unnecessary litigation and a waste of public and private resources. The principles, therefore, are important, whether or not the NRDA regulations are expressly followed or adopted in a particular case.

Federal trustees aren't required to follow the federal NRDA regulations unless a rebuttable presumption is desired. In addition, the federal NRDA regulations don't legally apply to NRD claims brought solely by state government agencies. Nonetheless, the principles apply to the merits of all federal and state NRD claims. If parties aim to follow the principles underlying the Interior and NOAA rules in their development, negotiation and litigation of NRD claims, there is a strong argument that less litigation will occur and restoration will occur more promptly.

The other ''guiding principles'' identified in this document reflect the basic principles underlying the Interior and NOAA NRDA regulations. These principles relate to causation, injury to trust resources, quantification of service losses to the public and restoration.

Case/Site Examples: *Shell Martinez Refinery, California; New Mexico v. General Electric Co.*; and *New Jersey Dep't of Envtl. Prot. v. Essex Chemical Corp.*

Adherence to Principles Can Result in Prompt Settlement and Restoration. Following an April 1988 spill of more than 400,000 gallons of crude oil from a tank at a Shell refinery in Martinez, Calif., the company and multiple government agencies promptly mobilized experts to undertake assessment activities. The spill affected more than 100 acres of marsh and many miles of shoreline. The parties collectively selected an expert to perform an assessment of the extent of ecological injury caused by the spill.

With government input and oversight, Shell undertook a systematic work scope that included video and aerial photographic surveys and mapping of the areas affected by the spill, a study of fish and macroinvertebrate abundance and distribution, hydrocarbon analyses of fish and clam tissue, comparison of the effects of oil on marsh vegetation, survey of the distribution and abundance of the benthos, ambient aquatic toxicity study, survey of endangered species (birds and mammals), chemical analyses of the sediment and water, chemical and physical characterizations of San Joaquin Valley crude oil and a study of the weathering of the oil. Shell also performed a preliminary study to estimate economic losses to the public (including recreation losses, aesthetic losses, wildlife losses and habitat losses). The preliminary economic study included discussions with state and federal personnel, local citizens and a review of the literature. The damage estimates provided background information for negotiations with the trustees, which had performed independent studies as well.

By December 1989, the parties were able to settle all NRD claims for $10.8 million, enabling the trustees to embark on a prompt and much-lauded restoration program that ultimately preserved 10,000 acres of salt ponds, 168 acres of waterfront property, and 198 acres of marsh and uplands in the region.

Departure from Principles Can Result in Lengthy and Unsuccessful Litigation. In contrast, the state of New Mexico sued General Electric and other industry defendants in 1999 to recover more than $1 billion in NRD for damage to groundwater at the South Valley Superfund Site.[11] New Mexico claimed the proper measure of damages was ''the market value, with future losses adjusted to present value, of the volume of water affected by the contamination, together with the replacement cost of the storage capacity of the aquifer.'' In essence, the state claimed the entire volume of contaminated groundwater was lost to all beneficial use regardless of the degree of contamination, actual uses of the groundwater or the availability of substitute sources of water. On June 19, 2004, the court granted the defendants' motion for summary judgment and dismissed the case.[12] The court examined the ''highest and best use'' of the groundwater and concluded that since potable water was in fact obtained from the aquifer, the injury was the volume of water that exceeded applicable drinking water standards.

After a detailed analysis of the facts, the court held that New Mexico failed to demonstrate any actual loss of groundwater services. The court also examined the state's theory of lost ''market value/replacement cost'' and concluded the proposed measure of damages necessarily assumed a complete and permanent loss of that resource. The court held that the claimed measure of NRD isn't appropriate when the groundwater injury isn't permanent and can be remediated, and the groundwater still has beneficial uses other than drinking water (such as agricultural or industrial uses). The court's decision was upheld on appeal. The appellate court agreed that the state hadn't demonstrated ''loss-of-use damages'' because there was no impairment in groundwater services to water rights holders.

In another instance, the government's outside expert departed from basic concepts, such as resource services, in other groundwater NRD cases having similar results. NJDEP sought to require Essex Chemical Corp. to pay $8 million in natural resource damages ($5.7 million in primary restoration damages and $2.3 million in compensatory restoration damages) for the release of hazardous substances from an adhesives facility owned and operated by Essex from 1976 through 1984.[13] The

[9] 43 C.F.R. Part 11.
[10] 15 C.F.R. Part 990.

[11] *New Mexico v. General Electric Co.*, 467 F.3d 1223, 63 ERC 1225 (10th Cir. 2006).
[12] *New Mexico v. General Electric Co.*, 322 F. Supp. 2d 1237 (D.N.M. 2004); *see also* 335 F. Supp. 2d 1185 (D.N.M. 2004).
[13] *New Jersey Dep't of Envtl. Prot. v. Essex Chemical Corp.*, 2012 BL 333977, N.J. Super. Ct. App. Div., No. A-0367-10T4, 3/20/12).

case was filed in June 2007 and went all the way to trial. Among other things, NJDEP argued it was entitled to recover natural resource damages to compensate the public for the amount of ''gallon years'' that the groundwater on the subject properties had been contaminated without regard to whether the public had lost any quantifiable services or benefits as a result of the contamination or suffered any threatened harm to humans or the environment.

NJDEP's expert tried to use resource equivalency analysis (REA) to calculate how much groundwater allegedly was injured by contamination and how much acreage should be purchased and protected to compensate for the alleged injury. The ''expected price'' of the acreage to be purchased was the monetary amount of compensatory NRD sought by the NJDEP. The REA compared residential, commercial and industrial real estate values in and around the area where the Essex Chemical facility was located. The trial court in July 2010 held that the NJDEP's analysis was ''inaccurate and insufficient,'' observing that no basis was provided for the use of REA to show groundwater damages; the damages should ''reflect or be equivalent to the loss''; and the cost of residential and commercial real estate isn't relevant to an industrial site. According to the court, the expert's analysis unfairly imposed costs on Essex Chemical that were unrelated to any injury resulting from the contamination, and the claimed damages weren't indicative of or equivalent to the loss. The trial court noted that the state suffered no compensable harm in the absence of any lost services or any actual or imminent harm to humans or the environment. The court further found the state's proposed primary restoration plan unjustifiable in light of the undisputed evidence that Essex Chemical had cooperated fully with the NJDEP's Site Remediation Program, in addition to the lack of provable benefits from the state's proposed primary restoration program. On appeal, the appellate court upheld the trial court's decision in all respects.

Guiding Principle 4

Consider that existence of injury doesn't always result in a loss of natural resource services to the ecosystem or people. A loss of services must be established and measured to scale restoration projects or determine damages. If a restoration-based settlement can be achieved by the parties, then a rigorous quantification of lost services may not be necessary.

Suggested Standards of Practice for Guiding Principle 4

Injuries lead to losses of natural resource services when they are of a type and magnitude that actually can result in a diminishment of services. The translation of injury to service loss involves considering the causal relationship between the particular injury and the particular services, as well as the degree to which the injury at issue can cause a diminishment. Further, it is important to consider that a release doesn't always result in injury, especially in areas with pre-existing elevated concentrations of hazardous substances in the baseline condition.

The first consideration—understanding the causal linkage—can be accomplished using conceptual models together with information relevant to mechanisms of effect. For example, to determine if there is linkage between the injury and production of a species, it would be important to establish how the injury alters survival, reproduction or growth of at least some portion of the population. Understanding that the injury and the life history characteristic may be related isn't sufficient to establish the injury actually has caused a change in the characteristics of some individuals.

Associations are different from actual losses of individuals or reproductive success. Associations, in the absence of establishment of causation, should be considered as ''soft'' technical bases for advancing discussions on restoration-based settlement. In such cases, large uncertainties exist and should be recognized when aligning restoration projects with presumed injury. Quantification in such cases mainly serves as an alignment tool, as loss of services hasn't been established.

The second consideration involves the degree to which the injury can diminish a natural resource service. For non-ecologists, this often is a difficult aspect of the injury-service relationship to conceptualize because it isn't a simple proportional relationship. Biological systems are nonlinear and possess feedback loops and compensatory processes. Therefore, the occurrence of an injury (e.g., loss of individuals or diminishment of habitat quality) doesn't translate proportionally into a loss of service. For many biological systems, there are threshold effects below which injury would be negligible for a specified service. Populations of animals and plants are dynamic and experience losses of individuals due to a variety of causes. Because losses are a reality for all living things, growth and reproduction compensate for losses to perpetuate the species.

All species are adapted to compensate for losses due to natural stressors to varying degrees. In addition, population success isn't a simple function of losses of individuals. When an additional stressor is added to the system (e.g., via an oil spill or exposure to a chemical) it may affect individual survival, reproduction or growth. However, if the oil or chemical-related injury is very small relative to the natural dynamics of the population's survival, growth or reproduction, the oil or hazardous chemical exposure may have a negligible influence on the population. Similarly, different populations of species within an ecosystem can exhibit functional redundancy in the services they provide, where a reduction in the number of individuals of a given population may be compensated for by an increase in the number of individuals of a different but functionally similar population. The challenge to properly aligning injury and service loss is determining the thresholds of oil or chemical-induced injury that are ecologically meaningful.

If a restoration-based settlement can be achieved by the parties, then rigorous quantification of lost services may not be necessary. The key to advancing these discussions is achieving a mutually agreeable alignment of injury and restoration. Geographical and/or population scales may be useful for discussing this alignment, but it should be recognized that the alignment is largely a semi-quantitative process and service loss parameters (e.g., baselines) are rough estimates that serve to provide boundaries. If Habitat Equivalency Analysis and Resource Equivalency Analysis procedures are used, they can employ reasonable ranges of input values based on available data and/or reasonably conservative assumptions to obtain approximate estimates of service loss to guide settlement discussions.

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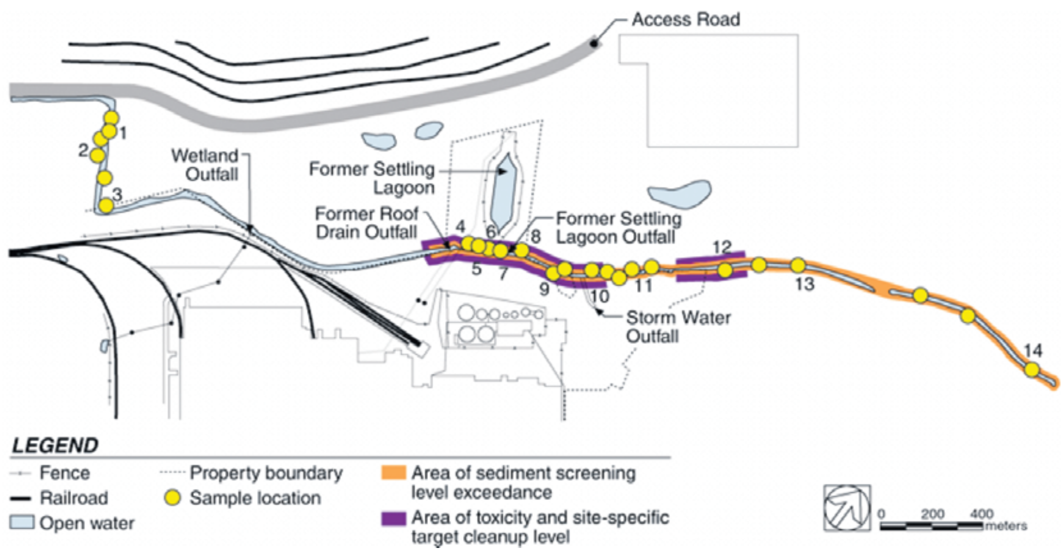

Source: McArdle et al. (2009)

Case Examples: Anonymous Case and *New Mexico v. General Electric Co.*

Two case examples are used to illustrate Guiding Principle 4. The first contrasts a potential footprint of injury, determined using a sediment benchmark, to a footprint determined from site-specific studies. The second illustrates the point that services can be provided and sustained despite the occurrence of an injury identified as an exceedance of a benchmark value.

Determining Potential Injury Footprints Using Benchmarks versus Site-Specific Studies. Case 1 involves a site where sediment in a small urban brook was contaminated with polycyclic aromatic hydrocarbons (PAHs) and metals. During site investigations, the PRP was obligated to compare sediment concentrations of metals, total PAHs, total polychlorinated biphenyl aroclors and total DDT to probable effect concentrations (PECs) and threshold effect concentrations (TECs) to judge whether adverse biological effects to benthic macroinvertebrates could be occurring.[14] This screening process revealed that an area of approximately 1.5 acres (see nearby figure) had sediment concentrations of PAHs and/or metals exceeding screening values. Exceedances of such screening values are often used in NRD cases to establish the extent of natural resource injury. However, use of screening values to determine injury is flawed in two major ways:

■ Screening values can be interpreted only in one direction—if a concentration is below a screening value, it can be inferred an adverse effect is unlikely. However, the converse isn't true. It is common for field studies to reveal that there are no adverse ecological effects at environmental concentrations of constituents that far exceed screening values.

■ In the absence of confirmatory biological data, interpretation that an exceedance of a screening value has resulted in an adverse effect is merely an inference of injury, as no causal linkage has been demonstrated.

Returning to the example of the contaminated brook, the PRP conducted additional sediment chemistry and biological testing to develop site-specific sediment cleanup levels based on quantitative (predictive) relationships between contaminant concentrations and biological effects. This approach established a causal link between the releases and biological injury and resulted in the identification of an injury footprint of just over 0.5 acre. Thus, there were no lost ecological services in over approximately two-thirds of the brook area defined by the exceedance of a tabulated effects threshold.

Natural Resource Services Provided Despite Exceedance of a Benchmark Value. Case two involves the matter of *New Mexico v. General Electric Co.*, (a.k.a. the South Valley Case),[15] which shows that the mere existence of an injury isn't necessarily associated with a reduction in services (and by extension NRD) for groundwater resources. Among other claims, New Mexico sought monetary damages, claiming the presence of solvents at any level effectively rendered the affected volume of groundwater permanently lost. The NRD claim in part was composed of the alleged lost use resulting from the closure of a municipal water supply well. Putting aside other nuances of the case, summary judgment was granted in favor of the PRPs in this matter for two key reasons: 1) there was a readily available substitute resource, and 2) a substitute was provided by diverting water extraction from well SJ-6 to well B-4. First, according to the court, "the Middle Rio Grande Underground Water Basin was and is already fully appropriated, leaving the State unable to make additional water available for appropriation." Because there were no claims on the water by water rights holders, the change in the point of diversion wasn't a loss of use because the same amount of groundwater from the same aquifer remained available for use.

[14] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems," Arch. Environ. Contam. Toxicol.

[15] *New Mexico v. General Electric*, 467 F.3d 1223, 63 ERC 1225 (10th Cir. 2006).

Second, a substitute resource was deemed by the court to have restored the use, and the cost of providing the resource is the appropriate measure of damages—thus the public had been made whole. Alternatively, when the substitute diversion was placed in operation, the court said the state essentially ''acquired the equivalent'' of the resources lost, which is wholly consistent with the principal measure of damages to which the state is entitled.[16] Also, the court held that the cost of moving the well wasn't the appropriate measure of damages suffered by the state. Rather, the court found that the state—which was the plaintiff—hadn't incurred that cost, and the City of Albuquerque, which did incur that cost, wasn't a plaintiff in the matter.

In summary, in the South Valley case, an NRD claim was brought (in part) based on evidence that one or more releases resulted in contaminant concentrations in groundwater that exceeded maximum contaminant level goals (MCLGs), and such exceedances resulted in lost use due to closure of an extraction well. However, to the extent there were any lost uses, they were fully compensated by the defendants' provision of equivalent resources.

Guiding Principle 5

Quantify lost natural resource services as reductions in services compared with the baseline (i.e., the level of services that would have existed *but for* the release in question), taking into account the resource recovery period and recovery rate and omitting speculative services. To the extent practicable, the baseline calculation considers and adjusts for all significant external contributing factors related to the release—naturally occurring or otherwise.

Suggested Standards of Practice for Guiding Principle 5

To determine whether a natural resource in fact is injured and quantify any such injury and the service loss it has caused, the level of resource services after the release or releases in question need to be compared to the baseline level of the services provided in the absence of the release. Otherwise, trustees could recover damages for conditions that are unrelated to the release in question, which isn't authorized by statute or the common law. Baseline is defined in Interior's NRDA regulations as: ''conditions that would have existed at the assessment area had the . . . release of hazardous substance under investigation not occurred,''[17] taking into account both natural processes and those that are the result of human activities. Similarly, the NOAA NRDA regulations define baseline as ''the condition of the natural resources and services that would have existed had the incident not occurred.''[18] Thus, baseline reflects the ''but for'' condition of natural resources and services under both regulations; deviations from the baseline would be attributable to the release or spill.

Baseline isn't a static concept, and the condition at the time of the injury is only a snapshot of a dynamic baseline condition. As such, baseline must be addressed over the relevant recovery period in the damage assessment. ''Recovery period'' in the Interior regulations is the length of time required to return the services of the injured natural resource to their baseline condition. Although the NOAA regulations don't define ''recovery period,'' they define ''recovery'' as the return of injured natural resources and their services to baseline. The determination of the recovery period should take into account ongoing and future removal or remedial actions affecting the services of the injured natural resource and ''normal'' management practices. If these actions and practices aren't taken into account, then the recovery period will be overstated.

When the injured natural resource provides multiple services, the recovery period should reflect the length of time required for the representative service, or an index of services, to return to their baseline condition—not the length of time required for the most-affected service or least-affected service to return to its baseline condition. The determination of the recovery period doesn't require the recovered ecosystem or other resource to be identical to its baseline condition because small deviations in relatively unimportant services won't have a substantial impact on the compensation required for natural resource injuries. However, the determination of the recovery period requires that the important and measurable services of the injured resource have returned to their baseline condition.

Experience from other recoveries of similar resources should be a major source of information in determining the recovery period because such experience reflects actual results rather than modeled results or professional judgments. Case studies in peer-reviewed articles in journals and published symposia (and the peer-reviewed references in those articles) can be used as the basis for determining the recovery period, since such documents presumably provide more reliable results than documents in the grey literature. The results of case studies can be adjusted to reflect local conditions whenever appropriate. Cost-effective modeling and knowledge of degradation and natural processes may be useful in determining the recovery period.

Factors to consider when determining the recovery period include ecological succession patterns; growth or reproductive patterns, life cycles, and ecological requirements of the biological species involved; bioaccumulation and the extent of contaminants in the food chain; and chemical, physical and biological removal rates of contaminants from the media involved.

''Recovery rate'' refers to the degree of recovery of services each year within the recovery period. When the injured natural resource provides multiple services, the recovery rate can reflect the degree of recovery for the representative service or an index of services, not the recovery rate for the most-affected service or the least-affected service. Experience gained during other recoveries of similar resources, as reflected in peer-reviewed articles and published symposia, can be the basis for determining recovery rates. As noted previously, such documents presumably provide more reliable results than documents in the grey literature. Linear (i.e., constant) recovery rates can be used only when other recovery rates aren't available in peer-reviewed literature for the services of the injured resource.[19] Factors that

[16] *New Mexico v. General Electric Co.*, 467 F.3d 1223, 63 ERC 1225 (10th Cir. 2006).

[17] 43 C.F.R. § 11.14(e).

[18] 15 C.F.R. § 990.30.

[19] A linear recovery rate has the same incremental recovery in each year of the recovery period. For example, a linear recovery rate for a 20-year recovery period would be 5 percent in

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may affect the ability of the services of a resource to recover include the degree to which a resource is affected, the proportion of available resources affected in an area and the characteristics and services of adjoining or nearby resources. Actions intended to shorten the recovery period or increase the recovery rate should be implemented only if the cost of those actions isn't grossly disproportionate to the resulting reduction in compensable values or compensatory restoration costs. Otherwise, those actions will increase natural resource damages.

In general, reasonably accurate recovery rates and recovery periods are needed in order to estimate the appropriate amount of restoration for a release of oil or hazardous substances. Otherwise, the amount of restoration won't match the losses incurred by the public as a result of the release, which means the public is either over- or under-compensated.

Case Example for Guiding Principle 5: Anonymous Case

Reduction in Natural Resources Services and Gains in Compensatory Restoration Project Measured Against Baseline. A smelter operated for many years on a mining site in an arid western state. Air emissions from the smelter increased the concentration of copper in the rangeland downwind from the smelter. Given the mineralized nature of the rangeland, relatively high concentrations of copper were common. Technical discussions between the trustees and the PRP led to an agreement on an injury threshold for copper in the rangeland, where rangeland with a copper concentration above the threshold was considered ''injured'' by air emissions from the smelter.

The next step in the NRDA was to quantify the ecological services provided by both injured and uninjured rangeland, with the latter being used as the baseline services for the injured rangeland. Several years prior to the start of the NRDA, one of the parties conducted an evaluation of the quality of rangeland in the area, generating an Observed Apparent Trend (OAT)[20] score for the rangeland. The trustees and PRP agreed to use OAT scores as a proxy for the ecological services of rangeland. Specifically, an OAT score of 30 was common for uninjured, ungrazed rangeland, so it was used as the measure of baseline services. OAT scores below 30 on injured, ungrazed rangeland were used to generate percentage reductions from baseline. For example, an OAT score of 24 on injured, ungrazed rangeland represented a 20 percent service loss, because 24 is 20 percent below the baseline of 30. The degraded level of services on the injured, ungrazed rangeland was assumed to continue indefinitely.

One of the compensatory restoration projects under consideration in the NRD assessment was for the PRP to donate a large property abutting a state park and then erect and maintain a fence around the property to eliminate grazing. Over time, the lack of grazing would improve the ecological services of the rangeland. Specifically, the rangeland was expected to improve from an OAT score of 20 to the baseline score of 30 over a 20-year period and then remain at the baseline level indefinitely. This is equivalent to an improvement from 67 percent with grazing to 100 percent without grazing (an increase of 33 percentage points) over 20 years. In summary, both the reduction in services from the releases and the gain in services from the compensatory restoration project were measured relative to the baseline level of ecological services provided by uninjured, ungrazed rangeland. External factors, both natural and anthropogenic, were reflected in the baseline condition.

the first year (one twentieth), 10 percent in the second year (an additional 5 percent), and an additional 5 percent each year until 100 percent is reached in year 20.

[20] A semi-quantitative method for determining the ecological condition of rangeland by scoring six categories: vigor, seedlings, surface litter, pedestals, surface crusting, and rills and gullies. Bureau of Land Management guidance provides details on how to score for each category. For more information, *see* http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=33943.wba.

Guiding Principle 6

Select and use assessment methods that are cost-effective, given the circumstances of the site, using available data where feasible, and focusing new studies on the gathering of information needed to determine injuries, quantify service losses and/or scale restoration projects.

Suggested Standards of Practice for Guiding Principle 6

There are a range of assessment methods that can be applied at many NRD sites. The selection of the assessment methodology for any particular site should be based upon the objectives for which the data will be used and on cost-effectiveness, taking into account the anticipated types of injury and/or service loss, any assessments of, or conclusions regarding, that injury or service loss already performed, and any already-available data that provide a metric directly related to such injury or service loss.

Application of a Data Quality Objective (DQO) approach would be beneficial. For example, one may ask, ''Will the testing or analysis ultimately help determine the amount of service loss or the amount of restoration necessary to compensate?'' For any new data collection that is considered, a DQO process should be followed to determine if and how such data collection should proceed,[21] including performing a sensitivity analysis to assess whether the information to be gained from that data will, in a significant way, improve the quality of the determination or decision to be made. In applying the DQO approach, the assessment must ultimately quantify or estimate the reduction in services that has occurred as a result of the release.[22] Consequently, data relating to a service loss that cannot be shown to have resulted from the release, or for which it isn't possible to quantify the portion of service loss attributable to the release, may not be of value to the determinations or decisions to be made.

If there is a related response action, it would be efficient to evaluate existing applicable data and analysis, as well as any planned data collection and analysis, for potential use in the NRD assessment. In some cases, closely linked components of the response action (for example, ecological risk assessments and groundwater

[21] *See* U.S. EPA, ''Guidance on Systematic Planning Using the Data Quality Objectives Process,'' EPA QA/G-4, February 2006, EPA/240/B-06/001.

[22] *See* U.S. DOI Regulation 43 C.F.R. § 11.71.

testing and analysis) already will have made determinations or reached conclusions that will inform, or perhaps usefully bound, the assessment of injury and service loss. In other cases, data that already have been collected (for example, soil, water or sediment data in a remedial investigation) may be analyzed in different ways in support of the NRD assessment.

Consistent with economic principles and the Interior and NOAA NRDA regulations,[23] the assessment should employ the least costly form of data collection that provides data of sufficient applicability, accuracy and precision for the purposes for which that data will be used. The additional cost of a more complex procedure should be reasonably related to the expected increase in the quantity and/or quality of relevant information provided by the more complex procedure.[24] In every case, the desired goal is to fund that amount of data collection and analysis required to make reasonable estimates or supportable determinations of service loss (with the level of certainty in the estimation or determination depending on the context of the assessment), to maximize the funds that can be applied to restoration. Robust, reliable, cost-effective assessment methods will help to minimize controversy and the risk of litigation, which will accelerate restoration and its concomitant benefits to the public.

Since service reductions as a result of a release are estimated relative to baseline services, both the baseline and with-injury services that focus on the same or similar services are most productive. Otherwise, the assessment will be comparing ''apples to oranges.'' Similarly, the data for both baseline and with-injury services should ideally be collected using the same or similar analytical methods. Otherwise, the baseline and with-injury service estimates won't be comparable, which will undermine the service reduction determination.

Case Examples for Guiding Principle 6—Lake Hartwell, South Carolina and Two Anonymous Cases

There are a number of cases for which value-of-information concepts have been used to guide the selection of assessment methods and to establish the study design for situations where new studies are warranted. We present three cases to illustrate this.

Use of Existing Data and Cost-Effective Restoration. The first case (Lake Hartwell) is illustrative of both use of existing data and selection of cost-effective restoration[25]. Key allegations by the trustees in this case included injury to fish as well as recreational fishing losses due to the accumulation of PCBs in fish tissue. At the time of the assessment, there was annual sampling of three fish species at six locations in the lake over a 14-year period.

Compilation of the raw results revealed striking spatial trends in decreasing concentrations with distance from the source(s) of PCBs in Twelvemile Creek. However, a cursory look of the data didn't reveal temporal trends as clearly. In particular, there appeared to be a spike in PCB concentrations in largemouth bass and hybrid bass with a subsequent decrease over the last four to eight years in the period of record. This spike may have been related to releases of contaminated sediment from upstream sources as a result of remediation activities and natural high flow events. A closer analysis of the temporal trends was undertaken using multiple regression. This revealed a consistent and accelerating trend of decreasing concentrations of PCBs in fish over time. This finding was instrumental in establishing a realistic assessment of potential service losses from recreational fishing. Trustees previously had assumed fishing advisories would exist in perpetuity, whereas a robust analysis of existing data suggested PCB levels could return to baseline levels within about a decade.

Existing data regarding ecological conditions and ecological stressors revealed that causal linkages between baseline-related stressors and adverse effects in the Lake Hartwell ecosystem were much stronger than causal relationships between PCBs in sediment, water, and biota and adverse effects. This was particularly true for the Twelvemile Creek drainage, where significant historical habitat degradation resulted from historical dam construction. This is explicitly acknowledged in the Restoration and Compensation Determination Plan that states: ''The preferred restoration alternative to compensate for ecological losses in the Assessment Area from PCBs is removal of the Woodside I and Woodside II dams, followed by stream corridor restoration in Twelvemile Creek.'' The restoration design includes dredging sediments behind the two dams, which are located within the site, and implementing stream corridor improvement such as constructing in-stream habitat, establishing erosion and runoff controls and riparian vegetation restoration.

By restoring natural hydrology, dam removal is expected to enhance natural sedimentation processes, improve biodiversity and population density of native species and provide more appropriate habitat for submerged and emergent vegetation. With the exception of removal of sediment (contaminated and uncontaminated) from behind the dams, all of the ecological services improvements associated with the restoration project are unrelated to any potential injury associated with PCBs in the environment. The dam removal project thus provided a significant increase in ecological services at a lower cost than would restoration options such as dredging, the sole aim of which is to reduce exposure to PCBs.

Cost-Effective Data Collection via Integration of NRDA and RI/FS Process. Two other examples of achieving data collection efficiency by integrating NRD with the Remediation Investigation/Feasibility Study (RI/FS) process include sites in New England and the Mid-Atlantic. The example site in New England included a detailed planning stage during which the PRPs and their consultants discussed data needs with trustees. As part of these discussions, a weight-of-evidence methodology served to identify the types of measures all parties felt would be most useful for determining risks and potential for injuries. A key aspect of the ap-

[23] 43 C.F.R. § 11.61(d)(2), 15 C.F.R. § 990.27(c)(2).

[24] 15 C.F.R. § 990.27(a)(2).

[25] Georgia DNR, South Carolina DNR, South Carolina DHEC, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service. 2006. Lake Hartwell Restoration and Compensation Determination Plan. Prepared by Georgia Department of Natural Resources, South Carolina Department of Natural Resources, South Carolina Department of Health and Environmental Control, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service with assistance from Exponent Inc., Industrial Economics, Inc., and Schlumberger Technology Corp. http://www.dnr.sc.gov/lakehartwell/LakeHartwellFinal32006.pdf.

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proach was achieving agreement on reference areas for different types of habitat that could serve as a baseline against which departures can be judged. Those reference areas that served to identify a baseline were chosen to reflect urban areas that received urban runoff but which were out of the influence of hazardous waste sites or other sources of oil and hazardous chemicals beyond those associated with urban runoff. Sampling was conducted collaboratively with regulatory agencies and trustees. This provided for a more cost-effective sampling effort and also increased the comfort level of all parties in the reliability and limitations of the data. The assessment was based largely on the work carried out as part of a remedial investigation with an eye toward the possible eventual use of that same body of information for NRD purposes.

A similar case is currently underway in the Mid-Atlantic. Again, for this site, the long-term plan was to use data collected as part of the remedial investigation to guide NRD restoration planning. The PRP group, their consultants and the trustees discussed the elements of the approach and how scaling would be carried out. The project proceeded in two directions. These included a bottom-up approach involving the injury determination and a top-down approach that included a set of potential restoration projects. Information was used to help align the two information sets.

Guiding Principle 7

Facilitate a collaborative, transparent and efficient NRDA process that offers opportunities for meaningful involvement of PRPs throughout the process.

Suggested Standards of Practice for Guiding Principle 7

Trustees and other stakeholders increasingly are recognizing the benefits of actively encouraging cooperative assessments. Whether by optimizing coordination of remediation and restoration activities, reducing or eliminating the prospects for disputes leading to litigation or reducing overall costs, cooperative NRDAs often can substantially enhance the prospects for achieving cost-effective restoration while minimizing transaction costs for all stakeholders.

There is no established definition of what constitutes a ''cooperative'' NRDA, and in practice it may take one of many forms. Certainly, a cooperative NRDA may entail a comprehensive agreement up front on the development, utility and determinative aspects of all data, analyses and metrics needed to support the NRDA's conclusions. However, more limited arrangements also may yield benefits and should be encouraged. For example, the trustees and PRPs might cooperate on gathering and distributing available technical literature and information, but choose to analyze that information separately and preserve their positions with respect to its utility. Furthermore, the parties might cooperate on collecting new information under agreed protocols and conditions, but might separately analyze that information. Likewise, the trustees and PRPs may agree to cooperate on some elements of an NRD claim, but not others (e.g., injuries to surface water and biological resources, but not groundwater).

However limited or comprehensive in scope, a successful cooperative assessment will exhibit several common aspects. It will require flexibility, focus and commitment from both the PRPs and trustees to create and develop the parameters for the cooperative effort and to see it through to the anticipated outcome. A well-designed cooperative NRDA should result in more efficient and cost-effective data collection and analysis with concomitant economies of scale, and produce a scientifically valid, cost-effective result that minimizes misunderstandings, unmet expectations and resultant disputes.

Since restoration is the ultimate goal of the NRD process, restoration topics should be given meaningful attention at initial and subsequent stages of the cooperative-assessment process. Ideally, the restoration project evaluation will proceed on a parallel track with the injury determination and quantification. Early restoration efforts can focus on identifying potential projects and the criteria for evaluating those projects.

Case/Site Examples: *Lavaca Bay, Texas,* and *Former Indian Refinery, Illinois*

PRP Implementation of Restoration Activities. Since the 1940s, Alcoa operated an aluminum smelter and then an alumina refinery at its Point Comfort, Texas, facility. Additional supporting operations included a coal-tar processing facility and chlor-alkali processing unit. From the mid-1960s to the early 1970s, Alcoa discharged process waters containing mercury and tar processing residuals into Lavaca Bay and nearby areas. Beginning in 1988, bans on finfish taking and crab consumption were imposed for a portion of Lavaca Bay due to elevated mercury levels.

In early 1992, the trustees filed a formal Notice of Intent to Sue for NRD. That led to negotiation and agreement with Alcoa on a Preliminary Studies Funding Agreement covering early sediment sampling work and related modeling tasks, which served as a precursor to subsequent cooperative NRDA work.

During this period, the EPA separately moved to list the Lavaca Bay Site on the National Priorities List (NPL), with the listing becoming final in 1994. Thereafter, EPA, NOAA, Interior, U.S. Fish and Wildlife Service (FWS) and the Texas trustees entered into a Cooperative Management Agreement, setting the framework for coordinated cleanup and restoration activities. Principal among those was Trustee involvement in the design of the Remedial Investigation and Ecological Risk Assessments.

As the level of coordination among the trustees increased, Alcoa's commitments to funding agreements for various projects expanded in 1997 to a Cooperative Memorandum of Agreement (MOA) with the trustees. The MOA focused on cooperative identification of injuries attributable to the site and determination of appropriate compensatory restoration actions. By design, the NRDA process was constructed to be carried out in tandem with and to build upon the RI/FS studies and planning elements. The joint RI/FS and NRDA studies conducted thereafter led to identification of remedial impacts to resources and potential restoration actions. Subsequently, Alcoa agreed to implement the identified restoration projects pursuant to a consent decree, comprehensively resolving its remedial and damages liabilities.

The cooperative assessment wasn't without its missteps, but the trust and improved communication and collaboration developed over many years eventually produced results justifying the efforts. By working cooperatively, the trustees, the EPA and Alcoa were able to substantially integrate NRDA planning with the RI/FS process. This integration fostered thorough remedial investigations and ecological risk assessments that yielded the requisite data and information to assess resource injuries and develop appropriate restoration plans more promptly than is typical.

Eventually, the cooperative NRDA process illustrated the benefits of Trustee (and EPA) coordination, getting the key decision-makers and contributors to the table and keeping them there, developing clearly scoped studies and projects with defined paths forward and end points and understanding the interpersonal skills necessary to building and maintaining trust.

PRP Engagement in NRDA Activities and Working Groups. The Former Indian Refinery site in Lawrenceville, Ill., consists of approximately 990 acres surrounded by residential neighborhoods, cropland, bottomland forested wetlands, the Embarras River and a tributary of Indian Creek. The former facility at the site was operated as a petroleum refinery from the early 1900s until the mid-1990s. The facility's activities generated a variety of petroleum and waste products that allegedly were disposed of or released into areas on- and off-site. In conjunction with the cleanup response under Superfund, the trustees conducted an NRDA for the site, in cooperation with Chevron Environmental Management Co. (Chevron) on behalf of Texaco Inc., the responsible party.

In 2004, the State of Illinois, the FWS and Chevron signed a Funding and Participation Agreement to facilitate a cooperative NRDA for the site. A Technical Workgroup was formed and drew input and participation from representatives of the EPA, the Illinois Department of Natural Resources, the Illinois Environmental Protection Agency, the FWS and Chevron. The cooperation between the trustees and Chevron was instrumental in allowing for an effective NRDA process. The parties were able to take advantage of their collective expertise and experience in order to identify possible restoration projects aimed at the best interest of the public to compensate for the alleged injuries to natural resources.

Under the Funding and Participation Agreement, Chevron agreed to undertake the NRDA activities in order to complete the NRD process under the direction and guidance of the trustees. The agreement allowed Chevron to be a part of the NRDA process, with input from the trustees to approve of the process. The agreement was made without any admission of liability by Texaco. The ability of the parties to work cooperatively prior to completing the settlement process and determining liability made it possible for the NRDA process to move forward more quickly and efficiently. The cooperation was beneficial for both Texaco as the PRP and the trustees by saving time and moving to restoration sooner. In particular, both parties were able to have an active role in the overall NRDA and restoration process, including maintaining a focus on restoration, coordinating assessment/restoration with remediation activities and providing input relative to a proposed schedule for completing the NRDA and getting to restoration.

Current and Future Use of Best Practices

This article has illustrated how each of seven guiding principles can be used in the context of specific cases and sites involving natural resource damage issues in order to facilitate a more consistent and cost-effective practice arena nationwide. Looking to the future, the best practices can be used to identify key issues that are likely to arise at individual sites. They provide practical guidance, as well as a roadmap for moving through the NRDA process toward a well-defined and expeditious restoration conclusion. The information presented here reflects those methods and processes—based on the current state of the art—that have worked in various circumstances under differing conditions nationwide. Implementation and use of the best practices can benefit a variety of stakeholder groups, including government, industrial parties and the general public, by helping to fairly resolve liability; returning resources to local use; promoting greater economy of scale where possible; and improving the ability to move through the process with greater predictability and productivity, thus increasing efficiency, cost-effectiveness and better use of personnel and monetary resources.

Government authorities and industrial companies alike have a unique opportunity to build upon the collective lessons learned over the past 30 years concerning what best advances the objectives of the nation's NRD programs—namely, to restore the services or uses attendant to various natural resources via restoration or replacement of the resource, or acquisition of an equivalent resource. The best practices are intended to be a ''living'' set of principles and approaches and will be updated and revised as warranted based on continuing maturation of the NRDA and restoration practice arena and/or new scientific or other practice developments. Continued dialogue and practice exchange among and between the private and public sector practitioner communities, perhaps in consultation with local communities, can inform any needed revisions or expansion of the principles and standards of practice covered here.

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