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ADDRESSING UNCERTAINTY AND DATA LIMITATIONS IN DAMAGE ASSESSMENT

7.1 INTRODUCTION

Uncertainties exist in any damage claim. For example, it may be difficult to establish the exact number of birds or fish killed as a result of an oil spill, to estimate the time period required for full recovery of a resource, or to measure the public's willingness to pay for an environmental improvement. Uncertainty in the context of damage assessment often extends beyond standard measures of statistical confidence to cases in which little or no primary data are available to support development of a claim. This is especially true for preliminary damage estimates developed for purposes of assessment planning or settlement negotiations. While not explicitly mentioned in DOI's proposed rule the treatment of uncertainty in an economic damage claim is addressed in NOAA's proposed rule, which state that "[u]ncertainty regarding the predicted consequences of restoration options and predicted supply and demand of natural resources and/or services should be addressed in the economic analysis of restoration alternatives and determination of compensable values and documented in the administrative record" [15 CFR 990.79(d)].

This chapter outlines the various factors that introduce uncertainty into an economic damage estimate. It also proposes a value of information approach for determining whether to undertake additional investigations to reduce such uncertainties. This approach can be applied during any phase of the damage assessment process as a means to prioritize potential data gathering and analytic tasks.

7.2 SOURCES OF UNCERTAINTY IN DAMAGE ASSESSMENT

An economic damage estimate may include multiple sources of uncertainty. Among the common sources of uncertainty are:

- The absence of data on the baseline condition of a resource, including the services provided by the resource prior to the release;
- A lack of detailed injury data (e.g., the precise change in ecosystem function resulting from a release, or the exact geographic area over which injury has occurred);

- The likely effectiveness of spill cleanup activities or a hazardous waste site remedy;
- Whether, and at what rate, natural recovery will occur;
- The estimated period over which a resource will be injured or service flows will be interrupted;
- The likely effectiveness of natural resource restoration activities;
- The reliability/accuracy of existing economic benefit estimates (if benefits transfer is used);
- The accuracy of primary benefit estimates; and
- The accuracy of restoration cost estimates.

In addition, other types of uncertainty associated with administrative, policy and legal matters are commonly encountered during a damage assessment. These include, but are by no means limited to, the availability of funds to conduct damage assessment activities, the ability to recover damages from a responsible party, and the actions taken by other trustee agencies. These factors, while important, are outside the scope of this manual.

7.3 THE VALUE OF ADDITIONAL INFORMATION

While various factors act to introduce uncertainty into the economic damage estimate, it is often necessary for trustees to move forward with the development of damage claims based on available data and, in some cases, additional data gathering or analyses. Service employees involved in case management should consider formal or informal application of a value of information approach in determining whether to conduct additional assessment activities. The value of information framework allows analysts to consider whether the cost of additional studies is warranted given the likely improvement in the accuracy or precision of the final estimate. For example, a principal source of uncertainty in an oil spill damage assessment might be in the economic value of a day of recreational fishing at a site. Site-specific analyses might allow the trustees to measure this factor with a high degree of accuracy, but at some cost, in terms of both the funds and the time required to complete such analyses. In determining whether to proceed with additional analyses, trustees should consider such factors as the probability that a reasonable settlement can be reached with the responsible party in the absence of additional information, whether an estimate based on benefits transfer would be acceptable in a litigation setting, and whether the magnitude of the claim warrants additional research. In all cases, any assessment activities that are undertaken should represent the most cost-effective means of improving the accuracy or precision of the final damage estimate.

In undertaking a value of information analysis, trustees need to:

- List each factor believed to introduce significant uncertainty into the damage estimate;
- Rank these factors according to the magnitude of their effect;
- Determine the extent to which uncertainty in the damage estimate can be reduced through additional studies;
- Estimate the cost of undertaking additional studies; and,
- Identify those studies that most cost-effectively act to reduce uncertainty in the damage estimate to an acceptable level.

An informal application of the value of information framework is presented in Section 7.4.

In many cases the tradeoff faced by trustees is between a more certain damage estimate and a delay in the collection of damages, and thus the initiation of restoration activities. For example, the tradeoff may be between settlement with a responsible party in the near term, allowing for immediate initiation of some restoration activities, versus waiting until additional field study can be completed which might allow for a more comprehensive claim. In determining whether to undertake additional studies, trustees should consider such factors as the status of negotiations, the trustee's relationship with the responsible party, and the value of undertaking restoration activities in the short term.

In most cases, some degree of uncertainty will remain in the final damage estimate. In these cases it may be appropriate to report restoration cost and compensable values in the form of ranges, reflecting varying assumptions regarding the most significant factors. Presentation of a range of values based on explicitly stated assumptions is particularly important in the context of preliminary damage estimates. While these presentations need not reflect every potential source of uncertainty, significant factors should be described, and the sensitivity of the damage estimate to these factors reported (see the example below). In cases in which various factors act to potentially over- or understate economic losses, trustees should not assume that these factors cancel each other out, but should describe each significant factor and the influence it may have on the final estimate.

CASE STUDY: DAMAGE ASSESSMENT UNDER UNCERTAINTY

In early 1990, 500,000 gallons of number 2 fuel oil were accidentally released to the Arthur Kill of New York Harbor. This spill resulted in the oiling of regionally important wetlands, a bird and fish kill, and the closure of one of the country's busiest waterways for a period of five days. Following the release, the trustees undertook field investigations to determine the extent of natural resource injury resulting from the spill (e.g., number of birds, mammals and fish killed, acres of wetland and mudflat oiled). Soon after the release, the responsible party came forward with a

settlement offer. The trustees reviewed this offer and performed additional analyses in order to generate a comprehensive damage claim.

Exhibit 7-1 presents a summary of the damage estimates developed by the responsible party and the trustees. As shown, the responsible party considered four categories of economic loss: diminished recreational boating activity; lost or diminished bird viewing opportunities; disruptions in "other" intertidal services; and reductions in "existence" (i.e., passive use) values for the injured resources.

Exhibit 7-1

SUMMARY OF LOST USE AND PASSIVE USE VLAUE ESTIMATES

Category	Responsible Party	Trustee Estimates		
		Scenario A	Scenario B	Scenario C
Boating	$14,250	$14,250	$14,250	$14,250
Bird Viewing	11,250	11,250	11,250	11,250
Transportation +	0	84,000[1]	240,000[2]	400,000[3]
Other Intertidal Services	525,000	557,060[4]	743,000[5]	1,501,948[6]
Existence Values	2,564,000	12,820,000[7]	19,230,000[8]	25,640,000[9]
TOTAL	$3,114,500	$13,486,560	$20,238,500	$27,567,448

\+ Transportation impacts not considered by RP.
1 Assumes 35 vessels diverted for two days at a cost of $1,200 per diversion.
2 Assumes 40 vessels diverted for two days at a cost of $3,000 per diversion.
3 Assumes 40 vessels diverted for two days at a cost of $3,000 per diversion, 40 vessels delayed for 10 days at $400 per vessel.
4 Assumes 73 acres of wetland impacted.
5 Assumes 73 acres of wetland and 136 acres of mudflat impacted.
6 Assumes 73 acres of wetland and 136 acres of mudflat impacted, but assumes oiled areas provide no service flow until fully restored.
7 Assumes 1.0 million households hold existence values for study area.
8 Assumes 1.5 million households hold existence values for study area.
9 Assumes 2.0 million households hold existence values for study area.

Source: Meade and Unsworth (1990).

The trustees reviewed each component of this settlement offer, and developed a range of alternative damage estimates (shown as "scenarios" A, B and C in Exhibit 7-1). Based on a review of available information, the trustees determined that the responsible party's estimates of damages due to lost recreational boating and bird viewing activities were reasonable, especially given that the release had occurred in mid-winter (recreational boating in the Arthur Kill involves use of the Kill as a means to access other areas of New York Harbor from several marinas in New Jersey, while

recreational bird viewing principally involves occasional trips organized by bird viewing clubs in the New York metropolitan area). The damage estimates presented by the responsible party for these two categories of lost use were based on estimates of the number of lost trips (developed through discussions with marina operators and regional bird viewing clubs), multiplied by estimates derived from the economics literature of the trip values.

The responsible party also presented estimates of economic damage associated with "other intertidal services" and lost existence values for the resources of the Kill. The responsible party based its offer of $525,000 for lost intertidal services on an estimate of the number of acres of wetland heavily oiled as a result of the spill, the expected recovery period for these wetland acres, and a review of the literature on the economic surplus value of an acre of wetland. The trustees felt that this estimate was likely to understate actual losses, since it failed to account for lost services from partially impaired wetland, and for lost services provided by mudflats oiled as a result of the release. The trustees developed three alternative damage estimates, based on the following assumptions:

- An assumed loss in economic value of $3,000/impaired wetland acre/year (the same value as that used by the responsible party);
- An assumed loss of $1,500/impaired acre of mudflat/year (assumed equal to one-half of the value of wetland services);
- Estimates of the number of acres of wetland and mudflat impaired by the spill (also based on a field survey done for the trustees);
- The expected time period to full recovery of these resources (based on a field survey performed for the trustees and best professional judgement); and
- A real discount rate of three percent.

As shown on Exhibit 7-1, this analysis implied an economic loss of between $557,000 and $1.5 million associated with injured intertidal resources, with the high end estimate assuming that oiled areas provide no value until they are fully restored.

Similarly, the trustees reviewed the responsible party's offer for compensation for lost existence values resulting from the spill. Despite its urban location, the Kill provides habitat for several endangered and threatened bird species, and a number of species of migratory waterfowl. Given the level of attention paid to the spill in the New York press, the trustees felt that many residents of the New York-New Jersey metropolitan area placed a value on the resources injured by this spill. The responsible party assumed that as many as 200,000 households in the area of New Jersey bordering the Kill experienced existence value losses resulting from the spill, and estimated these losses to be about $13/household (assuming a one-time payment to preserve these resources). The responsible party based this per-household value on a review of contingent valuation studies of similar resources.

The trustees accepted the responsible party's estimate of $13/household, but estimated that at least 1.0 to 2.0 million households were likely affected. As a result, the trustees established a much higher estimate of lost existence values from this spill (i.e., $13 to $26 million).

Finally, the trustees considered one category of economic loss not addressed by the responsible party: the loss of the Kill as a commercial transportation corridor. As noted in Chapter 2, economic damages include lost economic rent resulting from a release event, whether or not that rent was collected prior to the release event. In this case the trustees estimated the lost economic rent associated with the closure of the Arthur Kill while oil spill cleanup activities were conducted.[1] Specifically, the trustees found that 35 to 40 large vessels were diverted for two days at a cost of between $1,200 and $3,000 per diversion; in addition, at least 40 vessels experienced delays for another 10 days (due to limits on vessel speed in the Kill), at a cost of $400/delay. The economic loss associated with these diversions was estimated by the trustees to be between $84,000 and $400,000.

In this case, settlement with the responsible party was reached relatively quickly. However, had settlement not been reached, it would have been necessary for the trustees to consider the need for, and value of, additional investigations to better understand the magnitude of damages resulting from this release event, and to generate damage estimates of sufficient quality to be presented in court. Exhibit 7-2 presents the relative magnitude of uncertainty and compensable value in each damage category (e.g., boating, transportation, etc.). For example, the trustees might have made the following determinations:

- Conduct no further assessments of boating and bird viewing impacts, and rely on the responsible party's estimate.

- Conduct additional interviews with regional transportation authorities and ship owners/operators to better define the magnitude of lost transportation services. Additional investigations on this topic might be called for, since: (1) the responsible party's estimate does not address this category of loss; (2) significant uncertainty exists in the trustee's current damage estimate (i.e., a five-fold difference between the high and low estimates); (3) the cost to conduct additional assessments on this topic is minimal ($20,000 or less); and (4) additional assessment is likely to substantially reduce the uncertainty in the final estimate.

- Conduct no additional investigations of economic damages associated with "other intertidal services." The responsible party's offer is very close to the low end of the trustees estimated range of damages for this category of compensable value (see

[1] Lost economic rent in this case represents the amount that individual vessel operators would have been willing to pay (e.g., in the form of an access fee to a regional transportation authority) for the unimpeded use of the Kill. These operators' willingness- to-pay was demonstrated by the fact that they were willing to incur extra costs in sailing around Staten Island during the period in which the Kill was closed.

Exhibit 7-2). In addition, new analyses may not substantially reduce the degree of uncertainty in the final estimate, and would require substantial funding relative to the magnitude of damages (i.e., $200,000 to $300,000). Also, such analyses would result in significant delays in recovery of damages (6-12 months).

- Consider additional investigations of existence values, if the responsible party is unwilling to increase their settlement offer. For this category of damages there was substantial disagreement between the responsible party's damage estimate and that of the trustees, although the willingness of the responsible party to consider such damages was unusual (see Exhibit 7-2). However, the cost of conducting a primary contingent valuation study would be substantial (i.e., one million dollars or more) and the research would be very time consuming (12 to 24 months), thus delaying initiation of restoration activities. In addition, it was unknown at the time of this assessment whether the government would be able to make a successful passive use value claim in court based on a contingent valuation survey.

Exhibit 7-2

SUMMARY OF COMPENSABLE DAMAGE ESTIMATES