STRATUS CONSULTING

Hanford Site Natural Resource Damage Assessment, Phase 1 Summary Report

Prepared for:

Hanford Natural Resource Trustees:
Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, National Oceanic and Atmospheric Administration, Nez Perce Tribe, State of Oregon, State of Washington, U.S. Department of Energy, U.S. Fish and Wildlife Service

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U.S. Department of Energy
U.S. Fish and Wildlife Service

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List of Acronyms and Abbreviations

CHRPC	CH2M Hill Plateau Remediation Company
CRC	Columbia River Closure
CSM	conceptual site model
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EDA	Environmental Dashboard Application
FS	Feasibility Study
GIS	geographical information system
HEIS	Hanford Environmental Information System
IDMS	integrated document management system
NOAA	National Oceanic and Atmospheric Administration
NRDA	natural resource damage assessment
PIE	preliminary injury evaluation
POCs	Points-of-Contact
RCDP	Restoration and Compensation Determination Plan
RI	Remedial Investigation
TWG	Technical Working Group
USFWS	U.S. Fish and Wildlife Service
WCH	Washington Closure Hanford
WDFW	Washington Department of Fish and Wildlife
WIDS	Waste Information Data System

1. Introduction

This document and related appendices and attachments constitutes the final report of Stratus Consulting's activities related to Phase 1 of the Hanford natural resource damage assessment (NRDA). All work was performed on behalf of the Hanford Natural Resource Trustee Council (Trustee Council). The natural resource trustee agencies and tribal governments that comprise the Trustee Council include the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), the Nez Perce Tribe, the Washington Department of Ecology and Department of Fish and Wildlife (WDFW) (on behalf of the State of Washington), the Oregon Department of Energy (on behalf of the State of Oregon), the U.S. Department of Energy (DOE), the U.S. Fish and Wildlife Service (USFWS) (on behalf of the U.S. Department of the Interior, DOI), and the National Oceanic and Atmospheric Administration (NOAA) (on behalf of the U.S. Department of Commerce).

Phase 1 of the Hanford NRDA was intended to assist the Trustees in the initial phases of planning an injury assessment. Specifically, objectives of Phase 1 included developing an understanding of the perspectives and objectives of the individual Trustees; working with Trustee representatives to develop a shared understanding of NRDA concepts and approaches; developing a conceptual model of the site to help inform injury assessment planning; identifying existing and upcoming data sources that could be used as part of the NRDA; and identifying potential planning issues related to developing a formal injury assessment plan. Specific tasks accomplished in Phase 1 included the following:

- Meetings with each individual Trustee to learn about each Trustee's involvement in the process to date, their level of knowledge about the NRDA process, and specific perspectives and objectives related to the NRDA process for the Hanford Site.

- Conducting training sessions to help familiarize Trustees with the NRDA process, approaches to performing injury assessment, the relationship between NRDA and remedial action processes, the use and development of conceptual site models (CSMs), and other related issues.

- Preparation of a memorandum describing tribal resources and discussing certain tribal perspectives regarding natural resources. This document was developed following meetings with Tribal Trustees and a review of relevant information. The memorandum, which is attached as Appendix A, provides an introduction to tribal lifeways and the potential adverse impacts of contaminant releases on these lifeways.

- Development of a CSM. The CSM was developed in conjunction with a series of CSM planning workshops in which Trustees and invited experts provided information and direction related to the site. The CSM developed as part of this activity provides a conceptual perspective and overview of site history, contaminant releases, pathways, and potential natural resource injuries

- Preparation of a data management report that reviews existing and anticipated future data sources and discusses recommendations regarding overall data integration and management for the NRDA.

- Assistance with overall injury assessment planning and organization of the Trustee Council. Stratus Consulting met with Trustees, discussed alternative organizational frameworks that have been used in large NRDAs, presented approaches to developing technical working groups (TWGs), and ultimately assisted in recommending TWG objectives, actions items, and composition.

- Assistance with establishing a Restoration TWG and developing potential criteria that could be used to evaluate time-critical opportunities for early restoration.

- Development of recommendations to further aid the Trustees in proceeding with injury assessment planning.

These Phase 1 tasks, each of which is intended to help provide a foundation to aid the Trustees in planning a natural resource injury assessment, are summarized below. Subsequent chapters of this report provide more detail on certain aspects of our Phase 1 activities.

1.1 Planning Meetings with Individual Trustees

Over the period August to October 2008, Stratus Consulting participated in meetings with each of the individual Trustees participating on the Trustee Council. In those meetings, Trustees discussed their overall objectives for the NRDA process, perspectives regarding the nature of the cooperative and collaborative structure of the Trustee Council, as well as any concerns about the Hanford NRDA.

The results of those Trustee meetings were summarized in a meeting with the Trustee Council in November 2008. In that summary, we identified certain themes that had emerged in the course of our various discussions. Themes that were discussed included the following:

- Longstanding institutional mistrust among many of the Trustees

- Appreciation of the current team assigned by the DOE to the NRDA

- Concerns regarding the influence of outstanding litigation on the cooperative process
- Concerns regarding the Remedial Investigation/Feasibility Study (RI/FS) process and relationship between the RI/FS and the NRDA
- Concerns regarding the availability of stable, long-term funding for the NRDA
- Frustrations regarding progress on the NRDA, coupled with a level of concern regarding committing to a specific course of action at this time
- Concerns regarding potential early restoration actions, including concerns that early actions could be premature, concerns that early actions should be associated with restoration credits, and concerns that development of an approach to quantify such credits could unduly influence a comprehensive restoration plan
- Concerns regarding the influence of treaty violations regarding Tribal rights to access natural resources
- Emphasis regarding the importance of "place" and tribal lifeways for Tribal Trustees
- Lack of empowerment of the Trustees in the face of uncertain funding and limited influence over response actions.

1.2 Training

In various meetings with the Trustees, Stratus Consulting discussed the NRDA process, specific methods used in conducting injury (and damage) assessment, the relationship between NRDA and RI/FS, organizational approaches used by other trustee councils, the use of CSMs in NRDA and RI/FS, and a number of other related topics. These meetings included presentations of information coupled with extensive discussions among the Trustees regarding relevant topics of concern. Some of these discussions occurred during regularly scheduled meetings of the Trustee Council. Two separate meetings were conducted that were entirely focused on NRDA training: a two-day training on June 30 and July 1, 2008, and another day of NRDA training on December 16, 2008.

1.3 Tribal Resources Memorandum

In early 2009, Stratus Consulting completed a memorandum regarding Tribal resources. This memorandum first describes the general significance of natural resources to the Tribes. It then describes potentially injured natural resources, and incorporates a previously developed list of potentially injured biota. Finally, it proposes a possible framework to incorporate tribal use

losses of natural resource services in the NRDA and discusses how the list of potentially injured natural resources may fit within that framework.

1.4 Conceptual Site Model

Working in cooperation with the Trustees, Stratus Consulting prepared a CSM for the Hanford NRDA. The CSM is intended to frame issues that the Trustees will need to address as part of the injury assessment. Although based on a review of a considerable amount of existing information and data, as well as on detailed technical input from Trustee representatives during CSM planning workshops, the CSM is not a comprehensive review of all literature pertaining to Hanford operations or potential releases, nor is it intended to serve as a blueprint for an injury assessment plan. Rather, the CSM provides an overview of how site information relates to key steps in the injury assessment process, including releases of hazardous substances, transport and exposure processes, and potential injuries to natural resources.

Chapter 2 summarizes the NRDA CSM. The CSM report is contained in a separate file as Appendix B.

1.5 Data Management Report

Stratus Consulting prepared a report that summarizes many of the existing sources of environmental information, documents, and data for the Hanford Site. This summary is intended to provide further insights into the management and location of existing data sources beyond the many individual reports cited in the CSM. The data report also identifies anticipated future environmental studies and data sources and discusses processes by which the Trustees may obtain any new data collected for these studies. Finally, the data report presents recommendations regarding overall data and information management for injury assessment planning as well as for the assessment phase of the NRDA.

Chapter 3 summarizes the data management report. The full report is contained in a separate file as Appendix C.

1.6 Injury Assessment Planning and Recommendations

Over the course of Phase 1, Stratus Consulting has provided the Trustee Council with a series of recommendations regarding overall injury assessment organization and planning. These recommendations have been contained in a series of presentations to the Trustee Council regarding issues ranging from the development of TWGs (for which a separate memorandum was prepared on February 10, 2009), to how Trustees have staged injury assessments at other

complex sites, to approaches to integrating restoration planning into injury assessment, and other related topics. These and related recommendations regarding injury assessment planning and the scope and staging of complex injury assessments are discussed in greater detail in Chapters 4 and 5 of this report.

1.7 Early Restoration Opportunities

Stratus Consulting and the Trustee Council have undertaken a series of discussions regarding early restoration opportunities. In these discussions, various themes have been articulated by different Trustee representatives:

- Opportunities to undertake early restoration activities may exist. Such projects potentially could provide benefits to natural resources and their users, and those benefits might be realized sooner if certain actions could be conducted prior to the completion of a full NRDA.

- Early restoration activities should not be undertaken if premature, if poorly evaluated, if benefits are uncertain, or if they unreasonably preclude a more comprehensive evaluation of injuries and damages.

- Actively seeking restoration projects may be premature, particularly if it prejudges conclusions regarding injuries, damages, or approaches that would be used in quantifying losses and necessary compensation.

- Prior to undertaking early restoration activities, a framework for evaluating restoration projects should be agreed upon.

On April 22, 2009, Stratus Consulting and Trustee representatives met in Richland to discuss such a framework for evaluating early restoration opportunities. Charlene Andrade, who is currently transitioning from WDFW to NOAA, volunteered to chair the Restoration TWG and therefore to propose a formal framework based on the results of the meeting. In their discussions, the Restoration TWG supported:

- Initiating early restoration projects in order to reduce temporal losses (e.g., restoration today has more value than restoration 10 years from now)

- Ensuring that early restoration projects do not compromise properly executing holistic and site wide restoration planning or resolution of the overall NRDA claim

- Focusing on compensatory projects (meant to replace injury from interim losses over time) rather than on primary restoration (meant to restore resources to "baseline" conditions).

Further, the restoration TWG developed draft restoration screening and selection criteria for evaluating restoration projects.

Proposed follow-up actions identified by the TWG included finalizing project selection criteria; evaluating natural resources and resource management actions to understand needs and opportunities for restoration and to support restoration planning in a holistic, site-wide manner; and gathering and compiling a list of potential restoration projects for present and future restoration planning efforts.

Chapter 6 discusses issues and opportunities associated with early restoration in greater detail.

2. Conceptual Site Model

The NRDA CSM was developed to assist injury assessment planning; coordination between RI/FS and natural resource injury assessment data collection, analysis, and review; and to aid in future identification of potential data gaps. The CSM was developed through a review of site reports and data, discussions with individuals with knowledge of the site, and CSM planning workshops held with the Trustees and other technical experts.

In developing the NRDA CSM, we also reviewed and relied upon existing CSMs and supporting site characterization work that were developed as part of Hanford RI/FS activities or other activities at the site. Key features of these existing CSMs are included as an appendix to the NRDA CSM. It is emphasized, however, that the NRDA CSM is intended to serve as an a planning tool to help inform development of injury (and ultimately damage) assessment plans. Consequently, certain elements differ from existing CSMs. This does not imply that existing CSMs, which are designed to address the different needs of these other processes, are flawed. The goals and needs in NRDA differ from those in, for example, RI/FS, and the Trustee Council has a specific set of objectives that must be considered in their planning process. To the extent, however, that the NRDA and RI/FS CSMs share common attributes, these commonalities should be used to facilitate efficiencies in data collection and analysis.

The design of the NRDA CSM focuses on the fundamental elements of NRDA and therefore integrates individual CSMs that address the stressors associated with releases of hazardous substances; the pathways by which stressors affect natural resources and the services they provide (including how substances are transported in the environment); where and how natural resources and the services they provide may be adversely affected (both directly and indirectly) by those stressors; and the nature of adversely affected ecological and human services.

Figure 2.1 presents a simple depiction of the relationship between the seven individual CSMs that comprise the overall NRDA CSM. These CSMs include the Stressor CSM, which addresses releases of hazardous substances and their by-products, as well as unavoidable affects from response actions (including institutional controls); the Pathway CSM, which considers the pathways through which natural resources and humans may be exposed to stressors; the Natural Resources CSMs, which address the resources that may have been exposed to and injured by stressors from the site; and the Human Services CSM, which considers human services associated with natural resources in the assessment area.

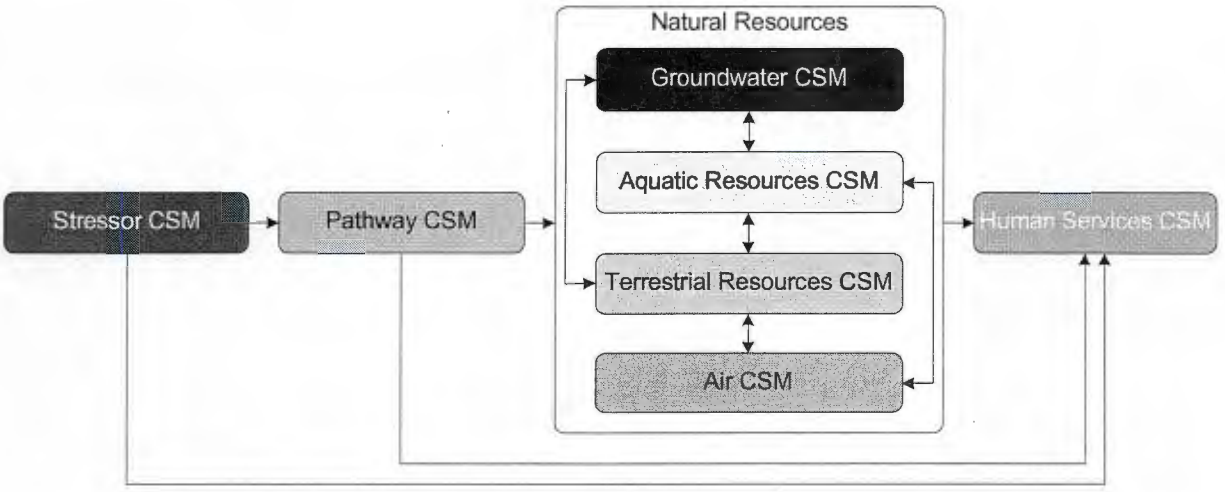

Figure 2.1. General organizational framework of the Hanford natural resources injury assessment CSM.

The **stressor CSM** describes known and potential site stressors that may have resulted in injuries to natural resources. Figure 2.2 shows the main categories of operational, response action, and secondary stressors at the site. As discussed in the report, there may also be stressors that have come to be located on-site that originated from off-site sources. Such non-Hanford sources are not addressed explicitly in the CSM, but may also need to be considered in future NRDA activities to help define baseline conditions for injury and damage quantification.

The **pathway CSM** presents an overview of the pathways through which natural resources and humans may be exposed to stressors. Figure 2.3 shows these general categories of stressors and associated exposure pathways to natural resources and humans. Operational stressors, including those associated with air emissions, process wastes/liquids, and solid wastes, may adversely effect humans and other biota through direct contact and through the physical disruption of habitat. In addition, hazardous substances released can be transported through biotic and abiotic pathways and expose and potentially injure natural resources and humans. Biotic components of pathways include dermal contact; respiration and inhalation; ingestion of food, water, or soils; uptake from soils by plants; decomposition of plants and animals; and the distribution of hazardous substances by the physical movement of biota (biotic vectors). Examples of abiotic components of pathways include processes such as volatilization, evaporation, aeolian transport, infiltration, runoff, flooding, and irrigation.

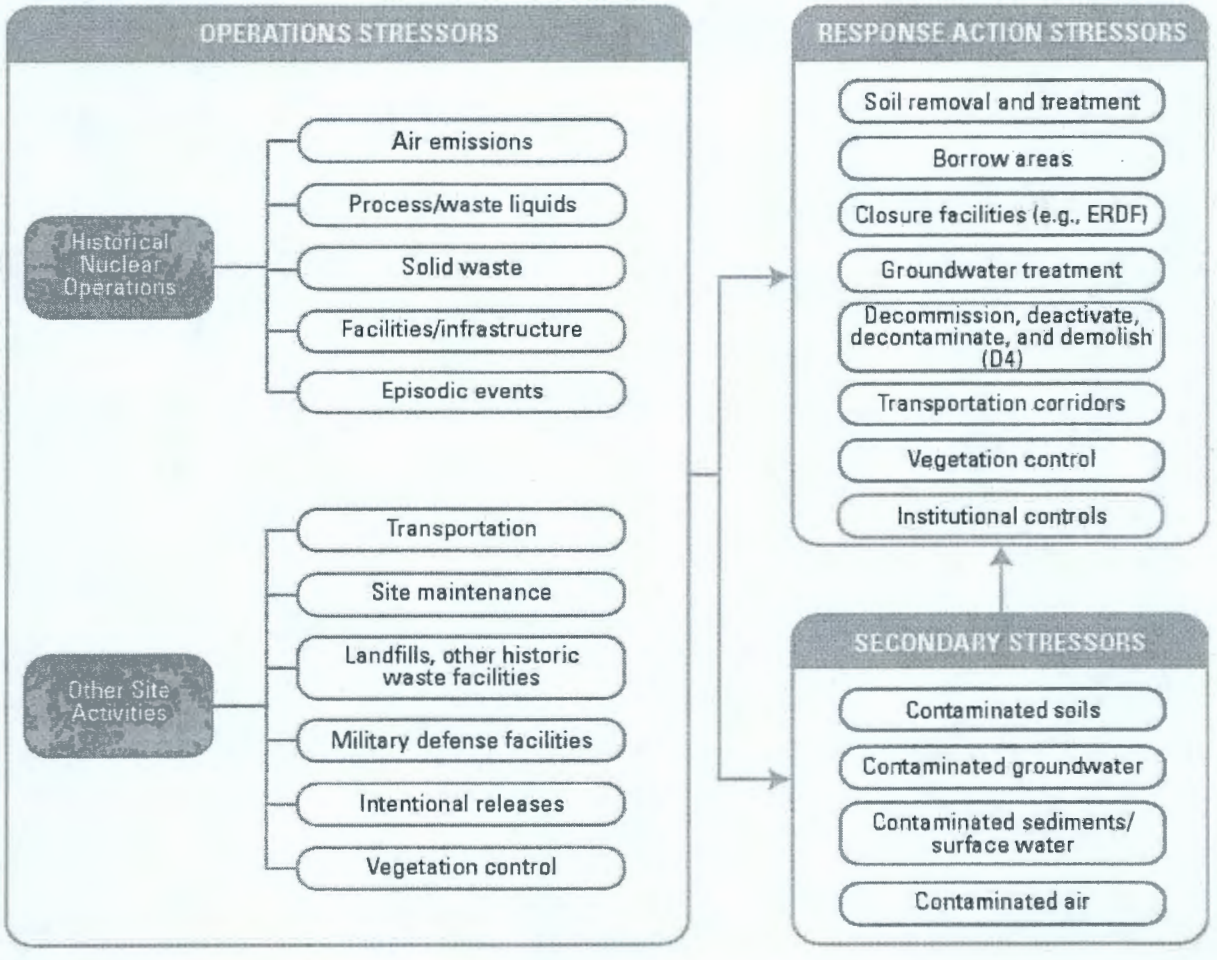

Figure 2.2. Stressor CSM diagram showing operational, response action, and secondary stressors at the Site.

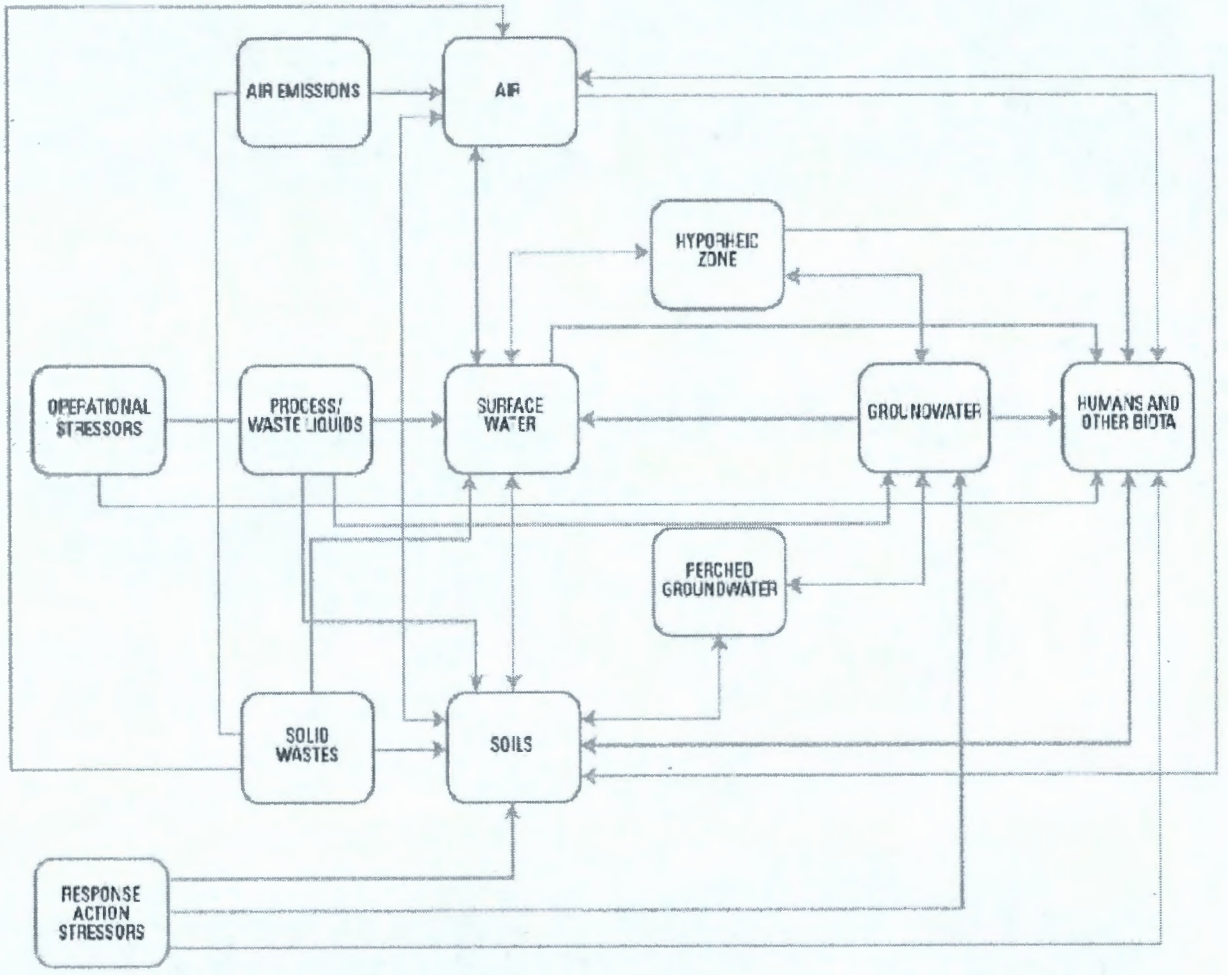

Figure 2.3. Sources, natural resources, and transport pathways, as described in the NRDA CSM.

Natural resources that are exposed to hazardous substances through both biotic and abiotic pathways may in turn act as secondary stressors, or secondary sources of contaminants. For example, contaminated soils may expose groundwater through infiltration mechanisms, or the air through aeolian transport. Contaminated groundwater may enter the hyporheic zone and then expose surface water and sediments, which may in turn lead to the exposure of aquatic biota and humans. Response actions may inadvertently facilitate contaminant transport. They may also cause direct physical disruption of habitat, potentially resulting in injuries to natural resources and reductions in the services provided by natural resources to people. For example, pump and treat and re-injection systems that are designed to treat a specific contaminant may inadvertently transport and disperse other contaminants. Surficial disturbances undertaken as part of response actions, such as the physical removal and displacement of contaminated soils and road construction, can cause physical disruptions of habitat which may result in injuries to natural resources.

The **groundwater and vadose zone CSM** discusses groundwater resources, including water and aquifer materials, as well as vadose zone soils, which are geological resources. The groundwater CSM includes a definition and description of the groundwater and vadose zone natural resources, a brief summary of stressors that may have exposed and/or injured groundwater and the vadose zone, factors influencing contaminant migration through these resources, a summary of the known extent of contamination, and a description of potential approaches to characterize and quantify injuries.

As illustrated in Figure 2.4, hazardous substances and their by-products have been released to the vadose zone and to groundwater from site operations. They have infiltrated into the ground from cribs, trenches, ponds, and other surface impoundments; leaked from underground storage tanks and other containers; and have been injected at reverse wells. Response actions, such as the installation of groundwater pump and treat systems and soil vapor extraction systems and the implementation of institutional controls to prevent groundwater use, may also have caused injuries to the vadose zone and groundwater services.

Other natural resources are likely secondary sources of hazardous substances to the vadose zone and groundwater. For example, hazardous substances may be deposited on the ground surface from the air, and then infiltrate through surface soils with precipitation. Further, the vadose zone and groundwater may be secondary sources to each other. Contaminants bound to soil in the vadose zone may be leached and transported to groundwater by percolation. Contaminated groundwater may transport contaminants to vadose soils in the "smear zone" created by fluctuating groundwater levels. Finally, the vadose zone and groundwater may be secondary sources and pathways to other natural resources such as surface water.

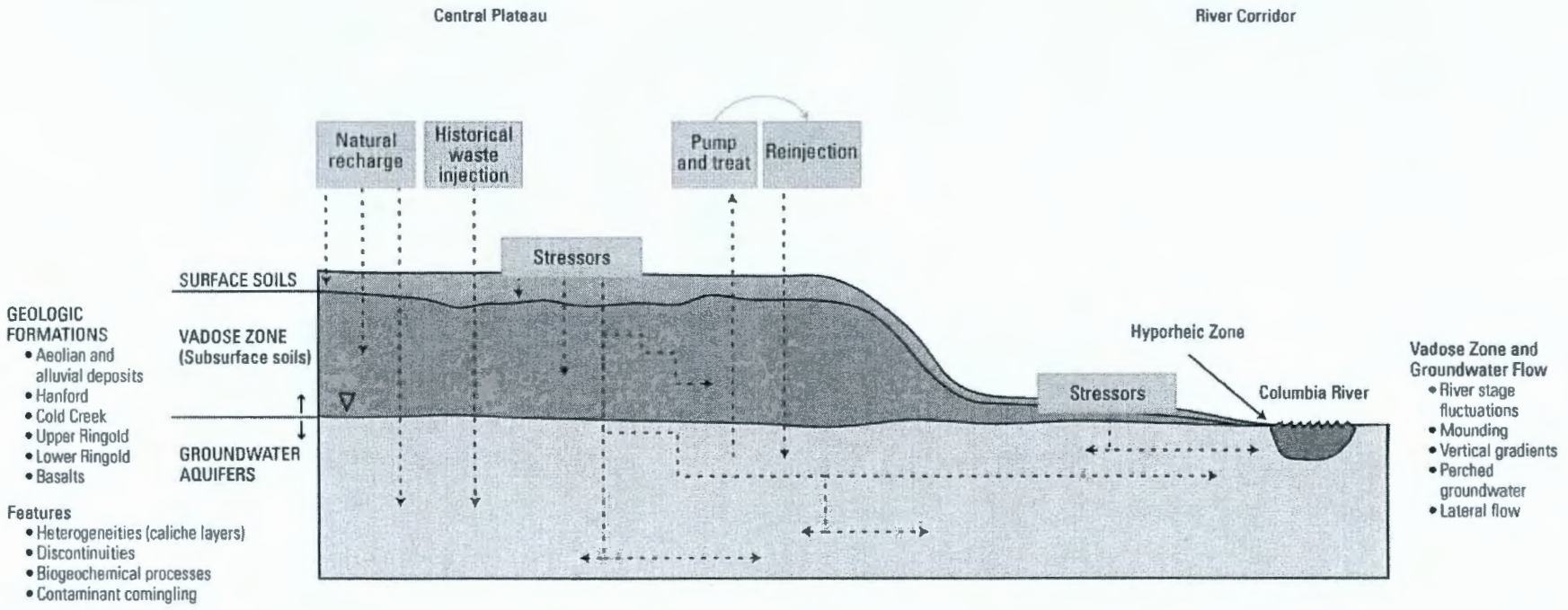

Figure 2.4. Factors influencing contaminant fate and transport in vadose soils and groundwater, as depicted in the groundwater and vadose zone CSM. Human-created factors include both surface and subsurface releases of contaminants as well as pump and treat systems. Physical factors include the properties of the vadose soils and aquifer (geologic formation) materials, as well as vertical and horizontal discontinuities that result in less predictable vertical and lateral groundwater flow.

Transport through the vadose zone and groundwater at the site is complex and may be influenced by many factors. Some of the features that may influence contaminant transport include geologic heterogeneities and discontinuities, biogeochemical processes, and contaminant co-mingling, river stage fluctuations, mounding, vertical gradients, and lateral flow effects.

The **aquatic resources CSM** focuses on surface water resources, including sediments and pore water, and on aquatic, riparian, wetland, and hyporheic biological resources. These resources include riparian and aquatic plants (including rooted plants and plankton); aquatic biota, including finfish, shellfish, invertebrates, and microbes; and birds and mammals that are either partly or wholly dependent on aquatic or riparian resources, including shorebirds, waterfowl, and fish-eating birds and mammals. The aquatic resources CSM considers surface water; hyporheic water; bed, bank, and floodplain sediments; and pore water in sediments both as potentially injured natural resources and as pathways of contaminant transport to aquatic biological resources and their supporting habitat. Riparian resources are considered in both the aquatic resources CSM and the terrestrial resources CSM because of their role in linking aquatic and terrestrial ecosystems. For the aquatic resources CSM, riparian resources are considered on their own as well as in the context of how they affect the functioning of the aquatic habitats they border. Figure 2.5 describes an example of a conceptual model of the pathway and food-chain relationships for aquatic resources.

Adverse effects to aquatic resources can occur through direct exposure to stressors, including exposure to radiation or other hazardous substances released from the site. Adverse effects to aquatic organisms also can occur through indirect effects if stressors from the site result in a loss of habitat, a loss of prey base, changes in the food-web structure, or other impacts to an organisms' physical or biological environment.

The geographic scope for the aquatic resources CSM includes all the locations where hazardous substances released from the site may have come to be located. The geographic scope therefore includes the Columbia River, beginning upstream of the Hanford site and continuing through the Hanford Reach, downstream through a series of dam impoundments, and finally to the Pacific Ocean, including the ocean zone influenced by discharge from the Columbia River (Figure 2.6). This geographic scope may change in the future as more information is gained about contaminant transport and natural resource injury. Smaller surface water bodies on and around the site and the resources they support are discussed in the terrestrial CSM, because of their important connections to the terrestrial ecology and food-webs of the site.

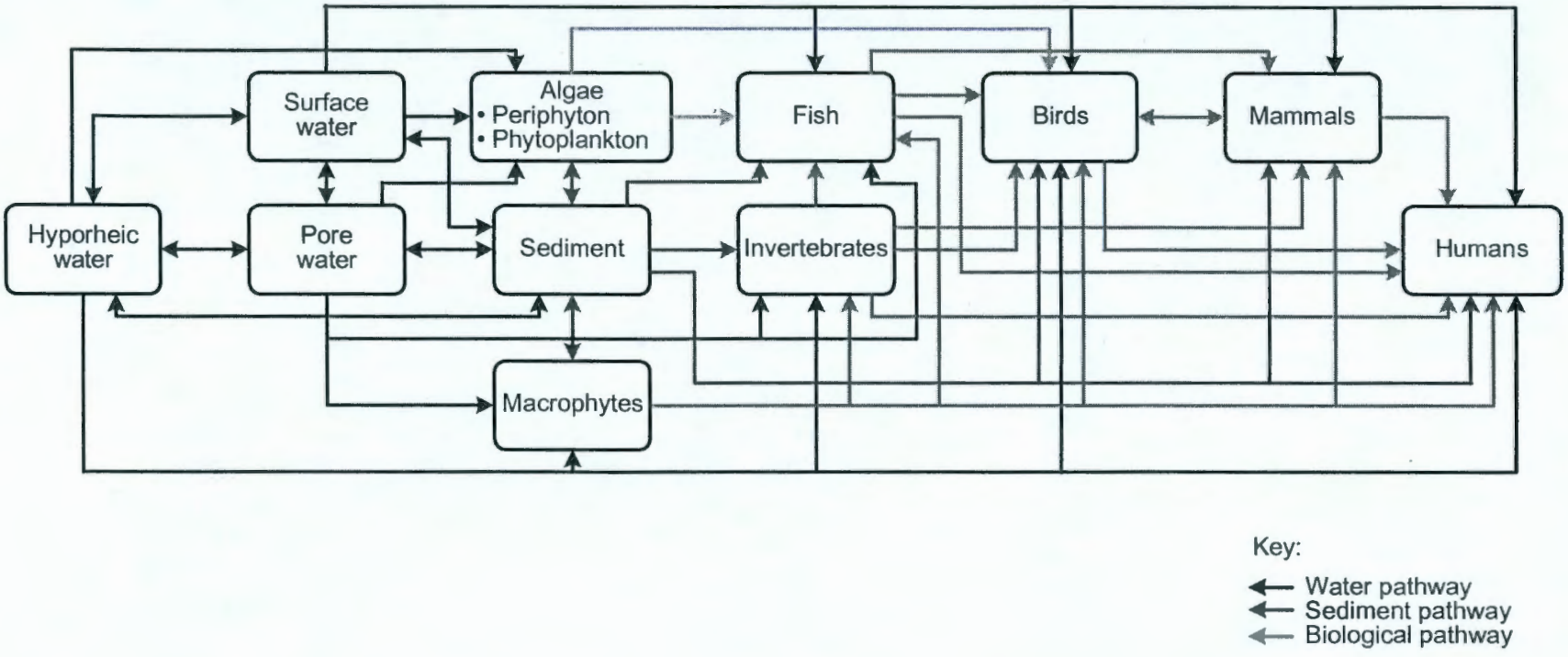

Figure 2.5. Generalized food-web diagram for aquatic and riparian resources in the Hanford Reach, from the NRDA CSM.

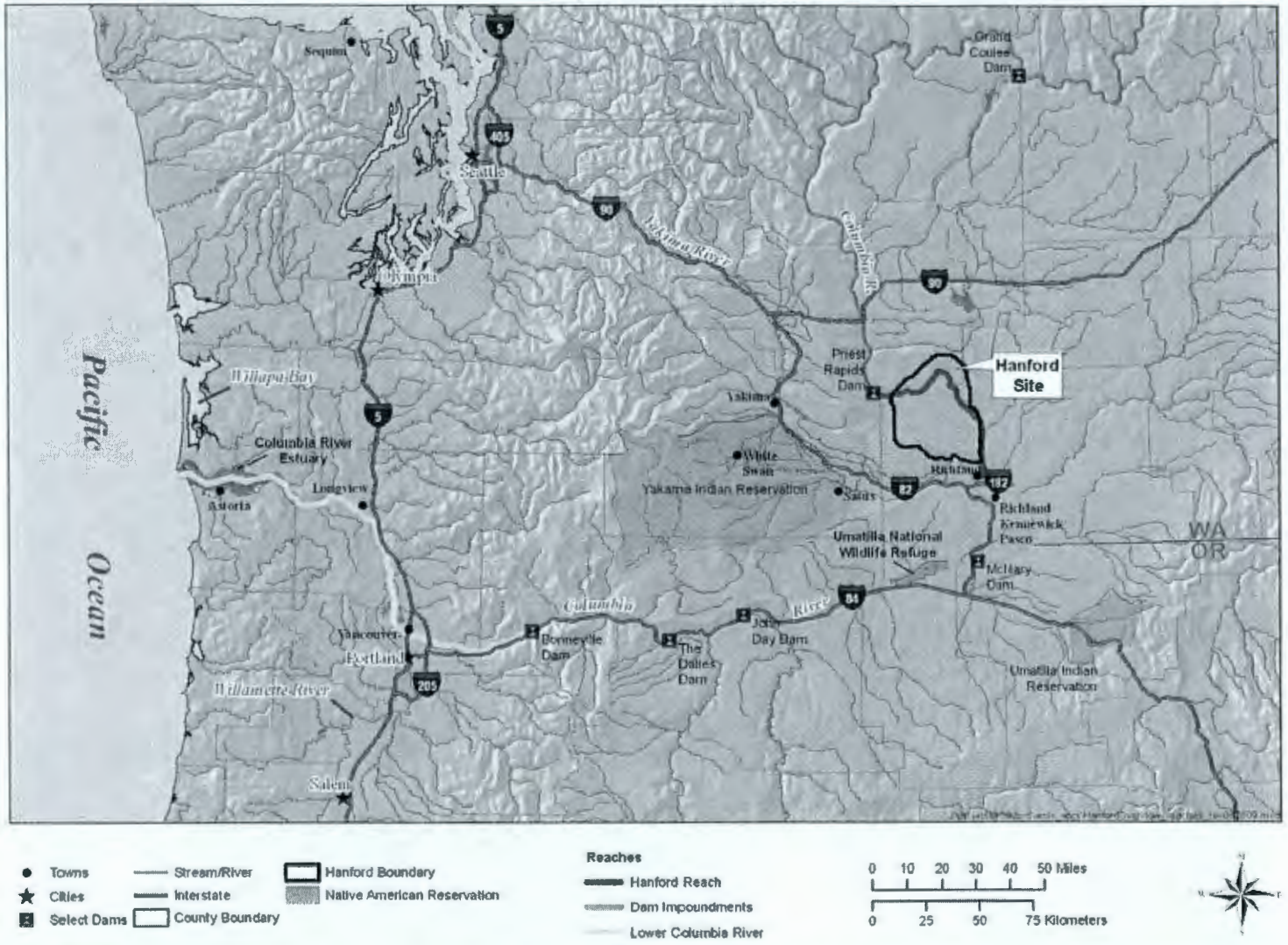

Figure 2.6. The aquatic resources assessment area, including the Hanford site, Columbia River, and surrounding area from upstream of the site to the Pacific Ocean.

The **terrestrial resources CSM** describes both biological resources, such as flora and fauna, as well as soils which can be considered to be both supporting habitat for biological resources and a geologic resource. The terrestrial resources CSM focuses on upland resources and on the small aquatic and riparian habitats that are found within the uplands at the Hanford site, including ponds, ephemeral streams, and springs. These natural resources include surface soils, vegetation, and biota, including but not limited to soil microbes, invertebrates, mammals, birds, and herpetofauna (reptiles and amphibians). The terrestrial resources CSM considers soils both as a potentially injured natural resource and as a pathway of contaminant transport to terrestrial biological resources and their supporting habitat. Deep soils are discussed more broadly in the context of vadose zone impacts in the groundwater CSM. A generalized pathway and food-chain diagram for terrestrial resources is shown in Figure 2.7.

The geographic scope of the terrestrial resources CSM includes all the locations where hazardous substances and by-products of hazardous substances released from the site have come to be located in terrestrial habitats, as well as locations of response actions that cause unavoidable injuries to terrestrial natural resources. This includes the Hanford operations area managed by DOE, the surrounding Hanford Reach National Monument, as well as other off-site locations potentially exposed to hazardous substances released from the site. Off-site locations may have been exposed to hazardous substances through aerial transport and deposition, deposition of contaminated surface water and sediment into riparian and floodplain habitats along the Columbia River, and potentially deposition on agricultural lands through downstream irrigation.

The **air resources CSM** considers air as a natural resource that has been exposed to and potentially injured by stressors at the site. It is also an important exposure pathway to other natural resources, as discussed in the pathways CSM.

The **human services CSM** discusses a holistic conceptual model for evaluating losses of human services associated with injuries to natural resources. Losses of human services can occur to both the general public and to the Tribes; however, the type and severity of losses may vary greatly. Impacts to human services can occur at multiple levels, from the very localized (e.g., loss of harvestable plants in one specific locations) to more fundamental changes in habitats that can alter the overall landscape and view shed. In this CSM, "general public" refers to any non-Tribal member of the population, and "Tribes" refers to the Yakama Nation, the Nez Perce Tribe, the Wanapum, and the CTUIR, which includes the Cayuse, Walla Walla, and Umatilla Tribes. For both Tribes and the general public, the services provided by uninjured natural resources as a whole are more than the sum of the enumerated services of each individual natural resource.

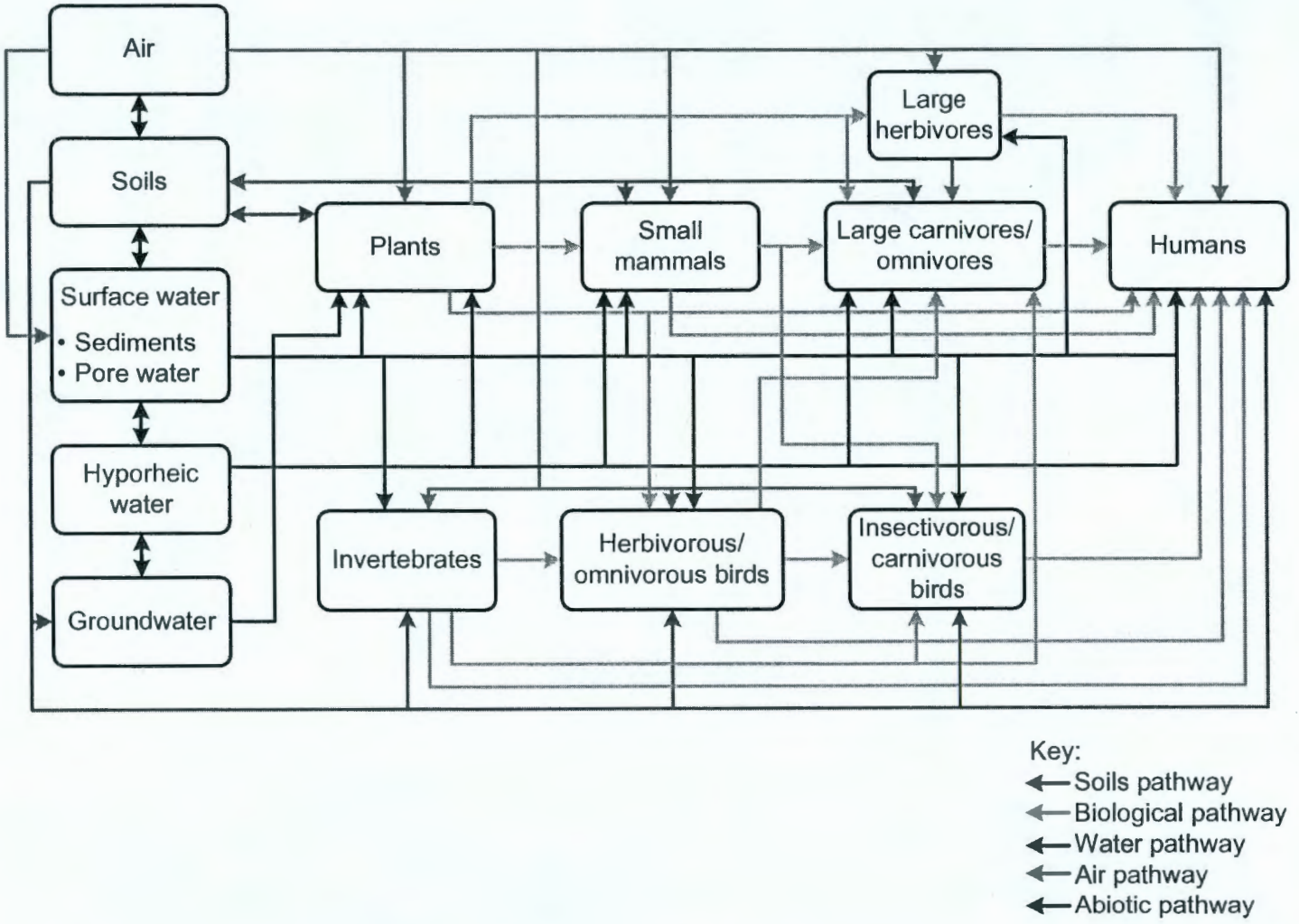

Figure 2.7. Generalized food-web diagram for terrestrial resources in the Hanford Reach.

The uses and importance of resources at the site to the Tribes are both broad and deep. Tribes have depended historically on a wide-range of resources at the site for sustenance as well as for cultural and religious activities. As a result, a human services conceptual model of the site comprises a web of interrelated services, rather than a set of individual uses. From this perspective, injuries to a single natural resource on the site has cascading effects throughout this system. Consequently, the primary objective of the NRDA for the Tribes is full restoration of resources and services, leading to full restoration of Tribal lifeways. Natural resources are a critical component of the Tribal cultural resources of the area. While the remediation of individual resources and services is an intermediate step, anything short of a fully cleaned and restored site may leave the Tribes and general public less than whole. This holistic perspective is emphasized in the discussion of Tribal uses.

Several aspects of the NRDA CSM involved considerable discussion among the Trustees. Key discussion topics included the spatial and temporal scope of the NRDA CSM, as well as the legal and regulatory context of injury assessment planning. The temporal scope of the CSM explicitly recognizes that natural resource damage authorities enable the Trustee Council to quantify damages for losses that have occurred in the past, that are ongoing in the present, and that can reasonably assumed to occur in the future. Therefore, although much of the information reviewed in developing conceptual models of the site focuses on recent past and current conditions, the CSM contemplates and provides for consideration of past, present, and future injuries and damages.

The spatial scope of the CSM encompasses consideration of the full geographic extent of the areas where hazardous substances (and their by-products) released from the site may have come to be located, as well as the geographic extent of natural resources that may have been injured as a result of that exposure. It is emphasized that development of a CSM that considers such a comprehensive geographic scope is undertaken to facilitate thoughtful assessment planning. However, it neither implies that the Trustee Council must necessarily assess (or prioritize) the entire spatial region or the potential exposure of every natural resource, nor does it suggest that the NRDA will necessarily focus within any specific area or location. Finally, it should also be emphasized that the spatial scope of potential environmental exposures and natural resource injuries is itself dynamic and must reflect temporal changes in site operations, releases and transport of hazardous substances, as well as potential natural resource injuries that may occur in the future.

Key issues related to the regulatory and legal context of NRDA planning included the specific substances which will be the focus on the injury assessment, as well as potential types of injuries that may be examined as part of the NRDA. CSM planning workshops included wide-ranging discussions regarding these matters. Consequently, the NRDA CSM adopts broad definitions and perspectives to reflect these discussions. It should be noted, however, that consensus positions regarding many of these issues have not been reached among the Trustees. Therefore, the

perspectives included in the CSM are intended to further injury assessment planning discussions and do not represent final consensus positions or statements of Trustee Council policy or any explicit or implicit commitment to a specific course of action in designing the NRDA.

Ultimately, the CSM, which is intended to be a living document and is subject to modification as new information is developed or the perspectives of the Trustee Council evolve, is designed to aid in injury assessment planning by highlighting conceptual elements of the site. It should not be construed as representing a comprehensive analysis or evaluation of all available information or a preliminary evaluation of natural resource injuries or damages. Additional perspectives on recommended steps in injury assessment planning are discussed in the following chapters.

3. Data and Document Management

Stratus Consulting prepared a data management report that summarizes many of the existing sources of environmental information, documents, and data for the Hanford Site. This summary is intended to provide further insights into the management and location of existing data sources beyond the many individual reports cited in the CSM. The data report also identifies anticipated future environmental studies and data sources and discusses processes by which the Trustees may obtain any new data collected for these studies. Finally, the data report presents recommendations regarding overall data and information management for injury assessment planning as well as for the assessment phase of the NRDA.

DOE has compiled large amount of historical and current environmental data into the Hanford Environmental Information System (HEIS). Until recently, tools that access HEIS were only available to badged DOE staff and contractors with login access to the Hanford computer network. However, DOE recently created the Environmental Dashboard Application (EDA), which provides access to all HEIS groundwater and soil boring data to members of the public who request login access. Therefore, we are optimistic that DOE will provide access to all HEIS environmental data in the future; this will facilitate independent data analysis by the Trustees.

Washington Closure Hanford (WCH) compiled a separate database of environmental data from the Columbia River, as part of the Columbia River Closure (CRC) project. These data were included on a disk accompanying a recent RI report. In creating this database, WCH conducted a data quality review to attempt to ensure that all data included in the database are usable. Similarly, CH2M Hill Plateau Remediation Company (CHRPC) has conducted data review of all data entered into HEIS. Given the work done to date to compile these two databases, we recommend that the Trustees focus on HEIS and CRC data for an initial data review and data gap analysis in the next phase of the NRDA.

In compiling the information for the data management report, Stratus Consulting obtained geographical information system (GIS) data from DOE, including locations of structures, roads, boundaries, and areas included in the Waste Information Data System (WIDS). WIDS information is helpful for identifying known contaminant disposal sites. Figure 3.1 presents WIDS information.

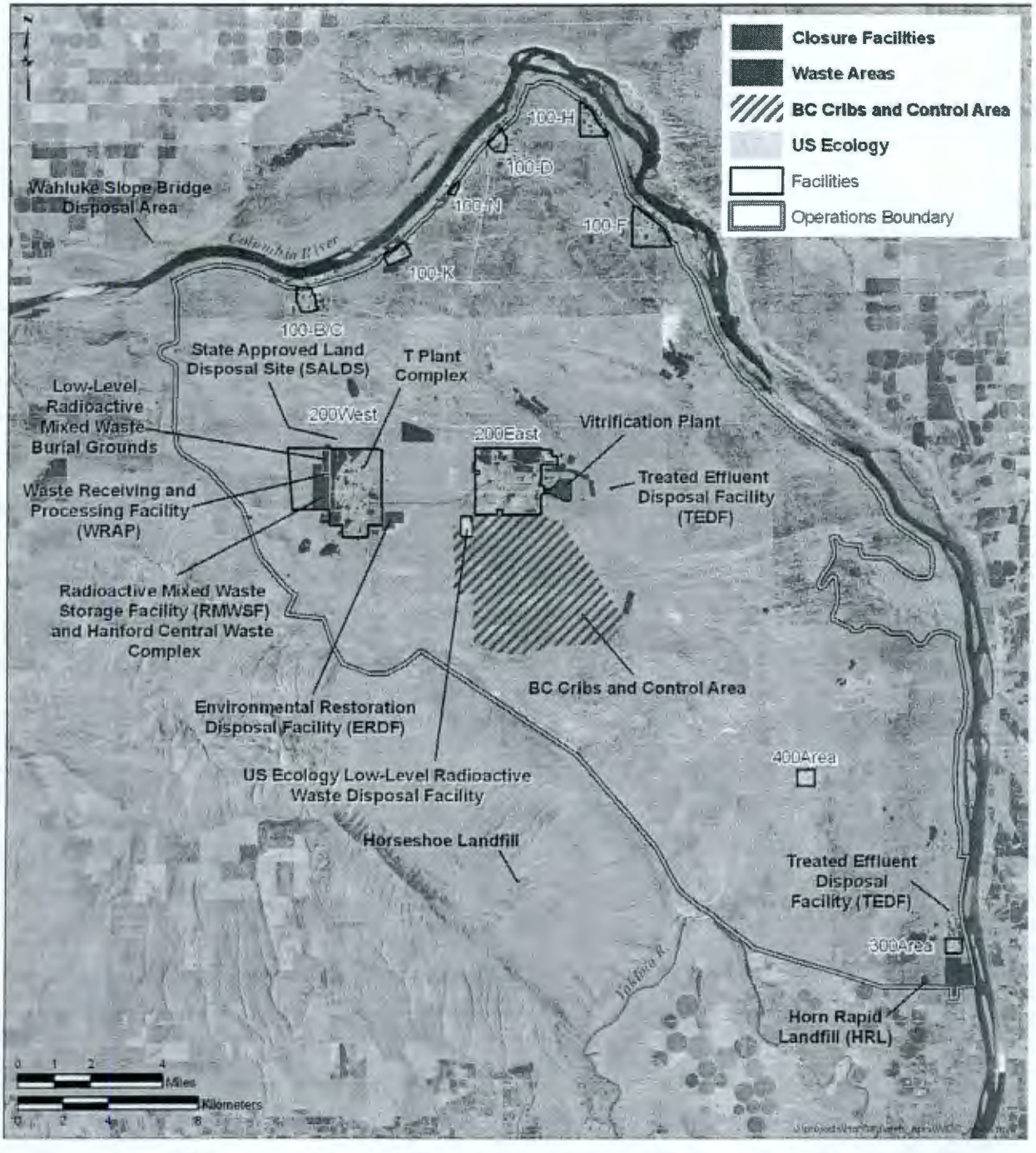

Figure 3.1. Hanford historical landfill sites, waste areas, and closure facilities constructed to process or store Hanford contaminants. Most of this information was obtained from the WIDS data layer (see text).

In our review of existing documents containing Hanford environmental data, we identified online databases that contain thousands of Hanford documents. Documents within these online databases are generally searchable by author, title, or keyword. Web sites containing large numbers of Hanford environmental documents include:

- Tri-Party Agreement Administrative Record and Public Information Record (http://www5.hanford.gov/arpir/)
- DOE Energy Citations Database (http://www.osti.gov/energycitations/) and Science and Technology Information Bridge (http://www.osti.gov/bridge/)
- Hanford Declassified Document Retrieval System (http://www5.hanford.gov/ddrs/index.cfm).

Users with a login to the Hanford computer network can also access the integrated document management system (IDMS), which ties together several different online document repositories at DOE. The contractor report database contains roughly 700,000 contractor reports, including reports containing environmental data. Given the number of these report already available from publicly accessible web sites, we again are optimistic that DOE would not restrict Trustee access to this information by deeming contractor reports with IDMS to be official use only.

The data management report provides several recommendations for future data and document management in this NRDA. Key recommendations include the following:

- Development of a formal data and document management process of the NRDA. This process would include identifying both a Data Manager and a Document Manager. Figure 3.2 presents an organizational diagram for the proposed data and document team.
- Identification of one or more Trustee Points-of-Contact (POCs) to access DOE databases and documents, as well as facilitate data and document sharing between DOE and the Trustees.
- Development of a Trustee environmental database, integrating environmental data from HEIS, CRC, and other electronic databases and sources. The NRDA data manager would work closely with the designated Trustee POC to develop a detailed database design and data management plan. The data manager would then develop and maintain the database of environmental data that the Trustees could use to evaluate natural resource injuries.
- Creation of a document repository for documents likely to be useful for natural resource injury assessment. The NRDA document manager would create and maintain a repository. We envision a repository available to the Trustees through a secure website with an intuitive query interface. Figure 3.3 provides an example that Ridolfi Inc. developed for the Portland Harbor NRDA

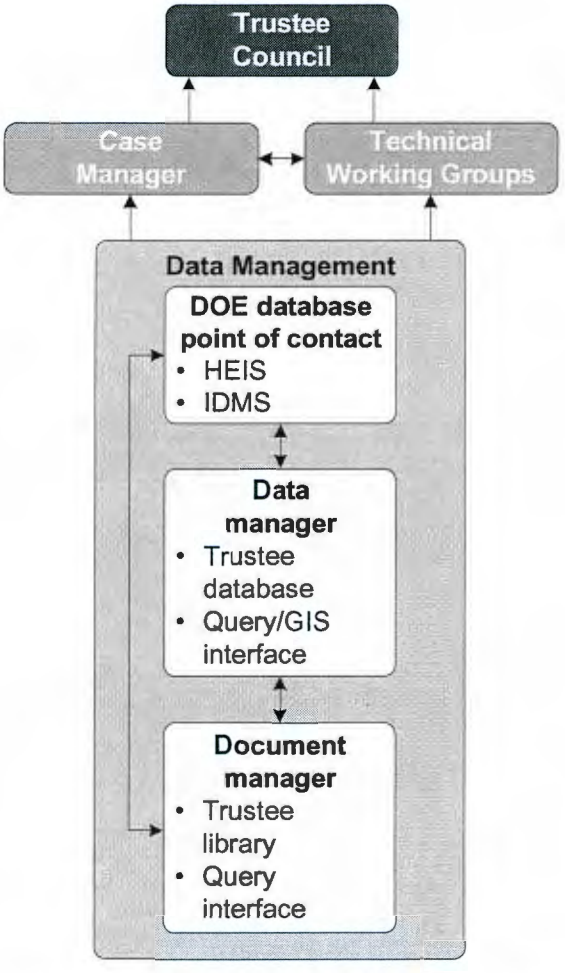

Figure 3.2. Proposed organization of data and document management.

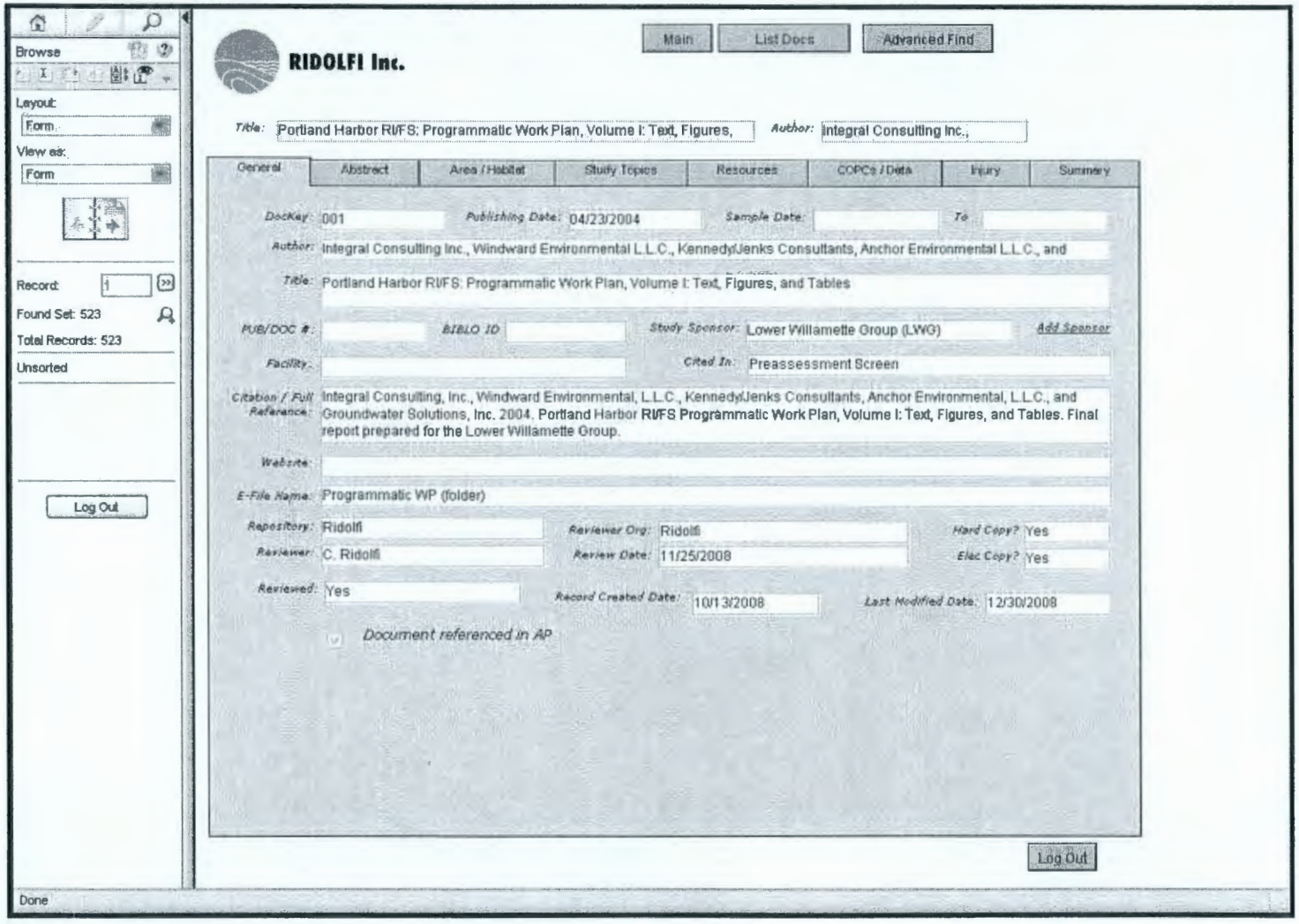

Figure 3.3. Example of secure bibliographic database website with Filemaker interface, created by Ridolfi Inc. for the Portland Harbor NRDA.

- Development of a formal document review and synthesis process that would take plan under the aegis of the TWGs. We recommend that each TWG be responsible for reviewing documents relevant to their CSM. Document review might be approached broadly, with all TWG members reviewing key documents, or it may be streamlined by delegating document review to a specific expert or contractor. The relevant documents identified in the initial rapid review will need to be reviewed in more detail to help determine potential injuries and data gaps. The specific process for document review will depend on the Trustees' preferences. We recommend that the process include a qualitative ranking (high, medium, low) of the importance or relevance of each document, with the ranking added as a field to the online bibliography interface. Each TWG would be able to generate a bibliography of high-importance documents for evaluating their specific resources or services.

- Implementation of a data review process within the TWGs. Under this process, the data manager would compile available environmental data into the Trustee database. Once a database is built, we again recommend that each TWG take responsibility for the initial data review. As with the document review, the data review could be approached broadly, with several Trustees and their representatives performing specific data review tasks, or it could be streamlined, with the data manager or a contractor performing the bulk of the analyses. In general, we suggest that the TWG, the data manager, and other experts whom the TWG designate should jointly evaluate the spatial and temporal coverage of the data.

- Development of data synthesis reports. We recommend that each TWG produce one or more data synthesis reports as the final step in the initial document and data review process. The synthesis reports would summarize the data that the TWG reviewed, including preliminary estimates of stressors, injuries, and damages.

Ultimately, we recommend that the TWG synthesis reports include initial recommendations for future assessment, specifying assessment tasks, data collection, and appropriate data analyses. These reports would be used to develop preliminary estimates of injuries and damages for the Assessment Plan, as well as provide guidance for initial injury assessment studies.

4. Injury Assessment Planning

This chapter provides suggested steps for planning the natural resource injury assessment at Hanford. First, we propose that injury assessment planning and activities be undertaken using a sequential, phased approach. The initial phase of the injury assessment would rely on existing data. The intent of such a first-phase injury assessment would not be to circumscribe the scope of a comprehensive injury assessment. Rather, it would provide Trustees with a clearer sense of the potential nature and extent of injuries (based on existing information), and it would aid in identifying data gaps and critical uncertainties, coordinating NRDA with RI/FS activities (including response actions), and defining the nature of follow-up work that should be performed in subsequent injury assessment phases. Such phased assessments have become increasingly common in complex NRDAs.

Figure 4.1 presents an overview of recommended planning steps under such a phased approach. Each of these steps is described in greater detail below.

4.1 Organizational/Administrative Activities

4.1.1 Trustee organization

We recommend formalizing the TWG process that has been initiated by the Trustee Council. Figure 4.2 outlines a proposed organizational structure for the TWGs, as well as for the previously mentioned data and document managers. The TWGs would work quasi-independently, reporting the results of their work at regular Trustee meetings. The data and document managers would report to the Trustee Council, but would also be available to assist each of the other TWGs with data and document retrieval and data analysis.

We previously provided a memorandum to the Trustee Council outlining the function and "charter" of TWGs. We recommend that this approach be deliberated, formalized, and adopted, and that the formal composition and management structure of each TWG be determined.

4.1.2 Coordination with RI/FS

We recommend initiating a formalized approach for information exchange with RI/FS activities. This would include identifying points of contact for both the RI/FS and the NRDA, and establishing regulatory telephone and in-person meetings. The Trustees are frequently briefed on upcoming RI/FS activities; it would be helpful to formalize a process by which new data are shared, including any data that were rejected for data quality reasons.

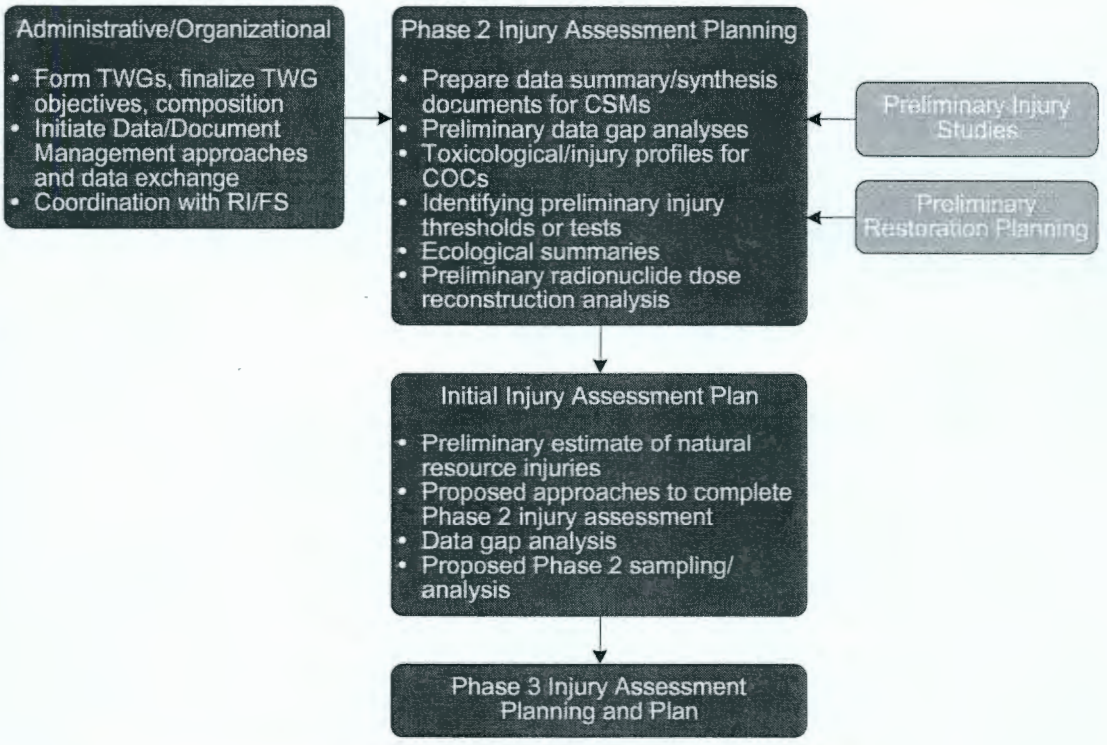

Figure 4.1. Proposed organization for injury assessment planning.

It is anticipated that all new RI/FS data will be entered into HEIS. As mentioned previously, we recommend that the Trustees establish a data sharing agreement with DOE that will allow the Trustees to build an independent environmental database for the NRDA.

4.1.3 Data/document management

We recommend proceeding with data/document management tasks, as described in Chapter 3 and the Data Report. Specific next steps could include:

- Appointing Trustee POCs, a data manager, and a document manager
- Initiating discussions to obtain all relevant environmental data from HEIS
- Developing an independent Trustee environmental database, starting with HEIS and CRC data
- Creating a library database of word-searchable PDF documents, with an online bibliographic interface.

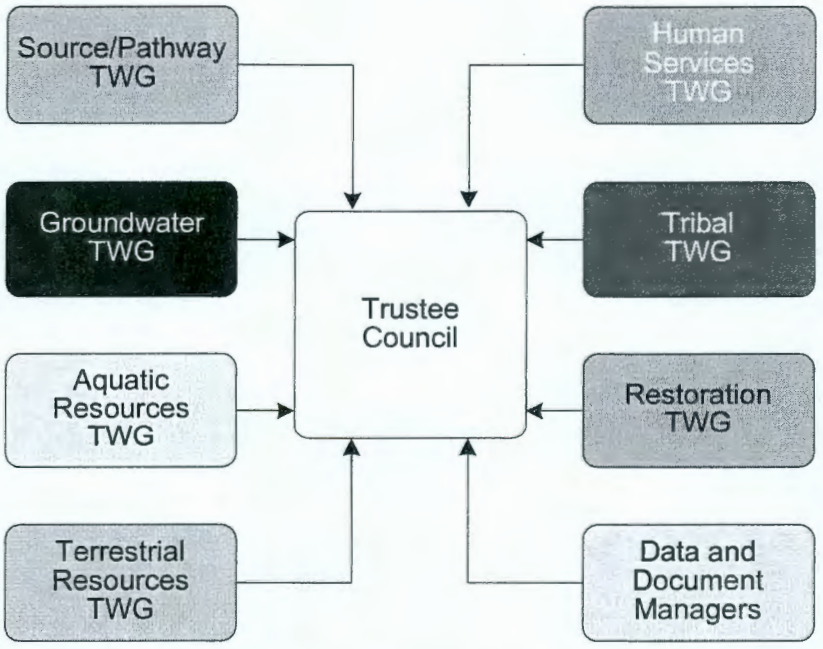

Figure 4.2. Proposed TWG organizational structure. Each TWG would operate quasi-independently, reporting the results of their work to the Trustee Council on a regular basis. The data and document managers would report to the Trustee Council and be available to assist the TWGs with data and document retrieval and analysis.

4.1.4 Stable long-term funding

In meetings with individual Trustees, the availability of stable long-term funding has been identified as a planning uncertainty. We recommend that the Trustees adopt a long-term funding model in which future activities, benchmark goals, and costs are estimated and tracked. Chapter 5 provides additional detail regarding this issue.

4.2 Injury Assessment Planning Activities: Phase 2

The Trustees previously characterized the work described herein, including the CSM and the data management report, as Phase 1 of Hanford natural resource injury assessment planning. As mentioned previously, we recommend that the Trustees continue to approach injury assessment planning in multiple phases. This will allow for more flexibility in their assessment approach, as well as the ability to commence assessment activities for some known data gaps while still evaluating other potential data gaps.

Phased assessment planning is increasingly common at large NRDA sites. The Leviathan Mine Assessment Plan (Stratus Consulting, 2003) describes the phased approach for that NRDA (Figure 4.3), with an initial data review phase, injury assessment studies to address data gaps in Phase 2, followed by injury determination and quantification in Phase 3.

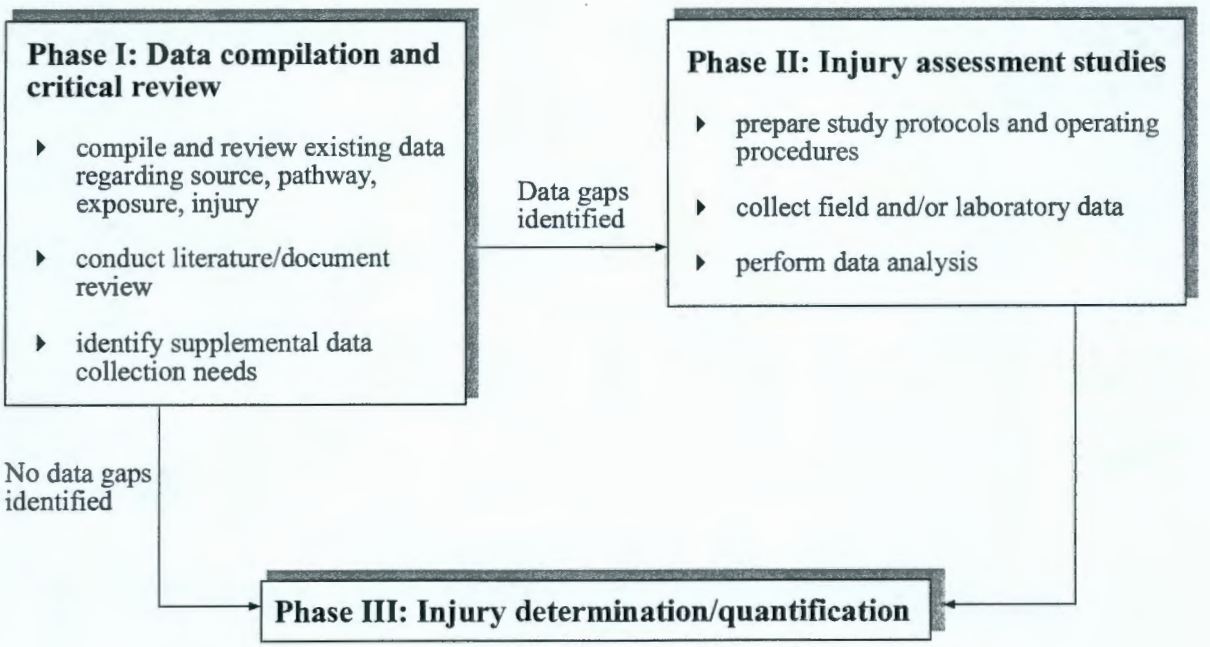

Figure 4.3. Phased injury assessment approach in the Leviathan Mine NRDA.

Source: Stratus Consulting, 2003.

The Trustees have expressed concern that a phased approach to injury assessment would lead to a premature focus on obvious injuries at the expense of conducting a comprehensive and holistic injury assessment. This need not be the case. With careful planning and clear goals for each phase, the Trustees can approach injury assessment in phases without reducing the comprehensiveness of the assessment. In fact, the scope of the Hanford assessment is sufficiently large that approaching injury assessment in a single phase with a single assessment plan may become prohibitively cumbersome, potentially delaying onset of injury assessment activities.

In the next phase of injury assessment for Hanford, a number of discrete activities might be undertaken. These include:

- Preparation of data synthesis/summary reports within the individual TWGs
- Preparation of preliminary data gap reports, based on the data synthesis documents
- Preparation of toxicological/injury profiles
- Development of initial injury thresholds/tests
- Preparation of ecological summary reports
- Development of a preliminary ecological radionuclide dose reconstruction assessment
- Development/implementation of preliminary injury studies, if desired
- Preliminary restoration planning
- Bench-scale NRDA.

The above tasks would ultimately lead to completion of a preliminary estimate of natural resource injuries, a formal data gap plan, and an initial injury assessment plan.

4.2.1 Data synthesis/summary reports

The objective of preparing data synthesis/summary reports would be to complete and summarize a systematic review of existing data relevant to the scope of each TWG's activity. The Trustees (or each individual TWG) will need to decide how much of the preliminary assessment work they can accomplish themselves within the TWGs, and how much they want to delegate to contractor support, with the TWGs providing review and oversight.

4.2.2 Preliminary data gap analysis

Based on the data synthesis reports, TWGs should undertake an initial identification and inventory of NRDA data gaps. This initial data gap analysis should be presented to RI/FS staff to determine whether relevant data collection is planned, or whether such data gathering could be incorporated into upcoming RI/FS work plans. The preliminary data gap analysis ultimately will assist in long-term assessment planning and budget projections.

4.2.3 Preliminary toxicological/injury profiles

Preliminary toxicological/injury profiles should be completed for obvious hazardous substances of concern for the injury assessment. These profiles should summarize existing data on the toxicity of the substance to various potential natural resources and site receptors, potentially relevant types of injury, and available exposure-response information. In addition, the profiles should address approaches to considering the potential toxicity of mixtures.

4.2.4 Preliminary injury thresholds/tests

Based on the results of the toxicological/injury thresholds, together with discussions among the Trustees, the Trustees should prepare lists of preliminary injury thresholds and tests. This information would identify concentrations (and, if appropriate, exposure durations) of substances that would be associated with different injury endpoints for natural resources. In addition, the potential use of ecological risk assessment information (e.g., hazard quotients) as injury tests could be explored. The information developed in this task will help inform the preliminary evaluation of natural resource injuries.

4.2.5 Ecological summary reports

The NRDA CSM, Ridolfi Inc.'s comprehensive species lists, and other existing site documents provide overviews of the types of potentially injured organisms and habitats. Focused ecological summary reports could be undertaken by the terrestrial and aquatic TWGs in which the specific habitat, life-cycle, and other ecological attributes of key species of concern would be detailed. Such information would facilitate more informed evaluations of potential data gaps and injury interpretations.

4.2.6 Ecological radionuclide dose reconstruction

Approaches to calculating radiation doses to ecological receptors is less developed than for human receptors. While dose reconstruction models for humans downwind of the Hanford Site were developed extensively in the early 1990s, no dose reconstruction work has occurred for ecological receptors. Recent publications (e.g., Valentin, 2007) have included radiation dose models for reference flora and fauna. These recent models can be evaluated with respect to potential species of concern at Hanford to develop preliminary radionuclide dosing models for biota.

4.2.7 Preliminary injury studies

As part of the Phase 2 injury plan development, certain focused initial injury studies could be undertaken. Identification of these studies would occur following the preliminary data gap analysis. Examples of preliminary studies that have been discussed with the Trustees include a spatial evaluation of exposures to terrestrial resources (soils, vegetation) to help ascertain the current extent of contamination; an evaluation of potential upwelling of contaminants in the Hanford Reach of the Columbia River; an evaluation of potential exposure/injury to young-of-year salmon and sturgeon in the Hanford Reach; and an evaluation of potential exposure/injury

to benthic bivalves; and documentation of the types and general spatial location of public and tribal uses of resources in the region.

4.2.8 Preliminary injury evaluation

Based on the foregoing tasks, the Trustees can complete a preliminary injury evaluation (PIE) of natural resource injuries. This preliminary evaluation would present initial estimates of the nature and extent of natural resource injuries based on the detailed review of existing data (and any preliminary injury studies). As illustrated in Figure 4.3, the objective of the PIE would *not* be to circumscribe or pre-judge injuries. Rather, the objective of the PIE would be to assist Trustees in identifying key data gaps and assessment tasks, identifying likely/unlikely injuries, identifying assessment priorities, and demonstrating the potential influence of key policy/regulatory issues (see Chapter 1) on the nature and extent of injuries to help inform Trustee Council deliberations. The results of the PIE would be used in preparing the Assessment Plan (see below).

4.2.9 Preliminary restoration planning

Preliminary restoration planning activities could include (as already identified by the restoration TWG) finalization of evaluation criteria for early restoration actions; compilations of potential restoration alternatives; and development of a restoration model that might be implemented to aid in evaluating restoration needs to offset potential losses associated with response actions. Chapter 6 discusses restoration planning in more detail.

4.2.10 Bench-scale NRDA

We recommend that the Trustees consider conducting a full NRDA "demonstration project" on a small designated area of the Hanford site, starting with an injury assessment using existing data, and ending with a formal agreement between the Trustees and DOE that spells out natural resource injuries, damages, and compensatory restoration. As discussed previously, we believe that such a bench-scale NRDA at the site can be conducted without compromising the stated objective of a holistic and comprehensive NRDA. Conducting this bench-scale NRDA would provide the Trustees several benefits, including:

- Working knowledge of the NRDA process from start to finish
- Known and vetted approach to evaluating injuries and damages, addressing and reaching resolution on legal issues such as temporal extent of injury, injury definitions, and baseline conditions.

- Tangible demonstration of progress to the public, senior administration, and Congress, providing evidence that long-term funding of the NRDA will be a good investment
- Identification of and justification for Trustee-governed environmental restoration, which will start to make whole the Tribes and the general public.

The Trustees would likely select a simple and small parcel of injured habitat, where adequate data for injury assessment already exist. Ideally, it will be a parcel where the Trustees can also agree on the level of injury and service loss in the future; alternatively, the Trustees can assess only past and current injuries, reserving assessing of future injuries for a later date.

4.3 Phase 2 Injury Assessment Plan

As discussed with the Trustees, a phased approach to the Assessment Plan is recommended. This phased approach would allow the Trustees to move forward with initial injury assessment studies while concurrently identifying additional data gaps for future resolution. Each phase of the assessment would be designed to accomplish three goals: (1) fill data gaps identified in the previous phase; (2) identify new data gaps; and (3) plan and budget for the next phase of the assessment. Under this approach, Trustees would be able to make progress on resolving outstanding issues associated with identified injury determination and quantification needs, while at the same time planning for the next phase of the assessment. Specifically, the steps implemented in each phase would include:

- Undertake planned studies or analyses
- Identify additional data gaps
- Identify methods to resolve data gaps
- Coordinate with and/or incorporate the results of RI/FS data collection
- Budget for next phase efforts.

Depending on funding cycles, the timing of a phase may not coincide with annual budget cycles. Therefore, we anticipate that two specific, but interrelated, planning activities occur each year. The first would consist of reporting on the status of on-going assessment studies and data gap identification. The second would entail development of annual budgets will be necessary to secure funding for each upcoming calendar year. In Chapter 5 we discuss the budgeting process in more detail.

The initial assessment plan would come at the conclusion of Phase 2. This plan could identify the selected approach to injury assessment, and present initial injury assessment studies to address known data gaps. As discussed above, we recommend a phased approach to injury assessment planning and implementation. Assessment activities at large NRDA sites are constantly evolving,

as new data are analyzed and the results of early injury assessment studies become known. Therefore, we recommend that the Trustees publish an initial assessment plan in approximately 18 months, providing the background information such as confirmation of exposure that are suggested in the DOI regulations. The initial draft may also include an initial round of preliminary injury assessment studies. We anticipate that multiple addenda to this plan may be necessary as the assessment progresses, with additional data gaps identified and new information revealed during the RI/FS process.

In addition, we believe it may be helpful for the Trustees to develop a draft framework for damages assessment (e.g., restoration-based equivalency analysis, stated preference modeling) prior to publishing an initial injury assessment plan. The purposes of developing such a draft framework will be to consider how the results of injury studies and analyses would be used to inform damage determination (including restoration), to aid in consideration of early restoration actions, and to identify information needs (e.g., relevant to restoration planning) that could be incorporated into injury studies. Development of this framework would be necessary should the Trustees perform the "bench-scale" NRDA demonstration project discussed in the previous section. However, should the Trustees decide against this NRDA demonstration project, we would still encourage the development of the framework for this NRDA in Phase 2.

Other discrete elements of the initial injury assessment plan might include:

- Confirmation of exposure of Hanford natural resources to hazardous substances
- Identification of contaminants of concern
- Applicable definitions of injury
- Approach to injury determination and quantification.

As the Trustees fill some data gaps and identify others, the focus of injury assessment studies will change. In subsequent phases, the Trustees should describe the new data gaps identified and the studies that will be undertaken to fill those data gaps.

References

Stratus Consulting. 2003. Leviathan Mine Natural Resource Damage Assessment Plan. Final. Prepared by The Leviathan Mine Council Natural Resource Trustees and Stratus Consulting Inc., Boulder, CO. December 16.

Valentin, J. (ed.). 2007. *Environmental Protection: The Concept and Use of Reference Animals and Plants. Draft 4a.* International Commission on Radiological Protection. December. Pergamon, NY.

5. Planning and Budget

This chapter presents recommendations for administrative planning and budget for the Hanford NRDA. Based on experience with other large NRDA sites, we anticipate that the Hanford assessment will take no less than 5 years to fully resolve, with 10 years a more likely estimate. Over this time period, we would expect that the Trustees might anticipate completing injury, damage, and restoration assessments for past, current and near future releases/injuries, thereby addressing the majority of injuries and damages. However, because final remedy selection is not anticipated to occur for more than 10 years, certain aspects of the damage assessment may extend beyond this time frame.

Estimating appropriate budgets for injury (and damage) assessments depends on many factors, including the speed with which the Trustees hope to resolve matters, the approach to handling uncertainty, the likelihood of reaching consensus, and the handling of unexpected results that inevitably occur during the assessment phase. In creating this outline scope and budget we have assumed that the cooperative process will continue, and that the Trustees will work toward consensus.

5.1 Schedule

As discussed in Chapter 4, we suggest a phased assessment process. Phase 2, the next step in the process will culminate in the completion of a PIE and publication of the assessment plan. Phase 3, which itself is likely to be performed in stages, will include implementation of NRDA-specific studies and injury and damage analyses, and would culminate in a Report of Assessment and Restoration and Compensation Determination Plan (RCDP). Based on NRDA projects performed at other large sites, project time frames for these activities would be on the order of 12–18 months for the completion of the Phase 2 activities described in Chapter 4, and no less than five years for completion of Phase 3.

5.2 Public Involvement

We have assumed that multiple documents would be prepared for public review and comment. These include, at a minimum, an initial Assessment Plan (perhaps with multiple addenda), and the RCDP and Report of Assessment. These documents are identified in the DOI NRDA regulations at 43 CFR Part 11. In addition to these public review documents, we anticipate that on-going public interactions (e.g., meetings, fact-sheet development, public presentations) will occur. We recommend that a public participation plan be developed to coordinate and mange the

public outreach process. We have assumed that the assessment would be conducted in a manner consistent with the DOI regulations, as appropriate, and reflecting the most appropriate assessment and restoration scaling approaches.

5.3 Planning Process

While recognizing that NRDA planning and funding at Hanford relies on congressional and high-level administrative support, we propose this general process for long-term NRDA planning as a helpful method for deciding future tasks and budget. Developing and following a known planning and budgeting process and developing stable and sufficient funding is crucial to making good progress on the assessment. We recommend that the Trustees approach planning of NRDA administration and NRDA assessment separately. NRDA administration planning would focus on Trustee Council participation, public participation, data management, and other regular Trustee activities that are ongoing and predictable. NRDA assessment planning would address specific assessment studies planning and implementation, which is more episodic and variable, depending on specific data gaps identified and studies and analyses planned to address those data gaps.

For the NRDA administration, we recommend a rolling three-year planning horizon, with 1-, 2- and 3-year planning goals and associated budgets developed on a rotating basis. This approach to planning for Trustee administration will help identify longer-term funding needs and assist in securing funding sources.

Assessment study planning is inherently more variable. Study implementation varies across study design and goals. The results of a specific study may trigger the need for further investigation along a similar path or trigger new avenues of investigation. Figure 5.1 presents a conceptual approach to the assessment studies process and highlights the feedback process of assessment studies. There is no guarantee that an injury assessment study will in fact answer the intended question and fill the data gap; it is not uncommon for the results of an injury assessment study to provide new questions as well as new answers, requiring additional studies to be designed and implemented. To accommodate variability of planning assessment studies over a long-term assessment, we recommend developing an annual planning and budgeting process that incorporates a steady base flow of effort and anticipates additional variable annual costs.

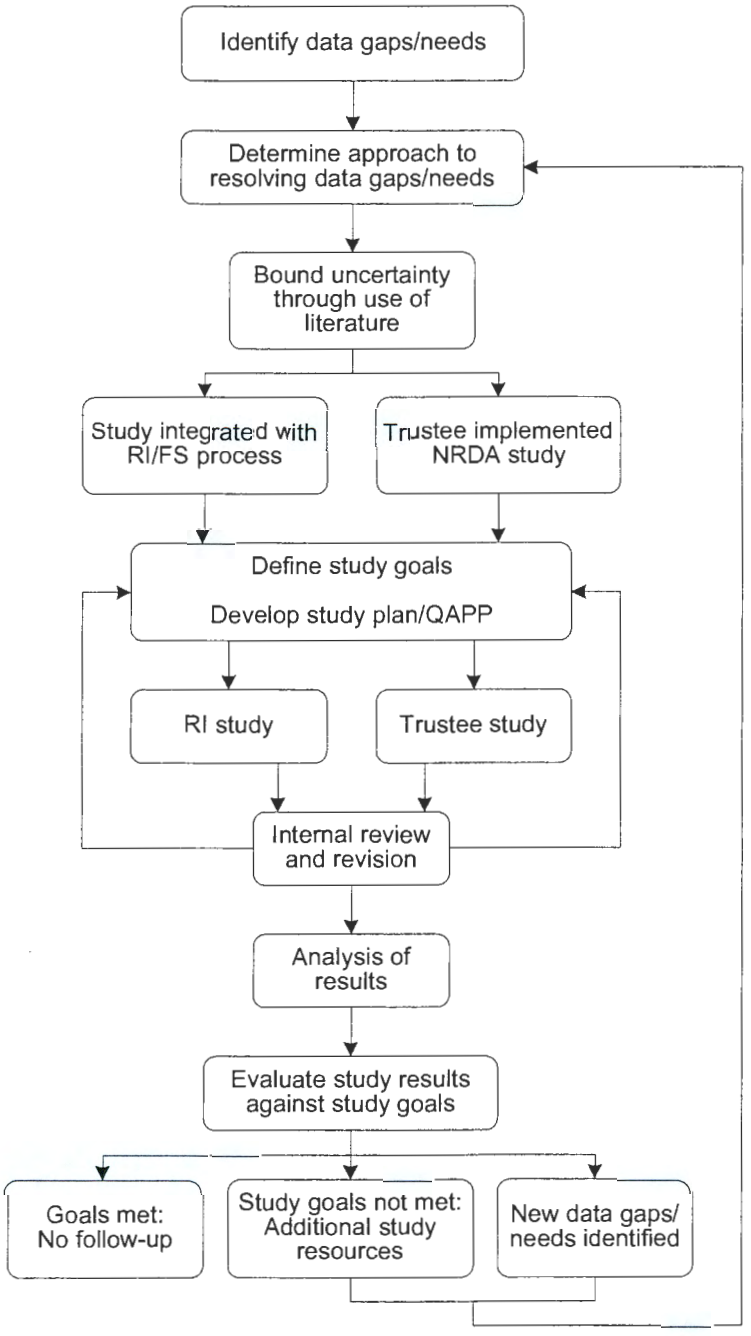

Figure 5.1. Conceptual approach to injury assessment. Multiple iterations may be necessary to address data gaps, as injury assessment studies or analyses may provide new questions in addition to answers.

5.4 Assessment Budget

Commitment to fund reasonable costs of the overall assessment should be secured between the Trustees and DOE. If possible, specific commitments to fund base Trustee administration activities should be secured for at least three years out on a rolling basis. Annual augmentation to base funding should occur depending of the identified specific assessment activities to be completed.

In developing a general estimate of the overall assessment budget, we have assumed the following:

- Base funding will cover Trustee administrative actions, participation in TWGs, integration with ongoing RI/FS investigations, database management, and public involvement in assessment activities
- Annual budget augmentations will be developed to implement specific assessment activities
- The TWGs will be supported by outside consultants to help plan, oversee, and where appropriate, implement specific assessment studies.

Annual base funding for Trustees administration activities are dependent on the needs of the individual Trustee representatives. Based on experience at other large sites and our understanding of the Hanford Site and Trustee wishes, we believe that stable funding for extramural assessment activities (including contracting costs, field and laboratory studies, etc.) can reasonably be expected to be on the order of $1 to $5 million per year for the 5- to 10-year assessment time frame to be achieved. The end of the range would be the bear minimum for conducting injury assessment activities, while the high end would allow the Trustees to conduct multiple concurrent injury assessment activities and complete an injury assessment more expeditiously.

6. Early Restoration Opportunities

On April 22, 2009, Stratus Consulting and Trustee representatives met in Richland to discuss a framework for evaluating early restoration opportunities. Charlene Andrade, who is currently transitioning from the WDFW to NOAA, volunteered to chair the Restoration TWG and therefore to propose a formal framework based on the results of the meeting.

The focus of the Restoration TWG meeting in April was establishing a framework for evaluating time-critical early restoration opportunities. The Trustees do not propose actively seeking and identifying potential restoration opportunities at this time; however, all were amenable to determining a process by which the Trustees can evaluate time-critical early restoration opportunities that DOE or others present. We recommend that the Trustees take advantage of possible early restoration opportunities.

On April 28, 2009, Stratus Consulting provided the members of the Restoration TWG with a memorandum summarizing the principles and concepts discussed in the April 22 meeting, as well as the restoration project evaluation criteria that TWG members proposed, including both threshold criteria and preference criteria.

Charlene Andrade prepared a summary of early restoration principles and a draft Trustee Council resolution in support of early restoration, using the evaluation criteria presented in the April 28 memorandum. The general principles that the Restoration TWG supported were:

- Initiating early restoration projects in order to reduce temporal losses (e.g., restoration today has more value than restoration 10 years from now).
- Ensuring that early restoration projects do not compromise properly executing holistic and site-wide restoration planning or resolution of the overall NRDA claim.
- Focusing early restoration projects on compensatory projects (meant to replace injury from interim losses over time) and will not focus on primary restoration (meant to restore resources to "baseline" conditions). Baseline means the environmental condition that would have occurred, "but for" the release.

To our knowledge, the Trustee Council resolution has not yet been adopted, as Charlene is in transition from WDFW to NOAA and has not actively participated in Trustee Council activities for several weeks.

Moving forward, we recommend that the Trustees incorporate restoration project identification and scaling into Phase 2. In Chapter 4, we recommended a bench-scale NRDA demonstration project for Phase 2, in which the Trustees would conduct all phases of an NRDA on a discrete area of the Hanford site. This would include establishing a framework for quantifying natural resource injuries and damages, selecting an appropriate restoration project, and scaling the restoration project such that it offsets the injuries in the selected area. Should the Trustees decide not to undertake this study, we still recommend establishing a framework for quantifying injuries, calculating damages, and scaling appropriate restoration.

Establishing a framework for damage calculation and restoration scaling will provide the Trustees with a basis for evaluating and selecting potential early restoration projects. Early restoration will help make Tribes and the general public whole, will provide demonstrable progress in the NRDA process, and will allow Trustees to take advantage of restoration opportunities that may not be available at the conclusion of the injury assessment process. As stated previously, we believe that careful planning and consideration of the NRDA approach will allow the Trustees to quantify injuries and implement early restoration without compromising a comprehensive and holistic approach to the NRDA.

We recommend that the Restoration TWG begin the process of identifying and vetting potential restoration projects in Phase 2 of the injury assessment. In general, the process of identifying restoration opportunities involves:

- Establishment of restoration goals and criteria.
- Identification of specific restoration projects. For this preliminary identification of restoration opportunities in Phase 2, we recommend that the TWG attempt to identify projects internally, rather than solicit public input.
- Establishment of evaluation criteria, building upon the threshold and preference criteria identified in the April 22 meeting.
- Calculation of per-unit credit (offsetting liability for natural resource injuries) that each project would provide.
- Evaluation and prioritization of restoration opportunities, after comparison to evaluation criteria, restoration goals, and credit.
- Selecting candidate restoration projects.
- Scaling restoration, based on per-unit credit provided and quantification of injuries.

The aim of identifying early restoration opportunities is to create a working inventory of projects that could potentially be shared with DOE officials and RI/FS managers. This could stimulate thinking regarding how certain restoration projects might be integrated into response action planning and remedial decision-making. Restoration projects could potentially qualify for stimulus funding as well.

A. Tribal Use of Natural Resources in NRDA Memorandum, January 8, 2009

Confidential Memorandum

To: Hanford Natural Resource Trustee Council

From: Peter Jones, Bäuu Institute
David Chapman and Jamie Holmes, Stratus Consulting Inc.

Date: 1/8/2009

Subject: Tribal use of natural resources in NRDA

Task 2 of the initial Hanford natural resource damage assessment (NRDA) delivery order requires Stratus Consulting and its subcontractors to develop a list of potentially injured natural resources that are of significance to the Hanford tribal trustees (the Tribes). Those Tribes include the Yakama Nation, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), which includes the Cayuse, Walla Walla, and Umatilla Tribes. This memorandum first describes the general significance of natural resources to the Tribes. It then describes potentially injured natural resources, and incorporates a previously developed list of potentially injured biota. Finally, it proposes a possible framework to incorporate tribal use losses of natural resource services in the NRDA and discusses how the list of potentially injured natural resources may fit within that framework.

1. Significance of Natural Resources to Tribes

This memorandum focuses specifically on natural resources that are of particular importance to tribal people. All people, Tribal and otherwise, have activities and resources that are part of their culture. Defining the significance of a particular resource is difficult. Hunn (1982) defines the cultural significance of an organism by its particular role within a specific culture. In the context of NRDA, cultural significance varies with both the culture and the natural resource in question. Furthermore, cultural significance depends on the particular values that individual people have for specific natural resources and/or the natural environment as a whole.

Turner (1988) developed the first theoretical model of cultural significance. Her principal assumptions were (1) cultural significance is equal to use, where "use" includes any knowledge of use; (2) every natural resource, so recognized, has some degree of cultural significance; and (3) cultural significance varies in quality, intensity, and exclusivity. Turner attempted to quantify cultural significance as the product of these three variables. However, this kind of quantification can require subjective judgment by the researcher (Phillips, 1996). Therefore, researchers often attempt to quantify cultural significance for a particular natural resource by examining multiple lines of evidence, such as:

- Ethnographic data
- Archaeological data
- Historical data

- Biological data
- Ecological data
- Geological data
- Linguistic data
- Traditional ecological knowledge
- Oral tradition.

Natural resources can be significant both as discrete elements (i.e., specific types of natural resources) as well as for their contribution to the natural environment as a whole, and therefore their contributions to the identity and livelihood of affected tribal members. Many Native Americans, including the Nez Perce, Yakama, Cayuse, Walla Walla, and Umatilla peoples, describe a direct relationship with natural resources as a key element of their cultural identity. In fact, many Native American tribal members describe their individual and collective well-being as derived from membership in a healthy community that has access to, and utilization of, ancestral lands and natural resources (Harper et al., 2007).

The importance of natural resources to the Tribes was codified in the treaties that each of the Hanford Tribes signed in 1855. The Nez Perce Tribe, Yakama Nation, and Cayuse, Walla Walla, and Umatilla Tribes hold treaty rights that specify use of culturally significant natural resources in the Hanford area. When non-Native Americans arrived in the Hanford area during the early 1800s, Native Americans were living in numerous villages from the mouth of the Yakima River to Priest Rapids. The U.S. Government entered into the following treaties with the Nez Perce Tribe, Yakama Nation, and Cayuse, Walla Walla, and Umatilla Tribes at Walla Walla on June 9, 1855:

- Treaty with the Nez Perce [12 Stats. 957]
- Treaty with the Yakama [12 Stats. 951]
- Treaty with the Walla Walla, Cayuse, Umatilla et al. [12 Stats. 945].

Under the terms of the three preceding treaties, the Tribal Nations agreed to cede large blocks of traditional land to the United States, including the lands of the Hanford site. The Tribal Nations retained certain lands for their exclusive use (i.e., reservations) and also retained certain rights and privileges to continue traditional activities outside the reservations. These included (1) the right to fish and erect temporary fish curing facilities at usual and accustomed places in common with citizens of the United States; and (2) the privileges of hunting, gathering roots and berries, and pasturing horses and cattle on open and unclaimed lands. Thus, the treaties acknowledged the relationship between the Tribes and the natural resources in the Hanford area.

Native American tribal members utilize these natural resources for many purposes. Natural resources of traditional tribal significance include:

- Fish, mammals, birds, insects, plants, and other biological resources
- Surface water resources
- Groundwater
- Soil, minerals, and other geologic resources
- Air resources.

Activities involving natural resources include drinking the water and breathing the air; hunting, trapping, and fishing; subsistence gathering; plant gathering; medicinal gathering; recreation; educational, spiritual, religious activities; and any other activity within the traditional lifeways (Hunn, 1990; Walker, 1998; Landeen and Pinkham, 1999; Harris and Harper, 1997, 2004; CTUIR, 2000; Ridolfi, 2007).

Areas where traditional tribal activities occurred are located throughout the Hanford site. Some specific sites have been identified, such as archaeological sites and districts (Krieger, 1928; Drucker, 1948; Rice, 1968a, 1968b, 1980), traditional tribal properties, and village sites. In general, most areas within the Hanford site boundaries as well as areas where Hanford hazardous substances have come to be located are areas of traditional significance to the Tribes.

To account for Tribal utilization of natural resources at Hanford, Harris and Harper (1997, 2004) and Ridolfi (2007) developed scenarios that describe how tribal members interact with the environment. The scenarios incorporate traditional uses of natural resources and can be used to evaluate whether tribal members may face greater exposure to hazardous substances than the non-Native American public. These exposure scenarios will be useful for identifying the loss of natural resource services at Hanford.

In summary, all natural resources are significant to the Tribes. A list of significant natural resources potentially injured by Hanford hazardous substance releases is therefore a list of all potentially injured natural resources. While research into traditional uses of specific natural resources has been conducted as part of the development of exposure scenarios, prioritization of these natural resources in the context of NRDA can be a difficult and complicated task.

2. List of Potentially Injured Natural Resources

The Hanford Natural Resource Trustees previously compiled lists of natural resources potentially injured by Hanford hazardous substance releases. Ridolfi Inc. compiled perhaps the most comprehensive list of potentially injured biota, including 13 algae species, 56 fish species, 269 bird species, 52 mammal species, 21 amphibian and reptile species, over 800 aquatic and terrestrial plant species, and dozens of orders, families, and genera of aquatic and terrestrial

insects. This list, included as a separate electronic file with this memorandum, will be useful when constructing conceptual site models. We have not attempted to transcribe the list.

As described in the previous section and in the exposure scenarios, each of these natural resources is significant to the Tribes. Many of the specific biota that Ridolfi Inc. identifies are of traditional importance to the Tribes for food, medicinal, spiritual, and/or ceremonial purposes. These uses are incorporated into the existing exposure scenarios (Harris and Harper, 1997, 2004; Ridolfi, 2007). However, within the broader context of the NRDA, the Tribes may wish to keep confidential the natural resources that have these specific uses. Below we discuss a potential framework for incorporating tribal use of natural resources into the Hanford NRDA while respecting the confidential nature of the information.

3. Incorporating Tribal Use of Natural Resources in NRDA

The NRDA for the Hanford site is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA defines natural resources broadly to include "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources." These natural resources have been categorized into the following five groups: surface water resources, ground water resources, air resources, geologic resources, and biological resources. CERCLA further specifies that a natural resource is a resource "belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by" the United States, any State, an Indian Tribe, a local government, or a foreign government [CERCLA § 101(16)]. CERCLA confers trusteeship of natural resources, including assessing damages and litigating or settling natural resource damage claims, to the Federal Government, States, and Tribes.

The U.S. Department of the Interior regulations for pursuing NRDA under CERCLA (43 CFR Part 11) do not include explicit guidance for evaluating tribal significance of natural resources within the context of NRDA. However, the regulations specify that NRDA should restore natural resources and the services that they provide, where services are defined as the "physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource" [43 CFR § 11.14(nn)]. Human use services arise from both the direct use of natural resources and nonuse (existence and bequest) services. For tribal members, human use services include both active use of natural resources (e.g., drinking, breathing, hunting, fishing, and gathering of edible plants) and passive services (e.g., spiritual identity). Because tribal identity is so strongly defined by their relationship to their natural environment (e.g., Harper et al., 2007), natural resources and habitats that support natural resources provide more services (on average) to tribal members than to members of the non-tribal public.

In the Hanford NRDA, as in many other cases involving tribal trustees, a significant challenge is to identify and quantify the lost tribal services in a meaningful way, without unnecessarily divulging information that the Tribes wish to keep confidential. Unique tribal use losses have been addressed in other NRDA cases in several ways, as described below.

- *Exxon Valdez* NRDA: This assessment focused on one service (food) that biological resources provide to Tribes. Lost natural resource services to the Tribes was limited to lost subsistence hunting resulting from the oil spill (Duffield, 1997). The assessment did not address many other natural resources services important to Tribes and potentially lost because of the spill.

- Leviathan Mine NRDA: In the Assessment Plan for Leviathan Mine (Leviathan Mine Council Natural Resource Trustees and Stratus Consulting, 2003), the Trustees defined injury to be hazardous substance concentrations above baseline that result in any lost services to the non-tribal public or the Washoe Tribe, regardless of whether of the concentrations exceed a specific regulatory threshold as described in 43 CFR Part 11. Thus, injury may occur at relatively low hazardous substance concentrations. AESE, Inc. (Harper, 2005a, 2005b) developed a tribal exposure scenario that was incorporated into the injury assessment at Leviathan. The Washoe Tribe investigated the potential loss of traditional services such as food and material gathering from contamination of natural resources through the application of the exposure scenario, using their own cultural resource specialists. AESE, Inc. and Stratus Consulting are assisting the Tribe with this effort and have agreed to maintain confidentiality as requested.

- Rio Tinto NRDA: The Shoshone-Paiute Tribes of Duck Valley conducted their own investigation of cultural use losses resulting from injuries to natural resources, The Shoshone-Paiute investigation relied on their own cultural specialists, with Stratus Consulting assisting the Tribe and maintaining confidentiality where necessary.

- Tar Creek NRDA: The Tar Creek Trustee Council (TCTC), including state and federal trustees and seven tribal nations, recently released a draft Assessment Plan. The Tar Creek Assessment Plan (Stratus Consulting, 2008) specifies that traditional tribal services potentially lost because of hazardous substance releases (such as those described previously in this memorandum) will be evaluated and incorporated into the quantification of natural resource injuries. Although Tar Creek hazardous substances have affected the Quapaw Nation, they are not one of the seven Tribes on the TCTC. Instead, they have elected to pursue damages separately. AESE, Inc. has developed a Quapaw exposure scenario that is being used to define the extent of lost human use in the Quapaw litigation.

- Fox River/Green Bay NRDA: The Menominee Indian Tribe of Wisconsin and the Oneida Tribe of Indians of Wisconsin relied on an integrated assessment of biological injuries, recreational fishing losses, and total valuation of all losses led by the U.S. Fish and Wildlife Service. These Tribes assumed that the integrated assessment would sufficiently cover particular losses of traditional tribal services. These Tribes also used in-house experts to evaluate the traditional significance of losses caused by hazardous substance releases but ultimately focused on identifying practical restoration options of significance to the Tribes, rather than independent assessment of particular traditional losses as damages.

In the context of NRDA, natural resources provide services to Tribes that may be distinguishable from services provided to others in the region. In some cases, injuries to natural resources could result in a greater level of service loss (on average) to the Tribes than to the general public. Accordingly, restoration of equivalent natural resources may provide a greater level of service gain (on average) to the Tribes than to the general public.

The degree of NRDA focus on specific cultural priorities is dependent upon the Tribes' willingness to divulge information that would allow practical assessment techniques to be effective. However, particularly in a cooperative NRDA, information may be incorporated in the injury quantification and restoration scaling framework without divulging sensitive information to the other Trustees or to the public. Options that the Tribes might consider include:

- Creation of a technical working group within the Hanford Natural Resources Trustee Council specifically for evaluating service loss to the Tribes. The working group can provide the other Trustees with general information on traditional use and importance of certain natural resources, without divulging specific sensitive information, and can evaluate the extent to which the existing exposure scenarios can be used for determining lost services.

- Focusing on a restoration-based assessment, where compensation for injured natural resources and the services they provide is the restoration of equivalent natural resources and the services they provide, rather than estimation of the monetary value of the lost services. The Tribes could implement a focused restoration scaling effort and potentially oversee restoration projects, ensuring that specific natural resources of traditional importance are being restored, without divulging the species that they are restoring or how the natural resources are used.

In summary, all natural resources and areas that may have been injured from releases at the Hanford site are important to the Tribes. Therefore, quantification of natural resource injuries and service losses, and quantification of natural resource restoration and service gains, will require careful assessment focus that accounts for potentially distinguishable tribal services and priorities. Within a cooperative NRDA process, it may be possible for the Tribes to account for

their specific lost services without divulging sensitive and confidential information about specific natural resources and their uses.

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B. Hanford Site Natural Resource Damage Assessment Conceptual Site Model