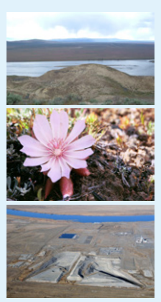
Poster series for Hanford NRDA public meeting

HANFORD: Natural Resource Damage Assessment and Restoration

WHAT IS NRDA?

When hazardous substances are released into the environment, fish, wildlife, and other natural resources can be injured. Federal, State, and Tribal governments act as "trustees" for these resources. Trustees are responsible for identifying and quantifying injury associated with hazardous substances and for restoring the affected resources. The process for assessing injuries and planning restoration is called a Natural Resource Damage Assessment (NRDA). NRDA is guided by federal regulations, which allow Trustees to work collaboratively with those responsible for the hazardous release.



Scenes from Hanford.
Plant photograph by Jim Cummins

HANFORD BACKGROUND

Since 1943, Hanford Site operations in south-central Washington have resulted in the widespread release of over 400 radiological and other contaminants into the terrestrial and aquatic environments. Clean-up of the site began in the 1990s and will continue for many decades. Data indicate that natural resources have been injured, and that these injuries will continue at least until final site cleanup.

As clean-up efforts continue, the Hanford Natural Resource Trustee Council is conducting a natural resource damage assessment (NRDA). The goal of NRDA is to restore, replace, or acquire the equivalent of natural resources injured as a result of the release of hazardous substances.

CURRENT ASSESSMENT PHASE

Currently, the Hanford NRDA is in the injury assessment phase. The Trustees have selected studies that will identify and quantify injuries at Hanford, and these studies are described in the Draft Injury Assessment Plan. After the assessment is complete, the Trustees will have a better understanding of the type and quantity of injuries that have occurred over time and then will be able to determine the type and amount of restoration required to offset those injuries.

RESTORATION

Generally, restoration means restoring natural resources to the condition that would exist had the releases not occurred. An important means of accomplishing this goal is through identification and implementation of appropriate primary and compensatory natural resource restoration projects.

- Primary restoration includes actions to restore injured resources to baseline conditions.
- Compensatory restoration includes actions to compensate for interim losses of natural resources.

RESTORATION PLANNING TO DATE

The Trustees are developing a plan to guide restoration of Hanford's natural resources that have been injured as a result of contaminant releases. This restoration plan will include information on early restoration projects, ecological goals, valuation of potential restoration projects, and long term monitoring. The restoration plan will be revised as information becomes available.

EARLY RESTORATION

Using existing information and restoration planning performed to date, the Trustees can identify early restoration projects that can be implemented prior to the completion of the damage assessment. Early restoration can be part of primary restoration and/or can help meet goals for compensatory restoration. The Hanford Trustees believe that early restoration, done at carefully selected locations can begin to heal resources injured by decades of hazardous releases at Hanford. The Trustees are actively considering potential early restoration projects. The Trustees encourage public participation in this process and invite you to provide suggestions for restoration projects as well as to assist in evaluating and selecting future projects.

AQUATIC: Technical Working Group

AQUATIC · GROUNDWATER · HUMAN USE · RESTORATION · SOURCE & PATHWAY · TERRESTRIAL

MISSION OF AQUATIC TWG

The Hanford Natural Resource Trustee Council (Council) has established Technical Working Groups (TWGs) to aid the Council in completing the technical aspects of the Hanford Natural Resource Damage Assessment (NRDA). The Aquatic TWG provides information and recommendations to the Council for identifying and quantifying injury and damages to aquatic resources associated with Hanford releases.

AQUATIC RESOURCES AT HANFORD

Aquatic resources include fish, wildlife, biota (and their habitats), water and drinking water, and sediments in and alongside the Columbia River. These resources include but are not limited to riparian and aquatic plants; fish, shellfish, aquatics invertebrates, and microbes; and reptiles, amphibians, birds and mammals that are either partly or wholly dependent upon the aquatic resources, including shorebirds, waterfowl, and fish-eating birds and mammals.

Chinook salmon Chinook salmon, an economically and culturally important species, spawns within the Hanford Reach.

Sculpin Sculpin may accumulate contaminants faster than larger fish. The Trustees are considering potential effects on sculpin in areas exposed to contaminants.

Caddisfly larvae Caddisflies, important prey for fish, accumulate contaminants and can be important indicators of water quality.

Western pearlshell mussels Western pearlshells, historically important to Columbia River Tribes, were once abundant in the Hanford Reach, but are now rare or absent.

INJURY ASSESSMENT PLANNING

The following are some initial studies and analyses being proposed in the Injury Assessment Plan by the Council to help determine and quantify aquatic injuries at Hanford. The Aquatic TWG will manage and implement these studies as directed by the Council.

Effects of Hexavalent Chromium and Other Stressors on Native Mussels: This study will help determine if injury has occurred to native mussels from exposure to hexavalent chromium alone or in combination with other stressors, such as temperature, nitrate, and uranium. The objectives of this study are 1) to determine the sensitivity of a native mussel (*Margaritifera falcata*) and a surrogate mussel species (*Lampsilis siliquoidea*) to contaminants, and 2) to determine the concentration at which mussels might be considered injured.

Chinook salmon habitat evaluation: This study involves comparing habitat characteristics and contaminant concentrations at known and potential spawning locations to determine whether contamination influences spawning site selection and avoidance.

Contamination Data Review: The Aquatic TWG is reviewing existing cleanup data for each reactor area in order to characterize potential injury, identify study locations, and focus studies. The Aquatic TWG will compare existing data against preliminary injury thresholds for aquatic resources.

Aquatic Habitat Study, Hanford Reach: This study will characterize suitable habitat for aquatic resources within the Hanford Reach, including, but not limited to, chinook salmon, white sturgeon, sculpin, Pacific lamprey and native freshwater mussels. The objectives of this study are to identify habitats of importance to potentially injured aquatic resources, to aid in the planning of field studies.

NEXT STEPS

The Aquatic TWG will continue to identify, assist and oversee those studies that have been approved by the Council as part of the Hanford NRDA, including the studies proposed in the Injury Assessment Plan and associated products. The Aquatic TWG will also play a major role in compiling and analyzing existing data to identify potential injuries and to scope studies.

GROUNDWATER: Technical Working Group

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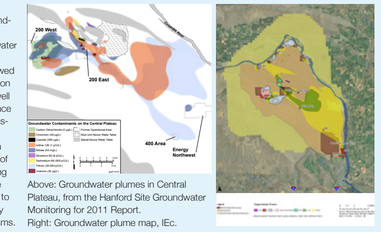
MISSION OF GROUNDWATER TWG

The Mission of the Hanford Natural Resources Trustee Council (Council) Groundwater Technical Working Group (TWG) is to provide information and recommendations to the Council concerning injury and damages to the groundwater resource associated with contaminant releases at Hanford, to identify and evaluate models that have been used to characterize contaminant transport, and to identify spatial and temporal groundwater data gaps.

GROUNDWATER RESOURCES AT HANFORD

The impacted Hanford resources include, of course, Hanford groundwater, but also include resources related to contaminated groundwater that flows to the Columbia River. Hanford groundwater can be viewed as a potential drinking and irrigation water source for future uses as well as a cultural resource; the presence of contaminants can impact terrestrial fauna and flora through subsurface irrigation and output from springs and can affect the range of cultural uses. Groundwater flowing from springs or upwelling into the river not only adds contaminants to downriver drinking water, but may also impact river dwelling organisms.



Above: Groundwater plumes in Central Plateau, from the Hanford Site Groundwater Monitoring for 2011 Report.
Right: Groundwater plume map, IEc.

INJURY ASSESSMENT PLANNING

The Injury Assessment Plan contains several studies to determine and quantify injury to Hanford groundwater services, including studies that address contamination of the vadose zone.

Compiling a comprehensive groundwater database: This study involves creating a comprehensive Hanford groundwater database to allow the Council to analyze the impact of well data quality on the sampling and modeling of contaminant plumes. This information will help with injury determination.

Defining the legal, political, economic environment for baseline groundwater services: The objective of this study is to describe the services that would be provided by groundwater at the Hanford site under baseline conditions and how these services have been impacted by the release of hazardous contaminants. An understanding of the baseline services is necessary to determine how the services have been affected and to identify and scale appropriate restoration projects to restore or replace those lost services.

Verifying current vadose zone models: This study will assess the ability and limitations of currently used models to characterize vadose zone contamination in order to determine whether the models can be used to accurately predict the impact of vadose contamination on groundwater resources. A variety of models are used by the Department of Energy, and verifying model accuracy will allow the Council to make an informed decision on whether to rely on model results to help estimate the quantity of injured groundwater and the impact of vadose contamination.

Characterizing contaminated groundwater upwellings: This study will help characterize the nature, spatial extent, and temporal variability of contaminated upwellings in the Hanford Reach. This will help determine potential impacts to river-dwelling organisms such as fish, mussels, and invertebrates.

NEXT STEPS

An evaluation of Hanford contaminant plume maps is currently underway. The next steps for the Groundwater TWG include beginning to compile a groundwater database, starting to assess the impacts of river stage on groundwater geochemistry, and looking at the current understanding of the vertical distribution of contaminants in the Hanford plumes. The next big step for groundwater injury assessment will be a thorough evaluation of the Hanford groundwater models to determine whether their output can be used for groundwater injury determination-damage assessment purposes.

HUMAN USE: Technical Working Group

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MISSION OF HUMAN USE TWG

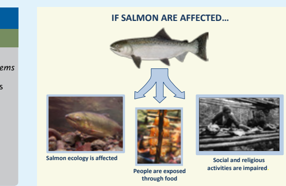
The Human Use Technical Working Group (TWG) provides recommendations to the Hanford Natural Resource Trustee Council (Council) for establishing injury assessment priorities and selecting methods for quantifying potential losses in human use services due to injuries to natural resources at the Hanford site. These include services provided by natural resources to members of Tribal Nations and the general public.

Bitterroot photograph by Leah Aleck

INJURY ASSESSMENT PLANNING AT HANFORD

A variety of human use services are provided by the Hanford Reach of the Columbia River and the surrounding lands. As part of a Natural Resource Damage Assessment (NRDA), when "quantifying changes in natural resource services," the analysis must consider human use services such as recreation and other products or services used by humans. Human use losses in NRDA do not include commercial loss or personal injury claims, but focus instead on the loss of use of the natural resources, such as recreation or cultural uses. Often, closures or access restrictions are used to identify potential injuries to human use services. Once an injury is identified, the magnitude of injury has to be quantified by estimating the amount of services lost over time and space.

ECOSYSTEM SERVICES	
Provisioning Services	Cultural Services
Products obtained from ecosystems	*Nonmaterial benefits obtained from ecosystems*
· Food · Fresh Water · Fuelwood · Fiber · Biochemicals · Genetic resources	· Spiritual and religious · Recreation and ecotourism · Aesthetic · Inspirational · Educational · Sense of place · Cultural Heritage



Above left: Information from the Millenium Ecosystem Assessment

INJURY ASSESSMENT RELATED TO HUMAN USES

The Council is exploring a number of methods for assessing potential human use service losses. The Human Use TWG has examined potential human use service losses to date as part of the Injury Assessment process. A few human use studies are highlighted below.

Inventory of Institutional Controls: The Human Use TWG and the Council will be working on an inventory of institutional controls that may have prevented on-site access due to the release of hazardous contaminants. This will provide information on the nature and geographic scope of institutional controls that could impact past, present, or future human use of the site.

Assessment of Tribal Service Losses: Tribal services may have been diminished in quality, or interrupted, by the presence of contaminants released from Hanford operations. As a result, specific restoration actions may be required to address these service losses. The Human Use TWG and the Council are exploring methods for assessing tribal service losses and for identifying and scaling appropriate restoration.

Development of Tribal and Non-Tribal Human Use Matrices: The Human Use TWG has been working on developing both tribal and non-tribal human use matrices that describe Hanford natural resource categories, ecosystem services provided by those natural resources, and associated human uses or tribal services.

NEXT STEPS

The Human Use TWG will continue to assist and oversee human use activities that have been approved by the Council as part of the Hanford NRDA.

RESTORATION: Technical Working Group

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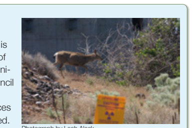
MISSION OF RESTORATION TWG

The ultimate goal of the Hanford Natural Resource Damage Assessment (NRDA) is to resolve past, present and future natural resource impacts caused by releases of hazardous substances from the Hanford Site. The mission of the Restoration Technical Working Group (TWG) is to advise the Hanford Natural Resource Trustee Council (Council) on a path forward for restoration. The TWG will continue to advise the Council on how to restore resources injured from releases of hazardous substances and how to offset the injuries that occurred before cleanup actions were completed.

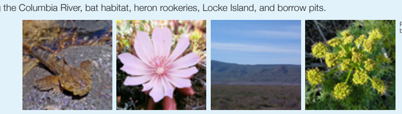


Photograph by Leah Aleck

RESTORATION PLANNING AT HANFORD

The purpose of the Restoration TWG is to help the Council develop a plan for restoring, rehabilitating, replacing and/or acquiring the equivalent of those natural resources that have been injured as a result of hazardous substances. This includes developing a process and methods to solicit, evaluate, rank, and select projects.

Restoration activities can fall into two categories 1) Primary (to restore injured resources to baseline conditions), or 2) Compensatory (to restore injured resources lost over time; such as losses that occurred before resources are cleaned up or continue after cleanup). Trustees may also implement early restoration before a final NRDA plan is fully developed, and before final cleanup is completed. The Trustees are actively pursuing such opportunities at Hanford in order to start the recovery as soon as possible. Projects that are being considered include but are not limited to restoration of old agricultural fields along the Columbia River, bat habitat, heron rookeries, Locke Island, and borrow pits.



Sculpin · Bitterroot · Shrub-steppe · Gray's desert parsley

Plant photographs by Jim Cummins

INJURY ASSESSMENT RELATED TO RESTORATION

The Restoration TWG is actively working on the activities identified below. All of these activities will help the Council identify restoration projects at Hanford.

Hanford Natural Resources Restoration Plan: A Restoration Plan will aid in guiding what projects are needed to restore injured resources at Hanford. The Restoration TWG is currently developing sections of the Plan that will guide early restoration, set ecological goals for restoration, determine how to rank proposals, and develop frameworks for monitoring and ensure long term conservation. The Restoration Plan will continuously be revised and improved throughout the NRDA as new information becomes available, input is received, and processes are developed.

Restoration Integration Activities: The Restoration TWG and the Council continue to collaborate with the Department of Energy to identify restoration opportunities that can be implemented during cleanup of contaminated waste sites. The goal is to ensure an efficient cleanup that only occurs one time and that restoration is completed as quickly as possible.

Early Restoration: The Council is actively considering implementing early restoration defined in the regulations as "any primary or compensatory restoration actions that are implemented prior to the completion of the damage assessment phase." Early restoration carefully considered and done at uncontaminated and protected locations, can begin to compensate for lost natural resource services caused by decades of releases of contaminants at Hanford.

NEXT STEPS

The Restoration TWG will continue to identify, assist, and oversee restoration activities that have been approved by the Council as part of the Hanford NRDA. They will also play a major role in writing a final Hanford NRDA Restoration Plan for the Council and public review. Additionally, the Restoration TWG will evaluate and work with the Department of Energy to determine methods for valuing restoration and establishing protocols to ensure the selected restoration projects are successful.

SOURCE & PATHWAY: Technical Working Group

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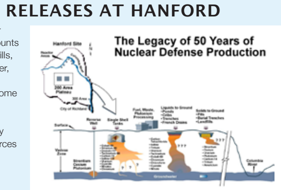
MISSION OF SOURCE & PATHWAY TWG

The Source and Pathway Technical Working Group (TWG) provides information to the Hanford Natural Resource Trustee Council (Council) and other TWGs to characterize: potential sources and known or suspected releases of hazardous substances; inventories of contaminants in soil, groundwater, surface water, and sediment; and pathways by which hazardous substances are transported from the source through the environment. The TWG also evaluates relative contributions of contaminants from on- and off-site sources to help assess effects of Hanford releases.

HAZARDOUS SUBSTANCE RELEASES AT HANFORD

The Source & Pathway TWG provides support to other TWGs, including providing information on residual amounts of post-remediation contamination, inventories of landfills, and contamination in deep soils, sediment, groundwater, and other media. This includes providing information on past, present, and future levels of contamination. Some of the hazardous substances released to the soil and groundwater at Hanford include chromium, cesium, plutonium, uranium, and tritium. The Source & Pathway TWG is currently working on determining potential sources and pathways of mercury on the Hanford site.



Sources of contamination and associated hazardous contaminants found at the Hanford Site.

INJURY ASSESSMENT PLANNING

As mentioned above, the Source & Pathway TWG supports other TWGs and compiles information on sources of contamination, pathways from source to media, as well as inventories of contamination. A few of the TWG efforts are highlighted below.

DQO and Data Retrieval. This effort involves assisting other TWGs in working through a Data Quality Objective (DQO) process to define the level of detail and precision of contaminant concentration data needed by other TWGs and the Council. The TWG will then work with the Council data manager to retrieve the information and compile it in the requested format, including reviewing, validating, and formatting the data per the criteria of the end user, and to the extent possible summarizing data gaps.

Data needs for other TWGs. A critical function of the Source & Pathway TWG is to provide information to other TWGs regarding contaminants at Hanford. The TWG will respond to requests from other TWGs for contaminant and/or location-specific information about contaminant source location, inventory, waste form, mobility, etc. that can be used to evaluate exposure and injury (e.g. to biota).

Source inventory summaries. The TWG is working to summarize existing data including the location of waste sites and waste inventories for contaminants of concern. Information will be presented in tabular and map formats and will be used in part to assess the nature and extent of injury to geologic resources at Hanford.

Contaminants of concern and baseline conditions for specific locations. Information requests will draw on existing Hanford databases, as well as on Remedial Investigation/Feasibility Study work plans, historical purchasing records, contaminant trend data, and mass balance studies, as appropriate. In compiling information for individual areas, such as a Reactor area, information will also be summarized about the chemistry for each contaminant, primary biogeochemical forms in the environment, and mechanisms of mobility.

NEXT STEPS

The Source & Pathway TWG will work with the Council and other TWGs to prioritize and implement studies in support of the Hanford injury assessment. This includes analysis of injury to geologic resources and review/analysis of data to support information needs of other TWGs.

TERRESTRIAL: Technical Working Group

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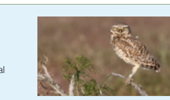
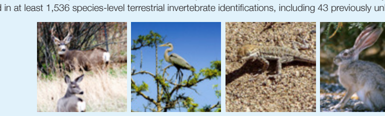
MISSION OF TERRESTRIAL TWG

The Hanford Terrestrial Working Group (TWG) provides information and recommendations to the Hanford Natural Resource Trustee Council (Council) that allows the Council to select injury assessment studies related to terrestrial resources which includes soils, flora, and fauna.



TERRESTRIAL RESOURCES AT HANFORD

The Hanford Site, with hundreds of documented plant species, represents one of the largest relatively undisturbed tracts of sagebrush/steppe habitat remaining in the state of Washington. Many species of concern, such as burrowing owls, sage sparrows and badgers rely on sage/steppe habitat for food, cover, and nesting. Hanford also supports 40 species of mammals, over 220 species of birds, and several amphibians and reptiles. The Nature Conservancy's insect inventory resulted in at least 1,536 species-level terrestrial invertebrate identifications, including 43 previously unknown taxa.



Mule deer Mule deer are the most abundant big game at Hanford. Coyotes are their main predator and have been documented to take up to 40% of the annual fawn crop. Many mule deer give birth in the Hanford Reach islands.

Great blue heron Great blue herons are permanent residents at Hanford and have established rookeries in several areas along the Hanford Reach. They forage for fish and amphibians along the river but also hunt inland for small mammals and reptiles.

Side blotched lizard This short-lived lizard is very common across Hanford and is found in open grassland/forb habitats. It eats mostly insects, but is preyed upon by birds, snakes, and mammals.

Black tailed jackrabbit: Black-tailed jackrabbits are abundant at Hanford, however recently their population has declined similar to other areas in the Great Basin. Coyotes, bobcats, badgers, owls, and snakes prey on these rabbits.

INJURY ASSESSMENT PLANNING

Some brief descriptions of ongoing efforts, and studies that the Terrestrial TWG is considering to determine whether terrestrial resources have been injured, are described below. Many of these efforts include literature surveys of studies that have occurred at Hanford and compiling and analyzing contaminant uptake information.

Biota Contamination Data Review: This is a study that was initiated by the Council in 2012 and is ongoing. It consists of compiling and analyzing all available vegetation and biota contaminant uptake information from the Hanford Site. This will help the trustees identify potential injuries and help focus on future studies.

Natural Resource Injuries Related to Remediation Activities: This study will identify injuries to natural resources that have occurred as a result of Hanford remediation activities. Many times in the process of conducting cleanup at waste sites, natural resources can be seriously impacted.

Species and Contaminant Profiles: Profiles of species and contaminants of concern is an ongoing effort. Both generic and Hanford site specific information is being gathered. Completed profiles include strontium, cesium, plutonium, uranium, and iodine, rabbits, great blue heron, coyote, mule deer, lamprey, tree frog, white sturgeon, bulrush, and mussels.

Soil Contamination Data Review: Compiling and analyzing existing soil contamination data at Hanford will aid the trustees in identifying injuries and areas where there are correlations between soil contaminant levels and associated contamination in biota.

NEXT STEPS

The Terrestrial TWG will continue to identify, assist and oversee those studies that have been approved by the Council as part of the Hanford NRDA. The Terrestrial TWG will also play a major role in compiling and analyzing existing data to identify potential injuries to natural resources.