NOAA Damage Assessment and Restoration Program

PROPOSED SETTLEMENT FOR SEDIMENT-BASED INJURIES TO NATURAL RESOURCES IN HYLEBOS WATERWAY, COMMENCEMENT BAY

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April 24, 2002

TOPICS WE WILL COVER

-- Identifying injuries to natural resources

-- Assigning levels of injury

-- Mapping areas where injuries occur

-- Translating mapped areas into injury compensation currency

-- Evaluating Compensation from a habitat perspective

-- Allocation of Liability for Injuries

Identifying Injuries to Natural Resources

IDENTIFYING INJURIES TO NATURAL RESOURCES

-- ROUND I Injury Studies

3-way Sediment Survey & Fish Exposure Work

-- ROUND II Injury Studies

Identified Problem Contaminants

-- ROUND III Injury Studies

Identified Threshold Levels for Problem Contaminants

IDENTIFYING INJURIES TO NATURAL RESOURCES

Round I--Results.

-- Elevated levels of one or more contaminants;

-- Significantly less species abundance and diversity;

-- Contaminants found in fish stomachs and tissues;

-- Diseased English and rock sole;

-- Reproductive problems for English sole; and

-- Evidence of physiological stress in juvenile salmon.

IDENTIFYING INJURIES TO NATURAL RESOURCES

Round II--Results on Juvenile Chinook Salmon

-- Weakened immune system and reduced growth

-- Elevated tissue concentrations of PCBs and biomarkers after 60 days; and

-- Study results comparable to field-collected salmon

IDENTIFYING INJURIES TO NATURAL RESOURCES

Round III--Results on Juvenile Chinook Salmon

Incomplete

-- Evidence of growth effects from both PCBs and PAHs

-- Further work on hold; pending settlement proposal

Assigning Injury Levels to Adverse Effects

DEFINING INJURY AS SERVICES LOST

--Organisms live on finite energy budget

--Organisms must redirect energy to deal with stressor

--Redirecting energy comes at expense of usual processes

-- Stressful habitat provides less service

--Less service means a percentage of services lost

Relating Contaminant Toxicity to Services Lost

-- Different biota are affected at different concentrations.

-- More biota affected, greater impact on biological community

-- Percent service losses should reflect the cumulative effects of increasing injuries, and

-- Should be portrayed as a loss to entire biological community.

An Example: Injuries from PAHs

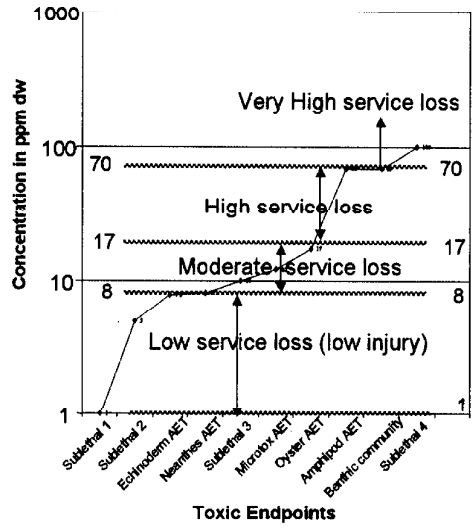
TOXIC EFFECTS FROM PAHs

-- At 1 ppm dw, first signs of problems in flatfish

-- By 5 ppm, flatfish effects increase and invertebrate effects begin;

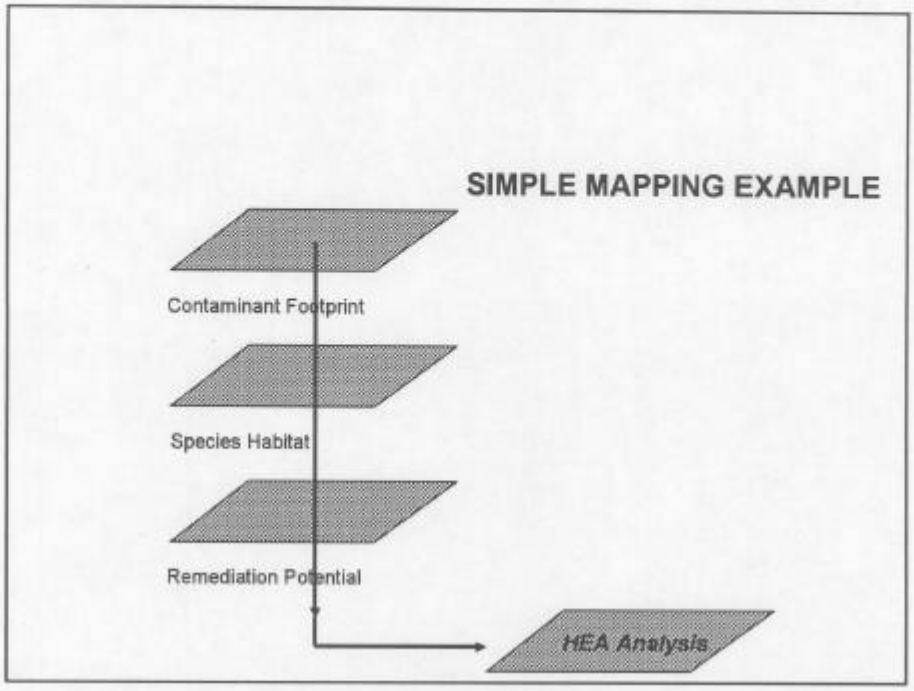
-- By 50 ppm, > half of AETs exceeded; flatfish fecundity down by 25%;

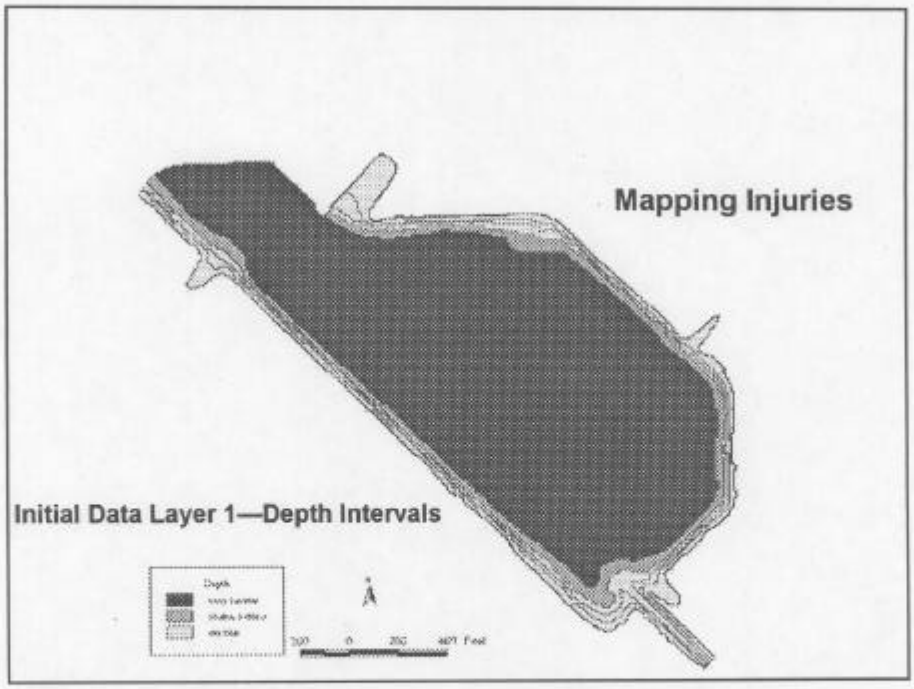
-- By 100 ppm,
all AETs exceeded;
flatfish reproductive potential diminished by ~ 50%;
~75% of flatfish have lesions.

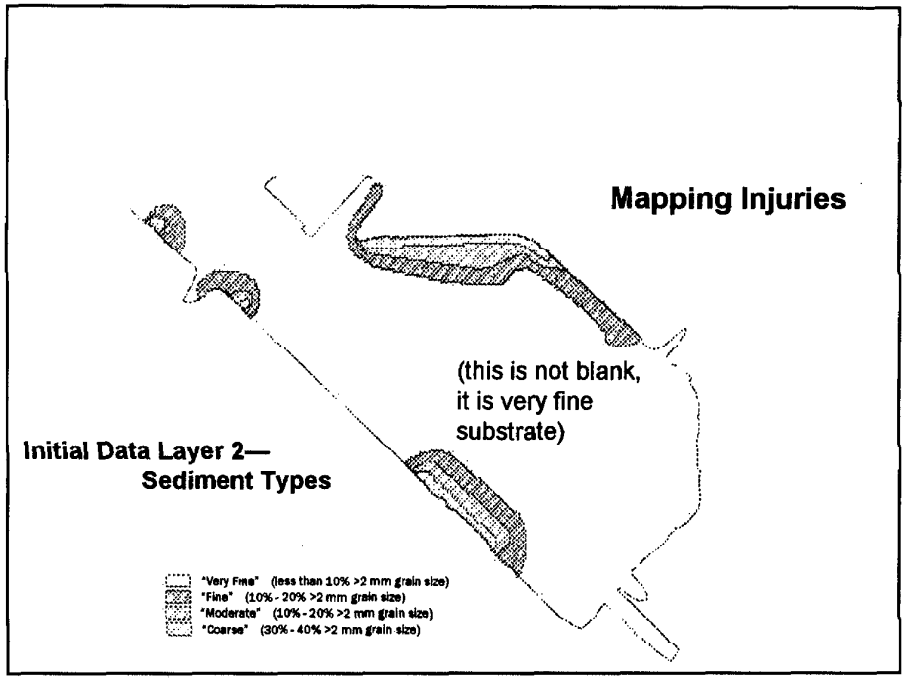


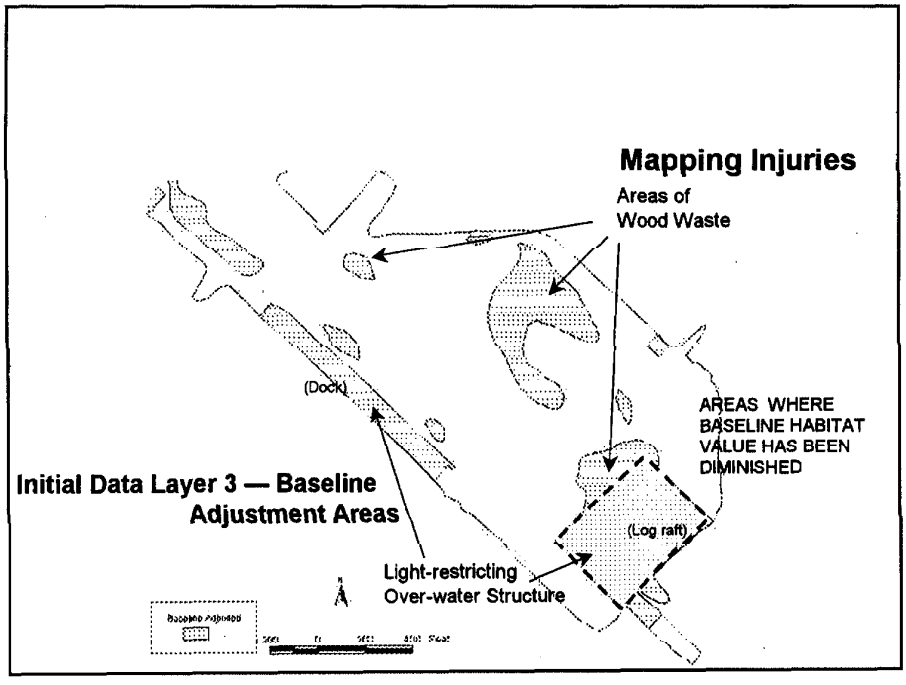
PERCENT SERVICE LOSS FROM PAHs

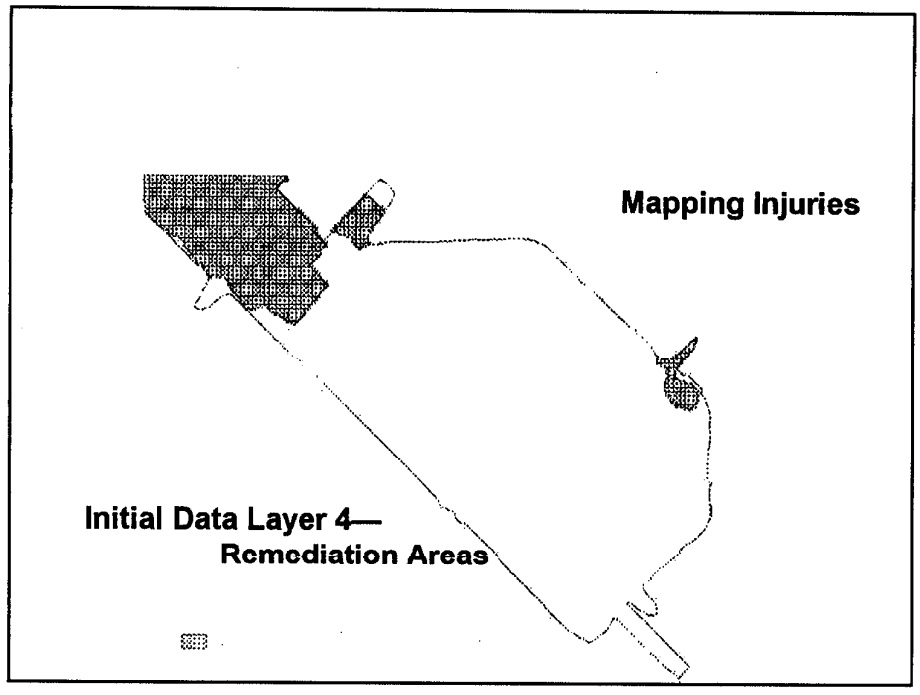
How The Injuries Were Mapped

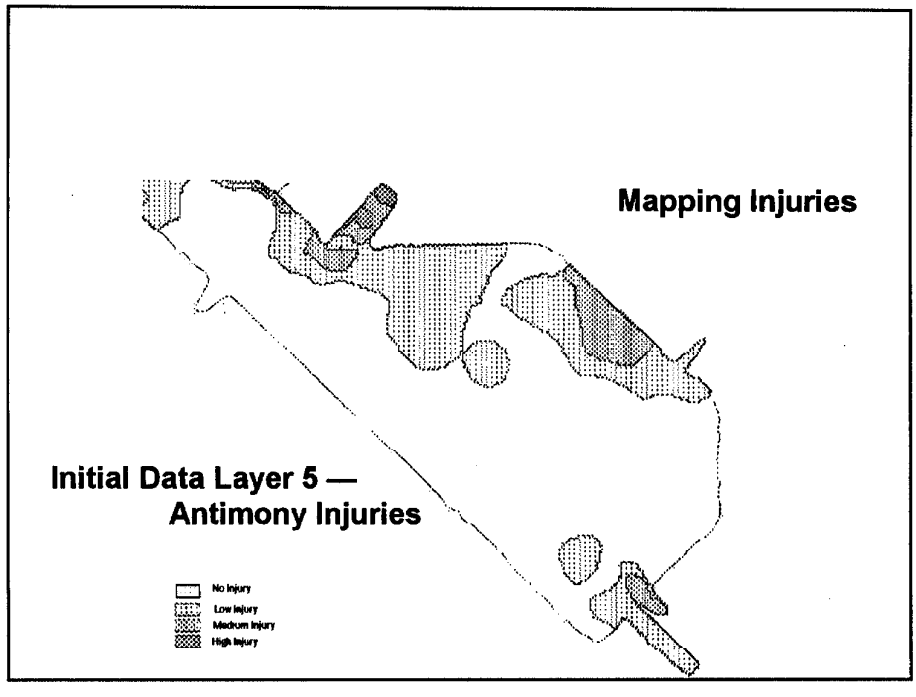

SIMPLE MAPPING EXAMPLE
Contaminant Footprint
Species Habitat
Remediation Potential
HEA Analysis


Mapping Injuries
Initial Data Layer 1—Depth Intervals

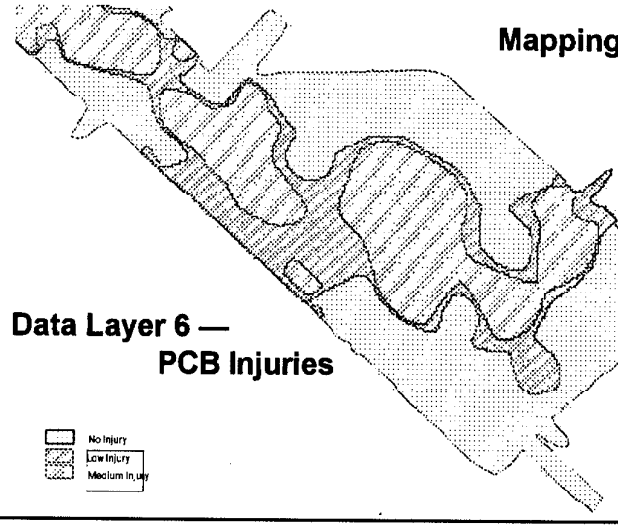

Mapping Injuries
(this is not blank, it is very fine substrate)
Initial Data Layer 2— Sediment Types
"Very Fine" (less than 10% >2 mm grain size)
"Fine" (10% - 20% >2 mm grain size)
"Moderate" (10% - 20% >2 mm grain size)
"Coarse" (30% - 40% >2 mm grain size)


Mapping Injuries
Areas of Wood Waste
(Dock)
AREAS WHERE BASELINE HABITAT VALUE HAS BEEN DIMINISHED
(Log raft)
Initial Data Layer 3 — Baseline Adjustment Areas
Light-restricting Over-water Structure


Mapping Injuries
Initial Data Layer 4—
Remediation Areas

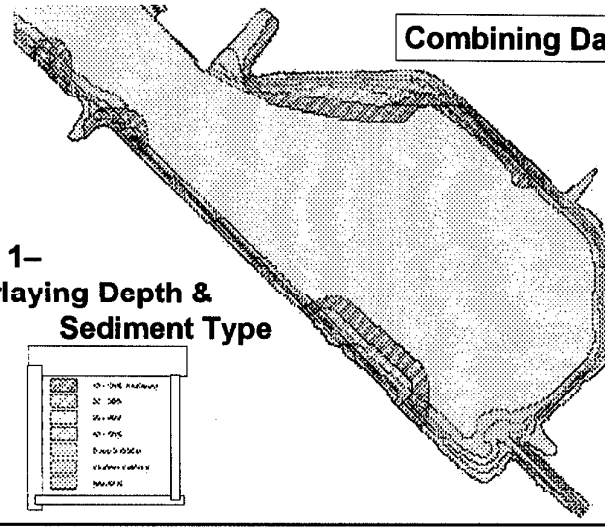

Mapping Injuries
Initial Data Layer 5 —
Antimony Injuries
No Injury
Low Injury
Medium Injury
High Injury

Mapping Injuries



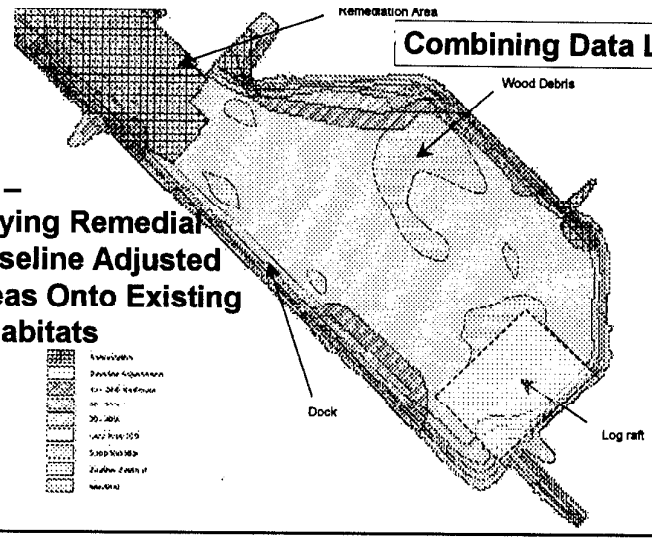
Initial Data Layer 6 — PCB Injuries

Combining Data Layers



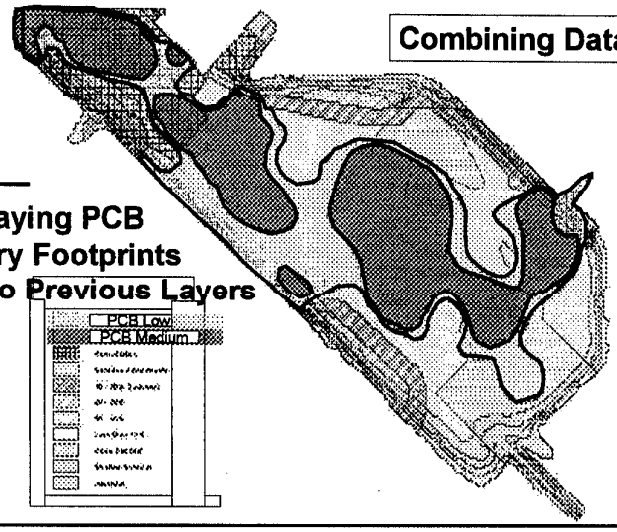
Step 1– Overlaying Depth & Sediment Type

Combining Data Layers



Step 2 – Overlaying Remedial & Baseline Adjusted Areas Onto Existing Habitats

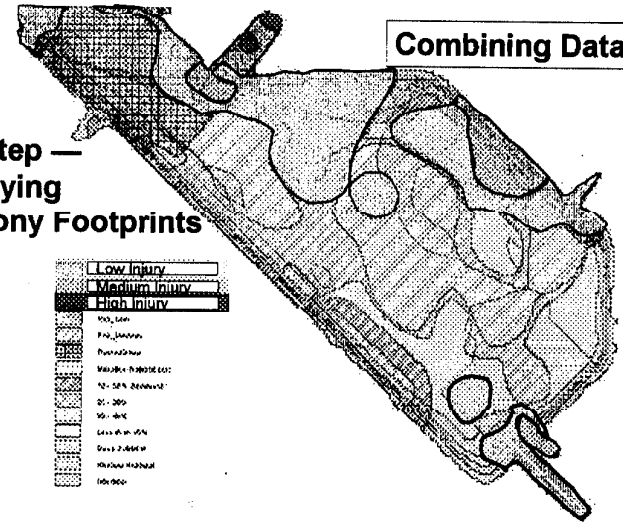
Combining Data Layers



Step 3 — Overlaying PCB Injury Footprints onto Previous Layers

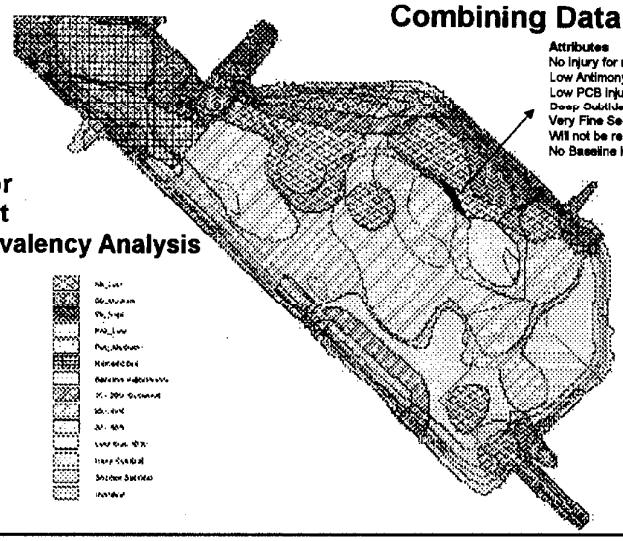
Combining Data Layers

Last Step — Overlaying Antimony Footprints

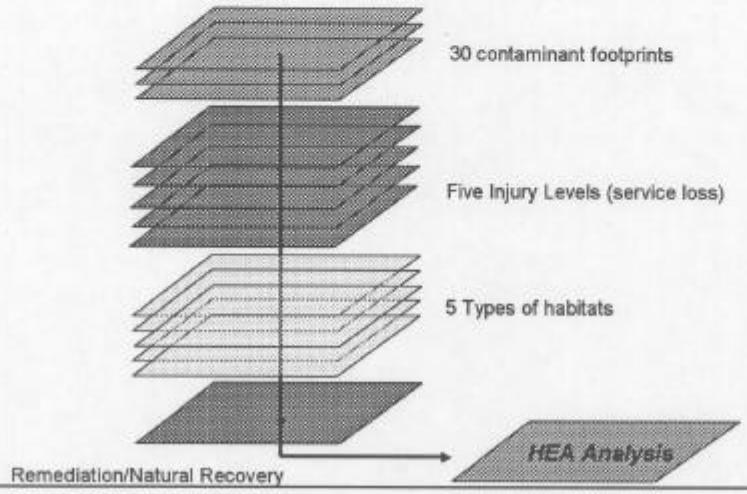


Combining Data Layers

Output for Habitat Equivalency Analysis



OUR HABITAT EQUIVALENCY ANALYSIS



Translating Mapped Injuries into Compensation Currency

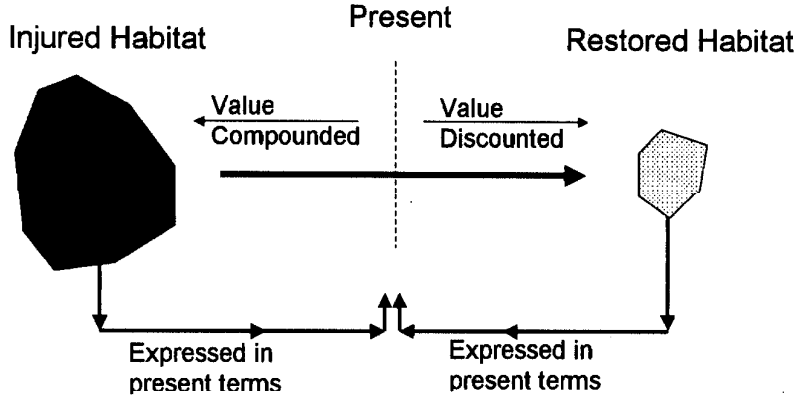
HABITAT EQUIVALENCY ANALYSIS

a tool for quantifying injury

a bookkeeping process that uses ecological currency

determines amount of restored habitat for compensation.

HABITAT EQUIVALENCY ANALYSIS
Valuing Habitat in Present Terms



Injury and Compensation Metric:

Service Acre Years

Natural Resource Restoration Objectives

Compensate for the loss of natural resource services from the time of the injury to full recovery of the resources.

Provide services of comparable value as those lost due to the injury

Habitat Equivalency Analysis

Tool for determining equivalency between lost and restored resources.

HEA adjusts the size of restoration actions to ensure that the value of project gains equal the value of losses.

Habitat Equivalency Analysis Steps

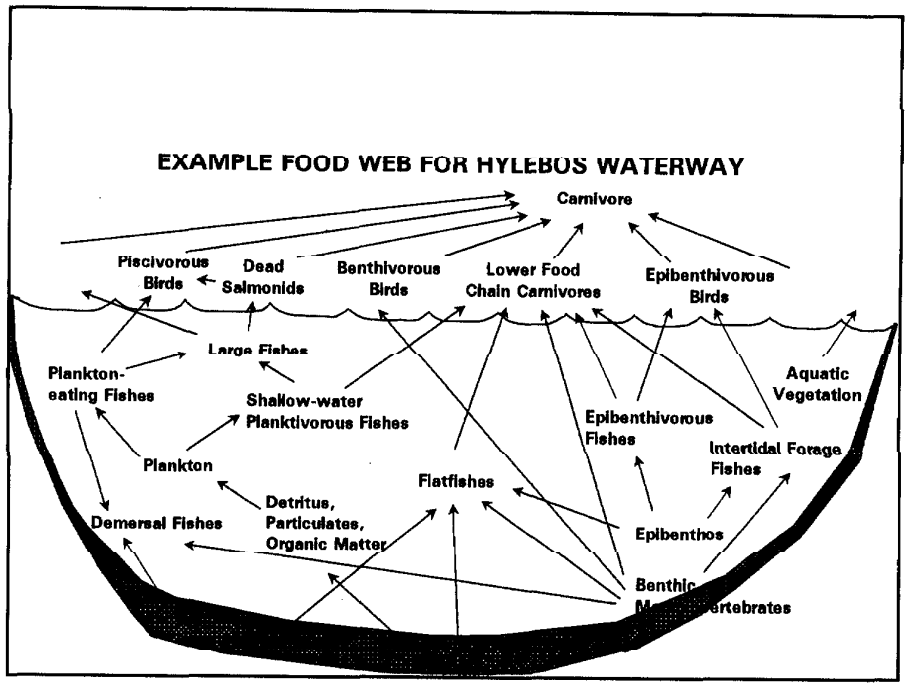
1. Define an indicator that represents habitat services at the injured and replacement habitats.
2. Document the duration and extent of the injury (i.e. habitat services lost)
3. Calculate the gain in habitat services at replacement projects.
4. Determine the type and size of replacement projects needed to ensure that habitat services gained equal habitat services lost.

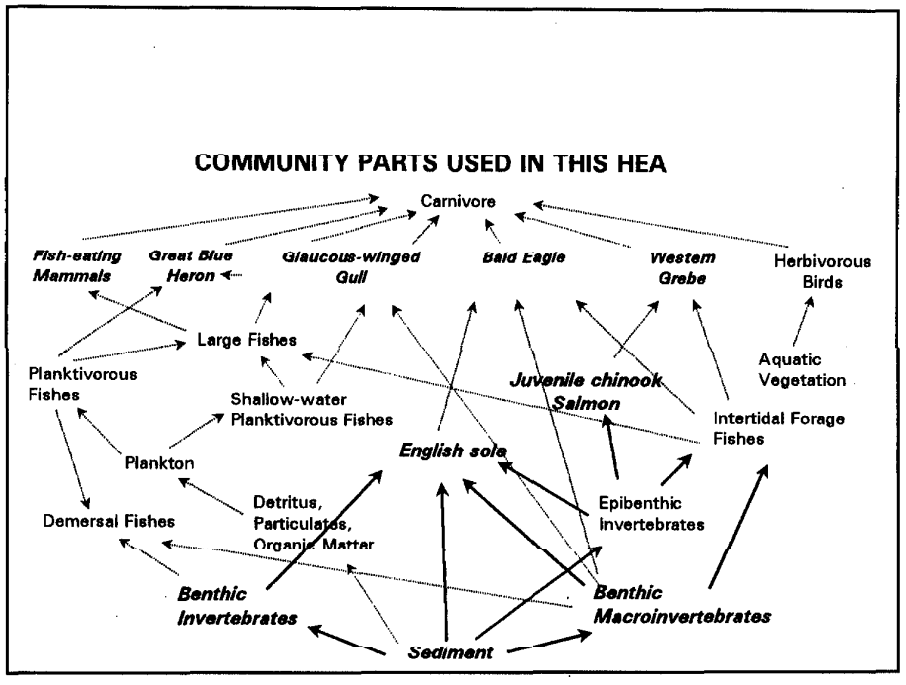
Factors to Consider in Assigning Habitat Values for Injury Assessment

1. Habitat types
2. Representative species
3. Relative importance of habitats to species

Aquatic Habitat Types in Hylebos Waterway

1. Intertidal (26%)
   +14 to -4 feet
2. Shallow subtidal (10%)
   -4 to –14 feet
3. Deep subtidal (64%)
   > -14 feet


EXAMPLE FOOD WEB FOR HYLEBOS WATERWAY
Carnivore
Piscivorous Birds
Dead Salmonids
Benthivorous Birds
Lower Food Chain Carnivores
Epibenthivorous Birds
Large Fishes
Plankton-eating Fishes
Shallow-water Planktivorous Fishes
Aquatic Vegetation
Epibenthivorous Fishes
Intertidal Forage Fishes
Plankton
Flatfishes
Detritus, Particulates, Organic Matter
Demersal Fishes
Epibenthos
Benthic


COMMUNITY PARTS USED IN THIS HEA
Carnivore
Fish-eating Mammals
Great Blue Heron
Glaucous-winged Gull
Bald Eagle
Western Grebe
Herbivorous Birds
Large Fishes
Planktivorous Fishes
Aquatic Vegetation
Juvenile chinook Salmon
Shallow-water Planktivorous Fishes
Intertidal Forage Fishes
English sole
Plankton
Epibenthic Invertebrates
Detritus, Particulates, Organic Matter
Demersal Fishes
Benthic Invertebrates
Benthic Macroinvertebrates
Sediment

HABITAT EQUIVALENCY ANALYSIS
Inputs

Species-Habitat relationships

Based on analysis of literature on habitat preferences and discussions with co-trustee representatives.

Species	Habitat Attributes
Juvenile chinook salmon	depth and substrate
English sole	substrate only
Hylebos Birds complex	depth and substrate

Defining the Habitat Equivalency Metric

Habitats are arranged according to functional importance.

Relative values are assigned, similar to HSI concept, where 1.0 equals optimal conditions, 0 equals unsuitable conditions.

Estuarine Marsh is the habitat type with the highest value across all species and is assigned a functional value of 1.0.

All other habitats are valued relative to Estuarine Marsh.

HABITAT EQUIVALENCY ANALYSIS EXAMPLE

Examples of relative habitat values for juvenile chinook salmon

RELATIVE VALUE	HABITAT DESCRIPTION	HABITAT VALUE
Most Valuable	Estuarine Marsh	1.00
Less Valuable	Intertidal	0.67
Even Less Valuable	Shallow subtidal	0.40
Least Valuable	Deep subtidal	0.05

HABITAT EQUIVALENCY ANALYSIS

Relative habitat values for all species

Habitat Type	Relative Value for juvenile chinook	birds	English sole
--Estuarine Marsh	1.00	1.00	1.00
--Intertidal	0.67	0.67	1.00
-- Shallow subtidal	0.40	0.40	1.00
--Deep subtidal	0.05	0.05	1.00

HABITAT EQUIVALENCY ANALYSIS

Focus is on juvenile chinook salmon

Juvenile chinook salmon	Birds	English sole
50%	25%	25%

Combining values across species and habitats

All habitats are evaluated relative to a common denominator --Estuarine Marsh--and also across all species. This is a way of combining services across species and habitats.

Habitat Type	Combined value for all species
--Estuarine marsh	1.00
--Intertidal	0.75
--Shallow subtidal	0.55
--Deep subtidal	0.30

HABITAT EQUIVALENCY ANALYSIS EXAMPLE

EXAMPLE: Injury to 10 acres of deep subtidal habitat, 100% loss of function.

INJURED HABITAT	**10 Acres of deep subtidal area**
HABITAT VALUE PER ACRE	**0.30**
CALCULATION OF HABITAT VALUE	**10 x 0.30 = 3.0 Functional units**

HABITAT EQUIVALENCY ANALYSIS EXAMPLE

Compensation Requirements:

Injury to 10 acres of deep subtidal habitat (3.0 functional units lost) would require the creation of :

10.0 acres of deep subtidal habitat, OR

5.45 acres of shallow subtidal habitat, OR

4.0 acres of intertidal habitat, OR

3.0 acres of estuarine marsh.

HABITAT EQUIVALENCY ANALYSIS

What happens when habitat is less than fully functional before being injured by contamination?

HABITAT EQUIVALENCY ANALYSIS

Value Adjustments

Within habitat types, not all are of equal value.

There is a range in functional value in what currently exists and what is envisioned as a pristine, fully functioning habitat.

Habitat complexes provide more ecological value.

Physical impacts affect habitat quality (log rafts, over water structures, etc.)

HABITAT EQUIVALENCY ANALYSIS

Habitat Classifications based on Value Adjustments

Fully functional - based on premise that presence of adjacent desirable habitat results in a complex that enhances overall production.

Baseline adjusted - no adjacent desirable habitat to enhance value.

Degraded - habitat value limited by physical conditions.

Restoration Project Valuation

Project value, in DSAYs, is measured as the incremental gain in functional value associated with the restoration action.

Initial value	→	Final value
0.1		0.75

Increase of 0.65 is translated into DSAYs.

The greater the difference between initial and final habitat condition, the greater the value of the restoration project.

Restoration Projects

Examples:

- removing overwater structures or log rafts
- excavating upland to create aquatic habitat
- planting aquatic vegetation (marsh creation)
- planting riparian buffers
- removing obstacles to fish and wildlife access

Allocating Injury Among Responsible Parties in Hylebos Waterway

Key Elements of Allocation

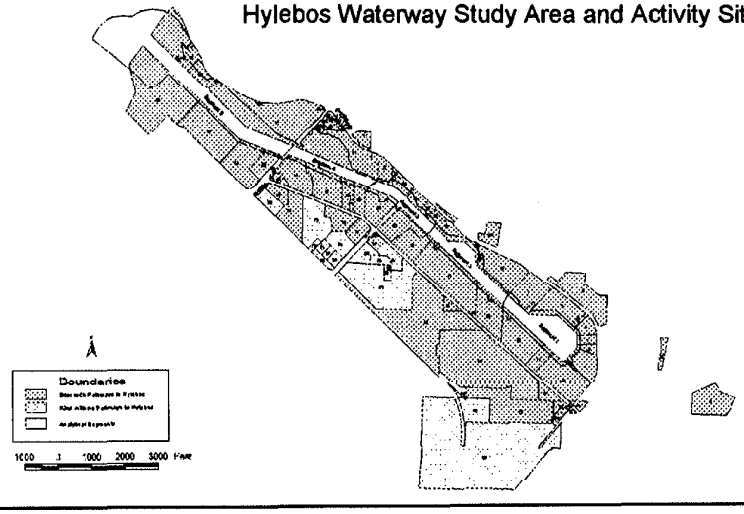
Allocates by Substance

- Up to 30 Contaminants
- Based on Footprint Maps for areas exceeding injury thresholds

Allocates by Site

- All properties adjacent to the Waterway
- Plus some additional non-residential properties

Hylebos Waterway Study Area and Activity Sites



Record Review

- **Potential Sites Designated from Property Records**
- **Actual Sites Based on Review of Files on Site Activities, Permit Violations, and Spills**
  - Washington Dept of Ecology
  - USEPA Region 10
  - Others
- **Sites for Allocation Based on a Trigger for Contaminant**

Trigger Requirements

1. **Pathway to Waterway?**
2. **Activity that is likely Contaminant source?**
3. **Evidence of Contamination?**
   a. NPDES Discharge
   b. Surface Water Contamination
   c. Groundwater Contamination
   d. Soil or Sediment Contamination
   e. Sediment Footprint Adjacent to the Site

Answers to 1, 2, and at least one component of 3 must be "yes".

Allocation Method

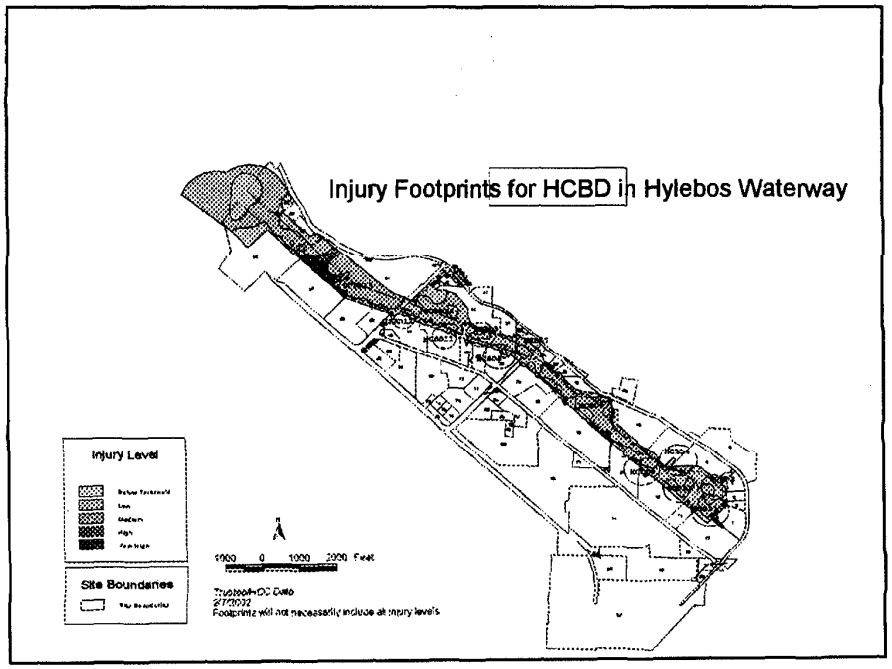
- **Assigned by Unique Footprint If:**
  - Footprint is immediately adjacent to site and only one site; and
  - Site activity is associated with the contaminant.
- **Assigned by "Relative Indexing" If:**
  - Footprint shared with more than one site;
  - Contaminant footprint so widespread that an index of relative input of potential contamination is used for allocation among all sites.

Relative Indexing

- **Based on**
  - Site activities;
  - Proximity to waterway;
  - Volume of products/by-products produced;
  - Site activity is associated with contaminant;
  - Record of releases;
  - Quantities released;and
  - Time span

Unresolved Footprints

- **Type I Unresolved**
  - Not adjacent to sites
- **Type II Unresolved**
  - No record of releases



In Summary

- **Key Elements for Allocation**
  - Based on Footprints of Contaminants
  - Injuries Allocated by Sites
  - Sites Determined by Record Review
  - Injuries Assigned via Trigger Requirements
  - "Unique Footprint" Allocation and "Relative Indexing"
  - Unresolved Footprints

TOPICS WE COVERED

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-- Translating mapped areas into injury compensation currency

-- Evaluating Compensation from a habitat perspective

-- Allocation of Liability