



# Recent advances in consideration of ecosystem services in contaminated clean-ups and risk assessments

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# Overview

- ▶ What are ecosystem goods and services (ES)?
- ▶ How does ES fit into other similar initiatives and what we are trying to do?
- ▶ How do they translate to cleanups?
- ▶ Why should I care and do I have the legal authority to consider?
- ▶ Where have they been applied?
- ▶ What tools are available?
- ▶ How do I get help?

# What are ecosystem goods and services?

# ES are . . . ?

- ▶ Benefits that people derive from nature that are essential to human health and well-being, such as clean air, clean water, and food, as well as flood control, erosion control, recreation, and spiritual renewal are generally referred to as Ecosystem Goods and Services or Ecosystem Services (ES).

**Clean Air for Public Health**



**Clean & Plentiful Water for Drinking, Fishing, & Swimming**

**Biodiversity Conservation**



**Food, Fuel, & Materials**



**Natural Hazard Mitigation**

**Climate Stabilization**



**Recreation, Culture, & Aesthetics**

**Ecosystem Services / Benefits from Nature / Co-benefits**

# Formal Definition: Final Ecosystem Services

The **components of nature** within an **environment** that are **directly enjoyed, consumed or used** to yield human well-being

We call these *Final* ES (FEGS)

Ecological End  
Product



Fauna

Environment Type



Wetlands

Beneficiary



Recreational  
Experiencers & Viewers

The ES in this  
example:  
*fauna in wetlands  
that people  
enjoy viewing for  
recreation*

Figure inspired by  
Amanda Nahlik.

# What is a Beneficiary?



Site owner



Residential neighbor



Farmer



Owning or managing commercial or public property



Owning residential property



Transporting people or goods



Caring about existence of nature



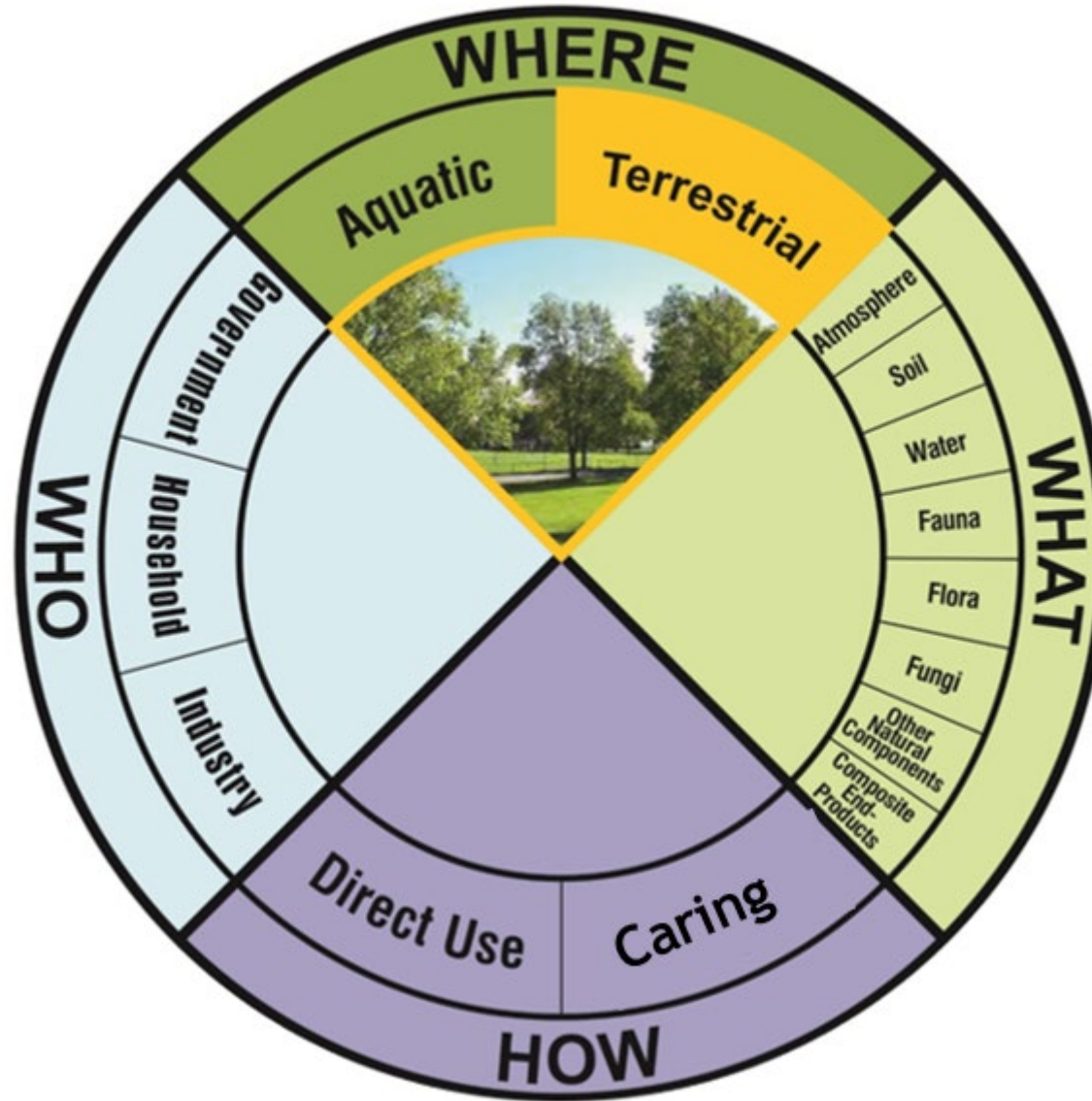
Recreating



Viewing/experiencing nature

How do people benefit from the environment?

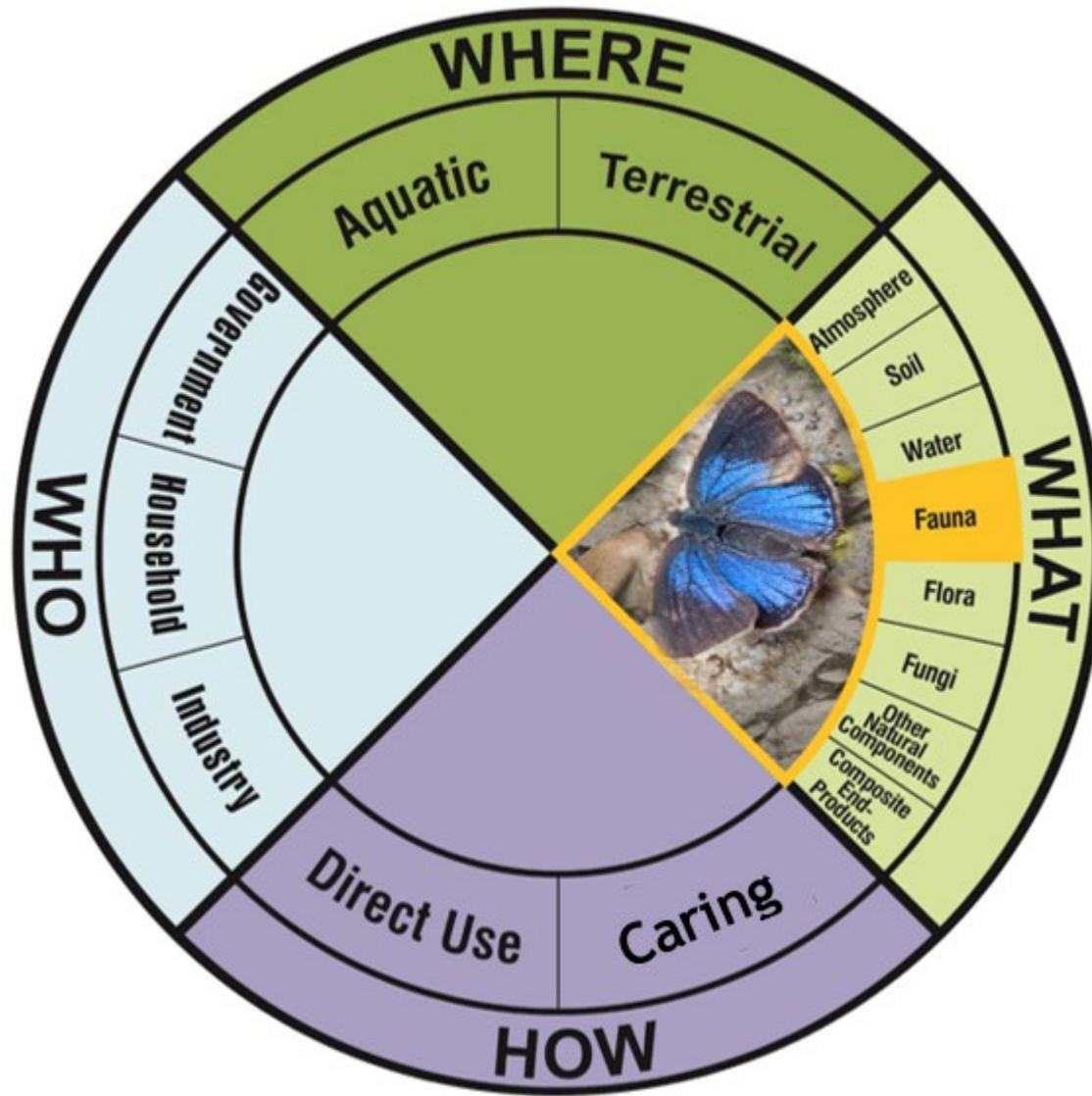
Ask the **WHERE?** question





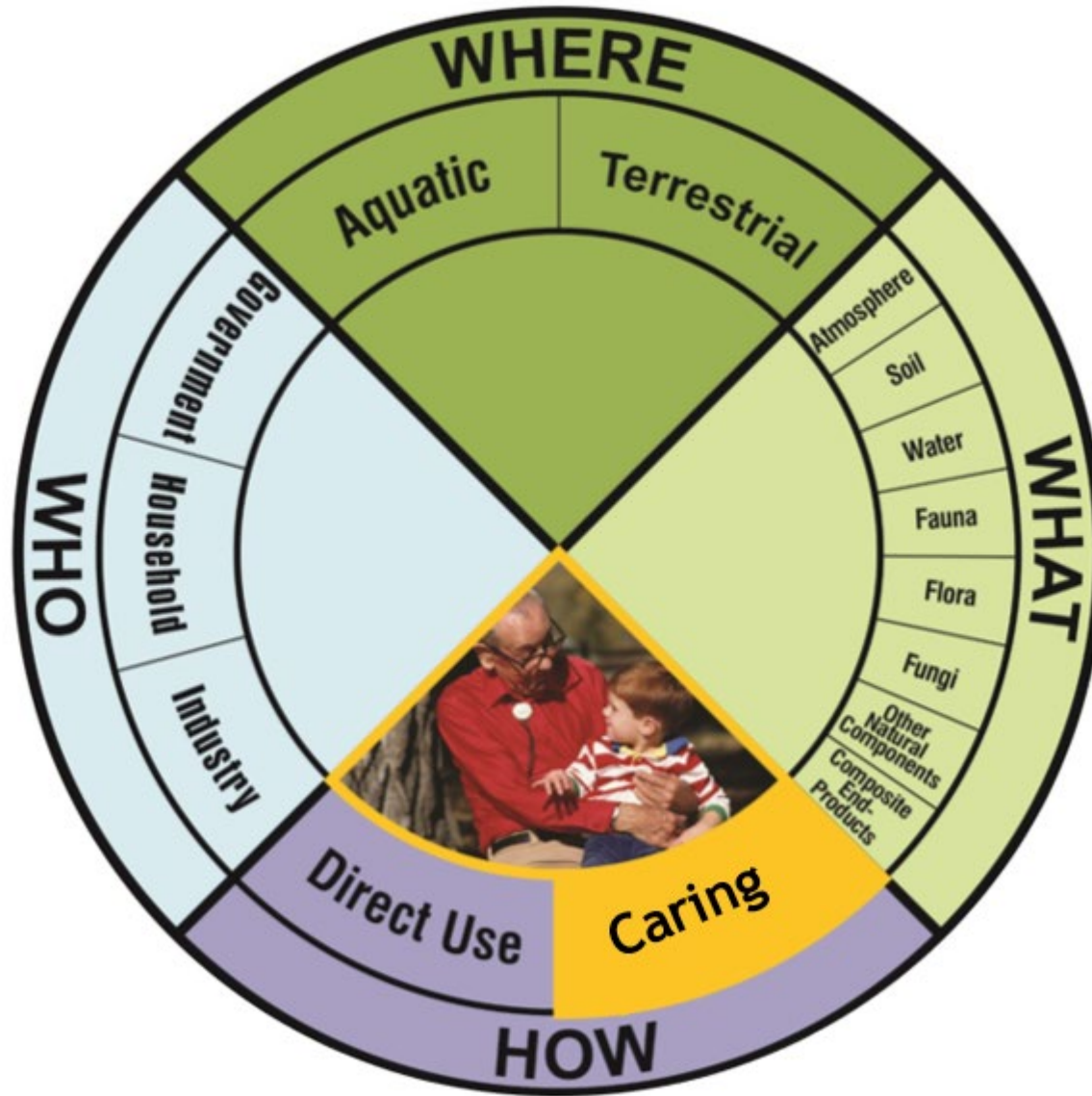
How do people benefit from the environment?

Ask the WHAT? question



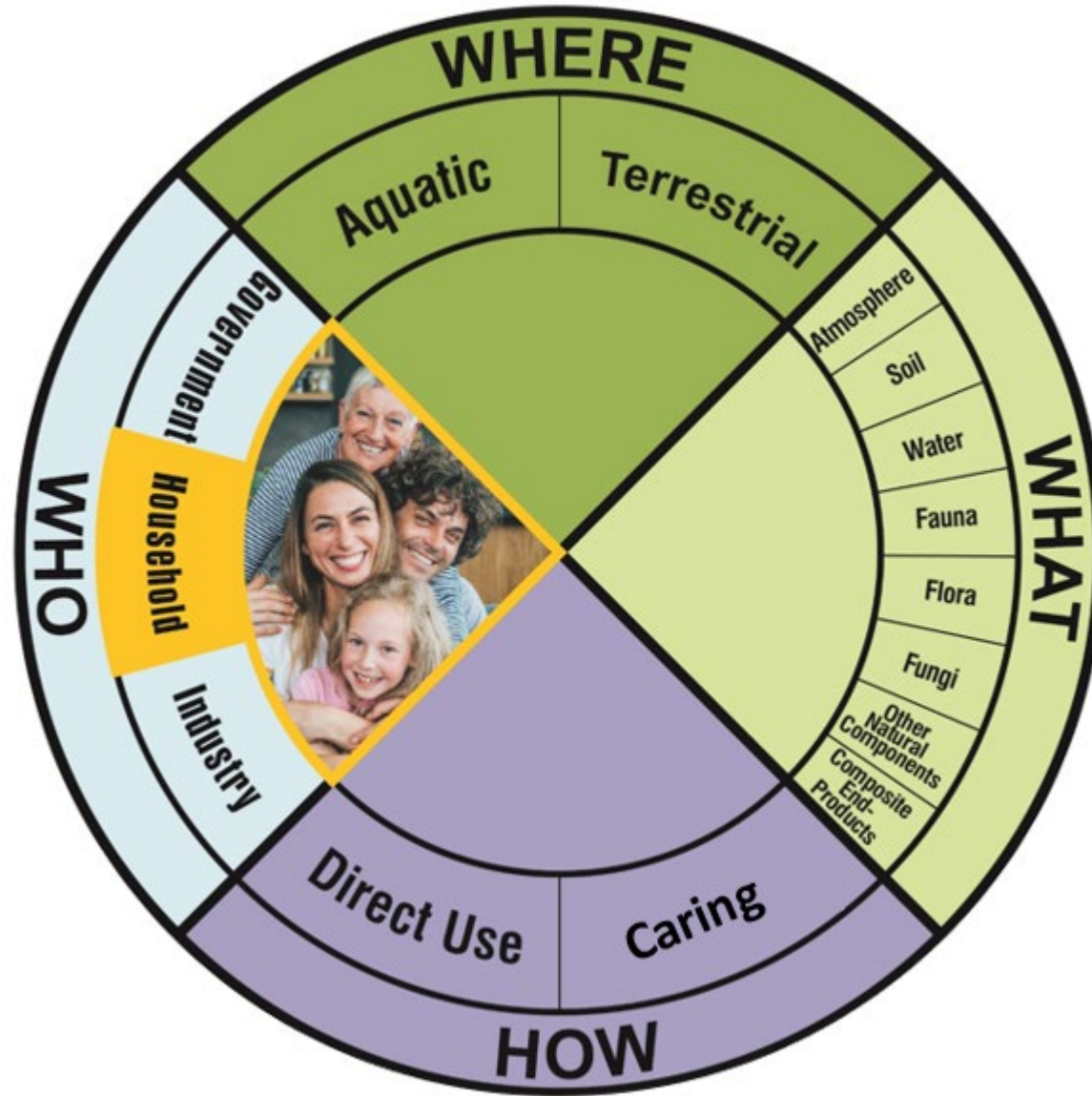
How do people benefit from the environment?

Ask the HOW? question



How do people benefit from the environment?

Ask the WHO? question



# How do people benefit from the environment?

Typical starting place + Ask the ES questions = More relevant metrics for assessing benefits

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Improved Biodiversity at a CERCLA or RCRA Landfill

**What?**

Improved **biodiversity** to ensure survival of threatened species, increase in pollinators,

**Where?**

in and around the **landfill site and adjacent** parks, farms, homes, neighborhoods

**For whom?  
or  
For what?**

for farmers, recreationists, state and local conservation agencies, home gardeners, and the general public.

# Examples of Environmental Benefits (Ecosystem Services) at Site Cleanup Projects



**Subsistence fishing -  
Portland Harbor,  
Washington State**



**Timber production -  
Black Butte Mine,  
Oregon**



**Groundwater  
reclamation - Phoenix-  
Goodyear Airport Area,  
Arizona**



**Erosion control - Bunker  
Hill Mining and  
Metallurgical Complex,  
Idaho**



**Pollinator habitat -  
Palmerton Zinc Pile,  
Pennsylvania**



**Cultural heritage - Indian  
Island, California**



**Recreational fishing -  
California Gulch, Colorado**



**Bird watching - Rocky  
Mountain Arsenal, Colorado**



**Educational experiences - Sangamo  
Electric Dump/Crab Orchard  
National Wildlife Refuge, Illinois**

# Quick Pulse

- ▶ Do you have any experience using ES concepts?

# What is this initiative trying to do?

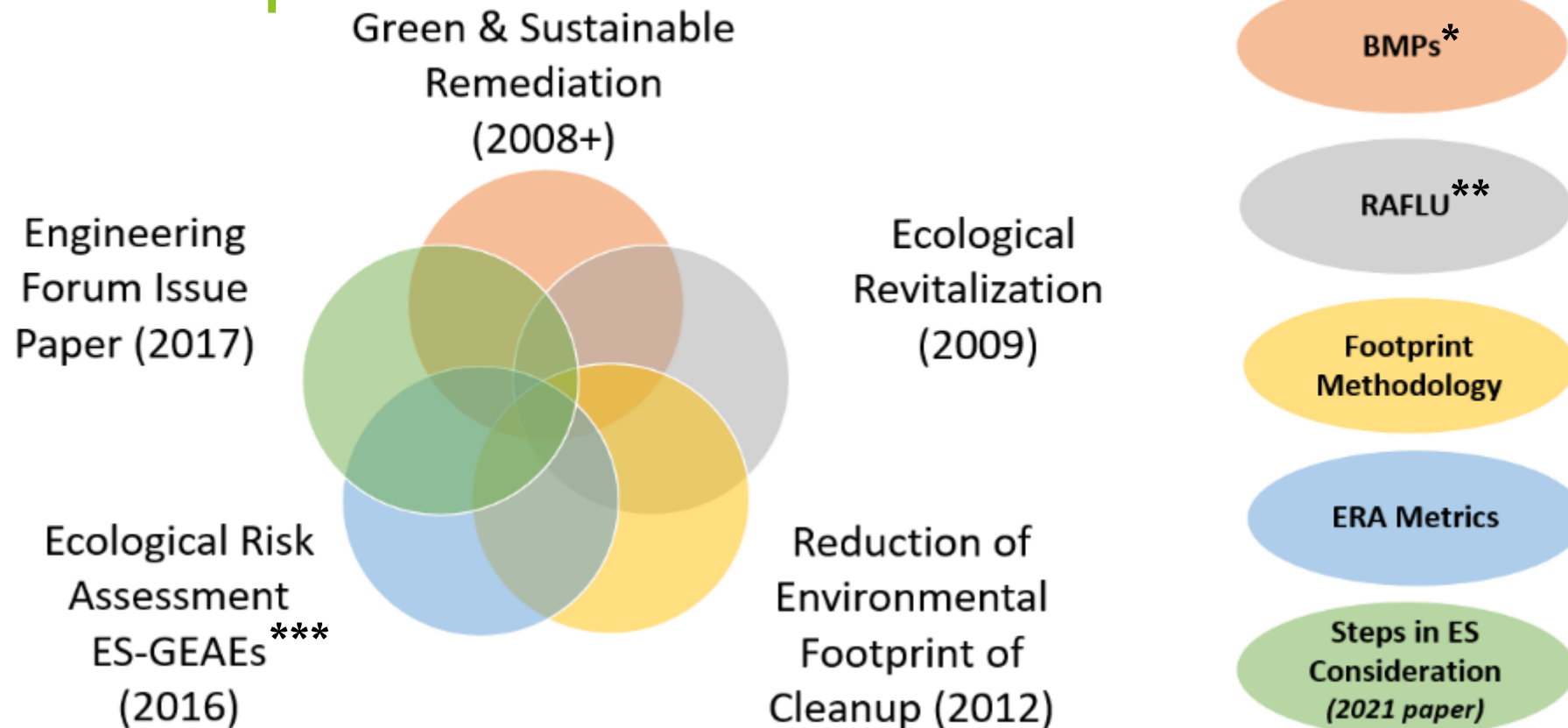
Connect ES concepts, where appropriate and allowed, to support enhancement of environmental benefits at cleanup sites.

# Does EPA have the authority to require consideration of ES specifically?

- ▶ Superfund has constraints by its statute and regulation.
- ▶ Brownfields - rather than leads or oversees, EPA supports and grants dollars to communities to help them assess and plan for sites, often small, they want to return to greater economic use.
- ▶ However, ES can be a vital tool in cleanup and revitalization.
- ▶ Examples:
  - In a landfill case, the seed mix/plantings on the cap allow for pollination and bird habitat while reducing maintenance costs and the articulated drainage channel allowed for emerging habitat to develop for emergent insects.
  - On a dredging site, dredge spoils were able to be used for improving bird habitat for the common tern and piping plovers.

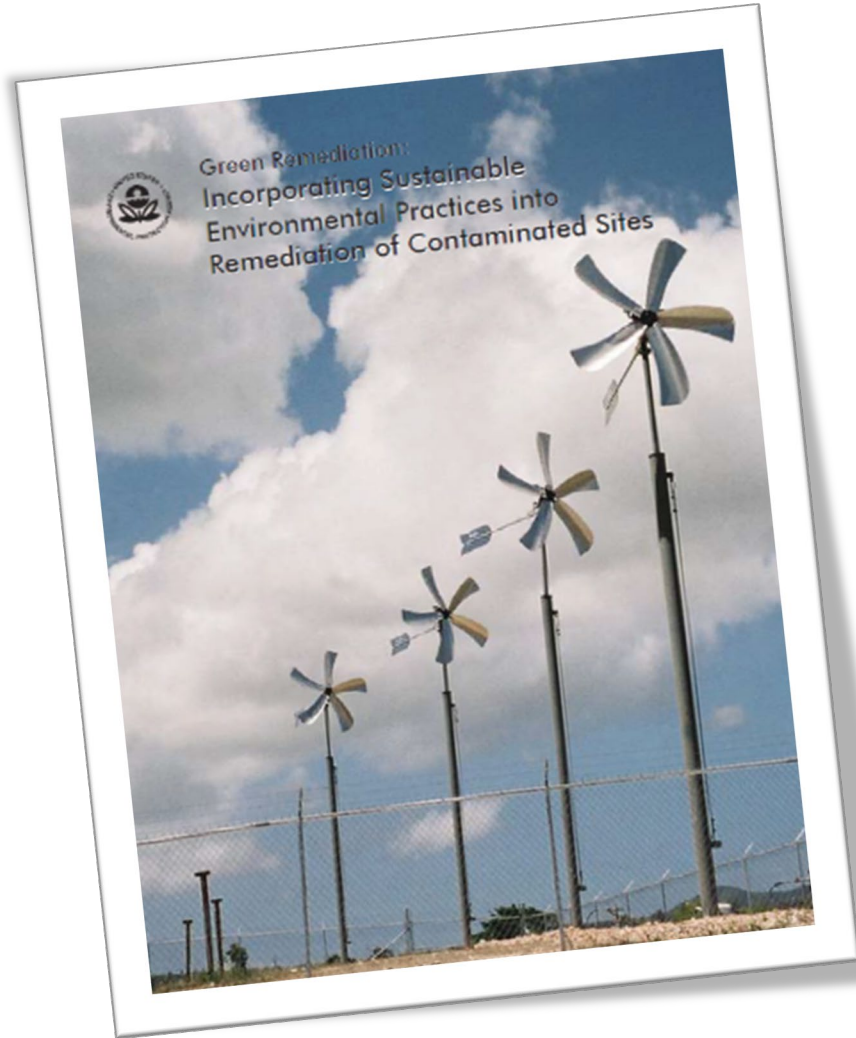


# Basis for Considering ES at Superfund Cleanups



\* BMP = Best Management Practices  
\*\* RAFLU = Reasonably Anticipated Future Land Use  
\*\*\* GEAE = Generic Ecological Assessment Endpoints

# Green Remediation Strategies: 2008+



- ▶ Builds on statute/regulatory programs goals to achieve greater net environmental benefit of a cleanup
- ▶ Although criteria/standards vary with statutory or regulatory authority, goals remain common among different cleanup programs
- ▶ Practices provide a whole-site approach, accelerating reuse of degraded land while preserving wildlife habitat and enhancing biodiversity
- ▶ Site management plans can describe approach to ecological preservation that considers anticipated reuse as well as natural conditions prevailing before contamination occurred

U.S. EPA. (2008). Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites. EPA542-R-08-002. <https://clu-in.org/greenremediation/docs/Green-Remediation-Primer.pdf>



# Contaminated Site Clean-Up Information

- Technologies
- Contaminants
- Issues
- Strategies & Initiatives
- Technology Developer Tools
- Training & Events
- Additional Resources

## Green Remediation Focus

Minimizing the environmental footprint of site cleanup

Site Name	State	Core Elements					
		Energy: Efficiency	Energy: Renewable	Air Emission	Water	Land & Ecosystem	Materials & Waste
<i>(Click on any of these site names to learn the details)</i>							
Aerojet-General Corporation <i>*Update*</i>	CA		☀️	🌬️	💧	🌳	
Altus Air Force Base <i>*Update*</i>	OK		☀️	🌬️	💧		♻️
Apache Nitrogen Products, Inc.	AZ		☀️	🌬️	💧		
Barksdale AF Base	LA				💧	🌳	♻️
BP Casper	WY					🌳	♻️
BP Paulsboro <i>*Update*</i>	NJ		☀️	🌬️			
Busy Bee's Laundry	MO	⚙️	☀️	🌬️		🌳	♻️
California Gulch	CO			🌬️			♻️
Camp Lejeune Military Reservation <i>*New*</i>	NC	⚙️	☀️	🌬️	💧	🌳	♻️
Continental Steel Corp. <i>*New*</i>	IN	⚙️	☀️	🌬️	💧	🌳	♻️
Crozet Orchard	VA		☀️	🌬️	💧		



ASTM INTERNATIONAL Designation: E2893 - 16<sup>1</sup>

Standard Guide for Greener Cleanups<sup>1</sup>

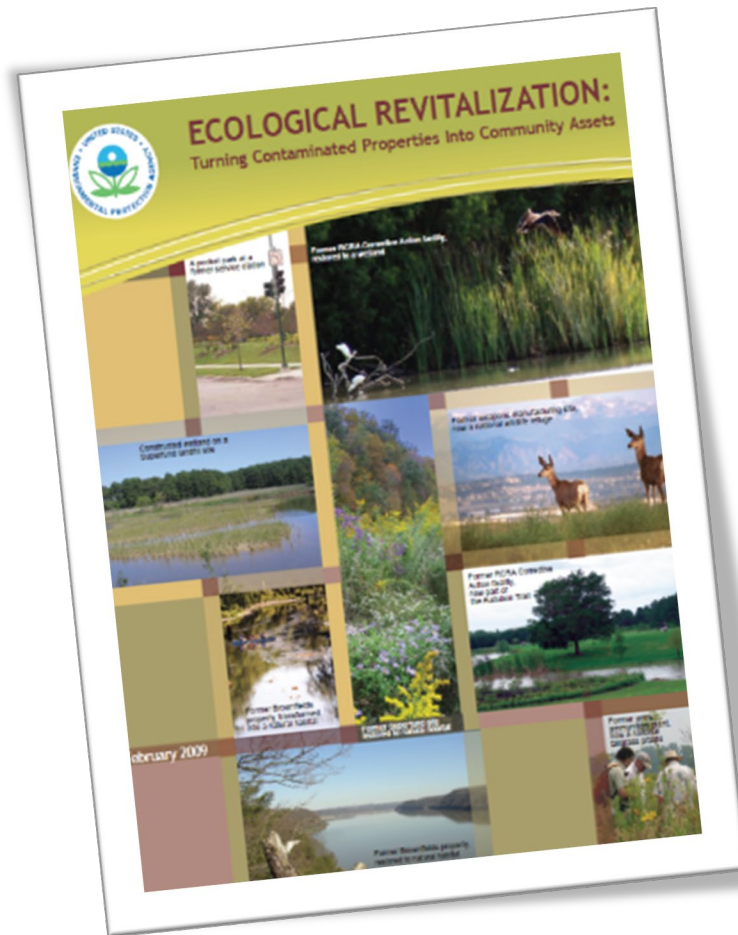
E2893 - 16<sup>1</sup>

TABLE X3.1 Greener Cleanup BMP Table

Category	Best Management Practice	Core Element Addressed (at Site Level)						Remediation Technology										
		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Emission	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MHA	In-situ Thermal Treatment	Phytoremediation	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	in-situ Bioremediation	Landfill Covers and Closures	Water Infiltration Mitigation
Buildings	Capture roof runoff for on-site use, as appropriate based on the water quality.			X			X											
Buildings	Choose water efficient plumbing fixtures (for example, low flow fixtures, tankless water heaters).			X			X		X									
Buildings	Install a green roof on buildings to minimize stormwater management and improve energy efficiency.	X		X		X	X		X									

**Land & Ecosystems**

# Ecological Revitalization



- ▶ Returning land from a contaminated state to one that supports a functioning & sustainable habitat
- ▶ Ecological revitalization not typically considered an “enhancement,” so can generally be funded by EPA (e.g., under Superfund) & may be required by CWA §404
  - E.g., Developing a wetlands design that will achieve the stated ecological functions
  - E.g., Designing & implementing cleanups that facilitate ecological revitalization of streams & stream corridors
  - E.g., Property-specific plant selection with preference for native plants in terrestrial environments
- ▶ Long-term stewardship necessary to ensure protectiveness of remedy & functioning of associated ecosystems

U.S. EPA. (2009). Ecological Revitalization: Turning Contaminated Properties into Community Assets. EPA 542-R08-003. <https://www.epa.gov/remedytech/ecological-revitalization-turning-contaminated-properties-community-assets>

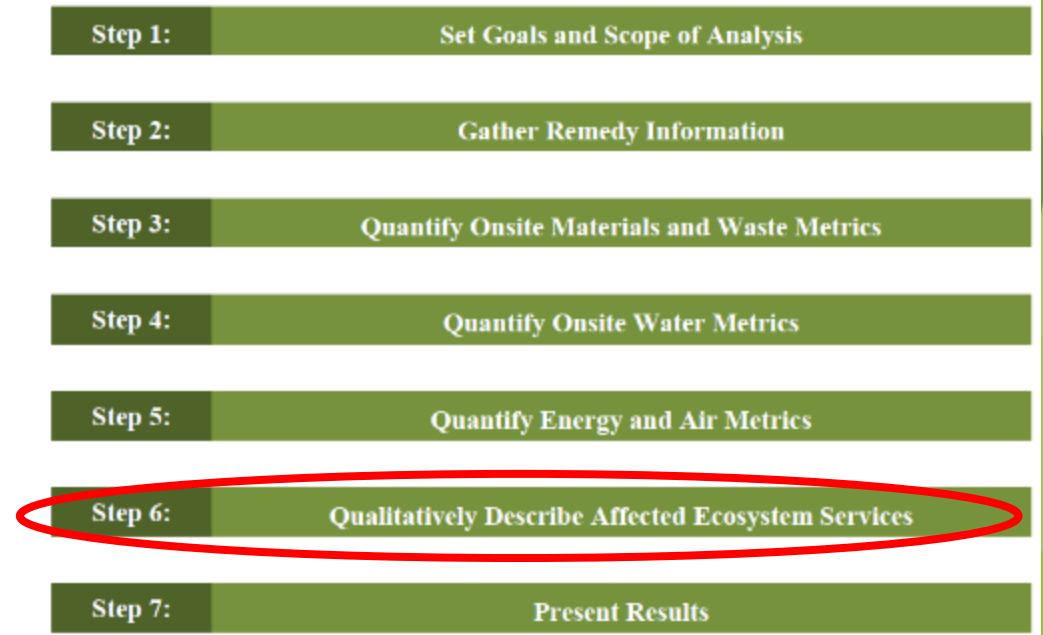
# Environmental Footprint



"a qualitative or quantitative estimate of various environmental contributions of a cleanup phase or activity to the core elements of a greener cleanup."

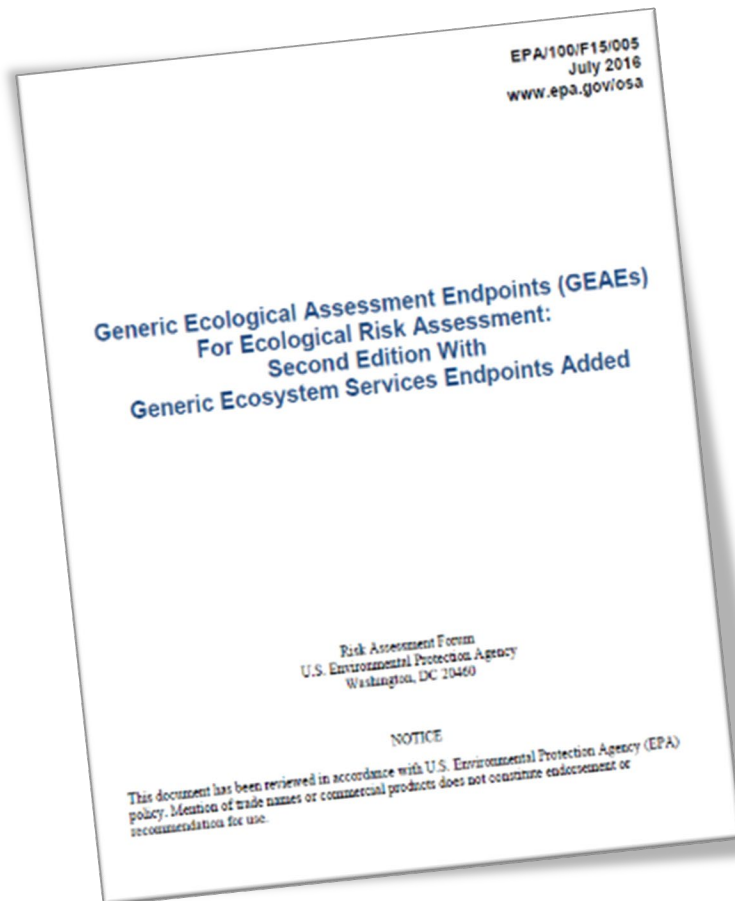
The 2012 methodology suggests use of descriptions of remedy effects on land & ecosystem services (e.g., nutrient uptake & erosion control)

Figure 3.1. Overview of Footprint Methodology



U.S. EPA. (2012). Methodology for Understanding and Reducing a Project's Environmental Footprint. EPA 542-R-12-002.  
[https://www.epa.gov/sites/default/files/2015-04/documents/methodology\\_enviro\\_footprint.pdf](https://www.epa.gov/sites/default/files/2015-04/documents/methodology_enviro_footprint.pdf)

# ES as ERA Endpoints: 2015+



- ▶ ES as endpoints to enhance ecological risk assessments
- ▶ Going beyond conventional assessment endpoints to describe the valued attributes of endpoints may be useful or essential to success in informing risk decisions
- ▶ Not required, but can be useful when benefits of protection must be estimated or when benefits to humans are not obvious & must be described to decision makers, stakeholders, or public to help justify or inform a decision

U.S. EPA. (2016). Generic Ecological Assessment Endpoints (GEAEs) for Ecological Risk Assessment: Second Edition w/ Generic Ecosystem Services Endpoints Added. EPA/100/F15/005.

[https://www.epa.gov/sites/production/files/2016-08/documents/geae\\_2nd\\_edition.pdf](https://www.epa.gov/sites/production/files/2016-08/documents/geae_2nd_edition.pdf)

# ES as ERA Endpoints: 2023



Kim, S. et al. (2023). Operationalizing Ecosystem Services Endpoints and Assessment Tools for Supporting Risk Assessments. Superfund and Technology Liaison Research Project Report. Project ID: 2477. U.S. Environmental Protection Agency. EPA/600/R-23/039.

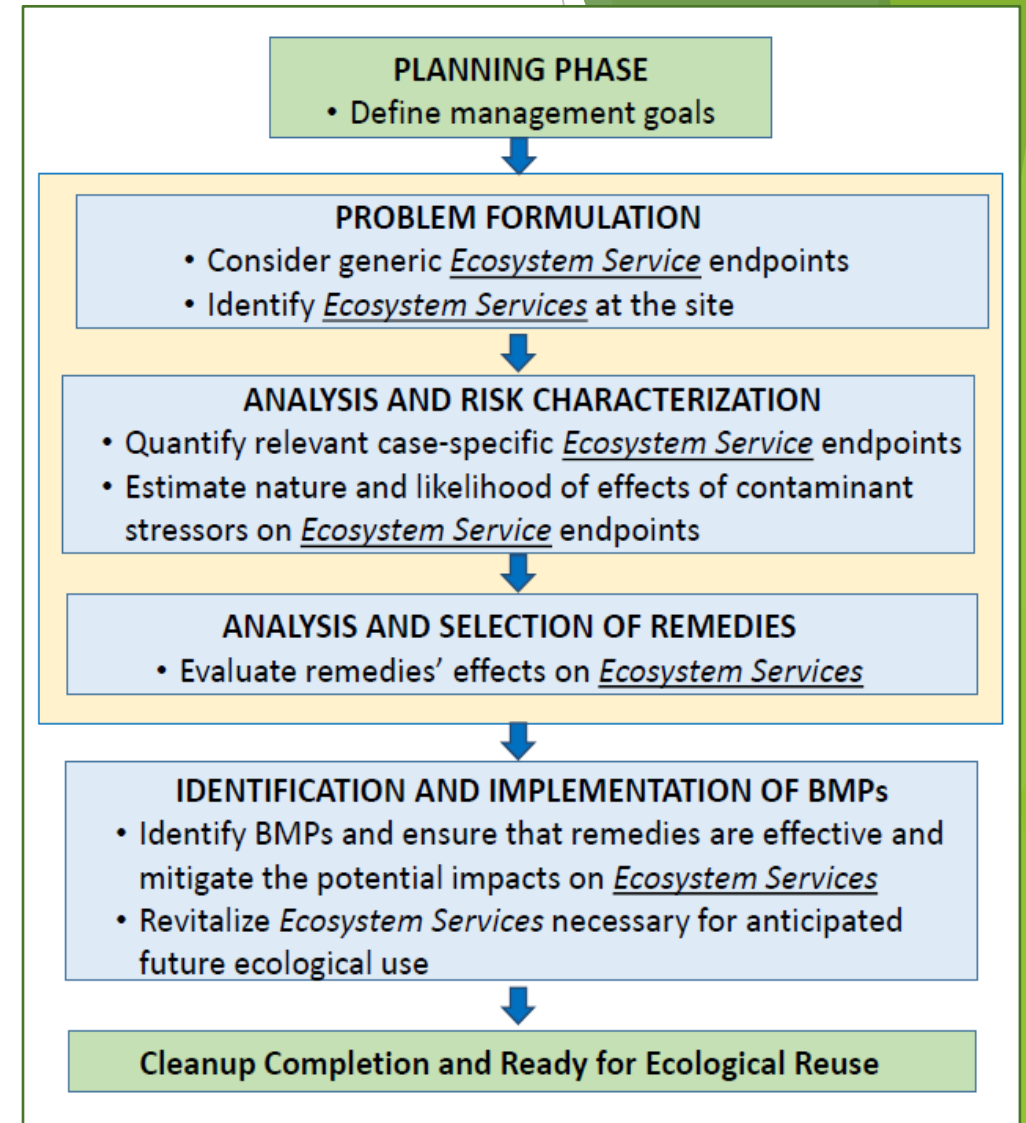
[https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?Lab=CPHEA&dirEntryId=357699](https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=CPHEA&dirEntryId=357699)

## 2017 - Engineering Forum Issue Paper: Ecosystem Services at Contaminated Site Cleanups\*

- ▶ Engagement with the public and stakeholders about anticipated future ecological use
- ▶ Replicable, defensible selection of greener cleanup BMPs
- ▶ Can inform environmental decision-making at different parts of clean-up process
- ▶ Transparent documentation of the ecosystem conditions on the site “before and after” cleanup
- ▶ Communication of the benefits & societal relevance of ecological risk-based cleanups

\*EPA 542-R-17-004, August 2017

<https://www.epa.gov/remedytech/superfund-remedy-report>





# Quick Check of the Q&A box

# What are Current Barriers to Change?

- ▶ No statutory requirement
- ▶ Approach is relatively new and may not be well understood by those who actively implement Superfund (remedial project and program managers, community involvement specialists, and their managers)
- ▶ No policy or guidance encouraging and providing direction and detail
- ★ Misconceptions about if and how EPA can incorporate ES into its cleanup programs
- ▶ Some Responsible Parties (RP) are likely resistant (but many may embrace)
- ★ Lack of translation or bridge mechanisms to move from theory to practice to implementation
- ▶ 2021-2023 - ORD co-led series of workshops with EPA Partners to explore concepts further for contaminated site cleanups (in general), brownfields, and ecological risk assessments

# Theory of Change - Co-developed Workshops

To Accomplish  
These  
Long-Term  
Outcomes ...

ES are delivering  
benefits on multiple  
cleanup sites

Considering ES becomes  
routine in a cleanup  
operation

Demonstrate at least one  
long-term focused  
example for OLEM

Work Towards  
Short-Term  
Outcomes & ...

Cleanup staff see value in ES &  
how it can improve remediation  
outcomes & community relations

Cleanup staff aware &  
understands ES

EPA cleanup staff &  
contractors are technically  
capable of incorporating ES  
into cleanups

ES language is considered as one  
evaluation factor in selecting clean-  
up contractors

Legal sideboards are  
understood and not a  
barrier to ES  
consideration

Demonstrate at least one  
short-term focused example  
for OLEM

Focus On  
Possible  
Outputs &  
Activities

• Training  
• Guidance

• “Guidebook” or matrix describing: ES tools; how used; incorporate into community engagement & decisions; why help protect Human Health and Environment.

• Sample contractor language

• EPA case studies  
• Pilots

• Translational report & Factsheet

• ES tools portal

• Literature on successes

• Mgmt sanction  
• Legal memo providing clarity  
• Include rationale

# How does ES translate to cleanup at EPA?

For RCRA, CERCLA, and Brownfield

# Site Cleanup Phases:

Different Names -

Same Concept  
Across Programs

General Environmental Cleanup Steps		CSM Life Cycle	CERCLA - Superfund	RCRA	Brownfields	UST	VCUP Varies by State
SITE ASSESSMENT	Preliminary CSM	Conceptual	Preliminary Assessment (PA) Site Inspection (SI) National Priorities List (NPL) No Further Remedial Action Planned (NFRAP)	Facility Assessment (RFA)	Phase I Environmental Site Assessment (ESA)	Initial Site Characterization Initial Response	PA SI
	Baseline CSM						
SITE INVESTIGATION AND ALTERNATIVES EVALUATION	Characterization CSM Stage		Remedial Investigation/ Feasibility Study (RI/FS) Removal Actions - Emergency/ Time Critical/Non-Time-Critical	Facility Investigation (RFI) Corrective Measures Study (CMS)	Phase II ESA	SI Corrective Action Plan (CAP)	RI/FS
	Design CSM Stage		Proposed Plan Record of Decision (ROD)	Statement of Basis (SB) Final Decision and Response to Comments	Remedial Action Plan (RAP)	Cleanup Selection	ROD
REMEDY IMPLEMENTATION	Remediation/ Mitigation CSM Stage		Remedial Design (RD) Remedial Action (RA) – Interim and Final	Corrective Measure Implementation (CMI)	Cleanup and Development	Corrective Action - Low-impact site cleanup - Risk-based remediation - Generic remedies - Soil matrix cleanup	RD RA
	Post-Remedy CSM Stage		Operational & Functional Period Operation & Maintenance (O&M) Long term monitoring (LTM) Optimization Long Term Response Action (Fund-lead groundwater/surface water restoration)	O&M On-site inspections and oversight	Property Management Long-term O&M Redevelopment Activities (Private- and Public-led)	LTM	O&M LTM
POST-CONSTRUCTION ACTIVITIES		Quantitative	Construction Complete (CC) Preliminary or Final Close Out Report (PCOR/FCOR) Site Completion - FCOR Site Deletion O&M as appropriate	Certification of Completion Corrective Action Complete with Controls or without Controls	CC Property Management	No Further Action (NFA) CC	
SITE COMPLETION							

<https://www.epa.gov/sites/default/files/2015-04/documents/csm-life-cycle-fact-sheet-final.pdf>

# More Practical Approach: Develop ES & Cleanup Step Crosswalks

Contaminated Site Cleanup Step
1 - Site Assessment
2 - Site Investigation and Alternatives Evaluation
3 - Remedy Selection
4 - Remedy Implementation
5 - Post-Construction Activities

# Multiple Crosswalks

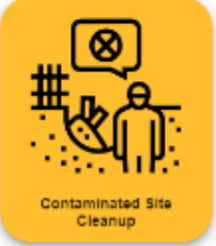
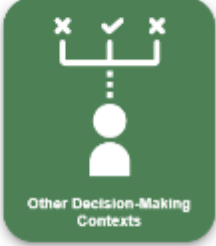
ES Crosswalks done for:

- ▶ Ecological Risk Assessments
  - ▶ (e.g., BERA, SLERA)
- ▶ Contaminated Site Clean-up Steps
- ▶ Other Generic Decision-Making Contexts
- ▶ ORD created a Tool Selection Portal...

**EPA's Ecosystem Services Tool Selection Portal**

Ecosystem services assessment tools help you describe, quantify, and sustain the benefits nature offers humans and weigh the impact of decisions. This tool portal helps select the best tools for your scenario. Choose a path below to find the tools that match your needs.

I'm looking for help with...

Ecological Risk Assessments	Contaminated Site Cleanup	Other Decision-Making Contexts
		
<p>Choose this path if you are:</p> <ul style="list-style-type: none"><li>• Evaluating the possible impact of environmental stressors such as chemicals, disease, or invasive species.</li><li>• Predicting the likelihood of future effects.</li><li>• Using an Ecological Risk Assessment in Remedy Decisions.</li><li>• Preparing and/or reviewing Ecological Risk Assessments.</li></ul>	<p>Choose this path if you are:</p> <ul style="list-style-type: none"><li>• Doing a preliminary assessment or investigation of a contaminated site.</li><li>• Planning or engaged in cleanup or reuse of a contaminated site.</li><li>• Working with a Contaminated Site process or model.</li></ul>	<p>Choose this path if you are:</p> <ul style="list-style-type: none"><li>• Working towards a goal that isn't ecological risk assessment or contaminated site cleanup (for example, natural resource management, park and recreation planning, habitat restoration, and stormwater management).</li><li>• Have a general interest in ecosystem services.</li></ul>

Step 1 Step 2 Step 3 Matching Tools

# Why should I care?

There are a number of rationales for incorporating ES depending on a site:

- ▶ operations and maintenance savings;
- ▶ reduced risk to human health and the environment;
- ▶ community acceptance;
- ▶ better projects incorporating green and gray infrastructure together for achieving many co-benefits;
- ▶ reputational benefits for the responsible party(ies);
- ▶ meeting ARARs or other permitting requirements;
- ▶ addressing environmental justice in some cases, such as increased access to green space, urban gardening, etc.;
- ▶ making sites more resilient to climate impacts such as flooding and erosion.



# Examples from Site Investigation to post-Construction







# Lake Sandy Jo Case Study



- ▶ Superfund site (Gary, Indiana) - a 55-acre former landfill
- ▶ EPA completed cleanup in 1994, including a soil cover vegetative cap, providing municipal water supply to local residents, and implementing controls to prevent direct contact with the buried landfill material.
- ▶ Although the remedy protected against spreading contamination, it offered no other direct benefits to the community.
- ▶ The ES process included two community workshops on ES and the site and one design charrette with both youth and adult sessions.
  - The community identified three priorities or benefits from nature: safety and security, health, and improved living standards.
  - Ideas for use of the non-developed portion included recreation and outdoor education, siting of a solar array, safety fencing and clear, well-lit paths, recreational assets such as raised gardens, a pollinator garden, and an exercise area, and improved living standards through renewable energy options like solar roofs, streetlights, and solar-covered parking.
- ▶ As an outcome, the LSJ project is one of the first, and perhaps the very first, example in the country with the incorporation of ecosystems services codified as a city ordinance.

# East Mount Zion Case Study

- ▶ The East Mount Zion Landfill Superfund Site (York County, PA).
- ▶ The remedy is currently protective of human health and the environment, but area has dominated by weeds and non-native species and landscape encouraged the habitation of groundhogs, whose burrows create significant risks to the landfill cap and to the safety of on-site monitoring activities.
- ▶ Explored whether site revegetation could result in increased benefits to the community and ease of management, while continuing to protect the integrity of the cap and the restrictions for use of and access to the site.
- ▶ Project identified increased pollination, improved bird habitat, recreational enhancement, and reduction in groundhogs as key services that could be provided
- ▶ Elimination of the existing "weedy" cover and replaced with more local, native, and diverse species.

Engagement Outcomes		
Community Priorities		
 Increased Pollinator Populations	 Endangered or Threatened Species Protection	 Increased Rare Bird Presence
 Native Meadow Creation	 Additional Shrubs	 Wildlife Structures
Recommended Site Plan		
<b>Weed Removal</b>	Synthetic herbicide	
<b>Seed Mix</b>	Balanced mix of grasses and wildflowers	
<b>Shrubs</b>	Included around fence and wetland	
<b>Mowing Regime</b>	Every three years	

# Example ESML models applied for East Mount Zion Landfill

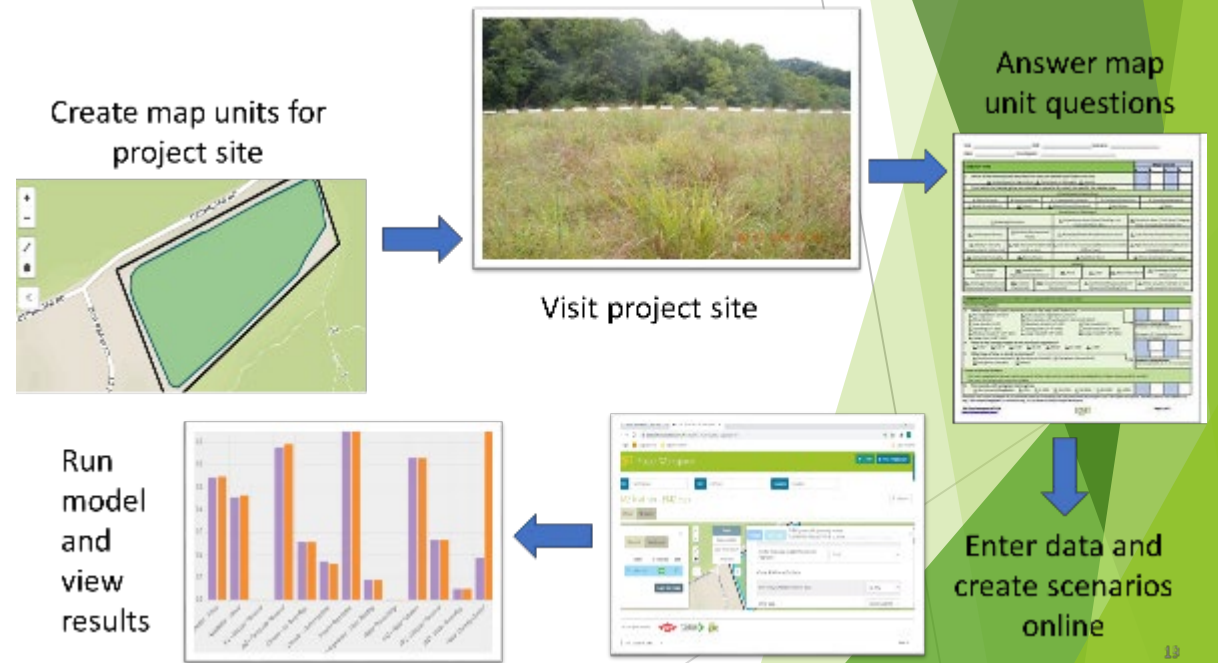
**InVEST**

Pollinators



**ESII**  
*tool*

Ecosystem Services Identification & Inventory - ESII



<https://esml.epa.gov>

# Snow Creek Wetlands Restoration Case Study

## Snow Creek Wetlands Restoration

Remediate the concrete material, address high pH in the soil, and remove hydrocarbon-contaminated fill

Courtesy of Kansas McGahan,  
Placer County, CA



# Snow Creek Wetlands Restoration Case Study

Focused on features that provided environmental benefits (ES), community benefits, and citizen engagement

## Environmental Benefits:

- ▶ water quality improvements
- ▶ access to greenspace
- ▶ improvement in aesthetics
- ▶ stream and upland habitat restoration
- ▶ multi-use path
- ▶ environmental education signage



# Snow Creek Wetlands Restoration Case Study

Focused on features that provided environmental benefits (ES), community benefits, and citizen engagement

## Sustainability Benefits:

- ▶ reuse/repurpose existing site materials
- ▶ climate change resiliency in design process
- ▶ extensive stakeholder engagement
- ▶ community involvement through educational outreach
- ▶ consensus-driven decision making



# Quick Check of the Q&A box



# You have sold me on ES, so what tools and resources are available to help?

A Google Scholar search for “ecosystem services” yields 1.5 million articles

“top down” versus “bottom up”, or maybe it’s both!

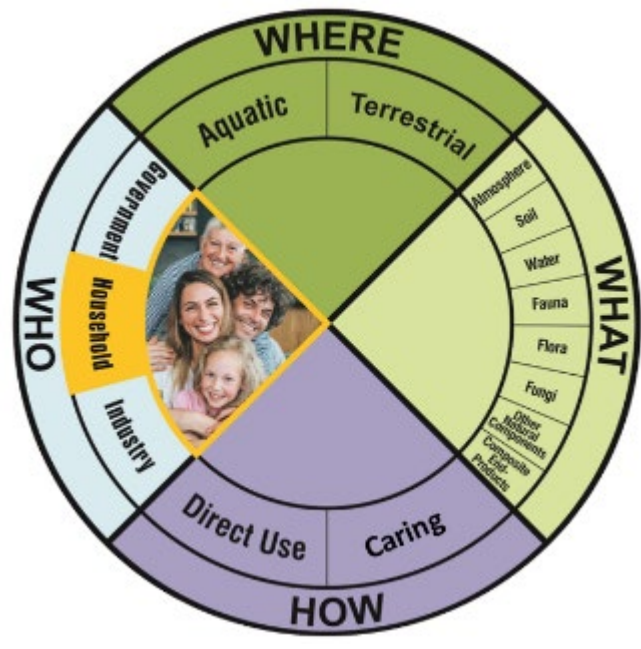
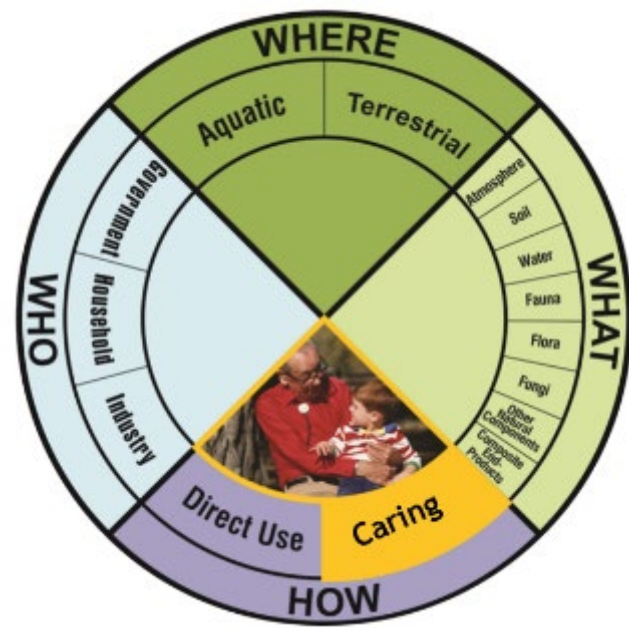
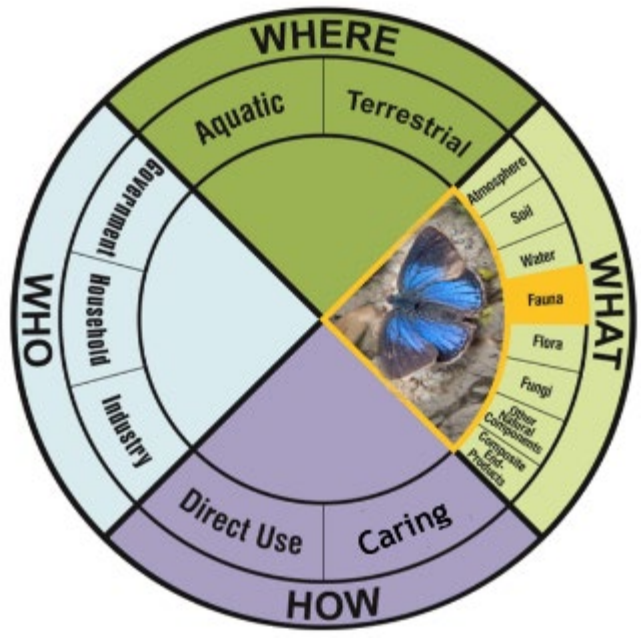
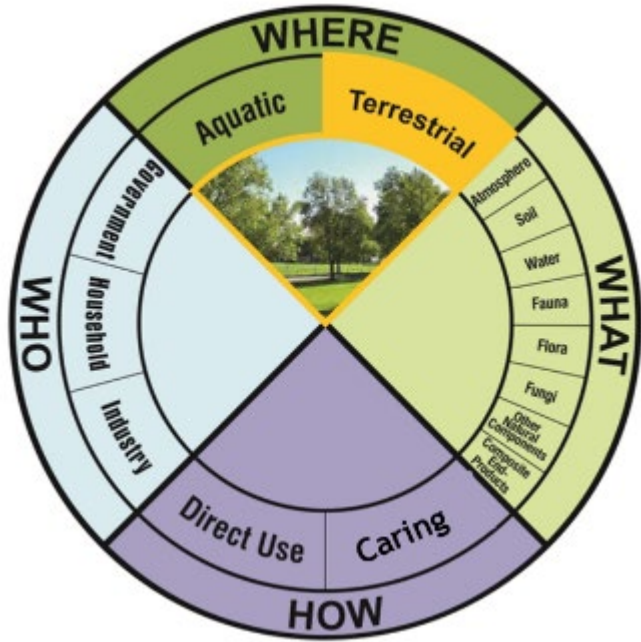
# Classification System Supports Standardized Approaches

NESCS Plus aids identifying and classifying what matters directly to people



1. Focus on direct benefits to people
2. Organized framework
3. Discrete terminology
4. Clearly defined classes and codes
5. Integration with ORD tools

<https://www.epa.gov/eco-research/nescs-plus>



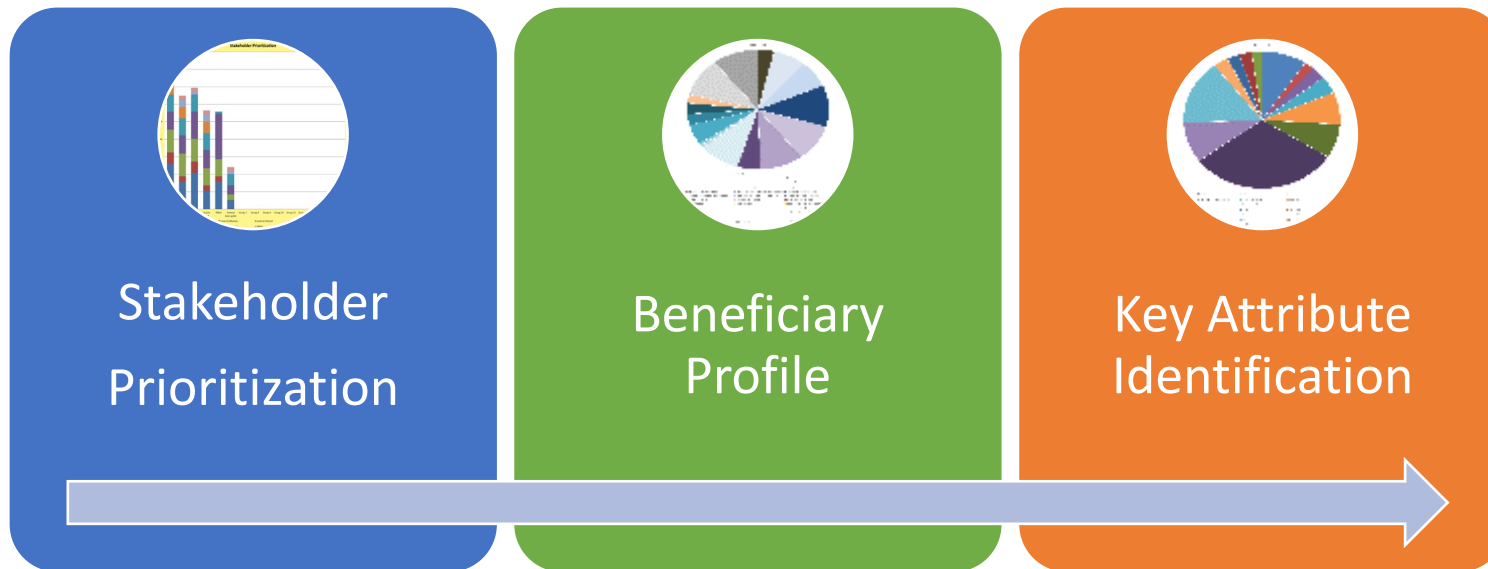
# A Decision Making Process



- ▶ In generic decision-making processes there are multiple points at which consideration of ecosystem services can be beneficial



# FEGS Scoping Tool



- ▶ Helps identify and prioritize stakeholders and environmental attributes
- ▶ Used in the scoping stage of community-level decisions
- ▶ Intended users are community-level decision makers, but applications are very flexible

*Book Chapter by Leah Sharpe:* <https://www.epa.gov/eco-research/ecosystem-based-management>

<https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-fegs-scoping-tool>

# FEGS Scoping Tool Application Case Study

- ▶ To identify ways in which stakeholders could benefit from a project
- ▶ To find common interests among stakeholder groups
- ▶ To identify restoration goals and metrics
- ▶ To explicitly lay out an understanding of the stakeholder context and have an opportunity to correct misconceptions



## **Application:**

Identifying priority ecosystem services for consideration in the revitalization effort of a Superfund site (York, PA)

## EnviroAtlas & Brownfields

*This fact sheet highlights resources that can support brownfield redevelopment and revitalization for those managing and seeking U.S. Environmental Protection Agency Brownfields grant funding.*

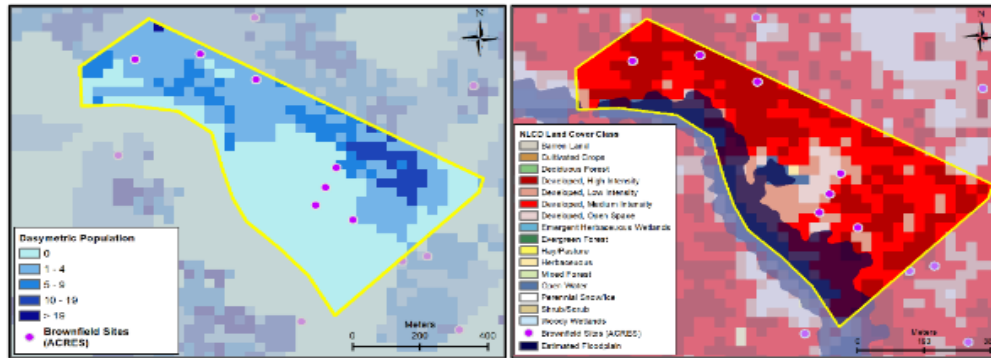
### About EnviroAtlas

EnviroAtlas is a free web-based resource that provides data, tools, research, and analysis on the relationships between nature, people, health, and the economy. Users can view and analyze diverse information to better understand how decisions can affect ecological, health, and equity outcomes at the national level all the way down to the neighborhood level.

EnviroAtlas maps and tools can help communities tell the story about the status of their local environments, populations, contaminated sites and areas needing improvement.

### How to Use these Resources

Use EnviroAtlas maps and tools to tell the story of brownfields you want



*Example EnviroAtlas maps in Wilmington, DE. Left: downscaled population and existing brownfield sites. Right: potential hotspots and flood-prone areas*

and Percent of Low-Wage Workers can indicate heat, flooding, and economic vulnerabilities; this capability helps address the complexity of intersecting and compounding issues.

Updated as new features and data are available, the [EnviroAtlas Interactive Map](#) provides hundreds of geospatial datasets for the entire U.S. and includes built-in analysis

change in your community by exploring modeled climate scenarios and comparing the change in climate variables (e.g., precipitation) between two time periods (from 1950-2099).

- **Raindrop:** See the general raindrop flow path and distance to the nearest water feature.
- **Watershed Navigator:** How might pollutants from

# EnviroAtlas ES and related data layers to inform contaminated cleanups










<https://www.epa.gov/enviroatlas>

# EnviroAtlas

Showing 48 EnviroAtlas layers

Search:

Data Layer Name ▲	Topic ▾	Extent ▾	Fact Sheet	Metadata	View Map
	ALL ▼	ALL ▼			
Air Quality System (AIRS AQS)	Sites Reporting to EPA	National		 	
Average reduction in daytime ambient temperature (Celsius)	Weather and Climate	Community			
Average reduction in nighttime ambient temperature (Celsius)	Weather and Climate	Community			
Brownfield Properties (ACRES)	Sites Reporting to EPA	National			
Business address vacancy rate for 2014	Vacancy	National			

### Brownfield Data Matrix

Use the matrix below to explore data that may be relevant to your specific brownfields project.

- To use the matrix:
  - Sort columns by clicking in the header.
  - Start typing in the search box to instantly narrow data layers.
  - Hover over the data layer name to get a short map description.
  - Access the data fact sheet and metadata, or open the map directly, by clicking the appropriate icon.
- Want to see all available EnviroAtlas data? [Access the full Dynamic Data Matrix.](https://www.epa.gov/enviroatlas)

<https://www.epa.gov/enviroatlas>



# EcoService Models Library (ESML)

A searchable database of ecological models for estimating the production of ecosystem goods and services.



Home



Search EMs



My EMs (0)



Learn about ESML



View ESML Data Map

Filter based on: Hide Filters

- EM Source/Collection i
- EM Environmental Subclass i
- Ecosystem Service i
- Hazardous Waste Site ERA i**
- Generic Ecological Assessment Endpoints i
- Full Report**
- Table 3 (About PDF) EXIT

Type a value or select from list

EM ID	Model Short Name	Response Variable Name(s)	EM Environmental Sub-Class	Ecosystem Services (CICES)	Ecosystem Services (NESCS)	Year
<a href="#">EM-339</a>	INVEST crop pollination, NJ and PA, USA [Application]	Pollinator abundance service score   Pollinator abundance source score   Total pollinator abundance service score	Terrestrial Environment (sub-classes not fully specified)   Agroecosystems	+ [Ecosystem] Regulation & Maintenance  8/31/2023 49	+ Agroecosystems (22)	2009
<a href="#">EM-374</a>	INVEST carbon storage and sequestration	Carbon sequestration over total time period	Not applicable	+ [Ecosystem] Regulation & Maintenance	None	2015

# Ecosystem Services Tool Selection Portal

## EPA's Ecosystem Services Tool Selection Portal

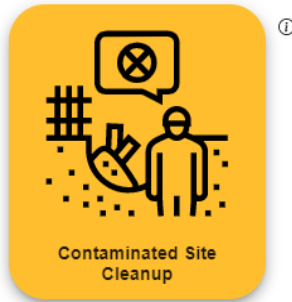
Ecosystem services assessment tools help you describe, quantify, and sustain the benefits nature offers humans and weigh the impact of decisions. This tool portal helps select the best tools for your scenario. Choose a path below to find the tools that match your needs.

I'm looking for help with...



Choose this path if you are:

- Evaluating the possible impact of environmental stressors such as chemicals, disease, or invasive species.
- Predicting the likelihood of future effects.
- Using an Ecological Risk Assessment in Remedy Decisions.
- Preparing and/or reviewing Ecological Risk Assessments.



Choose this path if you are:

- Doing a preliminary assessment or investigation of a contaminated site.
- Planning or engaged in cleanup or reuse of a contaminated site.
- Working with a Contaminated Site process or model.



Choose this path if you are:

- Working towards a goal that isn't ecological risk assessment or contaminated site cleanup (for example, natural resource management, park and recreation planning, habitat restoration, and stormwater management).
- Have a general interest in ecosystem services.

Step 1

Step 2

Step 3

Matching Tools

- ▶ EPA has developed an extensive set of tools
  - Meet different needs
  - Used at different points in the process
- ▶ Tools Portal Available Now!

<https://www.epa.gov/eco-research/ecosystem-services-tool-selection-portal>

# Ecosystem Services Tool Selection Portal

Your Selections:  
[ES Portal Home](#) > [Ecological Risk Assessments: Planning & Scoping](#) > Select Tasks > Your Tool Matches

## What do you need help doing with Ecosystem Services (ES)?

**Planning & Scoping** Select All

- Identify and prioritize stakeholders and ES
- Map ES and biodiversity at the site
- Identify established links between ES and human health
- Identify potential ES using clearly defined terms and a comprehensive list

[< Back](#)

### Your Tool Matches

Click on a matched tool to view details, or view [all tool matches for steps in this path](#)

Process Phase	Recommended Ecosystem Services Tools
Planning & Scoping	<a href="#">Final Ecosystem Goods and Services (FEGS) Scoping Tool</a>
Planning & Scoping	<a href="#">EnviroAtlas</a>
Planning & Scoping	<a href="#">Eco-Health Relationship Browser</a>
Planning & Scoping	<a href="#">National Ecosystem Services Classification System</a>

[Contact us](#) to let us know if you have additional tool needs not addressed by these tools or to submit ideas for future tools. This Portal includes a limited selection of curated tools. Please contact us to suggest including additional tools for specific phases and tasks.

- 1 Step 1: Select Path
- 2 Step 2: Select Process Phases
- 3 Step 3: Select Tasks
- 4 Step 4: View Matching Tools

- ▶ Choose your pathway
- ▶ Choose your step(s)
- ▶ Crosswalk language to ES
- ▶ Tool selection results

<https://www.epa.gov/eo-research/ecosystem-services-tool-selection-portal>

# Ecosystem Services Tool Selection Portal

**What do you need help doing with Ecosystem Services (ES)?**

**Site Assessment** Select All

- Identify established links between ES and human health
- Map ES and biodiversity
- Identify and prioritize stakeholders and ES
- Create conceptual model for how stressors impact ES
- Identify potential ES using clearly defined terms and a comprehensive list
- Identify most relevant and meaningful final ecosystem goods and services metrics

**Site Investigation and Alternatives Evaluation** Select All

- Identify established links between ES and human health
- Identify most relevant and meaningful final ecosystem goods and services metrics
- Estimate stressors and impacts on ES
- Map ES and biodiversity
- Find models for estimating ES
- Identify and prioritize stakeholders and ES
- Examine ES risks and benefits to compare and communicate decision alternatives

**Your Tool Matches**

Click on a matched tool to view details, or view [all tool matches for steps in this path](#)

Process Phase	Recommended Ecosystem Services Tools
Site Assessment	<a href="#">Eco-Health Relationship Browser</a>
Site Assessment	<a href="#">National Ecosystem Services Classification System</a>
Site Investigation and Alternatives Evaluation	<a href="#">Eco-Health Relationship Browser</a>
Site Investigation and Alternatives Evaluation	<a href="#">Rapid Benefit Indicators (RBI) Approach</a>

[Contact us](#) to let us know if you have additional tool needs not addressed by these tools or to submit ideas for future tools. This Portal includes a limited selection of curated tools. Please contact us to suggest including additional tools for specific phases and tasks.

[< Back](#)

1
2
3
4

<b>Level of expertise needed:</b>	Low - No technical expertise is necessary to use the tool, only familiarity with the community and its stakeholder groups.	
<b>Level of effort needed:</b>	<b>Approach</b>	<b>Effort Needed</b>
	Tool Orientation	30 minutes
	An individual or group using the tool alone: 2-4 hours.	
	One or more groups using the tool in consultation with stakeholders.	Time varies based on method of consultation and the number of groups involved, could range from a single workshop to a series of conversations/meetings.
<b>Questions it might answer:</b>	How are stakeholder groups benefiting from the environment?	
	What aspects of the environment are necessary for these benefits?	
	What interests do different groups have in common?	
<b>Tasks it can help with:</b>	Identify and prioritize stakeholders and ES.	
<b>Resources:</b>	<a href="#">Prioritizing Stakeholders, Beneficiaries, and Environmental Attributes: A Tool for Ecosystem-Based Management (2020)</a>	
	<a href="#">EECS Supporting Tool Investigation</a>	

<https://www.epa.gov/eco-research/ecosystem-services-tool-selection-portal>

# How does ES fit into other similar initiatives?

# Recent Policy Tools & Initiatives

Recent policy initiatives encourage land revitalization that enhances ecosystem services and applies nature-based solutions.

1. EO 13990 (2021) “Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis”
2. EO 14072 (2022) “Strengthening the Nation's Forests, Communities, and Local Economies”
3. CEQ (2022) “Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity”
4. OIRA and OPM (2023 Public Comment) “Guidance for Assessing Changes in Environmental and Ecosystem Services in Benefit-Cost Analysis”

***Key Message: these policy tools and initiatives provide conceptual guidance to link contaminated cleanups with goals of enhancing multiple ecosystem services.***

# Reverse Q&As

We would like to learn about other examples and best practices for enhancing environmental benefits in contaminated site cleanups.

We would like to identify projects that would like to utilize one or more of these tools as part of their effort.

[Harwell.Matthew@epa.gov](mailto:Harwell.Matthew@epa.gov)

# Resources

**Updated soon** - Clu-In website for Ecosystem Services information!!

- ▶ Resource: <https://clu-in.org/ecotools/ecosystem.cfm>

## NESCS Plus

- ▶ Tool: <https://www.epa.gov/eco-research/national-ecosystem-services-classification-system-nescs-plus>

## FEGS Scoping Tool

- ▶ Tool: <https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-fegs-scoping-tool>
- ▶ Journal article: <https://pubmed.ncbi.nlm.nih.gov/33413974/>
- ▶ Book chapter: [https://link.springer.com/chapter/10.1007/978-3-030-45843-0\\_10](https://link.springer.com/chapter/10.1007/978-3-030-45843-0_10)

## EnviroAtlas

- ▶ Tool: <https://www.epa.gov/enviroatlas>
- ▶ Publications: <https://www.epa.gov/enviroatlas/enviroatlas-publications>
- ▶ Dynamic Data Matrix: <https://www.epa.gov/enviroatlas/enviroatlas-dynamic-data-matrix>
- ▶ Interactive Map: <https://www.epa.gov/enviroatlas/enviroatlas-interactive-map>

## Eco-Health Relationship Browser

- ▶ Tool: <https://www.epa.gov/enviroatlas/enviroatlas-eco-health-relationship-browser>

## **NEW** - Ecosystem Services Tool Selection Portal

- ▶ Tool: <https://www.epa.gov/eco-research/ecosystem-services-tool-selection-portal>

## **NEW** - Ecosystem Services and Risk Assessments

- ▶ Report: Kim et al. (2023). Operationalizing Ecosystem Services Endpoints and Assessment Tools for Supporting Risk Assessments. EPA/600/R-23/039.  
[https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?dirEntryId=357699&Lab=CPHEA](https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=357699&Lab=CPHEA)