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# Comparing Classifications of Ecosystem Services under NRDA, the Millennium Assessment, and the USEPA

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# Millennium Ecosystem Assessment (MA)

Classification of Ecosystem Services

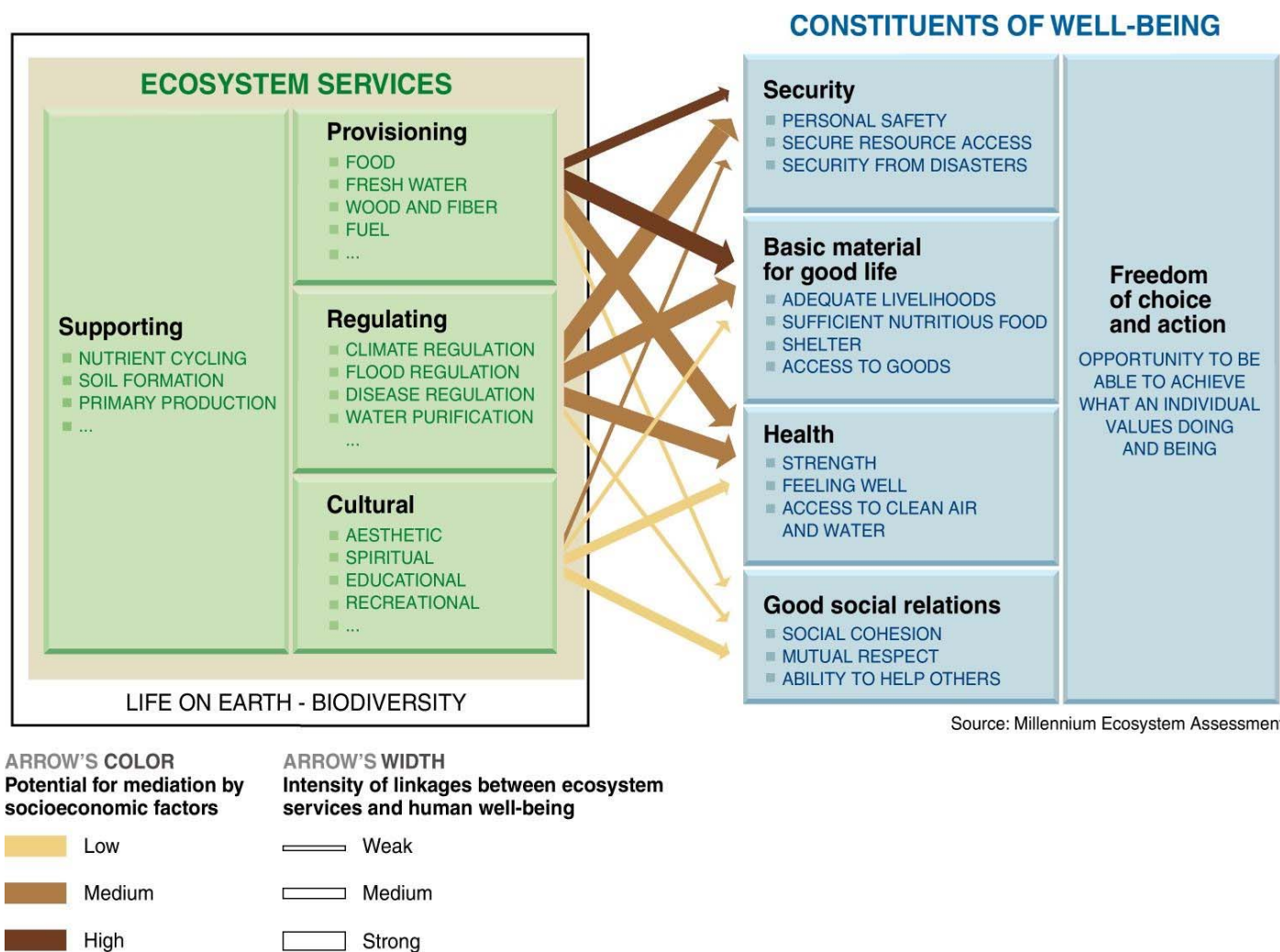


## Purpose and Definition

- A critical evaluation of information concerning the consequences of ecosystem changes for human well-being
- Largest assessment of the health of Earth's ecosystems
- Called for by UN Secretary General in 2000
- Prepared by 1,360 experts from 95 countries between 2001 and 2005
- Includes information from 33 sub-global assessments
- Focus on the benefits people obtain from ecosystems and consequences of ecosystem change for human well-being



# Ecosystem Services and Consequences of Ecosystem Change for Human Well-being





# Ecosystem Services Categories under MA

Provisioning Services	Regulating Services	Cultural Services	Supporting Services
<ul style="list-style-type: none"> <li>➤ Food <ul style="list-style-type: none"> <li>• Crops</li> <li>• Livestock</li> <li>• Capture Fisheries</li> <li>• Aquaculture</li> <li>• Wild Foods</li> </ul> </li> <li>➤ Fiber <ul style="list-style-type: none"> <li>• Timber</li> <li>• Cotton, Hemp, Silk</li> <li>• Wood Fuel</li> </ul> </li> <li>➤ Genetic Resources</li> <li>➤ Biochemicals, Natural Medicines, Pharmaceuticals</li> <li>➤ Freshwater</li> </ul>	<ul style="list-style-type: none"> <li>➤ Air Quality Regulation</li> <li>➤ Climate Regulation <ul style="list-style-type: none"> <li>• Global</li> <li>• Regional and Local</li> </ul> </li> <li>➤ Water Regulation</li> <li>➤ Erosion Regulation</li> <li>➤ Water Purification and Waste Treatment</li> <li>➤ Disease Regulation</li> <li>➤ Pest Regulation</li> <li>➤ Pollination</li> <li>➤ Natural Hazard Regulation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Spiritual and Religious Values</li> <li>➤ Aesthetic Values</li> <li>➤ Recreation and Ecotourism</li> </ul>	<ul style="list-style-type: none"> <li>➤ Nutrient Cycling</li> <li>➤ Soil Formation</li> <li>➤ Primary Production</li> <li>➤ Biologically Mediated Habitat</li> <li>➤ Photosynthesis</li> </ul> <p>* Note that supporting services are not used directly by people</p>



# Final Ecosystem Goods and Services Classification System (FEGS-CS) USEPA



## Purpose and Definition

- Developed as a foundation to define, classify, and measure ecosystem services
- Framework is similar to **North American Industry Classification System (NAICS)** which tracks economic goods and services
- Separate, quantify, and value the ecological production function from the total economic value (including economic production function)
- Represents environmental goods and services derived with no or minimal inputs of human capital or labor



# FEGS Components

## FEGS Environmental Classification

X Environmental Classes		
1. Aquatic	1. Terrestrial	1. Atmospheric
XX Environmental Sub-Classes		
11. Rivers and Streams	21. Forests	31. Atmosphere
12. Wetlands	22. Agroecosystems	
13. Lakes and Ponds	23. Created Greenspaces	
14. Estuaries and Near Coastal Marine	24. Grasslands	
15. Open Oceans and Seas	25. Scrublands / Shrublands	
16. Groundwater	26. Barren / Rock and Sand	
	27. Tundra	
	28. Ice and Snow	





# FECS Components

## FECS Beneficiary Categorization

XX.XX Beneficiary Categories				
00.01 Agricultural	00.02 Commercial / Industrial	00.03 Government, Municipal, and Residential	00.04 Commercial / Military Transportation	00.05 Subsistence
XX.XXXX Beneficiary Sub-Categories				
00.0101 Irrigators 00.0102 CAFO Operators 00.0103 Livestock Grazers 00.0104 Agricultural Processors 00.0105 Aquaculturists 00.0106 Farmers 00.0107 Foresters	00.0201 Food Extractors 00.0202 Timber, Fiber, and Ornamental Extractors 00.0203 Industrial Processors 00.0204 Industrial Dischargers 00.0205 Electric and other Energy Generators 00.0206 Resource-Dependent Businesses 00.0207 Pharmaceutical and Food Supplement Suppliers 00.0208 Fur / Hide Trappers and Hunters	00.0301 Municipal Drinking Water Plant Operators 00.0302 Waste Water Treatment Plant Operators 00.0303 Residential Property Owners 00.0304 Military / Coast Guard	00.0401 Transporters of Goods 00.0402 Transporters of People	00.0501 Water Subsisters 00.0502 Food Subsisters 00.0503 Timber, Fiber, and Fur / Hide Subsisters 00.0504 Building Material Subsisters



# FEGS Components

## FEGS Beneficiary Categorization (cont.)

XX.XX Beneficiary Categories				
00.06 Recreational	00.07 Inspirational	00.08 Learning	00.09 Non-Use	00.10 Humanity
XX.XXXX Beneficiary Sub-Categories				
00.0601 Experiencers and Viewers	00.0701 Spiritual and Ceremonial Participants and Participants of Celebration	00.0801 Educators and Students	00.0901 People Who Care (Existence)	00.1001 All Humans
00.0602 Food Pickers and Gatherers	00.0702 Artists	00.0802 Researchers	00.0902 People Who Care (Option / Bequest)	
00.0603 Hunters				
00.0604 Anglers				
00.0605 Waders, Swimmers, and Divers				
00.0606 Boaters				

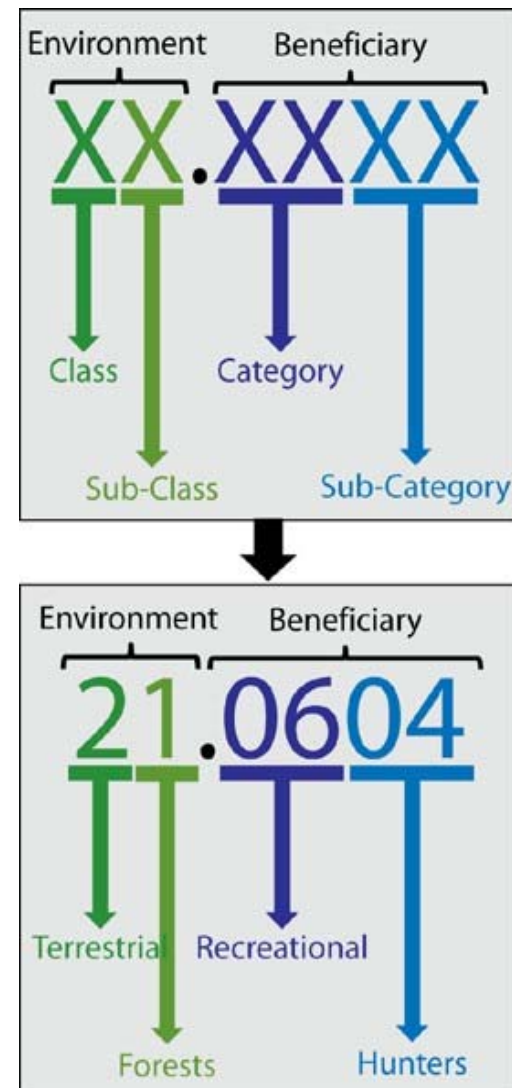
Source: Landers, Dixon H, and Amanda M. Nahlik, 2013, EPA Final Ecosystem Goods and Services Classification System (FEGS-CS), August.



# FEGS Construct



Source: Landers, Dixon H, and Amanda M. Nahlik, 2013, EPA Final Ecosystem Goods and Services Classification System (FEGS-CS), August.





## Future for FEGS

- Valuation using this system has not yet been established
- Potential for actual economic analysis using this system in the future because of three characteristics:
  - Systematic identification of FEGS
  - Minimized double-counting
  - Explicit linkages to beneficiaries
- Long-term goals is to ***connect FEGS-CS and NAICS***



# MEA Comparison with FECS-CS

## MA

- System to define and classify ecosystem services
- Focus on linkages between ecosystems and human well-being
- Final ecosystem services are intermingled with intermediate services
- Double counting may occur
- Four broad categories and limited classifications
- Framework based on interaction between biodiversity, ecosystem services, human well-being and drivers of change
- Does not provide metrics and indicators that can be estimated in the environment

## FECS - CS

- System to define and classify ecosystem services
- Focus on linkages between ecosystem services and beneficiaries
- Final ecosystem services are specified
- Reduces double counting
- Numerous classifications and sub-classifications
- Framework based on similarities with NAICS system
- Valuation will be possible under this system using a Leontief framework



# Natural Resource Damage Assessment (CERCLA/OPA NRDA)

Classification of Ecosystem Services



## Purpose and Definition

- NRD are for injury to, destruction of, or loss of natural resources, including the reasonable costs of a damage assessment [CERCLA §§101(6); 107(a)(4)(C); OPA §§1001(5); 1002(b)(2)]. The measure of damages is the cost of restoring injured resources to their baseline condition, compensation for the interim loss of injured resources pending recovery, and the reasonable cost of a damage assessment [ 43 CFR Part 11 ; 15 CFR Part 990].
  - CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended
  - OPA = Oil Pollution Act of 1990



## NRDA Definitions

- *Natural resources* means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the Exclusive Economic Zone), any State or local government or Indian tribe, or any foreign government, as defined in section 1001(20) of OPA (33 U.S.C. 2701(20)).
- *Services (or natural resource services)* means the functions performed by a natural resource for the benefit of another natural resource and/or the public.



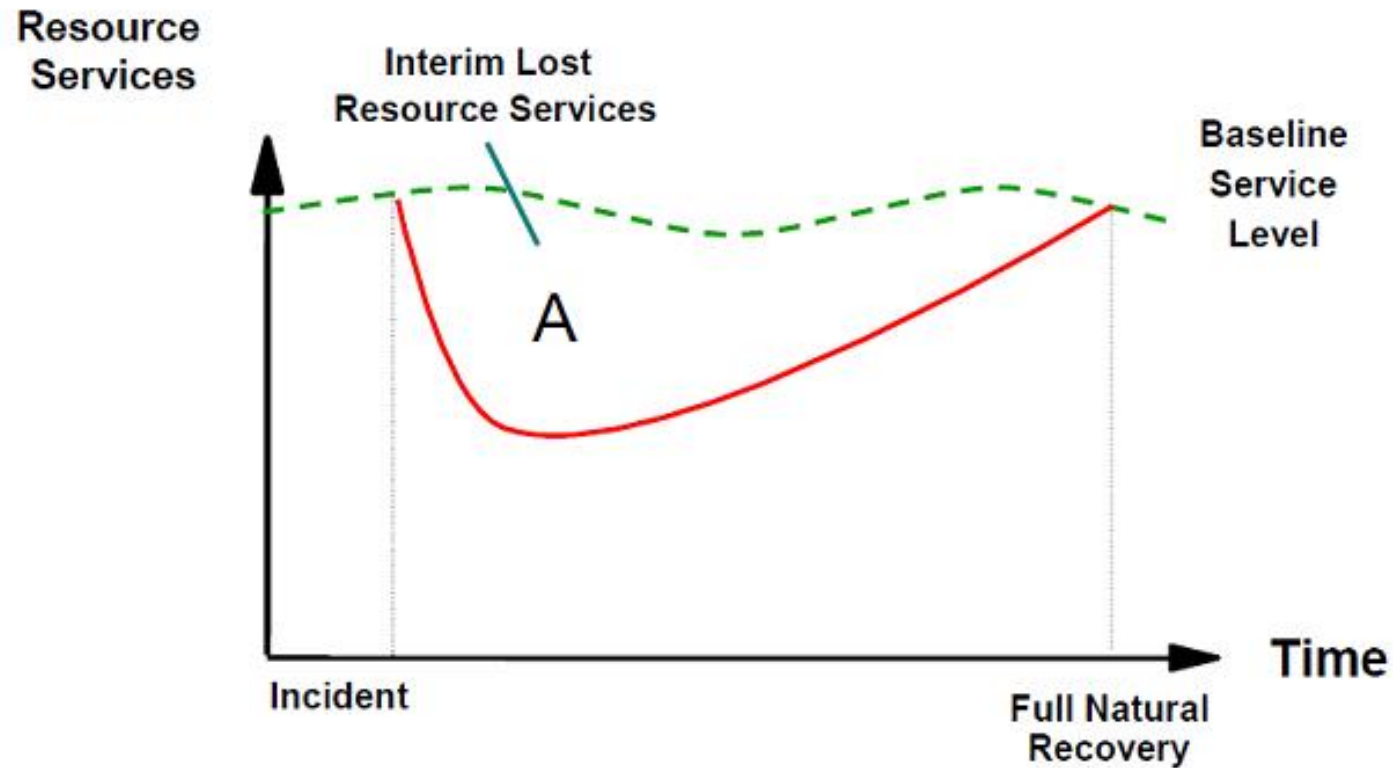


# NRDA Definitions

- *Injury* means an observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service.
- *Interim losses* and *interim lost services (uses)* refer to the reduction in resources and the services they provide, relative to baseline levels, that occur from the onset of an incident until complete recovery of the injured resources.
- *Value* means the maximum amount of goods, services, or money an individual is willing to give up to obtain a specific good or service, or the minimum amount of goods, services, or money an individual is willing to accept to forgo a specific good or service. The total value of a natural resource or service includes the value individuals derive from direct use of the natural resource, for example, swimming, boating, hunting, or birdwatching, as well as the value individuals derive from knowing a natural resource will be available for future generations.



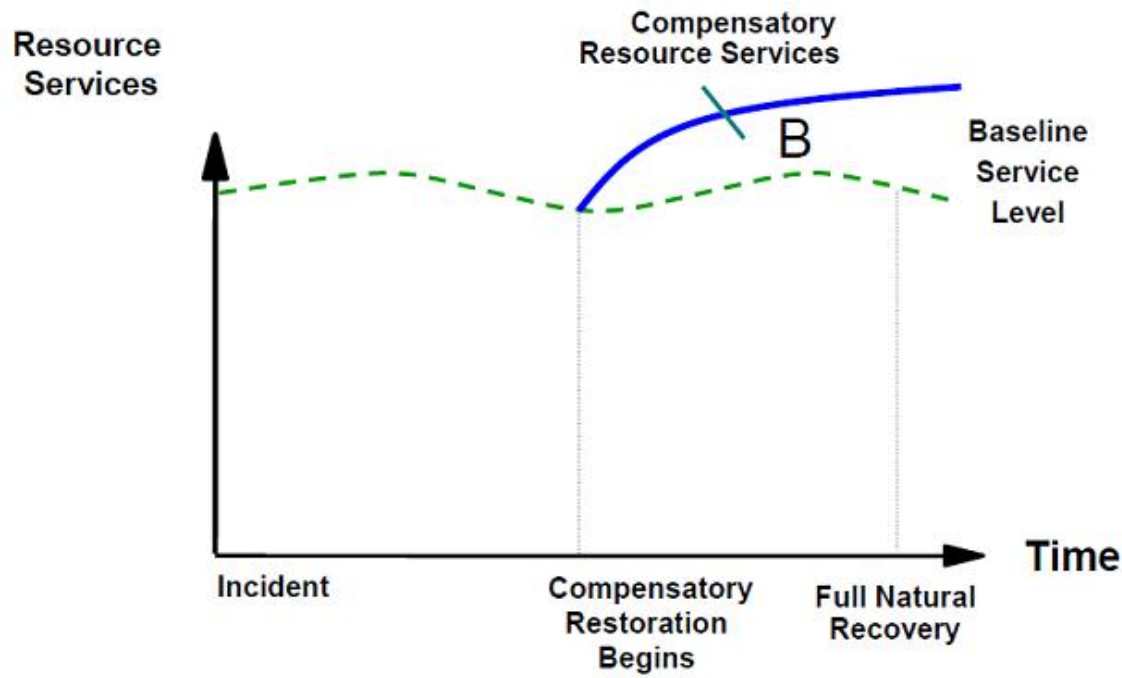
# Ecosystem Service Flows



Source: <http://www.darrp.noaa.gov/economics/> Accessed 12/10/14



# Compensatory Restoration



“The goal of DARRP's economic analyses is to determine the amount of restoration required so that the restoration gain (area B) equals the loss from the injury (area A). The compensation owed to the public can be defined either in dollars or the amount of species or habitat restoration required, depending on the restoration scaling tool used”.

Source: <http://www.darrp.noaa.gov/economics/> Accessed 12/10/14



## Comparison with Millennium Assessment and NOAA's Damage Assessment, Remediation, and Restoration Program (DARRP)

- “DARRP's assessment work quantifies the injuries across these categories of ecosystem services [Millennium Assessment] and determines the type and amount of compensatory restoration projects that will make the public whole for their losses.
- Although the Millennium Ecosystem Assessment focuses on the benefits people derive from ecosystems in their definition of ecosystem services, DARRP's definition instead focuses on services natural resources perform for people *or* for another resource.
- Both definitions aim to encompass those benefits people directly enjoy as a result of natural resources (e.g., food, fuel, timber, recreation) and those services that have more indirect linkages to people, but are nonetheless critical (e.g., nutrient cycling, soil formation)”.

Source: <http://www.darrp.noaa.gov/economics/> Accessed 12/10/14



# NRDA and Millennium Assessment Comparison

	MA	NRDA
Double Counting	Yes	Potentially
Private versus Public Natural Resources	Does not distinguish	Must distinguish
Spatial Extent	None	Trust resources
Valuation Methods  Measure WTP or WTA	Not stated	<ul style="list-style-type: none"><li>• Revealed Preference, Stated Preference, Resource Equivalency Methods</li><li>• Focuses on Restoration Scaling</li><li>• Higher Standards (litigation) for Valuation</li></ul>
Baseline	Implicit	Explicit
Measureable Injury to Resources	No	Yes



# Summary