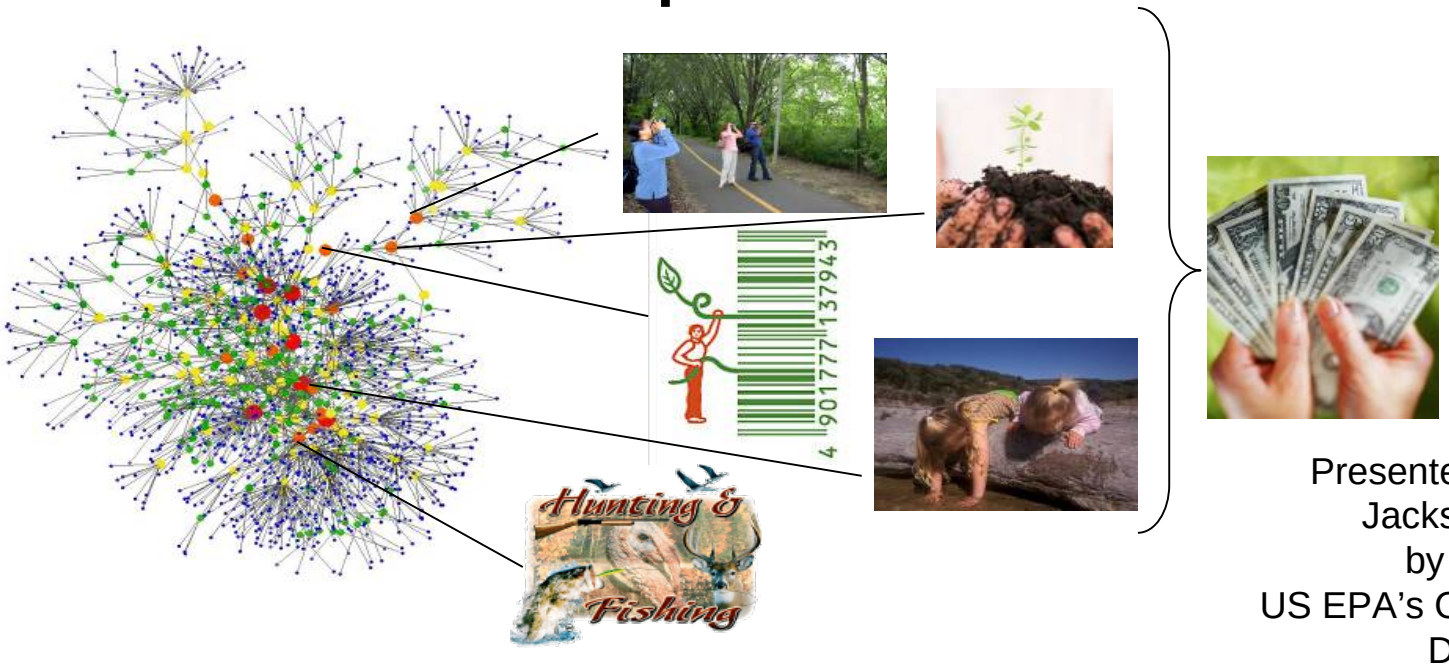
SUSTAINABLE and HEALTHY COMMUNITIES RESEARCH PROGRAM

An operational structured decision making framework for assessing changes in final ecosystem goods and services with consequences to human well-being.



Presented at ACES 2016 in
Jacksonville FL, USA
by Marc Russell
US EPA's Office of Research and Development

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2016 Executive Order - CEQ

Per M-16-01, the "implementation guidance will outline the elements and approaches for integrating consideration of ecosystem services into existing agency decision processes such as:

1. Describing the Federal action
2. Identifying and selecting key ecosystem services
3. Quantifying changes in ecosystem services
4. Valuing the biophysical and socio-economic effects
5. Integrating those effects on ecosystem services into decisions

- Existing frameworks are conceptually sound but decision makers **lack operational methods and tools**
- Methods and tools are required before ecosystem services assessments can become standard practice
- Established approaches (NEPA) would benefit from the incorporation of ecosystem services change assessment with linkages to human well-being
- We propose **an approach and tools** for operationalizing this idea based on:
  - structured decision making (SDM; DASEES)
  - final ecosystem goods and services (FEGS-CS; NESCS; ESML)
  - human well-being index (HWBI)
  - scenario development (H2O; ENVISION)

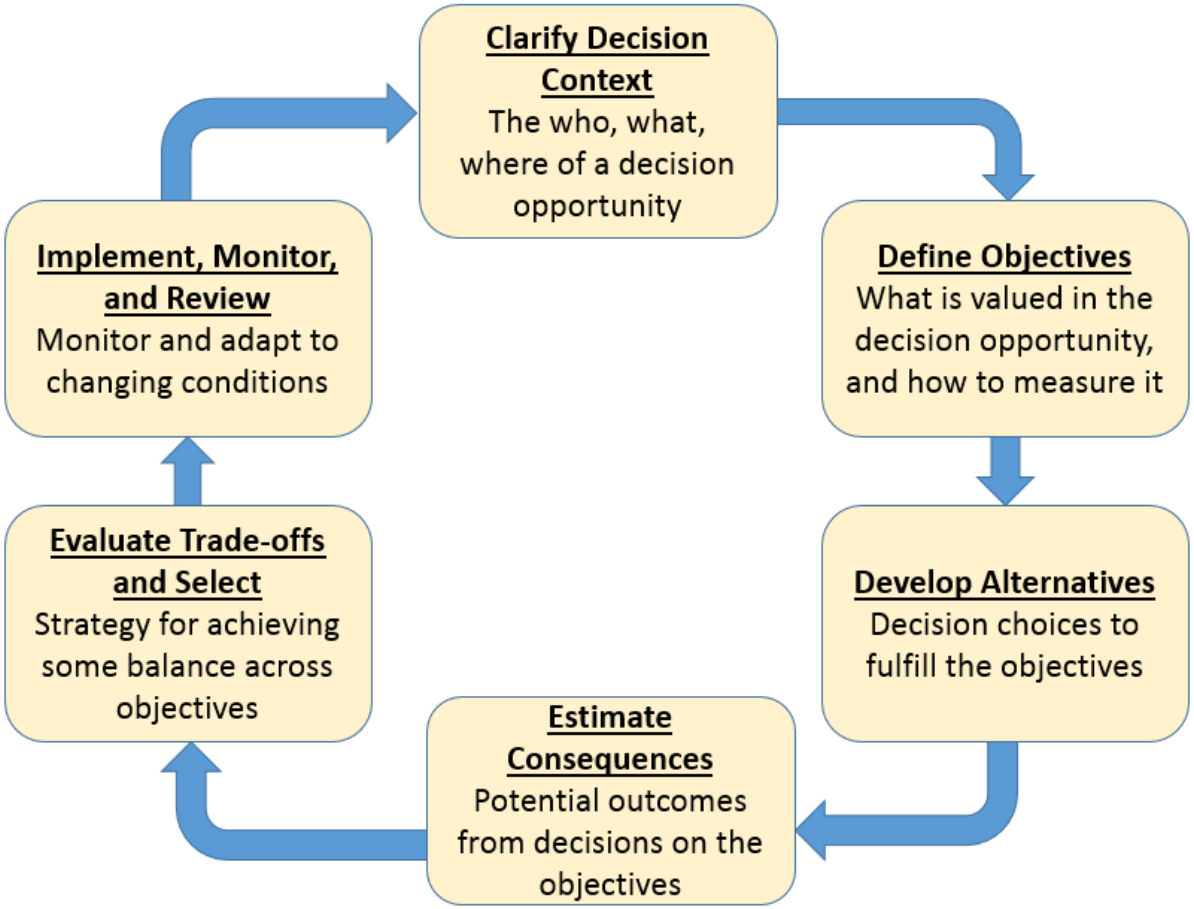


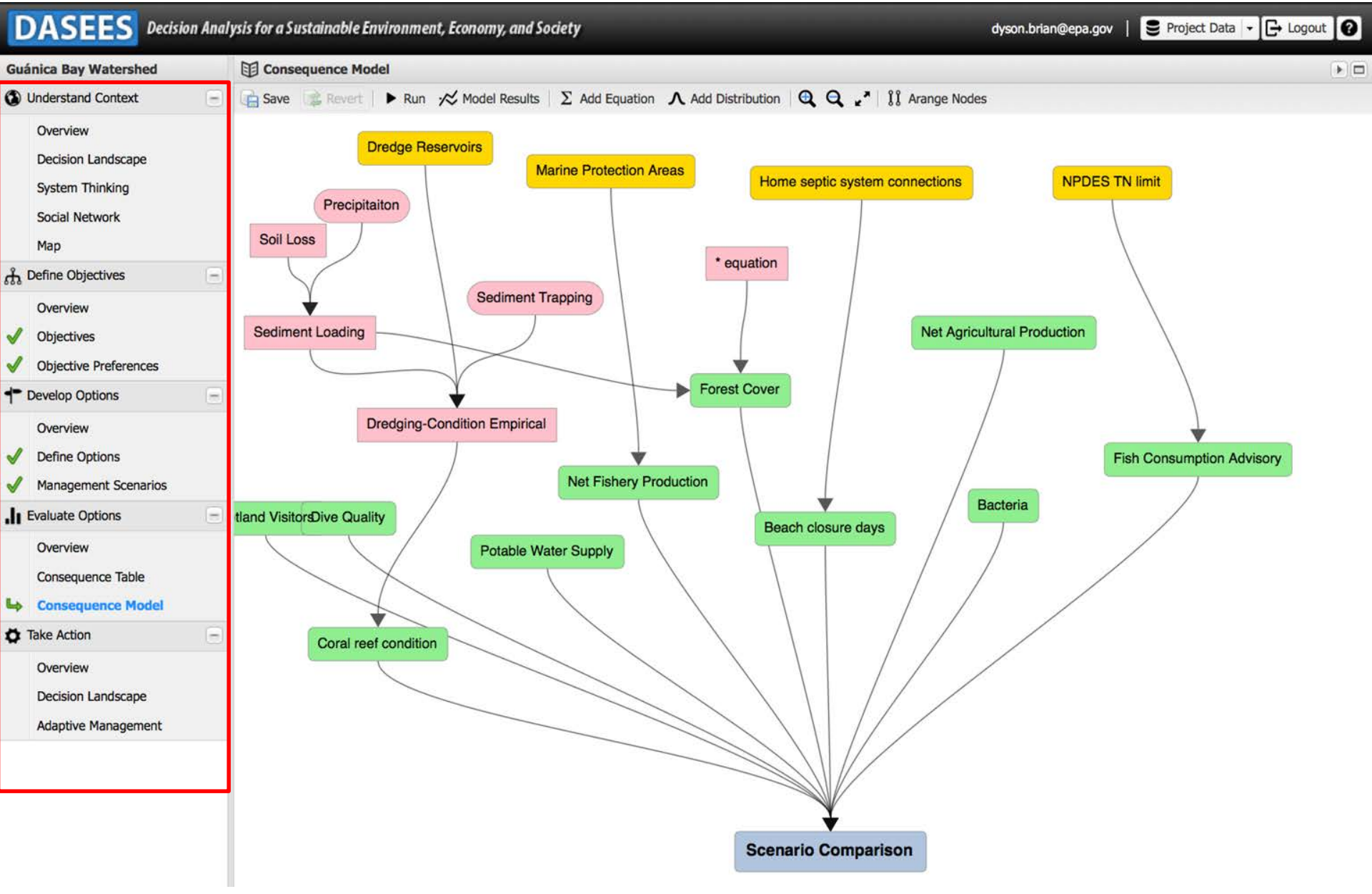
Figure 1. The steps in a generic decision process (NRC 2011; Carriger and Benson 2012; Gregory et al. 2012).

Decision Analysis for a Sustainable Environment, Economy, and Society (DASEES)

Function and Philosophy:

- **Web-based framework supporting stakeholder-driven group decision-making**
- **Organizes use of tools/data/information needed for decision**
- **Includes stakeholder perspectives and tools for analysis and evaluation**

Problem Formulation → Alternative assessment → Selection → Implementation


DASEES
Decision Analysis for a Sustainable Environment, Economy, and Society
dyson.brian@epa.gov
Project Data
Logout
Guánica Bay Watershed
Understand Context
Overview
Decision Landscape
System Thinking
Social Network
Map
Define Objectives
Overview
Objectives
Objective Preferences
Develop Options
Overview
Define Options
Management Scenarios
Evaluate Options
Overview
Consequence Table
Consequence Model
Take Action
Overview
Decision Landscape
Adaptive Management
Consequence Model
Save
Revert
Run
Model Results
Add Equation
Add Distribution
Arange Nodes
Dredge Reservoirs
Marine Protection Areas
Home septic system connections
NPDES TN limit
Precipitaiton
Soil Loss
* equation
Sediment Trapping
Sediment Loading
Net Agricultural Production
Forest Cover
Dredging-Condition Empirical
Fish Consumption Advisory
Net Fishery Production
Bacteria
tland Visitors
Dive Quality
Beach closure days
Potable Water Supply
Coral reef condition
Scenario Comparison

1) Identify decision context and beneficiaries:
   - Structured decision making (SDM; DASEES)
   - Final ecosystem goods & services classification system (FEGS-CS or NESCS)

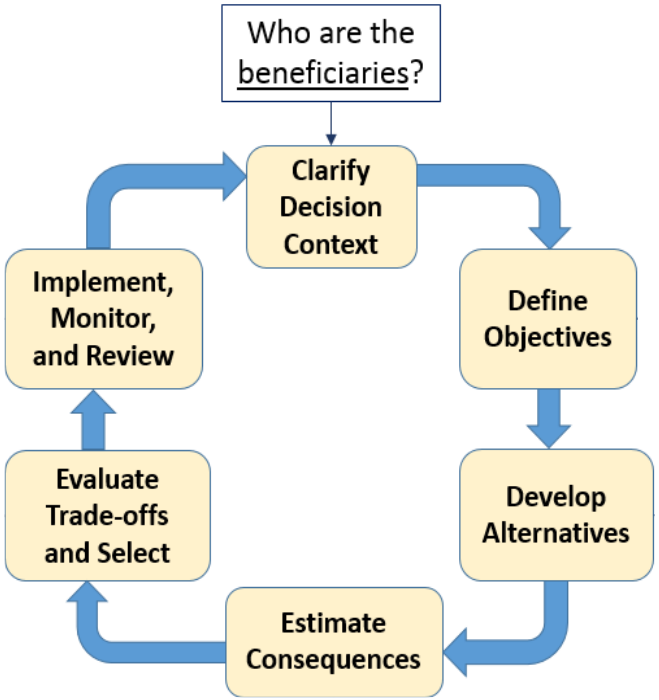
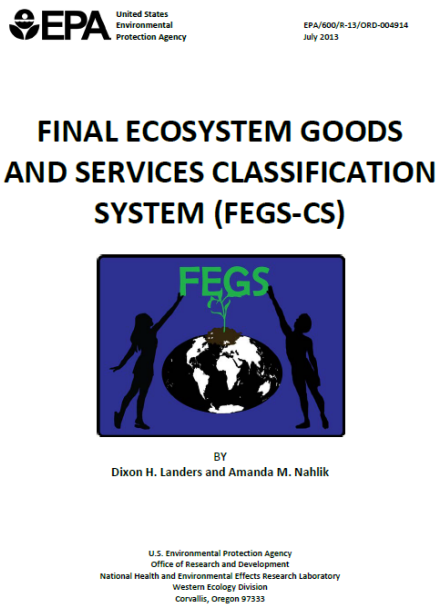


Figure 2. Integrating FEGS approaches into a generic decision process.

"components of nature, directly enjoyed, consumed, or used to yield human well-being" *(Boyd & Banzhaf 2007)*

Environmental Class + Beneficiary → FEGS class

FEGS-CS Published EPA Report: EPA/600/R-13/ORD-004914. Interactive FEGS-CS website at http://gispub4.epa.gov/FEGS


EPA United States Environmental Protection Agency

EPA/600/R-13/ORD-004914
July 2013

FINAL ECOSYSTEM GOODS AND SERVICES CLASSIFICATION SYSTEM (FEGS-CS)

FEGS

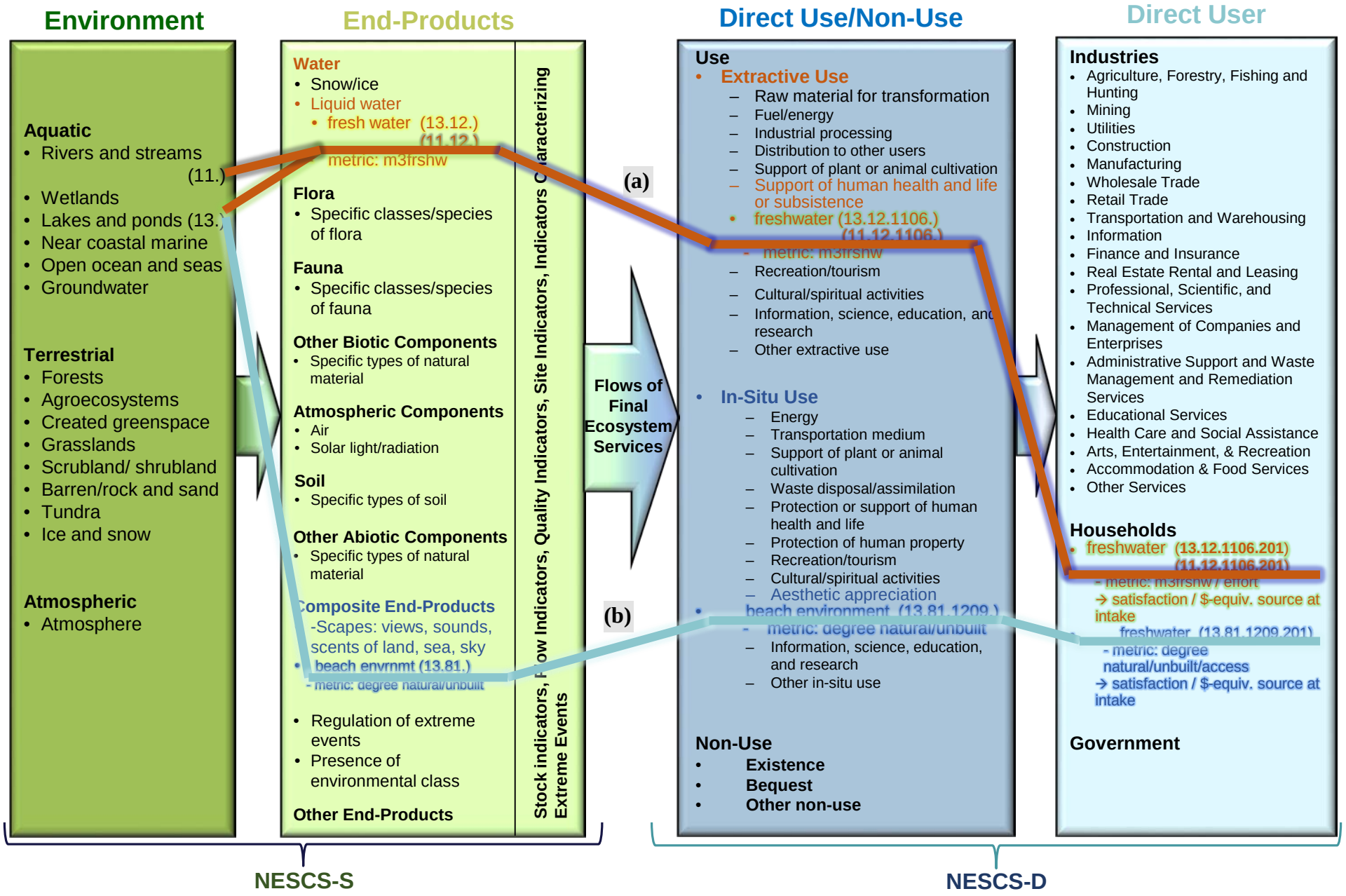
BY
Dixon H. Landers and Amanda M. Nahlik

U.S. Environmental Protection Agency
Office of Research and Development
National Health and Environmental Effects Research Laboratory
Western Ecology Division
Corvallis, Oregon 97333

4-Group NESCS Structure – "Wiring Diagram" with Proposed Metrics By Group

Example: (a) lake, river, or stream water for drinking – m³ fresh water for Households (13.12.1106.201)

(b) same water in beach viewing environment – degree natural/unbuilt for Beach Goers (13.81.1209.201)



2) Weight objectives and identify metrics:

- Determine stakeholder relative priorities for domains in the Human Well-Being Index (HWBI)
- Identify beneficiary-relevant metrics for FEGS using either the National Ecosystem Services (NESCS) or Final Ecosystem Goods and Services Classification Systems (FEGS-CS)

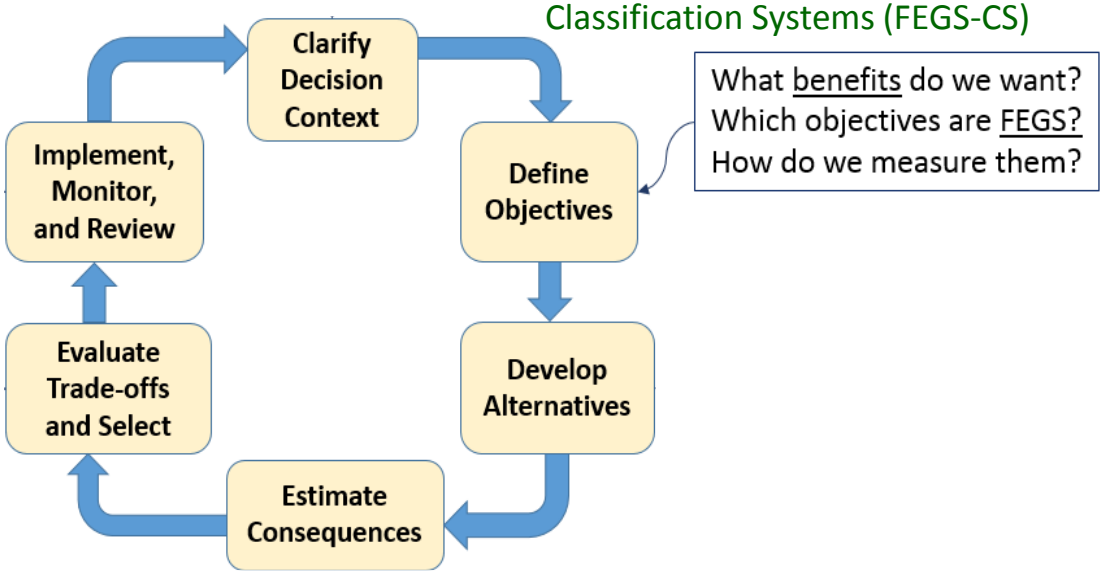
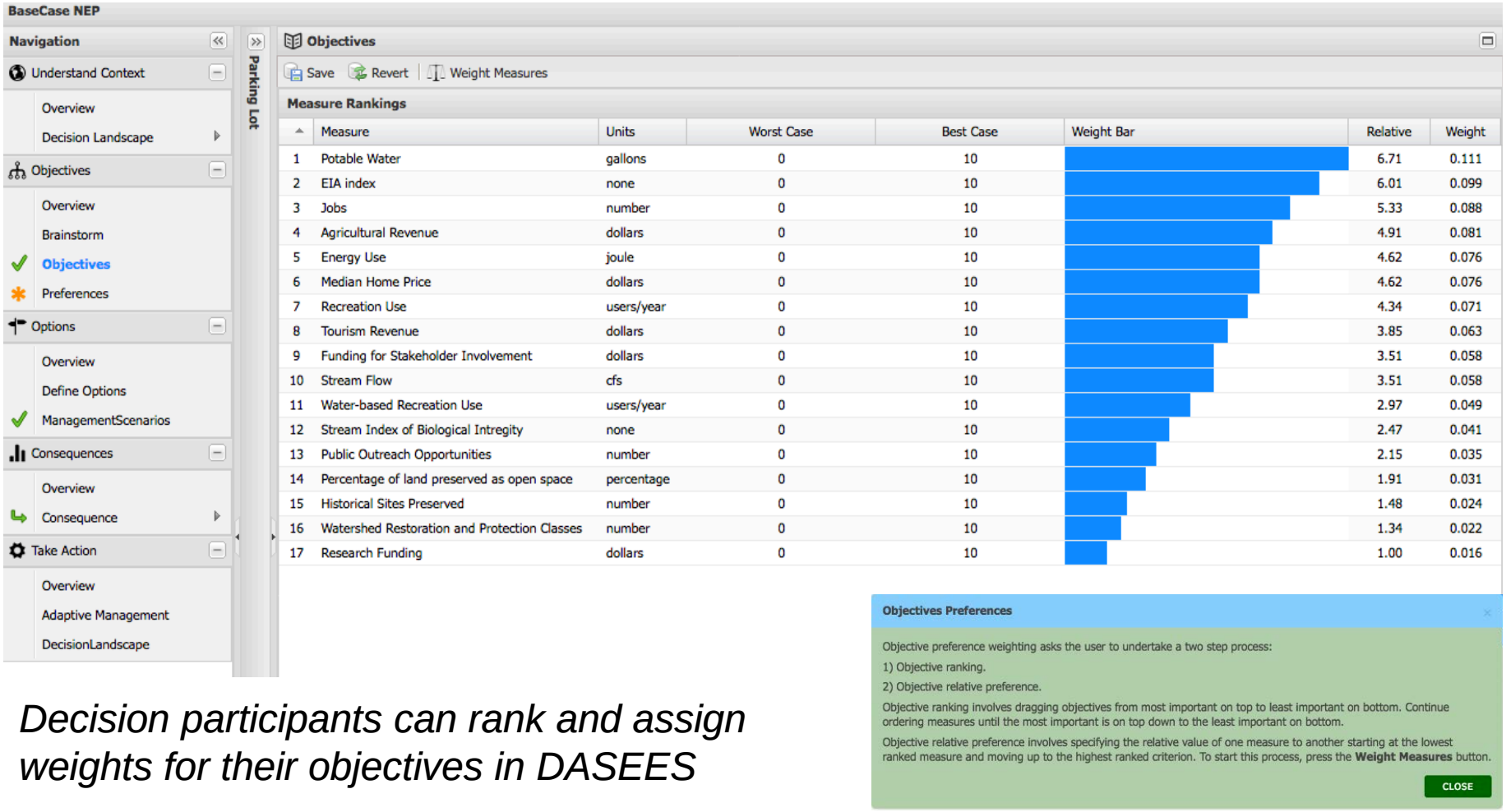


Figure 2. Integrating FEGS approaches into a generic decision process.

Value-focused decision making places a much stronger emphasis on defining objectives before defining alternatives (Keeney 1992).



Decision participants can rank and assign weights for their objectives in DASEES

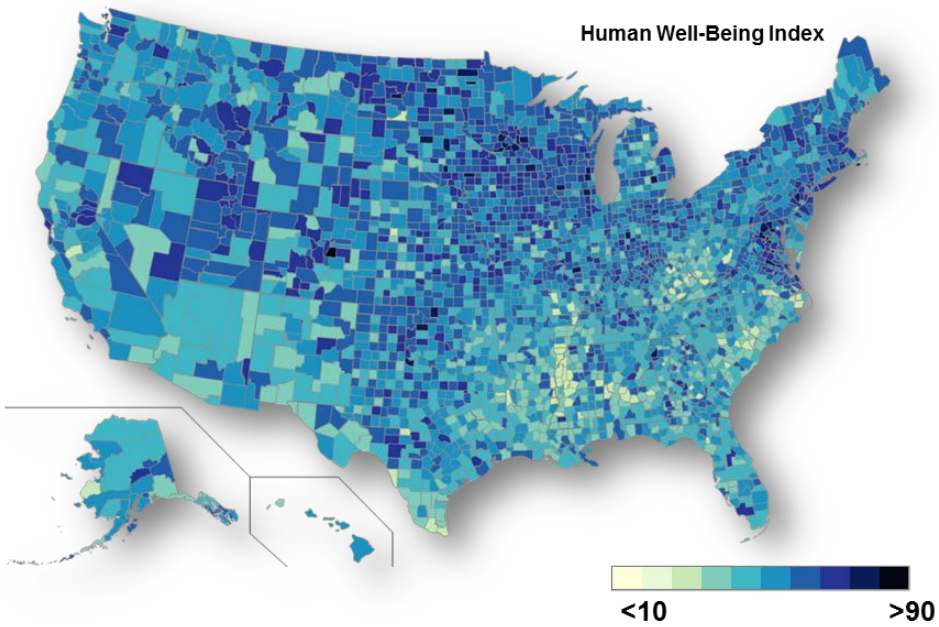
The Human Well-Being Index (HWBI)

- Assess how ecosystem, economics, and social services influence eight well-being domains:

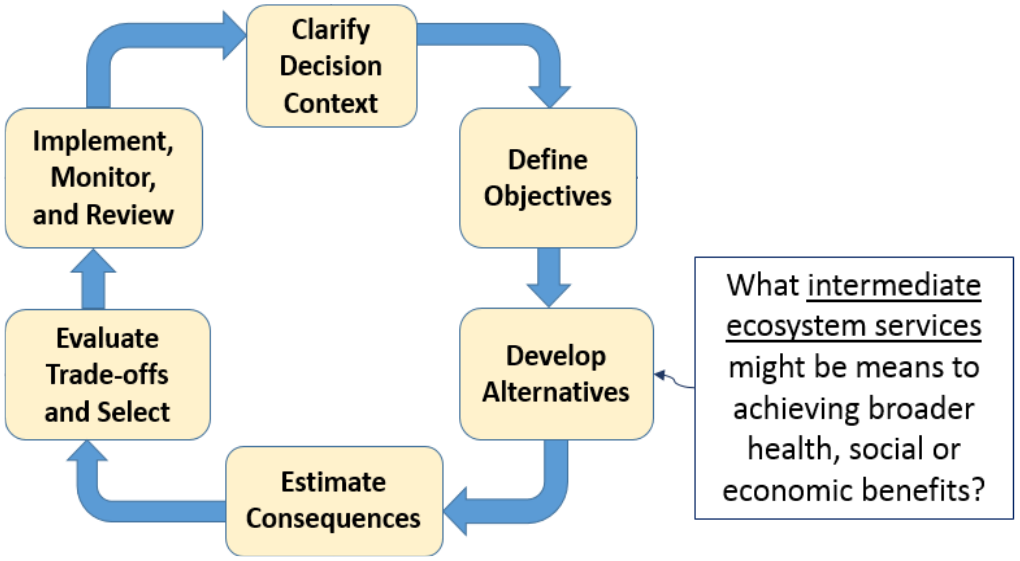
  1) social cohesion, 2) living standards, 3) education, 4) leisure time, 5) connection to nature, 6) safety and security, 7) health, and 8) cultural fulfillment (Smith et al. 2012)

- HWBI encourages stakeholders to characterize what fundamentally matters to them (Fulford et al. 2016)

Demonstration of HWBI Approach



- HWBI metrics useful as performance measures for comparing decision options
- Relative values of stakeholders can be applied to weight decision alternatives during tradeoff analysis



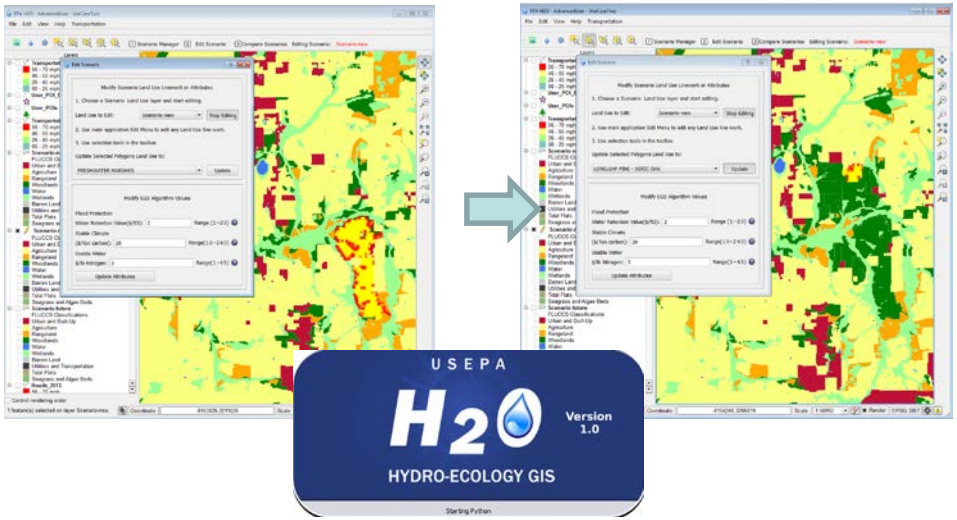
3) Develop alternative future scenarios

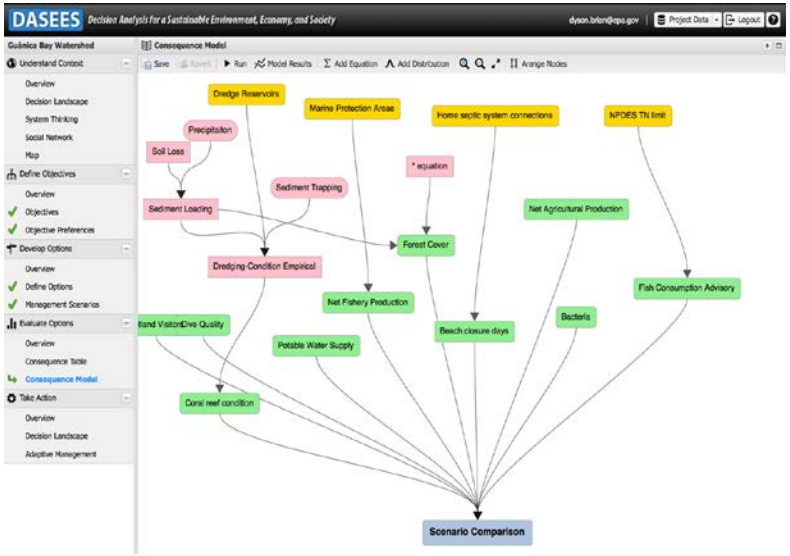
Figure 2. Integrating FEGS approaches into a generic decision process.

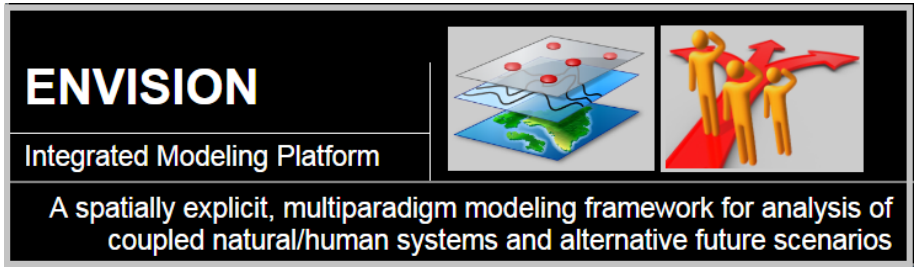
Scenarios need to address and define the inputs into ecological production functions

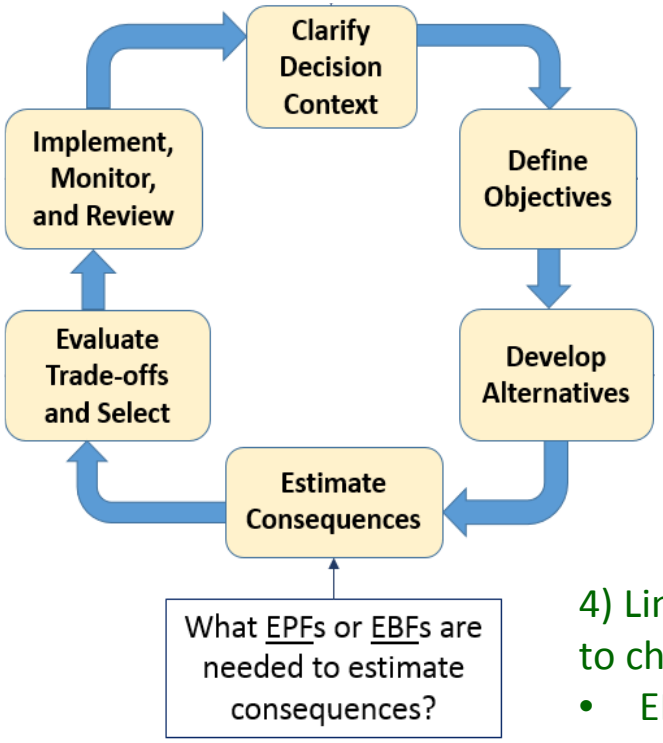
Ways to generate alternative-future scenarios:

- story boarding
- conceptual modeling
- participatory development
- empirical and simulation modeling





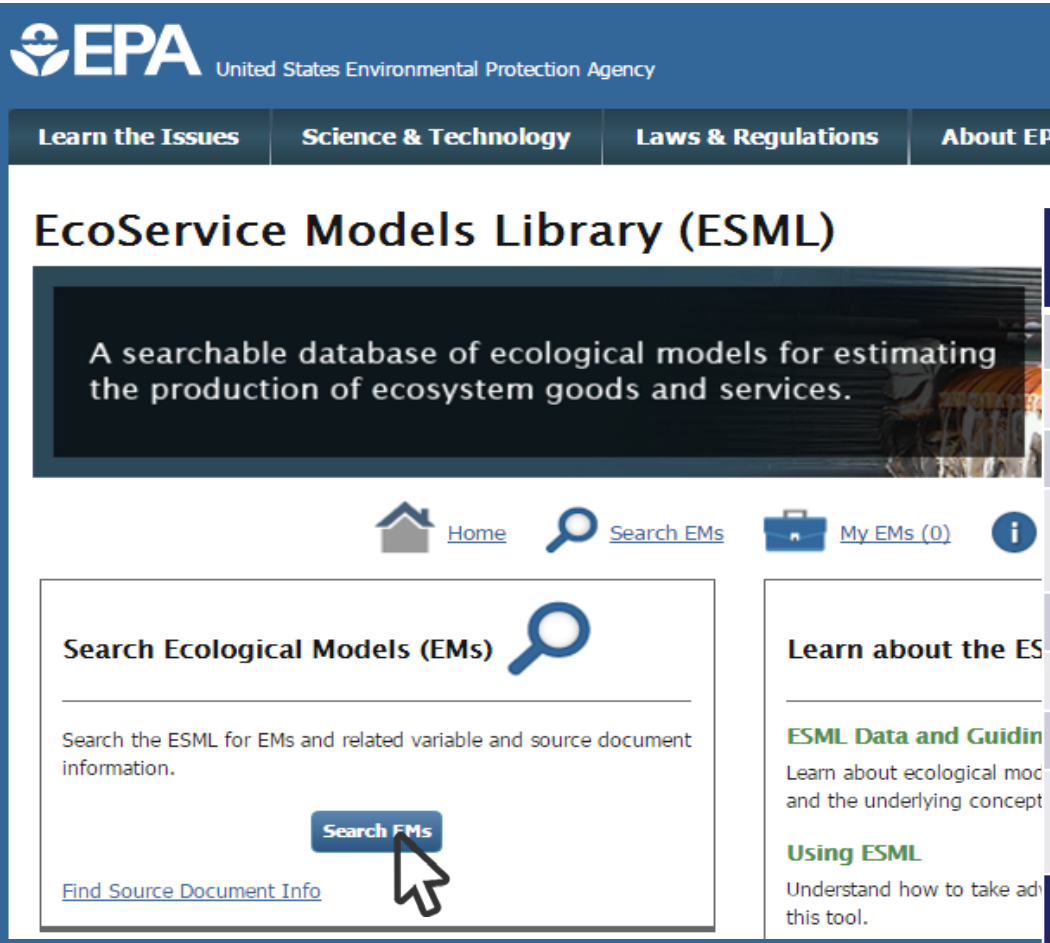




4) Link decision alternatives to changes in FEGS

- EPF's in the EcoService Models Library (ESML)

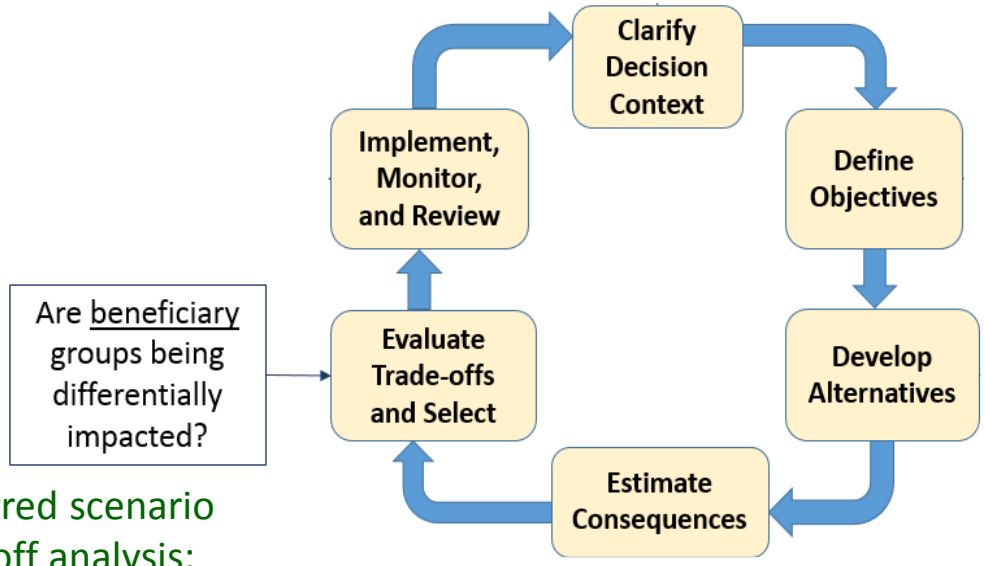
Figure 2. Integrating FEGS approaches into a generic decision process.



Model (application) source	Current content
ARIES	6
EnviroAtlas	6
Envision	3
EU Effort to Map Services	25
i-Tree Suite	6
InVEST Tools	16
US EPA	26
Other (e.g., ecological literature)	18
CURRENT TOTAL	**98 (some categories overlap)**

Ecological production functions (EPFs):

"usable expressions (i.e., **models**) of the **processes by which ecosystems produce ecosystem services**, often including external influences on those processes" (Bruins et al. 2016).



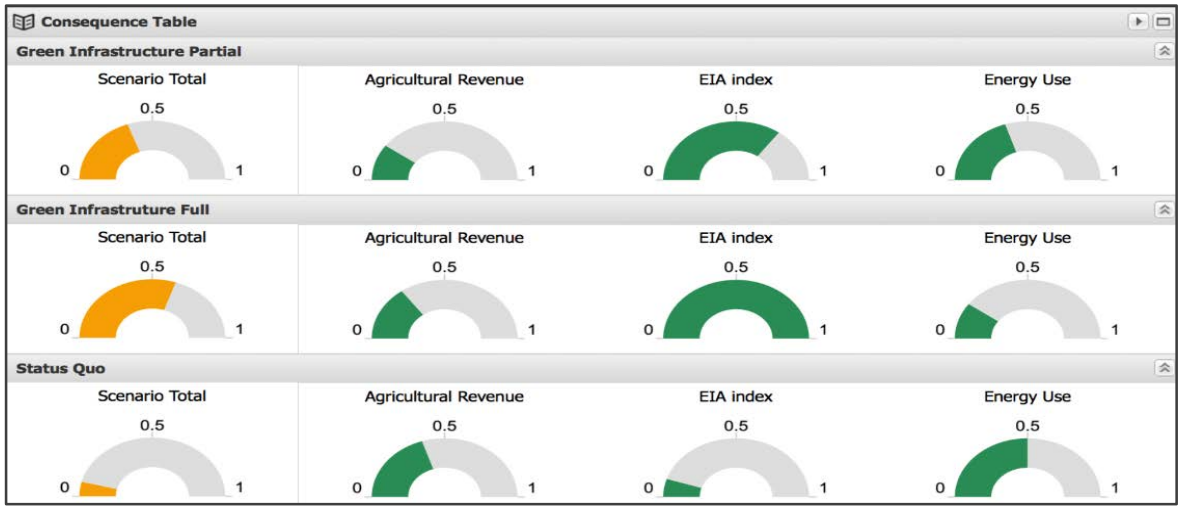
5) Select preferred scenario through trade-off analysis:

- How changes in FEGS affect well-being of beneficiaries and community for each scenario
  - DASEES
  - HWBI

Figure 2. Integrating FEGS approaches into a generic decision process.

A **decision analysis approach** requires exploring tradeoffs among the objectives (Keeney 1992).

Tradeoffs can be quantified, but their role should be to provide greater insight into the deliberation process, not prescribe an optimal solution or approach (Gregory et al. 2012).



The DASEES system can help decision makers to compare alternatives with a consequence table, and provides tools for assigning relative values to different stakeholder objectives.

Clear measures of human benefit that consider all important services to people from the ecosystem are a critical end point of best practices for FEGS-based decision making (Olander et al. 2015).

- **The Human Well-Being Index (HWBI),**
  - Defined in terms of how ecosystem, economics, and social services influence eight well-being domains
  - Encourages stakeholders to think beyond economic goals and to characterize what fundamentally matters to them (Fulford et al. 2016).
  - Metrics and indicators of the HWBI represent good examples of performance measures for comparing decision options.
  - Relative values of stakeholders for the domains of the HWBI can weight decision alternatives during tradeoff analysis.

6) Implement the selection and monitor changes in ecosystem status and human well-being:

- FEGS metrics/indicators
- HWBI
- DASEES

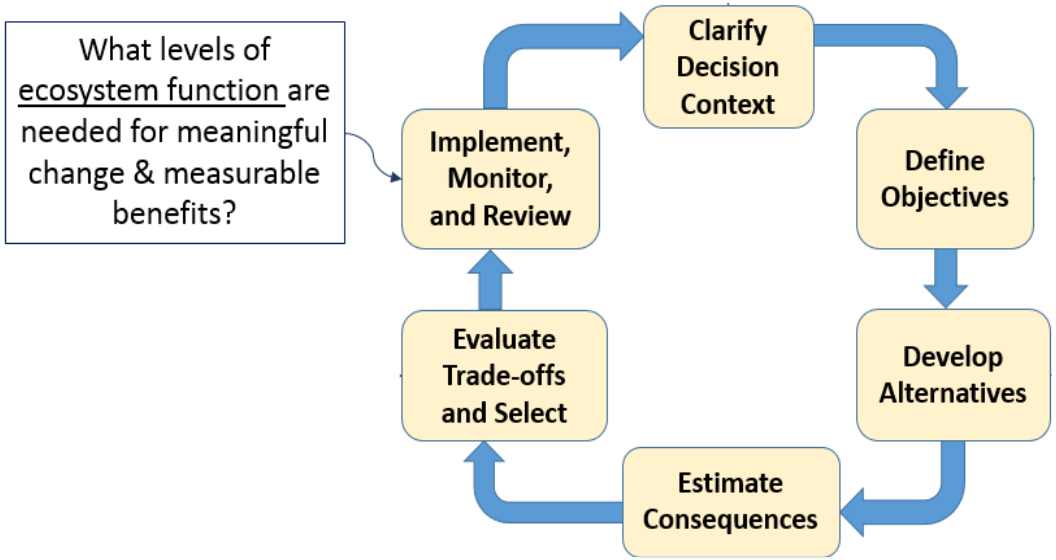
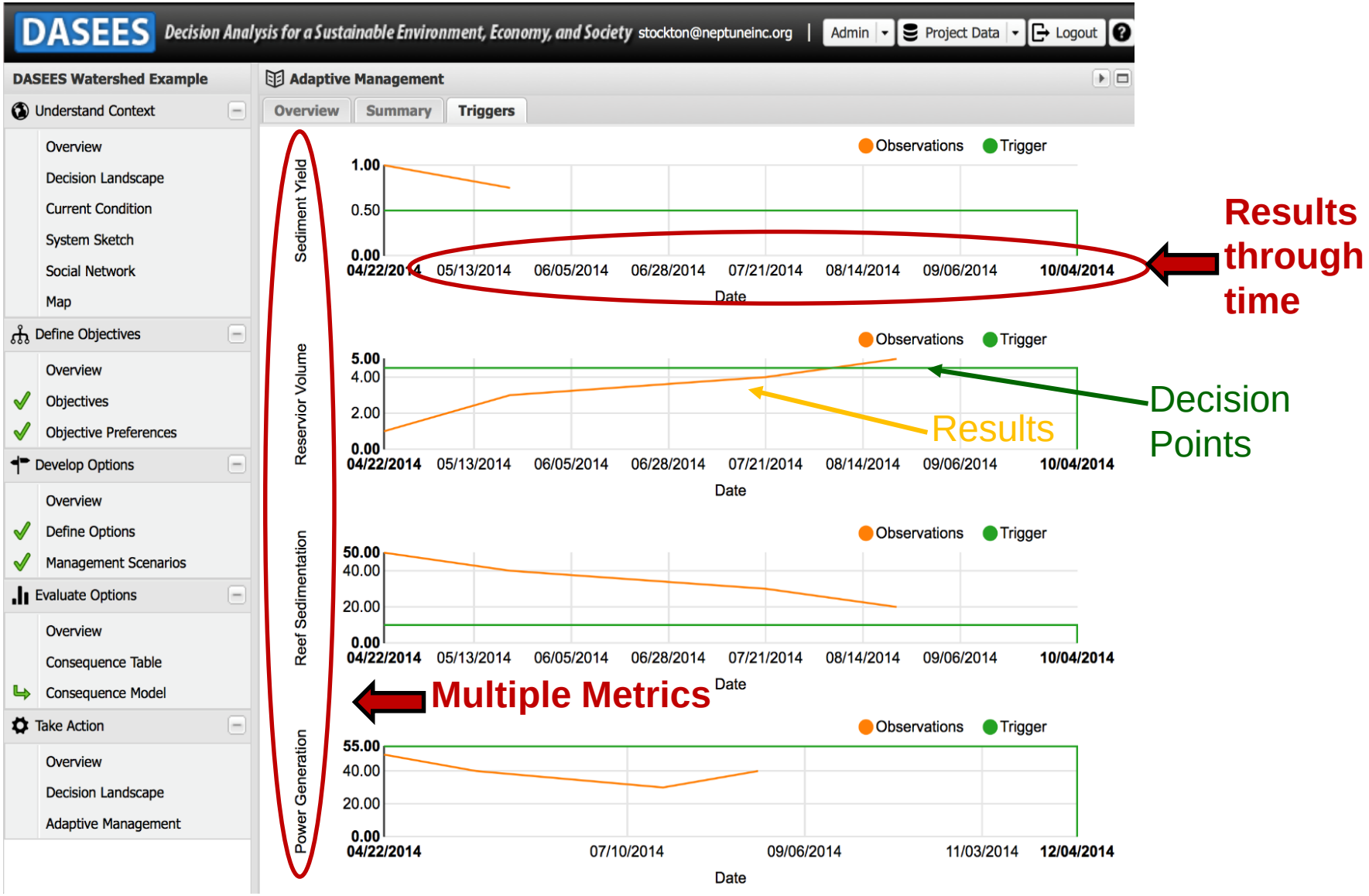


Figure 2. Integrating FEGS approaches into a generic decision process.


DASEES
Decision Analysis for a Sustainable Environment, Economy, and Society
stockton@neptuneinc.org
Admin
Project Data
Logout
DASEES Watershed Example
Understand Context
Overview
Decision Landscape
Current Condition
System Sketch
Social Network
Map
Define Objectives
Overview
Objectives
Objective Preferences
Develop Options
Overview
Define Options
Management Scenarios
Evaluate Options
Overview
Consequence Table
Consequence Model
Take Action
Overview
Decision Landscape
Adaptive Management
Adaptive Management
Overview
Summary
Triggers
Sediment Yield
Reservoir Volume
Reef Sedimentation
Power Generation
Observations
Trigger
Date
Results through time
Decision Points
Results
Multiple Metrics

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DASEES
http://beta.dasees.org
ESML Beta sign up
https://esml.epa.gov/epf_l/public/signup
HWBI
https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=318653

FEGS-CS Published EPA Report: EPA/600/R-13/ORD-004914

Interactive FEGS-CS website at http://gispub4.epa.gov/FEGS

NESCS Published EPA Report: EPA-800-R-15-002
http://www.epa.gov/eco-research/ecosystems-services
EPA H2O – Scenario Assessment Tool
https://www.epa.gov/water-research/ecosystem-services-scenario-assessment-using-epa-h2o