Development of a BLM National Aquatic Monitoring Program

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BLM
AIM – Assessment, Inventory, and Monitoring

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Background

BLM's mission:

To sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations

Background

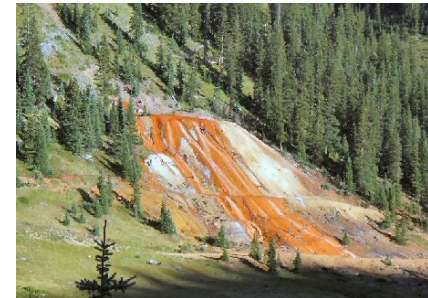*Management objectives: Fisheries, Riparian & SWA*

Background

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*Management objectives: Fisheries, Riparian & SWA*

Background

Common goal of Fisheries, Riparian and SWA Programs:

Protect, restore and maintain the chemical, physical and biological integrity of freshwater resources for present and future generations
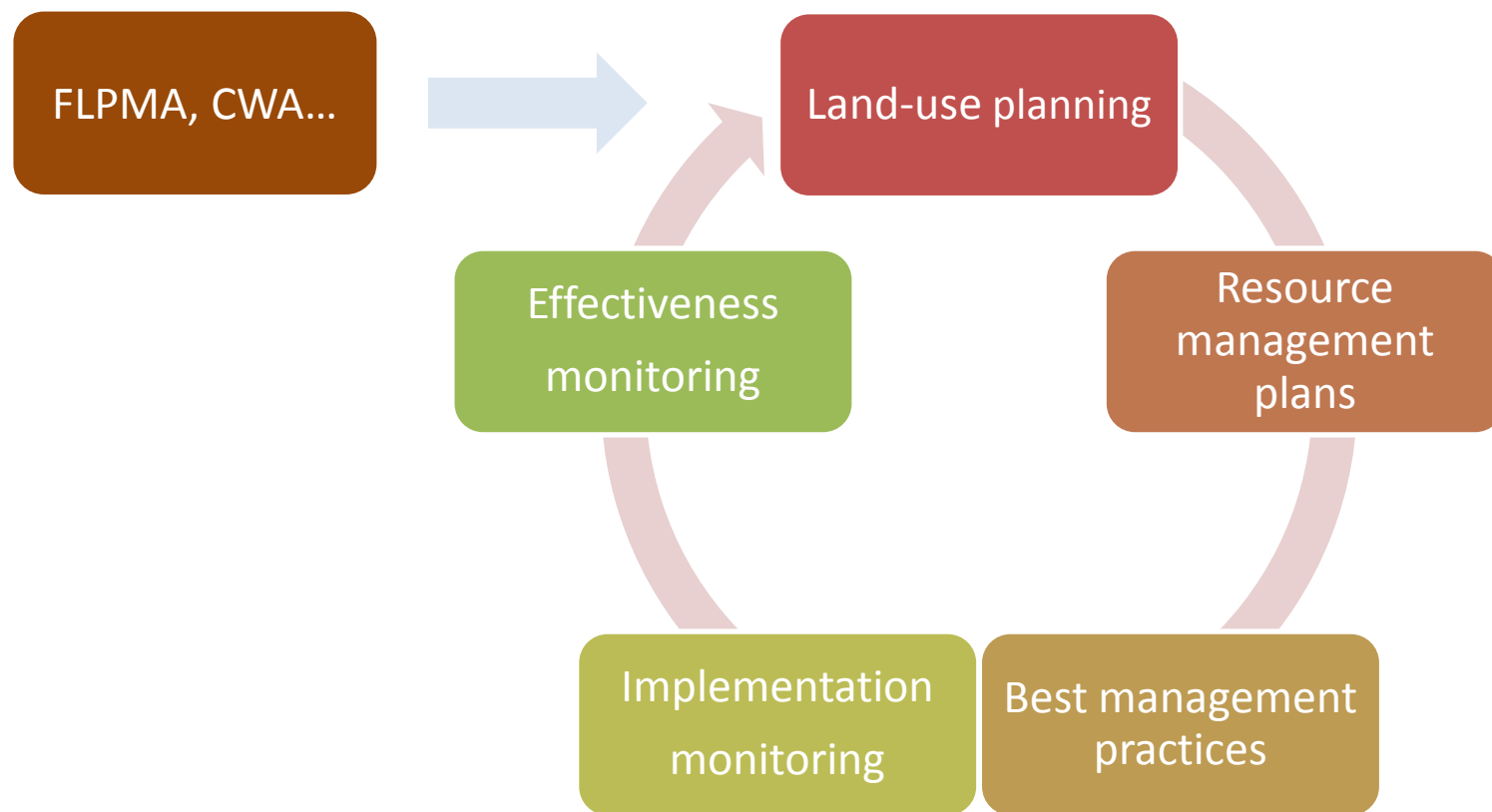
Background

- BLM oversees > 250,000 km of perennial streams and rivers (12 Western states including AK)
    - Linear stream km = 5 x Earth's equatorial circumference

45,075 km
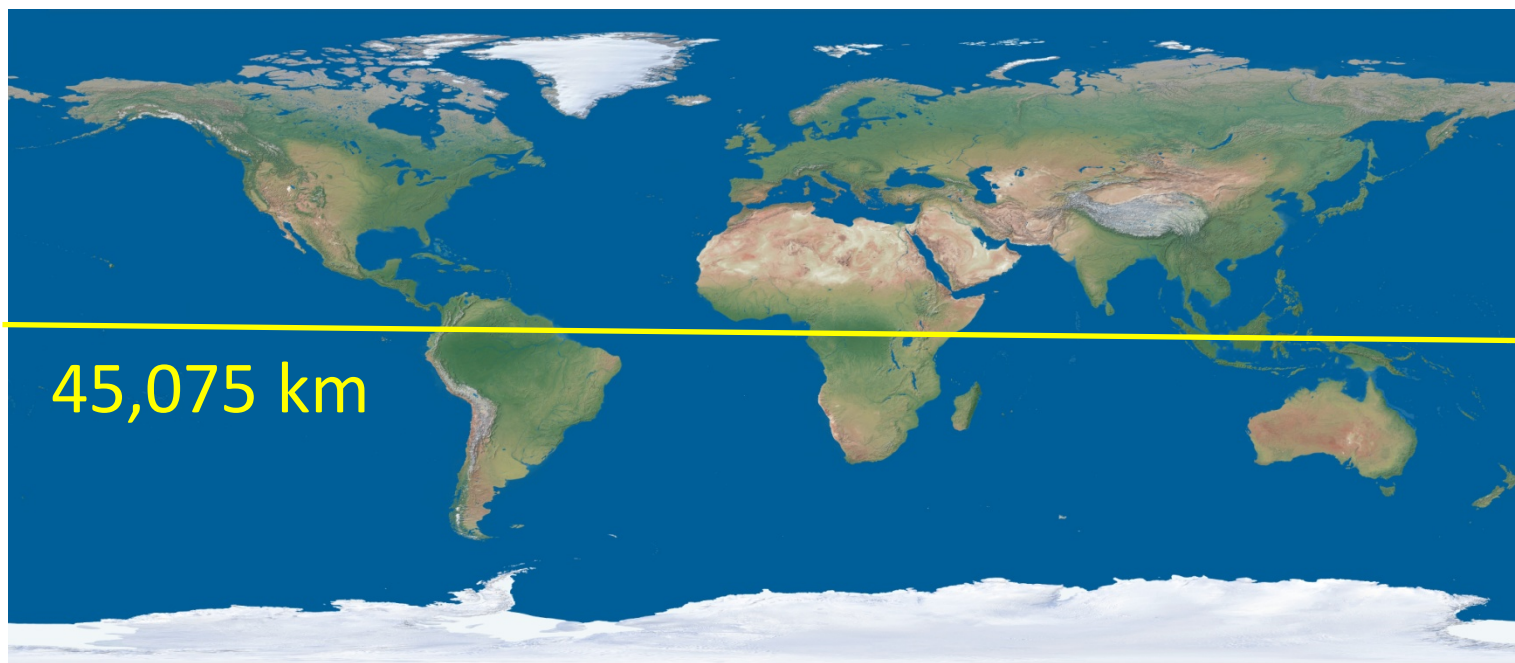
Background

Management objectives driven by policy and achieved through the planning process:

FLPMA, CWA...

Land-use planning

Resource management plans

Best management practices

Implementation monitoring

Effectiveness monitoring

Background

- Monitoring (status, trend and effectiveness) is critical because it provides us with information regarding:

    o Resource extent (inventory)

    o Condition and trend

    o Compliance

    o Stressor identification

    o Treatment/BMP effectiveness

Background

- Example tools to ensure compliance with FLPMA and CWA mandates:
  - PFC
  - MIM
  - Macroinvertebrates
  - Water quality monitoring

- But…
  - PFC: qualitative and not a monitoring tool
  - MIM: not inclusive of all management elements (chemical, physical and biological)
  - Macroinvertebrates and water quality: disparate sampling methodologies and interpretation challenges
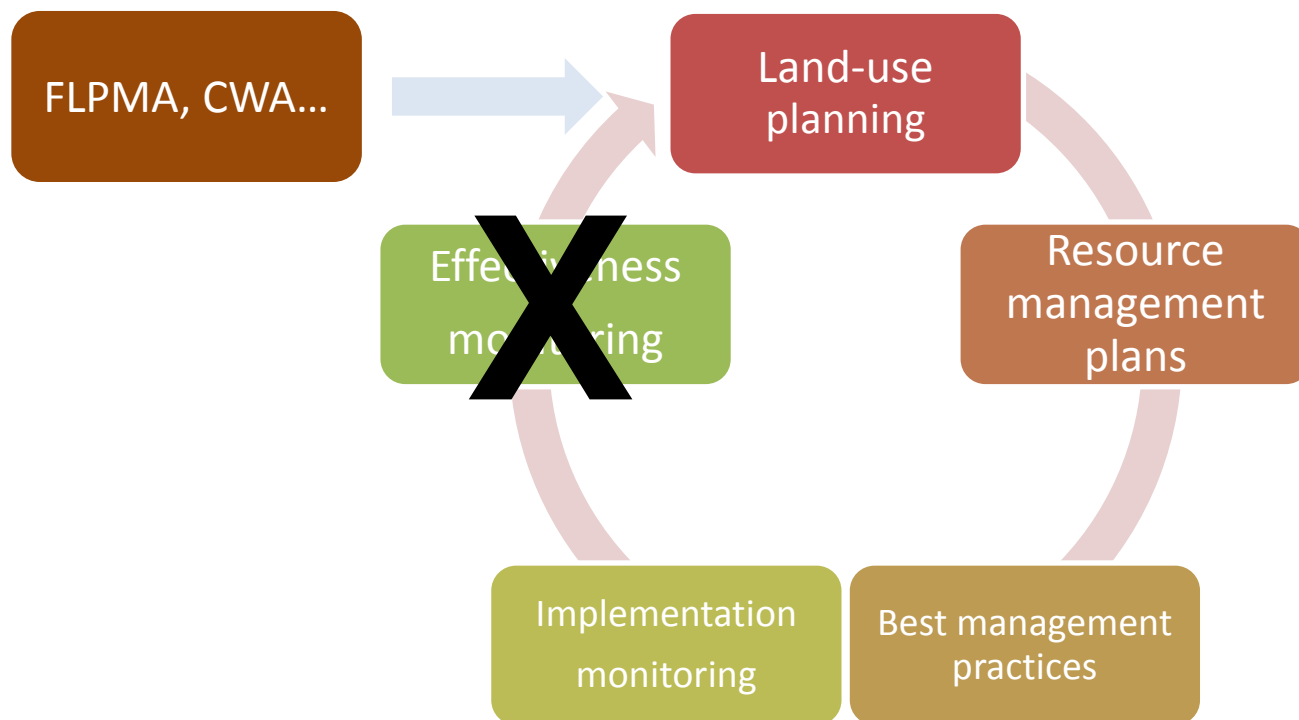
Background

- Problem:
  - o BLM has no interdisciplinary monitoring strategy to determine what, how, when or where different aquatic or riparian indicators are measured and used to make status and trend determinations

- Consequences:
  - o Data collection methodologies not standardized
  - o Data cannot be integrated within or among agencies
  - o Limited scope of inference – largely reach based
  - o Frequently not making data-driven mngt. decisions

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Background

- Consequences:
  - o Are we compliant with federal and state regulations...?
  - o What is the effectiveness of BMP…?
  - o Collaboration and partnerships…

FLPMA, CWA...

Land-use planning

Resource management plans

Effectiveness monitoring

Best management practices

Implementation monitoring

X

BLM – AIM Strategy

- Motivation for change:
  - Non-compliance with federal regulations
  - Increasing litigation
  - Landscape-scale management challenges and the advent of various landscape-scale initiatives
  - OMB report regarding BLM's terrestrial monitoring

- BLM's Assessment, Inventory and Monitoring Strategy coming to fruition!

BLM – AIM Strategy

- Central tenants of the AIM Strategy:
  - o Quantitative core indicators and methodologies
    - Supplemental indicators
  - o Statistically valid sampling frameworks
  - o Integration of remote sensing technologies
  - o Data acquisition and management plans

- Fundamental objectives:
  - o Document the distribution and abundance of natural resources on public lands
  - o Determine resource conditions
  - o Identify natural resource trend or change

BLM – AIM Strategy

- Terrestrial core indicators, sampling methodologies and survey design established and actively implemented in numerous demonstration projects
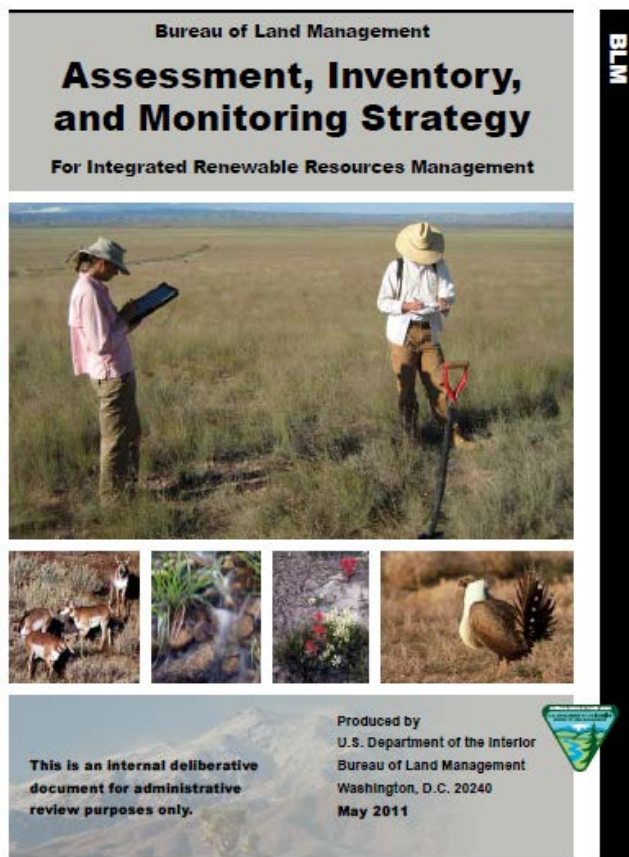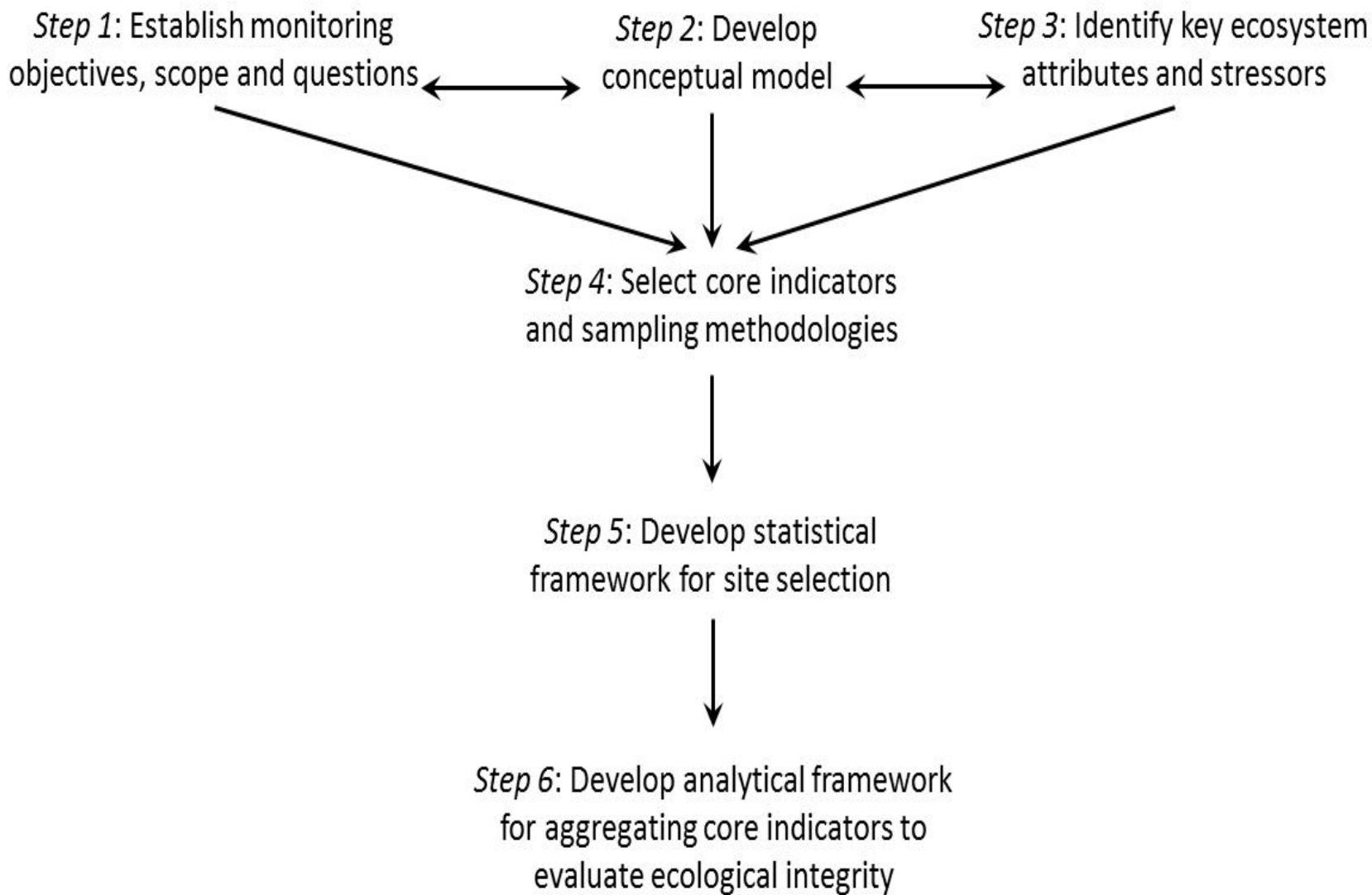
BLM - National Aquatic Monitoring Program

- Aquatic corollary to AIM:
  - Oct. 2011: BLM working group established
  - External science advisory team (USGS, EPA, NPS, USFS, academics)

- Objectives:
  - Quantitative aquatic core indicators and methodologies
  - Statistically valid sampling frameworks
  - Integration of remote sensing technologies…?
  - Data acquisition and management plans

- Will be developed through application of a six step process

Road map for developing BLM's NAMP

Step 1: Establish monitoring objectives, scope and questions

Step 2: Develop conceptual model

Step 3: Identify key ecosystem attributes and stressors

Step 4: Select core indicators and sampling methodologies

Step 5: Develop statistical framework for site selection

Step 6: Develop analytical framework for aggregating core indicators to evaluate ecological integrity

NAMP - Step 1: Scope, objectives and questions

- *Objective(s)*: to provide the BLM and its partners with quantitative, defensible information needed to understand the condition and trend of lotic ecosystems

- *Scope/extent*: multiple scales (e.g., stream segment, allotment, field office, state, national), but greatest extent is national level inference

- *Target population*: all perennial, wadeable streams and associated riparian areas on BLM lands

- *Type of monitoring*: status, trend and effectiveness

- *Monitoring questions:*
  - Are key processes (hydrologic, geomorphic, biogeochemical, biological) that sustain functioning riparian and stream systems intact?

  - What stressors are present and what are their relative risks to perennial stream and riparian systems?

  - Has the state or condition of key aquatic indicators shifted in a direction indicating improved or degraded condition through time?

NAMP - Step 2: Conceptual model
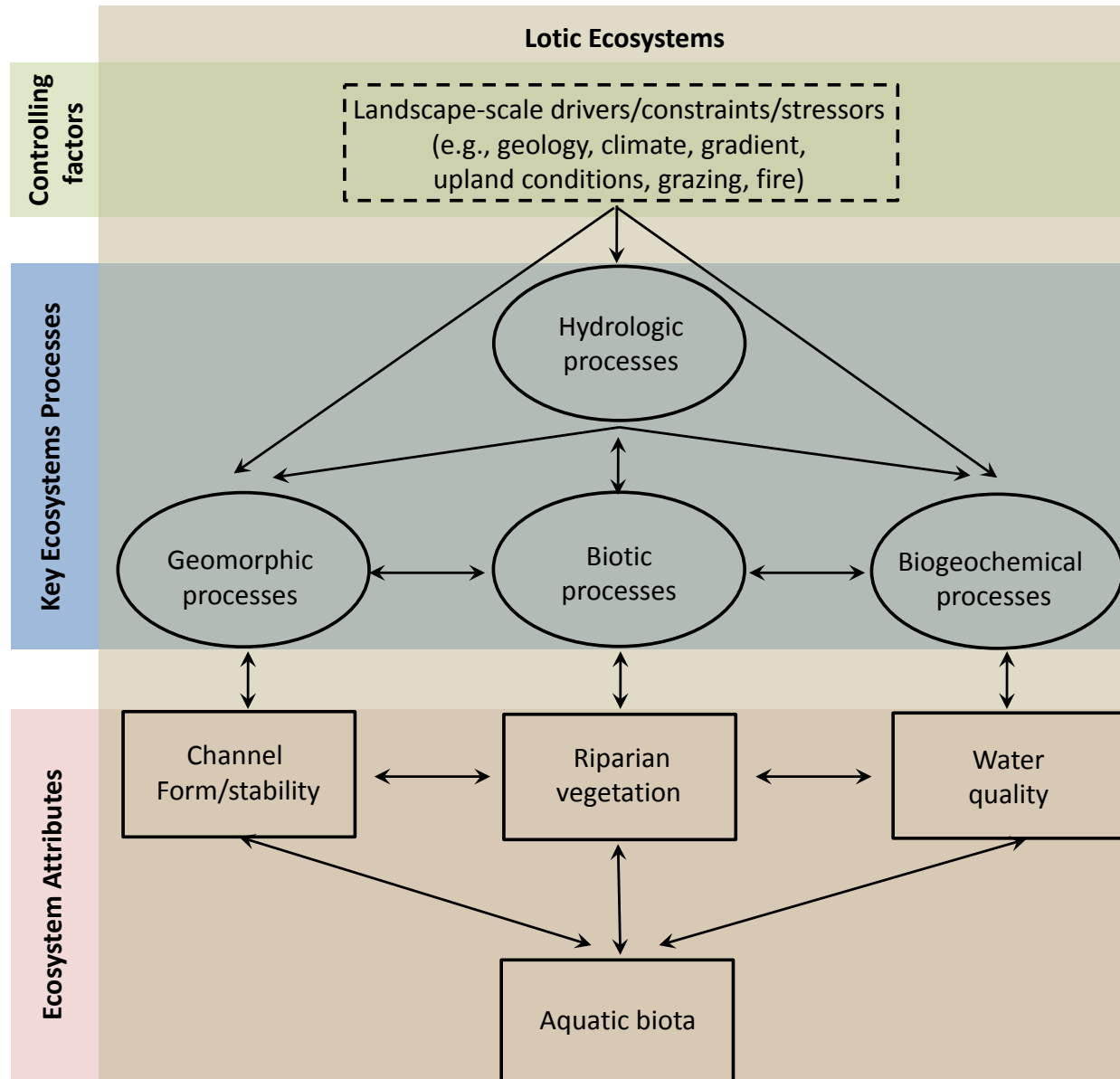
NAMP - Step 3: Ecosystem attributes and stressors
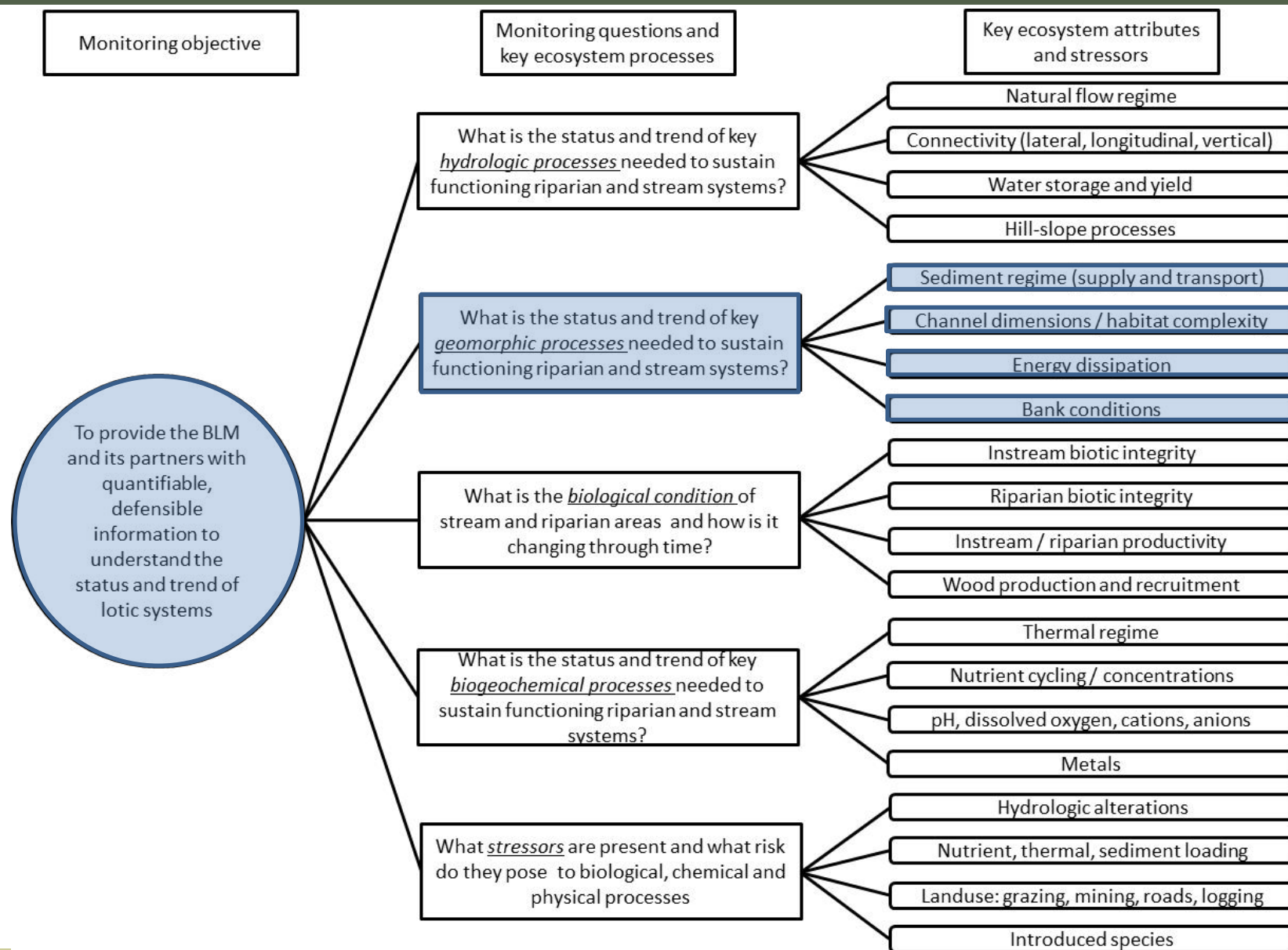
NAMP - Step 4: Select aquatic core indicators

- *Aquatic core indicators*: structural or functional measures that either directly or indirectly quantify the condition of critical ecosystem processes and/or attributes

- Would like to directly measure key processes/attributes, but their inherent complexity = need surrogates

- Developed four phase process for identifying scientifically defensible ACI

NAMP - Step 4: Select aquatic core indicators
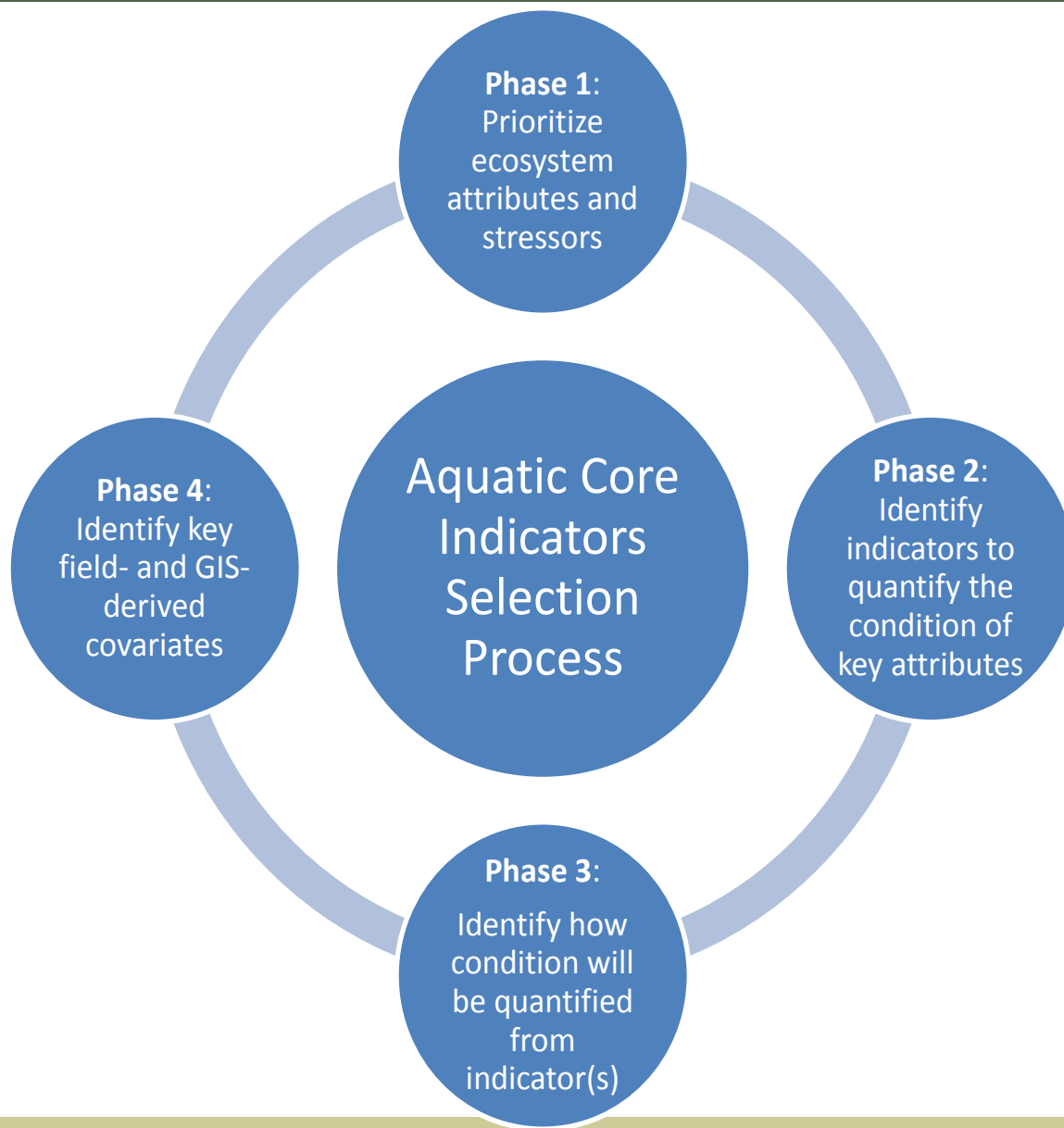
NAMP - Step 4: Select aquatic core indicators

- *Phase 1 – prioritize ecosystem attributes*: survey of state leads and FO personnel

- *Phase 2 – ACI selection*: survey of indicators used in existing monitoring programs; FO feedback; workshop to prioritize indicators based on selection criteria:
  - o Minimal observer bias
  - o Documented relationship to attribute(s)/processes
  - o Responsive at relevant time-scales
  - o Cost
  - o Used by multiple agencies

- *Phase 3 – Status determinations*: workshop with science advisory team and others
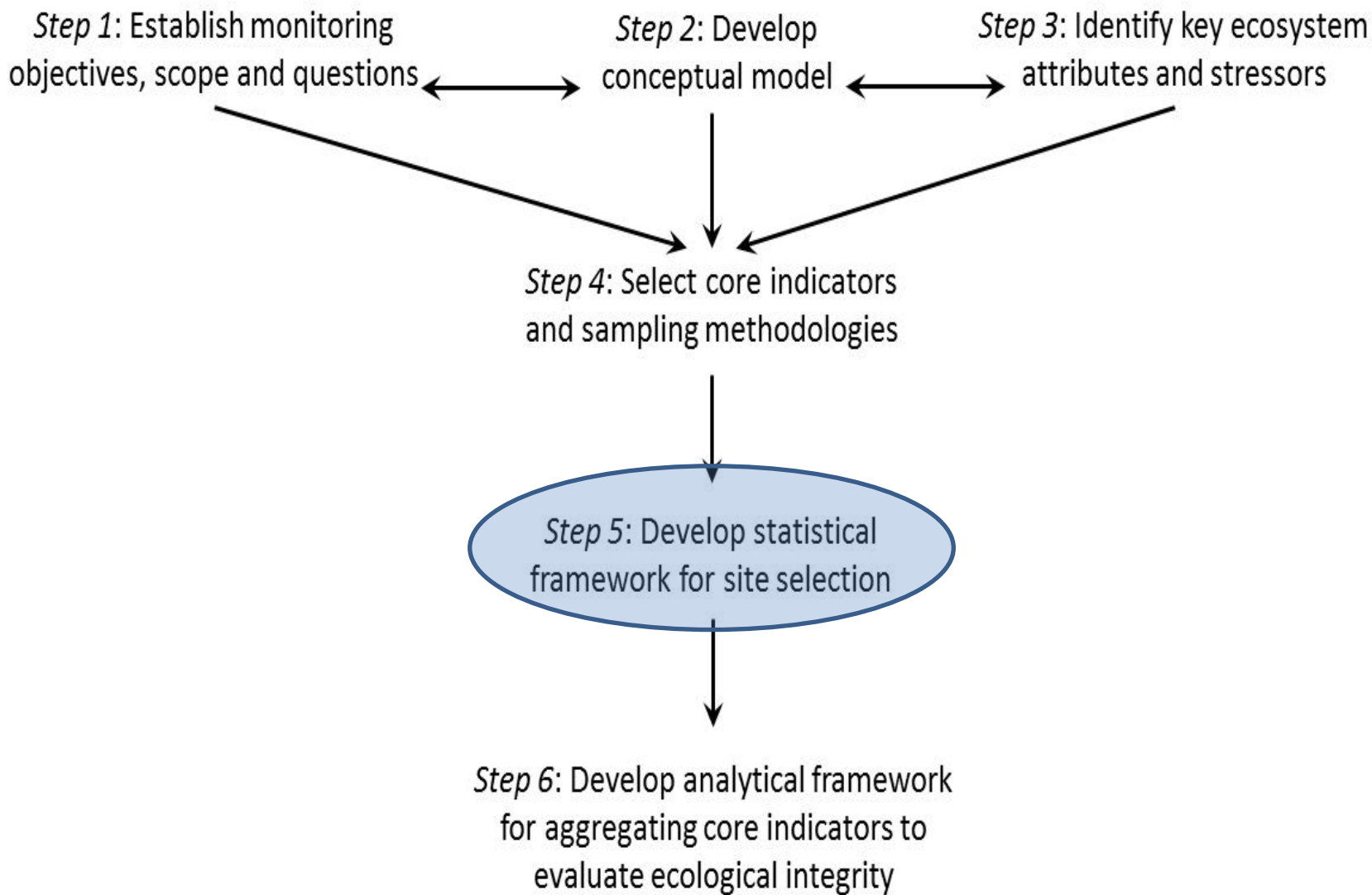
NAMP - Step 4: Select aquatic core indicators

- *Phase 4 – Field- and GIS-dervied covariates*: how to account for natural spatial gradients; changing chemical, physical and biological potential of sites
  - ACI working group, science advisory team and FO feedback

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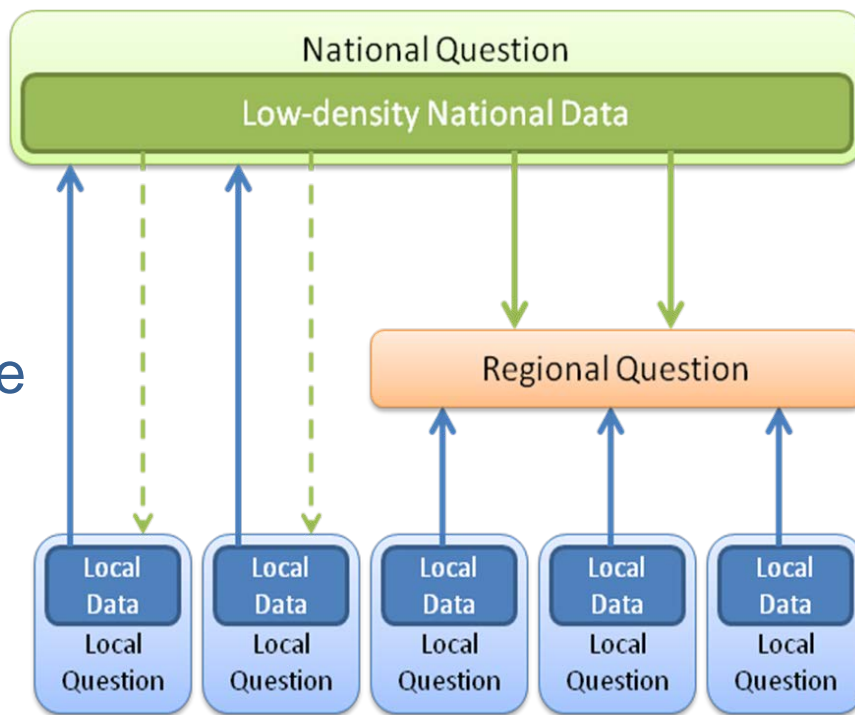Step 6: Develop analytical framework for aggregating core indicators to evaluate ecological integrity

NAMP - Step 5: Statistical framework
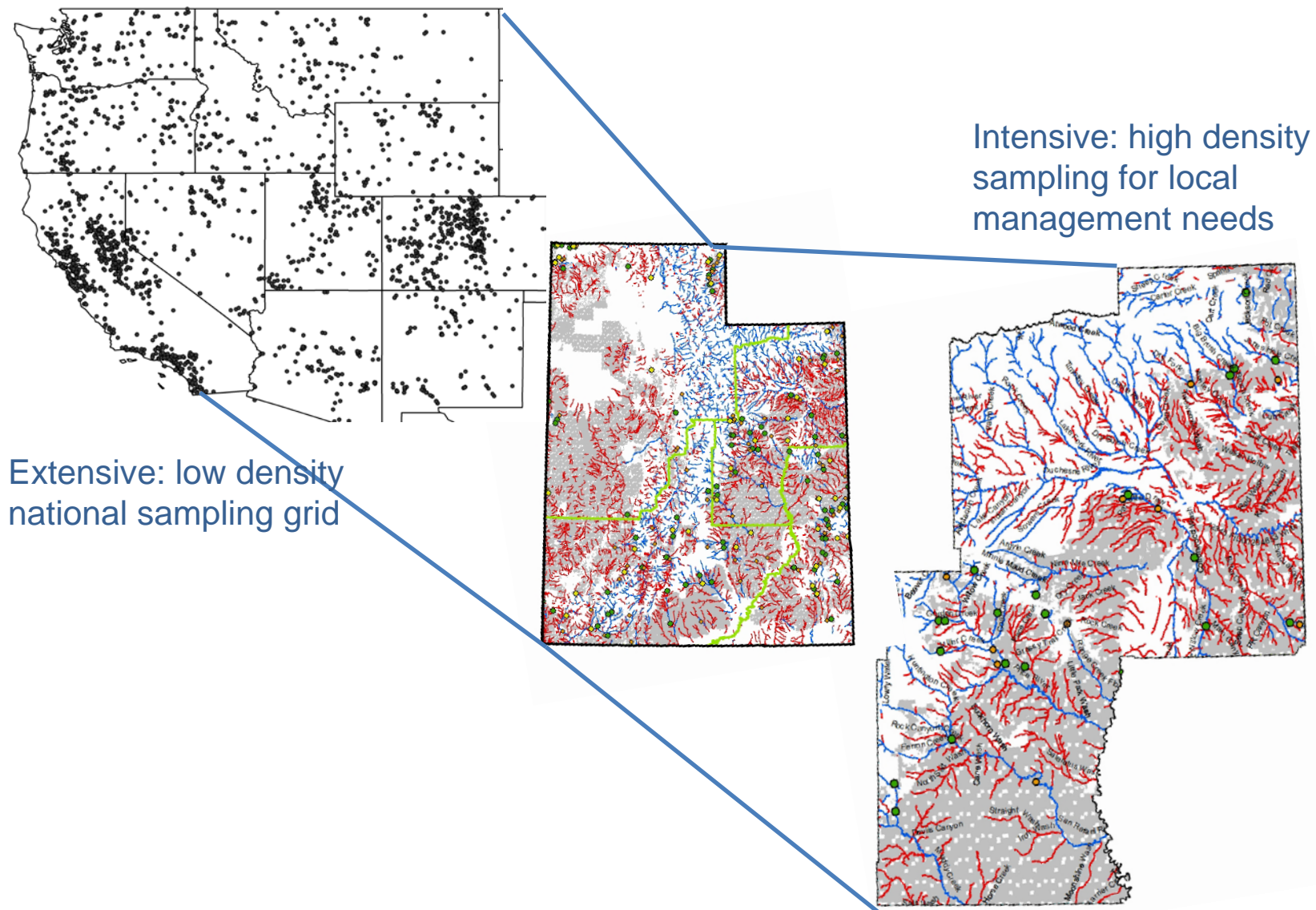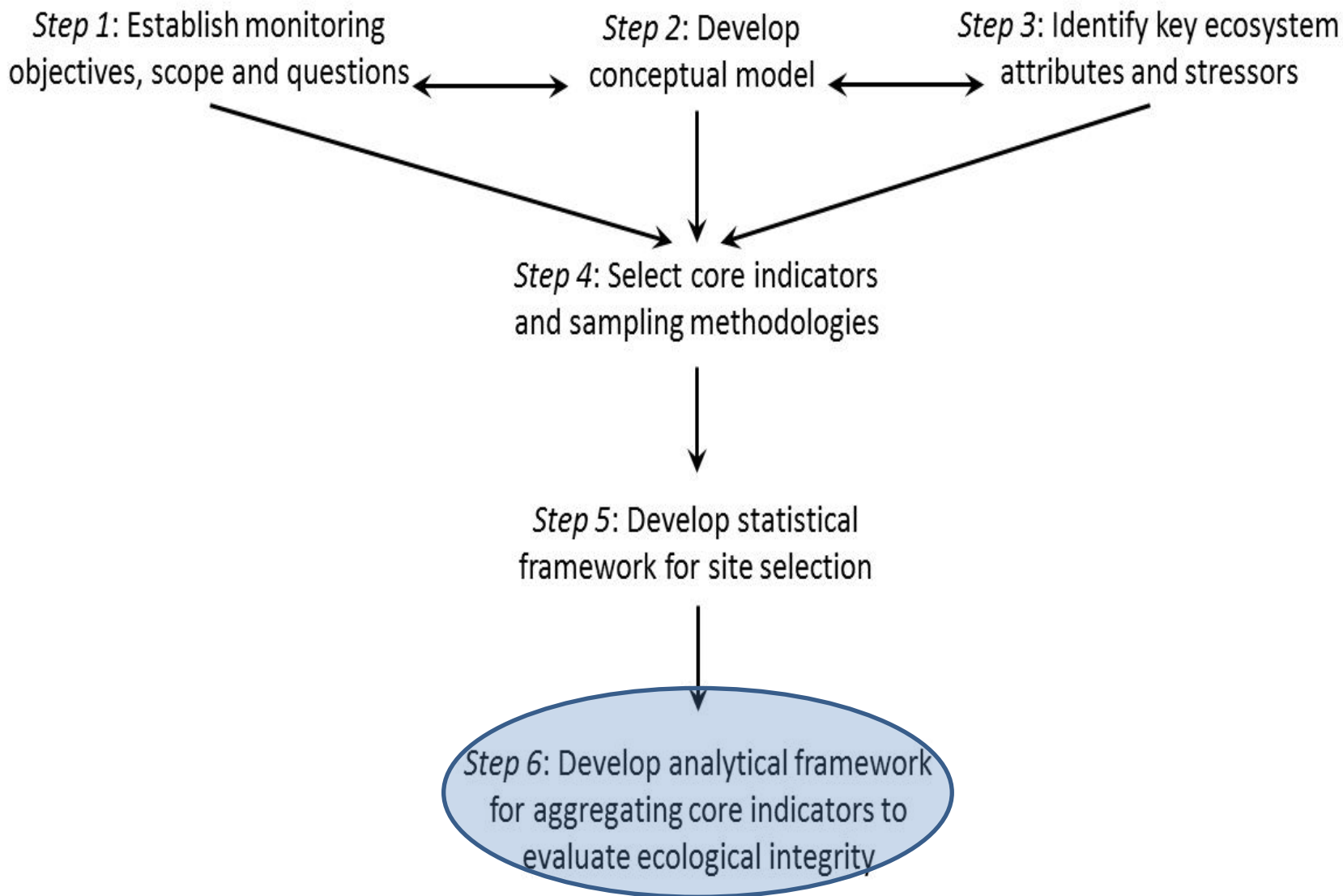
- Statistically valid survey design:
  - Unbiased: all sites have some known, non-zero probability of being sampled

  - Data integration among spatial scales

  - Known degree of confidence

  - Spatially balanced

- Targeted site selection

NAMP - Step 5: Statistical framework

Intensive: high density sampling for local management needs

Extensive: low density national sampling grid

Road map for developing BLM's NAMP

Step 1: Establish monitoring objectives, scope and questions ⟷ *Step 2*: Develop conceptual model ⟷ *Step 3*: Identify key ecosystem attributes and stressors

Step 4: Select core indicators and sampling methodologies

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NAMP – Example: Benthic macroinvertebrates

Monitoring questions and key ecosystem processes	Key ecosystem attributes and stressors	Indicator

What is the status and trend of key *hydrologic processes* needed to sustain functioning riparian and stream systems?
- Natural flow regime
- Connectivity (lateral, longitudinal, vertical)
- Water storage and yield
- Hill-slope processes

What is the status and trend of key *geomorphic processes* needed to sustain functioning riparian and stream systems?
- Sediment regime (supply and transport)
- Channel dimensions / habitat complexity
- Energy dissipation
- Bank conditions

What is the *biological condition* of stream and riparian areas and how is it changing through time?
- Instream biotic integrity
- Riparian biotic integrity
- Instream / riparian productivity
- Wood production and recruitment

Benthic macroinvertebrates

What is the status and trend of key *biogeochemical processes* needed to sustain functioning riparian and stream systems?
- Thermal regime
- Nutrient cycling / concentrations
- pH, dissolved oxygen, cations, anions
- Metals

What *stressors* are present and what risk do they pose to biological, chemical and physical processes
- Hydrologic alterations
- Nutrient, thermal, sediment loading
- Landuse: grazing, mining, roads, logging
- Introduced species
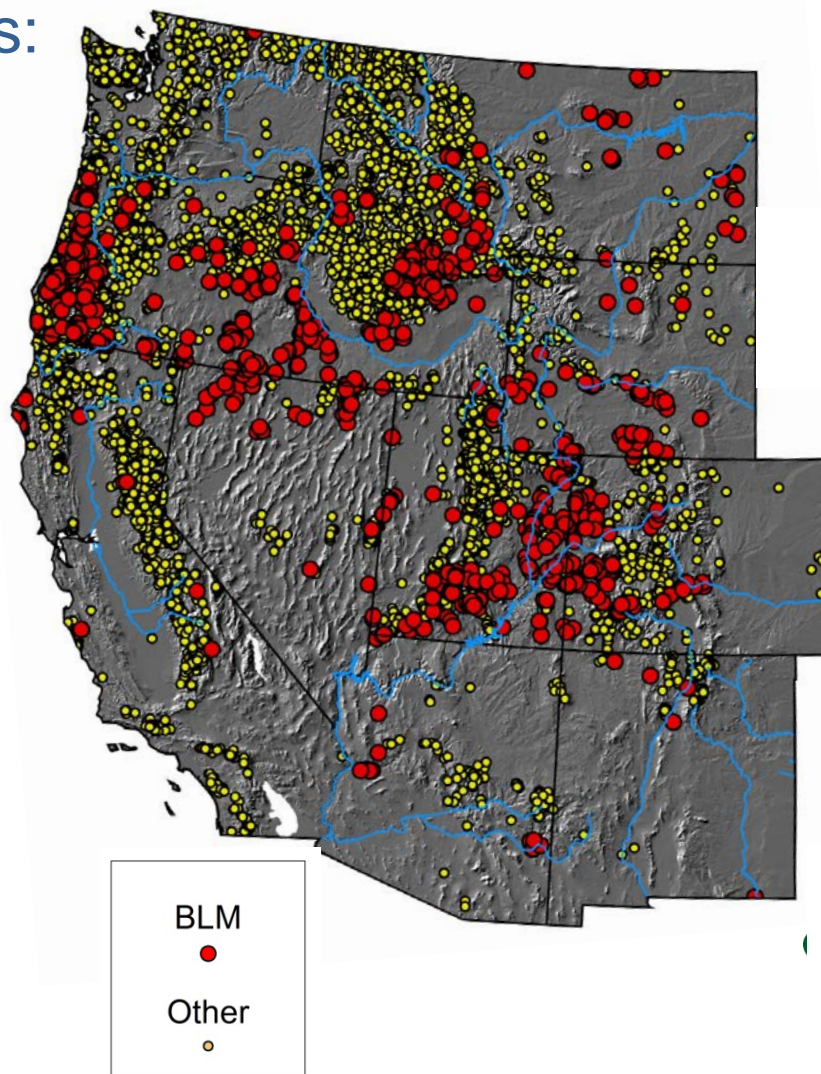
NAMP – Example: Benthic macroinvertebrates

NAMP – Example: Benthic macroinvertebrates

- BLM use of macroinvertebrates:
  - ~2300 unique stations

  - Only ~1200 of the ~2300 stations contain reliable data

 - Only ~58% of FO personnel use data to make management decisions

BLM
●

Other
○

NAMP – Example: Benthic macroinvertebrates

- BMI good core indicator because:
  - o Can be measured with minimal observed bias
  - o Documented relationship to the health of lotic system
  - o Responds to disturbance at relevant time-scales
  - o Used by regulatory agencies for status determinations
  - o Actively used by multiple stated, federal and tribal entities

- Standardized collection methodologies: 2011 Instructional memorandum (IM OC-2011-044)

- Analytical framework for making status determinations

NAMP – Example: Benthic macroinvertebrates

- Analytical framework for making status determinations
    - Use of state specific MMI or OE models
    - Facilitates integration of state-based reference conditions

Reference Sites

Number of Observations

Decreasing biological integrity

0   O/E   1
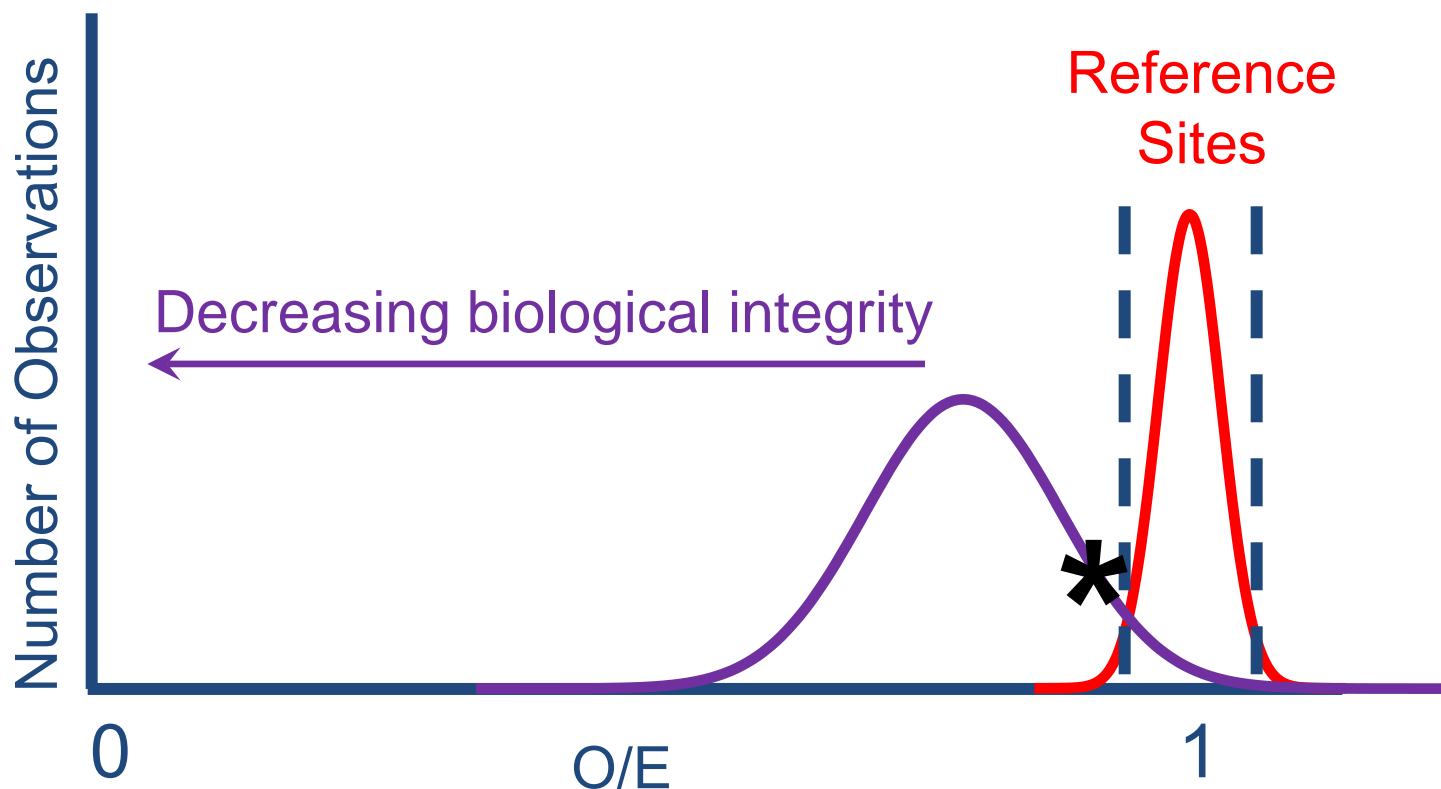
NAMP – Example: Benthic macroinvertebrates

Is O/E score > 2*S.D. from reference average?

Yes   No

Were replicate samples collected (>3)?

Site comparable to reference = meeting beneficial uses

Yes   No

Site Impaired

O/E > 3 S.D.?
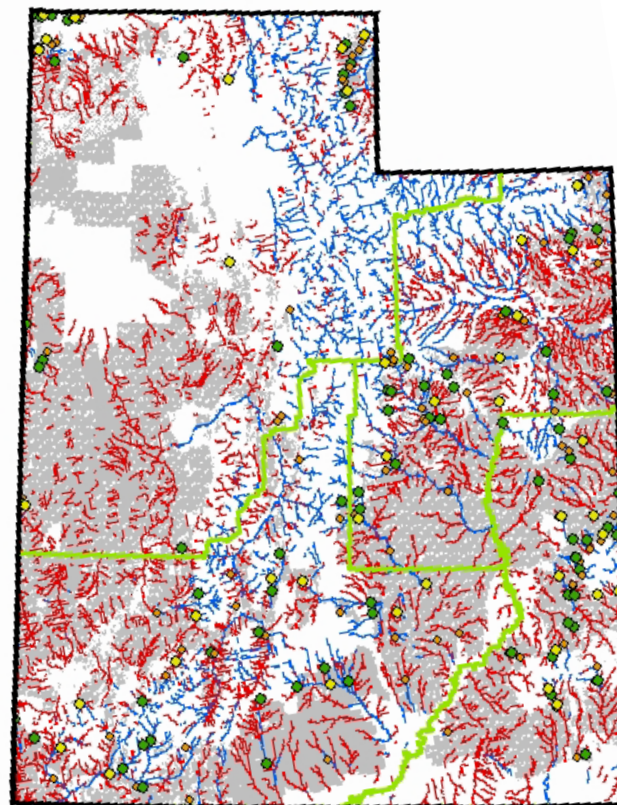
Yes   No

Site impaired

More data needed

NAMP – Example: Benthic macroinvertebrates

- Site selection methodology (statistical design):

Reach-scale: targeted
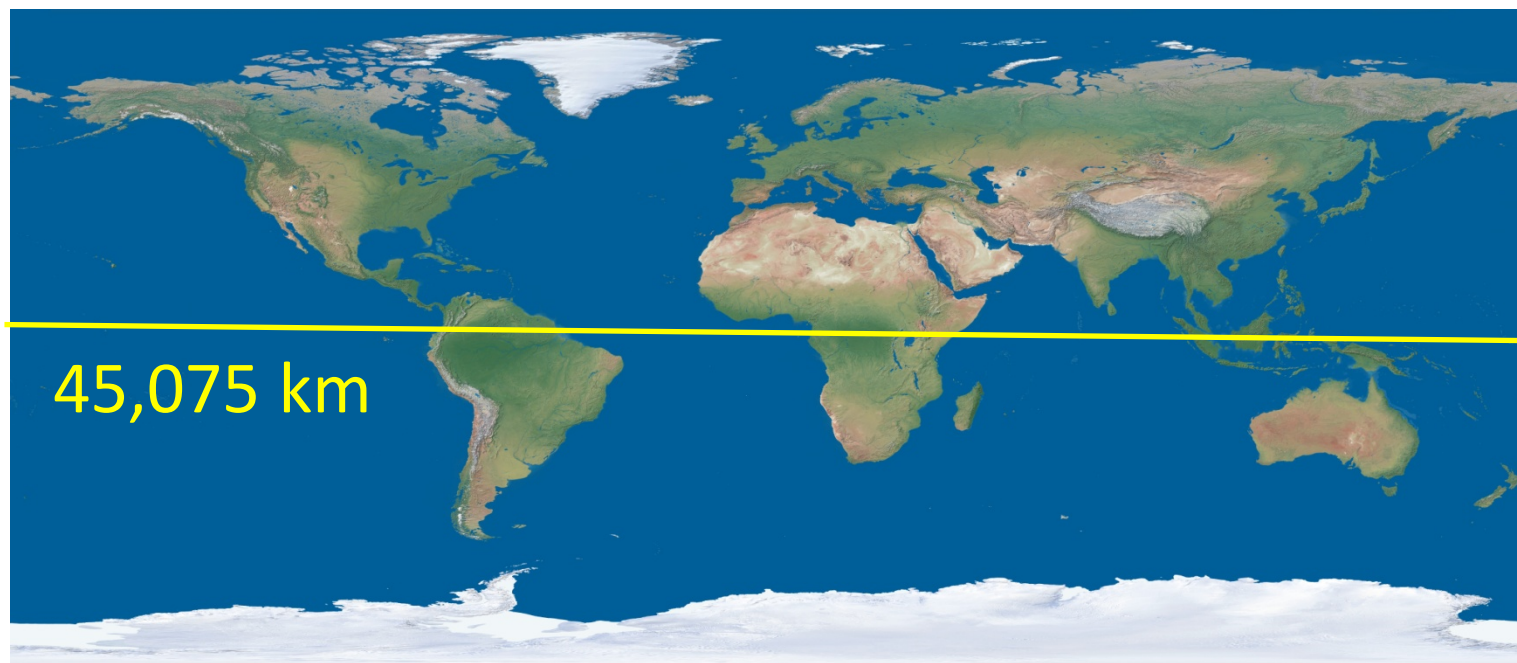(historic focus)

Landscape-scale: prob. based
(moving towards)

NAMP – Example: Benthic macroinvertebrates

- What is the biological condition of lotic wadeable, perennial streams on BLM lands throughout Utah?
    - UT: 5,200 km of perennial streams and rivers

45,075 km

NAMP – Example: Benthic macroinvertebrates

- Landscape-scale status and trend determinations, as well as stressor prioritization

- Data integration with existing state and federal programs

Relative Extent of Aquatic Stressors

% of Stream Length in Most Disturbed Condition
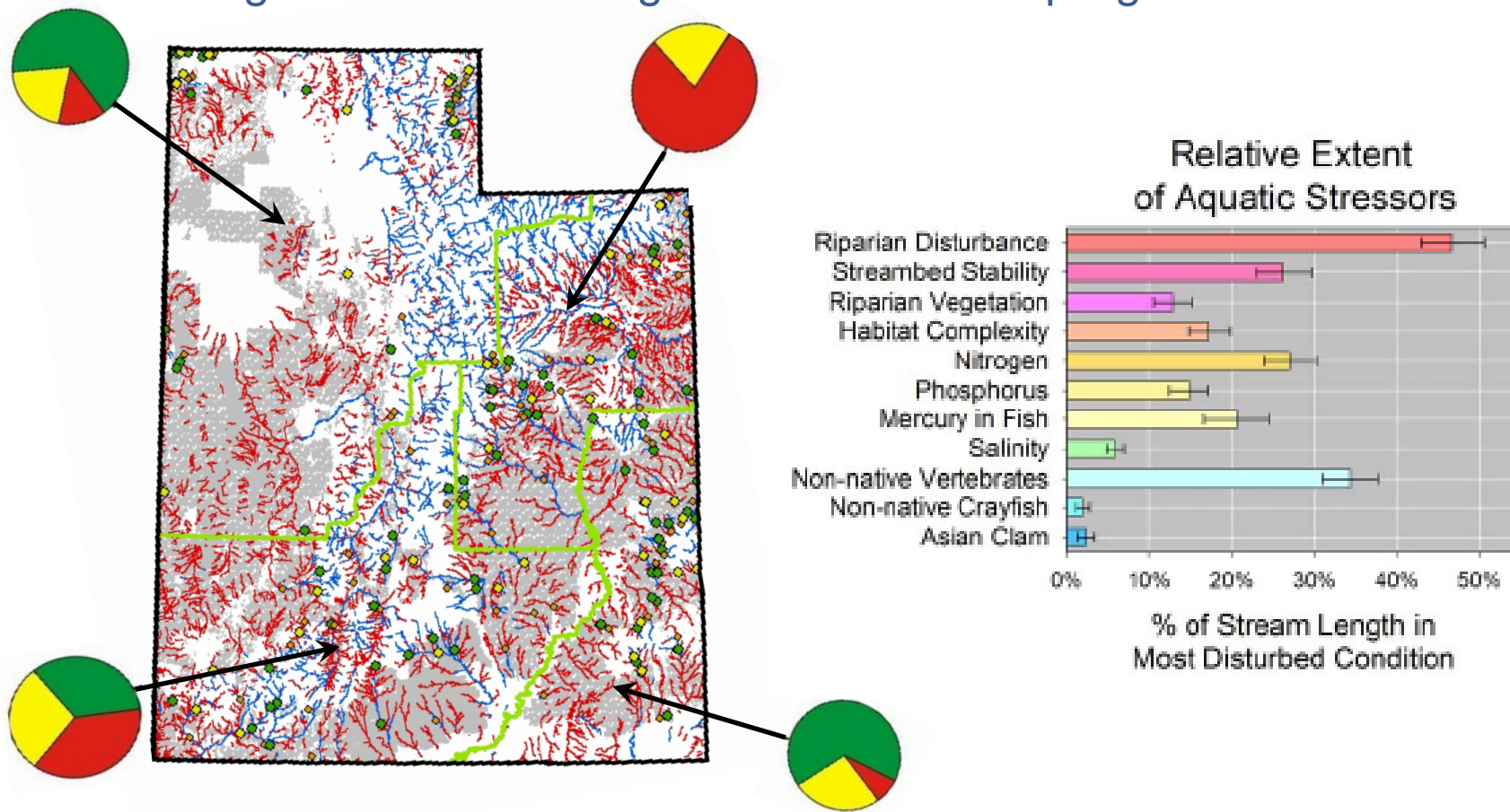
NAMP – Next steps

- Survey to prioritize ecosystem attributes (June, 2012)
  - Currently recruiting participants

- Workshop to select preliminary core indicators (Summer 2012)

- Demonstration projects:
  - Utah (ongoing): probabilistic state-wide surveys stratified by BLM district

  - CA (2012 start): probabilistic surveys of lentic and lotic resources for two large grazing allotments

  - Owyhee uplands (2013 start): integration of terrestrial and aquatic core indicators

Thank you...

Questions?

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