Watershed Condition Framework

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Healthy Streams Partnership
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Elements of Presentation

• Background: 1999 Clean Water Action Plan
  ▪ Priority Watersheds, PSW Regional direction to spend 80% of restoration funds in priority watersheds, Annual Accomplishment reports were sent to Washington, D.C.

• Broad-scale assessments
  ▪ 1994 Klamath-Sierra logging cumulative effects study (Hawkins et al. 2000 1st CA RIVPACS), EPA-EMAP/NARS, 2013 BLM-EPA WRSA, BLM Conservation Success Index, TNC-TU Below the Surface

• 2011 USFS Watershed Condition Assessment (WCA)
  ▪ 2006 OMB Report suggested the Forest Service needed a national standard for assessment to prioritize watershed restoration, WCA was a response to this report
  ▪ Attributes, compare-contrast with HSA, results for National Forest watersheds

• NWFP AREMP (Aquatic Riparian Effectiveness Monitoring Program)
  ▪ Range of attributes, scale of analysis, probabilistic design
  ▪ How may we measure whether 15 years of restoration efforts have been successful?

• Aquatic Management Indicator Species (MIS)
  ▪ Combined CA Perennial Stream Assessment & aquatic MIS – benthic invertebrates
  ▪ What is the condition of perennial streams, rivers and lakes in Sierra Nevada national forest watersheds?

• Aquatic Ecological Integrity
  ▪ Definitions, Assessment & mapping in the Sierra Nevada Bioregion to support forest plan revisions under the new Planning Rule, determination of where to place Critical Aquatic Reserves (CARs) for conservation of native species and aquatic ecosystem structure and function
Attributes are:
- Weighted
- Limited to activities related to Forest Service management (excludes climate change)
- Final overall Condition Score is the mean average of all 12
## WCA Attributes

### AQUATIC PHYSICAL INDICATORS

<table>
<thead>
<tr>
<th>1. Water Quality</th>
<th>Alteration of physical, chemical, and biological components of water quality.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Water Quantity</td>
<td>Changes to the natural flow regime - magnitude, duration, or timing of the natural stream flow hydrograph.</td>
</tr>
<tr>
<td>3. Aquatic Habitat</td>
<td>Aquatic habitat condition - habitat fragmentation, large woody debris, and channel shape and function.</td>
</tr>
</tbody>
</table>

### AQUATIC BIOLOGICAL INDICATORS

<table>
<thead>
<tr>
<th>4. Aquatic Biota</th>
<th>Distribution, structure, and density of native and introduced aquatic fauna.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Riparian/Wetland Vegetation</td>
<td>Function and condition of riparian vegetation along streams, water bodies, and wetlands.</td>
</tr>
</tbody>
</table>

### TERRESTRIAL PHYSICAL INDICATORS

<table>
<thead>
<tr>
<th>6. Roads and Trails</th>
<th>Changes to the hydrologic and sediment regimes due to the density, location, distribution, and maintenance of the road and trail network.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Soils</td>
<td>Alteration to natural soil condition, including productivity, erosion, and chemical contamination.</td>
</tr>
</tbody>
</table>

### TERRESTRIAL BIOLOGICAL INDICATORS

<table>
<thead>
<tr>
<th>8. Fire Regime or Wildfire</th>
<th>Potential for altered hydrologic and sediment regimes due to departures from historical ranges of variability in vegetation, and fire behavior.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Forest Cover</td>
<td>Potential for altered hydrologic and sediment regimes due to the loss of forest cover on forest lands.</td>
</tr>
<tr>
<td>10 Rangeland Vegetation</td>
<td>Impacts to soil and water relative to the vegetative health of rangelands.</td>
</tr>
<tr>
<td>11. Terrestrial Invasive Species</td>
<td>Potential impacts to soil, vegetation, and water resources due to terrestrial invasive species (including vertebrates, invertebrates, and plants).</td>
</tr>
<tr>
<td>12. Forest Health</td>
<td>Forest mortality impacts to hydrologic and soil function due to major invasive and native forest pest insect and disease outbreaks and air pollution.</td>
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</tbody>
</table>
## Comparison between USFS WCA & EPA-CA Healthy Streams Assessment

<table>
<thead>
<tr>
<th>Attribute</th>
<th>USFS WCA</th>
<th>EPA HSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Scale of Watersheds</td>
<td>12-unit HUCs, mean average of 23,000 acres (36 mi²), Range 8,000 to ~40,000 acres</td>
<td>Mean &lt; 800 acres or 1.2 mi²</td>
</tr>
<tr>
<td>Number of Watersheds</td>
<td>15,066</td>
<td>135,255</td>
</tr>
<tr>
<td>Treatment of Public vs. Private lands</td>
<td>All watersheds with at least 5% USFS ownership</td>
<td>All lands, depending on position of site</td>
</tr>
<tr>
<td>Weighing of Attributes</td>
<td>YES</td>
<td>NO?</td>
</tr>
<tr>
<td>Objectives</td>
<td>Forest-, Region- and nation-wide standard for assessment, priorities for watershed restoration and protection</td>
<td>Identification of which watersheds are in best condition and should be protected</td>
</tr>
<tr>
<td>Origin of Attributes</td>
<td>Numeric, GIS-derived and best professional judgment</td>
<td>Numeric, GIS-derived</td>
</tr>
<tr>
<td>Climate Change</td>
<td>Not included, only related to USFS management activities</td>
<td>Extensively evaluated for several variables</td>
</tr>
</tbody>
</table>
Number of Watersheds Analyzed ~1748

Number of bioassessment sites in Watersheds of interest 1070

Number of watersheds with at least one bioassessment site 504
Aquatic Invasive Species

- Quagga mussel  
  (*Dreissena rostriformis bugensis*)
- Zebra Mussel  
  (*Dreissena polymorpha*)
- New Zealand mudsnail  
  (*Potamopyrgus antipodarum*)
- Asian clam  
  (*Corbicula fluminea*)
- Red-rimmed melania snail  
  (*Melanoides tuberculatus*)
- Crayfish (*Pacifastacus leniusculus, Orconectes virilis*)
- Aquatic plants  
  Eurasian water milfoil  
  (*Myriophyllum spicatum*),  
  Hydrilla (*Hydrilla verticillata*),  
  *Didymosphenia geminata* - diatom  
  Chytrid fungus  
  (*Batrachochytrium dendrobatidis*)

Data Quality – Major gaps
Stanislaus National Forest Example- Life Form Presence

- Fish-bearing
- Steelhead historic range
- Bioassessment Scores

Stanislaus Bioassessment Sites
- Margaritifera sites
- Clavey Watershed 2006
- 2000-01 Reference Sites
- MIS 2009-2010
- MIS 2012
- Grazing Bioassessment 2007-09
- State Perennial Stream Assessment 2000-09
- Rim Fire Perimeter Sept 10, 2013
Influence of Private Lands: For any given 6th-field HUC watershed, how do scores on the national forest vs. private portions compare? (Public-Pvt)

For Example, let the Public WS Score = 1
Private WS Score = 2;
Sum = -1 because Pvt was worse than Public portion.

**Conclusion**: While there was no difference for the majority of watersheds, when there were differences in score, the Private Portion of mixed ownership watersheds was usually assessed to be in worse condition than the public portion of the watershed.
Maps were produced to depict composite, mean average scores for all attributes: Example for the Aquatic Biological Attribute.
Impaired watersheds are concentrated on the southern, urban national forests & mother load region.
Distribution of watershed condition scores for 1,490 6th-field HUC watersheds by forest:

- Klamath
- Mendocino
- Shasta-Trinity
- Six Rivers
- Eldorado
- Inyo
- Lassen
- LTMBU
- Modoc
- Plumas
- Sequoia
- Sierra
- Stanislaus
- Tahoe
- Angeles
- Cleveland
- Los Padres
- San Bernardino

- Northern
- Sierra Nevada
- Southern

- Impaired Function: 2%
- Functioning at Risk: 35%
- Functioning Properly: 63%
Distribution of watershed condition scores for 15,066 6th-field HUC watersheds by Forest Service Region

- **Impaired Function**: 3%
- **Functioning at Risk**: 45%
- **Functioning Properly**: 52%

### Forest Service Region

- **1**: 11th-Region Field HUC watersheds (Northern)
- **2**: Rockies Field HUC watersheds (Rocky Mt)
- **3**: Southwest Field HUC watersheds (SW)
- **4**: Inter-Mt West Field HUC watersheds (Inter-Mt West)
- **5**: Pacific Southwest Field HUC watersheds (PSW)
- **6**: Pacific Northwest Field HUC watersheds (PNW)
- **8**: Southern Field HUC watersheds (Southern)
- **9**: Eastern Field HUC watersheds (Eastern)
- **10**: Alaska Field HUC watersheds (Alaska)
NWFP – Aquatic Riparian Effectiveness Monitoring Program (AREMP)

Sample design

- Minimum of 25% federal ownership
- 250 randomly selected watersheds
- 28 watersheds sampled per year on an 8-year rotation
- Duration 1994 to present
Location of AREMP sites in the Klamath-Siskiyou & Franciscan Aquatic Province

Aquatic Province Boundaries

Aquatic Provinces
1. Olympic Peninsula
2. North Cascades
3. Willamette-Puget Trough
4. West Cascades
5. Oregon Coast
6. High Cascades
7. Klamath-Siskiyou and Franciscan

NWFP AREMP Monitoring Sites
- AREMP 2000-06
- AREMP 2007
- AREMP 2008

National Forest
California Rivers
**Attributes**

- Scale 7th field HUCs
- Vegetative cover
- Riparian cover
- Road Crossings
- Road Density
- Landslide Risk

**AREMP Watershed Assessment**

Klamath/Siskiyou & Franciscan

Dataset 05-21-2010
How can we measure success? An example from AREMP tracking 15 years of restoration efforts to determine whether watershed condition is improving.

Table 6—Watersheds (n = 1,379) that decreased, increased, or had no change in watershed scores between 1994 and 2008

<table>
<thead>
<tr>
<th></th>
<th>Decrease</th>
<th>No change</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All watersheds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No min. threshold(^a)</td>
<td>23</td>
<td>8</td>
<td>69</td>
</tr>
<tr>
<td>± 0.1 min. threshold(^b)</td>
<td>4</td>
<td>86</td>
<td>10</td>
</tr>
<tr>
<td>Congressional reserve(^c)</td>
<td>38</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td>Late-successional reserve</td>
<td>17</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>Matrix</td>
<td>16</td>
<td>3</td>
<td>81</td>
</tr>
<tr>
<td>Key</td>
<td>23</td>
<td>9</td>
<td>68</td>
</tr>
<tr>
<td>Nonkey</td>
<td>23</td>
<td>7</td>
<td>70</td>
</tr>
</tbody>
</table>

\(^a\) No min. threshold: decrease > -2.0
\(^b\) ± 0.1 min. threshold: -2.0 ≤ decrease ≤ 0.0
\(^c\) Congressional reserve: 0.0 ≤ decrease ≤ 0.5

Improvement
RIVPACS-IBI hybrid USFS & CDFW combined indicate that 78% of perennial stream miles on Sierra Nevada national forests are in reference condition.
Condition Assessments by Region (8 Years)

Thanks to Tom Kincaid and Tony Olsen, EPA, Corvallis

Statewide: ~50% of stream length has impaired biology
~22% of stream length has very impaired biology

Slide from Pete Ode, CDFW
Mapping Aquatic Ecological Integrity
From Michael Kellett, USFS, Regional Fisheries Biologist

**Ecological Integrity**
6th-level subwatershed unit (HUC12)

Data were gathered and classified according to 6th level subwatershed units (HUC 12). Values for each factor (see table below) within the subwatersheds were normalized to a range from -10 to +10 based on either the number of occurrences within a HUC, determined condition for the HUC, or change within the HUC. Scores from each factor were summed for each subwatershed. Finally, a percent of absolute maximum value (wherever the summed area is the greatest difference from zero) was calculated.

**Inputs for Aquatic Ecological Integrity**
- Fish, Invertebrates, Herptiles: Positive factor
- Invasive/non-native species: Negative factor
- Water development: Negative factor
- Road density: Conditional factor
- Range contraction: Negative factor