Examples of Level 3 Indicators for the National Wetlands Condition Assessment
Lessons from State and Tribal Programs

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# Indicators of Wetland Condition

## 3-Level Technical Approach

<table>
<thead>
<tr>
<th>Level 1 Indicators - Landscape Assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use GIS and remote sensing to gain a <strong>landscape view of watershed and wetland condition.</strong> Typical indicators include wetland coverage (NWI), land use, and land cover.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2 Indicators – Rapid Wetland Assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate the <strong>general condition of individual wetlands using relatively simple field measurements.</strong> Akin to a physical habitat assessment for wetlands. Assessment can also be based on the characterization of stressors known to limit wetland services. (e.g. road crossings, tile drainage, ditching).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 3 Indicators – Intensive Site Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators requiring intensive field measurements.</strong> Often involves developing an index of biological integrity. Can be used to validate Level 1 or 2 indicators or diagnose the causes of wetland degradation.</td>
</tr>
</tbody>
</table>
National Wetland Condition Assessment
Indicators Workshop: Key Concepts

**Condition** – Current state of a resource compared to reference standard for physical, chemical, and biological characteristics.

**Ecological integrity** – The ability of a system to support and maintain a balanced integrated, adaptive community of organisms having species composition, diversity, and functional organization typical of wetlands in the region. In this case, it is quantitatively defined by the condition of reference standard sites.

**Reference Standard** – Reference standard represents least-disturbed physical, chemical, and biological conditions across a population of wetlands and includes an estimate of natural variability.

**Reference Gradient** – The gradient of ecosystem condition across a region varying from least-disturbed (reference standard) to highly impaired.

**Natural Disturbance** – Disturbance events or regimes that are natural processes and attributes of an ecosystem.

**Exogenous Perturbation** – Human-caused or mediated disturbance that may lead to changes in ecosystem attributes or disruption of processes through 1) direct physical or biotic impacts or inputs, or 2) alteration of natural disturbance regimes.

**Response Attribute** – Key biotic, abiotic, and hydrologic ecosystem elements.

**Stressor** – Any abiotic or biotic entity that can impair ecosystem condition. For NWCA purposes, stressors result from human activities.

**Indicator Class** – Major ecosystem component or stressor type used to assess ecological integrity or reflect current condition.

**Indicator** – Major element of an indicator class that can be used to assess or reflect the condition of the indicator class.

**Metrics** – Measurements of an indicator.

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**Example 1:**
- Biotic (stressor)
  - Ecosystem (indicator type)
  - Alien plant taxa (indicator)
  - Candidate metrics
    - % alien richness
    - Relative alien cover
    - # number invasive species
    - Invasive species cover
    - Indices of alien impact

**Example 2:**
- Hydrology (response attribute)
  - Water quantity (indicator type)
  - Inundation (indicator)
  - Candidate metrics
    - Percent assessment area inundated at sampling
    - Estimated percent assessment area inundated at high water based on site evidence (e.g., high water sediments marks, drifted vegetation)
    - Percent of assessment area occupied by emergent or submerged obligate wetland plants

**Example 3:**
- Stressor
  - On-site perturbation (indicator type)
  - Buffer condition (indicator)
  - Candidate metrics
    - Vegetated buffer present/absent
    - Buffer width or area
    - Land cover types adjacent to buffer
    - Number of buffer penetrations
Level 3 – Intensive Site Assessment

- Intensive field assessment requiring one or more days in the field

- Metrics of indicators can be combined to form a Multi-Metric Index (e.g., IBI)

- Site assessment can involve long-term data collection (e.g., monitoring wells)
Index of Biotic Integrity
Approach to Wetland Condition Assessments

Example: Vegetative IBIs
Existing State and Regional VIBIs

- Colorado
- Minnesota
- Ohio
- Pennsylvania
- North Dakota
- Massachusetts Index of Vegetative Integrity
- Wisconsin Wetland Plant Biotic Index
Other State and Regional Level 3 Assessments of Vegetation

- Florida
- Delaware
- California
- Gulf of Mexico
Common State/Regional Vegetation Indicators

- **Species Composition**
  - FQAI (Floristic Quality Assessment Index)
  - Native/non-native/invasive Species Richness
  - metrics related to annual, perennial biennial richness

- **Functional Guild Indicator**
  - hydrophyte richness (FACW, OBL spp.) or abundance

- **Tolerance**
  - abundance or richness of tolerant/sensitive species

- **Structure**
  - cover of persistent litter or invasive graminoids
Other State/Regional Vegetation Metrics

- aquatic guild richness or abundance
- monocot or dicot richness
- shade tolerant species richness
- similarity (% shared species)
- biomass
Other Commonly Used Level 3 Indicator Classes and Associated Indicators

Macroinvertebrates, Invertebrates, Fish, Amphibians
Common Biological Indicator Class, Indicators and Metrics

- Macroinvertebrates
  - Composition
  - Species Abundance
  - % Alien
  - % Sensitive
  - % Tolerant

- Benthic Algae, Birds, Amphibians
  - Composition
Common Physical Habitat Indicator Class, Indicators and Metrics

- **Abiotic**
  - **Soil**
    - Bulk Density
    - pH
    - Salinity of Soil
    - Soil Redux/Eh potential

- **Hydrology**
  - Hydrologic Connectivity
    - Water table depth: within 30.5 centimeters of surface
State and Regional Level 3 Condition Assessments

Indicators/Metrics in Application
MINNESOTA

- Vegetation
  - Density of vegetation, composition
- Macroinvertebrates
  - Number and richness
- Fish and Amphibians
  - Number and richness
- Physical Habitat
  - Bulk Density
MINNESOTA

Water Quality

<table>
<thead>
<tr>
<th>DEPARTMENT OF HEALTH SAMPLES</th>
<th>FIELD MEASUREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Turbidity, Color -- 1 125 ml General*</td>
<td>□ pH ------</td>
</tr>
<tr>
<td>*If shipping required, otherwise use 1 L General</td>
<td>□ Specific Conductivity ---</td>
</tr>
<tr>
<td>□ Chloride, Sulfate, TOC -- 1 L General</td>
<td>□ Water Temp ---</td>
</tr>
<tr>
<td>□ Calcium &amp; Magnesium -- 1 500 ml</td>
<td>□ Field Turbidity ---</td>
</tr>
<tr>
<td>□ Preserved with HNO₃</td>
<td>□ Dissolved Oxygen ---</td>
</tr>
<tr>
<td>□ Nitrogen and Phosphorus -- 1 250 ml</td>
<td>% Saturation ---</td>
</tr>
<tr>
<td>□ Preserved with H₂SO₄</td>
<td>time of measurement : :</td>
</tr>
<tr>
<td>CHLOROPHYLL WATER/FILTER</td>
<td>Wetland Zone Water Chem. Data Collected:</td>
</tr>
<tr>
<td><strong>to be chilled in cooler, filtered and sent TO MDH</strong></td>
<td>Emergent Floating Submergent Open Water</td>
</tr>
<tr>
<td>□ 1 Liter amber glass bottle (or 1 liter general)</td>
<td>(if other than location indicated on diagram on first page)</td>
</tr>
<tr>
<td>*** Volume filtered -----------</td>
<td></td>
</tr>
</tbody>
</table>
MAINE

- Vegetation
  - Dominant Species

- Algae
  - Composition, Productivity

- Physical/Chemical
  - Dissolved Oxygen, Temp., Conductivity, pH
# Maine DEP Biological Monitoring Unit
## Stream Macroinvertebrate Field Data Sheet

<table>
<thead>
<tr>
<th>Log Number</th>
<th>Directions</th>
<th>Type of Sample</th>
<th>Date Deployed</th>
<th>Number Deployed</th>
<th>Date Retrieved</th>
<th>Number Retrieved</th>
<th>Agency/Collector(s)</th>
</tr>
</thead>
</table>

**Location:**

**Stressor:**

### 1. Land Use (surrounding watershed)
- [ ] Urban
- [ ] Upland conifer
- [ ] Cultivated
- [ ] Swamp hardwood
- [ ] Pasture
- [ ] Swamp conifer
- [ ] Upland hardwood
- [ ] Marsh

### 2. Terrain (surrounding watershed)
- [ ] Flat
- [ ] Rolling
- [ ] Hilly
- [ ] Mountains

### 3. Canopy Cover (surrounding view)
- [ ] Dense (75-100% shaded)
- [ ] Partly open (25-75% shaded)
- [ ] Open (0-25% shaded)
- [ ] (% daily direct sun)

### 4. Physical Characteristics of Bottom (estimate % of each component over 12 m stretch of site; total = 100%)
- [ ] Bedrock
- [ ] Cobble (2.5” - 10”)
- [ ] Sand (<1/8”)
- [ ] Boulders (>10”)
- [ ] Gravel (1/8” - 2.5”)
- [ ] Silt-clay-muck (circle which)
- [ ] Detritus

### 5. Habitat Characteristics (immediate area)

<table>
<thead>
<tr>
<th>Time AM PM</th>
<th>Wetted Width (m)</th>
<th>Bank Full Width (m)</th>
<th>Depth (cm)</th>
<th>Flow (cm/s)</th>
<th>DISS. O₂ (ppm)</th>
<th>Temp (°C)</th>
<th>SPC (µS/cm)</th>
<th>pH</th>
<th>DO Meter # Cal? Y/N</th>
<th>SPC Meter # Cal? Y/N</th>
</tr>
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<td>SPC Meter # Cal? Y/N</td>
</tr>
</tbody>
</table>

### Temperature Probe #
- [ ] deployed  [ ] retrieved

### 6. Observations (describe)
- Fish
- Algae
- Macrophytes
- Habitat quality
- Dams/impoundments
- Discharges
- Nonpoint stressors
- Other

### 7. Water Samples
- [ ] Standard
- [ ] Metals
- [ ] Pesticides
- Lab Number

### 8. Photographs
# GULF OF MEXICO

## Vegetation

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Above-Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clip Plot</td>
<td>(0.25m²)</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

- C:N:P (15 dead/15 live) sp. ________
- Stable isotope (15 dead/15 live)

## Water

<table>
<thead>
<tr>
<th>Water</th>
<th>Depth</th>
<th>Sal (pr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface H₂O</td>
<td>mid</td>
<td>cm</td>
</tr>
<tr>
<td>AA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjacent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pore H₂O - Plot 1</td>
<td></td>
<td>cm</td>
</tr>
<tr>
<td>Plot 2</td>
<td></td>
<td>cm</td>
</tr>
<tr>
<td>Plot 3</td>
<td></td>
<td>cm</td>
</tr>
</tbody>
</table>

- Nut 1 - unfilt
- Nut 1 - filt

## Sediment

<table>
<thead>
<tr>
<th>Sediment</th>
<th>Clip Plot</th>
<th>10-cm Surficial Layer</th>
<th>Depth Below Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite Sediment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clip Plot</td>
<td>10-cm Surficial Layer</td>
<td>Depth Below Vegetation</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- No sample; insufficient sediment down to 50 cm

- Contaminants (500-cc nalgene)
- TOC (125-cc nalgene)
- Sed C:N:P (125-cc nalgene)
- Cation Exchg (125-cc nalgene)
- Grain Size (125-cc nalgene)
- H₂O Hold (125-cc nalgene)

## Bulk Density:

- 50-cc core taken from surface sediment (50-cc Falcon Tube)

- Actual volume of sample taken ________ cc

## Microbial:

- **Biomass**: Surface scoop near vegetation/sediment interface (125-cc nalgene)
- **Array**: Surface scoop near vegetation/sediment interface (125-cc nalgene)
Alternative Multi-Metric Approach to Wetland Condition Assessments

Delaware Index of Wetland Condition
Delaware Index of Wetland Condition

- Rolls metrics of different indicator types into a single composite score

- Developed by selecting the strongest variables that discriminated sites based on condition

- Combination of most useful HGM variables
Delaware Index of Wetland Condition

- Habitat (Vegetation)
  - % cover of invasives
  - Presence of sapling indicator species
  - Presence of shrub indicator species

- Hydrologic (Stressor)
  - Presence of filling, ditching or excavation in floodplain
  - Condition of stream within 100m assessment area

- Landscape
  - Vegetation cover type within 20 to 100 meters of the edge of floodplain
QUESTIONS?

COMMENTS?
CHARGE TO THE WORK GROUP
- Develop Portfolio or Toolbox of Indicator Types, Indicators, and Candidate Metrics
- Represent key wetland ecosystem components
- Accommodate different assessment questions and the diversity of wetland classes.