305(b) - purpose

Clean Water Act requires each state to conduct water quality surveys to determine if its waterways are:

- healthy
- sufficient quality to meet their designated uses
305(b) - report

- submitted every two years
- uses chemical data from STORET database, biology data from the Statewide Biological database, and fish consumption advisory data
- prepared by the Basin Planning and Management Section
305(b) Methodology - activities

12 steps to complete assessment

1. subdivide State into watersheds
2. identify waterbody type
3. identify waterbody classification and designated use
4. inventory chemical data - STORET
5. inventory biological data - Statewide Biologic Database
6. inventory fish consumption advisory data - Mercury Project
305(b) Methodology - activities

12 steps to complete assessment (cont’d)

7. calculate Index - WQI or TSI
8. identify exceedances of water quality standards
9. status determination
10. apply confidence filters
11. use determination status
12. other EPA reporting requirements -
   • screen for poor water quality values (causes)
   • nonpoint source survey (sources)
   • analyze trends
1. **Subdivide state into watersheds**
   - 52 major river basins
   - 4,934 watersheds
**Watershed:**

- a waterbody and feeder streams that flow to it
- analytic unit for assessing surface water quality
- named for the major waterbody located within it
- water quality stations located within a given watershed are used to assess that watershed

**305(b) Methodology - watershed assignment and classification**
Winter Park Chain of Lakes

Howell Lake
Howell Creek
Lake Maitland
Lake Minnehaha
Lake Osceola
Lake Mizell
Lake Jessup

Foose polygon
14 miles long
40 square miles
305(b) Methodology - watershed assignment and classification

2. **Identify waterbody type**
   - watershed identified by the predominant type of waterbody located within it
     - *i.e.*, stream, black water stream, lake, estuary or spring
   - watershed determined by visual inspection of data or GIS mapping
   - water quality assumed to be homogeneous in each waterbody
### 305(b) Methodology - *watershed assignment and classification*

<table>
<thead>
<tr>
<th>Waterbody type</th>
<th>Number of waterbodies</th>
<th>Characteristics</th>
<th>Assessment technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream</td>
<td>3,359</td>
<td></td>
<td>Water Quality Index</td>
</tr>
<tr>
<td>Stream-black water</td>
<td>73</td>
<td>Color &gt; 275 platinum color units, pH&lt; 6</td>
<td>Water Quality Index</td>
</tr>
<tr>
<td>Lake</td>
<td>556</td>
<td></td>
<td>Trophic State Index</td>
</tr>
<tr>
<td>Spring</td>
<td>88</td>
<td>Low dissolved oxygen</td>
<td>Water Quality Index</td>
</tr>
<tr>
<td>Estuary</td>
<td>458</td>
<td>Conductivity &gt; 5000 uhmos, chloride &gt; 1500 ppm</td>
<td>Trophic State Index</td>
</tr>
</tbody>
</table>
305(b) Methodology - watershed assignment and classification

3. *Identify water body classifications and designated use for each waterbody*
   - functional classifications are applied to all Florida surface waters (Class I through V)
   - standards and water quality criteria have been established for each class of waterbody under Chapter 62-302
### 305(b) Methodology - watershed assignment and classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Function</th>
<th>Number of watersheds</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Drinking Water</td>
<td>46</td>
<td>Usually lakes or reservoirs</td>
</tr>
<tr>
<td>II</td>
<td>Shellfish harvesting</td>
<td>124</td>
<td>Estuarine</td>
</tr>
<tr>
<td>III - Freshwater</td>
<td>Wildlife and recreation</td>
<td>3989</td>
<td></td>
</tr>
<tr>
<td>III - Marine</td>
<td>Wildlife and recreation</td>
<td>374</td>
<td>Chlorides &gt; 1500 ppm</td>
</tr>
<tr>
<td>IV</td>
<td>Agriculture</td>
<td>1</td>
<td>Everglades area</td>
</tr>
<tr>
<td>V</td>
<td>Industrial</td>
<td>0*</td>
<td></td>
</tr>
</tbody>
</table>

* Fenholloway River changed to Class III in 1997
4. Inventory chemical data

STORET

- 9,200 STORET stations sampled since 1980
- in 1,900 of the 4,934 watersheds in Florida
- by 33 agencies
- current data defined as 1993-1997
- historic data defined as 1980 - 1992
Major agencies collecting STORET stations since 1970
5. Inventory biological data

Statewide Biological database

- SCI - Stream condition index
- uses 7 different indices based on types and numbers of macroinvertebrates present
  - if less than 20th percentile, then poor
  - if greater than 70th percentile, then good
- have other historical and new bioassessment data that needs to be integrated into assessment
## Biological Index

<table>
<thead>
<tr>
<th>METRIC Lookup</th>
<th>METRIC</th>
<th>REGION</th>
<th>SEASON</th>
<th>5</th>
<th>3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Total Taxa</td>
<td>TOTAXA</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&gt;=31</td>
<td>30.0-16.0</td>
<td>&lt;16</td>
</tr>
<tr>
<td>No. of EPT Taxa</td>
<td>EPTTAXA</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&gt;=7</td>
<td>6.0-4.0</td>
<td>&lt;4</td>
</tr>
<tr>
<td>No. of Chironomidae Taxa</td>
<td>CHIRTAXA</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&gt;=9</td>
<td>8.0-5.0</td>
<td>&lt;5</td>
</tr>
<tr>
<td>% Dominant Taxon</td>
<td>PERDOM</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&lt;=22</td>
<td>23-61</td>
<td>&gt;61</td>
</tr>
<tr>
<td>% Diptera</td>
<td>PERDIP</td>
<td>Panhandle</td>
<td>Summer</td>
<td>.</td>
<td>&lt;=50</td>
<td>&gt;50</td>
</tr>
<tr>
<td>Florida Index</td>
<td>FLAIND</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&gt;=16</td>
<td>15-8</td>
<td>&lt;8</td>
</tr>
<tr>
<td>% Filters</td>
<td>PERFIL</td>
<td>Panhandle</td>
<td>Summer</td>
<td>&gt;=12</td>
<td>11.0-6.0</td>
<td>&lt;6</td>
</tr>
</tbody>
</table>

- **Meets**
- **Partially**
- **Does not meet**
305(b) Methodology - database development

6. Inventory fish consumption advisory data

Mercury Survey

- In 1989, FGFFC, FDHRS, and FDEP initiated a project to sample fish tissue for mercury concentration
- Approximately one million acres of fresh water are “no consumption” areas (do not support their designated use)
- Approximately one million acres of fresh water have “limited consumption” advisories (partially support their designated use)
Fish consumption advisories (mercury)

- Limited consumption (fair)
- No consumption (poor)
## Fish Consumption Advisory

<table>
<thead>
<tr>
<th>Mercury in fish tissue</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.5 mg/kg</td>
<td>Meets</td>
<td>0.5-1.5 mg/kg (limited consumption)</td>
<td>Meets</td>
</tr>
<tr>
<td>0.5-1.5 mg/kg</td>
<td>Partially</td>
<td>Meets</td>
<td></td>
</tr>
<tr>
<td>&gt;1.5 mg/kg</td>
<td>Does not meet</td>
<td>Meets</td>
<td></td>
</tr>
</tbody>
</table>
7. **Calculate index**
   a. **Water Quality Index (WQI)**
      - developed and used in 1988 305(b) report
      - a single numeric value condensed from several water quality parameters
      - applies to streams, black waters, and springs
      - annual median water quality values derived from STORET chemical data
      - includes five (5) categories of measurements:
7. Calculate index - indices are primarily designed to address impacts from nutrients given narrative nutrient criteria

a. Water Quality Index (WQI)

Five Categories:

- Water Clarity
  - Turbidity and Total suspended solids
- Dissolved Oxygen
- Oxygen demanding substances
  - BOD, COD, and TOC
- Nutrients
  - Total N, Nitrate, and Total P
- Bacteria
  - Total Coliform and Fecal Coliform
7. Calculate index
   a. Water Quality Index (WQI)
      ‣ each parameter assigned a value between 0 and 99 based on the percentile distribution of stream water quality (Typical Water Quality Values, from 1989)
      ‣ values averaged to obtain an overall index value for each category
      ‣ each category are averaged to obtain a final WQI rating (good = 0-44, fair = 45-59, or poor = 60-99)
Stream phosphorus percentiles for 1980 and 1990

1980’s

1990’s
# Chemistry Index

## Water Quality Index Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Best quality</th>
<th>Worst quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>WQI Unit</td>
<td>10 20 30 40 50</td>
<td>60 70 80 90</td>
</tr>
<tr>
<td><strong>Category: Water clarity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbidity JTU</td>
<td>1.50 3.00 4.00 4.50</td>
<td>5.20 8.80 12.20 16.50</td>
</tr>
<tr>
<td>Total suspended solids milligrams per liter (mg/l)</td>
<td>2.00 3.00 4.00 5.50</td>
<td>6.50 9.50 12.50 18.00 26.50</td>
</tr>
<tr>
<td><strong>Category: Dissolved oxygen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved oxygen mg/l</td>
<td>8.00 7.30 6.70 6.30</td>
<td>5.80 5.30 4.80 4.00</td>
</tr>
<tr>
<td><strong>Category: Oxygen demand</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemical oxygen demand mg/l</td>
<td>0.80 1.00 1.10 1.30</td>
<td>1.50 1.90 2.30 3.30</td>
</tr>
<tr>
<td>Chemical oxygen demand mg/l</td>
<td>16.00 24.00 32.00 38.00</td>
<td>46.00 58.00 72.00 102.00</td>
</tr>
<tr>
<td>Total organic carbon mg/l</td>
<td>5.00 7.00 9.50 12.00</td>
<td>14.00 17.50 21.00 27.50</td>
</tr>
<tr>
<td><strong>Category: Nutrients</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total nitrogen mg/l as N</td>
<td>0.55 0.75 0.90 1.00</td>
<td>1.20 1.40 1.60 2.00</td>
</tr>
<tr>
<td>Nitrate plus nitrite mg/l as N</td>
<td>0.01 0.03 0.05 0.07</td>
<td>0.10 0.14 0.20 0.32</td>
</tr>
<tr>
<td>Total phosphorus mg/l as P</td>
<td>0.02 0.03 0.05 0.07</td>
<td>0.09 0.16 0.24 0.46</td>
</tr>
<tr>
<td><strong>Category: Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total coliform #/100 milliliters (ml)</td>
<td>100.00 150.00 250.00 425.00</td>
<td>600.00 1100.00 1600.00 3700.00</td>
</tr>
<tr>
<td>Fecal coliform #/100 ml</td>
<td>10.00 20.00 35.00 55.00</td>
<td>75.00 135.00 190.00 470.00</td>
</tr>
</tbody>
</table>

meets partially does not meet
7. Calculate index
   b. Trophic State Index (TSI)
      ‣ applies to lakes and estuaries
      ‣ measures the potential for algal or aquatic weed growth - total nitrogen, total phosphorus, chlorophyll
      ‣ a ten (10) unit change in the index represents a halving or doubling of algal biomass
      ‣ overall TSI is an average of chlorophyll and nutrient indices
7. Calculate index

b. Trophic State Index (TSI)

- Trophic State Index for lakes based on:
  - Chlorophyll - Florida lake index value
    - developed from a regression analysis of data collected from 313 Florida lakes
  - Nutrients - Nutrient Trophic State Index Value
    - based on phosphorus and nitrogen concentrations and the limiting nutrient concept
305(b) Methodology - data analysis

7. Calculate index

b. Trophic State Index (TSI)

Limiting Nutrient Concept

Identifies a lake as phosphorus limited if the nitrogen-to-phosphorous concentration ratio is greater than 30, nitrogen limited if the ratio is less than 10, and balanced if the ratio is between 10 and 30.
305(b) Methodology - data analysis

7. Calculate index
   b. Trophic State Index (TSI)
      ‣ Trophic State Index for Estuaries
         ‣ Rating scale is lower for each category
         ‣ Reflects a lower desirable upper limit for chlorophyll
7. **Calculate index**

* b. **Trophic State Index (TSI)**

  ▶ Trophic State Index

<table>
<thead>
<tr>
<th>Rating</th>
<th>Lake</th>
<th>Estuary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0 - 59</td>
<td>0 - 49</td>
</tr>
<tr>
<td>Fair</td>
<td>60 - 69</td>
<td>50 - 59</td>
</tr>
<tr>
<td>Poor</td>
<td>70 - 100</td>
<td>60 - 100</td>
</tr>
</tbody>
</table>

**305(b) Methodology - data analysis**
## Lake Trophic State Index Values

### Chemistry Index

<table>
<thead>
<tr>
<th>Tsi</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll ug/l</td>
<td>0.3</td>
<td>0.6</td>
<td>1.3</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>Total phosphorus mgP/l</td>
<td>0.003</td>
<td>0.005</td>
<td>0.009</td>
<td>0.01</td>
<td>0.02</td>
<td>0.04</td>
<td>0.07</td>
<td>0.12</td>
<td>0.2</td>
<td>0.34</td>
<td>0.58</td>
</tr>
<tr>
<td>Total nitrogen mg N/l</td>
<td>0.06</td>
<td>0.1</td>
<td>0.16</td>
<td>0.27</td>
<td>0.45</td>
<td>0.7</td>
<td>1.2</td>
<td>2.0</td>
<td>3.4</td>
<td>5.6</td>
<td>9.3</td>
</tr>
</tbody>
</table>

- **meets**
- **partially**
- **does not meet**
8. Identify exceedances of water quality criteria

- Florida's surface water quality criteria are used to assess whether a pollutant concentration in a watershed is high enough to preclude the designated use of the waterbody.
- Exceedances of metal’s and conventional pollutants are determined using chemical water quality data from STORET.
- Based on the number of violations in last 3 years.
8. Identify exceedances of water-quality standards

- parameters evaluated:
  - Conventional pollutants
    - Dissolved oxygen
    - Chlorides
    - Ammonium
  - Metals
    - Arsenic
    - Aluminum
    - Cadmium
    - Chromium
    - Iron
    - Lead
    - Mercury
    - Nickel
    - Selenium
    - Silver
    - Thallium
    - Zinc

305(b) Methodology - data analysis
### Determining water quality

*(based on exceeded standards over a three-year period)*

<table>
<thead>
<tr>
<th></th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional pollutants</td>
<td>&lt; 10%</td>
<td>11 - 25 %</td>
<td>&gt; 25%</td>
</tr>
<tr>
<td>Metals, unionized ammonia, chloride, cyanide, pesticides</td>
<td>&lt;= 1 sample</td>
<td>≥ 10%</td>
<td>&gt; 10%</td>
</tr>
<tr>
<td>Bacteria</td>
<td>0</td>
<td>≥ 10%</td>
<td>&gt; 10%</td>
</tr>
</tbody>
</table>
9. **Status determination**

- a single, simple averaging, over-all water quality rating for a watershed
- each assessment value is given a score
  - Good quality - 1
  - Fair quality - 3
  - Poor quality - 5
- Score chemistry, biology and fish consumption
9. Status determination

- overall average is calculated
  - Good - 1 to 2
  - Fair - 2 to 4
  - Poor - 4 to 5

- result is a status rating representing the present status for each watershed with sufficient data for assessment

- does not address data sufficiency, simply assesses whatever data are present

- not used for Use determination, which is basis for 303(d) list
10. Apply confidence filters

- A minimum of three “samples” (a sample is defined as two sampling events: one summer and one winter) is required for each watershed instead of only one sample. (Note the 3 samples could be taken in 1 year from 3 different stations or from 1 station sampled over 3 years.)

- Data from three or more Water Quality Index (WQI) categories (water clarity, DO, oxygen demanding substances, nutrients, and bacteria) are required to determine a WQI.

- For the oxygen demanding substances category of the WQI, if BOD data are available, COD and/or TOC will not be used.
305(b) Methodology - conclusions

11. Use designation determination

- results reported as
  - Meets Designated Use
  - Partially Meets Designated Use
  - Does Not Meet Designated Use

- result is a rating representing the present use designation for each watershed with sufficient data for assessment

- Note - EPA requires if biology and chemistry indicate poor quality, then the index is set to does not meet.
11. Use designation determination

- Assessment Components

- Chemistry Index
  - Stream WQI or Lake/estuary TSI

- Chemistry Violations
  - conventional
  - metals

- Biology Index

- Fish Contamination
The Assessment Calculation for Chemistry Passing Confidence Filter

- **Chemistry Index**
  - Stream WQI: good 1
  - Lake/estuary TSI

- **Chemistry Violations**
  - conventionals: fair 3
  - metals: good 1

- **Biology Index**: good 1

- **Fish Contamination**: fair 3

Status = \((1 + (3 + 1)/2 + 1 + 3)/4 = 7/4 = 1.75 = \text{good}

305(b) Use designation = Meets
The Assessment Calculation for Chemistry Not Passing Confidence Filter

- **Chemistry Index***
  - Stream WQI  good 1
  - Lake/estuary TSI

- **Chemistry Violations**
  - conventionals  fair 3
  - metals  good 1

- **Biology Index**  poor 5

- **Fish Contamination**  fair 3

305(b) Use designation = Does not Meet Use (because Biology is poor)

* Not used because not enough samples were collected to pass confidence filter.
The Assessment Calculation

- **Chemistry Index**
  - Stream WQI: good 1
  - Lake/estuary TSI

- **Chemistry Violations**
  - conventionals: fair 3
  - metals: good 1

- **Biology Index**: good 1

- **Fish Contamination**: fair 3

Overall call = \( \frac{(1 + (3+1/2)+ 1 + 3)/4}{4} = \frac{7}{4} = 1.75 = \text{good} \)

305(b) Use designation = Meets
12. **Other EPA reporting requirements - Screen for poor water quality (causes)**

- used to identify poor water quality
- compare water quality value to index criteria
  - used in eBASE to color code individual water quality measurements
305(b) Methodology - source determination

12. Other EPA reporting requirements - nonpoint source pollution data (sources)

1994 update of 1988 Survey

- In 1988, FDEP qualitatively assessed the effect of nonpoint pollution on Florida’s waters via a questionnaire sent to all major state agencies.
- Received 300-400 respondents from 150 agencies.
- Identified: nonpoint sources of pollution, pollutants, symptoms (fish kills & algal blooms).
- Updated survey in 1994.

1998 305(b) - used the pollution source information to identify sources (e.g. agriculture or urban runoff)
13. Other EPA reporting requirements - analyze trends

- trends determined by utilizing:
  - water quality measurements for individual parameters and
    - overall Stream Water Quality Index (streams, black water streams and springs) or
    - overall Trophic State Index (lakes and estuaries) for watersheds.
  - determined for watersheds with at least 5 years of data between 1988 and 1997; total of 945 statewide
13. Other EPA reporting requirements - analyze trends

- uses Spearman Ranked Correlation Coefficient
- determined by comparing improved and degraded water quality measurements
- annual median values for sampling stations are analyzed for changes
- if a waterbody shows no trend, or if just one indicator shows a trend, then the trend is classified as “no change”
305(b) Methodology - acknowledged weaknesses

- TSI for Estuaries based on Lakes
  - need estuarine-specific index
  - doesn’t differentiate between different types of estuaries
- Lake TSI not regionally based and doesn’t address nuisance aquatic vegetation
- WQI for streams not regionally based and criteria for good, fair, and poor (particularly fair) are questionable
305(b) Methodology - acknowledged weaknesses

(continued)

• Need to incorporate historical bioassessment data and data from BioRecons
• Uses mean Dissolved Oxygen (DO) values
  – doesn’t adequately address low DO at depth
  – high DO from algal blooms skew data
    • could use percent DO saturation
• Doesn’t address some designated uses
  – shellfish and beach closing
305(b) Methodology - Other Key Issues

- Confidence in assessment
  - frequency and number of samples
- Should we composite metrics or have independent applicability
- How to address natural perturbations and variability