CHARACTERIZING WATER QUALITY IN THE CHARLOTTE HARBOR ESTUARIES USING A TRAINED VOLUNTEER CORPS:


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This Program Briefly Describes the Charlotte Harbor Estuaries Volunteer Water quality Monitoring Network’s:

- Diverse Estuaries
- Methods & Procedures
- Water Quality Results
- Data Conclusions
- Program Conclusions
Charlotte Harbor Estuaries include 6 of Florida’s 42 Aquatic Preserves

FL Aquatic Preserves are Exceptional Submerged Resources Set Aside to be Preserved for Future Generations to Enjoy
Charlotte Harbor Estuaries are part of the Charlotte Harbor National Estuary Program & are the downstream receiving waters of a 4,500 mile$^2$ watershed.
Charlotte Harbor Estuaries include 7 Diverse Interconnected Estuaries

- **LEMON BAY**
  - 12 mi²
  - 7 tribs
  - 2 passes

- **GASPARILLA SOUND**
  - 10 mi²
  - 1 tribs
  - 2 passes

- **PINE ISLAND SOUND**
  - 80 mi²
  - 0 tribs
  - 4 passes

- **CHARLOTTE HARBOR**
  - 135 mi²
  - 2 tribs
  - 1 pass

- **MATLACHA PASS**
  - 21 mi²
  - 1 trib
  - 1 pass

- **SAN CARLOS BAY**
  - 10 mi²
  - 1 trib
  - 1 pass

- **ESTERO BAY**
  - 15 mi²
  - 5 tribs
  - 3 passes
Water Quality in these Estuaries is Monitored Monthly by the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network

CHEVWQMN is a partnership of:

>75 Citizen Monitors

FL Dept of Environmental Protection

Charlotte Harbor Environmental Center

Charlotte Harbor National Estuary Program
Purposes of the CHEVWQMN:

• Determine Baseline Estuary Health for Managing Charlotte Harbor Aquatic Preserves & CHNEP.

• Compliment Other Resource Monitoring Programs by Filling Gaps & Linking Programs.

• Assist with Developing Consistent Agency Water Quality Monitoring Program throughout Region.

• Enhance Community Understanding & Involvement in Managing Aquatic Preserves & CHNEP.
Sampling Protocols of the CHEVWQMN:

- **Time**: 1st Monday of Month at Sunrise.
- **Locations**: 46 Fixed Sites.
- **Sample Collection**: Surface Grab.
- **Parameters**: 13 Measured In Field & 6 Collected for Lab for Analysis.
- **Monitors**: >75 Well Trained & Equipped Reliable Volunteers Assigned to Specific Sites.
- **Lab Analyses**: By Certified Lab.
- **Quality Assurance**: Approved Plan & Standard Field & Lab Methods.
- **Data Management**: Verify Data, Access, Excel.
- **Biases**: Sunrise, Surface Only, Near Shore.
### Sampling Locations of CHEVWQMN:
- 41 Estuary & 5 Tribs.

### SUMMARY OF CHEVWQMN SAMPLING SITES

<table>
<thead>
<tr>
<th>Estuary</th>
<th># Estuary Sites</th>
<th># Trib Sites</th>
<th>Total Sites</th>
<th>Field Start Date</th>
<th>Lab Start Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon Bay</td>
<td>9</td>
<td>2</td>
<td>11</td>
<td>Jul-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>Gasparilla Sound</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>Jan-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>Charlotte Harbor</td>
<td>11</td>
<td>1</td>
<td>12</td>
<td>Jan-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>Pine Island Sound</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>Feb-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>Matlacha Pass</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>Feb-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>San Carlos Bay</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>Feb-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td>Estero Bay</td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>Mar-98</td>
<td>Jul-98</td>
</tr>
<tr>
<td><strong>Total No. of Sites</strong></td>
<td><strong>41</strong></td>
<td><strong>5</strong></td>
<td><strong>46</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Widely Distributed & Representative.
- Well Documented & Described w/Lat/Long.
CHARLOTTE HARBOR ESTUARIES
VOLUNTEER WATER QUALITY MONITORING NETWORK
FIELD DATA SHEET

Site # ____________  Date ____________  Time Start ____________  Time End ____________
Sunrise Time ___________

Monitors' Names  ______________________________    _____________________________
_________________________

Waterbody Name __________________________________   Estuary Region
_______________________________________

Wind Speed & Direction (see Beaufort Scale):
N, NE, E, SE, S, SW, W, NW
<1 mph           8-12 mph         25-31 mph
1-3 mph         13-18 mph            >32 mph
4-7 mph         19-24 mph

°F
°C

Weather:
1= Sunny             3= Overcast     5= Drizzle    7= Other
2= Partly Cloudy  4= Fog/Haze    6= Rain

Precipitation:
Amount in last 24 hours in inches

Air Temperature:
in °F & °C

Water Surface Conditions:
1= Calm    2= Ripples   3= Waves   4= White Caps

Tide Stage:
1= Incoming  2= High Slack  3= Outgoing   4= Low Slack

Water Depth in 1/10 meters:

Secchi Depth in 1/10 meters:
Disappear             Reappear             Average

Water Temperature:
in °F & °C

Dissolved Oxygen in mg/l:
Test #1             Test #2             Test #3 (if needed)

pH:

Salinity in ppt:

Water Color Observed:
1= Med Brown      4= Green Brown       7= Other
2= Dark Brown     5= Green                  8= Green Blue
3= Red Brown      6= Yellow green       9= Blue

Water Color Measured in PCUs:

Collect & Ice Chlorophyll a Sample:  Yes or No

Collect & Ice Fecal Coliform Sample:  Yes or No

Collect & Ice Phosphorus/Nitrogen:  Yes or No

General Conditions:
1= Dead fish    3= Odors     5= Debris    7= Other
2= Erosion       4= Oil film    6= Foam

Other Observations & Comments:

SAMPLING METHODS, EQUIPMENT, PRESERVATIVES & ANALYSIS METHODS
USED BY THE CHEVWQMN

<table>
<thead>
<tr>
<th>PARAMETER or ACTION</th>
<th>SAMPLING METHOD &amp; EQUIPMENT</th>
<th>HOLDING TIME &amp; PRESERVATIVE</th>
<th>ANALYSIS METHOD</th>
</tr>
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<tbody>
<tr>
<td>Data Recording</td>
<td>Data Sheet &amp; Clip Board</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Wind Speed &amp; Direction</td>
<td>Observation &amp; Beaufort Wind Scale</td>
<td>immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Percipitation (24 Hrs)</td>
<td>Rain Guage</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Water Surface</td>
<td>Observation</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Tide Stage</td>
<td>Observation &amp; Tide Chart</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Water Depth</td>
<td>Observation &amp; Weight</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Water Clarity</td>
<td>Secchi &amp; Calibrated Line</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Collect Water Sample</td>
<td>Plastic Bucket &amp; Line</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>Thermometer (Armored)</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Water Color</td>
<td>Observation, Color Test Kit</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Salinity</td>
<td>Hach # 2234-00, Hydrometer</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>pH</td>
<td>Colorimetric test kit</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Winkler Titration Test Kit</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Sample Transport</td>
<td>Small Cooler &amp; Ice Packs</td>
<td>Immediate</td>
<td>N/A</td>
</tr>
<tr>
<td>Total Phosphorus (TP)</td>
<td>Surface Grab Sample</td>
<td>Preserve with H2SO4</td>
<td>EPA 365.4 Colorimetric Auto-Block Digester</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen (TKN)</td>
<td>Surface Grab Sample</td>
<td>Preserve with H2SO4</td>
<td>EPA 351.2 Colorimetric Semi-auto Block Digester</td>
</tr>
<tr>
<td>NO2/NO3</td>
<td>Surface Grab Sample</td>
<td>Preserve with H2SO4</td>
<td>EPA 353.2 Colorimetric Auto-Cd Reduction</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>Surface Grab Sample</td>
<td>Put on Ice</td>
<td>SM 9222 10200 H Spectrophotometric</td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td>Surface Grab Sample</td>
<td>Put on Ice</td>
<td>SM 922 D</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Sterile Whirl Pack - 18 oz</td>
<td>Run within 6 Hours</td>
<td>Membrane Filter Method</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Plastic Jug with Kitty Litter</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Quality Assurance Methods of CHEVWQMN:

- Standard Field Collection & Analyses.
- Standard Sample Preservation & Transport.
- Standard Lab Procedures.
- 4 Field Duplicate Samples Each Month.
- 4 Field Blank Samples Each Month.
- 2 DO Samples Each Month at Each Site.
- 2 Network Wide Quality Assurance Practice Sessions Each Year.
- Volunteer Training in Classroom & Field.
- Site Specific Monitors & Equipment.
- 2 Monitors per Site.
1998-2003 Results of the CHEWQMN:

- 10 Parameters Presented:
  - Temperature
  - Turbidity
  - Tot Nitrogen
  - Dissolved Oxygen
  - Secchi
  - Tot Phosphorus
  - Salinity
  - Chl a
  - FC Bacteria
  - Color

- 72 Months Averaged.

- 7 Estuaries Summarized.

- Includes Only Small % of Possible Data Analyses.

- Data Continues to Accumulate Rapidly!
Guidelines for Interpreting Results:
1 Dissolved Oxygen: Fish & Wildlife Standard
2 Secchi, Color, Turbidity, TN & TP: FDEP Typical
Water Quality Values for FL Estuaries (lowest 30%,
middle 31-59% & highest 40% of FL Estuaries)
3 Chlorophyll: FDEP Impaired Waters Standard
4 Fecal Coliform Bacteria: Public Health Std
5 Suggested Ranges: Based on Typical FL WQ
Values & FL TSI for Estuaries

<table>
<thead>
<tr>
<th></th>
<th>DO¹ (mg/l)</th>
<th>Secchi² (m)</th>
<th>Color² (PCUs)</th>
<th>Chl² &amp; ³ (ug/l)</th>
<th>TN² (mg/l)</th>
<th>TP² (mg/l)</th>
<th>FC Bacteria⁴ CFUs/100 mls</th>
<th>ESTUARY⁵ HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above Ave</td>
<td>&gt; 5.0</td>
<td>&gt; 1.5</td>
<td>&lt; 12</td>
<td>&lt; 5</td>
<td>&lt; 0.6</td>
<td>&lt; 0.04</td>
<td>Ave &lt; 199 Max &lt; 799</td>
<td>(≤ 30%)</td>
</tr>
<tr>
<td>Average</td>
<td>2.1 - 4.9</td>
<td>1.1 - 1.4</td>
<td>13 - 29</td>
<td>6 - 10</td>
<td>0.7</td>
<td>0.05</td>
<td>0.05</td>
<td>(31-59%)</td>
</tr>
<tr>
<td>Below Ave</td>
<td>≤ 2.0</td>
<td>≤ 1.0</td>
<td>≥ 30</td>
<td>≥ 11</td>
<td>≥ 0.9</td>
<td>≥ 0.14</td>
<td>Ave ≥ 200 Max ≥ 800</td>
<td>(≥ 60%)</td>
</tr>
</tbody>
</table>
Remember the 7 Charlotte Harbor Estuaries:

- Lemon Bay: 9 Sites
- Gasparilla Sound: 3 Sites
- Pine Island Sound: 6 Sites
- Charlotte Harbor: 11 Sites
- Matlacha Pass: 4 Sites
- San Carlos Bay: 2 Sites
- Estero Bay: 6 Sites
Temperature Ranged from 4.0°C – 32.0°C
Highest Ave = Gasparilla S & Matlacha P (24.2°C)
Lowest Ave = Pine Island Sound (23.5°C)
Widest Range = Charlotte Harbor (4.0°C – 32.0°C)
Dissolved Oxygen:

**DISSOLVED OXYGEN AVERAGE FOR EACH ESTUARY (mg/l)**

- **Lemon Bay**: 4.5 mg/l
- **Gasparilla Sd**: 4.7 mg/l
- **Charlotte Hr**: 5.1 mg/l
- **Pine Is Sd**: 5.7 mg/l
- **Matlacha Ps**: 5.4 mg/l
- **San Carlos Bay**: 6.2 mg/l
- **Estero Bay**: 4.9 mg/l

- Dissolved Oxygen Ranged from 0.3 mg/l – 9.1 mg/l
- Highest Ave = San Carlos Bay (6.2 mg/l)
- Lowest Ave = Lemon Bay (4.5 mg/l)
- Widest Range = Pine Island S (0.3 mg/l – 9.0 mg/l)
Dissolved Oxygen:

DISSOLVED OXYGEN AVERAGE FOR EACH ESTUARY (mg/l)

- **4 Estuaries > DO Standard of 5.0 mg/l**
  (Charlotte H, Pine Island S, Matlacha P & San Carlos B)
- **3 Estuaries < DO Standard of 5 mg/l**
  (Lemon Bay, Gasparilla Sound & Estero Bay)
Salinity:

Salinity Avergae for Each Estuary (ppt)

- **Salinity Ranged from 1.0 ppt – 42.0 ppt**
- **Highest Ave = Gasparilla Sound (33.6 ppt)**
- **Lowest Ave = Matlacha Pass (23.4 ppt)**
- **Widest Range = Charlotte Harbor (1.1 – 39.1 ppt)**
Secchi: SECCHI AVERAGE FOR EACH ESTUARY (m)

- Secchi Depths Ranged from 0.2 m – 3.9 m
- Highest Ave = Matlacha Pass (1.6 m)
- Lowest Aves = Lemon Bay & Estero Bay (1.1 m)
- Widest Ranges = Matlacha Pass (0.4 m – 3.8 m) & San Carlos Bay (0.5 m – 3.9 m)
Secchi:

SECCHI AVERAGE FOR EACH ESTUARY (m)

- 1 Estuary > “Above Average” Value of 1.5 m (Matlacha Pass)
- 0 Estuaries < “Below Average” Value of 1.0 m
Water Color:

Water Color Ranged from 0 PCUs – 280 PCUs
Highest Ave = Charlotte Harbor (43 PCUs)
Lowest Ave = Gasparilla Sound (15 PCUs)
Widest Range = Charlotte Harbor (0 – 280 PCUs)
Water Color:

WATER COLOR AVERAGE FOR EACH ESTUARY (PCUs)

- 6 Estuaries fall within the “Average” Values of 13-29 PCUs
- 1 Estuary falls above the “Above Average” Value of 30 PCUs (Charlotte Harbor)
Turbidity Ranged from 0 NTUs to 120 NTUs
Highest Ave = Estero Bay (6.1 NTUs)
Lowest Ave = Matlacha Pass (2.6 NTUs)
Widest Range = Charlotte Harbor (0.2 – 120 NTUs)
Chlorophyll Ranged from 0.4 ug/l – 82.1 ug/l
• Highest Ave = Lemon Bay (7.3 ug/l)
• Lowest Ave = Gasparilla Sound (3.7 ug/l)
• Widest Range = Charlotte Harbor (0.5 – 82.1 ug/l)
• 4 Estuaries < “Above Average” Value of 5 ug/l (Gasparilla S, Matlacha P, San Carlos B & Estero B)
• 0 Estuaries > “Impaired” Standard of 11 ug/l
Total Nitrogen:

Total Nitrogen Ranged from 0.11 – 2.93 mg/l

- Highest Ave = Charlotte Harbor (0.93 mg/l)
- Lowest Ave = San Carlos Bay (0.72 mg/l)
- Widest Range = Matlacha Pass (0.14 - 2.93 mg/l)
Total Nitrogen:

TOTAL NITROGEN AVERAGE FOR EACH ESTUARY (mg/l)

- Lemon Bay: 0.72
- Gasparilla Sd: 0.91
- Charlotte Hr: 0.81
- Pine Is Sd: 0.93
- Matlacha Ps: 0.75
- San Carlos Bay: 0.89
- Estero Bay: 0.77

- 0 Estuaries < “Above Average” Value of 0.6 mg/l
- 2 Estuaries > “Below Average” Value of 0.9 mg/l (Lemon Bay & Charlotte Harbor)
Total Phosphorus:

TOTAL PHOSPHORUS AVERAGE FOR EACH ESTUARY (mg/l)

- Total Phosphorus Ranged from 0.01- 0.90 mg/l
- Highest Ave = Charlotte Harbor (0.17 mg/l)
- Lowest Aves = Gasparilla S, Pine Island S, San Carlos B & Estero B (0.07 mg/l)
- Widest Range = Charlotte Harbor (0.01 - 0.90 mg/l)
Total Phosphorus:

TOTAL PHOSPHORUS AVERAGE FOR EACH ESTUARY (mg/l)

- Lemon Bay: 0.12
- Gasparilla Sd: 0.07
- Charlotte Hr: 0.17
- Pine Is Sd: 0.07
- Matlacha Ps: 0.08
- San Carlos Bay: 0.07
- Estero Bay: 0.07

- 0 Estuaries < “Above Average” Value of 0.04 mg/l
- 1 Estuary > “Below Average” Value of 0.14 mg/l (Charlotte Harbor)
Fecal Coliform Bacteria:

FECAL COLIFORM BACTERIA AVERAGE FOR EACH ESTUARY
(cfu/100 ml)

- FC Bacteria Ranged from 1– 1452 cfu/100 ml (some TNTC, also)
- Highest Ave = Lemon Bay (41 cfu/100 ml)
- Lowest Aves = San Carlos Bay (5 cfu/100 ml)
- Widest Range = Matlacha Pass (1-1462 cfu/100 ml)
Fecal Coliform Bacteria:

FECAL COLIFORM BACTERIA AVERAGE FOR EACH ESTUARY
(cfu/100 ml)

- Lemon Bay: 41
- Gasparilla Sd: 22
- Charlotte Hr: 31
- Pine Is Sd: 14
- Matlacha Ps: 17
- San Carlos: 5
- Estero Bay: 29

- 7 Estuaries < Health Standard Ave 200 cfu/100 ml
- 15 Samples > Health Standard 1 Time 800 cfu/100ml
  (Lemon Bay, Charlotte Harbor & Matlacha Pass)
### Interpreting the 1998 - 2003 CHEVWQMN Data:

<table>
<thead>
<tr>
<th></th>
<th>DO¹ (mg/l)</th>
<th>Secchi² (m)</th>
<th>Color² (PCUs)</th>
<th>Chl² (ug/l)</th>
<th>TN² (mg/l)</th>
<th>TP² (mg/l)</th>
<th>FC Bacteria³ (CFUs/100ml)</th>
<th>1998-2003 RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEMON BAY (Ave of 9 Sites)</td>
<td>4.5</td>
<td>1.1</td>
<td>21</td>
<td>7.3</td>
<td>0.91</td>
<td>0.12</td>
<td>41 Ave</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GASPARILLA SD (Ave of 3 Sites)</td>
<td>4.7</td>
<td>1.5</td>
<td>15</td>
<td>3.7</td>
<td>0.81</td>
<td>0.07</td>
<td>22 Ave 1,600</td>
<td>Above Ave</td>
</tr>
<tr>
<td>CHARLOTTE HR (Ave of 11 Sites)</td>
<td>5.1</td>
<td>1.2</td>
<td>43</td>
<td>6</td>
<td>0.93</td>
<td>0.17</td>
<td>31 Ave 690</td>
<td>Average</td>
</tr>
<tr>
<td>PINE ISLAND SD (Ave of 6 Sites)</td>
<td>5.7</td>
<td>1.4</td>
<td>20</td>
<td>5</td>
<td>0.75</td>
<td>0.08</td>
<td>14 Ave 288</td>
<td>Average</td>
</tr>
<tr>
<td>MATLACHA PASS (Ave of 4 Sites)</td>
<td>5.4</td>
<td>1.6</td>
<td>31</td>
<td>4.5</td>
<td>0.89</td>
<td>0.08</td>
<td>17 Ave 1,452</td>
<td>Above Ave</td>
</tr>
<tr>
<td>SAN CARLOS BAY (Ave of 2 Sites)</td>
<td>6.2</td>
<td>1.5</td>
<td>20</td>
<td>4</td>
<td>0.72</td>
<td>0.07</td>
<td>5 Ave 98</td>
<td>Above Ave</td>
</tr>
<tr>
<td>ESTERO BAY (Ave of 6 Sites)</td>
<td>4.9</td>
<td>1.1</td>
<td>24</td>
<td>4.8</td>
<td>0.77</td>
<td>0.07</td>
<td>29 Ave 384</td>
<td>Average</td>
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</table>
CHEVWQMN Data Conclusions:

• “Above Average” to “Average” estuary health estimates show need to reduce human nutrient inputs to the estuaries.

• Watershed management activities should focus on the most critical estuaries & sites including Lemon Bay & Estero Bay, & LBV001, CHV013, PIV001 & EBV005.

• Additional Analysis is needed for
  ~ Seasonal & Yearly Trends
  ~ Spatial trends
  ~ Reference Sites Comparisons
CHEVWQMN Program Conclusions:

- CHEVWQMN Data is useful for
  - managing Aquatic Preserves
  - estimating pollutant load reduction goals
  - evaluating proposed development projects

- Models for estimating estuary health from data need to be improved.

- Value of Volunteer Contributions > $370,000
  (42 hrs/yr/vol + $200 gas/yr/vol X 75 volunteers)

- Consistent lab support is important for generating reliable data & for allowing the CHEVWQMN to...
Continue Monitoring, Managing & Enjoying Our Special Estuaries Wisely.

Dedicated to the Memory of Peter Ordway, Henry Welter & Wyatt Hooks.