REGIONAL COASTAL ASSESSMENT PROGRAM
(Formerly known as the Coastal Bend Bays Project)

A Proactive Approach in Coastal Monitoring for South Texas

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PARTNERS

• Coastal Bend Bays & Estuaries Program, Inc.
• Port Industries of Corpus Christi
• Texas Commission on Environmental Quality
  – Houston Analytical Laboratory (Year 1)
• Texas General Land Office
  – Coastal Coordination Council - Coastal Management Program
• National Oceanic and Atmospheric Administration
  – Coastal Zone Management Program
• U.S. Environmental Protection Agency
  – Region 6
  – National Health and Environmental Effects Research Laboratory - Gulf Ecology Division
CBBEP Region

- 3 of the 7 major Texas systems
  - Mission - Aransas, Nueces, and Upper Laguna Madre
  - 600 square miles
  - ~ 30% of the Texas Coastline

- Connected yet biogeographically distinct

- Salinity increases north to south
  - Laguna Madre one of a few hypersaline lagoons in the world

- Semi-arid, sub-tropical climate
  - Average rainfall 25 to 38 inches
  - highly variable
  - Tropical Storms / Hurricanes
BACKGROUND AND PROJECT JUSTIFICATION

- CBBEP region historically under sampled for water quality parameters
  - Decline in temporally and spatially intense monitoring since the mid-1970s
  - Sufficient monitoring of Copano and Aransas Bays is lacking
  - No consistent historical monitoring of specific parameters within the expansive Coastal Bend Bay System
BACKGROUND AND PROJECT JUSTIFICATION

• Historical data raised numerous Water Quality concerns within the CBBEP System
  – Chlorophyll-a, DO, salinity (lack of freshwater inflows)
  – Priority pollutant metals including cadmium, copper, chromium, lead, mercury, nickel, and zinc
  – Portions of CBBEP Region placed on Texas 303 (d) list of impaired waters for elevated zinc in oyster tissue. TMDL currently being conducted
    • Most listed for fecal coliforms (Oso Bay and ULM for DO)
    • Nearly listed for copper (d) (Station 13407 – Marker 62 in CC Bay)

• Stakeholder Concern (TMDL)

• Proactive Approach (Bottom-Up rather than Top-Down)
PROJECT OBJECTIVES

• Conduct an intensive, targeted monitoring study to adequately characterize CBBEP Water Quality conditions:
  – Produce scientifically sound Water Quality data
    • QAPP (but of course)
    • “Ultra - Clean” Sampling and Laboratory Techniques
    • Utilizing Improved Analysis Methods
  – Produce sufficient data to describe spatial and temporal Water Quality trends in the CBBEP region
    • Superior quality compared to historical monitoring data
    • Address areas and parameters of historic concern
  – Produce a extensive, reliable, and powerful data set
    • Solid basis for future management decisions
    • Accurate data that allows for precise localization of anthropogenic influences
30 “EMAP” Stations (n = 120)
   - One Per Hexagon Per Quarter
   - Field, RC, TM, and Bio
   - Sediment for 1 Quarter

6 “Targeted” Stations (n = 36)
   - Bi-monthly sampling
   - Field, RC and TM
   - TCEQ Established Stations

4 Inner Harbor Stations (n = 16)
   - Quarterly Sampling
   - Field, RC, TM
   - TCEQ Established Stations

4 Oso Creek and 4 Oso Bay (n = 16)
   - First 2 Quarters
   - Field, RC, and TM
   - TCEQ Established Stations

31 “EMAP” Stations (n = 124)
   - One Per Hexagon Per Quarter
   - Field, RC, TM, and Bio
   - Sediment for 1 Quarter
Monitoring Parameters

Field Measurements

Routine Water Chemistry

Sediments

Total & Dissolved Metals

Biological
Field Measurements

- **Field Data**
  - Weather
  - Wind Conditions
  - Sea State
  - Water Clarity

- **Hydrolab**
  - Water Temperature
  - Dissolved Oxygen
  - Conductivity / Salinity
  - pH
Routine Water Chemistry
TCEQ CONVENTIONALS

- Alkalinity
- Ammonia - Nitrogen
- Nitrate + Nitrite - Nitrogen
- Total Kjeldahl Nitrogen
- Chloride
- Sulfate
- Total Organic Carbon
- Total Dissolved Solids
- Total Suspended Solids
- Volatile Suspended Solids
- Total Phosphorus
- Ortho – phosphorous
- Chlorophyll – a
- Pheophytin – a

✓ Water quality criteria for nutrients and chlorophyll a in water have not been developed……yet.

✓ Screening levels used by TCEQ to identify secondary concerns.

✓ Currently based on a 10– sample minimum.
Ammonia Nitrogen (mg/l)

- <0.020
- 0.021 - 0.040
- 0.041 - 0.060
- 0.061 - 0.080
- 0.081 - 0.100
- > 0.100 (SLE 2000)

Spring 2000

Summer 2000

Fall 2000

Winter 2001
Ammonia Nitrogen

Ammonia Nitrogen (mg/l)
- <0.020
- 0.021 - 0.040
- 0.041 - 0.060
- 0.061 - 0.080
- 0.081 - 0.100
- > 0.100 (SLE 2000)

Kilometers

Spring 2002
Summer 2001
Fall 2001
Winter 2002
Spring 2002
Total Phosphorus

**Total Phosphorus (mg/l)**
- **< 0.040**
- **0.040 - 0.054**
- **0.055 - 0.109**
- **0.110 - 0.164**
- **0.165 - 0.219**
- **> 0.220 (SLE 2000)**

**Seasons:**
- Spring 2000
- Summer 2000
- Fall 2000
- Winter 2001
Total Phosphorus

Total Phosphorus (mg/l)
- < 0.040
- 0.040 - 0.054
- 0.055 - 0.109
- 0.110 - 0.164
- 0.165 - 0.219
- > 0.220 (SLE 2000)

Kilometers

Spring 2002
Summer 2001
Fall 2001
Winter 2002
Spring 2002
Chlorophyll a

Chlorophyll a (ug/l)
- < 1.00
- 1.00 - 2.87
- 2.88 - 5.74
- 5.75 - 8.63
- 8.64 - 11.49
- > 11.50 (SLE 2000)

Spring 2000

Summer 2000

Fall 2000

Winter 2001
Chlorophyll a

- Chlorophyll a (ug/l)
  - < 1.00
  - 1.00 - 2.87
  - 2.88 - 5.74
  - 5.75 - 8.63
  - 8.64 - 11.49
  - > 11.50 (SLE 2000)

Kilometers

- Spring 2002
- Summer 2001
- Fall 2001
- Winter 2002
- Spring 2002
Sediments

Trace Metals
Total Organic Carbon
Sediment Grain Size

- Sediment criteria developed by the EPA for only a few parameters, but not adopted.
- Screening levels (PEL’s and 85th percentile) used by TCEQ to identify secondary concerns.
- Currently based on a 10 – sample minimum.
Copper in Sediment (mg/kg)
- < 4.70
- 4.70 - 9.40
- 9.41 - 18.69
- 18.70 - 63.44 (TEL)
- 63.45 - 108.20
- > 108.20 (PEL)

Winter (March) 2001
Summer (August) 2001
Lead in Sediment (mg/kg)
- < 7.56
- 7.56 - 15.11
- 15.12 - 30.23
- 30.24 - 71.20 (TEL)
- 71.21 - 112.18
- > 112.81 (PEL)

Winter (March) 2001
Summer (August) 2001
0 5 10 15
Kilometers
Zinc in Sediment (mg/kg)
- < 31.00
- 31.00 - 61.99
- 62.00 - 123.99
- 124.00 - 197.49 (TEL)
- 197.50 - 271.00
- > 271.00 (PEL)

Winter (March) 2001
Summer (August) 2001
Mercury

Mercury in Sediment (mg/kg)
- < 0.033
- 0.033 - 0.064
- 0.065 - 0.129
- 0.130 - 0.409 (TEL)
- 0.410 - 0.696
- > 0.696 (PEL)

Winter (March) 2001
Summer (August) 2001

Kilometers
TRACE METALS IN SEAWATER: AN ANALYTICAL CHALLENGE

• Estuaries and coastal oceans ecologically important receiving waters

• Trace metal levels can be low (sub-ppb)

• Ultra-clean methods required

• Analytically difficult matrix
  – Not well covered in EPA 1600’s methods
  – Extraction / pre-concentration required to obtain accurate data
FACTORS AFFECTING TRACE METALS DATA QUALITY

• Sample collection (Field)
  – Must be representative of the region
  – Minimize contamination during collection and post collection sample handling
  – Carefully cleaned plastic ware and equipment
  – Clean hands & dirty hands approach
  – On-site filtration for dissolved measurements
  – Low detection limits require low blanks
    • Blanks taken at start and end of sampling day
CLEAN METALS CHEMISTRY

- **Laboratory Sample Analysis**
  - Comprehensive QA procedures
  - Minimize contamination during preparation & analysis
  - Clean, sensitive analytical methods
  - Control matrix interferences (from seawater)
    - Avoid inaccurate data- false positives or false negatives

- **Focus on data accuracy!**
Trace Metals

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Mercury
- Selenium
- Silver
- Zinc
Dissolved Copper

Dissolved Copper (ppb)
- < 0.500
- 0.501 - 0.900
- 0.901 - 1.800
- 1.801 - 2.700
- 2.701 - 3.600
- > 3.600 (TWC 2000)

Spring 2000
Summer 2000
Fall 2000
Winter 2001

Kilometers
Dissolved Copper

- < 0.500
- 0.500 - 0.900
- 0.901 - 1.800
- 1.801 - 2.700
- 2.701 - 3.600
- > 3.60 (TWC 2000)

Spring 2002

Summer 2001

Fall 2001

Winter 2002

Spring 2002

Kilometers
DISSOLVED COPPER - STATION 13407

TCEQ Chronic Marine WQS

Copper (ppb)

Mar-00  Apr-00  May-00  Jun-00  Jul-00  Aug-00  Sep-00  Oct-00  Nov-00  Dec-00  Jan-01  Feb-01  Mar-01  Apr-01  May-01
Total Mercury

Total Mercury (ppb)
- < 0.0005
- 0.0005 - 0.0135
- 0.0136 - 0.0270
- 0.0271 - 0.0406
- 0.0407 - 0.0541
- > 1.10 (TWC 2000)

Spring 2000

Summer 2000

Fall 2000

Winter 2001
Total Mercury

<table>
<thead>
<tr>
<th>Total Mercury (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.0005</td>
</tr>
<tr>
<td>0.0005 - 0.0135</td>
</tr>
<tr>
<td>0.0136 - 0.0270</td>
</tr>
<tr>
<td>0.0271 - 0.0406</td>
</tr>
<tr>
<td>0.0407 - 0.0541</td>
</tr>
<tr>
<td>&gt; 1.10 (TWC 2000)</td>
</tr>
</tbody>
</table>

- Spring 2002
- Summer 2001
- Fall 2001
- Winter 2002
- Spring 2002
Comparison of Nueces Bay Stations
Total Recoverable Mercury vs. Dissolved Mercury

Q2 Total  Q3 Total  Q4 Total  Q4 Dissolved

µg l⁻¹

Human Health WQS 0.025

Q2 Total  Q3 Total  Q4 Total  Q4 Dissolved

0.0000  0.0100  0.0200  0.0300  0.0400  0.0500  0.0600
Dissolved Arsenic

Dissolved Arsenic (ppb)

- < 0.500
- 0.500 - 3.250
- 3.251 - 6.500
- 6.501 - 9.750
- 9.751 - 13.000
- > 78.00 (TWC 2000)

Spring 2000
Summer 2000
Fall 2000
Winter 2001
Dissolved Arsenic

Dissolved Arsenic (ppb)
- < 0.500
- 0.500 - 4.875
- 4.876 - 9.750
- 9.751 - 11.446
- 11.447 - 19.500
- > 78.000 (TWC 2000)

Summer 2001

Fall 2001

Winter 2002

Spring 2002

Kilometers
Dissolved Lead

[Dissolved Lead (ppb)]
- <0.020
- 0.020 - 0.155
- 0.156 - 0.310
- 0.311 - 0.466
- 0.467 - 0.622
- > 5.300 (TWC 2000)

Kilometers

Spring 2000
Summer 2000
Fall 2000
Winter 2001
Dissolved Lead

Dissolved Lead (ppb)
- <0.020
- 0.020 - 0.155
- 0.156 - 0.310
- 0.311 - 0.466
- 0.467 - 0.622
- > 5.300 (TWC 2000)

Spring 2002
Summer 2001
Fall 2001
Winter 2002

0 5 10 15 Kilometers
Dissolved Nickel

Dissolved Nickel (ppb)
- < 0.500
- 0.500 - 3.275
- 3.276 - 6.550
- 6.551 - 9.825
- 9.826 - 13.100
- > 13.000 (TWC 2000)

Kilometers

Spring 2000
Summer 2000
Fall 2000
Winter 2001
Dissolved Nickel

- Dissolved Nickel (ppb):
  - < 0.500
  - 0.500 - 3.275
  - 3.276 - 6.550
  - 6.551 - 9.825
  - 9.826 - 13.100
  - > 13.100 (TWC 2000)

Maps for:
- Summer 2001
- Fall 2001
- Winter 2002
- Spring 2002
Dissolved Zinc

- Dissolved Zinc (ppb)
  - < 0.200
  - 0.200 - 5.375
  - 5.376 - 10.750
  - 10.751 - 16.125
  - 16.126 - 21.500
  - > 84.200 (TWC 2000)

Maps for different seasons:
- Spring 2000
- Summer 2000
- Fall 2000
- Winter 2001

Kilometers
Dissolved Zinc

- **Spring 2002**
- **Summer 2001**
- **Fall 2001**
- **Winter 2002**

**Dissolved Zinc (ppb)**
- < 0.200
- 0.200 - 5.375
- 5.376 - 10.750
- 10.751 - 16.125
- 16.126 - 21.500
- > 84.200 (TWC 2000)

Kilometers

**US EPA ARCHIVE DOCUMENT**
HISTORICAL vs. CLEAN METALS DATA

Source of historical data: Ward and Armstrong (1997)
CONCLUSIONS

• Ambitious, extensive monitoring study

• RCAP accomplished primary objectives
  – Scientifically sound, extensive Water Quality data set
  – Superior quality compared to historical monitoring data
  – Provided data missing from under sampled areas

• Precise localization of anthropogenic influences
Conclusions

• Water and sediment quality concerns identified

  – DO in Oso Creek / Oso Bay (currently listed / studies in progress)
  – Ammonia in Oso Bay (OWWTP), Inner Harbor, Baffin Bay Complex
  – Total Phosphorus in Oso Creek, Oso Bay, Nueces Bay, and Baffin Bay Complex
  – Chlorophyll a in Oso Creek (GWWTP), Inner Harbor, Baffin Bay Complex, and some parts of Upper Laguna Madre
  – Copper, Lead, Zinc, and Mercury in sediment at Station 21
  – Elevated levels of Mercury in Nueces Bay (TSS related)
Conclusions

• Clean aqueous metals data an important addition to sediment contaminants data
  – Aqueous data may be a better integrated index of WQ
  – Clear spatial trends for most metals
  – Even zinc exhibits consistent trend
  – Recurrent monitoring could identify future trends in toxic metals pollution in the region

• Remaining data gap is to obtain accurate clean metals measurements for permitted discharges into the system
What does it all mean and what can we do?

- Development and progress are inevitable
- Quality of our resources concerns everyone
- Cooperation is essential
- Partnerships are fundamental
Partnerships and Commitment

National Coastal Assessment

• EPA and TPWD
  • 50 Stations in Texas
  • Averaged 10 – 15 CBBEP
  • 100 Stations in Texas

• CBBEP
  • RCAP 2002 – 50 Stations
  • RCAP 2003 – 32 Stations
  • RCAP 2004 – 32 Stations
The benefits of sampling in the early morning!