Assessing the ecological and human health status of Baltimore's Inner Harbor

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Outline of this talk

• Motivation of current assessment
• Timeline
  – Data workshop: November 2010
  – Report available in mid-September
• Introduction to Baltimore Harbor and its watershed
• What is the current health of the Inner Harbor?
Two major river systems traverse the city
Baltimore is an historic urban city

- Founded as a port city in early 1700s
- Jones Falls Expressway (I-83, completed mid-1980s)
  - Built parallel and on top of Jones Falls Creek
  - Outflow is directly into the Inner Harbor between Pier 6 and Falls Avenue
- Jones Falls was bulkheaded as far back as the mid-1800s
Gradient from low to high impervious surface

- Jones Falls: 72.7% (Agriculture), 20.8% (Forest), 6.1% (Developed), 0.5% (Other)
- Gwynns Falls: 85.4% (Agriculture), 11.2% (Forest), 0.7% (Developed), 2.7% (Other)
- Direct Harbor: 97.2% (Agriculture), 1.5% (Forest), 0.8% (Developed), 0.4% (Other)
“Harbor” can mean different things
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Our study area is limited
Two sub-regions

- Initially looks like a lot of sampling sites
- Water quality vs. others
Methods follow Chesapeake Bay report card and MTAC Protocol

• Mostly 2009 data
• Ecologically relevant thresholds determined through Baywide report card and MTAC protocol
• Compare average value to threshold
• Mark as pass/fail or multiple threshold levels
• Score on 0 -100% scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Spring (Mar–May) thresholds (µg·l⁻¹)</th>
<th>Summer (Jul–Sept) thresholds (µg·l⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>≤2.09</td>
<td>≤1.7</td>
</tr>
<tr>
<td>4</td>
<td>&gt;2.09–≤6.2</td>
<td>&gt;1.7–≤7.7</td>
</tr>
<tr>
<td>3</td>
<td>&gt;6.2–≤11.1</td>
<td>&gt;7.7–≤11.0</td>
</tr>
<tr>
<td>2</td>
<td>&gt;11.1–≤19.1</td>
<td>&gt;11.0–≤15.8</td>
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<tr>
<td>1</td>
<td>&gt;19.1–≤49.8</td>
<td>&gt;15.8–≤35.8</td>
</tr>
<tr>
<td>0</td>
<td>&gt;49.8</td>
<td>&gt;35.8</td>
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</tbody>
</table>
Ecological health indicators

- Dissolved oxygen
- Chlorophyll $a$
- Water clarity
- Total nitrogen
- Total phosphorus
- Benthic macroinvertebrates
- Submerged aquatic vegetation
- Toxic contaminants

Water Quality Index
Dissolved oxygen

- 2009 and 2010 data
- Seasonal pattern - low in summer
  “Poor”
Chlorophyll a

- 2009 and 2010 data
- Seasonal pattern?
- Spring 2010 increases very quickly

“Moderately Poor”
Water clarity

- 2009 and 2010 data
- Seasonal pattern in 2009
- Very high score in April 2010

“Moderately Poor”
Total nitrogen

• 2009 data
• Seasonal pattern?

“Very poor”
Total phosphorus (TP)

- 2009 data
- Same seasonal pattern as TN

“Poor”
Inner Harbor ecological health indicators

- Dissolved oxygen (DO)
- Chlorophyll $a$
- Water clarity
- Total nitrogen (TN)
- Total phosphorus (TP)

Water Quality Index = 30.1%
**Ecological health indicators**

- Benthic macroinvertebrates = Very Poor
- Submerged aquatic vegetation = Very Poor
- Toxic contaminants = Very Poor
Human health and aesthetics

Bacteria

Trash

Fish toxicity
Bacteria

- Health indicator – is it safe to swim in the Harbor?
- 2009 Enterococci concentrations
- Inner Harbor = Poor
- Middle Branch = Fair
Different methods for collecting trash
- Trash nets
- Waterwheel
- Skimmers
- Street sweeper
- Volunteer pick-up
Fish toxicity

- Health indicator – is it safe to eat fish from the Harbor?
- White perch data, 2000-2010
- Fish consumption advisory – 1 meal every other month; high enough toxicity on average to warrant an advisory
Summary of harbor indicators

Ecological health

- DO: Poor
- TN: Poor
- TP: Poor
- N: Very poor
- P: Very poor

Human health and aesthetics

- Moderate
- Poor
- Poor
Acknowledgements

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• Holly Fowler, Baltimore Aquarium
• So many others!

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  – Heath Kelsey
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  – Sara Powell
  – Jane Hawkey

Partners

• Laurie Schwartz, Waterfront Partnership of Baltimore
• Fran Flanigan
• Bill Stack, Center for Watershed Protection
Watershed ecological health indicators

- **DO**: Dissolved oxygen
- **Conductivity**
- **TN**: Total nitrogen
- **TP**: Total phosphorus
- **Water temperature**
- **pH**
- **Total suspended solids**
- **Benthic macroinvertebrates**

**Water Quality Index** – Not Ready
Watershed data: Dissolved oxygen

- Baltimore City and MD DNR data
- No County data (not measured)
- Not an indicator of concern – not sensitive enough
Watershed data: Conductivity

- Baltimore City and MD DNR data, No County data (not measured)
- Moderate to Poor scores
- A measure of metal contaminants
Watershed data: Total nitrogen

- Baltimore City, County and MD DNR data
- Upper watershed scores are good but Direct Harbor is Very Poor
Watershed data: Total phosphorus

- Baltimore City, County, and MD DNR data
- Phosphorus scored worse than nitrogen
Watershed data: Water temp

- Baltimore City, County, and MD DNR data
- Good and Very Good scores
- Temperature is not an indicator of concern
Watershed data: pH

- Baltimore City, County, and MD DNR data
- Good scores
- pH is not an indicator of concern
Watershed data: TSS

- Baltimore City, County, and MD DNR data
- No current threshold for data comparison
Benthic macroinvertebrates

- 2009 County and 2008 City data
- Targeted and random sites
- Fair to Very poor scores
- Unable to average into watershed score
Watershed human health and aesthetics

Bacteria

Trash

Human health and aesthetics
Watershed bacteria data

- 2009 \textit{E. coli} data from Baltimore City and 2010 data from County
- Scored Poorly
- Better scores downstream, why?

\begin{itemize}
\item \textbf{MTAC}
\end{itemize}
At some sites, over 400 pounds of trash was collected in a single day.
Summary of watershed indicators

Ecological health

- DO: Good
- TN: Poor
- TP: Moderately good
- N, P, DO: Poor

Human health and aesthetics

- Poor

Conclusion: Inner Harbor degraded compared to watershed?

- Inner Harbor ecology, bacteria, trash, and fish toxicity conditions are generally poor.
- Watershed ecology ranges from Poor to Good, while bacteria and trash conditions are Poor.

<table>
<thead>
<tr>
<th>Harbor indicators</th>
<th>Watershed indicators</th>
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<tbody>
<tr>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Very poor</td>
<td>Poor</td>
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<td>Poor</td>
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<td>Very poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Very poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
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</tbody>
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- Harbor indicators:
  - Poor conditions for ecology, bacteria, trash, and fish toxicity.
  - Moderate condition for bacteria and trash.

- Watershed indicators:
  - Poor conditions for bacteria and trash.
  - Poor conditions for other indicators.