A Fishable, Swimmable (and Drinkable) Delaware River Estuary

Steve Tambini
John Yagecic
Amy Shallcross

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Meet Your Presenters

Amy Shallcross, P.E.
Manager of Water Resource Operations, Delaware River Basin Commission

Steve Tambini, P.E.
Executive Director
Delaware River Basin Commission

John Yagecic, P.E.
Manager of Water Quality Assessment Delaware River Basin Commission
A fishable, swimmable (and drinkable) Delaware River Estuary

Steve Tambini
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Amy Shallcross

Coalition for the Delaware River Watershed
September 17, 2020
Q1. What advice would you give your [spouse, partner, friend, child, etc.] if they wanted to go for a swim in Delaware River at a park in Philadelphia on a hot summer day and it rained the night before: (choose one)

1. Go for it ... enjoy your swim!
2. Wade up to your knees or belt line and be careful.
3. Go for it...but try to keep your head above water.
4. Stay out of the water.
Objectives

- Focus on the urban reaches of the Delaware River Estuary
- Identify fishable, swimmable, drinkable goals.
- A practical review of:
  - The problems impacting water quality.
  - The toolbox of potential solutions.
“The Delaware River is a national success story,” said Bob Irvin, President and CEO of American Rivers.

“Today, the Delaware River is on the mend and thriving... but, important work remains to be done. Continued action is critical to address ongoing challenges, such as aging water infrastructure, urban development and climate change. Severe storms, which occur with increasing frequency due to climate change, threaten drinking water intakes with saltwater intrusion and can cause sewage overflows at ill-prepared water treatment plants.”
Goals
Clean Water Act (1972)

“...fishable, swimmable waters...”

“for the protection and propagation of fish, shellfish, and wildlife, and to provide for recreation in and on the water.”
Goals

DRBC Water Quality Regulations

Uses to be Protected:

1. agricultural, industrial, and public water supplies after reasonable treatment, except where natural salinity precludes such uses;

2. wildlife, fish and other aquatic life;

3. recreation;

4. navigation;

5. controlled and regulated waste assimilation to the extent that such use is compatible with other uses;

6. such other uses as may be provided by the Comprehensive Plan.
Problems

Major Sources of water quality pollution in the urban Estuary:

• Domestic and industrial discharges: wastewater treatment plants
  Toxics/ carbon / **ammonia** (“us”)
• Stormwater runoff: **bacteria**, nutrients, trash, oils, greases, chemicals
• Combined sewer overflows: **bacteria** and raw sewage
• Other sewage overflows: **bacteria**
• Toxic and legacy pollutants (like **PCBs**)
• **Salinity**: ocean salt (sea level rise) and road salts
• Contaminants of Emerging Concern (like **PFAS**).
• **Spills** (land based and shipping)
Section 5.2: The commission may assume jurisdiction to control future pollution and abate existing pollution in the waters of the basin...
Complex and Integrated Solutions

REGULATION / POLICY / BMPs

Local, County, etc.
Complex and Integrated Solutions

REGULATION / POLICY / BMPs

LOCALIZED monitoring and assessment

Forecasting and Notification Tools

DATA / SCIENCE / TECHNOLOGY

Near real time monitoring

PUBLIC Notification of Combined Sewer Overflows
Complex and Integrated Solutions

REGULATION / POLICY / BMPs

DATA / SCIENCE / TECHNOLOGY

- Localized monitoring and assessment
- Forecasting and Notification Tools
- Near real time monitoring

INVESTMENT / INFRASTRUCTURE

- Green
- Grey

Local, County, etc.

Public Notification of Combined Sewer Overflows

Public Health
Complex and Integrated Solutions

REGULATION / POLICY / BMPs

Localized monitoring and assessment

Forecasting and Notification Tools

DATA / SCIENCE / TECHNOLOGY

Near real time monitoring

INVESTMENT / INFRASTRUCTURE

Public Notification of Combined Sewer Overflows

Green

Public Health

Grey

Local, County, etc.
Moderator:  *Steve Tambini*, DRBC Executive Director

- **Fishable and swimmable waters:**  *John Yagecic*, DRBC Manager of Water Quality Assessment
- **Drinkable waters:**  *Amy Shallcross*, DRBC Manager of Water Resource Operations
- **Wrap-up Comments:**  *Steve Tambini*
- **Questions:**  Send them in via chat at any time
Meeting Fishable Goals for the Delaware River
PCBs

- PCBs are probable human carcinogen
- Human exposure from fish & water consumption
- Delaware Estuary 100 to 1000X higher than criteria
- DRBC developed TMDLs 2003 & 2006
- 90+ Point dischargers perform pollutant minimization plans – DRBC reviews
- DRBC manages all the data from PMPs
- Decades long commitment
- Stage 2 TMDL refinement

76% Reduction from top 10 point dischargers
New Fish Consumption Advisories Reflect Continuing Improvements in Water Quality for Delaware Waterways

DNREC Secretary Shawn M. Garvin. “I anticipate that, with continued cleanup efforts and cooperation between DNREC, DHSS, and our regional partners who include New Jersey Department of Environmental Protection and the Delaware River Basin Commission that we will continue to see a trend of improvement into the future.”

Fish Consumption Advisory Changes for General Population

New Jersey and Delaware have revised advisories in the Delaware Estuary from PA/DE Border to C&D Canal (River Mile 80-58)
- All fin fish including; white perch and channel catfish
  - Before 2015: Do not eat
  - 2015-2017: One meal per year
  - 2018: Three meals per year

PA revised advisories from Trenton, NJ to Morrisville PA bridge to PA/DE border
- for carp
  - Before 2015: Do Not Eat
  - 2016: six meals per year
Historically, summer DO in estuary near Philadelphia & Camden was too low for migratory fish to reach upstream to spawn

- Pollution source? Carbon from wastewater treatment (CBOD).
- DRBC adopted water quality standards (1967) & wasteload allocation (1968)
- Secondary treatment added at wastewater treatment plants 70’s & 80’s – funding CWA
- 3.5 mg/L criteria near Philadelphia, Camden, & Wilmington protect fish migration (not propagation)
- By 2000’s that criteria is nearly always met
Next Phase for Dissolved Oxygen

Relative Point Discharge Load by Delaware Estuary River Mile
NH3 - Ammonia, whole water Loading

Median DO Saturation
July & August Observations
Boat Run 2005-2016
DRBC Resolution 2017-04
Studies Required Before Rulemaking

Fish/DO Studies
- 6(a). Input on the dissolved oxygen requirements of aquatic species
- 6(b). Field studies of the occurrence, spatial and temporal distribution of the life stages of Estuary fish species
- 6(c). Input from consultations pursuant to the Endangered Species Act ("ESA")

Modeling Studies
- 6(d). Development and calibration of a eutrophication model for the Delaware River Estuary and Bay;
- 6(e). Determination of the nutrient loadings from point and non-point sources necessary to support key aquatic species;

Cost/Feasibility Studies
- 6(f). Evaluation of the capital and operating costs for treatment capable of achieving higher levels of dissolved oxygen;
- 6(g). Evaluation of the physical, chemical, biological, social and economic factors affecting the attainment of uses,

6(h). Preparation of a draft report and final report containing findings and conclusions.

6. "Analysis of Attainability"
Eutrophication Modeling

- Development and calibration of a eutrophication model for the Delaware River Estuary and Bay
- Determination of the nutrient loadings from point and non-point sources necessary to support key aquatic species
Contracted with Kleinfelder
Planning level cost estimate for top 12 loading facilities to achieve new ammonia effluent levels
Coordination with facilities
Initiated summer 2018
2-year contract

<table>
<thead>
<tr>
<th>Effluent Level</th>
<th>Conventional Activated Sludge</th>
<th>Pure Oxygen Activated Sludge</th>
<th>Fixed Film (RBC and TF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₃-N – 10 mg/L</td>
<td>Conversion to IFAS with low level of media addition to aeration tanks</td>
<td>Add downstream BAF sized for approximately 50% of plant flow</td>
<td>Add downstream BAF sized for approximately 50% of plant flow</td>
</tr>
<tr>
<td>NH₃-N – 5 mg/L</td>
<td>Conversion to IFAS with medium level of media addition to aeration tanks</td>
<td>Add downstream BAF sized for approximately 75% of plant flow</td>
<td>Add downstream BAF sized for approximately 75% of plant flow</td>
</tr>
<tr>
<td>NH₃-N – 1 mg/L</td>
<td>Conversion to IFAS with high level of media addition to aeration tanks</td>
<td>Add downstream BAF sized for 100% of plant flow</td>
<td>Add downstream BAF sized for 100% of plant flow</td>
</tr>
<tr>
<td>TN – 3 mg/L</td>
<td>Conversion to IFAS with high level of media addition plus downstream DF</td>
<td>Add downstream BAF sized for 100% of plant flow plus DF</td>
<td>Add downstream BAF sized for 100% of plant flow plus DF</td>
</tr>
</tbody>
</table>
What's the Cost?

If each of the top 12 ammonia loading facilities upgraded to achieve 1.5 mg/L ammonia, the Total Present Worth Cost would be **$2.7 Billion**
Meeting Swimmable Goals for the Delaware River
F. "Recreation" includes all water-contact sports.

G. "Recreation - secondary contact" restricts activities to where the probability of significant contact or water ingestion is minimal, encompassing but not limited to:

1. boating,

2. fishing,

3. those other activities involving limited contact with surface waters incident to shoreline recreation.
### Current Recreational Uses / Criteria in Delaware Estuary (DRBC WQ Regs)


<table>
<thead>
<tr>
<th>Zone</th>
<th>Use</th>
<th>Fecal Coliform</th>
<th>Enterococcus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Geometric mean colonies per 100 mL</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Recreation</td>
<td>200</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>Recreation – Secondary Contact</td>
<td>770</td>
<td>88</td>
</tr>
<tr>
<td>Upper 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower 4</td>
<td>Recreation</td>
<td>200</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>Recreation</td>
<td>200</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Recommended 2012 RWQC.

<table>
<thead>
<tr>
<th>Criteria Elements</th>
<th>Estimated Illness Rate (NGI): 36 per 1,000 primary contact recreators</th>
<th>OR</th>
<th>Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GM (cfu/100 mL)</td>
<td>OR</td>
<td>GM (cfu/100 mL)</td>
</tr>
<tr>
<td>Indicator</td>
<td>STV (cfu/100 mL)</td>
<td></td>
<td>STV (cfu/100 mL)</td>
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<tr>
<td>Enterococci – marine and fresh</td>
<td>35</td>
<td>130</td>
<td>30</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli – fresh</td>
<td>126</td>
<td>410</td>
<td>100</td>
</tr>
</tbody>
</table>

Duration and Frequency: The waterbody GM should not be greater than the selected GM magnitude in any 30-day interval. There should not be greater than a ten percent excursion frequency of the selected STV magnitude in the same 30-day interval.

a EPA recommends using EPA Method 1600 (U.S. EPA, 2002a) to measure culturable enterococci, or another equivalent method that measures culturable enterococci and using EPA Method 1603 (U.S. EPA, 2002b) to measure culturable E. coli, or any other equivalent method that measures culturable E. coli.
Possible Sources of Bacteria?

- Combined Sewer Overflows
  - Sanitary sewage and storm water in same pipes
  - Legacy systems (100+ years) in our oldest, largest communities
- Other Urban Runoff (MS4s)
- Urban Animal Life
  - Sources are local

Image credit: Jersey Water Works

http://archive.phillywatersheds.org/watershed_issues/stormwater_management/combined_sewer_system
Shore-based, where recreation more likely
~ 5x per month, May - September
Fecal coliform, enterococcus, E. coli

- Riverton Yacht Club
- Palmyra Cove Nature Center
- Pennsauken Access
- Pyne Poynt Park
- National Park
- Washington Ave. Green
- Penns Landing Lagoon
- Frankford Arsenal Boat Ramp
- Penn Treaty Park (2020)
Site Specific Comparison to EPA E. Coli Criteria (126 cfu/100mL GM)

<table>
<thead>
<tr>
<th>Date</th>
<th>NPK</th>
<th>WAG</th>
<th>PLL</th>
<th>PPP</th>
<th>PSA</th>
<th>FAA</th>
<th>PCN</th>
<th>RYC</th>
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<tr>
<td>6/10/2019</td>
<td>132.7</td>
<td>212.9</td>
<td>174.4</td>
<td>759.6</td>
<td>223.3</td>
<td>889.9</td>
<td>300.5</td>
<td>168.5</td>
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<td>6/19/2019</td>
<td>104.7</td>
<td>212.9</td>
<td>123.1</td>
<td>809.6</td>
<td>177.2</td>
<td>737.5</td>
<td>309.5</td>
<td>142.6</td>
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<td>6/25/2019</td>
<td>185.5</td>
<td>429</td>
<td>177.4</td>
<td>786.8</td>
<td>240.5</td>
<td>105.2</td>
<td>309.5</td>
<td>182</td>
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<td>7/1/2019</td>
<td>332.2</td>
<td>737.8</td>
<td>326.8</td>
<td>140.6</td>
<td>194.9</td>
<td>50</td>
<td>301.1</td>
<td>173.8</td>
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<td>7/9/2019</td>
<td>316.4</td>
<td>599.5</td>
<td>312.5</td>
<td>168.2</td>
<td>182.3</td>
<td>87.4</td>
<td>381.6</td>
<td>144.5</td>
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<td>7/22/2019</td>
<td>414.3</td>
<td>356.6</td>
<td>352.8</td>
<td>92.5</td>
<td>139.1</td>
<td>111.9</td>
<td>359.4</td>
<td>118.2</td>
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<td>7/30/2019</td>
<td>182.2</td>
<td>182.3</td>
<td>233.6</td>
<td>138</td>
<td>130.1</td>
<td>283.9</td>
<td>400.3</td>
<td>84.9</td>
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<tr>
<td>8/6/2019</td>
<td>28.6</td>
<td>265.2</td>
<td>292.3</td>
<td>1162.8</td>
<td>95.8</td>
<td>109.6</td>
<td>131.4</td>
<td>38.7</td>
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<tr>
<td>8/12/2019</td>
<td>40.2</td>
<td>172.7</td>
<td>342.8</td>
<td>1716.9</td>
<td>72.2</td>
<td>83.3</td>
<td>47.4</td>
<td>61.7</td>
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<td>8/19/2019</td>
<td>57.9</td>
<td>124.5</td>
<td>257.9</td>
<td>1817.9</td>
<td>75.6</td>
<td>137.1</td>
<td>57.1</td>
<td>58.1</td>
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<td>8/28/2019</td>
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<td>296.5</td>
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<td>55.3</td>
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<td>9/4/2019</td>
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<td>588</td>
<td>1771.8</td>
<td>104.4</td>
<td>186</td>
<td>50.8</td>
<td>76.8</td>
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<tr>
<td>9/9/2019</td>
<td>491.2</td>
<td>134.1</td>
<td>505.8</td>
<td>1279.5</td>
<td>121</td>
<td>285.7</td>
<td>115.8</td>
<td>158.4</td>
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<tr>
<td>9/16/2019</td>
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<td>145.6</td>
<td>516.7</td>
<td>968.6</td>
<td>220.4</td>
<td>388.6</td>
<td>157.3</td>
<td>115.2</td>
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<tr>
<td>9/24/2019</td>
<td>216.4</td>
<td>231.3</td>
<td>892.6</td>
<td>203.9</td>
<td>235.2</td>
<td>362.9</td>
<td>147.2</td>
<td>139.6</td>
</tr>
</tbody>
</table>

NPK: National Park  
WAG: Washington Ave. Green  
PLL: Penns Landing Lagoon  
PTP: Penn Treaty Park  
PPP: Pyne Poynt Park  
PSA: Pennsauken Access  
FAA: Frankford Arsenal Access  
PCN: Palmyra Cove  
RYC: Riverton Yacht Club
Monitoring Results So Far

- Assessment by geometric mean, system-wide: Unfavorable
- Assessment by geometric mean, site-by-site: Mixed
- Assessment by STV, site-by-site: More favorable

- May predict conditions based on: Location, Cumulative rainfall
  - Need a larger, more robust data set than this one
Data & Technology *may* help us expand recreational opportunities

- **Question:** *Is it safe to swim?*
- **Statistical Models**
  - Use things we can measure in real time like rain & turbidity
  - Is today a red day or a green day?
- **Near real-time monitoring systems**
  - Fluidion Alert
  - In-situ, 6-hours from sample to report
- **Some locations are much better than others**

http://www.phillyrivercast.org/
Reducing Bacterial Loads?

- CSO Long Term Control Plans
- MS4 Permitting
- Stormwater management
- Capture & disinfect more combined sewage

- Happening now
- Long Term Proposition
- More reduction requires more $$$
Other Hazards & Challenges

- Beaches have an elaborate protocol for monitoring, beach closures, re-opening
- Busy shipping ports
- Hazardous currents
- Debris, pilings, junk
DRBC Next Steps

- Continued Monitoring in 2020 and beyond
- Expanded analytical approaches?
  - How much is human derived
  - How much is animal derived
- Coordination with our Water Quality Advisory Committee (WQAC)
  - Help in setting priorities for DRBC’s Water Resources Program
Drinkable (and Usable)

agricultural, industrial, and public water supplies after reasonable treatment, except where natural salinity precludes such uses
Water Users

- Drinking Water Providers
- Manufacturing
- Refining
- Energy Production
Risks to Drinkable Water

Projected Vinyl Chloride Concentrations in the Delaware River
Five-hour release: one percent total mass

Each line represents the concentration of Vinyl Chloride along the river for different times after the spill.

Vinyl Chloride Concentrations

- River miles from the mouth of the Bay
- Drinking Water Intakes

NOAA Office of Response and Restoration
DRBC Spill Model Analysis
Water Users, Risks and Salinity

Risks to Availability and Usability
Droughts, Spills, Contaminants of Emerging Concern, Salt (deicing, ocean), Sea Level Rise
Drought Management and the Salt Front

Median Monthly Salt Front Location (River Mile)

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>69.0</td>
</tr>
<tr>
<td>February</td>
<td>70.7</td>
</tr>
<tr>
<td>March</td>
<td>70.0</td>
</tr>
<tr>
<td>April</td>
<td>67.0</td>
</tr>
<tr>
<td>May</td>
<td>68.0</td>
</tr>
<tr>
<td>June</td>
<td>69.2</td>
</tr>
<tr>
<td>July</td>
<td>70.4</td>
</tr>
<tr>
<td>August</td>
<td>73.8</td>
</tr>
<tr>
<td>September</td>
<td>76.0</td>
</tr>
<tr>
<td>October</td>
<td>72.0</td>
</tr>
<tr>
<td>November</td>
<td>70.5</td>
</tr>
<tr>
<td>December</td>
<td>69.4</td>
</tr>
</tbody>
</table>

Based on upper salt front location data from January 1990 to February 2012.

7-Day Avg. RM Location of 250 mg/l Chlorides
Sea Level Rise and Salinity

Atlantic Ocean
River Mile 0

Salt Water
Mixing
Fresh Water

Trenton
River Mile 133

Sea Level Rise
Subsidence
Range of Salt Front Movement with dry conditions and different flow augmentation

Simulations of July-October 2002 conditions with additional water released in August and September. A significant amount of water may be needed to keep the salt front below RM 92.5.
What are the options to reduce the risk?

- Relocation
- Reservoir Releases
- Estuary Barrier
- Desalination
Investigate how climate change will affect hydrology

Inventory new storage opportunities (new infrastructure, under-utilized, revised operations)

Use existing models to quantify risk and examine mitigation options

Develop or modify strategies to manage issue
Summary

- Focus
- Funding
- Equity
- Priorities

Goal:
Fishable, swimmable waters in the urban Estuary
Measurable improvement in WQ in the urban Estuary, requires solutions focused on the urban Estuary.
Who Pays?

- Dischargers? - Local taxpayers and rate payers
- Water users?
- Federal Government?
- Those who benefit most?
- Philanthropic organizations?
• “New” federal funding is not aimed at the urban Estuary.
• More funds aimed at urban waters fishable/swimmable needs and solutions (CSOs, etc.).
• More funds to support urban recreational access.
• Increase share for the Delaware River.
• Increase share for clean water for disadvantaged communities.
• Clean water Infrastructure as economic stimulus.
• America’s Water Infrastructure Act.
• Fund the DRBC
Public infrastructure spending has fallen, and there is a backlog of more than $2 trillion.

Public spending on water and transportation infrastructure, 1980–2017, % of GDP

American Recovery and Reinvestment Act

Average 2.48

2010

Estimated 10-year infrastructure-funding gap by asset type, 2016–25, $ billion

- Roadways and transit: 1,101
- Rail: 29
- Waterways and ports: 15
- Electricity: 177
- Dams and levees: 109
- Water and waste: 108

Total: $2.1 trillion

Equity

Access to fishable, swimmable, drinkable waters.

*From EPA EJSCREEN: Environmental Justice Screening and Mapping Tool
Equity
Who pays for what?

Photo: Upstream Alliance

Photo: Aqua Vida

Photo: Paul Michael Bergeron
Priorities

Clean Water Act / DRBC
- Drinkable? Swimmable? Fishable?

Community / Society (Water Only)
- Climate change threats
- Safe and reliable drinking water
- Neighborhood flooding
- Trash
- Water main breaks
- Water efficiency
- Lead water service line replacements
- Recreation in the Delaware River
- Wastewater Treatment Updates
- Affordability

We will reach our economic endpoint long before we reach our environmental endpoint.

Howard Neukrug - Water Center at UPenn

Photo: Philadelphia Water Department
From “One Water” Policy Framework

• A focus on achieving multiple benefits, meaning that our water-related investments should provide economic, environmental, and societal returns.

• Utilizing watershed-scale thinking and action, that respects and responds to the natural ecosystem, geology, and hydrology of an area.

• Relying on partnerships and inclusion, recognizing that real progress will only be made when all stakeholders have a seat at the table.

River of the Year for 2020: The Delaware River

American Rivers announces 2020 River of the Year alongside Most Endangered Rivers of 2020 release.

Amy Souers Kober | April 14, 2020


“The Delaware River is a national success story,” said Bob Irvin, President and CEO of American Rivers
Managing, Protecting and Improving Our Shared Water Resources since 1961
Thank you for joining us!

We’d love your feedback on this session! Take our survey here: https://bit.ly/2Dm2Mxe
Find your next session at: https://delawareriverwatershedforum.sched.com/

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