Using Data To Manage Delaware River Basin Water Resources

AWRA Philadelphia

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Compact signed 1961

Five Equal Members:
- Delaware
- New Jersey
- Pennsylvania
- New York
- Federal Government

Broad Responsibilities / Authorities
- Water Supply
- Drought Management
- Flood Loss Reduction
- Water Quality
- Watershed Planning
- Regulatory Review (Permitting)
- Outreach/Education
- Recreation
Goal of this Presentation

* Describe Key DRBC Monitoring Programs & selected one-time projects
  * How we use the data
  * How we serve the data & interpretation to partners and stakeholders

* Highlight and demonstrate some unique data treatments including
  * Interactive web applications
  * Automated dashboards
  * Automated modeling
  * Animated graphing

* How we use data generated by others including USGS and NOAA
Delaware Estuary Water Quality Monitoring (Boat Run)

- Since mid-1960’s
- 22 Sites, once per month
- Parameter Groups
  - Dissolved Oxygen, pH, temperature, specific conductance, turbidity, secchi depth, PAR
  - Nutrients (ammonia, nitrate + nitrite, phosphorus)
  - Sodium, chloride, Chlorophyll a
  - Bacteria
  - Metals
How we use the Delaware Estuary water quality data

- Delaware River & Bay Water Quality Assessment Report
  - CWA 305(b)
  - Every even numbered year

- State of the Estuary Report
  - Cooperation with Partnership for the Delaware Estuary (PDE)
  - ~ Every 5 years

- Estuary Eutrophication Model (under development)

- Estuary Water Quality Explorer at https://johnyagecic.shinyapps.io/BoatRunExplorer/

- Canned database queries on DRBC web site at http://www.state.nj.us/drbc/quality/datum/
Special Protection Waters Program

- "It is the policy of the Commission ... no measurable change in existing water quality except towards natural conditions ..."
- Monitoring to define Existing Water Quality & Assess whether or not Existing Water Quality is being preserved
- Water Quality models to assess impact of new or expanding WWTPs
Special Protection Waters Monitoring

- Nutrients & field measurements

- Mainstem Delaware River stations
  - Interstate Control Points (ICPs)

- Tributaries near confluence with Delaware
  - Boundary Control Points (BCPs)

- Number of stations flexible from year to year depending on strength of definition of Existing Water Quality
Special Protection Waters Data

- Lower Delaware Measurable Change Assessment published August 2016

- Canned database queries on DRBC web site at
  http://www.state.nj.us/drbc/quality/datum/

- Special Protection Waters Monitoring Program Explorer
  https://elainepanuccio.shinyapps.io/specialprotectionwatersexplorer/
### Summary Matrix of Measurable Changes: 440 Within-Site Comparisons at a Glance

#### Site Color Key
- **Dark Blue**: Interstate Control Point (ICP)
- **Dark Red**: Pennsylvania Tributary Boundary Control Point (BCP)
- **Dark Green**: New Jersey Tributary Boundary Control Point (BCP)

#### Summary Matrix of Measurable Changes:

**Field**
- Dissolved Oxygen (DO) mg/l
  - **~**: Weak indication of measurable water quality change toward more degraded status
- Dissolved Oxygen Saturation %
  - ~
- Water Temperature, degrees C

**Nutrients**
- Ammonia Nitrogen as N, Total mg/l
- Nitrate + Nitrite as N, Total mg/l
- Nitrogen as N, Total (TN) mg/l
- Nitrogen, Kjeldahl, Total (TKN) mg/l
- Orthophosphate as P, Total mg/l
- Phosphorus as P, Total (TP) mg/l

**Bacteria**
- Enterococcus colonies/100 ml
  - ~
- Escherichia coli colonies/100 ml
  - **~**: Weak indication of measurable water quality change toward more degraded status
- Fecal coliform colonies/100 ml
  - ****: Indication of measurable water quality change toward more degraded status

**Conventional**
- Alkalinity as CaCO₃, Total mg/l
- Hardness as CaCO₃, Total mg/l
- Chloride, Total mg/l
- Specific Conductance µmho/cm
- Total Dissolved Solids (TDS) mg/l
- Total Suspended Solids (TSS) mg/l

**Turbidity NTU**

#### Key
- **~**: Weak indication of measurable water quality change toward more degraded status
- **~**: No indication of measurable change to EWQ

**Good News:**
- 88% of water quality tests showed no degradation

**Nutrient reductions corroborated by subsequent USGS assessment using different data, different methods**
* Macroinvertebrates & Periphyton

* 25 riffle sites in non-tidal Delaware River

* Every 2 or 3 years

* Assessment included in Delaware River Water Quality Assessment (305(b))

* Databases to be accessible via DRBC web site in 2018 (stay tuned)
Ambient Toxicity

- Surface Water Samples
- Detect *interactive* toxic effects of *mixtures* of chemicals
- Laboratory Tests using USEPA Short-Term Chronic Methods
- Freshwater and Estuarine species
- 1990 to present, 3 to 5 year cycle
- 2015 & 2016 in cooperation with DNREC WATAR program
- Next sampling proposed for main stem in 2018
Sediment Monitoring

- Periodic
- PCBs, PAHs, perflourinated compounds, emerging contaminants
- Monitoring recovery under PCB TMDL, special studies in support of states, document background conditions
Fish Tissue Monitoring

* 8 or 9 sites in both tidal (5 sites) and non-tidal (3 - 4 sites) Delaware River.


* Two fish species at each site representing benthic and pelagic trophic levels.
  - Tidal: white perch, channel catfish
  - Non-tidal: smallmouth bass, white sucker

* PCBs, Mercury, Methylmercury, Chlorinated pesticides, Dioxins/Furans, Perfluorinated Compounds, Metals

* Data used for fish consumption advisories by NJ
Special Projects

* Natural Gas Baseline Monitoring
  • Biological Monitoring
  • Conductivity Loggers
  • Radiochemistry
  • Archived samples, barium & strontium

* SPW Model Calibration Monitoring
  • Brodhead, Neversink, & Lehigh Watersheds

* Response Monitoring
  • Vinyl Chloride spill response monitoring
  • Estuary tritium, gross alpha, gross beta emitters
Aquatic Life Studies
- Lower non-tidal Delaware Mussel Survey
- Didymo Survey
  - *Didymosphenia geminate*, native diatom alga but prone to blooms
  - Matlock Periphytometer Study

Winter Estuary Ammonia monitoring

Support for other organizations
- PWD dye study support
- Support to Shad young-of-year survey
- Periodic Emerging Contaminant monitoring
How we use data generated by others
USGS-NWIS and NOAA-PORTS
Using Data Generated by Others: Flow & Water Quality Dashboards

- Near Real-Time Water Quality & Flow Dashboards
- Pulls data from USGS and NOAA via the internet
- Automated scripted processing and plotting of data
- Comparisons to criteria and thresholds
  - [http://drbc.net/Sky/waterq.htm](http://drbc.net/Sky/waterq.htm)
  - [http://drbc.net/Sky/flows.htm](http://drbc.net/Sky/flows.htm)
Water Quality Dashboard

* Last 5-days Dissolved Oxygen compared to Criteria
Water Quality Dashboard

- Temperature from both NWIS and NOAA-PORTS compared to Criteria
Water Quality Dashboard

- Reads specific conductance, converts to TDS using a regression relationship, plots TDS compared to criteria.
Flow Dashboard

- Animated map of water yields by HUC8 for last several days
- Pulls, processes, and plots data from ~140 USGS gages
Flow Dashboard

- Generates 20-year boxplots for each gage (goalpost)
- Generates profile plot including inflows from major tributaries to show how current condition compares
Mainstem Schuylkill River Discharge Profile on 11/19/2017
Compared to 20-year Boxplots at USGS Gage Sites

* Same thing for Schuylkill gages
Flow Dashboard

- Pulls observed and predicted water surface elevation data from NOAA-PORTS system
- Animated plot of last several days
Automated Daily Processes
No User Input Required

Freshwater Boundary Discharge Data and Predictions

Pre-Processor develops model input file

DYNHYD5

WASP

Tidal Boundary Water Surface Data and Predictions

Water Quality Simulation in Response to Spill Event

Spill Data

Predicted Location, Duration, and Concentration of Impacted Water Intakes

Prescriptive Measures to Mitigate Impact
Using Data Generated by Others: Overnight Hydrodynamic Model

* Pulls data from NOAA-PORTS, USGS, and AHPS overnight via internet

* Automated scripts formulate the data into an input file for existing model

* Runs existing DYNYD5 model using new data

* In the event of a spill, manually feed the output to WASP water quality model to simulate concentration, duration, and movement of plume
Continued Automated Model Development

* Earliest version utilized VBA scripts for pulling & processing data

* From fully automated to mostly automated in 2017 – human interaction is key

* Migrated pulling & processing to R in 2017

* Added daily calibration checks in 2017

* Expect to replace 1-D DYNHYD model with coarse and fine grid EFDC models in 2019
Automated Daily Calibration Checks

20-day Bivariate Modeled and Observed WSE Philadelphia_USGS
Simulated: 2017-09-08

R-squared: 0.974

20-day Comparison DYNHYD5 Channel 46 Upstream Junction to Observed at
Philadelphia_USGS Simulated: 2017-09-08 RMSE: 0.1572

Water Surface Elev. NGVD29

Aug 22 Aug 27 Sep 01 Sep 06
Amplification of Tidal Range

NOAA PORTS hourly Water Surface Observations
Delaware Estuary, 2002 through 2012
Comparison to Chesapeake
Orientation to Graph (static)

Delaware Estuary Water Surface Elevations
2011-08-25 12:24:00

Water Surface Elevation (meters above MLWY)

Flow (cfs)

Link to animation video
https://www.youtube.com/watch?v=RoVozobessc
Questions & Discussion

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http://www.nj.gov/drbc/quality/datum/
https://adventuresindata.blogspot.com/

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<th>Featured DRBC Staff</th>
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<td>Ron MacGillivray, Ph.D.</td>
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<td>Elaine Panuccio</td>
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<td>Tom Fikslin, Ph.D.</td>
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<td>Bob Limbeck (retired)</td>
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