Delaware River Basin Commission

WASP Water Quality Model of the Upper Delaware for Thermal Management

Subcommittee on Ecological Flows

J. Yagecic

Delaware River Basin Commission
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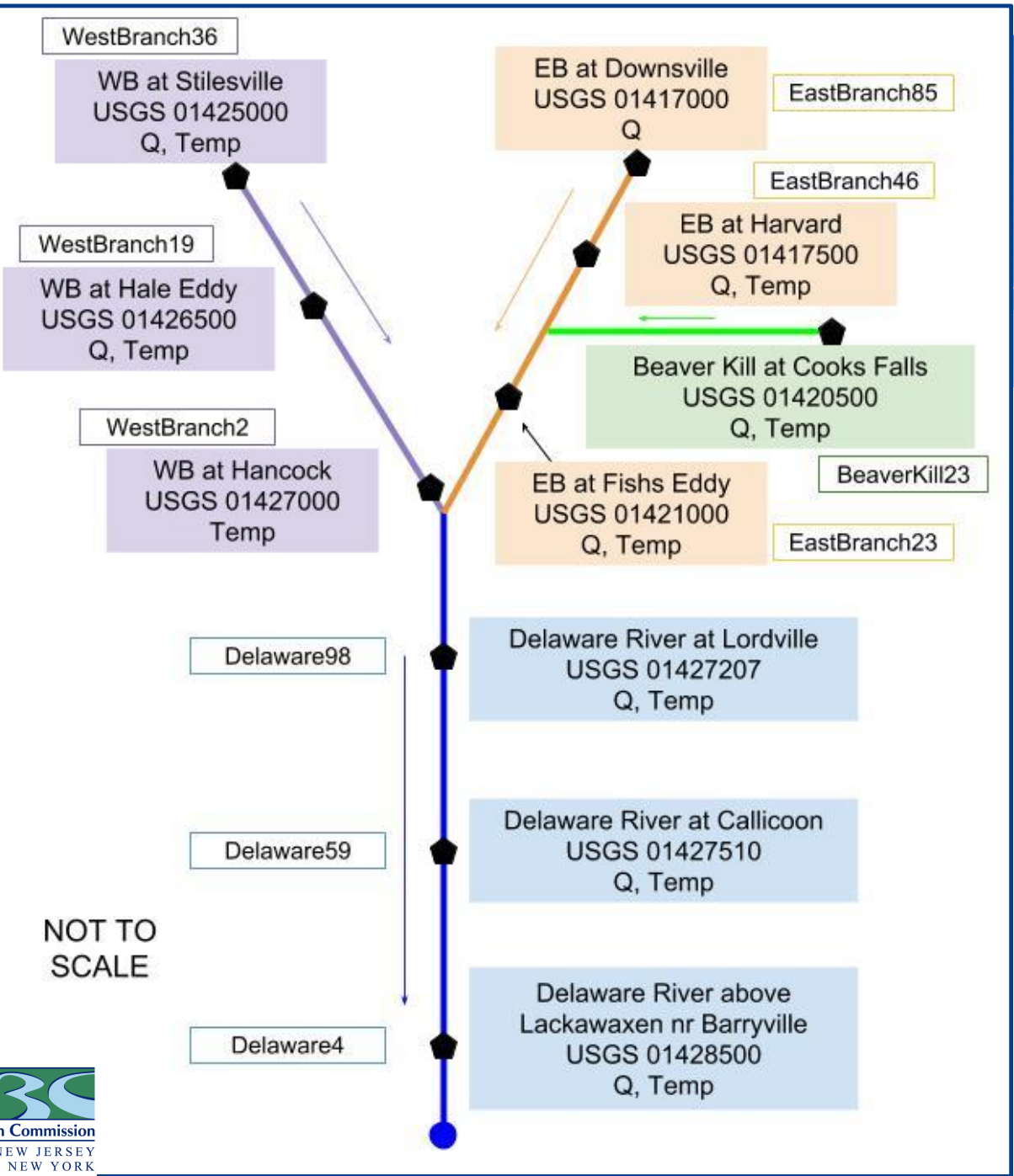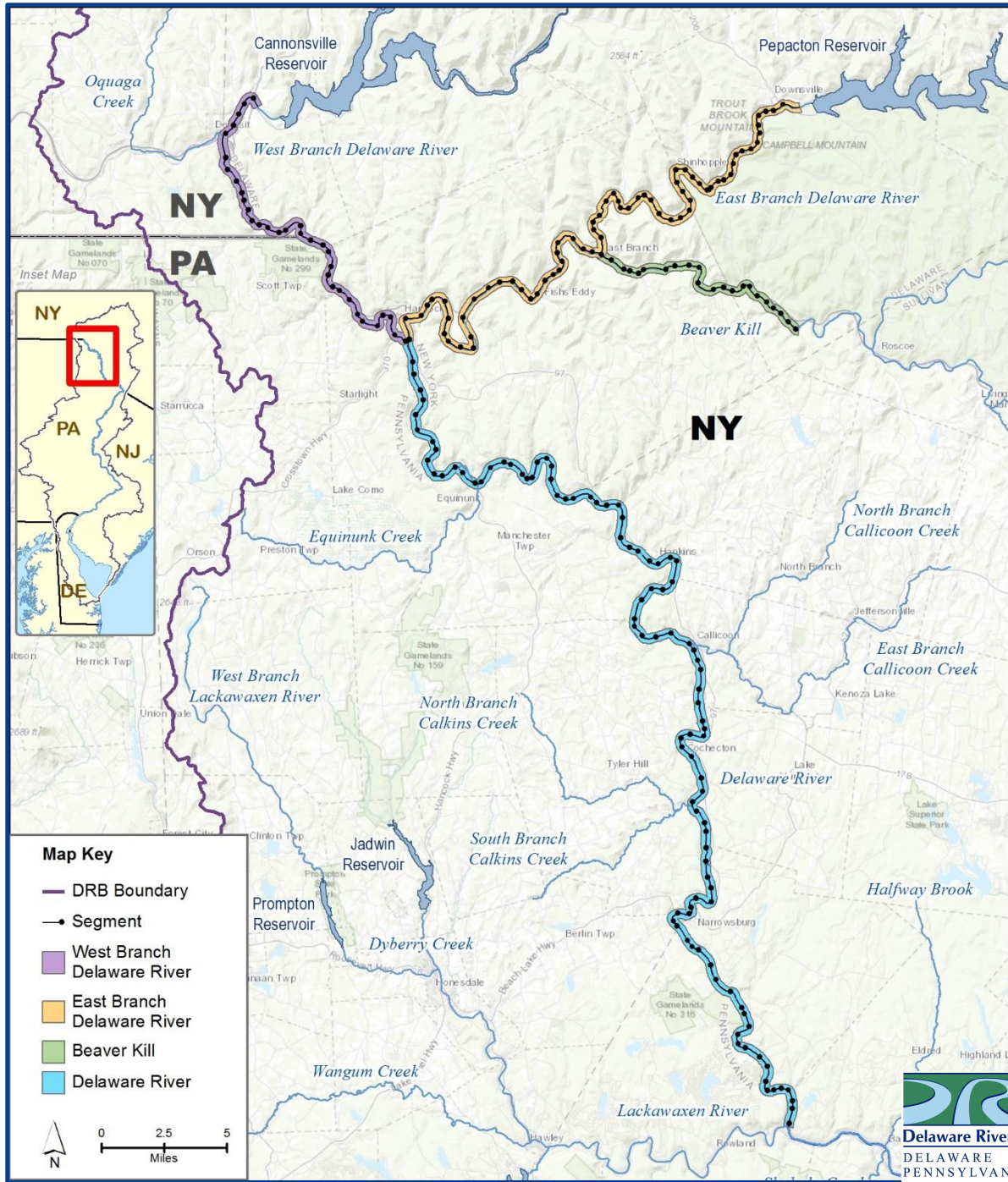PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

SEF Charge

* **SEF Charge**
* **Provide recommendations to RFAC on how to 'spend' a volume of reservoir water to mitigate thermal stresses in the Upper Delaware**
* **Due date May 31, 2019**

Motivation

* DRBC is building an Upper Delaware WASP model to facilitate evaluation of different temperature mitigation approaches
* Could be used in conjunction with other models & methods in various stages of development: Cole Heat Flux model, Kolesar statistical model, DSS, heuristics
* Support current and future deliberations

* Take advantage of new tools for generating model segments
* Take advantage of access to EPA
* Ultimately connect to downstream for time-of-travel and other needs (Hancock train derailment)

Map Key
- DRB Boundary
- Segment
- West Branch Delaware River
- East Branch Delaware River
- Beaver Kill
- Delaware River

0   2.5   5
Miles

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WestBranch36
WB at Stilesville
USGS 01425000
Q, Temp

EB at Downsville
USGS 01417000
Q

EastBranch85

EastBranch46

WestBranch19
WB at Hale Eddy
USGS 01426500
Q, Temp

EB at Harvard
USGS 01417500
Q, Temp

Beaver Kill at Cooks Falls
USGS 01420500
Q, Temp

WestBranch2
WB at Hancock
USGS 01427000
Temp

EB at Fishs Eddy
USGS 01421000
Q, Temp

BeaverKill23

EastBranch23

Delaware98

Delaware River at Lordville
USGS 01427207
Q, Temp

Delaware59

Delaware River at Callicoon
USGS 01427510
Q, Temp

NOT TO SCALE

Delaware4

Delaware River above
Lackawaxen nr Barryville
USGS 01428500
Q, Temp

Segmentation

* 261 model segments, West Branch, East Branch, Beaver Kill, Mainstem Delaware
* Upstream boundaries:
  * Stilesville gage (West Branch)
  * Downsville gage (East Branch)
  * Beaver Kill at Cooks Falls (Beaver Kill)

* Targeted segment length between 0.5 and 1 km
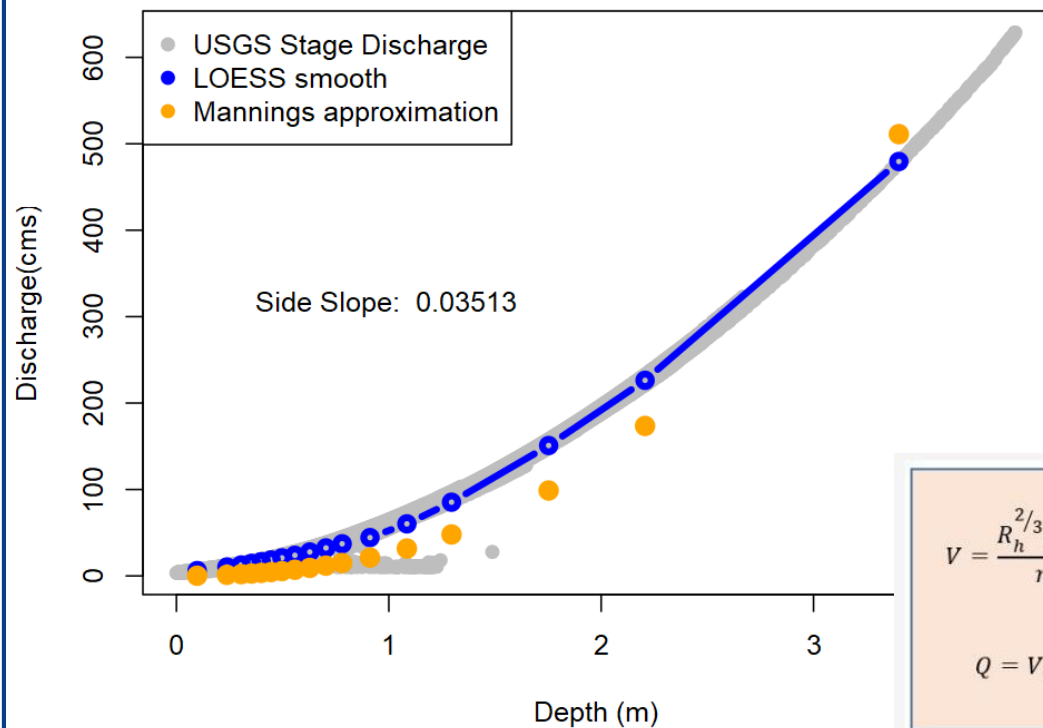* Trapezoidal channels with hydraulic properties that mimic stage discharge relationships at gages

Model Properties

Segments
* NHDplus (via BASINS)
* Width
* Length
* Bed slope
* Roughness

* Populated for model run period 2008 through November 2018
* Calibration focus 2018
* Ungaged tributaries estimated using QPPQ similar to BaSE

Stage Discharge Relationships and Manning's Equation

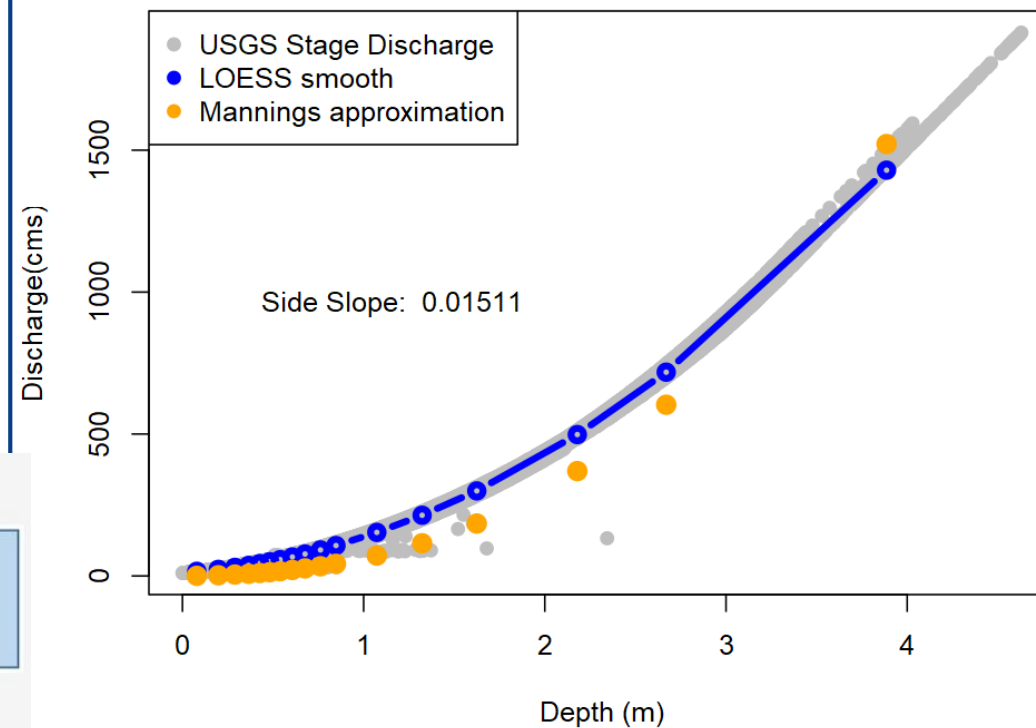**WEST BRANCH DELAWARE RIVER AT HALE EDDY NY**
Computed 2019-02-08

- USGS Stage Discharge
- LOESS smooth
- Mannings approximation

Side Slope: 0.03513

DELAWARE RIVER AT LORDVILLE NY
Computed 2019-02-08

- USGS Stage Discharge
- LOESS smooth
- Mannings approximation

Side Slope: 0.01511

$$V = \frac{R_h^{2/3} S^{1/2}}{n}$$

$$Q = VA$$

$$V \approx aQ^b$$

$$Depth \approx cQ^d$$

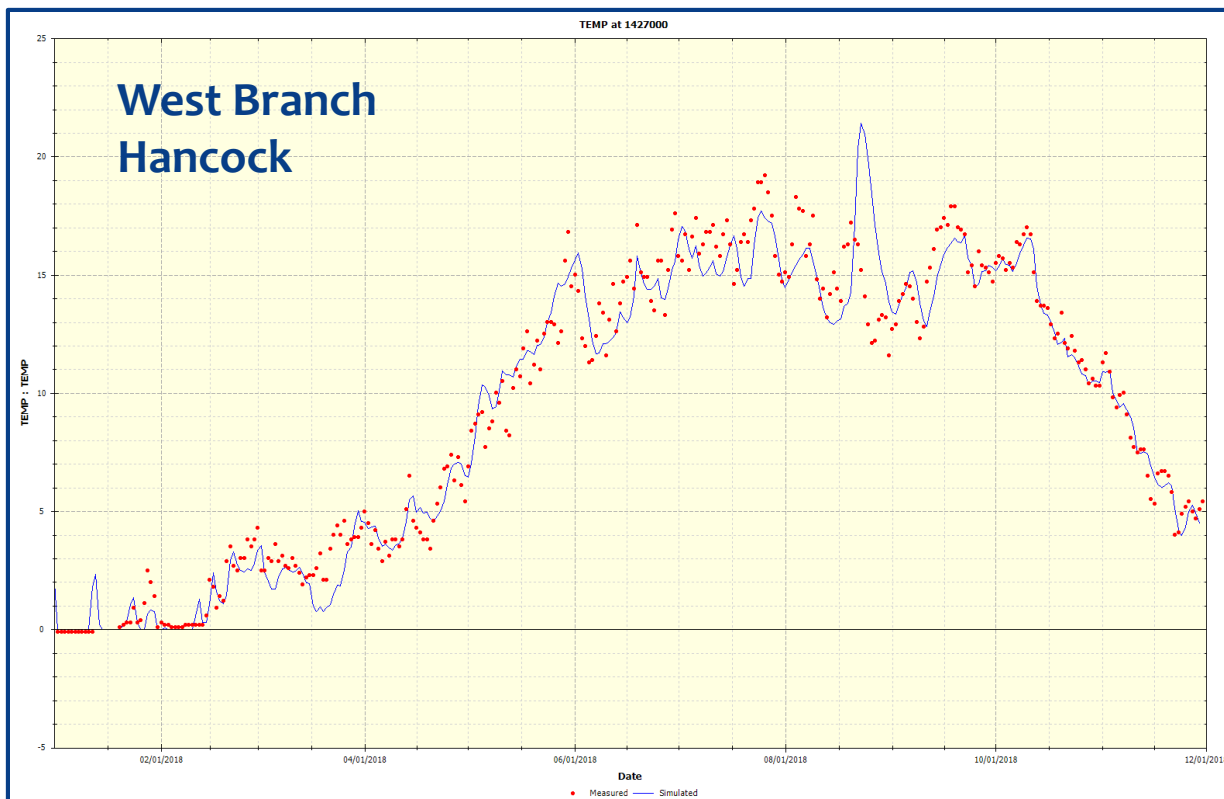# Temperature Calibration Status

East Branch
Fishs Eddy

West Branch
Hale Eddy
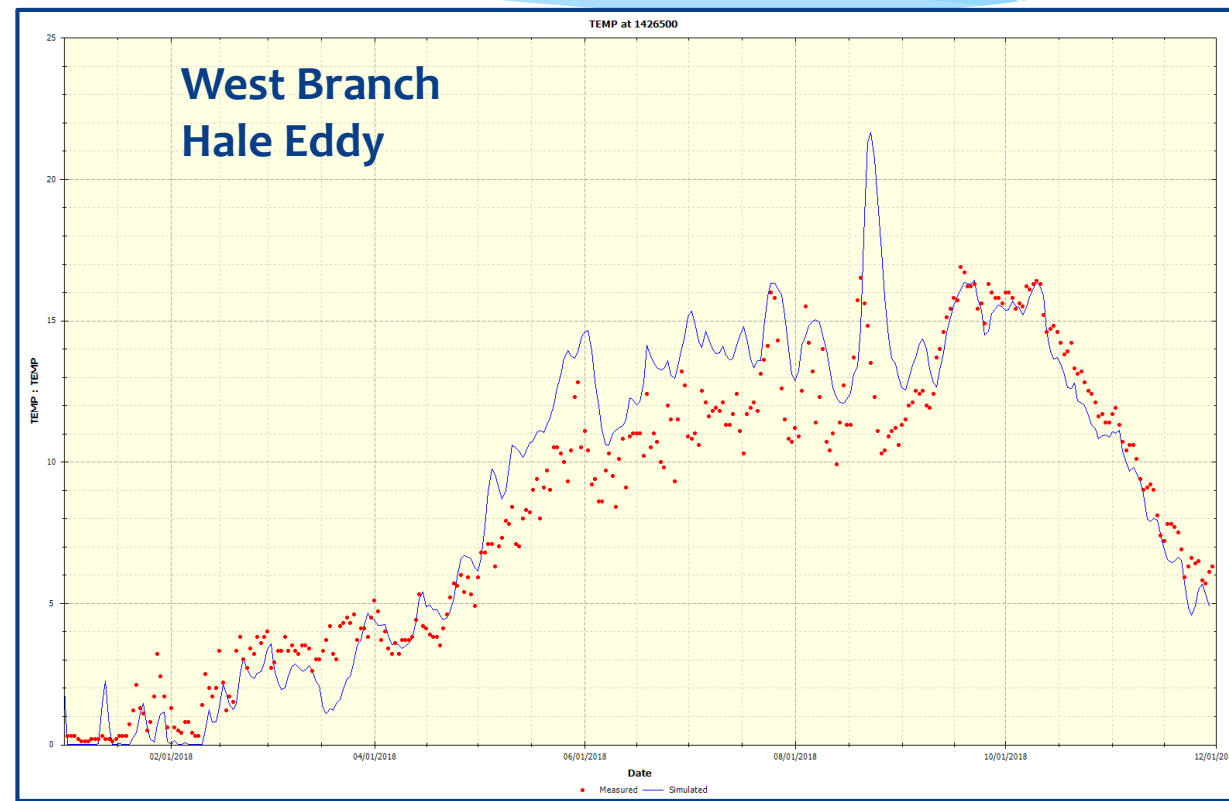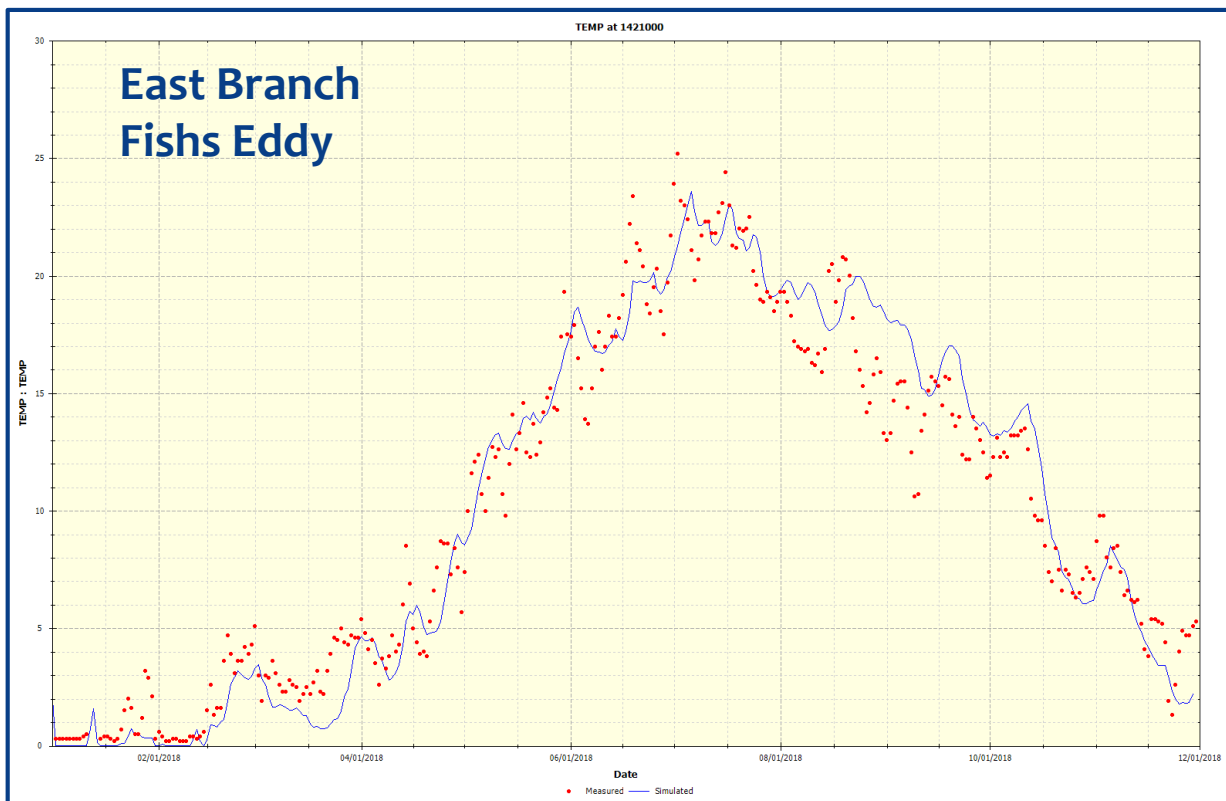
Temperature Calibration Status
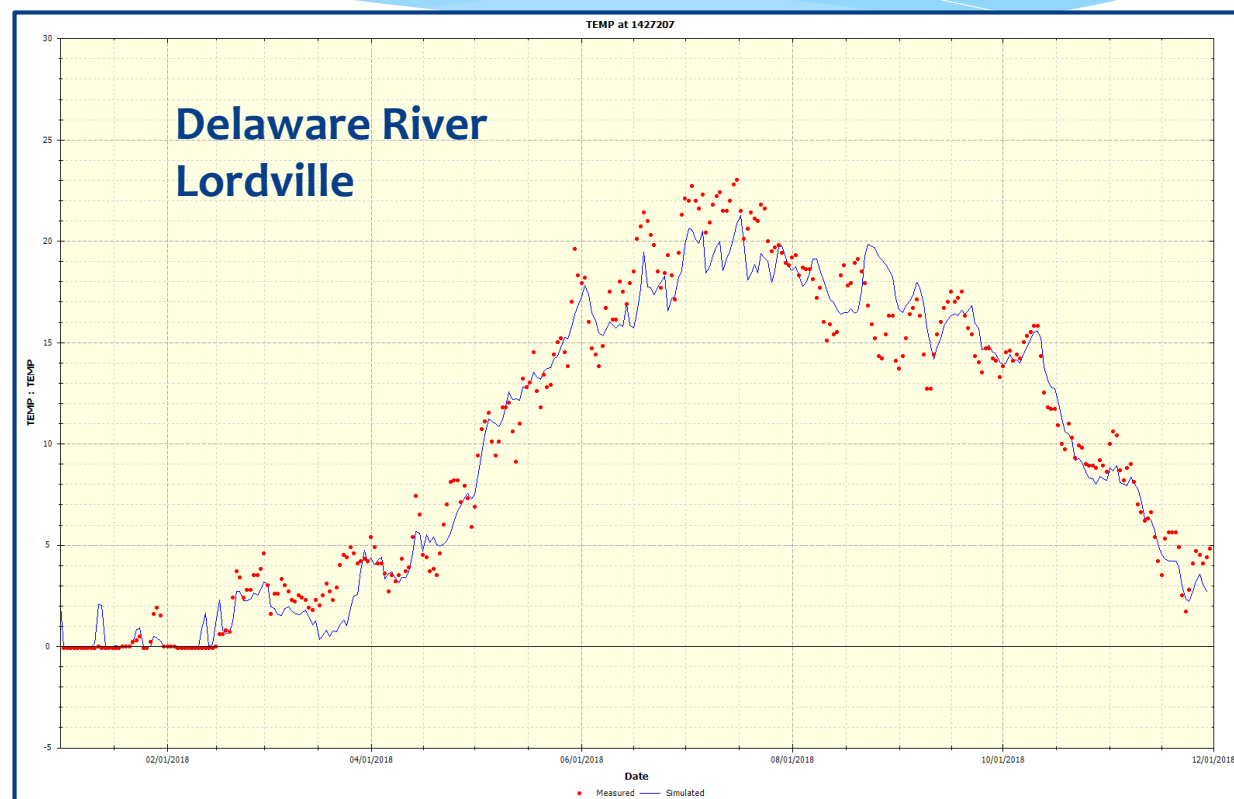
WASP Thermal Model – Next Steps

* Add WWTPs at Deposit and Hancock (maybe others)
* Thermal calibration

* Run with Cannonsville discharge at sustained low flow to estimate number of heat stress days in absence of coldwater inflow
* Evaluate default protocol for use of thermal pool
* Evaluate alternative protocols for use of thermal pool