

Thermal Mitigation Experience Summers 2021

For FUDR's

“Water Water Everywhere” On-Line Meeting,
October 12, 2021

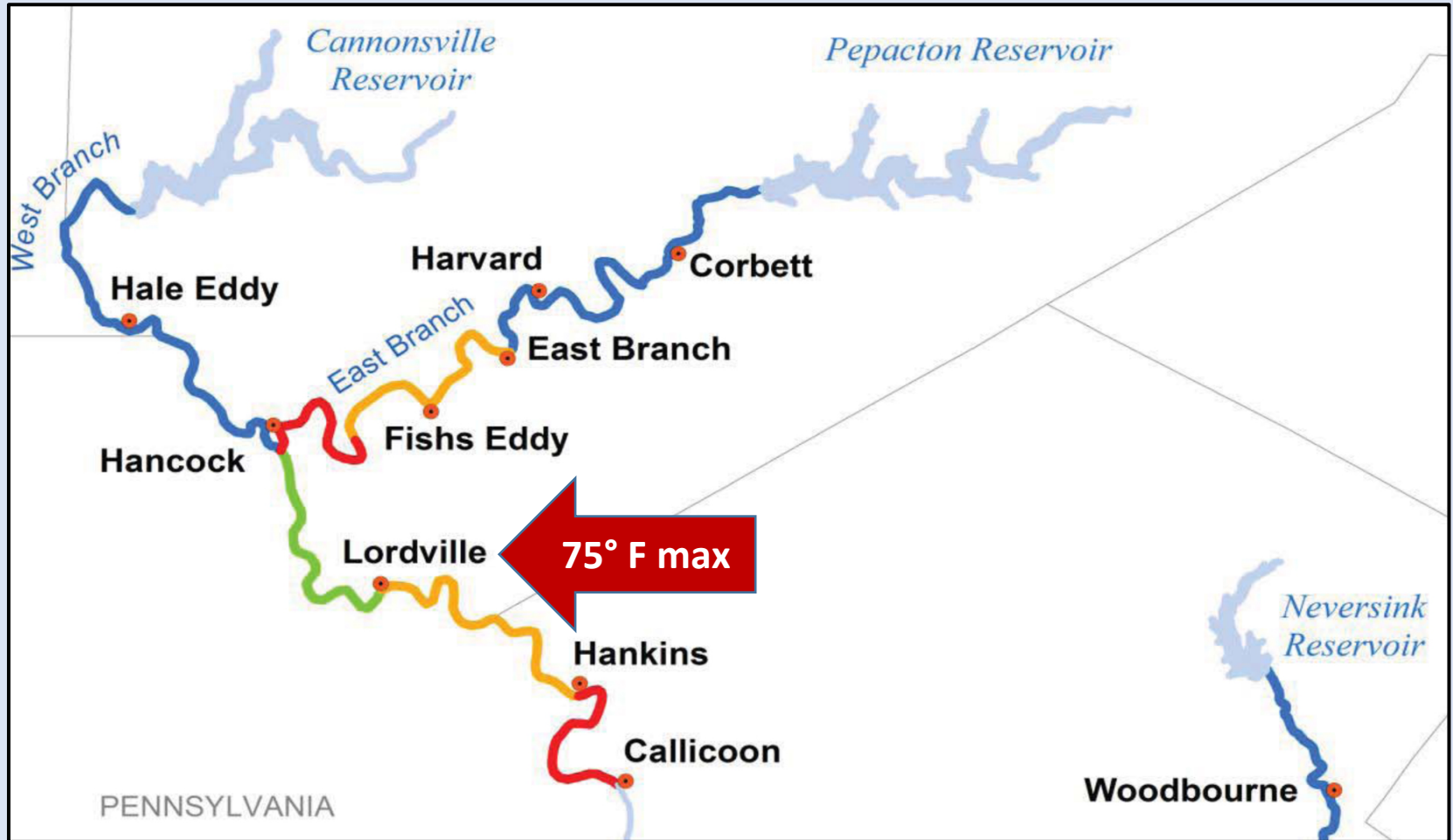
Peter J. Kolesar
Columbia Water Center

I. Introduction and Background

Thermal Mitigation Under FFMP 2017

- The FFMP 2017 includes a thermal mitigation bank, whose objective is to keep summertime Lordville daily maximum temperatures below 75 °F via timed pulses of cold water from Cannonsville when it is anticipated that Lordville temperatures would otherwise exceed the 75 °F limit.
- The bank size is set to 2,500 cfs days of water on June 1, the start of the FFMP water year, and expires on May 31 of the following calendar year.
- The use of the bank is at the discretion of NYS-DEC.
- The DRBC's Subcommittee on Ecological Flows (SEF) has contributed guidelines on the use of the thermal bank. (FUDR and TU have been well represented with Jeff Skelding, Garth Pettinger with Bob Bachman as an alternate, Jim Serio, Peter Kolesar among the 13 SEF members.)

Keeping maximum river temperatures at Lordville below 75° F protects the reach from Hancock to Lordville.



Source: Joint Fisheries White Paper, January 2010

A Pop Quiz from the Professor

Two thermal mitigation homework problems: Its now 8 am decision time. What would you do? Release? How much?

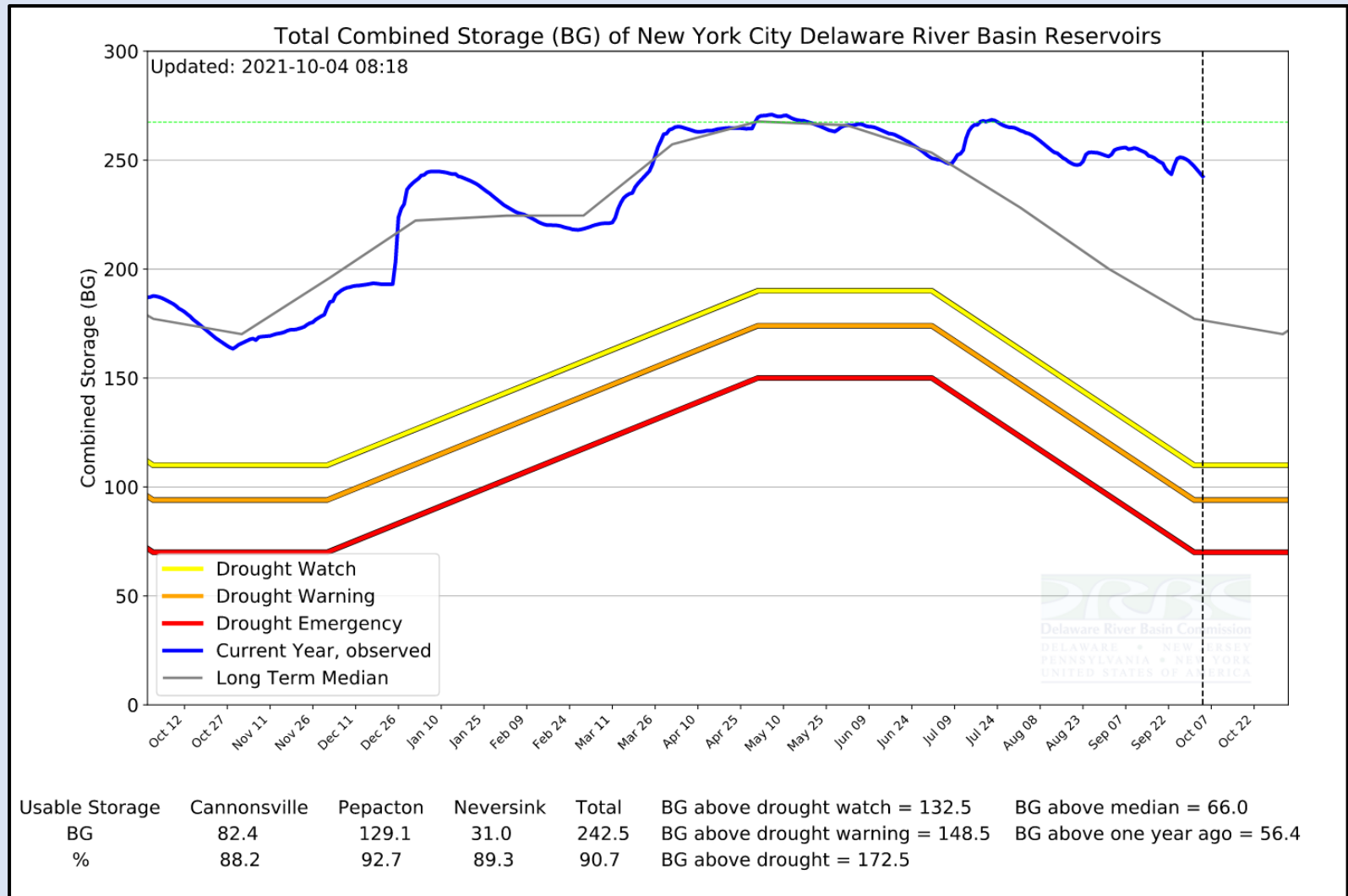
1. Yesterday Lordville was at 2060 cfs and 68°F. The Cannonsville release was 521 cfs. Fishs Eddy was at 700 cfs and 73°F. Binghamton forecasted high and low for today and tomorrow are: (87,66); (85,67).

2. Yesterday Lordville was at 1070 cfs and 74°F. Cannonsville release was 621 cfs. Fishs Eddy was at 278 cfs and 78°F. Binghamton forecasted high and low for today and tomorrow are: (81,70); (84,69)

Thermal release decisions are gambles,
made with a very limited bankroll of
water.

Driving Conditions Summer 2021

PCN Reservoir Storage: Was at or above the median through the Summer 2021

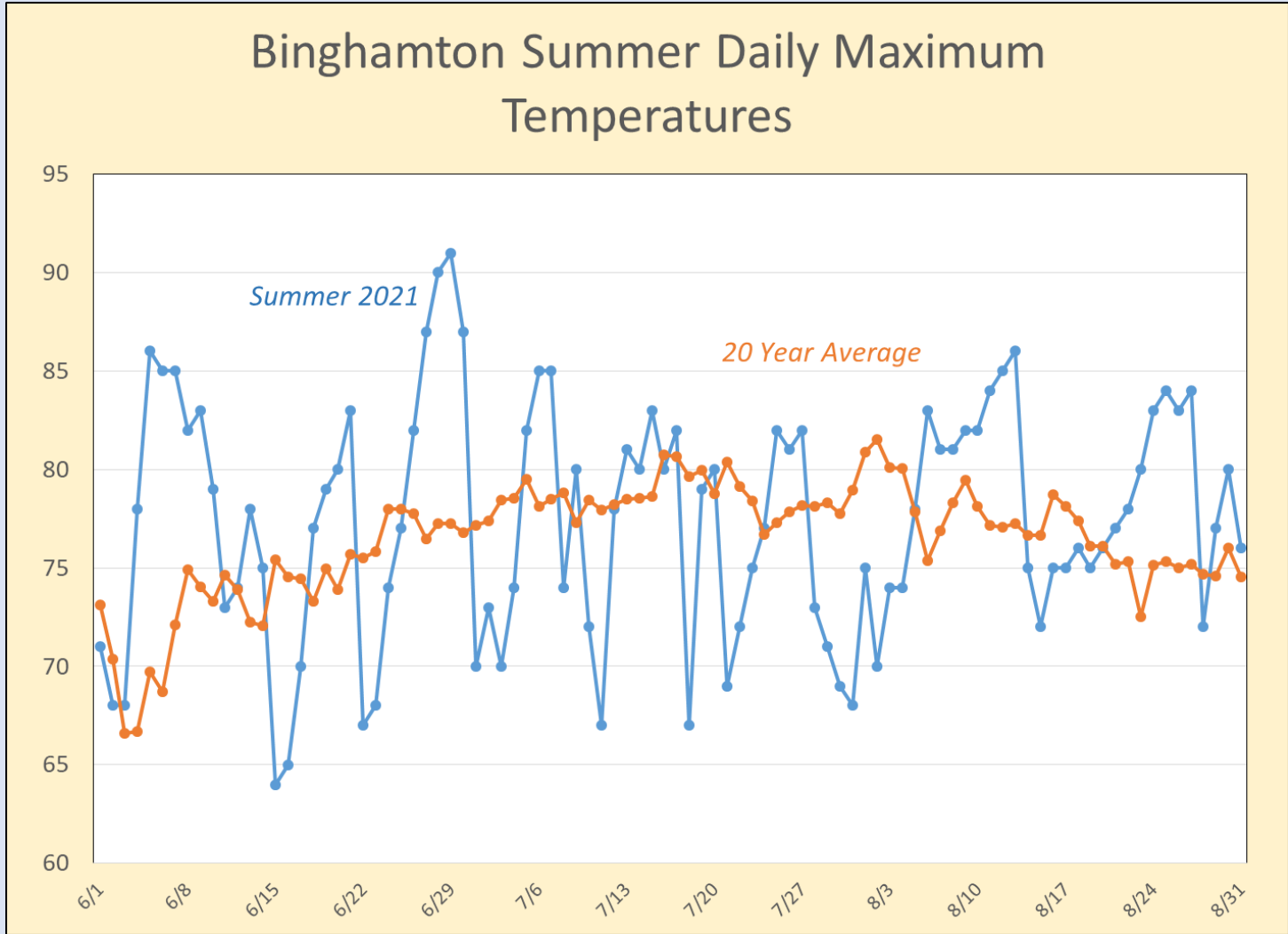


Weather as Driver: Binghamton Precipitation

	May	Jun	Jul	Aug	Sep
2019	5.2	5.4	3.3	3.4	1.9
2020	2.9	4.0	2.4	6.0	2.2
2021	5.3	3.3	9.8	6.2	4.4
20 Year Average	4.0	5.2	4.2	4.4	4.2

Wetter than average May, July and August

Local Air Temperatures (Binghamton) Summer 2021



Weather as a driver of thermal stress: (Binghamton Air Temperatures)

	Average Tmax			Days above 80°F		
	June	July	August	June	July	August
2019	72.3	80.9	76.0	4	20	10
2020	75.6	82.9	78.9	11	26	17
2021	77.5	76.2	78.5	12	13	14
20 Year Average	73.9	78.5	76.9	7.05	13.75	10.55

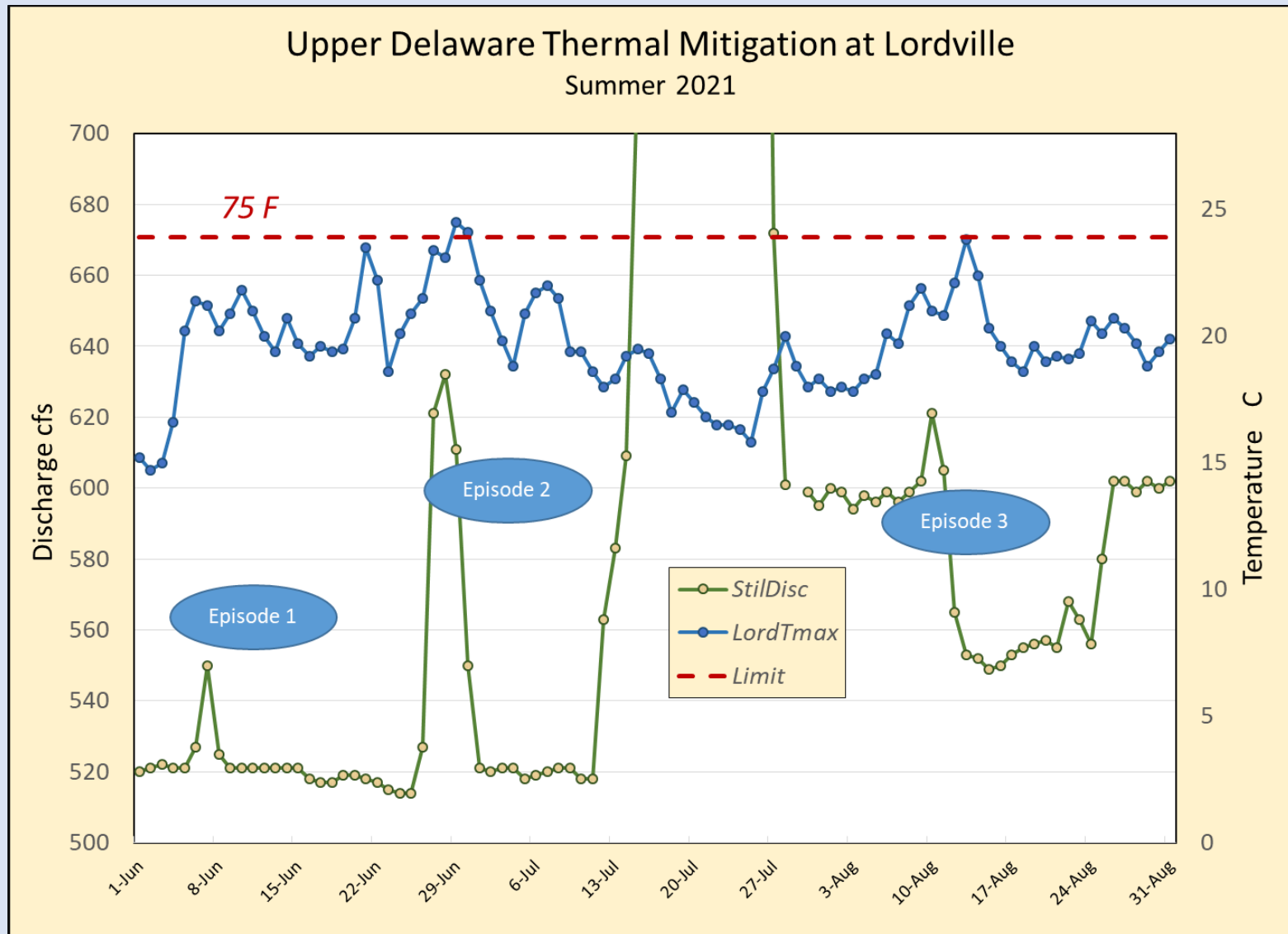
The upper Delaware experienced slightly lower than average maximum air temperatures, but more than average stressful days with temperatures above 80 °F.

II. Thermal Mitigation Experience Summer 2021

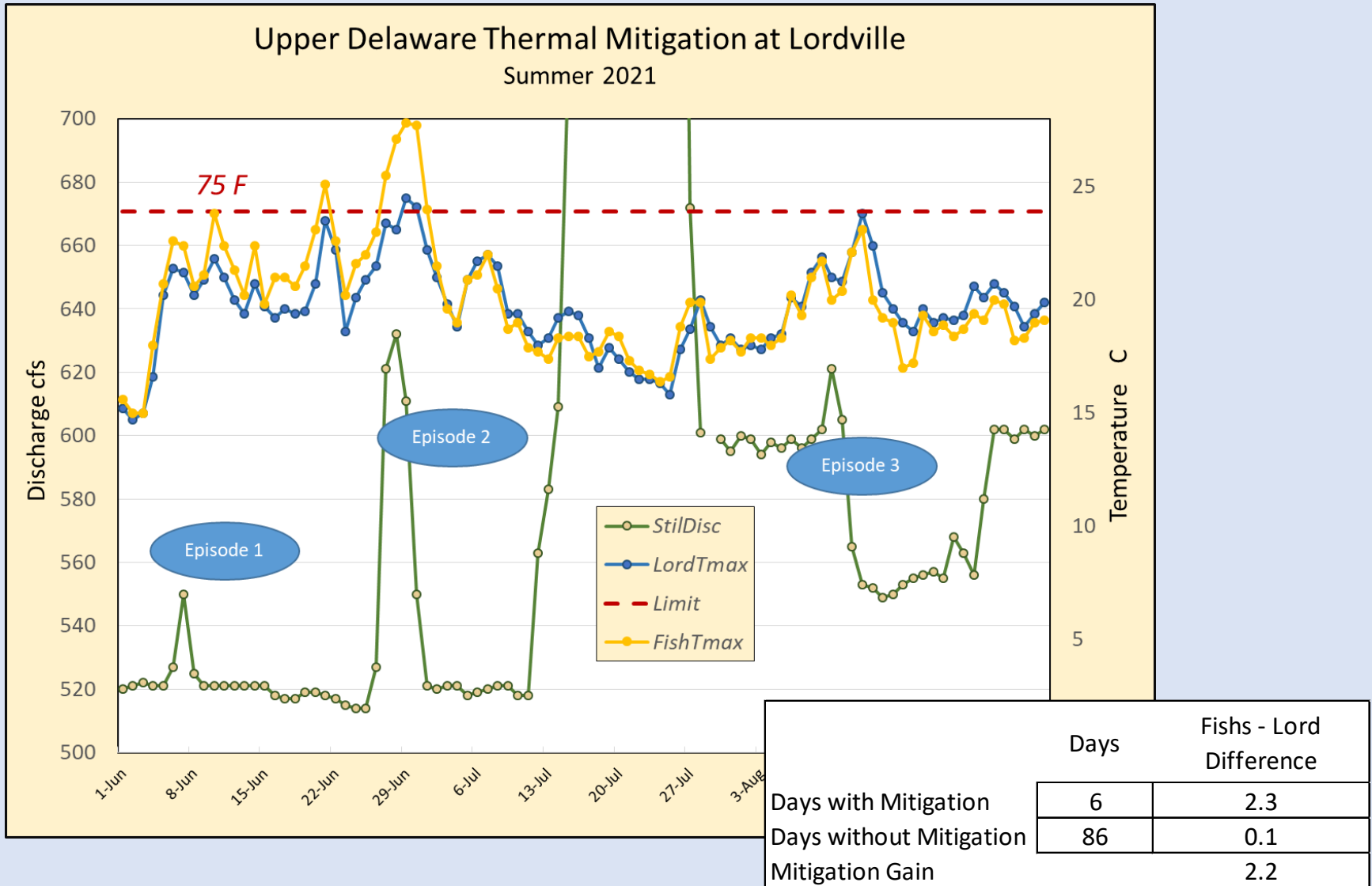
Thermal Mitigation Experience: Summer 2021

- 7 thermal relief requests were made by NYS-DEC. Mitigation releases were made over about 6 days, using about 650 cfs-days of water. I grouped the releases into 3 'thermal episodes'. About 1850 cfs days remains in the bank for use in May 2022.
- Lordville temperatures were kept below the 75°F stress threshold except on two days during a heat wave (76.1 on June 29 and 75.3°F on June 30)
- Using my regression-based calibration of the impact of Cannonsville releases on Lordville temperatures, I estimate that had the thermal releases not been made, Lordville temperatures would have exceeded the 75 °F limit on one or two additional days, and the temperatures on June 29 and June 30 would have been about 0.7°F higher.
- Although not an FFMP 2017 criterion, I examined exceedances of a 72°F daily average limit. The 72°F daily average limit was met whenever the 75 °F criterion was met. But, there were two exceedances, again on June 29 and 30.

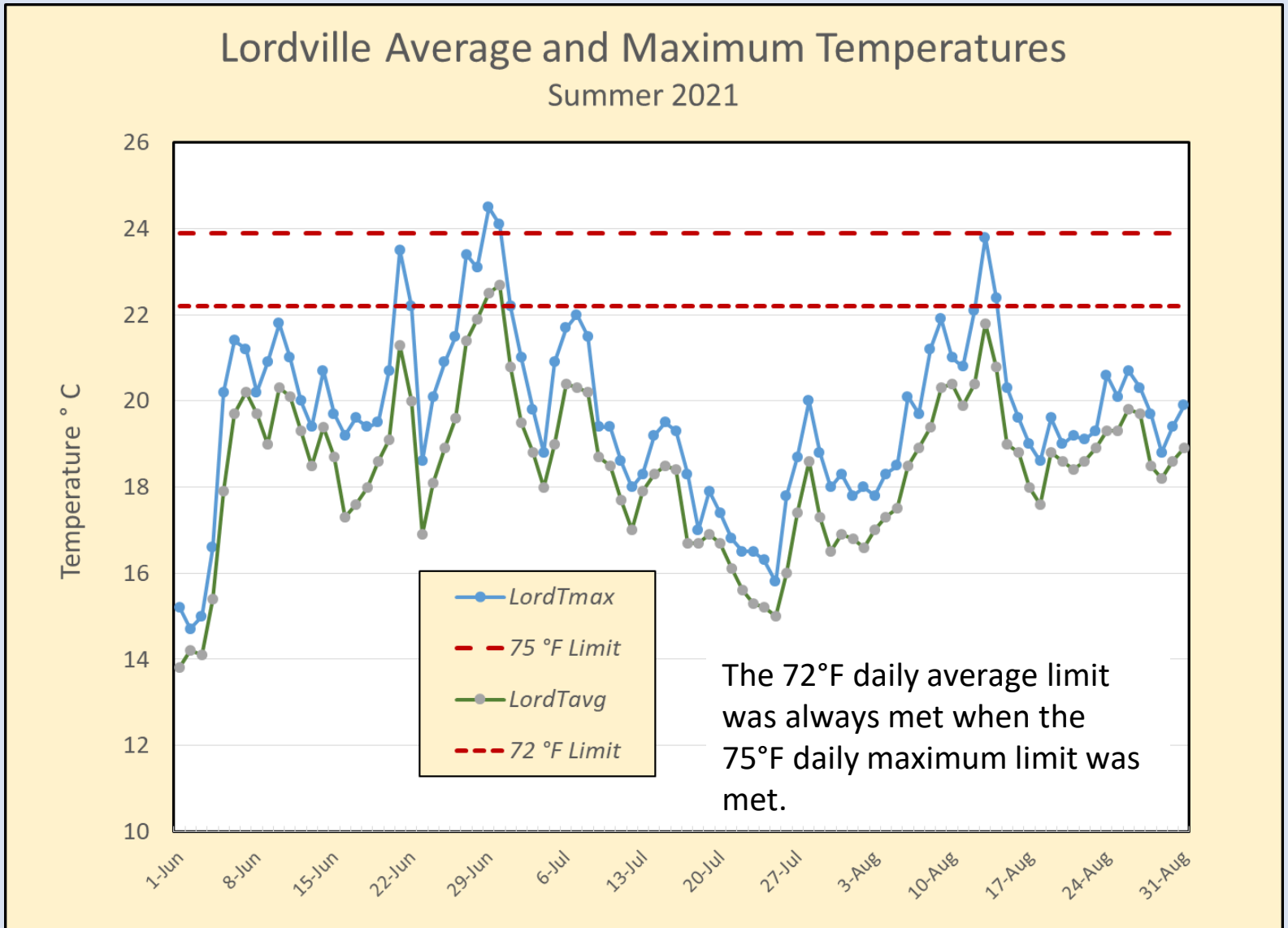
Thermal Mitigation Experience: Summer 2021



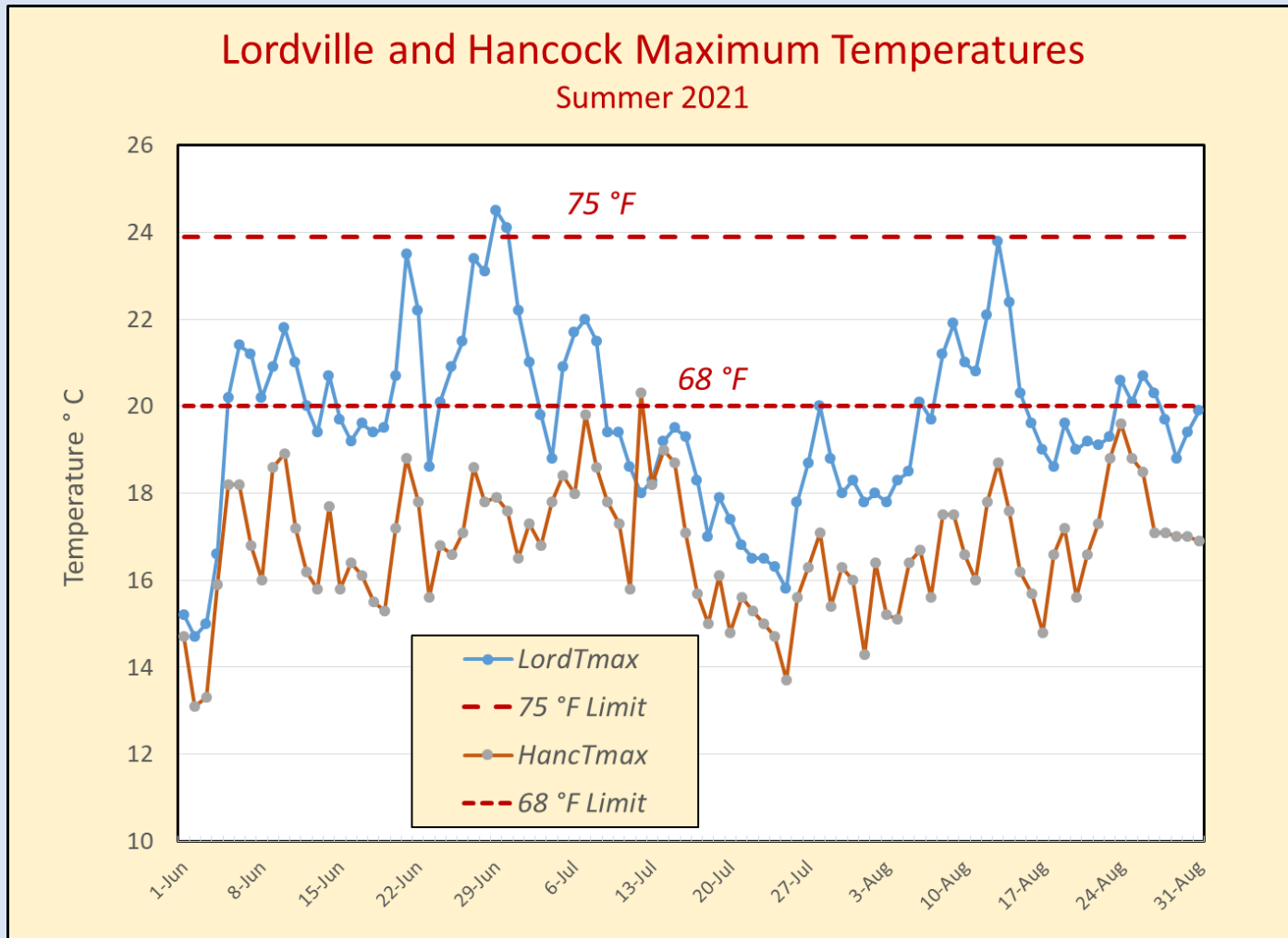
Assessing Mitigation Impact: Comparing Lordville and Fishs Eddy Temperatures



Another Concern: Daily Average Temperatures at Lordville: Summer 2021



Thermal Protection in the Hancock to Lordville Reach: Summer 2021



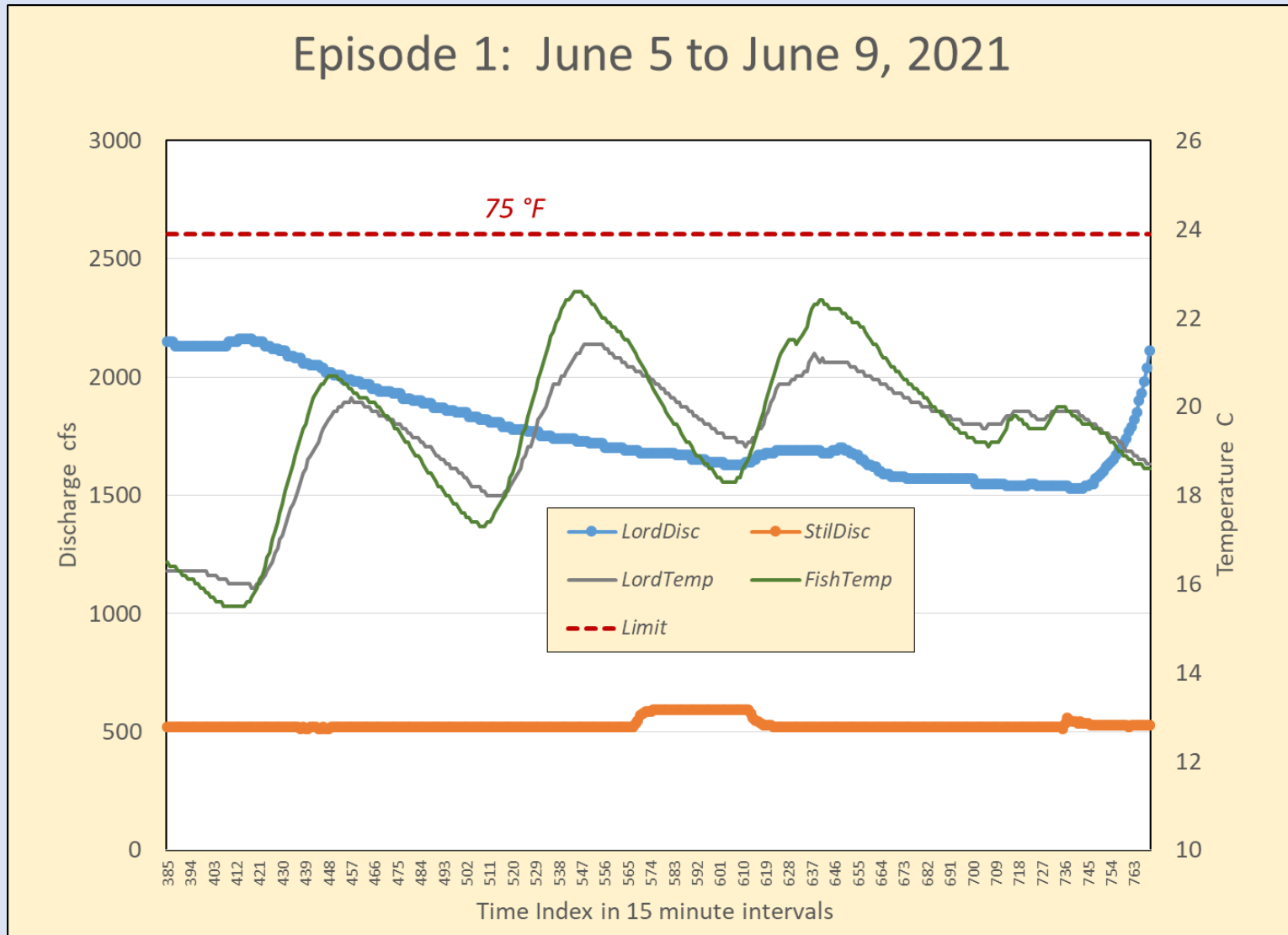
Keeping Lordville below 75°F, kept Hancock below 68 °F,

III. Some Details of the Releases

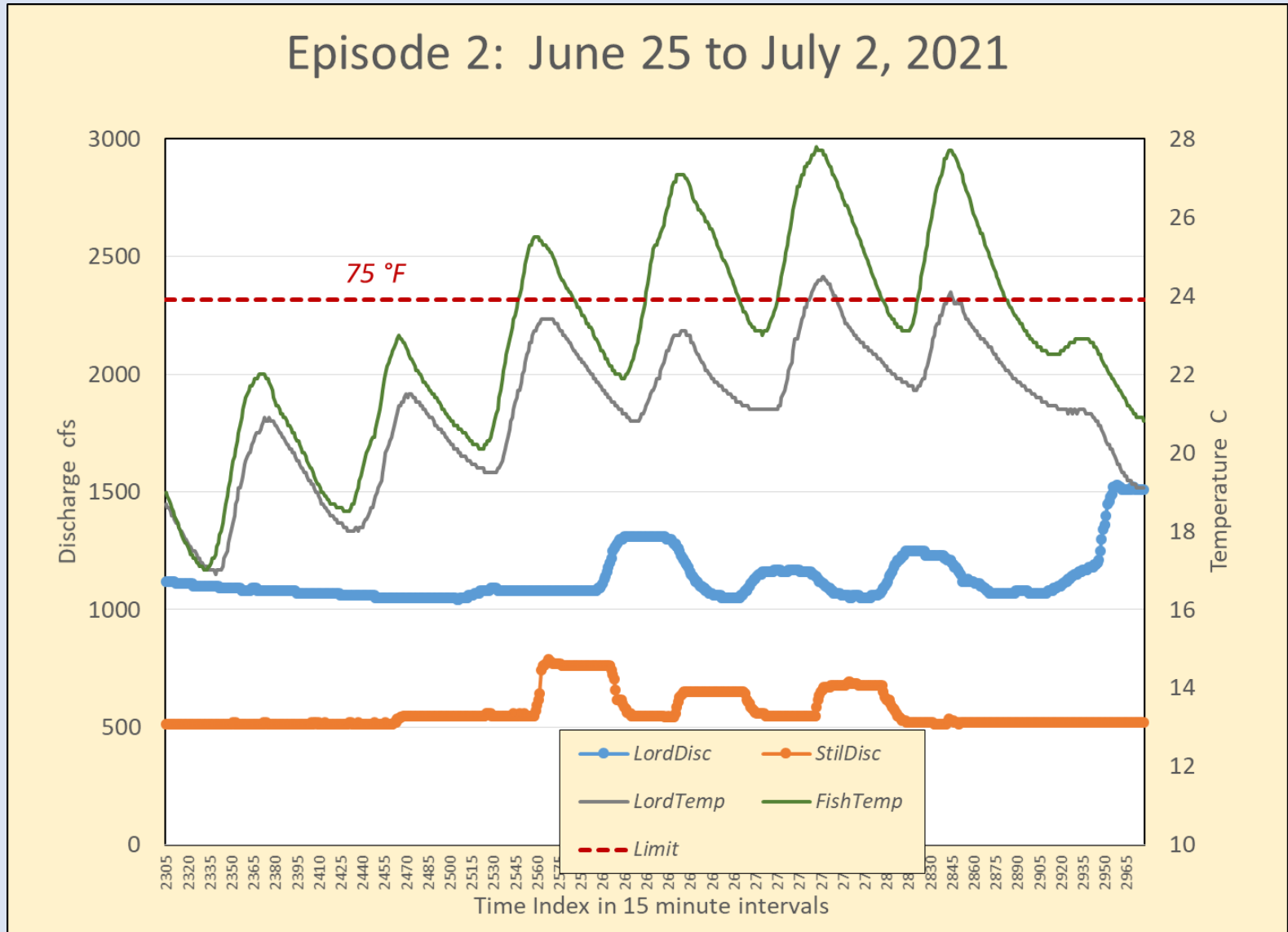
Charts by Peter Kolesar

Discussion led by Brenan Tarrier NYS-DEC

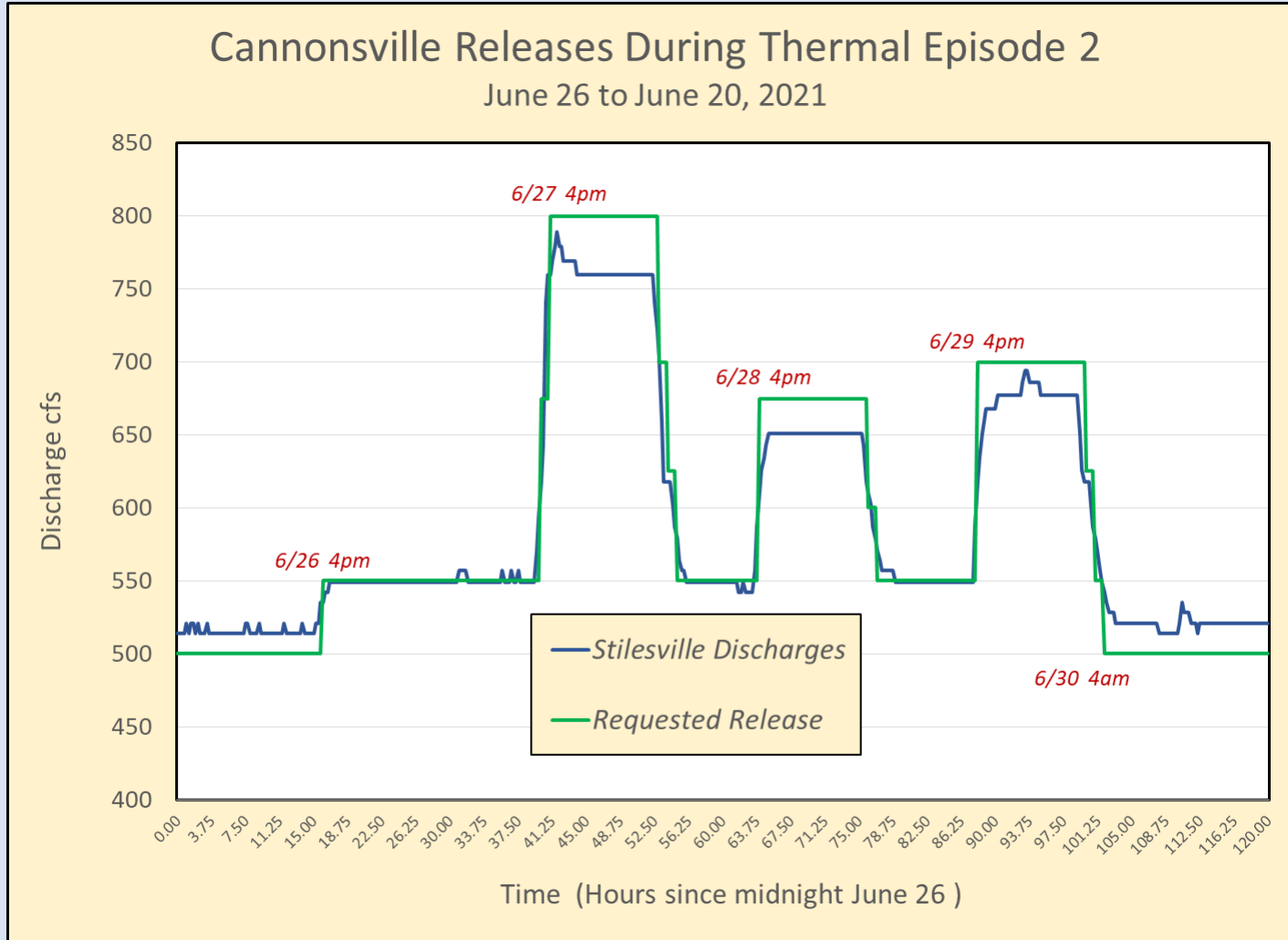
The Details: Episode 1



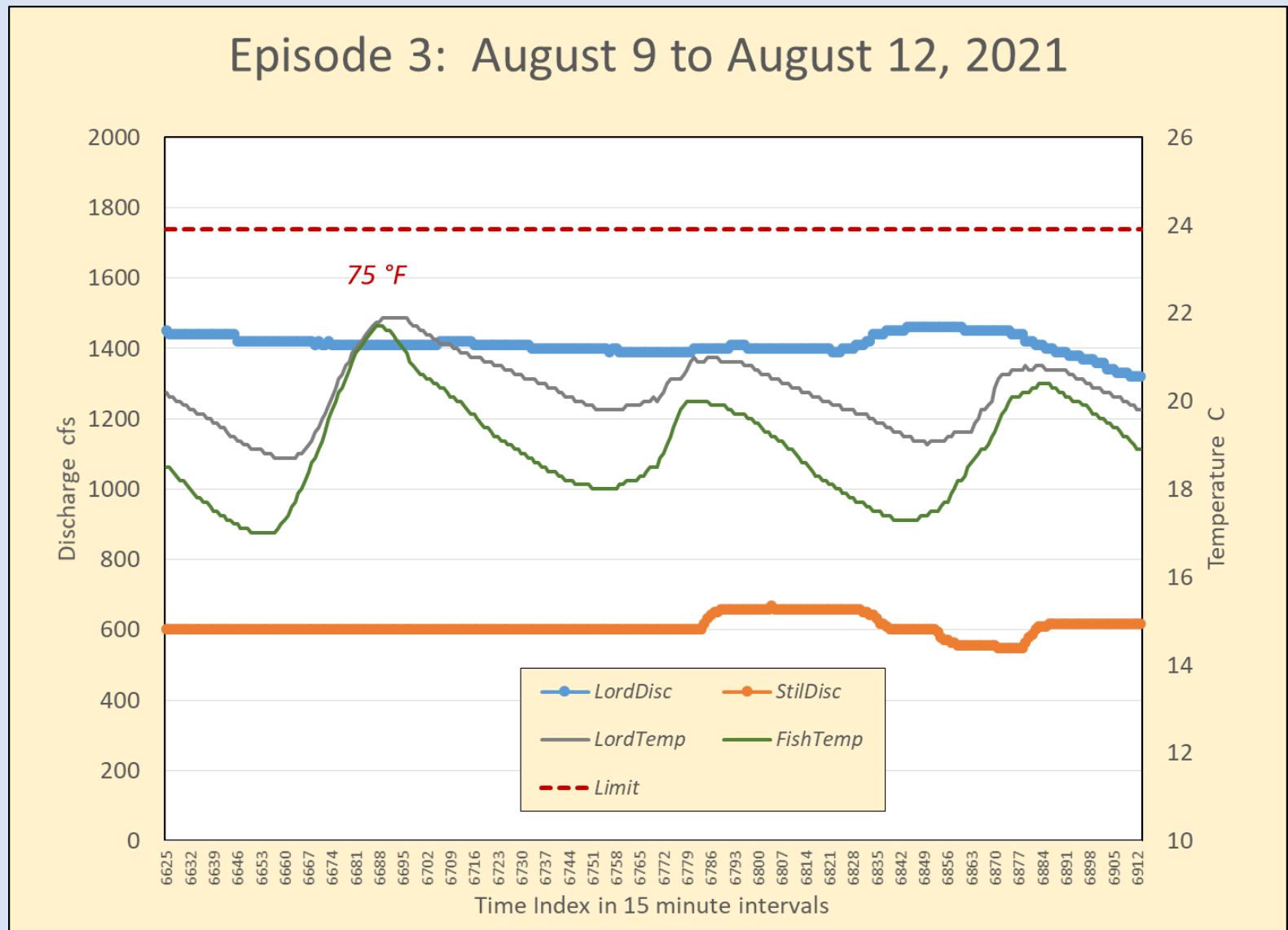
The Details Episode 2



Episode 2: Requested vs. Actual Releases

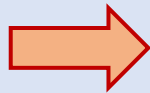
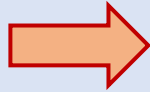
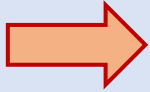


The Details: Episode 3



A Decision Makers View

NWS Temperature Forecasts for Binghamton KBGM					Previous Day River Data				
Date	ThatDay Max	ThatDay Min	NextDay Max	NextDay Min	LordTmax	LordTmin	LordTavg	LordDisc	StileDisc
3-Jun	71	61	74	59	14.7	13.8	14.2	2010	521
4-Jun	78	60	86	64	15	13.4	14.1	1950	522
5-Jun	87	64	88	65	16.6	14.3	15.4	2070	521
6-Jun	87	66	85	67	20.2	15.9	17.9	2060	521
7-Jun	84	69	81	67	21.4	18	19.7	1770	527
8-Jun	80	67	81	64	21.2	19.1	20.2	1660	550
25-Jun	77	63	77	68	20.1	16.3	18.1	1170	514
26-Jun	81	69	87	70	20.9	16.9	18.9	1090	514
27-Jun	87	70	89	69	21.5	18	19.6	1060	527
28-Jun	86	70	84	69	23.4	19.5	21.4	1070	621
29-Jun	87	71	84	66	23.1	20.8	21.9	1200	632
30-Jun	84	66	72	61	24.5	21.1	22.5	1110	611
1-Jul	73	61	70	56	24.1	21.6	22.7	1160	550
8-Aug	82	64	83	66	19.7	18.1	18.9	1490	596
9-Aug	82	67	85	68	21.2	17.7	19.4	1460	599
10-Aug	84	69	87	72	21.9	18.7	20.3	1420	602
11-Aug	89	72	89	69	21	19.8	20.4	1400	621
12-Aug	88	69	84	63	20.8	19	19.9	1410	605
13-Aug	84	63	73	52	22.1	18.9	20.4	1350	565



Open Issues & Research (Kolesar)

- Check the adequacy of the arbitrary 2,500 cfs –day thermal mitigation bank for protecting the upper main-stem Delaware River in a manner consistent with the goals identified in the FFMP. There is evidence that the bank can be bigger at little risk.
- Check the utility of short thermal pulses, such as 8 hour pulses vs 12 or 24 hour pulses etc. Short pulses can save water but permit higher daily average temperatures.
- Reassess the “Bank” strategy. What do you do when the bank is empty, but the reservoir is full.
- Refine the regression based mitigation calibration models and/or develop thermodynamic models of the impact of reservoir releases on downstream temperatures. Use best data and forecasts now available.
- Evaluate the impact of the thermal mitigation protocol on shad and warm water species such as smallmouth bass.
- Evaluate the feasibility of other temperature triggers or targets such as a 68° F daily max, a 72° F daily average or two successive days at the 75° F max, etc.

The End

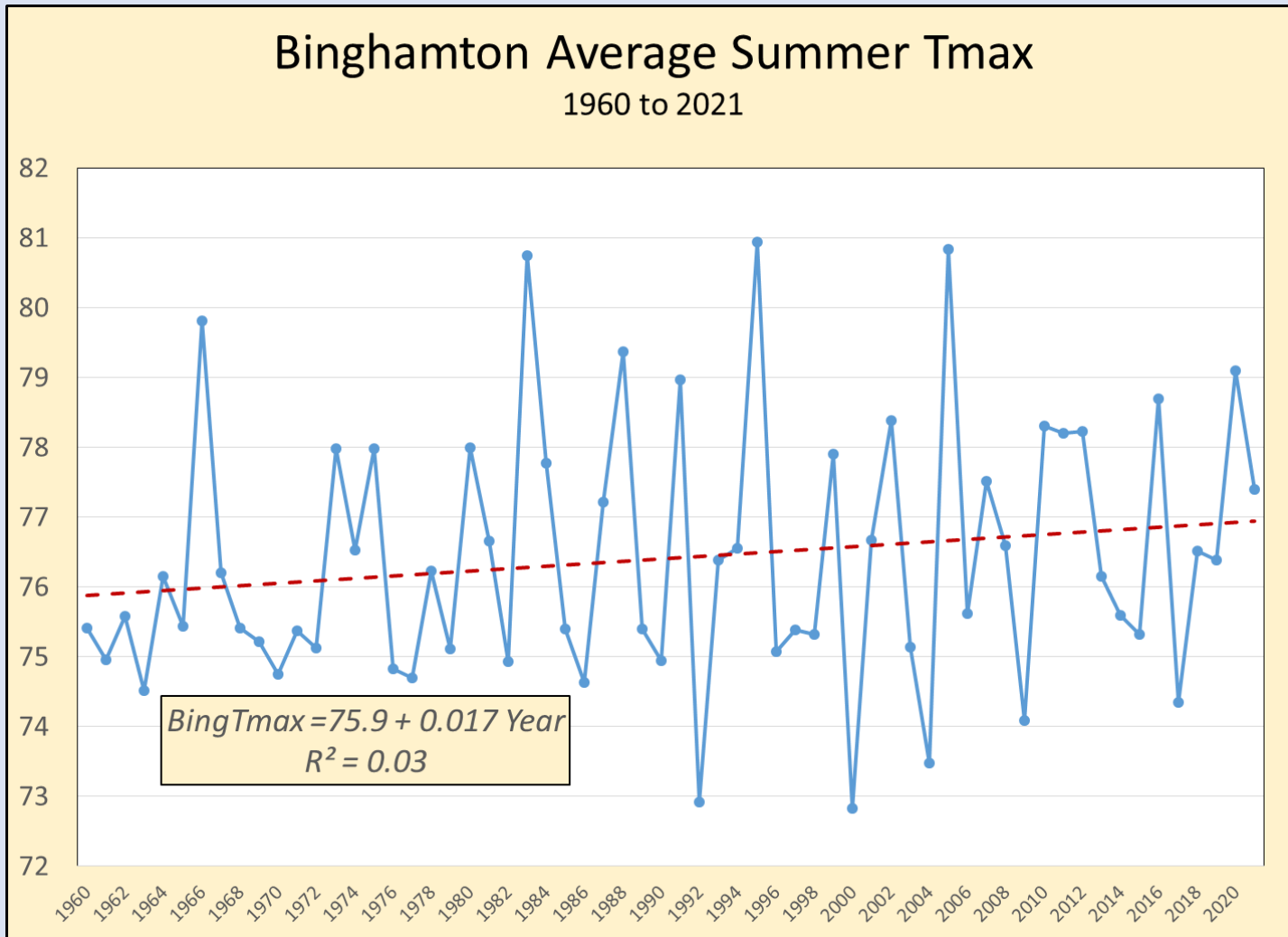
Questions?



Appendix

Slides Not Uses

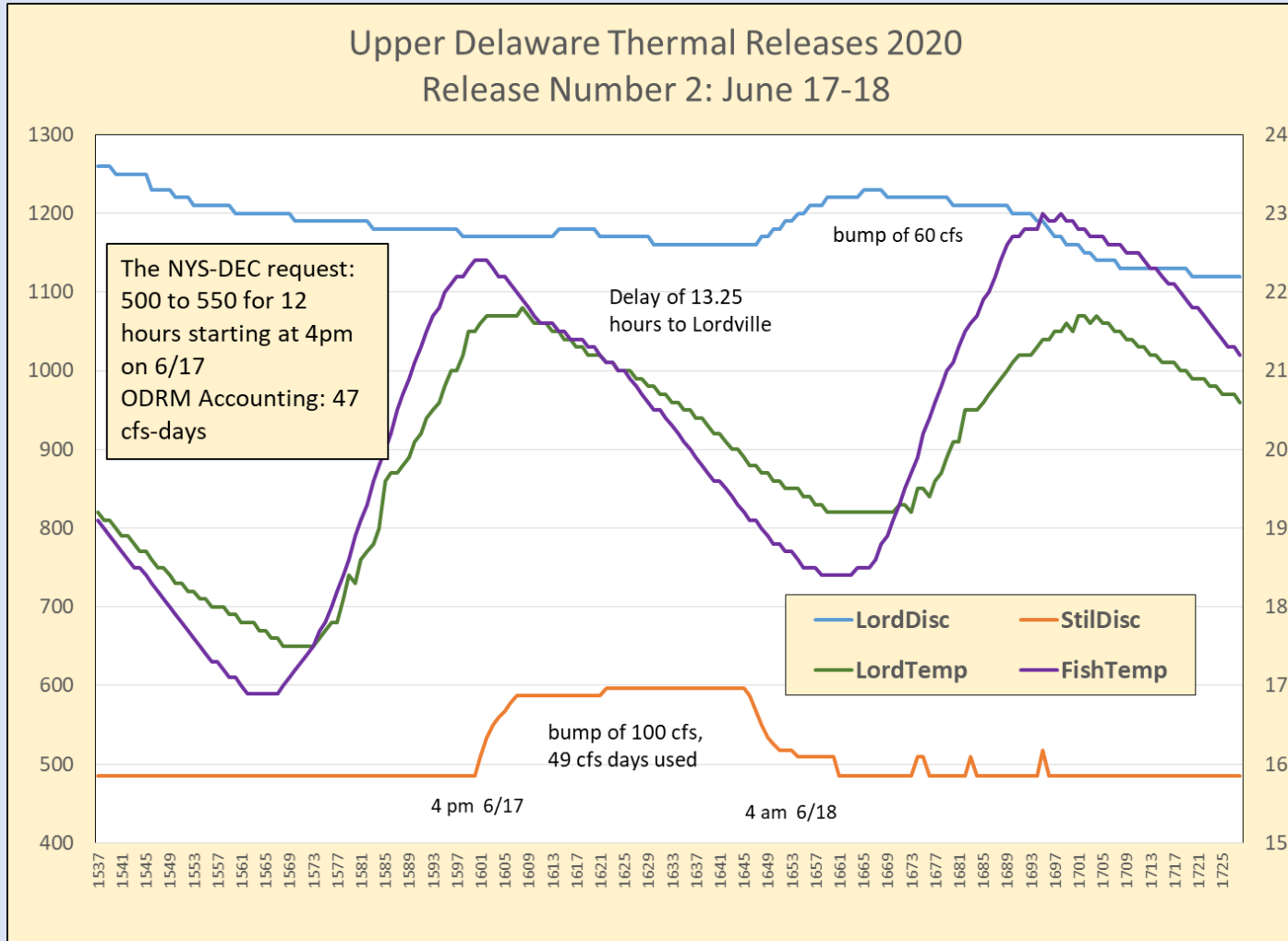
Trend in Summer Average Daily Maximum Temperatures at Binghamton



The Need for Thermal Mitigation: A Decade Plus of Struggle

- The releases of previous policies (Rev 1, Rev 7, etc.) and of the FFMP up to 2017 were inadequate to protect the trout during summer heat waves. There were 59 “thermal stress” events between 2008 and 2012 alone –each provoking a crisis-like situation for the fishing community -- and hence situations for the decree parties to respond to ad hoc.
- From the start of the FFMP in 2008 until 2018, before the thermal mitigation protocol was implemented, there have been at least 78 such stress days with one event lasting 12 days and with one day reaching 81.3°F.
- Until FFMP 2017, the decree parties declined to include a thermal mitigation procedure into the FFMP – treating each impending thermal stress event in an ad hoc manner – if at all.
- Meanwhile, analyses at Columbia, at NYS-DEC and PA F&BC showed the feasibility of thermal mitigation via calibrated pulses of cold water from Cannonsville.

What is planned is not always what happened. The Details on One Thermal Release:



Comparison of Cannonsville Release by DataSources June and July 2020

