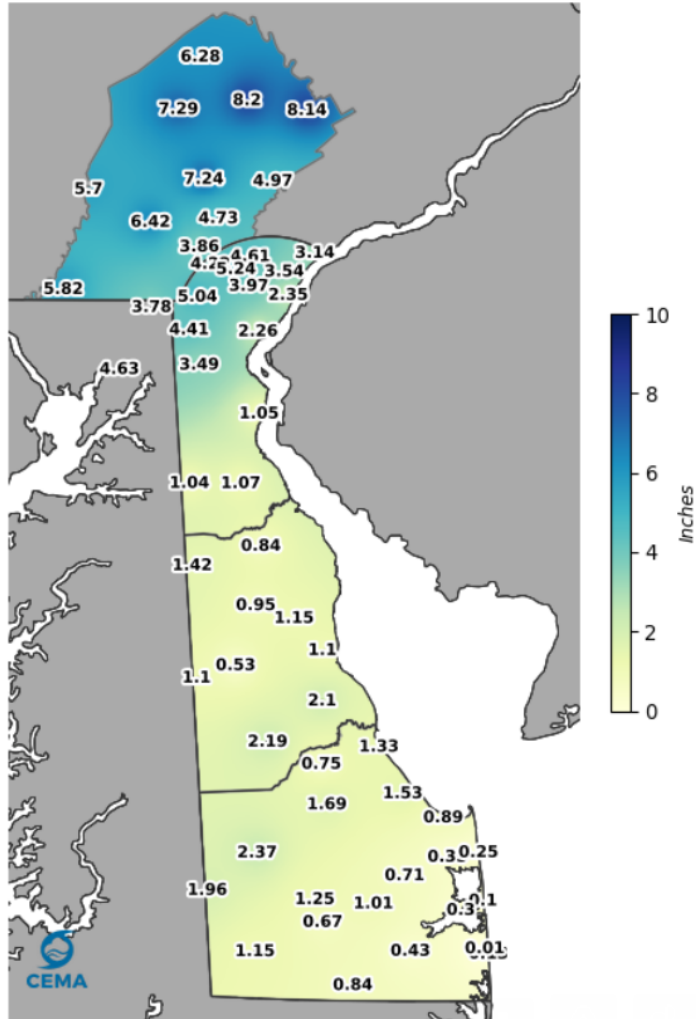


Tropical Storm Ida Remnants Brandywine River Wilmington, Del. Sep 1-2, 2021

The UDWRC utilized the USACOE HECRAS hydraulic model developed by FEMA to reconstruct and examine the effects of Tropical Storm Ida remnants along the Brandywine River in Wilmington, Del. on Sep 1-2, 2021.

Precipitation Totals
September 01, 2021



The remnants of Tropical Storm Ida left 7.29 inches of rain in the headwaters of the Brandywine River watershed at Coatesville and 8.2 inches at Downingtown in Chester County, Pennsylvania. According to NOAA Atlas 14, the 100-yr, 24-hr storm is 8.0 inches there.

Ida left 5.04 inches at Newark, Del. (10-yr storm) and 3.54 inches above Wilmington, Del. (2-yr storm).

USGS Gage	Date	Storm	Peak Flows ¹ (cfs)	Return Interval ²
Shellpot Creek at Wilmington, Del.	7/05/89	4 th of July	8,040	100-yr
01477800	9/13/71		6,850	50-yr
	10/1/10		5,760	25-yr
1945-present	8/27/67		4,650	>10-yr
	9/16/99	Floyd	4,460	25-yr
	8/28/11	Irene	4,400	10-yr
	8/7/20		3,250	5-yr
Christina River at Cooches Bridge, Del.	8/4/20	Isaias	8,780	>100-yr
01478000	8/28/11	Irene	7,780	>100-yr
1943-present	9/16/99	Floyd	7,050	>100-yr
	7/05/89	4 th of July	5,530	>50-yr
	9/28/04	Jeanne	5,430	>50-yr
	5/01/47		4,330	25-yr
	6/22/72	Agnes	3,320	10-yr
White Clay Creek near Newark, Del.	9/16/99	Floyd	19,500	>200-yr
01479000	8/28/11	Irene	17,000	>100-yr
1943-present	5/01/14		14,600	<100-yr
	9/15/03	Henri	13,900	>50-yr
	8/4/20	Isaias	12,100	50-yr
	7/05/89	4 th of July	11,600	>25-yr
	1/19/96		9,150	25-yr
	6/22/72	Agnes	9,080	25-yr
	9/2/21	Ida	8,500	>10-yr
Red Clay Creek at Wooddale, Del.	9/15/03	Henri	15,600	>500-yr
01480000	9/28/04	Jeanne	8,280	>50-yr
1943-present	8/28/11	Irene	7,680	50-yr
	9/16/99	Floyd	7,650	50-yr
	8/7/20		6,730	>25-yr
	4/30/14		5,840	>10-yr
	6/28/06		5,490	>10-yr
	8/4/20	Isaias	5,280	>10-yr
Brandywine Creek at Wilmington, Del.	9/2/21	Ida	33,700	>100-yr
01481500	6/23/72	Agnes	29,000	100-yr
1946-present	9/17/99	Floyd	28,700	>50-yr
	5/01/14		22,800	>25-yr
	1/25/79		22,400	>25-yr
	9/13/71		21,300	25-yr
	9/29/04	Jeanne	20,800	25-yr
	8/19/55	Diane	17,800	>10-yr
	1/26/78		17,200	>10-yr
	8/28/11	Irene	16,800	>10-yr
	8/5/20	Isaias	16,100	10-yr

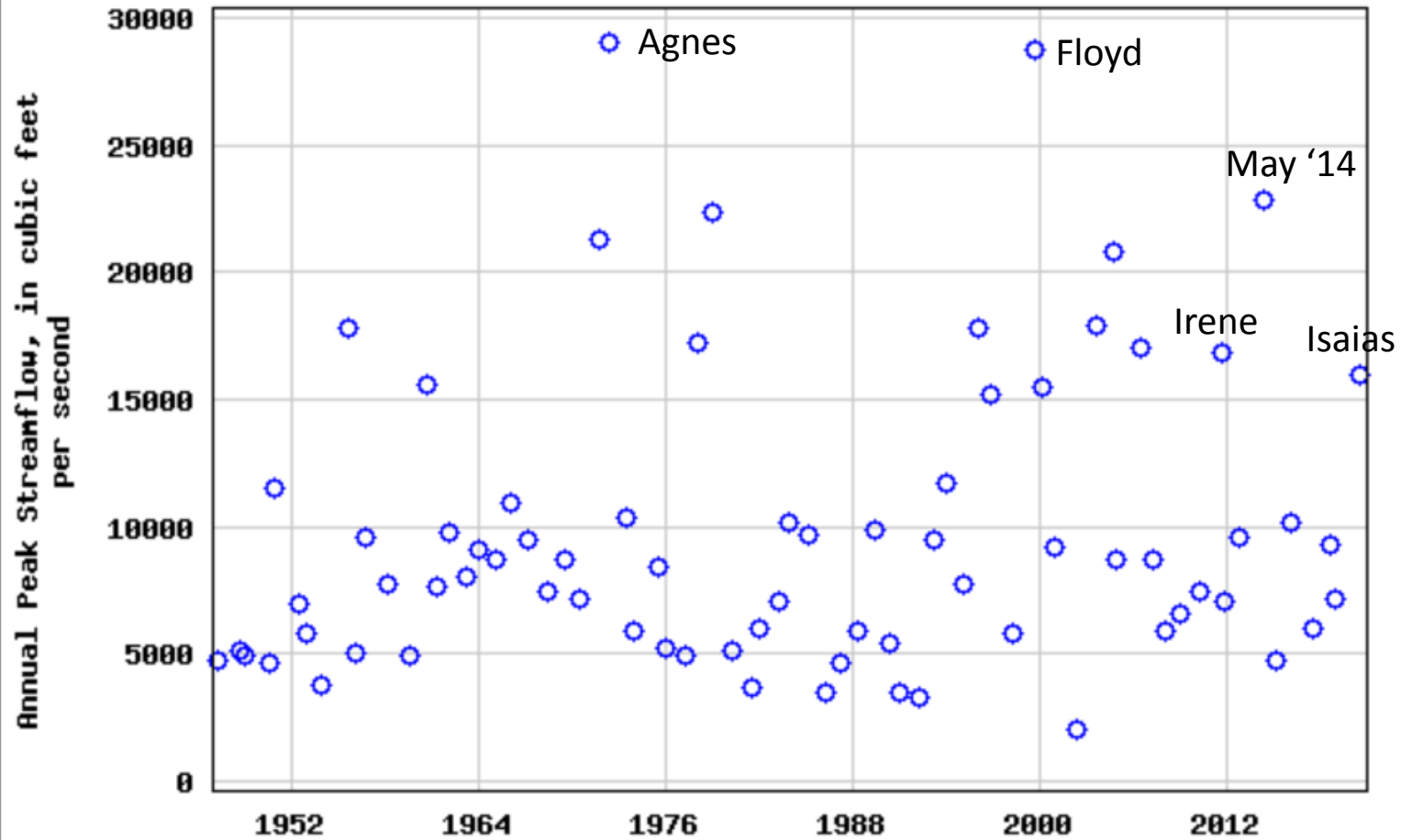
Ida peak flood **33,700 cfs** (>100-yr) on Sep 2, 2021 highest on record along Brandywine Creek at Wilmington dating to 1946 surpassing Hurricane Agnes of **29,000 cfs** on Jun 23, 1972.

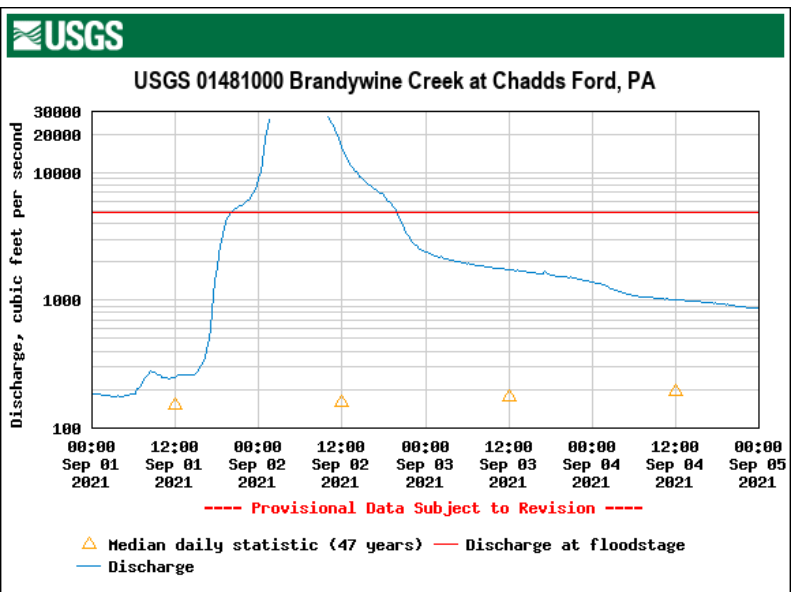
Ida peak flood of 8,500 cfs (>10-yr) on Sep 2, 2021 highest on record along White Clay Creek near Newark dating to 1943 just behind Hurricane Agnes of 9,080 cfs on Jun 22, 1972.



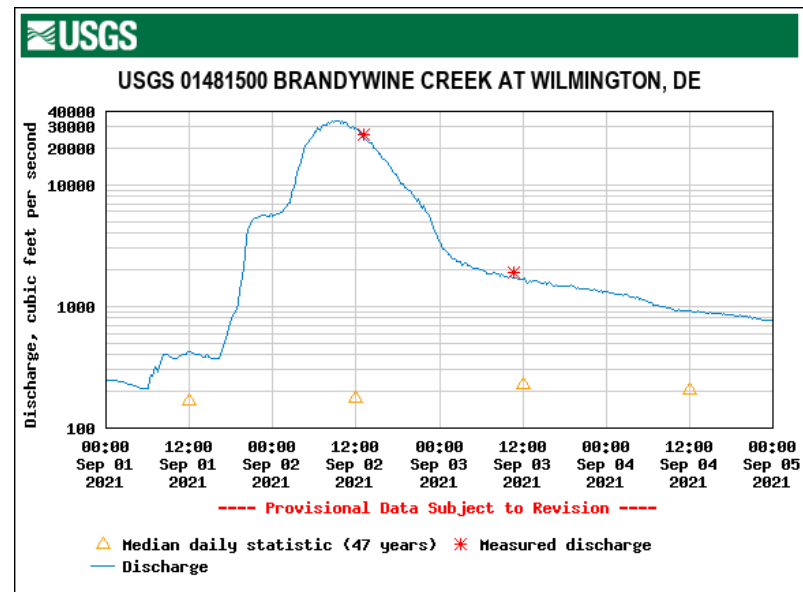
USGS 01481500 BRANDYWINE CREEK AT WILMINGTON, DE

Ida

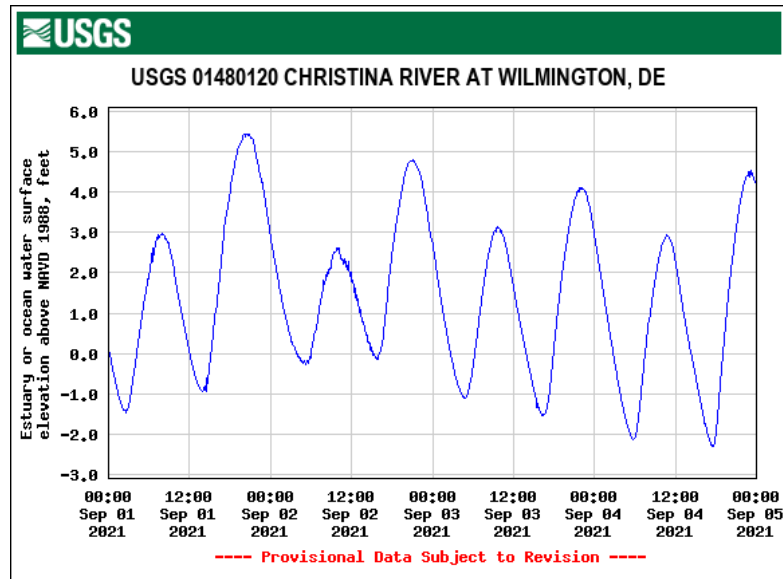




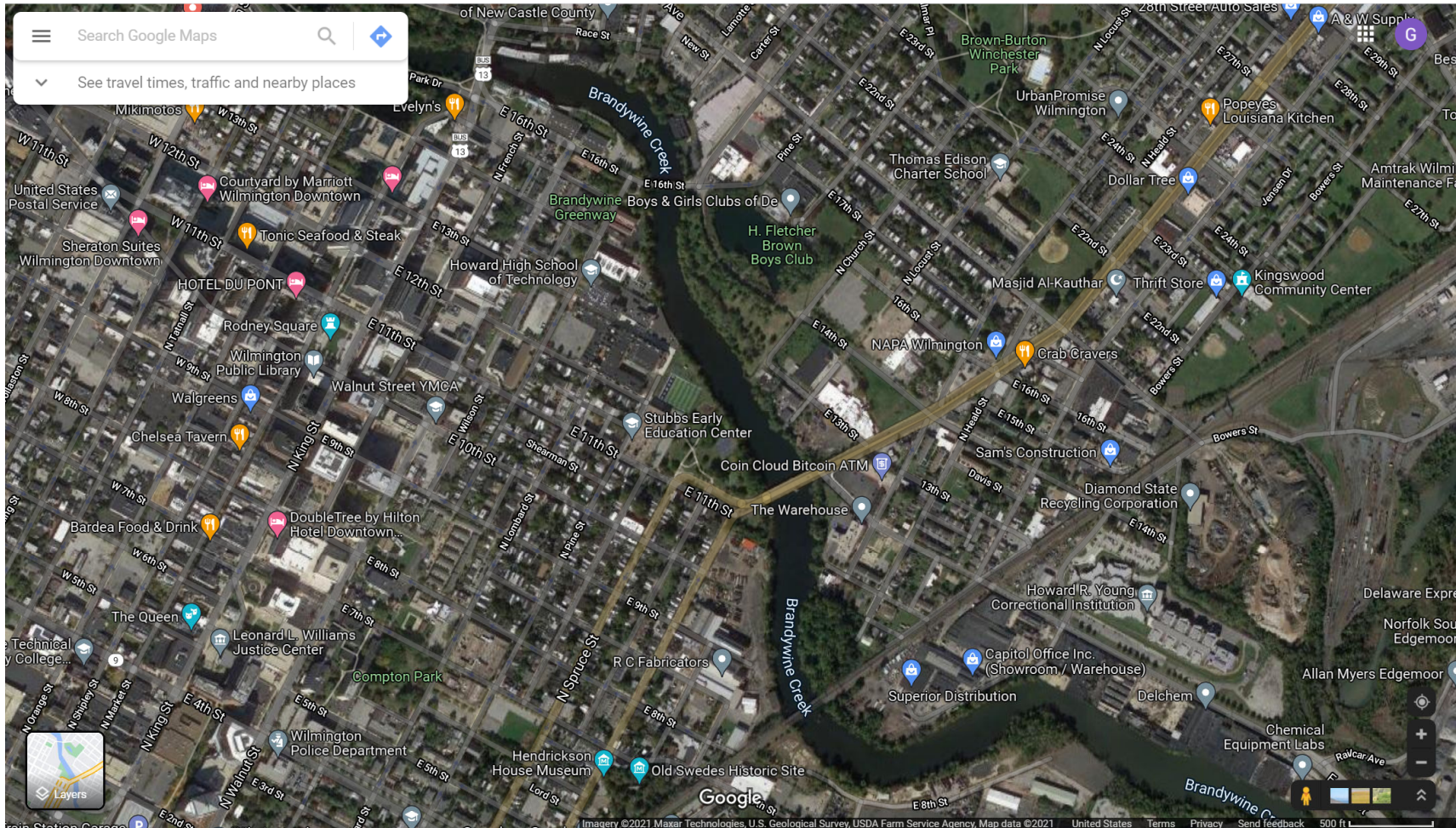
Ida peak discharge Brandywine Creek at Chadds Ford, PA > 33,000 cfs at 2 am Sep 2, 2021



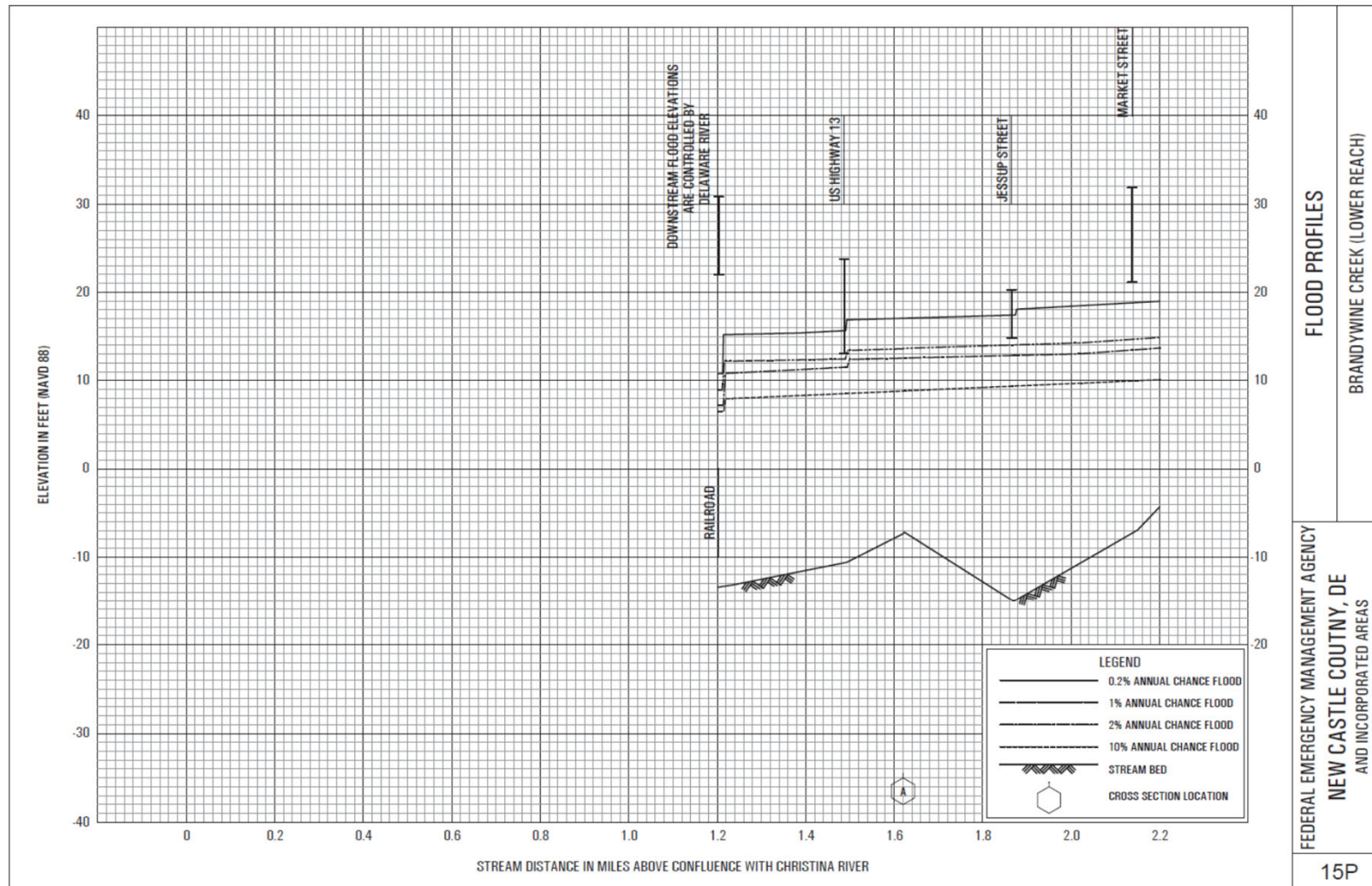
Ida peak discharge Brandywine Creek at Wilmington 33,700 cfs at 11 am Sep 2, 2021. Travel time of peak from DE/PA line was 9 hours.



Normal high tide Christina River at Wilmington 3 to 4 ft msl. Ida high tide 5.4 ft at 10 pm Sep 1 and 4.8 ft 11 pm Sep 2, 2021 fortunately out of phase with peak flood height.



There are 4 bridges over the tidal Brandywine upstream from mouth: AMTRAK RR, Northeast Blvd., E. 16th Street, and Market St. (Bus. Route 13.). Each is sized to safely convey the 100-yr design flood without overtopping the bridge deck. However, the AMTRAK RR bridge causes some backwater during the 100-yr flood.



There are 4 bridges over tidal Brandywine upstream from mouth: AMTRAK RR, US Hwy. 13/Northeast Blvd., Jessup St./ E. 16th Street, and Market St. (Bus. Route 13.). Each is sized to safely convey the 100-yr design flood without overtopping the bridge deck. However, the AMTRAK RR bridge causes 4 ft of backwater during the 100-yr flood.

Delaware.gov

FLOOD PLANNING TOOL

The Delaware Department of Natural Resources and Environmental Control (DNREC) Flood Planning Tool is an interactive web map application designed to aid you in researching your flood risk in the State of Delaware.

Disclaimer: The Flood Planning Tool provided herein is for reference only within the State of Delaware boundaries. The user of this information understands and acknowledges that the data may be inaccurate or contain errors or omissions and the user assumes full responsibility for any risks or damages resulting from any use or reliance upon this data. Delaware DNREC does not guarantee the accuracy or reliability of the data generated from

DELaware DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

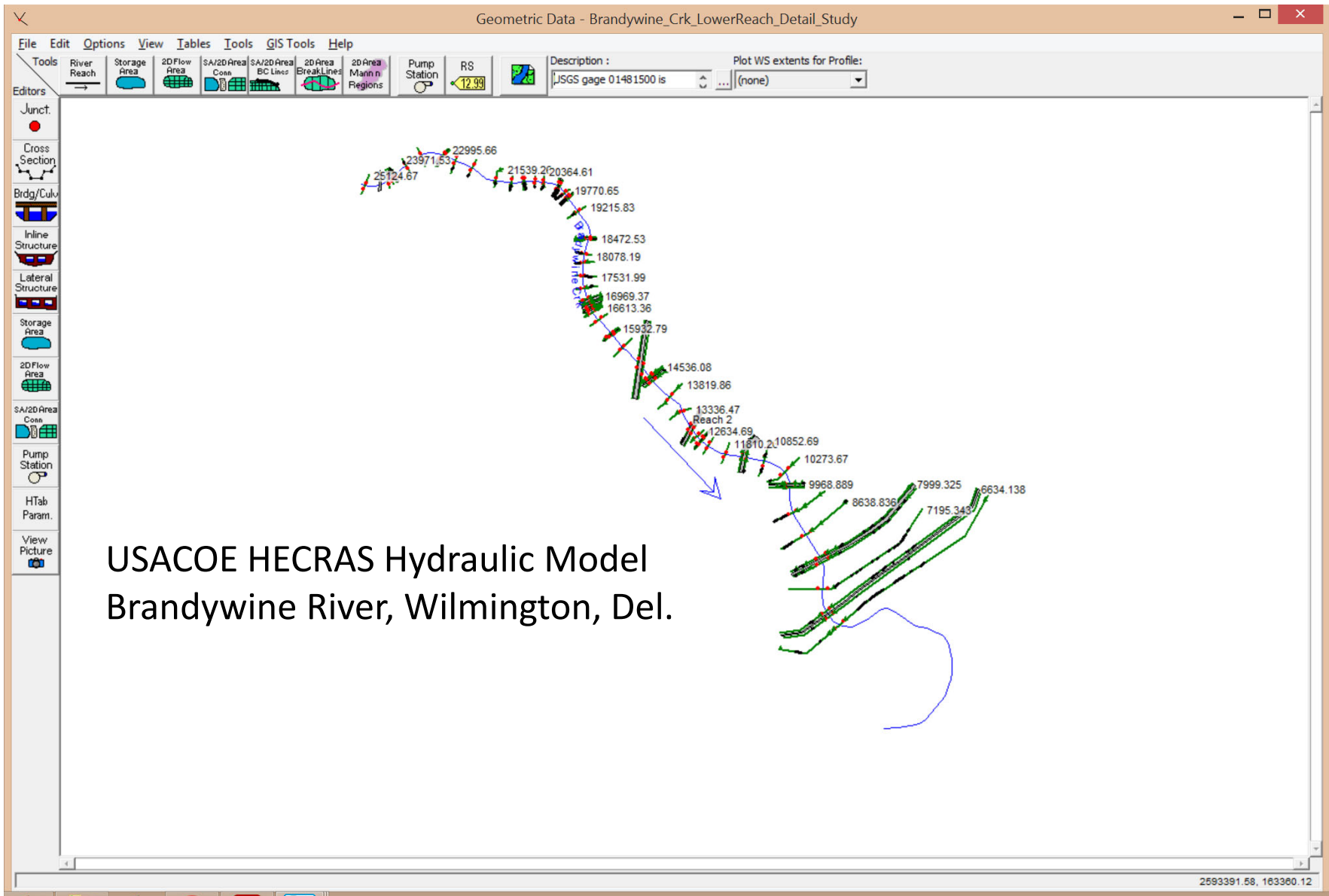
Street / Tax Parcel / Watershed

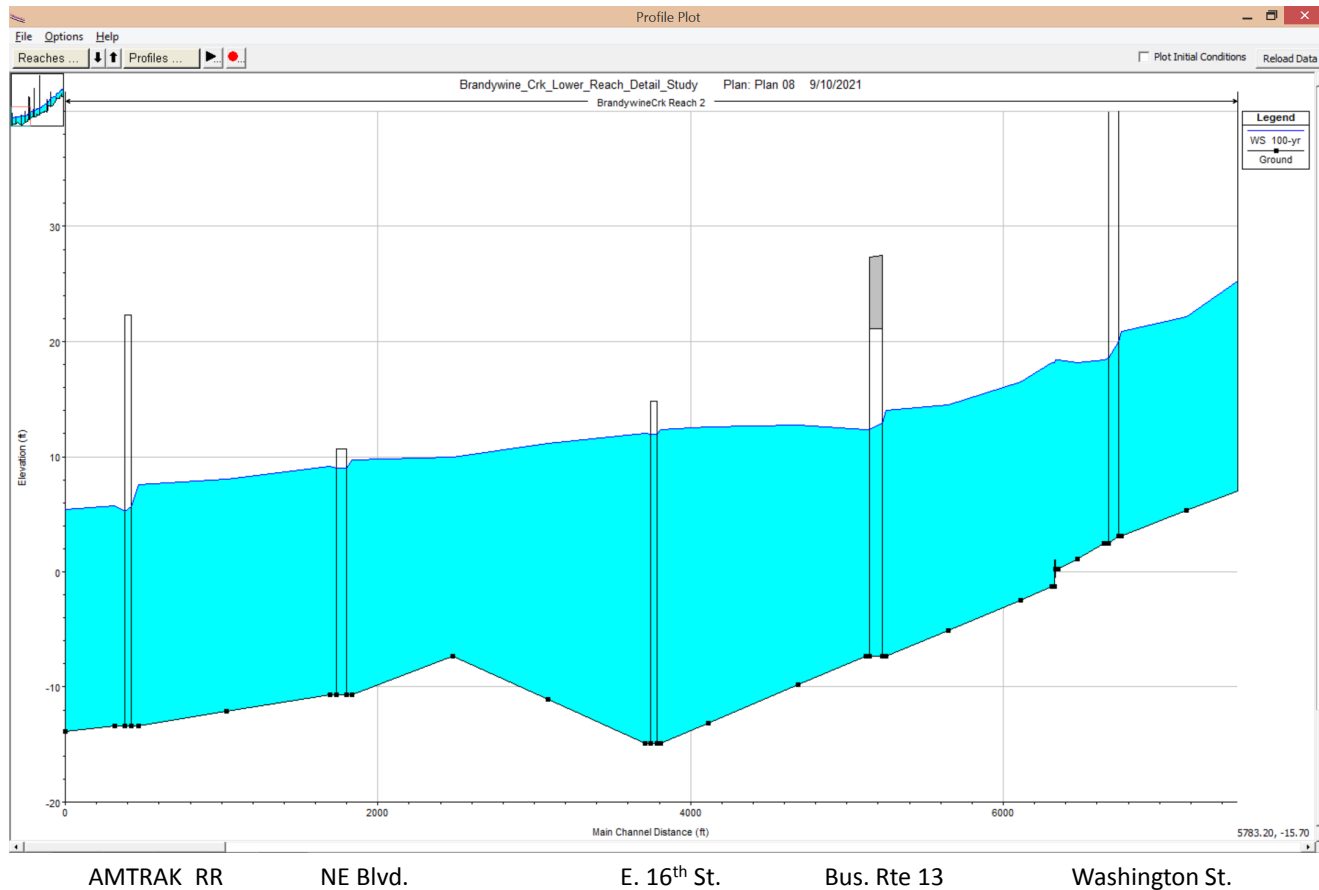
SEARCH or CLICK

LAT/LONG -75.547412, 39.744347

Maxar | FEMA | Esri Community Maps Contributors, County of Chester, New Castle County, data.pa.gov, Delaware FirstMap, New Jersey Office of GIS, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bur... Powered by Esri

The 100-yr floodplain in blue is 9 to 12 ft msl upstream from the NE Blvd bridge. Ida peaked above 10 ft there.





Ida's peak discharge (33,700 cfs > 100-yr flood, the blue line) caused about 1 ft of backwater at the AMTRAK (El. 9 ft) and NE Blvd (El. 10 ft) bridges and along with likely debris jams at the bridges contributed to flooding in the neighborhoods sitting at interior drained ground elevations at < 10 ft msl. The likely spill over point was just upstream of the NE Blvd bridge and backwater through storm sewers.

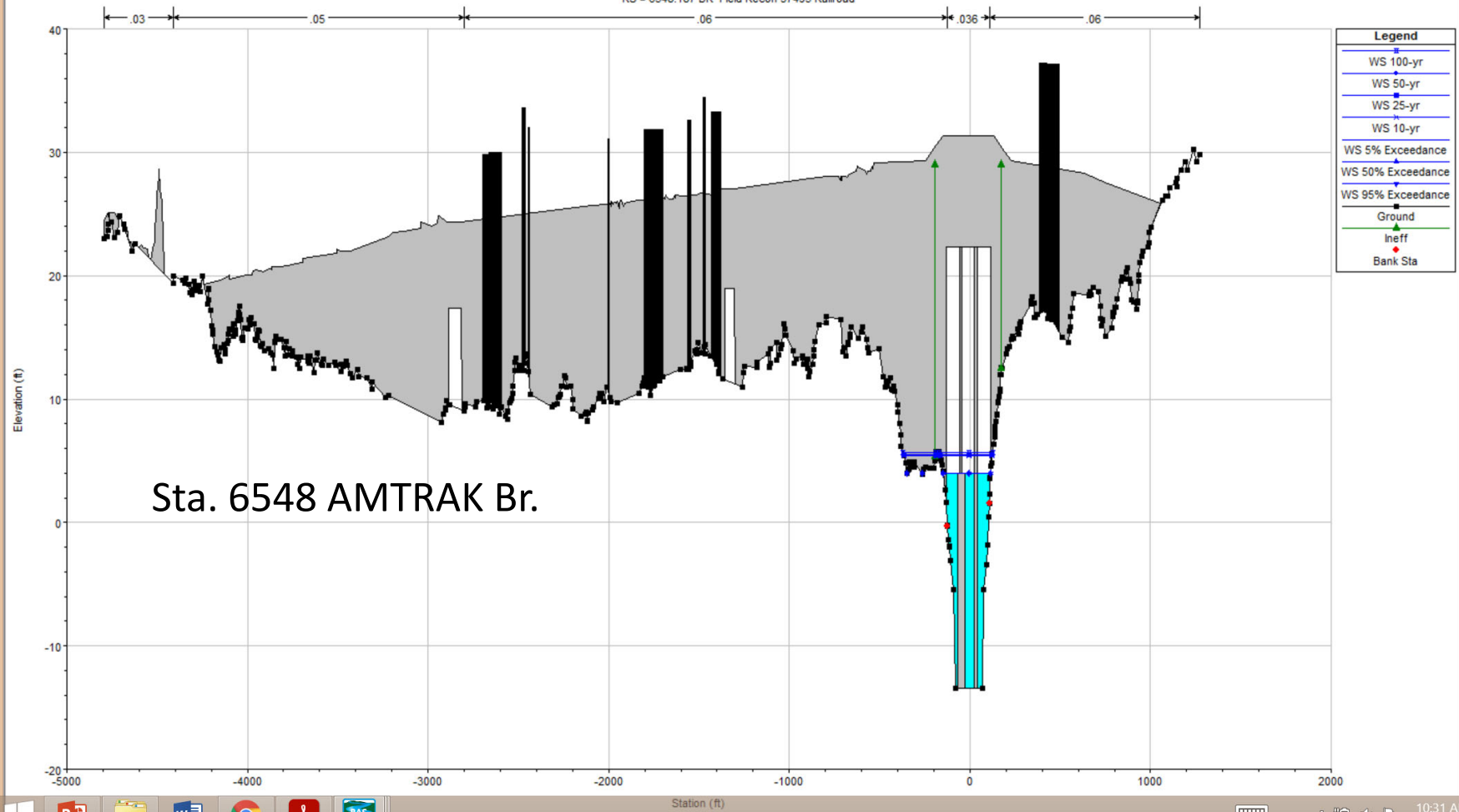
Cross Section

File Options Help

River: BrandywineCrk
Reach: Reach 2
River Sta.: 6548.187BR U

Reload Data

Brandywine_Crk_Lower_Reach_Detail_Study Plan: Plan 08 10/13/2021
RS = 6548.187 BR Field Recon 37495 Railroad



Station (ft)

10:31 AM
10/13/2021

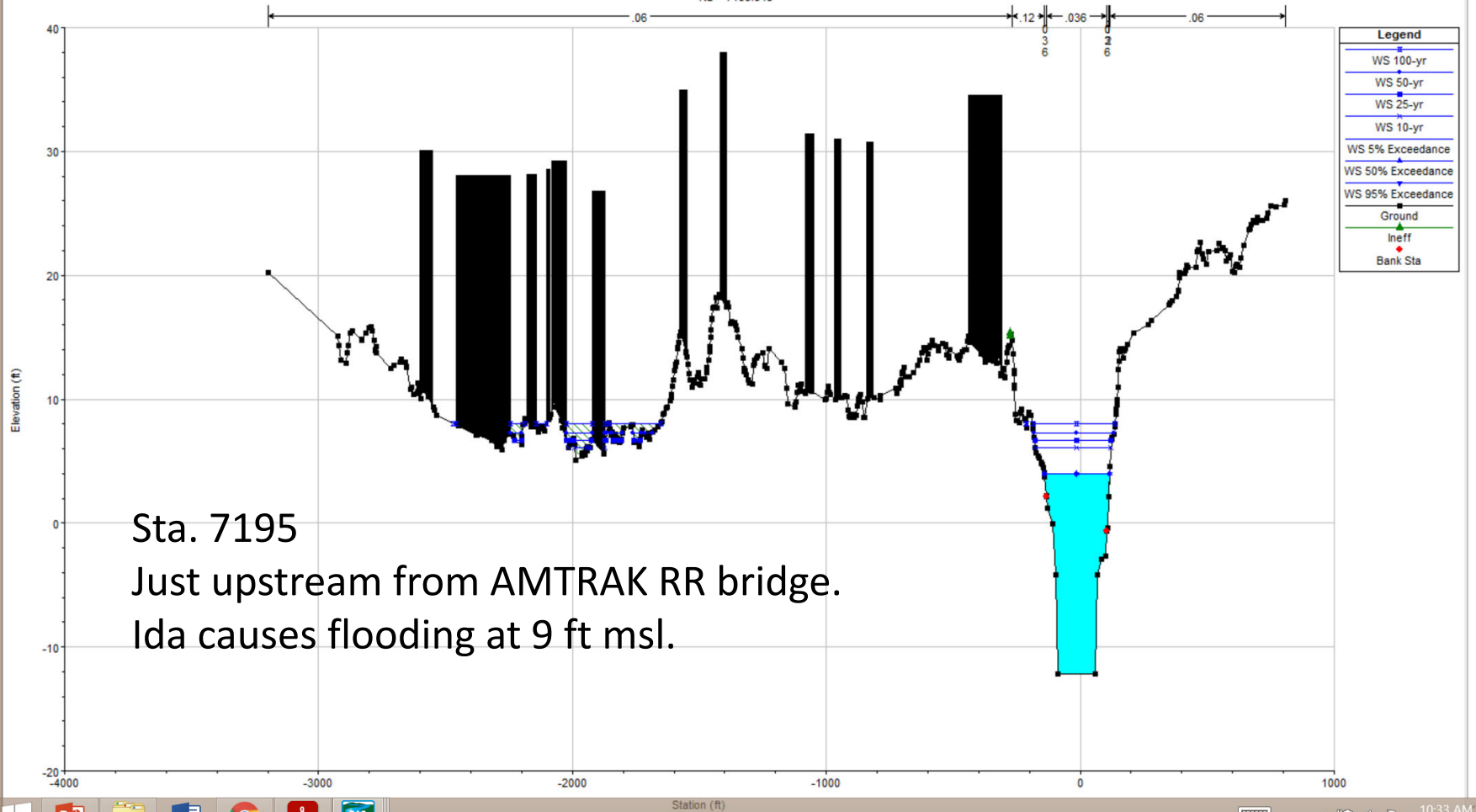
Cross Section

File Options Help

River: BrandywineCrk 181.67, -6.70
Reach: Reach 2 River Sta.: 7195.343

Reload Data

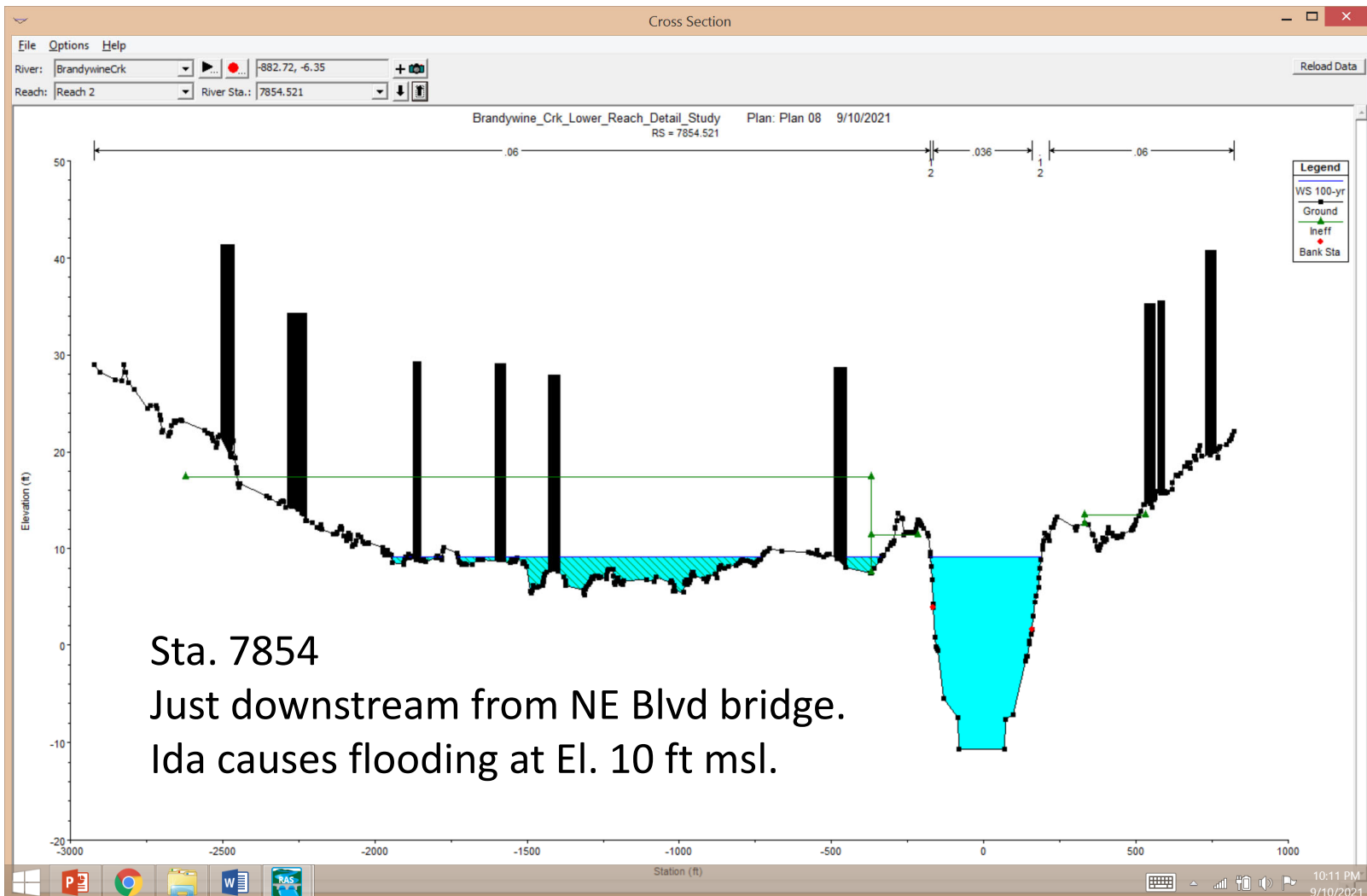
Brandywine_Crk_Lower_Reach_Detail_Study Plan: Plan 08 10/13/2021
RS = 7195.343



Sta. 7195
Just upstream from AMTRAK RR bridge.
Ida causes flooding at 9 ft msl.

Station (ft)





Ida peak discharge of 33,700 cfs overflowed into Wilmington neighborhoods at El. 10 ft msl near NE Blvd bridge.

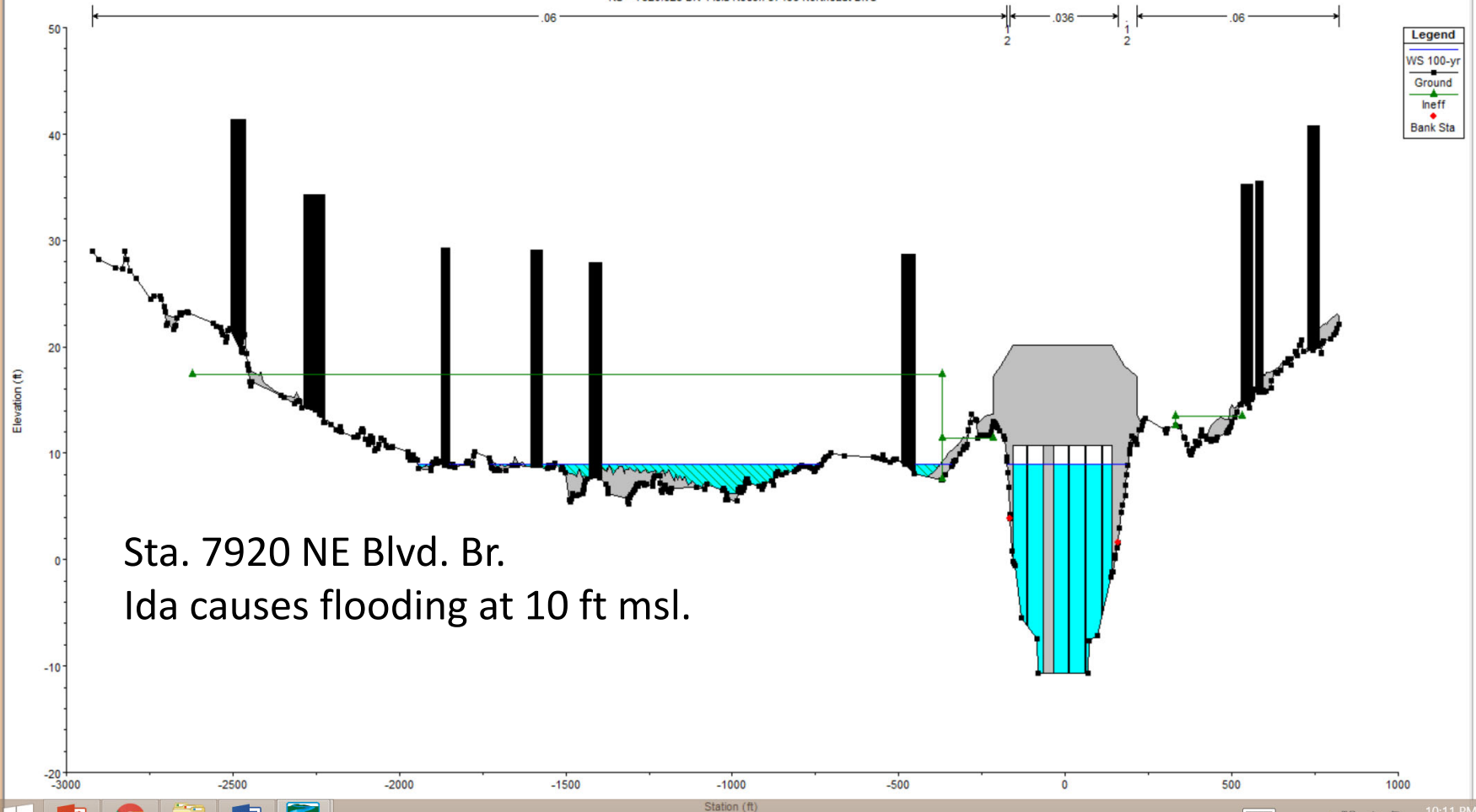
Cross Section

File Options Help

River: BrandywineCrk 793.59, 1.99
Reach: Reach 2 River Sta.: 7920.623BR D

Reload Data

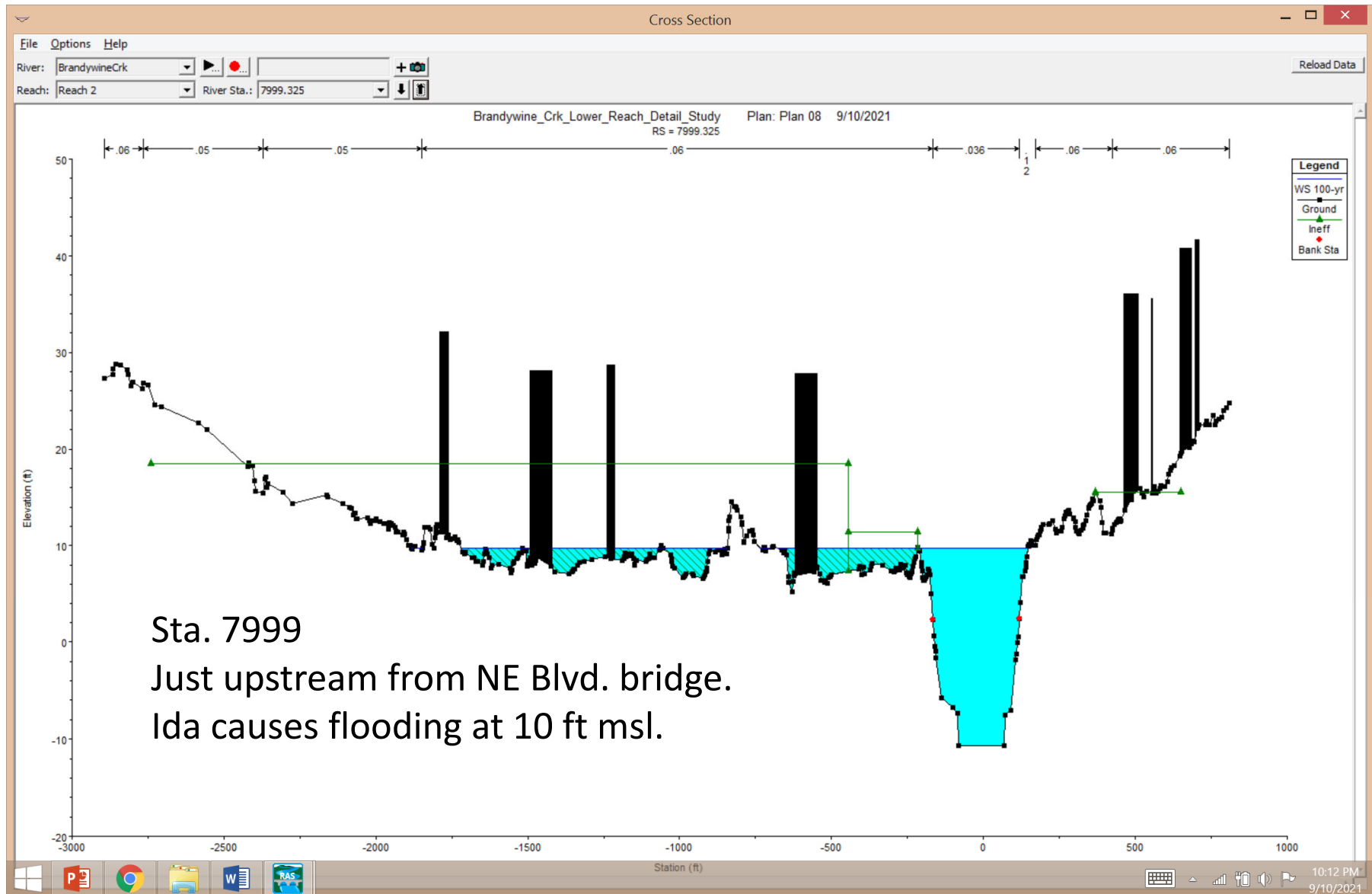
Brandywine_Crk_Lower_Reach_Detail_Study Plan: Plan 08 9/10/2021
RS = 7920.623 BR Field Recon 37496 Northeast Blvd



Sta. 7920 NE Blvd. Br.
Ida causes flooding at 10 ft msl.

Station (ft)

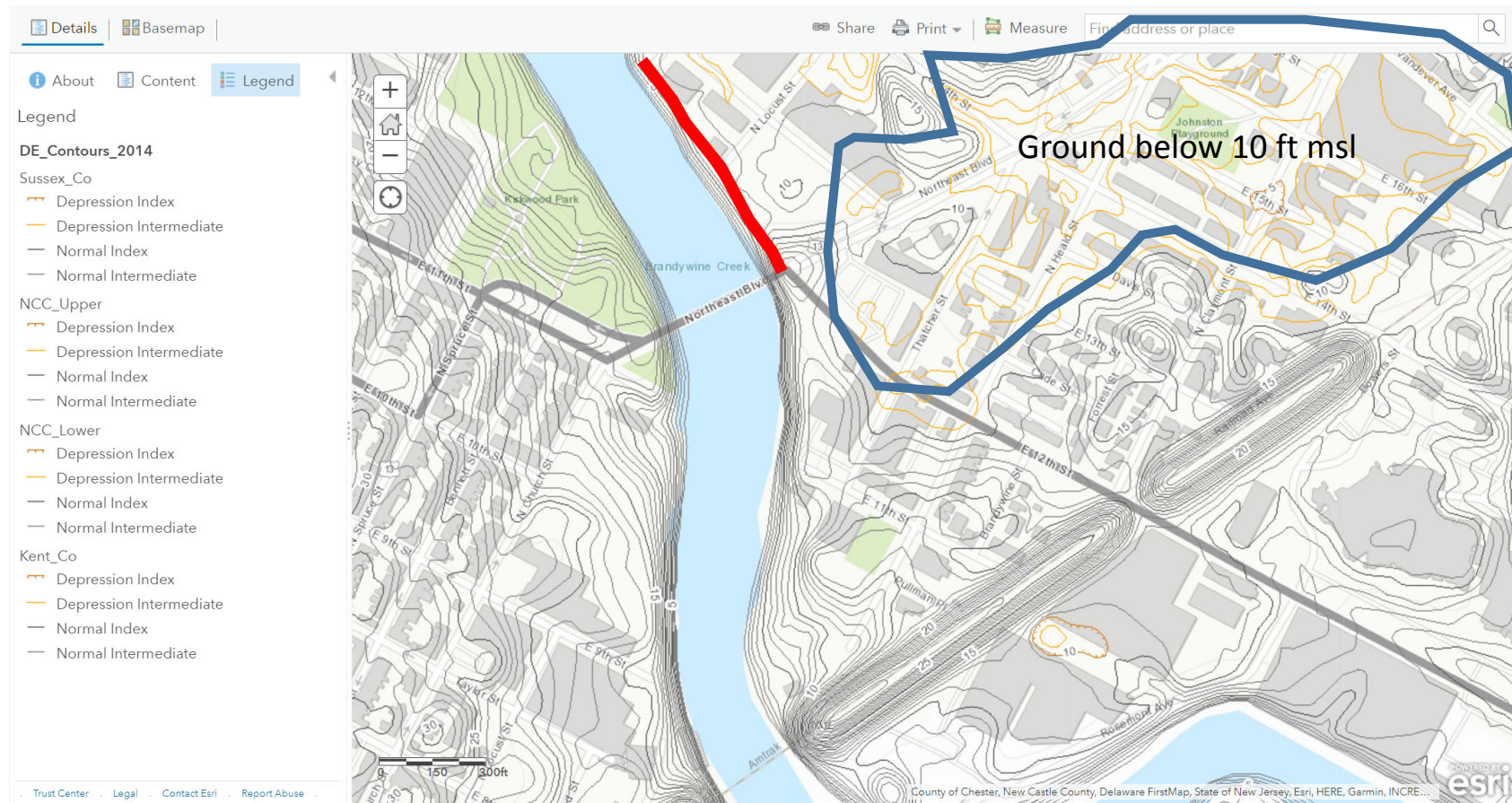
10:11 PM
9/10/2021





GIS topo map illustrates in blue the ground at El. 10 msl and less and depicts the overflow point upstream from the Northeast Blvd. Bridge this is the area where a low berm or dike would prevent overflow of the river.

Given that Ida just about spilled over the banks of the Brandywine at El. 10 ft msl, a mildly sloped 4 to 5 ft high grass Dutch style dike (1000 to 1,500 LF in red) with storm sewer backflow valves along with extension of Brandywine Park downstream to the AMTRAK RR bridge could flood proof this neighborhood.





AMTRAK RR Viaduct
9/2/21 AM COW DPW



NE Blvd bridge
9/2/21 AM COW DPW



NE Blvd bridge
9/2/21 AM COW DPW



NE Blvd bridge
9/2/21 AM COW DPW



E. 16th St. bridge
9/2/21 AM COW DPW

NE Blvd bridge
9/2/21 AM COW DPW

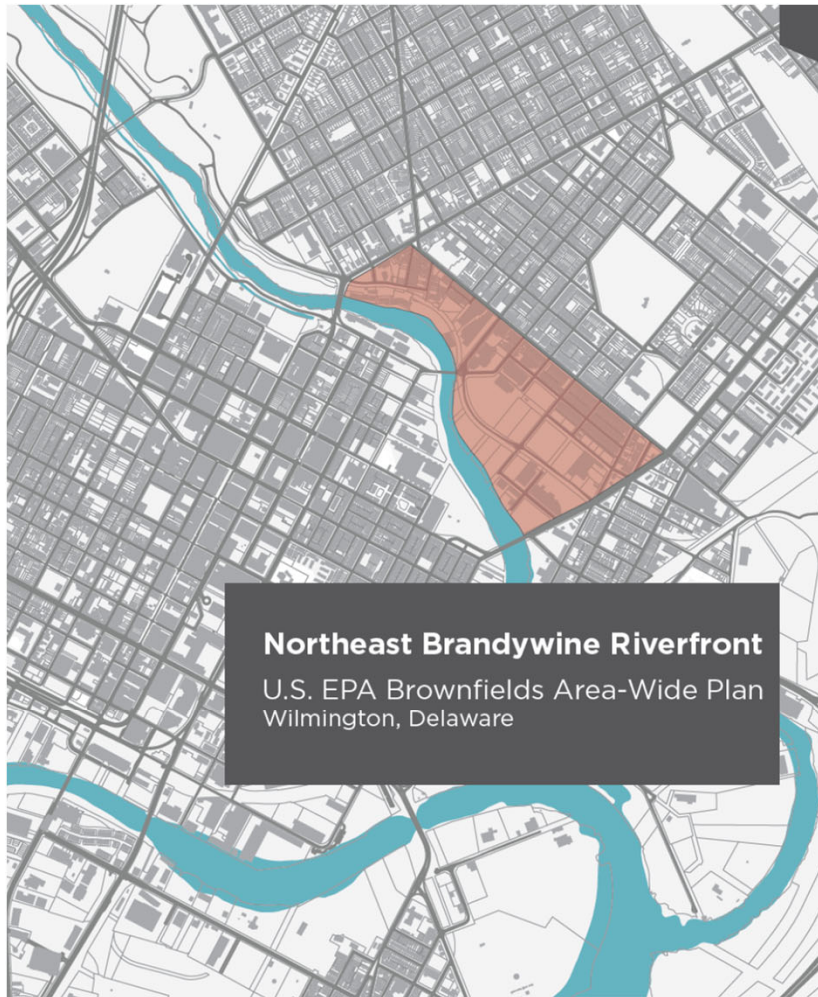




NE Blvd bridge
9/2/21 AM COW DPW



NE Blvd bridge
9/2/21 AM COW DPW



Northeast Brandywine Riverfront
U.S. EPA Brownfields Area-Wide Plan
Wilmington, Delaware

Fortunately the City is working with EPA Brownfields on a 2019 plan to revitalize the neighborhoods. The quarry pond is upstream from the NE Blvd bridge and was not flooded during Ida.



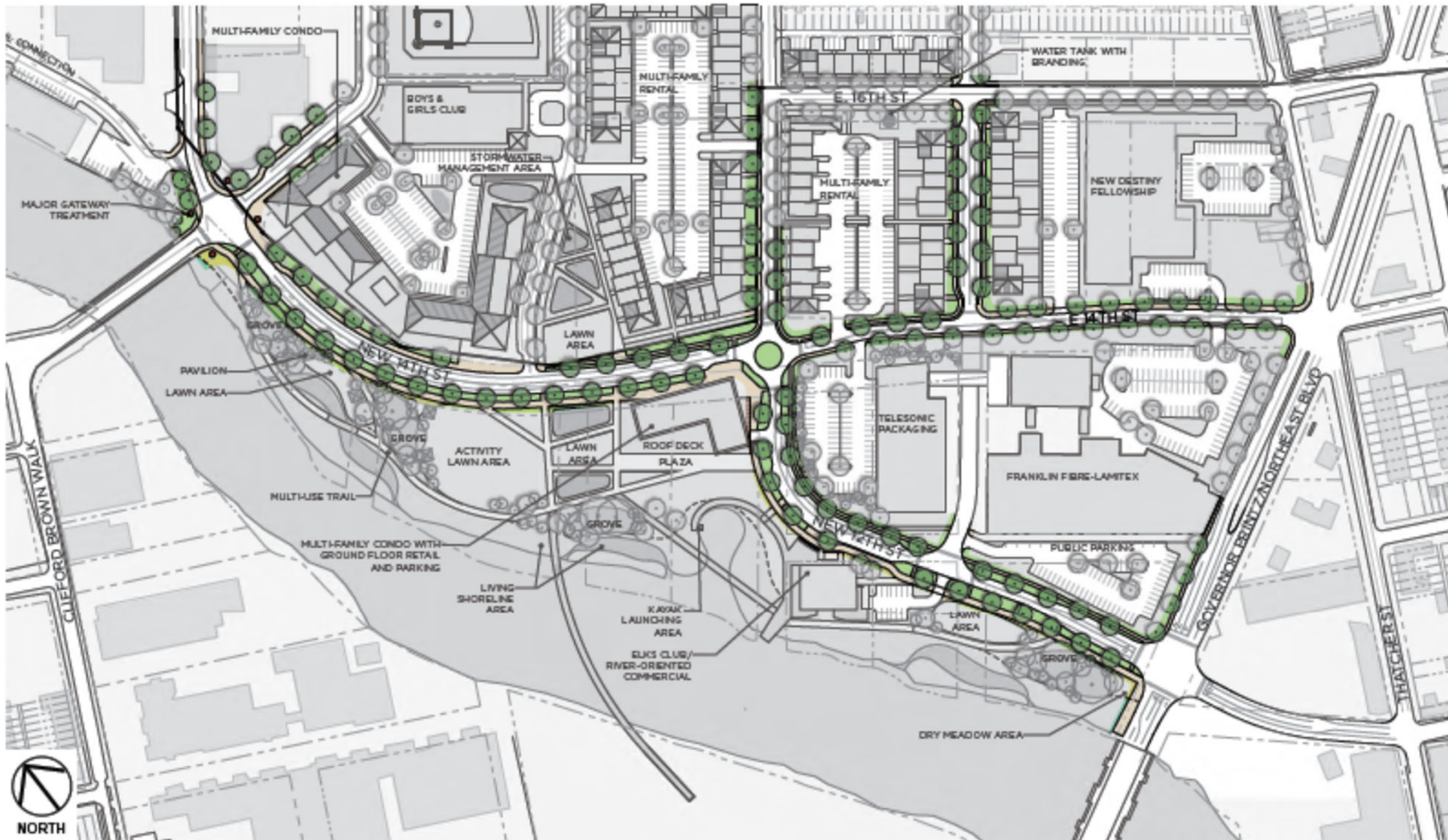
1931 Aerial view of the AWP study area showing the former industrial uses along the Brandywine, the Delaware Granite and Mining Company quarry pond, and the adjacent residential blocks of 17th Street and Vandever Avenue beyond. Note the smaller pond on the former Wiley Cork site to the right. This pond was located where the current asphalt cover exists today.

Overall Site Reuse Vision Plan



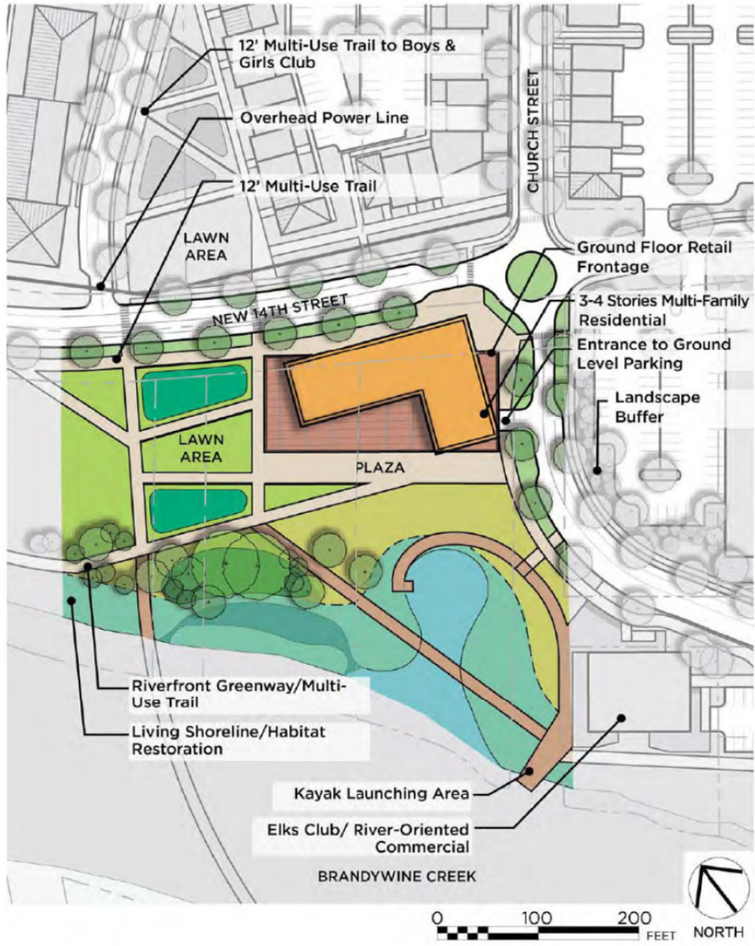
1 / Executive Summary

A low flood control dike can be created by simply raising the proposed pedestrian trail to 15 ft msl TOB from the E. 16th St bridge downstream to the NE Blvd. bridge.

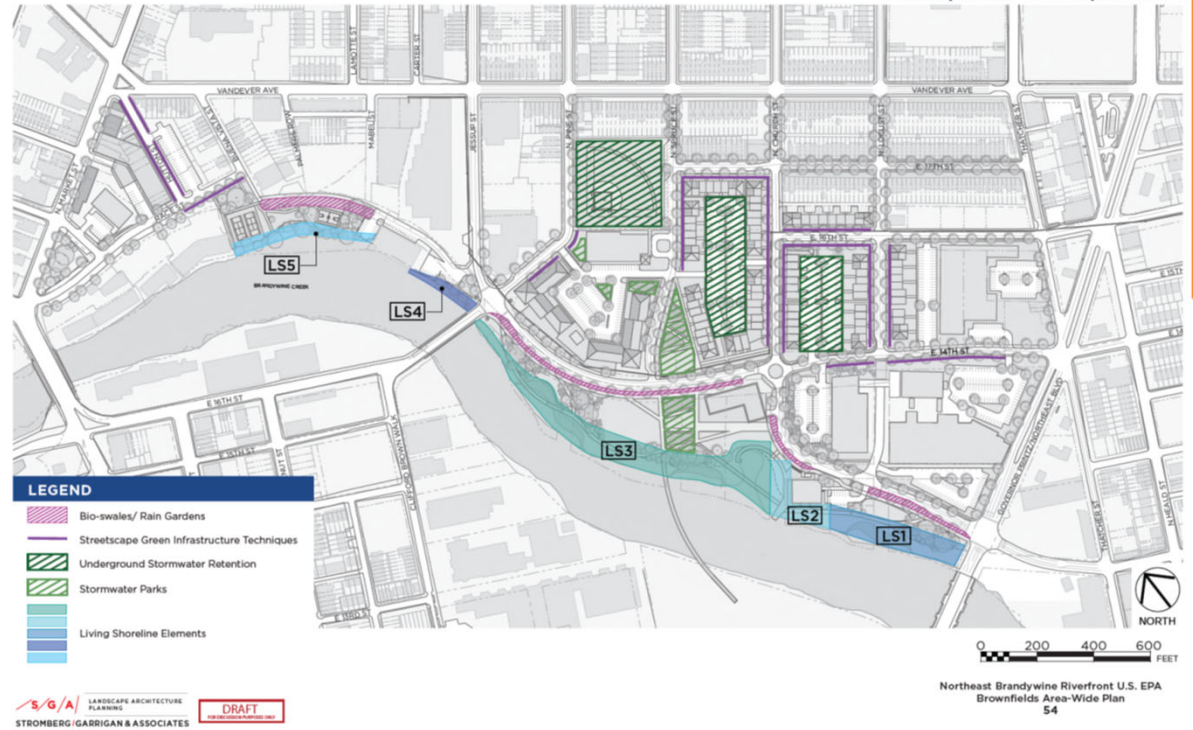


The limits of the proposed 12th Street connector project.

Targeted Reuse Area 1 - Diamond State Salvage Site



Northeast Brandywine Riverfront U.S. EPA Brownfields Area-Wide Plan
25



Northeast Brandywine Riverfront U.S. EPA
Brownfields Area-Wide Plan
54

PROJECT RECOMMENDATIONS - RESILIENCY INFRASTRUCTURE

Map Key #	Priority	Project	Estimate of Probably Costs*	Description
LS-RIVER-FRONT - WIDE	NEAR TERM	Living Shoreline/ Resiliency Preliminary Engineering	\$50K - Survey \$125K - Preliminary Engineering	This work would advance the concepts developed through this planning effort and the earlier Living Shoreline Concept Plan. The effort would link brownfields closure permitting with required earthwork and grading required to achieve sufficient flood resilience goals. Work could be performed as a part of remedial action work plan activities. Project should also occur prior, or in conjunction, with the final engineering of the 12th Street Connector Project (Project T1). Preliminary engineering would include areas LS1 through LS3 and cover park master planning elements.
LS1	MID TERM	Living Shoreline - Lower Greenway Access Area	\$45K Final Engineering/ Permitting \$275K Based on Concept Design - Construction	This area includes portions of the City Public Works Yard and the 2103, Inc. properties. The focus would be on flood protection, habitat protection, the greenway multi-use trailhead. Also a secondary neighborhood gateway landscape treatment should be included.
LS2	NEAR TERM	Living Shoreline - Civic Access Area	\$75K Final Engineering/ Permitting \$500K - Construction	The focus on this effort is to create a first public activity point at the river's edge. Linked to the Project P2 with an emphasis of civic improvements that would include a water overlook and habitat restoration. This resiliency project would also act as a component of flood-proofing the Elks Club building.
LS3	MID TERM	Living Shoreline - Diamond Park Area	\$150K Final Engineering/ Permitting \$1.5M - Construction	This area is the primary living shoreline element of the riverfront park area and includes all of the linear frontage of the former Diamond State Salvage site. Project should accommodate the riverfront multi-use trail network elements (Project T8).
LS4	NEAR TERM	Bulkhead - Special Access Area	\$6K Structural Engineering Evaluation \$18K Final Engineering/ Permitting \$70K-\$90K - Construction	Repair of existing riverfront bulkhead and accommodation of future river access point.
LS5	NEAR TERM	Brandywine Mills Park - Bulkhead/ Promenade Rehabilitation	\$20K - Structural Engineering Evaluation	Collaborate with ownership entity to evaluate bulkhead conditions and potential repairs. Structural evaluation should be done in conjunction with park master plan (Project P5) to determine the most desirable river edge treatment, if major modifications/repairs to existing structure are required.

NEAR TERM = 1-4 years
MID TERM = 5-9 years
LONG TERM = 10+ years

*These numbers do not include right-of-way and property acquisition, utility improvements and coordination, grant requirements (such as NEPA), and environmental and Geo-technical unknowns. Some and/or portions of projects maybe included/integrated into private developments therefore not publicly led/funded efforts.

Given that Ida just about overtopped the banks of the Brandywine at El. 10 ft msl, a mildly sloped 4 to 5 ft high grass Dutch style dike (1000 to 1,500 LF) built TOB to 15 ft msl with storm sewer backflow valves along with extension of Brandywine Park downstream to the AMTRAK RR bridge could floodproof this neighborhood employing a modest budget as a **Near Term** project.