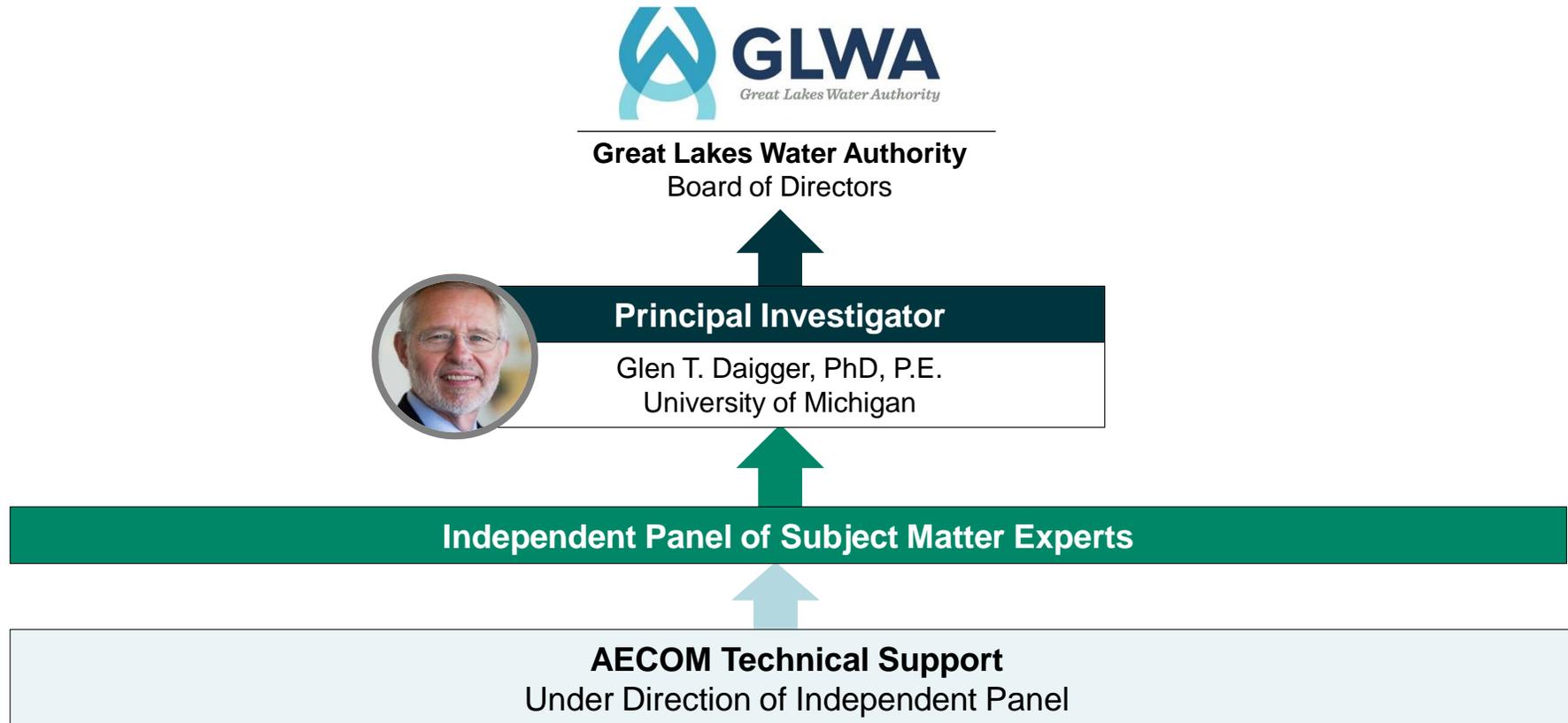


Independent Assessment Metro Detroit
Wet Weather Events

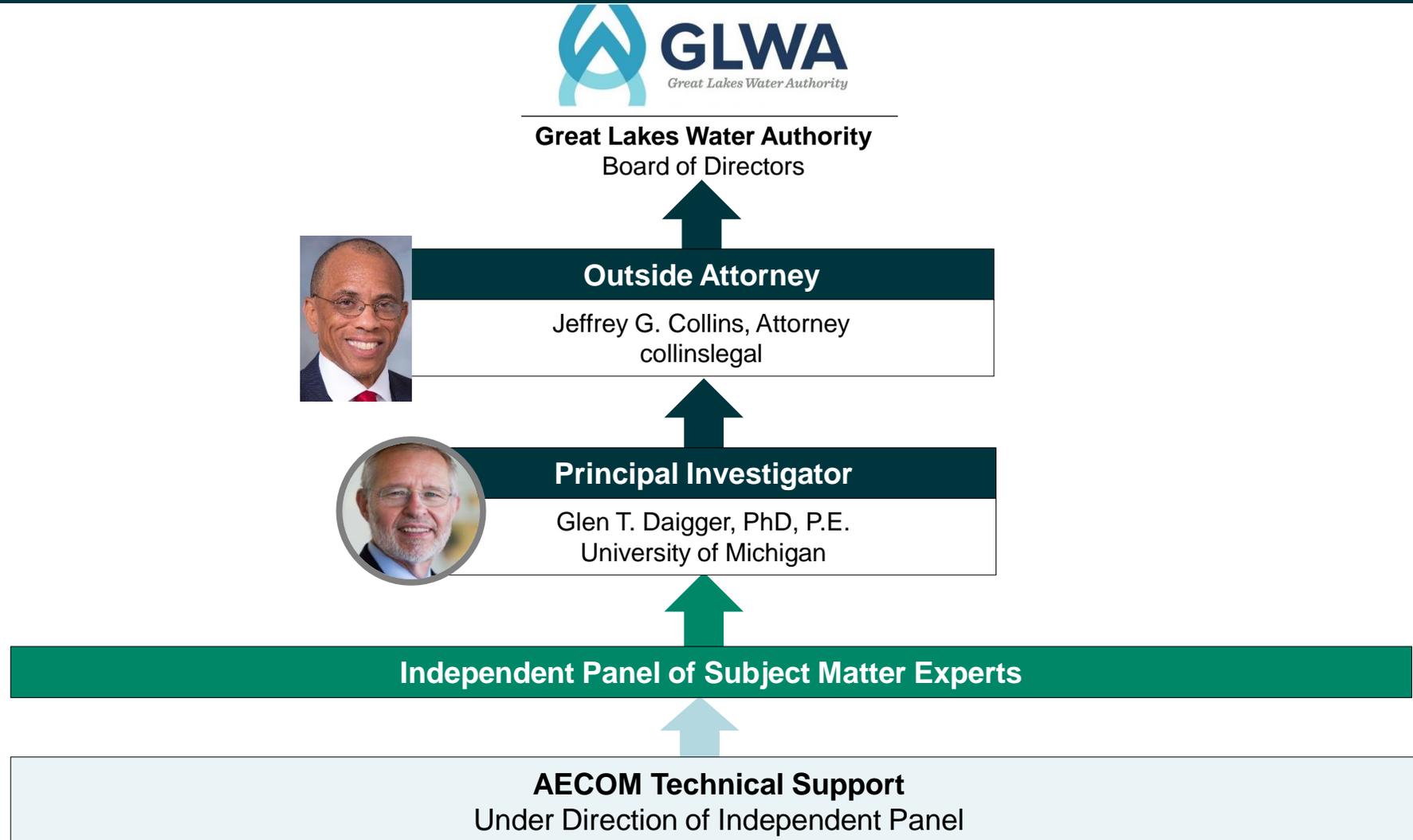
Presentation to GLWA Board of Directors

December 3, 2021

GLWA Board Investigation Team



GLWA Board Investigation Team



Organizational Chart

Independent Industry Experts



Great Lakes Water Authority
Board of Directors

Outside Attorney
Jeffrey G. Collins, Attorney
collinslegal

Principal Investigator
Glen T. Daigger, PhD, P.E.
University of Michigan

Executive Advisor
Beverley Stinson, PhD
AECOM



Team Manager
Devan Thomas, P.Eng.,
M.ASCE

Principal Investigator

Independent Industry Experts

Flood Predictive Modeling
Melanie Kueber Watkins, Ph.D., P.E.
Michigan Tech.

System Hydraulic Modeling
Jonathan Jones, P.E., PH., DWRE, Chris Olson, Ph.D., PE
Wright Water Eng.

Pump System Specialist
Paul W. Behnke, P.E., Behnke Pump Technologies, LLC

Electrical and Controls
Johanna Mathieu, Ph.D., University of Michigan

Operations and Maintenance
Salil Kharkar, PE, Licensed Operator, CMRP, DC Water

Organizational Chart

Complete Team



Great Lakes Water Authority
Board of Directors

Outside Attorney
Jeffrey G. Collins, Attorney
collinslegal

Principal Investigator
Glen T. Daigger, PhD, P.E.
University of Michigan

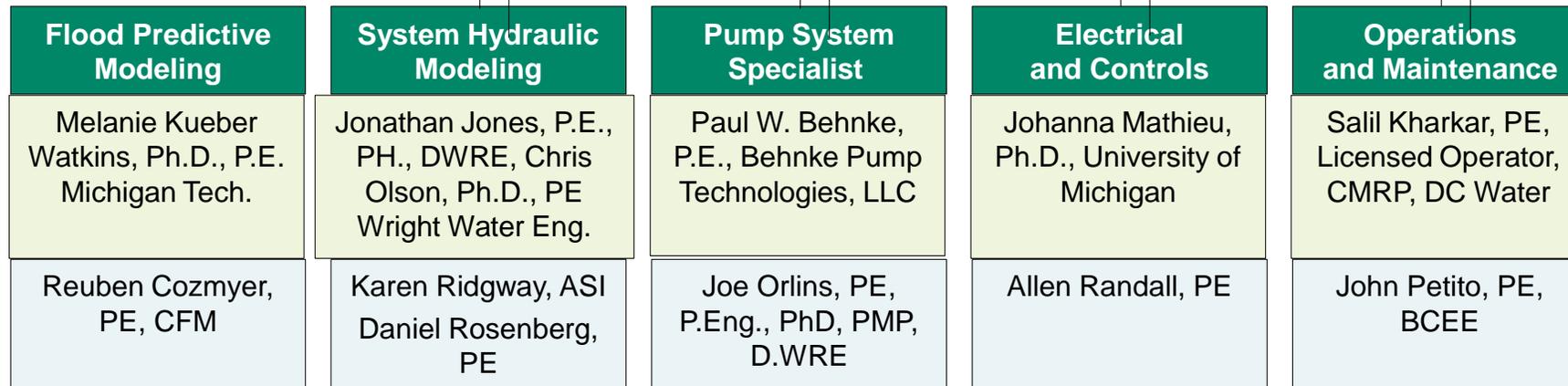
Executive Advisor
Beverley Stinson, PhD
AECOM

Team Manager
Devan Thomas, P.Eng.,
M.ASCE

Principal Investigator

Independent Industry Experts

AECOM Team Staff



Team Charge

Framed to Provide Factual Content and Then Interpretation and Recommendations

1. Determine the operational readiness of the Conner Creek, Freud, and Bluehill pump stations leading up to and through the June 25-26 and July 16 events.
2. Determine the sequence of events occurring during the June 25-26 and July 16 events.
3. Determine the status of recommendations made to GLWA in response to earlier flooding events.
4. Determine the interrelationship between the operation of the local collection systems tributary to the Conner Creek, Freud, and Bluehill Pump Stations and their impact on those pump stations.
5. Identify physical and operational improvements that can be made to the Conner Creek, Freud, Bluehill, and Fairview pump stations to increase their performance reliability and resilience in response to extreme weather events.
6. Identify methods to maximize the performance of existing and currently planned GLWA infrastructure during extreme weather events.
7. Generally, determine the extent of flooding associated with the GLWA and DWSD collection systems during the June 25-26 and July 16 events.
8. Generally, determine the reduction in flooding associated with the GLWA and DWSD collections systems during the June 25-26 and July 16 events if the Conner Creek and Freud pump stations had functioned as intended.
9. Identify steps that GLWA can take in addition to those to be identified above to increase the level of flood protection service provided, including not only those by GLWA but also other regional partners.
10. Identify sources of funding for actions such as those to be identified above.

Progress Report

Work Completed to Date

- Site Visits
 - September 9 and 10, 2021
- Interviews
 - GLWA Board
 - GLWA Senior Staff
 - Select Other GLWA Staff
- Extensive Data Collection
 - Standard Operating Procedures (SOP's)
 - Reports/Documents
 - Operating Logs
 - SCADA Data
 - Basement Flooding Data
 - High Water Marks
- System Modeling
- Interpretation and Analysis
- Panel and AECOM Team Worked Independently of Other Consultants That Evaluated These Storm Events for GLWA



Charge #1:

Determine the operational readiness of the Conner Creek, Freud, and Bluehill pump stations leading up to and through the June 25-26 and July 16 events.

- Conner Creek
 - June 25/26
 - 7 of 8 Storm Pumps; 3 of 4 Sanitary Pumps; Staffed
 - July 16
 - 7 of 8 Storm Pumps; 4 of 4 Sanitary Pumps; Staffed
- Freud
 - June 25/26
 - 3 of 8 Storm Pumps; 2 of 2 Sanitary Pumps; Staffed
 - Electric Power Supply Compromised
 - July 16
 - 5 of 8 Storm Pumps; 2 of 2 Sanitary Pumps; Staffed
- Bluehill
 - June 25/26
 - 4 of 4 Storm Pumps; 2 of 2 Sanitary Pumps; Not Staffed
 - July 16
 - 4 of 4 Storm Pumps; 2 of 2 Sanitary Pumps; Staff Dispatched
- Prepared per Usual Based on Anticipation of About 1-1/2 Inch Rainfall (Duration Not Specified)

Table 1: Equipment Availability at Conner Pumping Station on June 25th/26th Storm Event

Major System	Component	Availability		Comments
		Yes	No	
Mechanical	Storm Pump 1	X		
	Storm Pump 2	X		
	Storm Pump 3	X		
	Storm Pump 4	X		
	Storm Pump 5		X	"Malfunctioning 4-way on vacuum prime valve #1. Instrumentation is going to address. Also - Allen-Bradly display panels are displaying "?????" instead of values." ¹
	Storm Pump 6	X		
	Storm Pump 7	X		
	Storm Pump 8	X		
	Sanitary Pump 9	X		
	Sanitary Pump 10	X	X	SN10: Packing gland ^{1,2}
	Sanitary Pump 11	X		SN11: Local operation only ^{2,3}
	Sanitary Pump 12	X		SN12: Emergency use only ^{2,3}
Electrical	Utility Service 1	X		
	Utility Service 2	X		
	Transformer 1	X		
	Transformer 2	X		
	Emergency Generator 1	X		
	Emergency Generator 2	X		
	Emergency Generator 3	X		
	Emergency Generator 4	X		
Controls	Wet Well Sensors	X		
	SCADA	X		

1) Operator logbook, Conner PS

2) GLWA Red Tag Report, June 22, 2021

Table 3: Equipment Availability at Freud Pumping Station on June 25th/26th Storm Event

Major System	Component	Availability		Comments
		Yes	No	
Mechanical	Storm Pump 1		X	ST1: Warranty issue (motor protection) ^{2,3}
	Storm Pump 2		X	Unavailable due to utility feed issue ^{1,3}
	Storm Pump 3	X		
	Storm Pump 4		X	Unavailable due to utility feed issue ^{1,3}
	Storm Pump 5	X		
	Storm Pump 6		X	Unavailable due to utility feed issue ^{1,3}
	Storm Pump 7	X		
	Storm Pump 8		X	Unavailable due to utility feed issue ^{1,3}
	Sanitary Pump 9	X		
	Sanitary Pump 10	X		
Electrical	Utility Service 1		X	Unavailable due to severed cables
	Utility Service 2	X		
	Transformer 1		X	Unavailable due to utility feed issue
	Transformer 2	X		
	Transformer 3		X	Unavailable due to utility feed issue
	Emergency Generator 1	X		
	Emergency Generator 2	X		
	Emergency Generator 3	X		
	Emergency Generator 4	X		
Controls	Wet Well Sensors	X		
	SCADA	X		

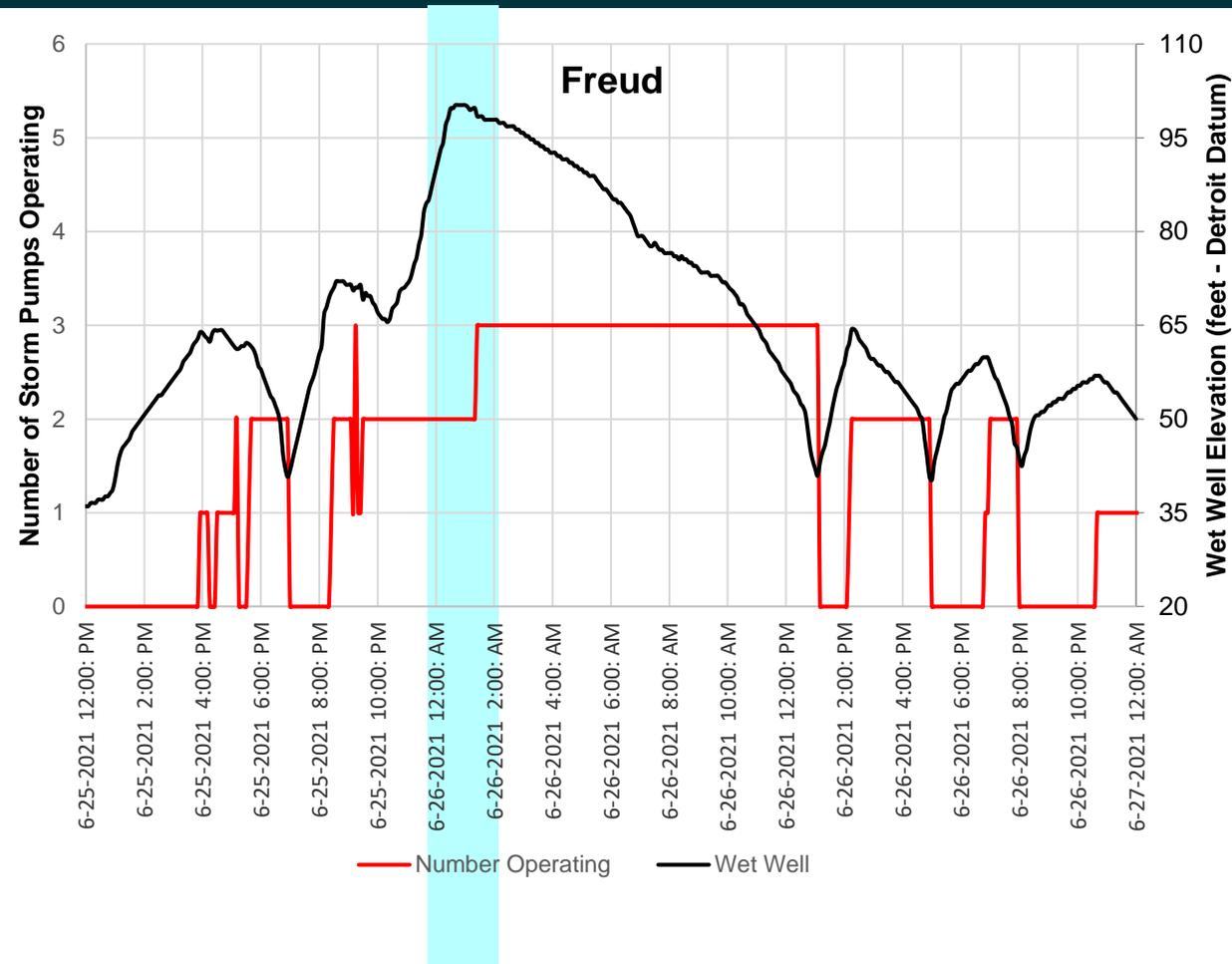
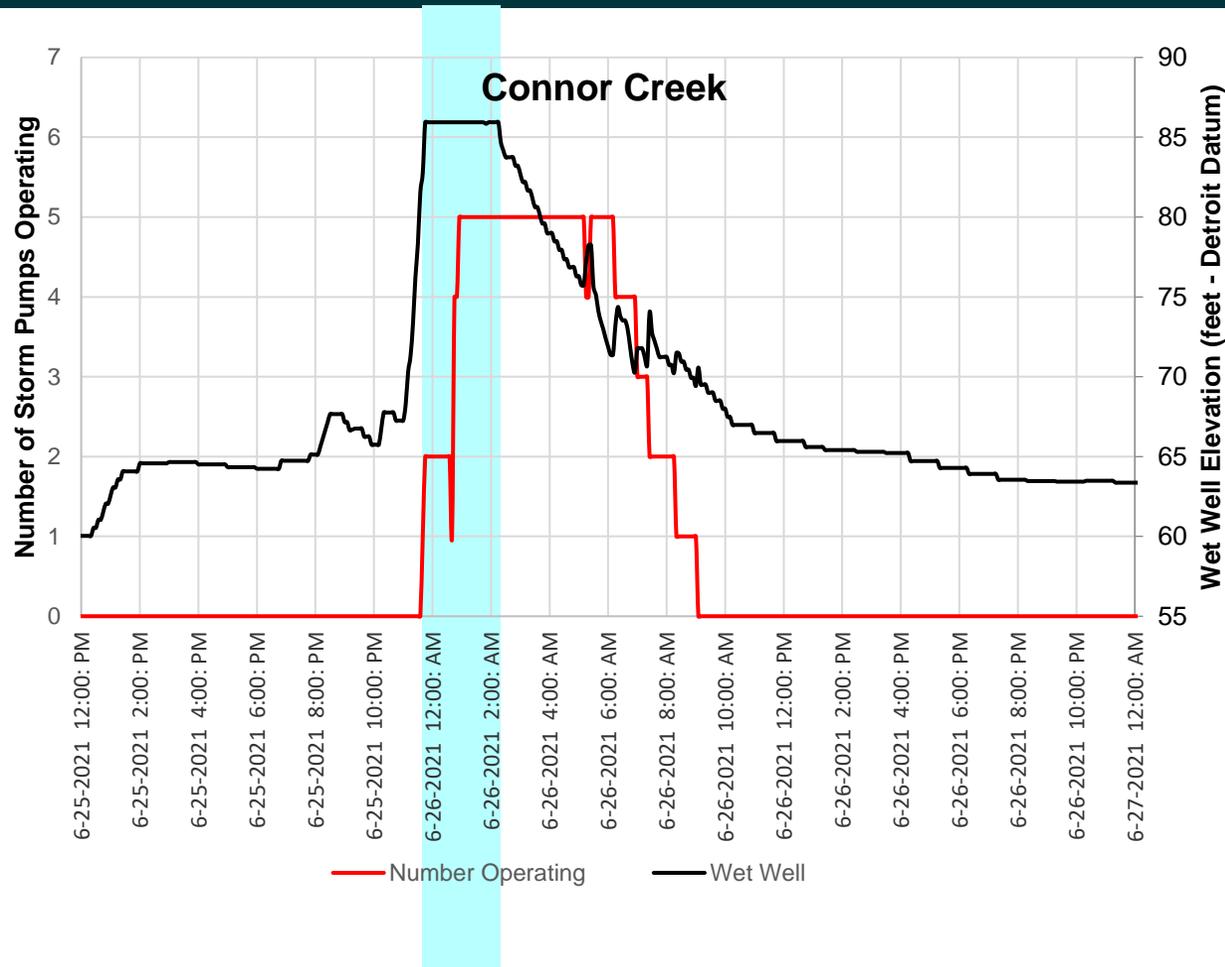
1) Operator logbook, Freud PS

2) GLWA Red Tag Report, June 22, 2021

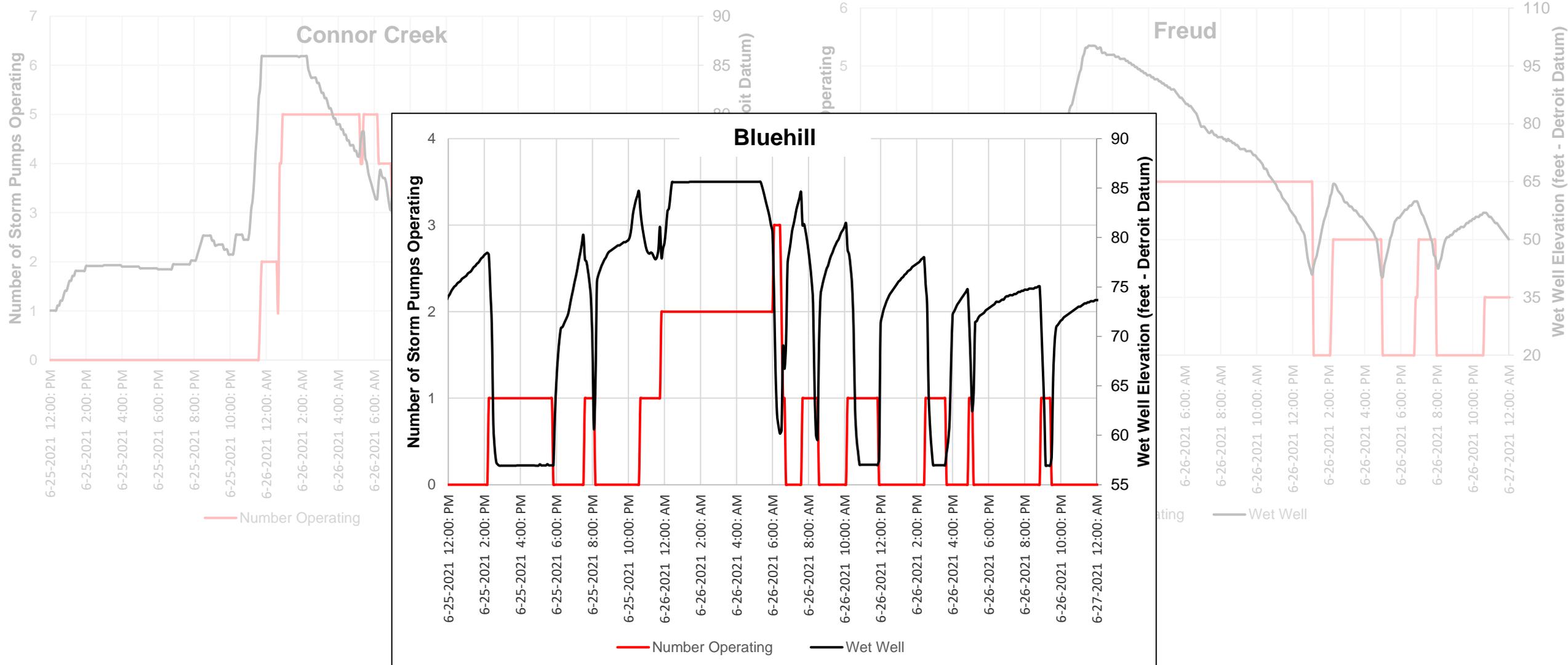
3) GLWA Red Tag Report, June 29, 2021

Charge #2:

Determine the sequence of events occurring during the June 25-26 event.



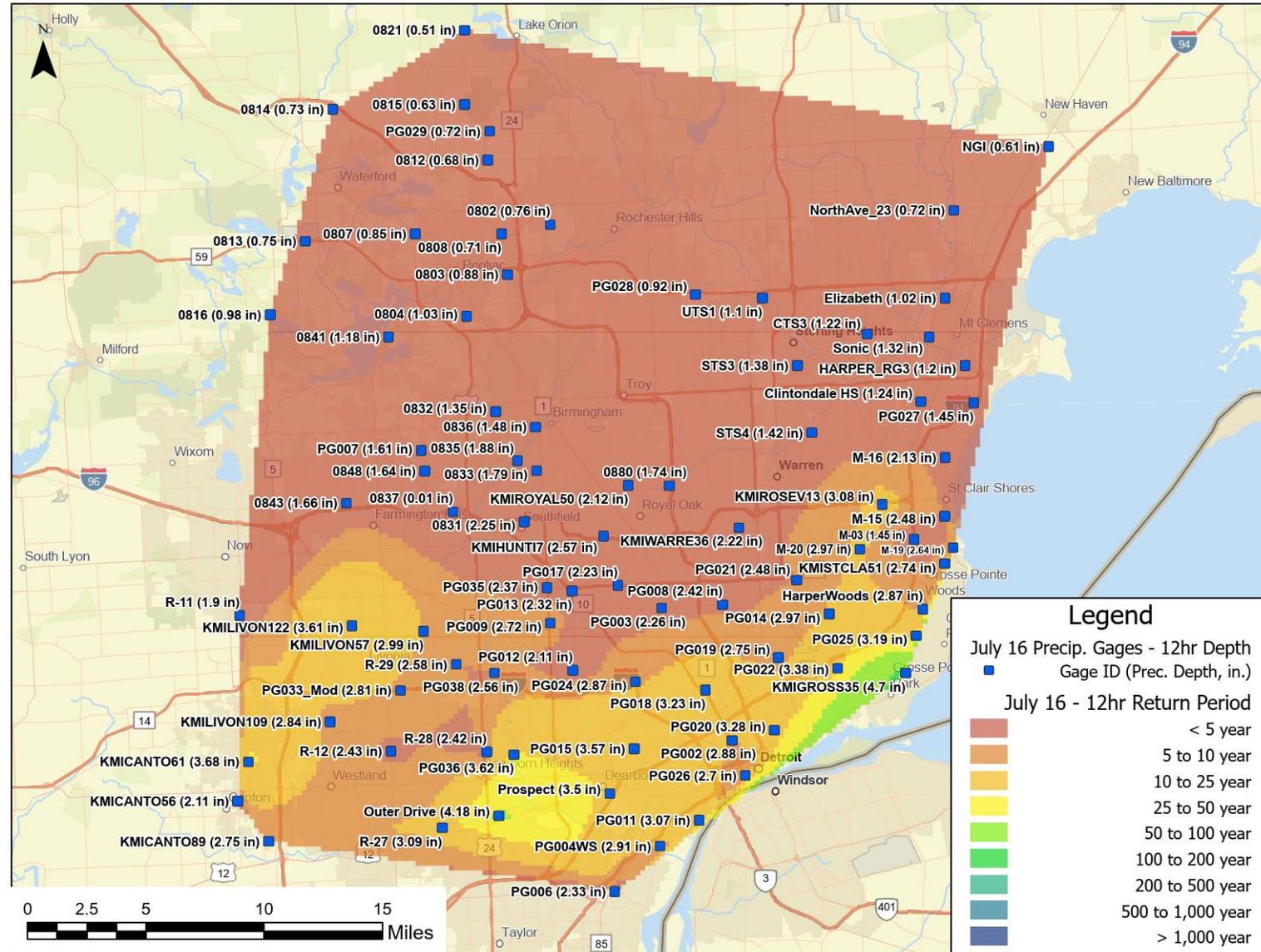
Charge #2: Determine the sequence of events occurring during the June 25-26 event.



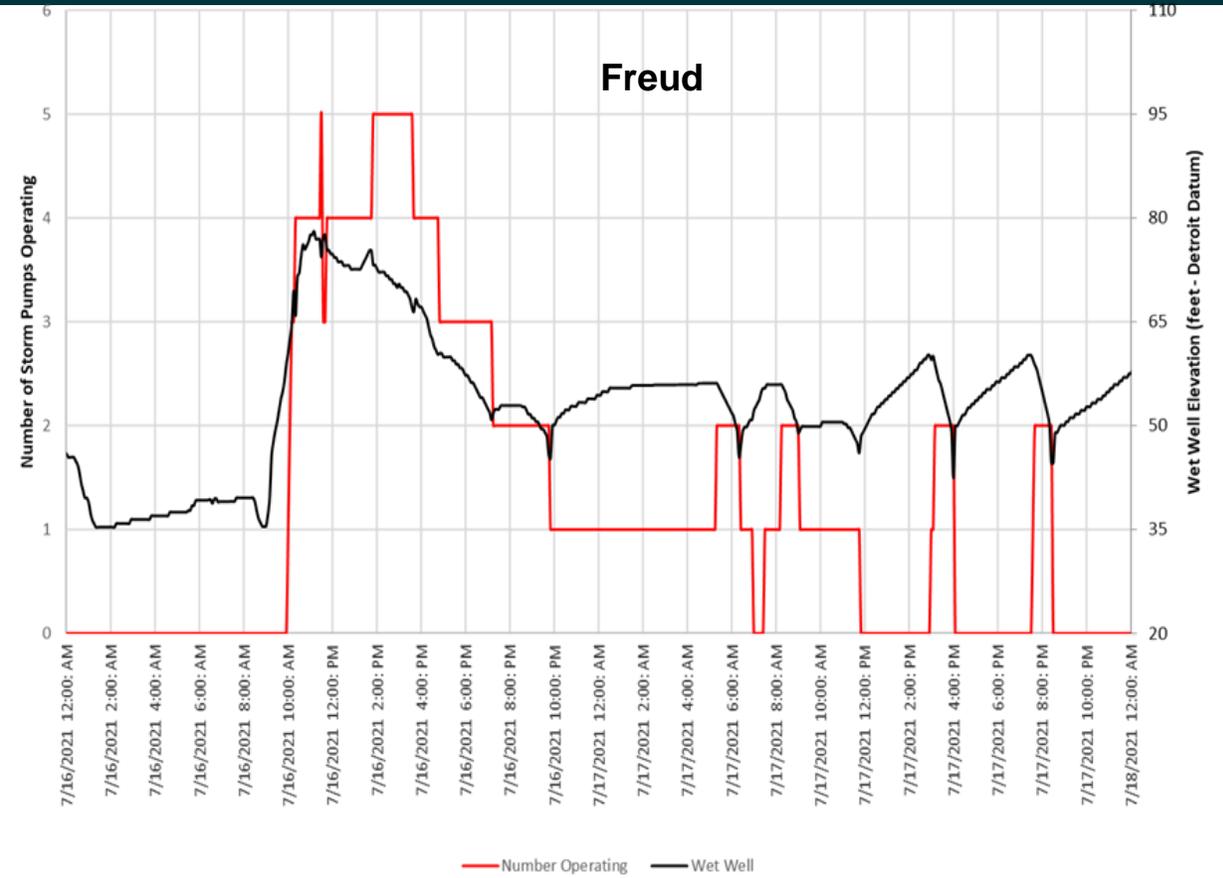
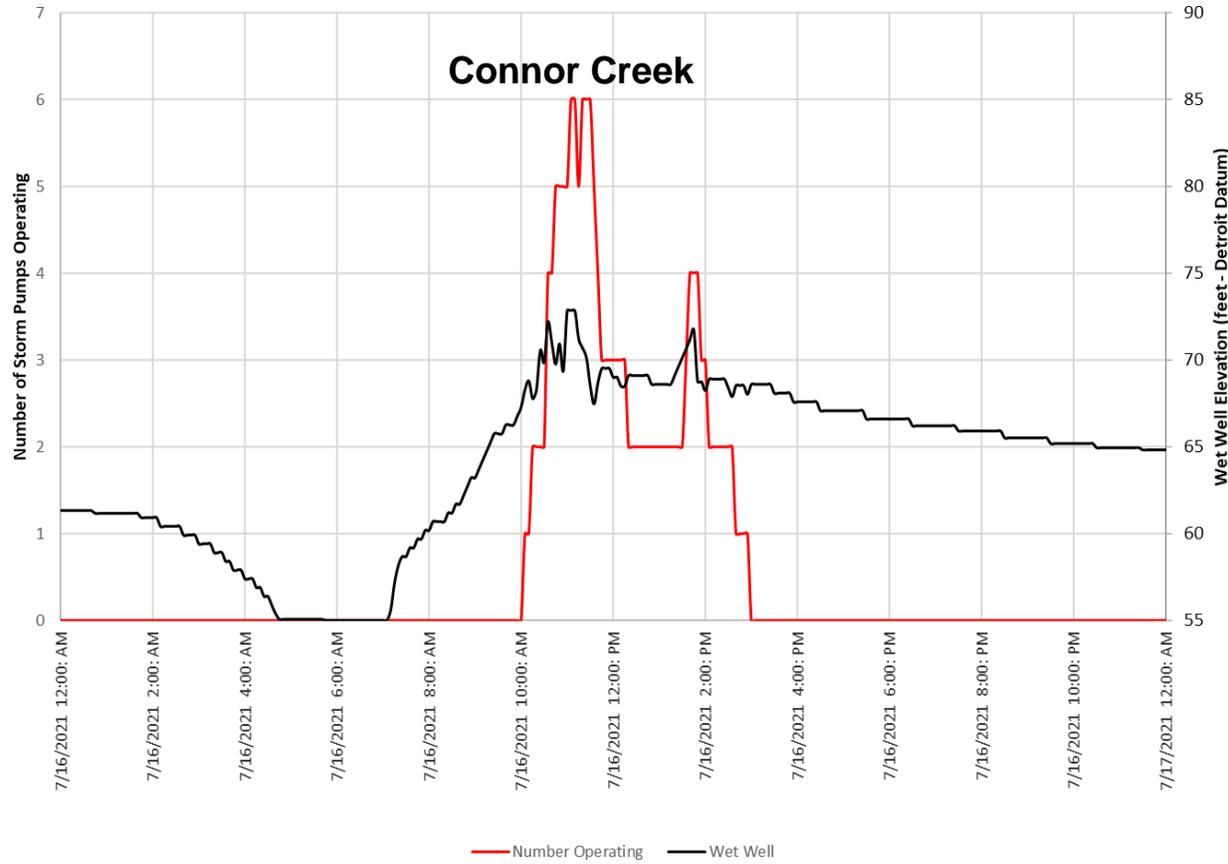
Charge #2:

Determine the sequence of events occurring during the June 25-26 and July 16 events.

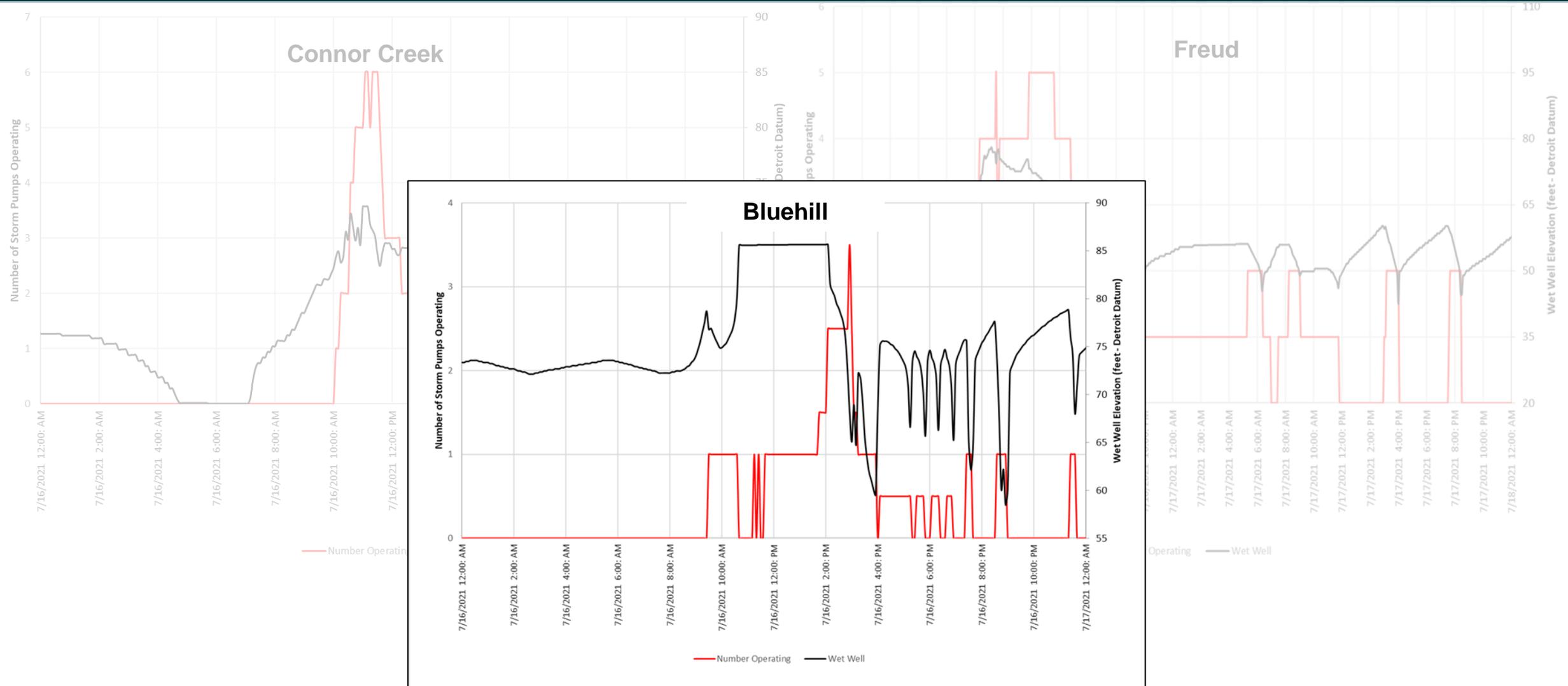
- July 16:
 - 06:00 to 18:00
 - Peak Intensity of 11.8 Inches/hr Over 5 Minutes
 - 4.5 Inches Over 6 Hours
- Conner Creek
 - 6 Pumps Operating at Peak
- Freud
 - 5 Pumps Operating at Peak
- Bluehill
 - Localized Street Flooding
 - Interrupted Electrical Service



Charge #2: Determine the sequence of events occurring during the July16 event.



Charge #2: Determine the sequence of events occurring during the July16 event.



Charge #3:

Determine the status of recommendations made to GLWA in response to earlier flooding events.

- METCO (June 2015), Vacuum Priming System Evaluation, System Analysis and Condition Survey of Sewerage Pumping Stations, report prepared for Detroit Water & Sewerage Department. This report was commissioned after the storm event on 11 August 2014. The objectives of this report were to:
 - Enhance operational reliability of the Conner Creek Pump Station
 - Develop and Operational Strategy to optimize use of the Conner Creek CSO basin and associated CSO control facilities
 - Determine the optimum hydraulic pumping capacity at Freud, Conner Creek, and Fairview Pump Stations
 - Conduct a condition assessment and identified required repair/upgrades to major equipment at Conner Creek and Freud Pump Stations
- GLWA (21 November 2016), Detroit East Side Flooding Event Analysis – July 8 and August 16, 2016. This report was commissioned by GLWA after the storm events of 8 July 2016 and 16 August 2016. The objectives of this report were to provide an understanding of the circumstances around the storm events that led to flooding, including:
 - Prediction / advance warning of the heavy rain events
 - The intensity of the rainfall events
 - The local and regional sewer systems to convey the rainfall
 - The characteristics of the areas and sewers where flooding occurred
 - The operator's responses to the events
- OHM Advisors (1/17/2017), DWSD Basement Backup Evaluation Following the July 8, 2016 and August 16, 2016 Rain Events and Related Flooding, report prepared for Detroit Water and Sewerage Department. This report was independently commissioned by DWSD after the storm events of 8 July 2016 and 16 August 2016 to identify the causes of flooding and develop alternatives to better protect the area. The report does not provide specific recommendations, but does summarize measures that were currently in progress to reduce flooding potential, and outlines additional improvements that could be considered, including:
 - Base-level improvements to existing system
 - Enhancements to the conveyance system
 - Peak flow reduction measures
 - Damage reduction measures
- Table in Report
 - 59 Items Total
 - Less Than Half Implemented
 - Specific Comments in Final Report

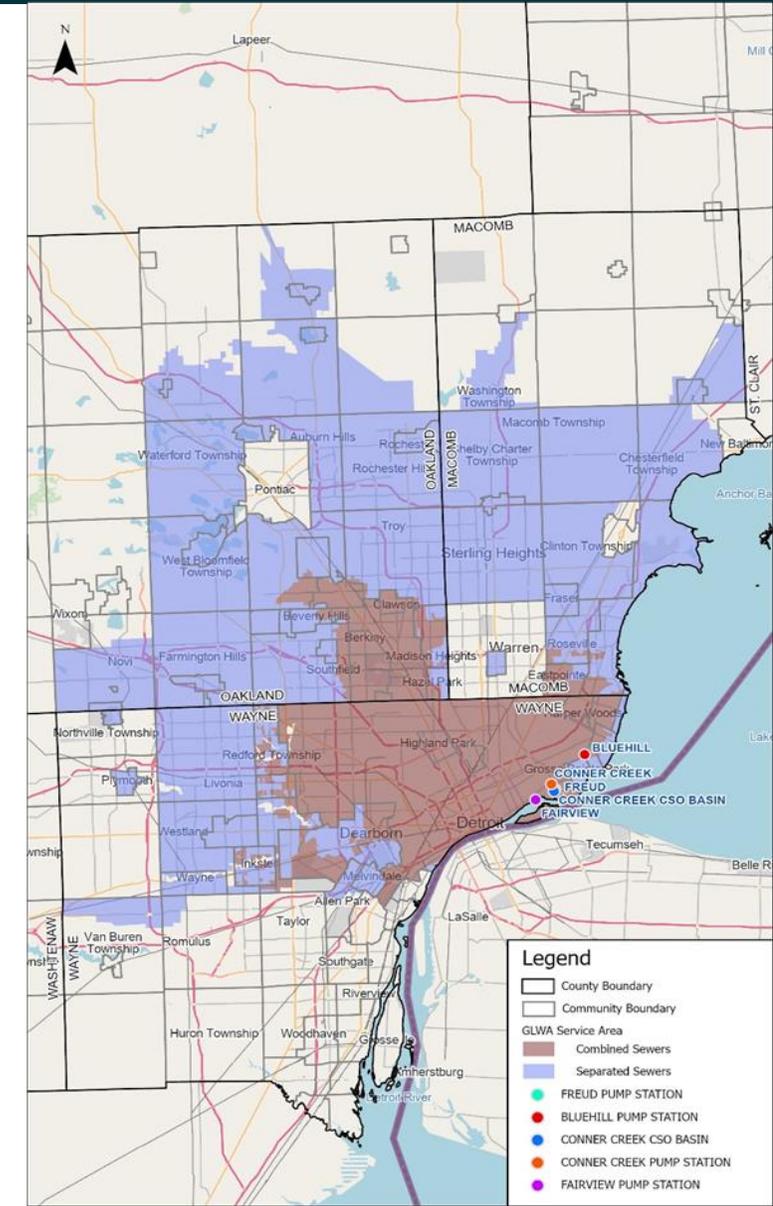
Table 7: Summary of Recommendations from Prior Studies

Report ¹	Rec. No. ²	Recommendation	Area of Focus ³			Completed		Comments
			Oper.	Phys.	O&M	Yes	No	
METCO	CN-01	Remove two (or four) existing centrifugal storm pumps and replace with vertically suspended (VS) wet-pit turbine pumps		X			X	Would eliminate need for priming system for first-used pumps at CC, thus allowing those pumps to start without having to wait for discharge level to reach required height for vacuum priming system
METCO	CN-02	Maintain existing siphon block in discharge piping	X			X		Would continue to provide function of check valve to control backflow from discharge channel
METCO	CN-03	Detailed internal inspection of existing storm pumps			X		X	Unable to determine based on visual inspection during AECOM site visit (2021).
METCO	CN-04	Convert existing electric motors to brushless type		X			X	Existing motors beyond range of general life period
METCO	CN-05	Install machine safety guards for storm pumps			X		X	Rotating shafts are exposed at intermediate floor levels, creating a safety hazard
METCO	CN-06	Replace the two existing primary transformers & associated controls		X			X	Existing transformers beyond range of general life period
METCO	CN-07	Upgrade existing lighting system			X		X	Lighting did not meet IES standards at time of METCO inspection (2014). Lighting appeared adequate during AECOM site visit (2021).
METCO	CN-08	Replace existing boilers, condensate pumps, associated piping and valves			X		X	Only one of two boilers operational; corrosion present on remaining boiler. No indication work was done.
METCO	CN-09	Replace existing heaters & ventilation fans			X		X	Current equipment was in poor condition. No indication work was done
METCO	CN-10	Resurface existing driveway			X		X	Cracks noted in existing driveway. Does not appear to have been addressed, based upon Google Earth imagery from 2015 – 2021

Charge #4:

Determine the interrelationship between the operation of the local collection systems tributary to the Conner Creek, Freud, and Bluehill Pump Stations and their impact on those pump stations.

- Mixture of Combined and Separate Systems
- Cooperative Agreements in Place
- Relative Roles of GLWA:
 - Provide Defined Flooding Service in Combined Sewer Areas
 - Accept Defined Quantity of Sanitary Sewage in Separate Sewer Areas
- Basement Flooding can be the Result of Local Restrictions and/or Trunk System Capacity
- Downspout and Catch Basin Restrictions Implemented in Some Jurisdictions But Not in Others
- Level of Service to Homeowners Needs to be Coordinated
- Further Analysis On-going



Charge #5:

Identify physical and operational improvements that can be made to the Conner Creek, Freud, Bluehill, and Fairview pump stations to increase their performance reliability and resilience in response to extreme weather events.

- Employ Risk Management Approach
 - Occurrence of Extreme Rainfall Events Occur Infrequently But with Severe Impacts
 - Require Different Approach to Mitigation Than More “Normal” Events
 - *Not Easily Predictable, Thus Must Assume That Can Occur and be Prepared*
- Approach:
 - Improve Electrical System Reliability and Resilience
 - Accelerate Transition to DTE Service
 - Ensure Full Electrical Service From N-1 Utility Feeds
 - Failure Modes and Effects Analysis to Determine Critical Components
 - Ancillary Equipment Might be Greatest Vulnerability
 - Recognize Seasonality of Extreme Events
 - Thorough Review of All Stormwater Pumping Facilities in Preparation for Summer Season
 - *Pumps, Electrical System, Ancillaries, etc.*
 - *Contract Out?*
 - Check List to Verify Facility Availability for All Predicted Rainfall Events > 1 Inch
 - Strategic Staffing for Anticipated Events
 - Formalize Operational Readiness Reporting Procedures
- Refined Recommendations in Final Report

Charge #6:

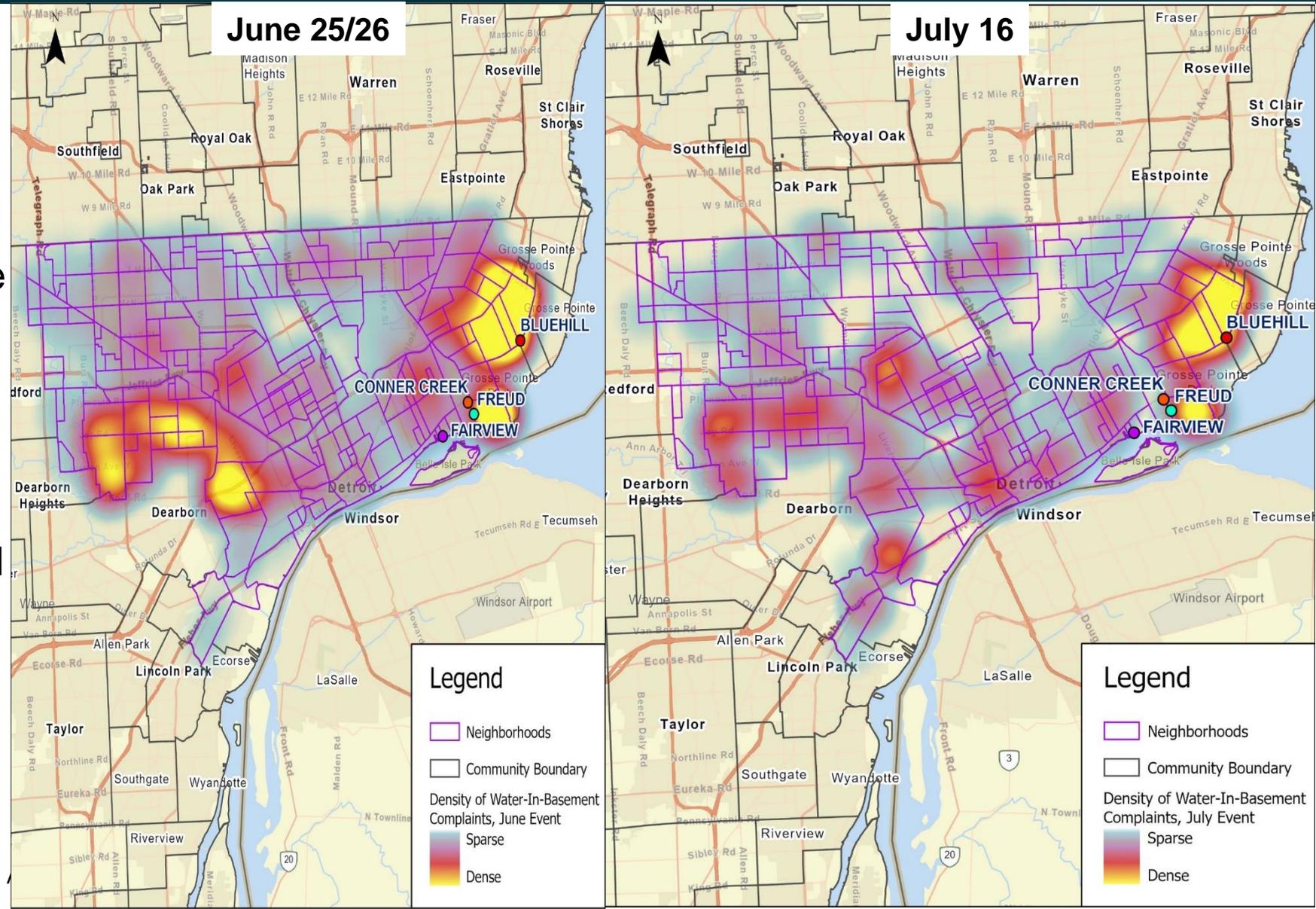
Identify methods to maximize the performance of existing and currently planned GLWA infrastructure during extreme weather events.

- Continued Assessment and Improvement of Existing System
 - Reviewing Existing Relevant Capital Improvements Plan Items
- Actions Under Review
 - Balancing Hydraulic Conveyance and Pumping Capacity
 - Full Capacity of System Likely Needed to Mitigate Flooding During High Intensity Rainfall Events
 - Identify Critical System Constraints
 - Balance Flood Mitigation Versus Water Quality Protection (Combined Sewer Overflow Reduction)

Charge #7:

Generally, determine the extent of flooding associated with the GLWA and DWSD collection systems during the June 25-26 and July 16 events.

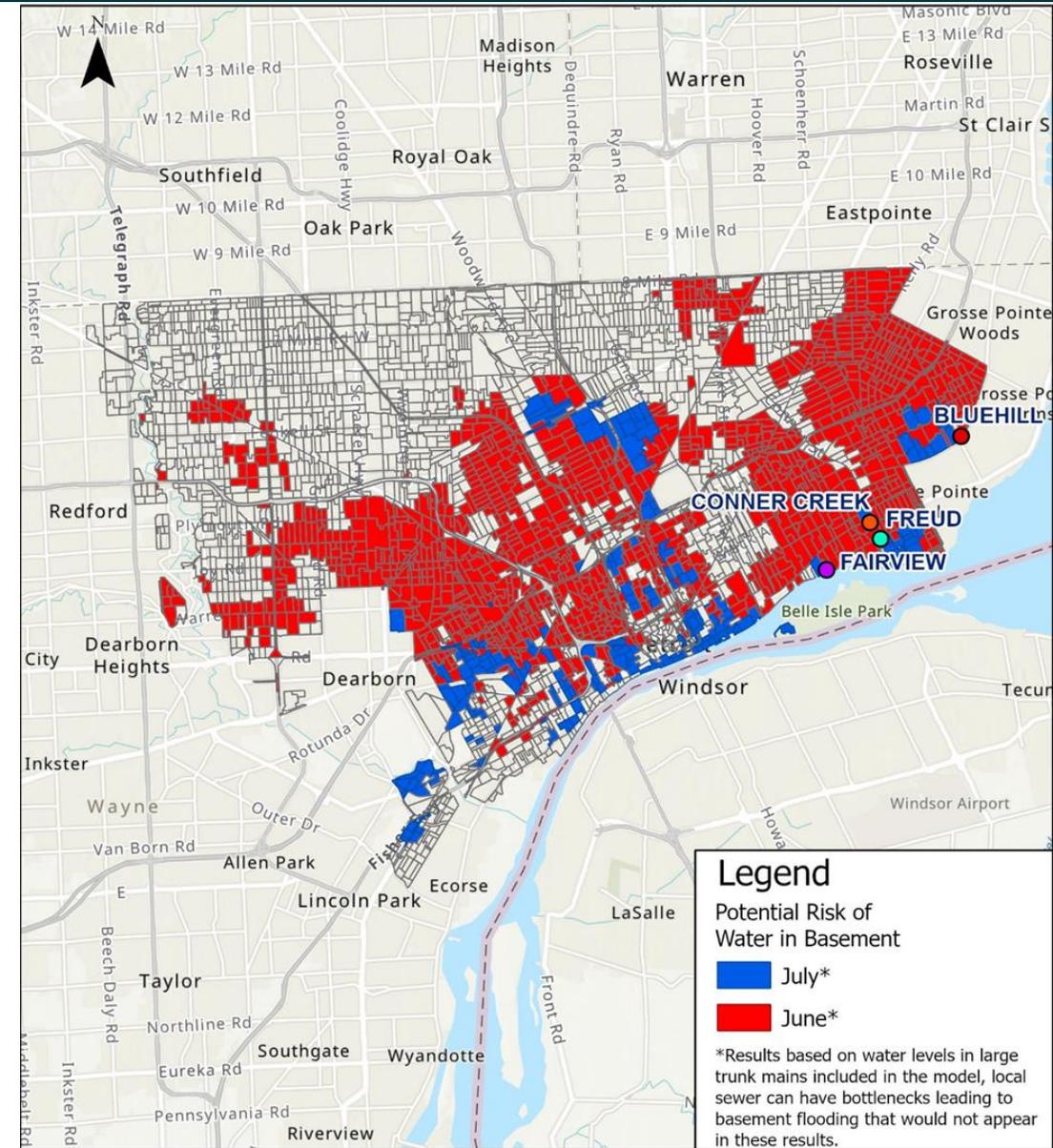
- Modeling Approach Used to Characterize Flooding
 - EPA SWMM for Collection System
 - PCSWMM 2D for Surface Flooding
- DWSD Basement Flooding Data Used to Calibrate
 - 4,940 Complaints June 25/16 and 364 July 16
- High Water Mark Data Used to Calibrate Surface Flooding Data
 - Tables in Report Demonstrate Good Calibration



Charge #7:

Generally, determine the extent of flooding associated with the GLWA and DWSD collection systems during the June 25-26 and July 16 events.

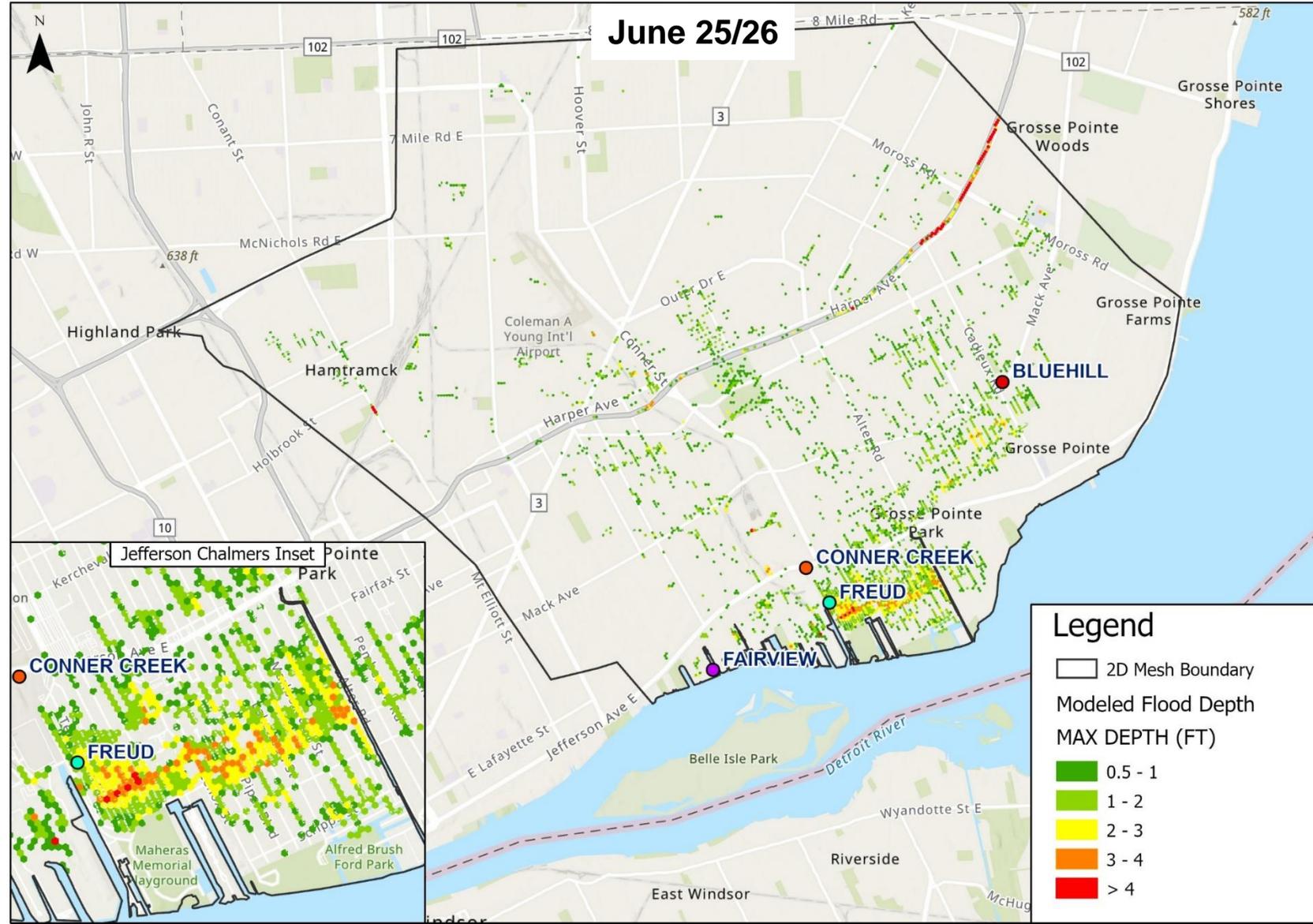
- Areas for Basement Flooding Risk Indicated on Accompanying Graph
 - Locations Where Trunk Sewer Water Level Within 8 Feet of Ground.
 - Further Basement Back-Ups Possible Due to Local Hydraulic Restrictions
 - Predicted Extent of Potential Basement Back-Ups
 - June 25/26 – 41,593 Acres
 - July 16 – 5,955 Acres



Charge #7:

Generally, determine the extent of flooding associated with the GLWA and DWSD collection systems during the June 25-26 and July 16 events.

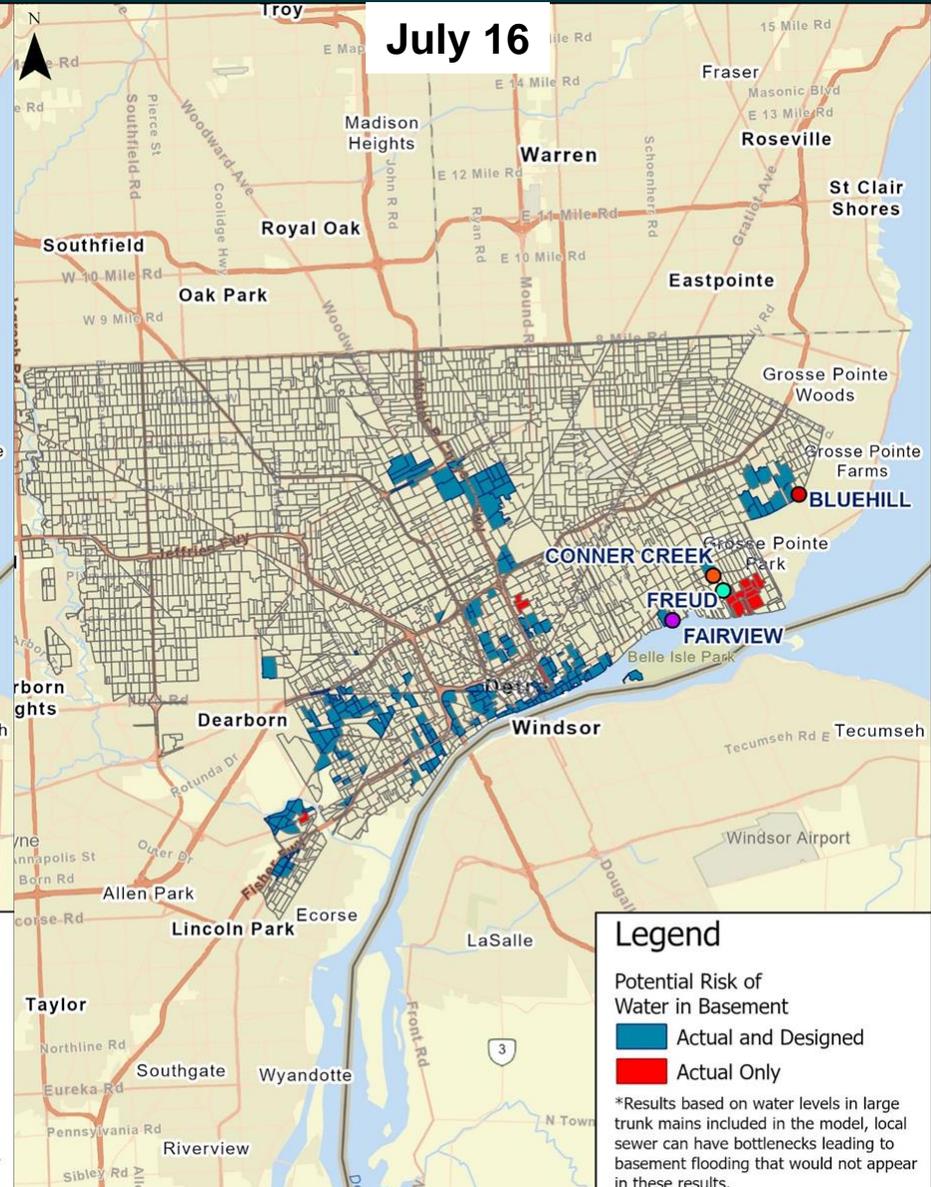
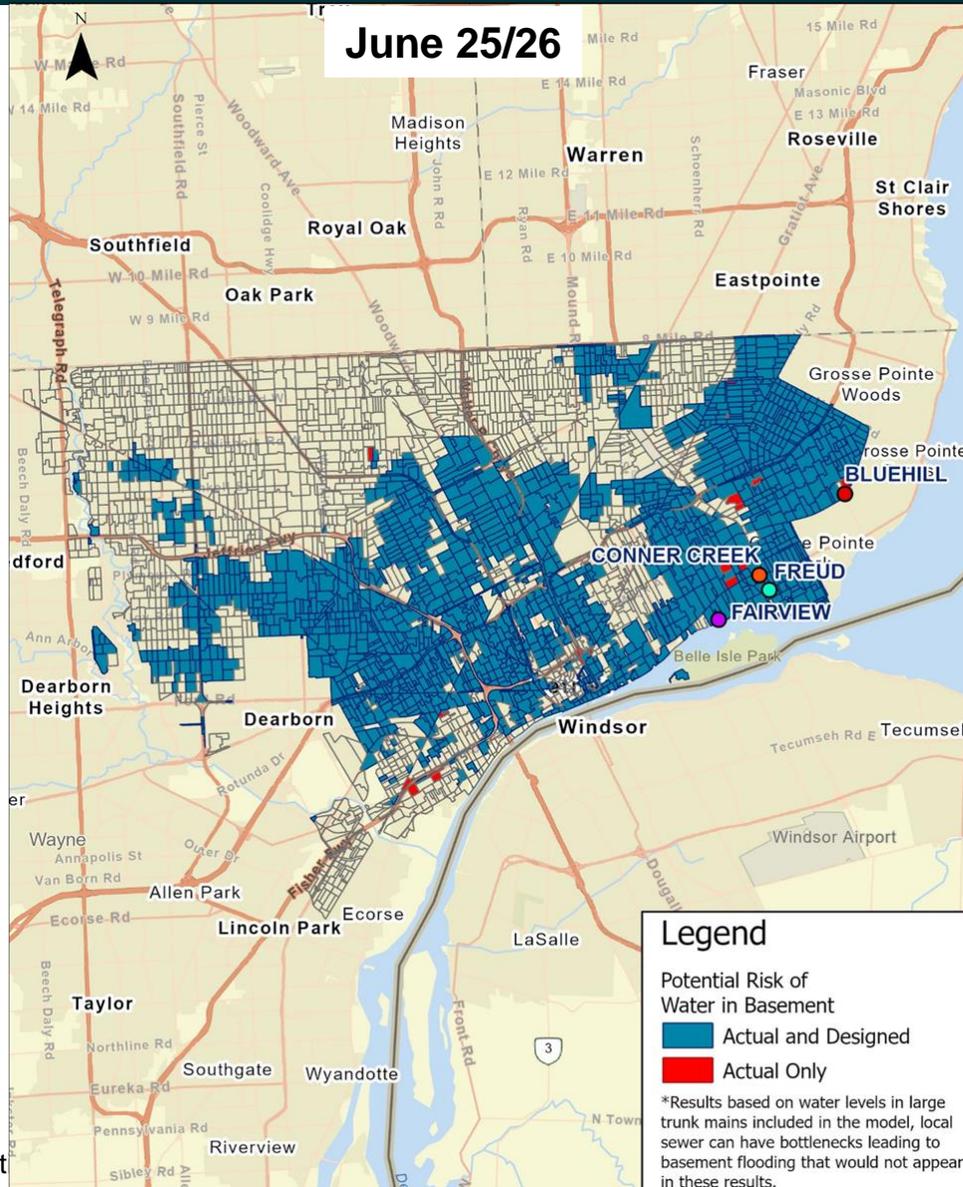
- Areas for Basement Flooding Risk Indicated on Accompanying Graph
 - Locations Where Trunk Sewer Water Level Within 8 Feet of Ground.
 - Further Basement Back-Ups Possible Due to Local Hydraulic Restrictions



Charge #8:

Generally, determine the reduction in flooding associated with the GLWA and DWSD collections systems during the June 25-26 and July 16 events if the Conner Creek and Freud pump stations had functioned as intended.

- Modeling Shows Only Marginal Reduction in Basement Flooding with All Pumps Operating - Less than 1 % Reduction in Impacted Areas



Charge #8:

Generally, determine the reduction in flooding associated with the GLWA and DWSD collections systems during the June 25-26 and July 16 events if the Conner Creek and Freud pump stations had functioned as intended.

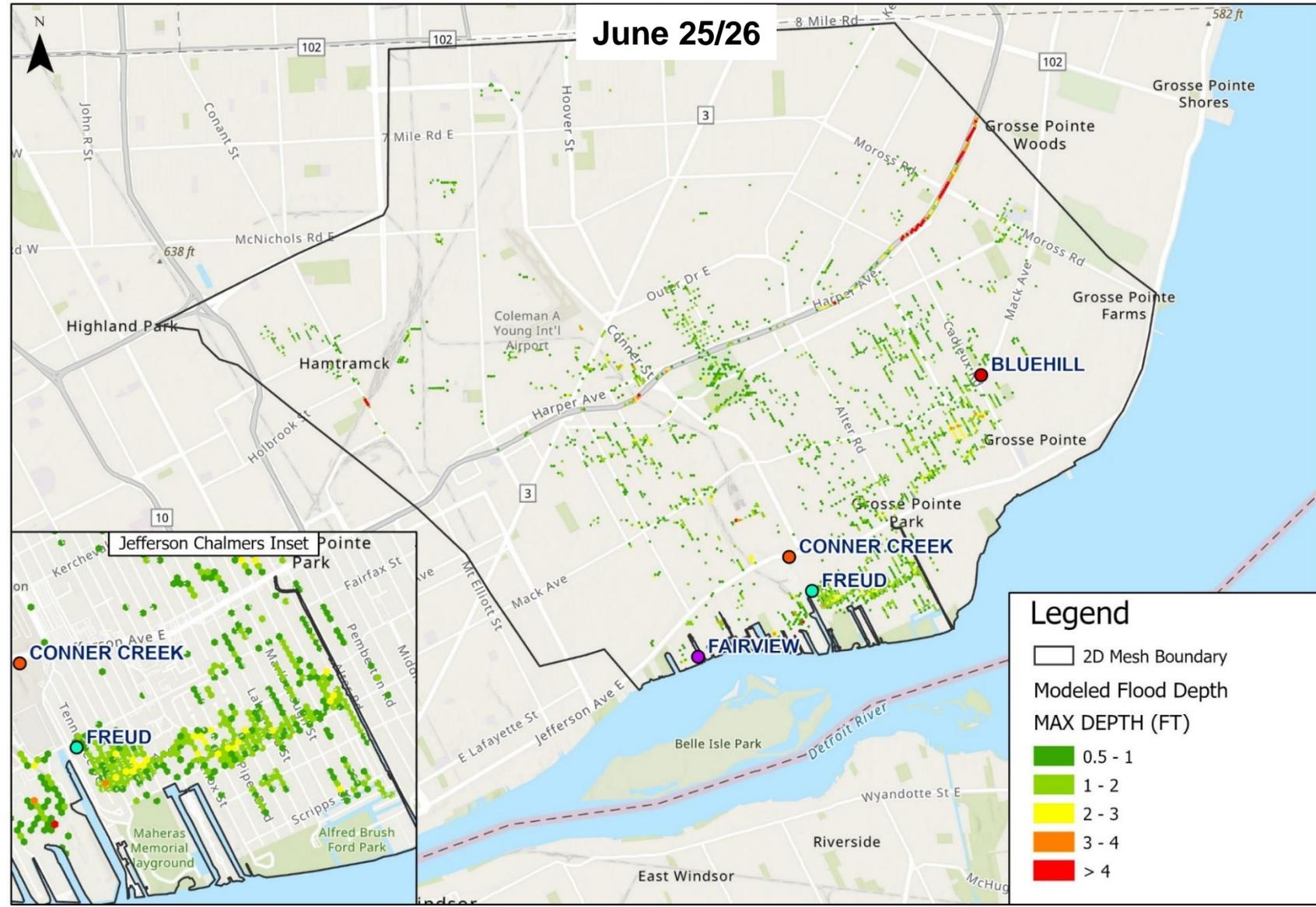
- Modest Difference in Pumped Volume Between Actual and Operation as Designed Explains Modest Difference in Basement Flooding
 - 819 Acre-Feet in Volume (267 MG) June 25/26 Storm
 - Suggests That Hydraulic Conveyance, Not Pumping is Limiting Factor

	June ACTUAL Volume (MG)	June DESIGN Volume (MG)	Difference June Event	% Change June Event	July ACTUAL Volume (MG)	July DESIGN Volume (MG)	Difference July Event	% Change July Event
Conner	505	705	200	28%	311	538	227	42%
Freud	702	769	67	9%	688	598	-90	-15%
Total - Conner + Freud	1207	1474	267	18%	999	1136	137	12%
Bluehill	177	181	4	2%	133	139	6	4%

Charge #8:

Generally, determine the reduction in flooding associated with the GLWA and DWSD collections systems during the June 25-26 and July 16 events if the Conner Creek and Freud pump stations had functioned as intended.

- 28 % Reduction in Surface Flooding for June 25/26 Event if All Pumps Operated
 - Reduction in Flood Depth Also



Charge #9:

Identify steps that GLWA can take in addition to those to be identified above to increase the level of flood protection service provided, including not only those by GLWA but also other regional partners.

- Encourage short-term mitigation measures for homeowners experiencing frequent basement flooding
 - These may include check valves/backflow preventers, sump pumps, sewer line cleanouts, basement sealing/floodproofing, yard grading, directing rooftop drainage away from foundations, etc.
 - Financial assistance may be required for many homeowners
- Other Items in Process and Presented in Final Report
 - Preliminary Level of Service Assessment
 - Based on Rainfall Volume and Intensity, Not Historical Return Period
 - Further Review System-Wide Operational Strategies
 - Identify Priority Conveyance Upgrade Opportunities
 - Summarizing Experience of Other Communities
 - Level of Service
 - Regional Collaboration

Charge #10:

Identify sources of funding for actions such as those to be identified above.

- Under Development

- "Produced" in the U.S. means a product was manufactured in the U.S. and the cost of its components that are mined, produced or manufactured in the U.S. is greater than 55 percent of the total cost of the manufactured product.
- Waivers may be granted if the iron, steel or manufactured product are not produced in the U.S. in sufficient and reasonably available quantities or of "satisfactory" quality

Wastewater Authorizations

- \$14.65 billion for the wastewater SRF program; FY 2022-2026
- \$1.4 billion for grants through FY 2026 to municipal entities to control and treat sewer overflows and stormwater and to provide public notification systems for such overflows
- \$250 million through FY 2026 for grants to private, non-profit organizations to provide assistance to low-to-moderate income individuals for the construction, repair or replacement of an individual household decentralized wastewater treatment system or for the installation of a larger decentralized wastewater system designed to provide treatment for two or more households
- \$200 million through FY 2026 for a grant program to help low-to-moderate-income individuals connect to a publicly owned treatment works
- \$125 million through FY 2026 to establish a clean water infrastructure resiliency and sustainability program to address natural hazard or cybersecurity vulnerabilities
- \$125 million through FY 2026 to continue a pilot program to help municipal, industrial or agricultural interests find alternative sources of water in areas experiencing critical water supply needs
- \$100 million through FY 2026 to establish a pilot wastewater efficiency grant program for owners or operators of publicly owned treatment works to carry out projects that create or improve waste-to-energy systems.
- \$75 million through FY 2026 for a competitive grant program to establish systems that improve the sharing of information concerning water quality, water infrastructure needs, and water technology, including cybersecurity technology, between states or among counties and other units of local government within a state
- \$50 million through FY 2026 for a circuit rider program to provide assistance to owners and operators of small and medium-sized publicly owned treatment works
- EPA must establish a Water Reuse Interagency Workgroup to develop and coordinate actions, tools, and resources to advance water reuse across the U.S., including through the implementation of the February 2020 National Water Reuse Action Plan
- EPA is to establish three to five Centers of Excellence for Stormwater Control Infrastructure Technologies
- Subject to the availability of funds, EPA would conduct a study of existing and potential future technology, including technology that could address cybersecurity vulnerabilities, that enhances or could enhance the treatment, monitoring,

To Be Included in Final Reporting

- Develop and Execute Plan to Collaborate with Wade Trim and Brown & Caldwell (As Directed by GLWA Board of Directors)
- Refine Recommendations Concerning Connor Creek, Freud, and Bluehill Pump Station Facility and Operational Improvements
- Complete Review of CIP and Identify Added Items
- Items From Previous Slide
 - Preliminary Level of Service Assessment
 - Based on Rainfall Volume and Intensity, Not Historical Return Period
 - Further Review System-Wide Operational Strategies
 - Identify Priority Conveyance Upgrade Opportunities
 - Summarizing Experience of Other Communities
 - Level of Service
 - Regional Collaboration
- Others Per Your Direction

Questions & Answers