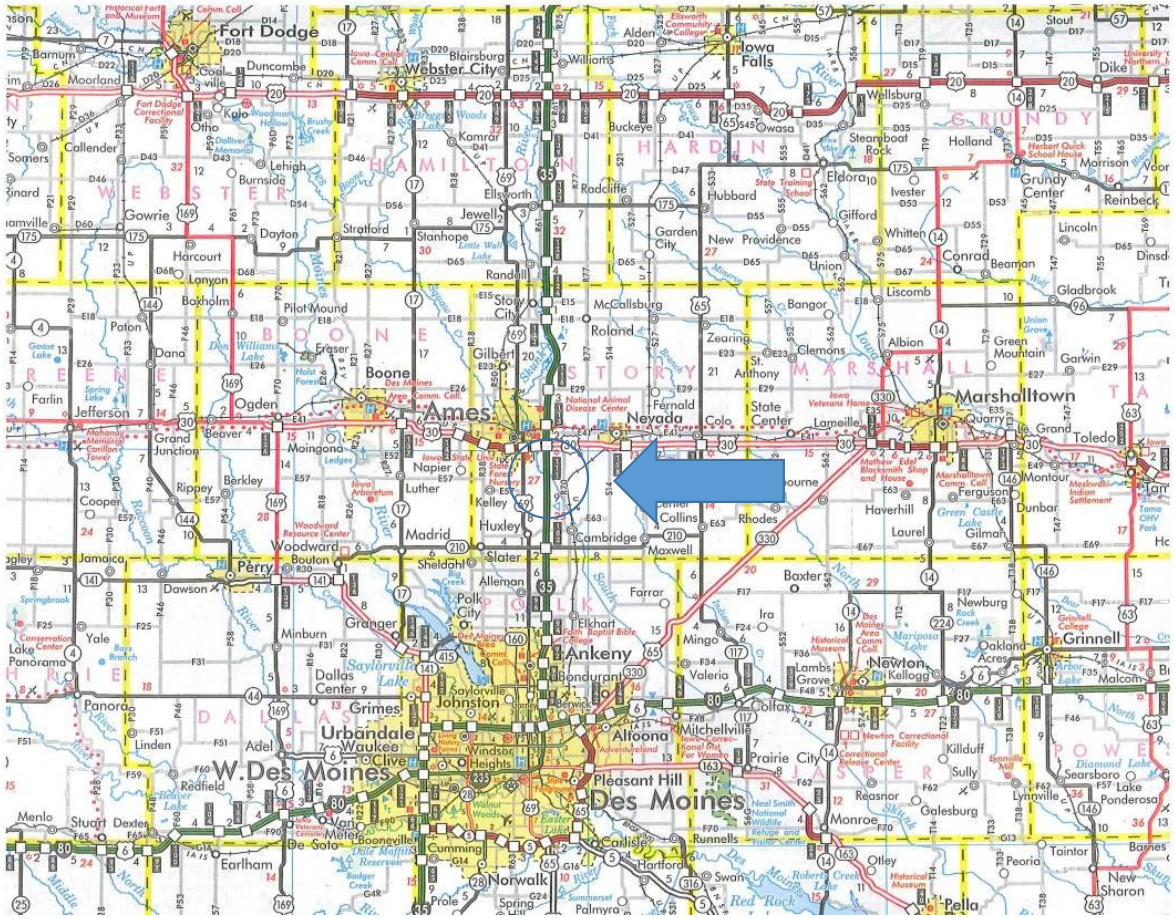
Incorporating Resiliency into Iowa DOT Infrastructure

Webster's Definition of Risk & Resiliency

- **Risk/Vulnerability –** Possibility of LOSS or Exposure to Hazard
- **Resiliency -** An ability to RECOVER from or ADJUST easily to MISFORTUNE or CHANGE..
- **Transportation Resilience** can be reflected as a measure of annualized monetary loss of service or mobility from weather related threats based on asset design, characteristics and vulnerability.

Design for Resiliency
I-35 over South Skunk River



I-35 over South Skunk River - 2010

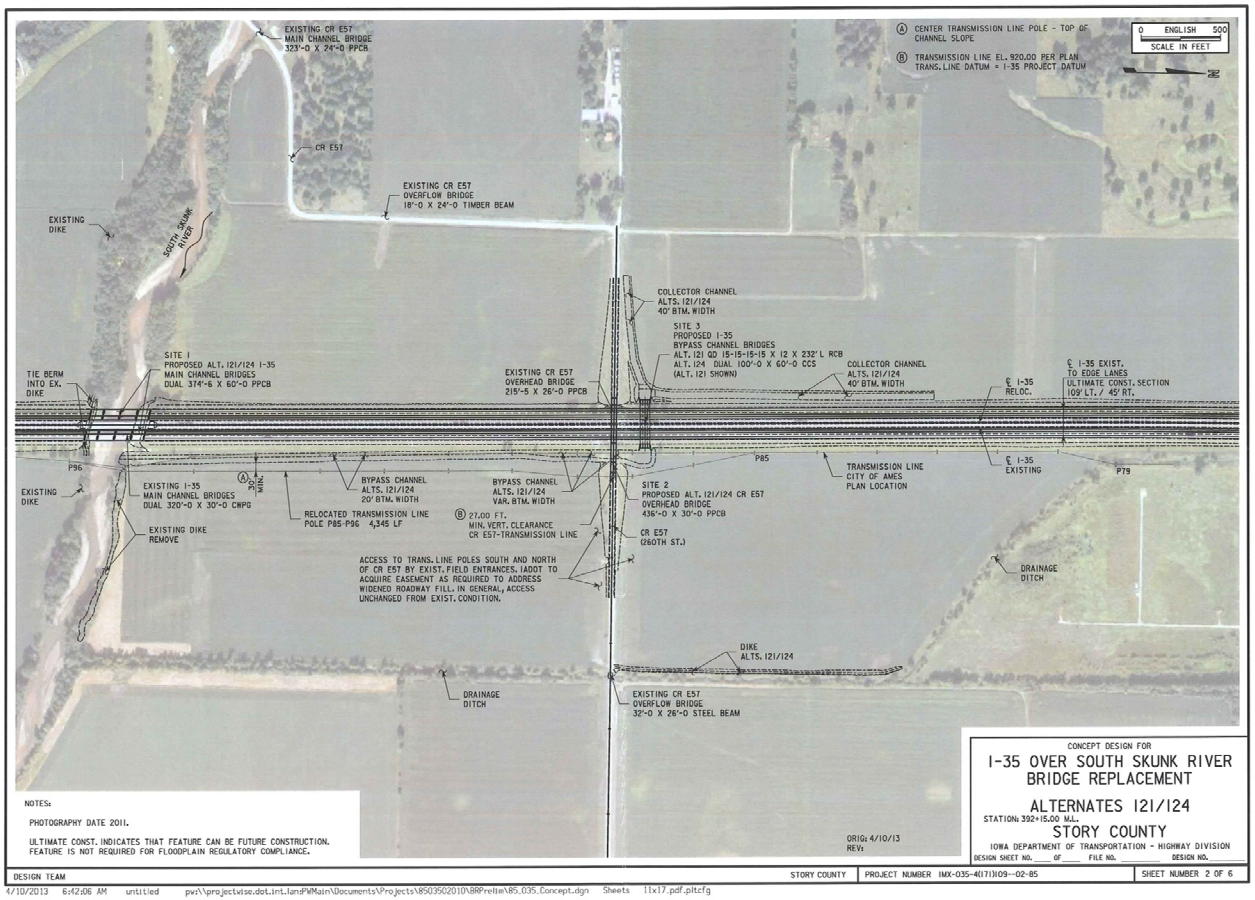
Flood Event

- South Skunk River - Over 500 Yr. Flood in 2010
  - Previous Peak = 26,000 cfs
  - 2010 Flood = 36,000 cfs (38% increase above Record Flood)
  - Gage has 63 years of record

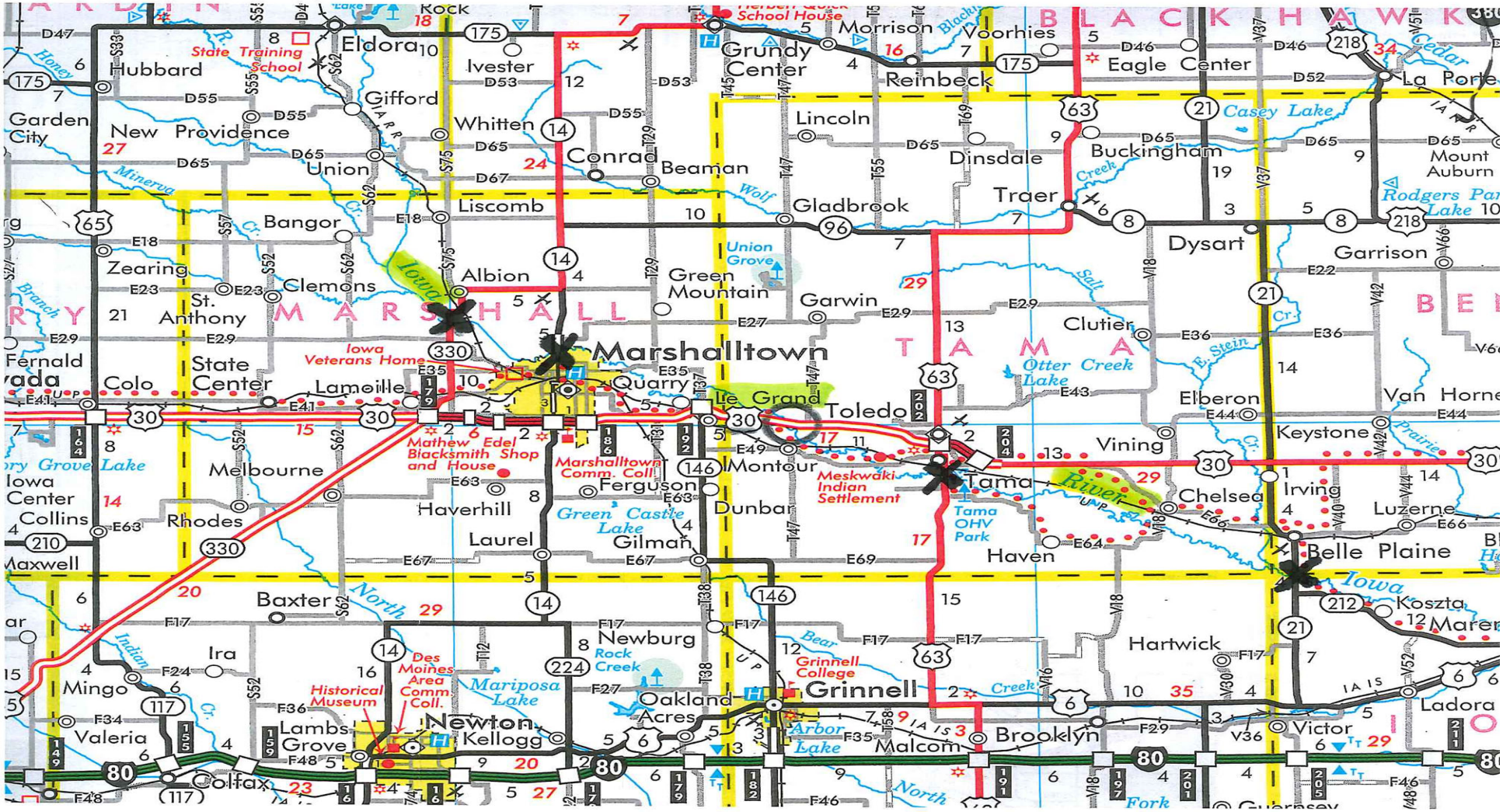
2D Hydraulic Modeling

- Conventional 1D Modeling is Difficult – Due to Levees/Dikes & Skewed Highway to Flood Plain
- 2D Hydraulic Model more Accurate
  - Modeling Surface vs. Cross Sections
- Model was Correlated with 2010 Flood

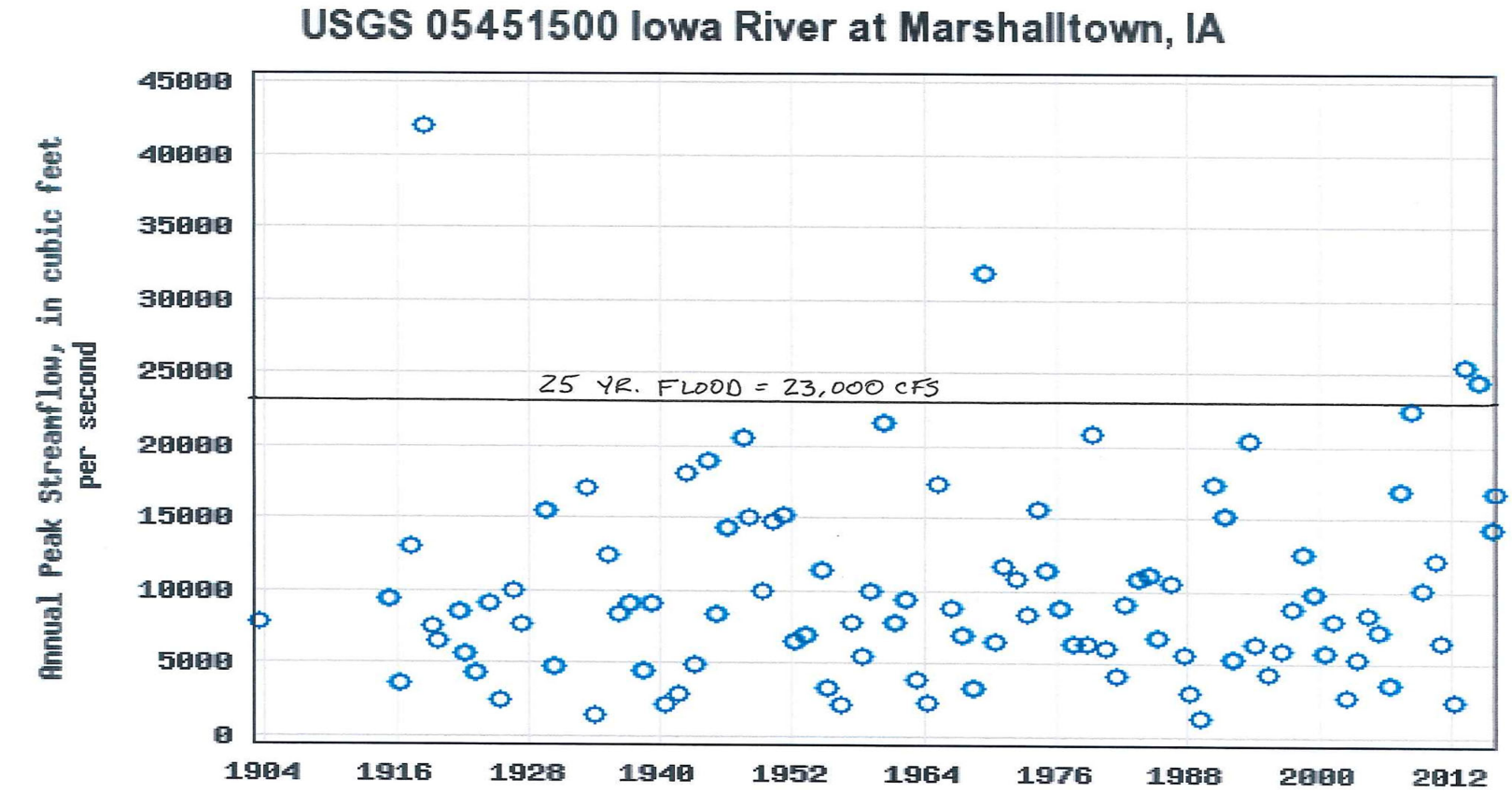
Design for Resiliency – I-35 over South Skunk River



TRANSPORTATION RESILIENCY

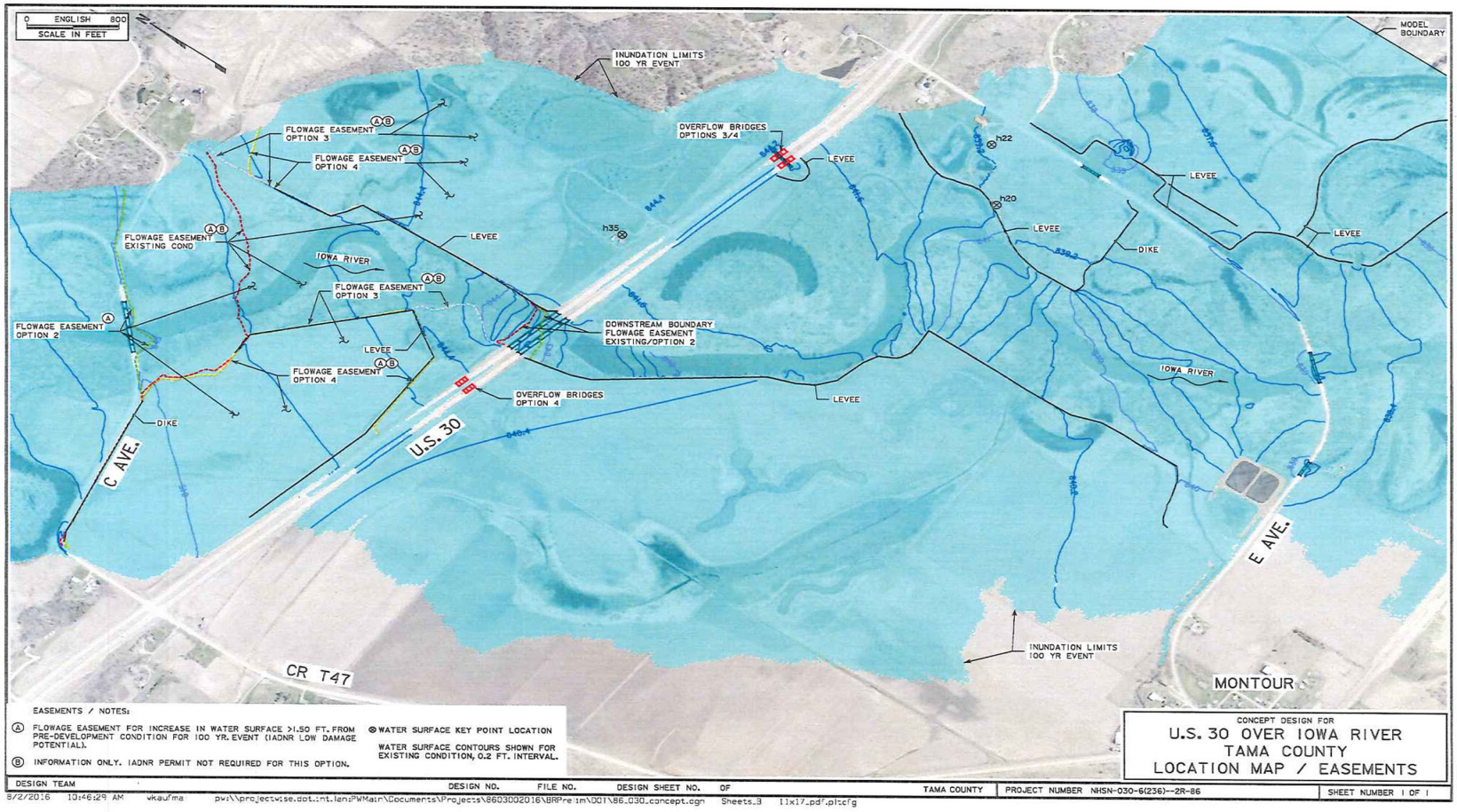


Gage Record – Historic Floods



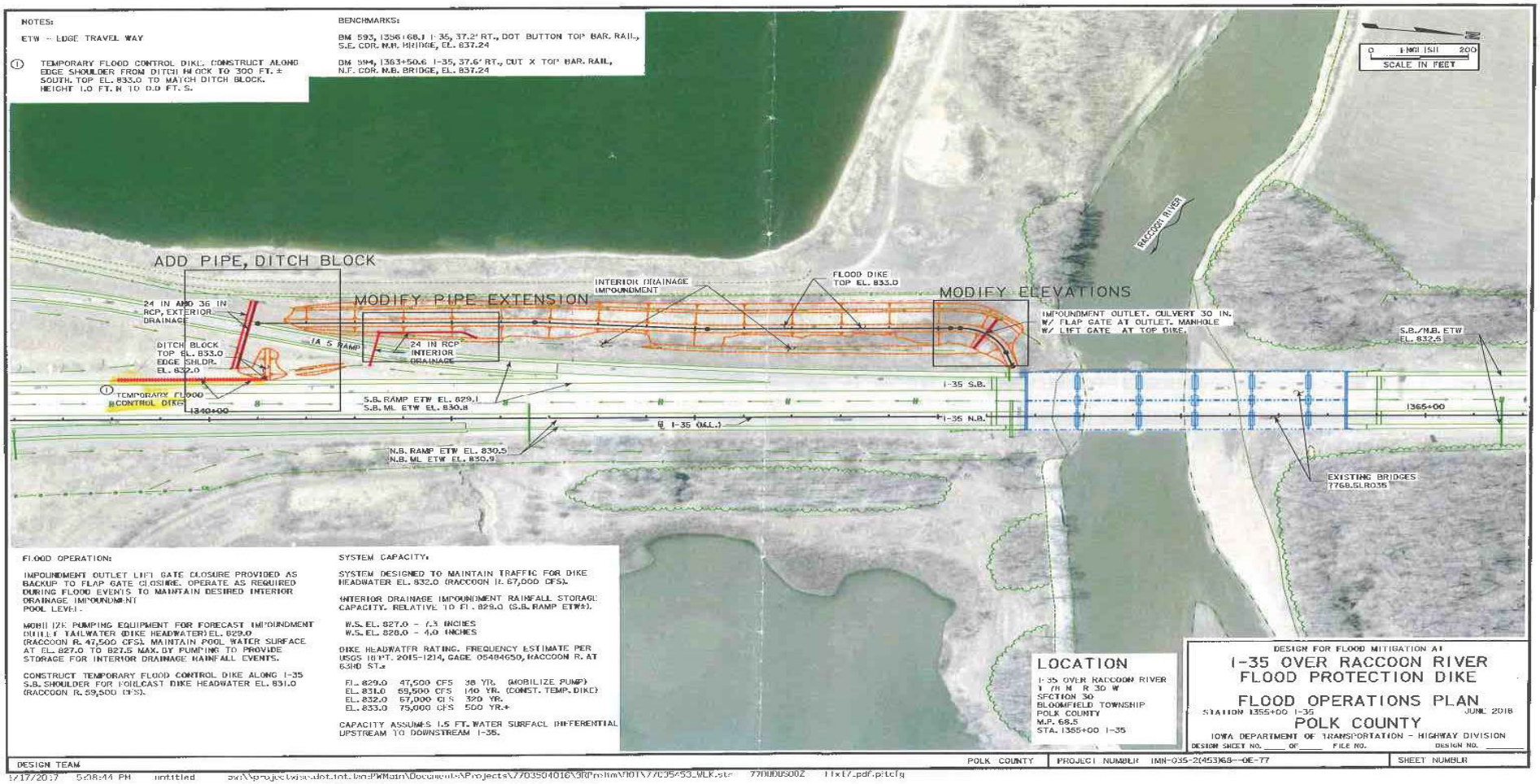
U.S. 30 over Iowa River near Le Grand, IA

U.S. 30 Flood Resiliency/Adaptation



I-35 over Raccoon River in West Des Moines

I-35 over Raccoon River



Resilient Mobility w/Implementation of Real-Time Monitoring of Highway Overtopping:

1. Integrating IFC technologies into the IDOT Operational Framework for Roadway Flooding

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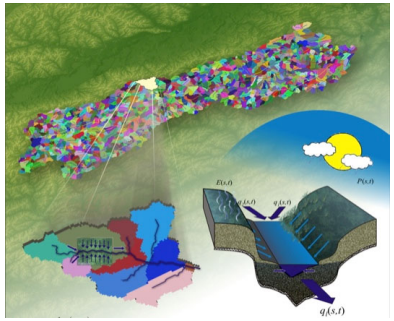
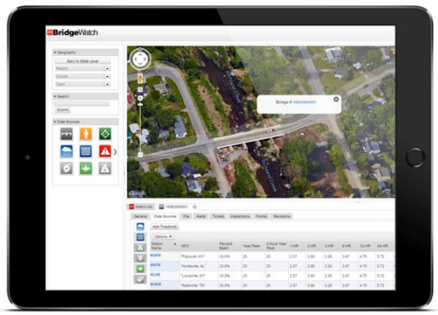




2. Proactively notifying Garage Supervisors of Highway Overtopping

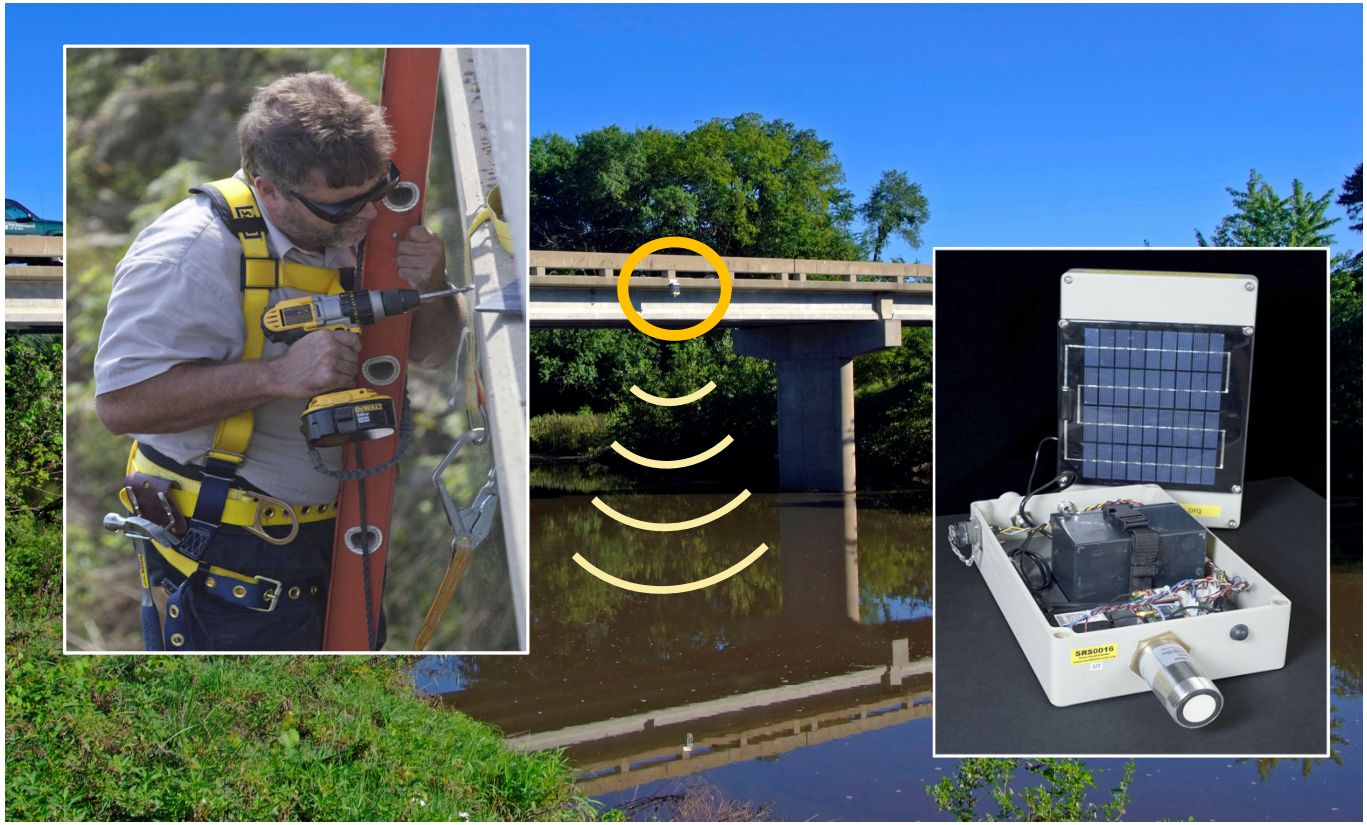
22 Most Susceptible Overtopping Sites

	CURRENT STAGE	FUTURE STAGE
11 Sensor Sites	**Ultrasonic Bridge Mounted Sensor** High Accuracy	**Hydrological Model + Rating Curve** Limited but Higher Accuracy
11 Model Sites **(*2 USGS Gauge)**	**Hydrological Model + Rating Curve** Limited Accuracy	**Hydrological Model + Rating Curve** Limited Accuracy

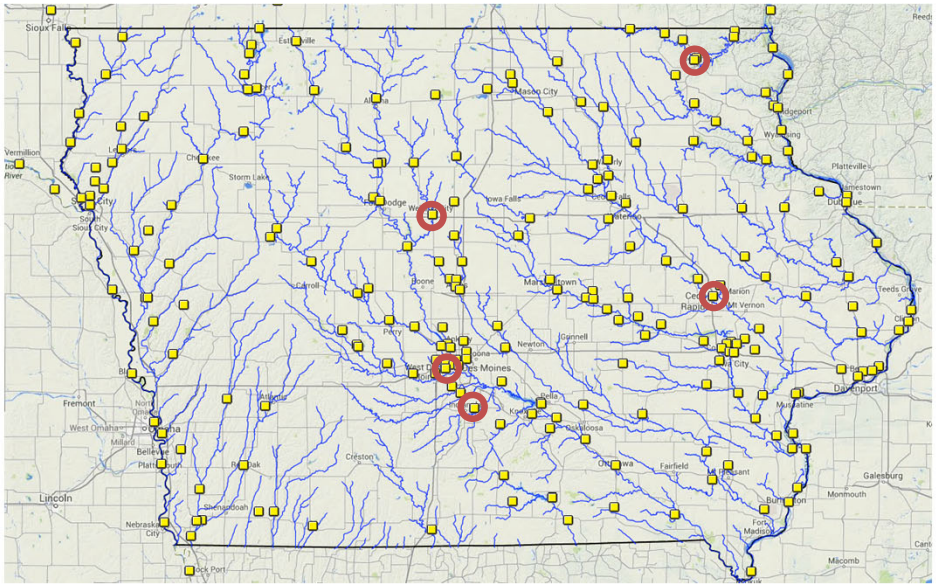
The Iowa Flood Center

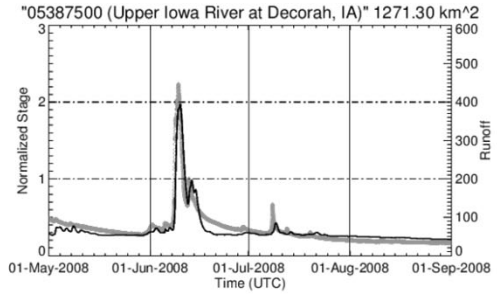
Since its creation in 2009 the IFC has been developing technologies for monitoring, predicting and anticipating the effect of floods and flash-floods in Iowa

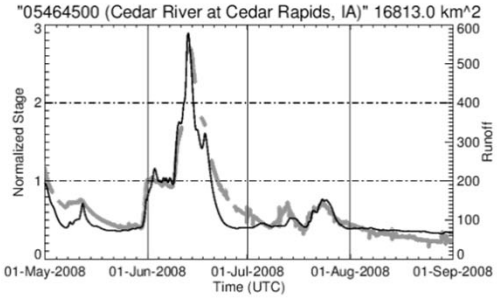
Sonic Stage Sensors

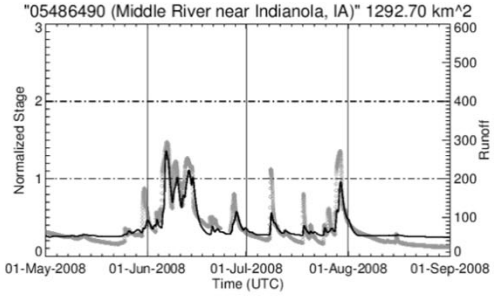


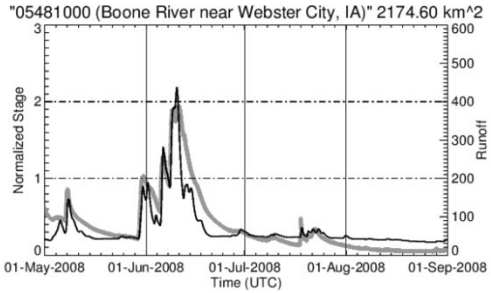
Flood Forecasting Model

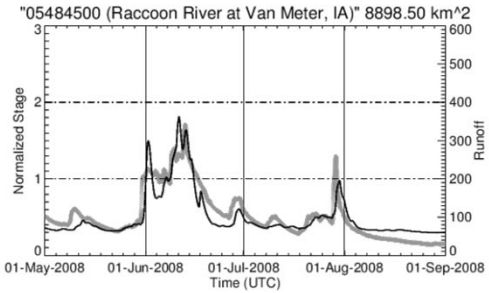




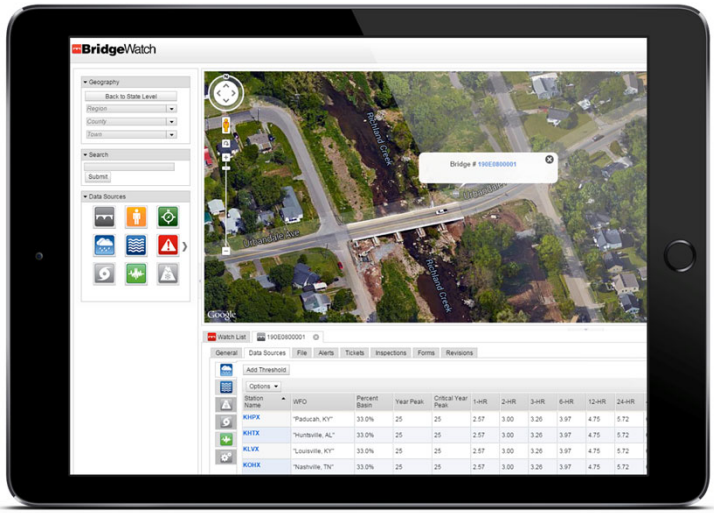






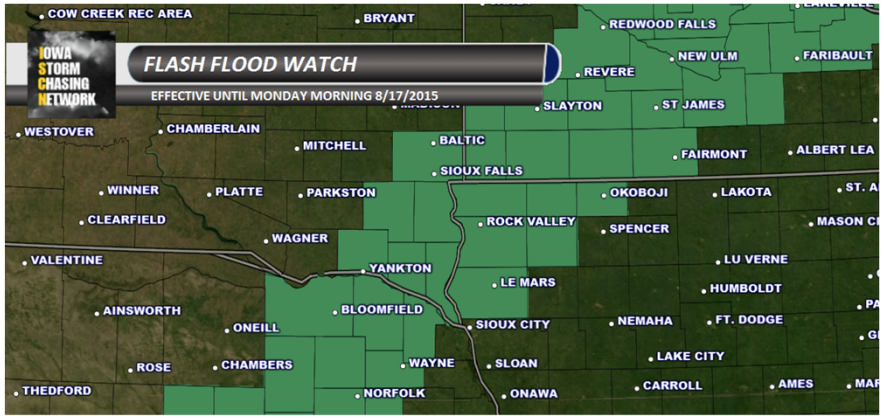


Integration with BridgeWatch™



Garage Supervisors will receive information from from actual observations by sonic-sensors or from model predicted states. In addition, roadway overtopping locations with rating curves will receive model forecast.

Resiliency is Proacative – Not Reactive



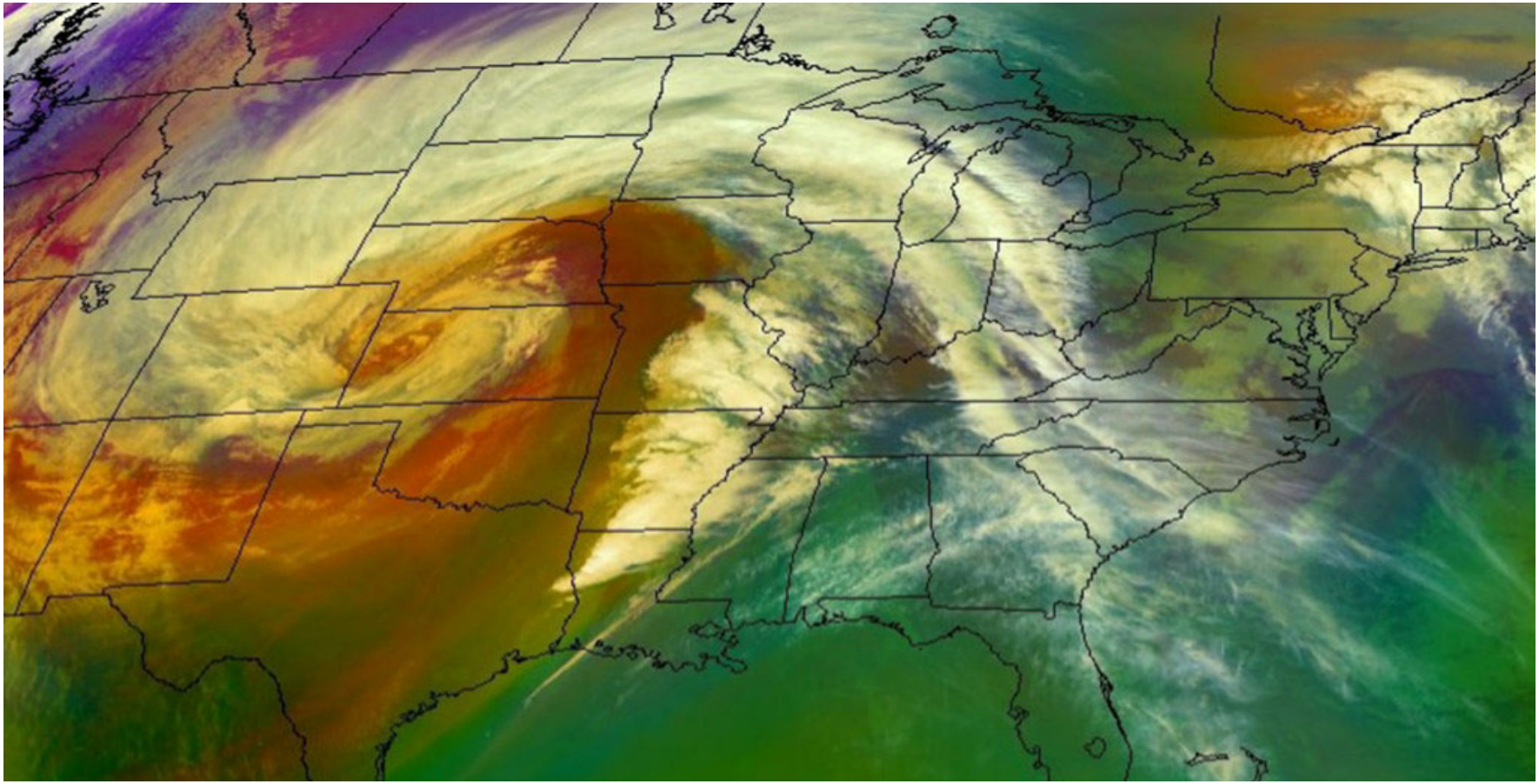
Monitoring will Accomplish:

Consistency - to develop a statewide framework which enhances public safety by proactively responding to overtopping alerts as opposed to responding to situations where overtopping has already occurred.

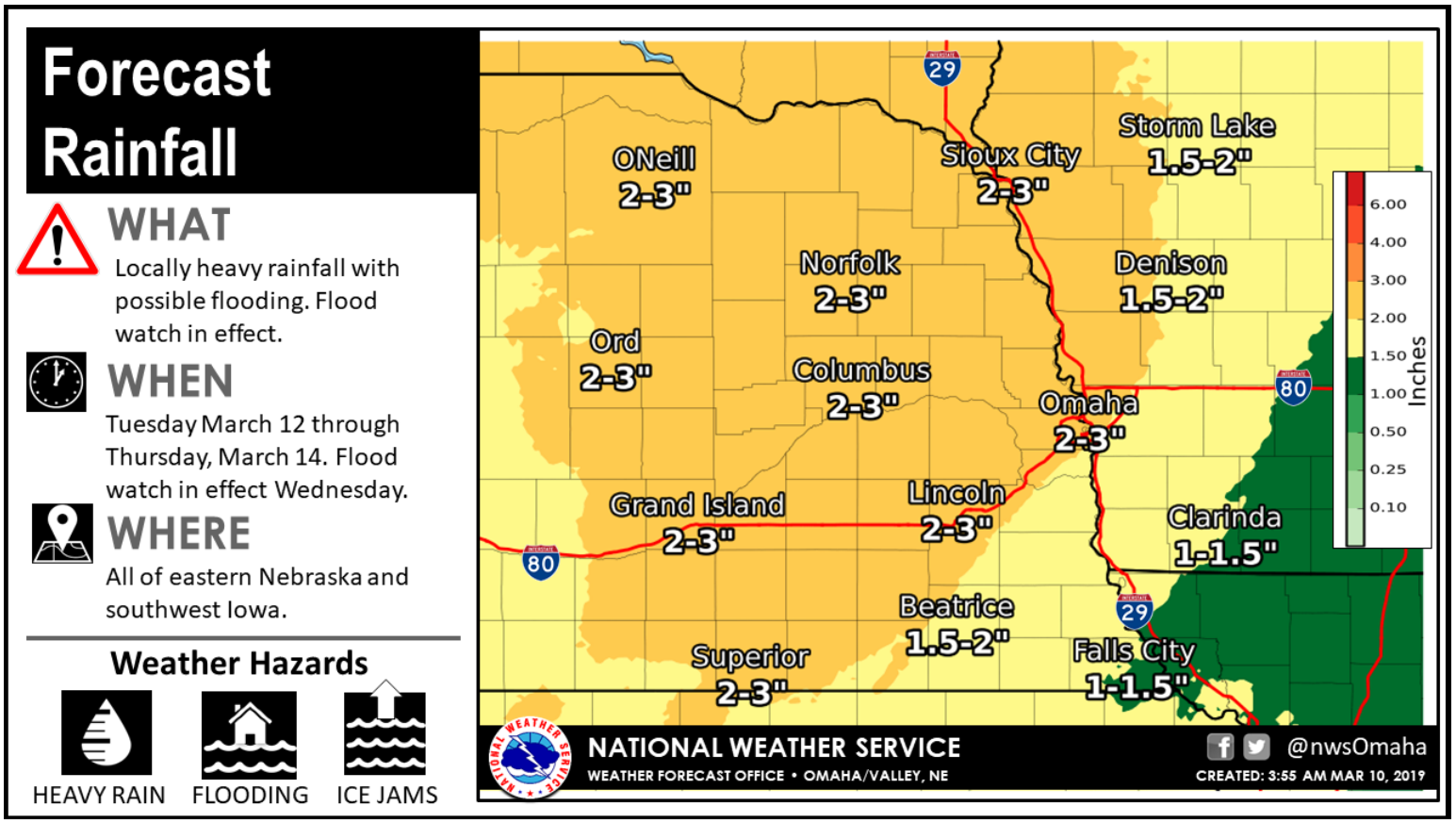
Quality - the degree to which the forecast corresponds to what actually happened.

Value - the economic benefits of the real-time forecast by properly allocating time and resources for monitoring and closing the road.

“Bomb Cyclone”



Rainfall from Bomb Cyclone



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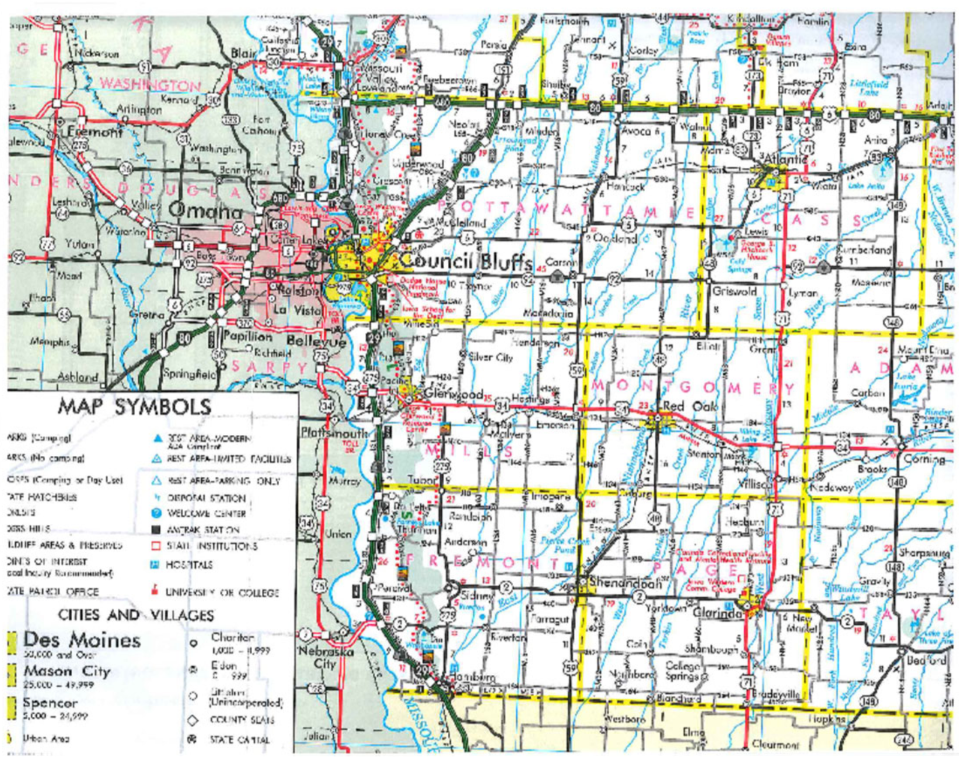
Levee Breach

Infrastructure Impacts



I-680 Damage - 2011

I-680 – Restored In-Kind – 34 Working Days

I-680 Damage – March 2019

Incorporating Resiliency - Flexamat

Sufficient Anchorage

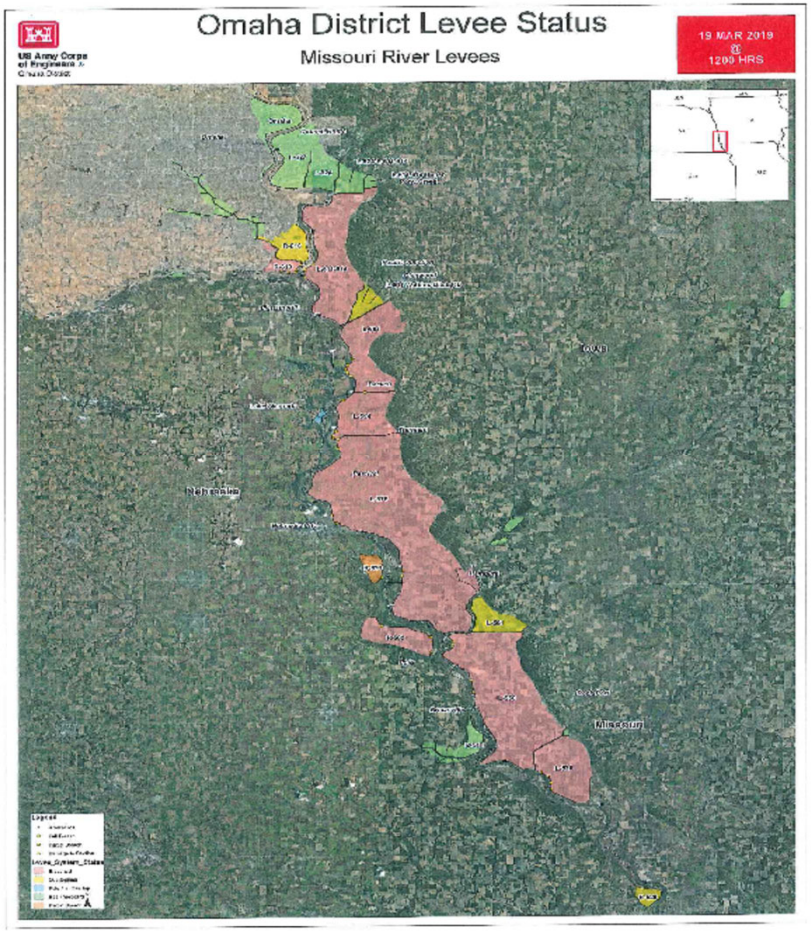
I-680 Asphalt Connection – June Event

I-680 June 2019 Flood Event

I-680 Flexamat – June Event

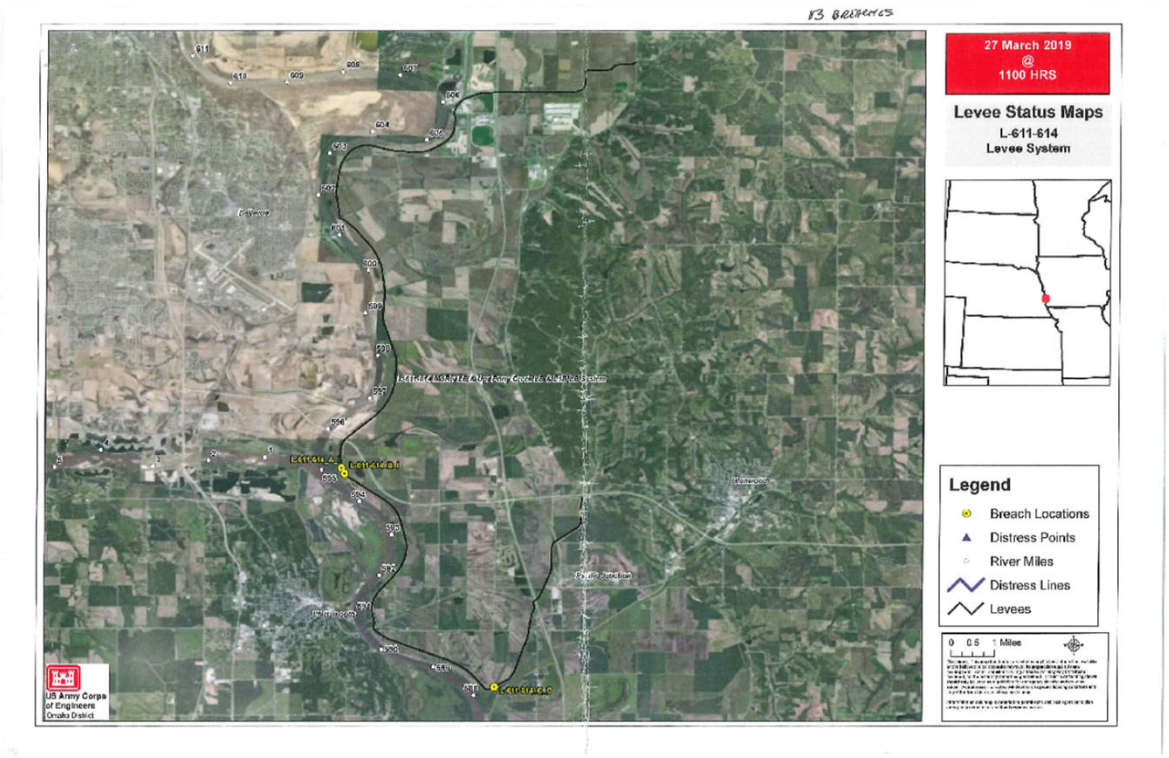
Minor Repairs – More Resilient

Corps Levee System



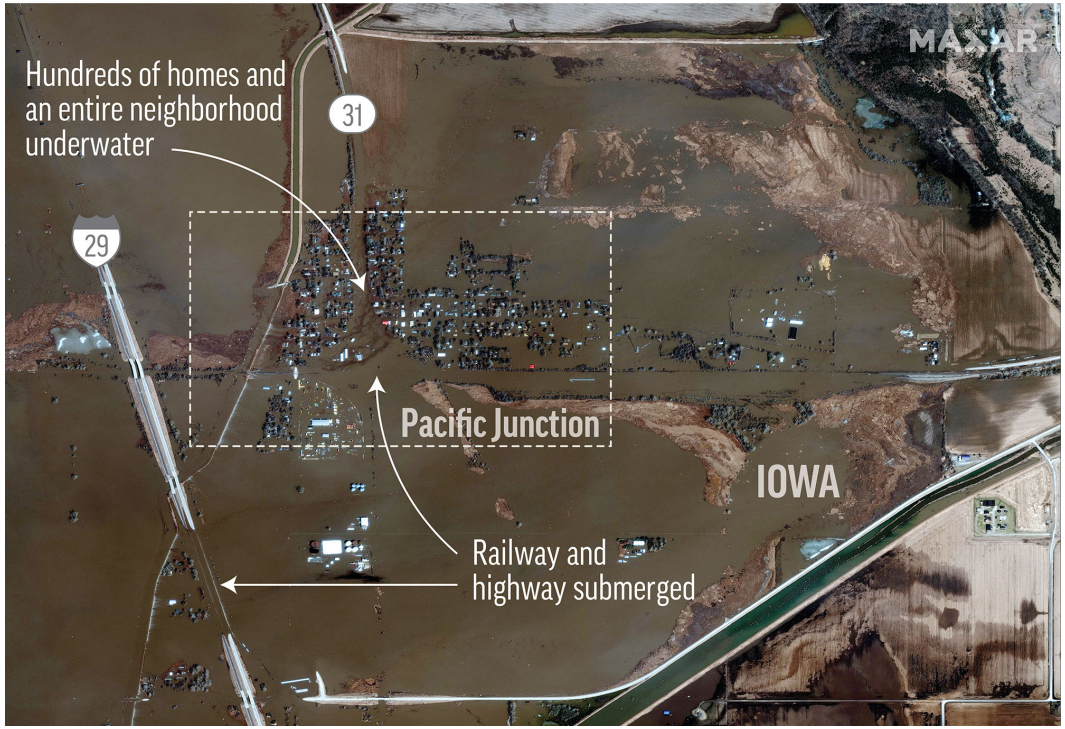
Recovery Status
May 23, 2019

L-611-614 – U.S. 34 & Pacific Junction



Pacific Junction - Before

Pacific Junction - After



U.S. 34 – March Event

U.S. 34 Damage – March 2019 Event

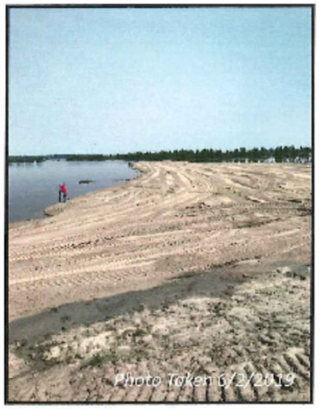
U.S. 34 – June Event – Revetment Countermeasure

North US 34 EB near St. Mary's Wildlife Mgmt Area (IWZ 3705) 2019-06-10 07:44:11

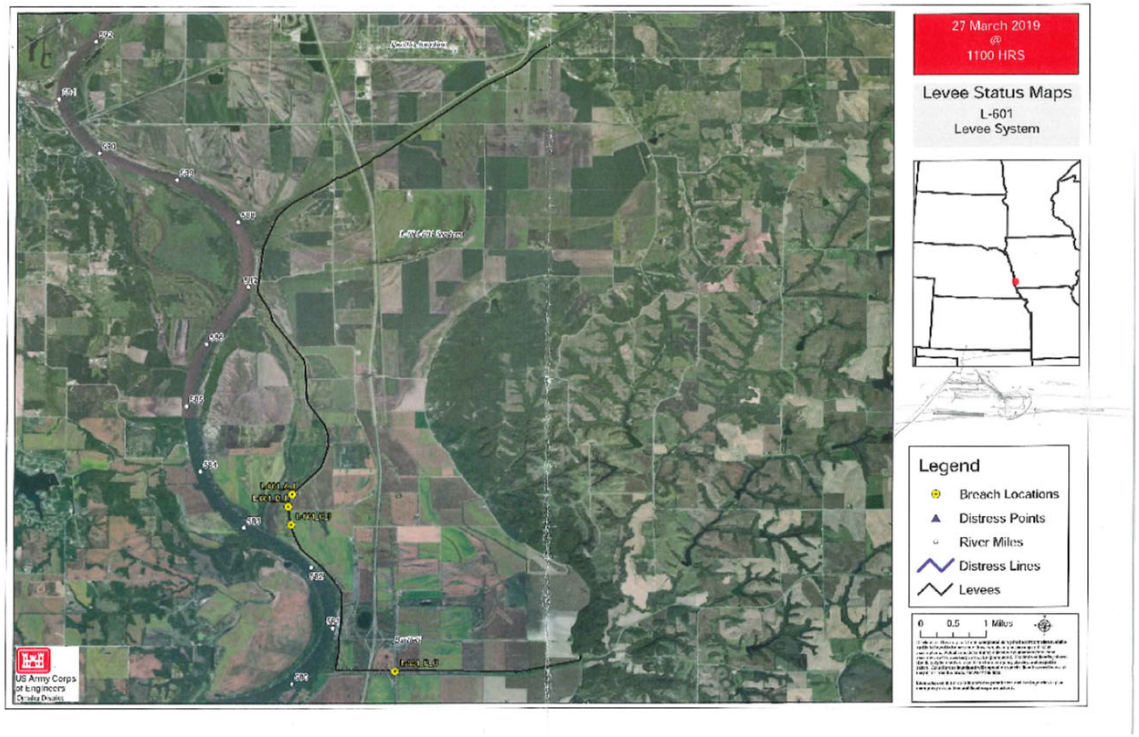
Corps Repair of L-611 – 614 Levee

L-611-614 Initial Breach Repair

- Breach Closure Target ~ 21 June 2019
- Sand placement on-going within berm alignment. Sand berm elevation changed to 965' (was 961'). ~1/3 of sand berm length now at 965'.

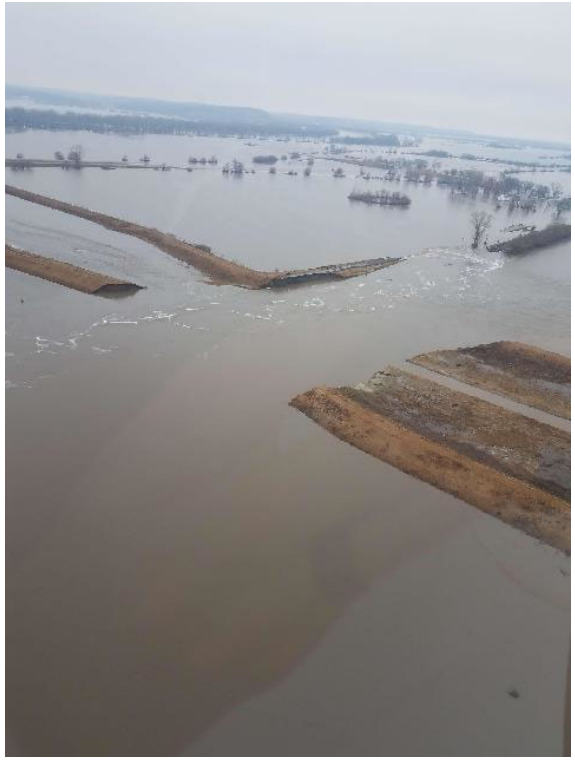


L-601 Cell - Bartlett



Wabonsie Creek - Before

Wabonsie Creek Flank Levee Breach

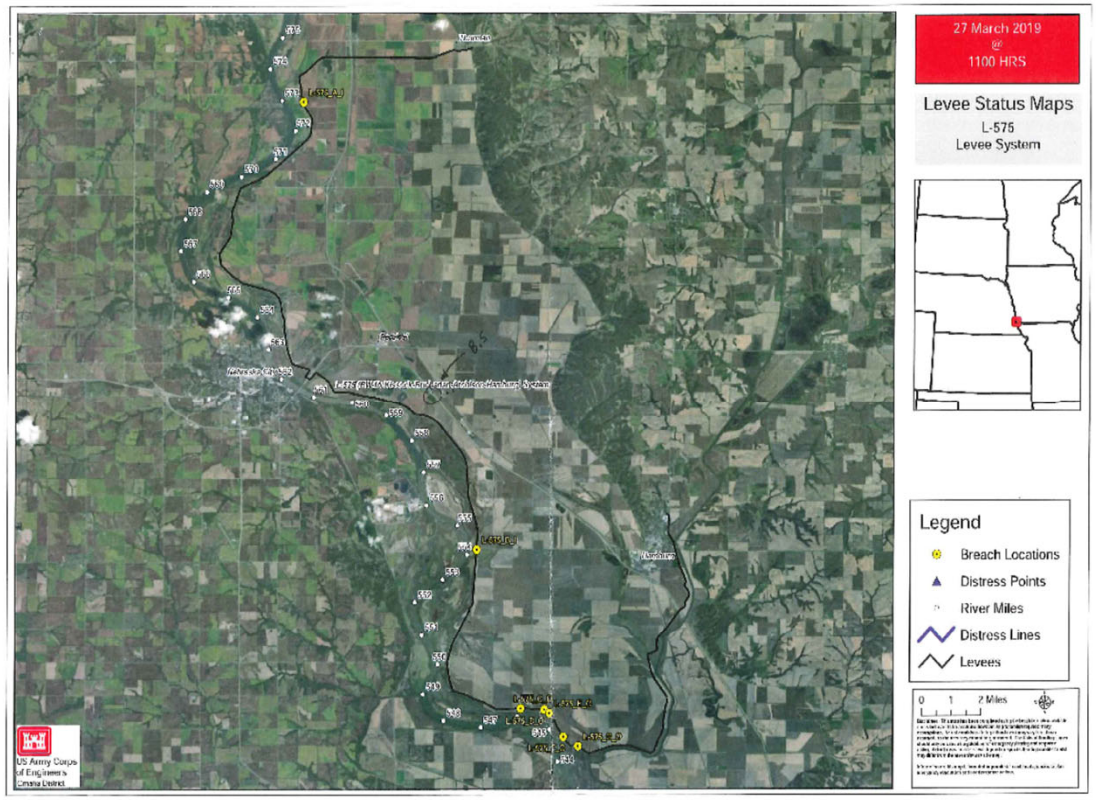


Corps Levee Repair L-601

2D Modeling for Resiliency along I-29 and Bartlett Interchange – Most Vulnerable Cell

- Modeling will Determine Level of Service
- Analyze Resiliency by Constructing Earthen Dike in Lieu of Raising I-29
- Provide Interior Drainage Design at Bartlett Interchange
- Determine Potential Use of AquaDam

L-575 Cell – IA 2 and Hamburg



Repair of L-575

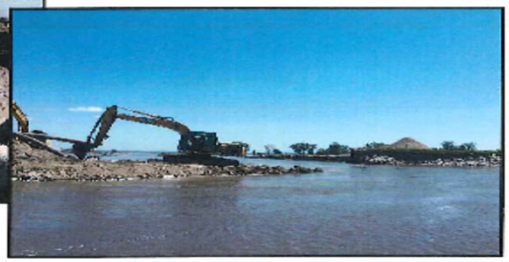
L-575 A_I Initial Repair

- Dredge Iowa re-mobilized and began pumping on 6/3
- Target breach closure is ~June 17th

L-575 Levee Repair

L-575_B Initial Breach Repair

- ❑ Target breach closure late this week
- ❑ Revetment construction is complete
- ❑ Roughly 80 LF of breach closure alignment remaining
- ❑ Contract is 80% complete



REILLY
REILLY
REILLY

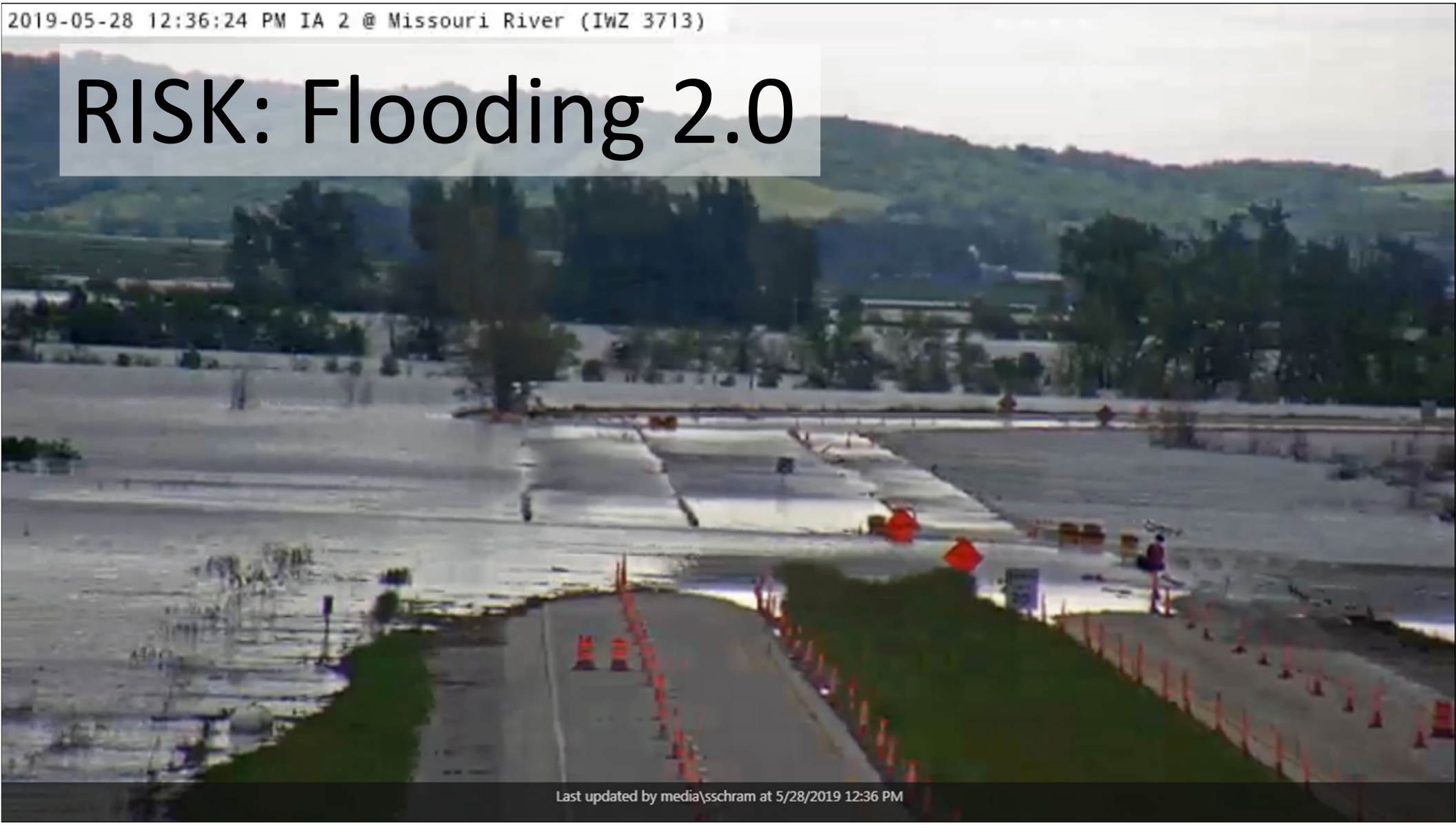
---Plow Cam--- IA 2: today at 10:25 AM CDT

Done

Temporary Mobility

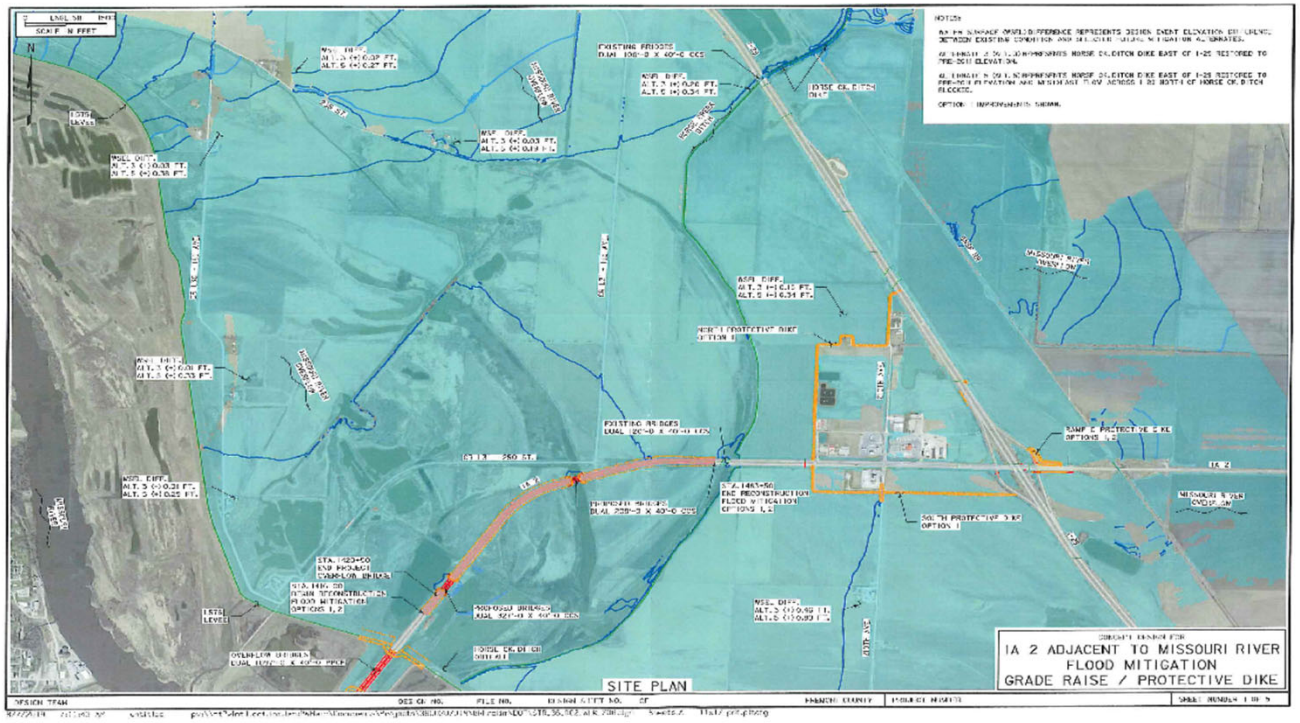
Temporary Mobility

RISK: Flooding 2.0



RISK: Additional Damages

IA 2 Grade Raise w/Overflow Bridges



Incorporating Resiliency for DOT Infrastructure

- Raise Road Grade
- Add More Conveyance under Highway
  - Bridges/Culverts
- Provide Real-Time Monitoring to Enhance Safety/Mobility
- Incorporate Cost Effective Strategies
  - Dikes
  - Paved Shoulders
  - Flexamat
- Design Anticipating Higher Design Storms/Flows

HYDRAULIC DESIGN for RESILIENCY

Continue to Design Based on the Past

or

Based on Potential Future Impacts?

Dave Claman, P.E.
Preliminary Bridge Engineer

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