HOUSTON engineering, inc.

Current Trends in Hydrometeorology and How They Apply to Water Resources Projects

5 March 2024 – NRD Water Programs Conference

Presentation Agenda

- What is Hydrometeorology?
- Uses of Hydrometerological Practices
- Advances in Hydrometeorology
- Project-specific Applications
- Future Capabilities

What is Hydrometeorology?

Hydrometeorology

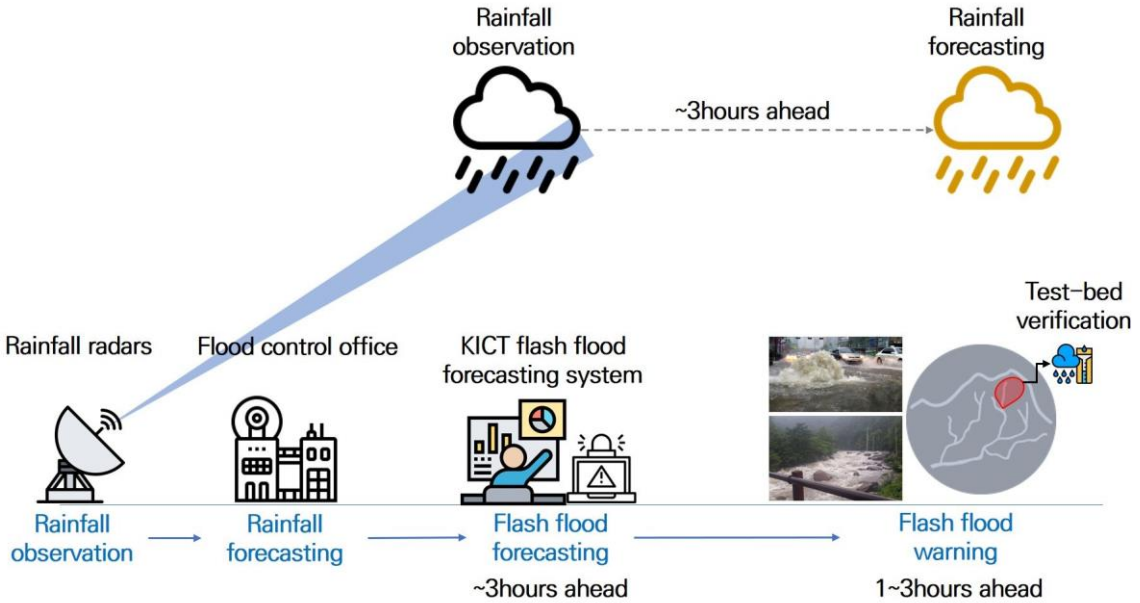
Article Talk

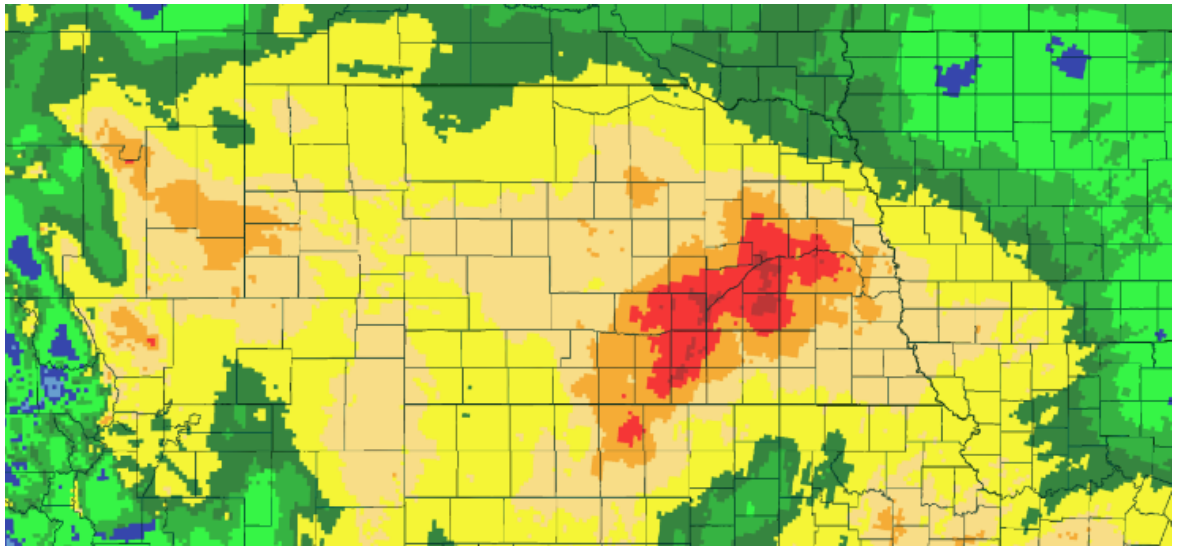
From Wikipedia, the free encyclopedia

Hydrometeorology is a branch of meteorology and hydrology that studies the transfer of water and energy between the land surface and the lower atmosphere. Hydrologists often use data provided by meteorologists.[1] As an example, a meteorologist might forecast 2–3 inches (51–76 mm) of rain in a specific area, and a hydrologist might then forecast what the specific impact of that rain would be on the local terrain.[2]

Uses of Hydrometeorological Practices

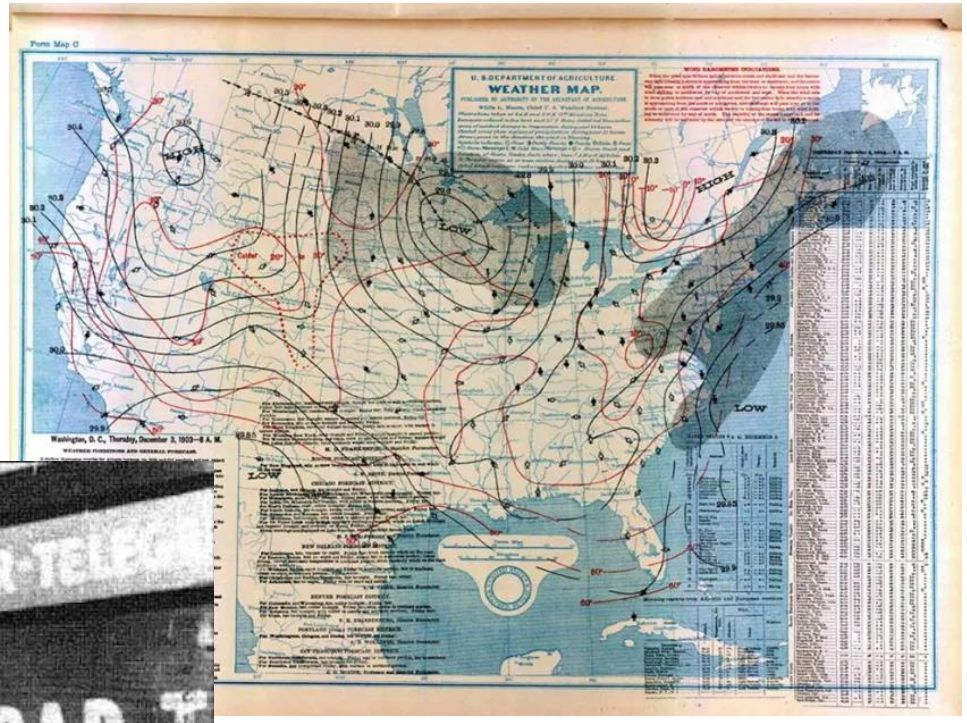
- **Forecasting**
  - Seasonal
  - Climatic
  - Real-Time
- **Risk Assessment**
  - Application of Statistics to Physical
  - Warning Systems
- **Development of Design Guidance**
  - Rainfall Depths
  - Occurrence Intervals
  - Temporal/Spatial Information

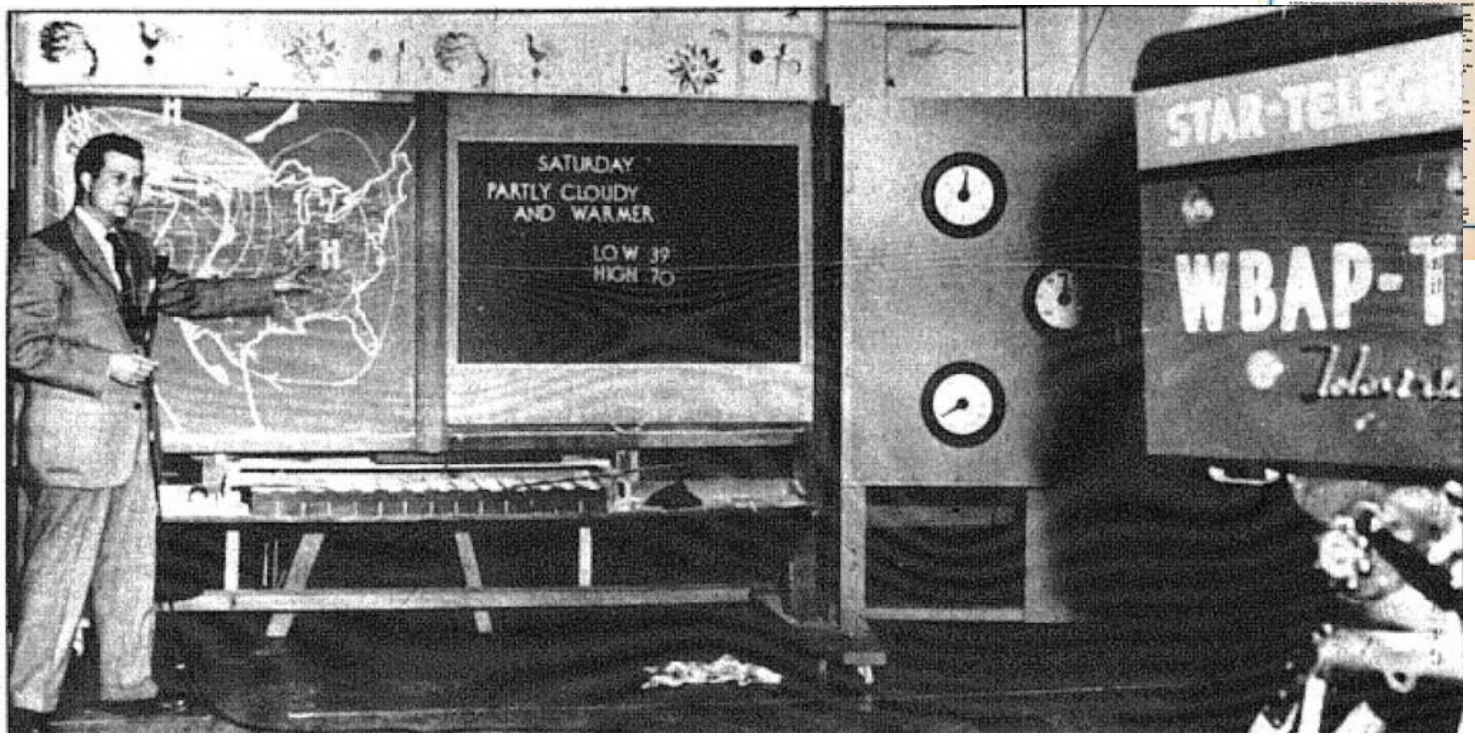




Advances in Hydrometeorology

- The Past
  - Before Radar (<1942)
  - Telephone/Telegraphs





Advances in Hydrometeorology

The First Improvements

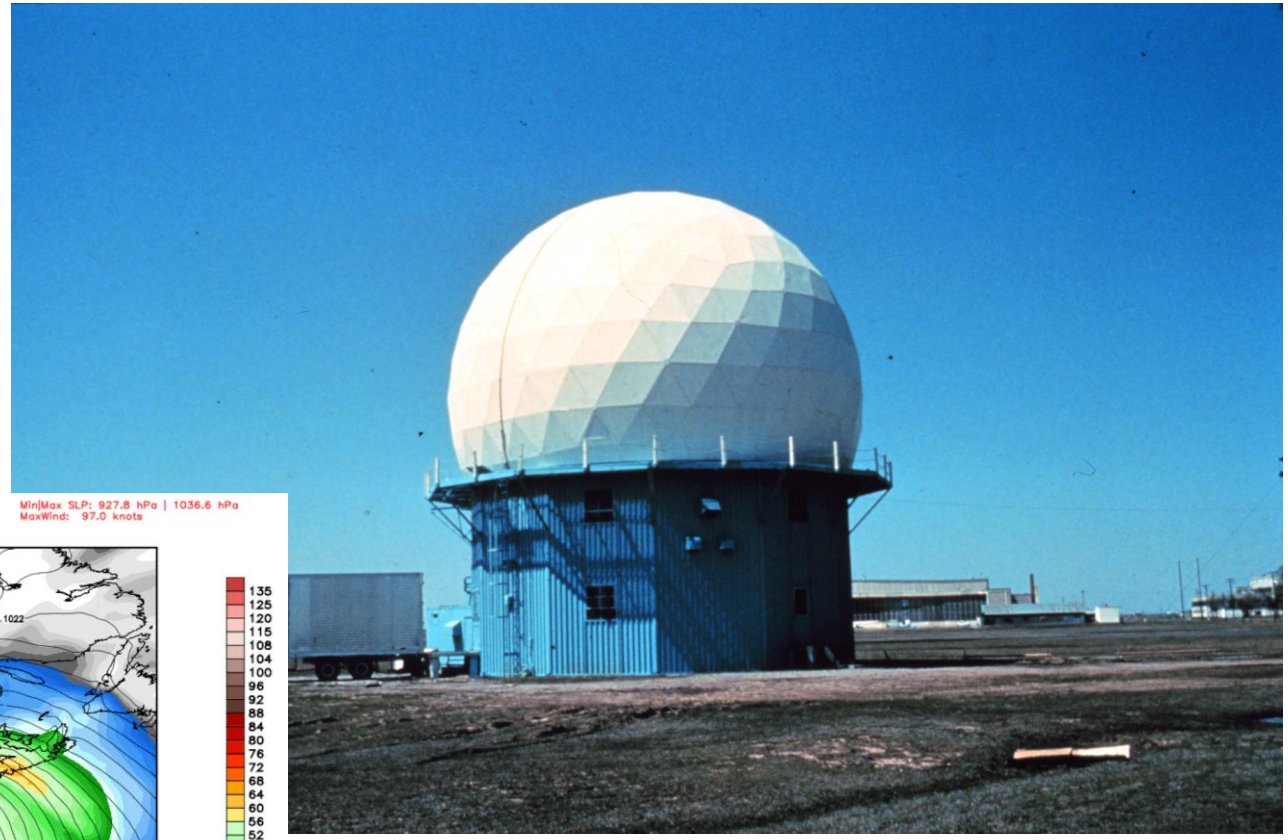
- NWS rolls out first network of warning radars in 1959
- Improvements in bands/frequencies that offered better resolution
- Time intervals reduced
- Wider array of radars

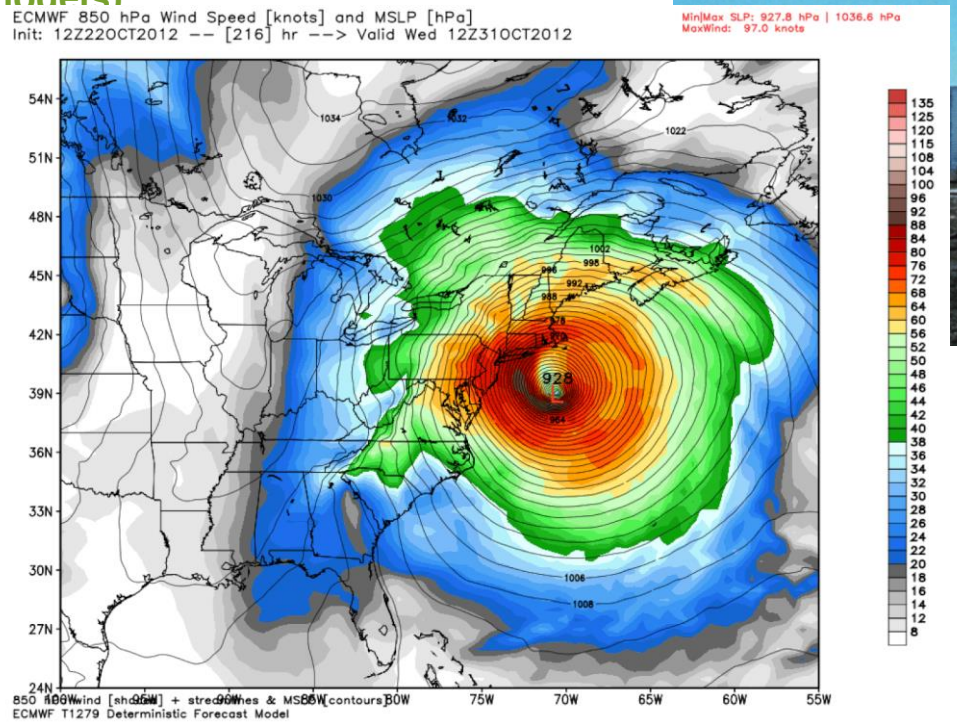
Standard Radar Frequency Letter-Band Nomenclature(IEEE Standard 521-1984)

Band Designator	Frequency (GHz)	Wavelength in Free Space (centimeters)
L band	1 to 2	30.0 to 15.0
S band	2 to 4	15 to 7.5
C band	4 to 8	7.5 to 3.8
X band	8 to 12	3.8 to 2.5
Ku band	12 to 18	2.5 to 1.7
K band	18 to 27	1.7 to 1.1
Ka band	27 to 40	1.1 to 0.75
V band	40 to 75	0.75 to 0.40
W band	75 to 110	0.40 to 0.27

Advances in Hydrometeorology

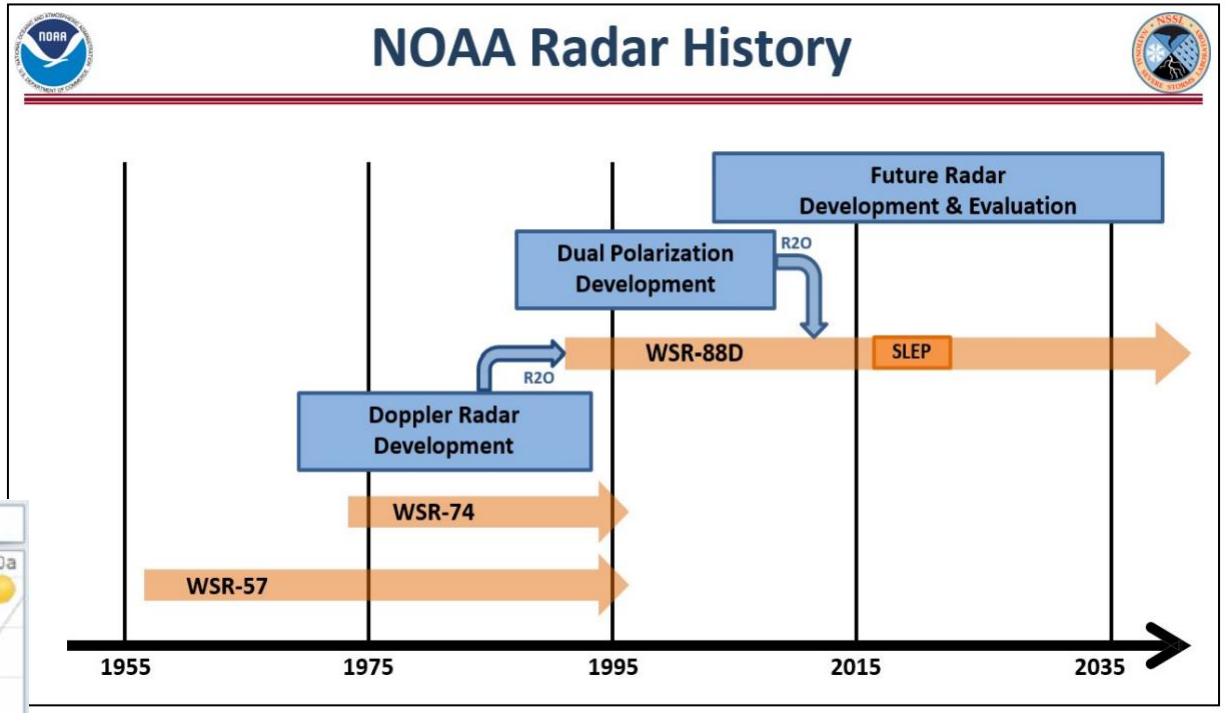
- **Current Capabilities**
  - NWS currently maintains 159 high-resolution stations across the US
  - FAA's NEXRAD
  - Improved reflectivity
  - Storm prediction (Future models)

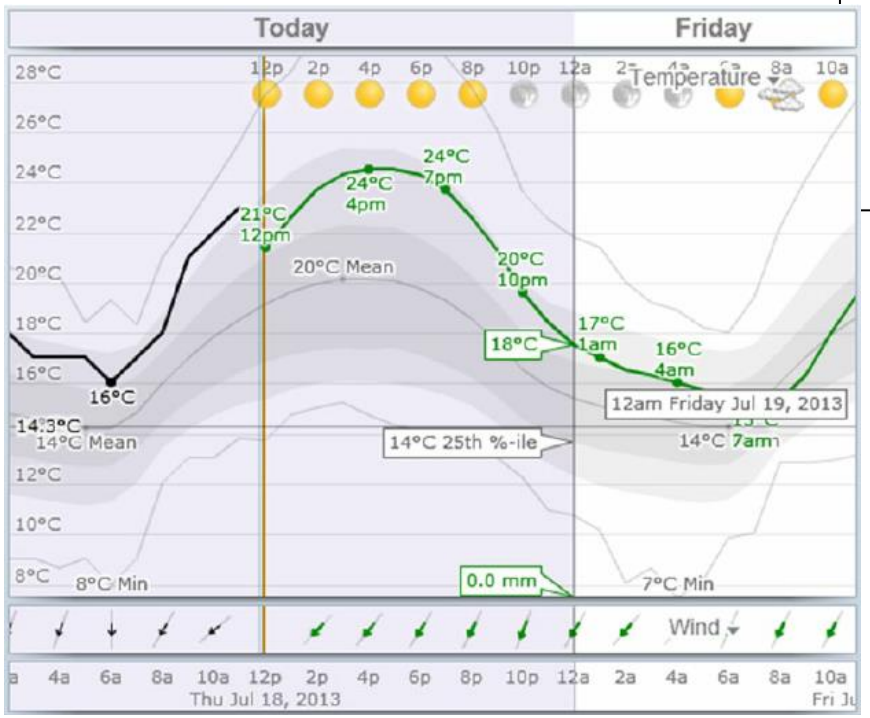




Advances in Hydrometeorology

- **What's coming?**
  - **NOAA's NSSL working on next generation of radars: Advanced Technology Demonstrator (ADT) dual-polarized, phased-array radar (PAR)**
  - **Greater accuracy and resolution**
  - **Model improvement to reduce uncertainty**





So Meteorologists Will be Less Wrong?

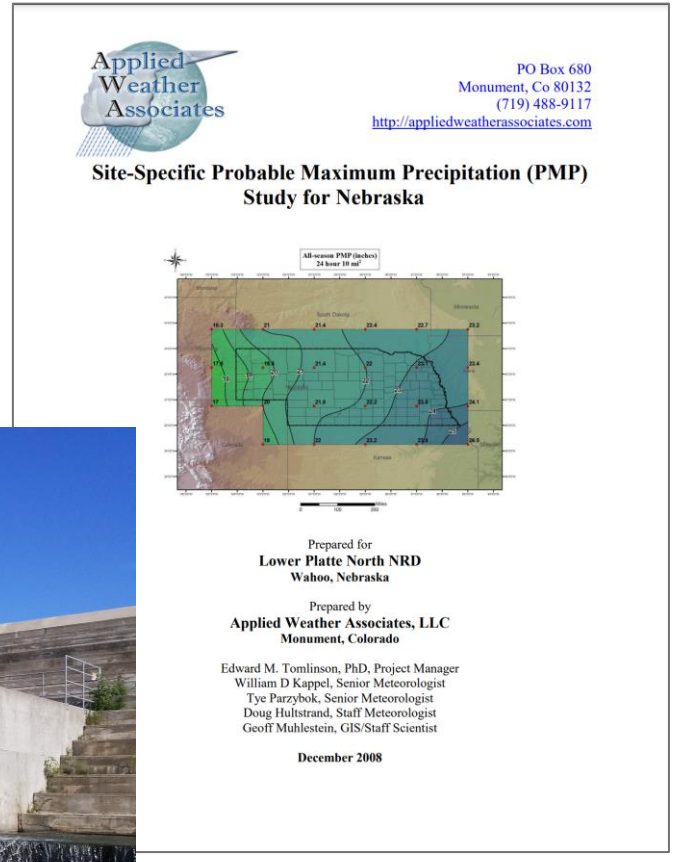
Project Specific Capabilities

Lake Wanahoo Site-Specific PMP

Reduced required 6-hr design storm from 26.2” to 22.1”

(HMR-52 Overpredicted Rainfall Amounts)

Result: Saved LPNNRD Millions



Applied Weather Associates

PO Box 680
Monument, Co 80132
(719) 488-9117
http://appliedweatherassociates.com

Site-Specific Probable Maximum Precipitation (PMP) Study for Nebraska

Prepared for
Lower Platte North NRD
Wahoo, Nebraska

Prepared by
Applied Weather Associates, LLC
Monument, Colorado

Edward M. Tomlinson, PhD, Project Manager
William D Kappel, Senior Meteorologist
Tye Parzybok, Senior Meteorologist
Doug Hultstrand, Staff Meteorologist
Geoff Muhlestein, GIS/Staff Scientist

December 2008

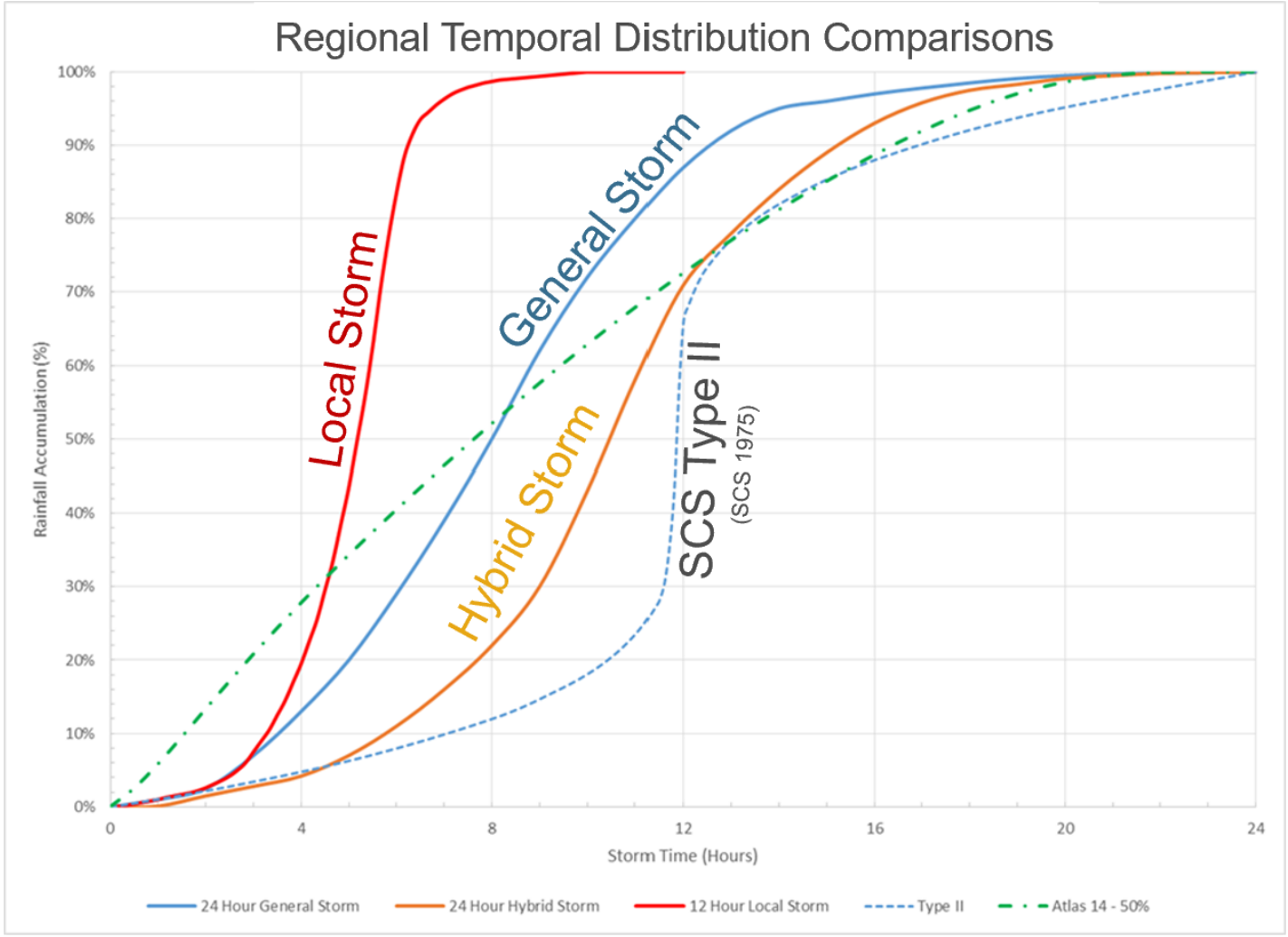
Project Specific Capabilities

Papillion Creek Hydrology Update

Re-assessed design storms and hydrologic model calibration

(Discovered SCS Type II Distribution was Physically Impossible)

Result: More accurate discharges throughout basin for dam and levee design



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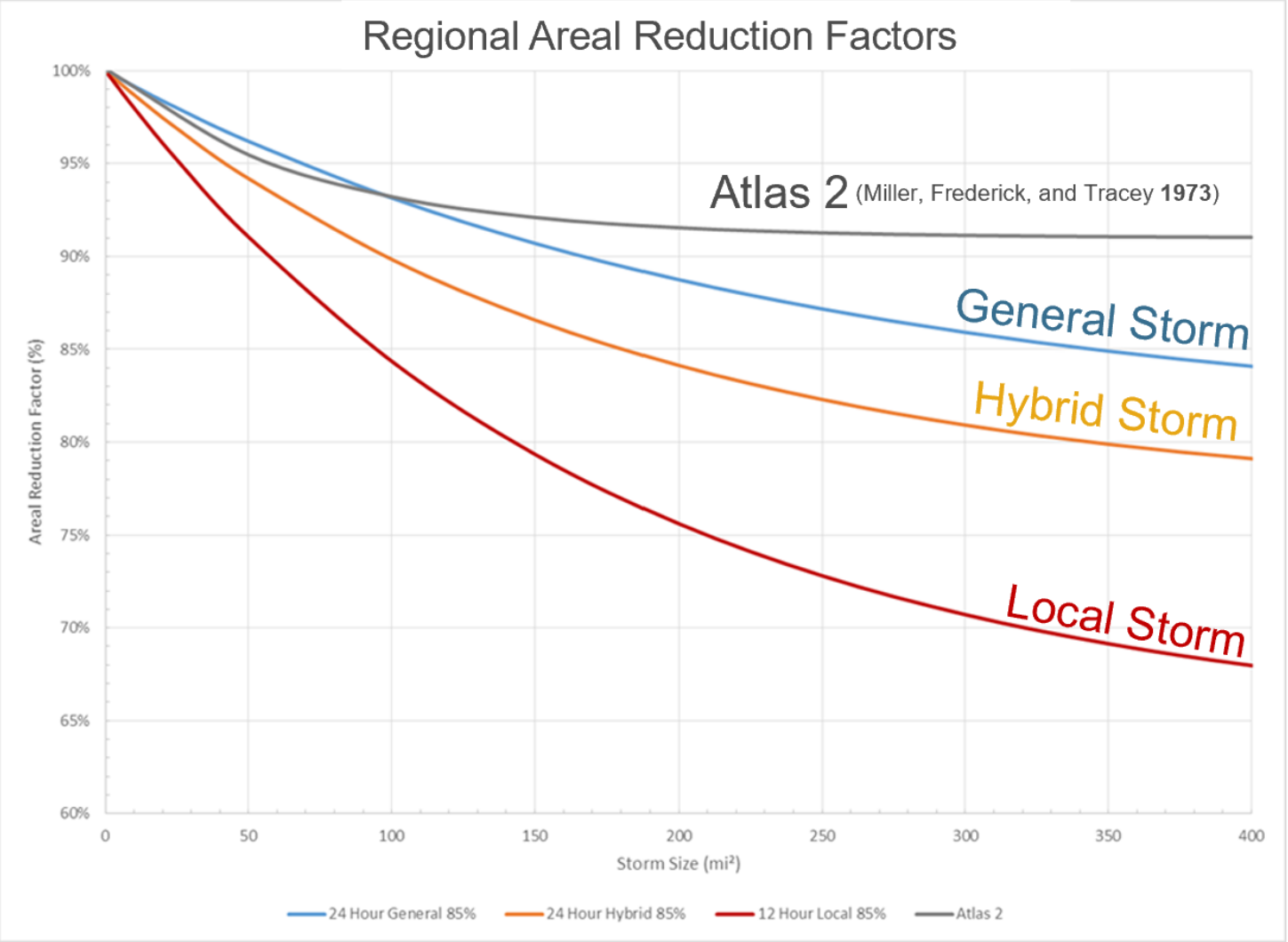

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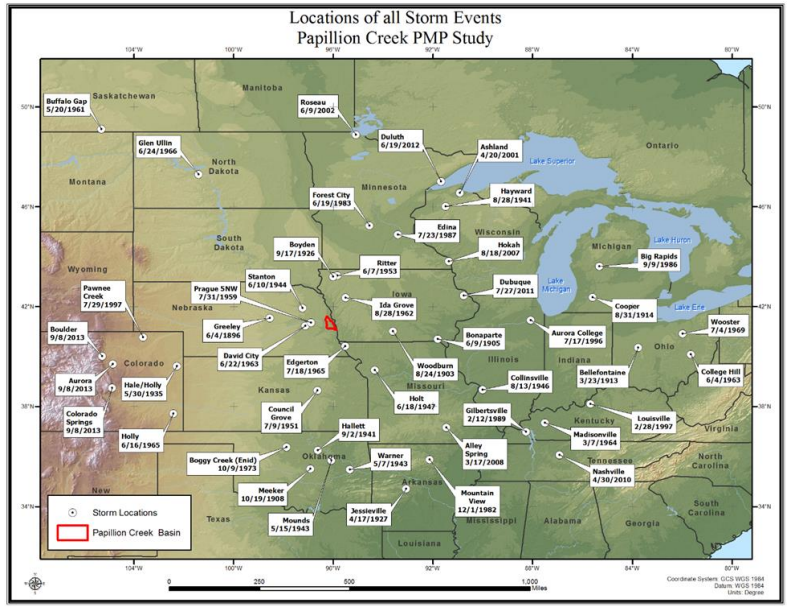

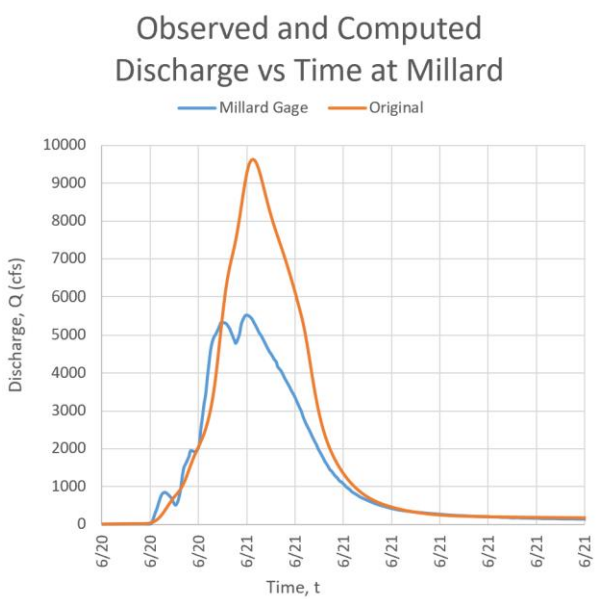

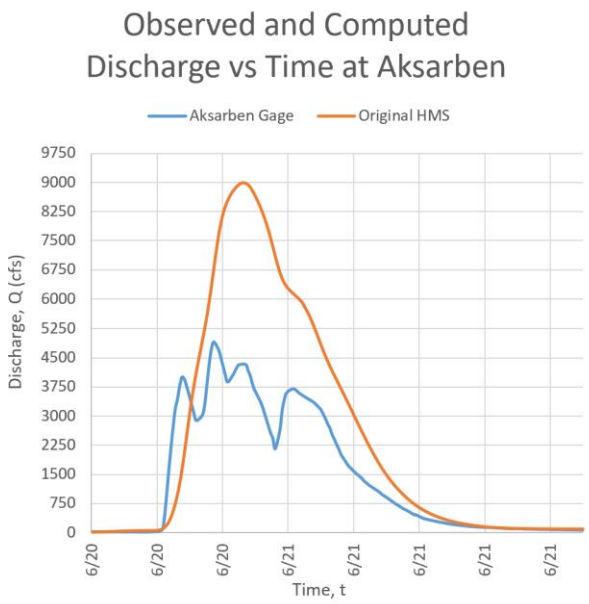

Project Specific Capabilities

LPSNRD Deadman's Run

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Validated overly conservative model changes

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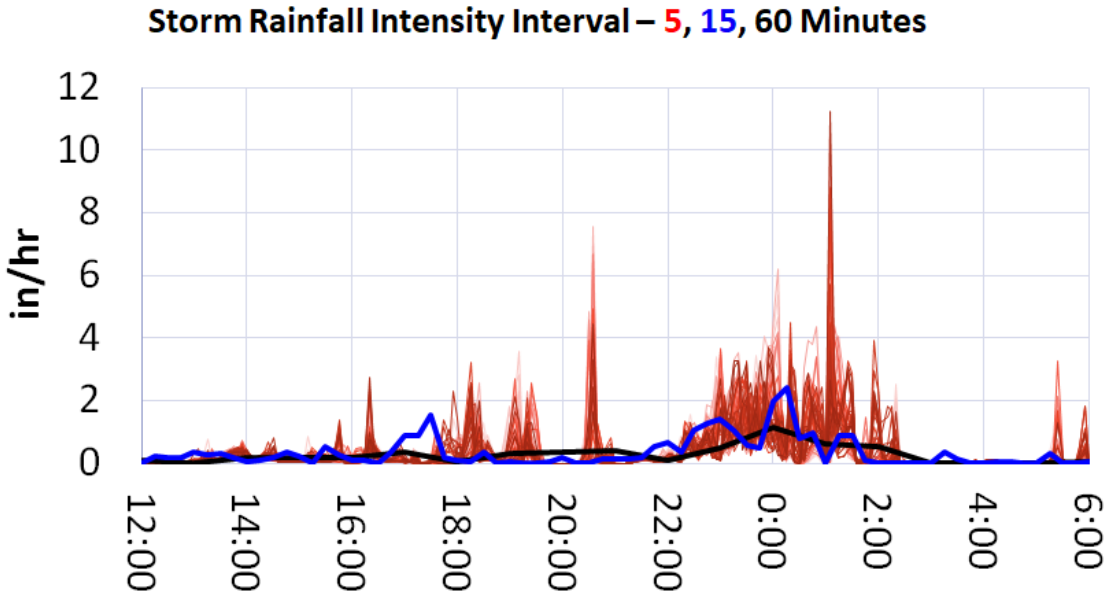
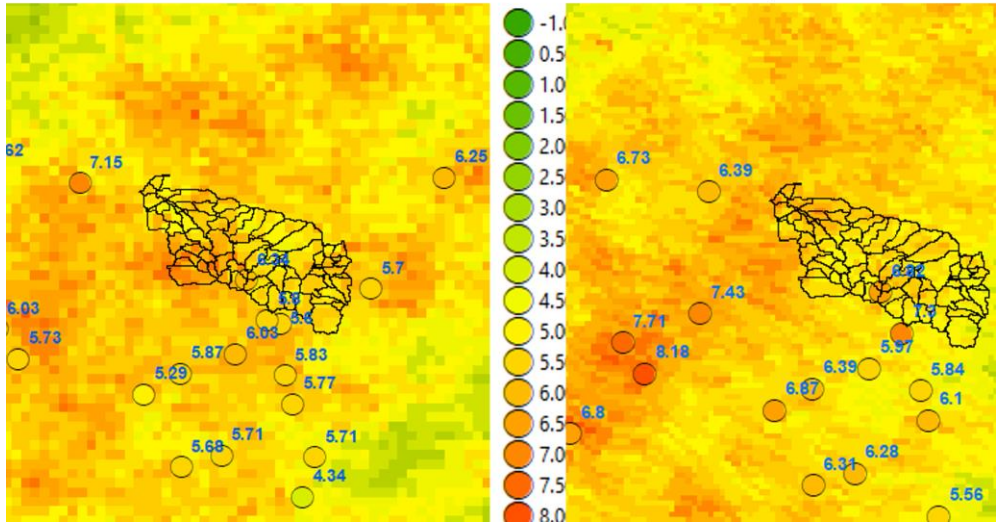


Sept 30 – Oct 1 2014

May 6 - 7 2015



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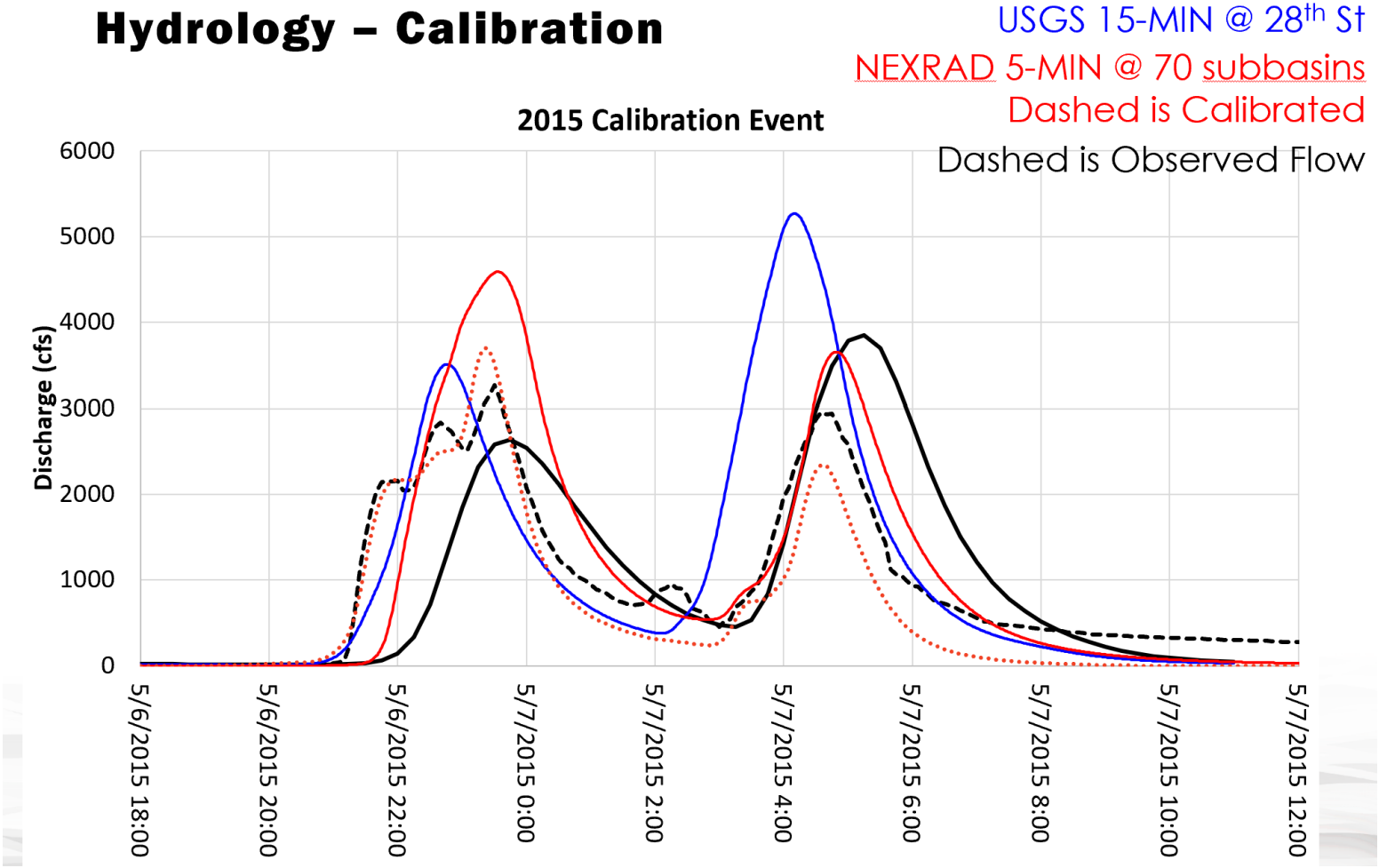


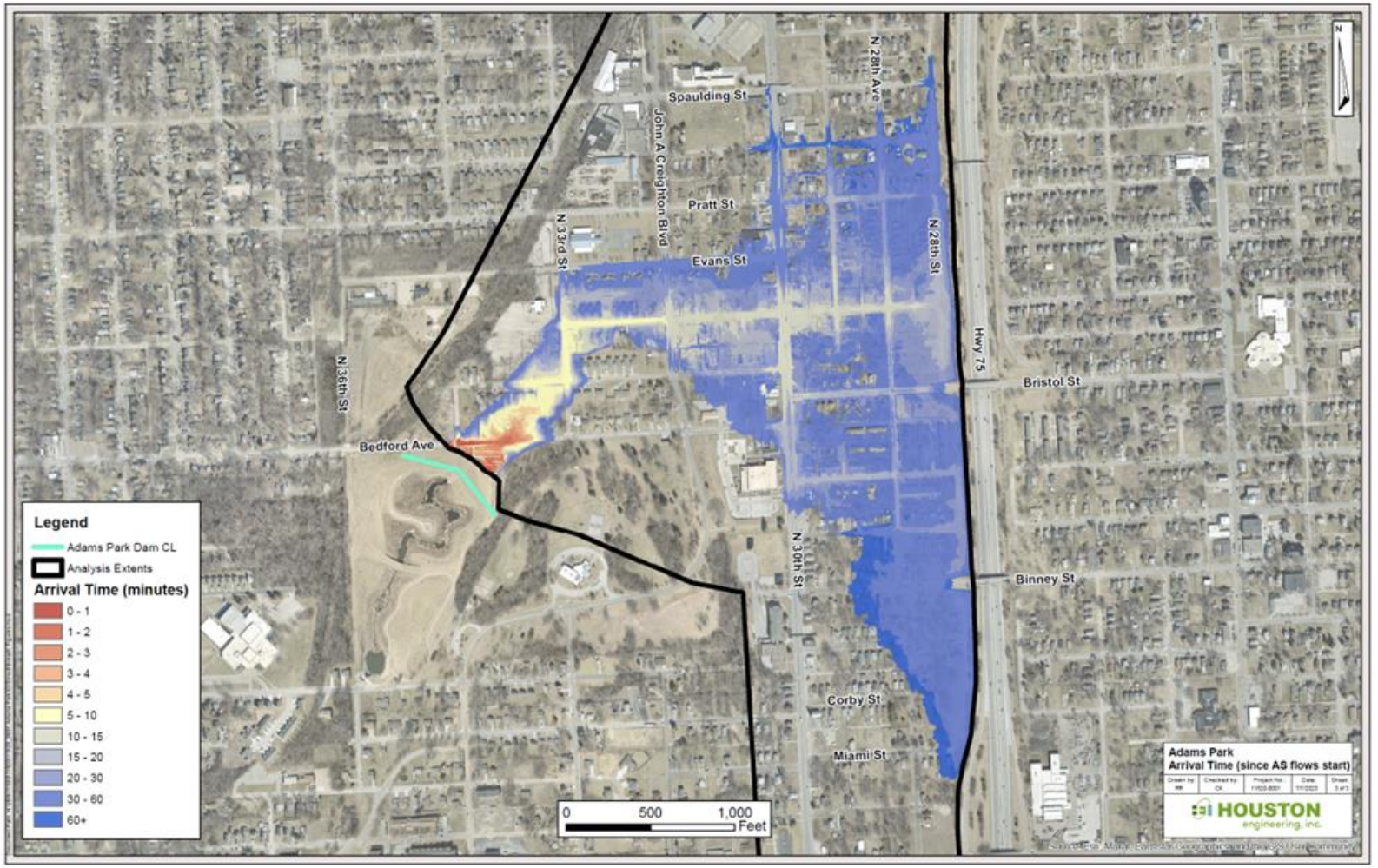
Project Specific Capabilities

City of Omaha Adams Park Dam

Predictive storm assessment for unique high hazard dam in urban Omaha.

Using combination of reservoir hydraulics and storm prediction to initiate Emergency Action Plan (EAP)

Result: Currently in design



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Short Duration Storms - Auxiliary Spillway Activation*							
		Routed WSEs (ft NAVD88)					
			SCS Type II	Frequency Storm			
		Combined Sewer Operating Condition	24 hours	24 hours	12 hours	6 hours	3 hours
Precip. Frequency	A14 Precip. Depth (in.)		Normal Operating Conditions	Normal Operating Conditions	Normal Operating Conditions	Normal Operating Conditions	Normal Operating Conditions
050-Year	6.18**	Normal	1082.40	1082.84	1082.73	1082.60	1082.25
		Blocked	1083.17	1083.41	1083.34	1083.26	1083.03
		Difference (ft)	0.77	0.57	0.61	0.66	0.78
100-Year	7.17**	Normal	1083.10	1083.38	1083.31	1083.23	1082.95
		Blocked	1083.59	1083.80	1083.74	1083.67	1083.45
		Difference (ft)	0.49	0.42	0.43	0.44	0.50
AS Crest***		1082.50					

*Assuming a diversion of up to 238 cfs through the combined sewer under normal conditions and 0 cfs under blocked
**From NOAA Atlas 14 Precipitation Frequency Data Server
***As measured from 2022 LiDAR

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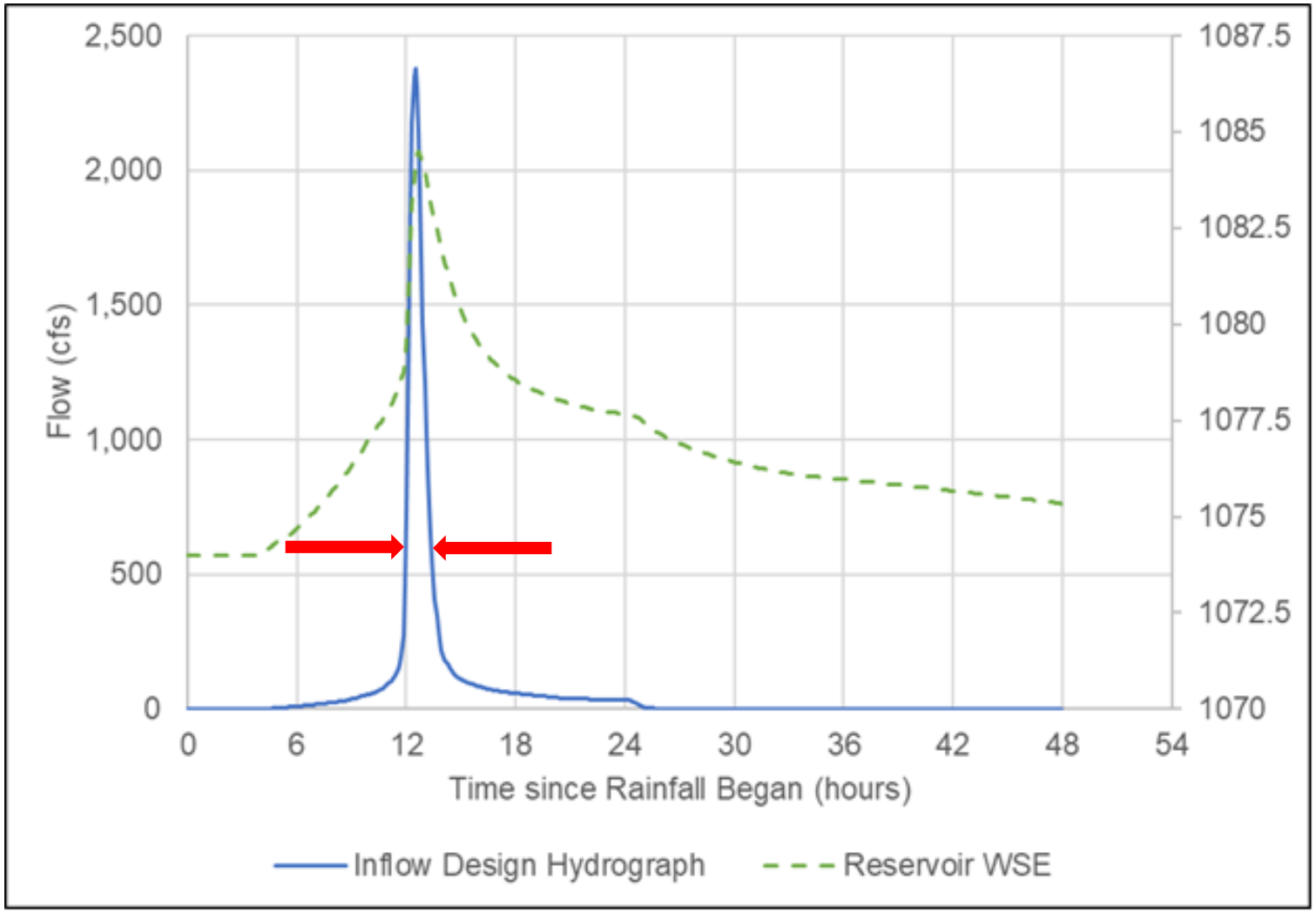

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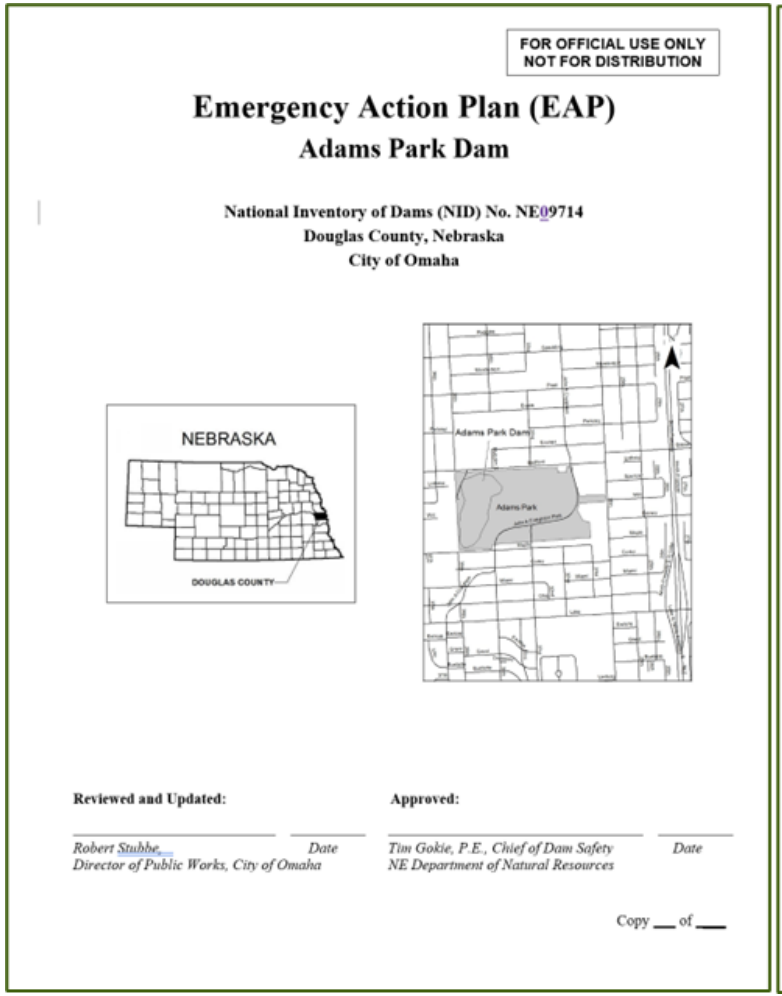

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Emergency Action Plan (EAP)
Adams Park Dam

National Inventory of Dams (NID) No. NE09714
Douglas County, Nebraska
City of Omaha

NEBRASKA
DOUGLAS COUNTY

Adams Park Dam
Adams Park

Reviewed and Updated:

Robert Stubbe
Director of Public Works, City of Omaha
Date

Approved:

Tim Gokie, P.E., Chief of Dam Safety
NE Department of Natural Resources
Date

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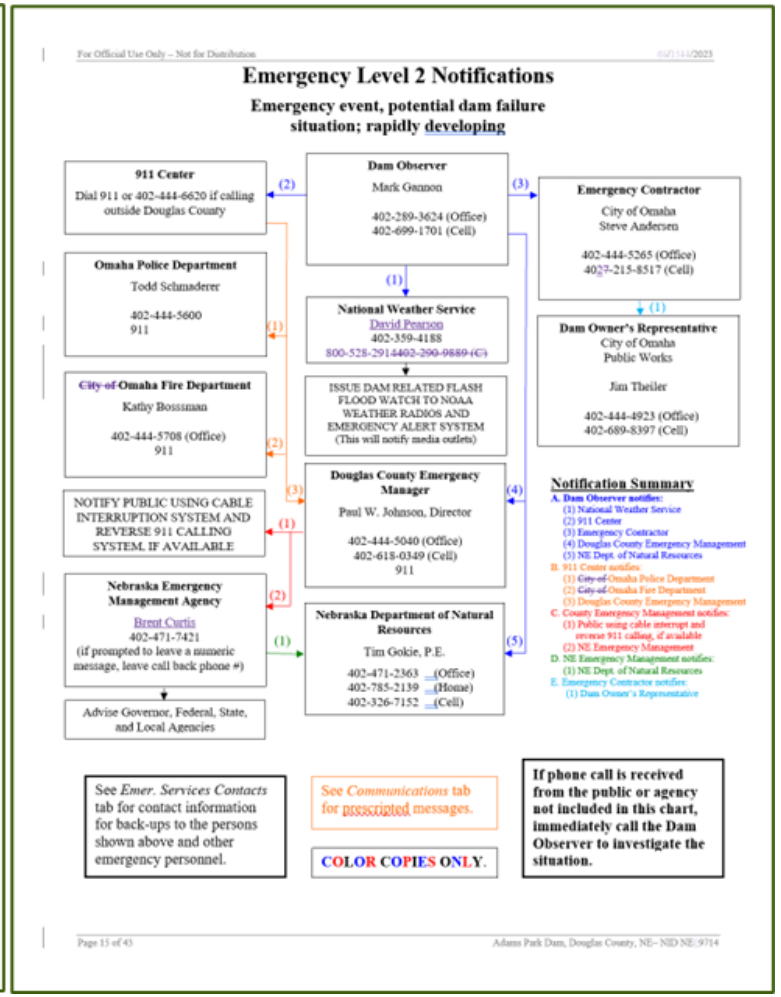

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Emergency Level 2 Notifications
Emergency event, potential dam failure situation; rapidly developing

911 Center
Dial 911 or 402-444-6620 if calling outside Douglas County

Dam Observer
Mark Gannon
402-289-3624 (Office)
402-699-1701 (Cell)

Emergency Contractor
City of Omaha
Steve Andersen
402-444-5265 (Office)
402-215-8517 (Cell)

Omaha Police Department
Todd Schmaderer
402-444-5600
911

National Weather Service
David Pearson
402-359-4188
800-528-2914402-290-9889 (C)

Dam Owner's Representative
City of Omaha
Public Works
Jim Theiler
402-444-4923 (Office)
402-689-8397 (Cell)

City of Omaha Fire Department
Kathy Bosssman
402-444-5708 (Office)
911

ISSUE DAM RELATED FLASH FLOOD WATCH TO NOAA WEATHER RADIOS AND EMERGENCY ALERT SYSTEM (This will notify media outlets)

NOTIFY PUBLIC USING CABLE INTERRUPTION SYSTEM AND REVERSE 911 CALLING SYSTEM, IF AVAILABLE

Douglas County Emergency Manager
Paul W. Johnson, Director
402-444-5040 (Office)
402-618-0349 (Cell)
911

Nebraska Emergency Management Agency
Brent Curtis
402-471-7421
(if prompted to leave a numeric message, leave call back phone #)

Nebraska Department of Natural Resources
Tim Gokie, P.E.
402-471-2363 (Office)
402-785-2139 (Home)
402-326-7152 (Cell)

Advise Governor, Federal, State, and Local Agencies

Notification Summary
A. Dam Observer notifies:
(1) National Weather Service
(2) 911 Center
(3) Emergency Contractor
(4) Douglas County Emergency Management
(5) NE Dept. of Natural Resources
B. 911 Center notifies:
(1) City of Omaha Police Department
(2) City of Omaha Fire Department
(3) Douglas County Emergency Management
C. County Emergency Management notifies:
(1) Public using cable interrupt and reverse 911 calling, if available
(2) NE Emergency Management
D. NE Emergency Management notifies:
(1) NE Dept. of Natural Resources
E. Emergency Contractor notifies:
(1) Dam Owner's Representative

See *Emer. Services Contacts* tab for contact information for back-ups to the persons shown above and other emergency personnel.

See *Communications* tab for prescripted messages.

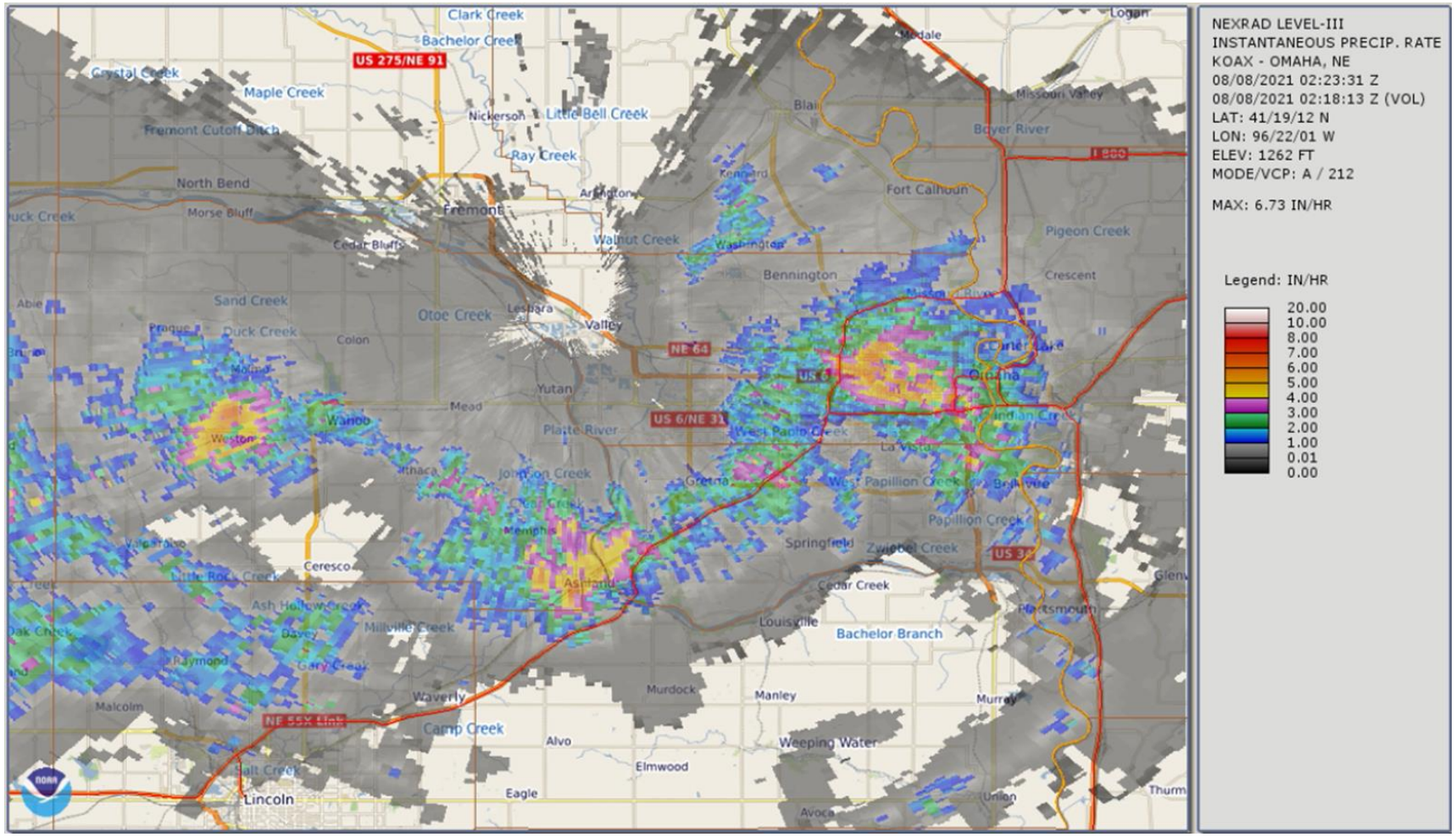
COLOR COPIES ONLY.

If phone call is received from the public or agency not included in this chart, immediately call the Dam Observer to investigate the situation.

Page 13 of 43
Adams Park Dam, Douglas County, NE– NID NE: 9714

Future Capabilities

- Improved equipment
  - Satellites
  - Radar
  - Instruments
- Predictive model accuracy
- Improved data assimilation
- AI – Hurricane forecasting



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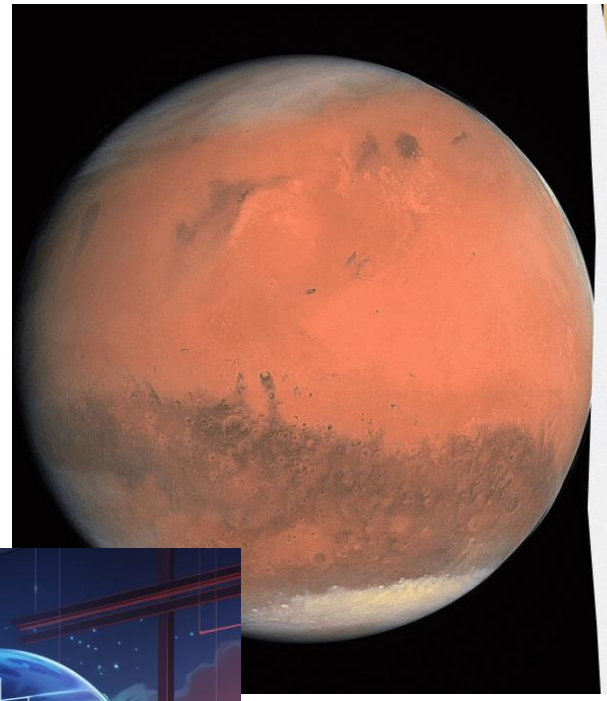

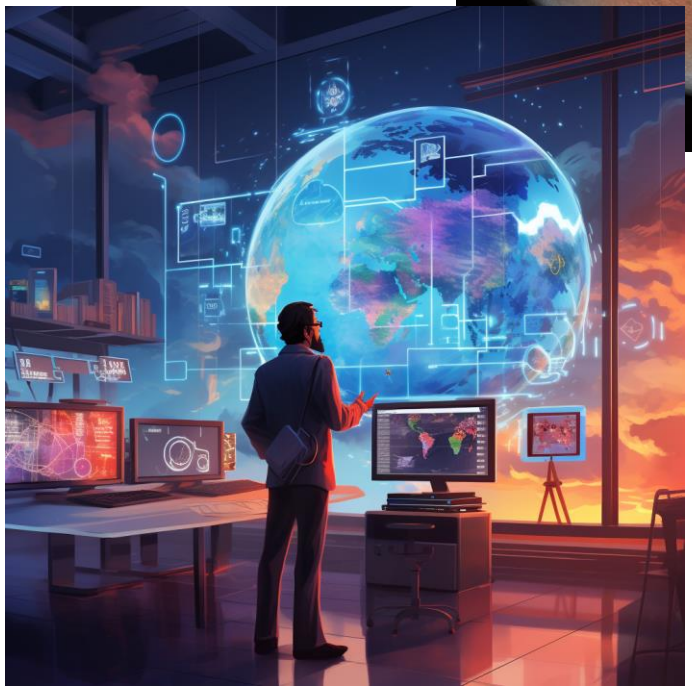

Current Untapped(?) Potential

- Precip-based irrigation planning
  - Pivots/Canals
  - Reservoir releases
- More efficient nutrient management
- Crop rotation planning
- Reservoir storage management
- Longer-term climatic prediction improvement