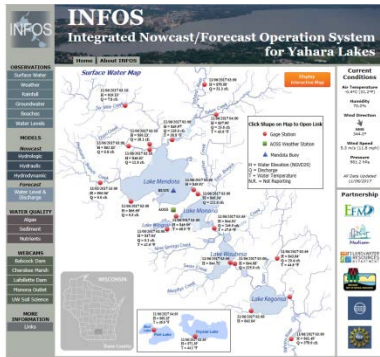


Science Driven Lake Level Management for the Yahara River Chain of Lakes

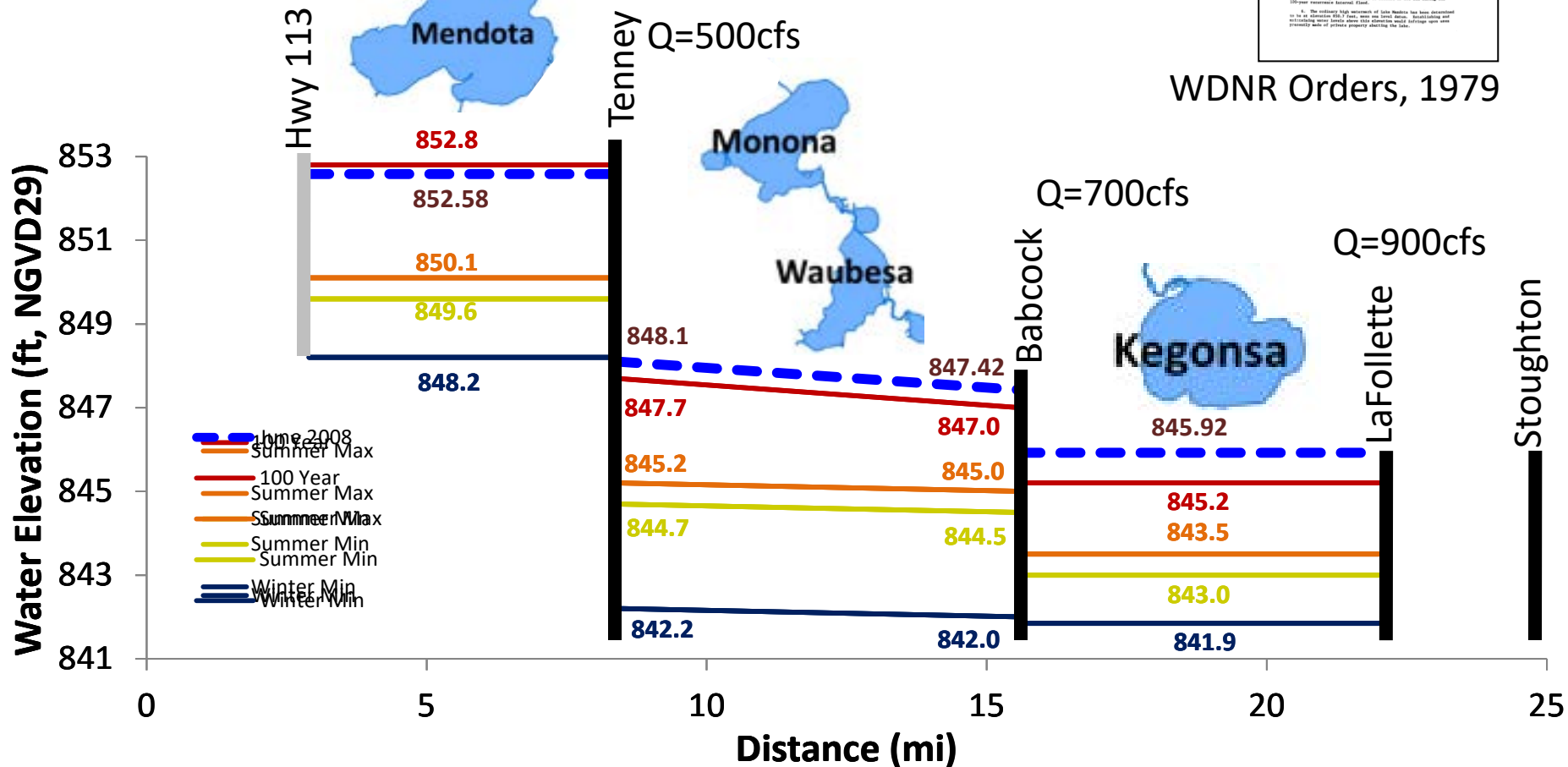
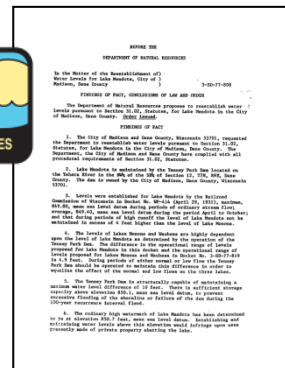
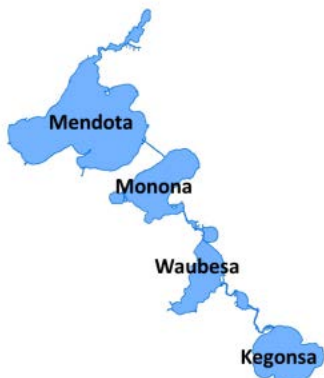


**Lakes & Watershed Commission
Environment, Agriculture & Natural Resources Committee
June 14, 2018**

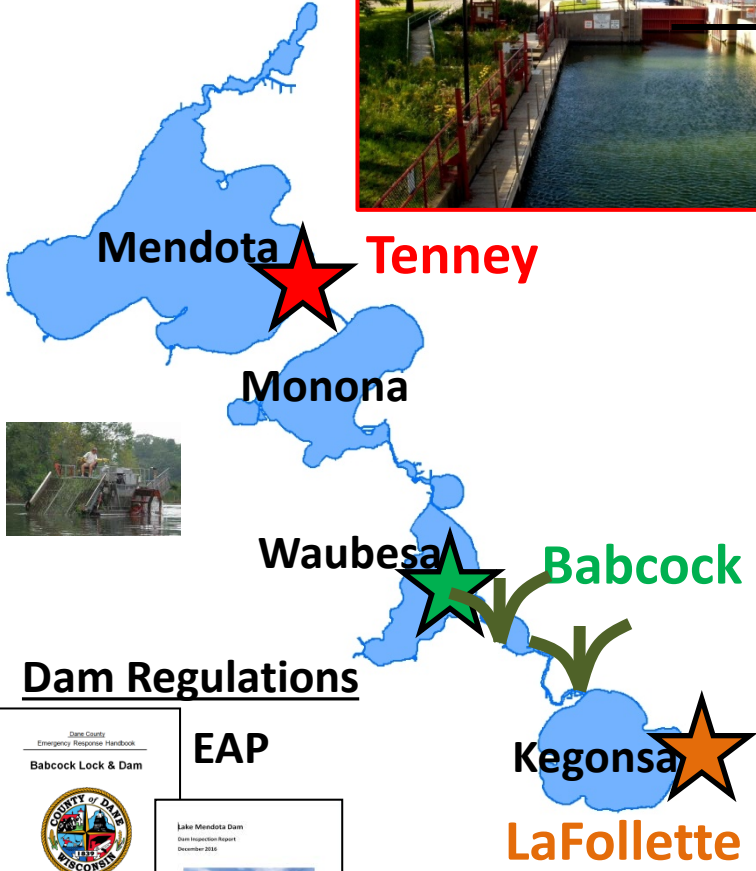
**John Reimer
Dane County Land & Water Resources**



Lake Level Orders



Lake Level Management



2017 Upgrades



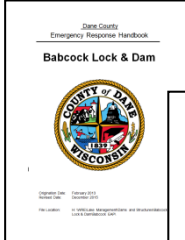
Automation



2013 Rehabilitation



Dam Regulations



EAP



IOM

Integrated Nowcast/Forecast Operation System for Yahara Waters

Observations

→ Integration

← Models



USGS Gauges
 Wireless Buoys
 AOSS
 INFOS Gauges
 Web Cam



INFOS

Integrated Nowcast/Forecast Operation System for Yahara Lakes

Home About INFOS
Display Interactive Map

OBSERVATIONS

- Surface Water
- Weather
- Rainfall
- Groundwater
- Beaches
- Water Levels

MODELS

- Nowcast
- Hydrologic
- Hydraulic
- Hydrodynamic
- Forecast
- Water Level & Discharge

WATER QUALITY

- Algae
- Sediment
- Nutrients

WEBCAMS

- Babcock Dam
- Cherokee Marsh
- Lafollette Dam
- Monona Outlet
- UW Soil Science

MORE INFORMATION

- Links

Surface Water Map

Click Shape on Map to Open Link

- Gauge Station
- AOSS Weather Station
- ▲ Mendota Buoy

H = Water Elevation (NGVD29)
 Q = Discharge
 T = Water Temperature
 N.R. = Not Reporting

Current Conditions

Air Temperature
6.4°C (43.5°F)

Humidity
55.0%

Wind Direction
W

Wind Speed
2.3 m/s (5.2 mph)

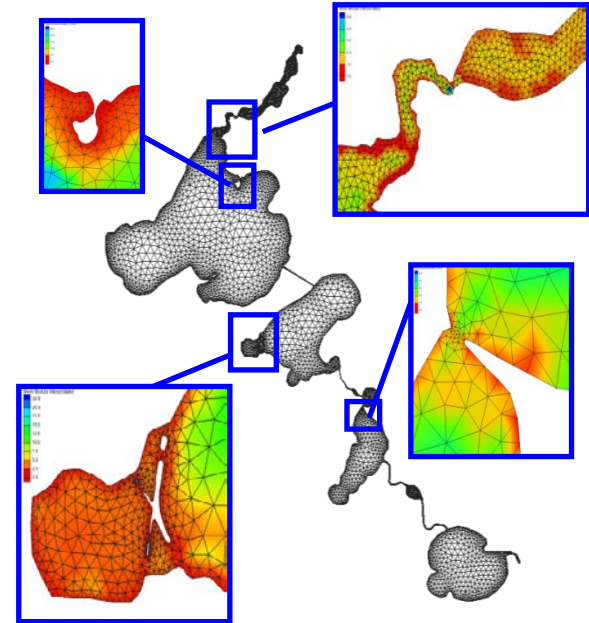
Pressure
968.3 hPa

All Data Updated
10/25/2017

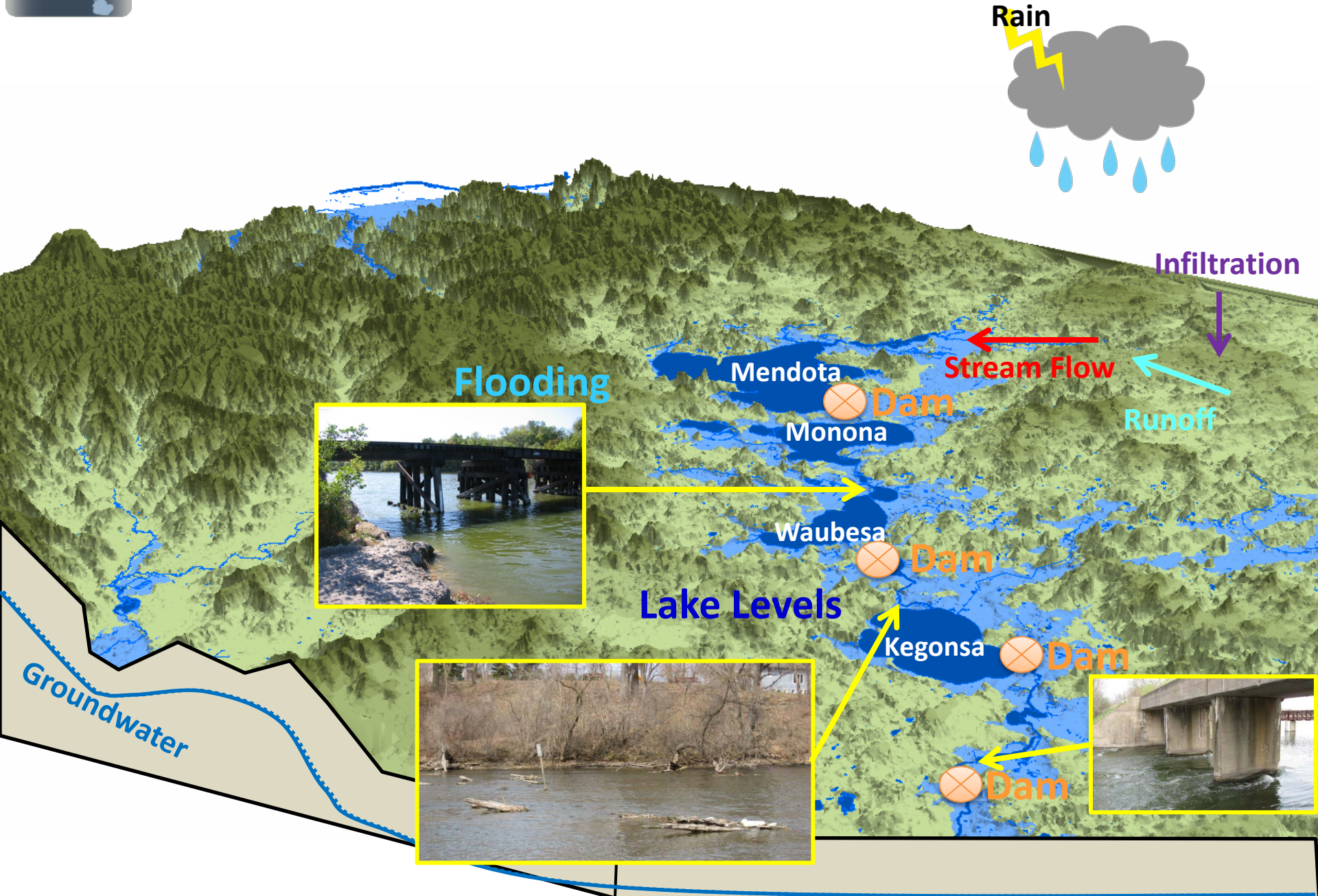
Partnership

www.infosyahara.org

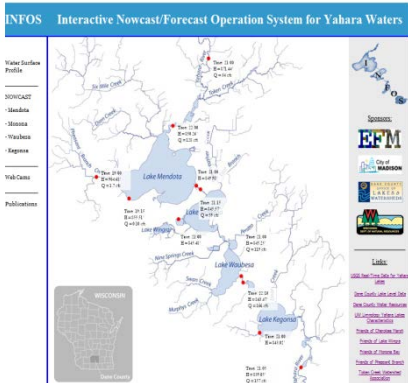
Hydrology (Runoff)
 Hydraulics (River/Lake)



Integrated Observations & Models



INFOS History



2009

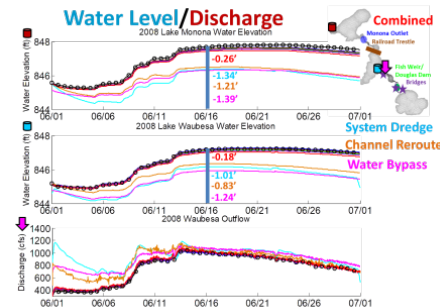


2010



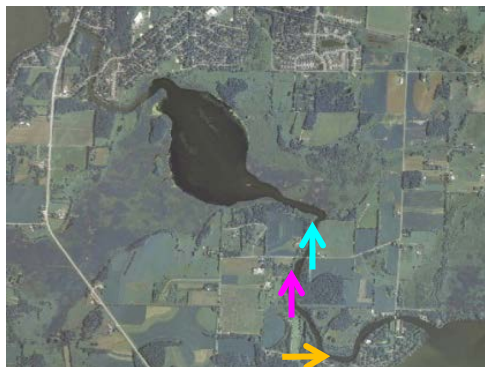
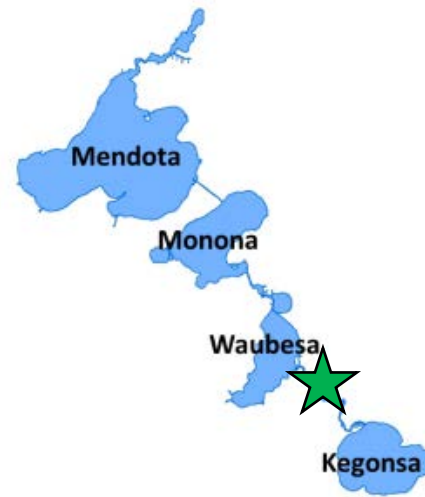
2012

YLAG2 – Water Levels



Scenario:

(i) Aquatic Plant Harvesting



2.5 times



Herling

	Discharge - No Vegetation	Discharge - Vegetation
Summer Minimum	350.2 cfs	144.8 cfs

New Developments

Integrated **N**owcast/**F**orecast **O**peration **S**ystem

for the Yahara River Chain of Lakes

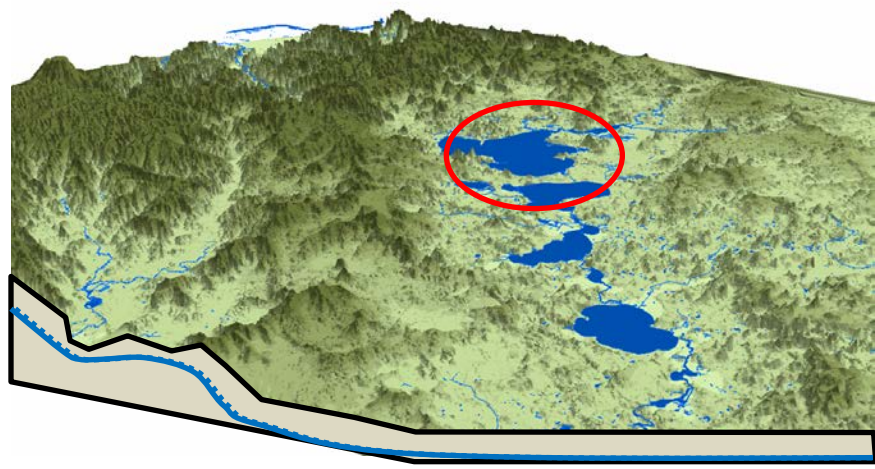


Flood Risk & Forecasting





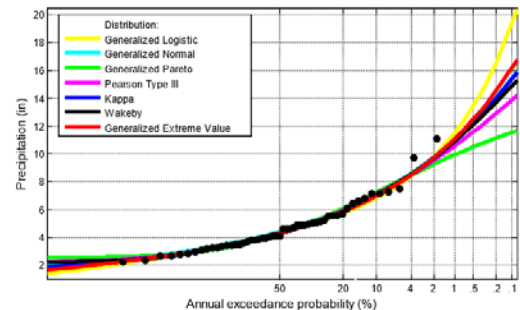
The 100 Year Flood



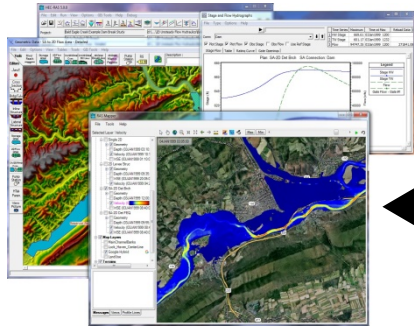
How was it determined for the Yahara Lakes?



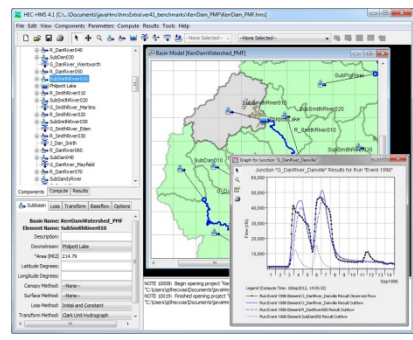
Rainfall



Statistical Rainfall



Hydraulic Modeling



Watershed Modeling

Myth:

A flood occurrence that happens once every 100 years!

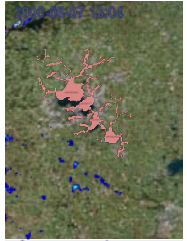
Fact:

A flood occurrence that has a 1% chance of occurring



Concept of Flood Risk

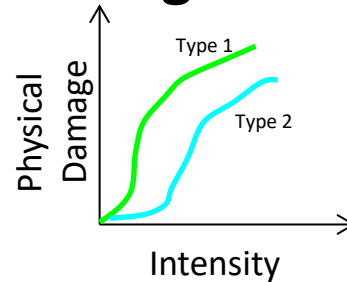
**Hazard
(Rainfall)**



**Vulnerability
(building)**

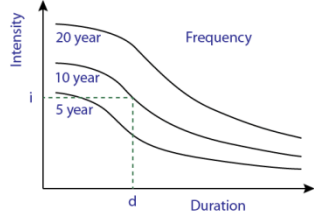


Damage Curve



= Risk

RP	A # B	V*A Eco	V*A #B (10 ⁷)
5	368	32	1.93
10	490	69	3.44
25	699	194	10.00
50	856	375	19.91
100	1588	1096	51.07



Probability



Loss

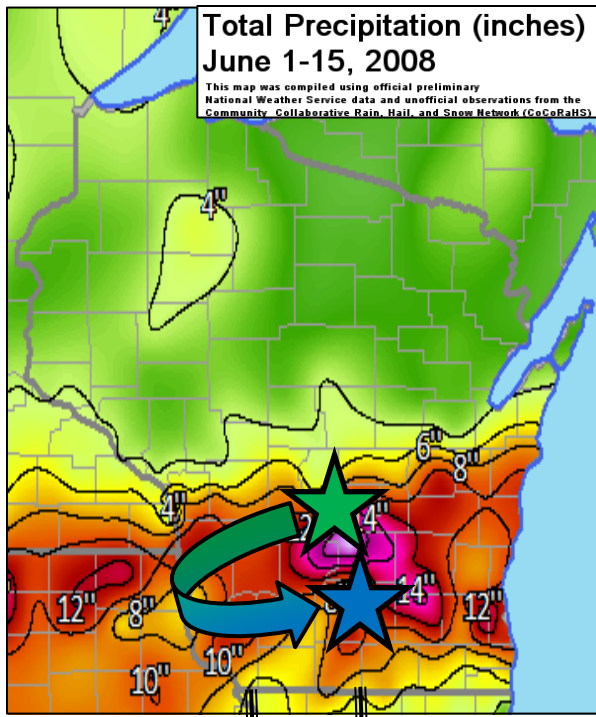


Year	Event	Property Damage (\$ Millions)	Loss of Life (\$ Millions)	Total (\$ Millions)
June 1952	Flood	0.0	0.0	0.0
May 1956	Severe Storm	\$1.1	\$0.19	\$1.3
June 2002	Flood	\$0.1	\$0.2	\$0.3
Summer 2002	Drought	0.0	\$4.4	\$4.4
June 2004	Tornado	\$1.5	0.0	\$1.5
August 2005	Tornado	\$14.3	\$ 7.1	\$21.4
May 2009	Hail	\$0.0	0.0	\$0.0
July 2009	Flood	\$10.0	0.0	\$10.0
August 2007	Flood	\$0.0	\$11.0	\$11.0
June 2009	Severe Storm and Flooding	\$13.0	\$4.4	\$17.4
Total		\$29.9	\$24.7	\$54.6



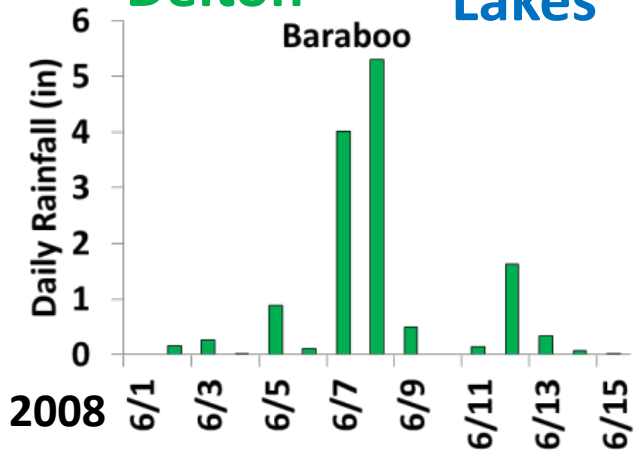
= Probability of Loss





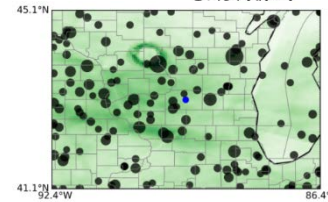
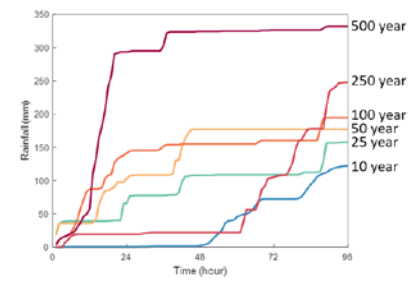
Storm Transposition

Deterministic
 Lake Delton → Baraboo → Yahara Lakes



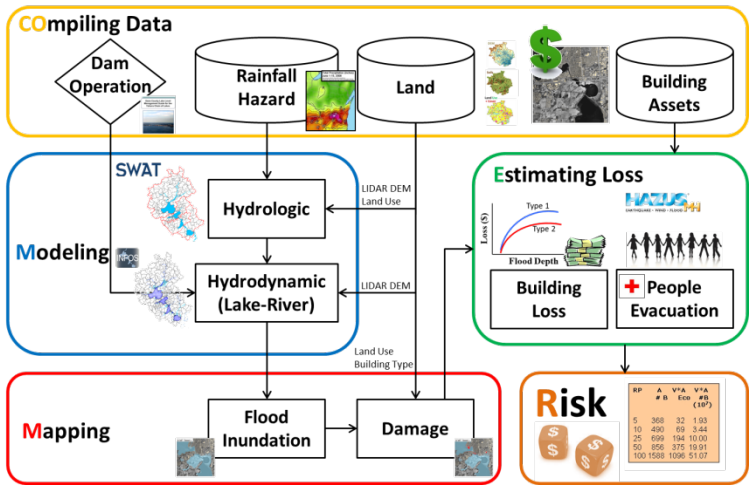
Hayden et al., 2016

Stochastic

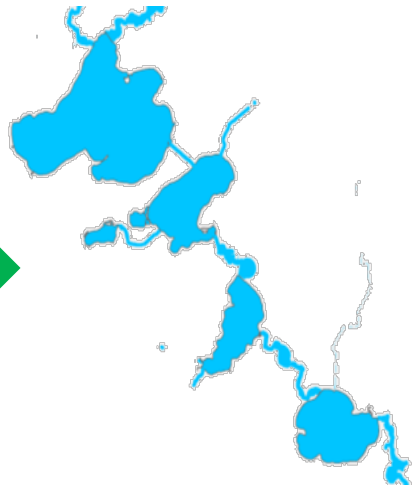


Wright et al., 2017

COMMER



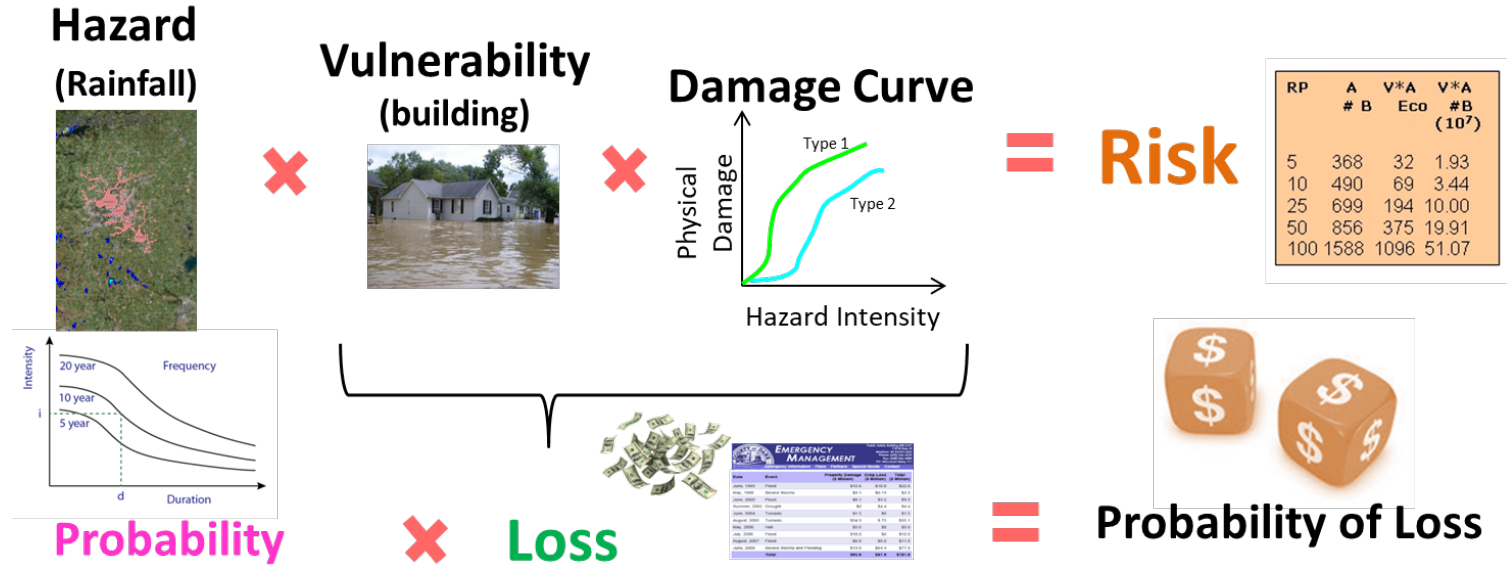
Reimer and Wu, 2016



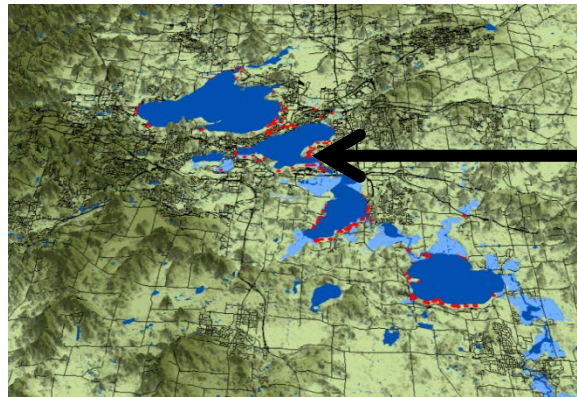
➔ \$??? Million



Recall: Flood Risk



Vulnerability Mitigation

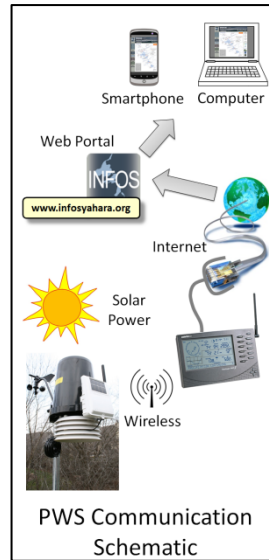
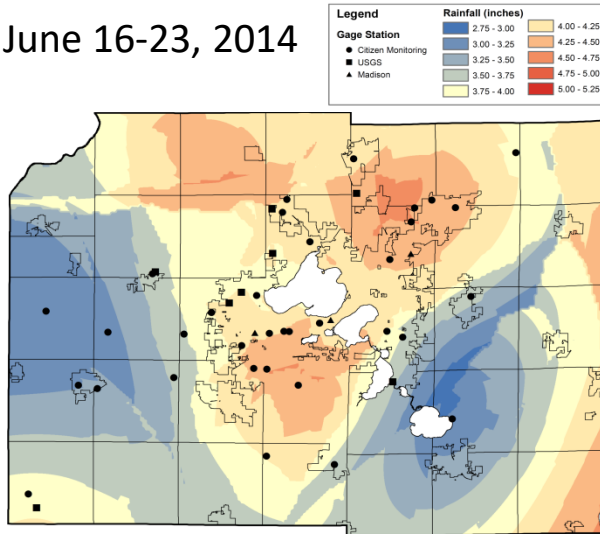


*Are we prepared today for tomorrow's **flood**?*

Flood Forecasts

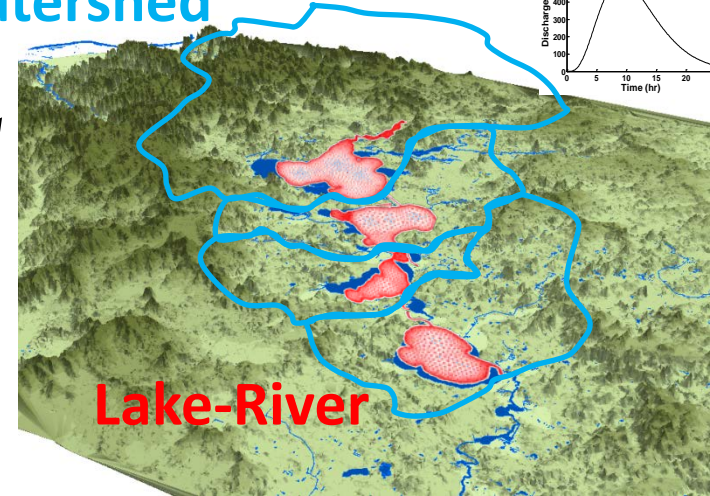
Past Rainfall

June 16-23, 2014



INFOS Integrated Models

Watershed



www.infosyahara.org

Forecast Rainfall

Weather Elements <input checked="" type="checkbox"/> Temperature (°F) <input checked="" type="checkbox"/> Dewpoint (°F) <input checked="" type="checkbox"/> Wind Chill (°F) <input checked="" type="checkbox"/> Surface Wind (mph) <input checked="" type="checkbox"/> Sky Cover (%) <input checked="" type="checkbox"/> Precipitation Potential (%) <input checked="" type="checkbox"/> Relative Humidity (%) <input checked="" type="checkbox"/> Rain <input checked="" type="checkbox"/> Thunder <input checked="" type="checkbox"/> Snow <input checked="" type="checkbox"/> Freezing Rain <input checked="" type="checkbox"/> Sleet <input type="checkbox"/> Fog	Fire Weather <input type="checkbox"/> Mixing Height (x100ft) <input type="checkbox"/> Haines Index <input type="checkbox"/> Trans. Wind (mph) <input type="checkbox"/> Vent Rate (x1000 mph-ft)	Probabilistic Forecasts (Experimental) Description Survey <input type="checkbox"/> 0.10 <input type="checkbox"/> 0.25 <input type="checkbox"/> 0.50 <input type="checkbox"/> 1.00 <input type="checkbox"/> Snowfall (5-hr) <input type="checkbox"/> 0.1in <input type="checkbox"/> 1in <input type="checkbox"/> 3in <input type="checkbox"/> 6in <input type="checkbox"/> 12in
---	--	---

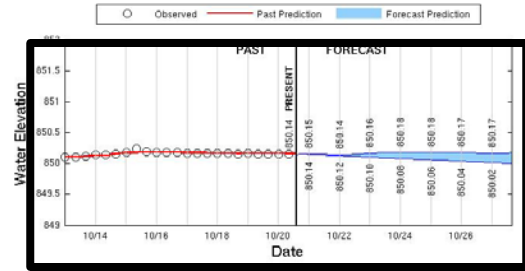
INFOS Integrated Nowcast/Forecast Operation System for Yahara Lakes

Water Level OUTLOOK
Lake Mendota Water Level

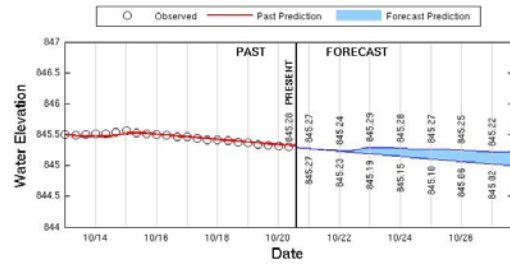
LAKE INFO

- Lake Mendota**
Surface Area: 3,963 ha
Max Depth: 25.3 m
Mean Depth: 12.7 m
- Lake Monona**
Surface Area: 1,330 ha
Max Depth: 22.6 m
Mean Depth: 8.3 m
- Lake Waubesa**
Surface Area: 843 ha
Max Depth: 11.6 m
Mean Depth: 4.7 m
- Lake Kegonsa**
Surface Area: 1,299 ha
Max Depth: 9.8 m
Mean Depth: 3.1 m

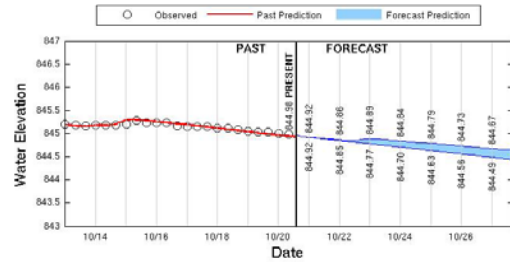
Flood Warning



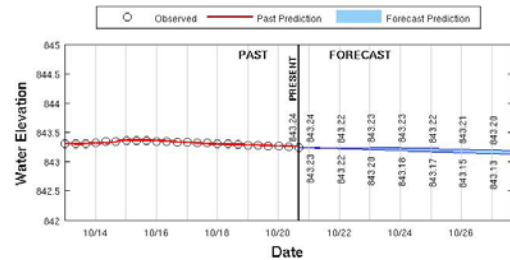
Lake Mendota



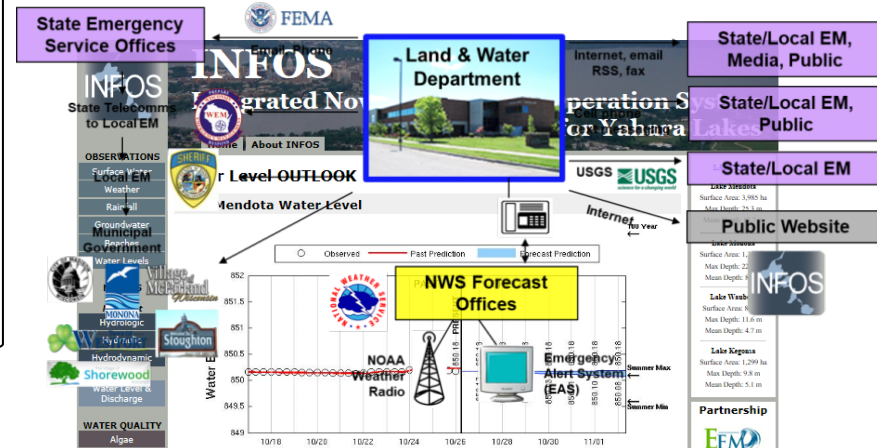
Lake Monona



Lake Waubesa



Lake Kegonsa



Summary

Science Driven Lake Level Management

Adaptation Strategies

(i) Aquatic Plant Harvesting



- Characterize **Flood Risk**

Vulnerability Mitigation

	LOSS	RISK
	Building	Building
Mendota	500 Year	250
Monona	500	10
Waubesa	500	250
Kegonsa	500	Mixed

- Develop **Flood Forecast and Warning**



Resilience & Preparedness

