National Weather Service

Genesis and Evolution of NOAA's Flood Inundation Mapping Services

Association of State Floodplain Managers
32nd Annual Conference

Reno-Sparks, NV
May 18-23, 2008

National Weather Service

Victor Hom

National Flood Inundation Mapping Service Leader

National Oceanic and Atmospheric Administration

National Weather Service Headquarters

Silver Spring, MD

ASFPM 32nd Annual Conference

Reno-Sparks, Nevada

May 22, 2008

National Weather Service

Presentation Overview

- National Oceanic Atmospheric Administration's (NOAA) Goals
- National Weather Service (NWS) Activities
  - *Advanced Hydrologic Prediction Service (AHPS)*
  - *Water Resource Program*
  - *Flood Inundation Mapping*

Copy of Presentation: http://www.weather.gov/os/water

NOAA's Strategic Goals

"We should integrate NOAA's collaborative research, data, and operations to generate products and services to help water resource managers"

Vice Admiral Conrad C. Lautenbacher, Jr., NOAA Administrator's Guidance (2003)

- Protect, Restore, and Manage Resources through an Ecosystem Approach to Management
- Understand Climate Variability and Change
- **Serve Society's Needs for Weather and Water Information**
- Support the Nation's Commerce with Information for Environmentally Sound Transportation

Water Resources Across NOAA

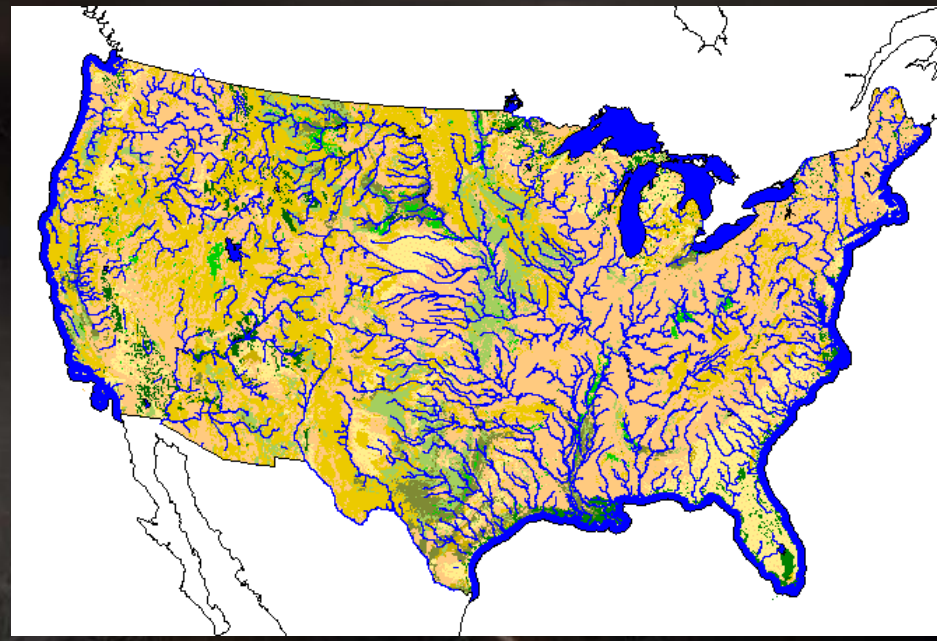
Satellite and Environmental Data
- Water surface conditions
- Land cover/land use

Oceans
- Biological monitoring
- Estuarine models

Research
- Earth system models
- Environmental observing systems

Fisheries
- Socio-economic assessments
- Protecting living marine resources

Weather
- Weather, water, and climate monitoring and prediction



Forecasting Infrastructure and Service Centers:

Rivers & Streams; Reservoirs & Lakes

The Great Lakes

Wetlands; Estuaries; Coasts

NWS Office of Hydrologic Development

Active Focus Areas

- Advanced Hydrologic Prediction Service (AHPS)
- Planning, Programming, and Coordination (PPC)
- Hydrology Laboratory (HL)
- RFC Development Management (RDM)
- Hydrology XML Consortium (HydroXC)
- Community Hydrologic Prediction System (CHPS)

Reference: http://www.weather.gov/ohd

Current NWS Hydrologic Research and Transition to Operations

Hydrology

- Physically-based soil moisture modeling
- Distributed modeling: DMIP-1 and DMIP-2
- Flash Flood modeling
- Drought

Hydrometeorology

- Enhanced Multisensor Precipitation Estimator (EMPE)
- Raingage Quality Control

Ensemble Modeling

- Short-term precipitation and temperature ensemble generation
- Data Assimilation

Hydraulics

- Evaluation of Hydraulic models

Hydrometeorological Design Studies Center

- Precipitation Frequency Maps

Other Hydrologic Development

- Debris Flows
- Water Quality

Reference: http://www.weather.gov/ohd

NOAA's Water Resources - Integrated Products & Services

Partners

NOAA

Federal Agencies

Tribal Agencies

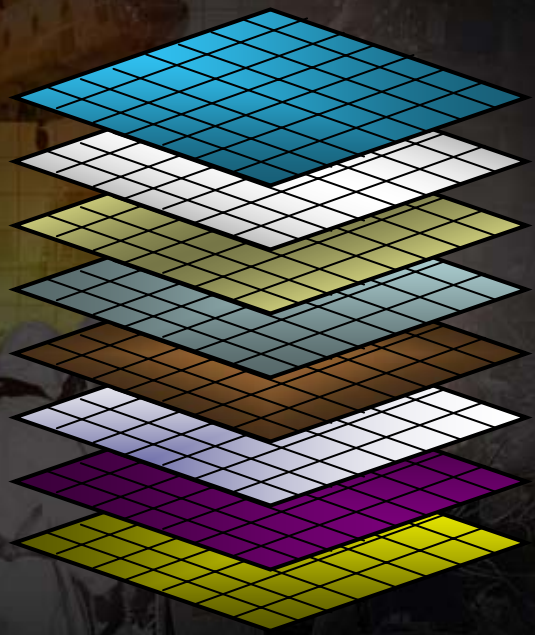
State Agencies

Local Agencies

Academia

Private Sector

High-resolution Gridded Water Resources Product Suite



- Precipitation
- Snowpack Properties
- Soil Moisture
- Evaporation
- Groundwater
- River Flow
- Surface Storage
- Runoff
- Water Quality

**Seamless transition from inland to coast*

Applications

Drought Mitigation

Flood Potential

Flood Management

Water Allocation

Transportation

Emergency Management

Agriculture

Debris Flows

Ecosystems Management

Research

NWS Mission and Goals

NOAA NWS Mission

- **Issue weather, water, and climate forecasts and warnings for the protection of life and property and the enhancement of the national economy.**

Water in the News

Rescue work continues in flood- ra Washington

By Jack Broom
Seattle Times staff reporter
Efforts resumed today to rescue people from flood-stricken homes in Southwest Washington after

National Weather Service tweaks Red River flood outloook

(Doug Barrett, KNOX, Grand Forks)
GRAND FORKS, N.D. (AP) The National Weather S
the spring flood ou
River Valley. March

Global Warming May Put U.S. in Hot Water

By SETH BORENSTEIN
AP Science Writer
WASHINGTON (AP) -- As the world warms, water - either too little or too much of it - is going to be the major problem for the United said n, with , and a hortages

Flooding forces thousands in Kansas, Oklahoma and Texas

The Associated Press
Published: July 1, 2007

Australia's epic drought: The situation is grim

By Kathy Marks in Sydney
Friday, 20 April 2007

Australia has warned that it will have to switch off the water supply to the continent's food bowl unless heavy rains break an epic drought - heralding what could be the first climate change-driven disaster to strike a developed nation.

Officials shut salmon fishing in seven coastal areas of California, Oregon

By Matt Weiser - mweiser@sacbee.com
Thursday, March 13, 2008

Wildlife officials moved Wednesday for early closure of seven coastal salmon

Scotts Valley wants to sell surplus irrigation water

San Jose Mercury News, USA – March 11, 200
SCOTTS VALLEY, Calif.—A Santa Cruz County tow has too much water

West Looking Again at Building New Dams

By NICHOLAS K. GERANIOS – Mar 2, 2008

SPOKANE, Wash. (AP) — The Western states' era of massive dam construction — which tamed rivers, swallowed towns, and created irrigated agriculture, cheap hydropower and

Relentless N. Carolina drought could be devastating in '08

RALEIGH, N.C. (AP) – The record-setting drought that has forced the gover home sprin

Lake Mead could run dry by 2021, study warns

Arizona Republic, AZ - Feb 12, 2008
Climate changes and an unquenched demand for water on the Colorado

Current Major Flooding in U.S. a Sign of Things to Come: NOAA Urges Communities to Prepare During Flood Safety Awareness Week (March 20, 2008)

Floods Across United States

- On average, over the past 20 years, flooding has claimed over 90 lives and caused damages in excess of $7 billion annually.

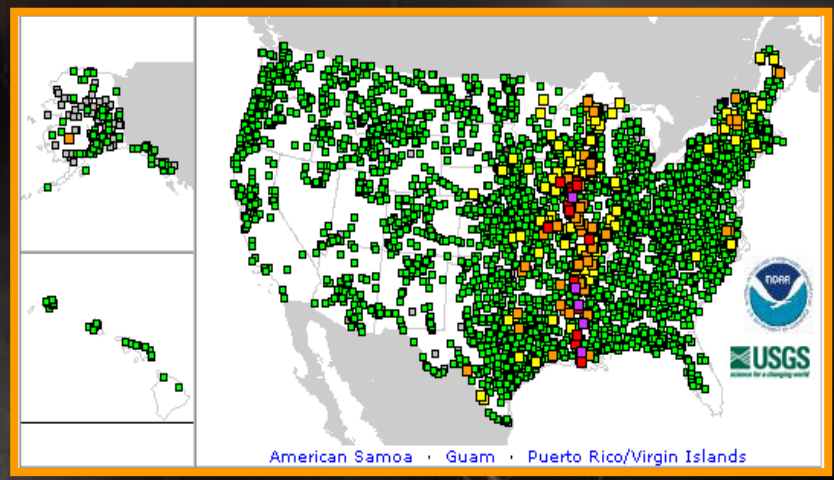
- Flooding is responsible for more fatalities than any other severe weather related phenomenon.

- More than half of all flood-related deaths result from motorists being swept away in their vehicles.

NOAA's NWS Water Forecasts

The Task:

- *Forecasts of stream flow provided at 4000 point locations on rivers*



Required Input:

- *Forecasts of several water resource elements provided at all locations (grid), at scale of event (high resolution)*

- *Snow water equivalent*
- *Snow depth & cover*
- *Precipitation*
- *Soil moisture*
- *Runoff*
- *Evaporation*

Advanced Hydrologic Prediction Service (AHPS)

- Provide *enhanced water availability and flood warning information* by leveraging NOAA's infrastructure and expertise
- *Modernize services* through infusion of new science and technology
  - *Flash-flood to seasonal freshwater forecasts*
  - *Quantification of forecast certainty*
  - *More accurate and timely forecasts and warnings*
  - *Partnered flood inundation mapping*
  - *Visually-oriented products*
- Provide consistent access to *standardized graphics via web* interface

Reference: http://www.weather.gov/ahps

Cost and Benefits of AHPS

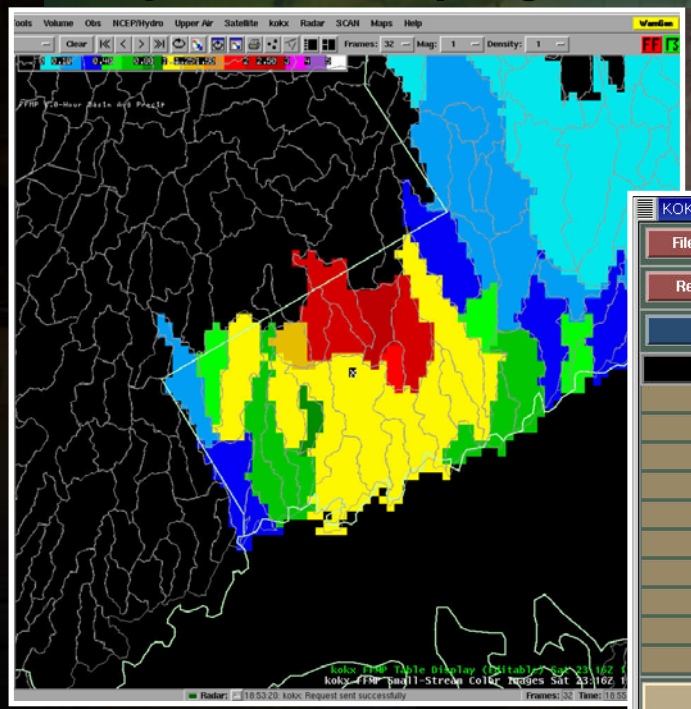
- $60 million/10 year program (completion year of 2014)
- $766 million estimated annual recurring benefit (National Hydrologic Warning Council study)

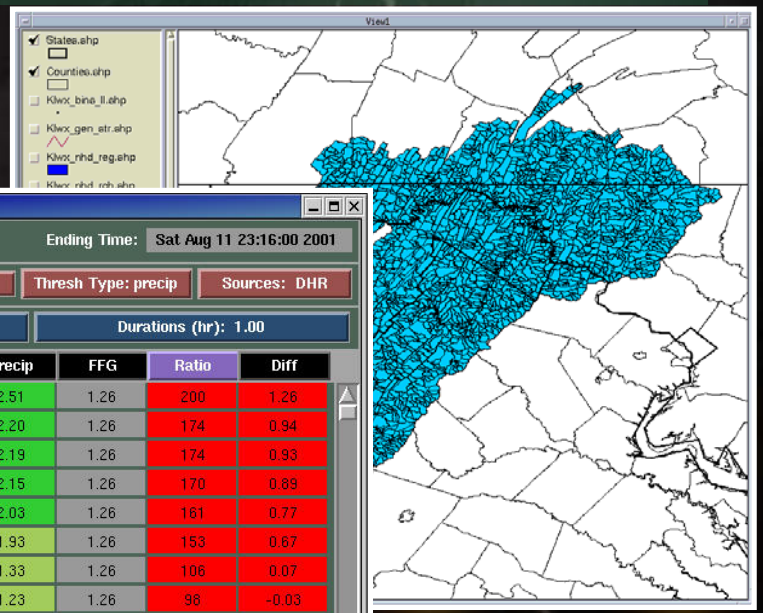
AHPS Flash Flood Decision Assistance

Flash Flood Monitoring and Prediction (FFMP)

- Continuous monitoring of rainfall and comparison to flash flood guidance for high resolution stream basins

- Alerts forecasters when a dangerous flash flood situation may be developing





KOKX FFMP Threat BASIN Table

File | Link to Frame | Ending Time: Sat Aug 11 23:16:00 2001

Refresh D2D | Display Rate | Thresh Type: precip | Sources: DHR

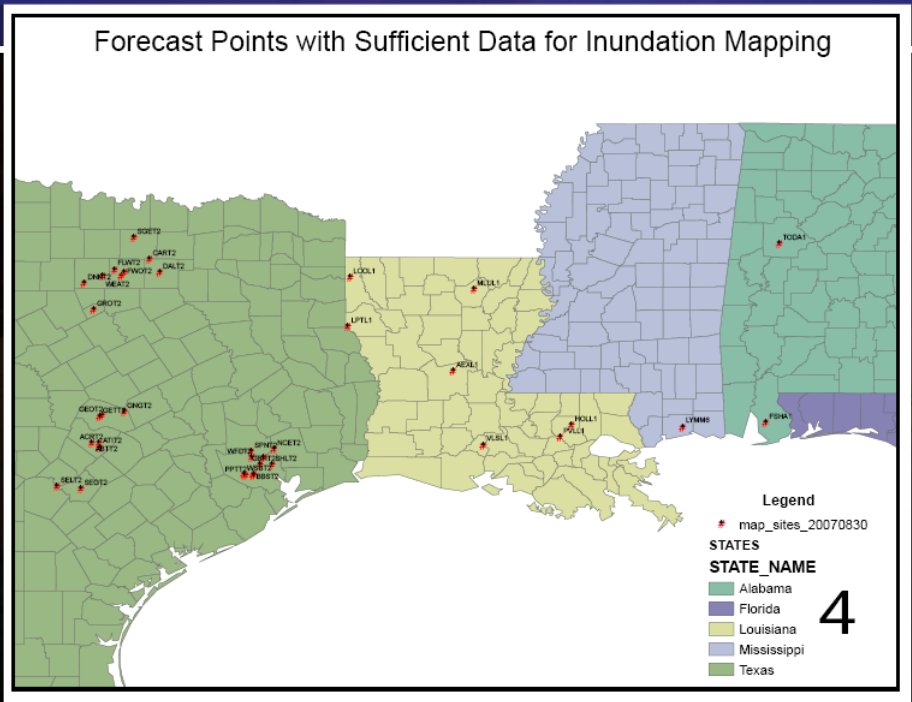
County: CT,FAIRFIELD | Durations (hr): 1.00

Area_Id	Rate	Precip	FFG	Ratio	Diff
295	1.47	2.51	1.26	200	1.26
294	1.98	2.20	1.26	174	0.94
1132	0.72	2.19	1.26	174	0.93
1129	0.57	2.15	1.26	170	0.89
1131	0.49	2.03	1.26	161	0.77
1128	0.17	1.93	1.26	153	0.67
273	0.96	1.33	1.26	106	0.07
274	0.08	1.23	1.26	98	-0.03
275	0.08	1.23	1.26	98	-0.03
252	0.26	1.17	1.26	93	-0.09

"America's NOAA National Weather Service: Protecting Lives, Livelihoods, and A Way of Life"

Enhancing the Communication of Flood Risk

- Hurricane Floyd Supplemental Funding helped with the deployment of 16 North Carolina Flood Inundation Map Libraries on October 22, 2007.
- Hurricane Katrina Supplemental Funds are being used to create an additional 25-35 libraries in 4 Gulf Coast States over the next two years.



Reference: http://www.weather.gov/ahps/inundation.php

NOAA-FEMA Partnership

- ***Both agencies convey flood risk***
  - ***FEMA for regulatory/legal insurance purposes to reduce damage costs***
  - ***NOAA/NWS for protection of life and property***
- ***Opportunity for enhanced relationship between NFIP flood zones and NWS flood categories/libraries***
- ***Decision-makers need additional/integrated inundation maps/information to most effectively mitigate the impacts of floods***
- ***Integrate NOAA/NWS inundation library guidelines with FEMA/FIS guidelines***

Partnering to Reduce Costs and Improve Efficiency

Costs go down

Efficiency goes up

- Additional cost to complete one inundation map library as part of the FIS: **5 – 10 K (~3% cost increase)**
- Cost doubles and time increases if inundation map library is created after FIS is completed: **10 – 20 K**
- Developing inundation libraries in conjunction with FIS yields significant user benefit for small incremental cost.

Enhancing Communication of Flood Risk

- **For NWS river forecast locations…..**
  - Enhance the communication of flood risk by a developing a library of inundation maps and linking them with observed/forecast river stages
  - Each library includes NWS flood severity categories and regulatory FEMA flood frequency events

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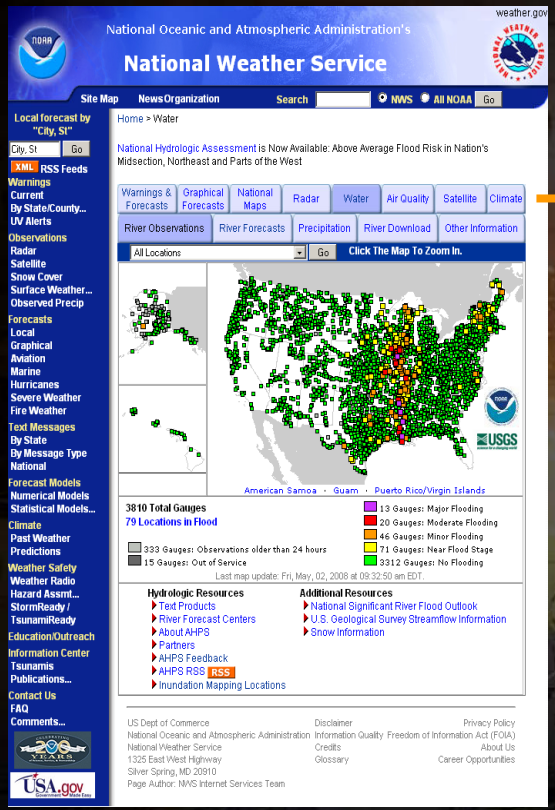
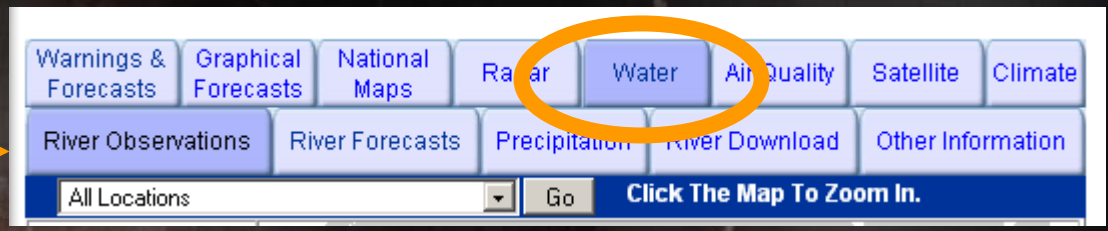
Advanced Hydrologic Prediction Service (AHPS)





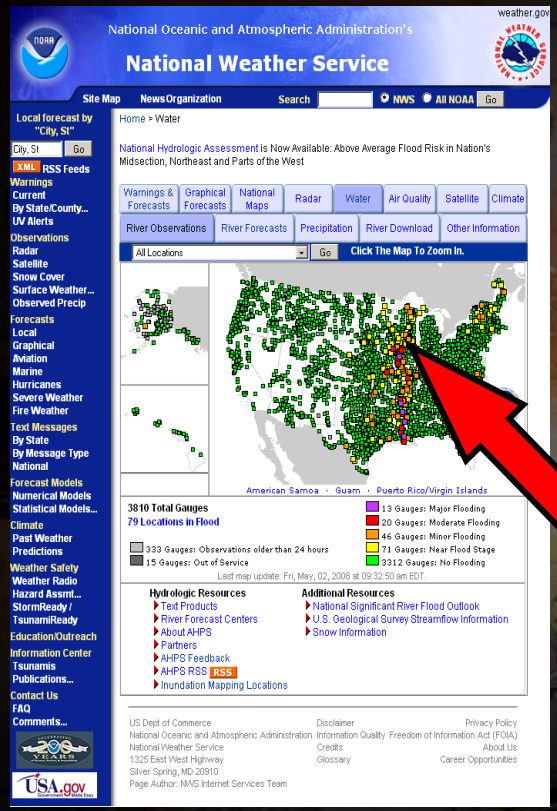
Reference: http://www.weather.gov/ahps

Water Predictions for Life Decisions

"America's NOAA National Weather Service: Protecting Lives, Livelihoods, and A Way of Life"

National Weather Service

Advanced Hydrologic Prediction Service



... numerous flooding

Reference: http://www.weather.gov/ahps

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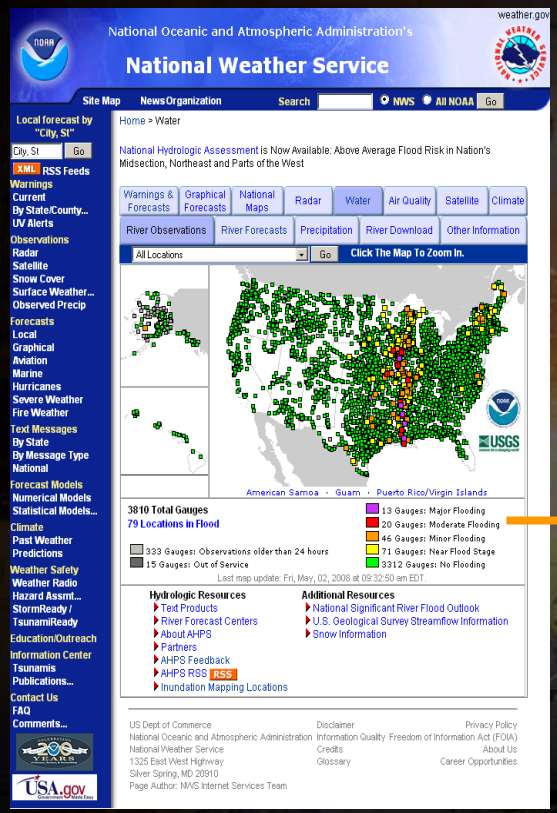
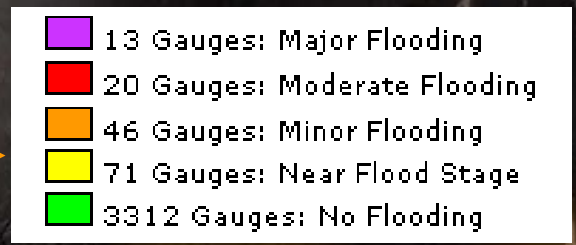
Advanced Hydrologic Prediction Service





... flooding at nearly 150 forecast locations

Reference: http://www.weather.gov/ahps

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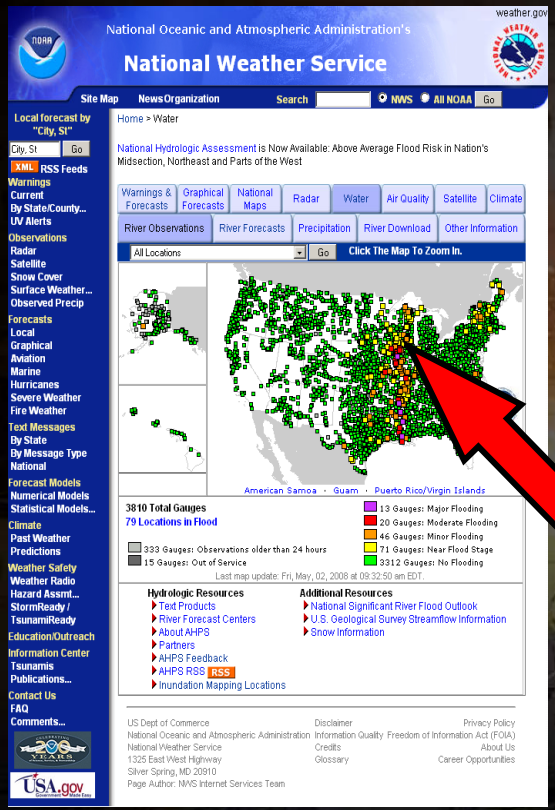
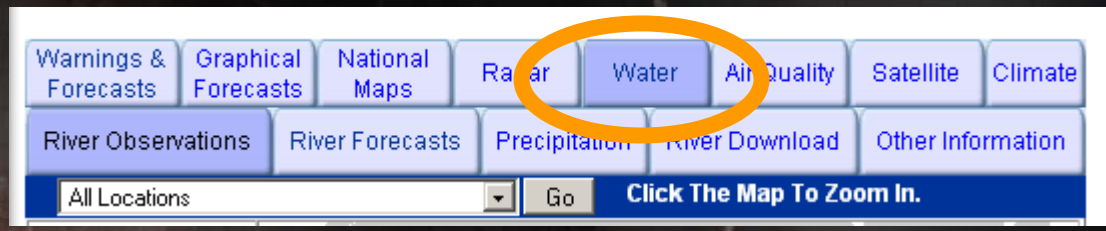
Advanced Hydrologic Prediction Service





... to the forecast area

Reference: http://www.weather.gov/ahps

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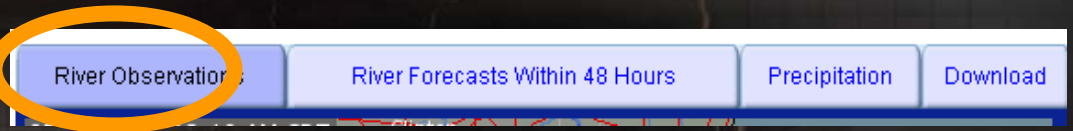

Review of the different sections.

Water Predictions for Life Decisions

Reference: http://www.crh.noaa.gov/ahps2/index.php?wfo=lot

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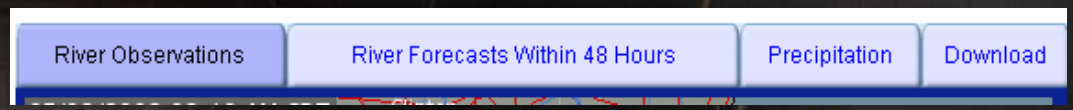
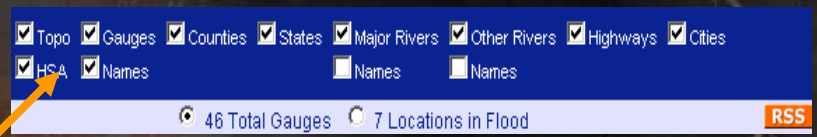
"Water Predictions for Life Decisions"





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National Weather Service

"Water Predictions for Life Decisions"

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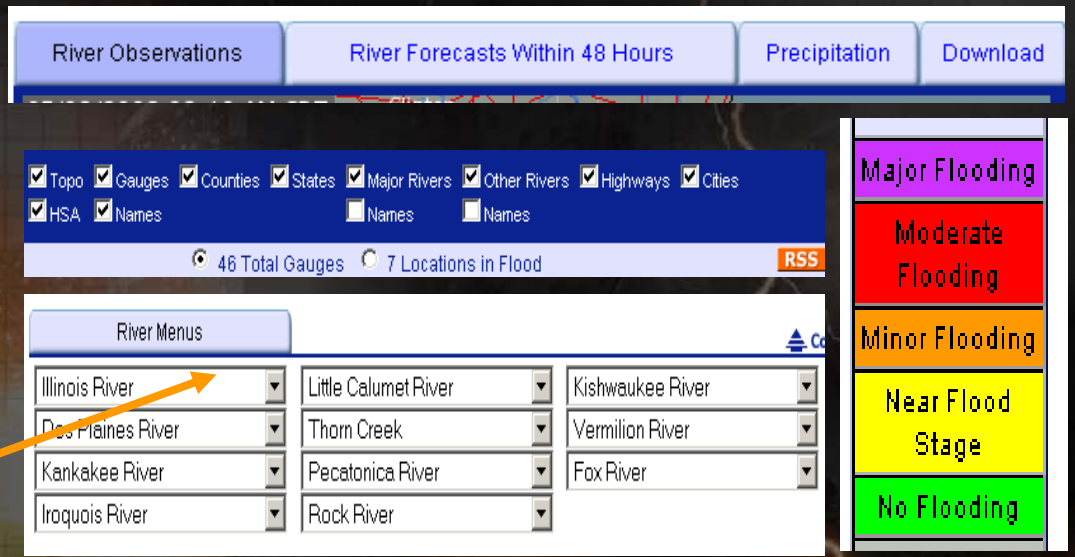

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National Weather Service

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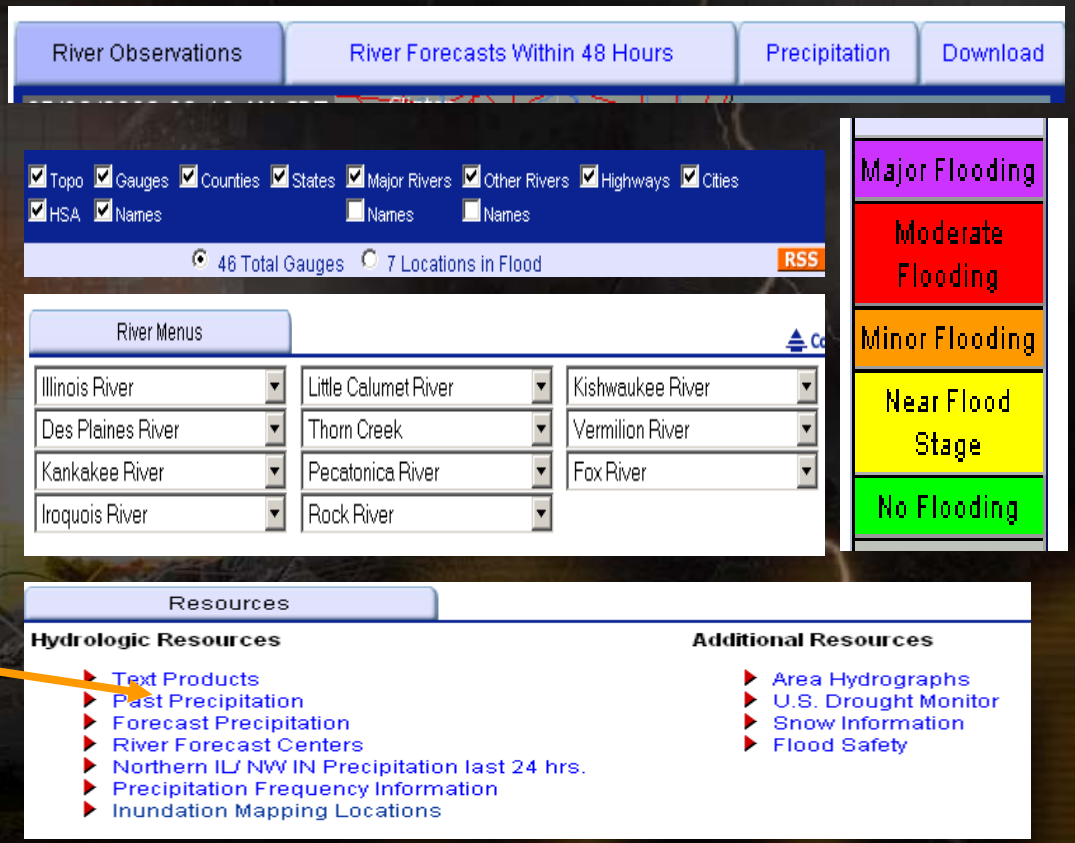

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Water Predictions for Life Decisions

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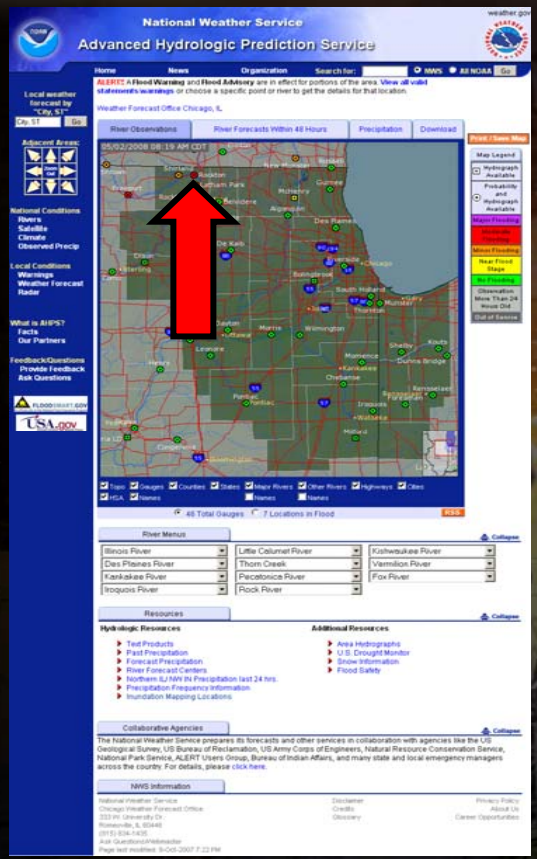
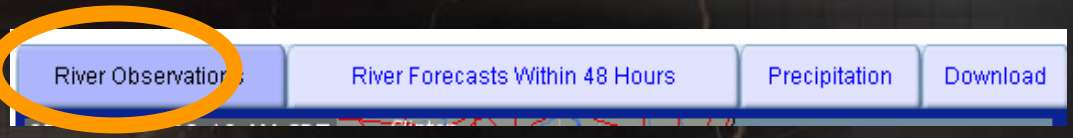
AHPS River Observations/Forecasts





... three ways to the forecast

Reference: http://www.crh.noaa.gov/ahps2/index.php?wfo=lot

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AHPS River Observations/Forecasts

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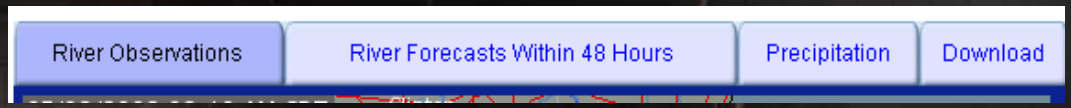

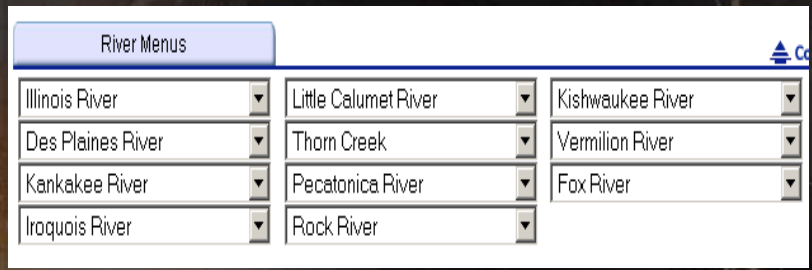

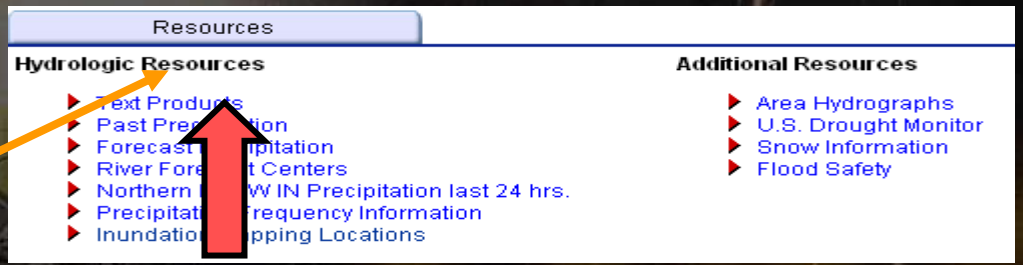

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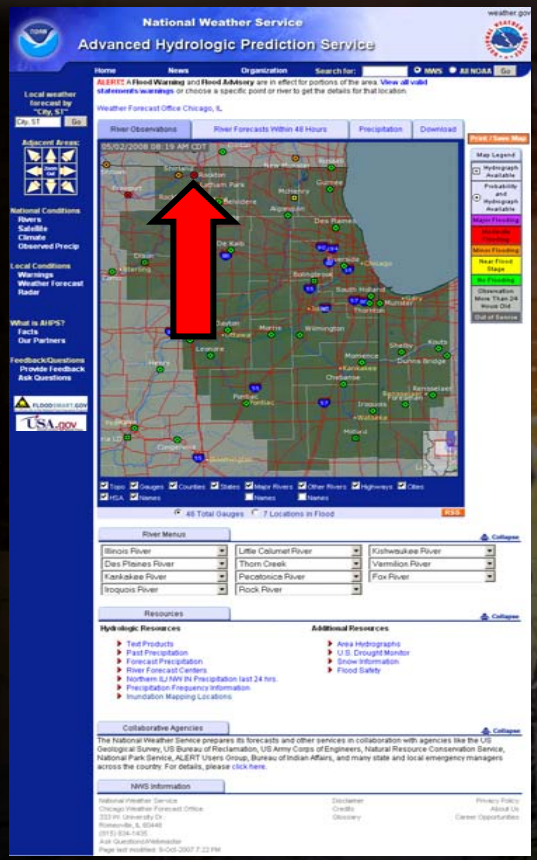

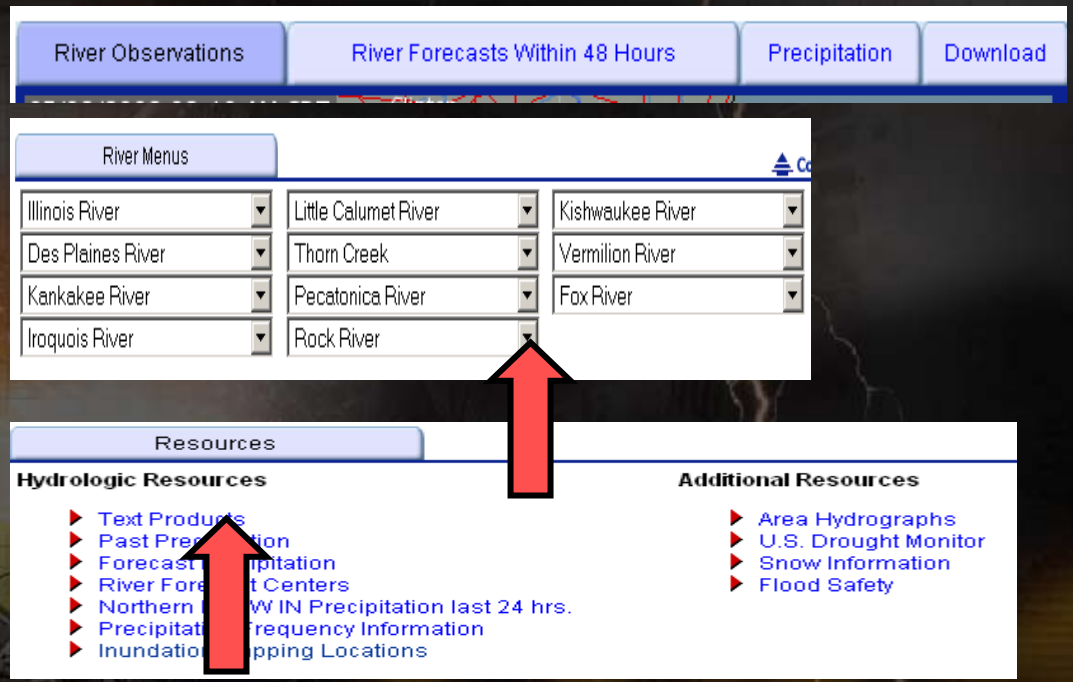

... three ways to the forecast

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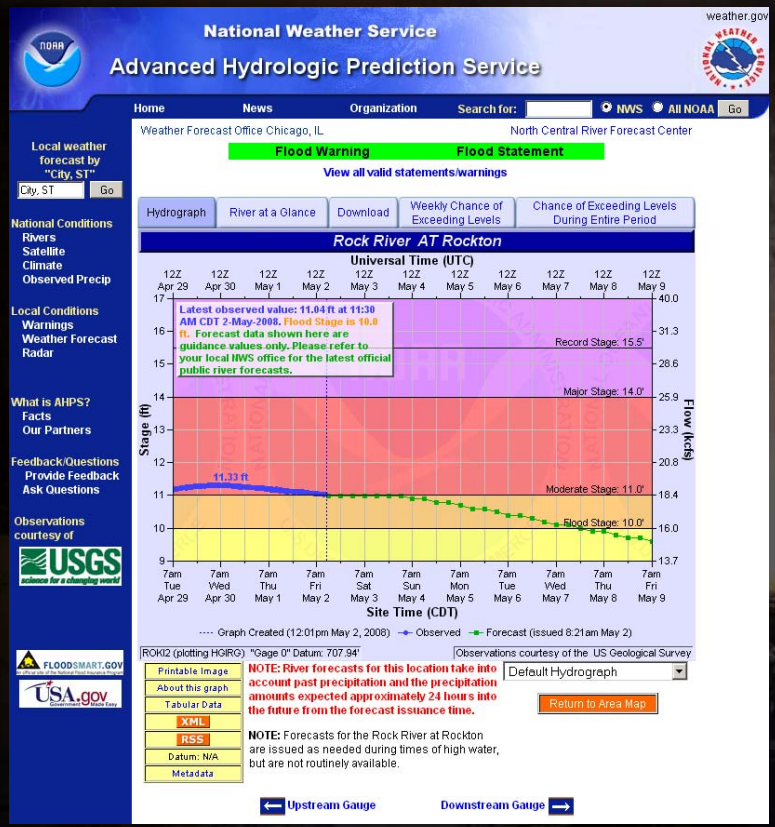
AHPS Forecast Page



- *Forecast Hydrograph*
- *Flood Categories*
- *Probabilistic Forecasts*
- *Data Downloads in XML, RSS*
- *Pertinent Information*

Reference:

http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=lot&gage=roki2

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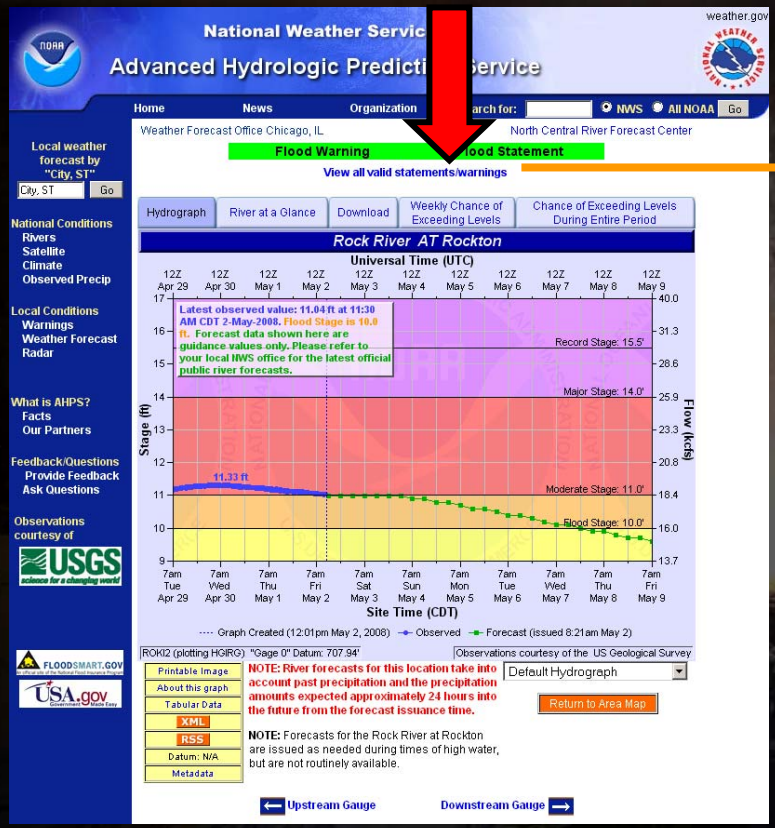
National Weather Service

AHPS Link to Flood Statement



Flood Statement

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WGUS83 KLOT 021450
 FLSLOT
 FLOOD STATEMENT
 NATIONAL WEATHER SERVICE CHICAGO/ROMEOVILLE IL
 950 AM CDT FRI MAY 02 2008

    THE FLOOD WARNING CONTINUES FOR THE FOLLOWING RIVERS IN
 ILLINOIS...

   ROCK RIVER AT ROCKTON AFFECTING WINNEBAGO COUNTY
   ROCK RIVER AT LATHAM PARK AFFECTING WINNEBAGO COUNTY
   PECATONICA RIVER NEAR SHIRLAND AFFECTING WINNEBAGO COUNTY

 .SHOWERS AND THUNDERSTORMS MOVING ACROSS SOUTHERN WISCONSIN AND
 NORTHERN ILLINOIS TODAY MAY CAUSE MINOR ADDITIONAL RISES ON AREA
 RIVERS THROUGH THE WEEKEND.

 SAFETY MESSAGE...IF YOU ENCOUNTER A FLOODED ROADWAY...TURN AROUND AND
 FIND AN ALTERNATE ROUTE.

 ILC201-030250-
 /O.EXT.KLOT.FL.W.0055.000000T0000Z-080508T0600Z/
 /ROKI2.2.RS.080328T0125Z.080415T2030Z.080508T0000Z.NO/
 950 AM CDT FRI MAY 02 2008

 THE FLOOD WARNING CONTINUES FOR
   THE ROCK RIVER AT ROCKTON.
 * UNTIL LATE WEDNESDAY NIGHT...OR UNTIL THE WARNING IS CANCELLED.
 * AT  830 AM FRIDAY THE STAGE WAS 11.0 FEET.
 * MODERATE FLOODING IS OCCURRING AND MODERATE FLOODING IS FORECAST.
 * FLOOD STAGE IS 10.0 FEET.
 * FORECAST...THE RIVER WILL REMAIN NEARLY STEADY THE NEXT COUPLE OF
   DAYS BEFORE IT BEGINS TO SLOWLY FALL AND GO BELOW FLOOD STAGE BY
   WEDNESDAY EVENING.
 * IMPACT...AT 10.5 FEET...WATER BEGINS TO FLOW OVER PORTIONS OF
   EDGEMERE TERRACE NEAR ROSCOE.

 $$
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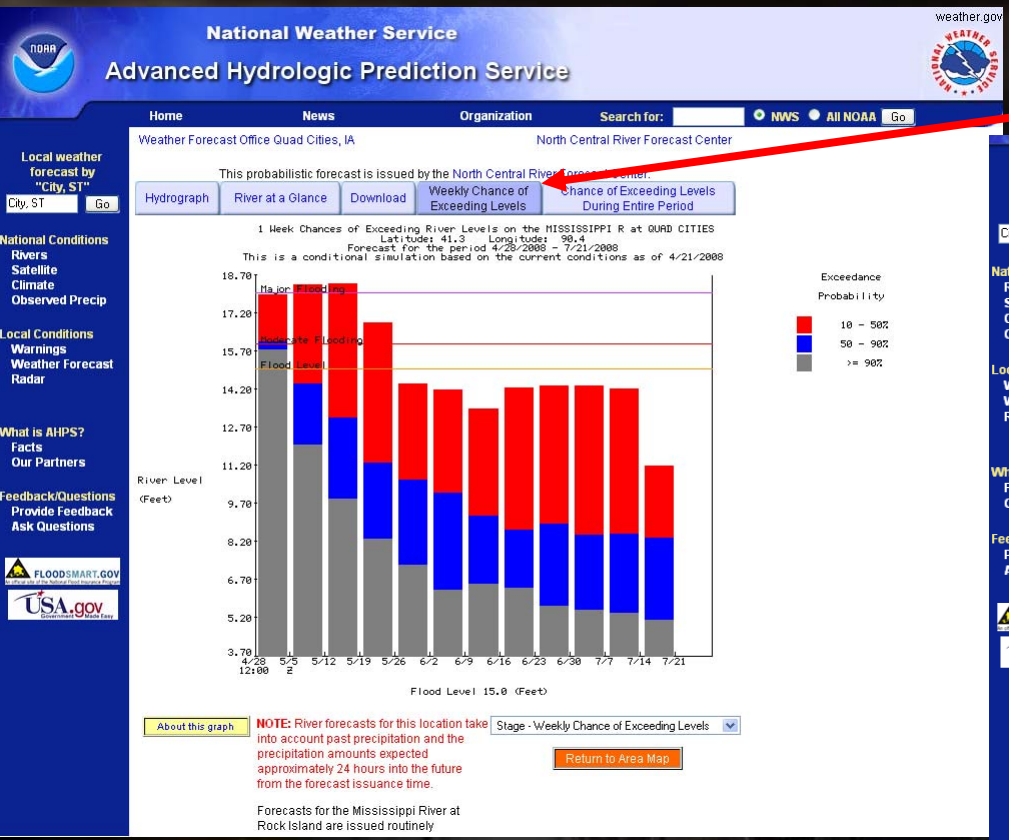
Reference:

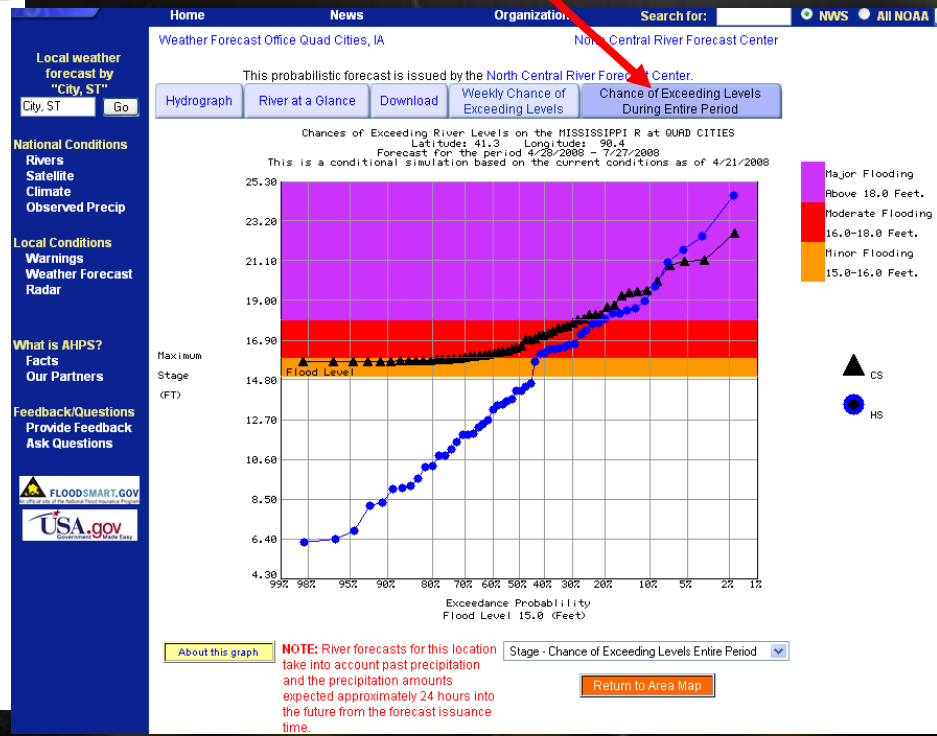
http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=lot&gage=roki2

Water Predictions for Life Decisions

Accessing AHPS Information

"click on" tabs for probabilistic forecasts

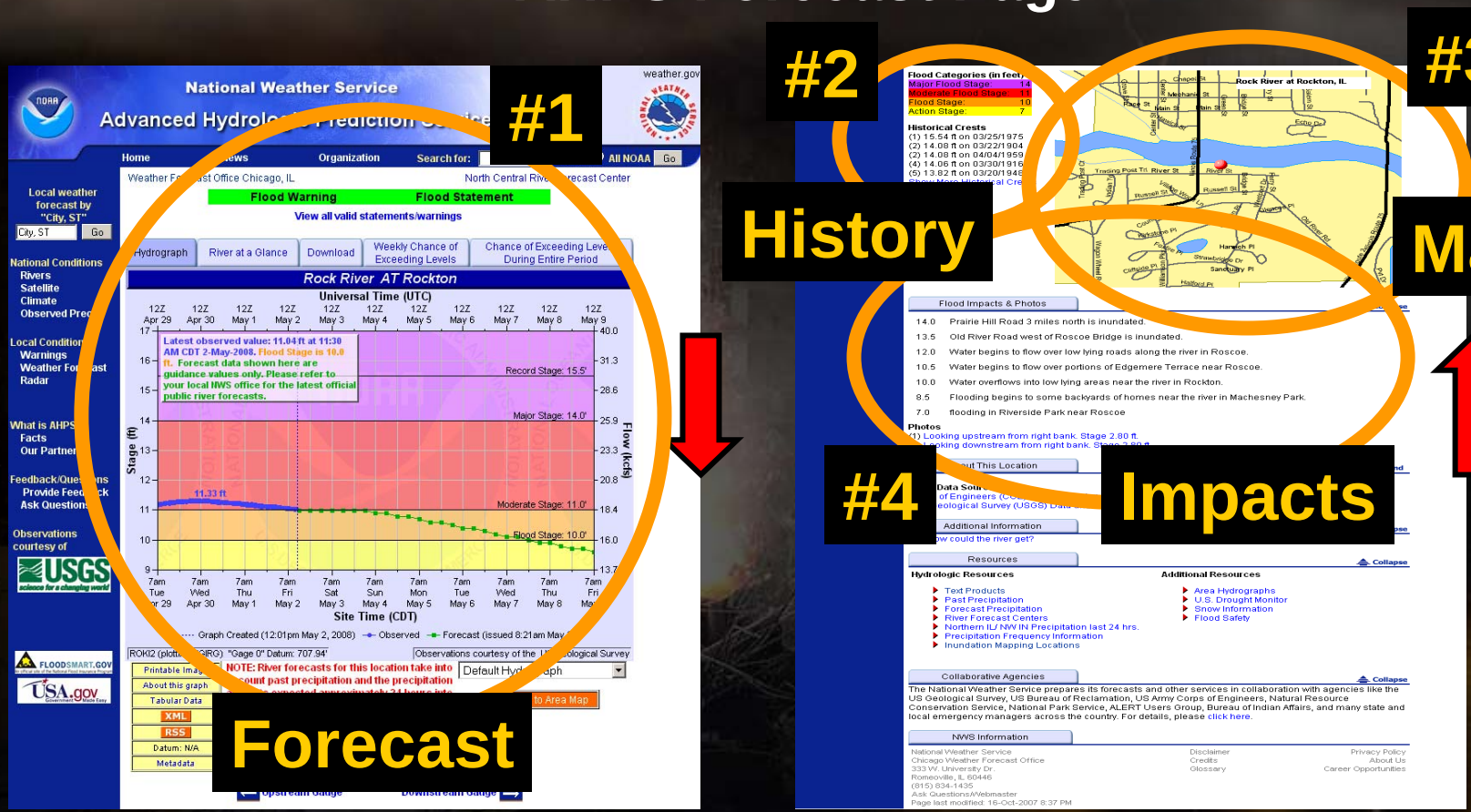




Currently demonstrating short-range ESP capability at 4 River Forecast Centers and plan to begin national implementation in FY12

National Weather Service

AHPS Forecast Page



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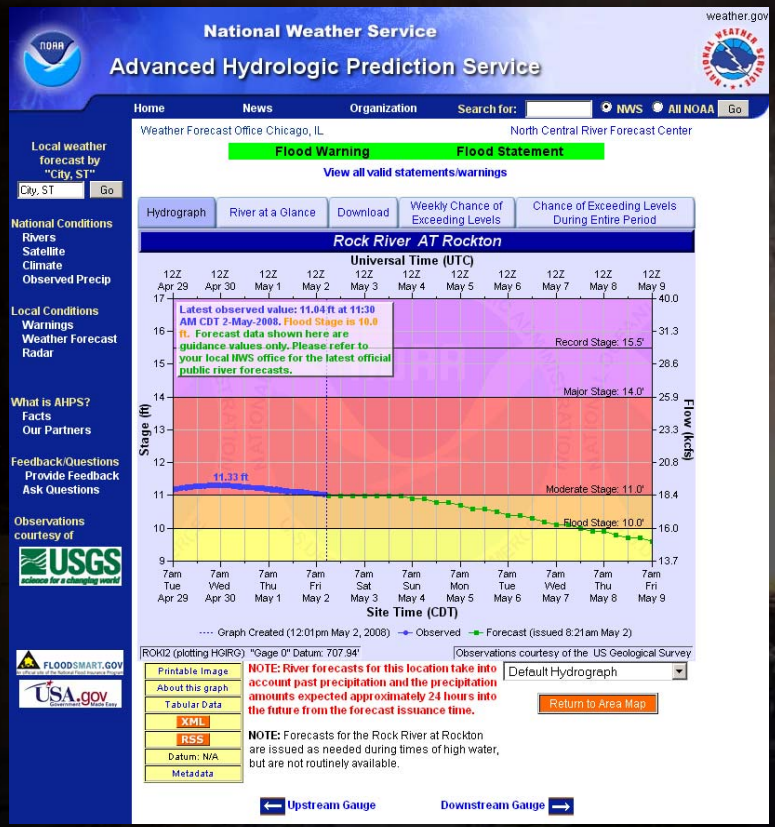
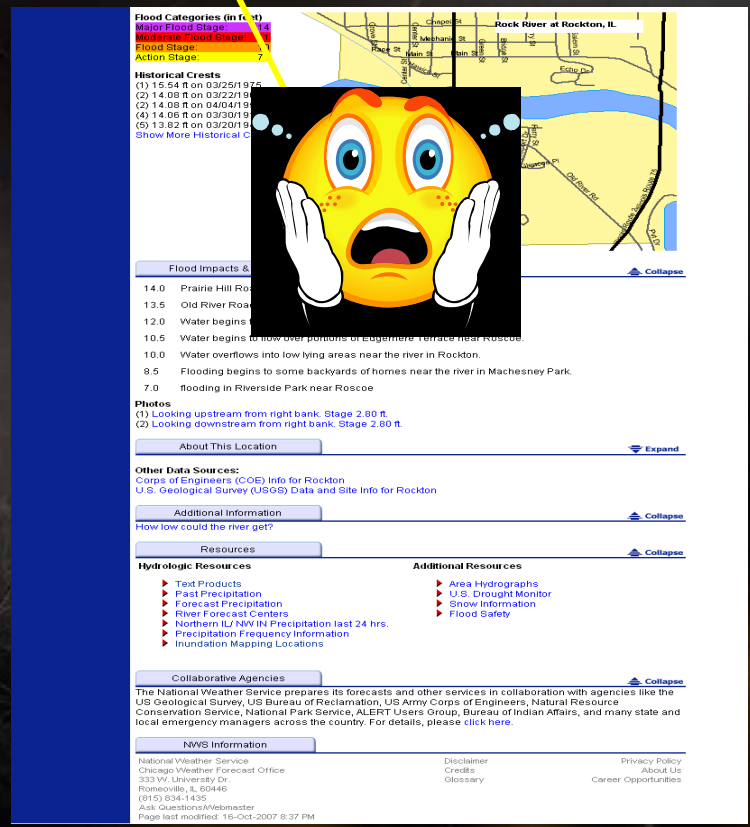
Water Predictions for Life Decisions

National Weather Service

Am I in harm's way?





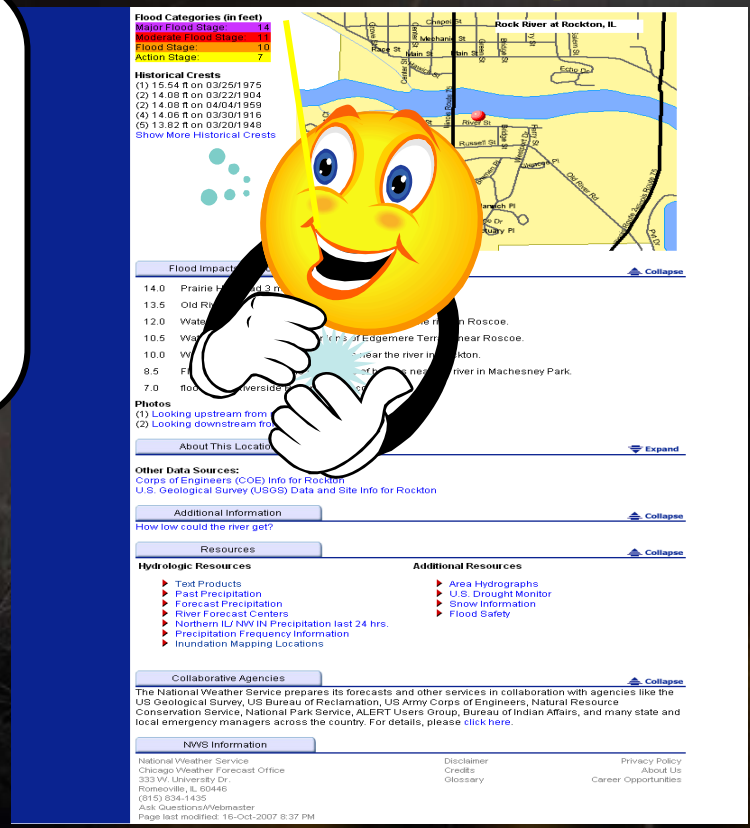
Reference:
http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=lot&gage=roki2

Water Predictions for Life Decisions

National Weather Service

That's Great! I live near a NWS forecast point?

If you have good inundation mapping we may be able to tell.



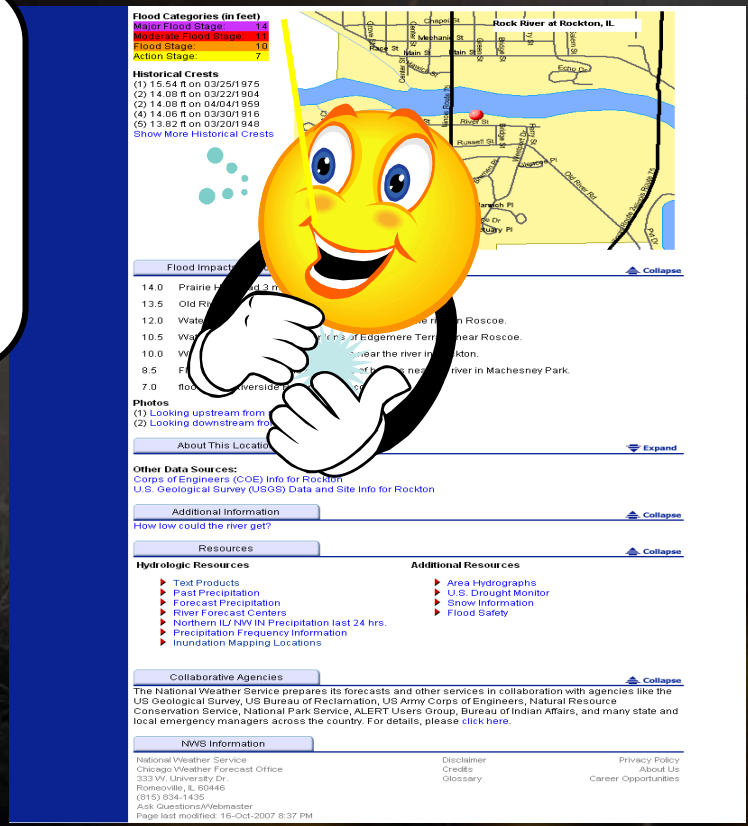
Reference:
http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=lot&gage=roki2

Water Predictions for Life Decisions

National Weather Service

Is that the Inundation Mapping folder tab?

If NOAA has an inundation map library, that's easy to do!



Reference:
http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=lot&gage=roki2

Water Predictions for Life Decisions

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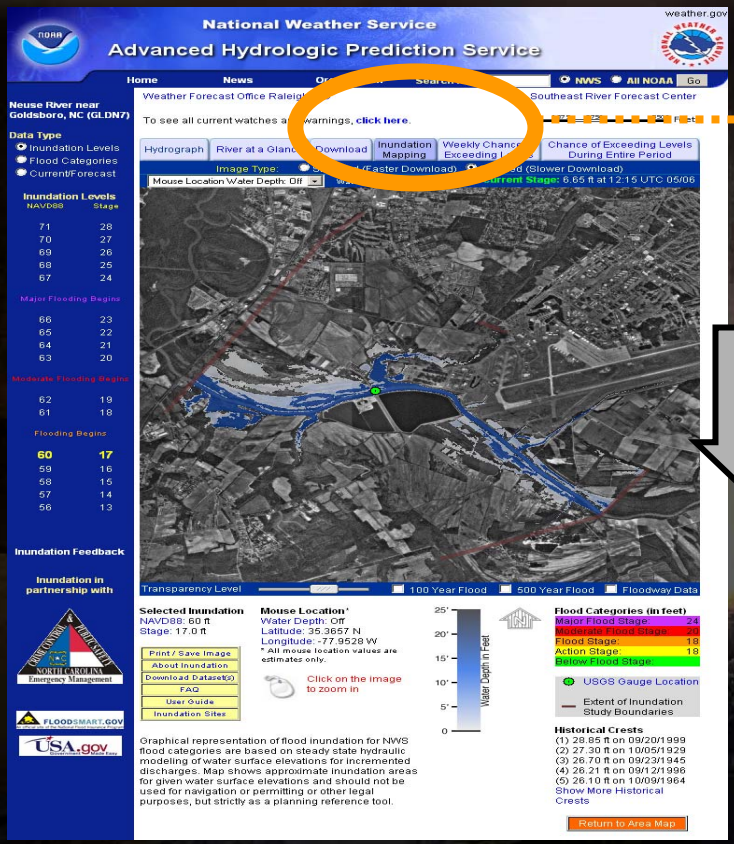
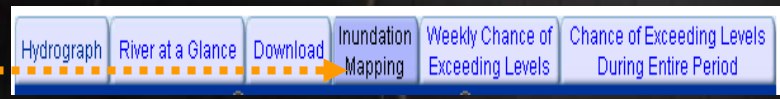
Available Inundation Map Library

DEMO





Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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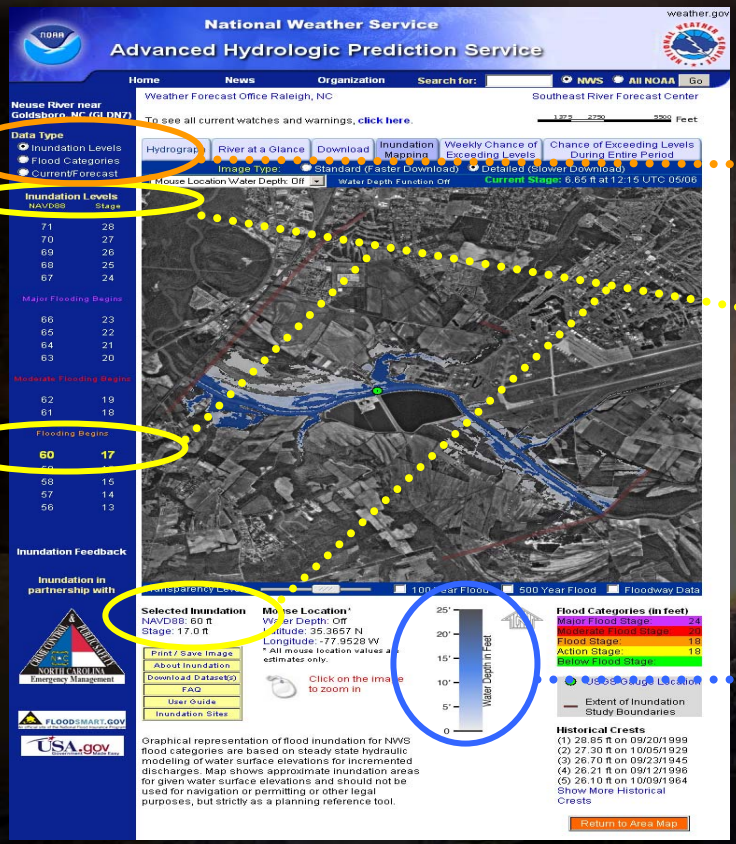
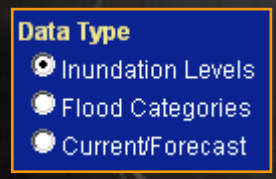
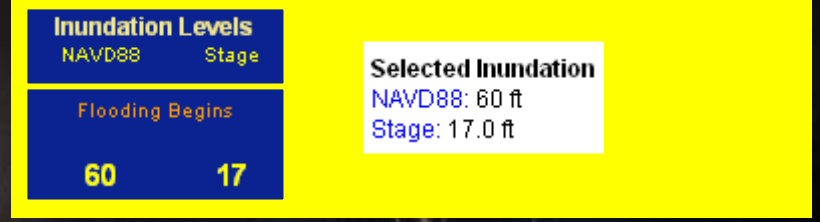
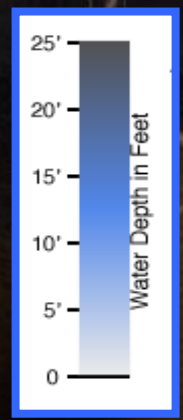
Inundation Map Interface – Inundation Level









Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

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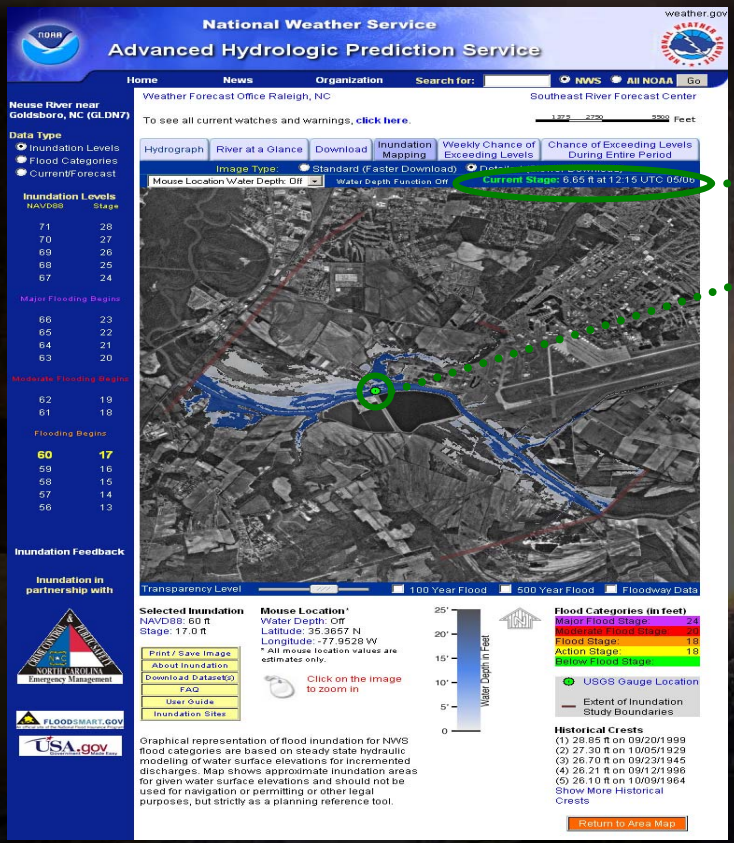
Inundation Map Interface – Current Stage



Current Stage: 6.65 ft at 12:15 UTC 05/06

Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

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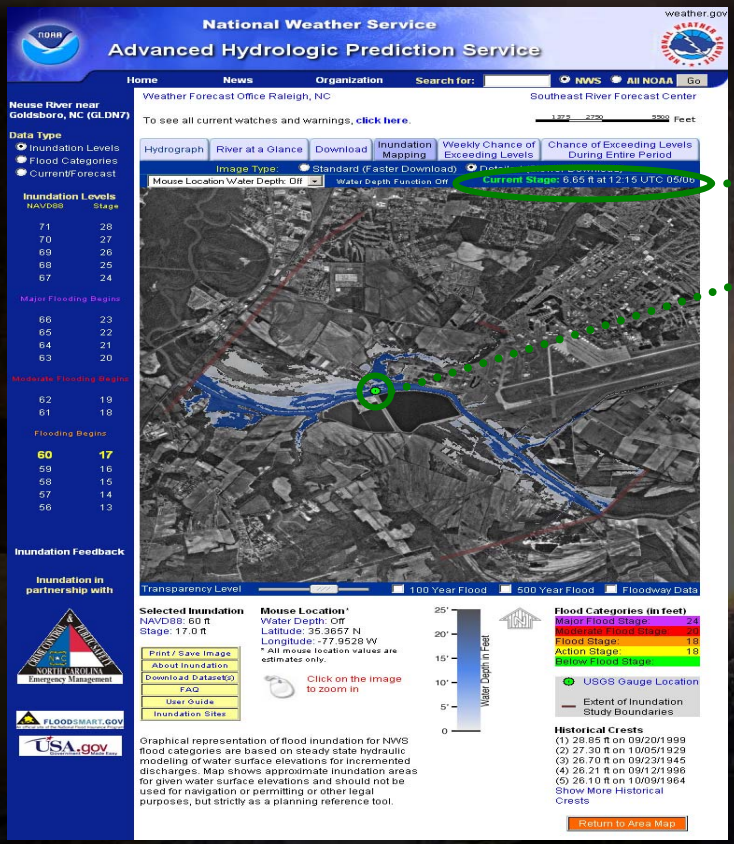
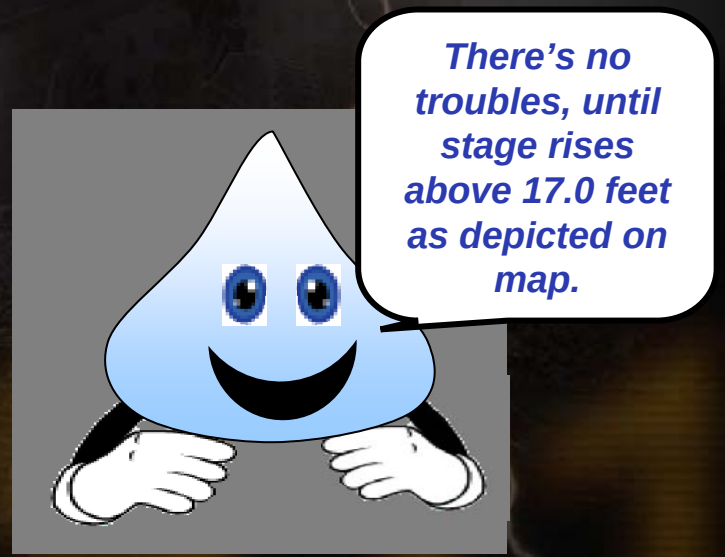
Inundation Map Interface – Current Stage



Current Stage: 6.65 ft at 12:15 UTC 05/06



Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

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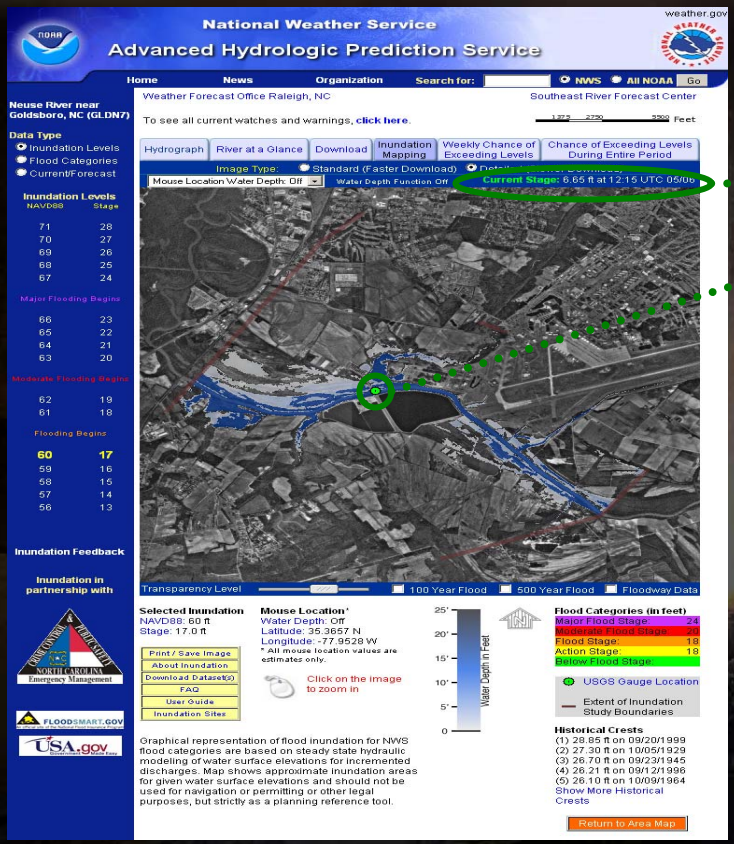
Inundation Map Interface – Current Stage



Current Stage: 6.65 ft at 12:15 UTC 05/06

Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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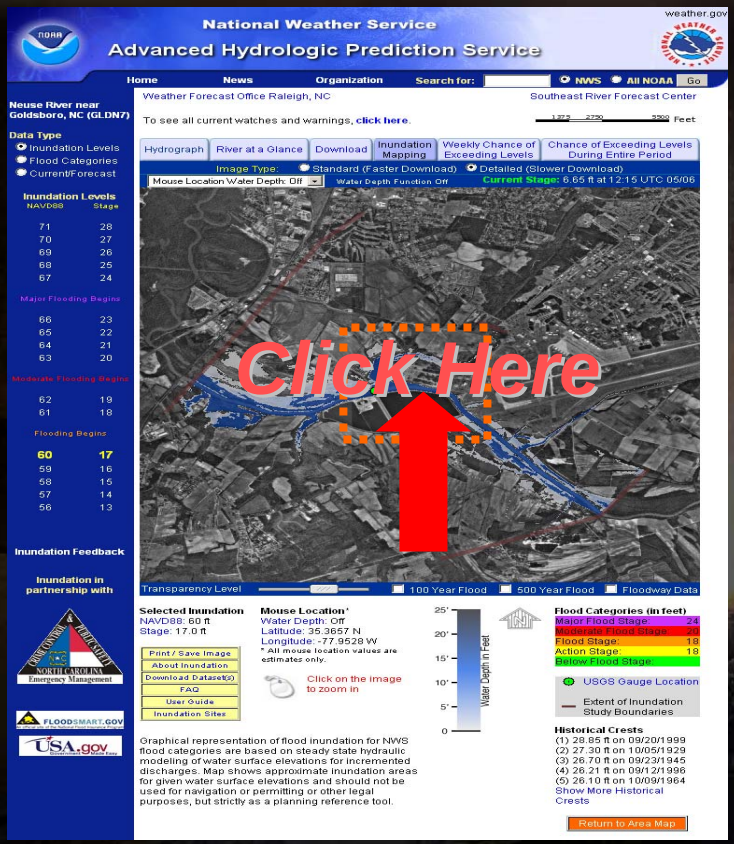
Inundation Map Interface – Zoom Features



Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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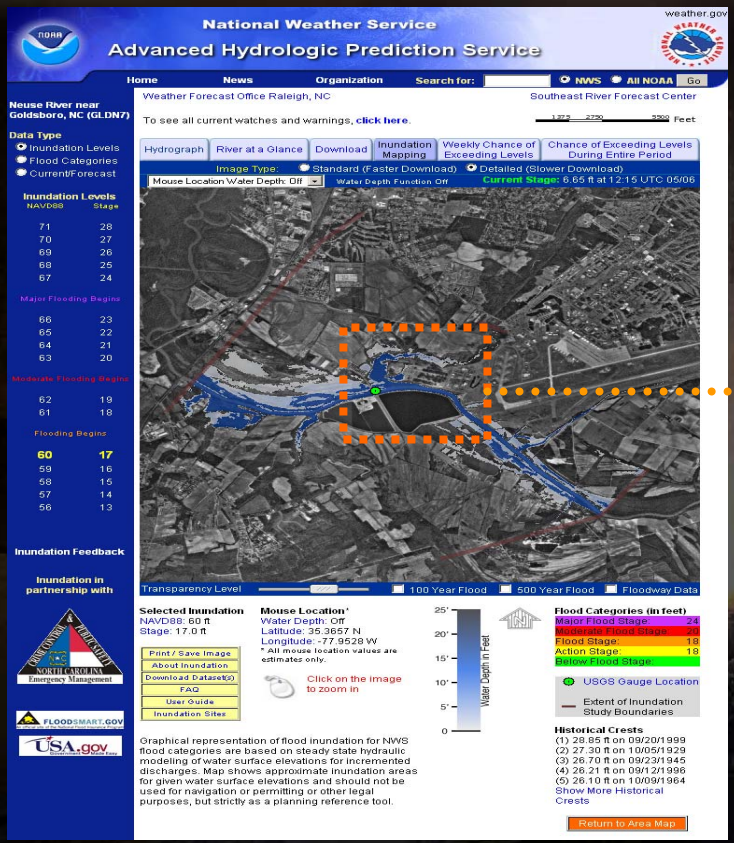
Inundation Map Interface – Zoom Features



Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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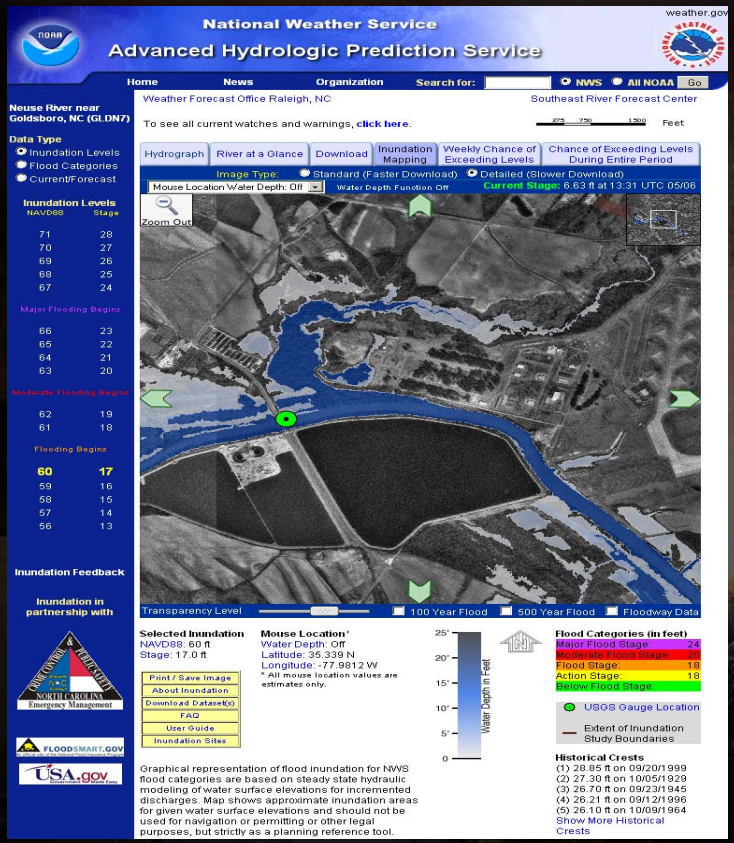
Inundation Map Interface – Zoom Features



Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

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Inundation Map Interface – Zoom Features

Mouse Location*
Water Depth: Off
Latitude: 35.3407 N
Longitude: -77.9919 W
* All mouse location values are estimates only.

Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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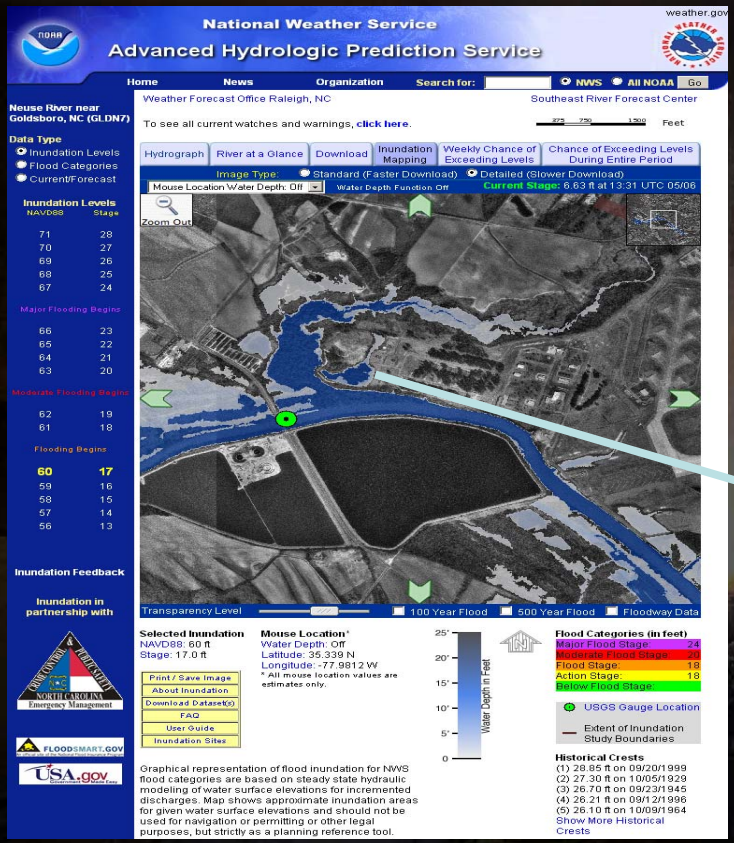
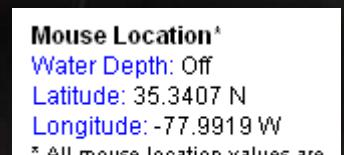
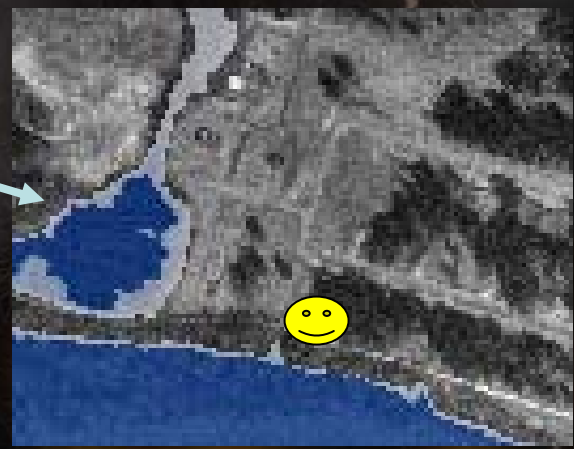
Inundation Map Interface – Zoom Features







Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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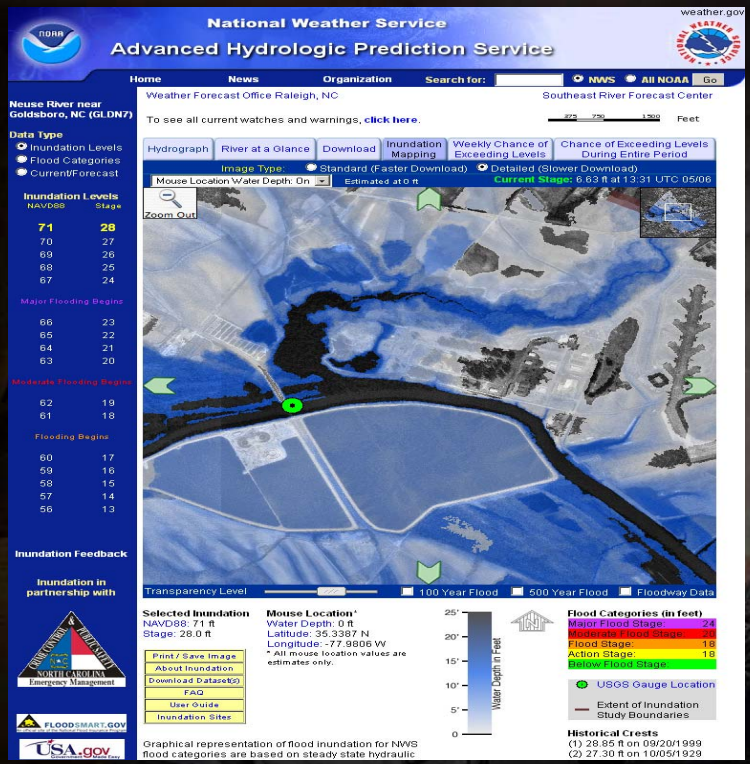
Inundation Map Interface – Zoom with Water Depths



Historical Crests
(1) 28.85 ft on 09/20/1999
(2) 27.30 ft on 10/05/1929
(3) 26.70 ft on 09/23/1945

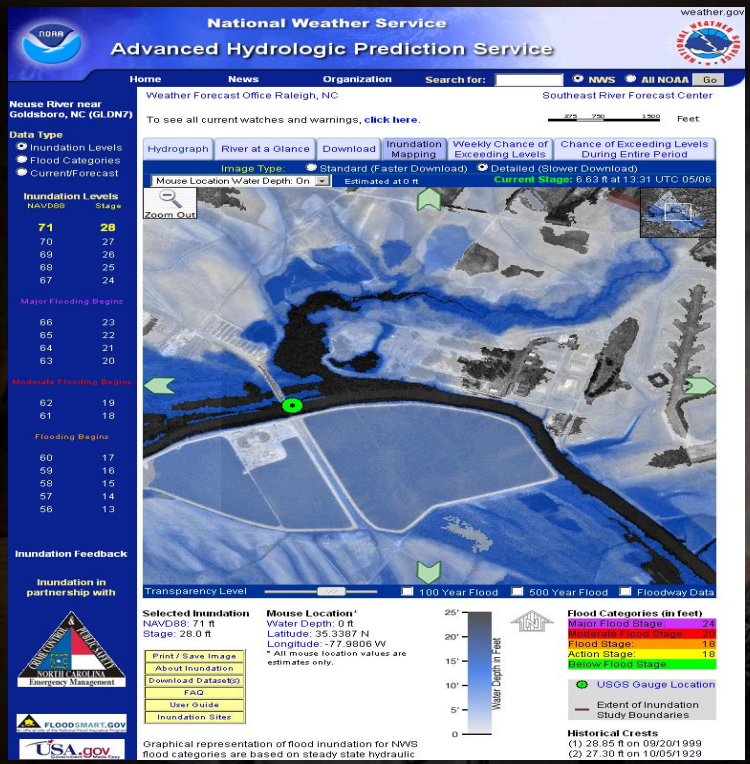
Selected Inundation
NAVD88: 71 ft
Stage: 28.0 ft

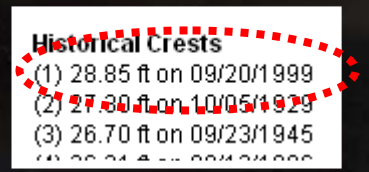
Water Predictions for Life Decisions

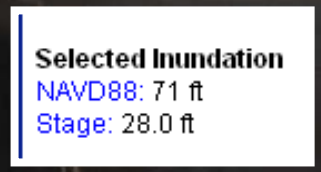
Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

National Weather Service

Inundation Map Interface – Zoom with Water Depths







Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Zoom with Water Depths

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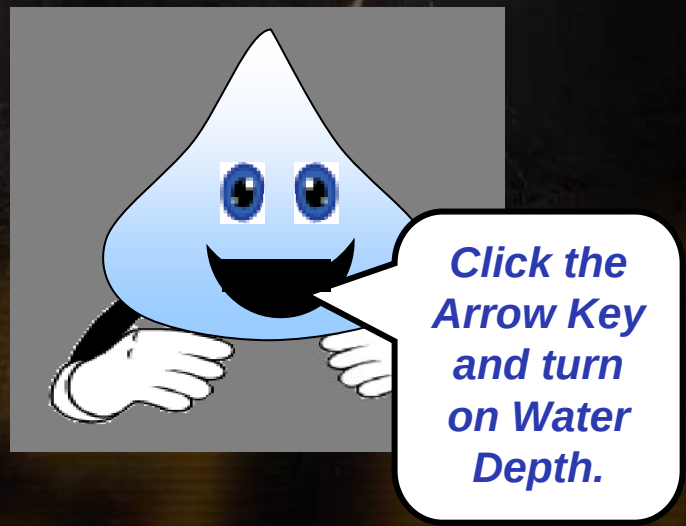

Water Predictions for Life Decisions

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http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

National Weather Service

Inundation Map Interface – Zoom with Water Depths

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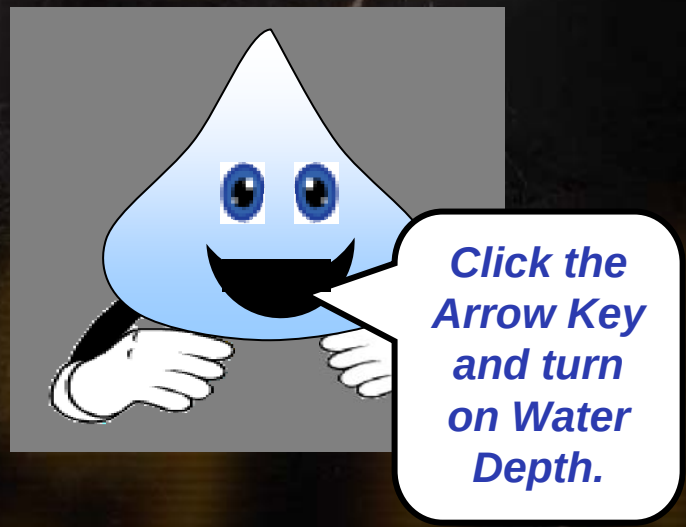
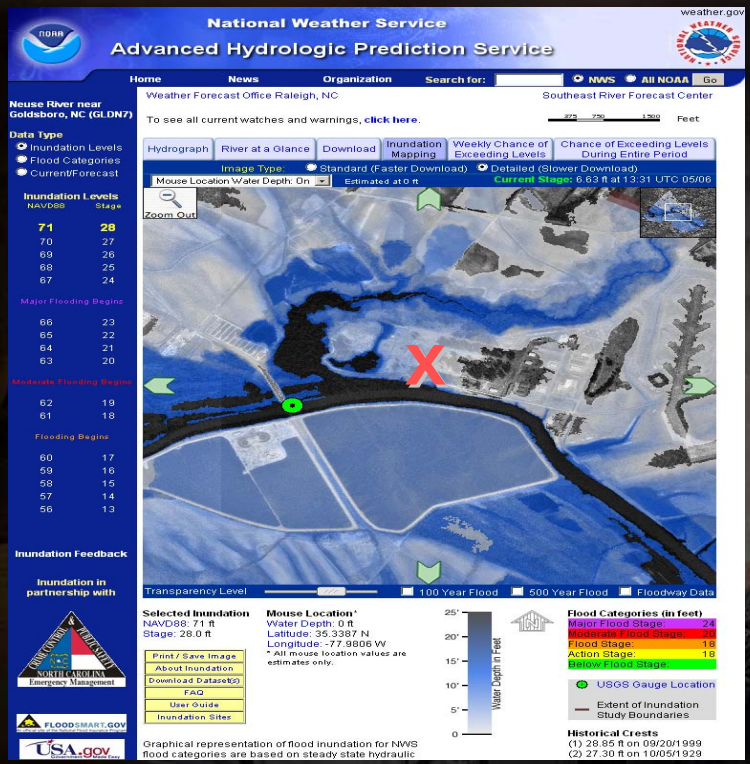


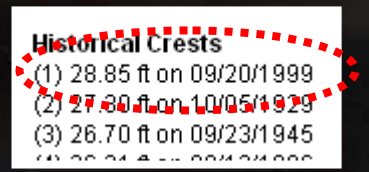
Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

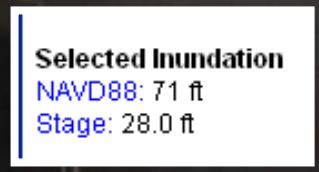
Water Predictions for Life Decisions

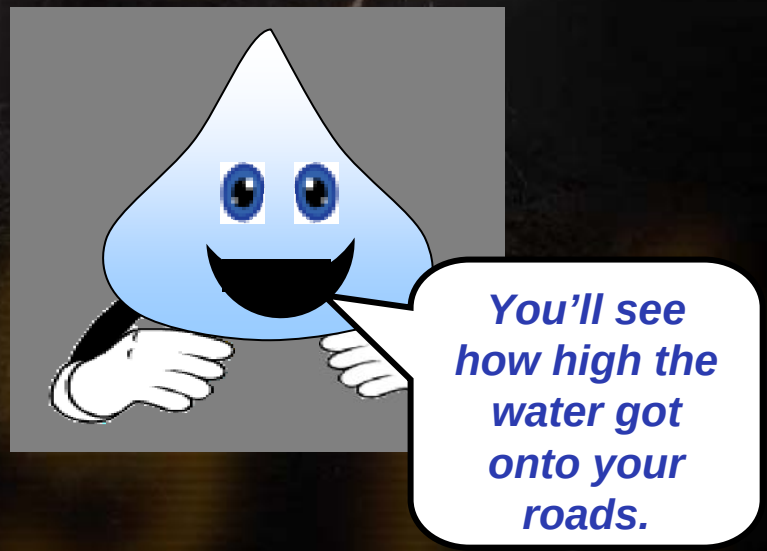
National Weather Service

Inundation Map Interface – Zoom with Water Depths







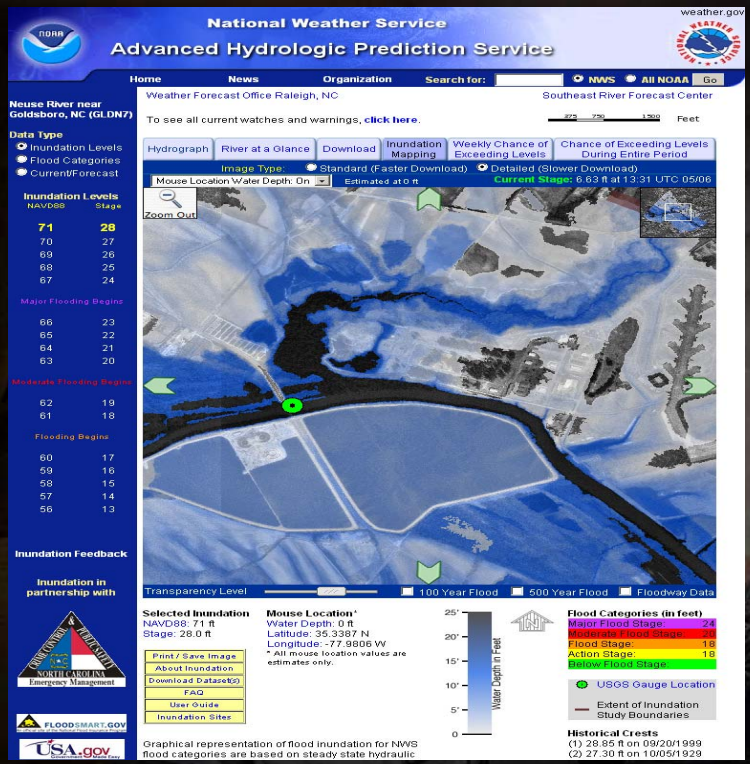


Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Zoom with Water Depths



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Water Predictions for Life Decisions

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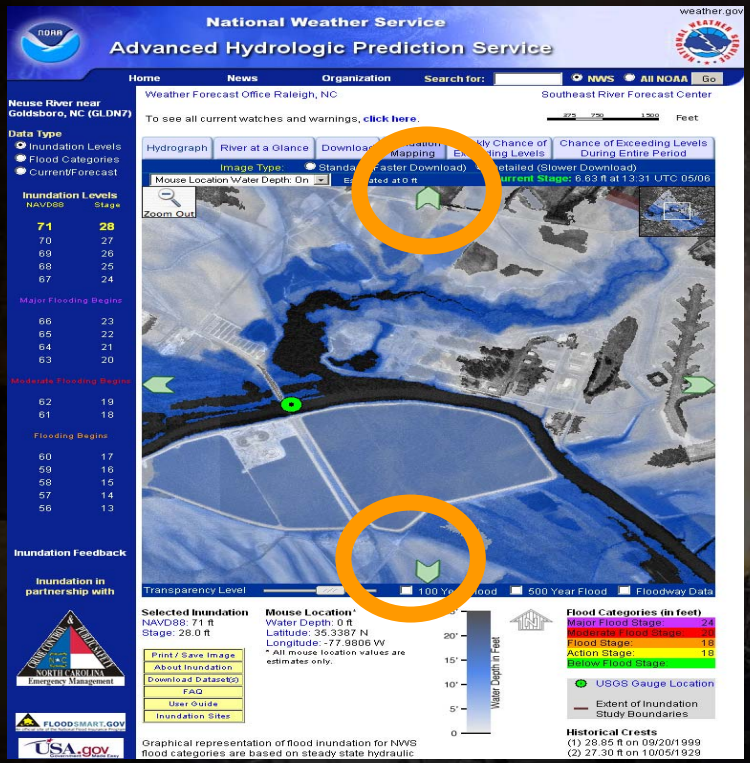
Inundation Map Interface – Navigation Features



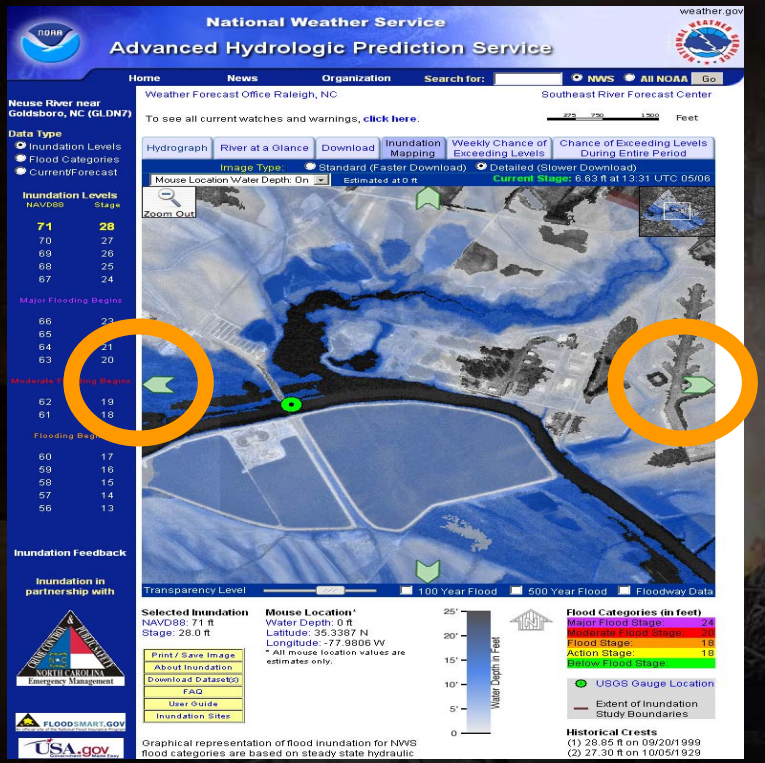
Up* and *Down
to other panels

Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Navigation Features



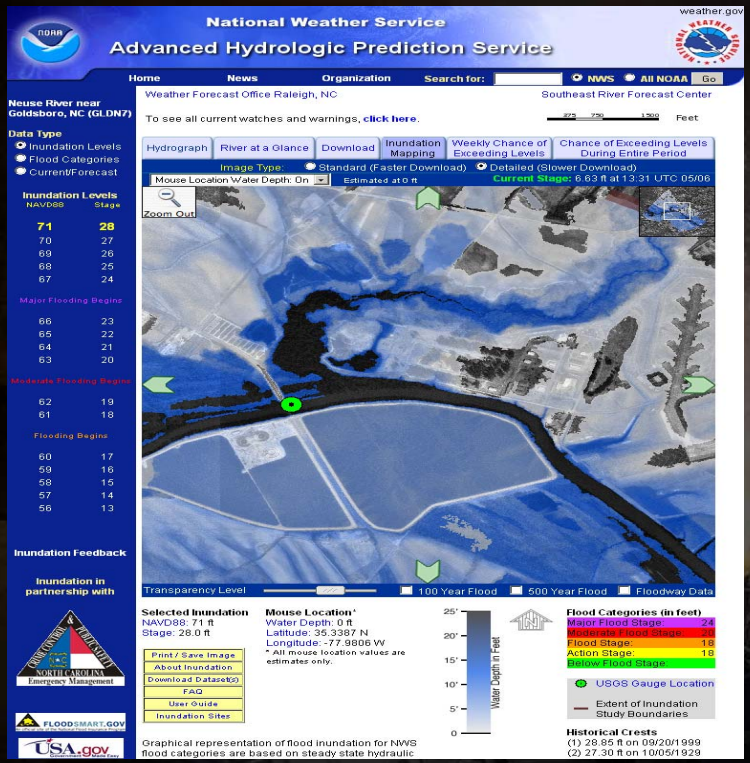
***Left* and *Right* to other panels**

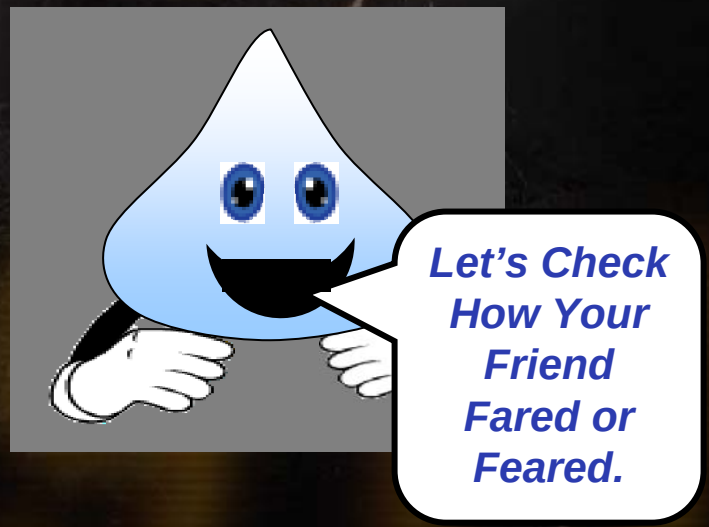
Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Navigation Features





Water Predictions for Life Decisions

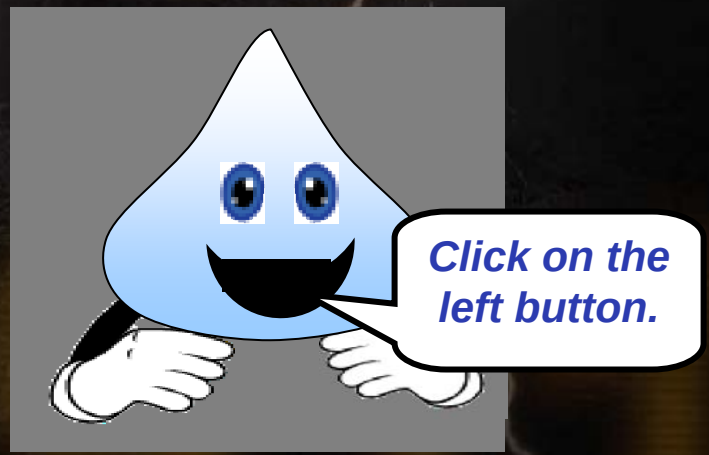
Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

National Weather Service

Inundation Map Interface – Navigation Features

Click Here



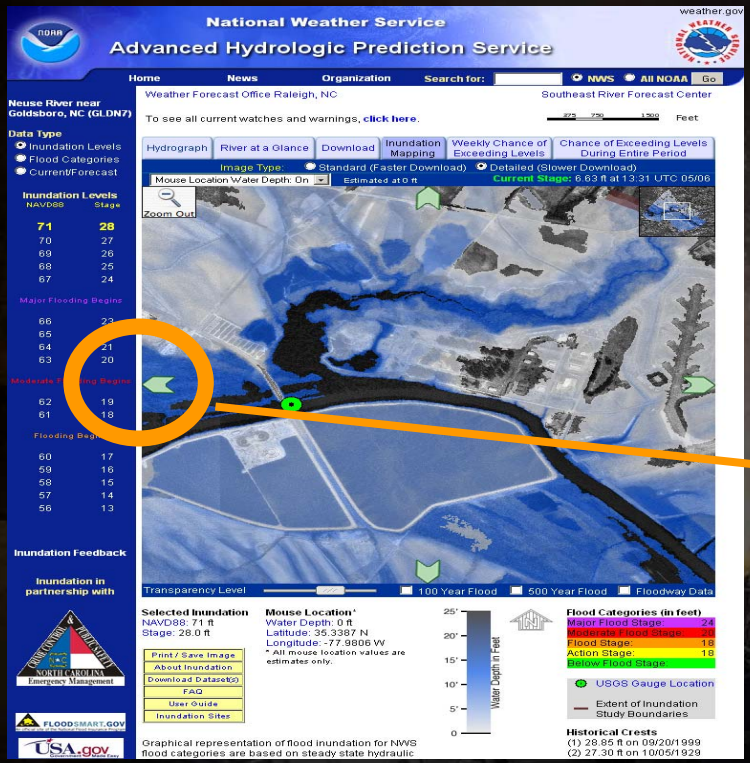
Water Predictions for Life Decisions

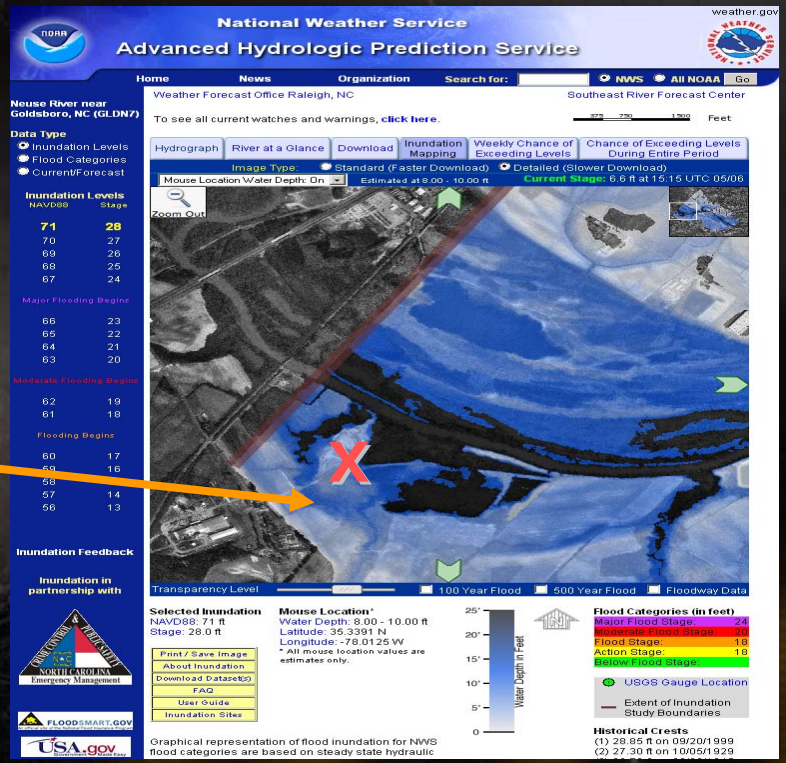
Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

National Weather Service

Inundation Map Interface – Navigation Features



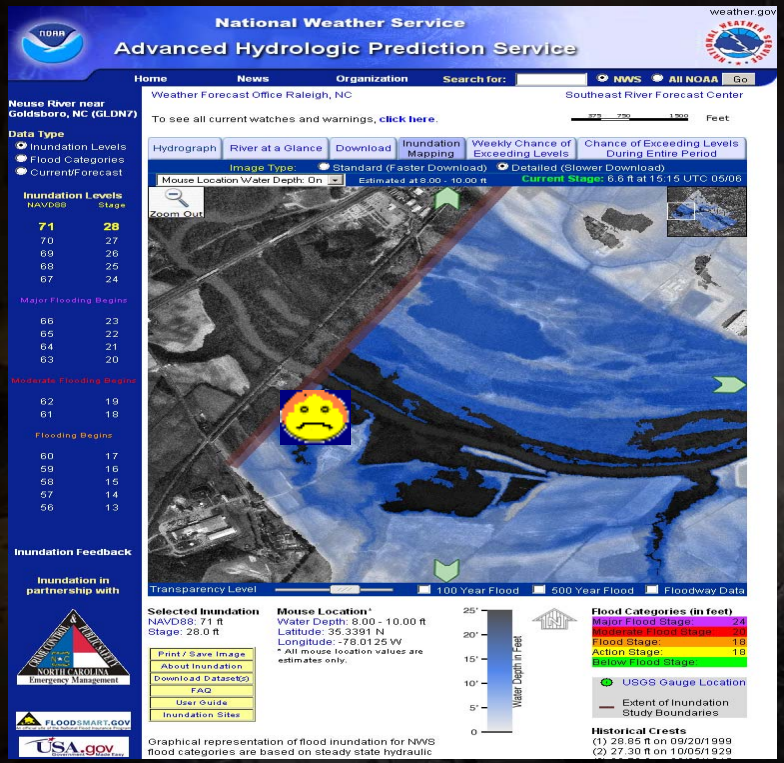


Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Navigation and Zoom

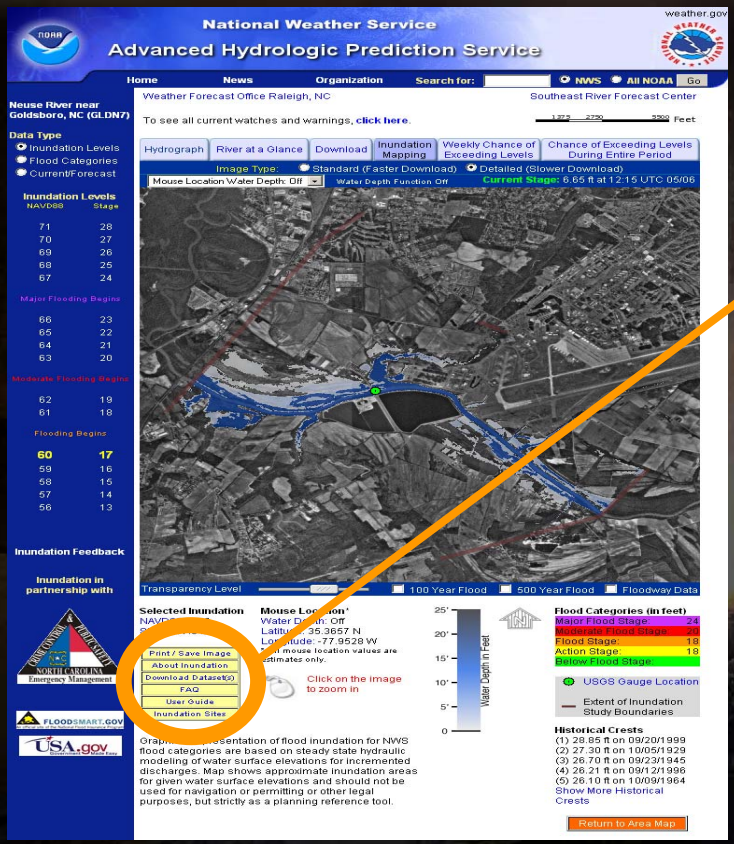


Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

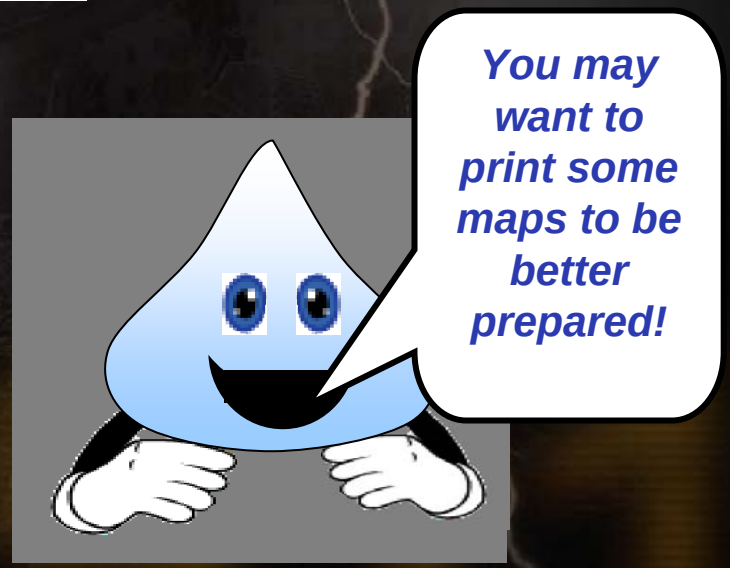
Water Predictions for Life Decisions

National Weather Service

Inundation Map Interface – Print Image



Click Here



Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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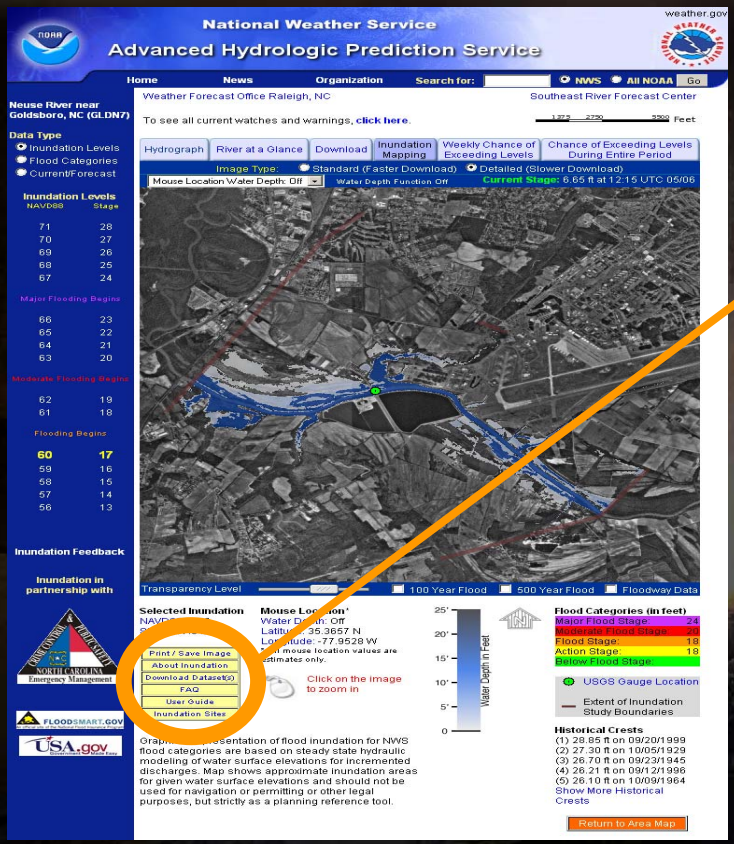
Inundation Map Interface – Download Data Sets



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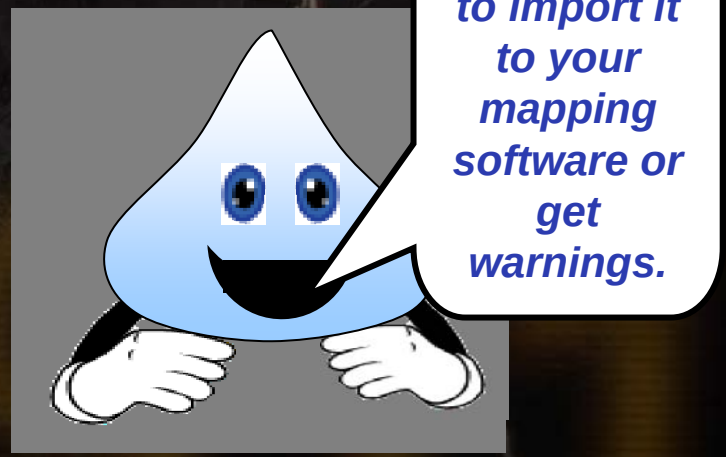

Reference:

http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

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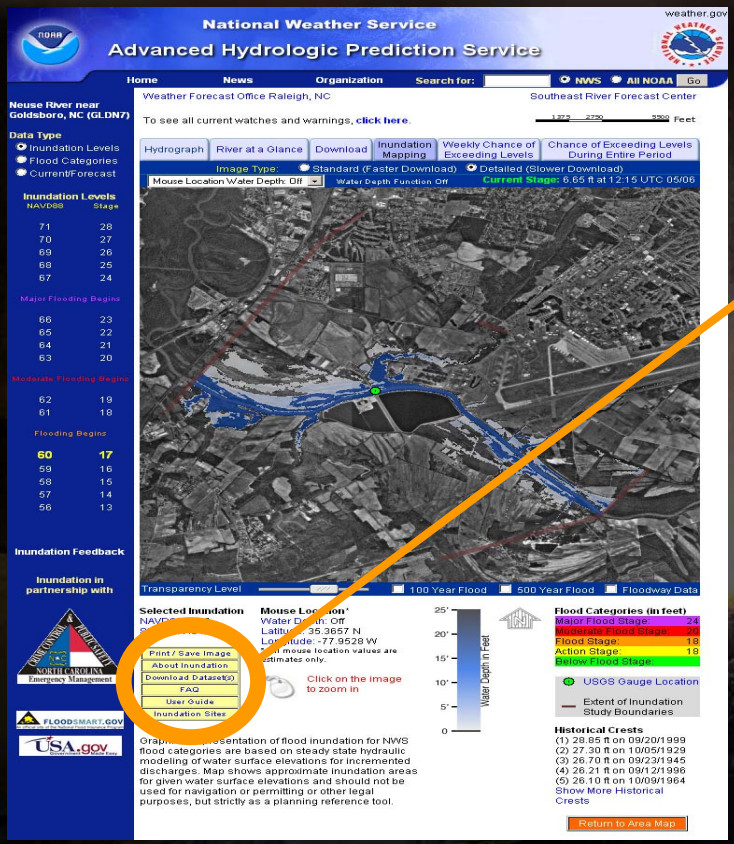
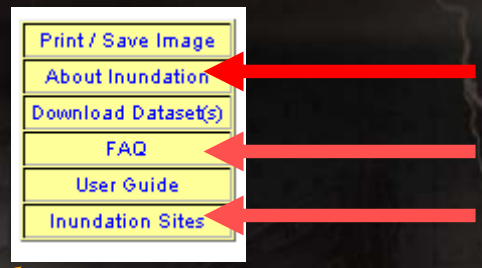
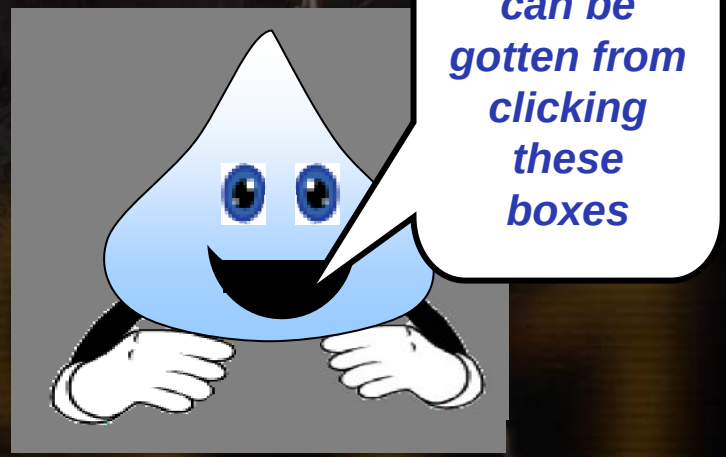
Inundation Map Interface – More Info





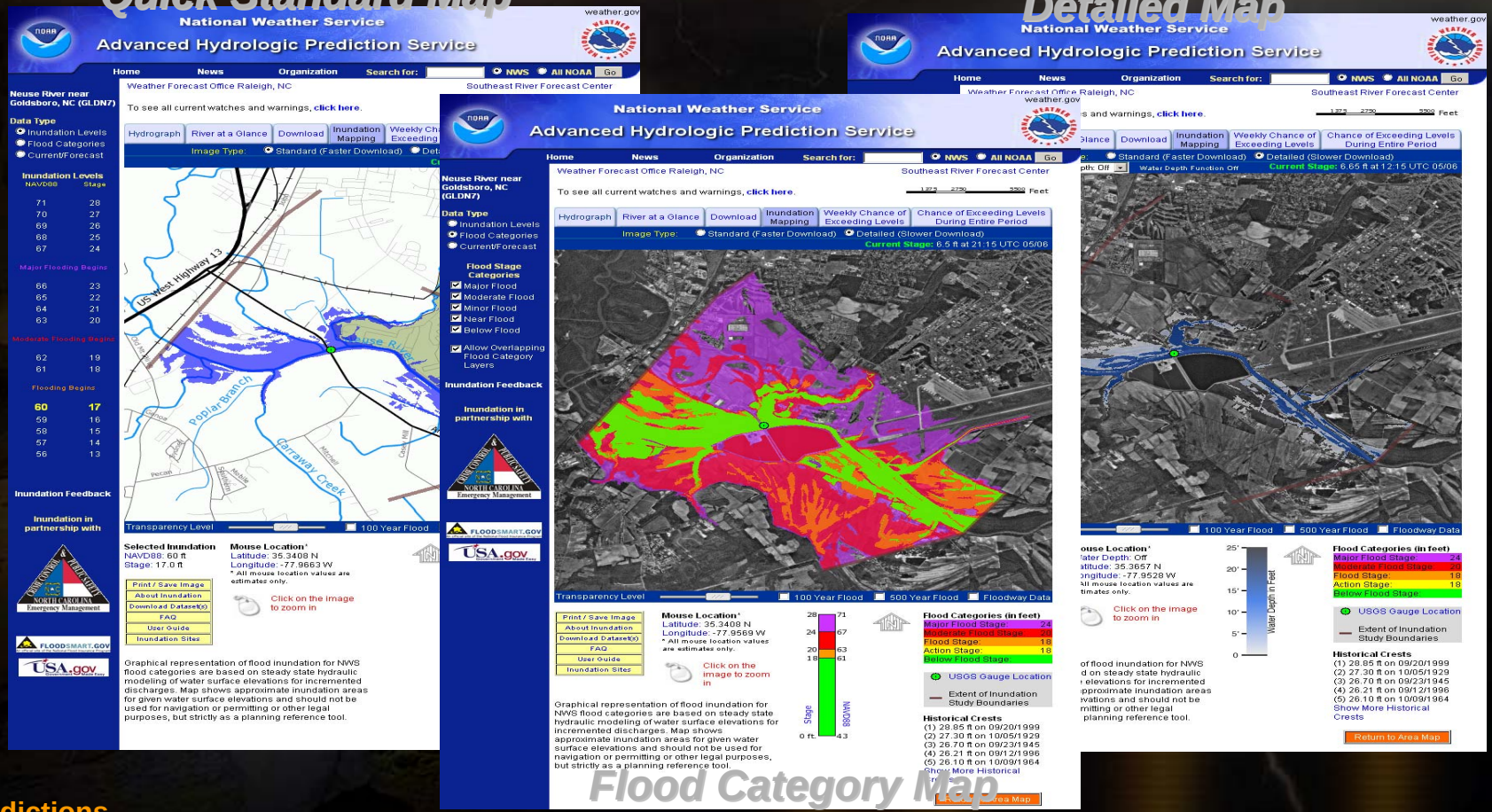


Reference:
http://newweb.erh.noaa.gov/ahps2/inundation/inundation.php?wfo=rah&gage=gldn7

Water Predictions for Life Decisions

National Weather Service

Inundation Mapping

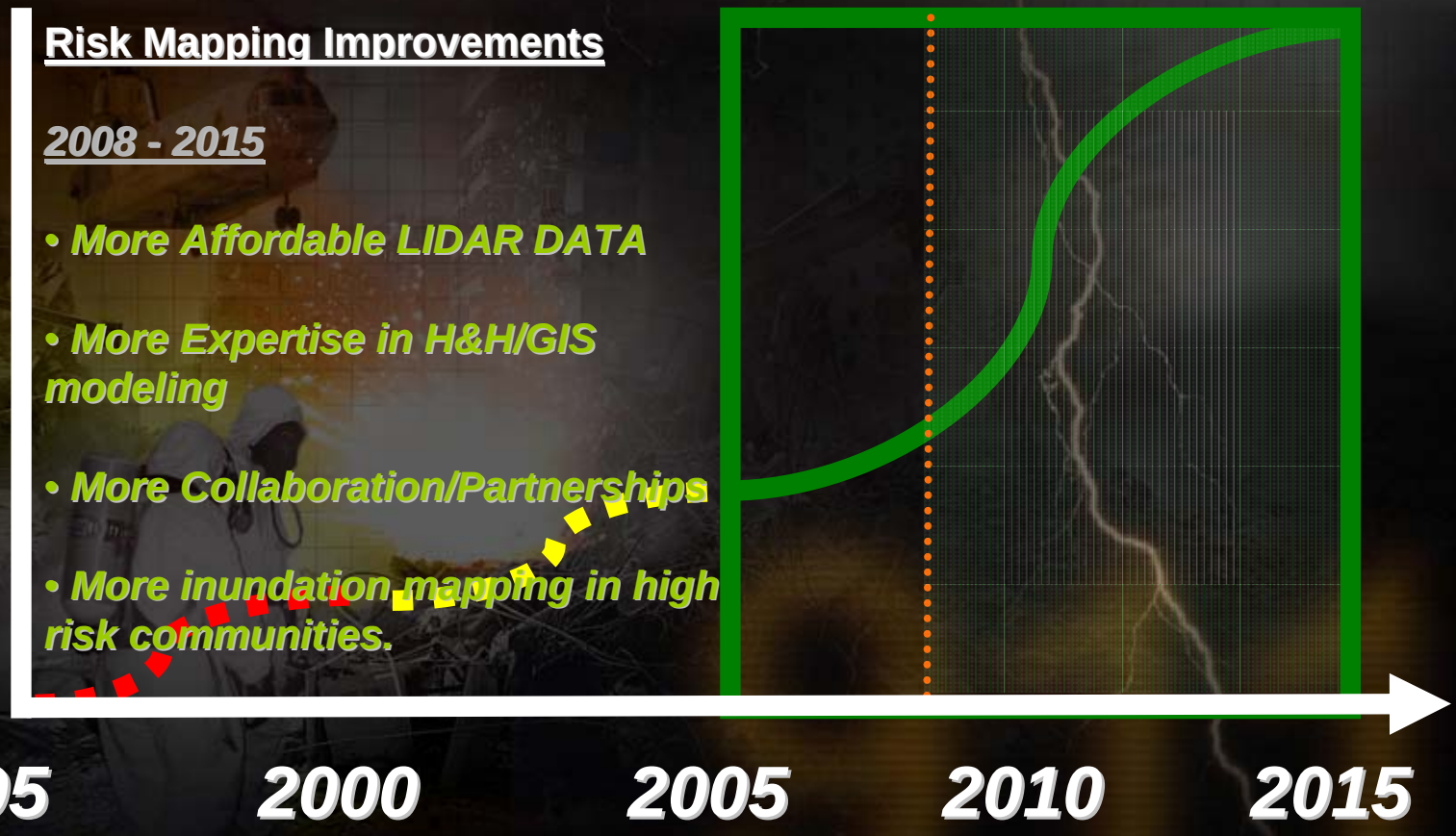


Water Predictions for Life Decisions

"America's NOAA National Weather Service: Protecting Lives, Livelihoods, and A Way of Life"

National Weather Service

Flood Mapping Science



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