

# NOAA's National Weather Service

## Water Resources Information on the Web A Manual for Users



Red River Flooding, March 19, 2010 Credit: NOAA/NOHRSC

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# Water Resources Information on the Web

## A Manual for Users

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## Introduction

NOAA's National Weather Service (NWS) provides a wide variety of water resources forecasts and information through the web. These web-based resources originate at NWS field, national center, and headquarters offices and are designed to meet the needs of a wide range of users from someone who needs the five-day forecast for a river near his home to the technically advanced water manager who needs probabilistic information to make long-term decisions on allocation of flood mitigation resources or water supply. The NWS will continue to expand and refine all types of web products to keep pace with the demands of all types of users.

### Gateway to Water Resources Web Resources

The gateway to water resources forecasts and information is entered at <http://water.weather.gov> or through the NWS home page (<http://www.weather.gov>) by clicking on the RIVERS, LAKES, RAINFALL link above the map.

### National Map – River Observations and River Forecasts Tabs

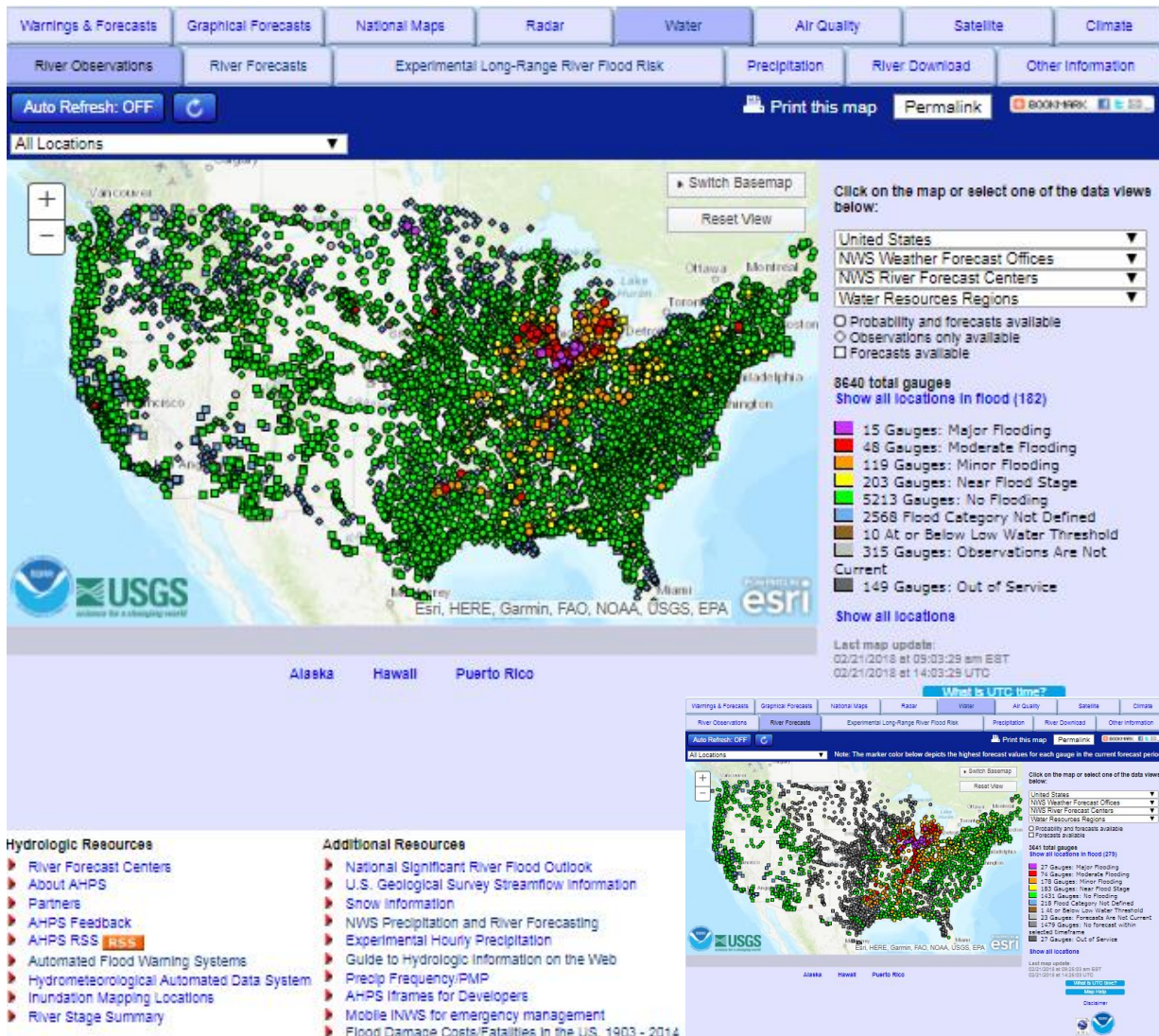
The starting point for obtaining NWS water resources products on the web is a national map showing locations where observations are available for river/stream gaging stations (Figure 1). Above the national map there are two rows of tabs. To access non-water related information, select tabs along the top row that are to the immediate left or right of the Water tab. The bottom row of tabs link to a specific map or menu and include: River Observations (default), River Forecasts, Experimental Long-Range River Flood Risk, Precipitation, River Download, and Other Information. The displays and other information available under these six tabs are discussed in this and other sections to follow.

When either the River Observations (default) or River Forecasts tabs above the national map are clicked, river/stream locations are displayed which are color coded according to the flood status of their most recent observation or the maximum forecast through the entire period as follows:

- **No Flooding (green)** – river/stream below level where flooding becomes a concern.
- **Near Flood Stage (yellow)** – flooding becomes a concern. River/stream is approaching or is forecast to approach the gage height – flood stage – where flooding is defined to begin. Flood stage is an established gage height for a given location at which a rise in water surface level begins to create a hazard to lives, property, or commerce.
- **Minor Flooding (orange)** - minimal or no property damage, but possibly some public threat.
- **Moderate Flooding (red)** - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- **Major Flooding (violet)** - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

The last three of these levels plus another not shown – record flooding – constitute the flood categories used by the NWS. While some degree of subjectivity is involved in determining flood

stage and the boundaries between minor, moderate, and major flooding, these categories have proven to be a valuable tool in describing the severity of flooding in all areas of the country. The upper left portion of Figure 1 is a sample map linked to the River Observations tab.



**Figure 1.** Portion of a sample web page for the NWS water resources web presence, showing default River Observations display and inset showing map linked to the River Forecasts tab.

The lower right portion of Figure 1 is a sample map linked to the River Forecasts tab. The River Forecasts map will show fewer locations than the River Observations map because river/stream forecasts (e.g., daily) are produced for fewer locations than where observations are available. NWS partners such as the U.S. Army Corps of Engineers and other Offices involved in river navigation, power generation, water management, emergency management, and similar water-related activities coordinate with the NWS on the river/stream locations, dams, reservoirs, and lakes which require routine forecasts. When high water or flooding occurs or threatens to occur, “non-routine” flood forecasts are issued for additional locations. Click [here](#) to view the current national river observations map and [here](#) to view the current national river forecasts map.

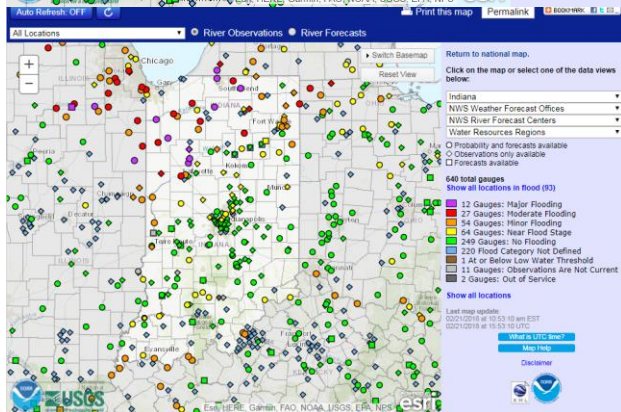
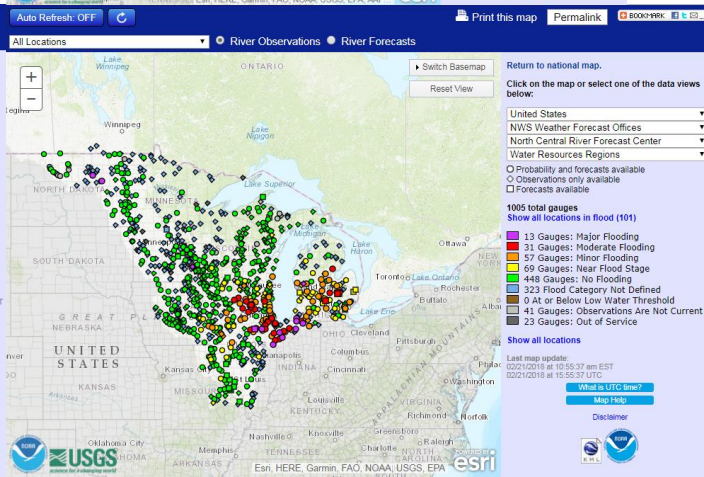
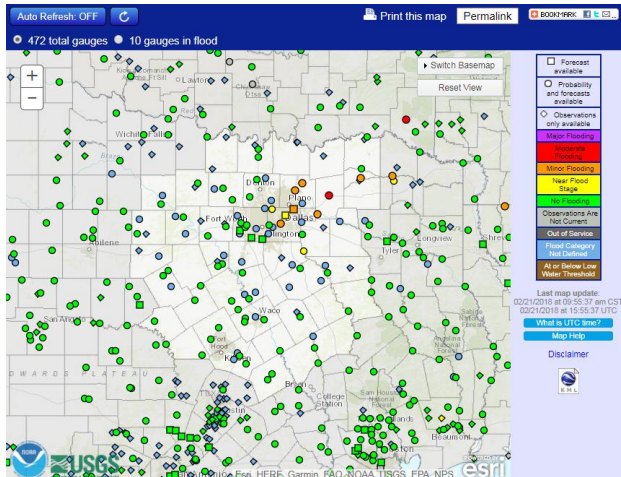
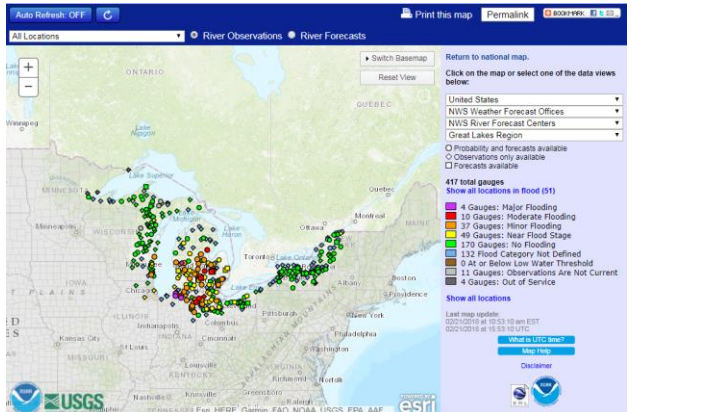
In the narrow dark blue area immediately below the tabs and above the national map, a white pull-down menu can be used to change the display of river/stream locations from all locations (default) to:

- **Hydrograph Only Locations** – hydrographs for individual river/stream locations provide a graphical overview of past and future conditions at a river/stream gage. Selecting this option causes the map to show only the locations for which hydrographs are available.
- **Hydrograph/Probability Forecast Locations** – specialized products with information on the probability of future river levels/flows are also available for selected river/stream locations. Selecting this option causes the map to show only the locations for which these probability forecasts and hydrographs are available.
- **Inundation Mapping Locations** – at a small but increasing number of river/stream locations, specialized interactive displays depicting the amount of land inundated on each side of the river/stream at various stages are available. Selecting this option causes the map to show only locations for which these inundation maps are available.
- **Near or Above Flood Stage Locations** – Selecting this option causes the map to show only locations that are or are forecast to be near or above flood stage.
- **At or Below Low Water Threshold Locations** – Selecting this option causes the map to show only locations that are or are forecast to be at or below low water threshold.

To the right of the National River Observations or River Forecasts maps, pull-down menus can be used to display river/stream locations across four types of regions. These regions include states, NWS Weather Forecast Office (WFO) hydrologic service areas (HSAs), NWS River Forecast Center (RFC) areas of responsibility, and United States Geological Survey (USGS) water resources regions (Figure 2).

Also available in the dark blue area are Auto Refresh: OFF/ON, Print this map, Permalink, and Bookmark & Share buttons. A permalink is a uniform resource locator (URL) that links to a web page that does not automatically have a web address associated with it. For example, if you want to always return to a web page with an ESRI map that is zoomed into a particular view, you can create a permalink for it by clicking on the Permalink button.

Below the national map under the Hydrologic Resources section is a [link](#) to a map showing NWS River Forecast Center (RFC) areas of responsibility. The 13 RFCs produce river forecasts for their own area of responsibility.

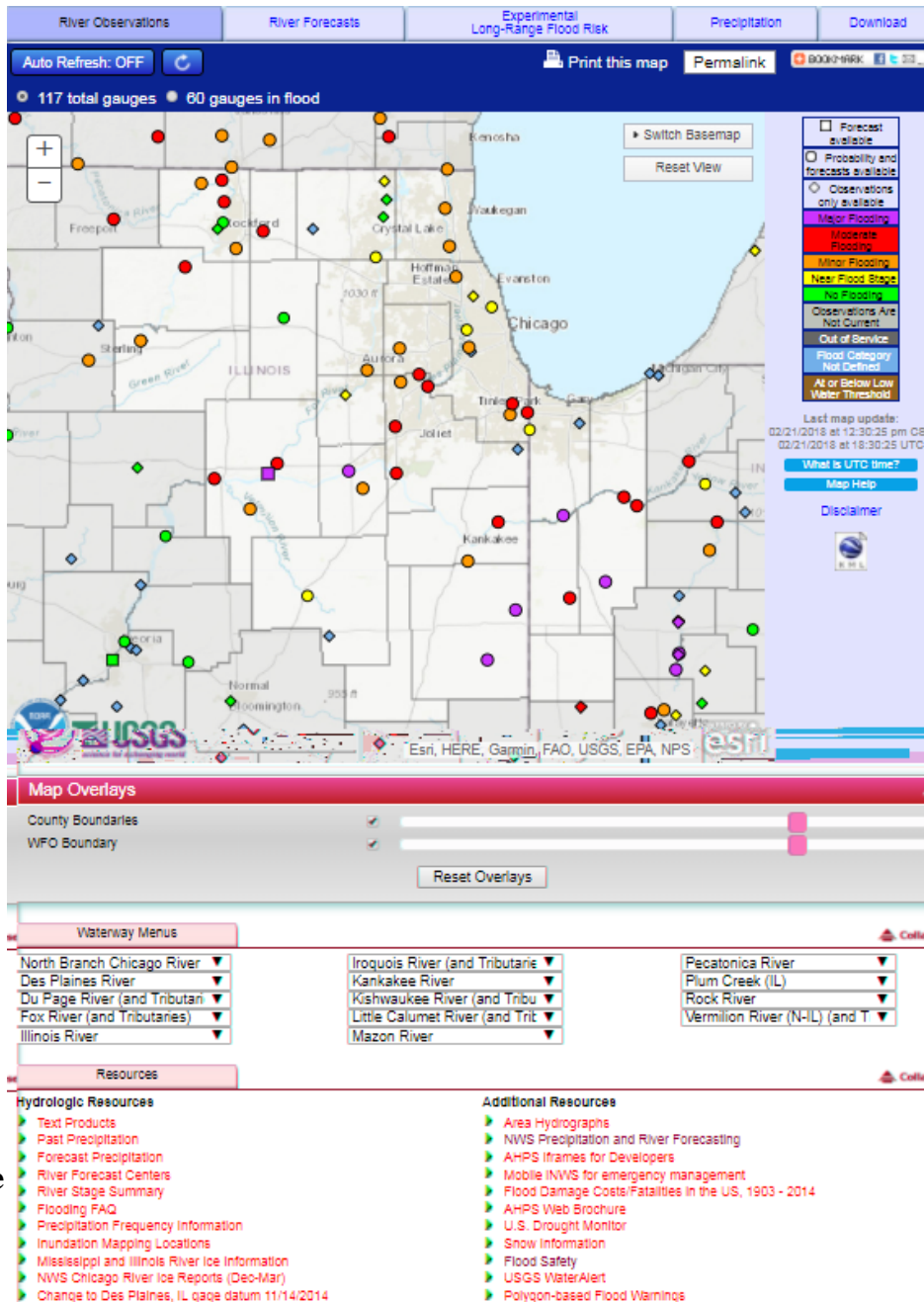


## **Regional Maps: River Observations and River Forecast Tabs**

Clicking on a point on the National River Observations or River Forecasts map displays a regional map covering an individual NWS WFO's HSA plus the surrounding area (Figure 3). Click [here](#) to view the current version of the HSA map shown in Figure 3. Most HSA maps cover all or portions of two or more states. For larger states, the map may cover only a portion of one state.

Users have access to ERSI's navigation controls on both national and regional maps. Use the ESRI plus and minus buttons to zoom in or out. Click and hold down your mouse button anywhere on the map and move the cursor to pan the map to the left, right, up, or down. Click on the Switch Basemap button to select the type of map to display. Options include a topographic map, USGS topographic map, imagery map with labels, street map, oceans, and light grey canvas. Clicking on the Reset View button takes you back to the original map view.

**Figure 2.** Portions of sample web pages depicting river forecast information at the state (upper left), WFO HSA (lower left), USGS water resource region (upper right), and River Forecast Center area of responsibility (lower right) levels.



**Figure**  
level.

the WFO HSA

River/stream gage locations on regional maps are color coded according to their current flood status using the same classification and color scheme as the National maps. Icons used for individual river locations, including diamonds, squares, and circles, provide additional information on the products available for a location. Diamonds indicate locations where only observations are available. Squares indicate locations where short-term forecasts are available. Circles indicate locations where short-term and probabilistic forecasts are available.

Like the national map, regional maps have tabs across the top allowing users to specify information provided at that scale. The first two tabs – “River Observations” and “River Forecasts” – correspond to the first two tabs on the national map with similar titles. The default “River



Observations” tab links to a regional map showing the flood status of the most current observation at river/stream gage locations. The “River Forecasts” tab links to a map that shows the maximum forecast flood category through the entire period at river/stream gage locations. Unlike the national map, a forecast timeline slider appears above the map and defaults to entire period. Because the period for which a forecast is prepared varies from RFC to RFC, the entire period generally ranges from 2 to 10 days. The forecast timeline slider consists of 6 to 10 tick marks and a yellow button. Each tick mark represents a day in the forecast period, ranging from day 1 on the far left to day 10 on the far right. When first bringing up a regional map, the forecast timeline slider button is at entire period, its default position. The locations on the regional map are color-coded according to their maximum forecast flood category through the entire period. To view the maximum forecast flood category through day 1, move the slider button all the way to the left to day 1. Above the forecast timeline slider, notice that the “Maximum Forecast Flood Category Through: day time” changes to “1-Day Maximum Forecast Flood Category Through: current day+1 time”. Moving the forecast timeline slider button to the right to tick mark #9 displays locations that are color-colored according to their maximum forecast flood category through day 9. When moving the button, a loading spinner will appear. Once changes to the forecast timeframe are complete, the loading spinner will disappear. Because not every RFC produces river forecasts out to 9 days, it is normal to expect an increase in the number of river/stream gage locations being grayed out (shown as No Forecast Within Selected Timeframe) as one increases the forecast timeframe from day 1 to day 9.

The Experimental Long-Range Flood Risk tab above the regional maps leads to a map showing the long-range (3-month) risk of minor, moderate, and major river flooding at locations where long-term probabilistic forecasts are produced. The Precipitation tab leads to maps of observed precipitation during the most recent 24-hour period ending at 1200 Coordinated Universal Time (UTC)<sup>1</sup>. The Download tab provides access to downloadable shapefiles, KMZ, and RSS/XML files.

**River Location: Hydrograph Tab.** Hovering over a color-coded river location on a regional “River Observations” or “River Forecasts” map brings up a small observed/forecast hydrograph for that location. Click on the location to bring up expanded information as shown in Figure 4. (Click [here](#) to view the latest hydrograph page for the Iroquois River at Iroquois, IL).

Hydrograph plots are divided into left and right portions, separated by a vertical blue dashed line. The vertical line represents the “base time” for which the hydrograph was created, with past observations plotted to the left using blue dots and forecasts for the future (if available) plotted to the right using purple dots. The bottom scale for the hydrograph is labeled with dates and time. The river/stream stage<sup>2</sup>, or gage height, in feet, is indicated along the left vertical axis of the

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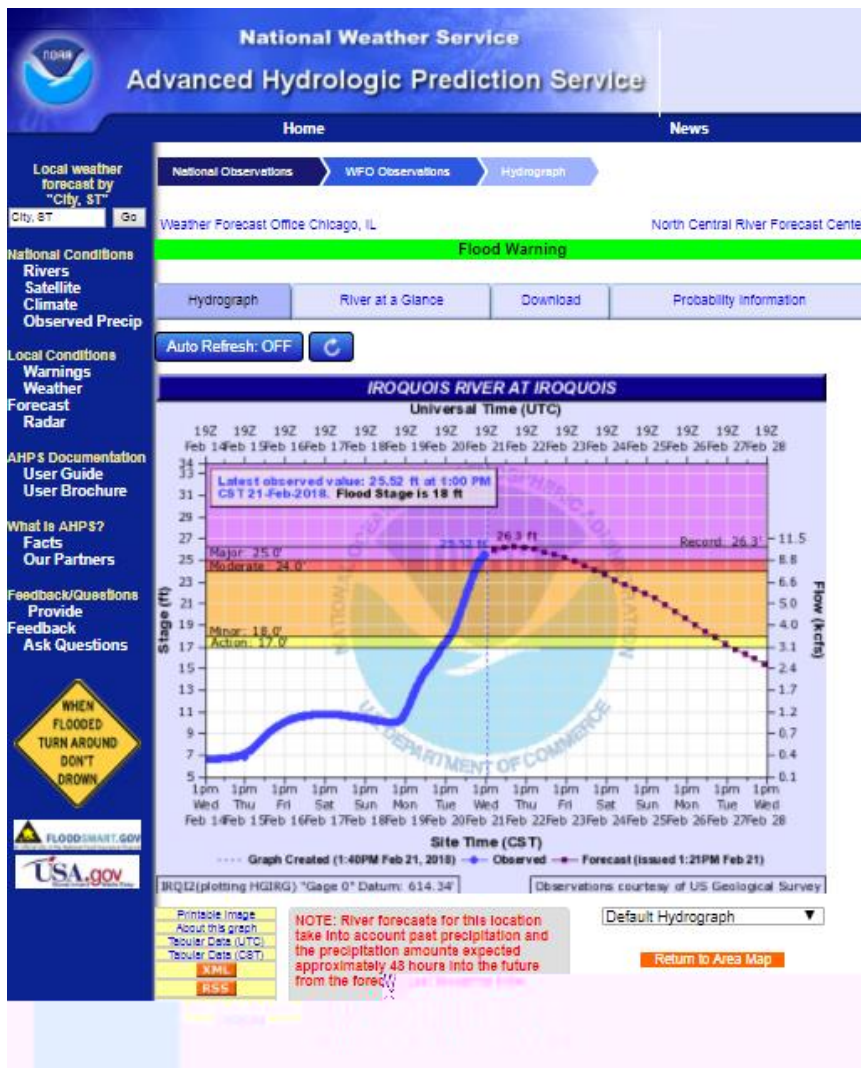
<sup>1</sup> 1200 UTC is 7:00 a.m. EST (8:00 a.m. EDT), 6:00 a.m. CST (7:00 a.m. CDT), 5:00 a.m. MST (6:00 a.m. MDT), 4:00 a.m. PST (5:00 a.m. PDT), and 3:00 a.m. AKST (4:00 a.m. AKDT).

<sup>2</sup> Stage for a river or stream is provided in two ways – (1) height above a locally fixed level known as gage datum or gage zero and (2) absolute elevation above a fixed location in North America (at Father Point, Rimouski, Quebec, Canada) known as the North American Vertical Datum of 1988 (NAVD 88 – new standard) or an older datum known as National Geodetic Vertical Datum of 1929 (NGVD 29). 0.0 feet NAVD 88 or NGVD 29 is not the same as mean sea level (MSL), but they are fairly close (see [http://tidesandcurrents.noaa.gov/datum\\_options.html](http://tidesandcurrents.noaa.gov/datum_options.html) for more precise definitions). In general, stages above locally fixed levels tend to be numerically smaller than elevations above NAVD 88 or NGVD 29, because absolute elevations are in the hundreds or thousands of feet in higher inland areas. Of course, this may not hold true for gages in low elevation areas near the coast.

observed/forecast hydrograph. The flow (discharge) corresponding to the stage is provided along the right vertical axis in cubic feet per second (cfs) or thousands of cubic feet per second (kcfs). Some readers may be more familiar with flows in gallons per minute, but hydrologists and engineers decided long ago that the numbers were too large when flows were expressed in those units. You may notice that each stage on the left side corresponds to a single flow on the right, and flow rate increases with stage. This is true except in the rare case of near-peak flood flows on rivers in very flat areas.

Information Below Hydrograph. A small yellow menu below the hydrograph provides access to:

- A printable .pdf version of the hydrograph,
- A definition of a hydrograph along with explanations of key terms used in the display,
- A tabulation of all the observed and, if available, forecast data shown in the hydrograph,
- A downloadable XML file containing all observed and, if available, forecast data shown in the hydrograph,
- A description of how to automatically receive, via RSS, an XML-encoded version of the hydrograph you are viewing each time it is updated,
- The datum which stages are referenced to (NAVD 88 or NGVD 29), and
- A metadata (i.e., descriptive information on a location) table for the stream gage station.



**Figure 4.** Sample hydrograph showing observed and forecast data.

Also below the hydrograph, a small pull-down menu to the right gives the user the option to display the hydrograph with a vertical scale that is close to the range of past, current, and future (if available) stages, or a vertical scale that is stretched out to include colored portions indicating the minor, moderate, and major flood categories as well as the action stage and record flood level. The former is the default display, but if a river/stream is already in flood or is forecast to be in flood, the hydrograph display will automatically include flood categories.

If the location currently being viewed has upstream and/or downstream gages, arrows labeled “Upstream Gauge” and “Downstream Gauge” can be found under the hydrograph and below the level of the yellow menu. This allows the user to review the hydrographs for river/stream locations in sequential order, which can be useful during a flood episode.

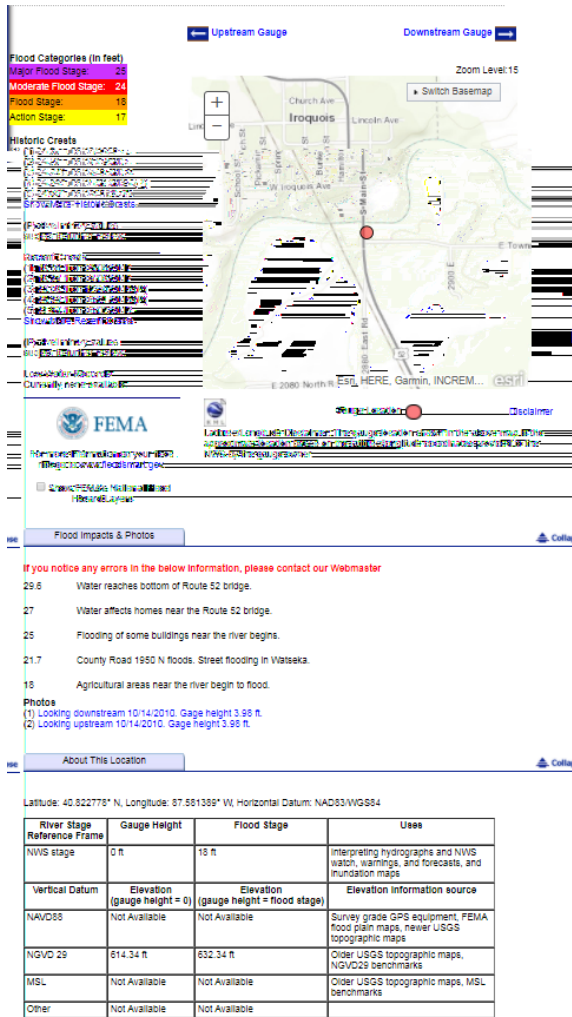
Still further below the hydrograph, a gage location map is provided with ESRI Map capabilities (Figure 5). For many locations, users can choose to display FEMA’s National Flood Hazard Layers on this map. To the left of this map, tables of historic crests, recent crests, and, if

available, low water records are provided. This historical information is useful in comparing a current flood or low flow event to past events.

A list labeled “Flood Impacts” or “Flood Impacts & Photos” is provided below the gage location map and historical flood/low flow tables (Figure 5, lower half). This information describes impacts a river/stream will have at various upstream and downstream locations (e.g., roads, bridges, homes, commercial buildings, water treatment plants) at various stages. The lowest stage and associated impact is at the bottom of the list and the highest stage and most severe flood impact is listed the top. Photos of the river/stream gage locations may also be included.

Several tabbed sections are found below the flood impact list providing access to other kinds of information on the river/stream location (Figure 5). Each of these tabbed sections can be expanded or collapsed by the user. Information under these tabs includes:

- “About This Location,” which provides the same information obtained when clicking on “Metadata” in the yellow menu box;
- “Additional Information,” which provides miscellaneous information on the river/stream gaging station such as photos of upstream and downstream areas;
- “Resources,” which provides links to several web locations where additional information supporting the decision making process during hydrologic events can be found;
- “Collaborative Agencies,” which lists agencies at all levels of government with interests in hydrologic conditions at the location; and
- “NWS Information,” which contains the address of the NWS WFO responsible for forecasts and warnings at the gaging station, a point of contact at the WFO, a disclaimer notice, and various NWS-related links.



**Figure 5.** Sample gauge location map, flood impact descriptions, and tabs for various types of information on a river/stream location.

**River Location: River at a Glance Tab.** Clicking on this tab allows the user to create a customized product for all or a subset of locations along a given river. Users select any combination of the following graphics and data to be included in this product: observed stage/flow and forecast hydrograph for the point; numerical observed stage/flow and forecast values; flood impact information; chance of exceeding stage, flow and/or volume levels during entire (long term) period graphic; weekly chance of exceeding stage, flow, or volume levels graphic; location map; historical crests; low flow, low water impacts, low water records, and downloadable RSS/XML files. Some of these items, such as the probabilistic products, are not available for all forecast points. Therefore, the menu for selecting items to include in a customized product is not identical for all areas of the country. Click [here](#) to view the menu which appears after clicking on the “River at a Glance” tab for the Iroquois River at Iroquois location.

**River Location: Download Tab.** Clicking on this tab brings up a menu providing for the download of several forms of information on the river/stream location, which include, but aren't limited to, an:

- Observed/forecast hydrograph image,
- Observed/forecast data and metadata on the forecast point in XML format,
- Criteria-based RSS feeds initiated by subscription, location map image,
- Flood Impacts
- Weekly chance of exceeding levels image (discussed shortly),
- Chance of exceeding levels during entire (long term) period image (discussed shortly),
- Record crest history,
- Low flow impacts and records,
- Inundation map shapefiles,
- Inundation map KMZ files,
- Inundation map images, and
- Photos.

The number of options available varies by location. Click [here](#) to view the menu with the options appearing after clicking the “Download” tab for the Iroquois River at Iroquois.

**River Location: Inundation Mapping Tab.** The inundation mapping interface (Figure 6), if available for the location, is accessed through this tab. This feature is available for NWS forecast points where data sets known as flood inundation libraries have been developed through partnerships with federal, state, or local agencies. The inundation mapping interface provides information on the spatial extent and, for some locations, depth of flood waters in the vicinity of the forecast point. It provides the ability to view inundation levels at stage (to the nearest foot) in the minor, moderate, and major flood categories. Figure 6 shows inundation at a stage of 21 feet for Killbuck Creek at Killbuck. From this interface, the user can also view maps of observed or forecast inundation levels based on current NWS river forecasts. The user has the option to use six different types of maps, including topographic map, USGS topographic map, imagery map with labels, street map, oceans, and light grey canvas map. Click [here](#) to view the current inundation map interface for Killbuck Creek at Killbuck.

Additional information on the inundation mapping interface is available at:

[http://water.weather.gov/ahps2/inundation/inundation\\_mapping\\_user\\_guide.pdf](http://water.weather.gov/ahps2/inundation/inundation_mapping_user_guide.pdf)

A user guide video on YouTube is available at:

<http://www.youtube.com/watch?v=flyTdd7f2JI>

Currently, a limited number of NWS forecast locations have a flood inundation mapping interface. A list of these locations can be found at:

<http://water.weather.gov/ahps/inundation.php>

As already mentioned, inundation map shapefiles, KMZ files, and images may be downloaded by clicking on the “Download” tab along the top of an inundation map.

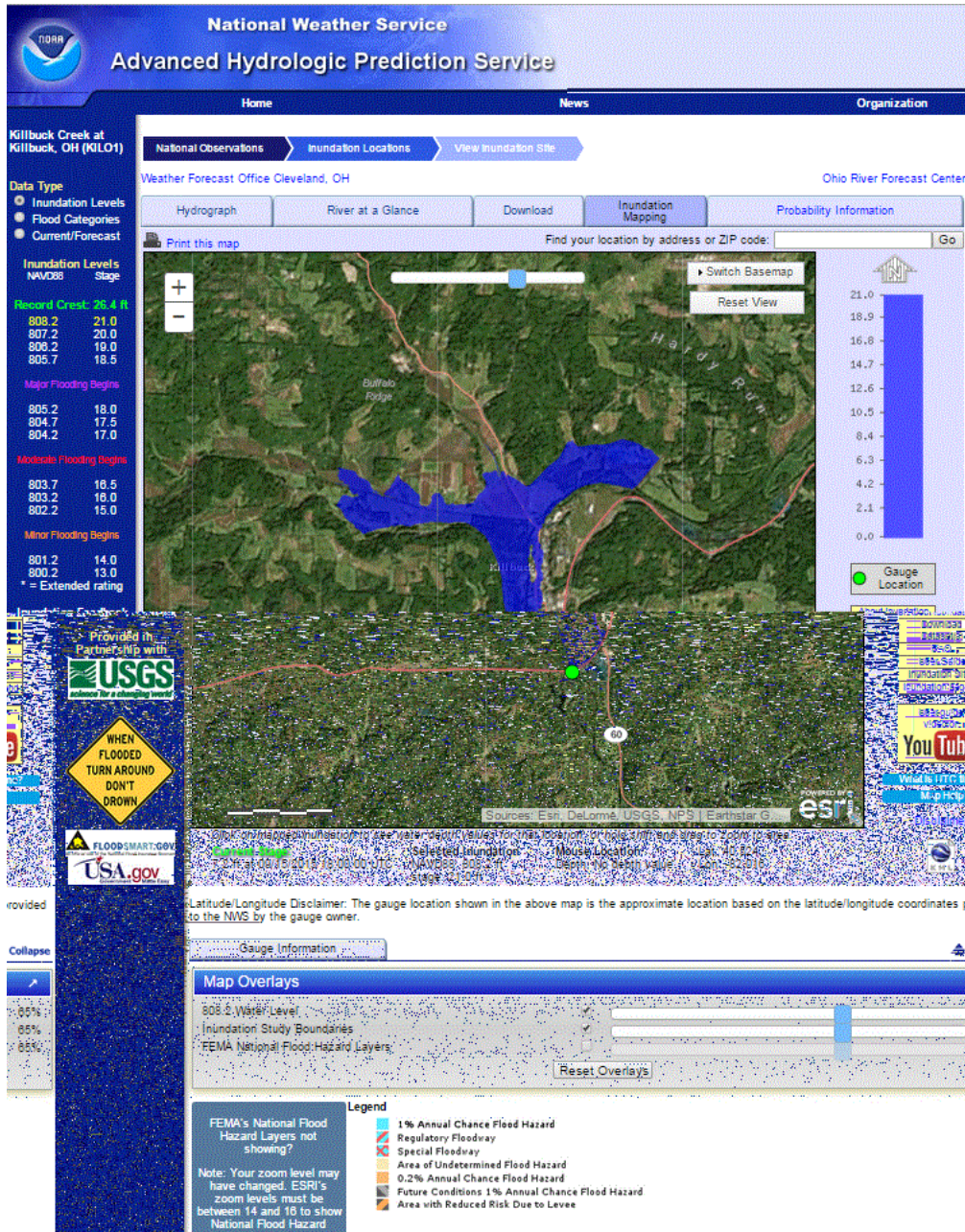


Figure 6. Sample Flood Inundation Mapping Interface.

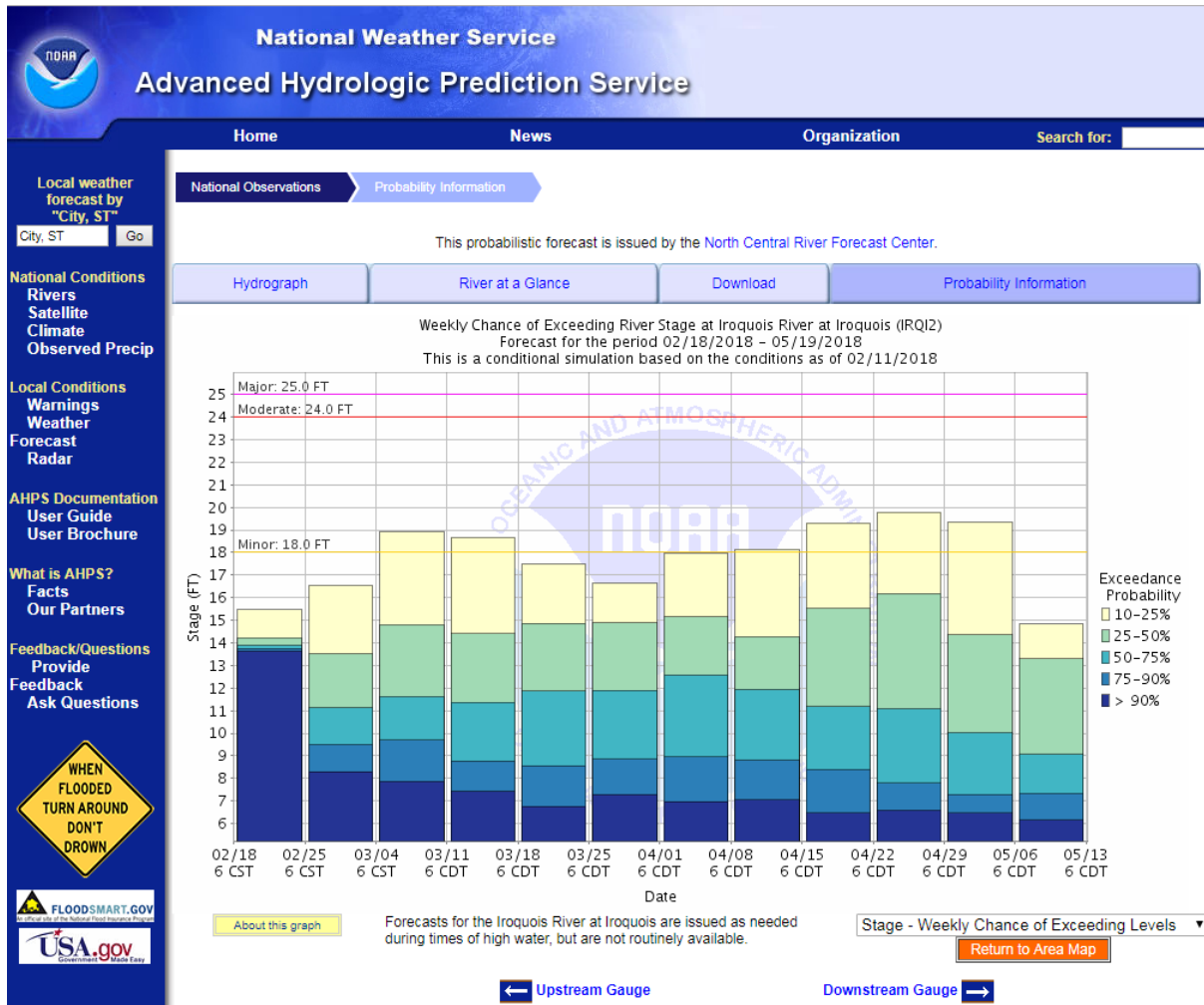


Figure 7. Sample Weekly Chance of Exceeding Levels product.

**River Location: Probability Information Tab (Weekly Chance of Exceeding Levels).**

Hovering over this tab and selecting Weekly Chance of Exceeding Levels brings up a graphical product showing the probability or chance of the maximum stage, flow or volume at a point on a river exceeding a particular value for consecutive 7-day periods in a 90-day interval. The vertical axis shows river stage or level measured in feet (ft) and the horizontal axis shows time. An individual multi-color vertical bar represents the exceedance probabilities for a 7-day period, each color representing a range of probability as defined in the key to the right of the graph. A sample display is provided in Figure 7. Click [here](#) to view the most recently generated Weekly Chance of Exceeding Levels product for the Iroquois River at Iroquois.

**River Location: Probability Information Tab (Chance of Exceeding Levels During Entire Period).**

Hovering over this tab and selecting Chance of Exceeding Levels During Entire Period brings up a graphical product showing probability of the river stage, flow, or volume (the user selects one of these) going above various levels during the forecast period labeled above the graph (usually 30 or 90 days). A sample display is provided in Figure 8. This graphical product shows two sets of connected dots forming somewhat irregular traces which look somewhat like curving lines. These two traces can be described as follows:



- **Historical simulation (HS).** A trace of small, blue dots indicating chances of a river going above the stages, flows, or volumes read along the vertical graph axis based on the total range of past levels in the long-term historical record (e.g., covering next 90 days).
- **Conditional simulation (CS).** A trace of small, black triangles indicating chances of a river going above the stages, flows, or volumes read along the vertical axis. This trace is based on current weather and hydrologic observations plus the years from the historical record which are similar to the expected weather pattern as indicated in the long-term weather (climate) forecast (e.g., for next 90 days).



**Figure 8.** Sample Chance of Exceeding Levels During Entire Period product.

Chance of Exceeding Levels During Entire Period graphics may look a bit too technical and abstract at first, but they provide a significant amount of information on the probability of hydrologic conditions reaching various levels of impact during the next 1-3 months, including:

- If the black trace is above the blue trace (historical simulation), future river/stream flows are expected to be higher than normal. If the black trace is below the blue trace (as in Figure 8), flows are expected to be lower than normal.

- If the left portion of the black trace is level (for higher probabilities), the river was already at that level at the start of the long-term forecast period.
- Noting the probability on the horizontal axis where the traces first intersect the flood level (stage) and enters the orange (minor flooding) area of the graph gives an indication of the likelihood of future flooding. The higher the probability where the traces intersect flood stage, the more likely flooding is during the period covered by the graphic.

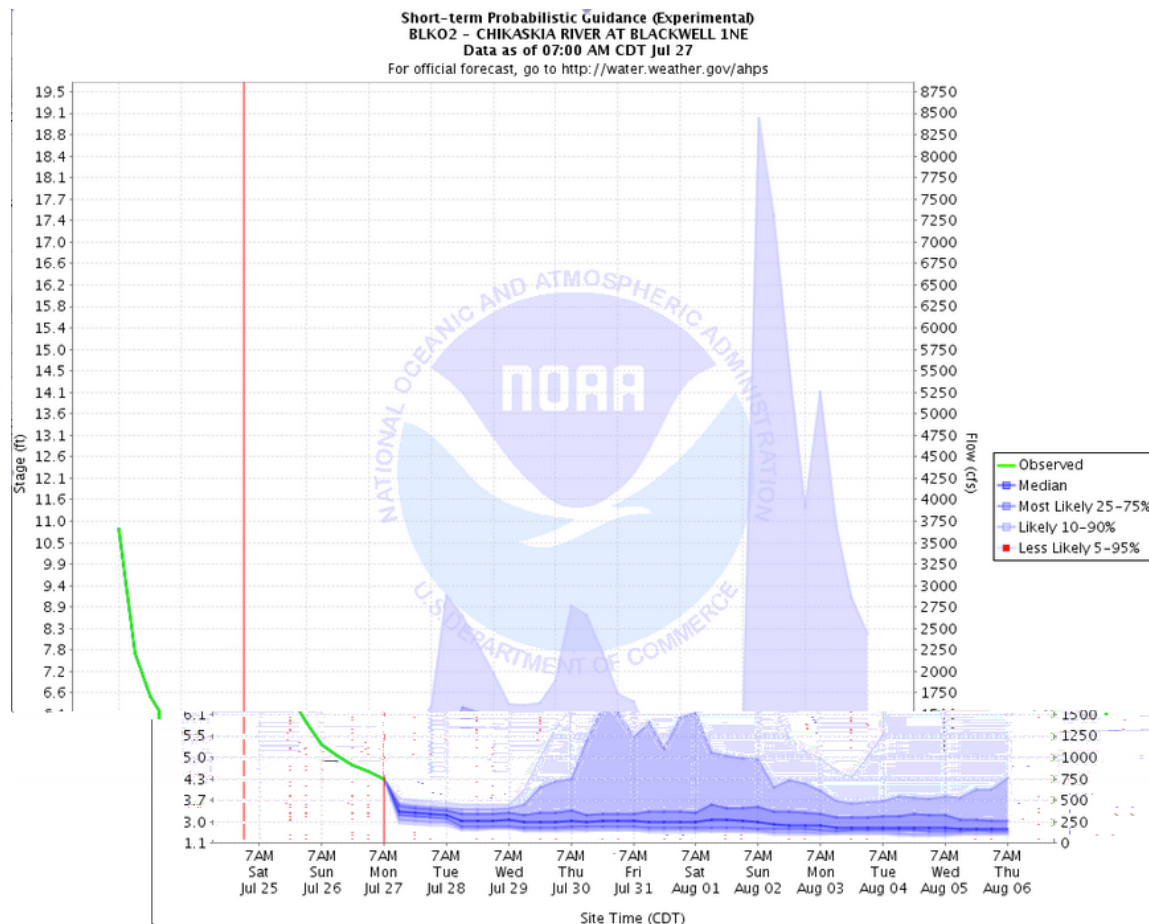
In Figure 8, the historical simulation crosses flood level at a probability of 57% and the conditional simulation crosses flood level at a probability of 55%. This indicates the river was less likely to reach flood stage during the period than indicated by the historical record. Click [here](#) to view the most recently generated Chance of Exceeding Levels During Entire Period product for the same location (Iroquois River at Iroquois).

**River Location: Probability Information Tab (Short-term Probabilistic Guidance (Experimental)).**

Hovering over this tab and selecting Short-term Probabilistic Guidance (Experimental) brings up a graphical hydrograph depiction of short- to medium-range river forecast uncertainty. The product displays uncertainty bounds for the river forecast in the context of high and low water thresholds.

Providing uncertainty bounds for water resources forecasts at all time scales is one of the most pressing needs of operational water resources forecasting [NRC report (2006), CFI survey (2008), multiple NWS service assessments]. NOAA’s National Weather Service (NWS) is implementing a short- to long-range Hydrologic Ensemble Forecast Service (HEFS) to address this need. The HEFS extends the existing hydrologic ensemble services to include short- to medium-range forecasts, incorporate additional weather and climate information, and better quantify uncertainty in water resources forecasting. It provides, at forecast time horizons of less than a day to more than a year, ensemble forecasts and verification products that can be tailored to users’ needs. This experimental product is the first attempt to convey uncertainty in NWS short-to medium-range river forecasts.

In the graphic shown below (Figure 9), the darkest blue region highlights the river levels that have the greatest chance of occurring at that location in time, while the lightest blue region shows river levels that have the smallest chance of occurring at that location in time. The cone generally becomes larger farther out in time as more uncertainty exists as to what the actual forecasted river level will be. Along with the chance the river will actually reach a certain level at a given point in the future, there is also a measurement of confidence. For example, the confidence in one of the levels actually occurring within the dark blue region on July 28 is higher than the confidence in one of the levels actually falling within the dark blue region on August 2.



**Figure 9.** Sample Experimental Short-term Probabilistic Guidance Product.

**When are forecasts in these web products updated?**

The hydrologic models used to generate near-term river/stream forecasts are generally executed in the morning on a daily cycle. When river/stream conditions are below flood levels, the forecasts as seen in the hydrographs are issued at fairly regular times in the morning. However, during flood/high water situations, much more data is coming in and forecasters may need additional time to analyze observations and model output, causing the forecasts to be issued somewhat later than usual. Updates to the forecasts are issued more frequently during flood/high water situations. Updated long-term products such as exceedance probability graphics may only be generated once or twice a month after new long-term weather (climate) forecasts are issued.

**National Map – Experimental Long-Range River Flood Risk Tab**

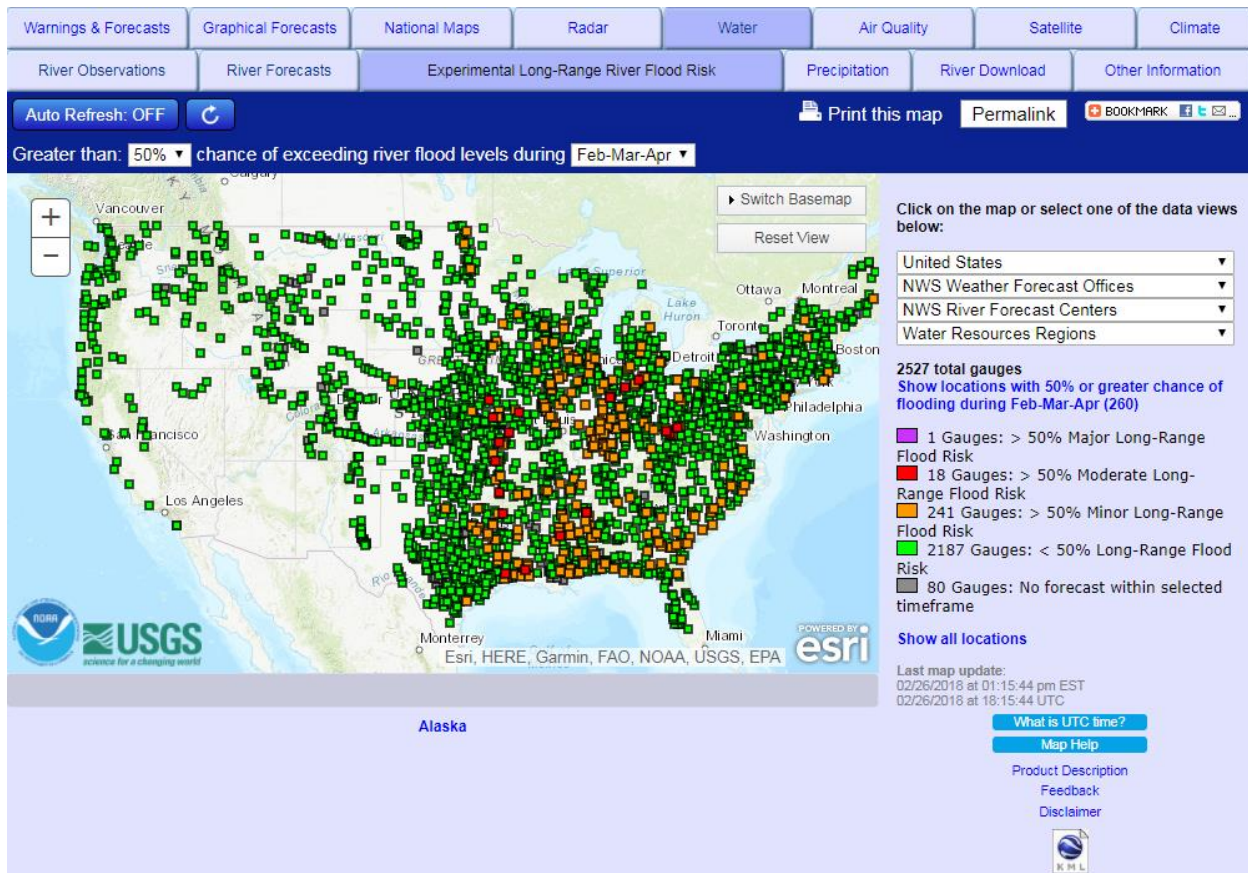
When the experimental long-range river flood risk tab is clicked on the National map page, a map showing locations that are color-coded according to the long-range (3-month) risk of minor, moderate, and major river flooding is displayed as follows:

- Less than X% chance of flooding (green)

- Greater than X% chance of minor flooding (orange)
- Greater than X% chance of moderate flooding (red)
- Greater than X% chance of major flooding (violet)

When first bringing up the experimental long-range river flood risk map (as in Figure 10), the percent (X) chance defaults to 50. Use the dropdown menu immediately above the map to select different percentages, including 5, 10, 25, 50, 75, 90, and 95%. From the 1<sup>st</sup> to the 28<sup>th</sup> of every month, the 3-month period defaults to the current month-current month + 1-current month + 2. After the 28<sup>th</sup> of every month, the 3-month period defaults to the current month + 1-current month + 2-current month +3. Locations where long-range flood risk is not calculated are shown in gray.

Long-range (3-month) risk information is based on NWS Ensemble Streamflow Prediction (ESP) forecasts which are generated for thousands of river and stream forecast locations across the nation. With this capability, a stakeholder, such as a local emergency manager, can quickly view flood risk at the levels which are known to affect their specific area of concern.



**Figure 10.** Portion of a sample web page for the NWS water resources web presence showing default Experimental Long-Range River Flood Risk display.

## National Map - Precipitation Tab

When the precipitation tab is clicked on the National map page, a map showing observed 24-hour precipitation in the conterminous U.S. (CONUS) and Puerto Rico is displayed, along with a third row of tabs immediately above the map and a large menu area with multiple selection options below (Figure 11). This national precipitation map is the default display for the new third row of tabs and initially depicts observed precipitation for the most recent 24-hour period ending at 1200 Coordinated Universal Time (UTC). 1200 UTC is used because it marks the end of the "hydrologic day" – a standard used in river modeling – and it is also when many daily weather observations are taken in the morning. This map integrates 24-hour totals of multi-sensor precipitation estimates from the 12 NWS river forecast centers (RFC) serving the lower 48 states. Multi-sensor precipitation estimates are produced by integrating radar-based precipitation estimates, satellite-based precipitation estimates, and ground-based precipitation gage data. The default map is initially set to display at the CONUS scale with Puerto Rico shown in the lower right.

The precipitation generation is currently processing September 18, 2015 UTC and began at September 18, 2015 - 16:30 UTC.

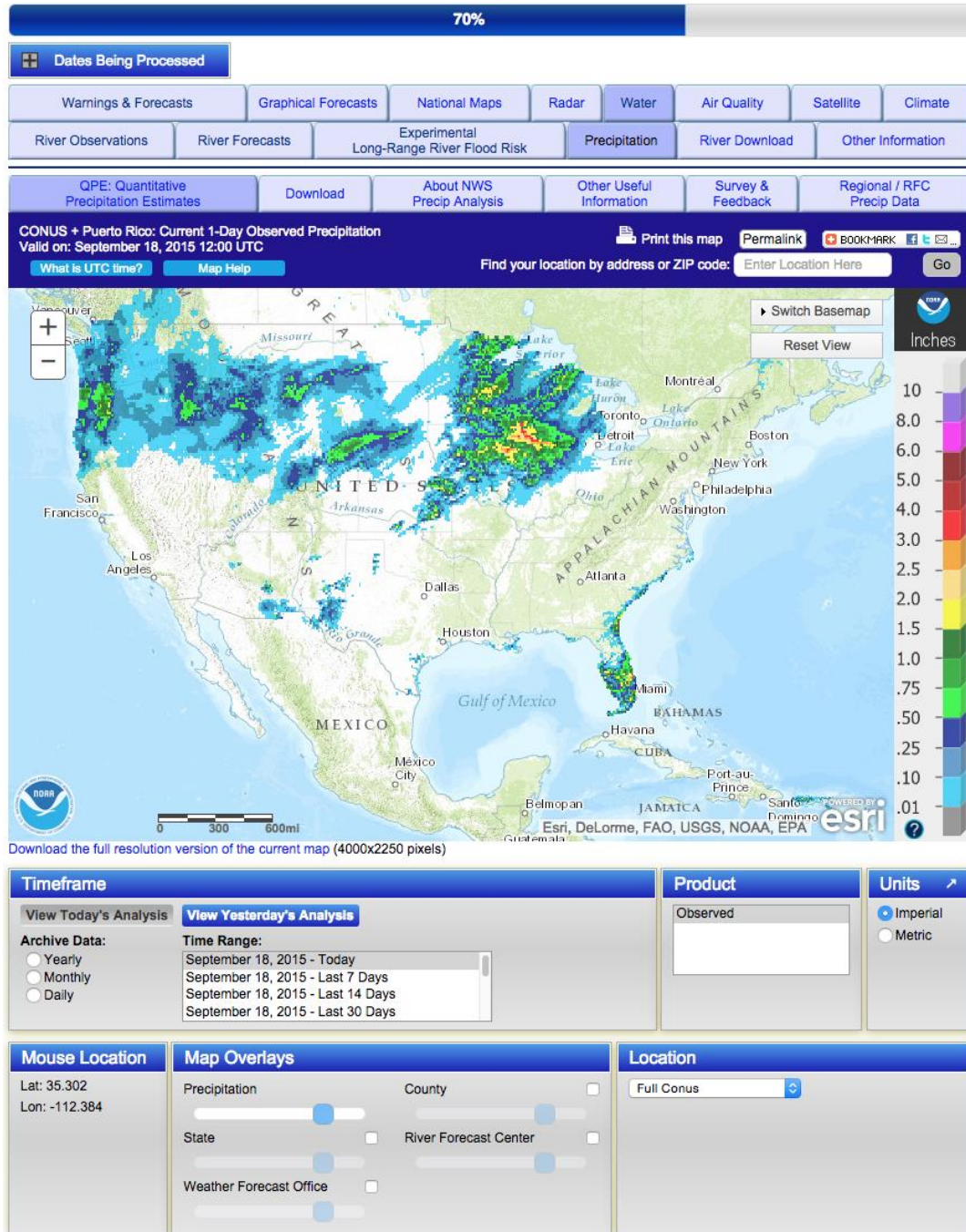


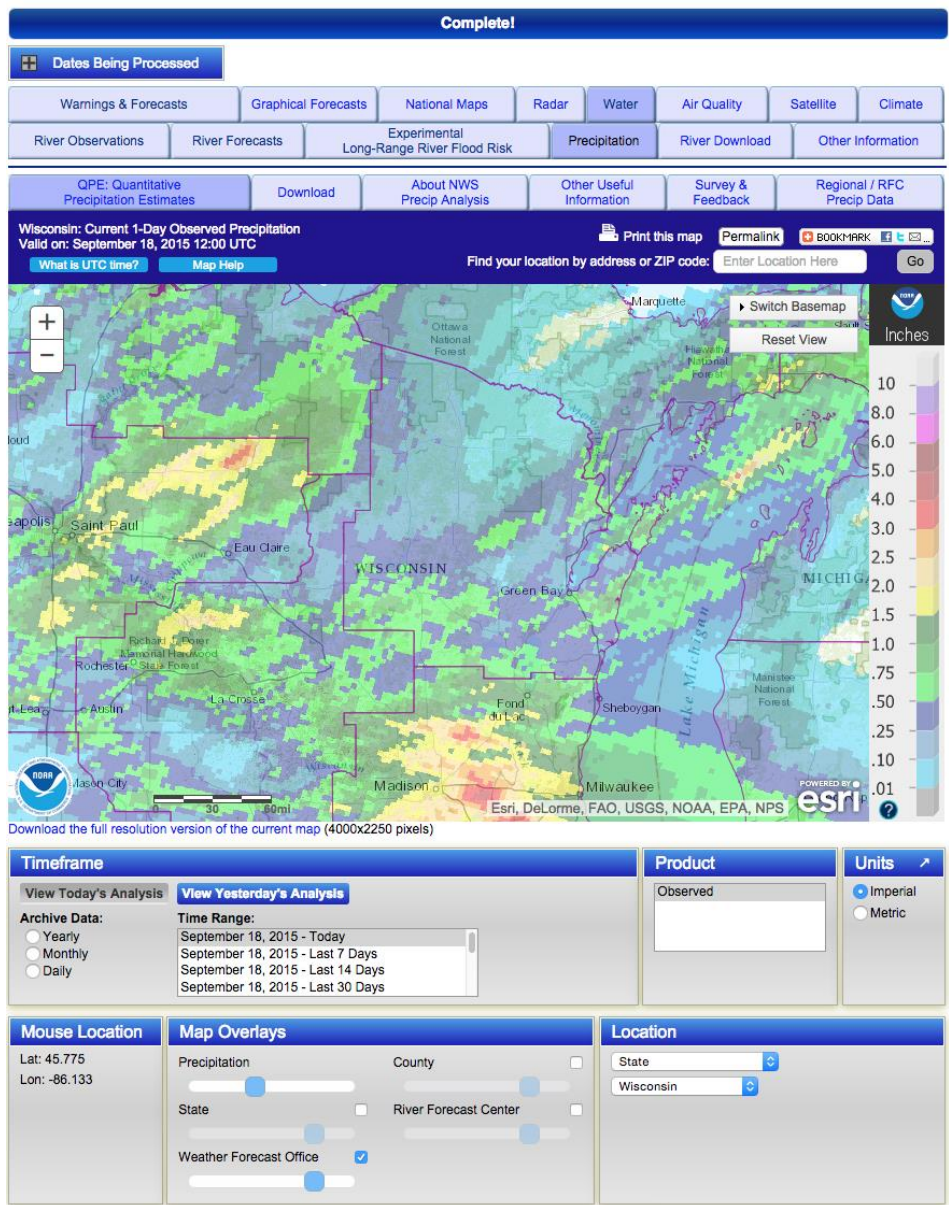
Figure 11. Sample national scale observed (24-hour) precipitation display.

Several tools below the precipitation map give the user control over the information displayed. The Timeframe tools menu allows users to select to view current precipitation for the most recent 24-hour period (default), yesterday's analysis, as well as totals for the last 7 days, 14 days, 30 days, 60 days, 90 days, 180 days, month to date, year to date, and water year (starts Oct. 1) to date. The user can also display archived data by water year, calendar year, month, and day, with the option to display normal, departure from normal, and percent of normal for the time period covered by the archived data being viewed. Normals in the western U.S. were calculated using the Parameter-elevation Relationships on Independent Slopes Model (PRISM) analysis, a technique developed by Oregon State University to account for variability of precipitation in mountainous areas. The Location tool provides control over the geographical area displayed, including full CONUS, NWS/RFC Region, State, WFO, and Water Resource Region. The Units tool allows the user to display data in Imperial/English units as used in the U.S.A. or metric units. Map Overlays allow the user to choose if he or she would like to view county, state, RFC, and WFO boundaries on the precipitation map. Users can set the overall transparency of the overlays by moving the sliders to the left or right.

The other tabs in the third row immediately above the national precipitation map allow users to interact with multi-sensor precipitation data in several ways:

- The “**Download**” tab allows current or archived precipitation data to be downloaded as gridded digital quantitative precipitation estimates (QPE) derived from Stage III data in either shapefile or netCDF formats prior to March 22, 2017 or gridded digital QPE derived from the National Centers for Environmental Prediction (NCEP) Stage IV data in either CF-compliant netCDF or GeoTiff formats after March 22, 2017.
- The “**About NWS Precip Analysis**” tab brings up an in-depth discussion on how the data is acquired and brought into the format seen in the display.
- The “**Other Useful Information**” tab brings up a condensed list of links to other related climate, water, and weather information.
- The “**Survey & Feedback**” tab provides instructions and links for various ways feedback can be provided to the NWS on the usefulness of information available through the precipitation web page.

- The “**Regional/RFC Precip Data**” tab provides access to the precipitation data sets from most RFCs that were contributed to this national precipitation web page. Links to experimental precipitation products being tested by the NWS may also be provided here.



**Figure 12.** Sample state scale precipitation display.

### State Precipitation Map

If State is selected from the Location drop-down menu, an observed precipitation map for the state and its surrounding area is displayed (



Figure 12). The color scheme and user interface is the same as that provided for the national level. Observed precipitation for an individual NWS RFC Region, WFO, and Water Resource Region can also be displayed.

### **When is the precipitation map updated?**

The data sets used to produce national, state, and weather forecast office scale precipitation maps are updated on a daily basis. An update for the entire U.S. is usually ready by about 1600 UTC<sup>3</sup>.

### **National Map – River Download, Other Information Tabs**

The River Download tab provides access to observed and forecast data for all locations in the CONUS and Puerto Rico in shapefile and KMZ formats, long range flood risk data in KMZ and .CVS format, as well as RSS/XML.

---

<sup>3</sup> 1500 UTC is 10:00 a.m. EST (11 a.m. EDT), 9:00 a.m. CST (10:00 a.m. CDT), 8:00 a.m. MST (9:00 a.m. MDT), 7:00 a.m. PST (8:00 a.m. PDT), and 6:00 AKST (7:00 a.m. AKDT)

The Other Information tab provides links to a variety of other NWS climate, water, and weather information, including water supply information, climatological information, snow information, drought information, and seasonal information.

## National Significant River Flood Outlook

The National Significant River Flood Outlook identifies areas where potential exists for significant river flooding over the coming 5-day period. It is not intended to depict all areas of minor flooding or small-scale events such as localized flooding or flash flooding. This graphical product is accessed at:

<http://www.hpc.ncep.noaa.gov/nationalfloodoutlook/index.html>

As it is used in this product, "significant flooding" corresponds to the moderate and major flood categories, which can be described as follows (see [NWS Manual 10-950 - Definitions and General Terminology](#)):

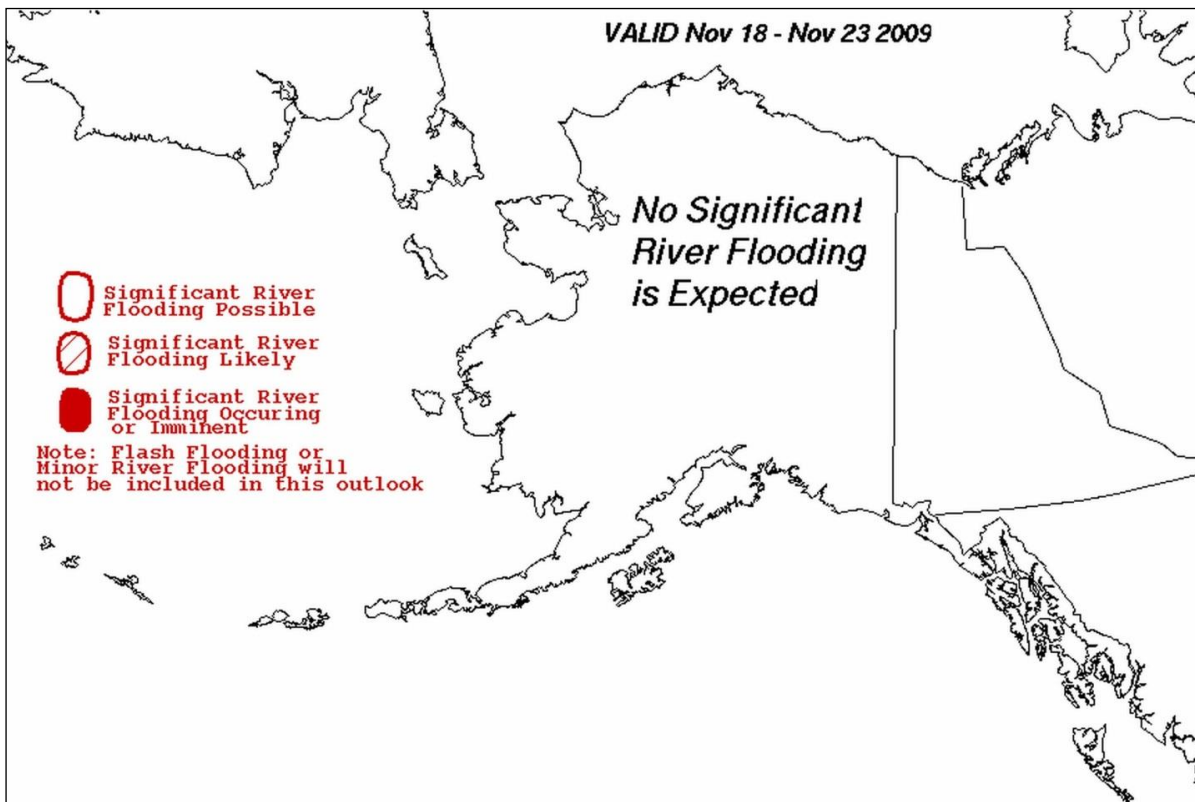
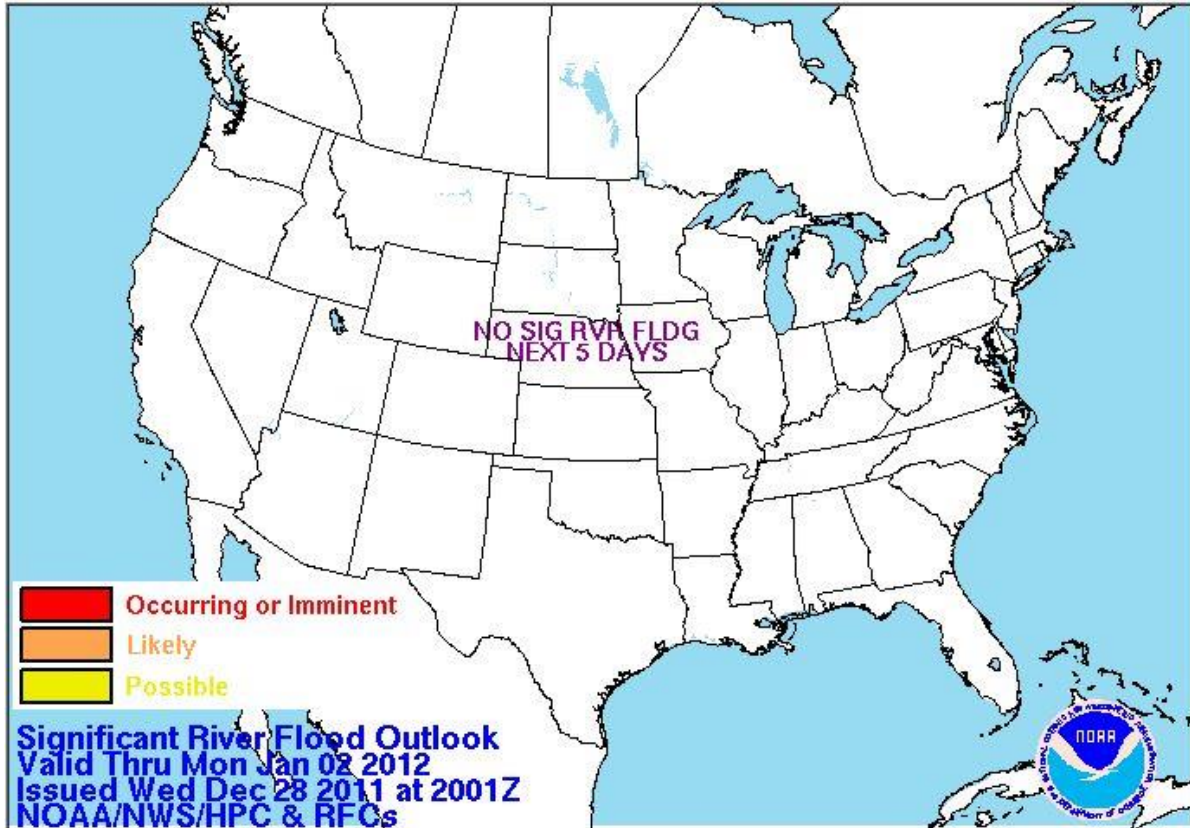
**Moderate Flooding** – involves some inundation of structures and roads near the river/stream. Some evacuations of people and/or transfer of property to higher elevations are necessary.

**Major Flooding** – involves extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary.

The National Significant River Flood Outlook covers the lower 48 states and is created by the Weather Prediction Center in the National Centers for Environmental Prediction by joining together individual graphical outlooks from the 12 NWS river forecast centers serving the lower 48 states. A separate significant river flood outlook for Alaska is provided by the Alaska-Pacific River Forecast Center (click [here](#) to view current outlook). Outlooks for both the lower 48 states and Alaska are posted on the Web once a day by approximately 2100 UTC (4 p.m. EST).

The National Significant River Flood Outlook provides links to the flood outlooks produced by individual RFCs. Each RFC's significant river flood outlook links back to the National product. Using the color scheme and patterns shown in Figure 12, flood potential is characterized in the National Significant River Flood Outlook according to the following criteria:

- a. Possible: Hydrometeorological conditions indicate that significant flooding could occur. Such flooding is neither certain nor imminent.
- b. Likely: Hydrometeorological conditions indicate that significant flooding can be expected during the outlook period.
- c. Occurring/Imminent: Significant flooding is already occurring or is imminent during the outlook period.



**Figure 13.** Sample National Significant River Flood Potential Outlook for CONUS and Alaska.

# Precipitation Frequency Data Server

Civil engineers and others involved in the design of structures that will affect or be affected by runoff and streamflow caused by precipitation are concerned with extreme precipitation events. For some structures, extreme precipitation events as short as five minutes must be considered while others must take longer duration (e.g., multi-day) events into account. Statistical techniques have been used to calculate frequency estimates of precipitation intensities for a wide range of frequencies and durations. Such estimates are used in the design of a variety of structures from urban storm water drainage systems to dams and spillways.

In 1953, the National Weather Service began publishing precipitation frequency estimates – commonly known as intensity-frequency-duration values – in hard copy Weather Bureau Technical Papers and Memoranda. After NOAA was formed in 1970, they were provided in NOAA atlases. The estimates in these documents became de-facto national standards for a wide variety of design and planning activities at the federal, state, and local levels as well as in the private sector.

The screenshot shows the NOAA's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server (PFDS) home page. The page has a blue header with the NOAA logo and the text "NOAA's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server (PFDS)". The URL "www.nws.noaa.gov" is in the top right corner. A navigation bar includes "Home", "Site Map", "News", "Organization", "Search", and "Go" buttons. A "NEW! Precipitation frequency estimates for California published" banner is at the top of the main content area. Below it is a "State:" dropdown menu with "Choose a state (or click map)" and a "Load" button. A map of the United States is displayed, with states colored in shades of blue. A legend indicates "Updated data available" (dark blue) and "Data update in progress" (light blue). The footer contains contact information for the US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Office of Hydrologic Development, 1325 East West Highway, Silver Spring, MD 20910. It also includes links for "Disclaimer", "Credits", "Glossary", "Privacy Policy", "About Us", and "Career Opportunities". The page author is listed as "HDSC webster" and the page was last modified on April 8, 2011.

Figure 14. Precipitation Frequency Data Server home page.

The Precipitation Frequency Data Server home page (<http://hdsc.nws.noaa.gov/hdsc/pfds/>), as shown in Figure 14, is now the mechanism by which precipitation frequency estimates are provided by the National Weather Service. In general, the server provides these estimates in two formats:

- 1) New Format. For areas where recent statistical analyses have been performed to provide updated estimates for new volumes of NOAA Atlas 14, an interactive web capability is available which allows users to access digital output for any location interactively selected on a map (see example in Figure 14).
- 2) Old Format. For areas of the U.S. where updated estimates are yet to be derived, data are provided online in the form of scanned versions of the old Weather Bureau Technical Papers, Memoranda, and NOAA atlases (see example in Figure 16). Once the entire document appropriate to the location selected is retrieved by the server, the user must locate the map corresponding to the required frequency (e.g., 100-year) and rainfall duration (e.g., 24 hours), visually locate the point of interest on the map, and interpolate the precipitation depth from the isohyets (lines of constant precipitation depth).

On the Precipitation Frequency Data Server home page's national map, areas where updates have been completed for a new volume of NOAA Atlas 14 are shown in dark blue, areas where updated statistical analyses have not yet been performed are shown in white, and areas where updates are currently in progress are shown in light blue. Precipitation frequency estimates in the new digital format are provided for any user-selected location in the dark blue areas of the map, while estimates for the white and light blue areas are provided in the old format.

If a user clicks on one of the dark blue states on the national map, an interactive (Google) map of that state and its surrounding area is displayed. Initially, a red selection cursor will appear at the center of the state map, along with a table of precipitation frequency estimates for that central location displayed immediately below. A user can then move the cursor to any desired location and zoom into progressively more localized areas with a standard slide mechanism. Across the top of the map, pull-down menus give the user control of whether precipitation depth or precipitation intensity frequency estimates calculated based on statistical analysis of partial duration or annual maximum series are displayed in English or metric units. The map and accompanying menus give the user four ways to obtain digital precipitation frequency estimates for a location:

- Manually enter a latitude and longitude (decimal degrees) of a desired location
- Select one of the historical observation locations from a pull-down menu. These represent locations where a historical record of observations was available for use in the analysis conducted to derive the precipitation frequency estimates.
- Select one of the green historical observation location icons on the map (the "show stations on map" box must be checked and the map must be zoomed in at least one increment from initial display).
- Drag the red cursor to select any location on the map.

NOAA's National Weather Service  
 Hydrometeorological Design Studies Center  
 Precipitation Frequency Data Server (PFDS)

www.nws.noaa.gov

Home Site Map News Organization Search NWS All NOAA Go

### NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

**DATA DESCRIPTION**  
 Data type: precipitation depth Units: english Time series type: partial duration

**SELECT LOCATION**  
 1. Manually:  
 a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude: submit  
 b) Select station: select station

2. Use map:

a) Select location (move crosshair)  
 b) Click on station icon (show stations on map)

**LOCATION INFORMATION:**  
 Name: Altadena, California, US\*  
 Latitude: 34.2255  
 Longitude: -118.0730  
 Elevation: 4618 ft\*

\* source: Google Maps

### POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

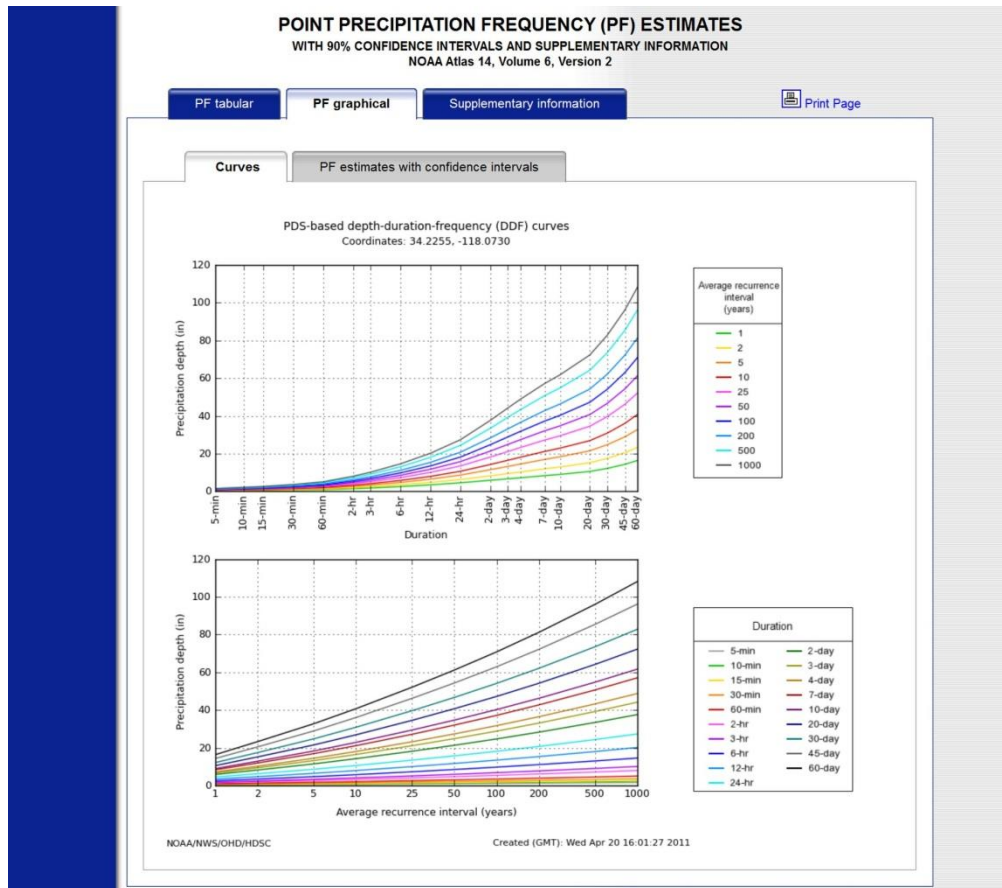
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
 NOAA Atlas 14, Volume 6, Version 2

PF tabular PF graphical Supplementary information Print Page

| Duration | Average recurrence interval (years) |                        |                        |                        |                        |                       |                      |                      |                      |                     |
|----------|-------------------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|----------------------|----------------------|----------------------|---------------------|
|          | 1                                   | 2                      | 5                      | 10                     | 25                     | 50                    | 100                  | 200                  | 500                  | 1000                |
| 5-min    | 0.267<br>(0.223-0.324)              | 0.369<br>(0.308-0.448) | 0.506<br>(0.420-0.616) | 0.620<br>(0.510-0.761) | 0.778<br>(0.619-0.989) | 0.903<br>(0.702-1.17) | 1.03<br>(0.782-1.37) | 1.17<br>(0.859-1.60) | 1.35<br>(0.955-1.94) | 1.50<br>(1.02-2.23) |
| 10-min   | 0.383<br>(0.219-0.464)              | 0.529<br>(0.441-0.642) | 0.726<br>(0.602-0.883) | 0.889<br>(0.732-1.09)  | 1.11<br>(0.887-1.42)   | 1.29<br>(1.01-1.68)   | 1.48<br>(1.12-1.97)  | 1.67<br>(1.23-2.29)  | 1.94<br>(1.37-2.78)  | 2.15<br>(1.47-3.20) |
| 15-min   | 0.463<br>(0.380-0.561)              | 0.640<br>(0.533-0.777) | 0.877<br>(0.729-1.07)  | 1.07<br>(0.885-1.32)   | 1.35<br>(1.07-1.71)    | 1.56<br>(1.22-2.03)   | 1.79<br>(1.35-2.38)  | 2.02<br>(1.49-2.77)  | 2.35<br>(1.66-3.36)  | 2.61<br>(1.77-3.87) |
| 30-min   | 0.643<br>(0.536-0.779)              | 0.889<br>(0.740-1.08)  | 1.22<br>(1.01-1.48)    | 1.49<br>(1.23-1.83)    | 1.87<br>(1.49-2.38)    | 2.17<br>(1.69-2.82)   | 2.48<br>(1.88-3.31)  | 2.81<br>(2.07-3.85)  | 3.26<br>(2.30-4.67)  | 3.62<br>(2.46-5.38) |
| 60-min   | 0.891<br>(0.743-1.08)               | 1.23<br>(1.03-1.49)    | 1.69<br>(1.40-2.05)    | 2.07<br>(1.70-2.54)    | 2.60<br>(2.06-3.30)    | 3.01<br>(2.34-3.91)   | 3.44<br>(2.61-4.58)  | 3.89<br>(2.87-5.34)  | 4.52<br>(3.18-6.47)  | 5.01<br>(3.41-7.45) |
| 2-hr     | 1.39<br>(1.15-1.68)                 | 1.91<br>(1.59-2.32)    | 2.62<br>(2.18-3.19)    | 3.22<br>(2.65-3.95)    | 4.06<br>(3.23-5.16)    | 4.73<br>(3.69-6.14)   | 5.43<br>(4.12-7.23)  | 6.17<br>(4.54-8.46)  | 7.20<br>(5.09-10.3)  | 8.04<br>(5.46-11.9) |
| 3-hr     | 1.76<br>(1.47-2.14)                 | 2.44<br>(2.03-2.95)    | 3.35<br>(2.78-4.07)    | 4.12<br>(3.39-5.05)    | 5.29<br>(4.13-6.81)    | 6.07<br>(4.72-7.98)   | 6.96<br>(5.29-9.30)  | 7.96<br>(5.85-10.9)  | 9.31<br>(6.56-13.3)  | 10.4<br>(7.08-15.5) |
| 6-hr     | 2.50<br>(2.08-3.03)                 | 3.45<br>(2.87-4.18)    | 4.75<br>(3.94-5.78)    | 5.85<br>(4.82-7.18)    | 7.42<br>(5.90-9.43)    | 8.67<br>(6.74-11.3)   | 9.99<br>(7.58-13.3)  | 11.4<br>(8.39-15.7)  | 13.4<br>(9.45-19.2)  | 15.0<br>(10.2-22.3) |
| 12-hr    | 3.44<br>(2.87-4.17)                 | 4.75<br>(3.95-5.76)    | 6.54<br>(5.43-7.95)    | 8.06<br>(6.63-9.89)    | 10.2<br>(8.12-13.0)    | 11.9<br>(9.29-15.5)   | 13.8<br>(10.4-18.4)  | 15.7<br>(11.6-21.6)  | 18.5<br>(13.0-26.5)  | 20.7<br>(14.1-30.8) |
| 24-hr    | 4.55<br>(4.03-5.24)                 | 6.31<br>(5.58-7.26)    | 8.72<br>(7.70-10.1)    | 10.8<br>(9.43-12.6)    | 13.7<br>(11.6-16.5)    | 16.0<br>(13.3-19.7)   | 18.5<br>(14.9-23.3)  | 21.1<br>(16.6-27.3)  | 24.8<br>(18.7-33.5)  | 27.8<br>(20.3-38.9) |
| 2-day    | 5.92<br>(5.25-6.82)                 | 8.39<br>(7.41-9.67)    | 11.7<br>(10.4-13.6)    | 14.5<br>(12.8-17.0)    | 18.6<br>(15.8-22.5)    | 21.9<br>(18.2-26.9)   | 25.3<br>(20.5-31.9)  | 29.0<br>(22.8-37.6)  | 34.2<br>(25.8-46.1)  | 38.4<br>(28.0-53.6) |
| 3-day    | 6.70<br>(5.93-7.72)                 | 9.60<br>(8.49-11.1)    | 13.6<br>(12.0-15.7)    | 16.9<br>(14.8-19.7)    | 21.7<br>(18.4-26.1)    | 25.5<br>(21.2-31.4)   | 29.6<br>(23.9-37.3)  | 33.9<br>(26.7-43.9)  | 40.0<br>(30.2-54.0)  | 45.0<br>(32.8-62.8) |
| 4-day    | 7.27<br>(6.44-8.38)                 | 10.5<br>(9.26-12.1)    | 14.9<br>(13.1-17.2)    | 18.6<br>(16.2-21.6)    | 23.8<br>(20.2-28.7)    | 28.1<br>(23.3-34.5)   | 32.5<br>(26.3-41.0)  | 37.3<br>(29.4-48.3)  | 44.1<br>(33.3-59.5)  | 49.5<br>(36.2-69.2) |
| 7-day    | 8.46<br>(7.49-9.74)                 | 12.2<br>(10.6-14.1)    | 17.3<br>(15.3-20.0)    | 21.7<br>(19.0-25.3)    | 27.9<br>(23.6-33.6)    | 32.8<br>(27.2-40.4)   | 38.1<br>(30.8-48.0)  | 43.7<br>(34.4-56.6)  | 51.6<br>(39.0-69.7)  | 58.0<br>(42.4-81.1) |
| 10-day   | 9.12<br>(8.07-10.5)                 | 13.2<br>(11.6-15.2)    | 18.7<br>(16.5-21.6)    | 23.4<br>(20.5-27.3)    | 30.0<br>(25.4-38.2)    | 35.4<br>(29.4-43.6)   | 41.1<br>(33.2-51.7)  | 47.1<br>(37.1-61.0)  | 55.7<br>(42.1-75.1)  | 62.6<br>(45.7-87.5) |
| 20-day   | 10.7<br>(9.47-12.3)                 | 15.5<br>(13.7-17.8)    | 22.0<br>(19.4-25.4)    | 27.5<br>(24.0-32.0)    | 35.3<br>(29.9-42.5)    | 41.5<br>(34.5-51.1)   | 48.1<br>(39.0-60.7)  | 55.2<br>(43.5-71.5)  | 65.2<br>(49.3-88.0)  | 73.3<br>(61.5-102)  |
| 30-day   | 12.3<br>(10.9-14.2)                 | 17.9<br>(15.8-20.6)    | 25.4<br>(22.4-29.3)    | 31.7<br>(27.7-37.0)    | 40.7<br>(34.4-49.0)    | 47.9<br>(39.7-58.9)   | 55.4<br>(44.9-69.9)  | 63.5<br>(50.0-82.3)  | 74.9<br>(56.6-101)   | 84.1<br>(61.5-118)  |
| 45-day   | 14.5<br>(12.8-16.7)                 | 21.0<br>(18.5-24.2)    | 29.8<br>(26.3-34.4)    | 37.2<br>(32.5-43.4)    | 47.6<br>(40.3-57.4)    | 56.0<br>(46.4-68.9)   | 64.8<br>(52.4-81.6)  | 74.1<br>(58.4-96.0)  | 87.3<br>(68.6-118)   | 98.0<br>(71.6-137)  |
| 60-day   | 16.5<br>(14.6-19.0)                 | 23.8<br>(21.1-27.5)    | 33.8<br>(29.8-39.1)    | 42.2<br>(36.9-49.2)    | 54.0<br>(45.7-65.1)    | 63.4<br>(52.6-78.0)   | 73.2<br>(59.3-92.3)  | 83.7<br>(66.9-108)   | 96.4<br>(74.4-133)   | 110<br>(80.6-154)   |

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).  
 Numbers in parentheses are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates for a given duration and average recurrence interval will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.  
 Please refer to NOAA Atlas 14, Volume 6, Version 2 for more information.

Figure 15. New format – digital precipitation frequency estimates for a location produced by the Precipitation Frequency Data Server from a new volume of NOAA Atlas 14.

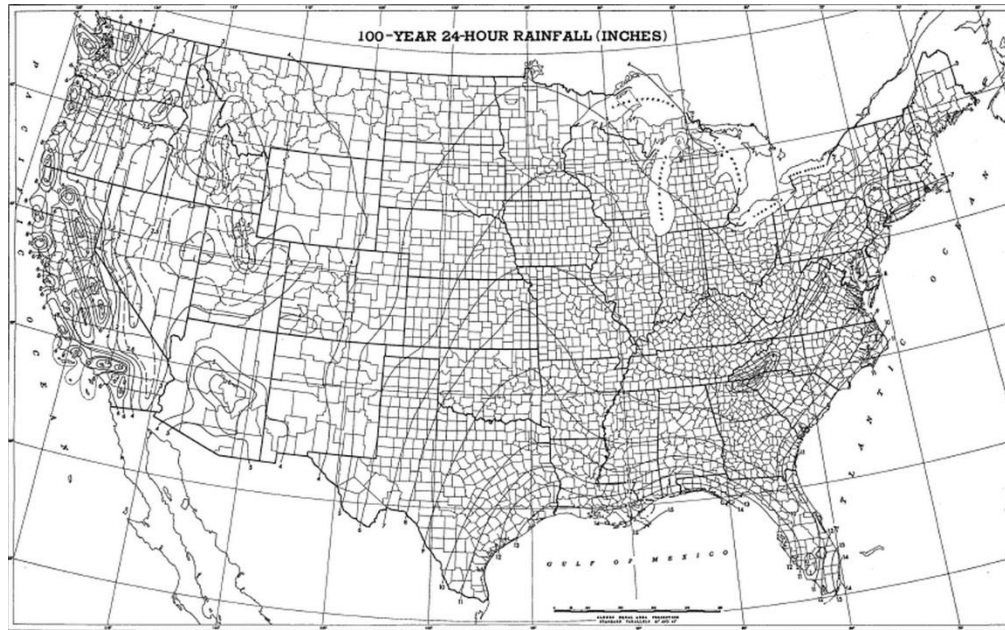


**Figure 16.** New format – precipitation frequency estimates displayed in graphic form for the same location used in **Figure X**. This is displayed by clicking on the “PF graphical” tab.

After one of these four ways has been used to select a specific location, a table of precipitation frequency (PF) estimates with corresponding upper and lower bounds of 90% confidence interval is displayed for the location as shown in the bottom half of Figure 14. As can be seen in this figure, this table is actually the default display associated with the first of three tabs (PF tabular). The tabular data can also be downloaded as comma-separated values (.csv) by selecting the type of data (mean estimates, upper bound, lower bound, or all) via a button beneath the table. The second tab, PF graphical, provides access to graphical representations of the same information provided under the first tab (Figure 15). The third tab, Supplementary information, provides access to the following:

- Document. The on-line volume of NOAA Atlas 14 describing the in-depth study that was conducted to derive updated precipitation frequency estimates for the project area encompassing the selected location.
- PF in GIS format. Spatially interpolated precipitation frequency estimates for a user-selected frequency and duration (with upper and lower bounds of the 90% confidence interval) in GIS compatible formats.
- PF cartographic maps. State maps with colorized isopluvials (lines of constant depth) of precipitation frequency estimates for selected frequencies and durations.





**Figure 17.** Old format – national map with lines of constant depth for 100-year, 24 hour precipitation, scanned from Technical Paper No. 40 and provided via the Precipitation Frequency Data Server.

- Temporal distributions of heavy precipitation. Files (.csv), viewable as spreadsheets in MS Excel, containing cumulative percentages of precipitation totals at various time steps which can be used to calculate the temporal distribution of precipitation frequency estimates for 6-, 12-, 24-, and 96-hour durations.
- Seasonality analysis. Graphs showing the monthly distribution of precipitation totals (percent of total recorded events) for all stations in each climate sub-region that exceeded the precipitation frequency estimates for 50, 20, 10, 4, 2, and 1 percent annual exceedence probabilities for user-selected durations of 60 minutes, 24 hours, 2 days, or 10 days.
- Rainfall frequency estimates. Rainfall (liquid precipitation only) frequency estimates for 60-minute, 2-hour, 3-hour, 6-hour, 12-hour, and 24-hour durations. These tables provide estimates for rainfall only, as opposed to the main precipitation estimate tables (as shown earlier in Figure 14), which apply to all forms of precipitation (e.g., including snow). Differences in these types of estimates will only be relevant for higher elevations.
- Time series data. Annual maximum series precipitation data are available if an observing station has been selected on the interactive map or from the pull-down list. Partial duration series data are currently only available for areas covered by NOAA Atlas 14, Volumes 1-3.
- Climate data source. Links to general information on data sites near the currently selected location which use the search engine of NOAA's National Climatic Data Center (NCDC). User can select all stations within  $\pm 30$  minutes ( $1/2$  degree) or  $\pm 1$  degree. Not all stations obtained through this search will have necessarily been used in the study to calculate precipitation frequency estimates.

- Watershed information. A link that can be used to obtain information on the watershed containing the location of interest from the U.S. Environmental Protection Agency (EPA) web site.

## National Snow Analysis

Snow and snow information is of critical importance to the Nation's economy. Information on snowpack conditions is essential to support river, flood and water-supply forecasting, agriculture and forest management, recreation and tourism, and the commerce, industry and transportation sectors of the Nation's economy. The National Snow Analysis (NSA) produced by the National Operational Hydrologic Remote Sensing Center (NOHRSC) in Chanhassen, MN, offers users a variety of web-based snow information available in near real-time (<http://www.nohrsc.noaa.gov>).

The NOHRSC uses daily ground-based, aircraft, and satellite snow observations from all electronically-available sources coupled with numerical weather prediction models to drive a sophisticated snow model known as SNODAS (SNOW Data Assimilation System)<sup>4</sup>. SNODAS products are available in a variety of interactive map, text discussion, alphanumeric, time-series, and gridded formats through the NSA.

The home page for the National Snow Analysis is: <http://www.nohrsc.noaa.gov/nsa/> (Figure 17). From the NSA page, users can access many forms of snowpack-related information including some of the observational data sets used in the snowpack modeling process. In the dark blue margin on the left side of the NSA page, a list of main categories and clickable sub-categories controls the current display. The following is a "tour" of NOHRSC products and services that are available via the clickable categories on the left margin of the NSA web page.

### Snow Information Heading – National Analysis


The NSA home page is shown in Figure 18. This home page shows a large U.S. map above nine smaller maps depicting the following modeled snow parameters: snow water equivalent, snow depth, average snowpack temperature, snow water equivalent change, snow precipitation, snow melt, blowing snow sublimation, surface sublimation, and non-snow precipitation. The larger U.S. map is divided into 18 geographic areas. Snowpack conditions for each of these 18 areas (e.g., Northern Rocky Mountains) can usually be summarized on a regional basis. When a user clicks on one of these geographic areas in the large map, the small maps will display the region of interest. The user can access past information by selecting a year, month, day and region using the pull-down menu between the large and small maps. For any one of the nine maps, the user can animate the variable displayed. The "season" animation loops through daily data for the snow season, beginning on October 1 and proceeding to the present. The "two weeks" and "one day" animations loop through hourly data. The animations are helpful for visualizing broad spatial changes in snowpack characteristics over time.

The NSA page also includes a table to the right of the large U.S. map summarizing the most recent snow model analysis including percent of the U.S. (or selected geographic region) covered by snow and modeled snow depth and snow water equivalent statistics. A separate table below the maps highlights the top ten snowfall observations for the country or for a specified snow region.

---


<sup>4</sup> SNODAS is an energy-and-mass-balance, spatially-uncoupled, vertically-distributed, multi-layer snow model run operationally at 1-km<sup>2</sup> spatial resolution and hourly temporal resolution for the nation. Ground-based and remotely-sensed snow observations are assimilated into the simulated state variables of the snow model.

weather.gov



# National Weather Service

## National Operational Hydrologic Remote Sensing Center



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- Airborne Surveys
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**Observations near**

City, ST

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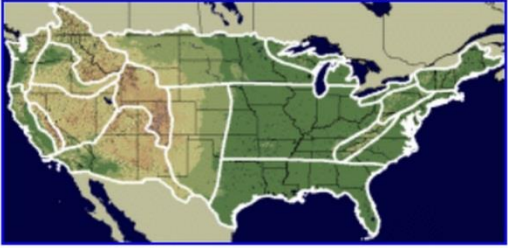
Please Send Us Comments!



## National Snow Analyses

Snow Reports
Model Assimilation Schedule
Snow Survey Schedule

Click On Map for Regional Analyses



**Automated Model Discussion:**  
November 29, 2010

- Area Covered By Snow: 35.0%
- Area Covered Last Month: 8.2%

**Snow Depth**

- Average: 3.0 in
- Minimum: 0.0 in
- Maximum: 841.6 in
- Std. Dev.: 6.5 in

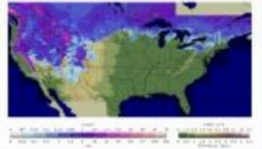
**Snow Water Equivalent**

- Average: 0.5 in
- Minimum: 0.0 in
- Maximum: 414.5 in
- Std. Dev.: 1.1 in

more... Metric Units...

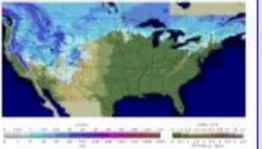
Select Region and Date

Snow Water Equivalent



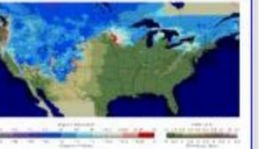
Animate: Season --- Two weeks --- One Day

Snow Depth



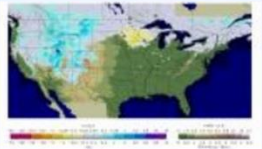
Animate: Season --- Two weeks --- One Day

Average Snowpack Temp



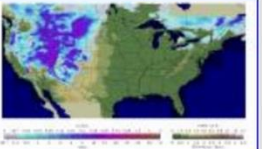
Animate: Season --- Two weeks --- One Day

SWE Change



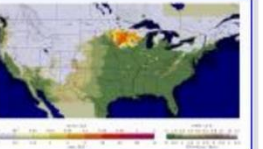
Animate: Season --- Two weeks --- One Day

Snow Precipitation



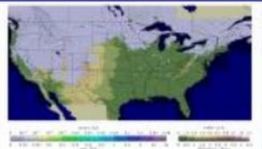
Animate: Season --- Two weeks --- One Day

Snow Melt



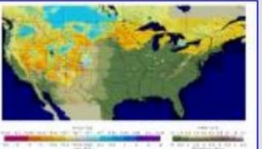
Animate: Season --- Two weeks --- One Day

Blowing Snow Sublimation




Animate: Season --- Two weeks --- One Day

Surface Sublimation



Animate: Season --- Two weeks --- One Day

Non-Snow Precipitation



Animate: Season --- Two weeks --- One Day

**Figure 18.** Home page for the National Snow Analysis.

Below the maps are links to station snowfall, snow water equivalent and snow depth reports. Clicking on any one of those links will bring the user to a table with observations for whichever geographic region is selected in the maps above.


Near the bottom of the NSA page is a section describing the most recent snow data assimilation and a section describing upcoming airborne snow surveys. Both the assimilation description and survey schedule will update depending on which region is selected in the maps.

## Snow Information Heading – Interactive Maps and Time Series

### Interactive Maps

For users who need more spatial and temporal flexibility than what is provided in the default NSA display, the [Interactive Maps](#) link provides access to a powerful Web-based interactive tool (Figure 18) for accessing and viewing snow information. It is not practical to completely describe every capability of this interactive display, but some of its highlights include the following:

- Any of the following physical elements (data types) can be selected for display on the map: hourly and daily elements related to snowpack condition (e.g., hourly snow water equivalent, 24-hour change in snowpack temperature), daily and hourly elements driving snowpack conditions (e.g., surface air temperature), archived satellite snowpack observations, climatic data elements (e.g., freezing degree days), observational elements (e.g., total precipitation), and static NOHRSC model datasets, such as elevation and forest cover density.
- One or more overlays can be selected for display on the map, including hydrologic, political, civic, transportation and other features.
- A box labeled "Navigation tools" at the top of the page can be used to re-center the map and zoom in on a point of interest. These tools can be used to change the extent of the map extent for the lower 48 states, Alaska, or a custom target. The zoom tool (box with the "target") is activated by default when the interactive page is brought up, and the user can draw a box on the map to zoom to that extent. Zooming can also be done with the "zoom control" toggle or by centering the map on latitude and longitude
- Once the user has zoomed into an area of interest, they may use the query tool to gather information about a point, such as an observing station. To query a point of interest, select the query tool (the button with an "i" and an arrow) from the menu in the upper right dark blue bar. When the query tool is active, the cursor will change from a plus sign to an arrow. When the cursor is hovering over a point that can be queried, the cursor will change to a hand icon. The default query leads to time series plots of station information (described below). However, the pull-down menu in the query box next to the query tool can be used to query other elements such as flight lines, state and regional snowpack averages, basin snowpack averages and latest observations. The "latest observations" query option is activated to coincide with a selected "Latest Observation" from the "Select Physical Element" pull-down menu in the upper right-hand corner of the page.



National Operational Hydrologic Remote Sensing Center

# Interactive Snow Information

Quick Query Links

Get Time Series for Station ID:   [Listing](#)

Get Time Series for Basin ID:    [Listing](#)


Get Basin Averages for    [Listing](#)

Get Climatology for Station ID:   [Listing](#)

Navigation Tools

Home Help

Comments



Lon:  Lat:

Query

**Redraw Map**

Select Physical Element

Select Date

2010 November

30 16:00 Z

Snap to nearest time

Select Overlays

**Hydrologic Features**

Basins  Label

HUCs (6-digit)

RFC Boundaries

Major Rivers

Rivers and Streams

Lakes and Reservoirs

**Political Features**

County Boundaries

CWA Boundaries

State Boundaries

National Boundaries

**Point Features**

Stations  Label

Cities  Label

Flight Lines  Label

Climate Stns.  Label

Skiing  Label

**Transportation Features**

Roads and Highways

**Other features**

NSA Disc. Regions

NSA Disc. Subregions

NSA Modelling Tiles

**Map Preferences**

English units

Legend below map

Background image

Hill shading

High-contrast palette

Minimize top banner

Title on image

600 pixels map width

450 pixels map height

Show all observations

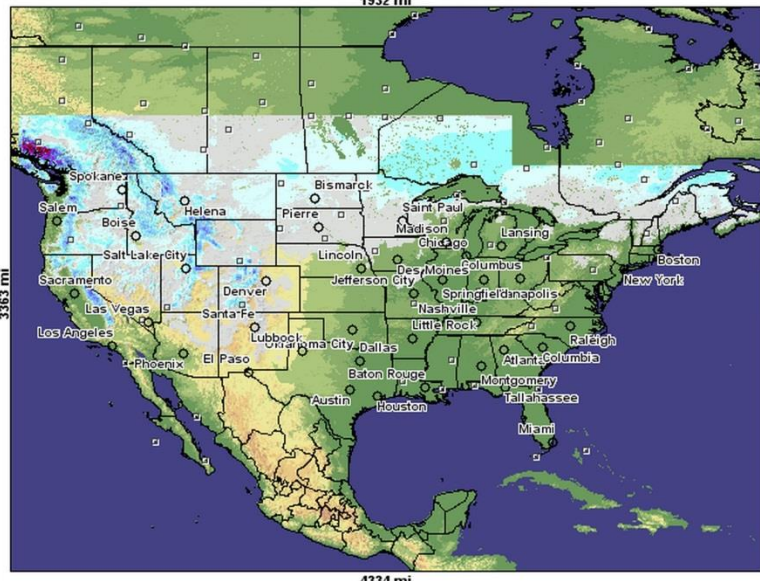
Small text

Link to this image

Link to latest image

Link to latest page

**Modeled Snow Water Equivalent (updated hourly) forecasted for 2010 November 30, 16:00 Z**



**Inches of water equivalent**

|  |               |
|--|---------------|
|  | > 30          |
|  | 20 to 30      |
|  | 18 to 20      |
|  | 16 to 18      |
|  | 14 to 16      |
|  | 12 to 14      |
|  | 10 to 12      |
|  | 8 to 10       |
|  | 6 to 8        |
|  | 4 to 6        |
|  | 2 to 4        |
|  | 1 to 2        |
|  | 0 to 1        |
|  | Not Estimated |

Elevation in feet (Not estimated)

|  |               |
|--|---------------|
|  | > 13124       |
|  | 8203 to 13124 |
|  | 3281 to 8203  |
|  | 3 to 3281     |
|  | < 3           |

**Model Adjustments:**

A model adjustment was done on November 24 across much of the West except for the Northwest and the southern half of the U.S. Rockies. Adjustments were needed due to the recent storm. In the Sierra Nevada, the model underdid snow precipitation at low and high elevations, where mainly 1 to 2 inches of water were added. Between those zones, 1 to 2 inches of water was removed due to too much snow water. Higher elevations in Nevada and Utah had about an inch of water added due to under-simulation of precipitation. Farther north, across southern Idaho, western Wyoming, and western Montana, up to 4 inches of water were removed around Yellowstone National Park, but most snow water amounts were adjusted downward by about an inch. About an inch of water was removed from the higher elevations in southern British Columbia and southern Alberta.

**Directions:**

- Select a physical element to view, select a date, select overlays, and click "Redraw Map."
- Clicking on the map while the Recenter button is selected (red) will recenter the map on that point.
- Clicking on the Zoom Control slider will zoom into or out of the map.
- Clicking on the map and dragging with the button held down while the Recenter button is selected (red) will zoom to a rectangle when the button is released.
- Stations and regions can be queried using the Query button and menu.

**Vector GIS Datasets used by this page**

**Raster GIS Datasets used by this page**

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Figure 19. Initial display for Interactive Snow Information interface.

- The "Redraw Map" button can be clicked on at any time when a new physical element or overlay is chosen for display. The map will not refresh automatically.
- A series of "Link to..." options which allows the user to bring up their area and most recent element of interest whenever they visit the page using a bookmark. A user can set up this customized link by zooming in on a desired area, highlighting a physical element of interest (e.g. snow water equivalent), clicking on the "Link to latest page" option, and then making the new page a bookmark in their browser.
- At the very bottom of the dark blue margin on the left hand side is a series of "Link to..." options. If the user wishes to zoom into an area of interest and highlight a physical element of interest (e.g. snow water equivalent), they can click on the "Link to latest page" option and make the new page a bookmark in their browser. This allows the user to bring up their area and most recent element of interest whenever they visit the bookmarked page.

### **Time-series plots**

- Once the user selects an observing station using the query tool, a page with time-series plots will appear. The user can select varying dates of interest at the top of the page. A user can also query a station by entering its station ID in the "Quick Query Links" box in the upper right corner of the Interactive page. A list of stations and their IDs can be obtained by clicking on the "Listing" option to the right of the query box.
- The time-series plots depict both modeled and observed snow information at a station. These plots include snow depth, snow water equivalent, snowpack temperature, snowpack density, surface snow sublimation and blowing snow sublimation. Station time series pages also include modeled and observed meteorological parameters such as air temperature, precipitation (snow and non-snow), wind speed, snow surface radiation fluxes and snow surface energy exchanges (click [here](#) to view a sample time-series plot).
- All data displayed in the time-series plots are available in tabular format and can be downloaded as a .csv file. Under the date range box, there is a pull-down menu that displays "All Images" as its default and is used to access individual plots, tabular data or .csv files. To change units from Metric to English, select the "Units" drop down menu.
- Time-series plots and associated text files for NWS River Forecast Center basin snow characteristics such as average snow depth, average snow water equivalent and percent snow cover can be obtained by using the "Get Time Series for Basin ID" option under the "Quick Query Links" in the upper right hand corner of the interactive page. Basin identifiers (ID) can be obtained by clicking on the "Listing" option to the right of each query option.
- The "Quick Query Links" also allow the user to search basins according to state, county, NWS County Warning Area (CWA), 6-digit US Geological Survey Hydrologic Unit Code (HUC-6) or NWS River Forecast Center. These options are particularly useful for water managers from groups other than the NWS.

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## National Snow Analyses 3D Interface

**Instructions**

Below are several links to ".kmz" files suitable for viewing with KML interpreters (such as Google Earth). Software and plugin information can be found [here](#). More information on these products can be found [below](#).

*Information for Internet Explorer users*  
*Information for Safari users*

**Snow Analyses Overlays**



|                  |      |
|------------------|------|
| November 3, 2010 | 2 KB |
| November 2, 2010 | 2 KB |
| November 1, 2010 | 2 KB |
| October 31, 2010 | 2 KB |
| October 30, 2010 | 2 KB |
| October 29, 2010 | 2 KB |

[Latest Snow Analyses Overlays](#)  
[Archive](#)

**Snow Reports and Stations**



|                  |        |
|------------------|--------|
| November 3, 2010 | 284 KB |
| November 2, 2010 | 281 KB |
| November 1, 2010 | 277 KB |
| October 31, 2010 | 276 KB |
| October 30, 2010 | 274 KB |
| October 29, 2010 | 272 KB |

[Latest Snow Reports and Stations](#)  
[Archive](#)

**Figure 20.** Initial display for the National Snow Analysis 3D Interface.

## Snow Information Heading – 3D Visualization

The [3D Visualization](#) link of provides snow and snowpack data that can be projected onto three-dimensional images of terrain (Figure 19). Three dimensional viewing allows users to visualize elevation and terrain impacts on snow distribution and snow events.

The Snow Analyses Overlays displayed through this capability are three-dimensional views of the same data one can see in the NSA two-dimensional maps. These overlays are provided in .kmz (Keyhole Markup Language, Zipped) files, which allow geographic data sets to be viewed using Internet-based, three-dimensional Earth browsers (e.g., Google Earth). Instructions for how to download appropriate software and view the 3D overlays are found near the top of the page.



## Snow Information Heading – Airborne Surveys

One of the key inputs to the National Snow Analysis is remotely-sensed snowpack data collected by NOAA aircraft. Airborne snow survey data collection is based on the relationship between gamma radiation emitted from the ground and the amount of water in the overlying snowpack. Naturally-occurring low level radiation is continually emitted from the soil from trace amounts of isotopes. Water, whether in the form of snow, ice or liquid, reduces (attenuates) the radiation that makes it into the open air. Sensitive detectors in the aircraft measure the radiation levels through the snow, compare the results from a previous snow-free flight and compute the amount of water contained in the snowpack. These flight lines are pre-selected to provide useful snowpack data to support NWS River Forecasting Centers.

The [Airborne Surveys](#) link brings up a web page with a photograph of the NOAA aircraft used to conduct airborne snow surveys and a short description of the program. Below the photograph is a table listing completed surveys for the current water year. At the bottom of the page is set of links providing access to the airborne snow survey schedule for the current snow accumulation period, aerial photos taken during surveys, an index and a map of flight lines, a link to soil moisture (snow-free) surveys, tables with historical snow survey information, a key to understanding Standard Hydrometeorological Exchange Format (SHEF) messages with airborne data, users guide for the Airborne Gamma Radiation Snow Survey Program (fairly technical), and information about the aircraft used in the collection of airborne snow data.

## Snow Information Heading – Satellite Obs.

The [Satellite Obs](#) link provides access to graphical products depicting snow cover over the conterminous U.S., Alaska, and the Northern Hemisphere. These products are generated by the National Ice Center – an interagency center supported by NOAA, the U.S. Navy, and the U.S. Coast Guard.

## Snow Information Heading – Forecasts

The [Forecasts](#) link provides access to numerous short- to long-term snow forecast products issued by entities outside the NOHRSC. The 3D Snowfall Probability Forecasts are derived from two-dimensional Weather Prediction Center (WPC) data and have been reformatted by the NOHRSC to produce 3D files. Instructions for viewing the 3D files are directly above the file links. The rest of the products on this page, such as nationwide watches and warnings and river flood conditions, are produced by NOAA entities other than the NOHRSC.

## Snow Information Heading – Data Archive

The [Data Archive](#) link provides access to past grid-based daily output from the SNODAS model archived at the National Snow and Ice Data Center. Documentation and instructions on how to use the archive are provided, and data is accessed via FTP.

## Snow Information Heading – SHEF Products

The [SHEF Products](#) link provides access to text products containing basin averages for one of seven snowpack-related variables, encoded in SHEF, for any user-selected date and time. The products are produced for basins within each NWS River Forecast Center domain. The seven simulate snowpack-related variables are: snow water equivalent, basin snow-covered area, average snowpack temperature, snow melt, blowing snow sublimation, snow depth and snow-pack surface sublimation. This product is primarily intended for NWS River Forecast Centers, but it is also made available to the public through this link. The SHEF Products display includes links which also allow users generate lists of [Observation stations by WFO](#), [CoCoRaHS station identifiers](#), and [Stations with unknown metadata](#).

## Observations Near Heading

This feature allows the user to request, for any city and state, the five closest observations of recent snowfall, snow depth, snow water equivalent, and total precipitation. The “Observations near” box will bring up a web page where the user can select a new location, time, date, year and English or metric units (click [here](#) for an example).

## Science/Technology Heading - NOHRSC

The [NOHRSC](#) link brings up a mission statement for the NOHRSC and an overview of its functions. Following these are lists of documents and publications covering various aspects of the NOHRSC’s operations. For an in-depth overview of the SNODAS model, refer to “NOAA’s National Snow Analysis: Western Snow Conference, 2006 April” under the heading “NOAA’s National Snow Analysis (NSA).”

## Science/Technology Heading – GIS Data Sets

The [GIS Data Sets](#) link brings up several tables listing geographic information system (GIS) files and instructions for downloading and decompressing the files. Available datasets include: (1) basin boundaries for each NWS river forecast center area, (2) datasets that are used on the NOHRSC interactive web page, and (3) rivers and streams in each of the NWS River Forecast Center regions.

## Science/Technology Heading – Special Purpose Imagery

The [Special Purpose Imagery](#) link brings up thumbnails for various images created for special projects. These images, usually satellite-derived, are used to support NWS River Forecast Center operations, particularly during flood events.

## Other Links on National Snow Analysis Page

On the bottom of the dark blue margin on the left side of the home page, links are provided to: (1) the National Operational Hydrologic Remote Sensing Center staff directory, (2) information on snow climatology and other snow resources, (3) the websites of related NWS offices and

centers, NOAA centers, and external data providers, (4) a menu for obtaining help on using key features of the National Snow Analysis web pages (including frequently asked questions), and (5) a menu enabling users to submit comments.