Burlington Street Bridge in Iowa City on June 30, 2014
(*Photo Credit: Adam Wesley/The Gazette-KCRG-TV9*)

Warning Operations Course: Flash Flood

Simulation Application #2
Conveying the Flash Flood Threat

June 30 – July 1, 2014 Des Moines event

Designed by the National Weather Service
WARNING DECISION TRAINING DIVISION (WDTD)
Office of the Chief Learning Officer (OCLO)
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Table of Contents

(Labels are clickable links to navigate to that section)

I. Introduction

Simulation Application #2 is a displaced real-time simulation designed to allow forecasters the opportunity to apply radar analysis, FFMP, and local storm reports (LSRs) into the warning decision making process. This is the second part of the simulation for the June 30-July 1, 2014 event. The student must complete Simulation Application #1 before attempting this simulation.

For the majority of the simulation, the trainee will analyze multiple data sources, including observations, radar products, FFMP, and local storm reports. The event begins with four active Flash Flood Warnings that do not expire during the simulation. The goal of the simulation is to update the preloaded Flash Flood Warnings with appropriate follow-up statements, as well as to issue new warnings that convey the current flash flood threat. Forecaster decision making should be heavily influenced by precipitation accumulation products, FFG and FFMP analyses, Dual-Pol signatures, and local storm reports.

Defining effective performance objectives and evaluation criteria are essential to a successful simulation. The performance objectives outlined here (and in the embedded quizzes) coincide with the learning objectives from the WOC Flash Flood Track. However, the facilitator is encouraged to enhance the learning experience by creating supplemental objectives that tailor the training to any specific needs at their office. The student should have a clear understanding of the objectives prior to starting the simulation.

II. Receiving Credit

In order to receive credit for Simulation Application #2, the trainee must pass all quizzes embedded in the recorded pre- and post-brief presentations within the WESSL script. At the end of each quiz, there is a code that should be written down. Upon completion of Simulation Application #2, the trainee must log into the LMS, navigate to the lesson "FY16 WOC FF Simulation Application #2", and provide the codes in order to be marked complete. After the trainee has passed the LMS lesson for Simulation Application #2, he/she will have completed all requirements to get a certificate for the FY16 WOC Flash Flood course (assuming they previously completed all of the recorded lessons in the LMS curriculum).

III. Simulation Details

WFO Localization	Des Moines, IA (DMX)
Simulation Start Date/Time	June 30, 2014 – 1800 UTC
Simulation End Date/Time	June 30, 2014 – 1930 UTC
Case Name	Hydro Case WFO Capability AWOC FF
WESSL Script	WOC_Flash_Flood_Sim_Application_2
Simulation Mode	Displaced Real-Time
Estimated Completion Time	120 minutes (including quizzes)

IV. Starting the Simulation

In the upper-left corner of the WES-2 Bridge desktop, navigate to the Applications menu, and then the WDTD submenu. Click "WDTD Training Resources" (see figure below).

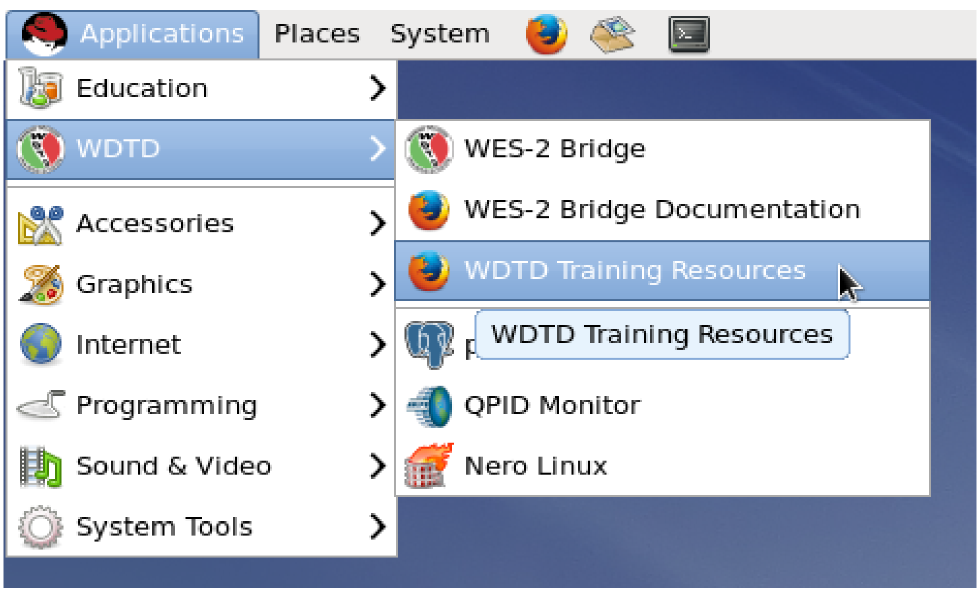


Figure. Link to the WDTD Training Resources webpage.

By clicking this button, a Firefox web browser will open a local web page with a link to "FY16 WOC Flash Flood Simulation Documents" (see figure below). Clicking this link will lead you to supplemental documentation for this course, including a PDF titled "Instructions for Launching Simulations". Please refer to this document for details on how to load, launch, and start the simulation.

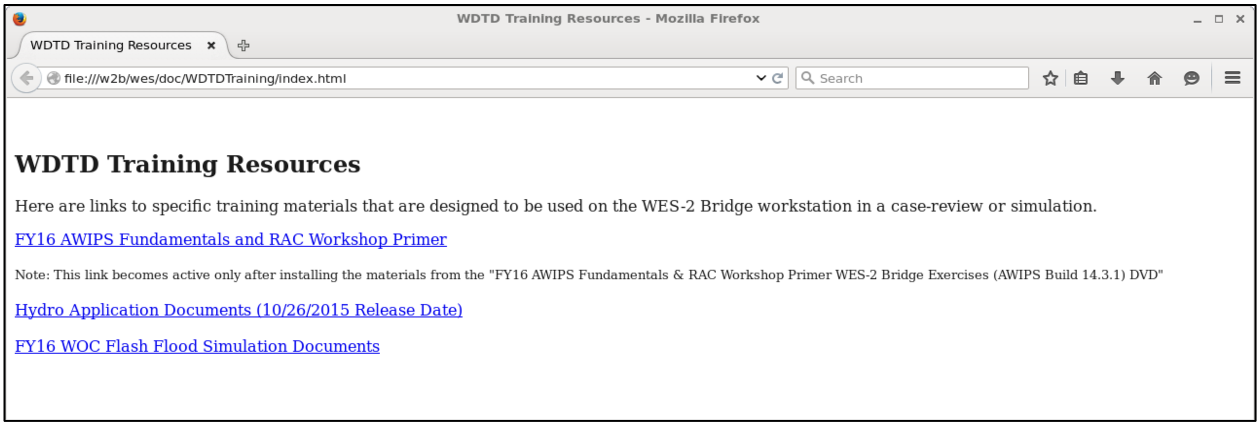


Figure. WDTD Training Resources webpage, with links to supplemental documentation.

V. Performance Objectives

1. Rainfall Analysis

Identify the meteorological variables related to rainfall rate and duration that contribute to the ongoing flash flood threat. Specifically, evaluate the recent features and trends of the heavy rain event using the WSR-88D base products, including dual-polarization applications.

Evaluation Criteria 1.1 – Recall from the RAC lesson "Flash Flood Meteorology" that a Low-Echo Centroid Signature is a radar depiction of convection dominated by warm rain processes. The two characteristics that define a Low-Echo Centroid Signature are:

1. Enhanced reflectivity at or below the freezing level, and
2. Low or non-existent reflectivity above the -20C level.

With these criteria in mind, open the SimApp2 procedure bundle and load the "RainfallAnalysis_LEC" procedure. This procedure has all-tilts reflectivity and LAPS temperature. Turn on Sampling, and acquaint yourself with the current radar trends by looking throughout the volume scan, and back in time a few scans.

Question #1: Using the 1757 UTC reflectivity volume scan, do you see a Low-Echo Centroid Signature?

Evaluation Criteria 1.2 – Dual-Polarization products can provide valuable information in determining areas of high precipitation rates and heavy rainfall. In the SimApp2 procedure bundle, load the "RainfallAnalysis_DP" procedure.

Question #1: Using the 1800 UTC scan, focus on the storm over Perry and Minburn (just west of the radar). In particular, zoom in on the area just southwest of Dallas Center.

What Dual-Pol characteristics in this portion of the storm point to the existence of heavy rainfall? (Turning on sampling may help)

Question #2: For Storms 1 and 3 in Figure 1, what reasons may these storms be less efficient heavy rainfall producers, based on their Dual-Pol characteristics?

Evaluation Criteria 1.3 – To analyze areas with long rainfall durations, we can use factors such as storm area and motion to determine residence time over a location.

Question #1: In general, is storm motion in this event fast or slow?

Question #2: How is the precipitation area oriented with respect to the motion path?

Question #3: Is there a slow-moving or stationary boundary that would promote storm training?

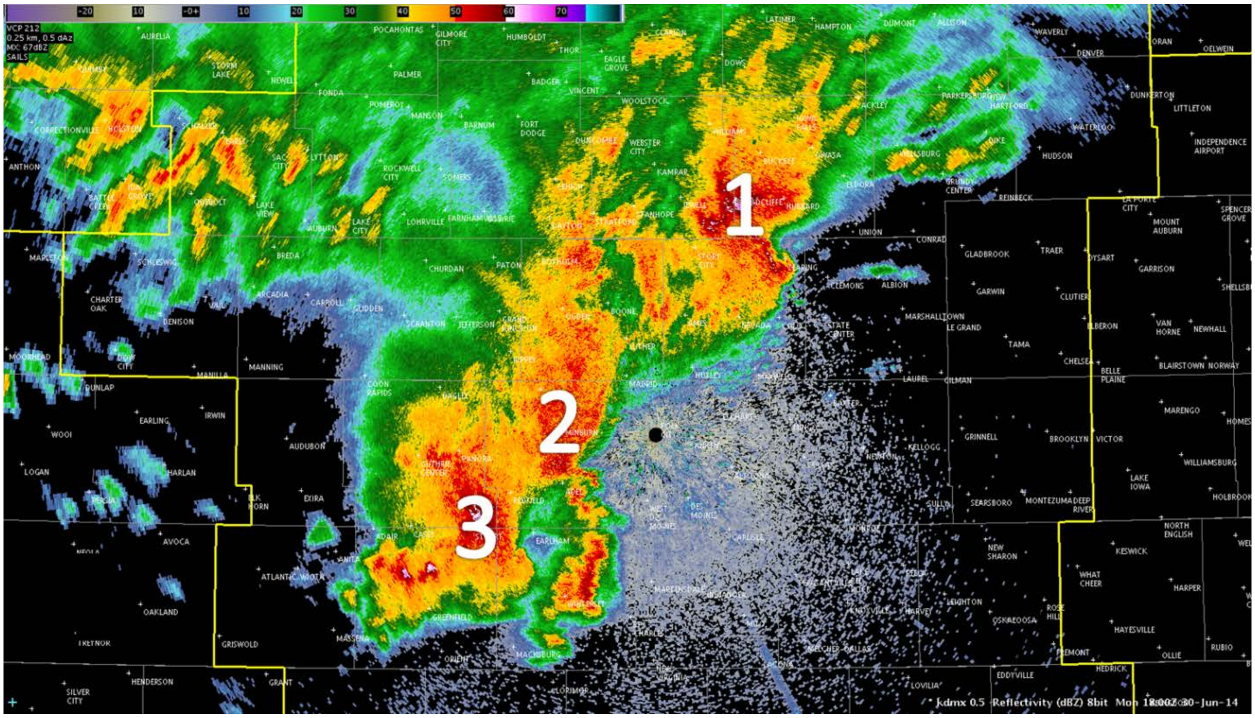


Figure 1. KDMX reflectivity at 1800 UTC, with the predominant storms numbered.

2. Choose Your Initial Precipitation Source

Identify the optimal precipitation source, in order to determine how much rain has fallen and when. Use factors, such as coverage and resolution, to help determine the best QPE. When available, compare your QPEs to surface observations and reports, including using Virtual Gauge Basins.

Evaluation Criteria 2.1 – Recall the table provided in the lesson “Flash Flood Warning Decision Making” (Figure 2). As noted on the table, there are issues with several sources that can limit their use for flash flood decision making. However, there are updates coming down the pipe:

1. By 16.1.2, the DPR bug in FFMP will be fixed, and this source will become usable in FFMP. Remember, you can always use DPR (even before this fix) by loading it straight from the radar menu, and it is a valuable source of real-time precipitation rates.
2. By 16.2.1, MRMS will be available within FFMP. Again, MRMS precip products are currently available in the MRMS product menu, and can be pulled up in CAVE as another QPE source other than Legacy and Dual-Pol accumulations.

For this Des Moines case, the data was archived from the 14.2.4 AWIPS-2 build, and then reprocessed for use in the 14.3.1 WES-2 Bridge. Therefore, there are some limitations to what you will be able to use within this simulation:

1. Bias HPE still has bugs in the raw data, and should not be used (nor in real-time at your WFO).
2. This case occurred in 2014, before there was MRMS data available in AWIPS, so MRMS is not usable.
3. The bug with DPR in FFMP existed back then, so you should not use it within FFMP. However, remember that you can still load it manually to view in CAVE (and are encouraged to do so!).
4. There is a bug with HPE being loaded via the Volume Browser and FFMP that causes precip rates to be off, so you should not use HPE at all.

Therefore, your only available FFMP source is the Legacy single-radar DHR. However, to ensure you still get acquainted with the process of choosing your precip source, we have a few questions:

Question #1: In this simulation, which precip source(s) is/are available for you to load manually in CAVE?

Question #2: In this simulation, we gave you the best QPE source. However, in operations, what are some reasons to use a single-radar source versus a mosaic source?

Evaluation Criteria 2.2 – Choosing the right precip source doesn't end after your initial selection. You should routinely compare your precip sources to surface observations and spotters throughout the event. Open the SimApp2 procedure called "PrecipSource_Obs", which includes the Legacy and Dual-Pol one-hour precip accumulations overlaid with METARs.

Question #1: Find the METAR station named KHNR (at 73nm@263 from kdmx). At 1755 UTC, how much rain did the METAR register in the last hour?

Question #2: At 1757 UTC, what are the Legacy and Dual-Pol one-hour totals at the same location as the METAR observation (KHNR)?

Question #3: How do these one-hour totals compare to the METAR observation? How does this comparison aid in your warning decision-making?

Evaluation Criteria 2.3 – When using Dual-Pol estimates, it is important to keep in mind the location of the low-altitude Melting Layer. For Dual-Pol QPEs, Z-R relationships are assigned pixel-by-pixel based on hydrometeor classifications. The location of the Melting Layer can affect these classifications, and thus, the Z-R that gets assigned to a pixel.

Question #1: In Dual-Pol, how might the Melting Layer affect the reliability of precipitation estimates?

Question #2: In the Dual-Pol One-Hour Accumulation (OHA) product in Figure 3, which region can you have the most confidence in your QPE estimates based on the location of the Melting Layer?

Question #3: Go to the SimApp2 procedure called "Accum_LegacyandDP". Toggle over to the one-hour and storm total difference products. Does the location of the Melting Layer appear to have an effect on the difference products?

	Maximized coverage?	Dual-Pol?	Bias corrected?	Resolution	Accumulation intervals
Single radar DHR	No	No	No (default, but configurable at RPG)	1 km x 1 deg 3-6 min	1-, 3-, 6-hr, STP
Single radar DPR Bug in FFMP	No	Yes	No	0.25 km x 1 deg 3-6 min	1-, 3-, 6-hr, STA
HPE mosaic	Yes	Yes	No	1 km x 1 km 5 min	1-hr
Bias HPE mosaic Bugs in raw data	Yes	Yes	Yes	1 km x 1 km 5 min	1-hr
MRMS mosaic Not in FFMP	Yes	No	No	1 km x 1 km 2 min	(2-min) 1-hr (≥ 1 hr) 3-, 6-, 12-, 24-, 48-, 72-hr

Figure 2. Table from the lesson “Flash Flood Warning Decision Making” which describes the characteristics of each precipitation source. These factors should be considered when determining a source for flash flood warning operations.

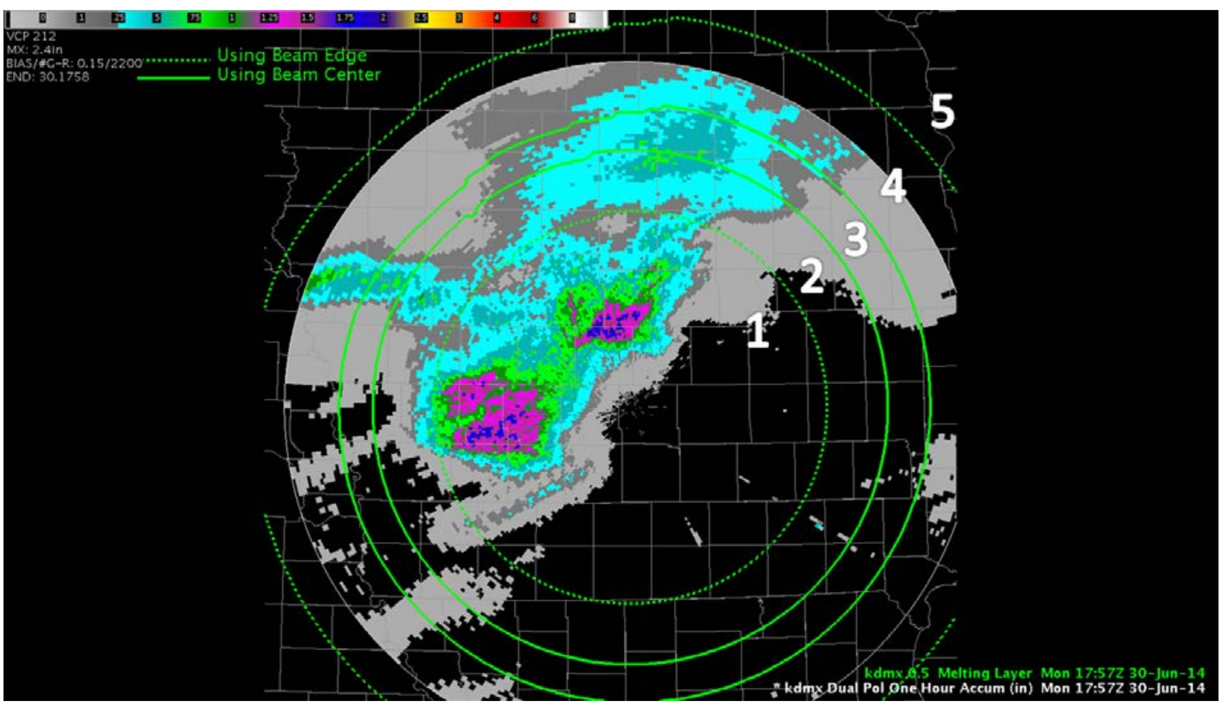


Figure 3. KDMX Dual-Pol One-Hour Accumulation (OHA) at 1757 UTC, overlaid with the KDMX 0.5 Melting Layer (green lines). Regions of the Melting Layer are annotated.

3. FFG and FFMP Analyses

Manually compare your QPE to Flash Flood Guidance (FFG) to interpret the flash flood threat. Use FFMP to compare your QPE and FFG to interpret the flash flood threat. Within FFMP, be able to load the appropriate settings and follow the necessary best practices for flash flood decision making.

Evaluation Criteria 3.1 – We will start by manually comparing your Legacy and Dual-Pol QPEs to Flash Flood Guidance (FFG). Open the SimApp2 procedure called "Hydro_Manual". **[NOTE: Please make sure the FFG product is on the bottom. If not, right-click the legend name and choose "Move Down". Your time-matching should still link to the precip products.]**

Question #1: Sample the area south of Audubon, specifically near Exira, at 1757 UTC. At first glance with FFG, does this area of higher one-hour totals pose an immediate flash flood threat?

Question #2: True/False: You should use Forced FFG to manually increase FFG in urban areas.

Evaluation Criteria 3.2 – Now we will use FFMP to compare Legacy DHR to Flash Flood Guidance (FFG). Open the SimApp2 procedure called "Hydro_FFMP", which has FFMP loaded using the Legacy DHR source, as determined from Section 2.

As recommended in the "Flash Flood Warning Decision Making" lesson, please configure your FFMP as follows:

- Config: All options checked (default)
- D2D: ratio
- Layer: All & Only Small Basins
- Zoom: All options unchecked
- CWA: DMX
- Click: Downstream Basin Trace

Question #1: Beginning with a 1.0 hour duration, what is the highest ratio at 1757 UTC? [NOTE: You may need to change your frame count to go back to 1757 UTC.]

Question #2: What does this ratio tell you about the flash flood threat for this basin?

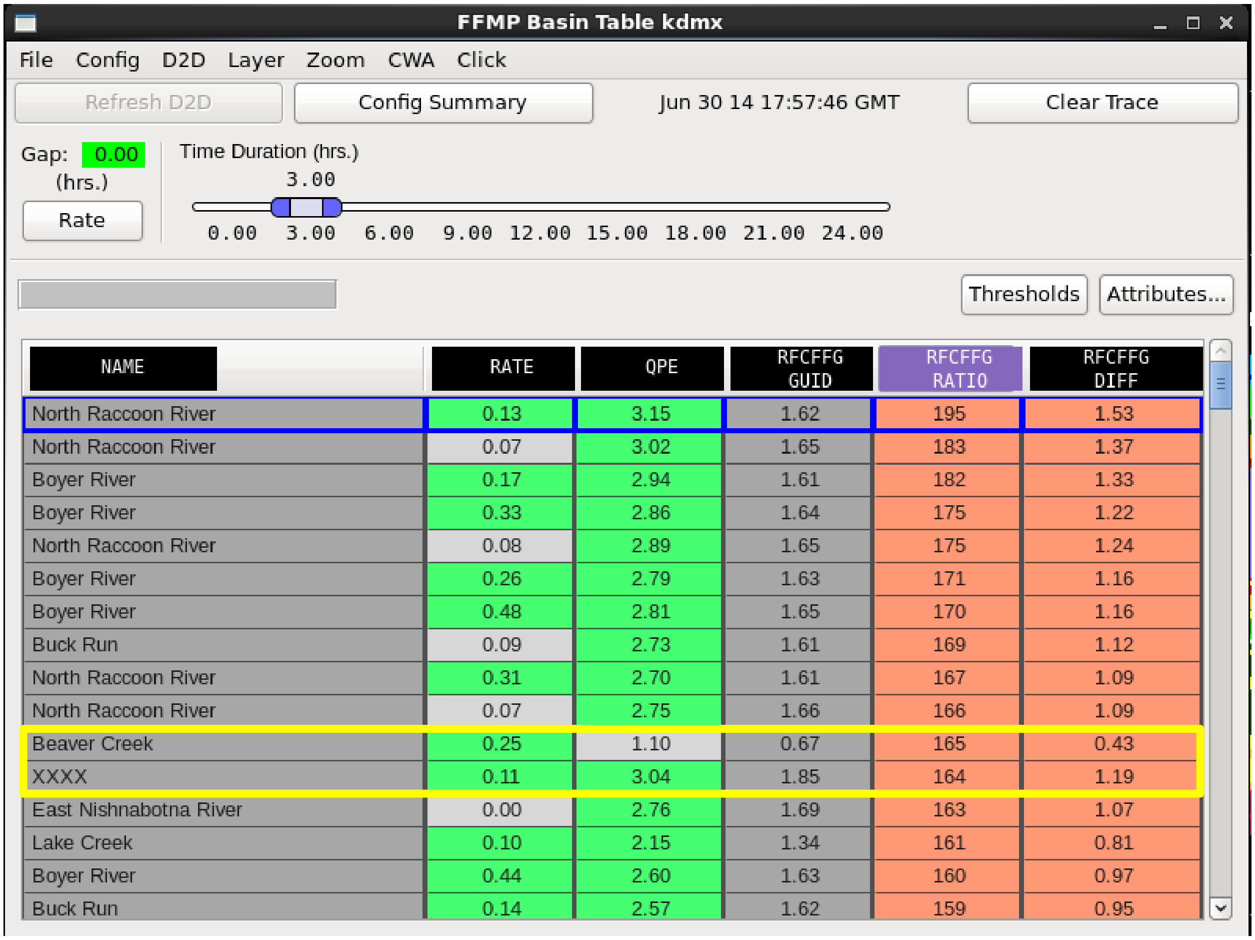
Question #3: Increase your time duration to 3.0 hours. At 1757 UTC, what county in the DMX CWA has the most widespread longer-fuse flash flood threat?

Question #4: Look at the 3.0 hour FFMP Basin Table (Figure 4). Which of the two highlighted basins has the bigger flash flood threat?

Question #5: Analyze the FFMP basin trend graph for the North Racoon River basin (Figure 5). When did this basin receive the majority of its QPE within the last three hours?

Question #6: Change your duration back to 1.0 hour. Change the D2D menu setting to display diff. Sort the table by diff. Left-click on the first basin, Davids Creek.

What is the downstream direction for this basin?
[Note: You may have to make the FFMP Table Display in CAVE "Editable" by middle-clicking on the layer name in the bottom-right.]



NAME	RATE	QPE	RFCFFG GUID	RFCFFG RATIO	RFCFFG DIFF
North Raccoon River	0.13	3.15	1.62	195	1.53
North Raccoon River	0.07	3.02	1.65	183	1.37
Boyer River	0.17	2.94	1.61	182	1.33
Boyer River	0.33	2.86	1.64	175	1.22
North Raccoon River	0.08	2.89	1.65	175	1.24
Boyer River	0.26	2.79	1.63	171	1.16
Boyer River	0.48	2.81	1.65	170	1.16
Buck Run	0.09	2.73	1.61	169	1.12
North Raccoon River	0.31	2.70	1.61	167	1.09
North Raccoon River	0.07	2.75	1.66	166	1.09
Beaver Creek	0.25	1.10	0.67	165	0.43
XXXX	0.11	3.04	1.85	164	1.19
East Nishnabotna River	0.00	2.76	1.69	163	1.07
Lake Creek	0.10	2.15	1.34	161	0.81
Boyer River	0.44	2.60	1.63	160	0.97
Buck Run	0.14	2.57	1.62	159	0.95

Figure 4. FFMP Basin Table for the 3.0-hour duration at 1757 UTC.

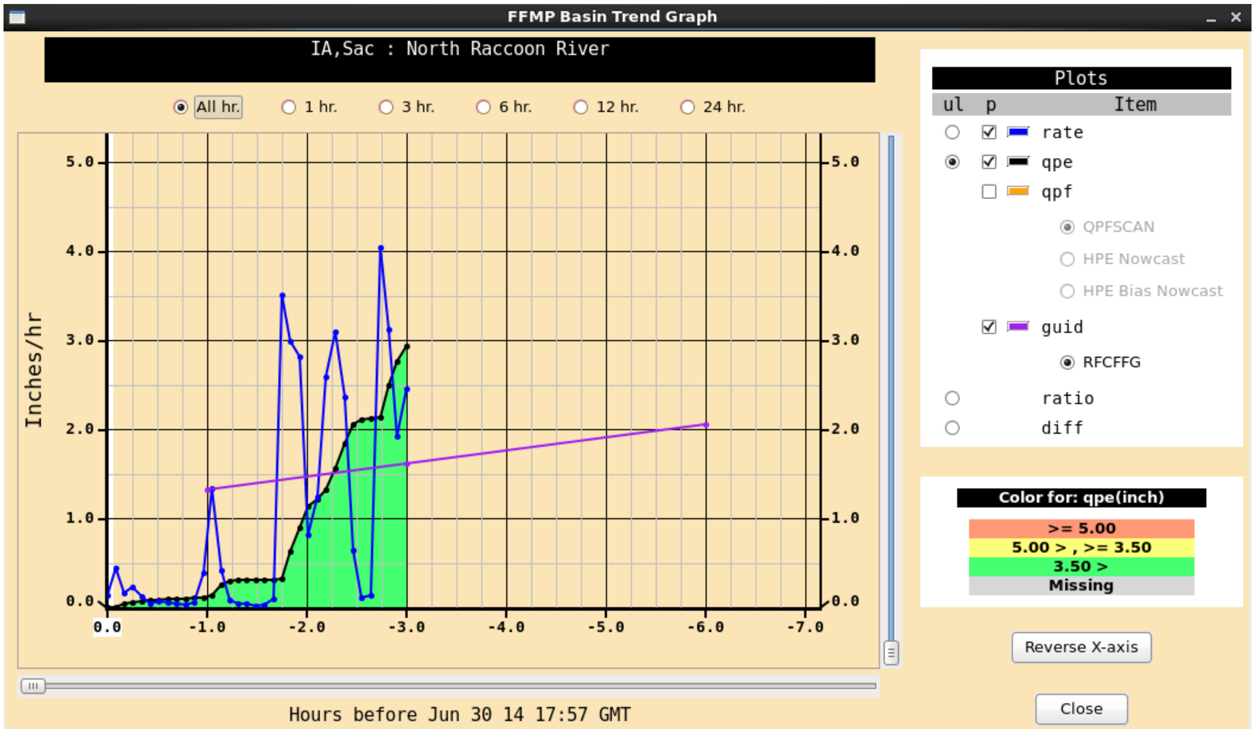


Figure 5. FFMP Basin Trend Graph for the North Raccoon River basin at 1757 UTC.

4. Conveying the Flash Flood Warning Threat

Using all available data and AWIPS-2 tools, effectively convey the flash flood threat by issuing Flash Flood Warnings and follow-up Flash Flood Statements. Apply warning polygon and text best practices when appropriate, including size and duration thresholds, and basis and call-to-action details. Determine if the criteria have been met for using Flash Flood Emergency enhanced wording.

Please refer back to the lesson on “Flash Flood Warning Fundamentals” if you need to recall some of the best practices related to warning polygonology and text.

While we will not test you directly on this objective, it is obviously the most operationally-relevant component of this simulation application. If you like, have your Training Officer review your warnings at the end of the warning period. The post-event debrief that will pop up at 1930 UTC will show some of our examples, and walk through some of the warning decisions made throughout the event.