Appendix A

Photographs

Nashville Flood 2010

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The U.S. Army Corps of Engineers Nashville District operated area dams along the Cumberland River and its tributaries to minimize flooding and reduce lake levels during heavy rainfall and flooding on May 1-2, 2010. Tennessee and southern Kentucky received record rainfalls during the two days.

Record high lake elevations were recorded at dams J. Percy Priest in Nashville; Old Hickory in Hendersonville, Tenn.; and Cheatham in Ashland City, Tenn.

(Left) An aerial view of Cheatham Lock and Dam in Ashland City, Tenn.

U.S. Army Corps of Engineers photo

Cheatham Lock and Dam May 2, 2010

Flood waters crested in downtown Nashville at 51.86 feet reaching 1st and 2nd streets.
Nashville May 3,2010

Photo by Mark Rankin, U.S. Army Corps of Engineers

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Old Hickory Lock & Dam May 2, 2010

Large chunks of trees and debris sit on top a ledge that houses a crane at the Old Hickory dam powerhouse. The debris lifted the crane off its roller.

Water behind the dam in Old Hickory Lake reached a record elevation of 451.4 on Sunday afternoon, just seven inches short of the Corps losing control of the project due to the lake overtopping the dam. Corps engineers are collecting and studying data to verify exactly how much flooding Corps dams actually prevented. Current data shows that Corps reservoirs have prevented more than a million cubic feet per second in water from reaching the Cumberland River over the weekend.

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Cordell Hull Lock & Dam

Large Debris pushes against the Cordell Hull dam during the storms May 1-2.

Trees and Debris litter a large portion of the area below the dam at Cordell Hull. May 3, 2010

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Cheatham Hull Lock & Dam

The Cheatham Lock and Dam Lockmasters office and master control center was totally submerged underwater on May 2, 2010 when more than 13 inches of torrential rains fell.

The record rainfall was labeled as what water managers refer to as a 1,000 year event. A 1,000 year rain event has a 0.1% chance, or a 1 in 1,000 chance, of happening every year.

This unprecedented event stretched the capabilities of the ten Corps dams on the Cumberland and its tributaries, but the projects have performed as designed.

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Nashville Flooding

The Opryland Hotel was flooded when high flood waters breeched levees on the Cumberland River during the May1-2 flood in Nashville. Photos taken May 3, 2010.

1st and 2nd streets down town Nashville were flooded with 10 feet of water covering the train station and Demonbreun Street.

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Appendix B – Lessons Learned

The issues have been grouped by the following categories:

Communication	(Issues 1 through 5)
Emergency Management	(Issues 6 through 17)
Water Management	(Issues 18 through 27)

The issues are not in any particular order within the category.

Category: Communication

1. Issue: Improve integration with the United States Geological Survey.

What was planned?

-Maintain communication and cooperation between the Corps, National Weather Service (NWS) and United States Geological Survey (USGS) during a flood event.

What actually happened?

-The Kentucky and Tennessee USGS Water Science Centers (WSCs) were under utilized by LRD, LRN and the NWS during the event. The USGS wanted to be better integrated with the LRD, LRN and NWS response in the midst of the event. During the event, USGS deployed personnel in the field to take flow measures at key locations, improve stage-discharge rating curves and repair equipment. They could have also provided real-time observations.
-The USGS could not assist in maintaining operation of critical gages during the event since they were not aware of what gages were critical.
-The USGS could not insure the critical gage readings were obtained during the event since they were not aware of what gages are critical or what the critical flood levels are.
-The NWS Ohio River Forecast Center (OHRFC) did request high water measurements on Sunday morning for the Harpeth River and utilized the information received in its river modeling.

Why did it happen?

-Due to budget considerations, LRN withdrew from the USGS Cooperative Gaging Program approximately 5 years ago and ended its direct working relationship with the USGS.
-The LRD, LRN and the NWS did not consider involving the USGS in the LRD led conference calls.
-The USGS did not contact the LRN WM or the NWSWFO to see if they needed assistance until after the crest and the river began to recede.
-Critical gages and gage ratings have not been communicated to the USGS. LRN WM has contracted gage maintenance during the last five years. The gage rating curves have not been updated during this period.
-Past budget decisions and priorities may have impacted gage maintenance.

How can we do it better and who has the lead to fix it?

-District Water Management offices will invite USGS to participate in conference calls.
-LRN has established a transition plan to enter the USGS Cooperative Gaging Program.
-LRD WM will evaluate the use of NWS Chat.
-LRN and the NWS OHRFC and the NWS Nashville WFO will provide the USGS with a listing of critical gages such that they can assist in maintaining their operation during flood events.
-The local NWS WFOs will provide the Kentucky and Tennessee USGS a listing of all critical flood stages and major flood levels. Manual readings (stage and flow) for sites where major flooding is occurring, where gages are out (overtopped, etc.) or where readings are above current ratings are valuable to the NWS. The USGS will be able to monitor these locations during flood events.
-LRN WM will evaluate having high level staff gages at various locations that can be used during record flood events.
-USGS, NWS, and the Division Water Management offices will conduct annual office visits. Participation will also continue in the Ohio Valley Tri-agency meetings. Many offices participate annually, but will need to require attendance by all affected offices to ensure important topics are discussed.

Category: Communication

2. Issue: Improve internal communications before and during potential flood events.

What was planned?

-Provide communication regarding potential for flooding.

What actually happened?

-On Wednesday, April 28th, LRD noted the high NWS Quantitative Precipitation Forecast (QPF) and began monitoring the storm. The Early Morning Weather and River Update issued that day discussed the rainfall potential and noted that reservoir releases would increase over the next several days in response to the forecast rainfall.

-On Thursday, April 29th, the NWS Quantitative Precipitation Forecast QPF continued to show 3-6" of rainfall and LRD issued a Flood Potential Update apprising the senior leadership, the LRN Commander, Emergency Operations and Public Affairs of the upcoming rainfall event. The LRN Commander responded with LRN measures being taken in response to the QPF. This email did not get immediate attention by LRD staff resulting in slower communication up the chain of command regarding the potential severity of the event.

-LRD WM only issues the Flood Potential Updates when there is a significant event forecasted.

-LRD WM and the NWS OHRFC began coordinating the flood potential on April 28th.

Why did it happen?

-The emails were not read, perhaps from an overload of emails in mailboxes.

-A trigger does not exist at the Division staff level to activate the staff into an emergency mode. Note that this would be the Crisis Action Team according to the LRD Emergency Operations Center's (EOC's) standard operating procedures.

How can we do it better and who has the lead to fix it?

-LRD WM will add the District EOCs to its distribution list for the Early Morning Weather and River Update.

-The Division office will utilize telephonic notification for passing critical notifications. The Division Office will consider adoption of an Automated Notification System (ANS).

-The Deputy Division Commander will develop a trigger for significant events that would convene an emergency meeting of key staff. The staff would then have the opportunity to:

1. Receive briefing on the developing situation to ensure common understanding.
2. Allow the impacted district(s) to request support and identify resources needed.
3. Have each staff officer explain what they are doing, what they plan to do to support, and any issues. This ensures all resources and support are brought to bear on the situation as well as to synchronize efforts.
4. Allow the commander an opportunity to give intent and guidance to everyone.

-An alternate trigger may be developed that activates a Division Team for coordination across functions. The Team should include as a minimum, the Deputy Commander, Water Management, Emergency Management, Public Affairs Office (PAO), Counsel, Operations, and Dam Safety.

Category: Communication
3. Issue: Provide redundant communication systems.

What was planned?
-Communicate with project personnel concerning project release updates during the flood event.

What actually happened?
-Internet outage occurred due to a Verizon communication line break.
-The network outage that occurred on May 2 (Sunday) during a critical period eliminated the electronic transmission of project data to the Water Management office. The only source of project data was via telephone conversations with the operators located at the projects.
-The outage impaired the ability of the Water Management personnel to quickly analyze and respond to changing conditions.

Why did it happen?
-The hydropower operators manually enter project data into a spreadsheet system that is subsequently transferred via the network to the District Office where it automatically updates both the water control database and the web-site. Data is also transmitted via satellite to a local downlink station located at J. Percy Priest project office. The data from the local downlink is also transmitted to the District via the Internet. When the network went down these processes became inoperable.

How can we do it better and who has the lead to fix it?
-LRN WM will build redundancy into the project data reporting system so a single point of failure in the network will not compromise information exchange.
–Air cards and laptops have been secured for the Water Management office and for the manned powerhouses to facilitate information exchange.
-Satellite phones are being secured for the Water Management office and the manned powerhouses as a backup for landlines and cell phones, both of which are prone to failure during certain natural disasters.

Category: Communication
4. Issue: Improving risk communication.

What was planned?
-Provide effective risk communication to the public.

What actually happened?
-LRN WM fielded several questions from the public during the event regarding the physical extent of the areas that have the potential to be flooded based on the NWS stage forecasts. There is also a misconception of which projects provide flood control benefits. This is particularly true for the Nashville area, downstream of Old Hickory Dam where the public associates the upstream dam with flood protection rather than for navigation.
-LRN WM personnel fielded numerous phone calls from the public during the flood event requesting information on the extent of flooding expected in their area. With minimum personnel available the calls diverted staff time away from developing and implementing reservoir system operation plans.

Why did it happen?
-NWS forecast are provided in terms of river stage with some associated reference points/impacts.
-This event occurred over the weekend, when limited personnel were in the District office to handle communication with the public.
-A common public misperception is that all navigation projects hold back floodwaters just like flood risk management projects.
-NWS is responsible for providing the public flood forecast information; however, most people appear to associate that responsibility to the Corps.

How can we do it better and who has the lead to fix it?
-The Corps (LRN-EC-H) (Nashville District Corps of Engineers, Hydraulics and Hydrology Branch) and the NWS Nashville WFO will develop an interagency process that relays crest stage information in a manner that gives the general public more knowledge as to the effect on an individual, i.e. what does 51.5' Nashville river stage mean for Pennington Bend?
-Inundation maps available to the public would be beneficial. Model-based GIS inundation map products could be developed for a range of river stage values. NOAA, USGS and Corps are developing an Integrated Water Resources Science and Services (IWRSS) Memorandum of Understanding (MOU) to create a technical team to evaluate inundation maps as part of the data synchronization team. Options are being explored for publishing these maps in a forum that would enhance the protection of public health and safety.
-The LRN and LRD Public Affairs offices will develop operating procedures that ensure all public affairs communication functions are adequately covered, such as handling media inquiries, media interviews, message development, fielding calls from the public and other essential strategic communication (STRATCOM) functions.
-Affected Corps' Districts will have a small number of people dedicated to answering telephone calls in order to give consistent information to callers.

-LRN will increase risk communication discussions with the public to improve awareness of the operations of Corps' project and the flooding risks.
-Silver Jackets[1] can assist in education of the public through its members. The Silver Jackets can also serve to improve communications between all stakeholders for flood risk management.

[1] **The Silver Jackets program is a program through which the US Army Corps of Engineers, Federal Emergency Management Agency, State EMA, and State Department of Natural Resources, and other Federal and State agencies collaborate to develop and implement solutions to State natural hazard priorities. The Silver Jackets Program provides a formal and consistent strategy for an interagency approach to planning and implementing measures to reduce the risks associated with natural hazards. The program's primary goals are to leverage information and resources, improve public risk communication through a united effort, and create a mechanism to collaboratively solve issues and implement initiatives.**

Category: Communication
5. Issue: Improve District recall of personnel.

What was planned?
-Assure that appropriate District personnel were on hand to provide assistance during the event.

What actually happened?
-The LRN District office was minimally staffed as the event developed on Saturday.
-Many of the District's personnel were being impacted by the flood. The extreme weather made it difficult and in some cases impossible for personnel to return to duty at the District headquarters. The staff at the District headquarters had to divide their time between regular duties and answering public inquiries.
-A 100% accountability procedure (phone tree) was implemented Sunday to establish accountability of personnel and to check on their status.
-The District recalled critical personnel to duty but there was no clear communication of who was considered "non-essential" personnel versus "essential" personnel.

Why did it happen?
-The event unfolded over a weekend; hence, the office was not staffed as it would have been on a weekday.
-LRN office closed on Monday as well. Only essential personnel asked to report.
- The flood directly impacted many staff members who experienced great obstacles in travel around the city.

How can we do it better and who has the lead to fix it?
-LRN will evaluate, update and revise their recall processes and system. The Division Office will consider adoption of an Automated Notification System (ANS) to assist the District Offices with their recall process.

Category: Emergency Management

6. Issue: Sustain communications between LRN Emergency Management and the Tennessee Emergency Management Agency.

What was planned?

-Effective communications.

What actually happened?

-A line of communication between the Tennessee Emergency Management Agency (EMA) and the LRN EOC was established.

-The EOC personnel felt that they would be more effective if they had a data sheet from the subject matter experts dealing with each event so that the EOC can speak accurately about relative topics.

-Communication with the State of Tennessee Emergency Management Agency went very well. The Emergency Management Liaison embedded in the State EOC, was able to coordinate delivery of supplies within hours of being requested: and was able to supply them with information concerning PL 84-99.

-LRN conducted numerous conference calls

-The LRN EOC has three assigned personnel. One person was assigned to the State EOC. The remaining two personnel maintained EOC operations at the District headquarters and provided technical assistance to other local agencies.

-Effective communication with the EM in Memphis District was maintained throughout the event.

Why did it happen?

- The LRN EOC has well established and understood standard operating procedures.

How can we do it better and who has the lead to fix it?

-LRN EM will work with LRN Engineering and Construction Division to establish a standard data sheet from subject matter experts so that the EOC personnel can speak accurately about relevant topics.

-The LRN EM Office will provide basic emergency management training for District personnel to ensure all personnel understand their role during response operations.

Category: Emergency Management
7. Issue: Sustain Emergency Management Operations.

What was planned?
-The LRN EM office provided timely response efforts in accordance to Public Law 84-99 (provides the authority to conduct emergency preparation and response activities for a flood fight) and Public Law 93-288, Robert T. Stafford Relief and Emergency Assistance Act

What actually happened?
-LRN initiated its All Hazard Plan (Draft) during this event. The plan provided an effective framework for responding to the event.
-LRN EM established a liaison with the Tennessee State EM Operations beginning May 2, 2010.
-LRN followed the All Hazard Plan and LRD EM SOP during the event.
-Under Public Law 84-99 LRN provided equipment, Technical Assistance and sandbags to the state or local governments.
-The District smoothly transitioned to support under Public Law 93-288 Robert T. Stafford Relief and Emergency Assistance Act. Emergency Support Function (ESF) # 3 support was established on May 5, 2010. A Team Leader and LRN EM office continued to provide support to FEMA at the State EMA and Joint Field Office.

Why did it happen?
-LRN EM Office has well established, rehearsed and coordinated procedures.

How can we do it better and who has the lead to fix it?
-LRN EM will distribute and store sandbags throughout the Tennessee and Cumberland River Basins to ensure faster response to sandbag requests.
-The District will augment the LRN EM Liaison with the appropriate subject matter expert from the District (or externally augmented) who is well versed in the type of event occurring.

Category: Emergency Management
8. Issue: Efficient use of ENGLink.

What was planned?
-Effective usage of ENGLink.[2]

What actually happened?
-The LRN EOC specialist was very adaptable and eager to learn some new techniques as the event progressed.
-EOC members need to have all rights as a Strike Team member.
-Enlisted the help of a LRN Strike Team member (Navigation Branch) to assist in the preparation of the Response Organization Document and the tasker process. This helped EOC personnel greatly by allowing the smooth transition of taskers.

Why did it happen?
-Standard Operating Procedure.

How can we do it better and who has the lead to fix it?
- LRD EM will continue to provide training so that EOC personnel can perform their duties in ENGLink more efficiently.

[2] **ENGlink is the software program use by USACE to manage information, execution and personnel in response to an event. It also contains a database of all Corps personnel to document physical status, training and essential personnel data.**

Category: Emergency Management
9. Issue: Sustain pre-event coordination.

What was planned?
-In accordance with proven Business Line practices LRD-EM coordinated calls with LRD WM and the potentially impacted Districts (LRL/LRN).

What actually happened?
-LRD EM remained in close coordination with both LRL and LRN EM a week in advance of the May 1, 2010 flood event. The EM offices had been working response to storms in the Midwest the week prior. On April 28th the LRD WM office sent an update that indicated heavy precipitation west of the Ohio River Basin. EM and WM offices have a long standing practice of sharing information on a routine basis, anticipating potential impacts, and posturing for a timely effective response.
-The LRD EM office maintained coordination with the USACE Operations Center and other Major Subordinate Command through the use of daily conference call that started on April 28. Water Management participated in these coordination calls and briefs.
-Coordinated with HQUSACE and identification of appropriate ESF #3 personnel to staff key Command and Control positions at FEMA IV and Incident Management Assistance Team (IMAT) prior to the actual May 1, 2010 flood event.
-Temporary duty cancelled on April 30, 2010 for LRD-EM and MVM-EM scheduled to attend ESF #3 ATL workshop the week of May 2, 2010 in anticipation of the potential flooding.
-Ironically, LRD and representatives from our seven District EM offices participated in a Response Mission Workshop (April 21-22, 2010), coordinated by LRN-EM, with TEMA where each of our Districts presented Mission Planning Response Teams specific operational briefs. Would also note participants included FEMA IV, TVA, and MVM representatives.

Why did it happen?
-LRD along with the seven district offices utilized the accepted and best practices procedures which have been in place for years. The Lead Districts for each state work closely with their state counterparts on training, exercises and yearly briefings on the Corps' authorities and missions assigned by FEMA during a declaration.

How can we do it better and who has the lead to fix?
-Sustain this activity.

Category: Emergency Management
10. Issue: Sustain response phase activities.

What was planned?
-An effective, coordinated, and timely response under Corps' authorities and missions assigned under the National Response Framework.

What actually happened?
-Pre-event posturing of appropriate resources was critical in our timely and effective deployment of ESF #3 personnel to FEMA IV Regional Response and Coordination Center and TN IMAT in support National Response Framework activities was on target. Our ESF #3 Team Leader arrived on time and date requested by FEMA IV as well as our TL on the TN IMAT arriving in Nashville ahead of FEMA personnel.
-Under Corps' Authority (PL 84-99) LRN EM responded to and fully supported TEMA requests for flood fighting. From issuing sandbags, providing technical assistance, to embedding a District EM in TN EOC, there were no unanswered requests for Corps' assistance. In one particular case, the LRN EM utilized reach back to a sister District (LRL) to virtually provide effective technical assistance and develop an appropriate course of action to sandbag a communication's facility potentially impacted by the rising waters.
-With one of two water treatment plants that supplies Nashville's drinking water impacted and off line, sandbagging assistance coordinated by LRN EM office with TEMA greatly mitigated impacts to the remaining facility as it remained online.
-Internal to Corps, with one of the LRN Projects (Cheatham) severely impacted and without communications, EM's timely and effective deployment of RRV #3 quickly established a communications platform for District personnel engaged in project recovery operations.
-Additional seamless coordination activities undertaken to mitigate impact to District resources was the utilization of National resources in support of Receiving Staging Onward Movement and Integration processing and FEMA Mission Assignments. With regards to RSOI, ULA assets at LRD were engaged to successfully accomplish for personnel arriving into the area of responsibility. RAO personnel identified and deployed to support preliminary damage assessment and project worksheet activities, here again, minimizing impacts to LRN's active workforce.

Why did it happen?
-Proven Business Practices that are validated during the annual Standard Operating Procedure Week, Corps/FEMA Remedial Action Program, the Senior Leadership Seminar and annual National Response Mission exercises.

How can we do it better and who has the lead to fix?
-Sustain this activity.

Category: Emergency Management
11. Issue: Sustain recovery phase.

What was planned?
- Execution of missions under the Stafford Act.

What actually happened?
-Six mission assignments were issued by FEMA Region IV to LRD. Division Office has the responsibility for executing the Regional Activation and the Nashville District is responsible for executing all other
-Working on orderly, physical and fiscal closeout of FEMA

Why did it happen?
-The Corps has well understood business practices that are exercised and validated annually with partner agencies.

How can we do it better and who has the responsibility?
-Sustain this activity.

Category: Emergency Management
12. Issue: Improve logistics response.

What was planned?
-During an event, seamless communication will be maintained between the Division Logistics Staff (Regional Logistics Liaison [RLL], Regional Logistics Planner [RLP], and Logistics Management Specialist) and the affected District Logistics Staff (Logistics Delivery Point [LDP]) to allow proper situational awareness and to facilitate rapid planning for the response effort, as well as, higher to ULA Logistics Activity Center (LAC) for guidance and potential reachback support.

What actually happened?
-Communication and information flow was extremely limited during the early phases of this event. Various members of the LRD logistics team were aware of different pieces of information before and during the weekend flooding event, which should have caused joint logistics preliminary coordinating meetings, an almost instinctive and intuitive sense for collaboration.

Why did it happen?
-The combination of the ULA Logistics Activity Center (LAC) displacement without communications due to floodwaters at the Naval Air Station, Millington, TN, and the rapidly evolving events in the Nashville area hindered the transfer of information and guidance to properly plan the support effort.
-The RLL, RLP, and LDP should have conducted teleconferences early in the event to ensure all logistics support requirements were well defined and activities were being conducted to satisfy those requirements.
-The RLL and RLP should have better communicated the requirements and status with the ULA Logistics Planning and Operations Division (LPOD) and leadership.

How can we do it better and who has the responsibility to fix it?
-The Regional Logistics Liaison (RLL) will develop a standard operating procedure (SOP) as to when to start preliminary coordinating meetings.
- For any event, RLL, RLP and Logistics Management Specialist (LMS) will establish and maintain clear and effective communications from the onset.
- LRD Logistics Management will develop a logistics work plan early in every operation that outlines all communication and reporting requirements. This work plan will anticipate a 24-hour presence, and therefore prepare for possible reach-back support if continuous operations are anticipated to last longer than 7 days.

Category: Emergency Management
13. **Issue: Improve continuity of operations for the ULA.**

What was planned?
-Clear lines of succession of the ULA leadership and key, critical tasks performed at the ULA Logistics Activity Center to allow continuity of operations if access to the LAC is denied.

What actually happened?
-The storm and flood's large geographical region included the ULA headquarters, located at the US Naval Air Station, Millington, TN. The base was flooded, knocking out all computer and telephone lines and nodes of communication on 2May. LRD Logistics RLL and RLP recognized this situation from afar in Cincinnati, OH and stepped up to fill the leadership void, providing both necessary national and local logistics guidance and priorities. The ULA HQ resumed communications and control on 7May.
-The effect of ULA leadership / guidance, reach-back support, and potential Logistics Planning and Response Team (LPRT) deployment during timeframe when LAC operation was impacted due to the flood in Millington, TN which prevented access to the LAC for 5 days.
-If a LPRT had been required during the early phase of this event, the ULA may not have been able to rapidly deploy a logistics team to assist the response effort.

Why did it happen?
-ULA Continuity of Operations Plan (COOP) was not finalized and key participants did not know their roles in the event of ULA COOP execution.

How can we do it better and who has the responsibility to fix it?
-ULA will finalize its Continuity of Operations Plan (COOP) to ensure critical tasks can be performed if its facilities are damaged or inoperable.
-The ULA will train and exercise the COOP plan after it has been developed.

Category: Emergency Management
14. **Issue: Improve the Logistics support plan for no-notice events.**

What was planned?
-LRN Logistics Delivery Point (LDP) will execute its 24-36 hour support plan when needed to support response to a no-notice event. Its plan will cover all facets of logistics support required to provide Reception, Staging, Onward movement, and Integration (RSOI) and initial life support to all responders processing into the flood zone.

What actually happened?
-Although LRN LDP staff effectively executed their support plan, this event showed the criticality of having an updated 24-36 hour plan to facilitate support during the early phases of a no-notice event. The plan should specifically outline what support will be provided to the EOC, district Crisis Management Team / Crisis Action Team, and incoming responders, as well as, who and how this support will be provided.

Why did it happen?
-The 24-36 hour support plan contained the guidelines to support any no-notice event, however, the magnitude of this event demonstrated additional detail and support planning is required within the plan.

How can we do it better and who has the responsibility to fix it?
-LRN LDP will update their plan and battle book based on lessons learned from this event.

Category: Emergency Management
15. **Issue: Improve resourcing of the Logistics Planning and Response Team.**

What was planned?
-All Logistics Planning and Response Team Members will deploy with the necessary equipment to conduct RSOI and logistics support operations.

What actually happened?
-LPRT members did not have (deploy with) required equipment. Both members of the LPRT deployed with personal cell phones.

Why did it happen?
-The individuals were not pre-issued government cell phones. The ULA does not have additional equipment to issue all members on deployment teams. To be fully effective, each member of the LPRT requires a laptop, with air card, portable printer, and a government issued cellular phone, preferably BlackBerry to sync with email. In this case, they could have secured phones from FEMA due to the FEMA logistics tail being fully set up, however, in other situations, each member must deploy with the equipment that will enable the team to operate and communicate during events where communications may be disrupted for extended periods of time prior to FEMA being available to provide such support.

How can we do it better and who has the responsibility to fix it?
-Logistics Point of Distribution will develop and procure "fly-away kits"; the kits must contain phones and portable computers that can be used to access the internet (ENGLink and Webmail) to assist with RSOI.

Category: Emergency Management
16. **Issue: Improve logistics personnel ability to use ENGLink.**

What was planned?
-The supporting logistics personnel (LDP and LPRT) will assist the EOC with receiving and in-processing all responders in ENGLink Interactive. All logistics personnel will be trained in the logistics attributes and functions within ENGLink.

What actually happened?
-The efforts of the deployed LPRT and district LDP personnel greatly assisted in the overall success of the mission. They in-processed 48 responders and ensured they had the proper paperwork and equipment. Once the LPRT members re-deployed to home station, the LDP staff resumed operations to ensure mission accomplishment.
-The only shortfall was proficiency in ENGLink processing. Not all logistics support members were familiar and proficient in the logistics and deployment module sections of the database.

Why did it happen?
-Key contingency logistics support personnel throughout the ULA are not familiar or proficient with ENGLink to effectively conduct RSOI operations. ENGLink training is neither a requirement for LDP staffs nor every member of LPRTs. Whether a LDP is executing its 24-36 hour support plan or an LPRT performing RSOI, there are several logistics functions, reports, and other tools in the system, which are vital to personnel / equipment accountability and overall success of any operation. For example: the logistics personnel supporting the operation must ensure the reporting instructions and RSOI details are provided to the EOC to ensure tasker templates are updated so responders know where to report, what lodging arrangements have been secured, etc.

How can we do it better and who has the responsibility to fix it?
-The ULA will add ENGLink Logistics / Deployment Module training to the Master Training Plan for all Regional Planners, LPRT members, Regional Logistics Liaisons, and LDP Chiefs.

Category: Emergency Management
17. **Issue: Develop duty descriptions for logistic team members.**

What was planned?
-Each logistics team member supporting an event should be assigned an appropriate duty description on a tasker in ENGLink.

What actually happened?
-Each logistics member supporting this event, not deployed as part of a LPRT, was tasked using the "Logistics Officer/Subject Matter Expert" duty description.

Why did it happen?
-Currently, there is no way to accurately select a LDP chief, LDP supply specialist, or transportation specialist for a tasker within ENGLink. The ENGLink system allows for requesting an individual with specific skill sets that are differentiated by the duty description, however, all applicable logistics duty descriptions have not been created.
-To effectively assign logistics team members to an event in ENGLink, duty descriptions must be available for every position within the LDP staff, RLP, and the RLL.

How can we do it better and who has the responsibility to fix it?
-ULA / LPOD will create duty descriptions for each applicable position (RLP, RLL, and LDP staff members) and work with ENGLink / RSC to update the Duty Description database.

Category: Water Management
18. Issue: Improve awareness of project maintenance status.

What was planned?
-Knowledge of the availability and use of turbines and spillway gates for use to manage project releases.

What actually happened?
-Old Hickory hydropower unit #4 was out of service during the event. This was an unscheduled outage. Unit #4 has been off-line for several months.
-Old Hickory spillway gate #1 was out of service during the event for scheduled maintenance. There was a bulkhead in place at the time of the flood that was overtopped when the lake level exceeded elevation 447.5. The other five gates were available and used extensively during this event.
-One of the four spillway gates at J. Percy Priest Dam did not operate initially when spillway gate releases were initiated late on May 3 (Monday). An Old Hickory Power Plant electrician was called in and within 30 minutes had diagnosed and repaired the problem. The repaired gate was then immediately put in service to prevent it from being overtopped.
-While all gates were mechanically available at Barkley Dam, they could not all be operated at the same time due to a submergence issue associated with exceptionally large project releases.
-While there were individual gate or turbine outages at other plants, none were of the nature to significantly impact project operations during the flood.

Why did it happen?
-Hydropower unit and spillway gate outages are common occurrences associated with operating and maintaining multi-purpose projects with individual components that have in some cases far exceeded their design life.
-The LRN Hydropower staff, both in the District Office and at the projects, routinely coordinates with Water Management on any outages that impact the ability of the project to release water. That was the case for Old Hickory where Water Management was aware that hydropower unit #4 was not available and that one of the spillway gates had been taken out of service for maintenance. The issue with the spillway gate at J. Percy Priest did not become apparent until it was being operated during the event.
-With Old Hickory spillway gate #1 not available during this event it forced the five available gates to be operated at larger gate openings. The maximum gate opening during this event was 34 feet. The maximum gate opening for Old Hickory spillway gates is 42 feet. Therefore, with one gate not readily available the project was still able to pass the required flow.

How can we do it better and who has the lead to fix it?
-LRN will develop and disseminate a tracking system that identifies in real-time what project components (turbines, spillway gates, sluice gates, fixed cone valves, etc.) are available for use.
-Water Management and LRN Operation elements responsible for scheduling maintenance outages will enhance communication to ensure that scheduled maintenance can be performed at the best time with respect to water control operations.

Category: Water Management
19. Issue: Improve triggers for activation of Water Management offices.

What was planned?
-Maintain Water Management operations during a flood event.

What actually happened?
-LRD was in communication with the OHRFC since Wednesday.
-On Friday, April 30, LRD WM directed the District offices to work the weekend. LRD staffed its office for Saturday and Sunday during morning business hours.
-On Saturday, LRD initiated communication with TVA/LRN/NWS anticipating the need to initiate Lower Ohio/Mississippi River flood control operations. LRD did not arrange for 24-hour staffing because TVA River Scheduling staffs 24/7 routinely and has standing orders to contact LRD personnel at home during rapidly changing conditions. LRD does not have enough water management staff to man the office on a 24-hour basis. LRD WM does not have a Standard Operating Procedure for 24-hour operation.
-LRN typically staffs the Water Management office with one water manager on weekends and holidays. During routine operations all evaluations and coordination are complete and the necessary instructions issued to the projects by noon. LRN WM does not have a Standard Operating Procedure for 24-hour operation.
-LRN WM followed established procedures by staffing the office with a highly experienced water manager on Saturday morning. The water manager, through coordination with other personnel and the Water Management Section Chief, implemented a number of measures to respond to changing conditions. Prior to leaving at 1340 hours, the water manager issued a number of instructions to operators at the projects on how to respond to changing water conditions.
-There was a 15.5 foot rise in the Nashville gage on Saturday, most of which occurred during the afternoon.
-Kentucky and Barkley pools rose 4 feet from Saturday night to Sunday morning.
-LRN WM (senior water manager that worked earlier in the day and the Section Chief) returned to the office at 1900 hours to complete a supplemental evaluation of rainfall, runoff, and project conditions and to make any needed adjustments. Prior to leaving the office at 2300 hours a new set of instructions (including when to call during the night for additional guidance) were issued to the projects and an e-mail was sent out to LRN management and LRD WM. LRD WM forwarded the LRN WM email to the NWS OHRFC at 0416 hours Sunday morning. NWS OHRFC read the email at 0700 hours.
-NWS OHRFC attempted to contact LRN WM Saturday evening and Sunday morning prior to anyone coming to office.
-Conference calls between LRN and the NWS OHRFC began at 0830 hours on Sunday.
-The LRN WM Section Chief contacted staff on Saturday evening and made arrangements for 24-hour operations to start with the 0630 hours shift on Sunday morning. The office was staffed around the clock until 2200 hours Tuesday night.
-The NWS WFO maintains 24/7/365 operations.
-The NWS Nashville WFO has a Nashville Hydrologic Program Manual which contains at least one off-hour contact number for LRN.

Why did it happen?

-An experienced LRN water manager was on duty Saturday until 1340 hours and returned at 1900 hours and remained in the office until 2300 hours. The situation at the time did not appear to warrant around the clock staffing as late as Saturday afternoon.

-The NWS OHRFC standard operating procedure is to include the Corps' release schedule into its forecast. Beginning very late Saturday night and into early Sunday, May 2, the NWS OHRFC needed to know how LRN was operating the projects and could not contact anyone in Nashville. Calls to LRN were placed at approximately 2200 hours Saturday, and 0600 hours and 0700 hours Sunday. No voice messages were left on LRN WM telephones.

-Although they had off-duty contact information, NWS OHRFC did not attempt to contact LRD WM until Sunday morning to obtain contact information for LRN WM.

-The NWS OHRFC did not try to contact LRD WM until 0615 hours Sunday morning. The NWS OHRFC was advised to call LRN at 0730 hours by LRD.

-The TVA River Scheduling night shift did not contact LRD WM. Inexperienced personnel were on duty and they did not know who to contact.

-LRD and LRN WM should have begun 24-hour operations Saturday to provide continuous monitoring and communications with NWS and TVA.

How can we do it better and who has the lead to fix it?

-LRD WM will consider NWS Chat via BlackBerry.

-Water Management is developing a common trigger for 24-hour operations and increased communication. Trigger may be based on rate of rise, predicted crest, QPF, etc. and may be based on the basin. This will be accomplished by developing a Standard Operating Procedure (SOP) that will define when to initiate 24-hour flood operations, staff levels and schedules, and frequency of increased communication. The SOP will include how to assist Water Management due to lack of personnel (illness, etc.), loss of equipment or loss of office. The SOP will include additional support to Water Management such as administration support to answer telephones, faxes, etc. and liaisons to other offices, etc. This SOP will allow Water Management to stay focused on its mission.

-TVA and NWS OHRFC will utilize the contact information to contact personnel during off-duty hours when the situation is rapidly changing and the established triggers have not been reached.

-The Corps will share off-hours contact information and insure it is maintained with up to date information.

-TEMA can provide contact numbers for key staff at the various agencies and is willing to provide assistance.

-LRN WM will share system operation plans with TVA River Operations staff. This would provide a continuous 24/7 source of information on the Cumberland River system projects.

-LRN is expanding current cross-training of LRN Water Resources and LRN WM personnel.

-LRD WM will evaluate the necessity to increase staff versus leveraging existing capabilities in other Water Management offices. Note that LRD WM has been approved to increase staff by 2 employees beginning in FY2012.

-Insure LRD and LRN water managers are monitoring situation in afternoon and evening hours as well.

Category: Water Management

20. Issue: Improve the understanding of technical information between the Corps and the National Weather Service.

What was planned?

-Provide effective communication of project operations with the NWS.

What actually happened?

-Misunderstanding of technical information and the frequency of communication regarding the operation of Old Hickory Dam.

-Frequency of information exchange under existing communication protocols between the NWS and Corps was inadequate for this type of rapidly changing event; additional conference calls beyond the morning and afternoon calls were not requested by the NWS; the Corps did not understand that the NWS wanted spillway gate changes as they were made.

-Due to the chaotic nature of the flood event and the frequency of required spillway gate changes, LRN water managers did not provide estimated Old Hickory discharges to the NWS as gate changes were made on Sunday, May 2. On Sunday afternoon the Corps was dealing with multiple issues along the mainstem of the Cumberland from Cordell Hull to Barkley including record discharges at several projects. Old Hickory was above the surcharge pool and near the pool of record.

-During 1330 conference call on Sunday, LRN WM indicated that the surcharge pool was fully utilized and assumed the NWS understood the Corps was passing all inflows and would change their modeling approach accordingly. However, the NWS assumed that since the Corps was operating the spillway gates (ie., the gates were not all fully raised in the free-flow position), the gate-rated discharges at the time of the conference calls were still reflective of current flow conditions later in the afternoon and into the evening. The NWS continued to use the information provided during the conference calls as the primary basis for NWS forecasts on the mainstem Cumberland River.

-NWS should have considered that with the surcharge pool fully utilized, all inflows at Old Hickory Dam would be passed downstream to prevent additional rises in the Old Hickory pool.

-When the NWS OHRFC reservoir model indicated higher outflow, they deferred to the release information provided directly by the Corps, unless they had other data to tell them otherwise (such as real time tailwater readings to confirm and/or adjust the model). Due to the lag time for flow between Old Hickory and Nashville, it was late evening before they recognized that the flow information provided during the scheduled conference calls by the Corps was no longer valid.

-An evening conference call was not requested by the NWS OHRFC at the time of the afternoon call on Sunday, May 2. Neither the Corps nor the NWS could foresee the excessive rainfall that continued to drive rapidly changing conditions into the evening. Information was exchanged late in the evening first from LRN WM through the Nashville WFO to the NWS OHRFC then via direct conversations between the NWS OHRFC and LRN WM.

Why did it happen?

-A misunderstanding of technical information and frequency of communication between agencies, i.e. LRN intended for its conversations to indicate that they were operating the gates to pass the inflow while maintaining the Old Hickory pool and that the discharges were above their gate rating curves. The NWS felt that since the Corps was operating the gates, the project was not passing inflows and the afternoon discharges were reflective of the evening conditions.
-Corps and NWS assumed each was aware of what the other agency meant by their operations and modeling. For example, the Corps indicated on teleconferences that Old Hickory's flood surcharge pool had been utilized and assumed the NWS was aware that project was passing inflow with gate operations.
-Discrepancies between NWS hydrological simulations and Corps' release projects (outflows) were never successfully resolved on Sunday as rainfall exceeded the forecast and the river stage approached critical levels in Nashville. These misunderstandings affected the accuracy of the NWS OHRFC forecasts to some degree.
-The Corps provides the NWS with observed project data, precipitation data, stage, and flow data from Corps' stream gages, and forecasts of project releases and lake levels from the Corps' multipurpose projects. The forecast data provided by the Corps is for the current day and the next five days and is for eight of the ten projects within the Cumberland Basin. LRN WM does not prepare a daily forecast of lake level and project releases for either Martins Fork Dam or Laurel River Dam. Information is provided for the other eight projects within the Cumberland Basin reservoir system. Corps of Engineers forecast information is based on rain on the ground as of 0600 (Central Time) on the forecast date. Given the dynamic nature of river flows and stages at the mainstem Cumberland River projects during a significant rainfall event, the LRN WM discharge forecasts for the mainstem navigation projects (Cordell Hull, Old Hickory, and Cheatham) cannot be relied upon to develop stage crest forecasts for the damage centers. During extreme events like the one observed in May 2010, LRN water management operations at navigation projects (Cordell Hull, Old Hickory, and Cheatham) are driven by runoff from their uncontrolled drainage areas, and can be characterized as reacting to match increasing inflow levels. Conversely, at the Cumberland Basin flood storage projects (Wolf Creek, Dale Hollow, Center Hill, J. Percy Priest, and Barkley) where large flood control pools are available to capture local runoff, meaningful long-range (3 – 5 day) forecasts can be developed. Due to these constraints, the standard data exchange practice between LRN WM and NWS OHRFC during high flow events (for 30+ years) has been to continue with the daily data exchange and to supplement that with discussions on the water control plans for the flood control projects – specifically Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest. LRN WM's understanding of the modeling approach employed by the NWS OHRFC was to pass inflow at the navigation projects where only the surcharge pool storage was available and to route the releases from the flood control projects to develop stage forecasts at the damage centers. This assumption was based on 26 years of experience by the current LRN WM senior forecasters during which, this procedure had been followed for 16 high flow events when the Nashville stage had exceeded 30 feet. The NWS OHRFC was basing crest forecasts on modeling that applied mainstem release patterns discussed during the coordination calls. In reality, the conditions at Cordell Hull, Old Hickory, and Cheatham were so dynamic that discharge information relayed during the calls quickly became outdated. LRN had discussed conditions at the navigation projects to portray the serious nature of the flooding observed at those projects, and not with the understanding that the NWS OHRFC was applying the discharge information in their hydraulic models. As a result, LRN WM did not recognize the need to update that information as it rapidly

changed throughout the afternoon and evening on Sunday, May 2. Once that expectation was realized, LRN WM readily shared updated spillway release information with NWS OHRFC.
-Increased communication was delayed until late Sunday night when an OHRFC forecaster called LRN shortly after arriving on shift (approximately 2300 hours Sunday, May 2.)
-There was not an established procedure to update the project operational data after the initial morning and afternoon data exchange with the NWS.

How can we do it better and who has the lead to fix it?

-The Corps and NWS will develop a better understanding and appreciation of each other's models, operations and how to alert each other of changing conditions.
-LRN will conduct annual Flood Table Top Exercises with NWS, USGS, TEMA and others as appropriate to improve understanding of reservoir system operations and strengthen communication ties among the agencies.
-LRN WM will review and revise the water control manuals to insure they address extreme events and update as necessary. Extend gate ratings and update other critical guidance for above and below normal ranges.
-LRN will develop electronic updates for the tailwater conditions at the Corps' dams.
-LRN will investigate options to provide real time communication with the NWS regarding water releases from Corps' projects. Example: Remote monitoring of gate operations similar to gates at Smithland Lock and Dam on the Ohio River. In the short-term implement procedures for the operators at the projects to notify the NWS WFO when they make spillway gate changes during flood operations.
-LRD WM will evaluate NWS Chat to assist with communication.
-LRN WM will develop a Standard Operating Procedure (SOP) that will define the protocol and frequency of increased communication. Critical operations personnel must be able to be reached at all times (off hour phone numbers, cell phones, etc.). When critical changes are made by either the Corps or NWS, phone calls must be initiated. The SOP will include common triggers for increased communication that are coordinated with the NWS. Trigger may be based on rate of rise, predicted crest, QPF, etc. or may be based on the basin.
-LRD WM will continue working with the NWS to develop joint models.

Category: Water Management

21. Issue: Implement redundant Water Management Enterprise Architectural (WMEA).

What was planned?

-Maintain Water Management operations (enterprise and legacy systems) during a flood event, including uninterrupted access to water control data during the flood event.

What actually happened?

-Network outage at LRN started at 0930 hours Sunday morning and persisted until 2005 hours that night as a result of a Verizon communication line break.
-This impeded LRN WM staff's ability to obtain data and post project data.
-LRN water managers found alternative ways to obtain gage data, such as using personal cell phones with internet access.
-A call was placed to the Corps' Information Technology Office (ACE-IT) Service Desk at 1124 hours Sunday morning. ACE-IT did not issue a ticket; however, they did respond later that day at 1930 hours with a wireless router equipped with an air card that allowed access to the internet by Water Management staff that had laptops (limited to two staff members).
-The LRN WM database is located outside of the production network which prevented access to the data when the internet failed.
-During the network outage updated information was not placed on the Corps' website; therefore, it was not readily available to other agencies or the general public.
-The local readout ground station (LRGS) equipment located at the J. Percy Priest Water Management COOP site had been in-place for only a week following a lengthy outage to allow ACE-IT migration of software to an updated platform. The LRGS had experienced network issues due to local (J. Percy Priest project) connectivity and power problems at the site. There was uncertainty concerning the functionality of the LRN LRGS system. However, based on subsequent evaluations the COOP site was functional and available during the event.
-NWS not aware that LRN gage data was also available on Rivergages.com
-LRN fielded numerous calls from the public requesting gage information.
-The flow of rainfall, stage, and flow data was disrupted by a prolonged network outage that occurred on May 2 (Sunday). During this time any data streams that were dependent on a functioning network were not available.
-Prior to this event LRN was in the process of relocating the water control database from outside of the production area to inside the production area. The location of the database did not interrupt the access to data during the event.

Why did it happen?

-Major network communication line (by external provider) went out during event.
-ACE-IT did not provide Priority 2 Critical Service upon request as listed in Performance Work Statement (PWS) Technical Exhibit 9 and in accordance to the ACE-IT/Water Management Memorandum of Agreement, dated August 25, 2008.
-Local ACE-IT mandated the water management database be outside the production network rather than on the water management subnet as in other offices.

-Under certain circumstances, ACE-IT should not be allowed to set the priorities for requested work or services related to critical water management operations.

How can we do it better and who has the lead to fix it?

-LRN has purchased air cards, laptops and cell phones for the Water Management staff to provide redundant internet capability and evaluating alternatives for internet access.
-LRN WM will establish water management subnet with a controlled internet accessible segment and move the water management database back inside the production network.
-LRN has a local COOP site located at the J. Percy Priest Lake project. Given the close proximity of the COOP site to the Water Management Office, power, network, and/or weather related issues would likely affect both sites simultaneously. Accessibility also becomes an issue during an event like the May 2010 flood when access to the local COOP site was difficult at best during extended periods of time. Trigger points should be established that would lead to pre-positioning staff at the local COOP prior to access becoming limited.
-LRN will evaluate establishing a long distance COOP Site where a redundant database and modeling capability are maintained in a ready state. The logical arrangement would be for LRL and LRN to set up reciprocal COOP Sites.
-ACE-IT (Service Assurance Officer, CECI) will provide the service listed in the Performance Work Statement Technical Exhibit 9 and the ACE-IT/Water Management Memorandum of Agreement, dated August 25, 2008. The ability to affect priorities on ACE-IT actions in preparation for and during an event needs to be enhanced.
- Corps' Water Management System (CWMS) could not have been run during the time of the network outage. An alternate connection to CWMS at the COOP site or long distance coop will be established.
-LRN WM will evaluate a local readout ground station (LRGS) at the District office for satellite telemetered data to be received independent of the internet.
-The USGS, NWS, and Corps will provide www links between their web pages such that the public is aware that data is also available on other agency web sites.
-Corps and USGS web sites will contain notes to reflect that the NWS is responsible for river forecasts and provide a link to their web site. Note that the NWS OHRFC provides guidance to the WFOs who are responsible for issuing forecasts and warnings.
-LRN WM will complete the relocation of the water control database to within the production area. This will require a subsequent update to the method used to transmit data to the Southeastern Power Administration (SEPA).
-LRN WM will develop alternative methods to interface with water control data that are not solely dependent on the network.

Category: Water Management

22. Issue: Improve communication between the Corps and the National Weather Service.

What was planned?

-Provide effective communication regarding project operations with the NWS.

What actually happened?

-When the NWS OHRFC was contacted to inform them of high releases from Kentucky Lake and Lake Barkley, the staff on duty asked LRD WM to contact the Paducah WFO directly. The NWS OHRFC did not advise LRD WM to contact the LMRFC but advised to contact the Paducah WFO. LMRFC is responsible for forecast operations downstream of Barkley, while WFO Paducah is responsible for issuing all watch/warning products for this area.

-NWS Paducah WFO issued a Special Weather Statement to address the high releases from Kentucky Lake and Lake Barkley; a Flash Flood Warning would have activated the Emergency Alert System.

Why did it happen?

-The staff at the Paducah WFO did not fully understand the information. The flow information that was provided was not translated to stage, thus the extent of the increase was not recognized.

-Technical communication and understanding of each agency's operations played a large role in this misunderstanding.

-NWS can only convert flows to stages at NWS rated forecast points. There are no forecast points on the Cumberland River downstream of Barkley.

How can we do it better and who has the lead to fix it?

-The Water Management office will translate flows to river height levels, as necessary, when working with the WFOs.

-LRD WM LMRFC and the OHRFC will develop an interagency process that specifies the correct language and emergency activation system levels for communicating urgent events regarding operation of Corps' projects. This will ensure a common operational picture and appreciation for rapidly developing events.

Category: Water Management
23. Issue: Sustain pre-event water management actions.

What was planned?
-Adjust lake levels prior to rainfall event.

What actually happened?
-LRN WM makes nearly all operational decisions based on rain on the ground. The exception is a relatively short suspense (3 days or less) rainfall forecast that carries a high degree of certainty. Given that scenario it may be appropriate to make adjustments to Cumberland River Basin lake levels in advance of the event to better position the system to respond to significant increases to project inflow. That was done for this event on Thursday and Friday prior to the heavy rain that began on Saturday when pool levels at Cordell and Old Hickory were lowered about 0.5 ft and Cheatham was lowered by around 1.0 ft.
-The challenge in pre-positioning lake levels is that by the time there is enough confidence in a rainfall forecast to warrant taking proactive measures there is not enough time to significantly lower lake levels and clear the water from the system to avoid merely moving the problem downstream. That was the case during this event given the situation on the Ohio River where the river was nearly at flood stage at Cairo when the Cumberland event began and a flood crest was moving down the Ohio.
-The decision to lower lake levels at the main-stem projects was based on modeling of forecasted rainfall performed by LRN WM. LRN currently has two system water control models available. The RAI Model (vintage 1978) is the production model and has been in use for more than 30 years. LRN, in conjunction with work being done by a contractor, is in the process of developing a Corps' Water Management System (CWMS) application for the Cumberland Basin reservoir system. The CWMS model is a system of real-time data analysis tools and hydrologic models that will also utilize radar precipitation data provided by the NWS. The CWMS model is in draft form. It was used leading up to this event to perform simulations of forecasted rain. These model runs looked at project response at Wolf Creek and Center Hill (DSAC I dams) in addition to conditions on the Cumberland River. The simulated runs were coordinated with similar efforts performed by water managers at LRD and TVA to develop a regional view of the forecasted event.
-LRD WM issued instructions to the districts to work Saturday/Sunday. Note that LRN works all holidays and weekends.

Why did it happen?
- Although precipitation forecasts have improved, it will still take significant advances in the science behind rainfall and runoff forecasts to reach a point where lake level adjustments of a magnitude necessary to effect significant flood crest reductions can be made in advance of a major rainfall event. A shift of only 50-100 miles of the rainfall from the May 2010 event would have completely changed the outcome.

How can we do it better and who has the lead to fix it?
-LRN WM will continue CWMS development for the Cumberland Basin and replace the older RAI model for daily production use.

-Water Management and the NWS will develop a program that takes advantage of tools currently either in use or under development at NWS to prepare project inflow forecasts based on the latest forecasted rainfall information. The hydrology modeling could be performed by NWS and provided to the Corps to evaluate using CWMS. The early stages of such a process are currently in place with NWS providing a daily update of inflows to Wolf Creek and Center Hill. The NWS is experimenting with several different methods of utilizing probabilistic QPF. It is currently providing to some of its partners the experimental MMEFS (Meteorological Model Ensemble Forecast System) and the experimental probabilistic QPFs prepared by the Hydrometeorological Predication Center, along with several other experimental QPF ensembles.
-The Corps and the NWS will continue to evaluate a common modeling approach to facilitate a consolidated approach to hydrology and hydraulic modeling.

Category: Water Management
24. Issue: Improve awareness of the Quantitative Precipitation Forecasts.

What was planned?
-Awareness of QPFs issued by the NWS during the flood event.

What actually happened?
-QPFs and experimental probabilistic QPFs are published twice daily in the early morning and late afternoon/evening by the Hydrometeorological Prediction Center (HPC). As a result they often first become available when the LRN WM office is not staffed. As a result, revision to a QPF that may warrant action (revise project releases, increase staffing, etc.) by LRN water managers may not be seen until many hours after it was issued. During the May 2010 event the QPF published on Friday evening was not observed until Saturday morning at 0700 hours when LRN WM staff reported for duty. A review of this QPF was warranted; however, it did not impact flood operations.

Why did it happen?
-NWS publishes the QPFs on a twelve hour time basis.
-LRN water managers do not routinely check the evening QPF after duty hours.

How can we do it better and who has the lead to fix it?
-Look at another alert measure to alert key personnel.
-LRD, the Districts, OHRFC and the WFOs will update their contact lists so that the OHRFC can alert the appropriate office if significant changes occur in the evening QPF.
-LRD WM will consider NWS Chat via Blackberry.
-LRN WM will assign a water manager the responsibility to check evening QPFs.
-Note that the OHRFC will expand ensemble probabilistic forecasting (MMEFS – meteorological model ensemble forecast system) to all Corps' districts in the near future. MMEFS Training will be provided this summer. In addition, the OHRFC has begun to provide MMEFS inflows for Wolf Creek and Center Hill to address risk to high risk dams.

Category: Water Management

25. Issue: Improve situational awareness of the National Weather Service published forecasts.

What was planned?

-Awareness of crest forecast by the NWS during the flood event.
-Assist NWS by insuring that project operations do not differ from those that were used to develop the crest forecast.

What actually happened?

-NWS developed revised flood crest forecasts and LRN WM was not immediately aware of the new forecast. This occurred on Sunday evening. LRN WM was coordinating releases from Old Hickory and J. Percy Priest based on an early Monday morning crest, and was not aware that the crest had been pushed back to early Monday afternoon.

Why did it happen?

-NWS not aware that LRN WM was not receiving forecasts directly.
-LRN WM was not aware of alternatives to receive the NWS forecasts.

How can we do it better and who has the lead to fix it?

-LRN WM will investigate possibility of receiving NWS forecast provided through email notification.
-LRN WM staff has acquired Blackberries.
-LRN WM will configure Local Data Management (LDM) systems to receive the NWS suite of products in real-time from LRD. LDM system may also be configured to provide email notification of forecasts.

Category: Water Management
26. Issue: Improve long term reliability of rainfall and stream gages.

What was planned?
-Continuous operation of rainfall and stream gages to provide the information necessary to support flood fight efforts.
-Repair gages as necessary during the event to support the continuous flow of data.

What actually happened?
-Operation and maintenance of rainfall and stream gages within the Cumberland Basin is executed by a combination of LRN WM staff, contract personnel, and the USGS.
-The LRN stream gaging maintenance contract expired on April 30, 2010, the day before the high rainfall for this event started. Emergency repairs were performed by LRN WM staff. Only four LRN gages were damaged by the flood. They consisted of two stream gages (Harpeth River at Kingston Springs and Bledsoe Creek at Gallatin) and two tailwater water quality monitors (Old Hickory and Cheatham). The Harpeth River site was the most critical as it is a NWS forecast point. The gage was repaired and brought back online within one week of when the high water flooded out the electronics. The Bledsoe Creek gage was reinstalled at a later date.
-The Tennessee USGS office contacted LRN WM on Wednesday (May 5) and offered to set up temporary gages at locations where gages were damaged or destroyed. They also offered to make stream flow measurements at key locations. There was not a need for any temporary gages, but the USGS did make several flow measurements that will provide valuable information for documenting the flood.

Why did it happen?
-The Harpeth River experienced what appears to be a greater than 500-year event that overtopped the gage equipment by several feet.
-There is not a viable location for the Bledsoe Creek gage that does not place it in harm's way for extreme events.
-The Old Hickory tailwater water quality monitor is located on the lower lock wall and is vulnerable to greater than 100-year events.
-The Cheatham tailwater water quality monitor was located on the left descending bank and was also susceptible to damage from high flows.

How can we do it better and who has the lead to fix it?
-LRN WM recently completed a thorough evaluation of its gaging program with respect to establishment of the Cumberland River Basin CWMS application. This indicates that individual gage locations need to be evaluated with respect to inundation potential.
-LRN is entering into a formal partnership with the Kentucky and Tennessee USGS offices through participation in the Cooperative Stream Gaging Program. LRN has a gage transition plan that supports this action.

Category: Water Management
27. Issue: Sustain the ability to operate projects under extreme conditions.

What was planned?
-Operate the Cumberland Basin reservoir system using the water control manuals.

What actually happened?
-The magnitude, duration, and location of the rainfall were such that flood stages along the Cumberland River were pushed to new record levels during the event.
-Information contained in the water control manuals did not cover the full range of operations required to respond to this record rainfall event.
-LRN water managers were working with incomplete data sets, access to the District Office was difficult, and multiple demands were placed on staff to provide information and brief officials, both in-house and external. Reservoir system operations were further hampered by a prolonged network outage that occurred on Sunday. The three LRN WM team members making the operational decisions each had thirty plus years of direct water management experience and had been through multiple high water events in the Cumberland River Basin. Their experience of knowing when and how to deviate from direct application of the water control manuals can be credited with preventing additional damages and perhaps saving several lives in the basin.
-A chronological analysis of water control actions taken during this event is presented below. Where appropriate, an explanation of deviation from operations detailed in the water control manuals is included.
-In order to evaluate the impacts of water control operations that were outside of the guidance presented in the water control manuals, a detailed analysis using sophisticated hydrology and hydraulic modeling was required. This analysis required taking existing model components and combining them into a system model. In turn, this model was calibrated to the May 2010 flood event. Given limitations with respect to time and resources, a preliminary analysis of actual and water control manual guidelines were completed using a detailed Hydrologic Engineering Centers River System Analysis (HEC-RAS) model. In this analysis, the modeler was able to employ an iterative approach to project operations to meet water control guidelines and reduce downstream impacts. However, during the actual event, Corps' water managers were not afforded this opportunity. They were placed in the position of making multiple time-sensitive decisions spaced across multiple projects within the Cumberland Basin and to do so without the availability of a detailed model. The results of the HEC-RAS model evaluation are included where appropriate in the following sections of this report.

29-30 April 2010: Thursday and Friday
-Based on the NWS rainfall forecast (Quantitative Precipitation Forecast (QPF) products) indicating significant rainfall (3-5 inches within the Cumberland River Basin) starting on Saturday, May 1, LRN WM made the decision to pull some water out of the mainstem projects in advance of the storm. The lake levels at Cordell Hull and Old Hickory were lowered approximately 0.5 feet. The Cheatham pool was lowered about 1.0 foot. This was not completed until Saturday, May 1 prior to the initial heavy rainfall. These actions were taken to better position the reservoir system to be able to respond to the forecasted rainfall totals.

- This is a typical operation to manipulate lake levels within normal operating ranges. It is better characterized as an adjustment as opposed to a significant change.

1 May 2010: Saturday

-1000 hours - The hydropower unit at J. Percy Priest and one of three units at Center Hill were each brought on-line at 1000 hours and run continuously for the remainder of the day. These decisions were based on observation of the radar rainfall amounts and the near certainty that both the Stones River and Caney Fork Watersheds were going to receive excessive rainfall.

- These are typical same day adjustments to the hydropower generation schedule needed to react to changing hydrologic conditions. The J. Percy Priest hydropower unit was not scheduled to be run on this date. It was brought online at 1000 hours. Center Hill had eight hours of generation scheduled for May 1. Once one unit was brought online at 1000 hours it was left on for the remainder of the day. The action at Center Hill was taken to conserve flood control storage and manage the lake level in accordance with the Interim Risk Reduction Measure (IRRM) pool restriction for a Dam Safety Action Classification (DSAC) I dam. The additional flow did not pose a threat to Carthage, TN, the immediate downstream damage center.
- Wolf Creek was operating four hydropower units around the clock in response to rain, which fell about one week prior to this event. The pool elevation at this time was 682.92. Wolf Creek operates with a DSAC I IRRM pool restriction target elevation of 680 ft. The lake level at Dale Hollow was elevation 650.16. One hydropower unit was running around the clock for lake level management.
- Section 2.4.5 of the Old Hickory Water Control Manual states "The size of the surcharge storage pool was derived considering flows expected while the storage reservoirs were being emptied. It was not intended to also compensate for heavy local runoff simultaneous with peak releases from Wolf Creek, Dale Hollow, and Center Hill."

1200 hours – Spillway discharges are initiated at Old Hickory.

- The spillway discharge was increased at a rate of approximately 5,000 cfs/hr in accordance with the water control manual until a total flow of 75,000 cfs was reached.
- LRN WM made the decision to not apply the Nashville crop season control limit of 54,000 cfs. According to the water control manuals, crop season is generally understood to be from April 15 through December 15; however, these dates may be adjusted depending on actual field conditions. Flood season is designated as anytime other than crop season. Since the area had experienced an average of two inches of rainfall approximately a week before, and with the limited agricultural activity observed in this reach of the river, the flood control flow of 90,000 cfs was selected for use. Therefore, by going to 75,000 cfs out of Old Hickory, an additional capacity of 15,000 cfs was reserved for a combination of J. Percy Priest releases and local runoff from the 275 mi^2 of local uncontrolled runoff between Old Hickory Dam and Nashville. The objective of this course of action was to keep the Cumberland River from reaching flood stage at Nashville.

1730 hours – Spillway releases are initiated at Cordell Hull.

- The spillway discharge was increased at a rate of approximately 5,000 cfs/hr in accordance with the water control manual until a total flow of 50,000 cfs was reached. When the pool reached elevation 505.25, the flow was increased to 60,000 cfs. The

control flow of 72,000 cfs for flood season was used for Carthage. Therefore, by going to 60,000 cfs out of Cordell Hull, an additional capacity of 12,000 cfs was reserved for a combination of Center Hill releases and local runoff from the 420 mi^2 of local uncontrolled runoff between Cordell Hull Dam and Carthage. This action was taken in an effort to keep the Cumberland River from reaching flood stage at Carthage.

- When the Cordell Hull discharge reached 60,000 cfs at 2400 hours on Saturday, May 1, the discharge was held steady in an effort to limit the volume of water entering Old Hickory Lake.
- A total of three spillway gate changes were made on May 1.

1900 hours – Cheatham goes to free flow.

- The Cheatham Lock and Dam was designed to allow overtopping of the lock and spillway gate section without threat of failure of the dam. The power plant is at a higher elevation and does not become inundated during extremely high flows such as those observed during this event. When the river flow past Cheatham exceeds the flow that can be regulated by the seven available spillway gates, the gates are lifted out of the water and the river goes to what is referred to as free flow. In this condition there can be very little difference (less than 1 ft) between headwater and tailwater elevations.

2300 hours – 75,000 cfs outflow reached at Old Hickory

- This outflow was maintained to allow time for excessive local flows to recede downstream.
- A total of nine spillway gate increases were used to reach 75,000 cfs on May 1**.**

2 May 2010: Sunday

0930 hours – The district office lost network access and no real time data was available until it was restored at 2005 hours. The phones were still working and project data was available when projects were called.

1000 hours –Releases from Old Hickory had been managed overnight to hold Nashville to the control flow limit and keep the river below flood stage. As a result the headwater elevation at Old Hickory had risen to elevation 447.75 at 0600 hours. Intense storms that started around 0700 hours on May 2 had already dumped in excess of three inches of rainfall onto saturated ground in the Nashville and Old Hickory area by 1000 hours. A series of spillway gate increases were made at Old Hickory as LRN water managers reacted to rapidly increasing lake levels resulting from runoff from the local uncontrolled basin to Old Hickory Lake.

- The Old Hickory Water Control Manual limits spillway gate increases to 5,000 cfs/hr. This rate of increase is not to be exceeded until the headwater elevation reaches the top of the surcharge pool. At that point the water control manual states that the discharge is increased as necessary to maintain the water surface at the top of the flood surcharge pool, elevation 450.0. It quickly became apparent that the Old Hickory Lake level could not be adequately managed by adhering to this requirement. Project releases were managed in as controlled a method as possible. However, spillway discharge increases as frequently as every 15 minutes and some by as much as 10,000 cfs were necessary to prevent the upstream lock wall from being overtopped. By following this course of action, a one step increase in discharge of a magnitude to match project inflows was avoided. This allowed LRN water managers to reduce the rate of rise in the Old Hickory pool by continuing to maintain controlled releases from the project. Ultimately, by

maintaining control at Old Hickory Dam, a reduction of downstream flood impacts was realized.

- Figure 1 presents stage hydrographs and flow at the Nashville gage for two modeled scenarios. The red lines are a model representation of the actual operations. The blue curves represent the scenario where strict adherence to the water control manuals was maintained. A significant divergence can be observed in the two sets of curves beginning late Saturday night, May 1, and extending through Monday (May 3). If LRN water managers had made the extreme spillway gate increases necessary to prevent the Old Hickory Lake level from exceeding the top of the surcharge storage pool, elevation 450.0, that action would have resulted in Nashville area flooding that would have started several hours earlier and would have been characterized by a more aggressive rate of rise than what was observed during the event. The difference in ultimate flood crest between the two scenarios was not significantly different.

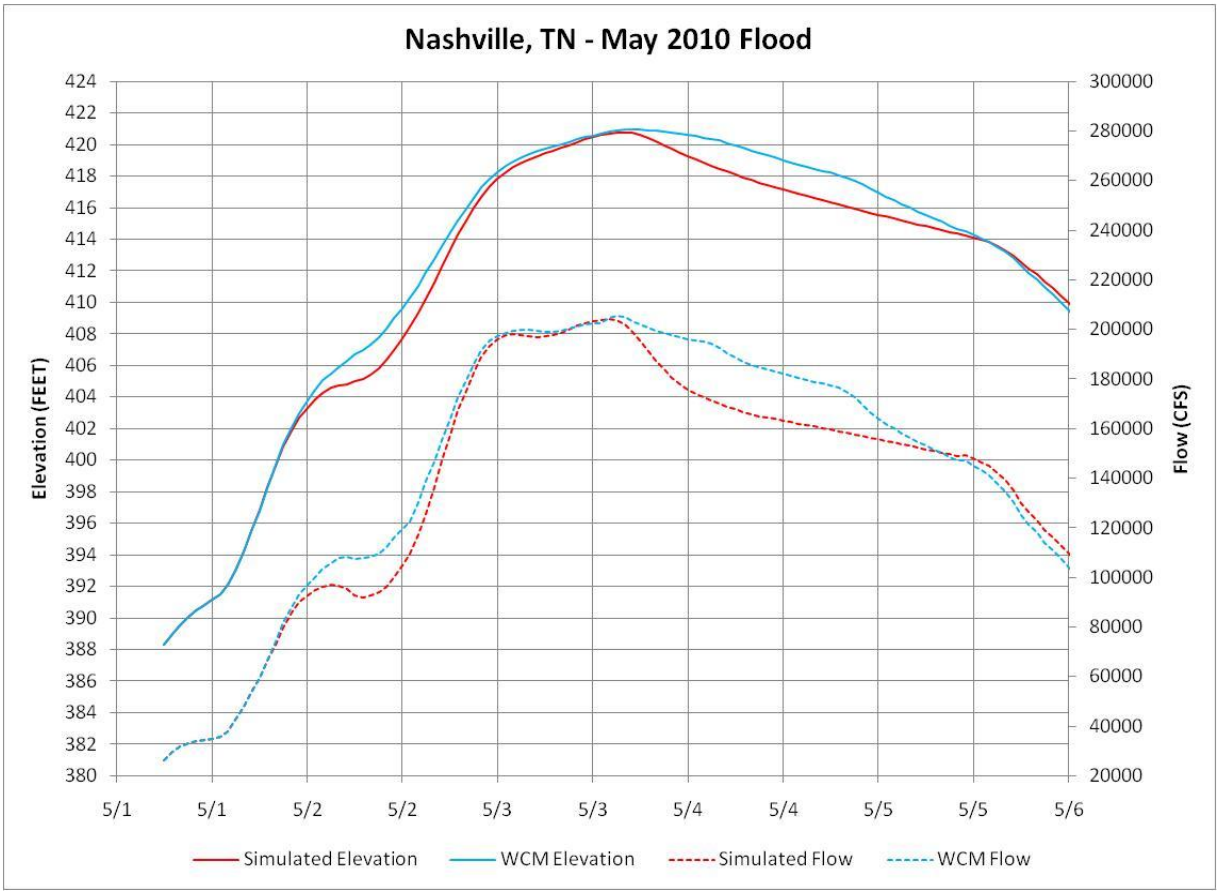

Figure 1 - Comparison of Stage Hydrographs and Flow Rates for Simulated.

- Operations and water control manual operations at Nashville. The water control manual states that "When the headwater rises to elevation 450, the 5,000 cfs per hour limitation will no longer apply and releases may be increased as necessary to prevent any further rises in the headwater." Despite the numerous spillway gate increases employed, the Old

Hickory lake level exceeded the top of the surcharge pool, elevation 450, and by 1400 hours had reached a new pool of record of elevation 451.45. At this point, water was only 6.6 inches from flowing over the upstream lock wall, and threatening continued operation of the project. If the powerhouse had been flooded, plant staff would have been required to pull the gates out of the water and abandon the project. An analysis of this scenario indicates that if that had occurred the stage would have been approximately four feet higher at the Nashville gage.

- During the event, one of the six spillway gates was out of service for scheduled maintenance. The maintenance being done on the gate required the bulkhead to be put in place and a great deal of equipment and scaffolding to be in the immediate area which prevented it from being put back in service. Ultimately, following a total of 19 spillway gate increases, the five available spillway gates reached a maximum opening of 34 feet at 1700 hours. The corresponding discharge at this gate setting was estimated to be 212,260 cfs. Once the headwater elevation exceeded 450 and the gate opening exceeded 25 feet, the spillway gate rating tables were no longer applicable. To address this issue during the event, LRN water managers performed an analysis and provided the Old Hickory Power Plant operators with updated rating tables to cover the full range of use. The maximum gate opening for Old Hickory is 42 feet.
- If an even more aggressive spillway discharge pattern had been followed in order to keep the pool below elevation 450, much larger releases from Old Hickory would have been required. These higher flows would have been in the river in the Nashville area at the same time as the peak local runoff. This would have resulted in a more aggressive rate of rise and pushed the river to flood stage much sooner (several hours) in the Nashville area resulting in very limited warning time for homes and businesses.
- The Old Hickory spillway gate change implemented at 1000 hours resulted in a total project discharge of 90,000 cfs. At this time, instead of stopping all discharge from J. Percy Priest as detailed in the water control manual, the decision was made to reserve the remaining storage available in J. Percy Priest for when the flood crest approached Nashville. Given the existing hydrologic conditions, LRN water managers knew that the crest was still many hours away, and that the storage in J. Percy Priest would be much more valuable later in the event.

1000 hours – Given the regional nature of this event and ambient conditions on the Lower Ohio River, LRD WM had already assumed control of the releases from Barkley and Kentucky. Through a series of discussions between Corps' and TVA water managers, a plan was developed that resulted in a series of spillway gate increases being started at 1000 hours.

- The Barkley Water Control Manual limits spillway gate increases to 5,000 cfs/hr and no more than 40,000 cfs in one day. Given the magnitude of this event and the corresponding water control measures, it was clear that this event could not be properly managed within the guidelines of the water control manual. By midnight on 2 May, the discharge had been increased by 114,400 cfs to 156,500 cfs and several of the increases were on the order of 10,000 cfs/hr. This was done to preserve flood storage in the Barkley and Kentucky pools for later in the event. This plan also addressed a flood crest moving down the Ohio River from rainfall that had occurred several days earlier in the Ohio Basin.

2100 hours –Generation at J. Percy Priest was stopped and the first spillway gate reduction at Old Hickory was made. These actions were taken to manage the flood crest at Nashville that was forecast at the time to occur at 0100 hours on May 3.

- The reduction at J. Percy Priest was based on the travel time from J. Percy Priest Dam to the Nashville area. It was timed to reduce the flood crest through Nashville.
- A series of spillway gate reductions were implemented at Old Hickory starting at 2100 hours. Again, this was designed to reduce the flood crest through Nashville. These cuts were initiated when the Old Hickory lake level was still above the top of the surcharge pool. This is best characterized as an extraordinary measure to attempt to utilize every bit of possible storage in an effort to protect Nashville. Close attention was paid to the lake level in Old Hickory to avoid a lake level greater than the previous crest. By midnight, Old Hickory releases had been reduced from a peak of 212,260 cfs down to 193,400 cfs. Although this operation was outside the guidelines in the water control manual, if the manual would have been strictly followed, more water would have been put onto Nashville by evacuating surcharge storage from Old Hickory. Figure 1 above also covers this water control action. As noted in this plot the stage hydrograph for Nashville would have been somewhat higher for the water control manual operation than for the water control operations that were carried out during the event. However, for the last several hours on Sunday and the early morning hours on Monday the differences are fairly small.
- A total of nineteen spillway gate increases and three decreases were made at Old Hickory on May 2.

2100 hours, 2200 hours – LRN coordinated operations at Center Hill and Cordell Hull to provide flood control benefits for Carthage, TN. Hydropower generation at Center Hill was stopped at 2100 hours in anticipation of Cordell Hull discharges being increased above the control flow limit of 72,000 cfs at Carthage. At 2200 hours, following heavy rainfall in the Cordell Hull Watershed, a series of spillway gate increases were required to manage the Cordell Hull Lake level.

- Since control flow at Carthage could not be maintained while holding the Cordell Hull headwater elevation within the power pool, the water control manual states that the surcharge storage is to be utilized. Until 1500 hours, the Cordell pool was holding steady at control flow while utilizing only 1 foot of surcharge storage. Once the rain arrived in the Cordell Hull basin, it continued to be intense and slow moving. The water control manual states that if the headwater is rising faster than 0.15 feet per hour, Cordell Hull releases are to be increased and the Carthage control flow may be exceeded, but the increase is limited to 5,000 cfs per hour until the surcharge storage is used. It quickly became apparent that the Cordell Hull Lake level could not be properly managed by adhering to this requirement. Project releases were managed in as controlled a method as possible. However, spillway discharge increases as frequently as every 30 minutes and some by as much as 10,000 cfs were necessary to prevent the upstream lock gate from being overtopped. Since the water control manual states that once the top of the surcharge pool, elevation 508, is reached, then the discharge is increased as necessary at that time to maintain the water surface at that level. By allowing it to go slightly higher and increasing faster, control of the structure was maintained and sudden, significantly higher discharges were avoided, thus reducing flood impacts downstream. As noted in Figure 2 the differences in stage and flow at Carthage between the two operational

scenarios evaluated with the calibrated HEC-RAS model, actual operations and water control manual operations, are not significant. This can be attributed to how quickly the Cordell Hull Lake level responded to uncontrolled runoff from the 1,372 mi^2 local drainage area above Cordell Hull Dam. The timing and magnitude of spillway gate openings was quite consistent between the two scenarios.

- The water control actions at Cordell Hull that began late on May 2 continued through the night.
- A total of seven spillway gate increases were made at Cordell Hull on May 2.

2300 hours, 2400 hours - Hydropower generation at Dale Hollow was stopped at 2300 hours. Hydropower generation at Wolf Creek was first reduced at 2300 hours and subsequently stopped at 2400 hours. These actions were taken in accordance with the system flood control operation to store water to reduce flows downstream during the crest.

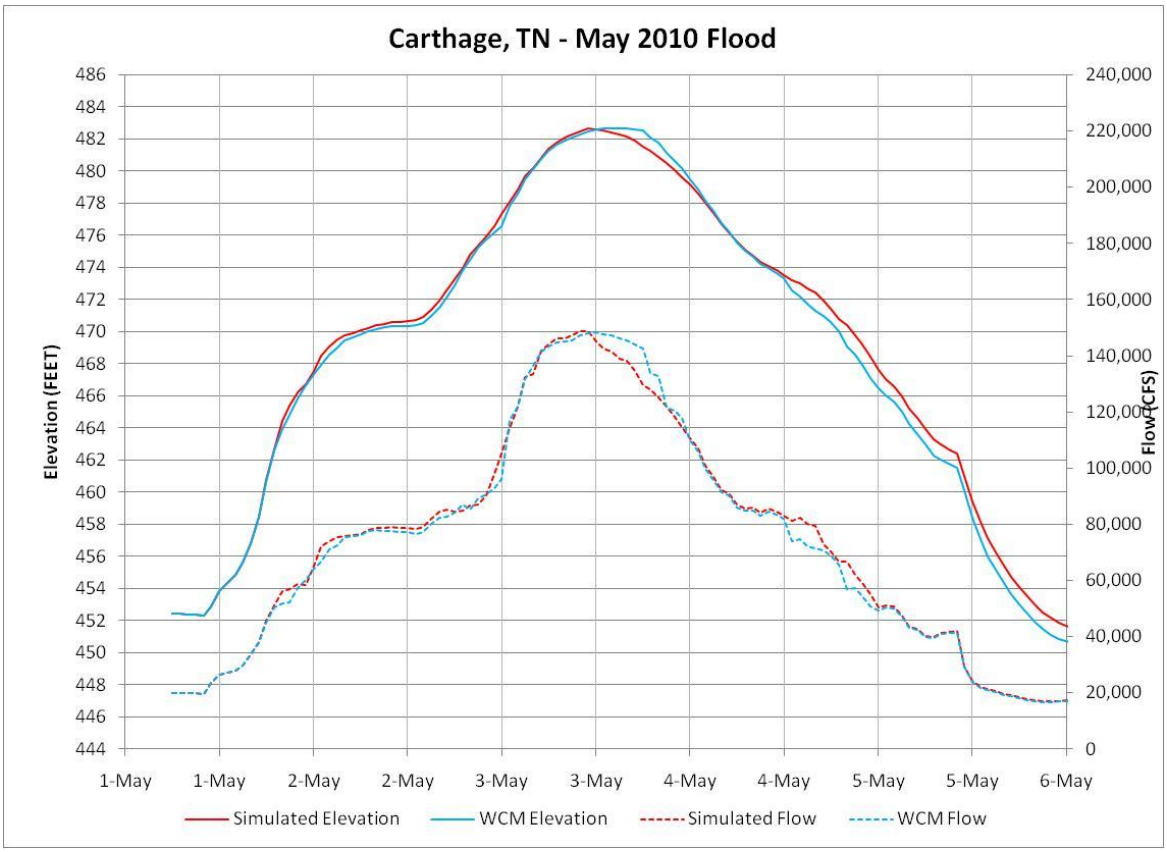

Figure 2 - Comparison of Stage Hydrographs and Flow Rates for Simulated Operations and Water Control Manual Operations at Carthage

3 May 2010: Monday

0000 hours - 0615 hours - Old Hickory makes additional spillway gate reductions at 0000 hours and 0100 hours; however, by 0300 hours the inflows to Old Hickory originating from large discharges at Cordell Hull and local uncontrolled runoff had pushed the Old Hickory pool up to

elevation 451.25. In order to slow the rise in the Old Hickory lake level, spillway gate increases were necessary at 0300 hours, 0400 hours, and again at 0615 hours.

- Collectively, these three gate openings increased the Old Hickory discharge by about 15,000 cfs to a total of approximately 197,000 cfs. This release setting was held steady until 1300 hours when a series of reductions were initiated. This action recovered a small volume of storage at Old Hickory that could be applied later when the crest approached Nashville.

0000 hours -0500 hours – Cordell Hull continued to make spillway gate increases as the lake level responded to local uncontrolled runoff. The maximum gate opening of 16 feet for this event was reached at 0450 hours. Soon after reaching this maximum gate opening the Cordell Hull lake level started to decrease. The discharge was held constant until the pool fell to elevation 507.80.

- Despite the series of spillway gate increases that had started the previous day to match the rise in inflows, Cordell Hull reached a new pool of record of elevation 508.33 at 0500 hours. At this elevation, Cordell Hull was only 2.0 inches from overtopping the upstream lock gate.

0600 hours – A flood crest of 37.62 is observed at the Celina gage.

0715 hours – The J. Percy Priest hydropower unit was brought back online.

- The J. Percy Priest headwater elevation was forecasted to go above 504.5 in the next several hours. When the lake level reaches elevation 504.5 the spillway gates have to be operated to prevent overtopping the gates. LRN water managers made the decision to bring hydropower generation back online and preserve the remaining storage in J. Percy Priest for the crest that appeared to be several hours from reaching Nashville.

1100 hours – Cordell Hull pool level drops below the elevation 508.0 surcharge storage threshold, allowing spillway gate reductions to be made. Flow reductions were made in an effort to protect Carthage, TN; the damage center located a short distance downstream of Cordell Hull Dam.

- LRN water managers issued the instruction to the Cordell Hull operators to continue to make spillway gate reductions in an aggressive fashion as long as they could do so without causing the pool level to go back above elevation 508.0.
- The Cordell Hull Water Control Manual states once the lake elevation peaks within the surcharge storage pool that the maximum discharge reached should be maintained until the headwater level recedes back to the top of the power pool (elevation 504.5).
- A total of 11 spillway gate reductions were made between 1100 hours and 2300 hours on May 3 as the project inflows continued to fall throughout the day.
- A total of six spillway gate increases and eleven decreases were made at Cordell Hull on May 3.

1200 hours – Initiated spillway gate increases at Barkley.

- LRD WM was directing operations at Barkley and Kentucky Dams. Earlier in the day the Barkley discharge had been increased to 260,000 cfs and then held steady for three hours. At 1200 hours, a series of four 10,000 cfs/hr spillway gate increases were initiated to take the total release to 300,000 cfs. These 10,000 cfs/hr increases exceeded the maximum guideline of 5,000 cfs/hr identified in the Barkley Water Control Manual. The 300,000 cfs flow represented a new record discharge for the Barkley project.

- This action was taken to conserve storage in the Barkley and Kentucky pools for a flood crest that was coming down the Ohio River.
- When these flow increases were made the Barkley tailwater rose accordingly, resulting in the flooding of several homes downstream of the dam.
- The Barkley Water Control Manual does not address notification of downstream interests when significant flow increases are made. The practice has always been that LRN WM contacts the Barkley Power Plant operator and issues instructions on how and when spillway gate changes are to be made. In turn, the operator alerts both Barkley Lock and Lock &Dam (L&D) 52 of the upcoming change. Ultimately, the Barkley Resource Manager's Office typically coordinates with local emergency management offices on flow increases; however, this procedure is not a formalized process. The Barkley Resource Manager is very familiar with the river and will call if they sense a change. LRN will develop a formalized plan to alert downstream emergency managers (in addition to the ongoing process through the NWS) similar to what is in place with the lock for timely communication of changes in discharge.

1200 hours – A flood crest of 46.06 is observed at the Carthage gage.

1300 hours - Spillway reductions are initiated at Old Hickory in an effort to reduce the flood crest through Nashville. There was a particular emphasis placed on preventing inundation of Nashville's Omohundro Water Treatment Plant due to the fact that the other Nashville water treatment plant (K. R. Harrington located at the mouth of the Stones River) had been flooded earlier in the event. Thanks to the intensive sand bagging efforts, using sandbags furnished by LRN, the City of Nashville was able to prevent the loss of their potable water supply.

- Between 1300 hours and 1730 hours a total of spillway gate reductions were made at Old Hickory. These reductions reduced the flow out of Old Hickory from 196,500 cfs at 1300 hours to 144,200 cfs at 1900 hours, or a total flow reduction of around 52,000 cfs.
- The Old Hickory Lake level was closely monitored by Project and Water Management personnel during and following these flow reductions. The pool was allowed to rise back above the top of the surcharge storage pool. This prevented additional water from being placed on top of the crest as it entered the Nashville area. A break in weather conditions provided an opportunity for this action to be taken. The rain had ended and significant flow reductions had been made at the upstream projects as the flood crest had already moved through.
- The Old Hickory Water Control Manual states once the lake elevation peaks within the surcharge storage pool that the maximum discharge reached should be maintained until the headwater level recedes back to the top of the power pool (elevation 445.0).
- A total of three spillway gate increases and eight decreases were made at Old Hickory on May 3. No additional spillway gate changes were required until Wednesday, May 5.

1500 hours – A special request was made by TVA to address a power transmission line problem associated with Dale Hollow being off-line. The remedy for this problem was to bring one hydropower unit back online. LRN WM reviewed the request, and determined that since Celina had crested and local flows were receding, this could be done without any downstream impacts. One turbine was placed in service at 1500 hours.

- This action was consistent with guidance in water control manuals with respect to recovering flood control storage after the flood crest has passed.

1800 hours – A flood crest of 51.86 is observed at the Nashville gage.

1900 hours - Spillway reductions initiated at Barkley in response to downstream flooding.

- Two spillway gate reductions were made to reduce the Barkley outflow to around 280,000 cfs. This was done in response to flooding of several homes in an area a short distance downstream of Barkley Dam. This flow was maintained through the end of the day.

2200 hours – Cheatham reaches a new pool of record of elevation 404.15.

2330 hours – LRN performed surcharge operation at J. Percy Priest.

- Old Hickory Hydropower personnel were dispatched to J. Percy Priest Dam to carry out a surcharge storage operation. They were instructed to continuously track the J. Percy Priest Lake elevation and when the pool reached the top of gates they were to open each of the gates 0.5 foot. This was done to limit releases as much as possible to prevent an increase in water levels above the observed crest.
- The J. Percy Priest spillway gates were initially opened at 2330 hours. However, one of the gates did not function properly. The field staff opened one of the gates to 1.0 foot and two gates to 0.5 ft. An Old Hickory Power Plant electrician was called in. He quickly diagnosed the problem with the gate and made the necessary repair. This quick action prevented the non-functioning gate from being overtopped. At 2400 hours all four gates were opened to 0.5 foot. This resulted in a project release of 7,000 cfs.
- With the J. Percy Priest headwater elevation at 504.5, the water control manual specifies a total project release of 17,000 cfs. This is generally considered to be the channel capacity for the Stones River below J. Percy Priest. However, given how high the Cumberland River was at the time, a release of 17,000 cfs would have induced additional flooding along the Stones River and would have likely increased the Nashville stage higher than the earlier crest. The HEC-RAS model results for the Nashville gage presented in Figure 1 are somewhat inconclusive in that the stage difference observed at Nashville cannot be specifically tied to flow reductions at Old Hickory or delaying spillway operations at J. Percy Priest. Rather, for the period starting Monday (May 3) evening and extending through the middle of the day on Wednesday (May 5), the combination of water control actions executed by LRN water managers at these two projects resulted in significant stage reductions (~ 2 feet for much of this period) at Nashville when compared to the water control manual operational scenario modeled with HEC-RAS.

4 May 2010: Tuesday

0000 hours – Two hydropower units were brought online at Wolf Creek and one at Center Hill. A third Wolf Creek unit was brought online at 1200 hours.

- This is in accordance with the water control manuals that state, "After the flood crest has passed, utilized flood control storage is evacuated as fast as practical to prepare for future potential floods."

0000 hours - 0500 hours – Spillway gate reductions at Cordell Hull.

- As the Cordell Hull local runoff receded, a series of spillway gate reductions were made to reach control flow (0500 hours). LRN WM instructed Cordell Hull to hold control flow until the pool fell to within two feet of guide curve (1600 hours). At that point a spillway gate cut scheme was developed to allow a smooth transition to normal operating levels.

- All gates at Cordell Hull were closed at 0600 hours on the next day.

0400 hours -1600 hours – Submergence problems with the spillway gates at Barkley.

- When the Barkley project experiences extremely high tailwater elevations like it did on this date a submergence problem is encountered with operation of the spillway gates. The Barkley spillway gates must be clear of the water on the tailwater side when in operation or they will be subject to extreme vibration. Therefore, a gate must be either closed or open high enough to clear the tailwater. As a result, operators and water managers are sometimes unable to produce the desired flow and must decide on either a flow lower than the target or higher. The differences can be fairly significant since extremely large gate openings are required at the individual gates.
- The Barkley Power Plant operators were forced to make a series of gate changes between 0500 hours and 0805 hours to address submergence problems. During high discharges from Barkley Dam, when the tailwater elevation becomes high, the spillway gates can become partially submerged. This results in intense vibration that threatens the structural integrity of the spillway section. Therefore, adjustments to the gate arrangement must be made quickly to alleviate this situation. The solution to this problem requires that individual gates are either raised to very large gate openings or they remain closed. As a result, rather than opening many or all gates to a moderate gate opening, a few gates are opened to very large gate openings. The final result is that project outflows are often either higher or lower than the target release due to the limitations on spillway gate use. During this period the spillway gate settings resulted in project releases that were higher than the objective.
- Barkley set a new discharge record of 303,200 cfs at 0800 hours.
- At 0800 hours per direction from LRD WM, LRN WM directed Barkley to reduce project discharge to 240,000 cfs. Again, due to submergence the closest the operators could get to this target was 266,000 cfs by completely closing one gate.
- At 1600 hours per direction from LRD WM, LRN WM directed Barkley to close one additional spillway gate. This resulted in a project discharge of 230,000 cfs.

0700 hours – A flood crest of 62.58 feet is observed at the Clarksville gage.

0800 hours – Spillway gate adjustment at J. Percy Priest.

- A surcharge operation at J. Percy Priest had been initiated at 2330 hours the previous day. By 0800 hours the lake level had risen to the point that a gate adjustment was required to prevent overtopping the gates. The gates were raised an additional 0.3 foot each to prevent water from spilling over the gates. This increased the project release from 7,000 cfs to 8,600 cfs.

5 May 2010: Wednesday

0600 hours – All spillway gates at Cordell Hull were closed and the project was returned to normal operations.

0900 hours – A series of spillway gate reductions were initiated at Old Hickory as the inflow to the project steadily declined.

- A total of ten spillway gate reductions were made at Old Hickory on May 5.

1200 hours – Additional hydropower units were brought online at Wolf Creek, Dale Hollow, and Center Hill as the effort to recover reservoir storage continued.

- Wolf Creek – went from three units to five units at 1200 hours

- Dale Hollow – went from one to two units at 1200 hours
- Center Hill – went from one to two units at 1200 hours and from two to three units at 1400 hours.

6 May 2010: Thursday
0000 hours -1300 hours – Spillway gate reductions at Old Hickory continued throughout the day. Old Hickory was back within its normal operating range by the end of the day.
1000 hours – Continued to adjust project release schedules at the tributary projects to evacuate water from storage.

- Wolf Creek – opened two sluice gates at 1000 hours
- Center Hill – opened two sluice gates at 1230 hours

1000 hours – Ohio River Flood Control Operation

- Initiated a series of spillway gate reductions to reach a total flow of 150,000 cfs by 1900 hours. This was directed by LRD WM to support ongoing flood control operations for the Lower Ohio River.

7 May 2010: Friday
0000- hours 2400 hours – No significant water management actions were required.

- Cordell Hull and Old Hickory had already returned to normal operating levels.
- The process of evacuating water from storage continued at Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest.
- Cheatham remained in free flow as it had been since Saturday, May 1 at 1900 hours.
- Releases at Barkley continued to follow the requirements of the ongoing Ohio River flood control operation.

1600 – Barkley reached a peak elevation for this event of 369.00. This is about 1.0 ft lower than the pool of record established during the May 1984 flood event.

8 May 2010: Saturday
0830 hours – The spillway gates were placed back in service at Cheatham. This action returned Cheatham to normal project operations.
1000 hours – Continued to adjust project release schedules at the tributary projects to evacuate water from storage.

- J. Percy Priest – increased spillway discharge by 1,000 cfs to a new total discharge of 9,100 cfs at 1000 hours
- J. Percy Priest – increased spillway discharge by an additional 1,000 cfs at 1100 hours. The revised total project discharge was now 10,100 cfs.

1000 hours -1200 hours – Reduced project discharge from 150,000 cfs to 120,000 cfs by applying three 10,000 cfs reductions.

- The 120,000 cfs discharge at Barkley was continued until May 17 when flows were further reduced to 70,000 cfs. On May 18 the flows were reduced again to 50,000 cfs.

<u>Why did it happen?</u>
-The Cumberland Basin was subjected to an epic rainfall and a flash flood event that started on May 1, 2010. A significant amount of the intense rain fell over the uncontrolled portion of the

basin adjacent to the Cordell Hull, Old Hickory, and Cheatham projects. The two-day rainfall totals were in excess of 15 inches in many areas, and exceeded the 1,000-year rainfall event.
-This event generally outpaced the science in terms of being able to develop accurate, timely rainfall forecasts, model the hydrology, and develop well-timed flood crest forecasts.
-The event also outpaced the capability of the Cumberland Basin reservoir system to manage the event in a prescribed manner.
-The notification process for flow increases at Barkley, which in the past had worked adequately during moderate storm events, did not hold up to the rigors of a major flood.
-The network outage that occurred on Sunday, May 2 limited LRN WM's access to data during a critical period. The only access to this data was via internet service on personal cell phones and by calling the projects.
-Rating tables for spillway gates at Old Hickory were not extensive enough to cover the full range of gate openings required during the event.
-The water control manuals do not include slope storage tables for Cordell Hull, Old Hickory, and Cheatham. This made developing reasonable estimates of project inflows during the event problematic when slopes on individual projects of approximately 35 feet were observed.
-The current water control manuals for the Cumberland River Basin projects were last updated in 1998. The 1998 revisions were updates of manuals prepared when the projects were constructed, which for several was in the 1950s. For some of the newer projects, the 1998 manuals were the first manuals developed.

How can we do it better and who has the lead to fix it?
-LRN will develop a notification process in the water control plans for the projects to pass critical information to emergency managers in a timely manner with clear roles and responsibilities defined. The process should include notification of the Resource Managers.
-LRN WM will update the project water control manuals to cover more extreme events and will include updated rating curves and slope storage tables for the main river projects.
-LRN WM will investigate issues within the water control manuals that were not robust enough to deal with the magnitude of this flood event. Those issues required LRN water managers to deviate from guidance in the manuals in order to reduce flood impacts at particular locations.
Cordell Hull.

- The hourly rate of change limit of 5,000 cfs/hr was not sufficient to manage the project inflows during this event. LRN is evaluating raising the allowable increase to better position the project to manage surcharge storage without imposing sudden flow increases on Carthage.
- The current water control manual states that once the surcharge storage upper limit of elevation 508.0 is reached, a one step flow increase large enough to pass inflow (and prevent any further pool rise) should be implemented. A sudden discharge increase of the magnitude necessary for extreme flow events would result in a rapid rise downstream, including the Carthage damage center.
- The water control manual states that the maximum discharge should be maintained until the Cordell Hull Lake level gets back to near normal operating range. This operational scheme runs the risk of putting the maximum discharge on the crest when flows could be reduced by employing available surcharge storage.

Old Hickory

- The hourly rate of change limit of 5,000 cfs/hr was not sufficient to manage the project inflows during this event. LRN is evaluating raising the allowable increase to better position the project to manage surcharge storage without imposing sudden flow increases on downstream areas including Pennington Bend and Nashville.
- Existing guidance in the water control manual correlates discharge increases to prescribed rates of rise in the surcharge storage pool. This policy does not always support utilization of available surcharge storage at the most opportune time to maximize downstream flood risk management benefits. LRN will evaluate and update the water control manual.
- The current water control manual states that once the surcharge storage upper limit of elevation 450.0 is reached, a one step flow increase large enough to pass inflow (and prevent any further pool rise) should be implemented. A sudden discharge increase of the magnitude necessary for extreme flow events would result in a rapid rise downstream including the Nashville damage center. LRN will evaluate and update the water control manual.
- The water control manual states that the maximum discharge should be maintained until the Old Hickory Lake level gets back to near normal operating range. This operational scheme runs the risk of putting the maximum discharge on the crest when flows could be reduced by employing available surcharge storage. Need to evaluate and update the water control manual.

J. Percy Priest

- The J. Percy Priest water control manual states "If the Nashville flow is forecasted to exceed the maximum desired level, releases from J. Percy Priest are curtailed, and flood control storage utilized in a manner that will reduce the flood crest at Nashville as much as practical." Under scenarios like the May 2010 flood event, this requirement forces flood storage to be used early in an event rather than save it for use at the time of the crest.
- Existing guidance for operation of J. Percy Priest using the Emergency Operations Schedule in the water control manual does not accommodate (under all flood related scenarios) reducing the discharge from the project at critical times as flood crests approach Nashville. This flood control project provides the last opportunity to reduce the flood crest at the Nashville damage center. However, when the lake level is within the surcharge pool (greater than elevation 504.5) the Emergency Operations Schedule requires a minimum of 17,000 cfs being released from the project. This goes against the effort to utilize all available flood control in an effort to reduce downstream flood damages.
- The Emergency Operations Schedule requires that if the rate of rise in the headwater at specific headwater ranges reaches (both above and below elevation 504.5) a prescribed amount, then the pre-determined releases should be made. For the May 2010 event, this requirement would have resulted in a spillway gate increase of approximately 11,000 cfs over what was observed. Given the timing of when this guidance would have applied, the additional water would have increased the flood crest in Nashville.

Barkley

- The hourly rate of change limit of 5,000 cfs/hr and the corresponding 40,000 cfs daily discharge increase were not sufficient to manage the project inflows during this event.

LRN will evaluate raising the allowable discharge increase, both the hourly rate of rise and the daily limit, to better position the project to manage flood control storage in support of flood control operations for the Ohio and Mississippi Rivers.

Appendix C – Corps Timeline of Events

This Great Lakes and Ohio River Division (LRD) and the Nashville District (LRN) Water Management events are in this timeline.

Date	Time (CDT)	Event
28-Apr	700	5-Day QPF issued showing storm system of up to 6.2 inches
29-Apr	0	Nashville stage - 18.50
	600	Nashville stage - 18.75
	700	5-Day QPF issued showing storm system of up to 6.6 inches
	800	WFO Nashville morning data received by LRN WM
	816	LRN WM observed data sent to NWS
	854	LRD sent a Flood Potential Update to the LRD Senior Leaders, EM and PAO
	1146	LRN WM forecast data sent to NWS
	1200	Nashville stage - 19.02
	1700	3-Day QPF issued
	1800	Nashville stage - 19.46
30-Apr	0	Nashville stage - 19.77
	416	3-Day QPF issued
	600	Nashville stage - 20.08
	700	5-Day QPF issued showing storm system of up to 7.8 inches
	800	WFO Nashville morning data received by LRN WM
	801	LRN WM observed data sent to NWS

Date	Time (CDT)	Event
30-Apr	1000	LRD and TVA made QPF model runs forecasting Cairo, IL to reach a stage of 40 ft and Kentucky Lake to reach 363.5. The official NWS forecast was for 37 ft at Cairo, IL.
	1146	LRN WM forecast data sent to NWS
	1200	Nashville stage - 20.17
	1314	Although the NWS forecast did not indicate reaching the criteria for LRD to take direction of Kentucky Lake and Lake Barkley, LRD ordered the Districts to staff water management for the weekend and arranged staffing for its office.
	1800	Nashville stage - 19.68
	2138	3-Day QPF issued
1-May	0	Nashville stage - 19.01
	435	3-Day QPF issued
	600	Nashville stage - 18.83
	700	5-Day QPF issued showing storm system of up to 8.6 inches
	700	Rainfall totals for the past 24 hours ranged from 0.5-4 inches of the Area of Concern (AOC)
	700	LRD initiated coordination with TVA
	715	LRD initiated coordination with LMRFC
	716	LRN WM observed data sent to NWS
	730	LRD initiated coordination with LRN
	0800	LRD called OHRFC to obtain an updated weather forecast
	1000	Hydropower releases at J. Percy Priest started
	1200	Spillway discharges at Old Hickory started

Date	Time (CDT)	Event
1-May	1200	LRD provided afternoon TVA release schedule to LMRFC and LMRFC produces a Cairo, IL stage forecast of 41 feet
	1200	Nashville stage - 20.79
	1242	LRD assumed direction of Kentucky Lake and Lake Barkley; no changes to the release schedule are made
	1319	LRD Water Management Update was sent to an internal notification list that a flood control operation was initiated and provided an assessment of the severe weather, past 24 hours rainfall and QPF
	1701	3-Day QPF issued
	1730	Spillway discharges at Cordell Hull started
	1800	Nashville stage - 28.04
	1900	LRN Water Management increased staff. Cheatham went to free flow.
	2200	OHRFC stated that it tried to contact LRN WM to get updated forecast. LRN WM office was manned from 1900-2300. LRN WM did not receive any calls or messages from OHRFC during this period.
	2230	LRN notified District Senior Leadership and LRD WM via e-mail of the potential for Nashville to reach flood stage and exceed the 1984 crest of 45 ft. The NWS forecast was for a crest of 36.2 ft overnight.
2-May	0	Nashville stage - 34.52
	1	Spillway releases brought up to 60,000 cfs range at Cordell Hull
	416	LRD forwarded LRN's e-mail message forecasting flood stage and above at Nashville to the Ohio River Forecast Center.

Date	Time (CDT)	Event
2-May	427	LRD forwarded LRN's e-mail message forecasting flood stage and above at Nashville to the LRD Senior Leadership.
	452	3-Day QPF issued
	600	Nashville stage - 37.33
	638	OHRFC contacted LRD and indicated they cannot reach anyone in LRN. The LRN WM office was manned starting at 0630 Sunday morning - no phone calls or messages from the OHRFC were received. OHRFC indicates they have updated the Nashville forecast to 40 feet. LRD arranged for a 0830 coordination call between LRN, LRD and OHRFC.
	700	Rainfall totals for the past 24 hours ranged from 4-8 inches of the AOC; two day totals were 7 to 10 inches
	700	1-Day QPF issued showing storm system of an additional 0.25 to 4 inches of rain
	700	WFO Nashville morning data received by LRN WM
	700	LRD exchanged data with TVA
	715	LRD exchanged data with LMRFC indicating the release schedule was expected to change substantially
	730	LRD exchanged data with LRN; LRN was engaged in the flood fight
	746	LRN WM observed data sent to NWS
	830	NWS/Corps' coordination conference call

Date	Time (CDT)	Event
2-May	830	Coordination call was conducted between LRN, LRD and OHRFC and the LRN WM strategy was related
	930	LRN reported network loss
	930	Nashville Gage reached flood stage
	950	NWS forecasted Nashville crest 41.9 on 5/2 at 1900
	1000	Rapid spillway release increases at Old Hickory started and spillway release increases at Barkley started
	1000	TVA provided its updated Kentucky and Barkley release schedule and Kentucky pool forecast. However, this schedule and forecast did not have updated Lake Barkley inflows (Cheatham outflows) from LRN as LRN had to manage the upper projects first. Based on the pool rise and the preliminary release schedule, TVA requested to begin increasing releases at Kentucky Lake by 30,000 cfs and by 10,000 cfs at Lake Barkley. LRD WM concurred, and orders were issued to the projects to begin increasing releases. LRD Senior Management and LRD Dam Safety were notified via e-mail that orders were given to start increasing releases.
	1040	OHRFC provided its public forecast for Nashville of 41.9 ft, but noted that the Nashville stage was already 41 feet. OHRFC noted that the forecast would be updated at 18z (1:00 pm CDT)
	1100	LRD issued orders to begin increasing releases at Kentucky Lake by 30,000 cfs and at Lake Barkley by 10,000 cfs based on TVA's noon preliminary model updates. LRN had not yet provided Cheatham flows (inflows to Lake Barkley) so a final release schedule and pool forecast was not made
	1118	NWS Forecasted Nashville crest 45.0 on 5/2 at 1900

Date	Time (CDT)	Event
2-May	1136	LRD called LRN to let them know they urgently needed the Cheatham flows. LRN WM reported that LRN had just provided its estimate of Cheatham flows to TVA. LRN conveyed to LRD that the Cheatham flows were uncertain due to the rapidly changing hydraulic conditions as Cheatham became submerged and rain continued to fall and that the flows did not include any rain since 0600 hours.
	1145	Corps' Emergency Manager sent to TEMA
	1200	Nashville stage - 42.61
	1230	TVA developed a new release schedule and pool forecast and reported it to LRD. The schedule indicated a pool crest of 366.1 feet on May 4. This release schedule produced an Ohio River crest at Cairo, IL of 46.2 on May 7th, using the LRD Ohio River model. Discussion then ensued between LRD and TVA on multiple operating objectives including stabilizing the pool elevation at 365 feet and increasing discharges in advance of the Ohio River flood crest. TVA then returned to developing another schedule in light of the discussion.
	1300	Coordination call was conducted between LRN, LRD and OHRFC and the LRN WM strategy was related; it was apparent that critical conditions for J. Percy Priest, Old Hickory and Cheatham existed. The OHRFC noted the storm system had stalled and more rain was expected; the OHRFC issued a crest forecast for Nashville of 48.5 feet for the evening of 2 May
	1330	NWS/Corps' coordination conference call

Date	Time (CDT)	Event
2-May	1400	Old Hickory pool of record 451.45.
		TVA proposed a revised schedule that achieved several objectives. The new schedule increased releases ahead of the Ohio River flood crest then reduced flows during the crest to prevent increasing flood damages on the Lower Ohio River. Even with these high releases, the pool was forecast to continue to climb an additional foot to nearly 365 feet, and then stabilize. This elevation was still significantly above Lake Barkley's Storage Utilization Guide that provided the amount of storage that can be committed to a flood event. This elevation also began to trigger dam safety concerns. Reductions in the pool were also sought to reduce backwater pressure upstream increasing levels at Clarksville and above. The uncertainty in the local and Cheatham inflows to the reservoirs and the rain still to fall in the next 24 hours increased the urgency to stabilize the pool levels in advance of the Nashville flood wave entering Lake Barkley. LRD WM conducted a teleconference with TVA and LRN to discuss the proposed release schedule. In light of the worsening conditions upstream of Lake Barkley and the record local inflows to both Kentucky Lake and Lake Barkley, the consensus was that the proposed discharges were necessary. LRD WM provided the final release schedule to the LMRFC.
	1430	The release schedule was then communicated to the following: Barkley Dam Tender, LRN Senior Leaders, LRD Dam Safety Officer, LRD Chief, EOC, LMRFC, OHRFC, Paducah WFO, and the Olmsted Project Office
	1500	The LRD WM Update was sent out

Date	Time (CDT)	Event
2-May	1500	During a call with Metro Nashville EOC, the LRN Deputy for Programs and Project Management (DPM) was asked by the Nashville Mayor why the Corps was not feeding Metro information on the river levels. The LRN DPM explained to the Mayor that the NWS was responsible for river stage forecast. When the Mayor responded that he thought Metro received that information from the Corps, his staff verified that they look to the NWS for river information.
	1530	LRD WM staff left the office
	1603	The NWS Paducah WFO issued the Special Weather Statement advising persons downstream of the Kentucky and Barkley Dams to prepare for higher water immediately.
	1619	NWS forecasted Nashville Crest at 48.0 on 5/3 at 0100
	1643	WFO Nashville called the LRN WM. WFO Nashville stated they relayed Nashville forecast to Corps and Corps was fairly confident Old Hickory could hold 150,000 cfs. At that time, Old Hickory was already 7 feet over maximum rated spillway opening (150,000 cfs). This represents an apparent breakdown in communication as LRN WM would not have made that statement.
	1700	Old Hickory gate opening 34 ft
	1800	Nashville stage - 46.86
	1828	NWS forecasted Nashville Crest at 48.0 on 5/3 at 0100
	1930	Air card provided by ACE-IT for internet connectivity for LRN WM
	1943	WFO Nashville called LRN WM and leaves a message

Date	Time (CDT)	Event
2-May	1950	LRN WM returned WFO Nashville's call. WFO Nashville stated that JPP increased from 5,000 cfs to 10,000 cfs and cuts were anticipated at Old Hickory Dam but flow was currently 150,000 cfs. This represents another apparent breakdown in communication. The discharge information was characterized as the last reliable flow rating (within the spillway gate rating table) was 150,000 cfs, but that we had made several increases since then. There were no short term flow increases at J. Percy Priest implemented or considered during this event. LRN WM passed along the information that spillway gate releases were required at J. Percy Priest, but every attempt was made to delay that until after the crest passed through Nashville.
	2004	WFO Nashville informed OHRFC that JPP went from 5,000 cfs to 10,000 cfs for about an hour. This action was not considered during the event. JPP cut back to zero at 2100 - this action was implemented to manage for the flood crest in Nashville. Old Hickory was at 150,000 cfs. This was an apparent breakdown in communication as LRN WM was fully aware that the discharge from Old Hickory was greater than 150,000 cfs.
	2005	Network Restored
	2049	LRD Dam Safety Officer provided Cumberland Basin Update/Actions to the Division Commander, Deputy Commander and the LRD Director of Programs.
	2100	Center Hill and J. Percy Priest hydropower generation stopped. First spillway reduction at Old Hickory was made.
	2200	NWS forecasted Nashville crest at 50.3 on 5/3 at 1300
	2200	Rapid spillway release increases at Cordell Hull started
	2300	Dale Hollow hydropower generation stopped

Date	Time (CDT)	Event
2-May	2300	OHRFC called LRN WM. LRN WM advised OHRFC to use 220,000 cfs as an estimate for Old Hickory discharge.
3-May	0	LRN WM called OHRFC and reported having trouble contacting Old Hickory
	0	Nashville stage - 49.63
	1	Wolf Creek Hydropower generation stopped
	20	LRN WM called OHRFC back. Cordell Hull opened up to 90,000 cfs. Old Hickory was going down by 5,000 cfs per hour to no lower than 175,000 cfs
	30	The Metro Water Services Director requested the latest information on Old Hickory releases and the plan for future releases. After a call to the LRN WM Chief, The LRN DDPM provided the requested information as of midnight 3 May.
	130	LRN WM called OHRFC and provided Old Hickory update
	402	NWS Nashville crest forecast 51.5 on 5/3 at 1300
	500	Cordell Hull pool of record 508.33
	600	Celina crest 37.62
	600	LRD staff reported to Reservoir Control Center
	600	Nashville stage - 50.56
	601	LRN WM observed data sent to NWS
	630	Cordell Hull reached max gate opening of 16 ft
	700	Total storm event rainfall was between 10-15 inches over a widespread area
	700	Morning exchange of data between TVA and LRN
	700	WFO Nashville morning data received by LRN WM
	715	J. Percy Priest hydropower unit back online

Date	Time (CDT)	Event
3-May	0718	LRN DDPM emailed the Metro Water Services Director the latest information on Old Hickory and J. Percy Priest discharges.
	725	NWS Nashville crest forecast 51.5 on 5/3 at 1300
	830	NWS/Corps' coordination conference call
	830	Coordination call with LRD, LRN, OHRFC
	900	Water Management Strategy was briefed at EOC with LRL and Kentucky EM; Releases on the town of Smithland were discussed as well as the possibility of Barkley tailwater going to 348 feet.
	1000	Release schedule for Kentucky and Barkley was finalized with TVA and LRN. Releases increasing up to 300,000 cfs were determined as necessary to ensure sufficient storage was available for the Nashville flood wave. LMRFC predicted a crest of 50 feet at Cairo, IL.
	1100	Initiated spillway discharge reductions at Cordell Hull
	1200	Carthage Crest 46.06
	1200	Nashville stage - 51.19
	1230	Conference call between LRN WM, WFO Nashville, OHRFC, and OEM
	1300	Initiated spillway discharge reductions at Old Hickory
	1330	NWS/Corps' coordination conference call
	1330	Afternoon coordination call with LRD, LRN and OHRFC and Nashville WFO
	1400	Attended emergency operations center call with HQ UOC.

Date	Time (CDT)	Event
3-May	1430	Coordination call between OHRFC and LRN WM to discuss if anything else could be done with JPP to hold the 52 feet at Nashville. Spillway releases at JPP were delayed as long as possible.
	1500	Barkley spillway discharge reached 300,000 cfs. Dale Hollow hydropower unit back online.
	1523	Water Management Update was issued discussing the record flooding and release schedule from Kentucky Lake and Lake Barkley
	~1525	Corps' EM Liaison sent to KYEM
	1542	NWS Nashville crest forecast 52.0 on 5/3 at 1900
	1600	LRD WM and the LRD Dam Safety Officer briefed the Division Commander and the LRD Director of Programs in the Executive Office on the flooding situation and LRD and LRN's flood control strategies.
	1700	EOC notified WM of concerns for downstream flooding in the town of Iuka below Barkley Dam
	1730	Flow reductions were coordinated with TVA and LRN and approved by the LRD Dam Safety Officer with recognition that the pool level would rise
	1758	Paducah WFO issued Special Weather Statement warning of high pools, tailwaters and lake releases
	1800	Nashville Crest 51.86
	1830	Coordination call between LRN WM, OHRFC.
	1900	Spillway discharge reductions at Barkley were made
	1956	Paducah WFO issued Flash Flood Warning

Date	Time (CDT)	Event
3-May	2011	The LRN DDPM emailed the Metro Water Services Director to explain that water must be discharged to keep J. Percy Priest gates from being overtopped, but the increased flow out of Priest was less than the reductions that were occurring at Old Hickory.
	2025	WFO Nashville coordinated with LRN WM
	2115	LRN notified LRD that the full reductions cannot be made as hydropower is offline and gate adjustments offer alternatives of 280,800 cfs or 235,000 cfs. LRD WM directed the flows to remain at 280,800 due to high risk of pool storage utilization
	2200	Cheatham pool of record 404.15
	2238	Senior leadership was notified and the LRD Dam Safety Officer concurred with the decision.
	2330	Surcharge storage operation at J. Percy Priest
4-May	0	Nashville stage - 51.27
	1	Wolf Creek and Center Hill hydropower units back on line
	400	Spillway discharge increases at Barkley started
	600	LRD staff reported to Reservoir Control Center
	600	Nashville stage - 50.47
	646	LRN WM observed data sent to NWS
	700	Clarksville Crest 62.58
	700	LRD exchanged data with TVA
	715	LRD exchanged data with LMRFC
	730	LRD exchanged data with LRN
	800	Barkley reached maximum discharge of 303,200 cfs

Date	Time (CDT)	Event
4-May	800	WFC Nashville morning data received by LRN WM
	830	NWS/Corps' coordination conference call
	830	Coordination call with LRD, LRN, OHRFC
	1000	Release schedule for Kentucky and Barkley was finalized with TVA and LRN. Releases were reduced in anticipation of Cairo, IL crest
	1200	Wolf Creek added additional hydropower unit
	1200	Nashville stage - 50.02
	1330	NWS/Corps' coordination conference call
	1330	Afternoon coordination call with LRD, LRN and OHRFC and Nashville WFO
	1400	Attended emergency operations center call with HQ UOC.
	1524	Water Management Update was issued discussing the record flooding and release schedule from Kentucky Lake and Lake Barkley
	1800	Barkley reaches steady discharge of 230,000 cfs
	1800	Nashville stage - 49.49
5-May	0	Nashville stage - 49.14
	600	Nashville stage - 48.75
	700	LRD exchanged data with TVA
	701	LRN WM observed data sent to NWS
	715	LRD exchanged data with LMRFC
	730	LRD exchanged data with LRN
	800	WFO Nashville morning data received by LRN WM

Date	Time (CDT)	Event
5-May	0828	TN USGS sent LRN email asking if they needed the USGS to place a "Rapid Deployment Gage" at Kingston Springs.
	830	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	1200	Nashville stage - 48.48
	1330	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	1800	Nashville stage - 47.63
6-May	0	Nashville stage - 46.08
	600	Nashville stage - 43.53
	700	LRD exchanged data with TVA
	715	LRD exchanged data with LMRFC
	730	LRD exchanged data with LRN
	746	LRN WM observed data sent to NWS
	800	WFC Nashville morning data received by LRN WM
	830	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	1200	Nashville stage - 40.6
	1330	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	1431	LRN WM forecast data sent to NWS
	1800	Nashville stage - 37.92
7-May	0	Nashville stage - 35.73
	600	Nashville stage - 34.1
	700	LRD exchanged data with TVA

Date	Time (CDT)	Event
7-May	715	LRD exchanged data with LMRFC
	730	LRD exchanged data with LRN
	731	LRN WM observed data sent to NWS
	800	WFC Nashville morning data received by LRN WM
	830	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	1200	Nashville stage - 32.51
	1316	LRN WM forecast data sent to NWS
	1800	Nashville stage - 31.33
8-May	0	Nashville stage - 30.24
	600	Nashville stage - 29.43
	700	LRD exchanged data with TVA
	715	LRD exchanged data with LMRFC
	730	LRD exchanged data with LRN
	800	WFC Nashville morning data received by LRN WM
	830	Conference call between LRN WM, LRD WM, and OHRFC to discuss present operating plan.
	916	LRN WM observed data sent to NWS
	1200	Nashville stage - 28.48
	1316	LRN WM forecast data sent to NWS
	1800	Nashville stage - 27.80
	2400	Nashville stage - 27.45

Appendix D – National Weather Service Timeline of Events

National Weather Service Timeline

(All times CDT)

Event timeline for the Ohio River Forecast Center (OHRFC) and the Nashville Weather Forecast Office (WFO). This timeline was provided by the OHRFC and NWFO.

- Apr. 26…Enhanced situational awareness began internal to OHRFC Monday
- Apr 27…WFO Nashville issued first Hazardous Weather Outlook that mentions heavy rain and strong storms
- Apr. 28…OHRFC issued CRWHMDTIR highlighting weekend flood threat
- Apr. 28…OHRFC sent email coordinating flood risk to Cumberland and Lower Ohio Valley for the weekend with Corps LRD.
- Apr. 29…OHRFC issued CRWHMDTIR highlighting dramatically increasing flood threat for the weekend.
- Apr 29…WFO Nashville issued Hydrologic Outlook for potential heavy rain and flooding (a.m. and p.m.)
- Apr. 29…OHRFC participated in coordination via conference calls beginning Thursday with the Corps LRD. Corps LRD was briefed to expect widespread 3-5 inches but could not rule out 9-10 inches some places.
- Apr. 29…OHRFC coordinated contingency forecast of near 400,000 cfs flows for Lower Ohio Smithland 7-8 days out and possible 100,000-200,000 cfs outflows from Lower Cumberland River near Clarksville to Corps LRD.
- Apr. 29…OHRFC coordinated contingency forecast near 400,000 cfs flows to LMRFC for Lower Ohio Smithland flows for 7-8 days out.
- Apr. 29…OHRFC sent coordinated email alert to Customer Advisory Board on fixing an issue with GFS MMEFS and risk of flooding to Kentucky and Tennessee. This included 19 partners such as FEMA Region IV, TEMA, and Corps LRD.

- Apr 30, 5am…WFO Nashville re-issues Hydrologic Outlook for potential heavy rain and flooding.
- Apr. 30…OHRFC issued CRWHMDTIR with a headline of flood threat. In addition, highlighted potential for moderate to major flood threat.
- Apr. 30, 10am…OHRFC issued Flood Potential Outlook product for at least 30% chance of moderate to major flood potential in Nashville.
- Apr. 30…OHRFC produced an operational 72-hour QPF. Issued 3-4 inches of QPF for Nashville and just upstream. Hydrometeorological Prediction Center (HPC) had 5 inches. Coordinated this to WFO Nashville.
- Apr. 30…OHRFC coordinated with partners via Hydrologic Alert Message. This alerted them to at least moderate flood potential in Kentucky and Tennessee. Partners included FEMA Region IV, USGS all offices, USGS national flood coordinator, WFOs, Lower Mississippi RFC, TEMA.
- Apr 30, 130pm…WFO Nashville sent e-mail briefing to EMAs and TEMA
- Apr. 30, 330pm…WFO Nashville issued Flash Flood Watch for Saturday morning thru Monday morning (Sunday focus)
- May 1…OHRFC 24-hour operations began.
- May 1…OHRFC issued 48-hour QPF – one of the biggest non-tropical QPF known to be issued by OHRFC. OHRFC issued over 6 inches in Nashville area. This was coordinated with WFOs.
- May 1, 8am…WFO Nashville updated Flash Flood Watch to 2-4 inches with locally 8 inches
- May 1, 8am…OHRFC sent urgent e-mail about the SREF MMEFS to WFOs including Nashville and Corps LRD as follows. (WFOs and Corps LRD have access to all MMEFS products):
- "Please take the attached results very seriously. The model trends have been consistent. We are looking at a significant potential for Major Flooding. The OHRFC will be staffed 24-hrs from now through Monday morning, with increased weekend day and evening staffing as well."
- May 1, 830am…OHRFC participated in conference call with Corps led by Corps LRD
- May 1, 950am…WFO Nashville issued Flood Advisory for Metro Nashville and most neighboring counties specifically addressing Mill Creek and Whites Creek
- May 1, 1102am…WFO Nashville issued Flood Watch for rivers
- May 1, 1145am…Flash Flood Watch updated to 4-6 inches, locally 12 inches

- May 1, 1239pm…WFO Nashville issued first Flood Warning for Mill Creek
- May 1, 1pm…OHRFC coordinated with partners via Hydrologic Alert Message. Upgraded threat to major flooding in parts of Tennessee and Kentucky. Sent to FEMA Region IV, TEMA, USGS, Corps and 167 partners e-mail addresses
- May 1, 230pm…WFO Nashville conducted update webinar via GoToMeeting for EMAs and TEMA
- May 1, Approx. 315pm…WFO Nashville issued Flood Warning for most rivers in west and northwest Middle TN plus Areal Flood Warning for much of mid-state (valid 24 hours)
- May 1, 343pm…WFO Nashville upgraded Mill Creek Flood Warning to moderate flooding (major flooding now forecast)
- May 1, 547pm…WFO Nashville issued Civil Emergency Message at request of Nashville OEM to urge Davidson County citizens to stay off roads
- May 1, 630pm…WFO Nashville briefed OEM and Mayor on potential for much more rain on Sunday
- May 1, 640pm…WFO Nashville re-issued Civil Emergency Message to urge drivers to stay off roads
- May 1, 7:45pm…WFO Nashville briefed OEM regarding break in the rain overnight
- May 1, 9pm…OHRFC coordinated with partners via Hydrologic Alert Message. Upgraded threat to major and record flood risk in Tennessee and Kentucky at 10 pm. Sent to the FEMA Region IV 24-hour watch center, TEMA, USGS, Corps and 167 partner e-mail addresses.
- May 1, 10pm…OHRFC unsuccessfully tried to contact Corps Nashville to get updated flow forecast.
- May 1, 1157pm…WFO Nashville re-issued Civil Emergency Message to discourage drivers
- May 2, Midnight…OHRFC called WFO Nashville and told them Nashville would probably make flood stage.
- May 2, 3am…OHRFC issued forecast for Nashville just below flood stage. Based on estimated model simulations, with no input available from Corps' releases.
- May 2, 416am…Corps Great Lakes and Ohio Division relayed an e-mail to OHRFC from Corps Nashville originally issued at 808pm Saturday night (5/1) stating Corps Nashville will try and hold 40-42 feet at Nashville based on Corps Nashville model runs (e-mail not read until 7 am).

- May 2, 5am…OHRFC held internal discussion on Nashville. Midnight shift told day shift it was imperative to get a hold of Corps Nashville. Model runs with no QPF produced 40 feet (flood stage) at Nashville, with 54 feet modeled using full QPF and ignoring Corps' reservoir release forecasts.
- May 2, OHRFC tried unsuccessfully to call Corps Nashville before 6 am and again shortly after 6 am. Contacted Corps LRD to see how we can contact them. We were told they will be in around 715 am CDT.
- May 2, 636am…WFO Nashville issued Flood Advisory for Cumberland River at Nashville
- May 2, approx. 715am…WFO Nashville coordinated with OHRFC and USGS about gage outage
- May 2, 812am…WFO Nashville coordinated with OHRFC
- May 2, 830am…WFO Nashville sent e-mail briefing to all EMAs and TEMA
- May 2, OHRFC coordinated with Corps Ohio River Division and Nashville and WFOs via phone/conference calls
- May 2, during first conference call at 830am, Corps Nashville asked OHRFC for QPF. OHRFC said at least 3-4 inches of rain Nashville and east (upstream). OHRFC informed Corps Nashville that OHRFC forecast would be dependent on Corps' release forecast. Coordinated 41.9 feet forecast with WFO Nashville.
- May 2, 930am…WFO Nashville briefed OEM and Mayor's Office
- May 2, 950am…WFO Nashville issued first Flood Warning for Cumberland River at Nashville (42 foot crest this eve)
- May 2, 1008am…WFO Nashville coordinated with USGS about gage outages
- May 2, 1042am…WFO Nashville issued Civil Emergency Message for West/Middle TN based on request by TEMA
- May 2, 1043am…WFO Nashville coordinated with OHRFC
- May 2, 1118am…WFO Nashville updated Flood Warning for Cumberland River at Nashville (possible major flooding at 45 feet tonight)
- May 2, 1125am…WFO Nashville issued Flood Warning for Metro creeks
- May 2, 1145am…WFO Nashville coordinated with OHRFC
- May 2, 1157am…WFO Nashville issued Civil Emergency Message for Hickman County at request of County Mayor (drivers, shelters, communication outage)

- May 2, 130pm…Corps LRD and Corps Nashville coordination call. Corps' reports 124,000 cfs out of Old Hickory and could go to 130,000-140,000 cfs. This was used to issue 337pm update of 48 feet after midnight or 3 feet above major flood stage at Nashville.
- May 2, 130pm…LRD WM called the NWS OHRFC staff to inform them of the Kentucky and Barkley release schedules and asked them to coordinate with the Paducah Weather Forecast Office to issue the necessary warnings. The NWS OHRFC asked LRD WM to call the Paducah WFO staff directly to apprise them of Lake Barkley's release schedule to ensure the information was correctly conveyed. LRD WM called the Paducah WFO and communicated the release schedule and the expected rapidly changing conditions below the dam. LRD WM requested that the Paducah WFO issue the appropriate public advisories and warnings.
- May 2, 419pm…WFO Nashville updated Flood Warning for Cumberland River at Nashville
- May 2, 436pm…WFO Nashville relayed Nashville forecast to OEM
- May 2, 443pm…WFO Nashville relayed Nashville forecast to Corps. Corps now fairly confident they can hold at 150,000 cfs.
- May 2, 510pm…WFO Nashville coordinated with OEM
- May 2, 527pm…WFO Nashville issued Area Flood Warning for most of Middle TN for 24 hours
- May 2, 628pm…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 46 feet (forecast 48 feet after midnight)
- May 2, 739pm…OEM calls WFO Nashville asking about 2-3 foot rise in Cumberland River
- May 2, 743pm…WFO Nashville called Corps
- May 2, 746pm…WFO Nashville coordinated with OHRFC
- May 2, 750pm…Corps returns call; states that Percy Priest increased from 5,000 cfs to 10,000 cfs; cuts anticipated at Old Hickory Dam but flow is currently 150,000 cfs
- May 2, 628pm…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 46 feet (forecast 48 feet after midnight)
- May 2, 739pm…OEM calls WFO Nashville asking about 2-3 foot rise in Cumberland River
- May 2, 743pm…WFO Nashville called Corps
- May 2, 746pm…WFO Nashville coordinated with OHRFC

- May 2, 750pm…Corps returns call; states that Percy Priest increased from 5,000 cfs to 10,000 cfs; cuts anticipated at Old Hickory Dam but flow is currently 150,000 cfs
- May 2, 800pm…WFO Nashville passed Corps info to OEM
- May 2, 804pm…WFO Nashville informed OHRFC of call they had with Corps Nashville that Percy Priest went from 5,000 cfs to 10,000 cfs for about an hour but would cut back to 0 cfs at 9 pm. OHRFC asked about Old Hickory and what information WFO Nashville had. WFO Nashville said Old Hickory now at 150,000 cfs.
- May 2, At 926 pm…OHRFC issued 50.3 feet for Nashville based on information relayed from WFO Nashville.
- May 2, 1000pm…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 48 feet and heading for 50.3 feet early May 3 afternoon
- May 2, 1047pm…OHRFC looked at situation in Cumberland and prioritized forecasts at Clarksville, Carthage, and Nashville. Updated Clarksville to around 57 feet. Model generated 44.5 feet at Kingston Springs and issued this too. Coordinated this with WFO Nashville.
- May 2, just before 11pm…OHRFC called WFO Nashville. WFO Nashville did not have any updates from Corps Nashville. WFO Nashville did say sand-bagging not working in Nashville.
- May 2, around 11pm…OHRFC called Corps Nashville and told them situation has gone from bad to very serious. Needed flow forecasts for projects so OHRFC can put out the best forecast. OHRFC asked what Old Hickory was doing. Corps Nashville stated Old Hickory went to 220,000 cfs but that was a ballpark number as they were above the gate ratings. Use as an estimate. Said they will get back with us shortly.
- May 3, 1200am…Corps Nashville called the OHRFC and reported that they were having trouble contacting Old Hickory and would call back shortly.
- May 3, 1220am…Corps Nashville called OHRFC back. Cordell Hull opened up to 90,000 cfs. Confirmed that Old Hickory was at approximately 220,000 cfs going down to no lower than 175,000 cfs and being lowered by 5,000 cfs per hour.
- May 3, 1am…OHRFC updated Carthage to 43 feet from 39 feet. Coordinated with WFO Nashville.
- May 3, 1am…OHRFC updated all processors and quality controlled rainfall for 1am operational run before doing Nashville forecast to get a final stage.
- May 3, 0130am…Corps Nashville called the OHRFC and provided update on Old Hickory.
- May 3, 245am…OHRFC coordinated with WFO Nashville on 51.5 feet at Nashville. (Crested 14 hours later at 51.86 feet).

- May 3, 300am…OHRFC issued 51.5 feet for Nashville based on latest flow forecasts.
- May 3, 402am…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 50.4 feet and heading for 51.5 feet early this afternoon
- May 3, 649am…WFO Nashville coordinates with OHRFC
- May 3, 725am…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 50.7 feet and heading for 51.5 feet early this afternoon
- May 3, 830am…OHRFC participated in conference call with Corps LRD and Nashville. Kept 51.5 feet.
- May 3, 9am…OHRFC coordinated with partners via Hydrologic Alert Message - major to record flooding alert sent.
- May 3, 920am…WFO Nashville coordinates with OHRFC
- May 3, 1030am…WFO Nashville conducts update webinar via GoToMeeting for EMAs and TEMA
- May 3, 1030am…OHRFC participated in conference call with WFO Nashville and TEMA
- May 3, 1101am…WFO Nashville briefs TEMA Regional Director about Cheatham Dam river levels
- May 3, 1230pm…OHRFC and WFO Nashville participated in conference call with Corps Nashville and OEM
- May 3, 1240pm…WFO Nashville briefs TEMA Regional Director about Cheatham Dam river levels
- May 3, 130pm…OHRFC participated in conference call with Corps LRD, Corps Nashville, WFO Nashville.
- May 3. 145pm…OHRFC updated Nashville slightly to 52 feet by evening. Coordinated this with WFO Nashville.
- May 3, 145pm…OHRFC hosted conference call with City of Nashville OEM, Nashville Mayor's Office – Deputy Mayor, TEMA, WFO Nashville, and Corps LRD. Told them NWS forecast crest for Nashville is 52 feet. Gave them the range of uncertainty of 51.5 to 52.5 feet but really thought 52 feet would hold. Actual crest was 51.86 feet.
- May 3, 230pm…OHRFC participated in coordination call with Corps Nashville. Asked if there was anything else they could do with Percy Priest to hold the 52 feet at Nashville.
- May 3, 335pm...WFO Nashville issued Civil Emergency Message for TEMA (drivers, roadblocks, wastewater, drinking water concerns)

- May 3, 342pm…WFO Nashville issued Flood Statement... Cumberland River at Nashville now at 51.6 feet and heading for 52 feet this evening
- May 3, 630 pm…OHRFC participated in coordination call with Corps Nashville. Nashville crested at 6pm.
- May 3, 819pm…WFO Nashville coordinates with OHRFC
- May 3, 825pm…WFO Nashville coordinates with Corps
- May 4, 700am…WFO Nashville issued Flood Statement... Cumberland River at Nashville crested last night, now at 50.5 feet and falling; will stay above flood stage until early Wednesday (May 5)
- May 4, 845am…OHRFC participated in conference call with Corps LRD and Nashville. Also coordinated near 600,000 cfs out of Lower Ohio River at Smithland.
- May 4, 1030am…OHRFC participated in conference call with Nashville Metro Water, Fire, Mayor's Office, OEM, TEMA and WFO Nashville. Stated our forecast based on NWS/Corps' coordination is for a slow fall below 48 feet Wednesday at Nashville and 40 feet Thursday. Contingent on Corps' release.
- May 4, 1pm…OHRFC issued another Hydrologic Alert Message updating major to record flooding downstream of Nashville.
- May 5…OHRFC participated in Corps' conference calls 830 am and 130 pm.
- May 6…OHRFC participated in Corps' conference calls 830 am and 130 pm.
- May 7…OHRFC participated in Corps' conference call 830 am
- May 8…OHRFC participated in Corps' conference call 830 am

Appendix E – Project and Gage Plots

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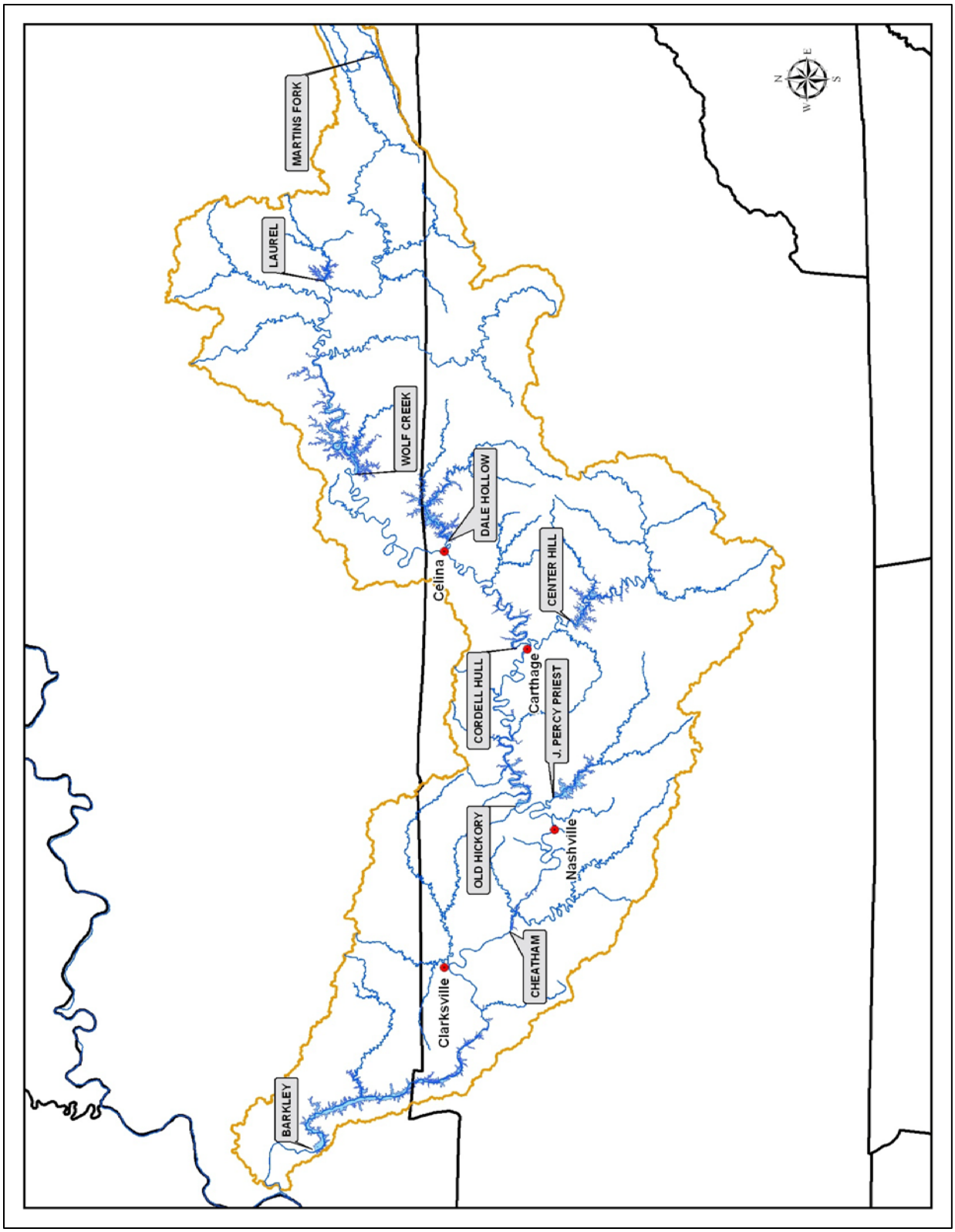
MARTINS FORK
LAUREL
WOLF CREEK
DALE HOLLOW
Celina
CENTER HILL
CORDELL HULL
Carthage
J. PERCY PRIEST
OLD HICKORY
Nashville
CHEATHAM
Clarksville
BARKLEY
N
E
S
W

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Project Headwater and Discharge Plots

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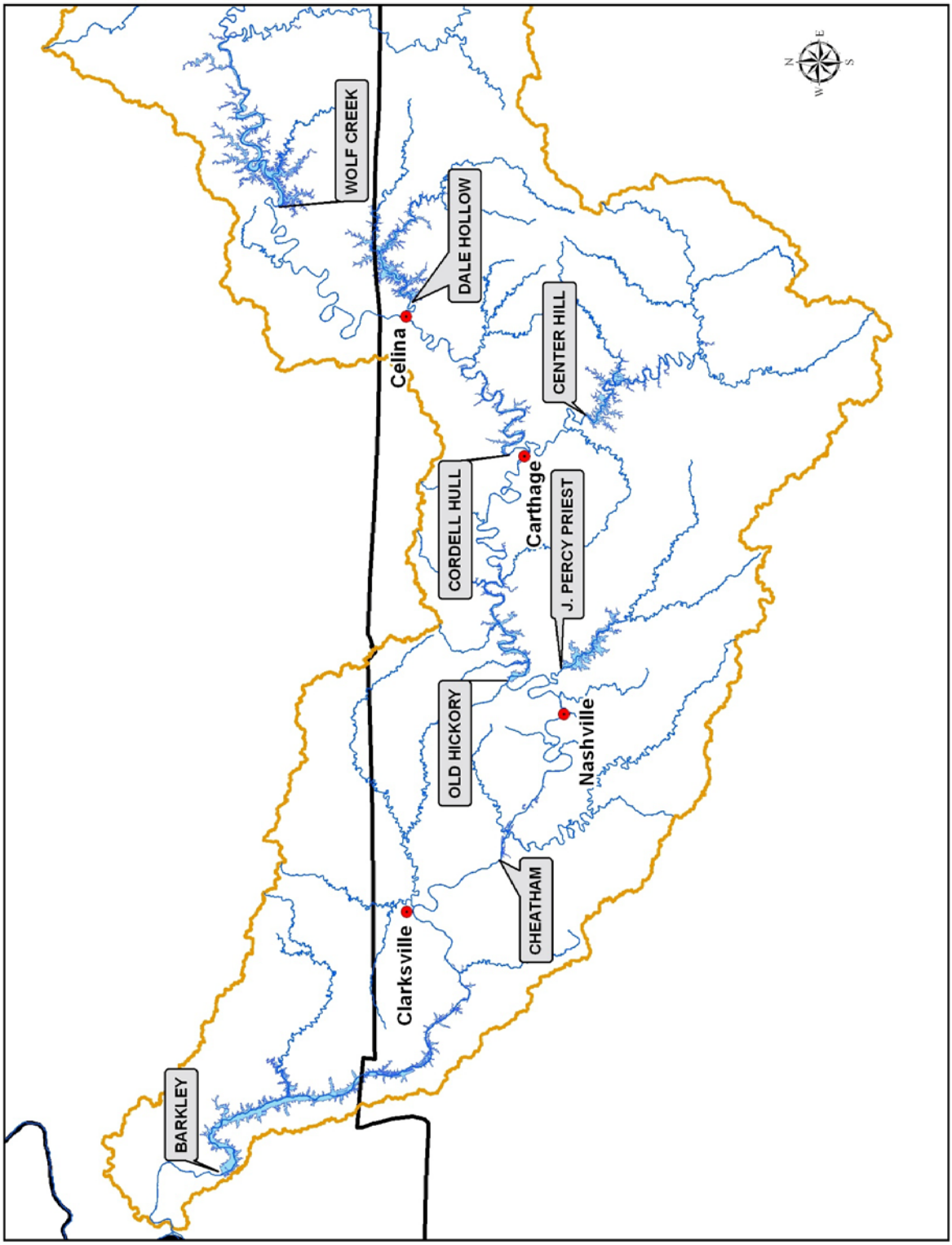
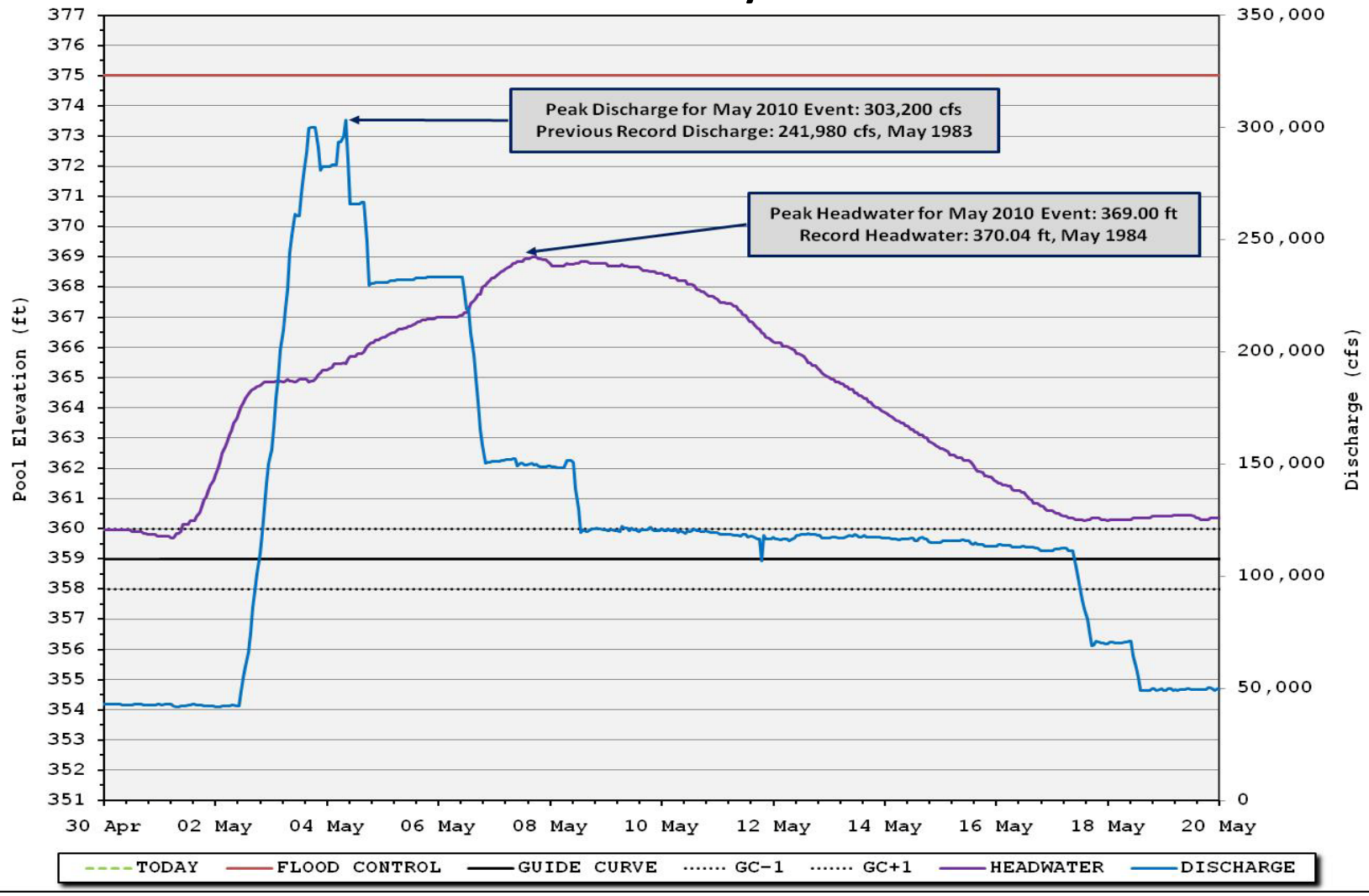
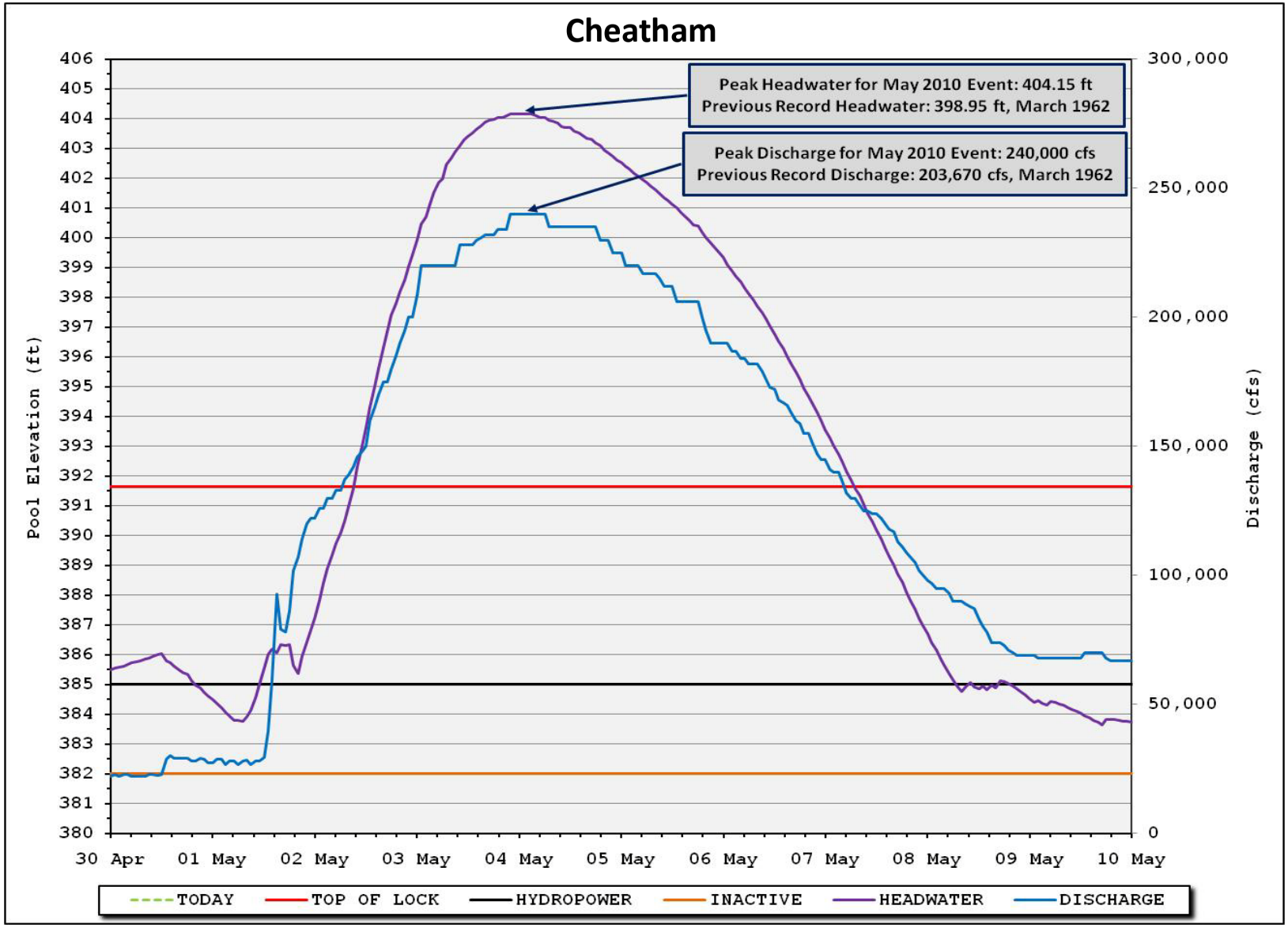
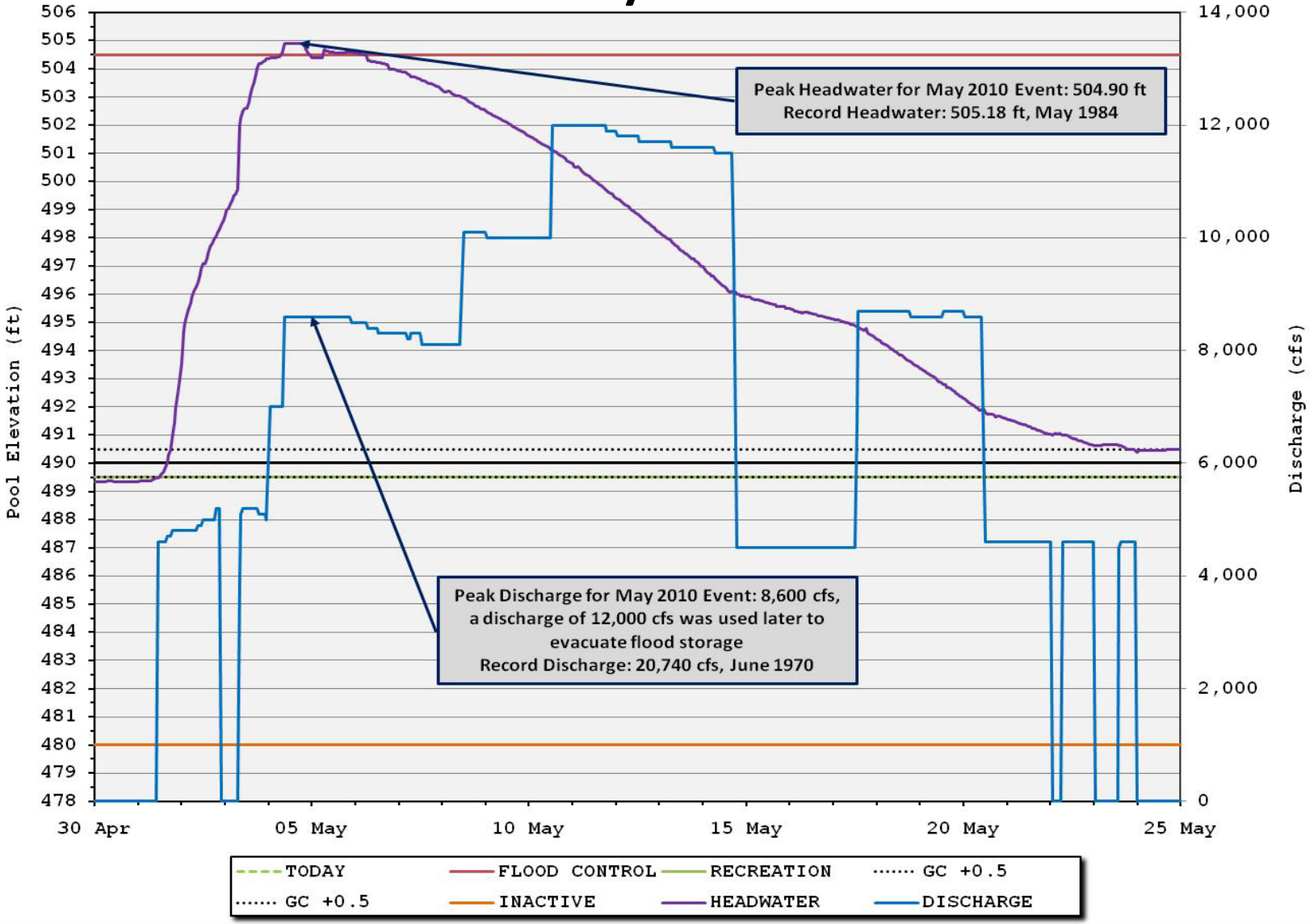

WOLF CREEK
DALE HOLLOW
Celina
CENTER HILL
CORDELL HULL
Carthage
J. PERCY PRIEST
OLD HICKORY
Nashville
CHEATHAM
Clarksville
BARKLEY
N
E
S
W

Barkley

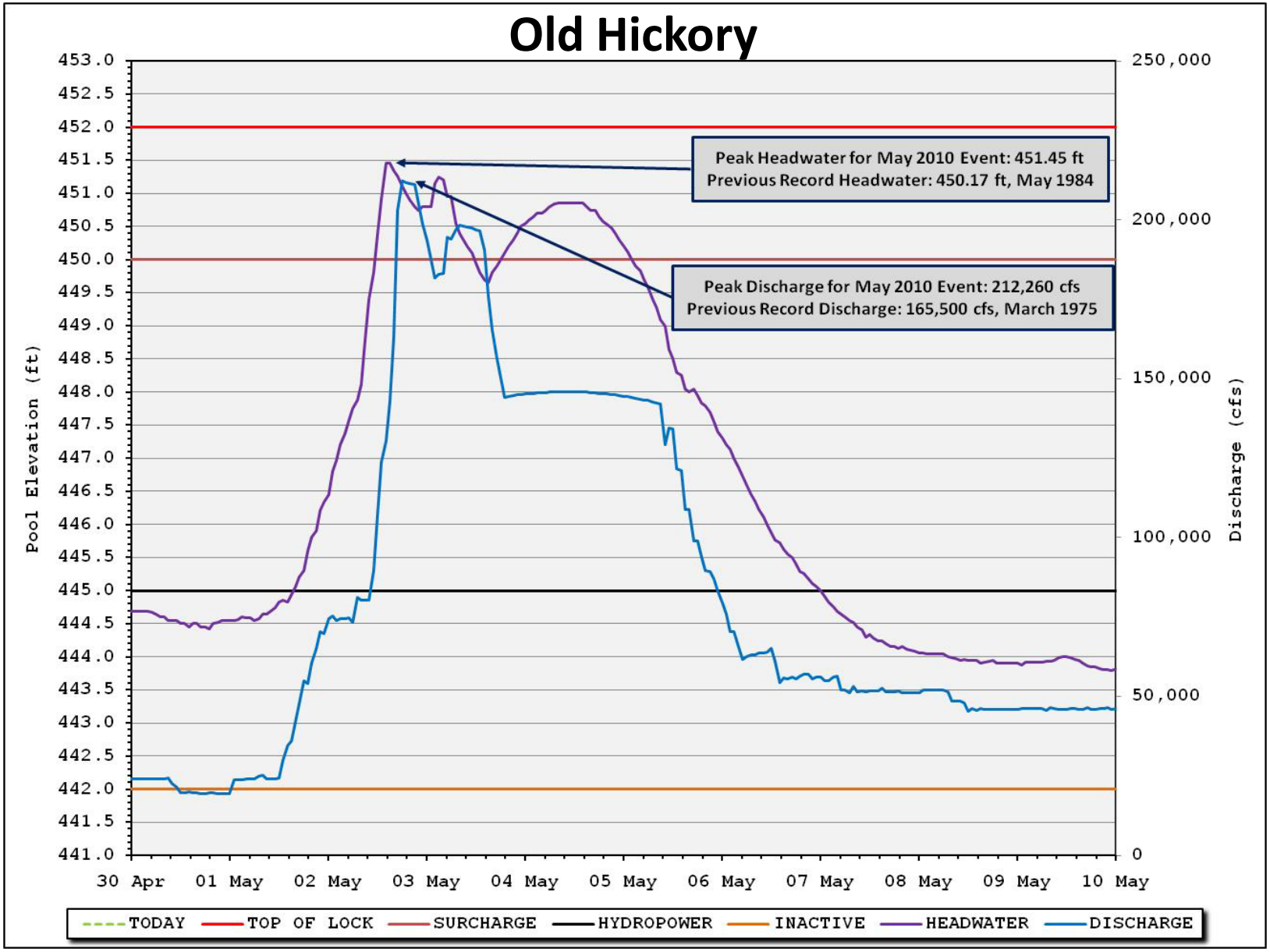

Peak Discharge for May 2010 Event: 303,200 cfs
Previous Record Discharge: 241,980 cfs, May 1983
Peak Headwater for May 2010 Event: 369.00 ft
Record Headwater: 370.04 ft, May 1984
Pool Elevation (ft)
Discharge (cfs)
377
376
375
374
373
372
371
370
369
368
367
366
365
364
363
362
361
360
359
358
357
356
355
354
353
352
351
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
30 Apr
02 May
04 May
06 May
08 May
10 May
12 May
14 May
16 May
18 May
20 May
TODAY
FLOOD CONTROL
GUIDE CURVE
GC-1
GC+1
HEADWATER
DISCHARGE


Cheatham
Peak Headwater for May 2010 Event: 404.15 ft
Previous Record Headwater: 398.95 ft, March 1962
Peak Discharge for May 2010 Event: 240,000 cfs
Previous Record Discharge: 203,670 cfs, March 1962
Pool Elevation (ft)
Discharge (cfs)
406
405
404
403
402
401
400
399
398
397
396
395
394
393
392
391
390
389
388
387
386
385
384
383
382
381
380
300,000
250,000
200,000
150,000
100,000
50,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
TODAY
TOP OF LOCK
HYDROPOWER
INACTIVE
HEADWATER
DISCHARGE

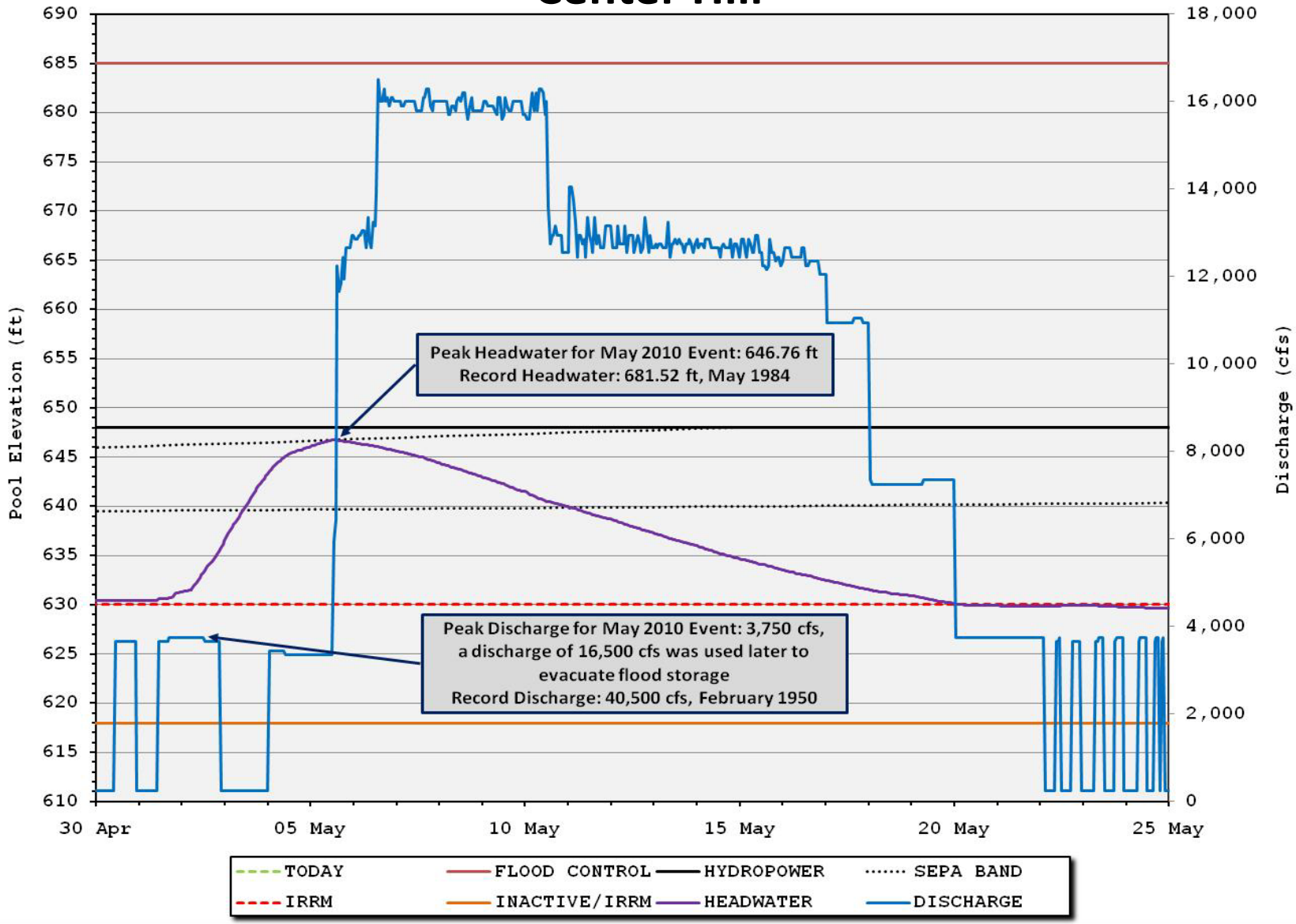
J. Percy Priest



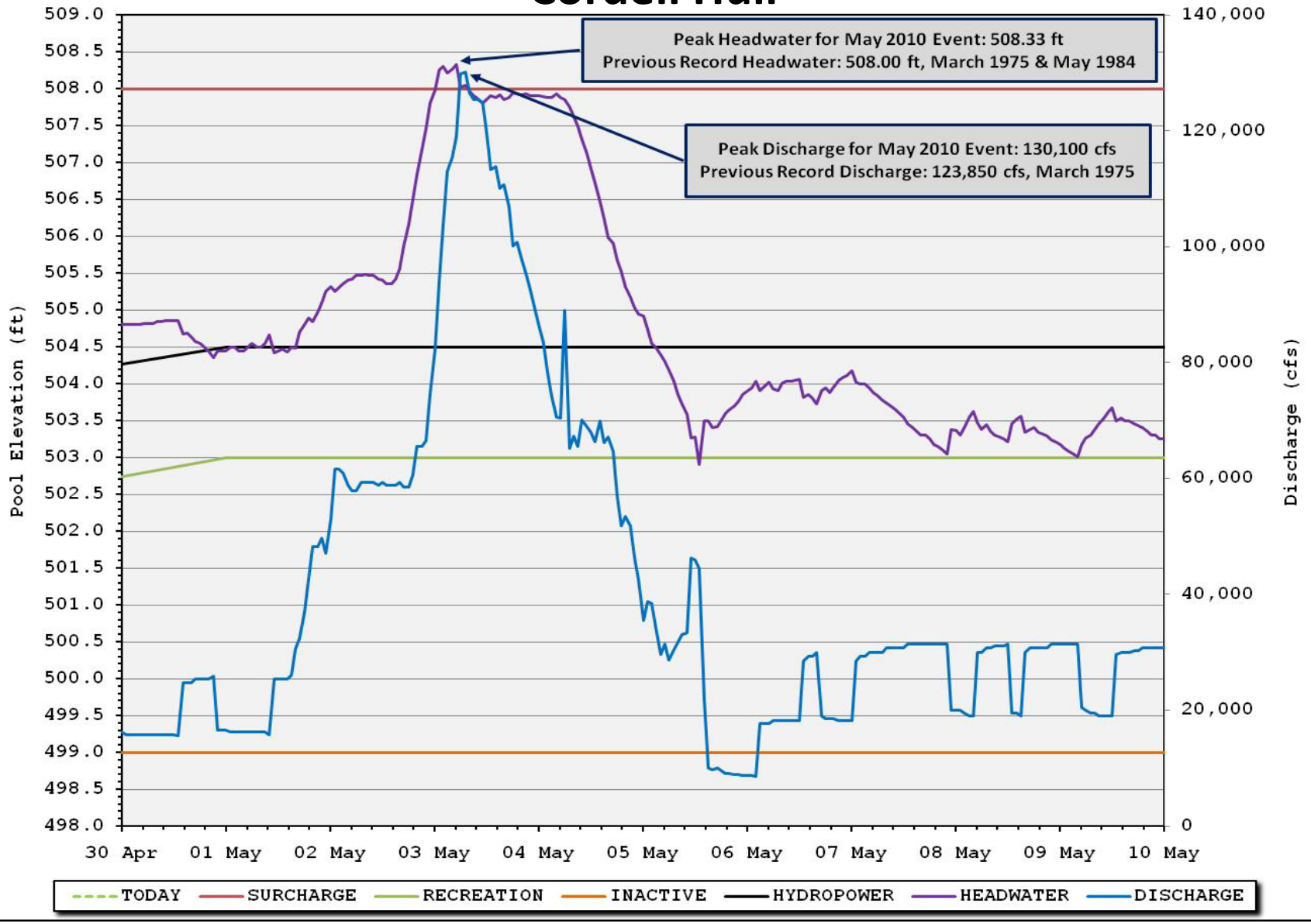
Old Hickory


Peak Headwater for May 2010 Event: 451.45 ft
Previous Record Headwater: 450.17 ft, May 1984
Peak Discharge for May 2010 Event: 212,260 cfs
Previous Record Discharge: 165,500 cfs, March 1975
Pool Elevation (ft)
Discharge (cfs)
453.0
452.5
452.0
451.5
451.0
450.5
450.0
449.5
449.0
448.5
448.0
447.5
447.0
446.5
446.0
445.5
445.0
444.5
444.0
443.5
443.0
442.5
442.0
441.5
441.0
250,000
200,000
150,000
100,000
50,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
TODAY
TOP OF LOCK
SURCHARGE
HYDROPOWER
INACTIVE
HEADWATER
DISCHARGE

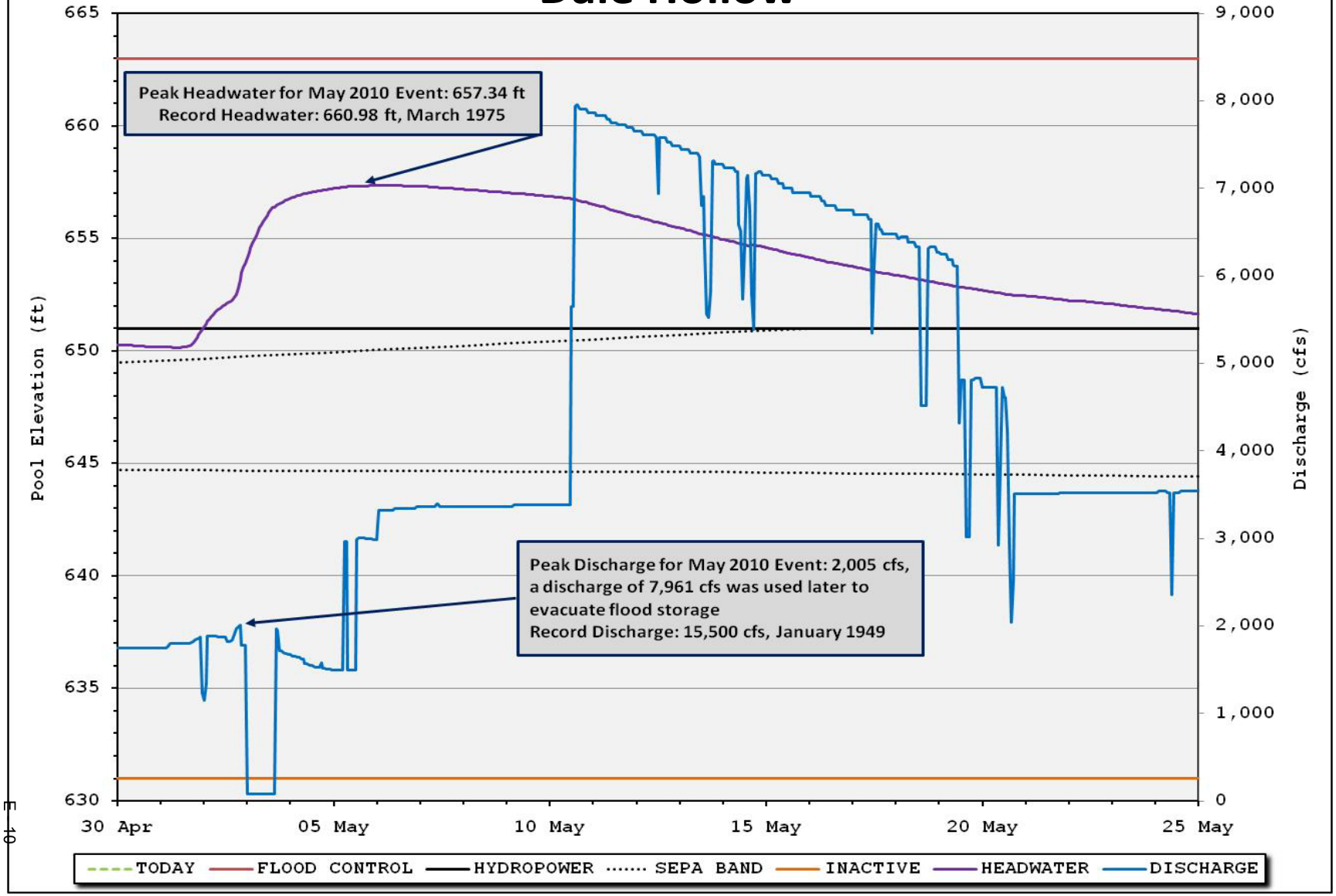
Center Hill


Pool Elevation (ft)
690
685
680
675
670
665
660
655
650
645
640
635
630
625
620
615
610
Discharge (cfs)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
30 Apr
05 May
10 May
15 May
20 May
25 May
Peak Headwater for May 2010 Event: 646.76 ft
Record Headwater: 681.52 ft, May 1984
Peak Discharge for May 2010 Event: 3,750 cfs,
a discharge of 16,500 cfs was used later to
evacuate flood storage
Record Discharge: 40,500 cfs, February 1950
TODAY
FLOOD CONTROL
HYDROPOWER
SEPA BAND
IRRM
INACTIVE/IRRM
HEADWATER
DISCHARGE

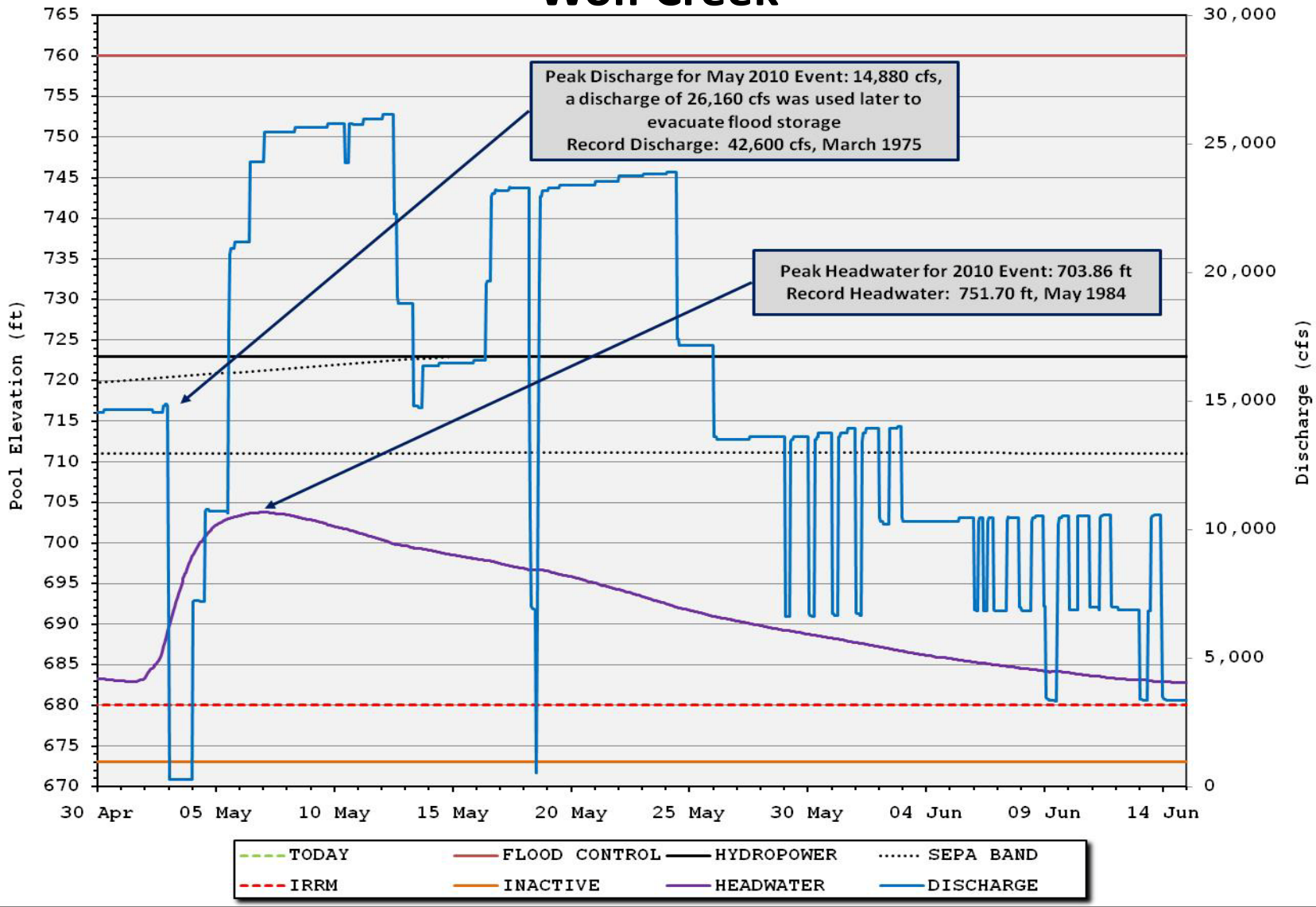
Cordell Hull



Dale Hollow


Peak Headwater for May 2010 Event: 657.34 ft
Record Headwater: 660.98 ft, March 1975
Peak Discharge for May 2010 Event: 2,005 cfs, a discharge of 7,961 cfs was used later to evacuate flood storage
Record Discharge: 15,500 cfs, January 1949
Pool Elevation (ft)
Discharge (cfs)
665
660
655
650
645
640
635
630
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
30 Apr
05 May
10 May
15 May
20 May
25 May
TODAY
FLOOD CONTROL
HYDROPOWER
SEPA BAND
INACTIVE
HEADWATER
DISCHARGE

Wolf Creek


Peak Discharge for May 2010 Event: 14,880 cfs, a discharge of 26,160 cfs was used later to evacuate flood storage
Record Discharge: 42,600 cfs, March 1975
Peak Headwater for 2010 Event: 703.86 ft
Record Headwater: 751.70 ft, May 1984
Pool Elevation (ft)
765
760
755
750
745
740
735
730
725
720
715
710
705
700
695
690
685
680
675
670
Discharge (cfs)
30,000
25,000
20,000
15,000
10,000
5,000
0
30 Apr
05 May
10 May
15 May
20 May
25 May
30 May
04 Jun
09 Jun
14 Jun
TODAY
FLOOD CONTROL
HYDROPOWER
SEPA BAND
IRRM
INACTIVE
HEADWATER
DISCHARGE

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Project Tailwater Plots

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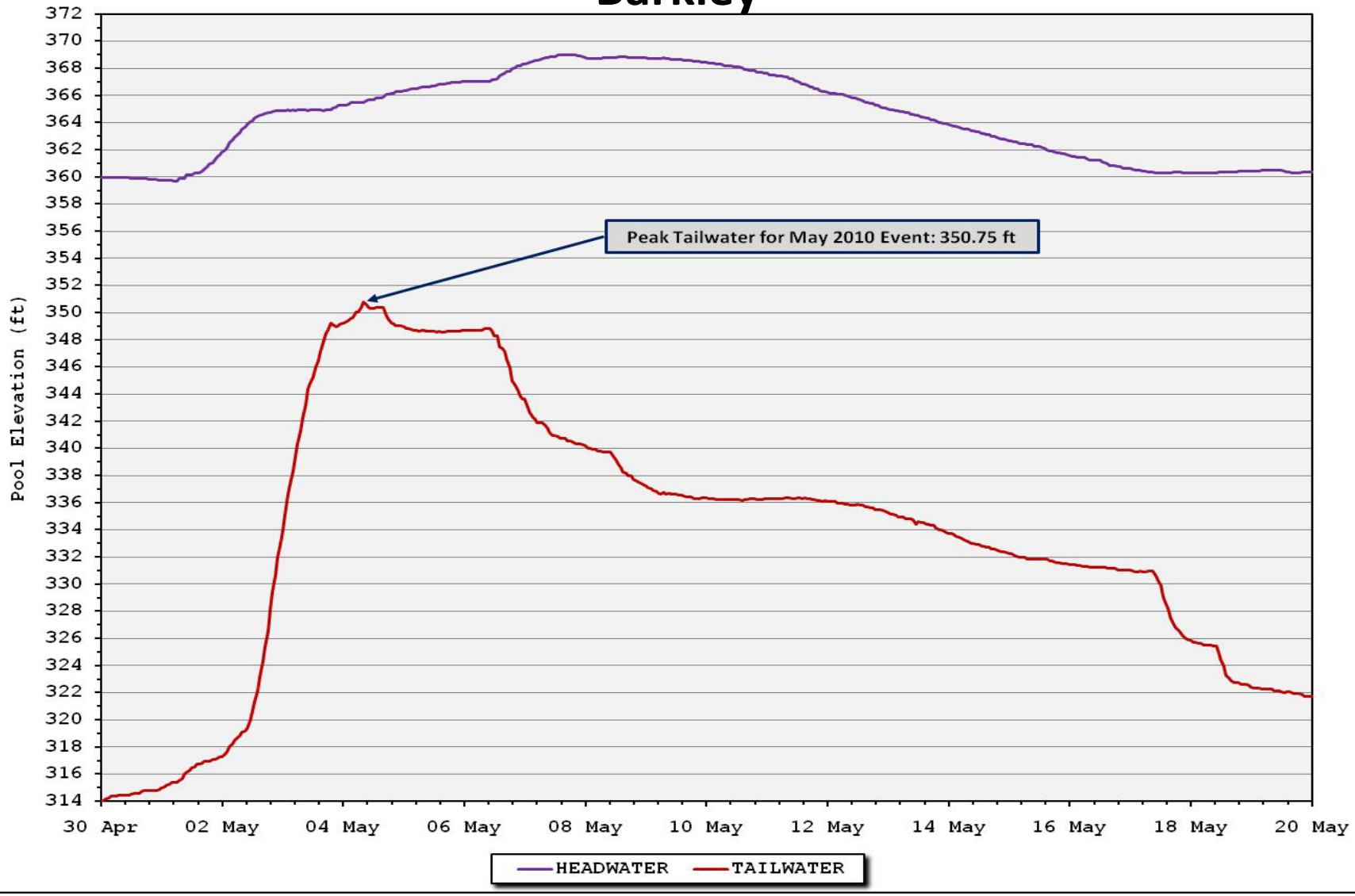
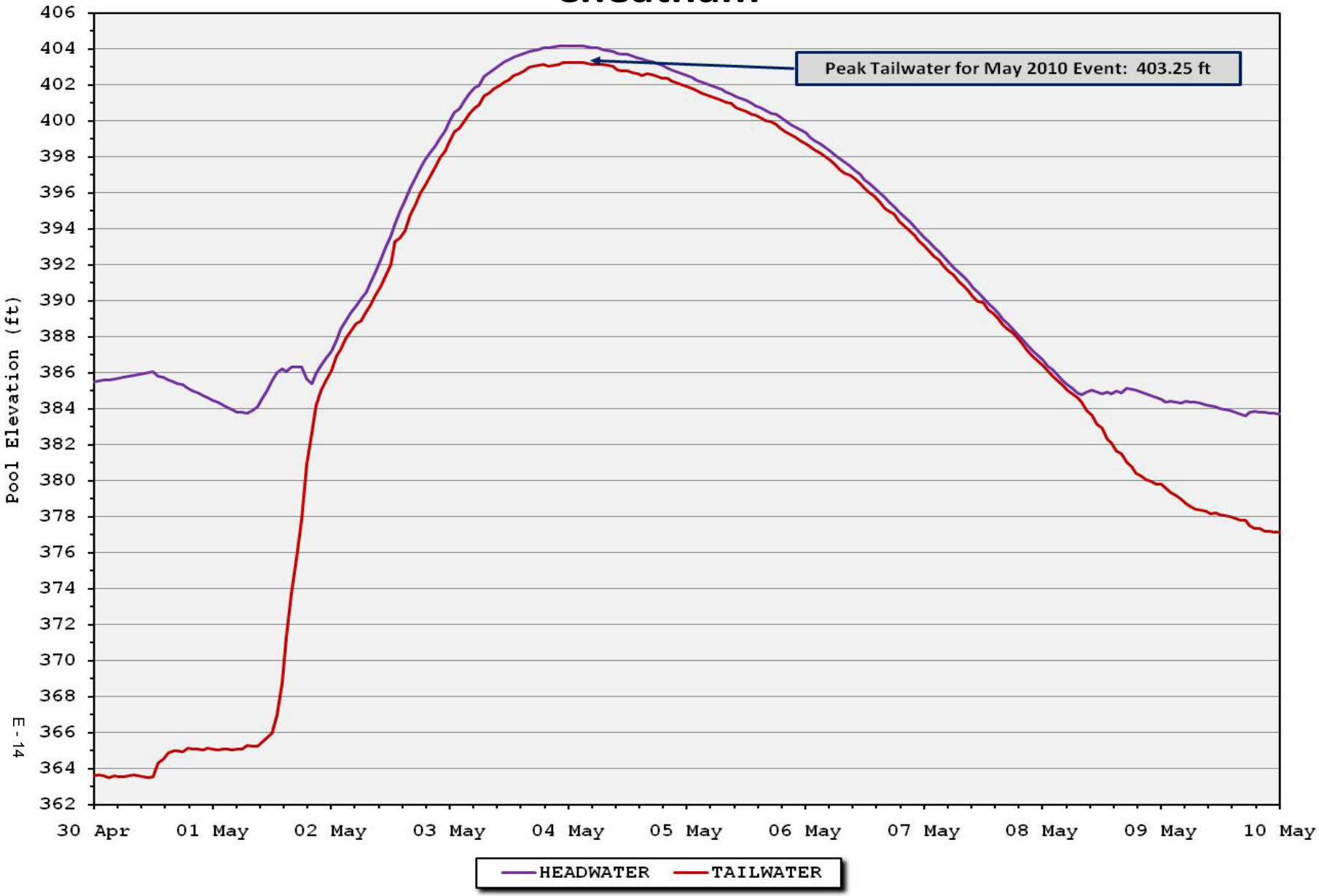
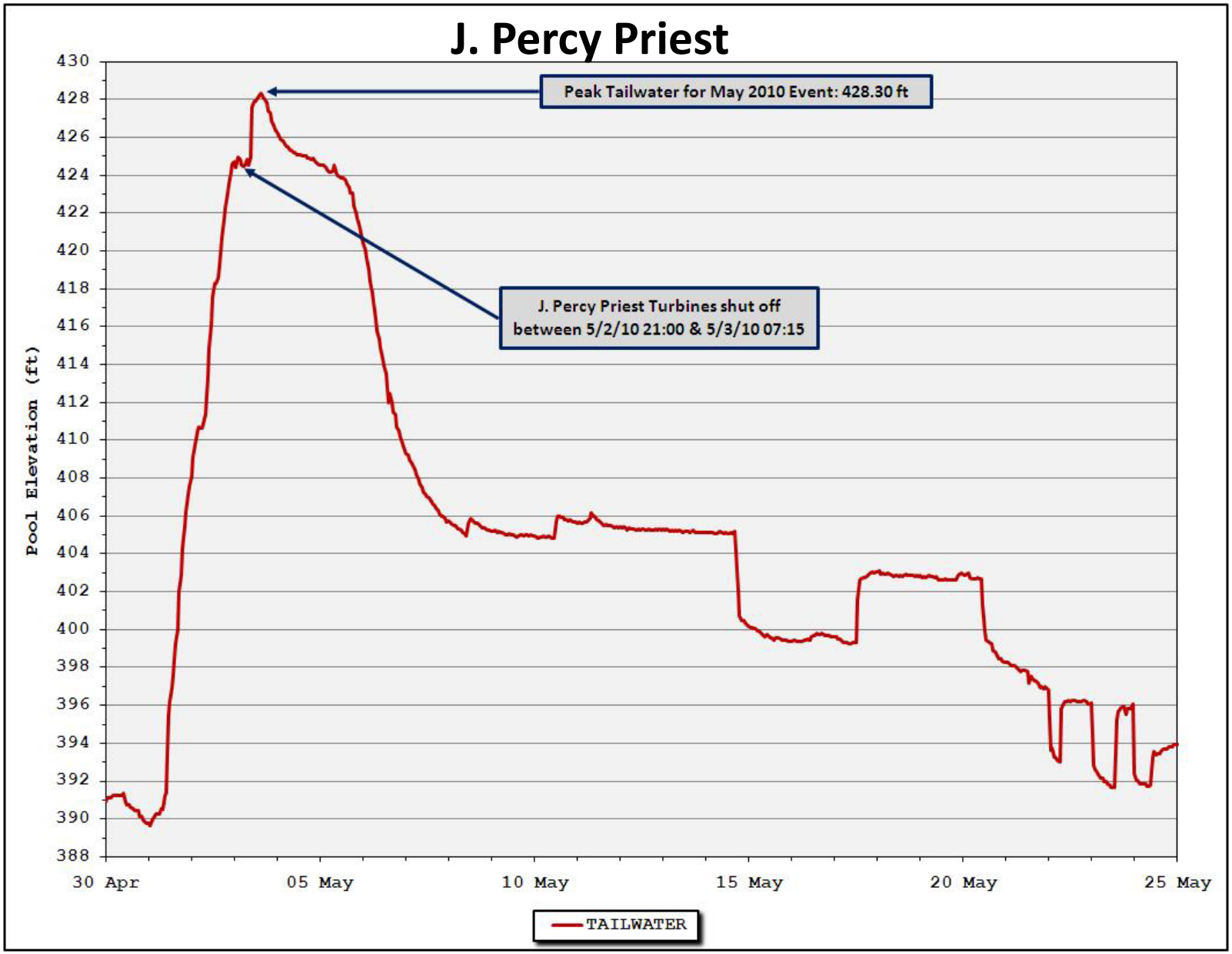
Barkley

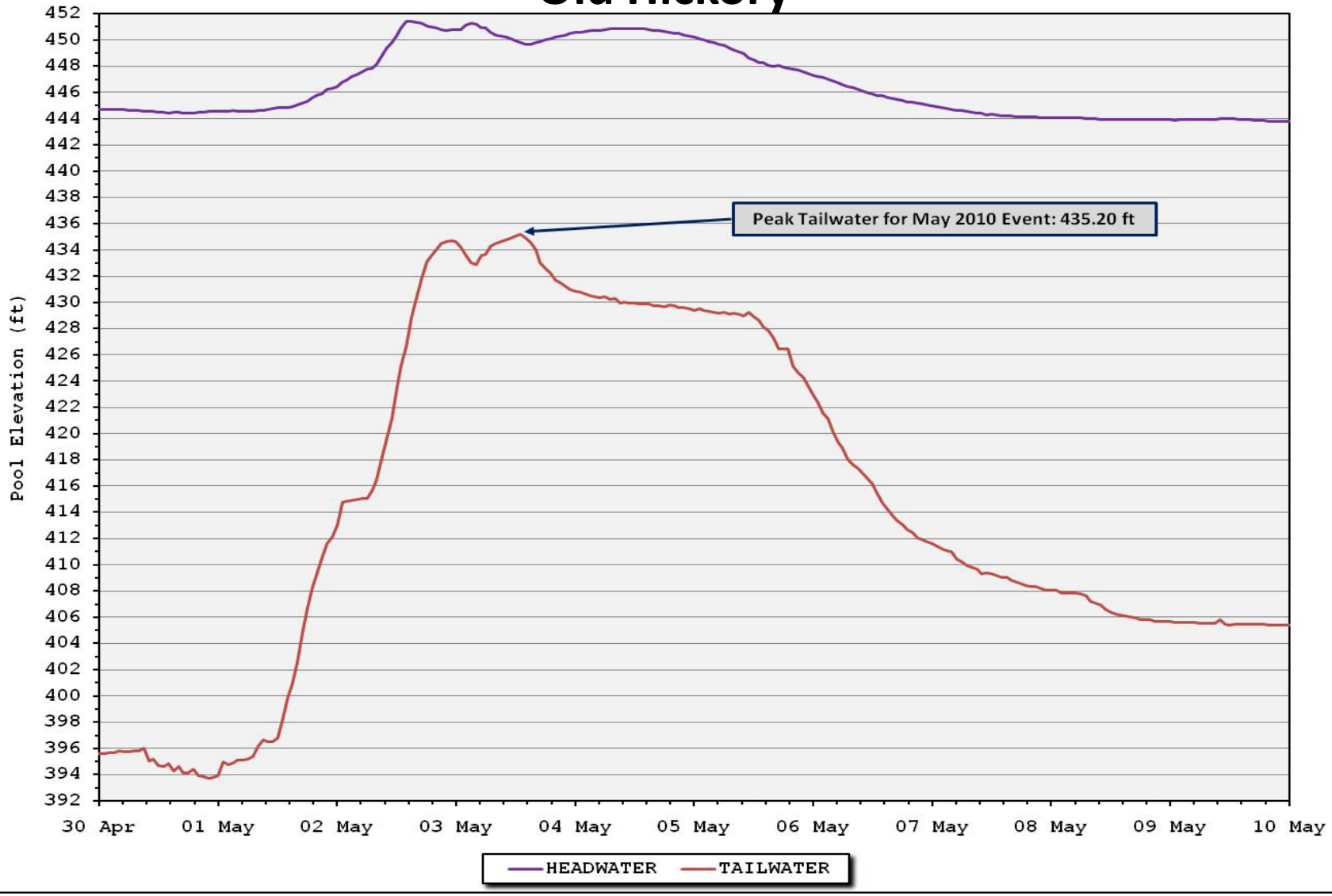

Pool Elevation (ft)
372
370
368
366
364
362
360
358
356
354
352
350
348
346
344
342
340
338
336
334
332
330
328
326
324
322
320
318
316
314
30 Apr
02 May
04 May
06 May
08 May
10 May
12 May
14 May
16 May
18 May
20 May
Peak Tailwater for May 2010 Event: 350.75 ft
HEADWATER
TAILWATER

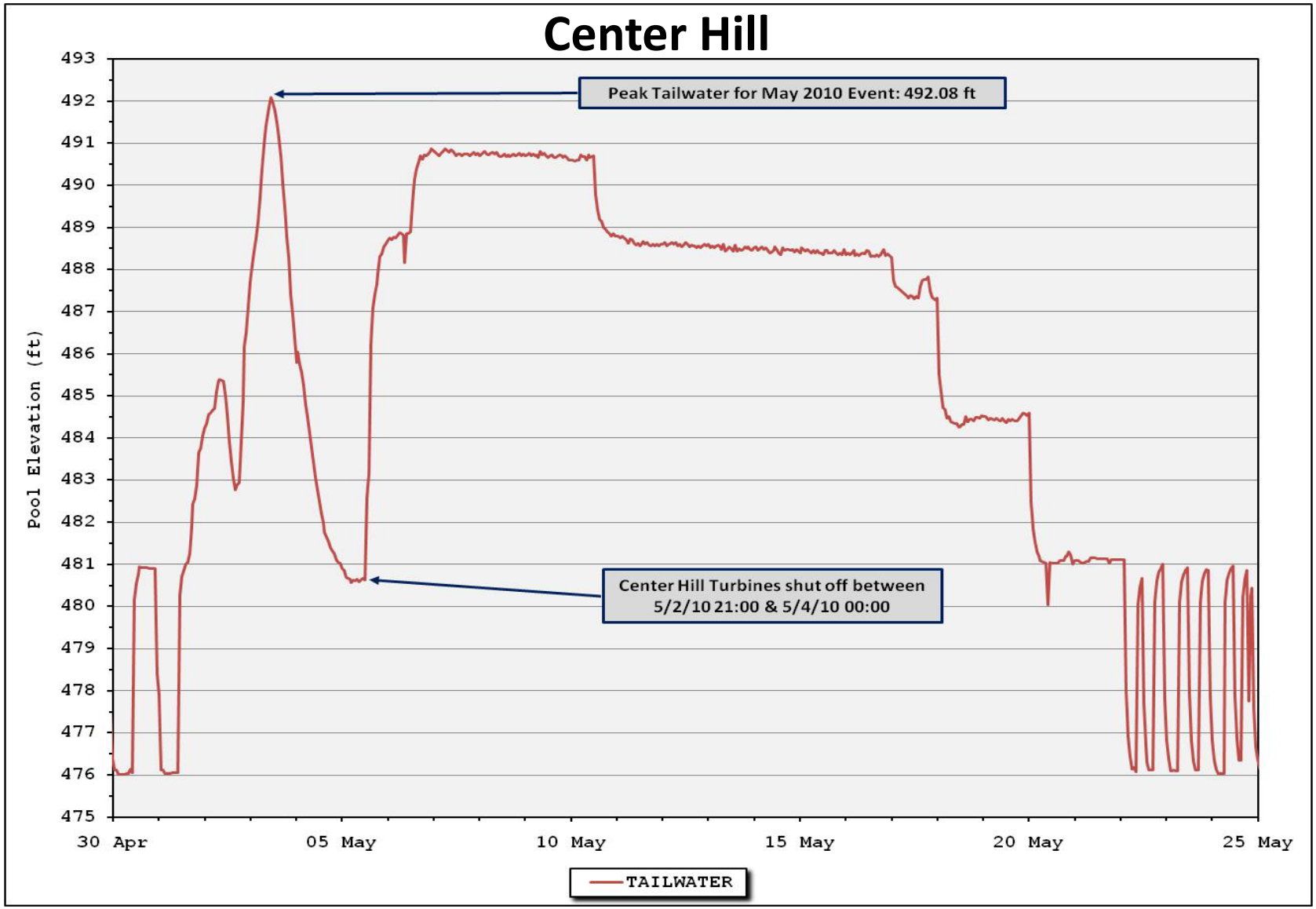
Cheatham


Peak Tailwater for May 2010 Event: 403.25 ft
Pool Elevation (ft)
406
404
402
400
398
396
394
392
390
388
386
384
382
380
378
376
374
372
370
368
366
364
362
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
HEADWATER
TAILWATER

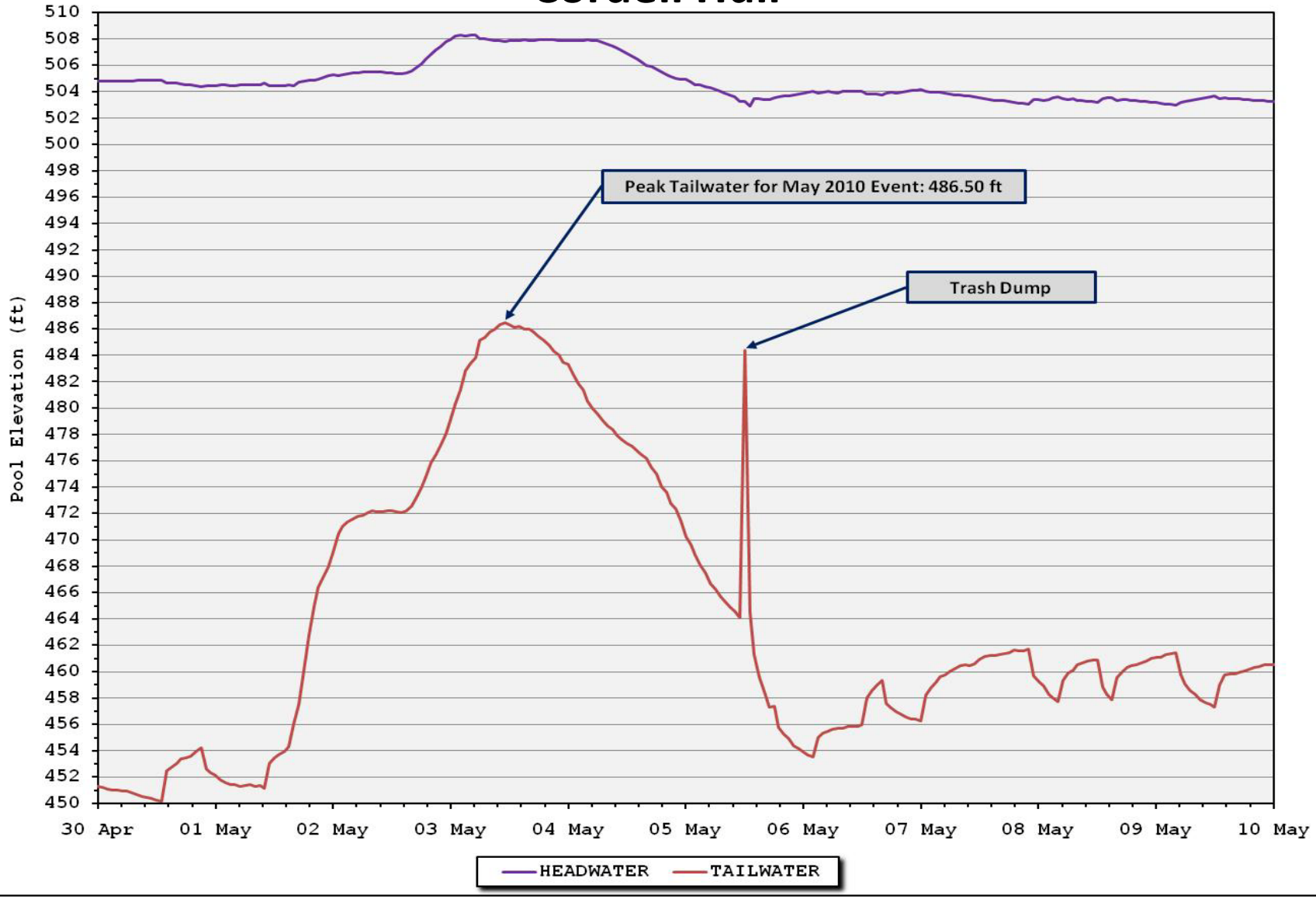

J. Percy Priest
Peak Tailwater for May 2010 Event: 428.30 ft
J. Percy Priest Turbines shut off
between 5/2/10 21:00 & 5/3/10 07:15
Pool Elevation (ft)
430
428
426
424
422
420
418
416
414
412
410
408
406
404
402
400
398
396
394
392
390
388
30 Apr
05 May
10 May
15 May
20 May
25 May
TAILWATER

Old Hickory

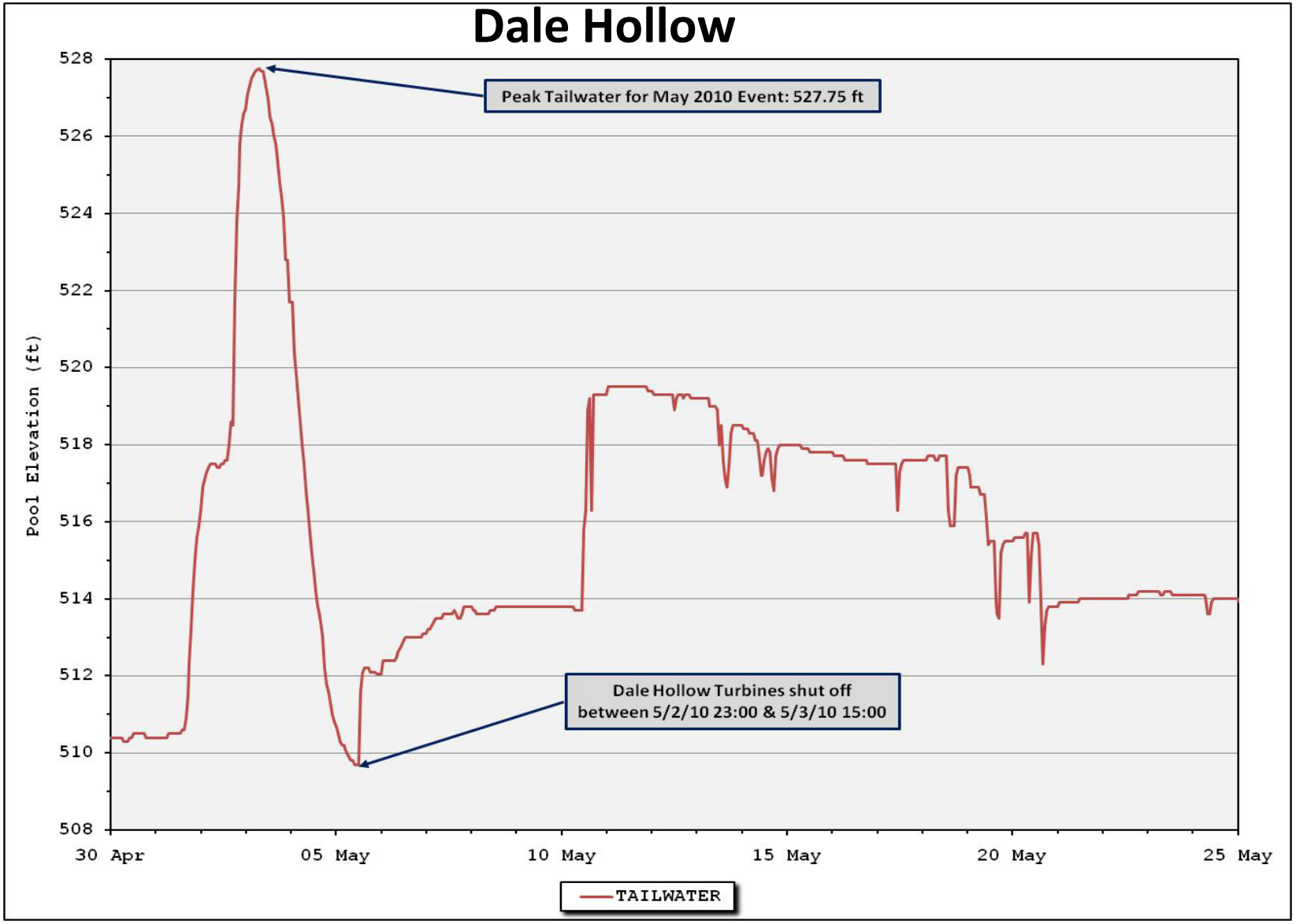

Pool Elevation (ft)
452
450
448
446
444
442
440
438
436
434
432
430
428
426
424
422
420
418
416
414
412
410
408
406
404
402
400
398
396
394
392
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
Peak Tailwater for May 2010 Event: 435.20 ft
HEADWATER
TAILWATER


Center Hill
Peak Tailwater for May 2010 Event: 492.08 ft
Center Hill Turbines shut off between
5/2/10 21:00 & 5/4/10 00:00
Pool Elevation (ft)
493
492
491
490
489
488
487
486
485
484
483
482
481
480
479
478
477
476
475
30 Apr
05 May
10 May
15 May
20 May
25 May
TAILWATER

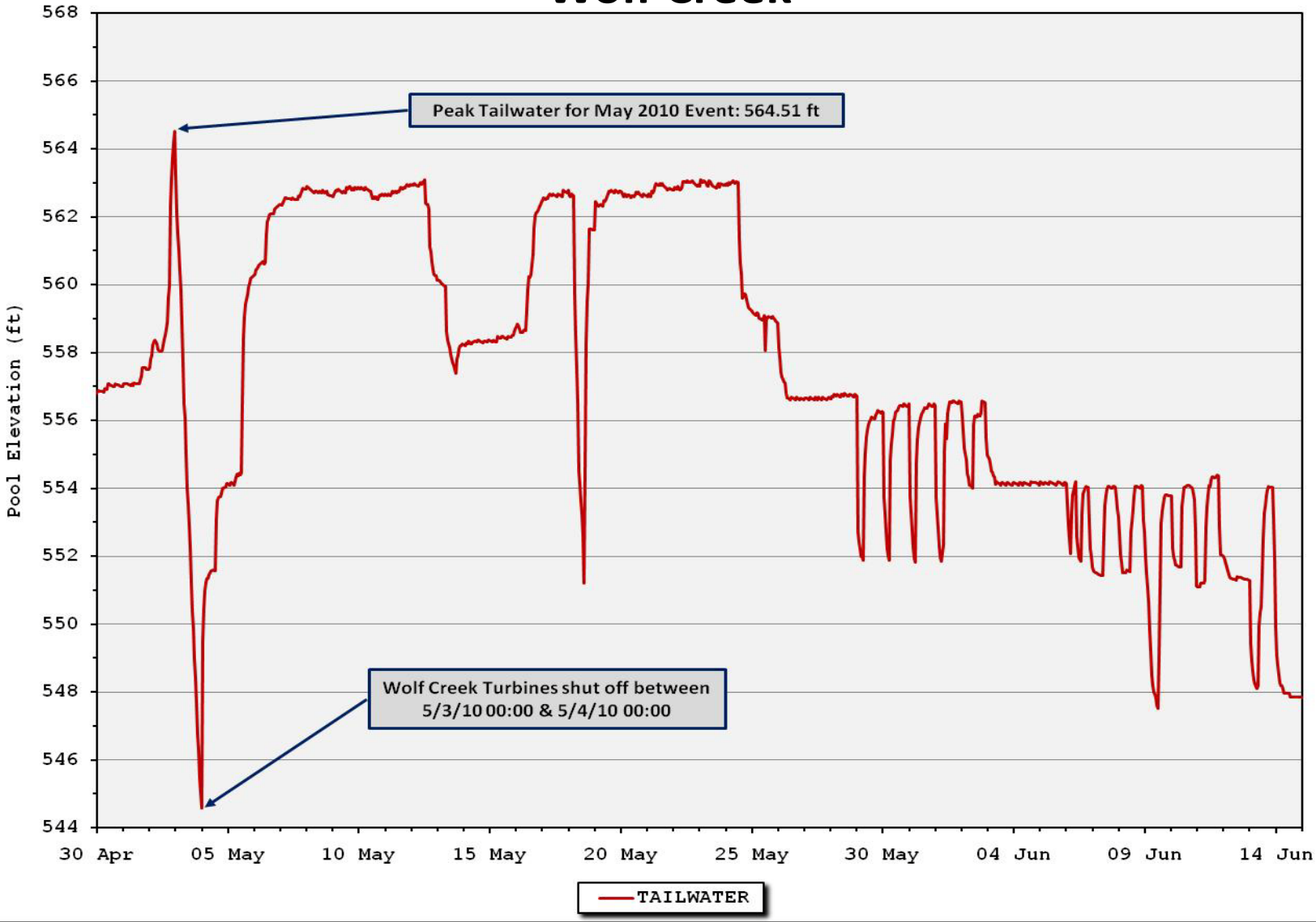
Cordell Hull



Dale Hollow


Peak Tailwater for May 2010 Event: 527.75 ft
Dale Hollow Turbines shut off
between 5/2/10 23:00 & 5/3/10 15:00
Pool Elevation (ft)
528
526
524
522
520
518
516
514
512
510
508
30 Apr
05 May
10 May
15 May
20 May
25 May
TAILWATER

Wolf Creek


Peak Tailwater for May 2010 Event: 564.51 ft
Wolf Creek Turbines shut off between
5/3/10 00:00 & 5/4/10 00:00
Pool Elevation (ft)
568
566
564
562
560
558
556
554
552
550
548
546
544
30 Apr
05 May
10 May
15 May
20 May
25 May
30 May
04 Jun
09 Jun
14 Jun
TAILWATER

Damage Center Stages Plots

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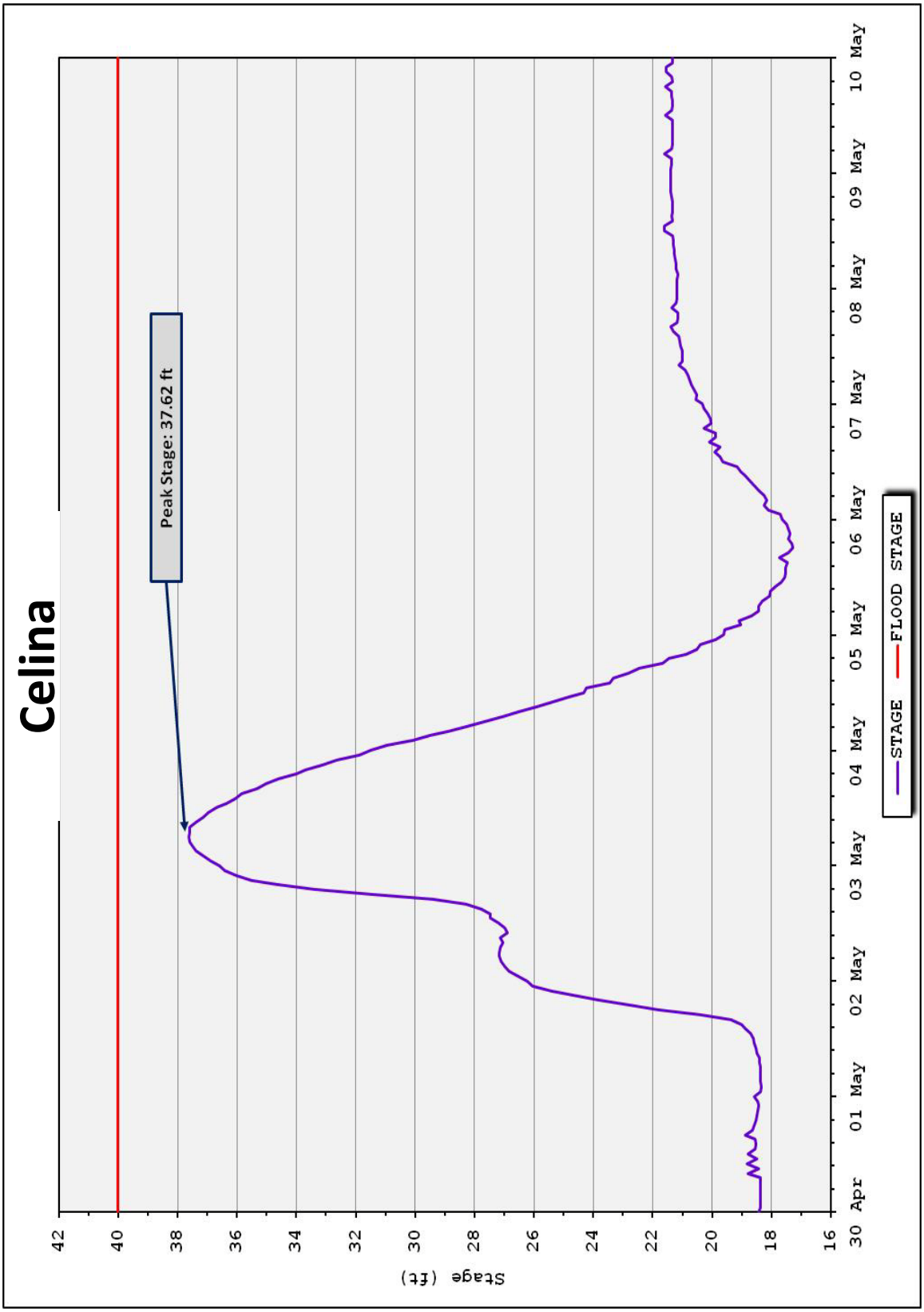
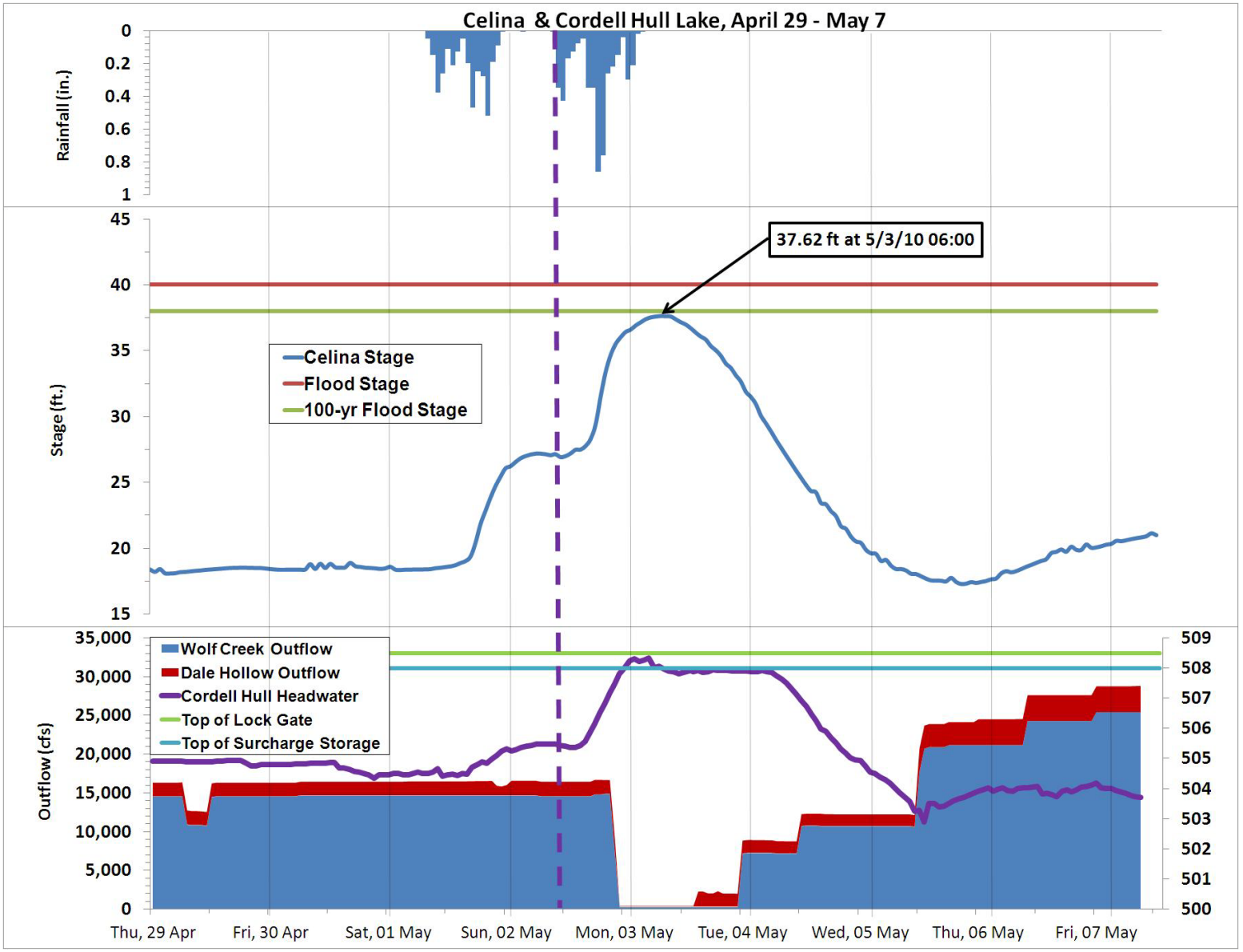
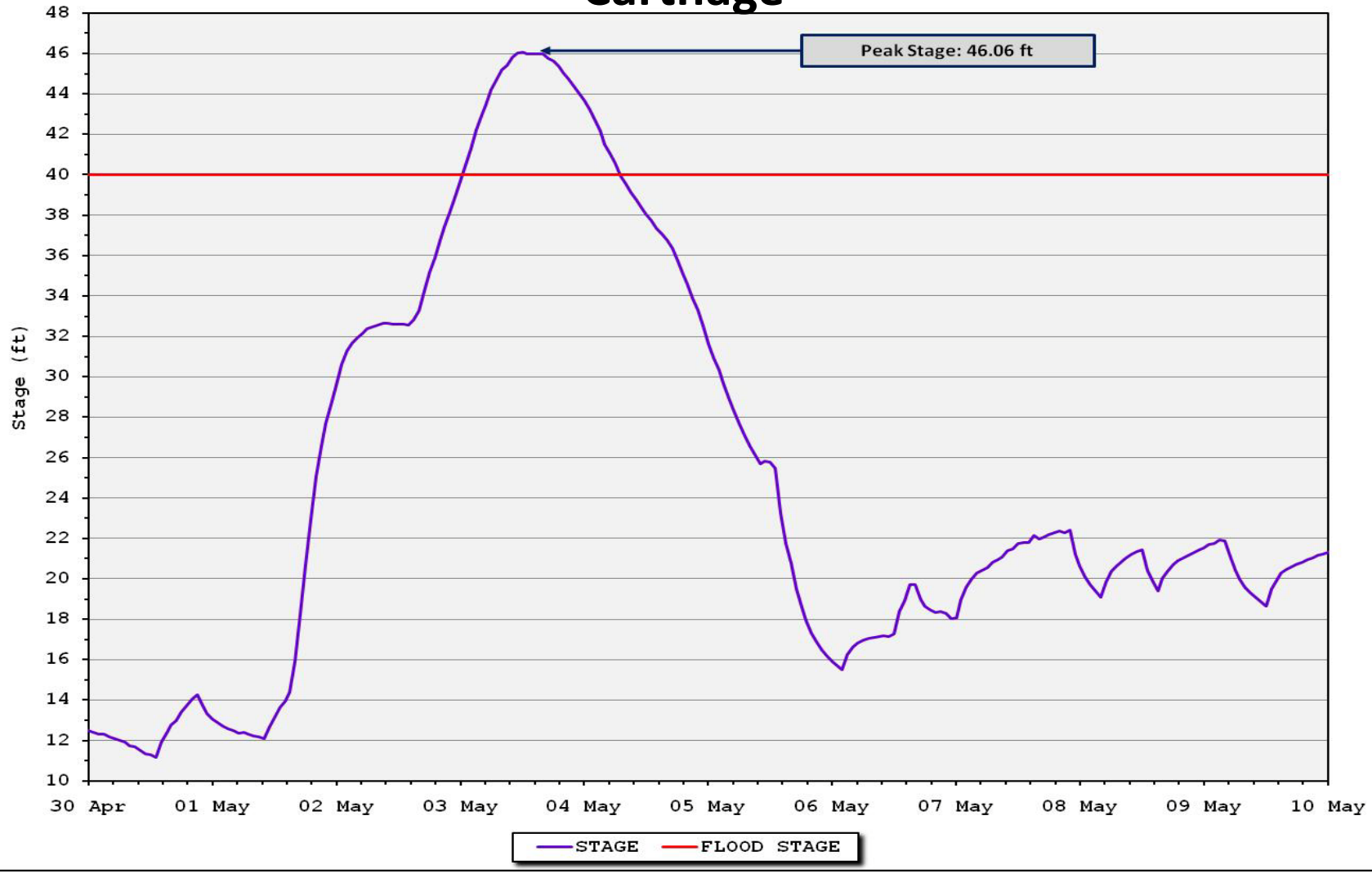
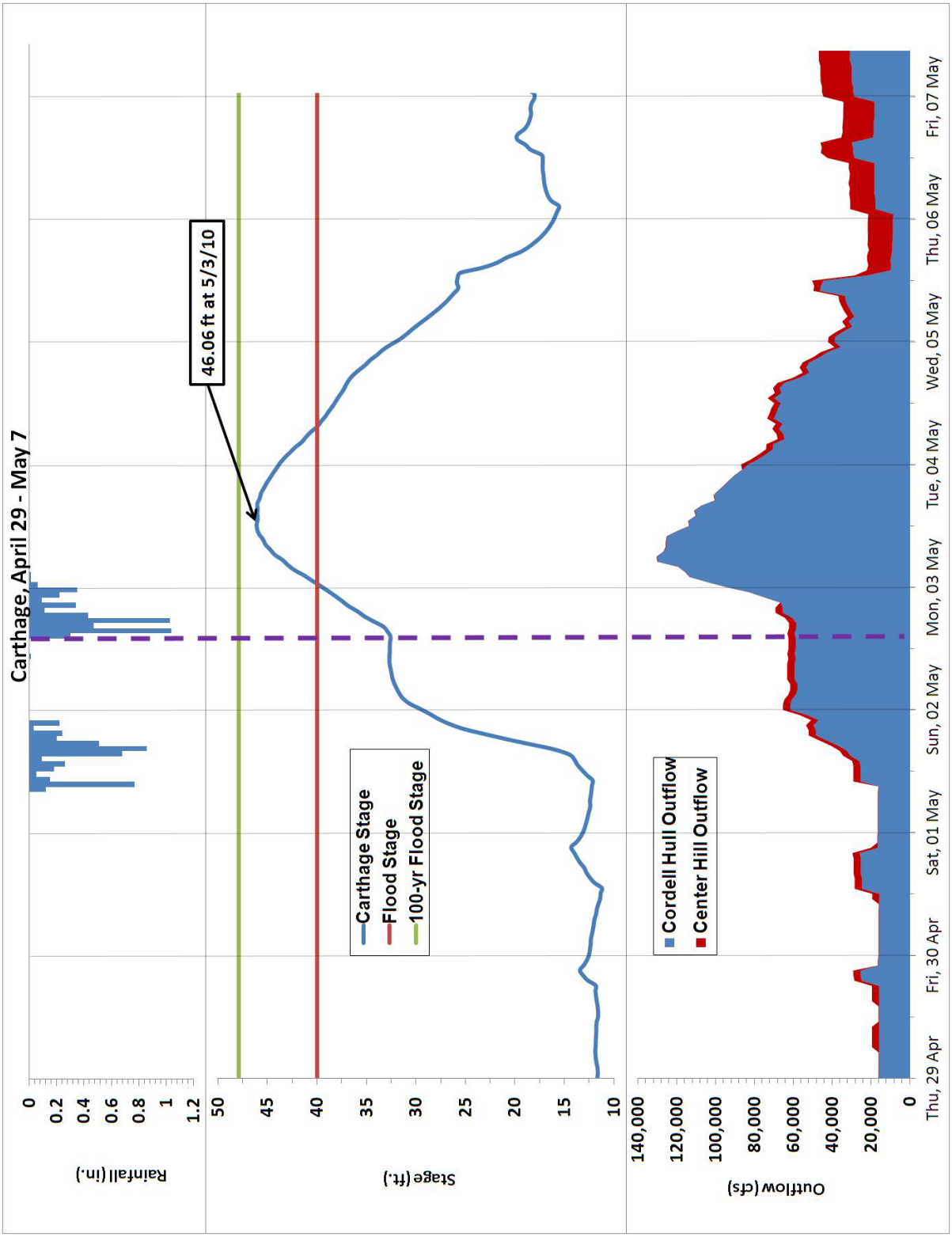

Celina
Peak Stage: 37.62 ft
Stage (ft)
42
40
38
36
34
32
30
28
26
24
22
20
18
16
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
STAGE
FLOOD STAGE

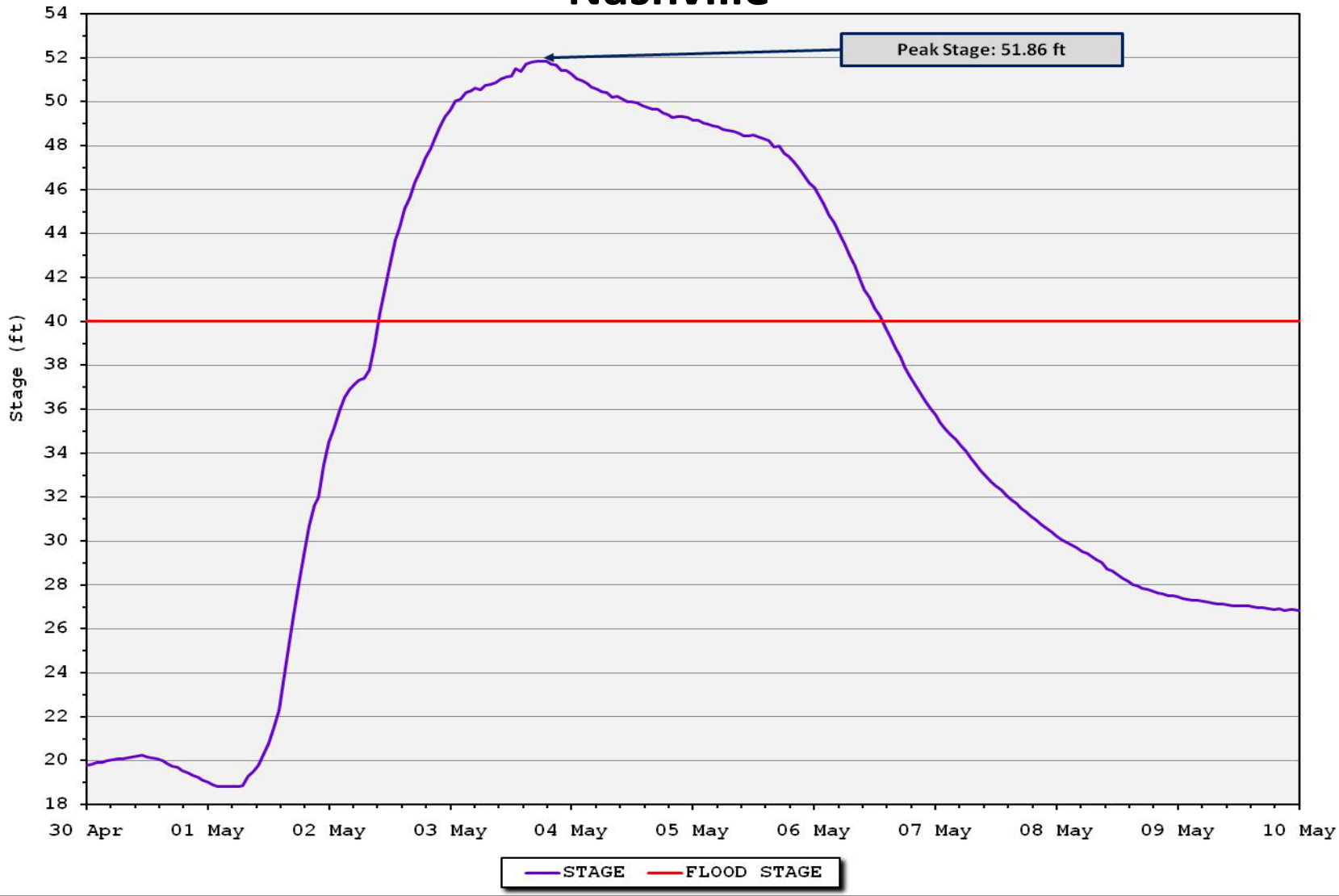

Celina & Cordell Hull Lake, April 29 - May 7
Rainfall (in.)
0
0.2
0.4
0.6
0.8
1
Stage (ft.)
45
40
35
30
25
20
15
37.62 ft at 5/3/10 06:00
Celina Stage
Flood Stage
100-yr Flood Stage
Outflow (cfs)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Wolf Creek Outflow
Dale Hollow Outflow
Cordell Hull Headwater
Top of Lock Gate
Top of Surcharge Storage
509
508
507
506
505
504
503
502
501
500
Thu, 29 Apr
Fri, 30 Apr
Sat, 01 May
Sun, 02 May
Mon, 03 May
Tue, 04 May
Wed, 05 May
Thu, 06 May
Fri, 07 May

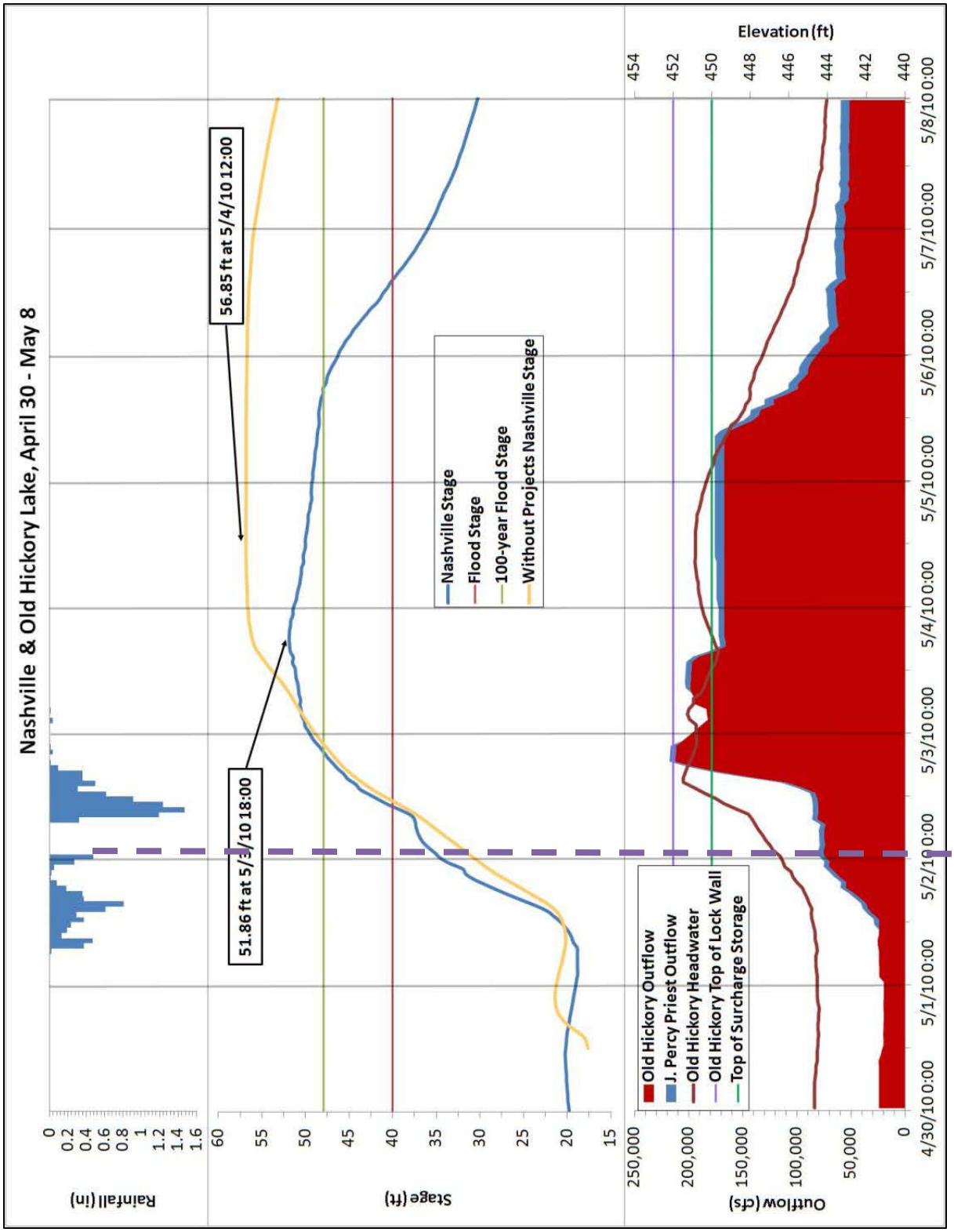
Carthage


Peak Stage: 46.06 ft
Stage (ft)
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
STAGE
FLOOD STAGE

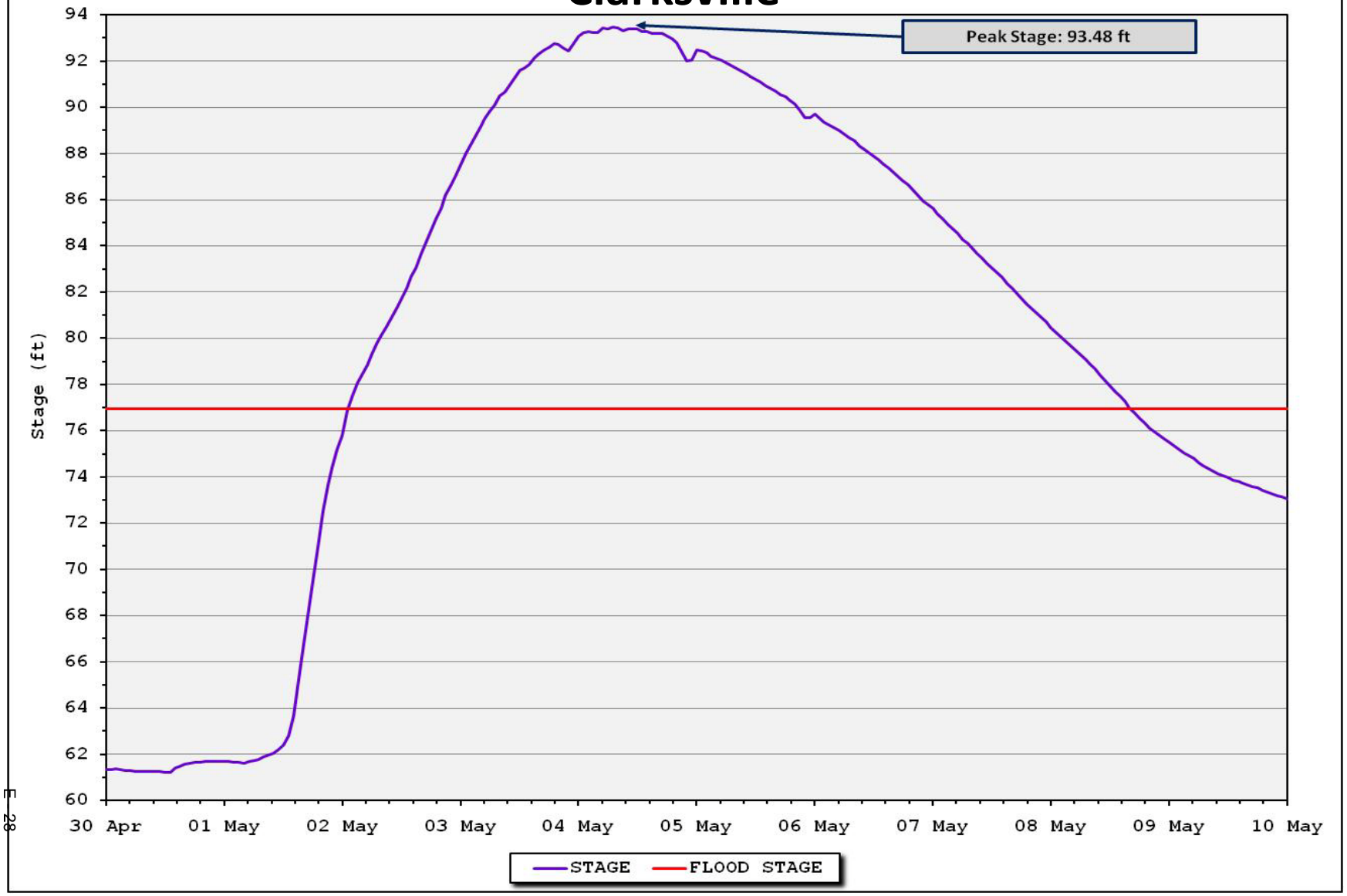

Carthage, April 29 - May 7
46.06 ft at 5/3/10
Rainfall (in.)
0
0.2
0.4
0.6
0.8
1
1.2
Stage (ft.)
50
45
40
35
30
25
20
15
10
Carthage Stage
Flood Stage
100-yr Flood Stage
Outflow (cfs)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Cordell Hull Outflow
Center Hill Outflow
Thu, 29 Apr
Fri, 30 Apr
Sat, 01 May
Sun, 02 May
Mon, 03 May
Tue, 04 May
Wed, 05 May
Thu, 06 May
Fri, 07 May

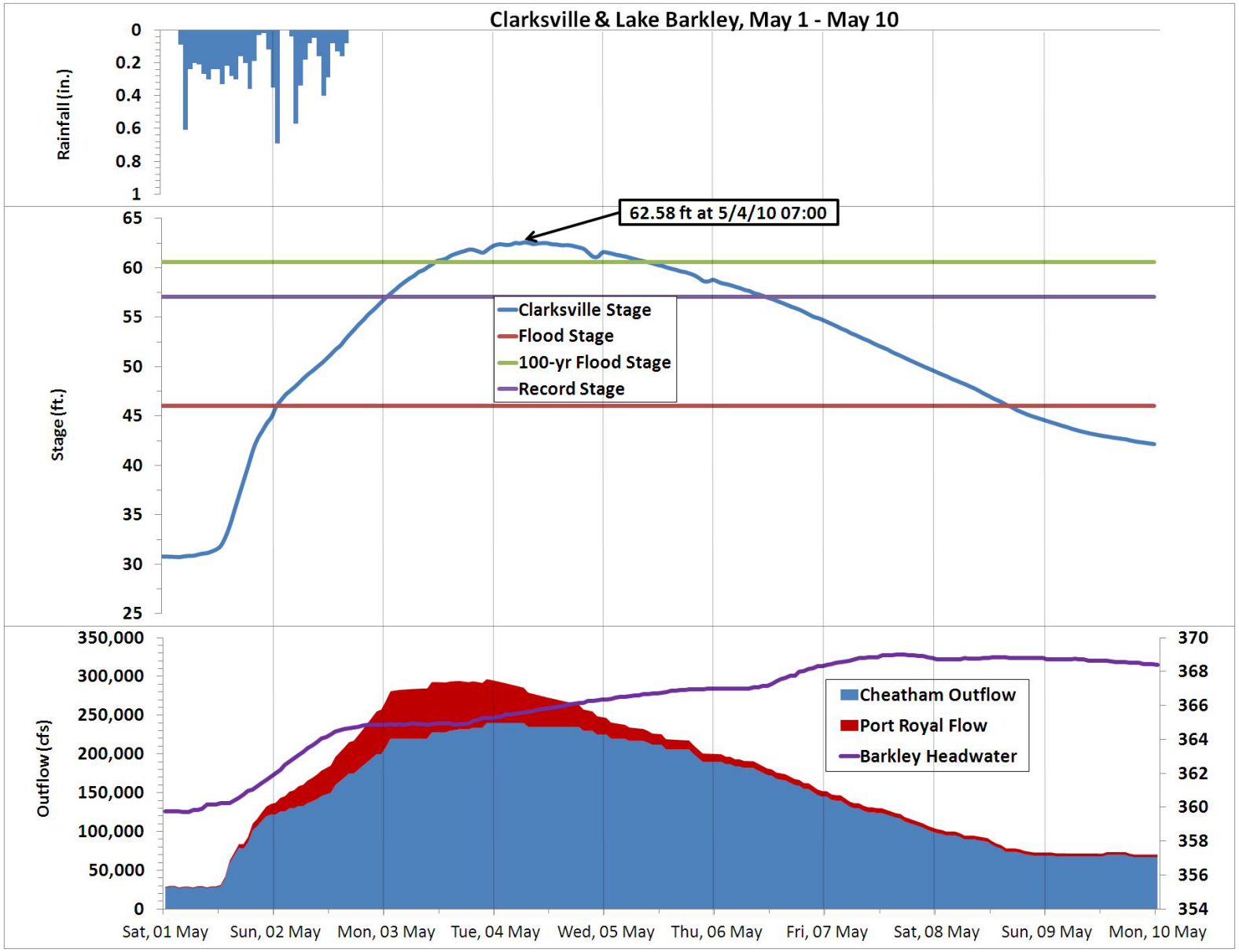
Nashville


Peak Stage: 51.86 ft
Stage (ft)
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
STAGE
FLOOD STAGE


Nashville & Old Hickory Lake, April 30 - May 8
Rainfall (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Stage (ft)
60
55
50
45
40
35
30
25
20
15
Outflow (cfs)
250,000
200,000
150,000
100,000
50,000
0
Elevation (ft)
454
452
450
448
446
444
442
440
56.85 ft at 5/4/10 12:00
51.86 ft at 5/3/10 18:00
Nashville Stage
Flood Stage
100-year Flood Stage
Without Projects Nashville Stage
Old Hickory Outflow
J. Percy Priest Outflow
Old Hickory Headwater
Old Hickory Top of Lock Wall
Top of Surcharge Storage
4/30/10 0:00
5/1/10 0:00
5/2/10 0:00
5/3/10 0:00
5/4/10 0:00
5/5/10 0:00
5/6/10 0:00
5/7/10 0:00
5/8/10 0:00

Clarksville




Clarksville & Lake Barkley, May 1 - May 10
Rainfall (in.)
0
0.2
0.4
0.6
0.8
1
62.58 ft at 5/4/10 07:00
Stage (ft.)
65
60
55
50
45
40
35
30
25
Clarksville Stage
Flood Stage
100-yr Flood Stage
Record Stage
Outflow (cfs)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
370
368
366
364
362
360
358
356
354
Cheatham Outflow
Port Royal Flow
Barkley Headwater
Sat, 01 May
Sun, 02 May
Mon, 03 May
Tue, 04 May
Wed, 05 May
Thu, 06 May
Fri, 07 May
Sat, 08 May
Sun, 09 May
Mon, 10 May

Plots of Stream Gage Discharges

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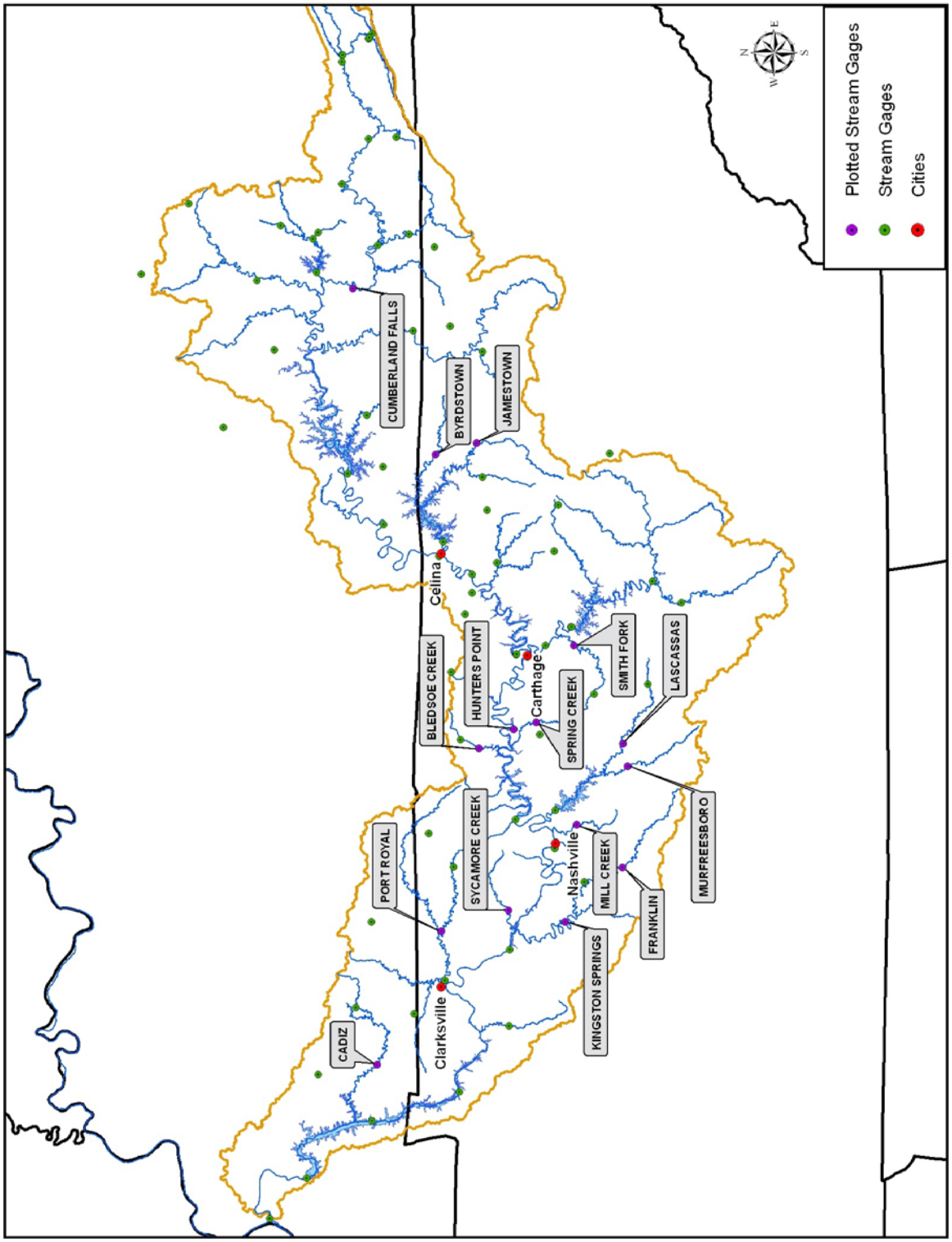
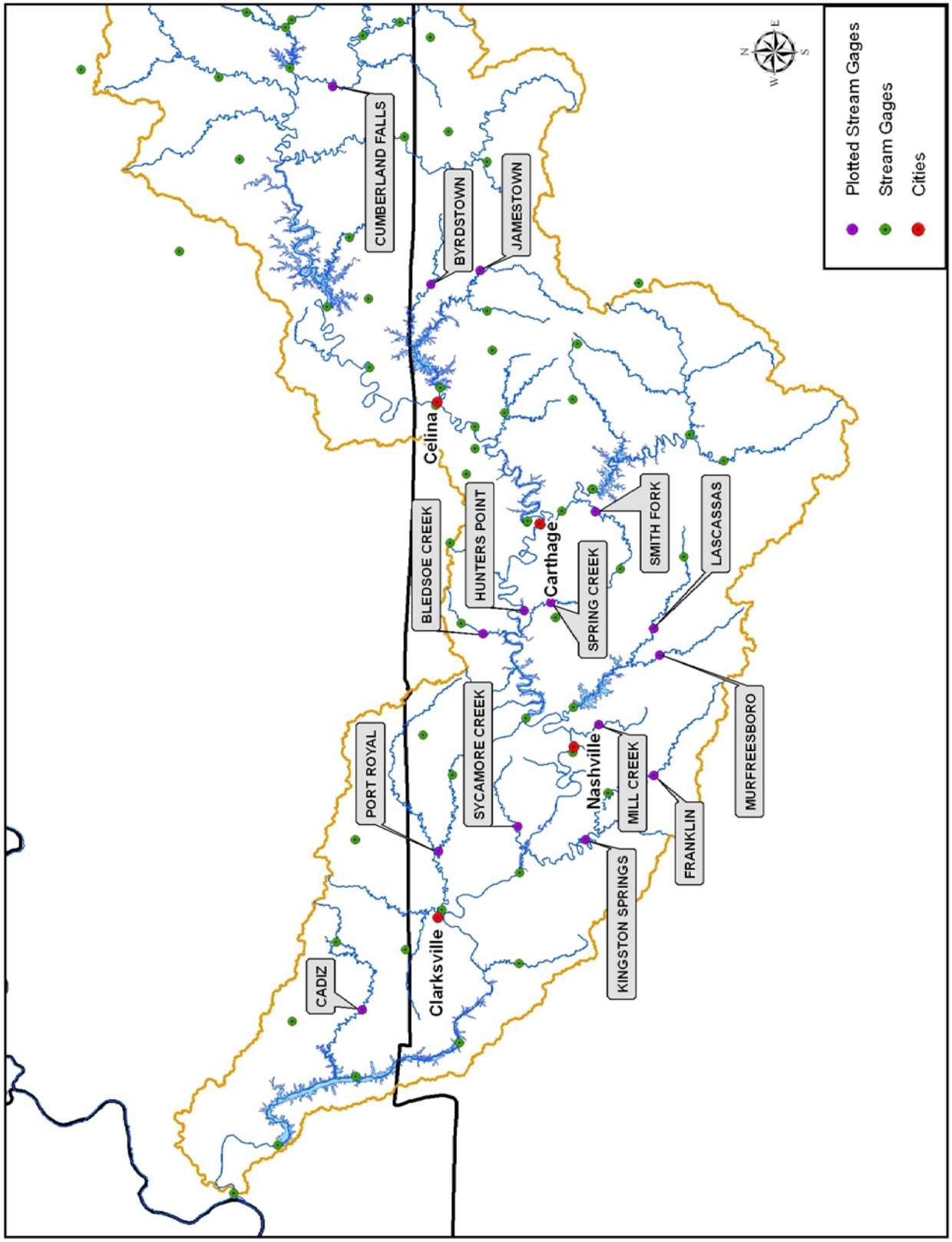
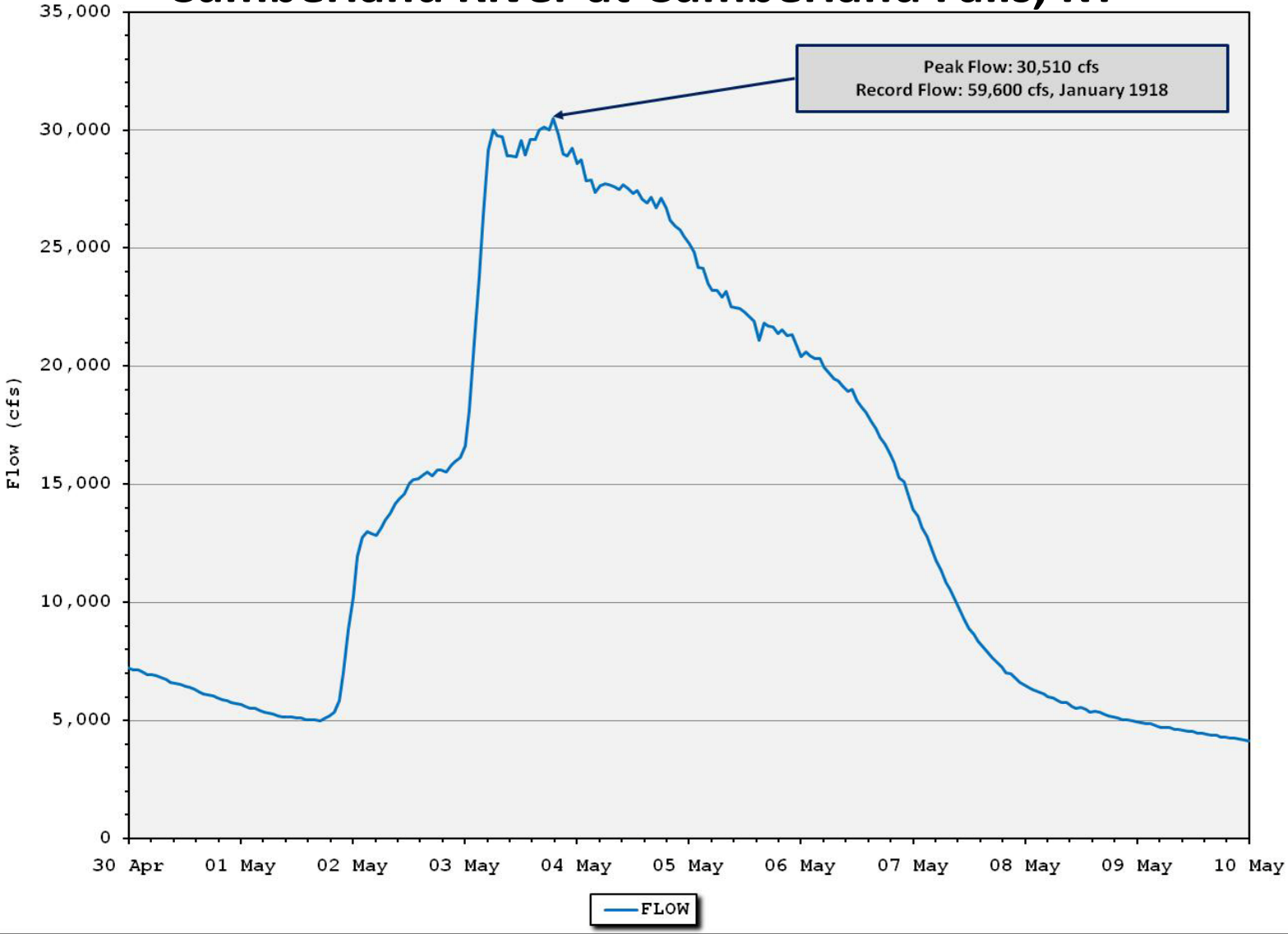
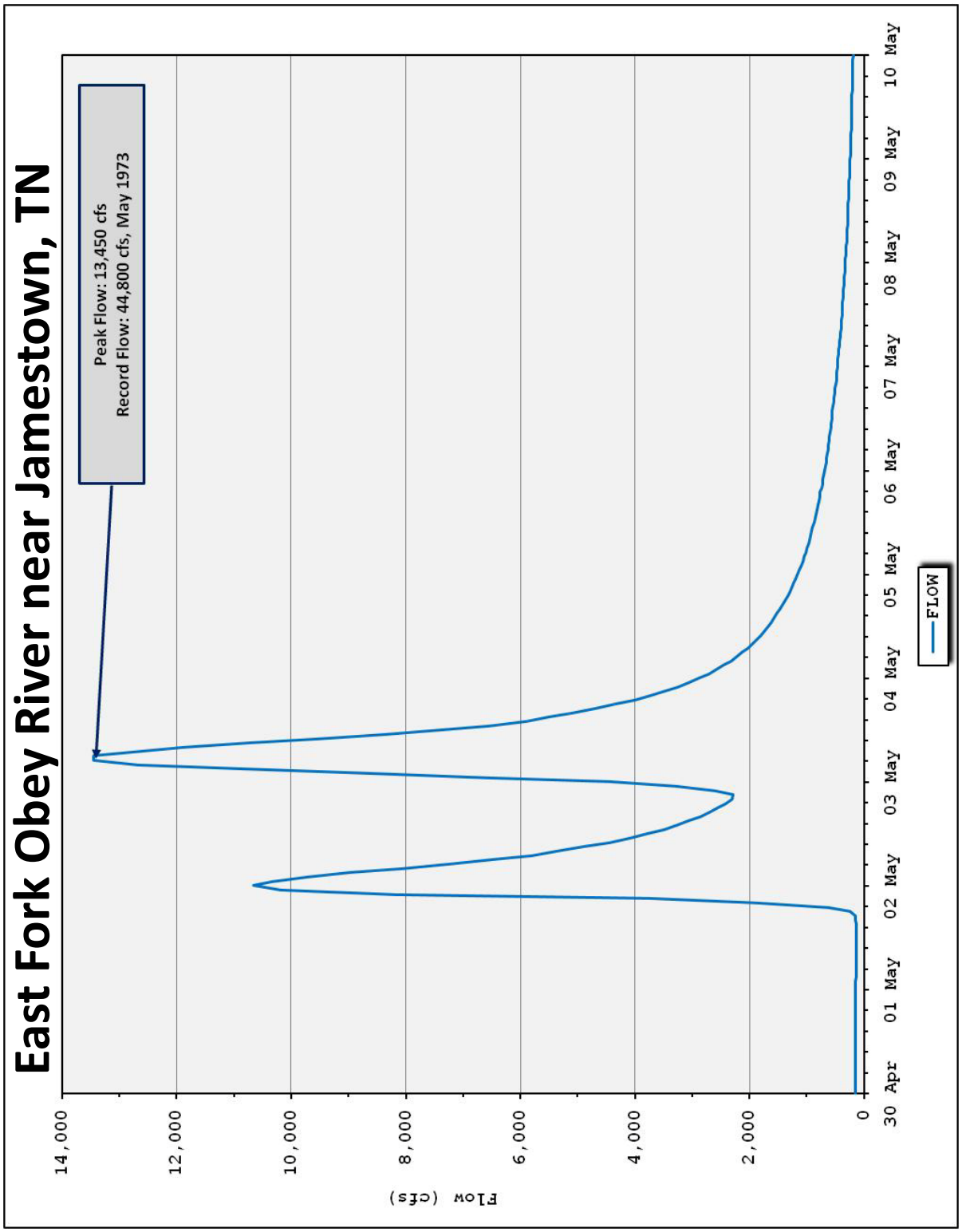
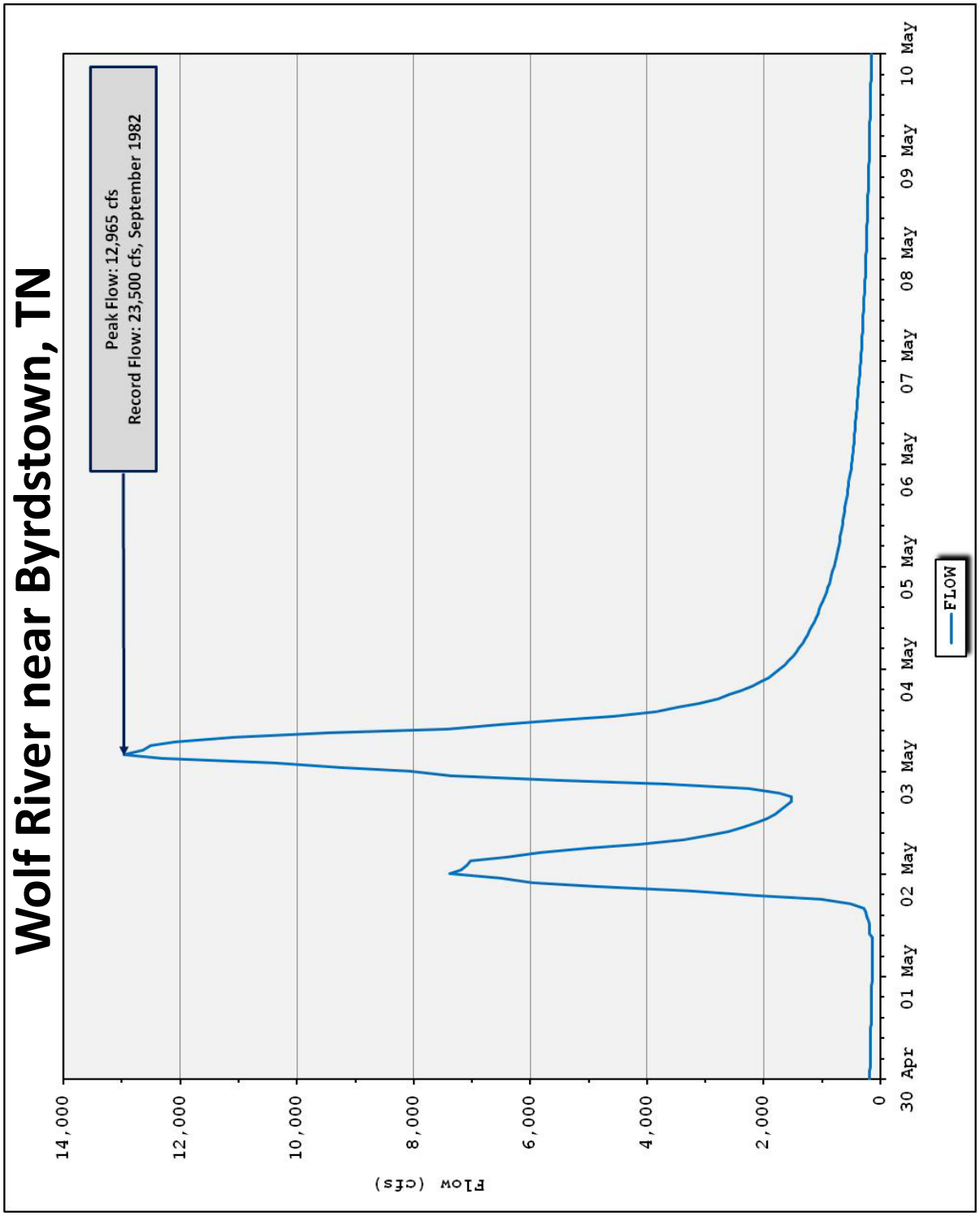

CUMBERLAND FALLS
BYRDSTOWN
JAMESTOWN
Celina
BLEDSOE CREEK
HUNTERS POINT
Carthage
SPRING CREEK
SMITH FORK
LASCASSAS
MURFREESBORO
SYCAMORE CREEK
Nashville
MILL CREEK
FRANKLIN
PORT ROYAL
KINGSTON SPRINGS
Clarksville
CADIZ
N
E
S
W
Plotted Stream Gages
Stream Gages
Cities

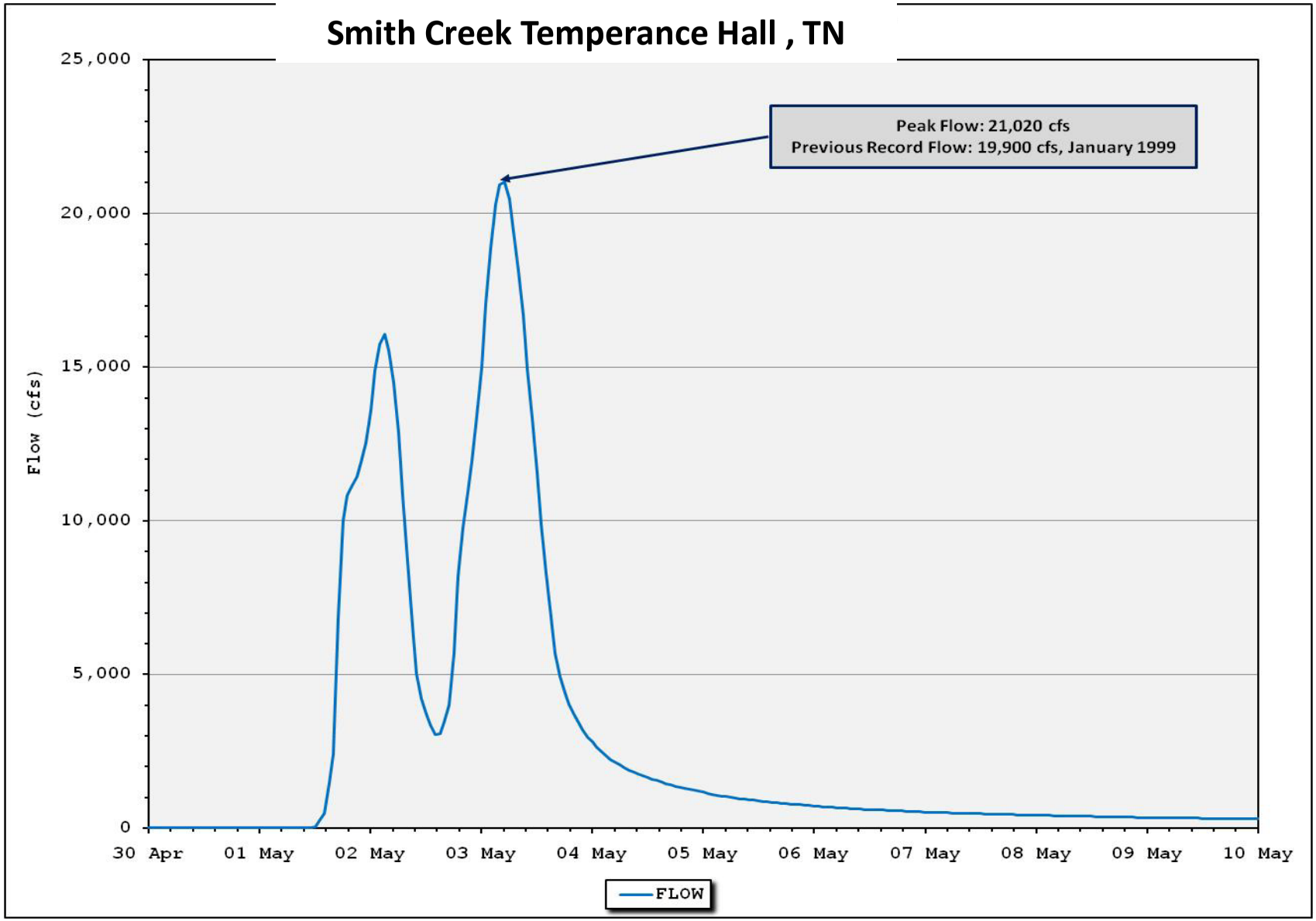

Plotted Stream Gages
Stream Gages
Cities
N
E
S
W
CUMBERLAND FALLS
BYRDSTOWN
JAMESTOWN
Celina
BLEDSOE CREEK
HUNTERS POINT
Carthage
SPRING CREEK
SMITH FORK
LASCASSAS
MURFREESBORO
SYCAMORE CREEK
Nashville
MILL CREEK
FRANKLIN
PORT ROYAL
KINGSTON SPRINGS
Clarksville
CADIZ

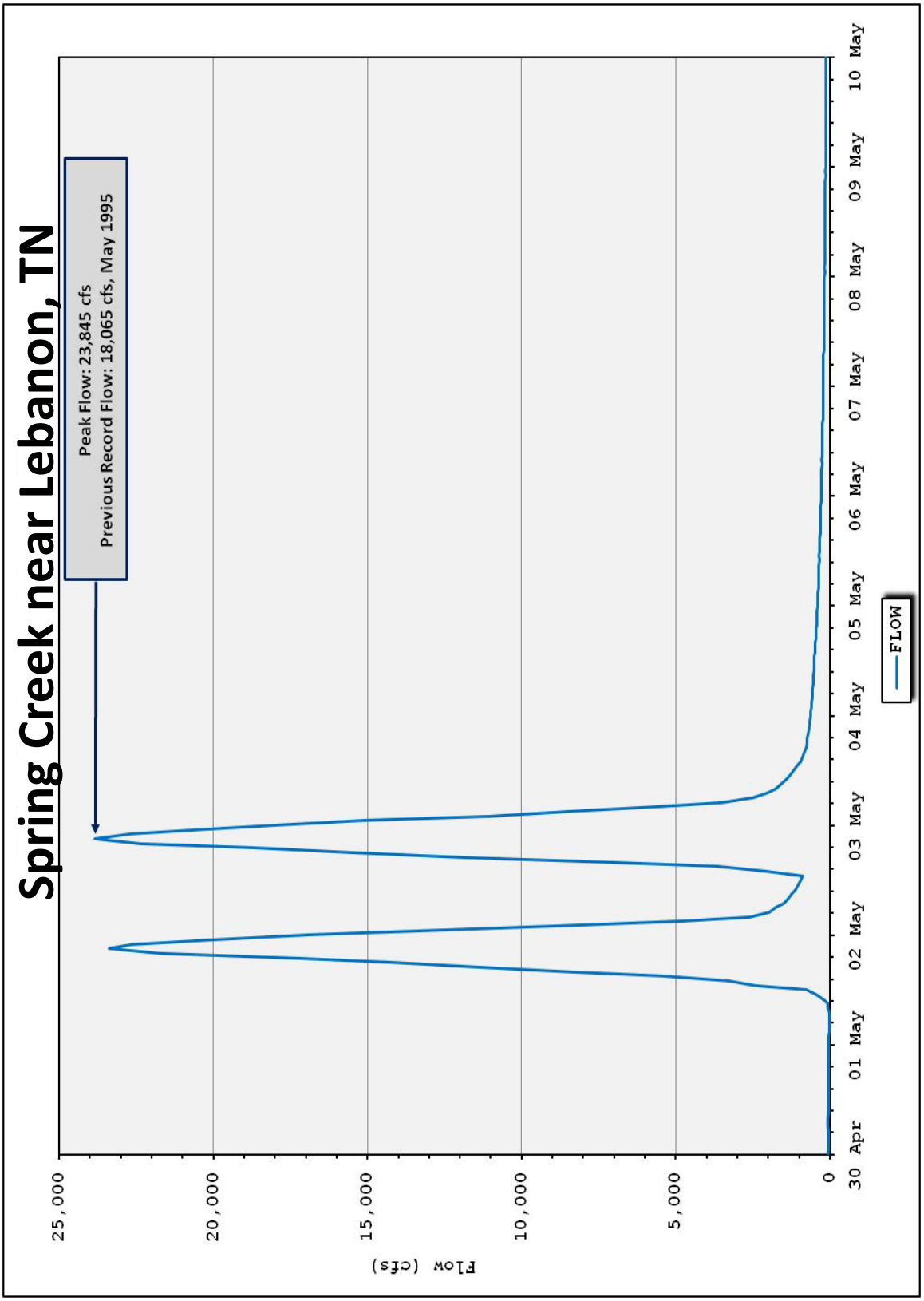
Cumberland River at Cumberland Falls, KY



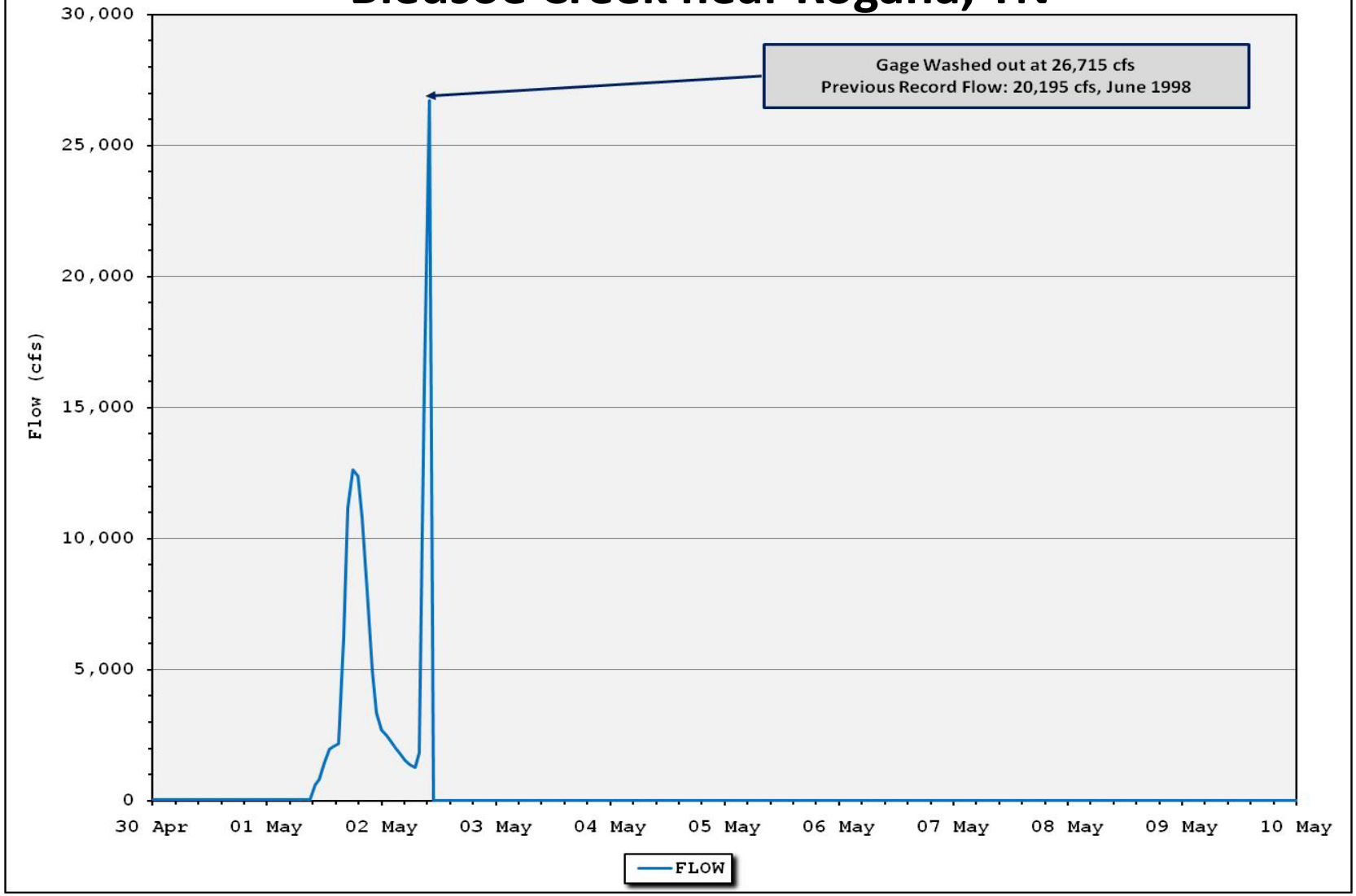

East Fork Obey River near Jamestown, TN
Peak Flow: 13,450 cfs
Record Flow: 44,800 cfs, May 1973
Flow (cfs)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
FLOW

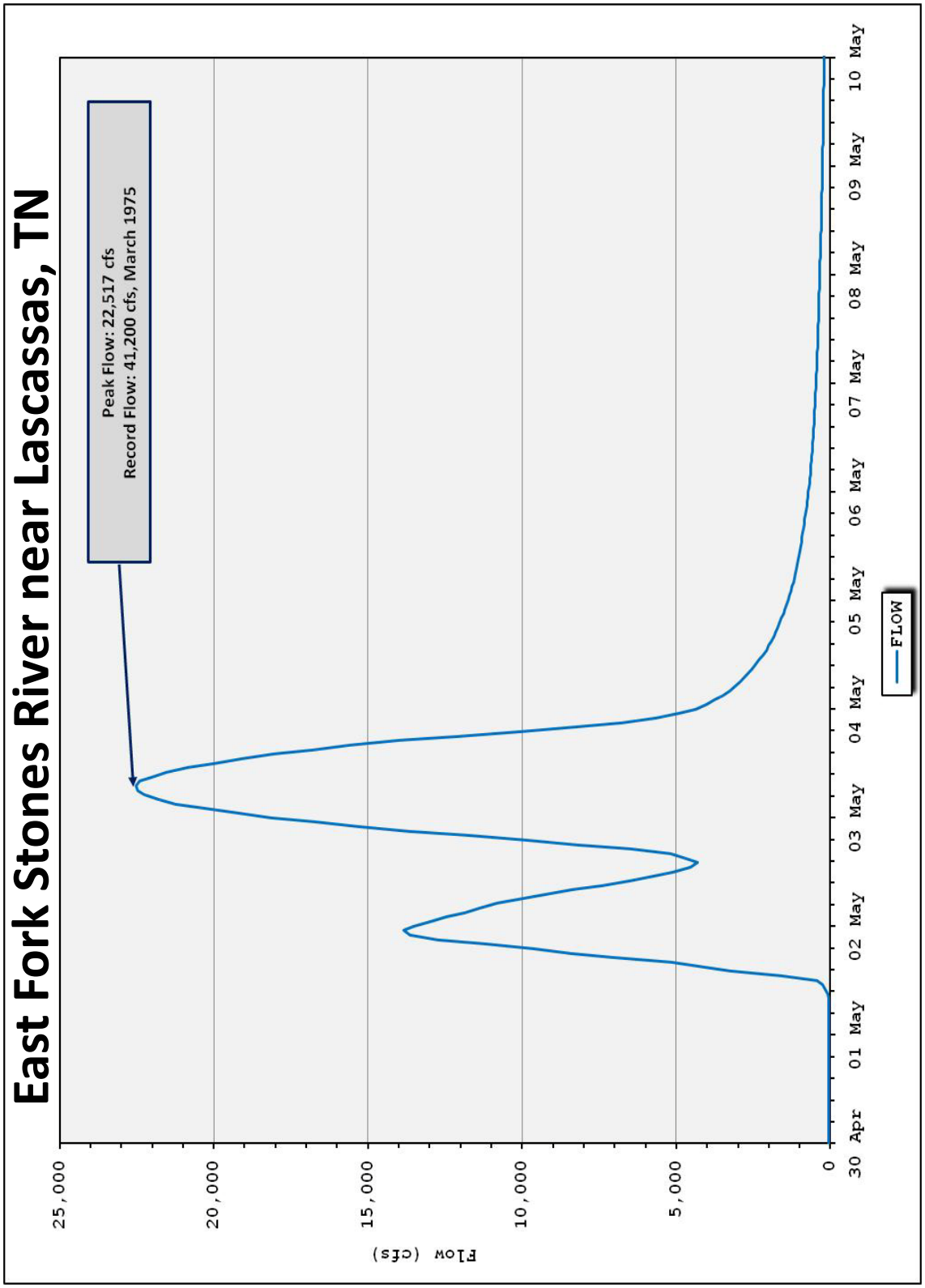

Wolf River near Byrdstown, TN
Peak Flow: 12,965 cfs
Record Flow: 23,500 cfs, September 1982
Flow (cfs)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
FLOW


Smith Creek Temperance Hall , TN
Peak Flow: 21,020 cfs
Previous Record Flow: 19,900 cfs, January 1999
Flow (cfs)
25,000
20,000
15,000
10,000
5,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
FLOW

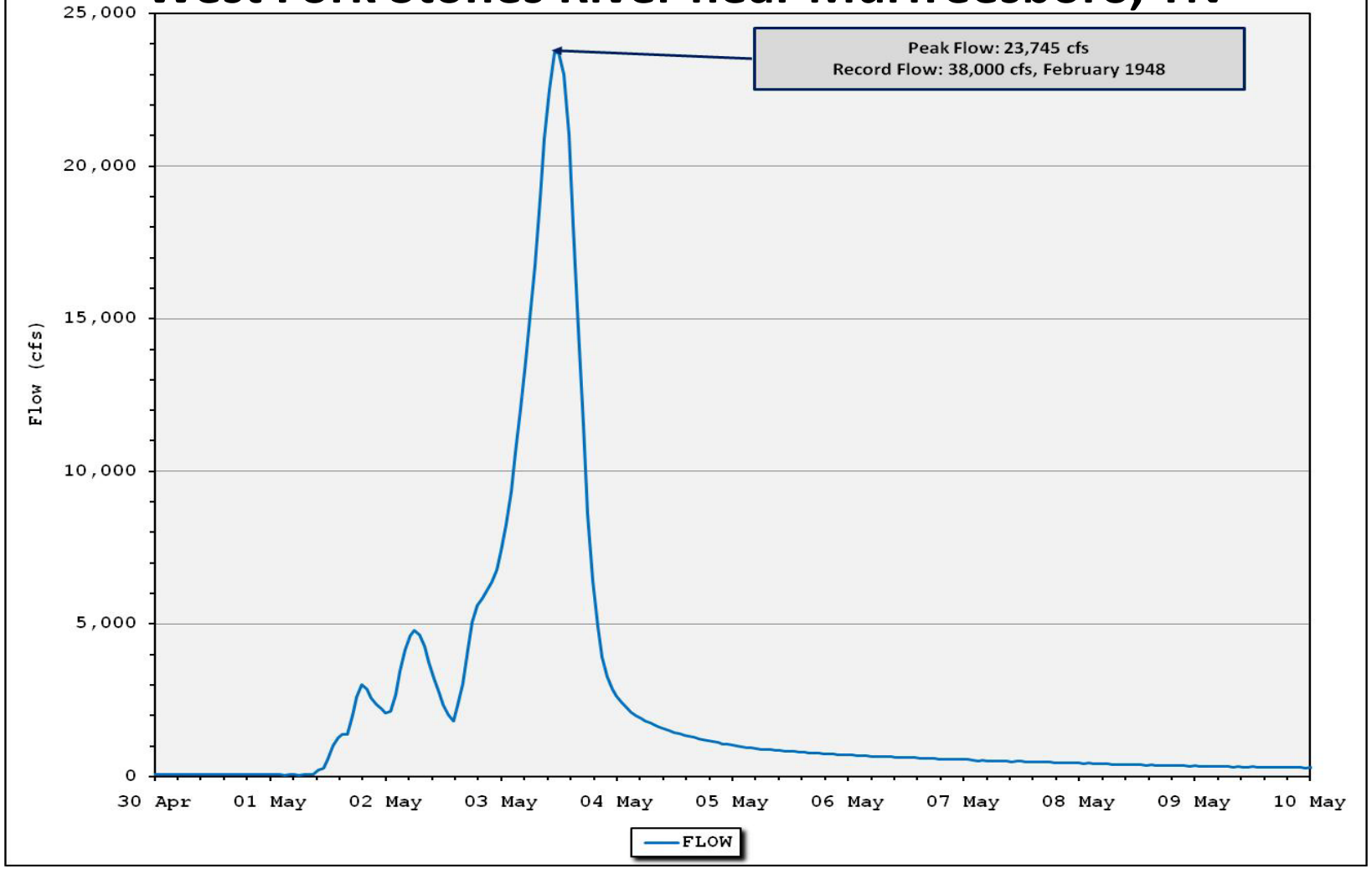

Spring Creek near Lebanon, TN
Peak Flow: 23,845 cfs
Previous Record Flow: 18,065 cfs, May 1995
Flow (cfs)
25,000
20,000
15,000
10,000
5,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
FLOW

Bledsoe Creek near Rogana, TN

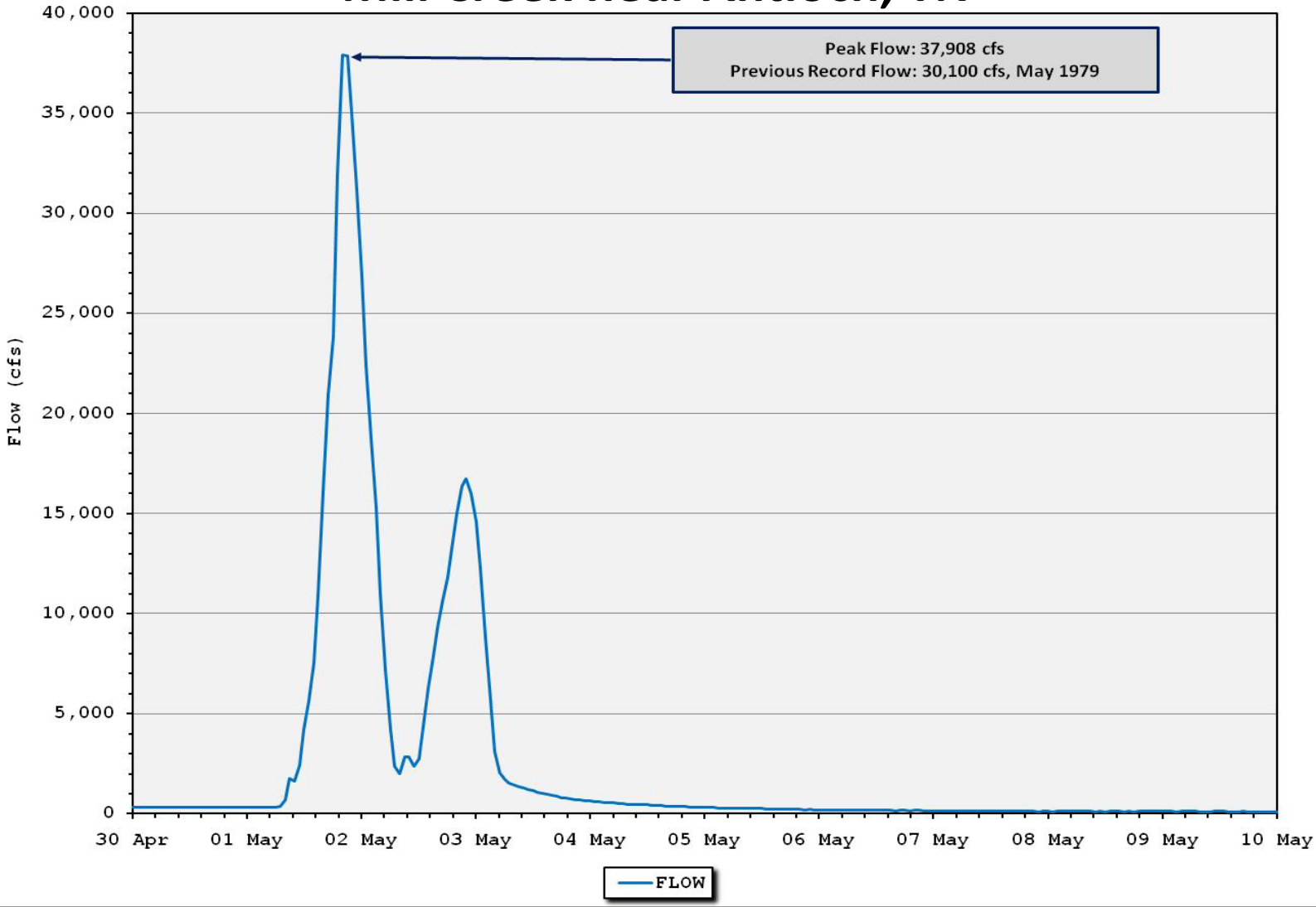



East Fork Stones River near Lascassas, TN
Peak Flow: 22,517 cfs
Record Flow: 41,200 cfs, March 1975
Flow (cfs)
25,000
20,000
15,000
10,000
5,000
0
30 Apr
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
FLOW

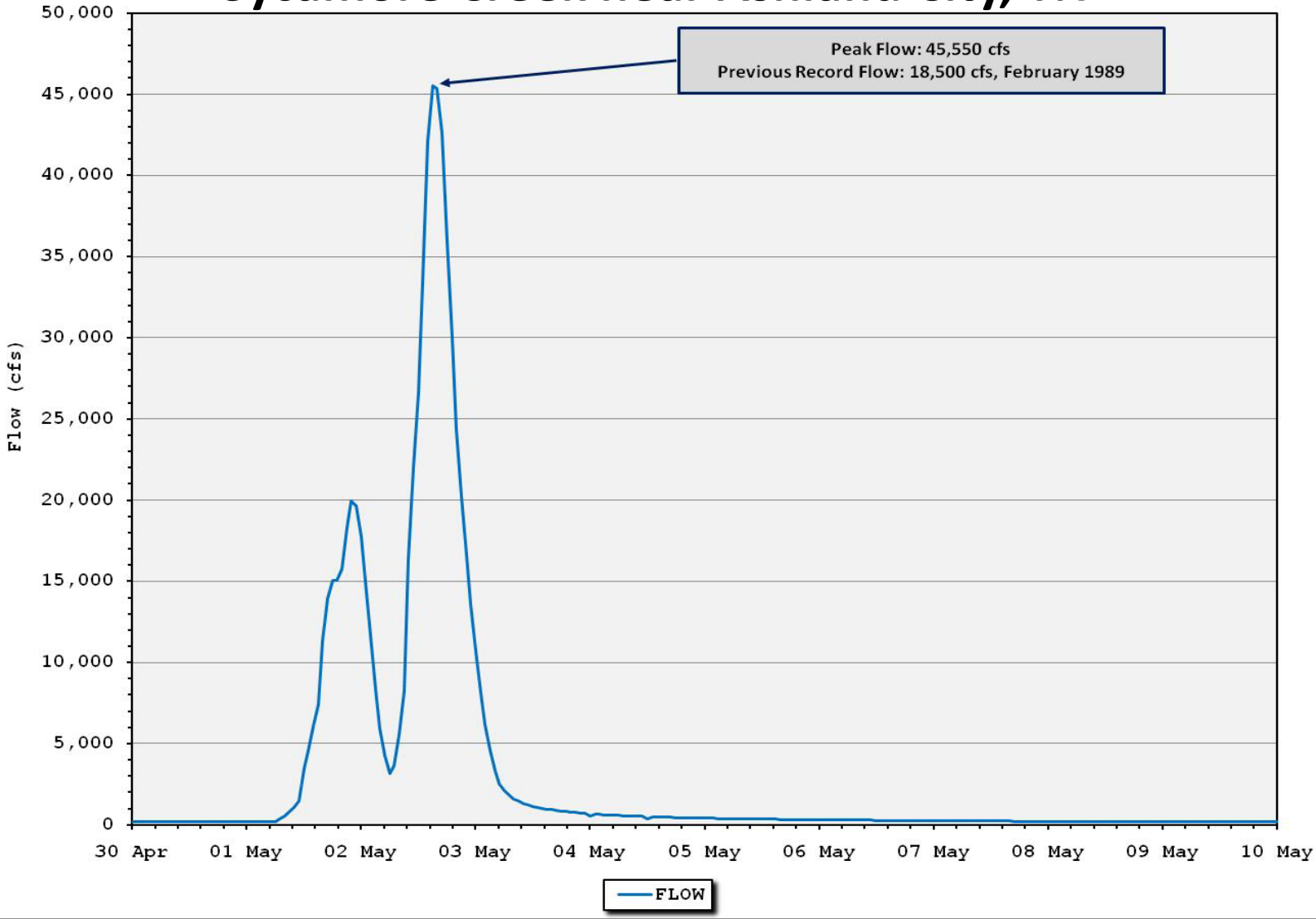
West Fork Stones River near Murfreesboro, TN



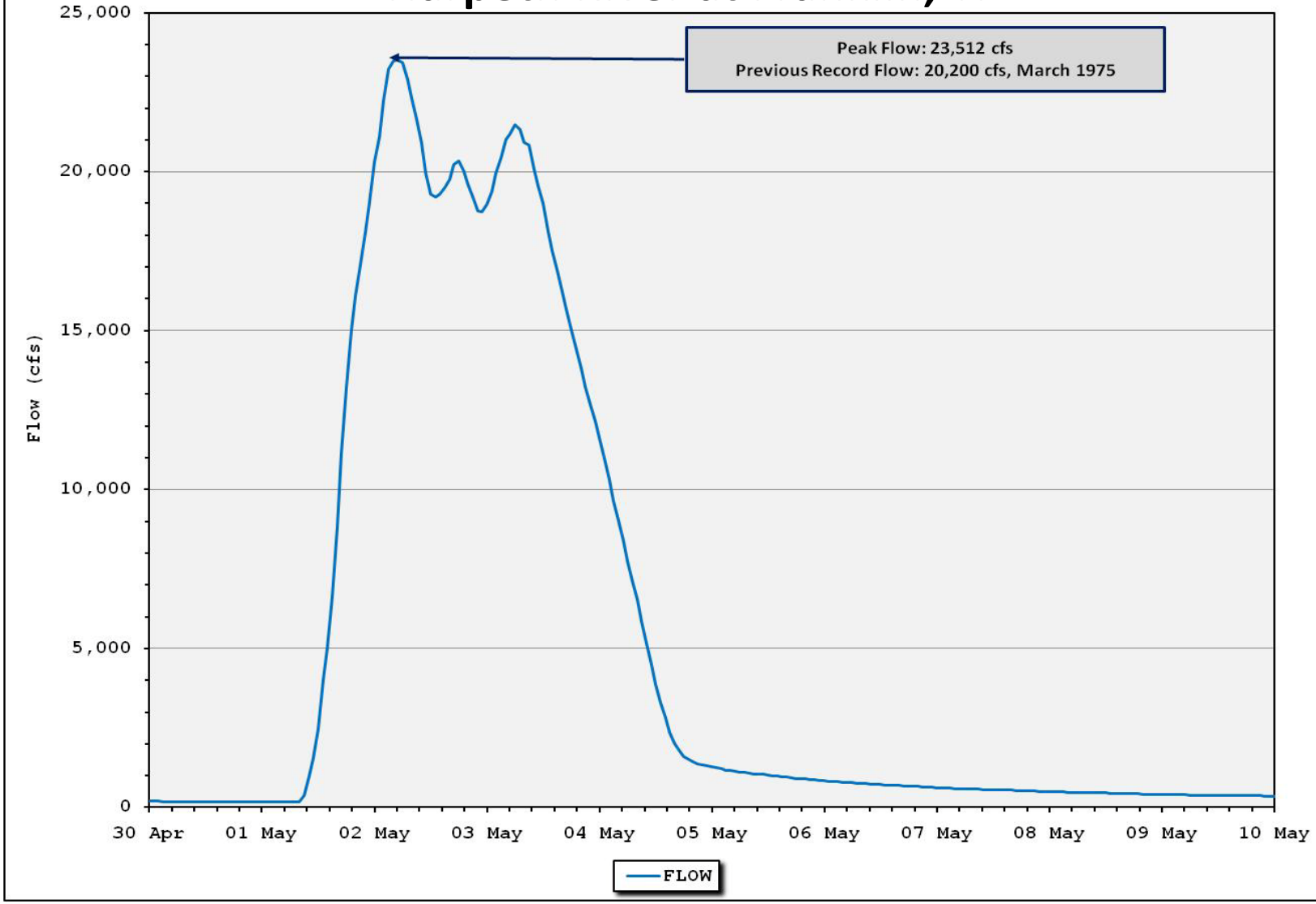
Mill Creek near Antioch, TN



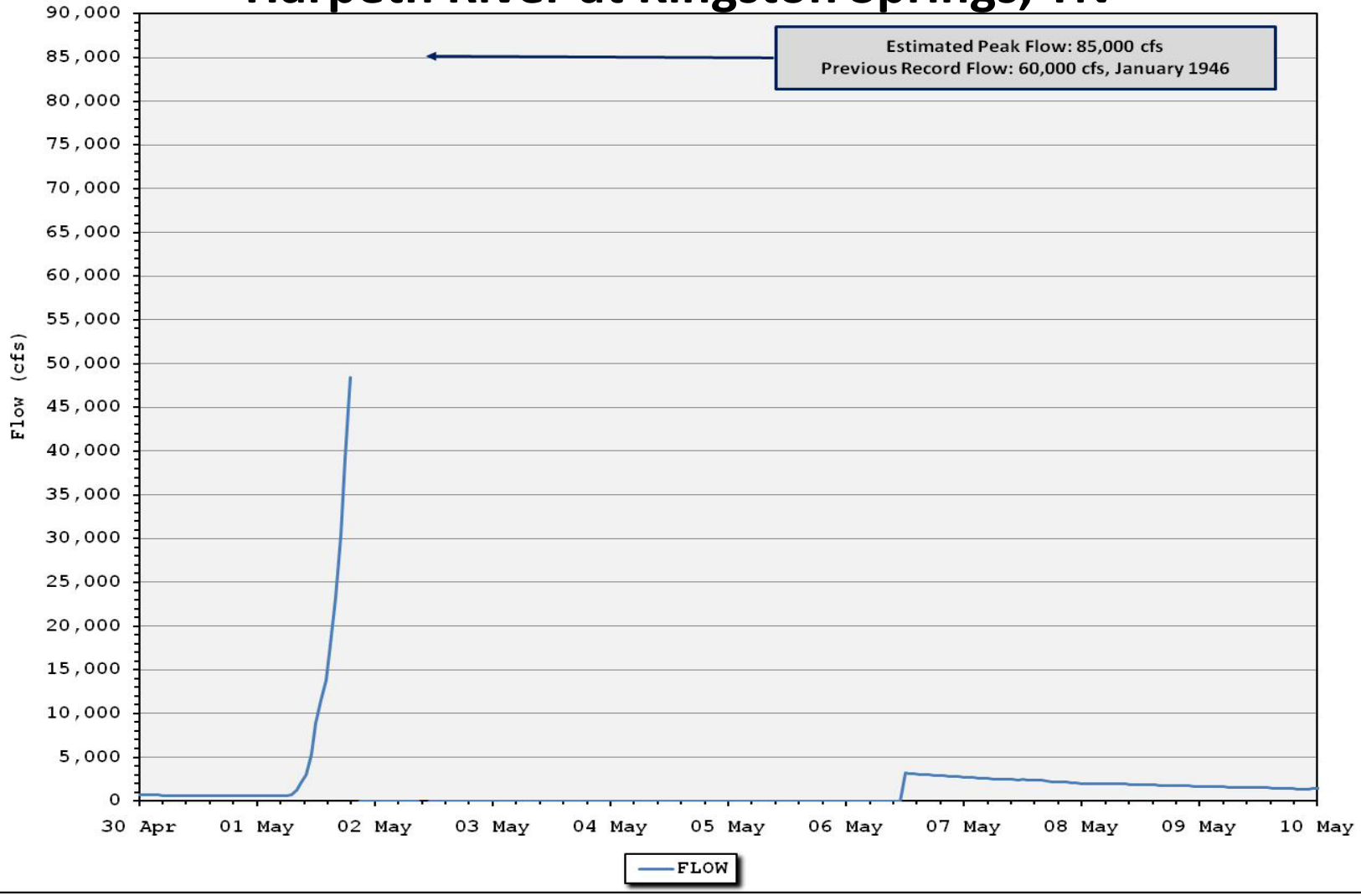
Sycamore Creek near Ashland City, TN



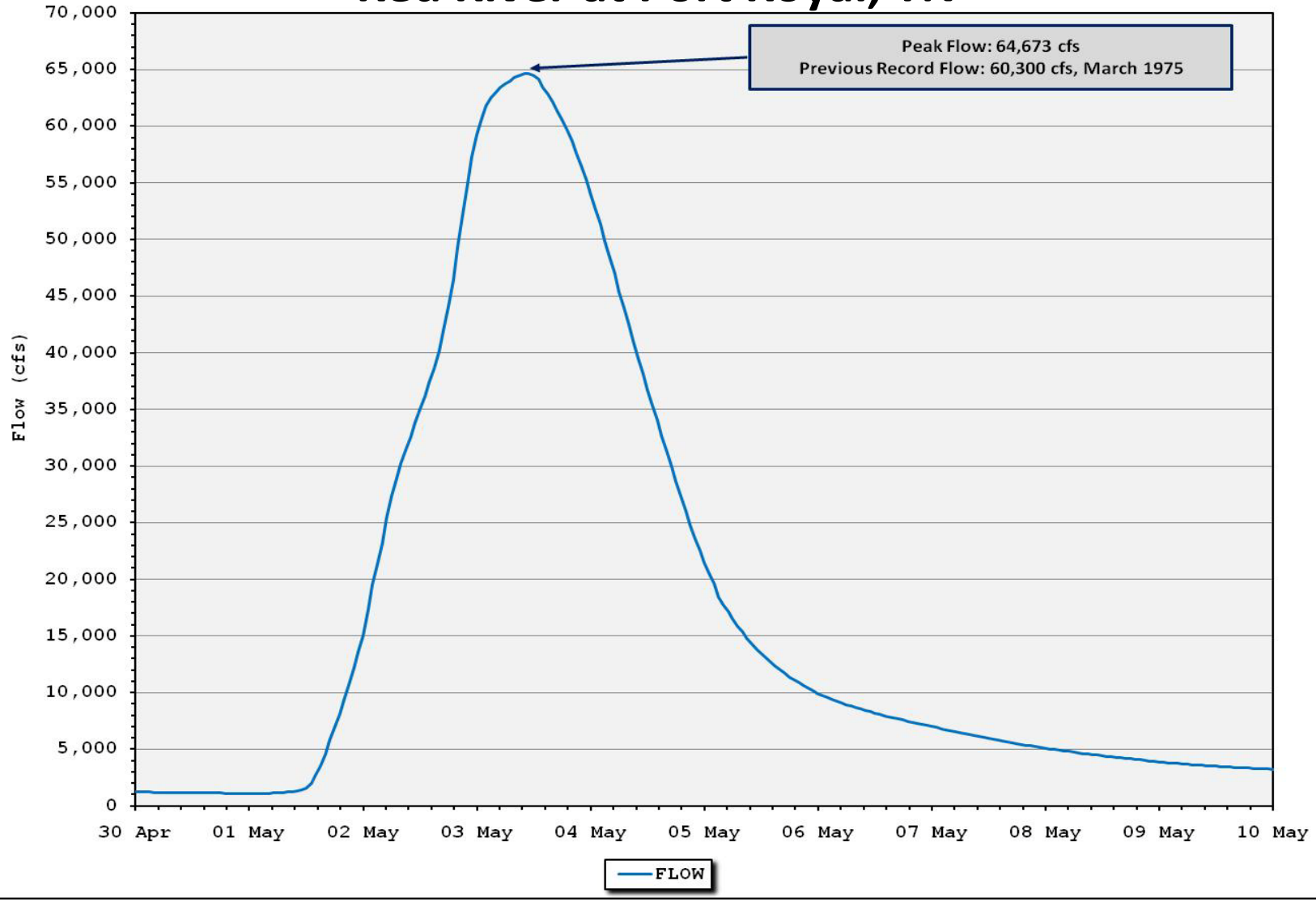
Harpeth River at Franklin, TN



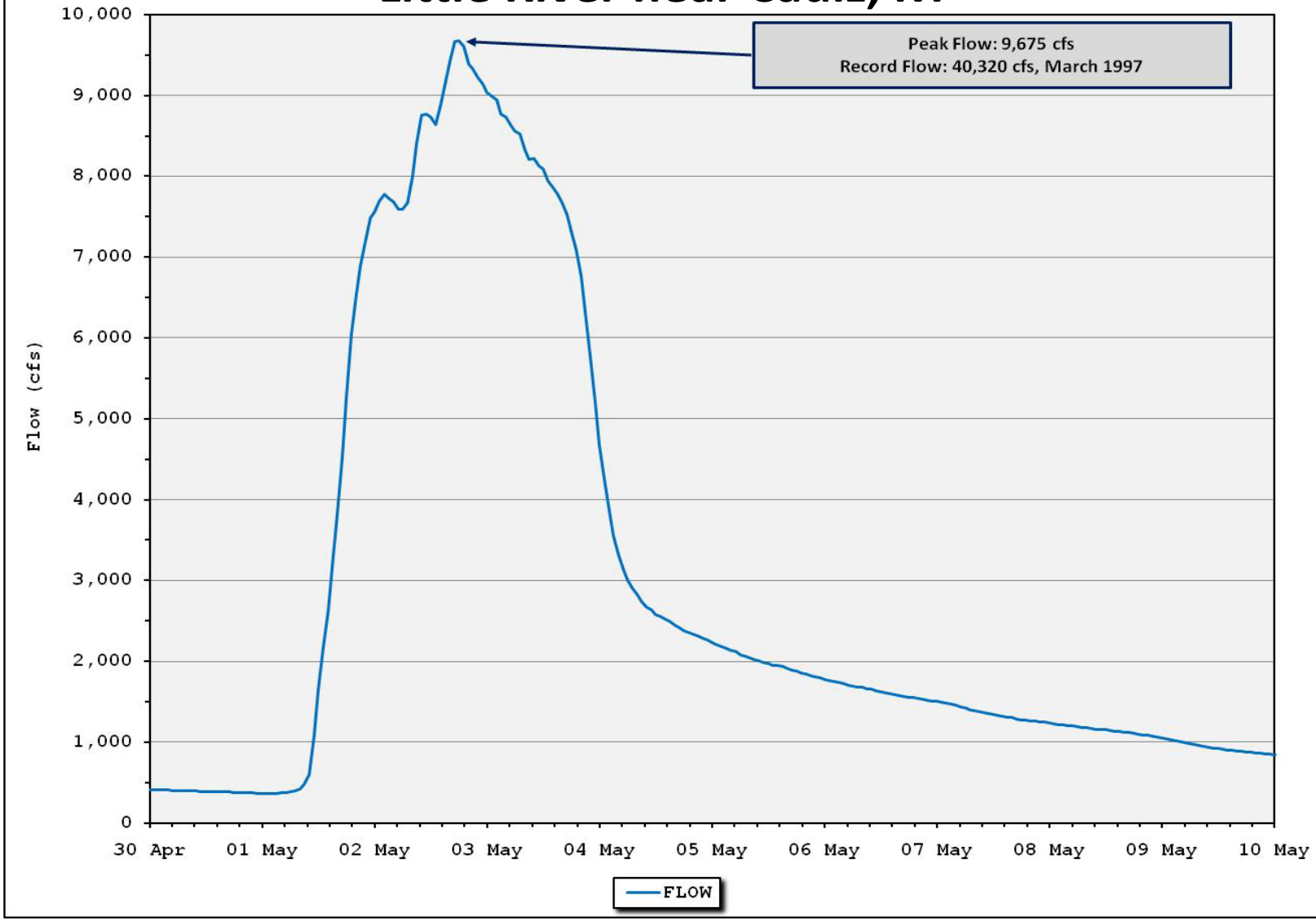
Harpeth River at Kingston Springs, TN



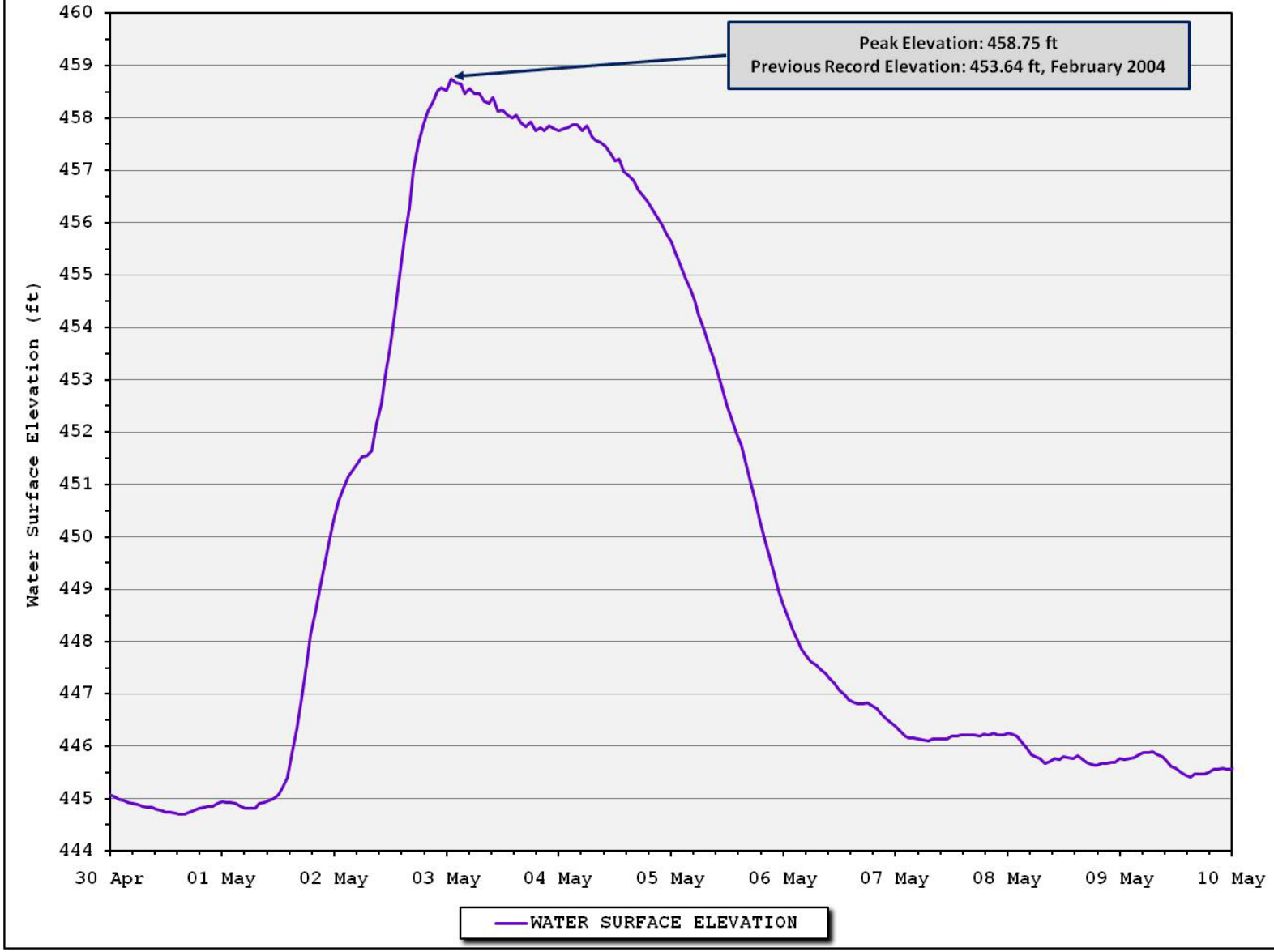
Red River at Port Royal, TN



Little River near Cadiz, KY



Cumberland River at Hunters Point – River Mile 263 (Old Hickory Project)



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Project Tables

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Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
29-Apr-2010	1:00	504.90	450.90	15,800	445.07	393.27	19,200	384.98	362.98	14,800	360.10	312.90	42,200
29-Apr-2010	2:00	504.90	450.90	15,800	445.07	393.37	19,200	385.09	362.59	14,600	360.10	313.00	42,200
29-Apr-2010	3:00	504.90	450.90	15,800	445.07	393.37	19,200	385.20	362.10	14,400	360.10	313.10	41,900
29-Apr-2010	4:00	504.90	450.90	15,800	445.07	393.27	19,200	385.30	362.10	14,400	360.10	313.10	41,900
29-Apr-2010	5:00	504.90	450.90	15,800	445.08	393.28	19,200	385.41	361.91	14,200	360.10	313.10	41,900
29-Apr-2010	6:00	504.90	450.90	15,800	445.05	393.35	19,200	385.52	361.92	14,200	360.10	313.10	41,900
29-Apr-2010	7:00	504.88	450.88	15,800	445.05	393.35	19,200	385.65	361.85	14,000	360.10	313.20	42,200
29-Apr-2010	8:00	504.89	450.89	15,800	445.00	393.20	19,200	385.70	361.80	14,000	360.10	313.40	42,200
29-Apr-2010	9:00	504.89	450.89	15,800	445.05	392.25	19,200	385.55	362.75	21,600	360.10	313.40	42,200
29-Apr-2010	10:00	504.89	450.79	15,800	445.00	393.20	19,200	385.50	363.00	21,600	360.10	313.40	42,200
29-Apr-2010	11:00	504.89	450.79	15,800	444.95	394.15	21,900	385.50	363.20	21,600	360.10	313.40	42,200
29-Apr-2010	12:00	504.89	450.69	15,800	444.95	394.45	23,400	385.40	363.30	22,200	360.10	313.40	42,200
29-Apr-2010	13:00	504.90	450.80	15,800	444.90	394.80	23,700	385.40	363.40	22,200	360.10	313.40	42,200
29-Apr-2010	14:00	504.90	450.80	15,800	444.90	395.00	23,700	385.35	363.45	22,200	360.10	313.40	42,200
29-Apr-2010	15:00	504.92	450.92	15,800	444.90	395.00	23,700	385.30	363.40	22,200	360.10	313.40	42,200
29-Apr-2010	16:00	504.92	451.02	15,800	444.90	395.00	23,700	385.30	363.50	22,200	360.05	313.45	42,200
29-Apr-2010	17:00	504.92	451.02	15,800	444.85	395.15	23,700	385.30	363.60	22,200	360.05	313.55	42,200
29-Apr-2010	18:00	504.92	451.02	15,800	444.85	395.15	23,700	385.30	363.50	22,200	360.05	313.55	42,200
29-Apr-2010	19:00	504.85	452.65	24,800	444.80	395.30	23,700	385.35	363.45	22,200	360.05	313.65	42,500
29-Apr-2010	20:00	504.75	453.35	25,400	444.77	395.47	24,000	385.37	363.47	22,800	360.05	313.65	42,500
29-Apr-2010	21:00	504.75	453.55	25,400	444.75	395.45	24,000	385.40	363.50	22,800	360.00	313.80	42,500
29-Apr-2010	22:00	504.80	451.90	16,200	444.72	395.52	24,000	385.41	363.51	23,400	360.00	313.80	42,500
29-Apr-2010	23:00	504.80	451.40	16,200	444.71	395.51	24,000	385.46	363.56	22,800	359.95	313.85	42,500
29-Apr-2010	24:00:00	504.80	451.30	16,200	444.68	395.58	24,000	385.50	363.60	22,200	359.95	313.95	42,800
30-Apr-2010	1:00	504.80	451.20	15,800	444.68	395.58	24,000	385.54	363.64	22,800	359.95	314.05	42,800
30-Apr-2010	2:00	504.80	451.10	15,800	444.69	395.69	24,000	385.59	363.59	22,200	359.95	314.15	42,800

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
29-Apr-2010	1:00	504.90	450.90	15,800	445.07	393.27	19,200	384.98	362.98	14,800	360.10	312.90	42,200
29-Apr-2010	2:00	504.90	450.90	15,800	445.07	393.37	19,200	385.09	362.59	14,600	360.10	313.00	42,200
29-Apr-2010	3:00	504.90	450.90	15,800	445.07	393.37	19,200	385.20	362.10	14,400	360.10	313.10	41,900
29-Apr-2010	4:00	504.90	450.90	15,800	445.07	393.27	19,200	385.30	362.10	14,400	360.10	313.10	41,900
29-Apr-2010	5:00	504.90	450.90	15,800	445.08	393.28	19,200	385.41	361.91	14,200	360.10	313.10	41,900
29-Apr-2010	6:00	504.90	450.90	15,800	445.05	393.35	19,200	385.52	361.92	14,200	360.10	313.10	41,900
29-Apr-2010	7:00	504.88	450.88	15,800	445.05	393.35	19,200	385.65	361.85	14,000	360.10	313.20	42,200
29-Apr-2010	8:00	504.89	450.89	15,800	445.00	393.20	19,200	385.70	361.80	14,000	360.10	313.40	42,200
29-Apr-2010	9:00	504.89	450.89	15,800	445.05	392.25	19,200	385.55	362.75	21,600	360.10	313.40	42,200
29-Apr-2010	10:00	504.89	450.79	15,800	445.00	393.20	19,200	385.50	363.00	21,600	360.10	313.40	42,200
29-Apr-2010	11:00	504.89	450.79	15,800	444.95	394.15	21,900	385.50	363.20	21,600	360.10	313.40	42,200
29-Apr-2010	12:00	504.89	450.69	15,800	444.95	394.45	23,400	385.40	363.30	22,200	360.10	313.40	42,200
29-Apr-2010	13:00	504.90	450.80	15,800	444.90	394.80	23,700	385.40	363.40	22,200	360.10	313.40	42,200
29-Apr-2010	14:00	504.90	450.80	15,800	444.90	395.00	23,700	385.35	363.45	22,200	360.10	313.40	42,200
29-Apr-2010	15:00	504.92	450.92	15,800	444.90	395.00	23,700	385.30	363.40	22,200	360.10	313.40	42,200
29-Apr-2010	16:00	504.92	451.02	15,800	444.90	395.00	23,700	385.30	363.50	22,200	360.05	313.45	42,200
29-Apr-2010	17:00	504.92	451.02	15,800	444.85	395.15	23,700	385.30	363.60	22,200	360.05	313.55	42,200
29-Apr-2010	18:00	504.92	451.02	15,800	444.85	395.15	23,700	385.30	363.50	22,200	360.05	313.55	42,200
29-Apr-2010	19:00	504.85	452.65	24,800	444.80	395.30	23,700	385.35	363.45	22,200	360.05	313.65	42,500
29-Apr-2010	20:00	504.75	453.35	25,400	444.77	395.47	24,000	385.37	363.47	22,800	360.05	313.65	42,500
29-Apr-2010	21:00	504.75	453.55	25,400	444.75	395.45	24,000	385.40	363.50	22,800	360.00	313.80	42,500
29-Apr-2010	22:00	504.80	451.90	16,200	444.72	395.52	24,000	385.41	363.51	23,400	360.00	313.80	42,500
29-Apr-2010	23:00	504.80	451.40	16,200	444.71	395.51	24,000	385.46	363.56	22,800	359.95	313.85	42,500
29-Apr-2010	24:00:00	504.80	451.30	16,200	444.68	395.58	24,000	385.50	363.60	22,200	359.95	313.95	42,800
30-Apr-2010	1:00	504.80	451.20	15,800	444.68	395.58	24,000	385.54	363.64	22,800	359.95	314.05	42,800
30-Apr-2010	2:00	504.80	451.10	15,800	444.69	395.69	24,000	385.59	363.59	22,200	359.95	314.15	42,800

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
30-Apr-2010	3:00	504.80	451.00	15,800	444.68	395.68	24,000	385.62	363.52	22,800	359.95	314.25	42,800
30-Apr-2010	4:00	504.80	451.00	15,800	444.68	395.78	24,000	385.68	363.58	22,800	359.95	314.35	42,800
30-Apr-2010	5:00	504.82	450.92	15,800	444.67	395.77	24,000	385.73	363.53	22,200	359.95	314.35	42,800
30-Apr-2010	6:00	504.82	450.92	15,800	444.64	395.74	24,000	385.77	363.57	22,280	359.95	314.35	42,800
30-Apr-2010	7:00	504.82	450.82	15,800	444.60	395.80	24,000	385.80	363.60	22,280	359.95	314.45	43,100
30-Apr-2010	8:00	504.84	450.64	15,800	444.60	395.80	24,000	385.85	363.65	22,280	359.95	314.45	42,700
30-Apr-2010	9:00	504.84	450.54	15,800	444.55	396.05	24,300	385.90	363.60	22,900	359.95	314.45	42,700
30-Apr-2010	10:00	504.85	450.45	15,800	444.55	395.05	22,500	385.95	363.55	22,900	359.95	314.45	42,700
30-Apr-2010	11:00	504.85	450.38	15,700	444.55	395.15	21,300	386.00	363.50	22,400	359.95	314.45	42,700
30-Apr-2010	12:00	504.86	450.26	15,700	444.50	394.70	19,800	386.05	363.55	22,900	359.90	314.50	42,700
30-Apr-2010	13:00	504.86	450.16	15,600	444.50	394.60	19,800	385.80	364.30	28,600	359.90	314.60	42,800
30-Apr-2010	14:00	504.68	452.48	24,700	444.45	394.85	20,100	385.75	364.55	30,000	359.90	314.60	42,800
30-Apr-2010	15:00	504.69	452.79	24,700	444.50	394.30	19,800	385.60	364.90	29,100	359.90	314.60	42,800
30-Apr-2010	16:00	504.64	453.04	24,700	444.50	394.60	19,800	385.50	365.00	29,100	359.90	314.70	42,800
30-Apr-2010	17:00	504.57	453.37	25,300	444.45	394.15	19,500	385.40	365.00	29,100	359.85	314.75	42,600
30-Apr-2010	18:00	504.54	453.44	25,300	444.45	394.15	19,500	385.35	364.95	29,100	359.85	314.75	42,600
30-Apr-2010	19:00	504.50	453.60	25,300	444.42	394.42	19,800	385.13	365.13	27,900	359.80	314.80	42,600
30-Apr-2010	20:00	504.45	453.95	25,300	444.50	393.90	19,800	384.99	365.09	27,900	359.80	314.80	42,600
30-Apr-2010	21:00	504.35	454.25	25,900	444.52	393.82	19,500	384.88	365.08	29,100	359.80	314.80	42,600
30-Apr-2010	22:00	504.45	452.65	16,500	444.54	393.74	19,500	384.75	365.05	28,600	359.80	314.80	42,600
30-Apr-2010	23:00	504.45	452.35	16,500	444.55	393.75	19,500	384.62	365.12	27,500	359.75	314.85	42,800
30-Apr-2010	24:00:00	504.45	452.15	16,500	444.55	393.95	19,500	384.49	365.09	27,500	359.75	314.95	42,800
1-May-2010	1:00	504.50	451.80	16,200	444.55	394.95	23,700	384.36	365.06	28,700	359.75	315.05	42,500
1-May-2010	2:00	504.50	451.60	16,200	444.56	394.76	23,700	384.21	365.11	28,700	359.75	315.15	42,800
1-May-2010	3:00	504.45	451.45	16,200	444.60	394.90	23,700	384.07	365.07	26,700	359.75	315.25	42,800
1-May-2010	4:00	504.45	451.45	16,200	444.59	395.09	24,000	383.94	365.04	27,900	359.75	315.35	42,800

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
1-May-2010	5:00	504.50	451.30	16,200	444.59	395.09	24,000	383.79	365.09	27,900	359.70	315.40	43,100
1-May-2010	6:00	504.55	451.35	16,200	444.55	395.15	24,000	383.81	365.11	26,700	359.70	315.40	42,300
1-May-2010	7:00	504.50	451.40	16,200	444.58	395.38	24,900	383.77	365.27	28,200	359.85	315.55	41,900
1-May-2010	8:00	504.50	451.30	16,200	444.64	396.14	25,200	383.92	365.22	28,400	359.85	315.65	41,900
1-May-2010	9:00	504.54	451.34	16,200	444.65	396.65	24,000	384.14	365.24	26,700	359.90	316.00	42,200
1-May-2010	10:00	504.66	451.16	15,800	444.68	396.48	24,000	384.55	365.45	27,900	360.15	316.15	42,200
1-May-2010	11:00	504.42	453.02	25,400	444.74	396.54	24,000	385.00	365.70	27,900	360.15	316.25	42,200
1-May-2010	12:00	504.45	453.45	25,400	444.82	396.82	24,300	385.55	365.95	29,500	360.15	316.45	42,500
1-May-2010	13:00	504.47	453.77	25,400	444.85	398.25	30,000	386.00	367.00	39,600	360.25	316.55	42,500
1-May-2010	14:00	504.43	453.93	25,400	444.83	399.93	34,400	386.20	368.80	59,700	360.25	316.75	42,800
1-May-2010	15:00	504.50	454.30	26,000	444.94	400.84	36,100	386.08	371.28	92,700	360.25	316.75	42,800
1-May-2010	16:00	504.48	456.08	30,600	445.05	402.55	41,700	386.35	373.75	79,100	360.40	316.80	42,500
1-May-2010	17:00	504.70	457.50	32,400	445.20	404.80	47,600	386.31	375.71	78,000	360.55	316.95	42,600
1-May-2010	18:00	504.80	460.10	36,900	445.30	406.70	55,000	386.35	377.85	86,000	360.75	316.95	42,600
1-May-2010	19:00	504.89	462.79	42,700	445.60	408.30	54,200	385.65	380.95	102,000	360.95	316.95	42,300
1-May-2010	20:00	504.84	464.94	48,300	445.80	409.50	60,400	385.38	382.68	107,000	361.05	317.05	42,300
1-May-2010	21:00	504.97	466.37	48,300	445.90	410.50	65,200	385.95	384.15	114,000	361.25	317.05	42,100
1-May-2010	22:00	505.10	467.20	49,700	446.21	411.61	70,300	386.44	385.04	120,000	361.45	317.15	42,100
1-May-2010	23:00	505.25	467.95	47,100	446.33	412.13	69,700	386.82	385.62	122,000	361.60	317.30	42,100
1-May-2010	24:00:00	505.32	469.12	53,000	446.45	413.05	74,500	387.21	386.11	122,000	361.80	317.30	41,900
2-May-2010	1:00	505.25	470.45	61,600	446.80	414.80	75,400	387.82	386.92	126,000	362.00	317.50	41,900
2-May-2010	2:00	505.30	471.00	61,600	446.97	414.87	73,900	388.41	387.31	126,000	362.20	317.70	41,900
2-May-2010	3:00	505.35	471.35	60,900	447.20	414.90	74,400	388.90	387.90	130,000	362.50	318.00	42,000
2-May-2010	4:00	505.40	471.60	58,800	447.37	414.97	74,400	389.33	388.33	130,000	362.70	318.20	42,000
2-May-2010	5:00	505.42	471.82	57,800	447.57	415.07	74,800	389.73	388.73	133,000	362.90	318.50	42,300
2-May-2010	6:00	505.47	471.87	57,800	447.75	415.05	73,300	390.10	388.90	133,000	363.10	318.70	42,300

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
2-May-2010	7:00	505.47	472.07	59,400	447.88	415.68	81,100	390.50	389.40	137,000	363.25	318.85	42,400
2-May-2010	8:00	505.48	472.18	59,400	448.12	416.48	80,200	390.97	389.77	139,000	363.50	319.10	42,400
2-May-2010	9:00	505.47	472.17	59,400	448.78	418.08	80,200	391.60	390.30	142,000	363.65	319.15	42,100
2-May-2010	10:00	505.47	472.17	59,400	449.40	419.60	80,300	392.30	390.80	146,000	363.85	319.35	42,100
2-May-2010	11:00	505.42	472.22	58,800	449.80	421.10	89,700	393.00	391.40	148,000	364.05	319.95	48,500
2-May-2010	12:00	505.40	472.20	59,300	450.38	423.48	107,000	393.62	392.02	150,000	364.15	320.65	54,900
2-May-2010	13:00	505.36	472.16	58,800	450.91	425.21	123,600	394.30	393.30	160,000	364.30	321.30	59,600
2-May-2010	14:00	505.35	472.05	58,800	451.45	426.65	130,300	395.00	393.50	165,000	364.45	322.15	66,300
2-May-2010	15:00	505.42	472.22	58,800	451.45	428.85	142,900	395.62	393.92	170,000	364.55	323.15	74,600
2-May-2010	16:00	505.56	472.56	59,400	451.35	430.35	163,200	396.30	394.80	175,000	364.60	324.30	86,000
2-May-2010	17:00	505.87	473.27	58,500	451.26	431.86	202,850	396.86	395.36	175,000	364.65	325.35	93,300
2-May-2010	18:00	506.16	474.06	58,500	451.10	433.10	212,260	397.40	396.00	180,000	364.70	326.50	101,100
2-May-2010	19:00	506.50	474.80	60,600	451.00	433.50	211,730	397.80	396.40	185,000	364.75	328.15	110,200
2-May-2010	20:00	506.83	475.83	65,500	450.90	434.00	211,400	398.20	396.90	190,000	364.80	329.40	119,600
2-May-2010	21:00	507.17	476.47	65,600	450.80	434.50	211,070	398.60	397.40	195,000	364.85	330.65	130,400
2-May-2010	22:00	507.46	477.26	66,500	450.75	434.65	204,960	399.05	397.95	200,000	364.85	331.95	141,300
2-May-2010	23:00	507.80	478.10	74,500	450.80	434.70	199,025	399.45	398.35	200,000	364.85	333.05	150,500
2-May-2010	24:00:00	507.98	479.08	82,300	450.80	434.60	193,400	399.95	398.85	209,000	364.85	333.95	156,500
3-May-2010	1:00	508.25	480.35	94,000	450.80	434.20	187,620	400.48	399.38	220,000	364.85	335.05	166,700
3-May-2010	2:00	508.30	481.40	103,900	451.15	433.55	181,840	400.70	399.60	220,000	364.90	336.60	179,700
3-May-2010	3:00	508.21	482.81	113,100	451.25	433.05	182,820	401.14	400.04	220,000	364.85	337.35	187,900
3-May-2010	4:00	508.27	483.37	115,500	451.20	432.90	183,100	401.54	400.44	220,000	364.90	338.40	200,900
3-May-2010	5:00	508.33	483.83	119,000	450.95	433.55	194,600	401.85	400.75	220,000	364.85	339.35	209,900
3-May-2010	6:00	508.02	485.12	129,800	450.95	433.65	193,850	401.98	400.88	220,000	364.90	340.30	219,300
3-May-2010	7:00	508.05	485.35	130,100	450.55	434.25	196,748	402.48	401.38	220,000	364.95	341.25	227,900
3-May-2010	8:00	507.97	485.77	126,500	450.40	434.50	198,405	402.68	401.58	220,000	364.90	342.20	244,200

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
3-May-2010	9:00	507.91	486.01	125,400	450.30	434.60	197,940	402.89	401.79	220,000	364.90	343.20	251,900
3-May-2010	10:00	507.87	486.37	125,400	450.20	434.80	197,630	403.09	401.99	228,000	364.85	344.35	261,400
3-May-2010	11:00	507.80	486.50	124,900	450.10	434.90	197,320	403.29	402.19	228,000	364.90	344.80	260,700
3-May-2010	12:00	507.86	486.36	119,500	449.95	435.05	197,010	403.40	402.30	228,000	364.95	345.25	260,700
3-May-2010	13:00	507.90	486.10	113,400	449.80	435.20	196,545	403.54	402.54	228,000	364.95	345.85	270,900
3-May-2010	14:00	507.88	486.18	113,900	449.70	434.90	190,400	403.66	402.66	230,000	364.95	346.45	279,000
3-May-2010	15:00	507.92	486.02	110,000	449.65	434.55	175,925	403.78	402.78	231,000	364.95	347.15	289,200
3-May-2010	16:00	507.86	485.96	110,800	449.80	434.00	165,402	403.89	402.99	232,000	364.85	347.85	299,700
3-May-2010	17:00	507.88	485.78	107,000	449.90	433.00	156,320	403.94	403.04	232,000	364.90	348.40	300,000
3-May-2010	18:00	507.95	485.45	100,200	450.00	432.60	150,183	403.99	403.09	232,000	364.90	348.70	300,000
3-May-2010	19:00	507.93	485.13	100,800	450.10	432.28	144,235	404.05	403.15	234,000	364.95	349.25	300,000
3-May-2010	20:00	507.92	484.82	98,200	450.20	431.70	144,450	404.05	403.05	234,000	365.10	349.10	291,200
3-May-2010	21:00	507.93	484.33	95,300	450.30	431.50	144,670	404.10	403.10	234,000	365.15	348.95	280,800
3-May-2010	22:00	507.91	484.01	92,600	450.40	431.20	144,885	404.15	403.15	240,000	365.25	349.05	282,400
3-May-2010	23:00	507.90	483.50	89,700	450.50	431.00	145,100	404.15	403.25	240,000	365.25	349.15	282,400
3-May-2010	24:00:00	507.90	483.30	86,100	450.55	430.85	145,210	404.15	403.25	240,000	365.25	349.25	282,400
4-May-2010	1:00	507.89	482.59	83,500	450.60	430.80	145,315	404.15	403.25	240,000	365.30	349.30	282,400
4-May-2010	2:00	507.88	481.88	78,400	450.65	430.65	145,425	404.15	403.25	240,000	365.35	349.45	283,200
4-May-2010	3:00	507.88	481.38	74,300	450.70	430.50	145,530	404.15	403.25	240,000	365.45	349.55	283,200
4-May-2010	4:00	507.93	480.53	70,600	450.70	430.40	145,530	404.10	403.20	240,000	365.45	349.65	283,200
4-May-2010	5:00	507.88	479.98	70,400	450.75	430.35	145,640	404.05	403.15	240,000	365.45	350.05	293,600
4-May-2010	6:00	507.86	479.56	89,000	450.80	430.40	145,750	404.05	403.15	240,000	365.45	350.05	293,600
4-May-2010	7:00	507.75	479.05	65,200	450.84	430.24	145,835	403.95	403.15	235,000	365.50	350.40	296,000
4-May-2010	8:00	507.62	478.62	67,400	450.86	430.26	145,880	403.91	403.11	235,000	365.45	350.75	303,200
4-May-2010	9:00	507.49	478.39	65,600	450.85	429.95	145,855	403.85	403.05	235,000	365.60	350.60	285,800
4-May-2010	10:00	507.31	477.91	70,100	450.85	430.05	145,855	403.75	402.85	235,000	365.70	350.40	266,000

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
4-May-2010	11:00	507.12	477.62	68,900	450.85	429.95	145,855	403.70	402.80	235,000	365.70	350.30	266,000
4-May-2010	12:00	506.92	477.32	68,000	450.85	429.95	145,855	403.70	402.80	235,000	365.70	350.30	266,000
4-May-2010	13:00	506.72	477.12	66,400	450.85	429.85	145,855	403.60	402.70	235,000	365.80	350.40	266,000
4-May-2010	14:00	506.47	476.77	69,900	450.85	429.85	145,855	403.52	402.62	235,000	365.80	350.40	266,000
4-May-2010	15:00	506.24	476.44	66,200	450.80	429.90	145,750	403.45	402.55	235,000	365.80	350.40	266,700
4-May-2010	16:00	505.98	476.18	67,100	450.75	429.75	145,640	403.35	402.65	235,000	365.85	350.35	266,700
4-May-2010	17:00	505.90	475.50	64,700	450.75	429.75	145,640	403.30	402.60	235,000	366.05	349.75	249,300
4-May-2010	18:00	505.68	474.98	56,800	450.65	429.65	145,425	403.20	402.50	235,000	366.10	349.50	229,800
4-May-2010	19:00	505.52	474.02	51,800	450.58	429.78	145,275	403.09	402.39	230,000	366.15	349.25	230,400
4-May-2010	20:00	505.32	473.62	53,400	450.53	429.73	145,165	402.96	402.36	230,000	366.15	349.15	230,400
4-May-2010	21:00	505.18	472.78	51,800	450.48	429.58	145,055	402.85	402.25	230,000	366.25	349.05	231,000
4-May-2010	22:00	505.03	472.33	46,500	450.39	429.59	144,860	402.74	402.14	225,000	366.25	349.05	231,000
4-May-2010	23:00	504.95	471.45	42,500	450.30	429.50	144,670	402.63	402.03	225,000	366.30	349.00	231,000
4-May-2010	24:00:00	504.92	470.22	35,500	450.20	429.40	144,450	402.52	401.92	225,000	366.35	348.95	231,000
5-May-2010	1:00	504.74	469.64	38,800	450.12	429.52	144,280	402.42	401.82	220,000	366.35	348.85	231,000
5-May-2010	2:00	504.54	468.84	38,400	450.00	429.40	144,020	402.30	401.70	220,000	366.40	348.80	231,000
5-May-2010	3:00	504.50	468.10	34,400	449.90	429.30	143,805	402.15	401.55	220,000	366.45	348.75	231,600
5-May-2010	4:00	504.39	467.49	29,700	449.84	429.24	143,675	402.07	401.47	220,000	366.50	348.70	231,600
5-May-2010	5:00	504.30	466.70	31,500	449.70	429.20	143,370	401.96	401.36	217,000	366.50	348.70	231,600
5-May-2010	6:00	504.19	466.29	28,600	449.58	429.28	143,115	401.86	401.26	217,000	366.55	348.65	232,200
5-May-2010	7:00	504.03	465.73	30,400	449.40	429.10	142,720	401.75	401.15	217,000	366.60	348.70	232,200
5-May-2010	8:00	503.86	465.36	31,800	449.27	429.17	142,440	401.62	401.02	217,000	366.60	348.70	232,200
5-May-2010	9:00	503.73	464.93	33,000	449.09	429.09	142,045	401.50	401.00	215,000	366.65	348.65	232,200
5-May-2010	10:00	503.58	464.58	33,400	449.00	429.00	129,200	401.35	400.75	212,000	366.65	348.65	232,200
5-May-2010	11:00	503.26	464.06	46,300	448.65	429.25	134,405	401.25	400.65	212,000	366.70	348.60	232,200
5-May-2010	12:00	503.28	484.38	45,900	448.50	428.91	134,150	401.13	400.53	212,000	366.70	348.60	232,200

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
5-May-2010	13:00	502.90	464.50	44,400	448.30	428.60	121,550	401.00	400.40	206,000	366.75	348.55	232,200
5-May-2010	14:00	503.50	461.30	22,000	448.25	428.15	120,975	400.85	400.35	206,000	366.80	348.60	232,800
5-May-2010	15:00	503.50	459.60	10,000	448.05	427.85	108,965	400.75	400.15	206,000	366.85	348.55	232,800
5-May-2010	16:00	503.40	458.50	9,700	448.00	427.30	108,900	400.60	400.00	206,000	366.85	348.55	232,800
5-May-2010	17:00	503.42	457.32	10,100	448.05	426.45	99,000	400.45	399.95	206,000	366.90	348.60	232,800
5-May-2010	18:00	503.51	457.41	9,500	447.95	426.45	98,800	400.40	399.80	206,000	366.90	348.60	232,800
5-May-2010	19:00	503.60	455.80	9,100	447.84	426.44	94,000	400.20	399.60	200,000	366.95	348.65	233,400
5-May-2010	20:00	503.65	455.25	9,100	447.79	425.09	89,500	400.00	399.40	195,000	366.95	348.65	233,400
5-May-2010	21:00	503.70	454.90	8,900	447.70	424.60	89,200	399.83	399.23	190,000	366.95	348.65	233,400
5-May-2010	22:00	503.77	454.37	8,900	447.55	424.25	86,900	399.68	399.08	190,000	366.95	348.65	233,400
5-May-2010	23:00	503.85	454.15	8,700	447.40	423.60	83,200	399.50	398.90	190,000	367.00	348.70	233,400
5-May-2010	24:00:00	503.90	453.90	8,700	447.30	422.90	79,400	399.33	398.73	190,000	367.00	348.70	233,400
6-May-2010	1:00	503.95	453.65	8,700	447.20	422.40	75,800	399.09	398.59	190,000	367.00	348.70	233,400
6-May-2010	2:00	504.03	453.53	8,500	447.13	421.53	70,400	398.90	398.40	187,000	367.00	348.70	233,400
6-May-2010	3:00	503.90	455.00	17,700	447.00	421.10	70,400	398.72	398.22	187,000	367.00	348.70	233,400
6-May-2010	4:00	503.97	455.37	17,700	446.85	420.05	65,500	398.52	398.02	184,000	367.00	348.70	233,400
6-May-2010	5:00	504.02	455.52	17,700	446.73	419.33	61,500	398.32	397.82	184,000	367.00	348.70	233,400
6-May-2010	6:00	503.93	455.63	18,200	446.60	418.90	62,400	398.12	397.62	182,000	367.00	348.70	233,400
6-May-2010	7:00	503.90	455.70	18,200	446.45	418.05	63,100	397.92	397.32	182,000	367.00	348.70	233,400
6-May-2010	8:00	504.01	455.71	18,200	446.35	417.65	63,100	397.70	397.10	182,000	367.00	348.80	233,400
6-May-2010	9:00	504.03	455.83	18,200	446.23	417.33	63,800	397.49	396.99	179,000	367.05	348.85	233,400
6-May-2010	10:00	504.03	455.83	18,200	446.12	416.92	63,800	397.27	396.77	176,000	367.05	348.85	233,400
6-May-2010	11:00	504.05	455.85	18,200	445.99	416.49	63,900	397.05	396.55	173,000	367.15	348.65	226,800
6-May-2010	12:00	504.06	455.96	18,200	445.88	416.18	65,200	396.76	396.26	172,000	367.15	348.25	219,000
6-May-2010	13:00	503.81	458.01	28,500	445.77	415.37	61,200	396.53	396.03	168,000	367.25	348.25	219,000
6-May-2010	14:00	503.85	458.55	29,300	445.72	414.72	54,500	396.29	395.79	167,000	367.45	347.45	207,900

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010													
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Total Discharge cfs	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Total Discharge cfs	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Total Discharge cfs	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Total Discharge cfs
6-May-2010	15:00	503.80	459.00	29,300	445.63	414.23	55,700	396.02	395.52	166,000	367.55	347.35	198,600
6-May-2010	16:00	503.73	459.33	30,000	445.55	413.75	55,600	395.77	395.17	163,000	367.65	347.15	187,900
6-May-2010	17:00	503.90	457.60	19,000	445.50	413.40	56,100	395.51	395.01	160,000	367.75	346.55	177,500
6-May-2010	18:00	503.95	457.25	18,600	445.40	413.10	55,600	395.24	394.84	159,000	367.75	345.95	165,400
6-May-2010	19:00	503.88	456.98	18,600	445.29	412.69	56,500	394.94	394.44	155,000	368.00	345.00	158,400
6-May-2010	20:00	503.96	456.76	18,600	445.26	412.46	57,100	394.69	394.19	155,000	368.05	344.65	150,400
6-May-2010	21:00	504.05	456.55	18,200	445.17	412.07	57,100	394.42	393.92	151,000	368.15	344.35	150,600
6-May-2010	22:00	504.08	456.38	18,200	445.11	411.91	55,600	394.14	393.64	147,000	368.20	343.80	150,800
6-May-2010	23:00	504.11	456.41	18,200	445.06	411.76	56,200	393.86	393.36	145,000	368.30	343.60	151,000
6-May-2010	24:00:00	504.18	456.28	18,200	444.99	411.59	56,200	393.57	393.07	145,000	368.30	343.60	151,000
7-May-2010	1:00	504.02	458.22	28,500	444.91	411.41	54,900	393.28	392.78	141,000	368.40	343.00	151,200
7-May-2010	2:00	503.99	458.79	29,300	444.82	411.22	54,900	393.00	392.50	140,000	368.45	342.65	151,200
7-May-2010	3:00	503.99	459.19	29,300	444.76	411.06	56,100	392.75	392.25	140,000	368.50	342.30	151,600
7-May-2010	4:00	503.94	459.64	30,000	444.69	410.99	56,500	392.47	391.97	136,000	368.55	342.15	151,600
7-May-2010	5:00	503.88	459.78	30,000	444.64	410.44	52,100	392.15	391.65	132,000	368.60	341.90	151,800
7-May-2010	6:00	503.84	460.04	30,000	444.60	410.20	51,900	391.87	391.47	130,000	368.65	341.85	151,800

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
29-Apr-2010	1:00	683.33	14,560	650.32	1,745	630.44	250	489.31	0
29-Apr-2010	2:00	683.33	14,560	650.32	1,745	630.44	250	489.31	0
29-Apr-2010	3:00	683.35	14,560	650.32	1,745	630.44	250	489.32	0
29-Apr-2010	4:00	683.35	14,560	650.32	1,745	630.45	250	489.32	0
29-Apr-2010	5:00	683.35	14,560	650.32	1,745	630.45	250	489.32	0
29-Apr-2010	6:00	683.35	14,560	650.32	1,745	630.45	3,650	489.32	0
29-Apr-2010	7:00	683.34	14,560	650.31	1,795	630.46	3,650	489.33	0
29-Apr-2010	8:00	683.34	10,930	650.31	1,795	630.45	3,650	489.33	0
29-Apr-2010	9:00	683.33	10,840	650.30	1,795	630.45	3,650	489.33	0
29-Apr-2010	10:00	683.33	10,840	650.30	1,795	630.43	3,650	489.33	0
29-Apr-2010	11:00	683.32	10,840	650.30	1,745	630.43	250	489.33	0
29-Apr-2010	12:00	683.32	10,780	650.30	1,745	630.43	250	489.33	0
29-Apr-2010	13:00	683.31	14,480	650.29	1,745	630.43	250	489.34	0
29-Apr-2010	14:00	683.31	14,560	650.29	1,745	630.43	250	489.34	0
29-Apr-2010	15:00	683.31	14,560	650.28	1,745	630.43	3,650	489.34	0
29-Apr-2010	16:00	683.31	14,560	650.28	1,745	630.43	3,650	489.34	0
29-Apr-2010	17:00	683.31	14,560	650.28	1,745	630.42	3,650	489.34	0
29-Apr-2010	18:00	683.31	14,560	650.27	1,745	630.41	3,650	489.34	0
29-Apr-2010	19:00	683.31	14,560	650.27	1,745	630.40	3,650	489.34	0
29-Apr-2010	20:00	683.31	14,560	650.27	1,745	630.40	3,650	489.34	0
29-Apr-2010	21:00	683.31	14,560	650.27	1,745	630.40	3,650	489.34	0
29-Apr-2010	22:00	683.31	14,560	650.27	1,745	630.40	250	489.34	0
29-Apr-2010	23:00	683.31	14,560	650.27	1,745	630.40	250	489.34	0
29-Apr-2010	24:00:00	683.31	14,560	650.26	1,745	630.40	250	489.34	0
30-Apr-2010	1:00	683.29	14,560	650.26	1,745	630.42	250	489.34	0
30-Apr-2010	2:00	683.27	14,560	650.26	1,745	630.42	250	489.34	0
30-Apr-2010	3:00	683.26	14,560	650.25	1,745	630.42	250	489.34	0

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
30-Apr-2010	4:00	683.25	14,560	650.25	1,745	630.42	250	489.34	0
30-Apr-2010	5:00	683.25	14,560	650.25	1,745	630.42	250	489.35	0
30-Apr-2010	6:00	683.25	14,560	650.25	1,745	630.42	250	489.35	0
30-Apr-2010	7:00	683.23	14,680	650.24	1,745	630.44	250	489.36	0
30-Apr-2010	8:00	683.22	14,680	650.24	1,745	630.44	250	489.36	0
30-Apr-2010	9:00	683.21	14,680	650.23	1,745	630.44	250	489.36	0
30-Apr-2010	10:00	683.19	14,680	650.22	1,745	630.46	250	489.36	0
30-Apr-2010	11:00	683.17	14,680	650.22	1,745	630.46	3,650	489.35	0
30-Apr-2010	12:00	683.15	14,680	650.21	1,745	630.45	3,650	489.35	0
30-Apr-2010	13:00	683.13	14,680	650.21	1,745	630.45	3,650	489.35	0
30-Apr-2010	14:00	683.12	14,680	650.20	1,745	630.44	3,650	489.35	0
30-Apr-2010	15:00	683.11	14,680	650.20	1,745	630.43	3,650	489.35	0
30-Apr-2010	16:00	683.10	14,680	650.19	1,745	630.43	3,650	489.35	0
30-Apr-2010	17:00	683.08	14,680	650.19	1,745	630.42	3,650	489.35	0
30-Apr-2010	18:00	683.06	14,680	650.19	1,745	630.42	3,650	489.35	0
30-Apr-2010	19:00	683.06	14,680	650.19	1,745	630.41	3,650	489.35	0
30-Apr-2010	20:00	683.05	14,680	650.18	1,745	630.41	3,650	489.35	0
30-Apr-2010	21:00	683.03	14,680	650.18	1,745	630.41	3,650	489.35	0
30-Apr-2010	22:00	683.01	14,680	650.18	1,745	630.41	3,650	489.35	0
30-Apr-2010	23:00	683.01	14,680	650.18	1,745	630.41	250	489.35	0
30-Apr-2010	24:00:00	682.99	14,680	650.17	1,745	630.41	250	489.35	0
1-May-2010	1:00	682.99	14,680	650.17	1,745	630.42	250	489.36	0
1-May-2010	2:00	682.99	14,680	650.17	1,745	630.42	250	489.36	0
1-May-2010	3:00	682.99	14,680	650.17	1,745	630.44	250	489.36	0
1-May-2010	4:00	682.98	14,680	650.16	1,770	630.44	250	489.36	0
1-May-2010	5:00	682.96	14,680	650.16	1,795	630.44	250	489.36	0
1-May-2010	6:00	682.94	14,680	650.16	1,795	630.44	250	489.36	0

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
1-May-2010	7:00	682.92	14,680	650.15	1,795	630.46	250	489.37	0
1-May-2010	8:00	682.88	14,680	650.14	1,795	630.46	250	489.40	0
1-May-2010	9:00	682.92	14,680	650.14	1,795	630.46	250	489.45	0
1-May-2010	10:00	682.92	14,680	650.14	1,795	630.46	250	489.47	0
1-May-2010	11:00	682.88	14,680	650.15	1,795	630.58	3,650	489.48	4,600
1-May-2010	12:00	682.88	14,680	650.16	1,795	630.61	3,650	489.50	4,600
1-May-2010	13:00	682.98	14,680	650.18	1,795	630.65	3,650	489.60	4,600
1-May-2010	14:00	682.98	14,680	650.18	1,795	630.61	3,650	489.68	4,600
1-May-2010	15:00	682.89	14,680	650.20	1,795	630.65	3,650	489.84	4,600
1-May-2010	16:00	682.89	14,680	650.22	1,795	630.65	3,650	490.00	4,700
1-May-2010	17:00	683.01	14,680	650.24	1,815	630.70	3,750	490.30	4,700
1-May-2010	18:00	683.06	14,680	650.35	1,825	630.73	3,750	490.45	4,700
1-May-2010	19:00	683.15	14,680	650.45	1,845	630.85	3,750	490.95	4,800
1-May-2010	20:00	683.15	14,680	650.59	1,855	631.07	3,750	491.43	4,800
1-May-2010	21:00	683.20	14,680	650.71	1,855	631.15	3,750	491.93	4,800
1-May-2010	22:00	683.20	14,680	650.83	1,875	631.15	3,750	492.43	4,800
1-May-2010	23:00	683.30	14,680	650.97	1,235	631.25	3,750	492.95	4,800
1-May-2010	24:00:00	683.35	14,680	651.07	1,145	631.33	3,750	493.55	4,800
2-May-2010	1:00	683.61	14,680	651.20	1,335	631.35	3,750	494.68	4,800
2-May-2010	2:00	683.82	14,680	651.31	1,885	631.35	3,750	494.97	4,800
2-May-2010	3:00	684.04	14,680	651.42	1,885	631.40	3,750	495.26	4,800
2-May-2010	4:00	684.21	14,680	651.53	1,885	631.45	3,750	495.49	4,800
2-May-2010	5:00	684.36	14,680	651.62	1,885	631.50	3,750	495.71	4,800
2-May-2010	6:00	684.50	14,680	651.72	1,885	631.70	3,750	495.91	4,800
2-May-2010	7:00	684.55	14,680	651.78	1,885	631.94	3,750	496.11	4,800
2-May-2010	8:00	684.70	14,560	651.86	1,875	632.20	3,750	496.25	4,800
2-May-2010	9:00	684.76	14,560	651.91	1,875	632.48	3,750	496.40	4,900

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
2-May-2010	10:00	684.94	14,560	651.99	1,875	632.75	3,750	496.67	4,900
2-May-2010	11:00	685.02	14,560	652.03	1,875	633.01	3,750	496.87	4,900
2-May-2010	12:00	685.15	14,560	652.07	1,875	633.24	3,750	497.07	5,000
2-May-2010	13:00	685.33	14,560	652.14	1,825	633.50	3,650	497.10	5,000
2-May-2010	14:00	685.50	14,560	652.18	1,825	633.93	3,650	497.30	5,000
2-May-2010	15:00	685.72	14,560	652.22	1,835	633.99	3,650	497.47	5,000
2-May-2010	16:00	685.90	14,560	652.27	1,845	634.17	3,650	497.70	5,000
2-May-2010	17:00	686.24	14,560	652.39	1,905	634.39	3,650	497.80	5,000
2-May-2010	18:00	686.75	14,560	652.52	1,965	634.64	3,650	497.95	5,000
2-May-2010	19:00	687.25	14,800	652.79	1,985	634.93	3,650	498.05	5,200
2-May-2010	20:00	687.62	14,800	653.15	2,005	635.16	3,650	498.17	5,200
2-May-2010	21:00	688.13	14,880	653.47	1,775	635.46	3,650	498.29	5,200
2-May-2010	22:00	688.60	14,880	653.73	1,775	635.80	250	498.46	0
2-May-2010	23:00	689.11	14,800	653.87	1,775	636.12	250	498.61	0
2-May-2010	24:00:00	689.54	7,480	654.12	75	636.51	250	498.71	0
3-May-2010	1:00	689.93	280	654.36	75	636.89	250	498.98	0
3-May-2010	2:00	690.40	280	654.59	75	637.24	250	499.06	0
3-May-2010	3:00	690.83	280	654.78	75	637.54	250	499.22	0
3-May-2010	4:00	691.25	280	654.94	75	637.82	250	499.36	0
3-May-2010	5:00	691.72	280	655.10	75	638.11	250	499.48	0
3-May-2010	6:00	692.14	280	655.34	75	638.38	250	499.56	0
3-May-2010	7:00	692.63	280	655.47	75	638.66	250	499.72	0
3-May-2010	8:00	693.00	280	655.62	75	638.92	250	502.00	3,900
3-May-2010	9:00	693.36	280	655.77	75	639.21	250	502.25	5,100
3-May-2010	10:00	693.82	280	655.90	75	639.49	250	502.50	5,200
3-May-2010	11:00	694.20	280	656.01	75	639.78	250	502.60	5,200
3-May-2010	12:00	694.54	280	656.12	75	640.06	250	502.60	5,200

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
3-May-2010	13:00	694.88	280	656.26	75	640.36	250	502.80	5,200
3-May-2010	14:00	695.30	280	656.37	75	640.60	250	503.00	5,200
3-May-2010	15:00	695.66	280	656.39	75	640.93	250	503.30	5,200
3-May-2010	16:00	695.85	280	656.44	1,965	641.21	250	503.50	5,200
3-May-2010	17:00	696.18	280	656.50	1,945	641.52	250	503.80	5,200
3-May-2010	18:00	696.40	280	656.55	1,715	641.78	250	504.01	5,200
3-May-2010	19:00	696.78	280	656.59	1,715	642.07	250	504.20	5,100
3-May-2010	20:00	697.15	280	656.63	1,695	642.28	250	504.18	5,100
3-May-2010	21:00	697.46	280	656.71	1,685	642.60	250	504.25	5,100
3-May-2010	22:00	697.78	280	656.71	1,685	642.83	250	504.30	5,100
3-May-2010	23:00	698.02	280	656.74	1,675	643.08	250	504.35	5,000
3-May-2010	24:00:00	698.37	280	656.78	1,675	643.30	250	504.35	6,000
4-May-2010	1:00	698.54	7,180	656.81	1,655	643.54	3,450	504.40	7,000
4-May-2010	2:00	698.76	7,240	656.83	1,655	643.75	3,450	504.40	7,000
4-May-2010	3:00	698.98	7,240	656.86	1,655	643.95	3,450	504.40	7,000
4-May-2010	4:00	699.22	7,240	656.89	1,645	644.14	3,450	504.40	7,000
4-May-2010	5:00	699.44	7,240	656.92	1,645	644.31	3,450	504.42	7,000
4-May-2010	6:00	699.64	7,240	656.94	1,625	644.48	3,450	504.42	7,000
4-May-2010	7:00	699.87	7,240	656.97	1,625	644.63	3,450	504.54	7,000
4-May-2010	8:00	700.10	7,180	656.98	1,565	644.78	3,450	504.60	7,000
4-May-2010	9:00	700.16	7,180	657.00	1,565	644.92	3,450	504.90	8,600
4-May-2010	10:00	700.29	7,180	657.02	1,555	645.07	3,350	504.90	8,600
4-May-2010	11:00	700.48	7,180	657.04	1,545	645.17	3,350	504.90	8,600
4-May-2010	12:00	700.67	7,180	657.06	1,545	645.30	3,350	504.90	8,600
4-May-2010	13:00	700.79	10,720	657.07	1,535	645.40	3,350	504.90	8,600
4-May-2010	14:00	700.95	10,780	657.09	1,525	645.49	3,350	504.90	8,600
4-May-2010	15:00	701.12	10,780	657.10	1,525	645.47	3,350	504.90	8,600

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
4-May-2010	16:00	701.24	10,780	657.12	1,525	645.56	3,350	504.90	8,600
4-May-2010	17:00	701.36	10,720	657.13	1,575	645.66	3,350	504.90	8,600
4-May-2010	18:00	701.47	10,720	657.14	1,515	645.70	3,350	504.90	8,600
4-May-2010	19:00	701.59	10,720	657.16	1,515	645.73	3,350	504.85	8,600
4-May-2010	20:00	701.71	10,720	657.17	1,505	645.85	3,350	504.80	8,600
4-May-2010	21:00	701.82	10,720	657.18	1,505	645.91	3,350	504.68	8,600
4-May-2010	22:00	701.93	10,720	657.20	1,505	645.95	3,350	504.55	8,600
4-May-2010	23:00	702.04	10,720	657.21	1,495	646.02	3,350	504.48	8,600
4-May-2010	24:00:00	702.15	10,720	657.22	1,495	646.11	3,350	504.40	8,600
5-May-2010	1:00	702.22	10,720	657.23	1,495	646.15	3,350	504.40	8,600
5-May-2010	2:00	702.30	10,720	657.24	1,495	646.19	3,350	504.40	8,600
5-May-2010	3:00	702.38	10,720	657.25	1,495	646.27	3,350	504.40	8,600
5-May-2010	4:00	702.46	10,720	657.26	1,495	646.34	3,350	504.40	8,600
5-May-2010	5:00	702.53	10,720	657.27	1,495	646.37	3,350	504.39	8,600
5-May-2010	6:00	702.60	10,720	657.28	2,965	646.43	3,350	504.39	8,600
5-May-2010	7:00	702.65	10,720	657.28	2,965	646.50	3,350	504.70	8,600
5-May-2010	8:00	702.72	10,720	657.30	1,495	646.54	3,350	504.62	8,600
5-May-2010	9:00	702.78	10,720	657.31	1,495	646.58	3,350	504.61	8,600
5-May-2010	10:00	702.84	10,720	657.31	1,495	646.63	3,350	504.60	8,600
5-May-2010	11:00	702.90	10,720	657.32	1,495	646.68	3,350	504.59	8,600
5-May-2010	12:00	702.96	10,630	657.32	1,495	646.72	3,350	504.58	8,600
5-May-2010	13:00	702.98	17,780	657.32	2,985	646.75	5,950	504.57	8,600
5-May-2010	14:00	703.02	20,730	657.32	3,005	646.76	6,450	504.56	8,600
5-May-2010	15:00	703.08	20,930	657.33	3,005	646.71	12,250	504.55	8,600
5-May-2010	16:00	703.14	20,930	657.33	3,005	646.70	11,650	504.55	8,600
5-May-2010	17:00	703.16	20,930	657.33	3,005	646.70	11,850	504.55	8,600
5-May-2010	18:00	703.20	20,930	657.33	2,995	646.65	12,450	504.55	8,600

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Total Discharge cfs	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Total Discharge cfs	Center Hill Dam Headwater Elevation ft	Center Hill Dam Total Discharge cfs	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Total Discharge cfs
5-May-2010	19:00	703.23	21,180	657.33	2,995	646.60	11,950	504.60	8,600
5-May-2010	20:00	703.25	21,180	657.34	2,995	646.60	12,650	504.60	8,600
5-May-2010	21:00	703.28	21,180	657.34	2,995	646.57	12,650	504.59	8,600
5-May-2010	22:00	703.31	21,180	657.34	2,985	646.53	12,650	504.58	8,500
5-May-2010	23:00	703.34	21,180	657.34	2,985	646.50	12,950	504.57	8,500
5-May-2010	24:00:00	703.37	21,180	657.34	2,985	646.48	12,950	504.56	8,500
6-May-2010	1:00	703.40	21,180	657.31	3,365	646.44	12,850	504.55	8,500
6-May-2010	2:00	703.43	21,180	657.31	3,365	646.41	12,850	504.54	8,500
6-May-2010	3:00	703.46	21,180	657.30	3,365	646.38	12,950	504.53	8,500
6-May-2010	4:00	703.49	21,180	657.30	3,365	646.35	12,950	504.52	8,500
6-May-2010	5:00	703.51	21,180	657.29	3,365	646.31	13,050	504.50	8,500
6-May-2010	6:00	703.54	21,180	657.29	3,365	646.28	13,050	504.49	8,500
6-May-2010	7:00	703.56	21,180	657.28	3,365	646.25	12,650	504.29	8,400
6-May-2010	8:00	703.58	21,180	657.28	3,365	646.22	13,350	504.28	8,400
6-May-2010	9:00	703.62	21,180	657.34	3,325	646.17	12,850	504.26	8,400
6-May-2010	10:00	703.66	21,180	657.34	3,345	646.15	12,650	504.25	8,400
6-May-2010	11:00	703.66	24,300	657.34	3,345	646.13	13,250	504.24	8,400
6-May-2010	12:00	703.66	24,300	657.34	3,345	646.10	13,150	504.23	8,400
6-May-2010	13:00	703.66	24,300	657.34	3,345	646.08	13,900	504.22	8,300
6-May-2010	14:00	703.66	24,300	657.34	3,345	646.03	16,500	504.21	8,300
6-May-2010	15:00	703.70	24,300	657.33	3,345	645.98	16,000	504.20	8,300
6-May-2010	16:00	703.70	24,300	657.33	3,345	645.94	16,000	504.19	8,300
6-May-2010	17:00	703.70	24,300	657.33	3,345	645.90	16,300	504.17	8,300
6-May-2010	18:00	703.70	24,300	657.33	3,345	645.91	16,000	504.16	8,300
6-May-2010	19:00	703.73	24,300	657.32	3,345	645.82	16,100	504.00	8,300
6-May-2010	20:00	703.76	24,300	657.32	3,345	645.79	15,900	503.98	8,300
6-May-2010	21:00	703.79	24,300	657.32	3,345	645.75	16,100	503.98	8,300

Cumberland River Basin Projects Hourly Water Control Data -> 29 April - 07 May 2010									
Date	**Time**	**Wolf Creek Dam Headwater Elevation ft**	**Wolf Creek Dam Total Discharge cfs**	**Dale Hollow Dam Headwater Elevation ft**	**Dale Hollow Dam Total Discharge cfs**	**Center Hill Dam Headwater Elevation ft**	**Center Hill Dam Total Discharge cfs**	**J. Percy Priest Dam Headwater Elevation ft**	**J. Percy Priest Dam Total Discharge cfs**
6-May-2010	22:00	703.81	24,300	657.32	3,365	645.71	16,100	503.97	8,300
6-May-2010	23:00	703.83	24,300	657.32	3,365	645.67	16,000	503.95	8,300
6-May-2010	24:00:00	703.86	24,300	657.32	3,365	645.63	16,000	503.92	8,300
7-May-2010	1:00	703.84	25,450	657.31	3,365	645.58	16,000	503.90	8,300
7-May-2010	2:00	703.82	25,450	657.31	3,365	645.54	16,000	503.89	8,300
7-May-2010	3:00	703.79	25,450	657.30	3,365	645.50	15,900	503.88	8,300
7-May-2010	4:00	703.76	25,450	657.30	3,365	645.46	15,900	503.87	8,300
7-May-2010	5:00	703.76	25,450	657.29	3,365	645.41	16,000	503.82	8,200
7-May-2010	6:00	703.75	25,450	657.29	3,365	645.37	16,000	503.77	8,200

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
29-Apr-2010	1:00	683.33	556.63	14,280	280	14,560	140
29-Apr-2010	2:00	683.33	556.63	14,280	280	14,560	140
29-Apr-2010	3:00	683.35	556.65	14,280	280	14,560	140
29-Apr-2010	4:00	683.35	556.65	14,280	280	14,560	140
29-Apr-2010	5:00	683.35	556.65	14,280	280	14,560	140
29-Apr-2010	6:00	683.35	556.65	14,280	280	14,560	140
29-Apr-2010	7:00	683.34	556.64	14,280	280	14,560	140
29-Apr-2010	8:00	683.34	555.34	10,650	280	10,930	105
29-Apr-2010	9:00	683.33	554.83	10,560	280	10,840	105
29-Apr-2010	10:00	683.33	554.13	10,560	280	10,840	105
29-Apr-2010	11:00	683.32	553.92	10,560	280	10,840	105
29-Apr-2010	12:00	683.32	553.72	10,500	280	10,780	105
29-Apr-2010	13:00	683.31	555.11	14,200	280	14,480	140
29-Apr-2010	14:00	683.31	556.21	14,280	280	14,560	140
29-Apr-2010	15:00	683.31	556.41	14,280	280	14,560	140
29-Apr-2010	16:00	683.31	556.61	14,280	280	14,560	140
29-Apr-2010	17:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	18:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	19:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	20:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	21:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	22:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	23:00	683.31	556.81	14,280	280	14,560	140
29-Apr-2010	24:00:00	683.31	556.81	14,280	280	14,560	140
30-Apr-2010	1:00	683.29	556.89	14,280	280	14,560	140
30-Apr-2010	2:00	683.27	556.87	14,280	280	14,560	140
30-Apr-2010	3:00	683.26	556.86	14,280	280	14,560	140

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
30-Apr-2010	4:00	683.25	556.85	14,280	280	14,560	140
30-Apr-2010	5:00	683.25	556.85	14,280	280	14,560	140
30-Apr-2010	6:00	683.25	556.84	14,280	280	14,560	140
30-Apr-2010	7:00	683.23	556.93	14,400	280	14,680	140
30-Apr-2010	8:00	683.22	556.92	14,400	280	14,680	140
30-Apr-2010	9:00	683.21	556.91	14,400	280	14,680	140
30-Apr-2010	10:00	683.19	557.09	14,400	280	14,680	140
30-Apr-2010	11:00	683.17	557.07	14,400	280	14,680	140
30-Apr-2010	12:00	683.15	557.05	14,400	280	14,680	140
30-Apr-2010	13:00	683.13	557.03	14,400	280	14,680	140
30-Apr-2010	14:00	683.12	557.02	14,400	280	14,680	140
30-Apr-2010	15:00	683.11	557.01	14,400	280	14,680	140
30-Apr-2010	16:00	683.10	557.00	14,400	280	14,680	140
30-Apr-2010	17:00	683.08	557.08	14,400	280	14,680	140
30-Apr-2010	18:00	683.06	557.06	14,400	280	14,680	140
30-Apr-2010	19:00	683.06	557.06	14,400	280	14,680	140
30-Apr-2010	20:00	683.05	557.05	14,400	280	14,680	140
30-Apr-2010	21:00	683.03	557.03	14,400	280	14,680	140
30-Apr-2010	22:00	683.01	557.01	14,400	280	14,680	140
30-Apr-2010	23:00	683.01	557.01	14,400	280	14,680	140
30-Apr-2010	24:00:00	682.99	557.09	14,400	280	14,680	140
1-May-2010	1:00	682.99	557.09	14,400	280	14,680	140
1-May-2010	2:00	682.99	557.09	14,400	280	14,680	140
1-May-2010	3:00	682.99	557.09	14,400	280	14,680	140
1-May-2010	4:00	682.98	557.08	14,400	280	14,680	140
1-May-2010	5:00	682.96	557.06	14,400	280	14,680	140
1-May-2010	6:00	682.94	557.04	14,400	280	14,680	140

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
1-May-2010	7:00	682.92	557.02	14,400	280	14,680	140
1-May-2010	8:00	682.88	557.08	14,400	280	14,680	140
1-May-2010	9:00	682.92	557.02	14,400	280	14,680	140
1-May-2010	10:00	682.92	557.12	14,400	280	14,680	140
1-May-2010	11:00	682.88	557.08	14,400	280	14,680	140
1-May-2010	12:00	682.88	557.08	14,400	280	14,680	140
1-May-2010	13:00	682.98	557.08	14,400	280	14,680	140
1-May-2010	14:00	682.98	557.08	14,400	280	14,680	140
1-May-2010	15:00	682.89	557.09	14,400	280	14,680	140
1-May-2010	16:00	682.89	557.19	14,400	280	14,680	140
1-May-2010	17:00	683.01	557.31	14,400	280	14,680	140
1-May-2010	18:00	683.06	557.56	14,400	280	14,680	140
1-May-2010	19:00	683.15	557.55	14,400	280	14,680	140
1-May-2010	20:00	683.15	557.55	14,400	280	14,680	140
1-May-2010	21:00	683.20	557.50	14,400	280	14,680	140
1-May-2010	22:00	683.20	557.50	14,400	280	14,680	140
1-May-2010	23:00	683.30	557.50	14,400	280	14,680	140
1-May-2010	24:00:00	683.35	557.55	14,400	280	14,680	140
2-May-2010	1:00	683.61	557.81	14,400	280	14,680	140
2-May-2010	2:00	683.82	557.92	14,400	280	14,680	140
2-May-2010	3:00	684.04	558.24	14,400	280	14,680	140
2-May-2010	4:00	684.21	558.31	14,400	280	14,680	140
2-May-2010	5:00	684.36	558.36	14,400	280	14,680	140
2-May-2010	6:00	684.50	558.30	14,400	280	14,680	140
2-May-2010	7:00	684.55	558.25	14,400	280	14,680	140
2-May-2010	8:00	684.70	558.10	14,280	280	14,560	140
2-May-2010	9:00	684.76	558.06	14,280	280	14,560	140

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
2-May-2010	10:00	684.94	558.04	14,280	280	14,560	140
2-May-2010	11:00	685.02	558.02	14,280	280	14,560	140
2-May-2010	12:00	685.15	558.05	14,280	280	14,560	140
2-May-2010	13:00	685.33	558.23	14,280	280	14,560	140
2-May-2010	14:00	685.50	558.40	14,280	280	14,560	140
2-May-2010	15:00	685.72	558.52	14,280	280	14,560	140
2-May-2010	16:00	685.90	558.90	14,280	280	14,560	140
2-May-2010	17:00	686.24	559.64	14,280	280	14,560	140
2-May-2010	18:00	686.75	559.95	14,280	280	14,560	140
2-May-2010	19:00	687.25	562.35	14,520	280	14,800	140
2-May-2010	20:00	687.62	563.12	14,520	280	14,800	140
2-May-2010	21:00	688.13	563.73	14,600	280	14,880	140
2-May-2010	22:00	688.60	564.20	14,600	280	14,880	140
2-May-2010	23:00	689.11	564.51	14,520	280	14,800	140
2-May-2010	24:00:00	689.54	563.24	7,200	280	7,480	70
3-May-2010	1:00	689.93	562.13	0	280	280	0
3-May-2010	2:00	690.40	561.50	0	280	280	0
3-May-2010	3:00	690.83	561.03	0	280	280	0
3-May-2010	4:00	691.25	560.45	0	280	280	0
3-May-2010	5:00	691.72	559.82	0	280	280	0
3-May-2010	6:00	692.14	558.84	0	280	280	0
3-May-2010	7:00	692.63	557.73	0	280	280	0
3-May-2010	8:00	693.00	556.50	0	280	280	0
3-May-2010	9:00	693.36	556.06	0	280	280	0
3-May-2010	10:00	693.82	555.02	0	280	280	0
3-May-2010	11:00	694.20	554.00	0	280	280	0
3-May-2010	12:00	694.54	553.54	0	280	280	0

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
3-May-2010	13:00	694.88	552.28	0	280	280	0
3-May-2010	14:00	695.30	551.20	0	280	280	0
3-May-2010	15:00	695.66	550.36	0	280	280	0
3-May-2010	16:00	695.85	549.85	0	280	280	0
3-May-2010	17:00	696.18	548.98	0	280	280	0
3-May-2010	18:00	696.40	548.40	0	280	280	0
3-May-2010	19:00	696.78	547.68	0	280	280	0
3-May-2010	20:00	697.15	546.75	0	280	280	0
3-May-2010	21:00	697.46	546.26	0	280	280	0
3-May-2010	22:00	697.78	545.48	0	280	280	0
3-May-2010	23:00	698.02	545.02	0	280	280	0
3-May-2010	24:00:00	698.37	544.57	0	280	280	0
4-May-2010	1:00	698.54	549.54	6,900	280	7,180	80
4-May-2010	2:00	698.76	550.46	6,960	280	7,240	80
4-May-2010	3:00	698.98	550.98	6,960	280	7,240	80
4-May-2010	4:00	699.22	551.22	6,960	280	7,240	80
4-May-2010	5:00	699.44	551.34	6,960	280	7,240	80
4-May-2010	6:00	699.64	551.34	6,960	280	7,240	80
4-May-2010	7:00	699.87	551.47	6,960	280	7,240	80
4-May-2010	8:00	700.10	551.50	6,900	280	7,180	80
4-May-2010	9:00	700.16	551.56	6,900	280	7,180	80
4-May-2010	10:00	700.29	551.59	6,900	280	7,180	80
4-May-2010	11:00	700.48	551.58	6,900	280	7,180	80
4-May-2010	12:00	700.67	551.57	6,900	280	7,180	80
4-May-2010	13:00	700.79	553.09	10,440	280	10,720	120
4-May-2010	14:00	700.95	553.65	10,500	280	10,780	120
4-May-2010	15:00	701.12	553.72	10,500	280	10,780	120

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
4-May-2010	16:00	701.24	553.74	10,500	280	10,780	120
4-May-2010	17:00	701.36	553.76	10,440	280	10,720	120
4-May-2010	18:00	701.47	553.87	10,440	280	10,720	120
4-May-2010	19:00	701.59	553.99	10,440	280	10,720	120
4-May-2010	20:00	701.71	554.01	10,440	280	10,720	120
4-May-2010	21:00	701.82	554.02	10,440	280	10,720	120
4-May-2010	22:00	701.93	554.03	10,440	280	10,720	120
4-May-2010	23:00	702.04	554.14	10,440	280	10,720	120
4-May-2010	24:00:00	702.15	554.15	10,440	280	10,720	120
5-May-2010	1:00	702.22	554.12	10,440	280	10,720	120
5-May-2010	2:00	702.30	554.10	10,440	280	10,720	120
5-May-2010	3:00	702.38	554.18	10,440	280	10,720	120
5-May-2010	4:00	702.46	554.16	10,440	280	10,720	120
5-May-2010	5:00	702.53	554.13	10,440	280	10,720	120
5-May-2010	6:00	702.60	554.10	10,440	280	10,720	120
5-May-2010	7:00	702.65	554.35	10,440	280	10,720	120
5-May-2010	8:00	702.72	554.42	10,440	280	10,720	120
5-May-2010	9:00	702.78	554.38	10,440	280	10,720	120
5-May-2010	10:00	702.84	554.44	10,440	280	10,720	120
5-May-2010	11:00	702.90	554.40	10,440	280	10,720	120
5-May-2010	12:00	702.96	554.46	10,350	280	10,630	120
5-May-2010	13:00	702.98	556.48	17,500	280	17,780	200
5-May-2010	14:00	703.02	558.42	20,450	280	20,730	225
5-May-2010	15:00	703.08	559.08	20,650	280	20,930	225
5-May-2010	16:00	703.14	559.44	20,650	280	20,930	225
5-May-2010	17:00	703.16	559.56	20,650	280	20,930	225
5-May-2010	18:00	703.20	559.70	20,650	280	20,930	225

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Wolf Creek Dam Headwater Elevation ft	Wolf Creek Dam Tailwater Elevation ft	Wolf Creek Dam Turbine Discharge cfs	Wolf Creek Dam Gate Release cfs	Wolf Creek Dam Total Discharge cfs	Wolf Creek Dam Gross Energy mwh
5-May-2010	19:00	703.23	559.93	20,900	280	21,180	225
5-May-2010	20:00	703.25	560.05	20,900	280	21,180	225
5-May-2010	21:00	703.28	560.18	20,900	280	21,180	225
5-May-2010	22:00	703.31	560.21	20,900	280	21,180	225
5-May-2010	23:00	703.34	560.24	20,900	280	21,180	225
5-May-2010	24:00:00	703.37	560.27	20,900	280	21,180	225
6-May-2010	1:00	703.40	560.30	20,900	280	21,180	225
6-May-2010	2:00	703.43	560.43	20,900	280	21,180	225
6-May-2010	3:00	703.46	560.46	20,900	280	21,180	225
6-May-2010	4:00	703.49	560.59	20,900	280	21,180	225
6-May-2010	5:00	703.51	560.61	20,900	280	21,180	225
6-May-2010	6:00	703.54	560.64	20,900	280	21,180	225
6-May-2010	7:00	703.56	560.66	20,900	280	21,180	225
6-May-2010	8:00	703.58	560.68	20,900	280	21,180	225
6-May-2010	9:00	703.62	560.62	20,900	280	21,180	225
6-May-2010	10:00	703.66	560.66	20,900	280	21,180	225
6-May-2010	11:00	703.66	561.46	21,000	3,300	24,300	225
6-May-2010	12:00	703.66	561.86	21,000	3,300	24,300	225
6-May-2010	13:00	703.66	561.96	21,000	3,300	24,300	225
6-May-2010	14:00	703.66	562.06	21,000	3,300	24,300	225
6-May-2010	15:00	703.70	562.10	21,000	3,300	24,300	225
6-May-2010	16:00	703.70	562.10	21,000	3,300	24,300	225
6-May-2010	17:00	703.70	562.10	21,000	3,300	24,300	225
6-May-2010	18:00	703.70	562.10	21,000	3,300	24,300	225
6-May-2010	19:00	703.73	562.23	21,000	3,300	24,300	225
6-May-2010	20:00	703.76	562.26	21,000	3,300	24,300	225
6-May-2010	21:00	703.79	562.29	21,000	3,300	24,300	225

Wolf Creek Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	**Time**	**Wolf Creek Dam Headwater Elevation ft**	**Wolf Creek Dam Tailwater Elevation ft**	**Wolf Creek Dam Turbine Discharge cfs**	**Wolf Creek Dam Gate Release cfs**	**Wolf Creek Dam Total Discharge cfs**	**Wolf Creek Dam Gross Energy mwh**
6-May-2010	22:00	703.81	562.31	21,000	3,300	24,300	225
6-May-2010	23:00	703.83	562.33	21,000	3,300	24,300	225
6-May-2010	24:00:00	703.86	562.36	21,000	3,300	24,300	225
7-May-2010	1:00	703.84	562.34	22,150	3,300	25,450	225
7-May-2010	2:00	703.82	562.42	22,150	3,300	25,450	225
7-May-2010	3:00	703.79	562.49	22,150	3,300	25,450	225
7-May-2010	4:00	703.76	562.56	22,150	3,300	25,450	225
7-May-2010	5:00	703.76	562.56	22,150	3,300	25,450	225
7-May-2010	6:00	703.75	562.55	22,150	3,300	25,450	225

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
29-Apr-2010	1:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	2:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	3:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	4:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	5:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	6:00	504.90	450.90	15,800	0	15,800	66
29-Apr-2010	7:00	504.88	450.88	15,800	0	15,800	66
29-Apr-2010	8:00	504.89	450.89	15,800	0	15,800	66
29-Apr-2010	9:00	504.89	450.89	15,800	0	15,800	66
29-Apr-2010	10:00	504.89	450.79	15,800	0	15,800	66
29-Apr-2010	11:00	504.89	450.79	15,800	0	15,800	66
29-Apr-2010	12:00	504.89	450.69	15,800	0	15,800	66
29-Apr-2010	13:00	504.90	450.80	15,800	0	15,800	66
29-Apr-2010	14:00	504.90	450.80	15,800	0	15,800	66
29-Apr-2010	15:00	504.92	450.92	15,800	0	15,800	66
29-Apr-2010	16:00	504.92	451.02	15,800	0	15,800	66
29-Apr-2010	17:00	504.92	451.02	15,800	0	15,800	66
29-Apr-2010	18:00	504.92	451.02	15,800	0	15,800	66
29-Apr-2010	19:00	504.85	452.65	24,800	0	24,800	99
29-Apr-2010	20:00	504.75	453.35	25,400	0	25,400	99
29-Apr-2010	21:00	504.75	453.55	25,400	0	25,400	99
29-Apr-2010	22:00	504.80	451.90	16,200	0	16,200	66
29-Apr-2010	23:00	504.80	451.40	16,200	0	16,200	66
29-Apr-2010	24:00:00	504.80	451.30	16,200	0	16,200	66
30-Apr-2010	1:00	504.80	451.20	15,800	0	15,800	66
30-Apr-2010	2:00	504.80	451.10	15,800	0	15,800	66
30-Apr-2010	3:00	504.80	451.00	15,800	0	15,800	66

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
30-Apr-2010	4:00	504.80	451.00	15,800	0	15,800	66
30-Apr-2010	5:00	504.82	450.92	15,800	0	15,800	66
30-Apr-2010	6:00	504.82	450.92	15,800	0	15,800	66
30-Apr-2010	7:00	504.82	450.82	15,800	0	15,800	66
30-Apr-2010	8:00	504.84	450.64	15,800	0	15,800	66
30-Apr-2010	9:00	504.84	450.54	15,800	0	15,800	66
30-Apr-2010	10:00	504.85	450.45	15,800	0	15,800	66
30-Apr-2010	11:00	504.85	450.38	15,700	0	15,700	66
30-Apr-2010	12:00	504.86	450.26	15,700	0	15,700	66
30-Apr-2010	13:00	504.86	450.16	15,600	0	15,600	66
30-Apr-2010	14:00	504.68	452.48	24,700	0	24,700	99
30-Apr-2010	15:00	504.69	452.79	24,700	0	24,700	99
30-Apr-2010	16:00	504.64	453.04	24,700	0	24,700	99
30-Apr-2010	17:00	504.57	453.37	25,300	0	25,300	99
30-Apr-2010	18:00	504.54	453.44	25,300	0	25,300	99
30-Apr-2010	19:00	504.50	453.60	25,300	0	25,300	99
30-Apr-2010	20:00	504.45	453.95	25,300	0	25,300	99
30-Apr-2010	21:00	504.35	454.25	25,900	0	25,900	99
30-Apr-2010	22:00	504.45	452.65	16,500	0	16,500	66
30-Apr-2010	23:00	504.45	452.35	16,500	0	16,500	66
30-Apr-2010	24:00:00	504.45	452.15	16,500	0	16,500	66
1-May-2010	1:00	504.50	451.80	16,200	0	16,200	66
1-May-2010	2:00	504.50	451.60	16,200	0	16,200	66
1-May-2010	3:00	504.45	451.45	16,200	0	16,200	66
1-May-2010	4:00	504.45	451.45	16,200	0	16,200	66
1-May-2010	5:00	504.50	451.30	16,200	0	16,200	66
1-May-2010	6:00	504.55	451.35	16,200	0	16,200	66

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
1-May-2010	7:00	504.50	451.40	16,200	0	16,200	66
1-May-2010	8:00	504.50	451.30	16,200	0	16,200	66
1-May-2010	9:00	504.54	451.34	16,200	0	16,200	66
1-May-2010	10:00	504.66	451.16	15,800	0	15,800	66
1-May-2010	11:00	504.42	453.02	25,400	0	25,400	99
1-May-2010	12:00	504.45	453.45	25,400	0	25,400	99
1-May-2010	13:00	504.47	453.77	25,400	0	25,400	99
1-May-2010	14:00	504.43	453.93	25,400	0	25,400	99
1-May-2010	15:00	504.50	454.30	26,000	0	26,000	99
1-May-2010	16:00	504.48	456.08	30,600	0	30,600	111
1-May-2010	17:00	504.70	457.50	32,400	0	32,400	114
1-May-2010	18:00	504.80	460.10	34,100	2,800	36,900	114
1-May-2010	19:00	504.89	462.79	37,100	5,600	42,700	114
1-May-2010	20:00	504.84	464.94	37,000	11,300	48,300	109
1-May-2010	21:00	504.97	466.37	37,000	11,300	48,300	105
1-May-2010	22:00	505.10	467.20	38,400	11,300	49,700	105
1-May-2010	23:00	505.25	467.95	35,700	11,400	47,100	99
1-May-2010	24:00:00	505.32	469.12	38,700	14,300	53,000	99
2-May-2010	1:00	505.25	470.45	38,300	23,300	61,600	95
2-May-2010	2:00	505.30	471.00	38,300	23,300	61,600	95
2-May-2010	3:00	505.35	471.35	37,600	23,300	60,900	91
2-May-2010	4:00	505.40	471.60	35,500	23,300	58,800	86
2-May-2010	5:00	505.42	471.82	34,500	23,300	57,800	84
2-May-2010	6:00	505.47	471.87	34,500	23,300	57,800	84
2-May-2010	7:00	505.47	472.07	36,000	23,400	59,400	84
2-May-2010	8:00	505.48	472.18	36,000	23,400	59,400	84
2-May-2010	9:00	505.47	472.17	36,000	23,400	59,400	84

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
2-May-2010	10:00	505.47	472.17	36,000	23,400	59,400	84
2-May-2010	11:00	505.42	472.22	35,500	23,300	58,800	83
2-May-2010	12:00	505.40	472.20	36,000	23,300	59,300	84
2-May-2010	13:00	505.36	472.16	35,500	23,300	58,800	83
2-May-2010	14:00	505.35	472.05	35,500	23,300	58,800	83
2-May-2010	15:00	505.42	472.22	35,500	23,300	58,800	83
2-May-2010	16:00	505.56	472.56	36,000	23,400	59,400	84
2-May-2010	17:00	505.87	473.27	35,000	23,500	58,500	82
2-May-2010	18:00	506.16	474.06	35,000	23,500	58,500	79
2-May-2010	19:00	506.50	474.80	37,000	23,600	60,600	83
2-May-2010	20:00	506.83	475.83	35,500	30,000	65,500	77
2-May-2010	21:00	507.17	476.47	35,500	30,100	65,600	77
2-May-2010	22:00	507.46	477.26	31,300	35,200	66,500	66
2-May-2010	23:00	507.80	478.10	32,900	41,600	74,500	69
2-May-2010	24:00:00	507.98	479.08	30,800	51,500	82,300	65
3-May-2010	1:00	508.25	480.35	34,000	60,000	94,000	65
3-May-2010	2:00	508.30	481.40	31,600	72,300	103,900	59
3-May-2010	3:00	508.21	482.81	28,600	84,500	113,100	52
3-May-2010	4:00	508.27	483.37	24,200	91,300	115,500	46
3-May-2010	5:00	508.33	483.83	25,300	93,700	119,000	44
3-May-2010	6:00	508.02	485.12	24,800	105,000	129,800	37
3-May-2010	7:00	508.05	485.35	24,900	105,200	130,100	41
3-May-2010	8:00	507.97	485.77	21,500	105,000	126,500	31
3-May-2010	9:00	507.91	486.01	20,500	104,900	125,400	28
3-May-2010	10:00	507.87	486.37	20,500	104,900	125,400	28
3-May-2010	11:00	507.80	486.50	20,200	104,700	124,900	26
3-May-2010	12:00	507.86	486.36	20,000	99,500	119,500	25

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
3-May-2010	13:00	507.90	486.10	19,100	94,300	113,400	24
3-May-2010	14:00	507.88	486.18	19,600	94,300	113,900	26
3-May-2010	15:00	507.92	486.02	19,100	90,900	110,000	24
3-May-2010	16:00	507.86	485.96	19,900	90,900	110,800	25
3-May-2010	17:00	507.88	485.78	19,500	87,500	107,000	26
3-May-2010	18:00	507.95	485.45	19,500	80,700	100,200	26
3-May-2010	19:00	507.93	485.13	20,100	80,700	100,800	29
3-May-2010	20:00	507.92	484.82	20,900	77,300	98,200	30
3-May-2010	21:00	507.93	484.33	21,600	73,700	95,300	32
3-May-2010	22:00	507.91	484.01	22,400	70,200	92,600	34
3-May-2010	23:00	507.90	483.50	22,800	66,900	89,700	35
3-May-2010	24:00:00	507.90	483.30	22,600	63,500	86,100	37
4-May-2010	1:00	507.89	482.59	23,500	60,000	83,500	38
4-May-2010	2:00	507.88	481.88	23,400	55,000	78,400	42
4-May-2010	3:00	507.88	481.38	24,300	50,000	74,300	44
4-May-2010	4:00	507.93	480.53	25,500	45,100	70,600	48
4-May-2010	5:00	507.88	479.98	26,900	43,500	70,400	53
4-May-2010	6:00	507.86	479.56	24,400	64,600	89,000	48
4-May-2010	7:00	507.75	479.05	25,000	40,200	65,200	51
4-May-2010	8:00	507.62	478.62	27,300	40,100	67,400	56
4-May-2010	9:00	507.49	478.39	25,600	40,000	65,600	52
4-May-2010	10:00	507.31	477.91	30,200	39,900	70,100	61
4-May-2010	11:00	507.12	477.62	29,100	39,800	68,900	59
4-May-2010	12:00	506.92	477.32	28,200	39,800	68,000	60
4-May-2010	13:00	506.72	477.12	26,800	39,600	66,400	57
4-May-2010	14:00	506.47	476.77	30,400	39,500	69,900	64
4-May-2010	15:00	506.24	476.44	26,800	39,400	66,200	57

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
4-May-2010	16:00	505.98	476.18	27,800	39,300	67,100	59
4-May-2010	17:00	505.90	475.50	27,800	36,900	64,700	59
4-May-2010	18:00	505.68	474.98	27,100	29,700	56,800	60
4-May-2010	19:00	505.52	474.02	28,400	23,400	51,800	64
4-May-2010	20:00	505.32	473.62	30,100	23,300	53,400	69
4-May-2010	21:00	505.18	472.78	31,600	20,200	51,800	72
4-May-2010	22:00	505.03	472.33	29,400	17,100	46,500	70
4-May-2010	23:00	504.95	471.45	31,100	11,400	42,500	75
4-May-2010	24:00:00	504.92	470.22	29,800	5,700	35,500	76
5-May-2010	1:00	504.74	469.64	33,200	5,600	38,800	84
5-May-2010	2:00	504.54	468.84	32,800	5,600	38,400	86
5-May-2010	3:00	504.50	468.10	28,800	5,600	34,400	76
5-May-2010	4:00	504.39	467.49	24,100	5,600	29,700	66
5-May-2010	5:00	504.30	466.70	25,900	5,600	31,500	73
5-May-2010	6:00	504.19	466.29	23,000	5,600	28,600	69
5-May-2010	7:00	504.03	465.73	30,400	0	30,400	85
5-May-2010	8:00	503.86	465.36	31,800	0	31,800	90
5-May-2010	9:00	503.73	464.93	33,000	0	33,000	95
5-May-2010	10:00	503.58	464.58	33,400	0	33,400	96
5-May-2010	11:00	503.26	464.06	10,800	35,500	46,300	31
5-May-2010	12:00	503.28	484.38	10,400	35,500	45,900	30
5-May-2010	13:00	502.90	464.50	8,900	35,500	44,400	25
5-May-2010	14:00	503.50	461.30	10,200	11,800	22,000	32
5-May-2010	15:00	503.50	459.60	10,000	0	10,000	33
5-May-2010	16:00	503.40	458.50	9,700	0	9,700	33
5-May-2010	17:00	503.42	457.32	10,100	0	10,100	35
5-May-2010	18:00	503.51	457.41	9,500	0	9,500	33

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
5-May-2010	19:00	503.60	455.80	9,100	0	9,100	33
5-May-2010	20:00	503.65	455.25	9,100	0	9,100	33
5-May-2010	21:00	503.70	454.90	8,900	0	8,900	33
5-May-2010	22:00	503.77	454.37	8,900	0	8,900	33
5-May-2010	23:00	503.85	454.15	8,700	0	8,700	33
5-May-2010	24:00:00	503.90	453.90	8,700	0	8,700	33
6-May-2010	1:00	503.95	453.65	8,700	0	8,700	33
6-May-2010	2:00	504.03	453.53	8,500	0	8,500	33
6-May-2010	3:00	503.90	455.00	17,700	0	17,700	66
6-May-2010	4:00	503.97	455.37	17,700	0	17,700	66
6-May-2010	5:00	504.02	455.52	17,700	0	17,700	66
6-May-2010	6:00	503.93	455.63	18,200	0	18,200	66
6-May-2010	7:00	503.90	455.70	18,200	0	18,200	66
6-May-2010	8:00	504.01	455.71	18,200	0	18,200	66
6-May-2010	9:00	504.03	455.83	18,200	0	18,200	66
6-May-2010	10:00	504.03	455.83	18,200	0	18,200	66
6-May-2010	11:00	504.05	455.85	18,200	0	18,200	66
6-May-2010	12:00	504.06	455.96	18,200	0	18,200	66
6-May-2010	13:00	503.81	458.01	28,500	0	28,500	99
6-May-2010	14:00	503.85	458.55	29,300	0	29,300	99
6-May-2010	15:00	503.80	459.00	29,300	0	29,300	99
6-May-2010	16:00	503.73	459.33	30,000	0	30,000	99
6-May-2010	17:00	503.90	457.60	19,000	0	19,000	66
6-May-2010	18:00	503.95	457.25	18,600	0	18,600	66
6-May-2010	19:00	503.88	456.98	18,600	0	18,600	66
6-May-2010	20:00	503.96	456.76	18,600	0	18,600	66
6-May-2010	21:00	504.05	456.55	18,200	0	18,200	66

Cordell Hull Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cordell Hull Dam Headwater Elevation ft	Cordell Hull Dam Tailwater Elevation ft	Cordell Hull Dam Turbine Discharge cfs	Cordell Hull Dam Gate Release cfs	Cordell Hull Dam Total Discharge cfs	Cordell Hull Dam Gross Energy mwh
6-May-2010	22:00	504.08	456.38	18,200	0	18,200	66
6-May-2010	23:00	504.11	456.41	18,200	0	18,200	66
6-May-2010	24:00:00	504.18	456.28	18,200	0	18,200	66
7-May-2010	1:00	504.02	458.22	28,500	0	28,500	99
7-May-2010	2:00	503.99	458.79	29,300	0	29,300	99
7-May-2010	3:00	503.99	459.19	29,300	0	29,300	99
7-May-2010	4:00	503.94	459.64	30,000	0	30,000	99
7-May-2010	5:00	503.88	459.78	30,000	0	30,000	99
7-May-2010	6:00	503.84	460.04	30,000	0	30,000	99
7-May-2010	7:00	503.78	460.28	30,000	0	30,000	99
7-May-2010	8:00	503.74	460.44	30,800	0	30,800	99

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
29-Apr-2010	1:00	445.07	393.27	19,200	0	19,200	75
29-Apr-2010	2:00	445.07	393.37	19,200	0	19,200	75
29-Apr-2010	3:00	445.07	393.37	19,200	0	19,200	75
29-Apr-2010	4:00	445.07	393.27	19,200	0	19,200	75
29-Apr-2010	5:00	445.08	393.28	19,200	0	19,200	75
29-Apr-2010	6:00	445.05	393.35	19,200	0	19,200	75
29-Apr-2010	7:00	445.05	393.35	19,200	0	19,200	75
29-Apr-2010	8:00	445.00	393.20	19,200	0	19,200	75
29-Apr-2010	9:00	445.05	392.25	19,200	0	19,200	75
29-Apr-2010	10:00	445.00	393.20	19,200	0	19,200	75
29-Apr-2010	11:00	444.95	394.15	21,900	0	21,900	85
29-Apr-2010	12:00	444.95	394.45	23,400	0	23,400	90
29-Apr-2010	13:00	444.90	394.80	23,700	0	23,700	90
29-Apr-2010	14:00	444.90	395.00	23,700	0	23,700	90
29-Apr-2010	15:00	444.90	395.00	23,700	0	23,700	90
29-Apr-2010	16:00	444.90	395.00	23,700	0	23,700	90
29-Apr-2010	17:00	444.85	395.15	23,700	0	23,700	90
29-Apr-2010	18:00	444.85	395.15	23,700	0	23,700	90
29-Apr-2010	19:00	444.80	395.30	23,700	0	23,700	90
29-Apr-2010	20:00	444.77	395.47	24,000	0	24,000	90
29-Apr-2010	21:00	444.75	395.45	24,000	0	24,000	90
29-Apr-2010	22:00	444.72	395.52	24,000	0	24,000	90
29-Apr-2010	23:00	444.71	395.51	24,000	0	24,000	90
29-Apr-2010	24:00:00	444.68	395.58	24,000	0	24,000	90
30-Apr-2010	1:00	444.68	395.58	24,000	0	24,000	90
30-Apr-2010	2:00	444.69	395.69	24,000	0	24,000	90
30-Apr-2010	3:00	444.68	395.68	24,000	0	24,000	90

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
30-Apr-2010	4:00	444.68	395.78	24,000	0	24,000	90
30-Apr-2010	5:00	444.67	395.77	24,000	0	24,000	90
30-Apr-2010	6:00	444.64	395.74	24,000	0	24,000	90
30-Apr-2010	7:00	444.60	395.80	24,000	0	24,000	90
30-Apr-2010	8:00	444.60	395.80	24,000	0	24,000	90
30-Apr-2010	9:00	444.55	396.05	24,300	0	24,300	90
30-Apr-2010	10:00	444.55	395.05	22,500	0	22,500	85
30-Apr-2010	11:00	444.55	395.15	21,300	0	21,300	80
30-Apr-2010	12:00	444.50	394.70	19,800	0	19,800	75
30-Apr-2010	13:00	444.50	394.60	19,800	0	19,800	75
30-Apr-2010	14:00	444.45	394.85	20,100	0	20,100	75
30-Apr-2010	15:00	444.50	394.30	19,800	0	19,800	75
30-Apr-2010	16:00	444.50	394.60	19,800	0	19,800	75
30-Apr-2010	17:00	444.45	394.15	19,500	0	19,500	75
30-Apr-2010	18:00	444.45	394.15	19,500	0	19,500	75
30-Apr-2010	19:00	444.42	394.42	19,800	0	19,800	75
30-Apr-2010	20:00	444.50	393.90	19,800	0	19,800	75
30-Apr-2010	21:00	444.52	393.82	19,500	0	19,500	75
30-Apr-2010	22:00	444.54	393.74	19,500	0	19,500	75
30-Apr-2010	23:00	444.55	393.75	19,500	0	19,500	75
30-Apr-2010	24:00:00	444.55	393.95	19,500	0	19,500	75
1-May-2010	1:00	444.55	394.95	23,700	0	23,700	90
1-May-2010	2:00	444.56	394.76	23,700	0	23,700	90
1-May-2010	3:00	444.60	394.90	23,700	0	23,700	90
1-May-2010	4:00	444.59	395.09	24,000	0	24,000	90
1-May-2010	5:00	444.59	395.09	24,000	0	24,000	90
1-May-2010	6:00	444.55	395.15	24,000	0	24,000	90

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
1-May-2010	7:00	444.58	395.38	24,900	0	24,900	93
1-May-2010	8:00	444.64	396.14	25,200	0	25,200	94
1-May-2010	9:00	444.65	396.65	24,000	0	24,000	90
1-May-2010	10:00	444.68	396.48	24,000	0	24,000	88
1-May-2010	11:00	444.74	396.54	24,000	0	24,000	88
1-May-2010	12:00	444.82	396.82	24,300	0	24,300	89
1-May-2010	13:00	444.85	398.25	25,200	4,800	30,000	90
1-May-2010	14:00	444.83	399.93	24,900	9,500	34,400	87
1-May-2010	15:00	444.94	400.84	26,600	9,500	36,100	89
1-May-2010	16:00	445.05	402.55	26,400	15,300	41,700	85
1-May-2010	17:00	445.20	404.80	26,400	21,200	47,600	80
1-May-2010	18:00	445.30	406.70	29,100	25,900	55,000	84
1-May-2010	19:00	445.60	408.30	28,200	26,000	54,200	78
1-May-2010	20:00	445.80	409.50	29,400	31,000	60,400	78
1-May-2010	21:00	445.90	410.50	29,200	36,000	65,200	76
1-May-2010	22:00	446.21	411.61	29,300	41,000	70,300	74
1-May-2010	23:00	446.33	412.13	28,700	41,000	69,700	71
1-May-2010	24:00:00	446.45	413.05	28,500	46,000	74,500	69
2-May-2010	1:00	446.80	414.80	29,100	46,300	75,400	66
2-May-2010	2:00	446.97	414.87	27,600	46,300	73,900	63
2-May-2010	3:00	447.20	414.90	28,100	46,300	74,400	64
2-May-2010	4:00	447.37	414.97	28,100	46,300	74,400	64
2-May-2010	5:00	447.57	415.07	28,500	46,300	74,800	66
2-May-2010	6:00	447.75	415.05	27,000	46,300	73,300	63
2-May-2010	7:00	447.88	415.68	29,100	52,000	81,100	66
2-May-2010	8:00	448.12	416.48	28,200	52,000	80,200	63
2-May-2010	9:00	448.78	418.08	27,600	52,600	80,200	60

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
2-May-2010	10:00	449.40	419.60	27,700	52,600	80,300	59
2-May-2010	11:00	449.80	421.10	26,100	63,600	89,700	54
2-May-2010	12:00	450.38	423.48	23,900	83,100	107,000	49
2-May-2010	13:00	450.91	425.21	21,600	102,000	123,600	45
2-May-2010	14:00	451.45	426.65	21,300	109,000	130,300	42
2-May-2010	15:00	451.45	428.85	18,900	124,000	142,900	36
2-May-2010	16:00	451.35	430.35	13,200	150,000	163,200	21
2-May-2010	17:00	451.26	431.86	7,800	195,050	202,850	13
2-May-2010	18:00	451.10	433.10	0	212,260	212,260	0
2-May-2010	19:00	451.00	433.50	0	211,730	211,730	0
2-May-2010	20:00	450.90	434.00	0	211,400	211,400	0
2-May-2010	21:00	450.80	434.50	0	211,070	211,070	0
2-May-2010	22:00	450.75	434.65	0	204,960	204,960	0
2-May-2010	23:00	450.80	434.70	0	199,025	199,025	0
2-May-2010	24:00:00	450.80	434.60	0	193,400	193,400	0
3-May-2010	1:00	450.80	434.20	0	187,620	187,620	0
3-May-2010	2:00	451.15	433.55	0	181,840	181,840	0
3-May-2010	3:00	451.25	433.05	0	182,820	182,820	0
3-May-2010	4:00	451.20	432.90	0	183,100	183,100	0
3-May-2010	5:00	450.95	433.55	0	194,600	194,600	0
3-May-2010	6:00	450.95	433.65	0	193,850	193,850	0
3-May-2010	7:00	450.55	434.25	0	196,748	196,748	0
3-May-2010	8:00	450.40	434.50	0	198,405	198,405	0
3-May-2010	9:00	450.30	434.60	0	197,940	197,940	0
3-May-2010	10:00	450.20	434.80	0	197,630	197,630	0
3-May-2010	11:00	450.10	434.90	0	197,320	197,320	0
3-May-2010	12:00	449.95	435.05	0	197,010	197,010	0

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
3-May-2010	13:00	449.80	435.20	0	196,545	196,545	0
3-May-2010	14:00	449.70	434.90	0	190,400	190,400	0
3-May-2010	15:00	449.65	434.55	0	175,925	175,925	0
3-May-2010	16:00	449.80	434.00	0	165,402	165,402	0
3-May-2010	17:00	449.90	433.00	0	156,320	156,320	0
3-May-2010	18:00	450.00	432.60	0	150,183	150,183	0
3-May-2010	19:00	450.10	432.28	0	144,235	144,235	0
3-May-2010	20:00	450.20	431.70	0	144,450	144,450	0
3-May-2010	21:00	450.30	431.50	0	144,670	144,670	0
3-May-2010	22:00	450.40	431.20	0	144,885	144,885	0
3-May-2010	23:00	450.50	431.00	0	145,100	145,100	0
3-May-2010	24:00:00	450.55	430.85	0	145,210	145,210	0
4-May-2010	1:00	450.60	430.80	0	145,315	145,315	0
4-May-2010	2:00	450.65	430.65	0	145,425	145,425	0
4-May-2010	3:00	450.70	430.50	0	145,530	145,530	0
4-May-2010	4:00	450.70	430.40	0	145,530	145,530	0
4-May-2010	5:00	450.75	430.35	0	145,640	145,640	0
4-May-2010	6:00	450.80	430.40	0	145,750	145,750	0
4-May-2010	7:00	450.84	430.24	0	145,835	145,835	0
4-May-2010	8:00	450.86	430.26	0	145,880	145,880	0
4-May-2010	9:00	450.85	429.95	0	145,855	145,855	0
4-May-2010	10:00	450.85	430.05	0	145,855	145,855	0
4-May-2010	11:00	450.85	429.95	0	145,855	145,855	0
4-May-2010	12:00	450.85	429.95	0	145,855	145,855	0
4-May-2010	13:00	450.85	429.85	0	145,855	145,855	0
4-May-2010	14:00	450.85	429.85	0	145,855	145,855	0
4-May-2010	15:00	450.80	429.90	0	145,750	145,750	0

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
4-May-2010	16:00	450.75	429.75	0	145,640	145,640	0
4-May-2010	17:00	450.75	429.75	0	145,640	145,640	0
4-May-2010	18:00	450.65	429.65	0	145,425	145,425	0
4-May-2010	19:00	450.58	429.78	0	145,275	145,275	0
4-May-2010	20:00	450.53	429.73	0	145,165	145,165	0
4-May-2010	21:00	450.48	429.58	0	145,055	145,055	0
4-May-2010	22:00	450.39	429.59	0	144,860	144,860	0
4-May-2010	23:00	450.30	429.50	0	144,670	144,670	0
4-May-2010	24:00:00	450.20	429.40	0	144,450	144,450	0
5-May-2010	1:00	450.12	429.52	0	144,280	144,280	0
5-May-2010	2:00	450.00	429.40	0	144,020	144,020	0
5-May-2010	3:00	449.90	429.30	0	143,805	143,805	0
5-May-2010	4:00	449.84	429.24	0	143,675	143,675	0
5-May-2010	5:00	449.70	429.20	0	143,370	143,370	0
5-May-2010	6:00	449.58	429.28	0	143,115	143,115	0
5-May-2010	7:00	449.40	429.10	0	142,720	142,720	0
5-May-2010	8:00	449.27	429.17	0	142,440	142,440	0
5-May-2010	9:00	449.09	429.09	0	142,045	142,045	0
5-May-2010	10:00	449.00	429.00	3,800	125,400	129,200	5
5-May-2010	11:00	448.65	429.25	15,600	118,805	134,405	27
5-May-2010	12:00	448.50	428.91	15,600	118,550	134,150	27
5-May-2010	13:00	448.30	428.60	15,600	105,950	121,550	27
5-May-2010	14:00	448.25	428.15	15,100	105,875	120,975	26
5-May-2010	15:00	448.05	427.85	15,600	93,365	108,965	27
5-May-2010	16:00	448.00	427.30	15,600	93,300	108,900	30
5-May-2010	17:00	448.05	426.45	18,000	81,000	99,000	33
5-May-2010	18:00	447.95	426.45	18,000	80,800	98,800	33

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Old Hickory Dam Headwater Elevation ft	Old Hickory Dam Tailwater Elevation ft	Old Hickory Dam Turbine Discharge cfs	Old Hickory Dam Gate Release cfs	Old Hickory Dam Total Discharge cfs	Old Hickory Dam Gross Energy mwh
5-May-2010	19:00	447.84	426.44	18,000	76,000	94,000	33
5-May-2010	20:00	447.79	425.09	18,500	71,000	89,500	35
5-May-2010	21:00	447.70	424.60	18,200	71,000	89,200	35
5-May-2010	22:00	447.55	424.25	17,900	69,000	86,900	35
5-May-2010	23:00	447.40	423.60	19,200	64,000	83,200	37
5-May-2010	24:00:00	447.30	422.90	19,400	60,000	79,400	38
6-May-2010	1:00	447.20	422.40	20,800	55,000	75,800	41
6-May-2010	2:00	447.13	421.53	21,400	49,000	70,400	44
6-May-2010	3:00	447.00	421.10	21,400	49,000	70,400	44
6-May-2010	4:00	446.85	420.05	22,900	42,600	65,500	47
6-May-2010	5:00	446.73	419.33	23,400	38,100	61,500	48
6-May-2010	6:00	446.60	418.90	24,400	38,000	62,400	50
6-May-2010	7:00	446.45	418.05	25,100	38,000	63,100	52
6-May-2010	8:00	446.35	417.65	25,100	38,000	63,100	52
6-May-2010	9:00	446.23	417.33	25,800	38,000	63,800	54
6-May-2010	10:00	446.12	416.92	25,800	38,000	63,800	54
6-May-2010	11:00	445.99	416.49	25,900	38,000	63,900	55
6-May-2010	12:00	445.88	416.18	27,200	38,000	65,200	58
6-May-2010	13:00	445.77	415.37	28,200	33,000	61,200	60
6-May-2010	14:00	445.72	414.72	26,500	28,000	54,500	58
6-May-2010	15:00	445.63	414.23	27,700	28,000	55,700	62
6-May-2010	16:00	445.55	413.75	27,600	28,000	55,600	64
6-May-2010	17:00	445.50	413.40	28,100	28,000	56,100	64
6-May-2010	18:00	445.40	413.10	27,600	28,000	55,600	63
6-May-2010	19:00	445.29	412.69	28,500	28,000	56,500	66
6-May-2010	20:00	445.26	412.46	29,100	28,000	57,100	68
6-May-2010	21:00	445.17	412.07	29,100	28,000	57,100	68

Old Hickory Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	**Time**	**Old Hickory Dam Headwater Elevation ft**	**Old Hickory Dam Tailwater Elevation ft**	**Old Hickory Dam Turbine Discharge cfs**	**Old Hickory Dam Gate Release cfs**	**Old Hickory Dam Total Discharge cfs**	**Old Hickory Dam Gross Energy mwh**
6-May-2010	22:00	445.11	411.91	27,900	27,700	55,600	66
6-May-2010	23:00	445.06	411.76	28,500	27,700	56,200	69
6-May-2010	24:00:00	444.99	411.59	28,500	27,700	56,200	69
7-May-2010	1:00	444.91	411.41	27,300	27,600	54,900	66
7-May-2010	2:00	444.82	411.22	27,300	27,600	54,900	66
7-May-2010	3:00	444.76	411.06	28,500	27,600	56,100	69
7-May-2010	4:00	444.69	410.99	28,900	27,600	56,500	70
7-May-2010	5:00	444.64	410.44	28,700	23,400	52,100	71
7-May-2010	6:00	444.60	410.20	28,500	23,400	51,900	72

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
29-Apr-2010	1:00	384.98	362.98	14,800	0	14,800	24
29-Apr-2010	2:00	385.09	362.59	14,600	0	14,600	24
29-Apr-2010	3:00	385.20	362.10	14,400	0	14,400	24
29-Apr-2010	4:00	385.30	362.10	14,400	0	14,400	24
29-Apr-2010	5:00	385.41	361.91	14,200	0	14,200	24
29-Apr-2010	6:00	385.52	361.92	14,200	0	14,200	24
29-Apr-2010	7:00	385.65	361.85	14,000	0	14,000	24
29-Apr-2010	8:00	385.70	361.80	14,000	0	14,000	24
29-Apr-2010	9:00	385.55	362.75	21,600	0	21,600	36
29-Apr-2010	10:00	385.50	363.00	21,600	0	21,600	36
29-Apr-2010	11:00	385.50	363.20	21,600	0	21,600	36
29-Apr-2010	12:00	385.40	363.30	22,200	0	22,200	36
29-Apr-2010	13:00	385.40	363.40	22,200	0	22,200	36
29-Apr-2010	14:00	385.35	363.45	22,200	0	22,200	36
29-Apr-2010	15:00	385.30	363.40	22,200	0	22,200	36
29-Apr-2010	16:00	385.30	363.50	22,200	0	22,200	36
29-Apr-2010	17:00	385.30	363.60	22,200	0	22,200	36
29-Apr-2010	18:00	385.30	363.50	22,200	0	22,200	36
29-Apr-2010	19:00	385.35	363.45	22,200	0	22,200	36
29-Apr-2010	20:00	385.37	363.47	22,800	0	22,800	37
29-Apr-2010	21:00	385.40	363.50	22,800	0	22,800	37
29-Apr-2010	22:00	385.41	363.51	23,400	0	23,400	38
29-Apr-2010	23:00	385.46	363.56	22,800	0	22,800	37
29-Apr-2010	24:00:00	385.50	363.60	22,200	0	22,200	36
30-Apr-2010	1:00	385.54	363.64	22,800	0	22,800	37
30-Apr-2010	2:00	385.59	363.59	22,200	0	22,200	36
30-Apr-2010	3:00	385.62	363.52	22,800	0	22,800	37

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
30-Apr-2010	4:00	385.68	363.58	22,800	0	22,800	37
30-Apr-2010	5:00	385.73	363.53	22,200	0	22,200	36
30-Apr-2010	6:00	385.77	363.57	22,280	0	22,280	37
30-Apr-2010	7:00	385.80	363.60	22,280	0	22,280	37
30-Apr-2010	8:00	385.85	363.65	22,280	0	22,280	37
30-Apr-2010	9:00	385.90	363.60	22,900	0	22,900	38
30-Apr-2010	10:00	385.95	363.55	22,900	0	22,900	38
30-Apr-2010	11:00	386.00	363.50	22,400	0	22,400	37
30-Apr-2010	12:00	386.05	363.55	22,900	0	22,900	38
30-Apr-2010	13:00	385.80	364.30	23,000	5,600	28,600	36
30-Apr-2010	14:00	385.75	364.55	24,400	5,600	30,000	37
30-Apr-2010	15:00	385.60	364.90	23,500	5,600	29,100	34
30-Apr-2010	16:00	385.50	365.00	23,500	5,600	29,100	34
30-Apr-2010	17:00	385.40	365.00	23,500	5,600	29,100	34
30-Apr-2010	18:00	385.35	364.95	23,500	5,600	29,100	34
30-Apr-2010	19:00	385.13	365.13	22,400	5,500	27,900	32
30-Apr-2010	20:00	384.99	365.09	22,400	5,500	27,900	32
30-Apr-2010	21:00	384.88	365.08	23,600	5,500	29,100	33
30-Apr-2010	22:00	384.75	365.05	23,100	5,500	28,600	33
30-Apr-2010	23:00	384.62	365.12	22,000	5,500	27,500	31
30-Apr-2010	24:00:00	384.49	365.09	22,000	5,500	27,500	31
1-May-2010	1:00	384.36	365.06	23,200	5,500	28,700	32
1-May-2010	2:00	384.21	365.11	23,200	5,500	28,700	32
1-May-2010	3:00	384.07	365.07	21,200	5,500	26,700	29
1-May-2010	4:00	383.94	365.04	22,400	5,500	27,900	31
1-May-2010	5:00	383.79	365.09	22,400	5,500	27,900	31
1-May-2010	6:00	383.81	365.11	21,200	5,500	26,700	29

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
1-May-2010	7:00	383.77	365.27	22,700	5,500	28,200	29
1-May-2010	8:00	383.92	365.22	22,900	5,500	28,400	31
1-May-2010	9:00	384.14	365.24	21,200	5,500	26,700	29
1-May-2010	10:00	384.55	365.45	22,400	5,500	27,900	31
1-May-2010	11:00	385.00	365.70	22,400	5,500	27,900	31
1-May-2010	12:00	385.55	365.95	24,000	5,500	29,500	33
1-May-2010	13:00	386.00	367.00	20,800	18,800	39,600	28
1-May-2010	14:00	386.20	368.80	20,700	39,000	59,700	24
1-May-2010	15:00	386.08	371.28	19,700	73,000	92,700	16
1-May-2010	16:00	386.35	373.75	11,100	68,000	79,100	6
1-May-2010	17:00	386.31	375.71	0	78,000	78,000	0
1-May-2010	18:00	386.35	377.85	0	86,000	86,000	0
1-May-2010	19:00	385.65	380.95	0	102,000	102,000	0
1-May-2010	20:00	385.38	382.68	0	107,000	107,000	0
1-May-2010	21:00	385.95	384.15	0	114,000	114,000	0
1-May-2010	22:00	386.44	385.04	0	120,000	120,000	0
1-May-2010	23:00	386.82	385.62	0	122,000	122,000	0
1-May-2010	24:00:00	387.21	386.11	0	122,000	122,000	0
2-May-2010	1:00	387.82	386.92	0	126,000	126,000	0
2-May-2010	2:00	388.41	387.31	0	126,000	126,000	0
2-May-2010	3:00	388.90	387.90	0	130,000	130,000	0
2-May-2010	4:00	389.33	388.33	0	130,000	130,000	0
2-May-2010	5:00	389.73	388.73	0	133,000	133,000	0
2-May-2010	6:00	390.10	388.90	0	133,000	133,000	0
2-May-2010	7:00	390.50	389.40	0	137,000	137,000	0
2-May-2010	8:00	390.97	389.77	0	139,000	139,000	0
2-May-2010	9:00	391.60	390.30	0	142,000	142,000	0

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
2-May-2010	10:00	392.30	390.80	0	146,000	146,000	0
2-May-2010	11:00	393.00	391.40	0	148,000	148,000	0
2-May-2010	12:00	393.62	392.02	0	150,000	150,000	0
2-May-2010	13:00	394.30	393.30	0	160,000	160,000	0
2-May-2010	14:00	395.00	393.50	0	165,000	165,000	0
2-May-2010	15:00	395.62	393.92	0	170,000	170,000	0
2-May-2010	16:00	396.30	394.80	0	175,000	175,000	0
2-May-2010	17:00	396.86	395.36	0	175,000	175,000	0
2-May-2010	18:00	397.40	396.00	0	180,000	180,000	0
2-May-2010	19:00	397.80	396.40	0	185,000	185,000	0
2-May-2010	20:00	398.20	396.90	0	190,000	190,000	0
2-May-2010	21:00	398.60	397.40	0	195,000	195,000	0
2-May-2010	22:00	399.05	397.95	0	200,000	200,000	0
2-May-2010	23:00	399.45	398.35	0	200,000	200,000	0
2-May-2010	24:00:00	399.95	398.85	0	209,000	209,000	0
3-May-2010	1:00	400.48	399.38	0	220,000	220,000	0
3-May-2010	2:00	400.70	399.60	0	220,000	220,000	0
3-May-2010	3:00	401.14	400.04	0	220,000	220,000	0
3-May-2010	4:00	401.54	400.44	0	220,000	220,000	0
3-May-2010	5:00	401.85	400.75	0	220,000	220,000	0
3-May-2010	6:00	401.98	400.88	0	220,000	220,000	0
3-May-2010	7:00	402.48	401.38	0	220,000	220,000	0
3-May-2010	8:00	402.68	401.58	0	220,000	220,000	0
3-May-2010	9:00	402.89	401.79	0	220,000	220,000	0
3-May-2010	10:00	403.09	401.99	0	228,000	228,000	0
3-May-2010	11:00	403.29	402.19	0	228,000	228,000	0
3-May-2010	12:00	403.40	402.30	0	228,000	228,000	0

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
3-May-2010	13:00	403.54	402.54	0	228,000	228,000	0
3-May-2010	14:00	403.66	402.66	0	230,000	230,000	0
3-May-2010	15:00	403.78	402.78	0	231,000	231,000	0
3-May-2010	16:00	403.89	402.99	0	232,000	232,000	0
3-May-2010	17:00	403.94	403.04	0	232,000	232,000	0
3-May-2010	18:00	403.99	403.09	0	232,000	232,000	0
3-May-2010	19:00	404.05	403.15	0	234,000	234,000	0
3-May-2010	20:00	404.05	403.05	0	234,000	234,000	0
3-May-2010	21:00	404.10	403.10	0	234,000	234,000	0
3-May-2010	22:00	404.15	403.15	0	240,000	240,000	0
3-May-2010	23:00	404.15	403.25	0	240,000	240,000	0
3-May-2010	24:00:00	404.15	403.25	0	240,000	240,000	0
4-May-2010	1:00	404.15	403.25	0	240,000	240,000	0
4-May-2010	2:00	404.15	403.25	0	240,000	240,000	0
4-May-2010	3:00	404.15	403.25	0	240,000	240,000	0
4-May-2010	4:00	404.10	403.20	0	240,000	240,000	0
4-May-2010	5:00	404.05	403.15	0	240,000	240,000	0
4-May-2010	6:00	404.05	403.15	0	240,000	240,000	0
4-May-2010	7:00	403.95	403.15	0	235,000	235,000	0
4-May-2010	8:00	403.91	403.11	0	235,000	235,000	0
4-May-2010	9:00	403.85	403.05	0	235,000	235,000	0
4-May-2010	10:00	403.75	402.85	0	235,000	235,000	0
4-May-2010	11:00	403.70	402.80	0	235,000	235,000	0
4-May-2010	12:00	403.70	402.80	0	235,000	235,000	0
4-May-2010	13:00	403.60	402.70	0	235,000	235,000	0
4-May-2010	14:00	403.52	402.62	0	235,000	235,000	0
4-May-2010	15:00	403.45	402.55	0	235,000	235,000	0

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
4-May-2010	16:00	403.35	402.65	0	235,000	235,000	0
4-May-2010	17:00	403.30	402.60	0	235,000	235,000	0
4-May-2010	18:00	403.20	402.50	0	235,000	235,000	0
4-May-2010	19:00	403.09	402.39	0	230,000	230,000	0
4-May-2010	20:00	402.96	402.36	0	230,000	230,000	0
4-May-2010	21:00	402.85	402.25	0	230,000	230,000	0
4-May-2010	22:00	402.74	402.14	0	225,000	225,000	0
4-May-2010	23:00	402.63	402.03	0	225,000	225,000	0
4-May-2010	24:00:00	402.52	401.92	0	225,000	225,000	0
5-May-2010	1:00	402.42	401.82	0	220,000	220,000	0
5-May-2010	2:00	402.30	401.70	0	220,000	220,000	0
5-May-2010	3:00	402.15	401.55	0	220,000	220,000	0
5-May-2010	4:00	402.07	401.47	0	220,000	220,000	0
5-May-2010	5:00	401.96	401.36	0	217,000	217,000	0
5-May-2010	6:00	401.86	401.26	0	217,000	217,000	0
5-May-2010	7:00	401.75	401.15	0	217,000	217,000	0
5-May-2010	8:00	401.62	401.02	0	217,000	217,000	0
5-May-2010	9:00	401.50	401.00	0	215,000	215,000	0
5-May-2010	10:00	401.35	400.75	0	212,000	212,000	0
5-May-2010	11:00	401.25	400.65	0	212,000	212,000	0
5-May-2010	12:00	401.13	400.53	0	212,000	212,000	0
5-May-2010	13:00	401.00	400.40	0	206,000	206,000	0
5-May-2010	14:00	400.85	400.35	0	206,000	206,000	0
5-May-2010	15:00	400.75	400.15	0	206,000	206,000	0
5-May-2010	16:00	400.60	400.00	0	206,000	206,000	0
5-May-2010	17:00	400.45	399.95	0	206,000	206,000	0
5-May-2010	18:00	400.40	399.80	0	206,000	206,000	0

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
5-May-2010	19:00	400.20	399.60	0	200,000	200,000	0
5-May-2010	20:00	400.00	399.40	0	195,000	195,000	0
5-May-2010	21:00	399.83	399.23	0	190,000	190,000	0
5-May-2010	22:00	399.68	399.08	0	190,000	190,000	0
5-May-2010	23:00	399.50	398.90	0	190,000	190,000	0
5-May-2010	24:00:00	399.33	398.73	0	190,000	190,000	0
6-May-2010	1:00	399.09	398.59	0	190,000	190,000	0
6-May-2010	2:00	398.90	398.40	0	187,000	187,000	0
6-May-2010	3:00	398.72	398.22	0	187,000	187,000	0
6-May-2010	4:00	398.52	398.02	0	184,000	184,000	0
6-May-2010	5:00	398.32	397.82	0	184,000	184,000	0
6-May-2010	6:00	398.12	397.62	0	182,000	182,000	0
6-May-2010	7:00	397.92	397.32	0	182,000	182,000	0
6-May-2010	8:00	397.70	397.10	0	182,000	182,000	0
6-May-2010	9:00	397.49	396.99	0	179,000	179,000	0
6-May-2010	10:00	397.27	396.77	0	176,000	176,000	0
6-May-2010	11:00	397.05	396.55	0	173,000	173,000	0
6-May-2010	12:00	396.76	396.26	0	172,000	172,000	0
6-May-2010	13:00	396.53	396.03	0	168,000	168,000	0
6-May-2010	14:00	396.29	395.79	0	167,000	167,000	0
6-May-2010	15:00	396.02	395.52	0	166,000	166,000	0
6-May-2010	16:00	395.77	395.17	0	163,000	163,000	0
6-May-2010	17:00	395.51	395.01	0	160,000	160,000	0
6-May-2010	18:00	395.24	394.84	0	159,000	159,000	0
6-May-2010	19:00	394.94	394.44	0	155,000	155,000	0
6-May-2010	20:00	394.69	394.19	0	155,000	155,000	0
6-May-2010	21:00	394.42	393.92	0	151,000	151,000	0

Cheatham Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Cheatham Dam Headwater Elevation ft	Cheatham Dam Tailwater Elevation ft	Cheatham Dam Turbine Discharge cfs	Cheatham Dam Gate Release cfs	Cheatham Dam Total Discharge cfs	Cheatham Dam Gross Energy mwh
6-May-2010	22:00	394.14	393.64	0	147,000	147,000	0
6-May-2010	23:00	393.86	393.36	0	145,000	145,000	0
6-May-2010	24:00:00	393.57	393.07	0	145,000	145,000	0
7-May-2010	1:00	393.28	392.78	0	141,000	141,000	0
7-May-2010	2:00	393.00	392.50	0	140,000	140,000	0
7-May-2010	3:00	392.75	392.25	0	140,000	140,000	0
7-May-2010	4:00	392.47	391.97	0	136,000	136,000	0
7-May-2010	5:00	392.15	391.65	0	132,000	132,000	0
7-May-2010	6:00	391.87	391.47	0	130,000	130,000	0

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
29-Apr-2010	1:00	360.10	312.90	32,700	9,500	42,200	115
29-Apr-2010	2:00	360.10	313.00	32,700	9,500	42,200	115
29-Apr-2010	3:00	360.10	313.10	32,400	9,500	41,900	114
29-Apr-2010	4:00	360.10	313.10	32,400	9,500	41,900	114
29-Apr-2010	5:00	360.10	313.10	32,400	9,500	41,900	114
29-Apr-2010	6:00	360.10	313.10	32,400	9,500	41,900	114
29-Apr-2010	7:00	360.10	313.20	32,700	9,500	42,200	114
29-Apr-2010	8:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	9:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	10:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	11:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	12:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	13:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	14:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	15:00	360.10	313.40	32,700	9,500	42,200	114
29-Apr-2010	16:00	360.05	313.45	32,700	9,500	42,200	114
29-Apr-2010	17:00	360.05	313.55	32,700	9,500	42,200	114
29-Apr-2010	18:00	360.05	313.55	32,700	9,500	42,200	114
29-Apr-2010	19:00	360.05	313.65	33,000	9,500	42,500	114
29-Apr-2010	20:00	360.05	313.65	33,000	9,500	42,500	114
29-Apr-2010	21:00	360.00	313.80	33,000	9,500	42,500	114
29-Apr-2010	22:00	360.00	313.80	33,000	9,500	42,500	114
29-Apr-2010	23:00	359.95	313.85	33,000	9,500	42,500	114
29-Apr-2010	24:00:00	359.95	313.95	33,300	9,500	42,800	114
30-Apr-2010	1:00	359.95	314.05	33,300	9,500	42,800	114
30-Apr-2010	2:00	359.95	314.15	33,300	9,500	42,800	114
30-Apr-2010	3:00	359.95	314.25	33,300	9,500	42,800	114

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
30-Apr-2010	4:00	359.95	314.35	33,300	9,500	42,800	114
30-Apr-2010	5:00	359.95	314.35	33,300	9,500	42,800	114
30-Apr-2010	6:00	359.95	314.35	33,300	9,500	42,800	114
30-Apr-2010	7:00	359.95	314.45	33,600	9,500	43,100	114
30-Apr-2010	8:00	359.95	314.45	33,200	9,500	42,700	113
30-Apr-2010	9:00	359.95	314.45	33,200	9,500	42,700	113
30-Apr-2010	10:00	359.95	314.45	33,200	9,500	42,700	113
30-Apr-2010	11:00	359.95	314.45	33,200	9,500	42,700	113
30-Apr-2010	12:00	359.90	314.50	33,200	9,500	42,700	113
30-Apr-2010	13:00	359.90	314.60	33,300	9,500	42,800	113
30-Apr-2010	14:00	359.90	314.60	33,300	9,500	42,800	113
30-Apr-2010	15:00	359.90	314.60	33,300	9,500	42,800	113
30-Apr-2010	16:00	359.90	314.70	33,300	9,500	42,800	113
30-Apr-2010	17:00	359.85	314.75	33,100	9,500	42,600	112
30-Apr-2010	18:00	359.85	314.75	33,100	9,500	42,600	112
30-Apr-2010	19:00	359.80	314.80	33,100	9,500	42,600	112
30-Apr-2010	20:00	359.80	314.80	33,100	9,500	42,600	112
30-Apr-2010	21:00	359.80	314.80	33,100	9,500	42,600	112
30-Apr-2010	22:00	359.80	314.80	33,100	9,500	42,600	112
30-Apr-2010	23:00	359.75	314.85	33,300	9,500	42,800	112
30-Apr-2010	24:00:00	359.75	314.95	33,300	9,500	42,800	112
1-May-2010	1:00	359.75	315.05	33,000	9,500	42,500	111
1-May-2010	2:00	359.75	315.15	33,300	9,500	42,800	111
1-May-2010	3:00	359.75	315.25	33,300	9,500	42,800	111
1-May-2010	4:00	359.75	315.35	33,300	9,500	42,800	111
1-May-2010	5:00	359.70	315.40	33,600	9,500	43,100	111
1-May-2010	6:00	359.70	315.40	32,800	9,500	42,300	109

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
1-May-2010	7:00	359.85	315.55	32,400	9,500	41,900	108
1-May-2010	8:00	359.85	315.65	32,400	9,500	41,900	108
1-May-2010	9:00	359.90	316.00	32,700	9,500	42,200	108
1-May-2010	10:00	360.15	316.15	32,700	9,500	42,200	108
1-May-2010	11:00	360.15	316.25	32,700	9,500	42,200	108
1-May-2010	12:00	360.15	316.45	33,000	9,500	42,500	108
1-May-2010	13:00	360.25	316.55	33,000	9,500	42,500	108
1-May-2010	14:00	360.25	316.75	33,300	9,500	42,800	108
1-May-2010	15:00	360.25	316.75	33,300	9,500	42,800	108
1-May-2010	16:00	360.40	316.80	33,000	9,500	42,500	108
1-May-2010	17:00	360.55	316.95	33,000	9,600	42,600	108
1-May-2010	18:00	360.75	316.95	33,000	9,600	42,600	108
1-May-2010	19:00	360.95	316.95	32,700	9,600	42,300	108
1-May-2010	20:00	361.05	317.05	32,700	9,600	42,300	108
1-May-2010	21:00	361.25	317.05	32,400	9,700	42,100	108
1-May-2010	22:00	361.45	317.15	32,400	9,700	42,100	108
1-May-2010	23:00	361.60	317.30	32,400	9,700	42,100	108
1-May-2010	24:00:00	361.80	317.30	32,100	9,800	41,900	108
2-May-2010	1:00	362.00	317.50	32,100	9,800	41,900	108
2-May-2010	2:00	362.20	317.70	32,100	9,800	41,900	108
2-May-2010	3:00	362.50	318.00	32,100	9,900	42,000	108
2-May-2010	4:00	362.70	318.20	32,100	9,900	42,000	108
2-May-2010	5:00	362.90	318.50	32,400	9,900	42,300	108
2-May-2010	6:00	363.10	318.70	32,400	9,900	42,300	108
2-May-2010	7:00	363.25	318.85	32,400	10,000	42,400	108
2-May-2010	8:00	363.50	319.10	32,400	10,000	42,400	108
2-May-2010	9:00	363.65	319.15	32,100	10,000	42,100	108

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
2-May-2010	10:00	363.85	319.35	32,100	10,000	42,100	108
2-May-2010	11:00	364.05	319.95	32,700	15,800	48,500	108
2-May-2010	12:00	364.15	320.65	33,300	21,600	54,900	108
2-May-2010	13:00	364.30	321.30	33,600	26,000	59,600	108
2-May-2010	14:00	364.45	322.15	34,500	31,800	66,300	108
2-May-2010	15:00	364.55	323.15	35,400	39,200	74,600	108
2-May-2010	16:00	364.60	324.30	36,600	49,400	86,000	108
2-May-2010	17:00	364.65	325.35	38,100	55,200	93,300	108
2-May-2010	18:00	364.70	326.50	38,700	62,400	101,100	106
2-May-2010	19:00	364.75	328.15	39,000	71,200	110,200	102
2-May-2010	20:00	364.80	329.40	38,100	81,500	119,600	96
2-May-2010	21:00	364.85	330.65	38,600	91,800	130,400	93
2-May-2010	22:00	364.85	331.95	37,700	103,600	141,300	87
2-May-2010	23:00	364.85	333.05	38,500	112,000	150,500	85
2-May-2010	24:00:00	364.85	333.95	36,100	120,400	156,500	78
3-May-2010	1:00	364.85	335.05	36,500	130,200	166,700	75
3-May-2010	2:00	364.90	336.60	36,200	143,500	179,700	70
3-May-2010	3:00	364.85	337.35	34,700	153,200	187,900	65
3-May-2010	4:00	364.90	338.40	34,300	166,600	200,900	61
3-May-2010	5:00	364.85	339.35	30,900	179,000	209,900	53
3-May-2010	6:00	364.90	340.30	28,500	190,800	219,300	47
3-May-2010	7:00	364.95	341.25	27,300	200,600	227,900	42
3-May-2010	8:00	364.90	342.20	25,800	218,400	244,200	37
3-May-2010	9:00	364.90	343.20	23,100	228,800	251,900	30
3-May-2010	10:00	364.85	344.35	22,200	239,200	261,400	26
3-May-2010	11:00	364.90	344.80	21,500	239,200	260,700	24
3-May-2010	12:00	364.95	345.25	20,700	240,000	260,700	22

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
3-May-2010	13:00	364.95	345.85	20,500	250,400	270,900	21
3-May-2010	14:00	364.95	346.45	19,000	260,000	279,000	18
3-May-2010	15:00	364.95	347.15	12,300	276,900	289,200	11
3-May-2010	16:00	364.85	347.85	5,800	293,900	299,700	5
3-May-2010	17:00	364.90	348.40	0	300,000	300,000	0
3-May-2010	18:00	364.90	348.70	0	300,000	300,000	0
3-May-2010	19:00	364.95	349.25	0	300,000	300,000	0
3-May-2010	20:00	365.10	349.10	0	291,200	291,200	0
3-May-2010	21:00	365.15	348.95	0	280,800	280,800	0
3-May-2010	22:00	365.25	349.05	0	282,400	282,400	0
3-May-2010	23:00	365.25	349.15	0	282,400	282,400	0
3-May-2010	24:00:00	365.25	349.25	0	282,400	282,400	0
4-May-2010	1:00	365.30	349.30	0	282,400	282,400	0
4-May-2010	2:00	365.35	349.45	0	283,200	283,200	0
4-May-2010	3:00	365.45	349.55	0	283,200	283,200	0
4-May-2010	4:00	365.45	349.65	0	283,200	283,200	0
4-May-2010	5:00	365.45	350.05	0	293,600	293,600	0
4-May-2010	6:00	365.45	350.05	0	293,600	293,600	0
4-May-2010	7:00	365.50	350.40	0	296,000	296,000	0
4-May-2010	8:00	365.45	350.75	0	303,200	303,200	0
4-May-2010	9:00	365.60	350.60	0	285,800	285,800	0
4-May-2010	10:00	365.70	350.40	0	266,000	266,000	0
4-May-2010	11:00	365.70	350.30	0	266,000	266,000	0
4-May-2010	12:00	365.70	350.30	0	266,000	266,000	0
4-May-2010	13:00	365.80	350.40	0	266,000	266,000	0
4-May-2010	14:00	365.80	350.40	0	266,000	266,000	0
4-May-2010	15:00	365.80	350.40	0	266,700	266,700	0

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
4-May-2010	16:00	365.85	350.35	0	266,700	266,700	0
4-May-2010	17:00	366.05	349.75	0	249,300	249,300	0
4-May-2010	18:00	366.10	349.50	0	229,800	229,800	0
4-May-2010	19:00	366.15	349.25	0	230,400	230,400	0
4-May-2010	20:00	366.15	349.15	0	230,400	230,400	0
4-May-2010	21:00	366.25	349.05	0	231,000	231,000	0
4-May-2010	22:00	366.25	349.05	0	231,000	231,000	0
4-May-2010	23:00	366.30	349.00	0	231,000	231,000	0
4-May-2010	24:00:00	366.35	348.95	0	231,000	231,000	0
5-May-2010	1:00	366.35	348.85	0	231,000	231,000	0
5-May-2010	2:00	366.40	348.80	0	231,000	231,000	0
5-May-2010	3:00	366.45	348.75	0	231,600	231,600	0
5-May-2010	4:00	366.50	348.70	0	231,600	231,600	0
5-May-2010	5:00	366.50	348.70	0	231,600	231,600	0
5-May-2010	6:00	366.55	348.65	0	232,200	232,200	0
5-May-2010	7:00	366.60	348.70	0	232,200	232,200	0
5-May-2010	8:00	366.60	348.70	0	232,200	232,200	0
5-May-2010	9:00	366.65	348.65	0	232,200	232,200	0
5-May-2010	10:00	366.65	348.65	0	232,200	232,200	0
5-May-2010	11:00	366.70	348.60	0	232,200	232,200	0
5-May-2010	12:00	366.70	348.60	0	232,200	232,200	0
5-May-2010	13:00	366.75	348.55	0	232,200	232,200	0
5-May-2010	14:00	366.80	348.60	0	232,800	232,800	0
5-May-2010	15:00	366.85	348.55	0	232,800	232,800	0
5-May-2010	16:00	366.85	348.55	0	232,800	232,800	0
5-May-2010	17:00	366.90	348.60	0	232,800	232,800	0
5-May-2010	18:00	366.90	348.60	0	232,800	232,800	0

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
5-May-2010	19:00	366.95	348.65	0	233,400	233,400	0
5-May-2010	20:00	366.95	348.65	0	233,400	233,400	0
5-May-2010	21:00	366.95	348.65	0	233,400	233,400	0
5-May-2010	22:00	366.95	348.65	0	233,400	233,400	0
5-May-2010	23:00	367.00	348.70	0	233,400	233,400	0
5-May-2010	24:00:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	1:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	2:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	3:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	4:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	5:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	6:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	7:00	367.00	348.70	0	233,400	233,400	0
6-May-2010	8:00	367.00	348.80	0	233,400	233,400	0
6-May-2010	9:00	367.05	348.85	0	233,400	233,400	0
6-May-2010	10:00	367.05	348.85	0	233,400	233,400	0
6-May-2010	11:00	367.15	348.65	0	226,800	226,800	0
6-May-2010	12:00	367.15	348.25	0	219,000	219,000	0
6-May-2010	13:00	367.25	348.25	0	219,000	219,000	0
6-May-2010	14:00	367.45	347.45	0	207,900	207,900	0
6-May-2010	15:00	367.55	347.35	0	198,600	198,600	0
6-May-2010	16:00	367.65	347.15	0	187,900	187,900	0
6-May-2010	17:00	367.75	346.55	0	177,500	177,500	0
6-May-2010	18:00	367.75	345.95	0	165,400	165,400	0
6-May-2010	19:00	368.00	345.00	0	158,400	158,400	0
6-May-2010	20:00	368.05	344.65	0	150,400	150,400	0
6-May-2010	21:00	368.15	344.35	0	150,600	150,600	0

Barkley Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Barkley Dam Headwater Elevation ft	Barkley Dam Tailwater Elevation ft	Barkley Dam Turbine Discharge cfs	Barkley Dam Gate Release cfs	Barkley Dam Total Discharge cfs	Barkley Dam Gross Energy mwh
6-May-2010	22:00	368.20	343.80	0	150,800	150,800	0
6-May-2010	23:00	368.30	343.60	0	151,000	151,000	0
6-May-2010	24:00:00	368.30	343.60	0	151,000	151,000	0
7-May-2010	1:00	368.40	343.00	0	151,200	151,200	0
7-May-2010	2:00	368.45	342.65	0	151,200	151,200	0
7-May-2010	3:00	368.50	342.30	0	151,600	151,600	0
7-May-2010	4:00	368.55	342.15	0	151,600	151,600	0
7-May-2010	5:00	368.60	341.90	0	151,800	151,800	0
7-May-2010	6:00	368.65	341.85	0	151,800	151,800	0

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
29-Apr-2010	1:00	630.44	476.94	0	250	250	0
29-Apr-2010	2:00	630.44	476.34	0	250	250	0
29-Apr-2010	3:00	630.44	476.14	0	250	250	0
29-Apr-2010	4:00	630.45	476.15	0	250	250	0
29-Apr-2010	5:00	630.45	476.75	0	250	250	0
29-Apr-2010	6:00	630.45	479.75	3,400	250	3,650	40
29-Apr-2010	7:00	630.46	480.36	3,400	250	3,650	40
29-Apr-2010	8:00	630.45	480.55	3,400	250	3,650	40
29-Apr-2010	9:00	630.45	480.65	3,400	250	3,650	40
29-Apr-2010	10:00	630.43	480.83	3,400	250	3,650	40
29-Apr-2010	11:00	630.43	477.83	0	250	250	0
29-Apr-2010	12:00	630.43	476.73	0	250	250	0
29-Apr-2010	13:00	630.43	476.33	0	250	250	0
29-Apr-2010	14:00	630.43	476.33	0	250	250	0
29-Apr-2010	15:00	630.43	480.13	3,400	250	3,650	40
29-Apr-2010	16:00	630.43	480.53	3,400	250	3,650	40
29-Apr-2010	17:00	630.42	480.72	3,400	250	3,650	40
29-Apr-2010	18:00	630.41	480.81	3,400	250	3,650	40
29-Apr-2010	19:00	630.40	480.90	3,400	250	3,650	40
29-Apr-2010	20:00	630.40	480.90	3,400	250	3,650	40
29-Apr-2010	21:00	630.40	480.90	3,400	250	3,650	40
29-Apr-2010	22:00	630.40	478.00	0	250	250	0
29-Apr-2010	23:00	630.40	476.90	0	250	250	0
29-Apr-2010	24:00:00	630.40	476.40	0	250	250	0
30-Apr-2010	1:00	630.42	476.12	0	250	250	0
30-Apr-2010	2:00	630.42	476.12	0	250	250	0
30-Apr-2010	3:00	630.42	476.02	0	250	250	0

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
30-Apr-2010	4:00	630.42	476.02	0	250	250	0
30-Apr-2010	5:00	630.42	476.02	0	250	250	0
30-Apr-2010	6:00	630.42	476.02	0	250	250	0
30-Apr-2010	7:00	630.44	476.04	0	250	250	0
30-Apr-2010	8:00	630.44	476.04	0	250	250	0
30-Apr-2010	9:00	630.44	476.14	0	250	250	0
30-Apr-2010	10:00	630.46	476.06	0	250	250	0
30-Apr-2010	11:00	630.46	480.16	3,400	250	3,650	40
30-Apr-2010	12:00	630.45	480.55	3,400	250	3,650	40
30-Apr-2010	13:00	630.45	480.75	3,400	250	3,650	40
30-Apr-2010	14:00	630.44	480.94	3,400	250	3,650	40
30-Apr-2010	15:00	630.43	480.93	3,400	250	3,650	40
30-Apr-2010	16:00	630.43	480.93	3,400	250	3,650	40
30-Apr-2010	17:00	630.42	480.92	3,400	250	3,650	40
30-Apr-2010	18:00	630.42	480.92	3,400	250	3,650	40
30-Apr-2010	19:00	630.41	480.91	3,400	250	3,650	40
30-Apr-2010	20:00	630.41	480.91	3,400	250	3,650	40
30-Apr-2010	21:00	630.41	480.91	3,400	250	3,650	40
30-Apr-2010	22:00	630.41	480.91	3,400	250	3,650	40
30-Apr-2010	23:00	630.41	478.41	0	250	250	0
30-Apr-2010	24:00:00	630.41	477.91	0	250	250	0
1-May-2010	1:00	630.42	476.12	0	250	250	0
1-May-2010	2:00	630.42	476.12	0	250	250	0
1-May-2010	3:00	630.44	476.04	0	250	250	0
1-May-2010	4:00	630.44	476.04	0	250	250	0
1-May-2010	5:00	630.44	476.04	0	250	250	0
1-May-2010	6:00	630.44	476.04	0	250	250	0

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
1-May-2010	7:00	630.46	476.06	0	250	250	0
1-May-2010	8:00	630.46	476.06	0	250	250	0
1-May-2010	9:00	630.46	476.06	0	250	250	0
1-May-2010	10:00	630.46	476.06	0	250	250	0
1-May-2010	11:00	630.58	480.28	3,400	250	3,650	40
1-May-2010	12:00	630.61	480.71	3,400	250	3,650	40
1-May-2010	13:00	630.65	480.85	3,400	250	3,650	40
1-May-2010	14:00	630.61	481.01	3,400	250	3,650	40
1-May-2010	15:00	630.65	481.05	3,400	250	3,650	40
1-May-2010	16:00	630.65	481.25	3,400	250	3,650	40
1-May-2010	17:00	630.70	481.90	3,500	250	3,750	40
1-May-2010	18:00	630.73	482.43	3,500	250	3,750	40
1-May-2010	19:00	630.85	482.55	3,500	250	3,750	40
1-May-2010	20:00	631.07	482.87	3,500	250	3,750	40
1-May-2010	21:00	631.15	483.65	3,500	250	3,750	40
1-May-2010	22:00	631.15	483.75	3,500	250	3,750	40
1-May-2010	23:00	631.25	484.05	3,500	250	3,750	40
1-May-2010	24:00:00	631.33	484.23	3,500	250	3,750	40
2-May-2010	1:00	631.35	484.35	3,500	250	3,750	40
2-May-2010	2:00	631.35	484.55	3,500	250	3,750	40
2-May-2010	3:00	631.40	484.60	3,500	250	3,750	40
2-May-2010	4:00	631.45	484.65	3,500	250	3,750	40
2-May-2010	5:00	631.50	484.70	3,500	250	3,750	40
2-May-2010	6:00	631.70	485.10	3,500	250	3,750	40
2-May-2010	7:00	631.94	485.34	3,500	250	3,750	40
2-May-2010	8:00	632.20	485.40	3,500	250	3,750	40
2-May-2010	9:00	632.48	485.38	3,500	250	3,750	40

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
2-May-2010	10:00	632.75	485.35	3,500	250	3,750	40
2-May-2010	11:00	633.01	485.01	3,500	250	3,750	40
2-May-2010	12:00	633.24	484.54	3,500	250	3,750	40
2-May-2010	13:00	633.50	483.90	3,400	250	3,650	40
2-May-2010	14:00	633.93	483.43	3,400	250	3,650	40
2-May-2010	15:00	633.99	483.04	3,400	250	3,650	40
2-May-2010	16:00	634.17	482.77	3,400	250	3,650	40
2-May-2010	17:00	634.39	482.89	3,400	250	3,650	40
2-May-2010	18:00	634.64	482.94	3,400	250	3,650	40
2-May-2010	19:00	634.93	483.93	3,400	250	3,650	40
2-May-2010	20:00	635.16	484.86	3,400	250	3,650	40
2-May-2010	21:00	635.46	486.16	3,400	250	3,650	40
2-May-2010	22:00	635.80	486.50	0	250	250	0
2-May-2010	23:00	636.12	487.12	0	250	250	0
2-May-2010	24:00:00	636.51	487.71	0	250	250	0
3-May-2010	1:00	636.89	488.09	0	250	250	0
3-May-2010	2:00	637.24	488.44	0	250	250	0
3-May-2010	3:00	637.54	488.74	0	250	250	0
3-May-2010	4:00	637.82	489.12	0	250	250	0
3-May-2010	5:00	638.11	489.71	0	250	250	0
3-May-2010	6:00	638.38	490.38	0	250	250	0
3-May-2010	7:00	638.66	490.96	0	250	250	0
3-May-2010	8:00	638.92	491.42	0	250	250	0
3-May-2010	9:00	639.21	491.71	0	250	250	0
3-May-2010	10:00	639.49	491.99	0	250	250	0
3-May-2010	11:00	639.78	492.08	0	250	250	0
3-May-2010	12:00	640.06	491.96	0	250	250	0

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
3-May-2010	13:00	640.36	491.76	0	250	250	0
3-May-2010	14:00	640.60	491.50	0	250	250	0
3-May-2010	15:00	640.93	491.13	0	250	250	0
3-May-2010	16:00	641.21	490.71	0	250	250	0
3-May-2010	17:00	641.52	490.02	0	250	250	0
3-May-2010	18:00	641.78	489.48	0	250	250	0
3-May-2010	19:00	642.07	488.77	0	250	250	0
3-May-2010	20:00	642.28	488.28	0	250	250	0
3-May-2010	21:00	642.60	487.40	0	250	250	0
3-May-2010	22:00	642.83	486.93	0	250	250	0
3-May-2010	23:00	643.08	486.38	0	250	250	0
3-May-2010	24:00:00	643.30	485.80	0	250	250	0
4-May-2010	1:00	643.54	486.04	3,200	250	3,450	40
4-May-2010	2:00	643.75	485.75	3,200	250	3,450	40
4-May-2010	3:00	643.95	485.55	3,200	250	3,450	40
4-May-2010	4:00	644.14	485.24	3,200	250	3,450	40
4-May-2010	5:00	644.31	484.81	3,200	250	3,450	40
4-May-2010	6:00	644.48	484.48	3,200	250	3,450	40
4-May-2010	7:00	644.63	484.13	3,200	250	3,450	40
4-May-2010	8:00	644.78	483.78	3,200	250	3,450	40
4-May-2010	9:00	644.92	483.42	3,200	250	3,450	40
4-May-2010	10:00	645.07	483.07	3,100	250	3,350	40
4-May-2010	11:00	645.17	482.77	3,100	250	3,350	40
4-May-2010	12:00	645.30	482.50	3,100	250	3,350	40
4-May-2010	13:00	645.40	482.20	3,100	250	3,350	40
4-May-2010	14:00	645.49	481.99	3,100	250	3,350	40
4-May-2010	15:00	645.47	481.77	3,100	250	3,350	40

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
4-May-2010	16:00	645.56	481.66	3,100	250	3,350	40
4-May-2010	17:00	645.66	481.56	3,100	250	3,350	40
4-May-2010	18:00	645.70	481.40	3,100	250	3,350	40
4-May-2010	19:00	645.73	481.33	3,100	250	3,350	40
4-May-2010	20:00	645.85	481.25	3,100	250	3,350	40
4-May-2010	21:00	645.91	481.11	3,100	250	3,350	40
4-May-2010	22:00	645.95	481.05	3,100	250	3,350	40
4-May-2010	23:00	646.02	481.02	3,100	250	3,350	40
4-May-2010	24:00:00	646.11	480.91	3,100	250	3,350	40
5-May-2010	1:00	646.15	480.85	3,100	250	3,350	40
5-May-2010	2:00	646.19	480.69	3,100	250	3,350	40
5-May-2010	3:00	646.27	480.67	3,100	250	3,350	40
5-May-2010	4:00	646.34	480.64	3,100	250	3,350	40
5-May-2010	5:00	646.37	480.57	3,100	250	3,350	40
5-May-2010	6:00	646.43	480.63	3,100	250	3,350	40
5-May-2010	7:00	646.50	480.60	3,100	250	3,350	40
5-May-2010	8:00	646.54	480.64	3,100	250	3,350	40
5-May-2010	9:00	646.58	480.58	3,100	250	3,350	40
5-May-2010	10:00	646.63	480.63	3,100	250	3,350	40
5-May-2010	11:00	646.68	480.68	3,100	250	3,350	40
5-May-2010	12:00	646.72	480.62	3,100	250	3,350	40
5-May-2010	13:00	646.75	482.55	5,700	250	5,950	72
5-May-2010	14:00	646.76	483.16	6,200	250	6,450	80
5-May-2010	15:00	646.71	486.21	12,000	250	12,250	147
5-May-2010	16:00	646.70	487.10	11,400	250	11,650	142
5-May-2010	17:00	646.70	487.40	11,600	250	11,850	144
5-May-2010	18:00	646.65	487.65	12,200	250	12,450	148

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
5-May-2010	19:00	646.60	487.90	11,700	250	11,950	143
5-May-2010	20:00	646.60	488.30	12,400	250	12,650	150
5-May-2010	21:00	646.57	488.37	12,400	250	12,650	150
5-May-2010	22:00	646.53	488.53	12,400	250	12,650	150
5-May-2010	23:00	646.50	488.60	12,700	250	12,950	152
5-May-2010	24:00:00	646.48	488.68	12,700	250	12,950	152
6-May-2010	1:00	646.44	488.74	12,600	250	12,850	150
6-May-2010	2:00	646.41	488.71	12,600	250	12,850	150
6-May-2010	3:00	646.38	488.78	12,700	250	12,950	151
6-May-2010	4:00	646.35	488.75	12,700	250	12,950	151
6-May-2010	5:00	646.31	488.81	12,800	250	13,050	152
6-May-2010	6:00	646.28	488.88	12,800	250	13,050	152
6-May-2010	7:00	646.25	488.85	12,400	250	12,650	148
6-May-2010	8:00	646.22	488.82	13,100	250	13,350	154
6-May-2010	9:00	646.17	488.17	12,600	250	12,850	151
6-May-2010	10:00	646.15	488.85	12,400	250	12,650	148
6-May-2010	11:00	646.13	488.85	13,000	250	13,250	153
6-May-2010	12:00	646.10	488.90	12,900	250	13,150	152
6-May-2010	13:00	646.08	489.58	12,500	1,400	13,900	147
6-May-2010	14:00	646.03	490.13	13,100	3,400	16,500	152
6-May-2010	15:00	645.98	490.38	12,600	3,400	16,000	147
6-May-2010	16:00	645.94	490.54	12,600	3,400	16,000	147
6-May-2010	17:00	645.90	490.70	12,900	3,400	16,300	150
6-May-2010	18:00	645.91	490.61	12,600	3,400	16,000	147
6-May-2010	19:00	645.82	490.72	12,700	3,400	16,100	147
6-May-2010	20:00	645.79	490.69	12,500	3,400	15,900	145
6-May-2010	21:00	645.75	490.75	12,700	3,400	16,100	147

Center Hill Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Center Hill Dam Headwater Elevation ft	Center Hill Dam Tailwater Elevation ft	Center Hill Dam Turbine Discharge cfs	Center Hill Dam Sluice Gate Release cfs	Center Hill Dam Total Discharge cfs	Center Hill Dam Gross Energy mwh
6-May-2010	22:00	645.71	490.81	12,700	3,400	16,100	147
6-May-2010	23:00	645.67	490.87	12,600	3,400	16,000	146
6-May-2010	24:00:00	645.63	490.83	12,600	3,400	16,000	146
7-May-2010	1:00	645.58	490.78	12,600	3,400	16,000	146
7-May-2010	2:00	645.54	490.74	12,600	3,400	16,000	146
7-May-2010	3:00	645.50	490.70	12,500	3,400	15,900	145
7-May-2010	4:00	645.46	490.76	12,500	3,400	15,900	145
7-May-2010	5:00	645.41	490.81	12,600	3,400	16,000	146
7-May-2010	6:00	645.37	490.87	12,600	3,400	16,000	146
7-May-2010	7:00	645.32	490.82	12,600	3,400	16,000	146
7-May-2010	8:00	645.28	490.78	12,600	3,400	16,000	146

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
29-Apr-2010	1:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	2:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	3:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	4:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	5:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	6:00	650.32	510.20	1,720	25	1,745	18
29-Apr-2010	7:00	650.31	510.30	1,770	25	1,795	18
29-Apr-2010	8:00	650.31	510.30	1,770	25	1,795	18
29-Apr-2010	9:00	650.30	510.40	1,770	25	1,795	18
29-Apr-2010	10:00	650.30	510.40	1,770	25	1,795	19
29-Apr-2010	11:00	650.30	510.30	1,720	25	1,745	18
29-Apr-2010	12:00	650.30	510.30	1,720	25	1,745	18
29-Apr-2010	13:00	650.29	510.30	1,720	25	1,745	18
29-Apr-2010	14:00	650.29	510.30	1,720	25	1,745	18
29-Apr-2010	15:00	650.28	510.40	1,720	25	1,745	18
29-Apr-2010	16:00	650.28	510.40	1,720	25	1,745	18
29-Apr-2010	17:00	650.28	510.50	1,720	25	1,745	18
29-Apr-2010	18:00	650.27	510.50	1,720	25	1,745	18
29-Apr-2010	19:00	650.27	510.40	1,720	25	1,745	18
29-Apr-2010	20:00	650.27	510.40	1,720	25	1,745	18
29-Apr-2010	21:00	650.27	510.40	1,720	25	1,745	18
29-Apr-2010	22:00	650.27	510.40	1,720	25	1,745	18
29-Apr-2010	23:00	650.27	510.40	1,720	25	1,745	18
29-Apr-2010	24:00:00	650.26	510.40	1,720	25	1,745	18
30-Apr-2010	1:00	650.26	510.40	1,720	25	1,745	18
30-Apr-2010	2:00	650.26	510.40	1,720	25	1,745	18
30-Apr-2010	3:00	650.25	510.40	1,720	25	1,745	18

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
30-Apr-2010	4:00	650.25	510.40	1,720	25	1,745	18
30-Apr-2010	5:00	650.25	510.40	1,720	25	1,745	18
30-Apr-2010	6:00	650.25	510.40	1,720	25	1,745	18
30-Apr-2010	7:00	650.24	510.30	1,720	25	1,745	18
30-Apr-2010	8:00	650.24	510.30	1,720	25	1,745	18
30-Apr-2010	9:00	650.23	510.30	1,720	25	1,745	18
30-Apr-2010	10:00	650.22	510.40	1,720	25	1,745	18
30-Apr-2010	11:00	650.22	510.40	1,720	25	1,745	18
30-Apr-2010	12:00	650.21	510.50	1,720	25	1,745	18
30-Apr-2010	13:00	650.21	510.50	1,720	25	1,745	18
30-Apr-2010	14:00	650.20	510.50	1,720	25	1,745	18
30-Apr-2010	15:00	650.20	510.50	1,720	25	1,745	18
30-Apr-2010	16:00	650.19	510.50	1,720	25	1,745	18
30-Apr-2010	17:00	650.19	510.50	1,720	25	1,745	18
30-Apr-2010	18:00	650.19	510.50	1,720	25	1,745	18
30-Apr-2010	19:00	650.19	510.40	1,720	25	1,745	18
30-Apr-2010	20:00	650.18	510.40	1,720	25	1,745	18
30-Apr-2010	21:00	650.18	510.40	1,720	25	1,745	18
30-Apr-2010	22:00	650.18	510.40	1,720	25	1,745	18
30-Apr-2010	23:00	650.18	510.40	1,720	25	1,745	18
30-Apr-2010	24:00:00	650.17	510.40	1,720	25	1,745	18
1-May-2010	1:00	650.17	510.40	1,720	25	1,745	18
1-May-2010	2:00	650.17	510.40	1,720	25	1,745	18
1-May-2010	3:00	650.17	510.40	1,720	25	1,745	18
1-May-2010	4:00	650.16	510.40	1,745	25	1,770	18
1-May-2010	5:00	650.16	510.40	1,770	25	1,795	18
1-May-2010	6:00	650.16	510.40	1,770	25	1,795	18

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
1-May-2010	7:00	650.15	510.50	1,770	25	1,795	18
1-May-2010	8:00	650.14	510.50	1,770	25	1,795	19
1-May-2010	9:00	650.14	510.50	1,770	25	1,795	18
1-May-2010	10:00	650.14	510.50	1,770	25	1,795	18
1-May-2010	11:00	650.15	510.50	1,770	25	1,795	19
1-May-2010	12:00	650.16	510.50	1,770	25	1,795	18
1-May-2010	13:00	650.18	510.50	1,770	25	1,795	18
1-May-2010	14:00	650.18	510.60	1,770	25	1,795	18
1-May-2010	15:00	650.20	510.60	1,770	25	1,795	19
1-May-2010	16:00	650.22	510.90	1,770	25	1,795	18
1-May-2010	17:00	650.24	511.50	1,790	25	1,815	18
1-May-2010	18:00	650.35	512.30	1,800	25	1,825	19
1-May-2010	19:00	650.45	513.20	1,820	25	1,845	18
1-May-2010	20:00	650.59	514.20	1,830	25	1,855	18
1-May-2010	21:00	650.71	515.00	1,830	25	1,855	18
1-May-2010	22:00	650.83	515.60	1,850	25	1,875	19
1-May-2010	23:00	650.97	515.90	1,210	25	1,235	11
1-May-2010	24:00:00	651.07	516.30	1,120	25	1,145	10
2-May-2010	1:00	651.20	516.90	1,310	25	1,335	12
2-May-2010	2:00	651.31	517.10	1,860	25	1,885	19
2-May-2010	3:00	651.42	517.30	1,860	25	1,885	18
2-May-2010	4:00	651.53	517.40	1,860	25	1,885	18
2-May-2010	5:00	651.62	517.50	1,860	25	1,885	18
2-May-2010	6:00	651.72	517.50	1,860	25	1,885	19
2-May-2010	7:00	651.78	517.50	1,860	25	1,885	18
2-May-2010	8:00	651.86	517.50	1,850	25	1,875	18
2-May-2010	9:00	651.91	517.40	1,850	25	1,875	19

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
2-May-2010	10:00	651.99	517.40	1,850	25	1,875	18
2-May-2010	11:00	652.03	517.50	1,850	25	1,875	18
2-May-2010	12:00	652.07	517.50	1,850	25	1,875	18
2-May-2010	13:00	652.14	517.60	1,800	25	1,825	19
2-May-2010	14:00	652.18	517.60	1,800	25	1,825	18
2-May-2010	15:00	652.22	518.00	1,810	25	1,835	18
2-May-2010	16:00	652.27	518.60	1,820	25	1,845	19
2-May-2010	17:00	652.39	518.50	1,880	25	1,905	18
2-May-2010	18:00	652.52	521.80	1,940	25	1,965	19
2-May-2010	19:00	652.79	523.80	1,960	25	1,985	18
2-May-2010	20:00	653.15	524.70	1,980	25	2,005	18
2-May-2010	21:00	653.47	525.80	1,750	25	1,775	16
2-May-2010	22:00	653.73	526.30	1,750	25	1,775	17
2-May-2010	23:00	653.87	526.60	1,750	25	1,775	16
2-May-2010	24:00:00	654.12	526.70	50	25	75	0
3-May-2010	1:00	654.36	527.10	50	25	75	0
3-May-2010	2:00	654.59	527.30	50	25	75	1
3-May-2010	3:00	654.78	527.50	50	25	75	0
3-May-2010	4:00	654.94	527.60	50	25	75	0
3-May-2010	5:00	655.10	527.70	50	25	75	0
3-May-2010	6:00	655.34	527.73	50	25	75	1
3-May-2010	7:00	655.47	527.75	50	25	75	0
3-May-2010	8:00	655.62	527.70	50	25	75	0
3-May-2010	9:00	655.77	527.69	50	25	75	0
3-May-2010	10:00	655.90	527.41	50	25	75	1
3-May-2010	11:00	656.01	527.27	50	25	75	0
3-May-2010	12:00	656.12	527.00	50	25	75	0

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
3-May-2010	13:00	656.26	526.51	50	25	75	1
3-May-2010	14:00	656.37	526.33	50	25	75	0
3-May-2010	15:00	656.39	526.00	50	25	75	0
3-May-2010	16:00	656.44	525.80	1,940	25	1,965	16
3-May-2010	17:00	656.50	525.30	1,920	25	1,945	17
3-May-2010	18:00	656.55	524.80	1,690	25	1,715	16
3-May-2010	19:00	656.59	524.40	1,690	25	1,715	16
3-May-2010	20:00	656.63	523.90	1,670	25	1,695	16
3-May-2010	21:00	656.71	522.80	1,660	25	1,685	17
3-May-2010	22:00	656.71	522.80	1,660	25	1,685	17
3-May-2010	23:00	656.74	521.70	1,650	25	1,675	16
3-May-2010	24:00:00	656.78	521.70	1,650	25	1,675	16
4-May-2010	1:00	656.81	521.70	1,630	25	1,655	16
4-May-2010	2:00	656.83	520.40	1,630	25	1,655	16
4-May-2010	3:00	656.86	519.80	1,630	25	1,655	16
4-May-2010	4:00	656.89	519.20	1,620	25	1,645	16
4-May-2010	5:00	656.92	518.60	1,620	25	1,645	17
4-May-2010	6:00	656.94	518.00	1,600	25	1,625	16
4-May-2010	7:00	656.97	517.50	1,600	25	1,625	16
4-May-2010	8:00	656.98	516.80	1,540	25	1,565	16
4-May-2010	9:00	657.00	516.30	1,540	25	1,565	16
4-May-2010	10:00	657.02	515.70	1,530	25	1,555	16
4-May-2010	11:00	657.04	515.17	1,520	25	1,545	16
4-May-2010	12:00	657.06	514.70	1,520	25	1,545	16
4-May-2010	13:00	657.07	514.20	1,510	25	1,535	16
4-May-2010	14:00	657.09	513.80	1,500	25	1,525	16
4-May-2010	15:00	657.10	513.70	1,500	25	1,525	16

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
4-May-2010	16:00	657.12	513.40	1,500	25	1,525	16
4-May-2010	17:00	657.13	513.00	1,550	25	1,575	16
4-May-2010	18:00	657.14	512.20	1,490	25	1,515	16
4-May-2010	19:00	657.16	511.80	1,490	25	1,515	16
4-May-2010	20:00	657.17	511.60	1,480	25	1,505	16
4-May-2010	21:00	657.18	511.30	1,480	25	1,505	16
4-May-2010	22:00	657.20	511.00	1,480	25	1,505	16
4-May-2010	23:00	657.21	510.80	1,470	25	1,495	16
4-May-2010	24:00:00	657.22	510.70	1,470	25	1,495	16
5-May-2010	1:00	657.23	510.50	1,470	25	1,495	16
5-May-2010	2:00	657.24	510.30	1,470	25	1,495	16
5-May-2010	3:00	657.25	510.20	1,470	25	1,495	16
5-May-2010	4:00	657.26	510.20	1,470	25	1,495	16
5-May-2010	5:00	657.27	510.10	1,470	25	1,495	16
5-May-2010	6:00	657.28	510.00	1,470	1,495	2,965	16
5-May-2010	7:00	657.28	509.90	1,470	1,495	2,965	16
5-May-2010	8:00	657.30	509.80	1,470	25	1,495	16
5-May-2010	9:00	657.31	509.80	1,470	25	1,495	16
5-May-2010	10:00	657.31	509.70	1,470	25	1,495	16
5-May-2010	11:00	657.32	509.70	1,470	25	1,495	16
5-May-2010	12:00	657.32	509.70	1,470	25	1,495	16
5-May-2010	13:00	657.32	511.60	2,960	25	2,985	32
5-May-2010	14:00	657.32	512.10	2,980	25	3,005	32
5-May-2010	15:00	657.33	512.20	2,980	25	3,005	32
5-May-2010	16:00	657.33	512.20	2,980	25	3,005	32
5-May-2010	17:00	657.33	512.20	2,980	25	3,005	32
5-May-2010	18:00	657.33	512.10	2,970	25	2,995	32

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
5-May-2010	19:00	657.33	512.10	2,970	25	2,995	32
5-May-2010	20:00	657.34	512.10	2,970	25	2,995	32
5-May-2010	21:00	657.34	512.10	2,970	25	2,995	32
5-May-2010	22:00	657.34	512.00	2,960	25	2,985	32
5-May-2010	23:00	657.34	512.00	2,960	25	2,985	32
5-May-2010	24:00:00	657.34	512.00	2,960	25	2,985	32
6-May-2010	1:00	657.31	513.20	3,340	25	3,365	36
6-May-2010	2:00	657.31	513.20	3,340	25	3,365	36
6-May-2010	3:00	657.30	513.30	3,340	25	3,365	36
6-May-2010	4:00	657.30	513.40	3,340	25	3,365	36
6-May-2010	5:00	657.29	513.50	3,340	25	3,365	36
6-May-2010	6:00	657.29	513.50	3,340	25	3,365	36
6-May-2010	7:00	657.28	513.50	3,340	25	3,365	36
6-May-2010	8:00	657.34	512.50	3,300	25	3,325	36
6-May-2010	9:00	657.34	512.60	3,300	25	3,325	36
6-May-2010	10:00	657.34	512.70	3,320	25	3,345	36
6-May-2010	11:00	657.34	512.80	3,320	25	3,345	36
6-May-2010	12:00	657.34	512.90	3,320	25	3,345	36
6-May-2010	13:00	657.34	513.00	3,320	25	3,345	36
6-May-2010	14:00	657.34	513.00	3,320	25	3,345	36
6-May-2010	15:00	657.33	513.00	3,320	25	3,345	36
6-May-2010	16:00	657.33	513.00	3,320	25	3,345	36
6-May-2010	17:00	657.33	513.00	3,320	25	3,345	36
6-May-2010	18:00	657.33	513.00	3,320	25	3,345	36
6-May-2010	19:00	657.32	513.00	3,320	25	3,345	36
6-May-2010	20:00	657.32	513.00	3,320	25	3,345	36
6-May-2010	21:00	657.32	513.00	3,320	25	3,345	36

Dale Hollow Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	Dale Hollow Dam Headwater Elevation ft	Dale Hollow Dam Tailwater Elevation ft	Dale Hollow Dam Turbine Discharge cfs	Dale Hollow Dam Gate Release cfs	Dale Hollow Dam Total Discharge cfs	Dale Hollow Dam Gross Energy mwh
6-May-2010	22:00	657.32	513.10	3,340	25	3,365	36
6-May-2010	23:00	657.32	513.10	3,340	25	3,365	36
6-May-2010	24:00:00	657.32	513.10	3,340	25	3,365	36
7-May-2010	1:00	657.31	513.20	3,340	25	3,365	36
7-May-2010	2:00	657.31	513.20	3,340	25	3,365	36
7-May-2010	3:00	657.30	513.30	3,340	25	3,365	36
7-May-2010	4:00	657.30	513.40	3,340	25	3,365	36
7-May-2010	5:00	657.29	513.50	3,340	25	3,365	36
7-May-2010	6:00	657.29	513.50	3,340	25	3,365	36

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
29-Apr-2010	1:00	489.31	389.11	0	0	0	0
29-Apr-2010	2:00	489.31	389.11	0	0	0	0
29-Apr-2010	3:00	489.32	389.12	0	0	0	0
29-Apr-2010	4:00	489.32	389.22	0	0	0	0
29-Apr-2010	5:00	489.32	389.22	0	0	0	0
29-Apr-2010	6:00	489.32	389.22	0	0	0	0
29-Apr-2010	7:00	489.33	389.23	0	0	0	0
29-Apr-2010	8:00	489.33	389.23	0	0	0	0
29-Apr-2010	9:00	489.33	389.23	0	0	0	0
29-Apr-2010	10:00	489.33	389.23	0	0	0	0
29-Apr-2010	11:00	489.33	389.33	0	0	0	0
29-Apr-2010	12:00	489.33	389.43	0	0	0	0
29-Apr-2010	13:00	489.34	390.04	0	0	0	0
29-Apr-2010	14:00	489.34	390.14	0	0	0	0
29-Apr-2010	15:00	489.34	390.44	0	0	0	0
29-Apr-2010	16:00	489.34	390.44	0	0	0	0
29-Apr-2010	17:00	489.34	390.44	0	0	0	0
29-Apr-2010	18:00	489.34	390.54	0	0	0	0
29-Apr-2010	19:00	489.34	390.64	0	0	0	0
29-Apr-2010	20:00	489.34	390.74	0	0	0	0
29-Apr-2010	21:00	489.34	390.84	0	0	0	0
29-Apr-2010	22:00	489.34	390.84	0	0	0	0
29-Apr-2010	23:00	489.34	390.94	0	0	0	0
29-Apr-2010	24:00:00	489.34	390.94	0	0	0	0
30-Apr-2010	1:00	489.34	391.14	0	0	0	0
30-Apr-2010	2:00	489.34	391.14	0	0	0	0
30-Apr-2010	3:00	489.34	391.14	0	0	0	0

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
30-Apr-2010	4:00	489.34	391.24	0	0	0	0
30-Apr-2010	5:00	489.35	391.25	0	0	0	0
30-Apr-2010	6:00	489.35	391.25	0	0	0	0
30-Apr-2010	7:00	489.36	391.26	0	0	0	0
30-Apr-2010	8:00	489.36	391.24	0	0	0	0
30-Apr-2010	9:00	489.36	391.24	0	0	0	0
30-Apr-2010	10:00	489.36	391.36	0	0	0	0
30-Apr-2010	11:00	489.35	390.85	0	0	0	0
30-Apr-2010	12:00	489.35	390.75	0	0	0	0
30-Apr-2010	13:00	489.35	390.75	0	0	0	0
30-Apr-2010	14:00	489.35	390.65	0	0	0	0
30-Apr-2010	15:00	489.35	390.55	0	0	0	0
30-Apr-2010	16:00	489.35	390.45	0	0	0	0
30-Apr-2010	17:00	489.35	390.45	0	0	0	0
30-Apr-2010	18:00	489.35	390.45	0	0	0	0
30-Apr-2010	19:00	489.35	390.15	0	0	0	0
30-Apr-2010	20:00	489.35	390.15	0	0	0	0
30-Apr-2010	21:00	489.35	389.95	0	0	0	0
30-Apr-2010	22:00	489.35	389.85	0	0	0	0
30-Apr-2010	23:00	489.35	389.75	0	0	0	0
30-Apr-2010	24:00:00	489.35	389.75	0	0	0	0
1-May-2010	1:00	489.36	389.66	0	0	0	0
1-May-2010	2:00	489.36	389.96	0	0	0	0
1-May-2010	3:00	489.36	390.16	0	0	0	0
1-May-2010	4:00	489.36	390.26	0	0	0	0
1-May-2010	5:00	489.36	390.26	0	0	0	0
1-May-2010	6:00	489.36	390.26	0	0	0	0

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
1-May-2010	7:00	489.37	390.57	0	0	0	0
1-May-2010	8:00	489.40	390.50	0	0	0	0
1-May-2010	9:00	489.45	391.25	0	0	0	0
1-May-2010	10:00	489.47	391.37	0	0	0	0
1-May-2010	11:00	489.48	395.48	4,600	0	4,600	30
1-May-2010	12:00	489.50	396.20	4,600	0	4,600	30
1-May-2010	13:00	489.60	396.90	4,600	0	4,600	30
1-May-2010	14:00	489.68	397.58	4,600	0	4,600	30
1-May-2010	15:00	489.84	399.24	4,600	0	4,600	30
1-May-2010	16:00	490.00	400.00	4,700	0	4,700	30
1-May-2010	17:00	490.30	402.00	4,700	0	4,700	30
1-May-2010	18:00	490.45	402.85	4,700	0	4,700	30
1-May-2010	19:00	490.95	404.25	4,800	0	4,800	30
1-May-2010	20:00	491.43	405.43	4,800	0	4,800	30
1-May-2010	21:00	491.93	406.23	4,800	0	4,800	30
1-May-2010	22:00	492.43	407.13	4,800	0	4,800	30
1-May-2010	23:00	492.95	407.55	4,800	0	4,800	30
1-May-2010	24:00:00	493.55	408.05	4,800	0	4,800	30
2-May-2010	1:00	494.68	409.08	4,800	0	4,800	30
2-May-2010	2:00	494.97	409.77	4,800	0	4,800	30
2-May-2010	3:00	495.26	410.46	4,800	0	4,800	30
2-May-2010	4:00	495.49	410.69	4,800	0	4,800	30
2-May-2010	5:00	495.71	410.61	4,800	0	4,800	30
2-May-2010	6:00	495.91	410.61	4,800	0	4,800	30
2-May-2010	7:00	496.11	411.11	4,800	0	4,800	30
2-May-2010	8:00	496.25	411.35	4,800	0	4,800	30
2-May-2010	9:00	496.40	413.30	4,900	0	4,900	30

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
2-May-2010	10:00	496.67	414.86	4,900	0	4,900	30
2-May-2010	11:00	496.87	416.17	4,900	0	4,900	30
2-May-2010	12:00	497.07	417.57	5,000	0	5,000	30
2-May-2010	13:00	497.10	418.30	5,000	0	5,000	30
2-May-2010	14:00	497.30	418.30	5,000	0	5,000	30
2-May-2010	15:00	497.47	418.57	5,000	0	5,000	30
2-May-2010	16:00	497.70	419.90	5,000	0	5,000	30
2-May-2010	17:00	497.80	420.70	5,000	0	5,000	30
2-May-2010	18:00	497.95	421.65	5,000	0	5,000	30
2-May-2010	19:00	498.05	422.25	5,200	0	5,200	30
2-May-2010	20:00	498.17	422.97	5,200	0	5,200	30
2-May-2010	21:00	498.29	423.49	5,200	0	5,200	30
2-May-2010	22:00	498.46	424.16	0	0	0	0
2-May-2010	23:00	498.61	424.61	0	0	0	0
2-May-2010	24:00:00	498.71	424.71	0	0	0	0
3-May-2010	1:00	498.98	424.40	0	0	0	0
3-May-2010	2:00	499.06	424.96	0	0	0	0
3-May-2010	3:00	499.22	424.82	0	0	0	0
3-May-2010	4:00	499.36	424.56	0	0	0	0
3-May-2010	5:00	499.48	424.48	0	0	0	0
3-May-2010	6:00	499.56	424.56	0	0	0	0
3-May-2010	7:00	499.72	424.82	0	0	0	0
3-May-2010	8:00	502.00	424.50	3,900	0	3,900	18
3-May-2010	9:00	502.25	424.95	5,100	0	5,100	27
3-May-2010	10:00	502.50	427.60	5,200	0	5,200	30
3-May-2010	11:00	502.60	427.90	5,200	0	5,200	30
3-May-2010	12:00	502.60	427.90	5,200	0	5,200	30

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
3-May-2010	13:00	502.80	428.10	5,200	0	5,200	30
3-May-2010	14:00	503.00	428.25	5,200	0	5,200	30
3-May-2010	15:00	503.30	428.30	5,200	0	5,200	30
3-May-2010	16:00	503.50	428.10	5,200	0	5,200	30
3-May-2010	17:00	503.80	428.00	5,200	0	5,200	30
3-May-2010	18:00	504.01	427.81	5,200	0	5,200	30
3-May-2010	19:00	504.20	427.40	5,100	0	5,100	30
3-May-2010	20:00	504.18	427.28	5,100	0	5,100	30
3-May-2010	21:00	504.25	426.85	5,100	0	5,100	30
3-May-2010	22:00	504.30	426.60	5,100	0	5,100	30
3-May-2010	23:00	504.35	426.45	5,000	0	5,000	30
3-May-2010	24:00:00	504.35	426.25	5,000	1,000	6,000	30
4-May-2010	1:00	504.40	426.10	5,000	2,000	7,000	30
4-May-2010	2:00	504.40	425.90	5,000	2,000	7,000	30
4-May-2010	3:00	504.40	425.80	5,000	2,000	7,000	30
4-May-2010	4:00	504.40	425.70	5,000	2,000	7,000	30
4-May-2010	5:00	504.42	425.52	5,000	2,000	7,000	30
4-May-2010	6:00	504.42	425.52	5,000	2,000	7,000	30
4-May-2010	7:00	504.54	425.34	5,000	2,000	7,000	30
4-May-2010	8:00	504.60	425.30	5,000	2,000	7,000	30
4-May-2010	9:00	504.90	425.20	5,000	3,600	8,600	30
4-May-2010	10:00	504.90	425.20	5,000	3,600	8,600	30
4-May-2010	11:00	504.90	425.10	5,000	3,600	8,600	30
4-May-2010	12:00	504.90	425.10	5,000	3,600	8,600	30
4-May-2010	13:00	504.90	425.10	5,000	3,600	8,600	30
4-May-2010	14:00	504.90	425.00	5,000	3,600	8,600	30
4-May-2010	15:00	504.90	425.00	5,000	3,600	8,600	30

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
4-May-2010	16:00	504.90	425.00	5,000	3,600	8,600	30
4-May-2010	17:00	504.90	424.90	5,000	3,600	8,600	30
4-May-2010	18:00	504.90	424.90	5,000	3,600	8,600	30
4-May-2010	19:00	504.85	424.85	4,900	3,700	8,600	30
4-May-2010	20:00	504.80	424.90	4,900	3,700	8,600	30
4-May-2010	21:00	504.68	424.78	4,900	3,700	8,600	30
4-May-2010	22:00	504.55	424.65	4,900	3,700	8,600	30
4-May-2010	23:00	504.48	424.58	4,900	3,700	8,600	30
4-May-2010	24:00:00	504.40	424.50	4,900	3,700	8,600	30
5-May-2010	1:00	504.40	424.50	4,900	3,700	8,600	30
5-May-2010	2:00	504.40	424.50	4,900	3,700	8,600	30
5-May-2010	3:00	504.40	424.40	4,900	3,700	8,600	30
5-May-2010	4:00	504.40	424.30	4,900	3,700	8,600	30
5-May-2010	5:00	504.39	424.19	4,900	3,700	8,600	30
5-May-2010	6:00	504.39	424.19	4,900	3,700	8,600	30
5-May-2010	7:00	504.70	424.20	4,900	3,700	8,600	30
5-May-2010	8:00	504.62	424.50	4,900	3,700	8,600	30
5-May-2010	9:00	504.61	424.11	4,900	3,700	8,600	30
5-May-2010	10:00	504.60	424.00	4,900	3,700	8,600	30
5-May-2010	11:00	504.59	423.89	4,900	3,700	8,600	30
5-May-2010	12:00	504.58	423.88	4,900	3,700	8,600	30
5-May-2010	13:00	504.57	423.87	4,900	3,700	8,600	30
5-May-2010	14:00	504.56	423.76	4,900	3,700	8,600	30
5-May-2010	15:00	504.55	423.55	4,900	3,700	8,600	30
5-May-2010	16:00	504.55	423.35	4,900	3,700	8,600	30
5-May-2010	17:00	504.55	423.05	4,900	3,700	8,600	30
5-May-2010	18:00	504.55	423.05	4,900	3,700	8,600	30

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
5-May-2010	19:00	504.60	422.40	4,900	3,700	8,600	30
5-May-2010	20:00	504.60	422.00	4,900	3,700	8,600	30
5-May-2010	21:00	504.59	421.69	4,900	3,700	8,600	30
5-May-2010	22:00	504.58	421.28	4,800	3,700	8,500	30
5-May-2010	23:00	504.57	420.97	4,800	3,700	8,500	30
5-May-2010	24:00:00	504.56	420.46	4,800	3,700	8,500	30
6-May-2010	1:00	504.55	420.05	4,800	3,700	8,500	30
6-May-2010	2:00	504.54	419.64	4,800	3,700	8,500	30
6-May-2010	3:00	504.53	419.03	4,800	3,700	8,500	30
6-May-2010	4:00	504.52	418.42	4,800	3,700	8,500	30
6-May-2010	5:00	504.50	417.80	4,800	3,700	8,500	30
6-May-2010	6:00	504.49	417.29	4,800	3,700	8,500	30
6-May-2010	7:00	504.29	416.39	4,700	3,700	8,400	30
6-May-2010	8:00	504.28	415.78	4,700	3,700	8,400	30
6-May-2010	9:00	504.26	415.36	4,700	3,700	8,400	30
6-May-2010	10:00	504.25	414.85	4,700	3,700	8,400	30
6-May-2010	11:00	504.24	414.34	4,700	3,700	8,400	30
6-May-2010	12:00	504.23	413.93	4,700	3,700	8,400	30
6-May-2010	13:00	504.22	413.52	4,600	3,700	8,300	30
6-May-2010	14:00	504.21	412.01	4,600	3,700	8,300	30
6-May-2010	15:00	504.20	412.50	4,600	3,700	8,300	30
6-May-2010	16:00	504.19	411.99	4,600	3,700	8,300	30
6-May-2010	17:00	504.17	411.47	4,600	3,700	8,300	30
6-May-2010	18:00	504.16	411.36	4,600	3,700	8,300	30
6-May-2010	19:00	504.00	410.70	4,600	3,700	8,300	30
6-May-2010	20:00	503.98	410.49	4,600	3,700	8,300	30
6-May-2010	21:00	503.98	410.18	4,600	3,700	8,300	30

J. Percy Priest Dam Hourly Water Control Data -> 29 April - 07 May 2010							
Date	Time	J. Percy Priest Dam Headwater Elevation ft	J. Percy Priest Dam Tailwater Elevation ft	J. Percy Priest Dam Turbine Discharge cfs	J. Percy Priest Dam Sluice Gate Release cfs	J. Percy Priest Dam Total Discharge cfs	J. Percy Priest Dam Gross Energy mwh
6-May-2010	22:00	503.97	409.87	4,600	3,700	8,300	30
6-May-2010	23:00	503.95	409.65	4,600	3,700	8,300	30
6-May-2010	24:00:00	503.92	409.32	4,600	3,700	8,300	30
7-May-2010	1:00	503.90	409.20	4,600	3,700	8,300	30
7-May-2010	2:00	503.89	408.99	4,600	3,700	8,300	30
7-May-2010	3:00	503.88	408.78	4,600	3,700	8,300	30
7-May-2010	4:00	503.87	408.67	4,600	3,700	8,300	30
7-May-2010	5:00	503.82	408.42	4,500	3,700	8,200	30
7-May-2010	6:00	503.77	408.17	4,500	3,700	8,200	30

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Damage Center Tables

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Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
29-Apr-2010	1:00	18.21	507.21	17,187	11.59	449.12	16,531	18.50	386.61	18,438	61.38	361.38
29-Apr-2010	2:00	18.41	507.41	18,278	11.63	449.16	16,656	18.50	386.61	17,918	61.15	361.15
29-Apr-2010	3:00	18.09	507.09	16,548	11.73	449.26	16,969	18.51	386.62	17,430	60.99	360.99
29-Apr-2010	4:00	18.08	507.08	16,495	11.81	449.34	17,219	18.59	386.70	17,839	60.89	360.89
29-Apr-2010	5:00	18.10	507.10	16,601	11.85	449.38	17,344	18.66	386.77	17,793	60.83	360.83
29-Apr-2010	6:00	18.18	507.18	16,994	11.82	449.35	17,250	18.75	386.86	17,945	60.79	360.79
29-Apr-2010	7:00	18.20	507.20	17,068	11.80	449.33	17,188	18.81	386.92	17,374	60.77	360.77
29-Apr-2010	8:00	18.24	507.24	17,184	11.78	449.31	17,125	18.88	386.99	17,536	60.83	360.83
29-Apr-2010	9:00	18.28	507.28	16,441	11.75	449.28	17,031	18.95	387.06	18,735	60.74	360.74
29-Apr-2010	10:00	18.31	507.31	17,463	11.75	449.28	17,031	19.03	387.14	19,419	61.04	361.04
29-Apr-2010	11:00	18.35	507.35	17,714	11.70	449.23	16,922	19.05	387.16	19,087	61.15	361.15
29-Apr-2010	12:00	18.38	507.38	17,744	11.55	449.08	16,454	19.02	387.13	19,327	61.20	361.20
29-Apr-2010	13:00	18.41	507.41	17,875	11.57	449.10	16,564	19.08	387.19	19,985	61.24	361.24
29-Apr-2010	14:00	18.44	507.44	17,973	11.62	449.15	16,719	19.19	387.30	20,909	61.24	361.24
29-Apr-2010	15:00	18.47	507.47	18,138	11.70	449.23	16,969	19.27	387.38	21,387	61.23	361.23
29-Apr-2010	16:00	18.50	507.50	18,304	11.78	449.31	17,219	19.37	387.48	21,964	61.27	361.27
29-Apr-2010	17:00	18.51	507.51	18,326	11.83	449.36	17,423	19.40	387.51	21,548	61.24	361.24
29-Apr-2010	18:00	18.52	507.52	18,348	11.80	449.33	17,329	19.46	387.57	22,251	61.27	361.27
29-Apr-2010	19:00	18.52	507.52	18,314	12.60	450.13	19,880	19.50	387.61	22,175	61.23	361.23
29-Apr-2010	20:00	18.51	507.51	18,292	13.09	450.62	21,569	19.55	387.66	22,386	61.22	361.22
29-Apr-2010	21:00	18.50	507.50	18,304	13.40	450.93	22,656	19.58	387.69	22,045	61.25	361.25
29-Apr-2010	22:00	18.50	507.50	18,678	12.99	450.52	21,264	19.68	387.79	23,087	61.27	361.27
29-Apr-2010	23:00	18.46	507.46	18,624	12.68	450.21	20,215	19.73	387.84	22,935	61.29	361.29
29-Apr-2010	24:00:00	18.42	507.42	18,502	12.48	450.01	19,621	19.77	387.88	23,022	61.31	361.31
30-Apr-2010	1:00	18.38	507.38	18,113	12.39	449.92	19,341	19.83	387.94	23,157	61.34	361.34

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
30-Apr-2010	2:00	18.36	507.36	17,969	12.32	449.85	19,112	19.91	388.02	23,436	61.36	361.36
30-Apr-2010	3:00	18.36	507.36	18,003	12.30	449.83	19,059	19.93	388.04	22,899	61.33	361.33
30-Apr-2010	4:00	18.37	507.37	18,058	12.19	449.72	18,714	19.98	388.09	23,297	61.30	361.30
30-Apr-2010	5:00	18.36	507.36	17,969	12.08	449.61	18,378	20.03	388.14	23,346	61.27	361.27
30-Apr-2010	6:00	18.37	507.37	17,957	12.00	449.53	18,156	20.08	388.19	23,436	61.26	361.26
30-Apr-2010	7:00	18.38	507.38	18,012	11.93	449.46	17,974	20.08	388.19	22,929	61.26	361.26
30-Apr-2010	8:00	18.79	507.79	19,920	11.76	449.29	17,440	20.14	388.25	23,462	61.25	361.25
30-Apr-2010	9:00	18.43	507.43	18,255	11.68	449.21	17,236	20.17	388.28	22,982	61.24	361.24
30-Apr-2010	10:00	18.82	507.82	19,988	11.52	449.05	16,747	20.21	388.32	22,986	61.24	361.24
30-Apr-2010	11:00	18.50	507.50	18,508	11.35	448.88	16,242	20.23	388.34	22,892	61.23	361.23
30-Apr-2010	12:00	18.81	507.81	19,895	11.31	448.84	16,175	20.17	388.28	22,520	61.22	361.22
30-Apr-2010	13:00	18.55	507.55	18,687	11.18	448.71	15,792	20.10	388.21	22,904	61.19	361.19
30-Apr-2010	14:00	18.53	507.53	18,506	11.91	449.44	18,054	20.07	388.18	23,073	61.40	361.40
30-Apr-2010	15:00	18.55	507.55	18,618	12.38	449.91	19,484	20.00	388.11	23,190	61.47	361.47
30-Apr-2010	16:00	18.89	507.89	20,202	12.74	450.27	20,612	19.87	387.98	22,697	61.55	361.55
30-Apr-2010	17:00	18.63	507.63	18,381	12.98	450.51	21,452	19.76	387.87	22,631	61.62	361.62
30-Apr-2010	18:00	18.58	507.58	19,113	13.41	450.94	22,875	19.68	387.79	22,558	61.63	361.63
30-Apr-2010	19:00	18.52	507.52	19,012	13.72	451.25	23,862	19.55	387.66	22,543	61.65	361.65
30-Apr-2010	20:00	18.50	507.50	19,035	14.02	451.55	24,750	19.44	387.55	22,628	61.67	361.67
30-Apr-2010	21:00	18.47	507.47	18,984	14.28	451.81	25,555	19.33	387.44	22,492	61.67	361.67
30-Apr-2010	22:00	18.43	507.43	18,911	13.73	451.26	23,819	19.24	387.35	22,606	61.67	361.67
30-Apr-2010	23:00	18.47	507.47	19,170	13.34	450.87	22,579	19.12	387.23	22,366	61.68	361.68
30-Apr-2010	24:00:00	18.59	507.59	19,719	13.06	450.59	21,638	19.01	387.12	22,428	61.68	361.68
1-May-2010	1:00	18.37	507.37	18,743	12.88	450.41	21,034	18.92	387.03	22,480	61.67	361.67
1-May-2010	2:00	18.34	507.34	18,593	12.73	450.26	20,522	18.80	386.91	22,339	61.66	361.66

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
1-May-2010	3:00	18.37	507.37	18,726	12.60	450.13	20,072	18.81	386.92	23,233	61.64	361.64
1-May-2010	4:00	18.37	507.37	18,710	12.48	450.01	19,708	18.82	386.93	23,742	61.62	361.62
1-May-2010	5:00	18.38	507.38	18,715	12.35	449.88	19,303	18.81	386.92	24,204	61.70	361.70
1-May-2010	6:00	18.38	507.38	18,699	12.39	449.92	19,467	18.83	386.94	24,230	61.74	361.74
1-May-2010	7:00	18.39	507.39	19,475	12.30	449.83	19,155	18.84	386.95	24,413	61.76	361.76
1-May-2010	8:00	18.41	507.41	18,547	12.24	449.77	18,909	19.27	387.38	28,204	61.87	361.87
1-May-2010	9:00	18.48	507.48	18,905	12.18	449.71	18,711	19.48	387.59	27,370	61.98	361.98
1-May-2010	10:00	18.52	507.52	19,012	12.11	449.64	18,463	19.79	387.90	27,853	62.03	362.03
1-May-2010	11:00	18.57	507.57	19,142	12.69	450.22	20,218	20.27	388.38	29,480	62.20	362.20
1-May-2010	12:00	18.62	507.62	19,306	13.17	450.70	21,810	20.79	388.90	30,211	62.40	362.40
1-May-2010	13:00	18.71	507.71	19,615	13.64	451.17	23,344	21.52	389.63	33,349	62.79	362.79
1-May-2010	14:00	18.88	507.88	20,339	13.94	451.47	24,294	22.29	390.40	37,910	63.68	363.68
1-May-2010	15:00	19.02	508.02	20,771	14.41	451.94	25,695	23.58	391.69	46,136	64.93	364.93
1-May-2010	16:00	19.36	508.36	21,348	15.90	453.43	30,357	25.11	393.22	54,909	66.47	366.47
1-May-2010	17:00	20.40	509.40	24,128	18.26	455.79	38,071	26.61	394.72	63,030	67.98	367.98
1-May-2010	18:00	21.82	510.82	26,654	20.70	458.23	60,354	28.04	396.15	70,284	69.48	369.48
1-May-2010	19:00	22.83	511.83	29,052	22.93	460.46	69,717	29.38	397.49	78,304	70.97	370.97
1-May-2010	20:00	23.84	512.84	31,461	25.06	462.59	78,796	30.69	398.80	85,786	72.52	372.52
1-May-2010	21:00	24.72	513.72	33,611	26.57	464.10	83,742	31.61	399.72	89,298	73.64	373.64
1-May-2010	22:00	25.42	514.42	35,325	27.70	465.23	88,207	32.00	400.11	84,093	74.41	374.41
1-May-2010	23:00	26.06	515.06	36,894	28.60	466.13	92,064	33.45	401.56	99,653	75.20	375.20
1-May-2010	24:00:00	26.22	515.22	37,284	29.59	467.12	95,666	34.52	402.63	100,646	75.81	375.81
2-May-2010	1:00	26.54	515.54	38,066	30.63	468.16	99,521	35.15	403.26	103,546	76.85	376.85
2-May-2010	2:00	26.82	515.82	38,749	31.29	468.82	96,766	35.90	404.01	114,066	77.48	377.48
2-May-2010	3:00	26.99	515.99	39,164	31.66	469.19	89,718	36.51	404.62	115,400	78.04	378.04

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
2-May-2010	4:00	27.11	516.11	39,460	31.94	469.47	88,019	36.91	405.02	110,548	78.44	378.44
2-May-2010	5:00	27.17	516.17	39,608	32.18	469.71	87,584	37.17	405.28	106,979	78.83	378.83
2-May-2010	6:00	27.17	516.17	39,608	32.36	469.89	86,346	37.33	405.44	104,309	79.27	379.27
2-May-2010	7:00	27.13	516.13	39,509	32.45	469.98	83,931	37.43	405.54	102,633	79.74	379.74
2-May-2010	8:00	27.06	516.06	39,337	32.56	470.09	84,845	37.79	405.90	112,177	80.15	380.15
2-May-2010	9:00	27.13	516.13	39,509	32.65	470.18	84,505	38.93	407.04	126,650	80.51	380.51
2-May-2010	10:00	26.91	515.91	38,969	32.66	470.19	81,833	40.33	408.44	133,800	80.91	380.91
2-May-2010	11:00	26.99	515.99	39,164	32.62	470.15	80,251	41.50	409.61	140,182	81.29	381.29
2-May-2010	12:00	27.19	516.19	39,657	32.62	470.15	81,722	42.61	410.72	146,460	81.73	381.73
2-May-2010	13:00	27.47	516.47	40,347	32.59	470.12	81,639	43.72	411.83	153,467	82.19	382.19
2-May-2010	14:00	27.48	516.48	40,372	32.54	470.07	79,666	44.24	412.35	152,487	82.67	382.67
2-May-2010	15:00	27.76	516.76	41,061	32.83	470.36	91,057	45.14	413.25	163,050	83.05	383.05
2-May-2010	16:00	28.29	517.29	42,380	33.26	470.79	96,665	45.64	413.75	161,240	83.64	383.64
2-May-2010	17:00	29.40	518.40	45,165	34.24	471.77	113,271	46.34	414.45	171,240	84.16	384.16
2-May-2010	18:00	31.50	520.50	50,434	35.18	472.71	117,376	46.86	414.97	169,570	84.67	384.67
2-May-2010	19:00	33.38	522.38	55,207	35.89	473.42	115,909	47.44	415.55	177,092	85.19	385.19
2-May-2010	20:00	34.66	523.66	58,655	36.78	474.31	124,363	47.87	415.98	173,484	85.64	385.64
2-May-2010	21:00	35.50	524.50	60,917	37.44	474.97	121,302	48.33	416.44	178,155	86.17	386.17
2-May-2010	22:00	36.01	525.01	62,288	38.15	475.68	126,761	48.88	416.99	186,384	86.58	386.58
2-May-2010	23:00	36.41	525.41	63,363	38.89	476.42	131,485	49.31	417.42	183,949	87.03	387.03
2-May-2010	24:00:00	36.59	525.59	63,847	39.67	477.20	139,166	49.63	417.74	185,569	87.50	387.50
3-May-2010	1:00	36.90	525.90	64,680	40.50	478.03	142,790	50.04	418.15	188,644	87.95	387.95
3-May-2010	2:00	37.14	526.14	65,325	41.28	478.81	143,518	50.12	418.23	171,542	88.35	388.35
3-May-2010	3:00	37.38	526.38	65,970	42.23	479.76	150,344	50.43	418.54	186,034	88.74	388.74
3-May-2010	4:00	37.51	526.51	66,320	42.91	480.44	146,849	50.50	418.61	173,406	89.14	389.14

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
3-May-2010	5:00	37.58	526.58	66,508	43.45	480.98	143,510	50.62	418.73	177,075	89.49	389.49
3-May-2010	6:00	37.62	526.62	66,615	44.23	481.76	157,931	50.56	418.67	166,084	89.83	389.83
3-May-2010	7:00	37.60	526.60	66,562	44.68	482.21	145,087	50.74	418.85	181,505	90.10	390.10
3-May-2010	8:00	37.58	526.58	66,508	45.17	482.70	149,277	50.79	418.90	174,500	90.48	390.48
3-May-2010	9:00	37.37	526.37	65,943	45.42	482.95	139,278	50.87	418.98	176,935	90.67	390.67
3-May-2010	10:00	37.15	526.15	65,352	45.82	483.35	148,207	51.05	419.16	184,244	90.99	390.99
3-May-2010	11:00	36.97	525.97	64,868	46.02	483.55	139,641	51.13	419.24	179,161	91.28	391.28
3-May-2010	12:00	36.69	525.69	64,116	46.06	483.59	132,211	51.19	419.30	178,485	91.60	391.60
3-May-2010	13:00	36.36	525.36	63,228	45.96	483.49	123,991	51.49	419.60	194,425	91.70	391.70
3-May-2010	14:00	36.06	525.06	62,422	46.00	483.53	131,907	51.38	419.49	169,340	91.86	391.86
3-May-2010	15:00	35.83	524.83	61,804	45.97	483.50	129,875	51.71	419.82	197,865	92.14	392.14
3-May-2010	16:00	35.34	524.34	60,487	46.00	483.53	130,000	51.81	419.92	185,455	92.32	392.32
3-May-2010	17:00	35.02	524.02	59,627	45.76	483.29	114,810	51.85	419.96	179,643	92.48	392.48
3-May-2010	18:00	34.61	523.61	58,520	45.63	483.16	120,944	51.86	419.97	179,714	92.61	392.61
3-May-2010	19:00	34.01	523.01	56,901	45.34	482.87	110,071	51.83	419.94	179,500	92.76	392.76
3-May-2010	20:00	33.68	522.68	56,013	45.06	482.59	109,693	51.72	419.83	171,673	92.72	392.72
3-May-2010	21:00	33.12	522.12	54,508	44.72	482.25	104,742	51.68	419.79	175,859	92.56	392.56
3-May-2010	22:00	32.65	521.65	53,317	44.39	481.92	104,292	51.44	419.55	161,799	92.44	392.44
3-May-2010	23:00	31.87	520.87	51,362	44.02	481.55	100,650	51.43	419.54	176,643	92.75	392.75
3-May-2010	24:00:00	31.48	520.48	50,383	43.67	481.20	93,266	51.27	419.38	160,688	93.07	393.07
4-May-2010	1:00	30.94	519.94	49,029	43.22	480.75	91,858	51.03	419.14	158,933	93.25	393.25
4-May-2010	2:00	30.06	519.06	46,821	42.68	480.21	80,676	50.96	419.07	168,640	93.29	393.29
4-May-2010	3:00	29.48	518.48	45,366	42.16	479.69	81,319	50.82	418.93	163,310	93.22	393.22
4-May-2010	4:00	28.88	517.88	43,861	41.50	479.03	65,544	50.65	418.76	160,226	93.25	393.25
4-May-2010	5:00	28.24	517.24	42,255	41.08	478.61	88,747	50.57	418.68	164,922	93.42	393.42

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
4-May-2010	6:00	27.65	516.65	40,790	40.56	478.09	77,532	50.47	418.58	163,097	93.38	393.38
4-May-2010	7:00	27.06	516.06	39,337	39.96	477.49	68,393	50.44	418.55	169,000	93.48	393.48
4-May-2010	8:00	26.49	515.49	37,944	39.56	477.09	85,752	50.20	418.31	153,363	93.42	393.42
4-May-2010	9:00	25.91	514.91	36,526	39.12	476.65	81,568	50.26	418.37	171,300	93.31	393.31
4-May-2010	10:00	25.36	514.36	35,177	38.78	476.31	86,520	50.14	418.25	159,972	93.38	393.38
4-May-2010	11:00	24.81	513.81	33,830	38.38	475.91	82,184	49.99	418.10	157,380	93.41	393.41
4-May-2010	12:00	24.34	513.34	32,683	38.06	475.59	85,196	50.02	418.13	166,375	93.40	393.40
4-May-2010	13:00	24.24	513.24	32,439	37.72	475.25	83,020	49.95	418.06	161,756	93.29	393.29
4-May-2010	14:00	23.44	512.44	32,154	37.35	474.88	80,265	49.83	417.94	158,118	93.27	393.27
4-May-2010	15:00	23.33	512.33	30,234	37.08	474.61	84,146	49.76	417.87	160,563	93.19	393.19
4-May-2010	16:00	22.81	511.81	30,766	36.78	474.31	81,643	49.68	417.79	159,416	93.20	393.20
4-May-2010	17:00	22.44	511.44	29,809	36.35	473.88	73,958	49.68	417.79	164,143	93.18	393.18
4-May-2010	18:00	21.67	510.67	26,885	35.76	473.29	59,222	49.49	417.60	151,944	93.07	393.07
4-May-2010	19:00	21.47	510.47	26,746	35.10	472.63	52,124	49.43	417.54	158,850	92.96	392.96
4-May-2010	20:00	20.87	509.87	24,715	34.58	472.11	62,196	49.27	417.38	152,122	92.80	392.80
4-May-2010	21:00	20.51	509.51	23,746	33.89	471.42	47,434	49.34	417.45	165,563	92.39	392.39
4-May-2010	22:00	20.40	509.40	23,837	33.30	470.83	54,096	49.31	417.42	161,500	92.02	392.02
4-May-2010	23:00	19.87	508.87	22,106	32.52	470.05	38,598	49.27	417.38	158,893	92.04	392.04
4-May-2010	24:00:00	19.61	508.61	21,498	31.63	469.16	43,882	49.14	417.25	160,286	92.48	392.48
5-May-2010	1:00	19.57	508.57	21,810	30.94	468.47	42,753	49.16	417.27	160,429	92.45	392.45
5-May-2010	2:00	19.03	508.03	19,819	30.34	467.87	47,925	49.05	417.16	153,396	92.35	392.35
5-May-2010	3:00	19.11	508.11	20,559	29.68	467.21	42,756	48.98	417.09	155,237	92.22	392.22
5-May-2010	4:00	18.67	507.67	18,986	28.98	466.51	39,016	48.92	417.03	155,443	92.14	392.14
5-May-2010	5:00	18.42	507.42	18,199	28.32	465.85	40,493	48.88	416.99	158,625	92.05	392.05
5-May-2010	6:00	18.42	507.42	18,704	27.68	465.21	40,477	48.75	416.86	150,522	91.92	391.92

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
5-May-2010	7:00	18.31	507.31	18,509	27.10	464.63	42,859	48.69	416.80	154,037	91.79	391.79
5-May-2010	8:00	18.06	507.06	17,678	26.60	464.13	46,592	48.65	416.76	157,188	91.67	391.67
5-May-2010	9:00	18.04	507.04	17,891	26.14	463.67	48,017	48.57	416.68	152,175	91.57	391.57
5-May-2010	10:00	17.87	506.87	17,484	25.69	463.22	47,713	48.44	416.55	148,674	91.46	391.46
5-May-2010	11:00	17.69	506.69	16,964	25.83	463.36	65,262	48.43	416.54	155,812	91.34	391.34
5-May-2010	12:00	17.55	506.55	16,628	25.76	463.29	59,950	48.48	416.59	158,779	91.20	391.20
5-May-2010	13:00	17.54	506.54	16,832	25.48	463.01	53,244	48.41	416.52	151,764	91.10	391.10
5-May-2010	14:00	17.53	506.53	17,066	23.24	460.77	22,217	48.30	416.41	148,893	90.94	390.94
5-May-2010	15:00	17.48	506.48	17,119	21.75	459.28	20,215	48.22	416.33	150,051	90.81	390.81
5-May-2010	16:00	17.75	506.75	18,334	20.78	458.31	19,006	47.96	416.07	138,872	90.70	390.70
5-May-2010	17:00	17.44	506.44	16,791	19.48	457.01	42,429	47.97	416.08	152,938	90.55	390.55
5-May-2010	18:00	17.28	506.28	16,131	18.60	456.13	39,286	47.63	415.74	132,534	90.47	390.47
5-May-2010	19:00	17.31	506.31	16,284	17.93	455.46	36,969	47.52	415.63	144,210	90.32	390.32
5-May-2010	20:00	17.43	506.43	16,650	17.34	454.87	35,125	47.28	415.39	135,901	90.14	390.14
5-May-2010	21:00	17.37	506.37	16,327	16.86	454.39	33,625	46.99	415.10	131,370	89.87	389.87
5-May-2010	22:00	17.44	506.44	16,523	16.47	454.00	32,393	46.64	414.75	126,175	89.55	389.55
5-May-2010	23:00	17.51	506.51	16,676	16.15	453.68	31,250	46.31	414.42	125,815	89.53	389.53
5-May-2010	24:00:00	17.64	506.64	17,053	15.90	453.43	30,357	46.08	414.19	121,576	89.69	389.69
6-May-2010	1:00	17.70	506.70	17,171	15.69	453.22	29,656	45.69	413.80	119,781	89.52	389.52
6-May-2010	2:00	18.09	507.09	18,519	15.52	453.05	29,125	45.35	413.46	120,560	89.34	389.34
6-May-2010	3:00	18.26	507.26	19,041	16.27	453.80	31,679	44.85	412.96	109,480	89.25	389.25
6-May-2010	4:00	18.17	507.17	18,523	16.63	454.16	32,906	44.51	412.62	116,246	89.13	389.13
6-May-2010	5:00	18.26	507.26	18,793	16.82	454.35	33,500	44.00	412.11	104,591	88.98	388.98
6-May-2010	6:00	18.42	507.42	19,444	16.96	454.49	33,938	43.53	411.64	105,018	88.84	388.84
6-May-2010	7:00	18.59	507.59	20,045	17.04	454.57	34,188	43.00	411.11	99,200	88.66	388.66

Cumberland River Damage Centers Hourly Water Control Data -> 29 April - 07 May 2010												
Date	Time	Celina Stage ft	Celina Elevation ft	Celina Flow cfs	Carthage Stage ft	Carthage Elevation ft	Carthage Flow cfs	Nashville Stage ft	Nashville Elevation ft	Nashville Flow cfs	Clarksville Stage ft	Clarksville Elevation ft
6-May-2010	8:00	18.73	507.73	20,515	17.08	454.61	34,312	42.53	410.64	100,726	88.55	388.55
6-May-2010	9:00	18.89	507.89	21,090	17.16	454.69	34,562	41.89	410.00	94,873	88.33	388.33
6-May-2010	10:00	19.03	508.03	20,848	17.17	454.70	34,594	41.43	409.54	96,928	88.22	388.22
6-May-2010	11:00	19.17	508.17	20,530	17.16	454.69	34,562	41.09	409.20	101,022	88.05	388.05
6-May-2010	12:00	19.63	508.63	21,563	17.28	454.81	34,938	40.60	408.71	92,436	87.87	387.87
6-May-2010	13:00	19.72	508.72	21,767	18.38	455.91	38,500	40.25	408.36	97,244	87.73	387.73
6-May-2010	14:00	19.90	508.90	22,174	18.92	456.45	40,429	39.76	407.87	89,380	87.54	387.54
6-May-2010	15:00	19.73	508.73	21,789	19.73	457.26	43,139	39.31	407.42	89,557	87.37	387.37
6-May-2010	16:00	20.11	509.11	22,646	19.69	457.22	43,028	38.79	406.90	83,964	87.18	387.18
6-May-2010	17:00	19.88	508.88	22,129	19.02	456.55	40,786	38.36	406.47	86,932	86.98	386.98
6-May-2010	18:00	19.87	508.87	22,106	18.65	456.18	39,464	37.92	406.03	84,840	86.82	386.82
6-May-2010	19:00	20.28	509.28	23,027	18.46	455.99	38,786	37.48	405.59	83,492	86.64	386.64
6-May-2010	20:00	20.03	509.03	22,467	18.33	455.86	38,321	37.13	405.24	86,130	86.41	386.41
6-May-2010	21:00	20.06	509.06	22,534	18.39	455.92	38,536	36.74	404.85	83,712	86.16	386.16
6-May-2010	22:00	20.15	509.15	22,736	18.30	455.83	38,214	36.38	404.49	83,961	85.93	385.93
6-May-2010	23:00	20.27	509.27	23,005	18.02	455.55	37,250	36.02	404.13	83,099	85.80	385.80
6-May-2010	24:00:00	20.33	509.33	23,139	18.07	455.60	37,417	35.73	403.84	84,729	85.61	385.61
7-May-2010	1:00	20.56	509.56	23,675	18.98	456.51	40,705	35.41	403.52	82,528	85.40	385.40
7-May-2010	2:00	20.53	509.53	23,604	19.56	457.09	42,727	35.12	403.23	82,521	85.19	385.19
7-May-2010	3:00	20.61	509.61	23,794	19.96	457.49	43,891	34.85	402.96	82,198	84.97	384.97
7-May-2010	4:00	20.69	509.69	23,983	20.29	457.82	50,306	34.63	402.74	83,012	84.74	384.74
7-May-2010	5:00	20.76	509.76	24,149	20.42	457.95	47,452	34.34	402.45	79,613	84.56	384.56
7-May-2010	6:00	20.82	509.82	24,292	20.57	458.10	48,347	34.10	402.21	80,254	84.29	384.29

Appendix F – Cost Information

Table 1 – Corps' Account Summary.

Corps' Account Summary

STATE	FCCE	FEMA	O&M*
KY	$100,000	$0	$6,589,240
TN	$333,000	$2,835,000	$43,671,560
TOTAL	$433,000	$2,835,000	$50,260,800

* Includes emergency operations and estimated damages.

Table 2 – FCCE Summary of Class 200 Funding.

FCCE Summary

	FCCE	
Class	KY	TN
219 EOC Activation	$100,000	$116,000
219 Response Ops		$60,000
219 HWM		$107,000
249 Sandbags		$50,000
	$100,000	$333,000

LRN-OP Budget personnel duties during Emergency Operations

- Fund Control: Assist in the management of funding, Load and track
- CEFMs Preparation: Military Interdepartmental Purchase Request, Customer Orders, Labor and Contractual PR&Cs.

The primary role of LRN –OP Budget section during the flood fight was to control funding for responders and other associated missions. This allowed the Emergency Management Section to focus on the task at hand.

All funding was entered and monitored in ENGLink[1]. This allowed tracking by LRD-EM and others as the mission and spending progressed.

Table 1 illustrates the Corps' account summary for this event and includes the emergency operations and damages to the Corps' projects.

Table 2 shows the Class 200 funding received for this major flood event.

[1] **ENGlink is the software program use by USACE to manage information, execution and personnel in response to an event. It also contains a database of all Corps personnel to document physical status, training and essential personnel data.**

Appendix G – FEMA Mission Assignments

Pre-Declaration STATE	Mission Assignment Number	Description	Amount
Tennessee	7220SU-TN-COE-LRD-01	Regional Activation	$20,000
Total			$20,000

Post Declaration STATE	Mission Assignment Number	Description	Amount
Tennessee	1909DR-TN-COE-LRD-01	Regional Activation	$300,000
Tennessee	1909DR-TN-COE-LRD-02	Water/Wastewater	Cancelled
Tennessee	1909DR-TN-COE-LRD-03	Debris Oversight	$500,000
Tennessee	1909DR-TN-COE-LRD-04	Water/Wastewater Infrastructure	$400,000
Tennessee	1909DR-TN-COE-LRD-05	GIS Support	$115,000
Tennessee	1909DR-TN-COE-LRD-06	Project Worksheets	$1,500,000
Total			$2,815,000

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Appendix H – PL84-99: Separate Projects and Major Activities

Martin's Fork

Project: Martin's Fork Lake

Location: Harlan County, Kentucky, Mile 15.6 on Martin's Fork of Clover Fork, Cumberland River

The Flood of May 2010 resulted in a peak project headwater of 1322.2 feet msl, 12.2 feet above normal summer pool, and peak discharge of 515 cfs at Martin's Fork Lake.

Martin's Fork Lake sustained no damages as a result of the Flood of May 2010.

Laurel

Project: Laurel River Lake

Location: Laurel River Mile 2.3, Laurel and Whitley Counties, Kentucky

The Flood of May 2010 resulted in a peak project headwater of 1,016.1 feet msl, 2.4 feet below spillway crest, and peak discharge of 3,710 cfs at Laurel River Lake.

Laurel River Lake sustained no damages as a result of the Flood of May 2010.

Wolf Creek:

Project: Wolf Creek Dam – Lake Cumberland

Location: Cumberland River Mile 460.9, Russell County, Kentucky

The Flood of May 2010 resulted in a peak project headwater elevation of 703.86 feet, which is 23.86 feet above the target headwater under the current IRRM plan. Peak project discharges during the event were 14,880 cfs through a combination of sluices and turbines.

During the week prior to the Flood of May 2010, Wolf Creek Dam was operating four hydropower units around the clock. This was in response to rainfall over the basin the week before, and in order to manage the reservoir for the DSAC I interim risk reduction measure pool restriction target pool elevation of 680 feet.

Between 2400 hours on Sunday, May 2, and 0000 hours on Tuesday, May 4, all hydropower releases were discontinued in order to store water to reduce flows downstream during the flood crest. Beginning at 0000 hours on Tuesday, May 4, project discharges were resumed in accordance with the water control manual procedure to evacuate flood control storage as fast as practical after the flood crest has passed in order to prepare for future potential floods.

Wolf Creek had extensive foundation treatment completed in this past year along with extensive instrumentation and automated real time instrumentation readings that indicate any issues of possible distress in the dam and foundation. The potential for exceeding the interim operating levels at Wolf Creek on a short duration/temporary basis during floods have been factored into the projects risk analysis and do not place the dam at risk.

Flood damages sustained at Wolf Creek Dam, Lake Cumberland, are estimated at $1.2M. Slope failures occurred at the main campground and debris was deposited throughout the project area.

Dale Hollow

Project: Dale Hollow Lake

Location: Obey River Mile 7.3, Clay County, Tennessee

The Flood of May 2010 resulted in a peak project headwater elevation of 657.34 feet msl. Peak project discharges during the event were 2,005 cfs through a combination of fish hatchery and turbines releases.

Prior to the Flood of May 2010, one hydropower unit was running around the clock for routine reservoir level management at Dale Hollow Lake.

Between 2300 hours on Sunday, May 2, and 1500 hours on Monday, May 3, all hydropower releases were discontinued in order to store water to reduce flows downstream during the flood crest. Beginning at 1500 hours on May 3, in response to a special request by TVA to address a power transmission line problem associated with Dale Hollow being off-line, one hydropower unit was placed into service. This action was consistent with guidance in water control manuals with respect to recovering flood control storage after the flood crest has passed.

Flood damages sustained at Dale Hollow Lake are estimated at $1.2M. Recreation areas and access roads across the project were impacted by the high water, debris load, and erosion caused by the heavy rains.

Center Hill

Project: Center Hill Lake

Location: Caney Fork River Mile 26.6, DeKalb County, Tennessee

The Flood of May 2010 resulted in a peak project headwater elevation of 646.76 feet msl, which is 16.76 feet above the top of the operational band defined in the current IRRM plan. Peak project discharges during the event were 3,750 cfs through the hydropower turbines.

Prior to the Flood of May 2010, reservoir levels were being managed through a combination of constant sluice releases and hydropower pulsing operations. At 1000 hours on Saturday, May 1, one hydropower unit was brought online and run continuously for the remainder of the day. This decision was based upon the observation of radar rainfall amounts and the near certainty that the

Caney Fork Watershed was going to receive excessive rainfall. The action was taken to conserve flood control storage and to manage the lake level in accordance with the IRRM pool restrictions in place. At the time, the additional flow did not pose a threat to Carthage, the downstream damage center at the confluence of the Caney Fork and Cumberland River.

Between 2100 hours on Sunday, May 2, and 0000 hours on Tuesday, May 4, the total project discharge was reduced to zero in anticipation of discharges at Cordell Hull being increased above the control flow limit at Carthage. Beginning at 0000 hours on Tuesday, May 4, project discharges were resumed in accordance with the water control manual procedure to evacuate flood control storage as fast as practical after the flood crest passed to prepare for future potential floods.

Center Hill had extensive foundation treatment completed in this past year along with extensive instrumentation and automated real time instrumentation readings that indicate any issues of possible distress in the dam and foundation. The potential for exceeding the interim operating levels at Center Hill on a short duration/temporary basis during floods have been factored into the projects risk analysis and did not place the dam at risk.

Flood damages sustained at Center Hill Lake are estimated at $150K. The access road to the saddle dam sustained damage, boundary lines have been washed away, and mud, silt, propane and fuel tanks, and household chemicals were deposited in parking areas, on boat ramps, and recreation areas in the project.

J. Percy Priest

Project: J. Percy Priest Dam and Reservoir

Location: Stones River Mile 6.8, Davidson County, Tennessee

The Flood of May 2010 resulted in a peak project headwater elevation of 504.9 feet msl. Peak project discharges during the event were 8,600 cfs through a combination of spillway and turbine releases.

Prior to the Flood of May 2010, as a part of the normal process of filling the reservoir to summer pool elevation, there were no discharges from the project. At 1000 hours on Saturday, May 1, the lone hydropower unit was brought online. This decision was based upon the observation of radar rainfall amounts and the near certainty that the Stones River Watershed was going to receive excessive rainfall.

At 1000 hours on Sunday, May 2, when discharges from Old Hickory Lock and Dam reached 90,000 cfs, and when, according to the water control manual discharges from J. Percy Priest should be stopped, the hydropower discharges were continued to reserve storage in the reservoir for when the flood crest approached Nashville.

Between 2100 hours on Sunday, May 2, and 0715 hours on Monday, May 3, the total project discharge was reduced to zero to manage the crest along the Cumberland River at Nashville, forecast for 0100 on Monday, May 3. Beginning at 0715 hours on Monday, May 3, with the

crest apparently still several hours from reaching Nashville, the hydropower unit was brought back online in order to preserve the remaining storage in the reservoir.

A surcharge operation was initiated at 2330 hours on Monday, May 3, as the reservoir elevation reached the top of the spillway gates at elevation 504.5 feet msl. The plan to open all 4 spillway gates 0.5 feet as the reservoir reached 504.5 was hindered when one of the gates did not function properly. While emergency repairs were undertaken, one of the gates was opened to 1.0 foot instead. At 2400 hours, with the gate repaired, all 4 gates were opened to 0.5 foot resulting in a total discharge of 7,000 cfs. This discharge was maintained until 0800 hours on Tuesday, May 4, when, due to a reservoir which continued to rise, the gates were opened an additional 0.3 foot each, increasing the project discharge to 8,600 cfs. This configuration was maintained until 1100 hours on Friday, May 07, when the total discharge was increased to 10,100 cfs to continue evacuating water from storage to prepare for future potential floods.

Flood damage sustained at J. Percy Priest is estimated at $3.2M. Riprap bank protection at the project was washed away in numerous areas. Access roads, parking lots, and launching ramps have been damaged by severe erosion or blocked with drift and debris deposited by the flooding. Roadways and parking lots have been undercut and asphalt surfacing has crumbled in many places. Riprap at boat ramps has been washed out. Recreation areas across the project have been impacted by the high water event. Multiple campsites and picnic sites have been eroded and covered with mud, and have been taken out of service. Waste receptacles have been washed away and electrical hookups have been damaged and placed out of service. Picnic shelters have been affected by drift, debris, and erosion. Signs and bulletin boards have been damaged or destroyed by water and erosion. Retaining walls and handicap access points have also been affected by erosion and wave action resulting in damage of varying degrees.

Cordell Hull

Project: Cordell Hull Dam and Reservoir

Location: Cumberland River Mile 313.5, Smith County, Tennessee

The Flood of May 2010 resulted in a peak project headwater of 508.33 feet msl. A maximum discharge of 130,100 cfs was required to keep the pool elevation from overtopping the upstream lock miter gates.

Prior to the Flood of May 2010, based upon National Weather Service rainfall forecasts, the Cordell Hull Dam and Reservoir pool elevation was lowered approximately 0.5 foot. This adjustment was within normal reservoir levels.

Beginning at 1730 hours on Saturday, May 1, spillway discharges were initiated at Cordell Dam and Reservoir at a rate of approximately 5,000 cfs/hr until a total discharge of 50,000 cfs was reached. As the reservoir reached elevation 505.25, the discharge was increased to 60,000 cfs and held steady in an effort to keep the Cumberland River from reaching flood stage at Carthage, TN and to limit the volume of water entering Old Hickory downstream.

In response to the slow moving and intense rainfall, starting at 2200 hours on Sunday, May 2, a series of spillway gate increases were required to manage the reservoir elevation and prevent overtopping of the upstream lock miter gates. Spillway gate increases as often as every 30 minutes, and corresponding discharge increases as much as 10,000 cfs each, continued through the night. By 1100 hours on Monday, May 3, the reservoir had dropped back below the elevation 508.0 feet msl surcharge storage threshold allowing spillway discharge reductions to be made in an effort to protect Carthage. Discharge reductions were made as aggressively as possible without allowing the reservoir to rise above elevation 508.0 feet msl.

As local runoff to Cordell Hull receded between 0000 hours and 0500 hours on Tuesday, May 4, a series of spillway discharge reductions were made to reach control flow of 72,000 cfs. All gates at Cordell Hull were closed at 0600 hours on Wednesday, May 5.

Flood damages sustained at Cordell Hull Dam and Reservoir are estimated at $4.5M. The debris load, and force of the flood, damaged spillway gates and components, damaged underwater spillway structures, cluttered the forebay with riprap and debris, damaged railings, lighting system components, and steel plating on the lock, and left recreation areas covered with debris. Depth markers and buoys were washed away, as well as the sand on recreation beaches. Extensive erosion to access roadways and parking areas was experienced. The riprap protecting the channel banks downstream of the project were damaged and several government vehicles were lost during the flood.

Old Hickory

Project: Old Hickory Lock and Dam

Location: Cumberland River Mile 216.2, Davidson and Sumner Counties, Tennessee

The Flood of May 2010 resulted in a peak project headwater of 451.45 feet msl, and required an estimated maximum discharge of 212,260 cfs to control reservoir levels.

Prior to the Flood of May 2010, based upon National Weather Service rainfall forecasts, the Old Hickory Lock and Dam pool elevation was lowered approximately 0.5 foot. This adjustment was within normal reservoir levels.

Beginning at 1200 hours on Saturday, May 1, spillway discharges were initiated at Old Hickory Lock and Dam at a rate of approximately 5,000 cfs/hour until a total flow of 75,000 cfs was reached at 2300 hours on the same day. This discharge was held in an effort to allow local inflows to recede downstream, until 1000 hours on Sunday, May 2, when a series of spillway discharge increases were required as a result of rapidly increasing reservoir elevations. Spillway discharge increases as often as every 15 minutes, and as much as 10,000 cfs each, were necessary to prevent the upstream lock wall from being overtopped. Had the pool climbed 0.55 feet higher it would have overtopped the upstream lock wall, resulting in flooding of the powerhouse, and requiring complete evacuation of the dam. It has been estimated that such an event would have resulted in a flood crest approximately 4 feet higher in Nashville than was actually experienced.

At 2100 hours on Sunday, May 2, the first spillway discharge reductions were made to manage the crest at Nashville that was forecast at that time to occur at 0100 hours on Monday, May 3. Additional reductions were made throughout the night; however, at 0300 hours on Monday, May 3, spillway discharge increases were again required as large discharges from Cordell Hull and local uncontrolled runoff had pushed the reservoir dangerously high.

In an effort to reduce the flood crest through Nashville, and protect the lone remaining water treatment plant for the city, spillway discharges were reduced beginning at 1300 hours on Monday, May 3. Between 1300 hours and 1700 hours the total discharge out of Old Hickory Lock and Dam was reduced from 196,500 cfs to 144,200 cfs. These spillway gate settings were held until 0900 hours on Wednesday, May 5 when a series of spillway discharge reductions were made in response to steadily declining inflow to the project. By the end of the day on Thursday, May 6 Old Hickory Lock and Dam was back within its normal operating range.

Flood damages sustained at Old Hickory Lock and Dam are estimated at $11.5M. The debris load, and force of the flood, damaged spillway gates and components, the tail deck crane and collector rails, underwater spillway structures, capstans, handrails, and power cables on the lock and dam and left large amounts of debris in the intake trash screens. Large amounts of debris were deposited on the tail deck and in the left bank tailwater area. The tail deck crane was knocked off of its rails and sustained damage. Severe erosion occurred on the dam embankments and abutments resulting in destabilization of slopes, and on the bluff adjacent to the switchyard, resulting in slope instability which threatens the access road to the power plant as well as the parking lot. Damage occurred at numerous recreation areas and associated facilities; propane and fuel tanks and household chemicals were deposited at various areas across the project. Several campsites were inundated and electrical hookup facilities damaged by water. The nature trail by the dam was impacted as high water washed away the boardwalks and deposited tons of debris. The stream gage on Bledsoe Creek was lost during the event due to the extreme high water.

Cheatham

Project: Cheatham Lock and Dam

Location: Cumberland River Mile 148.7, Cheatham and Dickson Counties, Tennessee

The Flood of May 2010 resulted in a peak project headwater of 404.15 feet msl with a corresponding maximum discharge of 240,000 cfs.

Prior to the Flood of May 2010, based upon National Weather Service rainfall forecasts, the Cheatham Lock and Dam pool elevation was lowered approximately 1.0 foot. This adjustment was within normal reservoir levels.

Cheatham Lock and Dam was designed to allow overtopping of the lock and spillway gate section without threat of failure. The power plant is at a higher elevation and does not become inundated during extremely high flows such as those observed during this event. When the river

flow past Cheatham exceeds the flow which can be regulated by the seven available spillway gates, the gates are lifted out of the water and the river goes to what is referred to as free flow.

By 1900 hours on Saturday, May 1, Cheatham Lock and Dam had gone to free flow. It remained in that condition until Saturday, May 8, when the spillway gates were placed back in service and the project returned to "normal" operations.

Flood damages sustained at Cheatham Lock and Dam are estimated at $23.7M. Floodwaters overtopped the lock walls at Cheatham by more than 12 feet at crest. The debris load, and force of the flood, severely damaged spillway gates and components, damaged the power plant trash boom and control cables, and left submerged debris on the powerhouse intake trash screens. Major electrical components at the project were destroyed including high voltage transformers, breakers, feeder cables and auxiliary feeder cables. The hydraulic systems were left inoperable but repairable. The lock tow haulage system was completely wrecked, along with the camera monitoring system. The lock operations building's basement and first floor sustained severe damage which will require complete rehabilitation. The resource manager's office at the project, along with all contents, was destroyed. The lock maintenance shop and office, equipment, tools, and several government vehicles were a total loss. The project security fence and perimeter control have been knocked down completely. Severe erosion, resulting slope instabilities, and loss of bank protection riprap have occurred throughout the project where boundary lines have been washed away, and propane and fuel tanks, and household chemicals were deposited throughout the area. Corps'-managed recreation areas were severely damaged or destroyed by flood waters. Restrooms and shower houses were flooded; electrical equipment and wiring were destroyed or damaged. Drift and mud were deposited on parking lots, campsites, boat ramps, and picnic areas. Campsites and picnic sites were washed out. Playground equipment was damaged or destroyed. Beach areas were washed out and covered with drift and debris. Large trees were knocked over in the right bank area. Electrical service equipment at campgrounds was damaged or destroyed. Picnic tables, trash receptacles, grills, and other amenities were washed away. Picnic shelters were damaged and covered with mud and debris.

Barkley

Project: Barkley Dam and Lake Barkley

Location: Cumberland River Mile 30.6, Lyon and Livingston Counties, Kentucky

The Flood of May 2010 resulted in a peak project headwater of 369.00 feet msl with a corresponding maximum discharge of 303,200 cfs.

Prior to the Flood of May 2010, Barkley Lock and Dam was discharging a total of approximately 43,000 cfs through a combination of turbine and gate releases.

On May 1, when the criteria were met for Lower Ohio-Mississippi flood control, LRD assumed direction of Lake Barkley releases.

On May 1, Barkley discharges were increased based on forecast rainfall. On May 2, a series of spillway discharge increases was initiated at Barkley Lock and Dam beginning at 1000 hours. By 2400 hours that day, spillway discharges had been increased to 156,500 cfs. This was done to preserve flood storage in the Barkley and Kentucky Reservoirs for later in the flood event, as well as to address a flood crest that was moving down the Ohio River from rainfall that occurred several days earlier in the Ohio Basin.

By 0900 hours on Monday, May 3, total discharges from Barkley Lock and Dam had been increased to 260,000 cfs. At 1200 hours, a series of 10,000 cfs/hour spillway discharge increases were initiated to bring the total discharge to 300,000 cfs.

In response to flooding downstream of the project, spillway discharge reductions were made at 1900 hours on Monday, May 3. A total of two spillway gate changes were made which reduced the total project discharge to approximately 280,000 cfs.

When the Barkley project experiences extremely high tailwater elevations like it did on this date, a submergence problem is encountered with operation of the spillway gates. The Barkley spillway gates must be clear of the water on the tailwater side when in operation or they will be subject to extreme vibration. Therefore, a gate must be either closed or open high enough to clear the tailwater. As a result, operators and water managers are sometimes unable to produce the desired flow and must decide on either a flow lower than the target or higher. The differences can be fairly significant since extremely large gate openings are required at the individual gates. The Barkley Power Plant operators were forced to make a series of gate changes between 0500 hours and 0805 hours on Tuesday, May 4, to address submergence problems. The final result was the project discharge was higher than the target during this period, and set a new record of 303,200 cfs at 0800 hours.

At 0800 hours on Tuesday, May 4, project discharges reductions to 240,000 cfs were targeted, but due to submergence, the closest operators could get by completely closing one spillway gate was 266,000 cfs. At 1600 hours one additional spillway gate was closed resulting in a total discharge of 230,000 cfs.

By 1900 hours on Wednesday, May 5, after a series of spillway discharge reductions, starting at 1000 hours that day, to support ongoing flood control operations for the Lower Ohio River, total discharges from Barkley Dam and Lake Barkley were 150,000 cfs.

Total discharges were further reduced to 120,000 cfs between 1000 and 1200 hours on Saturday, May 8, where they remained until May 17 when discharges were reduced to 70,000 cfs.

Flood damages sustained at Barkley Dam and Lake Barkley have been estimated at $5.3M. The debris load and force of the flood caused damage to spillway gates and components, left debris submerged on powerhouse intake screens, and washed away bank protection riprap allowing severe erosion and bank instabilities to materialize. Propane and fuel tanks, household chemicals and other wastes were deposited throughout the project, including mud and silt in recreations areas. The dam inspection roadway, as well as other access roads and parking areas at the project, sustained damage.

Major Activities

Major flood fight activities directly, or indirectly, supported by LRN were the sandbagging of Metro Center Levee and the Omohundro Water Treatment Plant.

The District provided 62,000 sandbags to the state of Tennessee and arranged delivery of those sandbags to the State Emergency Operations Center on May 1-3. These assets were distributed by the State.

A technical expert, the District Levee Safety Program Manager, was dispatched to Metro Center Levee on Monday, May 3 to provide assistance in determining a plan of operations for sandbagging the levee. The sandbagging operation itself was carried out by a team of local volunteers.

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Appendix I

Memorandum of Agreement

Between the

US Army Corps of Engineers

And

National Weather Service

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MEMORANDUM OF AGREEMENT
BETWEEN THE
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
AND THE
U.S. DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS

I. PURPOSE

The purpose of this agreement is to foster cooperation between National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), and the U.S. Department of the Army (DA) U.S. Army Corps of Engineers (USACE) to develop modern, cost-effective, coordinated procedures and techniques for forecasting the status of the Nation's river systems and regulating the Nation's water control facilities.

II. NEED FOR THIS AGREEMENT

Whereas the NWS and USACE have missions that require the collection and analysis of meteorological and hydrological data and information, it is prudent and in the interest of efficient Government operations that data acquisition be coordinated and that information be exchanged. Developments now planned and/or underway in both agencies create the need to improve the timeliness and increase the amount and types of information exchanged.

III. INFORMATION EXCHANGE PRINCIPLES

The NWS and USACE agree to pursue a more effective environment for information exchange. In the conduct of their separate and distinct missions, both agencies make river flow forecasts: the NWS for dissemination of forecasts to the public and to their Federal, state, and local cooperators; and the USACE for the management of reservoirs, locks and dams, and other water control facilities for which it has responsibility. The accuracy and reliability of these forecasts can be improved through the real-time exchange of hydrometeorological data and forecasts and through collaboration on methods used in data acquisition and model development. Opportunities for improved, real-time information exchange and collaboration between the two agencies will occur as coordination progresses under this agreement.

Figure 1 illustrates the types of information that will be exchanged and also indicates which agency is the initiator and which is the recipient. The illustration assumes that each agency's modernization activities will proceed as planned for culmination in the mid-1990's. This agreement is intended to serve as a guide to both agencies during the transition from the present information exchange system to the one envisaged here.

Information and real-time data exchange will generally occur regionally between the USACE districts/divisions and the NWS River Forecast Centers/Weather Forecast Offices. Data exchange between these entities will usually be made through their respective computer systems.

Figure 1

FUTURE INFORMATION EXCHANGE

NATIONAL WEATHER SERVICE		CORPS OF ENGINEERS
METEOROLOGICAL FORECASTS	--------->	
HYDROLOGICAL FORECASTS	<--------->	HYDROLOGICAL FORECASTS
	<---------	WATER CONTROL INFORMATION
DATA ACQUISITION	<--------->	DATA ACQUISITION
PUBLIC DISSEMINATION OF METEOROLOGICAL AND HYDROLOGICAL FORECASTS	<--------->	PUBLIC DISSEMINATION OF WATER CONTROL INFORMATION FOR USACE PROJECTS
PRECIPITATION ANALYSIS NEXRAD (STAGE 1) AWIPS (STAGE 2,3) MODEL INPUT	<--------->	PRECIPITATION ANALYSIS MODEL INPUT
HYDROLOGICAL MODEL PARAMETERS AND INFORMATION	<--------->	HYDROLOGICAL MODEL PARAMETERS AND INFORMATION

The information categories appearing in Figure 1 are described briefly as follows.

Meteorological Forecasts

NWS precipitation and temperature forecasts need to be supplied to USACE.

Hydrological Forecasts

Both agencies prepare hydrological forecasts to support their unique mission requirements; the NWS for dissemination to the public and their Federal, state, and local cooperators, and the USACE for their project operations. Both agencies will exchange forecasts and information on their forecast methods.

Water Control Information

USACE is responsible for regulating reservoirs and various other water resources projects. Real-time information on current and future reservoir releases and on other project operations needs to be supplied to NWS in a timely way.

Data Acquisition

Both agencies are involved in data acquisition. Mechanisms are needed to share data in real time since the same data are often needed by both agencies. Redundant paths to the data may be needed to increase the reliability of real-time data exchange systems.

Public Dissemination

NWS has responsibility for public dissemination of meteorological and hydrological forecasts. USACE makes project-related data available to the public through electronic bulletin boards, taped messages, press releases, and other means. NWS and USACE both need real-time access to the information released to the public by the other agency.

Precipitation Analysis

NWS has invested, and plans to continue to invest, significant resources in precipitation analysis methods and technology. USACE plans to use precipitation estimates prepared by NWS to the maximum extent possible. This will require a highly reliable communications and data exchange capability. USACE will also invest in backup technology for direct access to Next Generation Weather Radar (NEXRAD) products directly from NEXRAD sites.

Hydrological Model Information

Information on the parameters of hydrological models, rating curves, geographic information, flood damage information, etc., needs to be shared. This will require improved data exchange capabilities as part of the modernization activities of both agencies.

IV. ANNUAL MEETING

NWS and USACE agree to meet annually to review progress of work under this agreement.

V. SPECIAL PROJECTS

NWS and USACE agree to develop improved, real-time data and information exchange through a series of projects. These will be organized as need arises. Specific project plans, including objectives and schedules, will be made for each project. These activities might lead to other Memoranda of Agreement between the NOAA/NWS and the DA/USACE or to attachments, appendices, or annexes to this umbrella agreement. Generally, these projects will be undertaken by USACE field offices together with appropriate NWS offices.

VI. AMENDMENTS OR MODIFICATIONS

This Memorandum of Agreement may be amended or modified by mutual agreement of NOAA/NWS and DA/USACE.

VII. TERMINATION

This Memorandum of Agreement may be terminated by either of the parties hereto upon 60 days written notice to the other party, notice to begin with date of mailing.

Feb 20, 1991

Signature Date
G. Edward Dickey
Acting Principal Deputy
Assistant Secretary (Civil Works)

Nov 2, 1990

Signature Date
John A. Knauss
Under Secretary
for Oceans and Atmosphere

Appendix J– Data Exchange Overview

Response to flood situations is not confined to one particular agency within the federal government. Successful completion of each agency's mission has always relied upon the exchange of technical data between other operational agencies. In light of this, the US Army Corps of Engineers and the National Weather Service entered into a cooperative Memorandum of Understanding in 1990, providing a formal framework for the types of data to be shared between the agencies. The data exchanges which take place routinely as a result of this MOU are defined below, as well as other protocols and procedures which have been established for specific interagency coordination purposes between Great Lakes and Ohio River Division offices and their partners.

Existing Procedures

Lower Ohio / Mississippi River Flood Operation Coordination

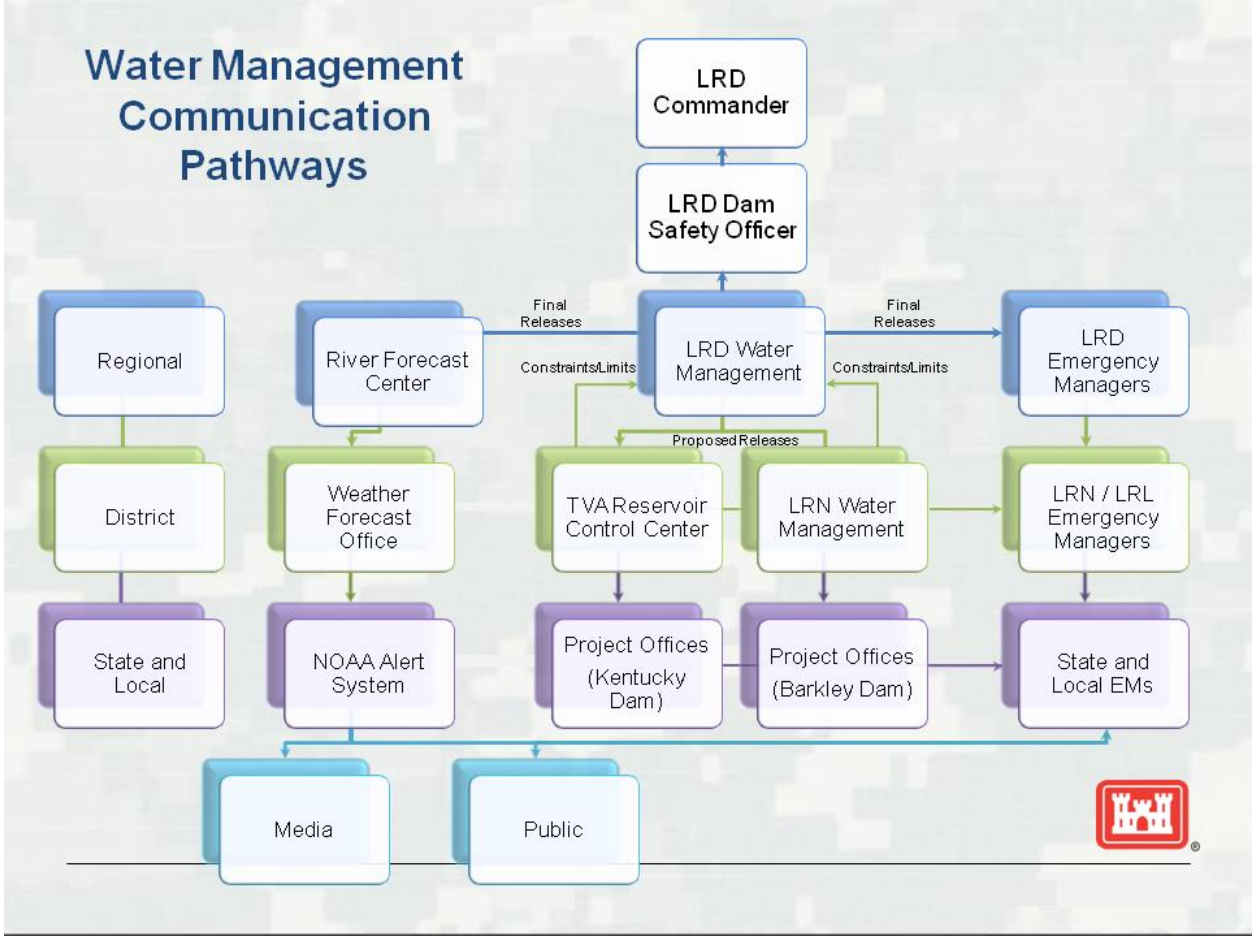
The confluence of the Ohio River with the Mississippi River is a hydraulically complex and hydrologically sensitive area. The Division Commander of the Great Lakes and Ohio River Division has been delegated the responsibility for coordinating flood risk management operations of the Tennessee and Cumberland Rivers for the reduction of flood levels at the confluence, as well as coordination of operations during extreme events which require the utilization of the New Madrid-Birds Point Floodway.

This area crosses numerous boundaries used to delineate areas of responsibility for both the Corps of Engineers, National Weather Service and Tennessee Valley Authority. As a result, the following long-standing communications schedule has been established for exchanging information among the agencies during a flood event in the lower Ohio, Cumberland, Tennessee, and lower Mississippi Rivers: (All times shown are in Central Time)

LRD Ohio River and Lower Mississippi River Daily Communication Process:
0700 USACE-LRD and TVA Coordination Call: Kentucky/Barkley Lakes data exchange and discussion of operational strategy; set preliminary reservoir release schedules .
0715 USACE-LRD and NWS-LMRFC Coordination Call: Provide preliminary Kentucky/Barkley reservoir release schedules to NWS LMRFC.
0730 USACE-LRD and LRN Coordination Call: Discuss Cumberland Basin conditions and LRD provides to LRN the preliminary Lake Barkley reservoir release schedule.
0945 Complete Ohio River model run and coordinate results with NWS-LMRFC. Coordinate and finalize reservoir release schedules and forecasts (include LRD, OHRFC, LMRFC, LRD Districts as necessary).
1000 Send forecasts, flood messages, water management updates, final TVA & LRN release schedules (incl. LRD, MVD, NWS, TVA) via email and automated data transfer.
1330 Assess new weather information; when conditions approach critical thresholds, hold regional interagency teleconference (incl. HPC, NCRFC, LMRFC, OHRFC, LRD, MVD & Districts)

1400 USACE-LRD and HQ Emergency Management Coordination Call: Reviews flood fighting efforts, critical flood conditions, and ensures necessary support is provided to District Emergency Management offices

The figure below illustrates the exchange of data between the regional, district and local offices of the USACE-LRD, TVA, the NWS and local and state emergency managers.



Nashville District Coordination Protocols

The Nashville District exchanges data on a routine daily basis in an automated procedure as described below with LRD, NWS, TVA and the USGS. Phone coordination as described above also takes place with LRD, TVA and the NWS. LRN also does extensive phone coordination with the LRN projects, both dam tenders and hydropower plant operators, and with TVA hydropower schedulers on a daily and hourly basis.

The information exchange process between LRN Water Management and the NWS includes routine and event driven requirements. The routine data exchange is done in two phases. Once the rainfall, river, and project data are collected, reviewed and any necessary corrections made, LRN initiates a process to

transmit this data to the NWS. Information provided to NWS includes rainfall, river stage, flow, headwater elevation, and tailwater elevation. This is typically done early in the workday (0700 - 0800 Nashville time) and includes observed data for the 24-hour period ending at 0600 of the current day. Once LRN completes the reservoir system release schedule for Wolf Creek, Dale Hollow, Center Hill, J. Percy Priest, and Barkley and the river flow forecast at Cordell Hull, Old Hickory and Cheatham, a second process is initiated that transmits that information to the NWS. The reservoir release schedule consists of the discharge plan for the current day and the next four days. The river flow forecast consists of estimated river flows for the current and the next four days, not considering forecast rainfall. Development and distribution of the reservoir release schedule requires coordination with both LRD Water Management and TVA River Operations. This information is typically provided to NWS in the late morning (1000 - 1200); however, this can be delayed due to unusual river conditions or network/computer issues. The NWS sends rainfall and weather data to LRN Water Management on a daily basis. Once received, automatic processes are in place on LRN's end to add this information to the Corps of Engineers (CE) database so that it is available when LRN develops the reservoir system forecast. This information is typically received by 0800.

During high water events the routine data exchange is supplemented with additional coordination and information. This is done via telephone conversations between LRN WM and NWS staff. A significant distinction between USACE and NWS river forecast information is that USACE forecasts are based on rain on the ground (national policy) and the NWS forecast includes forecasted rain. Therefore, the USACE forecast provided via the routine daily data exchange is of limited value at mainstem projects like Cordell Hull and Old Hickory to the NWS when developing their forecast during rainfall events. It is at this point that discussions among forecasters at the two agencies become very important. Prior to the May 2010 flood event, this coordination included a discussion of how USACE planned to operate the Cumberland Basin flood risk management projects. In turn, the NWS would take this information, along with observed river conditions, and develop a flood forecast based on forecasted rain. NWS's modeling effort would calculate the flows out of Cordell Hull, Old Hickory, and Cheatham where USACE does not have storage. Although not documented, this unwritten process has existed for many years.

Automated Data Exchange

LRD

A great deal of observed and modeled data is transmitted between the Corps of Engineers, National Weather Service, and the Tennessee Valley Authority each day. The LRD office maintains several satellite downlinks and electronic data transmission links via computer networks. The specific methods and programs used for these links are continually being updated in order to reflect the most current technology available.

Whenever possible, data exchanged between agencies is encoded in the Standard Hydrologic Exchange Format (SHEF), an efficient and established standard for automated data transfer. By far, the greatest volume of data is currently exchanged via the LDM software developed by Unidata. Data transferred from LRD to National Weather Service offices includes

- Hourly values of headwater, tailwater, total gate openings, and hydropower discharge for each navigation project in the Ohio Valley Division. These data are manually read and entered hourly into the OMNI system by personnel at each lock and dam, and are automatically SHEF-encoded and transmitted through the LDM server.

- Observed 0600 data for each flood risk management and navigation project throughout the Ohio River Valley. This data includes 24 hour precipitation, current computed flows at both mainstem and tributary locations, and, at some projects, a 24 hour average discharge.
- Modeled forecast release data for each flood risk management project in the Ohio River Valley (including the Cumberland Basin). Forecasts are daily values for the next 3 to 5 days of projected discharge based on rain on-the-ground (no forecast rain).

Data transmission links are continuously maintained with the following offices:

The TVA River Scheduling at Knoxville, TN
The NWS Ohio River Forecast Center at Wilmington, OH
The NWS Mississippi River Forecast Center at Slidell, LA
The Mississippi Valley Division (COE) at Vicksburg, MS

The Pittsburgh District (COE) at Pittsburgh, PA
The Huntington District (COE) at Huntington, WV
The Louisville District (COE) at Louisville, KY
The Nashville District (COE) at Nashville, TN
The Memphis District (COE) at Memphis, TN

LRN

Automated Outgoing Data:

As soon as observed information has arrived from the hydropower plants and GOES sources [project and river gaging station data transmitted from data collection platforms (DCPs) via satellite transmission] it is electronically distributed via the Internet using LDM to LRD and TVA and using FTP to the NWS Southern Region server from a single manual script known as MR (morning routine). The data is scanned nominally for errors before it is forwarded via this method. The DCP information is also directly available to the NWS, TVA, USGS and LRD in a comprehensive and un-altered form via their own satellite downlink receivers. The hydropower plant data is also automatically forwarded electronically via LDM to TVA in un-altered form as soon as it arrives in the LRN District office. If errors are detected in the hydropower plant data that were not discovered by the ingestion process in the LRN District office, the files are retransmitted (using FTP protocol via the Internet) to TVA once the corrections have been made. If corrections have been made that affect the morning routine (MR) distribution, they are resent as well. In the event that normal transmission methods fail (network, FTP, LDM, etc…) a printed version of each report can be sent via FAX. If the phone lines are down (faxing is not an option) LRN resorts to verbal transmission by cell phone if cellular service is still available.

After the observed information is transmitted and once the river (no-rain) flow forecasts and reservoir release schedules are made, the forecasts are forwarded using the same transfer mechanisms as the

observed information is transferred. In this case script MR with the "–f" option is used to produce the forecast versions.

The NWS OHRFC and WFOs receive the LRN posted products via FTP from the NWS Southern Region server. The LRN products are transmitted by the NWS as MEMRR1OHX and MEMRR2OHX via LDM.

LRD receives the LRN products directly from LRN as ord.resobs, ord.rivobs, ord.resfct (resfct), ord.rivfct (rivfct05d) via LDM. LRN products are sent to TVA from LRN as products tvarpt1, tvarpt2, tvarpt3 via FTP. A subset of the LRN data is routinely posted to the LRN web host as an alternate method of distribution.

Incoming data:

Automatic river and project gaging is exclusively transmitted from DCPs via the GOES satellite and the redundant domestic satellite (DOMSAT). This data arrives via LDM from LRD direct read out ground station (DRGS-GOES) and the multiply redundant local read out ground stations (LRGS-DOMSAT) from LRN, LRD, and LRH via the Internet.

Hydropower plant data is entered on spreadsheets by the operators and transferred by FTP to the District office. Normal frequency is routinely at the end of six hourly periods but in times of acute interest can be hourly.

The NWS Nashville WFO sends observer daily precipitation readings by FTP initially around 7:30AM and later resends as updates become available.

TVA Knoxville sends some hourly but mostly daily precip, stage, and discharge information for stations that are predominantly on the periphery of the Cumberland River Basin. Transfer method is by FTP.

DSAC Support from OHRFC

In order to provide support for dams classified as high risk under the Dam Safety Action Classification (DSAC) in the Ohio River basin, the National Weather Service has recently begun supporting the Corps of Engineers with experimental, ensemble based, probabilistic forecasts of inflows into some of the critical reservoirs: Bluestone (LRH), Muskingum Lakes (LRH), Wolf Creek (LRN) and Center Hill (LRN). This information is generated and transmitted automatically, with direct notification by OHRFC staff to the appropriate Corps office when the probability and risk of significant increases in inflows occurs.

Adaptive Management of Procedures During Floods

OHRFC and LRD have had a long history of communication prior to and during events. During the Cumberland River flood event, this coordination began during the week prior to the heavy rainfall, with several notifications sent by the OHRFC alerting partners to the possibility of flooding over the weekend and LRD contacting the OHRFC to discuss the hydrometeorological outlooks. Corps offices also

responded to this notification by taking proactive measures, documented elsewhere in this report, to prepare for the flood potential.

LRD initiated the standard lower Ohio / Mississippi River Flood Operation Coordination procedures on May 1st when the defined criteria were met. However, by the morning of the 2nd, it was apparent that additional coordination was required due to the severe nature of the event. During the morning hours of the 2nd, the standard Ohio River and Lower Mississippi Flood Coordination process was augmented by initiating the significant event conference call at 1330, as well as holding an additional conference call between OHRFC, LRN, and LRD at 0830 to facilitate the exchange of information to be used in the morning river forecasts issued by the RFC. Once the need for additional gate change information was identified during the evening of 2 May, frequent communications took place between LRN project offices and the OHRFC to keep the NWS abreast of each gate change.

Typical NWS communication practices across the Corps

Following the Cumberland River flood event, LRD undertook a survey of the other USACE Divisions communication practices with the NWS. Although all of the Divisions indicated they work closely with the NWS during flood events, none reported written protocols, guidelines or best practices. A review of applicable Corps regulations also revealed no specific guidance or requirements. One exception is the "Flood Playbook" recently developed by the MVD Fusion Team for the Upper Mississippi. This is an effort which should be pursued further to establish specific communication guidance between the Corps and the NWS.

Suggestions for improvement

The Cumberland River flood was a rapidly changing, dynamic event which required coordination beyond the typical rhythm of daily coordination established for lower Ohio-mid Mississippi Flood Control events. The location and intensity of the event – in the Cumberland Basin – highlighted the need to establish a new coordination protocol that would facilitate better communication between the proper federal offices – NWS River Forecast Centers, Weather Forecast Offices, USGS Water Science Centers, and Corps District and Division Offices. This protocol needs to be scalable and adaptable to handle both rapidly developing and slower building severe flood events, with clearly identified roles and responsibilities for each agency.

Appendix K

Public Comments

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National Weather Service Comments to May 2010 Flood Event AAR

1. Page 41:

"Due to rapidly changing conditions at the projects, the LRN WM staff returned at 1900 hours and worked until 2300 hours. There were no direct communications between LRN WM with the NWS OHRFC on Saturday other than the morning reports which are provided by LRD WM to the NWS OHRFC.

Suggested Revision:

"Due to rapidly changing conditions at the projects, the LRN WM staff returned at 1900 hours and worked until 2300 hours. There were no direct communications between LRN WM and the NWS OHRFC regarding USACE project discharge forecasts on Saturday.

Comment: Our understanding, based on review of NWS product archives and discussions with OHRFC, OHX, and USACE personnel, is that the regular morning reports with forecast discharges for USACE projects (RR2OHX products) were not provided on Saturday or Sunday.

2. Page 41/top of Page 42:

"The NWS utilized this information to publish a forecast of a crest at Nashville of 42 feet at 1900 hours on Sunday evening."

Suggested Revision: "The NWS utilized this information to publish a forecast on Sunday morning at 9:50 am of a crest at Nashville of 42 feet expected at 1900 hours on Sunday evening".

3. Page 43:

"From 1000 hours when the increased discharges were initiated at Old Hickory, until the 1330 hours conference call, LRN WM had no additional communications with the NWS OHRFC. The NWS OHRFC did not have the Old Hickory discharge information when they published another forecast at 1118 hours to state the crest would be 45 feet at 1900 hours. The next update to the NWS OHRFC was provided during the 1330 hours conference call. By this time Old Hickory was above its surcharge pool level and nearing the pool of record. LRN WM intended during the afternoon call to indicate that gate operations were made to pass all inflow to the dam, with the intent of preventing further rises in the Old Hickory pool level. LRN also noted that discharges at this time were above their gate rating curves. LRN assumed that based, on this information, the NWS would run its models as if the project was no longer present. However, the NWS felt that since the Corps was operating the spillway gates, their rated discharges were still reflective of current flow conditions. The NWS OHRFC did not understand the

hydraulics of the navigation project operations on the Cumberland River system under the full range of flow conditions. The discrepancies between NWS model outflows and Corps releases were not fully discussed or understood on Sunday as the observed precipitation exceeded the forecast and the river stage approached critical levels in Nashville. The lower projected QPF, coupled with these misunderstandings, affected the accuracy of the NWS OHRFC early forecasts

Suggested revision: "From 1000 hours when the increased discharges were initiated at Old Hickory, until the 1330 hours conference call, LRN WM had no additional communications with the NWS OHRFC. By the time of the 1330 conference call, Old Hickory was above its surcharge pool level and nearing the pool of record. LRN WM intended during the afternoon call to indicate that gate operations were made to pass all inflow to the dam, with the intent of preventing further rises in the Old Hickory pool level. LRN assumed that the NWS modeling approach would pass all inflows to Old Hickory. However, the NWS felt that since the Corps was operating the spillway gates, the rated discharges were still reflective of current flow conditions and they continued to use the latest release information as the primary basis for NWS forecasts on the mainstem Cumberland River. Discrepancies between NWS hydrologic simulations and Corps release projections (outflows) were never successfully resolved on Sunday as rainfall exceeded the forecast and the river stage approached critical levels in Nashville. These misunderstandings significantly compromised the accuracy of the NWS OHRFC forecasts.

Comments:
1) OHRFC never provided an updated forecast at Nashville for a crest of 45 foot. WFO Nashville updated the official Flood Statement product at 1118 to include additional rises to 45 feet based primarily on increasing stage observation trends.

2) Please review the statement "LRN also noted that discharges at this time were above their gate rating curves". We do not understand that to be the case on the 1330 conference call.

3) The statement regarding, "the NWS OHRFC did not understand the hydraulics of the navigation project operations on the Cumberland River…" is not an accurate reflection of the hydrologic and hydraulic modeling expertise at the NWS OHRFC. This statement should be deleted.

4. Page 43 (4th paragraph):

"Since the 1970s, the information provided to the NWS OHRFC by LRN WM during high flow events had consisted of a plan of operation for the LRN flood control projects (Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest) and not flow data from the mainstem navigation projects (Cordell Hull, Old Hickory, and Cheatham). The Barkley flows were provided by LRD WM. LRN understood the modeling approach used by the NWS OHRFC was to pass inflow at the mainstem projects where only the surcharge pool

storage was available and to route the releases from the flood control projects to develop stage forecasts at the damage centers. That was the data exchange approach employed by LRN WM when the May 2010 flood event began. The LRN senior water managers on duty had employed this same routine since 1984 on a daily basis. There have been 16 high flow events resulting in a Nashville stage greater than 30 feet during this 26 year period where LRN applied this approach. For the May 2010 flood event the NWS OHRFC was expecting more detailed information on releases from the mainstem projects. Once that expectation was realized around 2300 hours late Sunday evening, the updated spillway gate operations were routinely shared with NWS staff. As observed on Figure 14, the NWS forecast accuracy increased."

Comments: Request the USACE review the basic premise of this paragraph. NWS review indicates that USACE reports of observed and forecast discharge data is provided regularly for **all** USACE projects in the Cumberland River basin. This is true for all USACE data regularly provided to the NWS. In our review of NWS data archives, we can find no evidence of discharge data updates provided for only the flood control projects. In addition, during all phone conversations, conference calls, etc, made throughout this flood event, discharge updates were provided for all USACE projects (especially the mainstem navigation projects at Old Hickory and Cordell Hull).

We suggest a generic statement regarding the general lack of understanding of each agency's standard operations and forecast procedures/data needs (or specifically to the USACE's understanding of NWS processes/procedures) is more appropriate.

5. Page 55:

"Each day LRD WM provides the NWS OHRFC a morning report that contains the reservoir release data and forecast for the seven LRD District reservoirs."

Comment: This is the normal practice. But our understanding, based on review of product archives and discussions with OHRFC, OHX, and USACE personnel, is that the regular morning reports with forecast discharges for USACE projects (RR2OHX products) were not provided on Saturday or Sunday. Request you revise the sentence to reflect this change to normal practice.

6. Page 56:

"The NWS OHRFC received the LRD morning report on Saturday morning; however, NWS OHRFC did not obtain any additional project data that day."

Suggested Revision: "There were no direct communications between LRN WM and the NWS OHRFC regarding USACE project forecast discharges on Saturday."

Comment: Our understanding, based on review of product archives and discussions with OHRFC, OHX, and USACE personnel, is that the regular morning reports with forecast discharges for USACE projects (RR2OHX products) were not provided on Saturday or Sunday.

7. Page 56 (2nd paragraph):

"During this flood event, the resources of the United States Geological Survey (USGS) were under-utilized by the Corps and the National Weather Service."

Comment/Suggested revision: Generally, we agree the NWS did not fully leverage/utilize USGS capabilities during this event. There was, however, a specific request from the NWS to USGS for gage observations on the Harpeth River during the event on Sunday. This gage observation was provided to the NWS.

Since the focus of this section is on USACE-USGS interactions, please consider deleting references to the NWS from this section. The NWS service assessment will likely note specific recommendations regarding NWS interactions with the USGS and effective utilization of USGS resources.

8. Page 61:

"As part of their normal operating procedures, LRN WM provided project status and forecasts for the flood control projects to LRD WM. In turn, LRD WM provided this information to the NWS OHRFC in the morning report. The NWS OHRFC needed to discuss LRN reservoir operations late Saturday evening and early Sunday morning. They did not attempt to contact LRD WM until Sunday morning to obtain contact information for LRN WM."

Suggested Revision: "As part of their normal operating procedures, LRN WM provided project status and forecasts to LRD WM. Beginning very late Saturday night and into early Sunday, May 2, the NWS OHRFC needed to know how LRN was operating the projects and could not contact anyone in Nashville. Calls to LRN were placed at approximately 2200 hours Saturday, and 0200 hours and 0700 hours Sunday. No voice messages were left on LRN WM telephones. NWS OHRFC did not attempt to contact LRD WM until Sunday morning to obtain contact information for LRN WM."

Comment: Our understanding, based on review of product archives and discussions with OHRFC, OHX, and USACE personnel, is that the regular morning reports with forecast discharges for USACE projects (RR2OHX products) were not provided to the NWS on Saturday or Sunday.

9. Page 62 (2nd paragraph):

"LRN assumed that based on this information, the NWS would run its models as if the project was no longer present."

Suggested Revision: "LRN assumed that based on this information, the NWS modeling approach would pass all inflows to Old Hickory.

10. Page 62 (2nd paragraph):

"The NWS OHRFC did not understand the hydraulics of the navigation project operations on the Cumberland River system under the full range of flow conditions."

Comment: This statement is not an accurate reflection of the hydrologic and hydraulic modeling expertise at the NWS OHRFC. This statement should be deleted.

11. Page 62 (2nd paragraph):

"The discrepancies between NWS model outflows and Corps releases were not fully discussed or understood on Sunday as observed precipitation exceeded forecast and the river stage approached critical levels in Nashville"

Suggested Revision: "Discrepancies between NWS hydrologic simulations and Corps release projections (outflows) were never successfully resolved on Sunday, as rainfall exceeded the forecast and the river stage approached critical levels in Nashville."

12. Page 62 (3rd paragraph):

"Since the 1970s, the information provided to the NWS OHRFC by LRN WM during high flow events had consisted of a plan of operation for the LRN flood control projects (Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest) and not flow data from the mainstem navigation projects (Cordell Hull, Old Hickory, and Cheatham). The Barkley flows were provided by LRD WM. LRN understood the modeling approach used by the NWS OHRFC was to pass inflow at the mainstem projects where only the surcharge pool storage was available and to route the releases from the flood control projects to develop stage forecasts at the damage centers. That was the data exchange approach employed by LRN WM when the May 2010 flood event began. The LRN senior water managers on duty had employed this same routine since 1984 on a daily basis. There have been 16 high flow events resulting in a Nashville stage greater than 30 feet during this 26 year period where LRN applied this approach. For the May 2010 flood event the NWS OHRFC was expecting more detailed information on releases from the mainstem projects. Once that expectation was realized around 2300 hours late Sunday evening, the updated spillway gate operations were routinely shared with NWS staff. As observed on Figure 14, the NWS forecast accuracy increased."

Comment: Request the USACE review the basic premise of this paragraph. NWS review indicates that USACE reports of observed and forecast discharge data is provided regularly for **all** USACE projects in the Cumberland River basin. This is true for all USACE data regularly provided to the NWS. In our review of NWS data archives, we can find no evidence of discharge data updates provided for only the flood control projects. In addition, during all phone conversations, conference calls, etc, made throughout this flood event, discharge updates were provided for all USACE projects (especially the mainstem navigation projects at Old Hickory and Cordell Hull).

13. Pages 64 and 274:
"It is highly unlikely that the science behind rainfall and runoff forecasts will ever evolve to the point that lake level adjustments of a magnitude necessary to effect significant flood crest reductions can be made in advance of a major rainfall event."

Suggested Revision: "Although precipitation forecasts have improved, it will still take significant advances in the science behind rainfall and runoff forecasts to reach a point where lake level adjustments of a magnitude necessary to effect significant flood crest reductions can be made in advance of a major rainfall event."

14. Page 266:

"As part of their normal operating procedures, LRN WM provided project status and forecasts for the flood control projects to LRD WM. In turn, LRD WM provided this information to the NWS OHRFC in the morning report.
-Morning reports are provided to the NWS OHRFC."

Comments:
1) NWS review indicates that USACE reports of observed and forecast discharge data is provided regularly for **all** USACE projects in the Cumberland River basin. This is true for all USACE data regularly provided to the NWS. In our review of NWS data archives, we can find no evidence of discharge data updates provided for only the flood control projects. In addition, during all phone conversations, conference calls, etc, made throughout this flood event, discharge updates were provided for all USACE projects (especially the mainstem navigation projects at Old Hickory and Cordell Hull).

2) Our understanding, based on review of NWS product archives and discussions with OHRFC, OHX, and USACE personnel, is that the regular morning reports with forecast discharges for USACE projects (RR2OHX products) were not provided on Saturday or Sunday.

Suggested Revision: Delete these three sentences as these regular forecast discharge reports weren't provided to the NWS on Saturday or Sunday.

15. Page 267 (top):

“ -LRD and LRN WM followed established protocol for weekend and after-hours work. The offices were staffed during Saturday morning, instructions were issued, and project staff knew to call if they needed additional guidance. The situation at the time did not appear to warrant around the clock staffing as late as Saturday afternoon.
-Early Sunday, May 2, the NWS OHRFC needed to know how LRN was operating the projects and could not contact anyone in Nashville. Calls to LRN were placed at approximately 0200 hours and 0700 hours. No voice messages were left on LRN WM telephones. Note that the NWS OHRFC standard operating procedure is to include the Corps release schedule into its forecast. The first effort to obtain this information other than the daily morning reports was on Sunday.
-The NWS OHRFC did not try to contact LRD WM until 0615 hours Sunday morning even though they had off-duty contact information. The NWS OHRFC was advised to call LRN at 0730 hours by LRD.”

Suggested Revisions:
“ -LRD and LRN WM followed established protocol for weekend and after-hours work. The offices were staffed during Saturday morning, instructions were issued, and project staff knew to call if they needed additional guidance. The situation at the time did not appear to warrant around the clock staffing as late as Saturday afternoon.
-Beginning very late Saturday night and into early Sunday, May 2, the NWS OHRFC needed to know how LRN was operating the projects and could not contact anyone in Nashville. Calls to LRN were placed at approximately 2200 hours Saturday, and 0200 hours and 0700 hours Sunday. No voice messages were left on LRN WM telephones. Note that the NWS OHRFC standard operating procedure is to include the Corps release schedule into its forecast. The first effort to obtain this information other than the daily morning reports was very late Saturday night and into early Sunday morning.
-The NWS OHRFC did not try to contact LRD WM until 0615 hours Sunday morning even though they had off-duty contact information. The NWS OHRFC was advised to call LRN at 0730 hours by LRD.”

16. Page 269 (top of page):

“NWS should have considered Old Hickory Dam was in run of river operations.”

Suggested Revision: “NWS should have considered that all inflows at Old Hickory Dam would be passed downstream in order to prevent additional rises in the Old Hickory pool level.”

17. Page 269 (top of page):

“During conference calls, which began at 0830 hours on Sunday, May 2, between LRN and the NWS OHRFC, the NWS OHRFC thought that the Corps was providing them the forecast releases from Old Hickory rather than current releases”

Comment: During the Sunday afternoon (1330) conference call, LRN provided both update current and forecast releases from Old Hickory (currently 124, 000 cfs, going to between 130, and 140,000). Suggest deleting this sentence.

18. Page 269:

"The NWS OHRFC did not understand the hydraulics of the navigation project operations on the Cumberland River system under the full range of flow conditions."

Comment: This statement is not an accurate reflection of the hydrologic and hydraulic modeling expertise at the NWS OHRFC. Recommend that it be deleted.

19. Page 269:

"Discrepancies between NWS model outflows and Corps releases were not fully discussed or understood on Sunday as observed precipitation exceeded forecast and river stage approached critical levels in Nashville."

Suggested Revision: "Discrepancies between NWS hydrologic simulations and Corps release projections (outflows) were never successfully resolved on Sunday as rainfall exceeded the forecast and the river stage approached critical levels in Nashville."

Comment: There was some discussion, but never resolution. This closely mirrors language from NWS service assessment report.

20. Page 269:

" Since the 1970s, the information provided to the NWS OHRFC by LRN WM during high flow events had consisted of a plan of operation for the LRN flood control projects (Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest) and not flow data from the mainstem navigation projects (Cordell Hull, Old Hickory, and Cheatham)."

"LRN understood the modeling approach used by the NWS OHRFC was to pass inflow at the mainstem projects where only the surcharge pool storage was available"

"For the May 2010 flood event the NWS OHRFC was expecting more detailed information on releases from the mainstem projects. Once LRN realized that expectation around 2300 hours late Sunday evening, the updated spillway gate operations were routinely shared with NWS staff."

Comment: Request the USACE review the basic premise of this paragraph. NWS review indicates that USACE reports of observed and forecast discharge data is provided regularly for **all** USACE projects in the Cumberland River basin. This is true for all

USACE data regularly provided to the NWS. In our review of NWS data archives, we can find no evidence of discharge data updates provided for only the flood control projects. In addition, during all phone conversations, conference calls, etc, made throughout this flood event, discharge updates were provided for all USACE projects (especially the mainstem navigation projects at Old Hickory and Cordell Hull).

Suggest considering deletion of this section from AAR or significant re-write.

21. Page 270:

"For the May 2010 flood event the NWS OHRFC was expecting more detailed information on releases from the mainstem projects. Once LRN realized that expectation around 2300 hours late Sunday evening, the updated spillway gate operations were routinely shared with NWS staff."

Comment: NWS review indicates that USACE reports of observed and forecast discharge data is provided regularly for **all** USACE projects in the Cumberland River basin. This is true for all USACE data regularly provided to the NWS. In our review of NWS data archives, we can find no evidence of discharge data updates provided for only the flood control projects. In addition, during all phone conversations, conference calls, etc, made throughout this flood event, discharge updates were provided for all USACE projects (especially the mainstem navigation projects at Old Hickory and Cordell Hull were a particular focus of discussion). We don't believe this was a new "expectation" implemented on Sunday night as it was occurring during the conference calls at 0830 and 1330 Sunday.

22. Page 273:

"-When the NWS OHRFC was contacted to inform them of high releases from Kentucky and Barkley Lakes, the staff on duty asked LRD WM to contact the Paducah WFO directly. The NWS OHRFC did not advise LRD WM to contact the LMRFC but advised to contact the Paducah WFO. LMRFC is responsible for forecast operations downstream of Barkley."

Comment: OHRFC staff acted properly in directing this call to WFO Paducah.

Perhaps revise to: "LMRFC is responsible for forecast operations downstream of Barkley, while WFO Paducah is responsible for issuing all watch/warning products for this area."

23. Page 273:

"-Lack of understanding of the Cumberland System at extreme flows by hydrologists and

meteorologist at the NWS OHRFC and WFOs.”

Suggested Revision: Request you delete this sentence as it is not an accurate reflection of the hydrologic expertise at the NWS field offices.

24. Page 273:

"The NWS is experimenting with several different methods of utilizing probabilistic QPF. It is currently providing (experimentally) to some of their partners the MMEFS (Meteorological Model Ensemble Forecast System)."

Suggested Revision: "The NWS is experimenting with several different methods of utilizing probabilistic QPF. It is currently providing to some of their partners the experimental MMEFS (Meteorological Model Ensemble Forecast System) and the experimental probabilistic QPFs prepared by the Hydrometeorological Prediction Center, along with several other experimental QPF ensembles."

25. Page 276 :
"QPFs are published twice daily, early morning and late afternoon/evening by the Hydrometeorological Prediction Center (HPC)."

Suggested Revision: "QPFs and experimental probabilistic QPFs are published twice daily in the early morning and late afternoon/evening by the Hydrometeorological Prediction Center (HPC)."

26. Page 23 (footnote):
"Quantitative Precipitation Forecast (QPF) incorporate the surface and upper air analyses, radar data, satellite data, and model guidance in conjunction with information regarding satellite trends, precipitation and moisture availability estimates to develop an estimate of precipitation during a specified period and over a specified area."

Suggested Revision: "In making Quantitative Precipitation Forecasts (QPF) for a specified period and over a specified area, meteorologist forecasters rely heavily on computer model forecasts, surface and upper-air analyses, radar data, and satellite data".

27. Page 34:

“□0900 hours: A phone call from the KY EOC and the Livingston County Judge concerning the river predictions. The elevations the NWS was publishing and what they were seeing on the ground were not matching. Livingston County Officials continued to monitor the situation using a staff gage downstream of the dam.”

Comments/Questions:
What elevations are being discussed here? WFO Paducah transmits the Barkley pool and tailwater with information directly from the dam. WFO Paducah has no forecast points, daily or flood-only, downstream of Barkley Dam on the Cumberland River. The next point downstream of Barkley Dam is Smithland Lock and Dam on the Ohio River.

28. Page 63:

"Issue 22 addresses improving communications between the Corps and NWS. LRD WM contacted the NWS OHRFC to inform them of high releases from Kentucky Lake and Lake Barkley; however, the NWS staff on duty asked LRD to contact the NWS Paducah WFO directly in lieu of the LMRFC. LRD WM contacted the Paducah WFO as requested and the Paducah WFO issued a Special Weather Statement in lieu of a flood warning statement that would have activated the Emergency Alert System. The NWS staff at the Paducah WFO did not fully understand the information provided by LRD. The flow information that LRD provided was not translated to stage thus, the Paducah WFO did not fully recognize the extent of the increase. Technical communication and lack of understanding of each agency's operations played a large role in this misunderstanding."

Suggested Revision:
"Issue 22 addresses improving communications between the Corps and NWS. LRD WM contacted the NWS OHRFC to inform them of high releases from Kentucky Lake and Lake Barkley; however, the NWS staff on duty asked LRD to contact the NWS Paducah WFO directly in lieu of the LMRFC. LRD WM contacted the Paducah WFO as requested and the Paducah WFO issued a Special Weather Statement in lieu of a flash flood warning product that would have activated the Emergency Alert System. WFO Paducah did not fully understand the impacts/consequences of the information provided by LRD. Technical communication and lack of understanding of each agency's operations played a large role in this misunderstanding."

29. Page 273:

"The NWS OHRFC did not advise LRD WM to contact the LMRFC but advised to contact the Paducah WFO. LMRFC is responsible for forecast operations downstream of Barkley."

Suggested Revision: "The NWS OHRFC did not advise LRD WM to contact the LMRFC but advised to contact the Paducah WFO. LMRFC is responsible for forecast operations downstream of Barkley, while the Paducah WFO is responsible for issuing all official NWS watch and warning products for this area."

30. Page 273:

"Failure of NWS Paducah WFO to issue a flood warning statement that would have activated the Emergency Alert System when notified of high releases from Kentucky and Barkley Lakes; instead a Special Weather Statement was issued."

Suggested Revision:
"NWS Paducah WFO issued a Special Weather Statement to address the high releases from Kentucky and Barkley Lakes; a Flash Flood Warning would have activated the Emergency Alert System."

31. Page 273:

"Technical communication and understanding of each agency's operations played a large role in this misunderstanding. The NWS should have asked more specific questions in order to understand the impact and the level of urgency."

Suggested Revision (recommend deleting the 2nd sentence):
"Technical communication and understanding of each agency's operations played a large role in this misunderstanding."

Comment: This was a primary cause of this communication breakdown.

<u>Appendix D – Corps Timeline of Events Pages (78-92)</u>

2-May
"1643 WFO Nashville stated they relayed Nashville forecast to Corps and Corps was fairly confident Old Hickory could hold 150,000 cfs. At that time, Old Hickory was already 7 feet over maximum rated spillway opening (150,000cfs). This represents an apparent breakdown in communication as LRN WM would not have made that statement."

Suggested Revision:
"1643 WFO Nashville calls the LRN WM. WFO Nashville stated they relayed Nashville forecast to Corps and Corps was fairly confident Old Hickory could hold 150,000 cfs. At that time, Old Hickory was already 7 feet over maximum rated spillway opening (150,000cfs). This represents an apparent breakdown in communication as LRN WM would not have made that statement."

3-May
"130 LRN WM called OHRFC and provided OLD update"

Suggested Revision: "LRN WM called OHRFC and provided Old Hickory update"

Mr. Hancock Monday, Aug 23, 2010 at 2:51 PM

These comment are my own and may not be the same from all USGS personnel. None are meant to be personnel and only try to raise the issue of how important the scientific data are.

It is recognized that communications between the COE, Nashville District and the USGS, KY WSC have been much less since the NCOE decided to end their Federal partnership with the USGS when it drop all funding from the National Streamgaging Program. The NCOE made the decision to cut the collection of streamflow information by the USGS and fund a local contractor to just service the equipment. At the time, it was decided that keeping streamflow ratings current and having access to real-time streamflow was not in their highest interest. Over time, rating curves change and with no history of the data changes, when an event like the May 2010 flood occurs, those shortcomings are highlighted and recognized as a needed source of data. If the partnership had been in place, the USGS, KY WSC with its excellent staff that covers the entire state of KY would have been collecting streamflow information at NCOE gages in addition to its other funded gages and would have made this information available in real-time to the COE and the public through its web site. When you get an major event like Nashville had, the data are what is needed to help all agencies meet their mission. The AAR talks of a transition plan to bring back the streamgages into the National Streamgaging Program. After looking at the plan, a majority of the NCOE gages are still being left to service by the COE staff and their local contractor. Neither will be collecting what could be considered necessary streamflow information or capturing the essential data in an archiveable database that can be reviewed or shared with other Federal, state and local agencies for the next major event. From a lessons learned approach, have we not learned anything, I do not see enough progress being made to address the lack of streamgaging information being collected to help the NWS with their flood forecasting ability or the verification of the upper ends of the ratings below COE structures. When was the last time some of these sites were actually measured. Ratings do change over time. The NCOE and USGS, KYWSC will need additional discussions concerning the transition plan and a better approach to collecting streamflow data before the next flood event.

Michael S. Griffin (502) 493-1913
Assistant Director (502) 493-1909 fax
U.S. Geological Survey (502) 548-5448 cell
Kentucky Water Science Center
9818 Bluegrass Parkway
Louisville, KY 40299-1906 http://ky.water.usgs.gov

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Tennessee Associations of Broadcasters
Comments on U.S. Army Corps of Engineers After-Action Report
May 2010 Flood Event – Cumberland River Basin
(five pages)
Chapter 4.0 - Emergency Operations and 6.0 - Lesson Learned
Especially ISSUE #4 Improving Risk Communication

Executive Summary August 2010

The Tennessee Association of Broadcasters (TAB) is the state trade association for the federally-licensed, over-the-air radio and television stations in Tennessee and affiliated businesses and industry. As part of that license from the Federal Communications Commission (FCC) we are charged with the capabilities to respond to natural disasters, terrorist attacks, public health emergencies, and other large-scale events as part of our public interest.

Broadcasters also have an important role to play in ensuring that our nation's communications infrastructure serves our public's safety needs. Improving emergency communications across the country is a priority for broadcasters to help strengthen coordination efforts among emergency communications practitioners nationwide and guide our state, local, and government partners to invest in the right equipment and capabilities.

Responsible and reliable communications is critical to supporting the public's health and medical needs of a community in preparing for, responding to and recovering from natural disasters and emergencies, including terrorism acts and pandemics.

During emergencies, a station's primary mission is to ensure that essential communications networks and services are operable, redundant, reliable, and quickly restored when necessary so that the American public can communicate and receive emergency information.

Local Broadcast Stations Remain the Backbone of the Nation's Emergency Alert System

In addition to the on-going, comprehensive coverage during live or dedicated reporting of emergencies that broadcasters provide during emergencies, we are also the backbone of the Emergency Alert System (EAS). EAS is a largely wireless network that connects over-the-air radio, television and cable television systems. Since 1996, the in-place infrastructure of EAS has allowed for the prompt dissemination of alerts to the widest possible audience, or to target alerts to specific areas, as appropriate. Public reception is possible with or without electricity compromise. EAS is intended for use during sudden, unpredictable or unforeseen events that post an immediate threat to public health or safety, the nature of which precludes any advance notification or warning.

We feel certain with the help of this association that the National Weather Service and other government emergency operations can improve its emergency planning and response: education and training, outreach and collaboration, emergency operations and alerts, and network analysis with expanded and improved utilization of the broadcast Emergency Alerting System.

Improved Risk Communications

Outreach and Collaboration

Emphasize the importance of maintaining strong partnerships with federal, state, special interests, local governments, and the public safety community directly with broadcasters to ensure effective direct coordination when disaster strikes.

Emergency Operations and Alerts

Ensure that, during emergencies, stations are able to maintain operations, respond proactively to public safety communications needs, and communicate accurate and timely information directly to the public in addition to the National Weather Service. The TAB is working with its federal partners to identify improvements to the national emergency alert system, accounting for next-generation technologies.

Education and Training

Outline training programs including broadcast engineers and drills to equip stations, government and the public with the skills, tools, and information they need to respond to any emergency. This ongoing and on-air education and training can inform staff, businesses and families of their collective and individual roles during crisis situations. Staff will also learn about management software systems that provide accurate and timely information in emergencies directly to the public.

Broadcaster Emergency Alerting System (EAS) - Overview

Purpose

- To warn the public of sudden, unpredictable events that pose an immediate threat to public health or safety
- Original intent: Presidential message in case of nuclear attack
- Successful examples:
  - Samoa Tsunami, Hurricane Katrina, California Wildfires, Midwest Floods
  - AMBER Alerts.

- Presidential
  - local civil defense instructions
- Weather
  - storm or flood paths
  - shelter-in-place instructions
  - evacuation directions
- Amber Alert
  - child description
  - public safety contact information
  - makes the public the eyes and ears of law enforcement
  - Amber Alerts have saved 495 children's lives since 1997.

Informers

- The President (national alerts)
- Governors (statewide alerts)
- Local authorities (with a locally approved plan)

Key Players

- Federal Communications Commission (FCC)
- Federal Emergency Management Administration (FEMA)
- National Oceanic and Atmospheric Administration/National Weather Service (NOAA)
- Broadcasters (and cable TV, satellite TV and satellite radio) who partner with state, county and local emergency managers, police, etc.

Certain Requirements

- Broadcaster participation in EAS and the National Weather Service is voluntary
- FCC requires participating radio and TV stations (and cable systems with 5,000+ subs) to install an EAS encoder/decoder.
  - Decoder = receiver that continuously monitors at least two nearby signals for EAS messages, including at least one Local Primary Entry Point.

  - Encoder = capable of sending digitally coded EAS messages.

- Broadcasters buy EAS equipment at their own expense
- Maintain EAS logs and equipment certifications
- Provides President and Governors means to alert public in times of emergency
- In-place infrastructure to target local alarms to specific areas
- Fast, efficient warnings to widest possible audience with or without electricity
- Government coordination of emergency information
- Careful deployment by authorities only for true emergencies to prevent public "tune-out"
- EAS only the beginning of broadcasters' critical role during national, state and local emergencies. Broadcasters deliver on-going emergency news and instructions with continuous live LOCAL coverage

Why

- Critical knowledge of local communities
- Broadcasters are the "backbone" of the EAS system and keeping communities safe and informed
- Recognition of broadcasters as "First Informers"
  - Broadcast employees need access to facilities during disasters
- Credentialing and training for state and local emergency managers
- State EAS plans in all 50 States
- Required Monthly Tests (RMT)
  - Initiated by state emergency officials or primary relay station.
  - "The following is a test of the Emergency Alert System. This is only a test."
  - Stations must relay message within one hour.
  - Tests are scheduled and pre-announced, alternate day and night.

Conclusion

The ongoing reliability of the EAS network will depend on the success of several important developments. First, the success of EAS will largely turn on the expertise and ability of local authorities to fully deploy EAS and act as a "civil authority" with full access to the system. In the past, some of the isolated instances where EAS could have been used more judiciously directly resulted from a lack of awareness or expertise on the part of local officials concerning EAS. In this day and age, it is unacceptable that some local emergency managers remain unaware of the benefits of EAS, or how and when to trigger an EAS alert. TAB respectfully calls on all levels of government to consider funding a comprehensive EAS training program for state and local public safety officials, so that EAS will continue to work as intended for the benefit and safety of all Americans. Such a program could be administered through FEMA, which could allocate the funds as needed to various local authorities and also design and conduct seminars and other educational experiences for local officials and the public regarding EAS.

Second, FEMA is in the midst of implementing a next generation of EAS. This new system will modernize the technology and computer language used to deliver EAS messages from public safety officials to EAS Participants. Under the Commission's existing rules, broadcasters and other EAS Participants will be required to process an EAS message that is formatted in this new computer language known as the Common Alert Protocol (CAP) within 180 days of FEMA's formal adoption of standards for the new format. This will be a substantial burden for many broadcasters, as it will require the replacement of EAS equipment at most radio and television stations. The costs of such new equipment are beyond the means of many small broadcast stations and local governments, especially after the recent severe recession. As a result, it is possible that some radio and television stations and county agencies may be forced to opt out of initially participating in EAS going forward.

Therefore, we respectfully ask for consideration and funding that could be distributed through state emergency management offices to help certain broadcasters and local governments absorb the costs of replacing their EAS equipment to comply with the FCC/FEMA's new directives and standards. Such funds could be critical to the success of the next generation of EAS and the public's welfare. We feel certain with the help of this association and other outside consultants that government can improve its emergency planning and response with: education and training, public outreach and collaboration, emergency alerts, and network analysis.

Whit Adamson, President Tennessee Association of Broadcasters
Two International Plaza Drive, Suite 507 Nashville, Tennessee 37217
Office 615-365-1840 Email tabtn@bellsouth.net Website www.tabtn.org

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Galain Solutions, Inc
Comments on Army Corps of Engineers After-Action Report on May 2010 Flood Event – Cumberland Basin

Executive Summary

Galain Solutions, Inc. ("Galain") appreciates an opportunity to provide comments to the U.S. Army Corps of Engineers After Action Report regarding the May 2010 Flood Event – Cumberland Basin ("the AAR"). Galain is a consulting firm with subject matter expertise in notifications, alerts, and warnings. The company consults government organizations (local, state, and federal) on initiatives related to critical communications to staff and the public. Galain is well-known for its expertise among public safety officials and related industry. The company's Alerts and Notifications blog for award-winning Emergency Management magazine is well-followed. Galain deals with emergencies throughout the country, but is particularly interested in the May 2010 Flood Event because the company's principals are middle Tennessee residents. They experienced first-hand the experience of responding to a threat when sufficient notice was not provided.

Galain offers comments on three issues identified in the AAR: Issue 2-Improve Internal Communication, Issue 4-Improving Risk Communication, and Issue 5-Improve District Recall of Personnel. Issues 2 and 5 are addressed collectively; their resolution would be aided by use of the type of internal notification system used throughout federal government, but apparently not used by the Corps.

Issue 4 is more complex as it deals with public perceptions and questions about responsibility during emergencies. The Corps rightfully notes in the AAR that it is not responsible for issuing public alerts, but that doesn't change the fact that the public will turn to the Corps for information during flood events (as noted in the AAR). Unless the Corps can change the public's perception (which may not be practical, even possible), it should become actively involved in efforts, some of which are partially in place, that would help ensure that the public receives information fast enough to properly react to a flood threat.

Issue 2- Improve Internal Communication and Issue 5-Improve District Recall of Personnel

Galain's comments on Issues 2 and 5 are addressed collectively; the resolution suggested is the same for both. The Corps is encouraged to consider adoption of an Automated Notification System (ANS)[1]. A properly deployed ANS could have eliminated the problem identified in the AAR where the Great Lakes and Ohio Region Division (also known as "LRD") staff failed to respond promptly to a Nashville District Corps Commander's initial email concerning flood potential. Per the AAR Appendix, "This email did not

[1] ANS is intended as a generic term, and does not represent any particular vendor's product.

get immediate attention by LRD staff resulting in slower communication up the chain of command regarding the potential severity of the event". The AAR said the emails were not read, "…perhaps from an overload of emails in mailboxes". The AAR also noted that a "trigger does not exist at the Division staff level to activate the staff into an emergency mode". ANS would have made triggering and staff activating efficient.

While email can be an effective way of communicating certain information, it is a poor way of disseminating critical information that requires immediate action. As a remedy, the AAR stated that the Corps Division office "will utilize telephonic notification for passing critical notification". This is a step in the right direction. However, adopting ANS would take the remedy much further.

While ANS solutions often use telephones for notifications, the systems usually don't stop there. They use telephones in conjunction with other modes of delivery such as text messaging, email, computer "pop up" alerts, etc. Use of multiple devices ensures fast and complete message delivery. Communication devices used can vary, based on two factors: (1) nature of the event at hand, and (2) individual preferences. The devices can be used in logical order, rather than all at once, again reflective of the nature of the event and individual preferences. Message recipients can be asked to confirm delivery through the system, or could be asked questions such as estimated-time-of-arrival. The "rules" for the notification (devices, message, targeted individuals, confirmation, etc) can be established in advance; activation would occur with little effort during a critical event. Other advantages include:

- Accountability can be maximized. During an active notification, delivery can be monitored. Message senders can quickly find out who had received the notification. If necessary, adjustments to staff assignments can be made. Afterwards, reports can be analyzed that show precise results of delivery attempts.
- Different groups can receive different messages.
- Updated notifications can be effectively issued as events change, as they invariably will during a critical situation.
- Because it's an automated process, the number of people to be notified can be effortlessly expanded.
- Priorities can established so that one notification event supersedes another, depending on the nature of the event.

ANS is used by many government agencies, local, state, and federal. For example, the Federal Emergency Management Administration (FEMA) issues ANS notifications on a near-daily basis. The Tennessee Emergency Agency (TEMA) uses ANS for notifying its staff and local officials throughout the state.

ANS systems, suitable for Corps use, are available from multiple vendors. Cost for purchasing an on-site system or subscribing to a web-hosted solution, then properly deploying, would amount to no more than several hundred thousand dollars over a five-year period.

Additionally, the Corps should develop a specific Information Sharing Plan to determine which information needs to be sent and received so the various organizations involved can operate jointly, effectively, and quickly.

We are highly confident a properly deployed ANS with an appropriate Information Sharing Plan could have quickened response times and made more people aware of the situation at hand.

Issue 4: Improving Risk Communication

During a threat, a well informed public is a safe public. Stories abound about how uninformed individuals and businesses fail to properly respond to fast-evolving threats. Although consequences could have been much worse, the May 2010 Cumberland Basin flood produced its own stories. Clearly, improvements are needed.

The AAR cited a number of challenges it faced related to public notification and alerting. They include:

- Corps personnel "fielded numerous phone calls from the public during the flood event requesting information on the extent of flooding expected in their area."
- "With minimum personnel available the calls diverted staff time away from developing and implementing reservoir system operations plans."
- "This event occurred over the weekend, when limited personnel were in the District office to handle communications with the public."

We believe these issues only touch the surface. The challenges surrounding this topic could have been much worse. Fortunately, power outages were limited – unusual for an event of this magnitude. Television and radio stations were able to remain on the air; internet service was not significantly interrupted. Had power outages been severe, residents would have been in much greater danger. The Corps office would have been even more strained answering inquiries from the public. This would have further diverted staff from reservoir system operations plans, which would have made the impact even greater. While officials responded commendably, a good bit of luck was in play.

The AAR states the National Weather Service (NWS) has responsibility for providing the public flood forecast information. While the AAR may be technically correct, the Corps still has a practical responsibility, whether official or not. The AAR supports this statement. The public obviously exerted significant effort to get information from the Corps. Had they received it elsewhere, this would not have been necessary. Plus, the public associates flooding with the Corps, thus naturally turns to the Corps for information. As stated in the AAR, "NWS is responsible for providing public flood forecast information; however, most people appear to associate that responsibility to the Corps".

To mitigate this issue, the AAR states that the Corps will take the following actions:

- Work with the NWS to "develop an interagency process that relays crest stage information in a manner than gives the general public more knowledge as to the effect on an individual".

- "Develop operating procedures that ensure all public affairs communication functions are adequately covered".
- "Increase risk communication discussions with the public to improve awareness of the operations of Corps projects and the flooding risks".

These are positive steps. However, we believe more is needed. Short of suggesting that the Corps assume full responsibility for public notifications in a flood event, we propose the following:

- The Corps should support a statewide initiative to enhance public alerts and notifications in Tennessee. While the Corps may not have official responsibility for public alerts, the Corps and the public would clearly benefit from such an initiative. It would involve a managed "system of systems" approach - multiple systems working together to deliver more alerts and warnings faster to more people. The statewide program would take advantage of previous investments and other initiatives. It would modernize the Emergency Alert System (EAS). It would be poised to be connected to a national system being developed, which should enhance even more ability to deliver important alerts faster. The program would be developed collaboratively, engaging "communities of interest" including notifiers (i.e. local and state public safety agencies), network providers (i.e. broadcasters, telephone carriers, etc), special needs communities, and critical infrastructure providers (i.e. utilities, healthcare, transportation, etc). A public outreach program would be an important element. Residents will need to know how to make sure they are alerted, and what to do when they are.

- The Corps should support efforts to modernize The Emergency Alert System (EAS) in Tennessee. EAS is a critical component to alerting the public, and the primary means for NWS to alert the public. However, material EAS coverage gaps exist in Tennessee. These gaps could be filled at the same time EAS undergoes upcoming compulsory modernization.

Galain Solutions, Inc.

Galain Solutions, LLC is an independent consultancy with unique expertise, perspective, and experience with alerts and notifications. The company's principals have been involved in some of the decade's most significant deployments of alerts and notifications technology at local, state, and federal levels.

In addition to advising government organizations on alerts and notifications programs, Galain personnel are prominently published on the topic. Galain's Rick Wimberly and Lorin Bristow are featured bloggers and subject matter experts for *Emergency Management* magazine. Recent articles have appeared in *FireRescue* magazine and *PoliceOne.* A recent article in *Emergency Management* magazine examined alerts and warnings trends including movement that points to wider adoption of a "managed system of system" approach. Galain recently published a widely-circulated white paper, "Notifications, Alerts, and Warnings: the Next Generation".

Although Galain remains independent from vendors, the company's relationships with both industry and personnel are consistently nurtured. Galain's multi-faceted publication efforts place it in a unique vantage point to observe trends, successes, and failures. For example, company personnel have strong access to the federal Integrated Public Alerts and Warning System (IPAWS) program. IPAWS strives to, among other things, establish national standards and framework for enhanced public alerts, both Presidential and otherwise.

Galain President Rick Wimberly has worked closely in the last decade with many local, state, and federal agencies on their notification programs, including an enterprise solution for the Department of Homeland Security. He has conducted numerous briefings on the topic at the highest-levels of government, including Presidential cabinet-level.

For much of the past decade, Galain Managing Partner Lorin Bristow held senior management positions for communications technology companies within the public safety, government, defense, and private enterprise sectors. Prior to joining Galain, Bristow was Vice President of Marketing for PlantCML, a leading provider of 9-1-1 technologies.

Galain Solutions, Inc. is based in Franklin, Tennessee south of Nashville. The company's President, Rick Wimberly, may be reached at rick.wimberly@galainsolutions.com.

106 Gillette Drive
Franklin, TN 37069
615.504.8914 ph
GALAIN SOLUTIONS, INC.

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Appendix L– August 2010 Heavy Rainfall Event

Since the review process following the record flooding in May was initiated, the Corps of Engineers has been actively working to address the lessons learned identified in this After Action Report. During the final editing process of this report, a significant heavy rainfall event again impacted the Cumberland River Basin on August 17-19. While this event did not produce significant flooding along the mainstem Cumberland River, several counties in north central Tennessee were hard hit by widespread flash flooding. This appendix will provide a brief overview of the August event, and review the impact of lessons learned that have been implemented since May.

Event Overview

The August event was the result of two consecutive nights of heavy rainfall associated with nearly stationary thunderstorms forming along a warm front stalled from east to west across northern Tennessee. A week before the flood event, Tropical Depression Five formed in the northern Gulf of Mexico off the Louisiana coast. While the system lost tropical characteristics 30 hours later, a remnant upper level low persisted for the next week across the Gulf Coast.

As the system drifted northward on the afternoon of the August 17, it enhanced the flow of moist tropical air into the frontal boundary stalled over Tennessee, triggering a round of slow moving thunderstorms with very heavy rainfall rates, primarily across north-central Tennessee and south-central Kentucky. Following a lull during the morning hours of the August 18, thunderstorms again formed during the evening and intensified overnight. The heaviest rains again concentrated along the stalled frontal boundary, which was in roughly the same position as the night before. As a result, small creeks and streams in north central Tennessee and south central Kentucky quickly rose out of their banks, leading to severe flash flooding.

The heaviest rainfall was concentrated in the Cumberland basin immediately east and north of Nashville. Widespread amounts of 5 to 8 inches were recorded in this area over the 48 hour period ending the morning of the August 19, with a peak of 11.29 inches measured in northern Smith County, Tennessee. By far the heaviest rains fell the second night in the local drainage area to Old Hickory Dam. Reports of nearly 6 inches in 2 hours in Sumner County (just north of the Old Hickory Dam) were received.

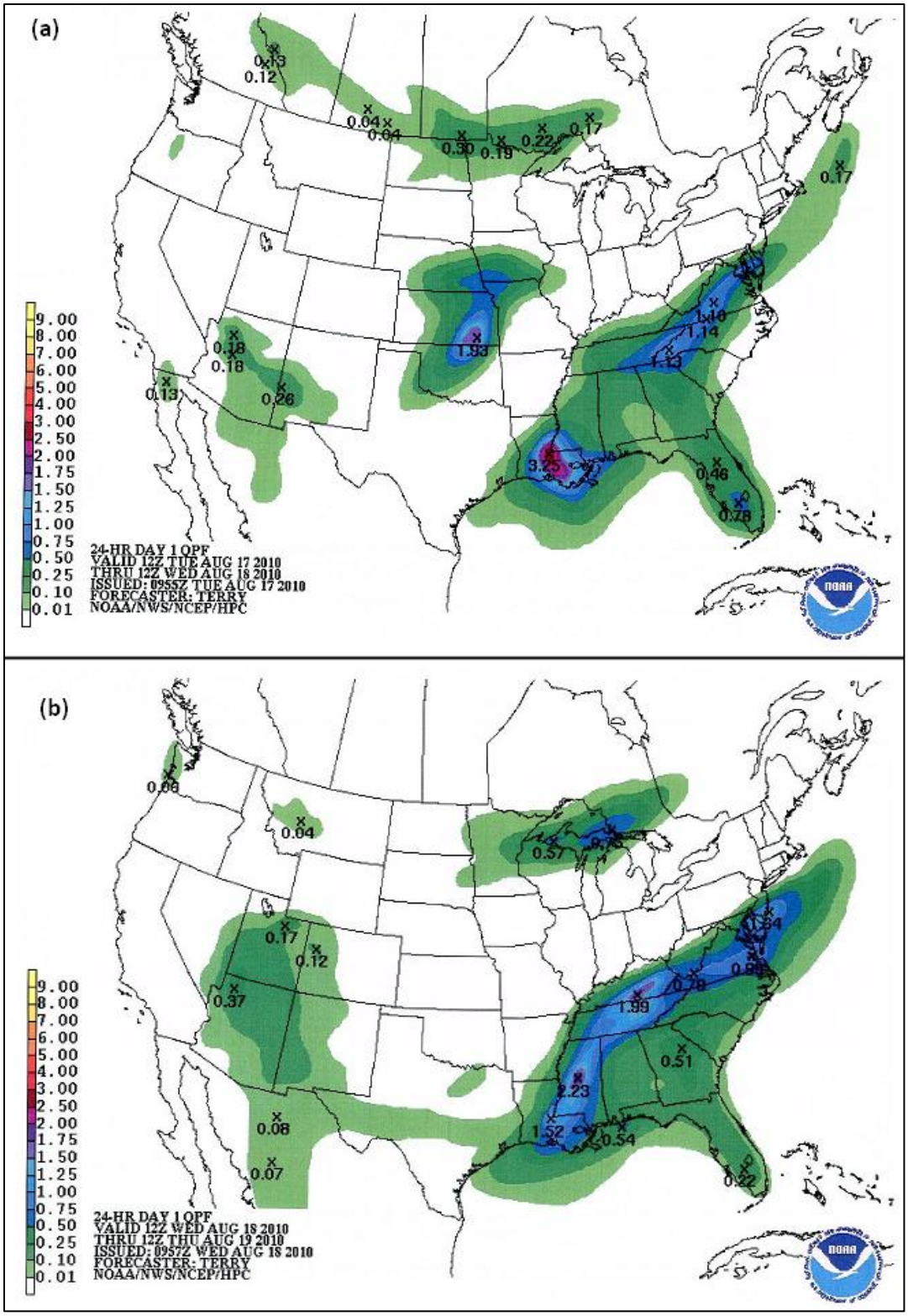

Figure 1 - 24 hour Quantative Precipitation Forecasts issued by the National Weather Service Hydrometeorological Prediction Center published (a) the morning of August 17 and (b) the morning of August 18, 2010. In both cases, the uncertainty in the rainfall forecast caused amounts to be underforecast; the location of the heaviest rainfall potential improved significantly on the 18th.

Despite the intense rainfall in the uncontrolled central portion of the Cumberland basin, flooding was limited to tributary creeks and streams. Water levels along the mainstem Cumberland River rose sharply from low summertime levels, but failed to reach flood stage, a marked difference from the May event.

Meteorological models historically have difficulty accurately forecasting heavy rainfall due to thunderstorm activity associated with weak storm systems such as the one responsible for the August flooding. This is due to the fact that in the absence of strong, large scale wind flows, the initiation and maintenance of thunderstorm activity is dominated by atmospheric processes operating at a scale much smaller than the models are capable of resolving. As a result, the 24 hour Quantative Precipitation Forecast (QPF) issued by the National Weather Service on 17 August, shown in Figure 1, indicated the heaviest rainfall would be well to the east of the Cumberland Basin. On the morning of 18 August, the 24 hour QPF forecast placed a rainfall maximum of just under 2 inches across north central Tennessee and south central Kentucky. The technical discussions issued by the National Weather Service during the day of the 18th highlighted the potential for higher rainfall amounts due to the tropical moisture, as well as the low confidence held in the forecasted placement of the heaviest rainfall due to the weak dynamics associated with the system.

Comparison to May Event

Figure 2 compares the observed rainfall in Tennessee May 1-3 and August 17-19. Although heavy rain again fell in the upper Cumberland Basin, the physical area impacted by heavy rainfall from the May event dwarfs the amount which was observed in August. During the May event, greater than ten inches of rain fell over the majority of at least 17 counties in western and central Tennessee; during the August event, more than 10 inches of rain was only observed in isolated locations across north Central Tennessee. While significant rainfall totals were observed, the August rain event was significantly smaller in scale than the May flood event.

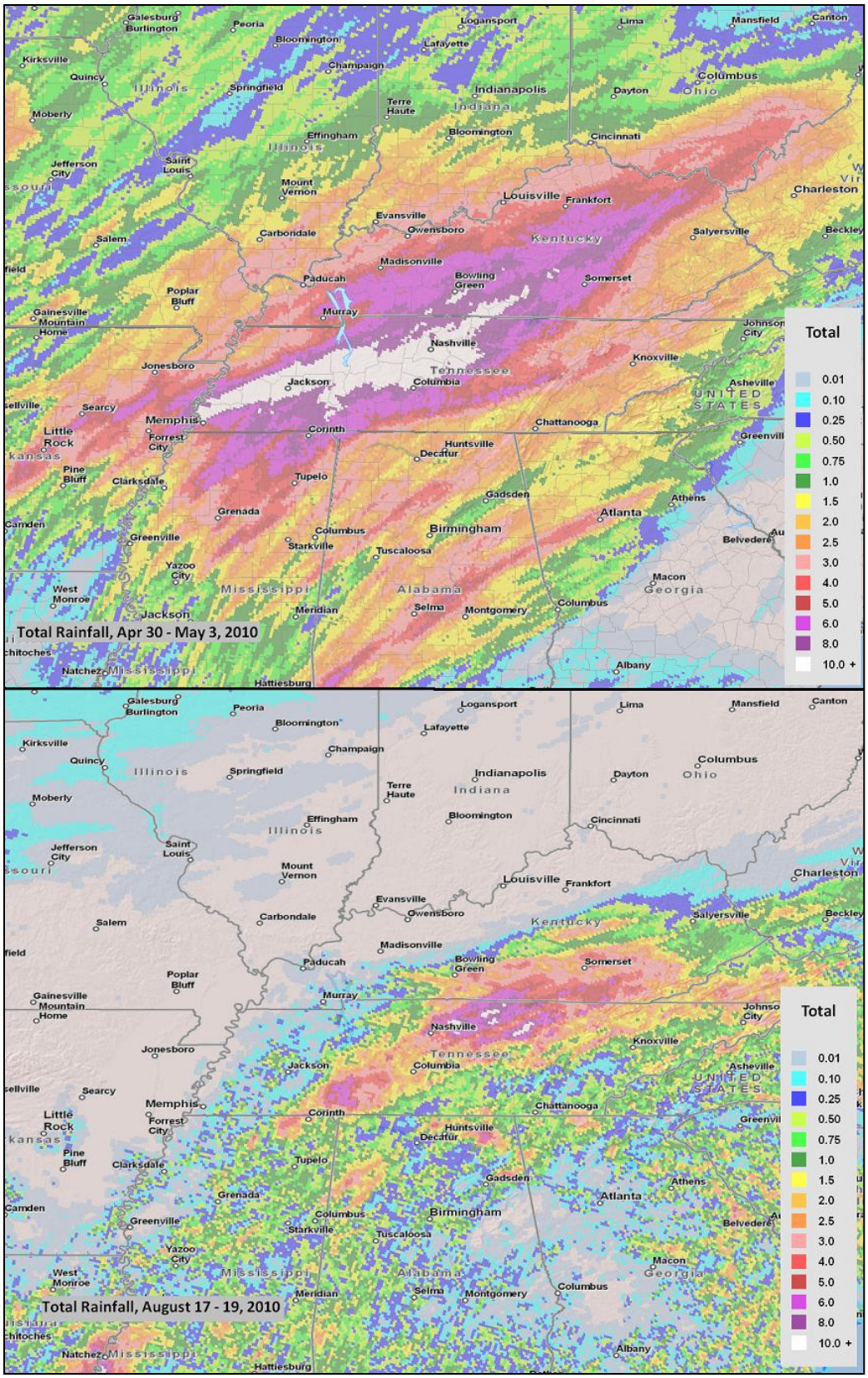

Figure 2 – Comparison of the observed rainfall totals across Tennessee during the May 1 - 3 and August 17 - 19 flood events. Areas in white indicate areas which received greater than 10 inches of rainfall.

The dramatic difference in runoff volume between the two floods can be seen in Figure 3, an overlay of hydrographs from the Nashville, TN gage. It should be noted that the system-wide response follows the same general "shape", a function of the fact that the two events were similar in the location and timing of rainfall in the uncontrolled portion of the Cumberland Basin upstream of Nashville, with the primary difference being the dramatic difference in magnitude of the rainfall.

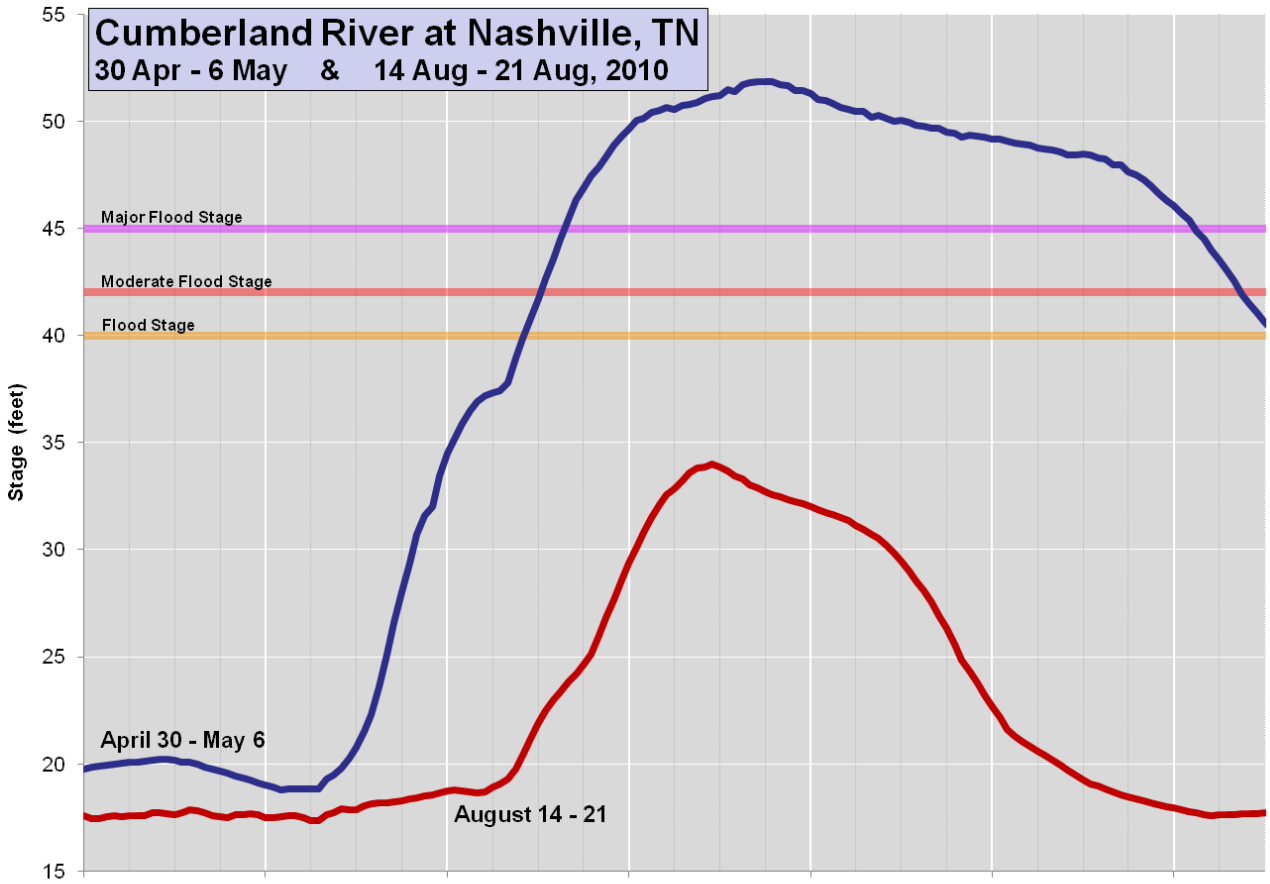

Figure 3 – Comparison of hydrographs from the May and August Flood Events for the Cumberland River at Nashville.

Implementation of Lessons Learned

In the three months following the May flood event in the Cumberland River Basin, there has been an extensive post-flood analysis of procedural areas which could be improved, documented within this report. Improvements to three core processes had already been initiated prior to and had a positive impact on the August event – improved interagency coordination, implementation of 24 hour operations, and improved public communication.

Improved Interagency Coordination

Following the May flood event, multiple interagency meetings between the National Weather Service, Corps of Engineers, and US Geological Survey have been held to review past practices and set the groundwork for enhanced communications during future flood events. A key finding of the May event was the need to increase the frequency of coordination calls and incorporate more partners and agencies related to the flood fight in the coordination call briefings. As the August event began to unfold, conference calls were initiated, including representatives from the following organizations:

- Corps of Engineers
  - Nashville District Water Management
  - Nashville District Emergency Management
  - Louisville District Emergency Management
  - Louisville District Water Management
  - LRD Water Management
  - LRD Emergency Management
- National Weather Service
  - Ohio River Forecast Center
  - Nashville Weather Forecast Office
- US Geological Survey
  - Tennessee Water Science Center
  - Kentucky Water Science Center
- Tennessee Valley Authority
  - River Scheduling Team
- Nashville Metro

Due to the uncertain nature of the rainfall forecast – particularly surrounding the evening of the August 18, when heavy rain was expected, but its location was highly uncertain – the conference calls provided an ideal means of communicating the risk and uncertainty contained within the forecast to all involved parties. Collaboration between Water Management and the National Weather Service Ohio River ForecastCenter (OHRFC) allowed the published river forecasts to incorporate the latest anticipated release strategies.

Another significant change implemented in the August event was direct communications between the mainstem Cumberland Dam operators and the OHRFC. Every spillway gate change made at Cordell Hull and Old Hickory dam was directly communicated to the Ohio RFC by the operator on duty. This allowed the OHRFC to stay abreast of how rapidly flows were changing along the mainstem Cumberland, and improved their modeling through that reach of the river. This is in contrast to the May event, when the OHRFC received twice daily briefings on spillway

gate operations, but did not receive direct notification of intermittent spillway gate changes made at the mainstem projects during periods of rapidly changing river conditions on May 1 and 2.

Improved Public Communications

National Weather Service Weather Forecast Offices (WFO's) are the primary public interface during a flood event. WFO's issue forecasts, statements, and warnings that have broad and immediate dissemination. The inclusion of the local WFO on coordination calls during the August event was a significant improvement, as the office responsible for disseminating the forecast had a solid understanding of the Corps activities. It also allowed for a consensus among all parties to be reached on the best means of communicating the uncertainty involved in the forecast in the NWS forecast statements for Nashville.

Due to the evolving and uncertain nature of the rainfall forecast on August 18, an additional conference call was held during the evening to provide an update of current conditions. The rising river was understandably a highly visible and sensitive subject in the Nashville metro area, and the additional coordination allowed the agencies to agree upon the proper forecast wording to be issued by the NWS prior to the late local newscasts.

24x7 Operations Implemented

During the May event, a formal plan for implementing 24x7 operations of Water Management was not in place. As a result of the lessons learned, LRN WM established a draft plan that outlined triggers and staffing strategies to implement 24x7 operations during significant flood events. LRN WM activated their draft plan at 0300 hours central time on August 19 as heavy rains near Nashville caused conditions along the mainstem Cumberland to approach activation thresholds. LRN WM continued 24 hour staffing until 1200 hours on August 20, when the river levels began to fall.

Summary

While not nearly as destructive or damaging as the historic May flood, the heavy rainfall across the Cumberland River valley 17 – 19 August provided an ideal opportunity to evaluate the effectiveness of changes already implemented by the Corps in response to the lessons learned in this report. The positive impact of the new communication and staffing strategies were evident in the interagency response to the event. The Corps is committed to completing the remaining lessons learned to provide the best possible service for all future events.

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