APPENDIX B

CUMBERLAND RIVER BASIN RESERVOIR SYSTEM WATER MANAGEMENT OPERATING PLAN DURING INTERIM POOL RESTRICTIONS AT WOLF CREEK AND CENTER HILL DAMS

Center Hill Lake and Dam
DeKalb County, Tennessee

August 24, 2007
Version 1.2

Cumberland River Basin Reservoir System Water Management Operating Plan During Interim Pool Restrictions at Wolf Creek and Center Hill Dams

Nashville District Corps of Engineers
Nashville, Tennessee

August 2007

Cumberland River Basin
Reservoir System
Water Management Operating Plan
During Interim Pool Restrictions at
Wolf Creek and Center Hill Dams

Table of Contents

Table of Contents

Cumberland River Basin Reservoir System Water Management Operating Plan During Interim Pool Restrictions at Wolf Creek and Center Hill Dams

1. Background

1.1. Purpose and Scope. The Corps of Engineers (CE) has implemented interim water control operating restrictions at both Wolf Creek Dam (Lake Cumberland) in Kentucky and Center Hill Dam in Tennessee. Wolf Creek and Center Hill are both experiencing foundation seepage issues that have led the CE to implement a number of risk reduction measures. These pool restrictions are the latest and most significant of these actions. The lower lake levels associated with these actions will reduce the hydrostatic pressure on the foundation and lower the frequency of high lake levels, thus reducing risk at both projects. These interim water control operating restrictions are considered to be dynamic in nature and are subject to modification based on observed conditions. The interim operating restriction at Wolf Creek in 2007 is to operate for a year-round target elevation of 680. Likewise, in 2007 Center Hill has been operated to follow the lower band of the Southeastern Power Administration (SEPA) power marketing zone within the hydropower pool. The operating restrictions at each project will be evaluated periodically as construction progresses. Future lake level restrictions may be more or less stringent than those adopted for 2007. The water management operational guidance outlined in this plan will be in effect until circumstances or data indicate that a different approach is warranted.

1.2. Cumberland River Basin Reservoir System.

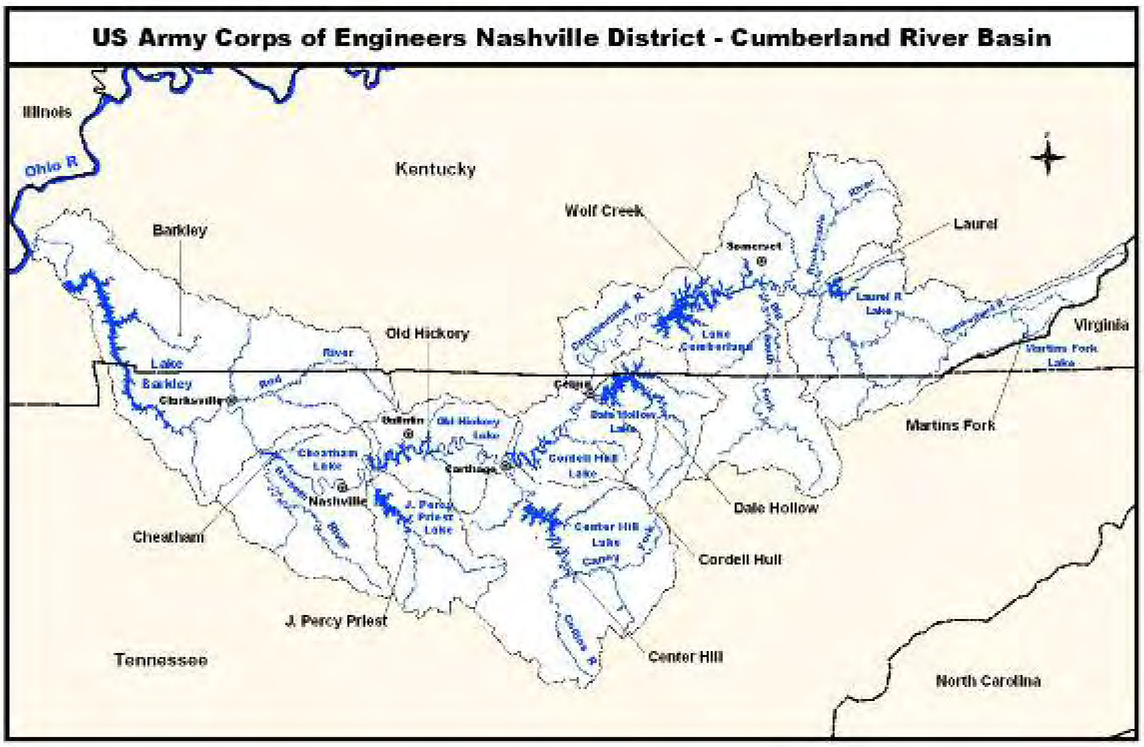
1.2.1. The Cumberland River Basin Master Water Control Plan (dated December 1998) has several general objectives for operation of the system of ten multipurpose water resources projects within the Cumberland River Basin. See Figure 1.

- To provide a significant volume to store flood waters and thereby reduce downstream flood peaks and associated flood damages, particularly at the four damage centers: Celina, Carthage, Nashville, and Clarksville, Tennessee, and also on the lower Ohio and Mississippi Rivers.
- To provide a significant volume to store water for the generation of hydropower at times of peak electrical demand.
- To provide a nine-foot channel depth for commercial navigation from the mouth of the Cumberland River to mile 381 at Celina, Tennessee.
- To provide a series of lake impoundments for the recreational enjoyment of the general public.
- To maintain a minimum reservoir level to offset lake sedimentation, to sustain adequate depths of cover for water supply intakes, to maintain permanent habitat for fish, and to reserve water for severe drought emergencies.

- To provide a sufficient flow of water in the system to enhance water quality for public consumption and aquatic life, and to maintain the availability of water for municipal and industrial users.

Figure 1

Cumberland River Basin Reservoir System



1.2.2. The ability to meet these operating objectives will be challenged by the impacts that these pool restriction requirements will impart on the system. Real-time reservoir system management requires a great deal of judgment in operation. It is recognized that the demands of water resource management are at times conflicting and the water control manager must have some degree of operational flexibility. Depending on the objectives of reservoir operations, the ten multipurpose projects in the Cumberland River Basin can be considered to operate as a unified system, as sub groups of the system, or as individual projects. This plan will outline how project and system operations may be impacted during this period of pool restrictions. The actual system operations will reflect how rainfall, temperature, and other outside influences have altered the water management capabilities of the Cumberland Basin Reservoir System.

1.2.3. The Cumberland River Basin receives an average of 51.64 inches of rainfall per year. Likewise, the average observed runoff generated by this rainfall is 21.82 inches. As noted in Table 1, rainfall and runoff are not evenly distributed over the course of a year.

Table 1

Average Rainfall and Runoff
For the Cumberland River Basin

Month	Rainfall (inches)	Runoff (inches)
January	4.75	3.47
February	4.30	3.43
March	5.75	4.07
April	4.61	2.84
May	4.52	1.87
June	4.18	0.93
July	4.45	0.67
August	3.70	0.47
September	3.75	0.38
October	2.80	0.34
November	4.08	1.07
December	4.75	2.28
TOTAL	51.64	21.82

1.2.4. It is this uneven distribution of runoff that has lead to the current reservoir system operation. Runoff is captured during the late winter and spring in the tributary storage projects (Wolf Creek, Dale Hollow, and Center Hill) and subsequently released during the typically dry summer and fall. Wolf Creek and Center Hill are the two largest storage projects in the Cumberland system. The 2007 pool restrictions will reduce the volume of water in storage by almost two-thirds. Environmental and water resources development within the Cumberland River Basin is dependent on the storage of a large volume of cold water at these projects. Water supply, water quality, fish and wildlife, operation of fossil fuel plants, recreation, and navigation are being impacted by these pool restrictions. The reservoir system will continue to be operated to provide flood control benefits, but the manner in which that is done will also change. Of the ten multipurpose projects within the Cumberland River Basin Reservoir System, Martins Fork will be the only project not impacted by these operating restrictions.

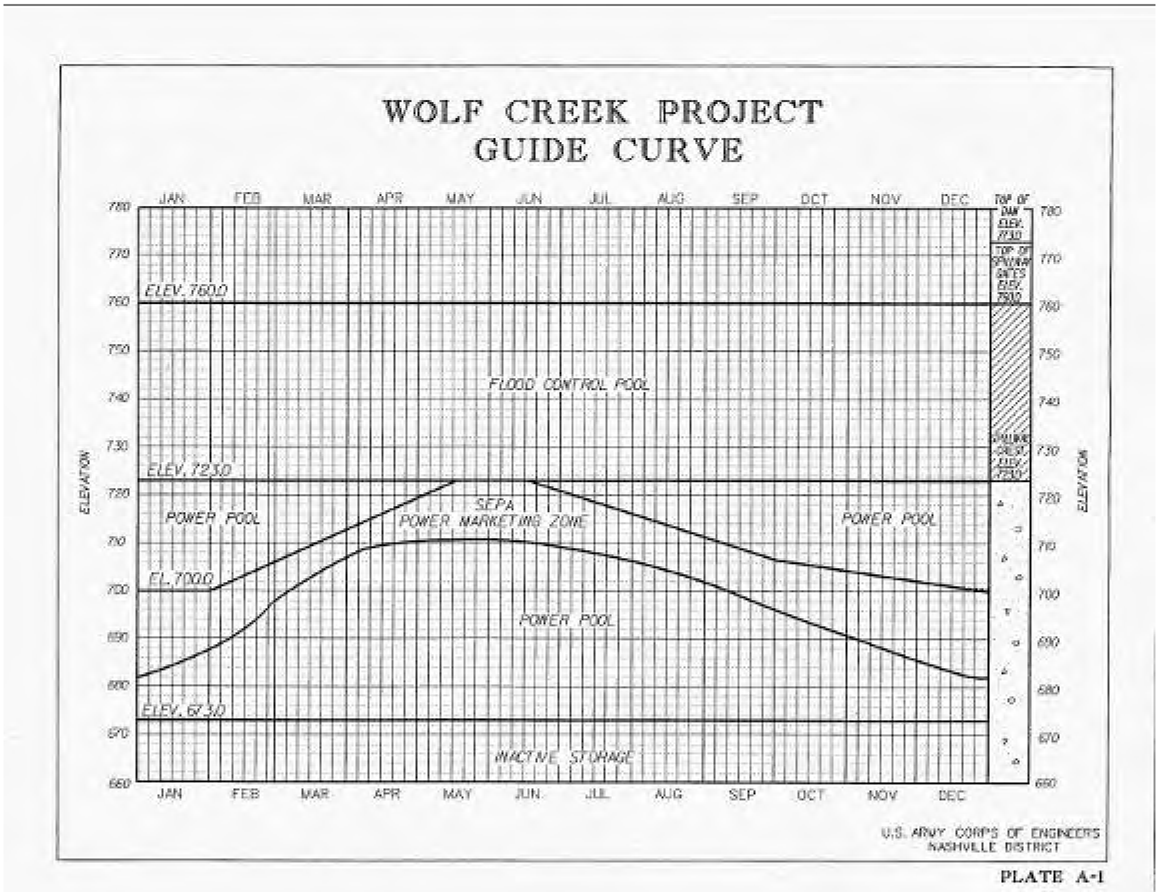
1.3. Wolf Creek.

1.3.1. Wolf Creek Dam was authorized by the Flood Control Act of 1938 and the River and Harbor Act of 1946 to provide flood control and hydropower benefits. Wolf Creek Dam is located on the Cumberland River at mile 460.9. The last of six 45-MW hydropower units was brought on line in August 1952. In addition to its originally authorized project purposes, the Wolf Creek project provides water supply, water quality, recreation, fish and wildlife, and drought mitigation benefits to the region. Wolf Creek has a drainage area of 5,789 mi^2, making it the largest tributary storage project within the Cumberland River Basin System. Lake Cumberland has an average depth of 80 ft and an average discharge of about 9,000 cfs. Wolf Creek is operated as part of the overall

Cumberland River Basin Reservoir System according to an established guide curve. See Figure 2.

Figure 2

Wolf Creek Project Guide Curve



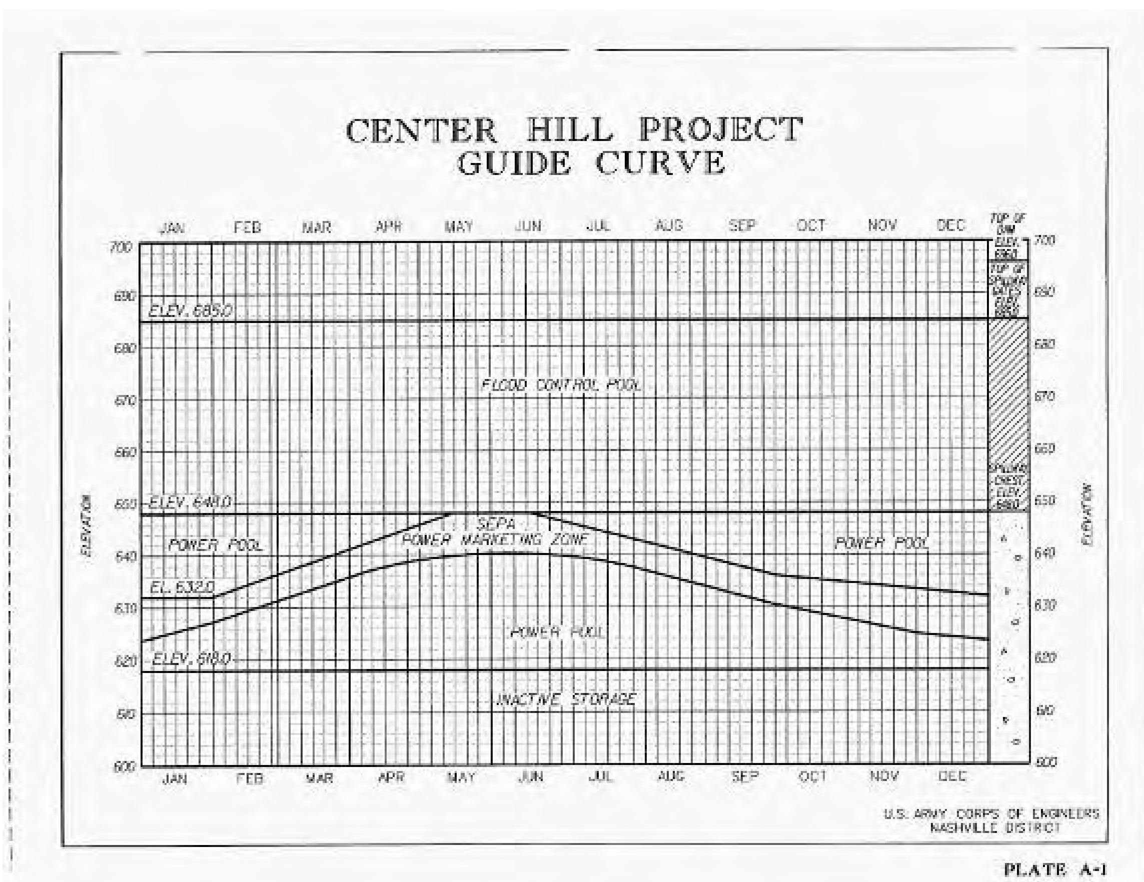
1.3.2. The hydropower pool extends from the top of the conservation pool elevation of 673 ft National Geodetic Vertical Datum (NGVD) of 1929 to elevation 723 ft. The flood control pool extends from 723 ft to 760 ft. The pool of record occurred in May 1984 when the lake reached elevation 751.7 ft. There is a seasonal operating guide within the power pool known as the SEPA power marketing zone. This operating zone was developed by SEPA, working closely with representatives from the Tennessee Valley Authority (TVA) and the CE. The SEPA power marketing zone starts the year low in the power pool, fills through the spring reaching the top of the power pool by summer, and then gradually falls through the summer and fall in time for the flood season. This is a non-binding operating guide that maximizes hydropower benefits while also supporting flood risk management, water quality, navigation, and other downstream uses dependent on the release of stored water through the summer and fall. The normal operation at Wolf Creek is to favor the top of the SEPA power marketing zone, targeting a June 1 elevation of 723 ft. The 2007 risk reduction measure for Wolf Creek Dam is to target a year-round elevation of 680 ft. This operation will reduce the volume of water stored in the hydropower pool by about 1,885,000 acre-feet (88.0%), and will severely impact both project specific and system operations.

1.4. Center Hill.

1.4.1. Center Hill Dam was authorized by the Flood Control Act of 1938 and the River and Harbor Act of 1946 to provide flood control and hydropower benefits. Center Hill Dam is located on the Caney Fork River at mile 26.6. The last of three 45-MW hydropower units was brought on line in April 1951. In addition to its originally authorized project purposes, the Center Hill project provides water supply, water quality, recreation, fish and wildlife, and drought mitigation benefits to the region. Center Hill has a drainage area of 2,174 mi^2, making it second only to Wolf Creek in terms of flood risk management capability. Center Hill Lake has an average depth of 73 ft and an average discharge of about 3,800 cfs. Center Hill is operated as part of the overall Cumberland River Basin Reservoir System according to an established guide curve. See Figure 3.

Figure 3

Center Hill Project Guide Curve



1.4.2. The hydropower pool extends from the top of the conservation pool elevation of 618 ft up to elevation 648 ft. The flood control pool extends from 648 ft up to 685 ft. The pool of record occurred in May 1984 when the lake reached elevation 681.5 ft. Within the power pool, the SEPA power marketing zone starts the year low in the power pool, fills through the spring reaching the top of the power pool by summer, and then gradually falls through the summer and fall in time for the flood season. This is a non-binding operating guide that maximizes hydropower benefits while also supporting flood risk management, water quality, navigation, and other downstream uses dependent on the release of stored water through the summer and fall. The normal operation at Center Hill is to favor the top of the SEPA power marketing zone, targeting a June 1 elevation of 648 ft. The 2007 risk reduction measure for Center Hill Dam is to follow the lower band of this zone, thus targeting a June 1 elevation of 640.6 ft. This operation will reduce the volume of water in storage by about 131,000 acre-feet (26.6%), but will retain some operational flexibility to support project and downstream water management objectives.

1.5. National Environmental Policy Act (NEPA) Considerations.

1.5.1 The CE is preparing Draft Environmental Impact Statements (DEIS) to address operational changes at Wolf Creek Dam and Center Hill Dam. The two DEIS are necessary to provide NEPA compliance to address changes that could include, but are not limited to, water quality, aquatic, riparian, and terrestrial habitat, recreation, water supply, flood storage, economics, hydropower production, and safety as a result of operating Lake Cumberland (Wolf Creek) and Center Hill Lake below normal pool elevations for extended periods of time. NEPA requires that prior to making any decision that would entail any irreversible and irretrievable commitment of resources, a Federal agency shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved, and shall solicit public input and comment. Notices of Intent have been issued for both projects to initiate the NEPA process.

2. System Operations

2.1 Drought Contingency Planning.

2.1.1 The pool restrictions at Wolf Creek and Center Hill have the effect of placing the Cumberland River Basin Reservoir System in a severe hydrologic drought. In fact, flow conditions will be more limited than any seen during operation of the developed reservoir system. From early 1985 through most of 1988, the Cumberland Basin experienced a severe drought; however, even in 1988 during the fourth year of that drought Lake Cumberland was filled to an elevation of 711.77 ft, about 32 ft higher than the 2007 criteria. Likewise, in 1988 Center Hill was filled to elevation 642.34 ft, about two feet above the bottom of the SEPA power marketing zone. The CE applied lessons learned from the 1985-1988 drought to develop an operating policy for drought conditions. The final product of this evaluation was the Cumberland River Basin

Drought Contingency Plan, published in November 1994. Prior to the drought in the 1980s there was not an effective drought contingency plan in place, making system operations during the drought problematic and often contentious. The 1994 drought contingency plan, coupled with recommendations developed in this plan, will form the basis for how the Cumberland River Basin Reservoir System will be operated during these pool restrictions. The established system regulation priorities are as follows.

1. Water Supply
2. Water Quality
3. Navigation
4. Hydropower
5. Recreation

2.1.2. These priorities are consistent with the logic that led to development of the pool restrictions where public health and safety was the overall guiding principle. In fact, dam safety and flood risk management considerations over-ride any other operating objectives. Otherwise, each of the operating objectives will be addressed both individually and from a system perspective. Because the pool restrictions impact the entire Cumberland River system, it will be necessary to have control points to monitor the effectiveness of the system operating plan.

2.2. Control Points. While it is desirable to develop overall water management objectives, it is not practical to apply fixed operating rules. The day to day reservoir system operations will be highly dependent on meteorological conditions, specifically the amount and distribution of rainfall and observed air temperature. System conditions will be evaluated on a daily basis and a forecast will be developed consistent with the overall system operating objectives. The existing precipitation, stream flow, and water quality remote monitoring network is designed for routine system operations. It will be supplemented as necessary to collect the information needed to develop the best possible forecasts. A number of Cumberland River Basin control points have been identified that will serve as overall guides for system operations. The system will be managed for these control points through application of the system priorities contained within the drought contingency plan. It is anticipated that these control points will be dynamic in nature, with one or more factors influencing system operations at any given time. It will remain imperative that water managers retain a reasonable degree of flexibility to be able to react to changing conditions. The Cumberland Basin control points are as follows (presented from upstream to downstream):

- John Sherman Cooper Power Plant
    - Maintain adequate supply of cooling water
- Lake Cumberland municipal and industrial water supply intakes
    - Maintain adequate pool level (680 ft)
- Lake Cumberland cold water budget
    - Protect coldwater fisheries in lake and tailwater
    - Project release objective: 6 mg/l dissolved oxygen
- Wolf Creek National Fish Hatchery

- Provide continuous supply of cold water

- Cumberland County, KY and Burkesville, KY water supply
  - Provide 500 cfs minimum mean daily release from Wolf Creek
- Dale Hollow cold water budget
  - Protect coldwater fisheries in lake and tailwater
- Cordell Hull project releases
  - Project release objective: 5 mg/l dissolved oxygen
  - Schedule releases to support navigation below Cordell Hull
  - Schedule releases to support TVA Gallatin Fossil Fuel Plant
- Center Hill cold water budget
  - Protect coldwater fisheries in lake and tailwater
  - Project release objective: 6 mg/l dissolved oxygen
  - Schedule releases to support TVA Gallatin Fossil Fuel Plant
- TVA Gallatin Fossil Fuel Plant
  - Provide cooling water flow – 1,300 cfs
  - Threshold temperature – 24.4 ^{o}C (76 ^{o}F)
- Old Hickory project releases
  - Project release objective: 5 mg/l dissolved oxygen
  - Schedule releases to support navigation below Old Hickory
- J. Percy Priest project releases
  - Project release objective: 5 mg/l dissolved oxygen
- Cheatham project releases
  - Project release objective: 5 mg/l dissolved oxygen
  - Schedule releases to support navigation below Cheatham
  - Schedule releases to support TVA Cumberland Fossil Fuel Plant
- TVA Cumberland Fossil Fuel Plant
  - Provide cooling water flow – 4,000 cfs
  - Threshold temperature – 29.4 ^{o}C (85 ^{o}F)
- Barkley Canal
  - Manage Canal flows to support TVA Cumberland operations
- Barkley and Kentucky project releases
  - Project release objective: 5 mg/l dissolved oxygen
  - Schedule releases to support navigation below Kentucky and Barkley
  - Ohio & Mississippi River flood risk management operations
  - Ohio & Mississippi River navigation concerns

2.3. Water Supply.

2.3.1. Lake Cumberland Municipal and Industrial Water Supply Users. The system will be operated to maintain a reliable and usable supply of water for both municipal and industrial users as hydrometeorological conditions permit. There are several municipal and industrial water supply users on Lake Cumberland with intakes located between the bottom of the power pool (673 ft) and the 2007 target elevation of 680 ft.

2.3.2. <u>John Sherman Cooper Power Plant.</u> The most vulnerable of these intakes is the one for the John Sherman Cooper Power Plant positioned at elevation 675 ft. This facility, that supplies power to over one million customers in Kentucky, experiences substantial reduction in megawatt production, depending on the water temperature in Lake Cumberland, at elevation 680 ft. Additional derates would be required for lake elevations below 680 ft. Once the lake elevation decreases to 675 ft John Sherman Cooper would be unable to generate power.

2.3.2. <u>Cumberland County, KY and</u> <u>Burkesville, KY Water Supply Intakes.</u> Burkesville, Kentucky and adjacent areas within Cumberland County represent the first concentrated population centers downstream from Wolf Creek Dam. They withdraw water directly from the Cumberland River about 30-40 miles downstream from Wolf Creek Dam. Recently completed HEC-RAS modeling of this reach of the Cumberland River indicates that a minimum mean daily flow of around 500 cfs from Wolf Creek Dam will provide adequate water depth for these intakes. This flow is also supportive of downstream environmental requirements. The minimum mean daily flow from Wolf Creek Dam during normal operating conditions is 1,800 cfs.

2.3.3. A review of the historical record of inflows to Lake Cumberland indicates that flows often get very low during the June through November period. See Table 2. The long term (1953 – 2006) minimum monthly inflow for the months of July, August, September, October, and November are all negative, indicating that evaporation from the lake surface exceeded inflow from the tributary streams. As a result it may be problematic to maintain a 680 elevation in Lake Cumberland during periods of low inflow and high evaporation. Beginning in December, inflows begin to increase significantly due to the increased frequency of rainfall events, making it much easier to meet various operating objectives.

Table 2
Wolf Creek Project Inflow 1953 – 2006

Month	**Minimum (Daily Avg. CFS)**	**Maximum (Daily Avg. CFS)**	**Mean (Daily Avg. CFS)**	**Median (Daily Avg. CFS)**
January	721	41,592	15,409	14,770
February	3,417	50,760	17,798	15,887
March	5,763	54,764	18,989	15,378
April	1,883	34,603	14,683	13,685
May	2,182	37,601	9,368	7,019
June	108	20,730	5,240	3,256
July	-20	16,945	2,916	2,364
August	-182	10,652	1,863	1,127
September	-258	15,212	1,951	630
October	-266	17,780	1,960	1,027
November	-126	20,198	5,831	4,406
December	201	41,922	12,230	11,233

2.3.4. Center Hill Municipal and Industrial Water Supply Users. There are three water supply intakes on Center Hill. They are all located below the bottom of the power pool; therefore, an operational scenario where the target guide curve is to follow the bottom of the SEPA power marketing zone will not impact their operation. The Smith County Utility District has an intake on the Caney Fork River about 19 miles downstream from Center Hill Dam. With the seasonal storage provided by the SEPA power marketing zone there will not be any quantity related issues with this utility. This has been confirmed by HEC-RAS modeling completed for the Caney Fork River. The CE (Center Hill Lake Resource Management) routinely coordinates with staff at the water treatment plant when sluicing operations are initiated at Center Hill so that they can anticipate changes in raw water quality and adjust their treatment accordingly.

2.3.5. Mainstem / Lock and Dam Water Supply Users. There are multiple municipal and industrial water supply intakes along the Cumberland River within the Cordell Hull, Old Hickory, Cheatham, and Barkley pools. There are no plans to lower the headwater operating guidelines for these projects, thus there will be sufficient water available for their continued operation. It is anticipated that there will be changes in the quality of water available for treatment and that treatment costs will go up accordingly. Quality impairments will be a byproduct of reduced flows through the system during the summer and fall. Water users can expect to experience warmer water temperatures, reduced dissolved oxygen levels, increased algal activity with associated taste and odor issues, and increased concentrations of certain metals and nutrients. The reservoir system will be operated to support water quality for water supply to the extent practical given the impacts of the anticipated flow reductions.

2.4. Water Quality.

2.4.1. Water quality impacts may be observed at Wolf Creek and Center Hill as a direct impact of the lower lake levels and/or may occur many miles downstream as a result of release schedule modification. The direct project impacts would be related to changes to the cold water budget.

2.4.2. Water Temperature and Dissolved Oxygen at Wolf Creek. With an operational target of elevation 680 ft (2007 target elevation), Lake Cumberland will begin the summer with a significantly reduced volume of cold water in storage. The coldwater fisheries in the lake, primarily stripers and walleye, are dependent on the maintenance of a zone of cold, oxygenated water. Likewise, the tailwater fishery that includes rainbow and brown trout in addition to striper and walleye is dependent on the release of cold, oxygenated water. If the cumulative project releases through Wolf Creek Dam during the summer exceed the volume of cold water in storage, significant fish die-offs would be expected both in the lake and in the river below the dam. A late spring major storm event or a series of spring or summer storms would increase the likelihood of this happening. The only water management option available for the tailwater at Wolf Creek is to use sluice gate releases in lieu of hydropower releases to provide cold, oxygenated water for the tailwater. Sluicing will conserve the zone of cold water in the lake used by important fish species as long as adequate dissolved oxygen is available. This can be effective up to a point, but once the cold water is gone there is nothing that can be done to protect these fisheries.

2.4.3. Water Temperature and Dissolved Oxygen at Center Hill. Center Hill will face similar cold water budget challenges; however, since the (2007) drawdown there is not as severe as that for Wolf Creek, the risk to these fisheries is less. Sluice gate releases are also a viable option at Center Hill to manage for either lake or tailwater cold water issues.

2.4.4. Water Temperature and Dissolved Oxygen at Dale Hollow. While Dale Hollow does not have any imposed operating restrictions, cold water budget issues could arise due to the increased reliability on water pulled from storage at this project. Dale Hollow also has sluice gates with intakes located deep in the water column that can be used for temperature and/or dissolved oxygen management.

2.4.5. Water Temperature and Dissolved Oxygen at Laurel and J. Percy Priest. The revised operations at Wolf Creek and Center Hill should not have any water quality impacts to either Laurel River Lake or J. Percy Priest Lake. The existing spillway releases for water quality management, pending the availability of water, will continue to be employed at J. Percy Priest as needed for dissolved oxygen, metals, and taste and odor issues observed in the tailwater and at downstream water treatment plants.

2.4.6. Water Temperature and Dissolved Oxygen at Mainstem Projects. Water quality impacts are also expected at the main-stem Cumberland River projects (Cordell Hull, Old Hickory, Cheatham, and Barkley) as a result of the reduced flows moving through the system. The lower flows will increase the hydraulic residence time in each of these projects resulting in warmer water temperatures and lower dissolved oxygen levels. There is little that can be done for temperature since temperature impacts are a direct function of the flow (residence time) through the system and weather conditions. In 2007, with approximately two-thirds of the normal storage eliminated, the summer and fall flow regime will be significantly reduced. The option of releasing water through spillway gates at Cordell Hull, Old Hickory, Cheatham, and Barkley is available to increase dissolved oxygen concentrations. The State Water Quality Standard applicable at each of these projects is a minimum of 5 mg/l.

2.5.6. Based on past experience during drought conditions the Old Hickory project is the most likely main-stem project to experience dissolved oxygen problems. Also, when Lake Cumberland was drawn down in the 1970s for construction of the existing cutoff wall, extremely low dissolved oxygen levels were observed in hydropower releases from Old Hickory.

2.5.7. Prior to 2007, the Nashville District did not have any direct experience of using spillway releases to manage for dissolved oxygen at the main-stem projects. Prior to this year CE reaeration experts at the Waterways Experiment Station indicated that spillway releases are an effective means of aerating project releases. Their recommendation was to spread the flow out over several spillway gates to avoid spilling more than 1,000 cfs through any one gate. CE experience using this release scenario at similar projects has resulted in 85-90% dissolved oxygen saturation and total dissolved gas levels of around 110%. The results to date at projects along the Cumberland River (Cordell Hull, Old Hickory, and Cheatham) have been very favorable. Spillway releases have proven to be an effective method to provide water quality conditions supportive of downstream water treatment and aquatic environment conditions.

2.5.8. TVA operates coal fired power plants at Gallatin and Cumberland City that are dependent on the Cumberland River for cooling water flow. The cooling water for these plants originates in the Cumberland River Basin storage projects (Wolf Creek, Dale Hollow, and Center Hill) during the summer and early fall when natural flows in the Cumberland River are typically very low. Given the elimination of storage at Wolf Creek and the reduction of storage at Center Hill, maintenance of adequate cooling water flow (both quantity and temperature) will become a primary driver for water management operations.

2.5.9. TVA Gallatin Fossil Fuel Plant. The TVA Gallatin Fossil Fuel Plant is located in the Old Hickory pool and is downstream of the three primary storage projects. The cooling water requirement for this facility is 1,300 cfs. The threshold cooling water intake temperature for this facility is 24.4 ^{o}C (76 ^{o}F). The combination of this flow requirement, the physical layout of the intake and discharge structures, and the proximity of the Gallatin plant to upstream cold releases places this facility in a favorable position to maintain reliable service. Water temperature will be the primary concern for this facility.

2.5.10. TVA Cumberland Fossil Fuel Plant. The TVA Cumberland Fossil Fuel Plant, located in the Lake Barkley pool, will be a much bigger challenge with regard to cooling water requirements. Cumberland is significantly larger than Gallatin and has a cooling water requirement of approximately 4,000 cfs and a threshold intake temperature of 29.4 ^{o}C (85 ^{o}F). This plant has a history of cooling water issues during extended hot, dry periods. The plant discharge structure is located close enough to the intake that heated water can recirculate upstream and mix with the Cumberland River flow in the vicinity of the intake. When this occurs the plant must adjust operations to preclude violation of temperature permit requirements. The typical solution for this recirculation issue has been to forego hydropower peaking operations at Cheatham Dam and schedule a steady one unit use throughout the day. This translates to a flow of around 6,300 cfs. However, without the water in storage at the upstream projects there may not be enough water to run a continuous one unit schedule at Cheatham.

2.5.11. A joint TVA/Corps team has been established to work on this issue. TVA has the capability to model temperature impacts to the Lake Barkley project including the immediate TVA Cumberland area. TVA has also made physical modifications to their discharge facility to significantly reduce the amount of heated water from reaching their intake. The cooling water requirements for TVA Cumberland will play an important role in how the Cumberland Basin reservoir system is operated. Water in storage will be conserved to the extent practical during the spring and early summer to save it for use during the critical July, August, and September period. This will be accomplished by only releasing from storage the volume of water necessary to meet flow and temperature requirements at TVA Cumberland.

2.5.12. Wolf Creek and Center Hill will be operated according to the pool restriction criteria. The additional water needed to meet flow requirements will originate from Dale Hollow. This operation could result in higher lake levels than those typically observed in the spring and early summer at Dale Hollow. Likewise, depending on the rainfall pattern fall lake levels at Dale Hollow could be lower than normal.

2.5. Navigation.

2.5.1. A nine-foot commercial navigation channel on the Cumberland River is generally supported by the maintenance of full, flat pools and minimum tailwater elevations at the four main-stem projects. There are navigation impediments in the approaches to both Old Hickory and Cheatham that can effect navigation during low flow conditions. Navigation industry equipment and operations have evolved over time to match observed conditions on the Cumberland River. This includes the decision by some towing companies to run 10-ft draft tugs and to routinely run over-draft (> 9-ft) barges. These practices are due in large part to the water originating from Wolf Creek and Center Hill that augment Cumberland River flows during otherwise low flow periods. Currently, tows are dependent on favorable release schedules to transit reaches below the navigation projects. Their practice is to wait on windows of opportunity to navigate these critical reaches rather than reconfiguring their load to reduce their draft. There will need to be some project release scheduling considerations as well as adjustments by the shipping industry to maintain a reliable commercial navigation pattern during periods of low flow at the navigation projects.

2.5.2. Impacts to Navigation due to Rapid Drawdowns. A rapid drawdown at Wolf Creek and/or Center Hill, followed by severe reductions in discharge, creates abrupt river fluctuations that result in adverse navigation conditions. These adverse conditions extend from the lower approach to Cheatham Lock through the Nashville harbor and into the Old Hickory pool. The lock approaches to Cheatham and Old Hickory along with the main river channel through Nashville are critical areas for commercial navigation. A lower than normal Old Hickory pool elevation has a significant impact to recreational boating, but less of an impact to commercial navigation. Therefore, when lowering Wolf Creek and Center Hill lakes a smooth transition is critical to avoiding navigation impacts downstream.

2.5.3. Impacts to Navigation at Barkley Dam, Kentucky Dam, Ohio River and Mississippi River. Navigation conditions on the Cumberland River at Barkley Lock and Dam and on the lower Ohio River (Lock and Dam 52 and Lock and Dam 53) may be more severely impacted than those upstream along the Cumberland. The Cumberland below Barkley is dependent on either project releases or the Ohio River (Lock and Dam

52 pool) or a combination of both to maintain a minimum tailwater elevation (302) to support navigation. The reduction of storage within the Cumberland system will limit the ability to maintain elevation 302 when Ohio River levels are low. Releases from Barkley and Kentucky are often scheduled to support navigation concerns on the lower Ohio and Mississippi. This capability will be reduced due to the reduction of storage within the Cumberland system and could lead to impaired conditions on the lower Ohio and Mississippi.

2.5.4. The operation of Kentucky and Barkley dams involves complicated and often contradictory issues. Therefore, a predetermined plan to deal with low tailwater levels is not practical. The operational response to navigation conditions when Ohio River levels are low will require coordinated effort between LRD, LRL, LRN, and TVA.

2.6. Hydropower.

2.6.1. Hydropower generated at the Cumberland River Basin plants is marketed by the Southeastern Power Administration (SEPA). In a 1984 Memorandum of Understanding between SEPA, TVA, and the Corps of Engineers minimum weekly energy goals were established. Since that time the CE has an excellent track record of meeting these hydropower goals. See Table 3 for a listing of the minimum energy requirements.

Table 3

Cumberland Basin Projects
Weekly Minimum Energy

Month	**Minimum Energy (MWH)**
January	24,000
February	29,400
March	32,000
April	32,000
May	22,600
June	24,600
July	32,200
August	32,200
September	21,000
October	15,800
November	16,000
December	20,000

2.6.2. Without the water in storage at Wolf Creek and Center Hill it will not be possible to meet these minimum energy goals. The marketing strategy has been revised to reflect only the energy available for production based on water allocations. Power is now marketed on a daily basis instead of a weekly basis. With the loss of storage due to restrictions at Wolf Creek, the Cumberland River basin will begin each summer at threshold level four of the Cumberland River Basin Drought Contingency Plan. Therefore, the priority for hydropower falls below those for water supply, water quality, and navigation. While a significant amount of the releases at the projects will be through generation, the scheduling will be based on the needs of the higher priority purposes. During periods when the conditions permit, more significance will be given to optimizing for hydropower benefits.

2.6.3. An effort will be made at Laurel River Lake to hold higher summer pool elevations (not to exceed elevation 1018 ft) to support operation of the John Sherman Cooper Power Plant. This will require close coordination with SEPA and the East Kentucky Electric Cooperative.

2.7. Recreation.

2.7.1. The recreation impacts at Lake Cumberland and to a lesser extent Center Hill Lake have been well documented. Lake recreation tends to be elevation dependent. The revised operations at these projects coupled with recreation's priority within the operating objectives established in the drought contingency plan, leaves little in the way of operational flexibility to support recreation interests. The lake level at Laurel can be held higher in the summer without significantly impacting other project purposes including system flood risk management capabilities. This operation would have the added benefit of supporting lake based recreation.

2.7.2. Typical seasonal pool elevations will be maintained at the remaining Cumberland Basin projects. Water control actions implemented for water supply and water quality requirements will have the added benefit of supporting fish and aquatic life based recreational pursuits. Minimum daily project releases will continue to be made from the projects where they are required under the existing operating criteria. The relatively low summer and fall releases from Wolf Creek and Center Hill will enhance wade fishing opportunities in their tailwaters.

2.8. Flood Risk Management.

2.8.1. Even though the Cumberland Basin reservoir system will be operated following drought condition guidelines, the basin is never more than one storm event away from initiating flood risk management operations. Flood risk management will continue to be the over-riding priority for system operations.

2.8.2. Although the lower pools targeted at Wolf Creek and Center Hill will actually increase the flood storage capacity of the system, the operation necessary to consistently maintain these lower levels could compromise the flood risk management benefits of the additional storage capacity. Following a significant runoff producing event, priority will be given to Wolf Creek and Center Hill to evacuate water stored above their target elevations. This presents a couple of issues that have the potential to compromise overall system flood risk management capability. First, if a series of events come in close succession, there is the potential to accumulate water in the other projects to a level that impacts system operation. Second, if a follow up event hits the downstream uncontrolled portion of the basin in conjunction with an aggressive release pattern at Wolf Creek and/or Center Hill to reduce their storage, flood crests could be higher than otherwise experienced. This could occur at any of the Cumberland River damage centers (Celina, Carthage, Nashville, and Clarksville) or along the lower Ohio or Mississippi Rivers. The following tables will be used as a guide on how to evacuate storage at Wolf Creek and Center Hill. Downstream impacts will always be a primary consideration when setting release schedules.

Table 4

Guidelines for Evacuating Storage at
Wolf Creek Dam (Lake Cumberland)

Elevation	Criteria
Wolf Creek:	
0 – 3 ft above upper guide curve elevation	Operate for most efficient use of water.
3 – 5 ft above upper guide curve elevation	Ramp up to turbine capacity as necessary to hold within 5 ft of the upper guide curve elevation if downstream conditions permit.
5 – 10 ft above upper guide curve elevation	Generate at turbine capacity to keep within 5 ft of the upper guide curve elevation. If the pool is forecast to exceed the upper guide curve elevation by more than 10 ft supplement flows with sluice gate releases.
10 ft above upper guide curve elevation up to elevation 723	Combination of turbine capacity and sluice gate releases unless downstream conditions require reductions.
> 723	Combination of turbine, sluice, and spillway releases to manage according to established flood risk management criteria. Total flow not to exceed 40,000 cfs. Full coordination with LRD required if Ohio River flooding is ongoing.

Table 5

Guidelines for Evacuating Storage at
Center Hill Lake

Elevation	Criteria
Center Hill:	
0 – 3 ft above upper guide curve elevation	Operate for most efficient use of water.
3 – 5 ft above upper guide curve elevation	Ramp up to turbine capacity as necessary to hold within 5 ft of the upper guide curve elevation if downstream conditions permit.
5 – 10 ft above upper guide curve elevation	Combination of turbine capacity and sluice gate releases unless downstream conditions require reductions. Discharges should be managed to stay within the downstream channel capacity of 30,000 cfs.
10 ft or more above upper guide curve elevation	Combination of turbine, sluice, and spillway releases to manage according to established flood risk management criteria. Total flow in the Caney Fork River not to exceed 30,000 cfs. Full coordination with LRD required if Ohio River flooding is ongoing.

2.9. Operational Modifications at Cumberland Basin Projects in Addition to Wolf Creek and Center Hill.

2.9.1. The pool restrictions at Wolf Creek and Center Hill have the potential to impact operations at nine of the ten Cumberland Basin Projects. Martins Fork is the only project where no impacts are anticipated. For most of the projects the water control variants are more flow than lake level related; however, there will be a conscious effort to target higher pool elevations at some projects. In all cases where higher headwater elevations are targeted this can be done without significantly compromising system flood risk management capabilities.

2.9.2. Laurel. Laurel has an uncontrolled spillway at elevation 1018.5 ft, and does not provide any flood risk management benefits. The top of the SEPA power marketing curve is at elevation 1018 ft. LRN will work closely with SEPA and the East Kentucky Power Electric Cooperative to target early summer lake levels higher than those typically observed (but not to exceed 1018 ft). The purpose of this operation is to support cooling water operations at the John Sherman Cooper Power Plant during the critical summer and early fall period.

2.9.3. Dale Hollow. The top of the power pool at Dale Hollow is elevation 651 ft. LRN will target a 1 June elevation of 653 ft at Dale Hollow, thus placing two feet of water on the spillway gates and reducing the flood control pool by 15.9 %. This water will be conserved to the extent practical to support downstream water supply, water quality, and navigation requirements along the main-stem Cumberland River projects. Given the ratio of project storage to drainage area, Dale Hollow will be very difficult to overfill under dry conditions (when the extra water would be the most valuable).

2.9.4. Mainstem Lock and Dams. A concerted effort will be made to hold the Cumberland River main-stem projects (Cordell Hull, Old Hickory, Cheatham, and Barkley) near the top to slightly over the top of the stated power pools when possible. The Cumberland River is flashy in nature; a condition that will be amplified due to the run of the river run operations adopted at Wolf Creek. This has the potential to create dramatic (relative to normal operations) swings in elevation along the navigable stretch of the Cumberland River. The maintenance of favorable conditions for commercial navigation is particularly vulnerable to sudden reductions in flow such as those created by operating for a fixed elevation at Wolf Creek. Since the overall dynamics of the main-stem system are difficult to predict under transitional flow regimes, this added water will be used as a buffer when conditions require.

2.9.5. Cordell Hull. The fill to summer pool at Cordell Hull may require additional time and thus needs to begin earlier in order to capture water when available while still passing enough flow to meet downstream requirements. When necessary, the early fill will start at the beginning of April instead of the middle of the month. It may also be necessary to fill Barkley and Kentucky pools early; however, that is a joint decision between LRD, LRN, and TVA since it involves three separate river systems.

3. Communication and Coordination

3.1. Nashville District Water Management. The Nashville District Water Management Office coordinates daily with LRD Water Management, TVA River Operations, SEPA, National Weather Service, LRN Power Plant Operators, and members of the public. Automated data exchange procedures are in place with water management partners and stakeholders. The water management impacts of the revised Wolf Creek and Center Hill operations will require increased communication and coordination efforts in terms of the addition of individuals and groups and also to the frequency of information exchange. The following table summarizes stakeholders, organized by prioritized project purpose, that LRN Water Management has been in contact with since the pool restrictions were announced. This list is considered dynamic in nature and will be supplemented as this process evolves.

Table 6

Water Management Customers
Organized by
Drought Contingency Plan Prioritized Purpose

Agency or Group	Issue
Water Supply:	
Lake Cumberland water supply users	Impacts of lake level on water supply intakes.
Kentucky Division of Water (KDOW)	Water quality impacts to water supply.
City of Burkesville	Low flow impact to raw water intake.
Tennessee Department of Environment and Conservation (TDEC)	Water quality impacts to water supply.
Tennessee Wildlife Resources Agency (TWRA)	Water quality impacts of flow modifications to fish and aquatic resources.
East Kentucky Power Cooperative (EKPC)	Cooling water at John Sherman Cooper Power Plant.
TVA Fossil Fuel Plants	Cooling water at Gallatin and Cumberland.
TVA Environmental Compliance	Cooling water at Gallatin and Cumberland.
Metro Nashville	Water quality impacts to water supply.
Water Quality:	
Kentucky Department of Fish and Wildlife Resources (KDFWR)	Impacts to the coldwater budget in Lake Cumberland and the river below.
Kentucky Division of Water (KDOW)	Impacts to the coldwater budget in Lake Cumberland and the river below.
U. S. Fish & Wildlife Wolf Creek National Fish Hatchery (USFWS)	Supply of cold water to the Wolf Creek National Fish Hatchery.
Tennessee Department of Environment and Conservation (TDEC)	Impacts to the Cumberland River impoundments in Tennessee.
Tennessee Wildlife Resources Agency (TWRA)	Fishery impacts at Center Hill and Cumberland River projects and impacts to native mussels in Cumberland River.
Metro Nashville	Impacts of water quality changes to wastewater treatment plant operations.
Trout Unlimited (TU)	Impacts to cold water fisheries.
Ohio Valley Fly Rod Club	Impacts to cold water fisheries.
Navigation:	
U. S. Coast Guard	Impacts to commercial navigation resulting

	from reduced flows in the system.
Navigation Industry	Impacts to commercial navigation resulting from reduced flows in the system.
Hydropower:	
Southeastern Power Administration (SEPA)	Impacts to power marketing agreements.
TVA River Operations	Impact of revised system operations on hydropower production.
TVA Power Scheduling	Hourly scheduling of hydropower.
East Kentucky Power Cooperative (EKPC)	Hydropower scheduling at Laurel River Lake.
Team Cumberland	Impact of revised system operations on hydropower production.
Recreation:	
Kentucky Department of Fish and Wildlife Resources (KDFWR)	Impact of Wolf Creek drawdown on fishing and boating opportunities.
Tennessee Wildlife Resources Agency (TWRA)	Impact of Wolf Creek and Center Hill drawdowns on fishing and boating opportunities.
Marina Operators	Impact of lake level revisions on marina operations.
Trout Unlimited (TU)	Impacts to cold water fisheries.
Ohio Valley Fly Rod Club	Impacts to cold water fisheries.
Middle Tennessee Amateur Retriever Club	Impact of pool restrictions on system operations.
Commercial Fishermen	Impact of pool restrictions on system operations.

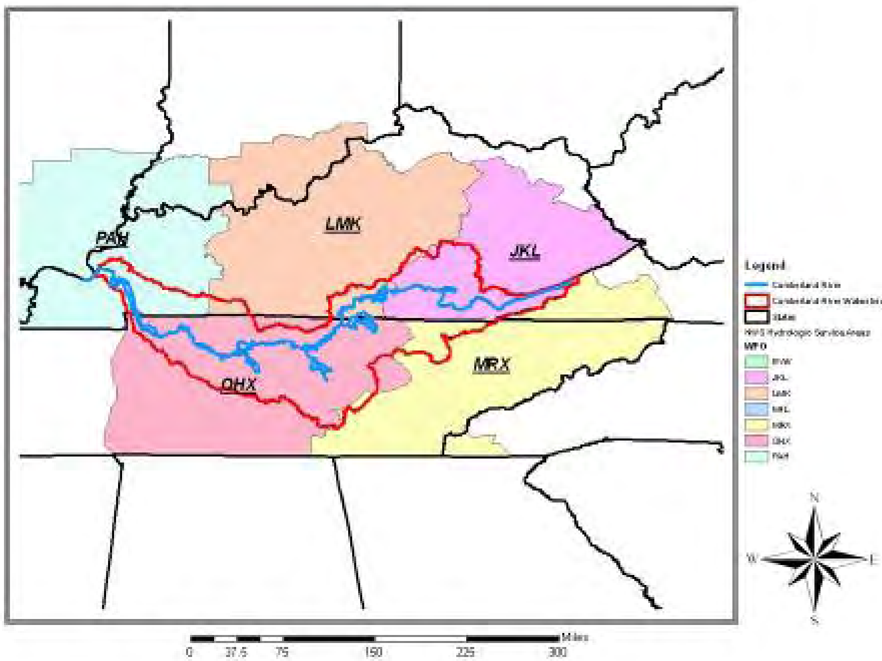
3.2. National Weather Service Coordination.

3.2.1. CE partners closely with the National Weather Service (NWS) and provides the agency with daily river and reservoir observations (flow and stage) and reservoir release schedules. The observations and reservoir release schedules are integral to the production of the NWS hydrologic forecasts. This information is transmitted daily from the Nashville District (and the other Ohio River District offices) in automated SHEF-encoded reports to the Division office (LRD) located in Cincinnati, Ohio. Data is then exchanged with the NWS Ohio River Forecast Center (OHRFC) in Wilmington, Ohio via a dedicated communication line.

3.2.2. The OHRFC has the primary responsibility for producing and disseminating stage and flow forecasts of the Ohio River and its tributaries. The OHRFC provides the forecasts to local Weather Forecast Offices by hydrologic service area

(HSA) for the issuance of flood watches and warnings to the public. Four HSAs primarily encompass the Cumberland River System. The service areas and river system are shown in Figure 4.

Figure 4
National Weather Service
Hydrologic Service Areas



3.2.3. During flood events on the lower Ohio and Mississippi Rivers, LRD communicates closely with the OHRFC and two other RFCs, the Lower Mississippi River Forecast Center (LMRFC) and the North Central River Forecast Center (NCRFC). The junction point for this delineation is located at Dover, TN, approximately Cumberland River Mile 89. Under Section 7 of the Flood Control Act of 1944, LRD directs the operations of Nashville District's Lake Barkley, and the Tennessee Valley Authority's Kentucky Lake, to reduce flood crests with the primary objective of preserving and protecting the Mississippi River levee system. LRD communicates closely with the RFCs in the production of the public river forecasts.

3.2.4. During the interim period, established data flow and communication procedures will continue. However, if the Wolf Creek release schedule should significantly change after the normal transmission time to LRD, the reservoir scheduler should inform LRD Water Management. If LRD cannot be reached, the Ohio River Forecast Center should be contacted directly. See Table 6 below for information for the various water control centers associated with Cumberland River Basin system operations.

Table 7

Water Control Centers

Office	Office Phone and Hours	Non-Duty Phone
LRD Water Management	(###) ###-#### 7:00 a.m. – 4:00 p.m.	(###) ###-####
LRN Water Management	(###) ###-#### 7:30 a.m. – 4:00 p.m.	(###) ###-####
TVA River Operations	(###) ###-#### 24-hour operation	(###) ###-####
Ohio River Forecast Center	(###) ###-#### 6:00 a.m. – 10:00 p.m.	(###) ###-####
Lower Mississippi River Forecast Center	(###) ###-#### 6:00 a.m. – 10:00 p.m.	

3.2.5. During flooding on the Cumberland System, LRN Water Management should maintain close contact with LRD Water Management, the NWS Ohio River Forecast Center, and the NWS Service Hydrologists for the four HSAs to keep all informed as to the flood control strategy. Should the strategy significantly change during the day invalidating the NWS publicly issued forecasts, LRN Water Management should notify the Service Hydrologists in addition to LRD and the OHRFC. NWS contact information is presented in Table 7.

Table 8

Contact Information for the
National Weather Service

Hydrologic Service Area	Service Hydrologist or Focal Point	Office Phone	Operations Desk Phone (24 x7)
LMK	**********, Louisville, KY WFO	(###) ###-####	(###) ###-####
JKL	********** Jackson, KY WFO	(###) ###-####	(###) ###-####
OHX	********** Nashville, TN WFO	(###) ###-####	(###) ###-####
PAH	********** Paducah, KY WFO	(###) ###-####	(###) ###-####
LCH	********** Slidell, LA WFO	(###) ###-####	(###) ###-####

3.2.6. When a lower Ohio flood control operation is in effect, decisions regarding Wolf Creek releases and other Cumberland System reservoirs must be coordinated with LRD Water Management to ensure that all system regulation objectives are met to the extent possible. This coordination must take place before Wolf Creek release decisions are effected, unless under conditions of imminent dam failure. This coordination should occur during the regularly scheduled flood coordination call at 8:30 a.m. Eastern time (7:30 a.m. Central) between LRD and LRN. In the event of an imminent dam failure, communication procedures as specified in the Wolf Creek Dam Emergency Operations plan are followed. A multi-agency phone list is presented in Table 9.

Table 9

Water Management Phone List

Position	Name	Office	Home
LRN Water Management:			
Chief, H&H Branch	**********	(###) ###-####	(###) ###-####
Chief, Water Management	**********	(###) ###-####	(###) ###-####
Senior Forecaster	**********	(###) ###-####	(###) ###-####
Senior Forecaster	**********	(###) ###-####	(###) ###-####
Data Management	**********	(###) ###-####	(###) ###-####
Data Management	**********	(###) ###-####	(###) ###-####
Modeler	**********	(###) ###-####	(###) ###-####
Modeler	**********	(###) ###-####	(###) ###-####
Stream Gauging	**********	(###) ###-####	(###) ###-####
Biologist	**********	(###) ###-####	(###) ###-####
Chemist	**********	(###) ###-####	(###) ###-####
LRN Offices:			
District Engineer	**********	(###) ###-####	
LRN DPM	**********	(###) ###-####	
OC – Chief	**********	(###) ###-####	
OC - Environmental	**********	(###) ###-####	
NEPA Coordination	**********	(###) ###-####	
Chief, EC Division	**********	(###) ###-####	
Chief, Civil Design Branch	**********	(###) ###-####	
Dam Safety Coordinator	**********	(###) ###-####	
Chief, Operations Division	**********	(###) ###-####	
Chief, Hydropower Branch	**********	(###) ###-####	
Chief, Navigation Branch	**********	(###) ###-####	
Chief, Natural Resources	**********	(###) ###-####	
WOL Project Manager	**********	(###) ###-####	
CEN Project Manager	**********	(###) ###-####	
Chief, Public Affairs	**********	(###) ###-####	
East Kentucky OM	**********	(###) ###-####	
EKY Power Plant Manager	**********	(###) ###-####	
WOL/P Superintendent	**********	(###) ###-####	
WOL/P Control Room	**********	(###) ###-####	
WOL/R Resource Manager	**********	(###) ###-####	
LAU/P Superintendent	**********	(###) ###-####	
LAU/R Resource Manager	**********	(###) ###-####	
Mid Cumberland OM	**********	(###) ###-####	
MCA Power Plant Manager	**********	(###) ###-####	
DAL/P Superintendent	**********	(###) ###-####	

DAL/P Control Room	**********	(###) ###-####	
DAL/R Resource Manager	**********	(###) ###-####	
COR/P Superintendent	**********	(###) ###-####	
COR/P Control Room	**********	(###) ###-####	
COR/L Lock Master	**********	(###) ###-####	
COR/R Resource Manager	**********	(###) ###-####	
CEN/P Superintendent	**********	(###) ###-####	
CEN/R Resource Manager	**********	(###) ###-####	
Nashville Area OM	**********	(###) ###-####	
NAS Power Plant Manager	**********	(###) ###-####	
OLD/P Superintendent	**********	(###) ###-####	
OLD/P Control Room	**********	(###) ###-####	
OLD/L Lock Master	**********	(###) ###-####	
OLD/R Resource Manager	**********	(###) ###-####	
JPP/R Resource Manager	**********	(###) ###-####	
CHE/P Superintendent	**********	(###) ###-####	
CHE/L Lock Master	**********	(###) ###-####	
CHE/R Resource Manager	**********	(###) ###-####	
West Kentucky OM	**********	(###) ###-####	
WKY Power Plant Manager	**********	(###) ###-####	
BAR/P Superintendent	**********	(###) ###-####	
BAR/P Control Room	**********	(###) ###-####	
BAR/L Lock Master	**********	(###) ###-####	
BAR/R Resource Manager	**********	(###) ###-####	
KY Lock Resident Engineer	**********	(###) ###-####	
KY Lock Field Office	**********	(###) ###-####	
KY/L Lock Master	**********	(###) ###-####	
WOL Resident Engineer	**********	(###) ###-####	
WOL Field Office	**********	(###) ###-####	
CEN Resident Engineer	**********	(###) ###-####	
CEN Field Office	**********	(###) ###-####	
LRD Offices:			
Division Engineer	**********	(###) ###-####	
Deputy Division Engineer	**********	(###) ###-####	
Chief, Water Management	**********	(###) ###-####	(###) ###-####
Senior Hydraulic Engineer	**********	(###) ###-####	(###) ###-####
Regional WCDS Manager	**********	(###) ###-####	(###) ###-####
Hydraulic Engineer	**********	(###) ###-####	
Hydraulic Engineer	**********	(###) ###-####	
IM Specialist	**********	(###) ###-####	
OC – NEPA	**********	(###) ###-####	
Dam Safety Coordinator	**********	(###) ###-####	
Environmental Business Line	**********	(###) ###-####	

HQ Offices:			
H&H COP	**********	(###) ###-####	
Water Quality	**********	(###) ###-####	
LRD RIT	**********	(###) ###-####	
HQ UOC	**********	(###) ###-####	
TVA Offices:			
Knoxville:			
Manager River Forecasting	**********	(###) ###-####	
Lead Engineer Assignment	**********	(###) ###-####	
Preschedule Assignment	**********	(###) ###-####	
Hydrothermal Modeling	**********	(###) ###-####	
Navigation	**********	(###) ###-####	
Chattanooga:			
Daily Scheduling	**********	(###) ###-####	
Environmental Compliance	**********	(###) ###-####	
Gallatin Fossil Plant:			
Plant Manager	**********	(###) ###-####	
Navigation/Coal Handling	**********	(###) ###-####	
Engineering Manager	**********	(###) ###-####	
Cumberland Fossil Plant:			
Environmental Specialist	**********	(###) ###-####	
Engineering Manager	**********	(###) ###-####	
Plant Operations	**********	(###) ###-####	
National Weather Service			
ORFC Service Hydrologist	**********	(###) ###-####	
LMK Service Hydrologist	**********	(###) ###-####	
JKL Service Hydrologist	**********	(###) ###-####	
OHX Service Hydrologist	**********	(###) ###-####	
PAH Service Hydrologist	**********	(###) ###-####	
Power:			
SEPA Hourly Scheduling	**********	(###) ###-####	
SEPA System Operations	**********	(###) ###-####	
SEPA Operations Center	**********	(###) ###-####	
Sherman Cooper Power	**********	(###) ###-####	
Navigation:			
Coast Guard – Paducah	**********	(###) ###-####	
Coast Guard – Nashville	**********	(###) ###-####	
LRL–Chief, Operations	**********	(###) ###-####	
LRL–Chief, Tech Support	**********	(###) ###-####	
LRL-Chief, Maintenance	**********	(###) ###-####	
LRL-L/D 52 Project Manager	**********	(###) ###-####	

LRL-Operations Manager	**********	(###) ###-####	
Smithland Lock Master	**********	(###) ###-####	
L&D 52 Lock Master	**********	(###) ###-####	
L&D 53 Lock Master	**********	(###) ###-####	
Water Quality:			
USFWS (Cookeville)	**********	(###) ###-####	
KDOW – Technical Manager	**********	(###) ###-####	
KDOW – Water Sampling	**********	(###) ###-####	
KDFWR – Water Quality	**********	(###) ###-####	
TDEC – Technical Manager	**********	(###) ###-####	
TDEC – Permits	**********	(###) ###-####	
TWRA – Technical Manager	**********	(###) ###-####	
Fish & Wildlife:			
USFWS – Regional Manager	**********	(###) ###-####	
USFWS – WOL Hatchery	**********	(###) ###-####	
USFWS – DAL Hatchery	**********	(###) ###-####	
KDFWR – Fisheries Director	**********	(###) ###-####	
KDFWR – Trout Coordinator	**********	(###) ###-####	
KDFWR – Regional Biologist	**********	(###) ###-####	
TWRA – Fisheries Director	**********	(###) ###-####	
TWRA – Trout Coordinator	**********	(###) ###-####	
TWRA – Regional Biologist	**********	(###) ###-####	

3.3. Decision Making Protocol. The intended purpose of this interim operating plan is to identify potential water management conflicts and outline how the Cumberland River Basin reservoir system would be operated to best address these issues. It is not reasonable to expect, given the inherent uncertainty associated with weather and related hydrologic conditions, that specific water control decisions can be made well in advance. Rather, this plan will provide LRN Water Management with an approved operational guide from which day to day water control decisions can be made. When water becomes short and water management actions become particularly contentious it may become necessary to elevate certain decisions. This will be done through application of existing protocol where established chain of command is followed. The nature of water management is that decisions have to be made quickly. There simply isn't the luxury of time in many scenarios. Whenever LRN Water Management recognizes or otherwise is made aware of the sensitive nature of certain water control actions they will concurrently raise the issue to LRN Senior Staff and LRD Water Management (for coordination with LRD Senior Staff) for resolution. LRN Water Management will serve in an advisory, information providing role to support the decision making process. Once the decision is made LRN Water Management will be tasked with its implementation and subsequent tracking and evaluation.

4. References

Cumberland River Basin Master Water Control Reference Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1990.

Cumberland River Basin Master Water Control Plan. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Barkley Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Cheatham Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Old Hickory Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Cordell Hull Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin J. Percy Priest Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Center Hill Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Dale Hollow Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Wolf Creek Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Laurel Water Control Manual. U.S. Army Corps of Engineers Nashville District. Nashville, 1998.

Cumberland River Basin Drought Contingency Plan. U.S. Army Corps of Engineers Nashville District. Nashville, 1994.

Memorandum of Understanding (Operating Agreement) Between Corps of Engineers, U.S. Army, Tennessee Valley Authority, and Southeastern Power Administration, Department of Energy, With Respect to Operations of the Cumberland System Projects. 1984.

Amended and Restated Agreement executed by The United States of America Department of Energy acting through the Southeastern Power Administration and Tennessee Valley Authority and Tennessee Valley Public Power Association. 1997.