Savannah River Basin Drought Management Plan

September 2012

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Cover photo: Lake Hartwell 21 feet below full pool, December 2008. Old Highway 93 Bridge over Seneca River. Hartwell reached a new low on 12/9/08 at 637.53', almost 22.5' below full pool.

1. **Purpose.** This Savannah River Basin Drought Management Plan (SRBDMP) describes the Savannah River Basin reservoir management procedures to be followed as hydrologic conditions in the basin transition into drought. This document consolidates the initial 1989 Savannah River Basin Drought Contingency Plan and all subsequent updates into a single plan. The (SRBDMP) attempts to balance the negative impacts of the drought on the congressionally authorized project purposes. We recognize the competing interests among project purposes - fish and wildlife management, hydropower, navigation, recreation, water quality and water supply and the possibility that they may not be fully satisfied. This is a dynamic plan, subject to change as warranted by additional information. Among the items that may be cause for reconsideration are: additional experience with the current and future droughts, further studies of salinity intrusion in Savannah Harbor, changing water supply needs, improvements to water intakes, and additional understanding of the in-lake and downstream environmental requirements. As the reservoir elevations decline, water supply becomes increasingly important and takes priority over all other project purposes when conservation storage is depleted upon entering Level 4.

2. **Policy.** While in Drought Conditions, the Savannah District policy is to adaptively manage the reservoir system with a focus on preserving the remaining conservation storage while minimizing and balancing impacts to the congressionally authorized project purposes both in-lake and downstream.

3. **Background.** The Corps of Engineers manages, Hartwell, Richard B. Russell, and J. Strom Thurmond, as a system of multipurpose projects on the Savannah River. They are operated for flood damage reduction, hydropower, recreation, fish and wildlife, water quality, water supply, and navigation. The navigation purpose for the system has become inactive due to the lack of commercial navigation on the river since the middle 1980s.

   In the management of the three Federal impoundments on the Savannah River, the Corps follows the Savannah River Basin Water Control Manual (Manual) to describe how it will operate these projects. The original 1989 Savannah River Basin Drought Contingency Plan (SRBDCP) was developed as a component of that Manual and was developed (1) to address the operation of those impoundments during drought, and (2) to assist the States of Georgia and South Carolina in drought contingency planning with respect to their water management responsibilities for the Savannah River Basin.

   In response to a severe drought occurring in the early 1980s, the Savannah District developed a Short-Range Drought Water Management Strategy in 1986, to address the water shortage conditions in the Savannah River Basin. That document served as a guide for using the remaining storage in the Corps-operated Savannah River impoundments for the duration of the drought. The development of that strategy was timely as the basin fell into a severe drought in the latter half of the 1980s. The short-range strategy served as a prelude to the development of a long-term drought strategy, the 1989 SRBDCP.

   The Corps' 1989 SRBDCP described activities that would be conducted during four stages of a continuing drought. Those four stages corresponded to different lake levels within the system. When the reservoirs declined to the Level 1 trigger elevation, the Corps issued a public safety advisory concerning recreational use of the reservoirs. When Levels 2 and 3 were reached, the Corps initiated reductions in reservoir discharges from the Thurmond Project. In an attempt to balance the in-lake impacts to users of the Corps projects, releases from the Hartwell project were also reduced. The balancing strategy targeted a foot for foot balance between Hartwell and Thurmond in the top 15 feet of their respective conservation pool storage.

   In response to a new drought of record which occurred between 1998 and 2002, that original plan was modified in 2006 by revising the actions that would be taken at various lake levels. The intent of those modifications was to act earlier in a drought in an attempt to preserve additional water in the lakes, thereby delaying the time when the conservation pools would be depleted. The selected action retained the major components of the 1989 SRBDCP and added several new features. The maximum weekly average discharge at J. Strom Thurmond Dam became 4200 cfs and 4000 cfs for drought levels 1 and 2, respectively. As a tradeoff, the minimum daily average release at Thurmond was adjusted from 3600 cubic feet per second (cfs) to 3800 cfs. The a maximum daily average release was raised to 3800 cfs in drought level 3. During drought recovery periods, the discharge restrictions at J. Strom Thurmond (JST) Dam were raised to those of the next higher action level when the pools at Hartwell and JST rise

approximately two feet into the new zone. In the original 1989 SRBDCP, drought level 3 discharge restrictions were not lifted until both Hartwell and Thurmond reach full pool. The Draft Environmental Assessment was released for public comment in May 2006. Savannah District signed a Finding Of No Significant Impact (FONSI) in September 2006 and the Corps' South Atlantic Division approved implementation of the update later that month.

Shortly after the implementation of the 2006 Drought rule changes, the Savannah River system again fell back into drought. In October 2007, the Federal and State natural resource agencies agreed with Savannah District's request to temporarily reduce the minimum daily average discharge from Thurmond Dam from the 3,800 cfs level specified in the 2006 EA back to the 3,600 cfs level that was in the original DCP. The Corps' South Atlantic Division office approved that temporary deviation to the DCP that same month. This action was taken in response to the continued drought as a means of preserving water in the lakes and delaying the time when the conservation pools would be depleted. As a result, downstream resources experienced slightly more impacts than would have occurred with strict adherence to the Drought Contingency Plan.

As the 2006-2009 drought in the southeastern US completed its third year, the Savannah River reservoir system experienced extreme pressure and difficulties. Rainfall and resulting stream flow were particularly low, causing the reservoirs to drop faster than any previous drought on record. Hartwell and Russell Lakes experienced their lowest pool elevations since they were initially filled. By December 2008, the Savannah System had less than 25% of its conservation storage remaining. Hartwell Lake had about 33% of its conservation storage left, while Thurmond had only 10% of its conservation storage remaining. The severity of this latest drought created conditions that stressed the traditional management concepts which Savannah District followed to regulate the Corps impoundments. Concerns and conflicts over competing water issues intensified as drought conditions became more severe and lake levels continued to fall.

During the winter of 2008-2009, the Savannah District, with concurrence from the state and federal resource agencies, implemented a temporary deviation lowering the Thurmond release to 3100 cfs. The Corps released a Draft Environmental Assessment for public comment in October 2008 and Savannah District signed the FONSI in November 2008. It was not until September 2009 that the system felt relief from the drought conditions. Lake levels and conservation storage began to return to normal and by November 2009 the reservoirs were completely restored to full pools. This drought became the new drought-of-record for the basin.

In response to this new drought of record, 2007- 2009 and concerns that a future drought may occur in which the conservation storage of system is totally depleted, the SRBDCP was again modified in 2011 to address and clarify Level 4 operations. This modification focused specifically on minimizing impacts to the basin with respect to drinking water supplies. The Corps released a Draft Environmental Assessment for public comment in June 2011. Savannah District signed the FONSI in October and the Corps' South Atlantic Division approved implementation of the update in January 2012.

The Savannah system fell back into drought beginning spring of 2011. Savannah District released a Draft Environmental Assessment for public comment in April 2012. Savannah District signed the FONSI in July 2012 and the Corps' South Atlantic Division approved the implementation of the limited revision in September 2012. In response to agency comments, inflow based decisions were introduced for Drought Levels 1 and 2. Wintertime Flow reductions were also introduced in Levels 2 and 3.

A copy of the various environmental documents and approvals are available in the Savannah District headquarters. A summary of previous droughts and actions taken is depicted below in Table 1.

Event	Action	Description
1986-1989 Drought (New Drought of Record)	1989 Drought Contingency Plan	Introduced flow restrictions Level 1 – Safety Advisory for boaters Level 2- Max weekly average 4500 cfs Level 3- Specified 3600 cfs daily average at Thurmond
1998-2002 Drought (New Drought of Record)	2006 Drought Plan Update Environmental Assessment	Level 1 – Max weekly average 4200 cfs Level 2- Max weekly average 4000 cfs Level 3- Specified 3800 cfs daily average at Thurmond
2007-2009 Drought (New Drought of Record)	Deviation to 3600 cfs at Thurmond Oct2007-May2009	Reduction occurred at Drought Level 2 (Hartwell @ 649.85 /Thurmond@319.76)
	Temporary Deviation to 3100 cfs Dec2008-Jan2009	Used adaptive management to maintain 3600 min @ Sav River at Augusta gage
	Drought Level 4 Study - Sep2011	Developed standard operating procedure for inactive storage (Level 4)
2011-? Drought	2012 Drought Plan Revision Environmental Assessment	Evaluation and modification of the 2006 EA rules in the 2007-2009 drought and temporary deviations

Table 1

4. **Implementation.** This plan shall be implemented when either the Hartwell or Thurmond pool elevation declines below its corresponding trigger level 1elevation. On a rising pool, flow restrictions are lessened only after both Hartwell and Thurmond pools have climbed 2 feet above the trigger elevation associated with that restriction. The Drought Trigger Levels and corresponding conservation measures are shown in Figure 1 and Table 2.

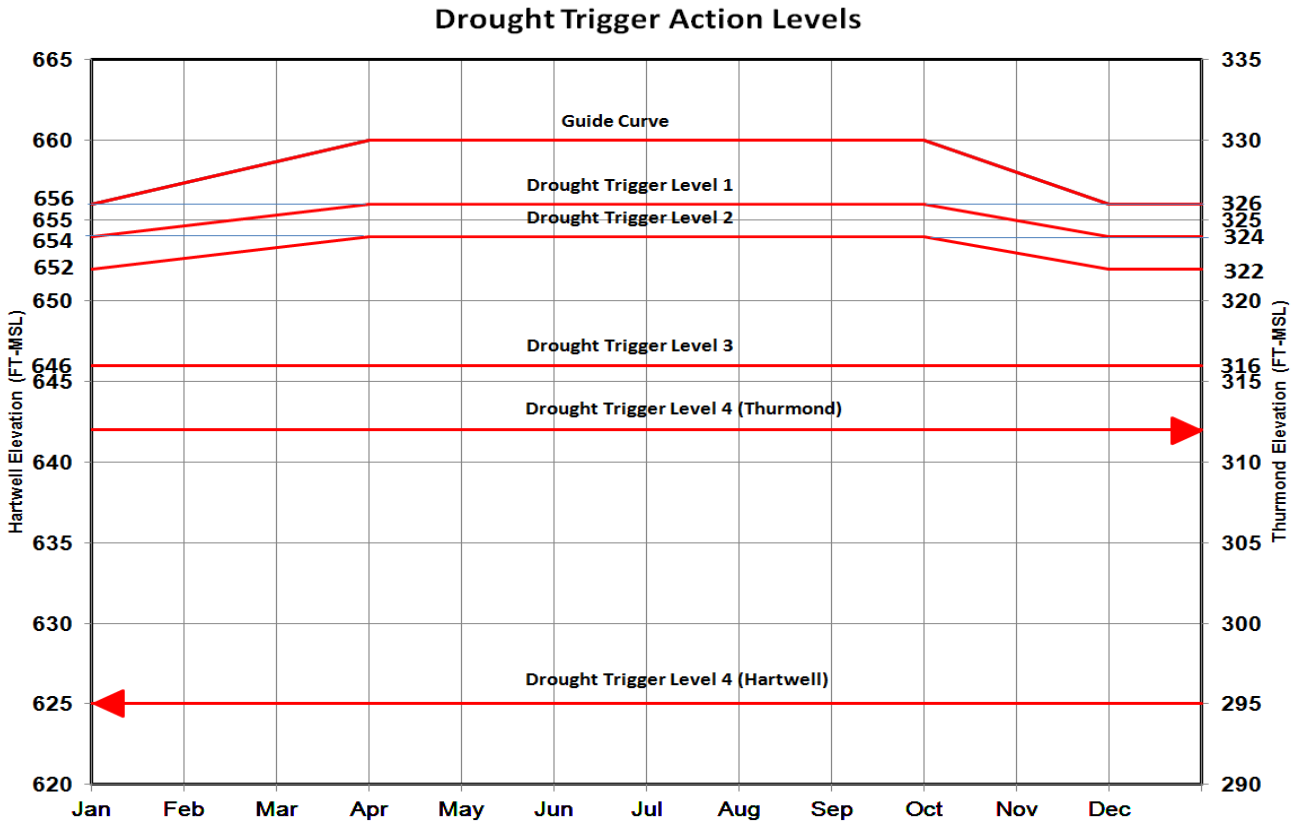


Figure 1

Drought Trigger Definitions

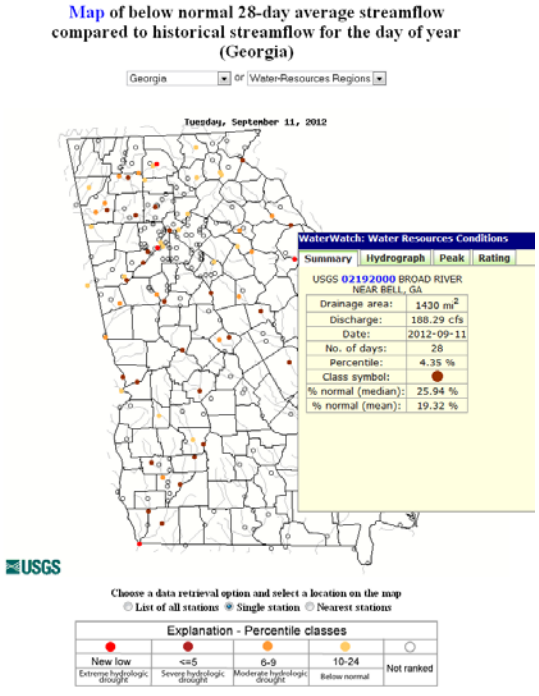
Trigger Level	Time of Year	Drought Response
1	Jan 1 - Dec 31	IF BR28 > BR28Q10, Target 4200 cfs (weekly average) release at Thurmond Dam IF BR28 < BR28Q10, Target 4000 cfs (weekly average) release at Thurmond Dam
2	Feb 1 - Oct 31	IF BR28 > BR28Q10, Target 4000 cfs (weekly average) release at Thurmond Dam IF BR28 < BR28Q10, Target 3800 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31	Target 3600 cfs (daily average) release at Thurmond Dam
3	Feb 1 - Oct 31	Target 3800 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31 (Feb 1 – Feb 28 w/NMFS approval)	Target 3100 cfs (daily average) release at Thurmond Dam
4	Feb 1 - Oct 31	Target 3600 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31 (Feb 1 – Feb 28 w/NMFS approval)	Target 3100 cfs (daily average) release at Thurmond Dam

Table 2

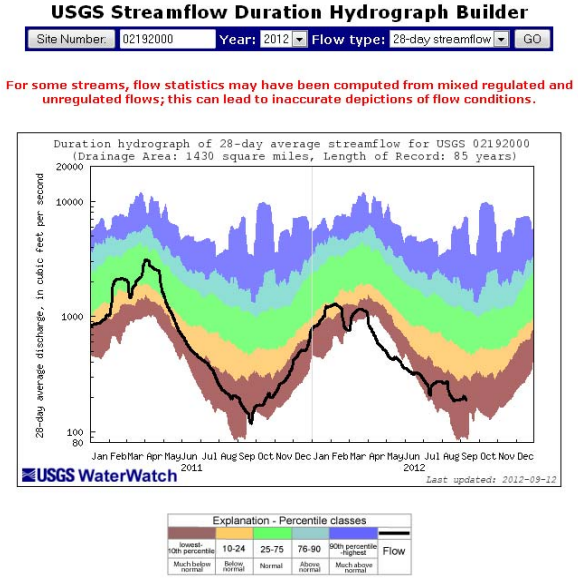
Inflow based Drought Indicator. When in Drought Levels 1 and 2, the water manager first evaluates on a weekly basis the streamflow at the USGS Broad River gage (02192000) and compares the 28-day running average streamflow (BR28) to the 10th percentile of the historical 28-day running average streamflow (BR28Q10) for that particular day of the year. The 10th percentile is used by the USGS as the breakpoint that delineates between below normal and moderate drought.

The link to USGS 28-day running average streamflow percentile site is:
http://waterwatch.usgs.gov/new/index.php?m=pa28d_dry&r=ga&w=map

Select the Broad River gage near Bell, GA. (02192000).



A summary of the 28 day average flow compared to the percentile flow can be found at the following link.
http://waterwatch.usgs.gov/new/index.php?id=wwchart_duration&sno=02192000&dt=dv28d



Conservation Pool Balancing Strategy. The Pool balancing strategy is to keep the Hartwell and Thurmond pools balanced foot for foot while in the top 15 feet of the conservation pool. For the remainder of the conservation pools, balance the Hartwell and Thurmond pools based on percent of depth remaining so that they hit bottom of conservation at the same time. Typically, the release requirement will be placed on the Thurmond release and the Hartwell release will be adjusted to stay in balance with Thurmond. The pool balancing strategy during fish spawn will occasionally vary as the objective becomes keeping each pool flat over the spawn. The spawn typically occurs between Mid-March and Mid April.

Release Decisions. Water Release Declarations will be made on a weekly basis at a minimum. The frequency at which the declaration is released is dependent on observed hydrology and changing forecasts during the week. Water Release Declarations will define releases from each of the three Savannah River projects for the following 7 day period.

5. **Operational Examples.**

EXAMPLE 1.

When in Drought Trigger **Level 1:**
If the time of year falls between Feb 1 and Oct 31, and

If the (BR28) is greater than the (BR28Q10) then the hydrology is not considered Moderate drought or worse. The flow target for Thurmond for the next 7-day period is set to a 4200 CFS weekly average maximum.

If the (BR28) is less than the (BR28Q10) then the hydrology is considered Moderate drought or worse. The flow target for Thurmond for the next 7-day period is set to a 4000 CFS weekly average maximum.

EXAMPLE 2.

When in Drought Trigger **Level 2:**
If the time of year falls between Nov 1 and Jan 31, the flow target for Thurmond for the next 7 day period is set to a 3600 CFS daily average maximum. With NOAA NMFS approval, the 3600 CFS could be extended thru February. An attempt to smoothly transition to lower flows should be made to benefit downstream habitat.

Otherwise, if the time of year falls between Feb 1 and Oct 31, and

If the (BR28) is greater than the (BR28Q10) then the hydrology is not considered Moderate drought or worse. The flow target for Thurmond for the next 7-day period is set to a 4000 CFS weekly average maximum.

If the (BR28) is less than the (BR28Q10) then the hydrology is considered Moderate drought or worse. The flow target for Thurmond for the next 7-day period is set to a 3800 CFS daily average maximum.

EXAMPLE 3.

When in Drought Trigger **Level 3:**

If the time of year falls between Nov 1 and Jan 31, the flow target for Thurmond for the next 7 day period is set to a 3100 CFS daily average maximum. With NOAA NMFS approval, the 3100 CFS could be extended thru February. An attempt to smoothly transition to lower flows should be made to benefit downstream habitat. The wintertime flow will monitored as described in Section 6 of this document allowing for adaptive changes to the flow target if needed.

Otherwise, if the time of year falls between Feb 1 and Oct 31, the flow target for Thurmond for the next 7 day period is set to a 3800 CFS daily average maximum.

Additional monitoring efforts are implemented when pools are in drought trigger Level 3. Readings will be taken in the Savannah Harbor with a hand-held probe operated from a river vessel. The measurements will attempt to locate the fresh-salt water interface in both the main channel and Back River. This interface is defined when the average salinity at 1 meter depth drops to 0.5 ppt.

EXAMPLE 4.

When in Drought Trigger **Level 4:**

If the time of year falls between Nov 1 and Jan 31, the flow target for Thurmond for the next 7 day period is set to a 3100 CFS daily average. With NOAA NMFS approval, the 3100 CFS could be extended thru February. An attempt to smoothly transition to this lower wintertime flow should be made to benefit downstream habitat. The wintertime flow will monitored as described in section 6 of this document allowing for adaptive changes to the flow target if needed.

Otherwise, if the time of year falls between Feb 1 and Oct 31, the flow target for Thurmond for the next 7-day period is set to a 3600 CFS daily average.

If either the elevation of Hartwell or Thurmond declines to the top of their respective inactive storage pools, Drought Trigger Level 4, due to drought-related causes, the Savannah District policy is to adaptively manage the reservoir system with a focus on preserving the remaining inactive storage, minimizing impacts to the serviced populations drinking water supplies both in-lake and downstream, and meeting the project's minimum environmental requirements.

Level 4 Pool Balancing Strategy. The Level 4 balancing strategy allows all three reservoirs to continue declining, into the inactive storage pool, to an elevation just above the point that major water supply impacts begin to occur. It is important to note that several smaller impacts to water supplies will have already occurred prior to the reservoirs declining to Level 4, the bottom of their conservation pools. Initially, Hartwell would be allowed to decline to 617 ft-msl and Thurmond to 310 ft-msl prior to allowing Russell to decline below 464 ft-msl, at which point population impacts greater than 15,000 would begin to occur. Due to the relative size of their drinking water populations, the Hartwell pool and the Thurmond pool would be maintained at these levels, while the Russell pool would be allowed to continue to decline utilizing its storage, in addition to inflow, to maintain a sufficient rate of flow for downstream populations and habitats. If the Russell project storage is fully depleted, the Thurmond storage would be allowed to decline, since that would result in the next smallest impact to drinking water supplies. If the Thurmond pool declines to an elevation of 308 ft-msl, a population of over 100,000 will be impacted. Thurmond's storage would be fully depleted at elevation 184 ft-msl, at which point the remaining storage in the Hartwell pool would be allowed to decline. If the Hartwell pool reaches elevation 615 ft-msl, the impacted population for the system would jump to over 250,000. If conditions persist, Hartwell would then be allowed to continue to decline until its inactive storage was fully exhausted at elevation 505 ft-msl.

It is important to note that in the SRBDMP, conservation measures are based on both pool elevation and inflow triggers. Flow restrictions for Level 3 and higher are lessened only after both Hartwell and Thurmond pools have climbed 2 feet above the trigger elevation associated with that restriction. As a Level 4 drought ends and conditions begin to improve, the inactive storage will be refilled in the opposite order that they declined. The objective during refill is to restore drinking water supplies to the largest population as soon as possible by refilling the reservoirs in an order which meets that goal. The pool balancing strategy associated with Level 4 operation is shown below in Table 3.

Level 4 Pool Balancing Strategy

HARTWELL			RUSSELL			THURMOND			SYSTEM		
Elevation	Hartwell Impacted Population	Percent of Inactive Storage Remaining	Elevation	Russell Impacted Population	Percent of Inactive Storage Remaining	Elevation	Thurmond Impacted Population	Percent of Inactive Storage Remaining	Total Impacted Population	Storage Remaining (AC-FT)	Percent of Inactive Storage Remaining
636	5200								5200		
635	5200								5200		
634	5200								5200		
633	5200								5200		
632	5200								5200		
631	5200								5200		
630	5200								5200		
629	5200								5200		
628	5200								5200		
627	5200								5200		
626	5200					313	4900		10100		
625	5200	100%	470		100%	312	4900	100%	10100	3488781	100%
623.7	5200	97%	469		97%	311.7	4900	99%	10100	3415188	98%
622.3	5200	93%	468		95%	311.3	4900	98%	10100	3334789	96%
621	5200	90%	467		92%	311	4900	97%	10100	3262160	94%
619.7	5200	87%	466		90%	310.7	4900	96%	10100	3192580	92%
618.3	5200	85%	465		87%	310.3	4900	95%	10100	3122992	90%
617	5200	82%	464	6500	85%	310	4900	94%	16600	3064030	88%
617	5200	82%	463	6500	83%	310	4900	94%	16600	3046067	87%
617	5200	82%	462	6500	81%	310	4900	94%	16600	3028104	87%
617	5200	82%	461	6500	79%	310	4900	94%	16600	3010141	86%
617	5200	82%	460	6500	77%	310	4900	94%	16600	2992399	86%
617	5200	82%	459	6500	76%	310	4900	94%	16600	2976649	85%
617	5200	82%	458	14627	74%	310	4900	94%	24727	2960899	85%
617	5200	82%	455.0	15127	69%	310	4900	94%	25227	2913649	84%
617	5200	82%	439.2	15127	41%	310	4900	94%	25227	2670424	77%
617	5200	82%	423.3	15127	25%	310	4900	94%	25227	2520324	72%
617	5200	82%	407.5	15127	13%	310	4900	94%	25227	2419674	69%
617	5200	82%	391.7	15127	7%	310	4900	94%	25227	2360074	68%
617	5200	82%	375.8	15127	3%	309	4900	91%	25227	2286674	66%
617	5200	82%	360.0	15127	1%	308	87700	88%	108027	2221949	64%
617	5200	82%	360	15127	1%	307	97500	85%	117827	2180949	63%
617	5200	82%	360	15127	1%	306	97500	83%	117827	2139949	61%
617	5200	82%	360	15127	1%	305	97500	80%	117827	2099849	60%
617	5200	82%	360	15127	1%	304	110500	78%	130827	2067849	59%
617	5200	82%	360	15127	1%	286.9	110500	47%	130827	1613049	46%
617	5200	82%	360	15127	1%	269.7	110500	26%	130827	1314299	38%
617	5200	82%	360	15127	1%	252.6	110500	13%	130827	1121849	32%
617	5200	82%	360	15127	1%	235.4	110500	8%	130827	1049249	30%
617	5200	82%	360	15127	1%	218.3	110500	3%	130827	980499	28%
616	5200	80%	360	15127	1%	201.1	110500	1%	130827	933239	27%
615	143200	78%	360	15127	1%	184	110500	0%	268827	897329	26%
614	143200	76%	360	15127	1%	184	110500	0%	268827	875869	25%
613	143200	74%	360	15127	1%	184	110500	0%	268827	854409	24%
612	148000	73%	360	15127	1%	184	110500	0%	273627	832949	24%
601.3	148000	61%	360	15127	1%	184	110500	0%	273627	704175	20%
590.6	148000	47%	360	15127	1%	184	110500	0%	273627	547775	16%
579.9	148000	33%	360	15127	1%	184	110500	0%	273627	385135	11%
569.2	148000	23%	360	15127	1%	184	110500	0%	273627	275595	8%
558.5	148000	17%	360	15127	1%	184	110500	0%	273627	209255	6%
547.8	148000	12%	360	15127	1%	184	110500	0%	273627	147975	4%
537.1	148000	8%	360	15127	1%	184	110500	0%	273627	105175	3%
526.4	148000	4%	360	15127	1%	184	110500	0%	273627	62375	2%
515.7	148000	3%	360	15127	1%	184	110500	0%	273627	48715	1%
505	148000	2%	360	15127	1%	184	110500	0%	273627	39085	1%

Table 3

As the reservoir elevations decline into the inactive storage pools, water supply takes priority over all other project purposes. The minimum releases defined in this plan attempt not to impact downstream water supply, and other critical downstream infrastructure such as Plant Vogtle, Plant Macintosh, or the Savannah River Site. Table 4 details the minimum lake level and impacted populations for each intake at the Corps of Engineers Projects, Hartwell reservoir, Russell reservoir, and Thurmond reservoir. Table 4 also details downstream water supply users and their constraints.

Pertinent Municipal and Industrial Water Supply Information

User	Source	User Type Municipal or Industrial	Lowest Lake Level or Flow at which WS Intake Becomes Inoperable FT-NGVD29	Intakes Reported Service Population	Drinking Water Estimated Service Population
Clemson University Heating and Cooling	Hartwell Lake		638		
Clemson Uni Ag Dept	Hartwell Lake		645		
Anderson County Joint Municipal Water System	Hartwell Lake	Municipal	615	200-300k	138,000
City of Hartwell Water Treatment Plant	Hartwell Lake	Municipal	612	7500	4800
City of Lavonia	Hartwell Lake	Municipal	636	12000	5200
JP Stevens Company (Closed, now Knop	Hartwell Lake		610		
Hart County Water and Sewer Utility Authority	Hartwell Lake	M&I		2267	
City of Elberton (Elberton Utilities)	RBR Lake	Muicipal	464	8500	6500
Santee Cooper Rainey Generating Station	RBR Lake	Cooling Water	462	50	
City of Abbeville	RBR Lake	Municipal	458	8500	8127
Mohawk Industries	RBR Lake	Industrial	454.75		500
City of Lincolnton, GA	JST Lake	M&I	307	2700	4600
City of Washington, GA - Aonia Plant	JST Lake	M&I (50/50%)	307	6250	5200
City of McCormick, SC	JST Lake	M	313	12646	4900
City of Thompson/McDuffie County, GA	JST Lake	M	304	16000	13000
Columbia County, GA Water Utility	JST Lake	M	308	6000	82800
Columbia County Water System	Stevens Creek	M	182		
SCE&G Stevens Creek	Stevens Creek				
Edgefield County W&SA	Augusta City Dam & Augusta	M&I	154.5	23,300	
Augusta-Richmond County (Hydromechanical)	Augusta City Dam & Augusta	M&I		180,000	
Augusta Canal Authority	Augusta City Dam & Augusta				
Avondale Mills - Augusta Canal (Sibley Mill)	Augusta City Dam & Augusta	I			
Standard Textile - King Mill	Augusta City Dam & Augusta				
Enterprise Mill or Hawk Gully	Augusta City Dam & Augusta				
Augusta-Richmond County (Diesel Pumps)	NSBL&D	M&I	119.5		
City of North Augusta	NSBL&D		108	30000	
Kimberly Clark Corporation Beech Island	NSBL&D		109		
SCE&G Urguhart Station	NSBL&D		111		
DSM Chemicals Augusta, Inc.	NSBL&D	I	103.9		
PCS Nitrogen Fertilizer, L.P.	NSBL&D	I	103.9		
General Chemical Corp., Augusta Plant	NSBL&D	I	111		
Masons Tree Farm	NSBL&D	Ag	112.5		
D/S of NSBL&D (Cretaceous Sand)					
International Paper Corporation - Augusta Mill	SRBA (Cretaceous Sand)	I	94		
DOE Savannah River Operation (Westinghouse	SRBA (Cretaceous Sand)	I	79		
Southern Nuclear Operating Co., Inc. (Vogtle)	SRBA (Cretaceous Sand)	I	70		
D/S of NSBL&D (Floridian Aquifer)	SRBA (Floridian Aquifer)				
Georgia Power Co - Plant McIntosh	SRBA (Floridian Aquifer)	I	7.5		
GA Pacific (Fort James Operating Company)	SRBA (Floridian Aquifer)	I	5.16		
Beaufort Jasper W&SA Main Plant	SRBA (Floridian Aquifer)		3		
Savannah City Water Supply	SRBA (Floridian Aquifer)		-10.22	10000	
Tronox Pigments (Savannah), Inc.	SRBA (Floridian Aquifer)	I	-4.1		
Weyerhaeuser Company	SRBA (Floridian Aquifer)	I	-10.5		
International Paper Corporation	SRBA (Floridian Aquifer)	I	-5		

Table 4

Most of the critical water supply intake locations are shown in Figure 2 below.

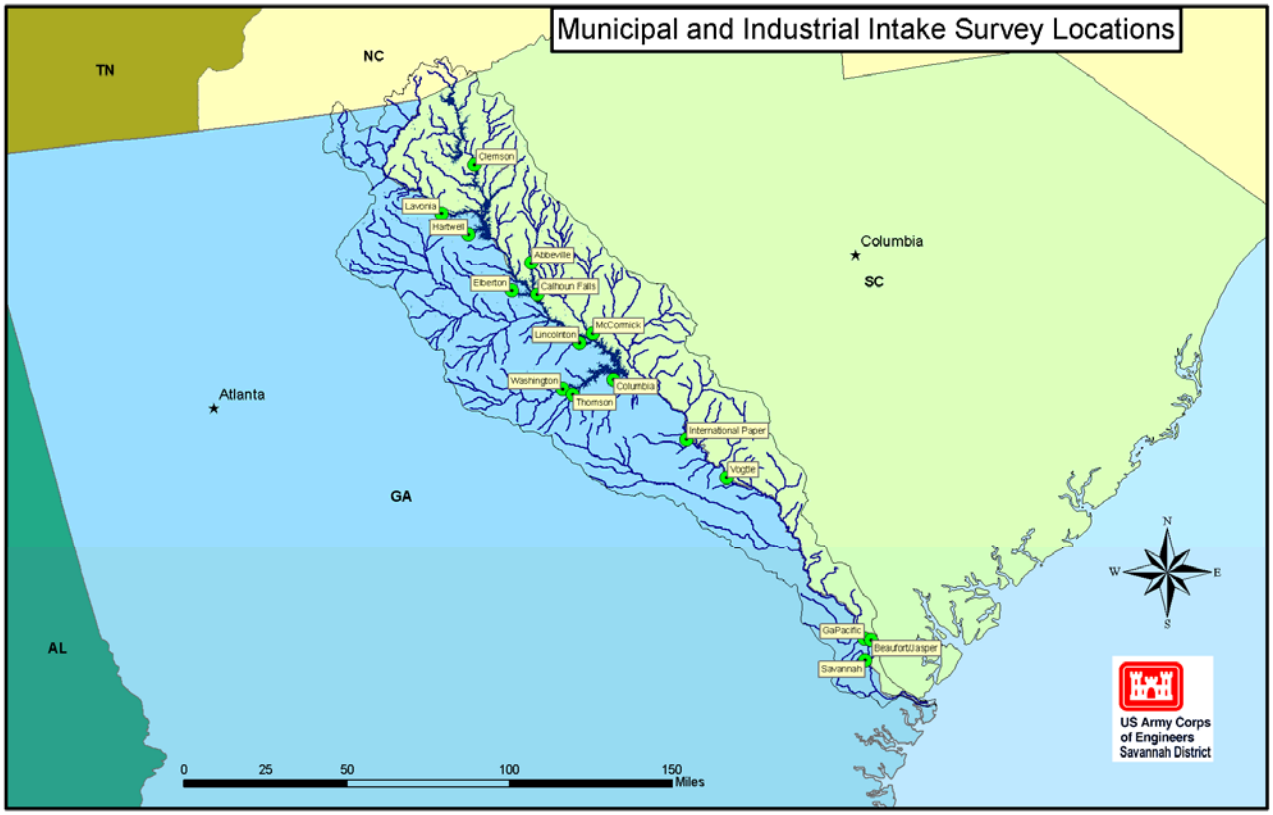


Figure 2

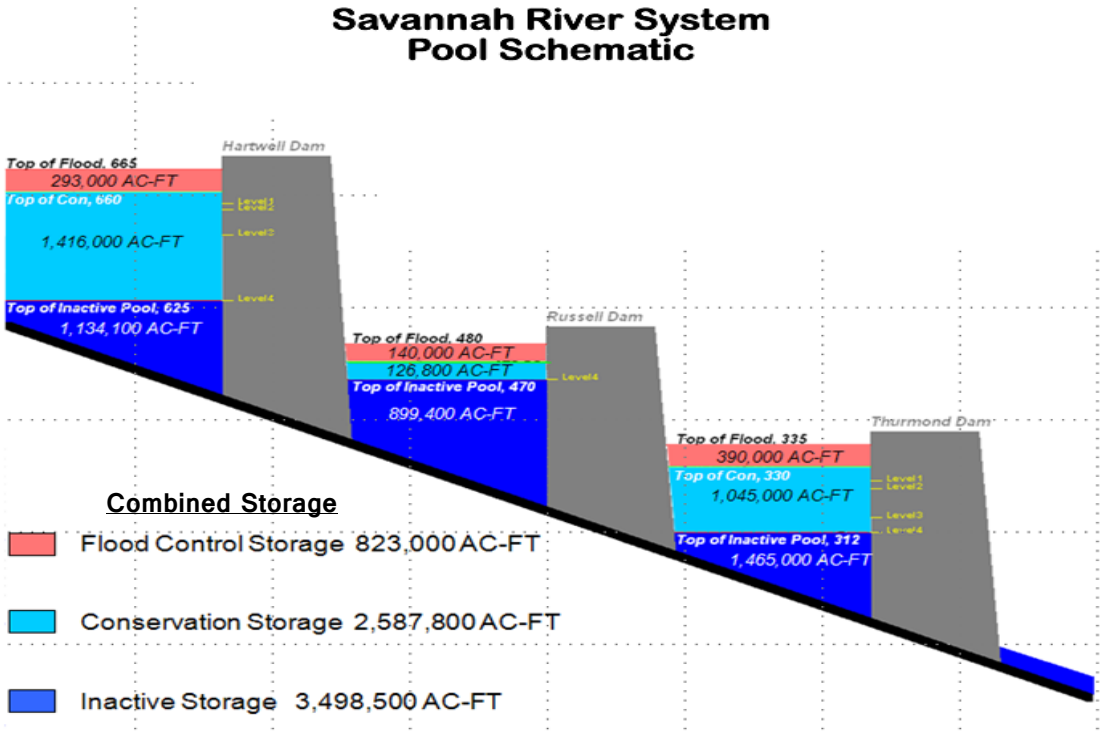


Figure 3

6. **Monitoring** Dissolved oxygen, temperature, conductivity, and pH measurements in the releases are recorded at each reservoir on a continuous basis. Automated retrieval is also used for hourly lake elevation, inflow, and discharge. Water quality monitoring is more critical downstream at Savannah Harbor as the lower releases from J. Strom Thurmond allow the saltwater wedge in the harbor to move further upstream. Salinity levels are continuously measured by four continuous recording gages. The four gages are located at: (1) the 1-95 bridge, 1.2 miles downstream of the Abercorn Creek intake, (2) the intake to the Lucknow Canal, on Little Back River, which supplies fresh water to the Wildlife Refuge, (3) inside the Lucknow Canal near the downstream gate, and (4) the U. S. Highway 17 Houlihan Bridge on the Front River. During critical low water periods, these gages will be supplemented by readings taken by a hand-held probe operated from a boat. Predictions based on data collected to date indicate salinity levels may reach 0.5 parts per thousand (ppt) at the mouth of Abercorn Creek (river mile 30.2) when river flows are less than 6000 cfs and tide heights exceed 10 feet, mean low water (mlw) at Houlihan Bridge. This is an extremely high tide height, which is never predicted to occur by the National Oceanic and Atmospheric Administration Tide Tables, however, could possibly occur with strong northeasterly winds.

Wintertime Flow Reductions. Additional monitoring and coordination associated with the wintertime flow reductions will be consistent with the 2012 EA. The District and other potentially affected parties will provide support to the State of Georgia and South Carolina, who will monitor a prescribed set of locations, parameters and general performance targets. The States would coordinate these monitoring efforts with the Savannah River Basin Drought Coordination Committee (SRBDCC). The SRBDCC members consist of the Savannah District and South Atlantic Division Corps of Engineers, the Georgia and South Carolina Water Resource agencies, U.S. Fish and Wildlife Service USFWS, and NOAA National Marine Fisheries Service NMFS. If measured parameters are found to exceed acceptable levels, the monitoring organization would notify the District, who would coordinate a meeting with the SRBDCC members which would recommend appropriate adjustments to Thurmond release levels. If requested by either the State of Georgia or South Carolina, the Corps will restore the Thurmond discharge up to the 3,800 cfs daily average. NOAA-Fisheries will be involved in discussions concerning the potential impact to spawning Shortnose sturgeon. The critical monitoring objectives and responsible parties are described in Table 5 below.

Critical Monitoring Objectives

Location	Target	Responsible Party
Augusta Shoals	Flow > 1,500 cfs	City of Augusta/USFWS
USGS 021989773 (USACE Dock)	DO > 5.0 mg/L daily average DO > 4.0 mg/L instantaneous Temperature ≤ 90 ºF pH 6.5-8.5	GA DNR-EPD
USGS 02198840 (I-95 Bridge)	Conductivity < 10,000 µS/cm	GA DNR-EPD
Abercorn Creek	Chloride < 16 ppm	City of Savannah
USGS 02198500 (Clyo)	Flow > 4,500 cfs	SC DHEC
Various	Water level at the intakes	Intake operators
Various	Sturgeon migration	SC DNR and NOAA Fisheries

Table 5

The values shown above are general performance targets and are not intended to be mandatory requirements. Failure to achieve the desired targets would initiate an evaluation of impacts, which could lead to a request by the State of Georgia or South Carolina to the Corps to restore the discharges from Thurmond Dam to as much as 3,800 cfs. Monitoring and reporting by other federal Agencies will be conducted directly with the Savannah District, Corps of Engineers. If the U.S. Department of Energy, Savannah River Site experiences unbearable insufficient river stages at their intake due to the reduced flow, they would make a request to increase the Thurmond release

directly to the Savannah District, Corps of Engineers. This same policy applies to the U.S. Fish and Wildlife Service - National Wildlife Refuge. The Savannah District will continue to coordinate with the National Wildlife Refuge during their filling season to ensure an adequate fresh water supply. Requests to increase flows by these Federal agencies would initiate discussion with the SRBDCC which could lead to an action by the Corps to restore the discharges from Thurmond Dam back up to as much as 3,800 cfs.

Agency Representation in the SRBDCC

Agency	Office	Individual
USACE-SAS	EN,OP,PD,CCO,EM	Chiefs or designated
GA DNR-EPD	Watershed Protection Branch	Jeff Larson, Assistant Branch Chief
SC DNR	Office of Environmental Programs	Bob Perry, Director
SC DHEC	Bureau of Water	David Baize, Assistant Bureau Chief
NOAA Fisheries, Southeast Regional Office	Protected Resources Division	Stephania Bolden, Fishery Biologist
USFWS	National Wildlife Refuge	Chuck Hayes
DOE	Savannah River Site	Bill Paine

TABLE 6

7. **Outlet Prioritization**. The normal method of releasing water at the projects is through the turbines during generation. As the pools decline into inactive storage, releases from the projects would continue through generation for as long as possible. Estimates have been made that release by generation could continue below the minimum design depth for generation for a significant depth into the inactive storage pool. It is important to note that the minimum elevations for generation and Speed-No-Load operation are well outside the original design limits. At a certain point, generation will no longer be an option, and the generating units will switch to "Speed-No-Load" in order to prevent destroying the generator. The switch to Speed-No-Load would result in the cessation of hydropower generation despite the passage of water through the units. Speed-No-Load could continue for some additional depth until potentially damaging vortices form. At that point, releases through the turbines would cease and releases would be initiated through the sluices. Table 7 below depicts critical elevations at which project discharge may transition from one outlet method to another.

Pertinent Outlet Information

	Estimated Minimum Generation Elevation (ft-msl)	Estimated Minimum Speed-No-Load Elevation (ft-msl)	Spillway Gates	Spillway Crest Elevation (ft-msl)	Sluice Invert Elevation (ft-msl)	Streambed Elevation (ft-msl)
Hartwell	596	574	12	630	500	479
Russell	434	418	10	436	320	304
Thurmond	294	275	23	300	190	176

TABLE 7

All operation of the turbines in the inactive storage pool will be monitored regarding static head limitations and other dam safety limitations by the on-site operations personnel. In the event that the Powerhouse Superintendent determines that further use of a turbine will cause unacceptable damage to the turbine or presents an unacceptable hazard to powerhouse personnel, District water management personnel will be notified and spillway or sluice releases will be initiated. Since water can be released well below the spillway crest through generation, it is unlikely that spillway gate releases will be required for Level 4 operations.

Each project can release water through turbines, spillways, and sluices. Outlet capacities for the various release methods were developed by the Hydroelectric Design Center which is attached as Appendix J to the 2011 EA. These capacities will be verified during Level 4 operation through periodic ad-hoc flow measurements. Estimates of outflow at various pool elevations are shown in Figures 4-16 below.

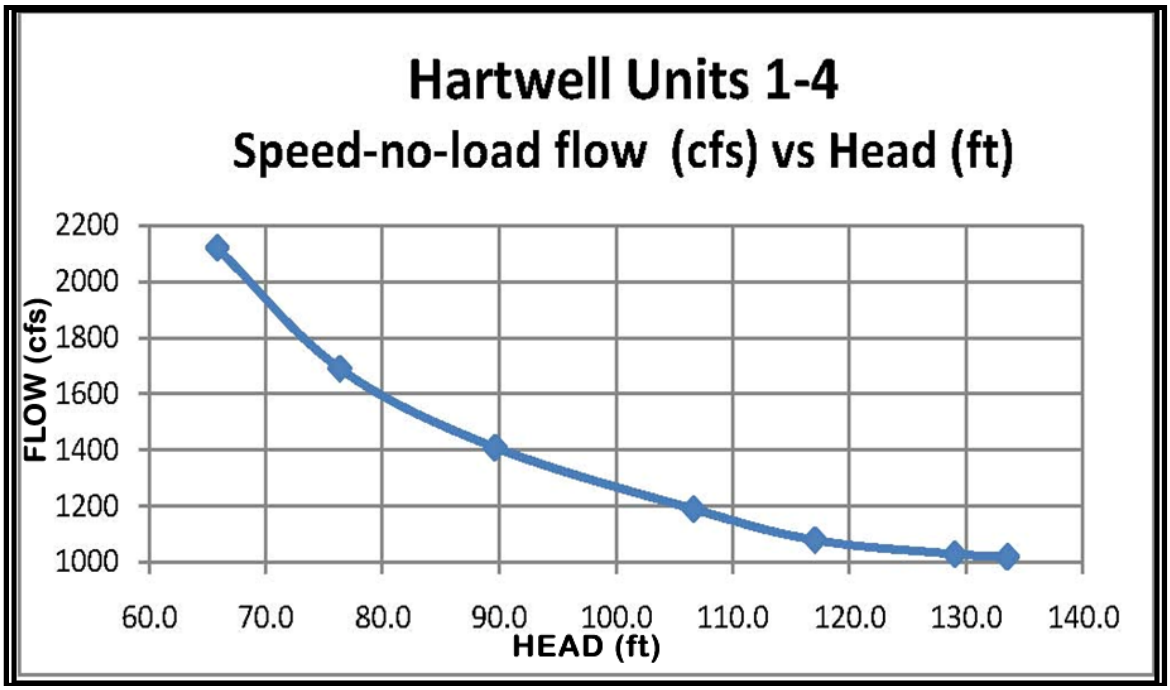


Figure 4

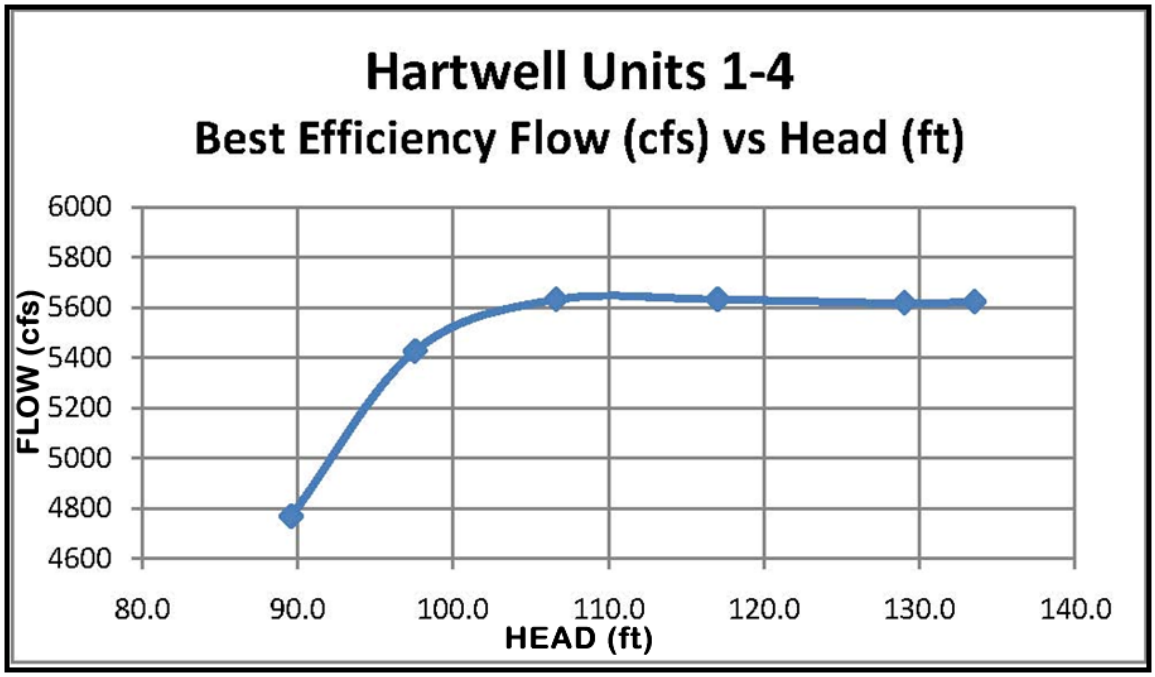


Figure 5

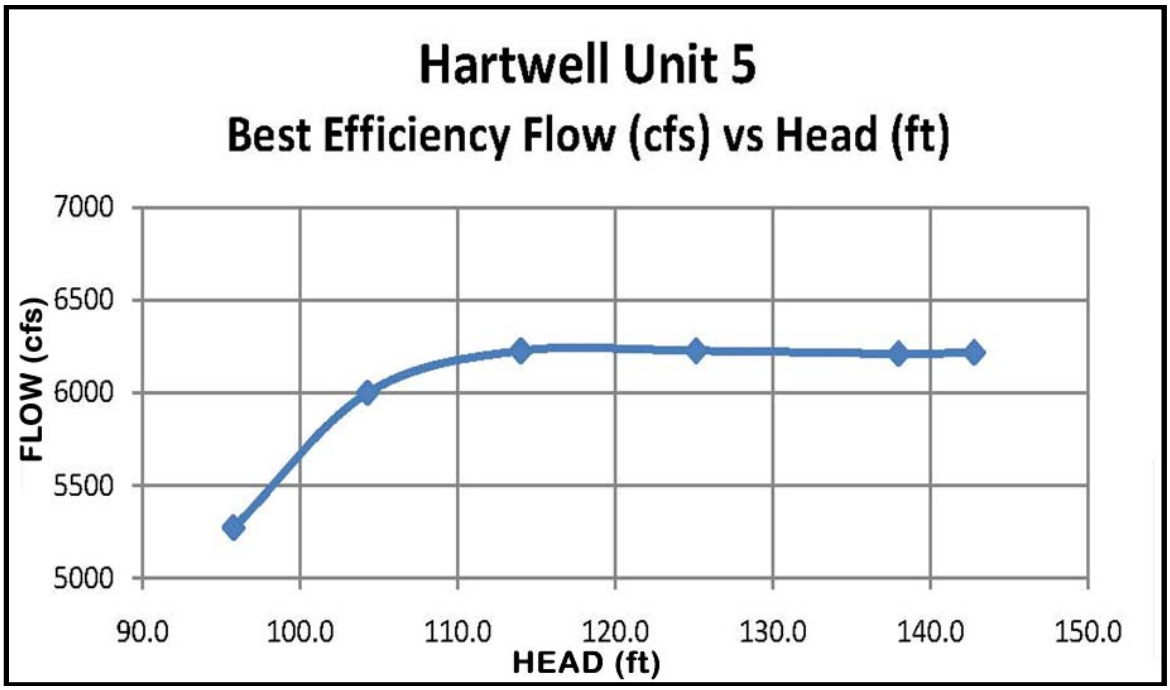


Figure 6

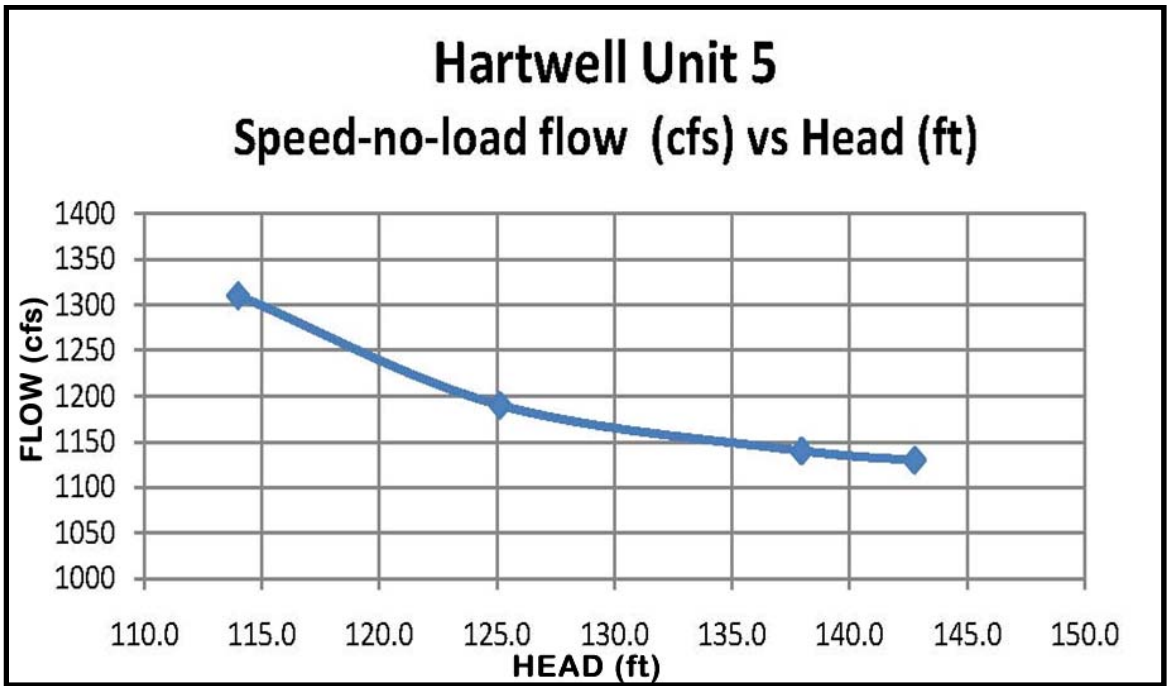


Figure 7

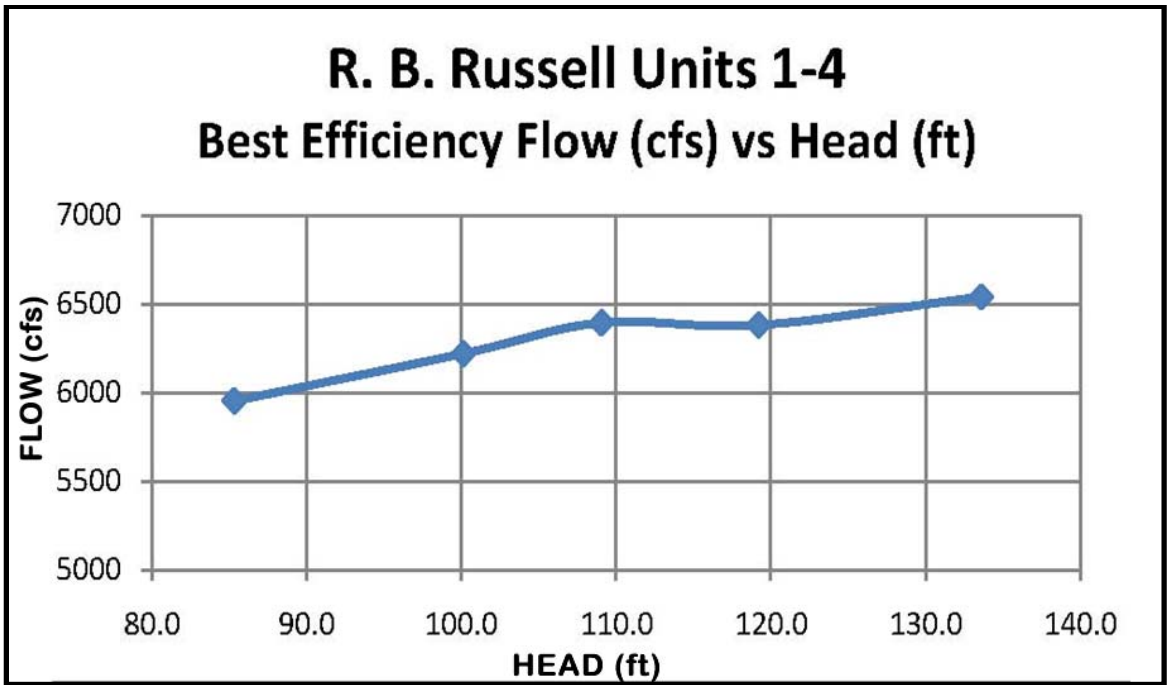


Figure 8

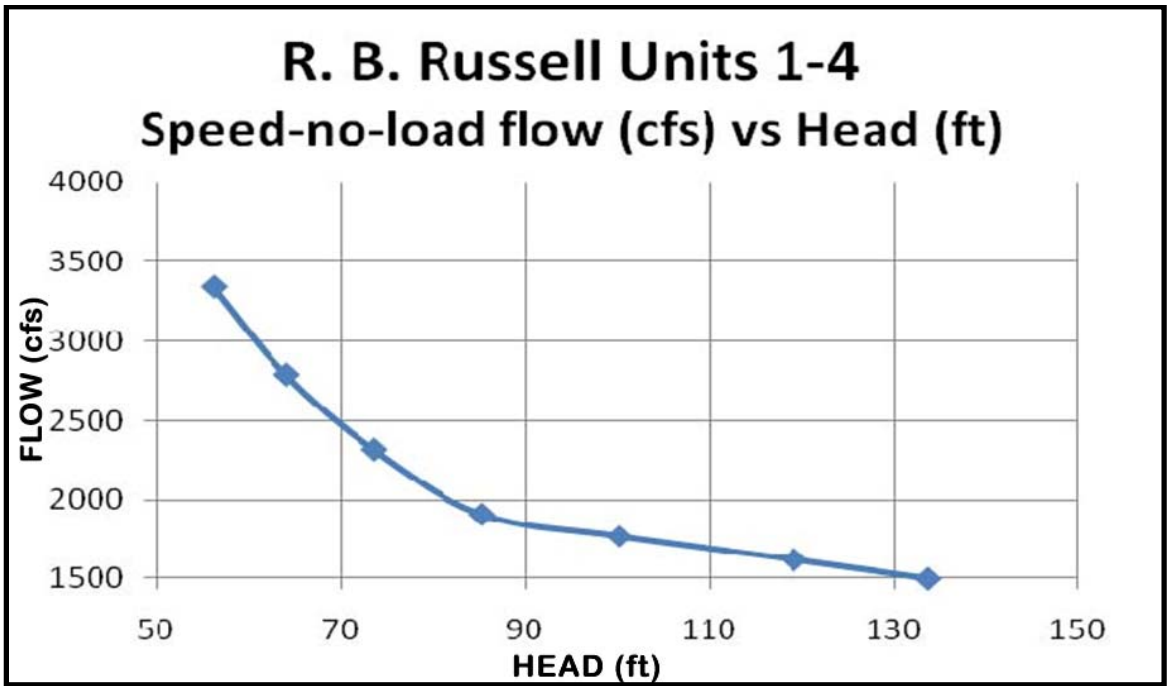


Figure 9

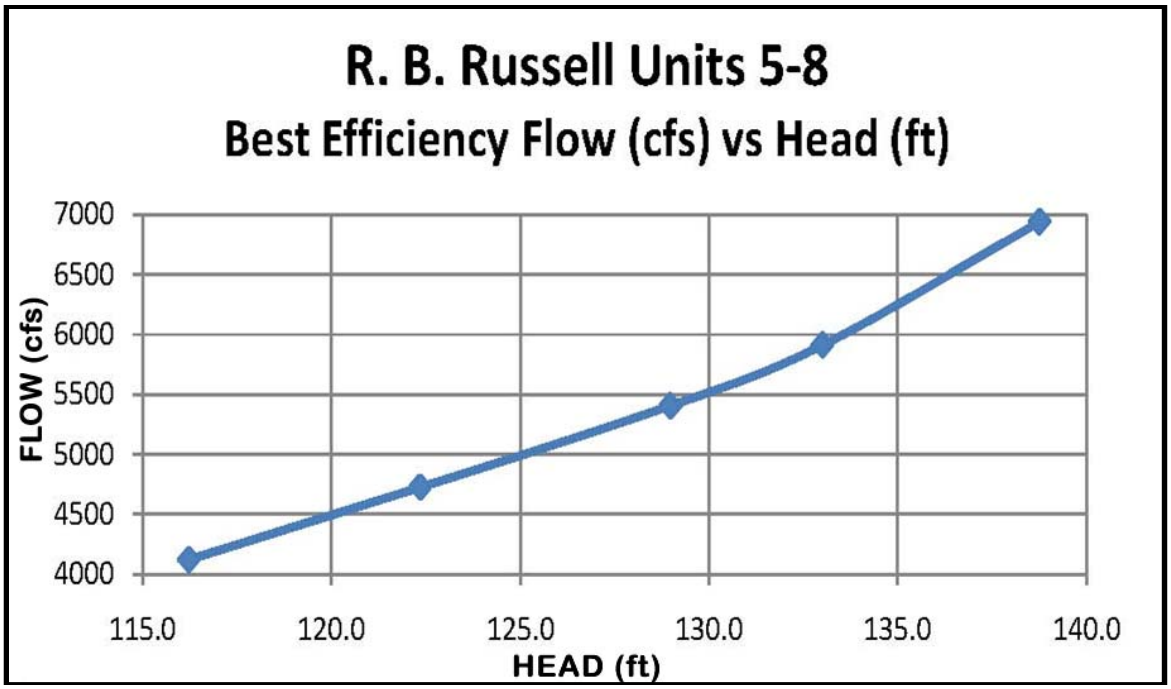
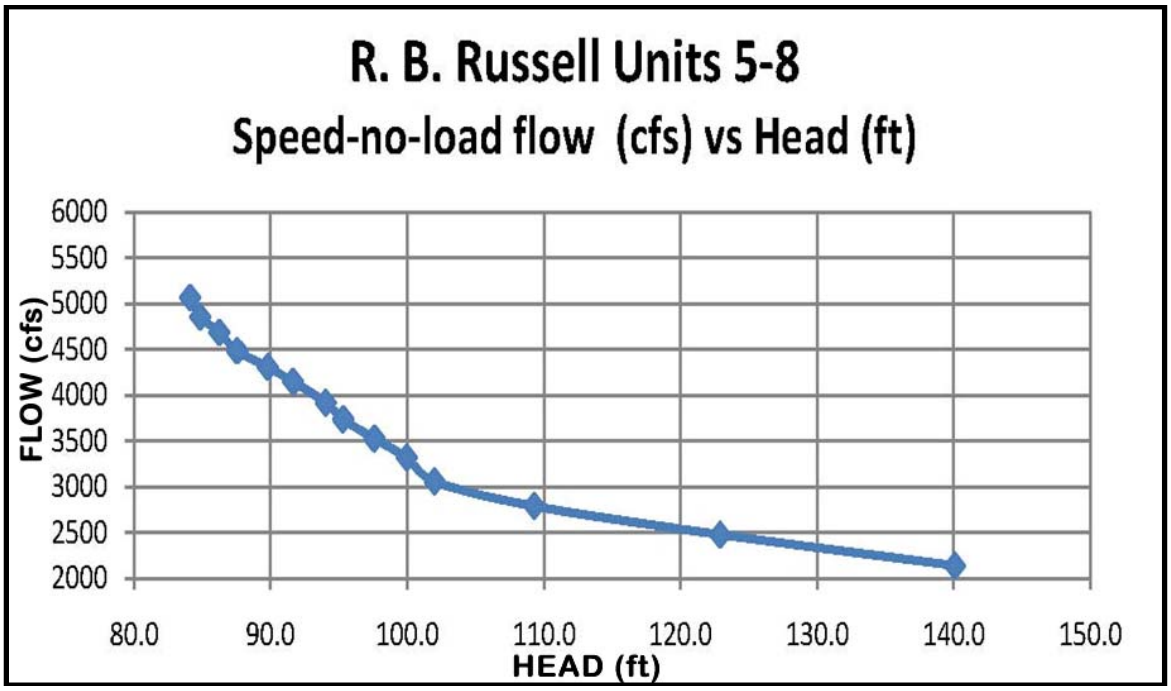


Figure 10



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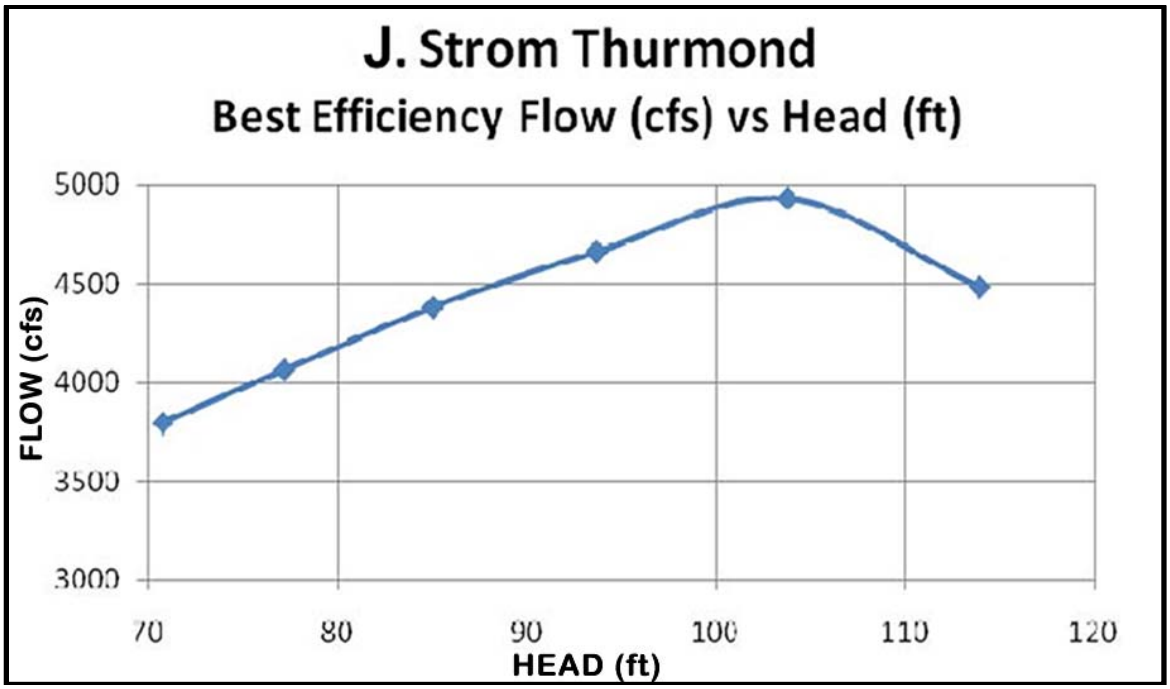

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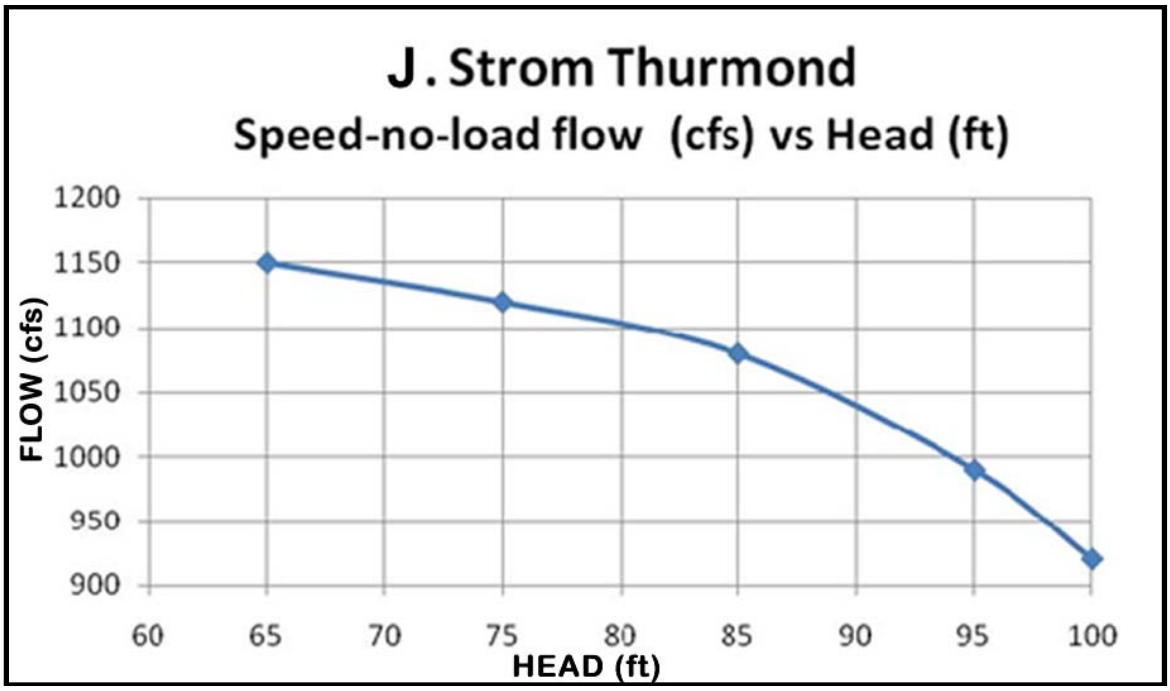

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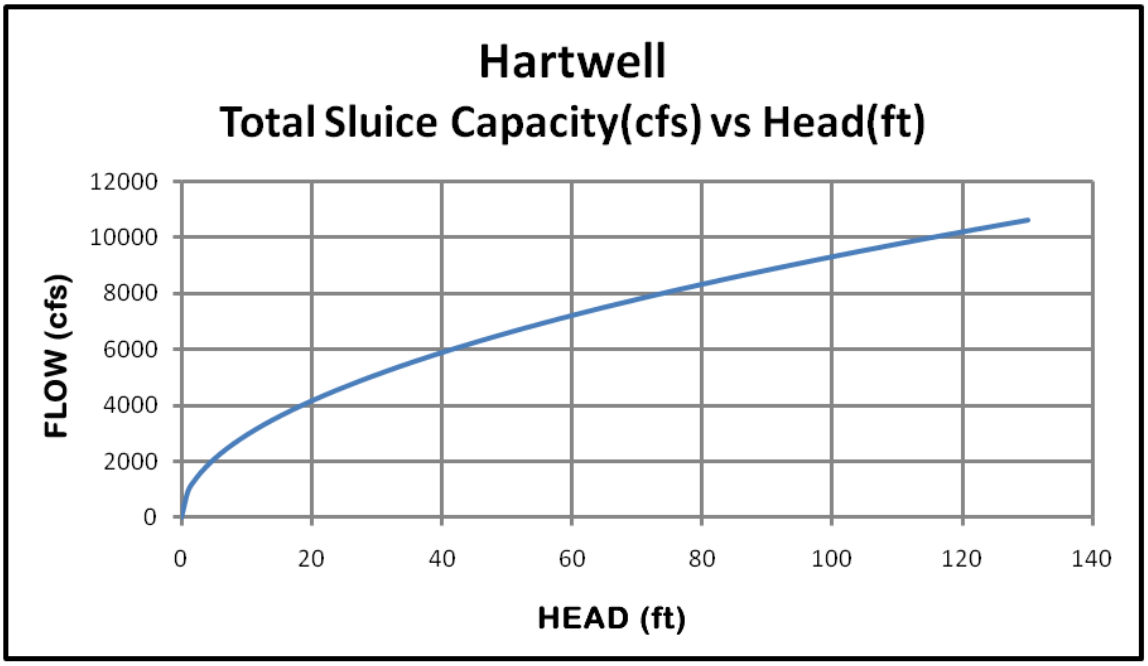

Figure 14

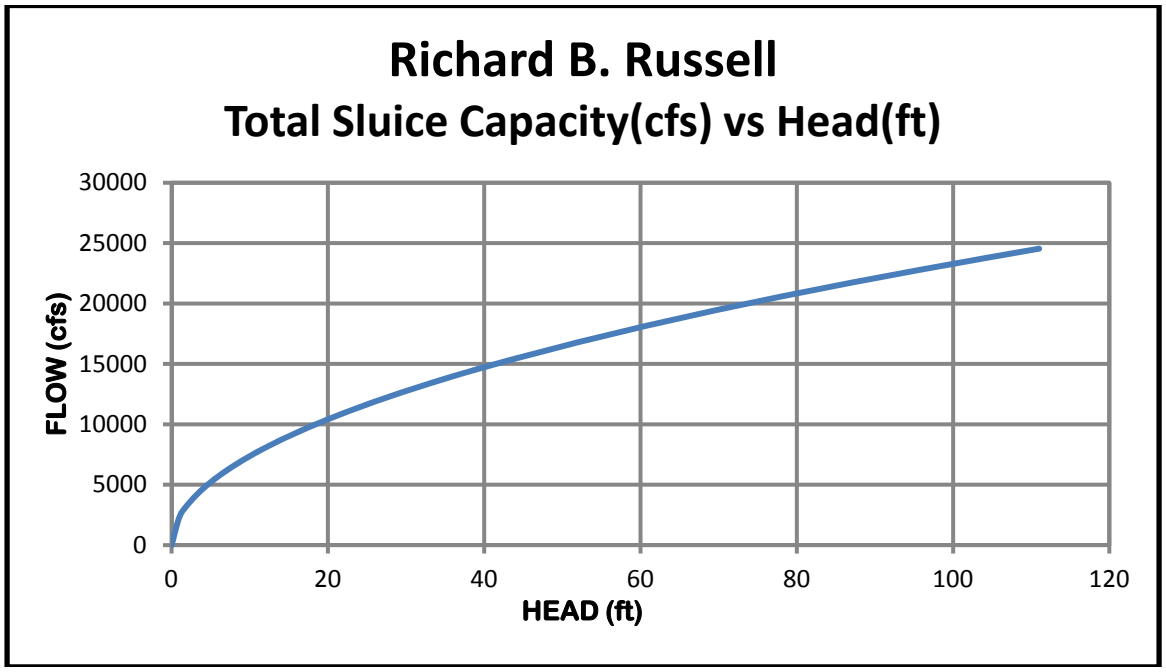

Figure 15

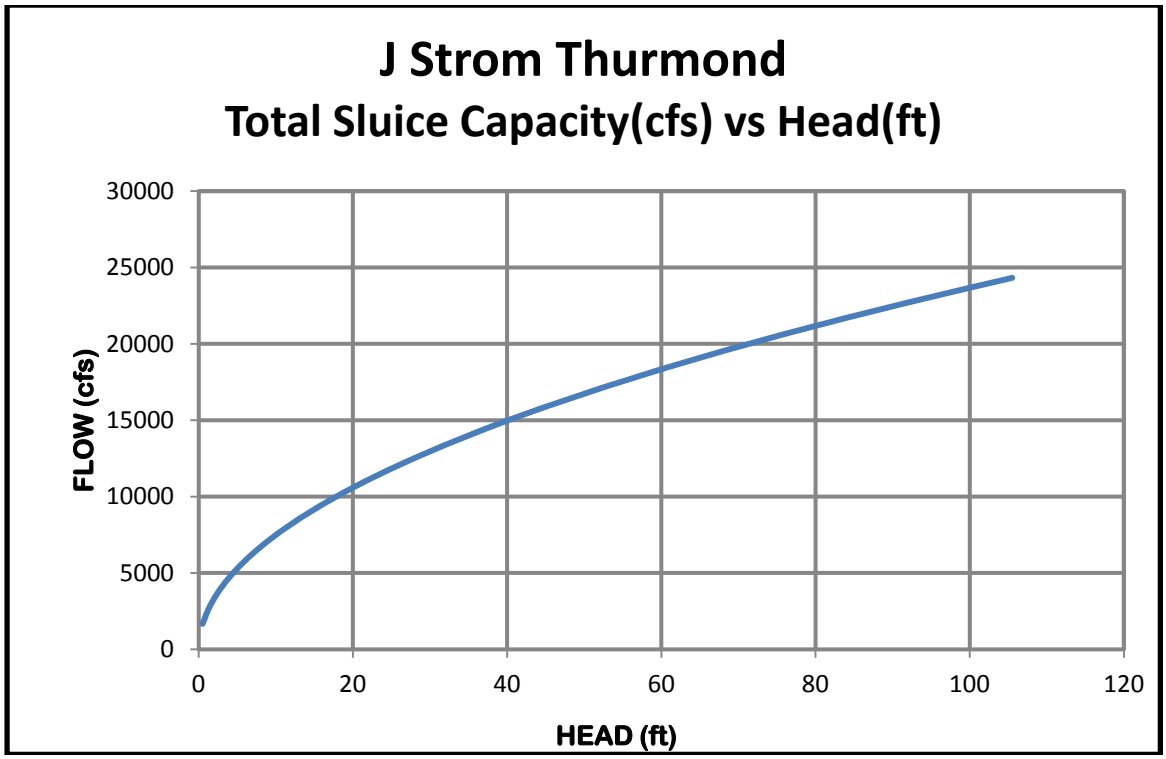

Figure 16

8. **Coordination**. The SRBDCC discusses the mutual concerns of the Federal and State agencies, organizations, communities, industries, and exchange information necessary for sound management decisions to be made by the respective agency heads.

A number of sequential actions would be required at each level as shown on Table 8. A one-week lag between reaching an action level and implementation of the flow reduction will provide the time necessary to implement and coordinate the drought water management strategy. These efforts will include coordination with the states of Georgia and South Carolina through the Savannah River Basin Drought Coordination Committee (SRBDCC), the establishment of a public information program, monitoring of conditions within the basin, and evaluation of other actions which may be required to fully implement the strategy.

Public Information Program**.** The Corporate Communications drought action plan is activated in stages keyed to the management action level. The first notification, will take place as the pools begin to drop below normal levels for a given time of year. First news releases will deal primarily with water safety-related issues, particularly if water levels begin dropping during peak recreation periods.

News releases will be issued in conjunction with any official public notices or correspondence concerning water shortage emergencies or alerts, drought alerts, or notification of public meetings. It is imperative that the District coordinate all public notifications internally before a public release is made. The Corporate Communications Officer will speak for the District concerning all policies and procedures instituted during a drought or water shortage emergency. Lake Resource Managers will confine comments to the news media to subjects related to operational aspects of the respective lakes.

During a prolonged water shortage the Corporate Communications Office will issue weekly update news releases and will seek opportunities to broaden public awareness through radio and television public service announcements or paid advertising, if deemed necessary. The Corporate Communications Office will establish a "Drought Hot Line" that will allow news media access to information on District activities on a continuing 24 hour-a-day basis during prolonged droughts.

Savannah River Basin Management Actions

*Pool Level	District Management Action	District **Action Office
Level 1	1. Notify District Drought Management Committee.	EN
	1. Recommend Thurmond release reduced to 4,200 cfs.	DDMC
	2. Issue news release to notify Congressional interests and members of public of anticipated worsening conditions.	CCO
	3. Begin inspecting designated navigation channel for hazards.	OP
	4. Inspect beaches, boat ramps and post signs where appropriate.	OP
	5. Begin informal discussion with SAD/SEPA regarding reduced generation.	EN/OP
	6. Notify lake concessionaires and park lessees concerning possible worsening conditions.	OP
	7. Be alert for worsening conditions.	EN
Level 2	1. Recommend Thurmond release reduced to 4,000 cfs.	DDMC
	2. Coordinate action with SRBDCC.	EN
	3. Coordinate action with SAD.	EN
	4. Notify Division Engineer 2 wks. prior to reduction.	DE
	5. Issue news release.	CCO
	6. Public notice to water users and local agencies.	OP
	7. Process intake modification permits on emergency basis	OP
	8. Coordinate with Congressional delegations	DD-X

Level 2, cont'd	9. Monitor status of water intakes	OP
	10. Reduce Thurmond release to 4,500 cfs pursuant to final decision by DE.	EN
	1l. Weekly status report to DE.	EN
	12. Increase monitoring of beaches and boat ramps.	OP
	13. Continue to advise lake concessionaires and park lessees of projected lake levels.	OP
	14. Continue water patrols to identify and mark navigation hazards in designated navigation channels.	OP
	15. Continue to extend boat ramps where appropriate.	OP
Level 3	1. Recommend Thurmond release reduced to 3,800 cfs.	DDMC
	2. Coordinate action with SRBDCC.	EN
	3. Coordinate action with SAD.	EN
	4. Notify Division Engineer 2 weeks prior to reduction.	DE
	5. Issue news release.	CCO
	6. Public notice to water users and local agencies	OP
	7. Coordinate with Congressional delegations	DDX
	8. Reduce Thurmond discharge to 3,800 cfs pursuant to final decision by DE.	EN
	9. Weekly status report to states.	PD
	10. Coordinate with in-lake withdrawers to lower intakes so lakes can be drawn below minimum conservation pool, if required.	EN/OP
	11. Continue to advise lake concessionaires and park lessees of projected lake levels.	OP
	12. Continue water patrols to identify and mark navigation hazards in designated navigation channels.	OP
	13. Continue to extend boat ramps where appropriate.	OP
Level 4	1. Analyze results of Action 10 of Level 3.	
	2. continue level 3 release rate as long as possible.	
	3. Coordinate action with SRBDCC.	EN
	4. Coordinate action with SAD.	EN
	5. Notify Division Engineer.	DE

Level 4, cont'd	6. Issue news release.	CCO
	7. Public notice to water users and local agencies.	OP
	8. Coordinate with Congressional delegations.	DDX

Table 8

The Drought Trigger Levels and corresponding conservation measures are shown in Figure 1 and Table 2.

** List of Abbreviations
DE District Engineer
DDMC District Drought Management Committee
DDX Administrative Officer
EN Engineering Division
OP Operations Division
PD Planning Division
CCO Coorporate Communications
SRBDCC Savannah River Basin Drought Coordination Committee

SAVANNAH RIVER BASIN DROUGHT COORDINATION COMMITTEE (SRBDCC)

PURPOSE

The Savannah River Basin Drought Coordination Committee (SRBDCC) will discuss mutual concerns of agencies, organizations, communities, and industries, and exchange information necessary for sound basin actions to be made by the respective agency heads.

In order to make informed and sound decisions in implementing the drought contingency plan for the Savannah River Basin, it is necessary that those affected by water management decisions be given the opportunity to provide input to the decision making process. The following describes the mechanism which will be used to implement the plan.

Successful implementation of the drought contingency plan will require the full and cooperative participation of the Savannah District and the South Atlantic Division of the Corps of Engineers and agencies within the States of Georgia and South Carolina. The involvement of these entities will be through a drought coordination committee. The purpose of the committee will be to coordinate the drought management actions of the States and the Corps by serving as a forum for an exchange of information and ideas. The committee may seek out advice of its members or other individual attendees, but will not seek to obtain consensus advice or recommendations. Committee members will be responsible for reporting individually to the organizations they represent with such advice as they deem appropriate. In no event will the committee be considered an agent of either the states or the Corps. Water Management decisions remain the responsibility of the District Commander.

SRBDCC MEMBERSHIP

The Savannah River Basin Drought Coordination Committee shall consist of a representative from each of the following organizations:

ORGANIZATION	OFFICE
Savannah District	Engineering Division Operations Division Planning Division
South Atlantic Division	Engineering Division
Georgia	Department of Natural Resources, Environmental Protection Division Coastal Resources Division Wildlife Resources Division
South Carolina	Department of Natural Resources
	Department of Health and Environmental Control
NOAA	National Marine Fisheries
USFWS	U.S. Fish and Wildlife Service

RESPONSIBILITIES

The representative from each state on the Drought Coordination Committee will be responsible for coordinating with the appropriate agencies and local governments. Similarly, Corps representatives will be responsible for coordinating with appropriate Federal agencies, private power companies, and lake concessionaires and lessees. Federal agencies which will be most involved in drought water management decisions will be the Department of the Energy's Southeastern Power Administration and the National Weather Service's Southeast River Forecast Center. Coordination will also be maintained with the U. S. Fish and Wildlife Service and the National Marine Fisheries Service to assure that impacts to fish and wildlife resources are considered.

The South Atlantic Division's representative will coordinate with other Corps Districts whose jurisdictional boundaries border the Savannah River drainage basin and whose water regulation activities could be impacted by drought management actions within the Savannah River Basin. Frequent public announcements in the form of "drought bulletins" will serve as an important mechanism for communicating to the various segments of the public the water shortage conditions. The "drought bulletins" will be mutually agreed upon by the committee. It will be the responsibility of each committee member to disseminate the bulletins to those interests which he/she represents. The SRBDCC will not be empowered with enforcement responsibilities. Such activities will continue to be the responsibility of appropriate state and local governmental entities. Existing state and local drought plans will be implemented as needed, and the committee will encourage governmental entities to undertake appropriate actions at the local level.

Successful implementation of the Savannah River Basin Drought Coordination Committee's recommendations will depend upon efficient and effective internal coordination within the Corps and institutional bodies within each of the States.

MEETINGS

The SRBDCC will meet at least twice a year, to insure that coordination links remain viable. These meetings will normally be held in late April or early May, following the winter and spring flood period, and in August, the beginning of the traditional low water period. These are appropriate times to appraise the conditions of the Federal impoundments within the basin and to develop projections for anticipated future conditions.

Once a significantly dry situation has been determined to exist within either the entire basin or a significant portion of the basin, the Committee will hold a "water shortage appraisal meeting." Any of the four participating parties will have the authority to call this initial meeting. If, based on the information evaluated at this meeting, it is determined that either the entire basin or a sub-basin may be entering a potential drought period, the committee will declare a "water shortage alert" for the affected region. Following the "water shortage alert" declaration, the committee will meet on an as-needed basis to monitor the status of the water shortage conditions, appraise the success of previous measures and determine appropriate future management measures. The committee will continue to meet monthly until conditions return to normal. Should conditions indicate a continuing trend toward a more severe water shortage, the committee will declare a "drought alert" for the basin. The "drought alert" will remain in effect until the committee collectively determines that the situation has improved. It should be emphasized that prior to issuance of either of these "alerts," the individual SRBDCC members must coordinate these actions within their respective organizations, as well as with other interests which could be affected by the various water management measures.

DISTRICT DROUGHT MANAGEMENT COMMITTEE (DDMC)

PURPOSE

The District Drought Management Committee (DDMC) will review staff recommendations for District actions required during a drought and make recommendations to the District Engineer on appropriate District actions. It will recommend to the District Engineer, the type, content, and timing of information to be provided to the public about the Savannah District's drought responses.

The District Drought Management Committee will be chaired by the Chief, Engineering Division, and vice-chaired by the Chief, Hydrology and Hydraulics Branch.

MEMBERSHIP

The District Drought Management Committee shall consist of a representative from each of the following staff elements:

ORGANIZATION	OFFICE	POC
DD-C (Deputy Commander)	DD-C	Deputy Commander
EM (Emergency Management)	EM	Chief EM
EN (Engineering Division)	EN/EN-H	Chief EN-H
OP (Operations Division)	OP	Chief OP
PD (Planning Division)	PD	Chief PD
CCO (Corporate Communications)	CCO	Chief CCO
RE (Real Estate Division)	RE	Chief RE

The Chief of Engineering Division may appoint additional members as necessary to insure broad based input on the committee.

RESPONSIBILITIES

A. The Committee Chairman will be advised of problems by the Chief, EN-H. Members of the District Drought Management Committee shall be notified at the onset of each drought alert phase and be provided information by the Chairman with respect to the drought alert phase.
B. Each member of the District Drought Management Committee is responsible for bringing to the attention of the committee items within the area of responsibility of their own Division/Office.
C. Members of the District Drought Management Committee may request that presentations on specific issues be made to the committee by other District personnel.

D. The District Drought Management Committee may delegate work tasks to individuals in the District with the approval of the committee member representing the individuals' Division/Office.
E. The District Drought Management Committee will recommend to the District Engineer the form, content, and timing of information provided to the public about the District's responses to the drought.
F. The committee will consider information received from the Savannah River Basin Drought Coordination Committee (SRBDCC).
G. The chairman of the District Drought Management Committee will present recommendations of that committee to members of the Savannah River Basin Drought Coordination Committee and to the District Engineer for his approval.

MEETINGS

The District Drought Management Committee would meet on a monthly basis during a drought. The chairman, or in his absence, the vice chairman, of the District Drought Management Committee will call this meeting. Additional meetings may be called at any time by any member of the District Drought Management Committee to address specific items which need attention before the next scheduled meeting. Minutes of each meeting will be kept by someone appointed by the vice-chairman of the District Drought Management Committee.

EMERGENCY ASSISTANCE MANAGEMENT MEASURES

Heretofore, the identified components of the SRBDMP are directed at a regional or basin management approach in addressing the adverse impacts of a drought. Despite the successful implementation of these measures, during the advanced stages of a severe water shortage, it is possible that the water supplies for a specific area may become inadequate to the point that a substantial threat is created to the health and welfare of the inhabitants of the area, including a threat of damage or loss of property. Accordingly, Public Law 93-288 allows an area to be designated a "Natural Disaster Area" under a Presidential declaration. Under this declaration an area may be eligible for a variety of assistance programs which are administered by the Federal Emergency Management Agency and other appropriate Federal agencies.

In addition, once an area has been determined to be "drought-distressed" by the Secretary of the Army, there is an emergency program available whereby the Corps of Engineers, under the approval of the Secretary of the Army, can assist in alleviating a water shortage situation. To qualify under this program an ·area need not have been designated as a "Natural Disaster Area." The authority for this program was provided by Public Law 95-51 which amended Public Law 84-99. Implementation of this program is governed by Corps of Engineers Regulation ER 500-1-1. The portion of this regulation which addresses the drought assistance program is included as Appendix G. Under this program the Corps can construct wells and transport water to farmers, ranchers, and political subdivisions which have been determined to be "drought-distressed." For the purposes of this assistance, a political subdivision has been defined as " a city, town, borough, county, parish, district, association, or other public body created by or pursuant to State laws, having jurisdiction over the water supply of such public body."

Since the responsibility for providing an adequate supply of water is basically non-Federal, the Corps, emergency program can be utilized only after non-Federal interests have exhausted all reasonable means for securing necessary water supplies, including assistance and support from other Federal agencies. As stated above, drought assistance under this program can assume two forms, construction of a well or transport of water. ER 500-1-1 Chapter 6, elaborates on the guidance for implementation of each of these assistance efforts. It can be found at http://publications.usace.army.mil/publications/eng-regs/ER_500-1-1/toc.htm .
It is important to note here that well construction is performed on a cost-reimbursable basis, whereas water transportation costs would be a 100 percent Federal expense. Another point which should be emphasized is that transportation of emergency water supplies will be provided only in connection with water needed for human and livestock consumption and not for irrigation, recreation, or other non-consumptive purposes. This emergency assistance program provides the opportunity to address the most severe localized situations which may be encountered under an extreme drought event. This program could be utilized to interface with state disaster management programs and plans, which may be undertaken as a water shortage becomes of increasing concern. To successfully utilize this program in consort with other state emergency programs, it will be necessary for the Savannah River Basin Drought Coordination Committee to become familiar with the availability, purposes, and

applicability of the various emergency programs which can be utilized as drought management measures. Therefore, once the Committee is established, one of its early efforts will be to investigate and document the management options available at the Federal and State levels and to develop an Emergency Plan of Action for implementing these measures. In the development of this Emergency Plan of Action it will be necessary to coordinate with the Corps, Emergency Management Division in the Savannah District and South Atlantic Division Offices, the Federal Emergency Management Agency, and the respective state emergency management offices to assure that all available programs have been considered and that a viable institutional organization exists by which the Emergency Plan of Action could be implemented.

It is important that the responsibility for the submission of emergency assistance requests remain within the States. In other words, the State representatives to the Committee should insure that individual requests made by local interests are reviewed at the State level prior to the submission to the Corps or other appropriate Federal agency. A systematic approach to the processing of these requests, which considers the overall water needs of the basin, would serve to insure that existing regional water shortage problems are not exacerbated by individual actions which are implemented to solve specific problems.

9. References.

a. Section 216, Public Law 91-611, (84 Stat. 1830), Rivers and Harbors Act of 1970.
b. ER 1110-2-1941
c. ER 1110-2-240.
d. Savannah River Basin Drought Contingency Plan (March 1989)
e. Savannah River Basin Water Control Manual (1996)
f. EA Drought Contingency Plan Update Savannah River Basin (August 2006)
g. EA Temporary Deviation Drought Contingency Plan Savannah River Basin (November 2008)
h. Drought Contingency Plan Update, Savannah River Basin (August 2006)
http://water.sas.usace.army.mil/Pub/Nepa/Final%20SRB%20Drought%20EA%20Aug%2006.pdf
i. EA Drought Contingency Plan Modification for Level 4 Drought Conditions in the Savannah River Basin (2011)
http://www.sas.usace.army.mil/reports.html
j. EA Drought Contingency Plan Update Savannah River Basin (August 2012)
http://www.sas.usace.army.mil/reports.html