

135 FERC ¶ 62,058  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Appalachian Power Company

Project No. 2210-199

ORDER MODIFYING AND APPROVING  
WATER MANAGEMENT PLAN UNDER ARTICLE 404

(Issued April 19, 2011)

1. On June 28, 2010, Appalachian Power Company, licensee for the Smith Mountain Pumped Storage Hydroelectric Project No. 2210 (Smith Mountain Project), filed a revised water management plan pursuant to Article 404 of the project license.<sup>1</sup> The project is located on the headwaters of the Roanoke River in Bedford, Campbell, Franklin and Pittsylvania Counties, Virginia.

**Background**

2. Article 404 requires, within 90 days of the effective date of the license, the licensee to file, for Commission approval, a final water management plan that addresses water management activities at the Smith Mountain Project. The plan must include the provisions of sections 1 through 5 of the proposed water management plan, filed July 15, 2008 with specific revisions described in Article 404.

3. The revised water management plan shall be prepared in consultation with the Virginia Department of Game and Inland Fisheries (Virginia DGIF), the Virginia Department of Environmental Quality (Virginia DEQ), the Virginia Department of Conservation and Recreation (Virginia DCR), the U.S. Army Corps of Engineers (Corps), the U.S. Fish and Wildlife Service (FWS), the Tri-County Relicensing Committee (or its successor), the Tri-County Administrative Commission, the Smith Mountain Lake Association, the Leesville Lake Association, the Roanoke River Basin Association, and Dominion Power. The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provide to the aforementioned consulted entities, and specific descriptions of how their comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the entities to comment before filing

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<sup>1</sup> See Order issuing New License 129 FERC ¶ 62,201 (issued December 15, 2009).

the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information.

4. The Commission reserves the right to require changes to the revised water management plan. Implementation of the water management plan, including any land-disturbing activities therein, shall not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee shall implement any such modification(s), including any changes required by the Commission.

### **Proposed Plan**

5. Water management at the Smith Mountain Project affects water uses within, and downstream of, the project. This is most evident during low-flow conditions, where maintaining sufficient flow for aquatic resources and recreational uses downstream of the project can lead to a drawdown of Smith Mountain Lake, or, conversely, where ensuring that lake levels are adequate for recreation can require a reduction in flows from Leesville that could harm downstream resources.

6. To address water management concerns at the project, the licensee will use an Operations Model<sup>2</sup> to forecast future Smith Mountain Lake levels and adjust downstream flow releases based on the probability of Smith Mountain Lake elevations reaching certain levels (trigger conditions) in the future. Under the water management plan, the project will continue to operate as a pumped storage facility, utilizing up to a 2-foot drawdown in Smith Mountain Lake and a 13-foot drawdown in Leesville Lake.

7. The plan includes, in part: (a) monthly minimum flows for aquatic organisms, habitat, and recreation in the Roanoke River downstream from Leesville, measured at Brookneal, Virginia; (b) operational restrictions during droughts, including absolute minimum flows; (c) a variance process for the operational provisions; (d) flood control operations; (e) a monitoring and reporting component to ensure that the project is operated in accordance with the license; and (f) an adaptive management component with a 5-year review and update cycle.

8. The plan includes absolute minimum flow releases (as an hourly average) as measured at Leesville Dam. The plan also includes target flows measured downstream at the Brookneal gage which combines flow contributions from tributaries below the project with flows released at Leesville Dam. The travel time between Leesville Dam and the Brookneal gage is approximately 16 hours. The licensee states that flows at Brookneal

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<sup>2</sup> The Operations Model is the *Roanoke River Basin Reservoir Operations Model*. The model incorporates the operating rules for each project in the Roanoke River Basin, as well as probabilistic triggers for reducing flow releases from Leesville.

will be monitored on a daily basis and releases from Leesville will be adjusted to meet the target flows at Brookneal. If average weekly flow at Brookneal does not meet the required flow targets, the licensee proposes to notify the Commission within 10 days of the incident.

9. The licensee proposes to submit annual reports to the Virginia DEQ, Virginia DGIF, and the Commission. The reports would include the following information, tabulated by date: 1) status of project in terms of trigger condition in effect; 2) adjusted elevation; 3) mean daily release at Leesville; and 4) target flow required by Section 2.C of the plan. The licensee proposes to submit the report by January 31<sup>st</sup> for the previous calendar year.

10. Section 5 of the plan includes a schedule and process for reviewing and updating the plan. Within five years after the date that the instream flow conditions become effective, and every five years thereafter, the licensee proposes to hold a public meeting to solicit comments on the performance of the project in maintaining lake levels and in providing flows necessary to protect instream beneficial uses. The comments would be summarized and provided to Virginia DEQ and the Commission. The licensee states that the report would also include consultation with Virginia DGIF regarding the effect of maximum flow releases under trigger conditions on the health of the downstream fishery.

11. The plan also includes reviewing and updating the plan every five years in consultation with the Corps, Virginia DEQ, Virginia DGIF, Virginia DCR, National Marine Fisheries Service (NMFS), Dominion Power, Tri-County Administrative Commission, Smith Mountain Lake Association, Smith Mountain Water Safety Council, Staunton River Water, Citizens for Preservation of the River, Upper Roanoke River Basin Association, Western Virginia Water Authority, county governments involved in water withdrawals, and other interested stakeholders.

12. The first meeting to review and update the plan would be held around five years from the issuance date of the license and continue every five years thereafter. Within six months of the meetings the licensee proposes to file reports with the Commission which would include the following information for the five year period preceding the report: a) summary of lake level fluctuations; b) summary of flow releases from Leesville; c) generation for Smith Mountain and Leesville; d) summary of permitted water withdrawals; e) discussion of how project operations compare to license requirements, including a record and explanation of any deviations from license requirements; f) proposed modifications to the water management plan for Commission approval; and g) documentation of consultation.

### **Consultation**

13. On March 28, 2010, the licensee forwarded copies of the revised plan to the Virginia DGIF, Virginia DEQ, Virginia DCR, the Corps, FWS, Tri-County

Administrative Commission, Smith Mountain Lake Association, Leesville Lake Association, Roanoke River Basin Association, and Dominion Power for a 30-day review period. Comments were received from the Virginia DEQ, Virginia DGIF, Smith Mountain Lake Association, and Dominion Power. No other entities provided comments on the plan. The licensee addressed all of the comments received and modified the plan to include the recommendations included in the comments.

### **Discussion and Conclusion**

14. The licensee's plan describes how the project will be operated to meet the requirements of the project license and water quality certification (WQC) issued by Virginia DEQ. The licensee's proposed reporting of any incident where weekly average flows measured at the Brookneal gage do not meet required targets is appropriate. In addition, the licensee should be required to notify the Commission in the event of any deviation from the absolute minimum flow releases required at Leesville Dam.

15. The licensee's reports of deviations should, to the extent possible, identify the cause, severity, and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report should also include: (1) operational data necessary to determine compliance with license requirements; (2) a description of any corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents do not recur; and (3) comments or correspondence, if any, received from the resource agencies regarding the incident. Based on the report and the Commission's evaluation of the incident, the Commission should reserve the right to require modifications to project facilities and operations to ensure future compliance.

16. The licensee's proposal to hold public meetings every five years would ensure that the interested public would have the opportunity to provide feedback regarding project operations over the life of the license. In addition, the five-year updates to the water management plan will help identify and address any issues related to water management at the project and ensure that stakeholders are included in the decision-making process. In order to consolidate reporting and reduce redundant consultations, the licensee should incorporate the results of the public meetings into the five-year plan update and reporting process (instead of submitting two separate reports to the Commission as described in the plan).

17. Following each five-year meeting, the licensee should compile the five-year report as described in its plan. The report should also include a summary of the public meeting and address the comments and recommendations raised during the public meeting. Prior to filing the five-year summary report with the Commission, the licensee should submit the report to the Virginia DGIF, the Virginia DEQ, the Virginia DCR, the Corps, the FWS, the Tri-County Relicensing Committee (or its successor), the Tri-County Administrative Commission, the Smith Mountain Lake Association, the Leesville Lake

Association, the Roanoke River Basin Association, the NMFS, and Dominion Power and allow them a minimum of 30 days to review and comment on the report. The licensee should include in its report, documentation of consultation, and address the comments received on the report. If the licensee does not adopt a recommendation from the above entities, the licensee should include its reasons based on project-specific information.

18. In order to track the licensee's compliance with this requirement, the reports should be filed with the Commission by July 1 starting in 2015 and every five years thereafter for the life of the license. The Commission should reserve the right to require changes to project operations and the water management plan based on the five-year reports and other relevant information.

19. The licensee's water management plan is a comprehensive plan to ensure that conditions of the project WQC and license are met. The plan includes provisions to review and update the plan on a regular basis for the life of the license and includes public, resource agency, and stakeholder participation in that process. The plan, as modified, meets the requirements of Article 404 and, therefore, should be approved.

The Director orders:

(A) Appalachian Power Company's (licensee) water management plan, filed June 28, 2010, pursuant to Article 404 of the Smith Mountain Pumped Storage Hydroelectric Project license, as modified by ordering paragraphs (B) and (C), is approved.

(B) The licensee shall notify the Commission within 10 days of any deviation from target flows, as a weekly average, measured at the Brookneal gage and/or absolute minimum flows, as an hourly average, measured at Leesville Dam as required by the project license. The licensee's reports of deviations shall, to the extent possible, identify the cause, severity, and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report shall also include: (1) operational data necessary to determine compliance with license requirements; (2) a description of any corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents do not recur; and (3) comments or correspondence, if any, received from the resource agencies and others regarding the incident. Based on the report and the Commission's evaluation of the incident, the Commission reserves the right to require modifications to project facilities and operations and the water management plan to ensure future compliance.

(C) The licensee shall file five-year reports with the Commission by July 1 starting in 2015 and following every five years thereafter for the life of the license. The reports shall include the information described in the plan and also include a summary of the five-year public meetings. Prior to filing the five-year summary report with the Commission, the licensee shall submit the report to the Virginia Department of Game and

Project No. 2210-199

- 6 -

Inland Fisheries, the Virginia Department of Environmental Quality, the Virginia Department of Conservation and Recreation, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the Tri-County Relicensing Committee (or its successor), the Tri-County Administrative Commission, the Smith Mountain Lake Association, the Leesville Lake Association, the Roanoke River Basin Association, the National Marine Fisheries Service, and Dominion Power and allow them a minimum of 30 days to review and comment on the report. The licensee shall include in its report documentation of consultation and address the comments received on the report. If the licensee does not adopt a recommendation from the above entities, the licensee shall include its reasons based on project-specific information. The Commission reserves the right to require changes to project operations and the water management plan to protect aquatic resources at the project.

(D) The licensee shall file any document required by this order with the Secretary of the Commission. Filings may be submitted electronically via the Internet, see 18 CFR 385.2001 (a)(1)(iii) and the instructions on the Commission's web site under the "e-filing" link. The Commission strongly encourages electronic filings. In lieu of electronic filing, an original and eight copies of all documents may be mailed to:

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E.  
Washington, D.C. 20426

(E) This order constitutes final agency action. Any party may file a request for rehearing of this order within 30 days from the date of its issuance, as provided in section 313(a) of the Federal Power Act, 16 U.S.C. § 8251 (2006), and the Commission's regulations 18 C.F.R. § 385.713 (2010). The filing of a request for rehearing does not operate as a stay of the effective date of this order, or of any other date specified in this order. The licensee's failure to file a request for rehearing shall constitute acceptance of this order

Steve Hocking  
Chief, Environmental Review Branch  
Division of Hydropower Administration  
and Compliance

**Smith Mountain Project No. 2210  
Appalachian Power Company  
Water Management Plan**

**June 2010**

**Table of Contents:**

<b>Section</b>		<b>Page</b>
1.	Description of Project and Prior License Operations.....	1
2.	Operation Under the Term of the License Effective April 1, 2010.	4
	A. Components of RRBROM.....	5
	B. Monthly Flow Requirements.....	5
	C. Trigger Points and Reduction in Flows.....	8
	D. Provisions for Downstream Recreation.....	9
	E. Striped Bass Spawning.....	11
	a) Releases for Spawning.....	11
	b) Surcharging of Lake.....	12
	F. Variance Process.....	12
	G. Summary of Flows.....	13
3.	Flood Operations.....	13
	A. Memorandum of Understanding with USCOE.....	13
	B. Notifications.....	14
	a) Smith Mountain Lake.....	14
	b) Downstream of Leesville Dam.....	15
4.	Project Operations and Monitoring.....	15
	A. Measurements of Water Levels .....	15
	B. Measurements of Flows.....	15
	C. Operations for Providing Minimum Flows from Leesville Development.....	16
	a) Autocycle Operations.....	16
	b) Providing Flow During Plant Outages.....	16
	D. Reporting Criteria.....	16
5.	Management Plan Review and Update.....	17

**Appendices**

- A. Summary of Historic Water Levels
- B. Summary of Trigger Events Based on Historic Record
- C. Graphs of Water Levels and Downstream Flows
- D. Appalachian and USACE Memorandum of Understanding – Flood Operations
- E. Example Smith Mountain Reservoir Flood Notification List
- F. Effects of Hourly Autocycling on Downstream Flows



## **Smith Mountain Project Water Management Plan:**

### **1. Description of Project and Prior License Operations:**

The Smith Mountain Project is a pumped storage facility that utilizes an upper reservoir (Smith Mountain development) and a lower reservoir (Leesville development). The water that is stored in Smith Mountain Lake first passes through turbine-generators in the Smith Mountain powerhouse to produce electricity and is then discharged into Leesville Lake. Most of this water is retained in Leesville Lake until it is pumped back into Smith Mountain Lake for re-use. A portion of the water in Leesville Lake however, is released through the turbine-generators at the Leesville powerhouse to generate additional electricity and to meet the discharge requirements of the Project's Federal Energy Regulatory Commission (FERC) license.

The Smith Mountain development utilizes a two-foot power pool. (Note: The term "two-foot" power pool is an approximation. The actual value is slightly less than two feet.) This means that when Smith Mountain is generating electricity, (i.e. releasing water), the Smith Mountain lake level can decrease up to two feet before Leesville Lake becomes full. In other words, a two-foot decrease in Smith Mountain results in Leesville Lake increasing thirteen (13) feet or from a minimum elevation of 600 feet to an elevation of 613 feet. Once Leesville is full (i.e. lake levels reach elevation 613 feet), power cannot be produced at Smith Mountain until some portion of the water is pumped back to Smith Mountain Lake or released through Leesville dam. There is no set schedule for operating the project. Generation is generally based on the demand for electricity. When the demand for electricity is high, Smith Mountain will generate. When the demand for electricity is low, water from the lower reservoir is pumped back into the upper reservoir. The operation of the project can change on an hourly basis depending on system demand.

The Project is considered full when the adjusted elevation for Smith Mountain Lake is 795.0 feet. The adjusted elevation is the elevation Smith Mountain Lake would be if the water that is held in Leesville for reuse (i.e. the water available between elevations 600 feet and 613 feet) is pumped back into Smith Mountain. It is important to understand the concept of and know the actual adjusted elevation because it places the current level of Smith Mountain Lake in perspective to the two foot power pool. If the lake level and the adjusted lake level are the same, then the lake may drop two feet during the day. On the other hand, if there is a difference of two feet between the lake level and the adjusted lake level, then the lake level will not drop further because the lake is at the bottom of the two-foot power pool.

Under the license that expired March 30, 2010, Appalachian was required to release a minimum average weekly discharge of 650 cfs from Leesville. This was accomplished by operating one unit at Leesville in autocycle mode. This means that

one unit was operated for 18 minutes every two hours for an average hourly discharge of 650 cfs.

Historic Water Levels on Smith Mountain:

Historic lake levels for the Smith Mountain Project are included in Appendix A. The lake reached full pond (795 feet elevation) on March 7, 1966. The highest elevation reached to date was 799.79 feet on April 27, 1978. The lowest elevation to date was 787.60 feet on January 23, 1970. It should be noted that DEQ granted variances to the minimum 650 cfs discharge requirement during the 1999, 2001 – 2002 and 2007-2008 droughts. The minimum lake levels below do not reflect the levels that would have resulted if the variances had not been obtained.

Below are the annual minimum and maximum actual water levels that have occurred at Smith Mountain Lake over the last ten years:

Table 1: Historic Smith Mountain Lake Water Levels (1997 – 2009)

\* Spill occurs when Smith Mountain Lake is above 795 feet.

YEAR	MAX. ELEV.	MAX. DATE	OTHER SPILL ELEV.	OTHER SPILL DATE	MIN. ELEV.	MIN. DATE
1997	795.00				791.55	OCT. 24
1998	795.83	JAN. 28	795.45	FEB. 5	789.11	DEC. 09
1999	795.07	DEC. 20	795.03	APR. 12	789.72	JAN. 05
2000	795.17	APR. 19	795.09	Apr. 20	791.59	NOV. 27
2001	795.09	MAR. 18			788.52	NOV. 28
2002	795.08	DEC. 16			788.83	JAN. 11
2003	796.15	FEB. 23			793.13	MAY 09
2004	797.42	SEP. 29			793.10	FEB. 20
			797.10	SEP.30		
			796.97	SEP. 28		
			796.01	OCT. 1		
			795.11	APR. 19		
2005	795.09	FEB. 16			791.85	OCT. 5
2006	795.09	SEP. 12			791.47	JUN. 22
2007	795.06	JAN. 1			789.57	OCT. 23

2008	795.01	MAR. 15				789.54	DEC. 10
2009	796.91	NOV. 13				791.61	OCT. 24

Minimum Flow Requirement and Variance Process:

Article 29 of the license that expired in March 2010 required Appalachian to release from the lower development (Leesville) a minimum average weekly flow of 650 cubic feet per second (cfs). In May 2000, Appalachian requested and received an amendment to Article 29 in order to respond more quickly to low flow events instead of waiting for the FERC to approve a variance. The amendment allowed flows to be temporarily modified if required by operating emergencies beyond the control of the licensee, and/or for short periods of time (up to 45 days) during drought and/or low inflow conditions, upon mutual agreement between the licensee and the Virginia Department of Environmental Quality (VDEQ), in consultation with the Virginia Department of Game and inland Fisheries, following appropriate public input as determined by VDEQ.

## **2. Operation Under the Term of the FERC License Effective April 1, 2010**

As part of Appalachian's relicensing efforts, two studies were completed to provide information to help formulate how the project should be operated over the term of the next license in order to meet the various demands on the available water source. These studies include the Instream Flow Needs Study and the Drought/Flood Management Study.

The Instream Flow Needs Study utilized PHABSIM to determine the relationship between streamflow and habitat suitability criteria for selected aquatic species, life-stages or community guilds. PHABSIM relies on hydraulic field data for calibration of computer simulation models, plus suitability criteria for the major mesohabitat variables of water velocity, depth, and substrate /cover. A demonstration flow assessment was utilized to assist in evaluating aquatic habitat and recreation use in areas too complex for hydraulic modeling (i.e. the braided channel and island complex known as the Hale Islands.)

The Drought / Flood Management Study utilized the RRBROM (Roanoke River Basin Reservoir Operations Model) to assess operating and management strategies and assist in balancing the various water uses. RRBROM is an application of Hydrologics' generic mass balance simulation model known as OASIS, which was designed specifically to investigate the interaction between multiple objectives in water allocation decisions. In a relicensing process, the most instructive way to use a simulation model is to run it iteratively for the period of record using one set of facilities, one set of withdrawals corresponding to either current or future demands, and one set of operating policies for each run. By running alternatives for the period of record, the performance of any particular system configuration can be examined over the full range of hydrologic conditions that have occurred over the period of record, which in this case is 77 years. Once an alternative has been developed and agreed to, the model can be used in a real-time predictive mode using ensemble stream flow forecasts to, among other things, indicate when to take corrective action during a drought.

Appalachian will be utilizing the model to provide forecasts of where Smith Mountain Lake levels are trending based on the historic record of inflows (1930 – present). During forecasted periods of low inflow as defined by the Triggers described in Section 2.C., adjustments will be made to the Leesville discharge flows in order to achieve a balance between maintaining Smith Mountain Lake levels and flow requirements needed to maintain downstream fishery and recreation resources. The model will be updated with current hydrologic data on an ongoing basis each time the model is run.

Probability-based triggers based on the ensemble forecasts are used so that flows can be reduced earlier but to a lesser degree than what has occurred during past low inflow periods. This is intended to keep the lake levels and the downstream flows higher for a longer period of time instead of waiting until lake levels drop too low and having to reduce downstream flows more severely. The Leesville discharge is to be

reduced if the forecasted lake level reaches a predetermined “Trigger” condition. Triggers are activated when the forecasted lake level has an “X” percent chance of reaching a level of “Y” within “Z” weeks. The conditions for activating the triggers are outlined in Section 2.C. of this Management Plan. Information obtained from the Instream Flow Needs Study and the Virginia Department of Game and Inland Fisheries (VDGIF) was utilized to formulate downstream flow requirements needed by month to maintain aquatic habitat for the species of concern. These flows are outlined in Section 2.B. of this Management Plan. Additionally, flows needed to support downstream recreation have also been incorporated into the model. There are times when the downstream recreation flow needs are higher than the biological flow needs. These flows are outlined in Section 2.D. of this Management Plan.

#### **A. Components of the RRBROM Model**

The RRBROM model comprises the operations of the entire Roanoke River Basin, including the hydropower operations at the Smith Mountain and Leesville Developments. It includes time series of natural, unregulated inflows to these projects as well as relevant locations downstream, including Altavista and Brookneal. It also includes estimates of precipitation and evaporation that are used to compute net evaporation from the lake surfaces. The mass balance accounting for each point in the system provides users with information about reservoir levels, reservoir releases including spills, water supply deliveries, and river flows. Output of the performance measures can be easily compared between existing and alternative operations to assess relative performance. The model also provides for the evaluation of probability-based triggers necessary for the development of effective drought management plans. These triggers are then implemented in real-time using RRBROM’s capability to generate ensemble forecasts.

#### **B. Monthly Flow Requirements**

The Virginia Department of Game and Inland Fisheries (VDGIF) provided information related to the required flows for downstream aquatic habitat needs by month and a minimum (“Floor”) for each month based on the weighted useable area / physical habitat index curves produced as part of the Instream Flow Needs Study for the species of concern. These flows are to be measured at the Brookneal USGS gage (No. 02062500) which is the sum of flows from Leesville dam and inputs from the local drainage area (i.e. downstream side flows). There is also a minimum average hourly flow, by month, to be discharged from the Leesville Development regardless of the flow at Brookneal. The minimum average hourly flows from Leesville dam are designed to ensure that aquatic habitat is maintained downstream of Leesville regardless of the distribution of sideflow inputs during any given time. The following table provides the normal minimum flow at the Brookneal gage when no trigger is in effect, Trigger 1 flows, Trigger 2 flows, Trigger 3 flows, and the minimum average hourly discharge from Leesville dam for all conditions. The flows reductions associated with the triggered events are discussed in Section 2.C. of the Management Plan. Units at Leesville are to be operated on an one-hour auto-cycling basis. In the

event that the units are out of service, the release may be made by spillway gate or other alternative methods available.

Appalachian shall release water at Leesville in an attempt to meet the target flows listed in Table 2 below. Target flows are measured at the Brookneal gage, USGS number 02062500, and expressed in units of cubic feet per second. Appalachian shall estimate tributary flows between Leesville and Brookneal when running the forecasting model and use such estimates in determining releases from Leesville when attempting to meet the target flows at Brookneal. Appalachian will work with the Department of Game and Inland Fisheries to study the effect of the maximum releases identified in notes 5,6 and 7 on the health of the fishery and provide a report to VDEQ as part of the 5-year review of the plan (Section 5).

The forecast based simulation model shall be run at least once every three (3) days to evaluate the probability of being at a certain elevation in the future.

Appalachian shall monitor on a daily basis adjusted storage levels in the Project lakes, inflow into the Project, downstream flows between Leesville dam and Brookneal, and releases from the Project into the Staunton River.

Table 2: Flows for Downstream Biological Needs (in cfs)

Month	Minimum Flow Required at Brookneal  Normal	Trigger 1	Trigger 2	Trigger 3	Minimum Discharge from Leesville (under all conditions) Avg. Hourly	Species of Concern
January	1100	990	990	770	375	Walleye - spawning habitat
February	1100	990	990	770	375	Walleye - spawning habitat
March	1100	935	825	770	400	Sucker - spawning habitat
April	1500	1275	1200	1050	400	Striped bass and American shad - habitat and fish passage/attraction
May	1500 <sup>4</sup>	1275	1200	1050	400	Striped bass and American shad - habitat and fish passage/attraction
June	900 <sup>1,3</sup>	765 <sup>2,6</sup>	765 <sup>3,6</sup>	630 <sup>3</sup>	400	Smallmouth bass and American shad – reproductive success
July	700 <sup>1</sup>	595 <sup>2,7</sup>	560 <sup>3,7</sup>	490 <sup>3</sup>	400	550 cfs represents the minimum acceptable flows for all species
August	See Note 1	570 <sup>2,7</sup>	570 <sup>3,7</sup>	420 <sup>3</sup>	400	550 cfs represents the minimum acceptable flows for all species
September	550	550 <sup>7</sup>	550 <sup>7</sup>	385	400	550 cfs represents the minimum acceptable flows for all species
October	600	570 <sup>7</sup>	570 <sup>7</sup>	420	400	550 cfs represents the minimum acceptable flows for all species
November	700	595 <sup>7</sup>	560 <sup>7</sup>	490	375	550 cfs represents the minimum acceptable flows for all species
December	800	720	720	560	375	Flows greater than 700 cfs - winter habitat for all species and to transition into Jan/Feb. flows.

\*Note: The flows in Table 2 are the flows needed for the fishery. There are times when the downstream recreation flow needs are higher than the biological needs. Recreation Flows are discussed in Section 2.D.

Notes:

1. Minimum release at Leesville of 650 cfs, in terms of an average hourly flow.
2. The minimum release of 650 cfs at Leesville will be made on Saturdays and Sundays and on Memorial Day, July 4<sup>th</sup> and on Labor Day for recreation. Appalachian shall time the release in an attempt to make it arrive at Long Island at 8 AM on Saturday and to subside at Brookneal at 8 PM on Sunday.
3. A minimum release of 650 cfs will be made at Leesville for 12 hours times to arrive at approximately sunrise at Long Island on Saturdays and on Memorial Day, July 4<sup>th</sup> and on Labor Day.

4. Upon notification by the Department of Game and Inland Fisheries that striped bass spawning is complete, Appalachian may reduce releases and only be required to make release for the June normal target of 900 cfs.
5. The maximum release that Appalachian is required to release in attempting to hit the target flow at Brookneal is 700 cfs.
6. The maximum release that Appalachian is required to release in attempting to hit the target at Brookneal is 650 cfs.
7. The maximum release that Appalachian is required to release in attempting to hit the target at Brookneal is 480 cfs.

### **C. Trigger Points and Reduction in Flows**

Appalachian will utilize a predictive model that provides a forecast of where Smith Mountain Lake levels are trending based on the historic record of inflows (1930 – present). Forecasting is used so that flows can be reduced earlier and to a lesser degree than in the past. This is to keep the lake levels and the downstream flows higher for a longer period of time instead of waiting until lake levels drop too low and having to reduce downstream flows more severely. This proactive approach allows for a more gradual transition to flow reduction than would have occurred under the current reactive approach.

The forecast based simulation model shall be run at least once every three (3) days to evaluate the probability of being at a certain elevation in the future. The model will be updated with current hydrologic data on an ongoing basis.

Discharges are to be reduced if the forecasted lake level reaches a predetermined “Trigger”. Triggers are activated when the forecasted lake level has an “X” percent chance of reaching a level of “Y” within “Z” weeks based on the predictive model. There are three trigger levels that have been utilized in the model as shown in Table 3. While the Smith Mountain Lake level used in the Triggers may seem low, the idea is to act early (looking out 4 months) to reduce flows so that the decreasing trend is reversed and further reductions are not needed. Appendix B contains a list of triggered events that would have occurred over the period of historic record (1930 – 2007) if the protocol had been in place at that time. Appendix C contains graphs showing lake levels and downstream flows under the protocol (HL\_8).



Table 3: Trigger Points and Reduction in Flows

<b>Trigger</b>	<b>Conditions for Trigger Activation</b>	<b>Flow Reduction at Brookneal</b>
Trigger 1	Forecasted lake level has a 20% chance of dropping below 790.5 feet adjusted in 16 weeks	<b>85%</b> of monthly Minimum Flow At Brookneal (Normal conditions - no trigger events in effect) or <b>“Floor”</b> Flow <b>whichever is larger</b>
Trigger 2	Forecasted lake level has a 2% chance of dropping below 790 feet adjusted in 10 weeks	<b>“Floor”</b> Flow at Brookneal”
Trigger 3	If Trigger 2 is in effect and adjusted elevation is less than 795 feet between December 1 and March 31 or anytime the adjusted elevation drops below 791.0 feet after September 30.	<b>70%</b> of monthly Minimum Flow At Brookneal (Normal conditions - no trigger events in effect)

The floor flow represents the maximum acceptable deviation from the recommended flows by month at Brookneal during extended low inflow conditions. The flows were provided by VDGIF and were based on the weighted usable area / physical habitat index curves for the species of concern.

All triggers are lifted if the elevation has reached 795 feet (adjusted) and there is less than a 2% chance of dropping below 790.5 feet (adjusted) sixteen weeks from that time.

The model will not be able to predict every scenario that can happen. During multi-year, extreme drought situations, additional steps may need to be taken to mitigate the low inflow impacts to the lake level and downstream areas. Therefore, provisions will be retained to seek a variance of the protocol outlined in this Management Plan. These steps are outlined under Section 2.G.

**D. Provisions for Downstream Recreation**

Under the flows provided by VDGIF, there are several months when the downstream recreation flow needs are higher than the biological flow needs. These months also happen to correspond to the traditional recreation period of Memorial Day to Labor Day (June – August). During these months, the model provides for additional flow in excess of the biological flow needs to support recreation. These flows are listed in the table below and are provided by a 650 cfs release from Leesville instead of being measured at Brookneal.

Table 4: Recreation Flows

	<b>Recreation Flows (June – August)* as Discharged from Leesville</b>	<b>Flow at Brookneal for periods when not releasing 650 cfs from Leesville (June, July, August) Based on VDGIF Biological Flows</b>
Trigger not in effect	Minimum Release of 650 cfs every day	650 cfs plus side flow below Leesville
Trigger 1	The minimum release of 650 cfs at Leesville will be made on Saturdays and Sundays and on Memorial Day, July 4 <sup>th</sup> and on Labor Day of recreation. Appalachian shall time the release in an attempt to make it arrive at Long Island at 8 AM on Saturday and subside at Brookneal at 8 PM on Sunday.*	June:765, July: 595, August: 570
Trigger 2	A minimum release of 650 cfs will be made at Leesville for 12 hours times to arrive at approximately sunrise at Long Island on Saturdays and on Memorial Day, July 4 <sup>th</sup> and on Labor Day.	June:765, July: 560, August: 570
Trigger 3	Release of 650 cfs for 12 hours times to arrive at approximately sunrise at Long Island on Saturdays and on Memorial Day, July 4 <sup>th</sup> and Labor Day.	June:630, July: 490, August: 420

\* The following recreation flow needs will also be accommodated for the following events when in Trigger 1 if requested in writing by the sponsoring organization thirty (30) days prior to the event: Uncle Billy's Day (Altavista, first Saturday in June), Striper Festival at Brookneal (first weekend in May), and Float Day at Long Island (Saturday after Father's Day).

## **E. Striped Bass Spawning**

### **a. Releases for Striped Bass Spawning**

Each year Appalachian consults with the Virginia Department of Game and Inland Fisheries regarding flow needs for striped bass spawning. Releases typically begin the middle of April and last approximately 45 days. The monthly flows for April and May provided in the protocol for the new license were designed with the spawning of striped bass in mind. Under the new license, Appalachian will continue to consult with the Virginia Department of Game and Inland Fisheries regarding discharges needed for striped bass spawning downstream of Leesville.

### **b. Surcharging**

To the extent that inflows allow, Appalachian shall store additional water in Leesville Lake so that the adjusted storage shall be equal to 795.3 feet adjusted by April 15<sup>th</sup> of each year. The extra 0.3 feet of storage is intended to be used to ensure the success of the striped bass spawning run and need not be retained past the end of that run unless Appalachian chooses to do so, while still complying with minimum instream flowby requirements.

## **F. Variance Process**

No protocol can anticipate all future conditions. It is important to have a process that allows for consultation with stakeholders for periods that are not typical or for extreme events. Under the new license, Appalachian wants to retain the ability to consult with state agencies, stakeholders that live on Smith Mountain Lake and stakeholders downstream from the project. Appalachian is requesting that the language in the new license include the following:

If required by operating emergencies beyond the control of the licensee, or when Trigger 3 events occur during drought or low inflow conditions, flows can be temporarily modified from those described in the *Water Management Plan* upon mutual agreement between the licensee and the Virginia DEQ, in consultation with the Virginia Department of Game and Inland Fisheries, following appropriate public input as determined by VDEQ.

## **G. Summary of Flows**

Table 2 in Section 2.B. provides a table that contains required minimum flows per month based on No Triggers in effect, Trigger 1 in effect, Trigger 2 in effect, Trigger 3 in effect and minimum average hourly discharge requirements. Also included are the recreational flows that will be provided at each Trigger level. Included in the model, but not indicated in the table, is a net water withdrawal of 12.5 MGD.

Frequency plots showing elevation or stream flow can be generated with the RRBRM to show the balance between conflicting uses such as lake levels and downstream flows. These plots show, for example, the percent of time that the lake level will be below a certain level when the project is operated over the period of record using the protocol. Considerable effort was made to ensure that the frequency of attaining desirable lake levels is approximately the same as the frequency of sustaining desired flows downstream.

## **3. Flood Operations**

### **A. Memorandum of Understanding with USACE**

Appalachian and the U.S. Army Corps of Engineers (USACE) operate under Memorandum of Understanding (MOU) concerning the operation of Smith Mountain Project for flood control. This MOU has been in place since July 22, 1966. The MOU outlines the responsibilities of Appalachian and the USACE and includes a Regulation Plan. A copy of this MOU dated July 22, 1966 is in Appendix D of this Water Management Plan. Appalachian has met with USACE and there was agreement to continue operating under this MOU.

In summary, the MOU requires the following:

Appalachian is required to notify the USACE whenever spill becomes necessary at Leesville. The USACE has the responsibility for developing, with Appalachian, detailed operating procedures for the project for use during flood periods. During flood periods, storm runoff will be stored, to the extent storage space is available, for the prevention or reduction of harmful river stages downstream. Whenever harmful river stages occur, or are forecasted at Altavista (USGS Gage No. 02060500), controllable releases from Smith Mountain reservoir shall be restricted when such restrictions will be effective in preventing or lowering the harmful river stages. Whenever harmful river stages occur, or are forecasted to occur, at or above Altavista, storage available in Leesville Reservoir will be used to re-regulate water releases for power generation at Smith Mountain to a uniform 24-hour discharge. Any remaining storage will be used to store runoff from the drainage area between the two dams or discharge over the Smith Mountain spillways. Storing water in Leesville reservoir need not reduce the discharge at Leesville below full gate operation of the turbines.

For floods which do not exceed the no-damage stage at Altavista (19.4 feet / 20,000 cfs), the restriction on releases from Smith Mountain will be continued until the runoff from the local area has peaked and evaluation of flood waters stored in Leesville Reservoir has begun. For floods which do exceed the no-damage stage at Altavista, the restriction will be continued until the peak has passed Altavista and generation can be increased without increasing the stage at Altavista.

Flood water stored in Smith Mountain and Leesville Reservoirs will be released as soon as possible consistent with the above requirements, using as much of the water as possible for power generation. However, in the event that rain again starts falling on the area, water stored in Leesville reservoir will be released, through spilling if necessary, at a rate which will not produce a rise at Altavista greater than has already taken place, and if possible, not to exceed the no-damage stage.

There are also provisions in the MOU that address the sharing of information between Appalachian and USACE. If at any time the Corps updates its Operations Manual for the Roanoke River, the licensee shall consult with the Corps regarding any needed updates to this agreement. The updated agreement shall be filed with the Commission for approval.

**B. Notification (upstream and downstream)**

a. Smith Mountain Reservoir:

The Smith Mountain Dam has two ungated overflow spillways that allow water to be released whenever the lake elevation exceeds full pond (795 foot) elevation. During inflow events where spilling water at Smith Mountain dam is anticipated, Appalachian notifies the local media to alert citizens that live on the lake that the lake will be exceeding full pond elevation. Under the new license, Appalachian will develop a flood notification list for alerting the lake community. It will include the media, county government, marinas, Tri-County Lake Administrative Commission, Smith Mountain Lake Association, Leesville Lake Association, and Association of Lake Area Communities. The information will also be provided on the American Electric Power's website, [www.aep.com](http://www.aep.com). There is no way to predict how high the water will rise on Smith Mountain Lake while it is still raining and/or the rivers have not crested; however, Appalachian will provide periodic updates on lake levels and conditions during the flood event.

An example Smith Mountain Reservoir Flood Notification List is included in Appendix E of this plan. This list contains a summary of the contacts that will be made in the event that spilling water at Smith Mountain dam is anticipated. This list, along with the appropriate contact numbers, will be incorporated as Page I-7 (Notification Flowcharts) into the Smith Mountain Emergency Action Plan and updated annually as part of that plan.

b. Downstream of Leesville Dam:

Appalachian maintains a notification sheet for downstream areas as part of the Emergency Action Plan – Condition C (Non-failure Flood Notification List). Appalachian first notifies the USACE if an anticipated spill is going to occur. If it is anticipated that the Altavista gage is going to reach 16 feet, then the Altavista Police Department and the Brookneal Hatchery are contacted. If it appears that the Altavista gage is going to reach 18 feet, then the National Weather Service, Virginia Department of Emergency Services, State Police, Campbell County Sheriff, Town of Brookneal Police, Pittsylvania County Sheriff, Halifax County Sheriff, Charlotte County Sheriff and the Virginia Department of Transportation are notified. These various groups are contacted with every two foot of gage height increase. There are also contacts for downstream businesses and residents that are included in the notification lists. Appalachian will continue to provide these contacts under the term of the new license. This notification sheet is updated yearly as part of the Smith Mountain Emergency Action Plan.

**4. Project Operations Monitoring**

**A. Measurement of Water Levels**

Forebay (reservoir) and tailrace (below dam) water level transducers provided upstream and downstream of Smith Mountain and Leesville dams record both elevations continuously. The elevations are monitored at the Roanoke Operations Center (ROC) located in Virginia and at the American Electric Power System Control Center located in Columbus, Ohio. In addition to the electronic devices, there are staff gages located upstream and downstream that are calibrated with the transducers. Cameras are located at both locations that give a continuous visual indication of forebay and tailrace elevations to the dispatch centers. At Smith Mountain, the primary forebay gauges are Sierra float models with backup provided by a bubbler system. Both gauges are located near to the center of the dam along the upstream side. At Leesville, the primary forebay gauge is a Sierra float model while the backup is an U.S. Gauge / Ametek pressure gauge. The primary tailrace gauges at both plants are U.S. Gauge / Ametek pressure gauge with a bubbler system backup.

**B. Measurement of Flows**

Discharges from Leesville dam are based on discharge curves for the units. The ROC monitors discharges and adjusts unit operations as needed to meet required flows.

Downstream flows are measured at the USGS river gages at Goose Creek (USGS Gage No. 02059500), Altavista (USGS Gage No. 02060500) and Brookneal (USGS Gage No. 02062500). These gages will be used to determine the local inflows between Leesville and Brookneal that will be incorporated in the estimate of the Leesville releases. The target flows at Brookneal will be met by a combination of



estimated local inflow and Leesville release, although the Leesville daily average related will not be allowed to drop below the minimum releases shown in Table 2 (375 cfs or 400 cfs, depending on the month). Altavista Gage (USGS Gage No. 02060500) is utilized during floods for monitoring flood stage downstream. Appalachian maintains equipment that is located inside the USGS gage houses at Goose Creek and Altavista, and flow and stage information is transmitted continually back to the ROC.

Inflows into the project are monitored at USGS River gages located on the Roanoke River (No. 02055000, Blackwater River (No. 02056900), and Pigg River (02058400). Appalachian maintains equipment that is located inside these USGS gage houses, and flow and stage information is transmitted continually back to the ROC.

### **C. Operations for Providing Minimum Flow from Leesville Development**

#### **a. Autocycle Operations**

During periods when the required discharge is less than one unit's discharge, a unit at Leesville will be operated on an hourly autocycle basis to provide the required flow. For example, one unit would be operated for 9 minutes each hour for an average hourly discharge of 675 cfs. (One unit averages a discharge of 4500 cfs.) The Purpose of adopting hourly autocycle operations is to reduce the magnitude of streamflow variability between cycles compared to the current condition. Examples of hourly autocycle operation on downstream flows are provided in Appendix F.

#### **b. Providing Flow during Plant Outages**

There are seldom times when both units at Leesville are out of service at the same time. However, when this occurs, required flows will be released downstream through an open spillway gate. The spillway gates are manually operated. If both units are scheduled out of service, plant personnel will open a spillway gate to establish required flows prior to taking the units out of service. If there is an event where both units are forced out of service, Roanoke Operations Center staff will immediately notify plant personnel to open a spillway gate in order to reestablish minimum flows as required. The flow will generally be restored within one hour. The response time during adverse conditions may be slightly longer.

### **D. Reporting Criteria**

Under the new license, the required flows will be measured at the Brookneal River gage. Travel time between the Leesville dam and Brookneal is approximately 16 hours. In other words, changes in flows from the Leesville dam will not show up at Brookneal for 16 hours. The Roanoke Operations Center will monitor flows on a daily basis and make adjustments to meet the downstream required flows. If the average weekly flow at Brookneal does not meet the required flow in the protocol, then Appalachian will notify the FERC within 10 days following the incident.

Appalachian shall file an annual report with the Virginia DEQ, the Virginia DGIF, and the Commission in accordance with Article 401(b), that tabulates the following by date:

- The status of the project in terms of the trigger condition in effect,
- Adjusted elevation,
- Mean daily release at Leesville, and
- Target flow required by Section 2.C.

The report shall be submitted by January 31<sup>st</sup> for the previous calendar year.

## **5. Management Plan Review and Update**

Within 5 years after the date that the instream flow conditions become effective, and every 5 years thereafter, the licensee shall hold a public meeting in the vicinity of the project and accept comments on the performance of the project in maintaining lake levels and in providing flows necessary to protect instream beneficial uses. The licensee shall summarize the comments and provide them to the Virginia DEQ, as well as the Commission, in accordance with Article 401(b), along with any recommendations that the licensee might have. Included in the report is to be consultation with VDGIF regarding the effect of the maximum releases identified in notes 5, 6, and 7 (Section 2.B) on the health of the fishery.

Appalachian is proposing that the protocol contained in the Water Management Plan be reviewed and updated every five years in consultation with the U.S. Army Corps of Engineers, Virginia Department of Game and Inland Fisheries, Virginia Department of Environmental Quality, Virginia Department of Conservation Recreation, National Marine Fisheries Service, Dominion Power, Tri-County Administrative Commission, Smith Mountain Lake Association, Smith Mountain Water Safety Council, Staunton River Water, Citizens for Preservation of the River, Upper Roanoke River Basin Association, Western Virginia Water Authority, county governments involved in water withdrawals and other interested stakeholders. The first review and update meeting will occur five years following the issuance of the license.

A report will be filed with the FERC within six months following the update meeting and will include consultation with the above listed stakeholders. The report will contain the following for the five year reporting period:

- a. Summary of lake level fluctuations
- b. Summary of flow releases from Leesville
- c. Generation records for Smith Mountain and Leesville
- d. Summary of permitted water withdrawals
- e. Discussion of how project operations compares to license requirements, including a record and explanation of any deviations from such requirements
- f. Proposed modifications to the Water Management Plan for Commission approval
- g. Consultation Documentation

Appendices:

- A. Summary of Historic Water Levels
- B. Summary of Trigger Events based on Historic Data
- C. Graphs of Water Levels and Downstream Flows
- D. Appalachian and USACE Memorandum of Understanding – Flood Operations
- E. Example of Smith Mountain Lake Flood Notification List
- F. Effects of Hourly Autocycling on Downstream Flows

## Appendix A

### SMITH MOUNTAIN LAKE HISTORICAL LAKE ELEVATIONS Annual Actual Maximum and Minimum Reservoir Elevations / Dates As Measured at the Smith Mountain Dam

\*Spill occurs during periods when the reservoir is above 795.0.

YEAR	MAX. ELEV.	MAX. DATE	OTHER SPILL ELEV.	OTHER SPILL DATE	MIN. ELEV.	MIN. DATE
1966	795.00				FIRST FULL	MAR. 7
1967	795.00				791.00	NOV. 17, NOV. 18
1968	795.00				788.70	OCT. 18
1969	795.00				790.40	JAN. 8
1970	795.00				787.60	JAN. 23
1971	795.20	MAY 16			789.60	FEB. 3
1972	797.60	JUN. 22			791.70	MAR. 10, MAR. 11
1973	795.00				791.80	NOV. 13, NOV. 30, DEC. 1
1974	795.00				790.50	DEC. 5, DEC. 6, DEC. 7
1975	796.80	MAR. 20			791.60	JAN. 3, JAN. 4
1976	795.00				789.90	SEP. 30
1977	795.20	APR. 5			788.30	OCT. 21, OCT. 22

1978	799.79	APR. 27	796.40	JAN. 27	790.30	NOV. 11
1979	796.90	FEB. 26	796.30	SEP. 22, SEP. 23	792.30	JAN. 1
1980	795.30	APR. 14			789.40	DEC. 5
1981	794.70	JUL. 13			789.30	JAN. 17
1982	795.00				791.80	NOV. 5
1983	795.80	APR. 10			789.80	OCT. 7 OCT. 20
1984	795.10	FEB. 14, FEB. 16			792.50	OCT. 20, OCT. 21, OCT. 22
1985	799.50	NOV. 5	795.80	AUG. 18, AUG. 19	792.60	MAY 14
1986	795.00				790.80	AUG. 15
1987	799.53	APR. 17	799.26 798.35 796.25	SEP. 8 APR. 26 MAR. 2	792.90	AUG. 27
1988	795.00				790.75	DEC. 13
1989	795.30	MAY 6			790.84	FEB. 17
1990	796.09	OCT. 23			793.33	JUL. 6
1991	795.00				790.34	NOV. 6
1992	797.46	APR. 22			791.44	FEB. 2
1993	796.56	MAR. 5			791.48	NOV. 18
1994	795.41	MAR. 29			791.92	NOV. 1
1995	796.31	JUN. 29	795.14	JUN. 24	791.11	OCT. 3
1996	796.56	SEPT. 7	795.63	JAN. 20	792.88	FEB. 7
1997	795.00				791.55	OCT. 24

1998	795.83	JAN. 28	795.45	FEB. 5	789.11	DEC. 09
1999	795.07	DEC. 20	795.03	APR. 12	789.72	JAN. 05
2000	795.17	APR. 19	795.09	Apr. 20	791.59	NOV. 27
2001	795.09	MAR. 18			788.52	NOV. 28
2002	795.08	DEC. 16			788.83	JAN. 11
2003	796.15	FEB. 23			793.13	^MAY 09
2004	797.42	SEP. 29			793.10	FEB. 20
			797.10	SEP.30		
			796.97	SEP. 28		
			796.01	OCT. 1		
			795.11	APR. 19		
2005	795.09	FEB. 16			791.85	OCT. 5
2006	795.09	SEP. 12			791.47	JUN. 22
2007	795.06	JAN. 1			789.57	OCT. 23
2008	795.01	MAR 15			789.54	DEC 10
2009	796.91	NOV 13			791.61	OCT 24

**Appendix B: Summary of Trigger Events based on Historic Data**

Trigger 1 events				Trigger 2 events			Trigger 3 events			Months below 792 feet (adjusted)
Start date	Start elevation (ft, adjusted)	7-day avg inflow to SM/Lee at trigger activation (cfs)	Approx. Days	Start date	Start elevation (ft, adjusted)	Approx. Days	Start date	Start elevation (ft, adjusted)	Approx. Days	
6/16/1930	793.1	774	315	6/23/1930	793.0	305	12/8/1930	788.8	140	7
7/4/1932	794.1	618	110	8/22/1932	792.5	60				2
7/24/1933	793.7	668	245							1
6/23/1941	794.4	757	15							
8/31/1953	792.6	485	160	9/7/1953	792.4	145	12/7/1953	790.6	60	3
7/5/1954	794.0	562	125	8/2/1954	793.7	70				1
6/25/1956	792.8	668	140	7/2/1956	793.6	130				2
7/20/1959	793.6	974	80							
6/10/1963	793.6	929	230	7/8/1963	792.9	205	12/2/1963	791.3	60	4
6/22/1964	793.5	627	75	7/13/1964	793.3	50				
7/5/1965	794.1	686	225							
7/4/1966	792.5	488	110	7/11/1966	792.2	100				3
7/24/1967	793.4	911	35							
7/15/1968	793.9	683	105	9/30/1968	792.2	20				1
6/23/1969	794.1	1237	60							
6/22/1970	793.7	685	55							
7/4/1977	793.8	673	130	8/1/1977	792.7	105				
9/8/1980	793.0	631	515	9/29/1980	792.6	490	12/8/1980	792.6	425	5
9/12/1983	791.9	432	80	9/19/1983	791.8	70				
5/19/1986	793.4	1164	190	7/7/1986	792.9	140				
8/31/1998	793.8	612	160	9/28/1998	793.2	125	12/7/1998	792.5	60	
6/21/1999	792.7	573	105	6/28/1999	792.5	95				1
7/23/2001	793.8	545	490	9/24/2001	792.9	420	12/3/2001	791.0	360	5
6/19/2006	793.2	706	10							
8/27/2007	792.1	506	130	9/3/2007	792.5	120	12/3/2007	792.2	30	2
<b>Total events</b>	<b>25</b>			<b>Total events</b>	<b>17</b>		<b>Total events</b>	<b>7</b>		

Trigger 1 days include trigger 2 and 3 days; trigger 2 days include trigger 3 days  
 Trigger 1 will not activate if elevation is above 794.5. A 7 day wait required between trigger activation  
 2007 water year inflow data are provisional  
 Table shows trigger events lasting 7 days or more  
 2007 water year inflow data are provisional

## **Appendix C: Graphs**

### **Protocol (HL\_8)**

Note: The following graphs include a future net water withdrawal of 12.5 MDG from the Smith Mountain Project that was incorporated into the model.