

2018 Washington Metropolitan Area Drought Exercise

Report submitted to the Interstate
Commission on the Potomac River Basin
by Policy Works LLC



November 30, 2018
Griffith Water Treatment Plant
Lorton, Virginia

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LIST OF ACRONYMS

CO-OP	Cooperative Water Supply Operations on the Potomac (a section of ICPRB)
ICPRB	Interstate Commission on the Potomac River Basin
LFAA	Low Flow Allocation Agreement of 1978
MDE	Maryland Department of the Environment
MGD	Million gallons per day
MOS	Margin of Safety
MWCOG	Metropolitan Washington Council of Governments
PRRISM	Potomac Reservoir and River Simulation Mode
UOSA	Upper Occoquan Service Authority
USACE	U.S. Army Corps of Engineers
VADEQ	Virginia Department of Environmental Quality
WMA	Washington Metropolitan Area
WSSC	Washington Suburban Sanitary Commission
WSCA	Water Supply Coordination Agreement of 1982
7Q10	7-day minimum flow with a 10-year recurrence interval

INTRODUCTION

Because the Washington Metropolitan Area (WMA) is reliant on the Potomac River Basin for three-quarters of its water supply, preparing for drought in the Potomac River Basin is essential to supporting water security for Washington, D.C. region as well as the ecological functions of the riverine system. The water suppliers of the region work with the Interstate Commission on the Potomac River Basin (ICPRB) to provide for a coordinated and cooperative approach to water supply management. To prepare for drought, the ICPRB's Cooperative Water Supply Operations on the Potomac (CO-OP) Section hosts annual drought exercises to practice and test drought operations. In 2018, ICPRB designed a drought exercise specifically focused on the regulatory and management response of federal, state, regional and utility-level entities in an extreme drought situation.

The three main water suppliers in the WMA have established a cooperative approach to water supply planning and management. These suppliers, Fairfax Water, Washington Suburban Sanitary Commission (WSSC), and the Washington Aqueduct (a division of the U.S. Army Corps of Engineers (USACE)) share and jointly fund storage in upstream reservoirs and coordinate their water supply operations to optimize resource use during dry periods and to address other water management concerns. Their cooperative approach is set out in two agreements: the 1978 Potomac River Low Flow Allocation Agreement (LFAA) and the Water Supply Coordination Agreement (WSCA) of 1982, and it is coordinated with the support of the CO-OP Section of ICPRB.

In 2017, ICPRB commissioned a study of the LFAA to determine whether the agreement should be updated or revised. The study involved interviews with LFAA signatories and review of documents related to the LFAA. The results of the study were presented to the ICPRB Commissioners in March 2018. One recommendation of the study was to provide opportunities for LFAA parties to practice response to a severe drought and test the application of the LFAA. While the CO-OP holds annual drought exercises to practice communications and operations, the exercise had not previously been designed to present hypothetical conditions that could result in the activation of the full scope of the LFAA agreement. Therefore, the 2018 exercise was designed to test response to drought conditions that were severe enough that the LFAA provisions would apply.

In addition to the LFAA and WSCA, drought response in the WMA region is addressed by multiple drought plans developed by the states of Maryland and Virginia, as well as the Metropolitan Washington Council of Governments (MWCOCG). While these plans are all designed with the goals of effective drought response, the plans vary in terms of their metrics and implementation. ICPRB included components of these plans in the 2018 drought exercise to evaluate whether the overlapping plans created any potential coordination issues that might need to be addressed.

2018 DROUGHT EXERCISE OBJECTIVES

ICPRB designed the 2018 drought exercise with the following two objectives:

- To test the mechanisms in the LFAA for allocating water during an extreme drought, and
- To explore the interactions between multiple drought management plans that encompass the Potomac River and the WMA.



DROUGHT EXERCISE FACILITATION

To assist with the drought exercise, ICRPB engaged the services of Policy Works LLC to provide facilitation services. Through this contract, Kristin Rowles and Mark Masters worked with ICRPB staff to plan, prepare for, and implement the 2018 drought exercise. Working in partnership with the facilitation team, ICRPB staff focused on technical aspects of the exercise and developed a model to simulate drought conditions and operations for the exercise. The facilitation team focused on planning for effective group process, ensuring engagement of all participants, creating a constructive environment for learning and collaboration, and supporting clear communications. In the exercise, as well as during advance meetings to prepare for the exercise, Kristin and Mark focused on helping the group to articulate its experiences and lessons learned, identifying areas for further exploration and discussion, and keeping meetings on track toward objectives.

The facilitation process extended well beyond in-meeting facilitation and included extensive preparation activities as well as post-meeting reporting. The facilitators sought to design the exercise to attain ICRPB's objectives, but also to support:

- Participation by all members through channels that accommodate individual styles of interaction
- Shared understanding by members of complex technical materials

- Efficient use of participants' time
- Constructive resolution of conflicts
- Open dialogue in an atmosphere of trust
- Accomplishment of project tasks within the time and budget available

DROUGHT EXERCISE REPORTING

The 2018 drought exercise was held on November 30, 2018 at the Griffith Water Treatment Plant of Fairfax Water in Lorton, Virginia. It was attended by 58 participants representing water suppliers, federal and state agencies, local governments, and regional planning and coordinating organizations. By providing the participants with an opportunity to consider the regional response to a severe drought, the exercise identified several areas for further investigation and discussion to increase the resiliency of the region in such conditions. This report describes the exercise and its findings. It summarizes pre-exercise preparation activities and exercise discussions and describes the themes, findings, and participant observations. The report concludes by identifying opportunities for extending the impact of the exercise with improved coordination and information to support drought response preparation.

PREPARATION FOR THE EXERCISE

Preparation for the November 2018 drought exercise began in the summer. The primary preparation activities to support the design of the exercise were:

- a) Advance interviews with participants
- b) Development of a model to simulate the hypothetical drought conditions for the exercise

These two activities provided the structure and the content for the exercise and are described below. Additional preparation activities included: review of LFAA, WSCA, and related documents; preparation of the agenda, meeting materials, and facilitation guide; planning for meeting logistics and administration of invitations and responses; and frequent communications and meetings between Policy Works and ICPRB.

PARTICIPANT INTERVIEWS

In September 2018, the facilitation team conducted interviews with stakeholders from 10 agencies, organizations, water suppliers, and utilities expected to participate in the 2018 drought exercise. The objective of the interviews was to identify issues for discussion and inform the development of an agenda for the exercise that would support constructive outcomes and make the best use of participants' time. The interviews also provided an understanding of issues and questions that participants were likely to focus on during the exercise.

ICPRB provided the facilitation team with a list of potential participants in the 2018 drought exercise and helped to select a list of interviewees. The facilitation team developed an interview guide with input from ICPRB. Each interview took approximately 30 minutes to an hour. A list of the interviews is included in Table 1. The interviews provided Policy Works with a broad range of

perspectives and a substantial amount of input to support the design of the drought exercise. A report on the interviews was developed by the facilitation team for the ICPRB staff. The primary findings in that report addressed two main topics: (1) comments and suggestions from interviewees regarding the exercise and (2) issues to explore during the exercise. These are summarized in Tables 2 and 3, respectively.

The input reflected in Tables 2 and 3 were considered in the development of the agenda and activities for the drought exercise. The interviews also provided the facilitation team with background information on the interviewees and their organizational drought response plans and perspectives, which also informed the design of the exercise. The list of topics in Table 3 was a starting point for the development of the agenda, but not all of the issues listed in the table were discussed in the exercise. The list was used to support Policy Works and ICPRB in prioritizing discussion topics.

TABLE 1: Drought Exercise Preparation Interviews		
Organization	Names	Date
Washington Suburban Sanitary Commission	Joel Caudill, Tom Hilton, JC Langley	Sept 11
Loudoun Water	Pam Kenel	Sept 11
DC Water	Anjuman Islam	Sept 12
Washington Aqueduct	Alex Gorzalski, Anne Spiesman	Sept 17
Metropolitan Washington Council of Governments	Steve Bieber	Sept 17
Virginia Department of Environmental Quality	Scott Kudlas, Brian McGurk, Robert Burgholzer, Joey Kleiner	Sept 18
Washington DC Department of Energy and Environment	Hamid Karimi, Collin Burrell, John Emmenizer	Sept 18
Maryland Department of Environment	Ginny Kearney, Saeid Kasraei, John Grace	Sept 24
Fairfax Water	Greg Prelewicz	Sept 25
U.S. Army Corps of Engineers (Jennings Randolph and Savage Reservoirs)	Julie Fritz	Sept 28

TABLE 2: Exercise Preparation Comments from Interviewees
Consider how to include or address upstream water users in the exercise
Encourage cross-jurisdictional discussions during the exercise, but also provide for organization teams to talk among themselves
Be clear about the participants' roles in the exercise
Provide information in a manner that all participants can understand despite varying levels of familiarity with the LFAA
Be prepared to correct misinformation if it arises during the exercise
Will federal institutions be addressed as a special issue during the exercise?
Include fire departments and health departments if possible, while also recognizing that it may be difficult to keep them fully engaged in the discussion
Provide advance materials for the exercise that describe the LFAA and WSCA
Inform water suppliers about the drought exercise scenario's water supply allocations so that they can evaluate potential impacts before the exercise
Inform the USACE about the drought exercise scenario's reservoir operations and release requests so that they can prepare any background analyses before the exercise

TABLE 3: Issues to Explore in Drought Exercise Based on Participant Interviews

Coordination	How will the parties communicate and coordinate with each other when the LFAA stages are in effect?
Demand Management	<p>Will the jurisdictions take a common approach? Is there unevenness in state and MWCOG plans in terms of actions, requirements, and triggers?</p> <p>Enforcement of demand management requirements by local governments could be a coordination and implementation issue.</p> <p>What level of water savings is possible with demand management and restrictions?</p> <p>Inter-day variation in water demands is substantial in DC. How can this best be addressed in the demand management strategies?</p>
Drought Plans	<p>Virginia drought plan is based on metrics driven by factors across multiple areas of impact and differ from those used by other plans in region. The Maryland plan is similar to the Virginia plan, but aligns more directly with the LFAA and MWCOG plans. Does this create conflict or unevenness in response?</p> <p>Implementation of state and MWCOG drought plans generally relies on action by local jurisdictions.</p>
State Permits	<p>How do the states differ in how their water withdrawal and consumptive use permits address low flows (MD, VA, WV)?</p> <p>For withdrawals upstream of the metropolitan Washington area, who gets the water released from the reservoirs? Will all those that are not parties to the LFAA be limited by their permits?</p> <p>If flows drop below 7Q10, what implications are there for water quality and water treatment?</p>
LFAA	<p>Are new storage facilities in region considered in LFAA implementation?</p> <p>How much water will Loudoun Water request from Fairfax Water during drought given limitations on its Potomac withdrawal and availability of storage from Quarry A?</p> <p>If there is a challenge to a decision of the moderator, what happens to LFAA implementation?</p> <p>Will the flow-by be questioned during the LFAA emergency phase?</p> <p>Is the science that supports the flow-by up to date?</p>
USACE Reservoir Operations	<p>Will USACE release to provide water for the flow-by from non-water supply storage? Operations Manual allows for it, but how would it play out?</p> <p>If USACE cannot meet their water quality flow objective at Luke (93 cubic feet per second), is it possible that they would have to consider using water supply storage to meet that objective?</p>
Other Issues	<p>What impacts would there be to groundwater-based water systems in the region?</p> <p>How can we sustain the response during drought over many months or years?</p>

DROUGHT SIMULATION MODEL

ICPRB staff developed a simulation model, to support the drought exercise. The model was designed to present a hypothetical, severe drought situation that would be plausible and support the objectives of the exercise. To develop this model, the ICPRB staff relied on previous work, including CO-OP's 2013 study of the potential impacts of climate change and water supply.¹ The model was developed as a Shiny application constructed in the R-scripting language. The flow and meteorological inputs for the model were based on the Chesapeake Bay Program's Phase 5 Watershed Model inputs and outputs. ICPRB's 2013 study provided the basis for a drought scenario for 2039 that considered the potential adverse impacts of climate change on the severity of drought conditions.

The drought simulation model provided a visual demonstration tool to guide the exercise participants through a three-month period in the summer of 2039. This model simulated Potomac River flows, reduction in river flows due to upstream consumptive use, reservoir inflows, outflows, storage, WMA supplier demands, and CO-OP operational decisions. Water demands for the simulation were based on ICPRB's demand projections for 2039.² The model also simulated WMA demand reductions corresponding to MWCOG drought plan stages and increases in river flow due to Maryland and Virginia drought declarations in upstream areas. The simulation incorporated triggers for the Virginia, Maryland, and MWCOG drought plans so that the stages of each plan could be tracked relative to the stages of the LFAA and CO-OP operations. A graphical dashboard interface was designed to provide participants with quick access to information on changing drought conditions throughout the exercise. A screenshot of the dashboard is included as Figure 1. The dashboard tracked reservoir levels and releases, river flows, demand management impacts, and drought stages for multiple drought plans and agreements.

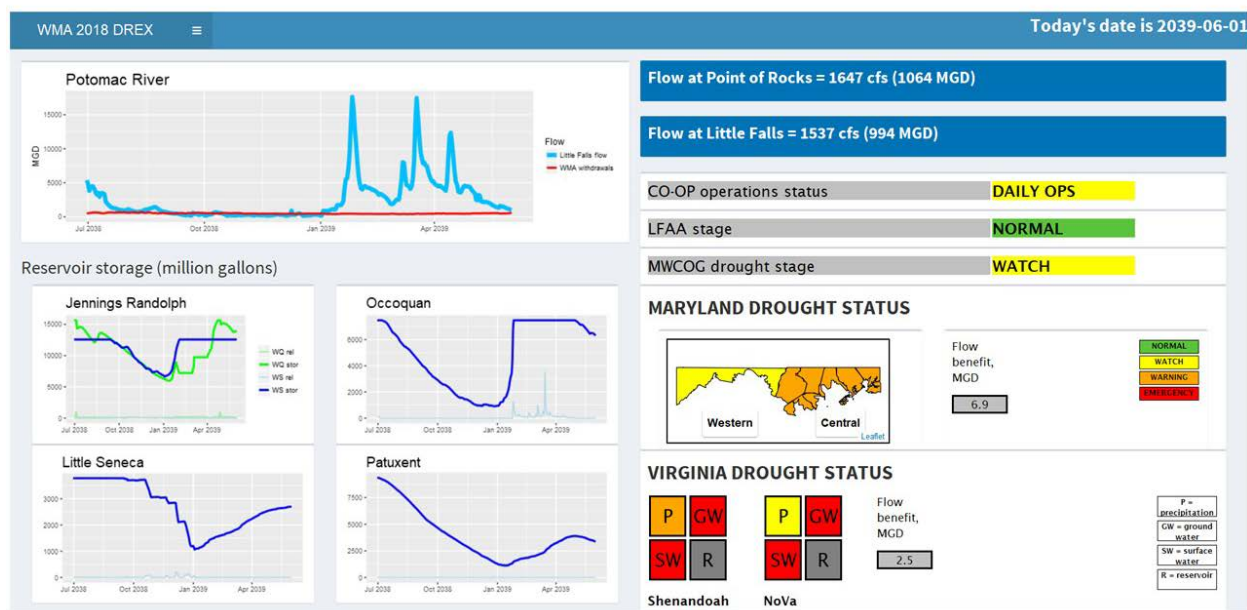
The simulation was the basis for the first half of the exercise. It tracked participants through the worsening drought between June and August of 2039 and supported discussion of drought response by various actors in the region. It allowed participants to evaluate and consider aspects of coordination across various plans and jurisdictions and supported evaluation by participants of overall drought response in the region. The simulation led up to and set the stage for the second half of the exercise, which was focused on allocations of water during the Restriction and Emergency Stages of the LFAA.

¹ Ahmed, S. N., K.R. Bencala, and C. L. Schultz. April 2013. 2010 Washington Metropolitan Area Water Supply Reliability Study, Part 2: Potential Impacts of Climate Change. ICPRB Report No. 13-07 (<https://www.potomacriver.org/wp-content/uploads/2014/12/ICPRB13-071.pdf>).

² Times series of daily unrestricted demands were obtained from CO-OP's Potomac Reservoir and River Simulation Model (PRRISM) version 2.0, based on forecasted 2039 demands. A multiplicative factor of 1.075 was applied to the demand time series to increase the severity of the drought scenario. The resulting annual average demands were approximately midway between those forecast in CO-OP's 2015 and 2010 water supply studies:

Ahmed, S.N., K.R. Bencala, and C.L. Schultz. August 2015. 2015 Washington Metropolitan Area Water Supply Study, ICPRB Report No. 15-4 (https://www.potomacriver.org/wp-content/uploads/2015/08/ICP15-04a_Ahmed.pdf).

Ahmed, S. N., K.R. Bencala, and C. L. Schultz. 2013. May 2010. 2010 Washington Metropolitan Area Water Supply Reliability Study, Part 1: Demand and Resource Availability Forecast for the Year 2040. ICPRB Report No. 10-01 (<https://www.potomacriver.org/wp-content/uploads/2014/12/ICPRB10-01.pdf>).

FIGURE 1: Screenshot of Drought Exercise Simulation Dashboard

The simulation could be used to support a live model exercise, but for the purposes of this exercise, it was determined that a more structured approach was needed to ensure that the broad range of issues to be addressed could be covered and to accommodate the challenges of managing an exercise with a large group. The simulation model could be adapted for future use with smaller groups for live model exercises to explore various scenarios and the sensitivity of the system to alternative management interventions.

In advance of the exercise, the model was shared with exercise participants from the Virginia Department of Environmental Quality (VADEQ) and the Maryland Department of the Environment (MDE). These agencies considered whether the scenario to be presented would be plausible and to understand when their agencies would make various drought declarations in the scenario. They also provided technical tools (in the case of MDE) and processing of simulation stream flow and meteorological time series (in the case of VADEQ) to ensure that the simulation of state plan drought stages was reasonably realistic. The scenario was also discussed with participants from the USACE and MWCOG in advance of the exercise to review technical assumptions of the simulation and facilitate constructive discussions during the exercise.

During the Restriction and Emergency Stages of the LFAA, water supply withdrawals are allocated to Fairfax Water, WSSC, and Washington Aqueduct based on formulas in the LFAA. The simulation provided the flow and demand information needed to calculate allocation scenarios to discuss in the exercise. The calculations were made by ICPRB staff and shared with the water suppliers to support their preparation for the exercise.

AGENDA AND PRE-MEETING MATERIALS DEVELOPMENT

The facilitation team worked closely with ICPRB staff during preparation to develop a detailed version of the exercise agenda, which was used to guide preparation activities and meeting implementation. Preparation calls for the full team were held on August 2, October 1, October 30, November 9, November 16, and November 27. Pre-meeting materials were developed by various team members and reviewed by the full team. Some materials were requested from participating agencies. A pre-meeting packet was distributed to exercise participants on November 20. These materials are presented in Appendix A of this report and included the following:

- Drought Exercise Agenda
- Summaries of the Potomac River Low Flow Allocation Agreement and the Water Supply Coordination Agreement
- Description of the LFAA Low Flow Process and two diagrams of major components of this process
- Description of the drought scenario that provided the basis for discussion during the exercise
- Summaries of the Metropolitan Washington Council of Governments -- Regional Water Supply and Drought Awareness Response Plan; Virginia Drought Assessment and Response Plan; and Maryland Statewide Water Conservation Advisory Committee Final Report

Additionally, links were provided to the full versions of the LFAA, WSCA, and state and MWCOG drought plans, as well as to the 2018 review of the LFAA conducted for ICPRB.

FINDINGS FROM DROUGHT EXERCISE PREPARATION

The preparation activities for the drought exercise provided a foundation for the exercise design and implementation. Information gathered during preparation was extensive. The following is only a summary list of findings, with an emphasis on key themes that shaped the exercise design and topics for further exploration that were not fully developed in the exercise.

Key Themes:

- Through the history of the agreement, the LFAA drought stages have not been declared. As a result, many stakeholders are not familiar with its content.
- Conditions have changed significantly in the WMA since the adoption of the LFAA. New water resources and tools are available that affect whether and when the LFAA would be activated.
- Re-visiting the LFAA in a collaborative setting can help to maintain familiarity with the agreement and to understand how its application might appear under current conditions.

- The LFAA applies to water supply management. The term “Restriction Stage” is sometimes misinterpreted to imply demand management. Demand management is addressed by the Virginia, Maryland, and MWCOG drought plans, but not by the LFAA.
- State drought plans are driven in part by different factors than regional drought plans and agreements. It is possible for state decisions on drought response to create coordination challenges and unevenness in response to drought in the region, but coordination is a consideration for the states.
- Metropolitan area stakeholders are uncertain about upstream drought response, requirements, and impacts, and more information could help to support constructive discussions of basinwide drought response.
- Engaging fire departments, health departments, and emergency management agencies in drought response will be important to implementation in extreme drought situation, but to date coordination with these stakeholders has been limited.

Topics for Further Exploration:

- Allocations calculated for the scenario might not be plausible to implement due to constraints presented by the minimum flows needs of filters and by limits on the capacity of distribution systems in parts of the utility service areas. These constraints were discussed with the water suppliers but not fully resolved in the scenarios considered. The long-term implications of these constraints for the LFAA need to be better understood to ensure that future response under severe conditions is not adversely limited.
- What level of water savings can be attained with demand management in the region? More evidence is needed to support better projections of the potential impacts of demand management as a part of the drought response strategy. This information can also be used to prioritize high impact strategies and water users for implementation.
- Is the science that supports a 100 million gallons per day (mgd) environmental flow metric at Little Falls (known as the “flow-by”) up-to-date? New research on instream flow needs has been done in recent years that may support evaluation of the ecological target.
- Some stakeholders have questions about how water quality storage water in Jennings Randolph Lake would be used in an extreme drought situation. Procedures for USACE releases from the Jennings Randolph water quality storage account are currently being evaluated by a joint USACE and ICPRB scoping project for a potential update of the Jennings Randolph Water Control Plan.
- The simulation model could be adapted for future use with smaller groups for live model exercises to explore various scenarios and the sensitivity of the system to alternative management interventions.

DROUGHT EXERCISE SUMMARY

The exercise started at 8:30 am. Carlton Haywood (ICPRB) welcomed the group to the 2018 Washington Metropolitan Area Drought Exercise and thanked everyone for their participation. Chuck Murray (General Manager, Fairfax Water) welcomed everyone to the Fairfax Griffith Water Treatment Plant. He commented on the importance of the Low Flow Allocation Agreement (LFAA) in drought management and planning in the Potomac Basin.

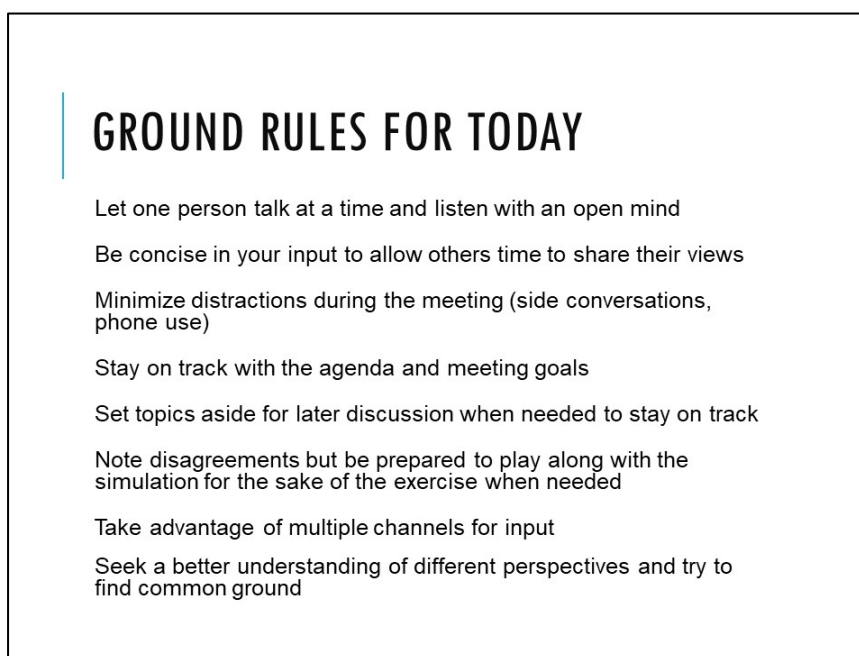
Carlton then asked all the participants to introduce themselves and gave an overview of the drought exercise. He acknowledged that not every question raised in the meeting today would be answered but that the stage was set for a meaningful discussion to advance understanding of the LFAA and other relevant drought management plans.

A list of attendees for the drought exercise is included in Appendix B.

AGENDA REVIEW

Kristin Rowles and Mark Masters (Policy Works LLC) were introduced as the facilitators for the exercise. They thanked participants who had provided support for the drought exercise preparation, reviewed the agenda for the day, and presented some ground rules for exercise (Figure 2).

Figure 2: Ground Rules for the Exercise



REVIEW OF EXISTING AGREEMENTS AND REGULATIONS

Carlton provided a summary of existing agreements, regulations, and plans that apply to drought management in the Potomac River Basin. He referred to the summaries of these documents provided in the pre-meeting materials. The slides for his presentation are provided in Appendix C.

DROUGHT SCENARIO: SETTING THE STAGE

The rest of the morning was focused on the drought operations during the months of June and July during the scenario for the exercise. A description of the drought scenario was provided in the pre-meeting materials (Appendix A). At the beginning of the scenario presentation, Cherie Schultz (ICPRB) provided an overview of drought conditions at the beginning of the scenario. Her slides are available in Appendix D.

Cherie explained that the scenario occurs in the year 2039, and the drought is more severe than the drought of record but reflective of possible conditions projected in climate forecasts for the region, based on a study of possible climate change impact on the region by ICPRB in 2013. Cherie said that it was assumed that Loudoun Water's Quarry A reservoir would be available at that time, but Fairfax Water's Vulcan Quarry reservoir would not be (due to come on line in 2040). Cherie said that the likelihood of the scenario was subject to uncertainties related to the effects of climate change and the availability of future water resources such as reservoirs.

Cherie said that the scenario would present very severe conditions, but that the region has options that can increase the reliability of the water supply system in 2040. These options include new storage and management operations that are in different states of development and/or investigation (e.g., Vulcan Quarry reservoir, Quarry A reservoir, use of Travilah Quarry as a reservoir, operation of Beaverdam reservoir for low flow augmentation, emergency use of Jennings Randolph water quality storage for emergency flow augmentation). Better flow forecasts will also be able to support more reliable management.



Cherie reviewed the sources of the information in the dashboard to be used to track the drought scenario. A hand-out with the dashboard for a selected set of days in the simulation was provided to participants and is included in Appendix E.

DROUGHT SCENARIO: JUNE

June 1: Drought Warning Stage declared in Shenandoah, Northern Virginia, Central Maryland, Watch Stage declared in Western Maryland; MWCOC is in Watch Stage

Participants from VADEQ, MDE, and MWCOC reviewed their drought plans, drought stage decision-making, and resulting requirements and activities. They also addressed the restrictions placed on upstream withdrawals during drought stages and expected levels of water savings that they expect to attain in each stage.

In discussion, participants addressed the following:

- Air conditioning is a major use water during heat waves and should be a primary conservation target.
- Demand levels will harden in a drought. Are expectations for 5-10-15% reductions in water use realistic?
- Many demand management efforts target indoor residential water use, but we should look at the real consumptive use in landscape irrigation.
 - It was noted by VADEQ that its drought plan does target consumptive uses.
- Virginia Tech completed a study on observed water savings during a Virginia drought; demand reductions were not as expected and, at some points, increases were observed.

June 3: CO-OP begins hourly operations

Cherie described CO-OP operations during daily and hourly operations stages. During hourly operations, CO-OP sends emails to stakeholders twice daily, receives demand and reservoir storage data via CO-OP's password-protected website, makes requests for concurrence from water suppliers' general managers before initiating releases from upstream reservoirs, calls by 9:00 AM to USACE to request water supply releases from Jennings Randolph, and makes regular calls to water supplier operations staff on system status and constraints.

In discussion, a participant asked for clarification of the differences between daily and hourly CO-OP operations. Cherie said that during hourly operations hourly data is collected on storage and utility withdrawals and returns, and hourly data improves management of time of travel issues for reservoir releases.

June 8: LFAA Alert Stage eligible

Kristin noted that current conditions allowed for consideration of whether to declare the LFAA Alert Stage. If the Alert Stage were declared, the resulting action would be notification of the LFAA moderator. Kristin referred participants to the diagram of LFAA in the pre-meeting materials (Appendix A). Declaration of the LFAA stages are made by Washington Aqueduct with input from the other LFAA signatory water suppliers (Fairfax Water, WSSC). Kristin asked Tom Jacobus

(General Manager, Washington Aqueduct Division of the USACE) to comment on whether he would declare the Alert Stage of the LFAA. Tom Jacobus noted that the LFAA Moderator attended the exercise and thanked him for his engagement. Tom said that while he could declare the Alert Stage, he did not think it was necessary at this time. In discussion of the LFAA Alert Stage, participants offered the following comments:

- The LFAA was adopted before there was augmentation from reservoirs available in the Potomac. Do we still need the LFAA? It is a good backstop. However, it would be irrational to impose constraints on withdrawals while we have augmentation capacity.
 - Constraints on withdrawals are not applied at the Alert Stage.
 - Do we need to consider adjusting the LFAA triggers to consider augmentation availability?
- During the 1999 drought, communication was a problem. Communication should be a major focus of drought planning.
 - During that drought, Maryland declared a statewide drought, with restrictions on users, while DC and Virginia did not have restrictions.
 - Hydrologic drought and political drought are different.
 - MWCOC Plan is now in place. It was not in 1999. In this scenario, in which the drought started in the prior year, MWCOC would have been implementing conservation messaging for a long time at this point in the drought.
- 1999 drought was bad, but Little Falls never went below 168 mgd, and there was not a water supply emergency.
- Virginia would likely be in Warning or Emergency Stage at this point. Conservation at this point “subsidizes” later reservoir releases and has political implications.
- ICPRB risk tools are fantastic improvements to drought management.

June 23: Emergency Stage declared in Central Maryland

June 25: CO-OP begins reservoir releases to augment flows

Cherie described the process by which reservoir release decisions are made using some of the slides included in Appendix D (Setting the Stage Slides). Time of travel for Seneca releases are approximately one day, and for Jennings Randolph, time of travel is 7 to 9 days. Releases are calculated by considering withdrawals and targeting a flow of 100 mgd at Little Falls (environmental flow-by) plus a 120 mgd Margin of Safety (MOS). The MOS applies only to Seneca releases. CO-OP release decisions also take into account the goal of keeping storage in the reservoirs in balance (as % of capacity).

In discussion, participants made the following comments:

- The environmental flow-by is a *daily average*. We need to be able to manage toward that objective in a balanced manner that allows us to approach that target without “terror.”
- What happens if flows go below the flow-by at Little Falls?
 - Environmental stakeholders will seek to maintain the flow-by.
 - State agencies indicated their support for maintaining the flow-by as well.
 - The flow-by is part of the LFAA agreement.
 - The environmental outcomes of violating the flow-by are uncertain. Recent research studies have shown that aquatic systems can recover from low flows.
- The flow-by study also addressed flow targets for Great Falls (300 mgd). The section of the Potomac between Great Falls and Little Falls has important aquatic habitat areas.
- Washington Aqueduct shifts its intake of water downstream during the Restriction and Emergency Stages of the LFAA to increase flows in that portion of the river.

Break Question: Kristin asked participants to respond to the question in Figure 3 during the morning break. After the morning break, Kristin reviewed responses to the break question. A compilation of participant responses to written questions, including this question, during the exercise is included in Appendix C. Comments from the participants on their responses included:

- The MOS is just right for Seneca, and it makes sense not to have a MOS for Jennings Randolph given how far it is upstream.
- It is not the 120 mgd MOS currently used by CO-OP. It is the metrics for risk tolerance (the probability of missing the flow-by is approximately 0.12% in any given year and 10% during the drought of record) that we should consider. Are these risk tolerances appropriate?
- How definitive can we be in targeting the flow-by? Do we really know when the river could crash? The river is not a concrete pipe.
- The MOS is appropriate and responsible. I appreciate the commitment to meeting the flow-by.
- We do not have the monitoring and data needed to fully evaluate the flow-by.

Figure 3: Morning Break Question for Participants

POST-IT NOTE QUESTION FOR THE MORNING BREAK

What do you think about the margin of safety that is used in reservoir release requests?

- Too High
- Too Low
- Just Right
- It Depends...

- Write your response on a post-it note and put it on the flip chart during the break.
- If you want, add comments to explain your response.
- Take a minute to read other responses during the break.

DROUGHT SCENARIO: JULY

July 1: Emergency Stage declared in Shenandoah and Western MD; LFAA Restriction Stage Eligible

Kristin noted that conditions made the Potomac eligible for declaration of the LFAA Restriction Stage. She noted that the actions that would follow from that declaration were listed in the LFAA diagram in the pre-meeting materials. She asked Tom Jacobus to comment on whether he would declare the Restriction Stage at this time.

Tom said that declaration of the Restriction Stage would shift some portions of withdrawals from the Potomac to the Occoquan and Patuxent Reservoirs. The LFAA Restriction and Emergency Stages require that use of these reservoirs be at the maximum practicable. He noted that it would not be desirable to begin draining these reservoirs at this time. Augmentation is still available in the Potomac. He asked others for their views, and the following comments were offered by participants:

- If we do not declare the Restriction Stage, should we declare the Alert Stage?
 - We have been in CO-OP daily operations for some time now, and that is very similar to the LFAA Alert Stage in terms of what happens. CO-OP operations have replaced parts of the LFAA.
- If there is sufficient water in the river to meet all needs, we should use it. We should preserve the resources that may be need as a backstop later.

- Investments in Jennings Randolph and Seneca were made by the water suppliers to avoid limitations on withdrawals. Plans need to be focused on resiliency.
- To serve our customers, as long as the river will meet demands (reduced), we should make use of the river and not have upstream users take water from storage.
- We need to make sure we are balancing “customer perception” of the drought as we make these declarations. Messaging should encourage responsible water use.
- In theory, we have the tools in place to coordinate messaging to the public during drought via the MWCOG plan. However, remember that the authority to set and enforce demand management restrictions mostly rests with local governments. WSSC is the only water supplier that does not have to coordinate on demand management with another local entity to implement restrictions. This is an example of political vs hydrologic drought.
- The Restriction Stage might be mis-named. It does not restrict water use. It directs suppliers to make use of alternate sources.
- Remember that there are other users in the area not using the Potomac (groundwater) and consider how they will be affected in our planning.

July 15: Emergency Stage declared in Northern Virginia

VADEQ noted that this declaration decision in would be driven in large part by other water suppliers that are located in this region and do not withdraw from the Potomac.

July 19: Warning Stage declared by MWCOG

Kristin noted that MWCOG declared a Warning Stage at this point. It was noted that at this Stage, the media messaging would increase, and demand management measures would be voluntary. The following comments were offered by participants:

- We have some areas with mandatory restrictions on water use (Emergency Stages, upstream areas) and others with voluntary conservation (Warning Stages, WMA).
- The public might be starting to experience conservation message fatigue.
- The region has one media market, so it is difficult to avoid mixed messaging.
- Emergency management agencies including fire and health department participants said their agencies would probably not be involved in drought response at this point.
- Where is coordination taking place? Do we have a plan for where and when we get together?
 - During the 1999 drought, utilities met at ICPRB and, later in the drought, at MWCOG.
 - Mechanisms are in place to handle the in-person coordination.

Note Card Question: Kristin asked participants to respond to the question shown in Figure 4. After a few minutes time to respond, she asked some participants to explain their responses regarding whether the level of drought response seems appropriate at this time. The following comments were offered by participants:

- Yes: We are conserving 21.5 mgd and sending 204 mgd to the estuary.
- No: It's only July, and we are already approaching the flow-by. Not good.
- No: Customers do not appreciate importance of conservation; demand does not drop as much as it should.
- In Between: It is hard to know where you are in the middle of a drought.
- In general, drought prediction tools are improving, and we should make use of these tools in planning and management.
 - The National Weather Service is a good partner for drought information and can provide forecasts of drought persistence.
 - Virginia includes the National Weather Service on its Drought Management Task Force. Virginia has also developed a partnership with the Drought Monitor program to provide input to weekly updates.

Figure 4: Note Card Question for Participants

QUESTION FOR THE GROUP

Does the level of drought response seem appropriate to you at this time?

Write your response on a note card – pick a color:

- Yes – GREEN
- No – PINK
- In Between – YELLOW

If you want, add comments to explain your response.

In further discussion of these responses, a participant asked whether it was possible for the rain scenario that was used in the simulation model for the exercise to occur. ICPRB responded that the rainfall data used was from a 2040 climate change projection generated by the U.S. Geological Survey and downscaled to the Potomac Basin.

Kristin collected the note card responses. In summary, 15 responses said Yes, 15 said No, and 8 responded In Between. A detailed description of the written responses can be found in Appendix C.

Before lunch, Cherie reviewed worsening conditions in the Basin throughout the remainder of July and the first half of August. During this time, reservoir levels declined dramatically. On August 19, flow in the river would be in the range of 200 to 400 mgd, and WMA water demands would be over 500 mgd. Combined upstream water supply storage, in Jennings Randolph and Little Seneca reservoirs, would be only about one billion gallons, and remaining storage in both the Patuxent and Occoquan reservoirs would be below the emergency levels for these reservoirs of one billion gallons.

Kristin noted that given the conditions, the discussion after lunch would be focused on the Restriction and Emergency Stages of the LFAA. During lunch, she asked participants to respond to the question in Figure 5 on a Post-It note. After lunch, Kristin reviewed participant response to this question. Responses included media representatives, local government administrative and elected officials, agency public information officers, and operations personnel. A detailed description of responses can be found in Appendix C.

Figure 5: Lunch Break Question for Participants

POST-IT NOTE QUESTION FOR THE LUNCH BREAK

Who is not here today that we will rely on and coordinate with to communicate and implement important aspects of drought response?

(Not looking for names of specific people, but more general responses about roles and organizations.)

- Write your response on a post-it note and put it on the flip chart during the break.
- If you want, add comments to explain your response.
- Take a minute to read other responses during the break.

DROUGHT SCENARIO: AUGUST

Carlton reviewed the procedures for fair share allocations under the Restriction and Emergency Stages of the LFAA. He referred to a description and a diagram of these procedures and calculations in the pre-meeting materials (Appendix A).

Kristin noted between late July and August 19, conditions were eligible for the Restriction Stage of the LFAA. She asked Tom Jacobus to comment on whether Washington Aqueduct would declare a Restriction Stage, and he responded that it was likely that the Restriction Stage would be declared at this time. The decline in availability of water in storage in upstream reservoirs made the declaration appropriate.

Next, she noted that the group would consider three days in late August during which fair share allocations would be made under the LFAA. She referred the participants to a handout of the allocation scenarios to be discussed (Appendix D).

August 25

Carlton reviewed the allocation calculations for this day (Appendix D). He explained the information in the allocation table. The requests for water from the water suppliers in the table are the predicted unrestricted demand less a percentage reduction due to conservation measures in place. Carlton noted that, at this point, the calculations assumed that demand would be reduced by 5% due to voluntary demand management practices in place in the region.

The fair share allocation is specified per LFAA Section 2.C.2. If initial allocation results in a water supplier having an allocation in excess of their request, the excess can be reallocated to other water suppliers in a “reasonable manner” per LFAA Section 2.C.4. Carlton reviewed the allocations and reallocations for this scenario day.

At this point, upstream storage is inadequate to maintain a margin of safety in releases, and the Little Falls flow is close to the flow-by requirement (148 mgd).

Kristin asked participants for general comments on this allocation scenario for this day:

- It was clarified that the allocation scenario is for one day in August and is not meant to represent a typical August day.
- WSSC noted that they would be unlikely to operate as indicated on the chart with respect to reservoir management. They could operate at that level, but it is unlikely.
- Is it practical to run down the Occoquan and Patuxent now? It might be possible to draw from the reservoirs at those levels for a day or two based on forecasts, but it is not possible to maintain.
- We need to consider what forces will be driving decisions 20 years from now. “Fair share” allocation is a term of art given possible changes in climate and operational and political complexities of the basin.
- We need to figure out how to efficiently allocate the billion gallons of storage available (LFAA and non-LFAA utilities).

Kristin asked if the assumption of a 5% demand reduction for the WMA was appropriate. The discussion that followed focused on demand management at this point in the drought:

- It was clarified that the allocation table assumes demand has already been reduced by 5%. It is not indicating that there will be a 5% reduction in demand on the next day.
- Demand reduction would likely be more, but it is not relevant because we “went to hell in a hand basket.” Demand reduction gives you hours, not days or weeks, of more water. “You gotta do it or catch hell politically, but the benefit is at the margin.”
- Demand reductions are not irrelevant; they are inadequate.
- Need to consider potential impacts to water quality.
- Now is probably the time to declare the emergency stage and mandatory restrictions under the MWCOG plan.
- The Virginia Drought Plan has a placeholder for a rationing stage. It has not been fully developed, but it would probably be considered at this point.

Kristin asked for the emergency management, fire, and health representatives to comment on their perspectives at this point in the drought. The following is a summary of the discussion:

- Emergency management impacts could be catastrophic.
- Public health impacts of drought need to be understood better and communicated.
- Who *really* must have the water? What are the extreme things that could happen and what are the *extreme* possible remedies?
- Fire protection is an issue if water is scarce.
- Depressurization is a health concern. If we cannot meet system demand, even by 1%, depressurization of parts of the system will occur.
- Distribution systems are a collection of pressure zones. If you cannot meet demand, water will ration itself.
- This whole process (WSCA, CO-OP, LFAA) is designed to avoid this outcome.

August 28

Three alternative allocation scenarios were presented for August 28 (A, B, C, see Appendix D). On this day in the scenario, flow is inadequate to meet the water suppliers’ requests and provide for the flow-by. In this situation, the deficit can be assigned to either water supply or the flow-by. In Alternatives A and C, deficits are assigned to water supply, and in Alternative B, the deficit is assigned to flow-by. Alternatives A and B assume that demand reduction levels are 5%, while Alternative C assumes that demand reduction is 10%. The flow-by levels are 99 mgd, 73 mgd, and 107 mgd for Alternatives A, B, and C, respectively. Total water supply deficits are 26 and 0 for Alternative A and B, after re-allocation; there is no water supply deficit for Alternative C.

Kristin asked for a show of hands about the preferred Alternative. Although there were some votes for A and B, most participants preferred Alternative C. Discussion of these Alternatives included the following:

- How long do you think flow-by is going to be below 100 mgd? It's not a very long stretch of the river.
- Washington Aqueduct would likely dip into the flow-by. They would cite a study after the 1999 drought in which species recovery in that stretch of river was strong.
- Water flowed by, and I don't have water. That is a tough sell.
- What are the maximum conservation measures that can be used? We should determine what these measures are.
- MWCOG has completed some analyses of moving larger users off the water system in extreme circumstances.
- As the nation's capital, WMA should set an example by maintaining flow-by. If we do not, others will follow.
- What happens in an extended de-pressurization event? It would take a long time to adequately flush the system.
- Can we conserve to the level that we could avoid this day? Or, how long can conservation keep us from getting to this day? We need the infrastructure for the future that will ensure we never even approach this day because conservation cannot adequately prevent it.
- It is great that we are having this discussion. I appreciate that we are getting to this point.

August 31

Flows have declined to a level where the total deficit in meeting water supply requests and the flow-by is 74 mgd. Two alternative allocation scenarios were presented for this day (Appendix D). Alternative A assigns the deficit to water supply, and Alternative B assigns the deficit to the flow-by. Both Alternatives assume that mandatory water conservation measures are in place under the Emergency Stage of the MWCOG plan, and resulting demand reductions are estimated at 15%. In Alternative A, all of the water suppliers except WSSC have water supply deficits. In Alternative B, all water requests are met.

Discussion of these alternatives included the following:

- These are dire circumstances.
- The proposed Travilah reservoir could prevent this situation. It could also help us to manage through a contamination event on the Potomac. It would provide WMA with two weeks of water supply. We need to advance this proposal.
- Fairfax is not meeting their demand at this point. It is worse than the scenario.

- If flows are 27 mgd at Little Falls, will we be able to physically withdraw water with flows that low?
 - It is possible because of dams and weirs.
- The ratios for LFAA allocations are based on winter demand levels. Why is there such a small difference in WSSC winter and summer demand?
 - One possibility is that other water systems have more users that need water for cooling and air conditioning. Cheap cooling puts a large demand on water systems. More data centers could lead to more demand for water.
 - Fairfax is seeing its peak summer demand drop with increased urbanization. There are fewer lawns and sprinklers.
- Is water reclamation an alternative?
 - The Occoquan Reservoir is oldest indirect potable reuse system in the country. The reservoir receives highly treated wastewater from the Upper Occoquan Service Authority (UOSA). In a drought, this inflow to the reservoir will help to maintain reservoir levels.
 - Washington Aqueduct has investigated pumping estuary water upstream for reuse and augmentation. Travilah Reservoir is a better option.
- Fairfax Water and others would be seeing significant depressurization events in Alternative A.
- The Patuxent Reservoir could be very low at this point. Occoquan would benefit from the inflow from UOSA.
- We would have exhausted all other possibilities before reaching this scenario. We would have cut off wholesale water customers. We will meet our customer needs first before we would make a sale to another utility in the event of an extreme drought.
- There are many other contractual agreements in place between utilities that may not coincide with the LFAA.
- Is there water quality storage water available in Jennings Randolph? Can it be used for water supply under these circumstances? USACE has started a study to see if this storage could be used for flow augmentation for water supply in emergency situations.
 - USACE can make an emergency release under current operations. This happened in another part of Virginia recently.
 - It would probably take about seven days for USACE to process such a request.
 - Would development of a contingency plan help to expedite an emergency release request to USACE?
- A hydropower facility is being established at Jennings Randolph. Hydropower is not an authorized use for this reservoir, and the hydropower agreement limits power generation to releases for other purposes.

- After the facility is constructed, will there be pressure to add hydropower as an authorized use? This would impact releases.
 - Even if it is an authorized use, hydropower would be a lower priority use.
- The flow-by study recommended flows at Great Falls of 300 mgd. In this scenario, there is 200 mgd at Great Falls.
 - Washington Aqueduct shifts its withdrawal downstream to provide for flow between Great Falls and Little Falls during drought.
- Raw water intakes cannot be operated with a high level of precision. We can meet a daily average for withdrawals, but we cannot operate at a specific withdrawal level constantly. We should understand that intakes will operate at plus or minus 10% from the daily average level.

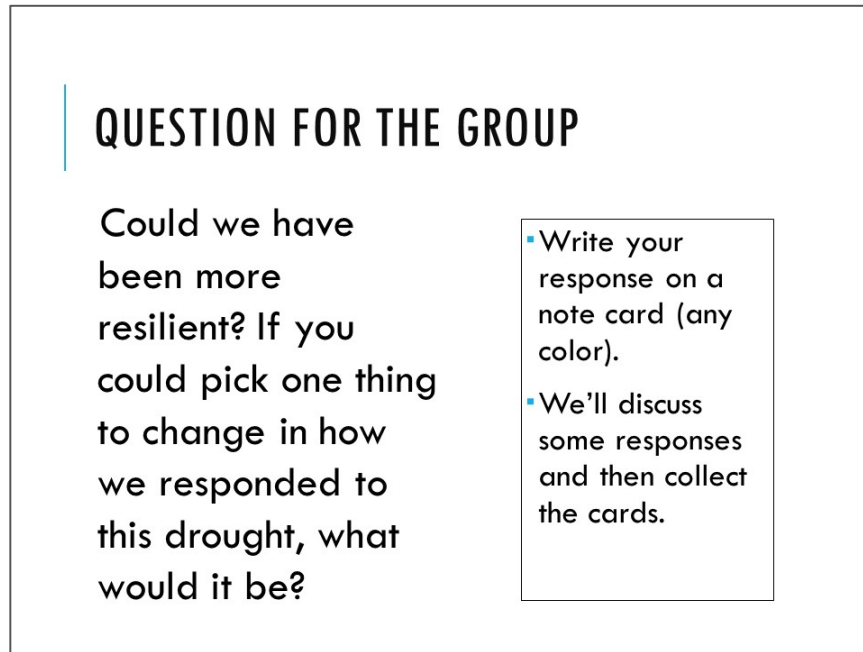
EXERCISE REVIEW AND CONCLUSION

Kristin asked the participants to reflect on the exercise and answer the question shown in Figure 6 on a note card. She asked participants to share some of their responses about how we might have been more resilient in this drought, and the following is a summary of that discussion:

- Coordination with industrial water customers can help to identify opportunities for substantial demand reduction in drought. Recommend meeting with these customers to identify demand management opportunities for drought.
- The area under the blue line (in the flow chart on the simulation dashboard) is water that could have been “saved.” (This refers to the water released from upstream reservoirs that augmented flow at a level above the flow-by and addresses the margin of safety.)
- A sensitivity analysis would be helpful. Consider looking at alternatives in the Seneca release Margin of Safety, use of Jennings Randolph water quality storage, and demand management. How would these alternatives affect our ability to avoid dire outcomes?
- What level of demand reduction would we actually see if we had declared the LFAA Restriction Stage on July 1? It would help to see that in the simulation.
- Note that the LFAA Restriction Stage does not affect demand management, but we could look at different times of implementation for mandatory conservation under the MWCOG drought plan.

- For the next exercise, consider stretching out the time frame so we can try to make a different in the outcome. The drought in this exercise started in the prior year. Our actions then might have been able to make a difference.

Figure 6: End of Exercise Question for Participants



QUESTION FOR THE GROUP

Could we have been more resilient? If you could pick one thing to change in how we responded to this drought, what would it be?

- Write your response on a note card (any color).
- We'll discuss some responses and then collect the cards.

Kristin reviewed a summary of themes that were discussed during the exercise and asked the group for further input. The following is the list of themes that resulted from the discussion:

- Is the LFAA out of date or a good back stop?
- The LFAA Restriction Stage is mis-named. It gives the impression that it involves water use restrictions.
- Communication and coordination are essential.
- We need to pursue monitoring and data collection to support better understanding of the flow-by and ecological needs.
- Better tools are available for drought prediction and risk management. We should be using them. Further improvement of these tools would be even better.
- Hydrological drought is different from political drought. Political factors come into play in drought response.
- The LFAA Restriction Stage requires use of the Occoquan and Patuxent Reservoirs to the maximum extent practicable, but in a drought, we want to preserve those resources for later use. As a result, we might choose to delay the declaration of the LFAA Restriction Stage.

- What impact does demand management have? What are the measures that will give us the maximum impact from demand management?
- We need to better coordinate with and educate agencies involved in emergency management, fire, and health to prepare for drought response.
- The proposed Travilah Reservoir would provide a tool for increasing regional resiliency that could help us to avoid dire drought outcomes and also address contamination events.
- USACE and ICPRB are conducting a joint scoping study to evaluate greater use of water quality storage in drought emergencies as a possible change in the Water Control Plan. The results should be incorporated into our drought response planning.
- For the next exercise, allow the participants a chance to act earlier to avoid the abyss of the dire drought outcomes in today's exercise.

Kristin asked participants to comment on follow-up actions from the exercise.

- Steve Bieber said that MWCOG plans to improve the evidence base for demand management strategies for the WMA.
- An ICPRB Commissioner noted that the exercise provided some momentum to the group to improve planning for drought response. The Commissioner looked forward to continued collaboration.
- Carlton Haywood said that ICPRB would be preparing a report of the exercise to share with participants.

Carlton and Kristin thanked the participants for being a part of the exercise and offering their contributions. They thanked Fairfax Water for hosting the meeting. The meeting was adjourned.

PROJECT FINDINGS

While the themes above capture the essence of the discussion during the exercise itself, the findings of the project extend beyond the exercise to include all the discussions and technical work that was a part of preparation for the exercise. The following is a summary of what was learned about LFAA implementation and drought response planning in the Potomac through the project as a whole.

Project Findings:

- *LFAA:* Conditions have changed significantly in the WMA since the adoption of the LFAA. New water resources and tools are available that affect decisions about its implementation. From this exercise, it appears that these decisions can still be made within the scope of the existing agreement, but this project did not include a legal review.

The LFAA applies to water supply management. The term “Restriction Stage” is frequently misinterpreted to imply demand management. Demand management is addressed by the Virginia, Maryland, and MWCOG drought plans but not by the LFAA.

The LFAA Restriction Stage requires use of the Occoquan and Patuxent Reservoirs to the maximum extent practicable, but in a drought, preservation of those resources for later use is a priority and as a result, the decision to declare the LFAA Restriction Stage may be delayed or foregone.

- *State Drought Plans:* State drought plans are driven in part by different factors than regional drought plans and agreements. It is possible for state decisions on drought response to create coordination challenges and unevenness in response to drought in the region, but coordination is a consideration for the states.
- *Drought Response:* WMA stakeholders are uncertain and concerned about how upstream water use affects downstream flows and reservoir release needs. However, during the exercise, conservation by and limits on upstream water use in early stages of the drought were acknowledged. Participants noted that demand management would likely be applied earlier upstream than downstream, and the exercise simulation estimated the impact of early stage upstream conservation. State agencies discussed limitations that would be applied to upstream water withdrawal permits.

Engaging fire departments, health departments, and emergency management agencies in drought response will be important to implementation in extreme drought situation, but to date coordination with these stakeholders has been limited.

The critical importance of strong communication and coordination to support an effective drought response was emphasized by participants throughout the exercise. Mechanisms that are in place to support communication and coordination were noted during the exercise but should also be reviewed and updated from time to time.

- *Reservoir Management:* Procedures for USACE releases from the Jennings Randolph water quality storage account are being evaluated by a joint USACE and ICPRB scoping project for a potential update of the Jennings Randolph Water Control Plan. Many stakeholders have questions about how water quality storage water would be used in extreme drought situations, and this review may help to make the agency's management decision-making process more predictable to other water resource managers in the basin.

In addition to the above findings, the project also identified several potential areas for follow-up from the exercise. These actions were suggested by exercise participants or identified through the technical work that was completed to prepare for the exercise. The list includes research, monitoring, modeling, and improved coordination opportunities that would support better drought response for the WMA.

Suggested Follow-Up Activities:

- *Address Low Flow Operational Constraints:* LFAA water suppliers are subject to constraints that may affect application of the LFAA allocations. These potential constraints include minimum flow needs of water treatment filters and limits on the capacity of distribution systems in parts of the utility service areas. The latter may be addressed over time by infrastructure updates and improvements. Some contingencies may be needed to address these constraints under extreme drought conditions.

- *Examine Evidence for Effective Demand Management Strategies:* More evidence is needed to support the specification of demand management strategies. What impact can demand management have in drought response? What are the strategies that maximize demand management? What is the best timing of the application of mandatory restrictions for water use? What uses and users should be targeted for the greatest impact?
- *Plan for Drought with Industrial Sector Customers:* Industrial customers may be able to provide substantial water savings in a drought. Advance planning and coordination with these customers could help to identify potential strategies for use during drought response.
- *Evaluate the Environmental Flow-By:* New research on instream flows and aquatic habitat is available, and the flow-by study could be reviewed for consistency with recent studies. Monitoring and data collection on aquatic habitat health in the Potomac are needed to support evaluation of the flow-by.
- *Assess the Sensitivity of the System:* The simulation model could be adapted for future use with smaller groups for live model exercises to explore various scenarios and the sensitivity of the system to alternative management interventions. Consider looking at alternatives for the margin of safety for Seneca Reservoir releases, water quality releases from Jennings Randolph Lake, and variations on timing and levels of demand management implementation. For evaluations of risks associated with alternative management options, CO-OP's long-term planning model, the Potomac Reservoir and River Simulation Model (PRRISM), can be used.
- *Adopt Improved Tools for Drought Management:* Improved meteorological and assessment tools have been developed in recent years and continued improvements will likely become available over time. The metrics used in drought response could be evaluated for updating relative to new tools and information.
- *Coordinate with Emergency Management Agencies:* A few representatives of emergency response agencies participated in the exercise, and MWCOG facilitated communication about the exercise with fire departments in the region. Stronger relationships with emergency management, fire, and health agencies would improve drought response planning across the region.
- *Initiate Reservoir Planning:* The proposed Travilah Reservoir could significantly improve system resiliency to drought and contamination events. Reservoir planning requires many years and substantial investment and can entail addressing significant stakeholder concerns.
- *Evaluate Jennings Randolph Management:* Water quality storage water in Jennings Randolph Lake could be made available to help address extreme low flows. USACE and ICPRB are currently conducting a joint scoping study on management of water quality storage in Jennings Randolph. The results should be incorporated into regional drought response planning, and if appropriate, contingency planning regarding those releases would help to facilitate emergency requests.

- *Assess Drought Management Metrics:* The metrics used to declare drought stages under the LFAA, CO-OP, and state and MWCOG drought plans are not aligned in a manner that supports clear communication and coordination of response. Each uses metrics that match the objectives of that plan or agreement, but it is difficult to project how drought response will proceed across the basin because basin-level response is driven by a broad set of metrics. Comprehensive assessment of the metrics could identify opportunities that would simplify and improve the coordination of drought response. It could also be an opportunity to evaluate incorporation of new meteorological and risk management tools into these metrics.

One of the most important findings of the drought exercise was that the LFAA is not well understood by water resource management stakeholders. Application of the technical aspects of the agreement is more complex than it might appear in a general reading. Moreover, a common misunderstanding is that the LFAA addresses demand management but that is not the focus of the agreement. Drought management is addressed in the Virginia, Maryland, and MWCOG drought response plans. A comprehensive drought response requires coordination in the implementation of multiple agreements and plans. Drought exercises are a critical tool in building the foundation for the necessary coordination. Drought exercises also improve understanding of the LFAA and drought response plans for the WMA. The 2018 Washington Metropolitan Area Drought Exercise helped to address education and coordination needs, created momentum toward further improvement and preparation, and identified many areas for improvement. Continued commitment to annual drought exercises and initiation of activities to address the follow-up suggestions from this exercise are needed to ensure that the WMA will be prepared to avoid the potentially dire consequences that extreme drought could present to the region.

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11/16/2018

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN

2018 Drought Exercise

PLACE: Griffith Water Treatment Plant, 9600 Ox Road, Lorton, VA 22079
DATE: November 30, 2018
TIME: 8:30 am to 4:00 pm

OBJECTIVES OF THE EXERCISE

1. To test the mechanisms in the LFAA for allocating water during an extreme drought, and
2. To explore the interactions between multiple drought management plans that encompass the Potomac River and the WMA.

AGENDA

8:30 Welcome and Introductions
8:45 Agenda Review
9:00 Review Existing Agreements & Regulations
9:20 Drought Scenario: Setting the Stage
9:40 Drought Scenario: June
10:15 Break
10:30 Drought Scenario: July
12:00 Lunch (provided)
1:00 Drought Scenario: August
2:00 Break
2:15 Drought Scenario: August (cont.)
3:30 Recap of Findings
4:00 Adjournment

Water Supply Coordination Agreement (WSCA)

Effective	22 July 1982
Signatories	United States (Baltimore District Engineer) Fairfax Water (Chairman) District of Columbia (Mayor) Washington Suburban Sanitary Commission (General Manager) Interstate Commission on the Potomac River Basin (Chairman)
Background	<p>The Washington, DC, metropolitan area (WMA), consisting of the District of Columbia and suburban areas in Maryland and Virginia, relies on the Potomac River as its primary source for municipal supply. The Washington Suburban Sanitary Commission, Fairfax Water and the Washington Aqueduct Division of the U.S Army Corps of Engineers (collectively, WMA water suppliers) jointly own water storage in upstream Jennings Randolph and Little Seneca reservoirs in the Potomac basin that they have agreed to operate for their common benefit during droughts. The institutional framework for the collaboration is developed through the WSCA. The Section for Cooperative Water Supply Operations on the Potomac (CO-OP) of ICPRB is designated in the WSCA to develop, implement, and maintain cooperative operating plans. The main goal of the agreement is to coordinate cooperative operations in order to minimize the chances that the allocation provision of the LFAA will need to be implemented.</p>
Provisions	<p>All suppliers agree to coordinate operation of all facilities.</p> <p>Reservoir releases shall be scheduled to meet all regional demands irrespective of any utility's participation in its cost – equal access to a reliable supply.</p> <p>Suppliers establish an Operations Committee that has met regularly since 1982 to oversee the implementation of the agreements and operational or planning needs.</p> <p>Every 5 years the adequacy of regional supply to meet projected demands is reviewed for a twenty-year planning horizon.</p>
CO-OP Activities during Drought	<p>When daily flow at Point of Rocks falls below 2000 cubic feet per second, CO-OP begins daily monitoring and reporting of flows and demands.</p> <p>When daily flow above the WMA intakes, less the minimum environmental flow-by at Little Falls dam, falls below twice the WMA's daily Potomac River withdrawals, CO-OP manages the WMA system to ensure that demands and the Little Falls flowby are met:</p> <ul style="list-style-type: none"> - Compiles data on river flow, reservoir storage, and WMA withdrawals on an ongoing basis, - Reviews river flow forecasts from its Low Flow Forecast System and other sources, - Determines release rates from upstream reservoirs (Jennings Randolph, Savage, and Little Seneca) to augment Potomac River flow, - Recommends shifts in withdrawals between intakes on the Potomac River and off-Potomac reservoirs (Occoquan and Patuxent) to help meet needs while preserving reservoir storage. <p>Operations in the droughts of 1999 and 2002 maintained an adequate and reliable supply of water while meeting the Little Falls environmental flow-by.</p>

Low Flow Allocation Agreement (LFAA)

Effective	11 January 1978
Signatories	United States (Secretary of the Army) Maryland Virginia District of Columbia Fairfax Water Washington Suburban Sanitary Commission
Background	The LFAA provides for the equitable allocation of Potomac River flows among all users in time of shortage. One of the driving forces behind the LFAA was to assure that the District's supply would be protected from future upstream withdrawals. The signatories of the LFAA agree that access to the subject portion of the Potomac River is subject to the provisions of the LFAA. The agreement further specifies that permittees within the subject portion of the River are subject to the provisions of the Agreement. (For example, the City of Rockville, though not a signatory, is subject to, and benefits from the LFAA through their water use appropriation permit.)
Provisions	Establishes an unbiased Moderator to resolve all disputes among the parties. Provides for an environmental flowby within the river. Requires annual review by signatory parties, and agreement in April of each year on the allocation formula that will be used in time of shortage. Identifies stages of Potomac flow (Alert, Restriction, and Emergency) that may be declared by the Washington Aqueduct.
Activity	Annual meetings of the signatories are to be held every year in April. Consumptive use (CU) regulations have been put in place in both Maryland (1985) and Virginia (2007) for the purpose of protecting the WMA's supply from upstream CU ¹ <ul style="list-style-type: none"> - Maryland non-residential surface water permits require low flow augmentation for CU above 1 MGD. - Maryland municipal residential users upstream of the WMA must reduce withdrawals from the Potomac River or its tributaries to average winter use levels when the LFAA Restriction stage is declared. - Virginia non-municipal permits for withdrawals from the Potomac River or its tributaries between West Virginia and Little Falls require low-flow protections if CU is above 0.5 MGD. - Virginia permits for Potomac River intakes between the Shenandoah River confluence and Little Falls require that withdrawals be reduced by an amount specified by VADEQ when the LFAA Restriction or Emergency stage is declared.

¹ See Code of Maryland Regulations 26.17.07.02, Code of Virginia 62.1-44.15:5.02, and Virginia Administrative Code 9VAC25-210-370 for more details.

Summary of the LFAA Low Flow Allocation Process

11/20/2018

1. When tomorrow's total daily withdrawal exceeds 50% of total daily flow, the Aqueduct, after consultation with WSSC and Fairfax Water, may declare an Alert Stage (LFAA 2.B.1).
2. Beginning when an Alert Stage is declared, the Aqueduct keeps Moderator informed as to stage of flow (LFAA 2.A).
3. When tomorrow's total daily withdrawal, plus 100 mgd for environmental flow-by, exceeds 80% of total daily flow, the Aqueduct, after consultation with WSSC and Fairfax Water, may declare a Restriction Stage (LFAA 2.B.2, 2.C, and Memorandum of Intent, July 20, 1978).
4. Beginning when a Restriction Stage is declared,
 - a. Aqueduct will request the U.S. Park Service to discontinue putting Potomac River water into the C&O Canal. (LFAA 2.B.2)
 - b. Aqueduct shall daily calculate and advise each user, and the Moderator, of each user's allocated fair share of the water available from the subject portion of the Potomac River. See below for Allocation of Flow (LFAA 2.C)
 - c. Aqueduct shall provide all parties, and the Moderator, with all information utilized for determining the allocation, the quantities of water being withdrawn by all users from any and all sources, and the flow of the Potomac River. (LFAA 2.C)
5. Beginning when the estimated total daily withdrawal, plus 100 mgd for environmental flow-by, for any day within the ensuing five (5) days from the subject portion of the Potomac River is expected to exceed the anticipated daily river flow, the Aqueduct may, after consultation with WSSC and FW, declare an "Emergency Stage" to be in effect. (LFAA 2.B.3, 2.C, and Memorandum of Intent, July 20, 1978)

Procedure for Allocation of Flow

- 1) Each day, compute each user's allocated fair share of the flow of the river for the next day, as follows (LFAA 2.C):
 - $\text{Aqueduct} = (\text{Aqueduct Winter Use}) / (\text{All Users Winter Use}) * (\text{Water available} - \text{Flow-by})$
 - $\text{Rockville} = (\text{Rockville Winter Use}) / (\text{All Users Winter Use}) * (\text{Water available} - \text{Flow-by})$
 - $\text{Fairfax} = (\text{Fairfax Winter Use}) / (\text{All Users Winter Use}) * (\text{Water available} - \text{Flow-by}) - \text{Occoquan}$
 - $\text{WSSC} = (\text{WSSC Winter Use}) / (\text{All Users Winter Use}) * (\text{Water available} - \text{Flow-by}) - \text{Patuxent}$
- 2) If the allocation formula results in an allocation exceeding the proposed withdrawal of any user, ... the Aqueduct shall reallocate said excess amount among the other users in a reasonable manner. (LFAA 2.C.4)
- 3) The Aqueduct will not invade the environmental flow-by "absent essential need" and, in determining such need, the Aqueduct shall assure itself that the localities and jurisdictions affected have made maximum use of other sources of water and imposed maximum conservation measures. (Memorandum of Intent, July 20, 1978, para. 6)

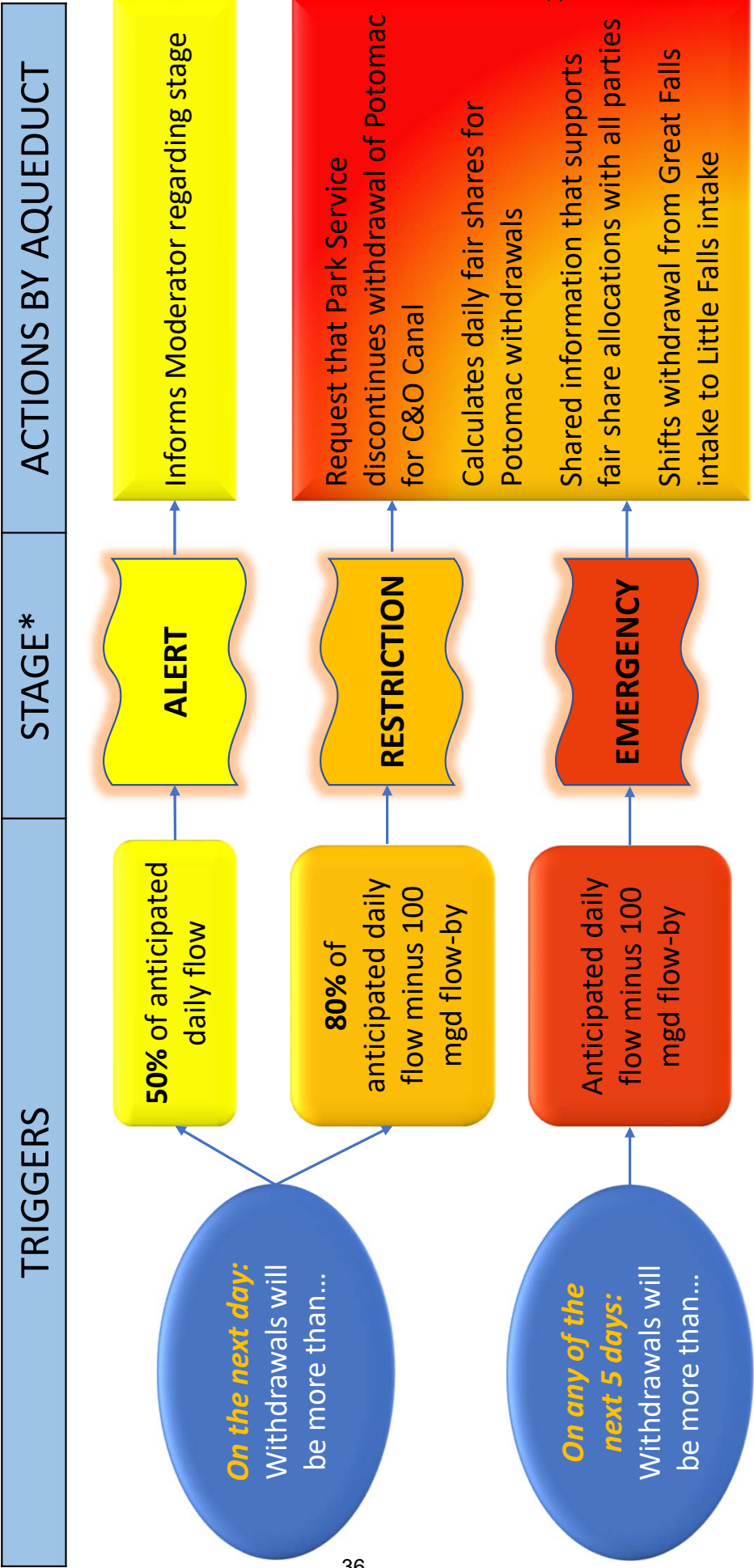
Definitions

- For purposes of calculating daily withdrawals or daily flows, LFAA Article 2.A defines a day as the 24-hour period from midnight to the following midnight, unless the parties subsequently agree to a different 24 hour measuring period.
- Subject portion of the Potomac River = from Little Falls to upstream end of Seneca Pool
- Total daily withdrawals = Aqueduct + FW + WSSC + Rockville
- Total daily flow = Little Falls observed + total daily withdrawals
- Water available = Total daily flow + Occoquan @ max capacity + Patuxent @ max capacity
- "... the term "users" refers to the following entities which are or may be appropriating water for public water supply purposes from the subject portion of the Potomac River; namely, the Government (including its water customers), the Commonwealth for and on behalf of herself and each of her political subdivisions and authorities (including the Authority), the State and the Administration (for and on behalf of its permittees whether or not parties to this Agreement), the District of Columbia, the Commission, and such entities which may formally be added or made subject to this Agreement subsequent to its initial execution. (LFAA C)

Considerations in allocation of water during Restriction and Emergency Stages

- 1) "On or before March 15 of each year, each user shall report to the Aqueduct (and to each other) the number of gallons of processed water pumped daily to all its customers from all sources during each winter period (the months of December through February). The amounts pumped during the 5 most recent winter periods shall be combined for the purpose of computing each user's average daily winter use. The ratio of each user's average daily winter use to the total average daily winter use of all users will be applied to the daily amount of water available at the time of allocation from the subject portion of the Potomac River (after deduction for environmental flow-by) and all other sources as specified ... below (calculated at maximum capacity practicable). The resulting amount, less the amount then available to said user by use of the maximum capacity practicable from all such other sources, will be such user's allocated fair share of the flow of the Potomac River." (LFAA 2.C.2)
- 2) An environmental flow-by is called for in LFAA Article 2.C and refers to a study then underway by Maryland. That study, *The Potomac River Environmental Flow-by Study* (1981), recommended a 100 MGD minimum flow-by at Little Falls and a minimum flow between Great Falls and Little Falls of 100 MGD plus the Washington Aqueduct's allocation (obtained by shifting, as needed, Aqueduct withdrawals from Great Falls to Little Falls). The Memorandum of Intent, July 20, 1978, paragraph 4, states, "The [Environmental Flow-by] study will automatically ... become the basis for execution of that provision of the Agreement".
- 3) "The water subject to the allocation formula under the terms of this Agreement includes (i) the maximum capacity then practicable from the Patuxent River and the Occoquan River; (ii) the natural flow of the subject portion of the Potomac River; and (iii) augmented flow of the subject portion of the Potomac River resulting from releases (for whatever purpose) from existing upstream reservoirs, including Bloomington Lake and Savage Lake and from the proposed Little Seneca Lake when completed and operational." (LFAA 2.C.5)
- 4) "In the event a disaster, such as a major fire or water main break, results in an abnormal loss of a significant portion of any user's water supply, the Aqueduct shall determine suitable adjustments in low flow allocation during the emergency period created by the disaster only, taking into consideration all sources available to the users." (LFAA 2.C.6)
- 5) "Water from the emergency pumping station having its intake at the estuary of the Potomac shall not be considered as water available from other sources for the purposes of Section 2.C.2 or otherwise included in computations made under this agreement." (LFAA 2.C.7)

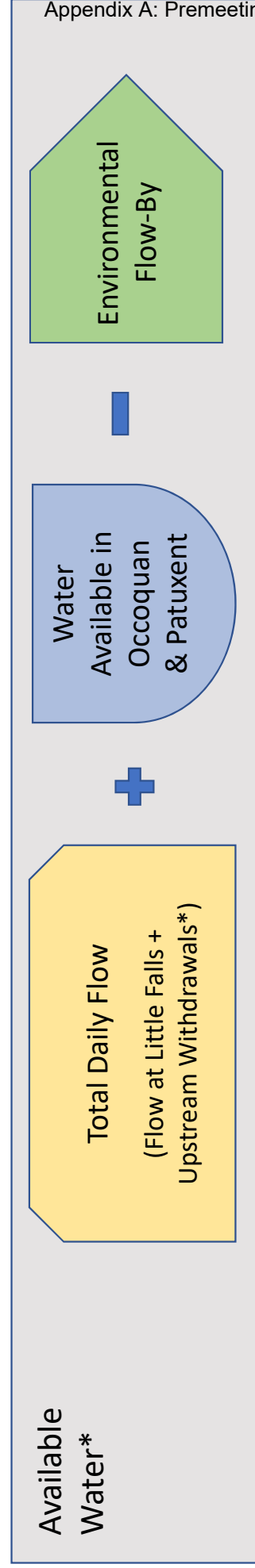
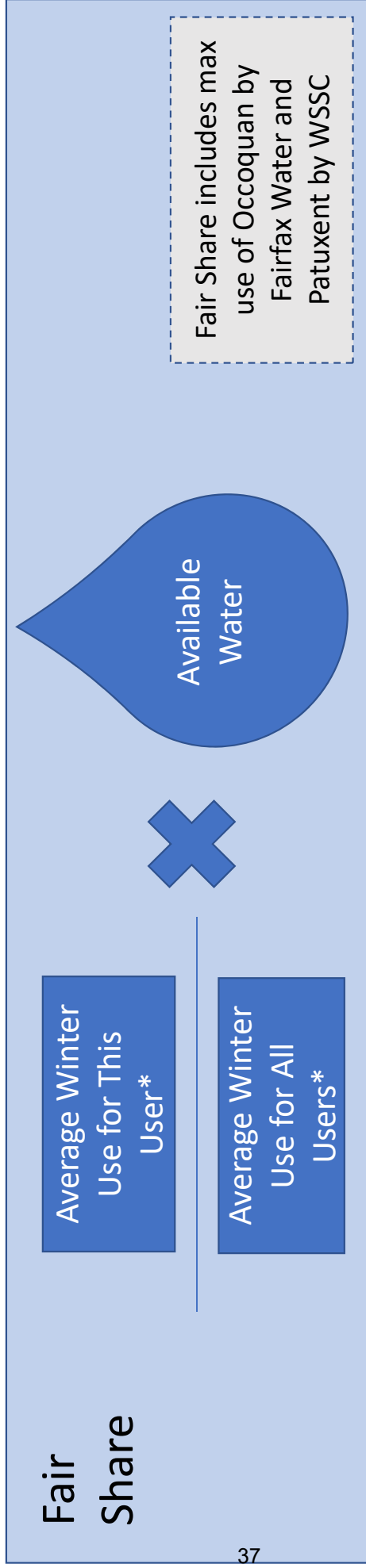
LFAA TRIGGERS AND ACTIONS



* Stages may be declared at these trigger levels BUT are NOT required to be declared at these levels.

FAIR SHARE ALLOCATION

Restriction and Emergency Stages



* In the Potomac between Seneca Pool (upstream end) and Little Falls

2018 Washington Metropolitan Area Drought Exercise

Drought Scenario:

The year is 2039, and the region is in the grip of a multi-year drought, which is believed to be a result of global climate change. In the fall of 2038, releases from Washington metropolitan area (WMA) reservoirs were initiated to augment low flows in the Potomac River, and states declared drought warnings in some upstream regions. By early winter, conditions had worsened significantly throughout the basin, and storage in most WMA reservoirs was low.

Morning discussion: At the beginning of the exercise's morning discussion, it is June 1, 2039, and storage volumes in both Little Seneca and the Patuxent reservoirs have only partially recovered from use during the previous fall and winter.

Afternoon discussion: At the beginning of the afternoon discussion, it is mid-August. Little Seneca Reservoir is empty, and storage levels in other system reservoirs are low.

System Resources:

In 2038-2039, the WMA is relying on the following resources to augment and supplement its Potomac River water supply (Fairfax Water's Vulcan Quarry is assumed to be not yet operational):

- Jennings Randolph and Savage reservoirs, located in Garrett County, Maryland, and Mineral County, West Virginia
- Little Seneca Reservoir, located in Montgomery County, Maryland
- Fairfax Water's Occoquan Reservoir in Fairfax, Virginia
- The Washington Suburban Sanitary Commission's Patuxent reservoirs, located between Montgomery and Howard counties in Maryland
- Loudoun Water's Quarry A, located in Loudoun County, Virginia (operated in accordance with VWP Permit 10-2020)

Drought Simulation:

A computer model is used during the morning portion of the exercise to simulate WMA reservoir operations and to display flow in the Potomac River, reservoir storage levels, and the various triggers and decision points that inform WMA drought responses and Maryland and Virginia drought declarations. The inputs for the simulation were based on Chesapeake Bay Program Phase 5 Watershed Model inputs and outputs for a climate change scenario considered in CO-OP's 2013 study of the potential impacts of climate change and water supply¹.

¹ Ahmed, S. N., K.R. Bencala, and C. L. Schultz. 2013. 2010 Washington Metropolitan Area water supply reliability study, Part 2: Potential Impacts of Climate Change. ICPRB report 13-07. (The exercise scenario uses a projection from the third Coupled Model Inter-comparison Project (CMIP3), INM-CM3.0, SREF A1B, statistically downscaled to the Chesapeake Bay watershed by the USGS's National Research Center).



REGIONAL WATER SUPPLY AND DROUGHT AWARENESS RESPONSE PLAN OVERVIEW FOR COG CHIEF ADMINISTRATIVE OFFICERS: JUNE 2018

WATER SUPPLY AND DROUGHT AWARENESS RESPONSE PLAN

Adopted in 2000, [COG's water supply and drought response awareness plan \(The Plan\)](#) provides a coordinated regional response to be implemented during drought conditions. The Plan consists of two interrelated components: (1) A year-round public outreach campaign emphasizing wise water use and conservation messages focused on both indoor and outside water uses; and (2) A water supply and drought awareness and response plan designed to insure a consistent and coordinated regional response to drought conditions.

The first part of the Plan, a year-round wise water use program consists of indoor and outdoor water conservation messages. The second part of the Plan establishes a series of triggers and associated actions tailored to the severity of drought conditions, focused on the Potomac River water supply system. Actions include coordinated regional decision-making through the Drought Coordination Committee concerning drought stage declarations (NORMAL, WATCH, WARNING, EMERGENCY) as well as public messaging, and if necessary, coordination concerning implementation of water use restrictions in the rare situation of a severe drought (WARNING and EMERGENCY stages).

ROLE OF CAOs DURING TIMES OF DROUGHT

The COG CAOs Committee, in conjunction with area water utility general managers, the Interstate Commission of the Potomac River Basin (ICPRB), state water supply coordinators, water utilities, and the NOAA Climate Prediction Center/National Weather Service, comprise the Drought Coordination Committee (DCC) under the Plan. **The DCC is the delegated authority under the Plan for issuing drought stage declarations (e.g., WATCH, WARNING, EMERGENCY) along with public notification associated with each stage.** The DCC is supported by the Drought Coordination Technical Committee (DCTC) comprised of COG, ICPRB, state and water utility technical staff.

When abnormally dry conditions persist in the Potomac River basin, as measured by the National Weather Service, the DCC may be convened to consider issuance of a drought WATCH. Should the region declare a drought WARNING or EMERGENCY, the DCC would be responsible for coordinating issuance of public messages and water use restrictions to insure regional consistency. The DCC would meet frequently via conference call to help manage drought response for the region. When conditions are in the NORMAL range, the CAOs receive monthly reports between May and October.

LAST DROUGHT WATCH DECLARED IN 2010

Since the regional plan was adopted, the region has declared a WATCH three times. COG's DCC last declared a drought 'WATCH' in September 2010. A press release was issued that urged residents and businesses to conserve water and use water wisely. It also emphasized that water supply reservoirs constructed in the early 1980s to provide water during droughts were full, but would be utilized if needed. The WATCH ended when Tropical Storm Nicole hit the region.

It has not been necessary to declare a WARNING or EMERGENCY for the Potomac River system, although in 2002, the combined reservoir storage in Jennings Randolph and Little Seneca briefly dropped to levels approaching the WARNING trigger. Due to sufficient rainfall it was not necessary to issue a WARNING. Since 2000, several smaller community water systems have briefly declared WARNING or EMERGENCY stages due to limited rainfall and less resilient water supply systems.

COG's WATER SUPPLY AND DROUGHT AWARENESS REPORT

COG issues monthly reports during the drought monitoring season (typically from April–October) unless conditions deteriorate and additional reporting is needed. The report is a snapshot of current water supply and drought monitoring conditions in the Potomac River Basin including streamflow, groundwater and precipitation data. The report is emailed to the DCC and DCTC each month and it is also posted on COG's Drought Website: <https://www.mwcog.org/drought>

WATER SUPPLY IN THE COG REGION

The Washington metropolitan region gets most of its drinking water from the free flowing Potomac River. Additional sources of water include the Patuxent and Occoquan reservoirs, as well as a number of additional small surface and ground water sources. During periods of low flow in the Potomac River, the Jennings Randolph Reservoir in West Virginia and the Little Seneca Reservoir in Montgomery County may be utilized to augment Potomac River flow.

Three major water supply utilities produce about 95% of the metropolitan Washington region's water. These are the Washington Aqueduct of the U.S. Army Corps of Engineers, Fairfax Water, and the Washington Suburban Sanitary Commission. Other agencies in our region supply the remaining 5% of the water. Some parts of the region are supplied by utilities that purchase water wholesale from one or more of the three large water utilities mentioned above.

During times of drought, natural flows on the Potomac may not always be sufficient to meet water supply needs while still maintaining a minimum flow in the river for sustaining aquatic resources. When low flows occur, the 1982 Water Supply Coordination Agreement designates ICPRB's Section for Cooperative Water Supply Operations on the Potomac (CO-OP) to be responsible for coordination of water resources among the three water supply utilities.

The three major supply utilities have paid for water storage held in the Jennings Randolph and Little Seneca reservoirs. Jennings Randolph Reservoir in the upper reaches of the Potomac River Basin stores 13 billion gallons of water for water supply purposes. Water released from Jennings Randolph takes at least a week during periods of significant drought before reaching the metropolitan Washington region. Located in Montgomery County, Little Seneca Reservoir has 4 billion gallons of water supply storage that can quickly reach water intakes for the major supply agencies in the metropolitan Washington region.

Recent investments in quarry storage reservoirs such as Luck Stone and Vulcan in Virginia, and future options such as water system interconnections and new storage reservoirs (e.g., the Travilah quarry in Maryland) will provide additional regional resilience for drought and water supply emergencies in the future.

Virginia Drought Assessment and Response Plan

The Virginia Drought Assessment and Response Plan (Plan) was developed after a state-wide drought emergency was declared by Governor Mark Warner during the summer of 2002. The Governor's subsequent Executive Order #39 directed the Commonwealth's Drought Coordinator (the Deputy Secretary of Natural Resources) to develop a formal plan to guide drought monitoring and responses in Virginia. The Plan was finalized in March, 2003 by the Drought Response Technical Advisory Committee, a coalition of stakeholders, including municipalities, State and Federal agencies, and representatives of citizen and industry groups. It describes proactive procedures for drought monitoring and response that recognize the complexity of hydrologic drought and its interactions with water supply.

The Plan designates the responsibility for monitoring drought conditions to the Drought Monitoring Task Force (DMTF), a group of state and federal agency representatives. The Plan also divides the Commonwealth into thirteen Drought Evaluation Regions based upon a combination of river basins, climatic divisions, and physiographic and geomorphic features. The Virginia Department of Environmental Quality is responsible for monitoring conditions during normal conditions and convening the DMTF upon the first occurrence of moderate drought conditions (D1) on the National Oceanic and Atmospheric Administration (NOAA) [U. S. Drought Monitor](#), or the occurrence of persistent abnormally dry (D0) conditions. Four indicators are used within each region to monitor for the development and/or persistence of drought conditions: precipitation, stream flow, groundwater levels, and reservoir storage.

The Plan describes how these indicators and other available drought indexes are to be evaluated by the DMTF. It also defines four drought stages: normal conditions, drought watch, drought warning, and drought emergency. The DMTF is responsible for making recommendations to the Virginia Drought Coordinator regarding the declaration of a drought stage. The Plan also describes in detail the responses to be made for each drought stage. These include the actions required by state agencies to communicate drought declarations as well as the recommended and/or required water conservation actions by water users that correspond to each stage. The Plan also lists the mandatory restrictions on nonessential water use that will be enacted during periods of declared drought emergencies.

Maryland Statewide Water Conservation Advisory Committee

Final Report November 2000

Robert L. Swann
Chairman

Parris N. Glendening
Governor

Kathleen Kennedy Townsend
Lieutenant Governor

EXECUTIVE SUMMARY

This report represents the efforts of the Maryland Statewide Water Conservation Advisory Committee, formed on January 7, 2000, by Governor Parris N. Glendening's Executive Order 01.01.2000.01. The committee was asked to make recommendations regarding water conservation and drought preparedness in Maryland. This report contains the Committee's recommendations, including a drought monitoring and response plan as well as recommendations for ongoing water conservation measures.

The drought monitoring and response plan outlines the methods and steps the State will take to monitor and respond to drought conditions. The plan divides the State into six regions for evaluating drought conditions, and describes a four-staged approach for monitoring and responding to drought. Using four indicators (precipitation, stream flow,

ground water levels, and available reservoir storage), water availability will be monitored year-round on a regional basis. If two or more indicators reach the "trigger" levels, appropriate responses outlined in the plan will ensure that water conservation efforts increase to reduce consumption of nonessential water uses.

In addition to explaining the staged drought monitoring and response to be undertaken, this document describes in detail the indicators to be used and how they will be monitored. The plan also includes mandatory water use restrictions that will become effective should any region reach the "Emergency" stage.

The committee also recommends ongoing efforts to increase water efficiency and water conservation, regardless of drought status

2018 DROUGHT EXERCISE, SIGN-IN SHEET

November 30, 2018

First Name	Last Name	Organization	Initials
Sarah	Ahmed	ICPRB	CA
Steve	Bieber	MWCOG	SB
Renee	Bourassa	ICPRB	RB
Rob	Burgholzer	VA DEQ	RB
Collin	Burrell	DOEE	CB
Joel	Caudill	WSSC	JC
Russell	Chambers	Leesburg	RC
Mark	Charles	City Rockville	MDC
Karrie	Crumlish	EPA Region 3	
Lee	Currey	MDE	LC
John	Deignan	DC Water	
Lucas	Donte	DC HSEMA	
Alton	Echols	Loudoun Water	AE
Jessica	Edwards-Brandt	Loudoun Water	JEB
Greg	Emanuel	Arlington County	
Laura	Felter	USACE	LF
Ray	Fernald	DGIF	
Charlie	Fitzsimmons	EPA Emergency Response On-Scene Coordinator	
Craig	Fricke	DC Water	CAF
Jillian	Galloway	VDH	JG
Alex	Gorzalski	Washington Aqueduct	AG
John	Grace	MDE	JG
Ian	Gregoire	Fairfax County Fire and Rescue Dept	IG
Ben	Grumbles	MDE	
Carlton	Haywood	ICPRB	HC
Jamie	Hedges	Fairfax Water	JH
Christine	Howard	MWCOG	CH
Dave	Hundelt	Arlington County	DH
Anjuman	Islam	DC Water	AI
Tom	Jacobus	Washington Aqueduct	TJ
Saeid	Kasraei	MDE	SK
Ginny	Kearney	MDE	GK
Pam	Kenel	Loudoun Water	PK
Salil	Kharkar	DC Water	
Scott	Kudlas	VA DEQ	SK
James	Langley	WSSC	JK
Dusti	Lowndes	DC Water	DL
Darryl	Madden	LFAA Standby Moderator ICPRB DC Commissioner	DM
Mary	Mahoney	VDH	MM
William	Marosi	MARFC	WM
Mark	Masters	Policy Works	MM
David	McDonough	WSSC, Police and Homeland Security Div	DM

First Name	Last Name	Organization	Initials
Bruce	Michael	MD DNR	EM
Susan	Miller	Fairfax Water	SGM
Heidi	Moltz	ICPRB	Hm
Mike	Moon	Arlington County	
Patrick	Moore	Leesburg	
Roddy	Mowe	Loudoun Water	RM
Chuck	Murray	Fairfax Water	CM
Clint	Osborn	DC HSEMA	
David	Paylor	VA DEQ	DICP
Mark	Peterson	Loudoun Water	
Greg	Prelewicz	Fairfax Water	GP
Lisa	Ragain	MWCOG	LJR
Brian	Ramaley	LFAA Moderator	BR
Matt	Ries	DC Water	ML
Dwayne	Roadcap	VDH	DR
Josh	Rodriguez	DOEE	JR
Kristin	Rowles	Policy Works	KR
Niffy	Saji	Fairfax Water	NV
Maureen	Schmelling	DC Water	✓
Cherie	Schultz	ICPRB	CS
John	Smith	MDE	
Anne	Spiesman	Washington Aqueduct	
Todd	Supple	WSSC	TS
Bob	Sussman	ICPRB Federal Commissioner Chair, ICPRB CO-OP	BS
Joel	Thompson	Fairfax Water	JS
Luke	Vawter	ICPRB	LV
Karen	Wright	WSSC	KW
Amy	Wyks	Leesburg	ARW
Susan	Yi	EPA Region 3	SY
Justin	Kirkman	Fairfax Water	JK
Justin	Green	Loudoun County Fire and Rescue	(JD)
Gert	Immerwalt	DC Water	GI
Joe	McCoy	DC HSEMA	JM
Joe	Darby	Fairfax Water	JD

Existing Agreements & Regulations

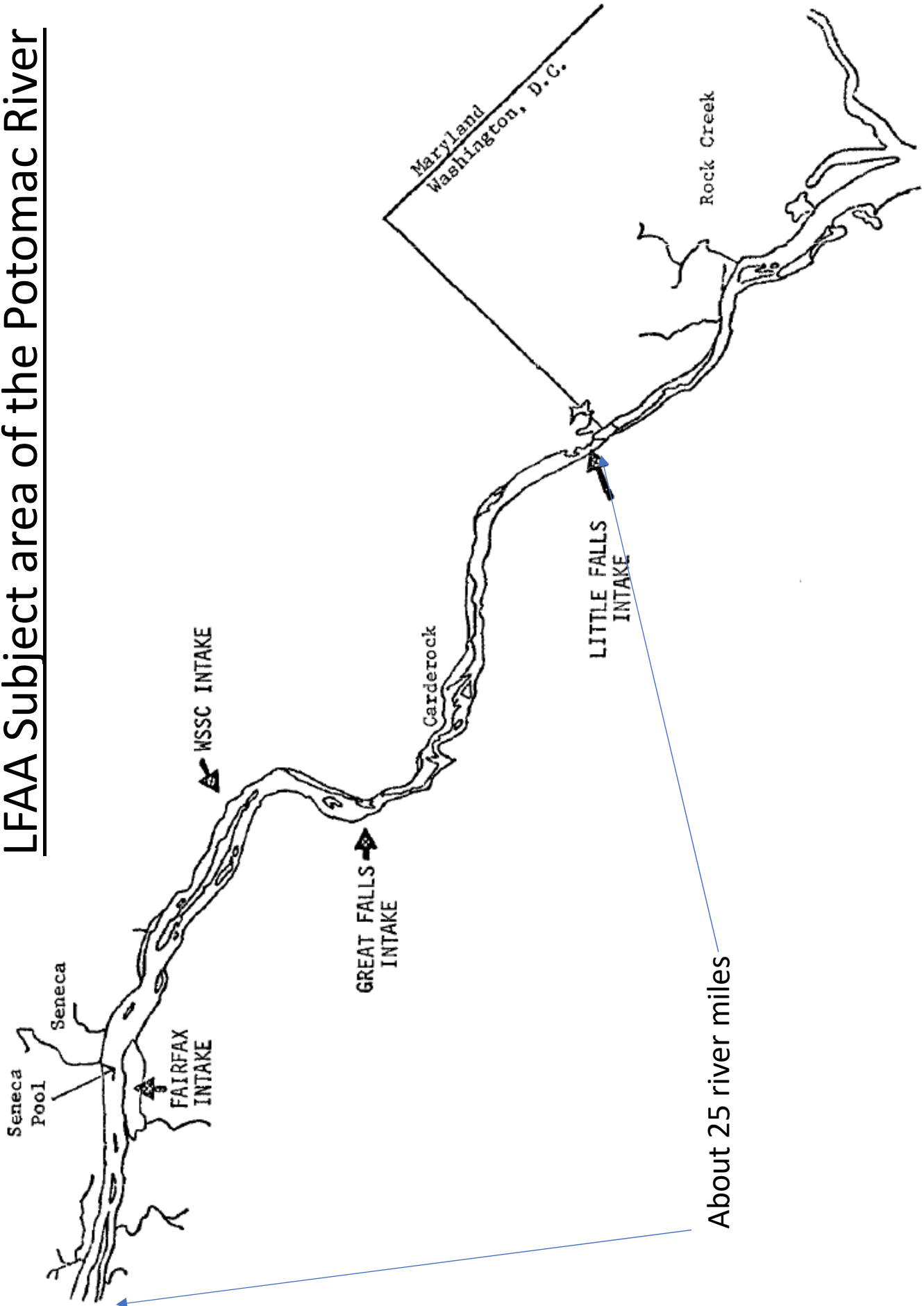
*2018 Washington Metropolitan
Area Drought Exercise*

November 30, 2018

Low Flow Allocation Agreement (LFAA) (1978)

- Provides for the equitable allocation of Potomac River flow among all users in time of shortage
- All permittees within the subject portion of the River are subject to the LFAA
- Establishes an unbiased Moderator to resolve disputes
- Provides for an environmental flow-by

LFAA Subject area of the Potomac River



About 25 river miles

Water Supply Coordination Agreement (WSCA) (1982)

- The main goal of the WSCA is to coordinate operations in order to minimize the chances that the allocation provision of the LFAA will need to be implemented
- The Section for Cooperative Water Supply Operations on the Potomac (CO-OP) of ICPRB is designated in the WSCA to develop, implement, and maintain cooperative operating plans
- Every 5 years the adequacy of regional supply to meet projected demands is reviewed for a twenty-year planning horizon

MWCOG Water Supply And Drought Awareness Response Plan (2000)

- Provides a coordinated regional response to be implemented during drought conditions
- Establishes a series of triggers and actions tailored to the severity of drought conditions, focused on the Potomac River water supply system
- Coordinates regional decision-making concerning drought stage declarations and public messaging
- Coordinates implementation of water use restrictions

Virginia Drought Assessment and Response Plan (2003)

- Guides drought monitoring and responses in Virginia
- Commonwealth divided into thirteen Drought Evaluation Regions
- Four drought stages: normal, watch, warning, and emergency
- Describes actions to be taken at each drought stage up to voluntary and mandatory water use restrictions
- A Drought Monitoring Task Force (DMTF) makes recommendations to the Virginia Drought Coordinator regarding the declaration of a drought stage

Maryland Drought Monitoring and Response Plan (2000)

- Outlines the methods and steps the State will take to monitor and respond to drought conditions
- Divides the State into six regions for evaluating drought conditions, one of which is the WSSC service area
- Four drought stages with levels of response for each, up to voluntary and mandatory water use restrictions
- WSSC is authorized to assess and respond to drought in its service area but State retains authority to impose drought response

Setting the Stage

2018 Washington Metropolitan Area Drought Exercise

November 30, 2018

Cherie Schultz, Ph.D.

Section for Cooperative Water Supply Operations on the Potomac (CO-OP)

Interstate Commission on the Potomac River Basin (ICPRB)

Outline

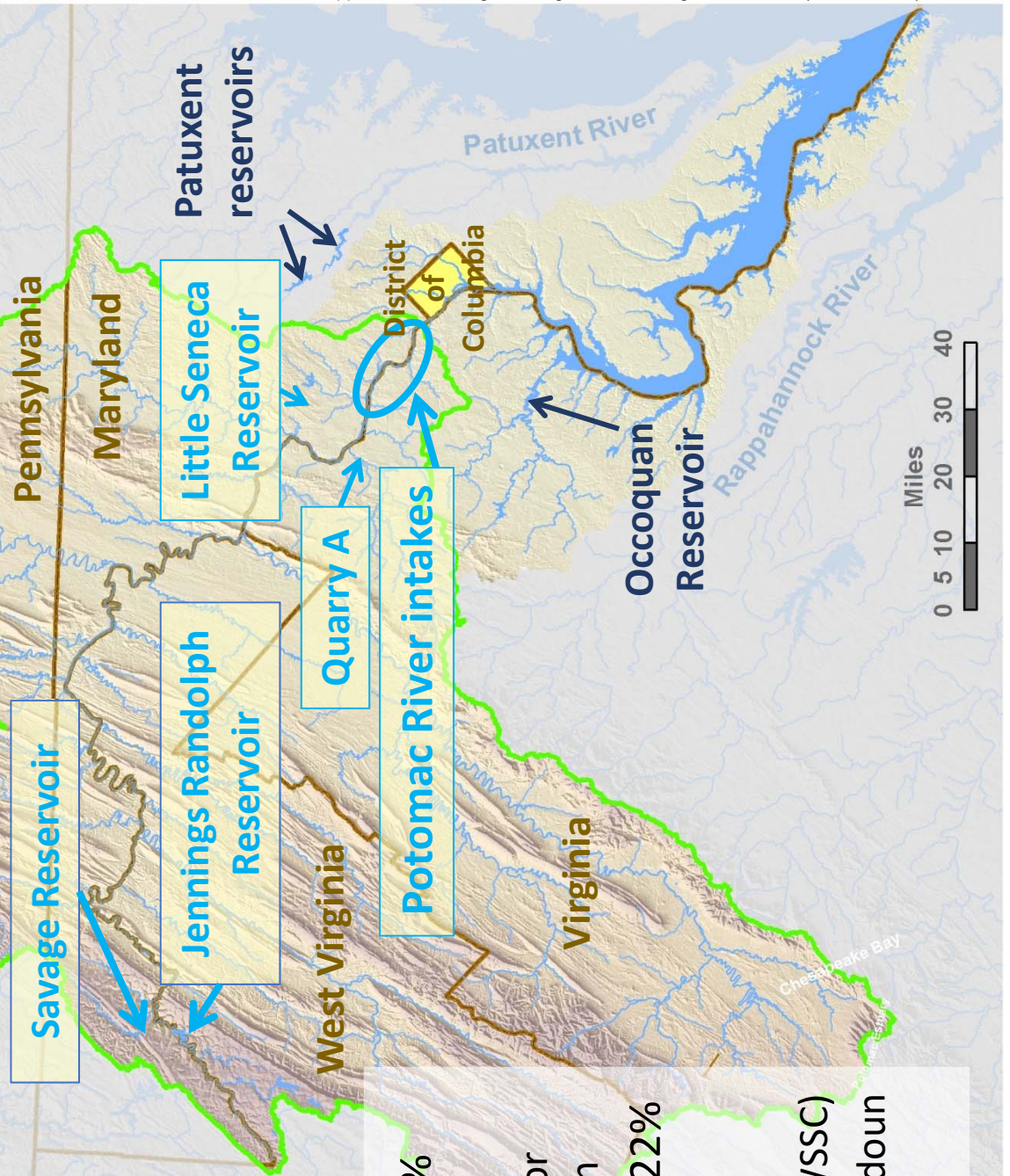
- Scenario: a VERY BAD multi-year drought
- CO-OP's role: cooperative management
- Exercise simulation
 - Morning: regional response & operations
 - Afternoon: LFAA allocations

Scenario

- Year: 2039
- Conditions: more severe than drought of record
- New resources:
 - Loudoun Water's Quarry A
 - (Fairfax Water's Vulcan Quarry NOT AVAILABLE until 2040)



Washington metropolitan area (WMA) system



- Shared resources – 78%
 - Potomac River
 - Upstream reservoirs for low flow augmentation
- Individual resources – 22%
 - Occoquan Reservoir (Fairfax Water)
 - Patuxent reservoirs (WSSC)
 - Quarry A in 2023 (Loudoun Water)

Institutional framework for drought operations

Low Flow Allocation Agreement (LFAA) - 1978

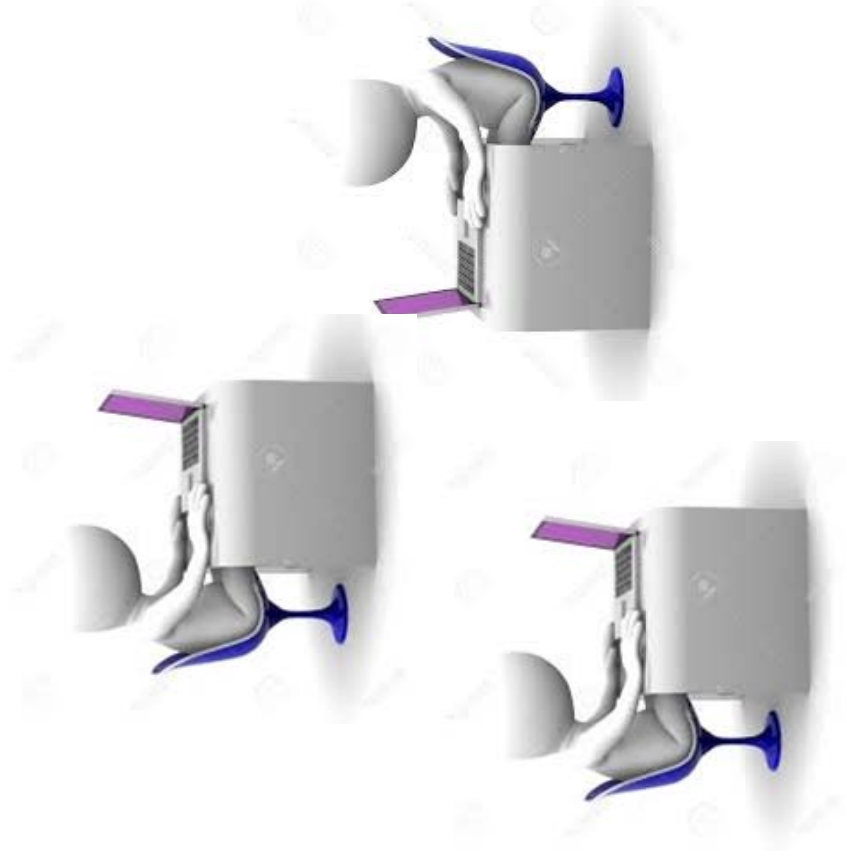
Water Supply Coordination Agreement (WSCA) - 1982

“it is in the mutual benefit of the suppliers to manage ... to reduce or eliminate the possibility that the Emergency Stage of the Low Flow Allocation Agreement will ever be reached”

“The suppliers agree to operate their respective water supply systems in a coordinated manner so as to provide the optimal utilization of all available water supply facilities”

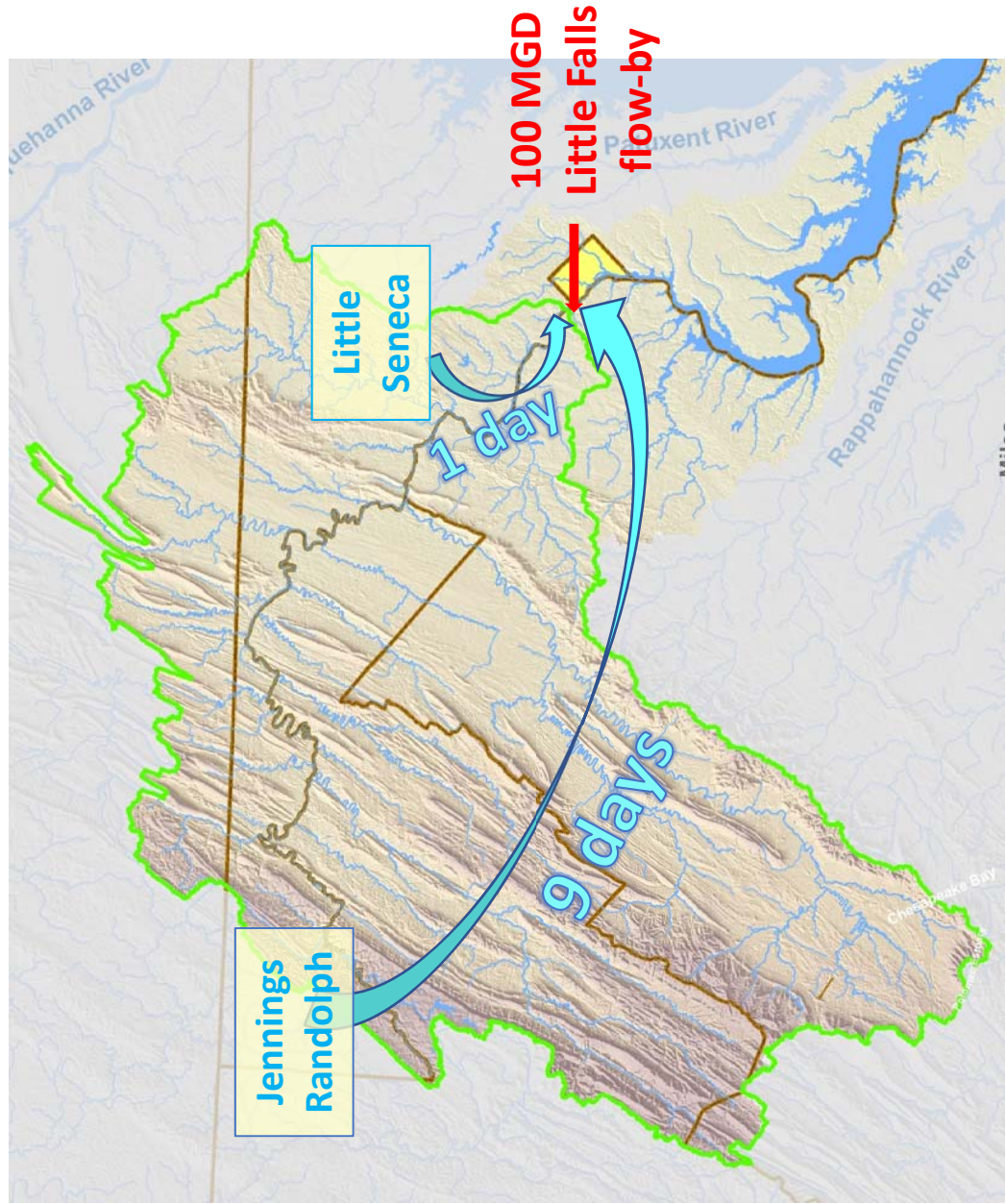
CO-OP's role during droughts

- Manage use of resources under WSCA
- Keep stakeholders informed
- Decisions subject to review by General Managers of WSCA signatory suppliers



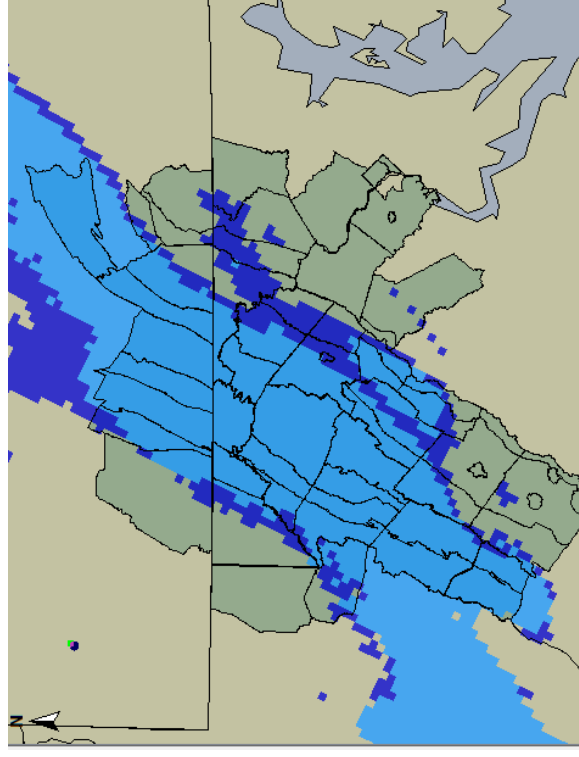
Importance of flow & demand forecasts

- Potomac flow highly variable
- WMA withdrawals have big impact during droughts



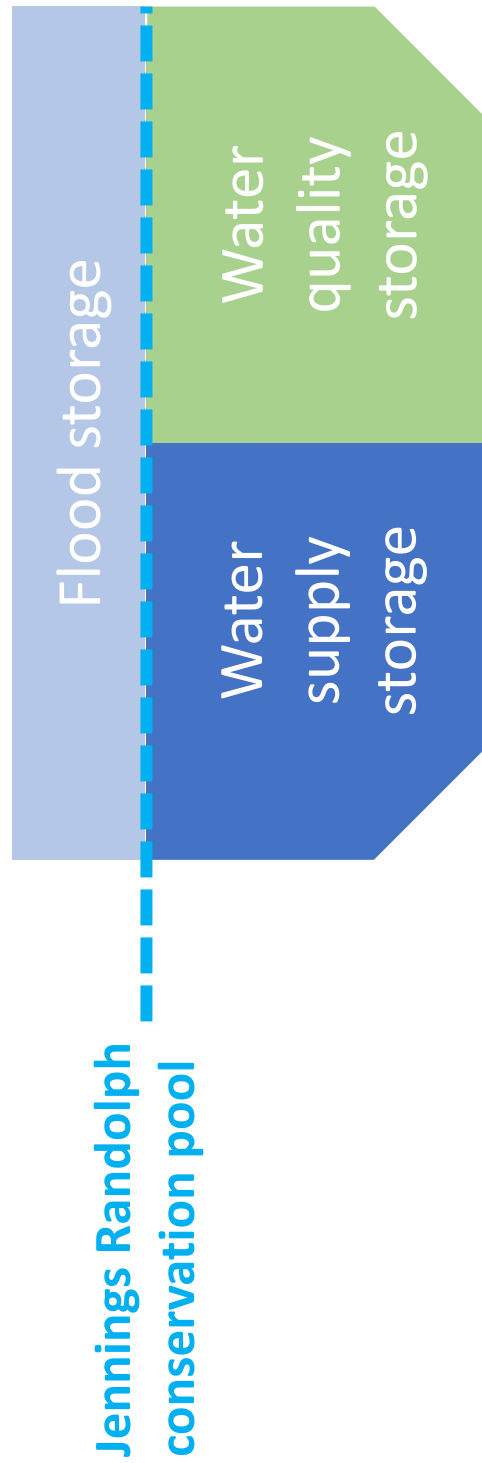
Compiles data

- Demand data from suppliers
- Flow data from USGS
- Meteorological data and forecasts from NWS



Determines Jennings Randolph “water supply” releases

- Based on 9-day flow forecasts
- Implemented via call to Corps’ Baltimore Office
- No “margin of safety” used



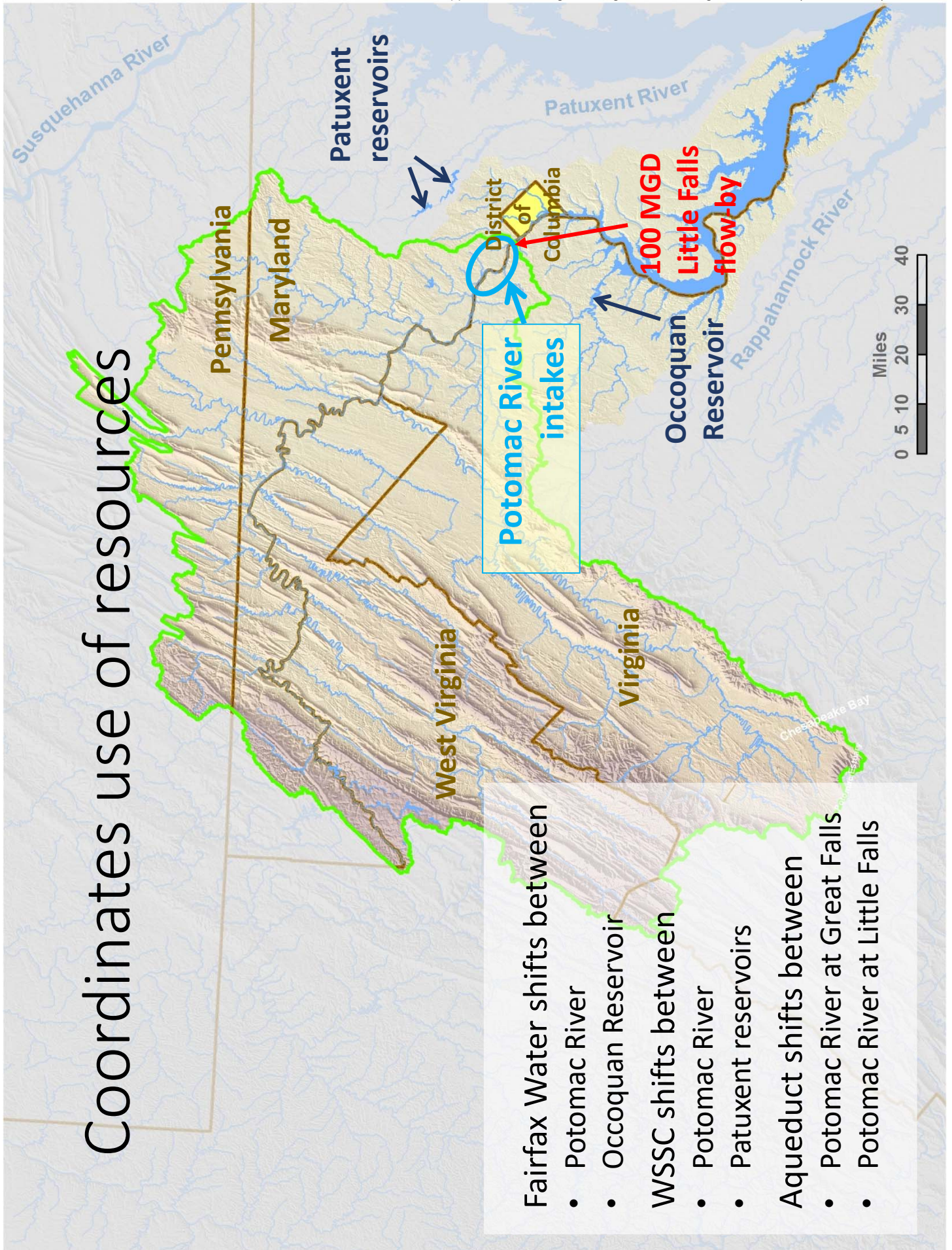
Determines Little Seneca releases

- Based on 1-day flow forecasts
- Implemented via call to WSSC
- Accompanied by Fairfax Water shifts to Occoquan
- 120 MGD margin of safety (MOS) added

Risk of missing Little Falls flow-by with 120 MGD MOS

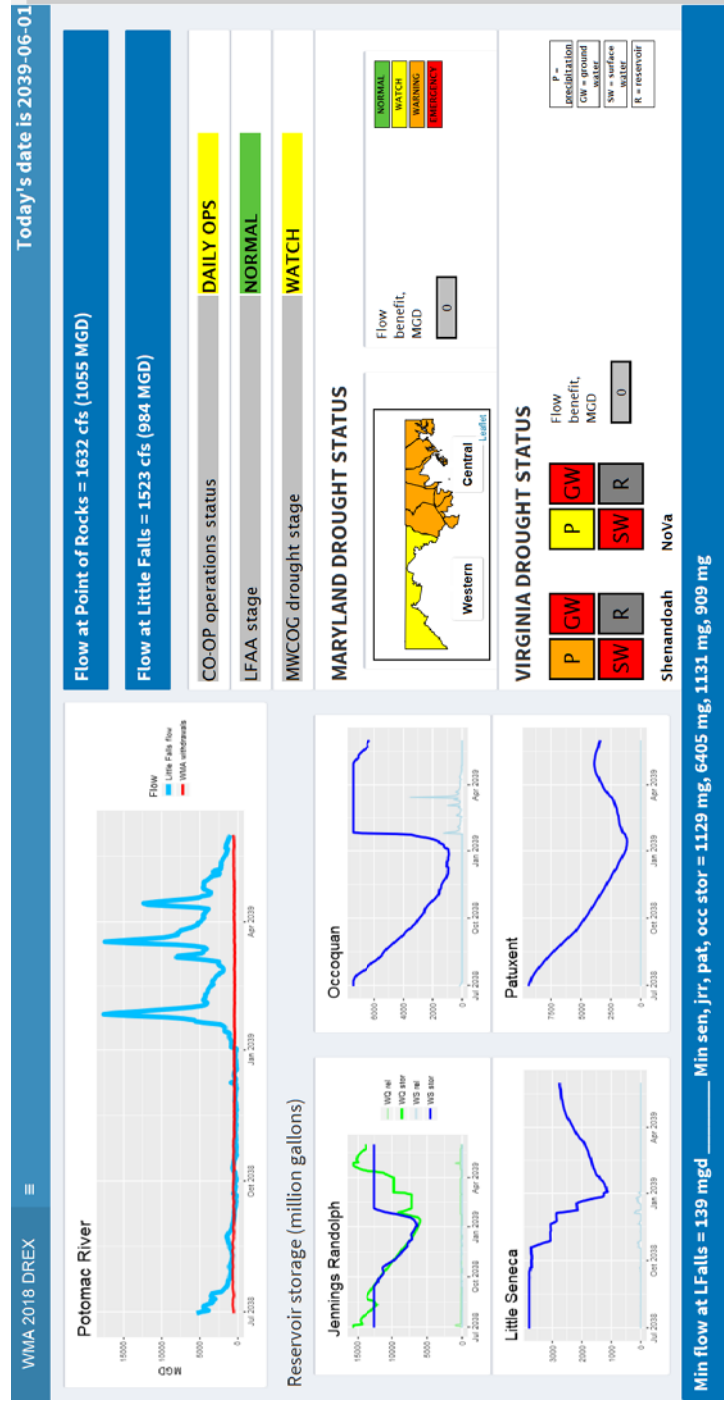
- 0.12% in any given year
- 10% in drought of record

Coordinates use of resources



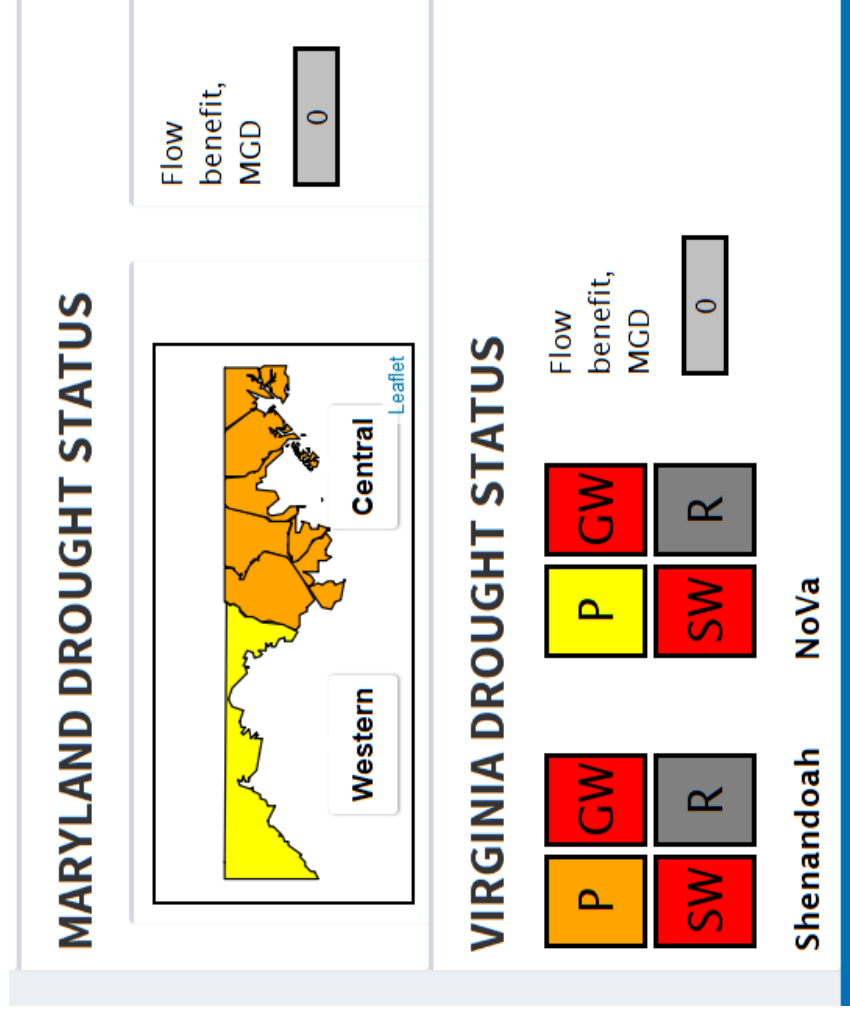
Morning simulation

- New model represents CO-OP resources & operations
- Climate change scenario from CO-OP's 2013 study
- Incorporates impact of state decisions on CO-OP system



Impact of state decisions

- Drought declarations
 - reduce upstream demands
 - increase river flow
- Upstream drought declaration regions
 - MD - Western
 - MD - Central
 - VA - Shenandoah



CO-OP's assumptions on WMA water use reductions

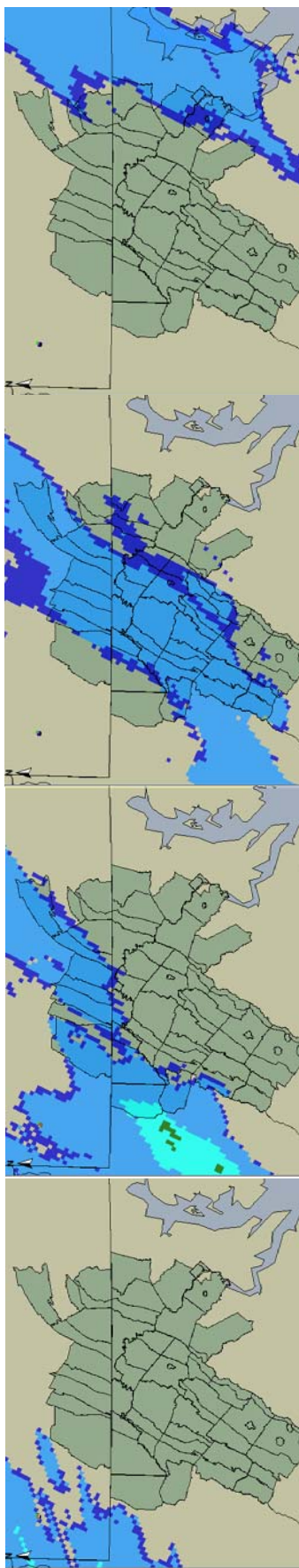
CO-OP models <~> MWCOG plan

- Voluntary restrictions during Warning Stage
 - 5% summertime reductions
 - 3% other month reductions
- Mandatory restrictions during Emergency Stage
 - 15% summertime reductions
 - 5% other month reductions





Simulation vs actual operations?

- New forecasts are available
 - 15-day demand forecasts from CO-OP
 - 15-day meteorological forecasts from NWS
 - Various flow forecasts
- Impact of state drought declarations not yet considered in CO-OP operations or in PRRISM



Options to meet 2040 challenges

4 ops alternatives + Vulcan  Reliability under 75% of climate projections

Travilah Quarry  Reliability under 90% of climate projections

Better flow forecasts

Beaverdam for low-flow augmentation

Vulcan

Quarry B

Travilah

Emergency use of Jennings WQ storage

Quarry A operated cooperatively



Flow at Point of Rocks = 1647 cfs (1064 MGD)

Flow at Little Falls = 1537 cfs (994 MGD)

CO-OP operations status

DAILY OPS

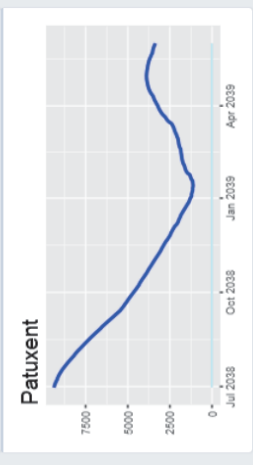
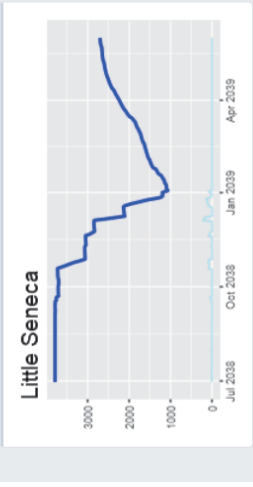
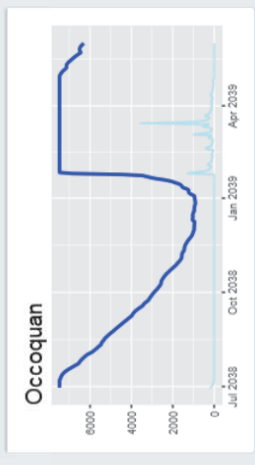
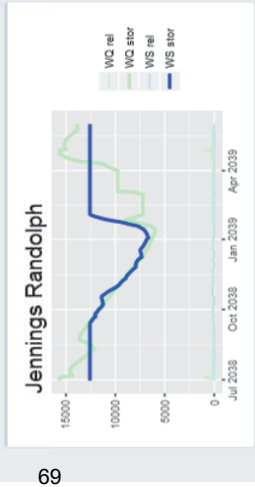
LFAA stage

NORMAL

MWCOG drought stage

WATCH

Reservoir storage (million gallons)



MARYLAND DROUGHT STATUS

Western Central Leaflet

Flow benefit, MGD

6.9

NORMAL WATCH WARNING EMERGENCY

VIRGINIA DROUGHT STATUS

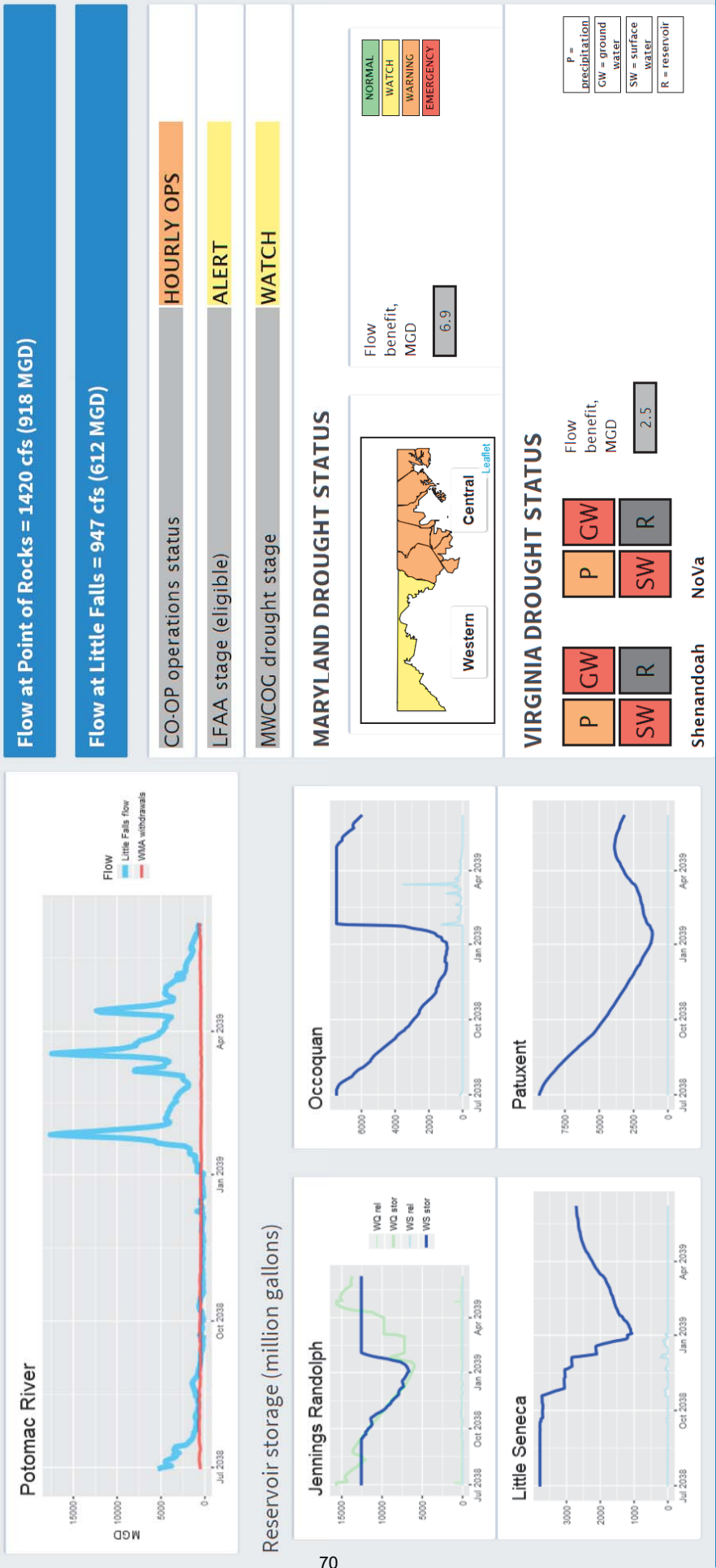
Shenandoah NoVa

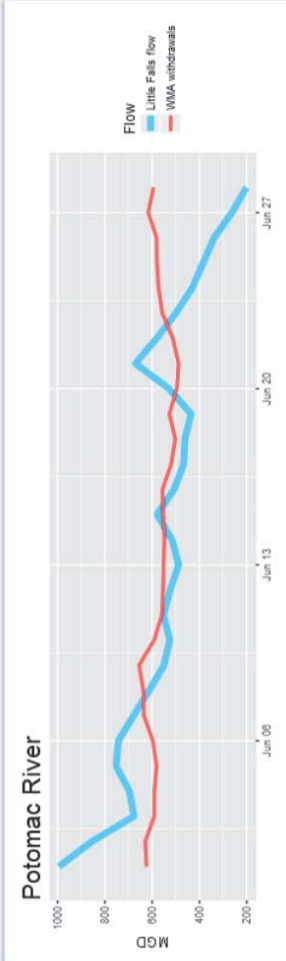
P GW SW R P GW SW R

Flow benefit, MGD

2.5

P = precipitation
GW = ground water
SW = surface water
R = reservoir





Flow at Point of Rocks = 932 cfs (602 MGD)

Flow at Little Falls = 311 cfs (201 MGD)

CO-OP operations status

HOURLY OPS

LFAA stage (eligible)

RESTRICTION

MWCOG drought stage

WATCH

MARYLAND DROUGHT STATUS

Flow benefit, MGD

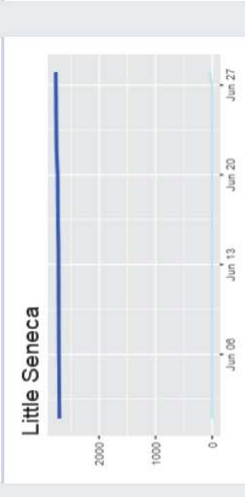
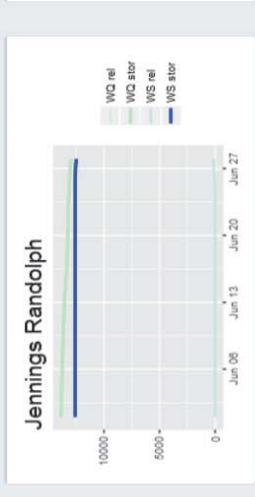
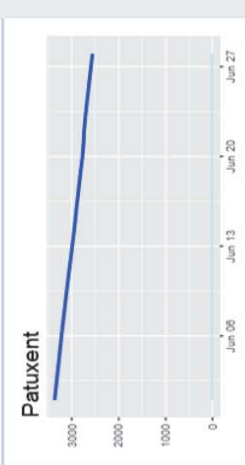
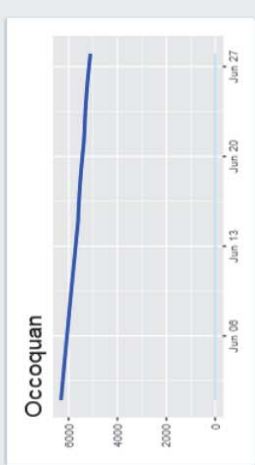
11.9

NORMAL

WATCH

WARNING

EMERGENCY



VIRGINIA DROUGHT STATUS

Shenandoah

NoVa

P

GW

P

GW

SW

R

SW

R

Flow benefit, MGD

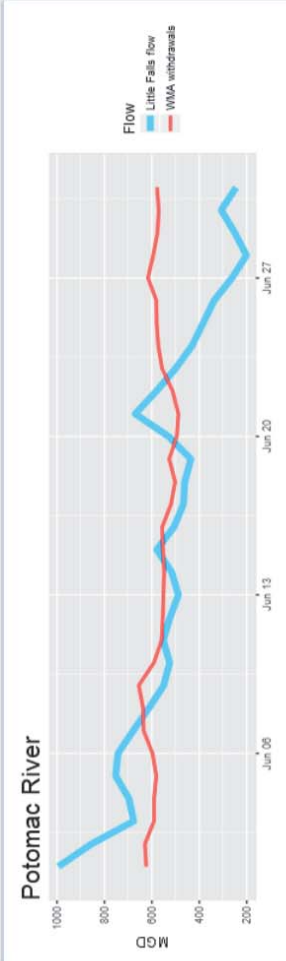
2.5

P = precipitation

GW = ground water

SW = surface water

R = reservoir



Flow at Point of Rocks = 863 cfs (558 MGD)

Flow at Little Falls = 379 cfs (245 MGD)

CO-OP operations status

HOURLY OPS

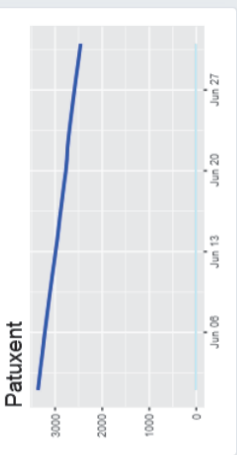
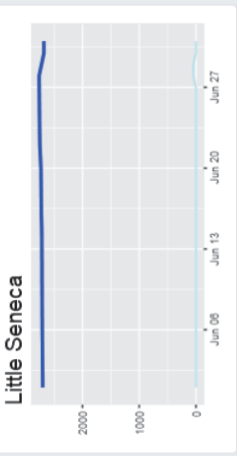
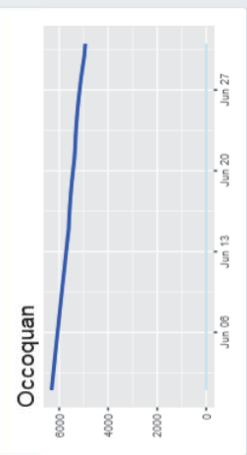
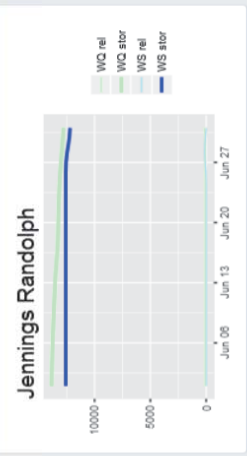
LFAA stage (eligible)

RESTRICTION

MWCOG drought stage

WATCH

Reservoir storage (million gallons)



MARYLAND DROUGHT STATUS

Western

Central

Leaflet

Flow benefit, MGD

11.9

NORMAL

WATCH

WARNING

EMERGENCY

VIRGINIA DROUGHT STATUS

Shenandoah

NoVa

P

GW

SW

R

P

GW

SW

R

Flow benefit, MGD

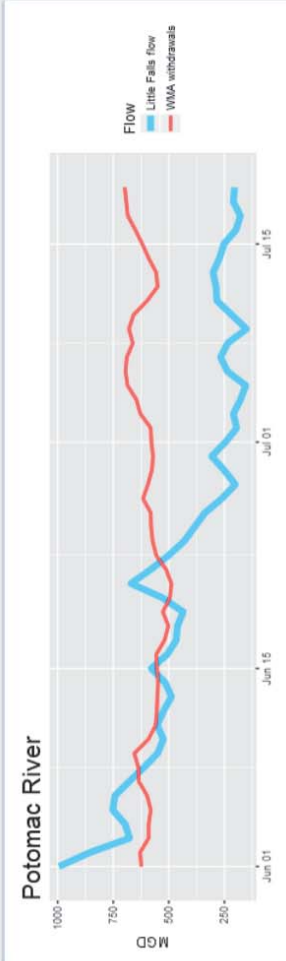
6.5

P = precipitation

GW = ground water

SW = surface water

R = reservoir



Flow at Point of Rocks = 492 cfs (318 MGD)

Flow at Little Falls = 316 cfs (204 MGD)

CO-OP operations status

HOURLY OPS

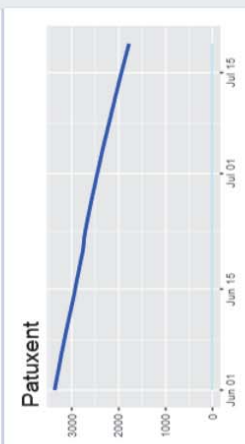
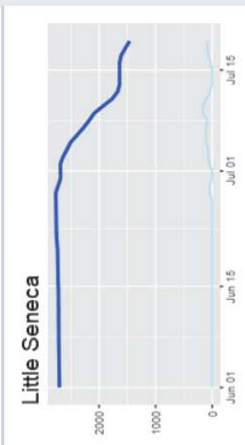
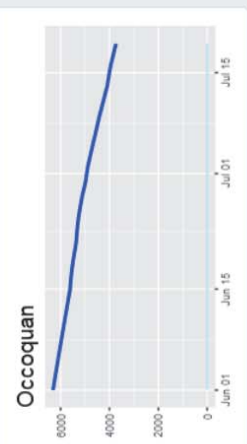
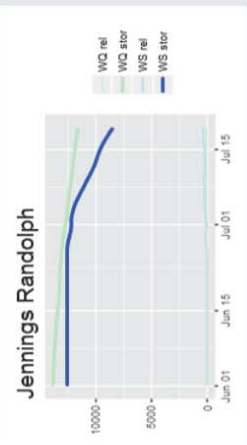
LFAA stage (eligible)

RESTRICTION

MWCOG drought stage

WARNING

Reservoir storage (million gallons)



MARYLAND DROUGHT STATUS

Western

Central

Leaflet

Flow benefit, MGD

15

NORMAL

WATCH

WARNING

EMERGENCY

VIRGINIA DROUGHT STATUS

P

GW

P

GW

SW

R

SW

R

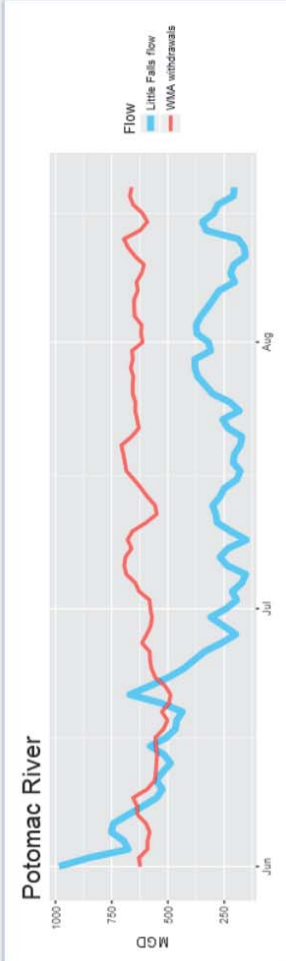
Shenandoah

NoVa

Flow benefit, MGD

6.5

P = precipitation
GW = ground water
SW = surface water
R = reservoir



Flow at Point of Rocks = 567 cfs (367 MGD)

Flow at Little Falls = 318 cfs (205 MGD)

CO-OP operations status

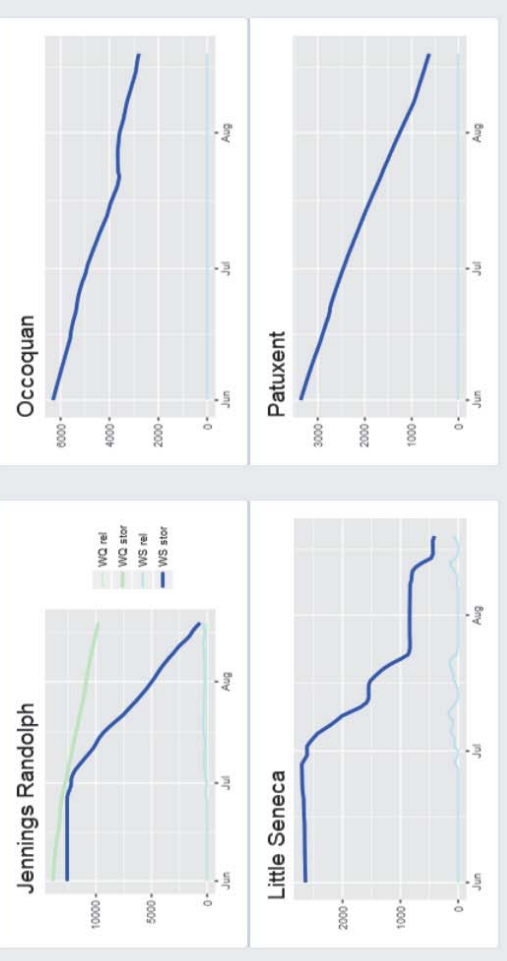
HOURLY OPS

LFAA stage (eligible)

RESTRICTION

MWCOG drought stage

WARNING



MARYLAND DROUGHT STATUS

Western

Central

Leaflet

Flow benefit, MGD

15

NORMAL

WATCH

WARNING

EMERGENCY

VIRGINIA DROUGHT STATUS

Shenandoah

NoVa

P

GW

SW

R

Flow benefit, MGD

6.5

P = precipitation

GW = ground water

SW = surface water

R = reservoir

POTOMAC DROUGHT EXERCISE: 11-30-2018

WRITTEN RESPONSES FROM PARTICIPANTS TO QUESTIONS POSED TO THE GROUP

WHAT DO YOU THINK ABOUT THE MARGIN OF SAFETY THAT IS CURRENTLY USED IN RESERVOIR RELEASE REQUESTS?

Asked at approximately 10:30 before the morning break. Responses written on post-it notes during the break and placed on a flip chart. Reviewed with the group after the break.

1. Margin of safety on the Seneca release (120 mgd) is probably appropriate for planning/modeling but actual margin of safety releases need to be done in context of actual flows at Little Falls.
2. It's not too low. Could be just right or it depends.
3. Too high
4. Just right. Has a scientific basis with all the simulating done by ICPRB and carried out during real droughts.
5. Close, maybe a bit too high, one day average at Seneca
6. Too high. How to explain priorities to customers if restrictions become too difficult for them.
7. Too high. Would like to understand relative risk of lower margin of safety compared to current margin of safety and risk to water supply.
8. Just right. Makes sense to do bulk with Jennings and today with Seneca.
9. The ICPRB is being appropriately responsible given the existing flow-by standard.
10. Too low.
11. Too high. (1) Should 100 mgd flow-by be adjusted to more of a weekly average to give more flexibility to the Seneca releases? i.e., if we drop below 100 mgd at Little Falls for a day or so while we fine tune the Seneca release, wouldn't the downstream environment still be ok? (2) The

POST-IT NOTE QUESTION FOR THE MORNING BREAK

What do you think about the margin of safety that is used in reservoir release requests?

- Too High
- Too Low
- Just Right
- It Depends...

■ Write your response on a post-it note and put it on the flip chart during the break.

■ If you want, add comments to explain your response.

■ Take a minute to read other responses during the break.

evaluation development of the 100 mgd target seems dated. Since development of the 100 mgd target has there been growth in tributary discharge to below Little Falls from other sources (e.g., WWTPs)?

12. Too high. Studies have shown that biology recovers fairly quickly after flow-by is reduced.

13. It depends. It ALWAYS depends. Will need to message and articulate by audience.

DOES THE LEVEL OF DROUGHT RESPONSE SEEM APPROPRIATE TO YOU AT THIS TIME?

Asked at approximately 11:30. Participants raised a card to indicate their answer (by color). Some made comments on cards. Cards were discussed during the meeting and then collected for tabulation.

RESPONSES:

PINK: 12

YELLOW: 8

GREEN: 15

Comments on note cards:

1. **PINK:** As far as messaging, what are the jurisdictions doing? Coordinate biological and living resource monitoring for Potomac and associated tributaries. Monitoring efforts should be coordinated, potentially by ICPRB. Fortunately, states (MD & VA) use similar biological monitoring methodologies.
2. **PINK:** Patuxent Reservoir very low, 25%; river flows very low; Metro Wash water demand increasing at this point (or high at this point); need to do better in reducing demand at this point.
3. **PINK:** Demand not dropping sufficiently
4. **PINK:** LFAA not being implemented; 200 mgd in July push well below assimilative capacity and close to flow-by
5. **PINK:** Simulated flows are about 25% lower than historical 1999 drought which means we are at an environmental condition never before observed.

QUESTION FOR THE GROUP

Does the level of drought response seem appropriate to you at this time?

- Write your response on a note card – pick a color:
 - Yes – **GREEN**
 - No – **PINK**
 - In Between – **YELLOW**
- If you want, add comments to explain your response.

6. **PINK:** Conservation measures are not consistent across the region. Upstream conservation for reservoirs should be in place to protect for future uncertainties. Close to LFAA and margin of safety. Reservoirs are on path to depletion.
7. **PINK:** Demand is going up. Potomac flows decreasing. Reservoirs decreasing and no end in sight to drought. 7/19/2039. Not even “dry” period yet.
8. **PINK:** No. The unsynchronized demand management structures are a challenge. It’s not clear how VA, MD, and COG plans would coincide. Different triggers, differing responses. Do we need a unified regional demand management plan? Not just for drought, but for reduced availability from source contamination, etc.
9. **PINK:** Demand not well coordinated.
10. **PINK:** Nope.
11. **YELLOW:** OK supply side. Not sure demand side is consistent or serious enough, or that we can’t have mixed messages.
12. **YELLOW:** Seems like mandatory restrictions and withdrawal restrictions should already have been imposed. Supplies dropping too fast to wait any longer.
13. **YELLOW:** Conservation = 21.5 mgd; Flow-by = 204 mgd – 104 mgd wasted?
14. **GREEN:** On 7-19. But planning to increase restrictions next 2 weeks, depending on trend.
15. **GREEN:** Yes. Doing well managing supply.
16. **GREEN:** Water management side ok. Demand not controlled.

WHO IS NOT HERE TODAY THAT WE WILL RELY ON AND COORDINATE WITH TO COMMUNICATE AND IMPLEMENT IMPORTANT ASPECTS OF DROUGHT RESPONSE?

Asked at approximately 12:00 before the lunch break. Responses written on post-it notes during the break and placed on a flip chart. Reviewed with the group after lunch.

1. Agriculture and forestry agencies
2. Plant and distribution operators
3. (a) Meteorological experts; (b) political decision makers; (c) communications experts; (d) state and local planning agencies
4. Would need PIOs, media contacts to help get messages out. Use industry groups to get messaging to large industrial water companies.
5. (a) VA Drought Management Task Force members; (b) agency public information officers

6. Local government to discuss mandatory restriction implementation and response and to understand public health and safety impacts when the system breaks.

7. Loudoun County: Public Affairs Office, Office of Emergency Management, CAO rep, Board of Supervisors staff

8. CAOs; local officials

9. (a) Emergency management (local and state); (b) agriculture departments; (c) health department; (d) fire; (e) police; (f) other enforcement

10. News media representation

11. (a) Elected officials; (b) CAOs; (c) non-CO-OP utilities; (d) USGS; (e) county environmental department; local media/weather

12. Loudoun County – drought ordinance revision (Clarified that this comment was a note that they are in the process of updating their drought ordinance.)

13. Operations superintendents and supervisors – people who will turn valves, operate pumps to make this happen

14. Al Roker and Jim Cantore

15. Mayors/elected officials

16. (a) Local health department; (b) hospitals; (c) critical customers

17. Need to include chief information officers or communication offices

18. County public info personnel and emergency management; daily -weekly calls to coordinate response

19. Elected/appointed/local officials who represent the counties, towns, city – who implement restrictions

20. Utility/government communications departments

21. D.C Office of the City Administrator

POST-IT NOTE QUESTION FOR THE LUNCH BREAK

Who is not here today that we will rely on and coordinate with to communicate and implement important aspects of drought response?

(Not looking for names of specific people, but more general responses about roles and organizations.)

- Write your response on a post-it note and put it on the flip chart during the break.
- If you want, add comments to explain your response.
- Take a minute to read other responses during the break.

COULD WE HAVE BEEN MORE RESILIENT? IF YOU COULD PICK ONE THING TO CHANGE IN HOW WE RESPONDED TO THIS DROUGHT, WHAT WOULD IT BE?

Asked at approximately 3:00. Participants wrote comments on cards (not color coded). Responses were discussed and collected as input.

1. Travilah Quarry would be in place. Possibly Loudoun Quarry B. Connection between Loudoun Quarries and Corbalis plant.
2. Need other supply augmentation salutation on-line, e.g., Vulcan, Travilah. Keep doing pro-active water supply planning and implement projects.
3. Invest more in alternate sources of water supply, to ensure that we never reach such a dire situation. Look into better operational flexibility practices or changes within system.
4. Better operational tools/water transfers to take advantage of flow > 100 mgd on Potomac. (e.g., transfer to Patuxent, Occoquan)
5. We could have saved significant water by keeping the flow-by at 100 mgd throughout, rather than 245 mgd or 204 mgd.
6. Other options that utilities have to reduce demand on Potomac River (i.e. stopping wholesale sales, exploring interconnects, exploring groundwater options. Utilize Potomac @ max while under drought and meeting Little Falls flow-by before pulling from off-Potomac storage.
7. Additional upstream raw water storage – This could be pre-arranged use of water quality storage at Jennings Randolph and/or new facilities such as Vulcan II or Travilah.
8. I would like to see a sensitivity analysis on: Seneca margin of safety, Jennings WS/WQ accounting, early demand reduction. What operational options could have bought us time? Pay customers to shut down vs. build infrastructure.
9. Early and consistent messaging on conservation. Coordinated, one message, public information channels.

QUESTION FOR THE GROUP

Could we have been more resilient? If you could pick one thing to change in how we responded to this drought, what would it be?

- Write your response on a note card (any color).
- We'll discuss some responses and then collect the cards.

10. Yes, we could always be more resilient. Use of JR water quality supply could be used more efficiently; have a better plan or process to use that source.
11. Build more storage or pursue transitioning JR water quality storage to drought management. As storage begins to be used, increase public awareness to extend the life.
12. Our region focuses heavily on resources within the Potomac Basin and the prospect of quarries for additional storage. But what about thinking on a much larger scale, such as pipelines connecting tie Potomac Basin to other water resources one or more states away. Larger scale – like on the scale of California/Nevada/Arizona/Colorado/Denver/etc. Also, Loudoun Water has Beaverdam now (and in 2039). 1.5 billion gallons. Could make up a deficit in the Potomac for several weeks to several months depending on the scenario.
13. Plan more storage 20 years ago (e.g., 2019).
14. Did we get too far in the hole in the preceding two years (before 2039) and did we waste the opportunity to change public use pattern?
15. The effects of water restriction should be a factor in decision making. This exercise treated as a post-effect or general discussion topic.
16. More emphasis and effort into reducing demand/usage earlier in the process. In such an emergency situation, there has to be a way to quickly reduce usage significantly. Media campaign?
17. More reuse options (potable or non-potable)
18. Realistic assumptions for Occoquan/Potomac/Patuxent availability during extreme drought.
19. Better sustainability planning to help with lowering consumptive use.
20. Developed and brought on additional resource. Reduce demands.
21. Focus on public messaging early. Prepare folks. Set expectations. Water conservation is not something the public considers here like they do in Texas and the West.
22. Monitor water loss in winter months (pre-scenario). Negotiating/working with big water users (industries) before the last weeks of August.
23. Not discussed is that VDH will work with locally regulated facilities (hospitals/other medical facilities, schools, restaurants, etc.) on how to reduce water and plan for total water outage. Need to focus on water quality during a drought.
24. As the drought develops over time, a new focus on water loss and unaccounted/billed water could help. Also, we should plan for source water quality changes as the drought worsens.
25. More resilient? Yes! We will see more frequent and severe drought conditions in the future. Climate change is already impacting the Chesapeake Bay watershed. Being more proactive with

water conservation is critical during drought conditions. Predicting droughts is extremely difficult, even with newer NOAA models. Conservation measures, even mandatory, earlier in the process/exercise will benefit all stakeholders in the long run!

26. Could we have been more resilient? Have JR use of water supply a reality. Have Travilah Quarry as a reality. Demonstrate real reductions in demand through leak detection, conservation, public education, use of air-cooling where feasible. Ban lawn irrigation with potable water (reclaimed ok). Better align drought stages with decrease in reservoir storage and Potomac flow. Act faster.
27. Short Term: Increase demand management sooner within the utilities' watersheds. Used water quality supply at Jennings-Randolph. Select specific high flow users to better target demand reductions. Build this into appropriation permits. Long-term: Increase/expand water storage options. Expand water reuse opportunities.
28. Included reservoir storage in Wash COG drought status determination in a manner that results in demand reduction earlier in drought. These reservoirs (Patuxent, Occoquan, Jennings, Seneca) should never have been so low prior to mandatory restrictions.
29. Develop additional raw water storage: water quality storage, Travilah, others. There may be worse drought than modeled.
30. TRAVILAH
31. Storage in aquifers; pipeline to Lake Erie; repair C&O Canal and improve water transportation.
32. Better public awareness campaign to educate on where water comes from/reservoir storage, effective conservation measures.
33. Additional off-river water storage; data driven approach to water conservation messaging; audits/modeling of how reduced production would affect distribution system performance.
34. It is important to encourage conservation.
35. Response is still based on planned, no mistake scenario; no contingencies have been planned for.
36. Good balance between conservation in case drought continues and more than just the minimum at Little Falls to allow for recreation and biota in the Potomac.
37. From the perspective of a water supply/government/primary agency – having no water is not an option. Drought does not take place overnight. Early planning reaction is important. Should accelerate building additional reservoir. Drought is the only natural disaster that takes a long time to have full impact. Early precautions/response; eliminating/reducing unnecessary usage (car wash, golf courses); build/accelerate reservoirs.

LFAA FLOW ALLOCATION: AUGUST 25

One-day Forecast					
Total Daily Flow will be 575			Available Water will be 680		

Fair Share Allocation					
Request (95% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	193	208	15	204	11
Fairfax Water	236	219 Occ: 120/Pot: 99	(17)	236 Occ: 120/Pot: 116	0
WSSC	197	246 Pat: 85/Pot: 161	49	233 Pat: 85/Pot: 148	36
Rockville	6.7	7.3	0.6	7.1	0.5
TOTAL	632	680	48	680	48

Restriction Stage Eligible			
Total Potomac withdrawals are 427, which is 92% of Daily Flow - 100 mgd			
Deficits are assigned to	Water Supply	Little Falls Flow-by	148

11/30/2018

Potomac River Drought Exercise

1

Scenario for August 25

Definitions

- Total Daily Flow (575 mgd) is the Potomac River flow at the top of the portion of the river to which the LFAA applies, i.e. the top of Seneca pool, and before water supply withdrawals.
- Available Water (680 mgd) = Total Daily Flow+ Occoquan production + Patuxent production – Flow-by
- Request is the predicted unrestricted demand less a percentage due to conservation measures
- A Fair Share Allocation of Potomac River water is specified in the LFAA in two ways:
 - An initial allocation according to LFAA Section 2.C.2.
 - A possible revised allocation, according to LFAA Section 2.C.4, if the initial allocation results in any utility having an allocation in excess of their request, in which case that excess may be reallocated to other utilities in a “reasonable manner”.
- Total Potomac Withdrawals (428 mgd) = Total Utility Request – (Occoquan + Patuxent production)
- LFAA Stages may be declared by Washington Aqueduct when
 - Alert: total water supply withdrawals are \geq 50% of Total Daily Flow
 - Restriction: total water supply withdrawals are \geq 80% of Total Daily Flow – 100 mgd Environmental Flow-by
 - Emergency: total water supply withdrawals during any of the next five days are \geq 100% of Total Daily Flow – 100 mgd Environmental Flow-by
- Water allocation deficits are assigned to either Water Supply or Little Falls Flow-by

LFAA FLOW ALLOCATION: AUGUST 28 – ALTERNATIVE A

One-day Forecast					
Total Daily Flow will be 500			Available Water will be 605		

Fair Share Allocation					
Request (95% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	193	185	(8)	189	(4)
Fairfax Water	236	195 Occ: 120/Pot: 75	(41)	213 Occ: 120/Pot: 93	(23)
WSSC	197	219 Pat: 85/Pot: 134	22	197 Pat: 85/Pot: 112	0
Rockville	6.7	6.5	(0.2)	6.6	(0.0)
TOTAL	632	605	(27)	606	(26)

Emergency Stage Eligible			
Total Potomac withdrawals are 401, which is 100% of Daily Flow - 100 mgd			
Deficits are assigned to		Water Supply	Little Falls Flow-by 99

11/30/2018

Potomac River Drought Exercise

2

August 28, Alternative A

Total daily flow forecast =500 mgd

Demand reduction = 5%

Deficits are assigned to Water Supply

LFAA FLOW ALLOCATION: AUGUST 28 – ALTERNATIVE B					
One-day Forecast					
Total Daily Flow will be 500			Available Water will be 605		
Fair Share Allocation					
Request (95% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	193	185	(8)	193	0
Fairfax Water	236	195 Occ: 120/Pot: 75	(41)	236 Occ: 120/Pot: 116	0
WSSC	197	219 Pat: 85/Pot: 134	22	197 Pat: 85/Pot: 112	0
Rockville	6.7	6.5	(0.2)	6.7	0.0
TOTAL	632	605	(27)	632	0
Emergency Stage Eligible					
Total Potomac withdrawals are 427, which is 105% of Daily Flow - 100 mgd					
Deficits are assigned to		Flow-by	Little Falls Flow-by	73	
11/30/2018		Potomac River Drought Exercise			3

August 28, Alternative B

Total daily flow forecast =500 mgd

Demand reduction = 5%

Deficits are assigned to Flow-by

LFAA FLOW ALLOCATION: AUGUST 28 – ALTERNATIVE C

One-day Forecast

Total Daily Flow will be 500

Available Water will be 605

Fair Share Allocation

Request (90% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	183	185	2	183	0
Fairfax Water	223	195 Occ: 120/Pot: 75	(28)	223 Occ: 120/Pot: 103	(0)
WSSC	186	219 Pat: 85/Pot: 134	32	192 Pat: 85/Pot: 107	6
Rockville	6.3	6.5	0.2	6.3	0.0
TOTAL	599	605	7	604	6

Emergency Stage Eligible

Total Potomac withdrawals are 394, which is 99% of Daily Flow - 100 mgd

Deficits are assigned to **Water Supply**

Little Falls Flow-by 107

11/30/2018

Potomac River Drought Exercise

4

August 28, Alternative C

Total daily flow forecast =500 mgd

Demand reduction = 10%

Deficits are assigned to Water Supply

LFAA FLOW ALLOCATION: AUGUST 31 – ALTERNATIVE A**One-day Forecast**Total Daily Flow will be **387**

Available Water will be 492

Fair Share Allocation

Request (85% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	173	150	(22)	151	(22)
Fairfax Water	211	158 Occ: 120/Pot: 38	(53)	159 Occ: 120/Pot: 39	(52)
WSSC	176	178 Pat: 85/Pot: 93	2	176 Pat: 85/Pot: 91	0
Rockville	6.0	5.3	(0.7)	5.3	(0.7)
TOTAL	565	492	(74)	491	(74)

Emergency Stage Eligible

Total Potomac withdrawals are 286, which is 100% of Daily Flow - 100 mgd

Deficits are assigned to **Water Supply**

Little Falls Flow-by

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11/30/2018

Potomac River Drought Exercise

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August 31, Alternative A

Total daily flow forecast = 387 mgdDemand reduction = 15%

Deficits are assigned to Water Supply

LFAA FLOW ALLOCATION: AUGUST 31 – ALTERNATIVE B

One-day Forecast

Total Daily Flow will be 387

Available Water will be 492

Fair Share Allocation

Request (85% unrest. demand)		Initial	Excess (deficit)	Revised	Excess (deficit)
Aqueduct	173	150	(22)	173	0
Fairfax Water	211	158 Occ: 120/Pot: 38	(53)	211 Occ: 120/Pot: 91	0
WSSC	176	178 Pat: 85/Pot: 93	2	176 Pat: 85/Pot: 91	0
Rockville	6.0	5.3	(0.7)	6.0	0.0
TOTAL	565	492	(74)	565	0

Emergency Stage Eligible

Total Potomac withdrawals are 360, which is 119% of Daily Flow - 100 mgd

Deficits are assigned to

Flow-by

Little Falls Flow-by

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11/30/2018

Potomac River Drought Exercise

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August 31, Alternative B

Total daily flow forecast =387 mgd

Demand reduction = 15%

Deficits are assigned to Flow-by