2014 Drought Exercise Report

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The report is available online at www.PotomacRiver.org as ICP15-2_Schultz.pdf.

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1 Introduction

The Washington, D.C., metropolitan area (WMA) relies on the Potomac River to supply approximately three quarters of the water it uses. The area's three major water suppliers, Fairfax Water, the Washington Suburban Sanitary Commission (WSSC), and the Washington Aqueduct Division of the U.S. Army Corps of Engineers (Aqueduct) participate in a cooperative system of water supply planning and management which includes joint funding of water supply storage in reservoirs located upstream of the suppliers' Potomac River intakes and coordinated operations when flows in the river fall below specified thresholds. This cooperative system is based on a set of agreements entered into more than 30 years ago. The Low Flow Allocation Agreement (LFAA) of 1978 specifies a formula for the allocation of water during shortages. The Water Supply Coordination Agreement (WSCA) of 1982 commits the three suppliers to operate "in a coordinated manner" to optimize the use of available resources and requires that water demand and availability forecasts be conducted every five years.

During periods of drought, the Interstate Commission on the Potomac River Basin (ICPRB) Section for Cooperative Water Supply Operations on the Potomac (CO-OP) helps manage this system by coordinating WMA water withdrawals from the Potomac River and off-river reservoirs. CO-OP also recommends releases from upstream reservoirs when forecasted flow in the river is not sufficient to meet expected needs. These needs include WMA demands and an environmental flow-by of 100 million gallons per day (MGD) on the Potomac River at Little Falls dam near Washington, D.C.[1]

Each year when flows are at or above normal, CO-OP conducts a drought exercise. These exercises allow participants to practice and improve communication procedures among organizations and also provide ICPRB's CO-OP staff with an opportunity to practice using operational tools and making management decisions. This ensures that during an actual drought all stakeholders are properly trained and key operational strategies have been discussed and tested beforehand.

This report describes activities and results of the 2014 drought exercise, which took place from September 30 through October 6. The 2014 exercise focused on vulnerabilities of regional drought operations during a power outage. Participants in this year's exercise include staff from:

- ICPRB CO-OP Section
- Washington Aqueduct – a Division of the U.S. Army Corps of Engineers, which supplies water to the District of Columbia via DC Water, and to parts of Virginia
- Washington Suburban Sanitary Commission, which supplies water to Montgomery and Prince George's counties in Maryland, and on a limited basis to other parts of Maryland
- Fairfax County Water Authority (Fairfax Water), which supplies water to Fairfax County, Virginia, and provides wholesale water to other suppliers in northern Virginia

[1] A complete discussion of CO-OP drought operations can be found in the report, 2010 Washington Metropolitan Area Water Supply Reliability Study; Part 1: Demand and Resource Availability Forecast for the Year 2040, by S.N. Ahmed, K.R. Bencala, and C.L. Schultz, ICPRB Report No. 10-01, May 2010, available at www.potomacriver.org under "Publications."

- Loudoun County Water Authority (Loudoun Water), a wholesale customer of Fairfax Water with plans to construct a Potomac River intake and water treatment plant to provide a portion of its future supply needs
- U.S. Army Corps of Engineers (USACE), Baltimore District Office
- U.S. Geological Survey Water Science Center for Maryland, Delaware, and the District of Columbia (USGS)
- Metropolitan Washington Council of Governments (MWCOG)
- National Weather Service Middle Atlantic River Forecast Center (MARFC)

2 Overview of CO-OP Drought Operations

The Potomac River is the primary source of raw water for the CO-OP suppliers which each have an intake on the river upstream of Little Falls dam near Washington, D.C. Fairfax Water also relies on stored water from the Occoquan Reservoir and WSSC relies on water from a pair of reservoirs in the Patuxent River watershed: Rocky Gorge and Tridelphia (see map in Figure 1). Aqueduct has intakes at two locations on the Potomac River: Little Falls and, several miles upstream, at Great Falls. In addition, these three suppliers jointly own storage in two reservoirs located upstream of their Potomac River intakes: Jennings Randolph Reservoir (JRR), located on the North Branch of the Potomac River adjacent to Garrett County in Maryland, and Mineral County in West Virginia, and Little Seneca Reservoir, located in Montgomery County, Maryland. Jennings Randolph Reservoir is operated by the U.S. Army Corps of Engineers and the dam at Little Seneca is operated by WSSC. The water suppliers pay a portion of the operations and maintenance costs of a third upstream reservoir, Savage, also located on the North Branch of the Potomac. These three reservoirs are available to augment Potomac River flow during low-flow periods.

Key operational goals for CO-OP staff during droughts are:

- Maintaining Potomac River flow at Little Falls dam, as measured by the USGS gage (Station ID 01646500), at or above the environmental flow-by of 100 MGD, or equivalently, 155 cubic feet per second (cfs).
- Maintaining estimated flow at Great Falls, located approximately 9.3 river miles upstream of Little Falls, at or above the recommended minimum flow of 300 MGD (464 cfs). Estimated travel time between Great Falls and Little Falls during extremely low-flow conditions is nine hours.
- Balancing use of storage in system reservoirs to ensure that adequate storage volumes are maintained in each reservoir to sustain expected withdrawals throughout the remainder of a severe drought and to ensure a 95 percent probability of refill to 90 percent capacity by June 1 of the following year.

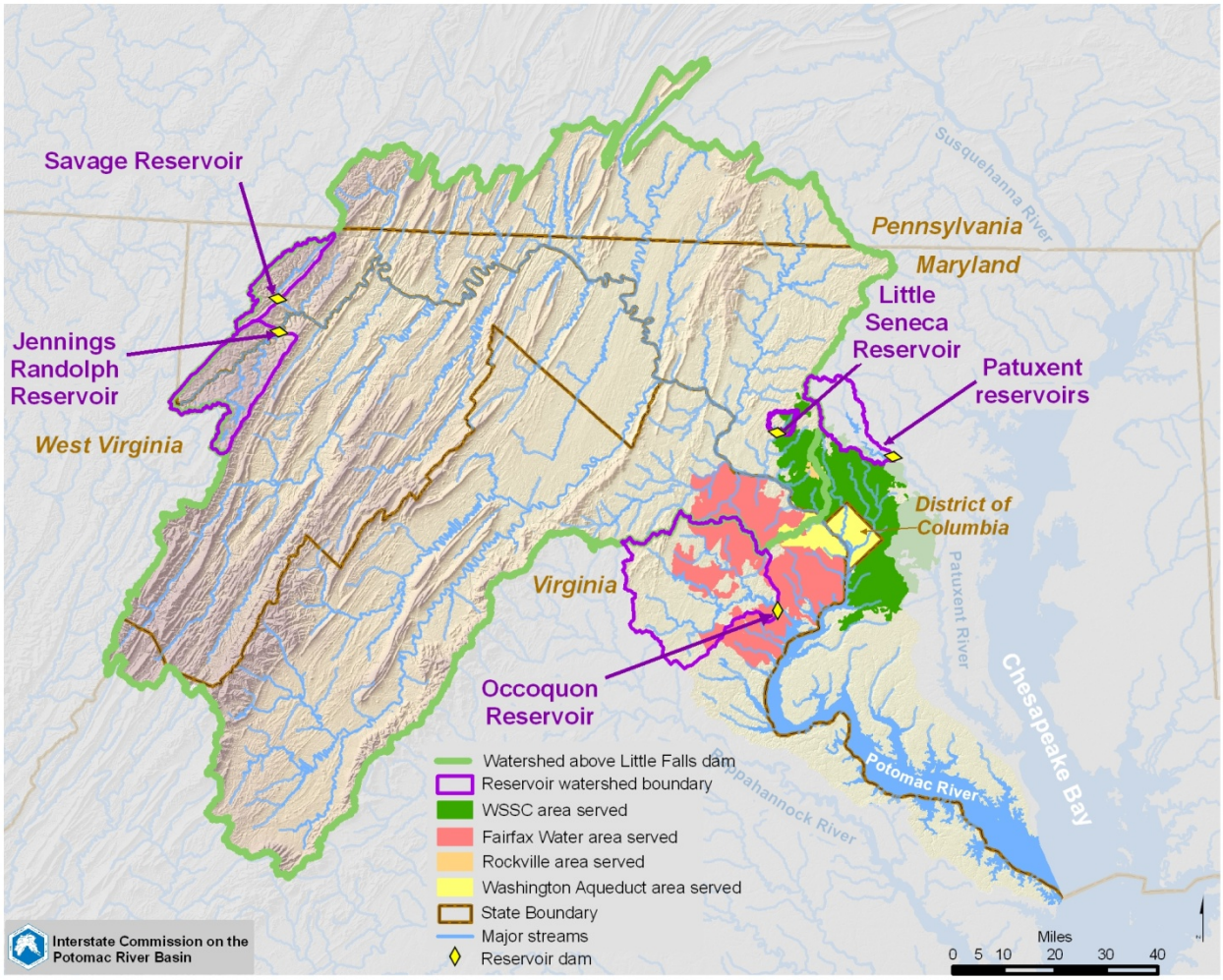

Figure 1 – WMA water supplies

To estimate future Potomac withdrawals for input into flow prediction tools, CO-OP staff develops withdrawal scenarios for both the Potomac River and off-Potomac reservoirs. Scenarios are based on estimates of near-term demands, estimates provided by the water suppliers, and historic data.

Withdrawal scenarios may require "load shifts" by the water suppliers between Potomac River intakes and off-Potomac reservoir intakes. Load shifting, that is, the shifting of some portion of a supplier's withdrawal from one intake to another, may be requested by CO-OP during droughts to help meet operational goals. Each of the WMA suppliers has two intakes. Fairfax Water and WSSC both have intakes at locations on the Potomac River and one off-Potomac intake (at the Occoquan and the Patuxent reservoirs, respectively). Aqueduct has two intakes on the Potomac River: one at Great Falls and one at Little Falls. Load shifting requires close communication between ICPRB CO-OP and water supplier staff.

3 Summary of Exercise Activities

The 2014 drought exercise was conducted from September 30 through October 6. A special focus of this year's exercise was vulnerabilities of drought operations activities to loss of power during a regional outage. Preparation for the exercise included discussions with participating organizations via telephone and at a pre-exercise meeting on the vulnerabilities and backup capabilities of individual organizations. These discussions helped CO-OP devise an exercise scenario that would allow each organization to play out a power outage in a realistic manner.

The exercise scenario was based on a severe storm which struck the Baltimore-Washington region on June 29, 2012, referred to as a Derecho. Exercise participants' experiences during the 2012 Derecho were incorporated into the exercise scenario. This storm was a fast-moving system of thunderstorms that began in the Midwest on the morning of June 29 and reached the mid-Atlantic by evening. Formation of this system was related to atmospheric instabilities associated with extremely hot conditions. The 2012 Derecho caused severe winds and extensive power outages in the Baltimore-Washington area. However, it had a minor and short-lived impact on mean daily flows in the Potomac River. Daily flow at Little Falls increased by approximately 350 MGD the first day after the Derecho and this increase remained above 300 MGD on the second day. Between the third and fifth day, flow at Little Falls was only 45 to 65 MGD above its pre-Derecho value and by day six (July 5, 2012) it had fallen to 52 MGD below its June 29th value.

3.1 Pre-exercise Meeting

A pre-exercise meeting took place on September 16 at ICPRB's office in Rockville, Maryland. Pre-exercise meetings give the WMA drought operations team an opportunity to get acquainted or reacquainted. This meeting also gives CO-OP staff a chance to review and update information on system constraints and to obtain information on the expected status of reservoirs and other system components during the following year's low-flow season. Updated information on the WMA system appears in Tables 1 through 4. Also, at this year's pre-exercise meeting, participants discussed their organization's vulnerabilities to power outages and backup capabilities and discussed their organizations' experiences during the 2012 Derecho.

3.2 Scenario and Timeline

A hypothetical scenario and timeline were used during the seven-day exercise; excerpts for key days appear below. ICPRB and utility staff used these prompts to guide each day's withdrawal and reservoir release decisions. Two dates are listed for each day of the exercise. The first represents the date simulated in the exercise, and specifically the demands that could be expected. The second, in parentheses, is the actual date of the exercise.

Day 1 – August 8, 2015 (Wednesday, September 30, 2014):

Today's date is August 8, 2015. The region is in moderate drought and is experiencing periods of extreme heat. Daily high temperatures over the past five days have ranged from 98 to 103 degrees Fahrenheit. Over the past several weeks, water supply releases have been made periodically from Jennings Randolph Reservoir and from Little Seneca Reservoir.

Day 3 – August 10, 2015 (Thursday, October 2, 2014):

7:30 a.m. exercise inject: A severe Derecho event struck the Washington/Baltimore area last night at 9:30 p.m. Power outages are widespread across the region. Impacts include:

Cellular service: Unavailable in most areas
Travel: Difficult due to downed trees
ICPRB: Rockville office closed; CO-OP staff homes without power
MWCOG: Building has power
USACE: Baltimore office without power; Water Control Group on backup power; Jennings Randolph dam has no power
Fairfax Water: Both water treatment plants (WTP) operating; Fairfax office on backup power
Washington Aqueduct: Both water treatment plants operating; Little Falls pumps have no power
WSSC: The Potomac plant was without power for four hours during the night but is now back on line; Patuxent plant is operating; Laurel office on backup power; Little Seneca dam has no power
USGS: Baltimore office on backup power
MARFC: Operational

Day 4 – August 11, 2015 (Friday, October 3, 2014):

7:30 AM exercise inject: Cleanup activities are ongoing after the Derecho, but power is still out in many areas, travel is still difficult, and cellular service is still unavailable in many areas. The status of CO-OP drought operations partners is as follows:

ICPRB: Rockville office still closed; two CO-OP staff homes have power
MWCOG: Building has power
USACE: Power has been restored to Baltimore office; some Water Control Group staff homes have power; power is back at Jennings Randolph
Fairfax Water: Both WTP's operating; Fairfax office has power
Washington Aqueduct: Both WTP's operating
WSSC: Both WTP's operating; Laurel office has had power restored; Little Seneca dam still has no power
USGS: Baltimore office still on backup power; real-time flow data is being made available by backup servers in California
MARFC: Operational

Day 5 – August 12, 2015 (Saturday, October 4, 2014):

Power is restored in many areas. Cellular service is now generally available. All drought operations partners are fully operational.

Table 1 – 2014 Fairfax Water Operational Constraints

Facility	MGD	Notes
Griffith plant max. production	120	The maximum production from the Griffith plant (Occoquan Reservoir) will be increased to 160 MGD at some time in the future.
Griffith plant min. production	45	The minimum current production at Griffith is approximately 45 MGD (25 to Prince William County East + 20 to Main Service area). More accurately, the minimum production rate is a function of the maximum possible transfer rate from the Potomac plant (Corbalis) and total demand in the Occoquan service area. The maximum transfer rate from the Potomac plant to the Occoquan service area is 65 MGD. Minimal advance notice is required to implement this change. In addition to this constraint, there is also a hydraulic limitation requiring a minimum Occoquan withdrawal of 45 MGD. The minimum Occoquan demand is the greater of these two constraints. The fraction of total demand that comes from the Potomac service area is currently about 0.6.
Corbalis plant max. production	225	Capacity of the Corbalis plant (Potomac River) will be expanded to 300 MGD at some point in the future.
Corbalis plant min. production	50 to 60	Lower in the winter and higher in the summer. The minimum current production at Corbalis is a function of demand in the Potomac service area as well as pump capacities and the need to furnish part of Loudoun Water demand directly from the Corbalis plant. Roughly, the minimum Potomac demand is the fraction of the total demand serviced by the Potomac minus 35 MGD. (30-35 MGD is the maximum that can be transferred from the Occoquan service area, but note that approximately a 24-hour notice is required to configure yard piping at Pohick Pump Station.)
Maximum WEST to EAST (Potomac TO Occoquan) transfer rate of finished water*	65	Minimal advance notice required.
Maximum EAST to WEST (Occoquan TO Potomac) transfer rate*	35	Recommended initial 24-hour advance notice required to configure yard piping at Pohick Pump Station. (In other words, Potomac withdrawals can be increased by up to 65 MGD to conserve Occoquan storage and, alternatively, can increase Occoquan withdrawals if Potomac is falling unexpectedly.
*These transfer amounts also depend on demands in the two service areas - in other words, check with Fairfax Water to OK all load shift requests.		

Table 2 – 2014 Washington Aqueduct Operational Constraints

Facility	MGD	Notes
Dalecarlia max. production	200	
Dalecarlia min. production	60	
McMillan max. production	65-70	Flat rate constrained by turbidity, although in the short term an increase to 120 max. is possible.
McMillan min. production	63	
Great Falls min. withdrawal	(32)	The gates can go as low as needed (Woody Peterson, 9/16/14). Under normal circumstances, changes in gate height are made at 0.5 foot increments. One gate can be closed, and the other one be open. According to our current algorithm, both gates are at the lowest setting, 0.5 foot, the withdrawal is 32 MGD.
Woody Peterson says that Little Falls pump #6 is closest to the USGS gage and may locally depress the water level in the vicinity of the gage (see Figure 2).		

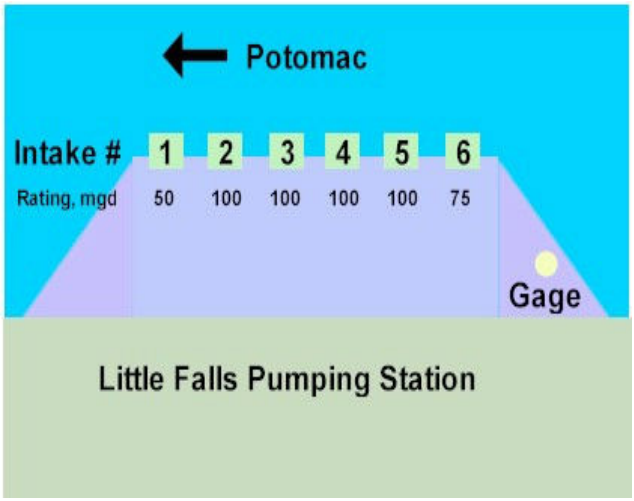

Figure 2 – Washington Aqueduct's Little Falls pump rates

Table 3 – 2014 WSSC Operational Constraints

Facility	MGD	Notes
Patuxent plant max. production	62 to 65	A max. of 70 MGD might be possible for a couple of days (Karen Wright, WSSC). The Patuxent plant max. depends on reservoir levels. When the new plant is completed, it will be rated at 72 MGD with an emergency maximum of 120 MGD.
Patuxent plant min. production	30	
Potomac plant max. production	283	
Potomac plant min. production	100	
Brighton dam will be undergoing repairs beginning in 2015 that are expected to take two years to complete. This will reduce available storage in the Patuxent reservoirs by approximately 50 percent. The work will include gate and dam repair and sediment removal.		

Table 4 – Other 2014 Operational Considerations

Organization - Facility	MGD	Notes
USACE – Jennings Randolph Reservoir		Rule of thumb: when water is being released only from water quality storage, typically JRR will not be dropped by more than a third of a foot per day in order to "get through the summer." If a water supply release is requested, however, the one-third foot per day rule of thumb is no longer applicable, and the release rate will be determined by the CO-OP request (Bill Haines, USACE).
Loudoun Water – BRWRF discharge	4.5	Loudoun Water's Broad Run Water Reclamation Facility (BRWRF) discharges treated wastewater into the Potomac River upstream of WMA system intakes.
USGS – Point of Rocks stream gage		During low flow conditions, the growth and/or die-off of aquatic grasses at the Point of Rocks gage may require more frequent updates of the rating curve. If grass effects are suspected, call Matt Baker of the USGS's Frostburg office.

3.3 Exercise of Communications and Operations Procedures

During annual drought exercises, participants practice communication procedures that would be used in an actual drought and also practice working with flow forecast spreadsheets and other operational tools. The Potomac basin was experiencing actual dry conditions during the fall of 2014, Daily drought monitoring and reporting of demands and flow conditions began on September 18, and continued throughout the exercise. During the exercise, CO-OP sent out separate emails everyday on actual conditions and on simulated conditions as part of the exercise. These emails included information to clarify whether the report was part of the exercise or actual monitoring. Also, to reduce confusion and

keep staff cognizant of potential worsening of conditions, training on use of flow forecast tools that occurred during the exercise was done using actual flow data.

Most drought operations communications take place via email, but operational changes are discussed and/or confirmed via telephone. The following types of communications were practiced during the 2014 exercise:

- Fairfax Water, Aqueduct, and WSSC sent twice daily reports to ICPRB on "yesterday's" actual hourly demands, "today" and "tomorrow's" forecasted daily demands, and reservoir storage volumes.
- Loudoun Water sent reports on actual daily demands and on "yesterday's" daily discharge from the Broad Run Water Reclamation Facility.
- CO-OP sent twice daily email reports to water suppliers, USACE, USGS, and other stakeholders on recent and forecasted demands, recent flows, and current system storage.
- CO-OP made telephone calls to the water suppliers to confirm simulated load shifts between intakes and simulated releases from Little Seneca Reservoir as part of the exercise scenario.
- CO-OP made telephone calls to the USACE's Baltimore District Office to request (simulated) changes in Jennings Randolph Reservoir water supply release rates.
- CO-OP supplier general managers were not contacted to request concurrence on simulated releases because the exercise scenario assumed that releases had been occurring periodically over the past several weeks and that concurrence was given when the initial releases were made. Staff would, however, be in contact with general managers anytime there was a significant new development in drought conditions or operations.

During the drought exercise, staff practiced using CO-OP spreadsheet tools to make Potomac River flow forecasts. They also reviewed on a daily basis the MARFC 72-hour flow predictions for Little Falls and other basin streams.[2] Staff also practiced devising load-shifting and reservoir release scenarios that would maintain flow at Little Falls above a specified threshold. During actual drought operations, this threshold is the 100 MGD flow-by at Little Falls. During the exercise, since flows were higher than would be experienced during actual reservoir release conditions, an artificially elevated threshold was used for training purposes.

3.4 Measures to Improve CO-OP Backup Capabilities during Power Outages

In preparation for the exercise, CO-OP staff examined ICPRB's own vulnerabilities during a power loss and determined that several measures could improve CO-OP's ability to conduct drought operations. Two of these measures, the operation of spreadsheet tools from "the cloud" and the use of designated emergency operations locations by CO-OP staff, were explored during the exercise. Other measures, including the acquisition of alternative communication devices and power supplies, appear in the list of recommendations in the last section of this report.

[2] Available at http://water.weather.gov/ahps/region.php?rfc=marfc.

3.4.1 Operation of Spreadsheet Tools on Google Drive

CO-OP spreadsheet tools reside in a designated folder on ICPRB's main server and backup copies exist on CO-OP's two laptops. There are currently four CO-OP staff persons available for drought operations and operations are generally conducted by two people at a time. Because drought operations may require staff to be available during non-business hours seven days a week, ICPRB's drought operations staff all have the ability to access files on ICPRB's server from remote locations and to use screen-sharing software to collaborate on operational decisions.

To maintain the ability to collaborate remotely if ICPRB's main server were shut down, a copy of the folder containing CO-OP's drought tools was copied onto a shared folder in Google Drive. Because these tools are implemented in a linked set of Excel files, the files had to be relinked in Google Drive. Operations staff then installed Google Drive on their office and home computers, and also on CO-OP's laptops. All staff worked with the Google Drive version of the tools so that the most recent data entries and other changes could remain available to all staff throughout the exercise.

The set of drought operations tools on Google Drive worked fairly well, but several problems were identified:

- If a person opened a file that was already open on someone else's drive, Google gave no warning of a conflict, and a second version of the file was created. To address this problem, an informational file was created with a table indicating who was currently using a given file, but staff sometimes failed to record their activities or consult with this table.
- Caution had to be exercised when saving a file before closing, to ensure that the save was completed. To address this problem, staff were reminded to pay attention to the Google Drive information icon located in the far right-hand bottom corner of the screen. This icon provides information on the status of a file save.

Because of these problems, multiple file versions sometimes arose when two or more people were working at the same time and rapidly opening and closing files in Google Drive. It is probably preferable to simply use Google Drive as a backup location for files, with backups made every afternoon as part of daily drought operations procedures. In case Google Drive needs to be used for actual emergency remote operations, detailed procedures need to be developed to avoid conflicts and generation of multiple file versions. That said, it can be expected that file-sharing technology will evolve rapidly, and that the problems encountered in this exercise may not be present in future years.

3.4.2 Use of Designated Alternative Emergency Operations Locations

The building that houses ICPRB's office in Rockville, Maryland, has no backup power supply for use in case of an emergency loss of power. ICPRB computers have backup batteries, but these only provide power for a couple of hours. On the other hand, all three CO-OP suppliers have backup power at their operations centers and at their plants. Prior to the exercise, CO-OP's drought operations personnel were given permission to make use of these locations to conduct simulated drought operations. MWCOG also offered to serve as an emergency operations location, since it is less susceptible to loss of power because this portion of the District of Columbia has underground power lines. An alternative emergency

operations location was designated for each of the four people on ICPRB's drought operations team. These alternative locations were based on proximity to the staff person's home since travel may be difficult during emergency events. The designated alternative locations used in the exercise were:

- Sarah Ahmed: WSSC's control center in Laurel, Md.
- Karin Bencala: MWCOG's office in Washington, D.C.
- Heidi Moltz: WSSC's Seneca wastewater treatment plant in Gaithersburg, Md.
- Cherie Schultz: MWCOG's office in Washington, D.C.

According to the scenario, on the morning of day three of the exercise there were widespread power outages in the Washington-Baltimore region due to the Derecho event and ICPRB's office and the homes of all four ICPRB drought operations staff were without power. In addition, it was assumed that cellular service was unavailable in most areas. All four CO-OP staff persons traveled to their designated alternative operations locations after first determining that they could do so without jeopardizing their own safety or the safety of their families.

The use of the alternative operations locations was largely successful. All staff members gained entrance to their designated locations, with the exception of Heidi Moltz, who was told that during a power outage the Seneca plant would not be able to provide a source of power for a laptop or internet access. Details on resources available at the three alternative locations appears below.

MWCOG

In the event of a power outage, MWCOG could be used as an alternate emergency location for staff to run drought operations. The use of a room would require coordination with a MWCOG staff member. Wireless internet and power outlets are available. MWCOG and the local emergency departments are all switching to a new service provider for RICCS and emergency communications.

WSSC's Headquarters

WSSC's Headquarter in Laurel worked well as a back-up work location. WSSC front desk personnel were not informed of the exercise ahead of time and so allowed a realistic test as to whether CO-OP staff could gain access to the control room. ICPRB is able to bring either Mac or PC laptops to this site and gain wireless internet access. As an alternative, a WSSC desktop computer equipped with Excel software is available for use on-site. If using their computer, it would be possible to download files; however, an employee with an account is required. Follow up with WSSC IT would be necessary to figure out how to log into a computer without a WSSC staff member present.

WSSC's Seneca Wastewater Treatment Plant

Staff attempted to utilize the Seneca Wastewater Treatment Plant as a back-up work location in the event of power failure. However, plant personnel said it would not work because the plant would not be able to provide a source of power for a laptop or internet access. Although there is a back-up generator on site, its sole purpose is to provide power to the production computer. The buildings would not have power and there would not be a place to connect.

After the exercise, more investigation was done to determine under what circumstances this plant might be available as an alternative location. Staff learned that the Seneca plant is powered by two Pepco feeders. It also has an emergency generator that would power certain processes to prevent separate sewer overflows and maintain discharge permit compliance for a period of time, but it would not power the Administration Building at the plant. The Administration Building has a UPS (uninterruptible power supply) system that powers the Process Control Computers only to help the staff monitor and control the treatment processes, but would not power other functions in the building. Therefore, if both Pepco feeders are out, the Administration Building at Seneca could not serve as a back-up site for ICPRB unless a new generator is installed (Approx. 400 KVA) for that building (Sam Amad, October 16, 2014).

4 Summary of Backup Capabilities

In this section information on the vulnerabilities and backup capabilities of organizations involved in WMA drought operations are summarized. This information was compiled over the course of the exercise, at the pre-exercise meeting, and from phone call and email exchanges.

Though the ability of the suppliers to treat and pump water during a regional outage was outside the scope of this exercise, which focused on activities specific to drought operations, some information on vulnerabilities of WTP and treated water distribution systems was provided by the water suppliers and is included in the summaries below.

USACE

(Primary exercise contact: Bill Haines, Water Resources Section, USACE Baltimore District Office)

During droughts CO-OP's requests for water supply releases from North Branch reservoirs are made by contacting staff of the USACE's Baltimore District Office's Water Control Group via telephone. Water Control Group personnel then implement any requested changes in release rates by contacting staff at Jennings Randolph and Savage dams via telephone.

Jennings Randolph has emergency generators which can be used in the event of a power failure. These generators can operate the dam's two main gates which release water from the bottom of the reservoir. During a power outage, the dam's two smaller water quality control gates would not be operable. These smaller gates release water drawn through the control tower's ports, which are located at various levels in the reservoir and can, therefore, control the temperature of the released water. Thus, in the event of a power failure, the Corps would lose its ability to fine-tune the temperature of water flowing below the dam. Savage dam also has emergency generators to operate its gates.

In the event of a power failure at the Corps' Baltimore District Office, the Water Control Group has an emergency power supply. In addition, all Water Control Group staff members have the ability to be fully operational from their individual homes. They can communicate with staff at the dams and in the office via satellite phones if necessary. If servers and individual computers cannot access real-time flow data from the USGS website, the Corps can acquire stage data directly from the gage sites via telephone

telemetry. Water Control Group staff has paper copies of stage-discharge relationships for all of the relevant gages in case electronic copies of these relationships cannot be accessed.

USGS

(Primary exercise contact: Jon Dillow, Maryland-Delaware-DC Water Science Center, Baltimore, Md.)

CO-OP relies on real-time stream flow data from USGS's National Water Information System (NWIS) to make the flow forecasts needed to support operational decisions. NWIS system data is automatically recorded at 15 minute intervals at stream gage locations throughout the basin, is relayed via satellite to USGS system servers, and is processed and made available to the public on a real-time basis via the NWIS website (http://waterdata.usgs.gov/nwis). The most important stream gages for CO-OP operations, are all operated by the USGS's Maryland-Delaware-DC Water Science Center in Baltimore, Maryland. The key gages are at the following locations:

- North Branch of the Potomac River at Luke, Md.;
- Potomac River at Point of Rocks, Md.:
- Potomac River at the Little Falls Pump Station near Washington, D.C.;
- Seneca Creek at Dawsonville, Md.

Servers located at this office make real-time data available online.

If the Water Science Center in Baltimore were to lose power their servers have backup batteries that will provide power for a short amount of time. Based on the Continuity of Operations Plan in effect for the USGS's Baltimore office, once it has been determined that there has been a power outage/failure (and that it will last for an indefinite period or a period exceeding 12 hours), a backup real-time data server which is located in Menlo Park, California, should be activated. That activation can be accomplished remotely by staff at the Baltimore office or by a phone call to other USGS staff not in this area (if the whole area is affected by the outage). Many of the stream gages operated by the Maryland-Delaware-DC Water Science Center are "off the grid," relying on solar and battery power, so gage data would be expected to be relayed via satellite to the USGS servers in Baltimore during a regional power outage. All gages powered by the grid have rechargeable batteries that would allow them to operate for a short period without grid power. USGS staff estimate that a fully charged back-up battery would allow transmission of data to continue for a few days. Stations could be re-supplied with fresh batteries to keep them operating if that was a high enough priority task during a widespread power-outage emergency.

From the information provided by the USGS, it was noted that one of the key gage relied upon during drought operations, the gage on the Potomac River at the Little Falls dam near Washington, D.C., is on the grid and vulnerable to loss of power during an outage.

WSSC

(Primary exercise contacts: Nick Gardner, Regional Water and Wastewater Manager, and Karen Wright, Systems Control Group Leader)

During drought operations, CO-OP relies on WSSC for data on water demands and storage in the Patuxent reservoirs and may request load-shifts between their Potomac and Patuxent intakes. This information is typically sent by email. CO-OP requests for water supply releases from Little Seneca Reservoir are made by telephoning the WSSC Operations Control Center, which has the ability to remotely operate the dam gates.

WSSC's Operations Control Center in their office in Laurel, Maryland, has backup generators. WSSC does not typically experience loss of communications. They have wireless infrastructure on their tanks that can run on back-up generators, which allows for cellular communications. They also have their own SCADA system for communications.

It would be possible to transport a backup generator to the dam at Little Seneca Reservoir to provide power for the control gates. Releases from the dam can also be altered manually.

Rolling blackouts and brownouts would likely affect WSSC'sWTPs and its ability to pump water. This was observed during a period of extremely low temperature that occurred in the winter of 2014. It was also observed after the 2012 Derecho event, which caused the Potomac WTP to shut down for 12 hours as well as temporary losses of service of pipelines and major pumping stations. WSSC's Patuxent WTP has two power feeds, one from Baltimore Gas & Electric (BG&E) and another from Pepco. The BG&E feed tends to be more reliable. Back-up generators at the WTPs cannot provide sufficient power to run the plants. If power to one of the plants was reduced but not completely lost, operational changes could be made, such as withdrawing and pumping to elevated storage overnight, which would result in less use of electricity. The Patuxent WTP can meet most WSSC system demand; the Potomac WTP can meet all demand.

Washington Aqueduct

(Primary exercise contact: John Peterson, Dalecarlia Water Treatment Plant)

During drought operations, CO-OP relies on Aqueduct for data on water demands. It may also request load-shifts between Aqueduct's Great Falls and Little Falls intakes.

Aqueduct's Little Falls Pump Station has two Pepco power feeds but no backup generators to allow pumps to run during an outage. The Little Falls pumps lost power during the 2012 Derecho.

Four PEPCO feeds come right into Aqueduct's facility at Dalecarlia Reservoir near Sibley Hospital. Only two of the four are needed to run the Dalecarlia WTP. Power surges and brownouts would lead to pumps going out. The Dalecarlia facility has three generators to keep the office, SCADA system, and the pump to boost raw water to the reservoir running during an outage. These generators can also support a flow meter and the WTP's chemical feed. The water in the reservoir will then make its way to the WTP at McMillan Reservoir by gravity. The McMillan plant can produce 70 MGD running off of a backup

generator. If DC Water's Bryant Street Pump Station is out of power then treated water from the McMillan plant can only flow by gravity to the city's low service zone and part of the first high zone. Aqueduct can push some water to DC Water's third high zone if there is power at Dalecarlia. Aqueduct has discussed holding some of this water back in an emergency until it assesses the extent of an outage and potential need for firefighting or other emergency services.

Fairfax Water

(Primary exercise contact: Greg Prelewicz, Planning)

During drought operations, CO-OP relies on Fairfax Water for data on water demands and on storage in the Occoquan Reservoir and may request load-shifts between Fairfax Water's Potomac and Occoquan intakes.

Fairfax Water's office building in Fairfax, Virginia, has back-up power. This building did not lose power during the 2012 Derecho.

Fairfax Water might have trouble load-shifting during a regional outage because some treated water transmission pumps might not have back-up power. Generators are located at the major pump stations that distribute treated water. But if power were lost at the Pohick Pump Station, the ability to shift water from the Griffith WTP north to the Potomac service area would be lost immediately. There is a mobile generator that could be moved to that station; however, a rental transformer would be required to connect it. The estimate is that it would take 24 hours before it could be brought back up. If power was out, water could be pumped from the Corbalis WTP on the Potomac River to the Occoquan service area using a generator.

Both the Corbalis WTP on the Potomac River and the Griffith WTP at Occoquan Reservoir are not likely to lose power under this scenario as Corbalis is supplied by an underground express feeder from the substation and Griffith is fed directly from a transmission line. No loss of power occurred at these plants during the 2012 Derecho. There are no back-up generators for the WTPs.

Loudoun Water

(Primary exercise contact: Thom Lipinski, Senior Project Engineer)

Loudoun Water has participated in the past three CO-OP drought exercises. It is in the process of constructing a water supply intake and WTP on the Potomac River just south of Leesburg, Virginia, and by 2021 it will also have completed a storage facility with a capacity of approximately one billion gallon. Loudoun Water has also recently purchased from the City of Fairfax a WTP located on Goose Creek. Once its new Potomac plant is operational, Loudoun Water's Virginia Water Protection permit specifies that during droughts it will provide CO-OP with data on water production, storage, and discharge from the Broad Run Water Reclamation Facility.

Loudoun Water did not lose cellular and internet service during the Derecho of 2012. The Broad Run plant should be able to run close to full capacity using the three to four available back-up generators. Getting fuel to run them all during an emergency can be a challenge.

At the present time, Loudoun Water obtains all of its water from Fairfax Water as a wholesale customer. Generators are located at the two places where water comes in from Fairfax Water. The back-up capabilities at the Goose Creek WTP are not yet known. There are no portable generators to run Loudoun Water's central service system.

MWCOG

(Primary exercise contact: Steve Bieber, Chief, Urban Watershed Programs and Homeland Security)

During droughts and other water supply emergencies, MWCOG is responsible for coordinating communications. It is also responsible for administering the Washington metropolitan area's coordinated drought response plan (see http://www.mwcog.org/environment/water/watersupply/drought_plan.asp).

MWCOG's office is located in a building in Washington, D.C., near Union Station. Because power lines in this area are underground, MWCOG's office is less susceptible to power outages during storm events. It did not lose power during the 2012 Derecho.

MWCOG staff noted that they, along with and the local emergency departments, are switching to a new service provider for the Regional Information and Communications and Coordination System (RICCS).

MARFC

(Primary exercise contact: Seann Reed, Development and Operations Hydrologist)

Each day during low-flow monitoring and operations, CO-OP reviews MARFC 72-hour stream flow forecasts, available online at http://water.weather.gov/ahps/region.php?rfc=marfc, to help inform operational decisions. MARFC also makes its gridded meteorological data and forecasts available to CO-OP on a real-time basis for input into CO-OP's new Low Flow Forecast System.

Because the MARFC has a primary role in flood forecasting, its office has back-up power that allows it to operate and to continue to provide forecasts and data products online during extreme weather events and other emergencies.

5 Recommendations

Valuable information was collected during the 2014 drought exercise on potential impacts of power outages on drought-related activities in the Washington metropolitan area. The exercise focused on impacts to communications between CO-OP and water suppliers; acquisition of data on water demands, reservoir storage, and stream flows; CO-OP's ability to run its operational tools; and implementation of water supply releases from system reservoirs and load shifts between water supply intakes. Below is a list of ICPRB recommendations based on lessons learned during the exercise.

1) The USGS's stream flow gage on the Potomac River at Little Falls near Washington, D.C., provides key data during droughts. Currently, equipment at this gage relies on the regional power grid. A solar or other off-grid source of power at this location is recommended.

2) Situations may arise which limit access to power, internet, and cellular data during CO-OP drought operations. CO-OP should prepare a brief written plan for continuing drought operations in the event of such an emergency. During emergencies, CO-OP staff members' primary responsibility is to ensure their own safety and the safety of their families. Thus, because CO-OP staff resources are limited, this plan will not meet the primary goal of a formal Continuity of Operations Plan, which is to ensure that essential functions are maintained in the event of an emergency. However, such a plan may assist staff in maintaining drought operations capabilities in many situations. Such a plan should:
    a. Include designation of emergency operations locations which are available for use by CO-OP staff members. Prior permission and credentials to allow entrance to these locations need to be arranged.
    b. Be updated on a yearly basis.
3) CO-OP should investigate the cost and feasibility of acquiring the following equipment:
    a. Backup computer and phone power supplies (battery and/or solar),
    b. Backup options for data connectivity (cellular data service for CO-OP laptops or satellite phone data connectors),and
    c. Backup communications system (radio or satellite phones).