

Deep Creek Hydroelectric Project MDE Dam No. 4

2019 PERMIT RENEWAL – PUBLIC HEARING

OCTOBER 15, 2019

Construction

- Construction began in 1923
- A Garrett County businessman who wanted to harness the power of the water on the Youghiogheny River to produce hydropower
 - The construction included a powerhouse on the Youghiogheny as well as an earthen-concrete core dam that spans Deep Creek

Producing Power

- Production began in 1925 at a level of 16 MW of installed capacity
- Power is sold into the PJM wholesale market



1

Generating Units

The powerhouse contains two vertical Francis units

2

Supplying Power to the Region

Enough energy is produced to provide clean, renewable power to 2,500 homes annually

3

More than Power

The Deep Creek dam created Deep Creek Lake & has resulted in recreational opportunities both on the lake and downstream

We invest and partner in the local communities where we operate

This Includes:

- Collaborating on projects that benefit the community
- Making charitable donations to local non-profits who fit our core mission
- Having staff available to act as a point of contact for questions or concerns that may arise from local residents & business owners
- Using local businesses and contractors on projects, where feasible
- Public safety messaging campaigns to ensure the safety of those who recreate on and around dams/waterways



Positively Impacting Garrett County

- Deep Creek Lake is the economic engine of the region, and we work closely with our partners both on the lake and downstream to ensure positive outcomes
- At the dam, we have two (2) full time employees and utilize seasonal employees for maintenance work
- Dam Safety/Public Safety is our priority and we invest in the asset, hiring local contractors where feasible
 - This included local contractor, Beitzel Construction, who performed a recent significant repair
- We partner with local government to partner when the need arises, such as drawing down the lake for a local sewer line project in 2016

THE GARRETT COUNTY REPUBLICAN

Brookfield Renewable announces work at Deep Creek Dam

From Staff Reports Aug 17, 2018

DEEP CREEK LAKE — Brookfield Renewable has announced it will be undertaking multiple projects at Deep Creek Dam, which will take place from mid-August into early/mid fall.

The first project will be mobilizing on-site, beginning this week, with work expected to begin shortly thereafter. This is an intake bridge concrete mitigation project that will consist of concrete work on the intake structure at Deep Creek Dam.

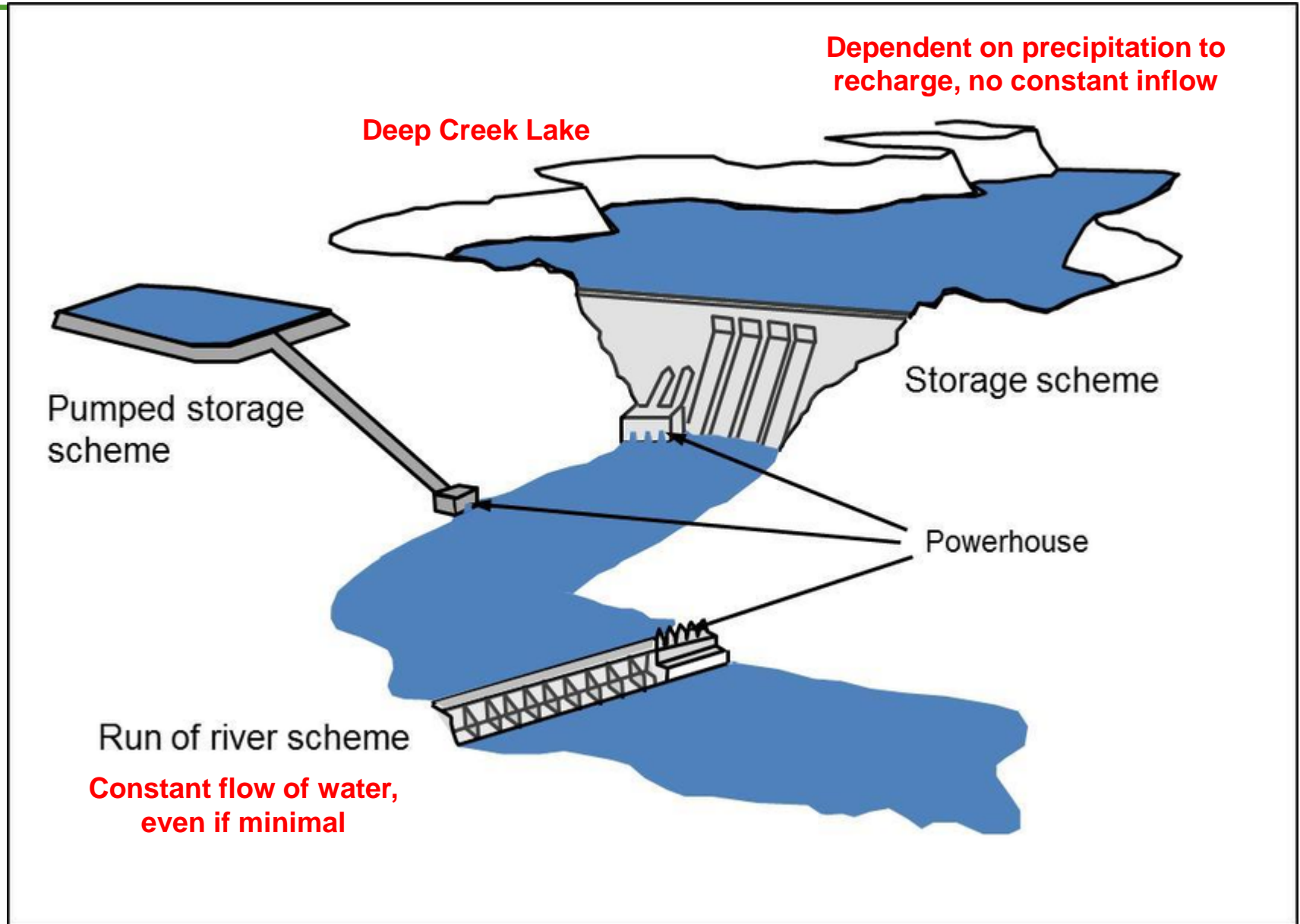
The screenshot shows a news article on the Garrett County Government website. The article title is "Brookfield Renewable Announces Work at the Deep Creek Dam". The text of the article includes:

- Brookfield Renewable announced on August 9th, 2018 that they will be undertaking multiple projects at the Deep Creek Dam, which will take place from mid-August and last into early/mid fall.
- The first project will be mobilizing equipment on site beginning next week (8/13), with work expected to begin shortly thereafter. This is an intake bridge concrete mitigation project that will consist of concrete work on the intake structure at the Deep Creek Dam. This maintenance work is necessary to maintain the long term structural integrity of the intake structure, which is utilized to discharge water from the lake, ultimately controlling water levels. It is located roughly 250 yards upstream from the dam.
- The second project that will be taking place will commence on, or soon after, August 27th, and will run approximately 10 weeks. The project will consist of clearing and grubbing along with installation of an enhanced filter barrier and flow drainage system, and is instrumental for the long term safe performance of the dam.
- Brookfield Renewable wanted to make the public aware of the following activities:
 - Increased vehicle & truck activity in and out of Maphewes Inn Inn. Trucks may be hauling gravel and materials to and from the site.
 - Construction will be on site during weekdays until completion of projects.
 - Grading work will be required, so you will see tracks near the intake structure in areas off limits to public access.
 - More noise than usual will be present at the site due to the nature of the work taking place; however, measures are in place to minimize the impact.
- Brookfield Renewable is asking that the public respect all signage and barriers in place during the length of this project, to include staying back from road crossing barricades that are in place near the intake structure to warn the public not to proceed any further.
- Anyone with questions or concerns are encouraged to reach out to Brian Norman at (517) 839-2659 or to e-mail inquiries to inquiries.M&B@brookfieldrenewable.com.

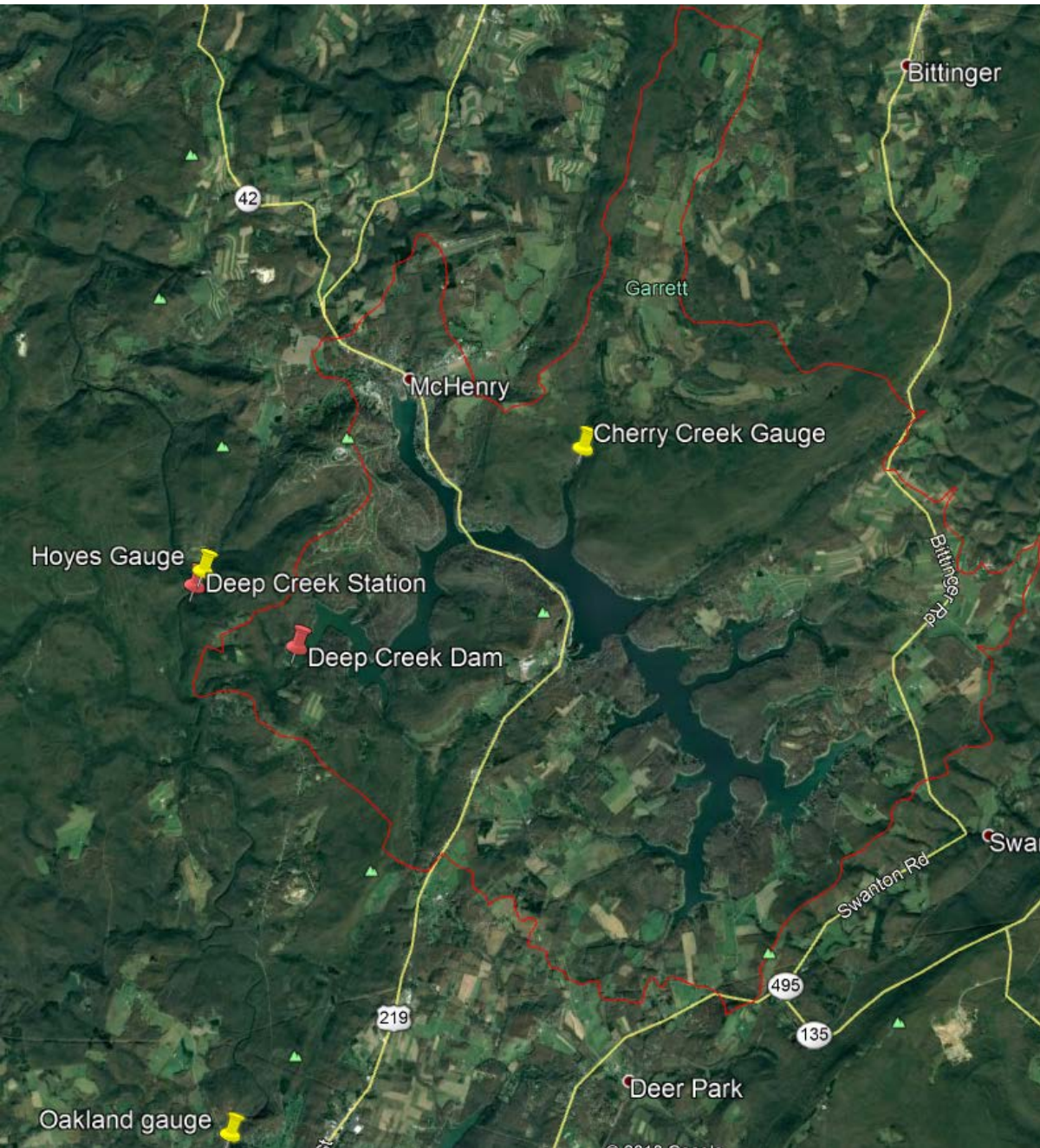


Deep Creek Project

How does Hydro work?



Deep Creek Lake



- Dam is on Deep Creek, 1.4 miles upstream of confluence of Deep Creek and Youghiogheny River
- Reservoir is 3,900 acres, with 65 miles of shoreline, and is owned and managed by MD DNR.
- Small watershed (64.7 square miles)
- Cherry Creek accounts for 20% of total inflow

Month	Average Flow cfs
Jan	33
Feb	46
Mar	54
Apr	37
May	40
Jun	22
Jul	13
Aug	8
Sep	10
Oct	12
Nov	19
Dec	39

General Layout of Dam



Total length of water conveyance is 1.49 miles

Power Generating Facilities

- Capacity – 19 MW
- Gross Head – 433 ft.

Power Tunnel

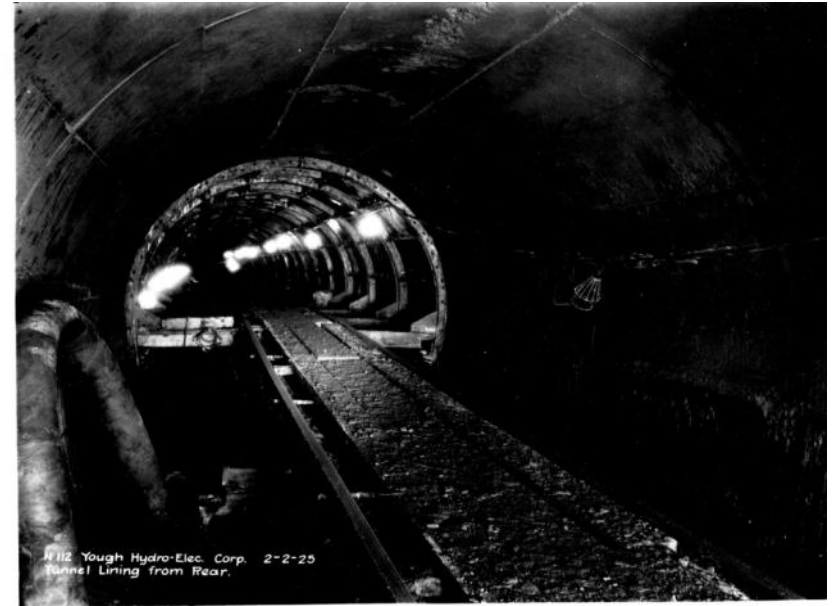
- Single concrete lined rock tunnel – 9 –foot diameter, 6,652 ft. long from intake to surge tank

Surge Tank

- Height – 145 ft. (52' above ground)
- Diameter – 30 ft.

Penstocks

- Two (2) steel pipes
- 6' diameter, 757' long from surge tank to powerhouse



General Layout of Powerhouse



Generation Floor & Powerhouse





Water Appropriation Permit

Current permit issued in April 2007 – expired April 1, 2019

- Brookfield submitted a renewal application to MDE on October 12, 2018
- Current permit is for average daily use of 94 million gallons per day (MGD)
- At MDE’s request, Brookfield applied for a larger average daily use of 128 MGD to include past extreme weather events (ex. 1996 – 128 MGD).
- Usage is dependent on precipitation and varies year to year.
- **More rain = more water used**
- Brookfield does not anticipate any changes to the usage of the water.

Average Daily Use and Precipitation 2003 – 2018

	Average Daily Use (MGD)	Precipitation (inches)
2003	119,370,321	69.54
2004	75,364,998	42.98*
2005	54,772,393	50.23
2006	43,976,914	51.31
2007	68,323,201	59.69
2008	76,955,911	60.30
2009	52,640,765	49.60
2010	53,441,059	44.60
2011	82,932,096	64.00
2012	42,164,367	49.70
2013	68,058,169	49.00
2014	51,345,653	48.20
2015	60,860,784	50.00
2016	55,215,412	50.00
2017	60,657,195	63.40
2018	123,785,011	80.02
Avg	68,116,516	56

* Missing September through December 2004 rainfall

RULE BAND AND OPERATION PROTOCOLS - THE PERMITTEE SHALL OPERATE THE DEEP CREEK HYDROELECTRIC PROJECT (PROJECT) ACCORDING TO THE PROJECT OPERATING RULES SPECIFIED THROUGHOUT THIS PERMIT SUCH THAT WATER ELEVATIONS IN DEEP CREEK LAKE ARE MAINTAINED WITHIN THE OPERATING RULE BAND EXCEPT THAT EXCURSIONS OF UP TO 0.3 FEET ABOVE THE OPERATING RULE BAND LASTING NOT MORE THAN 21 DAYS ARE ALLOWED FROM MAY THROUGH OCTOBER, AND EXCEPT IN THE EVENT OF UNUSUAL OR EMERGENCY CONDITIONS AS DEFINED BELOW. THE UPPER AND LOWER RULE BANDS ARE THE HIGHEST AND LOWEST DESIRABLE RESERVOIR LEVELS AT THE END OF EACH MONTH. THE UPPER AND LOWER END OF EACH MONTH ARE DEFINED IN THE FOLLOWING TABLE. WHEN LAKE LEVELS ARE ABOVE THE UPPER RULE BAND, THE PERMITTEE MAY RELEASE WATER AS NEEDED TO DRAW DOWN THE LAKE TO A LEVEL WITHIN THE RULE BAND. ELEVATIONS ARE GIVEN IN FEET ABOVE MEAN SEA LEVEL.

PROJECT OPERATING RULE BAND

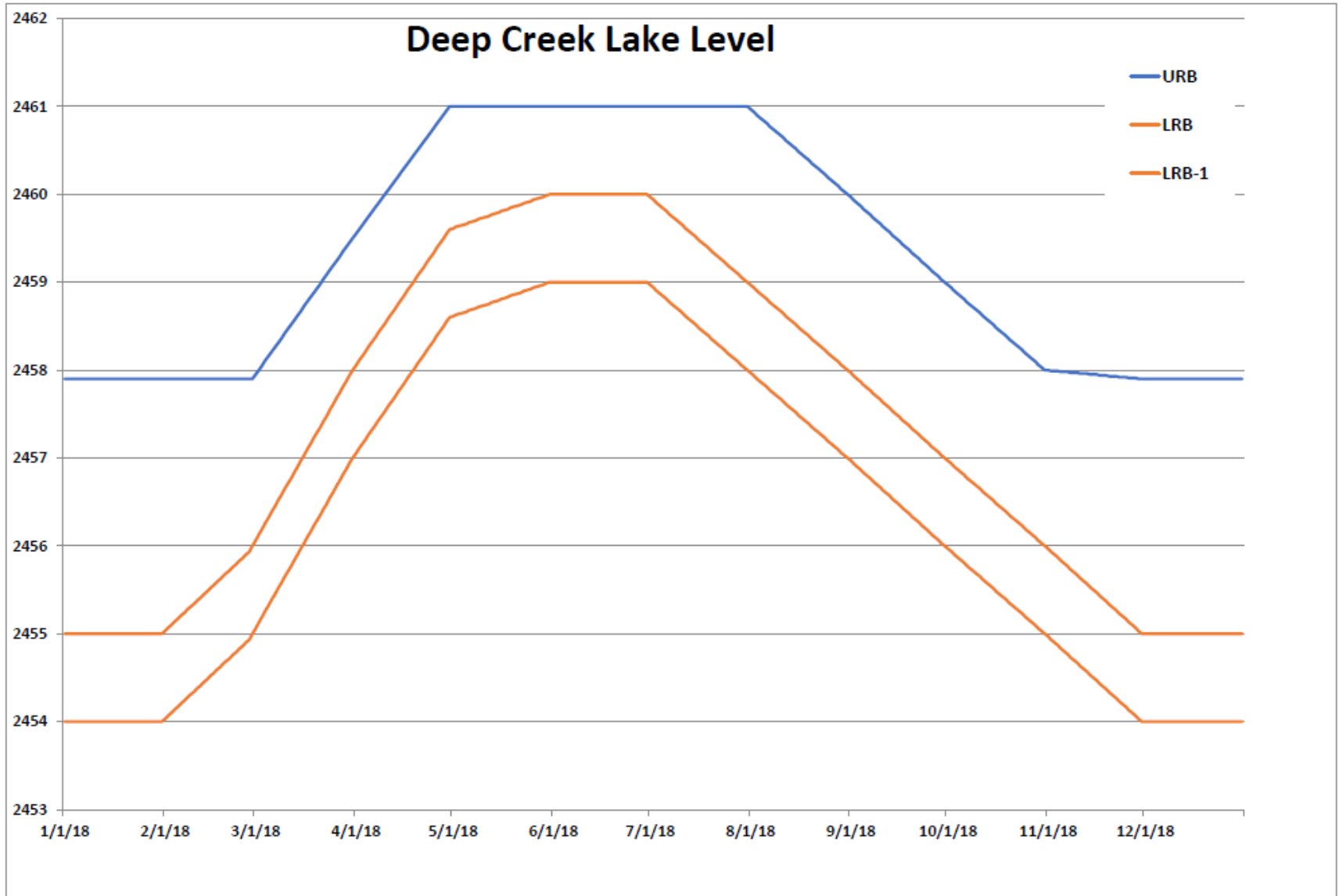
MONTH	UPPER BAND ELEVATIONS	LOWER BAND ELEVATIONS
JANUARY	2457.9	2455.0
FEBRUARY	2457.9	2456.0
MARCH	2459.5	2458.0
APRIL	2461.0	2459.6
MAY	2461.0	2460.0
JUNE	2461.0	2460.0
JULY	2461.0	2459.0
AUGUST	2460.0	2458.0
SEPTEMBER	2459.0	2457.0
OCTOBER	2458.0	2456.0
NOVEMBER	2457.9	2455.0
DECEMBER	2457.9	2455.0

RULE BAND AND OPERATION PROTOCOLS CONT'D

- (B) A SITE EMERGENCY SUCH AS FAILURE OR PROBABLE FAILURE OF THE DAM THAT REQUIRES MAXIMUM RELEASE FOR RAPID DRAWDOWN OF THE RESERVOIR;
- (C) A SITE EMERGENCY OR OTHER FORCED (UNSCHEDULED) OUTAGE REQUIRING SHUTDOWN OF THE INTAKE, POWER TUNNEL, PENSTOCKS, OR GENERATING UNITS, RESULTING IN THE INABILITY TO GENERATE OR TO OPERATE THE PROPOSED MINIMUM RELEASE BYPASS;
- (D) MAINTENANCE OF THE DAM OR REPAIR OF LAKE SHORELINE EROSION WHICH REQUIRES LOWERING OF LAKE LEVEL BELOW THE LOWER RULE BAND TO ALLOW ACCESS OR TO CONTROL INFLOW;
- (E) ACTUAL OR FORECAST EXTRAORDINARILY HIGH RUNOFF OR RAINFALL WHICH REQUIRES UNLIMITED GENERATION IN ORDER TO KEEP THE LAKE LEVEL FROM AVOID SPILLING OVER THE TOP OF THE DAM SPILLWAY.

THE DURATION AND TIMING OF PLANNED OUTAGES SHALL BE APPROVED IN ADVANCE BY THE ADMINISTRATION. IN PROPOSING PLANNED OUTAGES, THE PERMITTEE SHALL DETAIL REASONS WHY THE OUTAGE IS NECESSARY AS WELL AS HOW THE OUTAGE WILL IMPACT THE FISHERY AND WHITewater RECREATION IN THE YOUGHIOGHENY RIVER. TO THE EXTENT POSSIBLE, PLANNED OUTAGES SHALL NOT OCCUR DURING MID-APRIL THROUGH MID-OCTOBER.

- (A) A SYSTEM EMERGENCY, DEFINED AS MAXIMUM EMERGENCY GENERATION UNDER THE PENNSYLVANIA-NEW JERSEY-MARYLAND INTERCONNECTION (PJM) HIERARCHY OF EMERGENCY ORDERS, OR EMERGENCY LOADING OF SPINNING RESERVE CAPACITY, OR EMERGENCY CONTROL OF TRANSMISSION FACILITY LOADING;



One Team, Four Managers, 33 River Systems, 5 Reservoirs

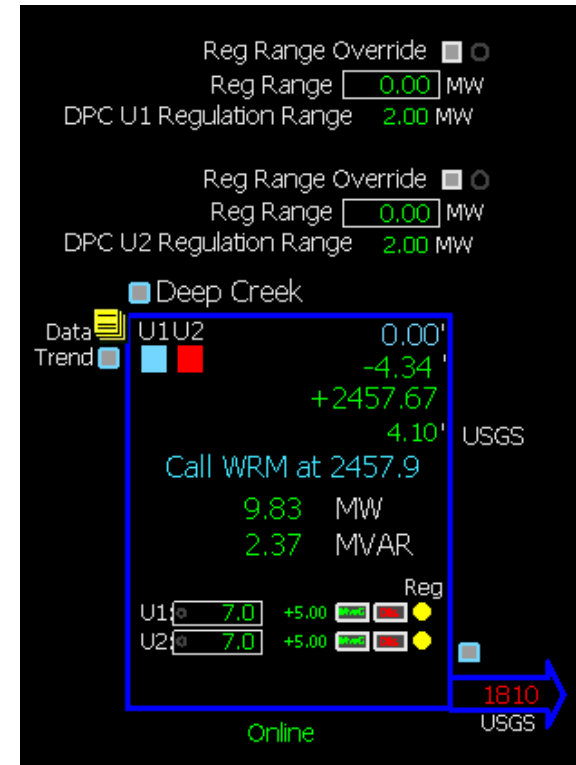
- 7-Day Coverage on all assets
- Extensive training and coordination
 - 41 years of combined experience
 - Training path is approximately 3-4 years

One Team, Multiple Locations

- 24/7 Coverage of monitoring and operation
 - Remote control from NASCC
 - Local control, response, and maintenance
- Extensive communication and coordination
- Support team with highly integrated specialized functions
 - Employee Safety
 - Public Safety
 - Dam Safety
 - Compliance
 - Capital Projects
 - Stakeholder Relations

Deep Creek – Daily Process

- Verify and update Outage Management System
 - Less than a .3% Forced Outage Rate over the last 6 years
 - This ensures units are available for WWR, TER, weather events, grid events
 - Outages are scheduled 1 Turbine in March and 1 turbine in November to avoid WWR, TER season.
- Verify current elevation and position the Rule Bands
- Local Report from Station on Rain Fall, Snowfall, and Elevation
- Gathering of Flow Information
 - USGS Cherry Creek (approximately 20 % of Watershed)
 - USGS Hoyes
 - USGS Oakland
 - USGS Friendsville
 - Perform Water Balance Calculation to retrieve actual Inflow and trend

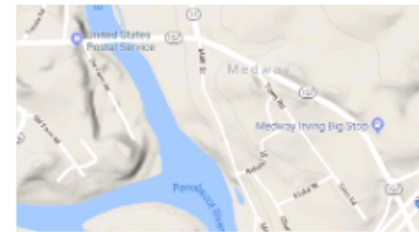


- Deep Creek Day Ahead Scheduling
 - Verify upcoming WWR and the frequency of Temp Releases (Average 12 per month June, July, and August)
 - Verify Friendsville flow and determine if flows/weather forecast will require generation adjustments in the schedule
 - Flows 600 cfs – 1300 cfs requires one turbine maximum operation, Flows 1300 cfs – 2500 cfs requires turbines to be offline.
 - Use predictive model to determine water available for discretionary generation
 - If there is generation available other than WWR's
 - May 1st thru Oct 31st ensure not exceeding URB >21 days
 - Utilize market demands to submit a Generation Schedule
 - Ensure that Safe Waters and the Deep Creek Hotline are updated for the upcoming release
 - Inform Precision Rafting of the upcoming Schedule

SHORT-TERM SCHEDULE

START DATE	START TIME	END DATE	END TIME	CFS
2/20/19	6:00 AM	2/21/19	8:59 PM	620
2/21/19	9:00 PM	2/21/19	11:59 PM	0

- Deep Creek Same Day Schedule Adjustments (Real Time)
 - Verify Position on the Rule Bands. Make adjustments based on position if required
 - Verify if it is a WWR day
 - Verify Friendsville flow and modify today's WWR Schedule if it has not already been forecasted.
 - Inform the NASCC to update generation schedule, the Safe Waters website, and the Deep Creek Hotline
 - Inform Precision Rafting of change.



Deep Creek
Near Oakland, MD

Thu February 21 01:46PM EST
Headwater Elevation Outside

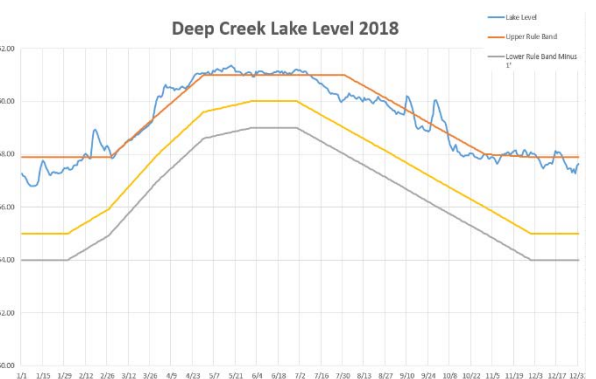
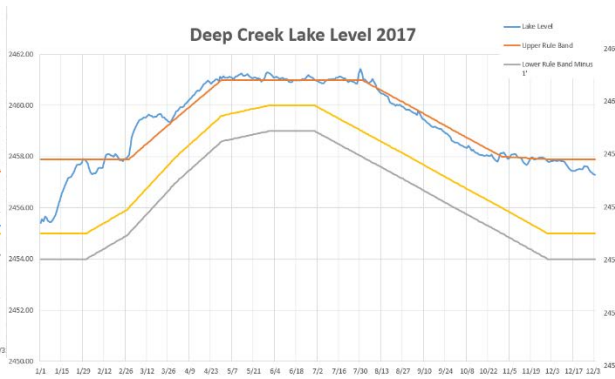
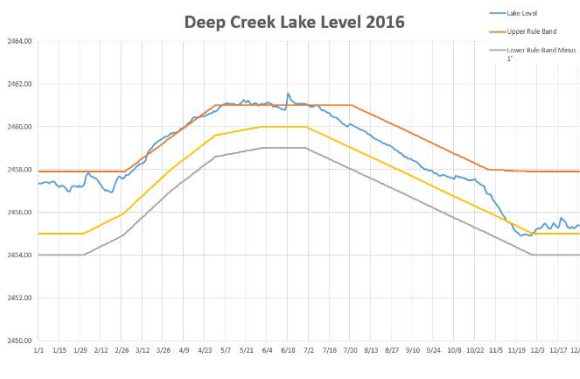
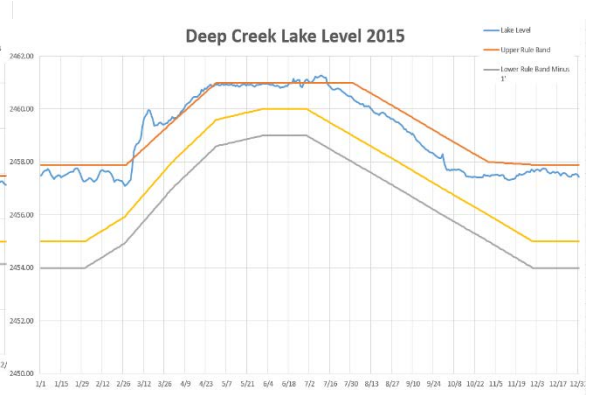
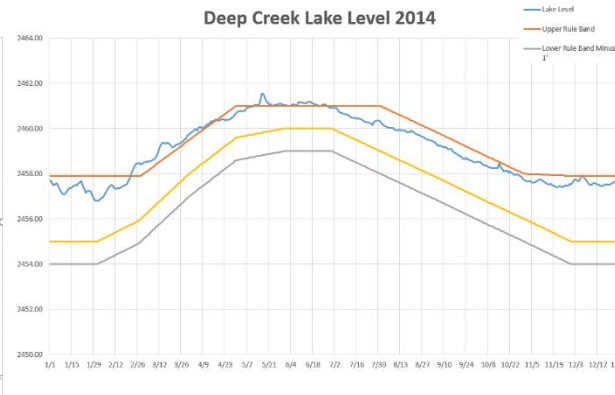
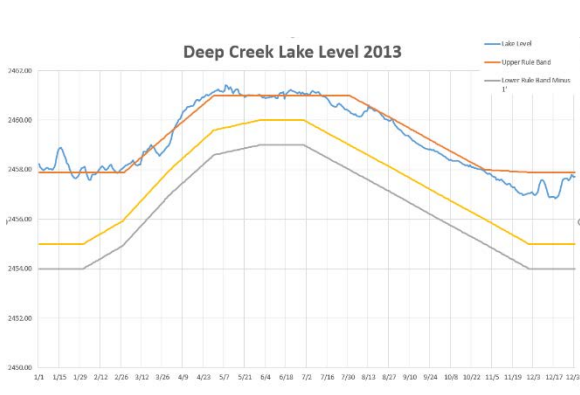
2457.68 ft

Number of Turbines Generating

2

- January 1st to May 1st
 - Utilize generation to achieve approximately 1.0' to 1.5' below the URB in preparations for the Spring Freshet.
 - The plan is to reach the URB and follow it up and achieve a 2461.0' elevation by May 1st
 - During the refill to 2461.0' we may exceed the URB capturing rain event/melt and allowing the URB to catch up. This is to ensure that we capture Spring rains.
 - An example would be that a months LTA rainfall occurs in the first 2 weeks of month and then dries up.
 - May 1st thru August 1st
 - Utilize generation to accomplish all WWR's and Temp Releases per the Water Appropriation Permit
 - The Scheduling tool (predictive model) is always looking 30 Days out and accounting all WWR requirements and the estimated 12 Temp Releases per month. (Temp Releases will be adjusted based on the current trend)
 - We try to maintain the Reservoir near the URB running only the required releases as LTA flows are minimal in summer months.
 - We utilize the .3' above the URB for 21 days to capture rain events during these months. That water is expended by WWR/Temp Releases or discretionary if the 21 days is approaching.
 - August 1st thru November 1st
 - The plan is to run only the required flows to achieve the URB draw rate.
 - November 1st thru January 1st
 - The plan is to run generation to maintain reservoir level between the URB and LRB
-

Lake Levels Since 2013



*2016-We brought water levels down to accommodate Garrett County sewer line work

- Maintain water temperatures less than 25 degrees C in the Youghiogheny River between the project tailrace and Sang Run, during the months of June, July and August.
- Real-time monitoring of river temperature.
- Reports submitted to MDE on July 7, August 7 and September 7 and then included in the Annual Report as well.



- Maintain a bypass system at the project to maintain a minimum flow of 40 cfs in the river downstream of the project tailrace.
- USGS Hoyes Run gauge directly downstream to monitor and ensure that min flows are met.
- A reduction in the min flow may be requested of the MDE when reservoir levels are one foot or more below the lower rule band.
- A report of flows and bypass releases shall be included in Annual Report.

Condition #18 – Dissolved Oxygen Mitigation



- Maintain and operate a tailrace weir designed to increase DO levels above MD water quality standards.
- Monitor June 1 to October 1
- Submit results in Annual Report

- Intent is to enhance recreational whitewater enjoyment from the project tailrace to Friendsville.
- Two types: Standard and Special Releases
- All are subject to the rule band and temperature enhancement releases


Special Releases Supported:

- Annual Team Friendsville Upper Yough Race WWR
- Gauley Festival Week WWR




Condition #21 – Zebra Mussel Monitoring

- Monitor intake area for zebra mussels from April to October
- None found
- Results shall be submitted in the Annual Report

Brookfield Renewable Power 

Deep Creek Lake, MD Zebra Mussel Monitoring Report

Brookfield Renewable Power
14 River View Terrace
Oakland, MD 21550
Phone: 301-387-6616
Fax: 301-387-5809



Zebra mussel showing byssal threads.

Collector's Name Sean Fredlock

Year 2018

Month 4

Day 30

Hour 10:00

Water Temperature ° F 58

How many days was the sampler exposed to the water prior to collecting this data? 30

Are zebra mussels present at the site? (NO) (YES) If yes comment below and notify the Superintendent and Maryland Department of Natural Resources immediately.

Other organisms observed on the sampler? NO

Comments _____

Water releases are designed to balance the uses of the lake:

- Temperature enhancement releases for trout fishery
- Whitewater releases
- Discretionary generation based on:
 - Current elevation and rule band
 - Weather forecast and flows
 - Plant outages

“The current permit is written to provide multiple benefits from the releases for multiple users” (Deep Creek Watershed Management Plan 2016)

Thank You

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BRIAN NOONAN, MANAGER, STAKEHOLDER RELATIONS