Upper Peninsula Power Company
1002 Harbor Hills Drive
Marquette, MI 49855
www.UPPCO.com

December 4, 2018

Sent via Email:
Ms. Amira Oun, MDEQ
Ms. Elle Gulotty, MDNR
Mr. Scott Hicks, FWS

Dear Amira, Elle, and Scott:

Dead River Hydroelectric Project
Request for Comments on Proposed Temporary Amendment to Operate the Dead River Hydroelectric Project January 2019 through December 2019

As previously mentioned Upper Peninsula Power Company (UPPCO) would like to obtain your formal comments on a proposed temporary license amendment (current proposal) for 2019. Specifically, UPPCO is proposing to make operational changes ("Start of Month Target Elevation" adjustments) to support a bankfull (channel forming) flow release during the spring (as required by the Consent Judgment) and support improved water quality downstream of the Dead River Storage Basin (DRSB) during July & August.

Since this plan is requesting changes to license requirements over multiple months, the Federal Energy Regulatory Commission (FERC), has indicated UPPCO will need to complete formal consultation with all agencies and file for a temporary license amendment for approval by FERC before it can be implemented. This request cannot be implemented as a planned deviation.

Based on the teleconference held on Friday November 30th the current proposal has been modified to reflect initial comments. UPPCO is requesting to receive your final comments by December 11, 2018 to allow for filling with the FERC on December 14, 2018. We apologize for the compressed schedule, but UPPCO did not plan for the temporary amendment schedule.

Background
In the final test report approved by the Commission on April 26, 2018, UPPCO concluded the current start of month target elevations for the Silver Lake Storage Basin (SLSB) do not allow for enough storage to maintain the start of month target elevations at the Dead River Storage Basin (DRSB) during the summer recreation season. It also concluded target elevations needed to be modified at both the SLSB and the DRSB to take advantage of spring runoff.

Due to the rebuilding efforts of the reach between Silver Lake and the AAO bridge, UPPCO is required to release 150cfs for a period of 72 hours two out of every three years. This channel forming flow requirement is typically coordinated during spring runoff when natural high flows in tributary streams entering the Dead River are occurring. The current proposal to modify certain start of month target elevations at the SLSB will ensure that UPPCO is able to perform the 72-hour release during the spring of 2019.

While reviewing data to ensure the channel forming flows could be released, it was determined that the ability to store additional water at the SLSB could have a positive impact on water quality downstream of the DRSB during late summer. Having additional water available would allow for

increased flows from the SLSB during the months of July and August and subsequently increased flow releases from the DRSB with a goal of improving downstream water quality.

Silver Lake Storage Basin

UPPCO believes the target elevations for the SLSB from February through October need to be modified to allow for full capture of spring runoff and increased cold water storage capacity over the summer months.

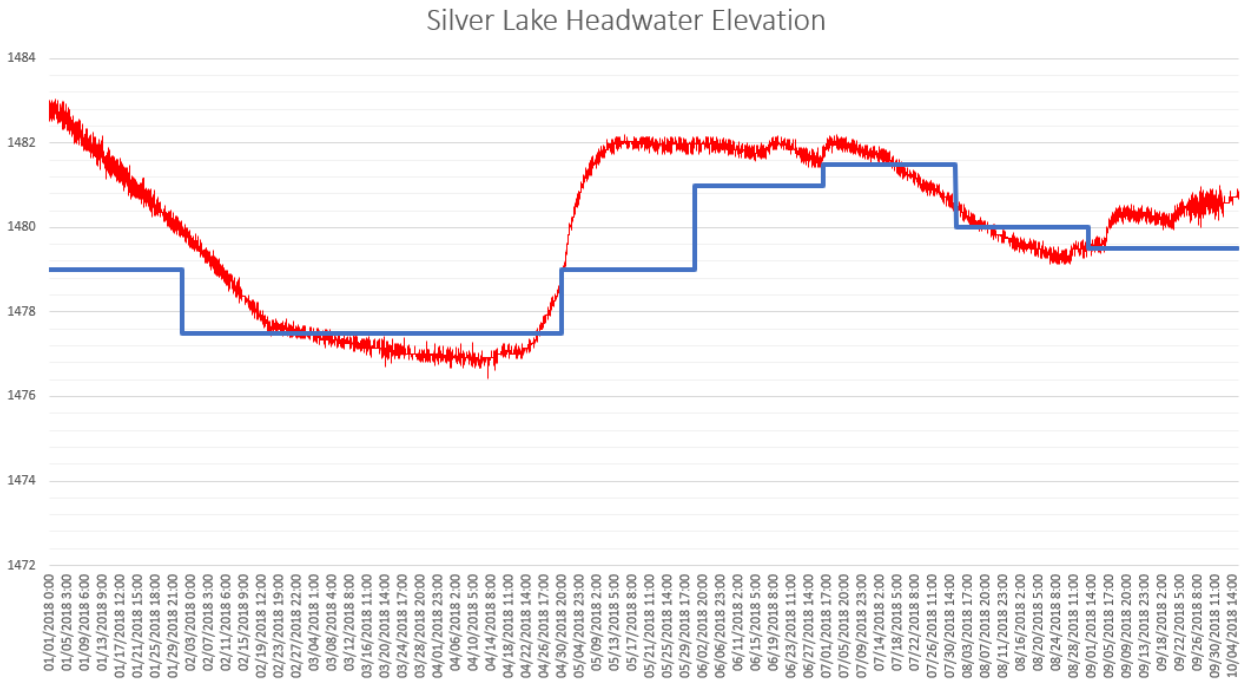
The proposed start of month target elevation modifications limit reservoir fluctuations during freezing conditions, which minimizes the impact upon hibernating herptiles. The capturing of the maximum amount of spring runoff ensures the ability for the required channel forming flow release and continued storage of colder water throughout early summer will benefit downstream water quality.

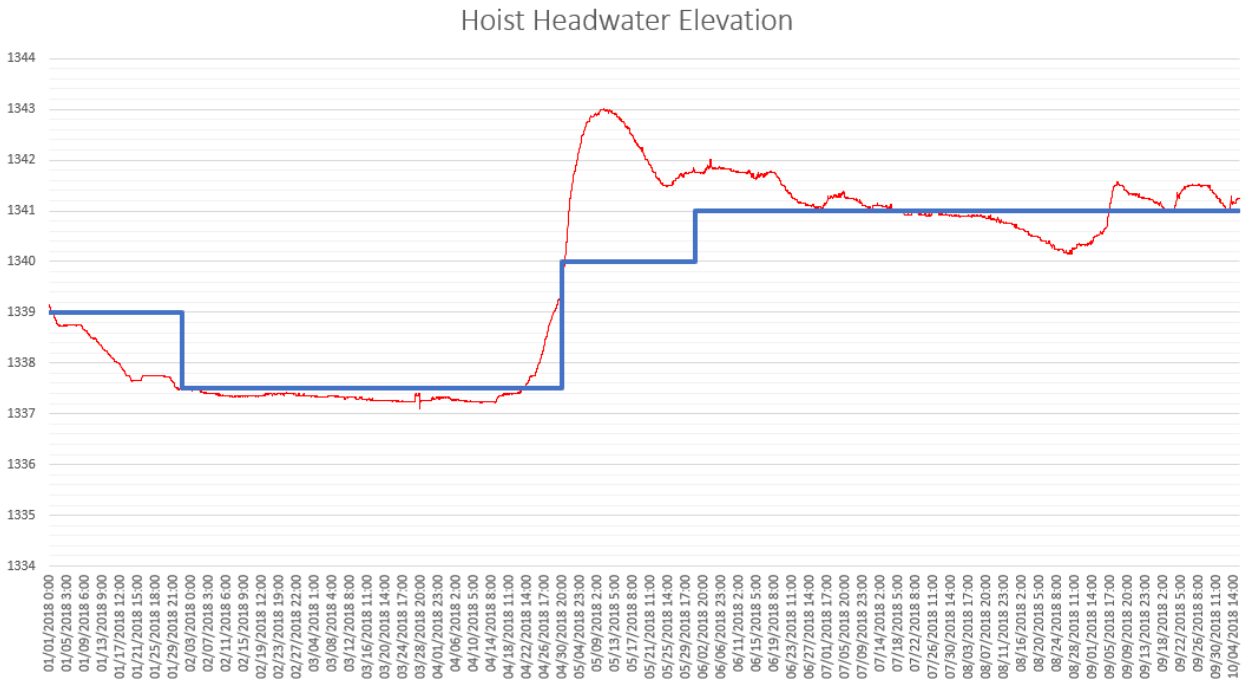
Dead River Storage Basin

UPPCO believes it is important to increase the May start of month target elevation to 1341.0 feet NGVD to capture spring runoff if it occurs during April. This situation has been occurring in recent years.

2018 Season Overview and Comparison

In the 2018 season through early October, UPPCO has been relatively successful in meeting the targets for SLSB, the DRSB and the reservoir elevation requirements at the McClure Reservoir. In the beginning of the season the late timing of spring runoff and rain events caused some concern. However, from these events and previous events, it has become clear using the storage at the SLSB continues to be a key to the operation of Dead River Hydroelectric Project. See Figures Below:





Winter Drawdown at Silver Lake Storage Basin

One of the challenges during early to mid-winter of 2018, was reaching the lower start of month targets for the SLSB prior to spring runoff. At the beginning of January 2018 due to late fall 2017 rains UPPCO had excess water remaining in the SLSB. As a result, UPPCO was required to release flows during the month of January above the minimum flow requirements to drive the SLSB reservoir elevation down to approximately 1479 feet NGVD to meet the start of month target for February 2018 of 1477.5 feet NGVD. After having reached the February 2018 start of month target elevation and lower outflows to the required minimum, there were insufficient inflows into SLSB to continue to maintain the reservoir elevation. As a result, the SLSB reservoir elevation dropped below the April start of month target of 1477.5 feet NGVD to the approximate minimum elevation of 1477.0 feet NGVD.

In reviewing the license record, UPPCO cannot determine any specific reason to target a reservoir elevation of 1477.5 feet NGVD during the wintertime as required by the license. It can only speculate the reason was to increase power generation during the winter months.

Potential Improvements to Water Quality

In the test report, UPPCO recommended a May, June, and July start of month target elevation of the spillway crest or approximately 1485 feet NGVD and 1483.2 feet NGVD for August and 1481.4 feet NGVD for September. These recommendations in part were based on UPPCO's belief that storing water in SLSB for use later in the summer would benefit both water quality and recreational use on the DRSB.

When looking at the temperature monitoring information for July and August of 2018, which was submitted to the Commission on September 28, 2018, the amount of water released from SLSB has an impact on the diurnal effects of temperature downstream of SLSB and consequently the water temperature entering the DRSB. This further supports the current proposal where water stored in SLSB provides a water quality benefit when released downstream in late summer.

Based on the available data it is uncertain how much water is required to be stored in the SLSB to allow for augmented releases in support of water quality and recreational use on the DRSB during the late summer.

Supporting Data

In developing the current proposal, UPPCO has conducted a sensitivity analyses evaluating several scenarios using a Hydrologic Model for the Dead River Hydroelectric Project.

The criteria used to evaluate each scenario are as follows:

1) The probability the SLSB reservoir fills to at least the top of the spillway (approximately 1485 feet NGVD) in any given year.
2) The probability dry-year consultation occurs at SLSB in any given year.
3) The probability the DRSB spills over the spillway (elevation of 1344.6 feet NGVD) in any given year.
4) The probability the DRSB does not reach 1341.0 feet NGVD by June 1 in any given year.
5) The probability dry-year consultation occurs at DRSB in any given year.

Results from the sensitivity analyses indicate that capturing as much spring runoff as possible and storing it in the SLSB until late summer reduces the number of spilling events at the DRSB. It also provides more water for release during the late summer months, which would help enhance water quality and maintain the target elevations at the DRSB. Additionally, it shows that if the SLSB is drawn down too low during late winter there may not be enough water available for bank full flow releases, during the peak of spring runoff in 2019 and later years.

Based on the sensitivity analysis and UPPCO's professional opinion it believes adjustments to the start of month targets included in the current proposal provide the best opportunities to; release the required channel forming flows downstream of the SLSB in the spring, store additional water in the SLSB which: reduce spilling events at the DRSB, provide water for increased flows during late summer to improve water quality and maintain summer recreation season target elevations at the DRSB.

In comparing the license conditions with the conditions proposed in the Test Report and the currently proposed operating scenario, it appears the current proposed operating scenario is most beneficial.

	40.75 Year Data Review: SLSB		**40.75 Year Data Review: DRSB**		
License Condition	**Spilling (> 1485')**	**Entering Dry Year Consultation**	**Spilling**	**Not Reaching 1341' by 6/1**	**Entering Dry Year Consultation**
As Written	2.5%	22.0%	36.8%	2.5%	31.7%
Test Report	29.4%	12.2%	31.9%	2.5%	19.5%
Current Proposal	49.0%	4.9%	31.9%	2.5%	12.2%

If the last 10+ years on inflows are indicative of future weather conditions, the following analysis was completed to show the differences.

	Last 10.75 Years of Data: SLSB		Last 10.75 Years of Data Review: DRSB		
License Condition	**Spilling (> 1485')**	**Entering Dry Year Consultation**	**Spilling**	**Not Reaching 1341' by 6/1**	**Entering Dry Year Consultation**
As Written	0.0%	18.2%	37.2%	9.3%	54.5%
Test Report	18.6%	18.2%	27.9%	9.3%	36.4%
Current Proposal	55.8%	0.0%	27.9%	9.3%	27.3%

The tables below show the current license requirements by month along with the conditions proposed in the Test Report and our current proposal for 2019. It should be noted the changes from the Test Report to our current "Proposed Operating Scenario" represent UPPCO's better understanding of the needs of the Dead River System and its attempt to further support spring channel forming flow releases downstream of the SLSB, improve water quality in late summer, reduce spilling events and maintain summer recreation target elevations on the DRSB. The changes and reasoning are described in detail following the tables.

Silver Lake Storage Basin					
Month	Min. flow (cfs)	Min. Elev. (ft)	License Target Elev. (ft)	Test Report Target Elev. (ft)	Current Proposal Target Elev. (ft)
January	15	1477.5	1479.0	1479.0	1479.0
February	15	1477.0	1477.5	1477.5	1479.0
March	15	1477.0	1477.5	1477.5	1479.0
April	25	1477.0	1477.5	1477.5	1485.0
May	20	1478.5	1479.0	1485.0	1485.0
June	15	1480.5	1481.0	1485.0	1485.0
July	10	1480.0	1481.5	1485.0	1485.0
August	10	1479.0	1480.0	1483.2	1482.5
September	10	1479.0	1479.5	1481.4	1480.0
October	15	1479.0	1479.5	1479.5	1480.0
November	15	1478.5	1479.0	1479.0	1479.0
December	15	1478.5	1479.0	1479.0	1479.0

Dead River Storage Basin					
Month	Min. flow (cfs)	Min. Elev. (ft)	License Target Elev. (ft)	Test Repot Target Elev. (ft)	Current Proposal Target Elev. (ft)
January	100	1337.5	1339.0	1339.0	1339.0
February	100	1337.0	1337.5	1337.5	1337.5
March	100	1337.0	1337.5	1337.5	1337.5
April	100	1337.0	1337.5	1337.5	1337.5
May	100	1339.0	1340.0	1341.0	1341.0
June	100	1339.0	1341.0	1341.0	1341.0
July	100	1339.5	1341.0	1341.0	1341.0
August	100	1339.5	1341.0	1341.0	1341.0
September	100	1339.5	1341.0	1341.0	1341.0
October	100	1339.5	1341.0	1341.0	1341.0
November	100	1339.5	1341.0	1341.0	1341.0
December	100	1338.5	1339.0	1339.0	1339.0

From the Silver Lake Storage Basin Table, you can see an increase in the start of month target elevation for the months of February and March from 1477.5 feet NGVD to 1479.0 feet NGVD. This increase provides a consistent headwater elevation during the winter months and avoids a reduction in reservoir elevation (elevation drop). Removing the elevation drop allows water to be stored and utilized for the required channel forming flow release timed with spring runoff. Without this water, the channel forming flow release could not occur until enough water has been captured from the spring runoff, at which point it might be too late in the season to be released at the ideal time (peak of spring runoff).

The start of month target for April has been increased to 1485.0 feet NGVD to allow for the capture of the maximum amount of spring runoff flows. In the last few years, spring runoff has occurred sometime between mid-March and early May, and a low start of month target for April 1 requires high water releases to ensure compliance in maintaining the target elevation. Without the current proposal for April, if the spring runoff occurred in mid-March, little to no water could be captured and stored in the SLSB. This could be detrimental to downstream water quality and recreation opportunities as the summer progressed.

Start of month target levels for May until July are set at the maximum controllable headwater level achievable at the SLSB (spillway crest). Although the probability of filling the SLSB is 50% in any give year, (see above tables), having a target based upon the maximum controllable headwater ensures that water releases from the SLSB will be no more than the minimum flow requirements (UPPCO must strive to meet the target, and the only way to increase headwater is to release required minimum flows). Minimum flows will be released until the start of month target is met, then flows will be adjusted to maintain the elevation.

During the month of July, UPPCO is proposing to reduce the SLSB elevation by 2.5 feet and again by 2.5 feet through the month of August. This is part of the current proposal in an attempt to have increased water release during the months when water quality tends to be affected by warm temperatures and reduced precipitation. UPPCO's goal would be a consistent release over the month to best trend towards the next month's target. Because the amount of water available during the months of July and August will be dependent on the captured spring runoff, precipitation received, evaporation loss, etc, UPPCO proposes to consult with the MDNR, MDEQ and the FWS no later than July 1, 2019 and again no later than August 1, 2019. Through the consultation

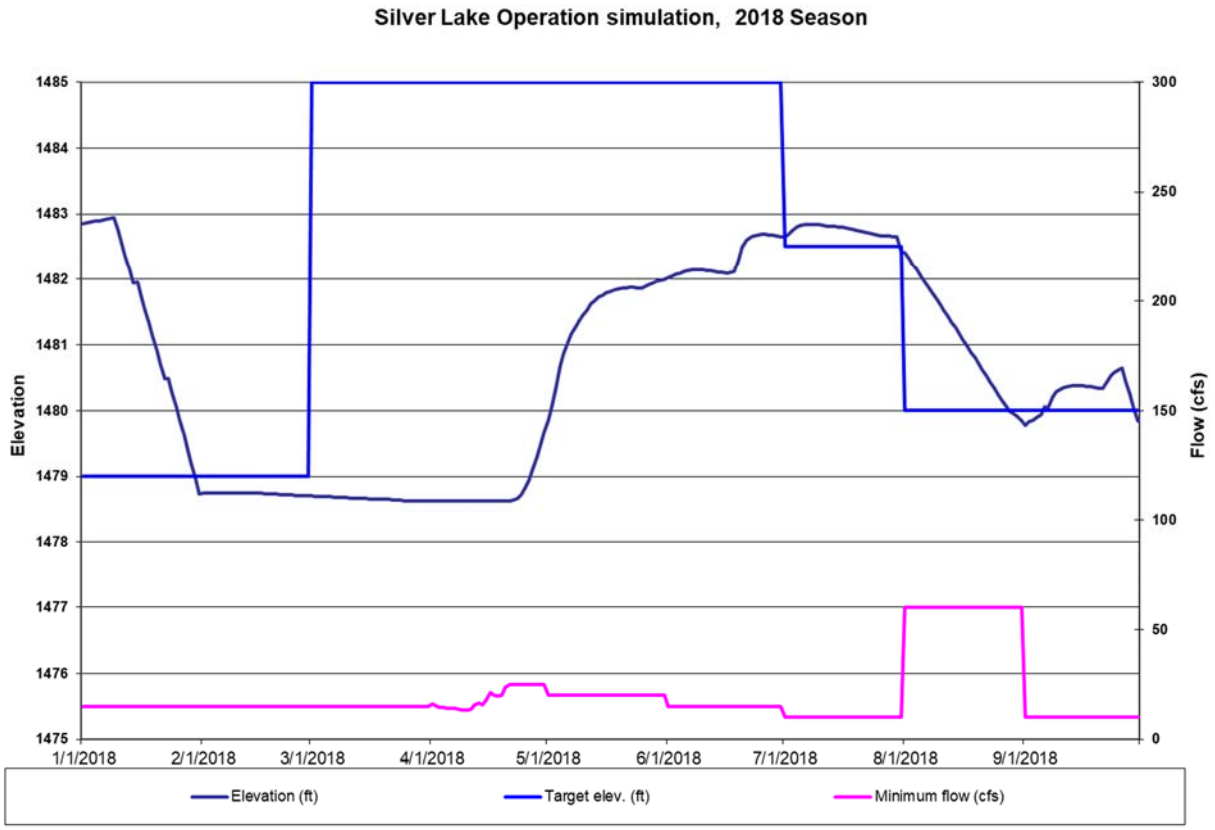
agreement will be obtained on the specifics of flows to be released from SLSB and DRSB during July and August 2019. The focus of the discussions will be based upon both the water quality downstream of the DRSB and recreation use of the DRSB.

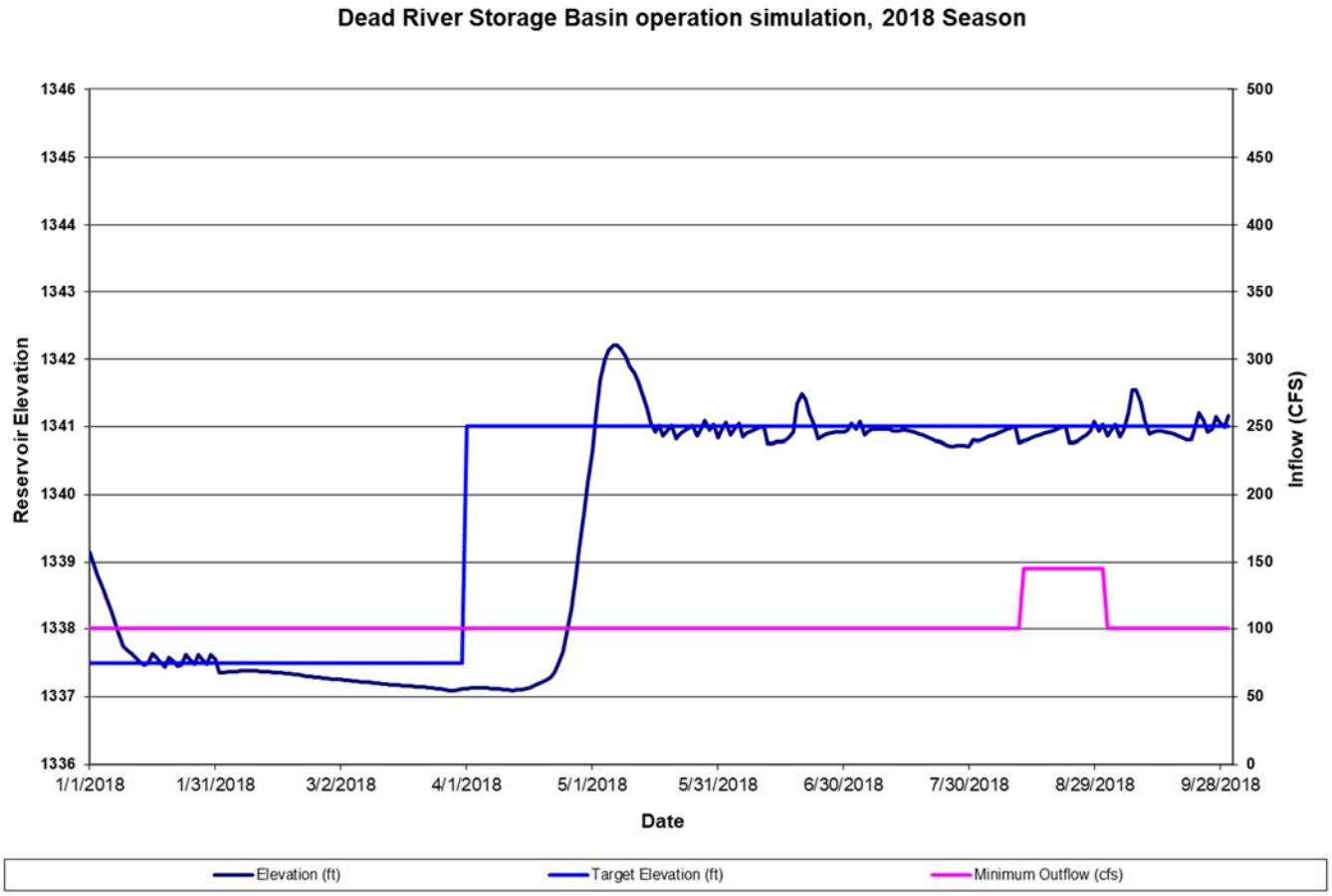
For September and October, the proposed target levels remain consistent, and typical fall rains will allow for sustained SLSB water releases. A small elevation change is part of the current proposal during the month of October to resume the license targets of the original license through the winter months.

From the Dead River Storage Basin Table you can see the change proposed is consistent with what was in the Test Report. The change increases the start of month target level for the month of May from 1340.0 feet NGVD to 1341.0 feet NGVD. This allows for spring runoff water to be captured in the storage basin. In the past, it has been proven that a target of 1340.0 feet NGVD misses the ability to store the water from spring runoff.

Synthesized 2018 Season Under Proposed Operating Scenario

According to the hydrologic model, if UPPCO would have implemented the proposed operating scenario in 2018, UPPCO would have been able to release the water that was stored in the SLSB at the beginning of August at a rate of 60 cfs until the end of August. This would have resulted in UPPCO releasing 145 cfs from the DRSB for the period August 12 through August 31, 2018. This increased flow release should have improved water quality in the tailwater during late August (the only period of dissolved oxygen levels below the standard reported to the FERC on September 14, 2018). Please see the figures below:





UPPCO also ran three other operations scenarios using 2018 model data with the proposed target levels. These are provided in the attached Appendix A. From the additional scenarios, UPPCO determined that if the proposed target changes were in effect during the 2018 season, outflows from the SLSB could have been increased to 55 cfs July 20th – August 15th and 50cfs August 16th – August 31st, the longest recorded period of Dissolved Oxygen Deviations in the last four years (2016). Also during this time, due to the increased releases from SLSB, the DRSB outflows could have been increased July 20th – August 31st to 125 cfs with no impact on headwater elevation, or 140 cfs with an elevation drop of 0.40 feet (~4.75").

Using previous water quality data, UPPCO believes increased flows positively impact dissolved oxygen levels, but it is uncertain what type of increase is necessary to create a positive impact. With the potential of increased flows to benefit water quality impacting headwater levels, UPPCO feels the agency consultation is essential to ensure the resource is being correctly allocated.

<u>UPPCO's Current Proposal</u>

Channel Forming Flow Releases from SLSB:
Regardless of the target elevation requirements for the license and the temporary amendment (if granted), UPPCO will release 150 cfs channel forming flows from the SLSB for a minimum of 72 hours during the peak of spring runoff. Releases can be made from the outlet, over the spillway, or a combination of both.

Start of Month Target Elevations:
The proposed start of month target elevations are displayed in the table below. The proposed changes from the current license are high-lighted in yellow.

	Silver Lake Storage Basin			Dead River Storage Basin		
	Min. Outflow (cfs)	Min. Elev. (ft)	Target Elev. (ft)	Min. Outflow (cfs)	Min. Elev. (ft)	Target Elev. (ft)
January	15	1477.5	1479.0	100	1337.5	1339.0
February	15	1477.0	1479.0	100	1337.0	1337.5
March	15	1477.0	1479.0	100	1337.0	1337.5
April	25	1477.0	1485.0	100	1337.0	1337.5
May	20	1478.5	1485.0	100	1339.0	1341.0
June	15	1480.5	1485.0	100	1339.0	1341.0
July	10	1480.0	1485.0	100	1339.5	1341.0
August	10	1479.0	1482.5	100	1339.5	1341.0
September	10	1479.0	1480.0	100	1339.5	1341.0
October	15	1479.0	1480.0	100	1339.5	1341.0
November	15	1478.5	1479.0	100	1339.5	1341.0
December	15	1478.5	1479.0	100	1338.5	1339.0

Minimum Reservoir Elevation:
UPPCO is not proposing to modify any minimum elevation requirements from the SLSB, DRSB and the MSB. This does not include changes that may need to be made as part of the dry year consultation process.

Planned Deviations:
UPPCO proposes to continue to consult with agencies (MDEQ, MDNR, and FWS) for concurrence prior to implementing any planned deviations.

Dry-Year Consultation:
UPPCO will continue to consult with MDEQ, MDNR, FWS, KBIC and DRCI to determine appropriate temporary modifications if minimum reservoir elevations cannot be maintained while releasing the minimum flows. The dry-year consultation will begin no later than the first business day following the day when the reservoir decreases below the minimum elevation due to inflow conditions.

Releases During July and August 2019:
Since the specific weather conditions for January through August 2019 are unknown, UPPCO proposes to consult with the MDNR, MDEQ and the FWS no later than July 1, 2019 and again no later than August 1, 2019 to agree on the specifics of flows to be released from SLSB and DRSB during July and August 2019. The focus of the discussions will be based upon improving water quality downstream of the DRSB and supporting recreation use of the DRSB.

UPPCO's current proposal will provide the following benefits:

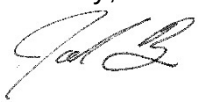
1) Avoids dewatering of hibernating herptiles by attempting to keep a constant reservoir elevation during the winter months (November 2018 to spring runoff 2019). The current license and the test period proposal allow for a 1.5 feet reduction during the month of January.
2) A reduction in elevation during late summer at the SLSB over a two-month long period as recommended by the MDEQ in their comments on the test period report.

3) Allows for steady reservoir elevation at the SLSB following spring runoff until July 1. This will benefit the spawning period of all fish in the SLSB including the bluegill spawning in June as recommended by the MDNR.
4) Minimizes the potential for dry-year consultations at SLSB and DRSB.
5) Increases the probability of spilling at the SLSB, which consequently supports spring channel forming flow releases downstream of the SLSB from 2.5% as currently written to 49.0% as currently proposed.
6) It will provide a greater probability for releasing channel forming flows from the SLSB during spring runoff as required in the Consent Judgment. Beyond the expiration of the Consent Judgment it will also increase the probability that passive channel forming flow releases will be made over the spillway.
7) It slightly reduces the probability of spilling at the DRSB from 36.8% as currently written to 31.9% under the current proposal and has the same potential of not reaching an elevation of 1341.0 feet NGVD at least once per year by June 1.
8) It will require UPPCO to release more water into the Dead River downstream of SLSB during the late summer months. This is believed to have a positive impact on water quality downstream through the DRSB.

As referenced above, please have you written comments submitted no later than December 11th to allow for a filing with the FERC by December 14th.

Thank you for your time and consideration.

Sincerely,



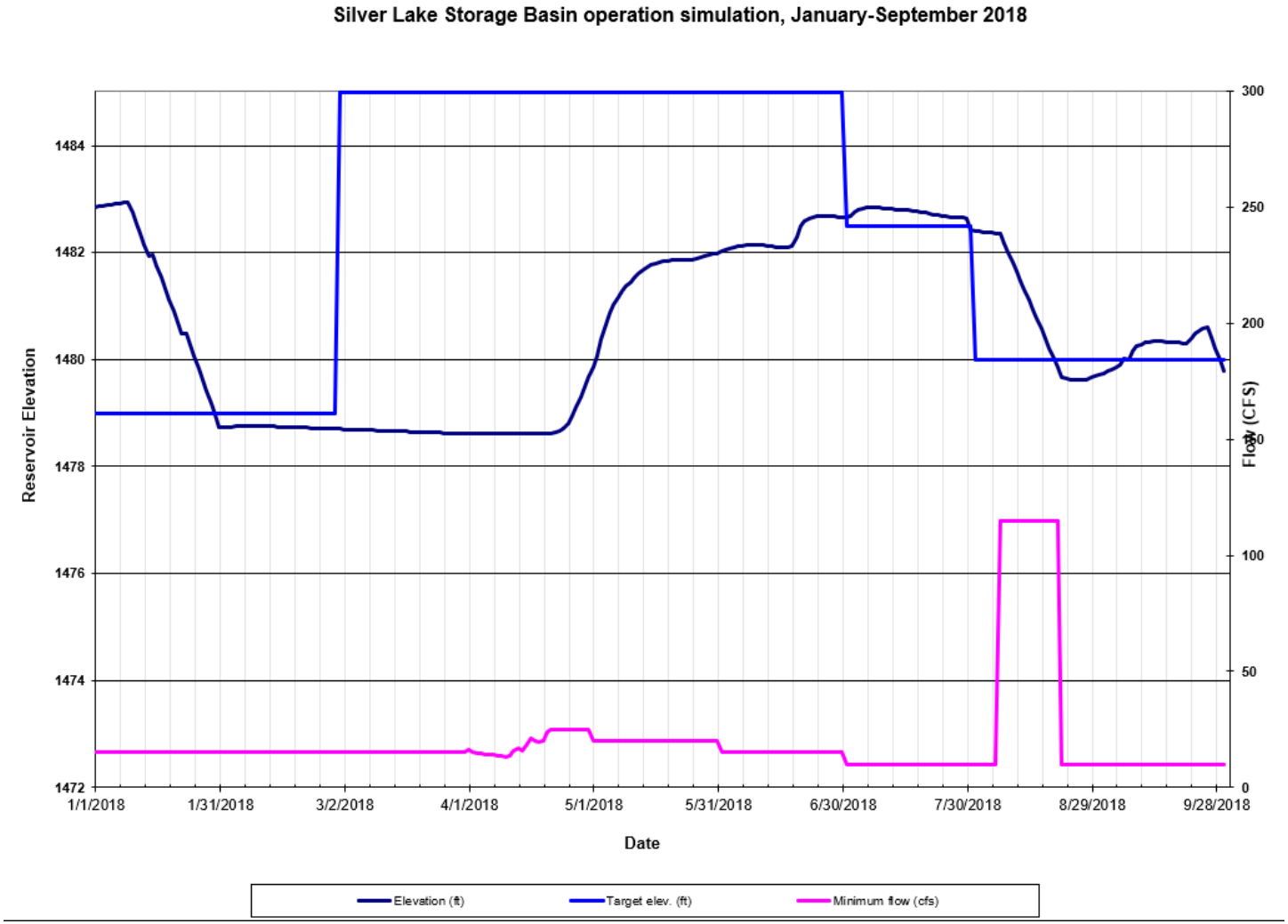
Josh Ball
Operations Supervisor – Eastern & Southern Hydro's

Encl: Appendix A – Additional Potential Operations Scenarios for 2018

cc: Mr. Mitch Koetje, MDEQ Mr. Virgil Schlorke, UPPCO Ms. Emily Rushford, UPPCO
Mr. Shawn Puzen, Mead & Hunt

Option 1: Provided in November 16, 2018 Request for Comments

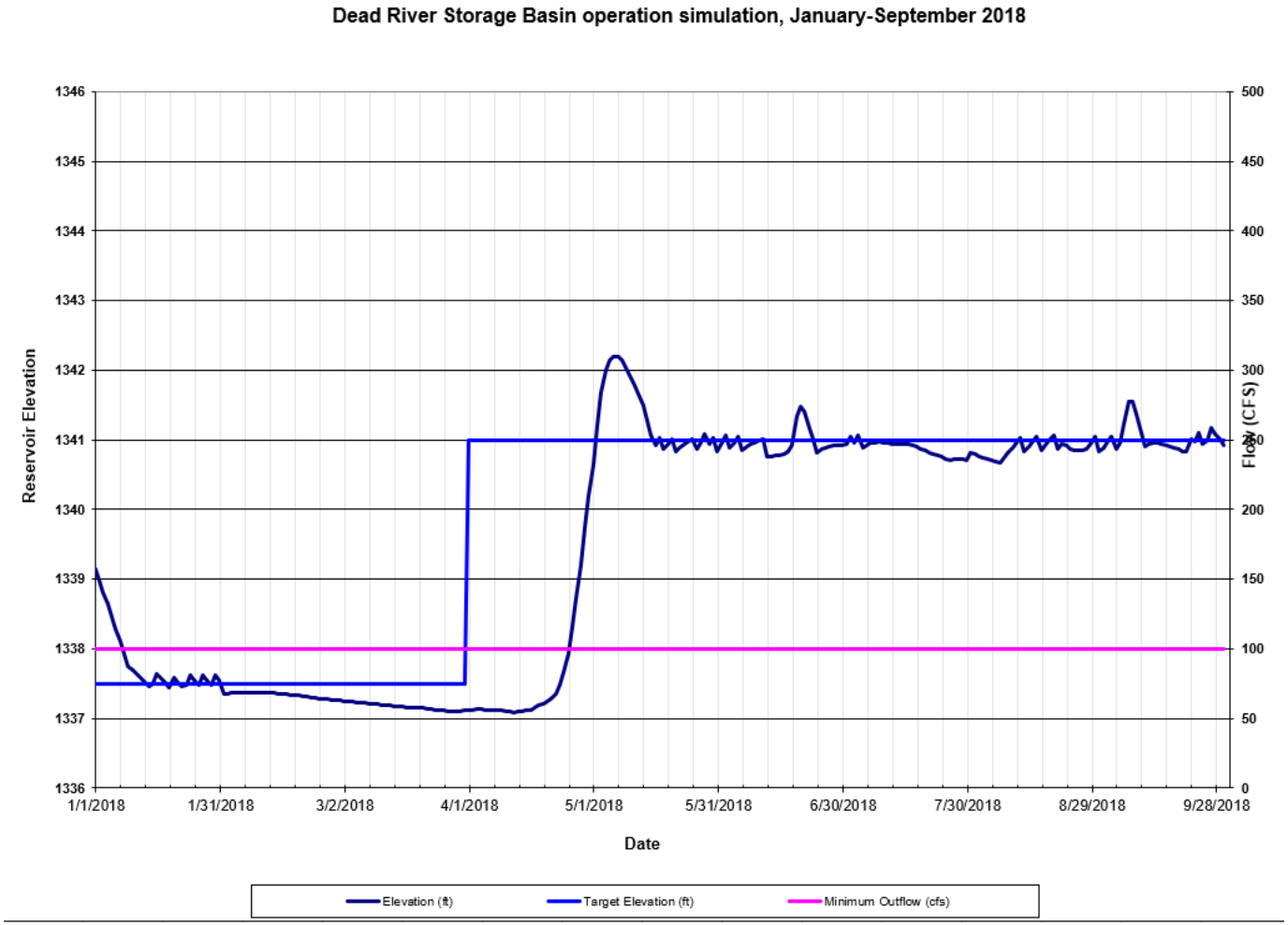
Option 2:
Shorter DO Deviation Period of August 7th to August 21st (2018)



Option 2: **115 cfs SLSB** release August 7th to 21st.

Option 1: Provided in November 16, 2018 Request for Comments

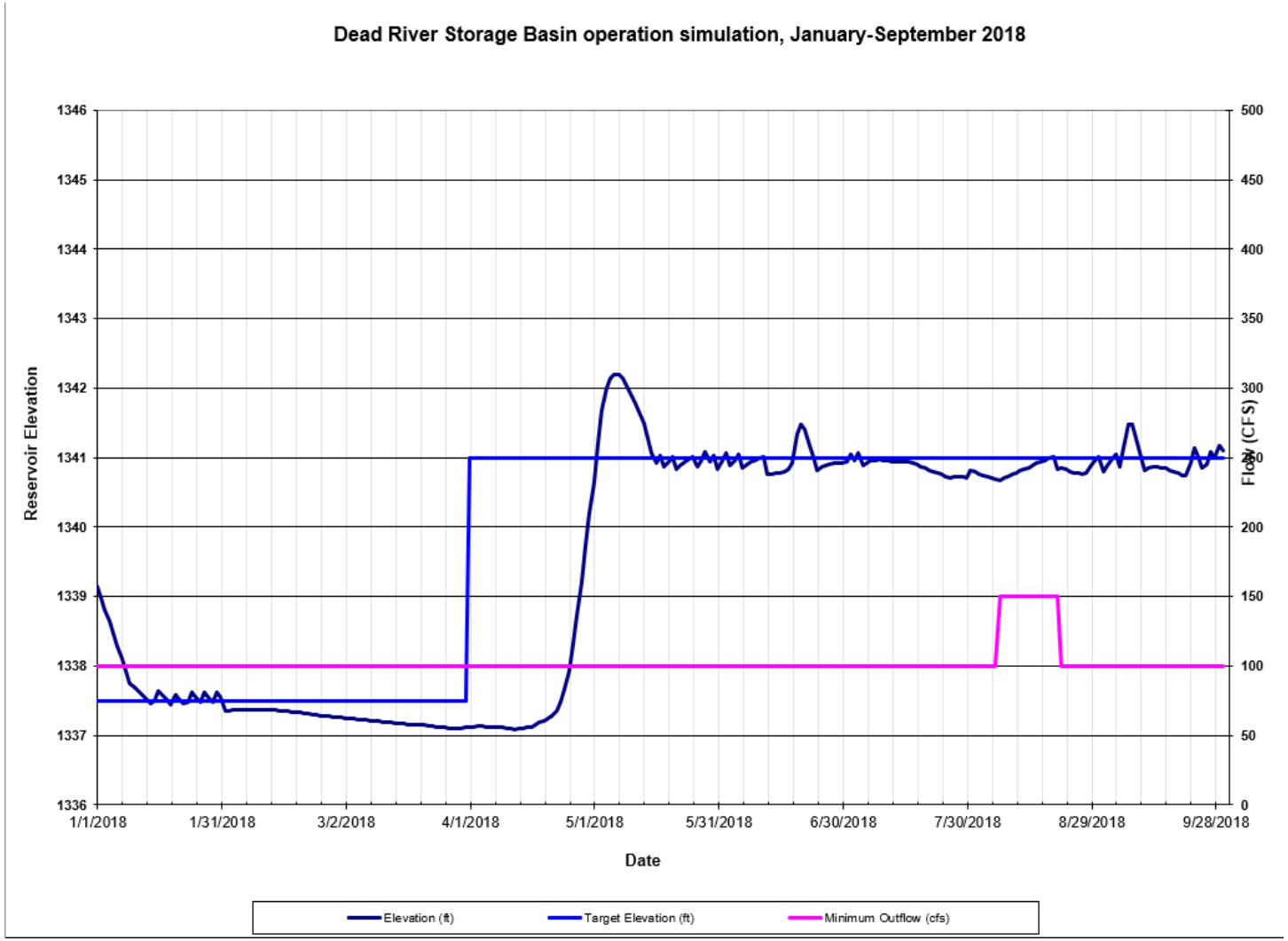
Option 2:
Shorter DO Deviation Period of August 7th to August 21st (2018)



Option 2a: **100 cfs** release from DRSB August 7th to August 21st. **Minimum 1340.7 at DRSB on August 7th.**

Option 1: Provided in November 16, 2018 Request for Comments

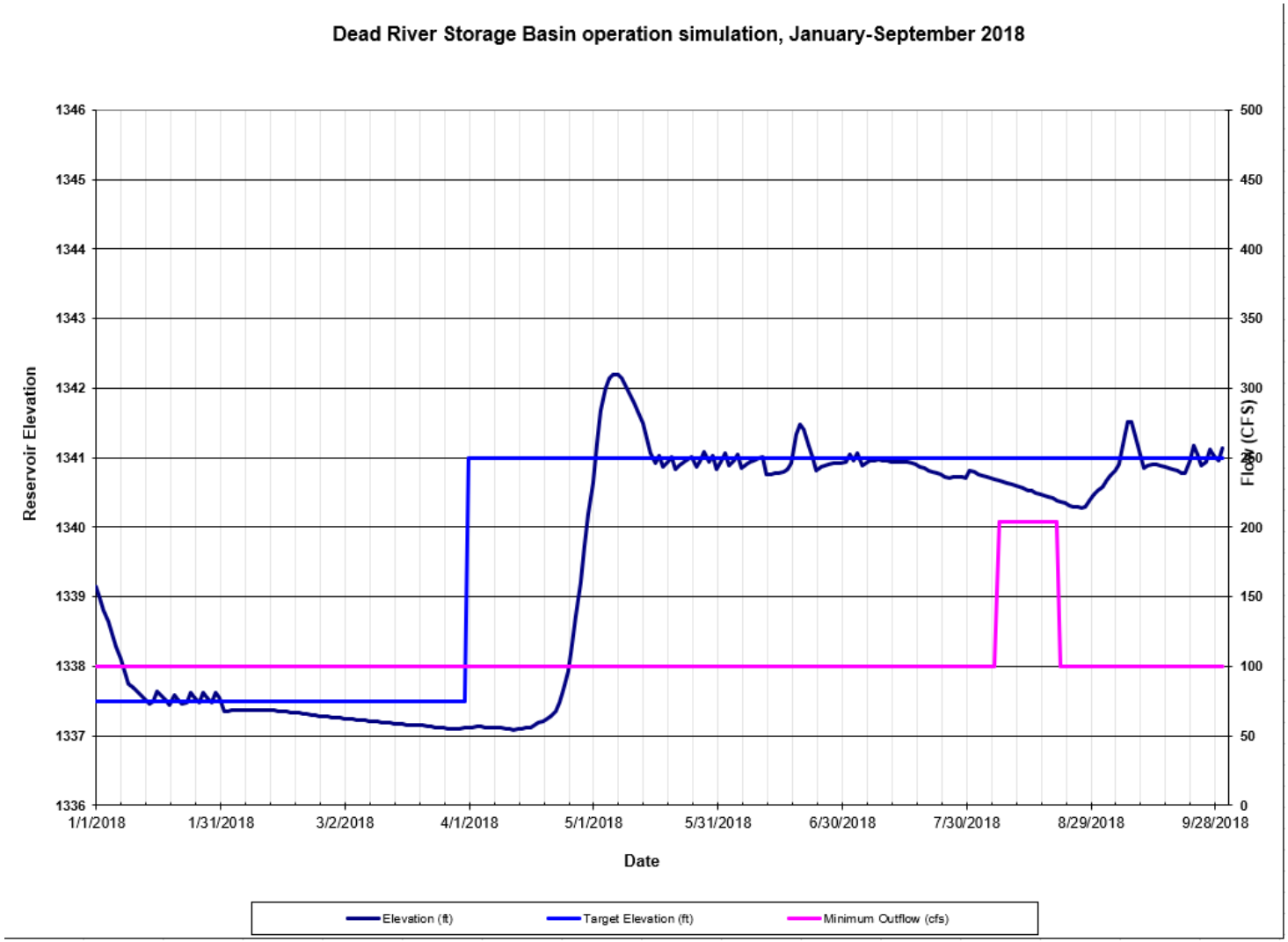
Option 2:
Shorter DO Deviation Period of August 7th to August 21st (2018)



Option 2b: **150 cfs** release from DRSB August 7th to August 21st. **Minimum 1340.7 at DRSB on August 7th.**

Option 1: Provided in November 16, 2018 Request for Comments

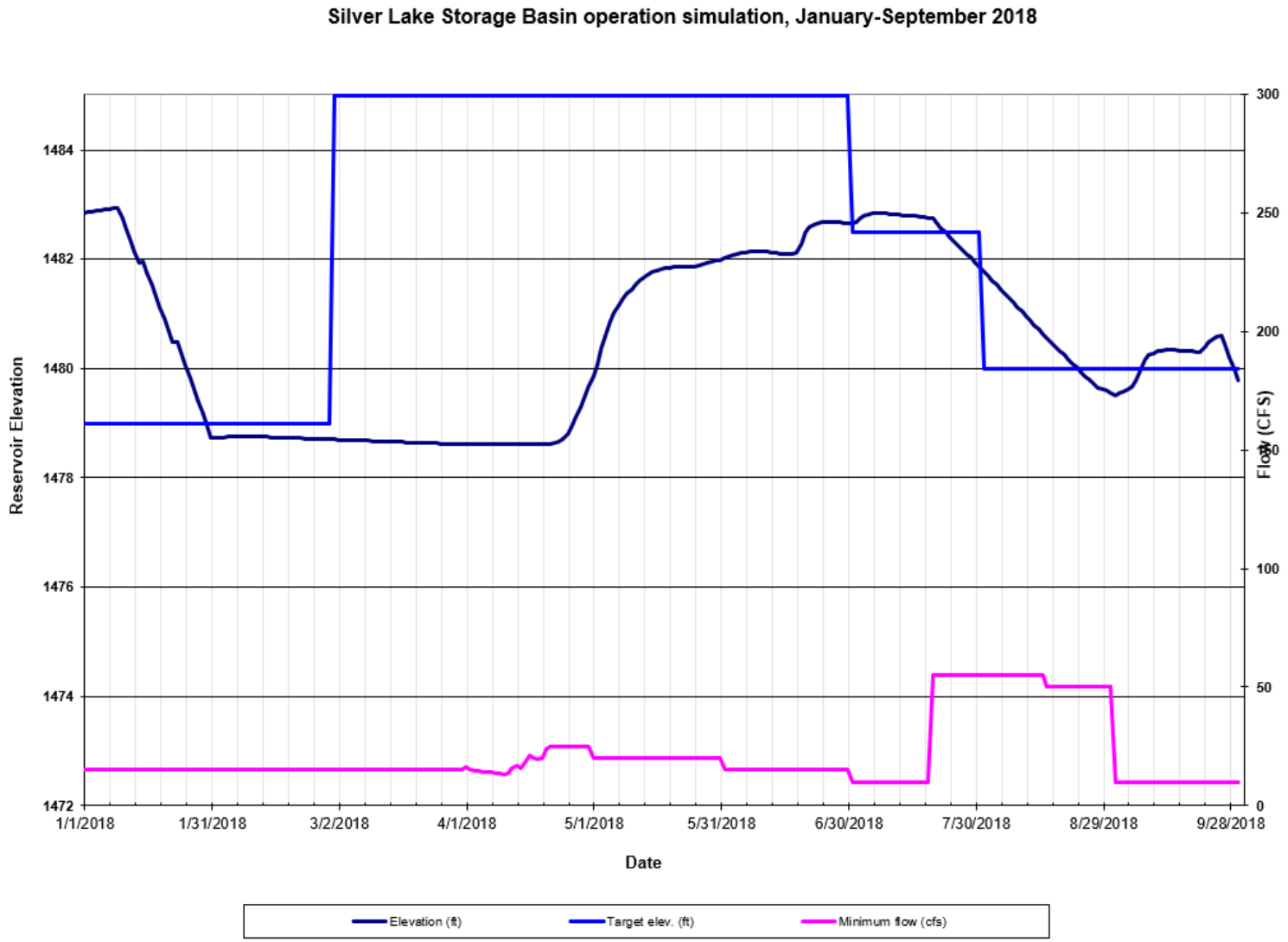
Option 2:
Shorter DO Deviation Period of August 7th to August 21st (2018)



Option 2c: **204 cfs** release from DRSB August 7th to August 21st. **Minimum 1340.3 at DRSB on August 28th**.

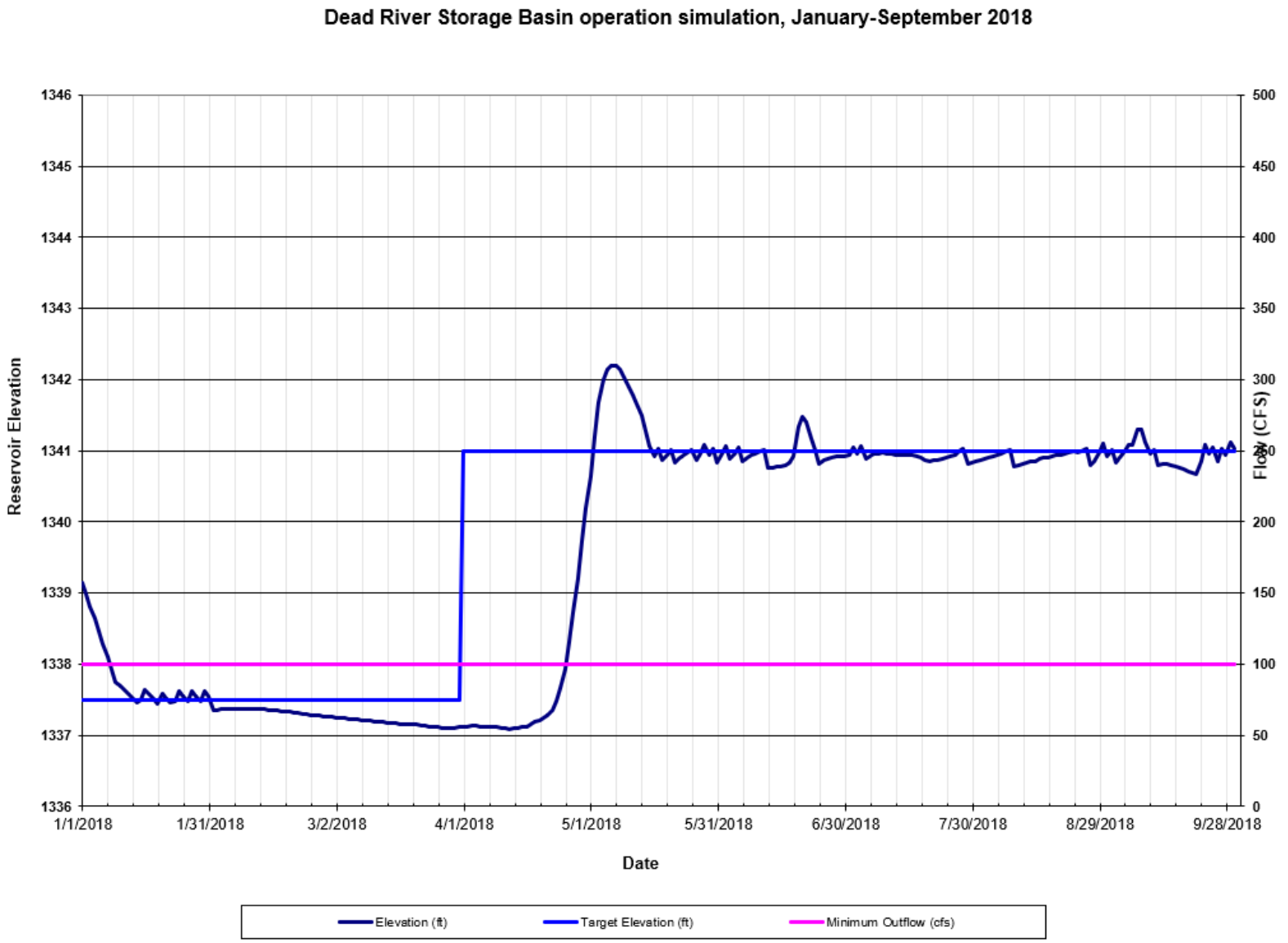
Option 3

Longer DO Deviation Period of July 20th to August 31st (2016)



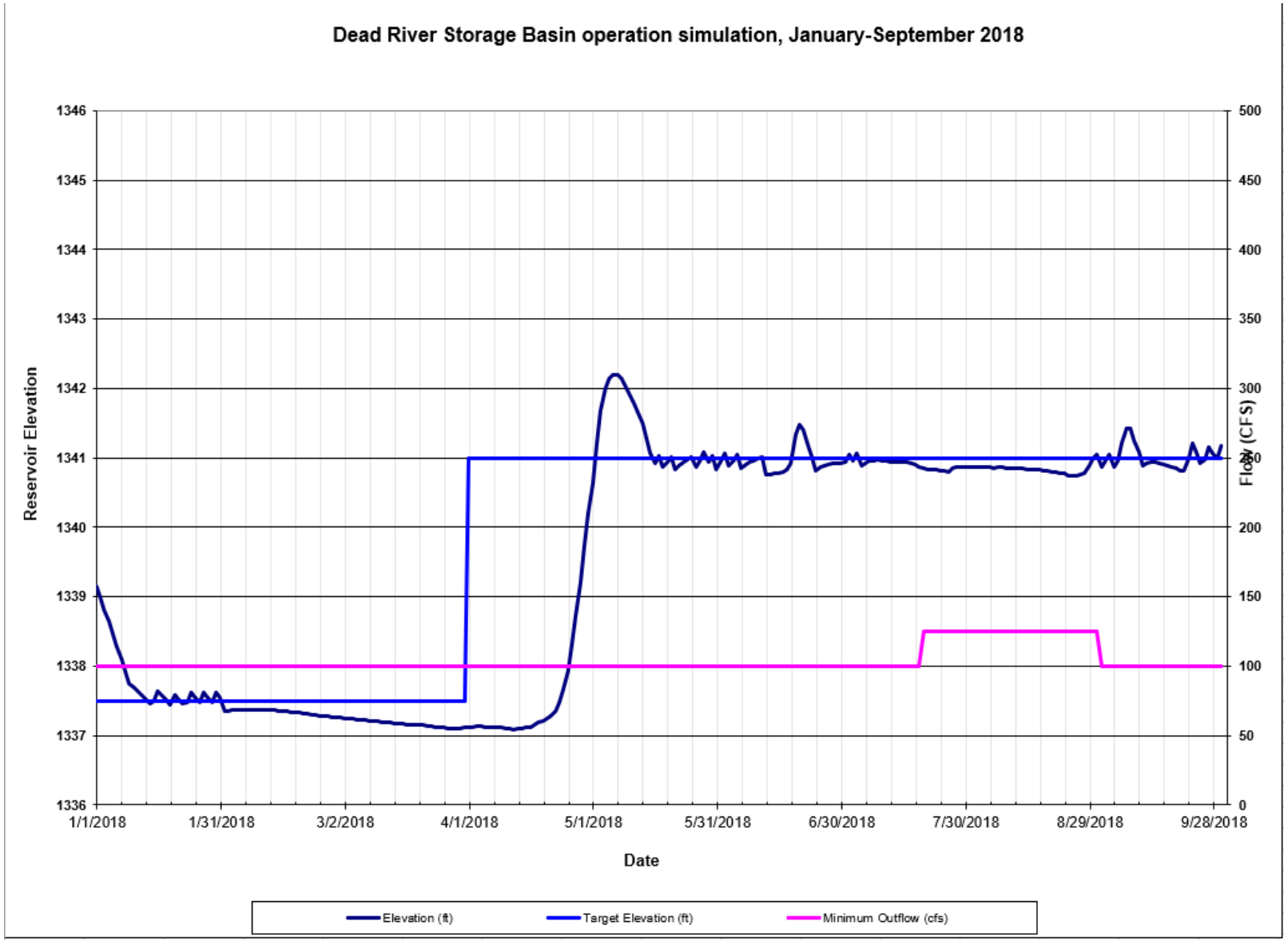
Option 3: **55 cfs** SLSB release **July 20th to August 15th** and **50 cfs** from **August 16th to August 31st**.

Option 3



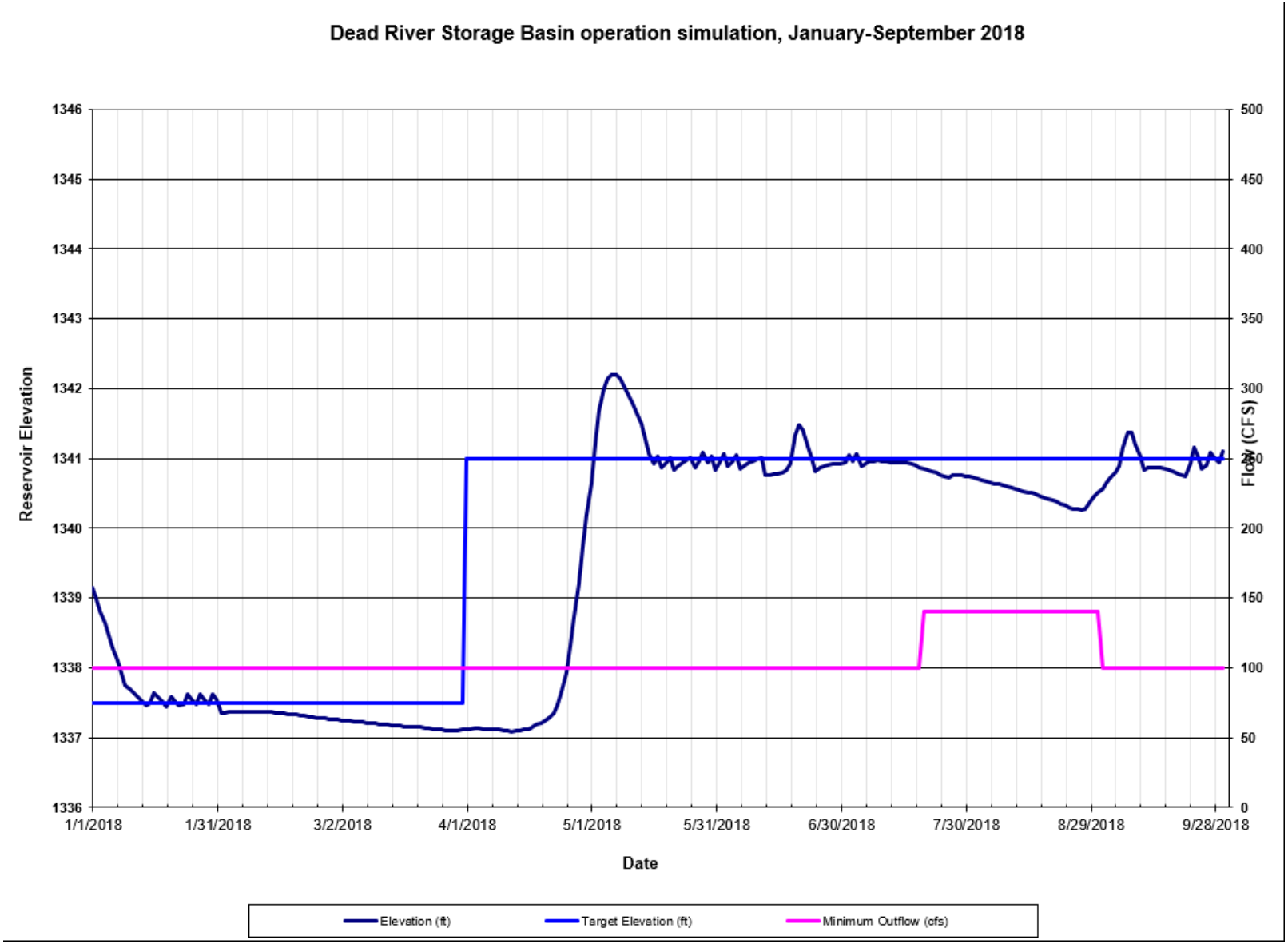
Option 3a: **100 cfs** release from **DRSB July 20th to August 31st. Minimum 1340.7 at DRSB on September 21st.**

Option 3



Option 3b: **125 cfs** release from **DRSB July 20th to August 31st**. **Minimum 1340.7 at DRSB on August 25th.**

Option 3



Option 3c: **140 cfs** release from **DRSB July 20th to August 31st**. **Minimum 1340.3 at DRSB on August 27th**.

2018 Season Comparison

Month	Total Precip.	Deviation	Average Temperature	Deviation
April	2.04	+1.15	31.1	-7.8
May	1.14	+0.19	51.0	+1.1
June	2.57	+1.43	56.8	-2.5
July	1.08	+0.03	67.7	+1.8
August	1.68	-0.35	66.4	+1.3

2015-2018 July and August WQ Comparison

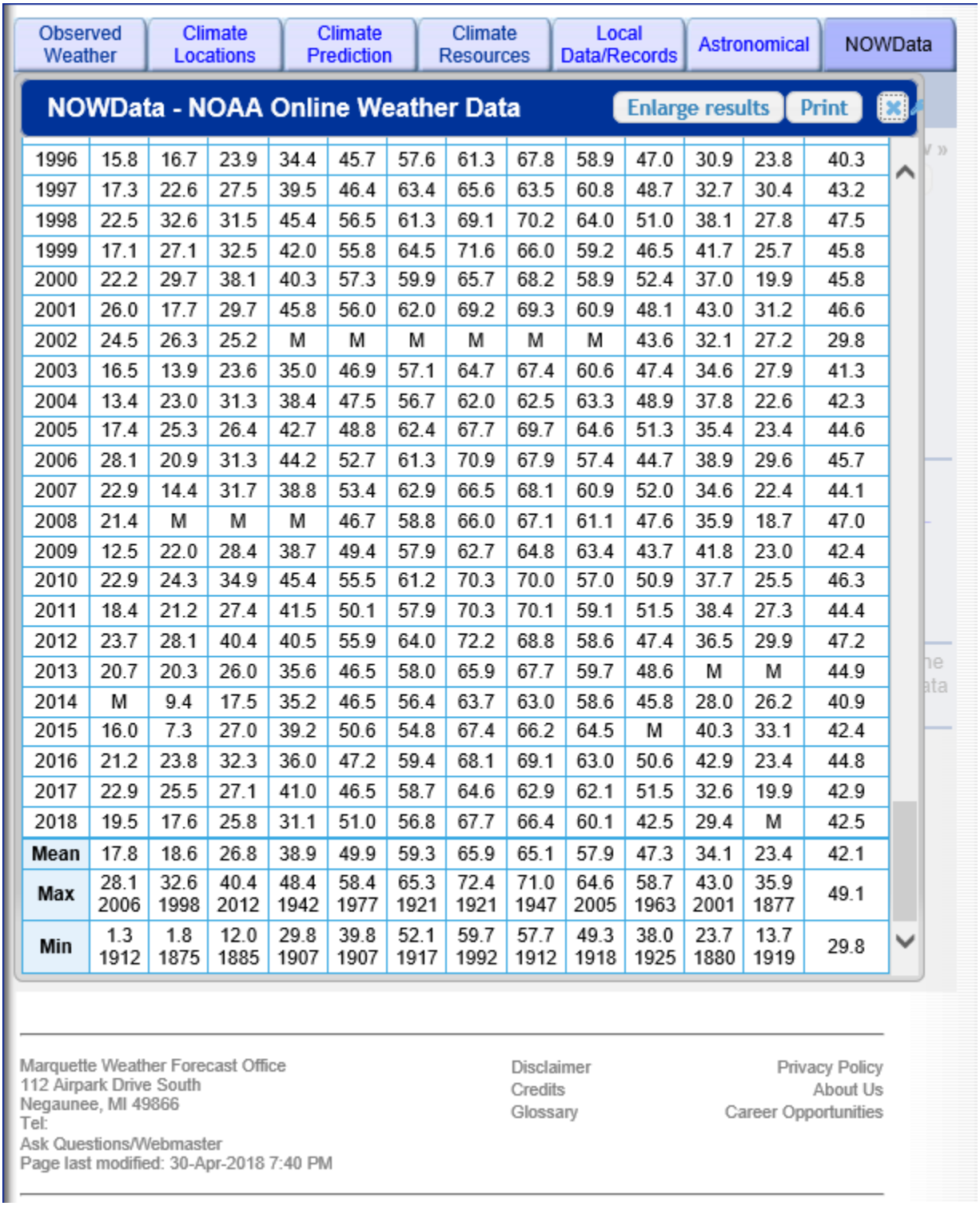
Year	Dissolved Oxygen Periods (Average daily reading below 7.5 mg/l)		Ave monthly temp deviation in degrees F	Ave monthly temp deviation in degrees F	Temperature Periods (Average Daily water temperature readings greater than 67.5 F)	
	July	August	July	August	July	August
2015	10th to 22nd 25th to 30th	15th to 20th	+1.5	+1.1	18th to 31st	1st to 24th
2016	20th to 25th 27th to 29th	6thth to 21st 24th to 25th 27th to 28th	+2.2	+4.0	1st to 2nd 4th to 31st	1st to 31st
2017[1]	12th to 13th 21st to 30th	6th to 7th 11th to 12th 13th to 18th	-1.3	-2.2	7th to 11th 18th to 31st	1st to 11th 21st to 23rd
2018	None	7th to 21st	+1.8	+1.3	1st to 31st	1st to 31st

Temperature record beginning in 1860 for Marquette, MINWS Forecast Office

[1] 2017 data for DO is not believed to be representative because of lack of post-calibration procedure.

2018 Season Comparison

Data for calculation of temperature deviations from mean (1875-2018)



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1996	15.8	16.7	23.9	34.4	45.7	57.6	61.3	67.8	58.9	47.0	30.9	23.8	40.3
1997	17.3	22.6	27.5	39.5	46.4	63.4	65.6	63.5	60.8	48.7	32.7	30.4	43.2
1998	22.5	32.6	31.5	45.4	56.5	61.3	69.1	70.2	64.0	51.0	38.1	27.8	47.5
1999	17.1	27.1	32.5	42.0	55.8	64.5	71.6	66.0	59.2	46.5	41.7	25.7	45.8
2000	22.2	29.7	38.1	40.3	57.3	59.9	65.7	68.2	58.9	52.4	37.0	19.9	45.8
2001	26.0	17.7	29.7	45.8	56.0	62.0	69.2	69.3	60.9	48.1	43.0	31.2	46.6
2002	24.5	26.3	25.2	M	M	M	M	M	M	43.6	32.1	27.2	29.8
2003	16.5	13.9	23.6	35.0	46.9	57.1	64.7	67.4	60.6	47.4	34.6	27.9	41.3
2004	13.4	23.0	31.3	38.4	47.5	56.7	62.0	62.5	63.3	48.9	37.8	22.6	42.3
2005	17.4	25.3	26.4	42.7	48.8	62.4	67.7	69.7	64.6	51.3	35.4	23.4	44.6
2006	28.1	20.9	31.3	44.2	52.7	61.3	70.9	67.9	57.4	44.7	38.9	29.6	45.7
2007	22.9	14.4	31.7	38.8	53.4	62.9	66.5	68.1	60.9	52.0	34.6	22.4	44.1
2008	21.4	M	M	M	46.7	58.8	66.0	67.1	61.1	47.6	35.9	18.7	47.0
2009	12.5	22.0	28.4	38.7	49.4	57.9	62.7	64.8	63.4	43.7	41.8	23.0	42.4
2010	22.9	24.3	34.9	45.4	55.5	61.2	70.3	70.0	57.0	50.9	37.7	25.5	46.3
2011	18.4	21.2	27.4	41.5	50.1	57.9	70.3	70.1	59.1	51.5	38.4	27.3	44.4
2012	23.7	28.1	40.4	40.5	55.9	64.0	72.2	68.8	58.6	47.4	36.5	29.9	47.2
2013	20.7	20.3	26.0	35.6	46.5	58.0	65.9	67.7	59.7	48.6	M	M	44.9
2014	M	9.4	17.5	35.2	46.5	56.4	63.7	63.0	58.6	45.8	28.0	26.2	40.9
2015	16.0	7.3	27.0	39.2	50.6	54.8	67.4	66.2	64.5	M	40.3	33.1	42.4
2016	21.2	23.8	32.3	36.0	47.2	59.4	68.1	69.1	63.0	50.6	42.9	23.4	44.8
2017	22.9	25.5	27.1	41.0	46.5	58.7	64.6	62.9	62.1	51.5	32.6	19.9	42.9
2018	19.5	17.6	25.8	31.1	51.0	56.8	67.7	66.4	60.1	42.5	29.4	M	42.5
Mean	17.8	18.6	26.8	38.9	49.9	59.3	65.9	65.1	57.9	47.3	34.1	23.4	42.1
Max	28.1 2006	32.6 1998	40.4 2012	48.4 1942	58.4 1977	65.3 1921	72.4 1921	71.0 1947	64.6 2005	58.7 1963	43.0 2001	35.9 1877	49.1
Min	1.3 1912	1.8 1875	12.0 1885	29.8 1907	39.8 1907	52.1 1917	59.7 1992	57.7 1912	49.3 1918	38.0 1925	23.7 1880	13.7 1919	29.8

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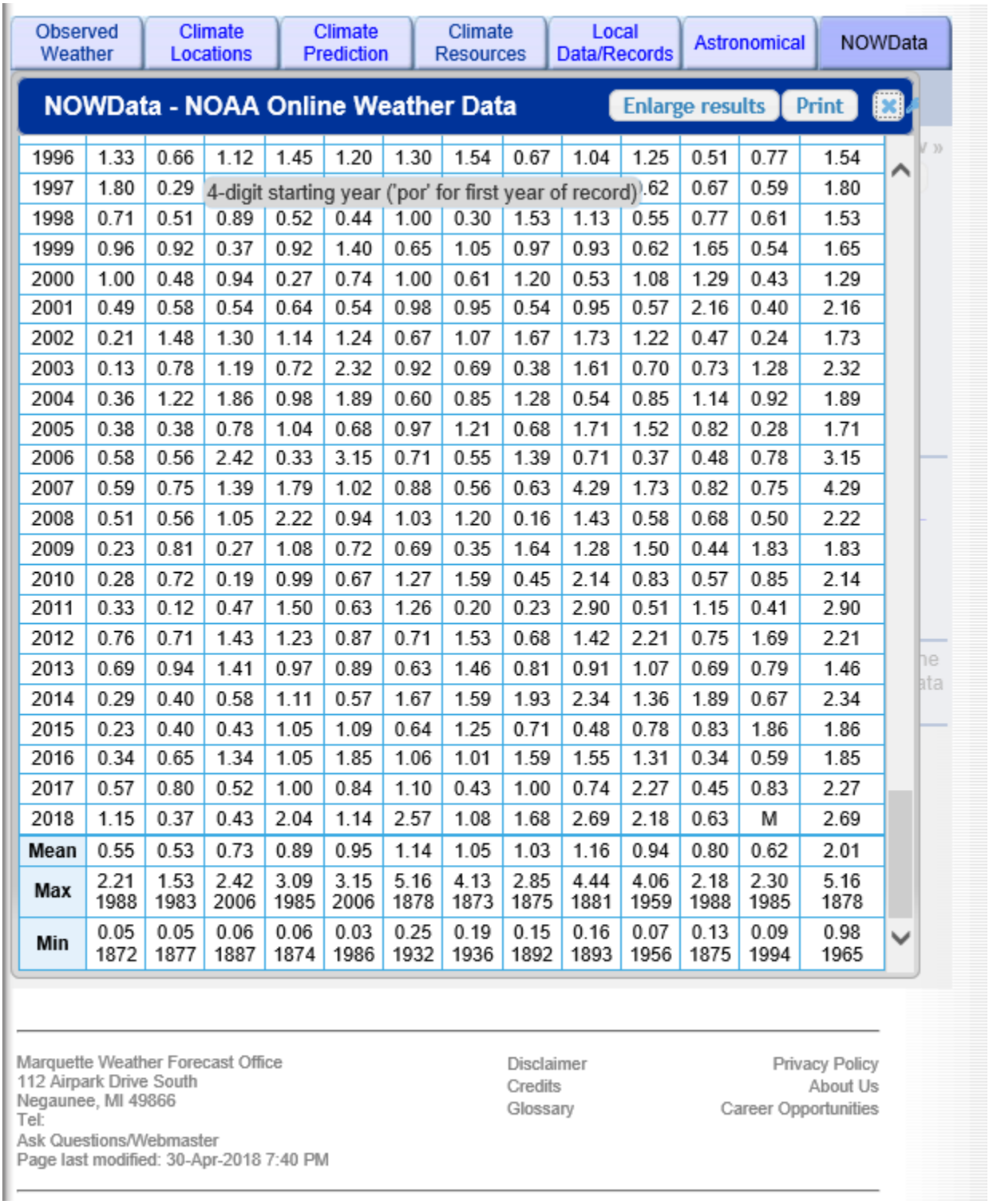
2018 Season Comparison

Data for calculation of precipitation deviations from mean (1871-2018)



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4-digit starting year ('por' for first year of record)

1996	1.33	0.66	1.12	1.45	1.20	1.30	1.54	0.67	1.04	1.25	0.51	0.77	1.54
1997	1.80	0.29								.62	0.67	0.59	1.80
1998	0.71	0.51	0.89	0.52	0.44	1.00	0.30	1.53	1.13	0.55	0.77	0.61	1.53
1999	0.96	0.92	0.37	0.92	1.40	0.65	1.05	0.97	0.93	0.62	1.65	0.54	1.65
2000	1.00	0.48	0.94	0.27	0.74	1.00	0.61	1.20	0.53	1.08	1.29	0.43	1.29
2001	0.49	0.58	0.54	0.64	0.54	0.98	0.95	0.54	0.95	0.57	2.16	0.40	2.16
2002	0.21	1.48	1.30	1.14	1.24	0.67	1.07	1.67	1.73	1.22	0.47	0.24	1.73
2003	0.13	0.78	1.19	0.72	2.32	0.92	0.69	0.38	1.61	0.70	0.73	1.28	2.32
2004	0.36	1.22	1.86	0.98	1.89	0.60	0.85	1.28	0.54	0.85	1.14	0.92	1.89
2005	0.38	0.38	0.78	1.04	0.68	0.97	1.21	0.68	1.71	1.52	0.82	0.28	1.71
2006	0.58	0.56	2.42	0.33	3.15	0.71	0.55	1.39	0.71	0.37	0.48	0.78	3.15
2007	0.59	0.75	1.39	1.79	1.02	0.88	0.56	0.63	4.29	1.73	0.82	0.75	4.29
2008	0.51	0.56	1.05	2.22	0.94	1.03	1.20	0.16	1.43	0.58	0.68	0.50	2.22
2009	0.23	0.81	0.27	1.08	0.72	0.69	0.35	1.64	1.28	1.50	0.44	1.83	1.83
2010	0.28	0.72	0.19	0.99	0.67	1.27	1.59	0.45	2.14	0.83	0.57	0.85	2.14
2011	0.33	0.12	0.47	1.50	0.63	1.26	0.20	0.23	2.90	0.51	1.15	0.41	2.90
2012	0.76	0.71	1.43	1.23	0.87	0.71	1.53	0.68	1.42	2.21	0.75	1.69	2.21
2013	0.69	0.94	1.41	0.97	0.89	0.63	1.46	0.81	0.91	1.07	0.69	0.79	1.46
2014	0.29	0.40	0.58	1.11	0.57	1.67	1.59	1.93	2.34	1.36	1.89	0.67	2.34
2015	0.23	0.40	0.43	1.05	1.09	0.64	1.25	0.71	0.48	0.78	0.83	1.86	1.86
2016	0.34	0.65	1.34	1.05	1.85	1.06	1.01	1.59	1.55	1.31	0.34	0.59	1.85
2017	0.57	0.80	0.52	1.00	0.84	1.10	0.43	1.00	0.74	2.27	0.45	0.83	2.27
2018	1.15	0.37	0.43	2.04	1.14	2.57	1.08	1.68	2.69	2.18	0.63	M	2.69
Mean	0.55	0.53	0.73	0.89	0.95	1.14	1.05	1.03	1.16	0.94	0.80	0.62	2.01
Max	2.21 1988	1.53 1983	2.42 2006	3.09 1985	3.15 2006	5.16 1878	4.13 1873	2.85 1875	4.44 1881	4.06 1959	2.18 1988	2.30 1985	5.16 1878
Min	0.05 1872	0.05 1877	0.06 1887	0.06 1874	0.03 1986	0.25 1932	0.19 1936	0.15 1892	0.16 1893	0.07 1956	0.13 1875	0.09 1994	0.98 1965

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