

RECLAMATION

Managing Water in the West

Bighorn Lake/Yellowtail Dam Operations

November 7, 2013

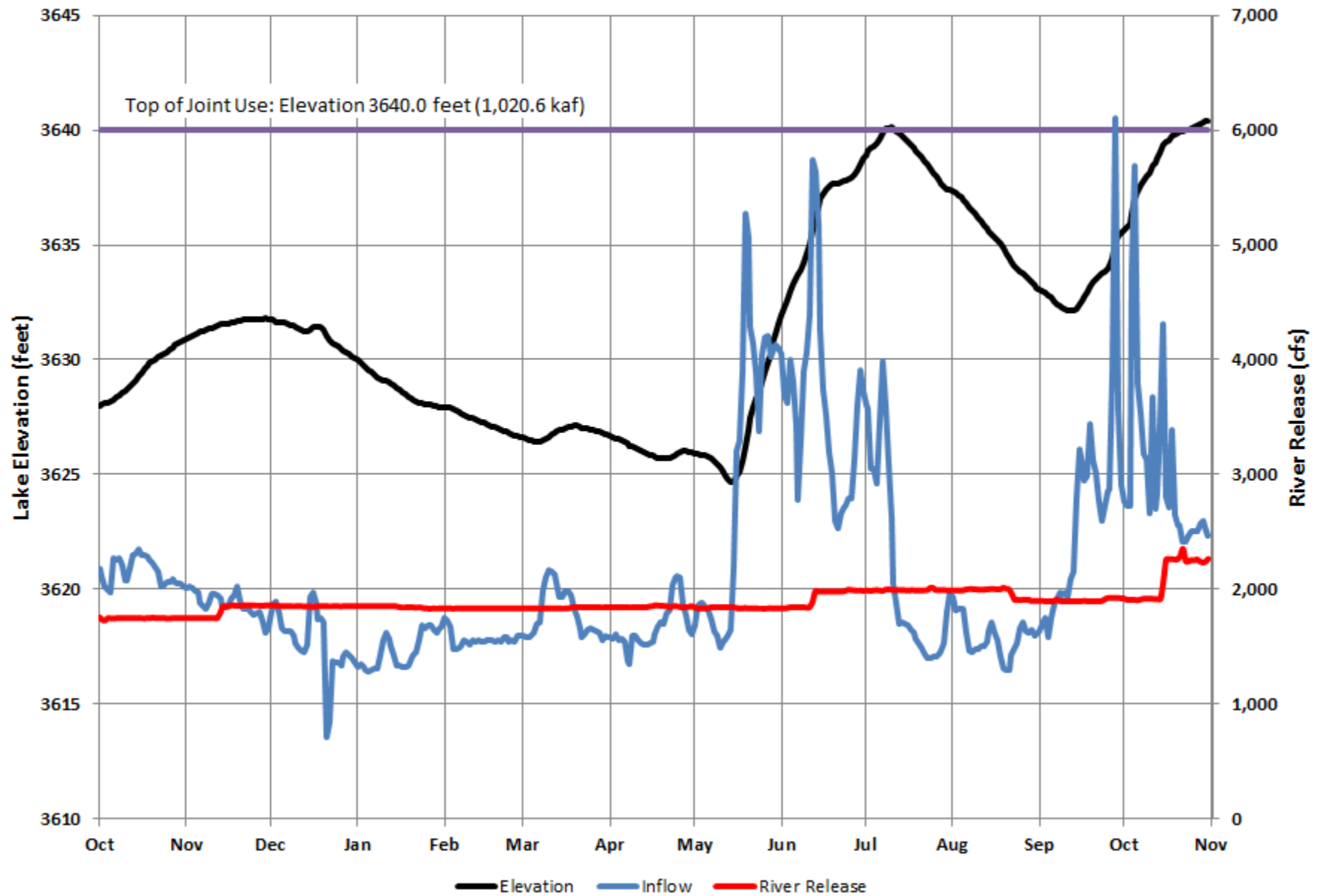


U.S. Department of the Interior
Bureau of Reclamation

Water Year 2013 Review

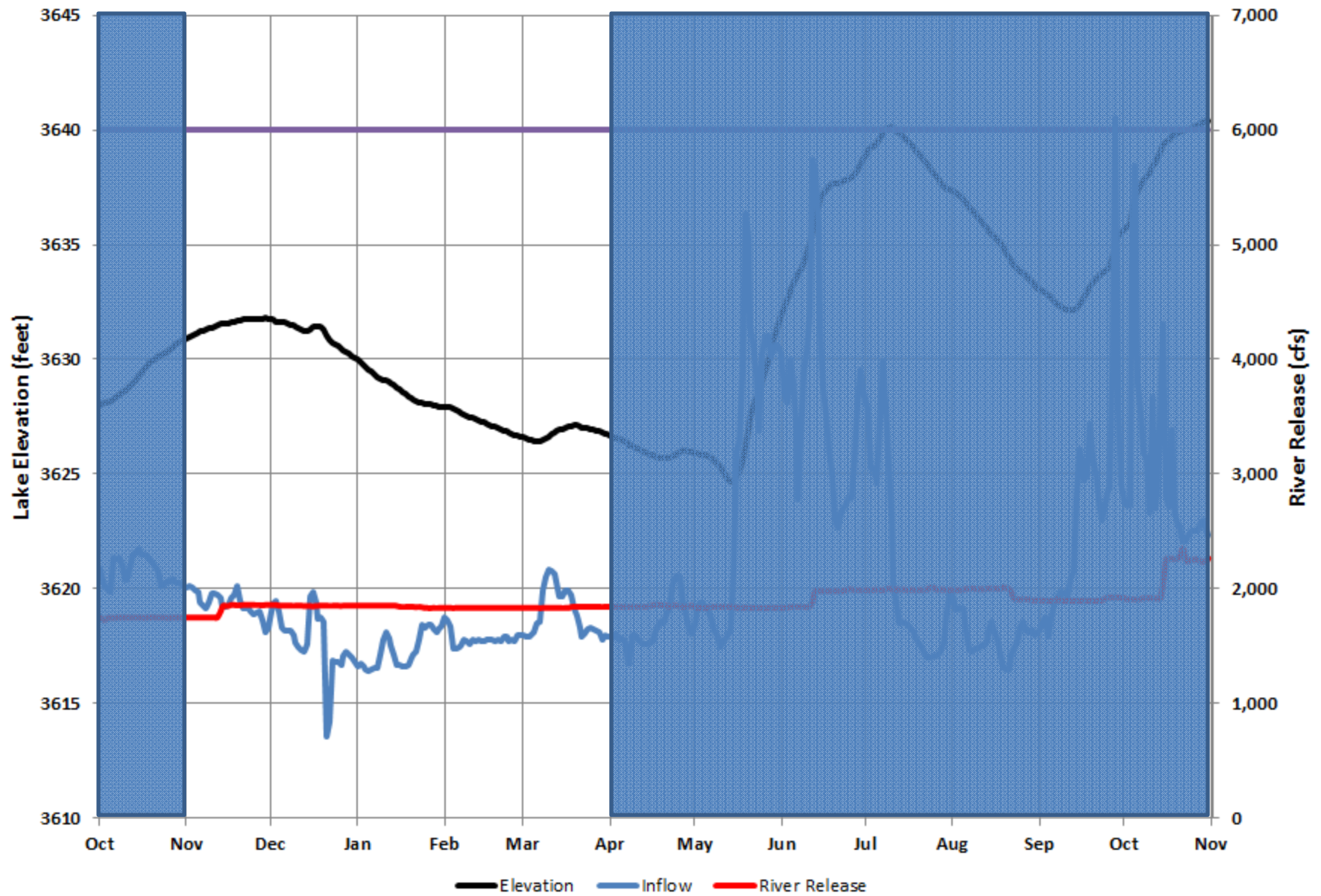
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Bighorn Lake Operations 2013



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Bighorn Lake Operations 2013



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Recap of Fall and Winter 2012/2013

2013 NOVEMBER - MARCH
Bighorn Lake River Release Rate

A ENTER Bighorn Lake Apr-Oct Gain in Acre-feet	B CALCULATED Nov-Mar Forecasted Gain Acre-feet	C ENTER Bighorn Lake Oct. 31 Storage AF	D ENTER Buffalo Bill Nov-Mar Release CFS	E ENTER Boysen Res Nov-Mar Release CFS	F End of March Bighorn Lake Stor. Target acre-feet (2007 AC Table)	G CALCULATED Release to Afterbay CFS	H CALCULATED River Release From Afterbay CFS	I 31-Mar-10 Reservoir Level Target	Month	Gain
-61,370	213,503	919,225	205	500	794,613	1834	1904	3615.0	April	35.04
Min Probable	178,503								May	13.53
Max Probable	248,503								June	23.74
									July	-95.77
									August	-78.76
									September	-18.77
									October	59.62
									Total	-61.37

Directions: Enter appropriate values in the Yellow Cells: A10, C10, D10, & E10.
Bighorn Lake River Release for Nov. - Mar. is calculated in cell H10 and the end of March target elevatio is displayed in I10.

$B = .145 \cdot A + 222402$ $R^2 = .6756$ Forecasted Gain

F = Desired end of March Storage

G is determined from calculations in J through L with Checks in M

H = Dam Release (G) + 70 cfs

Forecasted Gain Adjustments

	Elevation	Sotrage
1500-2000 cfs	3615	794,613
2000-2500 cfs	3617	807,921
> 2500 cfs	3619	821,949

Intermediate Calculations for River Release			
J CALCULATED Step One Release CFS >2500	K CALCULATED Step Two Release CFS 2000-2500	L CALCULATED Step Three Release CFS 1500-2000	M Check Results & Adjust Release CFS
1813	1859	1904	1859
1813	1859	1500	1859
	2000	1500	1904
			1904

	K End of March Reservoir Elev. Target	L End of March Reservoir Storage Target
If J > 2500 than set to J	3617.0	807,921
If K < 2500 than set to K	3617.0	807,921
If L < 2000 Then set to L	3615.0	794,613
If L < 1500 then set to 1500	3615.0	794,613

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Recap of Fall and Winter 2012/2013

STEP 1

- 2012 April-October Gain = -61,400 acre-feet
- Calculated November-March Gain = 213,500 af
- Upstream Reservoir Fall & Winter Releases =
 - Boysen = 500 cfs
 - Buffalo Bill = 205 cfs
- 2012 End-of-October Storage = 919,225 acre-feet
- Projected End-of-March Target Elevation = 3617
- Calculated Fall & Winter Release for Yellowtail:
River = 1,859 cfs

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Recap of Fall and Winter 2012/2013

STEP 2

- Since Calculated Fall & Winter Release is $< 2,000$ cfs
- Set End-of-March target elevation @ 3615
- Calculated New Fall & Winter Release for Yellowtail:
River = 1,904 cfs

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Recap of Fall and Winter 2012/2013

November through March Operations

GAINS:

Forecast on November 1, 2012: 213.5 kaf

Actual November-March Gains: 281.5 kaf

TOTAL INFLOW:

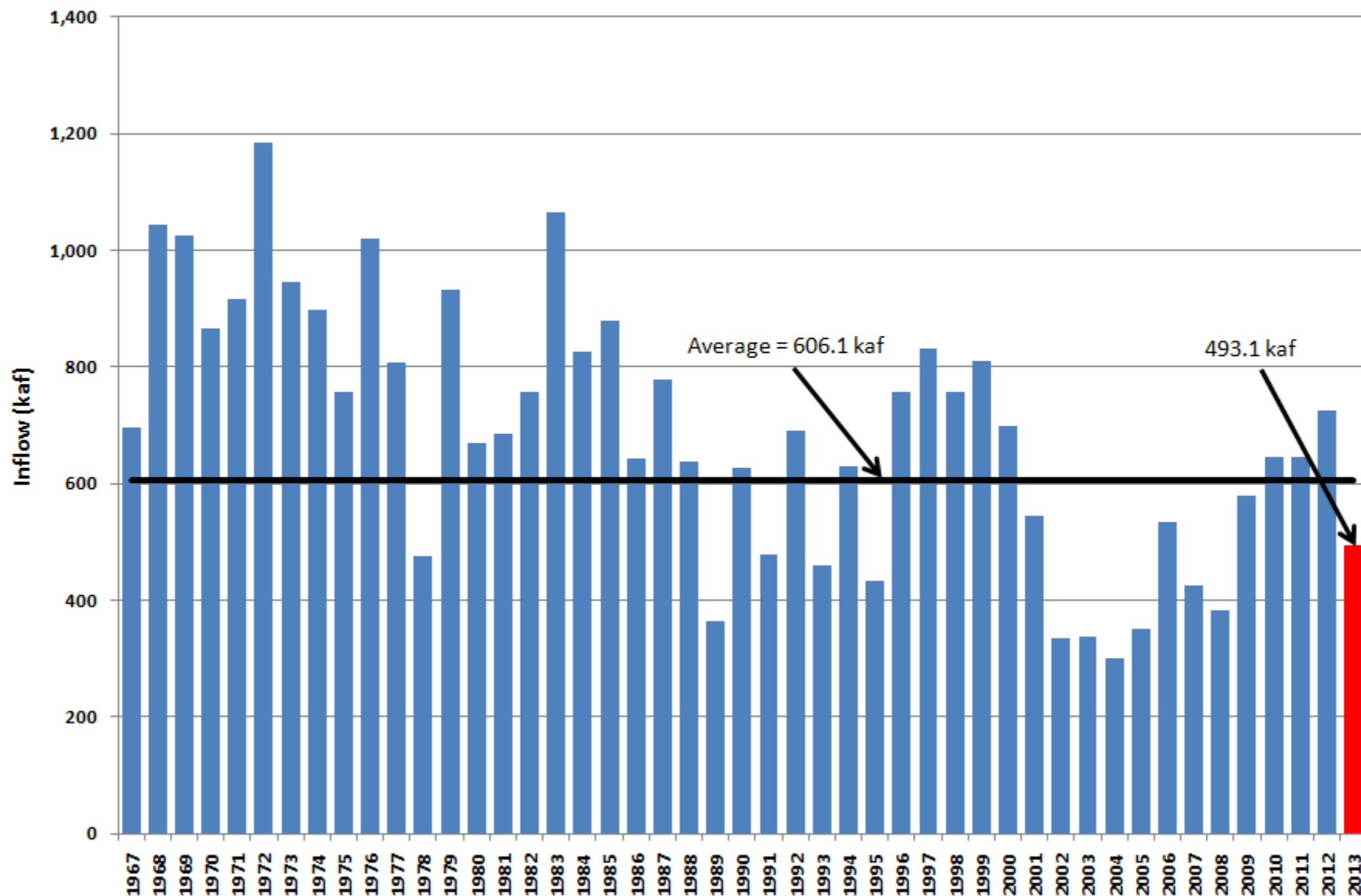
Forecast on November 1, 2012: 425.1 kaf

Actual November-March Inflows: 493.1 kaf

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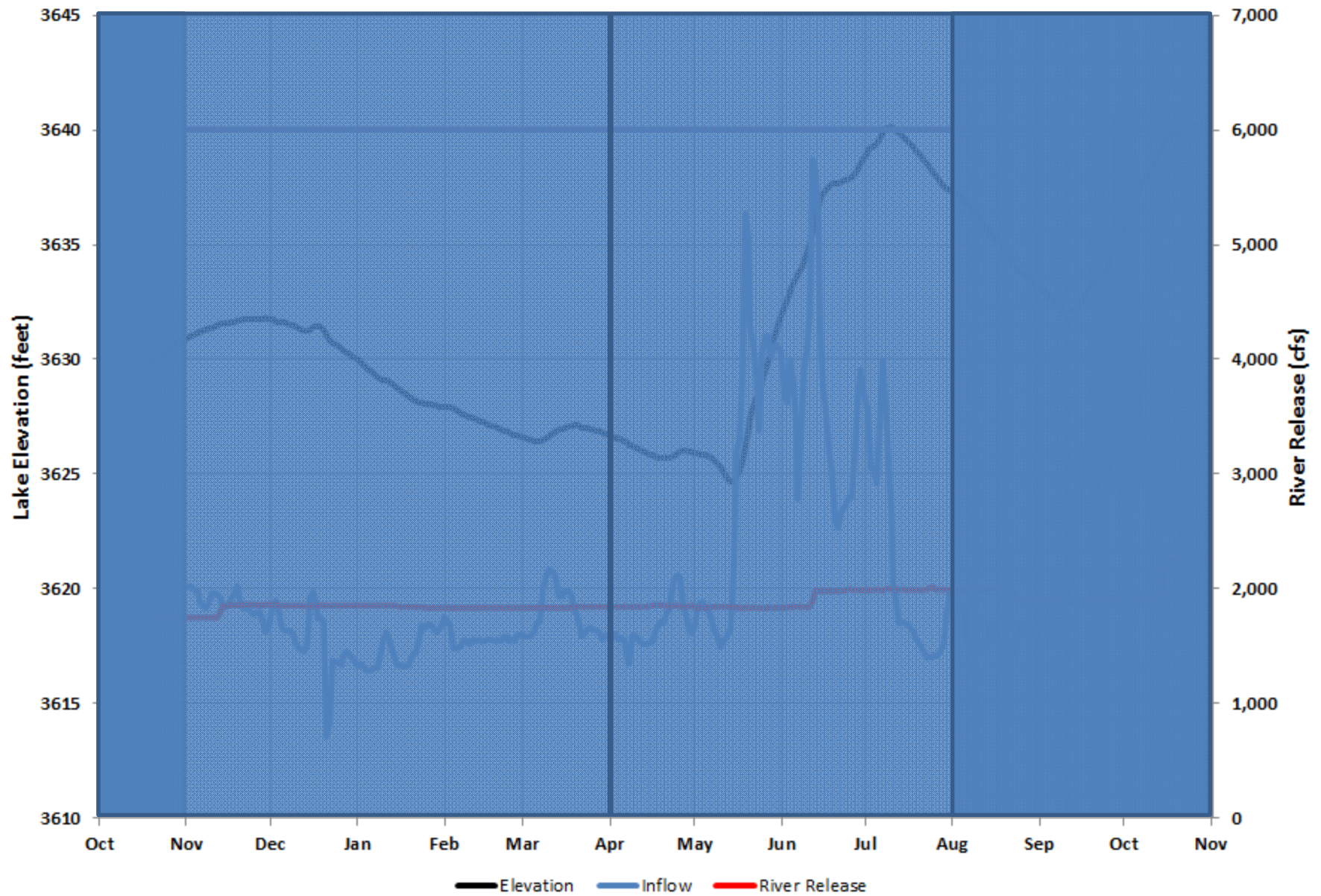
Bighorn Lake November through March Inflow

Period of Record 1967-2013



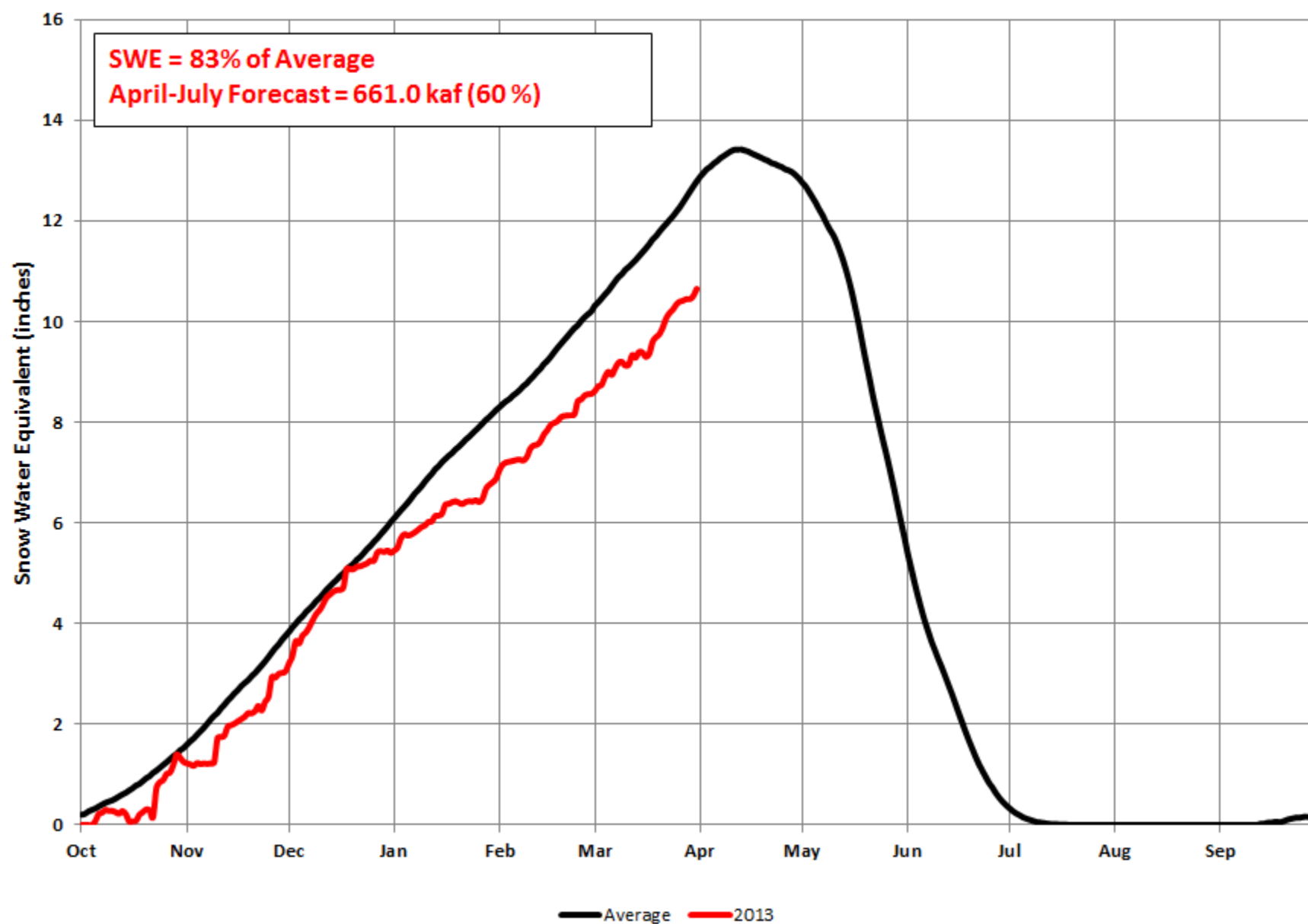
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Bighorn Lake Operations 2013



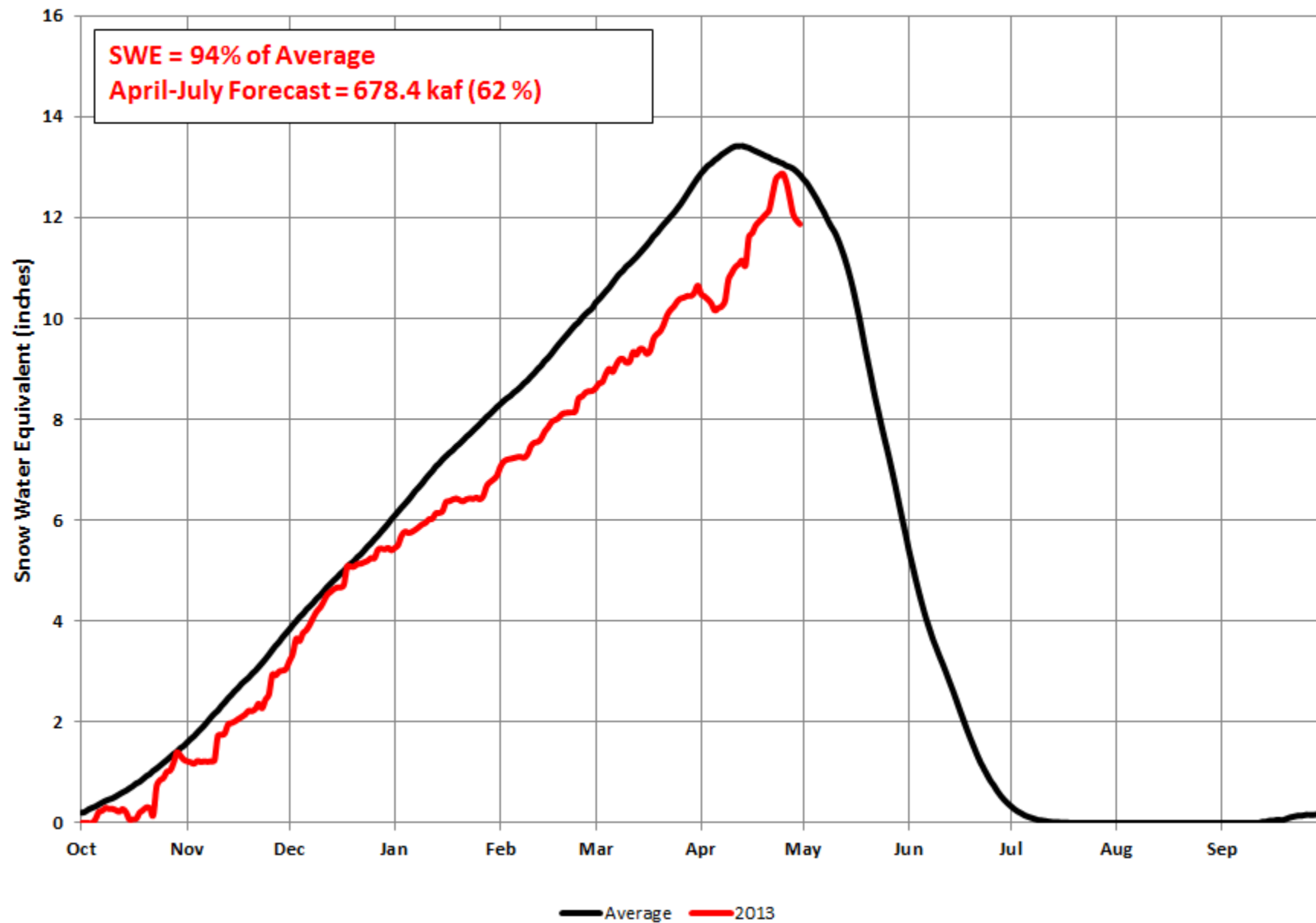
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Mountain Snowpack Conditions on April 1



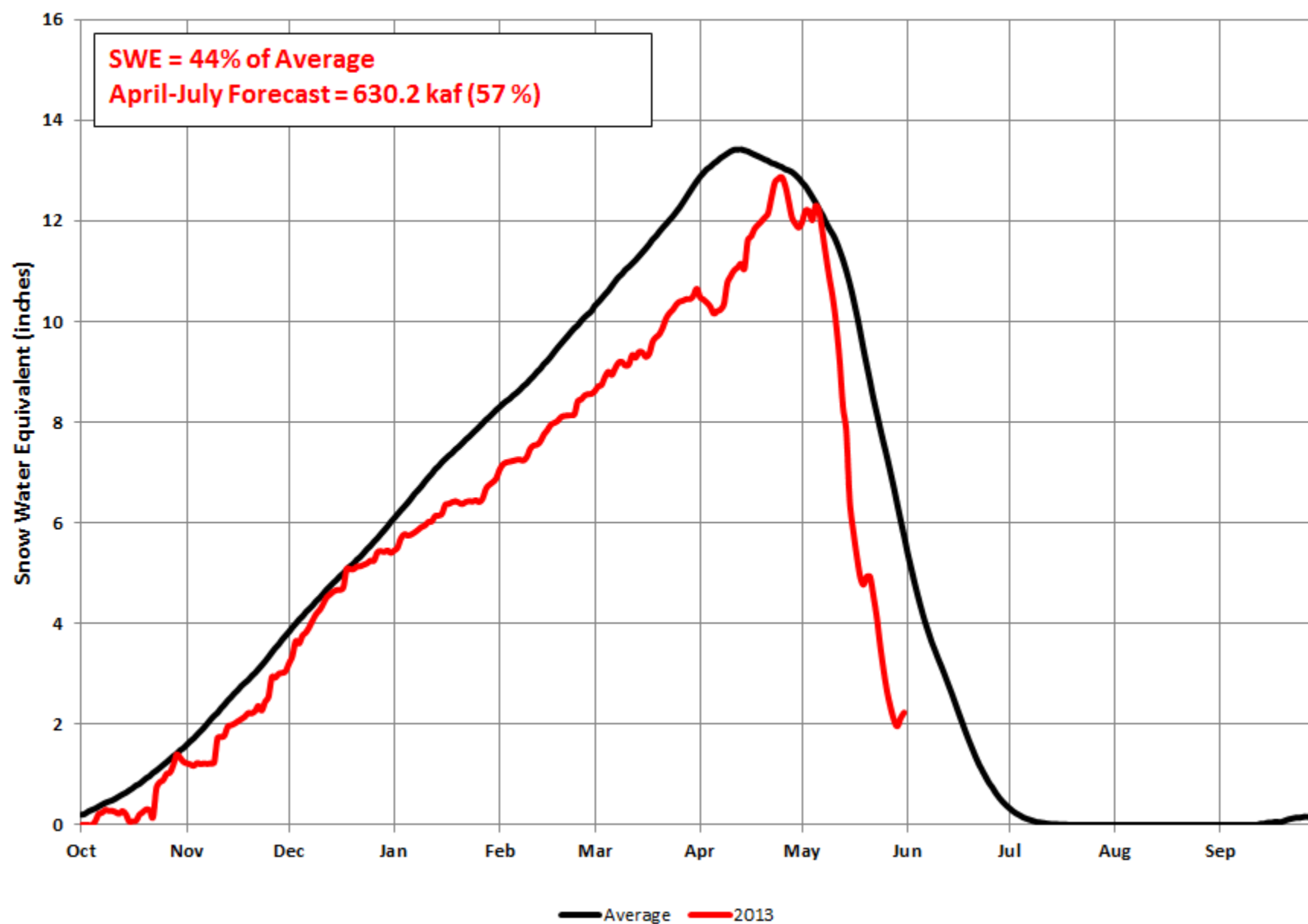
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Mountain Snowpack Conditions on May 1



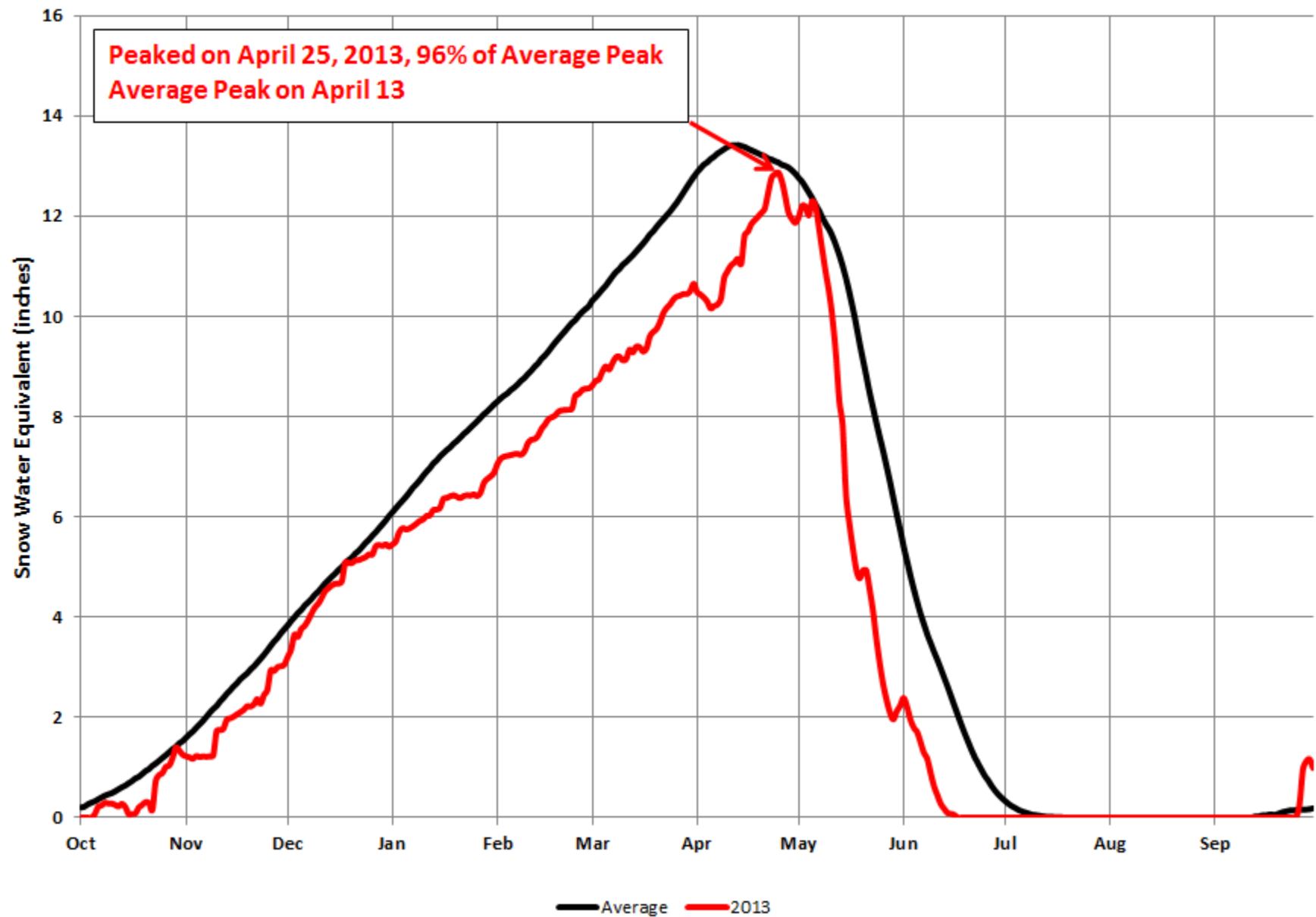
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Mountain Snowpack Conditions on June 1



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Mountain Snowpack Conditions



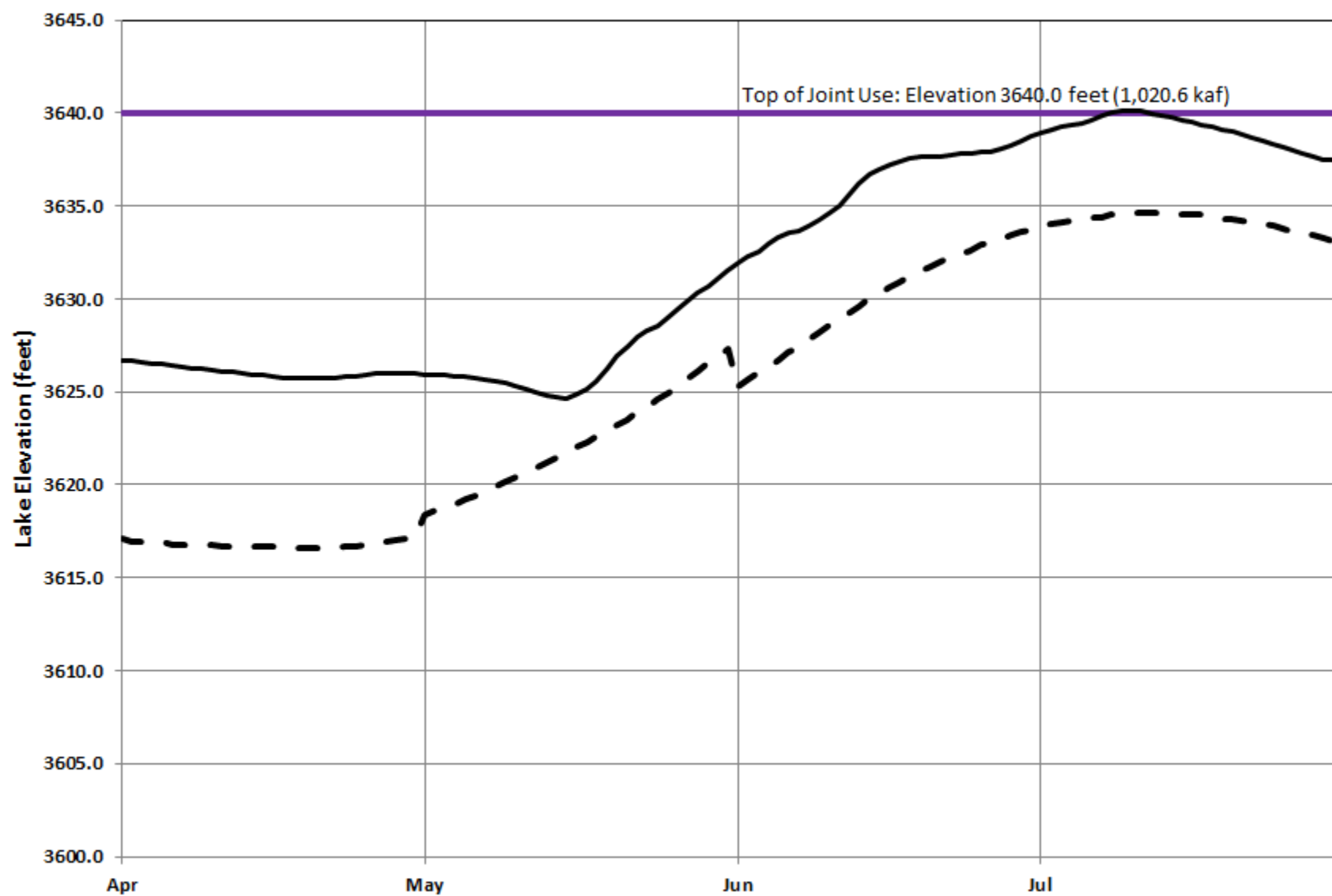
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2013 April-July Forecasts & Rule Curve Targets

<u>Date</u>	<u>Apr-Jul Forecast</u>	<u>% of Avg</u>	<u>Rule Curve Min Elev.</u>	<u>Date</u>
Jan. 1	812,000	74%	3617.0	4/01
Feb. 1	788,000	72%	3617.0	4/01
Mar. 1	688,000	63%	3617.0	4/01
April 1	661,000	60%	3617.0	4/01
May 1	678,400	62%	3617.0	4/01
June 1	630,200	57%	3617.0	4/01
Actual	627,900	57%		

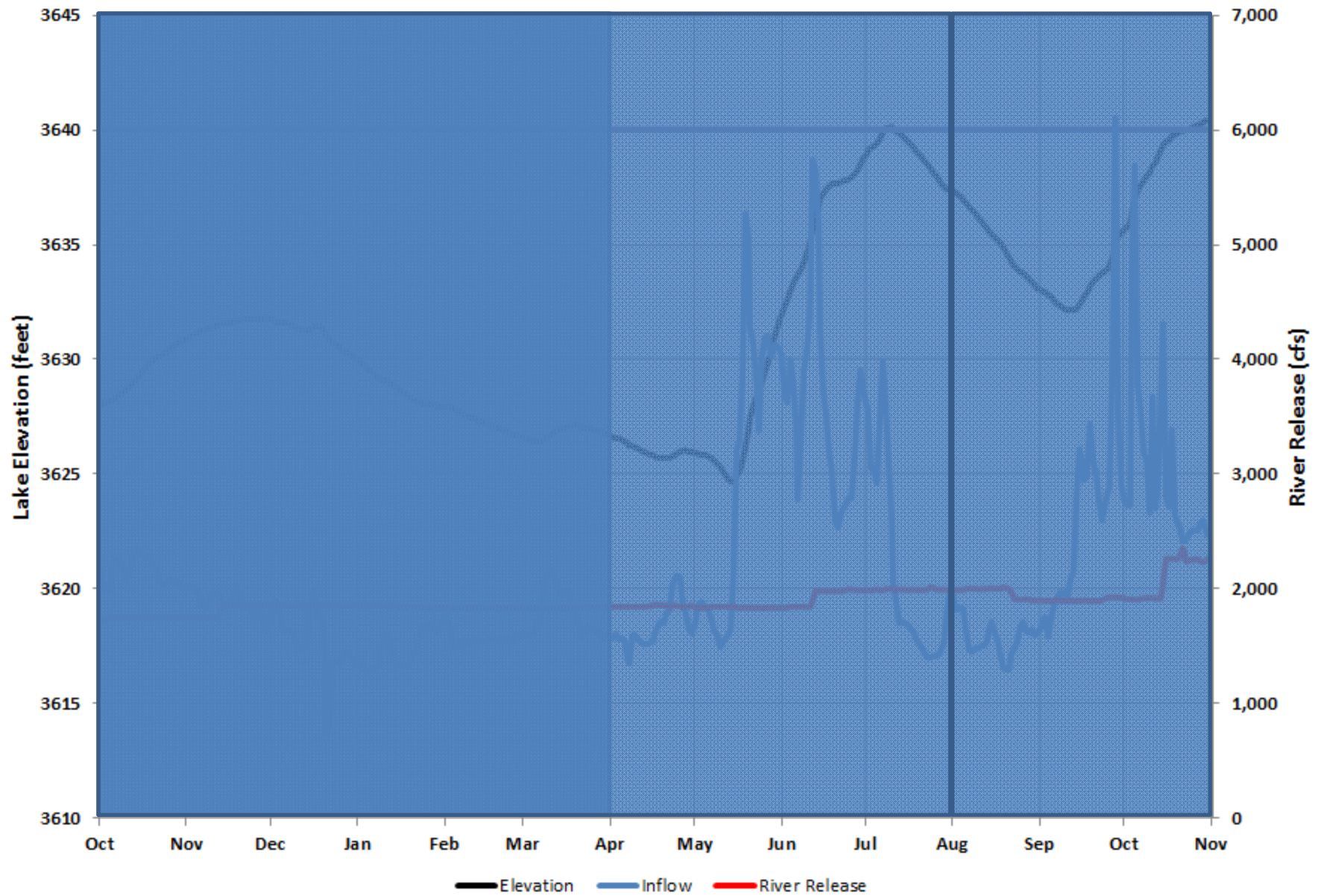
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Rule Curve for April - July



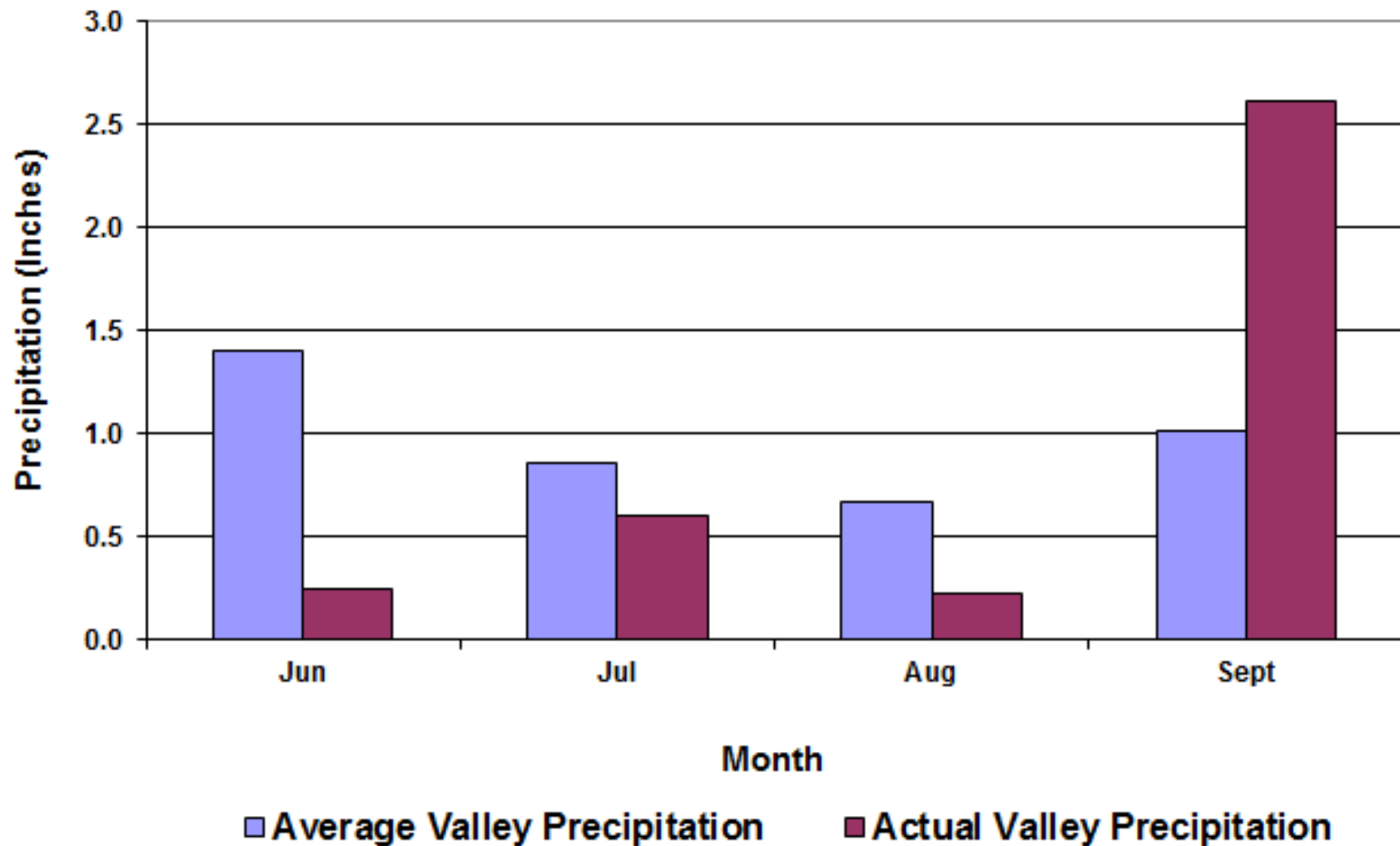
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Bighorn Lake Operations 2013



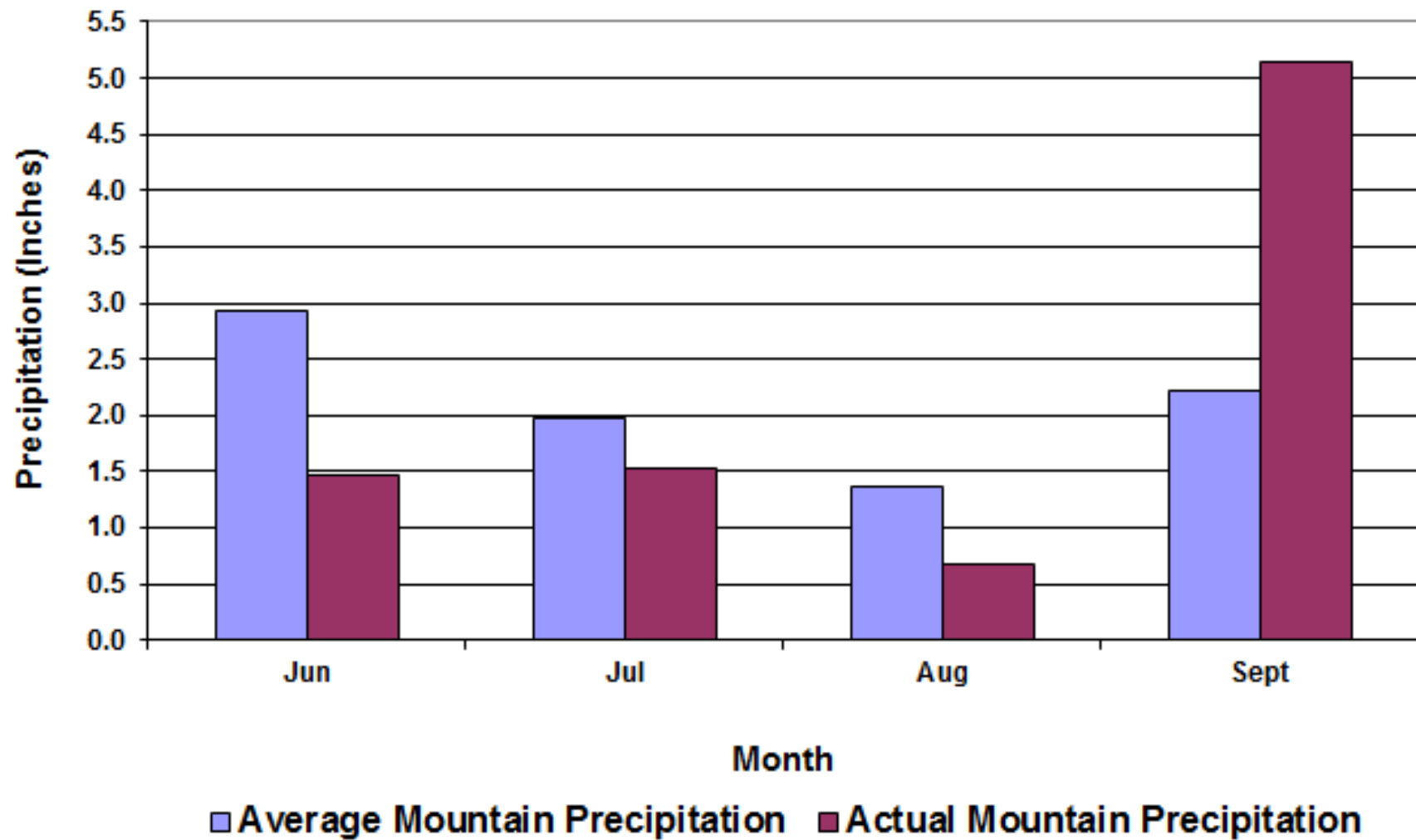
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2013 Valley Precipitation



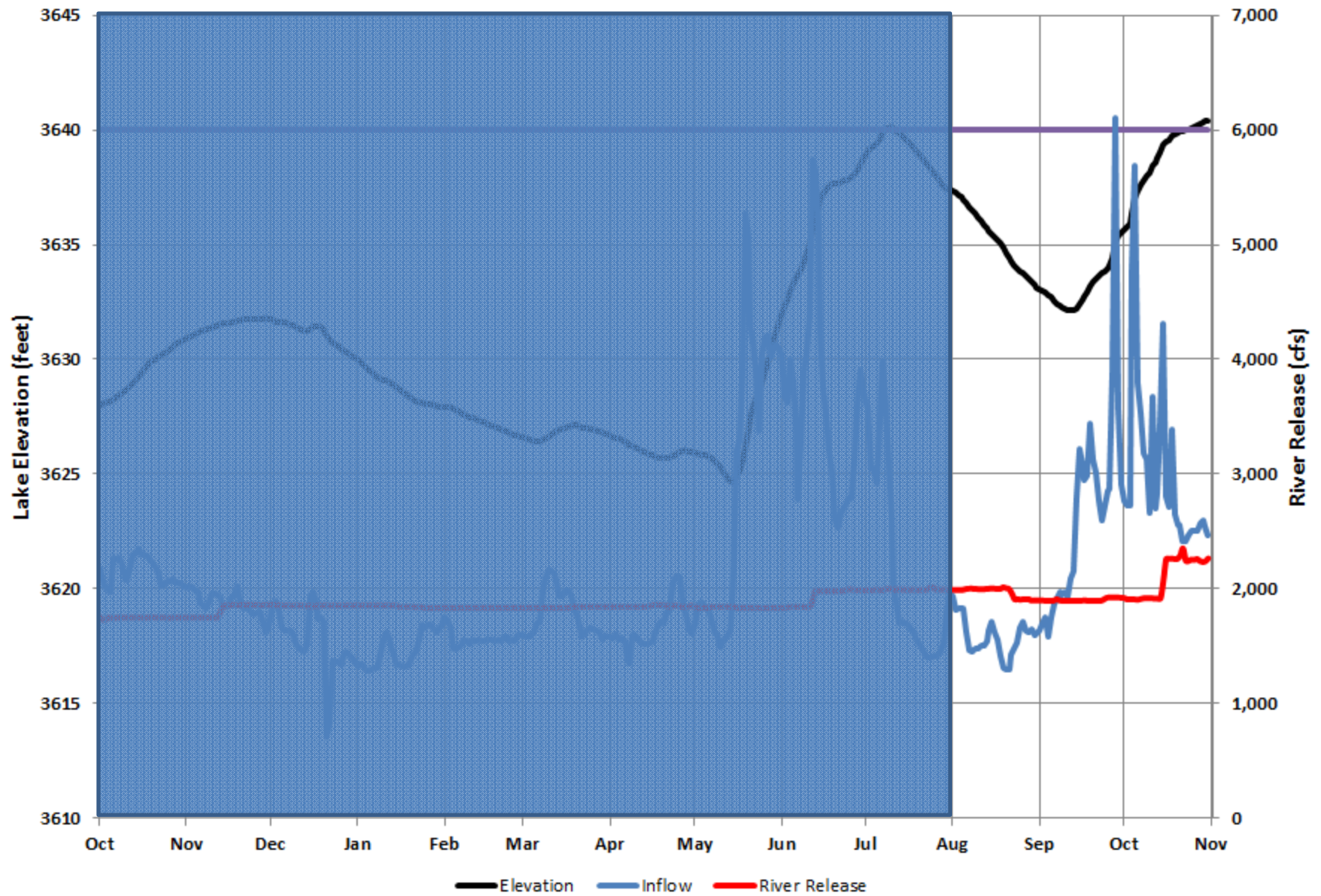
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2013 Mountain Precipitation



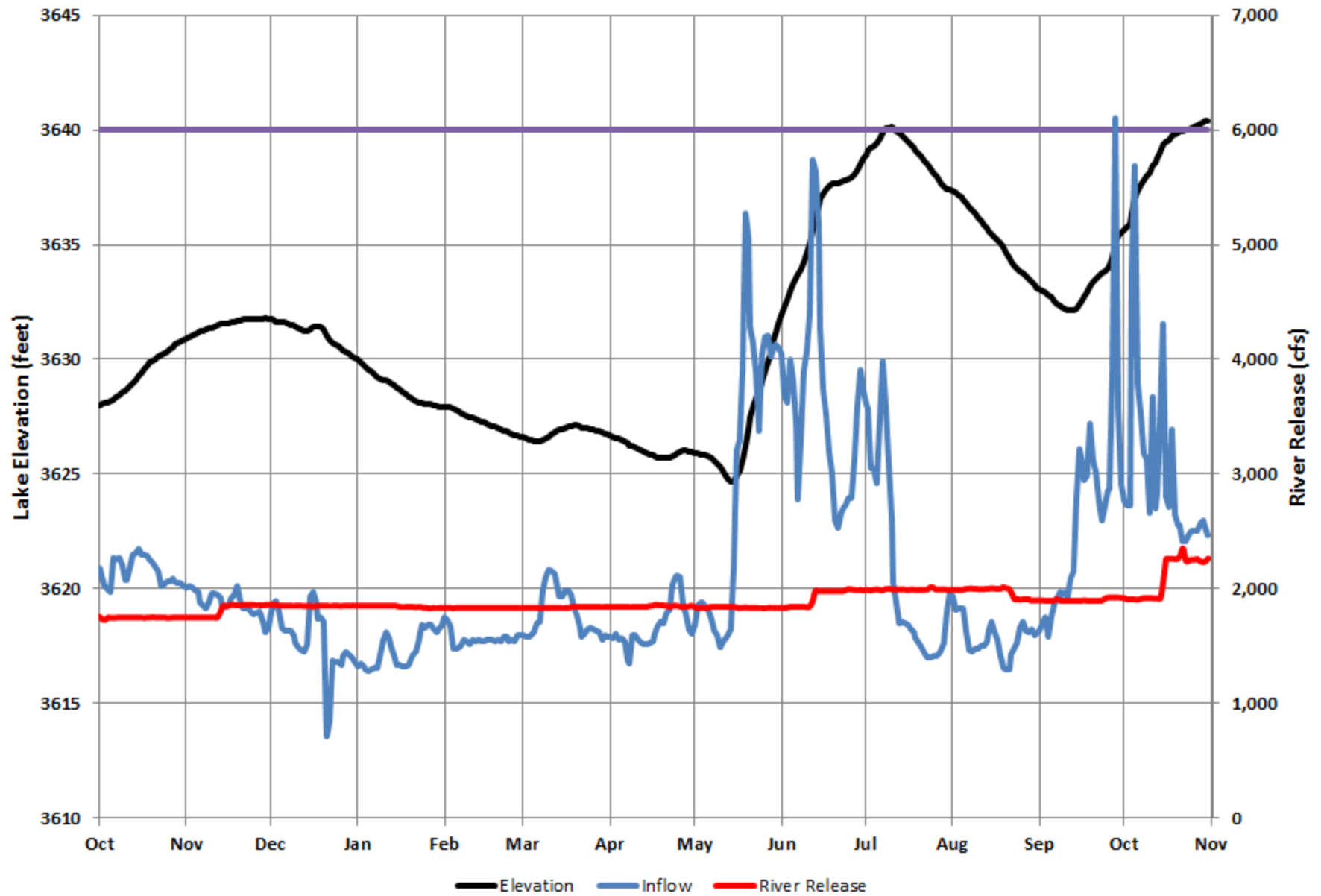
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Bighorn Lake Operations 2013



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Bighorn Lake Operations 2013



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Water Year 2014 Fall and Winter Outlook

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Current Conditions

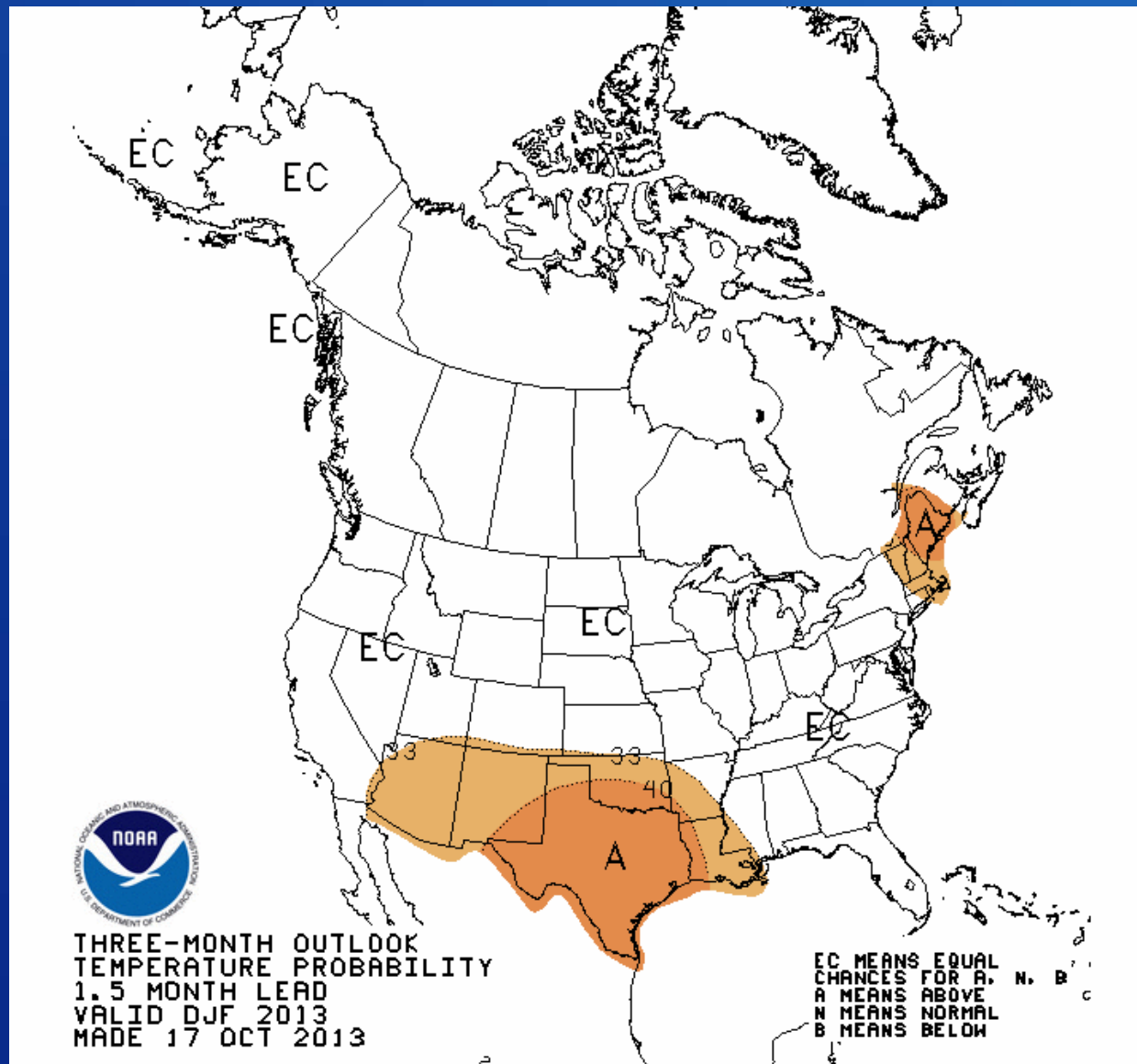
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Conditions on November 1, 2013

Elevation	3640.4 - 0.4 feet above full pool 9.6 feet higher than last year
Storage	1,025,766 acre-feet: 116% of average 101% full
Inflows	2,400 cfs
Outflow	Total: 2,300 cfs River: 2,300 cfs BIA Canal = 0 cfs

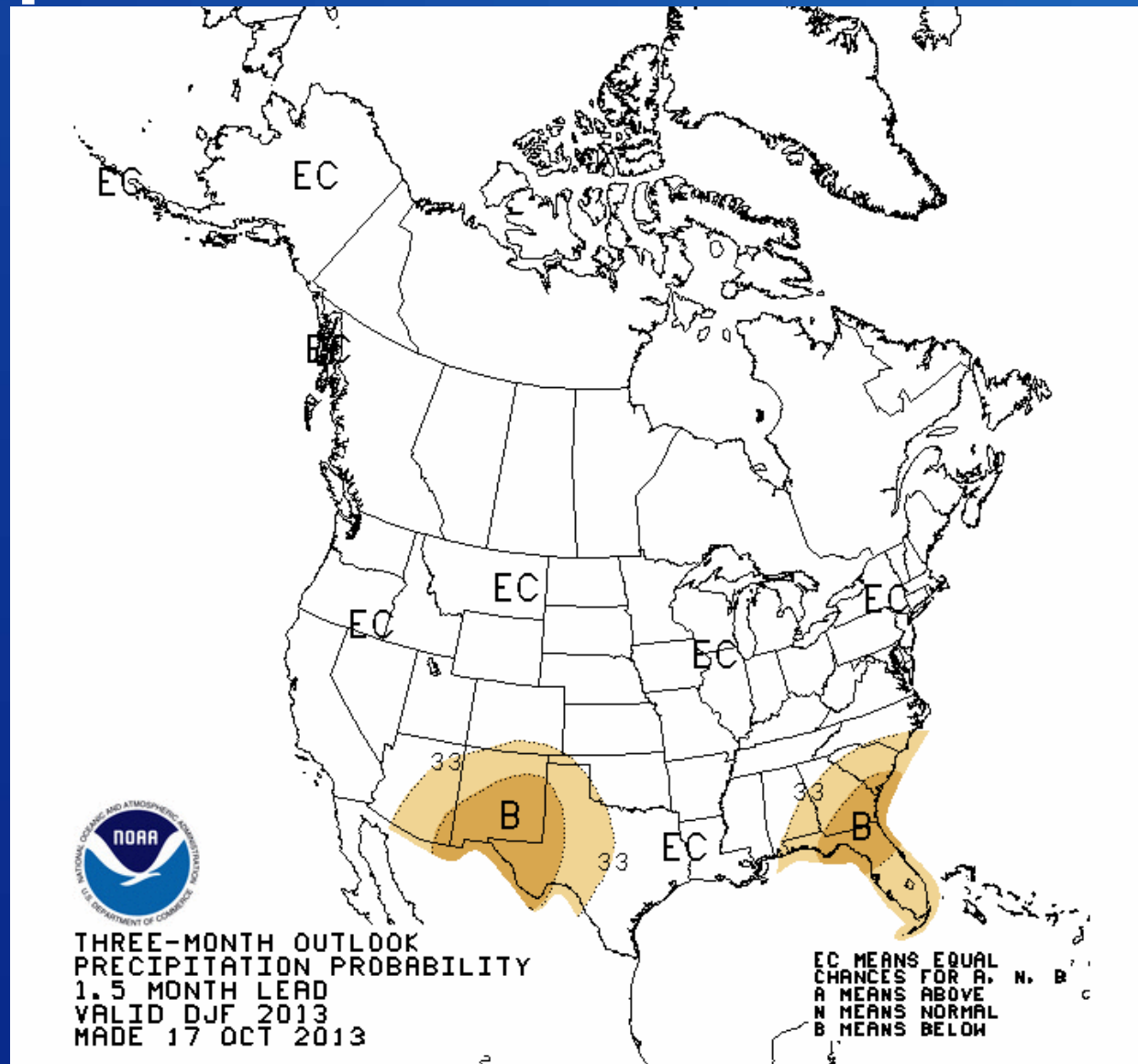
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Temperature Outlook: Dec - Feb



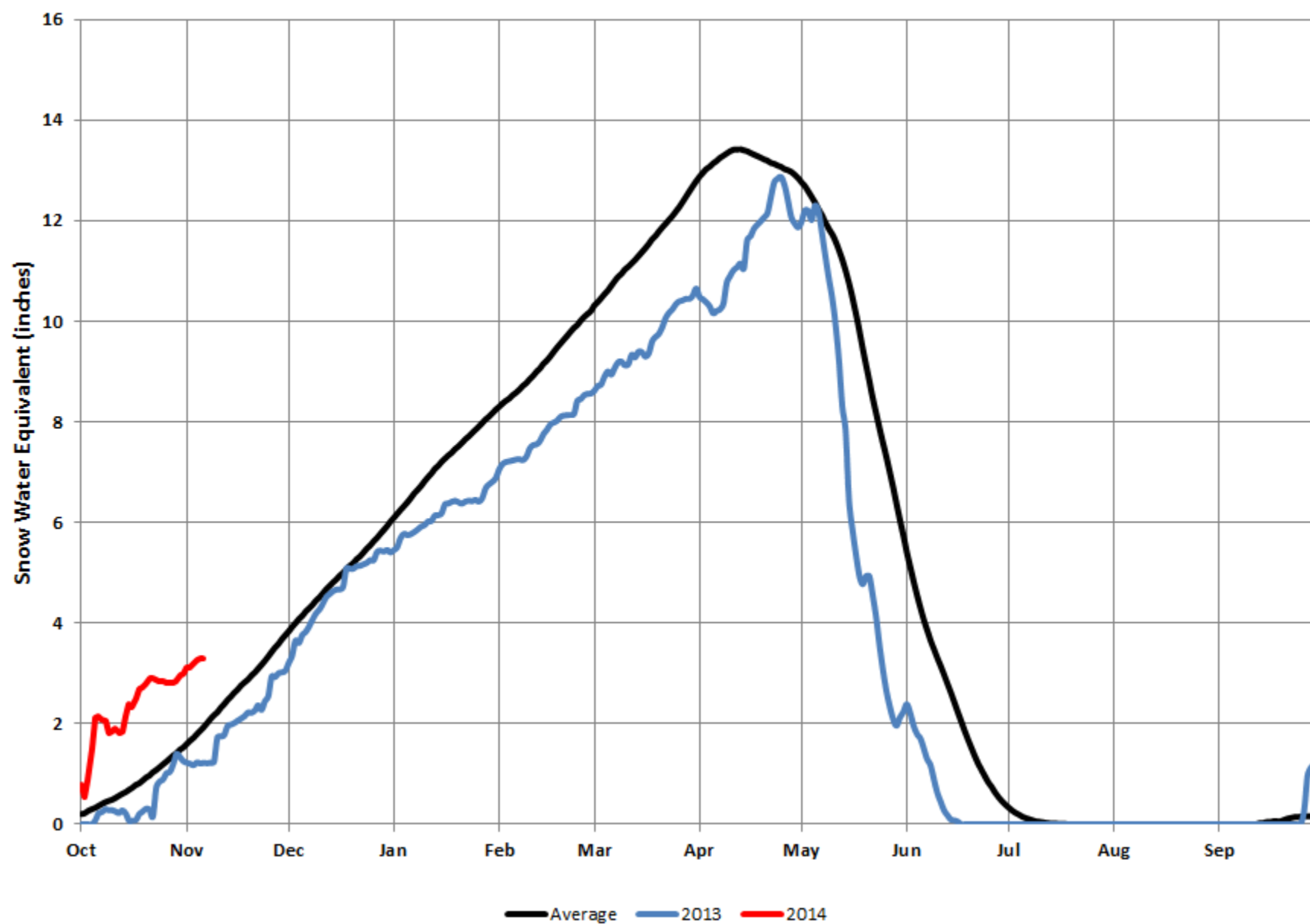
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Precipitation Outlook: Dec - Feb



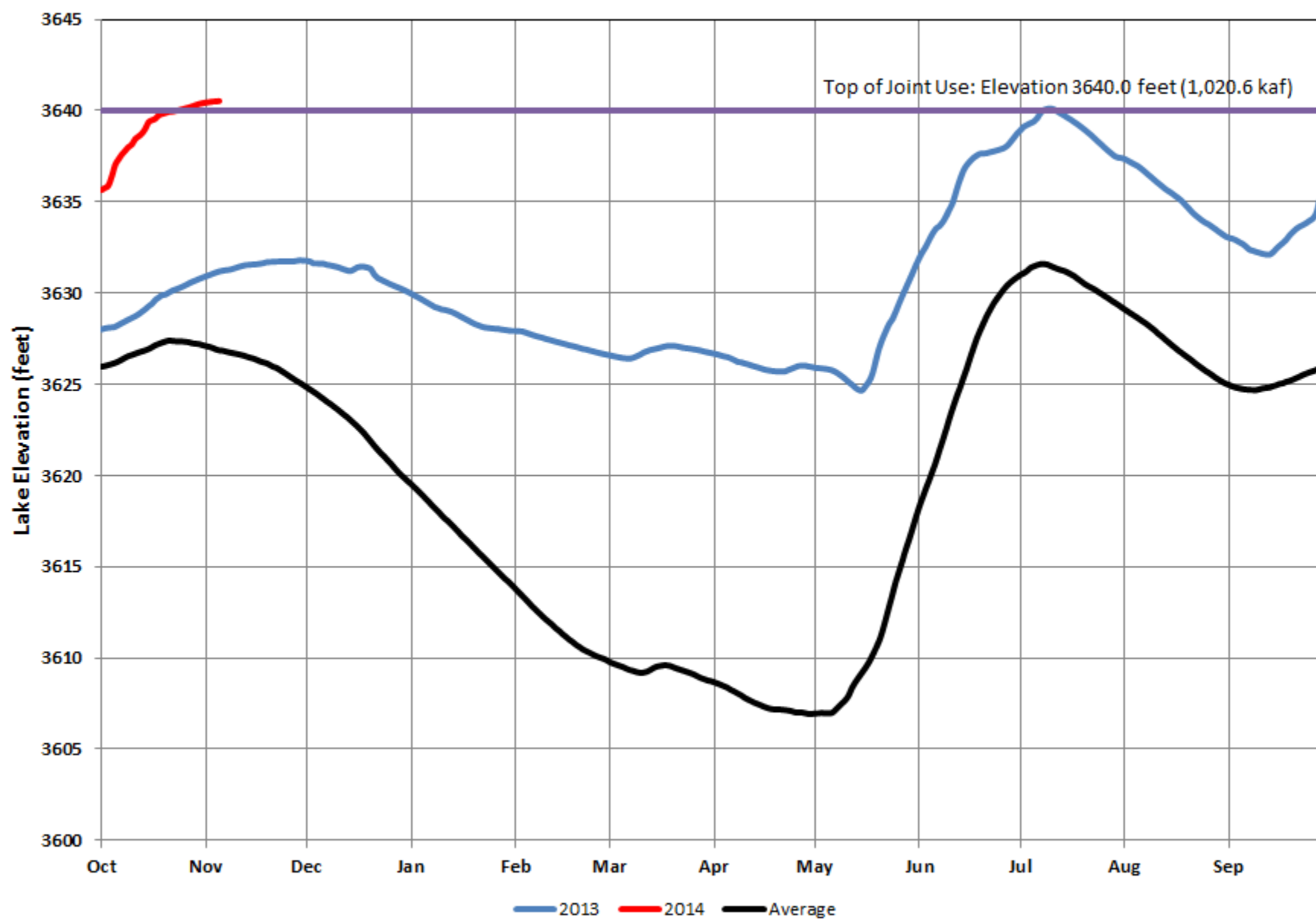
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Mountain Snowpack Conditions



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Bighorn Lake: November 4, 2013 Conditions



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2014 Outlook

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NOVEMBER - MARCH
Bighorn Lake River Release Rate

A ENTER Bighorn Lake Apr-Oct Gain in Acre-feet	B CALCULATED Nov-Mar Forecasted Gain Acre-feet	C ENTER Bighorn Lake Oct. 31 Storage AF	D ENTER Buffalo Bill Nov-Mar Release CFS	E ENTER Boysen Res Nov-Mar Release CFS	F End of March Bighorn Lake Stor. Target acre-feet (2007 AC Table)	G CALCULATED Release to Afterbay CFS	H CALCULATED River Release From Afterbay CFS	I 31-Mar-10 Reservoir Level Target	Month	Gain
									April	36
									May	14.7
									June	11.4
									July	-85
									August	-78.2
									September	32.7
									October	116.2
									Total	47.8
47,800	229,333	1,025,766	267	500	807,921	2260	2330	3617.0		
Min Probable	194,333									
Max Probable	264,333									

Directions: Enter appropriate values in the Yellow Cells: A10, C10, D10, & E10.
 Bighorn Lake River Release for Nov. - Mar. is calculated in cell H10 and the end
 of March target elevatio is displayed in I10.

B = .145*A+222402 R² = .6756 Forecasted Gain

F = Desired end of March Storage

G is determined from calculations in J through L with Checks in M

H = Dam Release (G) + 70 cfs

Forecasted Gain Adjustments

	Elevation	Sotrage
1500-2000 cfs	3615	794,613
2000-2500 cfs	3617	807,921
> 2500 cfs	3619	821,949

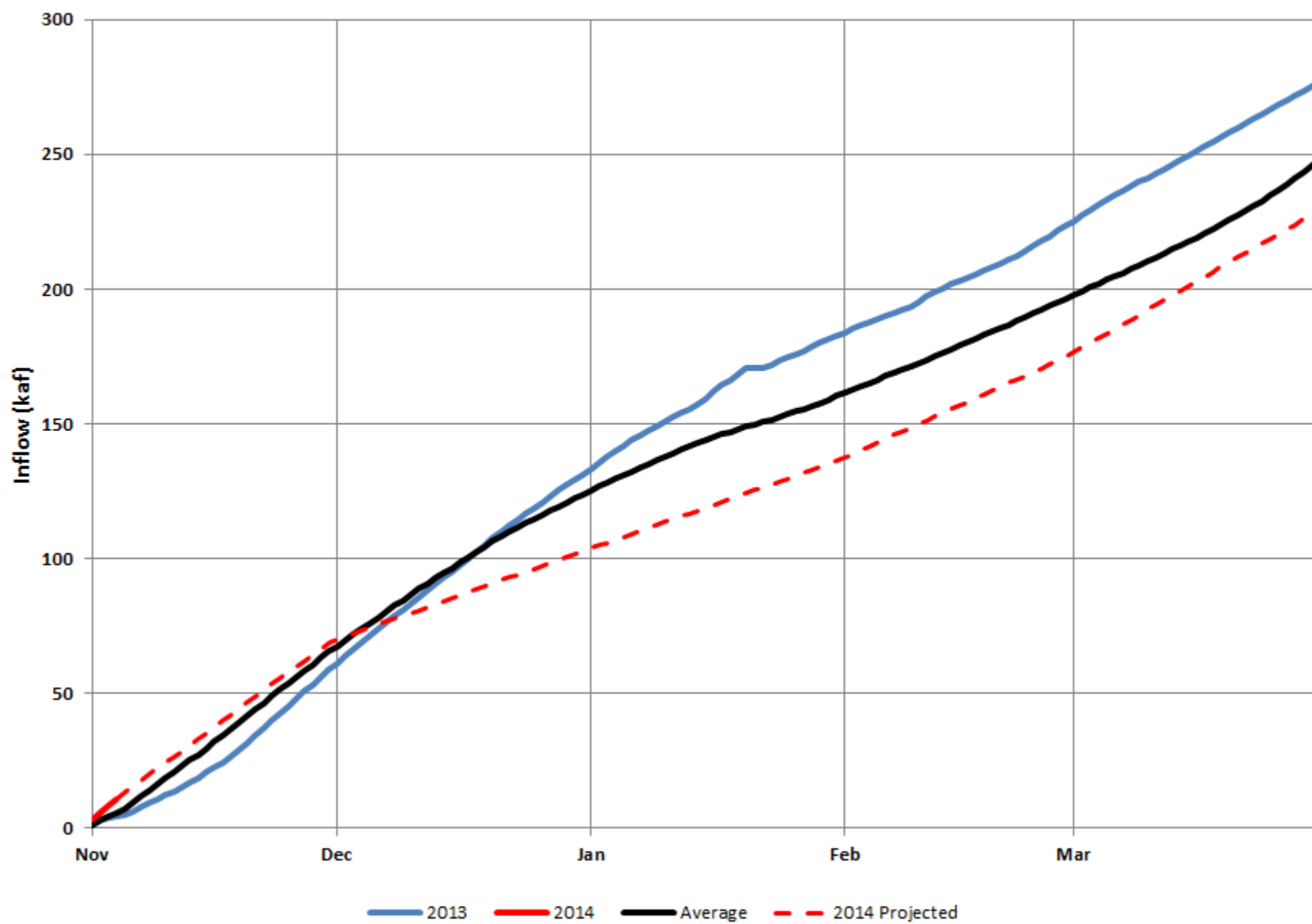
Intermediate Calculations for River Release			
J CALCULATED Step One Release CFS >2500	K CALCULATED Step Two Release CFS 2000-2500	L CALCULATED Step Three Release CFS 1500-2000	M Check Results & Adjust Release CFS
2283	2330	2374	2330
2283	2330	2000	2330
	2000	1500	2330
		1500	2330

If J > 2500 than set to J
 If K < 2500 than set to K
 If L < 2000 Then set to L
 If L < 1500 then set to 1500

K End of March Reservoir Elev. Target	L End of March Reservoir Storage Target
3617.0	807,921
3617.0	807,921
3617.0	807,921
3617.0	807,921

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Bighorn Lake Cumulative Gain



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November through March Gains and Release

April-October Gain = 47,800 acre-feet

Calculated November-March Gain = 229,333 acre-feet

Upstream Reservoir Fall & Winter Releases =

Boysen = 500 cfs

Buffalo Bill = 267 cfs

End-of-October Storage = 1,025,766 acre-feet

Projected End-of-March Target Elevation = 3617

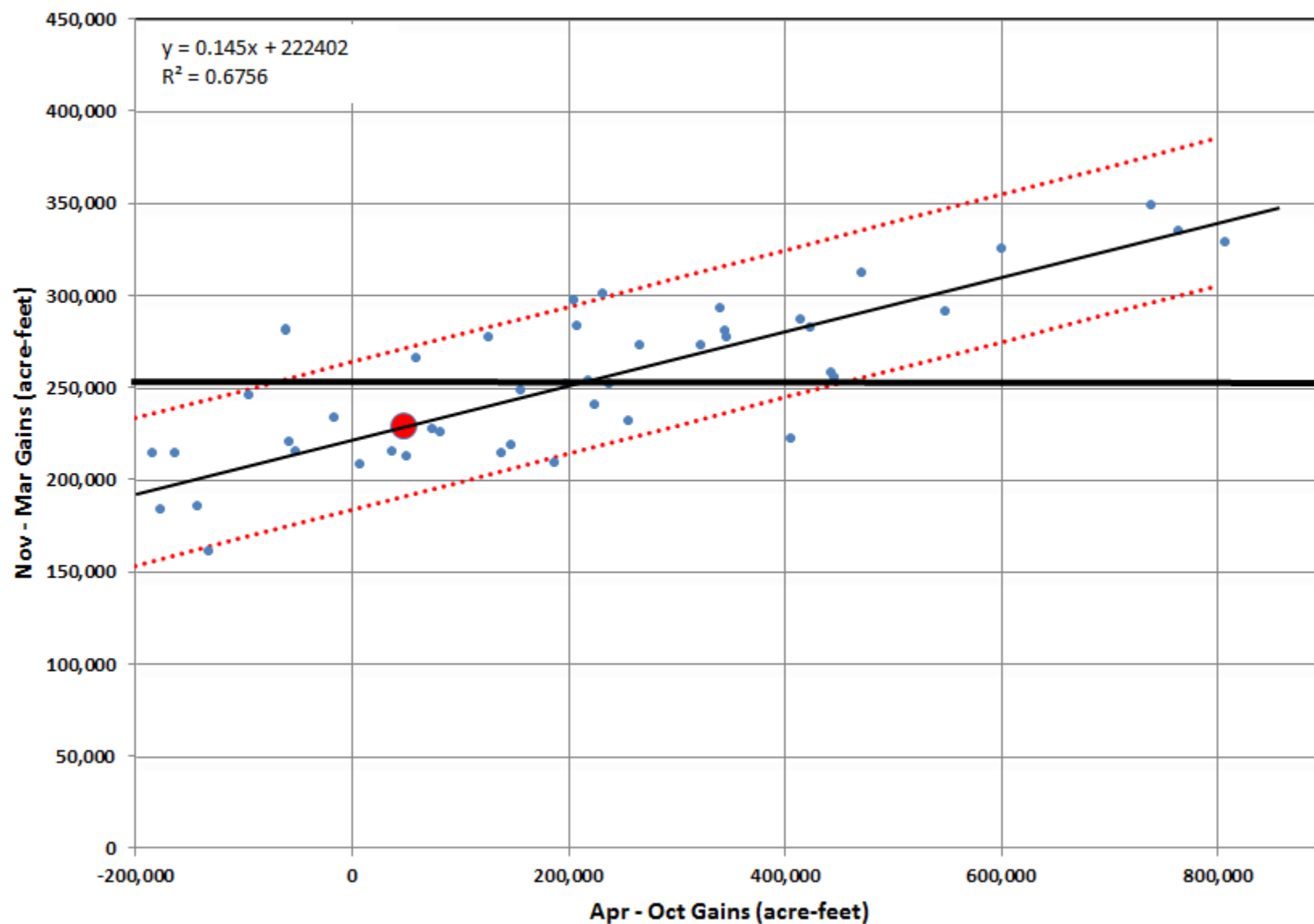
Calculated Fall & Winter Release for Yellowtail:

River = 2,330 cfs

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Bighorn Lake Adj. Gains 1968-2014 (without 1972)

Apr - Oct vs Nov - Mar

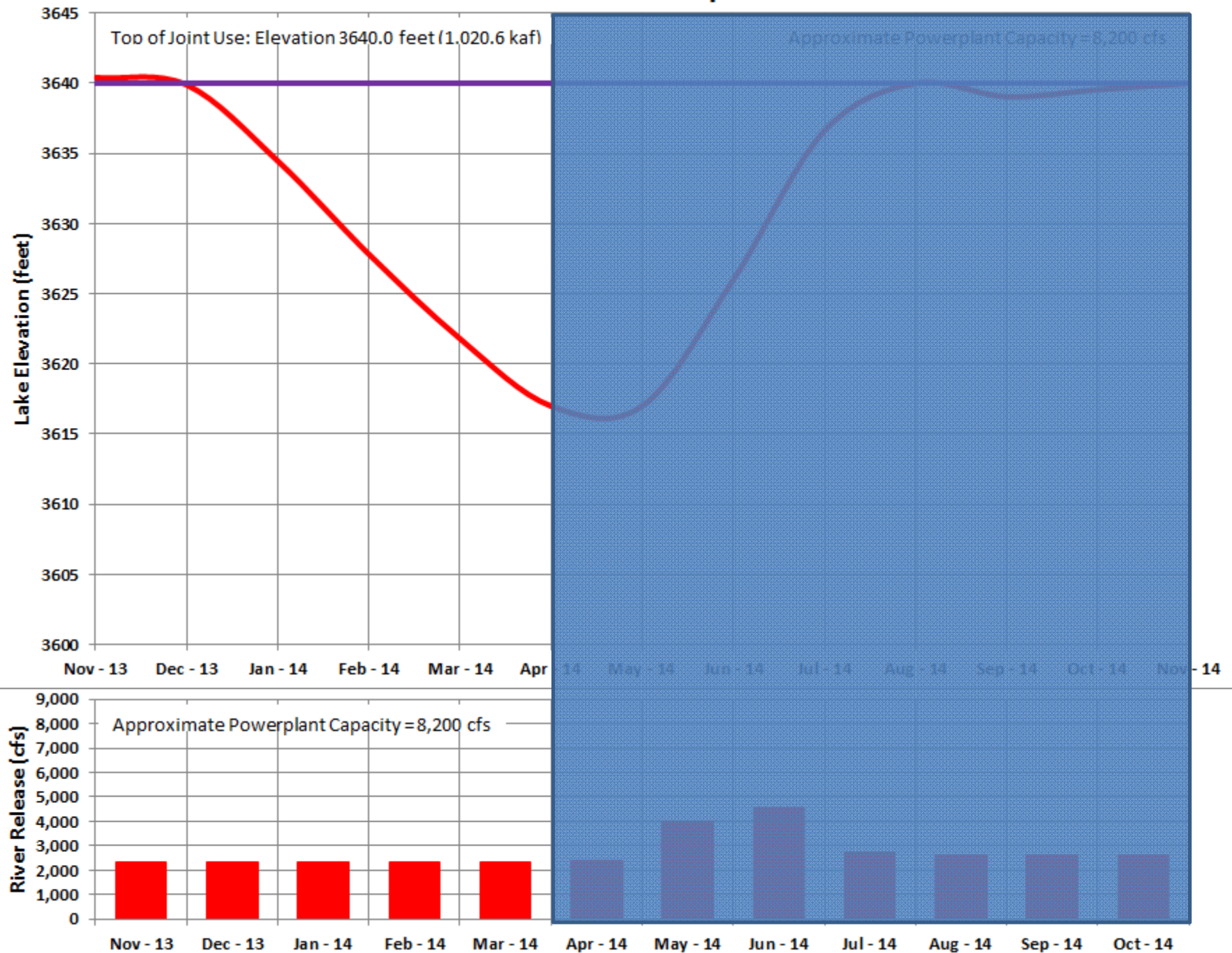


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Operating Plans

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Most Probable Inflow Operations

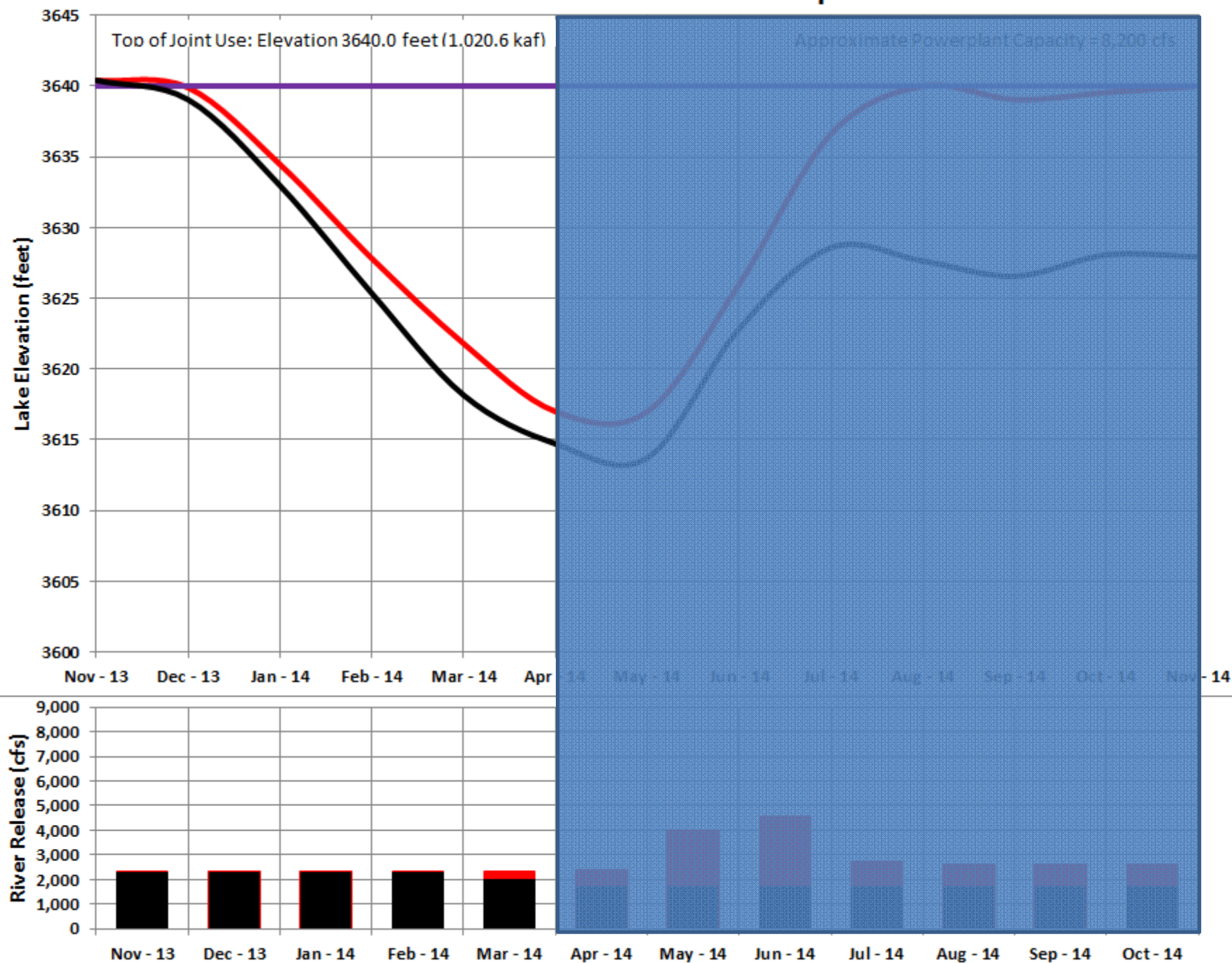


Most Probable Inflow Operations

- Nov–Mar Inflow forecast at 459 kaf (78% of ave)
- Reservoir level expected to reach end of March elevation of 3617 feet
- River release held at 2,330 cfs through March
- Generation during November through March would total 250 GWHrs

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Most and Minimum Probable Inflow Operations

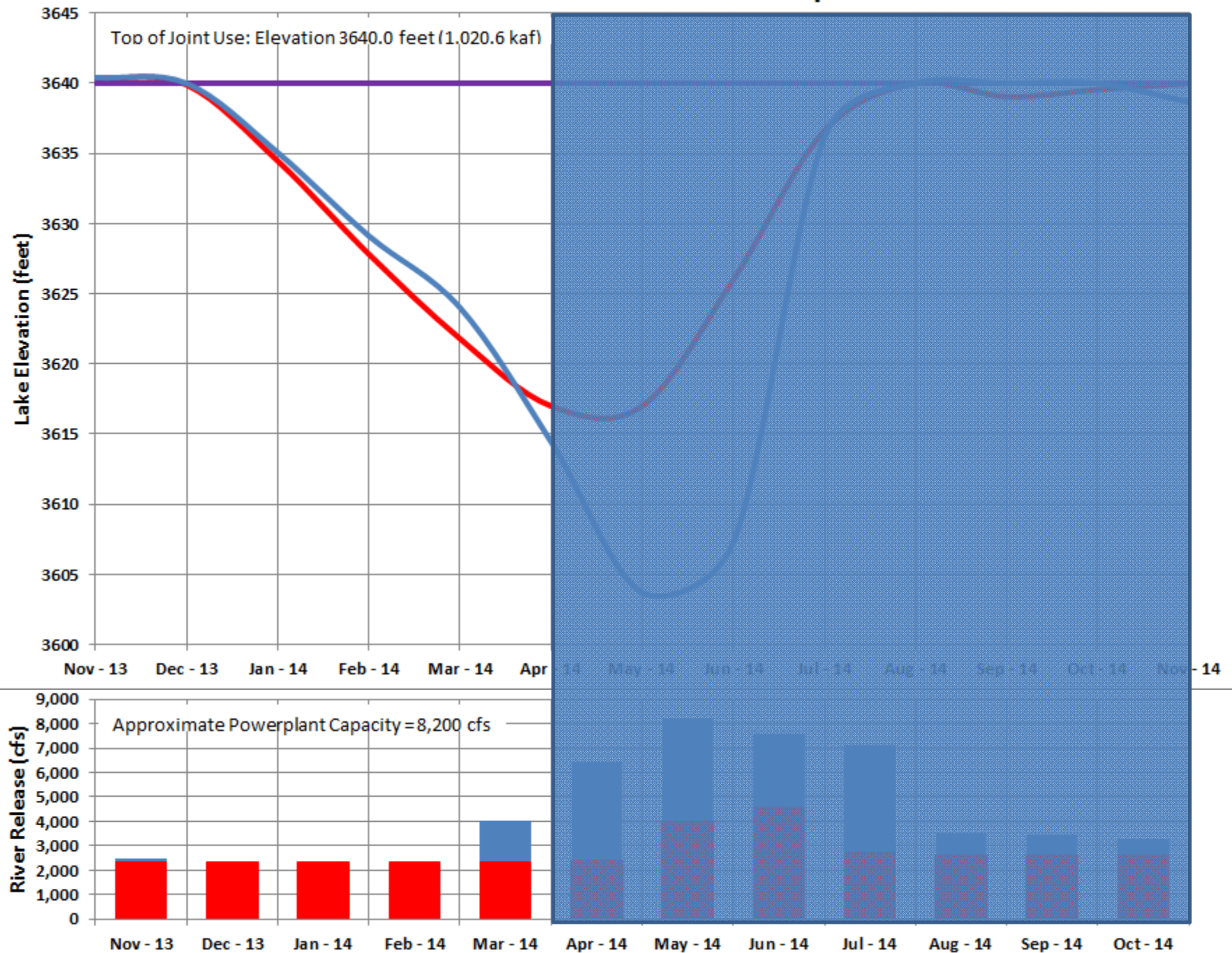


Minimum Probable Inflow Operations

- Nov–Mar Inflow forecast at 423.6 kaf (72% of ave)
- Reservoir level expected to be at an end of March elevation of 3614.8 feet
- River release held at 2,330 cfs through February
- River release would be reduced to 2,000 cfs or less in March
- Generation during November through March would total 240 GWHrs

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Most and Maximum Probable Inflow Operations

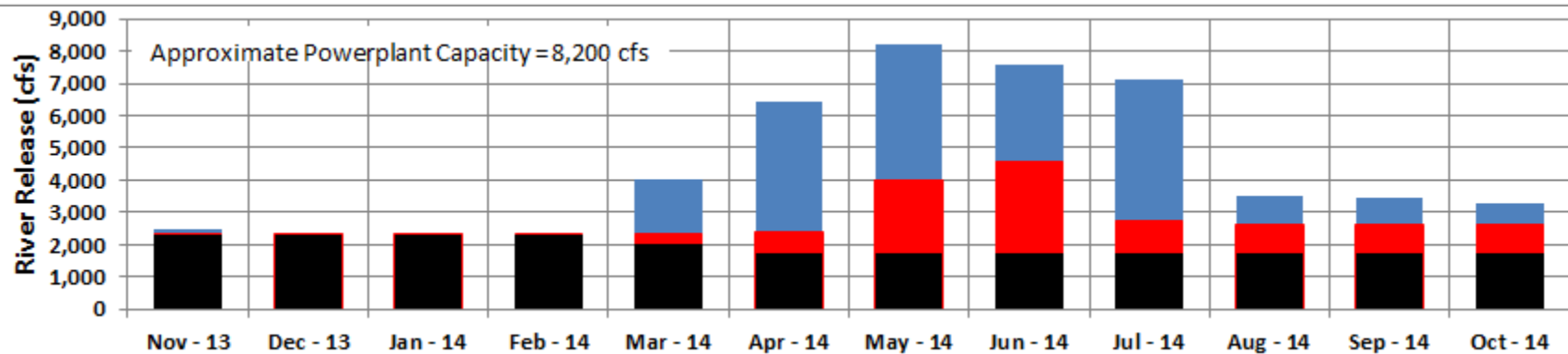
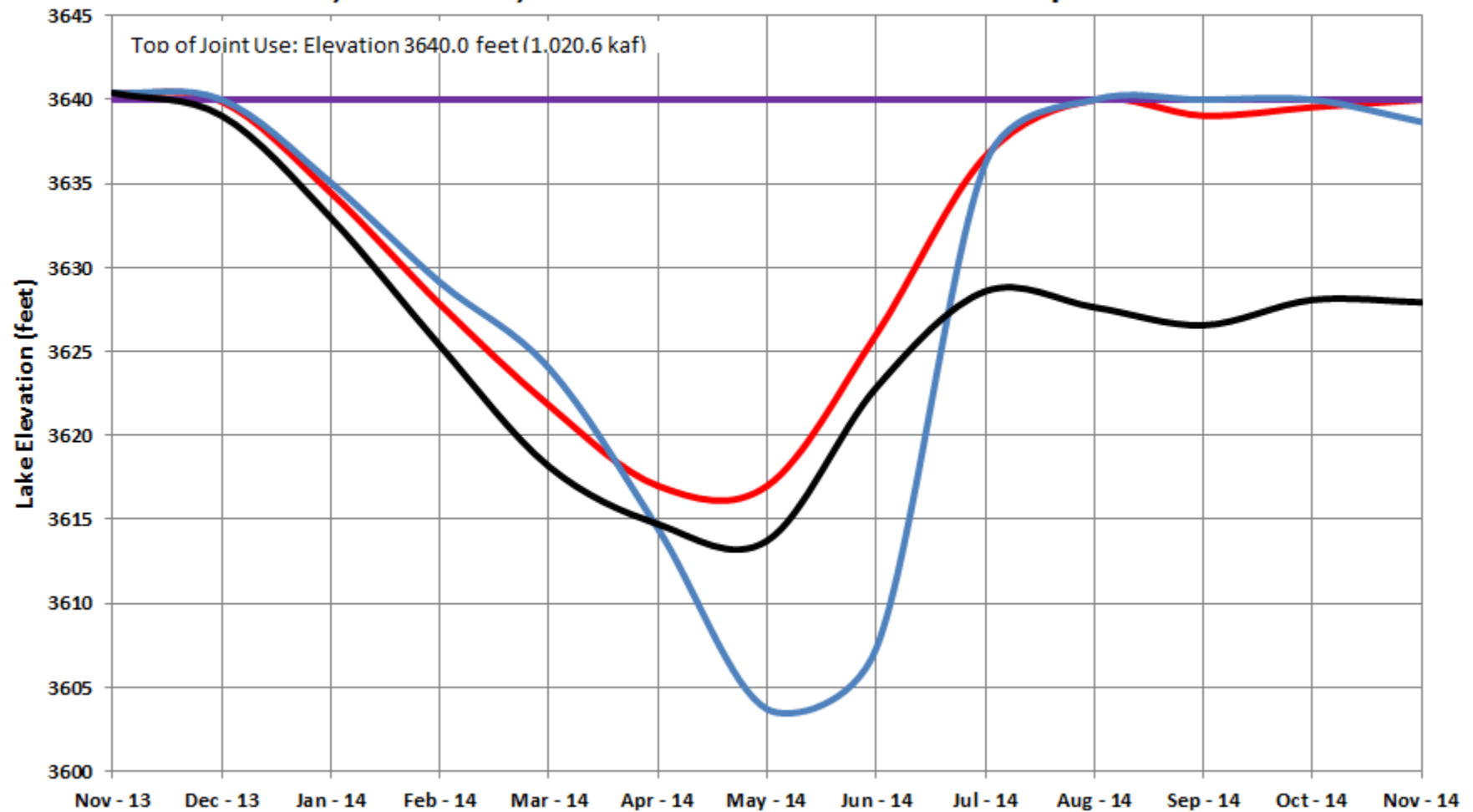


Maximum Probable Inflow Operations

- Nov–Mar Inflow forecast at 553.9 kaf (94% of ave)
- Reservoir level would be at an end of March elevation of 3614.5 feet
- River release would increase in November to evacuate water out of the exclusive flood control pool before going to 2,330 cfs for the winter
- River release would be increased to 4,000 cfs or higher in March
- Generation during November through March would total 298 GWHrs

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Most, Minimum, & Maximum Probable Inflow Operations



Reclamation's Internet Website

www.usbr.gov/gp/lakes_reservoirs/wareprts/main_menu.html

- near real-time data available through the HYDROMET data system
- summaries and plots of historical data
- annual reservoir operating plan publication
- monthly water supply reports
- project data
- snow plots
- links to related internet sites

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Questions and Comments

The information presented at this meeting can be found on the Montana Area Office website at:

www.usbr.gov/gp/mtao/yellowtail/index.html

Please mail comments to:

Bureau of Reclamation
2900 4th Avenue North, Suite 501
Billings, MT 59107

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