

# RECLAMATION

*Managing Water in the West*

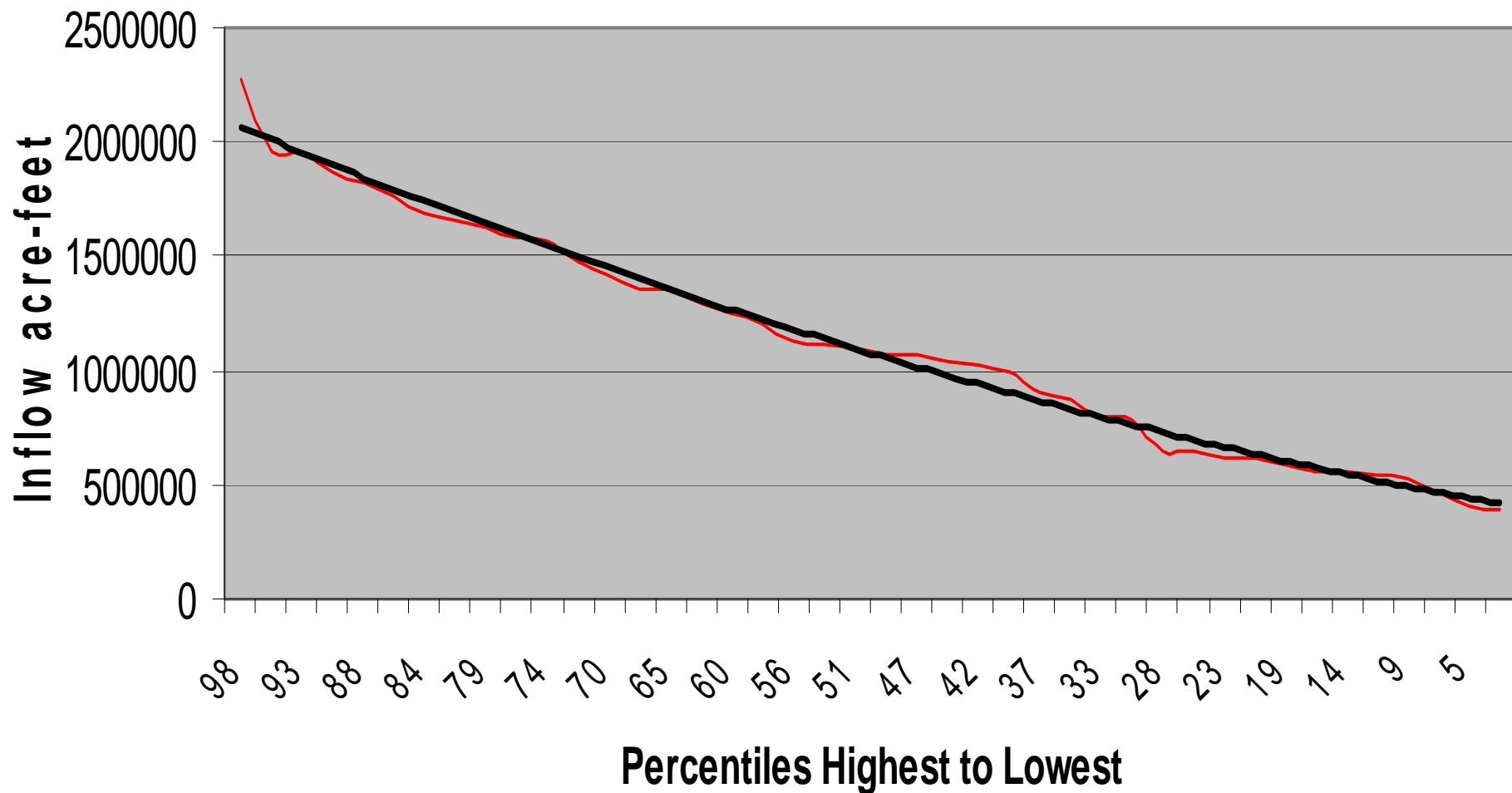
## Yellowtail Dam & Bighorn Lake Operation Rule Curves

Billings, MT  
January 15, 2009

# Bighorn Lake Apr-July Rule Curves

- **A series of Revised Flood Control/Operation Rule Curves Designed to:**
  - **Higher Spring & Summer Reservoir Levels**
  - **Provides Better Assurance of Filling Reservoir in Summer**
  - **Reduce Significant Release Reduction During Fill Season**
  - **Provide More Transparent View of Spring Operations**

# Bighorn Lake Apr-Jul Inflow Statistics



# Bighorn Lake Inflow Percentiles

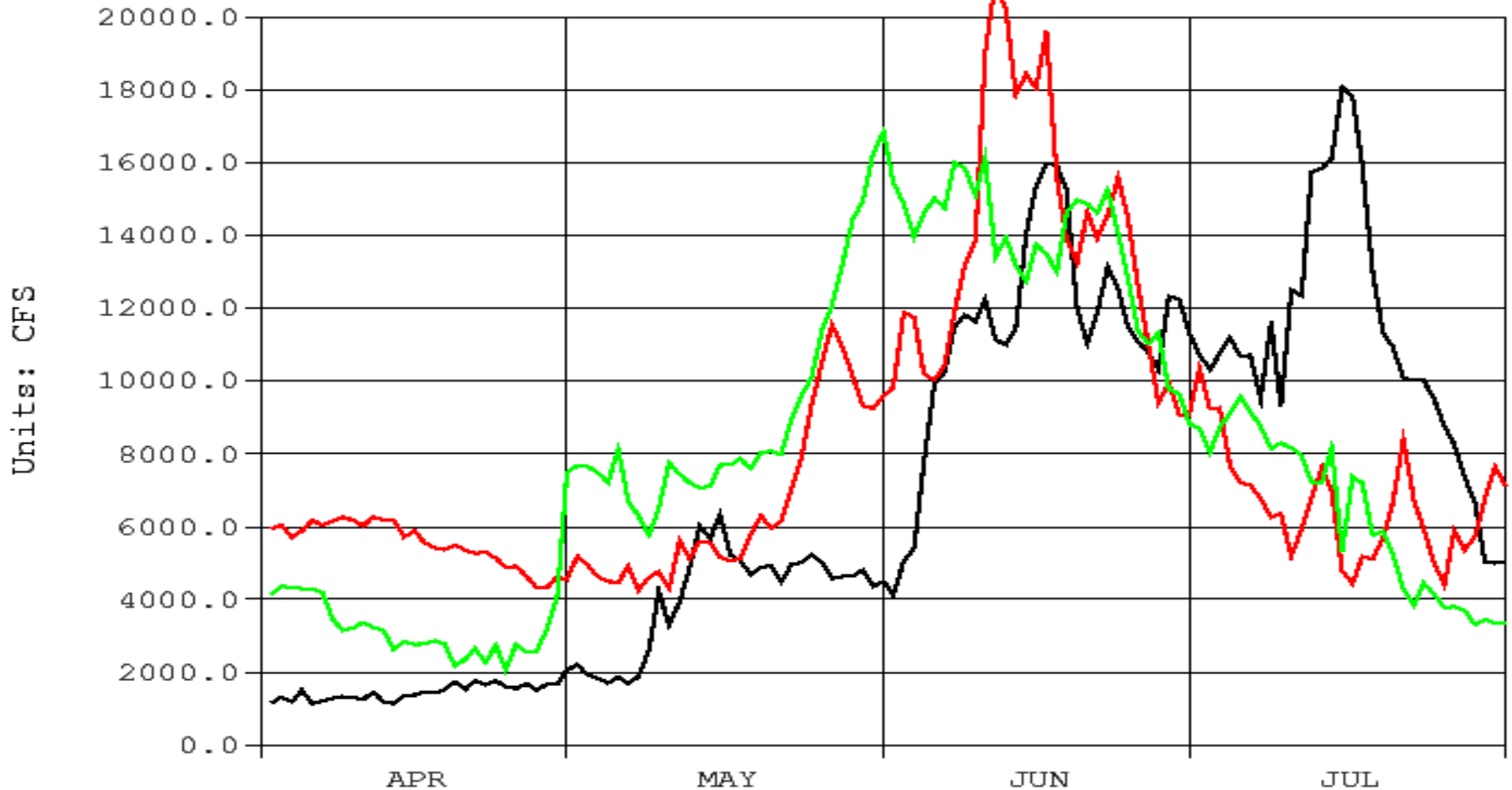
Percentile	1,000 acre-feet				
	Apr	May	June	July	Total
95%	244.1	482.2	845.3	428.1	2,000.7
90%	235.5	454.0	791.1	403.1	1,883.6
75%	191.1	397.8	646.5	318.5	1,554.0
50%	131.3	258.4	442.4	244.4	1,076.5
28% MF	127.0	221.1	239.9	131.9	719.9
25%	121.5	211.5	229.5	126.2	688.7
10%	97.2	154.1	165.3	82.6	499.2
5%	86.3	136.8	146.8	73.3	443.2

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# High Runoff Years

Archive Data From 1-APR Through 31-JUL

Plotted 01/12/2009 15:45



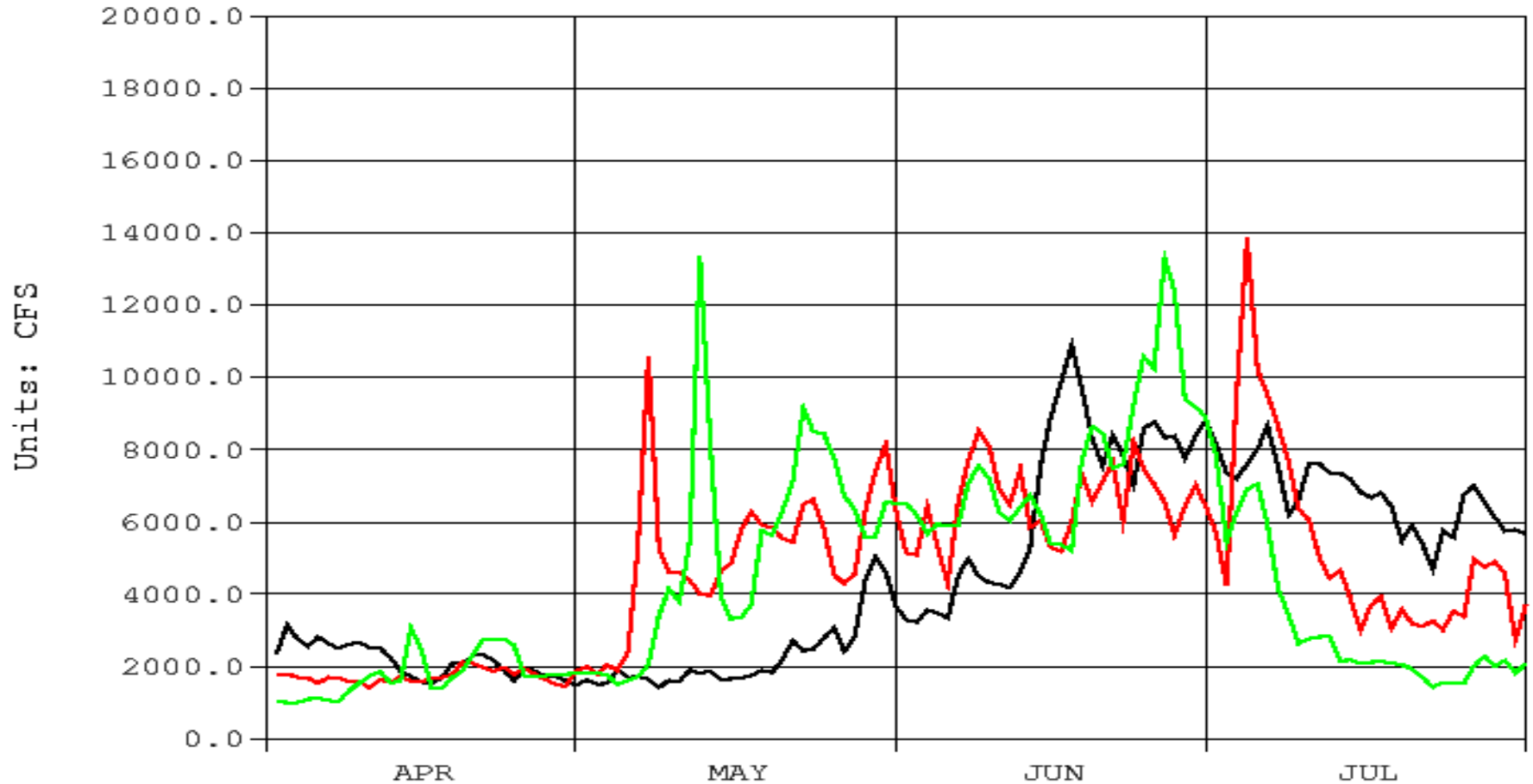
BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT  
IN Daily Mean Computed Inflow (cfs)

1995 1997 1999

# Medium Runoff Years

Archive Data From 1-APR Through 31-JUL

Plotted 01/12/2009 15:49



BHR

Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT

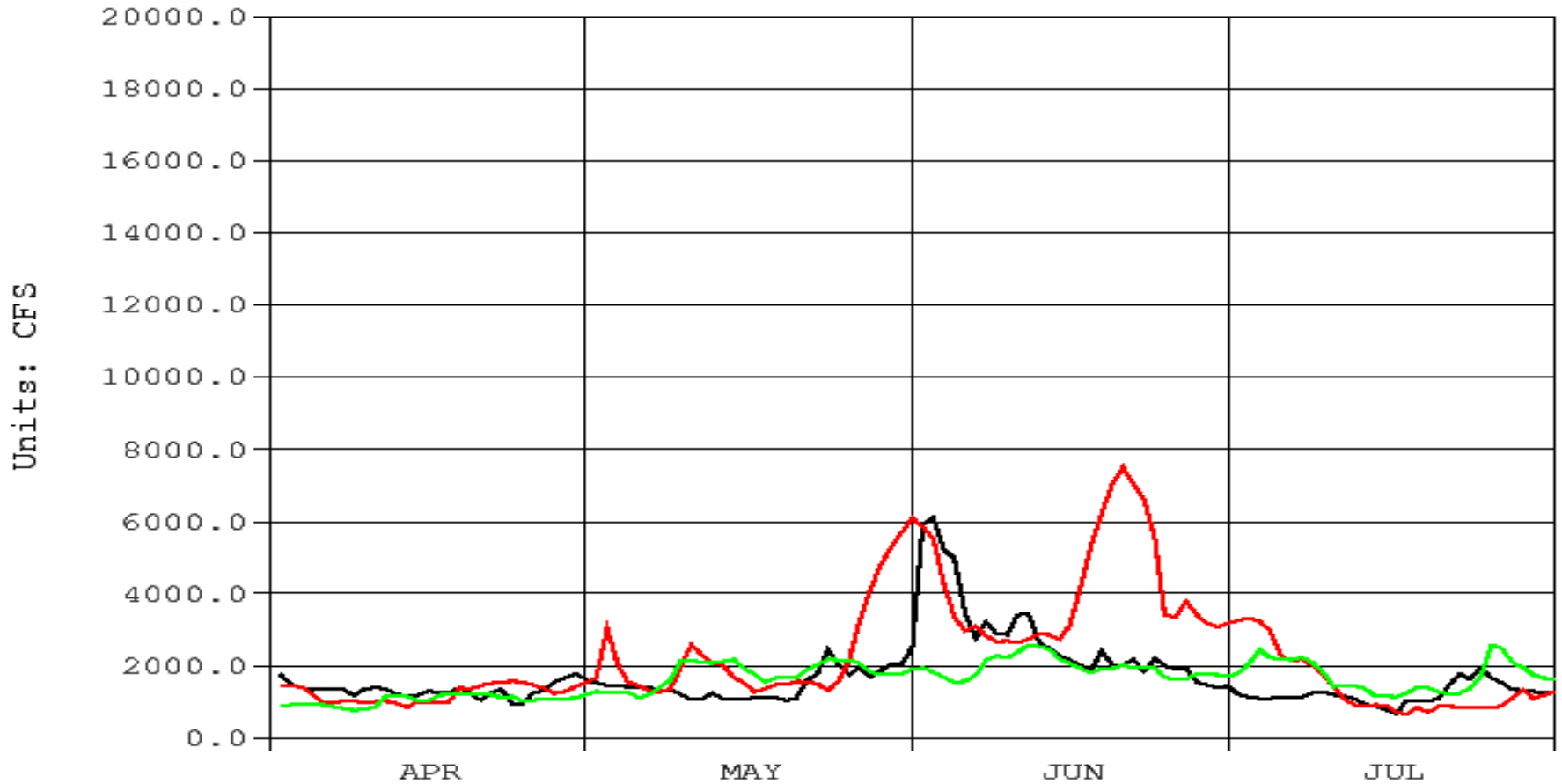
IN Daily Mean Computed Inflow (cfs)

1982 1993 2005

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# Drought Years

Archive Data From 1-APR Through 31-JUL  
Plotted 01/12/2009 15:52



BHR

Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT

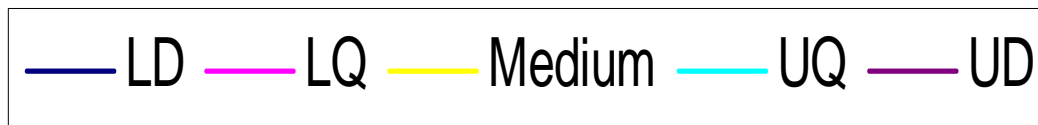
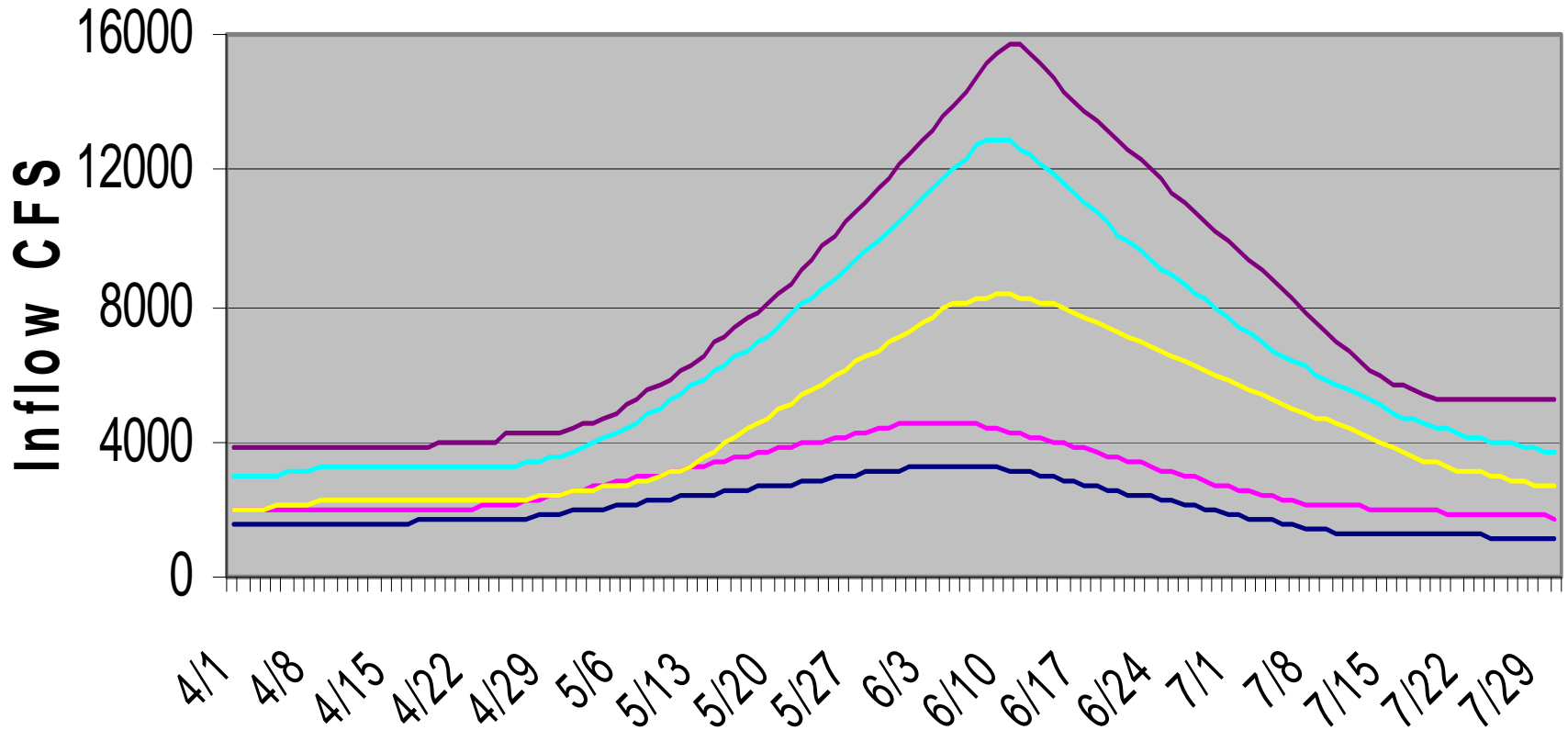
IN

Daily Mean Computed Inflow (cfs)

2002 2003 2004

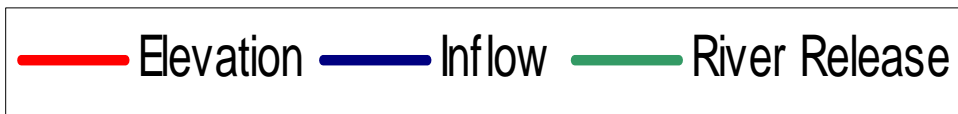
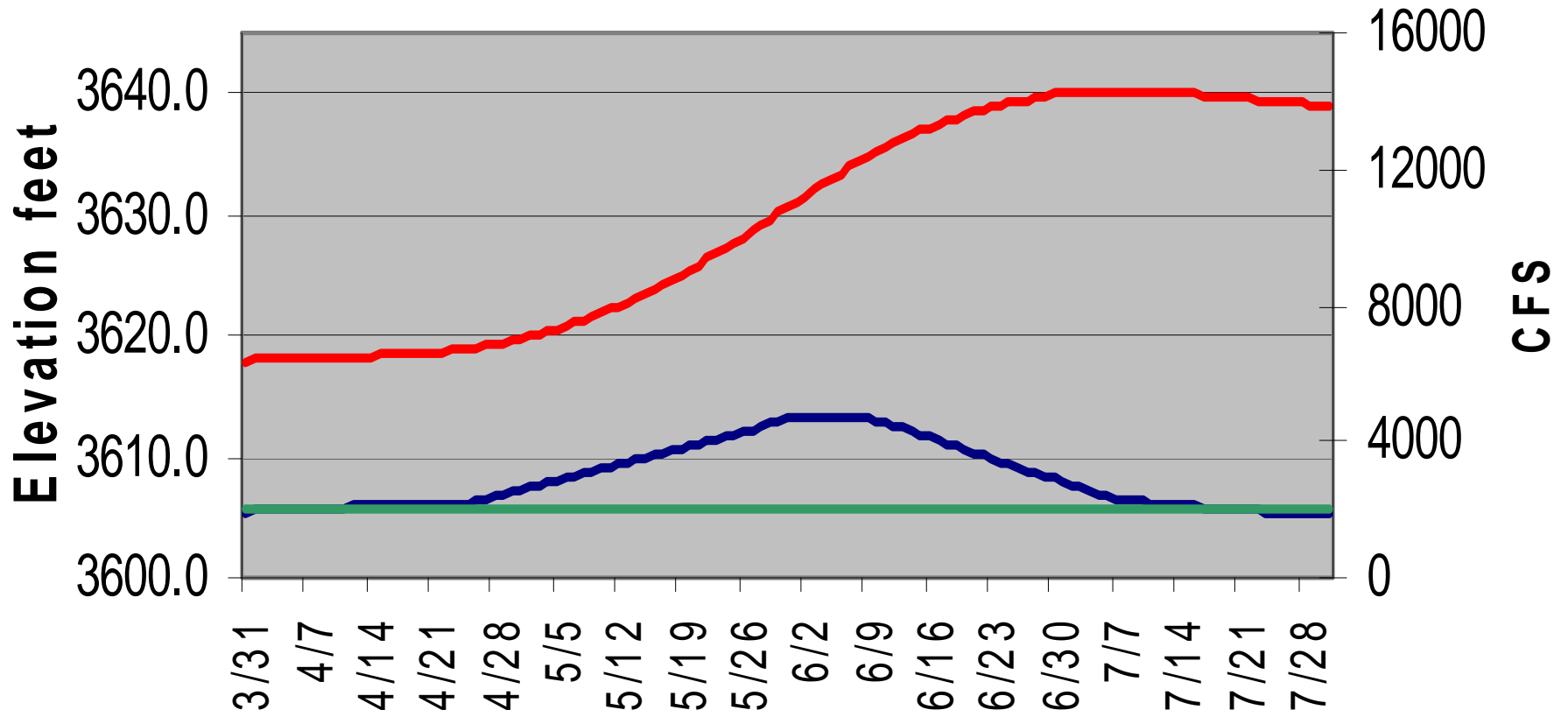
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# Bighorn Lake Statistical Inflow Levels

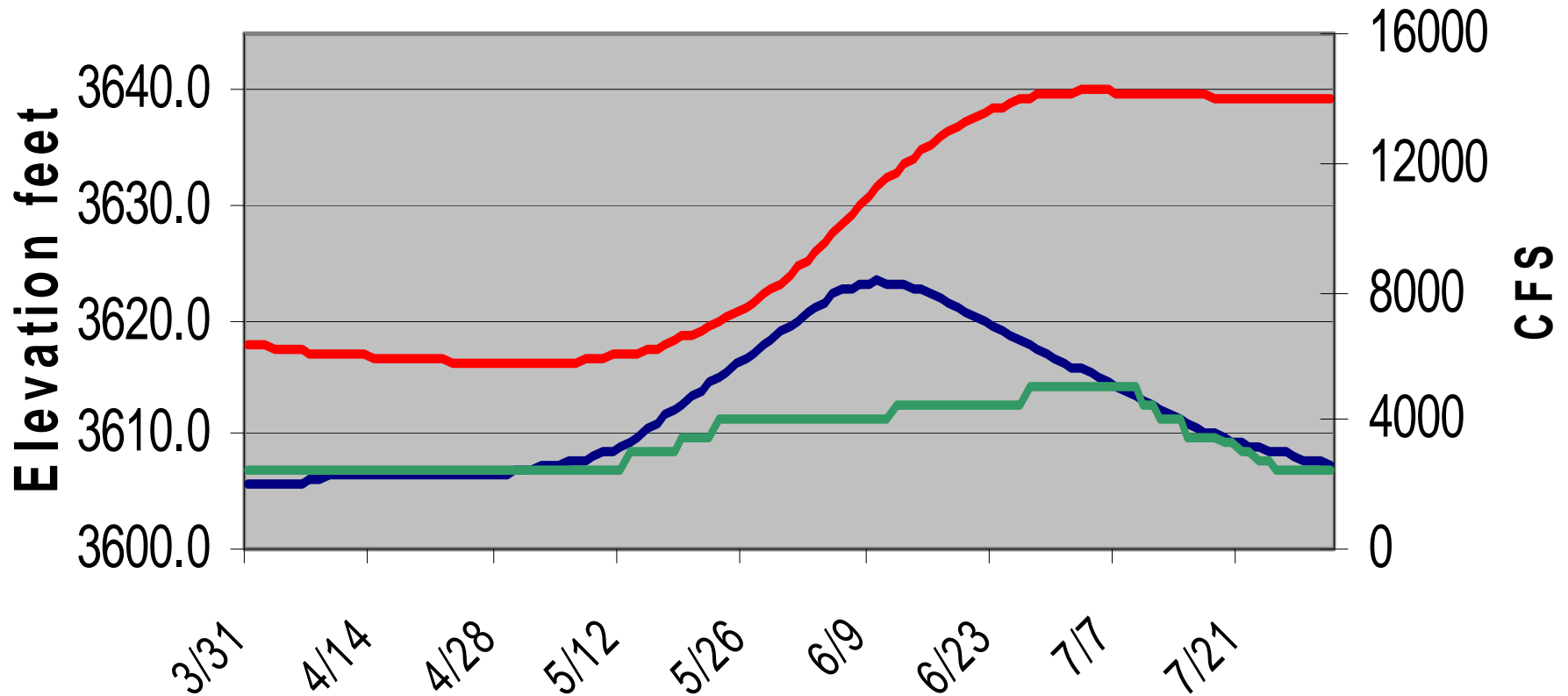




# Bighorn Lake 28 Percentile Inflow

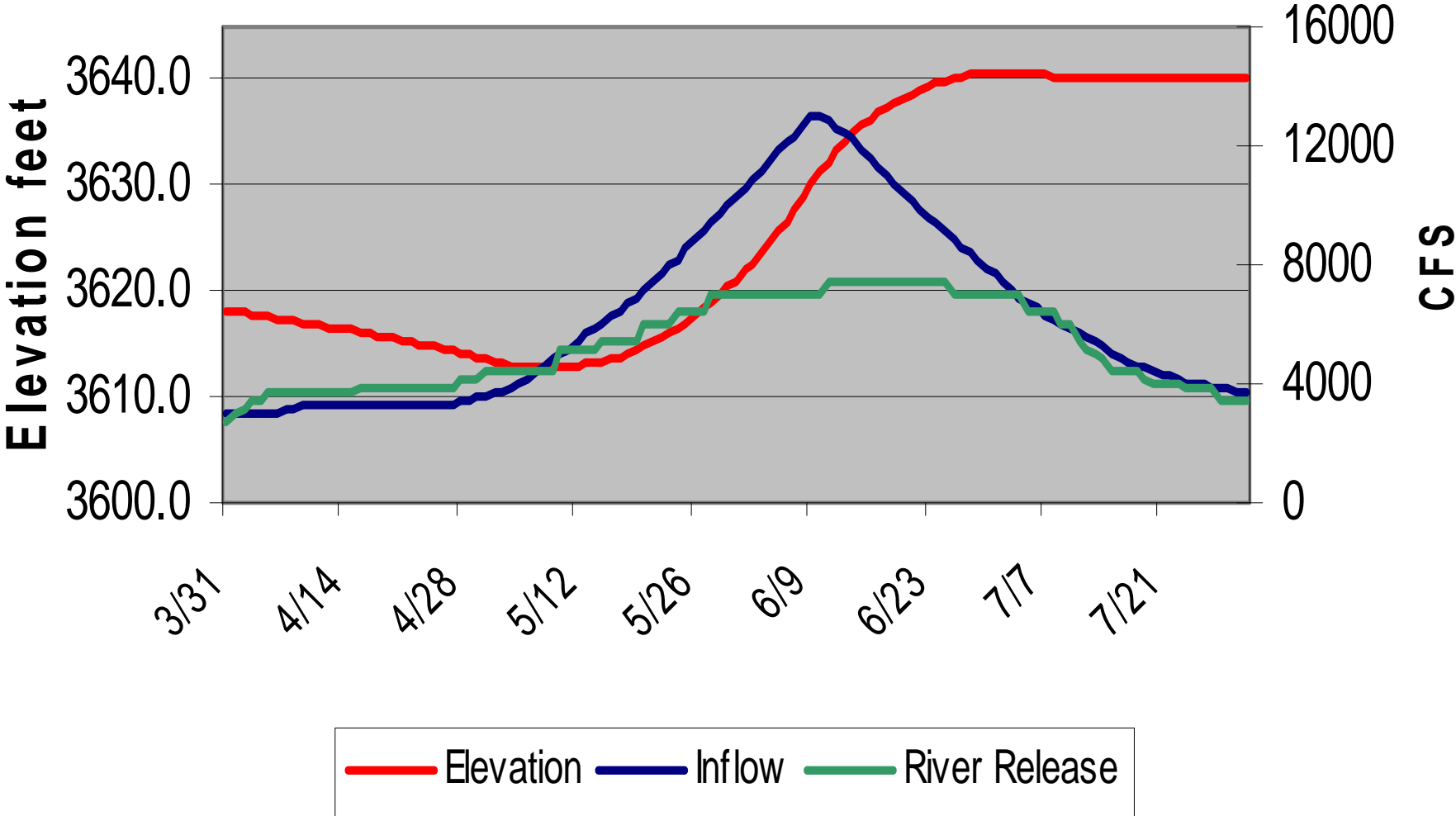


# Bighorn Lake Medium Inflow

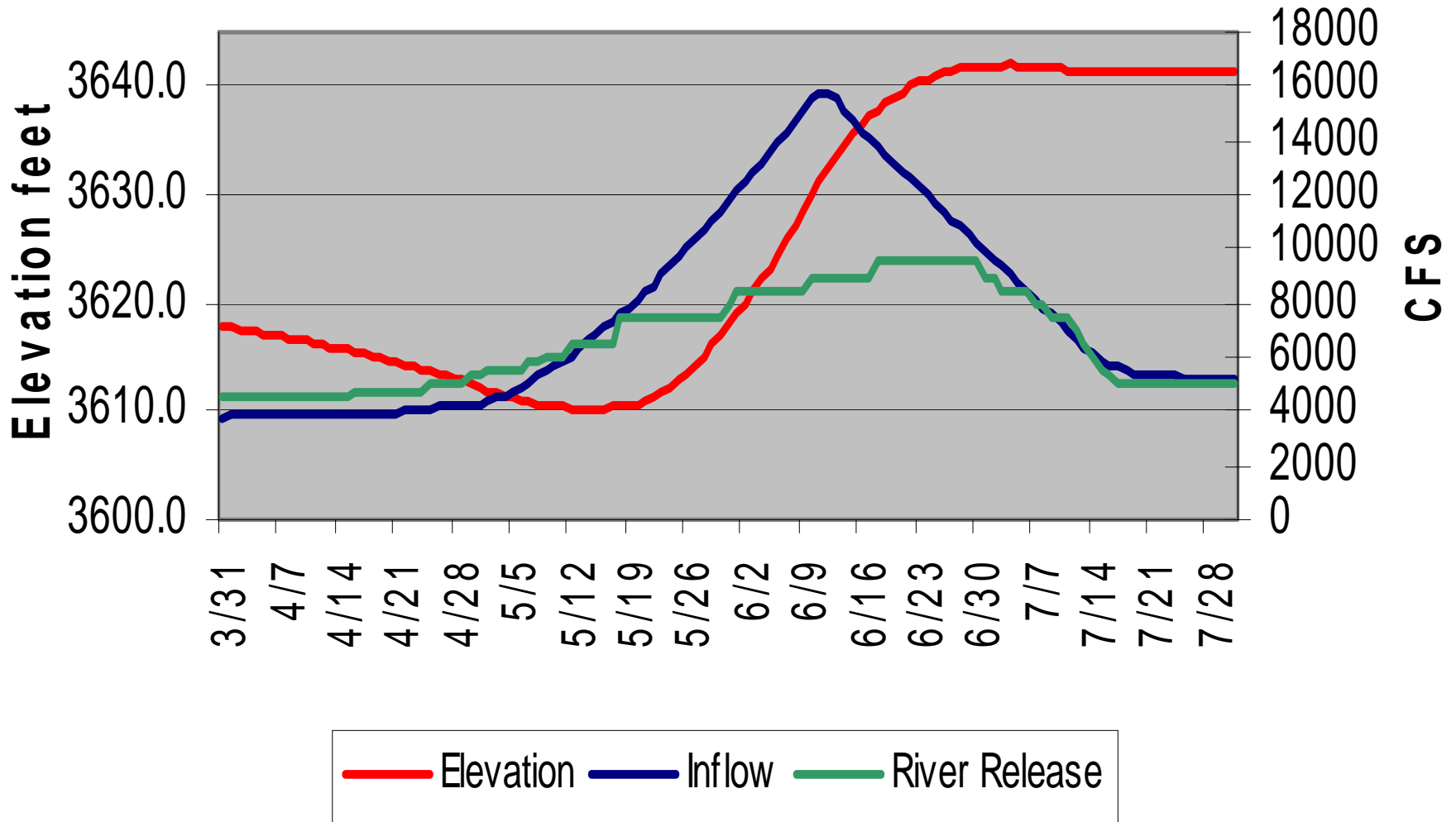


— Elevation — Inflow — River Release

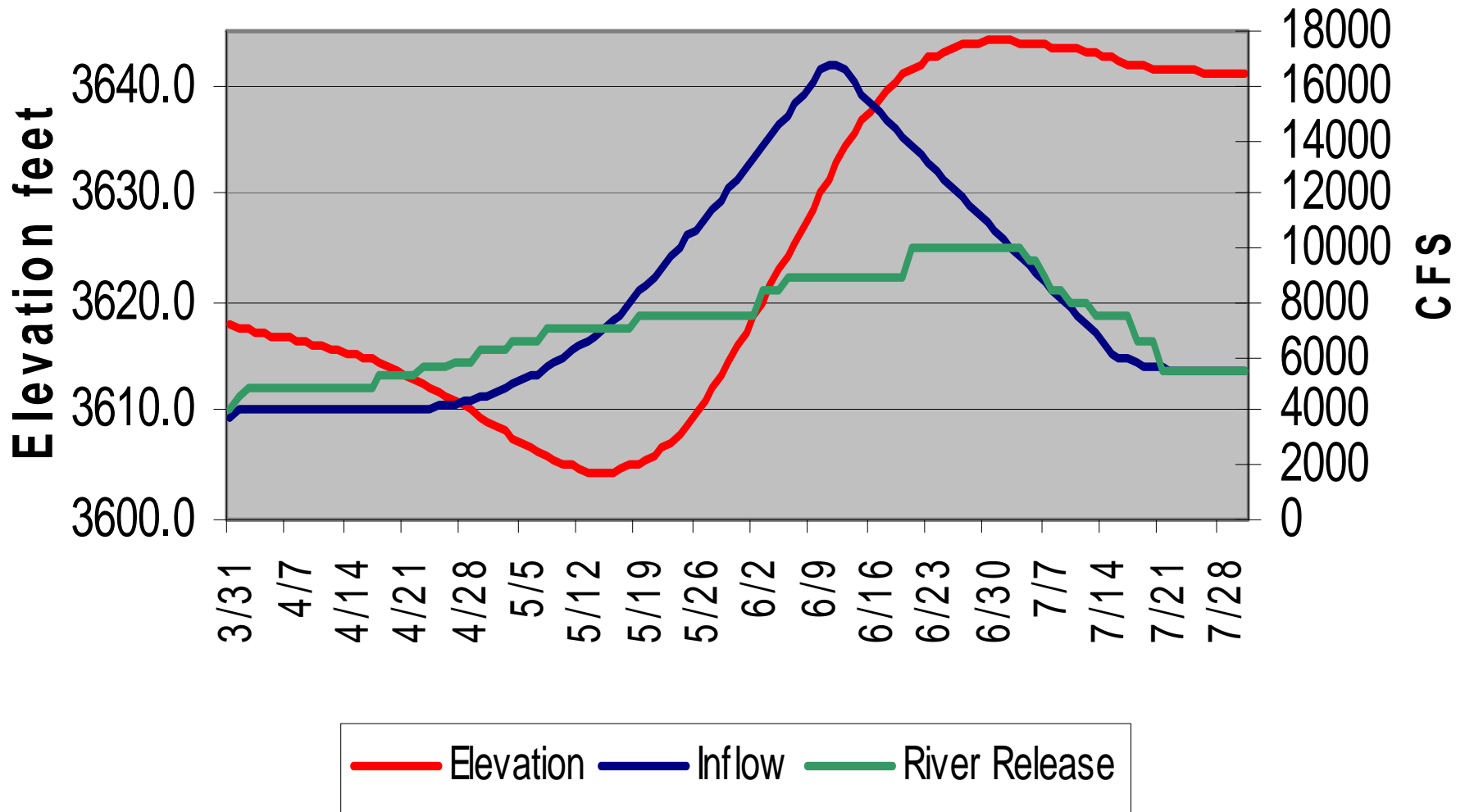
# Bighorn Lake UQ Inflow



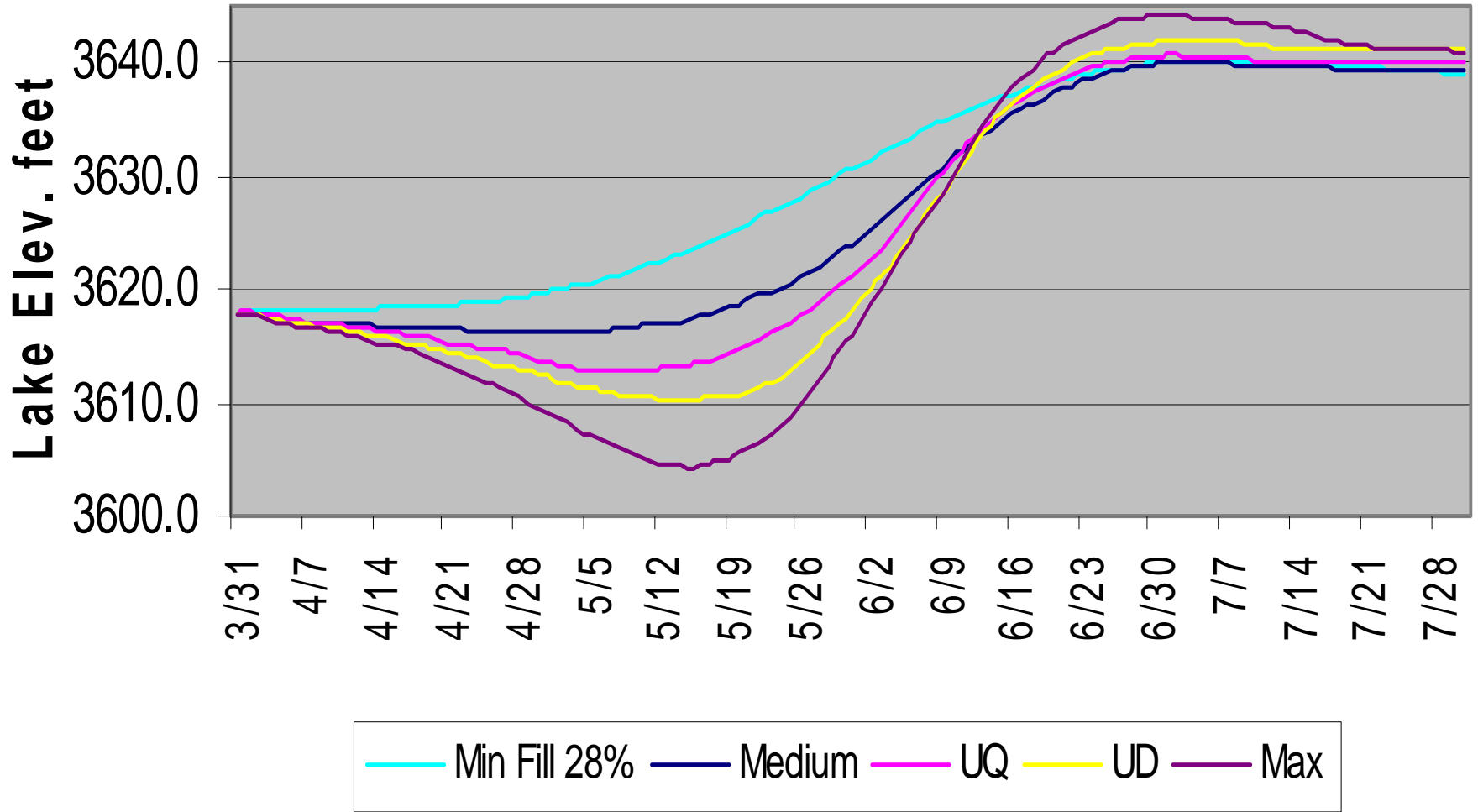
# Bighorn Lake UD Inflow



# Bighorn Lake Max Inflow



# Bighorn Lake Rule Curves



# Rule Curve Evaluation

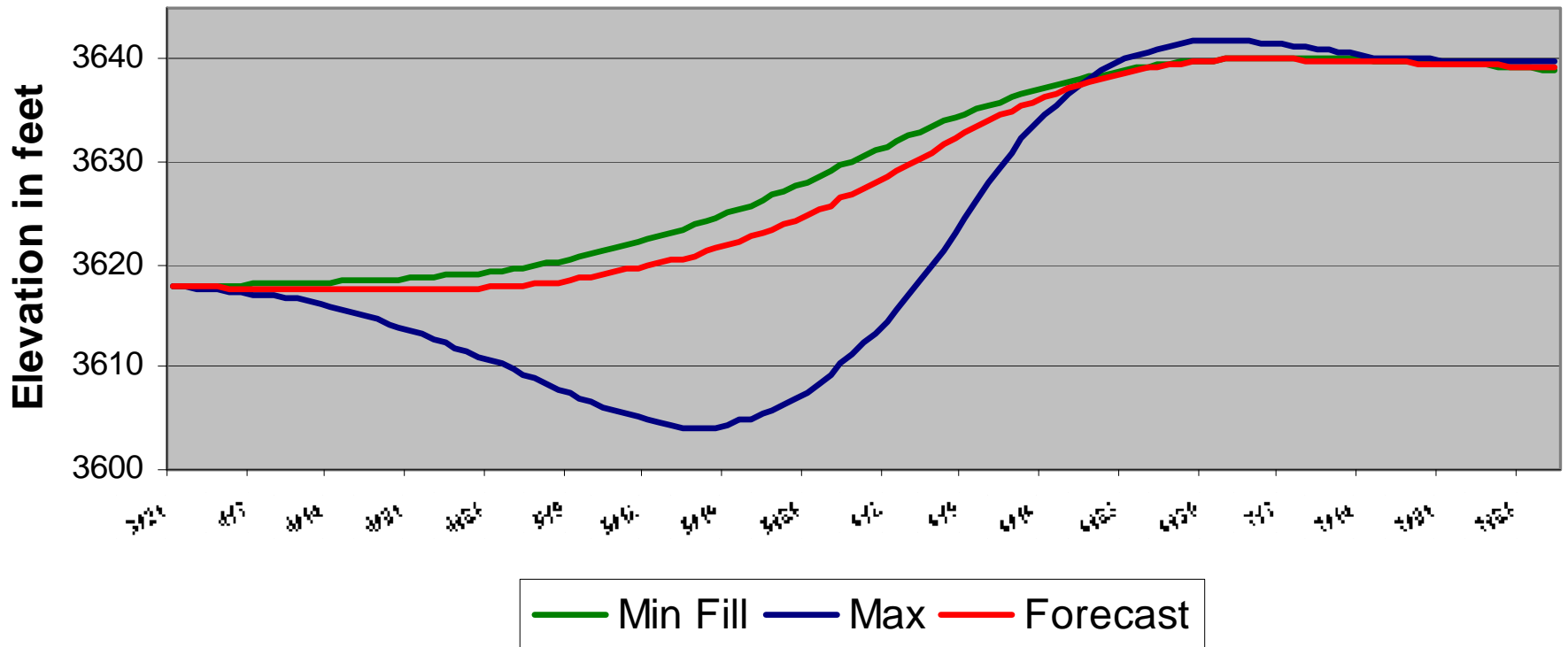
## Six Years Evaluated to Test Results

	Percent of Avg	Percentile
• 1995 High Runoff	149%	85
• 1997 High Runoff	173%	98
• 1998 Near Average	110%	61
• 1999 High Runoff	172%	95
• 2000 Low Runoff	57%	24
• 2008 Near Average	115%	63

1995 Apr 1  
897,000 acre-feet

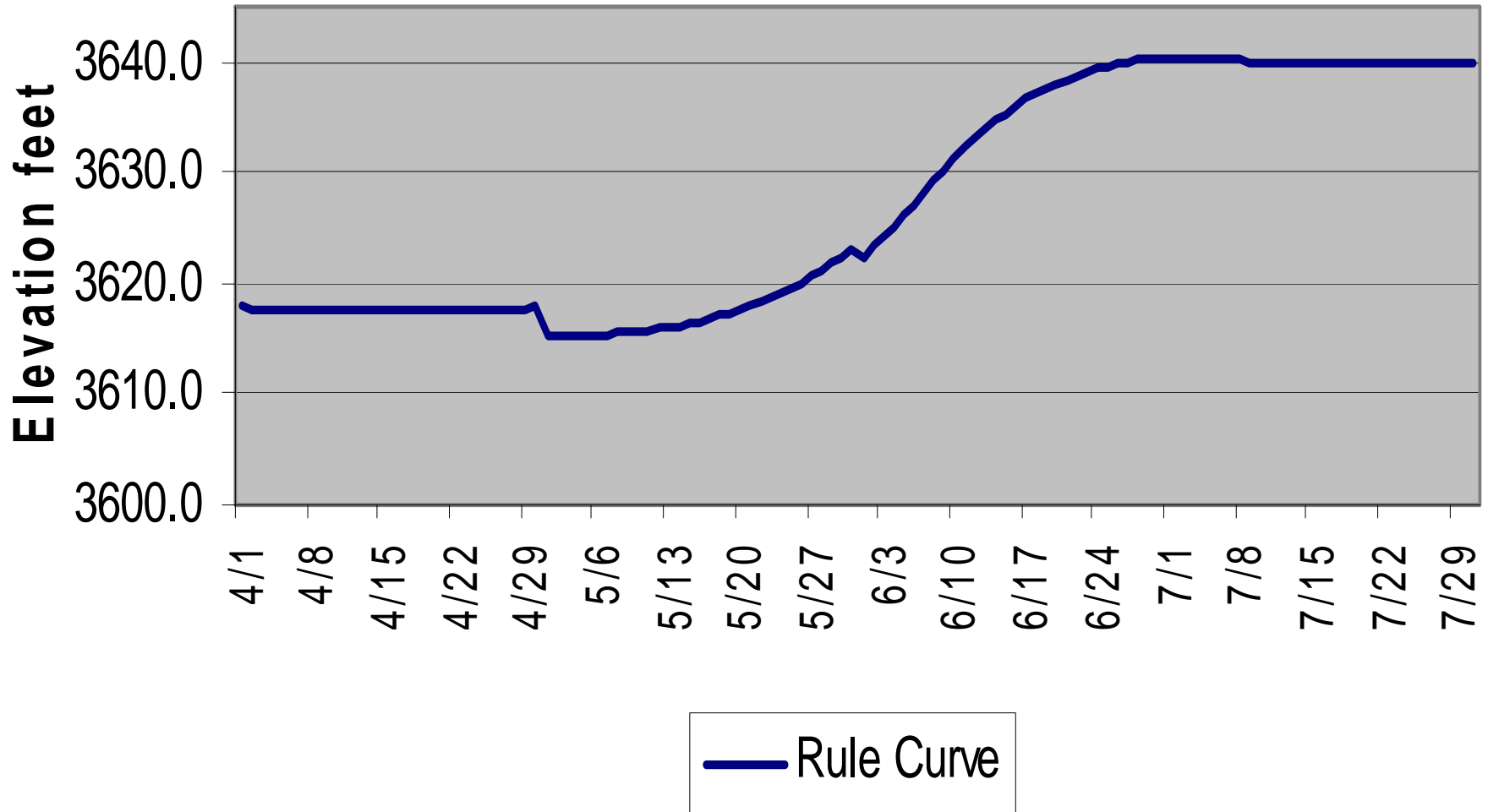
Apr-Jul Forecast  
36 Percentile Year

Bighorn Lake Elevation  
for Forecast A-J Inflow with Rule Curves

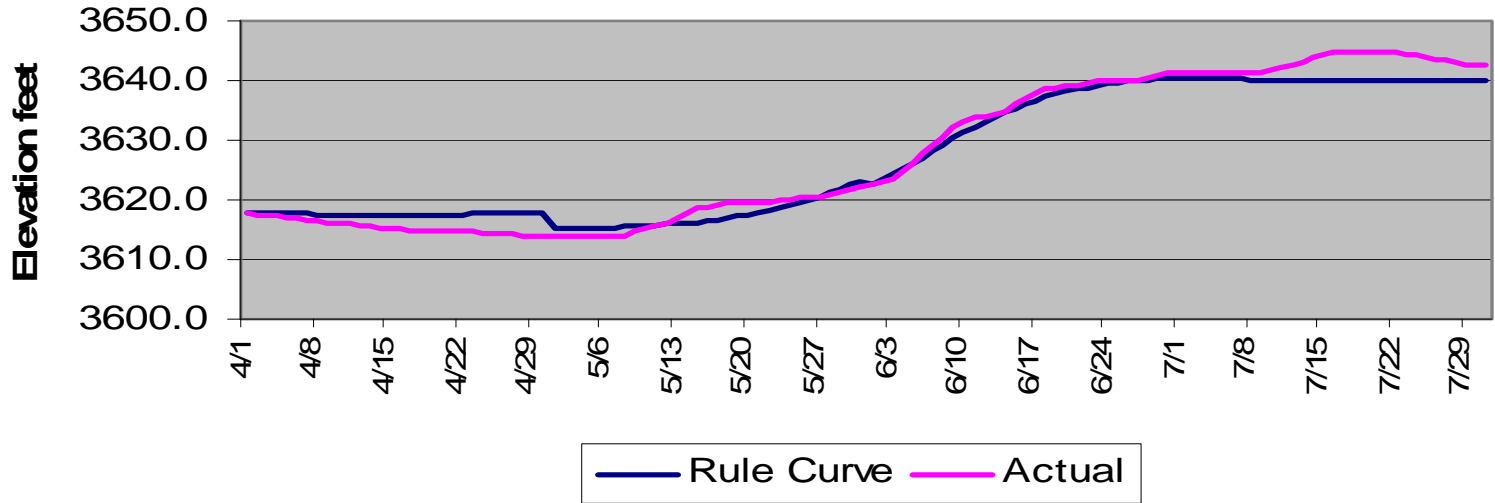




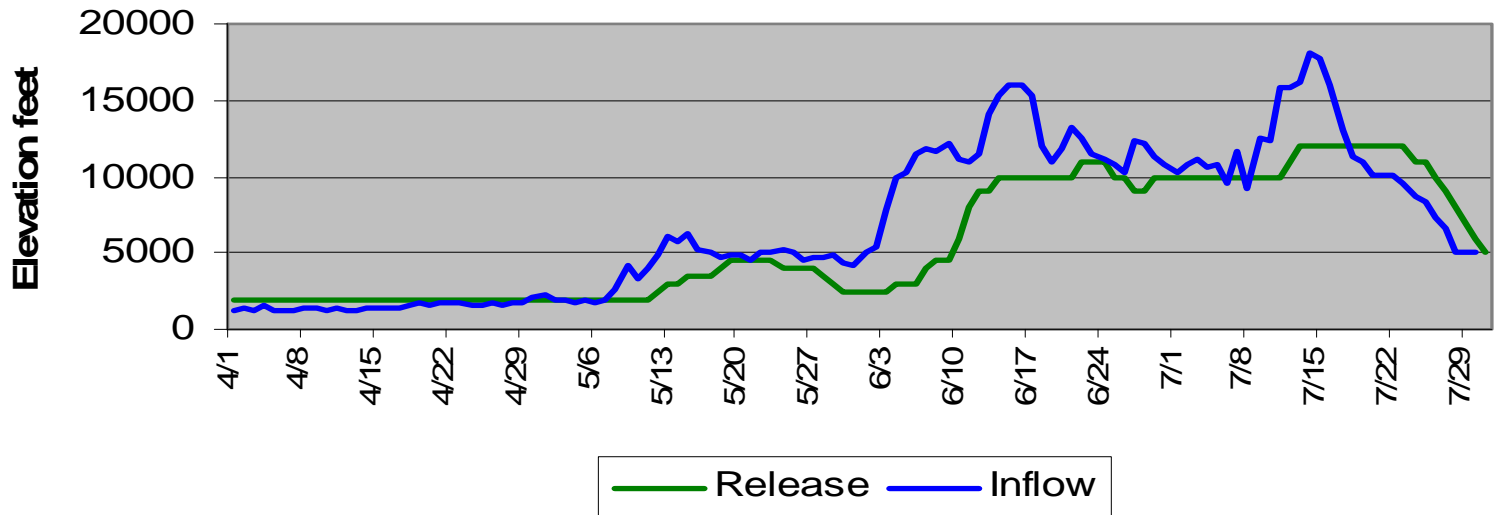
# Bighorn Lake Operations 1995



### Bighorn Lake Operations 1995



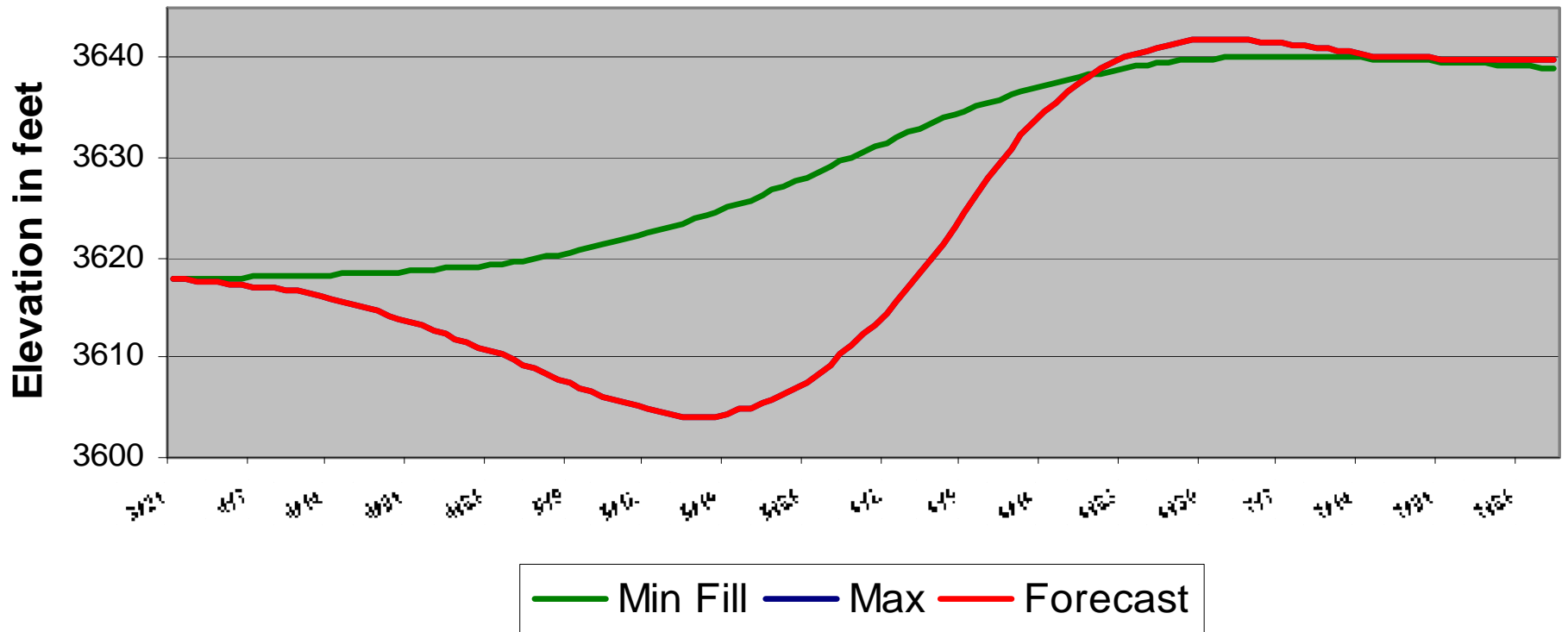
### Bighorn Lake Operations 1995



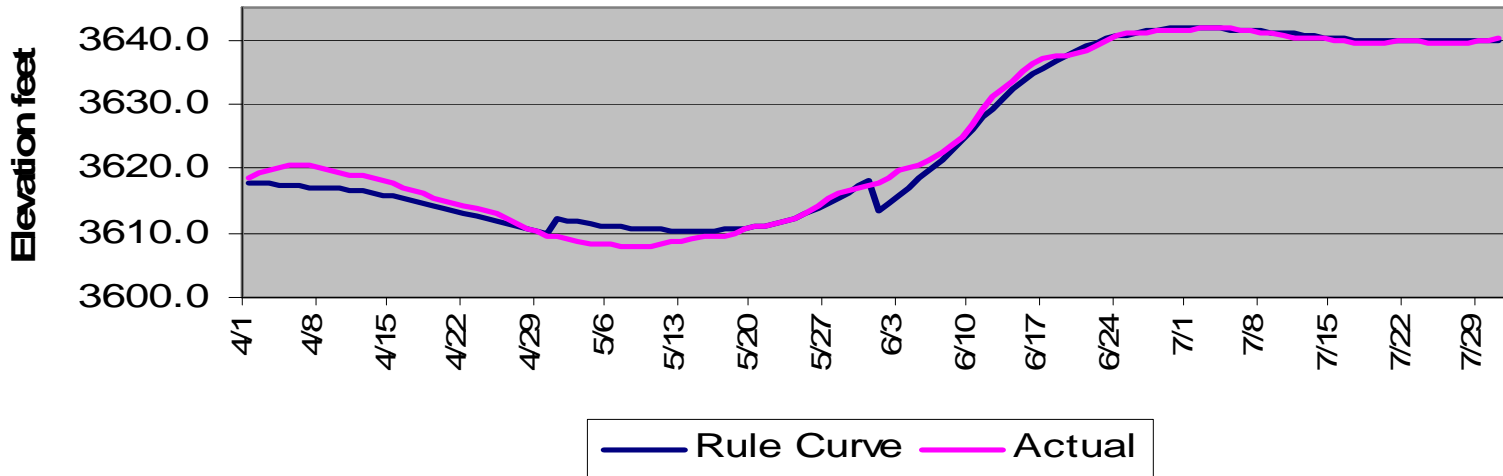
# 1997 Apr 1      Apr-Jul Forecast

## 2,099,000 acre-feet      99 Percentile Year

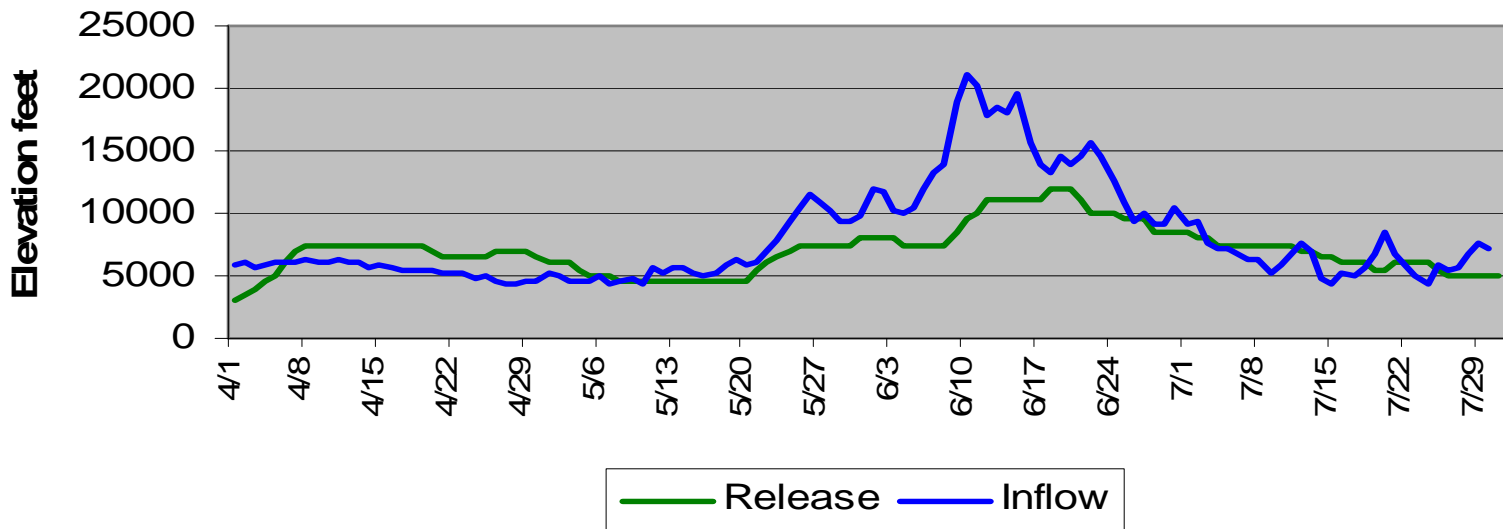
### Bighorn Lake Elevation for Forecast A-J Inflow with Rule Curves



### Bighorn Lake Operations 1997



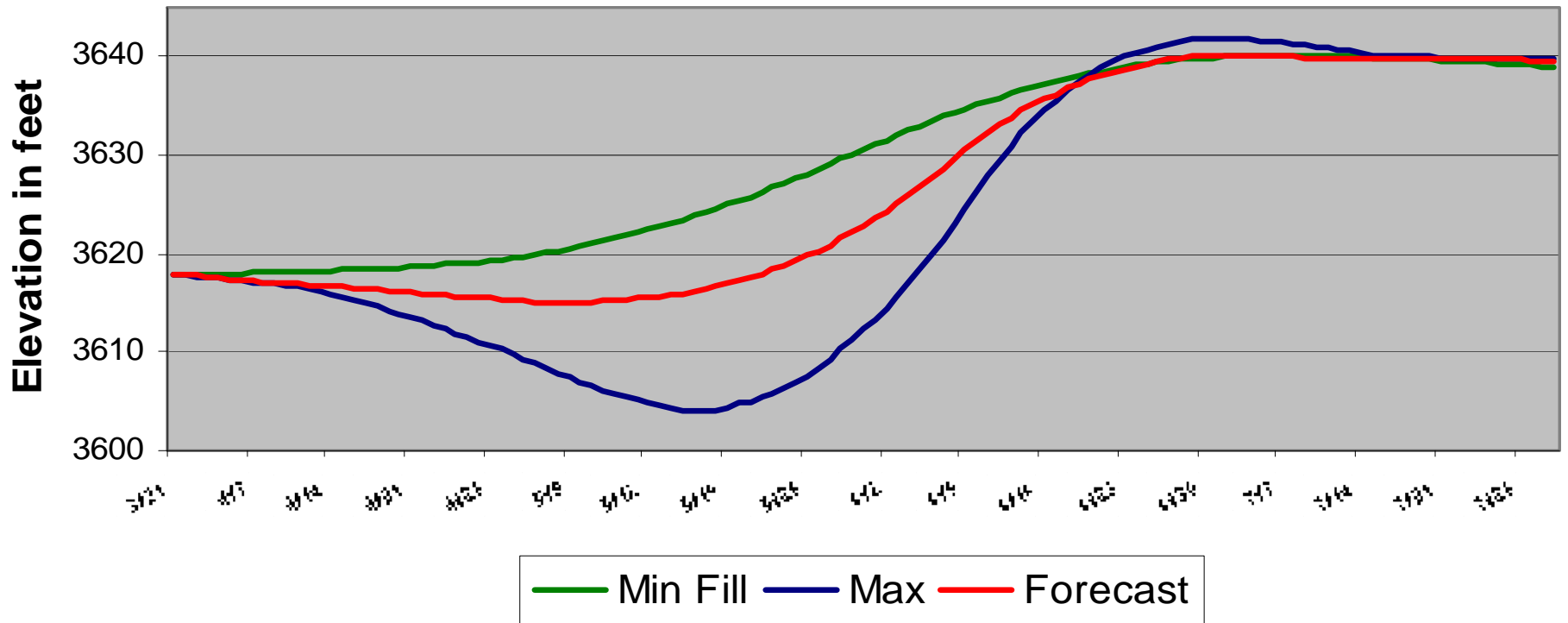
### Bighorn Lake Operations 1997



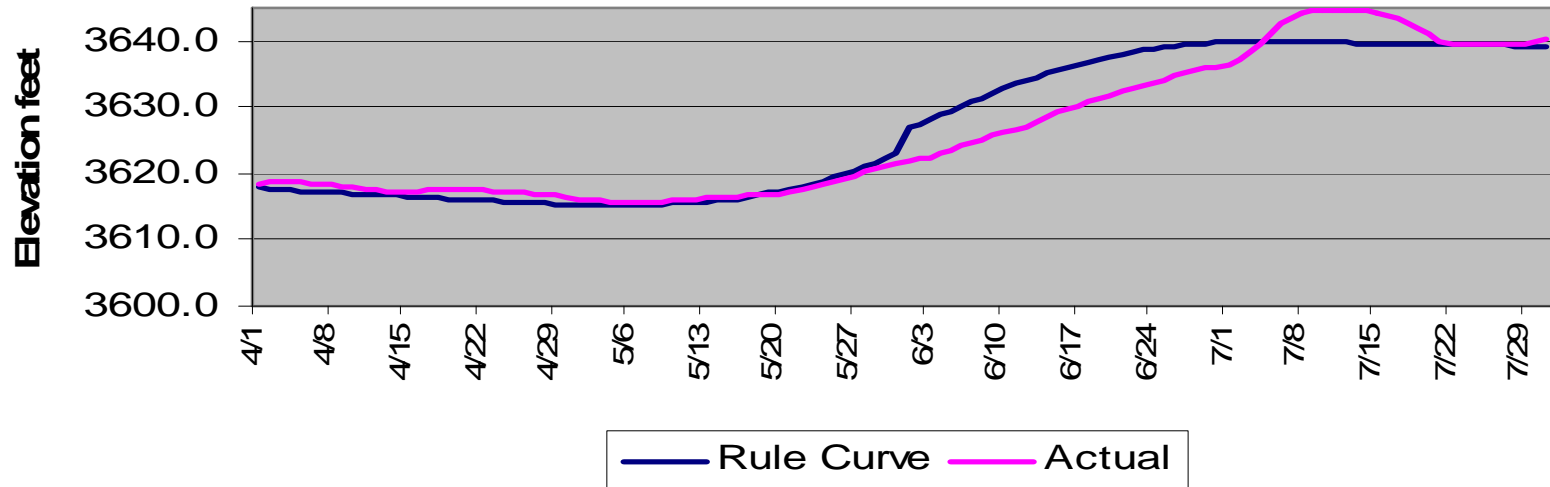
# 1998 Apr 1      Apr-Jul Forecast

## 1,267,000 acre-feet      62 Percentile Year

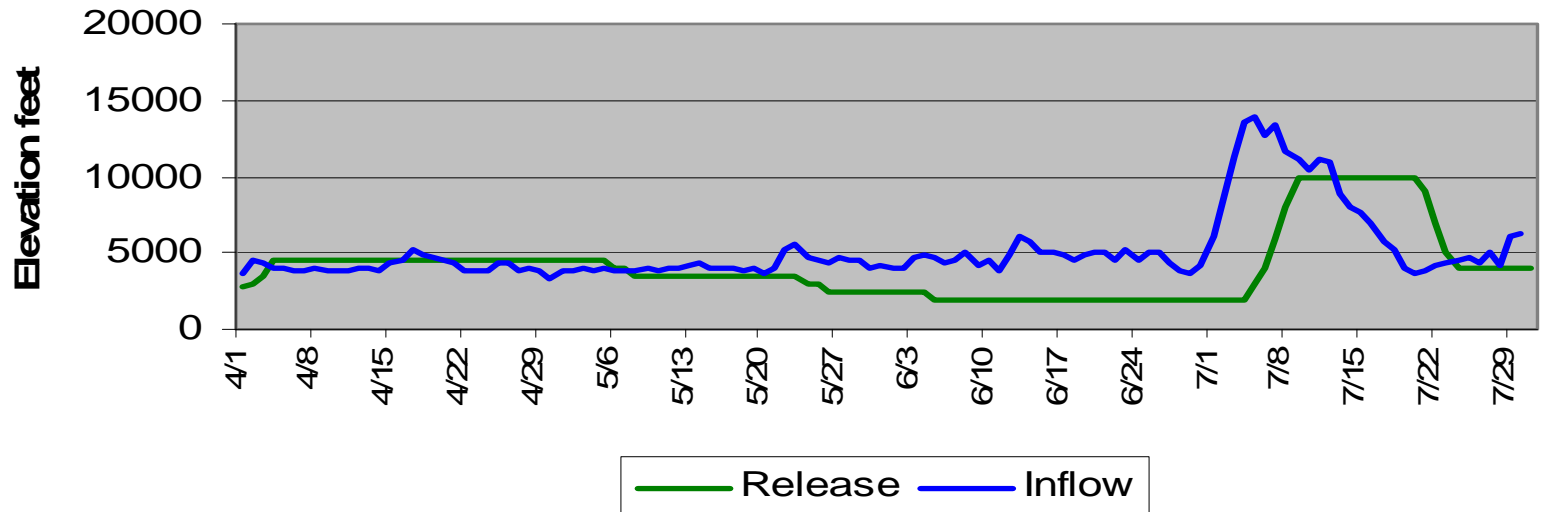
### Bighorn Lake Elevation for Forecast A-J Inflow with Rule Curves



## Bighorn Lake Operations 1998



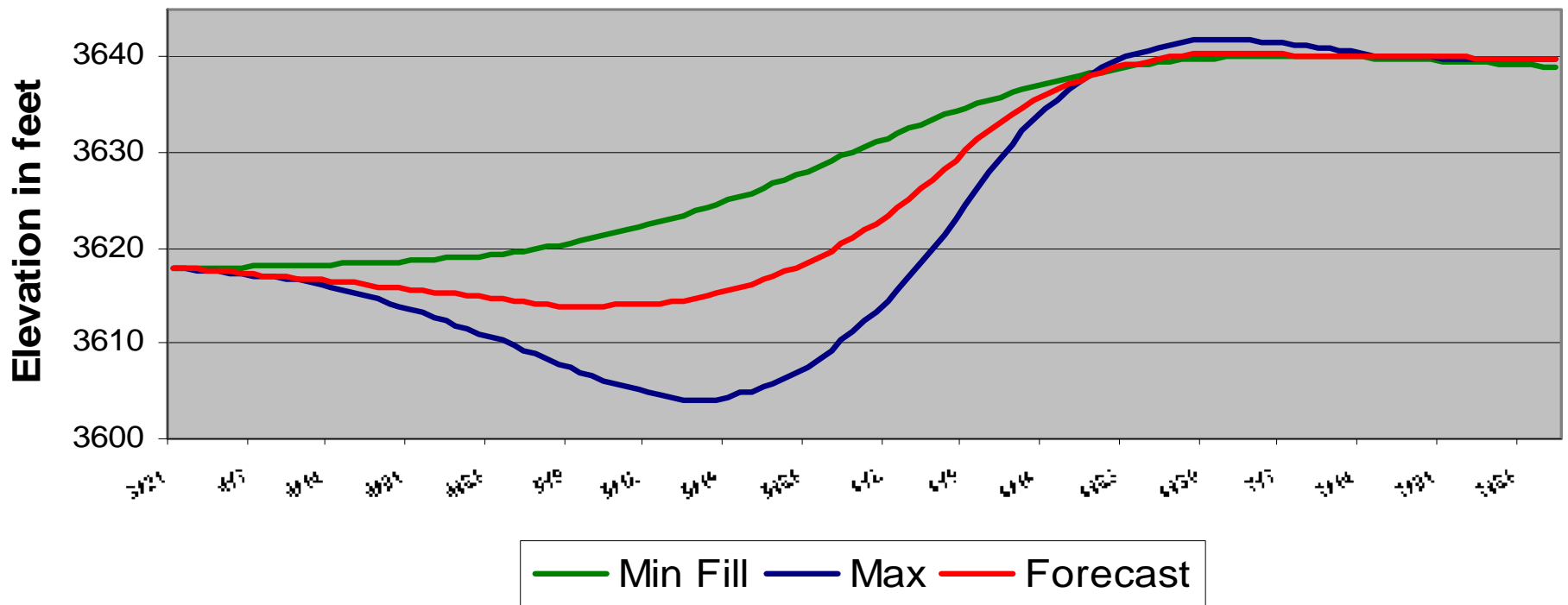
## Bighorn Lake Operations 1998



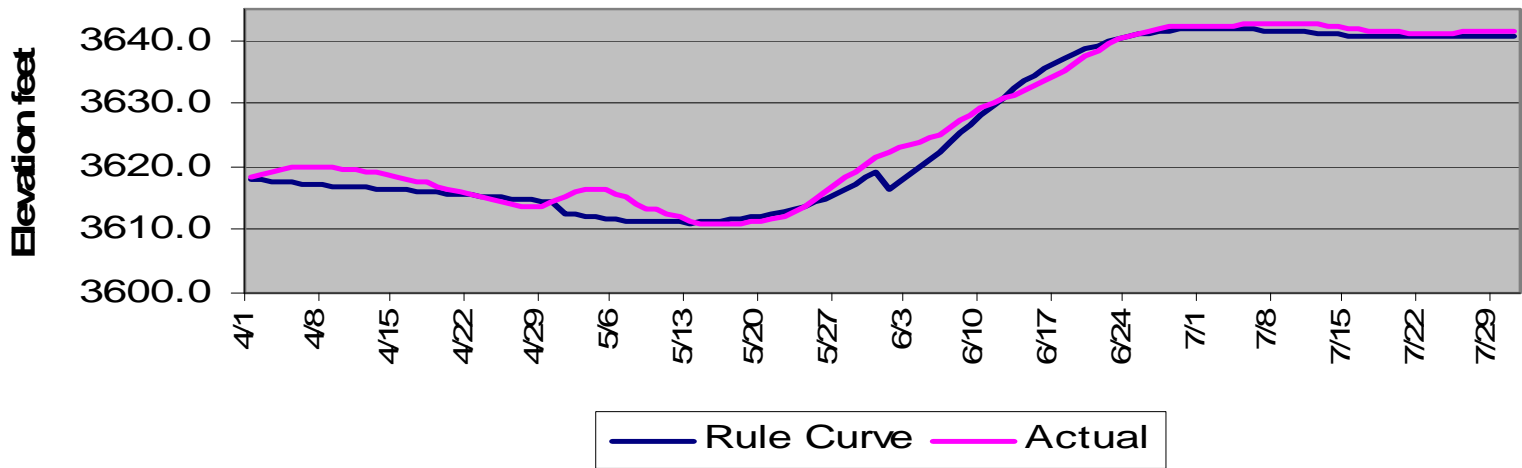
# 1999 Apr 1      Apr-Jul Forecast

## 1,445,000 acre-feet      72 Percentile Year

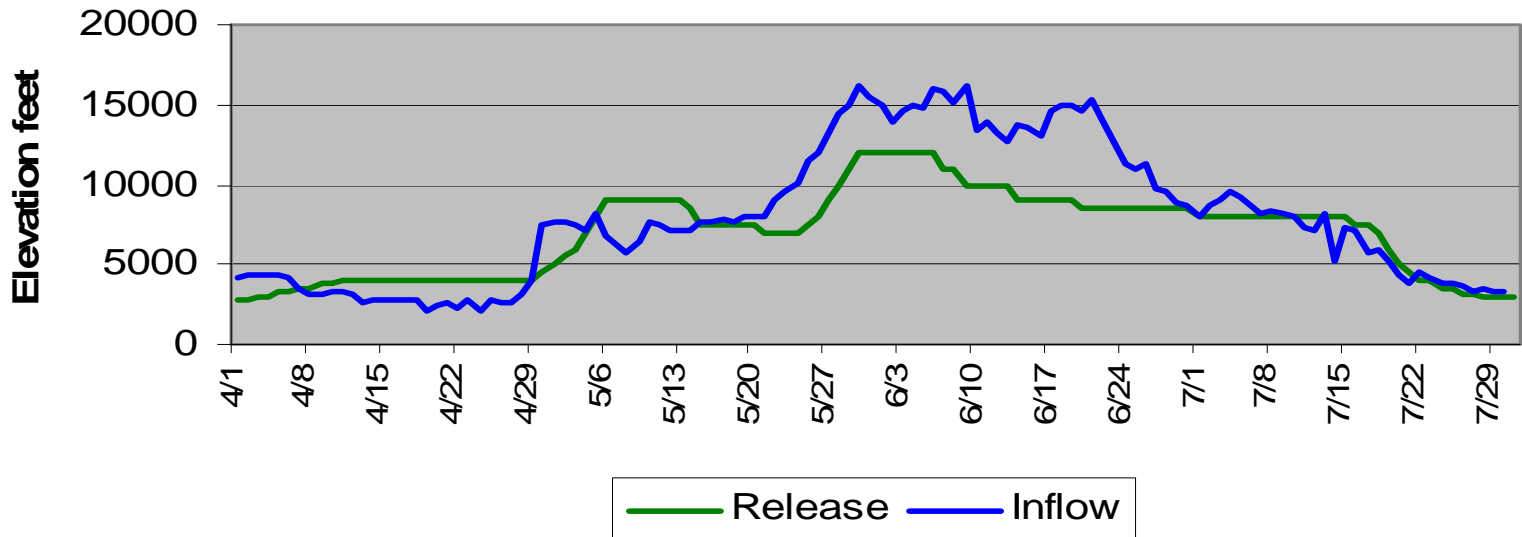
### Bighorn Lake Elevation for Forecast A-J Inflow with Rule Curves



### Bighorn Lake Operations 1999



### Bighorn Lake Operations 1999

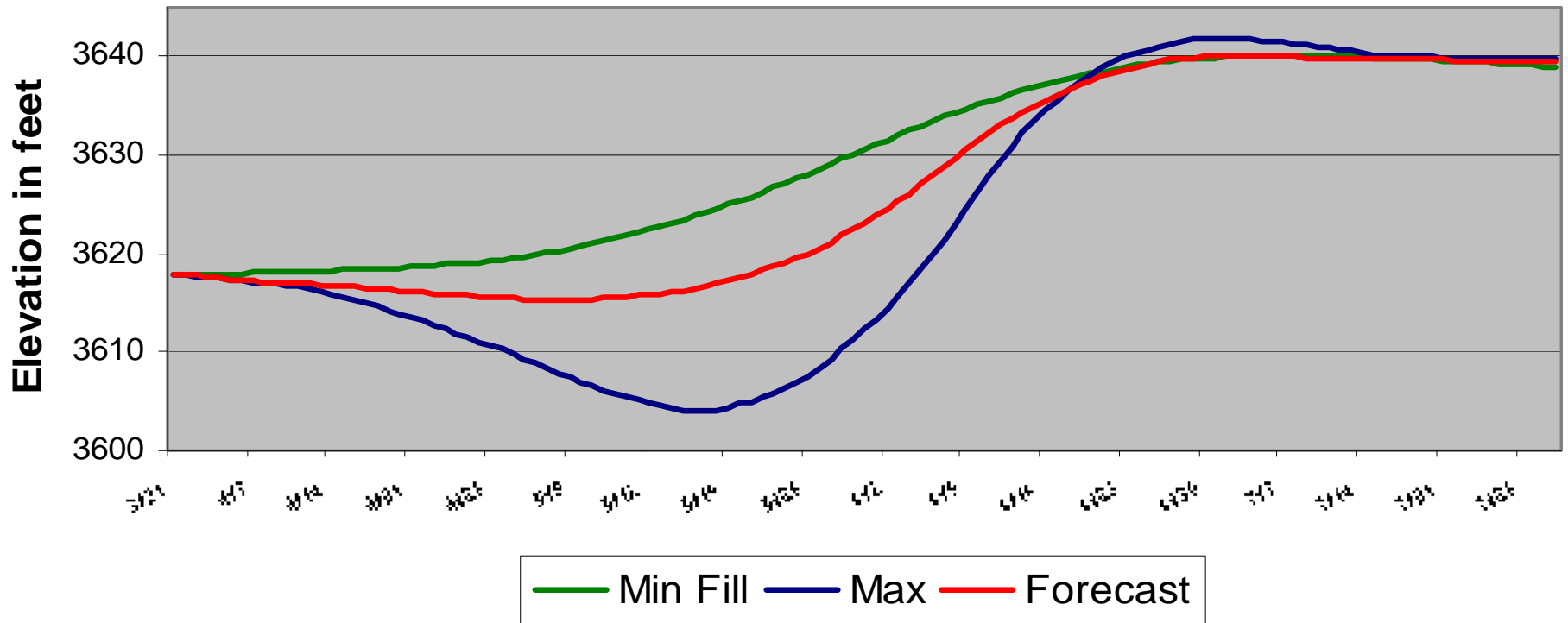




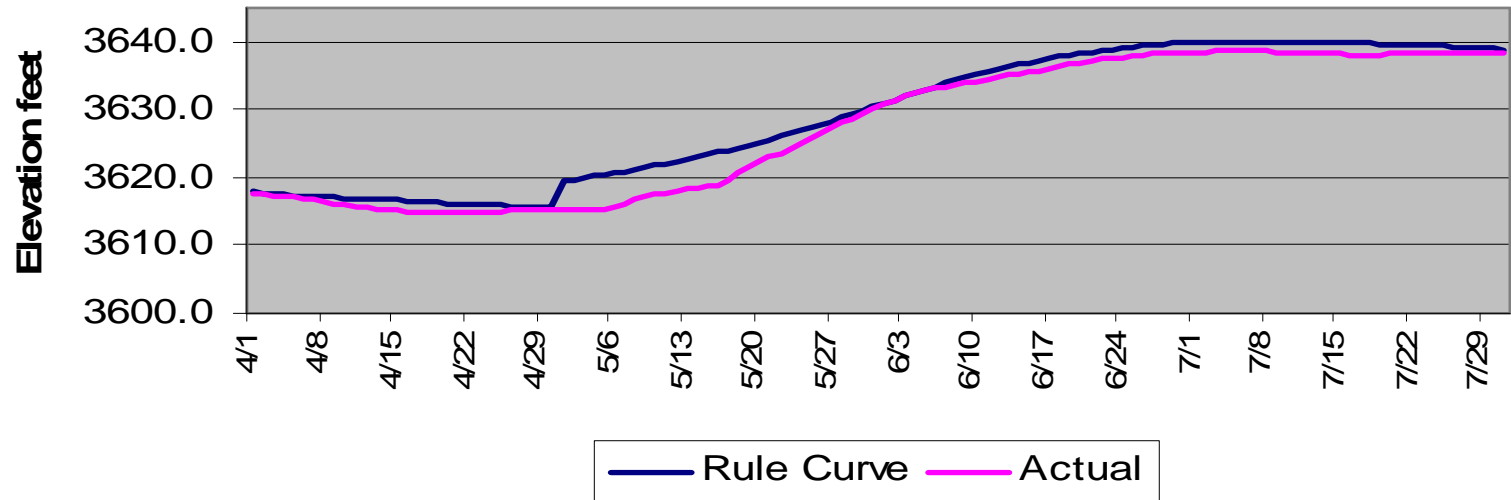
# 2000 Apr 1      Apr-Jul Forecast

## 1,228,000 acre-feet      60 Percentile Year

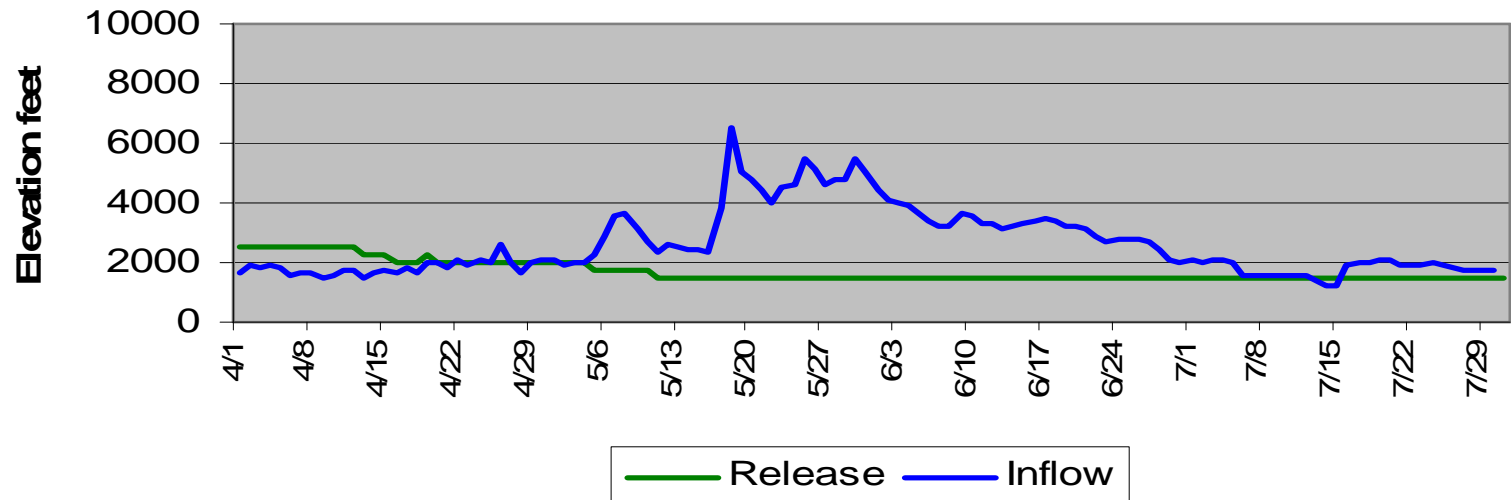
### Bighorn Lake Elevation for Forecast A-J Inflow with Rule Curves



## Bighorn Lake Operations 2000



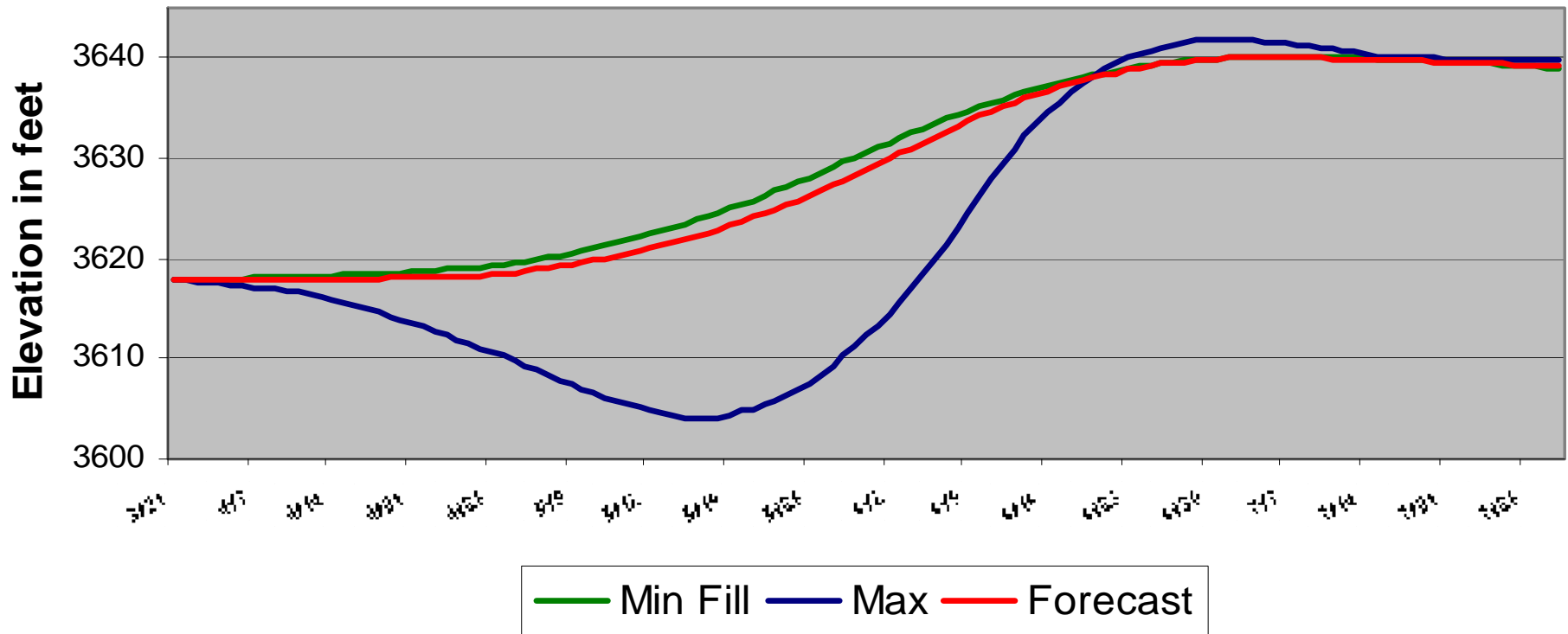
## Bighorn Lake Operations 2000



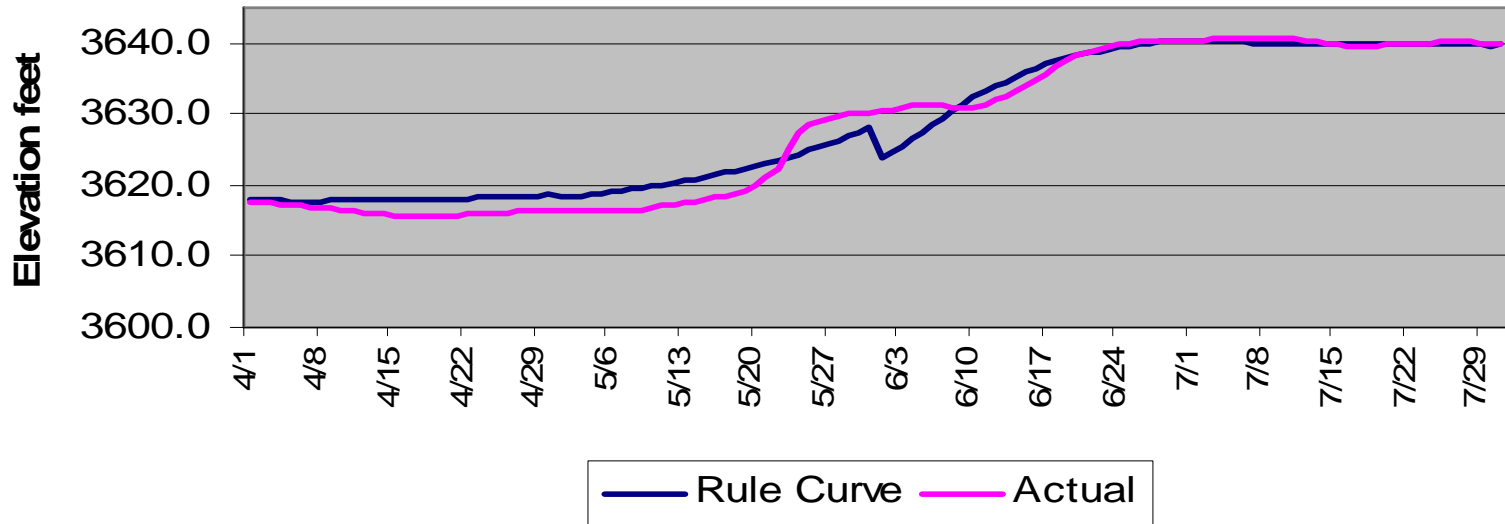
2008 Apr 1  
820,000 acre-feet

Apr-Jul Forecast  
32 Percentile Year

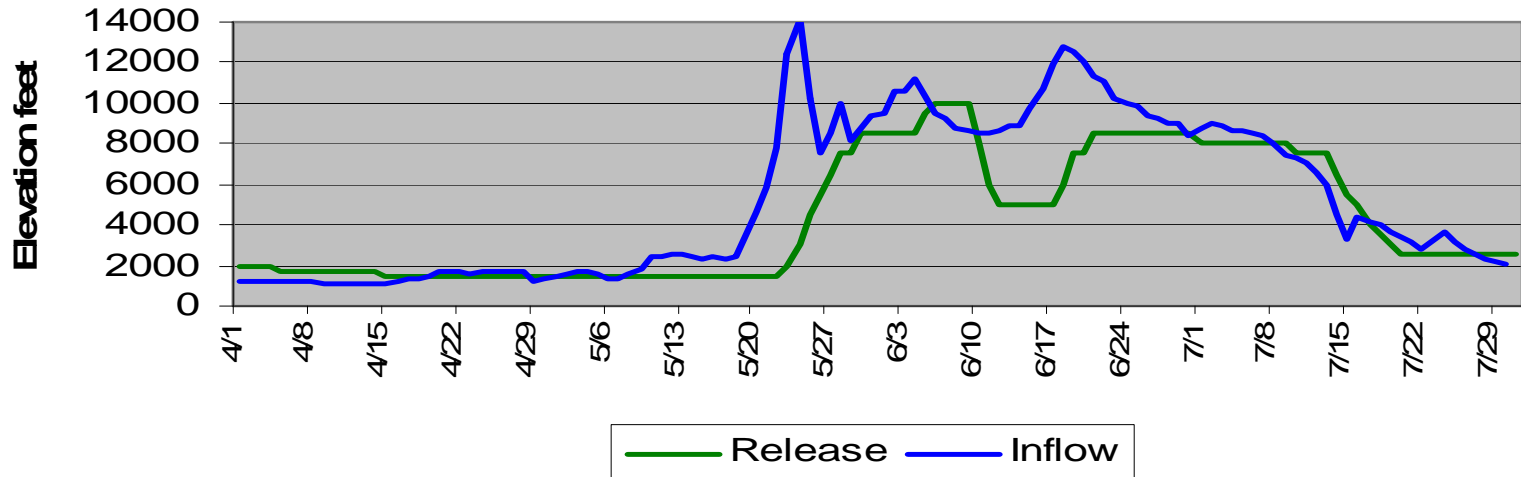
### Bighorn Lake Elevation for Forecast A-J Inflow with Rule Curves



## Bighorn Lake Operations 2008



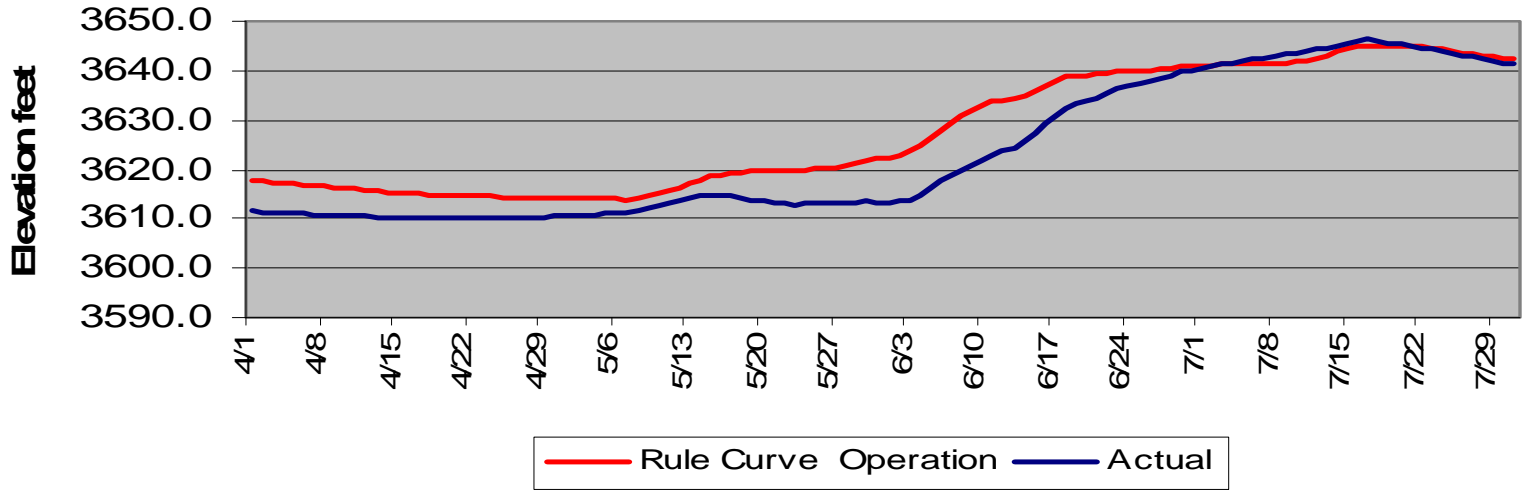
## Bighorn Lake Operations 2008



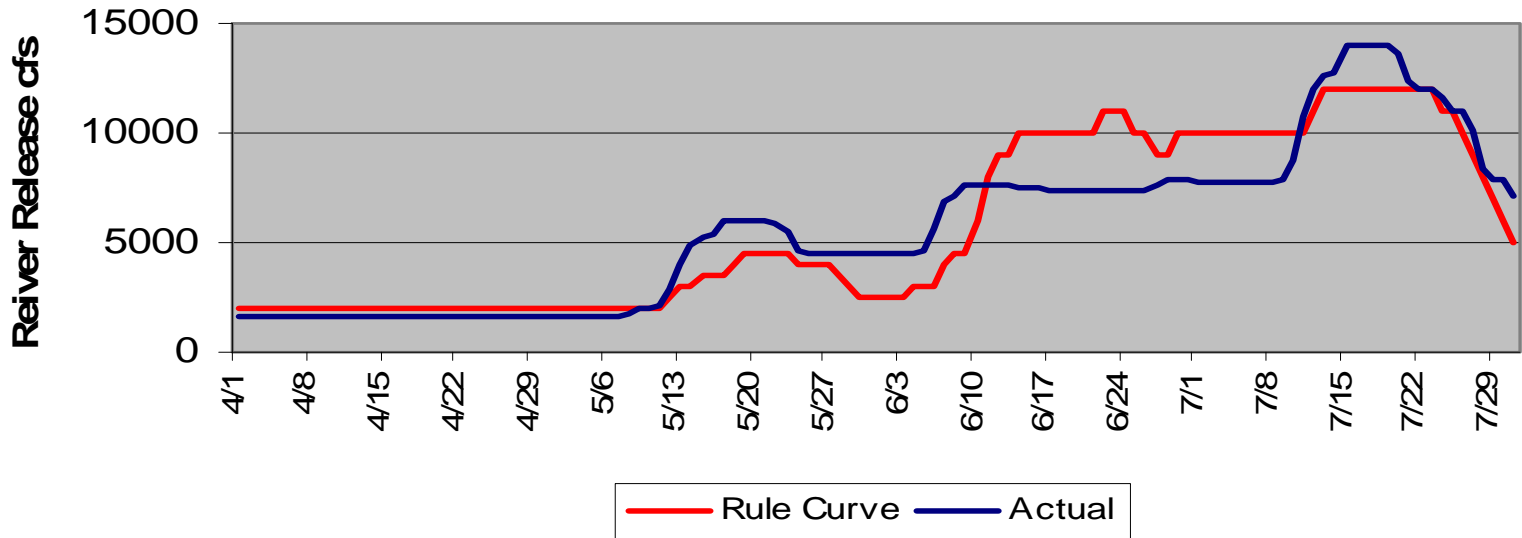
# COMPARISON RULE CURVES VS ACTUAL

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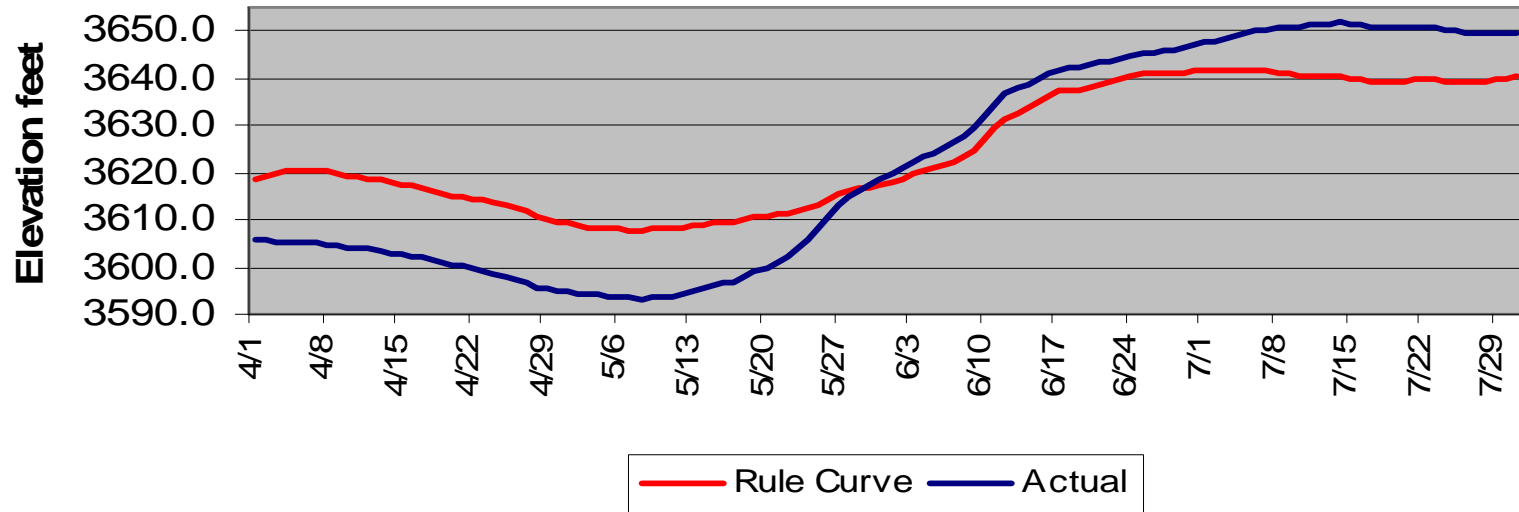
### Bighorn Lake Rule Curve Operation vs Actual 1995



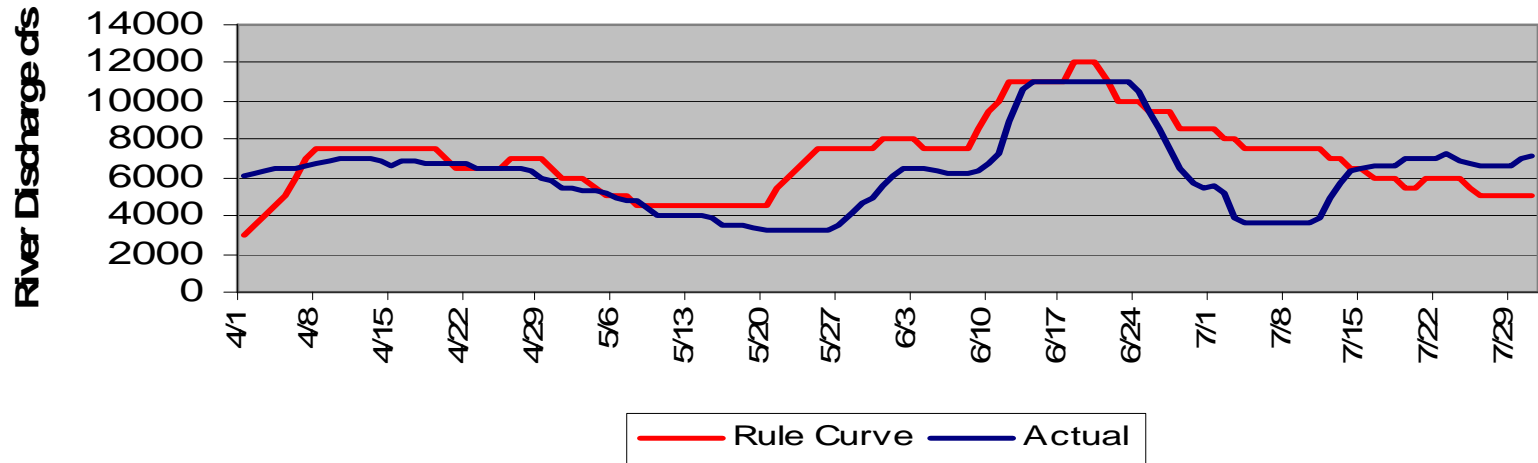
### Bighorn Lake - Rule Curve vs Actual 1995



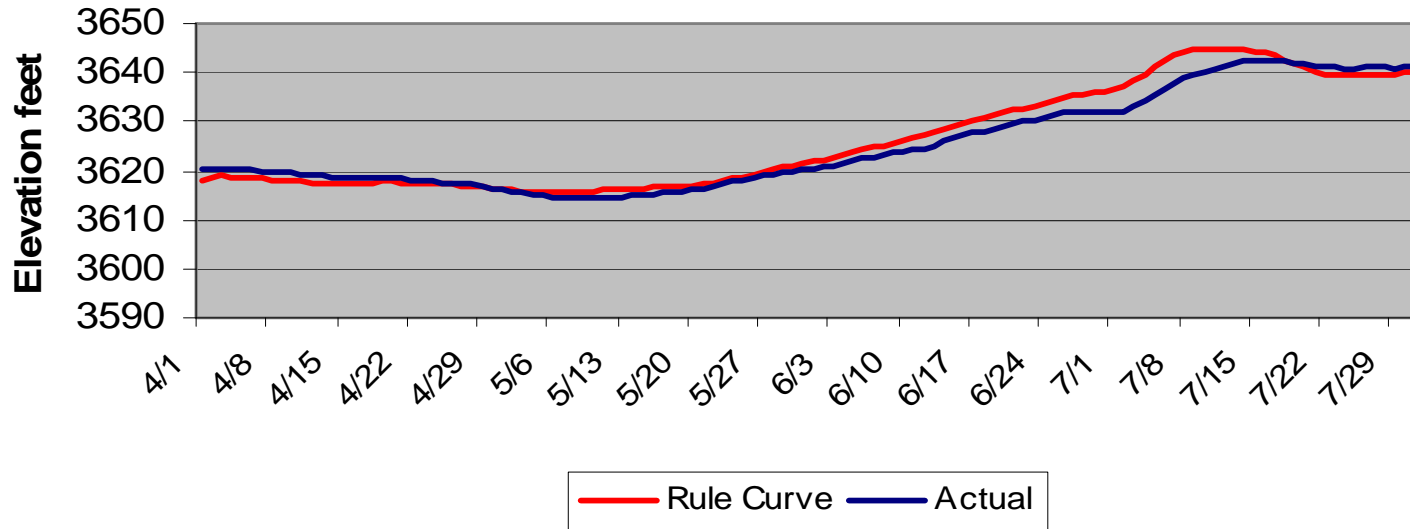
## Bighorn Lake - Rule Curve vs Actual 1997



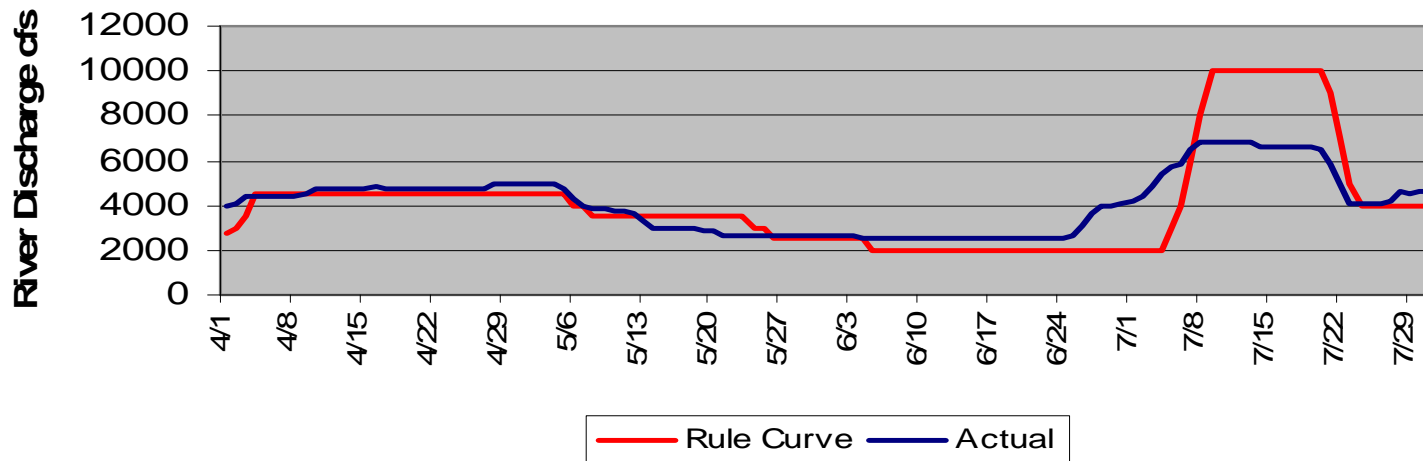
## Bighorn Lake - Rule Curve vs Actual 1997



## Bighorn Lake - Rule Curve vs Actual 1998

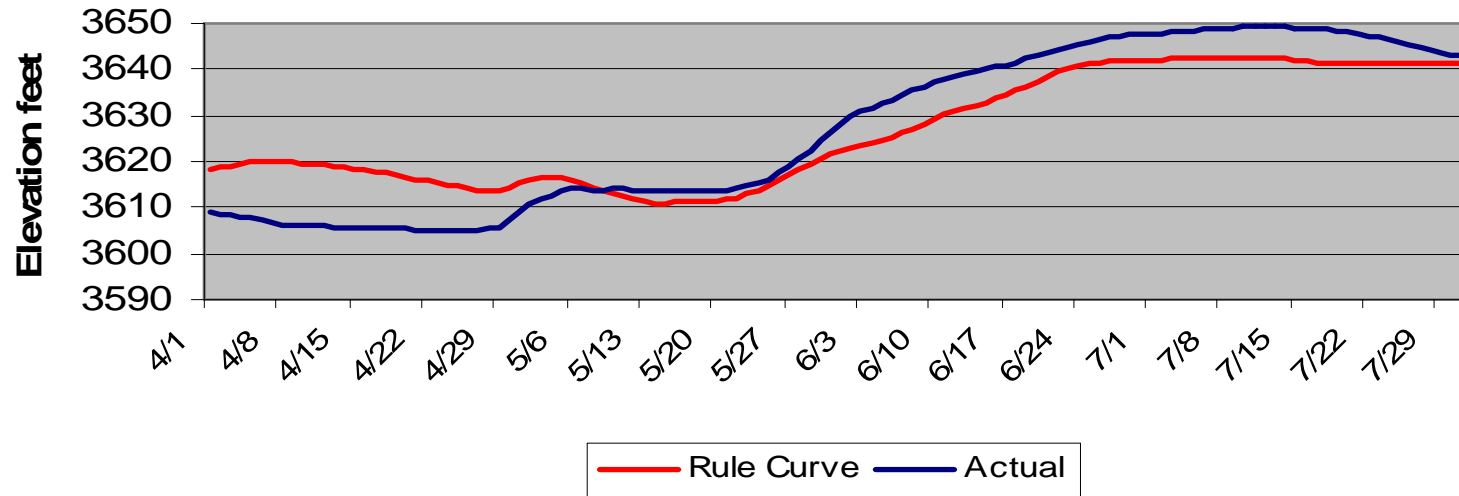


## Bighorn Lake - Rule Curve vs Actual 1998

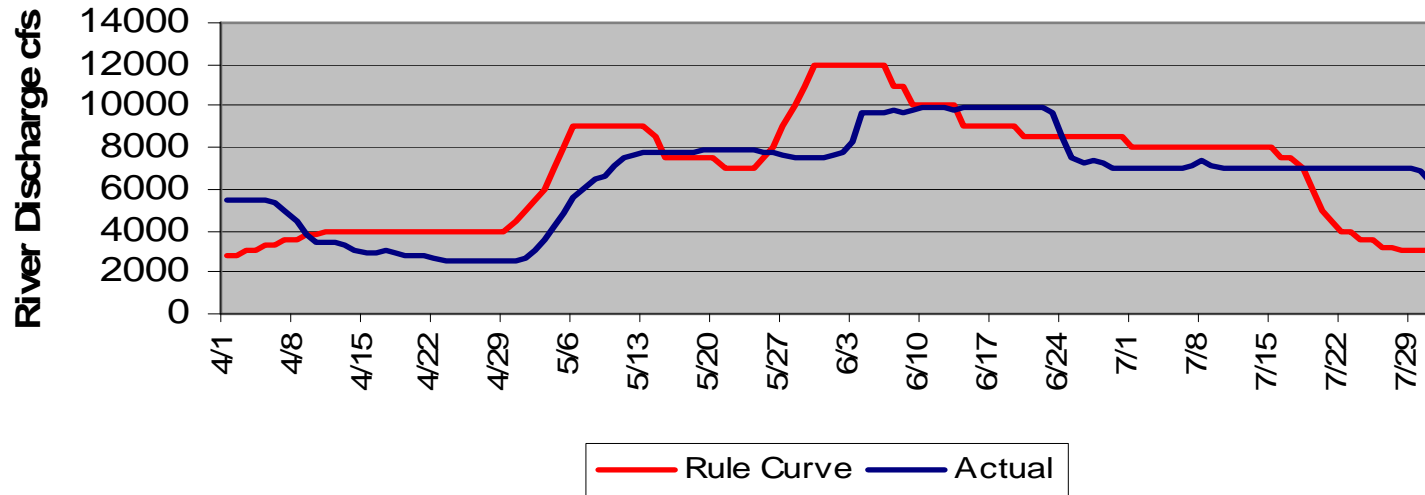




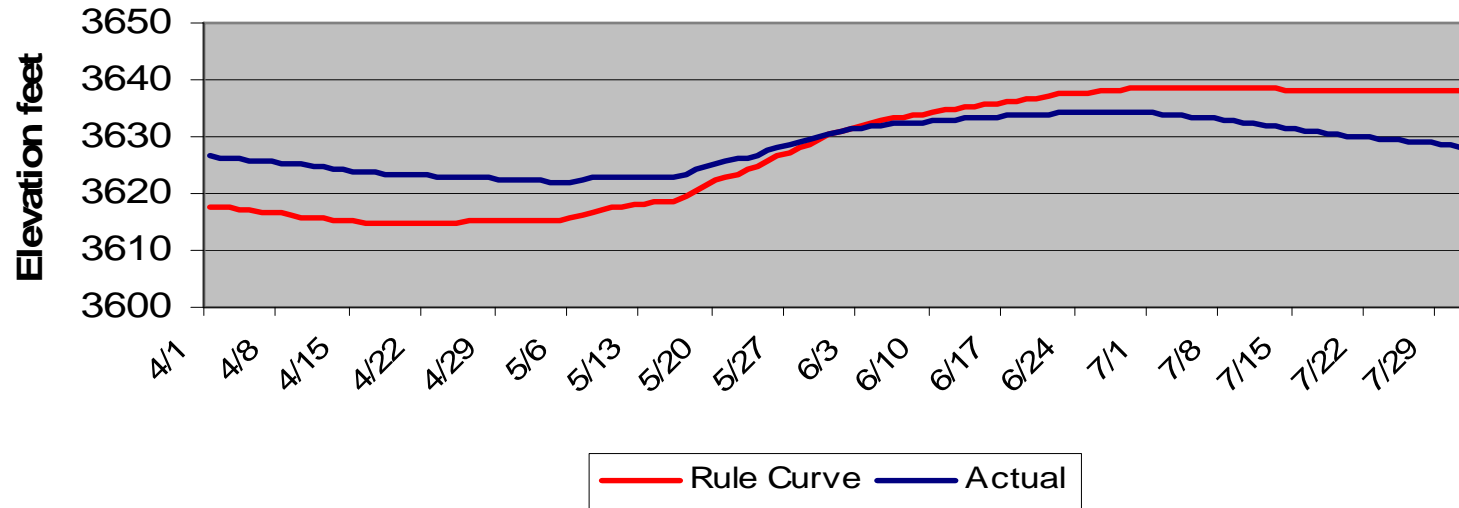
## Bighorn Lake - Rule Curve vs Actual 1999



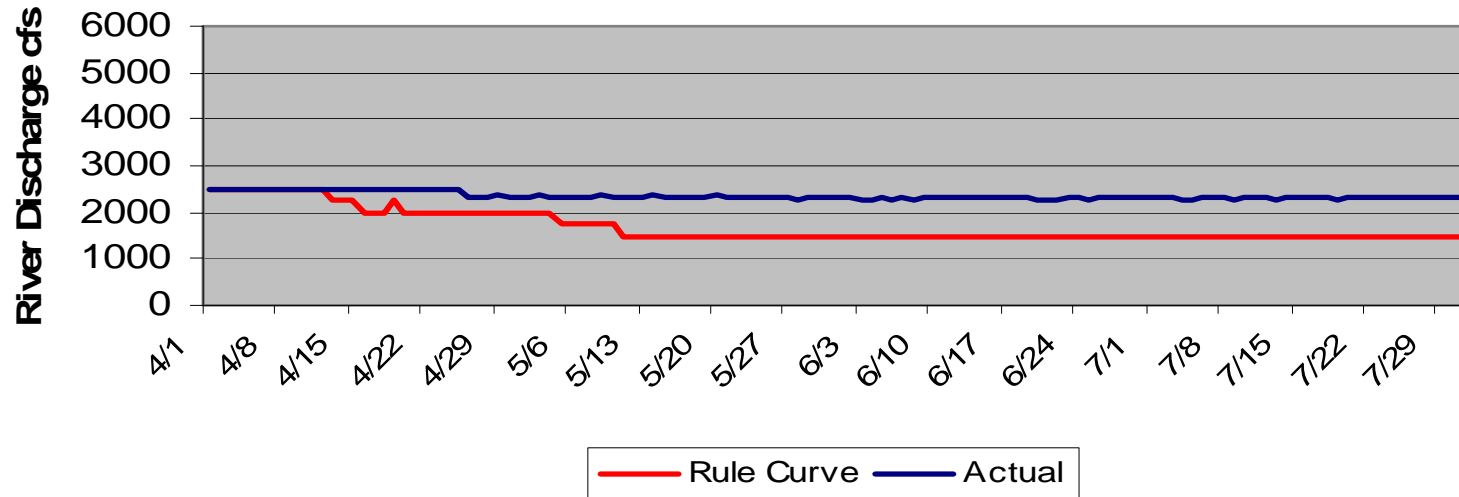
## Bighorn Lake - Rule Curve vs Actual 1999



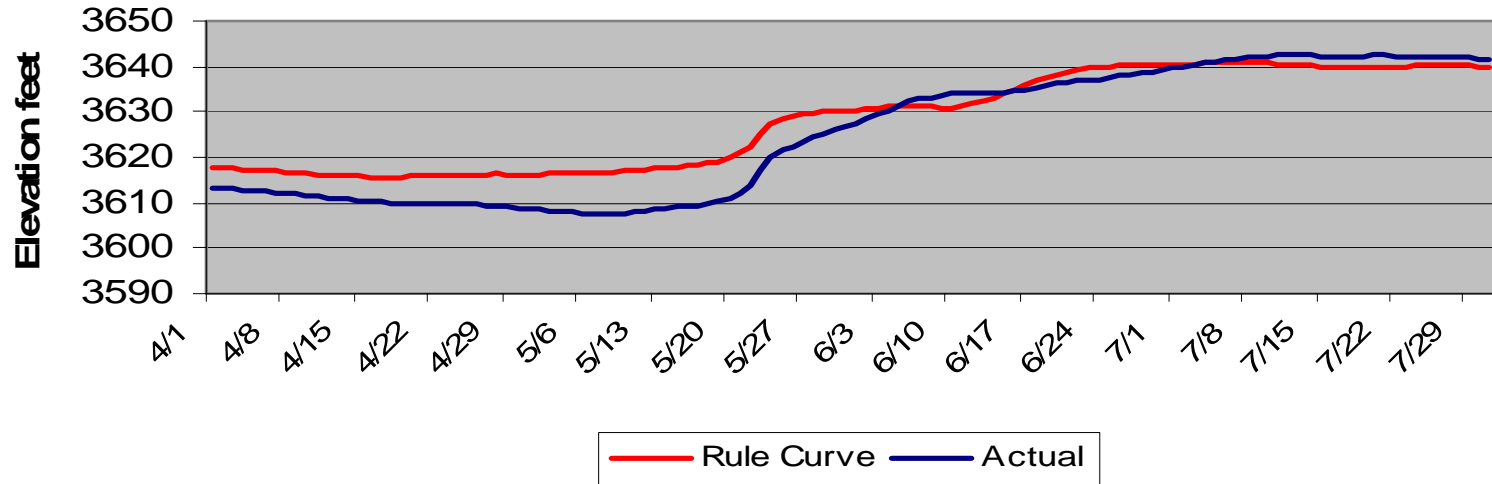
## Bighorn Lake - Rule Curve vs Actual 2000



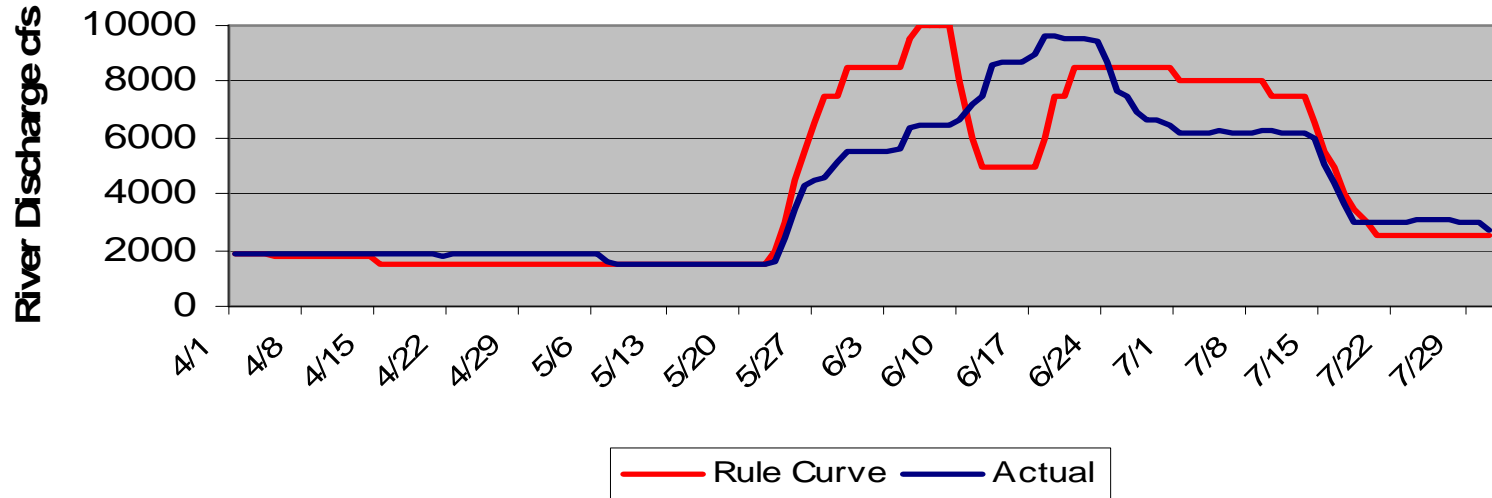
## Bighorn Lake - Rule Curve vs Actual 2000



## Bighorn Lake - Rule Curve vs Actual 2008



## Bighorn Lake - Rule Curve vs Actual 2008



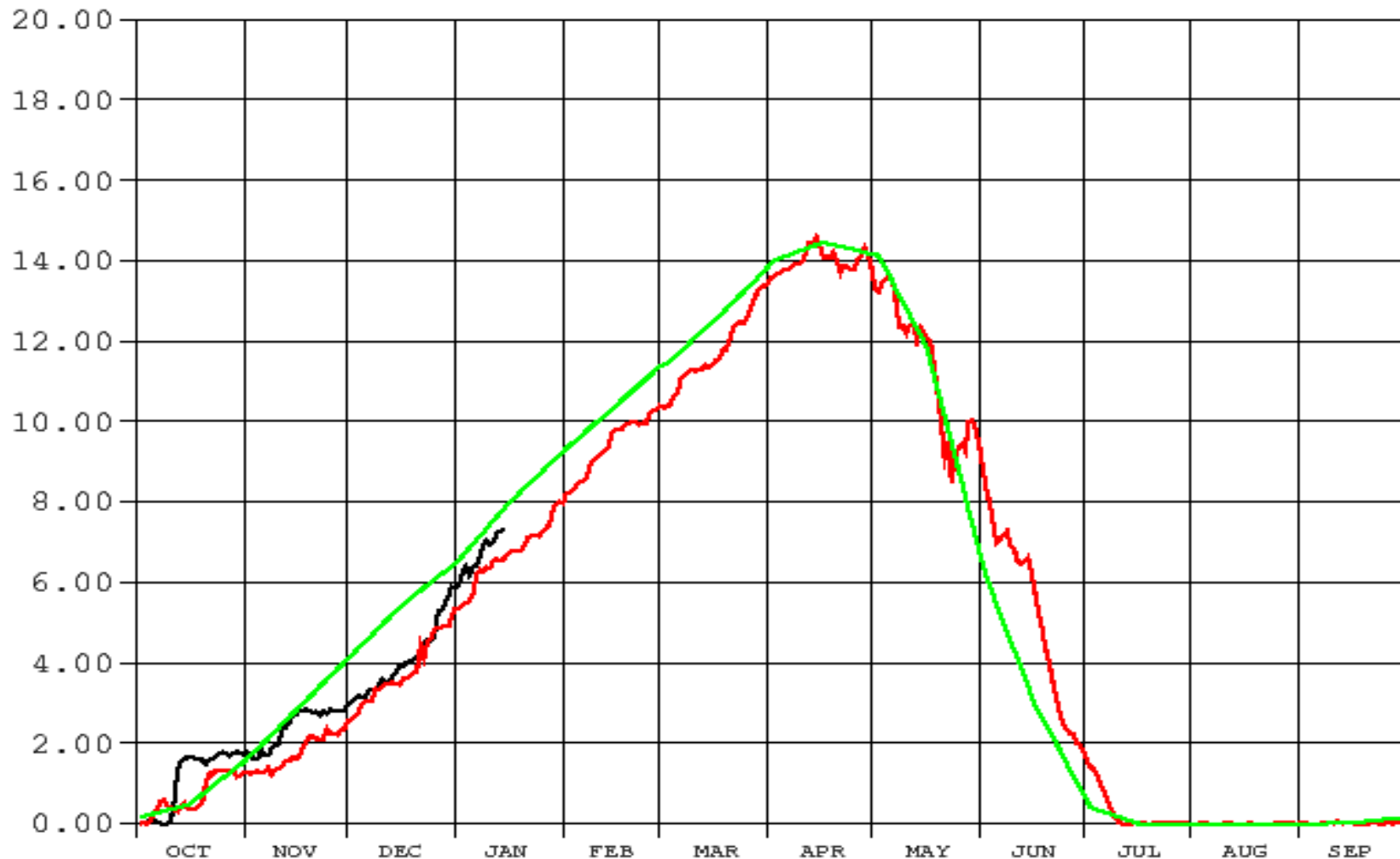
**2009  
LOOKING AHEAD**

**RECLAMATION**

Archive Data From 1-OCT Through 30-SEP

Plotted 01/14/2009 08:59

Units: INCHES



BOYR Boysen Reservoir, Wind River near Thermopolis, WY

SE Snow Water Equivalent (inches)

SE\_AVG Snow Water Equivalent Average (inches)

2009 2008

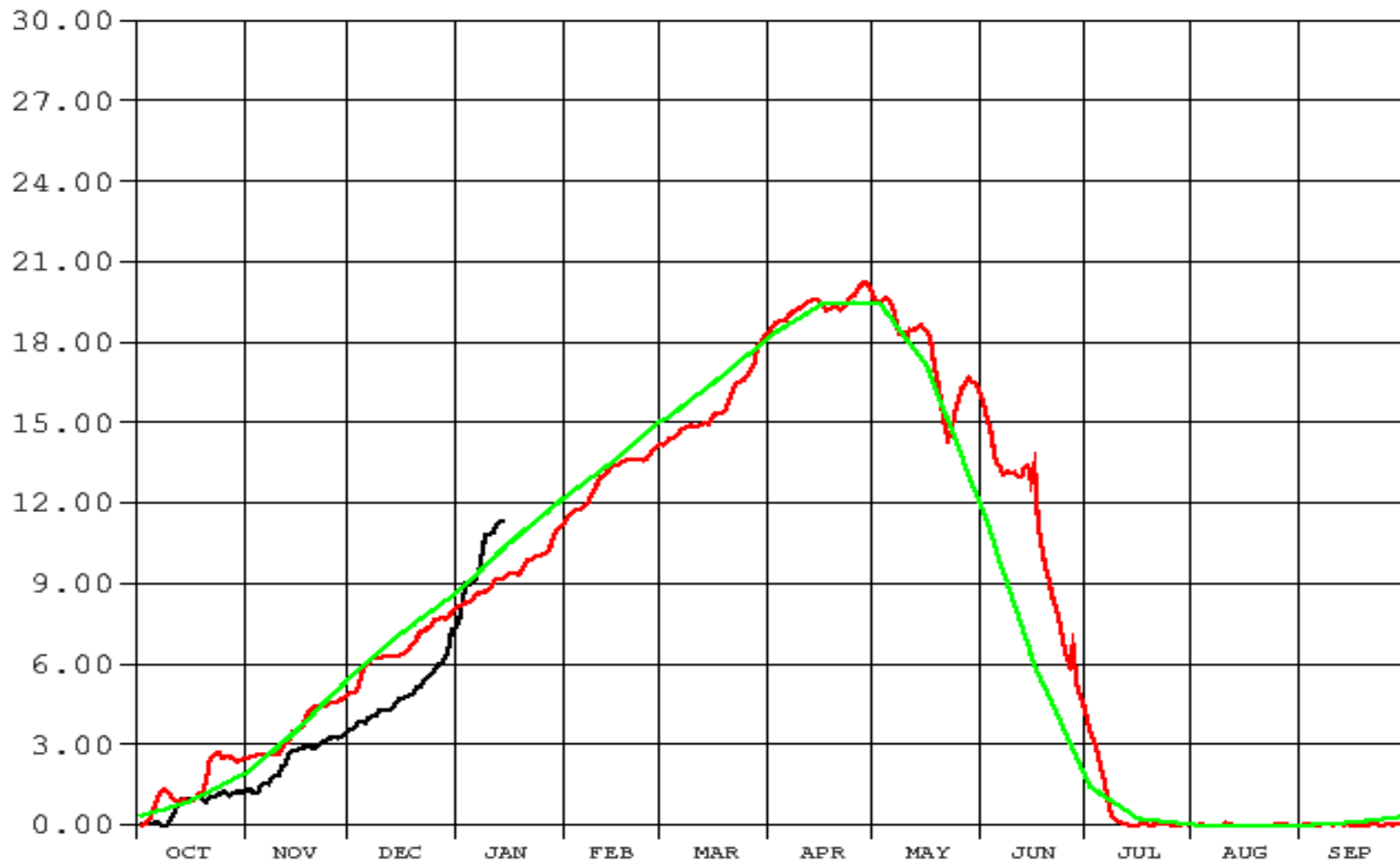
2008

RECLAMATION

Archive Data From 1-OCT Through 30-SEP

Plotted 01/14/2009 08:57

Units: INCHES



BBR Buffalo Bill Reservoir, Shoshone River near Cody, WY

SE Snow Water Equivalent (inches)

2009 2008

SE\_AVG Snow Water Equivalent Average (inches)

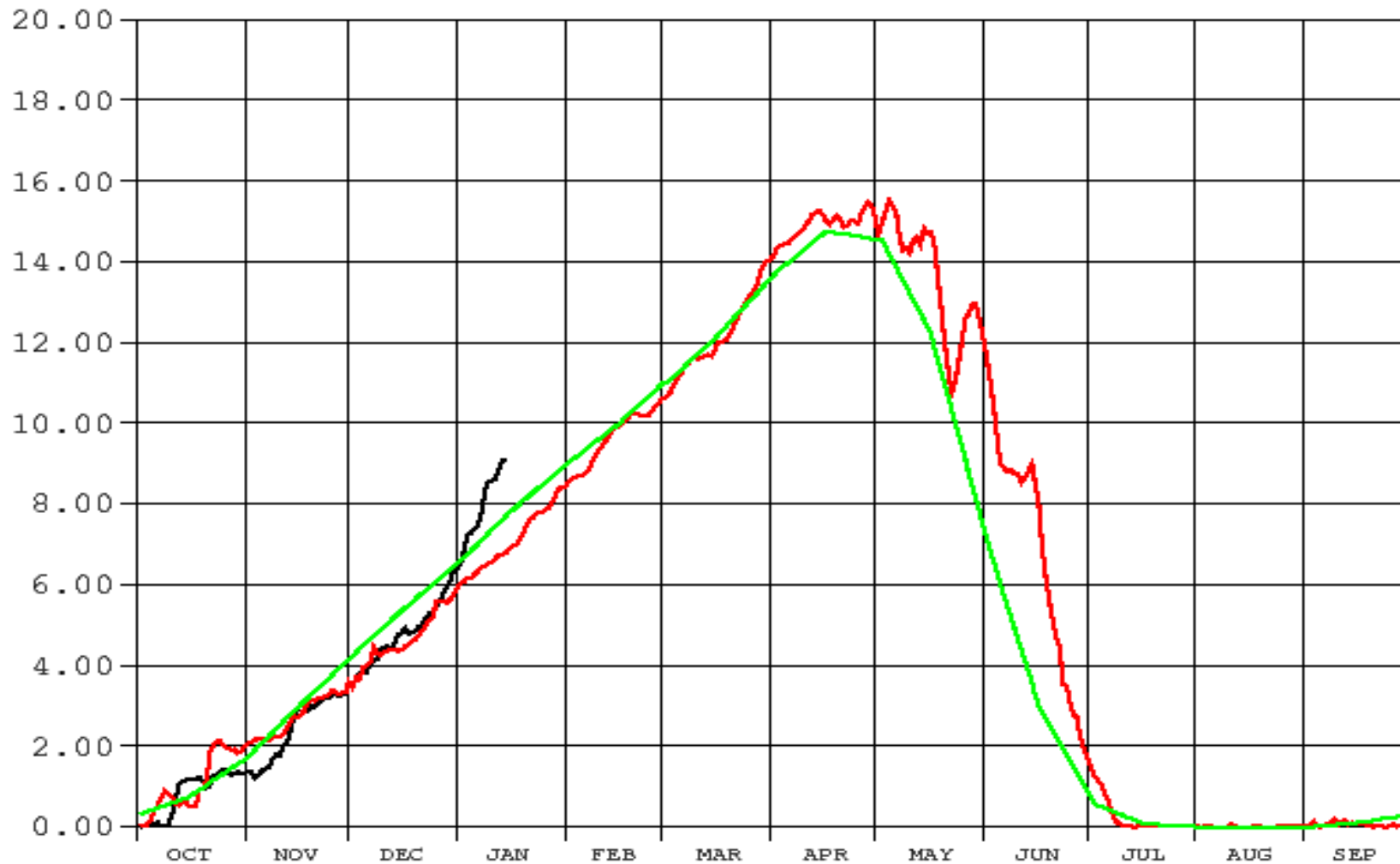
2008

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Archive Data From 1-OCT Through 30-SEP

Plotted 01/14/2009 08:56

Units: INCHES



BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT

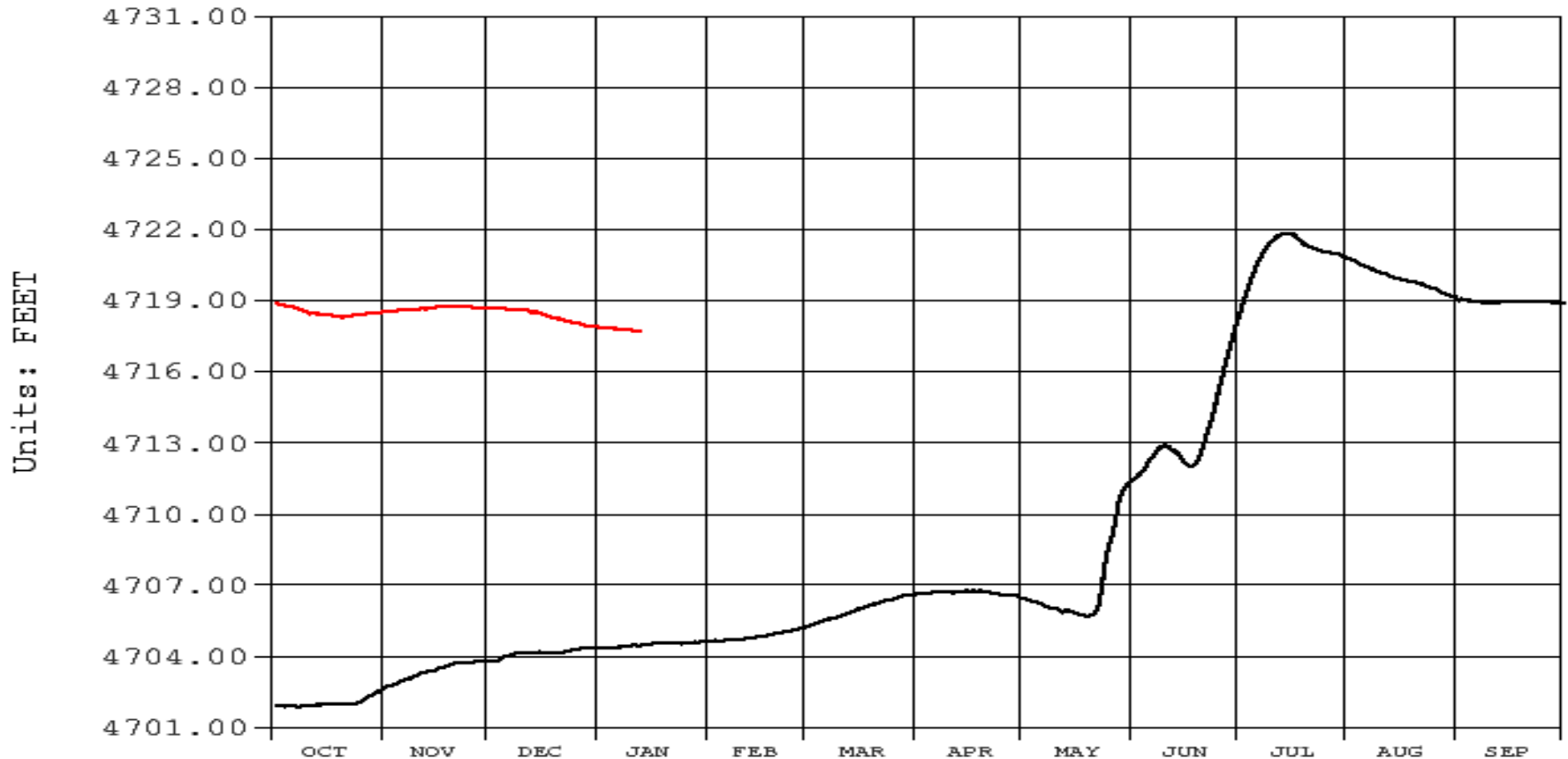
SE Snow Water Equivalent (inches)  
SE\_AVG Snow Water Equivalent Average (inches)

2009 2008  
2008

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# Boysen Reservoir Elevation 2008 vs 2009

Archive Data From 1-OCT Through 30-SEP  
Plotted 01/14/2009 13:36



BOYR  
\_\_\_\_\_FB

Boysen Reservoir, Wind River near Thermopolis, WY  
Reservoir Forebay Elevation (feet)

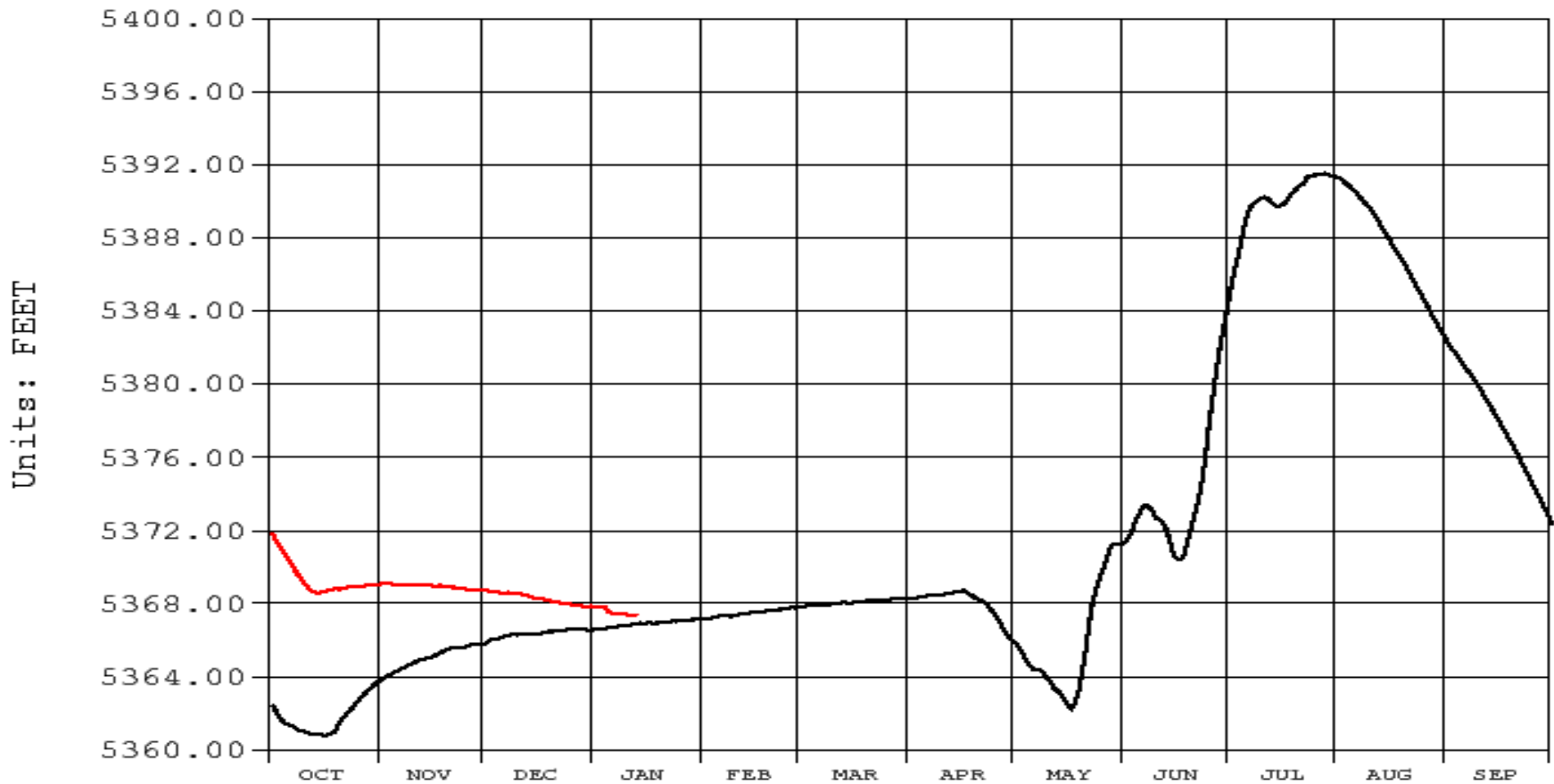
2008 2009

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# Buffalo Bill Elevation 2008 vs 2009

Archive Data From 1-OCT Through 30-SEP  
Plotted 01/14/2009 13:39



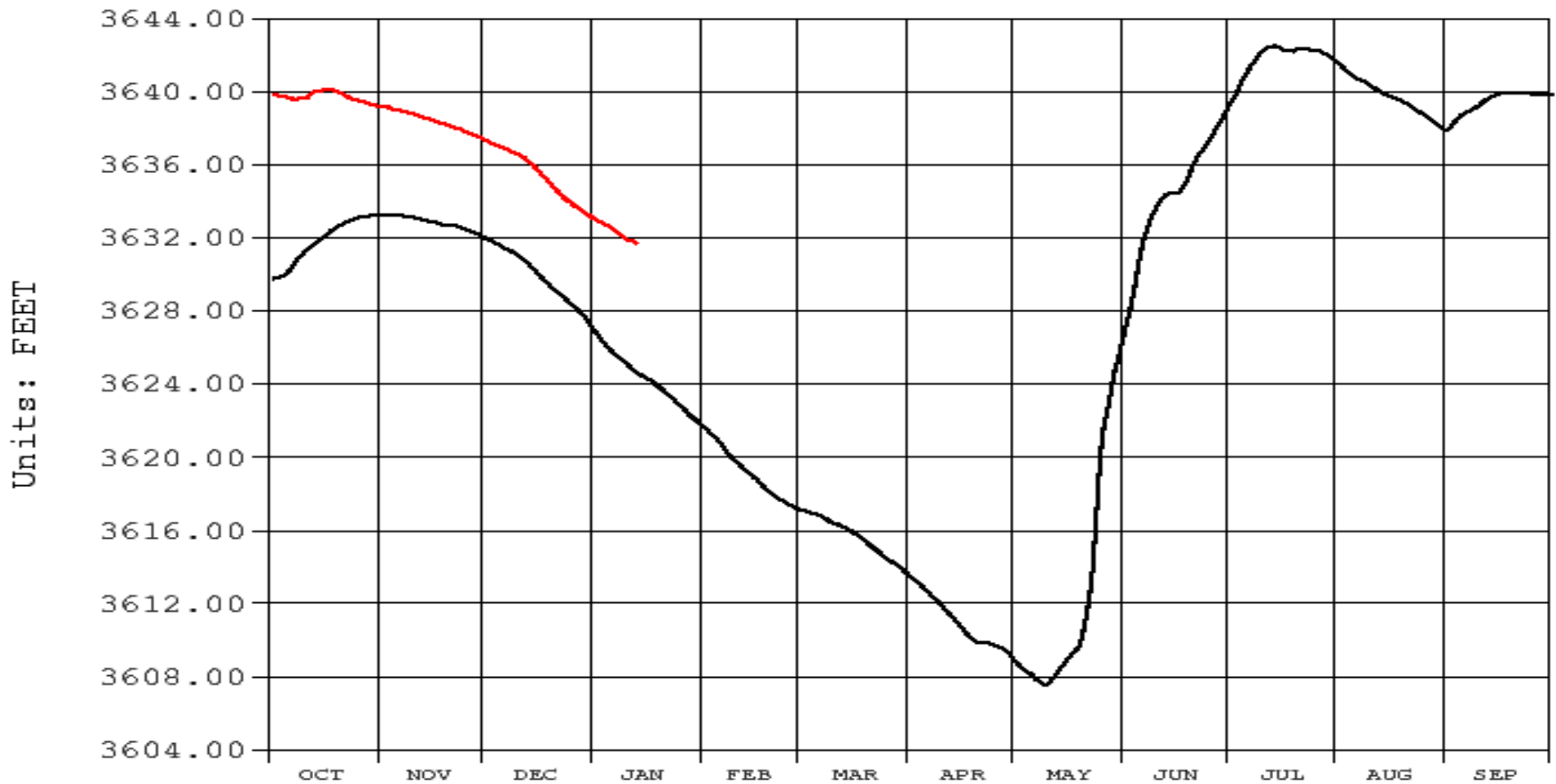
BBR Buffalo Bill Reservoir, Shoshone River near Cody, WY  
FB Reservoir Forebay Elevation (feet)

2008 2009

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# Bighorn Lake Elevation 2008 vs 2009

Archive Data From 1-OCT Through 30-SEP  
Plotted 01/14/2009 13:41



BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT  
FB Reservoir Forebay Elevation (feet)

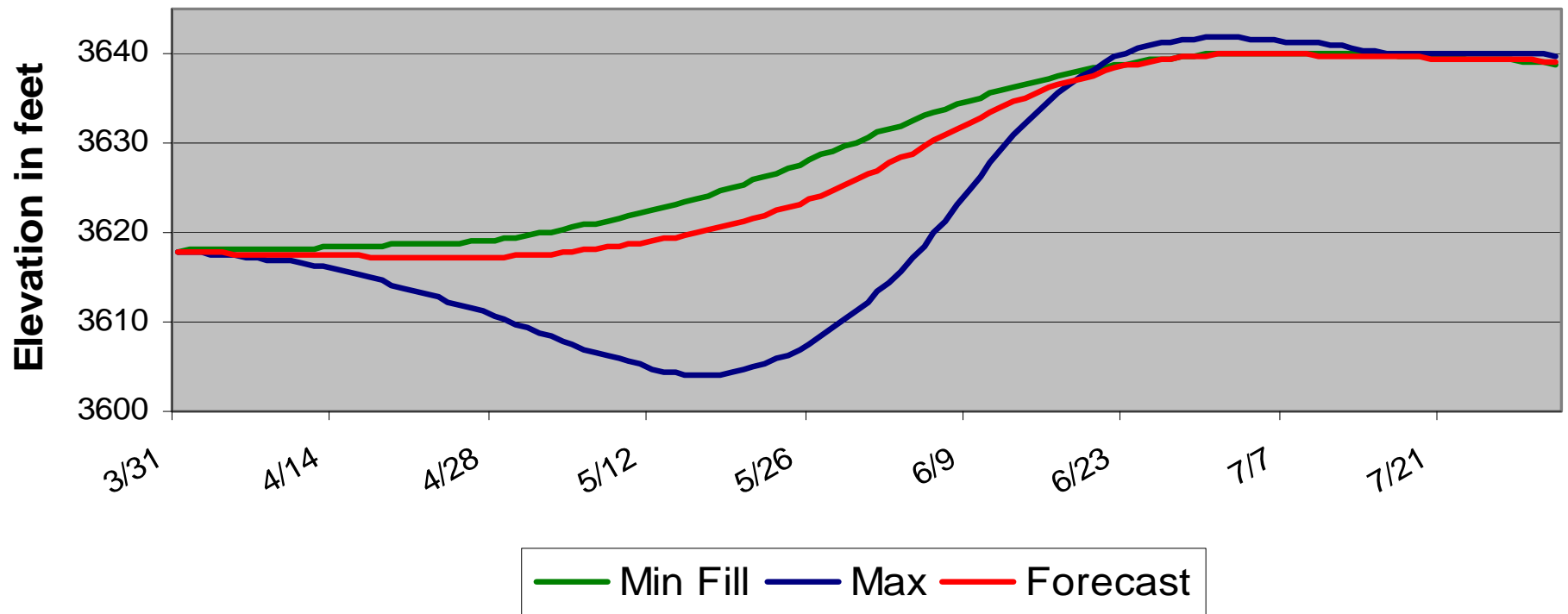
2008 2009

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2009 Jan 1  
948,800 acre-feet

Apr-Jul Forecast  
38 Percentile Year

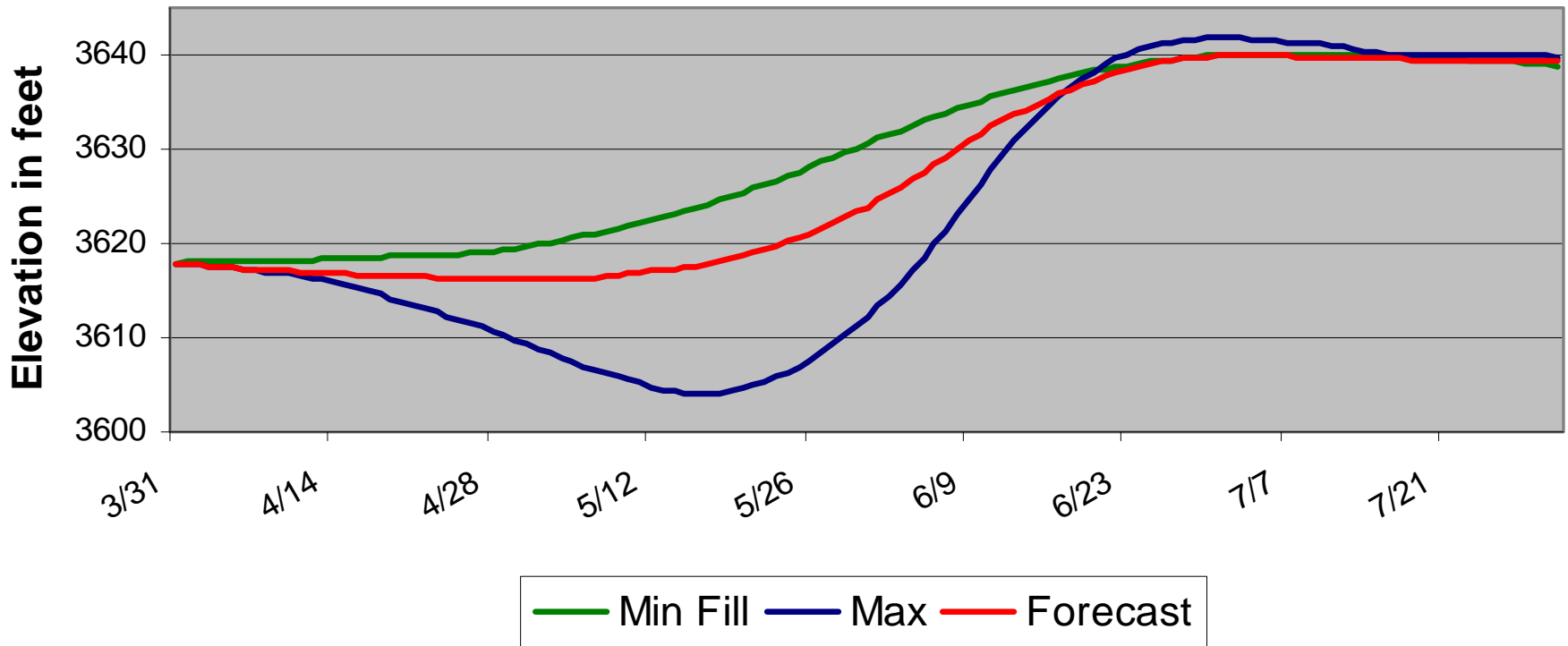
**Bighorn Lake Elevation  
for Forecast A-J Inflow with Rule Curves**



# 2009 Feb 1?      Apr-Jul Forecast

## 1,076,000 acre-feet      50 Percentile Year

**Bighorn Lake Elevation  
for Forecast A-J Inflow with Rule Curves**



# Discussion & Questions

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