Appendix F

Option Development Process
ARSP Modeling and Analysis
of Lake Levels and River Flows

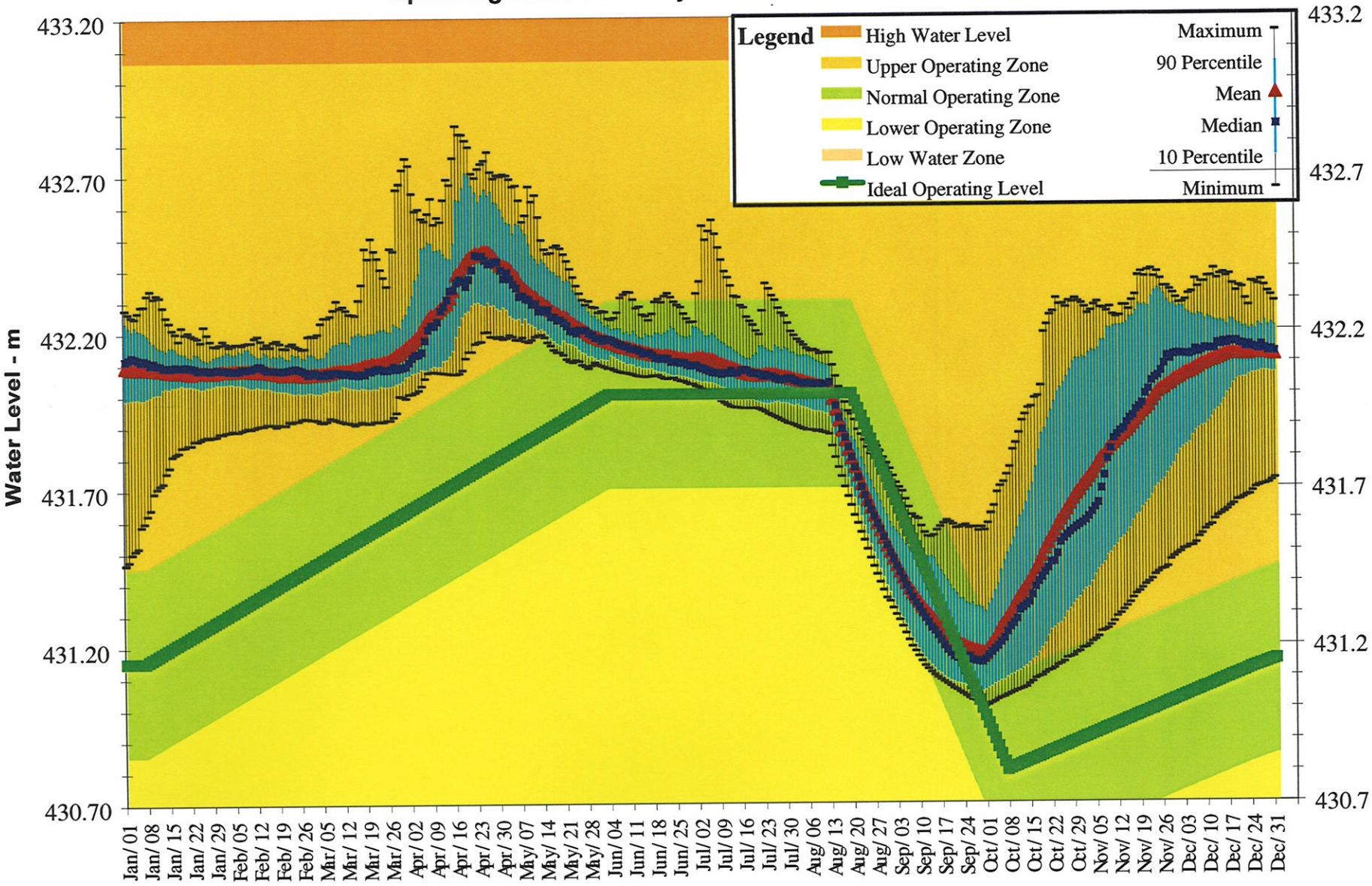
- **ARSP Base Case**
- **ARSP Case One**
- **ARSP Case Two**

Ragged Lake

Ragged Lake Water Levels

ARSP Simulation Base Case

Operating Rules and Daily Water Level Statistics



Ragged Lake Water Levels
ARSP Simulation Base Case

Peak Water Levels	
HWZ	433.06
No of Days in Exceedance	2
No of Years Exceeded	0
Maximum WL	432.86

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	432.79
Date of peak	16-Apr
Tolerance	0
Tolerated WL	432.79
Date tolerated exceeded	16-Apr

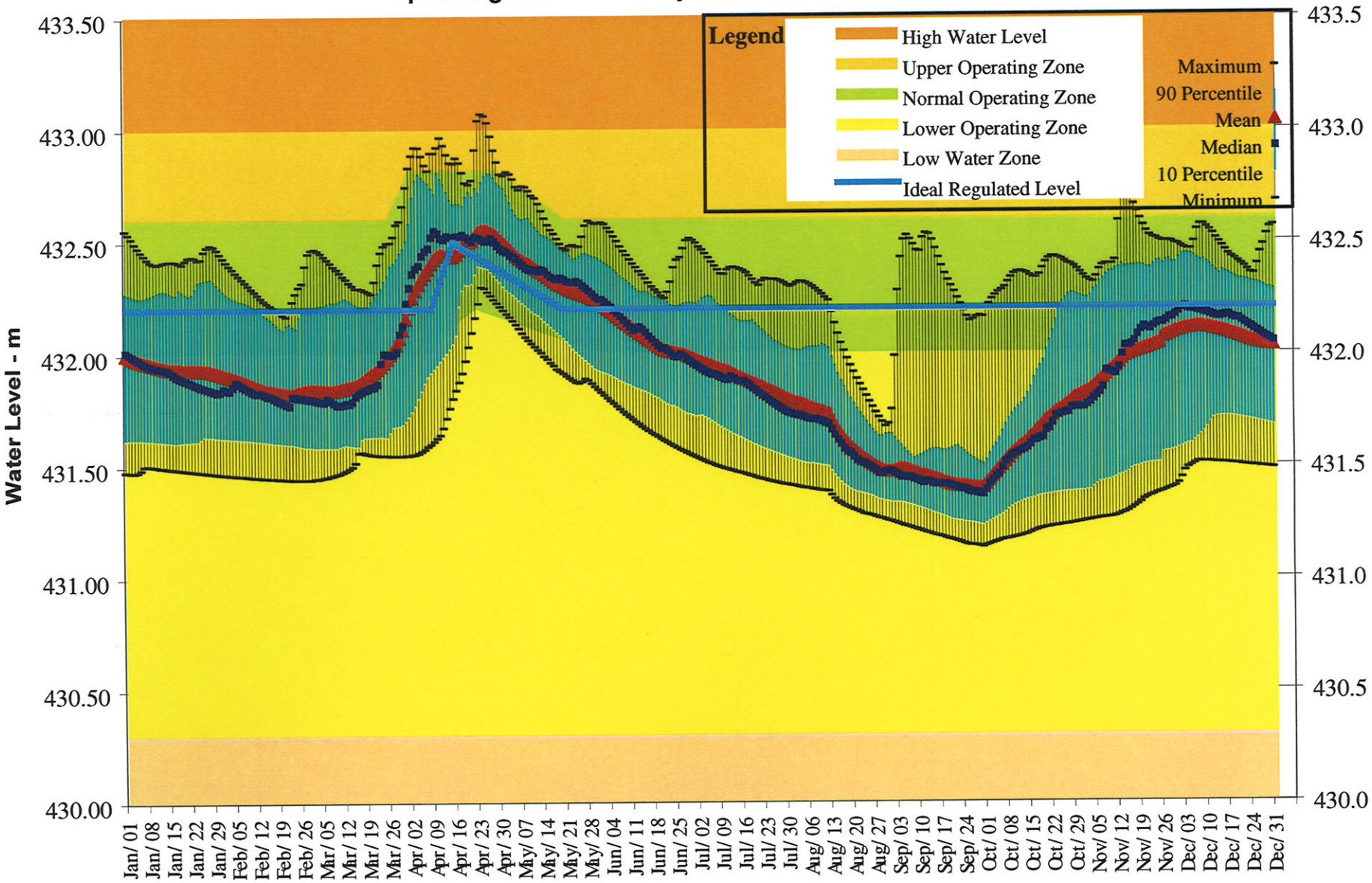
Summer recreation levels Jun-15 to Sep-30	
90 and 10 percentile range	
Max 90%	0.00
Min 10%	0.00
Range	0.00

Median range	
Max Median	0.00
Min Median	0.00
Range	0.00

Ragged Lake Water Levels

ARSP Simulation Proposed Case 1

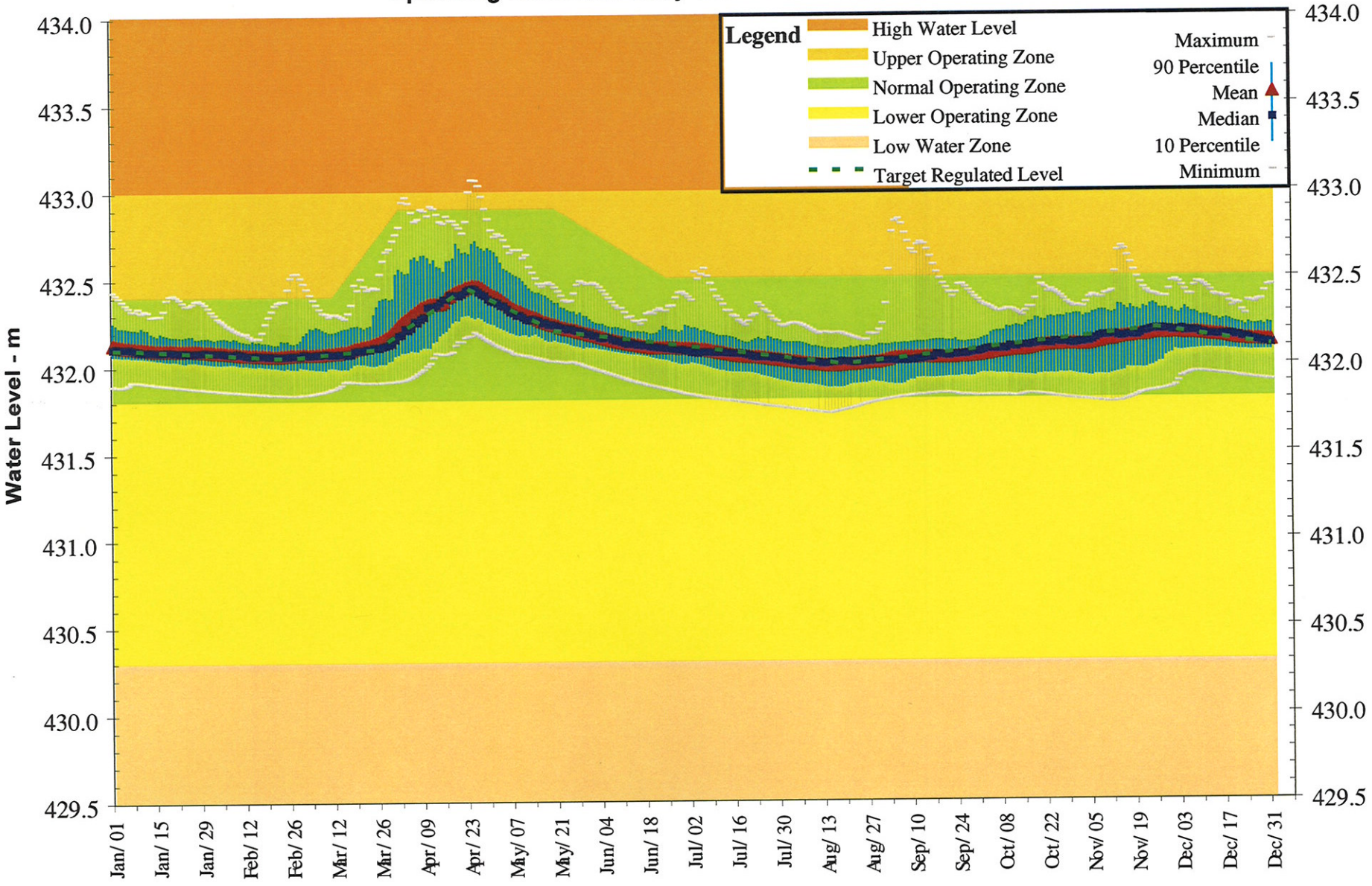
Operating Rules and Daily Water Level Statistics



Ragged Lake Water Levels

ARSP Simulation Case 2

Operating Rules and Daily Water Level Statistics



Ragged Lake Water Levels
ARSP Simulation Case 2

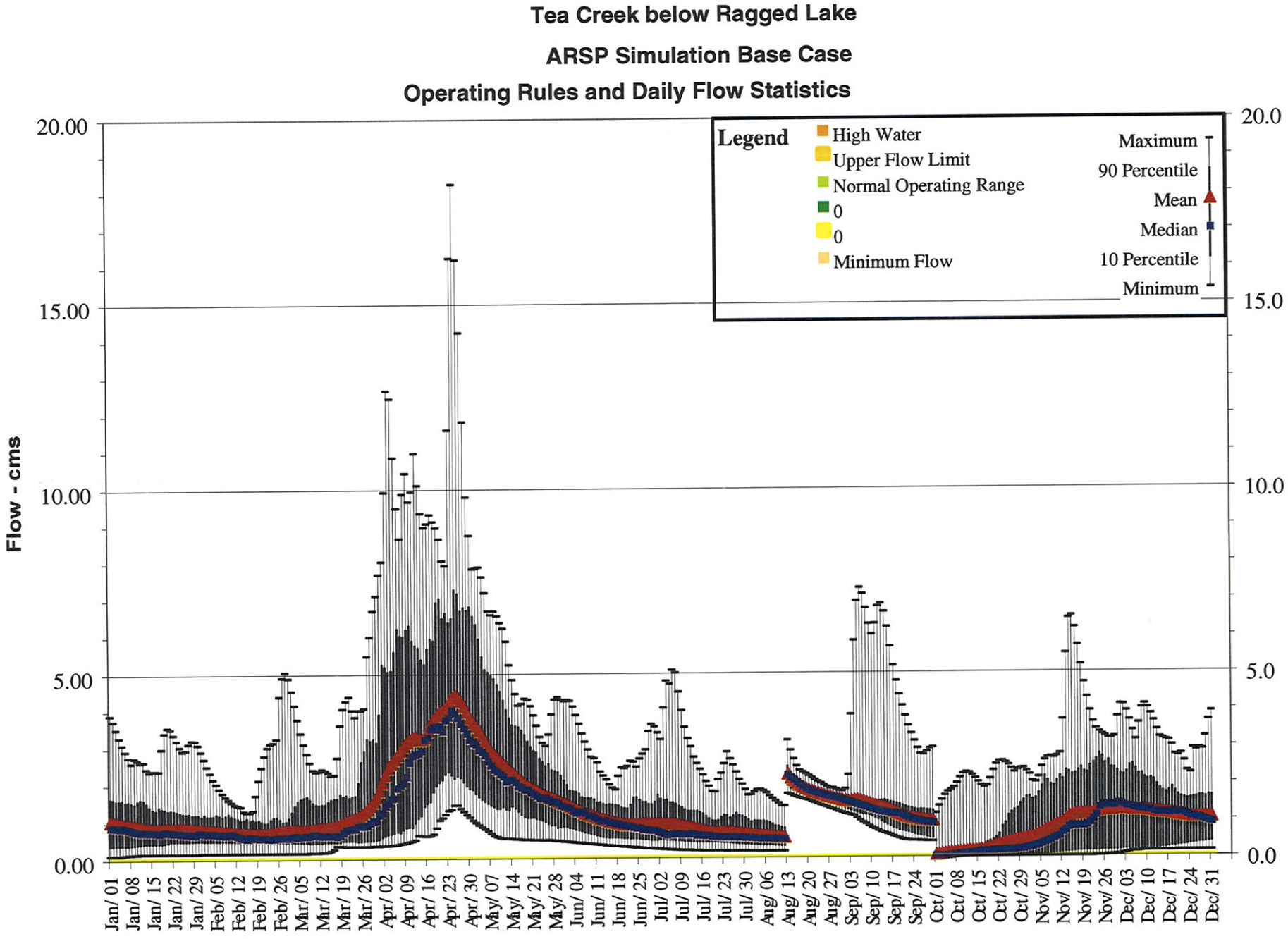
Peak Water Levels	
HWZ	433
No of Days in Exceedance	4
No of Years Exceeded	1
Maximum WL	433.07

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	432.72
Date of peak	25-Apr
Tolerance	0
Tolerated WL	432.72
Date tolerated exceeded	25-Apr

Summer recreation levels Jun-15 to Sep-30	
90 and 10 percentile range	
Max 90%	432.23
Min 10%	431.86
Range	0.36

Median range	
Max Median	432.11
Min Median	432.00
Range	0.11

Spring Peak Water Level	
Maximum - 50 yr Average	432.65
Date - 50 yr Average	20/Apr
Summer Average Level	432.08


Tea Creek below Ragged Lake
ARSP Simulation Base Case
Operating Rules and Daily Flow Statistics
Legend
High Water
Upper Flow Limit
Normal Operating Range
0
0
Minimum Flow
Maximum
90 Percentile
Mean
Median
10 Percentile
Minimum
Flow - cms
20.00
15.00
10.00
5.00
0.00
20.0
15.0
10.0
5.0
0.0
Jan/ 01
Jan/ 08
Jan/ 15
Jan/ 22
Jan/ 29
Feb/ 05
Feb/ 12
Feb/ 19
Feb/ 26
Mar/ 05
Mar/ 12
Mar/ 19
Mar/ 26
Apr/ 02
Apr/ 09
Apr/ 16
Apr/ 23
Apr/ 30
May/ 07
May/ 14
May/ 21
May/ 28
Jun/ 04
Jun/ 11
Jun/ 18
Jun/ 25
Jul/ 02
Jul/ 09
Jul/ 16
Jul/ 23
Jul/ 30
Aug/ 06
Aug/ 13
Aug/ 20
Aug/ 27
Sep/ 03
Sep/ 10
Sep/ 17
Sep/ 24
Oct/ 01
Oct/ 08
Oct/ 15
Oct/ 22
Oct/ 29
Nov/ 05
Nov/ 12
Nov/ 19
Nov/ 26
Dec/ 03
Dec/ 10
Dec/ 17
Dec/ 24
Dec/ 31

Flow Evaluation

Yellow cells indicate values that can be changed for analysis

Tea Creek below Ragged Lake
ARSP Simulation Base Case
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow 0 m³/s Achieved #N/A of time

No of days above minumum flow

First half of season

Min	25	days
Avg	25	days
Years Provided	100%	

Last half of season

Min	24	days
Avg	24	days
Years Provided	100%	

For whole season

Min	49	days
Avg	49	days
Years Provided	100%	

From flow duration curve

%	Flow		*No of days*
99%	0.52	m³/s	*min flow is achievd*
95%	0.87	m³/s	49 days

90%	*percentile peak flow*
5	m3/s

Summer Minimum 7-day Flow

	Maximum	0.48	m³/s
	Minimum	0.06	m³/s
90%	Percentile	0.24	m³/s
10%	Percentile	0.07	m³/s
	Median	0.13	m³/s

Mean 0.16 m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded	Maximum Daily Flow	
N/A	m³/s	0	18.26	m³/s

Minumum Flows

Min Daily flow		*7-day minimums*			
		2	10	20	return period
		-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.00	m³/s	0.01	0.00	0.00	m³/s

Summer Fluctuations

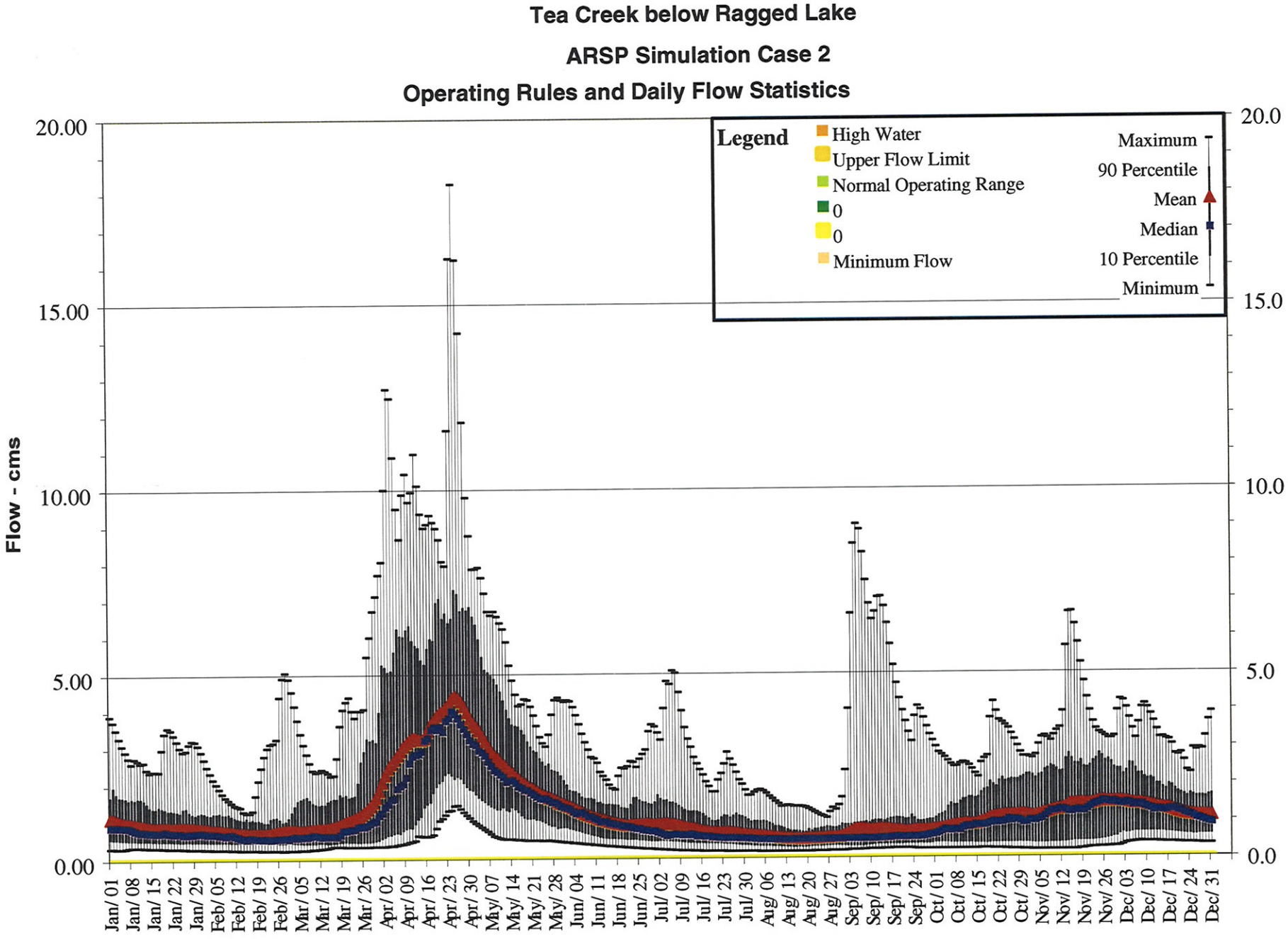
Delta Flow	Average number of daily flow fluctuations per year		
1	1.52		
3	0.00		
5	0.00		
>0.5035	2.16	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer m³/s	winter m³/s	summer m³/s	winter m³/s
1.03	0.87	0.12	0.00

Power Generation

	Quarter				Annual	
	1	2	3	4		
Flow	0.89	2.27	1.12	0.79	1.26	m³/s


Tea Creek below Ragged Lake
ARSP Simulation Case 2
Operating Rules and Daily Flow Statistics
Legend
High Water
Upper Flow Limit
Normal Operating Range
0
0
Minimum Flow
Maximum
90 Percentile
Mean
Median
10 Percentile
Minimum
Flow - cms
20.00
15.00
10.00
5.00
0.00
20.0
15.0
10.0
5.0
0.0
Jan/ 01
Jan/ 08
Jan/ 15
Jan/ 22
Jan/ 29
Feb/ 05
Feb/ 12
Feb/ 19
Feb/ 26
Mar/ 05
Mar/ 12
Mar/ 19
Mar/ 26
Apr/ 02
Apr/ 09
Apr/ 16
Apr/ 23
Apr/ 30
May/ 07
May/ 14
May/ 21
May/ 28
Jun/ 04
Jun/ 11
Jun/ 18
Jun/ 25
Jul/ 02
Jul/ 09
Jul/ 16
Jul/ 23
Jul/ 30
Aug/ 06
Aug/ 13
Aug/ 20
Aug/ 27
Sep/ 03
Sep/ 10
Sep/ 17
Sep/ 24
Oct/ 01
Oct/ 08
Oct/ 15
Oct/ 22
Oct/ 29
Nov/ 05
Nov/ 12
Nov/ 19
Nov/ 26
Dec/ 03
Dec/ 10
Dec/ 17
Dec/ 24
Dec/ 31

Flow Evaluation

Yellow cells indicate values that can be changed for analysis

Tea Creek below Ragged Lake
ARSP Simulation Case
2
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow **0** m³/s Achieved #N/A of time

No of days above minumum flow

First half of season

Min	25	days
Avg	25	days
Years Provided	100%	

Last half of season

Min	24	days
Avg	24	days
Years Provided	100%	

For whole season

Min	49	days
Avg	49	days
Years Provided	100%	

From flow duration curve

%	Flow		*No of days*		*percentile peak*
99%	0.52	m³/s	*min flow is achievd*		90% *flow*
95%	0.87	m³/s	49	days	5 m3/s

Summer Minimum 7-day Flow

	Maximum	0.63	m³/s
	Minimum	0.18	m³/s
90%	Percentile	0.55	m³/s
10%	Percentile	0.27	m³/s
	Median	0.44	m³/s

Mean 0.42 m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded	Maximum Daily Flow	
N/A	m³/s	0	18.26	m³/s

Minumum Flows

Min Daily flow		*7-day minimums*			
		2	10	20	return period
		-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.18	m³/s	0.42	0.26	0.24	m³/s

Summer Fluctuations

Delta Flow	Average number of daily flow fluctuations per year		
1	0.10		
3	0.00		
5	0.00		
>0.2715	1.00	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer m³/s	winter m³/s	summer m³/s	winter m³/s
0.74	0.97	0.39	0.19

Power Generation

	Quarter					
	1	2	3	4	Annual	
Flow	0.91	2.27	0.69	1.20	1.27	m³/s