Appendix F

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

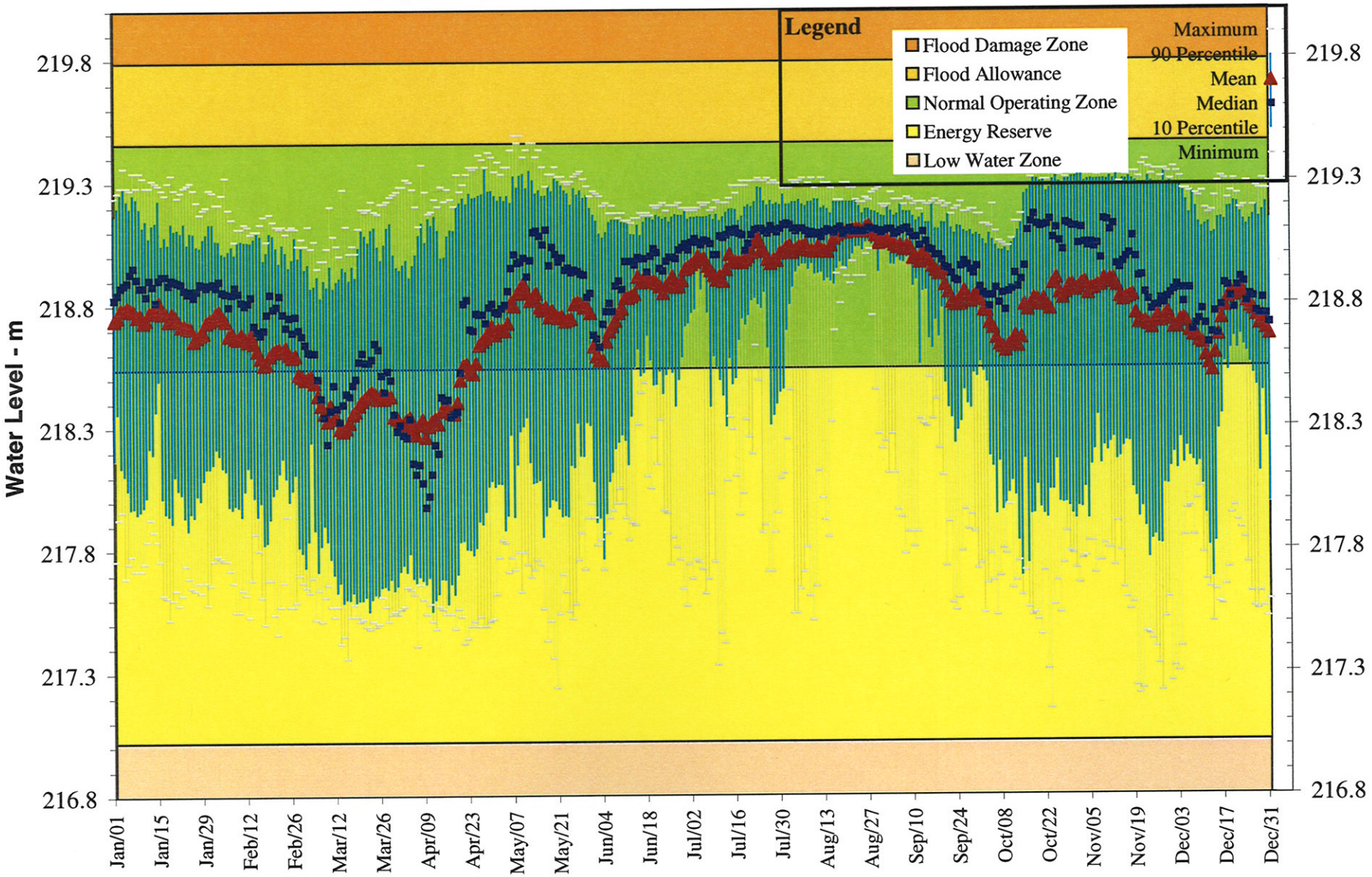
- **ARSP Base Case**
- **ARSP Case One**
- **ARSP Case Two**

Ragged Rapids GS

Ragged Rapids Reservoir Water

Historical Data 1984 to 2003

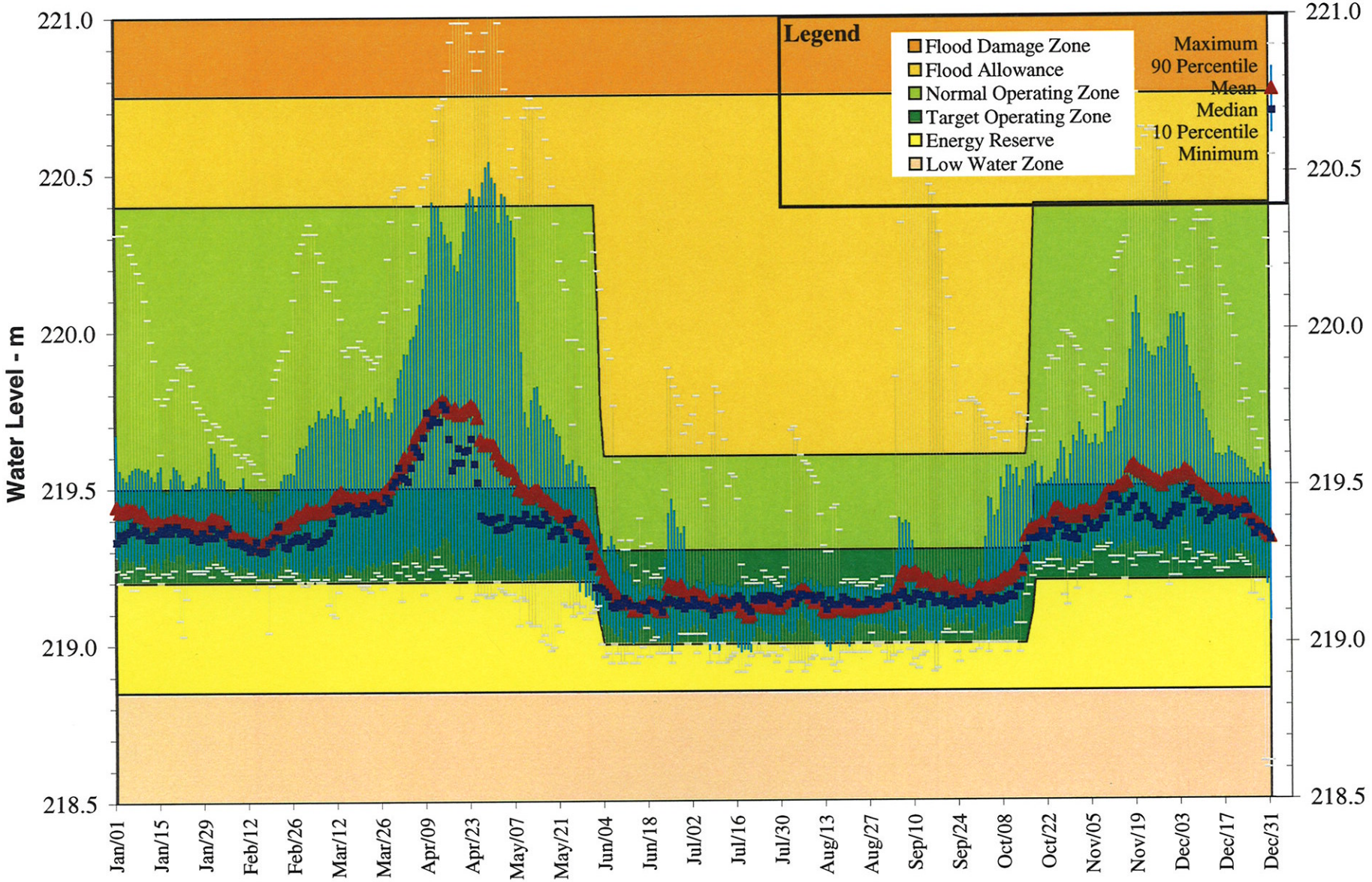
Operating Rules and Daily Water Level Statistics



Bala Reach Water Levels

Historical Data 1980 to 2003

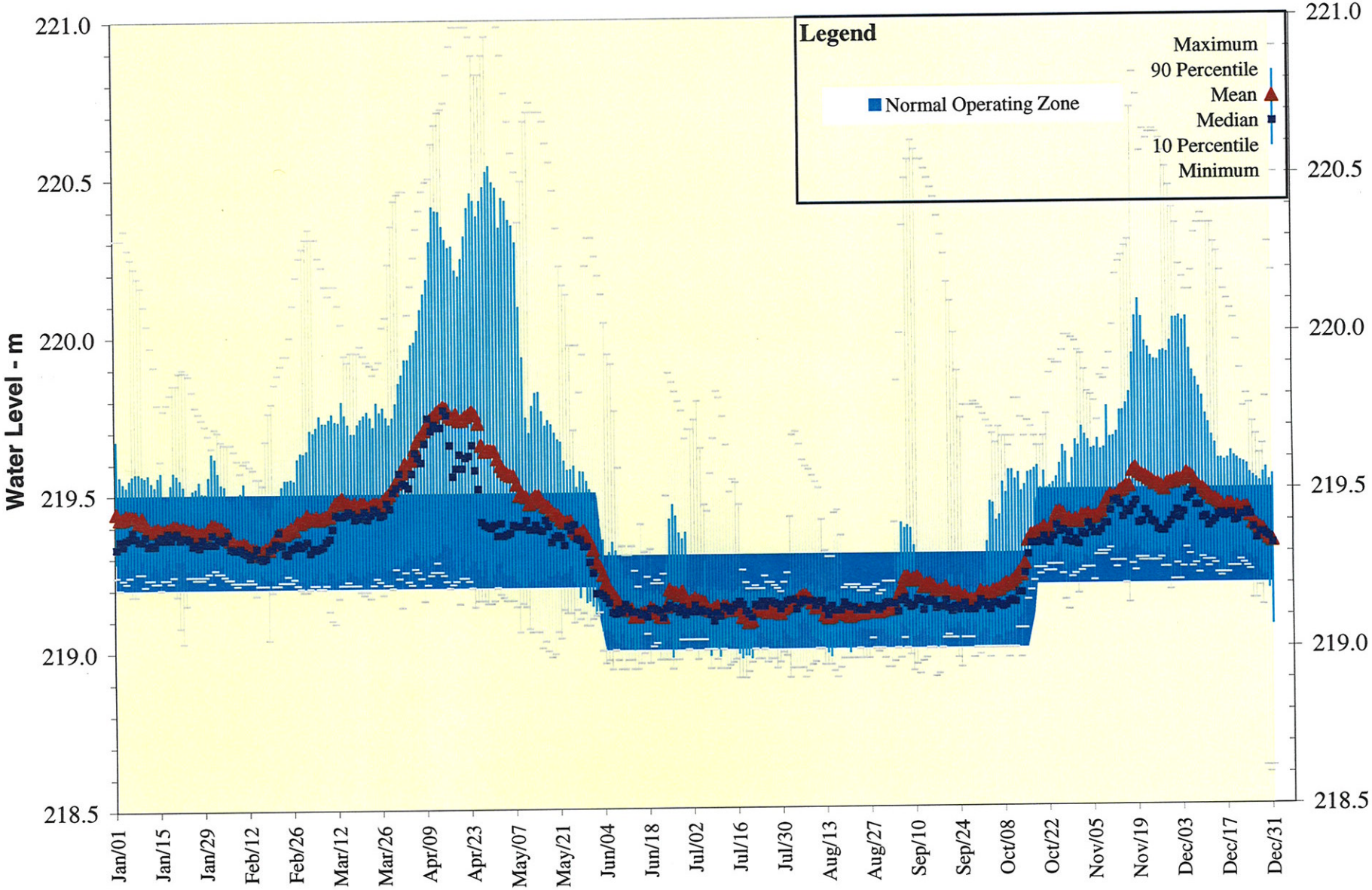
Operating Rules and Daily Water Level Statistics

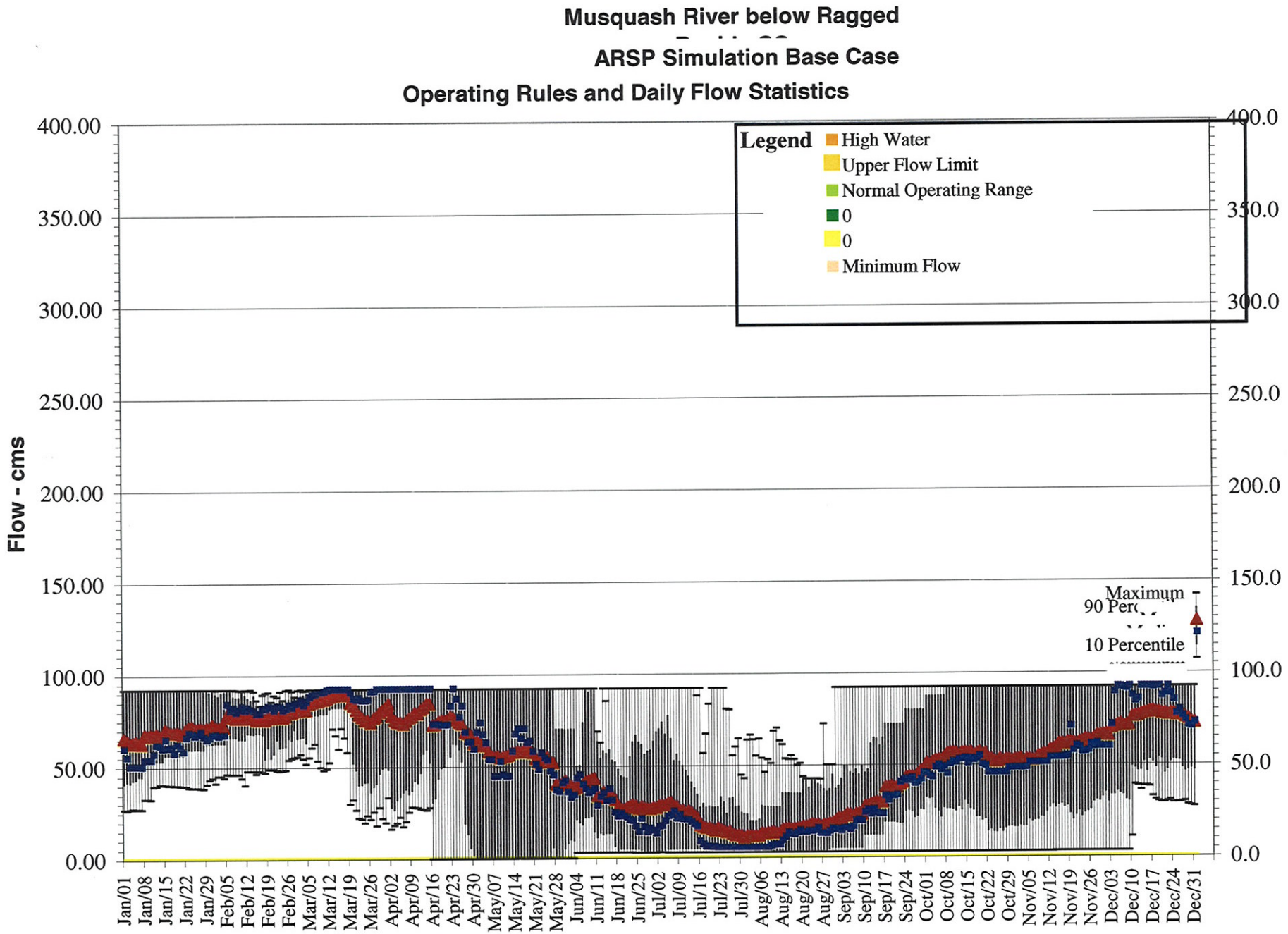


Bala Reach Water Levels

Historical Data 1980 to 2003

Proposed Operating Rules and Daily Water Level Statistics




Musquash River below Ragged
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 Perc
10 Percentile
Flow - cms
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
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

Musquash River below Ragged Rapids GS
ARSP Simulation Base Case
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow 3 m^3/s Achieved 89% of time

No of days above minumum flow

	First half of season	*Last half of season*	*For whole season*
Min	6 days	0 days	6 days
Avg	22.04 days	20.9 days	42.94 days
Years Provided	70%	82%	70%

From flow duration curve

%	Flow	
99%	-	m^3/s
95%	-	m^3/s

No of days min flow is achievd 6 days

90% *percentile peak flow* 92 m3/s

Summer Minimum 7-day Flow

	Maximum	22.75 m^3/s
	Minimum	3.01 m^3/s
90%	Percentile	14.51 m^3/s
10%	Percentile	3.02 m^3/s
	Median	5.05 m^3/s
	Mean	7.39 m^3/s

Maximum Flows

Regulatory Flood Outflow No of years exceeded Maximum Daily Flow

N/A	m³/s	0	92.23 m³/s

Minumum Flows

Min Daily flow	*7-day minimums*		
0.00 m³/s	2	10	20 return period
	-yr 7Q2	-yr 7Q10	-yr 7Q20
	5.03	0.00	0.00 m³/s

Summer Fluctuations

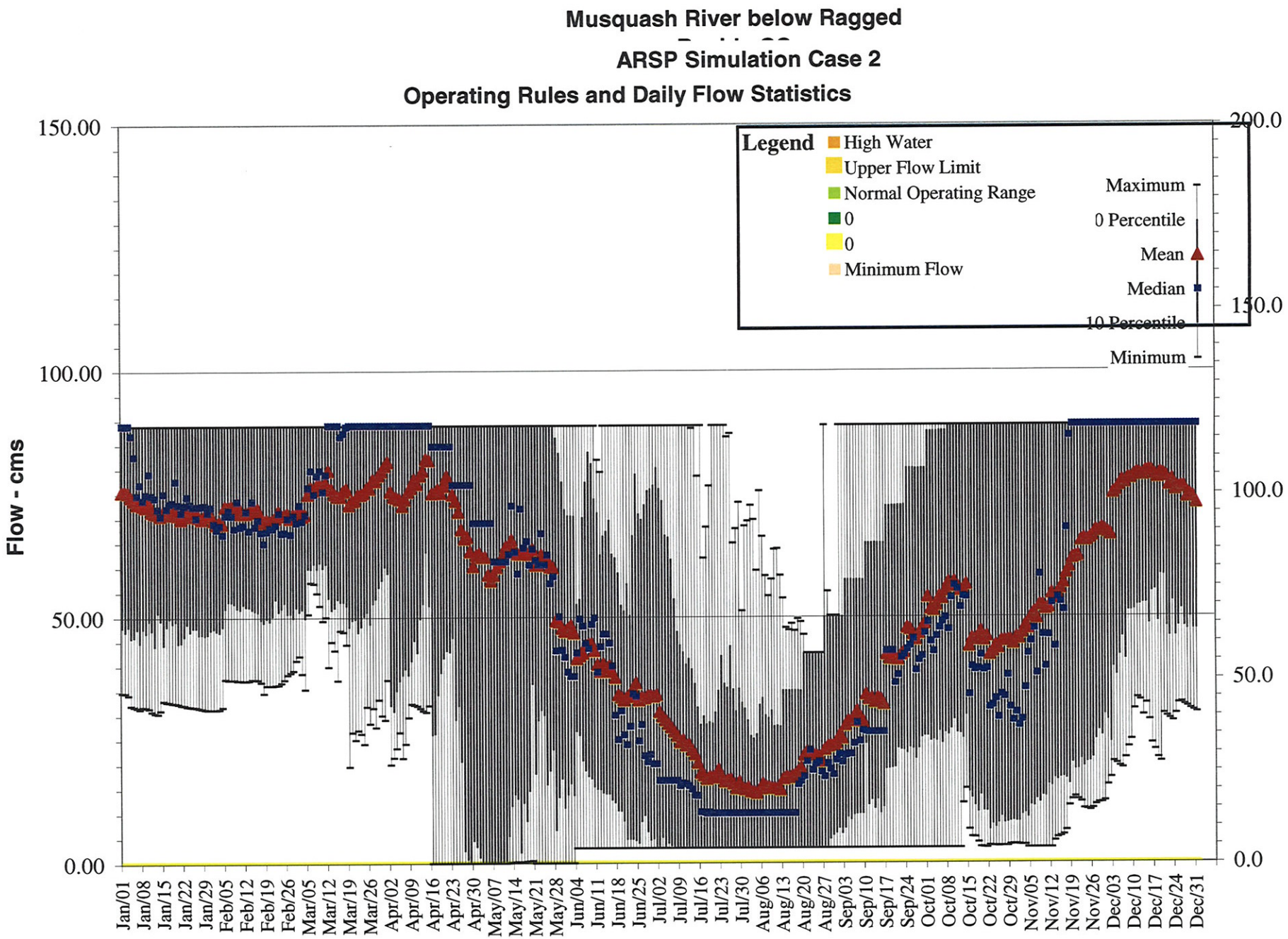
Delta Flow	Average number of daily flow fluctuations per year		
1	48.10		
3	29.90		
5	19.80		
>8.52175	10.06	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer m³/s	winter m³/s	summer m³/s	winter m³/s
27.66	81.41	5.02	0.00

Power Generation

	Quarter				
	1	2	3	4	Annual
Flow	75.95	54.49	22.82	62.80	53.90 m³/s


Musquash River below Ragged
ARSP Simulation Case 2
Operating Rules and Daily Flow Statistics
Legend
High Water
Upper Flow Limit
Normal Operating Range
0
0
Minimum Flow
Maximum
0 Percentile
Mean
Median
10 Percentile
Minimum
Flow - cms
150.00
100.00
50.00
0.00
200.0
150.0
100.0
50.0
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

Musquash River below Ragged Rapids GS
ARSP Simulation Case 2
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow 3 m^3/s Achieved 91% of time

No of days above minumum flow

First half of season		*Last half of season*		*For whole season*	
Min	3 days	Min	0 days	Min	3 days
Avg	21.7 days	Avg	21.56 days	Avg	43.26 days
Years Provided	72%	Years Provided	86%	Years Provided	72%

From flow duration curve

%	Flow	
99%	-	m^3/s
95%	-	m^3/s

No of days min flow is achievd 3 days

90% *percentile peak flow* 89 m3/s

Summer Minimum 7-day Flow

	Maximum	33.02 m^3/s
	Minimum	3.01 m^3/s
90%	Percentile	21.39 m^3/s
10%	Percentile	3.02 m^3/s
	Median	10.00 m^3/s
	Mean	10.13 m^3/s

Maximum Flows

Regulatory Flood Outflow No of years exceeded Maximum Daily Flow

N/A	m³/s	0	88.88 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	5.73	0.00	0.00 m³/s	

Summer Fluctuations

Delta Flow	Average number of daily flow fluctuations per year		
1	41.12		
3	27.52		
5	17.84		
>11.6665	5.64	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m³/s	m³/s	m³/s	m³/s
31.34	84.79	3.07	0.00

Power Generation

	Quarter				
	1	2	3	4	Annual
Flow	72.85	57.79	25.50	61.14	54.21 m³/s