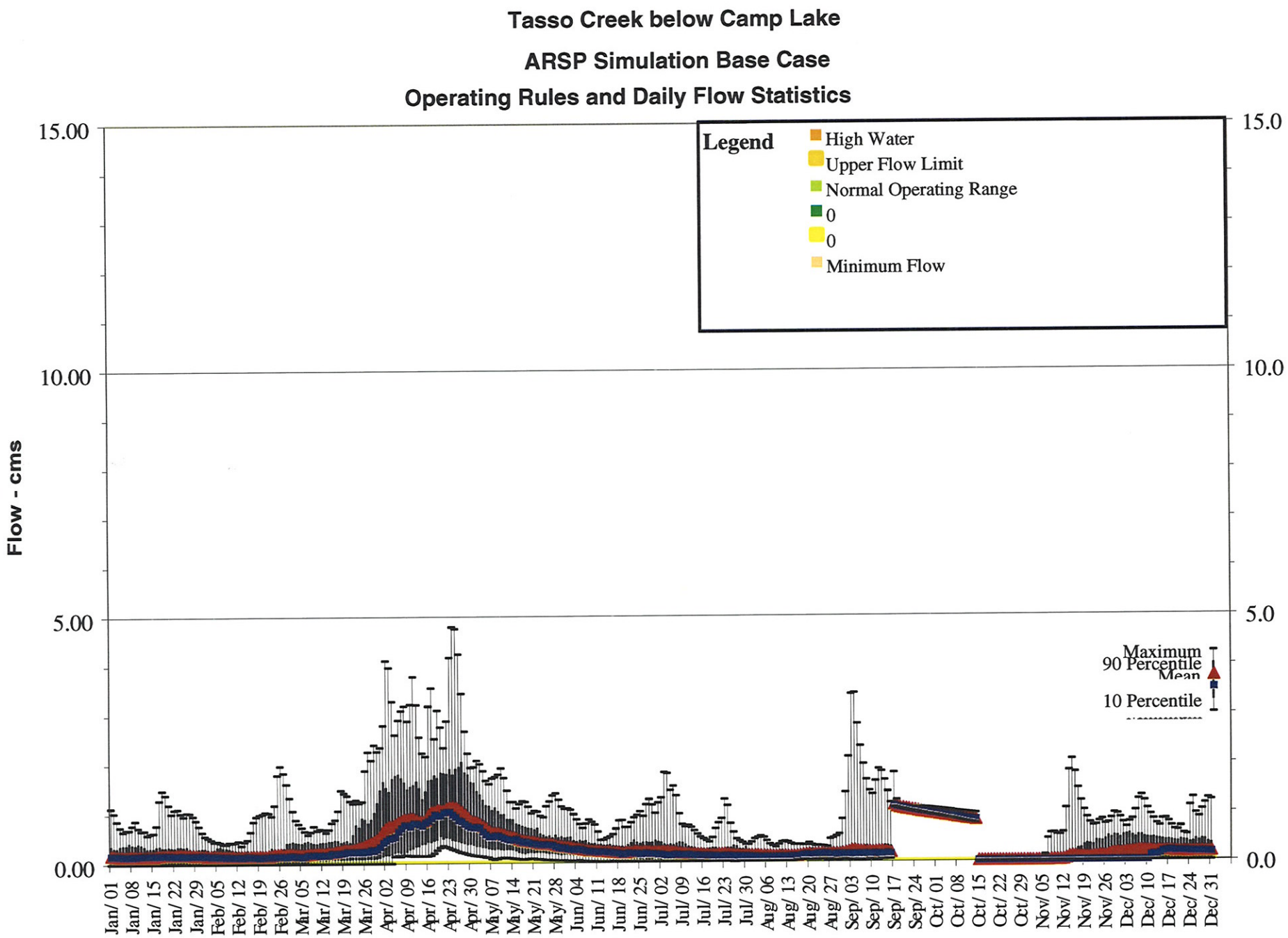
Appendix F

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

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

Tasso Lake


Tasso Creek below Camp 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
10 Percentile
Flow - cms
15.00
10.00
5.00
0.00
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

Tasso Creek below Camp 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	
99%	0.08	m³/s
95%	0.17	m³/s

No of days min flow is achievd

49 days

90% *percentile peak flow*

1 m3/s

Summer Minimum 7-day Flow

	Maximum	0.16	m³/s
	Minimum	0.02	m³/s
90%	Percentile	0.11	m³/s
10%	Percentile	0.04	m³/s
	Median	0.07	m³/s
	Mean	0.07	m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded
11	m³/s	0

Minumum Flows

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

Summer Fluctuations

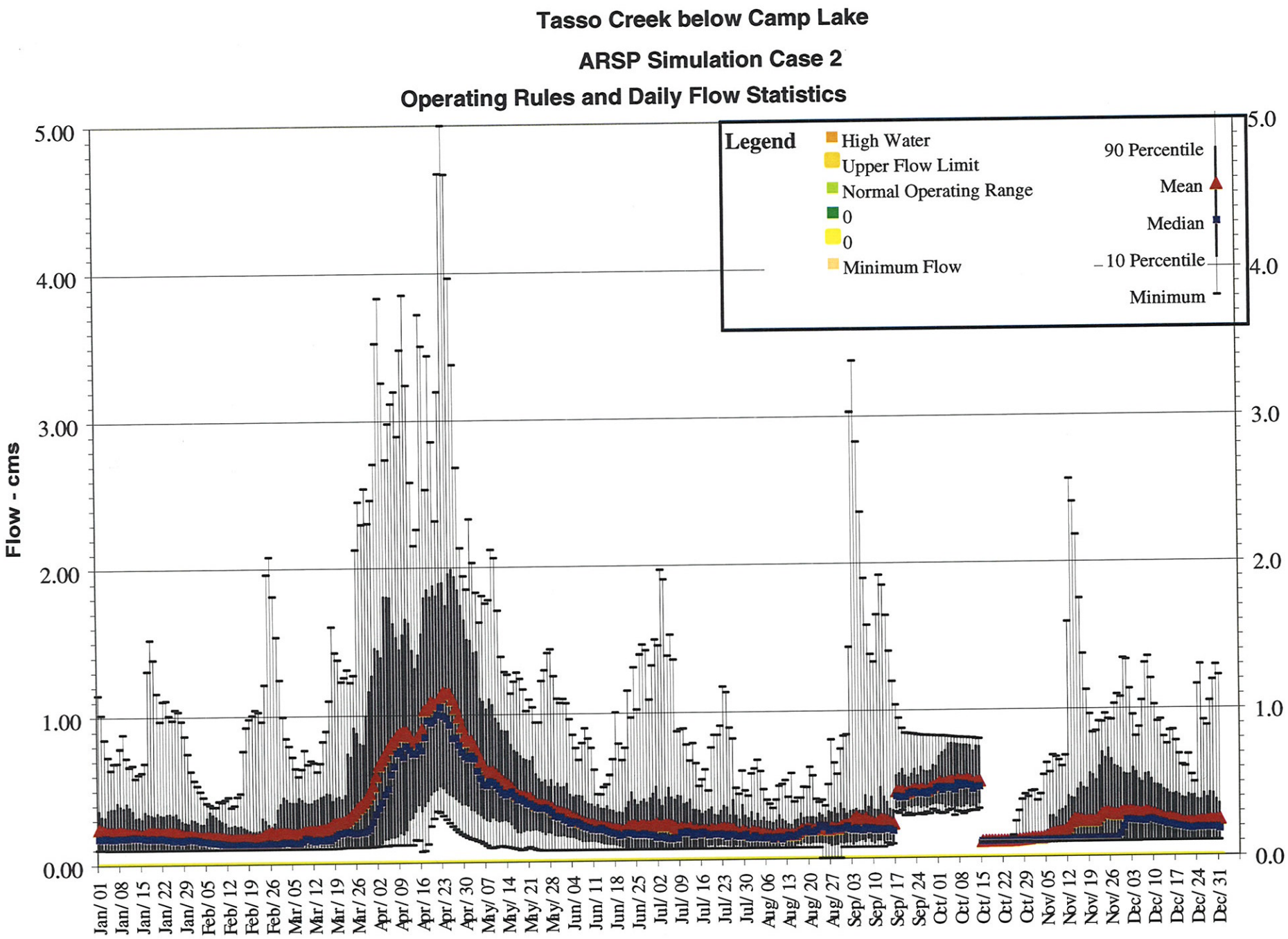
Delta Flow	Average number of daily flow fluctuations per year		
1	0.44		
3	0.00		
5	0.00		
>0.076	3.96	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m³/s	m³/s	m³/s	m³/s
0.19	0.16	0.03	0.00

Power Generation

	Quarter					
	1	2	3	4	Annual	
Flow	0.21	0.57	0.30	0.22	0.32	m³/s


Tasso Creek below Camp Lake
ARSP Simulation Case 2
Operating Rules and Daily Flow Statistics
Legend
High Water
Upper Flow Limit
Normal Operating Range
0
0
Minimum Flow
90 Percentile
Mean
Median
10 Percentile
Minimum
Flow - cms
5.00
4.00
3.00
2.00
1.00
0.00
5.0
4.0
3.0
2.0
1.0
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

Tasso Creek below Camp 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*
99%	0.09	m³/s	*min flow is achievd*
95%	0.18	m³/s	49 days

90% *percentile peak flow*

1 m3/s

Summer Minimum 7-day Flow

	Maximum	0.20	m³/s
	Minimum	0.00	m³/s
90%	Percentile	0.15	m³/s
10%	Percentile	0.08	m³/s
	Median	0.11	m³/s
	Mean	0.11	m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded
11	m³/s	0

Minumum Flows

Min Daily flow		*7-day minimums*			
		2	10	20	return period
		-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.00	m³/s	0.10	0.08	0.08	m³/s

Summer Fluctuations

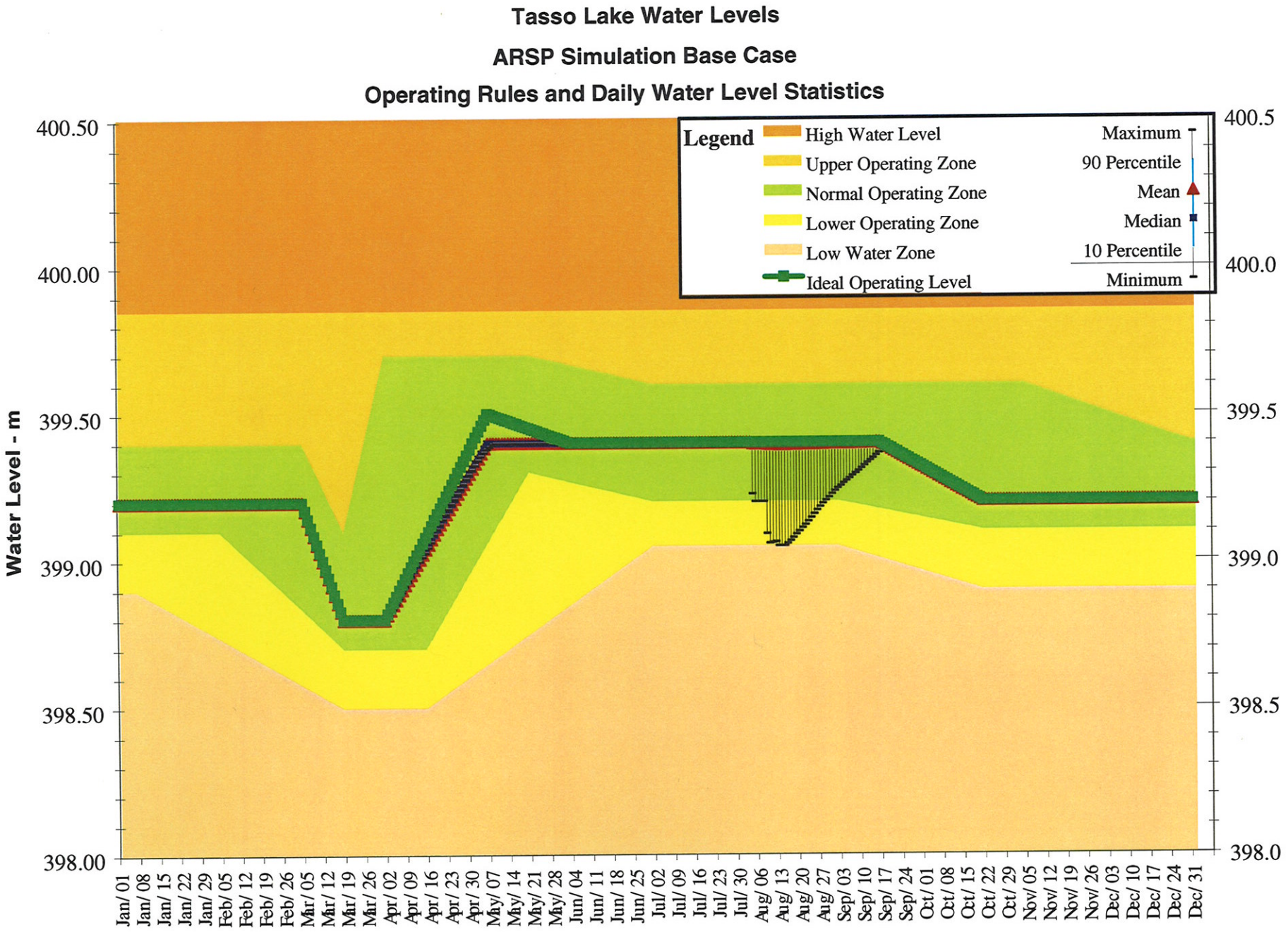
Delta Flow	Average number of daily flow fluctuations per year		
1	0.04		
3	0.00		
5	0.00		
>0.0945	11.52	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m³/s	m³/s	m³/s	m³/s
0.23	0.18	0.10	0.08

Power Generation

	Quarter					
	1	2	3	4	Annual	
Flow	0.23	0.56	0.25	0.26	0.32	m³/s


Tasso Lake Water Levels
ARSP Simulation Base Case
Operating Rules and Daily Water Level Statistics
Legend
High Water Level
Upper Operating Zone
Normal Operating Zone
Lower Operating Zone
Low Water Zone
Ideal Operating Level
Maximum
90 Percentile
Mean
Median
10 Percentile
Minimum
Water Level - m
400.50
400.00
399.50
399.00
398.50
398.00
400.5
400.0
399.5
399.0
398.5
398.0
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

Tasso Lake Water Levels
ARSP Simulation Base Case

Peak Water Levels	
HWZ	399.85
No of Days in Exceedance	0
No of Years Exceeded	0
Maximum WL	399.40

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	399.30
Date of peak	30-Apr
Tolerance	0
Tolerated WL	399.30
Date tolerated exceeded	30-Apr

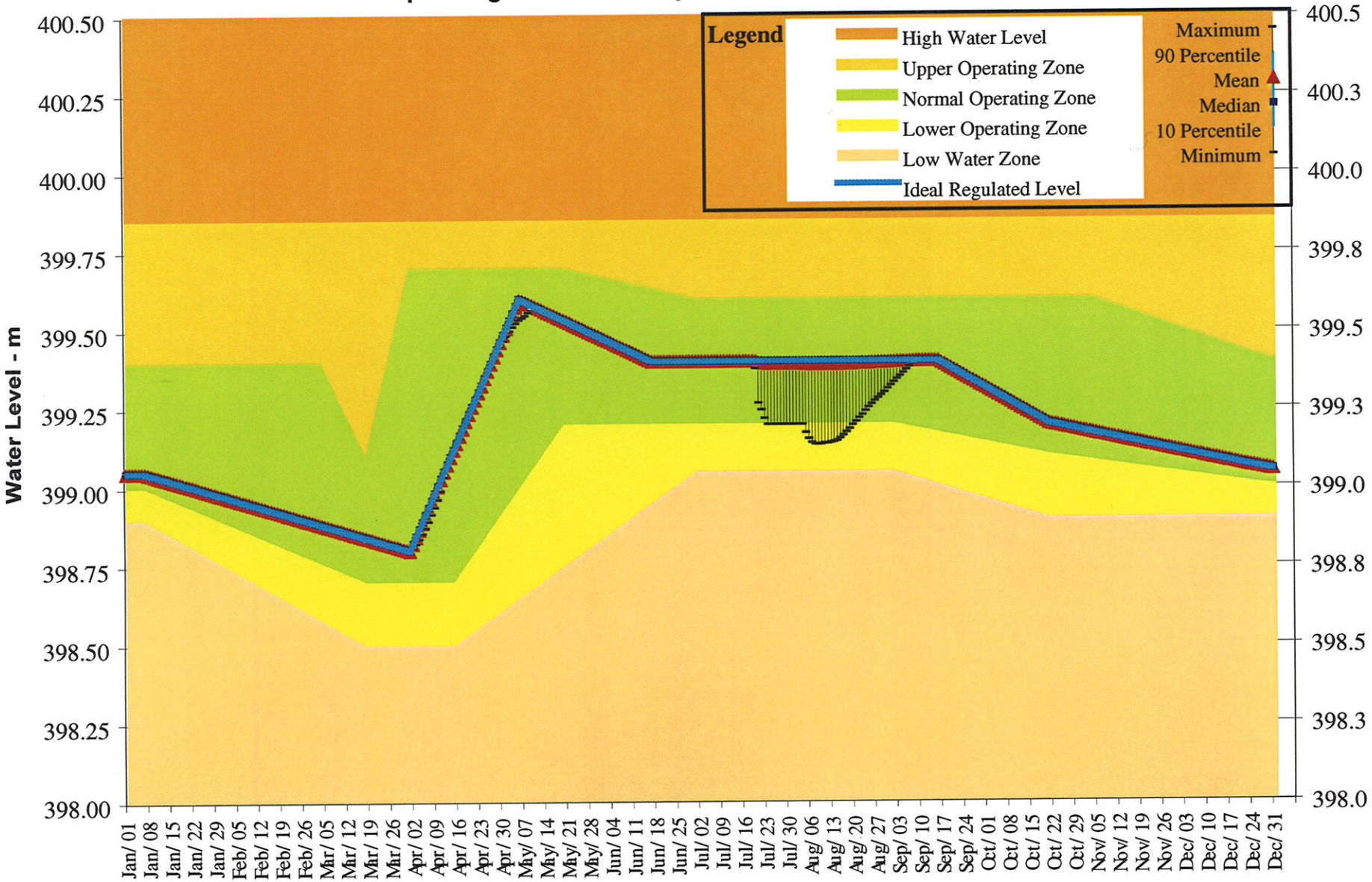
Summer recreation levels Jun-15 to Sep-30	
90 and 10 percentile range	
Max 90%	399.40
Min 10%	399.32
Range	0.08

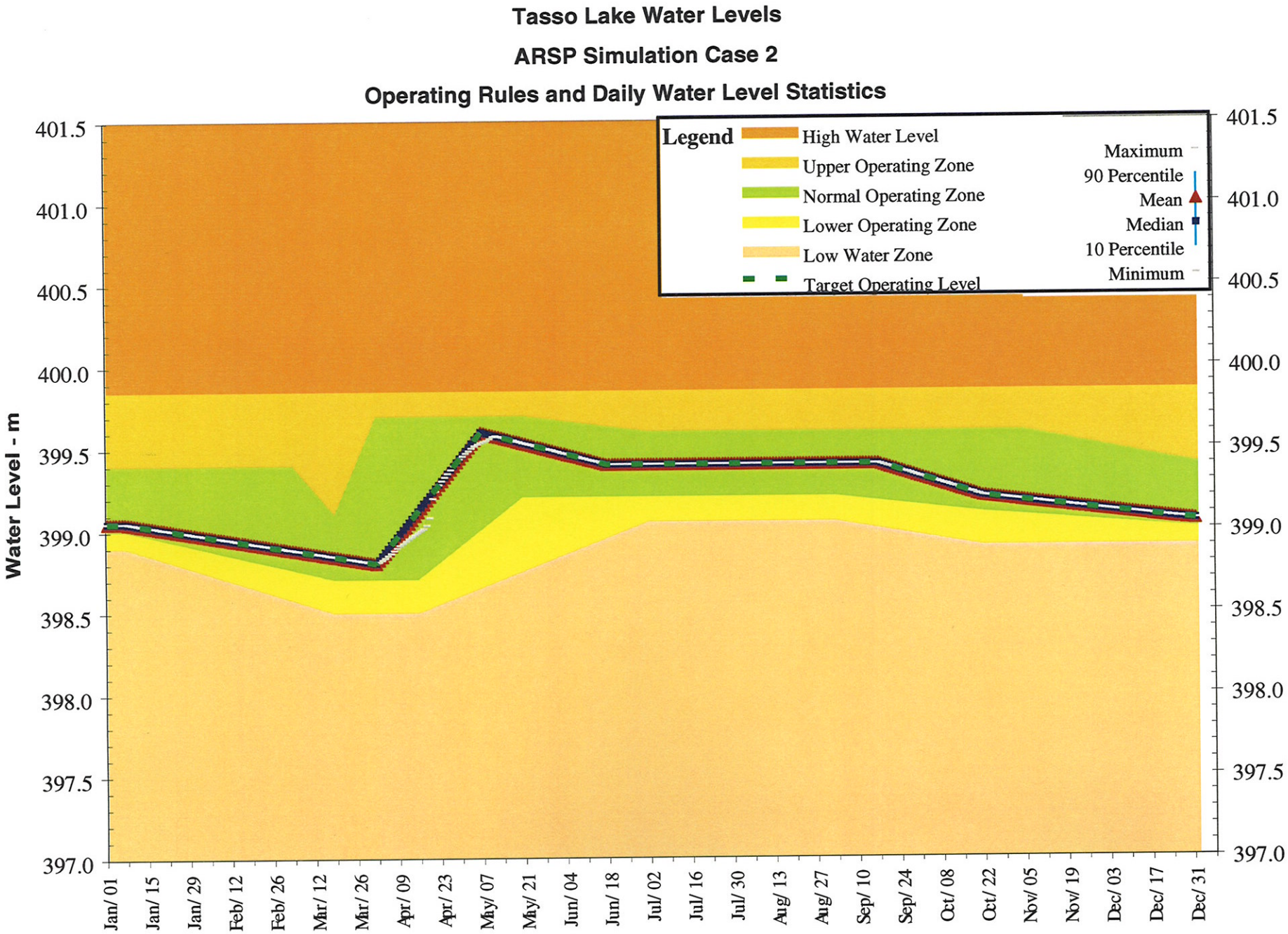
Median range	
Max Median	399.40
Min Median	399.32
Range	0.08

Tasso Lake Water Levels

ARSP Simulation Proposed Case 1

Operating Rules and Daily Water Level Statistics




Tasso Lake Water Levels
ARSP Simulation Case 2
Operating Rules and Daily Water Level Statistics
Water Level - m
401.5
401.0
400.5
400.0
399.5
399.0
398.5
398.0
397.5
397.0
Legend
High Water Level
Upper Operating Zone
Normal Operating Zone
Lower Operating Zone
Low Water Zone
Target Operating Level
Maximum
90 Percentile
Mean
Median
10 Percentile
Minimum
Jan/ 01
Jan/ 15
Jan/ 29
Feb/ 12
Feb/ 26
Mar/ 12
Mar/ 26
Apr/ 09
Apr/ 23
May/ 07
May/ 21
Jun/ 04
Jun/ 18
Jul/ 02
Jul/ 16
Jul/ 30
Aug/ 13
Aug/ 27
Sep/ 10
Sep/ 24
Oct/ 08
Oct/ 22
Nov/ 05
Nov/ 19
Dec/ 03
Dec/ 17
Dec/ 31

Tasso Lake Water Levels
ARSP Simulation Case 2

Peak Water Levels	
HWZ	399.85
No of Days in Exceedance	0
No of Years Exceeded	0
Maximum WL	399.60

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	399.46
Date of peak	30-Apr
Tolerance	0
Tolerated WL	399.46
Date tolerated exceeded	30-Apr

Summer recreation levels Jun-15 to Sep-30	
90 and 10 percentile range	
Max 90%	399.41
Min 10%	399.32
Range	0.09

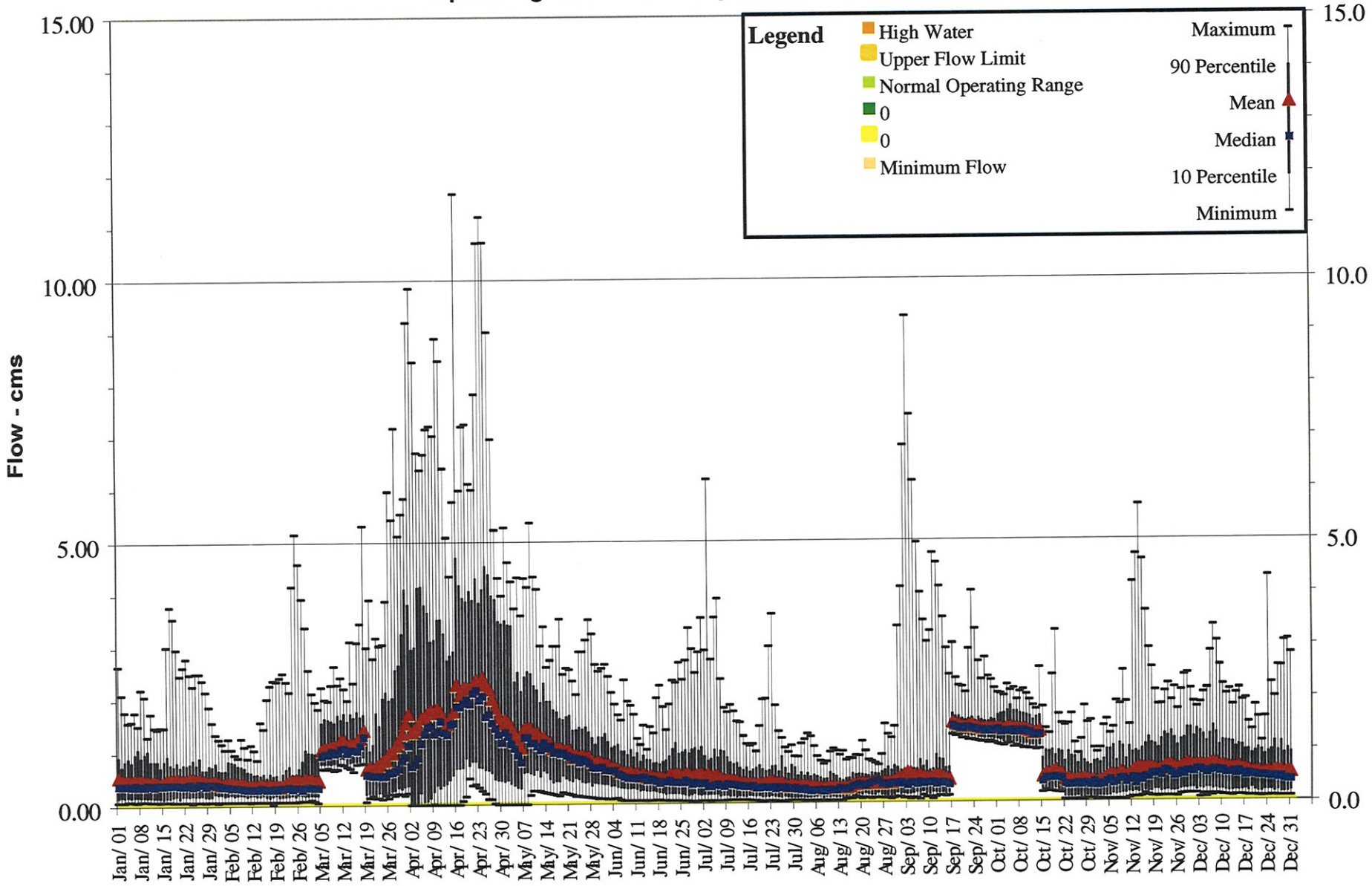
Median range	
Max Median	399.41
Min Median	399.32
Range	0.09

Spring Peak Water Level	
Maximum - 50 yr Average	399.60
Date - 50 yr Average	6/May
Summer Average Level	399.40

Tasso Creek below Tasso Lake

ARSP Simulation Base Case

Operating Rules and Daily Flow Statistics



Flow Evaluation

Yellow cells indicate values that can be changed for analysis

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

Walleye Spawning

Min Flow **0** m³/s Achieved 100% of time

No of days above minumum flow

First half of season

Min	13	days
Avg	24.72	days
Years Provided	96%	

Last half of season

Min	24	days
Avg	24	days
Years Provided	100%	

For whole season

Min	37	days
Avg	48.72	days
Years Provided	96%	

From flow duration curve

%	Flow	
99%	0.11	m³/s
95%	0.31	m³/s

No of days min flow is achievd

37 days

90%	*percentile peak flow*
3	m3/s

Summer Minimum 7-day Flow

	Maximum	0.36	m³/s
	Minimum	0.04	m³/s
90%	Percentile	0.25	m³/s
10%	Percentile	0.08	m³/s
	Median	0.16	m³/s
	Mean	0.17	m³/s

Maximum Flows

Regulatory Flood Outflow

32.5 m³/s

No of years exceeded

0

Minumum Flows

Min Daily flow

0.00 m³/s

7-day minimums

2	10	20	return period
-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.12	0.05	0.02	m³/s

Summer Fluctuations

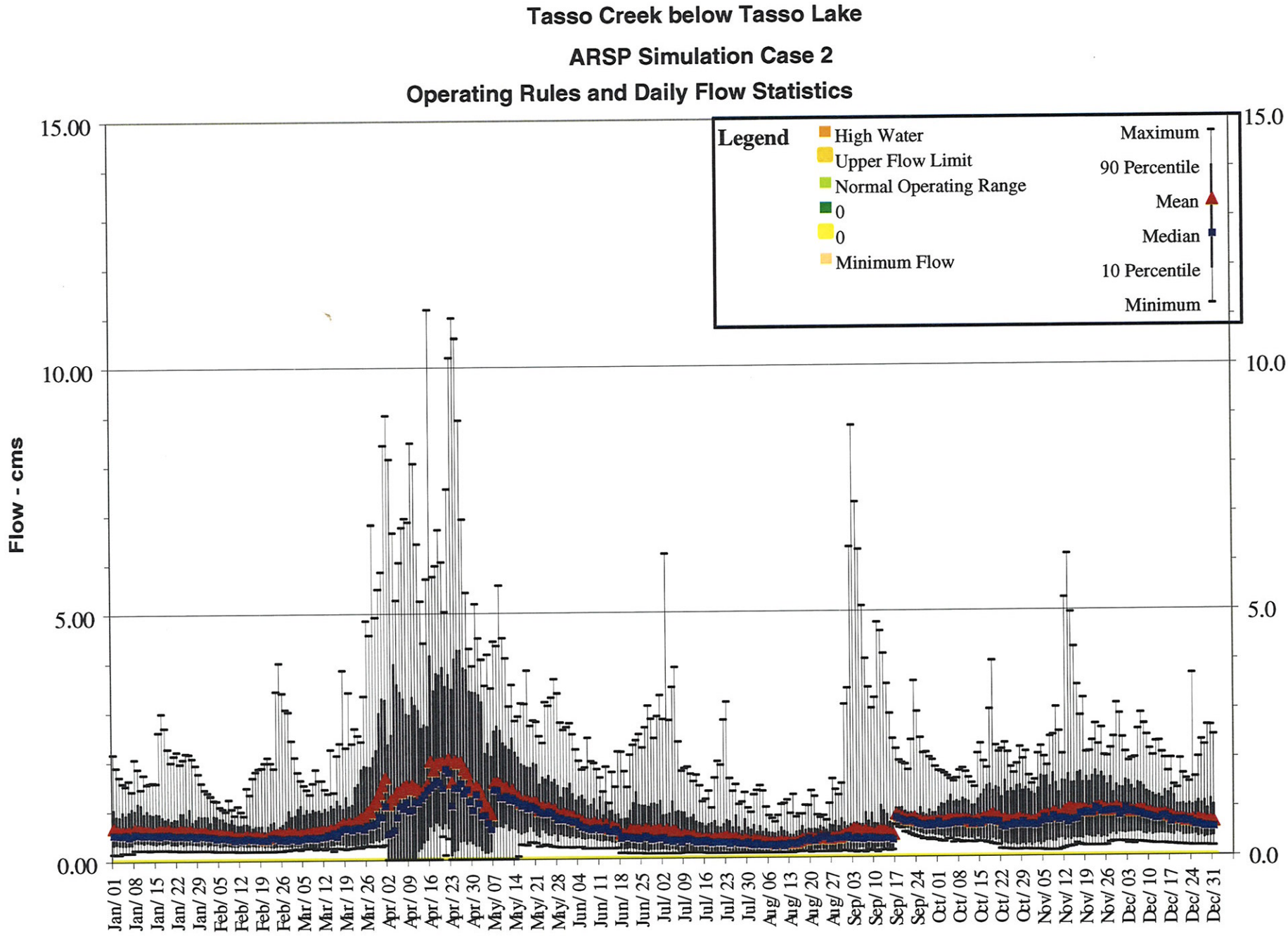
Delta Flow	Average number of daily flow fluctuations per year		
1	1.28		
3	0.04		
5	0.00		
>0.178	11.52	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m³/s	m³/s	m³/s	m³/s
0.49	0.50	0.16	0.00

Power Generation

	Quarter				Annual	
	1	2	3	4		
Flow	0.63	1.19	0.55	0.68	0.76	m³/s


Tasso Creek below Tasso 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
15.00
10.00
5.00
0.00
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

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

Walleye Spawning

Min Flow **0** m³/s Achieved 100% of time

No of days above minumum flow

First half of season

Min	7	days
Avg	23.48	days
Years Provided	86%	

Last half of season

Min	20	days
Avg	23.92	days
Years Provided	98%	

For whole season

Min	27	days
Avg	47.4	days
Years Provided	86%	

From flow duration curve

%	Flow	
99%	-	m³/s
95%	0.25	m³/s

No of days min flow is achievd 27 days

90% percentile peak flow 3 m3/s

Summer Minimum 7-day Flow

	Maximum	0.38	m³/s
	Minimum	0.10	m³/s
90%	Percentile	0.27	m³/s
10%	Percentile	0.12	m³/s
	Median	0.18	m³/s
	Mean	0.19	m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded
32.5	m^3/s	0

Minumum Flows

Min Daily flow		*7-day minimums*			
		2	10	20	return period
		-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.00	m^3/s	0.14	0.00	0.00	m^3/s

Summer Fluctuations

Delta Flow	Average number of daily flow fluctuations per year		
1	0.48		
3	0.04		
5	0.00		
>0.19	16.62	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m^3/s	m^3/s	m^3/s	m^3/s
0.52	0.61	0.18	0.00

Power Generation

	Quarter					
	1	2	3	4	Annual	
Flow	0.62	1.15	0.46	0.81	0.76	m^3/s