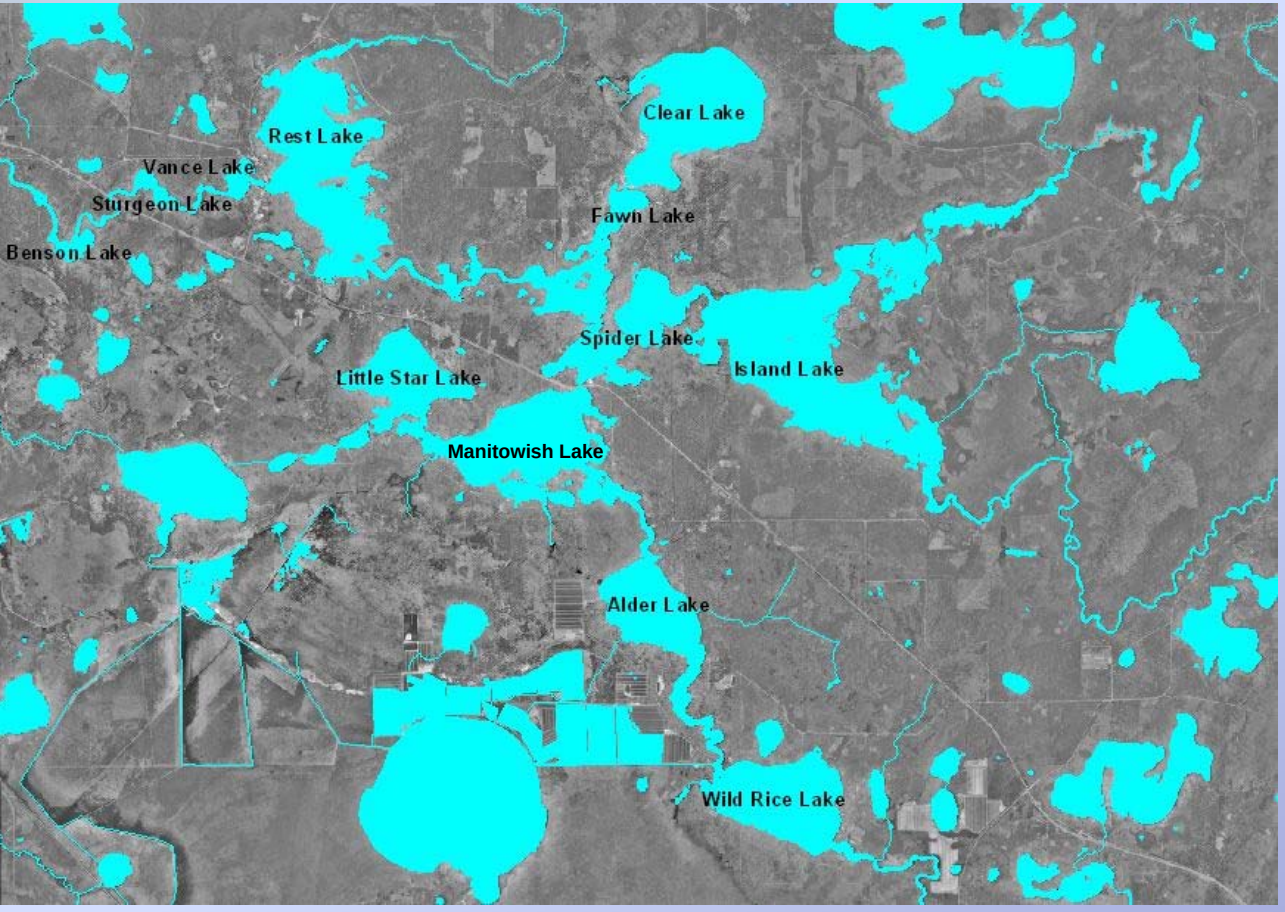
REST LAKE DAM

MANITOWISH CHAIN



- Drainage area is 243 square miles.
- This is about 12.9% of the total Flambeau River drainage area.
- The dam impounds ten natural lakes (Rest, Stone, Fawn, Spider, Clear, Island, Alder, Manitowish, Little Star and Wild Rice).
- The total surface area is 4,200 acres.
- The usable storage capacity is about 15,150 acre feet of water.

EXCEPTIONAL RESOURCE WATER FROM REST LAKE DOWNSTREAM TO TURTLE FLAMBEAU FLOWAGE.

REASONS FOR CONDUCTING THIS PROJECT

•Response to citizen complaints about dam operation.

•WDNR responsibility to protect the resource and the public interest in navigable waterways (includes sufficient instream flows for fish and wildlife).

•Implementation of the statewide Sturgeon Management plan.

•Age of the existing operating order (not being operated as called for under the existing 1939 order).

TONIGNTS PRESENTATION WILL COVER THE FOLLOWING RESOURCE ISSUES:

- Low spring river flows.
- Summer minimum flow /summer chain elevation.
- Spring and fall changes in water flow (ramping rates, fall draw down).
- Winter storage.

Where are we at?

•I feel field data has been collected to make management decisions.

•My opinion is that the options laid out are reasonable.

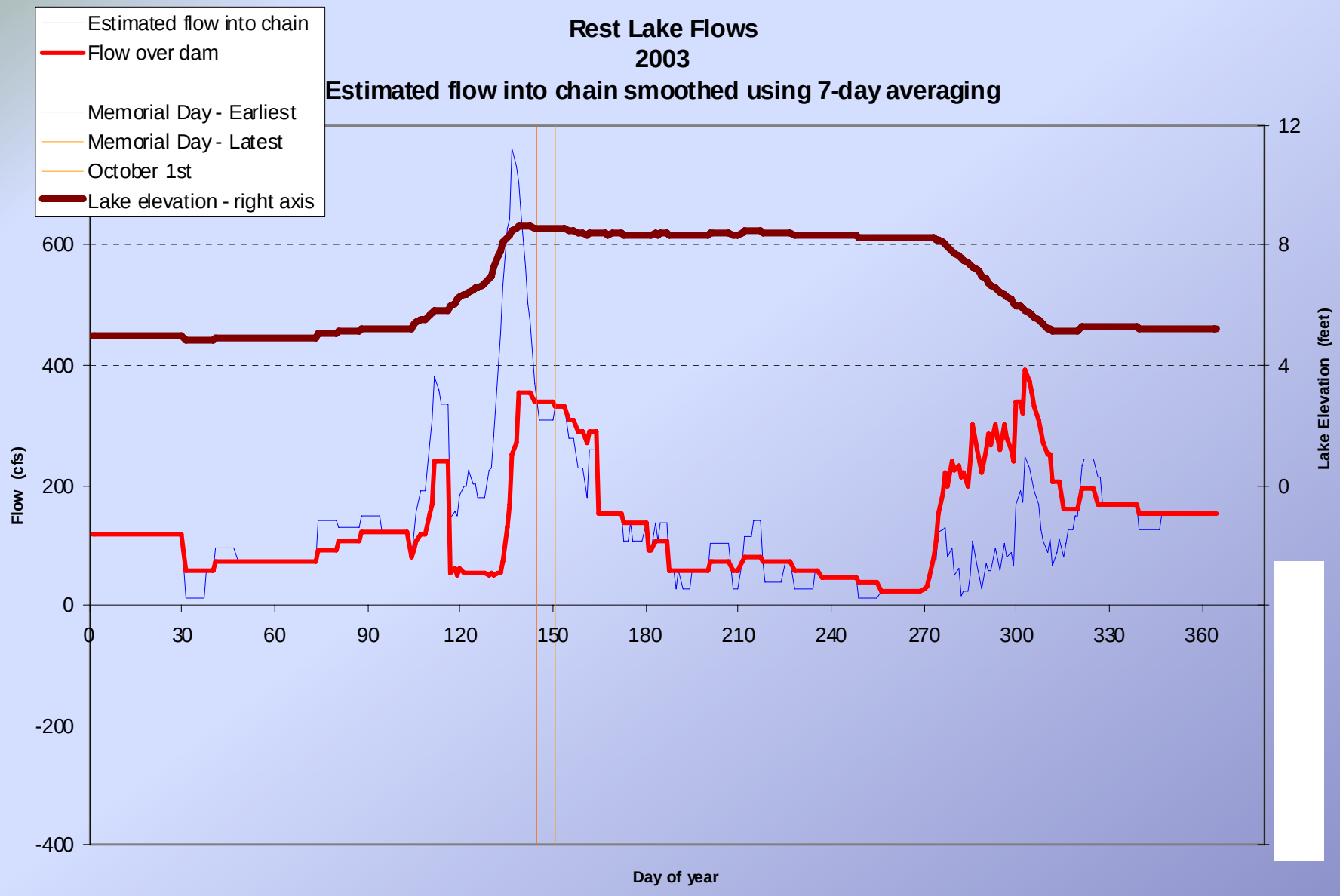
•Overall goal is to reach an agreement with user groups on future operation of Rest Lake Dam and implement an **Adaptive Management Plan**.

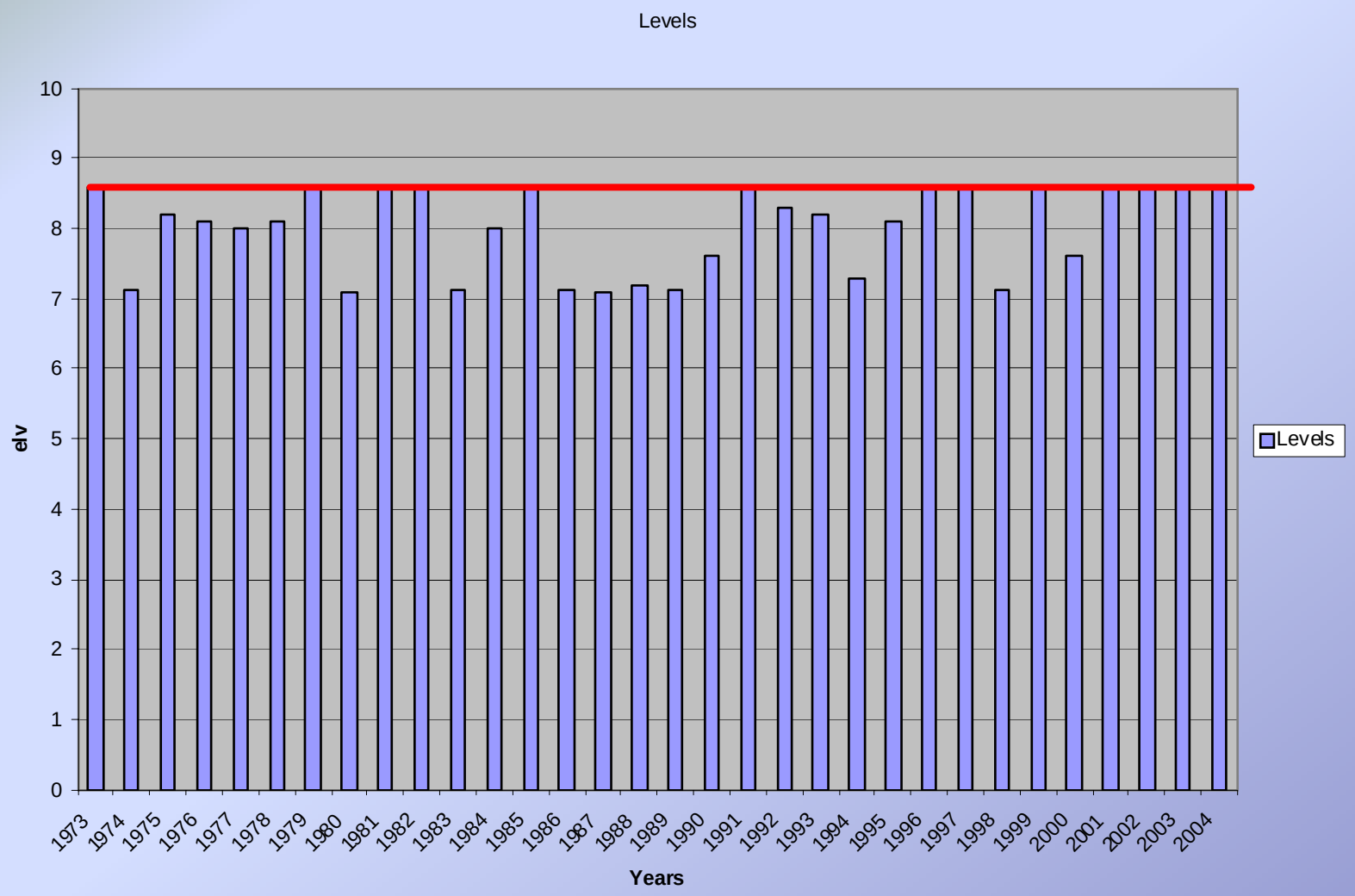
•The department has the responsibility to protect the resource. We have regulatory authority to request changes to the existing operating order.

ANNUAL OPERATION-EXISTING

DATES	STAFF GUAGE READING
November 1 to Spring Ice Break-up	Minimum of 5’.0”
Spring Break-up (ice is 75 % off of Rest Lake) to April 15	Minimum of 7’. 3” **(target is to fill chain by Memorial Day).**
April 15 to July 1	7’.3” – 8’.6”
July 1 to September 1	No lower than 7’. 3” **(Summer target water levels have been between 8’. 4” – 8’. 6”).**
September 1 to November 1 **(Draw down starts October 1).**	No lower than 5’.0”

- At no time shall the chain be lowered at a rate exceeding 2 inches per day
- At no time shall the chain be lowered after ice forms.
- Required to pass 50 cfs base flow minimum


Rest Lake Flows
2003
Estimated flow into chain smoothed using 7-day averaging
Estimated flow into chain
Flow over dam
Memorial Day - Earliest
Memorial Day - Latest
October 1st
Lake elevation - right axis
Flow (cfs)
Lake Elevation (feet)
Day of year
600
400
200
0
-200
-400
12
8
4
0
0
30
60
90
120
150
180
210
240
270
300
330
360



REST LAKE CHAIN ELEVATION ON MEMORIAL DAY (1973-2004)

13 out of 31 years, chain has been filled by Memorial Day

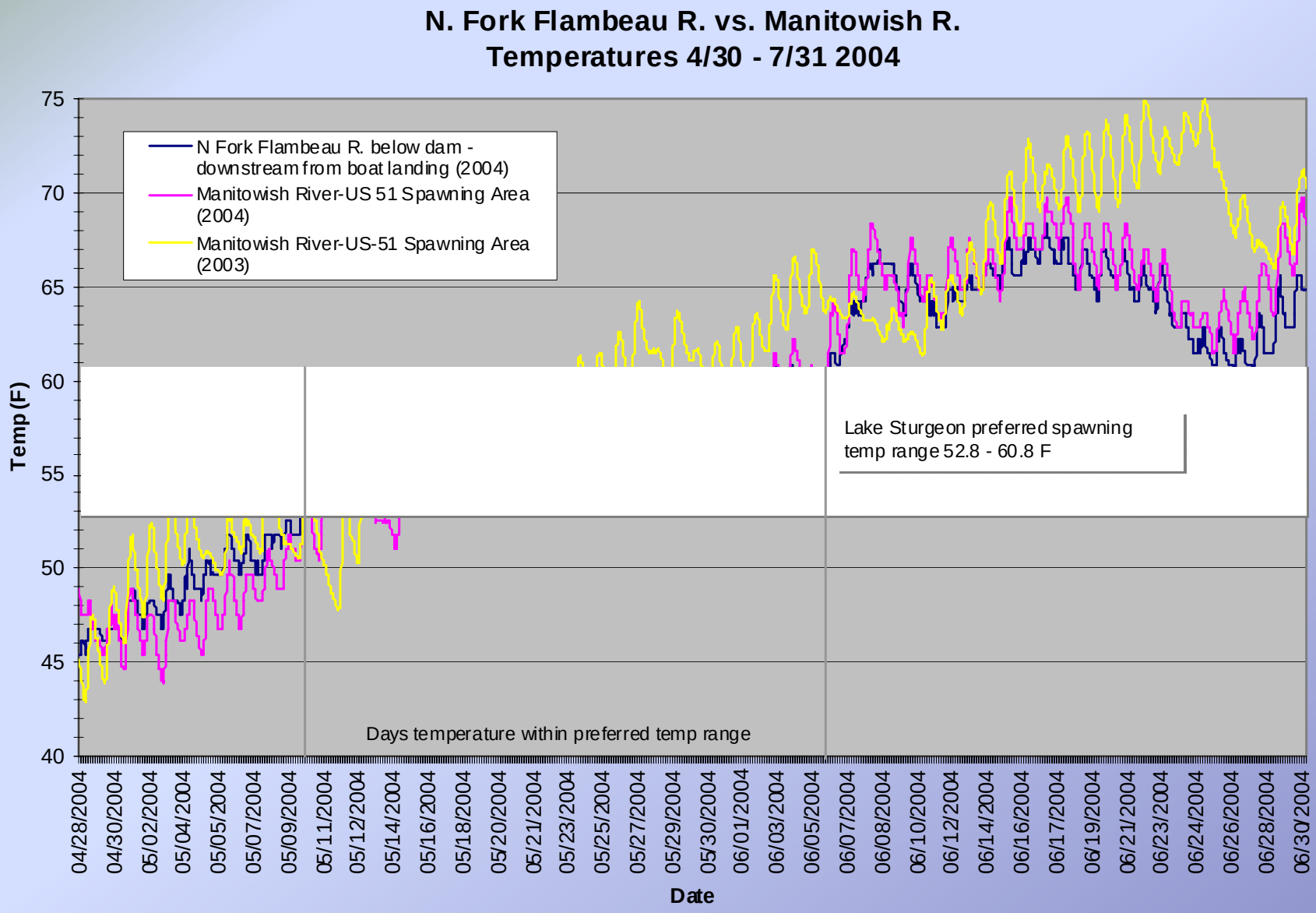
LOW DOWNSTREAM RIVER FLOWS IN SPRING

- REVIEWED SPRING FLOW DATA (APRIL -MAY) OVER THE LAST 30 YEARS

- 21 OUT OF THE LAST 30 YEARS HAD LOW FLOW (~ 50-60 CFS) DURING MOST OF THE MONTH OF MAY

- 17 OUT OF THE LAST 20 YEARS HAD LOW FLOW (~50-60 CFS) DURING THE MONTH OF MAY

- THE MONTH OF MAY IS CRITICAL FOR STURGEON SPAWNING AND RECRUITMENT (BASED ON RIVER WATER TEMPERATURE)


N. Fork Flambeau R. vs. Manitowish R.
Temperatures 4/30 - 7/31 2004
N Fork Flambeau R. below dam - downstream from boat landing (2004)
Manitowish River-US 51 Spawning Area (2004)
Manitowish River-US-51 Spawning Area (2003)
Lake Sturgeon preferred spawning temp range 52.8 - 60.8 F
Days temperature within preferred temp range
Temp (F)
75
70
65
60
55
50
45
40
04/28/2004
04/30/2004
05/02/2004
05/04/2004
05/05/2004
05/07/2004
05/09/2004
05/11/2004
05/12/2004
05/14/2004
05/16/2004
05/18/2004
05/20/2004
05/21/2004
05/23/2004
05/25/2004
05/27/2004
05/29/2004
05/30/2004
06/01/2004
06/03/2004
06/05/2004
06/07/2004
06/08/2004
06/10/2004
06/12/2004
06/14/2004
06/16/2004
06/17/2004
06/19/2004
06/21/2004
06/23/2004
06/24/2004
06/26/2004
06/28/2004
06/30/2004
Date

PURPOSE OF HABITAT MODEL

- Predicts physical habitat changes associated with flow alterations.

- Provides information on the amount of suitable habitat (depth, substrate, water velocity) available for sturgeon at different flows.

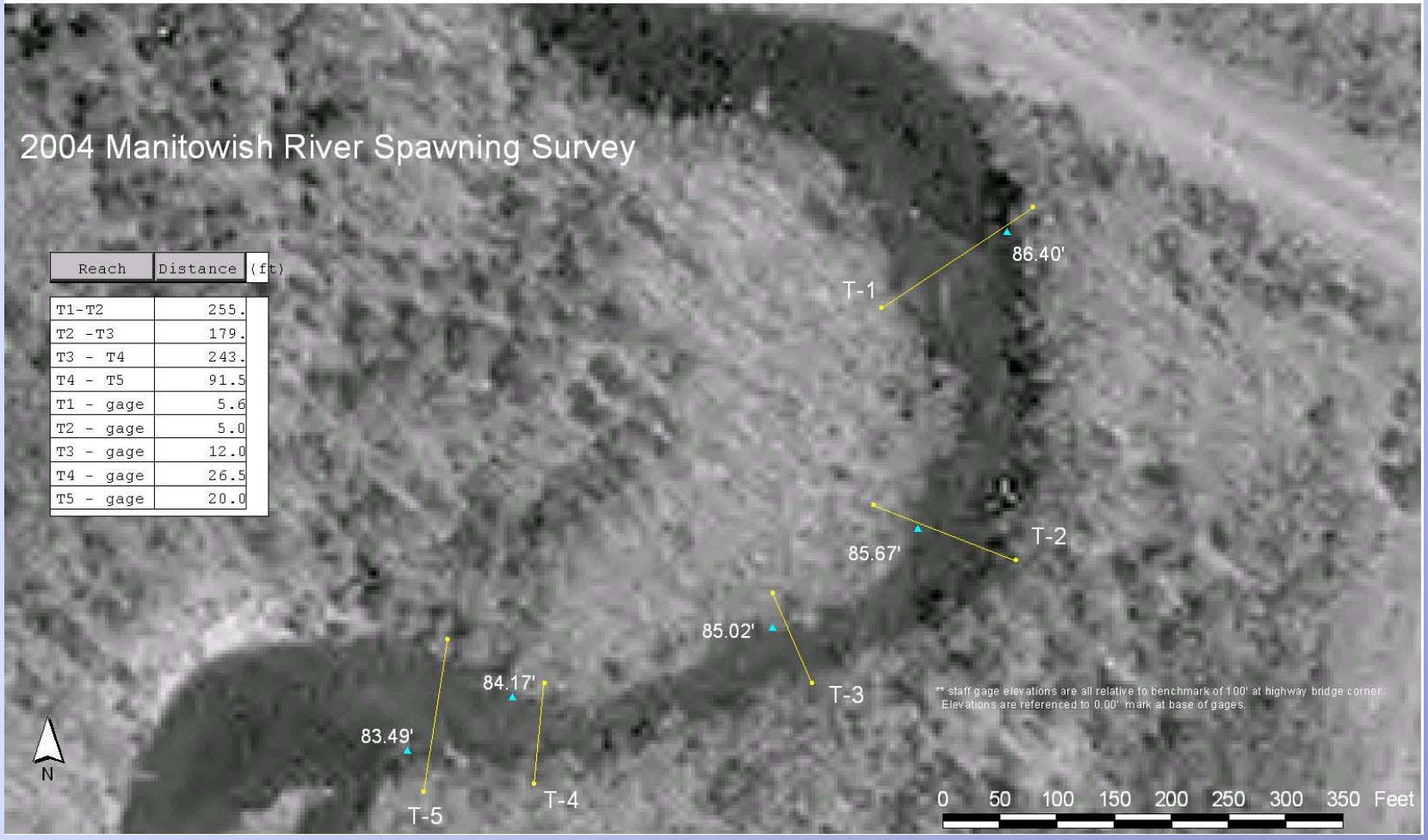
- It will allow us to determine a range of target flows suitable for sturgeon spawning and recruitment.

- It will also allow us to determine if these target flows are realistic (can the system provide it).

- If the target flows are realistic, it will help us formulate implementable options.

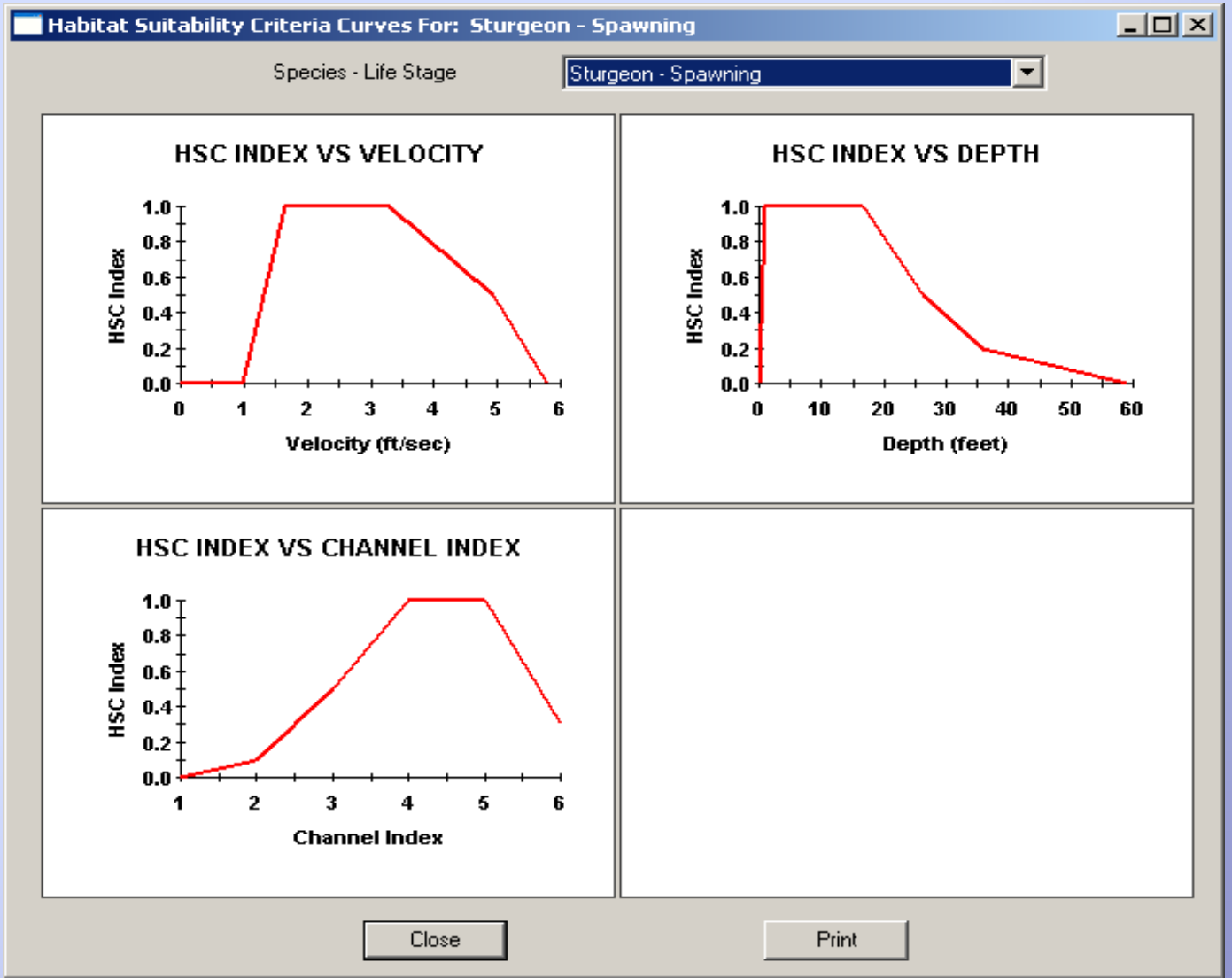
Requires field measurements of water temperature, stream width, water velocity (flow gauging), water depths and substrate along 5 transects located within the spawning site.

Manitowish River Transect Locations

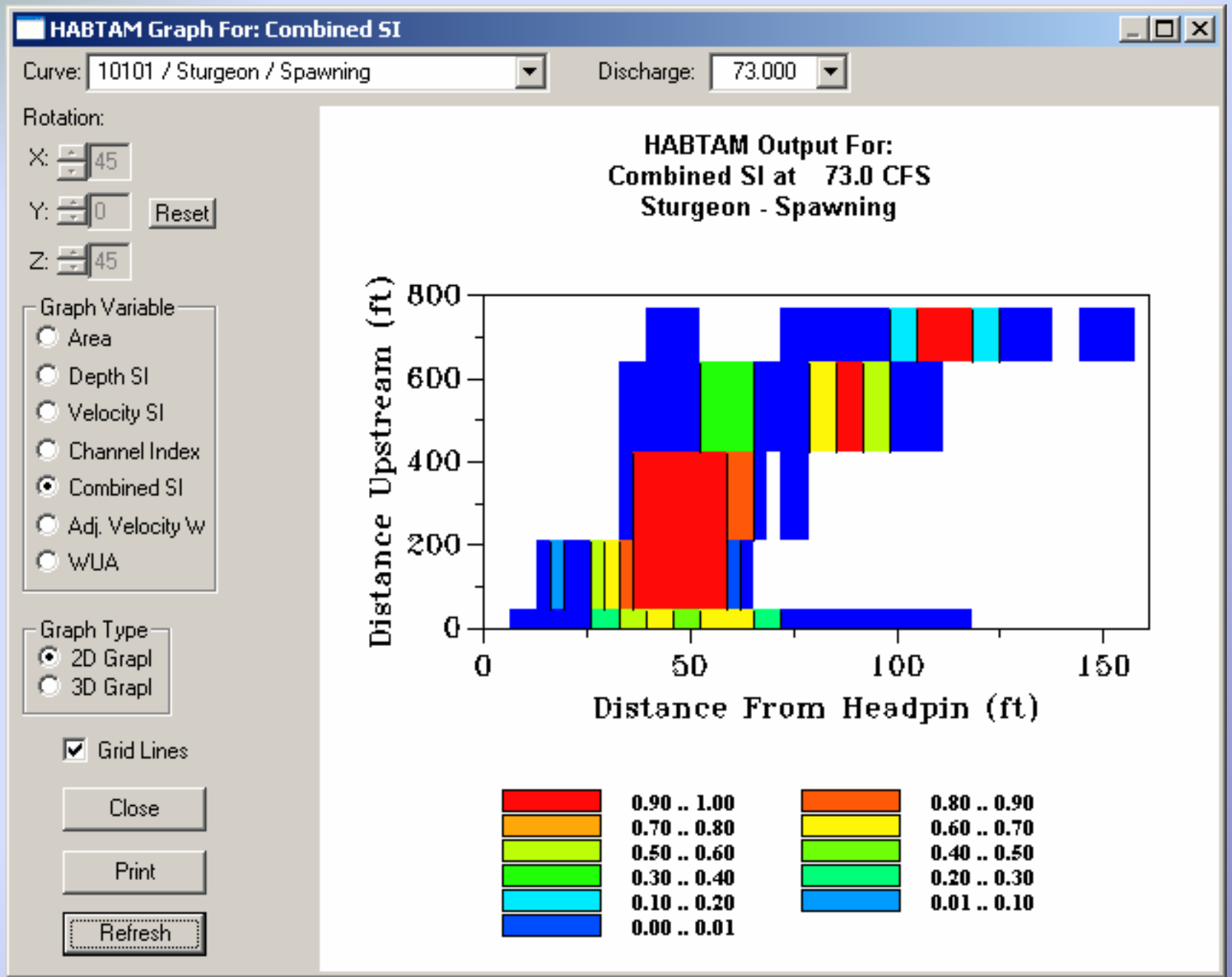


Reach	Distance (ft)
T1-T2	255.
T2 -T3	179.
T3 - T4	243.
T4 - T5	91.5
T1 - gage	5.6
T2 - gage	5.0
T3 - gage	12.0
T4 - gage	26.5
T5 - gage	20.0

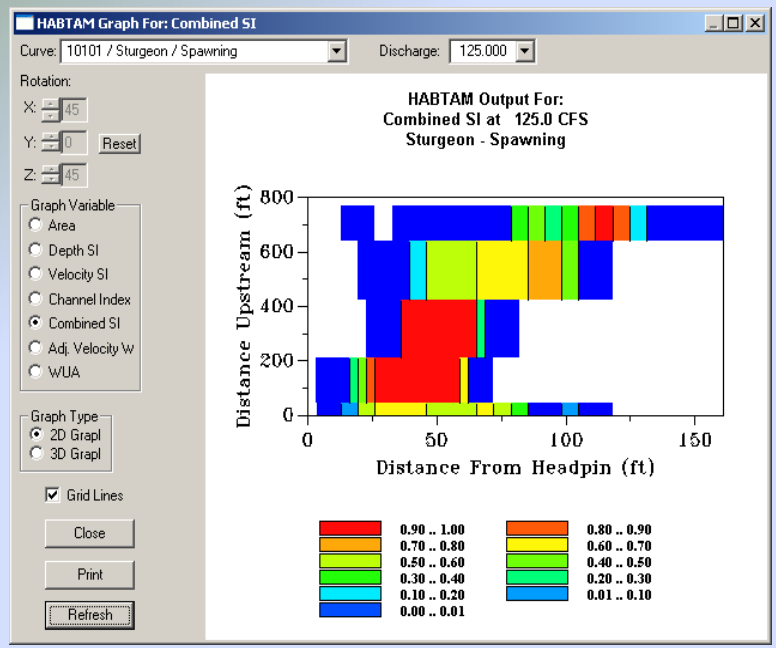
Habitat Suitability Curves for Sturgeon Spawning



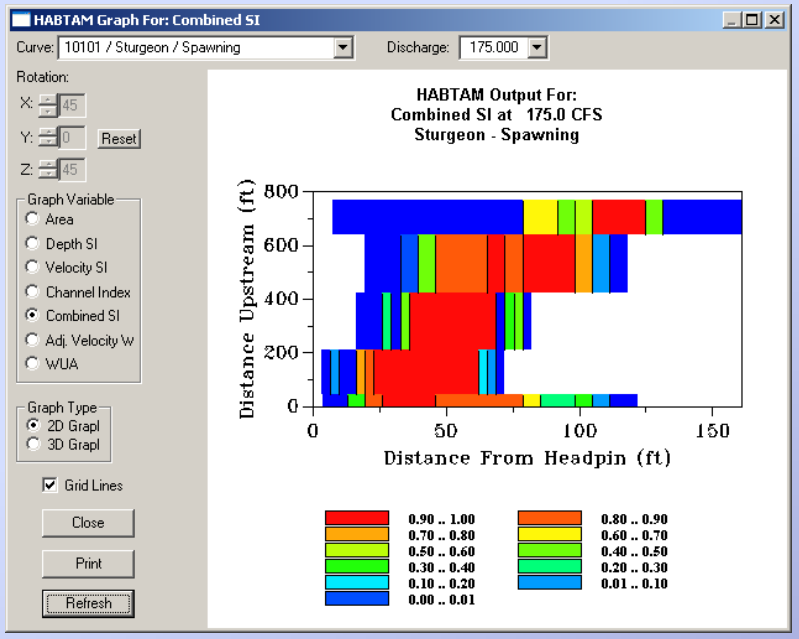
Habitat Suitability Index at 30 cfs



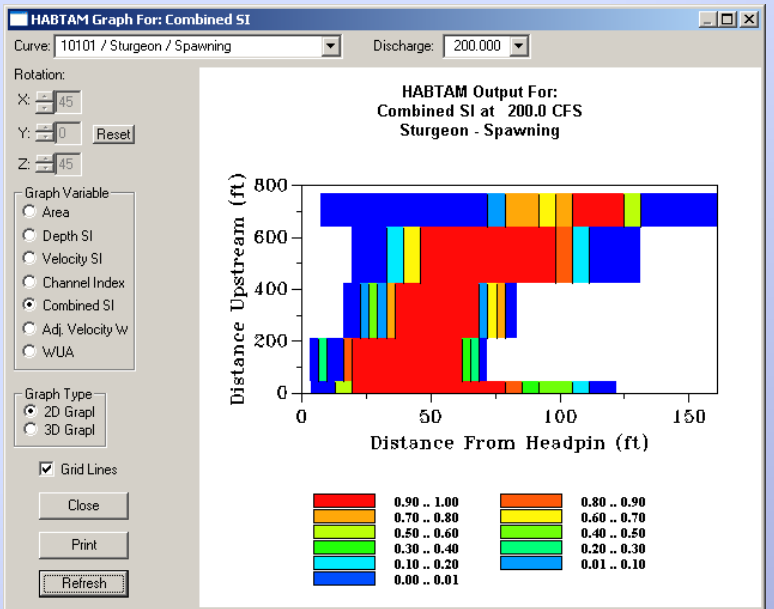
75 cfs



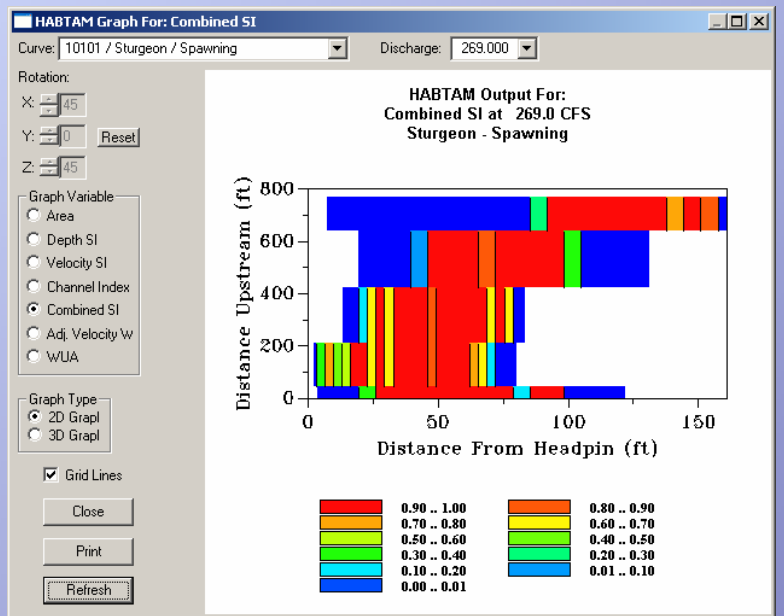
125 cfs



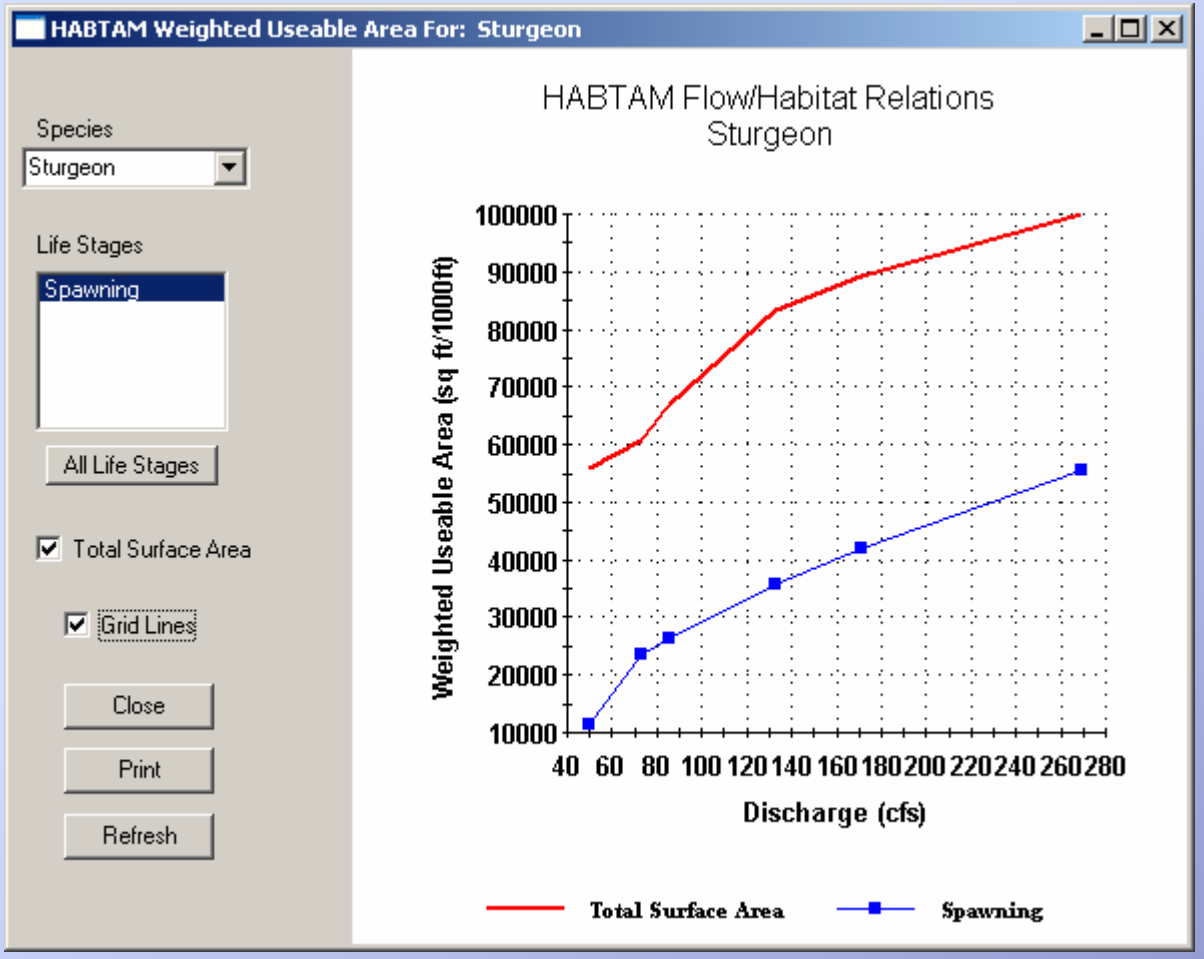
150 cfs

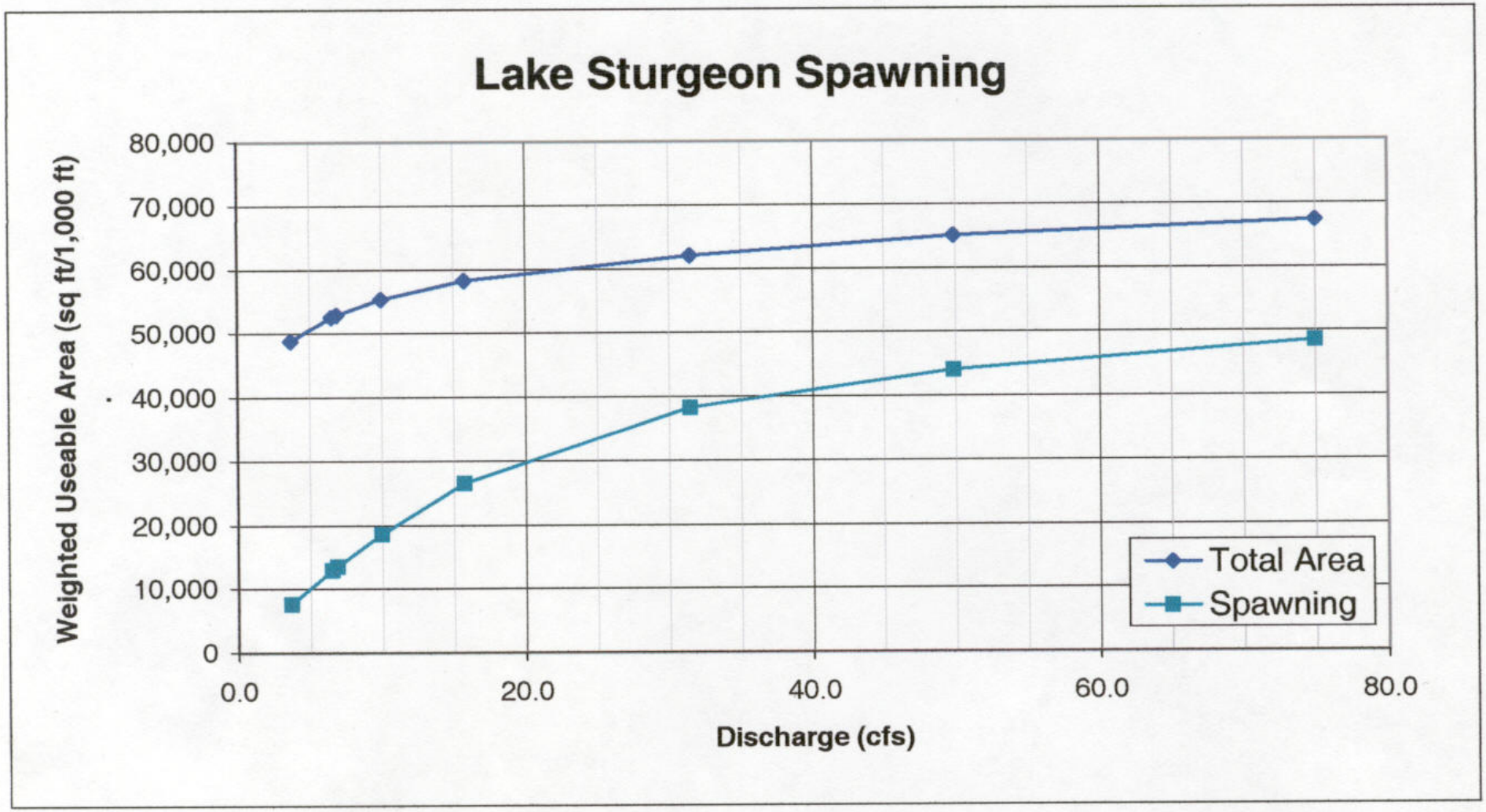


262 cfs



Usable sturgeon spawning habitat.





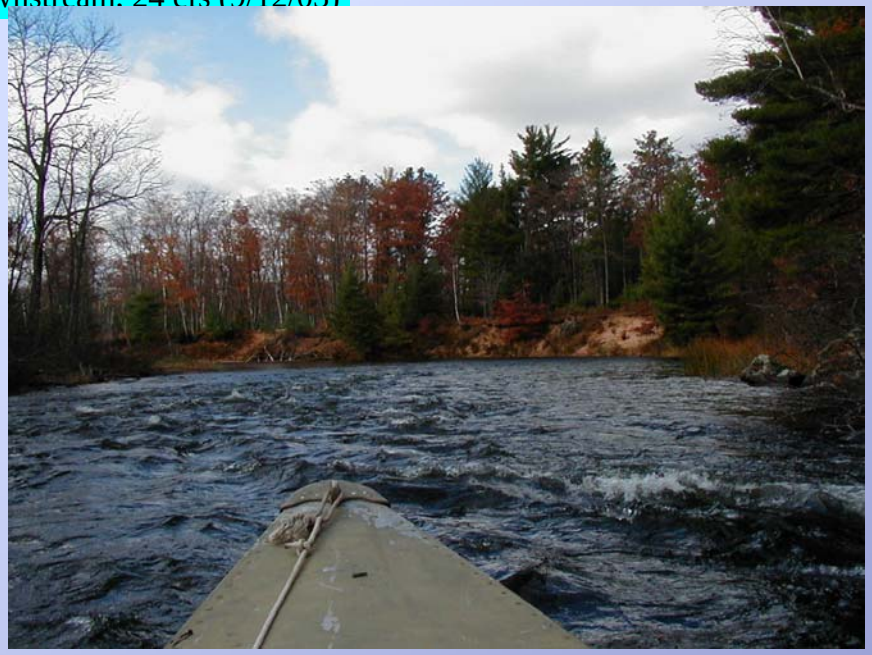
East Fork Chippewa River

AMOUNT OF SUITABLE STURGEON SPAWNING HABITAT BY FLOW (XCEL ESTIMATES).

- 30 cfs = 24,000 sq. ft/1000ft.
- 42 cfs = 27,000 sq. ft/1000ft.
- **75 cfs = 34,000 sq.ft/1000 ft.**
- **100 cfs = 40,000sq. ft/1000 ft.**
- **125 cfs = 45,000 sq. ft/1000 ft**
- **150 cfs = 52,000 sq, ft/1000 ft.**.
- 262 cfs = 55,000 sq. ft/1000ft.

Below 51 (lower), looking downstream, 24 cfs (9/12/03)

Below 51 (lower), looking downstream, 152 cfs (10/2/03)



Below 51, looking downstream, 240 cfs (10/15/03)

BASED ON THE MODELING RESULTS THE FOLLOWING RANGE OF FLOW GOALS SHOULD BE CONSIDERED DURING THE MONTH OF MAY OR WHEN WATER TEMPERATURES ARE SUITABLE.

- **An adaptive flow regime between 75 and 150 cfs should be considered.**
- These target flows are based on habitat suitability and variable water years (water entering the chain).
- If it is a low water year 75 cfs should be maintained.
- If it is a high water year provide up to 150 cfs or more.
- Careful consideration should be given to ramping rates or drastic changes in flow.
- Existing minimum flow is 50 cfs.

OPTIONS TO MEET FLOW GOALS?

1. Extend the fill period beyond Memorial Day (**Proposal 1**).

2. Reduce the winter draw down by up to 1’ .6” to provide additional storage (Help to improve late fall navigation and fish stranding issue, potentially improve musky and northern pike spawning habitat, improve chances of filling the chain by Memorial Day)(**Proposal 2**).

3. Begin filling the chain sooner before complete ice out to capture run-off that is normally passed (**Proposal 3**).

4. A combination of all 3 above.

5. Propose a 5 year trial period to fine tune **(Adaptive Management).**

ANNUAL OPERATION (Proposal 1)

DATES	STAFF GAUGE READING
November 1 to Spring Ice Break-up (ice 75 % off of Rest Lake)	Minimum of 5’.0”
Spring Break-up to July 1 (Filling Chain)	5’.0” – 8’.6”
July 1 to September 1	7”.3” – 8’.6” No lower than 7’.3”
September 1 to November 1 (Draw down)	No lower than 5’.0”

- At no time shall the chain be lowered at a rate exceeding 2 inches per day
- At no time shall the chain be lowered after ice forms.
- Required to pass 50 cfs base flow minimum
- Required to implement targeted sturgeon spring flow goals.

ANNUAL OPERATION (Proposal 2)

DATES	STAFF GAUGE READING
November 15 to Spring Ice Break-up (ice 75% off Rest Lake)	Minimum of 6’.6”
Spring Break-up to Memorial Day (May 30) (Filling Chain)	6’.6” – 8’.6”
May 31 to September 15	7’.3” – 8’.6” No lower than 7’.3”
September 16 to November 15 (Draw down)	No lower than 6’.6”

- At no time shall the chain be lowered at a rate exceeding 2 inches per day
- At no time shall the chain be lowered after ice forms.
- Required to pass 50 cfs base flow minimum.
- Target sturgeon spring flow goals based on water temperature and water year.

ANNUAL OPERATION (Proposal 3)

DATES	STAFF GAUGE READING
November 15 to Spring Thaw (first major runoff event)	Minimum of 5’.0”
Spring Thaw to Ice Out (75% of ice is off Rest Lake)	5’.0” – 6’.0” (or higher)
From Ice Out to Memorial Day (May 30) (Filling Chain)	6’.0” – 8’.6”
May 31 to September 15	7’.3” – 8’.6” No lower than 7’.3”
September 16 to November 15 (Draw down)	No lower than 5’.0”

- At no time shall the chain be lowered at a rate exceeding 2 inches per day
- At no time shall the chain be lowered after ice forms.
- Required to pass 50 cfs base flow minimum.
- Target sturgeon spring flow goals based on water temperature and water year.

FILLING RATES

Inflow into chain	Flow over dam	Chain elevation	Fill time
135 cfs	50 cfs	42" (5.0)	86 days
135 cfs	75 cfs	42 "	123 days
135 cfs	100 cfs	42"	210 days
135 cfs	125 cfs	42"	
135 cfs	150 cfs	42"	
135 cfs	50 cfs	30" (6.0)	62 days
135 cfs	75 cfs	30"	88 days
135 cfs	100 cfs	30"	150 days
135 cfs	125 cfs	30"	525 days
135 cfs	150 cfs	30"	
271 cfs	50 cfs	42" (5.0)	33 days
271 cfs	75 cfs	42"	38 days
271 cfs	100 cfs	42"	43 days
271 cfs	125 cfs	42"	50 days
271 cfs	150 cfs	42"	61 days
271 cfs	50 cfs	30" (6.0)	24 days
271cfs	75 cfs	30"	27 days
271 cfs	100 cfs	30"	31 days
271 cfs	125 cfs	30"	36 days
271 cfs	150 cfs	30"	43 days
366 cfs	50 cfs	42" (5.0)	23 days
366 cfs	75 cfs	42"	25 days
366 cfs	100 cfs	42"	28 days
366 cfs	125 cfs	42"	30 days
366cfs	150 cfs	42"	34 days
366 cfs	50 cfs	30" (6.0)	17 days
366 cfs	75 cfs	30"	18 days
366 cfs	100 cfs	30"	20 days
366 cfs	125 cfs	30"	22 days
366 cfs	150 cfs	30"	24 days

AVERAGE FLOW HELD BACK TO RAISE CHAIN

•Average flow to raise the lake chain 1 ft in one month=~ 70 cfs (This number can be used as a conversion factor.)

•Average flow held back to raise lakes = 70 cfs * change in lake elev. in ft / time to fill in months

•In spring, to raise the chain from 3'.6" in about month which would take an average flow held back of 245 cfs (70 * 3.5 / 1).

• If the change in elevation can be reduced to 2.5 ft over the same one month period, the average flow required is 175 cfs (70 * 2.5 / 1) leaving an additional 70 cfs that could be passed over the dam.

•A second example would be to keep the original elevation change of 3.5 ft but increase the filling period to 1.5 months. This would also require 163 cfs (70 * 3.5 / 1.5) to fill which would allow the same 81 cfs increase in downstream flow.

PUBLIC INTEREST FLOW REGIME FOR FISH/WILDLIFE AND RECREATION

EXISTING MINIMUM FLOW OF 50 CUBIC FEET PER SECOND IS SUITABLE TO PROTECT FISH/WILDLIFE AND RECREATION VALUES DOWNSTREAM DURING LOW FLOW CONDITIONS...

...BUT FLOWS BELOW THIS ARE NOT ACCEPTABLE

Looking upstream below Circle Lilly Creek (9/19/2003) (24 cfs)

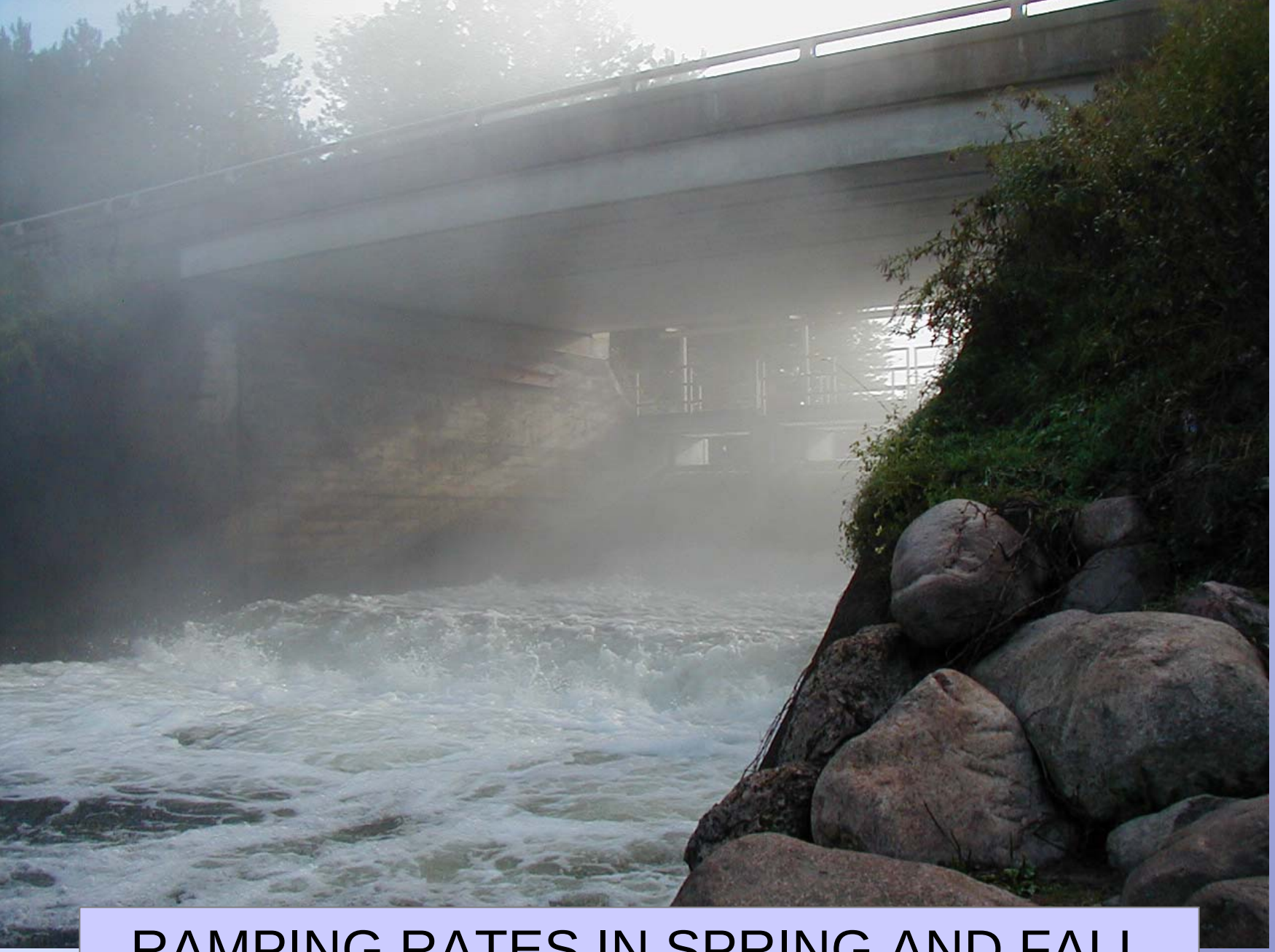
Looking Upstream below Circle Lilly Creek (8/26/03) (46 CFS)

Option to Consider

•In order to maintain a minimum flow of 50 cfs or higher during dry conditions in the summer months, may require a draw down below the 8’.4”- 8’.6” summer target elevation.

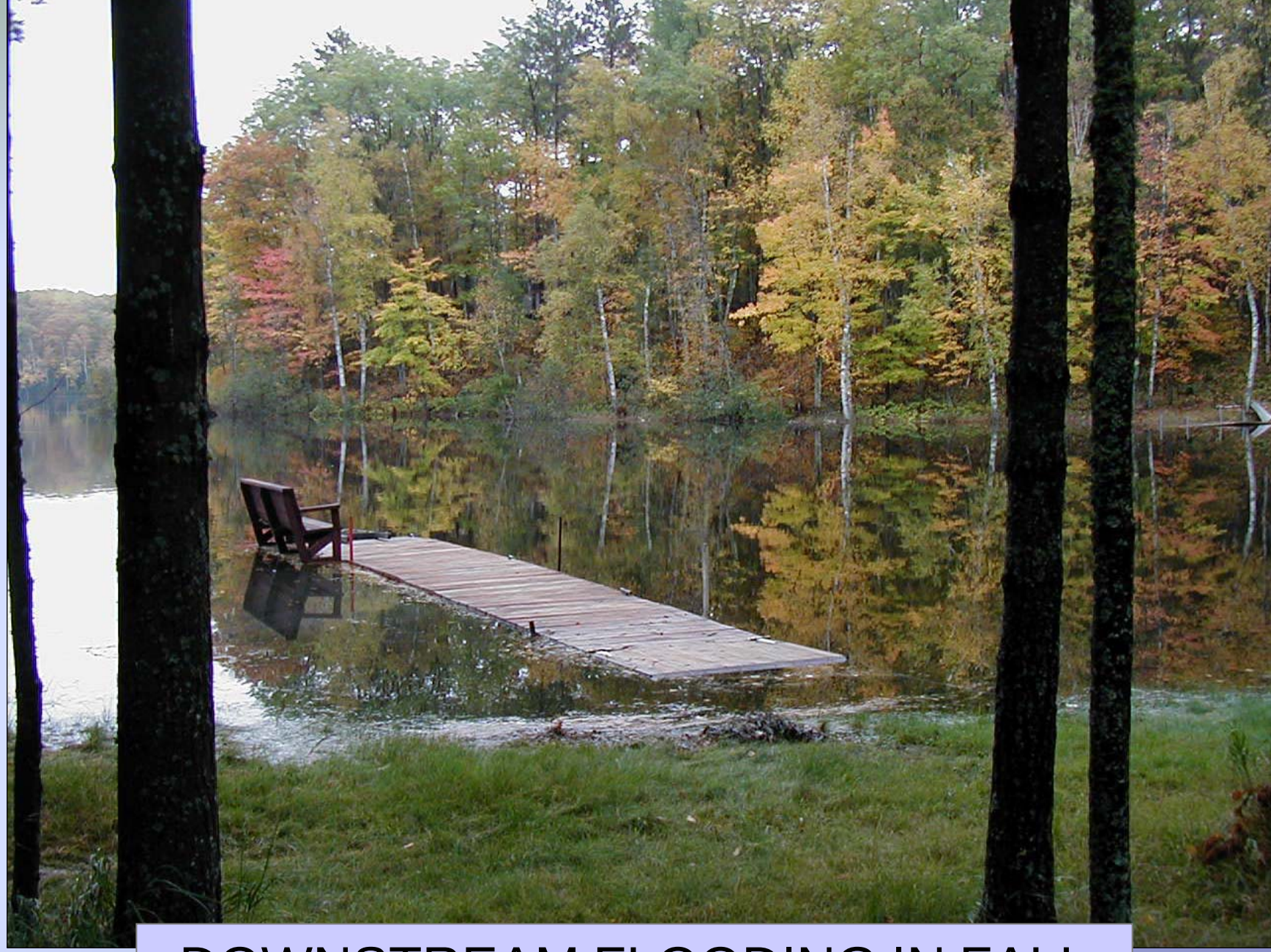
• Maintain summer minimum pool elevation of 7’.3” (or other agreed upon minimum).

•For example (assuming no precipitation), one inch of storage will provide about 5.8 cfs of flow over a months period. So if flows drop below 50 cfs (i.e. 24 cfs), we would have to drop the chain 4.5 inches that month to maintain a flow of 50 cfs.



RAMPING RATES IN SPRING AND FALL

RESULTS IN MAJOR SHORT-TERM CHANGES IN RIVER FLOW



DOWNSTREAM FLOODING IN FALL

WDNR SURVEYED IN A STAFF GAUGE ON THE TOWNSEND PROPERTY DOWNSTREAM OF THE DAM

THIS PROVIDED DATA ON VERTICAL WATER LEVEL FLUCTUATIONS AS A RESULT OF MAJOR FLUCTUATIONS IN WATER FLOW

- **Staff gauge read between May 18, 2004 and December 9, 2004.**
- **Low flow (30 cfs) reading was -12.0 inches.**
- **High flow (416 cfs) reading was +16.0 inches.**
- **Total water level fluctuation range was 28 inches.**

OPTIONS

- When possible implement a ramping rate to reduce major swings in water flow.

- An option to consider to reduce major changes in river flow in the fall is to extend the draw down period over two months instead of one.

- Proposed draw down period would be from September 15 through November 15.

WINTER DRAWDOWNS OF 3.6 FEET

IS A 3.6 FOOT WINTER DRAWDOWN NECESSARY TO PROTECT SHORELINE STRUCTURES?

Project: Manitowish Chain – structure survey at 6 FT of storage

Observers: _____ **Lake**
Name: _____

Date: _____ **GPS**
Unit: SN / Model _____

Photo #	Waypoint #	Is structure wet? Y,N	Vert. dist. from water to base of structure (inches)	Horiz. dist. from water line to base of structure (ft)	Parcel ID / T.R.S.	Site description / comments Type of structure (boathouse, wall, etc.) Structure material (steel, stone, wood, etc.) Condition of structure (good, cracked, in disrepair, etc.) High winds? (may affect water level measurements)

ALDER LAKE (10/27/2004), CHAIN ELEVATION 6.0

ALDER LAKE (10/26/2004), CHAIN ELEVATION 6.0

LITTLE STAR LAKE (10/27/2004), CHAIN ELEVATION 6.0

LITTLE STAR LAKE (10/27/2004), CHAIN ELEVATION 6.0

LITTLE STAR LAKE (10/26/2004), CHAIN ELEVATION 6.0

Summary of October 27, 2004 field survey of structures.

Structure (#)	5.0 elevation	6.0	6.5	7.0	8.0	8.5
	Dry Wet	Dry Wet	Dry Wet	Dry Wet	Dry Wet	Dry Wet
Boathouse (45)	38 7	19 26	13 32	11 34	6 39	5 40
Walls (30)	29 1	26 4	24 6	17 13	0 30	0 30
Docks/piers (13)	6 7	1 12	1 12	1 12	0 13	0 13
Rock Rip-rap (5)	5 0	4 1	2 3	1 4	0 5	0 5
Wood/Stone Bldg. (1)	1 0	1 0	1 0	0 1	0 1	0 1
Foot Bridge (1)	0 1	0 1	0 1	0 1	0 1	0 1
Shed (1)	1 0	1 0	1 0	0 1	0 1	0 1
Deck (1)	1 0	1 0	1 0	1 0	1 0	1 0
Total (97)	81 16	53 44	43 54	31 66	7 90	6 91

VISUALLY OBSERVED 549 DOCKS/PIERS ON OCTOBER 27TH THROUGHOUT CHAIN

CHAIN ELEVATION AT 6.0 (2.6 DRAWDOWN)

504 DOCKS/PIERS HAD A PORTION STILL IN THE WATER

45 WERE OUT OF THE WATER (DRY)

QUESTIONS/DISCUSSION?