UNITED STATES GOVERNMENT

memorandum

DATE: February 5, 1988

REPLY TO ATTN OF: Missisquoi N.W.R.
Refuge Manager

SUBJECT: Annual Water Management Program - 1988

TO: Ed Moses, Zone Supervisor (AWR)(RN)
Regional Office
Newton Corner, Massachusetts

Enclosed please find the 1988 Annual Water Management Program for review and approval.

Robert A. Zelley
Refuge Manager

RAZ:ssb

Enclosure

OPTIONAL FORM NO. 10
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MISSISQUOI NATIONAL WILDLIFE REFUGE

SWANTON, VERMONT

ANNUAL WATER MANAGEMENT PROGRAM

1988

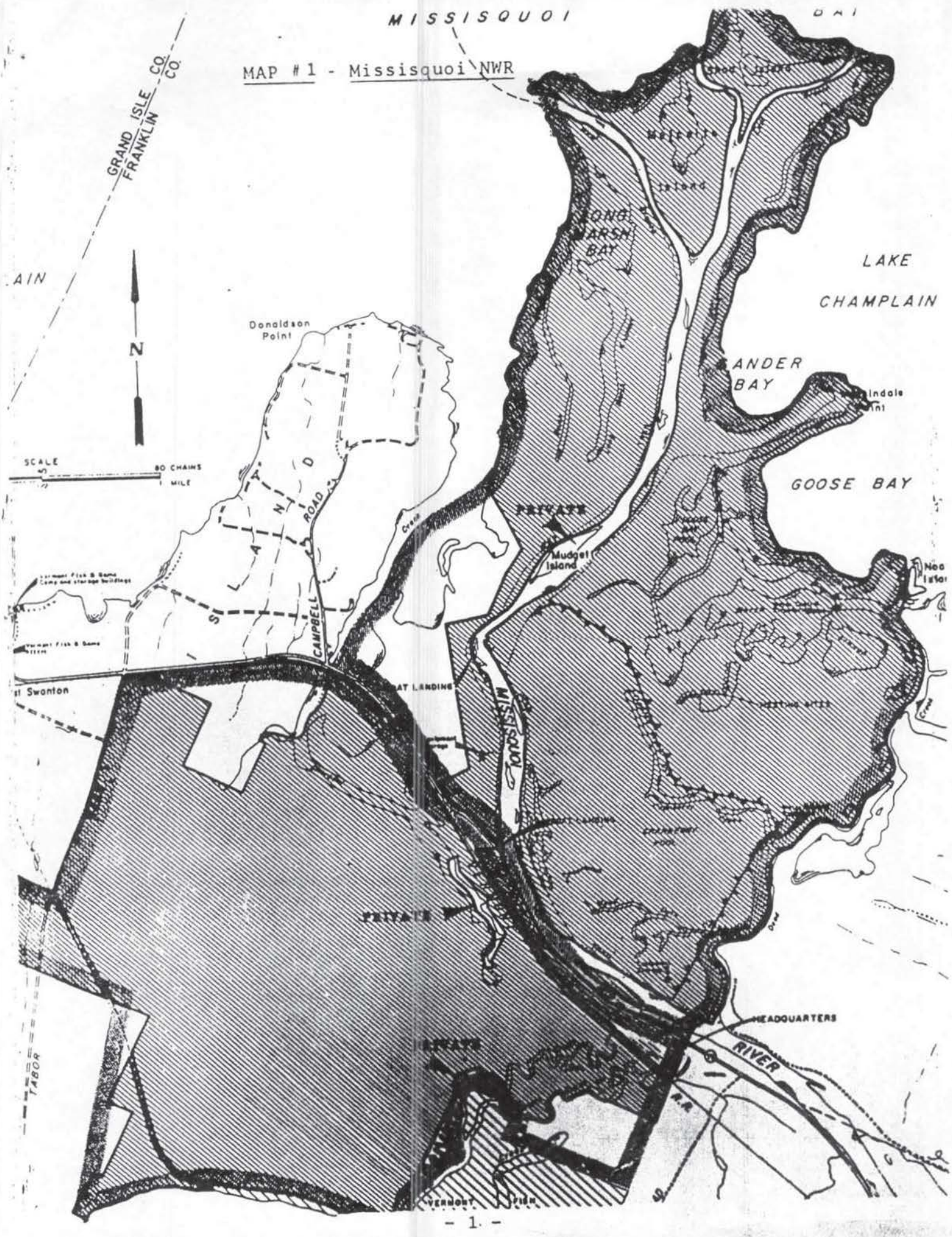
PREPARED BY: John B. Gallegos DATE: 2/4/88
John B. Gallegos, Ass't. Refuge Mgr.

SUBMITTED BY: Robert A Zelley DATE: 2/5/88
Robert A. Zelley, Refuge Manager

REVIEWED BY: _____ DATE: _____
Edward Moses, Zone Supervisor

APPROVED BY: _____ DATE: _____
Donald Young, Ass't. Regional Director

MAP #1 - Missisquoi NWR



MISSISQUOI NATIONAL WILDLIFE REFUGE
RD2-RT 78
PO BOX 163
SWANTON, VT 05488

I.A. 1988 Annual Water Management Program Outline

Refuge: Missisquoi Water Unit Name or Number: #2 - Cranberry Pool

Maximum elevation permissible: Approximately 99.25' mean sea level (MSL)

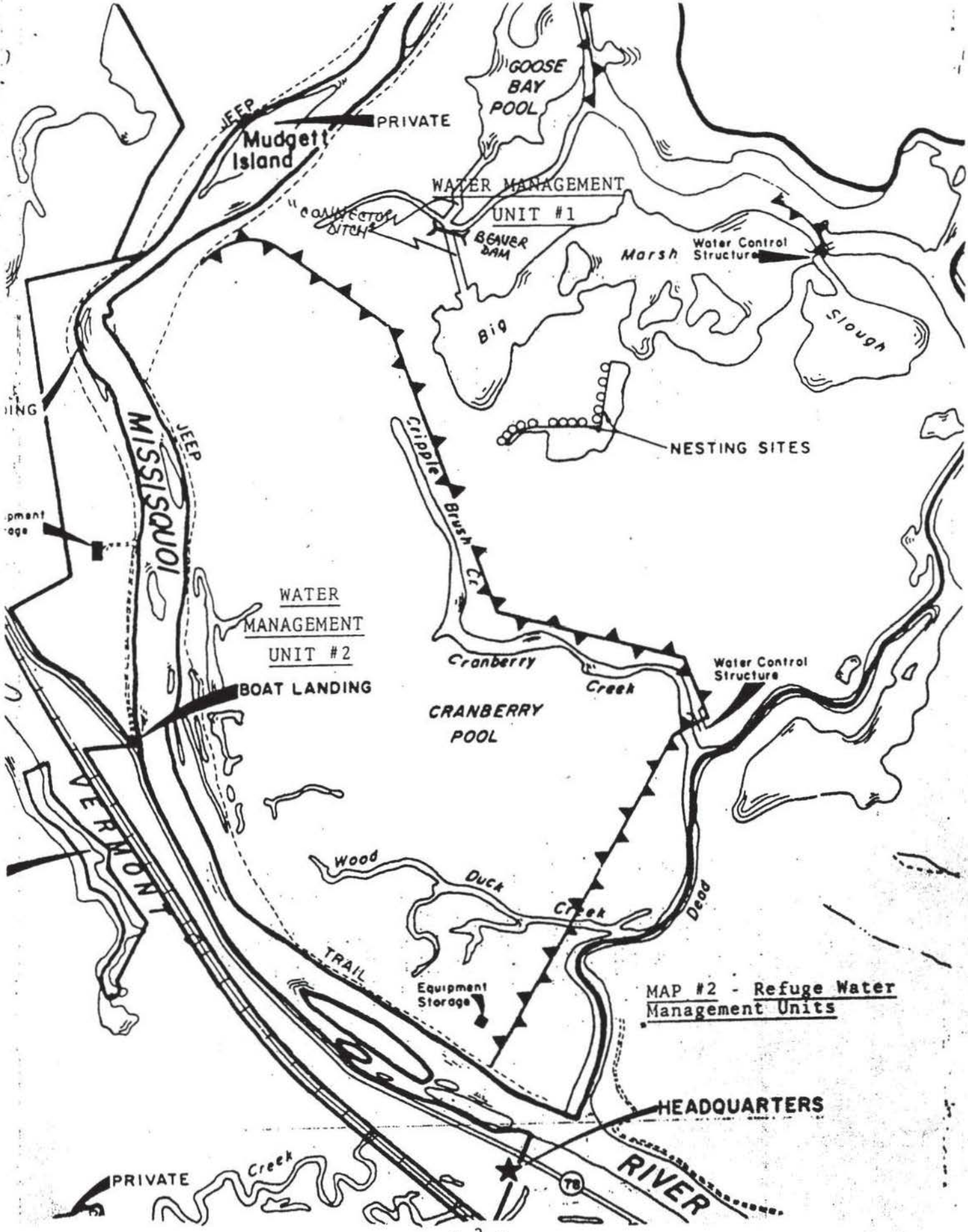
Flowline elevation of lowest drain structure: 93.00' MSL

Elevation of general pool bottom (not borrow pit bottom): Approximately 96.00' MSL

Date	A.1. Water Surface Elevations and Salinity for Past Year: Water Surface Elevations	*Salinity N/A (% of Sea Water)	B.2. Planned Elevation and Salinity for Program Year: Water Surface Elevation	*Salinity N/A Objective
Jan. 1	FROZEN		FROZEN	
15				
Feb. 1	FROZEN		FROZEN	
15				
Mar. 1	FROZEN		FROZEN	
15				
Apr. 1	98.01' MSL		100.00' MSL	
15	98.47' MSL		99.00' MSL	
May 1	98.43' MSL		99.00' MSL	
15	97.17' MSL		99.00' MSL	
June 1	97.27' MSL		99.00' MSL	
15	97.28' MSL		98.25' MSL	
July 1	97.15' MSL		98.25' MSL	
15	97.01' MSL			
Aug. 1	96.98' MSL			
15	96.91' MSL			
Sept. 1	96.70' MSL			
15	96.91' MSL			
Oct. 1	96.85' MSL			
15	96.84' MSL			
Nov. 1	96.95' MSL			
15	96.95' MSL			
Dec. 1	97.02' MSL			
15	97.32' MSL			
31	FROZEN		FROZEN	

*To be used for pools approved for brackish water management.

SRF-8/8/68



MAP #2 - Refuge Water Management Units

I.B. EFFECTS OF THE PAST YEAR'S WATER LEVELS ON THE ECOLOGY OF WATER MANAGEMENT UNIT #2

1. Water Supply and Use During 1987

As in 1986, 1987 was an unusual year, in that the lack of precipitation during April (1.91") permitted Lake Champlain water levels in this area to drop during the third and fourth weeks. The peak spring high water level was only 99.36' mean sea level (MSL) this year, and lasted approximately one week. This meant that the Cranberry Pool was only flooded for approximately one week. The pool floods when the Missisquoi River overtops the lowest levels (approximately 99.25' MSL) of its banks along the western side of the Cranberry Pool (Water Management Unit #2) - (WMU #2)). This fact is reflected in the peak WMU #2 pool level only reaching 98.49' MSL (4/17), rather than 99.00' - 100.00' MSL as in past years.

As a result, water levels were able to be lowered to the 1987 water management objective (97.20' MSL) by 5/14, something not normally accomplished until much later. Pool levels subsided to 97.17' MSL thereafter, where it stayed until 6/1, when thunderstorms during the last few days of April raised pool levels to 97.27' MSL. On 6/10, the pool level reached the monthly peak of 97.31' MSL, following additional heavy thunderstorms earlier, after which evapo-transpiration gradually lowered pool levels throughout the rest of June, and all of July and August, to the annual low of 96.69' MSL. Consistent rainfalls during the second week of September raised pool levels to 96.91' MSL (9/14), after which levels gradually subsided to 96.84' MSL (9/28). Levels rose again slightly on 9/30, to 96.85' MSL and stayed there until mid-October, when it first dropped to 96.81' MSL (10/27), and then rose to 96.98' MSL (11/10), after heavy rains during late October. Thereafter pool levels subsided to 96.92' MSL, until a late November rainfall of 2.36", and early December rains combined to raise waters to 97.32' MSL at the final freeze-up in mid-December. First ice formed within Cranberry Pool during the third week of November. However, intermittent warm spells throughout the rest of November and early December caused occasional melts, until the second week of December when "ice-up" was complete.

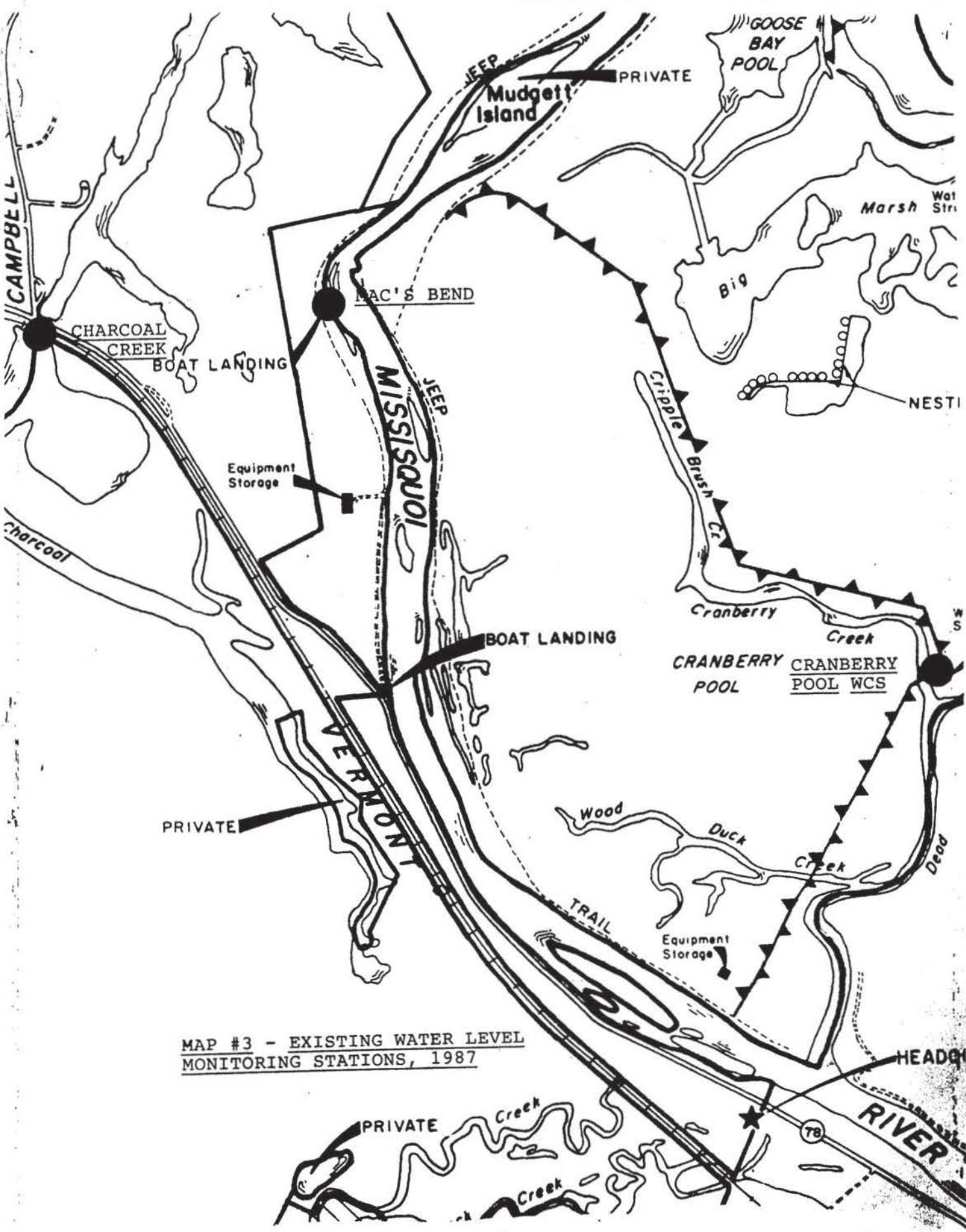
During 1987, the Missisquoi River's water levels were monitored - especially when levels were rising and falling. Observations during 1987 indicated that there was a "time lag" between when the Dead Creek - Missisquoi River system would rise and when

Lake Champlain water levels rose. In addition, the Lake levels never seemed to reach the (higher) levels of the Missisquoi River - Dead Creek system. Readings were taken at a benchmarked location on the bulkhead at Mac's Bend during water level changes (Ref. Map. #2). The results are presented in Graph #1, together with the water levels for Cranberry Pool and Lake Champlain. The graph reflects the suspected trend involving elevation differences between Lake Champlain and the Missisquoi River. Since Dead Creek currently receives much of the water volume from the Missisquoi River (further to the south of the Missisquoi River monitoring station - Ref. Map #3), and since Dead Creek is narrower than the Missisquoi River, it can be assumed that the water levels in Dead Creek may be slightly higher than those of the Missisquoi River during a flood event.

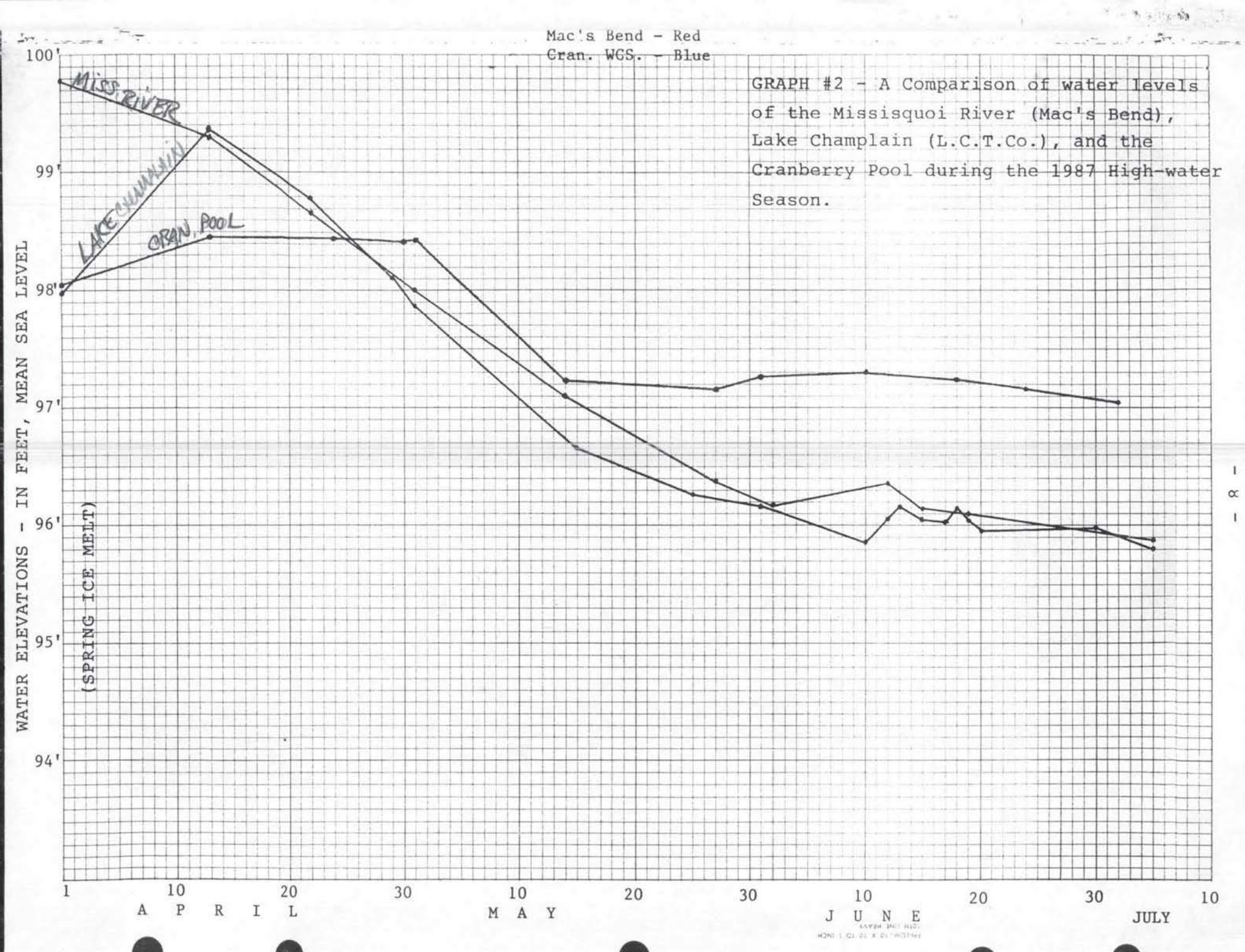
However, the "time lag" suspected in 1986, between when the Missisquoi River - Dead Creek system rose and when Lake Champlain's water levels rose, is not evident in Graph #1, because only peak levels were analyzed. Graph #2 examines readings from the three monitoring stations during the 1987 spring ice melt and subsequent higher water periods. Only actual readings are presented in the graph. In some cases, Missisquoi River readings are further apart than those of the other two stations.

Graph #2 portrays the "time lag" most clearly during the initial flooding onset during 3/31 - 4/1, when a difference of 1.8' is evident between the (higher) Missisquoi River and (lower) Lake Champlain water levels. Lake Champlain never reached the peak that the Missisquoi River did. A difference of 0.4' separated the two peaks. Thereafter, both the Missisquoi River and Lake Champlain dropped, although from mid-April to the end of April, the Missisquoi River appears to have dropped more quickly than Lake Champlain. The Missisquoi River maintained a higher level than Lake Champlain during the May - July period. The apparent exception to this is on or about 6/30. However, since no river readings were taken during this time frame (6/19 - 7/5), we are unable to determine whether the river actually dropped below the Lake Champlain level or not at that time.

During June 12th, the Missisquoi River again reflected the "time lag" effect, when water levels were approximately 0.3' higher than Lake Champlain's, and once again, the June river peak (96.34' MSL) was higher (Approximately 0.3') than the June Lake Champlain peak (96.16' MSL). That Lake Champlain peak (6/13/87) was one day later than the Missisquoi River peak (6/12/87).

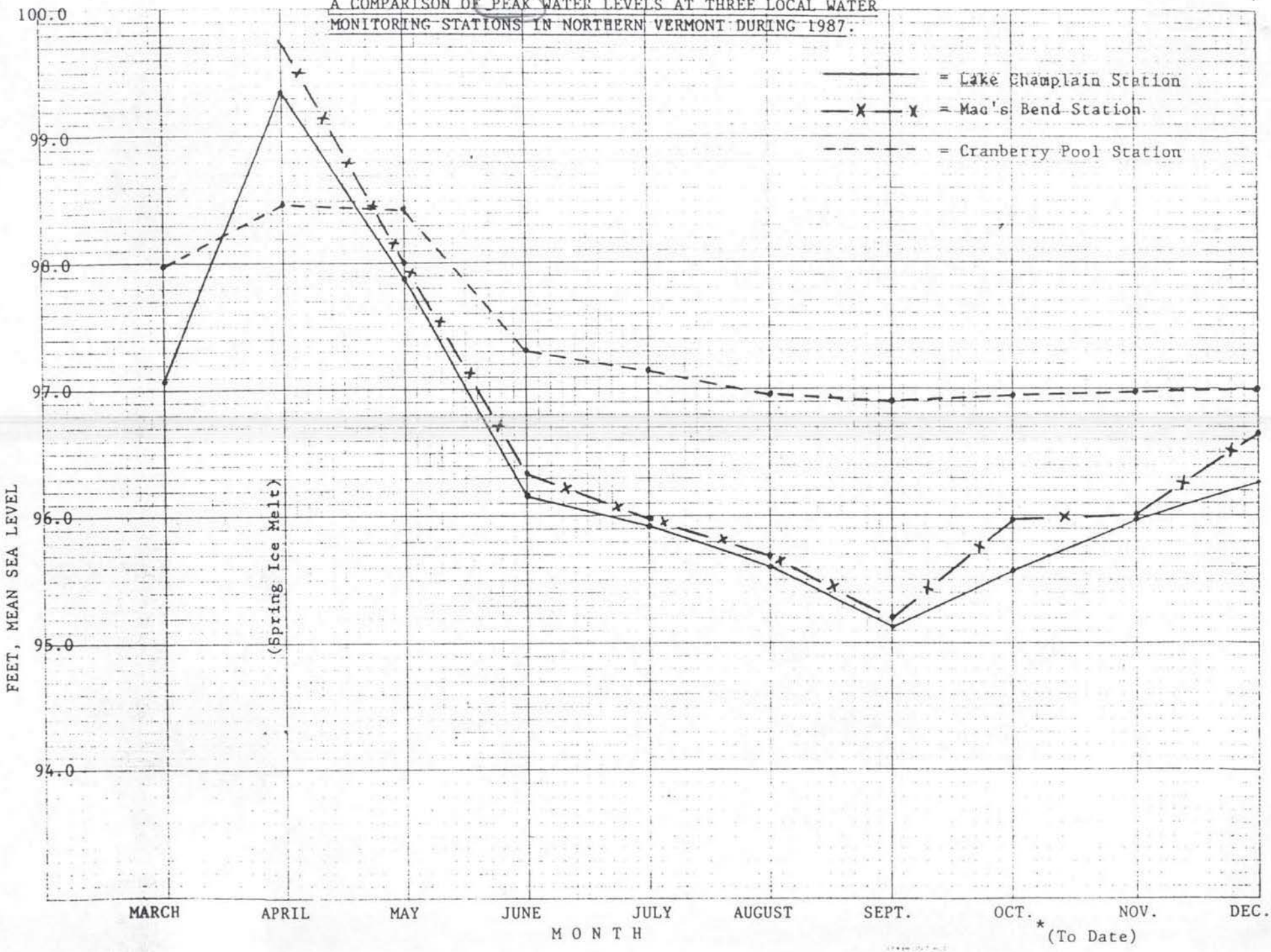


MAP #3 - EXISTING WATER LEVEL MONITORING STATIONS, 1987


Mac's Bend - Red
Cran. WGS. - Blue
MISS. RIVER
LAKE CHAMPLAIN
CRAN. POOL
GRAPH #2 - A Comparison of water levels of the Missisquoi River (Mac's Bend), Lake Champlain (L.C.T.Co.), and the Cranberry Pool during the 1987 High-water Season.
WATER ELEVATIONS - IN FEET, MEAN SEA LEVEL
(SPRING ICE MELT)
100'
99'
98'
97'
96'
95'
94'
1
10
20
30
10
20
30
10
20
30
10
A P R I L
M A Y
J U N E
JULY

GRAPH #1

A COMPARISON OF PEAK WATER LEVELS AT THREE LOCAL WATER MONITORING STATIONS IN NORTHERN VERMONT DURING 1987.



2. Related Biological Conditions and Wildlife Use

The current water management policy for the Cranberry Pool (WMU #2) continues to be one of getting the spring (or early summer) water level down to 97.20' MSL as soon as possible, and holding the water levels there throughout the rest of the year. This policy has been shown to meet the objectives of the station "Water Management Plan" best, in that waterfowl, food and cover plants, mammals and wading birds respond favorably to such a program. Management during 1987 was structured around the objectives presented in Section I.C. of this Program.

The limited rainfall during April and subsequent limited flooding of the Cranberry Pool provided refuge staff with the opportunity to draw-down the water levels earlier than usual. Nesting "hummocks" and grassy, "edge habitats" were available for such ground-nesters as the mallard, black duck and both teals, by early May, once pool levels dropped below 98.00' MSL. Brood surveys revealed that, mallards capitalized more this year on the low-water spring than in 1986. Mallard production was slightly higher than in 1986 in this WMU (from 20 ducklings observed in 2 broods (1986), to 30 ducklings observed in 3 broods (1987)).

Waterfowl use was higher than that for 1986, but lower than 1985's. Waterfowl food plant production was excellent, with large wild rice stands, arrowhead beds, pondweeds, pickerelweed, duckweed, etc. providing a variety of desirable food and cover throughout the pool.

Once considered an undesirable, buttonbush (locally referred to as "cripplebrush") is now recognized as valuable waterfowl brood cover, when adequate openings and "edge" are also available therein. The Water Management Program of the past year also provided this shrub with beneficial conditions. High water levels (above 98.00' MSL) that are maintained throughout the warm season will cause gradual mortality in buttonbush. When maintained for several years, high water levels could ultimately eliminate it, and also retard the growth, flowering and seed production of wild rice and sedges.

During 1987, three vegetation transects were completed across the northern Cranberry Pool. These transects were conducted at the request of Vermont State Fisheries Manager Jon Anderson. They not only provide a closer analysis of plant species compositions and habitat-types within the Cranberry Pool, but also provided Mr. Anderson with the opportunity to analyze impacts

to pike-spawning within the pool that might result from completion of the Cranberry dike system. Copies of the Transect Report were sent to Jon Anderson and Zone Biologist Gerry Atwell during January 1988. A copy is also on file at the Missisquoi N.W.R. headquarters for reference, analysis and comparison with future transects.

During 1987, wading birds consistently utilized the interior of this water management unit, particularly the great blue, black-crowned night and green-backed herons. The continuous presence of these "waders" in Cranberry Pool, indicates the presence of a viable fish and frog population that probably supports the large, great blue herony on Shad Island, approximately three miles to the north.

Raptors such as the marsh hawk and red-tailed hawk were also frequent visitors to this WMU during 1987. While muskrat and beaver populations increased, muskrat and beaver trapping harvests, house surveys, and a lack of negative impacts to wetland habitats, reflect viable populations of these mammals.

In summary, the Water Management Program for 1987 provided an optimum amount of open-water areas with a depth of two feet or less that benefitted most species of concern. However, it should also be made clear that, if spring floodwaters are excluded, the need for a draw-down during the waterfowl nesting season (early April - early June) would be precluded, and ground-nesting waterfowl production should start to increase. This should benefit refuge black duck production which is presently very low. Completion of the Cranberry Dike along the northwestern and western sides of the pool would exclude those spring floodwaters and allow refuge staff the opportunity to control interior water levels throughout the entire year. Such water control would be more in keeping with original water management objectives than the current program.

I.C. STATEMENT OF OBJECTIVES FOR THE PROPOSED LEVELS

From March through late April, water levels within this WMU are dictated by the elevations of the spring floodwaters in the Missisquoi River - Dead Creek system. When these floodwaters subside below the 99.25' MSL elevation, water management in Cranberry Pool becomes possible. However, draw-downs are limited to the levels of the waters outside the unit.

Section IV. B.2.c. of the Refuge "Water Management Plan" states that once every five years, starting in 1988, the following water management program will be carried out:

1. Maintain water levels above the usual objective level (97.20' MSL), at 99.00' MSL from April through mid-June.

2. On or about 6/15/88, pull all the stop-logs out of all four bays of the water control structure (WCS), and leave out until the water level drops to 98.25' MSL. This will help to clear the WCS of silt and debris. Inspect all stop-logs. Replace any showing signs of decay, rotting, excessive wear, fracturing, etc., with new ones.

3. After the 98.25' MSL objective level has been reached, all silt and debris will be manually cleared from the concrete base of the structure by raking and feeling by hand and/or foot. A proper seat, of stop-log to concrete, must be insured. The stop-logs will then be replaced, with the bottom three securely attached to one another with four (two per side) 1" x 3/8" x 2' hemlock strips and galvanized nails. Each of the four bays will then be completely closed and bolted.

4. A water level of approximately 98.25' MSL will be maintained throughout the rest of the year. This above average level will provide the unit's arrowhead beds with "a rest" from the heavy feeding of fall waterfowl migrants, while also flushing the unit with an additional foot of water that will maintain a more dynamic and less stagnant system.

Although the above 1988 objectives provide for a program of maintaining higher than normal water levels in this unit, the need for such an occasional variation in water levels within a closed system (after April) provides the above biological benefits, while also offsetting somewhat the eutrophication process. The higher water levels provided for during 1988 make the existing management program more dynamic, in that additional circulation and water depth are also provided for. Although the higher water levels may present minor stress upon wild rice, buttonbush and other aquatics, refuge staff feel that the one foot of additional water within the pool will not significantly affect wild rice production or other waterfowl food and cover plants within this WMU. Table 1 of the "Water Management Plan" (P. 15) illustrates that such higher water levels (approximately 98.25' MSL) were maintained throughout the growing seasons of 1979 and 1984. Annual narratives indicate that these waterfowl food plants yielded productions in keeping with that of lower water years. However, during 1983, when water

levels continuously exceeded 98.25' MSL (by ranging from 98.35' to 101.16' MSL) from April 15 to June 23, wild rice production was "minimal," although arrowhead production rose slightly (Ref. Table 4 - "Water Management Plan," P. 18, and "Annual Narrative Report, Calendar Year 1983," P. 16).

The higher water levels are not expected to significantly impact ground-nesting puddle duck (mallard, black duck and teals) production within this WMU, since such duck production is already low. However, adequate edge habitat, grassy hummocks and higher ground will still be available for the 3-4 known nesting pairs that have utilized this unit during the past several years.

The higher water levels during winter will also provide additional water depth in the interior creeks and borrow ditches to allow muskrats, otter, beaver and fish movement beneath the ice, and minimize the winter kill.

Water level readings should continue being taken during 1988 at all three stations (Ref. Map #3) at frequent intervals (at least twice a week), so that a more accurate record of water regimes for the Missisquoi River - Dead Creek system, Lake Champlain and Charcoal Creek can be developed for future water management policies.

MISSISQUOI NATIONAL WILDLIFE REFUGE
RD2-RT 78
PO BOX 163
SWANTON, VT 05488

II.A. Annual Water Management Program Outline

Refuge: Missisquoi Water Unit Name or Number: Unit #1 and rest of refuge

Maximum elevation permissible: Approximately 96.00' mean sea level (MSL)

Flowline elevation of lowest drain structure: N/A (Formerly 92.00' MSL)

Elevation of general pool bottom (not borrow pit bottom): Approximately 95.00' MSL

	A.1. Water Surface Elevations and Salinity for Past Year		B.2. Planned Elevation and Salinity for Program Year	
Date	Water Surface Elevations	*Salinity (% of Sea Water)	Water Surface Elevation	*Salinity Objective
Jan. 1	No water level readings were taken during 1987 due to an absence of benchmarks and water gauges.		Since water levels cannot be controlled, future planning is not practical.	
15				
Feb. 1				
15				
Mar. 1				
15				
Apr. 1				
15				
May 1				
15				
June 1				
15				
July 1				
15				
Aug. 1				
15				
Sept. 1				
15				
Oct. 1				
15				
Nov. 1				
15				
Dec. 1				
15				
31				

*To be used for pools approved for brackish water management.

SRF-8/8/68

II. B. EFFECTS OF THE PAST YEAR'S WATER LEVELS ON THE ECOLOGY OF WATER MANAGEMENT UNIT (WMU) #1 (Big Marsh Slough and Goose Bay Pool)

1. Water Supply and Use During 1987

Big Marsh Slough and Goose Bay Pool continue to be treated as a single Water Management Unit (#1). They were connected by a man-made ditch between the two systems during the latter 1960s (Ref. Map #2). Incomplete diking around the perimeter of these areas holds water only below the 96.50' MSL elevation.

The stop-logs in the Big Marsh Slough dike were not manipulated during 1987, since the water control structure (WCS) appears totally silted in. To our knowledge, that WCS has not be used for 10-to-15 years, since management has centered around simply retaining as much water as possible for as long as possible. Therefore, the unit operates in accordance with the water levels of Dead Creek and Lake Champlain, until the water levels drop below the perimeter elevation of approximately 96.50' MSL. The connecting ditch between Big Marsh Slough and Goose Bay Pool was plugged up by beavers during 1969, and a decision was made then to allow it to remain, in order that 2"-to-4" more water be retained within Goose Bay Pool than in Big Marsh Slough. This policy has continued to the present, and will be continued during 1988 since the waterfowl habitat in Goose Bay Pool is improved by the higher water levels.

Water levels in WMU #1 are not presently measurable since no known benchmark elevation is located therein that will permit measurements. However, if it is assumed that the levels in Big Marsh Slough are similar to those of Lake Champlain, and that Goose Bay Pool levels are slightly higher than the Lake Champlain - Big Marsh Slough levels, then the 1987 water level trends can be identified from Lake Champlain's water level readings. Using 1987 data from the refuge files, it appears that the WMU #1 water level dropped below 96.00' MSL during the second week of January, after which the level continued to subside slightly throughout February and early March, to a low of 95.14' MSL (3/5/87). Levels began rising thereafter to the annual high of 99.36' MSL (4/10-4/15), during the spring flooding. The

WMU #1 water levels gradually subsided throughout April, May and June, to below 96.00' MSL (6/20) once again, making this unit independent of Lake Champlain effects. The Lake Champlain level continued subsiding during the rest of June, July, August, to a low of 94.48' MSL on 9/10/87. It must be assumed that the WMU #1 water level also subsided somewhat below 96.00' MSL during this low-water period, although probably not to the extreme low of Lake Champlain, since the unit was then an independent, enclosed system. During the rest of September, this unit's water level fluctuated slightly between 94.90' MSL and 95.13' MSL. October and November levels also fluctuated gradually between 94.95' MSL (10/1) and 95.98' MSL (11/5), while December levels increased to 96.26' MSL (12/11), before dropping to 96.10' MSL (12/31). The 12/11/87 water level probably resulted in Dead Creek - Lake Champlain waters entering this WMU during the ten-day time period that their water levels were at or above the 96.25' MSL vicinity, that marks the low points of this WMU's perimeter. Therefore, it is likely that WMU #1 was at or near the 96.00' MSL - 96.25' MSL mark at the year's end.

In summary, WMU #1 maintained generally lower water levels during 1987, than in 1986. This permitted the system to remain independent of Lake Champlain - Dead Creek water level influences for approximately six months out of the year, when those outside water levels dropped below 96.25' MSL. During the other six months, this WMU operated not as an independent system, but as an extension of Lake Champlain.

2. Related Biological Conditions and Wildlife Use

Despite the lack of water control that currently characterizes Water Management Unit #1, the system fared well during 1987. The Lake Champlain - Dead Creek water levels kept this unit with an adequate amount of water surface acreage that provided for an excellent crop of waterfowl food plants. Wild rice stands predominated in shallow waters and along the water's edges throughout the entire Unit, while submergents and emergents, such as pickerelweed, arrowheads, pondweeds, spikerushes and duckweeds provided plenty of food for the nearly 6,700 ducks using Big Marsh Slough and the 730 ducks using Goose Bay Pool during mid-October. The stands of buttonbush did not seem negatively impacted

by 1986 water levels. Water lilies, water-shield and burreed were also common throughout the Unit. Water Management Unit #1 continues to provide the highest concentrations of waterfowl on-refuge, especially ring-necked ducks. No negative impacts attributable to water levels were observed in this Unit during 1987. The four Phragmites reed stands discovered along the eastern side of Big Marsh Slough during November 1987, continue to pose a threat to the area. Aerial treatment of those stands is scheduled for the summer of 1988.

No die-offs of fish, mammals or ducks were noticed during 1987. Beaver, otter and muskrat populations appeared healthy.

C. A STATEMENT OF OBJECTIVES FOR THE PROPOSED LEVELS -

Not Applicable

III. A. 1988 ANNUAL WATER MANAGEMENT PROGRAM OUTLINE FOR THE REMAINING REFUGE AREAS - Not Applicable (See Section II A.)

B. EFFECTS OF THE PAST YEAR'S WATER LEVELS ON THE ECOLOGY OF THE REMAINING REFUGE AREAS

1. Water Conditions During 1987

Water conditions within the remaining Missisquoi Delta, Lake Champlain shore areas, Charcoal Creek and Maquam Swamp vicinities, are all tied into the water levels of Lake Champlain. Therefore, their conditions were similar, if not identical, to those of Water Management Unit #1. Although the Maquam Swamp area was proposed for dike construction projects during the 1950s, nothing yet has been done.

2. Effects of 1987 Water Conditions

The effects of the 1987 water conditions were as favorable throughout the rest of the refuge as they were in WMU #1. The water levels provided for abundant waterfowl food plants and frequent use of Metcalfe Island's Pothole, Long Marsh Bay and Creek, Goose Bay and Gander Bay by dabblers and divers alike. Although the most puddler use (Mallards and Blacks) took place in Metcalfe Pothole, Long Marsh Channel and Gander Bay. Wild rice production appeared excellent throughout these remaining refuge areas, as did arrowhead, pickerelweed and submergent waterfowl food plants. Muskrat populations appeared to be healthy, as did beavers, although

a gradual increase in the beaver population of Metcalfe Island and Long Marsh Bay is becoming noticeable through the presence of new houses therein.

C. A STATEMENT OF OBJECTIVES FOR THE PROPOSED LEVELS - Not Applicable

IV. LITERATURE CITED

A. Refuge Manager - "Water Management Plan," (1986), unpublished document on file at Missisquoi NWR headquarters.

B. Refuge Manager - "Annual Narrative Report, Caldendar Year 1983," unpublished document on file at Missisquoi NWR headquarters.