UNITED STATES GOVERNMENT

memorandum

U.S. FISH AND WILDLIFE SERVICE

ONE GATEWAY CENTER
SUITE 700
NEWTON CORNER, MASSACHUSETTS 02158

TO: Refuge Manager
Missisquoi National Wildlife Refuge

FROM: Associate Manager, North

DATE: APR 2 1989

SUBJECT: 1989 Annual Water Management Program

Attached please find your approved Annual Water Management Program for 1989. A copy has been forwarded to Field Biologist Atwell for his information.

Please note that this is an annual program as compared to a plan. This is approved by me following review by the zone field biologist. You and your staff did a fine job of developing this plan, one minor point concerns the spacing that you chose for typing. A spacing of 12,89 or 15,86 would be more appropriate for a document such as this. Please make this adjustment on future water management programs.

Mark W. Sweeny

Attachment

MISSISQUOI NATIONAL WILDLIFE REFUGE

SWANTON, VERMONT

ANNUAL WATER MANAGEMENT ~~PLAN~~ PROGRAM

1989

MISSISQUOI NATIONAL WILDLIFE REFUGE

SWANTON, VERMONT

ANNUAL WATER MANAGEMENT PROGRAM

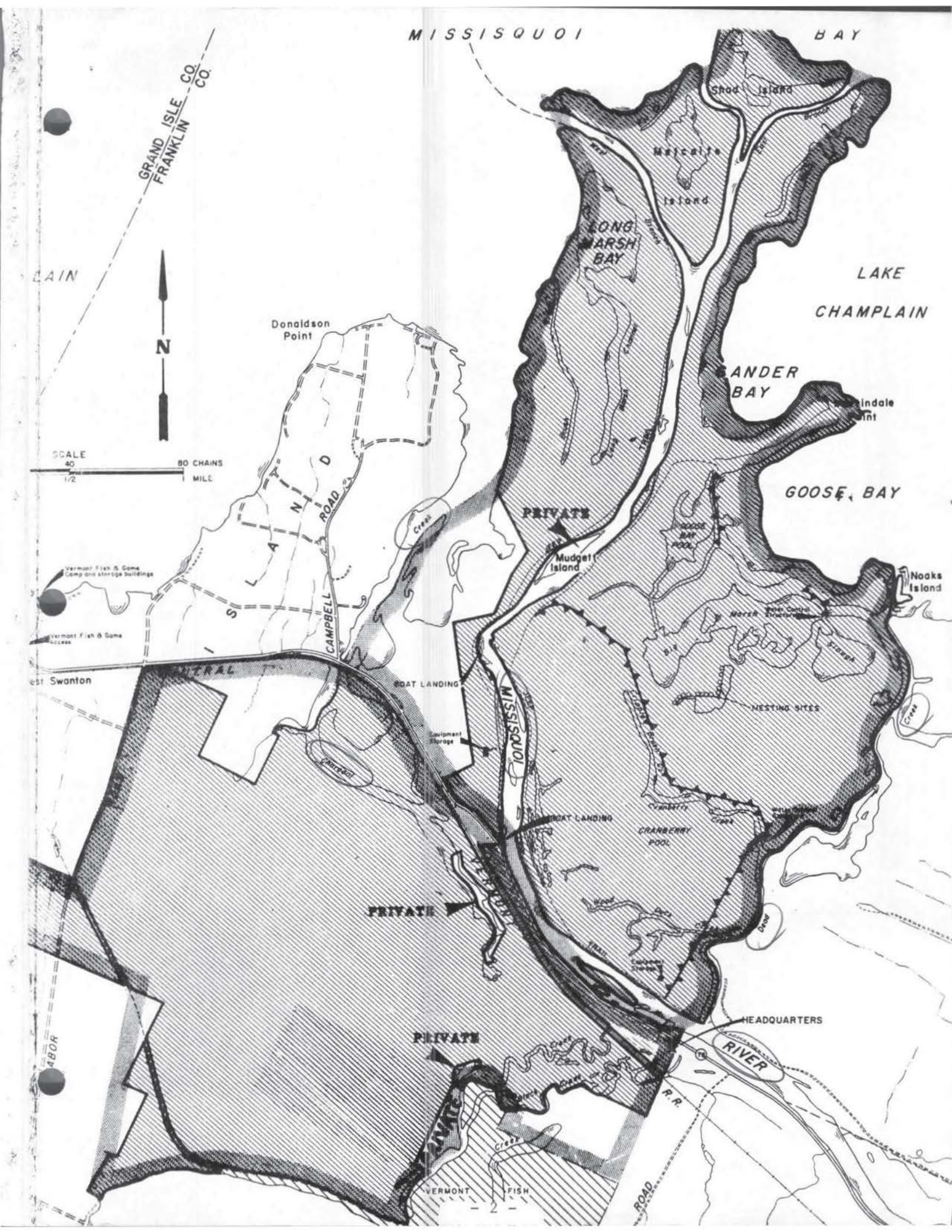
1989

Prepared by: John B. Gallegos Date: 2/1/89
John B. Gallegos, Assistant Refuge Manager

Submitted by: Robert A Zelley Date: 2/1/89
Robert A. Zelley, Refuge Manager
2-24-89 3-1-89

~~Reviewed~~ Approved by: Donald N. Frickie Date: 3-10-89
Don Frickie, Associate Director

Approved by: _____ Date: _____
Dom Young, Assistant Regional Director


MISSISQUOI BAY
GRAND ISLE CO.
FRANKLIN CO.
LAIN
N
SCALE
40 80 CHAINS
1/2 MILE
Donaldson Point
ISLAND ROAD
CAMPBELL
Vermont Fish & Game Campground storage buildings
Vermont Fish & Game Access
West Swanton
CENTRAL
Shad Island
Malcolm Island
LONG MARSH BAY
LAKE CHAMPLAIN
GANDER BAY
GOOSE BAY
PRIVATE
Mudget Island
GOOSE BAY POOL
Nooks Island
Marsh
Water Control Structure
Swamp
NESTING SITES
BOAT LANDING
Equipment Storage
MISSISQUOI
Cemetery
CRANBERRY POOL
Wood Duck Trail
Equipment Storage
HEADQUARTERS
RIVER
R.R.
VERMONT FISH
ROAD

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

I.A. Annual Water Management Program Outline

Refuge: MISSISQUOI Water Unit Name or Number: #2 - CRANBERRY POOL

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

Flowline elevation of lowest drain structure: 93.00' MSL

Elevation of general pool bottom (not borrow pit bottom): 95.00' - 96.00' 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	Frozen		97.80' MSL	
15	(No readings taken)		97.80' MSL	
Feb. 1			97.80' MSL	
15			97.80' MSL	
			(Draw pool down gradually 3/1/89)	
Mar. 1			97.00' MSL	
15			96.00' MSL	
			(Ice-out expected 3/25-26 & flooding)	
Apr. 1	99.25' MSL		97.00' MSL	
15	98.90' MSL		97.50' MSL (due to flooding)	
May 1	98.84' MSL		97.50' MSL	
15	98.68' MSL		97.20' MSL (draw-down if needed)	
June 1	98.45' MSL			
15	97.63' MSL			
July 1	97.80' MSL			
15	97.64' MSL			
Aug. 1	97.55' MSL			
15	97.57' MSL			
Sept.1	97.57' MSL			
15	97.46' MSL			
Oct. 1	97.44' MSL			
15	97.46' MSL			
Nov. 1	Water Control Structure		97.20' MSL	
15	Repairs. Readings not possible.		96.00' MSL (Draw-down)	
Dec. 1	Frozen			
15	(No readings taken)			
31				

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

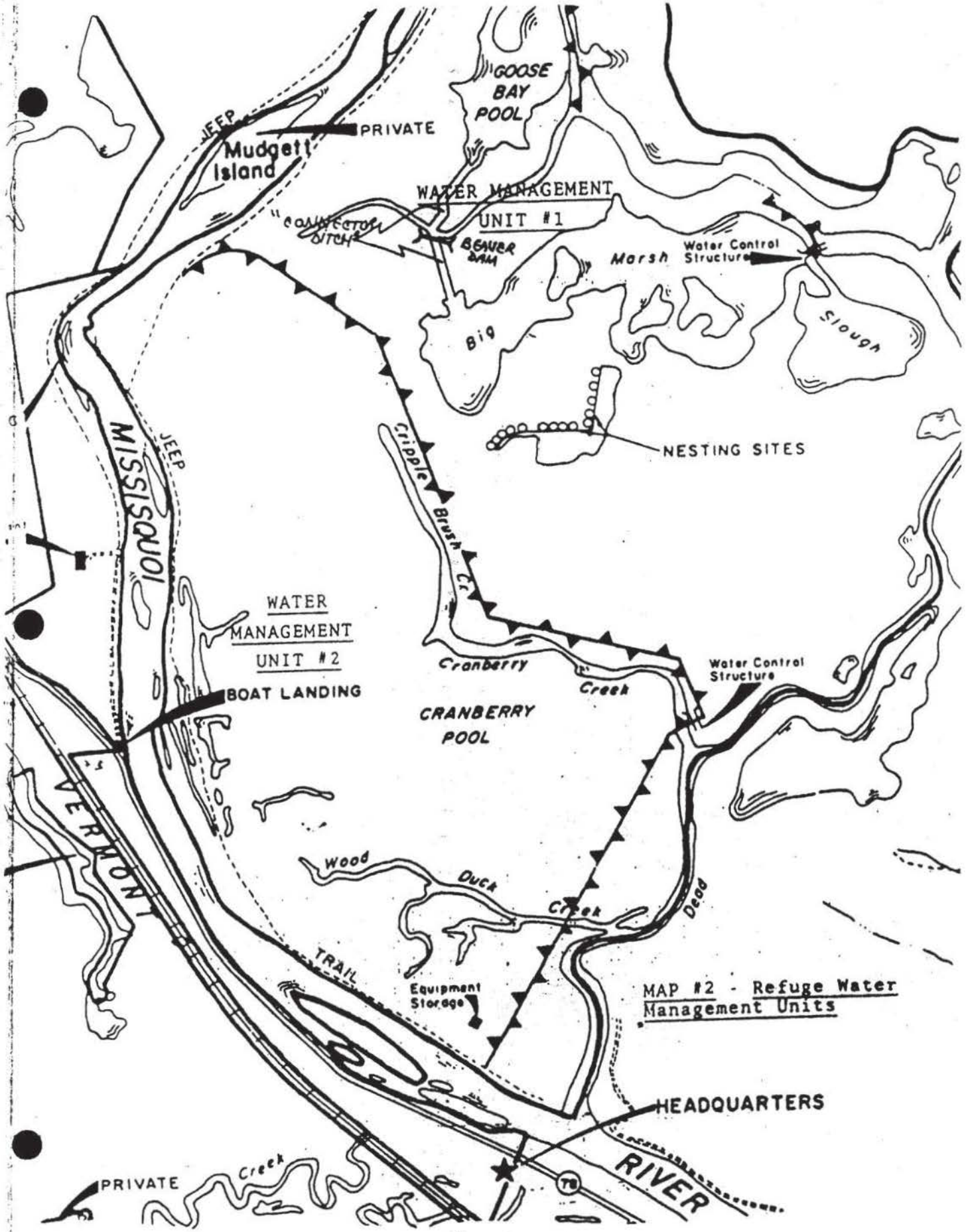
5RF-8/8/68

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

1. Water Supply and Use During 1988

As during 1986 and 1987, a low April rainfall combined with a general lack of winter snowfall, to create a brief ice-out and flooding this year. The floodwaters crested at 99.21' mean sea level (MSL) within Cranberry Pool this year during the first week of April, when the Missisquoi River - Dead Creek system was approximately 1-1/2' lower. This year, the Missisquoi River never rose to the 99.25' MSL elevation at which it overtops the lowest elevations of its banks along the western side of Water Management Unit #2 (WMU #2) - the Cranberry Pool. The high levels within the Pool apparently came from winter snow accumulations and the spring melt. With spring flood levels outside the Pool much lower than normal, the opportunity for a rapid draw-down during April was present. Unfortunately, both the "Water Management Plan" and the "1988 Annual Water Management Program" called for maintenance of higher than usual water levels within WMU #2. Normal annual programs would have called for dropping pool levels down to 97.20' MSL as soon as possible, to accommodate ground nesting duck use.

Therefore, in accordance with both the station Water Management Plan and the 1988 Program, water levels were kept as close to the April 15 through June 15 objective of 99.00' MSL as possible. On 4/7, the water control structure (WCS) for WMU #2 was opened until the next day,



MAP #2 - Refuge Water Management Units

when the level had drained down to 99.02' MSL. The WCS was then closed. During the rest of April, throughout May and up to June 15, the Pool levels subsided gradually at an average rate of 0.33' MSL every 30 days.

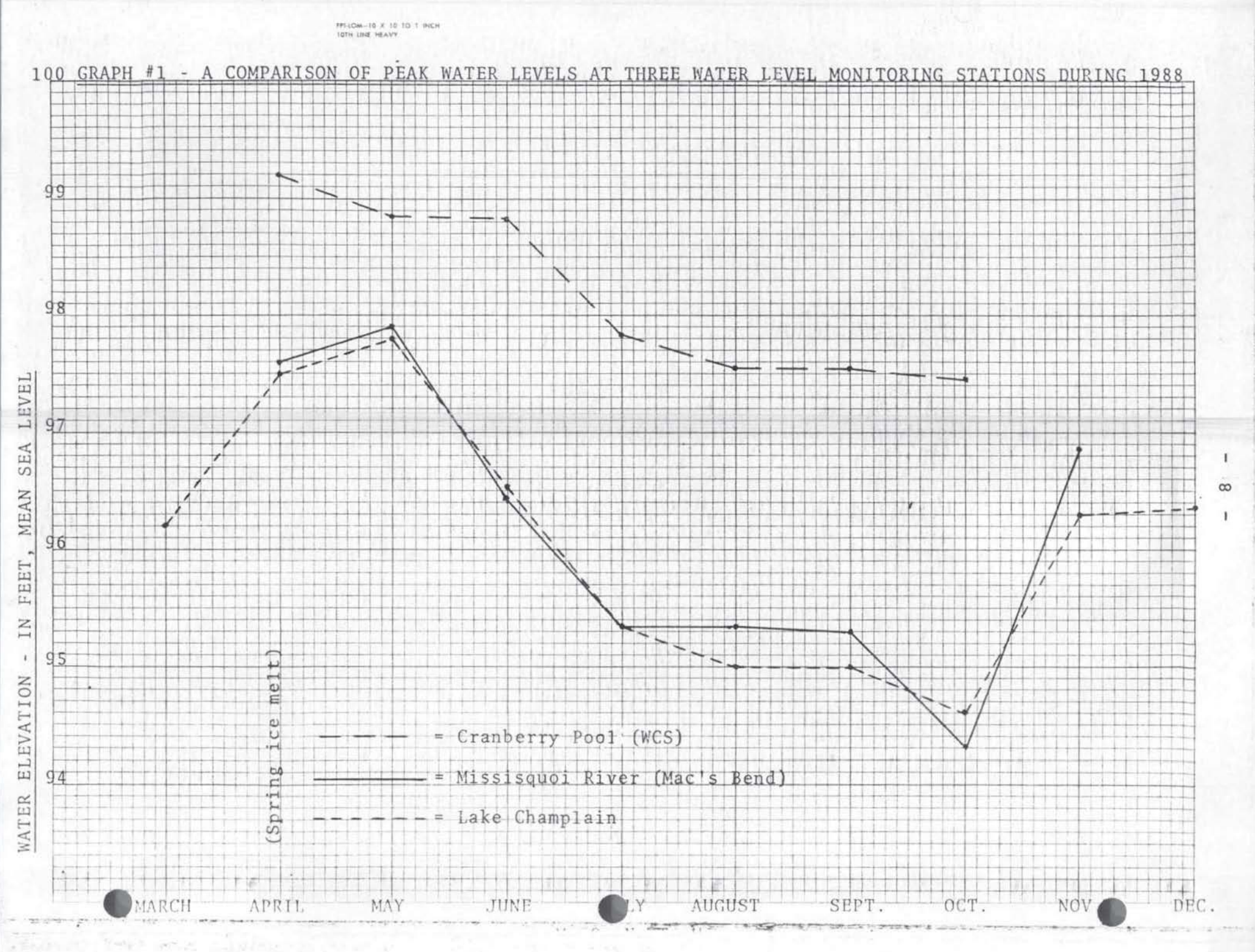
On 6/14, in keeping with the 1988 Annual Program, the WCS was opened to permit a flushing of the structure and subsequent inspection of all the stop-logs in all four bays. It took until 6/16 to adequately cleanse the concrete base of the WCS of silt and debris, to insure a proper seat of stop-logs to concrete. All stop-logs were then installed and defective ones replaced, with the bottom three securely attached to one another. All four bays were subsequently closed and bolted. At the scheduled time for the flushing and WCS inspection, the Pool level was already at 98.25' MSL- the desired objective level for the summer. A decision was made to proceed with the flushing operation and stop-logs inspection, although doing so would result in the pool dropping below the 98.25' MSL objective level. At the finish of the WCS flushing and inspection operation, the water level had dropped to 97.63' MSL, although by 7/5, it had "rebounded" to 97.81' MSL in response to rainfall. The Pool level gradually subsided thereafter during July, and leveled off at between 97.55' - 97.57' MSL during most of August. The Pool level continued to generally subside gradually to 97.44' MSL during early October. The final reading obtained from the WCS was 97.46' MSL on 10/13. Repairs of leaks in the WCS's underground corrugated metal piping

connecting Dead Creek to the Cranberry Pool's interior commenced soon thereafter and rendered the monitoring station inoperable until mid-December, well after freeze-up.

First ice formed in the Cranberry Pool during the third week in November again this year. Intermittent warm spells throughout the rest of November and early December caused partial ice melts until the second week of December when "ice-up" was complete.

The Missisquoi River's water levels were monitored during 1988, particularly during periods of significant rising and falling. Observations and readings during 1986 through 1988 reflect a "time lag" between when the Dead Creek - Missisquoi River system rises and when the Lake Champlain water level rises. In most cases, the Lake levels during 1988 did not reach the heights of the Missisquoi River-Dead Creek levels. Readings were obtained at a benchmarked location on the bulkhead at the Mac's Bend boat launch facility (Ref. Map. #3). The results are reflected in Graph #1, together with the peak levels for Cranberry Pool and Lake Champlain for comparison. The graph reflects a continued trend involving elevation differences between Lake Champlain and the Missisquoi River. In two cases, it appears to show that the Missisquoi River actually fell slightly below the level of Lake Champlain. However, these peaks of May and October may be attributable to human error or unusual weather conditions (ie.- high winds) in the vicinities of the monitoring station, for it is

100 GRAPH #1 - A COMPARISON OF PEAK WATER LEVELS AT THREE WATER LEVEL MONITORING STATIONS DURING 1988



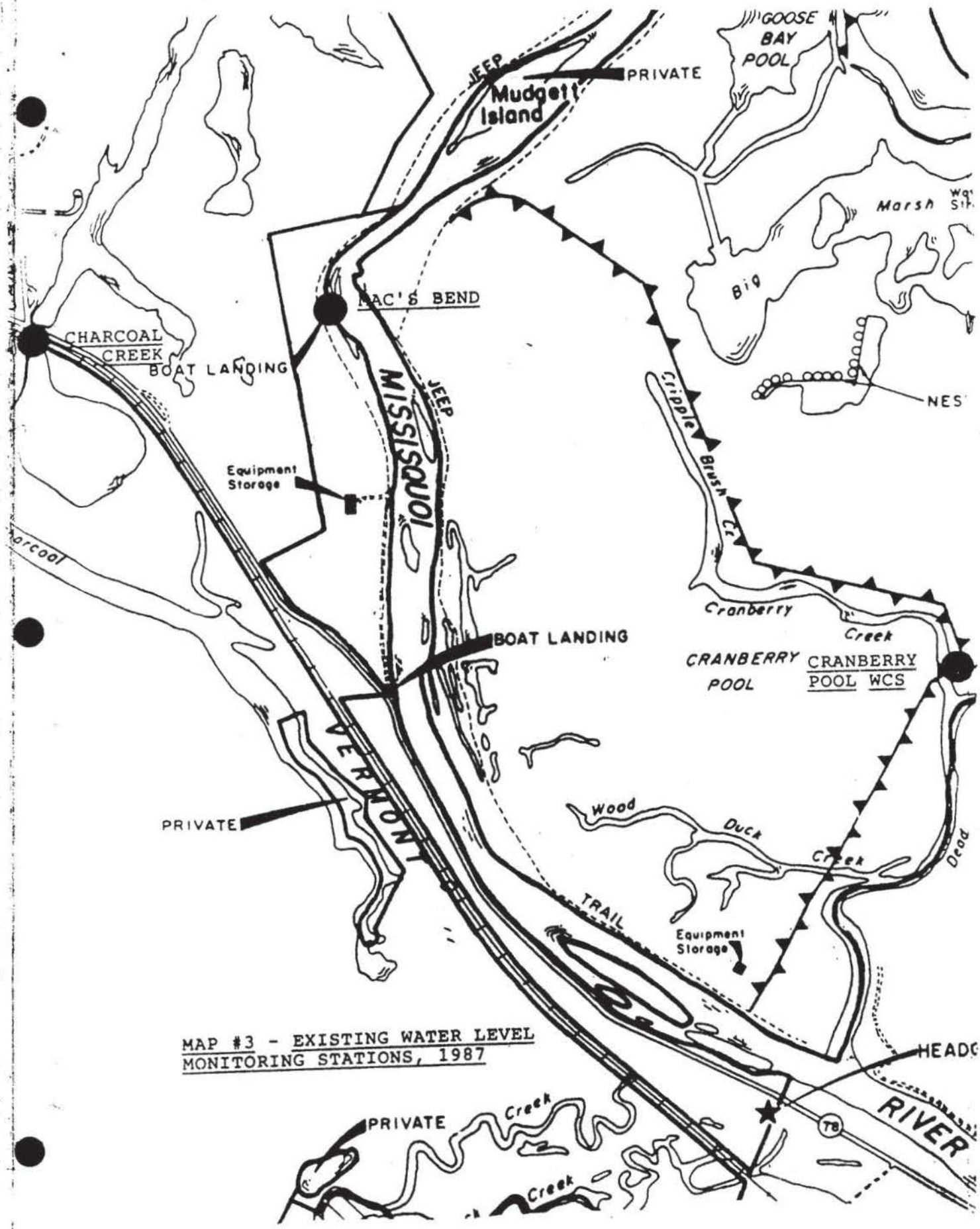
difficult to visualize a natural situation in which the Missisquoi River would actually be 0.3' lower than Lake Champlain. Since gravity should move the higher water from Lake Champlain back into the Missisquoi River before it reached such a difference in levels as it did in October.

Since Dead Creek is located to the south of the Missisquoi River water level monitoring station and appears to receive much of the water volume from the Missisquoi, and since Dead Creek is generally narrower than the Missisquoi River, it can be assumed that the water levels of Dead Creek may be slightly higher than those of the Missisquoi River during flood events.

Graph #2 examines more specifically the readings from all four monitoring stations during the 1988 spring flooding period. Readings for the Missisquoi River and Charcoal Creek are further apart than those of the other two stations due to a lesser number of actual checks made. This should be remedied in 1989, so that weekly checks of Charcoal Creek and the Missisquoi River are conducted regularly.

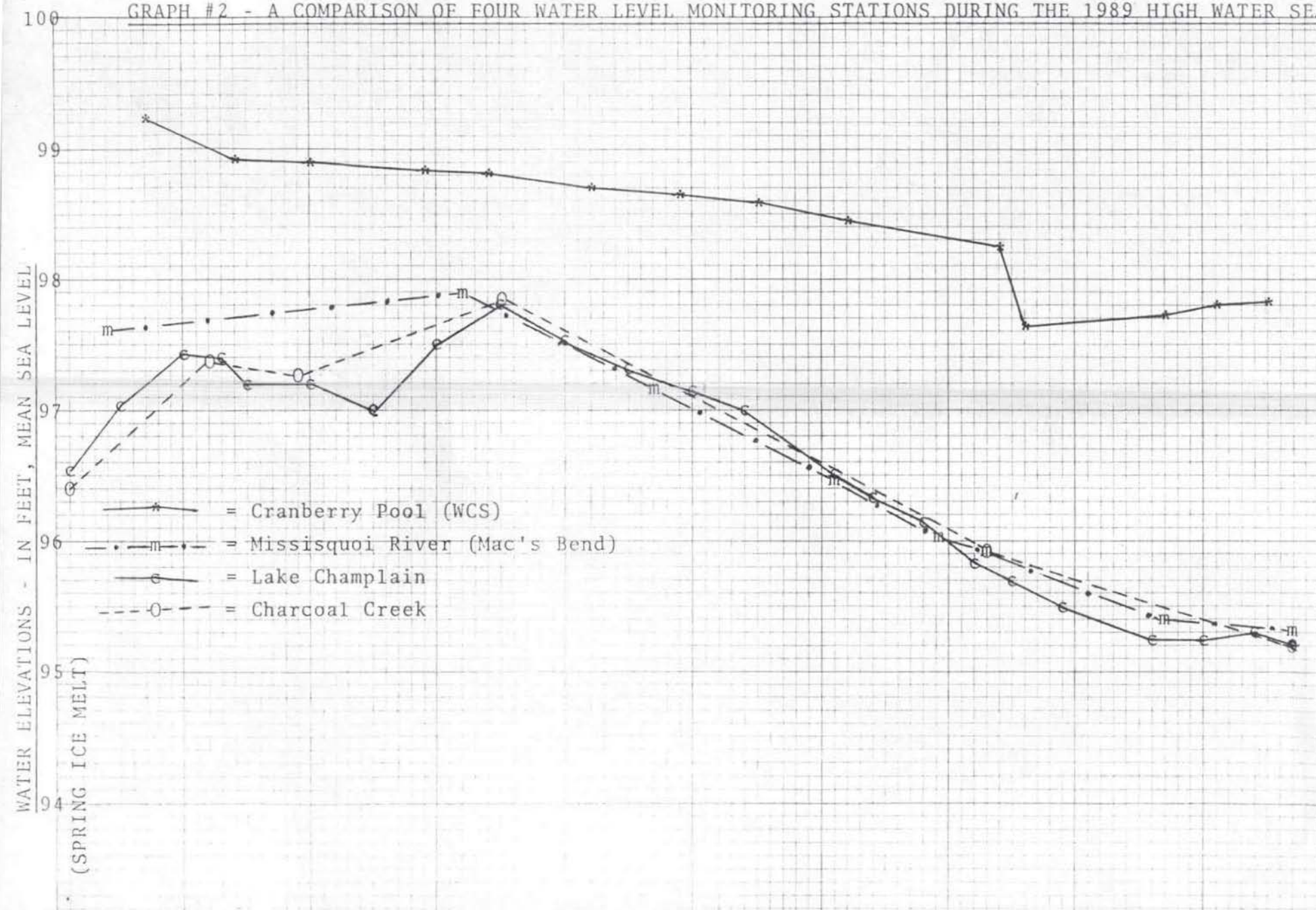
Graph #2 portrays the differences between water levels of the Missisquoi River, Lake Champlain and Charcoal Creek (Ref. Map #1) in greater detail. The peak flood period of 4/4 - 5/10 reflects the greatest differences between the Missisquoi River, Charcoal Creek and Lake Champlain.

On 4/2, the Missisquoi River reached and held its peak annual



MAP #3 - EXISTING WATER LEVEL MONITORING STATIONS, 1987

GRAPH #2 - A COMPARISON OF FOUR WATER LEVEL MONITORING STATIONS DURING THE 1989 HIGH WATER SEASON



elevation (97.90' MSL). This peak occurred three days prior to the Lake Champlain annual peak of 97.80' MSL. The Missisquoi River remained higher than Lake Champlain throughout April and until on or about 5/4. After 5/4, its water level closely paralleled those of Charcoal Creek and Lake Champlain.

During 5/10 - 6/9, Lake Champlain appeared to be slightly higher than the Missisquoi River, as mentioned earlier in this program. This trend was also noticed during 1987, and was mentioned in the "1988 Water Management Program." Thereafter, the Missisquoi continued to maintain higher levels than Lake Champlain.

Throughout the spring flooding period, WMU #2 appeared to operate independently of the other three more natural water systems in and around the refuge. After the initial 4/7-4/8 draw-down, the gradual subsidence of the water level is probably attributable to evapo-transpiration (Ref. Graph #2). The sudden drop of 6/14 - 6/16 reflects the WCS maintenance operation discussed earlier in this section. Rainfall contributed to the gradual increase thereafter up to the end of the survey period on 7/10.

Although the management goal of a water level of 98.25' MSL throughout the summer, fall and winter was not able to be maintained, since the Pool level fell to a low (97.44' MSL-97.46' MSL) near the end of the year, the objectives of this year's program seem to have been achieved. Levels within WMU #2 were 1-1/2' - 2-1/2' higher than

the levels of the adjacent Missisquoi River - Dead Creek system throughout the recorded year (April - October).

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.

However, 1988 was an exception to this general policy since the station "Water Management Plan" and Program stipulate that water levels this year - and every fifth year hereafter - were to be maintained at 99.00' MSL from April through mid-June, and at 98.25' MSL throughout the rest of the year. The brief low-water flooding period during the spring of 1988 provided an excellent opportunity for an earlier draw-down of WMU #2 than usual. However, the 1988 Management Program was adhered to, and the above-average water levels were maintained.

The effect on wild rice production was minimal, although fruiting appeared to be delayed 1 - 2 weeks later than usual.

Drought conditions resulted in only 1.13" of rainfall during 5/1 - 6/21. Pool levels fell below the objectives of this period,

however, duck use increased to above levels of the past few years. The lack of rain at that time made refuge staff (and probably ducks) glad that pool levels were kept higher than normal. The higher duck populations continued throughout the summer within Cranberry Pool.

Waterfowl food plant production was on a level with past years. However, no noticeable increase or decrease in arrowhead production was noted; nor did there seem to be an increased presence of the plant's leaves during the fall waterfowl migration. One objective of the higher Pool levels this year was to "...provide the unit's arrowhead beds with a 'rest' from the heavy feeding of fall waterfowl migrants, ... (Ref. "1988 Water Management Program"). This benefit may be more difficult to measure, for no database exists, as far as arrowhead bed locations and densities are concerned. In addition, tuber development and presences will need understanding and measuring (and not just the above-soil leaves), if actual benefits are to be realized. The below-ground tuber is the preferred duck food, and such tuber presences may not always be indicated by leaves. Whether mapping and analyzing this WMU's arrowhead bed presences, densities and developments, is practical with the limited staffing of the present, is something that needs to be decided in the future, in addition to the need for such an assessment.

The other hydrological benefits of this year's higher water levels were realized. The

entire unit was flushed with an additional foot of water that provided a less stagnant and more dynamic system. This was evidenced by a much lower algal presence inside WMU #2 this year. In addition, the WCS was cleared of silt and debris, and decaying stop-logs were replaced without having the Pool levels drop below 97.20' MSL, as they would have during an average year.

Buttonbush stands showed no noticeable mortality due to the higher water levels. Once considered an undesirable, buttonbush is now recognized as valuable waterfowl brood cover, when not a predominant species, and when adequate openings and "edge" are also available in those stands.

During 1988, 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 heronry 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 1988. 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. The higher water levels afforded them increased access to feeding

areas around their houses and below the ice during the winter.

I.C. STATEMENT OF OBJECTIVES FOR THE PROPOSED LEVELS

During 1988, a great deal of discussion and consultation took place between management staff and Dick Quinn of the Regional Office's engineering division, that involved understanding the hydrology of the Cranberry Pool and surrounding area. These discussions focused on the feasibility of WMU #2 maintaining a lower water level than the exterior water levels (of Dead Creek, the Missisquoi River and Lake Champlain) during the spring ice melt and subsequent flooding. If feasible, then completion of the Cranberry Pool dike system along the low-lying areas of the Missisquoi River on the western side of the pool would also be feasible. The outcome of those discussions remains yet to be seen. However, the following water management changes for 1989 and subsequent years are being initiated in an attempt to improve upon the current situation in this unit, and as a result of some of those discussions, in the event the diking remains incomplete. Section IV. B. 2. of the station "Water Management Plan" has been recently revised (pps. 24 and 25) to incorporate these changes. They are:

1. During March and November, gradually draw down the pool level to 96.00' MSL, to allow for the usual spring flooding of this unit. Should the unit fail to flood, then the WCS can be opened to permit pool levels to rise to the objective.

2. Start monitoring the water level of Dead Creek inside the WCS, at the same benchmark used for monitoring the pool level, with the aid of a long level.

3. Continue to monitor the two water levels at the WCS through the ice during winter, with the aid of an ice chisel.

4. Arrive at the 1989 summer and fall seasons' objective as soon as possible in April, in order that as much nesting substrate as possible be available for such ground-nesting waterfowl as the black duck, mallard and both teals. (In the Lake Champlain area,, mallards and black ducks start nesting during the first week of April.)

The above objectives are in keeping with the newer revisions to Sections IV. B. 2.a., IV. B. 2.c. that set an objective water level of 97.20' MSL for this WMU. The proposed water levels should benefit ground-nesting waterfowl production by providing increased nesting substrate earlier in the duck-nesting season. We can only hope that the raccoon population in this unit does not consume those production gains. (A raccoon trapping season planned for late 1989, should eliminate that concern in future years.)

Measuring both the Dead Creek and Cranberry Pool levels at the Cranberry Dike's WCS will allow a more accurate assessment and comparison of water level differences between Dead Creek, the Missisquoi River, Cranberry Pool and Lake Champlain. A better understanding of this station's hydrological dynamics should result in and provide for better management decision-making. Continuing the readings throughout the winter will provide data for a time of year when it had not been obtained in the past and plug the statistical gaps in the annual hydrological cycles of this area on refuge records.

The proposed winter draw-downs will provide a one foot water level buffer so that the spring flooding will fill, rather than flood, the pool. During 1987, the Pool level was raised approximately 0.6' by flooding along the low areas of the Missisquoi River. Should the Pool be flooded up to a 1.2' increase in water level, the objective will have been

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 & Rest of Refuge

Maximum elevation permissible: Approximately 96.25'-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): Approx. 95.00'MSL

A.1. Water Surface Elevations and Salinity for Fast 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 1988 due to an absence of benchmark and water gauge.		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.

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 1988

Big Marsh Slough and Goose Bay Pool continue to be treated as a single Water Management Unit (WMU #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 96.25' - 96.50' MSL elevation.

The stop-logs in the Big Marsh Slough dike were not manipulated during 1988, since the water control structure (WCS) is totally silted in. To our knowledge, that WCS has not been 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 approximate perimeter elevation of 96.50' MSL. The connecting ditch between Big Marsh Slough and Goose Bay Pool was dammed up by beavers during 1969, and a decision was made then to allow it to remain, in order that 2" - 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 1989, 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 1988 water level trends can be identified from Lake Champlain's water level readings. Using 1988 data from the refuge files, it appears that the water level of WMU #1 probably dropped below 96.00' MSL during early January, after which it continued subsiding gradually throughout February and up to 3/24. The winter low for Lake Champlain was 94.90' MSL during most of March. However, since water levels below 96.25' - 96.50' MSL do not seem to also cause a similar subsidence of this unit's water levels, it must be assumed that WMU #1 maintained levels of between 96.00' - 96.50' MSL during this same winter period. Lake levels rose rapidly from 94.90' MSL (3/24) to 96.55' MSL (4/1) in response to the ice melt. WMU #1's water levels can be assumed to have also risen to the 4/1 Lake Champlain level. Thereafter, both systems' water levels continued rising during April and early May to the annual peak of 97.80' MSL (5/5). A gradual subsidence occurred throughout the rest of May and until 6/2, when the waters dropped below 96.50' MSL, making WMU #1 independent of Lake Champlain. Lake Champlain continued to generally subside from July through the third week of October, when it reached the annual low of 94.20' MSL. It must be assumed that the WMU #1 levels also subsided below 96.00' MSL during the low-water period, due to evapo-transpiration and

limited rainfall, although not to the extreme low of Lake Champlain. Levels rose back up to 96.35' MSL during early December, and may possibly have entered WMU #1 along the lowest elevation areas south of the Goose Bay and Big Marsh Slough dikes, from 11/25 - 12/8. Therefore, we can assume that the water levels of WMU #1 may have risen during those two weeks, but just how far up is not known. At the year's end, the lake level had again subsided to 95.40' MSL. The water level within WMU #1 was not known, but assumed to be between 95.00' and 96.00' MSL.

In summary. WMU #1 maintained generally lower levels than the last two years (1987 and 1986), which permitted this system to remain independent of the Lake Champlain - Dead Creek water level influences for approximately nine months of the past year, when the outside levels dropped below the 96.25'-96.50' MSL threshold. During the remaining three months, this WMU operated 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 1988. 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 10,700 ducks using Big Marsh Slough and the 1,400 ducks using Goose Bay Pool during October. The stands of buttonbush did not seem negatively impacted by 1988 water levels. Water lilies, watershield 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 1988. 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 occurred on 7/28. However, retreatment during 1989 is necessary, since the stands were not killed - only stressed by the spraying.

No die-offs of fish, mammals or ducks were noticed during 1988.

Beaver, otter and muskrat populations appeared healthy.

C. **A STATEMENT OF OBJECTIVES FOR THE PROPOSED LEVELS**

Not applicable.

III.A. **1989 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 1988**

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 has been done. Because of the uniqueness of the Maquam Bog, development of that area should be discouraged.

2. **Effects of 1988 Water Conditions**

The effects of the 1988 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. 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, Long Marsh Bay and the branches of the Missisquoi River is becoming noticeable through the presence of new houses.

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 - "1988 Annual Water Management Program," unpublished document on file at Missisquoi NWR headquarters.

JG:ssb
01/27/89

WAMGTPRO.89