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Periodic Inspection Report No. 4
West River
Townshend, Vermont

Townshend Lake

October 1996

US Army Corps
of Engineers

New England Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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	October 1996	Periodic Inspection Report

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Periodic Inspection Report No.4
Townshend Lake
Townshend, Vermont

5. FUNDING NUMBERS

6. AUTHOR(S)
Carmen Suarez
Scott Acone

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742

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13. ABSTRACT *(Maximum 200 words)*

This inspection has been conducted under the authority in ER 1110-2-100, which provides for the "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures." The purpose of the inspection is to examine the physical condition of the Townshend Lake project as part of a continuing program to insure its structural stability, safety, and operational adequacy. The field examination includes soils and geologic aspects of embankments, channels, and other components, as well as structural, concrete, mechanical, electrical, and hydrologic and hydraulic features of the project.

14. SUBJECT TERMS
Periodic Inspection; dam safety.

15. NUMBER OF PAGES
296

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
unclassified	unclassified	unclassified	

CENAE-EP-GW

1 September 1998
Mr. Acone/jbo/78162

MEMORANDUM FOR Chief, Engineering/Planning Division

SUBJECT: Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures--Townshend Lake, Vermont

1. As requested in paragraph 4 of your 26 August memorandum, SAB, enclosed are annotated comments regarding subject periodic inspection.

2. If you have any questions, please call Scott Acone on X78162.

Encls

H. FARRELL MCMILLAN, P.E.
Chief, Geotechnical & Water
Management Branch

CF:
Mr. Acone - GWMB
Mr. Forbes - Eng Mgmt (w/encl)
GWMB - f:\gw\pi-ann.cmt)

CENAE-EP-MC

26 August 1998
Mr. Forbes/emm/78885

MEMORANDUM FOR Chief, Geotechnical & Water Management Branch

SUBJECT: Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures - Townshend Lake, Vermont

1. Reference CENAE-EP-GW memorandum dated 22 July 1998, SAB.

2. Periodic Inspection Report Technical Review Board met on 10 August 1998. Based upon this meeting, subject report is approved subject to resolution of enclosed comments.

3. The next inspection of Townshend Dam will be scheduled for FY2002.

4. Request that a memorandum be prepared concurring with attached comments and stating that they have been incorporated into the final report. If your office does not concur with any of the attached comments, a meeting with the technical evaluation board will be held to resolve these.

Encl

ANTHONY T. MACKOS, P.E.
Chief Engineering/Planning Division

CF (w/encl):
Mr. Carlson - Con/Ops
Mr. McMillan - GWMB
Mr. Marinelli - GWMB
Mr. Forbes - Eng Mgmt.
Eng. Div. Files - (disk/4-nick - TOWNSHEN.WP5)

TOWNSHEND LAKE - PERIODIC INSPECTIONS

ANNOTATED
COMMENTS BY PERIODIC INSPECTION REPORT
TECHNICAL REVIEW BOARD - 10 AUGUST 1998

PAGE	COMMENT
1	1. EXECUTIVE SUMMARY. Future periodic inspections should be conducted with all members of the inspection team present, during one session. *Agreed. Every effort is made to ensure the entire team is present. The geotechnical engineer for this inspection was changed at the last moment. This individual had a previously scheduled class on the day of the inspection. Rescheduling would have resulted in about a months delay, therefore, the original date was kept, with the geotechnical inspection being performed during the following 2 days.* Also, make the following corrections to last sentence of the last paragraph. "... operation of the project **or integrity of the dam** during flood events ..." *Incorporated.*
10	Paragraph 5. Rewrite the second sentence of the paragraph as follows: "Work is to be finished by **the end of** FY97." *Incorporated.*
12	Paragraph 5.e.(2) Pool Stage Recorder Information is incorrect, there is no bubble gage shelter at Townshend. *Agreed. Report was corrected.*

13. Paragraph 5.e.(4) Tailwater Gage Rewrite as follows.

"A new tailwater gage was installed about two years ago ~~in~~ **on** the left ~~embankment~~ **bank** to monitor discharges impacting the fish passage. At the time of inspection, discharge was read at ~~32~~ **34** cfs."

Incorporated.

Paragraph 6. RECOMMENDATIONS. Remove recommendation to schedule the next periodic inspection. This information should be included in the executive summary.

Statement was moved to the Executive Summary.

Also, next periodic inspection is scheduled for FY02, not FY01 as indicated in report.

Agreed. Statement was corrected.

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
TOWNSHEND, VERMONT

OCTOBER 1996

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS 02254-9149

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
TOWNSHEND, VERMONT

TABLE OF CONTENTS

APPENDICES

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
TOWNSHEND, VERMONT

1. EXECUTIVE SUMMARY

a. The fourth periodic inspection of Townshend Lake was performed in two sessions. On 8 October 1996 the electrical, mechanical, structural, and hydraulic/hydrologic aspects of the dam were inspected; then on 9 and 10 October the geotechnical aspects were inspected. The inspection team was formed by members of the Design, Geotechnical, and Water Control Divisions of the Engineering Directorate, and Operations Directorate, New England Division, Corps of Engineers.

b. The purpose of the periodic inspection was to examine the physical condition of the Townshend Lake project as part of a continuing program to insure the structural stability, safety and operating adequacy. The field examination included soils and geologic aspects of embankments, channels and other components, as well as the structural, concrete, mechanical, and hydrologic/hydraulic features of the project. The scope of work did not include an evaluation of the project design and construction for compliance with present design criteria.

c. Based on visual inspection, project features of Townshend Lake are generally in good condition. No deficiencies which could jeopardize the operation of the project or integrity of the dam during flood events were identified. The next periodic inspection will be scheduled for FY02.

CARMEN SUAREZ
Water Control Division
Hydraulic Engineer
(Team Captain)

KENNETH PATON
P. E. License #37848 (MA)
Design Division
Mechanical Engineer

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Design Division
Structural Engineer

ERIK MATTHEWS
Geotechnical Eng Division
Civil Engineer

THOMAS ROSATO
Operations Directorate
Project Engineer

FRANK TURNER
Design Division
Electrical Engineer

2. GENERAL STATEMENT OF INSPECTION PROGRAM

a. Authority for periodic inspections is contained in ER 1110-2-100 which provides for the "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures." This program requires a detailed, systematic, technical inspection of each Corps-owned facility whose failure or partial failure would endanger the lives of the public or result in substantial property damage.

b. Failure at Townshend Lake has the potential to result in loss of life and cause serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. Based on the hazard potential criteria adopted by the U.S. Army Corps of Engineers and presented in Appendix D of ER 1110-2-106 "Recommended Guidelines for Safety Inspection of Dams," Townshend Lake is a high hazard dam.

c. Approval authority for periodic inspection reports has been delegated by HQUSACE to the Division Commander, U.S. Army Corps of Engineers, New England Division, who has deferred to the Director of Engineering. This approval process includes an in depth review by Engineering and Operations Directorates.

3. PROJECT DESCRIPTION

Townshend Lake is one of two flood control reservoirs in the West River watershed. Located in Townshend, Vermont, the reservoir is 19.1 miles above the junction of the West and Connecticut Rivers at Brattleboro, Vermont and about 2.0 miles west of Townshend and Jamaica, Windham County, Vermont (figure 1). With a gross drainage area above the dam of 278 square miles (106 square miles net due to the Ball Mountain Lake flood control project about 9.0 river miles upstream), it is operated to reduce flooding on the main stem of the West and the Connecticut Rivers.

4. BRIEF PROJECT SUMMARY

a. Project Characteristics

Purpose	Flood control
Construction Period	November 1958 to June 1961
Construction Cost	$7,400,000

Location of Structures

State	Vermont
County	Windham
Town	Townshend

Reservoir

Drainage Area	106 square miles (net) 278 square miles (gross)

Operating Levels

Pool	Elevation (feet NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Inlet	457.0	---	---
Permanent Pool	478.0	95	800
Flood Control (Spillway Crest)	553.0	735	32,900

Dam

Type	Rolled earthfill, rock slope protection, impervious core
Maximum Height	133 feet
Length	1,700 feet
Top Elevation	583.0 feet NGVD

Spillway

Location	Left-East abutment
Type	Uncontrolled ogee, L-shaped side channel spillway
Crest Length	439 feet
Crest Elevation	553.0 feet NGVD
Maximum Discharge	201,000 cfs (at spillway design surcharge)

Intake

Intake	Concrete weir
Invert	457.0 feet NGVD

Outlet Works

Type	Horseshoe-shaped conduit
Size	20'-6" diameter
Length	360 feet
Gates	(3) 7'-6" x 17'-0" vertical lift (wheel)
Discharge at Spillway Crest	22,100 cfs
Stilling Basin	None

b. Significant Storages Since Last Inspection. Table 1 lists significant storages recorded at Townshend Lake since the last inspection.

c. History of Major Remedial Measures. Two major remedial measures have been conducted at this project to address seepage problems, in 1970 and 1985. Construction to stabilize and protect the outlet channel banks and portal from erosion was begun in FY96. Anchors were added through the spillway weir in 1979. Detailed description of remedial measures is presented in Appendix I.

TABLE 1

SIGNIFICANT STORAGES AT TOWNSHEND LAKE
SINCE LAST INSPECTION

Date	Maximum Elevation ft-NGVD	Storage Utilized Inches	Acre-Feet	Percent
Mar 1992	502.9	1.0	5,240	16
Apr 1993	532.1	3.3	18,160	55
Apr 1994	523.0	2.3	13,260	40
Oct 1995	506.5	1.1	6,480	20
Jan 1996	525.0	2.5	14,280	43
Apr 1996	515.3	1.8	9,870	30
May 1996	506.6	1.2	6,510	20

One inch of runoff = 5,650 acre-feet (net)

Drainage Area = 106.0 square miles (net)
278.0 square miles (gross)

Zero Stage = 457.0 feet NGVD

d. Deficiencies Corrected Since Last Inspection

(1) This periodic inspection of Townshend Lake was the fourth conducted since initiation of the dam inspection program. Listed below are the dates of prior inspections:

Periodic Inspection No. 1	October 1981
Periodic Inspection No. 2	October 1986
Periodic Inspection No. 3	October 1991

(2) Results of the intermediate inspection performed 17 July 1995 are presented in Appendix VI, Intermediate Trip Reports.

(3) Deficiencies at the project which have been corrected as a result of findings presented in the last periodic inspection are listed below.

CONCRETE/STRUCTURAL NEEDS :

Modify upcoming contract to build the fish passage facility to include repair of the concrete erosion at the base of the trash rack in front of gate 2. Completed during FY92.

MECHANICAL NEEDS :

(1) Modify scope of work for the scheduled FY92 gate painting contract to include painting of the emergency gate, embedded steel, entrance to air vents, and service gate lifting beams (including lower sheaves and steel between sheaves and gates). Also, perform touch-up painting of service gates. Already budgeted for FY92; estimated cost $ 50,000. Completed during FY92.

(2) Replace air operated hoist with an electric hoist to improve operational efficiency and safety. Operations Directorate to budget for FY93; estimated cost $ 10,000. Completed during FY93.

(3) Replace the kinked cable for service gate 3. Operations Directorate to budget for FY93; estimated cost $ 5,000. Completed during FY93.

GEOTECHNICAL NEEDS :

(1) Study the existing scour hole and outlet channel slope and access road. Scour hole measured and outlet channel remediation designed in FY95. Bank stabilization construction in progress (FY96).

(2) Automate instrumentation, scheduled for FY94. Completed FY95. (Periodic Inspection No 2)

e. Past Deficiencies Not Yet Corrected. Deficiencies which have been identified in the past but not yet corrected are listed below.

ELECTRICAL NEEDS

(1) Hire an electrician at an estimated cost of $ 1,000 to:

(a) Fix or replace the two damaged light fixtures and have them operate from a motion detector. Total cost should be less than $ 300.

(b) Rewire the station amp meter by moving the current transformers to the load side of the transformer switch. Cost approximately $ 200.

(c) Mount the transient suppressor. Cost $ 100.

(d) Replace the transformer and cleanup the melted insulation from the other equipment. Cost $ 400.

(e) Replace the 30A-3P breaker with a 15 or 20A-2P breaker.

(2) Perform an in-depth inspection of the electrical system in the gatehouse due to the many small electrical problems caused by the installer of the generator in 1987. The inspection should be performed after the above repairs have been made and should be performed by an electrical engineer from NED.

5. INSPECTION RESULTS

a. This inspection was performed on 8-10 October 1997, by the following personnel from Engineering and Operations Directorate.

Carmen Suarez	Hydrology/Hydraulics (Team Captain)	CENED-ED-WH
Michael Walsh	Concrete/Structural	CENED-ED-DG
Kenneth Paton	Mechanical	CENED-ED-DG
Yuri Yatsevitch	Geology	CENED-ED-GG
Erik Matthews	Geotechnical	CENED-ED-GD
Thomas Rosato	Operations	CENED-OD-P

Other personnel at the inspection were as follows:

Philip Morrison	Operations Project Manager	CENED-OD-P
Michael Curran	Operations Basin Manager	CENED-OD-P
Dale Berkness	Operations Park Ranger	CENED-OD-P
Tim Flynn	Operations Park Ranger	CENED-OD-P
John Hart	Geotechnical	CENED-ED-GD
Jim Law	Operations	CENED-OD-P
Robert Pisano	Operations	CENED-OD-P

b. Embankment. Visual inspection of dam embankment and abutment areas did not indicate any settlement, lateral movement, sloughing of slopes, significant irregularities, or evidence of instability that would affect its performance. There is no apparent vertical or horizontal movement of the dam.

(1) Crest. The crest of the dam is in good condition and appears to be stable, with good horizontal and vertical alignment. There is no apparent sign of sloughing or cracking along the crest.

(2) Upstream Slope. The rock fill slope is in good condition and appears stable with no indication of movement or sloughing. See Photo E-4, Appendix II.

(3) Downstream Slope. The rock fill slope is in good condition and appears stable with no indication of movement or sloughing. Sparse brush growth was observed on the slope. See Photo E-8, Appendix II.

(4) Seepage. Townshend Dam has a history of seepage problems including piping and boils along the downstream toe. On the day of the inspection, flow of about 5 to 10 gpm was observed at a point along the toe of the downstream slope, within the measuring pool. See Photos E-9

and E-10, Appendix II. No subsidence or movement of the rock fill slope immediately above the seepage area was observed.

(5) Seepage Pool. A new weir for the seepage pool was under construction during the time of this periodic inspection. Work is expected to be finished by the end of FY97. Water in the pool was clear with a reddish iron precipitate covering the bottom of the pool. The weir was clear of vegetation. See Photo E-10, Appendix II.

(6) Relief Wells. At the time of inspection, no flow was observed from the outlet end of the collector pipes. The manhole structure and about 50 feet of the collector pipe upstream were inspected and found to be clean and in good condition. See Photo E-2, Appendix II.

(7) Intake Service Road. The gravel-surface road from the dam crest to the inlet along the upstream slope is in good condition.

c. Spillway. Overall condition of the spillway, located at the left side of the project looking downstream, is good. Minor to moderate joint deterioration with efflorescence along approximately 30% of the exposed horizontal construction joint. See Photo A-3, Appendix II.

(1) Approach. The overall condition of the spillway approach is very good and clear of major obstructions. See Photo E-14, Appendix II.

(2) Weir. The spillway weir is in good overall condition. There are spalls and extensive random hairline cracks along the upstream side of the weir, that may need to be repaired. Eighteen concrete patches along the crest of the weir, where anchors were installed, have failed and need to be repaired. See photo A-4, Appendix II. The downstream edge is in good condition with minor efflorescence.

(3) Retaining Walls. The overall condition of the spillway retaining walls appears to be good with no significant change from the previous inspection.

(4) Access Bridge Over Spillway. There is no indication of movement of the concrete abutments. Alligator cracking in the concrete surface in the roadway approach lip is caused by deterioration of the concrete rather than by movement of the abutment. See Photo E-16, Appendix II. Overall condition of exposed rock is good. The structural condition of the bridges at this project are evaluated in the Bridge Inspection Program. The last inspection of the spillway bridge was performed in 1996, and is in good condition. The service bridge is scheduled to undergo an Inventory Inspection in FY97.

(5) Exit. The spillway exit channel is mostly clear and in good condition. See photo A-5, Appendix II.

d. Outlet Works

(1) Approach.

(a) Inlet Channel. The inlet channel is in good condition with no major obstructions. See photo D-3, Appendix II.

(b) Intake Structure. The pool level was below the top of the weir. The weir was observed to be in good condition. Two large tree trunks were jammed in the trash racks and need to be removed.

(c) Control Tower. The concrete of the exterior and interior of the control tower is in very good condition. The bulkhead crane, which has a 5 ton capacity, appears to be in very good condition.

(d) Gate Wells. Concrete of the three gate wells is good with no cracks or spalls noted. Minor rusting of steel railing at the three lowest landings in gate well #2 and at the lowest landing in gate wells #1 and #3 was noticed. See photo A-11, Appendix II.

(e) Service Gates. All service gates are in good condition. See photos A-12 and A-13, Appendix II. Only the downstream face of the bulkhead gate was inspected and is in good condition. However, the dogging devices used

to support it are in poor condition. A number of anchor bolts and nuts are heavily corroded.

(f) Service Bridge to Intake Structure. The abutment and piers are in good condition and appear to be stable. See paragraph 5.c.(4), above.

(2) Conduit.

(a) Gate and Gate Passage. All three outlet structure passages are in good operating condition. Gate 1 shows minor leakage along the top and side seals against a 15-foot head. Minor abrasion on the bottom 3 feet of the concrete walls of gate barrels 1 and 2 was noted.

(b) Transition. The concrete of the transition is in good condition with minor abrasion on the bottom 3 feet of the concrete walls

(c) Conduit. The 12-foot horseshoe conduit is in good condition. There is minor abrasion on the bottom foot of the concrete walls and minor deterioration of all joints between monoliths of the conduit

(d) Exit Channel. Concrete of the outlet portal, sidewalls, and apron is in good condition. The exit channel was clear. The scour hole formed in the outlet channel, extending about 140 feet downstream of the outlet works, has been surveyed. Stabilization of the banks was under way the day of the inspection. A new weir for the seepage pool is also being built. See photo E-10, Appendix II.

e. Project Instrumentation

(1) Rain Gage. The rain gage is in good operating condition.

(2) Pool Stage Recorder. The pool stage recorder, which consists of a Sutron 8200A Data Collection Unit in the control tower, is in good condition. At the time of inspection, the pool level was at 21.0 feet (Elevation 478.0 feet NGVD).

(3) Staff Gage Bases. The overall condition of the concrete in the staff gage bases is good. At the time of inspection stage gage was 21.0 feet

(4) Tailwater Gage. A new tailwater gage was installed about two years ago on the left bank to monitor discharges impacting the fish passage. At the time of inspection, discharge was read at 34 cfs.

(5) Embankment Instrumentation.

(a) Piezometers. The fifteen open-type piezometers, installed in FY87 are operable. An automated system to read piezometers and pool stage on a daily bases was installed in 1993.

(b) Seepage Measuring Weir. The new weir is currently under construction. Daily measurement of the seepage weir will be added to the automated data collection system.

(c) Crest Monuments. The crest monuments are located along the downstream edge of the crest of the dam and are in good condition.

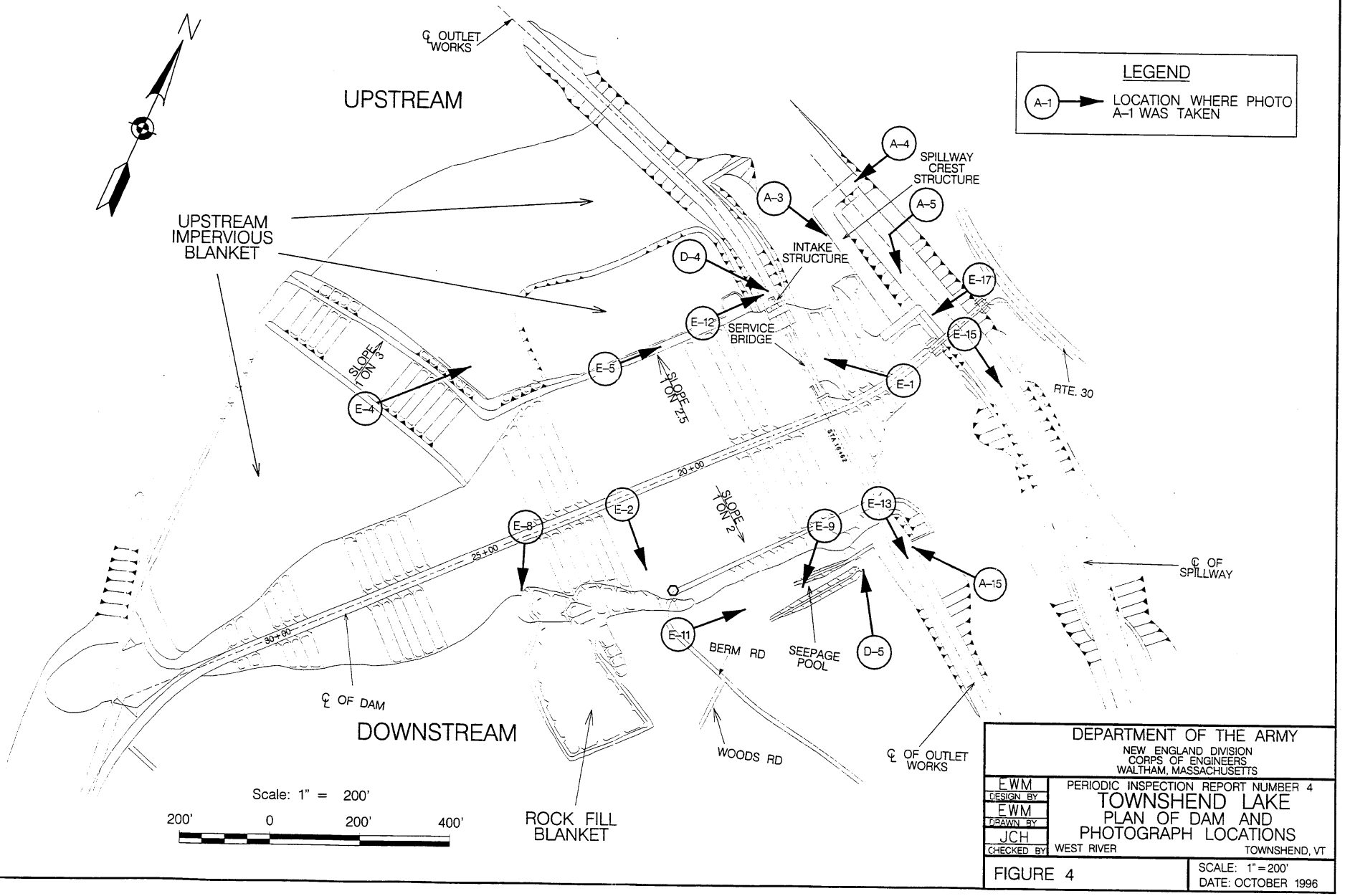
(d) Strong Motion Accelerographs. Three strong motion accelerographs were installed in 1979. The instruments are serviced twice a year by Waterways Experiment Station (WES) and are in good condition.

6. RECOMMENDATIONS

The inspection team members and project personnel held an exit meeting at the dam where the findings and recommendations were jointly discussed. There were no dam safety recommendations for this project. Needs and actions were of the "normal maintenance" category.

APPENDIX II

PHOTOGRAPHS



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

EWM DESIGN BY	PERIODIC INSPECTION REPORT NUMBER 4
EWM DRAWN BY	TOWNSHEND LAKE
JCH CHECKED BY	PLAN OF DAM AND PHOTOGRAPH LOCATIONS
	WEST RIVER — TOWNSHEND, VT
FIGURE 4	SCALE: 1" = 200'
	DATE: OCTOBER 1996

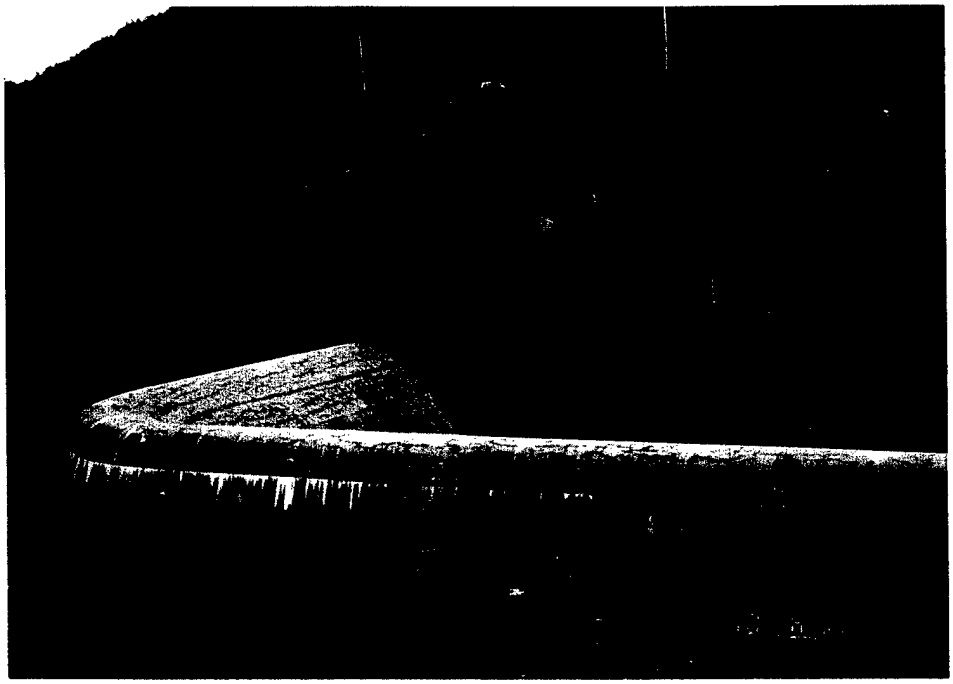


PHOTO A-1. General view of upstream face of spillway.

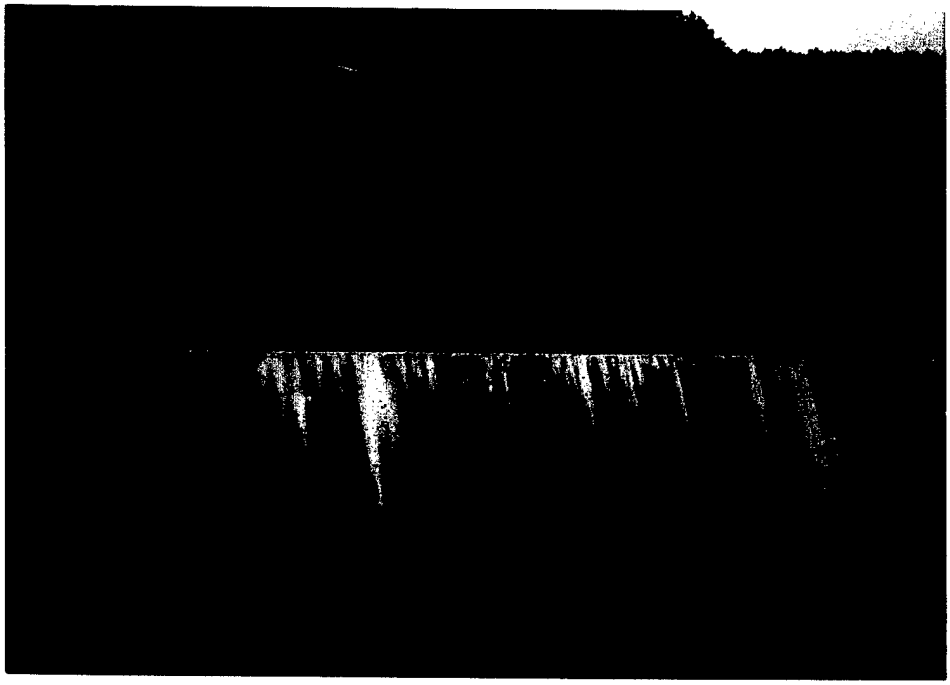


PHOTO A-2. Efflorescence at horizontal joint on upstream face of spillway.

PHOTO A-3. Spall on upstream face of spillway.

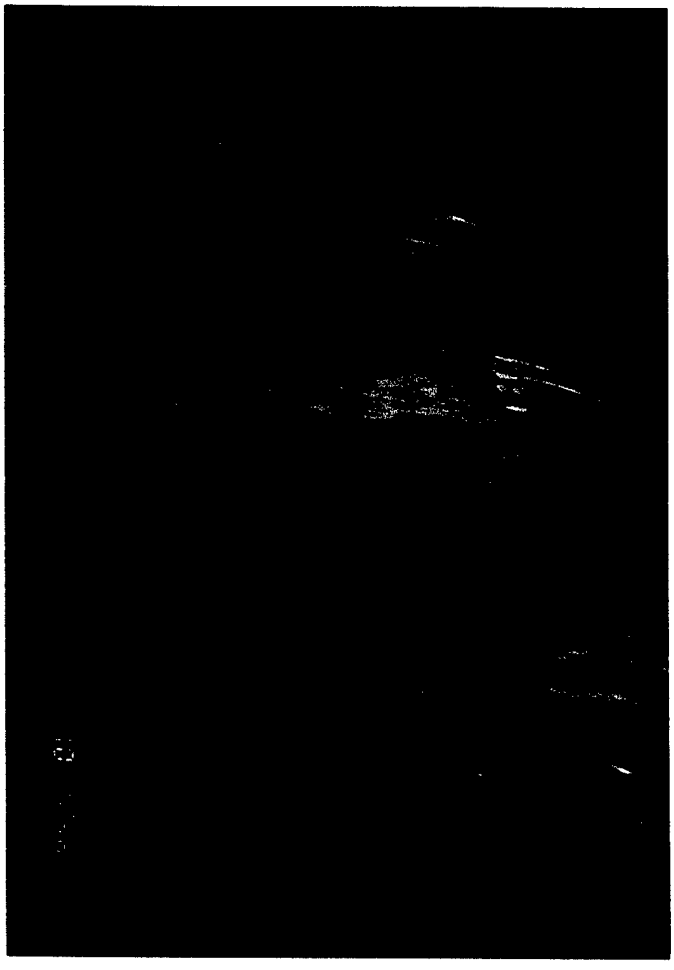


PHOTO A-4. Failed patches on crest of spillway, typical.

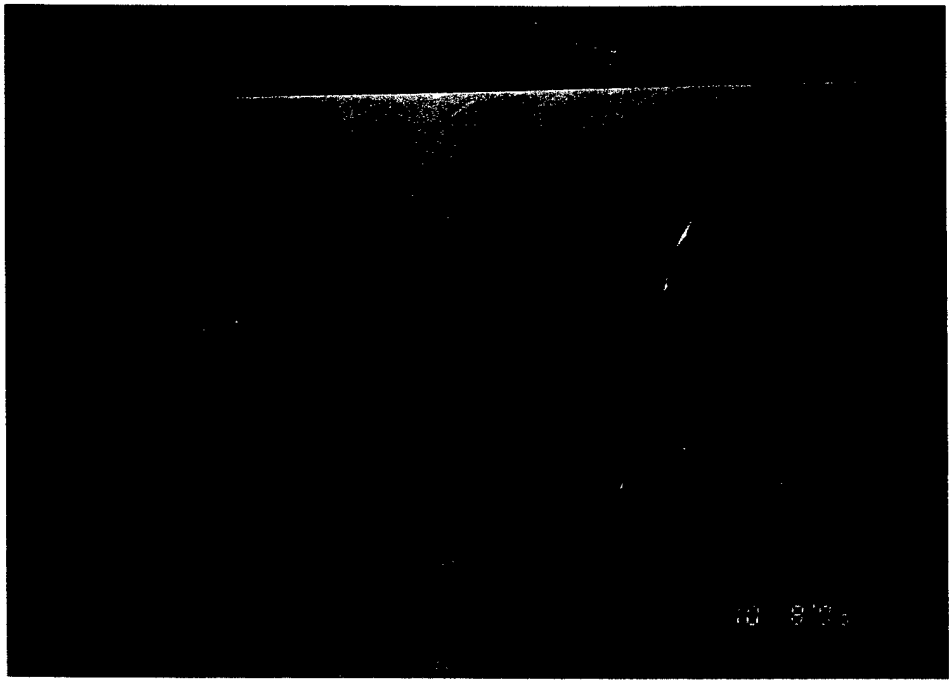


PHOTO A-5. Downstream face of spillway, typical.

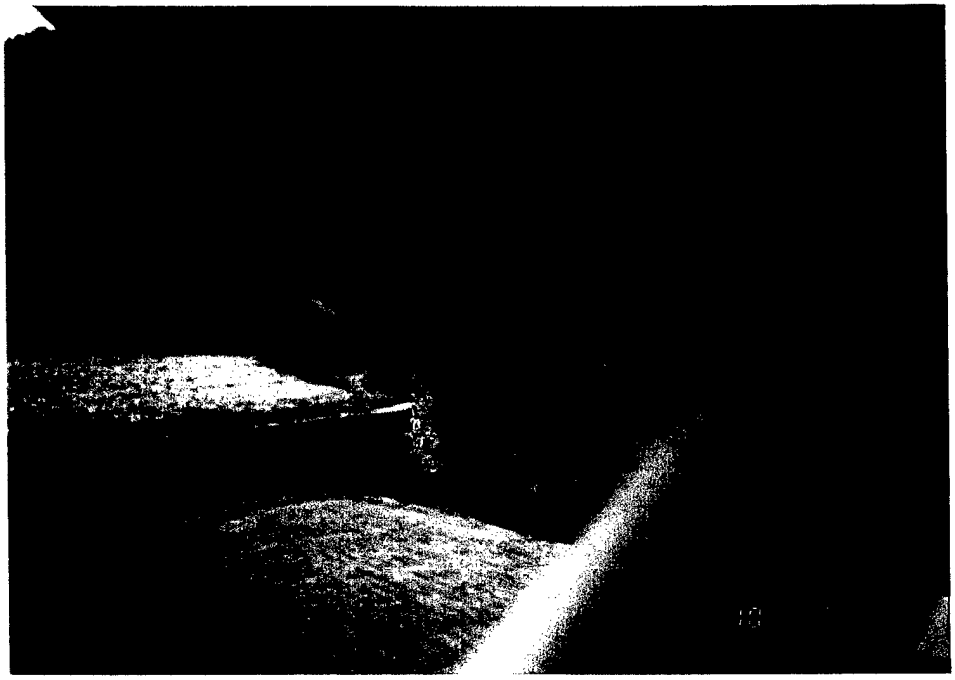


PHOTO A-6. Underside of exterior stairs, showing honeycomb at intersection with landing, typical.

PHOTO A-7. Spalled concrete on top of third landing from control platform.

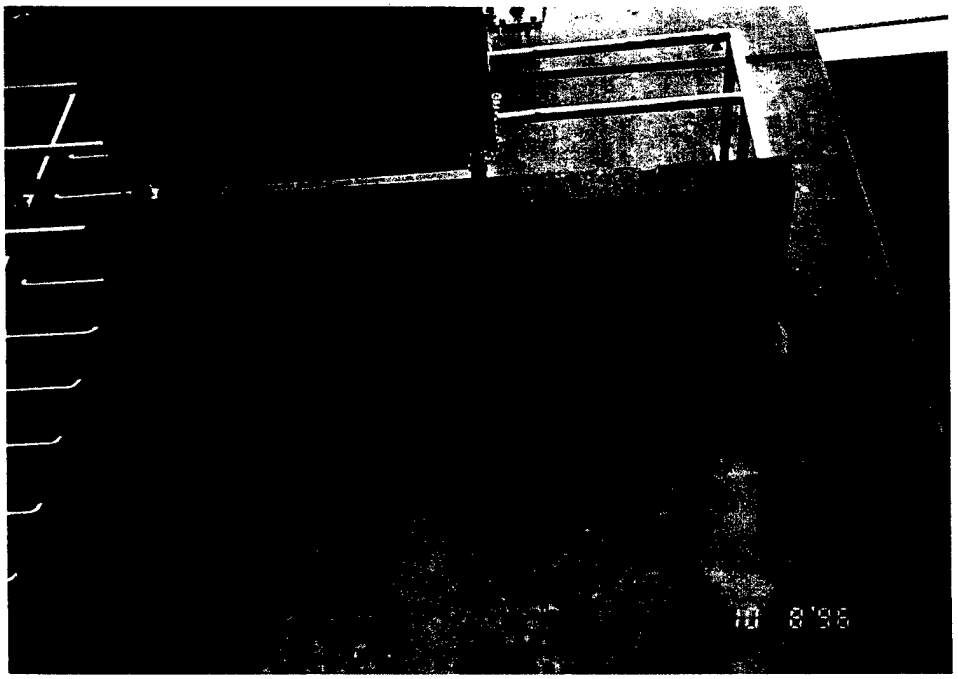


PHOTO A-8. Minor efflorescence at intersection of lower balcony (cantilever) and the north exterior tower wall.

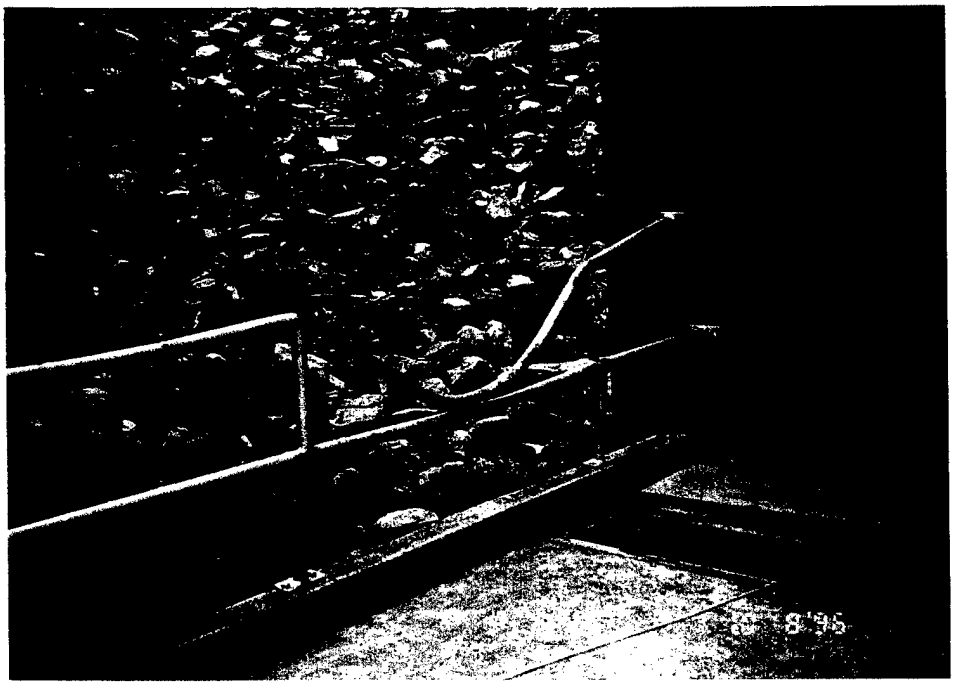


PHOTO A-9. Damaged railing section at the south east corner of the upstream control platform.

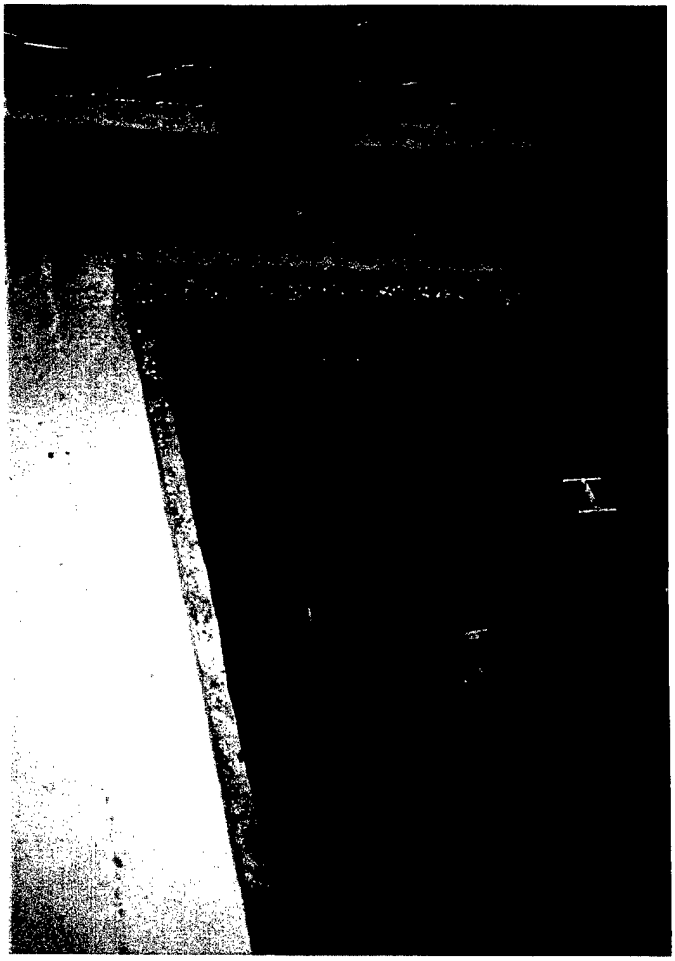


PHOTO A-10. Exposed reinforcement at the access hatch to gate well No. 2.

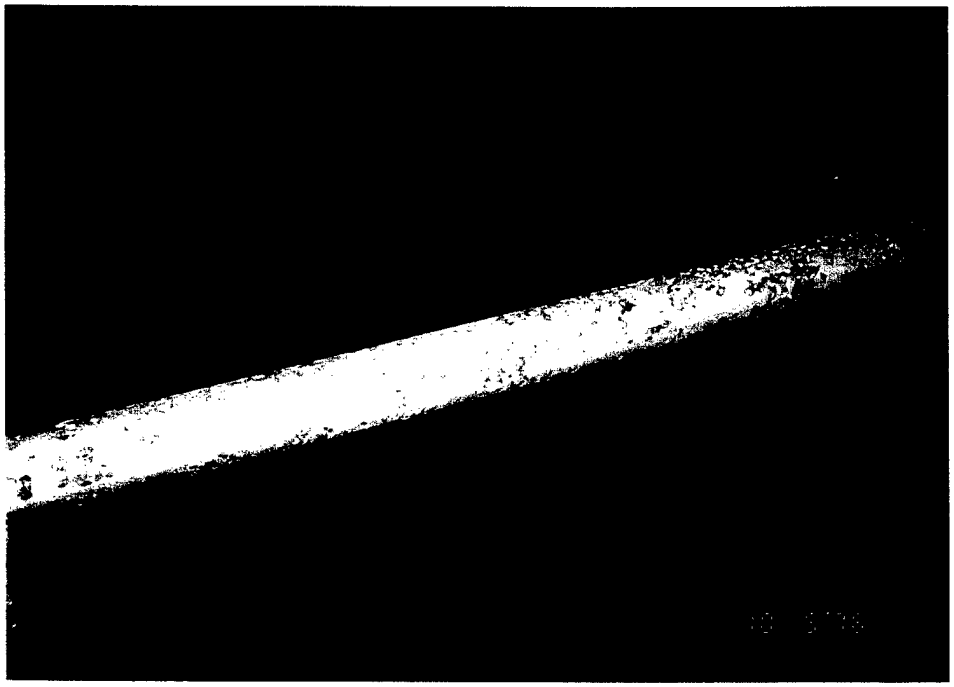


PHOTO A-11. Typical minor corrosion on lower level railings within the gate wells.

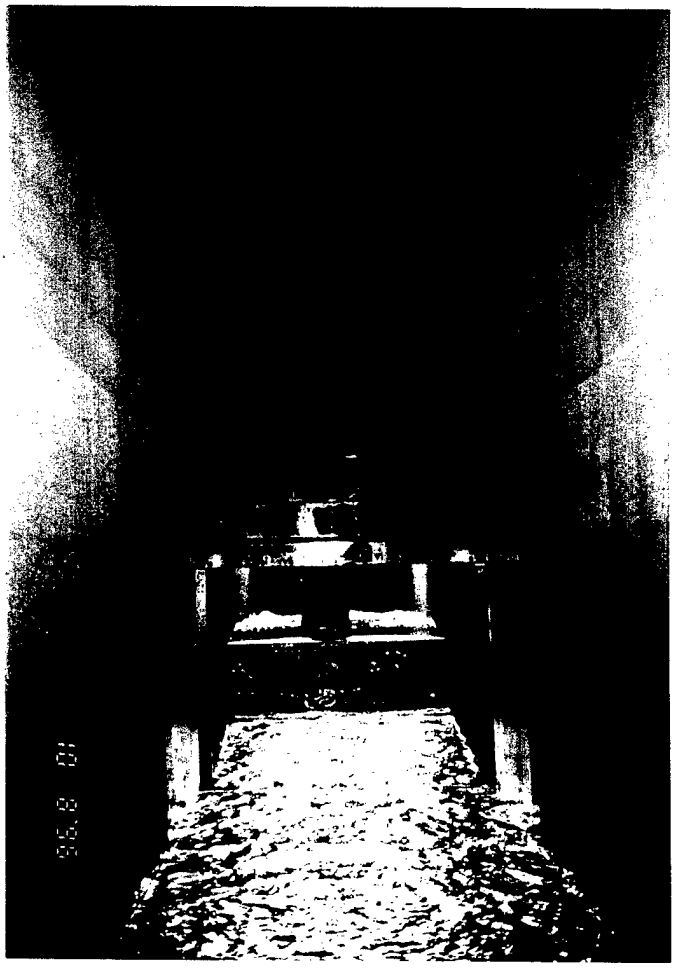


PHOTO A-12. Downstream face of service gate No. 2.

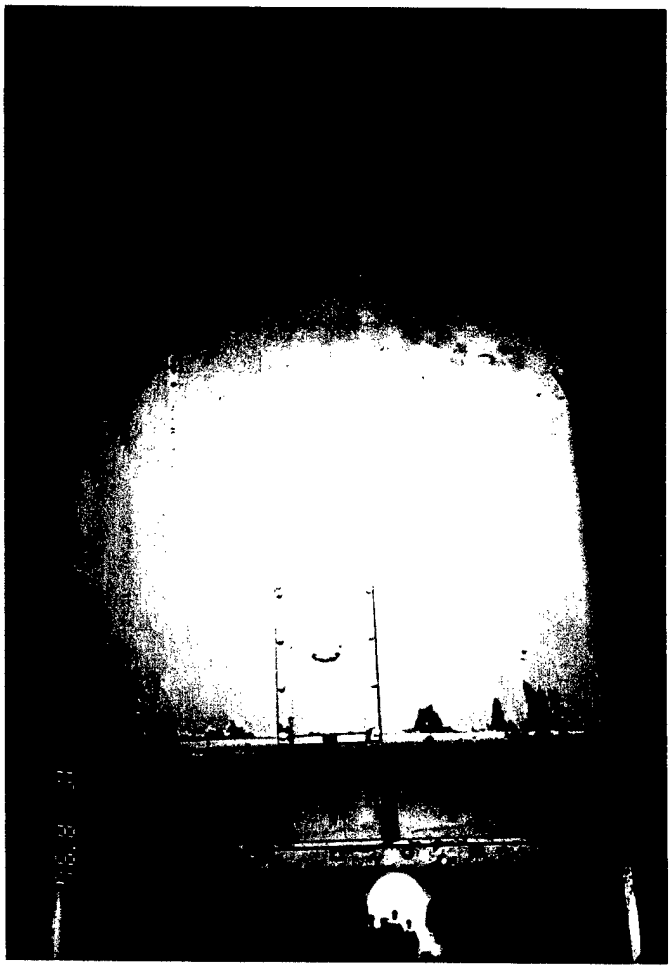


PHOTO A-13. Upstream face of service gate No. 2.

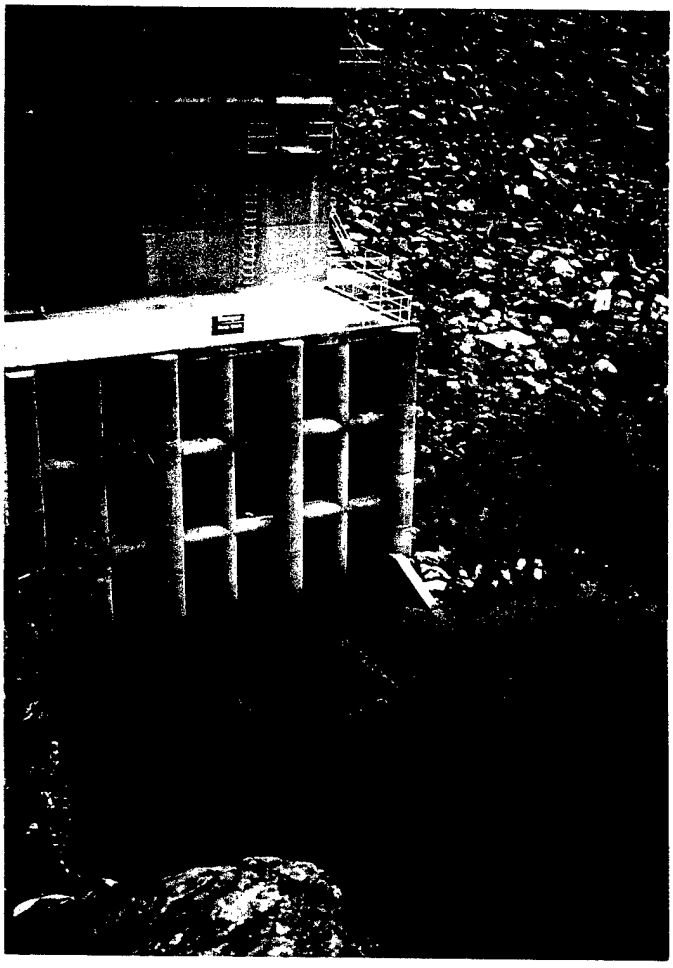


PHOTO A-14. General view of upstream control weir and trash rack.

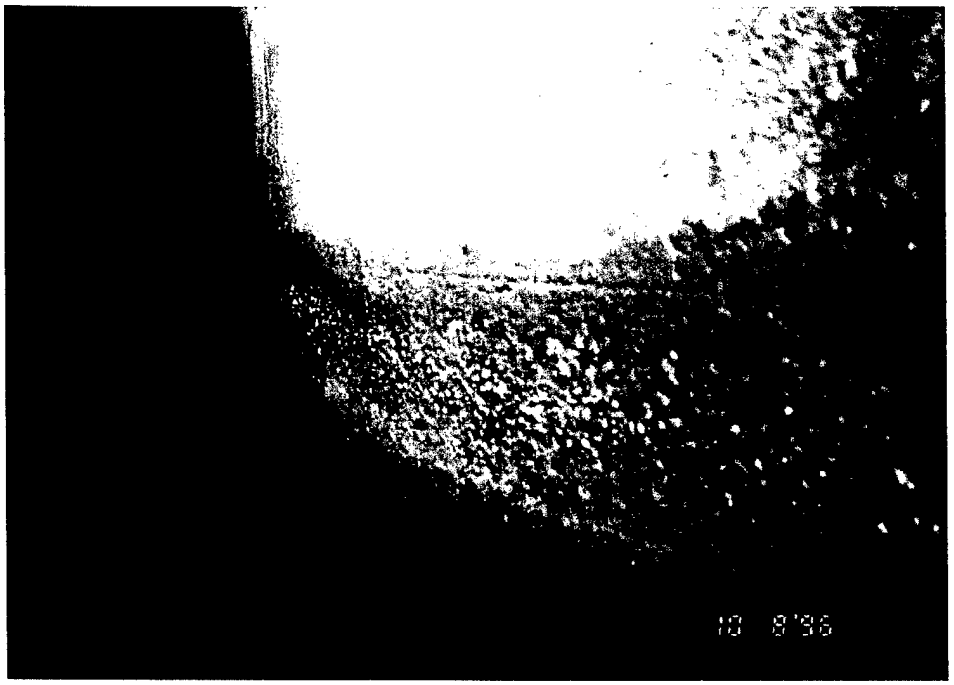


PHOTO A-15. Typical abrasion on the outlet sidewall.

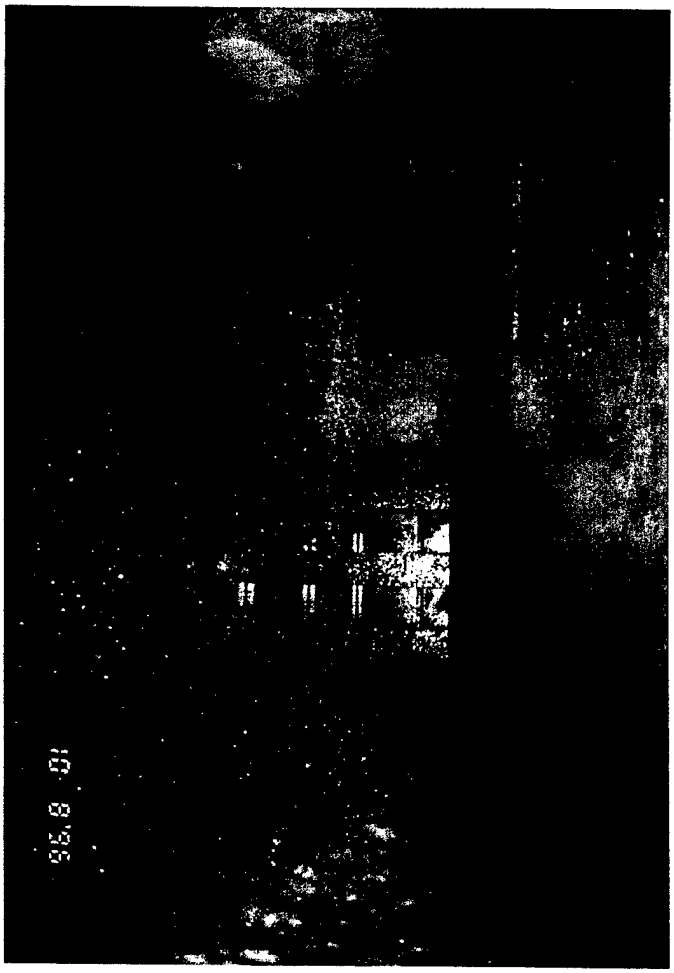


Photo B-1: Service Gate 1, Discharge Side

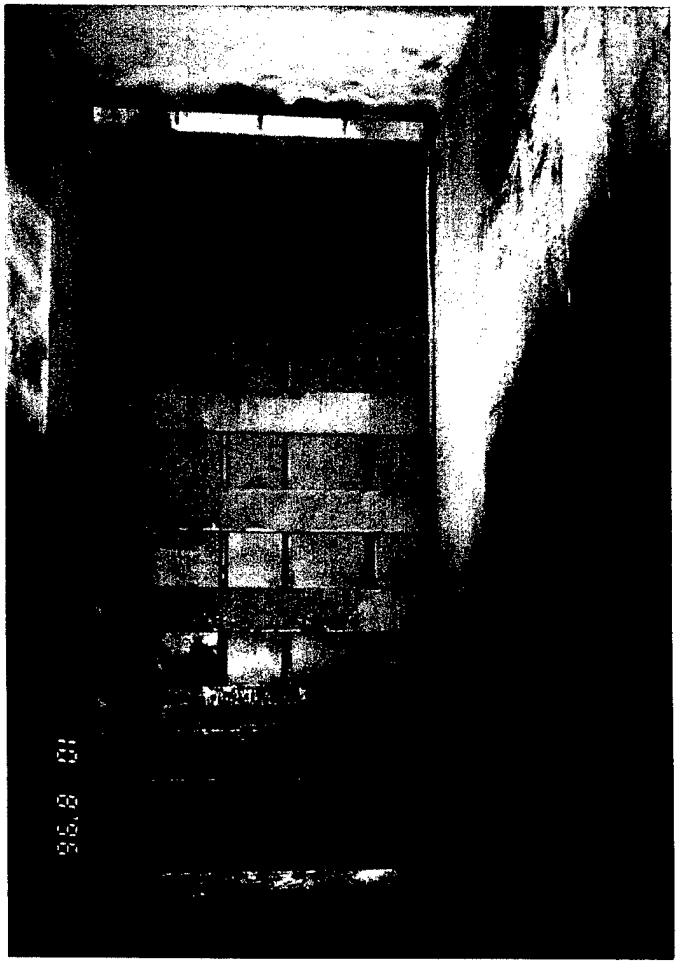


Photo B-2: Service Gate 2, Discharge Side

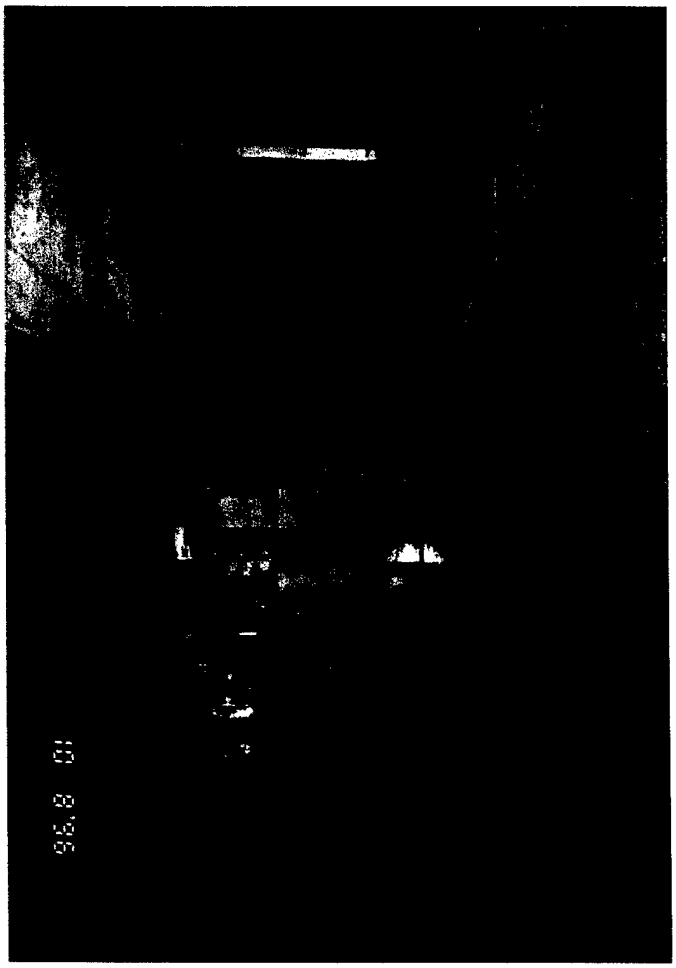


Photo B-3: Service Gate 3, Discharge Side

Photo D-1 Spillway approach looking upstream

Photo D-2 Spillway exit channel looking downstream

Photo D-3 Upstream view of inlet channel

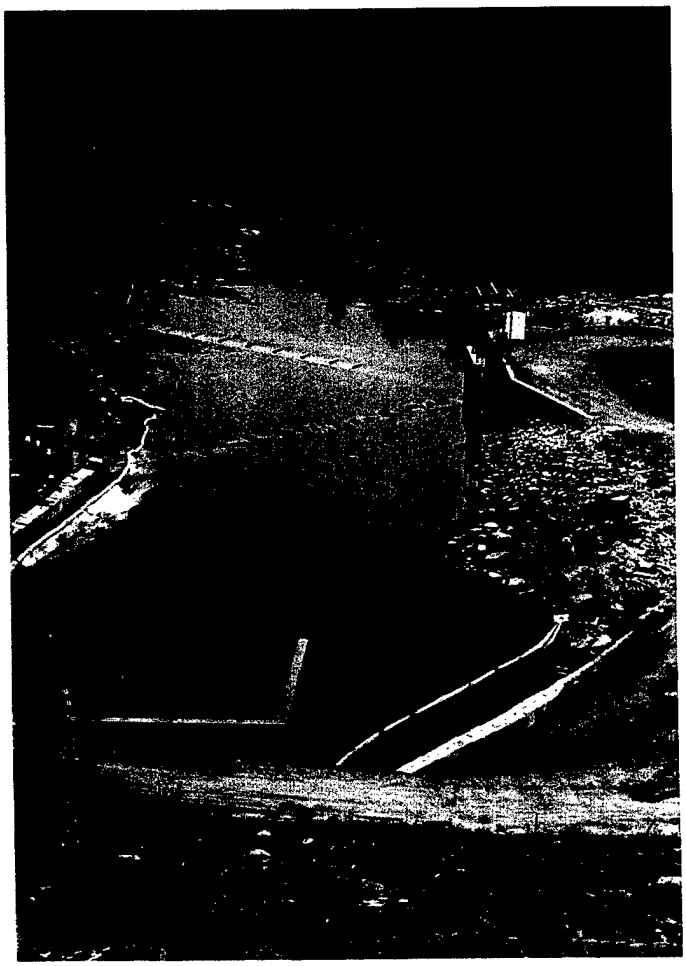


Photo D-4 Exit channel looking downstream

Photo D-5 View of seepage pool presently under construction

PHOTO E-1: View of upstream impervious blanket. Note brush at edges of blanket.

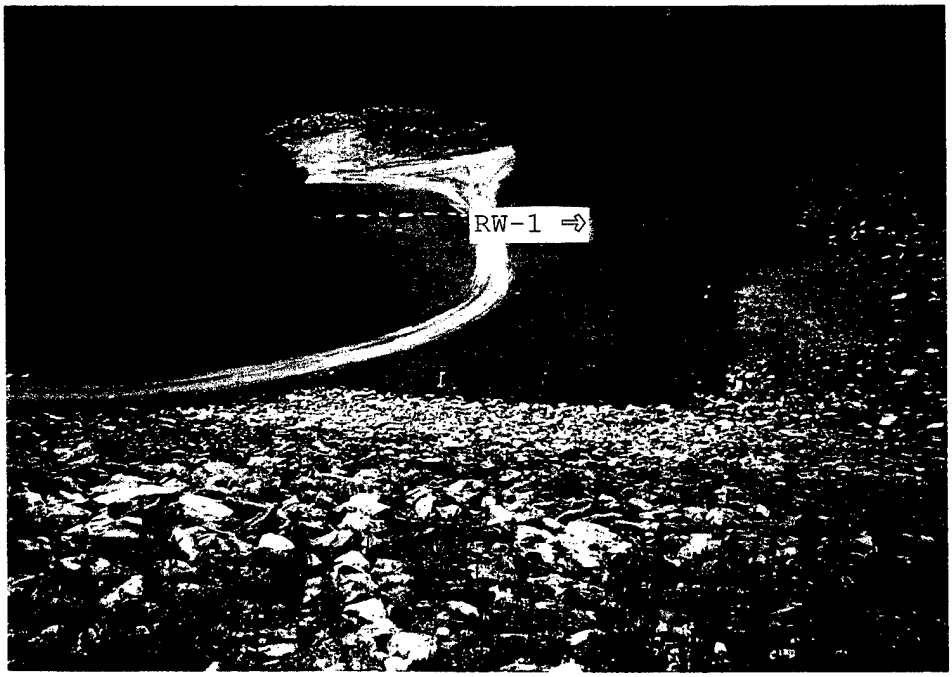


PHOTO E-2: View of relief wells at downstream toe of dam. Note large trees near relief well at upper right of picture.

PHOTO E-3: Crest of dam, looking towards right abutment. Note posts moved out of alignment by snow plows.

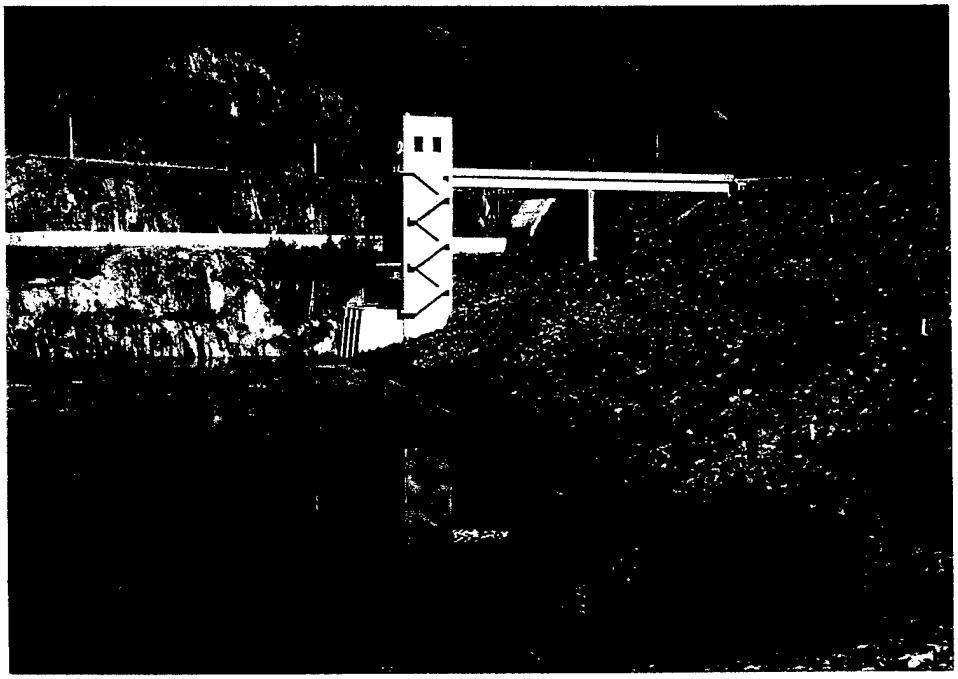


PHOTO E-4: General view of upstream slope and toe.

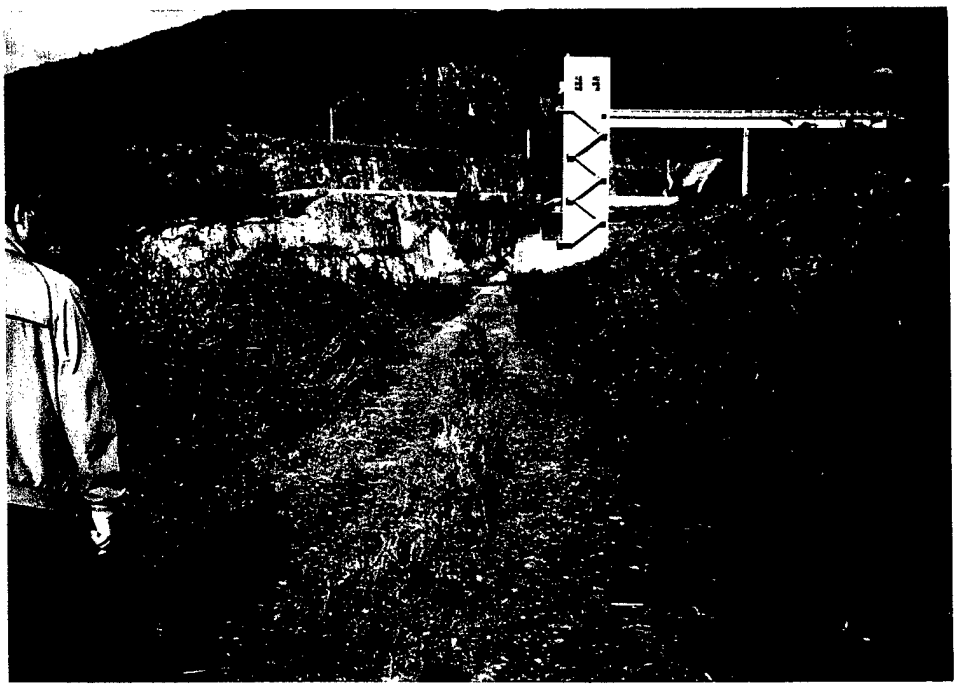


PHOTO E-5: View of edge of lower portion of upstream impervious blanket. Note heavy brush growth.

PHOTO E-6: Upper level of upstream impervious blanket. Note sapling at top of riprap slope.

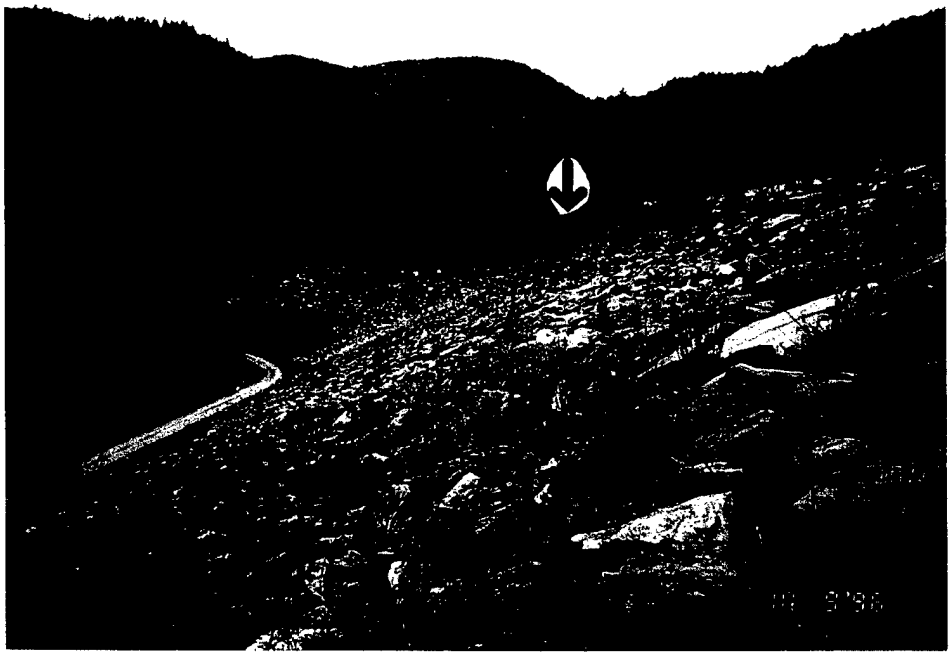


PHOTO E-7: General view of downstream slope of dam. Note tree growth at top of rock fill blanket (at arrow).

PHOTO E-8: Closeup view of downstream toe above rock fill blanket (area noted by arrow in Photo E-7). Note large trees and brush growth.

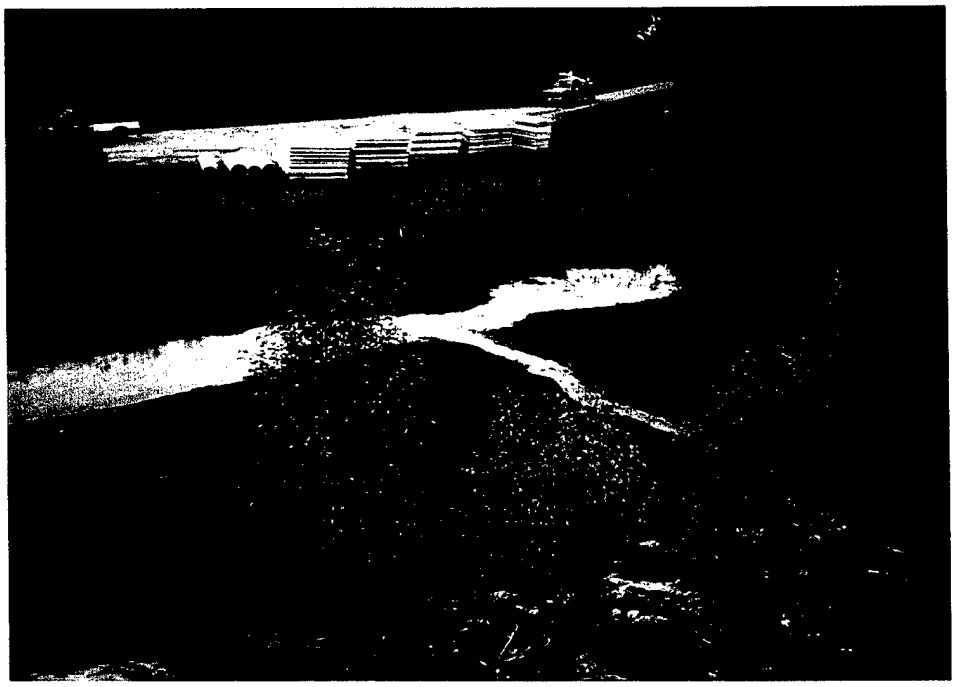


PHOTO E-9: Seepage emerging from downstream toe within the seepage pool. Flow was estimated at 10 gpm.

PHOTO E-10: View of seepage pool and outlet channel. Note seepage at downstream toe.

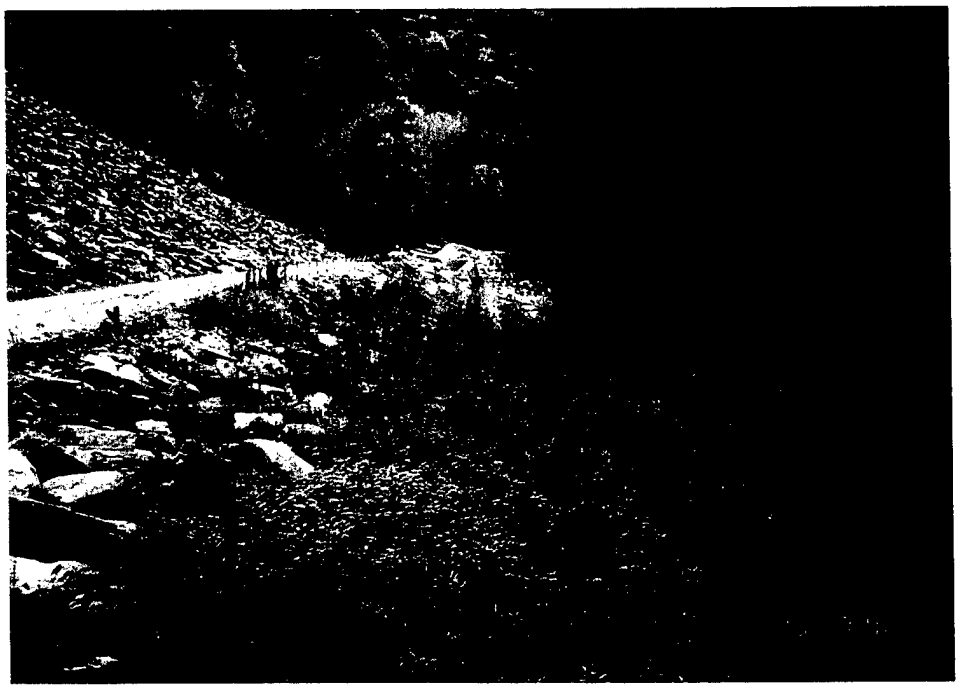


PHOTO E-11: View of relief well outlet channel. Note heavy brush growth within channel.

PHOTO E-12: Rock face at intake channel. Note impervious blanket in foreground.

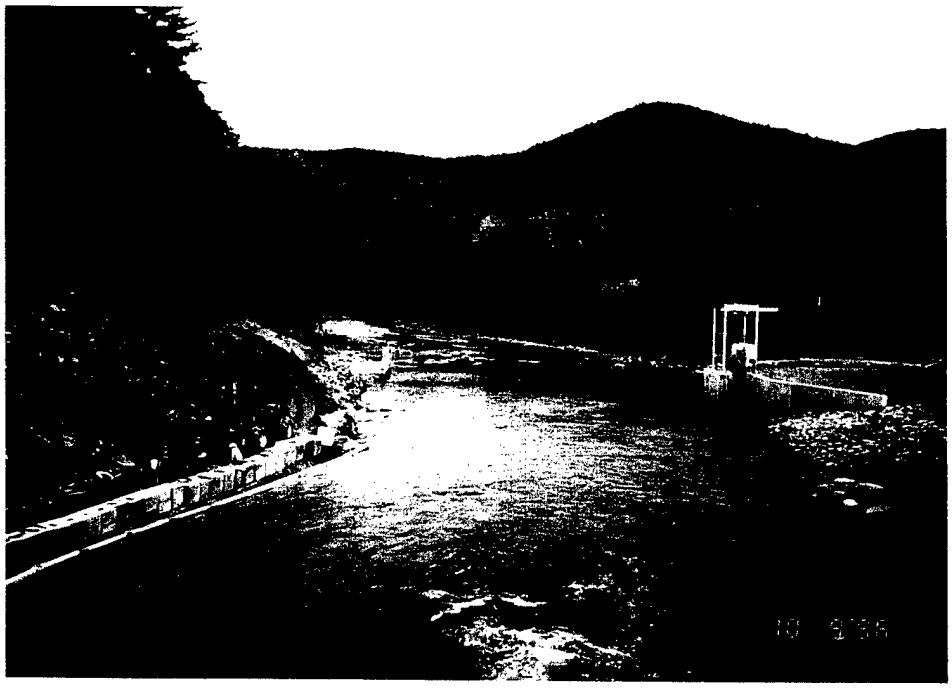


PHOTO E-13: Construction underway to repair banks of outlet channel.

PHOTO E-14: Spillway weir, with view of approach and discharge channels.

PHOTO E-15: Spillway discharge channel.

PHOTO E-16: Left side of spillway bridge. Note alligator cracking on asphalt and damaged safety fence.

PHOTO E-17: Exposed rock face at spillway bridge right abutment.

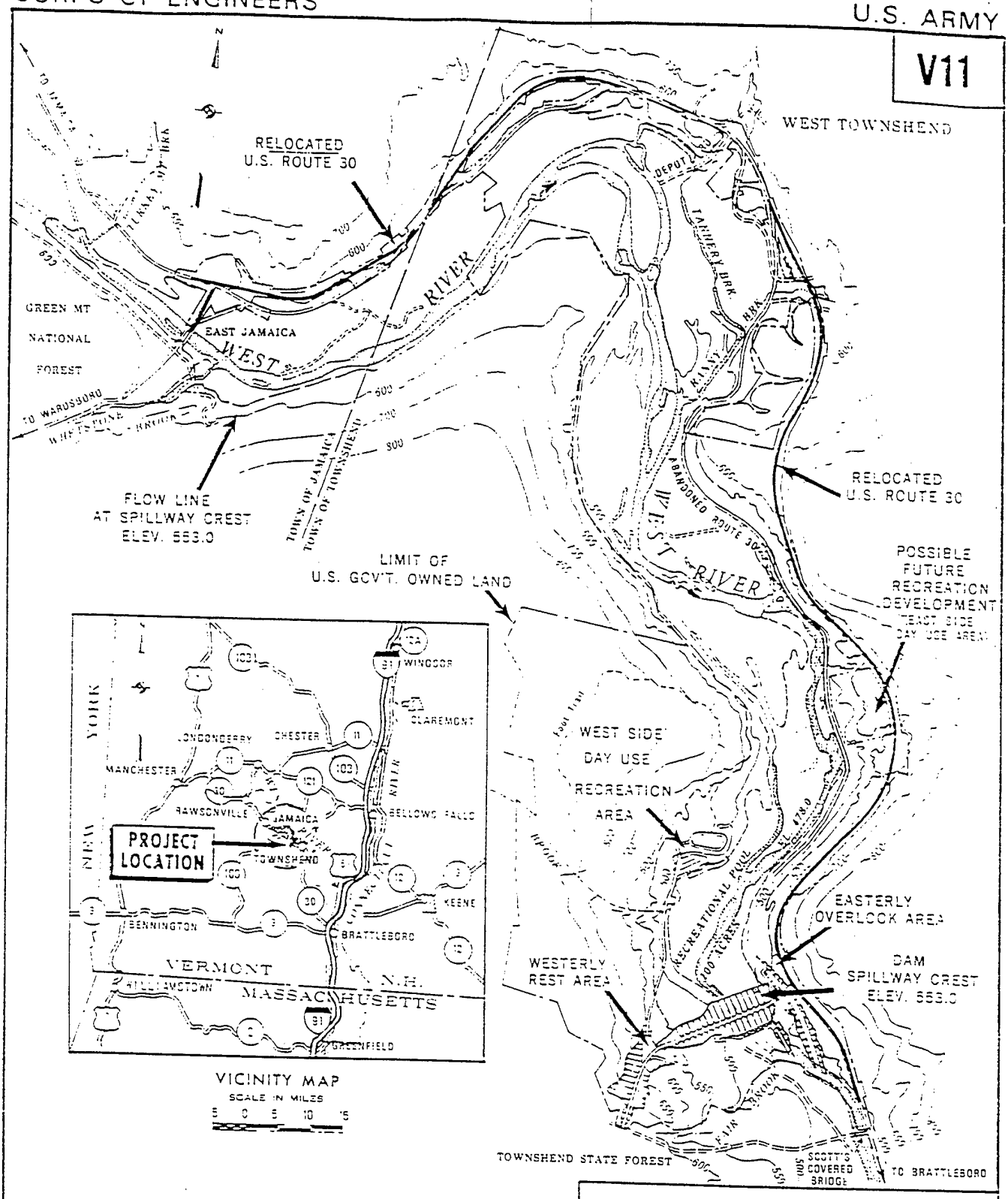
APPENDIX III

FIGURES

CORPS OF ENGINEERS

U.S. ARMY

V11



VICINITY MAP

SCALE IN MILES

5 0 5 10 15

CAPACITY OF
RES. = 33,600 A.F.

CONNECTICUT RIVER BASIN

TOWNSHEND LAKE

RESERVOIR MAP

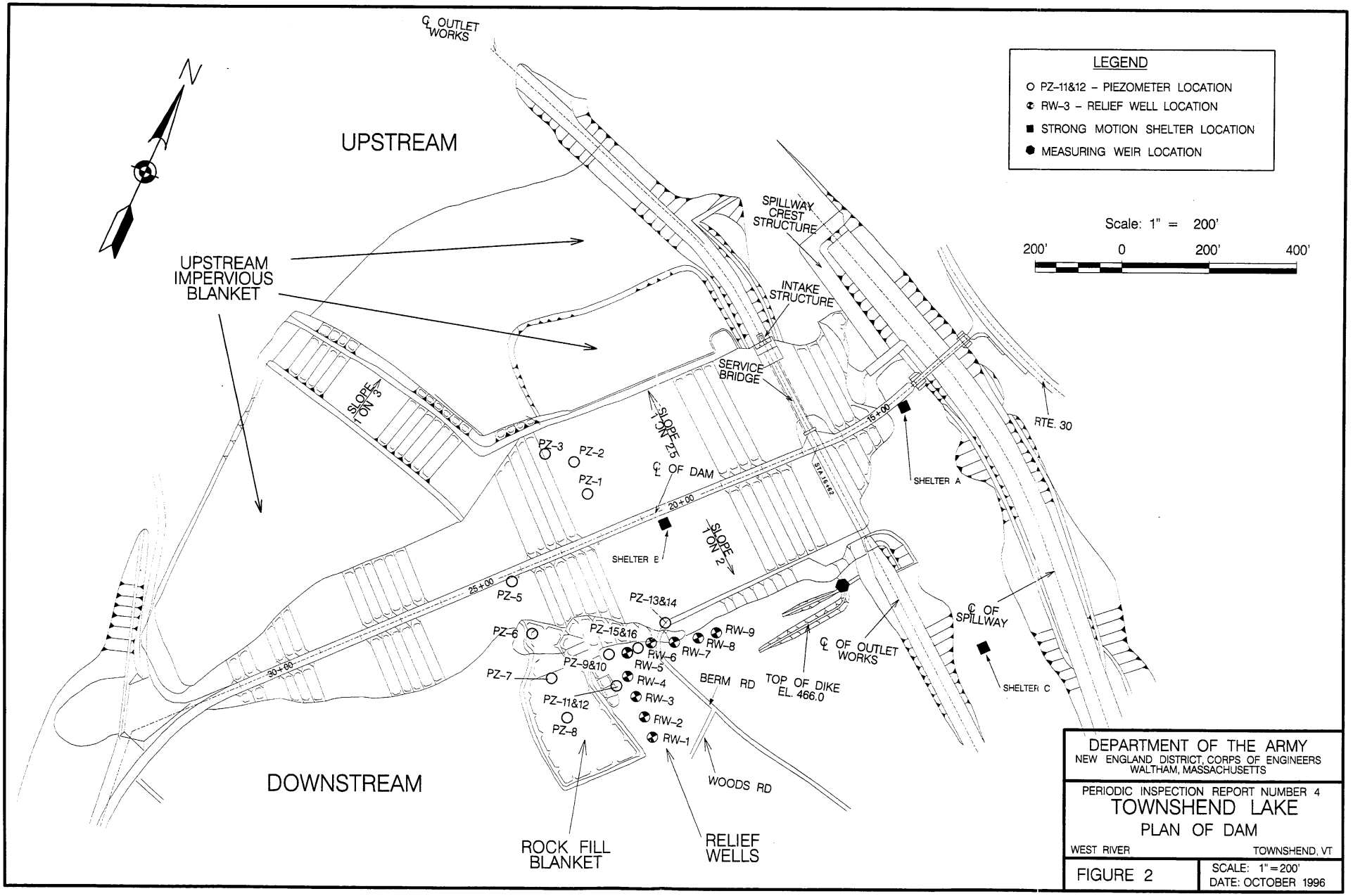
WEST RIVER VERMONT

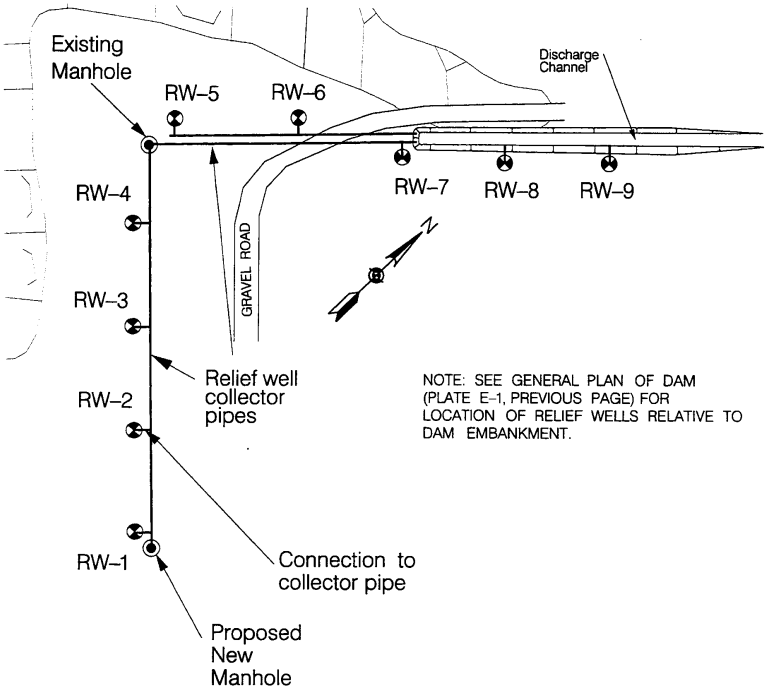
SCALE IN FEET

500 0 500 1000 1500

NEW ENGLAND DIVISION WALTHAM, MASS.

FIGURE 1

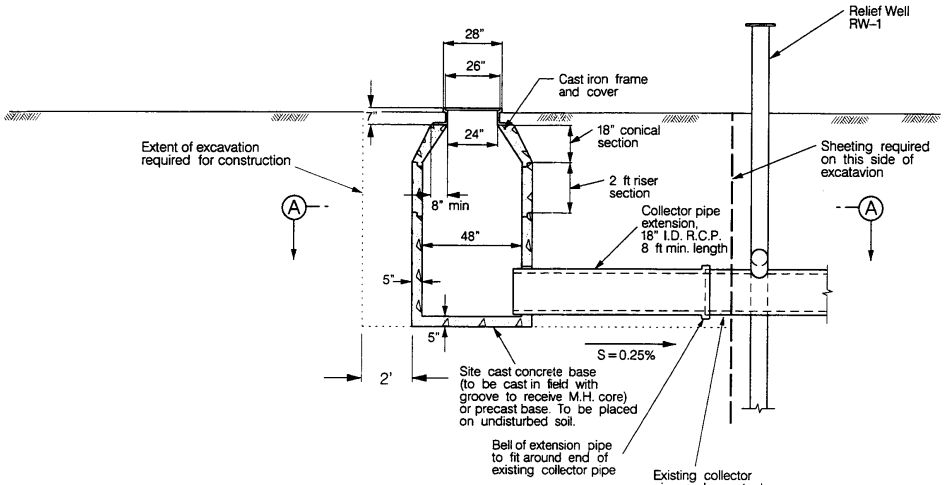

℄ OUTLET WORKS
UPSTREAM
UPSTREAM IMPERVIOUS BLANKET
SPILLWAY CREST STRUCTURE
INTAKE STRUCTURE
SERVICE BRIDGE
SLOPE 1 ON 3
SLOPE 1 ON 2.5
SLOPE 1 ON 2
℄ OF DAM
STA 15+82
15+00
20+00
25+00
30+00
PZ-1
PZ-2
PZ-3
PZ-5
PZ-6
PZ-7
PZ-8
PZ-9&10
PZ-11&12
PZ-13&14
PZ-15&16
RW-1
RW-2
RW-3
RW-4
RW-5
RW-6
RW-7
RW-8
RW-9
SHELTER A
SHELTER B
SHELTER C
RTE. 30
℄ OF SPILLWAY
℄ OF OUTLET WORKS
BERM RD
TOP OF DIKE EL. 466.0
WOODS RD
DOWNSTREAM
ROCK FILL BLANKET
RELIEF WELLS
LEGEND
PZ-11&12 – PIEZOMETER LOCATION
RW-3 – RELIEF WELL LOCATION
STRONG MOTION SHELTER LOCATION
MEASURING WEIR LOCATION
Scale: 1" = 200'
200' 0 200' 400'
DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS
PERIODIC INSPECTION REPORT NUMBER 4
TOWNSHEND LAKE
PLAN OF DAM
WEST RIVER
TOWNSHEND, VT
FIGURE 2
SCALE: 1" = 200'
DATE: OCTOBER 1996



PLAN VIEW

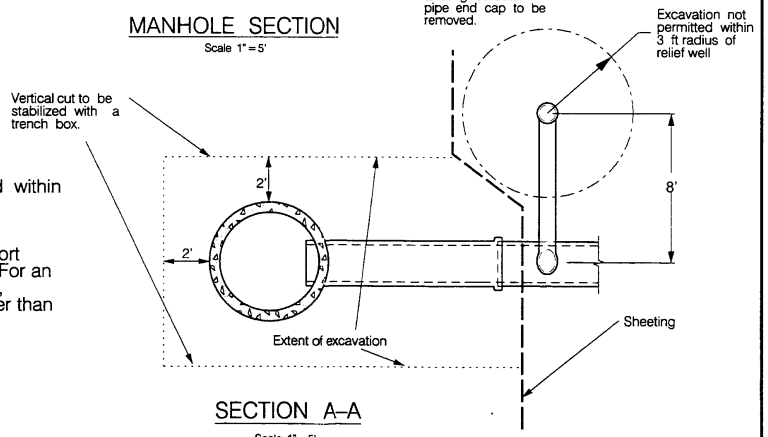
SCALE: 1" = 60'

NOTE: SEE GENERAL PLAN OF DAM (PLATE E–1, PREVIOUS PAGE) FOR LOCATION OF RELIEF WELLS RELATIVE TO DAM EMBANKMENT.



MANHOLE SECTION

Scale 1" = 5'

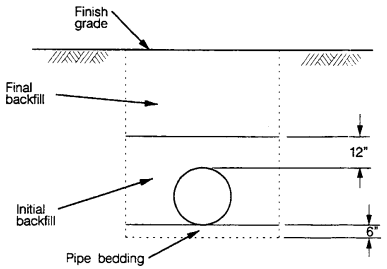


SECTION A–A

Scale 1" = 5'

NOTES

1. Excavation will not be permitted within a 3 ft radius of the relief well.
2. Vertical cut excavation must be braced with a proper earth support system such as a trench box. For an open cut unsupported excavation, side slopes should be no steeper than 1V:1.5H.



Typical Collector Pipe Trench Detail

N.T.S.

NEW MANHOLE DETAILS

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT, CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	
EWM DESIGN BY EWM DRAWN BY JCH CHECKED BY	PERIODIC INSPECTION REPORT NUMBER 4 TOWNSHEND LAKE RELIEF WELL MANHOLE INSTALLATION WEST RIVER TOWNSHEND, VT
FIGURE 3	SCALE: AS SHOWN DATE: OCTOBER 1996

APPENDIX IV

INSPECTION CHECKLISTS

TEAM MEMBER CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	**BY**	**CONDITION**
CONCRETE / STRUCTURAL	MW	
1. Spillway		
General condition of concrete		Good. Minor to moderate efflorescence on upstream and downstream faces.
Spalls		Few spalls on upstream face, and failed patches on crest.
Cracks		Random hairline cracks on crest.
Alignment of monoliths		Good.
2. Tower - Exterior		
General condition of concrete		Good. Minor efflorescence from beneath the lower balcony. Honeycomb on underside of stairs.
Spalls		Spalling on top of third landing of stairs.
Cracks		None.
3. Tower - Interior		
General condition of concrete		Very good.
Spalls		None.
Cracks		None.
Condition of roof		Very good.
4. Gate Wells		
General condition of concrete		Good.
Spalls		None.
Cracks	MW	None.

TEAM MEMBER CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	**BY**	**CONDITION**
CONCRETE / STRUCTURAL	MW	
General condition of Railings and Ladders		Good. Minor corrosion on lower level railings.
5. Service Gates		
General condition of service gates		Good.
6. Bulkhead Gates		
General condition of bulkhead gates		Good.
7. Log Boom		
General condition of log boom		Very good.
8. Inlet Weir & Trash Rack		
General condition of the concrete		Good. There is widespread abrasion on the walls of the inlet weir.
Spalls		None.
Cracks		None.
Alignment of monoliths		Good. 5/8" offset at intersection of west wall and tower.
9. Conduit		
General condition of the concrete		Good. Minor efflorescence at the roof joints, and abrasion along the lower one foot of wall.
Spalls		Two minor spalls at joint 12.
	MW	

TEAM MEMBER CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	**BY**	**CONDITION**
CONCRETE / STRUCTURAL	MW	
Cracks		None.
Joints		Joints are well aligned. There is minor deterioration at all of the joints.
9. Outlet		
General condition of the concrete		Good. Minor abrasion on the bottom 2 feet of the sidewalls and across the invert.
Spalls		None.
Cracks		None.
	MW	

TOWNSHEND LAKE 8 OCTOBER 1996

TEAM MEMBER'S CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	BY	CONDITION
MECHANICAL ITEMS		
a. Service Gates	KP	
(1) Service Gate 1		Structural condition and painted surfaces appear good. Moderate leakage, but not a concern. Lower sections of cable need grease. Limit switch properly set.
(2) Service Gate 2		Structural condition and painted surfaces appear good. Lower sections of cable need grease. Limit switch properly set.
(3) Service Gate 3		Structural condition and painted surfaces appear good. Moderate leakage, but not a concern. Lower sections of cable need grease. Excess slack in cable with gate in the closed position.
b. Air Vents & Embedded Steel	KP	Minor corrosion. Generally in good condition.
c. Bulkhead Gate	KP	Painted in 1993. Good Condition.
d. Emergency Generator	KP	Service gate 2 & lights operated from generator. Generator appears in good condition.
e. Heating System	KP	Warm Air Furnace replaced in 1995. Good Condition.
f. Overhead Crane	KP	Operates Satisfactorily.

TOWNSHEND LAKE

8 OCTOBER 1996

TEAM MEMBER'S CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	BY	CONDITION
g. Outside Jib Crane	KP	Operates Satisfactorily.
h. Bulkhead Gate Hoist	KP	Replaced in 1995. Good condition.
i. Float Well	KP	Operates Satisfactorily.

TEAM MEMBERS CHECKLIST FOR PERIODIC INSPECTION NO. 5		
AREA EVALUATED	**BY**	**CONDITION**
HYDROLOGY/HYDRAULICS		
Spillway	CS	
Approach		Clear
Control		Good
Exit		Clear
Outlet Works		
Inlet		
Log Boom		Good
Trash Bars		Good
Gates		Good
Air Vents		Good
Outlet		
Conduit		Good
Exit Channel		Good, clear
Instrumentation		
Rain Gage		Good
Pool Stage Recorder		Good
Tailwater Recorder		Good
Staff Gage		Good
	CS	

TOWNSHEND LAKE

TEAM MEMBERS CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	**BY**	**CONDITION**
GEOTECHNICAL	EWM	
DAM EMBANKMENT	JCH	
Crest Elevation	YY	583.0 feet NGVD
Surface Cracks		None.
Pavement Condition		Good. Minor shrinkage cracks were sealed in 1994.
Movement or Settlement of Crest		None observed.
Lateral Movement		None observed.
Vertical Alignment		Good.
Horizontal Alignment		Good.
Condition at Abutment and at Concrete Structures		Good.
Indications of Movement of Structural Items on Slope		None observed.
Trespassing on Slopes		Minor effects.
Sloughing or Erosion of Slopes or Abutments		Minor erosion.
Rock Slope Protection Riprap Failures		Good overall. Insignificant. Rock very durable.
Unusual Movement or Cracking at or Near Toes		None observed.
Unusual Embankment or Downstream Seepage		Clear seepage at point along downstream toe of embankment into measuring weir pool, 185 ft to right of outlet. Flow estimated at 5 to 10 gpm.
Piping or Boils		None observed.
Foundation Drainage Features		Nine relief wells at downstream toe appear to be functioning. Outlet channel is overgrown with vegetation. Large trees growing in close proximity to relief well RW-1.
Toe Drains		None.
Instrumentation System		15 Automated Casagrande-Type piezometers are in good condition. Seepage weir currently non-functional due to construction activities.

TOWNSHEND LAKE

TEAM MEMBERS CHECKLIST FOR PERIODIC INSPECTION NO. 4		
AREA EVALUATED	**BY**	**CONDITION**
GEOTECHNICAL DAM EMBANKMENT (cont'd.)	EWM JCH YY	
Vegetation or Debris		
Upstream Slope		Sparse brush on slope.
Crest		None.
Downstream Slope		Sparse brush on slope.
Toe		Heavy vegetation along portions of upstream and downstream toes.
Upstream impervious blanket		Well mowed, saplings and brush along edges.
SPILLWAY WEIR, APPROACH, AND DISCHARGE CHANNELS		
Approach Channel		
General Condition		Good.
Loose Rock Overhanging Channel		Stable rock face.
Floor of Approach Channel		Clear.
Discharge Channel		
General Condition		Good.
Loose Rock or Trees Overhanging Channel		Minimal. Minor rock falls.
Floor of Channel		Cleared to bedrock with sparse grass and saplings along edges.
Other Obstructions		None.
Condition of bridge abutments		Stable. Alligator cracking on left concrete roadway approach lip.
OUTLET WORKS		
Intake Channel		
Slope Conditions		Good.
Rock Slides or Falls		Minor.
Drains or Weep Holes		Working.
Outlet Channel		
Loose Rock or Trees Overhanging Channel		None.
Condition of Discharge Channel		Clear. Construction in progress to stabilize channel slopes.

APPENDIX V

SUMMARY OF INSPECTION NOTES

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
SUMMARY OF INSPECTION NOTES

TABLE OF CONTENTS

APPENDIX V-A

CONCRETE/STRUCTURAL FEATURES

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
CONCRETE/STRUCTURAL FEATURES

1. FIELD INSPECTION

The concrete/structural portion of Periodic Inspection No. 4 at Townshend Lake was performed on 8 October 1996 by Mr. Mike Walsh of Engineering Directorate. A visual inspection was performed on the following major project features:

- Spillway
- Control Tower
- Conduit
- Inlet and Outlet

2. SPILLWAY

The overall condition of the spillway is good. All of the monoliths are well aligned, with no signs of movement. The concrete on the upstream face of the spillway is in fair to good condition. There is minor to moderate joint deterioration with efflorescence along approximately 30% of the exposed horizontal construction joint (See Photo's A-1 and A-2). There are also a few minor spalled areas on the upstream face (See Photo A-3).

The concrete on the crest of the spillway is in fair condition. There is extensive random hairline cracking on the crest along the entire length of the spillway. There are 18 failed patches (30" x 30" by up to 6" deep) along the crest, one in each straight monolith and two in each corner monolith (See Photo A-4). These patches are located where rock anchors were installed to prevent uplift of the spillway.

The concrete on the downstream face of the spillway is in good condition (See Photo A-5). There is minor

efflorescence at a very few isolated locations, mostly at weep holes or construction joints.

3. OUTLET WORKS

a. Control Tower

(1) Exterior. The concrete of the exterior walls of the control tower is in very good condition, with no deterioration noted. The roofing is also in very good condition, with no deterioration noted.

The concrete of the exterior stairs is in fair condition. There is typical minor spalling and honeycomb underneath each length of stairs, mostly where the stairs come into the landings or the exterior tower wall. Typically the construction joints where the stair lengths come into the landings (as observed from beneath) have minor deterioration with efflorescence (See Photo A-6). There is moderate spalling on top of the third landing, numbered from the upstream control platform (See Photo A-7). The stair railings are typically in good condition. There are cracks in the curb along the stairs where the railing posts are anchored to the concrete.

The concrete of the upper balcony (at the equipment room level), the lower balcony (approximately 20 feet above the upstream control platform), and the upstream control platform is in good condition. There is minor efflorescence coming from where the lower balcony (cantilever) meets the exterior tower wall (See Photo A-8). The railings at the upstream control platform are generally loose and in fair to poor condition. The railing section which attaches to the northeast corner of the control tower has been damaged by debris and is torn away from its anchorage to the wall (See Photo A-9).

The bulkhead crane, which has a 5 ton capacity, appears to be in very good condition. The crane supports and monorail beam also appear to be in good condition. It

should be noted that the bulkhead crane system is designed to lift the bulkhead gates only under a balanced head. This means that the water on either side of the bulkhead gate (upstream and downstream) must be at the same level. Lifting of the bulkhead gates under an unbalanced head should not be attempted. A system or procedure needs to be developed to aid field personnel in determining when a balanced head condition has been achieved, prior to attempting removal of the bulkhead gates.

(2) Interior Levels. The concrete of the interior of the control tower (the equipment room) is in very good condition, with no cracks or spalls noted.

(3) Gate Wells. The concrete of gate wells 1, 2, and 3 (numbered west to east) is good, with no cracks or spalls noted. There is a short length of exposed reinforcement at the equipment room floor access hatch to gate well No. 2 (See Photo A-10). This condition appears to be due to insufficient cover. All of the ladders and railings in each of the gate wells are in good condition and securely anchored to the concrete. There is minor rusting of the steel railings at the three lowest landings in gate well No. 2, and only at the lowest landing in gate wells 1 and 3 (See Photo A-11). The gate guides in all three gate wells are in very good condition.

b. Gates

(1) Service Gates. All 3 service gates are in good condition. (See Photo's A-12 and A-13)

(2) Bulkhead Gates. The bulkhead gates were not fully inspected because they could not be raised out from in front of gate No. 3. (This was due to an unbalanced head against the bulkhead gates.) The downstream face of the bulkhead gates could be inspected, however, and are in good condition. The dogging devices used to support the bulkhead gates (when not in service) are in poor condition. A number of the anchor bolts and nuts are heavily corroded.

c. Approach Channel

(1) Log Boom. The log boom is in good condition with no deficiencies noted.

(2) Inlet Weir and Trash Rack. Both the inlet weir and the trash rack are in good condition (See Photo A-14). There is widespread minor abrasion of the concrete walls in the inlet weir. The floor of the inlet weir could not be inspected because water was being retained within the inlet weir structure to serve as a receiving pool for fish passing over the weir. There are two very large trees/limbs which are hung up on the trash rack and the gate which maintains the receiving pool in the inlet weir. The approach wall at Sta. 14+27.67 is offset 5/8" at the contract joint. This condition has not changed from the previous two inspections.

d. Conduit

(1) Gate Barrels. The concrete of the three gate barrels is in good condition. There is minor efflorescence at the roof joints of all three gate barrels. There is minor abrasion on the bottom 3 feet of the concrete walls of gate barrels 1 and 2. The embedded steel at the gate guides for all three gates is in good condition with only minor corrosion noted. There is a missing length of steel angle at the east upstream guide for gate 2. This missing guide is not of concern.

(2) Transition. The concrete of the transition is in good condition. There is minor abrasion on the bottom 3 feet of the concrete walls of the transition.

(3) Conduit. The concrete of the conduit is in good condition. There is minor abrasion on the bottom foot of the concrete walls and across the invert of the conduit for its entire length. There is minor joint deterioration at all of the joints between monoliths of the conduit. There are two small spalls at the bottom of the sidewalls of

joint 12 (numbered from the transition). There is some minor seepage with efflorescence from the roof joint at joint 5.

e. Stilling Basin and Exit Channel. The concrete of the outlet portal, outlet sidewalls, and outlet apron is in good condition. There is minor abrasion on the bottom 2 to 3 feet of the outlet sidewalls, and across the entire outlet apron (See Photo A-15).

4 RECOMMENDATIONS

a. Project Safety Items. There are no safety related concrete/structural deficiencies noted.

b. Normal Maintenance. The overall condition of the project is good. The deficiencies noted are not of a critical nature and do not affect the operation or structural integrity of the project at this time. The following maintenance items are recommended:

(1) Repair the failed patches on the crest of the spillway, as well as the minor concrete deterioration on the upstream face of the spillway - $30,000 construction cost, and $7,000 E&D.

(2) Replace/repair the anchor bolts for the bulkhead dogging devices - $8,000 construction cost, and $3,000 E&D.

(3) Replace/repair the railings at the upstream control platform - $10,000 construction cost, and $5,000 E&D.

(4) Develop a procedure to aid field personnel in determining when a balanced head condition has been achieved prior to removing the bulkhead gates.

APPENDIX V-B

MECHANICAL FEATURES

APPENDIX V-B

MECHANICAL

1. FIELD INSPECTION

The mechanical portion of Periodic Inspection No. 4 at Townshend Lake was performed on 8 October 1996 by Mr. Kenneth Paton of Engineering Directorate.

2. OUTLET WORKS

a. Service Gates The service gates were inspected from within the transition of the outlet conduit, and from the bottom of the gate wells in the control tower. The inspection team entered the outlet conduit by taking a boat up the outlet channel and stepping onto the concrete shelf at the end of the conduit. The pool was below the weir in front of service gate 2 and the emergency gate had been placed upstream of service gate 3 to reduce leakage flow in the conduit. This permitted the inspection team to walk up the conduit without difficulty. Prior to placing the emergency gate upstream of gate 3, flow in the conduit was at approximately 40 cfs and would have prevented the inspection team from gaining access. Significant rates of gate leakage have been documented back as far as October 1981 and were noted in Periodic Inspections 1, 2 and 3. The leakage is almost entirely through the bottom of the gates and is a result of the hydrostatic pressure holding the gates slightly above the invert. The service gates travel on rollers riding on bearing plates above 6 inches from the invert and don't encounter any difficulty in moving. Frictional forces on the service gate rubber seals increase during the last 6 inches of travel due to the tapered seal bearing plates. A service gate will not lower any further when the frictional forces, caused by hydrostatic pressure, equal the weight of the gate. Gates 1 and 3 are estimated to remain open approximately 1-inch and 3-inches respectively when attempting to fully close the gates.

(1) Service Gate 1 The downstream side of the gate was inspected from within the transition while in the closed position. Structural condition and painted surfaces of the gate appeared to be in good condition. Gate 1 could not be opened because there is only one bulkhead gate at Townshend Lake, and it was installed upstream of gate 3. Moderate leakage was noted at gate 1, but is consider typical for a gate of this size. Gate 1 could only be raised

approximately 6 inches, due to downstream construction, for inspection from the gate well. The pool side of Gate 1 was not fully inspected. Service gate 1 hoist was operated and appeared to be in satisfactory condition. The gate cables appeared to be in good condition, except that the lower sections required grease. A proper amount of slack was observed in the cable while gate 1 was in the closed position.

(2) Service Gate 2 The downstream and pool sides of the gate were both inspected from within the transition because the pool was below the weir resulting in a no flow condition. Structural condition and painted surfaces of the gate appeared to be in good condition. Minor damage to lower gate painted areas on the pool side of gate 2 was noted. The damage is probably the result of debris hitting the gate. Service gate 2 hoist was operated and appeared to be in satisfactory condition. The gate cables appeared to be in good condition, except that the lower sections required grease. A proper amount of slack was observed in the cable while gate 2 was in the closed position.

(3) Service Gate 3 The downstream side of the gate was inspected from within the transition while in the closed position. Structural condition and painted surfaces of the gate appeared to be in good condition. Moderate leakage was noted at gate 3, but is consider typical for a gate of this size. Service gate 3 was opened to approximately five feet above the invert to allow the water trapped between the bulkhead gate and gate 3 to flow out. Gate 3 was then closed without the effect of hydrostatic pressure. Leakage through the bulkhead gate then filled in the area between the two gates. Service gate 3 obtain close to a perfect seal after being lowered without hydrostatic pressure. This procedure was also shown effective during Periodic Inspection No. 3 as a closure method to eliminate leakage at gate 3. Service gate 3 hoist was operated and appeared to be in satisfactory condition. The gate cables appeared to be in good condition, except that the lower sections required grease. An excessive amount of slack was observed in the cable while gate 3 was in the closed position.

b. Air Vents and Embedded Steel Moderate corrosion was observed at the air vents and embedded steel. Air vents were clear of any debris.

c. Bulkhead Gate The bulkhead gate was inserted upstream of service gate 3 to reduce leakage and permit the inspection team to gain access into the outlet conduit. The gate was repainted in 1993 and is in good condition.

d. Emergency Generator The generator was started and operated until the engine oil pressure and temperature readings stabilized. Power was manually transferred from commercial to generator power. Service gate 2 and the control tower lights were operated on emergency power. The emergency generator appears to be in good condition and operation was satisfactory.

e. Heating System A new oil fired warm-air furnace was installed in the control tower in 1995 and is in good condition.

f. Overhead Crane The crane was inspected and appears to be in good condition.

g. Outside Jib Crane Crane is used to lower the bulkhead gate hoist from the control tower to the monorail. Condition of the crane is satisfactory.

h. Bulkhead Gate Hoist The bulkhead gate hoist is used to install the bulkhead gate on the pool side of the service gates for maintenance activities. A new electric hoist was purchased in 1995 and replaced an air operated hoist. The bulkhead gate hoist is designed to install and remove the gate under a balanced head of within two feet. The hoist is in good condition and operates satisfactorily.

i. Float Well Operation of the float well is satisfactory. The Project Manager indicated that the float well freezes at temperatures approaching zero degrees F, but the well is fairly easily thawed out by lowering a heat lamp into it.

3. RECOMMENDATIONS

a. Dam Safety Items (No mechanical items)

b. Normal Maintenance

(1) Recommend that project personnel continue to annually lubricate the service gate hoist cables.

(2) Recommend that Operations Directorate issue a Purchase Order Contract to adjust the hoist limit switch on service gate 3. Estimated cost is $600.00.

(3) No recommendation is made to alter service gate 3 in any way to make the gate leaf close tight to the invert. Tight closure is not required for flood control, therefor the existing gate leakage is not considered

critical. Project personnel should be aware that tight closure of service gate 3 can be obtained by using the procedure described below, in which the gate is lowered in "the dry". The procedure can only be used when the pool is below the height of the bulkhead gate.

(a) Install the bulkhead gate while service gate 3 is in the closed position.

(b) Raise service gate 3 to drain water between the service and bulkhead gates. This will put gate 3 in "the dry" and remove the hydrostatic pressure exerted by the pool.

(c) Lower service gate 3 into the fully closed position by allowing the hoist to shut off on the limit switch.

(d) Remove the bulkhead gate after the area between the service and bulkhead gates has filled in with water leaking through the bulkhead gate. The bulkhead gate hoist is only designed to lift the bulkhead gate under a balanced head in which the water level on both sides of the gate is approximately equal.

APPENDIX V-C

ELECTRICAL FEATURES

APPENDIX V-C
ELECTRICAL

1. FIELD INSPECTION

The electrical portion of Periodic Inspection No. 4 at Townshend Lake Dam was performed on 8 October 1996 by Mr. Frank Turner, Electrical Engineer, of Engineering Directorate. This inspection covered the three gate motors and their controls, cranes, power distribution, emergency generator, lighting, and lightning protection.

2. OUTLET WORKS

a. Service Gates. The gate motors, brakes, and controls tested satisfactorily. Some of the indicator lights did not function due to burned-out or missing lamps. Open limit switches for gates #1 and #3 were not tested because the gates were not allowed to be fully opened as this would create too great a flow downstream.

b. Cranes. All three cranes were checked and operated properly but the new 5HP unit used to raise the emergency bulkhead did not have enough power to overcome the water pressure created friction. (Emergency bulkhead is designed to be installed and removed under balanced head condition.)

c. Power Distribution. All the power problems listed in Periodic Inspection Report No. 3 are still present. These include: a melted transformer, improperly connected devices, oversized circuit breaker, and missing indicator lamps.

d. Emergency Generator. The generator was tested and run under a very light load.

(1) Meters. The frequency meter mounted on the generator was sticky. The digital frequency meter mounted on the control panel did not read anything.

(2) Transfer Switch. The switch used to transfer to the generator could not be operated because the key for the "Kirk Key Interlock" was stuck. The key mechanism was removed by me for testing.

(3) Test Switch. The generator has a test switch which removes the ground from the generator neutral. It was found open despite the red warning label "DO NOT TOUCH". If there was a short circuit to ground, the circuit breaker would not operate with this switch open.

(4) Testing and Preventative Maintenance. The generator was run a total of 7.7 hours in the last 5 years.

e. Lighting. All the lights in the center gate well were out, along with many others inside and outside of the gate tower.

f. Lightning Protection. This system is in good condition.

3. UNIQUE PROJECT FEATURES

Raising the gates with a cable-pulley system makes this dam somewhat unique, compared to most of our other projects. There are indicators for such things as: "slack rope", "overtravel upper inch," and negative current flow which need to be understood by all the project personnel. There is no operating manual describing how to respond to these indicators.

4. RECOMMENDATIONS

a. Dam Safety Items. The fact that no electrical repairs were made during the last 5+ years, except for the replacement of one control relay, forces me to list this recommendation as a Dam Safety Item instead of Normal Maintenance.

(1) Hire an electrician to take care of past recommendation.

(2) Appropriate $1500 for the electrical engineer to work with the electrician.

(3) Update the Operations manual to cover all aspects of normal and emergency operation of the gates.

b. Normal Maintenance

(1) Project manager must replace all burned-out light bulbs and indicator lamps within 10 days of this inspection.

(2) Project manager should lubricate the "Kirk Key" locks with WD-40. Should this treatment fail to free up the key, remove both locks and take the set to a locksmith.

c. Past Recommendations. None of the recommendations from Periodic Inspection Report No. 3 were done and are included again in the recommendations for this inspection.

Periodic Inspection Electrical Data Sheet
Townshend Lake
8 October 1996

1. Gate Motor Current (AC Amperes) Raising Gates Only

	Ratio	A Phase	B Phase	C Phase	Ave
*Motor #1	10.5				
Motor #2	10.5	6.6	6.7	7.6	7.0
Motor #3	10.5	6.9	6.6	7.5	7.0

2. Insulation Test (Megohoms @ 500 VDC)

Motor #1	10)	
Motor #2	10)	
Motor #3	5)	5 Times Better than 5 years ago
Crane	3	
Generator	40	

3. Generator Test

OHNAN Model 0649T

A. Running time before start of testing, 60.0 hours, stopped at 60.4 hours.

B. With load of 11, 6 & 12 amps voltage measured 483, 483, 481.

C. Frequency 60.36 HZ

D. Two batteries measured 12.6 VDC each no load and 21 V total at starting. Generator output 28 VDC.

E. Specific gravity - No Hygrometer

F. Run 7.7 hours in 5 years

G. Sticky frequency meter, off with RPM meter.

*Could not open enough for good readings.

APPENDIX V-D

HYDROLOGY/HYDRAULIC

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
HYDROLOGIC/HYDRAULICS

1. FIELD INSPECTION

The hydrology and hydraulic features of Townshend Lake were performed on 8 October 1996 by Carmen Suarez of the Water Management Section, Engineering Division. Major features inspected include the spillway, outlet and inlet works, and hydrologic monitoring equipment. Past operating experiences were also reviewed.

2. SPILLWAY

a. Approach. The overall condition of the approach channel is good with no major obstructions. See Photo D-1 Appendix II.

b. Control. The concrete spillway weir is in good condition. Minor spalls were noticed along the weir. Refer to Appendix V-A, Structural Features, for detailed information on condition and severity of spalls.

d. Exit. The spillway exit channel is in good condition with no major outgrowth of trees or vegetation which may obstruct the flow. See photo D-2, Appendix II.

3. OUTLET WORKS

a. Approach

(1) Inlet Channel. The inlet channel is in good condition with no major obstruction. See photo D-4, Appendix II.

(2) Control Weir. The control weir is in good condition.

(3) Trashracks. The trashracks are in good condition. Two large tree trunks were jammed in the racks during the inspection. The trunks will be removed by project personnel.

b. Conduit The outlet conduit was fully inspected and from the hydraulic point of view appears to be in good condition. No indication of hydraulic phenomena was observed.

c. Exit Channel. The exit channel was in good condition. Construction to repair a scour hole and outlet channel slopes was being conducted during the periodic inspection. See photo D-7, Appendix II.

d. Seepage Weir. The seepage pool and weir were under construction during the periodic inspection. See photo D-5, Appendix II.

4. PROJECT INSTRUMENTATION

a. Rain Gage. The rain gages located at the project are in good condition.

b. Staff Gages. Gages are in good condition.

c. Pool Stage Recorder. The mechanical pool stage recorder was replaced with a digital Sutron 8200A Data Collection Unit and shaft encoder in June 1994. The unit is in good condition. At the time of inspection, the pool level was 20.4 feet (Elevation 477.4 ft-NGVD).

d. Tailwater Gage. A new tailwater gage was installed in the west side of the channel upstream of the fish passage 2 years ago. In addition to it, continuous discharge records from Townshend Lake are obtained from the USGS gage station located approximately 30 feet downstream of the project. At the time of inspection the reservoir stage was 20.4 feet indicating a discharge of 34 cfs.

5. RECOMMENDATIONS

a. Dam Safety Items. There are no safety recommendations.

b. Normal Maintenance. There are no hydrologic/-hydraulic recommendations.

APPENDIX V-E

GEOTECHNICAL

PERIODIC INSPECTION NO. 4
TOWNSHEND LAKE
GEOTECHNICAL FEATURES

1. FIELD INSPECTION

Based upon the visual inspection performed on 10 October 1996, the geotechnical features of Townshend Lake are in good condition. Major features inspected include the upstream toe and slope, the crest, the downstream slope and toe, access roads, outlet works, the spillway and its channels, abutments, and all rock walls within the project limits. The geotechnical portion of this fourth periodic inspection was performed by:

Erik W. Matthews, Civil Engineer, Geotechnical Eng. Sect.
John C. Hart, Civil Engineer, Geotechnical Eng. Sect.
Yuri Yatsevitch, Geologist, Env. Eng. & Geol. Sect.

On 10 October 1996, water was flowing through the outlet works and the pool was impounded at El. 480.4[1] (23.4 ft stage). The maximum impoundment since the last inspection occurred in April 1996. During this event, the reservoir reached a peak stage of 68.0 ft (El. 525.0, 43% full).

The geotechnical inspection checklist for the periodic inspection is included in Appendix IV. Photographs taken during the inspection are included in Appendix II.

2. REMEDIAL WORK

Townshend Dam has a history of seepage problems, including piping and boils, along the downstream toe. Two separate remedial repair projects were constructed to correct these deficiencies, as shown on Figure 2 and summarized below:

a. Remedial measures completed in 1970 include extending and thickening the upstream impervious blanket (Photo E-1), construction of downstream graded rock filters, a concrete seepage measuring weir with an earth fill dike, and a piezometer through the upstream impervious blanket.

b. Remedial measures completed in 1985 consist of a system of nine relief wells installed along the downstream toe of the embankment and right[2] terrace slope, an extension

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[1] All elevations are in feet, NGVD unless otherwise noted.

[2] "Right" and "left" as used herein are as the reader looks downstream.

of the concrete wall adjacent to the seepage measuring weir, additional stone protection along the seepage containment dike, and dredging of the seepage pool (Photo E-2).

c. In addition, a third remedial project is currently underway to stabilize the banks of the outlet channel, which have had a history of instability. A contract was awarded in FY 1996 to protect the banks and portal from erosion. The remedial design consisted of:

(1) post and panel barriers along both sides of the channel for erosion protection, with stone slope protection above the barrier on the left side of the channel.

(2) replacing the derrick stone slope protection along 30 ft of the left bank next to the portal with a concrete wall.

(3) protecting the exposed submerged toe of the portal with mass tremie fill concrete.

This remedial repair work was in progress on the day of the periodic inspection (Photo E-13).

3. EMBANKMENT

No indications of settlement, lateral movement, or sloughing of slopes were noted during visual inspection of the dam embankment and abutment areas. There is no indication of horizontal or vertical movement of the dam.

a. Crest. The crest of the dam is generally in good condition and appears to be stable, with good horizontal and vertical alignment. The cable and timber guardrails are in good to fair condition, with some posts showing signs of deterioration and weathering. Some posts appeared to be out of alignment (Photo E-3), but this was likely due to snow plowing during the winter. The 20-ft wide bituminous paved access road along the crest of the dam is in good condition. Intermittent shrinkage cracks in the pavement were sealed in 1994.

b. Upstream Slope. The schistose rock fill slope is in good condition and appears stable with no evidence of moving or sloughing (Photo E-4). Sparse brush growth is evident across the entire upstream slope of the embankment.

c. Upstream Impervious Blanket. The lower level of the impervious blanket appears to be generally well mowed and clear, but has heavier brush and saplings growing along the edges (see Photos E-1 and E-5). There is some sparse brush growth through the riprap on the terrace slope. The upper

level of the impervious blanket, which extends west from the top of the terrace slope, is well mowed and clear, but has some brush growth and a few saplings growing along the edges (Photo E-6).

d. Downstream Slope. The schistose rock fill slope is in good condition and appears stable (Photo E-7). The stone on the slope is in good condition. Sparse brush growth was observed on the slope. Heavy brush and large trees are growing about 10 feet away from the toe of the downstream slope above the rock fill blanket (Photo E-8).

e. Seepage. On the day of the inspection, flow of about 5 to 10 gpm was observed emerging from a point along the toe of the downstream slope, within the measuring weir pool (Photos E-9 and E-10). This seepage area was located approximately 185 ft to the right of the outlet works. The seepage was clear, with no evidence of fines. There was no subsidence or movement of the rock fill slope immediately above the seepage area. This seepage does not appear to be a problem at this time.

f. Relief Wells.

(1) General. At the time of the inspection, no flow was observed from the outlet ends of the collector pipes. The existing manhole structure and collector pipe downstream of the manhole were visually inspected using a high powered flashlight, and were found to be clean and in good condition. It was not possible to visually inspect the collector pipe more than 50 ft upstream of the manhole, as the light from the flashlight would not penetrate further than that. Several large trees were growing within a 10 ft radius of relief well RW-1 (Photo E-2). There was heavy brush growth in the relief well discharge channel (Photo E-11). Additional discussion regarding the relief wells is included in the Instrumentation Appendix.

(2) Reading Schedule. During periods when the reservoir level is below the 26-foot stage (EL. 485), relief well readings should be made by project personnel at least once a month. When access is made hazardous by snow or ice, the readings may be deferred until safe access is possible. When the reservoir level is above the 26-foot stage, readings should be made on a daily basis. Pool elevations should be recorded simultaneously with relief well readings. If unusual changes in readings develop, the Geotechnical Engineering Section should be contacted.

(3) Measuring Weir Pool. The water in the measuring weir pool was clear, and a reddish iron precipitate covered the bottom of the pool. The measuring weir pool was clear of vegetation (Photo E-10).

4. OUTLET WORKS

a. Intake Channel. The intake channel is in good condition. The rock of the left wall is jointed, but appears stable without signs of significant potential failures (Photo E-12).

b. Outlet Channel. The channel is clear. There have historically been erosion and slope failures along both banks of the channel. A detailed discussion of these problems can be found in the Geotechnical Appendix of Periodic Inspection Report No. 3. In addition, a 120-ft wide, 13-ft deep scour hole had formed in the outlet channel approximately 140 feet downstream of the outlet works due to high velocity discharges during periods of high water. On the day of the inspection, construction of remedial repairs to stabilize the banks of the outlet channel was in progress (Photo E-13).

c. Concrete Abutment of Service Bridge to Intake Tower. The abutments and piers are in good condition and appear to be stable. A 1972 bridge inspection noted excessive rotation of the rocker-type shoes on the bridge pier and abutment, caused by movement of the concrete abutment of the bridge (founded on the upstream gravel and rock fill slope of the dam). Remedial work to recenter and replace the expansion shoes was accomplished in 1973. Geotechnical Engineering Section has been monitoring the bridge and abutment for indications of further movement since 1986. The distances from the ends of the east and west girders to the concrete back wall on the upstream dam embankment are measured at the top and bottom of each girder. The opening between the sliding plates of the expansion joint at this point is also measured. The table below shows all measurements taken to date.

Date	Temp.	East Side Girder		West Side Girder		Expansion Plate Separation (in)
		Top (inches)	Bottom (inches)	Top (inches)	Bottom (inches)	
10/22/86	73° F	10.75	17.38	10.75	16.75	2.38
10/10/91	62° F	-----	17.50	----	17.00	----
10/10/96	65° F	11.00	17.75	10.88	17.00	2.50

The record drawings do not specify a spacing tolerance between the girders and the concrete back wall, so the measurements

taken at these locations can only be compared with previous measurements. The east and west girder spacings measured over the last ten years show a very slight increase, but this is not a cause for concern. According to the record drawing (CT-1-5355), the expansion joint should be 3± inches wide at 50° F. These measurements should be repeated during the next periodic inspection.

5. SPILLWAY

a. Approach. The spillway approach is clear and in good condition (Photo E-14).

b. Discharge Channel. The channel is mostly clear. Only minor rock falls have occurred from the channel walls. A spillway discharge occurred in April 1987, and the spillway channel was cleaned to bedrock (Photos E-14 and E-15). There are trees along the channel sides but there are no significant obstructions.

c. Abutments of Spillway Access Bridge. The one lane bridge has a steel grid deck. There is no indication of movement of the concrete abutments. Alligator cracking which has occurred in the concrete roadway approach lip at the left abutment (Photo E-16) is apparently a result of deterioration of the concrete surface rather than an indication of movement of the abutment. A safety fence at the east abutment of the bridge has been damaged. The exposed rock at the abutments is overall in good condition. The nearly vertical orientation is favorably oriented transverse to the channel (Photo E-17). There are some individual detached rock blocks on the surface which could fail. No potential massive rock falls are evident.

6. INSTRUMENTATION

Instrumentation to monitor embankment performance at Townshend Lake consists of fifteen open-type piezometers, a seepage measuring weir, ten crest survey monuments, and three strong motion accelerographs (Figure 2). A complete discussion of the geotechnical instrumentation, interpretation, and evaluation of data is contained in the Instrumentation Appendix of this report.

a. Strong Motion Accelerographs. Three strong motion accelerographs were installed in 1979, one on the crest, one downstream, and one at the left abutment of the dam (Figure 2). The instruments are serviced twice a year by Waterways Experiment Station (WES) personnel, and are currently in good condition. Strong motion data are on file at WES and in the Geotechnical Engineering Section.

b. Piezometers. Fifteen open-type piezometers were installed in 1987 and are all operable. The piezometer riser pipes are 3/4" ID PVC SCH 80 pipe. An automated system to read piezometers and pool stage on a daily basis was installed in 1993.

c. Seepage Measuring Weir. The weir is currently not operational due to construction activities in the outlet channel. The weir is scheduled to be replaced in conjunction with the repair of the scour hole. When operational, the weir is read daily by the automated data collection system along with the piezometers and pool stage.

d. Crest Monuments. The ten crest monuments are located along the downstream edge of the crest of the dam and are in good condition. These monuments are surveyed by NED Survey Unit for movement every 5 years. The results of these surveys are presented in the Instrumentation Appendix.

7. CONCLUSIONS

Based on visual observations, Townshend Dam is in good condition. The dam has performed satisfactorily during periods of high water. The upstream impervious blanket is mostly clear and well mowed, except for brush and some small saplings at the edges of the blanket. The instrumentation system is functional.

8. RECOMMENDATIONS

a. Dam Safety.

(1) Scour Hole Surveillance. Funds in the amount of $15,000 should be programmed for FY99 for GED to continue hydrographic surveys of the scour hole area in the outlet channel. This baseline survey will define the extent of the scour hole relative to the toe of the left bank slope protection and proximity to the fish trap, in order to monitor the area for future erosion. This survey should use the same grid system used in the 1989 and 1990 hydrographic surveys.

(2) Relief Well Manhole. A manhole should be installed at the upstream end of the relief well collector pipe in order to facilitate future inspections and cleaning of the relief well system. Figure 3 shows a conceptual design. Excavation will not be allowed within a 3-ft radius of the relief well, to avoid disturbance to the filters around the well screen. GED will finalize the manhole design, prepare a purchase order, and provide full time inspection during installation. Estimated design cost is $2,000, and estimated construction cost is $5,000. This work should be performed in FY99.

b. Normal Maintenance Items.

(1) Clear brush and saplings along the edges of the impervious blanket and on the rip rapped terrace slope.

(2) Clear all brush and trees within 15 feet of the upstream and downstream toes of the dam and remove stumps. The relief well outlet channel should be cleared of heavy brush growth and trees. Large trees within a 15 ft radius of relief well RW-1 should be cleared and stumps removed.

(3) Repair the safety fence at left abutment of spillway bridge.

APPENDIX VI

SUPPLEMENTAL INSPECTIONS AND TRIP REPORTS

INTERMEDIATE INSPECTION
TOWNSHEND DAM
EVALUATION OF DEWATERING BULKHEADS

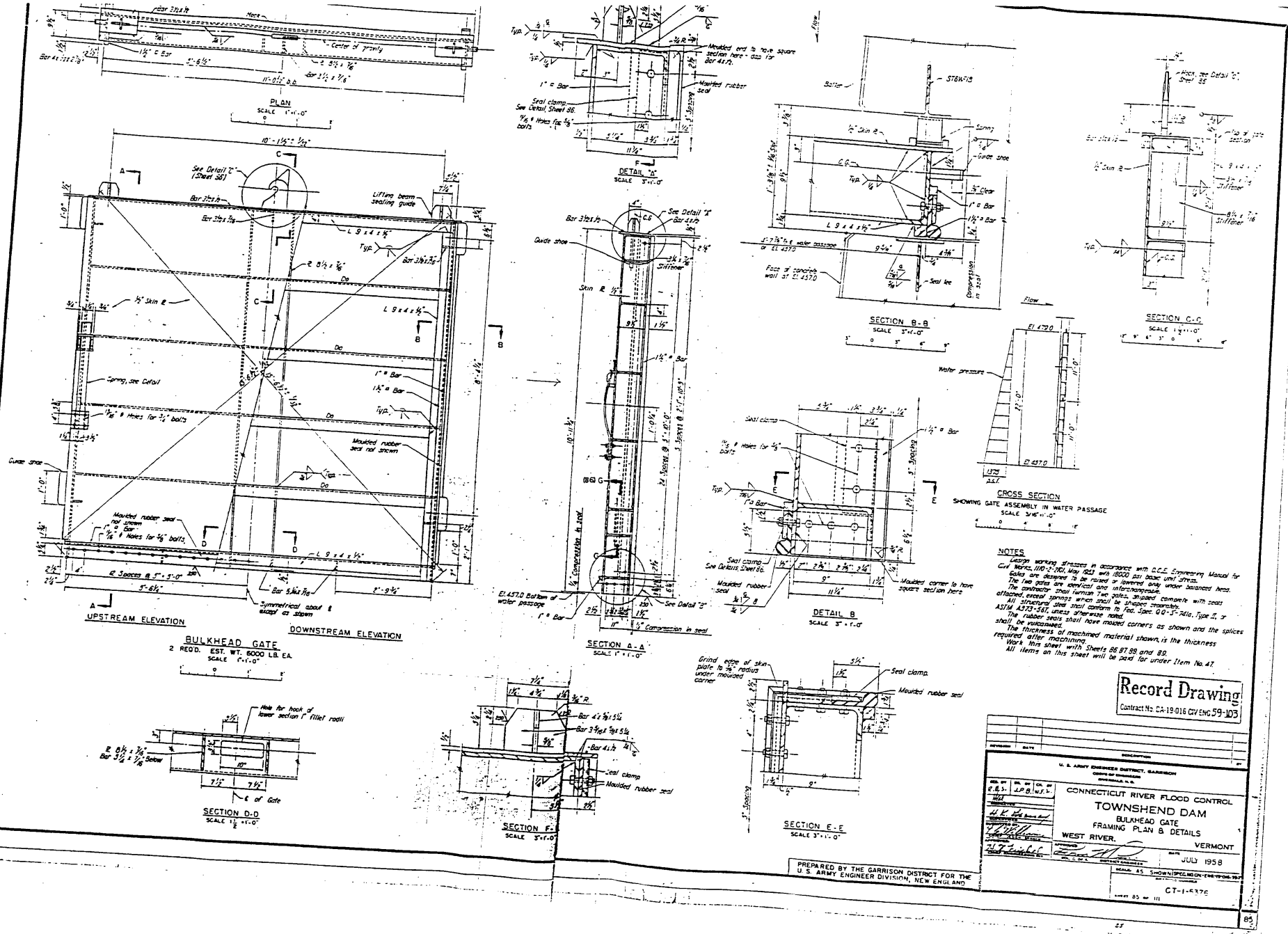
1. PURPOSE: The purpose of this intermediate inspection was to determine the condition of existing bulkheads in response to CECW-O/CECW-E memorandum dated 17 July 1995, subject "Inspection and Evaluation of Dewatering Stoplogs and Bulkheads".

2. FIELD INSPECTION: Dewatering bulkheads were inspected on 6 August 1996 by Laureen Borochaner and Jennifer Lee of Engineering Directorate. Project manager, Phil Morrison, participated in the inspection.

3. DISCUSSION: Townshend has two bulkhead gates and a single hook lifting beam, which are stored in the emergency gate wells located at the exterior upstream control platform. The 6000 pound gates are identical in design and are stacked vertically in the gate slot during use. The lifting hook of the bottom gate recesses into a hole in the bottom plate of the top gate. The gates, not including lifting hooks and guide wheels, are 10'-11 3/4" tall by 11'-5 1/2" wide (photo 1). The gates are designed for use at or below the conservation pool level of 22 feet of hydraulic head (479 feet NGVD) and are designed to be raised or lowered into the gate slots only under balanced head conditions. During dry seasons, the gate cannot be removed until pool levels reach a minimum of 22 feet.

The general condition of the welds at the gates and lifting beam are good. The condition of the paint at the gates, which were painted recently, is fair. The hook link release arm on the lifting beam, used to engage the single lifting hook at the top of the gate, doesn't work well and has to be manipulated by project personnel. Corrosion at bolt nuts along gate sides was not arrested by the painting contractor and is significant in a few areas (photo 2). Corrosion does not jeopardize the structural integrity of the gates and is not severe enough to warrant immediate correction. It is recommended that it be monitored during the periodic inspection program. The visual quality of the welds was observed to be good. Weld testing is not warranted as the structural system is redundant with no fracture critical members. Attachment A is a copy of the record drawing for the gates.

The gates are stored supported in the gate wells by dogging devices (attachment B) which lock into place under gate guide shoes. The condition of the dogging devices is poor. Corroded nuts were noted on many of the bolts anchoring the dogging device to its concrete base (photo 3). Deterioration is caused by the devices being immersed at high pools and pooled water that remains as the reservoir level drops. It is recommended that replacement of deteriorated anchor bolts and nuts at the dogging devices be initiated. The estimated cost for replacement is $11,000 including engineering and design.



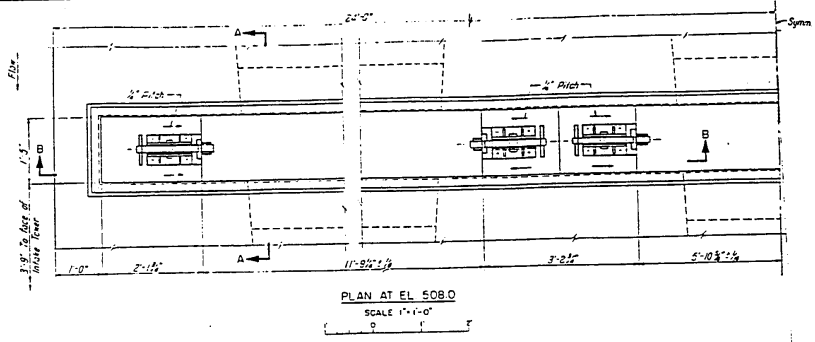
NOTES

Design working stresses in accordance with C.O.E. Engineering Manual for Civil Works, 1110-2-201, May 1953 with 18000 psi base unit stress.
The two gates are identical and interchangeable.
The contractor shall furnish two gates, assembled complete with seals attached, except springs which shall be shipped separately.
All structural steel shall conform to Fed. Spec. QQ-S-741a, Type II, or ASTM A373-58T, unless otherwise noted.
The rubber seals shall have molded corners as shown and the splices shall be vulcanized.
The thickness of machined material shown, is the thickness required after machining.
Work this sheet with Sheets 96, 97, 98 and 99.
All items on this sheet will be paid for under Item No. 47.

Record Drawing
Contract No. CA-19-016 CIVENG 59-103

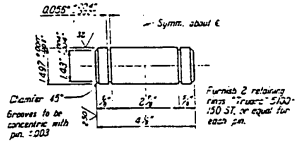
PREPARED BY THE GARRISON DISTRICT FOR THE U.S. ARMY ENGINEER DIVISION, NEW ENGLAND

U. S. ARMY ENGINEER DISTRICT, GARRISON
CONNECTICUT RIVER FLOOD CONTROL
TOWNSHEND DAM
BULKHEAD GATE
FRAMING PLAN & DETAILS
WEST RIVER, VERMONT
JULY 1958
SCALE AS SHOWN
CT-1-6376
SHEET 85 OF 111
85



PLAN AT EL 508.0

SCALE 1"=1'-0"



PIN

6 REQ'D — EST. WT 6 LB EA

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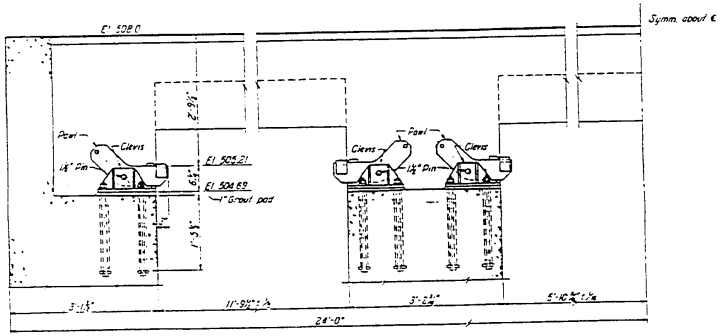

SECTION B-B

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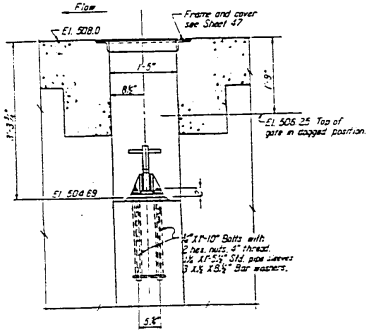


SECTION A-A

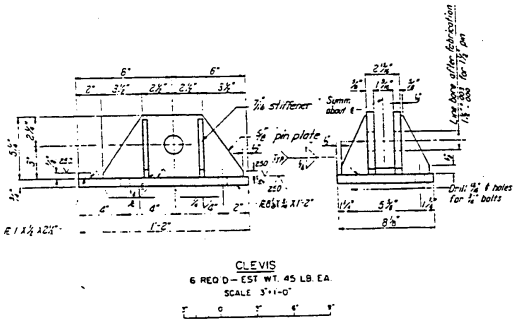
SCALE 1"=1'-0"

NOTES:

For general notes, see Sheet 85.

Work this sheet with Sheets 83, 85, 88 and 89.

All items on this sheet will be paid for under Item No. 47 unless otherwise noted.



CLEVIS

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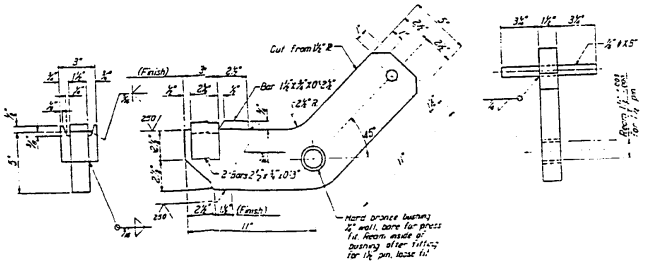
SCALE 3"=1'-0"



PAWL

6 REQ'D. — EST. WT. 50 LB EA

SCALE 3"=1'-0"

Record Drawing

Contract No. DA-19-016 CIV ENG 58-10

REVISION	DATE	DESCRIPTION

U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
SHERIDAN, WYO.

DES. BY	DR. BY	CK. BY
R E S	D H E	W F T

SUBMITTED
RECOMMENDED
APPROVED
CHIEF, ENGINEERING DIVISION

CONNECTICUT RIVER FLOOD CONTROL
TOWNSHEND DAM
BULKHEAD GATE
DOGGING DEVICE
WEST RIVER, VERMONT

APPROVED
DISTRICT ENGINEER

DATE
JULY 1958

SCALE AS SHOWN | SPECIFICATION

DRAWING NUMBER
CT-1-5378

SHEET 87 OF

PREPARED BY THE GARRISON DISTRICT FOR THE U.S. ARMY ENGINEER DIVISION, NEW ENGLAND

87-170 CT-1-51

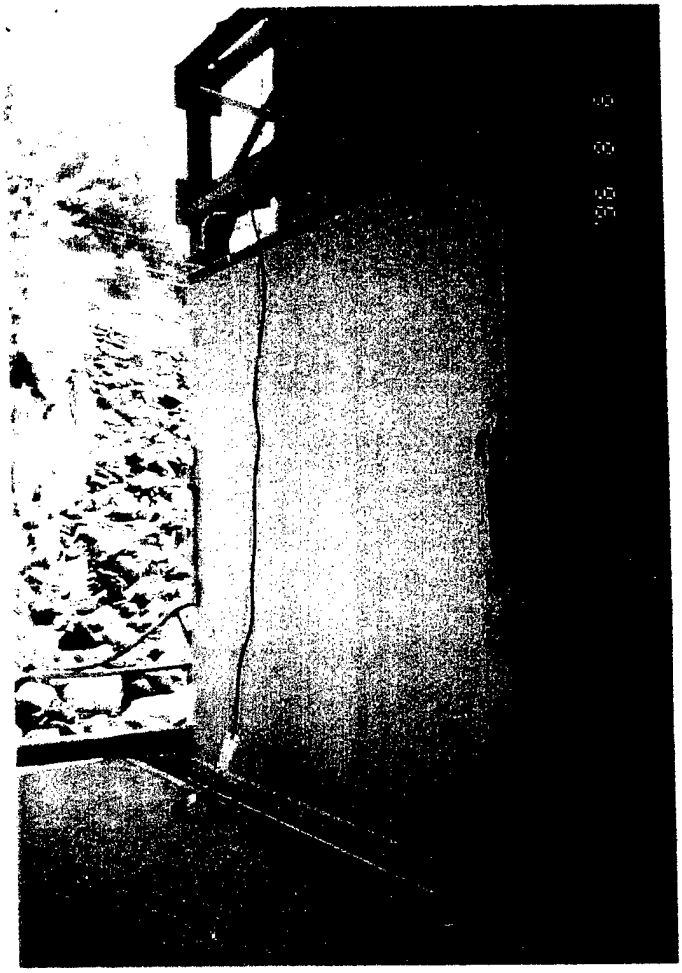


PHOTO 1: Townshend Gate

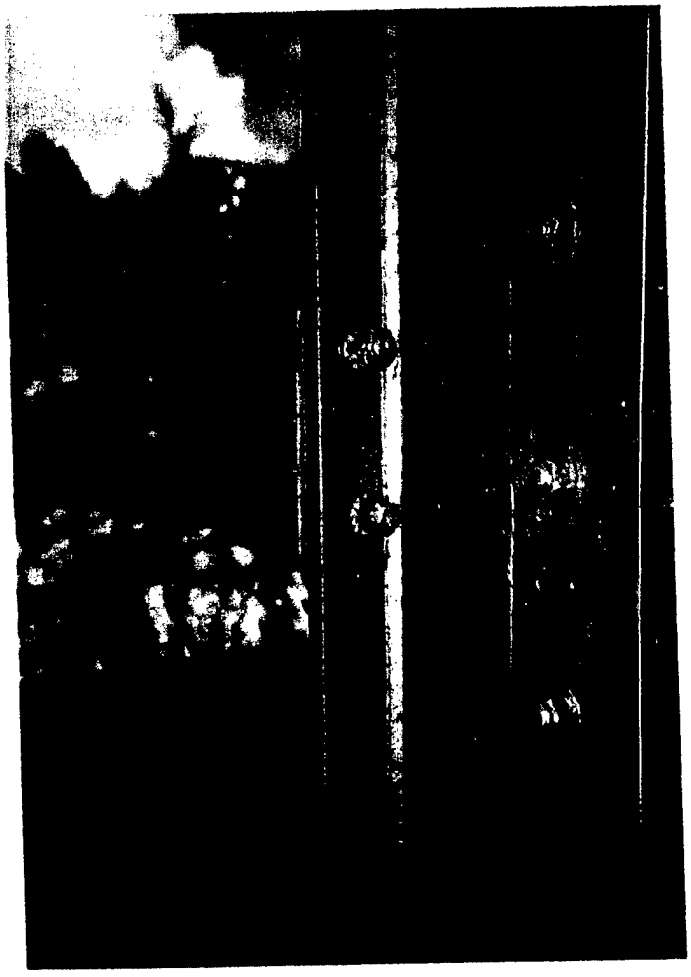


PHOTO 2: Townshend Corroded Anchor Nuts

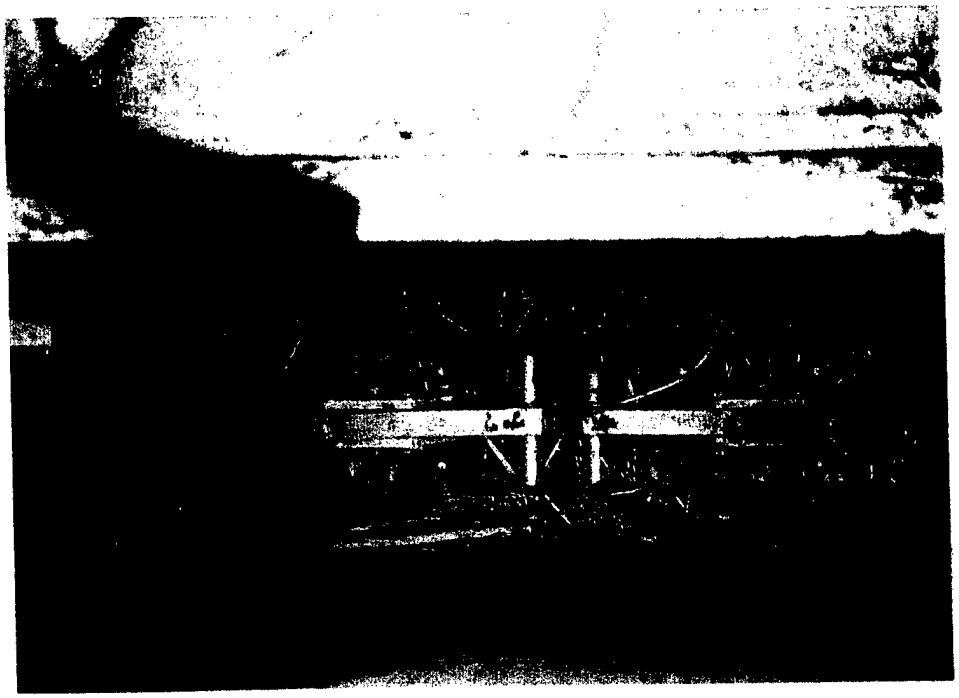


PHOTO 3: Townshend Dogging Devices

APPENDIX VII

INSTRUMENTATION DATA AND/OR PLOTS

SUPPLEMENTAL INSTRUMENTATION APPENDIX
TO PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND DAM, VERMONT

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SUPPLEMENTAL INSTRUMENTATION APPENDIX
TO PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND DAM, VERMONT

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SUPPLEMENTAL INSTRUMENTATION APPENDIX
TO PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND DAM, VERMONT

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SUPPLEMENTAL INSTRUMENTATION APPENDIX
TO PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND DAM, VERMONT

LIST OF PLATES (continued)

ATTACHMENTS

SUPPLEMENTAL INSTRUMENTATION APPENDIX TO PERIODIC INSPECTION REPORT NO. 4 TOWNSHEND DAM, VERMONT

1. PROJECT PERFORMANCE

Based on visual observation and instrumentation data compiled to date, the dam performance is rated as good. Crest monument data indicates settlement has been limited to or is less than 0.13 ft. It is not possible to quantify horizontal movement since the last survey due to computational errors from previous surveys. The errors have been corrected by establishing new control points. Based on collected piezometer and relief well data, the impervious blanket and the location and spacing of the relief wells appear to be sufficient to lower the pore pressures and exit gradients so that seepage pressures are relieved, and seepage is discharged safely.

2. GENERAL PROJECT DESCRIPTION

a. History

(1) General. Townshend Lake is one of 16 dams and reservoirs constructed by the Corps of Engineers to provide flood control in the Connecticut River watershed. The construction of Townshend Lake Dam, a rolled earth and rock fill embankment, began in October 1958, and was completed in June 1961. Townshend Lake Dam is operated in conjunction with the upstream Ball Mountain Dam, to reduce flooding along the West River in southern Vermont. The total drainage area controlled by Townshend Lake Dam is 278 square miles. Ball Mountain Lake Dam controls a drainage area of 172 square miles, which leaves a net drainage area for Townshend Lake of 106 square miles. A general plan of the dam is shown on Plate 1.

b. Geology and Foundations.

(1) General. The project is located within the New England Upland, in a glacial region of relatively high relief. Preglacial drainage patterns control the topography, but glacial action has altered the original relief resulting in broadened valleys, blocked and abandoned drainage courses, beveled ridges, and upgraded preglacial channels. Thick deposits of glacial till and more pervious outwash sand and gravel make up the valley fill material and provide a relatively incompressible foundation. In the area of the left[1] abutment, the outwash material was removed by post-glacial erosion and bedrock exposures are abundant. The rock is a moderately hard, quartz-injected schist, including gneissic and granitoid phrases. A minor amount of weathering and jointing was noted during subsurface investigations for the dam. Concentrated jointing and fracturing appears to be confined to the upper limits of the rock, and relatively few open joints were encountered.

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[1] "Left" and "right" are referenced as the reader looks downstream.

(2) Foundation Conditions. The foundation conditions at Townshend Dam consist primarily of glacial outwash sands and gravels overlying the schist and gneiss bedrock. The left abutment consists of bedrock with a thin, discontinuous mantle of sand and gravel. The valley section consists of a 50-foot thick layer of semi-pervious to pervious alluvial sands and gravels overlying bedrock. The riverbed has a surface layer of uniformly graded cobbles, which is generally from 1 to 2 feet thick. The right bank terrace consists of very pervious variable sands and gravels ranging in depth from 50 to 130 feet. The right abutment consists of a layer of glacial till immediately overlying bedrock. In general, the sands and gravels of the embankment foundation are relatively clean near the ground surface, and contain an increasing amount of fines with increasing depth. The right bank terrace section has a concentration of large boulders immediately overlying the preglacial valley. It is believed that the interstices between the boulders are filled with silts and fine sands, and therefore, the boulders do not necessarily serve as a more pervious layer for seepage concentrations. The foundation sands and gravels are classed as semi-pervious to very pervious and are generally stratified in horizontal layers.

(3) Embankment Description. Townshend Dam is 1,700 feet long and has a maximum height of 133 feet above the stream bed. The crest of the dam is at El. 583[2], and is 25 ft wide. The upstream slope is 1V:2.5H and the downstream slope is 1V:2H. The rolled earth and rock fill embankment has an inclined impervious core with adjacent pervious fill zones and rock fill outer shells. At the valley and right bank terrace, deep pervious sections of sand and gravel are included. A 5-foot thick upstream impervious blanket which is tied into the impervious core was included in the design for seepage control, and is protected at the right terrace slope by a 2-foot rock blanket on 12 inches of gravel bedding. The impervious blanket originally extended 200 feet upstream, but was extended to 500 feet in 1970, as discussed in later paragraphs. The downstream right terrace slope is protected by a 3 foot thick rock blanket which extends 200 feet downstream from the toe of the embankment. At the left abutment, the embankment is founded on bedrock with a shallow cutoff trench and grout curtain provided beneath the impervious core. A 15-foot wide berm is provided along the lower portion of the downstream slope to provide access to the discharge structure.

c. Seepage History and Remedial Work. Construction of the dam was initiated in October 1958 and completed in June 1961. Excessive seepage and subsequent piping of material from the right terrace and adjacent embankment toe occurred during a high impoundment in 1969. Seepage was observed emerging from a 20-25 ft reach of the toe of the dam extending eastward from the junction of the dam and the right terrace slope. Flowing seepage piped an estimated 50 to 60 cubic yards of fine sand and silt from the embankment foundation and possibly the underlying terrace slope. The piping action caused about 3 feet of settlement to occur on the slope of the dam over an area of approximately 100 square yards. Remedial work, which included construction of a graded filter, toe drain, and a concrete measuring weir with seepage impoundment dike, was completed in 1970.

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[2] All Elevations are in feet, NGVD.

Following the near record pool of 4 June 1984, numerous small boils, 2 to 3 inches in diameter, were observed on the right terrace slope and in the gravel access road which parallels the toe of the slope. The gravel road in this area heaved 4 to 5 inches from excessive uplift pressures. Remedial work was initiated in the fall of 1985 and completed in the spring of 1986. This work included installation of a system of 9 relief wells with 2 collector drains, and repairs to the seepage measuring weir and containment dike.

Inspection reports of the aforementioned remedial work during the heavy rains of April 1987 indicated no unusual seepage or boils were observed. Clear seepage was flowing from the relief well collector drains. The maximum flow noted during the eight day observation period was estimated to be approximately 250 gpm (based on depth of flow measured at pipe inverts) from each pipe. Seepage was flowing from the rock toe all along the drainage trench and seepage pool. No movement or settlement of the embankment was observed.

3. INSTRUMENTATION

a. Crest Monuments. Eleven crest monuments and four control points were installed in 1972 to monitor horizontal and vertical movement of the dam as part of the New England District's Dam Safety Program. The exact depth and composition of these monuments are unknown, but appear to consist of a sonatube of unknown length filled with concrete and capped with a brass disk. Assumed depths are approximately 5 feet. Two additional control points were installed in 1996. Crest monument and control point locations are shown in Plate 1. Eight of the crest monuments are located along the downstream edge of the embankment crest and are labeled T-3 through T-10. Crest monuments T-2, T-11 and T-12 are not located on the crest. T-2 is located on the left abutment, and monuments T-11 and T-12 are located on the right abutment. Control point T-1, used for horizontal control, is located on the left embankment. Control points T-13 through T-15 are assumed to be fixed reference points and are used for horizontal control. Horizontal control points "RICK" and "SHARON" were installed in 1996 because the original horizontal control points are located in a dense stand of mature trees. Surveys were performed in 1978, 1985, 1989 and 1996 (Plates 2 and 3). The current surveying standards and procedures employed for crest monument surveys are contained in Attachment No. 1.

b. Piezometers. There are currently 15 Casagrande open-type piezometers located on the dam embankment: five at station 22+00 (PZ-1, 2, 3, and 15&16), four at Sta.. 24+50 (PZ-5, 6, 7, and 8), and six along the downstream toe of the embankment (PZ-9&10, 11&12, and 13&14). Each piezometer consists of a 1 inch I.D. by 24 inch long Casagrande type tip connected to the surface by a 3/4 inch PVC riser pipe. All piezometers were installed using standard drilling techniques. A plan of the project with piezometer locations is shown on Plate 1.

PZ-9&10, 11&12, and 15&16 were installed in 1984 by Eastern Geotechnical Associates (EGA). PZ-6, 7, 8, 13&14 were installed in 1985 by Mobile District, and PZ-5 was installed in 1987 by Atlantic Testing Laboratories (ATL). PZ-1, 2, and 3 were also installed by ATL in 1987 to replace the existing pneumatic piezometers 1, 2, and 3 (installed in 1966 and reinstalled in

1970), which had become inoperative. PZ-4, a pneumatic type piezometer installed in 1970, has been inoperative since 1977 and has been abandoned. Piezometers 9 through 16 were installed two per borehole, i.e. PZ-9&10 are located in the same borehole. In 1993, all piezometers were retrofitted with vibrating wire sensors and attached to a computer automated instrumentation system. Table No. 1 includes a listing of piezometer locations (centerline stationing and offsets), piezometer riser top and tip elevations, and the zone/material where the tips are located.

Boring logs, piezometer installation reports and falling head test results for the 1984 and 1985 piezometers are contained in the Geotechnical Report prepared by Eastern Geotechnical Associates titled "Subsurface Investigations, Townshend Dam & North Springfield Dam", Contract No. DACW-33-83-D-0006, dated December 1985. Boring logs, piezometer installation reports and falling head test results for the 1987 piezometers are contained in the geotechnical report prepared by Atlantic Testing Laboratories, untitled, Contract No. DACW-33-85-D-0011, dated October 1987. Copies of these reports are on file in the Geotechnical Engineering Division. Boring logs were also included in the previous Instrumentation Appendix.

c. Relief Wells. A system of relief wells was installed in 1986 in order to control uplift pressures along the downstream toe of the embankment and the downstream right abutment. The system consists of nine relief wells spaced 50 feet on center which penetrate about 60% of the pervious strata above bedrock. The locations of the wells are shown on Plate 1. Table No. 3 includes relief well as-built locations (station and offset), riser pipe elevations, tee invert elevations, and bottom of well elevations.

All relief well installation, jetting, and pump testing reports are contained in a final report prepared by GEI titled, "Engineering During Construction and Quality Assurance for Relief Wells, Townshend Lake, Townshend, Vermont". This report is on file at the Geotechnical Engineering Division.

d. Measuring Weir. The stainless steel, 120 degree, v-notch measuring weir was reinstalled on a new gravity wall constructed in 1996 at the downstream end of the seepage pool as part of the Townshend Lake scour hole repair project ("Repair Scour Hole, Townshend Lake, Townshend, VT, contract No. DACW33-95-B-0061 dated May 1995). Daily weir readings are taken by a water level sensor at the weir, collected the automation system, and converted to a flow rate in cubic feet per second using a calibration curve. Details of the V-notch weir and the calibration curve are shown on Plate No. 44.

e. Strong Motion Accelerographs. In 1979, three strong motion accelerographs (SMA-1) were installed at Townshend Lake to monitor shock wave attenuation through the embankment and foundation during an earthquake. Shelter "A" is located just west of the spillway bridge on bedrock, shelter "B" is located on the crest of the embankment just outside the downstream guardrail of the dam, and shelter "C" is on in situ soils to the east of the outlet channel, approximately 400 feet downstream from the outlet portal (Plate 1). Each SMA-1 accelerograph is a compact, portable, self contained unit with three accelerometers that measure and record

vibrations in three orthogonal directions. The accelerographs are designed to be self-activated when they experience a vertical acceleration of 0.01g or greater. The instruments are serviced twice a year by the Waterways Experiment Station.

4. AUTOMATED INSTRUMENTATION SYSTEM

a. General. The automated instrumentation system at the Townshend Lake was installed in 1993 by Waterways Experiment Station (WES) personnel. The system is a real time data acquisition system designed to collect, process, and transmit data from piezometers, the measuring weir device, and a pool level sensor at the dam site to a local, on-site, host computer. Data is retransmitted to the NAE Geotechnical Engineering Section (GES) via a telephone modem.

b. System Design. The system comprises common, easy-to-replace modular electronic components designed to withstand severe weather including electrical storms. Maintenance of the system is performed by replacing modular components, rather trouble shooting and repairing electronics of the components. The configuration is expandable to accommodate additional instrumentation as required. The host computer has an uninterrupted power supply which provides temporary backup during power outages.

c. System Layout. The system consists of a host computer at the project office and a Measurement and Control Unit (MCU) in the control tower. The electronic sensors are hardwired to the MCU through underground cables. In this configuration, the MCU collects sensor data and communicates with the host computer via radios. The host computer communicates with a personal computer located at NAE, GES via telephone modem.

d. System Components.

(1) Host Computer. The host computer is an IBM compatible personal computer operating the Geomation model 2310-900 (Geonet) Standard system 2300 data acquisition and control network software. The host computer has an uninterrupted power supply and a printer. The basic functions of Geonet software are real time data collection and storage, data file management, user friendly interface to the network, data display, alarm annunciation, management of the network topology setups, and allowance for remote user access to stored data files. A laptop computer is used as a backup to the host computer. The laptop is fully compatible with the host and is capable of being linked into the system's network to emulate/communicate with other host computers, or retransmit information via telephone modem.

(2) Measurement and Control Unit. The Measurement and Control Unit (MCU) configuration consists of a Geomation 2350A MCU which is permanently mounted in the control tower. The MCU is a multi-tasking processor designed to handle all network communications and sensor interfaces in severe weather environments. The MCU is installed in a protective, water-tight enclosure.

(3) Piezometers. Long transmitting distances from the MCU to the piezometer sensor locations, as well as riser pipes with small inside diameters limited the selection of transducers for monitoring piezometer water levels. Geokon vibrating wire transducers, model 4500C were chosen for use at Townshend Lake. The 4500C sensor has a 0.438 inch outside diameter.

(4) Measuring Weir. The measuring weir water level measurement sensor is the Drexelbrook Model No. 508-211-9 water level transmitter. This sensor is mounted in a protective enclosure, and it has a 4-20 milliamp output which is well suited for long transmitting distances.

(5) Pool Level Gage. Pool level measurements are monitored using a Geomation Model No. 2350-500 Incremental rotary encoder (IRE). This model has quadrature output and 200 discrete states per revolution. The IRE is linked to the existing float system by a chain and sprocket.

(6) Cable and Conduit. The vibrating wire sensors and the weir sensor are hardwired to the MCU using shielded cable. The cable is encased in schedule 40 PVC electrical conduit that is buried approximately 18-24 inches below grade. The MCU and host computer are not hardwired to one another, and communicate via radio transmission.

5. DATA COLLECTION, INTERPRETATION, AND EVALUATION

a. Crest Monuments

(1) Data Collection. The results of the 1996 crest monument survey are included on Plate 2. Computed horizontal and vertical movements of each crest monument between 1978 and 1996 are plotted on Plate 3. Plate 5 lists monument and control point coordinates and elevations from the 1978, 1985, 1989, and 1996 surveys (the coordinates from the initial survey in 1972 are not comparable to later surveys due to a difference in survey techniques.).

(2) Interpretation and Evaluation. The 1978, 1985, 1989 and 1996 surveys were performed using an electronic measuring device (EDM) with a third order class II accuracy (1:5000) for horizontal measurements and third order class I accuracy (1:10,000) for vertical measurements according to the standards and procedures outlined in Attachment No 1. The instruments used to perform the initial survey in 1972 are unknown.

(a) Vertical Movement. As shown on Plate 3, the surveys indicate that the largest vertical movement of any one crest monument from 1978 to 1996 was 0.37 ft (4.43 in), measured at monument T-11. This movement is attributed to the monument having sustained physical damage from snow plowing prior to the 1996 survey. Excluding monument T-11, the largest settlement was 0.13 ft (1.56 in), which occurred at monument T-6. Monuments T-3 through T-6, all located above the old river valley where the embankment has its greatest height,

show an average settlement of 0.1 ft, or 1.2 in (refer to Plate 4, geologic section through centerline of dam). It is likely that minor settlement of the embankment (probably within the rockfill zone) above the old river valley is still occurring. No physical evidence of this settlement was visible during the periodic inspection. This small amount of settlement is not of major concern, but this area of the embankment should be monitored for potential future visible signs of settlement. Monuments T-7, T-8 and T-9, located where the embankment is shallower, show minimal change in elevation. Monument T-10, located near the right abutment, showed an elevation increase of 0.13 ft (1.56 in, equal to that of T-6 but opposite in direction). The increase may be due to localized ground heaving from frost action, but there were no physical indications of movement at this location noted during the periodic inspection. The magnitude of this change is not of major concern.

(b) Horizontal Movement. The results of the 1996 horizontal movement survey shows changes in horizontal position between 1989 and 1996 ranging from 0.6 ft (7.9 in) to 0.7 ft (8.5 in) for monuments T-3 through T-11, with the changes directed consistently towards the left abutment (Plate 3). This relatively large magnitude of change is due to a computational error in the original (1975) survey, which resulted in incorrect coordinates being established for control points T-13, T-14, and T-15. These control coordinates were then used to calculate monument coordinates for the 1978, 1985, and 1989 surveys, producing erroneous monument coordinates. During the 1996 survey, new control points ("RICK" and "SHARON"; see Plates 2 and 5) were established, because the stand of trees surrounding the original control points had matured to the point where the old control points were no longer useable. It was only after the 1996 survey was completed that the error in the 1975 survey was discovered. The result of this error is that relative changes in monument coordinates between the 1978 and 1989 surveys can be determined, but it is not possible to make comparisons between the 1996 survey and prior horizontal movement surveys. Therefore, it is not known whether any horizontal movement of the embankment has taken place since the 1989 survey (this error does not affect the settlement survey, which was performed using other control points). However, there was no physical evidence of movement at any monument, such as slumps, scarps, cracks, or depressions which would indicate movement of any significant magnitude within the embankment.

Monuments T-13, T-14, and T-15 should no longer be used for horizontal control unless the coordinates of these points are reestablished. Monuments "RICK" and "SHARON" should be used in future surveys in order to maintain consistency. In addition, horizontal coordinates established in future surveys should only be compared to the coordinates obtained from the 1996 survey, and not prior surveys.

b. Piezometers.

(1) Data Collection

(a) Location Map. Plate 1 shows a plan of the dam with the locations of the active piezometers and their corresponding identification numbers.

(b) Data Table. Table 1 lists the piezometer identification number, stationing and offset, as well as the piezometer top and tip elevations and the sensor elevations.

(c) Data Collection. The automated instrumentation system, which became operational in February 1994, records piezometer and pool elevations on a daily basis. Piezometer and pool data collected from February 1994 through January 1997 are listed in Table 2. There are several gaps in the data set where the automation system was not operational. In addition, obvious erroneous data obtained from the automation system was omitted to provide meaningful and readable plots. If unusual changes in the readings develop or if the automated system becomes inoperable, Geotechnical Engineering Section may direct site personnel to manually perform the readings.

(2) Interpretation And Evaluation

(a) Presentation of Data. In this Instrumentation Appendix, piezometer and pool information is summarized in a series of time history plots and scatter plots. Daily readings of pool and piezometer elevations versus time for two cross sections and one profile are plotted on Plates 7-9, 13-15, and 19-24. Between February 1994 and January 1997, the automation system was intermittently non-operational. As shown on these plates, the highest impoundment for this period (El. 525, January 1996) was not recorded by the automation system. Time history plots of piezometer response during two events were developed: the impoundment which occurred in April 1994 (max. pool El. 522), and the impoundment which occurred from December 1996 to January 1997 (max. pool El. 512). Although the Dec. 1996-Jan. 1997 event was not the highest impoundment recorded during the period covered by this Instrumentation Appendix, this event was investigated in depth because it was a much longer duration impoundment than the two higher events, and resulted in a more fully developed piezometer response. These event plots are shown on Plates 10-11, 16-17, and 25-26. Plates 27-30 contain scatter plots which show the responses of all piezometers to the rise and fall of the pool for all significant events between April 1993 and January 1997. For each plot, linear regression analysis was used to approximate the piezometer response for pool elevations up to the spillway crest elevation. It should be noted that these predictions have been extrapolated from events where the pool elevation is significantly below the spillway crest. Therefore, the predictions may not accurately predict piezometer responses for events where the pool is at or very near the spillway crest.

(b) Individual Piezometer Response. All pertinent information (station, offset, piezometer top and tip elevations, sensor tip elevation, zone and material type where piezometer tip is located) for each piezometer is listed in Table 1 and shown on Plates 6, 12, and 18 (NOTE: Table 1 shows the sensor tip elevation lower than the piezometer tip for PZ-5 and PZ-6. The automation system is scheduled to be recalibrated in FY 98 to correct these inconsistencies. All corrections will be shown in future instrumentation reports). Plates 6, 12, and 18 also show the average response to each piezometer to the recreational pool (El. 478). These responses were

determined based on averaged piezometer responses when the pool remained essentially constant (El. 478±1). Falling head tests performed on each piezometer immediately after installation confirmed that at the time of installation, all piezometers were functioning properly. Table 2 shows all piezometer data collected from the automation system from February 1994 to January 1997. It should be noted that because there was no soil sampling conducted when PZ-1, PZ-2, and PZ-3 were reinstalled, and no soil sampling was conducted when these piezometers were originally installed, it is not known exactly what type of material the tips of these piezometers are located in. Therefore, this information was approximated from information obtained in the record drawings.

i. PZ-1. PZ-1 was reinstalled in 1987 to replace the original pneumatic type PZ-1, which had become non-operational. PZ-1 is located at station 21+80, approximately 100 ft upstream of the dam centerline. The tip is located at approximately El. 458.5, in the foundation zone close to the foundation-embankment interface. The piezometer tip is surrounded by #4 filter sand which extends up about 4 ft above the piezometer tip. Immediately overlying the filter sand is a bentonite seal approximately 12 ft high. The foundation zone which influences the response of PZ-1 is most likely comprised of stratified gravels with silt (GP-GM) with traces of sand. A history of the piezometer's response to pool fluctuations between February 1994 and January 1997 is presented on Plates 7 through 9. The water level for PZ-1 during a normal pool is about El. 465. PZ-1 responded typically to pool fluctuations during the April 1994 event (Plate 10), slowly rising and falling with the pool, and peaking at El. 473.2 one day after the pool. Piezometer response during the December 1996 event was similar (Plate 11), with a time lag between the maximum pool stage and the maximum piezometer reading (El. 474.1) of one day. The projected piezometer water level for the pool at spillway crest, extrapolated using data from several flood events, is El. 483 (Plate 27).

ii. PZ-2. PZ-2 was reinstalled in 1987 to replace the original pneumatic type PZ-2, which had become non-operational. PZ-2 is located at station 21+80, 180 ft upstream of the dam centerline. The tip is located at El. 456.8, in the foundation zone close to the foundation-embankment interface. The piezometer tip is surrounded by #4 filter sand which extends up 5 ft from the piezometer tip. Immediately overlying the filter sand is a bentonite seal approximately 6 ft high. The foundation zone which influences the response of PZ-2 is most likely comprised of stratified gravels with silt (GP-GM) with traces of sand. A history of the piezometer's response to pool fluctuations between February 1994 and January 1997 is presented on Plates 7 through 9. The average water level for PZ-2 during a normal pool is about El. 470. When the pool elevation rises above El. 516, the piezometer becomes submerged, resulting in the automation system reading the piezometer elevation equal or very near the pool elevation. PZ-2 was submerged during the peak of the April 1994 event, and was also non operational (Plate 10). PZ-2 responded normally to the December 1996 event (Plate 11), rising and falling with the pool with about a 1 day lag time. The piezometer peaked at El. 487.6, 1 day after the pool. PZ-2 seems to be highly influenced by changes in the pool elevation, as is illustrated in the pool vs. piezometer plot for PZ-2 on Plate 27. The best fit line for the data is relatively steep compared to the other upstream piezometers. As previously noted, if the pool were at the spillway crest

(El. 553), PZ-2 would be submerged, giving an erroneous reading of piezometric head at the piezometer tip. It is however possible to extrapolate existing data to estimate the piezometric head elevation at the location of the piezometer tip when the pool is at spillway crest. The piezometric head elevation when the pool is at spillway crest is expected to be about El. 507 (Plate 27).

iii. PZ-3. PZ-3 is located at station 22+20, 240 ft upstream of the dam centerline. The tip is located at El. 451.2 in the foundation zone close to the embankment-foundation interface and under the impervious blanket. The piezometer tip is surrounded by #4 filter sand which extends up about 3 ft above the piezometer tip. Immediately overlying the filter sand is a bentonite seal approximately 5 ft high. The foundation zone which influences the response of PZ-3 is most likely comprised of stratified gravels with silt (GP-GM) with traces of sand. A history of the piezometer's response to pool fluctuations between February 1994 and January 1997 is presented on Plates 7 through 9. The average water level for PZ-3 during a normal pool is about El. 468. When the pool rises above El. 497, PZ-3 becomes inundated, and automated readings are at or very near the pool stage. This occurs during most significant flood events, as illustrated in Plates 7 through 9. The available data does show that PZ-3 does respond normally to rises in pool. The piezometer was submerged during the peak of the April 1994 event (Plate 10). PZ-3 rose slowly with the pool during the December 1996 event until it became submerged, and then dropped normally with the pool when the pool decreased below El. 497 (Plate 11). Because of the lack of meaningful piezometer data for higher pools, it is not possible to predict the piezometer water elevation for the pool at spillway crest.

iv. PZ-5. PZ-5 is located near the crest of the dam at station 24+50, 20 feet downstream of the dam centerline. The tip is located at El. 450.8, within the foundation 70 ft below the foundation-embankment interface. The piezometer tip is surrounded by #4 filter sand which extends up about 30 ft from the piezometer tip. Immediately overlying the filter sand is a bentonite seal approximately 6 ft high. The material in the foundation zone which influences the response of PZ-5 is comprised of stratified SANDS (SP) and GRAVELS with silt (GP-GM). A history of the piezometer's response to pool fluctuations from February 1994 through January 1997 is presented on Plates 13 through 15. The average water elevation in PZ-5 during a normal pool is about El. 468. During the 1994 event, PZ-5 rose and fell with the pool, peaking at El.478.9 two days after the pool (Plate 16). Response during the 1996 event was similar, but with a time lag between the maximum pool stage and the maximum piezometer reading (El. 479.1) of one day (Plate 17). The shorter lag time for the 1996 event is likely due to the fact that during the 1996 event, the pool rose more slowly and for a longer duration than during the 1994 event. The projected piezometer water level for the pool at spillway crest, extrapolated using data from several flood events, is El. 490 (Plate 28).

v. PZ-6. PZ-6 is located 145 ft downstream of the dam centerline at station 24+50. The tip is located at El. 461.7 in the right abutment foundation zone, about 70 ft below the ground surface. The piezometer tip is surrounded by #4 filter sand which extends up about 33 ft from the tip. Immediately overlying the filter sand is a bentonite seal approximately

5 ft high. The material in the foundation zone which influences the response of PZ-6 is comprised of stratified silty SANDS (SM) and GRAVELS with silt (GP-GM). A history of the piezometer's response to pool fluctuations from February 1994 to January 1997 is presented on Plates 13 through 15. During the April 1994 event, the piezometer responded slowly to the pool, peaking at El. 469.9 four days after the pool. The response during the 1996 event was much quicker, with the piezometer peaking at El. 470.4 only one day after the pool. The shorter lag time for the 1996 event is likely due to the fact that during the 1996 event, the pool rose more slowly and stayed up for a much longer duration than during the 1994 event, allowing a more fully developed piezometer response. The average water elevation in PZ-6 during a normal pool is about El. 463. The projected piezometer water level for the pool at spillway crest is El. 479 (Plate 28).

vi. PZ-7. PZ-7 is located at station 24+50, 310 feet downstream of the dam centerline. The tip is located at El. 463.2 in the right abutment foundation zone. The piezometer tip is surrounded by #4 filter sand which extends up about 30 ft from the piezometer tip elevation. Immediately overlying the filter sand is a bentonite seal approximately 5 ft high. The materials in the foundation zone which influence the response of PZ-7 are comprised of stratified silty SANDS (SM) with gravel. A history of the piezometer's response to pool fluctuations from February 1994 through January 1997 presented on Plates 13 through 15. During the April 1994 event, the piezometer responded slowly to the rise in pool, peaking at El. 472.6, four days after the pool. The piezometer responded more quickly during the December 1996 event, peaking at El. 470.4 one day after the pool. The shorter lag time for the 1996 event is likely due to the fact that during the 1996 event, the pool rose more slowly and stayed up for a much longer duration than during the 1994 event, allowing a more fully developed piezometer response. The average water elevation in PZ-7 is about El. 466 with a normal pool. The projected piezometer level with the pool at spillway crest is El. 478 (Plate 28).

vii. PZ-8. PZ-8 is located 420 ft downstream of the dam centerline at station 24+50. The tip is located at El. 461.4 in the right abutment foundation zone, 47 ft below ground surface. The piezometer tip is surrounded by #4 filter sand, which extends 8 ft above the tip. Immediately overlying the filter sand is a bentonite seal approximately 5 ft high. The material in the foundation zone which influences the response of PZ-8 is comprised of SANDS with silt (SP-SM) and silty SANDS (SM). A history of the piezometer's response to pool fluctuations from February 1994 through January 1997 is presented on Plates 13 through 15. PZ-8 responded slowly to the rise in pool elevation during the April 1994 event, peaking at El. 470.8 four days after the pool. The piezometer responded more quickly during the December 1996 event, peaking at the same elevation as the 1994 event (El. 470.8), but only one day after the pool. The shorter lag time for the 1996 event is likely due to the fact that during the 1996 event, the pool rose more slowly and stayed up for a much longer duration than during the 1994 event, allowing a more fully developed piezometer response. The average water elevation in PZ-8 is about El. 466 with a normal pool. The projected piezometer level with the pool at spillway crest is El. 474 (Plate 28).

viii. PZ-9 and PZ-10. PZ-9 and PZ-10 are located at station 23+00, 250 ft downstream of the dam centerline. Both piezometers were installed in the same bore hole and are protected by a common steel casing. The tip of PZ-9 is located at El. 430.1 and the tip of PZ-10 is at El. 450.1. Both piezometer tips are located in the foundation zone immediately downstream of the dam embankment. The piezometer tips are surrounded by #4 filter sand. The filter sand for PZ-9 extends up about 15 ft from the tip, and for PZ-10 it extends up about 18 ft from the tip. Immediately overlying the filter sand of each piezometer is a bentonite seal (4 ft thick for PZ-9 and 2 ft thick for PZ-10) . The materials in the foundation zone which influence the response of PZ-9 are comprised of SAND with gravel (SP). The materials in the foundation zone which influence the response of PZ-10 are stratified SANDS with gravel and silt (SW-SM) and sandy GRAVELS (GW). A history of each piezometer's response to pool fluctuations from February 1994 to January 1997 is presented on Plates 19-21. During normal pool (El. 478), the average water level in PZ-9 is El. 463, and the average water level in PZ-10 is El. 464. During the April 1994 event, both piezometers responded slowly to the rise in pool elevation, peaking four days after the pool peaked. PZ-9 peaked at El. 467.1, and PZ-10 peaked at El. 468.2, about 1 foot higher than the peak of PZ-9. The piezometer response to the rising pool during the December 1996 event was quicker, with a one day lag time. PZ-9 peaked at El. 468.4, and PZ-10 peaked at El. 468.9, about 0.5 ft higher than the peak for PZ-9. The generally higher water level in PZ-10 may be due to the fact that the tip of PZ-10 is located in what appears to be a more pervious foundation zone than PZ-9. Comparing the piezometer responses for the two events shows that the water levels in PZ-9 and 10 are much closer for the 1996 event than for the 1994 event. This might at first be attributed to the different characteristics of the two events, but looking at the time history data reveals an unexplained change in the response of PZ-9 beginning on September 13, 1995. Prior to this date, the readings for PZ-9 were generally 1 foot lower than the readings for PZ-10 (Plate 19 and 20). On 13 September, the reading for PZ-9 inexplicably jumped up about 1 foot from its reading on the previous day, and was nearly equal to PZ-10. The pool elevation was at about El. 478 on this day. The automation system reported that the two piezometers had nearly the same water level until October 1995, when the automation system became non-operational (Plate 20). When the automation system came back on line in February 1996, PZ-9 began consistently reading within 0.5 ft lower than PZ-10. This apparent change in piezometer response is likely due to some malfunction of the automation system. These piezometer should be carefully checked during the scheduled FY98 recalibration of the system. Based on the automation data, the projected piezometer levels with the pool at spillway crest are El. 472 for PZ-9 and El. 473 for PZ-10 (Plate 29).

ix. PZ-11 and PZ-12. PZ-11 and PZ-12 are located at station 22+50, 330 ft downstream of the dam centerline. Both piezometers were installed in the same bore hole and are protected by a common steel casing. The tip of PZ-11 is located at El. 430.4 and the tip of PZ-12 is El. 450.3. Both piezometer tips are located in the foundation zone of the dam. The piezometer tips are surrounded by #4 filter sand. The filter sand for PZ-11 extends up 15 ft from the tip, and is capped with a 4 ft bentonite seal. The filter sand for PZ-12 extends from the top of the seal for PZ-11 to about 21 ft above the tip of PZ-12. The filter sand is then capped with another 2 ft bentonite seal. The materials in the foundation zone which influence the response of

PZ-11 are comprised of stratified SANDS with silt and gravel (SP-SM). The materials in the foundation zone which influence the response of PZ-12 are comprised of gravelly SANDS (SP). A history of each piezometer's response to pool fluctuations from February 1994 through January 1997 is presented on Plates 19-21. During the April 1994 event, both piezometers responded slowly to the rise in pool, peaking four days after the pool peaked. PZ-11 and PZ-12 peaked at nearly the same elevation (El. 467.9 and El. 468.0, respectively). These piezometers responded quite differently during the December 1996 event. Both piezometers responded only one day after the pool, but the peak elevation of PZ-11 (El.468.7) was over 3 feet higher than the peak of PZ-12 (El. 465.4). This discrepancy may be the result of a malfunctioning sensor in PZ-12. The sensor which reads elevations in PZ-12 was replaced in August of 1996. Prior to this time, when the original sensor was operational, water levels recorded at PZ-12 were usually about 0.5 ft higher than the water levels recorded in PZ-11 (Plates 19 and 20). After PZ-12 was replaced, water level readings in this piezometer were consistently 3 feet lower than in PZ-11(Plates 20 and 21). It is possible that either the new sensor is not calibrated properly, or that the old sensor was not functioning properly from the time of installation. It is also possible that the new sensor is functioning properly, but that PZ-12 may have been subjected to some physical change such as being silted in, or that the surrounding foundation material has for some reason become less pervious, resulting in an erratic piezometer response. This is probably not the case, because similar changes were not noticed in adjacent piezometers whose tips situated in the same strata as PZ-12. In addition, PZ-12 experienced a similar but smaller change in readings in September 1995, increasing about 0.5 ft in one day to almost the same elevation as PZ-11. When the automation system came back on line in February 1994, PZ-12 was reading only slightly lower than PZ-11 until the sensor was replaced in 1996, when PZ-12 began reading about 3 feet lower than PZ-11. PZ-12 should be carefully checked during the scheduled recalibration of the automation system in FY98. Based on the data collected by the automation system, the average piezometer response for normal pool is El. 464 for PZ-11 and PZ-12. The projected piezometer response for the pool at spillway crest is El. 472 for PZ-11 and El. 471 for PZ-12 (Plate 29).

x. PZ-13 and 14. PZ-13 and PZ-14 are located at the downstream toe of the embankment at station 21+10, 240 feet from the dam centerline. Both piezometers were installed in the same bore hole and are protected by a common steel casing. The tip of PZ-13 is located at El. 431.3 and the tip of PZ-14 is at El. 451.4. Both piezometer tips are located in the foundation zone of the dam. The piezometer tips are surrounded by #4 filter sand. The filter sand extends 14 ft from the tip of PZ-13, and is capped by a 4 foot bentonite seal. The filter sand for PZ-14 extends from the first seal up 8 ft above the tip, and is capped with another 4 foot bentonite seal. The material in the foundation zone which influences the response of PZ-13 and PZ-14 consists of SAND with silt and gravel (SP-SM). Plates 22 through 24 show a time history of each piezometer's response to pool fluctuations for data collected from February 1994 to January 1997. The general response of PZ-13 and PZ-14, illustrated in the time history plots, tend to be nearly equal, with PZ-13 tending to read slightly higher than PZ-14, especially during high pool events. The average piezometer response to a normal pool is El. 463 for both piezometers. During the April 1994 event (Plate 25), both piezometers responded slowly to the rise in pool, peaking four days after the pool peaked. PZ-13 peaked at El. 465.6 and PZ-14

peaked at El. 465.4. Response during the December 1996 event (Plate 26) was similar but quicker, with both piezometers peaking one day after the pool at El. 466.1 for PZ-13 and El. 465.9 for PZ-14. The readings for these two piezometers do not exhibit the irregularities noticed in PZ-9&10 and PZ-11&12 (discussed above). The projected piezometer water surface elevation for the pool at spillway crest is El. 468 for both piezometers (Plate 30).

xi. PZ-15 and PZ-16. PZ-15 and PZ-16 are located at the downstream toe of the embankment at station 22+00, offset 270 feet from the dam centerline. Both piezometers were installed in the same bore hole and are protected by a common steel casing. The piezometer tip of PZ-15 is located at El. 430.6 and the tip elevation of PZ-16 is 450.5. Both piezometer tips are located in the foundation zone of the dam. The filter sand for PZ-15 extends up 15 ft from the tip, and is capped with a 4 ft bentonite seal. The filter sand for PZ-16 extends 11 ft from the tip, and is capped with a 2.5 ft bentonite seal. The material in the foundation zone which influences the response of PZ-15 consists of silty SAND (SM) and GRAVELS with sand (GW). The material in the foundation zone which influences the response of PZ-16 consists of GRAVEL with silt and sand (GP-GM) and sandy SILT (ML). A history of each piezometer's response to pool fluctuations for data collected from February 1994 through January 1997 is presented on Plates 22-24. Prior to September 1995, sensor data indicated that the response of PZ-15 was consistently about 0.5 ft lower than the response of PZ-16. In mid-September 1995, PZ-15 experienced a similar jump in elevation as PZ-10 and PZ-12, rising 0.5 feet in one day to read nearly the same elevation as PZ-16. Although this magnitude of change is not unusual, what is unusual is that all data collected after that date shows PZ-15 consistently responding at almost the same elevation as PZ-16, and in some cases slightly higher than PZ-16 (Plates 23-24). During the April 1994 event, both piezometers responded slowly to the rise in pool, peaking four days after the pool (Plate 25). PZ-15 peaked at El. 465.7, and PZ-16 peaked 0.4 ft higher at El. 466.1. During the December 1996 event (Plate 26), both piezometers peaked one day after the pool peaked. PZ-15 peaked at El. 466.8, and PZ-16 peaked 0.3 ft lower at El. 466.5. PZ-15 should be carefully checked during the next periodic inspection. Based on all collected automation data, the average response during a normal pool is El. 462.4 for PZ-15 and El. 462.8 for PZ-16. The projected water level for the pool at spillway crest is El. 470 for PZ-15 and El. 469 for PZ-16 (Plate 30).

(c) Cross-Sectional Evaluation. Piezometers located in the same cross-section were plotted with pool elevation and corresponding piezometer elevations cross-sections of the dam and foundation so that seepage characteristics could be evaluated. Cross sections were plotted at Station 22+00, at the location of the old river channel alignment (Plate 6), and at Section 24+50, at the right abutment (Plate 12). Four events are shown on these plates: the 1987 event (maximum surcharge), the 1993 event, the April 1994 event, and the December 1996 event. In addition, piezometer elevations for a normal pool and predicted elevations for the pool at spillway crest were also plotted on these sections.

i. Sta.. 22+00 (Section A-A). (Plates 6-11, 27, 30) The piezometers located along this cross section are PZ-1, 2, 3, 15, and 16 (Plate 6). Plates 7 through 9 show the

water level data recorded in these piezometers from February 1994 through January 1997. Plates 10 and 11 present the water level data recorded at this section during the April 1994 and December 1996-January 1997 flood events, respectively. Plates 27 and 30 show pool elevation vs. piezometer elevation for all significant events for these piezometers. The pore pressures read by the piezometers in this section generally decrease moving downstream. During normal pools, PZ-3 (El. 468.3) tends to read about a foot lower than PZ-2 (El. 469.5), and PZ-1 (El. 465.3) reads about 4 feet lower than PZ-2. The downstream piezometers (PZ-15 and PZ-16) read the same during normal pool (El. 463). During most significant events, PZ-2 and PZ-3 are submerged. Data available during the December 1996 event (Plate 11), when PZ-2 was not submerged, shows that PZ-2 is much more responsive than the other piezometers in this section, peaking at El. 487.6, over 13 feet higher than the peak for PZ-1 (El. 474.1). Although Plate 6 indicates that the tips of PZ-2 and PZ-1 are located in the same zone, the response of PZ-2 indicates that it is influenced by a more pervious zone than PZ-1. PZ-2 was submerged during the April 1994 event (Plate 10). There was no field sampling done when PZ-1, PZ-2, and PZ-3 were installed, so the actual strata where these piezometers are located cannot be confirmed. Because PZ-3 is so often submerged, it is not possible to determine whether PZ-3 is influenced by the same zone as PZ-2. Overall, the responses of the upstream piezometers seem to indicate that the upstream impervious blanket is functioning properly. PZ-15 and PZ-16, which are both influenced by the relief wells, appear to be located in the same foundation strata, as their responses to events is nearly equal, and the seals do not appear to have been located at elevations where each of the piezometer tips would have been isolated in different strata.

ii. Sta.. 24+40 (Section B-B). (Refer to Plates 12-17, 28) The piezometers located along this cross section are PZ-5, 6, 7, and 8 (Plate 12). Plates 13 through 15 show the water level data recorded in these piezometers from February 1994 through January 1997. Plates 16 and 17 present the water level data recorded for this section during the April 1994 and December 1996-January 1997 flood events, respectively. Plate 28 shows pool elevation vs. piezometer elevation for all significant events for these piezometers. The water levels in the piezometers tend to gradually decrease moving downstream, both during a normal pool and during flood events (Plate 12). PZ-5 and PZ-6 tend to exhibit larger fluctuations in water elevation during pool events than PZ-7 and PZ-8, evidenced in part by the steeper slope trends in the pool vs. piezometer plots (Plate 28). It is probable that PZ-7 and PZ-8 are more influenced by rainfall and runoff from the right abutment than from increases in pool elevation, whereas PZ-5 and PZ-6 are more influenced by changes in pool elevation. During pool events, the hydraulic gradient between PZ-5 and PZ-6 is usually about 5% (April 1994 and December 1996 events). The gradient between PZ-6 and PZ-7 is -2% (April 1994 and December 1996 events), indicating an increase in head between these piezometers. This apparent increase is likely due to influences from runoff from the right abutment, as previously discussed.

(d) Profile Evaluation. Piezometers located in the same profile were plotted with pool elevation and corresponding piezometer elevations on a profile of the dam and foundation to evaluate seepage characteristics along the dam and influences of seepage passing through the abutments. Due to the location of the piezometers, only one profile was plotted at

the downstream toe of the dam, 250 ft downstream of the dam centerline (Plate 18). Four events were plotted on this profile: the 1987 flood event (maximum surcharge), the 1993 flood event, the 1994 event (Plate 25), and the 1996 event (Plate 26). Piezometer elevations for normal pool and for the pool at spillway crest were also plotted on this profile. Time history plots of pool and piezometer response for February 1994 through January 1997 were also prepared (Plates 19-24).

i. 250 Feet Downstream of Centerline (Profile C-C). (Refer to Plates 18-26, 28-30). All of the piezometers in this profile, with the exception of PZ-7, are influenced by the relief well system. Average piezometer readings were estimated along this profile with a normal pool and are within 1 ft± for all piezometers along the downstream toe (PZ-9&10, 11&12, 13&14, and 15&16), with a slight downward gradient between PZ-9&10 and PZ-13&14. The average piezometer response for PZ-7 is about 3 feet higher than for the other piezometers in this section, as it is not significantly influenced by the relief wells. During pool events, PZ-9&10 and PZ-11&12 tend to respond about a 1-2 ft higher than PZ-13&14 and PZ-15&16, likely due to PZ-9-12 being influenced to some degree by runoff from the right abutment. For the April 1994 and December 1996 events, the hydraulic gradient between PZ-9&10 and PZ-13&14 was about 1.3%, and the gradient between PZ-7 and PZ-13&14 was about 2%. All of the double piezometers, with the exception of PZ-13&14, have experienced some erratic readings, likely due to malfunction of the automation system or sensor calibration errors (see above discussion on individual piezometer response).

(e) Phreatic Surface Elevation Plan. Plate 31 contains a plot of the maximum phreatic surface elevations based on the peak piezometer levels recorded for the December 1996 event. These contours of hydrostatic pressure heads indicate the maximum pressure heads recorded for this event. The contours closer to the middle of the valley are nearly parallel to the dam while contours in the right abutment tend to become more perpendicular to the dam. This change in direction of the contours along the right abutment indicates the effect of runoff and groundwater from the right abutment. The contours in the vicinity of the relief wells appear to be directed towards the seepage trench, illustrating the effect of the relief wells on the downstream piezometers. The higher pore pressures in the right abutment is attributed to the presence of very pervious highly stratified sands and gravels which comprise the foundation outwash deposits. The majority of the seepage is probably flowing under the right abutment impervious blanket (extended and thickened during the 1970 remedial work). Seepage emergence is being controlled by the downstream right abutment filter system on the slope, the toe drains located at the toe of the downstream right abutment and at the toe of dam, and the relief wells.

c. Relief Wells.

(1) Data Collection.

(a) Location Map. Plate 1 shows a plan of the dam with the locations of the relief wells and their corresponding identification numbers.

(b) Data Tables. Table 3 lists the relief well identification numbers, stationing and offset, as well as other pertinent information.

(c) Reading Schedule. Relief well monitoring at Townshend Lake has been manually performed by project personnel since the wells were installed. The reading schedule currently in effect is as follows: During normal pools, (pool below El. 489, 32 ft stage), relief wells are read on a monthly basis. Data is recorded on a standard field data sheet, and the data is sent to Geotechnical Engineering Section for input into a spreadsheet program. When access to the instrument is made hazardous by snow and ice, the readings may be deferred until safe access is possible. When the pool rises above El. 489, the relief wells are read by project personnel along with pool elevation on a daily basis. Daily readings are to continue for five days after the pool falls below El. 489. If unusual changes in relief well readings are observed, or if the relief wells appear inoperable, Geotechnical Engineering Section should be contacted.

(2) Interpretation And Evaluation.

(a) Presentation of Data. All pertinent information (station, offset, top and bottom elevations, zone and material type where screens are located) for each relief well is listed in Table 3. A profile of the relief wells is shown on Plate 32. Time history plots of relief well water levels and pool elevations were developed for all relief wells for data gathered between April 1994 and January 1997 and are presented on Plates 33-38. Time history plots of relief well water levels and pool elevations were also developed for the April 1994 event (Plates 39-40) and the December 1996 event (Plates 41-42). Maximum relief well readings for the April 1993, April 1994, and the December 1996 events are plotted on Plate 43. As-built plans and sections showing location, installation details, and foundation stratigraphy are included in the Instrumentation Appendix of Periodic Inspection Report No. 3..

(b) Relief Well Response. Pump tests were performed on all relief wells immediately after completion of installation. These tests confirmed that all relief wells were in working order at the time of installation, and they established a baseline for well performance. Relief well data collected to date shows that the relief wells respond as expected, rising and falling with the pool. The water levels in RW-1 through RW-4 tend to be nearly equal during normal pools and high pool events (Plates 33-35, 43), whereas there is a decrease in water elevation of 2-3 ft from RW-5 to RW-7 (Plates 36-38, 43). The water level in RW-6 and RW-7 does not appear to rise above the invert elevation of the tee, meaning that these relief wells do not flow during pool events. RW-1 through RW-5 flowed during high pool events, indicating that these wells are functioning to relieve groundwater pressures at the downstream toe. No data is available for RW-8 and RW-9 due to field personnel having difficulty accessing these wells. This problem will be addressed and corrected during FY98. All nine relief wells were cleaned in 1994, and pump tests were performed. The pump tests indicated that all wells were functioning properly. The results of these tests will be presented in a separate report "1994 Relief Well Pump Tests".

d. Measuring Weir. A general plan of the project showing the location of measuring weir is provided on Plate 1. Daily weir readings are collected by the automation system via a water level sensor at the weir, and converted to a flow rate in cubic feet per second using a calibration curve. Details of the V-notch weir and the calibration curve are shown on Plate 44. Due to equipment malfunction, no weir readings are available from the automation system. The weir was reinstalled on a new gravity wall constructed in 1997 at the downstream end of the seepage pool as part of the Townshend Lake scour hole repair project.

e. Strong Motion Accelerographs

(1) Data Collection. Waterways Experimentation Station (WES) maintains all of the strong motion instrumentation at Townshend Lake. WES personnel inspect each site twice a year, and maintenance and repair is performed as necessary. A monthly visual inspection by project personnel is mandatory to check the A-C poser inside each shelter and record the electromechanical counter reading at each instrument. The findings are recorded on a standard form and mailed each month to Geotechnical Engineering Section (GES) where they are kept on file. In the event of an earthquake and in accordance with ER 1110-2-1802, GES directs Townshend Dam personnel to read the counter and perform a visual inspection of the project. Based on this inspection and the intensity of the event an engineering team may be dispatched to perform a visual inspection and HQUSACE is advised. WES is also notified, and they retrieve the earthquake record from the activated accelerographs. GES compiles an Earthquake Incident Report for the earthquake event.

(2) Interpretation and Evaluation. In their fourteen year history, the accelerographs at Townshend Dam have experienced five seismic events but have never been activated. Seismic events with earthquake intensities are tabulated below. During 1996, the accelerograph on the downstream toe was activated on at least 12 separate occasions. These activations were caused by heavy equipment in the vicinity triggering the sensor.

EARTHQUAKE DATA

Seismic Event	Date	Intensity at Epicenter*	Recorded Maximum Acceleration at Townshend Dam
Grand Falls New Brunswick, Canada	9 Jan 1982	7.4 (R=5.8)**	Not Activated
Gaza, NH	19 Jun 1982	5.2 (R=4.7)	Not Activated
Blue Mountain	7 Oct 1983	6.0 (R=5.1)	Not Activated
Franklin, NH	25 Oct 1986	3.6 (R=3.9)	Not Activated
Saguenay, Quebec	25 Nov 1986	5.9 (R=7.6)	Not Activated

* Modified Mercalli Intensity (MMI); MMI = 2 x (Richter Magnitude) - 4.2

** Values in parentheses represent Richter Magnitude.

6. CONCLUSIONS AND RECOMMENDATIONS

a. General. All geotechnical instrumentation at Townshend Dam appears to be functioning properly. Calibration of the automation system, scheduled for FY98, is needed to insure accurate readings.

b. Crest Monuments

(1) Schedule. The crest monument survey at Townshend Dam is conducted once every five years, which coincides with the periodic inspection schedule. The next scheduled survey is to be performed in 2000. If unusual readings are obtained during the next survey or if field evidence of embankment movement occurs, the monitoring schedule will be adjusted as required.

(2) Evaluation of Adequacy. The surveys indicate that the largest vertical movement of any one crest monument was 0.13 ft (1.56 in), which occurred at monument T-6. Monuments T-3 through T-6, all located above the old river valley where the embankment has its greatest height, show an average settlement of 0.1 ft, or 1.2 in. It is likely that minor settlement of the embankment (probably within the rockfill zone) above the old river valley is still occurring. No physical evidence of this settlement was visible during the periodic inspection. This small amount of settlement is not a major concern, but this area of the embankment should be monitored for potential future visible signs of settlement. T-11, which appears to have been damaged, should no longer be surveyed. The results of the 1996 horizontal movement survey shows relatively large changes in horizontal position between 1989 and 1996 due to a computational error in the original (1975) survey, which resulted in incorrect coordinates being established for control points T-13, T-14, and T-15. During the 1996 survey, new control points ("RICK" and "SHARON"; see Plates 2 and 3) were established. Because of this error, it is not known whether any horizontal movement of the embankment has taken place since the 1989 survey. However, there was no physical evidence of movement at any monument, such as slumps, scarps, cracks, or depressions which would indicate movement of any significant magnitude within the embankment. Monuments T-13, T-14, and T-15 should no longer be used for horizontal control unless the coordinates of these points are reestablished. Monuments "RICK" and "SHARON" should be used in future surveys in order to maintain consistency. In addition, horizontal coordinates established in future surveys should only be compared to the coordinates obtained from the 1996 survey, and not prior surveys.

The present configuration and number of crest monuments and control points is considered adequate to monitor horizontal and vertical movement of the dam embankment. Monuments T-2 and T-12 should not be included in future surveys, as they are not on the embankment. Third order accuracy is presently the standard utilized to perform all crest monument surveys. Conventional higher accuracy surveys are too expensive to implement on a routine basis at this time. With the advent of Global Positioning System Surveys (GPS) the accuracy of three

dimensional movements can be detected at a level of less than 5 millimeters (Ref ETL 1110-1-133). The implementation of this type of monitoring is recommended when and if it proves to be cost effective.

c. Piezometers.

(1) Evaluation of Adequacy. Analysis of piezometer data and developed phreatic surface plan shows that seepage is occurring underneath the impervious blanket, directed from the right abutment upstream blanket. Historically, seepage emergence on the downstream toe and from the right abutment have been a problem since the dam was constructed. Remedial repair work, including installation of the downstream rock fill blanket and the relief wells, has been undertaken to control these seepage problems. The piezometers are currently monitored by an automated system. Erroneous readings obtained from the system indicate that the automation system needs to be recalibrated. This is scheduled for FY98. The present level of piezometers is considered adequate to monitor the performance of the embankment and right abutment and no additional piezometers are recommended at this time.

d. Relief Wells

(1) Reading Schedule. The current relief well reading schedule as outlined in paragraph four of this report should continue to be implemented by project personnel.

(2) Evaluation of Adequacy. Based on the data collected to date, the relief wells appear to be functioning properly. Clear seepage has been detected flowing from the collector pipes during significant impoundments. RW-8 and RW-9 have not been read since early 1994 due to accessibility problems. This problem should be corrected as soon as possible. RW-6 and RW-7 do not appear to be discharging during high pool events, possibly because the phreatic pressures in the vicinity of these wells are not higher than the pipe inverts. Further discussion of the relief well performance will be included in the report on the 1994 relief well cleaning.

e. Measuring Weir.

(1) Evaluation of Adequacy. The automation sensor should be calibrated so the weir readings can resume. No additional instruments are recommended at this time.

f. Strong Motion Accelerographs.

(1) General. Since their installation in 1979, the strong motion accelerographs at Townshend Dam have experienced five earthquakes but have never been activated. During 1996, the accelerograph on the downstream toe was activated on at least 12 separate occasions. These activations were caused by heavy equipment in the vicinity triggering the sensor.

(2) Schedule. The present schedule for reading all strong motion accelerographs at Townshend Dam is once per month. In the past, this schedule has been maintained very well and there is a very good data base of information for accelerographs The present schedule is adequate and should be maintained.

(3) Evaluation of Adequacy. The present level of strong motion instrumentation is adequate to monitor movement of the dam and foundation in the event of an earthquake. The maintenance of current equipment is adequate and no supplemental accelerographs are recommended at this time.

TABLE 1 - TOWNSHEND LAKE PIEZOMETER INFORMATION

Piezometer Number	Boring Number	Centerline Station	Centerline Offset	Riser Pipe Top Elev. (ft, NGVD)	Sensor Tip Elevation (ft, NGVD)	Piezometer Tip Elev. (ft, NGVD)	Zone Where Tip is Located	Material Type Where Tip is Located
PZ-1	FD87-3	21+80	100 ft u/s	548.90	458.60	458.46	Foundation	Gravel with silt (GP-GM)
PZ-2	FD87-5	21+80	180 ft u/s	516.43	457.19	456.81	Foundation	Gravel with silt (GP-GM)
PZ-3	FD87-6	22+20	240 ft u/s	496.77	453.08	451.15	Foundation	Gravel with silt (GP-GM)
PZ-5	FD87-1	24+50	20 ft d/s	585.54	450.22	450.79	Foundation	SAND w/silt and gravel (SP)
PZ-6	FD85-7	24+50	145 ft d/s	530.72	461.22	461.67	Foundation	silty SAND (SM)
PZ-7	FD85-6	24+50	310 ft d/s	516.74	463.44	463.17	Foundation	silty SAND w/gravel (SM)
PZ-8	FD85-5	24+50	420 ft d/s	506.53	461.53	461.42	Foundation	SAND w/silt (SP-SM)
PZ-9	FD84-1	23+00	250 ft d/s	478.05	430.32	430.12	Foundation	SAND w/gravel (SP)
PZ-10	FD84-1	23+00	250 ft d/s	478.09	450.09	450.06	Foundation	SAND w/gravel (SP)
PZ-11	FD84-3	22+50	330 ft d/s	479.31	430.64	430.41	Foundation	SAND w/silt and gravel (SP-SM)
PZ-12	FD84-3	22+50	330 ft d/s	479.29	450.53	450.34	Foundation	SAND with gravel (SW)
PZ-13	FD85-4	21+10	240 ft d/s	472.23	431.56	431.29	Foundation	silty GRAVEL w/sand (GM)
PZ-14	FD85-4	21+10	240 ft d/s	472.27	451.43	451.35	Foundation	silty GRAVEL w/sand (GM)
PZ-15	FD84-2	22+00	270 ft d/s	471.38	431.41	430.59	Foundation	SAND with silt (SM)
PZ-16	FD84-2	22+00	270 ft d/s	471.73	451.33	450.48	Foundation	SAND w/gravel (SP)

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
02/16/94	478.43	465.24	467.99	467.28	467.76	462.73	465.76	465.53	462.54	463.36	463.22	463.62	462.60	462.51	461.94	462.63
02/17/94	478.46	465.69	468.40	468.25	468.19	463.18	466.18	465.82	462.94	463.79	463.65	464.02	463.02	462.94	462.32	462.89
02/18/94	478.47	465.62	468.31	468.45	468.13	463.10	466.14	465.77	462.87	463.71	463.56	463.96	462.96	462.85	462.25	462.92
02/19/94	478.47	465.72	468.42	468.12	468.18	463.16	466.19	465.82	462.93	463.76	463.64	464.03	463.02	462.93	462.32	462.86
02/20/94	478.37	465.58	468.22	467.50	467.97	462.95	465.97	465.69	462.77	463.57	463.46	463.83	462.83	462.73	462.12	462.65
02/21/94	477.77	465.30	468.09	467.29	468.10	462.74	465.78	465.48	462.55	463.36	463.23	463.60	462.62	462.53	461.93	462.54
02/22/94	476.07	465.36	468.28	467.45	467.51	462.85	465.88	465.61	462.70	463.51	463.37	463.74	462.76	462.70	462.07	462.78
02/23/94	475.34	465.91	468.73	467.95	468.37	463.29	466.34	465.94	463.10	463.92	463.78	464.15	463.20	463.10	462.47	463.10
02/24/94	475.77	465.16	468.20	467.64	467.76	462.62	465.70	465.35	462.42	463.23	463.10	463.47	462.48	462.37	461.81	462.10
02/25/94	476.33	464.94	467.95	467.44	467.64	462.54	465.54	465.25	462.32	463.14	462.99	463.41	462.36	462.27	461.73	462.38
02/26/94	477.33	464.96	467.93	467.40	467.68	462.57	465.64	465.30	462.33	463.18	463.05	463.42	462.37	462.26	461.73	462.33
02/27/94	477.51	465.31	468.12	467.53	467.94	462.84	465.86	465.57	462.61	463.43	463.35	463.70	462.62	462.54	462.03	462.60
02/28/94	477.57	465.68	468.41	467.96	468.23	463.14	466.19	465.82	462.91	463.75	463.63	464.02	462.94	462.86	462.32	462.92
03/01/94	477.14	465.74	468.59	468.11	468.36	463.27	466.29	466.11	463.03	463.88	464.13	464.14	463.07	462.99	462.41	463.05
03/02/94	477.51	465.94	468.66	468.20	468.78	463.38	466.36	466.02	463.14	464.00	463.86	464.24	463.16	463.08	462.50	463.10
03/03/94	477.75	465.27	468.08	467.55	467.87	462.75	465.78	465.49	462.50	463.34	463.23	463.59	462.49	462.41	461.89	462.28
03/04/94	477.50	464.50	467.36	466.41	467.11	462.06	465.08	464.75	461.78	462.60	462.54	462.86	461.79	461.70	461.13	461.73
03/05/94	477.51	464.64	467.56	466.80	467.43	462.33	465.39	464.99	462.06	462.92	462.79	463.16	462.08	461.97	461.44	462.11
03/06/94	477.71	465.45	468.28	467.43	468.16	463.08	466.08	465.78	462.81	463.68	463.54	463.94	462.84	462.77	462.22	462.85
03/07/94	477.77	465.77	468.31	467.93	468.13	463.05	466.08	465.74	462.82	463.68	463.54	463.91	462.83	462.77	462.19	462.76
03/08/94	477.75	465.24	468.06	467.54	467.87	462.78	465.76	465.51	462.55	463.39	463.32	463.62	462.58	462.49	462.00	462.51
03/09/94	476.94	465.68	468.54	467.54	468.36	463.24	466.31	465.92	463.01	463.90	463.73	464.11	463.05	462.98	462.41	463.12
03/10/94	476.06	465.32	468.18	467.30	467.97	462.71	465.77	465.46	462.50	463.35	463.21	463.58	462.52	462.42	461.93	462.51
03/11/94	473.15	465.49	468.53	468.08	468.21	462.99	466.05	465.71	462.85	463.68	463.52	463.92	462.86	462.79	462.26	462.97
03/12/94	482.71	466.06	469.41	468.77	468.97	463.69	466.80	466.42	463.56	464.38	464.29	464.64	463.50	463.40	462.97	463.53
03/13/94	480.00	465.98	469.07	468.54	468.78	463.49	466.57	466.22	463.29	464.16	464.03	464.39	463.22	463.10	462.68	463.16
03/14/94	479.74	465.60	468.63	468.18	468.45	463.17	466.22	465.89	462.90	463.76	463.67	464.03	462.81	462.71	462.27	463.16
03/15/94	480.09	465.37	468.46	467.60	468.28	462.94	466.08	465.67	462.69	463.55	463.49	463.80	462.58	462.48	462.09	462.60
03/16/94	479.87	465.09	468.18	467.61	468.03	462.70	465.76	465.48	462.42	463.27	463.21	463.55	462.31	462.19	461.82	462.37
03/17/94	479.93	465.14	468.26	467.60	468.16	462.86	465.87	465.63	462.58	463.46	463.37	463.72	462.44	462.34	461.94	462.51
03/18/94	479.42	465.31	468.28	468.28	468.24	462.93	465.99	465.72	462.63	463.50	463.43	463.79	462.46	462.37	462.00	462.55
03/19/94	479.38	465.09	468.13	467.66	468.10	462.78	465.85	465.58	462.49	463.38	463.32	463.65	462.32	462.20	461.84	462.43
03/20/94	479.38	465.20	468.20	467.43	468.31	462.99	466.05	465.73	462.69	463.57	463.52	463.85	462.50	462.43	462.03	462.59
03/21/94	479.38	465.62	468.69	468.03	468.74	463.47	466.51	466.17	463.15	464.06	463.97	464.31	463.00	462.91	462.48	463.10
03/22/94	479.37	465.40	468.36	467.51	468.42	463.09	466.13	465.80	462.79	463.66	463.60	463.93	462.63	462.54	462.14	462.71
03/23/94	478.94	465.51	468.40	467.94	468.50	463.20	466.23	465.93	462.89	463.76	463.69	464.06	462.73	462.65	462.25	462.80
03/24/94	479.63	465.37	468.71	468.27	468.73	463.39	466.50	466.13	463.14	464.03	463.94	464.31	462.98	462.88	462.48	463.08
03/25/94	480.15	465.62	468.64	468.19	468.65	463.26	466.38	466.00	462.99	463.88	463.80	464.17	462.83	462.73	462.37	462.93
03/26/94	480.30	465.82	469.03	468.53	468.97	463.62	466.73	466.39	463.37	464.28	464.19	464.53	463.18	463.08	462.76	463.29
03/27/94	480.09	466.07	469.24	468.72	469.21	463.83	466.96	466.63	463.58	464.48	464.43	464.75	463.36	463.26	462.98	463.50
03/28/94	486.18	465.82	469.51	468.95	468.99	463.44	466.52	466.24	463.16	464.06	464.00	464.33	462.92	462.82	462.50	463.07
03/29/94	491.90	466.55	471.11	470.53	470.02	463.97	467.06	466.27	463.79	464.56	464.46	464.77	463.37	463.44	463.04	463.55
03/30/94	496.17	467.32	472.49	471.38	471.08	464.46	467.52	467.07	464.07	464.95	464.78	465.12	463.72	463.59	463.34	463.89
03/31/94	492.55	467.69	472.55	471.85	471.61	464.88	467.97	467.35	464.40	465.31	465.18	465.46	463.99	463.86	463.67	464.21
04/01/94	484.18	467.27	471.17	470.53	471.13	464.82	467.89	467.35	464.28	465.27	465.13	465.43	463.81	463.67	463.58	464.10
04/02/94	480.45	467.09	470.71	470.11	471.02	465.09	468.20	467.76	464.61	465.61	465.51	465.82	464.15	464.01	463.89	464.45
04/03/94	480.65	466.91	470.30	469.71	470.47	464.72	467.85	467.40	464.27	465.26	465.23	465.51	463.80	463.65	463.53	464.04
04/04/94	484.78	466.91	470.68	470.04	470.55	464.81	467.95	467.51	464.39	465.38	465.35	465.65	463.91	463.78	463.70	464.23
04/05/94	493.87	467.54	472.33	471.61	471.29	465.04	468.18	467.71	464.64	465.58	465.50	465.83	464.11	463.97	463.93	464.44
04/06/94	490.33	467.95	472.78	472.06	471.81	465.29	468.42	467.90	464.81	465.75	465.64	465.96	464.22	464.07	464.08	464.57

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
04/07/94	488.84	467.73	472.38	471.62	471.69	465.23	468.34	467.80	464.68	465.68	465.59	465.86	464.06	463.89	463.93	464.44
04/08/94	492.81	468.57	474.06	473.29	472.91	466.24	469.34	468.72	465.61	466.58	466.49	466.79	464.88	464.71	464.79	465.29
04/09/94	480.92	468.37	472.18	471.43	472.59	466.49	469.57	468.97	465.73	466.79	466.72	467.02	464.96	464.80	464.95	465.43
04/10/94	480.96	467.69	471.28	470.63	471.72	465.86	469.00	468.50	465.17	466.22	466.24	466.48	464.44	464.27	464.33	464.88
04/11/94	485.33	467.73	472.01	471.34	471.95	465.98	469.11	468.60	465.39	466.39	466.35	466.67	464.64	464.47	464.54	465.10
04/12/94	481.71	467.97	471.79	471.12	472.00	466.25	469.39	468.89	465.63	466.65	466.64	466.96	464.92	464.76	464.85	465.36
04/13/94	480.97	467.56	471.04	470.38	471.48	465.79	468.93	468.50	465.13	466.16	466.26	466.52	464.36	464.23	464.35	464.88
04/14/94	494.74	467.66	473.18	472.40	471.85	465.56	468.70	468.27	464.99	466.00	466.00	466.30	464.18	464.02	464.19	464.68
04/15/94	506.03	469.46	476.94	492.26	473.95	466.56	469.63	468.89	465.76	466.79	466.65	466.93	464.83	464.63	464.84	465.32
04/16/94	512.63	470.56	479.03	510.31	475.29	467.12	470.06	469.07	465.92	466.93	466.75	466.98	464.89	464.66	464.90	465.37
04/17/94	522.01	472.08	NA	519.68	477.12	468.08	470.84	469.60	466.34	467.33	467.06	467.22	465.16	464.92	465.13	465.60
04/18/94	518.86	473.20	NA	516.74	478.53	469.26	471.91	470.20	466.88	467.91	467.54	467.65	465.56	465.31	465.57	466.01
04/19/94	511.92	472.97	485.73	509.89	478.82	469.81	472.45	470.54	467.07	468.09	467.75	467.81	465.61	465.37	465.66	466.09
04/20/94	505.98	472.60	483.58	503.96	478.53	469.89	472.58	470.65	467.03	468.10	467.78	467.84	465.52	465.29	465.56	466.05
04/21/94	498.21	471.93	481.14	496.43	478.04	469.93	472.61	470.79	467.07	468.19	467.94	467.97	465.58	465.37	465.67	466.12
04/22/94	483.05	470.42	476.55	474.30	476.50	469.43	472.22	470.68	466.77	468.03	467.79	467.89	465.37	465.15	465.52	465.97
04/23/94	480.55	469.43	474.54	472.62	475.12	468.68	471.58	470.37	466.54	467.80	467.63	467.77	465.23	465.04	465.34	465.85
04/24/94	480.46	468.74	473.52	471.56	473.87	467.67	470.65	469.65	465.85	467.12	467.05	467.19	464.64	464.49	464.78	465.28
04/25/94	481.07	468.38	473.04	471.19	473.22	467.18	470.20	469.37	465.67	466.89	466.83	467.03	464.54	464.38	464.64	465.12
04/26/94	480.90	468.37	473.16	471.19	473.06	467.13	470.19	469.48	465.86	467.06	467.07	467.27	464.78	464.62	464.91	465.36
04/27/94	480.90	468.37	473.16	471.19	473.06	467.13	470.19	469.48	465.86	467.06	467.07	467.27	464.78	464.62	464.91	465.36
04/28/94	481.06	468.03	472.84	470.85	472.53	466.71	469.82	469.18	465.63	466.80	466.80	467.06	464.62	464.47	464.70	465.23
04/29/94	480.41	468.26	472.94	470.91	472.54	466.80	469.92	469.41	465.82	466.99	467.00	467.24	464.89	464.73	464.98	465.46
04/30/94	479.46	467.79	472.34	470.22	471.87	466.23	469.36	468.80	465.33	466.45	466.45	466.73	464.44	464.30	464.47	464.98
05/01/94	479.76	467.79	472.10	469.87	471.42	465.81	468.93	468.47	465.00	466.10	466.13	466.37	464.19	464.06	464.19	464.69
05/02/94	480.77	467.45	472.13	470.04	471.47	465.83	468.97	468.48	465.08	466.16	466.23	466.46	464.31	464.19	464.29	464.80
05/03/94	480.01	467.65	472.25	470.20	471.61	466.05	469.19	468.72	465.34	466.40	466.42	466.69	464.60	464.48	464.52	465.04
05/04/94	477.94	467.60	471.98	469.93	471.44	465.97	469.13	468.68	465.31	466.36	466.38	466.67	464.62	464.50	464.52	465.07
05/05/94	479.40	467.44	471.90	469.75	471.03	465.53	468.68	468.24	464.89	465.94	465.94	466.23	464.26	464.13	464.17	464.68
05/06/94	478.95	467.02	471.02	469.20	470.55	465.10	468.30	467.87	464.53	465.54	465.54	465.83	463.88	463.75	463.77	464.29
05/07/94	479.21	466.94	471.37	469.36	470.65	465.23	468.43	468.05	464.66	465.71	465.69	465.99	464.09	464.00	463.97	464.46
05/08/94	479.56	466.80	471.25	469.12	470.31	464.91	468.09	467.67	464.40	465.41	465.41	465.68	463.86	463.72	463.71	464.22
05/09/94	483.89	466.83	472.33	469.87	470.62	464.96	468.12	467.70	464.47	465.44	465.42	465.71	463.93	463.81	463.73	464.25
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05/20/94	479.26	466.79	471.27	469.30	470.15	464.93	468.15	467.79	464.57	465.58	465.53	465.83	464.26	464.17	463.96	464.49
05/21/94	479.11	466.85	471.23	469.26	470.15	464.88	468.09	467.72	464.54	465.53	465.46	465.78	464.23	464.13	463.88	464.43
05/22/94	478.88	466.76	471.11	469.14	470.05	464.81	468.01	467.65	464.46	465.43	465.38	465.70	464.16	464.07	463.81	464.37
05/23/94	478.62	466.47	470.82	468.85	469.73	464.48	467.67	467.32	464.12	465.11	465.10	465.38	463.86	463.75	463.49	464.02
05/24/94	478.62	466.47	470.82	468.85	469.73	464.48	467.67	467.32	464.12	465.11	465.10	465.38	463.86	463.75	463.49	464.02
05/25/94	478.43	466.29	470.57	468.61	469.47	464.29	467.49	467.13	463.95	464.90	464.84	465.18	463.67	463.57	463.31	463.86
05/26/94	478.69	466.20	470.52	468.56	469.42	464.22	467.41	467.09	463.90	464.85	464.78	465.10	463.63	463.54	463.27	463.80
05/27/94	479.42	466.16	470.53	468.67	469.45	464.21	467.39	467.09	463.92	464.85	464.77	465.10	463.65	463.55	463.26	463.81
05/28/94	479.44	466.32	470.87	468.89	469.84	464.52	467.69	467.34	464.09	465.11	465.09	465.38	463.63	463.53	463.44	463.93
05/29/94	478.64	466.30	470.78	468.84	469.86	464.54	467.70	467.33	464.11	465.11	465.10	465.40	463.66	463.53	463.45	463.96
05/30/94	478.52	466.29	470.74	468.79	469.84	464.51	467.68	467.31	464.08	465.08	465.07	465.38	463.66	463.56	463.43	463.94
05/31/94	478.52	466.29	470.74	468.79	469.84	464.51	467.68	467.31	464.08	465.08	465.07	465.38	463.66	463.56	463.43	463.94
06/01/94	479.55	465.86	470.32	468.36	469.23	463.87	467.03	466.71	463.45	464.43	464.43	464.70	463.07	463.00	462.79	463.32
06/02/94	478.16	465.74	470.07	468.20	469.18	463.85	466.98	466.71	463.45	464.43	464.44	464.70	463.09	463.02	462.80	463.33
06/03/94	478.23	465.89	470.19	468.36	469.37	464.03	467.19	466.93	463.65	464.63	464.59	464.90	463.30	463.24	463.00	463.54
06/04/94	478.31	465.57	470.26	468.40	469.36	464.02	467.19	466.89	463.66	464.60	464.58	464.87	463.34	463.26	463.00	463.55

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
06/05/94	477.95	465.94	470.11	468.38	468.92	464.05	467.18	466.95	463.69	464.65	464.61	464.93	463.38	463.31	463.06	463.59
06/06/94	477.98	465.81	469.95	468.21	469.10	463.85	466.99	466.70	463.57	464.22	464.43	464.71	463.32	463.25	462.84	463.40
06/07/94	478.11	465.36	469.52	467.75	468.94	463.37	466.49	466.16	462.99	464.33	463.64	464.23	462.73	462.67	462.34	462.88
06/08/94	477.89	465.44	469.57	467.93	468.73	463.34	466.69	466.34	463.19	464.16	464.09	464.41	462.96	462.88	462.52	463.12
06/09/94	477.78	465.62	469.65	468.04	468.91	463.66	466.79	466.49	463.31	464.27	464.20	464.54	463.09	463.03	462.66	463.24
06/10/94	477.74	465.65	469.65	468.08	468.92	463.71	466.85	466.54	463.36	464.33	464.28	464.57	463.16	463.09	462.74	463.29
06/11/94	478.26	465.78	469.84	468.24	469.04	463.78	466.90	466.56	463.44	464.38	464.35	464.63	463.25	463.19	462.82	463.37
06/12/94	478.14	465.68	469.72	468.10	468.84	463.60	466.74	466.36	463.27	464.22	464.13	464.46	463.10	463.04	462.61	463.19
06/13/94	478.18	465.62	469.65	468.09	468.83	463.57	466.70	466.36	463.25	464.20	464.10	464.44	463.10	463.04	462.60	463.19
06/14/94	479.46	465.61	469.78	468.20	468.76	463.48	466.59	466.23	463.18	464.10	463.98	464.33	463.06	463.01	462.37	463.13
06/15/94	480.02	465.86	470.18	468.94	469.41	463.73	466.79	466.50	463.45	464.35	464.27	464.57	463.32	463.26	462.83	463.36
06/16/94	479.50	465.91	470.30	468.64	469.12	463.80	466.93	466.59	463.60	464.43	464.35	464.65	463.39	463.31	462.89	463.46
06/17/94	478.91	465.79	470.01	468.37	468.95	463.64	466.73	466.39	463.33	464.26	464.16	464.48	463.22	463.15	462.72	463.30
06/18/94	478.83	465.65	469.84	468.23	468.81	463.51	NA	466.26	463.19	463.78	464.02	464.35	463.07	463.01	462.56	463.15
06/19/94	478.40	465.47	469.59	468.00	468.60	463.33	466.39	466.06	462.99	463.95	463.82	463.66	462.88	462.81	462.36	462.93
06/20/94	478.33	465.66	469.77	468.19	468.99	463.56	466.64	466.28	463.22	464.16	464.06	464.39	463.10	463.06	462.59	463.20
06/21/94	478.22	465.44	469.72	467.61	468.49	463.26	466.32	465.97	462.93	463.87	463.73	464.09	462.84	462.79	462.32	462.89
06/22/94	478.27	465.09	NA	467.45	468.19	462.98	466.03	465.72	462.71	463.58	463.51	463.81	462.61	462.52	462.06	462.67
06/23/94	478.25	465.15	469.24	467.66	468.24	463.04	466.09	465.78	462.74	463.63	463.51	463.87	462.66	462.60	462.09	462.69
06/24/94	478.22	465.15	469.22	468.13	468.26	463.03	466.03	465.75	462.75	463.63	463.51	463.84	462.66	462.60	462.10	462.71
06/25/94	478.34	465.09	469.20	467.63	468.15	462.93	465.96	465.69	462.66	463.54	463.44	463.76	462.61	462.53	462.03	462.63
06/26/94	478.49	465.13	469.19	467.40	468.18	462.99	466.03	465.72	462.71	463.61	463.50	463.83	462.66	462.61	462.10	462.69
06/27/94	478.47	465.22	NA	468.29	468.28	463.08	466.15	465.77	462.80	463.68	463.56	463.91	462.75	462.67	462.17	462.78
06/28/94	478.48	465.07	469.18	467.63	468.08	462.92	466.00	465.67	462.65	463.52	463.42	463.76	462.60	462.32	462.03	462.61
06/29/94	478.27	465.18	469.26	467.69	468.55	463.00	466.00	465.73	462.73	463.62	463.48	463.83	462.68	462.62	462.11	462.69
06/30/94	478.27	465.18	469.26	467.69	468.55	463.00	466.00	465.73	462.73	463.62	463.48	463.83	462.68	462.62	462.11	462.69
**********																
07/06/94	477.98	465.81	469.95	468.21	469.10	463.85	466.99	466.70	463.57	464.22	464.43	464.71	463.32	463.25	462.84	463.40
07/07/94	478.11	465.36	469.52	467.75	468.94	463.37	466.49	466.16	462.99	464.33	463.64	464.23	462.73	462.67	462.34	462.88
07/08/94	477.89	465.44	469.57	467.93	468.73	463.34	466.69	466.34	463.19	464.16	464.09	464.41	462.96	462.88	462.52	463.12
**********																
07/12/94	478.14	465.68	469.72	468.10	468.84	463.60	466.74	466.36	463.27	464.22	464.13	464.46	463.10	463.04	462.61	463.19
**********																
07/19/94	478.40	465.47	469.59	468.00	468.60	463.33	466.39	466.06	462.99	463.95	463.82	463.66	462.88	462.81	462.36	462.93
**********																
07/26/94	478.25	464.78	469.02	467.34	467.58	462.49	465.56	465.14	462.26	463.14	462.94	463.33	462.32	462.21	461.66	462.26
07/27/94	478.25	464.76	NA	467.39	467.58	462.50	465.55	465.15	462.26	463.12	462.92	463.33	462.35	462.27	461.67	462.24
07/28/94	478.25	464.84	469.10	467.46	467.64	462.55	465.63	465.23	462.33	463.18	463.00	463.38	462.41	462.35	461.73	462.33
07/29/94	478.47	464.96	469.20	467.63	467.81	462.70	465.76	465.39	462.48	463.35	463.14	463.51	462.58	462.53	461.87	462.49
07/30/94	478.36	465.11	469.36	467.76	467.92	462.80	465.85	465.53	462.65	463.45	463.31	463.62	462.74	462.46	461.89	462.63
07/31/94	478.29	465.13	469.36	467.75	467.90	462.84	465.87	465.56	462.68	463.50	463.03	463.68	462.79	462.75	462.08	462.67
08/01/94	478.62	465.18	469.44	467.85	467.95	NA	465.93	465.56	462.67	463.50	463.36	463.69	462.76	462.59	462.05	462.67
08/02/94	478.63	465.07	469.32	467.70	467.82	462.65	NA	465.31	462.47	463.29	463.08	463.50	462.61	462.55	461.85	462.44
08/03/94	478.53	465.01	469.29	467.66	467.76	462.48	465.46	465.03	462.32	463.10	462.83	463.23	462.54	462.49	461.71	462.28
08/04/94	478.42	464.99	469.28	467.61	467.71	462.45	465.42	464.97	462.26	463.03	462.81	463.16	462.49	462.44	461.66	462.28
08/05/94	478.40	464.72	468.97	467.32	467.39	462.13	465.09	464.62	461.95	462.70	462.48	462.82	462.19	462.13	461.34	461.96
08/06/94	478.40	465.06	469.26	467.69	467.79	462.55	465.50	465.04	462.37	463.14	462.84	463.23	462.66	462.62	461.80	462.42
08/07/94	478.40	465.18	469.32	467.81	467.87	462.75	465.76	465.44	462.56	463.40	463.19	463.57	462.72	462.67	461.94	462.56
08/08/94	478.39	465.16	469.34	467.75	467.84	462.75	465.76	465.43	462.55	463.40	463.20	463.59	462.67	462.61	461.91	462.51
08/09/94	478.25	465.05	469.25	467.65	467.77	462.67	465.70	465.36	462.47	463.32	463.11	463.50	462.58	462.53	461.84	462.46

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)													
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
08/10/94	478.13	464.77	NA	467.57	467.71	462.63	465.66	465.29	462.42	463.26	463.06	463.44	462.53	462.49	461.78	462.37
08/11/94	478.09	465.10	469.20	467.69	467.81	462.75	465.76	465.46	462.54	463.39	463.21	463.57	462.66	462.61	461.91	462.51
08/12/94	478.08	465.10	469.21	467.71	467.79	462.74	465.75	465.43	462.54	463.40	463.22	463.57	462.66	462.61	461.91	462.51
08/13/94	478.07	464.99	469.06	467.54	467.58	462.56	465.58	465.21	462.35	463.19	463.01	463.39	462.48	462.43	461.73	462.33
08/14/94	478.17	464.57	468.74	467.22	467.24	462.20	465.22	464.81	461.99	462.84	462.67	463.03	462.14	462.05	461.39	461.99
08/15/94	478.27	464.68	468.78	467.35	467.39	462.35	465.38	464.97	462.15	462.99	462.78	463.16	462.27	462.21	461.53	462.14
08/16/94	478.20	465.01	469.09	467.59	467.61	462.61	465.64	465.28	462.42	463.27	463.06	463.46	462.53	462.50	461.80	462.41
08/17/94	478.18	465.06	469.10	467.66	467.71	462.69	465.70	465.39	462.49	463.33	463.13	463.51	462.61	462.57	461.87	462.47
08/18/94	478.23	464.97	468.97	467.49	467.48	462.46	465.48	465.09	462.28	463.10	462.89	463.30	462.42	462.38	461.66	462.28
08/19/94	479.21	465.01	NA	467.73	467.68	462.56	465.57	465.18	462.41	463.24	463.00	463.40	462.55	462.52	461.80	462.45
08/20/94	479.45	465.05	469.32	467.87	467.74	462.61	465.64	465.28	462.46	463.29	463.10	463.46	462.60	462.55	461.85	462.48
08/21/94	479.34	464.90	469.20	467.62	467.55	462.41	465.44	465.05	462.24	463.08	462.87	463.26	462.35	462.28	461.62	462.25
08/22/94	479.48	464.84	NA	467.68	467.60	462.43	465.47	465.05	462.26	463.10	462.87	463.26	462.39	462.34	461.66	462.30
08/23/94	479.42	465.19	469.56	468.07	467.97	462.81	465.85	465.52	462.67	463.50	463.31	463.66	462.77	462.73	462.05	462.65
08/24/94	479.31	465.52	469.88	468.33	468.24	463.09	466.11	465.75	462.92	463.77	463.59	463.94	463.04	463.00	462.30	462.93
08/25/94	479.25	465.45	469.80	468.21	468.13	462.97	466.01	465.64	462.80	463.63	463.47	463.81	462.90	462.87	462.19	462.79
08/26/94	479.27	465.23	NA	468.08	468.00	462.83	465.89	465.53	462.66	463.49	463.34	463.66	462.75	462.72	462.03	462.65
08/27/94	479.22	465.20	469.58	467.99	467.90	462.71	465.77	465.42	462.54	463.38	463.19	463.56	462.64	462.60	461.91	462.55
08/28/94	479.15	465.19	469.57	467.97	467.89	462.72	465.77	465.41	462.53	463.39	463.19	463.55	462.64	462.60	461.89	462.56
08/29/94	479.09	464.90	469.30	467.68	467.64	462.48	465.54	465.13	462.28	463.12	462.90	463.33	462.37	462.32	461.66	462.28
08/30/94	478.48	465.03	469.37	467.79	467.81	462.68	465.74	465.36	462.47	463.34	463.13	463.51	462.57	462.54	461.84	462.46
08/31/94	478.47	465.16	469.43	467.87	467.85	462.74	465.80	465.46	462.54	463.40	463.22	463.59	462.64	462.62	461.92	462.56
09/01/94	478.31	464.96	469.24	467.62	467.64	462.54	465.59	465.17	462.33	463.19	462.98	463.36	462.43	462.41	461.71	462.33
09/02/94	478.31	465.19	469.45	467.90	467.94	462.83	465.89	465.54	462.65	463.50	463.33	463.68	462.74	462.71	462.00	462.64
09/03/94	478.36	465.32	469.61	468.11	468.08	462.99	466.04	465.64	462.80	463.65	463.49	463.84	462.90	462.88	462.17	462.80
09/04/94	478.24	465.43	469.67	468.08	468.08	462.98	466.03	465.67	462.80	463.65	463.50	463.84	462.91	462.87	462.16	462.80
09/05/94	478.20	465.20	469.44	467.87	467.87	462.76	465.82	465.48	462.58	463.43	463.25	463.61	462.68	462.66	461.94	462.60
09/06/94	478.19	464.81	469.04	467.48	467.42	462.36	465.41	464.99	462.15	462.99	462.79	463.18	462.26	462.20	461.51	462.14
09/07/94	478.12	464.71	469.01	467.42	467.42	462.36	465.41	464.98	462.16	463.01	462.79	463.20	462.27	462.22	461.53	462.16
09/08/94	478.10	464.80	469.01	467.47	467.48	462.43	465.46	465.08	462.24	463.08	462.86	463.27	462.36	462.31	461.60	462.23
09/09/94	478.09	464.84	469.05	467.54	467.50	462.45	465.46	465.08	462.26	463.11	462.89	463.31	462.37	462.36	461.64	462.24
09/10/94	478.09	464.86	469.05	467.56	467.51	462.48	465.50	465.11	462.29	463.14	462.91	463.33	462.41	462.38	461.67	462.31
09/11/94	478.09	464.89	469.09	467.58	467.56	462.51	465.54	465.16	462.33	463.17	462.95	463.36	462.45	462.43	461.70	462.35
09/12/94	478.09	464.97	469.07	467.60	467.60	462.53	465.57	465.18	462.35	463.20	462.98	463.40	462.48	462.46	461.73	462.33
09/13/94	478.07	464.77	468.91	467.44	467.37	462.33	465.35	464.94	462.14	462.99	462.77	463.16	462.27	462.21	461.51	462.16
09/14/94	478.07	464.63	468.94	467.32	467.26	462.22	465.23	464.83	462.04	462.87	462.69	463.05	462.16	462.10	461.40	462.03
09/15/94	478.07	464.85	468.97	467.55	467.53	462.48	465.51	465.11	462.30	463.15	462.93	463.35	462.44	462.43	461.69	462.28
09/16/94	478.07	464.90	469.01	467.59	467.50	462.48	465.48	465.10	462.30	463.14	462.92	463.33	462.42	462.42	461.67	462.28
09/17/94	478.07	464.60	468.74	467.31	467.19	462.15	465.16	464.80	461.99	462.81	462.63	462.99	462.11	462.06	461.34	461.96
09/18/94	478.07	464.63	NA	467.20	467.06	462.07	465.06	464.74	461.89	462.73	462.54	462.90	462.03	461.98	461.27	461.87
09/19/94	478.07	464.69	468.72	467.40	467.29	462.26	465.25	464.85	462.07	462.93	462.72	463.11	462.21	462.16	461.46	462.10
09/20/94	478.07	464.86	468.92	467.58	467.50	462.48	465.49	465.11	462.30	463.16	462.91	463.34	462.43	462.42	461.67	462.32
09/21/94	478.04	464.85	468.92	467.61	467.53	462.48	465.46	465.11	462.31	463.16	462.95	463.36	462.45	462.43	461.70	462.34
09/22/94	478.04	464.85	468.92	467.61	467.53	462.48	465.46	465.11	462.31	463.16	462.95	463.36	462.45	462.43	461.70	462.34
09/23/94	478.00	464.88	468.89	467.55	467.43	462.40	465.32	465.00	462.23	463.05	462.85	463.24	462.37	462.36	461.59	462.24
**********																
10/01/94	479.54	465.18	469.78	468.24	467.95	462.77	465.83	465.49	462.64	463.50	463.31	463.68	462.71	462.71	462.02	462.63
10/02/94	479.10	465.09	469.62	468.08	467.87	462.71	465.75	465.39	462.54	463.41	463.18	463.59	462.61	462.60	461.92	462.56
10/03/94	478.97	465.22	469.70	468.13	467.94	462.80	465.85	465.51	462.63	463.52	463.31	463.69	462.69	462.69	462.00	462.60
10/04/94	478.41	465.20	469.60	468.04	467.92	462.80	465.86	465.50	462.63	463.51	463.32	463.70	462.68	462.67	462.00	462.62

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
10/05/94	478.34	465.09	469.48	467.88	467.77	462.70	465.76	465.43	462.52	463.41	463.19	463.58	462.58	462.57	461.89	462.51
10/06/94	478.43	465.20	469.59	468.04	467.90	462.83	465.89	465.52	462.67	463.54	463.34	463.72	462.73	462.73	462.03	462.68
10/07/94	478.08	465.40	469.68	468.17	468.10	463.03	466.11	465.72	462.87	463.75	463.54	463.95	462.95	462.95	462.25	462.88
10/08/94	478.53	465.32	469.92	468.21	468.05	462.98	466.06	465.67	462.82	463.71	463.50	463.89	462.91	462.89	462.19	462.81
10/09/94	478.55	465.20	NA	467.99	467.82	462.75	465.83	465.47	462.58	463.45	463.23	463.63	462.67	462.65	461.95	462.56
10/10/94	478.55	465.05	NA	467.88	467.71	462.63	465.72	465.36	462.46	463.35	463.13	463.53	462.56	462.54	461.83	462.42
10/11/94	478.55	465.39	469.73	468.25	468.10	463.01	466.09	465.71	462.86	463.75	463.51	463.91	462.96	462.95	462.24	462.84
10/12/94	478.55	465.62	470.01	468.49	468.31	463.25	466.31	465.89	463.10	463.98	463.75	464.17	463.20	463.19	462.46	463.10
10/13/94	478.50	465.52	469.95	468.40	468.21	463.14	466.19	465.79	462.99	463.86	463.62	464.04	463.08	463.08	462.36	462.94
10/14/94	478.29	465.45	469.72	468.15	468.02	462.91	466.00	465.62	462.78	463.64	463.44	463.80	462.87	462.85	462.14	462.74
10/15/94	478.26	465.43	469.76	468.26	468.10	463.05	466.13	465.69	462.90	463.79	463.56	463.95	463.02	463.00	462.27	462.86
10/16/94	478.26	465.40	469.65	468.17	468.00	462.95	466.02	465.60	462.78	463.68	463.49	463.85	462.89	462.90	462.16	462.78
10/17/94	478.25	465.28	469.55	468.10	467.92	462.88	465.95	465.57	462.75	463.61	463.42	463.78	462.84	462.83	462.12	462.71
10/18/94	478.25	465.37	469.61	467.94	467.77	462.70	465.80	465.42	462.57	463.44	463.24	463.60	462.70	462.70	461.93	462.55
10/19/94	478.51	464.99	469.27	467.80	467.56	462.53	465.61	465.19	462.37	463.24	463.00	463.43	462.52	462.50	461.76	462.38
10/20/94	478.51	464.92	469.16	467.71	467.50	462.44	465.50	465.08	462.28	463.15	462.92	463.34	462.42	462.42	461.68	462.31
10/21/94	478.49	464.81	469.09	467.63	467.42	462.38	465.44	464.99	462.21	463.08	462.86	463.28	462.37	462.37	461.61	462.25
**********																
10/25/94	478.69	464.82	469.04	467.68	467.42	462.39	465.46	465.02	462.24	463.10	462.84	463.29	462.40	462.39	461.63	462.24
10/26/94	478.65	464.97	469.16	467.83	467.58	462.54	465.60	465.21	462.40	463.26	463.00	463.43	462.55	462.55	461.78	462.40
10/27/94	478.35	465.02	469.13	467.89	467.61	462.57	465.64	465.24	462.43	463.31	463.05	463.49	462.59	462.60	461.83	462.44
10/28/94	478.29	465.11	469.20	467.95	467.71	462.67	465.75	465.39	462.55	463.41	463.19	463.59	462.70	462.70	461.94	462.55
**********																
11/02/94	478.43	464.17	468.20	466.96	466.64	461.67	464.71	464.33	461.52	462.36	462.13	462.56	461.69	461.70	460.92	461.46
11/03/94	478.64	464.80	468.91	467.76	467.47	462.47	465.49	465.12	462.34	463.19	462.94	463.37	462.52	462.52	461.73	462.34
11/04/94	478.63	465.02	469.07	467.90	467.56	462.57	465.63	465.26	462.45	463.30	463.05	463.49	462.62	462.65	461.85	462.34
11/05/94	478.56	464.89	468.91	467.76	467.42	462.41	465.44	465.03	462.27	463.12	462.88	463.31	462.44	462.44	461.67	462.20
11/06/94	478.56	464.90	468.93	467.76	467.43	462.42	465.47	465.04	462.28	463.12	462.88	463.34	462.46	462.46	461.69	462.28
11/07/94	478.69	464.68	468.78	NA	467.37	462.36	465.41	464.98	462.23	463.08	462.85	463.28	462.40	462.42	461.64	462.23
11/08/94	478.70	465.07	469.08	467.95	467.58	462.56	465.61	465.23	462.44	463.30	463.05	463.48	462.61	462.62	461.84	462.43
11/09/94	478.72	464.67	468.73	467.59	467.21	462.20	465.22	464.82	462.06	462.89	462.70	463.09	462.23	462.22	461.45	462.06
11/10/94	478.59	464.84	468.84	467.72	467.40	462.40	465.46	465.02	462.27	463.11	462.87	463.31	462.45	462.46	461.68	462.26
11/11/94	478.55	465.05	469.03	467.96	467.64	462.65	465.71	465.36	462.53	463.37	463.14	463.57	462.70	462.70	461.93	462.55
11/12/94	478.56	465.31	469.24	468.20	467.85	462.84	465.89	465.55	462.74	463.57	463.36	463.77	462.91	462.89	462.12	462.73
11/13/94	478.56	465.06	469.00	467.93	467.58	462.56	465.62	465.22	462.45	463.31	463.05	463.48	462.62	462.63	461.84	462.47
11/14/94	478.55	465.14	469.16	468.14	467.77	462.76	465.80	465.47	462.65	463.49	463.27	463.68	462.84	462.82	462.05	462.67
11/15/94	478.53	464.98	468.93	467.82	467.50	462.47	465.49	465.11	462.34	463.19	462.94	463.38	462.53	462.52	461.75	462.35
11/16/94	478.53	465.22	469.16	468.13	467.77	462.76	465.81	465.50	462.68	463.51	463.33	463.68	462.83	462.82	462.05	462.67
11/17/94	478.53	465.43	469.31	468.29	467.95	462.93	465.97	465.61	462.81	463.66	463.48	463.83	463.01	462.99	462.20	462.83
11/18/94	478.52	465.37	469.22	468.19	467.81	462.76	465.82	465.48	462.69	463.50	463.32	463.70	462.86	462.85	462.07	462.67
11/19/94	478.52	464.86	468.65	467.64	467.30	462.29	465.30	464.90	462.16	463.00	462.78	463.18	462.35	462.34	461.55	462.15
11/20/94	478.52	465.15	NA	468.06	467.74	462.70	465.76	465.42	462.60	463.43	463.22	463.65	462.79	462.78	462.00	462.63
11/21/94	478.51	465.35	469.23	468.18	467.84	462.81	465.85	465.51	462.72	463.52	463.34	463.74	462.89	462.89	462.09	462.70
11/22/94	478.79	464.64	468.57	467.50	467.08	462.09	465.12	464.71	461.99	462.81	462.60	463.01	462.19	462.16	461.38	462.01
11/23/94	478.83	464.80	468.71	467.61	467.19	462.20	465.23	464.82	462.08	462.92	462.71	463.12	462.29	462.27	461.51	462.10
11/24/94	478.65	464.84	468.85	467.82	467.45	462.45	465.50	465.10	462.35	463.17	462.93	463.38	462.53	462.54	461.74	462.37
11/25/94	478.62	464.77	468.71	467.62	467.27	462.27	465.32	464.90	462.14	462.99	462.75	463.18	462.32	462.32	461.54	462.16
11/26/94	478.65	464.81	468.84	467.79	467.48	462.45	465.50	465.06	462.33	463.17	462.92	463.36	462.50	462.51	461.72	462.33
11/27/94	478.53	465.39	469.36	468.35	468.02	463.00	466.04	465.65	462.90	463.75	463.51	463.94	463.10	463.10	462.31	462.93
11/28/94	478.57	465.16	468.98	467.88	467.50	462.50	465.49	465.11	462.37	463.19	462.94	463.40	462.54	462.55	461.76	462.38

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
11/29/94	483.03	464.88	469.35	NA	467.47	462.33	465.36	464.92	462.26	463.05	462.79	463.25	462.46	462.47	461.68	462.30
11/30/94	483.56	465.53	470.34	469.18	468.21	462.79	465.82	465.46	462.74	463.49	463.28	463.68	462.90	462.88	462.12	462.71
12/01/94	479.27	465.62	469.83	468.72	468.31	463.05	466.11	465.67	462.93	463.74	463.54	463.96	463.05	463.02	462.32	462.91
12/02/94	479.58	465.45	469.72	468.59	468.18	462.98	466.01	465.61	462.83	463.66	463.49	463.85	462.93	462.92	462.21	462.82
12/03/94	478.89	465.47	469.52	468.44	468.19	463.00	466.05	465.65	462.86	463.68	463.50	463.91	462.96	462.93	462.24	462.84
12/04/94	478.86	465.48	469.51	468.44	468.16	463.04	466.08	465.68	462.88	463.72	463.53	463.94	462.96	462.96	462.26	462.86
12/05/94	479.10	465.53	469.56	468.47	468.19	463.06	466.12	465.72	462.91	463.74	463.55	463.97	463.00	462.99	462.29	462.91
12/06/94	494.59	466.11	473.13	471.49	468.99	462.96	466.00	465.61	462.97	463.70	463.44	463.83	463.09	463.07	462.36	462.94
12/07/94	491.58	466.76	474.16	472.02	470.21	463.54	466.54	465.98	463.41	464.20	463.85	464.27	463.41	463.35	462.76	463.35
12/08/94	481.98	466.70	472.21	470.59	470.31	464.12	467.12	466.64	463.85	464.72	464.49	464.84	463.70	463.64	463.17	463.73
12/09/94	480.11	466.59	471.47	470.03	470.04	464.33	467.37	466.99	464.03	464.93	464.74	465.13	463.81	463.76	463.33	463.91
12/10/94	480.48	466.32	471.15	469.70	469.70	464.05	467.14	466.78	463.80	464.68	464.52	464.90	463.56	463.49	463.09	463.66
12/11/94	479.98	465.87	470.55	468.92	468.89	463.36	466.45	466.01	463.08	463.99	463.81	464.20	462.87	462.86	462.38	462.97
12/12/94	480.07	466.27	470.94	469.60	469.65	464.15	467.27	466.86	463.90	464.79	464.63	465.02	463.71	463.65	463.23	463.77
12/13/94	479.85	466.54	471.19	469.76	469.79	464.35	467.45	467.11	464.11	465.05	464.85	465.24	463.93	463.89	463.44	463.99
12/14/94	479.03	466.45	471.02	469.57	469.71	464.33	467.45	467.13	464.09	465.02	464.84	465.25	463.90	463.85	463.41	463.97
12/15/94	479.33	466.42	470.96	469.53	469.63	464.28	467.39	467.08	464.05	464.99	464.81	465.20	463.86	463.81	463.38	463.93
12/16/94	479.41	466.38	470.95	469.54	469.57	464.29	467.42	467.08	464.06	465.00	464.84	465.22	463.90	463.83	463.38	463.94
12/17/94	479.36	466.21	470.74	469.23	469.33	464.00	467.13	466.83	463.76	464.70	464.55	464.94	463.58	463.55	463.10	463.63
12/18/94	479.34	465.83	470.28	468.76	468.84	463.54	466.67	466.29	463.29	464.23	464.07	464.44	463.14	463.10	462.60	463.20
12/19/94	479.31	465.64	470.11	468.70	468.79	463.52	466.63	466.26	463.27	464.22	464.03	464.43	463.13	463.11	462.60	463.17
12/20/94	479.15	465.96	470.41	469.00	469.12	463.84	466.95	466.57	463.61	464.54	464.42	464.77	463.46	463.42	462.95	463.50
12/21/94	478.66	466.04	470.39	468.97	469.12	463.89	466.99	466.68	463.67	464.59	464.44	464.81	463.53	463.47	462.99	463.53
12/22/94	479.12	465.82	470.17	468.75	468.79	463.57	466.69	466.29	463.34	464.27	464.09	464.50	463.23	463.21	462.68	463.26
12/23/94	479.12	465.82	470.17	468.75	468.79	463.57	466.69	466.29	463.34	464.27	464.09	464.50	463.23	463.21	462.68	463.26
12/24/94	479.14	465.47	469.81	468.32	468.34	463.15	466.26	465.88	462.91	463.84	463.64	464.07	462.81	462.79	462.24	462.83
12/25/94	481.53	465.51	470.17	468.71	468.53	463.20	466.29	465.90	463.01	463.90	463.69	464.10	462.93	462.89	462.35	462.94
12/26/94	480.41	465.92	470.57	469.16	469.12	463.75	466.86	466.45	463.56	464.45	464.30	464.67	463.42	463.38	462.90	463.46
12/27/94	479.91	466.07	470.68	469.24	469.26	463.92	467.05	466.68	463.74	464.63	464.50	464.85	463.56	463.49	463.05	463.60
12/28/94	480.95	465.90	470.62	469.08	468.97	463.59	466.73	466.33	463.37	464.28	464.12	464.52	463.22	463.19	462.70	463.25
12/29/94	479.94	465.68	470.26	468.80	468.86	463.51	466.64	466.80	463.28	464.22	464.04	464.43	463.12	463.09	462.59	463.18
12/30/94	479.25	466.07	470.64	469.23	469.39	464.07	467.18	466.87	463.83	464.75	464.59	465.00	463.66	463.60	463.16	463.73
12/31/94	478.92	466.21	470.71	469.26	469.44	464.15	467.27	466.95	463.91	464.84	464.68	465.09	463.73	463.68	463.24	463.81
01/01/95	478.91	465.85	470.24	468.70	468.84	463.59	466.73	466.34	463.35	464.28	464.13	464.54	463.17	463.14	462.68	463.29
01/02/95	479.03	465.55	469.84	468.33	468.49	463.26	466.42	466.03	463.02	463.95	463.80	464.21	462.84	462.81	462.35	462.96
01/03/95	479.06	465.81	470.12	468.72	468.91	463.70	466.83	466.48	463.46	464.39	464.28	464.63	463.30	463.25	462.79	463.37
01/04/95	479.19	465.74	470.11	468.64	468.76	463.54	466.68	466.31	463.30	464.23	464.08	464.47	463.15	463.11	462.60	463.23
01/05/95	478.94	465.74	470.05	468.64	468.84	463.61	466.70	466.36	463.36	464.28	464.14	464.53	463.22	463.19	462.69	463.27
01/06/95	478.73	465.35	NA	468.59	468.79	463.59	466.74	466.33	463.35	464.28	464.12	464.52	463.22	463.19	462.67	463.28
01/07/95	478.91	465.26	469.49	467.96	468.05	462.86	465.96	465.65	462.65	463.55	463.41	463.80	462.49	462.47	461.96	462.52
01/08/95	479.17	465.60	469.82	468.47	468.60	463.44	466.55	466.19	463.22	464.14	463.96	464.39	463.09	463.06	462.54	463.13
01/09/95	478.98	465.62	469.90	468.55	468.70	463.51	466.62	466.26	463.28	464.21	464.04	464.44	463.17	463.15	462.62	463.21
01/10/95	479.08	465.90	470.20	468.87	469.02	463.85	466.94	466.60	463.63	464.55	464.43	464.78	463.53	463.44	462.98	463.55
01/11/95	478.93	466.08	470.35	469.00	469.18	464.02	467.11	466.75	463.60	464.71	464.52	464.95	463.70	463.62	463.15	463.70
01/12/95	478.82	465.98	470.16	468.78	468.92	463.76	466.83	466.51	463.54	464.44	464.28	464.66	463.45	463.39	462.88	463.47
01/13/95	478.76	465.61	469.78	468.43	468.57	463.42	466.54	466.15	463.19	464.10	463.92	464.35	463.11	463.09	462.52	463.13
01/14/95	479.23	465.92	469.99	468.67	468.76	463.62	466.71	466.31	463.40	464.29	464.13	464.52	463.34	463.29	462.74	463.33
01/15/95	479.98	465.72	470.02	468.62	468.60	463.43	466.53	466.14	463.20	464.13	463.92	464.34	463.17	463.15	462.57	463.19
01/16/95	483.06	465.62	470.43	468.92	468.58	463.25	466.36	465.95	463.07	463.97	463.74	464.18	463.07	463.02	462.45	463.05
01/17/95	487.20	466.07	471.82	470.09	469.28	463.56	466.63	466.21	463.38	464.26	464.03	464.42	463.32	463.27	NA	463.34

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD) PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
01/18/95	483.77	466.54	471.98	470.78	470.05	464.15	467.20	466.85	463.91	464.80	464.58	464.94	463.77	463.69	463.25	463.82
01/19/95	482.44	466.51	471.69	469.97	469.83	464.13	467.24	466.88	463.87	464.79	464.58	464.96	463.70	463.62	463.21	463.77
01/20/95	480.15	466.02	470.73	469.07	469.20	463.64	466.74	466.33	463.32	464.28	464.10	464.49	463.13	463.08	462.66	463.23
01/21/95	484.72	465.68	470.96	469.23	468.94	463.20	466.30	465.86	462.93	463.86	463.65	464.05	462.72	462.68	462.26	462.83
01/22/95	484.52	465.99	471.55	469.73	469.52	463.57	466.70	466.26	463.28	464.22	464.00	464.40	463.03	462.98	462.58	463.18
01/23/95	481.03	466.02	471.02	469.32	469.57	463.84	466.96	466.50	463.50	464.47	464.33	464.68	463.20	463.14	462.81	463.37
01/24/95	480.11	466.04	470.72	469.08	469.44	463.88	467.01	466.65	463.53	464.50	464.39	464.76	463.20	463.15	462.82	463.39
01/25/95	479.93	465.99	470.67	469.12	469.50	463.99	467.14	466.78	463.64	464.64	464.50	464.87	463.33	463.26	462.96	463.51
01/26/95	479.64	465.98	470.60	469.00	469.44	463.97	467.10	466.75	463.60	464.59	464.50	464.83	463.31	463.26	462.91	463.49
01/27/95	479.25	465.89	470.43	468.87	469.36	463.92	467.05	466.72	463.56	464.56	464.43	464.79	463.27	463.21	462.88	463.45
01/28/95	478.89	465.92	470.40	468.87	469.36	463.96	466.99	466.81	463.65	464.62	464.50	464.85	463.34	463.26	462.94	463.48
01/29/95	478.86	466.06	470.49	468.99	469.52	464.15	467.30	466.94	463.85	464.80	464.68	465.07	463.55	463.47	463.16	463.71
01/30/95	478.70	465.95	470.34	468.80	469.26	463.97	467.10	466.82	463.67	464.64	464.51	464.89	463.37	463.31	462.98	463.53
01/31/95	478.77	465.57	469.96	468.39	468.86	463.58	466.76	466.39	463.29	464.26	464.13	464.54	463.00	462.96	462.61	463.17
02/01/95	478.98	465.28	469.80	468.11	468.55	463.31	466.47	466.08	463.01	463.97	463.86	464.26	462.73	462.69	462.32	462.87
02/02/95	479.21	465.27	469.75	468.23	468.63	463.41	466.56	466.19	463.10	464.08	463.94	464.35	462.84	462.79	462.41	462.99
02/03/95	478.95	465.77	470.11	468.66	469.13	463.89	467.04	466.71	463.59	464.58	464.47	464.83	463.35	463.29	462.94	463.50
02/04/95	478.97	465.65	470.00	468.44	468.84	463.62	466.78	466.47	463.32	464.28	464.18	464.57	463.10	463.04	462.65	463.23
02/05/95	478.88	464.68	469.00	467.45	467.87	462.67	465.83	465.52	462.38	463.33	463.22	463.61	462.16	462.07	461.69	462.29
02/06/95	478.75	464.96	469.36	467.92	468.36	463.18	466.32	465.95	462.89	463.85	463.71	464.12	462.66	462.62	462.22	462.78
02/07/95	478.49	465.35	469.57	468.14	468.60	463.44	466.58	466.23	463.14	464.10	463.97	464.39	462.94	462.90	462.47	463.03
02/08/95	478.86	465.35	469.60	468.18	468.57	463.39	466.53	466.17	463.12	464.06	463.94	464.34	462.94	462.87	462.45	463.00
02/09/95	479.00	465.28	469.57	468.14	468.55	463.35	466.48	466.13	463.08	464.03	463.89	464.31	462.92	462.85	462.41	462.97
02/10/95	479.04	465.24	469.53	468.13	468.47	463.31	466.42	466.05	463.03	463.97	463.82	464.24	462.86	462.82	462.37	462.95
02/11/95	479.04	465.05	469.37	467.91	468.24	463.06	466.19	465.83	462.80	463.74	463.59	463.99	462.65	462.60	462.14	462.73
02/12/95	479.04	465.16	469.47	468.09	468.44	463.27	466.36	466.01	462.98	463.93	463.77	464.18	462.86	462.79	462.31	462.88
02/13/95	479.04	465.55	469.78	468.41	468.78	463.59	466.70	466.32	463.29	464.23	464.09	464.48	463.18	463.12	462.66	463.23
02/14/95	479.07	465.87	NA	468.38	468.76	463.54	466.64	466.23	463.25	464.17	464.02	464.44	463.16	463.10	462.60	463.19
02/15/95	479.11	465.92	470.10	468.75	469.10	463.89	466.95	466.60	463.63	464.51	464.42	464.77	463.52	463.43	462.96	463.53
02/16/95	479.15	465.34	NA	468.26	468.32	463.11	466.21	465.81	462.82	463.73	463.59	463.98	462.76	462.70	462.18	462.78
02/17/95	479.20	465.65	469.84	468.51	468.83	463.64	466.70	466.34	463.35	464.27	464.11	464.50	463.31	463.24	462.71	463.31
02/18/95	479.20	465.69	469.92	468.55	468.89	463.69	466.75	466.41	463.42	464.34	464.19	464.57	463.38	463.31	462.80	463.36
02/19/95	479.20	465.40	469.82	468.44	468.73	463.54	466.62	466.24	463.27	464.18	464.01	464.43	463.23	463.17	462.63	463.22
02/20/95	479.20	465.32	469.50	468.13	468.41	463.22	466.30	465.91	462.95	463.85	463.68	464.09	462.94	462.87	462.32	462.90
02/21/95	479.19	464.94	NA	467.62	467.90	462.75	465.83	465.31	462.48	463.38	463.41	463.63	462.44	462.39	461.84	462.42
02/22/95	479.03	464.99	469.26	467.96	468.29	463.10	466.15	465.80	462.84	463.72	463.57	463.99	462.81	462.77	462.21	462.78
02/23/95	478.93	465.35	469.42	468.08	468.36	463.18	466.28	465.88	462.93	463.79	463.66	464.07	462.91	462.87	462.28	462.89
02/24/95	478.89	464.93	469.05	467.63	467.90	462.73	465.80	465.48	462.47	463.37	463.22	463.62	462.45	462.40	461.82	462.40
02/25/95	478.68	465.20	469.30	468.04	468.32	463.18	466.23	465.85	462.93	463.84	463.65	464.09	462.91	462.87	462.31	462.89
02/26/95	478.58	465.57	469.63	468.37	468.70	463.55	466.64	466.23	463.29	464.22	464.01	464.45	463.30	463.23	462.68	463.24
02/27/95	478.52	465.78	469.90	468.62	468.92	463.79	466.86	466.49	463.55	464.46	464.31	464.69	463.55	463.46	462.92	463.50
**********																
04/13/95	480.03	465.24	469.55	468.10	468.50	463.22	466.30	465.96	462.93	463.87	NA	464.07	462.80	462.72	462.27	462.82
04/14/95	479.85	465.19	469.56	468.08	468.49	463.21	466.33	465.95	462.94	463.88	463.71	464.11	462.79	462.72	462.28	462.86
04/15/95	479.66	465.26	469.58	468.14	468.58	463.29	466.43	466.04	463.01	463.95	463.79	464.20	462.89	462.81	462.36	462.94
04/16/95	479.49	465.23	469.56	468.12	468.55	463.28	466.40	466.01	463.00	463.95	463.78	464.18	462.87	462.79	462.35	462.91
04/17/95	479.31	465.51	469.80	468.40	468.89	463.61	466.77	466.38	463.34	464.28	464.12	464.53	463.22	463.13	462.68	463.23
04/18/95	478.82	465.51	469.72	468.34	468.86	463.62	466.75	466.36	463.34	464.29	464.13	464.54	463.21	463.12	462.68	463.24
04/19/95	479.04	465.37	469.64	468.20	468.66	463.41	466.54	466.18	463.13	464.07	463.92	464.33	463.02	462.93	462.46	463.05
04/20/95	479.47	465.30	469.63	468.20	468.62	463.39	466.52	466.12	463.11	464.06	463.88	464.30	462.99	462.92	462.45	463.07

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
04/21/95	478.99	465.53	469.77	468.36	468.86	463.61	466.74	466.36	463.34	464.27	464.14	464.53	463.22	463.15	462.68	463.29
04/22/95	479.54	465.22	469.51	468.06	468.47	463.22	466.35	465.95	462.96	463.89	463.72	464.15	462.84	462.77	462.29	462.92
04/23/95	479.33	465.30	469.61	468.18	468.62	463.39	466.52	466.15	463.12	464.06	463.88	464.30	463.00	462.92	462.46	463.06
04/24/95	479.16	465.32	469.60	468.18	468.62	463.38	466.54	466.15	463.12	464.08	463.90	464.30	463.02	462.93	462.46	463.04
04/25/95	479.83	465.35	469.69	468.26	468.65	463.39	466.53	466.13	463.13	464.07	463.90	464.31	463.04	462.95	462.48	463.05
04/26/95	479.51	465.40	469.75	468.40	468.83	463.56	466.69	466.30	463.30	464.23	464.08	464.48	463.20	463.10	462.66	463.21
04/27/95	479.45	465.70	469.99	468.56	468.99	463.74	466.87	466.50	463.52	464.40	464.25	464.65	463.38	463.29	462.84	463.41
04/28/95	479.40	465.49	469.77	468.29	468.71	463.46	466.60	466.22	463.21	464.15	463.96	464.35	463.13	463.05	462.55	463.18
04/29/95	479.43	465.60	469.86	468.40	468.83	463.57	466.71	466.33	463.35	464.27	464.09	464.50	463.27	463.18	462.70	463.29
04/30/95	478.82	465.66	469.87	468.40	468.84	463.62	466.80	466.36	463.39	464.32	464.16	464.55	463.32	463.25	462.75	463.32
05/01/95	479.28	465.64	469.90	468.41	468.79	463.58	466.70	466.33	463.34	464.27	464.10	464.51	463.30	463.21	462.72	463.28
05/02/95	479.40	465.57	469.82	468.33	468.73	463.53	466.69	466.27	463.29	464.22	464.04	464.44	463.25	463.16	462.64	463.23
05/03/95	478.89	465.89	469.71	468.22	468.65	463.46	466.59	466.23	463.24	464.16	463.99	464.38	463.19	463.11	462.61	463.16
05/04/95	479.01	465.70	469.83	468.39	468.79	463.62	466.73	466.39	463.39	464.29	464.13	464.52	463.36	463.26	462.75	463.31
05/05/95	478.80	465.62	469.69	468.21	468.62	463.44	466.54	466.22	463.21	464.14	463.94	464.35	463.20	463.12	462.58	463.19
05/06/95	478.84	465.30	469.53	468.04	468.45	463.29	466.44	466.04	463.06	464.00	463.80	464.21	463.06	462.98	462.44	463.03
05/07/95	478.87	465.58	469.68	468.26	468.65	463.48	466.58	466.22	463.25	464.17	463.98	464.40	463.25	463.17	462.62	463.26
05/08/95	478.73	465.57	469.63	468.21	468.65	463.49	466.62	466.24	463.26	464.19	463.99	464.41	463.26	463.19	462.64	463.22
05/09/95	476.94	465.56	469.40	468.04	468.60	463.59	466.70	466.37	463.35	464.29	464.12	464.52	463.36	463.28	462.74	463.32
05/10/95	477.59	465.32	469.25	467.78	468.28	463.34	466.45	466.13	463.11	464.02	463.87	464.30	463.12	463.04	462.50	463.08
05/11/95	475.03	464.97	468.72	467.27	467.94	463.11	466.22	465.86	462.90	463.81	463.65	464.08	462.91	462.86	462.28	462.87
05/12/95	475.67	464.63	468.66	467.03	467.63	462.87	465.99	465.70	462.73	463.60	463.48	463.88	462.73	462.67	462.09	462.64
05/13/95	478.69	464.81	468.68	467.45	467.79	462.95	466.05	465.74	462.79	463.68	463.56	463.93	462.82	462.77	462.19	462.75
05/14/95	478.94	465.36	469.30	468.02	468.28	463.32	466.43	466.08	463.15	464.05	463.85	464.28	463.21	463.15	462.55	463.14
05/15/95	478.01	465.02	468.73	467.58	467.95	462.96	466.05	465.72	462.79	463.66	463.54	463.88	462.84	462.79	462.18	462.74
05/16/95	479.09	464.93	469.07	467.72	468.07	463.01	466.11	465.78	462.79	463.69	463.53	463.96	462.69	462.64	462.15	462.74
05/17/95	479.16	464.96	469.12	467.78	468.10	463.00	466.08	465.74	462.77	463.66	463.50	463.92	462.70	462.63	462.12	462.69
05/18/95	479.18	464.67	468.87	467.50	467.82	462.66	465.77	465.47	462.43	463.34	463.17	463.59	462.38	462.32	461.78	462.44
05/19/95	479.07	464.86	468.77	468.07	467.89	462.72	465.82	465.51	462.47	463.37	463.20	463.63	462.42	462.37	461.83	462.43
05/20/95	479.00	464.73	468.89	467.54	467.92	462.75	465.85	465.54	462.51	463.41	463.28	463.65	462.47	462.41	461.86	462.48
05/21/95	478.94	464.90	469.09	467.78	468.13	462.97	466.04	465.70	462.74	463.61	463.46	463.87	462.70	462.65	462.10	462.69
05/22/95	478.79	465.03	469.14	467.83	468.16	463.04	466.10	465.78	462.81	463.69	463.56	463.96	462.81	462.75	462.18	462.77
05/23/95	478.89	465.39	469.45	468.18	468.52	463.38	466.49	466.06	463.15	464.04	463.87	464.29	463.15	463.09	462.52	463.14
05/24/95	478.80	465.15	469.21	467.92	468.21	463.08	466.17	465.81	462.85	463.76	463.57	463.98	462.85	462.79	462.23	462.83
05/25/95	478.74	465.14	469.24	467.99	468.29	463.18	466.25	465.88	462.95	463.85	463.69	464.10	462.95	462.89	462.32	462.92
05/26/95	478.90	465.28	469.36	468.09	468.37	463.24	466.29	465.93	463.01	463.91	463.72	464.15	463.02	462.97	462.39	463.00
05/27/95	478.92	465.43	469.44	468.18	468.49	463.34	466.40	466.04	463.10	464.00	463.82	464.25	463.12	463.06	462.48	463.02
05/28/95	478.83	465.62	469.61	468.35	468.66	463.52	466.59	466.21	463.29	464.21	464.03	464.42	463.30	463.24	462.68	463.25
05/29/95	478.69	465.22	469.27	467.95	468.23	463.10	466.13	465.78	462.85	463.76	463.59	463.98	462.86	462.82	462.22	462.81
05/30/95	478.89	464.82	468.96	467.64	467.94	462.81	465.89	465.55	462.59	463.46	463.33	463.70	462.59	462.55	461.94	462.58
05/31/95	479.57	465.07	469.27	468.01	468.21	463.04	466.10	465.77	462.82	463.71	463.53	463.94	462.86	462.81	462.21	462.83
**********																
06/26/95	478.05	464.77	468.80	467.55	467.74	462.72	465.79	465.46	462.47	463.41	463.18	463.59	462.58	462.55	NA	NA
06/27/95	477.99	465.06	469.07	467.80	468.05	463.00	466.10	465.68	462.78	463.69	463.48	463.89	462.88	462.86	462.16	462.78
06/28/95	477.92	465.06	469.07	467.79	468.00	462.97	466.02	465.67	462.75	463.65	463.46	463.81	462.83	462.82	462.14	462.77
06/29/95	477.89	464.93	468.87	467.56	467.81	462.75	465.84	465.46	462.52	463.44	463.20	463.61	462.63	462.60	461.91	462.53
06/30/95	477.87	464.71	468.69	467.39	467.61	462.58	465.64	465.26	462.33	463.23	462.99	463.42	462.45	462.41	461.72	462.31
07/01/95	477.85	464.46	468.48	467.22	467.40	462.37	465.43	464.99	462.14	463.03	462.79	463.21	462.23	462.20	461.51	462.14
07/02/95	477.84	464.40	468.42	467.14	467.35	462.31	465.36	464.94	462.06	462.97	462.73	463.16	462.18	462.14	461.45	462.05
07/03/95	477.84	464.51	468.57	467.26	467.47	462.43	465.47	465.07	462.19	463.08	462.86	463.24	462.31	462.27	461.59	462.24

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
07/04/95	477.81	464.69	468.72	467.47	467.69	462.66	465.71	465.36	462.43	463.33	463.08	463.51	462.53	462.52	461.82	462.45
07/05/95	477.79	464.77	468.77	467.50	467.73	462.69	465.72	465.37	462.44	463.36	463.12	463.53	462.55	462.57	461.83	462.47
07/06/95	477.84	464.73	468.72	467.47	467.66	462.61	465.64	465.31	462.37	463.29	463.04	463.44	462.49	462.49	461.77	462.39
07/07/95	477.80	464.35	468.55	467.29	467.45	462.43	465.44	465.05	462.17	463.08	462.84	463.26	462.30	462.27	461.58	462.18
07/08/95	477.78	464.39	468.38	467.12	467.27	462.24	465.26	464.89	462.00	462.89	462.67	463.06	462.13	462.10	461.40	462.01
07/09/95	477.82	464.31	468.34	467.09	467.21	462.21	465.23	464.83	461.99	462.87	462.66	463.03	462.13	462.10	461.38	462.00
07/10/95	477.83	464.40	468.40	467.14	467.29	462.28	465.31	464.88	462.06	462.94	462.73	463.08	462.17	462.17	461.45	462.10
07/11/95	477.80	464.48	468.41	467.14	467.30	462.29	465.30	464.90	462.06	462.96	462.73	463.09	462.19	462.18	461.46	462.05
07/12/95	477.71	464.56	468.30	467.31	467.43	462.44	465.85	465.05	462.31	463.11	462.86	463.33	462.38	462.38	461.65	462.26
07/13/95	477.63	464.56	468.51	467.29	467.40	462.43	465.44	465.04	462.20	463.10	462.84	463.26	462.35	462.34	461.59	462.24
07/14/95	477.53	464.36	468.03	467.07	467.17	462.21	465.22	464.83	462.00	462.89	462.68	463.05	462.13	462.10	461.38	462.02
07/15/95	477.48	463.98	468.13	466.73	467.03	462.09	465.07	464.71	461.88	462.74	462.53	462.92	461.99	461.98	461.25	461.83
07/16/95	477.70	464.39	468.36	467.15	467.27	462.30	465.25	464.93	462.07	462.95	462.76	463.12	462.22	462.21	461.46	462.08
07/17/95	477.81	464.35	468.31	467.07	467.13	462.17	465.09	464.77	461.94	462.84	462.66	462.99	462.10	462.10	461.33	461.94
07/18/95	478.13	464.26	468.26	467.04	467.04	462.07	465.01	464.66	461.85	462.73	462.54	462.88	462.01	462.02	461.25	461.91
**********																
08/25/95	477.91	464.48	468.83	467.39	467.29	462.31	465.25	464.94	462.10	463.02	462.78	463.07	462.24	462.27	461.49	462.05
08/26/95	477.90	464.61	468.97	467.47	467.37	462.41	465.30	465.01	462.19	463.10	462.86	463.18	462.34	462.39	461.58	462.14
08/27/95	477.88	464.42	468.77	467.30	467.14	462.20	465.17	464.79	461.97	462.90	462.65	462.95	462.14	462.16	461.37	461.94
08/28/95	477.85	464.60	468.93	467.50	467.39	462.43	465.31	465.02	462.21	463.12	462.86	463.19	462.37	462.43	461.62	462.15
08/29/95	477.82	464.50	468.79	467.34	467.21	462.26	465.25	464.85	462.02	462.96	462.69	463.02	462.19	462.23	461.44	462.00
08/30/95	477.78	464.43	468.71	467.33	467.17	462.23	465.23	464.83	462.02	462.93	462.70	463.00	462.19	462.21	461.40	461.97
08/31/95	477.72	464.34	468.66	467.28	467.09	462.17	465.21	464.75	461.93	462.86	462.64	462.91	462.09	462.14	461.34	461.90
09/01/95	478.01	464.09	468.34	466.94	466.77	461.81	464.88	464.42	461.61	462.51	462.26	462.55	461.75	461.81	461.00	461.57
09/02/95	477.92	464.21	468.62	466.86	466.98	462.04	465.10	464.62	461.83	462.74	462.51	462.78	461.99	462.04	461.22	461.79
09/03/95	477.81	464.48	468.71	467.38	467.21	462.27	465.31	464.85	462.05	462.96	462.70	463.03	462.21	462.25	461.44	461.94
09/04/95	477.72	464.48	468.73	467.42	467.27	462.33	465.37	464.92	462.10	463.03	462.75	463.10	462.27	462.33	461.51	462.01
09/05/95	477.63	464.52	468.72	467.41	467.26	462.32	465.42	464.91	462.09	463.03	462.74	463.06	462.25	462.32	461.49	461.99
09/06/95	477.46	464.36	468.61	467.34	467.16	462.25	465.39	464.83	462.04	462.98	462.69	463.01	462.20	462.25	461.42	461.90
09/07/95	477.07	464.29	468.40	467.09	466.93	462.03	465.15	464.60	461.83	462.74	462.48	462.78	461.97	462.03	461.22	461.77
09/08/95	476.80	464.23	468.32	467.05	466.96	462.09	465.24	464.67	461.85	462.80	462.54	462.84	462.03	462.09	461.26	461.76
09/09/95	476.95	464.23	468.25	467.00	466.87	462.01	465.20	464.61	461.77	462.72	462.46	462.79	461.96	462.02	461.20	461.68
09/10/95	477.32	464.07	468.20	467.00	466.82	461.97	465.20	464.56	461.78	462.70	462.43	462.74	461.93	461.99	461.17	461.68
09/11/95	477.68	464.50	468.57	467.40	467.19	462.34	465.52	464.92	462.12	463.03	462.77	463.11	462.29	462.36	461.53	462.11
09/12/95	477.84	464.44	468.65	467.44	467.21	462.30	465.50	464.88	462.08	463.02	462.76	463.05	462.27	462.33	461.50	462.03
09/13/95	477.86	465.02	468.25	467.11	466.98	461.95	465.06	464.50	461.76	462.64	462.36	462.76	461.83	462.03	461.22	461.81
09/14/95	478.55	464.75	468.05	467.64	466.75	461.56	465.18	464.04	462.27	462.50	462.50	462.47	461.74	461.70	461.62	461.34
09/15/95	478.54	465.02	468.47	468.11	467.24	462.10	465.28	464.49	462.75	463.00	463.02	462.97	462.22	462.18	462.10	461.83
09/16/95	478.54	465.34	468.77	468.33	467.45	462.34	465.43	464.74	463.03	463.25	463.25	463.22	462.48	462.48	462.37	462.42
09/17/95	478.53	465.03	468.39	467.98	467.01	461.85	465.37	464.27	462.56	462.78	462.84	462.75	462.01	461.98	461.89	461.95
09/18/95	478.62	464.78	468.22	467.87	466.91	461.80	465.30	464.19	462.52	462.72	462.71	462.67	461.96	461.95	461.85	461.89
09/19/95	478.63	465.18	468.64	468.26	467.34	462.23	465.35	464.63	462.91	463.12	463.15	463.09	462.38	462.38	462.27	462.33
09/20/95	478.60	465.11	468.55	468.20	467.21	462.12	465.34	464.52	462.79	462.98	463.05	462.93	462.27	462.26	462.11	462.16
09/21/95	478.68	464.97	468.45	468.09	467.09	461.97	465.31	464.42	462.68	462.88	462.91	462.81	462.14	462.13	462.00	462.07
09/22/95	478.80	464.87	468.34	467.99	466.96	461.81	465.29	464.31	462.53	462.73	462.75	462.67	462.01	462.00	461.89	461.94
09/23/95	479.22	464.95	468.47	468.18	467.14	462.00	465.29	464.43	462.75	462.93	462.96	462.89	462.25	462.27	462.12	462.14
09/24/95	478.92	465.35	468.97	468.51	467.50	462.37	465.30	464.79	463.10	463.28	463.30	463.24	462.60	462.60	462.46	462.50
09/25/95	478.84	465.26	468.81	468.34	467.35	462.21	465.29	464.62	462.91	463.10	463.15	463.07	462.42	462.41	462.28	462.31
09/26/95	480.69	465.10	468.70	468.35	467.12	461.98	465.24	464.35	462.67	462.84	462.89	462.82	462.14	462.15	462.04	462.09
09/27/95	482.64	465.15	469.10	468.75	467.24	461.92	465.24	464.31	462.64	462.79	462.86	462.75	462.14	462.12	461.98	462.04

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
09/28/95	482.77	465.38	469.55	469.14	467.65	462.20	465.24	464.56	462.91	463.06	463.11	462.99	462.41	462.41	462.25	462.32
09/29/95	479.04	465.77	469.54	469.09	468.04	462.70	465.93	465.08	463.40	463.58	463.59	463.50	462.91	462.90	462.73	462.78
09/30/95	478.80	465.71	469.30	468.90	467.90	462.58	465.84	464.98	463.31	463.48	463.51	463.44	462.79	462.80	462.64	462.71
10/01/95	478.77	465.51	469.02	468.62	467.65	462.37	465.64	464.78	463.07	463.25	463.29	463.24	462.56	462.57	462.40	462.47
10/02/95	478.77	465.19	468.67	468.29	467.26	462.09	465.31	464.48	462.77	462.90	462.99	462.91	462.25	462.22	462.07	462.12
10/03/95	478.74	465.10	468.57	468.21	467.22	462.03	465.27	464.43	462.74	462.91	462.98	462.87	462.21	462.19	462.00	462.11
10/04/95	478.74	464.97	468.46	468.13	467.09	461.91	465.21	464.32	462.63	462.78	462.84	462.77	462.11	462.09	461.92	462.02
10/05/95	479.03	465.14	468.45	468.36	467.32	462.12	465.25	464.53	462.84	463.01	463.08	462.99	462.35	462.34	462.17	462.23
**********																
02/06/96	479.64	469.10	473.75	472.51	473.60	467.69	470.82	469.65	467.18	467.67	467.99	467.67	465.43	465.27	466.06	465.92
02/07/96	479.34	468.98	473.61	472.29	473.28	467.46	470.60	469.56	467.12	467.62	467.95	467.66	465.38	465.27	466.04	465.92
02/08/96	479.49	468.45	472.91	471.42	472.22	466.55	469.72	468.77	466.38	466.84	467.17	466.92	464.67	464.58	465.31	465.23
02/09/96	479.88	467.68	472.52	470.65	471.28	465.66	468.87	468.00	465.60	465.92	466.17	466.14	464.01	463.92	464.19	464.52
02/10/96	479.85	467.52	472.36	470.62	471.28	465.68	468.93	468.08	465.73	466.20	466.53	466.28	464.21	464.12	464.75	464.72
02/11/96	479.82	467.37	472.09	470.29	470.71	465.17	468.39	467.58	465.31	465.71	466.06	465.79	463.80	463.68	464.34	464.30
02/12/96	479.82	466.94	471.75	470.00	470.55	465.03	468.24	467.46	465.20	465.61	465.95	465.70	463.79	463.69	464.29	464.25
02/13/96	479.55	467.37	471.98	470.26	470.61	465.13	468.33	467.60	465.35	465.70	466.06	465.85	464.03	463.93	464.46	464.44
02/14/96	479.61	466.96	471.76	470.05	470.33	464.85	468.08	467.34	465.15	465.48	465.82	465.59	463.84	463.75	464.26	464.24
02/15/96	479.28	466.80	471.53	469.83	470.14	464.67	467.92	467.21	465.01	465.41	465.72	465.48	463.77	463.68	464.17	464.10
02/16/96	479.17	467.14	471.67	470.02	470.28	464.88	468.12	467.38	465.28	465.64	465.91	465.68	464.05	463.97	464.41	464.36
02/17/96	479.22	466.62	471.23	469.51	469.66	464.22	467.49	466.81	464.64	465.03	465.26	465.07	463.48	463.37	463.82	463.79
02/18/96	479.22	466.28	470.94	469.29	469.52	464.10	467.34	466.70	464.51	464.90	465.11	464.93	463.41	463.31	463.70	463.65
02/19/96	479.13	466.83	471.42	469.94	470.19	464.79	468.04	467.35	465.25	465.64	465.87	465.66	464.18	464.11	464.43	464.44
02/20/96	479.25	467.23	471.70	470.21	470.25	464.91	468.15	467.45	465.43	465.76	465.99	465.80	464.34	464.28	464.59	464.57
02/21/96	479.70	466.96	471.49	469.97	469.88	464.45	467.75	467.04	464.99	465.36	465.59	465.42	463.99	463.92	464.21	464.18
02/22/96	480.15	466.96	471.33	469.81	469.73	464.29	467.54	466.87	464.87	465.18	465.41	465.24	463.89	463.81	464.11	464.04
02/23/96	481.22	466.78	471.59	469.97	469.76	464.27	467.55	466.85	464.87	465.20	465.38	465.22	463.91	463.84	464.11	464.07
02/24/96	484.71	466.48	472.06	470.22	469.60	463.98	467.22	466.52	464.55	464.86	465.06	464.87	463.56	463.48	463.79	463.73
02/25/96	488.16	466.84	472.95	470.80	469.96	463.97	467.21	466.48	464.54	464.83	465.00	464.80	463.50	463.43	463.74	463.68
02/26/96	484.46	467.21	472.84	471.14	470.51	464.47	467.67	466.92	464.97	465.30	465.46	465.25	463.90	463.81	464.17	464.10
02/27/96	481.12	467.03	472.23	470.67	470.45	464.70	467.92	467.20	465.23	465.54	465.77	465.55	464.10	464.02	464.37	464.31
02/28/96	482.43	466.72	472.51	470.11	470.17	464.13	467.34	466.69	464.61	464.95	465.13	464.93	463.47	463.40	463.79	463.75
02/29/96	480.03	466.51	471.49	470.08	470.01	464.35	467.60	466.92	464.88	465.24	465.45	465.26	463.77	463.67	464.07	464.06
03/01/96	479.64	466.87	471.65	470.22	470.17	464.64	467.87	467.17	465.16	465.46	465.73	465.52	464.03	463.95	464.30	464.26
03/02/96	479.50	466.83	471.54	470.08	470.06	464.52	467.81	467.11	465.07	465.40	465.65	465.44	463.97	463.89	464.24	464.21
03/03/96	479.52	466.46	471.16	469.63	469.61	464.15	467.38	466.79	464.67	465.00	465.21	465.05	463.56	463.48	463.85	463.82
03/04/96	478.98	466.66	471.35	470.05	470.07	464.65	467.85	467.22	465.17	465.52	465.76	465.55	464.10	464.02	464.36	464.33
03/05/96	479.43	466.90	471.53	470.05	470.06	464.62	467.91	467.22	465.22	465.51	465.77	465.56	464.12	464.05	464.37	464.32
03/06/96	479.29	466.47	NA	469.60	469.66	464.25	467.53	466.87	464.81	465.13	465.37	465.20	463.76	463.67	464.01	463.95
03/07/96	479.29	466.42	471.04	469.73	469.65	464.25	467.52	466.89	464.81	465.13	465.37	465.21	463.79	463.68	464.03	463.98
03/08/96	479.19	466.24	470.76	469.40	469.27	463.94	467.21	466.57	464.52	464.84	465.05	464.89	463.47	463.39	463.73	463.67
03/09/96	479.04	466.27	470.78	469.64	469.58	464.22	467.45	466.81	464.78	465.11	465.33	465.15	463.80	463.70	464.01	463.97
03/10/96	478.90	466.92	471.33	470.37	470.30	464.98	468.23	467.56	465.54	465.89	466.12	465.92	464.54	464.48	464.75	464.69
03/11/96	478.82	467.14	471.44	470.39	470.30	464.99	468.21	467.58	465.58	465.92	466.12	465.94	464.60	464.52	464.81	464.76
03/12/96	478.99	466.72	471.07	469.94	469.79	464.46	467.72	467.08	465.08	465.42	465.65	465.44	464.12	464.04	464.32	464.19
03/13/96	479.03	466.43	470.74	469.66	469.50	464.19	467.45	466.80	464.78	465.13	465.30	465.14	463.84	463.73	464.01	463.96
03/14/96	479.25	466.24	470.59	469.49	469.29	463.98	467.24	466.64	464.62	464.93	465.11	464.95	463.66	463.55	463.84	463.75
03/15/96	479.43	466.01	470.31	468.84	468.96	463.88	466.88	466.22	464.25	464.78	464.77	464.66	463.34	463.24	463.50	463.43
03/16/96	479.76	465.91	470.25	469.25	469.01	463.62	466.87	466.23	464.31	464.59	464.80	464.58	463.38	463.26	463.52	463.38
03/17/96	479.70	466.14	470.48	469.50	469.24	463.89	467.13	466.49	464.55	464.83	465.04	464.84	463.61	463.49	463.77	463.67

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
03/18/96	479.64	466.09	470.41	469.43	469.19	463.81	467.07	466.41	464.47	464.76	464.97	464.79	463.53	463.43	463.69	463.61
03/19/96	479.97	466.17	470.58	469.60	469.30	463.95	467.18	466.59	464.59	464.89	465.07	464.89	463.67	463.55	463.83	463.71
03/20/96	479.95	465.93	470.29	469.20	468.91	463.48	466.74	466.10	464.07	464.48	464.66	464.48	463.31	463.21	463.45	463.41
03/21/96	479.95	465.93	470.29	469.20	468.91	463.48	466.74	466.10	464.07	464.48	464.66	464.48	463.31	463.21	463.45	463.41
03/22/96	480.39	465.90	470.40	469.78	469.03	463.67	466.84	466.19	464.26	464.53	464.77	464.56	463.25	462.92	463.45	463.37
03/23/96	479.97	466.01	470.51	469.42	469.12	463.71	466.96	466.33	464.40	464.66	464.90	464.70	463.37	463.25	463.56	463.46
03/24/96	479.80	466.30	470.86	469.83	469.58	464.16	467.41	466.81	464.81	465.12	465.31	465.15	463.81	463.70	464.01	463.95
03/25/96	479.76	466.42	471.09	469.96	469.73	464.29	467.56	466.90	464.94	465.27	465.32	465.29	464.06	463.86	464.15	464.00
03/26/96	480.00	466.36	470.96	469.86	469.73	464.17	467.43	466.81	464.88	465.34	465.67	465.22	463.83	463.70	464.03	463.96
03/27/96	480.85	466.76	471.48	470.43	470.11	464.64	467.91	467.27	465.34	465.61	465.84	465.64	464.30	464.19	464.52	464.41
03/28/96	480.60	466.95	471.74	470.60	470.28	464.84	468.11	467.46	465.48	465.82	466.04	465.82	464.48	464.35	464.70	464.58
03/29/96	480.55	466.72	471.44	470.27	469.93	464.45	467.76	467.07	465.10	465.42	465.66	465.44	464.08	463.97	464.30	464.17
03/30/96	480.03	466.56	471.29	470.20	469.94	464.46	467.72	467.10	465.11	465.45	465.68	465.46	464.08	463.98	464.32	464.21
03/31/96	480.00	466.52	471.19	470.05	469.83	464.35	467.62	466.98	464.99	465.31	465.53	465.35	463.97	463.85	464.19	464.11
04/01/96	479.97	466.39	471.05	469.94	469.70	464.26	467.50	466.89	464.90	465.19	465.42	465.25	463.88	463.75	464.10	463.97
04/02/96	480.55	466.26	470.95	469.78	469.57	464.10	467.35	466.73	464.75	465.06	465.34	465.08	463.73	463.58	464.24	463.83
04/03/96	481.50	466.40	471.23	470.05	469.71	464.21	467.45	466.81	464.87	465.17	465.35	465.22	463.83	463.70	464.06	463.93
04/04/96	480.87	466.42	471.19	470.06	469.71	464.22	467.43	466.84	464.85	465.17	465.37	465.21	463.82	463.69	464.05	463.96
04/05/96	480.35	466.43	470.72	470.03	469.21	464.29	467.54	466.92	464.93	465.22	465.45	465.26	463.88	463.74	464.11	463.98
04/06/96	479.96	466.55	471.19	470.13	469.91	464.46	467.74	467.09	465.13	465.42	465.64	465.46	464.06	463.93	464.29	464.21
04/07/96	480.12	466.60	471.15	470.09	469.81	464.37	467.66	467.01	465.01	465.58	465.55	465.36	463.96	463.85	464.43	464.06
04/08/96	480.15	466.42	471.07	469.98	469.75	464.29	467.55	466.91	464.92	465.21	465.44	465.27	463.88	463.75	464.10	464.05
04/09/96	480.17	466.43	471.13	470.09	469.83	464.34	467.65	466.99	465.01	465.34	465.54	465.35	463.98	463.84	464.20	464.12
04/10/96	479.96	466.30	470.83	469.74	469.40	463.97	467.23	466.61	464.62	464.92	465.10	464.91	463.55	463.43	463.79	463.66
04/11/96	479.91	466.09	470.60	469.53	469.34	463.90	467.17	466.53	464.59	464.85	465.04	464.88	463.48	463.35	463.73	463.65
04/12/96	480.24	466.23	NA	469.78	469.50	464.04	467.31	466.68	464.70	464.97	465.18	465.02	463.48	463.49	463.86	463.79
04/13/96	480.62	466.51	471.27	469.78	469.94	464.43	467.74	467.08	465.14	465.40	465.65	465.45	464.28	463.93	464.30	464.21
04/14/96	482.39	466.58	471.59	470.32	469.88	464.38	467.68	467.04	465.09	465.37	465.62	465.39	464.04	463.90	464.27	464.18
04/15/96	489.84	467.55	474.06	472.30	471.07	464.99	468.22	467.54	465.65	465.60	466.33	465.91	464.52	464.38	464.78	464.71
04/16/96	490.65	468.00	475.16	472.88	471.59	465.08	468.30	468.07	465.46	465.92	466.23	465.84	464.30	464.26	464.72	464.57
04/17/96	508.29	469.03	480.68	507.35	472.79	465.32	468.47	467.56	465.82	466.07	466.17	465.95	464.47	464.36	464.84	464.67
04/18/96	515.19	471.05	484.80	514.73	475.30	466.93	469.95	468.74	466.88	467.20	467.25	466.99	465.27	465.07	465.73	465.50
04/19/96	512.46	472.07	485.27	512.16	476.71	468.05	470.95	470.03	467.31	468.08	467.49	467.46	465.69	465.58	466.18	465.95
04/20/96	509.30	472.16	484.67	508.85	477.69	468.49	471.34	469.36	467.62	467.55	467.88	467.52	465.65	465.43	466.16	465.98
04/21/96	504.56	NA	NA	NA	NA	NA	NA	NA	468.72	NA	NA	467.51	NA	NA	NA	465.60
04/22/96	497.43	471.61	481.35	497.29	477.13	469.06	471.85	470.14	467.80	468.23	468.25	467.88	465.89	465.68	466.41	466.22
04/23/96	496.69	470.94	480.00	477.06	476.32	468.56	471.38	469.96	467.52	467.84	468.11	467.46	465.50	465.37	466.03	465.83
04/24/96	496.69	470.94	480.00	477.06	476.32	468.56	471.38	469.96	467.52	467.84	468.11	467.46	465.50	465.37	466.03	465.83
04/25/96	497.22	471.10	480.51	493.50	476.43	468.65	471.47	469.80	467.42	467.88	467.90	467.50	465.51	465.29	466.06	465.85
04/26/96	490.89	470.32	478.25	476.11	475.46	468.12	471.01	469.42	466.97	467.42	467.50	467.09	465.06	464.84	465.62	465.41
04/27/96	487.33	469.69	476.46	474.56	474.87	467.95	470.89	469.48	467.06	467.52	467.65	467.26	465.19	464.99	465.77	465.50
04/28/96	482.97	469.66	475.57	474.16	474.61	468.04	471.02	469.73	467.33	467.82	467.97	467.61	465.55	465.36	466.11	465.91
04/29/96	484.29	469.48	475.33	473.62	474.17	467.77	470.80	469.65	467.31	467.77	467.96	467.64	465.58	465.42	466.14	465.97
04/30/96	493.56	469.69	477.14	474.42	474.17	467.34	470.40	469.28	466.97	467.41	467.60	467.27	465.28	465.09	465.81	465.55
05/01/96	493.20	469.81	477.50	474.80	474.36	467.38	470.43	469.26	467.02	467.41	467.58	467.24	465.32	465.13	465.84	465.59
05/02/96	502.47	470.77	481.00	488.86	475.34	467.79	470.74	469.42	467.21	467.61	467.72	467.34	465.41	465.21	465.93	465.71
05/03/96	491.40	NA	490.91	NA	NA	NA	NA	NA	468.23	NA	NA	467.40	NA	NA	NA	465.49
05/04/96	480.03	469.19	474.84	473.45	473.99	467.65	470.69	469.51	467.05	467.57	467.80	467.41	465.13	464.96	465.83	465.62
05/05/96	480.30	468.66	474.02	472.55	473.34	467.25	470.35	469.38	466.86	467.41	467.70	467.33	465.02	464.83	465.71	465.53
05/06/96	480.15	468.45	473.73	472.23	472.97	467.04	470.16	469.32	466.81	467.37	467.64	467.33	465.01	464.83	465.70	465.51

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
05/07/96	479.07	468.43	473.59	475.79	472.87	467.20	470.25	469.43	466.99	467.52	467.68	467.56	465.23	465.06	465.93	465.74
05/08/96	479.34	468.37	473.57	471.99	472.53	466.74	469.93	469.06	466.66	467.21	467.50	467.19	464.98	464.82	465.65	NA
05/09/96	475.77	467.79	472.69	471.01	471.95	466.42	469.64	468.84	466.49	466.53	467.29	467.06	464.83	464.65	465.47	465.31
05/10/96	478.98	467.65	472.65	470.87	471.59	466.05	469.27	468.53	466.30	467.12	466.99	466.76	464.62	464.48	465.26	465.10
05/11/96	480.30	467.37	472.50	470.27	471.07	465.42	468.66	467.96	465.72	466.13	466.39	466.15	464.14	463.98	464.70	464.62
05/12/96	499.14	468.09	476.62	489.06	471.82	465.34	468.53	467.80	465.73	466.08	466.28	466.05	464.17	464.00	464.71	464.55
05/13/96	506.61	470.18	481.82	499.73	474.40	466.82	469.91	468.83	466.77	466.91	467.31	467.01	465.10	464.88	465.65	465.49
05/14/96	506.01	471.37	483.04	499.97	476.01	468.02	471.00	469.63	467.40	467.91	467.96	467.61	465.65	465.46	466.24	465.95
05/15/96	495.01	471.24	480.42	485.67	476.14	468.52	471.43	470.00	467.77	468.18	468.23	467.85	465.78	465.61	466.39	466.26
05/16/96	480.60	469.86	475.61	474.88	474.72	468.12	471.12	469.92	467.38	467.94	468.08	467.73	465.50	465.31	466.14	465.93
05/17/96	480.00	468.83	474.31	472.78	473.51	467.30	470.41	469.37	466.68	467.58	467.63	467.29	465.03	464.85	465.68	465.50
05/18/96	479.35	468.45	473.73	472.23	472.95	467.00	470.14	469.14	466.76	467.25	467.52	467.19	464.95	464.76	465.60	465.38
05/19/96	479.43	468.08	473.37	471.09	472.35	466.45	469.67	468.75	466.37	466.83	467.12	466.84	464.59	464.43	465.24	465.09
05/20/96	479.49	467.61	472.74	471.08	471.69	465.92	469.09	468.14	465.85	466.32	466.68	466.36	464.16	464.02	464.99	464.66
05/21/96	479.01	467.39	472.45	470.86	471.41	465.73	468.94	468.10	465.75	466.28	466.53	466.24	463.88	463.98	464.73	464.56
05/22/96	478.77	467.28	472.35	470.78	471.33	465.68	468.93	468.13	465.79	466.31	466.58	466.28	464.23	464.08	464.80	464.61
05/23/96	478.41	467.33	472.34	470.78	471.28	465.72	468.95	468.19	465.89	466.67	466.69	466.37	464.37	464.23	464.90	464.80
05/24/96	478.98	467.37	472.40	470.83	471.25	465.73	468.98	468.20	465.93	466.39	466.44	466.38	464.43	464.29	464.96	464.82
05/25/96	478.90	467.48	472.48	470.91	471.28	465.73	468.98	468.25	466.03	466.33	466.74	466.45	464.53	464.40	465.04	464.92
05/26/96	478.76	467.43	472.41	470.82	471.13	465.59	468.87	468.13	465.92	465.95	466.65	NA	464.49	464.35	464.97	464.86
05/27/96	478.93	467.23	472.22	470.61	470.90	465.22	468.61	467.93	465.79	466.11	466.38	466.11	464.29	464.16	464.74	464.62
05/28/96	478.93	467.15	472.13	470.56	471.07	465.30	468.54	467.88	465.64	466.06	466.12	466.06	464.27	464.13	464.73	464.59
05/29/96	478.86	466.91	471.85	470.28	470.50	464.98	468.24	467.57	465.34	465.76	466.04	465.77	463.94	463.80	464.40	464.29
05/30/96	478.77	466.72	471.69	470.16	470.38	464.88	468.12	467.41	465.26	465.65	465.67	465.65	463.90	463.75	464.32	464.16
05/31/96	478.76	466.86	471.71	470.29	470.46	464.98	468.20	467.55	465.38	465.78	466.02	465.77	464.08	463.95	464.45	464.36
06/01/96	478.76	466.99	471.79	470.45	470.58	465.09	468.33	467.69	465.51	465.92	466.14	465.92	464.23	464.11	464.62	464.50
06/02/96	478.56	467.02	471.81	470.41	470.55	465.06	468.31	467.65	465.48	465.90	466.11	465.88	464.24	464.13	464.61	464.51
06/03/96	478.50	466.91	471.63	470.27	470.37	464.91	468.13	467.47	465.37	465.76	465.97	465.74	464.14	464.01	464.46	464.38
06/04/96	478.77	466.55	471.27	469.86	469.89	464.40	467.68	467.01	464.91	465.30	465.50	465.28	463.72	463.59	464.05	463.97
06/05/96	479.02	466.52	471.31	469.98	469.94	464.43	467.67	467.05	464.96	465.34	465.57	465.33	463.80	463.78	464.10	464.01
06/06/96	478.88	466.59	471.36	470.11	470.22	464.57	467.83	467.17	465.08	465.48	465.71	465.52	463.93	463.80	464.22	464.11
06/07/96	478.53	466.48	471.18	469.90	469.84	464.35	467.61	466.97	464.88	465.27	465.49	465.25	463.75	463.61	464.04	463.94
06/08/96	479.42	466.34	471.08	469.81	469.73	464.26	467.48	466.86	464.79	465.13	465.35	465.14	463.69	463.55	463.98	463.82
06/09/96	480.27	466.54	471.30	470.16	469.91	464.35	467.63	467.14	464.97	465.30	465.52	465.30	463.90	463.76	464.15	463.98
06/10/96	479.09	466.62	471.35	470.16	469.94	464.45	467.73	467.07	465.00	465.41	465.65	465.38	463.99	463.86	464.25	464.09
06/11/96	478.89	466.42	471.15	469.92	469.71	464.25	467.50	466.88	464.84	464.94	465.38	465.17	463.75	463.60	464.01	463.89
06/12/96	478.08	466.24	470.84	469.69	469.45	464.18	467.52	466.78	464.94	465.07	465.28	465.10	463.64	463.49	463.92	463.80
06/13/96	479.52	465.94	NA	469.86	469.57	464.09	467.22	466.74	464.69	465.01	465.19	NA	463.60	463.18	463.86	463.76
06/14/96	479.43	465.87	471.03	469.83	469.50	464.05	467.13	466.64	464.63	464.94	465.12	NA	463.52	463.39	463.78	463.62
06/15/96	479.40	465.90	471.00	469.82	469.55	464.10	467.21	466.71	464.44	464.55	465.18	NA	463.59	463.43	463.84	463.75
06/16/96	479.27	466.02	471.18	470.04	469.78	464.28	467.42	466.90	464.96	464.80	465.42	NA	463.83	463.68	464.05	463.88
06/17/96	479.16	466.01	471.11	469.92	469.65	464.19	467.30	466.84	464.81	465.08	465.27	NA	463.71	463.56	463.92	463.85
06/18/96	479.01	465.90	471.04	469.78	469.58	464.09	467.20	466.71	464.77	464.98	465.17	NA	463.61	463.47	463.83	463.74
06/19/96	478.72	465.97	471.00	469.85	469.60	464.17	467.24	466.76	464.74	465.06	465.24	NA	463.70	463.55	463.91	463.84
06/20/96	478.59	465.82	470.84	469.60	469.34	463.91	467.03	466.51	464.32	464.84	465.04	NA	463.49	463.36	463.58	463.57
06/21/96	478.59	465.58	470.55	469.36	469.08	463.62	466.75	466.23	464.25	464.37	464.79	NA	463.25	463.13	463.43	463.32
06/22/96	478.56	465.55	470.53	469.38	469.12	463.69	466.77	466.27	464.42	464.63	464.83	NA	463.68	463.20	463.49	463.43
06/23/96	478.54	465.45	470.43	469.31	469.01	463.53	466.69	466.67	464.19	464.53	464.73	NA	463.25	463.12	463.40	463.29
06/24/96	478.50	465.67	470.61	469.51	469.17	463.76	466.86	466.35	464.43	464.71	464.92	NA	463.44	463.30	463.58	463.53
06/25/96	478.48	465.45	470.36	469.24	468.88	463.49	466.58	466.06	464.10	464.10	464.61	NA	463.17	463.05	463.28	463.18

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
06/26/96	482.10	465.79	471.19	469.98	469.34	463.76	466.85	466.85	464.45	464.70	464.91	NA	463.49	463.33	463.61	463.52
06/27/96	478.74	465.90	470.99	469.90	469.42	463.91	466.97	466.50	464.64	465.08	465.03	NA	463.61	463.47	463.75	463.65
06/28/96	478.45	465.83	470.75	469.69	469.30	463.86	466.95	466.44	464.61	464.79	465.00	NA	463.56	463.42	463.70	463.59
06/29/96	478.28	465.86	470.73	469.72	469.34	463.91	467.01	466.84	464.59	465.03	465.00	NA	463.62	463.49	463.63	463.65
06/30/96	478.26	465.62	470.43	469.34	468.98	463.55	466.64	466.11	464.22	464.48	464.61	NA	463.26	463.06	463.40	463.24
07/01/96	478.23	465.43	470.21	469.23	468.81	463.41	466.47	465.96	464.04	464.80	464.51	NA	463.19	463.06	463.26	463.19
07/02/96	478.18	465.35	470.14	469.14	468.73	463.35	466.41	465.91	463.99	464.30	464.44	NA	463.12	463.01	463.21	463.13
07/03/96	478.17	465.02	469.81	468.86	468.42	463.06	466.15	465.61	463.89	463.77	464.14	NA	462.73	462.62	462.85	462.78
07/04/96	478.36	464.81	469.60	468.96	468.22	462.83	465.91	465.41	463.48	463.76	463.93	NA	462.54	462.41	462.63	462.58
07/05/96	478.53	464.97	469.81	468.93	468.47	463.08	466.15	466.02	463.70	464.00	464.34	NA	462.79	462.67	462.89	462.86
07/06/96	478.35	465.18	469.98	469.06	468.63	463.24	466.27	465.77	463.69	464.14	464.31	NA	462.98	462.86	463.06	463.00
07/07/96	478.26	465.18	469.95	469.10	468.62	463.23	466.28	465.77	463.83	464.15	464.32	NA	462.99	462.86	463.06	462.97
07/08/96	478.23	464.91	469.64	468.76	468.24	462.87	465.93	465.43	463.58	463.66	463.95	NA	462.63	462.54	462.71	462.63
07/09/96	478.18	464.77	469.50	468.47	468.17	462.74	465.82	465.42	463.47	463.70	463.89	NA	462.57	462.46	462.63	462.51
07/10/96	478.17	464.95	469.62	468.88	468.32	462.95	466.00	465.50	463.68	463.94	464.04	NA	462.83	462.73	462.84	462.74
07/11/96	478.18	465.33	470.01	469.25	468.73	463.36	466.39	465.89	464.05	464.47	464.45	NA	463.27	463.15	463.26	463.22
07/12/96	478.17	465.50	470.12	469.34	468.80	463.44	466.46	465.96	464.13	464.02	464.54	NA	463.35	463.24	463.37	463.27
07/13/96	478.14	465.35	469.96	469.14	468.55	463.22	466.25	465.73	463.94	464.15	464.28	NA	463.13	463.02	463.11	463.02
07/14/96	496.51	466.18	474.41	472.55	469.55	463.30	466.33	465.74	464.15	464.29	464.35	NA	463.38	463.25	463.36	463.26
07/15/96	491.53	467.15	475.53	473.78	470.94	464.03	467.04	466.28	464.70	464.89	464.95	NA	463.82	463.66	463.88	463.74
07/16/96	486.84	467.06	474.28	472.55	471.00	464.29	467.31	466.61	464.86	465.12	465.15	NA	463.85	463.73	464.03	463.88
07/17/96	481.18	466.67	472.71	471.34	470.50	464.36	467.39	466.78	464.99	465.19	465.28	NA	463.85	463.73	464.07	463.93
07/18/96	479.08	466.44	472.25	470.84	470.28	464.33	467.37	466.79	464.73	465.17	465.27	NA	463.80	463.65	464.01	463.86
07/19/96	478.77	466.02	471.55	470.04	469.61	463.79	466.88	466.23	464.32	464.78	464.83	NA	463.33	463.18	463.49	463.40
07/20/96	479.36	465.63	471.11	469.74	469.27	463.53	466.64	466.01	464.09	464.43	464.57	NA	463.12	463.00	463.28	463.17
07/21/96	479.31	465.63	471.11	469.77	469.26	463.58	466.68	466.08	464.30	464.62	464.65	NA	463.22	463.10	463.37	463.24
07/22/96	479.23	465.83	471.27	469.94	469.44	463.81	466.87	466.35	464.45	464.42	464.90	NA	463.46	463.33	463.60	463.50
07/23/96	478.22	465.74	471.01	469.69	469.24	463.67	466.76	466.17	464.16	464.56	464.73	NA	463.34	463.24	463.46	463.35
07/24/96	478.38	465.71	470.96	469.67	469.19	463.65	466.77	466.17	464.48	464.57	464.75	NA	463.40	463.24	463.50	463.40
07/25/96	478.32	465.67	470.86	469.57	469.09	463.62	466.71	466.12	464.37	464.92	464.69	NA	463.36	463.22	463.43	463.30
07/26/96	478.34	465.55	470.73	469.43	468.93	463.43	466.54	465.98	464.10	463.96	464.53	NA	463.24	463.12	463.31	463.25
07/27/96	479.25	465.59	470.88	469.64	468.98	463.51	466.59	466.02	464.18	464.59	464.58	NA	463.35	463.22	463.39	463.27
07/28/96	479.10	465.83	471.08	469.87	469.19	463.74	466.85	466.27	464.43	464.22	464.88	NA	463.58	463.45	463.65	463.45
07/29/96	479.28	465.89	471.17	469.95	469.19	463.75	466.84	466.29	464.47	464.30	464.90	NA	463.62	463.49	463.67	463.58
07/30/96	478.98	465.79	471.02	469.83	469.06	463.61	466.72	466.14	464.12	464.55	464.73	NA	463.49	463.37	463.53	463.45
07/31/96	478.32	465.66	470.80	469.58	468.93	463.51	466.60	466.02	464.39	464.57	464.61	NA	463.41	463.25	463.41	463.35
08/01/96	478.29	465.45	470.53	469.31	468.65	463.30	466.36	465.79	463.93	464.62	464.34	463.16	463.05	463.18	463.08	NA
08/02/96	478.44	465.37	470.43	469.28	468.60	463.25	466.30	465.76	463.87	464.22	464.31	463.14	463.02	463.16	463.08	NA
08/03/96	478.44	465.49	470.51	469.40	468.72	463.37	466.45	465.88	464.06	464.80	464.46	463.31	463.19	463.30	463.26	NA
08/04/96	478.41	465.53	470.53	469.44	468.78	463.45	466.51	465.94	464.14	464.38	464.54	463.40	463.24	463.37	463.31	NA
08/05/96	478.39	465.58	470.52	469.51	468.76	463.44	466.53	465.93	464.16	464.00	464.53	463.40	463.27	463.39	463.31	NA
08/06/96	478.38	465.57	470.51	469.49	468.75	463.40	466.48	465.92	464.03	464.10	464.51	463.39	463.26	463.37	463.29	NA
08/07/96	478.26	465.54	470.43	469.44	468.35	463.37	466.42	466.00	464.09	464.29	464.73	NA	463.38	463.23	463.30	463.26
08/08/96	478.20	465.38	470.22	468.72	468.50	463.21	466.30	465.69	464.08	464.17	464.28	NA	463.17	463.49	463.15	463.02
08/09/96	478.56	465.18	470.09	469.09	467.94	463.01	466.07	465.49	463.70	464.29	464.07	NA	462.99	462.80	462.94	462.88
08/10/96	478.81	465.21	470.14	469.17	468.32	462.65	466.09	465.52	463.93	464.00	464.09	463.04	463.23	462.99	462.95	NA
08/11/96	478.81	465.38	470.27	469.62	468.50	463.53	466.26	465.68	463.97	464.17	464.26	463.23	463.11	463.15	463.10	NA
08/12/96	478.27	465.43	470.27	NA	468.53	463.25	466.30	465.74	463.95	464.21	464.68	463.25	463.17	463.19	463.20	NA
08/13/96	478.02	465.27	470.02	469.14	468.73	463.09	466.13	465.56	463.87	464.05	464.15	463.08	NA	463.04	462.97	NA
08/14/96	478.24	465.14	469.93	468.72	468.29	463.01	466.01	465.49	463.69	463.95	464.07	463.01	462.91	462.93	462.90	NA

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
08/15/96	478.39	465.26	470.06	469.24	468.44	463.14	466.20	465.61	464.01	464.07	464.10	NA	463.13	463.02	462.89	463.03
08/16/96	478.03	465.17	469.87	469.06	468.55	462.96	466.00	465.62	463.66	463.91	464.22	NA	463.26	462.87	462.91	462.90
08/17/96	477.99	465.11	469.83	469.04	468.47	462.94	465.95	465.41	463.65	463.60	464.01	NA	462.99	462.90	462.91	462.81
08/18/96	477.96	465.14	469.81	469.08	468.45	463.02	466.01	465.40	463.70	464.19	464.06	NA	463.07	462.93	462.96	462.90
08/19/96	477.95	465.27	469.94	469.21	468.37	462.92	466.17	465.46	463.85	464.15	464.06	NA	463.20	462.83	463.13	463.07
08/20/96	477.93	465.34	469.96	468.80	468.37	463.19	466.22	465.65	463.87	464.16	464.37	NA	463.26	462.82	463.15	463.11
08/21/96	477.93	465.07	469.69	468.59	468.04	462.85	465.88	465.38	463.59	463.82	463.68	NA	462.93	462.83	462.84	462.81
08/22/96	477.84	465.03	469.63	469.37	468.08	462.88	465.91	465.42	463.61	464.22	463.99	NA	462.95	462.86	462.69	462.81
08/23/96	477.77	464.94	469.54	468.87	468.39	462.78	NA	465.32	463.55	463.38	463.89	461.88	462.59	462.76	462.76	462.72
08/24/96	477.78	464.77	469.40	468.72	468.14	462.62	465.69	465.20	463.36	463.59	463.75	461.61	462.45	462.56	462.60	462.54
08/25/96	477.84	464.83	469.43	468.79	467.44	462.71	465.73	465.51	463.42	463.66	463.72	461.71	462.88	462.61	462.64	462.61
08/26/96	477.81	464.67	469.29	469.08	467.76	462.51	465.59	465.08	463.08	463.52	463.60	461.47	462.55	462.47	462.48	462.48
08/27/96	477.75	464.61	469.25	468.61	467.53	462.55	465.65	465.14	463.17	463.50	463.38	461.40	462.60	462.24	462.40	462.36
08/28/96	477.71	464.58	469.29	468.61	468.17	462.57	465.67	465.13	463.07	463.49	463.64	461.78	462.28	462.17	462.37	462.29
08/29/96	477.71	464.46	469.10	468.44	467.63	462.29	465.47	464.79	462.95	463.25	463.20	461.49	462.09	461.93	462.17	462.18
08/30/96	477.70	464.43	469.08	468.61	467.67	462.42	NA	464.86	463.01	463.03	463.43	461.44	462.17	462.05	462.48	462.19
08/31/96	477.63	464.43	469.11	468.46	467.67	462.38	465.46	464.76	463.00	463.27	463.18	461.49	462.18	462.07	462.22	462.14
09/01/96	477.52	464.38	469.01	468.41	467.80	462.32	464.90	464.78	462.91	463.78	463.35	461.40	462.13	462.02	462.17	462.07
09/02/96	477.42	464.22	468.80	468.82	467.35	462.14	465.34	464.59	462.56	463.00	463.13	461.35	461.91	461.84	461.94	461.92
09/03/96	477.31	464.20	468.77	468.22	466.73	462.19	465.23	464.86	462.81	463.06	463.14	NA	461.98	461.89	461.99	461.97
09/04/96	476.80	464.22	NA	468.22	467.39	462.05	465.24	464.66	462.91	463.09	463.20	461.17	462.04	461.93	462.02	461.99
09/05/96	476.22	464.20	468.72	468.66	467.40	462.27	465.24	464.70	462.84	463.11	463.26	461.17	462.07	461.98	NA	462.04
09/06/96	475.62	464.16	468.65	468.05	466.73	462.24	465.26	464.67	462.85	463.09	463.23	461.31	462.06	461.97	462.06	462.03
09/07/96	475.56	464.03	468.47	467.85	466.55	462.07	465.23	464.53	462.69	462.95	463.11	NA	462.28	461.84	461.91	461.87
09/08/96	475.65	463.92	468.31	467.74	466.98	461.91	465.17	464.41	462.63	462.85	462.99	461.00	461.83	461.77	462.24	461.78
09/09/96	476.02	463.70	468.07	467.46	466.73	461.50	464.96	464.20	462.23	462.63	462.76	460.72	461.64	461.56	461.61	461.57
09/10/96	476.52	463.75	468.15	467.40	466.80	461.75	465.05	464.23	462.35	462.69	462.83	460.89	461.72	461.64	461.39	461.64
09/11/96	477.00	463.88	468.22	467.84	466.89	461.88	465.14	464.34	462.82	462.78	462.98	460.86	461.82	462.15	461.77	461.78
09/12/96	477.24	463.87	468.22	467.86	467.26	461.83	465.12	464.34	462.51	462.77	462.95	460.84	462.11	461.71	461.76	461.76
09/13/96	477.39	463.76	468.10	468.10	466.76	461.69	464.74	464.16	462.34	462.20	462.74	460.67	461.96	461.57	461.59	461.56
09/14/96	477.72	463.63	467.96	467.70	466.65	461.20	464.82	464.07	462.23	462.47	462.61	461.09	461.20	461.45	461.47	461.44
09/15/96	478.09	463.74	468.27	468.20	466.83	461.71	464.98	464.17	462.38	462.64	462.74	460.77	461.72	461.61	461.63	461.63
09/16/96	478.05	463.90	468.49	468.08	466.99	461.76	465.10	464.28	462.52	462.76	463.13	460.81	461.81	461.31	461.74	461.70
09/17/96	478.01	463.95	468.57	468.11	467.01	461.68	465.13	464.29	462.54	462.76	462.87	460.86	461.81	461.89	461.76	461.73
09/18/96	478.17	463.75	468.37	468.12	466.75	461.58	464.84	464.05	462.24	462.49	462.61	461.26	461.58	461.49	461.59	461.47
09/19/96	478.54	463.82	468.51	NA	466.91	461.72	464.75	464.18	462.45	462.97	462.76	460.82	461.72	461.64	461.71	461.67
09/20/96	478.26	463.96	468.66	468.43	467.07	461.91	465.09	464.35	462.60	462.82	462.68	460.89	461.85	462.03	461.81	461.78
09/21/96	478.11	464.02	468.68	468.26	467.11	462.09	465.13	464.41	462.62	462.84	462.73	460.90	461.88	461.34	461.84	461.77
09/22/96	483.51	464.35	469.75	469.05	467.50	461.91	464.99	464.27	462.56	462.78	463.23	460.77	461.85	461.27	461.78	461.72
09/23/96	487.01	464.70	471.26	470.51	468.16	462.35	464.99	464.34	462.48	462.87	462.92	460.79	461.98	461.89	461.93	461.87
09/24/96	485.91	465.27	472.06	471.55	468.99	462.60	465.56	464.86	463.21	463.43	463.28	461.50	462.41	462.47	462.40	462.27
09/25/96	483.09	465.10	471.47	470.56	468.90	462.62	465.52	464.88	463.12	463.40	463.42	461.47	462.29	462.19	462.33	462.31
09/26/96	479.29	465.37	471.01	470.25	469.21	463.13	466.02	465.61	463.61	463.91	464.34	461.93	462.88	462.67	462.80	462.73
09/27/96	478.45	465.37	470.72	469.87	468.91	463.03	466.10	465.15	463.65	463.96	464.15	462.11	462.81	463.06	462.87	462.86
09/28/96	478.79	465.03	470.40	469.43	468.45	462.79	465.74	465.19	463.30	463.59	463.73	461.47	462.40	462.39	462.51	462.53
09/29/96	479.57	464.77	470.21	469.25	468.47	462.57	465.55	464.70	463.15	463.44	463.72	461.56	462.34	462.37	462.38	462.38
09/30/96	481.90	465.03	470.86	469.81	468.98	462.85	465.77	465.22	463.39	463.66	463.78	461.48	462.54	462.46	462.59	462.59
10/01/96	479.40	465.34	470.91	470.32	468.80	463.19	466.13	465.51	463.68	463.99	463.93	462.14	462.84	463.09	462.91	462.90
10/02/96	479.14	465.13	470.64	469.55	468.93	462.96	465.90	465.32	463.52	464.03	463.91	461.77	462.54	462.55	462.69	462.68
10/03/96	479.22	464.73	470.22	469.20	468.14	462.57	465.57	464.63	463.11	463.43	463.52	461.53	462.28	462.20	462.33	462.32

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
10/04/96	479.19	465.11	470.58	469.56	468.57	463.08	466.01	465.42	463.57	463.86	464.00	461.95	462.56	462.95	462.80	462.81
10/05/96	478.68	465.33	470.71	469.71	468.72	463.25	466.21	465.62	463.75	464.49	464.18	462.01	462.94	462.86	462.98	462.95
10/06/96	478.63	465.23	470.62	469.52	468.53	463.11	466.10	465.47	463.54	463.93	464.03	462.07	463.04	462.73	462.84	462.81
10/07/96	478.62	464.79	470.21	469.08	468.08	462.61	465.66	465.05	463.17	463.49	463.59	461.53	462.35	462.28	462.39	462.36
10/08/96	478.17	464.51	469.86	468.80	467.81	462.36	465.43	464.81	462.85	463.21	463.33	461.31	462.11	462.02	462.15	462.12
10/09/96	478.65	464.00	469.28	468.18	467.14	461.75	464.82	464.23	462.34	462.63	462.73	460.62	461.56	461.49	461.55	461.54
10/10/96	480.40	464.32	469.89	468.79	467.55	462.10	465.14	464.50	462.69	462.53	463.05	461.12	461.86	461.81	461.89	461.91
10/11/96	481.74	464.63	470.47	469.39	468.06	462.48	465.53	464.89	462.92	463.36	463.47	461.51	462.30	462.22	462.33	462.31
10/12/96	482.41	465.14	471.23	470.01	468.53	462.92	465.86	465.29	463.46	463.72	463.85	461.68	462.66	462.59	462.69	462.65
10/13/96	482.32	465.17	471.33	470.04	468.53	462.88	465.80	465.23	463.38	463.67	463.78	461.58	462.56	462.49	462.60	462.52
10/14/96	481.89	464.75	470.89	469.52	468.09	462.37	465.32	464.73	463.01	463.16	463.27	461.03	462.04	461.96	462.12	462.04
10/15/96	481.38	464.99	470.98	469.80	468.47	462.77	465.72	465.11	463.25	463.55	463.70	NA	462.40	462.34	462.47	462.45
10/16/96	481.05	464.87	470.82	469.56	468.24	462.53	465.52	464.90	463.04	463.51	463.43	461.46	462.20	462.10	462.26	462.21
10/17/96	481.65	464.90	470.95	469.69	468.34	462.58	465.57	464.96	463.26	463.41	463.52	461.54	462.24	462.17	462.32	462.27
10/18/96	480.61	465.10	470.96	469.78	468.52	462.83	465.77	465.20	463.33	463.63	463.74	461.54	462.46	462.40	462.53	462.46
10/19/96	479.55	464.81	470.50	469.37	468.19	462.54	465.54	464.94	463.07	462.95	463.48	461.52	462.20	462.11	462.26	462.22
10/20/96	478.96	464.62	470.12	469.05	467.98	462.40	465.43	464.81	462.93	463.05	463.33	461.31	462.07	462.01	462.15	462.08
10/21/96	489.80	465.30	472.86	471.25	468.80	462.59	465.53	464.92	463.21	463.43	463.48	461.51	462.34	462.26	462.39	462.36
10/22/96	498.90	466.42	477.69	498.87	470.50	463.15	466.01	465.32	463.44	463.88	463.89	461.68	462.78	462.67	462.84	462.77
10/23/96	501.51	467.47	479.78	501.56	471.93	463.88	466.70	465.73	464.27	464.47	464.44	463.07	463.17	463.04	463.30	463.23
10/24/96	502.62	468.08	480.59	502.39	472.58	464.21	467.01	465.98	464.40	464.63	464.50	462.42	463.12	462.99	463.41	463.25
10/25/96	503.61	468.86	481.61	503.59	473.65	465.13	467.85	466.75	464.85	465.36	465.21	463.19	463.72	463.46	464.01	463.87
10/26/96	503.94	469.76	482.54	504.40	474.74	466.11	468.87	467.67	465.80	466.50	466.10	464.10	464.28	464.15	464.80	464.63
10/27/96	504.12	470.30	483.15	504.66	475.32	466.75	469.42	468.08	466.32	466.84	466.57	464.41	464.55	464.40	465.17	464.97
10/28/96	504.21	470.19	482.99	503.99	475.17	466.55	469.26	467.89	466.00	466.56	466.29	464.13	464.14	463.98	464.80	464.68
10/29/96	504.30	470.27	483.14	504.21	475.66	467.11	469.70	468.27	466.58	466.33	466.72	464.51	464.36	464.21	465.08	464.87
10/30/96	504.32	470.56	483.43	504.15	475.96	467.40	470.02	468.52	466.71	467.01	466.90	464.74	464.48	464.30	465.23	464.98
10/31/96	504.33	470.43	483.33	503.91	475.98	467.48	470.08	468.53	466.46	466.99	466.89	464.70	464.37	464.21	465.13	464.97
11/01/96	504.33	470.72	483.56	504.07	476.34	467.90	470.45	468.85	466.72	467.25	467.18	465.08	464.60	464.41	465.39	465.24
11/02/96	504.21	470.85	483.61	503.87	476.46	468.04	470.61	468.95	466.83	467.28	467.25	465.03	464.62	464.43	465.40	465.26
11/03/96	504.03	471.01	483.70	503.87	476.75	468.36	470.93	469.28	466.91	467.59	467.55	465.37	464.88	464.69	465.66	NA
11/04/96	503.79	471.44	484.02	504.01	477.24	468.92	471.44	469.73	467.47	468.04	467.71	465.70	465.31	465.13	465.87	465.91
11/05/96	503.49	471.66	484.09	503.75	477.32	469.03	471.57	469.83	467.62	467.64	468.08	465.89	465.39	465.21	466.17	465.95
11/06/96	503.16	471.83	484.12	503.58	477.51	469.23	471.82	470.04	467.90	468.33	468.26	466.13	465.58	465.41	466.36	466.15
11/07/96	502.81	471.82	483.95	503.44	477.38	469.15	471.69	469.82	467.65	468.37	468.21	465.99	465.47	465.27	466.25	466.05
11/08/96	502.50	471.40	483.45	502.29	476.90	468.69	471.24	470.04	467.19	468.04	467.71	465.49	465.21	464.79	466.25	465.53
11/09/96	503.13	471.05	483.11	502.47	476.50	468.29	470.84	469.11	466.79	467.56	467.25	465.03	464.64	464.47	465.40	465.20
11/10/96	512.10	472.28	486.80	512.09	477.74	469.09	471.57	469.73	467.48	467.99	467.89	465.69	465.30	465.09	466.04	465.83
11/11/96	511.38	472.76	487.26	511.25	478.27	469.58	472.01	469.97	467.68	468.21	468.04	465.68	465.51	465.25	466.18	465.99
11/12/96	507.81	472.95	486.41	507.95	478.64	470.05	472.54	470.40	467.91	468.55	468.43	466.19	465.91	465.57	466.46	466.29
11/13/96	502.74	472.87	484.89	503.22	478.65	470.38	472.83	471.09	468.40	468.88	468.76	466.48	466.08	465.83	466.80	466.62
11/14/96	492.63	472.10	481.39	487.55	477.78	470.13	472.66	470.72	468.37	468.80	468.75	466.48	466.23	465.77	466.72	466.62
11/15/96	479.46	470.53	476.62	476.65	476.08	469.52	472.18	470.60	467.99	468.21	468.75	466.51	465.78	465.62	466.62	466.48
11/16/96	478.92	469.77	475.26	474.19	474.88	468.73	471.48	470.26	467.68	467.95	468.59	466.35	465.55	465.41	466.44	466.29
11/17/96	478.95	468.99	474.43	473.09	473.81	467.87	470.67	469.70	467.19	467.61	468.05	465.92	465.11	464.95	466.00	465.87
11/18/96	478.95	468.33	473.68	472.12	472.73	466.93	469.79	468.91	466.43	466.73	467.28	465.13	464.48	464.33	465.30	465.10
11/19/96	478.98	467.61	472.98	471.37	471.80	466.06	468.98	468.21	465.61	466.35	466.63	464.46	463.89	463.77	464.70	464.63
11/20/96	479.10	467.12	472.54	470.86	471.26	465.59	NA	467.84	465.41	466.01	466.22	464.21	463.65	463.49	464.41	464.28
11/21/96	479.07	466.82	472.29	470.68	470.92	465.28	468.28	467.60	465.21	465.77	466.01	464.03	463.54	463.31	464.23	464.13
11/22/96	478.97	466.66	472.15	470.54	470.69	465.15	468.11	467.44	465.33	465.15	465.90	463.82	463.49	463.36	464.14	464.05

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
11/23/96	479.17	466.70	472.22	470.87	470.64	465.08	468.08	467.46	465.15	465.65	465.90	463.88	463.44	463.49	464.53	464.11
11/24/96	479.17	466.55	472.14	470.56	470.55	465.03	468.00	467.41	465.23	465.62	465.87	463.82	463.66	463.50	464.21	464.09
11/25/96	479.16	466.60	472.17	470.42	469.86	464.84	467.89	467.27	464.90	465.47	465.76	463.43	463.62	463.47	464.12	464.07
11/26/96	479.19	466.34	471.86	469.98	469.84	464.30	467.35	466.79	464.39	464.98	465.22	463.20	463.46	463.06	463.68	NA
11/27/96	484.60	466.46	472.80	470.65	470.28	464.53	467.53	466.95	464.83	465.25	465.44	463.21	463.50	463.37	463.96	463.90
11/28/96	486.07	467.32	474.22	471.83	471.05	464.70	467.95	467.36	465.24	465.86	465.84	463.79	463.93	463.48	464.69	464.30
11/29/96	486.21	467.40	474.35	472.09	471.17	464.99	467.92	467.28	465.18	465.89	465.77	463.64	463.81	463.60	464.02	464.16
11/30/96	486.14	467.55	474.52	472.31	471.41	465.15	468.09	467.43	465.18	465.75	465.90	463.87	463.97	463.80	464.41	464.34
12/01/96	485.94	467.39	474.34	472.06	471.18	464.91	467.85	467.15	465.05	465.47	465.66	463.51	463.66	463.50	464.14	464.07
12/02/96	495.55	467.31	476.17	472.55	471.15	464.45	467.42	466.74	464.70	465.12	465.19	463.15	463.37	463.23	463.85	463.71
12/03/96	507.29	469.48	482.76	501.46	473.75	465.93	468.79	467.88	466.17	466.36	466.36	464.32	464.51	464.35	465.04	464.89
12/04/96	502.92	470.69	482.25	500.78	474.61	466.77	469.49	468.33	466.49	466.82	466.83	463.68	464.69	464.54	465.32	465.04
12/05/96	496.23	470.51	480.26	494.80	474.82	467.31	470.06	468.85	467.00	467.17	467.28	464.29	464.93	464.77	465.64	465.39
12/06/96	485.97	469.40	476.52	476.70	473.65	466.88	469.56	468.52	466.38	466.81	466.91	463.82	464.37	464.24	465.13	464.91
12/07/96	481.20	468.33	474.08	473.02	473.07	466.48	469.26	468.00	466.15	466.62	466.79	463.66	464.19	464.07	464.98	464.74
12/08/96	480.51	467.59	473.10	471.45	471.46	465.48	468.37	467.58	465.32	465.79	465.99	462.85	463.44	463.31	464.21	464.00
12/09/96	479.94	467.31	472.64	471.24	471.69	465.51	468.44	467.70	465.40	465.91	466.11	462.99	463.62	463.49	464.32	464.19
12/10/96	479.36	467.32	472.58	471.47	471.28	465.56	468.48	467.84	465.65	466.15	466.23	463.14	463.82	463.70	464.52	464.36
12/11/96	480.62	467.20	472.59	470.97	470.97	465.26	468.16	467.52	465.21	465.75	465.98	462.86	463.64	463.51	464.29	464.12
12/12/96	480.78	467.35	472.73	471.16	471.10	465.38	468.33	467.73	465.46	465.94	466.14	463.04	463.88	463.77	464.50	464.32
12/13/96	482.19	467.52	473.12	471.32	471.10	465.35	468.29	467.68	465.46	465.48	466.15	463.05	463.89	463.86	464.56	464.41
12/14/96	483.96	467.57	473.53	471.52	471.12	465.25	468.14	467.53	465.40	465.50	466.01	462.87	463.88	463.76	464.45	464.30
12/15/96	485.17	467.86	474.26	472.03	471.51	465.44	468.39	467.60	465.63	465.79	466.22	463.14	464.13	464.01	464.69	464.53
12/16/96	485.96	468.00	474.49	472.24	471.59	465.41	468.34	467.67	465.68	466.10	466.14	463.02	464.04	463.92	464.61	464.37
12/17/96	487.50	467.97	474.83	472.34	471.56	465.25	468.11	467.43	465.45	465.45	465.91	462.81	463.80	463.67	464.36	464.28
12/18/96	490.42	468.01	475.56	472.79	471.77	465.25	468.11	467.38	465.23	465.73	465.85	462.75	463.76	463.61	464.35	464.19
12/19/96	494.38	468.54	477.31	473.85	472.40	465.51	468.39	467.58	465.62	465.94	466.05	462.91	463.93	463.81	464.55	464.39
12/20/96	497.49	468.83	478.61	496.31	472.91	465.79	NA	467.67	465.66	466.05	466.11	462.97	463.96	463.98	464.59	464.43
12/21/96	498.54	469.90	480.08	498.83	474.22	466.93	469.69	468.63	466.75	467.10	467.10	463.96	464.84	464.70	465.55	465.29
12/22/96	498.69	470.34	480.59	498.90	474.64	467.23	469.97	468.85	466.88	467.67	467.30	464.13	464.94	464.78	465.66	465.45
12/23/96	498.35	470.43	480.60	498.55	474.85	467.40	470.16	469.00	466.99	467.34	467.40	464.24	464.95	464.79	465.71	465.43
12/24/96	498.17	470.34	480.49	498.18	474.72	467.26	469.99	468.77	466.64	467.11	467.16	464.00	464.64	464.49	465.40	465.23
12/25/96	505.05	470.40	482.27	504.59	475.04	467.33	470.02	468.75	466.46	467.09	467.14	463.97	464.65	464.48	465.40	465.19
12/26/96	508.72	471.82	485.00	508.93	476.63	468.43	471.11	469.67	467.62	468.21	468.01	464.80	465.49	465.32	466.23	465.99
12/27/96	509.58	472.44	485.76	509.62	477.06	468.72	471.31	469.67	467.50	467.46	467.92	464.68	465.39	465.22	466.13	465.84
12/28/96	509.82	472.84	486.16	509.80	477.61	469.13	471.69	469.93	467.72	468.17	468.12	464.86	465.57	465.40	466.29	466.03
12/29/96	509.75	472.88	486.08	509.50	477.70	469.17	471.72	469.83	467.57	468.02	467.94	464.64	465.40	465.18	466.09	465.83
12/30/96	510.66	472.99	486.37	510.41	478.04	469.50	471.73	470.02	467.73	468.19	468.09	464.77	465.49	465.31	466.23	465.95
12/31/96	511.75	473.67	487.31	511.75	478.22	470.01	472.46	470.40	468.10	468.53	468.50	465.08	465.81	465.61	466.54	466.29
01/01/97	511.63	474.07	487.62	511.81	479.13	470.44	472.92	470.75	468.42	468.87	468.73	465.39	466.09	465.88	466.83	466.54
01/02/97	511.26	473.76	487.09	510.75	478.68	469.96	472.45	470.22	467.71	468.27	468.12	464.77	465.46	465.25	466.18	465.87
01/03/97	509.75	473.39	486.36	508.83	478.41	469.79	472.26	469.99	467.52	468.02	467.86	464.47	465.15	464.95	465.89	465.61
01/04/97	508.20	473.47	485.93	507.75	478.75	470.06	472.75	470.48	468.00	468.47	468.32	464.96	465.92	465.42	466.35	466.07
01/05/97	506.69	473.37	485.29	506.13	478.49	470.06	472.59	470.32	467.75	468.08	468.19	464.80	465.46	465.25	466.20	NA
01/06/97	505.49	472.82	484.60	504.62	477.96	469.63	472.18	469.94	467.45	467.95	468.23	464.45	465.10	464.88	465.82	465.52
01/07/97	505.17	472.82	484.30	504.52	478.04	469.75	472.33	470.74	467.64	468.14	468.02	464.63	465.29	465.09	466.04	465.70
01/08/97	504.42	472.80	484.07	503.85	477.96	469.79	472.36	470.20	467.71	468.21	468.09	464.73	465.39	465.19	466.12	465.87
01/09/97	502.90	472.86	483.69	502.56	478.01	469.89	472.37	470.35	467.92	468.41	468.33	464.96	465.81	465.41	466.31	466.07
01/10/97	501.42	472.20	482.55	500.24	477.27	468.91	471.58	469.53	467.04	467.50	467.62	464.07	464.70	464.57	465.45	465.20
01/11/97	500.29	471.86	481.96	499.34	476.88	468.97	471.65	469.66	467.20	467.67	467.63	464.26	464.90	464.70	465.64	465.31

TABLE 2 - TOWNSHEND LAKE PIEZOMETER READINGS

DATE	Pool Elev. (ft, NGVD)	Piezometer Water Surface Elevations (ft NGVD)														
		PZ-1	PZ-2	PZ-3	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10	PZ-11	PZ-12	PZ-13	PZ-14	PZ-15	PZ-16
01/12/97	498.30	471.81	481.37	497.75	476.85	469.09	471.83	469.94	467.47	467.98	467.94	464.60	465.22	465.04	465.97	465.68
01/13/97	496.23	471.68	480.63	488.31	476.71	469.12	471.82	470.10	467.63	468.15	468.13	464.81	465.39	465.24	466.17	465.93
01/14/97	494.49	471.48	479.91	478.47	476.35	468.95	471.69	470.04	467.60	468.13	468.13	464.83	465.41	465.25	466.16	465.91
01/15/97	493.77	471.31	479.51	476.79	476.06	468.77	471.55	470.00	467.57	468.09	468.12	464.84	465.41	465.25	466.17	465.85
01/16/97	492.36	470.68	478.46	475.51	475.04	467.91	470.70	469.28	466.82	467.35	467.78	464.12	464.68	464.54	465.29	465.19
01/17/97	490.38	470.01	477.26	474.83	474.74	467.57	470.43	469.07	466.66	467.46	467.27	464.02	464.55	464.41	465.32	465.08
01/18/97	487.82	469.78	476.39	474.49	474.20	467.42	470.34	469.11	466.70	467.75	467.36	464.23	464.60	464.47	465.22	465.22
01/19/97	484.99	469.52	475.41	473.80	473.51	467.33	470.30	469.43	466.80	467.15	467.52	464.32	464.50	464.60	465.49	465.32
01/20/97	481.53	468.82	473.97	472.30	472.89	466.77	469.77	468.78	466.39	466.94	467.48	463.94	464.36	464.23	465.19	464.92
01/21/97	481.27	468.62	473.60	472.46	472.71	466.72	469.77	468.85	466.49	467.03	467.19	464.05	464.52	464.41	465.34	465.09
01/22/97	479.31	468.43	473.13	471.73	472.11	466.30	469.32	468.18	466.27	467.13	466.97	463.81	464.33	464.23	465.13	464.88
01/23/97	479.19	467.73	472.29	471.31	471.75	465.09	468.47	467.79	465.45	465.98	466.17	463.01	463.64	463.52	464.41	464.15
01/24/97	479.19	468.12	472.68	470.97	471.83	465.79	469.22	468.53	466.39	466.74	466.97	463.82	464.54	464.54	465.25	464.97
01/25/97	479.16	467.68	472.21	470.40	470.59	465.03	468.06	467.43	465.17	465.67	465.85	462.73	463.83	463.39	464.18	464.06
01/26/97	479.28	467.36	471.69	471.08	470.53	464.95	468.01	467.39	465.14	465.61	465.85	462.60	463.57	463.45	464.17	464.02
01/27/97	479.21	467.73	472.31	470.98	471.70	465.49	468.64	468.00	465.81	466.26	466.48	463.33	464.28	464.17	464.86	464.65
01/28/97	479.10	467.41	471.81	470.41	470.09	464.45	467.59	467.00	464.85	465.23	465.45	462.30	463.33	463.43	463.88	463.75
01/29/97	479.40	467.15	471.70	470.33	470.71	464.75	467.85	466.87	465.13	465.53	466.15	462.62	463.98	463.57	464.17	464.06
01/30/97	479.32	467.48	471.97	470.74	470.53	464.94	468.05	467.47	465.33	465.74	465.86	462.81	463.96	463.26	464.44	464.28
01/31/97	479.35	467.11	471.63	470.03	469.88	464.29	467.36	466.82	464.71	465.10	465.30	462.21	463.38	463.26	463.82	463.73

Table 3 - Relief Well Information

Relief Well	Centerline Stationing	Centerline Offset	Riser Pipe Top Elevation (ft, NGVD)	Tee Invert Elevation (ft, NGVD)	Top of Well Screen Elev. (ft, NGVD)	Bottom of Well Elev.* (ft, NGVD)
RW-1	22+40	500' d/s	478.56	467.0	465.0	420.26
RW-2	22+40	450' d/s	476.30	467.0	465.0	420.45
RW-3	22+40	400' d/s	475.33	467.0	465.0	420.28
RW-4	22+40	350' d/s	474.90	467.0	463.0	420.34
RW-5	22+20	300' d/s	474.40	466.5	461.0	420.91
RW-6	21+65	300' d/s	471.97	466.5	456.0	420.58
RW-7	21+10	310' d/s	472.31	466.5	455.0	420.73
RW-8	20+65	310' d/s	468.68	466.5	455.0	421.68**
RW-9	20+10	310' d/s	468.35	466.5	455.0	421.35**

* Elevations based on soundings taken May 1998.

** Elevations based on soundings taken after 1994 well cleanout.

Note: All well screens are located in a zone of stratified gravelly SANDS and sandy GRAVELS.

Table 4 - Townshend Lake Dam Relief Well Water Surface Depth Readings

Date	Pool Stage (ft)	Depth to Water Surface, Meters (measured from Relief Well cover) RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
01/03/94	21.90	NA	NA	NA	NA	NA	NA	NA	NA	NA
04/19/94	54.70	3.52	2.72	NA	2.36	2.16	1.67	2.06	NA	NA
04/20/94	48.40	3.52	2.71	2.57	2.35	2.16	1.77	1.07	NA	NA
04/21/94	40.70	3.52	2.72	2.51	2.35	2.19	1.70	2.10	NA	NA
04/22/94	23.70	3.52	2.75	2.51	2.36	2.25	1.77	2.17	NA	NA
04/23/94	23.50	3.52	2.79	2.52	2.36	2.31	1.83	2.23	NA	NA
04/24/94	23.40	3.53	2.83	2.52	2.37	2.35	1.87	2.26	NA	NA
04/25/94	24.10	3.54	2.97	2.53	2.37	2.40	1.91	2.29	NA	NA
11/01/94	21.30	4.72	4.06	3.73	3.56	3.45	2.80	3.02	1.95	NA
12/01/94	22.20	4.62	3.95	3.62	3.45	3.34	2.70	2.92	NA	NA
02/01/95	22.00	4.24	3.60	3.25	3.10	3.05	2.46	2.75	NA	NA
02/28/95	21.70	RWI	RWI	RWI	RWI	RWI	RWI	RWI	NA	NA
04/03/95	23.71	4.31	3.66	3.32	3.16	3.11	2.52	2.80	NA	NA
04/30/95	22.70	4.35	3.68	3.34	3.20	3.11	2.51	2.74	NA	NA
06/01/95	21.80	4.52	3.85	3.51	3.36	3.27	2.65	2.87	NA	NA
06/30/95	20.87	4.70	4.02	3.69	3.53	3.44	2.79	3.03	NA	NA
08/01/95	21.00	4.79	4.13	3.79	3.62	3.51	2.87	3.10	NA	NA
09/01/95	20.80	4.83	4.19	3.84	3.67	3.57	2.92	3.14	2.08	NA
09/29/95	21.30	4.80	4.15	3.80	3.62	3.49	2.85	3.06	NA	NA
10/23/95	48.40	4.30	3.62	3.28	3.10	2.91	2.30	2.55	NA	NA
10/30/95	37.10	4.05	3.40	3.04	2.80	2.77	2.20	2.51	NA	NA
10/31/95	29.60	4.00	3.34	2.98	2.81	2.74	2.18	2.50	NA	NA
11/30/95	22.70	4.00	3.00	3.00	3.00	3.00	2.00	3.00	NA	NA
01/02/96	22.00	RWI	RWI	RWI	RWI	RWI	RWI	RWI	NA	NA
01/25/96	60.00	3.54	2.96	3.00	2.00	2.00	1.00	2.00	NA	NA
01/26/96	60.00	3.53	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
01/29/96	60.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
01/30/96	59.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
01/31/96	51.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
02/01/96	44.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
02/02/96	31.60	3.51	2.72	3.00	2.00	2.00	2.00	2.00	NA	NA
02/05/96	22.00	3.58	2.84	2.52	2.37	2.35	1.86	2.00	NA	NA
02/06/96	22.06	4.00	3.00	3.00	2.00	2.00	2.00	2.00	NA	NA
03/01/96	22.56	4.02	3.37	3.03	2.88	2.84	2.26	2.56	NA	NA
04/01/96	22.90	4.09	3.45	3.10	2.95	2.90	2.31	2.60	NA	NA
04/18/96	57.90	3.55	2.90	2.50	2.40	2.32	1.81	2.16	NA	NA
04/19/96	55.46	3.55	2.85	2.53	2.38	2.27	1.75	2.21	NA	NA
04/20/96	52.20	3.53	2.82	2.52	2.37	2.25	1.72	2.10	NA	NA
04/21/96	47.10	3.52	2.80	2.52	2.36	2.23	1.71	2.10	NA	NA
04/22/96	46.90	3.52	2.79	2.52	2.36	2.22	1.71	2.09	NA	NA
04/23/96	39.60	3.52	2.78	2.51	2.36	2.24	1.72	2.08	NA	NA
04/24/96	43.28	3.53	2.78	2.52	2.36	2.22	1.70	2.07	NA	NA
04/25/96	40.20	3.52	2.78	2.52	2.36	2.23	1.71	2.09	NA	NA
04/26/96	34.10	3.52	2.80	2.52	2.37	2.25	1.73	2.11	NA	NA
04/27/96	30.60	3.52	2.82	2.52	2.36	2.28	1.77	2.13	NA	NA
04/28/96	25.00	3.53	2.83	2.52	2.37	2.32	1.81	2.18	NA	NA
04/29/96	27.00	3.54	2.85	2.53	2.37	2.34	1.82	2.18	NA	NA
04/30/96	36.00	3.53	2.85	2.52	2.37	2.33	1.80	2.16	NA	NA
05/01/96	36.30	3.53	2.83	2.52	2.38	2.30	1.77	2.13	NA	NA
05/02/96	45.00	3.52	2.82	2.52	2.38	2.28	1.75	2.13	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

Table 4 - Townshend Lake Dam Relief Well Water Surface Depth Readings

Date	Pool Stage (ft)	Depth to Water Surface, Meters (measured from Relief Well cover) RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
05/03/96	33.00	3.53	2.82	2.52	2.37	2.30	1.80	2.18	NA	NA
05/04/96	23.00	3.53	2.85	2.52	2.37	2.36	1.86	2.94	NA	NA
05/05/96	23.20	3.53	2.87	2.53	2.38	2.40	1.91	2.29	NA	NA
05/06/96	22.99	3.55	2.90	2.55	2.39	2.43	1.94	2.32	NA	NA
05/07/96	24.09	3.57	2.94	2.59	2.43	2.46	1.97	2.36	NA	NA
05/08/96	21.73	3.60	2.97	2.61	2.46	2.49	1.99	2.36	NA	NA
05/13/96	49.71	3.54	2.87	2.54	2.39	2.34	1.83	2.20	NA	NA
05/14/96	48.80	3.53	2.84	2.52	2.37	2.30	1.79	2.16	NA	NA
05/15/96	38.60	3.53	2.83	2.52	2.37	2.29	1.79	2.17	NA	NA
05/16/96	23.50	3.53	2.85	2.52	2.37	2.35	1.85	2.23	NA	NA
05/17/96	22.73	3.54	2.87	2.53	2.38	2.38	1.89	2.26	NA	NA
05/18/96	22.30	3.55	2.90	2.54	2.40	2.40	1.93	2.30	NA	NA
05/19/96	23.60	3.56	2.93	2.56	2.41	2.44	1.95	2.32	NA	NA
05/20/96	22.49	3.58	2.95	2.59	2.45	2.47	1.97	2.34	NA	NA
06/03/96	21.40	4.02	3.39	3.04	2.89	2.86	2.30	2.61	NA	NA
07/01/96	21.10	4.32	3.67	3.32	3.16	3.10	2.49	2.76	NA	NA
07/14/96	39.40	4.36	3.69	3.35	3.18	3.02	2.40	2.65	NA	NA
07/15/96	34.10	4.25	3.60	3.25	3.08	2.95	2.34	2.61	NA	NA
07/16/96	29.80	4.19	3.54	3.18	3.01	2.91	2.31	2.59	NA	NA
07/17/96	24.10	4.16	3.50	3.16	3.00	2.91	2.33	2.61	NA	NA
07/18/96	22.00	4.18	3.53	3.19	3.02	2.96	2.37	2.66	NA	NA
07/19/96	21.70	4.20	3.55	3.21	3.05	3.10	2.39	2.68	NA	NA
08/01/96	21.10	4.41	3.75	3.41	3.26	3.17	2.56	2.81	NA	NA
09/03/96	20.20	4.78	4.15	3.79	3.62	3.55	2.92	3.19	NA	NA
10/01/96	21.99	4.67	4.01	3.67	3.50	3.42	2.81	3.08	NA	NA
10/10/96	23.40	4.72	4.07	3.72	3.57	3.51	2.87	3.11	NA	NA
10/22/96	42.30	4.56	3.89	3.55	3.39	3.24	2.63	2.92	NA	NA
10/23/96	44.59	4.43	3.78	3.43	3.25	3.11	2.53	2.84	NA	NA
10/24/96	45.50	4.31	3.66	3.30	3.11	2.98	2.42	2.76	NA	NA
10/25/96	46.50	4.20	3.54	3.18	2.98	2.87	2.32	2.70	NA	NA
10/26/96	46.80	4.09	3.43	3.06	2.88	2.77	2.25	2.64	NA	NA
10/27/96	47.10	3.97	3.31	2.94	2.75	2.66	2.15	2.56	NA	NA
10/28/96	47.13	3.85	3.21	2.82	2.63	2.56	2.07	2.49	NA	NA
10/29/96	47.24	3.78	3.14	2.75	2.55	2.51	2.03	2.45	NA	NA
10/30/96	47.21	3.71	3.07	2.68	2.51	2.44	1.99	2.41	NA	NA
10/31/96	47.20	3.66	3.01	2.63	2.43	2.41	1.94	2.38	NA	NA
11/01/96	47.24	3.60	2.97	2.58	2.40	2.37	1.91	2.35	NA	NA
11/02/96	47.10	3.56	2.93	2.54	2.38	2.35	1.89	2.33	NA	NA
11/03/96	46.90	3.56	2.91	2.54	2.38	2.34	1.90	2.32	NA	NA
11/04/96	46.60	3.54	2.90	2.54	2.37	2.33	1.86	2.30	NA	NA
11/05/96	46.35	3.55	2.90	2.53	2.37	2.34	1.86	2.30	NA	NA
11/06/96	46.00	3.55	2.90	2.53	2.37	2.32	1.86	2.30	NA	NA
11/07/96	45.67	3.54	2.88	2.53	2.37	2.31	1.84	2.28	NA	NA
11/08/96	45.39	3.54	2.88	2.53	2.38	2.30	1.85	2.27	NA	NA
11/09/96	46.80	3.56	2.84	2.53	2.39	2.29	1.77	2.20	NA	NA
11/10/96	55.30	3.52	2.82	2.52	2.36	2.23	1.74	2.20	NA	NA
11/11/96	53.88	3.53	2.80	2.52	2.36	2.20	1.71	2.15	NA	NA
11/12/96	50.50	3.52	2.79	2.52	2.36	2.19	1.70	2.14	NA	NA
11/13/96	43.00	3.52	2.79	2.52	2.36	2.21	1.72	2.16	NA	NA
11/14/96	33.60	3.53	2.81	2.53	2.36	2.25	1.78	2.20	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

Table 4 - Townshend Lake Dam Relief Well Water Surface Depth Readings

Date	Pool Stage (ft)	Depth to Water Surface, Meters (measured from Relief Well cover) RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
11/15/96	22.26	3.53	2.85	2.53	2.37	2.35	1.87	2.31	NA	NA
11/16/96	21.70	3.54	2.89	2.53	2.38	2.42	1.95	2.38	NA	NA
11/17/96	21.80	3.58	2.95	2.58	2.41	2.48	2.02	2.45	NA	NA
12/02/96	43.00	4.01	3.35	3.01	2.94	2.78	2.27	2.59	NA	NA
12/03/96	50.28	3.86	3.21	2.85	2.68	2.60	2.07	2.45	NA	NA
12/04/96	45.50	3.74	3.10	2.72	2.56	2.50	2.00	2.39	NA	NA
12/05/96	37.86	3.87	3.03	2.65	2.48	2.46	1.97	2.37	NA	NA
12/06/96	27.03	3.65	3.00	2.65	2.48	2.49	2.00	2.41	NA	NA
12/07/96	24.00	3.70	3.08	2.71	2.54	2.57	2.09	2.49	NA	NA
12/10/96	22.20	3.90	3.21	2.90	2.75	2.76	2.24	2.63	NA	NA
12/18/96	34.40	3.92	3.29	2.94	2.78	2.75	2.22	2.59	NA	NA
12/19/96	38.63	3.87	3.22	2.87	2.70	2.66	2.14	2.52	NA	NA
12/20/96	40.70	3.82	3.18	2.81	2.65	2.61	2.09	2.48	NA	NA
12/21/96	41.40	3.75	3.11	2.75	2.57	2.55	2.04	2.45	NA	NA
12/22/96	41.50	3.70	3.06	2.69	2.52	2.50	2.01	2.42	NA	NA
12/23/96	41.10	3.65	3.02	2.65	2.48	2.47	1.98	2.39	NA	NA
12/24/96	41.01	3.62	2.99	2.61	2.44	2.43	1.96	2.37	NA	NA
12/25/96	48.60	3.58	2.94	2.57	2.40	2.38	1.90	2.32	NA	NA
12/26/96	51.70	3.55	2.89	2.54	2.37	2.34	1.85	2.27	NA	NA
12/27/96	52.52	3.53	2.87	2.53	2.37	2.30	1.80	2.24	NA	NA
12/28/96	52.68	3.53	2.84	2.52	2.38	2.27	1.79	2.20	NA	NA
12/29/96	52.56	3.52	2.82	2.54	2.36	2.25	1.75	2.20	NA	NA
12/30/96	54.09	3.53	2.80	2.52	2.36	2.22	1.72	2.16	NA	NA
12/31/96	54.66	3.53	2.80	2.51	2.36	2.20	1.70	2.15	NA	NA
01/01/97	54.39	3.52	2.78	2.52	2.35	2.18	1.68	2.13	NA	NA
01/02/97	54.03	3.53	2.75	2.52	2.37	2.17	1.67	2.12	NA	NA
01/03/97	52.27	3.52	2.74	2.52	2.36	2.17	1.66	2.11	NA	NA
01/04/97	50.80	3.53	2.75	2.51	2.36	2.17	1.67	2.11	NA	NA
01/05/97	49.29	3.52	2.74	2.51	2.35	2.16	1.66	2.11	NA	NA
01/06/97	48.30	3.52	2.75	2.51	2.35	2.16	1.67	2.12	NA	NA
01/07/97	47.94	3.51	2.75	2.51	2.35	2.17	1.67	2.13	NA	NA
01/08/97	47.20	3.51	2.75	2.51	2.35	2.18	1.68	2.13	NA	NA
01/09/97	45.52	3.51	2.76	2.51	2.35	2.19	1.69	2.14	NA	NA
01/10/97	44.12	3.51	2.76	2.51	2.36	2.19	1.71	2.14	NA	NA
01/11/97	42.90	3.52	2.77	2.51	2.36	2.21	1.72	2.16	NA	NA
01/12/97	41.00	3.52	2.78	2.52	2.36	2.23	1.74	2.17	NA	NA
01/13/97	38.90	3.52	2.80	2.53	2.36	2.25	1.77	2.20	NA	NA
01/14/97	37.80	3.52	2.80	2.52	2.36	2.28	1.79	2.22	NA	NA
01/15/97	36.30	3.53	2.82	2.53	2.37	2.30	1.81	2.23	NA	NA
01/16/97	35.36	3.53	2.85	2.52	2.37	2.31	1.84	2.25	NA	NA
01/18/97	30.20	3.54	2.89	2.53	2.38	2.38	1.91	2.33	NA	NA
01/19/97	28.30	3.55	2.91	2.54	2.39	2.42	1.95	2.38	NA	NA
01/20/97	24.20	3.58	2.95	2.58	2.42	2.48	2.00	2.41	NA	NA
01/21/97	23.90	3.65	3.02	2.65	2.50	2.53	2.05	2.46	NA	NA
01/31/97	22.30	4.12	3.51	3.18	3.04	3.01	2.45	2.79	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

Table 5 - Townshend Lake Dam Relief Well Water Surface Elevations

DATE	Water Surface Elevation (ft, NGVD)									
	Pool	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
01/03/94	478.90	NA	NA	NA	NA	NA	NA	NA	NA	NA
04/19/94	511.70	467.01	467.38	NA	467.16	467.31	466.49	465.55	NA	NA
04/20/94	505.40	467.01	467.41	466.90	467.19	467.31	466.16	468.80	NA	NA
04/21/94	497.70	467.01	467.38	467.10	467.19	467.22	466.39	465.42	NA	NA
04/22/94	480.70	467.01	467.28	467.10	467.16	467.02	466.16	465.19	NA	NA
04/23/94	480.50	467.01	467.15	467.06	467.16	466.82	465.97	464.99	NA	NA
04/24/94	480.40	466.98	467.02	467.06	467.12	466.69	465.83	464.90	NA	NA
04/25/94	481.10	466.95	466.56	467.03	467.12	466.53	465.70	464.80	NA	NA
11/01/94	478.30	463.07	462.98	463.09	463.22	463.08	462.78	462.40	462.28	NA
12/01/94	479.20	463.40	463.34	463.45	463.58	463.44	463.11	462.73	NA	NA
02/01/95	479.00	464.65	464.49	464.67	464.73	464.39	463.90	463.29	NA	NA
02/28/95	478.70	RWI	RWI	RWI	RWI	RWI	RWI	RWI	NA	NA
04/03/95	480.71	464.42	464.29	464.44	464.53	464.20	463.70	463.12	NA	NA
04/30/95	479.70	464.29	464.23	464.37	464.40	464.20	463.74	463.32	NA	NA
06/01/95	478.80	463.73	463.67	463.81	463.88	463.67	463.28	462.89	NA	NA
06/30/95	477.87	463.14	463.11	463.22	463.32	463.11	462.82	462.37	NA	NA
08/01/95	478.00	462.84	462.75	462.90	463.02	462.88	462.55	462.14	NA	NA
09/01/95	477.80	462.71	462.55	462.73	462.86	462.69	462.39	462.01	461.86	NA
09/29/95	478.30	462.81	462.68	462.86	463.02	462.95	462.62	462.27	NA	NA
10/23/95	505.40	464.45	464.42	464.57	464.73	464.85	464.42	463.94	NA	NA
10/30/95	494.10	465.27	465.15	465.36	465.71	465.31	464.75	464.08	NA	NA
10/31/95	486.60	465.44	465.34	465.55	465.68	465.41	464.82	464.11	NA	NA
11/30/95	479.70	465.44	466.46	465.49	465.06	464.56	465.41	462.47	NA	NA
01/02/96	479.00	RWI	RWI	RWI	RWI	RWI	RWI	RWI	NA	NA
01/25/96	517.00	466.95	466.59	465.49	468.34	467.84	468.69	465.75	NA	NA
01/26/96	517.00	466.98	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
01/29/96	517.00	465.44	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
01/30/96	516.00	465.44	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
01/31/96	508.00	465.44	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
02/01/96	501.00	465.44	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
02/02/96	488.60	467.04	467.38	465.49	468.34	467.84	465.41	465.75	NA	NA
02/05/96	479.00	466.80	466.98	467.06	467.12	466.69	465.87	465.75	NA	NA
02/06/96	479.06	465.44	466.46	465.49	468.34	467.84	465.41	465.75	NA	NA
03/01/96	479.56	465.37	465.24	465.39	465.45	465.08	464.56	463.91	NA	NA
04/01/96	479.90	465.14	464.98	465.16	465.22	464.89	464.39	463.78	NA	NA
04/18/96	514.90	466.91	466.79	467.13	467.03	466.79	466.03	465.22	NA	NA
04/19/96	512.46	466.91	466.95	467.03	467.09	466.95	466.23	465.06	NA	NA
04/20/96	509.20	466.98	467.05	467.06	467.12	467.02	466.33	465.42	NA	NA
04/21/96	504.10	467.01	467.11	467.06	467.16	467.08	466.36	465.42	NA	NA
04/22/96	503.90	467.01	467.15	467.06	467.16	467.12	466.36	465.45	NA	NA
04/23/96	496.60	467.01	467.18	467.10	467.16	467.05	466.33	465.49	NA	NA
04/24/96	500.28	466.98	467.18	467.06	467.16	467.12	466.39	465.52	NA	NA
04/25/96	497.20	467.01	467.18	467.06	467.16	467.08	466.36	465.45	NA	NA
04/26/96	491.10	467.01	467.11	467.06	467.12	467.01	466.29	465.39	NA	NA
04/27/96	487.60	467.01	467.05	467.06	467.16	466.92	466.16	465.32	NA	NA
04/28/96	482.00	466.98	467.02	467.06	467.12	466.79	466.03	465.16	NA	NA
04/29/96	484.00	466.95	466.95	467.03	467.12	466.72	466.00	465.16	NA	NA
04/30/96	493.00	466.98	466.95	467.06	467.12	466.76	466.06	465.22	NA	NA
05/01/96	493.30	466.98	467.02	467.06	467.09	466.85	466.16	465.32	NA	NA
05/02/96	502.00	467.01	467.05	467.06	467.09	466.92	466.23	465.32	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

Table 5 - Townshend Lake Dam Relief Well Water Surface Elevations

DATE	Water Surface Elevation (ft, NGVD)									
	Pool	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
05/03/96	490.00	466.98	467.05	467.06	467.12	466.85	466.06	465.16	NA	NA
05/04/96	480.00	466.98	466.95	467.06	467.12	466.66	465.87	462.66	NA	NA
05/05/96	480.20	466.98	466.88	467.03	467.09	466.53	465.70	464.80	NA	NA
05/06/96	479.99	466.91	466.79	466.96	467.06	466.43	465.61	464.70	NA	NA
05/07/96	481.09	466.85	466.65	466.83	466.93	466.33	465.51	464.57	NA	NA
05/08/96	478.73	466.75	466.56	466.77	466.83	466.23	465.44	464.57	NA	NA
05/13/96	506.71	466.95	466.88	467.00	467.06	466.72	465.97	465.09	NA	NA
05/14/96	505.80	466.98	466.98	467.06	467.12	466.85	466.10	465.22	NA	NA
05/15/96	495.60	466.98	467.02	467.06	467.12	466.89	466.10	465.19	NA	NA
05/16/96	480.50	466.98	466.95	467.06	467.12	466.69	465.90	464.99	NA	NA
05/17/96	479.73	466.95	466.88	467.03	467.09	466.59	465.77	464.90	NA	NA
05/18/96	479.30	466.91	466.79	467.00	467.03	466.53	465.64	464.76	NA	NA
05/19/96	480.60	466.88	466.69	466.93	466.99	466.39	465.57	464.70	NA	NA
05/20/96	479.49	466.81	466.62	466.83	466.86	466.30	465.51	464.63	NA	NA
06/03/96	478.40	465.37	465.18	465.36	465.42	465.02	464.42	463.75	NA	NA
07/01/96	478.10	464.39	464.26	464.44	464.53	464.23	463.80	463.25	NA	NA
07/14/96	496.40	464.26	464.19	464.34	464.47	464.49	464.10	463.62	NA	NA
07/15/96	491.10	464.62	464.49	464.67	464.80	464.72	464.29	463.75	NA	NA
07/16/96	486.80	464.81	464.69	464.90	465.02	464.85	464.39	463.81	NA	NA
07/17/96	481.10	464.91	464.82	464.96	465.06	464.85	464.33	463.75	NA	NA
07/18/96	479.00	464.85	464.72	464.86	464.99	464.69	464.19	463.58	NA	NA
07/19/96	478.70	464.78	464.65	464.80	464.89	464.23	464.13	463.52	NA	NA
08/01/96	478.10	464.09	464.00	464.14	464.20	464.00	463.57	463.09	NA	NA
09/03/96	477.20	462.88	462.68	462.90	463.02	462.75	462.39	461.84	NA	NA
10/01/96	478.99	463.24	463.14	463.29	463.42	463.18	462.75	462.21	NA	NA
10/10/96	480.40	463.07	462.95	463.13	463.19	462.88	462.55	462.11	NA	NA
10/22/96	499.30	463.60	463.54	463.68	463.78	463.77	463.34	462.73	NA	NA
10/23/96	501.59	464.03	463.90	464.08	464.24	464.20	463.67	462.99	NA	NA
10/24/96	502.50	464.42	464.29	464.50	464.70	464.62	464.03	463.25	NA	NA
10/25/96	503.50	464.78	464.69	464.90	465.12	464.98	464.36	463.45	NA	NA
10/26/96	503.80	465.14	465.05	465.29	465.45	465.31	464.59	463.65	NA	NA
10/27/96	504.10	465.54	465.44	465.68	465.88	465.67	464.92	463.91	NA	NA
10/28/96	504.13	465.93	465.77	466.08	466.27	466.00	465.18	464.14	NA	NA
10/29/96	504.24	466.16	466.00	466.31	466.53	466.17	465.31	464.27	NA	NA
10/30/96	504.21	466.39	466.23	466.54	466.67	466.39	465.44	464.40	NA	NA
10/31/96	504.20	466.55	466.42	466.70	466.93	466.49	465.61	464.50	NA	NA
11/01/96	504.24	466.75	466.56	466.87	467.03	466.62	465.70	464.60	NA	NA
11/02/96	504.10	466.88	466.69	467.00	467.09	466.69	465.77	464.67	NA	NA
11/03/96	503.90	466.88	466.75	467.00	467.09	466.72	465.74	464.70	NA	NA
11/04/96	503.60	466.95	466.79	467.00	467.12	466.76	465.87	464.76	NA	NA
11/05/96	503.35	466.91	466.79	467.03	467.12	466.72	465.87	464.76	NA	NA
11/06/96	503.00	466.91	466.79	467.03	467.12	466.79	465.87	464.76	NA	NA
11/07/96	502.67	466.95	466.85	467.03	467.12	466.82	465.93	464.83	NA	NA
11/08/96	502.39	466.95	466.85	467.03	467.09	466.85	465.90	464.86	NA	NA
11/09/96	503.80	466.88	466.98	467.03	467.06	466.89	466.16	465.09	NA	NA
11/10/96	512.30	467.01	467.05	467.06	467.16	467.08	466.26	465.09	NA	NA
11/11/96	510.88	466.98	467.11	467.06	467.16	467.18	466.36	465.26	NA	NA
11/12/96	507.50	467.01	467.15	467.06	467.16	467.22	466.39	465.29	NA	NA
11/13/96	500.00	467.01	467.15	467.06	467.16	467.15	466.33	465.22	NA	NA
11/14/96	490.60	466.98	467.08	467.03	467.16	467.02	466.13	465.09	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

Table 5 - Townshend Lake Dam Relief Well Water Surface Elevations

	Water Surface Elevation (ft, NGVD)									
DATE	Pool	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9
11/15/96	479.26	466.98	466.95	467.03	467.12	466.69	465.83	464.73	NA	NA
11/16/96	478.70	466.95	466.82	467.03	467.09	466.46	465.57	464.50	NA	NA
11/17/96	478.80	466.81	466.62	466.87	466.99	466.26	465.34	464.27	NA	NA
12/02/96	500.00	465.40	465.31	465.45	465.25	465.28	464.52	463.81	NA	NA
12/03/96	507.28	465.90	465.77	465.98	466.11	465.87	465.18	464.27	NA	NA
12/04/96	502.50	466.29	466.13	466.41	466.50	466.20	465.41	464.47	NA	NA
12/05/96	494.86	465.86	466.36	466.64	466.76	466.33	465.51	464.53	NA	NA
12/06/96	484.03	466.59	466.46	466.64	466.76	466.23	465.41	464.40	NA	NA
12/07/96	481.00	466.42	466.20	466.44	466.57	465.97	465.11	464.14	NA	NA
12/10/96	479.20	465.76	465.77	465.82	465.88	465.34	464.62	463.68	NA	NA
12/18/96	491.40	465.70	465.51	465.68	465.78	465.38	464.69	463.81	NA	NA
12/19/96	495.63	465.86	465.74	465.91	466.04	465.67	464.95	464.04	NA	NA
12/20/96	497.70	466.03	465.87	466.11	466.21	465.84	465.11	464.17	NA	NA
12/21/96	498.40	466.26	466.10	466.31	466.47	466.03	465.28	464.27	NA	NA
12/22/96	498.50	466.42	466.26	466.50	466.63	466.20	465.38	464.37	NA	NA
12/23/96	498.10	466.59	466.39	466.64	466.76	466.30	465.47	464.47	NA	NA
12/24/96	498.01	466.68	466.49	466.77	466.89	466.43	465.54	464.53	NA	NA
12/25/96	505.60	466.81	466.65	466.90	467.03	466.59	465.74	464.70	NA	NA
12/26/96	508.70	466.91	466.82	467.00	467.12	466.72	465.90	464.86	NA	NA
12/27/96	509.52	466.98	466.88	467.03	467.12	466.85	466.06	464.96	NA	NA
12/28/96	509.68	466.98	466.98	467.06	467.09	466.95	466.10	465.09	NA	NA
12/29/96	509.56	467.01	467.05	467.00	467.16	467.02	466.23	465.09	NA	NA
12/30/96	511.09	466.98	467.11	467.06	467.16	467.12	466.33	465.22	NA	NA
12/31/96	511.66	466.98	467.11	467.10	467.16	467.18	466.39	465.26	NA	NA
01/01/97	511.39	467.01	467.18	467.06	467.19	467.25	466.46	465.32	NA	NA
01/02/97	511.03	466.98	467.28	467.06	467.12	467.28	466.49	465.35	NA	NA
01/03/97	509.27	467.01	467.31	467.06	467.16	467.28	466.52	465.39	NA	NA
01/04/97	507.80	466.98	467.28	467.10	467.16	467.28	466.49	465.39	NA	NA
01/05/97	506.29	467.01	467.31	467.10	467.19	467.31	466.52	465.39	NA	NA
01/06/97	505.30	467.01	467.28	467.10	467.19	467.31	466.49	465.35	NA	NA
01/07/97	504.94	467.04	467.28	467.10	467.19	467.28	466.49	465.32	NA	NA
01/08/97	504.20	467.04	467.28	467.10	467.19	467.25	466.46	465.32	NA	NA
01/09/97	502.52	467.04	467.24	467.10	467.19	467.22	466.43	465.29	NA	NA
01/10/97	501.12	467.04	467.24	467.10	467.16	467.22	466.36	465.29	NA	NA
01/11/97	499.90	467.01	467.21	467.10	467.16	467.15	466.33	465.22	NA	NA
01/12/97	498.00	467.01	467.18	467.06	467.16	467.08	466.26	465.19	NA	NA
01/13/97	495.90	467.01	467.11	467.03	467.16	467.02	466.16	465.09	NA	NA
01/14/97	494.80	467.01	467.11	467.06	467.16	466.92	466.10	465.03	NA	NA
01/15/97	493.30	466.98	467.05	467.03	467.12	466.85	466.03	464.99	NA	NA
01/16/97	492.36	466.98	466.95	467.06	467.12	466.82	465.93	464.93	NA	NA
01/18/97	487.20	466.95	466.82	467.03	467.09	466.59	465.70	464.67	NA	NA
01/19/97	485.30	466.91	466.75	467.00	467.06	466.46	465.57	464.50	NA	NA
01/20/97	481.20	466.81	466.62	466.87	466.96	466.26	465.41	464.40	NA	NA
01/21/97	480.90	466.59	466.39	466.64	466.70	466.10	465.24	464.24	NA	NA
01/31/97	479.30	465.04	464.78	464.90	464.93	464.52	463.93	463.16	NA	NA

NA=Reading Not Available RWI=Relief Well Inaccessible

ATTACHMENT NO. 1

The following standards and procedures are employed for Crest Monument Surveys at Corps of Engineers Dams.

STANDARDS FOR SETTLEMENT SURVEYS

1. Control points are stamped brass disks preferably set in a ledge area. Where no ledge is available, they are set in concrete bounds placed flush with the ground.

2. Control points are set in areas such that the maximum possible number of crest monuments on the dam are visible.

3. Control points are tied into four reference points by distance. This provides a check each time they are occupied for settlement surveys or allow them to be replaced if found to be destroyed.

4. Distances are read and recorded between settlement bounds. Both distance and angle are read and recorded from the control points that are being occupied to locate each settlement bound on the dam.

5. In locating each settlement bound, a control point will be occupied setting 0-00'-00" (referenced line of site) on a second control point, reading and recording both interior and exterior angle closure, along with distances through each settlement bound located on the dam. Each settlement bound is located from a minimum of two control points. These locations are third order, class II survey with relative accuracies of not less than 1 part in 5,000.

6. Levels are run from control points through each settlement bound on the dam with a return run back into the control points to check the elevation closure on the run. Closure tolerance should be no greater than 0.05'. These levels are third order, class I survey with relative accuracies not less than 1 part in 10,000.

7. Crest monument surveys are performed using Topcon EDM Total Stations and recording both horizontal angles and horizontal distances.

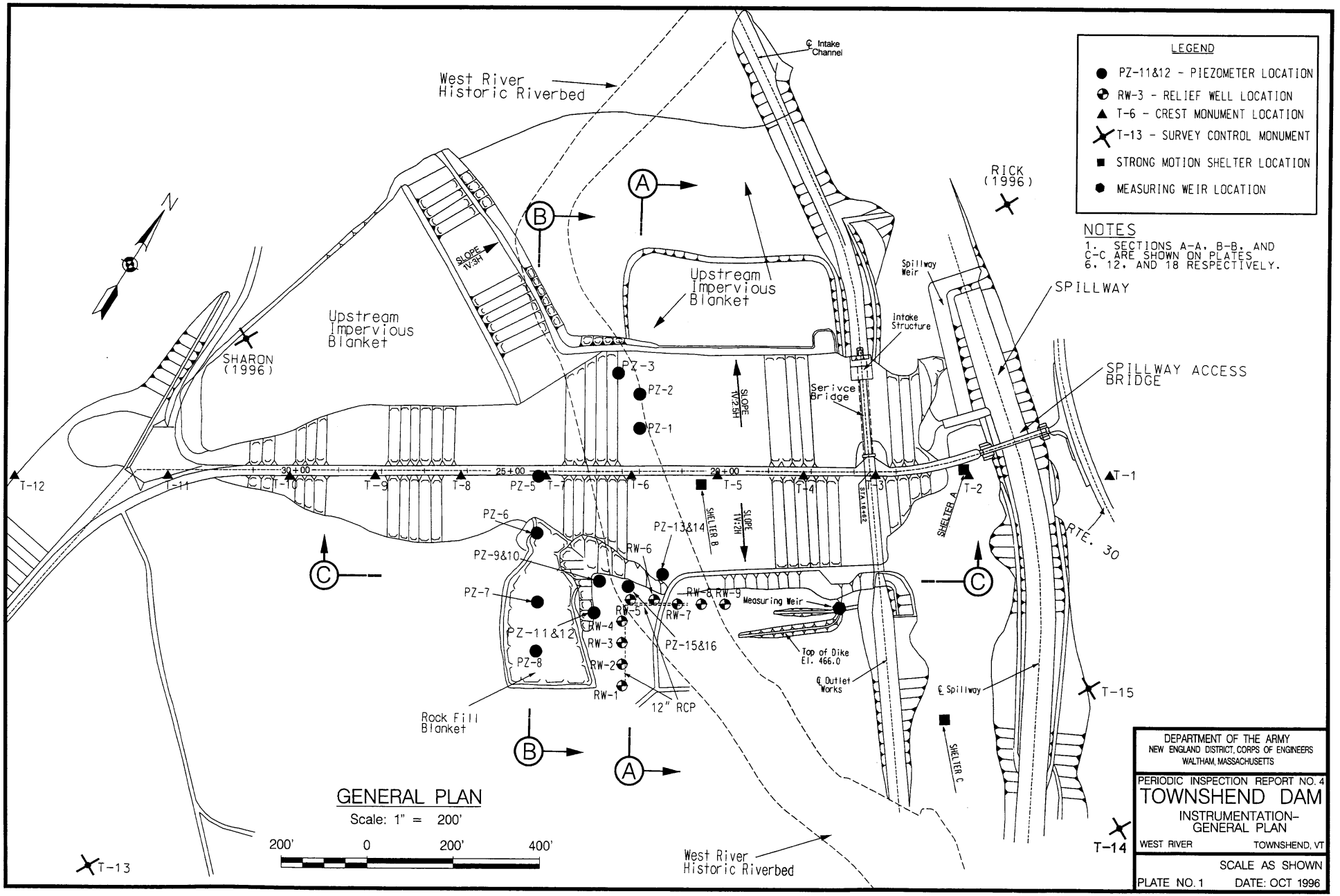
PROCEDURE FOLLOWED FOR SETTLEMENT SURVEYS

The horizontal and vertical monitoring plan for settlement bound movement points employed a combination of triangulation and trilateration angle and distance techniques to survey the control network. Control points, in the form of stamped brass disks, were placed off the dam structure in areas from which the entire length of the dam is visible. Settlement bounds themselves, with stamped brass disks, were placed on the dam structure in a location that is

clearly visible from the control points. Horizontal coordinates of the control points are based on the State Plane Coordinate System. Elevations of the control points are based on the National Geodetic Vertical Datum (NGVD). Control points are occupied utilizing an EDM Total Station; observed distances and angles (interior and exterior angles), between control points and settlement bound establishing permanent bench marks. Standard leveling techniques are followed. Levels are double run and the means of the front and back runs were computed and recorded.

DATA ADJUSTMENT

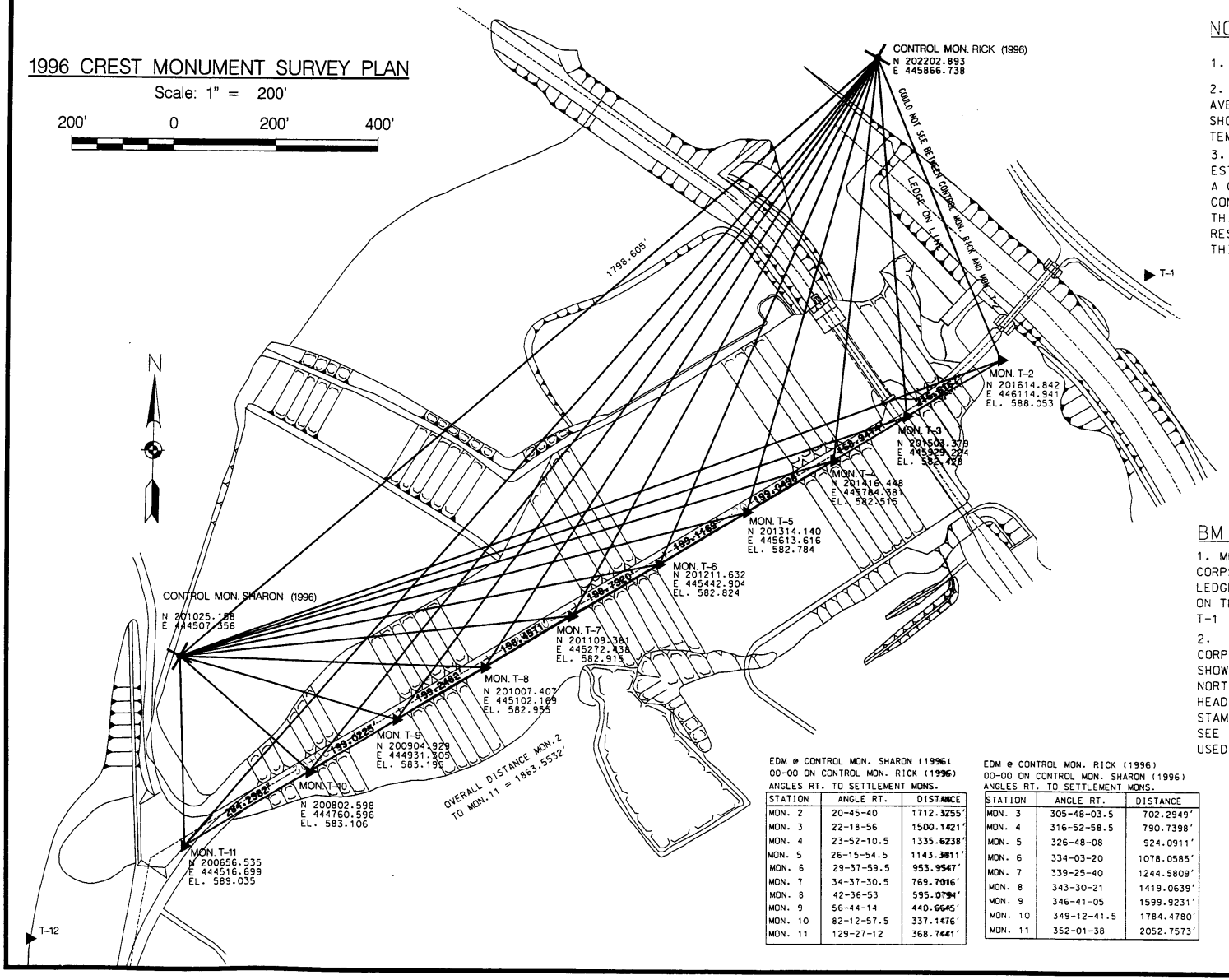
A combination of triangulation and trilateration surveying techniques are applied. Each crest monument is located from two control points and two sets of coordinates are calculated using adjusted field angles and compliments and EDM distances. The two sets of coordinates are averaged to give a net result. The averaged coordinates are then established on each settlement bound for use in determining shifts in the dam surface structure over a period of years by comparing repetitive surveys.


LEGEND
PZ-11&12 - PIEZOMETER LOCATION
RW-3 - RELIEF WELL LOCATION
T-6 - CREST MONUMENT LOCATION
T-13 - SURVEY CONTROL MONUMENT
STRONG MOTION SHELTER LOCATION
MEASURING WEIR LOCATION
NOTES
1. SECTIONS A-A, B-B, AND C-C ARE SHOWN ON PLATES 6, 12, AND 18 RESPECTIVELY.
West River Historic Riverbed
℄ Intake Channel
RICK (1996)
SHARON (1996)
Upstream Impervious Blanket
SLOPE 1V:3H
Spillway Weir
Intake Structure
SPILLWAY
SPILLWAY ACCESS BRIDGE
Service Bridge
PZ-1
PZ-2
PZ-3
PZ-5
PZ-6
PZ-7
PZ-8
PZ-9&10
PZ-11&12
PZ-13&14
PZ-15&16
RW-1
RW-2
RW-3
RW-4
RW-5
RW-6
RW-7
RW-8 RW-9
SHELTER A
SHELTER B
SHELTER C
Measuring Weir
Top of Dike El. 466.0
℄ Outlet Works
℄ Spillway
12" RCP
Rock Fill Blanket
RTE. 30
T-1
T-2
T-3
T-4
T-5
T-6
T-7
T-8
T-9
T-10
T-11
T-12
T-13
T-14
T-15
30+00
25+00
20+00
GENERAL PLAN
Scale: 1" = 200'
200' 0 200' 400'
DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS
PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND DAM
INSTRUMENTATION-GENERAL PLAN
WEST RIVER TOWNSHEND, VT
SCALE AS SHOWN
PLATE NO. 1 DATE: OCT 1996

1996 CREST MONUMENT SURVEY PLAN

Scale: 1" = 200'

200' 0 200' 400'



NOTES

1. ALL ELEVATIONS ARE GIVEN IN FEET, NGVD.
2. COORDINATES OF SETTLEMENT MONS. ARE AVERAGE COORDINATES DERIVED FROM 2 SETUPS. SHOT DISTANCES HAVE BEEN CORRECTED FOR TEMPERATURE AND BAROMETRIC PRESSURE.
3. HORIZONTAL CONTROL COORDINATES ESTABLISHED IN 1975 ARE INCORRECT DUE TO A COMPUTATIONAL ERROR. NEW HORIZONTAL CONTROL POINTS WERE ESTABLISHED DURING THIS SURVEY. FUTURE HORIZONTAL SURVEY RESULTS SHOULD ONLY BE COMPARED TO THIS (1996) SURVEY

BM DATA

1. MON. T-1 IS A BRASS U.S. ARMY CORPS OF ENGINEERS DISK SET FLUSH IN LEDGE AT THE EAST ABUTMENT OF THE DAM. ON THE EAST SIDE OF RT.30. IT IS STAMPED T-1 (72). EL. 583.189 (SEE FC-622, PG. 48)
2. B.M. IS A BRASS U.S. ARMY CORPS OF ENGINEERS B.M. DISK (NOT SHOWN HERE) SET FLUSH IN THE NORTHWEST CORNER OF THE EAST HEADWALL OF THE SPILLWAY BRIDGE. NO STAMPING. EL. 593.870 SEE FC-622 PG.48 THIS B.M. SHOULD BE USED FOR SETTLEMENT FROM NOW ON.

EDM @ CONTROL MON. SHARON (1996)
00-00 ON CONTROL MON. RICK (1996)
ANGLES RT. TO SETTLEMENT MONS.

STATION	ANGLE RT.	DISTANCE
MON. 2	20-45-40	1712.3255'
MON. 3	22-18-56	1500.1421'
MON. 4	23-52-10.5	1335.6238'
MON. 5	26-15-54.5	1143.3811'
MON. 6	29-37-59.5	953.9547'
MON. 7	34-37-30.5	769.7016'
MON. 8	42-36-53	595.0794'
MON. 9	56-44-14	440.6645'
MON. 10	82-12-57.5	337.1476'
MON. 11	129-27-12	368.7441'

EDM @ CONTROL MON. RICK (1996)
00-00 ON CONTROL MON. SHARON (1996)
ANGLES RT. TO SETTLEMENT MONS.

STATION	ANGLE RT.	DISTANCE
MON. 3	305-48-03.5	702.2949'
MON. 4	316-52-58.5	790.7398'
MON. 5	326-48-08	924.0911'
MON. 6	334-03-20	1078.0585'
MON. 7	339-25-40	1244.5809'
MON. 8	343-30-21	1419.0639'
MON. 9	346-41-05	1599.9231'
MON. 10	349-12-41.5	1784.4780'
MON. 11	352-01-38	2052.7573'

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NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPECTION REPORT NO. 4

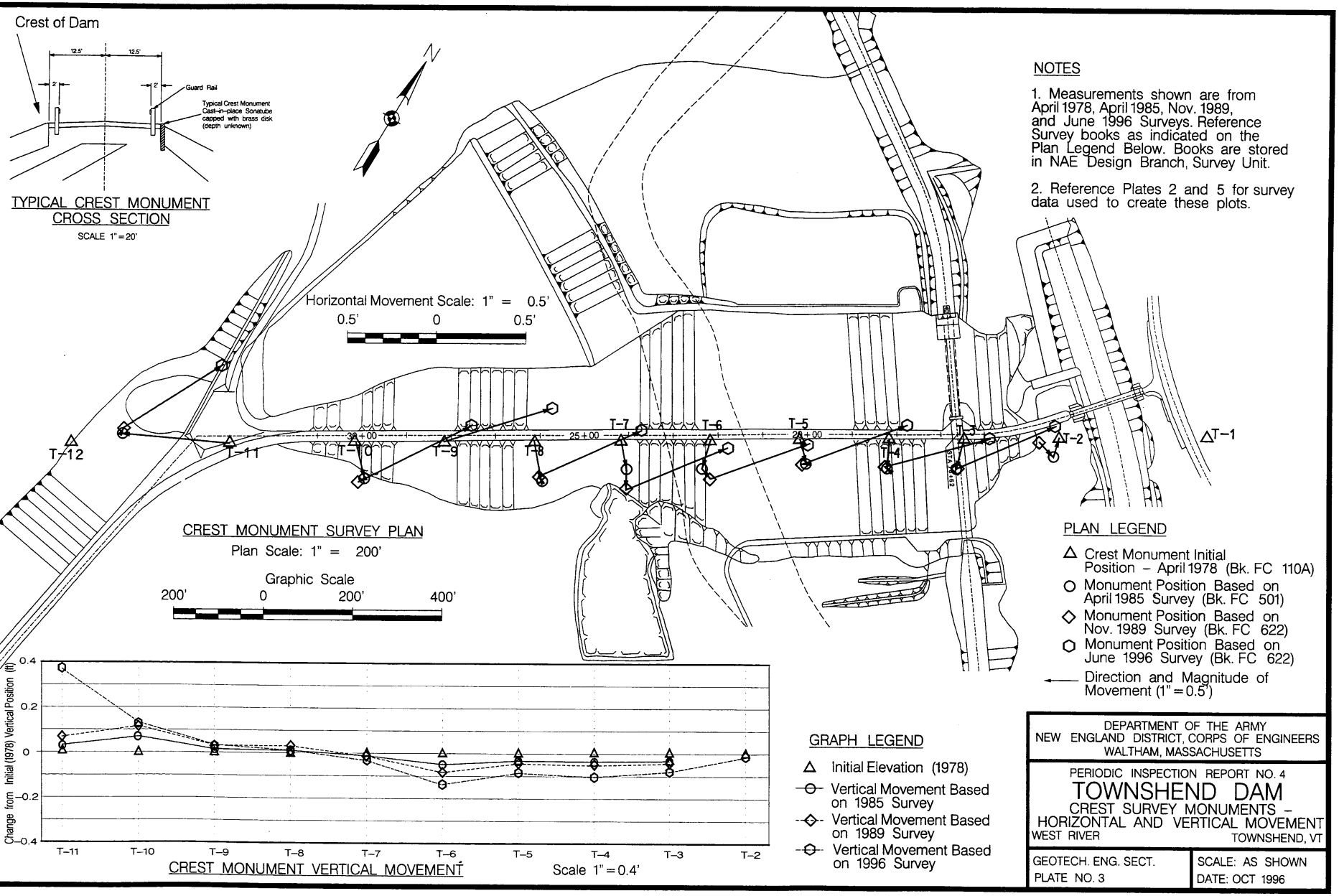
TOWNSHEND DAM

1996 CREST MONUMENT SURVEY

WEST RIVER — TOWNSHEND, VT

GEOTECH. ENG. SECT. — SCALE: AS SHOWN

PLATE NO. 2 — DATE: OCT 1996



NOTES

1. Measurements shown are from April 1978, April 1985, Nov. 1989, and June 1996 Surveys. Reference Survey books as indicated on the Plan Legend Below. Books are stored in NAE Design Branch, Survey Unit.

2. Reference Plates 2 and 5 for survey data used to create these plots.

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

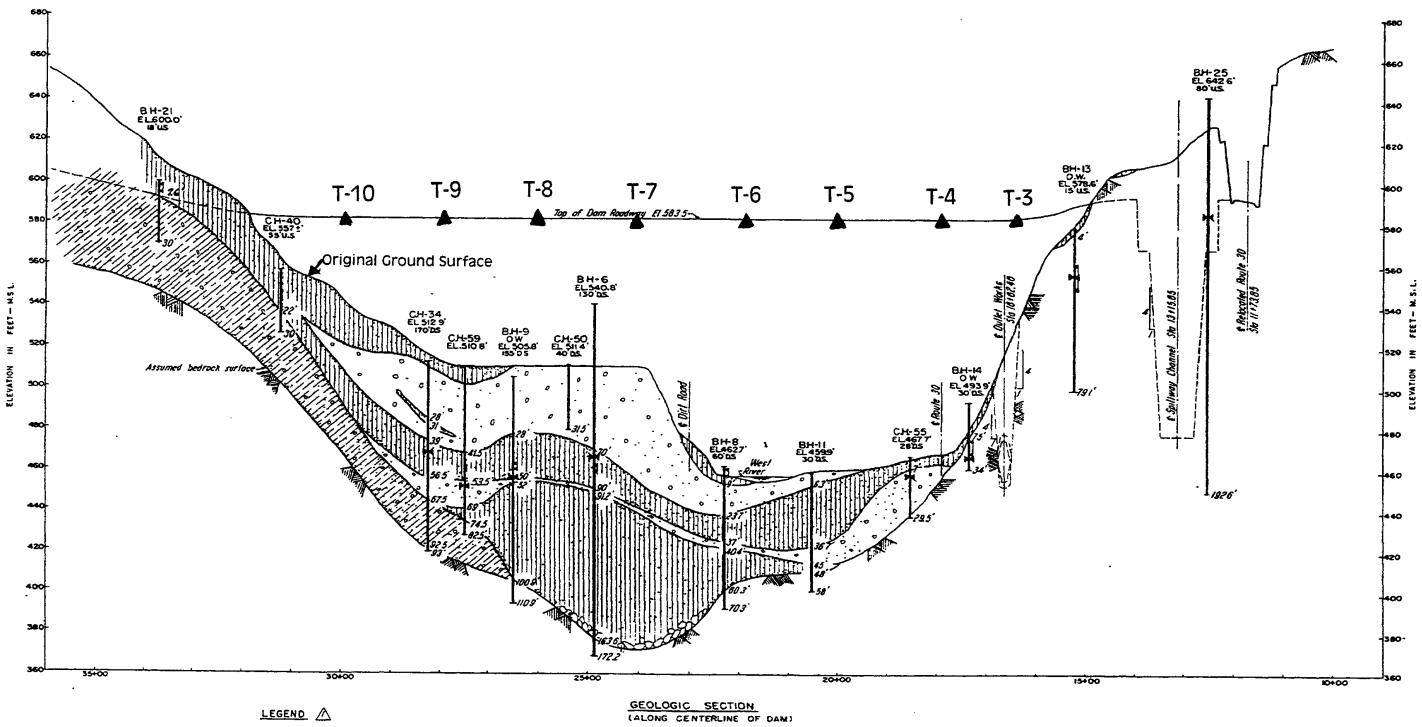
PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

CREST SURVEY MONUMENTS – HORIZONTAL AND VERTICAL MOVEMENT

WEST RIVER TOWNSHEND, VT

GEOTECH. ENG. SECT.	SCALE: AS SHOWN
PLATE NO. 3	DATE: OCT 1996



GEOLOGIC SECTION
(ALONG CENTERLINE OF DAM)

LEGEND

GRAVEL — Brown to gray, varying proportions of silt and sand, medium to coarse, compacted, often inter-stratified with silt and sand, semi-pervious to pervious (GP-GM)

SAND — Brown to gray, silty, includes strata of clean sand, chiefly fine to medium, often gravelly, generally well compacted, semi-pervious. (SP-SM)

SILT AND CLAY (Glacial Till) — Greenish-gray, sandy, gravelly including boulders, very well compacted, moist, semi-impervious to impervious (ML-CL)

BOULDERS — Nested boulders included with fine sand and silt.

BEDROCK — Chiefly sericite schist, densely foliated, often quartz injected and in sections includes granitoid phases.

Denotes subsurface water level at time of exploration.

Range of subsurface water level during period of observation.

GEOLOGIC SECTION TRHOUGH CENTERLINE OF DAM SHOWING ORIGINAL GROUND SURFACE AND LOCATION OF CREST MONUMENTS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPETION REPORT NO. 4

TOWNSHEND DAM

GEOLOGIC SECTION THROUGH CENTERLINE OF DAM

WEST RIVER — TOWNSHEND, VT

GEOTECH. ENG. SECT.	NOT TO SCALE
PLATE NO. 4	DATE: OCTOBER 1996

HORIZONTAL SURVEYS

Monument	APRIL 1978**		APRIL 1985**		NOV. 1989**		JUNE 1996**	
	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting
T-1	NR	NR	NR	NR	NR	NR	NR	NR
T-2	201614.47	446114.59	201614.36	446114.61	201614.39	446114.50	NR	NR
T-3	201503.05	445928.81	201502.88	445928.86	201502.89	445928.86	201503.38	445929.22
T-4	201416.15	445783.89	201416.01	445783.97	201416.01	445783.95	201416.45	445784.38
T-5	201313.76	445613.14	201313.66	445613.24	201313.65	445613.22	201314.14	445613.62
T-6	201211.37	445442.42	201211.21	445442.46	201211.18	445442.53	201211.63	445442.90
T-7	201109.09	445271.91	201108.97	445272.02	201108.87	445272.07	201109.36	445272.44
T-8	201007.05	445101.68	201006.87	445101.83	201006.89	445101.80	201007.41	445102.17
T-9	NR	NR	NR	NR	200904.46	444930.88	200904.93	444931.30
T-10	200802.19	444760.09	200802.03	444760.23	200802.00	444760.21	200802.60	444760.60
T-11	200656.17	444516.95	200655.91	444516.41	200655.95	444516.40	200656.53	444516.70

VERTICAL SURVEYS

Monument	**APRIL 1978** Elevation (ft, NGVD)	**APRIL 1985** Elevation (ft, NGVD)	**NOV 1989** Elevation (ft, NGVD)	**JUNE 1996** Elevation (ft, NGVD)
T-1	583.19	583.19	583.19	583.19
T-2	588.03	NR	NR	588.05
T-3	582.51	582.48	582.47	582.43
T-4	582.63	582.59	582.57	582.52
T-5	582.87	582.84	582.83	582.78
T-6	582.95	582.91	582.88	582.82
T-7	582.95	582.94	582.94	582.92
T-8	582.94	582.96	582.97	582.96
T-9	583.17	583.18	583.20	583.20
T-10	582.98	583.05	583.10	583.11
T-11	588.67	588.70	588.74	589.04

HORIZ. CONTROL POINTS

Monument	Northing	Easting
T-13 (ctrl)	**	**
T-14 (ctrl)	**	**
T-15 (ctrl)	**	**
SHARON 1996	201025.16	444507.36
RICK 1996	202202.89	445866.74

** NOTE: HORIZONTAL CONTROL COORDINATES ESTABLISHED IN 1975 FOR T-13, T-14, AND T-15 ARE INCORRECT DUE TO A COMPUTATIONAL ERROR. NEW HORIZONTAL CONTROL POINTS WERE ESTABLISHED DURING THE 1996 SURVEY. FUTURE HORIZONTAL SURVEY RESULTS SHOULD ONLY BE COMPARED TO THE 1996 SURVEY.

US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
WALTHAM, MASSACHUSETTS

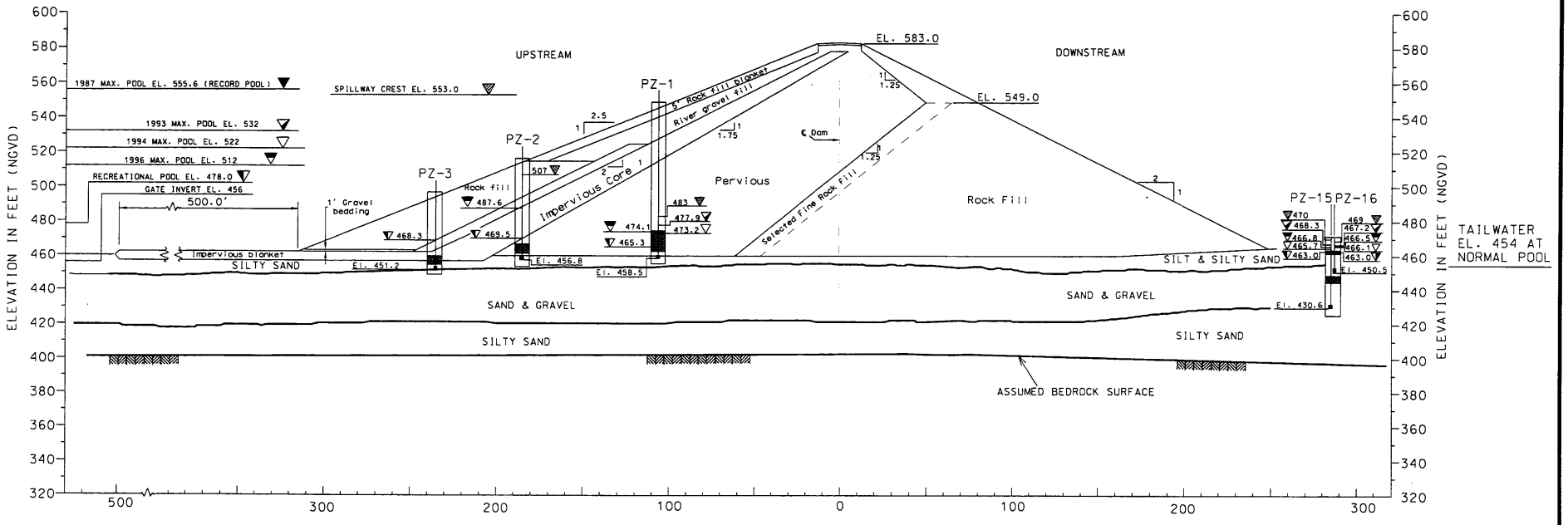
PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

CREST MONUMENT SURVEY DATA

WEST RIVER **TOWNSHEND, VT**

GEOTECH. ENG. SECT.	**SCALE: NA**
PLATE NO. 5	**DATE: OCT. 1996**

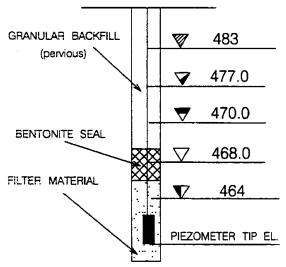


CROSS SECTION A-A AT STATION 22+00
Scale: 1"=60'

GRAPHIC SCALE
60 0 60 120

NOTE: SEE PLATE NO. 1 FOR LOCATION OF SECTION A-A

LEGEND FOR PIEZOMETERS



Projected maximum piezometer level with pool at spillway crest (based on combined data from several pool events)

Maximum piezometer reading during the March 1993 event

Maximum piezometer reading during the December 1996 event

Maximum piezometer reading during the April 1994 event

Average piezometer level with norm pool level (El. 478.0)

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

MAXIMUM PIEZOMETER READINGS
SECTION A-A AT STA 22+00

WEST RIVER TOWNSHEND, VT

GEOTECH. ENG. SECT.	SCALE: 1"=60'
PLATE NO. 6	DATE: OCT 1996

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/94 to 1/95)
Section A-A STA. 22+00 (PZ-1, 2, 3, 15, and 16)

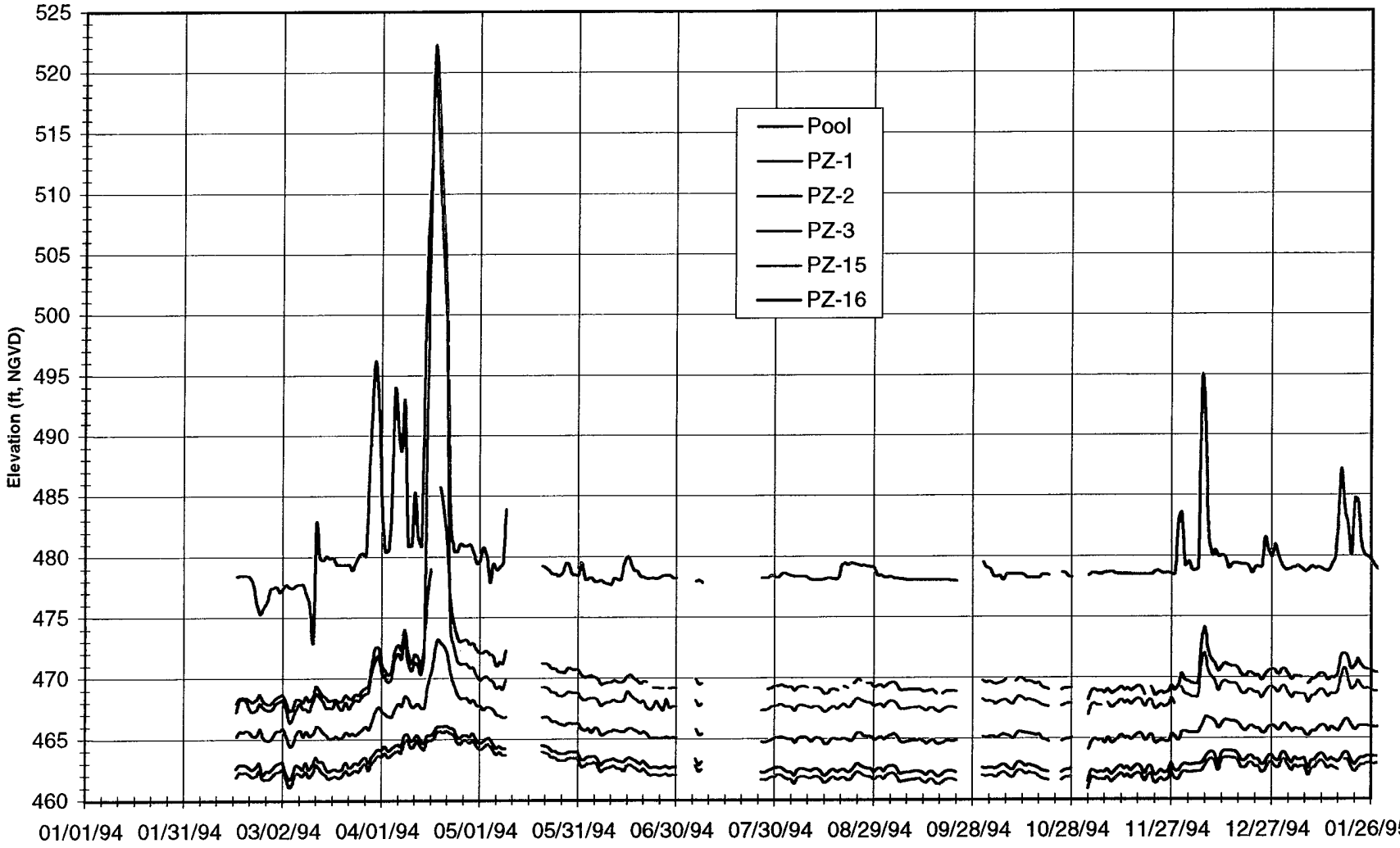


Plate 7

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/95 to 2/96)
Section A-A STA.22+00 (PZ-1, 2, 3, 15, and 16)

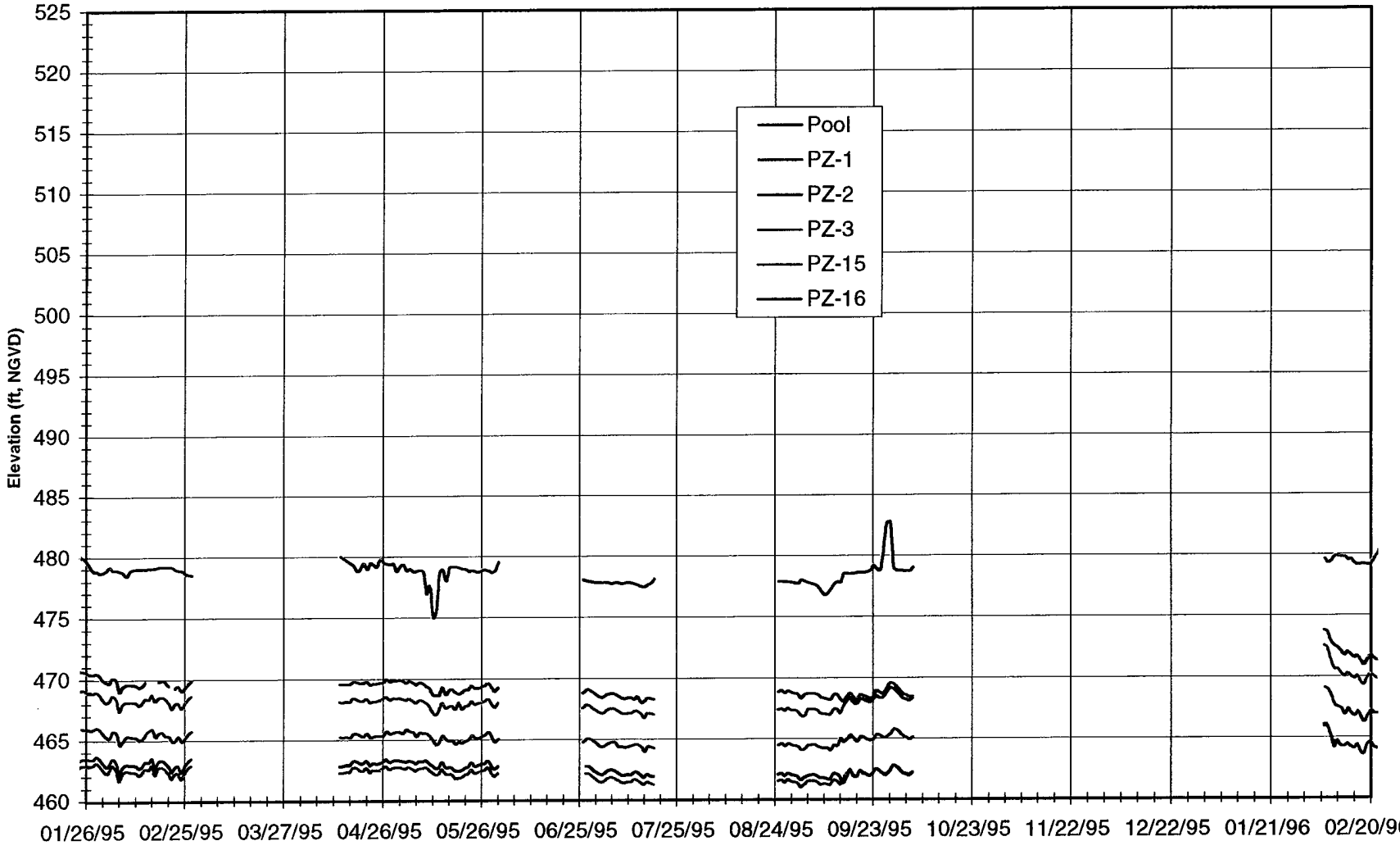


Plate 8

Townshend Lake Dam
Pool and Piezometer Time History Plots (2/96 to 2/97)
Section A-A STA.22+00 (PZ-1, 2, 3, 15, and 16)

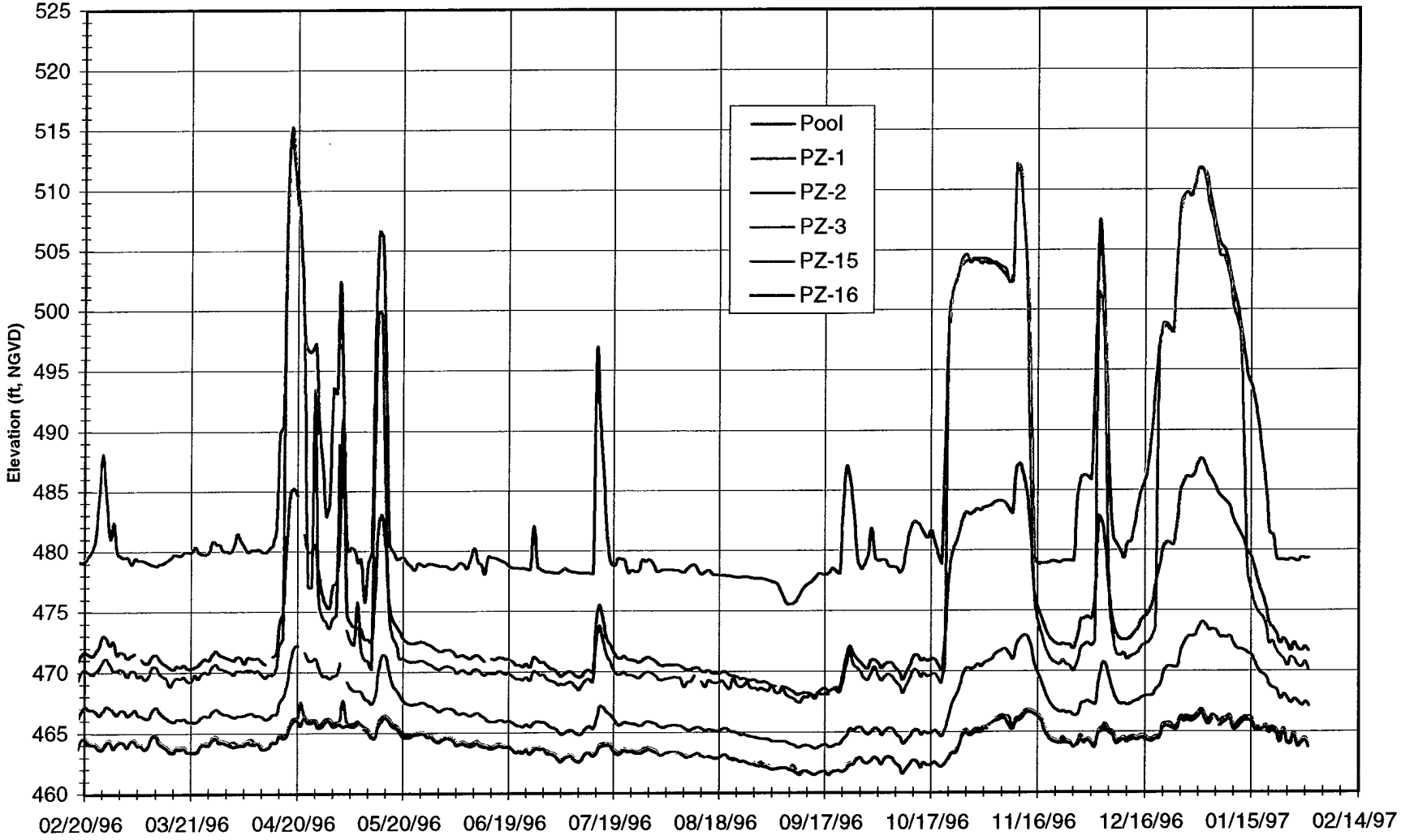


Plate 9

Townshend Lake
April 1994 Event Plot
Section A-A STA 22+00 (PZ-1, 2, 3, 15, 16)

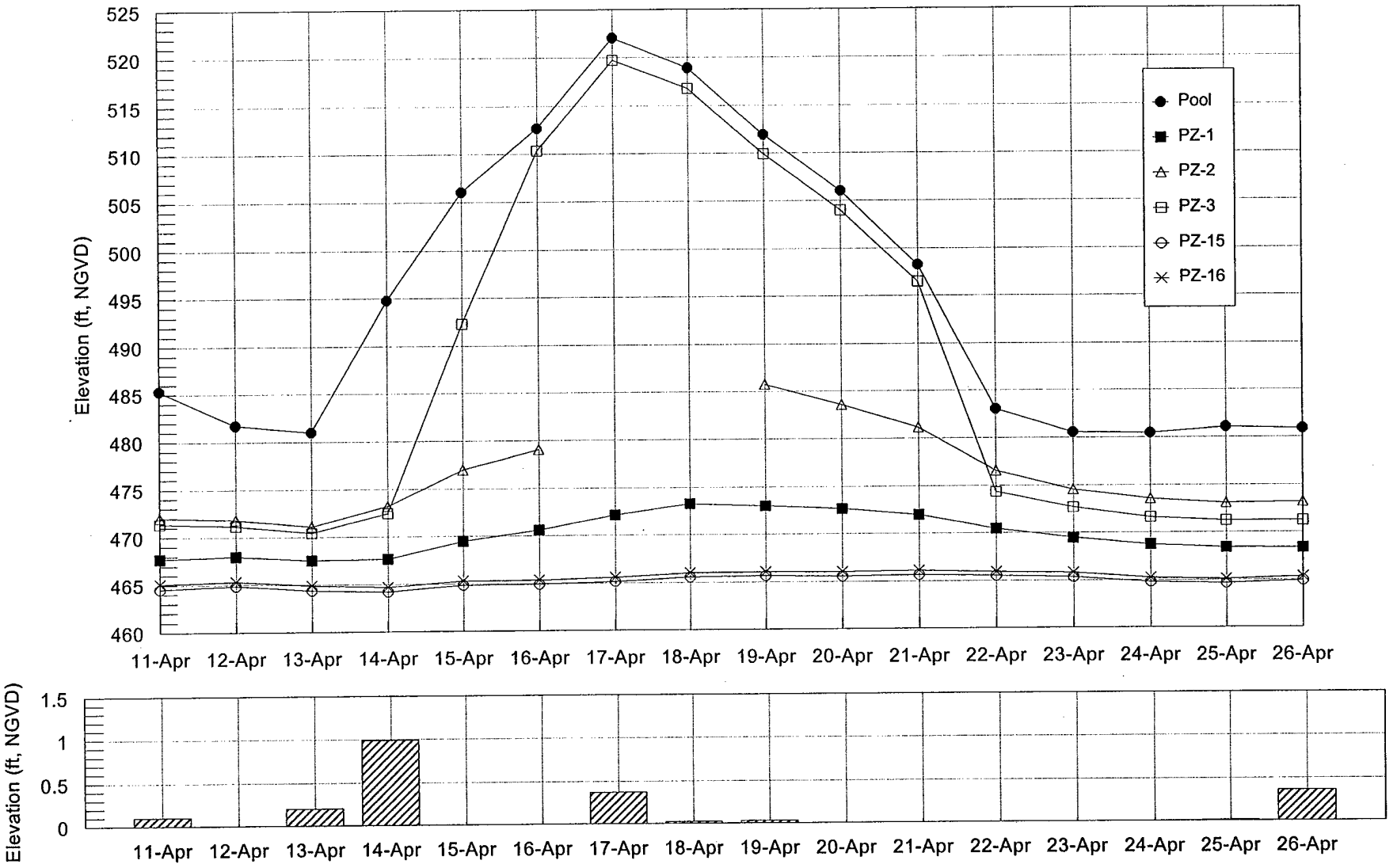


Plate 10

Townshend Lake
December 1996-January 1997 Event Plot
Section A-A STA 22+00 (PZ-1, 2, 3, 15, 16)

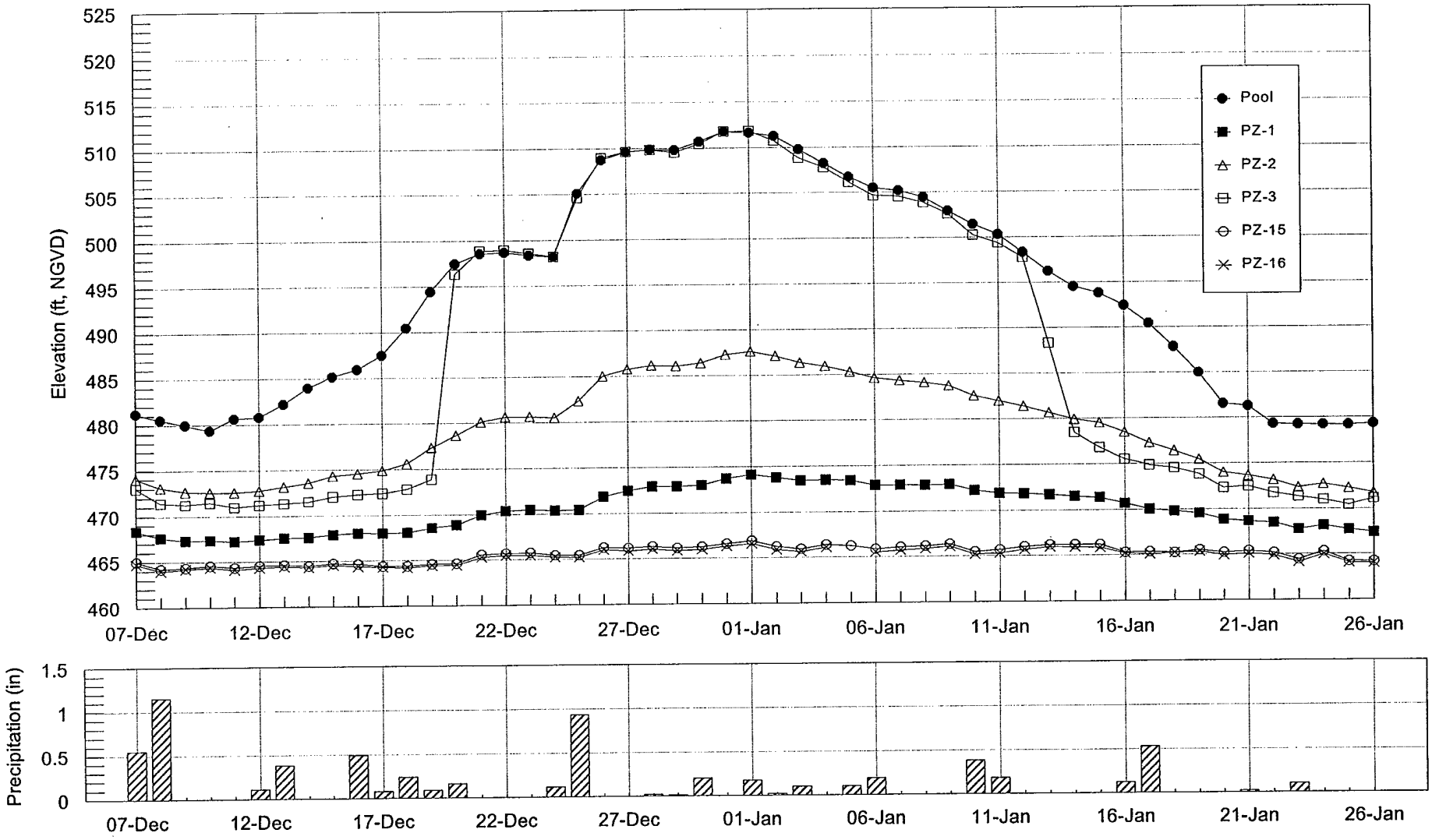
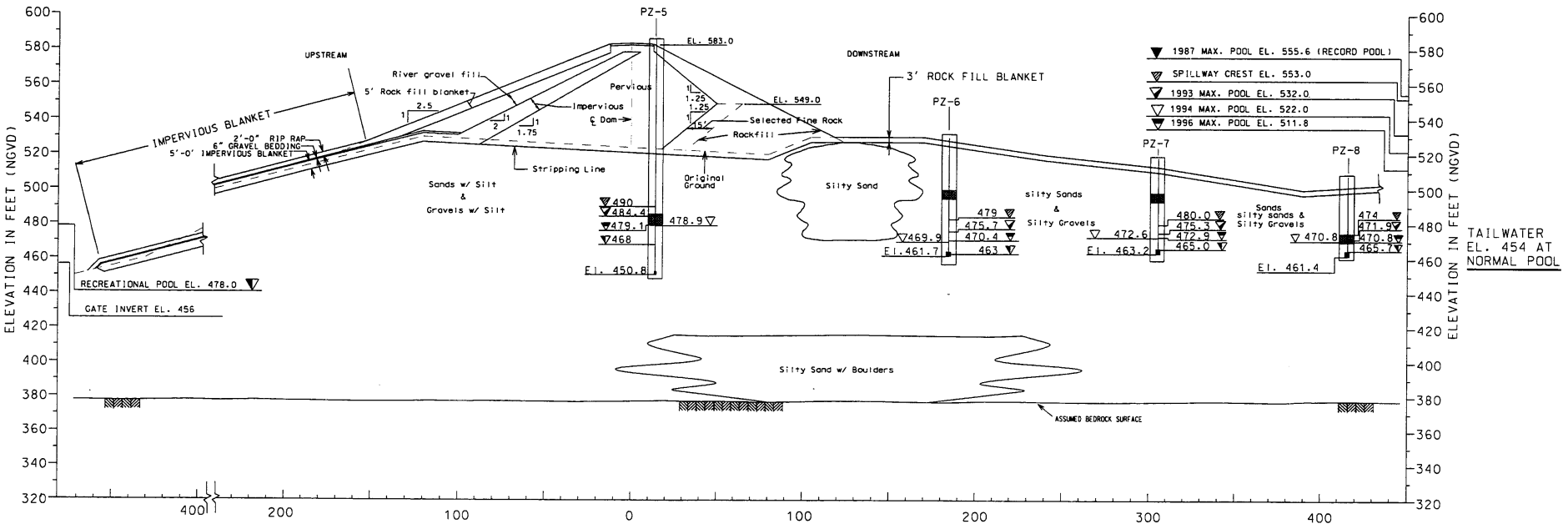


Plate 11



CROSS SECTION B–B AT STATION 24+50

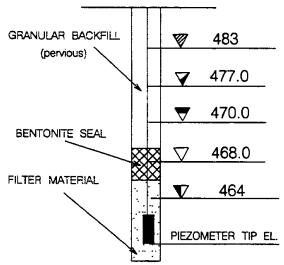
SCALE: 1"= 60'

NOTE: SEE PLATE NO. 1 FOR LOCATION OF SECTION B-B

GRAPHIC SCALE

60' 0 60' 120'

LEGEND FOR PIEZOMETERS



Projected maximum piezometer level with pool at spillway crest (based on combined data from several pool events)

Maximum piezometer reading during the March 1993 event

Maximum piezometer reading during the December 1996 event

Maximum piezometer reading during the April 1994 event

Average piezometer level with norm pool level (El. 478.0)

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

MAXIMUM PIEZOMETER READINGS
SECTION B–B AT STA 24+50
WEST RIVER TOWNSHEND, VT

GEOTECH. ENG. SECT.	SCALE: 1"=60'
PLATE NO. 12	DATE: OCTOBER 1996

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/94 to 1/95)
Section B-B STA 24+50 (PZ-5 - PZ-8)

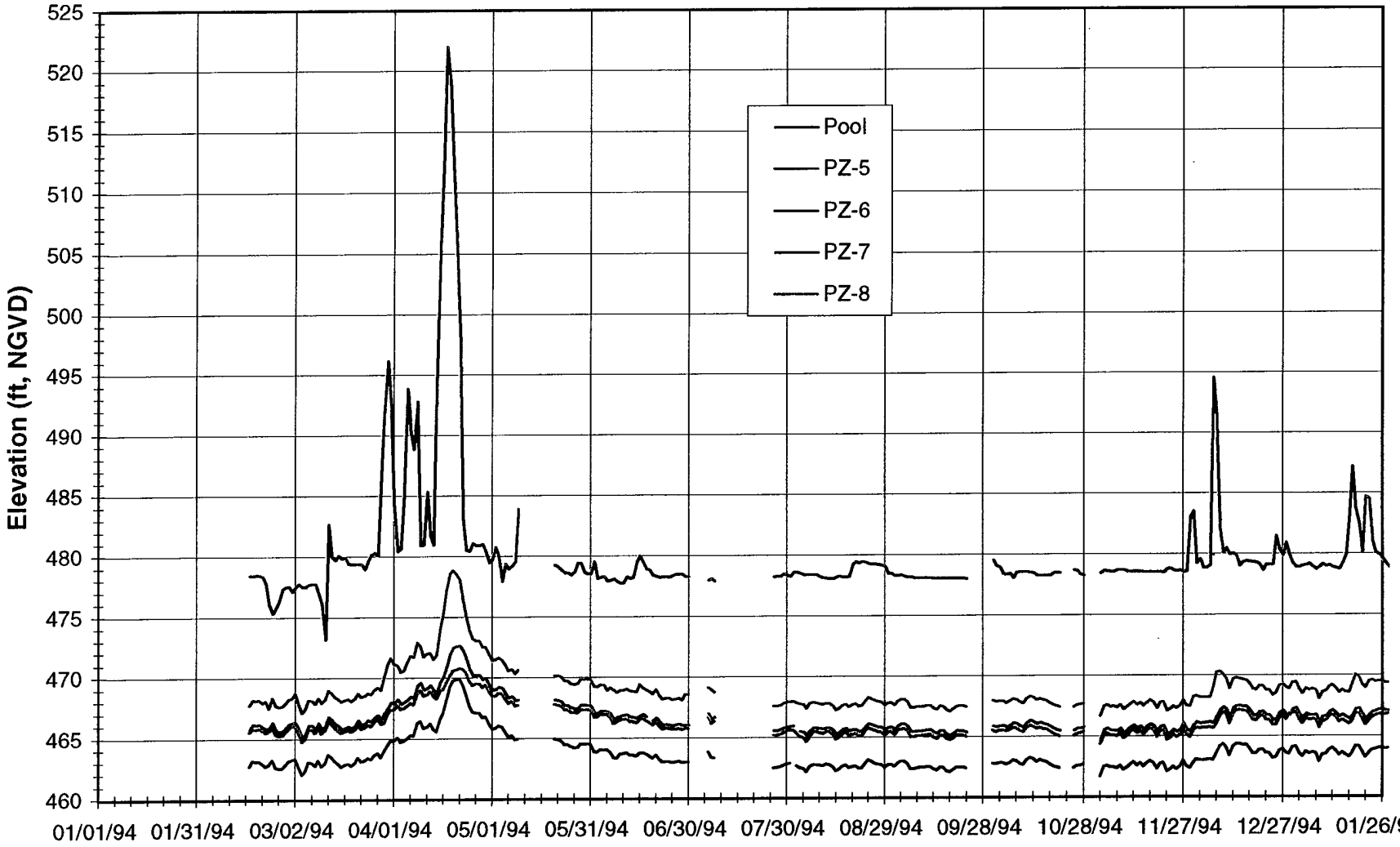


Plate 13

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/95 to 2/96)
Section B-B STA 24+50 (PZ-5 - PZ-8)

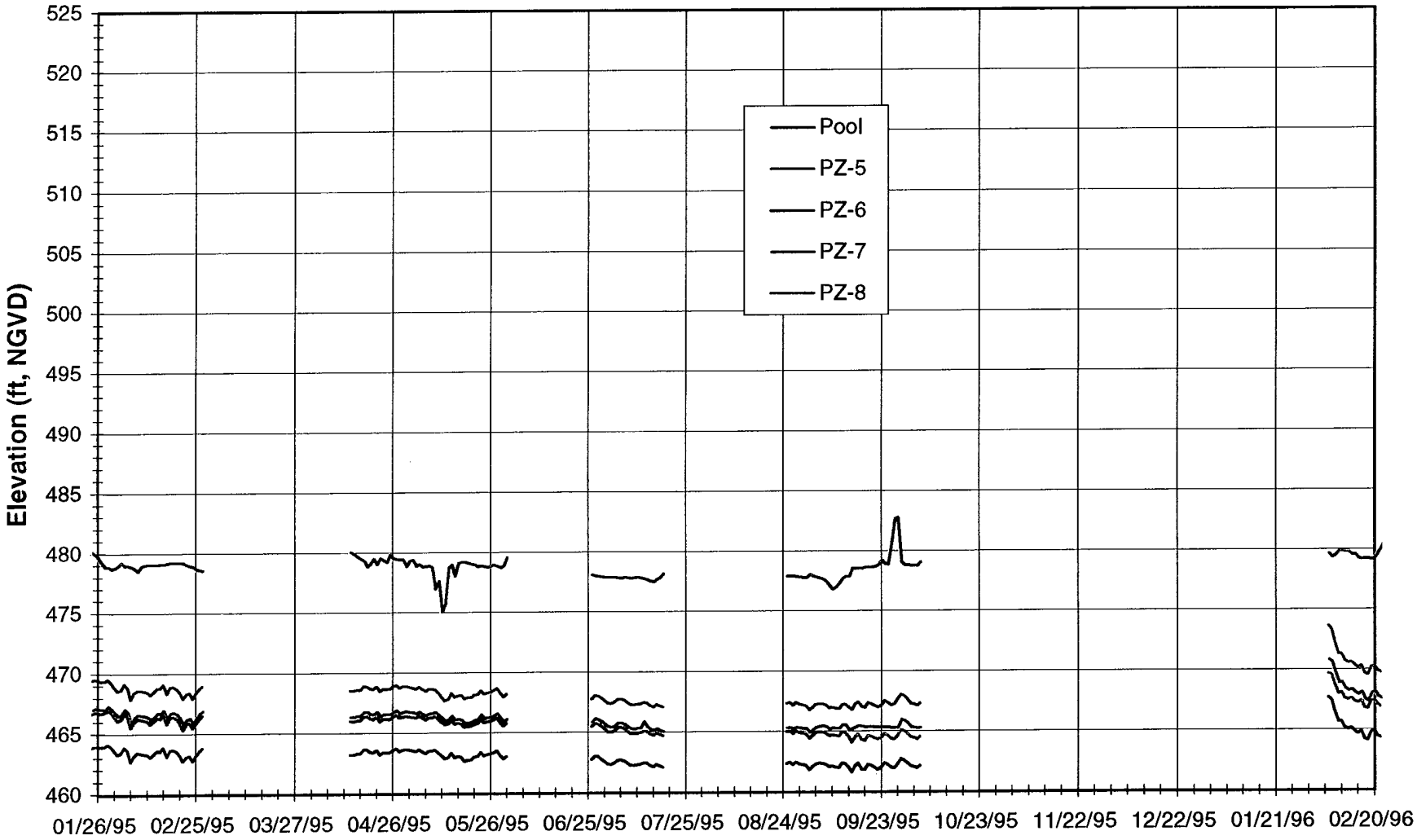


Plate 14

Townshend Lake Dam
Pool and Piezometer Time History Plots (2/96 to 1/97)
Section B-B STA 24+50 (PZ-5 - PZ-8)

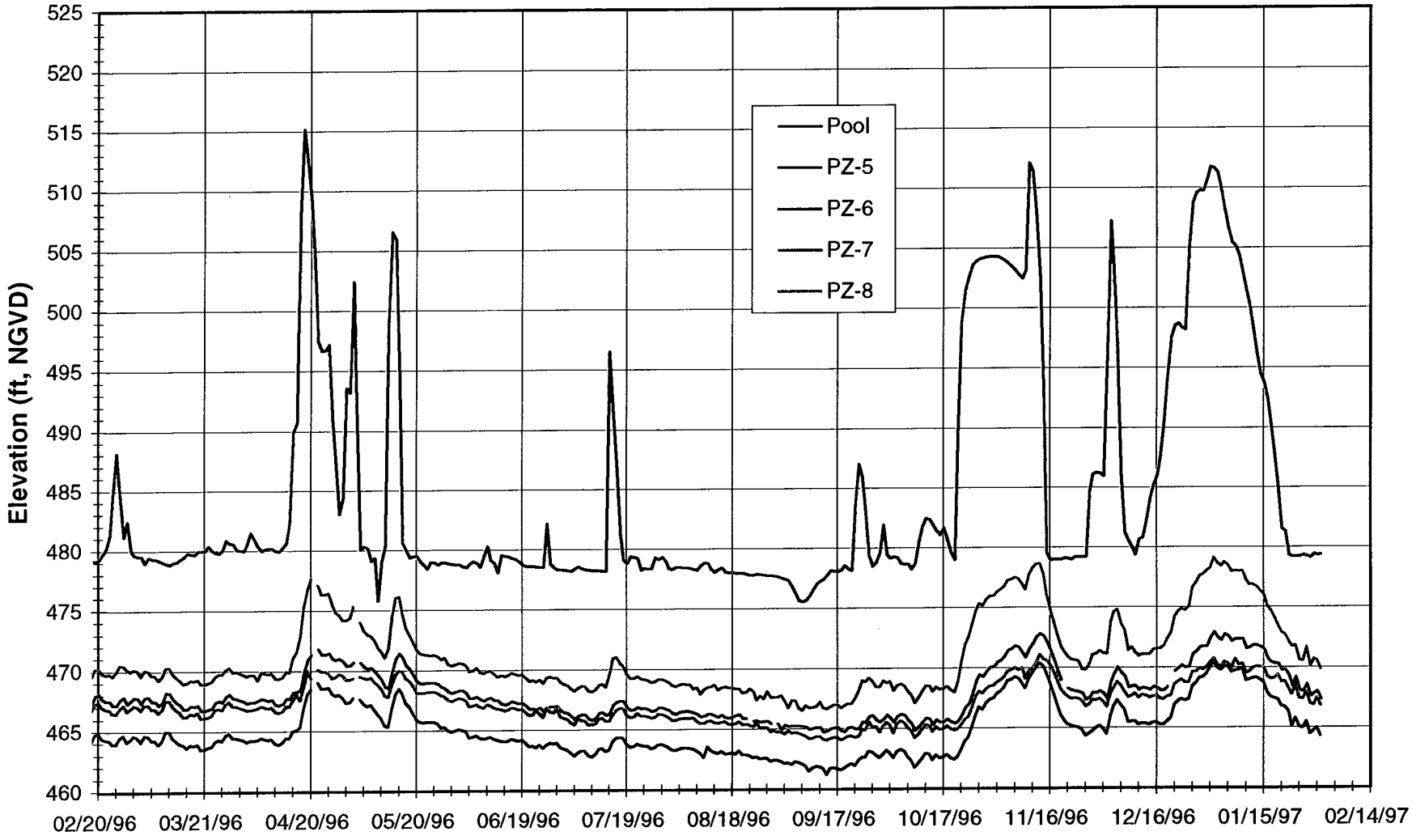


Plate 15

Townshend Lake
April 1994 Event Plot
Section B-B STA 24+50 (PZ-5, 6, 7, 8)

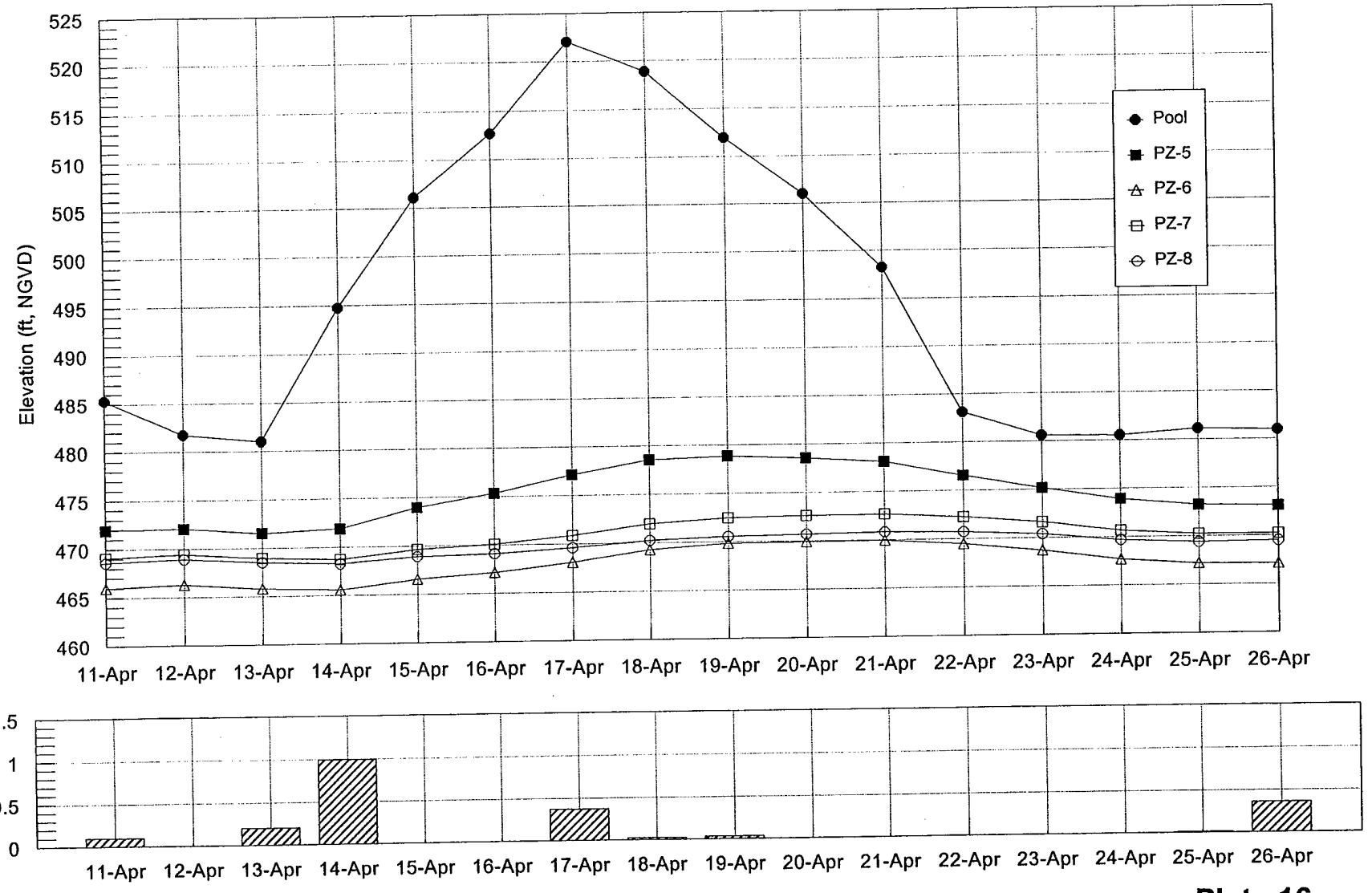


Plate 16

Townshend Lake
December 1996-January 1997 Event Plot
Section B-B STA 24+50 (PZ-5, 6, 7, 8)

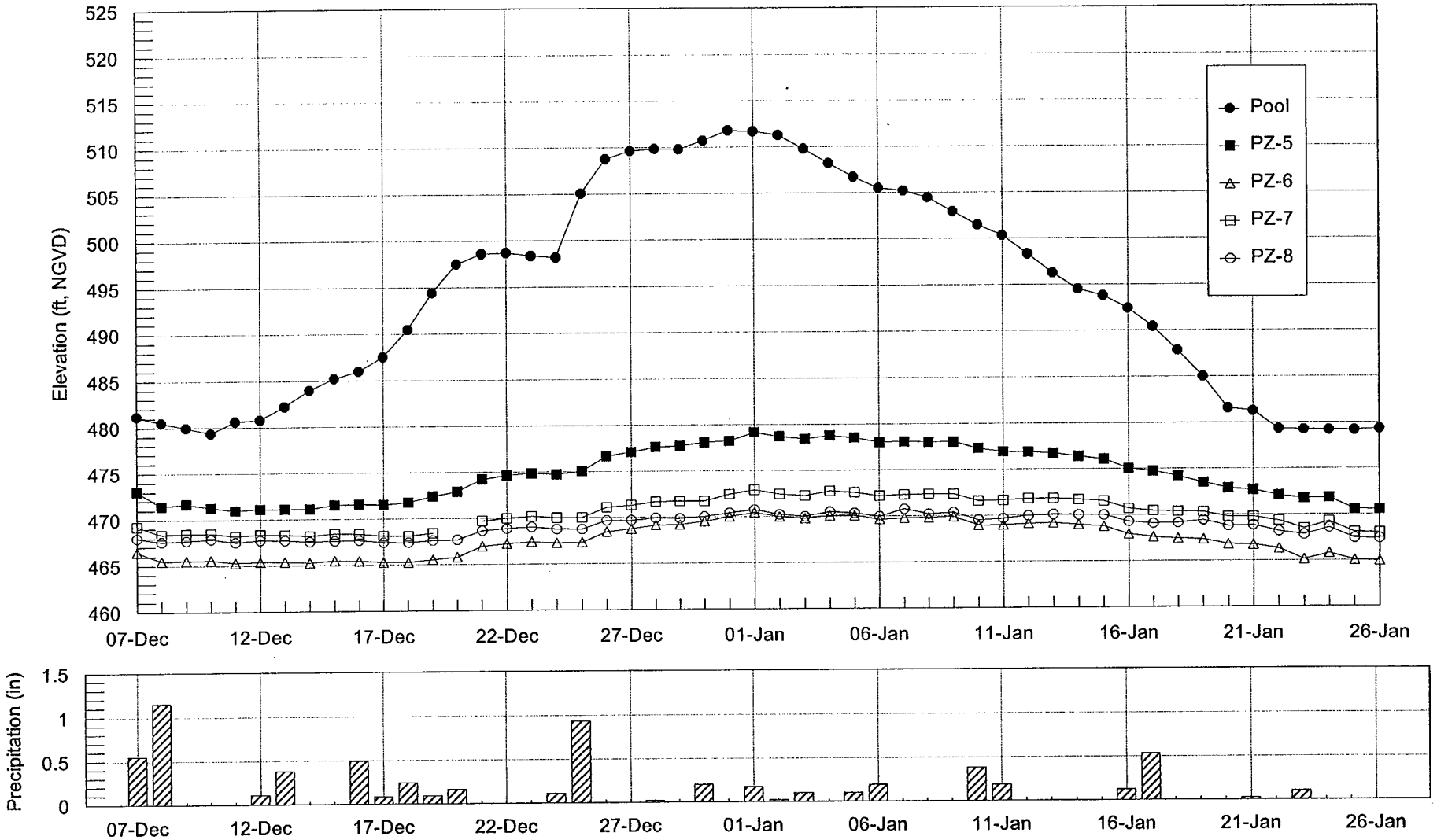
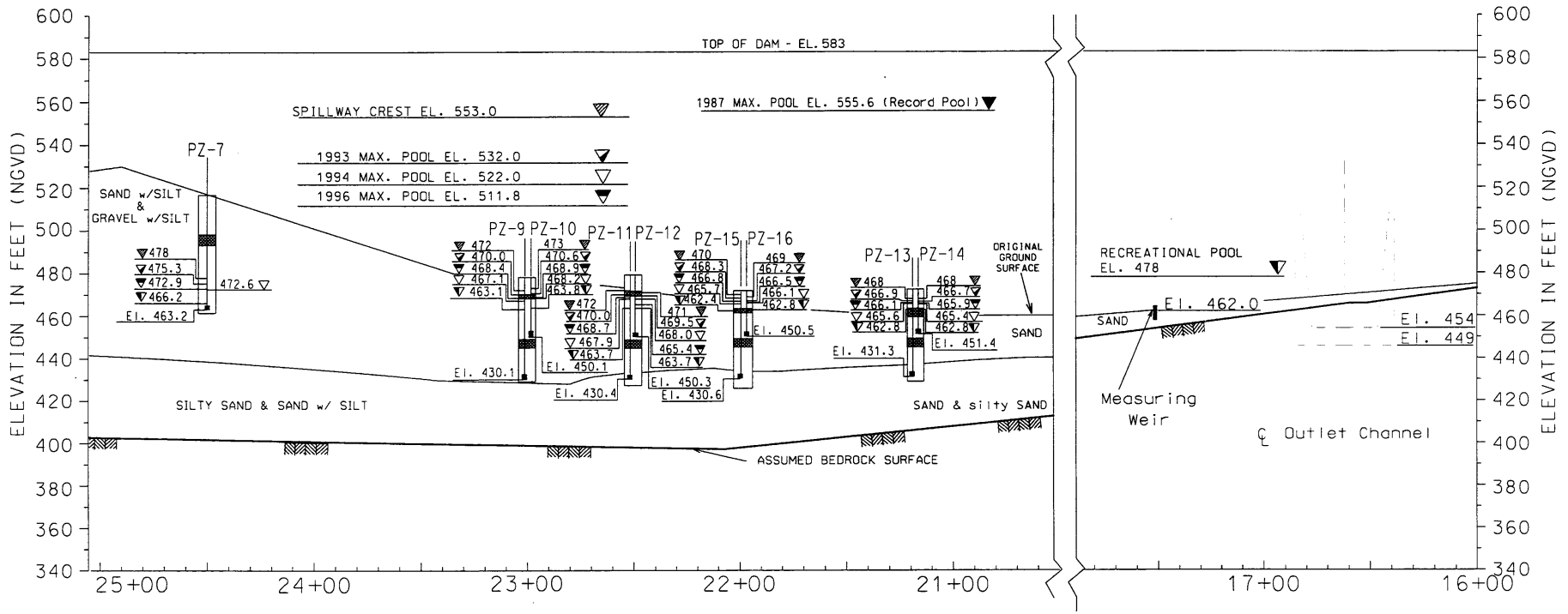


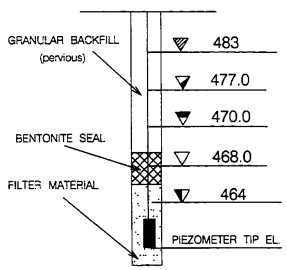
Plate 17



PROFILE C-C 250 FT DOWNSTREAM OF ℄ OF DAM

SCALE: 1"= 50'

LEGEND FOR PIEZOMETERS



Projected maximum piezometer level with pool at spillway crest (based on combined data from several pool events)

Maximum piezometer reading during the March 1993 event

Maximum piezometer reading during the December 1996 event

Maximum piezometer reading during the April 1994 event

Average piezometer level with norm pool level (El. 478.0)

NOTE: Location of Profile C-C is shown on Plate 1.

GRAPHIC SCALE

50' 0' 50' 100'

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

MAXIMUM PIEZOMETER READINGS
PROFILE C-C 250' D/S OF CENTERLINE

WEST RIVER TOWNSHEND, VT

GEOTECH. ENG. SECT.	SCALE: 1" = 50'
PLATE NO. 18	DATE: OCTOBER 1996

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/94 to 1/95)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 9-12)

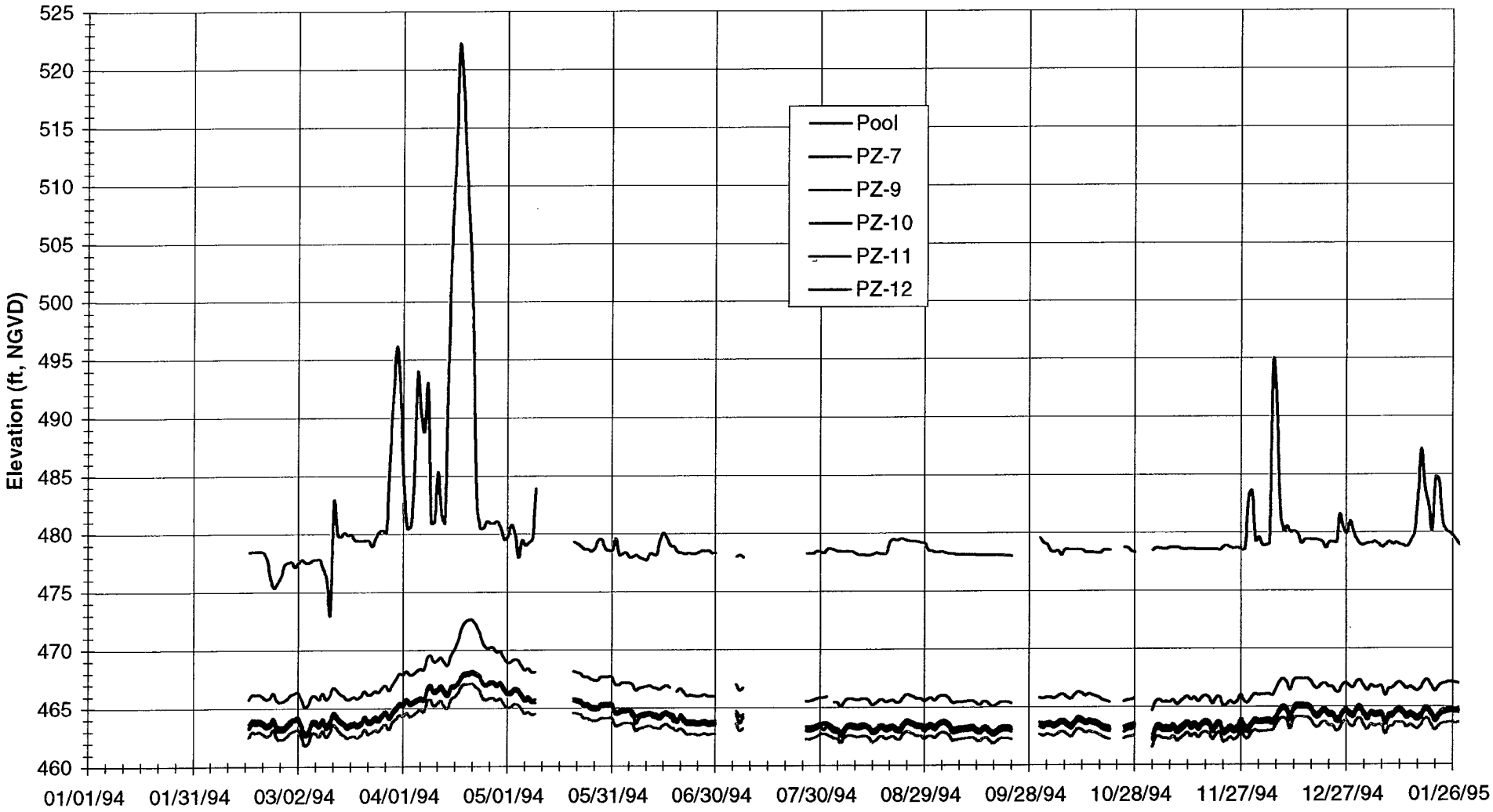
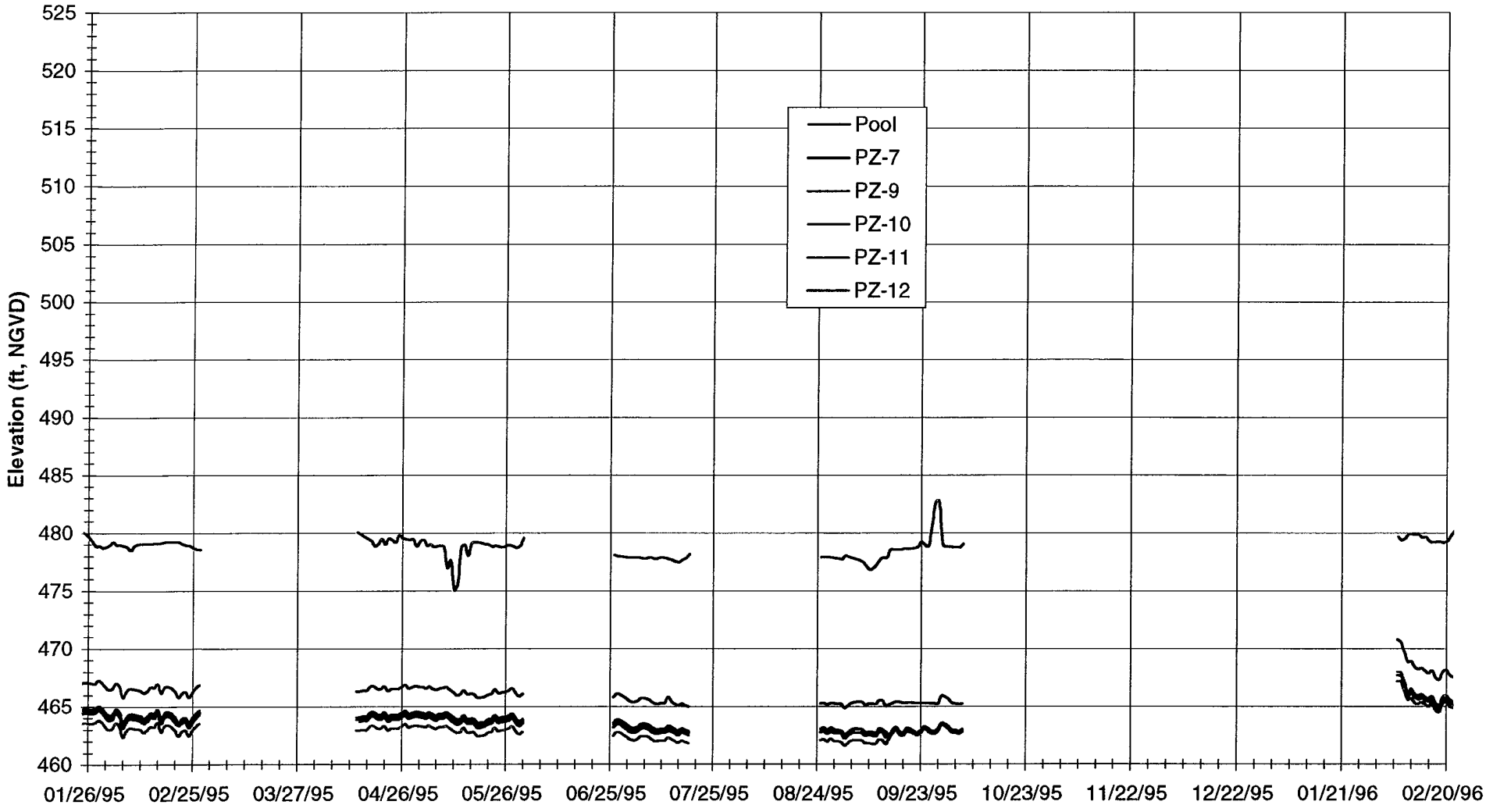


Plate 19

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/95 to 2/96)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 9-12)



Townshend Lake Dam
Pool and Piezometer Time History Plots (2/96 to 2/97)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 9-12)

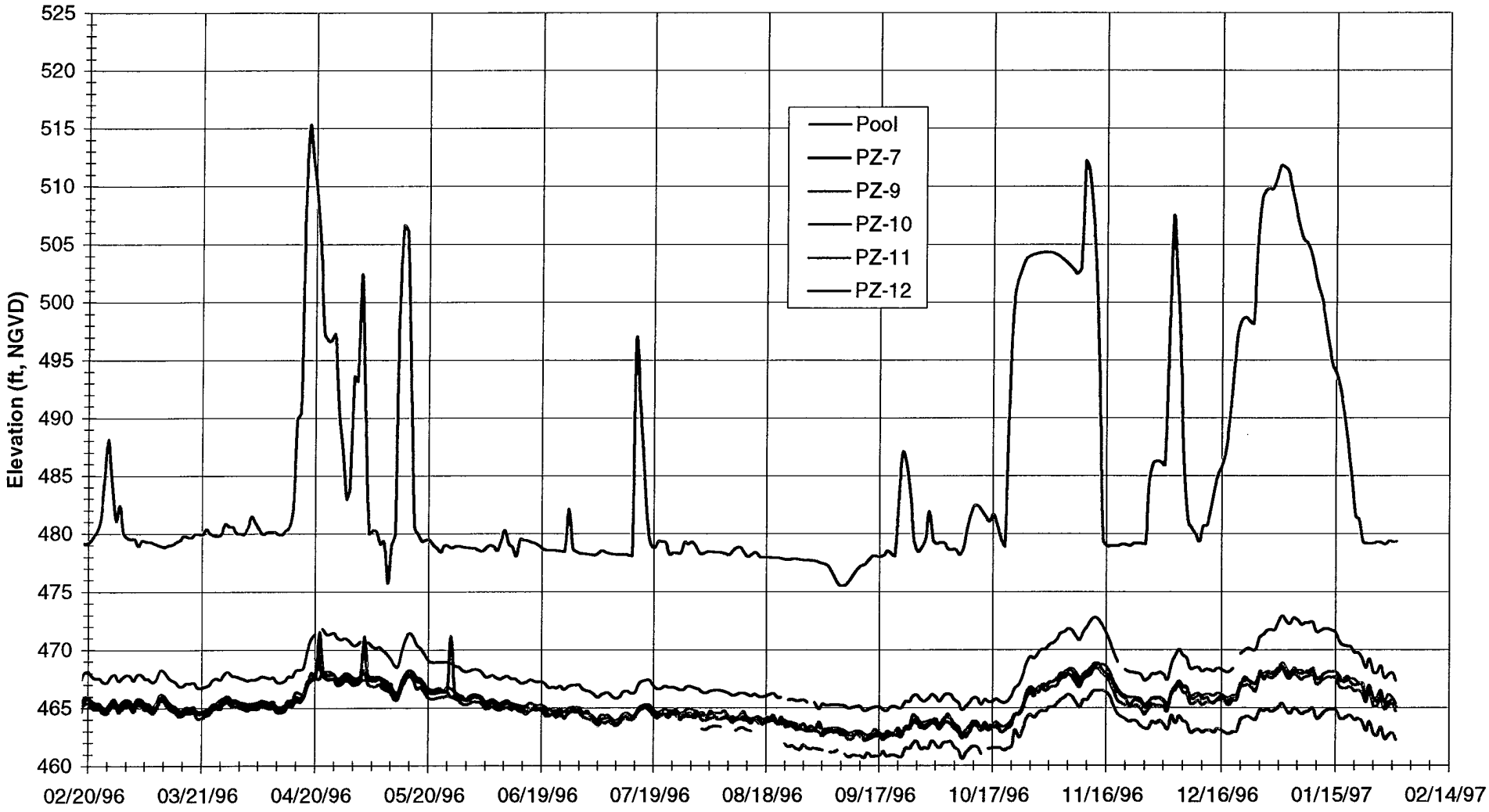
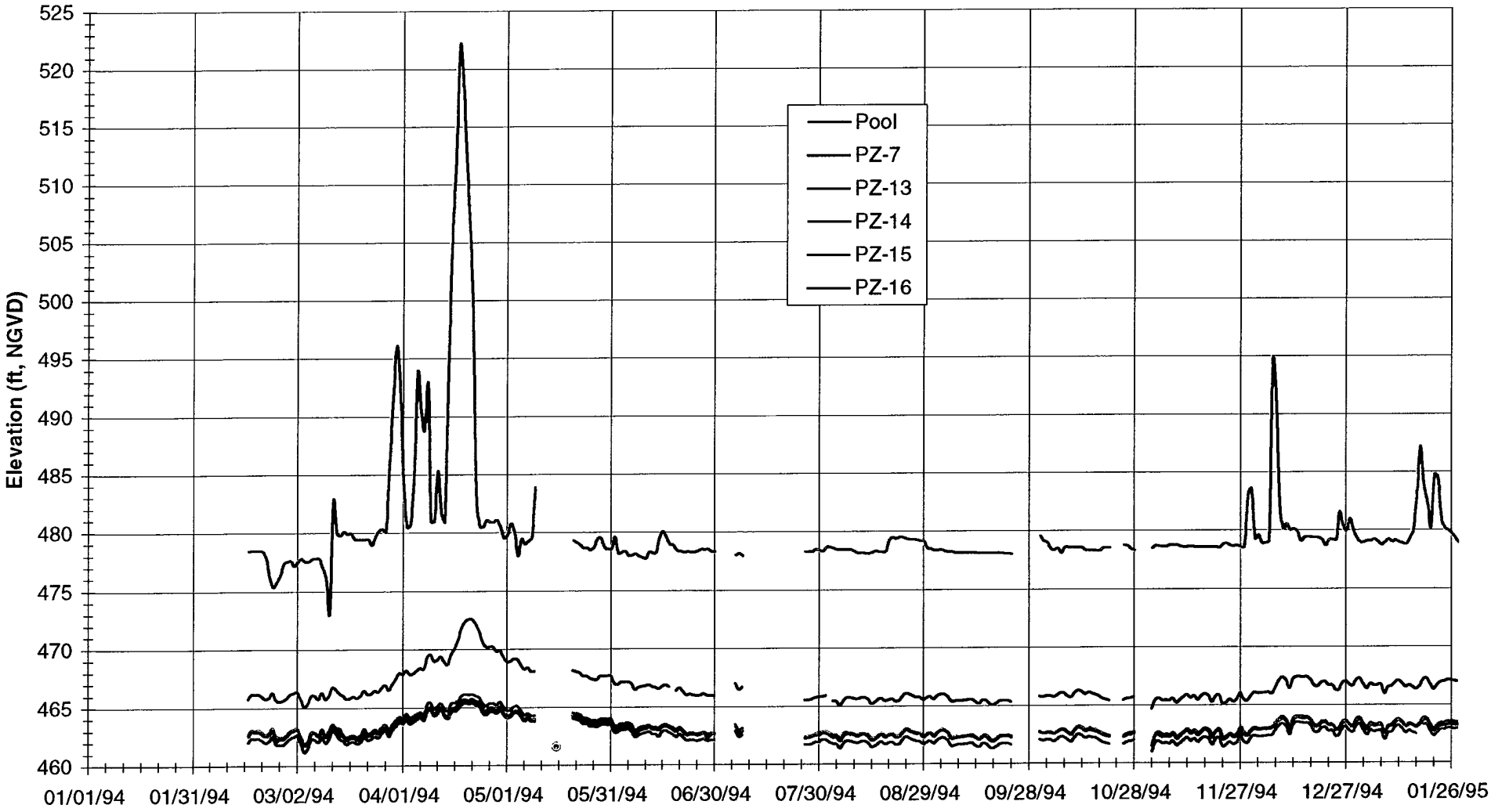


Plate 21

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/94 to 1/95)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 13-16)



Townshend Lake Dam
Pool and Piezometer Time History Plots (1/95 to 2/96)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 13-16)

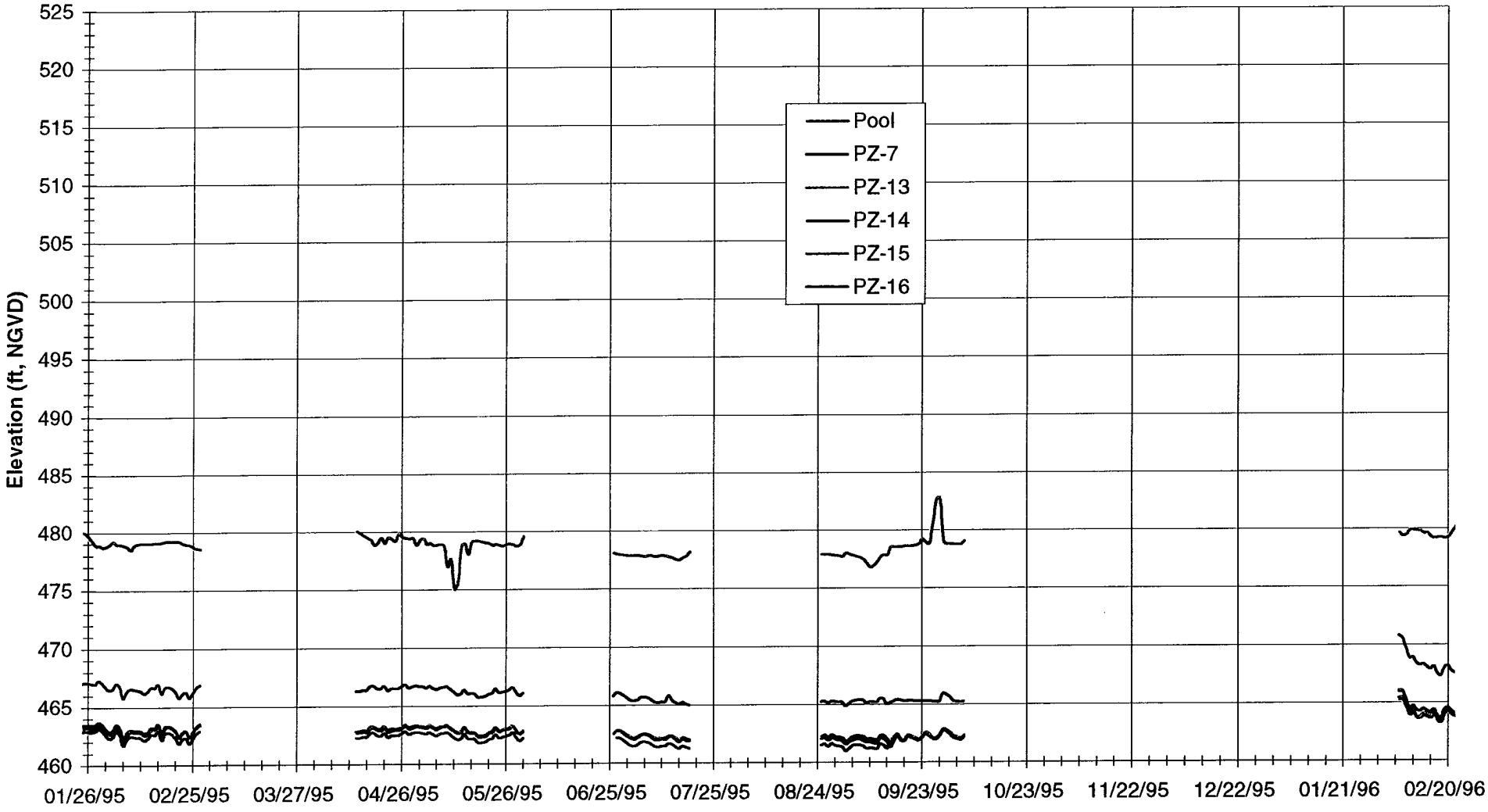


Plate 23

Townshend Lake Dam
Pool and Piezometer Time History Plots (1/95 to 2/96)
Profile C-C - 250' Downstream of Dam Centerline (PZ-7, 13-16)

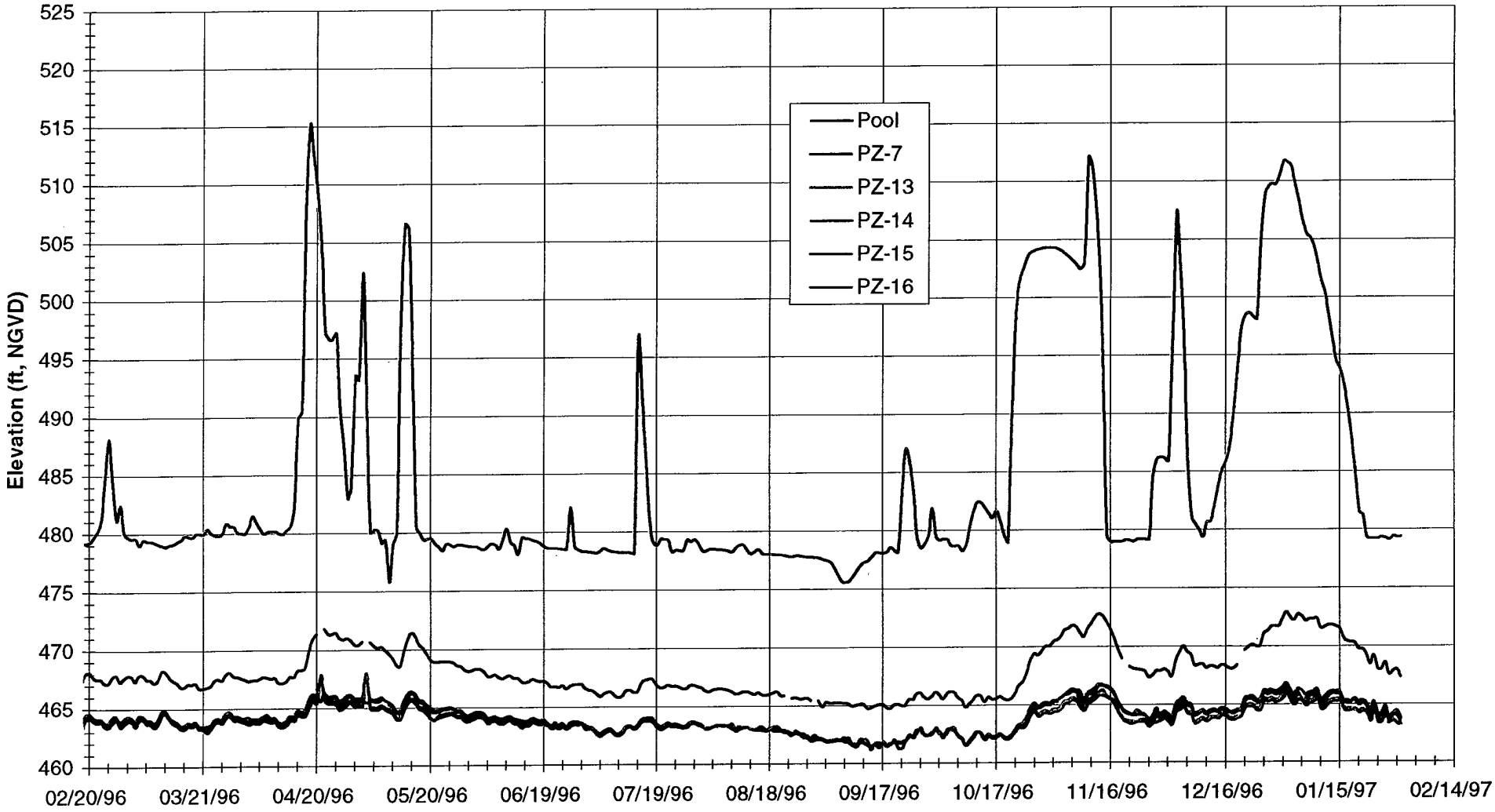


Plate 24

Townshend Lake
April 1994 Event Plot
Section C-C 250' D/S of Dam Centerline (PZ-7, 9-16)

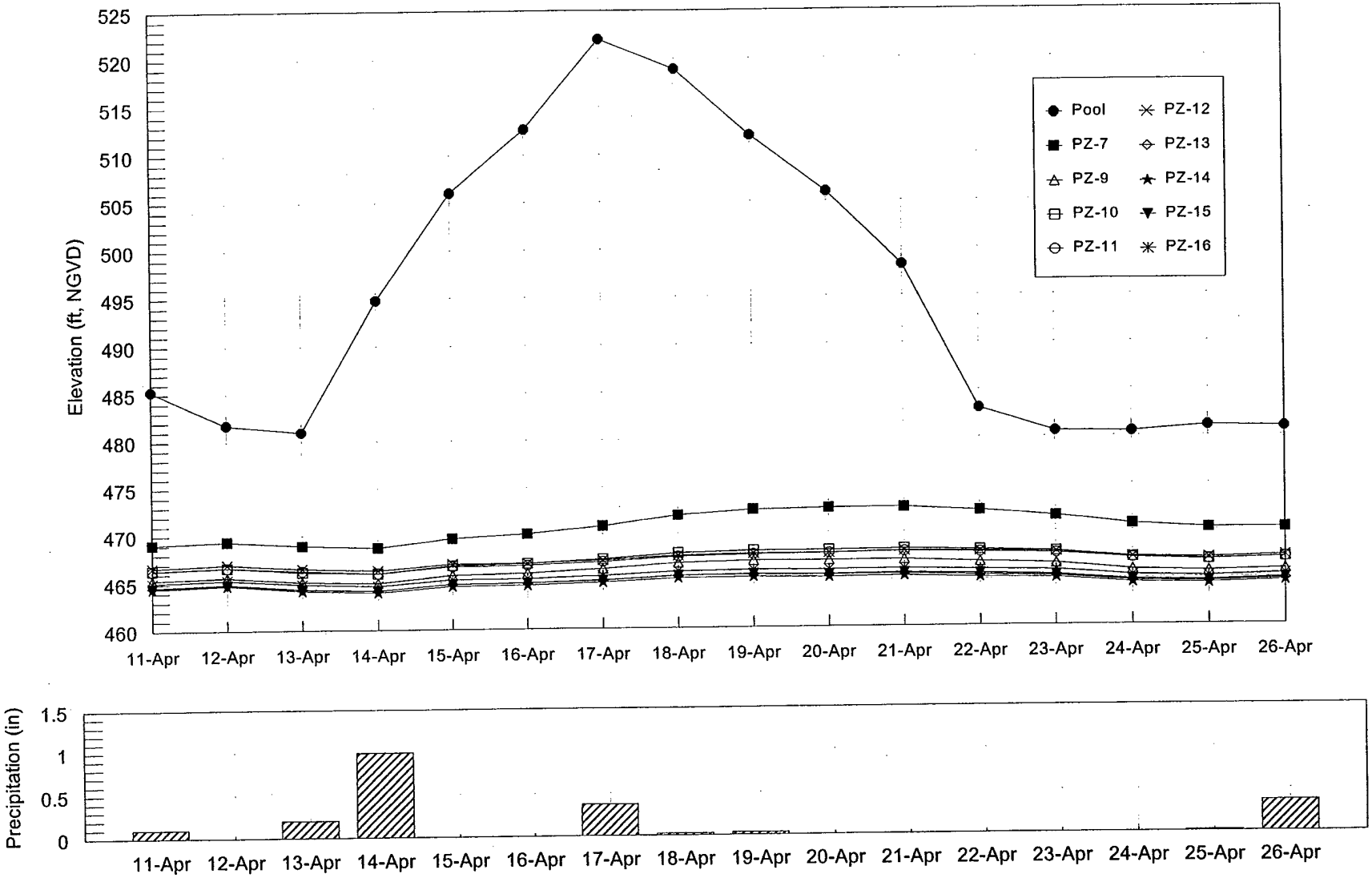
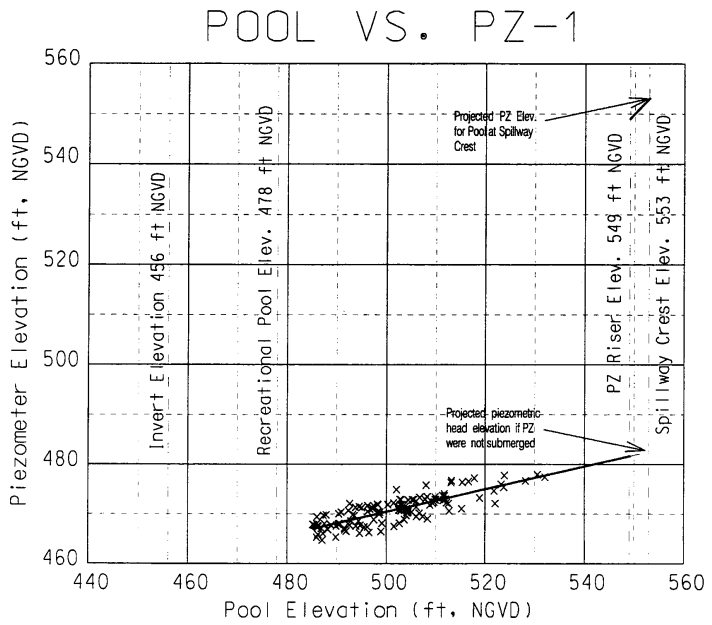
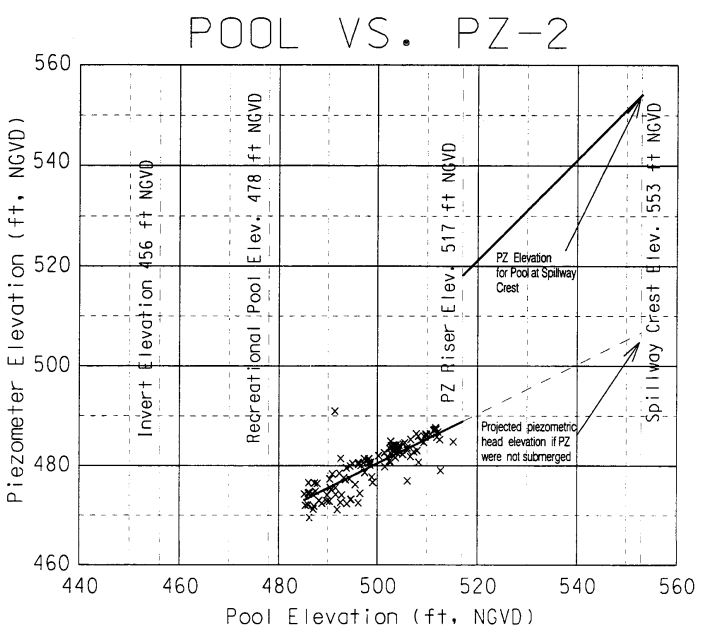
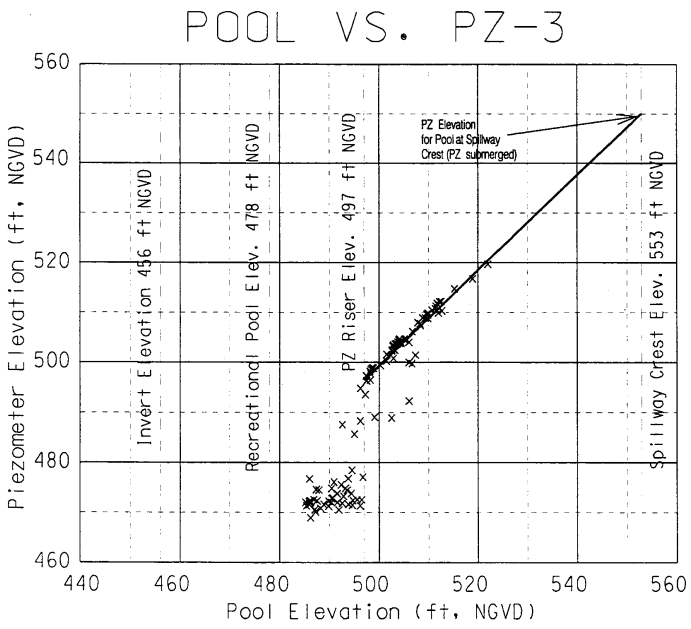


Plate 25







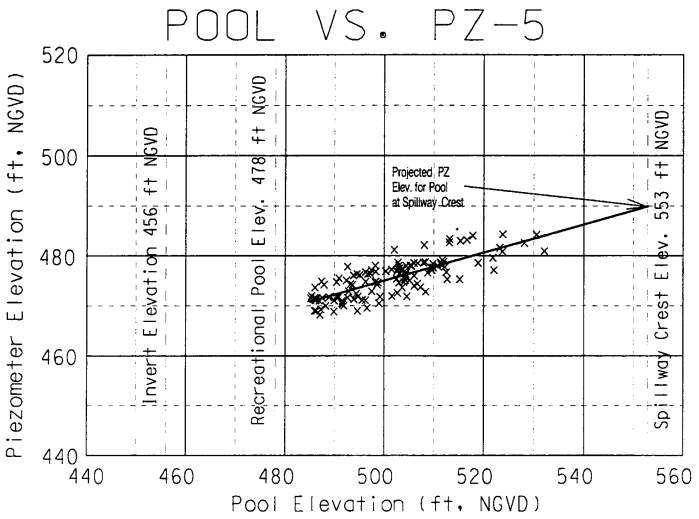
NOTE: WHEN THE POOL IS ABOVE THE TOP ELEVATION OF THE PZ RISER PIPE, THE PZ RESPONSE MATCHES THE POOL ELEVATION.

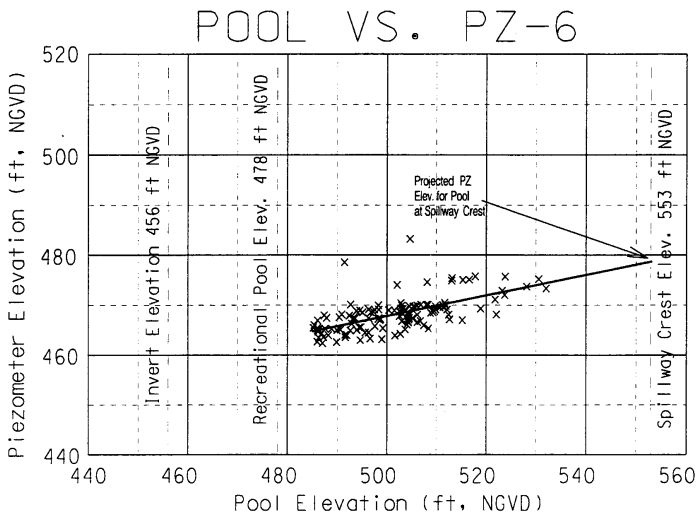
TOWNSHEND LAKE DAM

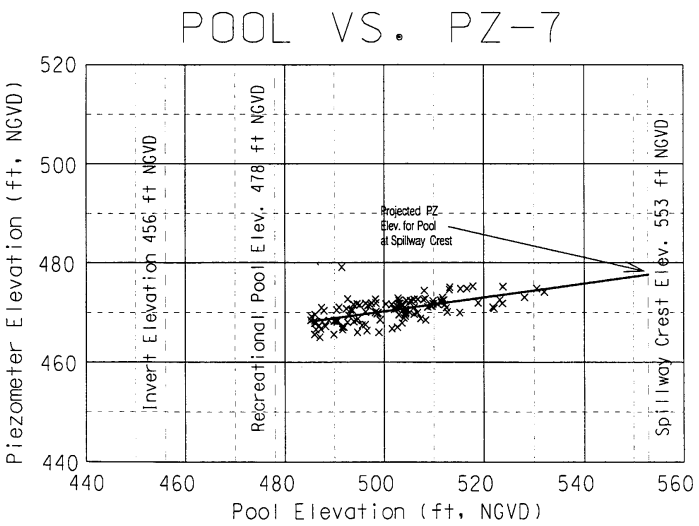
PERIODIC INSPECTION NO. 4

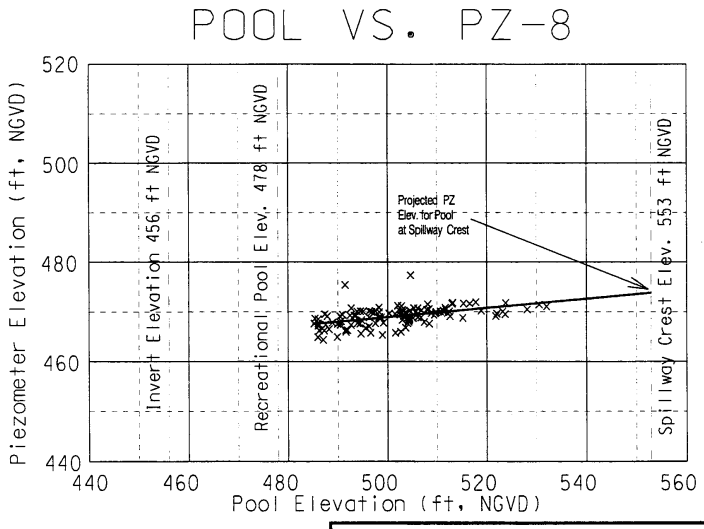
POOL VS. PIEZOMETER PLOTS – PIEZOMETERS ON UPSTREAM SLOPE (PZ-1, 2, 3)

PLATE 27







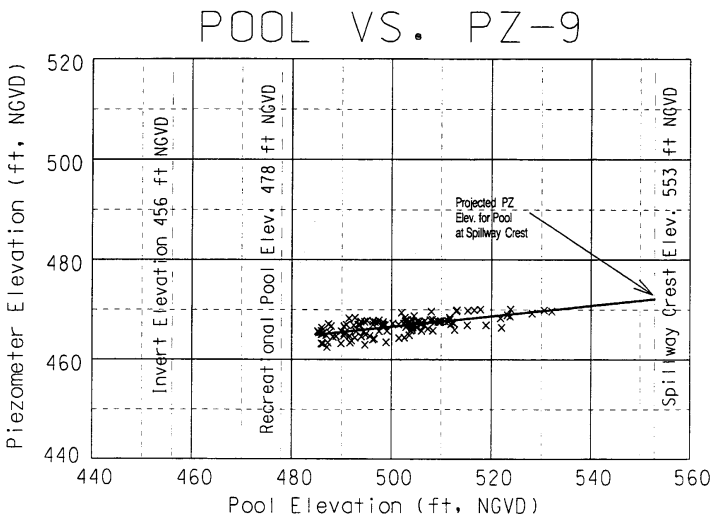


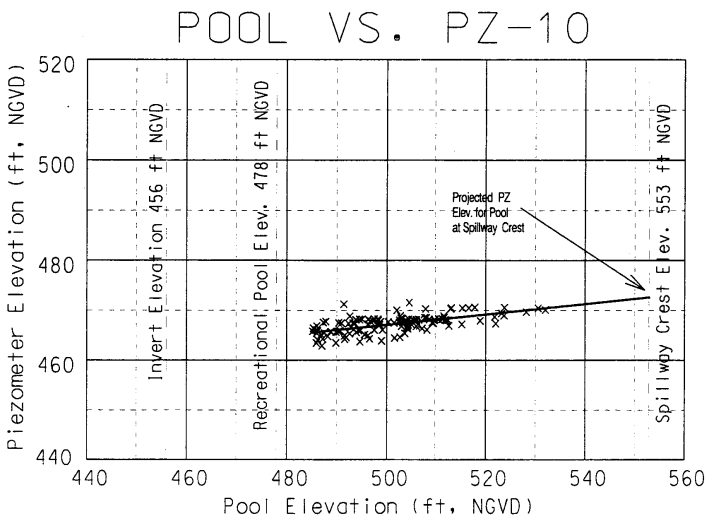
TOWNSHEND LAKE DAM

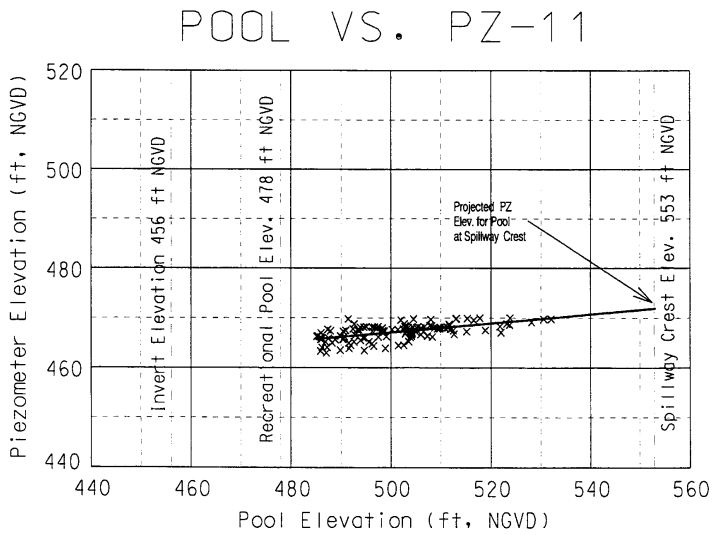
PERIODIC INSPECTION NO. 4

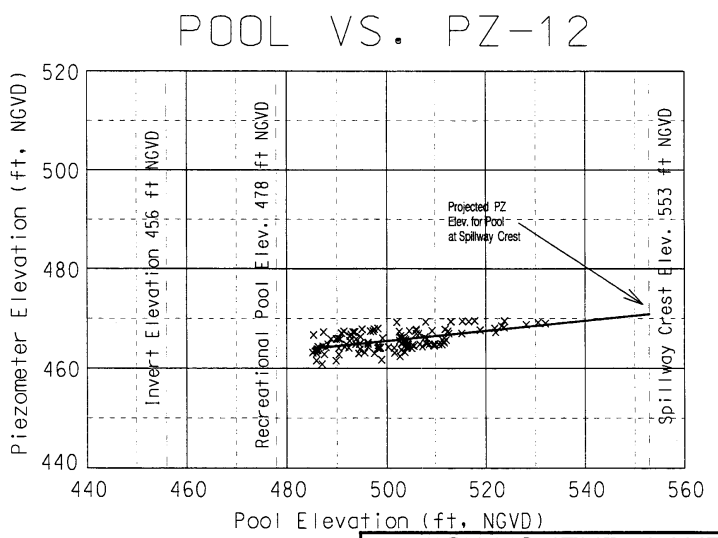
POOL VS. PIEZOMETER PLOTS – PIEZOMETERS ON DOWNSTREAM SLOPE (PZ–5, 6, 7, 8)

PLATE 28







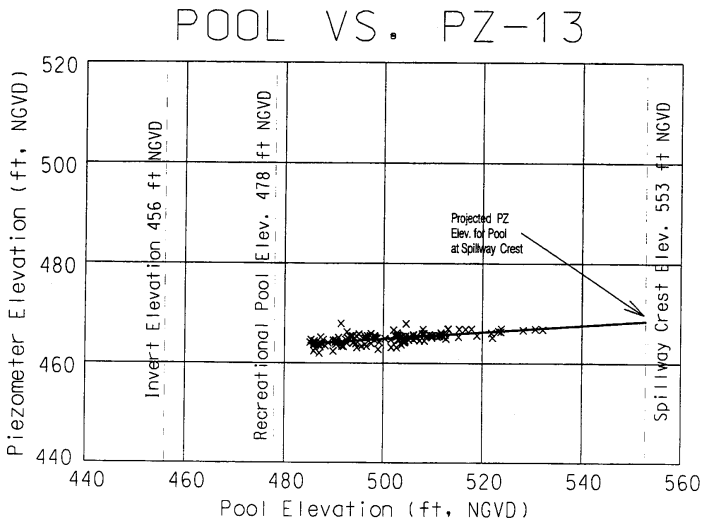


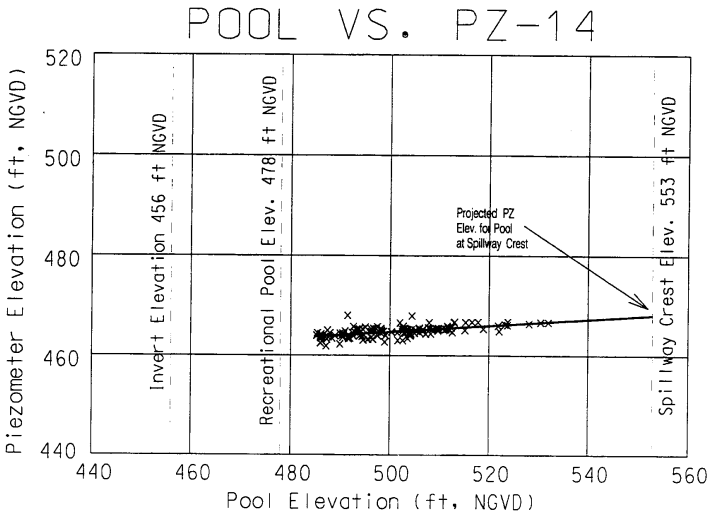
TOWNSHEND LAKE DAM

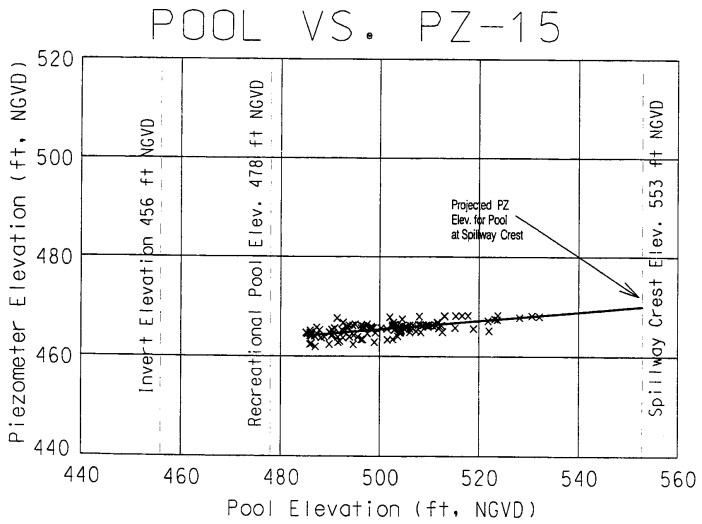
PERIODIC INSPECTION NO. 4

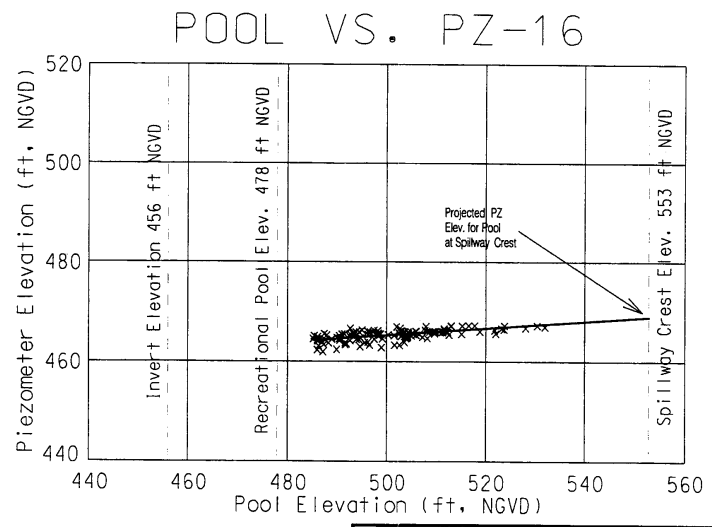
POOL VS. PIEZOMETER PLOTS – PIEZOMETERS ON DOWNSTREAM TOE (PZ-9, 10, 11, 12)

PLATE 29







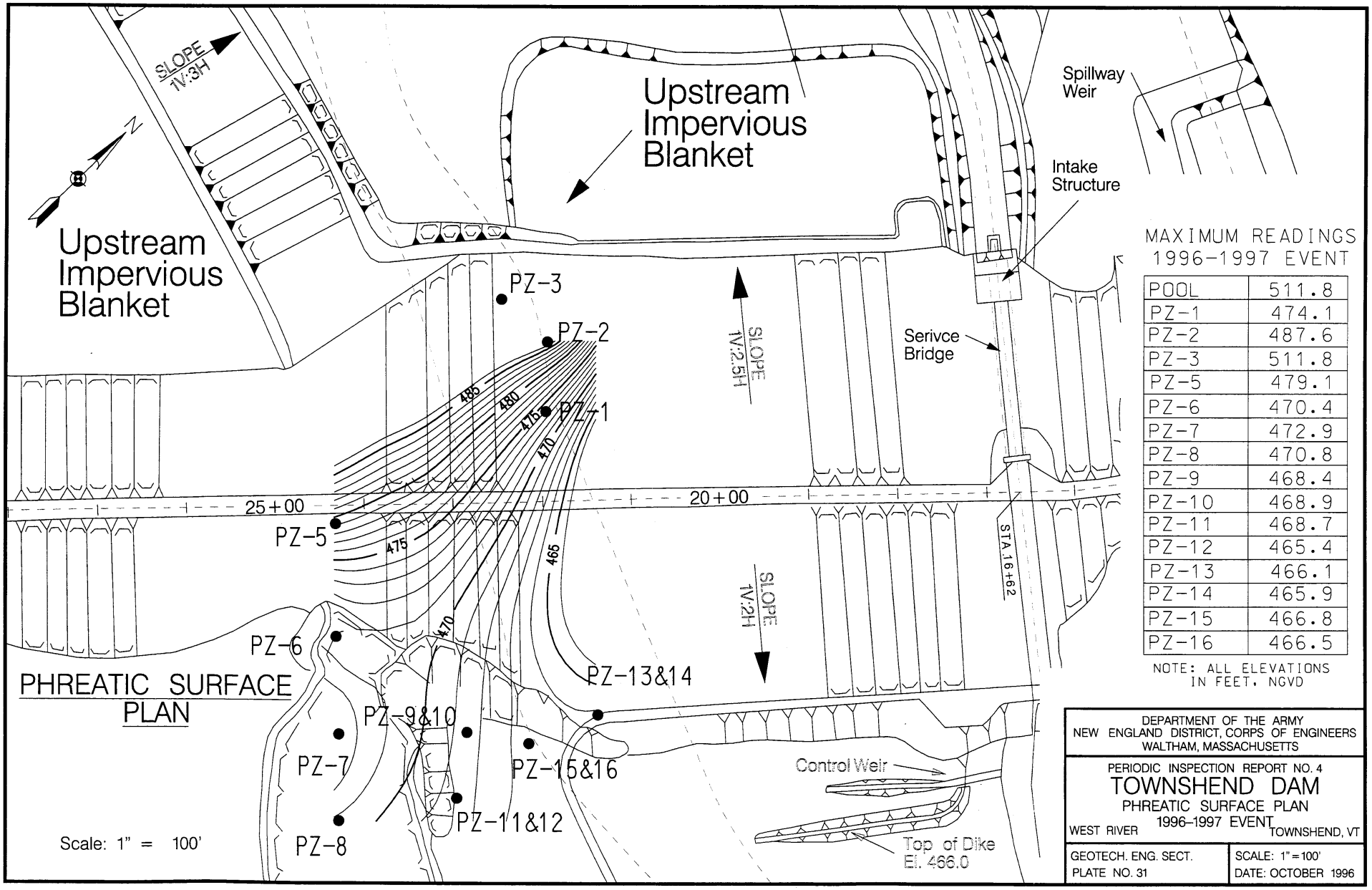


TOWNSHEND LAKE DAM

PERIODIC INSPECTION NO. 4

POOL VS. PIEZOMETER PLOTS – PIEZOMETERS ON DOWNSTREAM TOE (PZ–13, 14, 15, 16)

PLATE 30



MAXIMUM READINGS
1996-1997 EVENT

POOL	511.8
PZ-1	474.1
PZ-2	487.6
PZ-3	511.8
PZ-5	479.1
PZ-6	470.4
PZ-7	472.9
PZ-8	470.8
PZ-9	468.4
PZ-10	468.9
PZ-11	468.7
PZ-12	465.4
PZ-13	466.1
PZ-14	465.9
PZ-15	466.8
PZ-16	466.5

NOTE: ALL ELEVATIONS IN FEET, NGVD

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

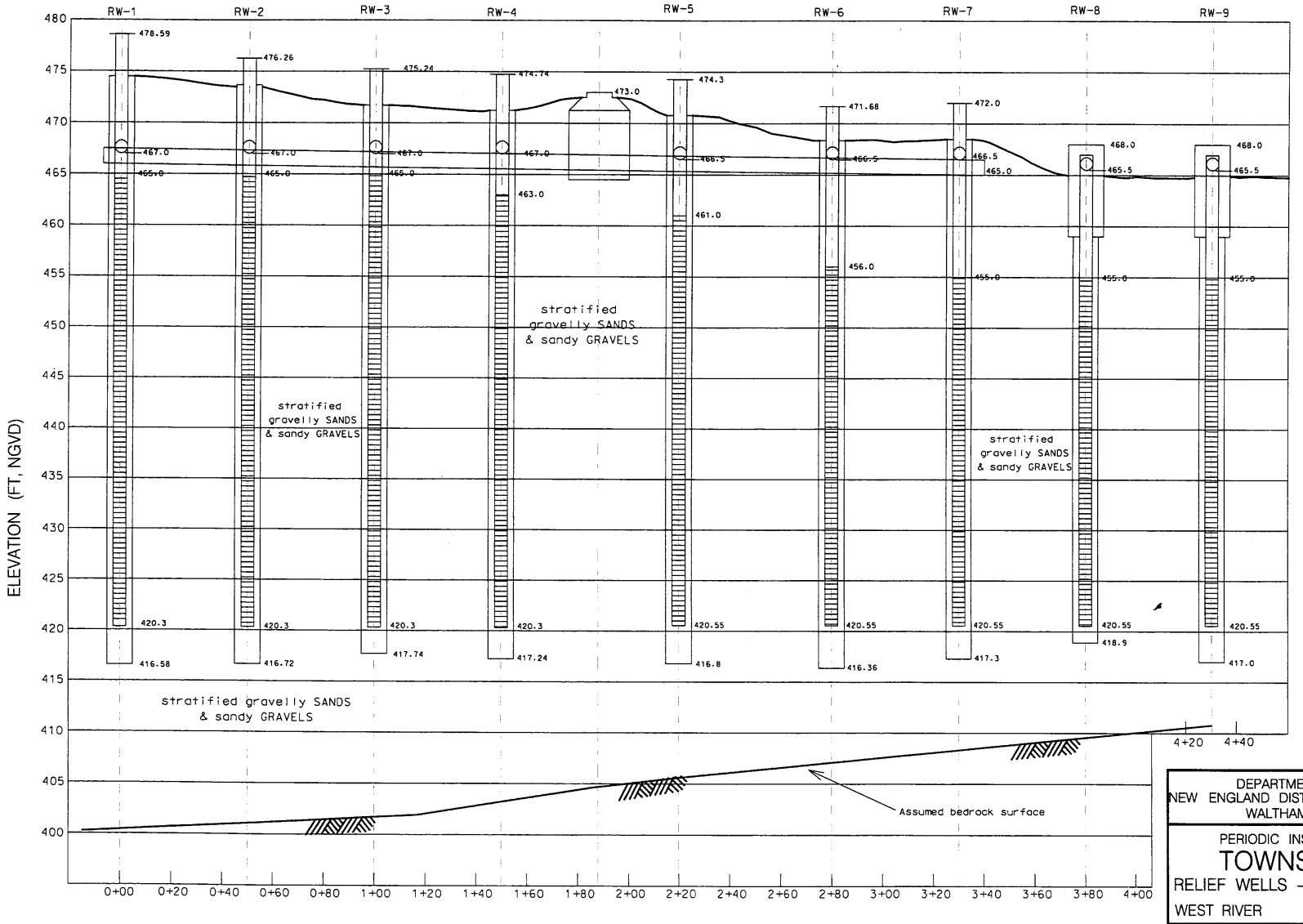
PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

PHREATIC SURFACE PLAN
1996-1997 EVENT

WEST RIVER TOWNSHEND, VT

GEOTECH. ENG. SECT.	SCALE: 1"=100'
PLATE NO. 31	DATE: OCTOBER 1996



SCALE:
Horiz. – 1" = 40'
Vert. – 1" = 10'

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PERIODIC INSPECTION REPORT NO. 4

TOWNSHEND DAM

RELIEF WELLS – SUBSURFACE PROFILE

WEST RIVER — TOWNSHEND, VT

GEOTECH. ENG. SECT.
PLATE NO. 32

SCALE: AS SHOWN
DATE: OCTOBER 1996

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/94 to 1/95)

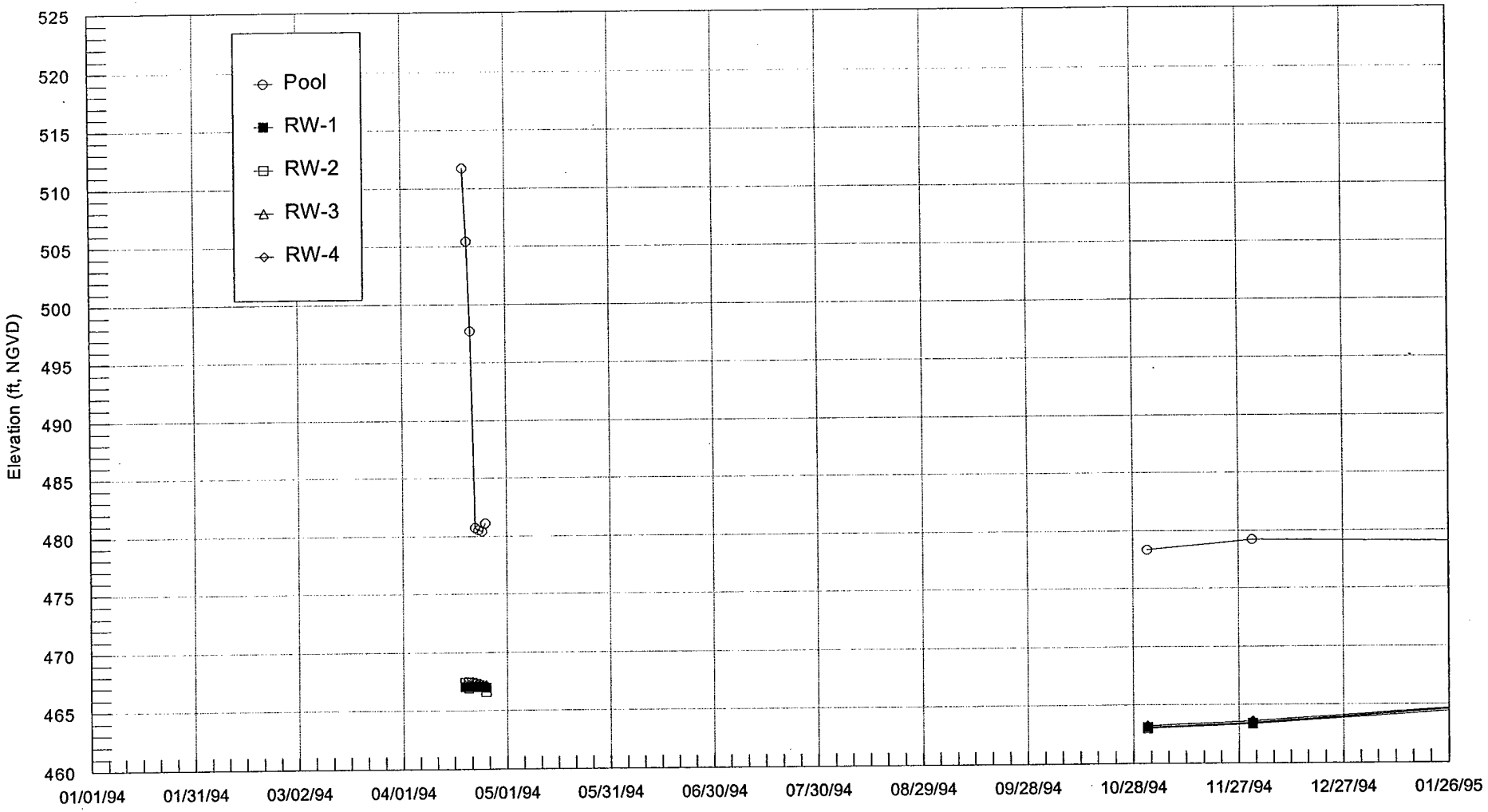


PLATE 33

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/95 to 1/96)

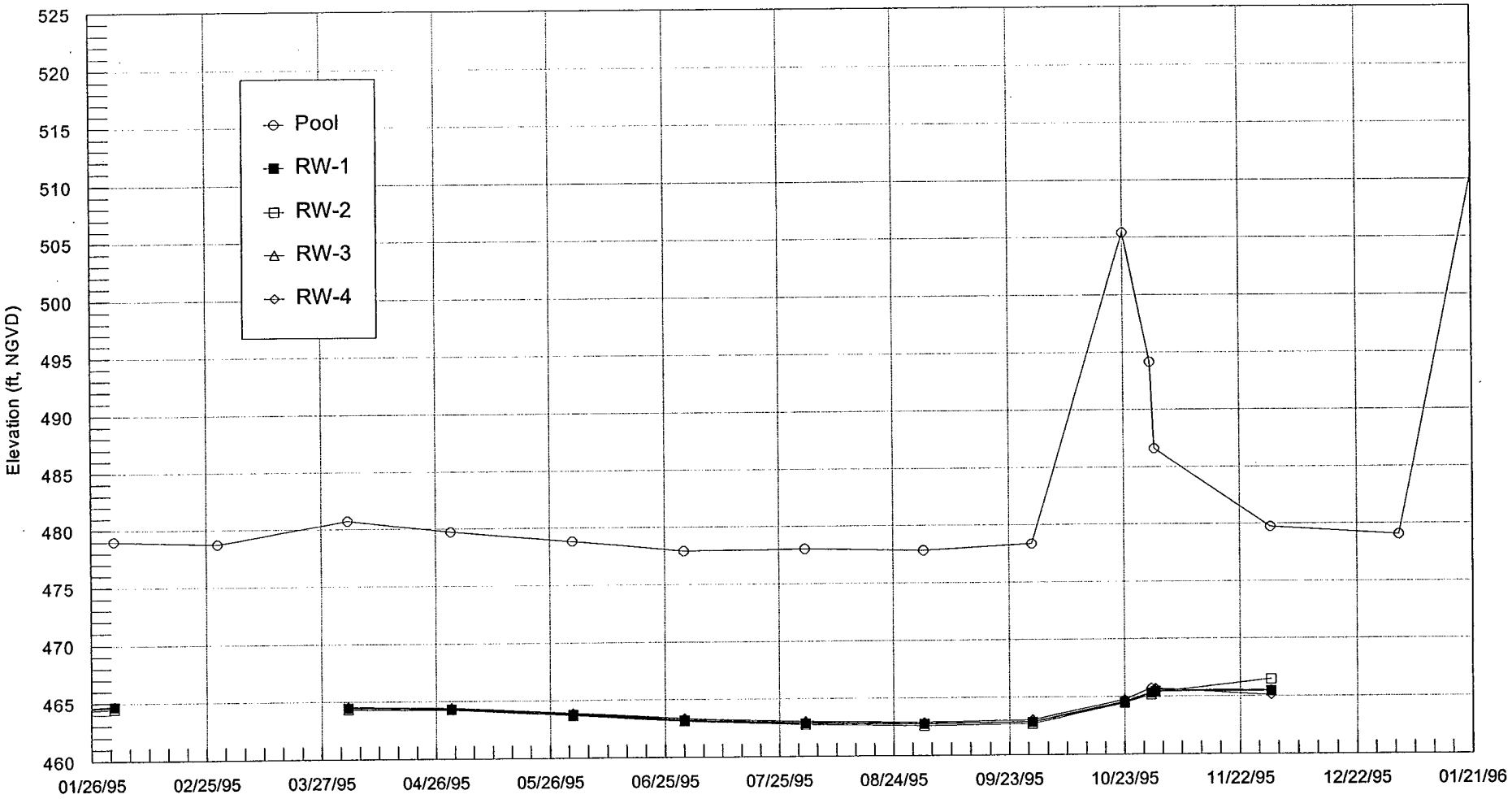


PLATE 34

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/96 to 1/97)

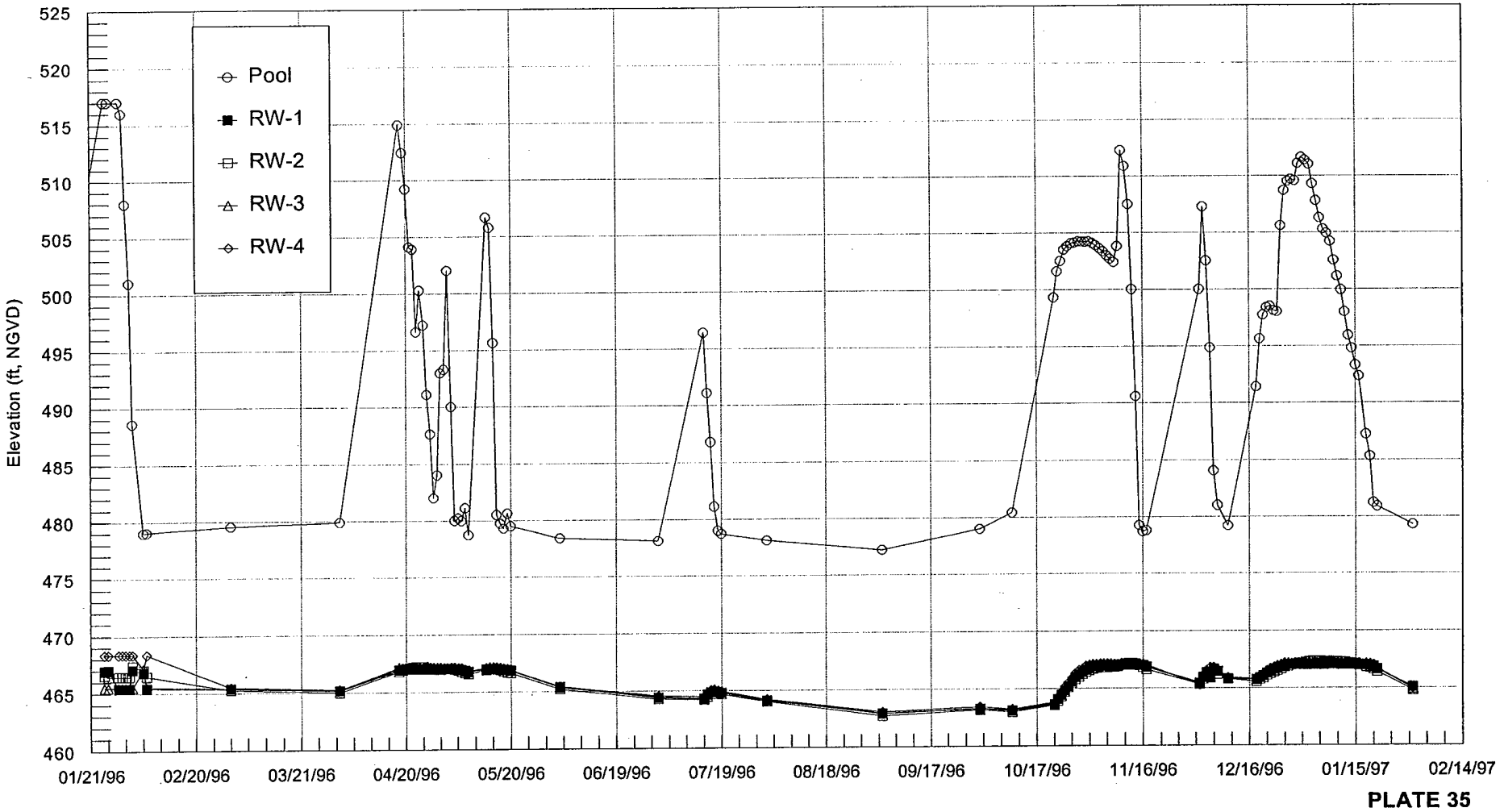


PLATE 35

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/94 to 1/95)

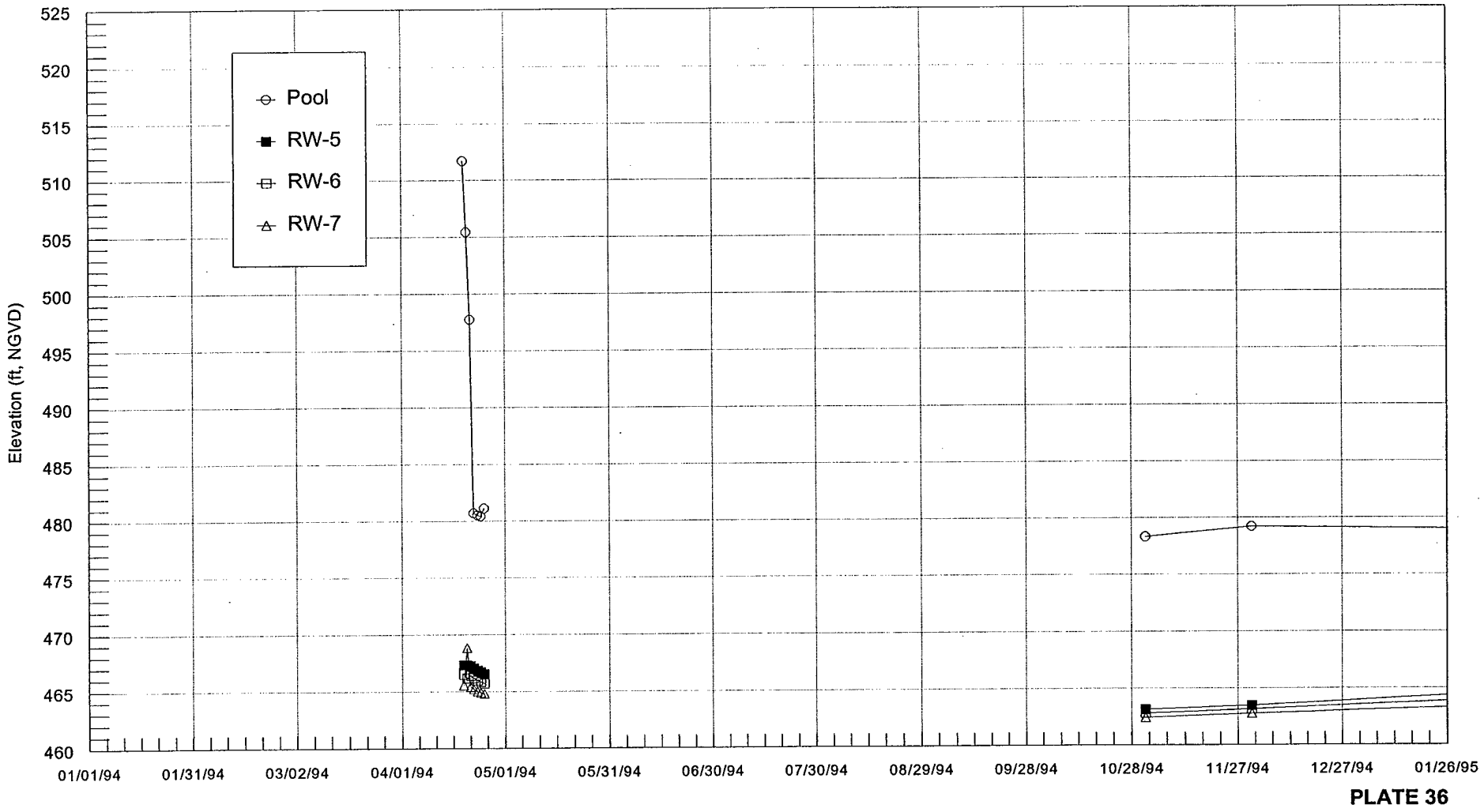


PLATE 36

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/95 to 1/96)

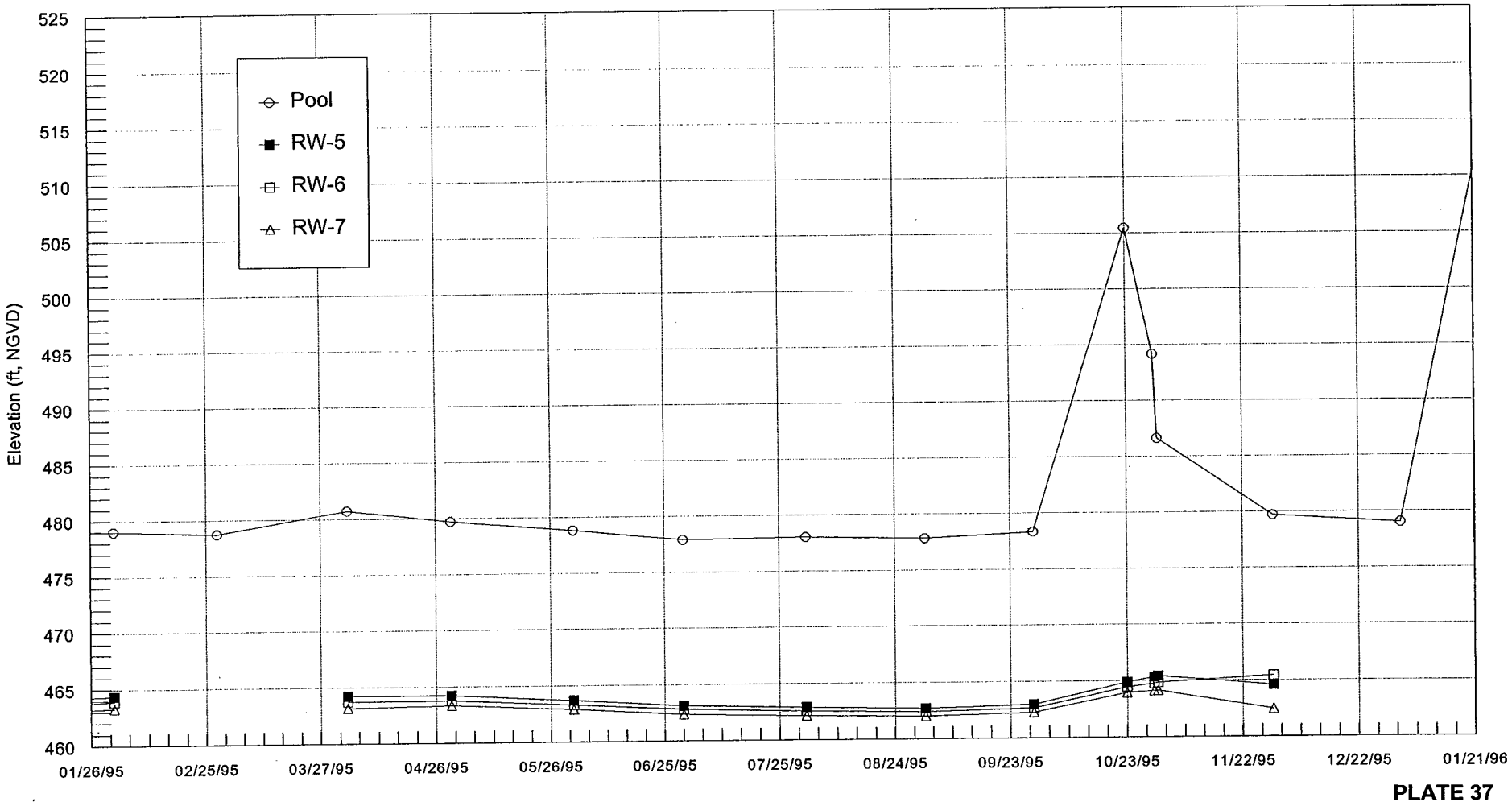


PLATE 37

Townshend Lake Dam
Pool and Relief Well Time History Plots (1/96 to 1/97)

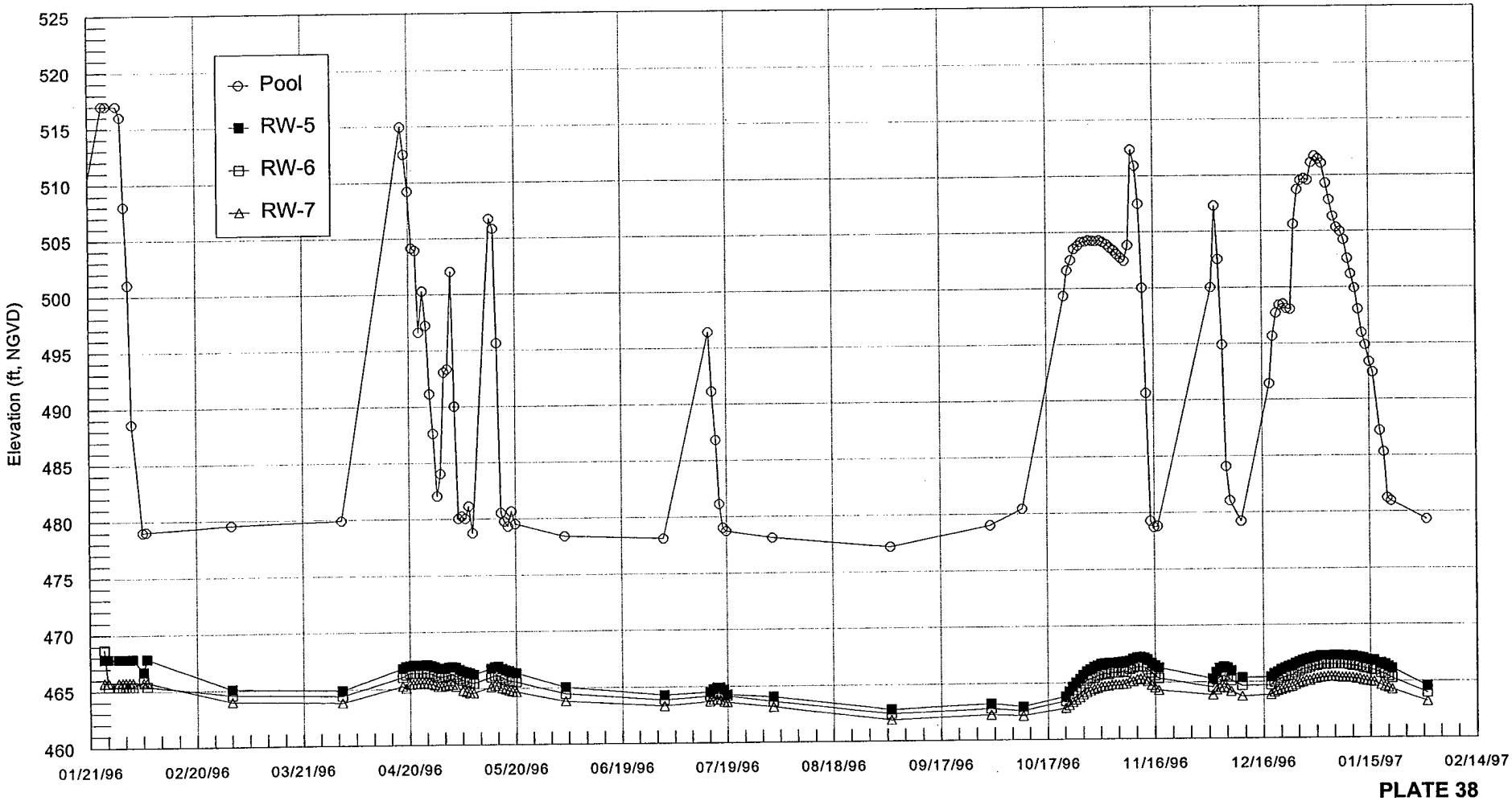


PLATE 38

Townshend Lake

April 1994 Event Plot

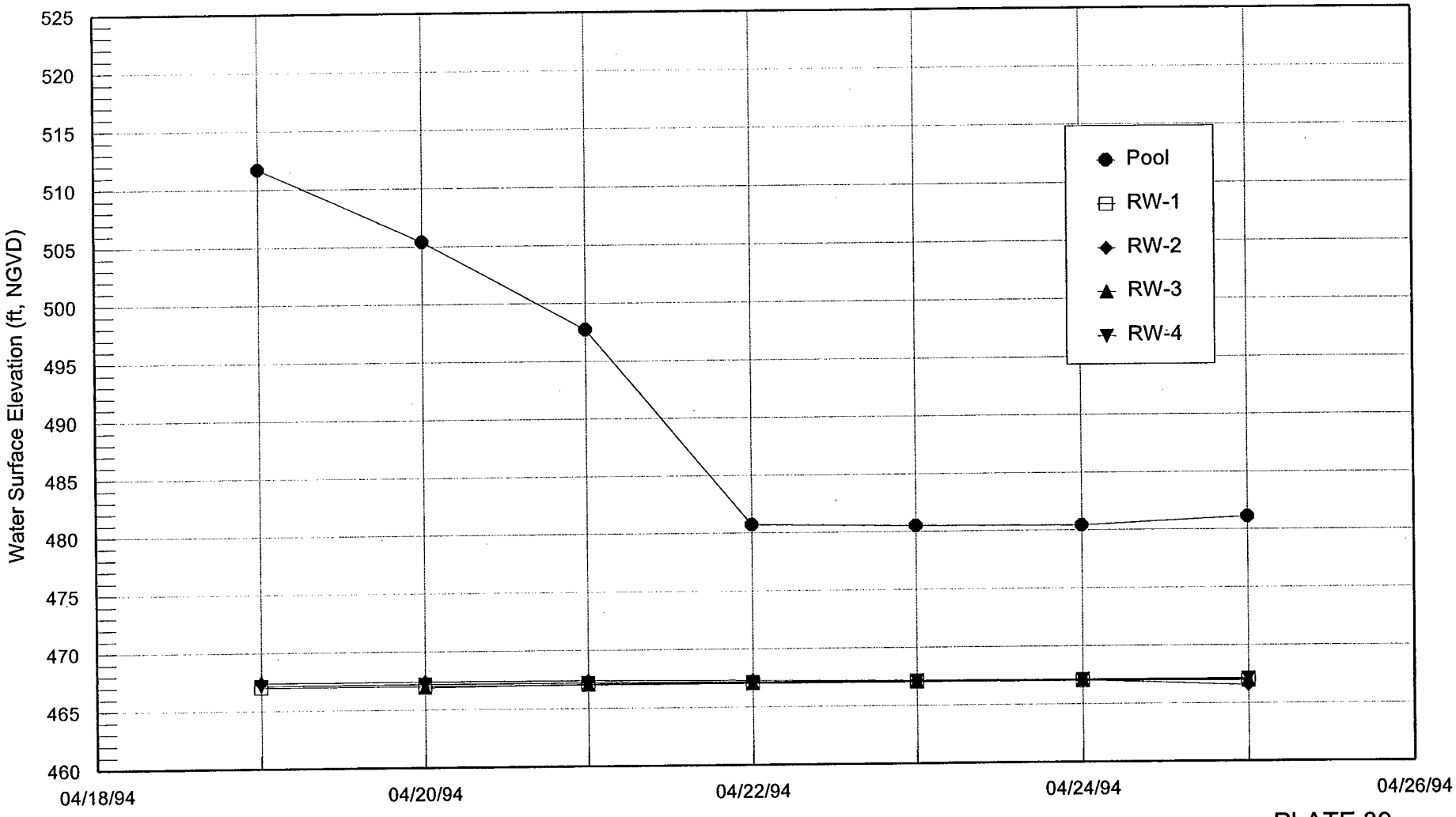


PLATE 39

Townshend Lake

April 1994 Event Plot

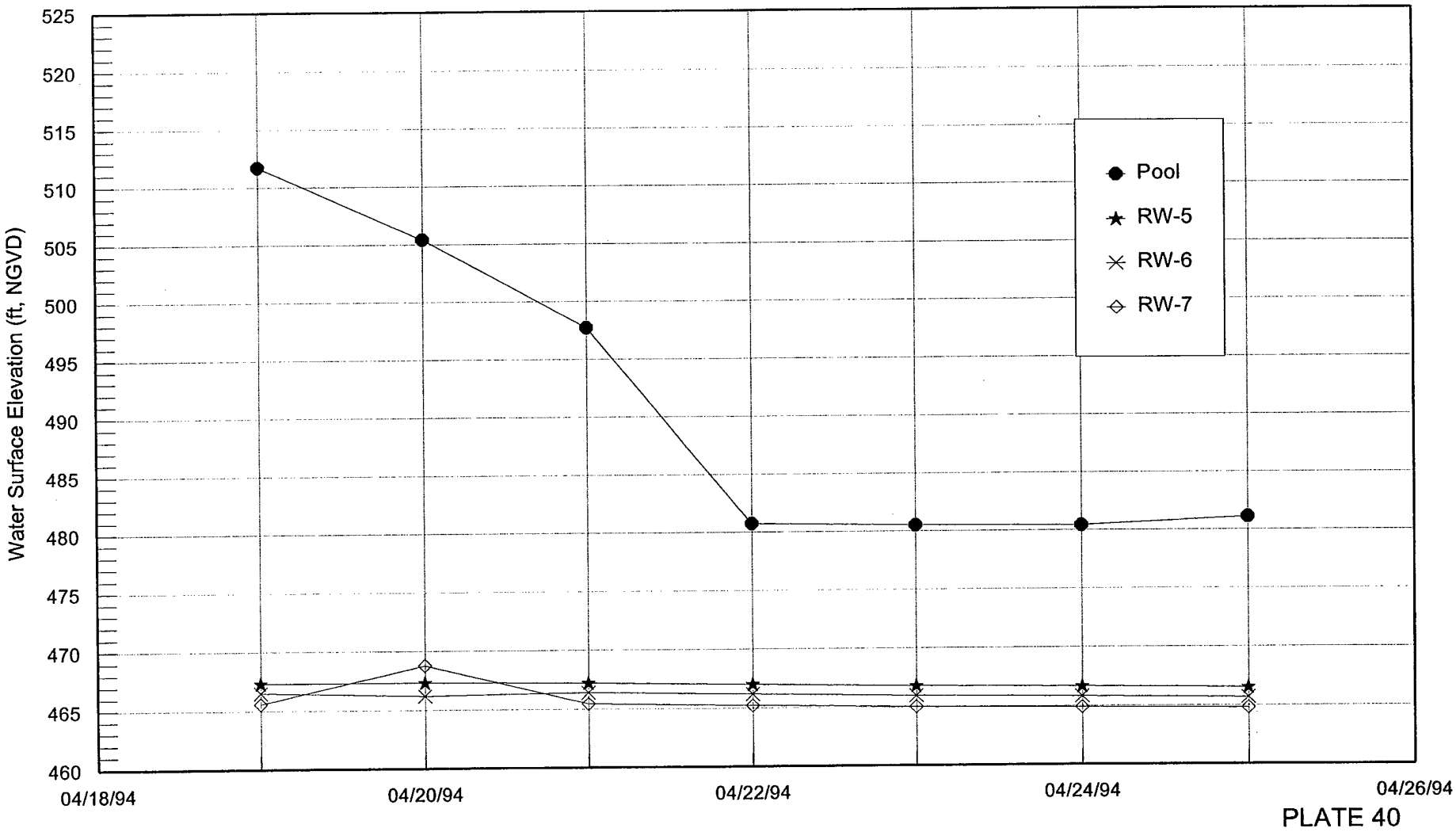


PLATE 40

Townshend Lake

December 1996-January 1997 Event Plot

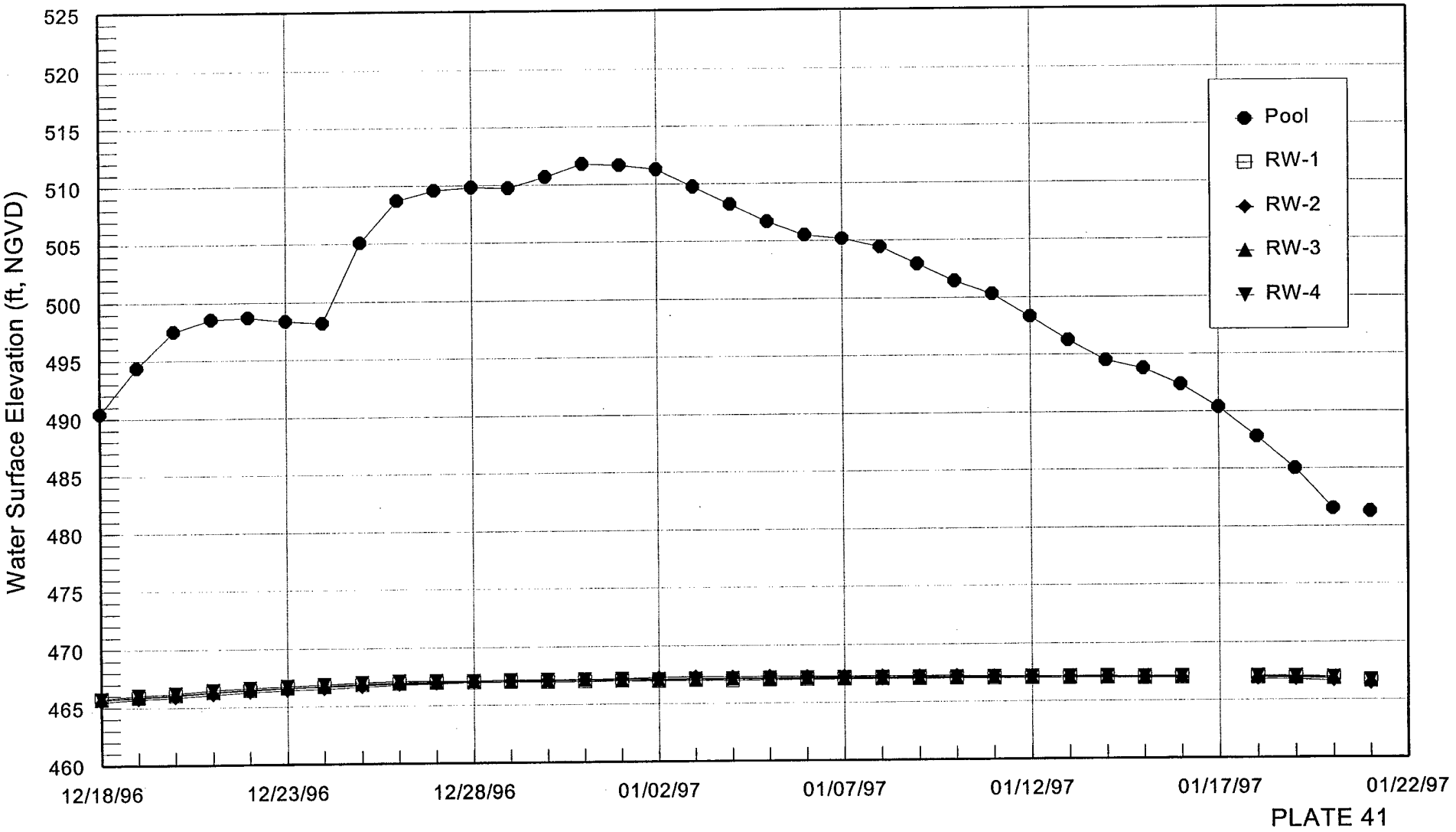


PLATE 41

Townshend Lake

December 1996-January 1997 Event Plot

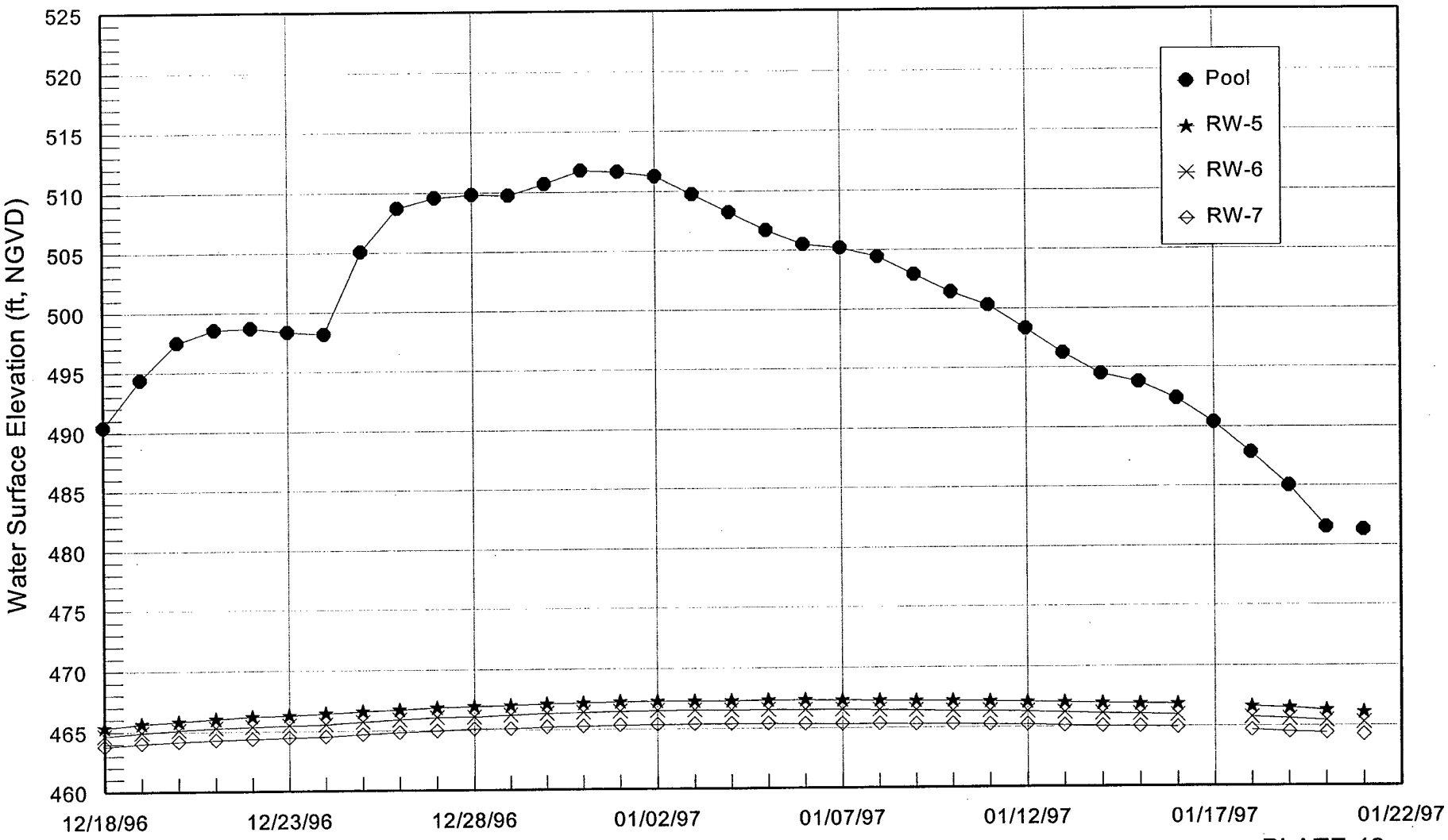


PLATE 42

TOWNSHEND DAM

MAXIMUM RELIEF WELL READINGS

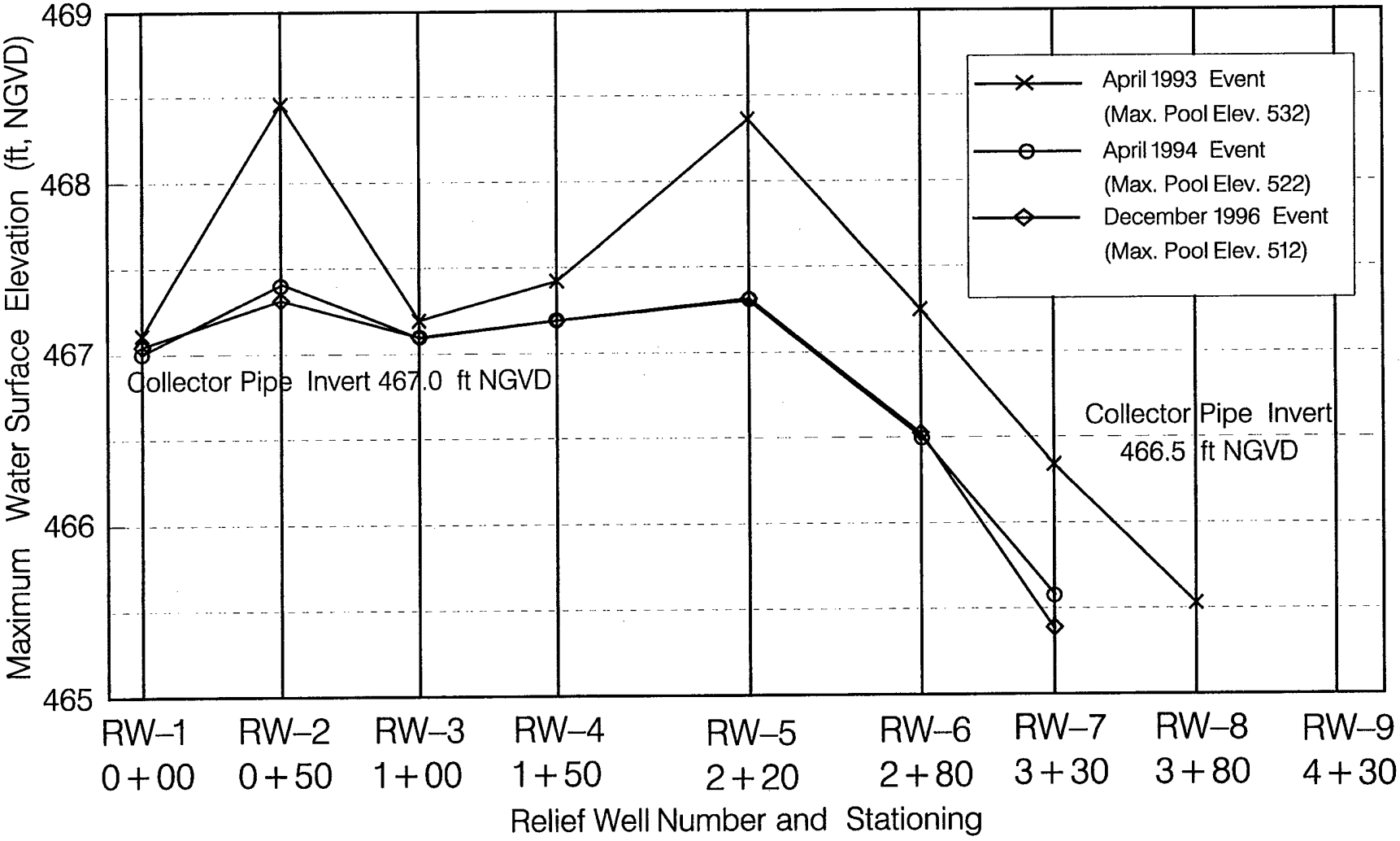
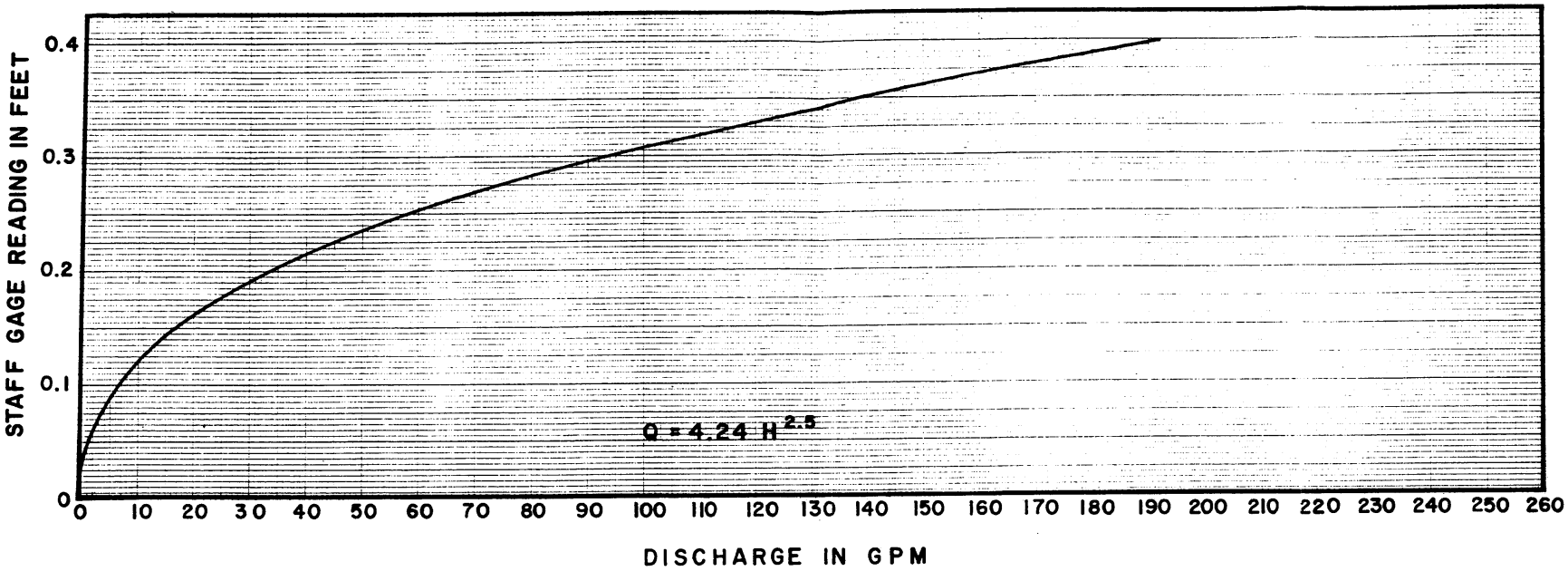
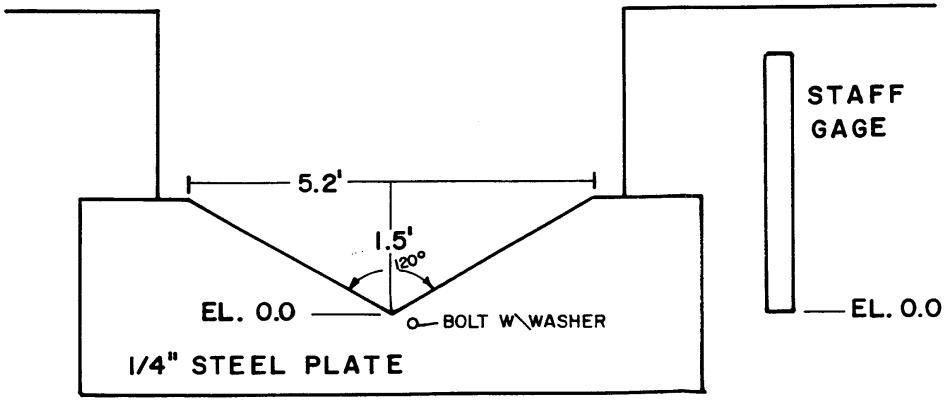


PLATE 43





TOWNSHEND LAKE

SEEPAGE WEIR

DISCHARGE RATING CURVE

HWQB 1991

PLATE 44

ATTACHMENT NO. 1

The following standards and procedures are employed for Crest Monument Surveys at Corps of Engineers Dams.

STANDARDS FOR SETTLEMENT SURVEYS

1. Control points are stamped brass disks preferably set in a ledge area. Where no ledge is available, they are set in concrete bounds placed flush with the ground.

2. Control points are set in areas such that the maximum possible number of crest monuments on the dam are visible.

3. Control points are tied into four reference points by distance. This provides a check each time they are occupied for settlement surveys or allow them to be replaced if found to be destroyed.

4. Distances are read and recorded between settlement bounds. Both distance and angle are read and recorded from the control points that are being occupied to locate each settlement bound on the dam.

5. In locating each settlement bound, a control point will be occupied setting 0-00'-00" (referenced line of site) on a second control point, reading and recording both interior and exterior angle closure, along with distances through each settlement bound located on the dam. Each settlement bound is located from a minimum of two control points. These locations are third order, class II survey with relative accuracies of not less than 1 part in 5,000.

6. Levels are run from control points through each settlement bound on the dam with a return run back into the control points to check the elevation closure on the run. Closure tolerance should be no greater than 0.05'. These levels are third order, class I survey with relative accuracies not less than 1 part in 10,000.

7. Crest monument surveys are performed using Topcon EDM Total Stations and recording both horizontal angles and horizontal distances.

PROCEDURE FOLLOWED FOR SETTLEMENT SURVEYS

The horizontal and vertical monitoring plan for settlement bound movement points employed a combination of triangulation and trilateration angle and distance techniques to survey the control network. Control points, in the form of stamped brass disks, were placed off the dam structure in areas from which the entire length of the dam is visible. Settlement bounds themselves, with stamped brass disks, were placed on the dam structure in a location that is

APPENDIX VIII

RESULTS OF CRACK SURVEYS

RESULTS OF CRACK SURVEYS
TOWNSHEND LAKE
PERIODIC INSPECTION NO. 4

1. PURPOSE

This crack survey is intended to monitor the condition and movement of cracks in concrete features at Townshend Lake. It is important to monitor cracks to determine the cause of cracking, the severity of the condition, and what remedial measures should be taken (if any) to strengthen the member.

2. STRUCTURAL CRACKS

Structural cracks are defined as cracks developed due to over stressing of a concrete member, or due to differential movement or settlement within a member or monolith. Structural cracks will typically be located in tensile zones of members subject to bending (flexural cracks), in beams or walls due to shear forces (shear cracks), and in walls or foundations due to differential movement or settlement (settlement cracks). It is the responsibility of the structural engineer/inspector to determine whether a crack is structural, and its cause. No structural cracks were found at Townshend Lake during Periodic Inspection No. 4.

3. NON-STRUCTURAL CRACKS

Non-structural cracks are typically due to improper placement and curing techniques during construction (Shrinkage and map cracking), and inadequate spacing of expansion/contraction joints to allow for thermal movement of concrete members (temperature cracks). Because non-structural cracks are not caused by over stressing of the concrete, they are of little concern. The following is a list of non-structural cracks found at Townshend Lake during Periodic Inspection No. 4:

NON-STRUCTURAL CRACKS	
CRACK LOCATION	**DESCRIPTION**
Spillway	Extensive map (random hairline) cracking on the entire crest of the spillway.
Tower Stairs	Random 1/16" to 1/8" wide cracks in the curbs of the exterior stairs, extending from the anchor bolts of the stair railings. This condition is typical, and is likely to have been caused by freeze/thaw of water in the anchor bolt holes.

4. RESULTS OF CRACK SURVEYS

There are currently no structural cracks at Townshend Lake that would require monitoring. All of the cracks found during Periodic Inspection No. 4 are non-structural and considered insignificant to the structural integrity of the project.

APPENDIX IX

STATUS OF PROJECT DOCUMENTATION

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
TOWNSHEND, VERMONT

1. STATUS OF PROJECT DOCUMENTATION

a. Engineering data related to project features is to be collected and permanently retained in accessible, appropriate files at the project site. The data should consist of, but not be limited to, design memoranda, subsurface exploration results, as-built drawings and pertinent construction records including foundations and embankment criteria reports, contract specifications, emergency plans, etc.

b. Existing data consisting of as-builts, plans and specifications, design memoranda, emergency plans, etc. are accessible in the files located at the project office. The following list details which documents are missing. These will be supplied by Engineering Directorate as soon as additional copies are obtained.

Townshend Lake

Document or Report	Located at Project (Yes, No or NA)	Date on Document
Project Construction Plans	Yes	Drawings
Post Construction Repair & Modification Plans	Yes	Drawings
Operations and Maintenance Manual	Yes	3/63
Construction Photographs	NO	
Master Manual of Water Control	Yes	11/83
Water Control Appendix		
Dam Break Flood Analysis	Yes	9/81
Flood Emergency Plan	Yes	6/85
Periodic Inspection No. 1	Yes	10/81
Periodic Inspection No. 2		
Periodic Inspection No. 3	Yes	10/91
Periodic Inspection No. 4		
Periodic Inspection No. 5		
Natural Disaster Procedures	Yes	4/80
Emergency Communications Manual		
Fed. Guid. for Dam Safety		
Analysis of Design		
Design Memoranda (include titles below)		
Supplement A to Design #9	Yes	5/66
Design Memorandum #9		4/61
#5		2/57
#4		11/56
#7		12/56
#1		2/57
Aerial Photographs	Yes	4/27/92
#3		11/56
#2		9/56
#6		8/56

Bridge Inspection Report	Yes	8/84
Static Analysis of Structure		
Dynamic Anal. of Structure		
Cultural Resource Management	yes	3/86
Spill Contingency	yes	10/95
EA	yes	6/79
EEP	yes	6/85
Forest Mgt.	yes	4/82

APPENDIX X

STATUS OF DAM OPERATION MANAGEMENT POLICY (DOMP) TRAINING

PERIODIC INSPECTION REPORT NO. 4
TOWNSHEND LAKE
TOWNSHEND, VERMONT

STATUS OF DAM OPERATION MANAGEMENT POLICY (DOMP) TRAINING

a. Reference ER 1130-2-419 (18 May 1978), Dam Operations Management Policy states that Division Engineers are directed to implement a dam safety training program for O&M personnel, with retraining every four years, that will address the following:

(1) Discussion of basic typical design considerations for various types of construction, including hydraulic considerations, foundation factors, etc.

(2) Procedures for monitoring potential problem areas.

(3) Dam safety features in design and construction.

(4) Normal operation, surveillance, monitoring and reporting procedures.

(5) Emergency Operations, surveillance, monitoring and reporting procedures.

b. DOMP training for the Connecticut River Basin, which includes Townshend Lake personnel, was last conducted on March 1990. Continued DOMP training throughout New England Division has not received funding in the last three years, but is scheduled to begin again in FY97.