

EVALUATION REPORT

RUM RIVER DAM

CITY OF ANOKA, MINNESOTA

October 1996

**EVALUATION REPORT
RUM RIVER DAM**

CITY OF ANOKA, MINNESOTA

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the state of Minnesota.

Signature: William E. Holma

Date: 10-7-96 Reg. No: 24427

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the state of Minnesota.

Signature: By Weber

Date: 10-7-96 Reg. No: 20419

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SECTION 1

INTRODUCTION

The City of Anoka retained Stanley Consultants to provide engineering services to evaluate the condition of the Rum River Dam. The purpose of the evaluation is to document the current condition of the facility and to identify any repairs and/or modifications required to maintain the required serviceability of the facility. Section 2 presents results of the field investigations performed on the dam. Investigations included both a "surface inspection" and an underwater inspection performed by a sub-consultant. Section 3 presents the evaluation of monitoring data for the dam including piezometer readings and soundings. Section 4 presents recommendations for the dam including both structural repairs and monitoring.

The City also requested that alternatives to the current flashboard system be analyzed and evaluated as part of the evaluation work. SCI's scope of services included the formulation of alternatives to the flashboard system currently used to control the upstream pool level at the dam. The flashboard alternatives evaluation report is included as Appendix D to this report.

SECTION 2

FIELD OBSERVATIONS

2.1 SURFACE OBSERVATIONS

2.1.1 General

The above water "surface" evaluation of the Rum River Dam was performed from 9:00 am to 11:30 am on June 6, 1996. Weather was sunny with a temperature of approximately 70° F. The following SCI personnel participated in the field evaluation.

Martin J. Weber, P.E.
Kent A. Paulson, P.E.
Kathy M. Burk

All structures that form part of the Rum River Dam were observed except for those areas that were below water. Coincident with the dam observation, City of Anoka personnel were installing the flashboards on the dam crest. To facilitate this, the upstream pool had been drawn down to approximately one foot below the dam crest.

This section presents findings for the major structural components of the project listed below. All references made to "right" and "left" are intended to indicate right and left when looking downstream. Photograph 1 presents a downstream view of the components of the Rum River Dam.

- Reservoir rim
- Abutments
- Revetments
- Tainter gate structure
- Overflow spillway
- Stilling Basin

Each of the topics listed below are discussed for each major structural component. If no comment is made for a particular topic in regard to a component, then no relevant field observations were made during the field observations.

- General condition
- Settlement
- Movement
- Erosion
- Seepage
- Leakage
- Cracking
- Deterioration
- Geologic conditions

- Foundation conditions
- Reservoir rim stability
- Functioning of foundation drains/relief wells

2.1.2 Reservoir Rim

The reservoir rim appeared stable with no evidence of erosion or sloughing. The right and left banks of the reservoir are shown in Photographs 2 and 3.

2.1.3 Left Abutment Area

As shown in Photograph 4, the left abutment area includes the former powerhouse area and left abutment wall.

Remains of the former powerhouse appear to be reinforced concrete piers. The rightmost pier is connected to the left abutment wall by a reinforced concrete "floodwall" (reference Photograph 5) which is believed to be a portion of the new dam structure. The exposed concrete tops of the piers and floodwall are in poor condition. The concrete exhibits severe deterioration and spalling. Surface concrete of the floodwall is also in poor condition with spalling and loss of concrete evident. The former powerhouse piers no longer serve as water retaining portions of the dam. Their purpose is now solely for historical interpretation and the only safety concerns would stem from people coming in contact with their rough surfaces. The City should consider this and evaluate the historical value versus the safety issues. The floodwall does however serve as a water retention structure. The surface concrete of the floodwall should be repaired.

The 5 foot thick left abutment wall (reference Photograph 18) serves as an abutment and as the left wall of the tainter gate structure. Concrete which forms this wall is generally in excellent condition. Expansion joint material is missing from portions of the joints between the monolith sections. The top and sides (above the waterline) of the joints should be sealed to prevent water from entering the joint from above. The construction joints in the walkway surface should be resealed to prevent water from entering the joint.

Handrail is solid and in good condition except for the paint system which is peeling in some areas allowing the steel to rust. One area of the handrail was apparently missing and had been temporarily blocked with construction fencing. Permanent handrail should be installed here.

2.1.4 Right Abutment Area

The right abutment area, shown on Photograph 6, includes the "overlook" structure and approach area.

The reinforced concrete abutment wall is generally in excellent condition. The on-grade concrete slab which forms the top of the overlook has settled (vertically) 3 to 4 inches at the abutment wall (reference Photograph 7). As shown on Photograph 11, the soil surface to the right of the overlook structure is experiencing erosion of up to 6 inches. This area should be filled and possibly surfaced with asphalt or other erosion resistant material.

Handrail at downstream edge of the overlook and on the abutment wall near upstream edge of overlook is loose. In addition and as shown on Photographs 8 and 9, the joint in the abutment wall at downstream edge of overlook area has opened about 2.75 inches at the top of the wall. Evidence of the separation is also depicted in Photograph 10. This movement was reported in 1987 [1] and should continue to be monitored as part of future observations.

2.1.5 Downstream Revetments

Downstream of the dam, each bank is armored with a riprap revetment. The left bank was recently repaired and as shown by Photograph 13, included construction of a walkway, handrail, a reinforced concrete retaining wall and riprap protection system. In general, the walkway, handrail, wall and riprap are in excellent condition. The following observations were made.

- Approximately 30 to 40 small (<3" diameter) trees are present on the bank and should be removed.
- Some settlement of the walkway was observed at three locations (reference Photograph 14). This settlement should be monitored and repaired if and when walking safety becomes an issue.
- A 6-inch diameter drain located 30-feet downstream of the tainter gate structure was flowing about 1/3 full, with clear water. This is not a concern, but included for comparison during the next field observation.
- A small seep was observed on the bank, approximately 170 feet downstream of the tainter gate structure (reference Photograph 15). No sand or fines were observed in the seep. Monitoring of this seep should continue.

As shown on Photograph 12, the downstream right bank consists of a riprap protected slope only. Apparently, no work has been performed on the right bank since original construction. The following observations were made.

- The riprap system is in fair condition with some loss of material having taken place through the years. The riprap itself is less desirable than that of the left bank because of its rounded (rather than angular) shape.
- As was the case with the left bank, 30 to 40 small trees are present and should be removed.
- A 12-inch diameter concrete drain pipe located a short distance downstream of the overlook was dry.
- A concrete/rock apron, located just downstream of the overlook, is being undermined and should be repaired.

2.1.6 Tainter Gate Structure

The tainter gate structure includes the 20-foot wide tainter gate and spillway, the right training wall, and operator/observation walkway. The left and right piers of the tainter gate structure are shown in Photographs 16 through 18 and 25.

Concrete portions of the tainter gate structure are generally in excellent condition. Expansion joint material is missing from portions of the joints between the monolith sections. Water can be seen

surging through the wall from the tainter gate sluiceway to the main river channel. The surging water does not appear to have any harmful effects. The top and sides (above the waterline) of the joints should be sealed to prevent water from entering the joint from above. The construction joints in the walkway surface should be resealed to prevent water from entering the joint. Stoplog slots upstream of the tainter gate are in good condition, but the embedded steel is rusting below the waterline (reference Photographs 19 and 20). At the time of the field observation, the tainter gate was open and discharging water. Therefore, the tainter gate spillway could not be observed.

Most of handrail is solid and in good condition, except the painting system which is peeling in some areas allowing the steel to rust. The two furthest upstream light fixtures have been damaged and the handrail near one of the lights was also damaged. Electrical wiring is exposed at one of the damaged light fixtures.¹

Some of the signage located on the tainter gate structure is aged and becoming difficult to read (reference Photograph 21). These signs should be replaced.

Photographs 22 and 23 show the tainter gate and hoist system. The tainter gate itself appears to be in good condition, except for its paint system and apparent slight misalignment. The paint is peeling near the top of the gate panel on the upstream side and on most of the downstream side of the gate. The tainter gate hoist support beams appear to be in good condition, but the paint is peeling allowing the steel to rust. The gate's apparent misalignment is observable from the leakage along the left and bottom seals (reference Photograph 24). Misalignment could be due to either lifting chain dissimilarity or shifting of the gate/structure itself. It is recommended that the gate lifting chains be adjusted to provide level closure of the gate against the sill's base plate. The tainter gate is fully functional as evidenced by its operation during the underwater inspection.

2.1.7 Overflow spillway

The overflow spillway is a buttress type dam with a total length of 236 feet. The spillway is formed by an 18-inch thick apron supported by 2-foot thick reinforced concrete buttresses spaced at 18.33 feet on centers.

With the pool drawn down, the crest of the dam was observed (reference Photograph 26). Concrete was found to be sound over the entire length of the spillway. Expansion joint material/sealant is deteriorating and missing in some areas.

The downstream side of the spillway apron and the buttresses were observed. Photographs 30 through 55 present downstream views of all the overflow spillway bays. Pier and apron concrete is generally in excellent condition with some exceptions as noted below.

- Minor spalling is present at top of downstream edge of Pier 4 (reference Photographs 35 and 36).

¹

At the time of this report's printing, the City had already repaired the light fixtures and handrail and therefore, no additional action is required.

- Water is leaking through the apron joint above Pier 4 and is visible on left side of Pier 4. Leakage in this bay was also reported in 1987 [1]. Some vegetation is present on the side of the pier.
- Unsound concrete is present near the top of the left side of Pier 8.
- A small amount of leakage is visible through the apron joint above Pier 8 and is visible on left side of Pier 8 (reference Photographs 45 and 46).
- A small amount of leakage is visible through the apron joint above Pier 9 and is visible on the left side of Pier 9 (reference Photograph 48).
- As shown on Photograph 50, several leaks are visible in the apron between Piers 10 and 11. Unsound concrete is also present in the leakage area. This problem was also reported in 1987 [1].

2.1.8 Stilling Basin

As shown on Photographs 1 and 16, the downstream stilling basin is a reinforced concrete structure formed by a 2-foot thick floor slab, a 2'-11" high by 2'-0" thick end sill, and a series of 59, 3'-9" high by 2-foot square baffle blocks. The stilling basin was observed by making a series of passes over it and sounding it's surfaces.

Some damage was observed on Baffle Blocks 1, 2, 3, 4, 8, 17, 41, 42, 43, and 47. Six of these blocks (1, 2, 3, 4, 8, & 47) were reported as being damaged in 1987 [1]. Baffle Block 52 had been displaced and is laying on its side a short distance downstream (also reported in 1987 [1]).

In general, the floor slab appeared to be in good condition. An exception to this is the 6-inch deep by 4-foot square void found approximately 8 feet downstream of the apron, near the right abutment. The 1987 evaluation report indicated a similar scour hole near the left abutment. This hole however was not evident during the 1996 inspection (reference Photograph 55). It is recommended that the entire stilling basin be observed and photographed on the next opportunity. The void near the right abutment (and if necessary, the void near the left abutment) should be observed and filled at this time.

As evidenced by Photographs 27 and 28, no significant scour is present in the river bed immediately downstream of the stilling basin

2.2 UNDERWATER INSPECTION

An underwater inspection was performed on July 26, 1996 by H2O, Inc. of St. Paul, Minnesota. Mr. William Holman of Stanley Consultants, Inc. was also present during the inspection. A complete copy of the underwater inspection report [2] is included as Appendix B and summarized below. A video cassette of the inspection was provided to the City with this report.

Components of the dam observed during the underwater inspection include:

- Upstream portion of west abutment
- Upstream spillway apron
- Tainter gate, tainter gate spillway, tainter gate approach, and tainter gate stilling basin

Visibility during the inspection was fair to poor and therefore, a portion of the inspection was performed by touch. Generally, underwater portions of the dam were found to be in good condition with no apparent significant deficiencies. Specific findings include:

- Upstream portion of the west abutment: Good condition.
- Upstream portion of the spillway: Good condition with one area showing minor weathering.
- Tainter gate approach walls/stilling basin walls: Good condition.
- Steel stoplog guides (in tainter gate approach walls and stilling basin walls): Generally good condition except for areas of rust and blisters which may inhibit stoplog installation and removal.
- Tainter gate steel/rubber seals: Good condition, however the gate's lifting chains appear to be out of adjustment as indicated by the tapering gap between the gate seal and concrete.
- Tainter gate stilling basin: Good condition.
- No evidence of scour or undermining along upstream edge of tainter gate approach or downstream edge of tainter gate stilling basin.

During the underwater inspection, depth of upstream "soundings" were also taken. Results of the soundings are presented in Section 3.

2.3 REFERENCES

1. Barr Engineering Co., "Preliminary Report: Repair and Modification of the Rum River Dam", June 1987.
2. H2O, Inc., "Underwater Investigations: Rum River Dam," July 29, 1996.

SECTION 3

MONITORING DATA

3.1 PIEZOMETERS

3.1.1 Description

As part of original construction, seven sets of piezometers were installed along the overflow spillway and tainter gate spillway. The sets are located beneath Piers 1, 3, 5, 7, 9, 11, and 13. Systems beneath piers 3, 5, 7, 9, 11, and 13 consist of three piezometric monitoring tubes, one considered "upstream" and two considered "downstream." The Pier 1 system consists of three tubes under the pier itself (one "upstream and two "downstream") and two beneath the tainter gate spillway (one "upstream" and one "downstream". Note that numbering of the piezometer locations originates at the left end of the dam which is the opposite of how the piers are numbered in Section 2.

3.1.2 Data

Piezometer data, dating back to 1971, is presented in Table 1 and graphically on Figures 3-1 through 3-8. Piezometers are numbered as follows. The first number designates the pier where the piezometer set is located (e.g. Piezometer 1-2 is located at Pier 1). The second number designates the tube location, as indicated below.

- 1 Tube located near the upstream sheeting
- 2 Tube located downstream of the sheeting
- 3 Tube located under the stilling basin

The piezometer set of Pier 1 differs as indicated on the as-built construction drawing Sheet 19 of 21 [2] and repeated below.

- 1 Between sheeting, tainter gate spillway area
- 2 Downstream sheeting, tainter gate spillway
- 3 Between sheeting, fixed crest slab area
- 4 Downstream sheeting, fixed crest slab
- 5 Downstream foundation slab

3.1.3 Evaluation

According to the Operation and Maintenance Manual [1], piezometer readings in upstream tubes should be on the order of Elevation 838.0 and other tubes, Elevation 832.0.

Results of the historic piezometer data evaluation are summarized below.

- In all cases, upstream piezometer readings historically average less than 838.0 and recent readings do not appear to show a significant increasing trend.

- In most cases, downstream piezometer readings historically average less than 832.0. Exceptions to this include Piezometer 3-3 and Piezometer 1-2. Piezometer 3-3, slightly high average of 832.1 is mostly due to an initial high reading and a second high reading taken in 1987. Piezometer 1-2 has an average reading of 833.9 due mostly to the past six readings.
- Recent readings in most downstream piezometers do not appear to show significant increasing trends. Exceptions to this include Piezometers 1-2, 7-2 and 7-3.

3.1.4 Recommendations

Recommendations relating to piezometer data are as follows.

- Although Piezometer 3-3 has a historic average reading higher than anticipated, no additional measures are recommended.
- Piezometers 7-2 and 7-3 indicate possible increasing trends. It is recommended that these piezometers be read quarterly until they stabilize or until the reason for their increase can be determined.
- Piezometer 1-2, located in the downstream area of the tainter gate bay is a concern because of the increasing trend over the past several years. It is recommended that the piezometer tube be flushed and checked for accuracy. If it is determined that accurate readings are being given, it is recommended that an investigation be performed to determine the cause of the unusually high readings. Such an investigation may require the installation of additional piezometers under the tainter gate spillway.

3.2 SOUNDINGS

3.2.1 Description

Soundings upstream of the dam were taken by H2O, Inc. during the underwater inspection that took place July 26, 1996. A copy of the inspection report is included as Appendix B. Upstream soundings were performed using a "pneumofathometer." The downstream sounding program was performed by Stanley Consultants on August 9, 1996. Soundings (or more appropriately, river bottom elevations) were determined using a surveyor's level and rod. City personnel manipulated the tainter gate to provide for wadeable conditions in the downstream area.

River bottom elevations in the area downstream of the tainter gate could not be obtained. However, the diving inspection revealed that at the "lip" of the tainter gate's stilling basin, the river bottom is level with the lip and slopes upward in a downstream direction.

3.2.2 Data

The sounding grid, recently recorded bottom elevations, and the resulting river bottom contours are shown on Figure 3-9.

3.2.3 Evaluation

Results of the sounding program indicate that no significant changes in river bottom topography has taken place since original construction. Soundings indicated that no apparent sedimentation or scour problems exist with the structure.

3.2.4 Recommendations

It is recommended that soundings continue to be performed every five years.

3.3 REFERENCES

1. Barr Engineering Co., "Operation and Maintenance: Rum River Dam - Anoka, Minnesota," revised July 28, 1972.
2. Barr Engineering Co. As-Built Construction Plans, "Rum River Dam - Anoka, Minnesota," 1968.

TABLE 3-1. HISTORIC PIEZOMETER READINGS

	DATE >	18-Sep-72	18-Sep-72	21-Jul-75	22-Jul-75	13-Jul-79	28-Apr-80	02-Apr-81	12-May-82	11-May-83	04-Jun-84	27-Mar-87	08-Apr-88	04-May-89	01-Nov-90	04-May-93	03-Nov-94	22-Nov-95	AVE	
	HWEL >	844.8	844.5	841.4	844.0	841.0	840.5	840.2	842.8	841.5	841.0		841.0	841.0	840.8	841.0	841.0	841.0	841.7	
	TWEL >	831.2	833.5	831.1	832.4	832.3	832.0	831.9	831.7	832.1	832.0	832.0	832.0	832.0	831.8	832.0	831.8	832.0	832.0	
BUTTRESS	PIEZ	ZERO																		
1	1	838.3																		
	2	838.2	834.60	833.90	833.30	833.00	832.50	832.30	833.14	832.80	833.00	833.07	832.50	833.05	832.85	832.60	832.30	832.70	833.0	
	3	838.2																		
	4	838.2	834.20	833.70	832.70	833.10	832.90	832.90	833.20	833.30	833.50	832.20	834.20	834.25	834.50	835.20	835.80	836.10	833.9	
	5	838.1	834.50	832.80	833.10	832.50	832.00	832.10	832.29	832.30	832.10	832.49	832.10	832.55	832.35	832.40	832.10	832.00	832.5	
	3	1	838.3	832.90	831.80	832.10	832.00	831.60	831.70	831.80	831.60	831.95	832.05	832.20	831.89	832.20	831.80	831.80	831.9	
		2	838.3	832.60	831.60	831.80	831.80	831.40	831.45	831.60	831.60	831.40	831.72	831.80	832.10	831.71	832.00	831.70	831.50	
		3	838.3	835.70	833.30	833.30	833.00	832.60	832.70	832.80	833.00	832.50	832.42	832.15	832.40	834.55	832.40	832.40	832.10	
		5	838.3	832.20	831.10	831.50	831.40	831.10	831.14	831.30	831.10	831.47	831.25	831.70	831.44	831.70	831.40	831.40	831.4	
		7	838.3	833.60	831.80	831.60	831.50	831.10	831.80	832.47	832.70	832.10	834.47	831.30	831.80	831.45	832.00	831.60	831.60	
		9	838.4	834.70	834.10	834.30	833.50	832.70	832.10	833.50	834.30	834.10	834.36	832.55	832.80	832.49	832.60	832.60	832.50	
		11	838.4	832.10	831.10	831.50	831.50	831.10	831.20	831.24	831.30	831.20	831.57	831.30	831.90	831.54	831.80	831.50	831.50	
		13	838.4	832.20	831.20	831.50	831.50	831.10	831.20	831.24	831.40	831.20	831.65	831.35	831.90	831.54	831.80	831.50	831.80	
		15	838.3	834.90	834.30	834.80	833.70	833.00	833.00	832.80	834.10	833.10	833.09	832.30	832.70	832.77	832.70	832.70	832.90	
		17	838.3	832.10	831.00	831.40	831.40	831.10	831.10	831.05	831.50	831.20	832.01	832.25	832.30	832.23	832.10	831.50	832.90	
		19	838.4	832.20	831.10	831.40	831.40	831.10	831.20	831.48	831.60	831.20	832.32	832.30	832.40	831.86	831.90	832.20	833.10	
		21	838.4	835.10	834.50	834.80	834.30	834.10	833.40	833.70	833.50	834.10	835.32	833.40	832.50	834.28	832.70	833.30	831.90	
		23	838.4	831.20	831.10	831.40	831.40	831.10	831.10	831.05	831.30	831.10	831.48	831.30	831.90	831.51	831.70	831.50	831.30	
		25	838.4	831.60	831.50	831.60	831.40	831.10	831.10	831.05	831.20	831.10	831.48	831.25	832.40	831.50	831.70	831.50	831.4	
		27	838.3	833.60	833.20	833.20	833.90	833.10	832.20	833.30	833.30	833.40	833.26	832.25	831.80	832.57	832.90	833.30	833.0	
		29	838.4	831.60	831.00	831.40	831.60	831.20	831.20	831.32	831.40	831.20	833.57	831.30	831.85	831.62	831.80	831.60	831.50	
		31	838.4	831.60	831.00	831.40	831.50	831.20	831.20	831.15	831.70	831.20	831.69	831.35	831.90	831.63	831.80	831.60	831.50	
		33	838.3	833.20	832.50	833.20	832.80	832.70	832.20	832.14	832.10	832.70	832.03	832.05	832.15	832.18	832.20	832.00	832.4	
		35	838.4	831.60	831.20	831.50	831.00	831.20	831.35	831.24	831.50	831.30	831.61	831.50	832.00	831.66	832.00	831.60	831.60	
		37	838.4	831.60	831.30	831.60	831.00	831.20	831.30	831.30	831.40	831.30	831.69	831.50	832.00	831.68	831.90	831.60	831.60	

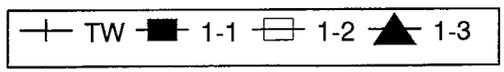
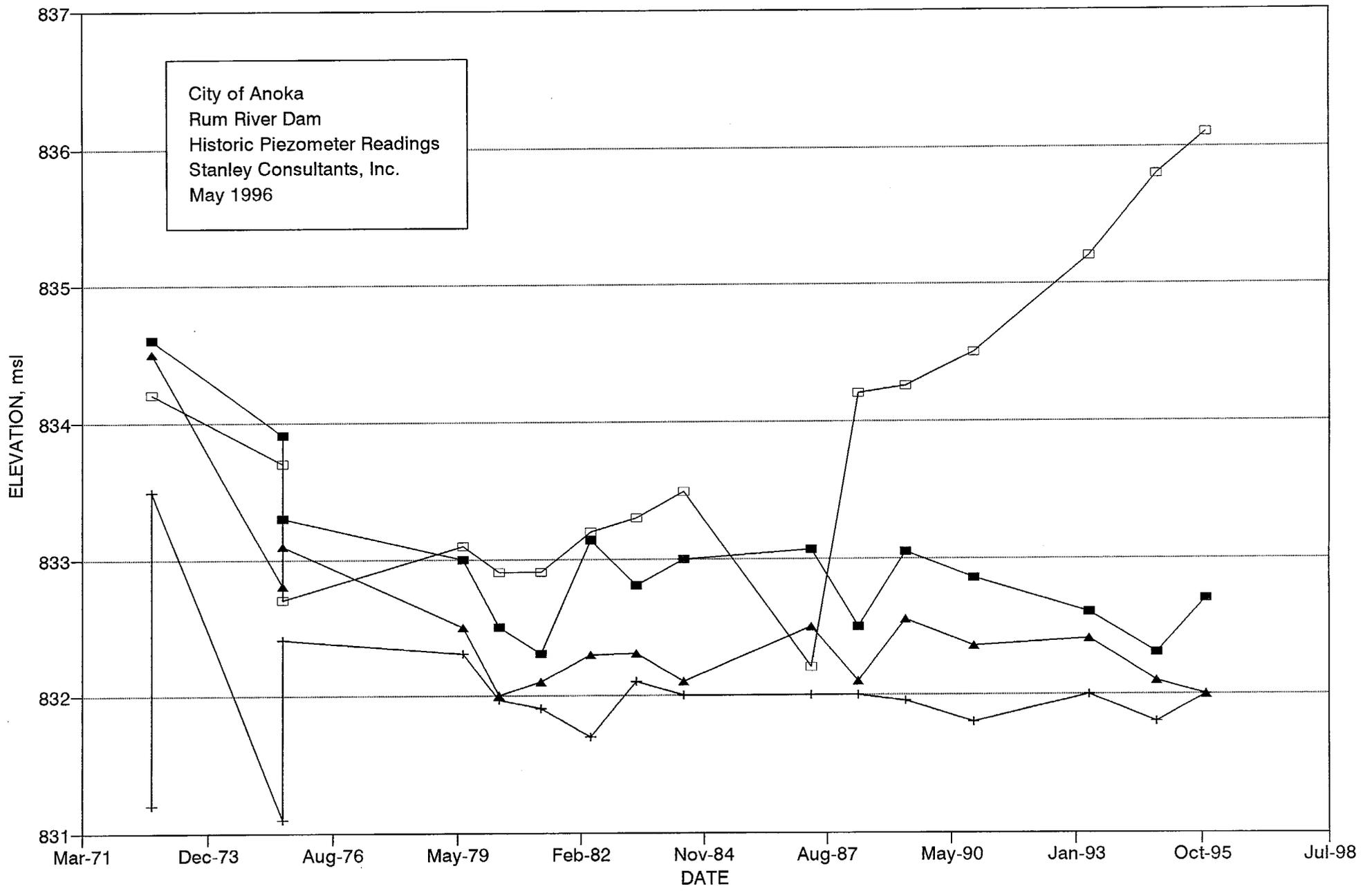


FIGURE 3-1

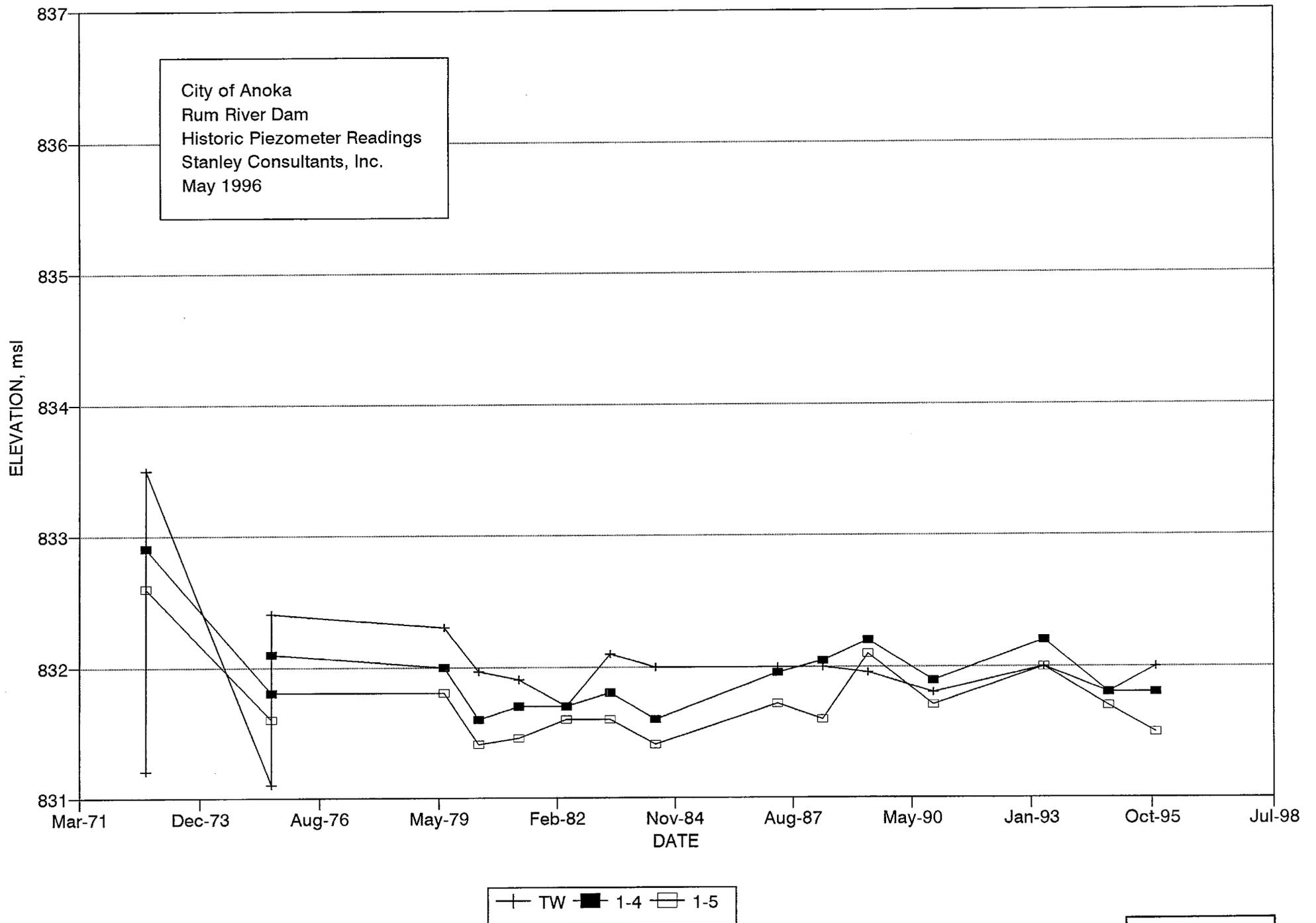
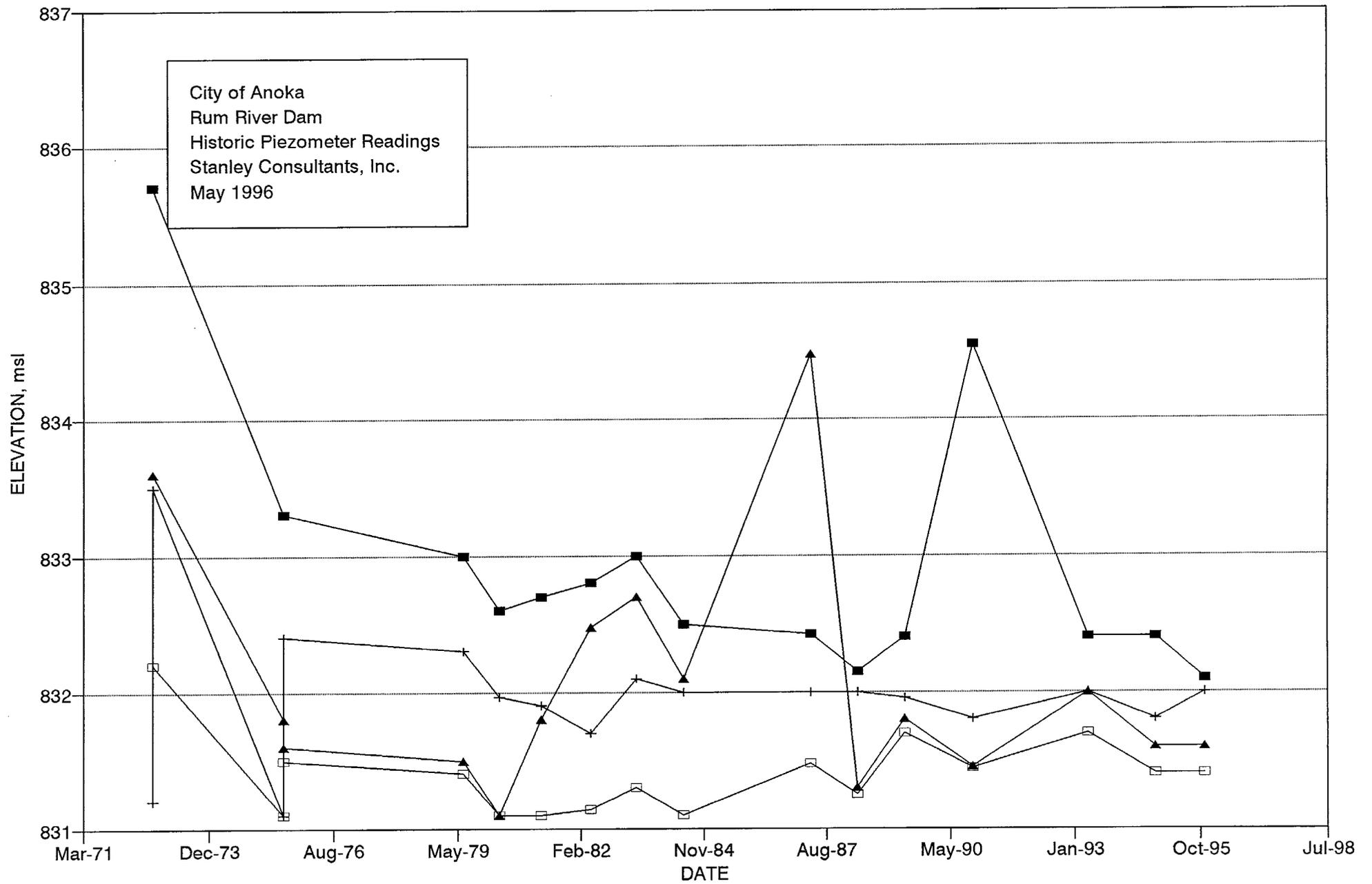
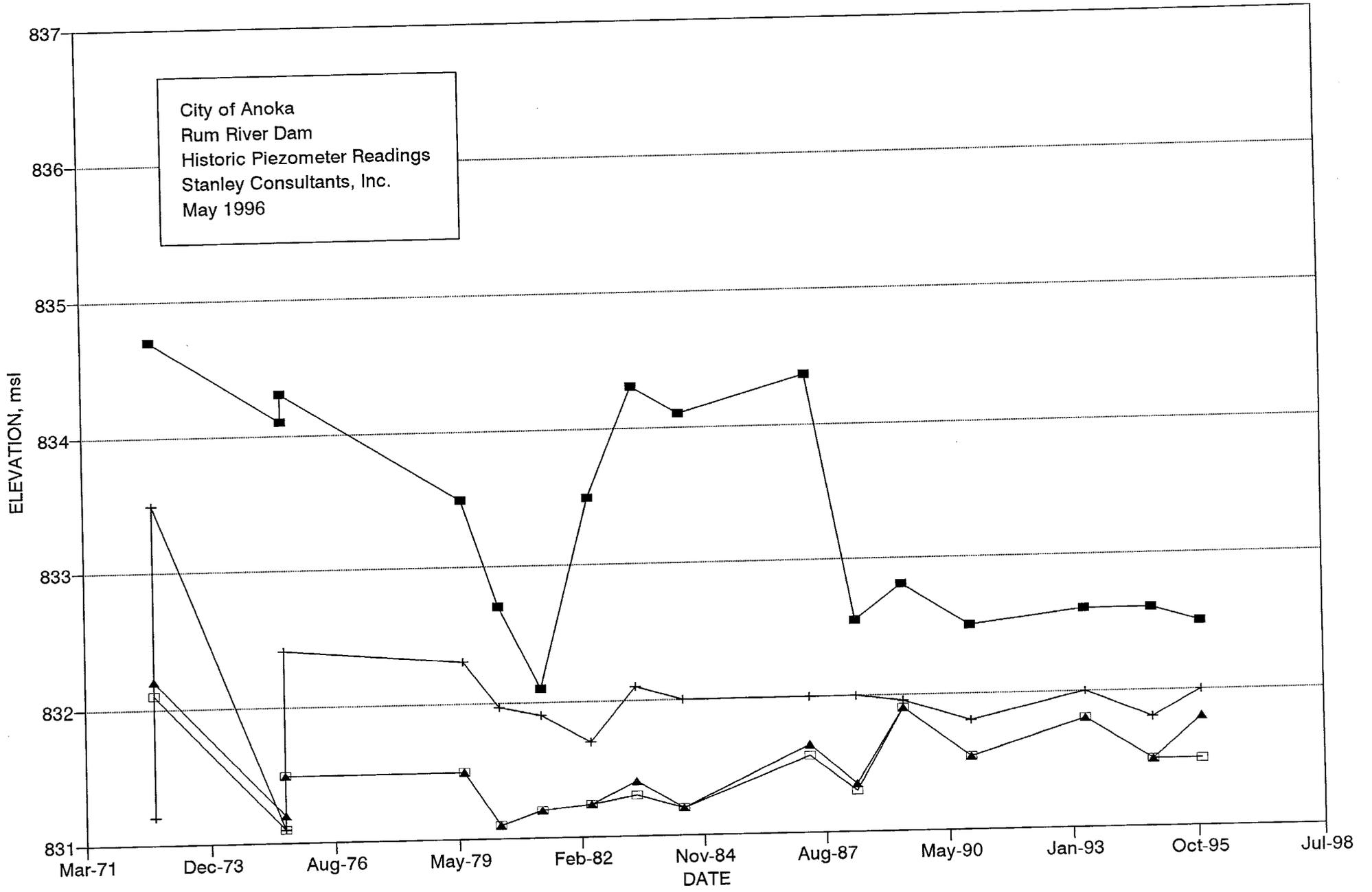


FIGURE 3-2



+ TW ■ 3-1 □ 3-2 ▲ 3-3

FIGURE 3-3



+ TW ■ 5-1 □ 5-2 ▲ 5-3

FIGURE 3-4

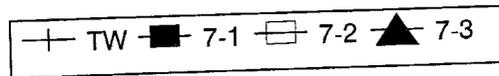
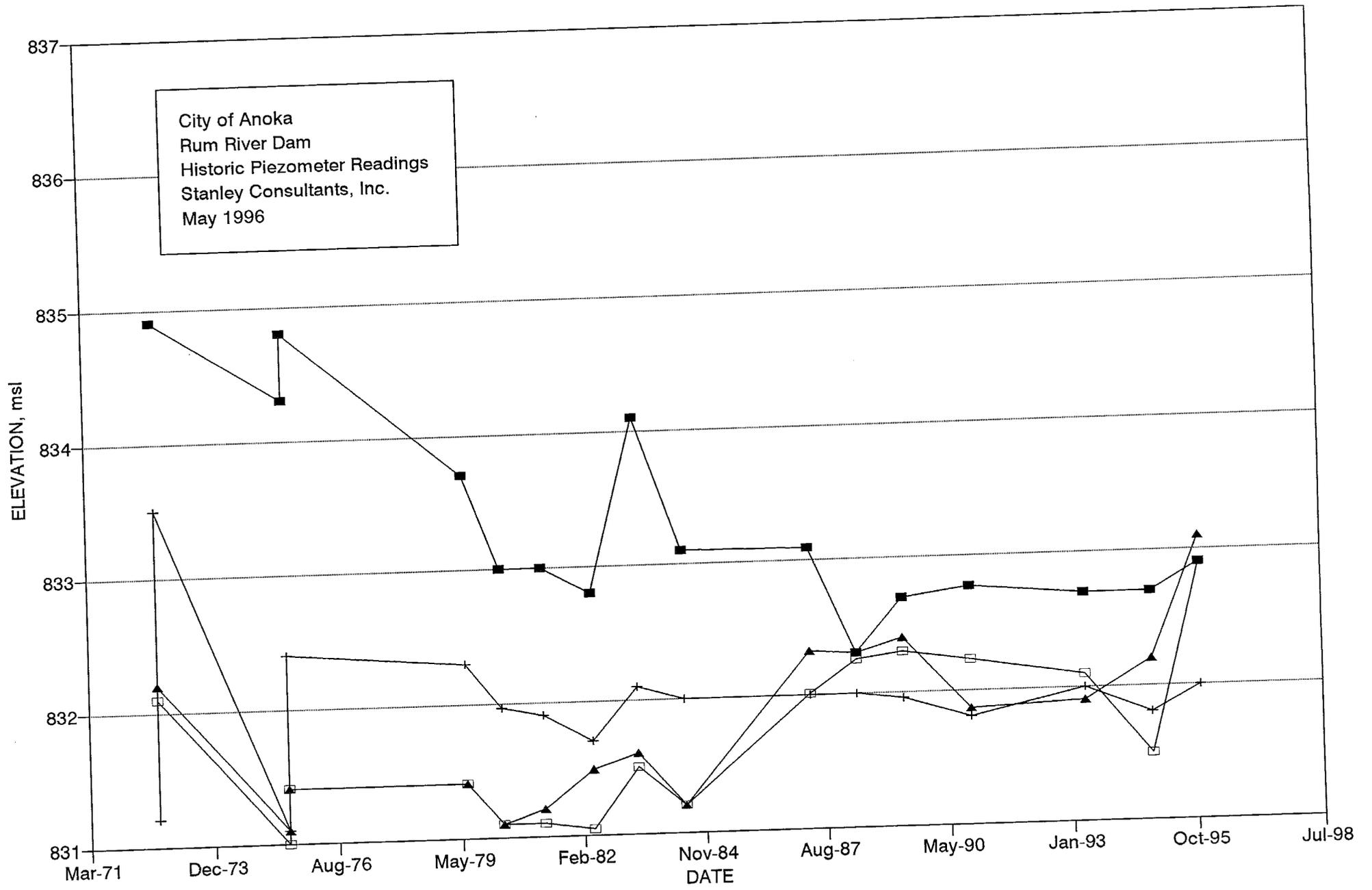
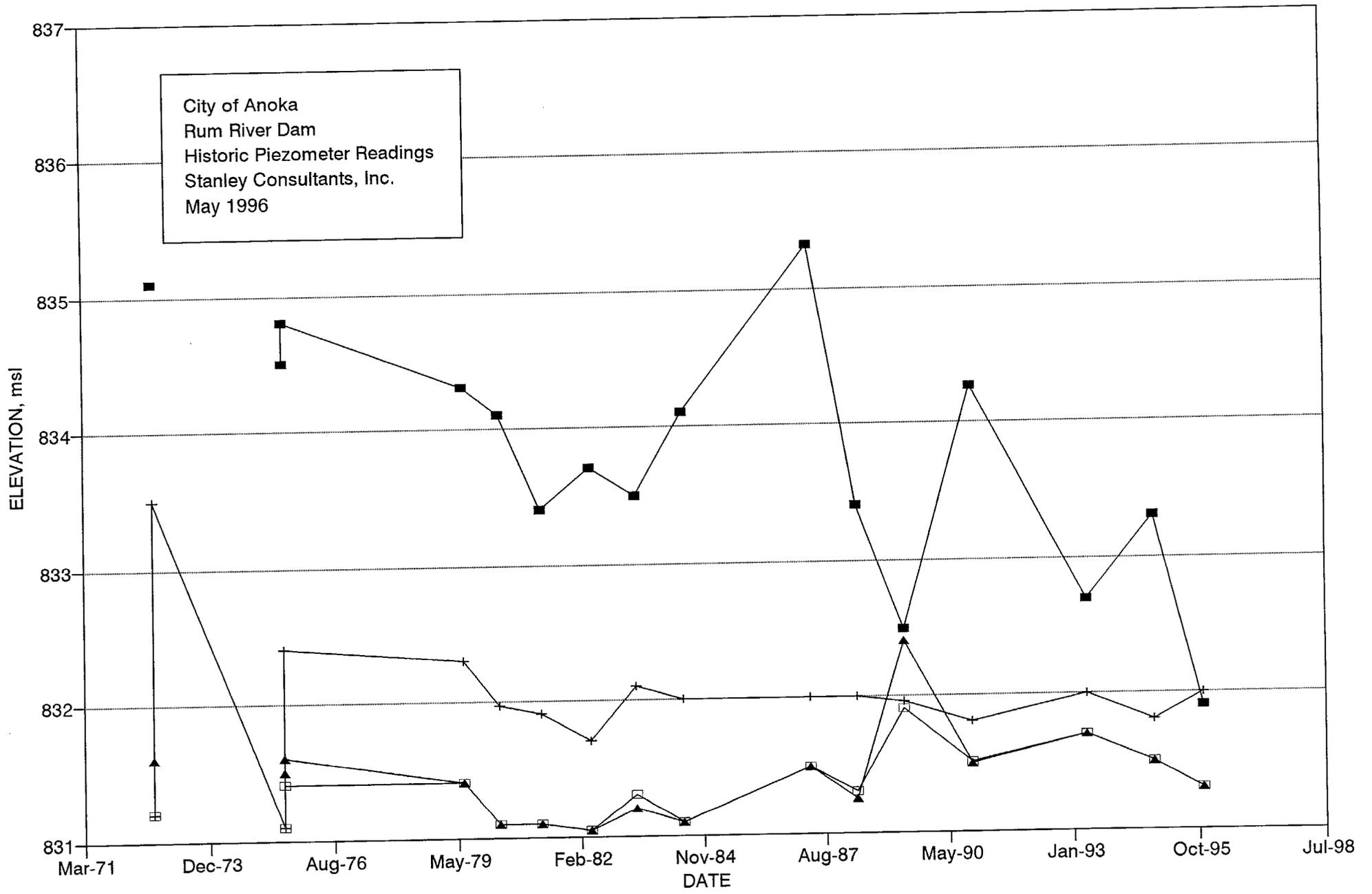
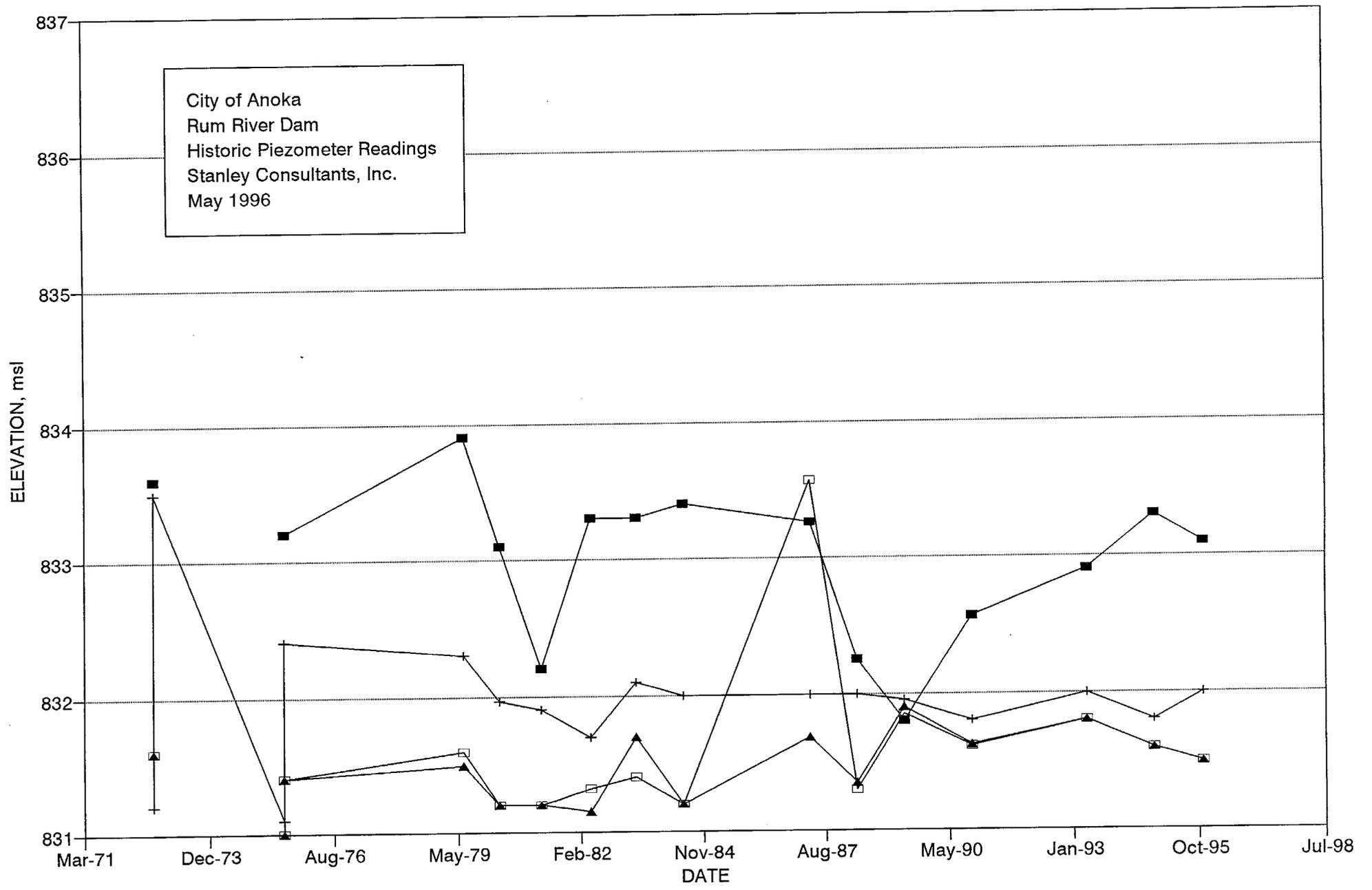


FIGURE 3-5



+ TW ■ 9-1 □ 9-2 ▲ 9-3

FIGURE 3-6



+ TW ■ 11-1 □ 11-2 ▲ 11-3

FIGURE 3-7

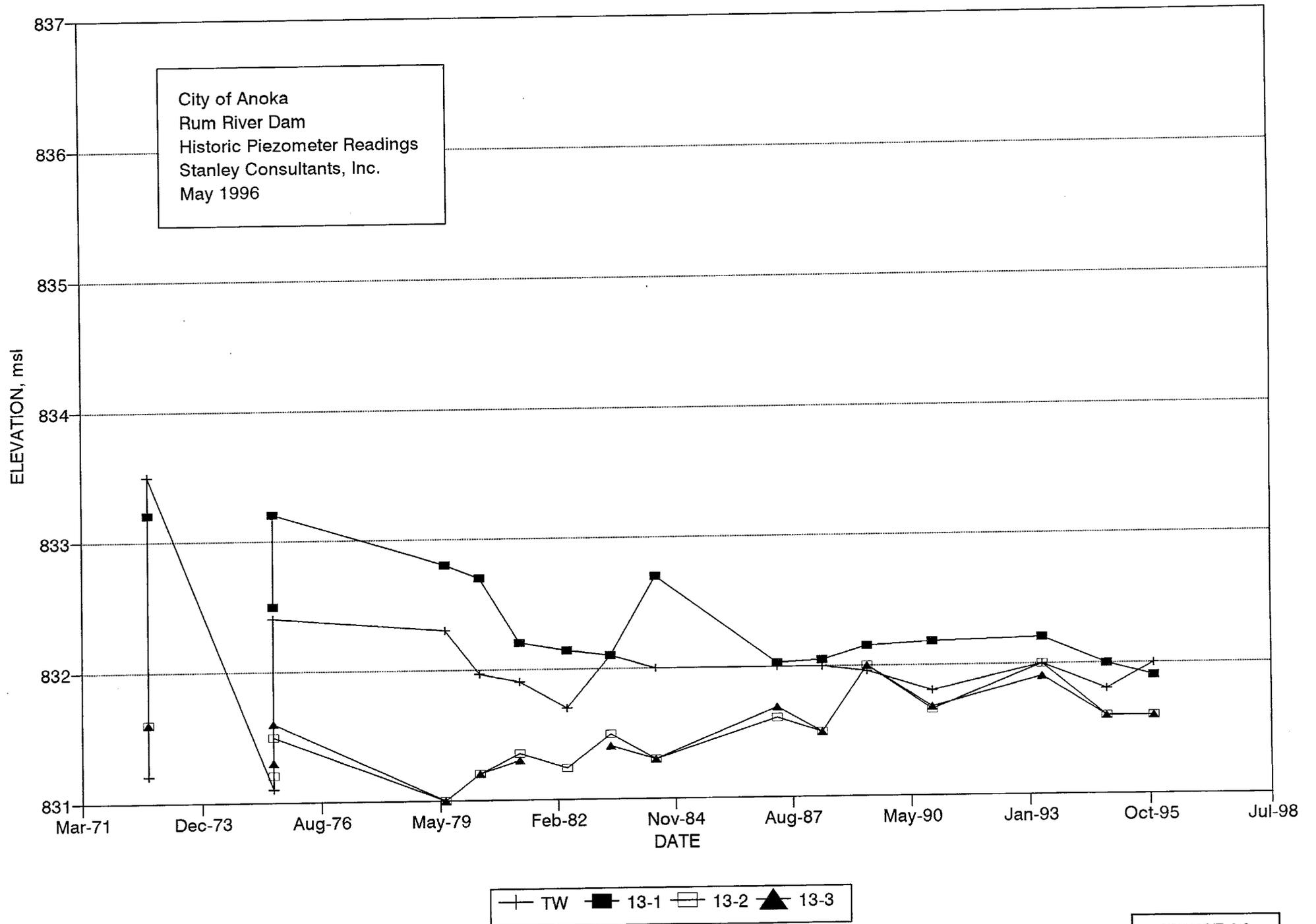
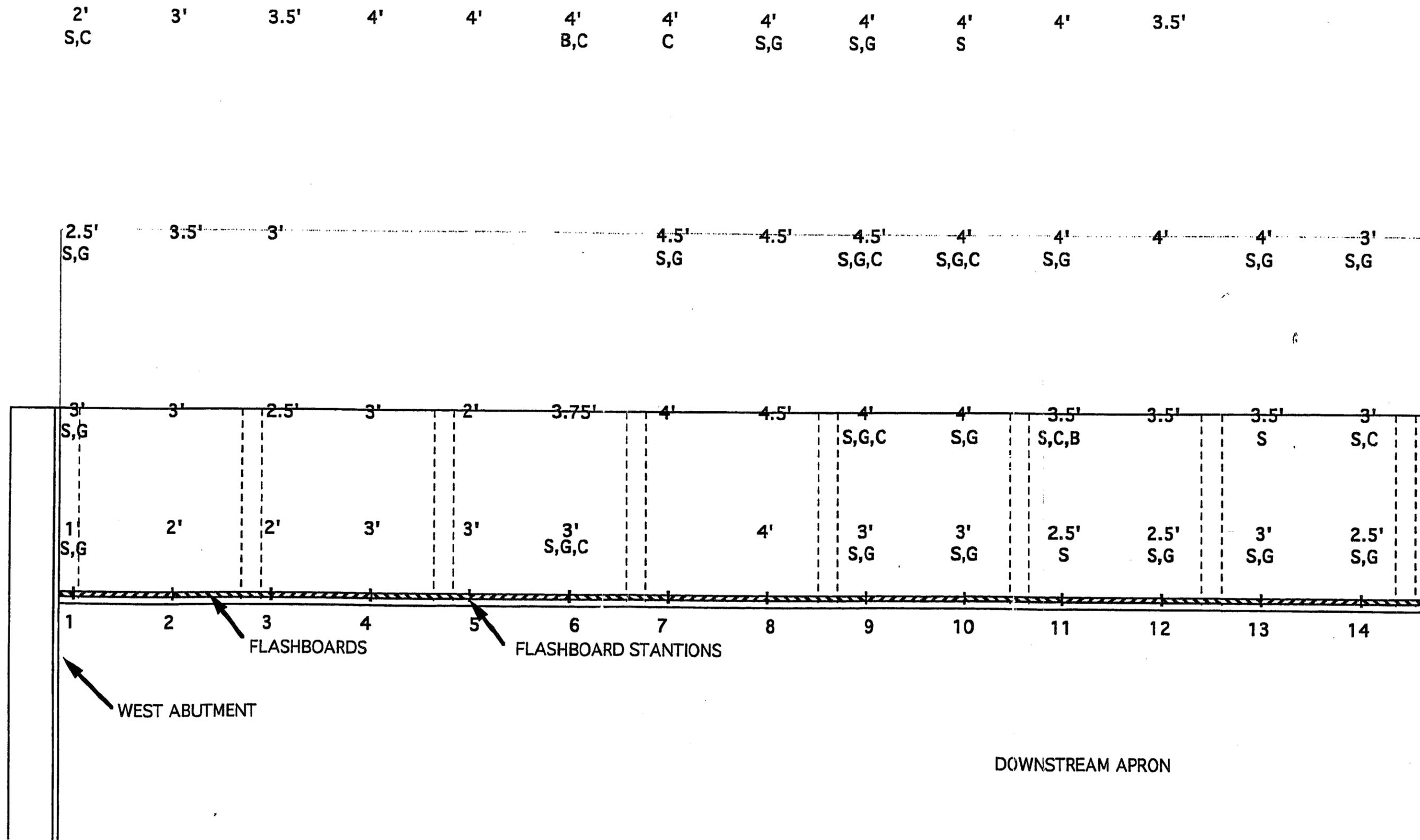


FIGURE 3-8



**WATER DEPTHS IN UPSTREAM RES
SPILLWAY APRON AREA 7-26-**

SECTION 4

RECOMMENDATIONS

4.1 DAM STRUCTURES

The surface and underwater inspections of the Rum River Dam revealed that the dam is generally in very good condition. Section 3 presented results of the inspection of the various dam components. Recommendations for repair of individual dam components are presented below. Table 4-1 summarizes the repairs and presents their estimated costs and recommended completion times.

- a. Warning signage on all project components should be repaired/replaced.
- b. The loose handrail at the downstream edge of the overlook and on the right abutment wall near upstream edge of overlook should be repaired.
- c. Construction joints in the left abutment and tainter gate structure should be resealed. Reference Photograph 17.
- d. The left and right downstream revetments should be cleared of trees and other vegetation. Regular dam maintenance should include removal of all future vegetation. Reference Photographs 12 and 13.
- e. The left abutment and tainter gate structure handrail/hoist paint system should be touched up as part of annual maintenance of the project. Reference Photographs 22 and 23.
- f. A new paint system should be applied to the tainter gate. Reference Photograph 22.
- g. Repair the surface concrete of the floodwall in the left abutment area. Reference Photograph 5.
- h. The soil area near the overlook should be filled. The City may wish to consider paving this area. Reference Photograph 11.
- i. The concrete/rock apron, located just downstream of the right bank overlook should be repaired.
- j. Adjust tainter gate lifting chains to provide level closure of the gate against the sill's base plate.

The majority of these recommended repairs can be completed by City personnel. It is however recommended that the new tainter gate paint system be completed by an experienced contractor. In addition, the City may wish to consider repairing the surface concrete of the former powerhouse piers located in the left abutment area. Consideration should be given to the historic value of the piers before proceeding with repairs. Reference Photograph 4.

TABLE 4-1. RECOMMENDED REPAIRS SUMMARY

DESCRIPTION	RECOMMENDED COMPLETION TIME	ESTIMATED COST, 1996 \$
a. Repair/Replace Warning Signs	1 year	400
b. Repair Handrail	1 year	1,500
c. Reseal Construction Joints	1 year	2,500
d. Remove Revetment Vegetation	Annually	1,500
e. Paint Handrail/Support Steel	Annually	1,100
f. Paint Tainter Gate	2 years	6,000
g. Repair Floodwall	2 years	1,600
h. Fill Area Adjacent to Overlook	3 years	1,000
i. Repair Apron D.S. of Overlook	3 years	1,000
j. Adjust Tainter Gate Lift Chains	1 year	1,500

4.2 MONITORING PROCEDURES

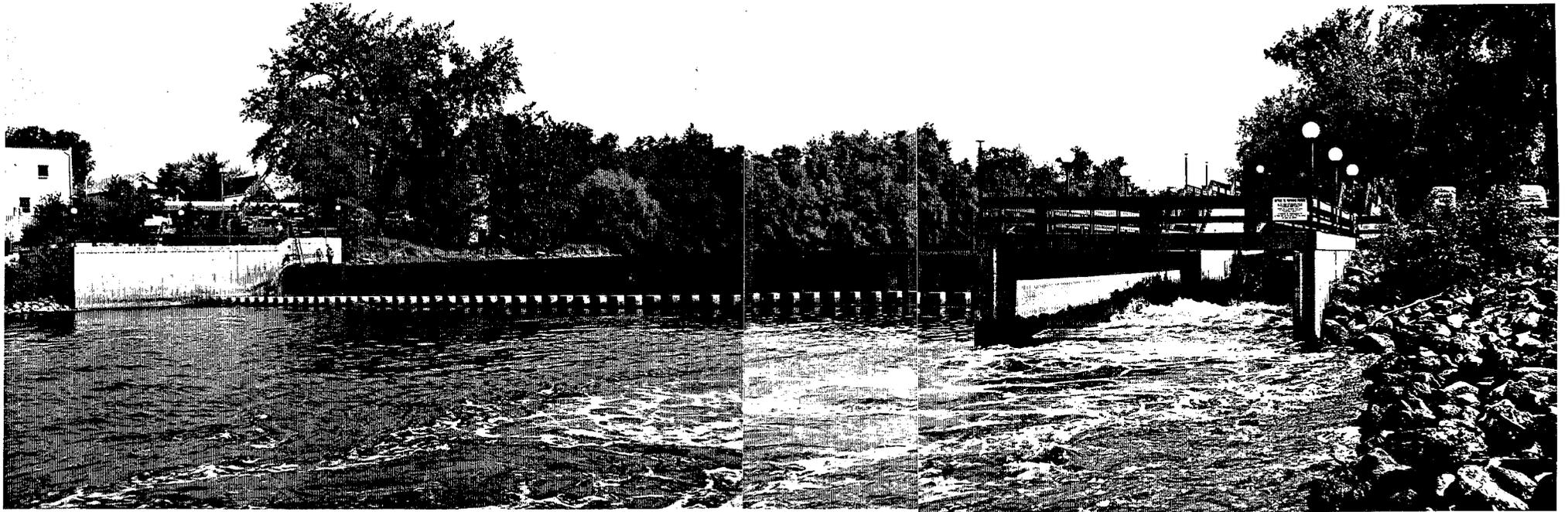
It is recommended that the following monitoring procedures be implemented for the Rum River Dam.

- a. Flush Piezometer 1-2 and test for accuracy. If high readings continue, perform investigation to determine cause of high uplift pressures.
- b. Continue to record and evaluated piezometers on an annual basis. Increase readings on Piezometers 7-2 and 7-3 to once per quarter.
- c. Continue to perform sounding program and evaluate results once every five years.
- d. The open joint in the right abutment wall at the downstream edge of overlook area should be monitored on an annual basis. Monitoring should include both physical measurement and photography. Reference Photographs 8 through 10.
- e. Settlement of the right abutment's on-grade concrete slab should be monitored on an annual basis. Monitoring should include both physical measurement and photography. Reference Photograph 7.
- f. The stilling basin voids should continue to be monitored.
- g. The deteriorated concrete on the overflow spillway should continue to be monitored but no repairs are presently recommended. Specific areas include Pier 4, Pier 8, Pier 9, and Bay 10.
- h. Expansion joint material/sealant on the overflow spillway should continue to be monitored and replaced if warranted.
- i. The three locations on the left revetment walkway currently showing signs of settlement should continue to be monitored on an annual basis. Reference Photograph 14.
- j. The seep observed on the left bank, should continue to be monitored. Reference Photograph 15.
- k. The right downstream revetment should continue to be monitored for loss of riprap protection. Reference Photograph 12.
- l. Baffle blocks 1, 2, 3, 4, 8, 17, 41, 42, 43, and 47 should continue to be monitored during periodic inspections.
- m. Continue to monitor tainter gate alignment/leakage.

APPENDIX A

PHOTOGRAPHS

- Photograph 1. Downstream view of dam.
- Photograph 2. Left bank of upstream pool.
- Photograph 3. Right bank of upstream pool.
- Photograph 4. Downstream view of left abutment area.
- Photograph 5. Downstream view of "floodwall".
- Photograph 6. Overflow spillway crest and right abutment.
- Photograph 7. Top of right overlook structure. Note settlement at edge.
- Photograph 8. Joint separation at right overlook structure.
- Photograph 9. Closeup view of joint separation at right overlook structure.
- Photograph 10. Downstream end of overlook. Note separation at joint.
- Photograph 11. Right abutment area. Note loss of soil near slab.
- Photograph 12. Downstream right bank.
- Photograph 13. Downstream left bank.
- Photograph 14. Typical settlement on downstream left walkway.
- Photograph 15. Seepage along downstream left bank.
- Photograph 16. Right face of right tainter gate pier/guidewall.
- Photograph 17. Left face of right tainter gate pier.
- Photograph 18. Right face of left tainter gate pier/abutment.
- Photograph 19. Upstream portion of right tainter gate pier.
- Photograph 20. Upstream portion of left tainter gate pier.
- Photograph 21. Pedestrian walkway.
- Photograph 22. Upstream view of tainter gate and hoist system.
- Photograph 23. Downstream view of tainter gate and left abutment.
- Photograph 24. Downstream view of closed tainter gate. Note leakage.
- Photograph 25. Tainter gate stilling basin in dewatered condition.
- Photograph 26. Overflow spillway crest.
- Photograph 27. Right portion of stilling basin (dewatered). Note absence of scour.
- Photograph 28. Left portion of stilling basin (dewatered). Note absence of scour.
- Photograph 29. Right abutment wall (dewatered). Note absence of scour.
- Photograph 30. Pier 1 and Bay 1 apron.
- Photograph 31. Right face of Pier 2.
- Photograph 32. Left face of Pier 2 & Bay 2 apron.
- Photograph 33. Right face of Pier 3.
- Photograph 34. Left face of Pier 3.
- Photograph 35. Right face of Pier 4.
- Photograph 36. Left face of Pier 4. Note leakage.
- Photograph 37. Closeup view of Bay 4 leakage.
- Photograph 37. Right face of Pier 5 & Bay 4 apron.
- Photograph 38. Left face of Pier 5 & Bay 5 apron.
- Photograph 40. Right face of Pier 6 & Bay 5 apron.
- Photograph 41. Left face of Pier 6 & Bay 6 apron.
- Photograph 42. Right face of Pier 7 & Bay 6 apron.
- Photograph 43. Left face of Pier 7 & Bay 7 apron.
- Photograph 44. Right face of Pier 8 & Bay 7 apron.
- Photograph 45. Left face of Pier 8 & Bay 8 apron.
- Photograph 46. Closeup view of Pier 8 unsound concrete.
- Photograph 47. Right face of Pier 9 & Bay 8 apron.
- Photograph 48. Left face of Pier 9 & Bay 9 apron.
- Photograph 49. Right face of Pier 10 & Bay 9 apron.
- Photograph 50. Left face of Pier 10 & Bay 10 apron. Note leakage.
- Photograph 51. Right face of Pier 11 & Bay 10 apron.
- Photograph 52. Left face of Pier 11 & Bay 11 apron.
- Photograph 53. Right face of Pier 12 & Bay 11 apron.
- Photograph 54. Left face of Pier 12 & Bay 12 apron.
- Photograph 55. Right face of Pier 13 & Bay 12 apron.



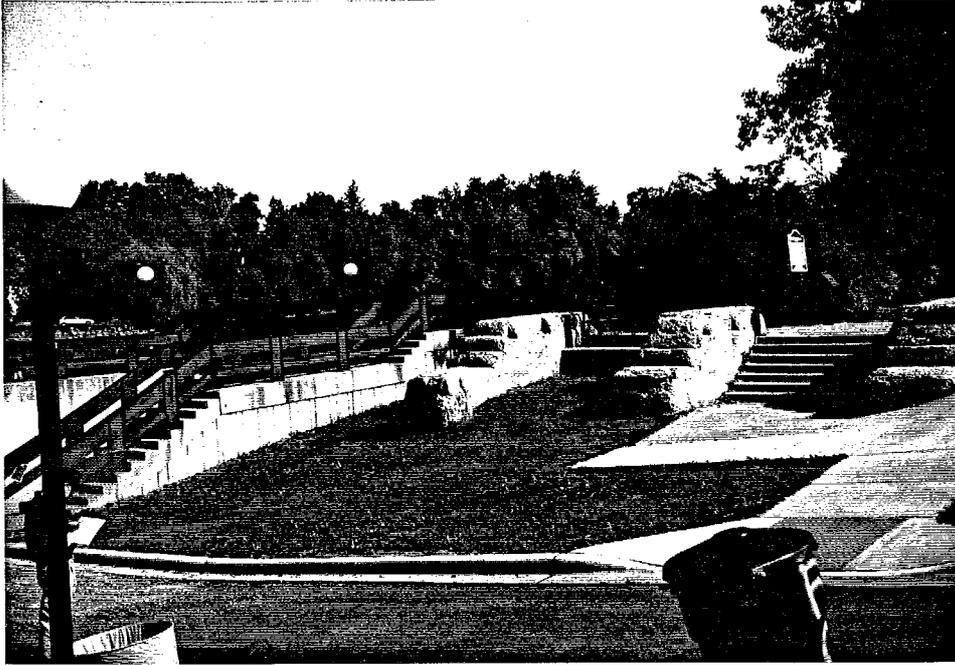
Photograph 1. Downstream view of dam.



Photograph 2. Left bank of upstream pool.



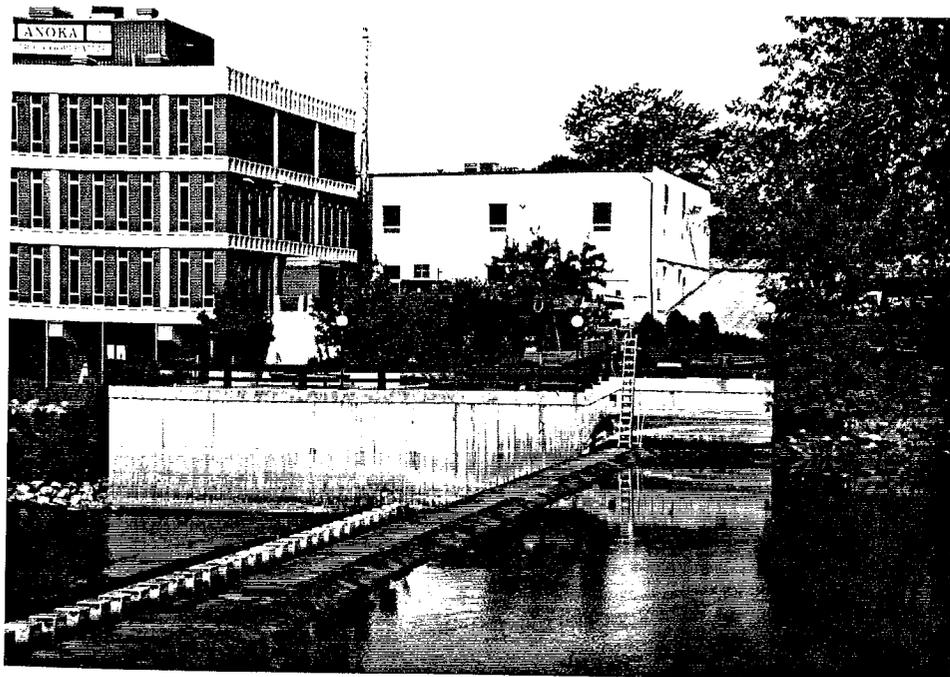
Photograph 3. Right bank of upstream pool.



Photograph 4. Downstream view of left abutment area.



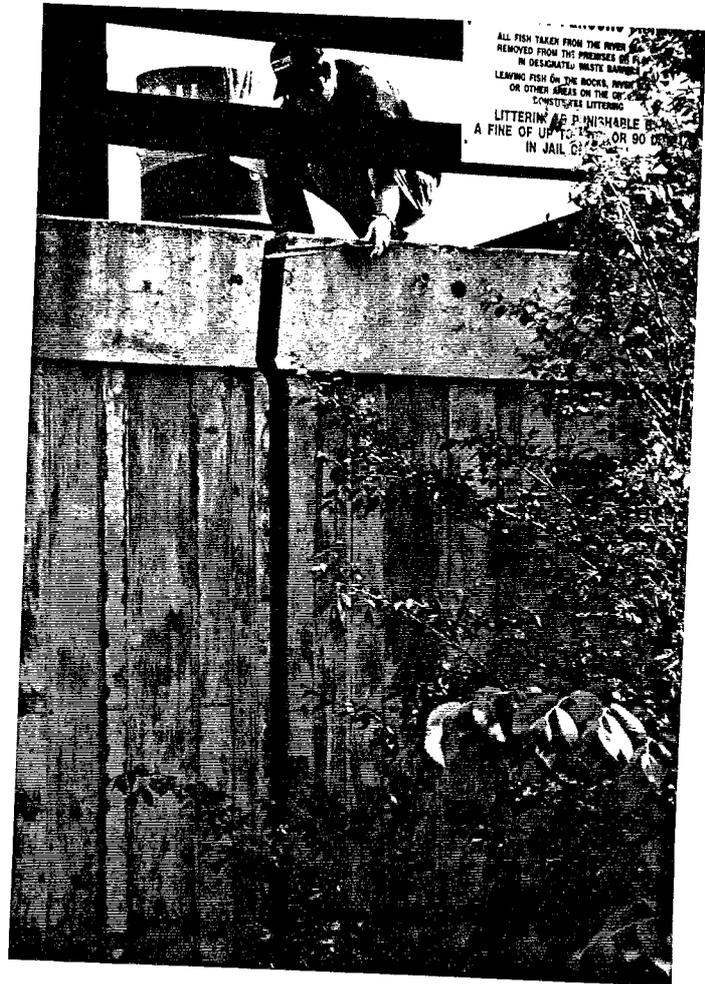
Photograph 5. Downstream view of "floodwall".



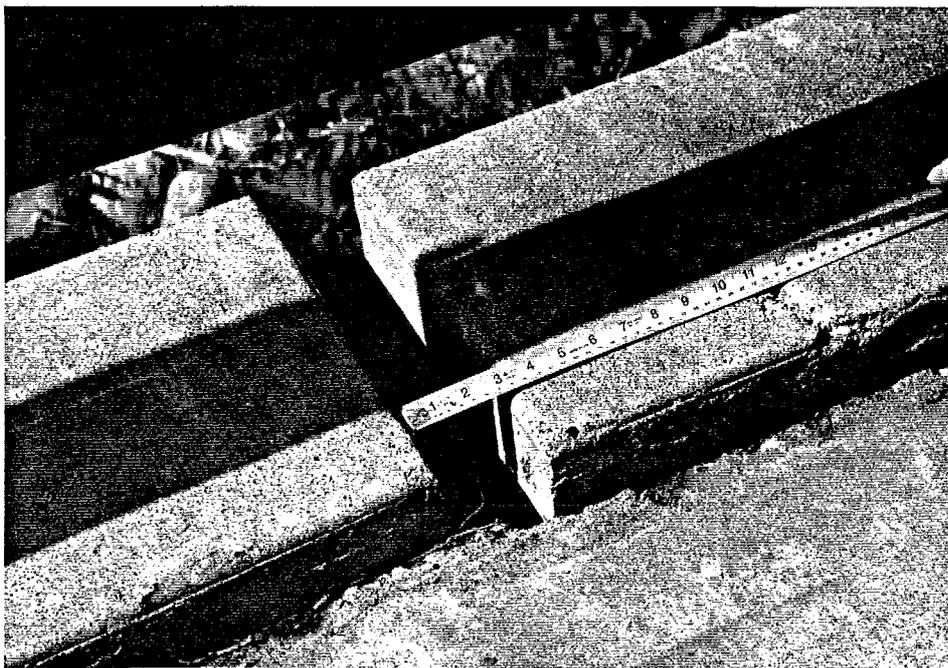
Photograph 6. Overflow spillway crest and right abutment.



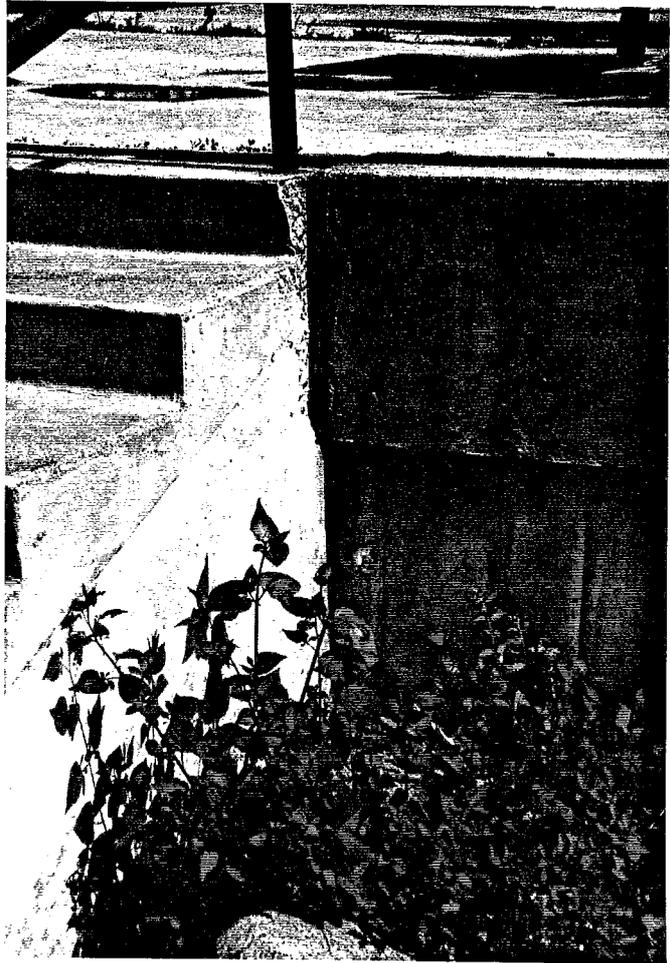
Photograph 7. Top of right overlook structure. Note settlement at edge.



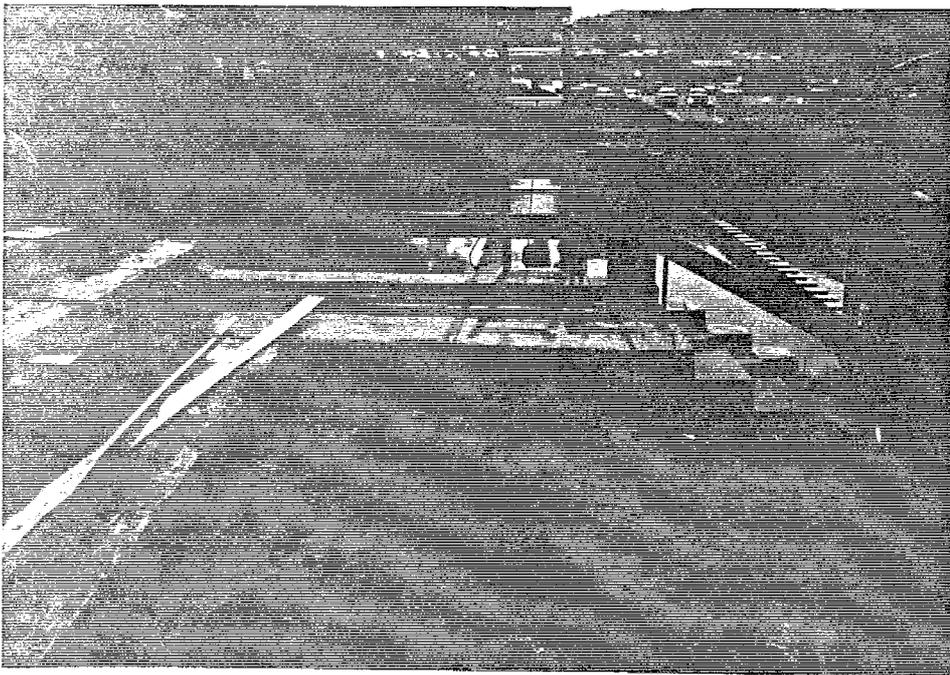
Photograph 8. Joint separation at right overlook structure.



Photograph 9. Closeup view of joint separation at right overlook structure.



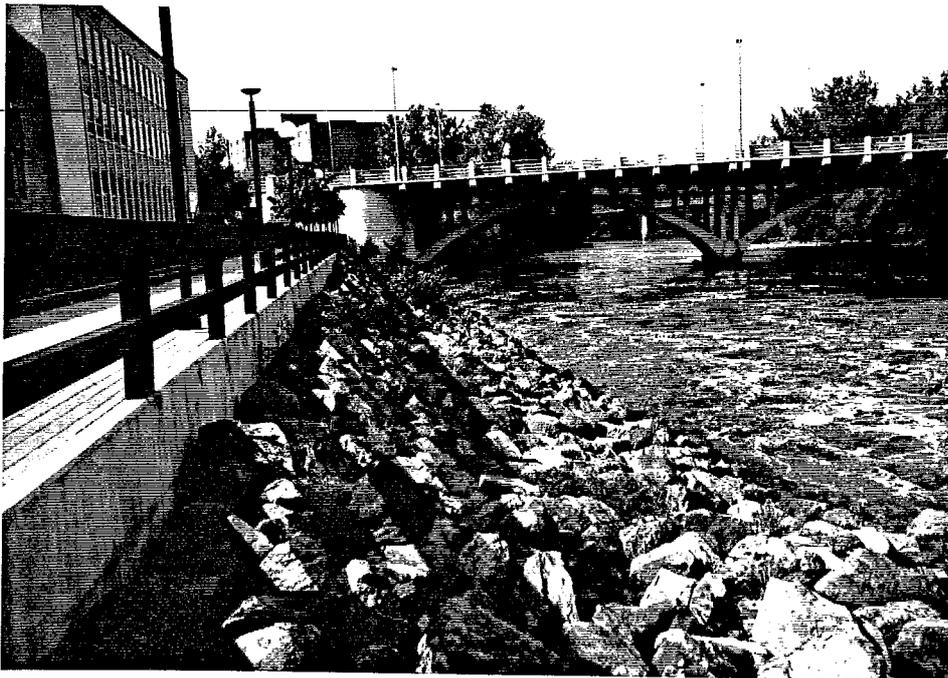
Photograph 10. Downstream end of overlook.
Note separation at joint.



Photograph 11. Right abutment area. Note loss of soil near slab.



Photograph 12. Downstream right bank.



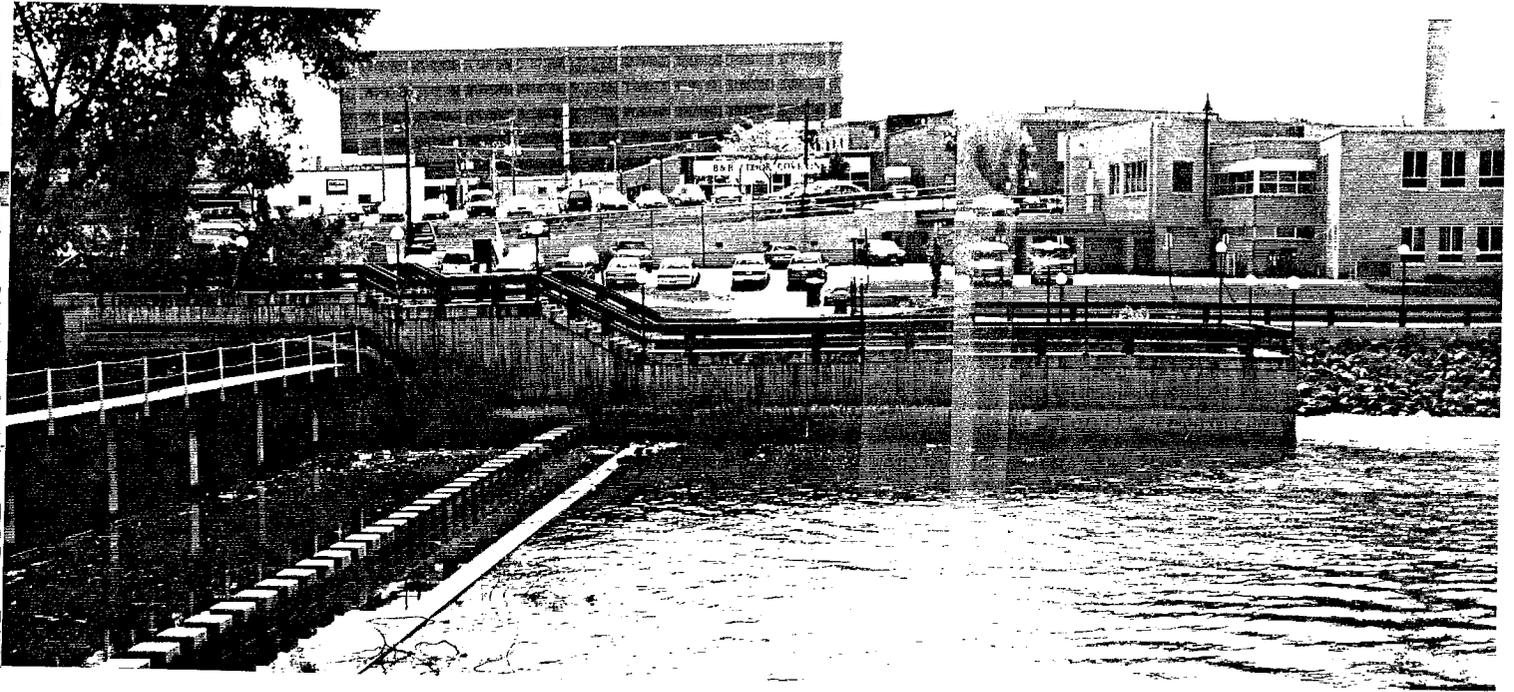
Photograph 13. Downstream left bank.



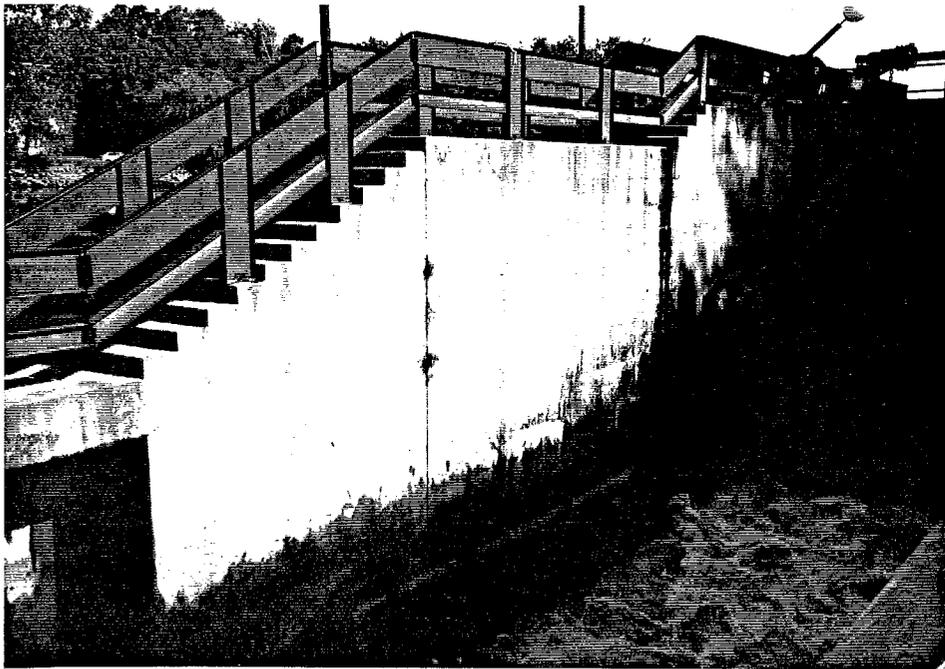
Photograph 14. Typical settlement on downstream left walkway.



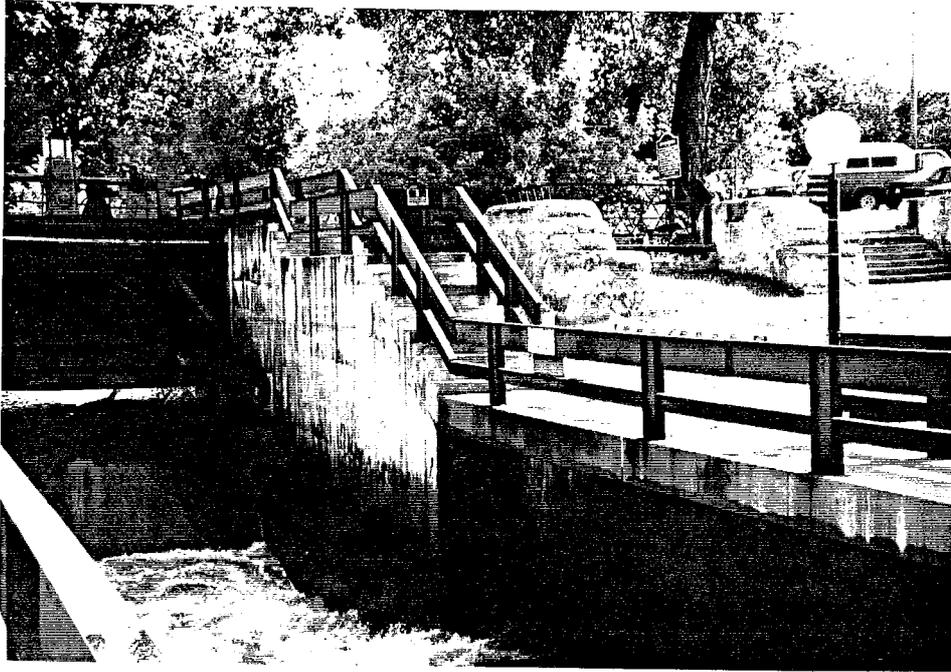
Photograph 15. Seepage along downstream left bank.



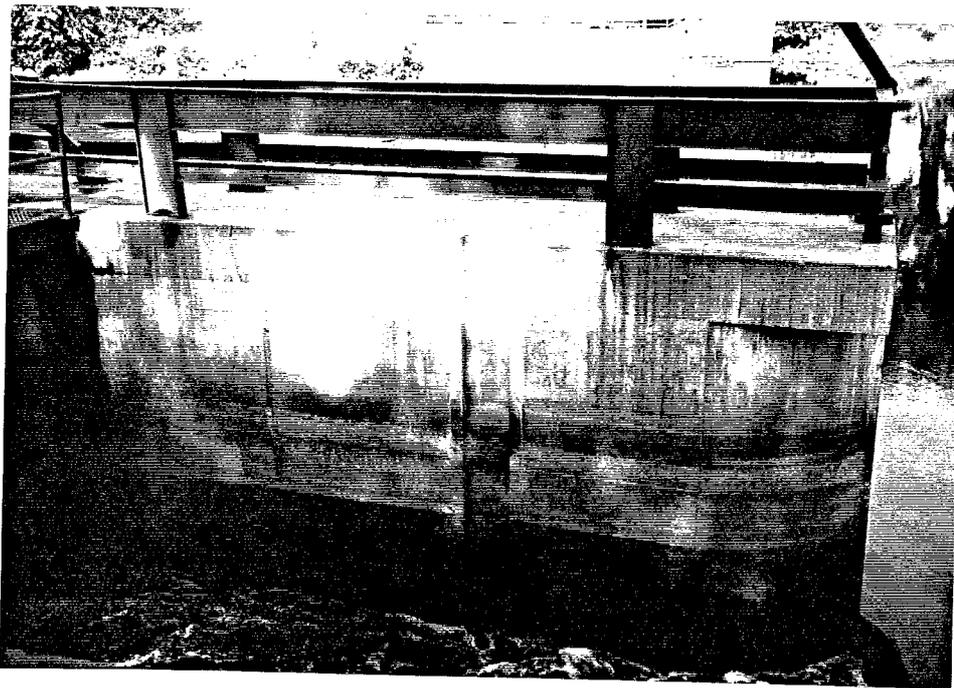
Photograph 16. Right face of right tainter gate pier/guidewall.



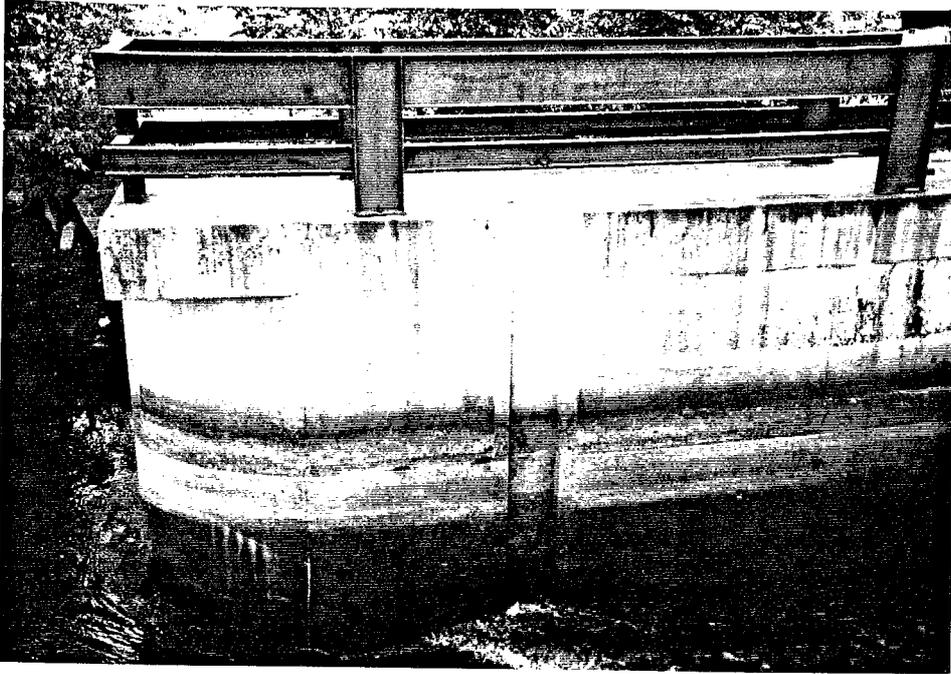
Photograph 17. Left face of right tainter gate pier.



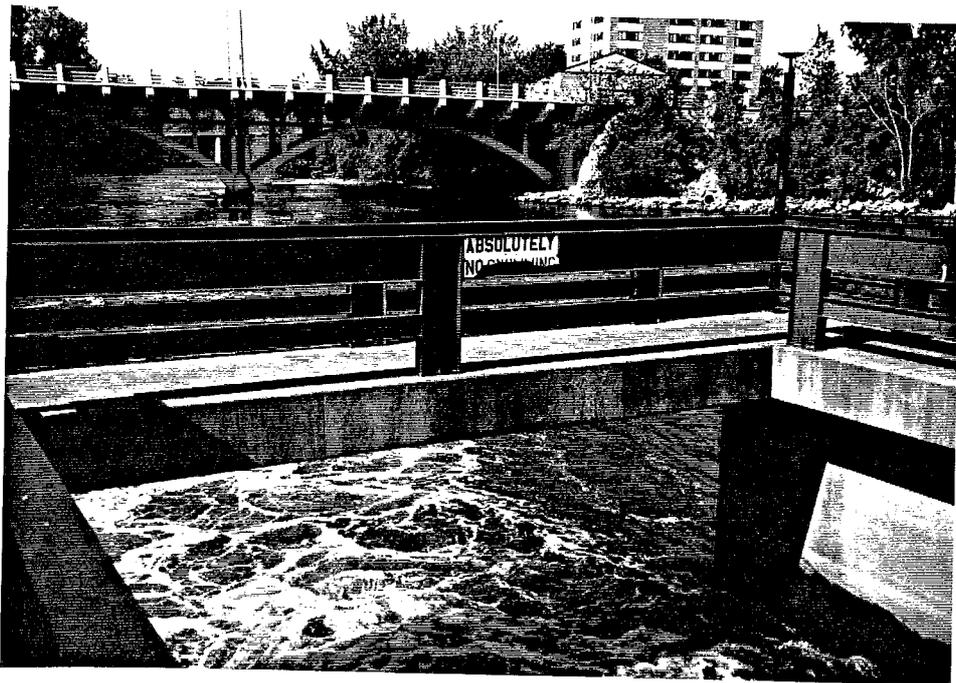
Photograph 18. Right face of left tainter gate pier/abutment.



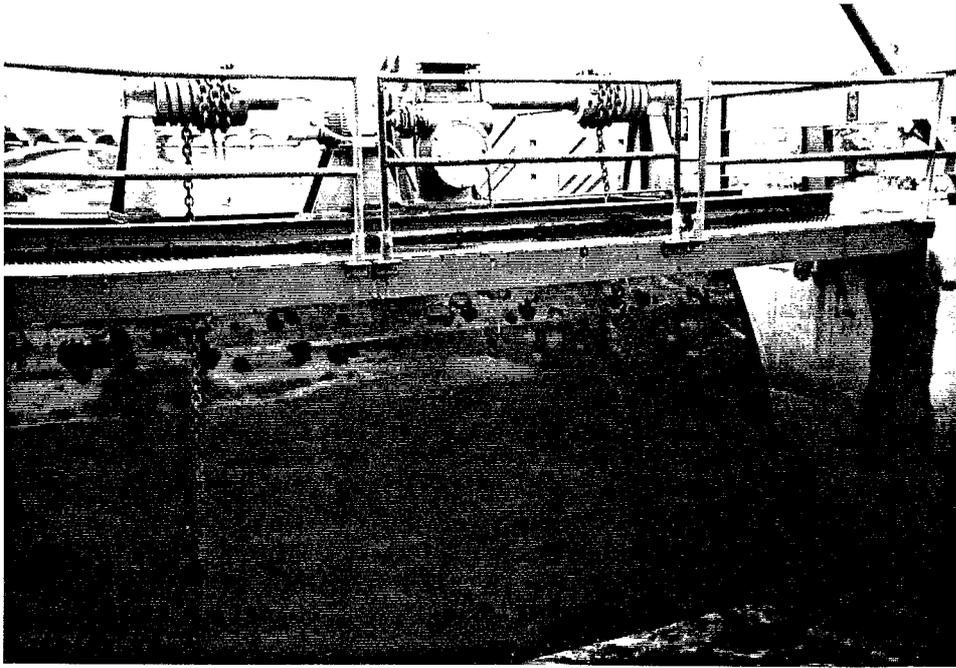
Photograph 19. Upstream portion of right tainter gate pier.



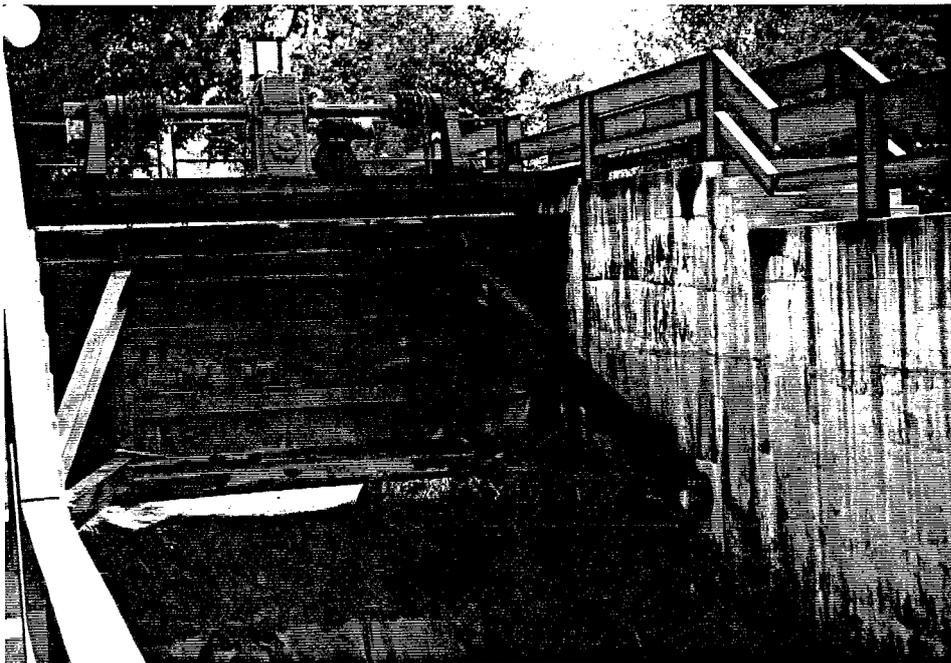
Photograph 20. Upstream portion of left tainter gate pier.



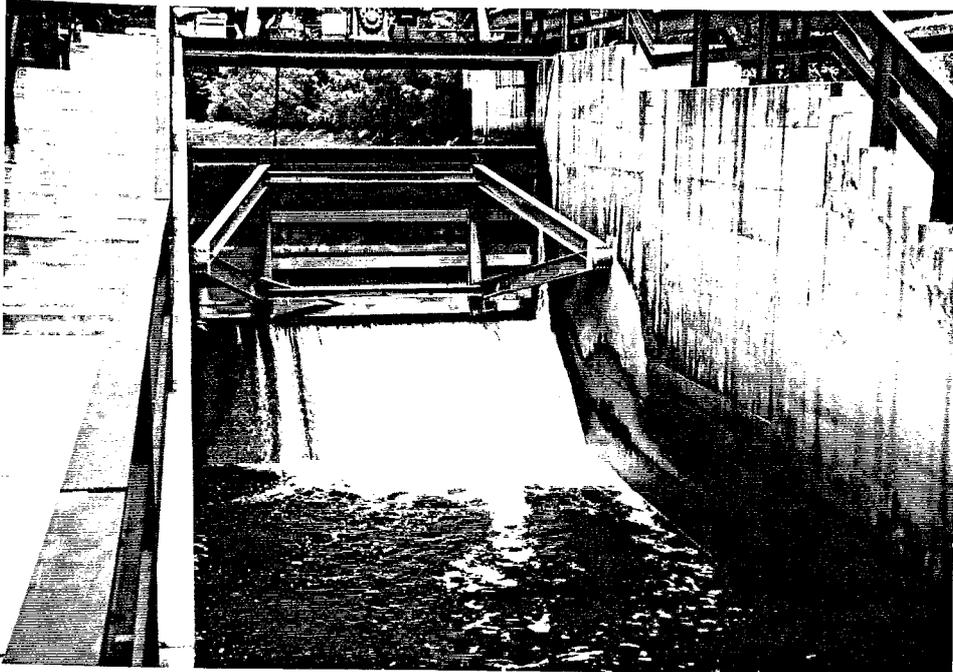
Photograph 21. Pedestrian walkway.



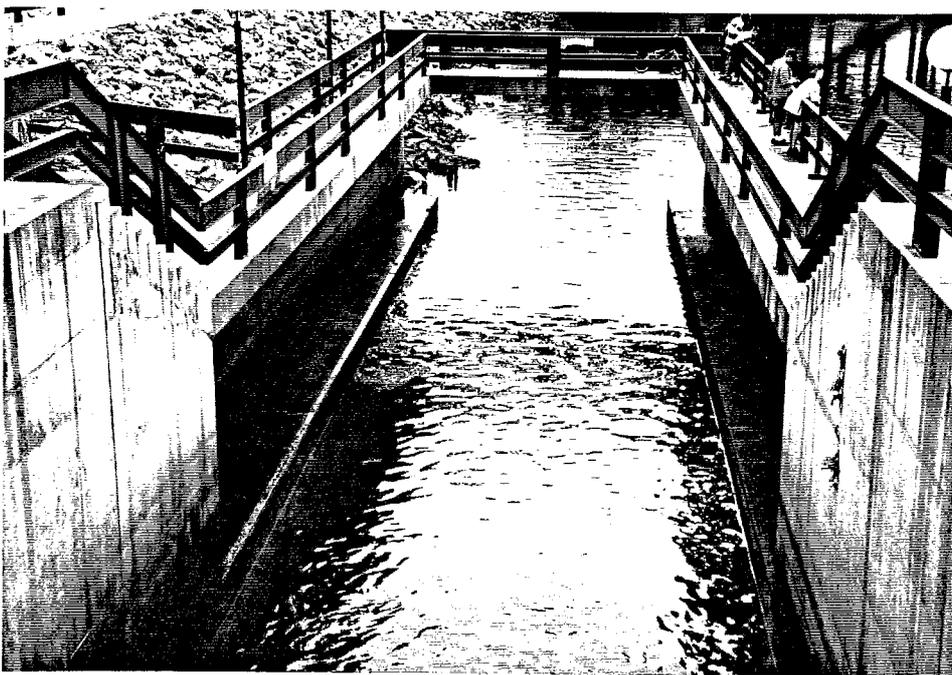
Photograph 22. Upstream view of tainter gate and hoist system.



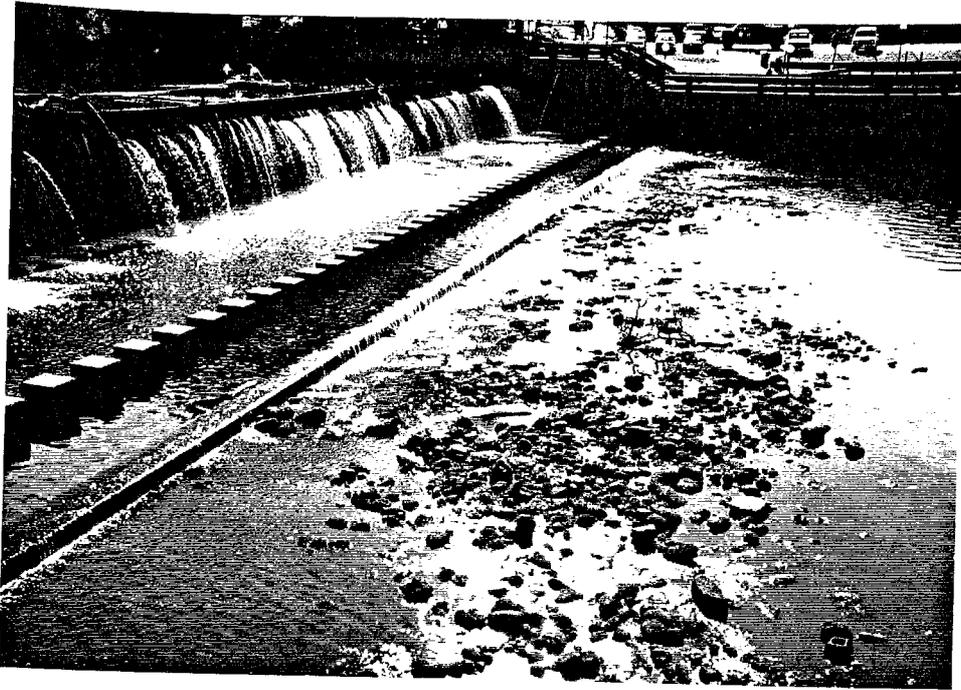
Photograph 23. Downstream view of tainter gate and left abutment.



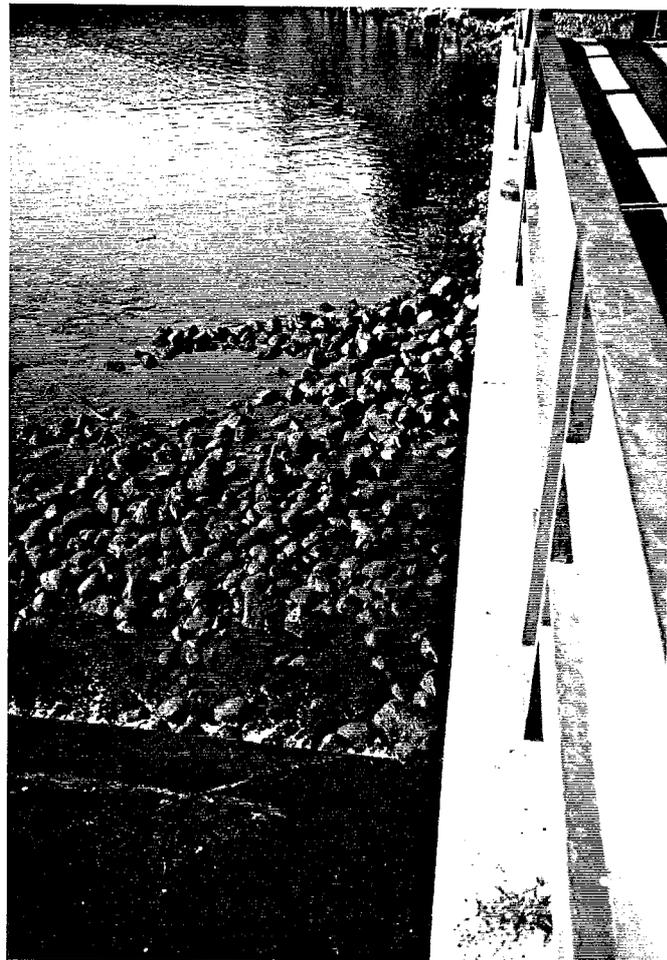
Photograph 24. Downstream view of closed tainter gate. Note leakage.



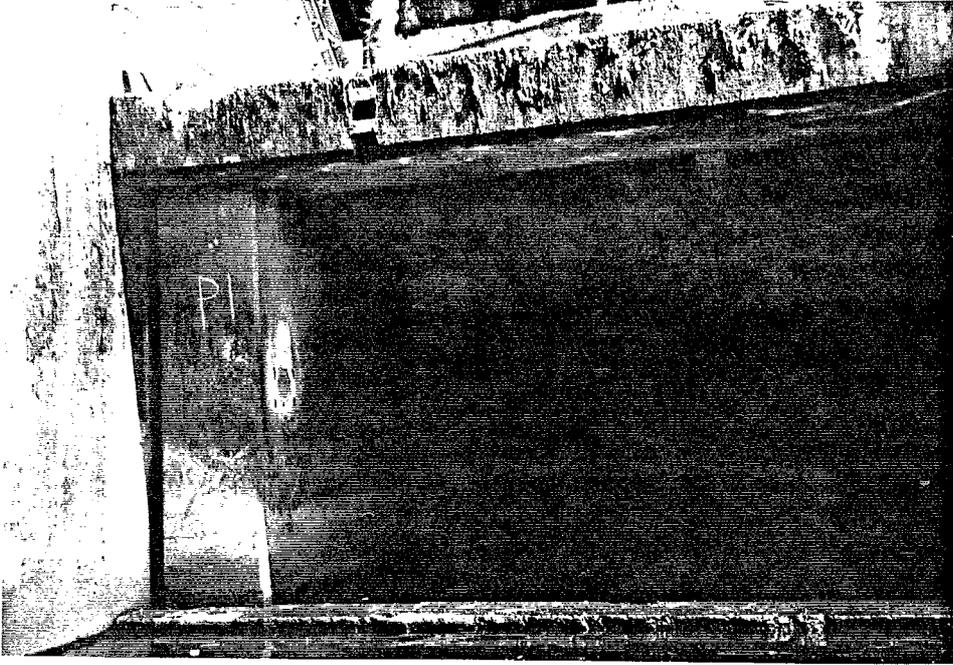
Photograph 25. Tainter gate stilling basin in dewatered condition.



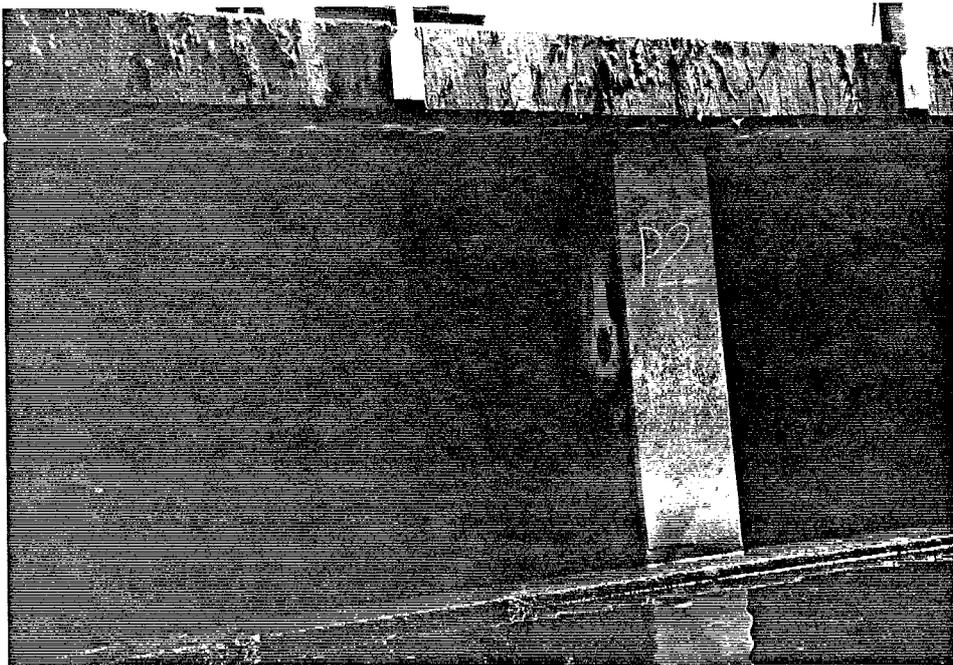
Photograph 28. Left portion of stilling basin (dewatered). Note absence of scour.



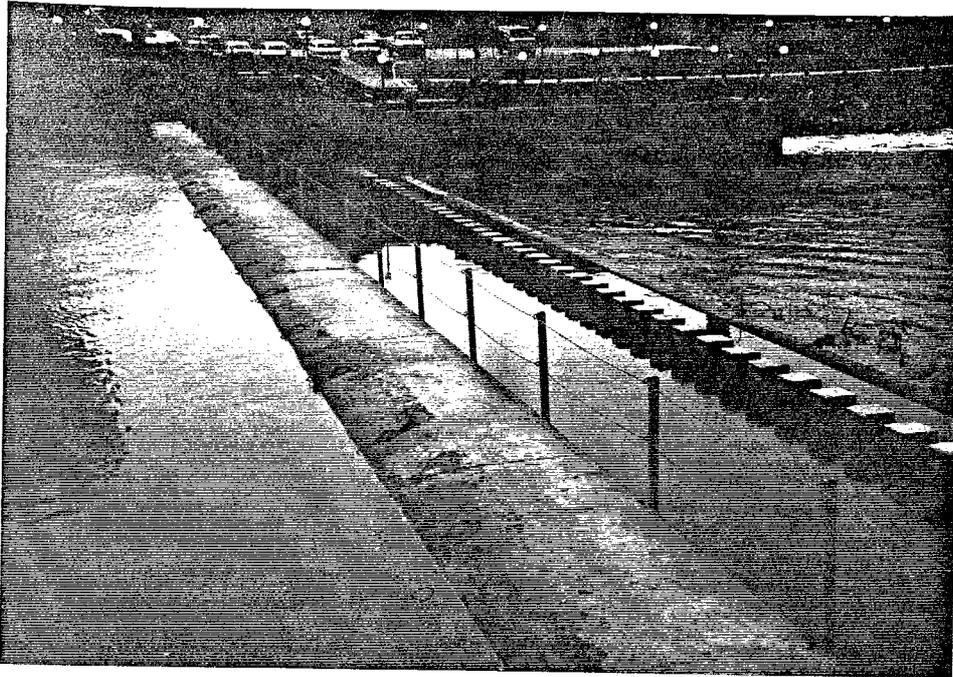
Photograph 29. Right abutment wall (dewatered).
Note absence of scour.



Photograph 30. Pier 1 and Bay 1 apron.



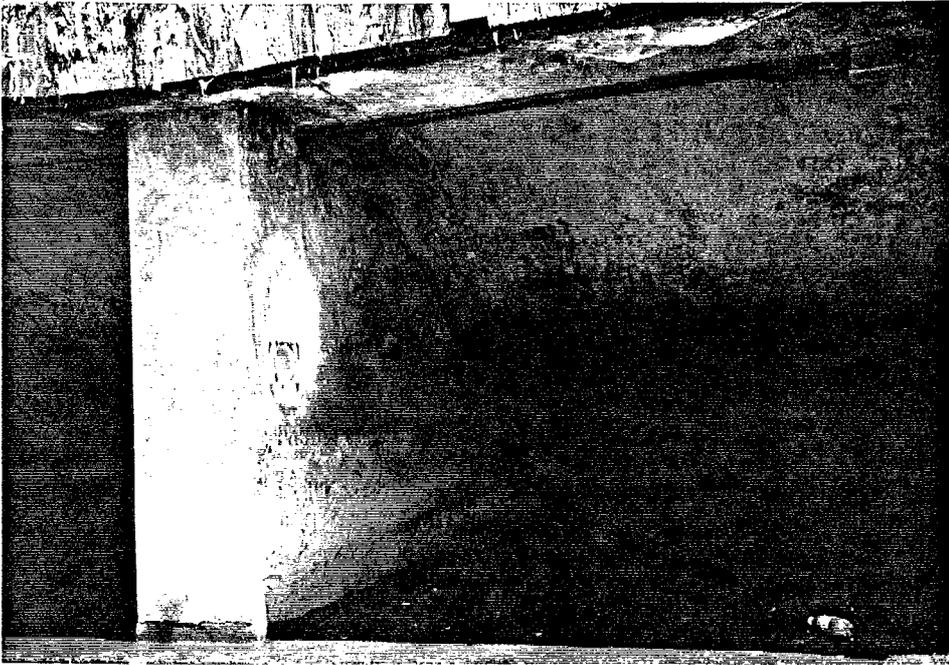
Photograph 31. Right face of Pier 2.



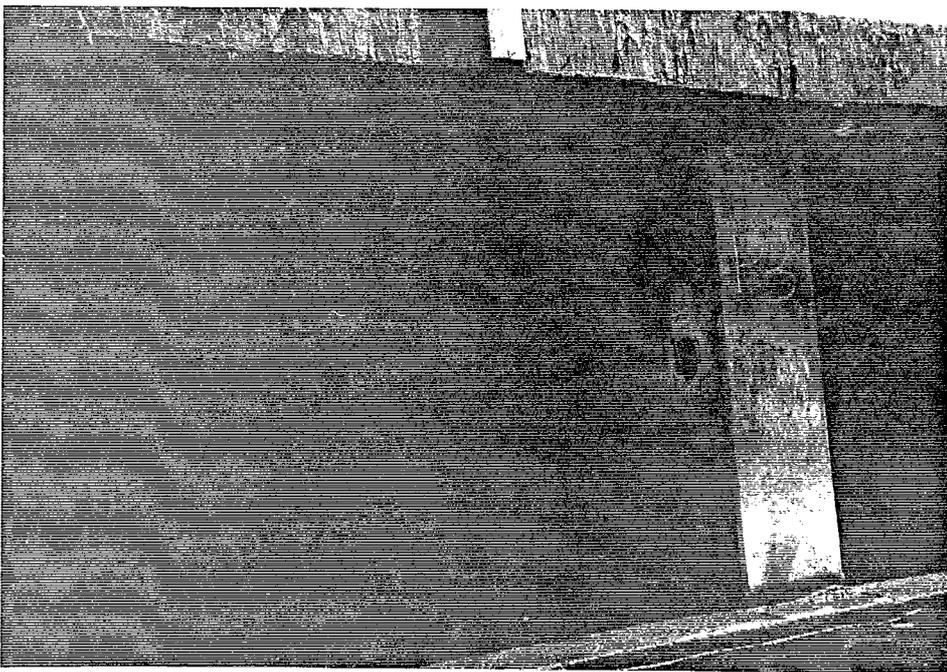
Photograph 26. Overflow spillway crest.



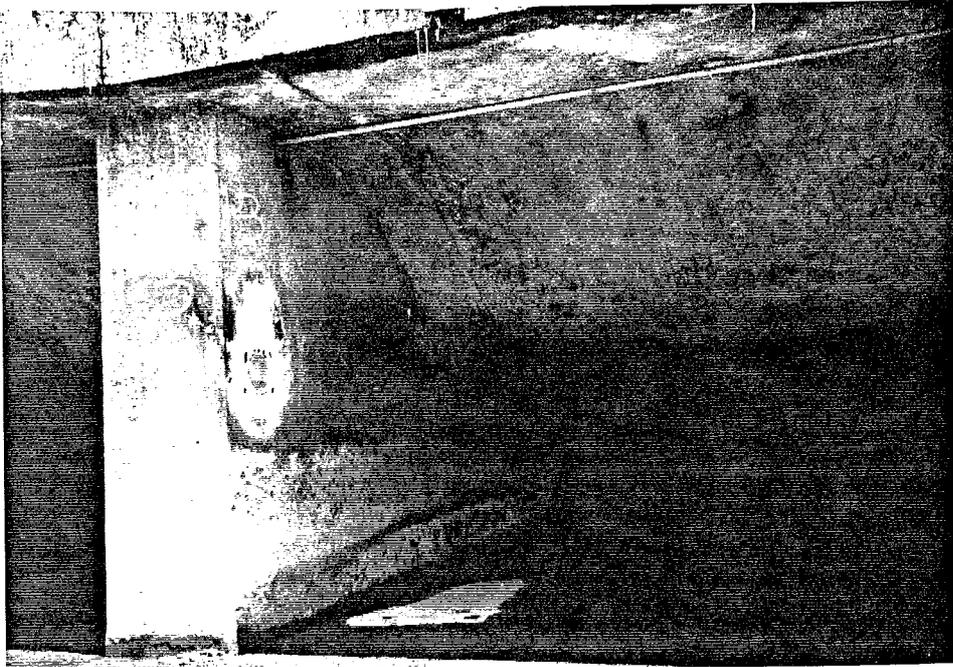
Photograph 27. Right portion of stilling basin (dewatered). Note absence of scour.



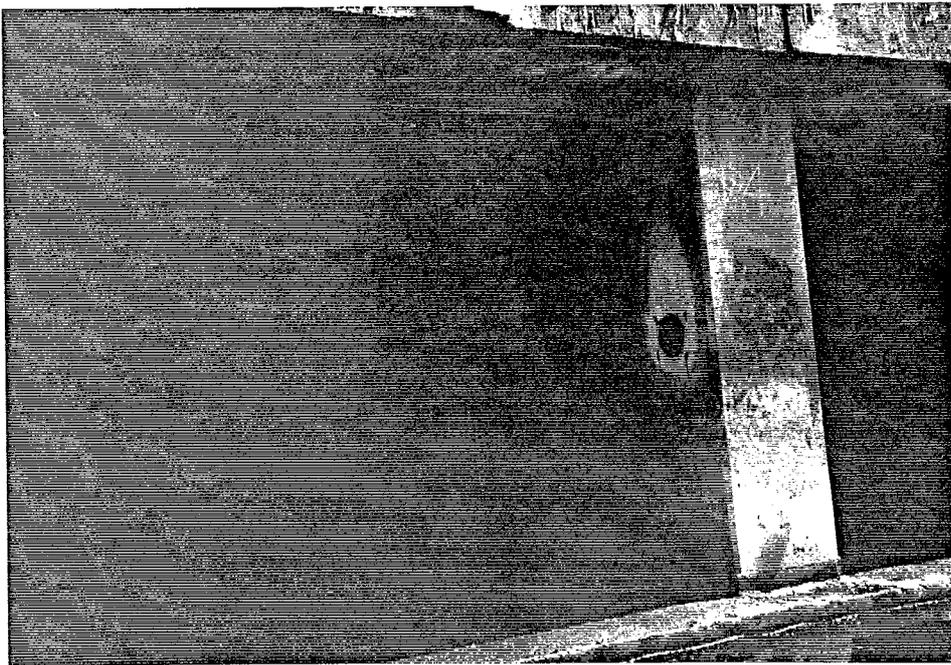
Photograph 32. Left face of Pier 2 & Bay 2 apron.



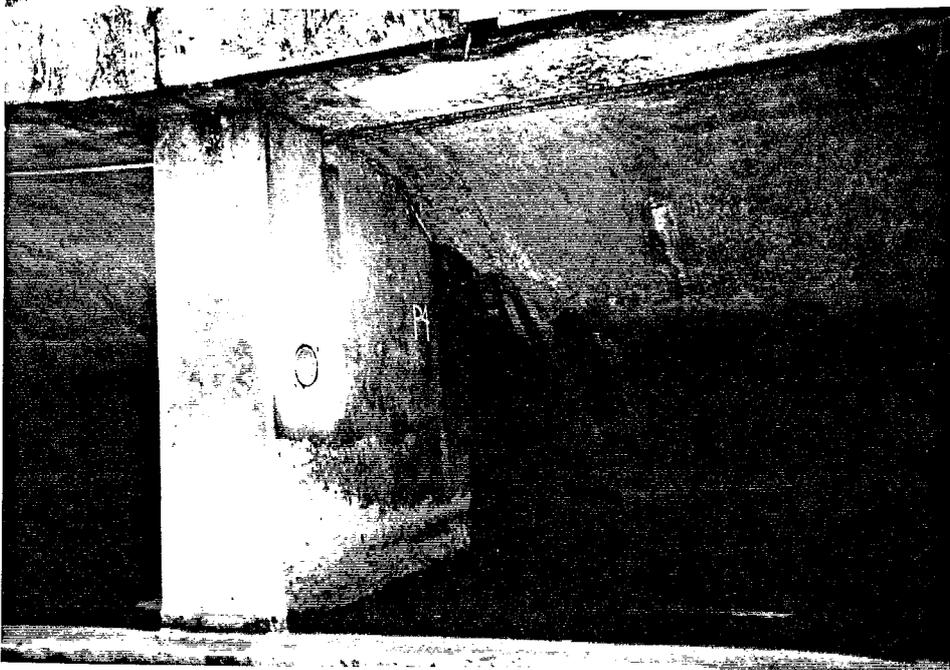
Photograph 33. Right face of Pier 3.



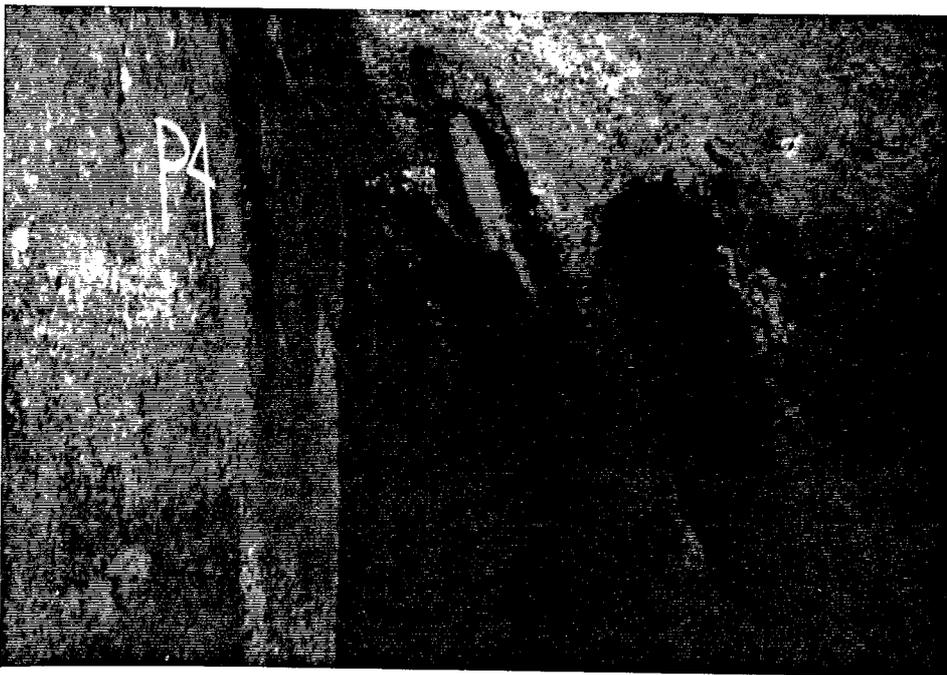
Photograph 34. Left face of Pier 3.



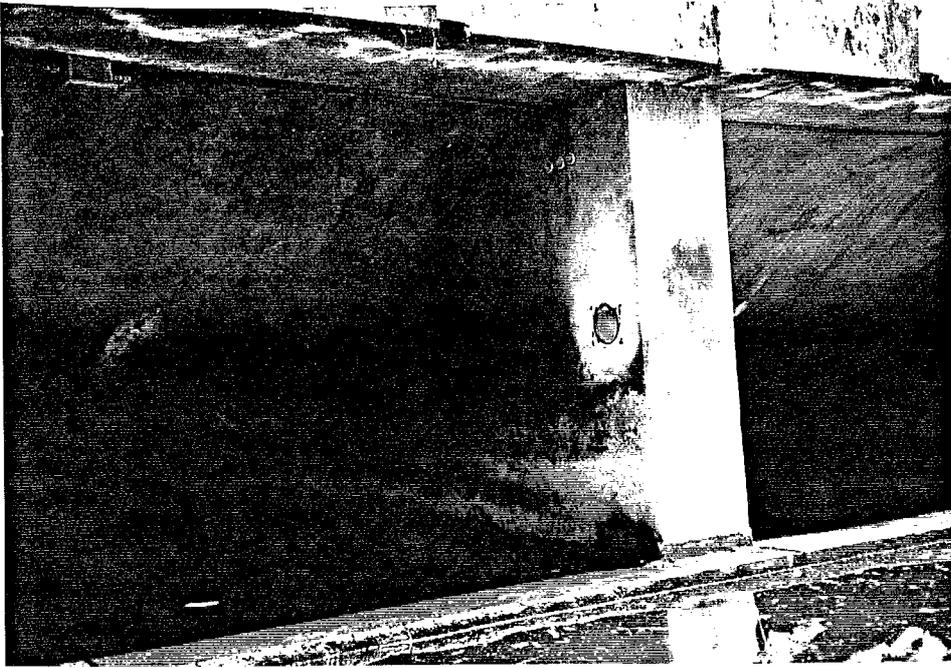
Photograph 35. Right face of Pier 4.



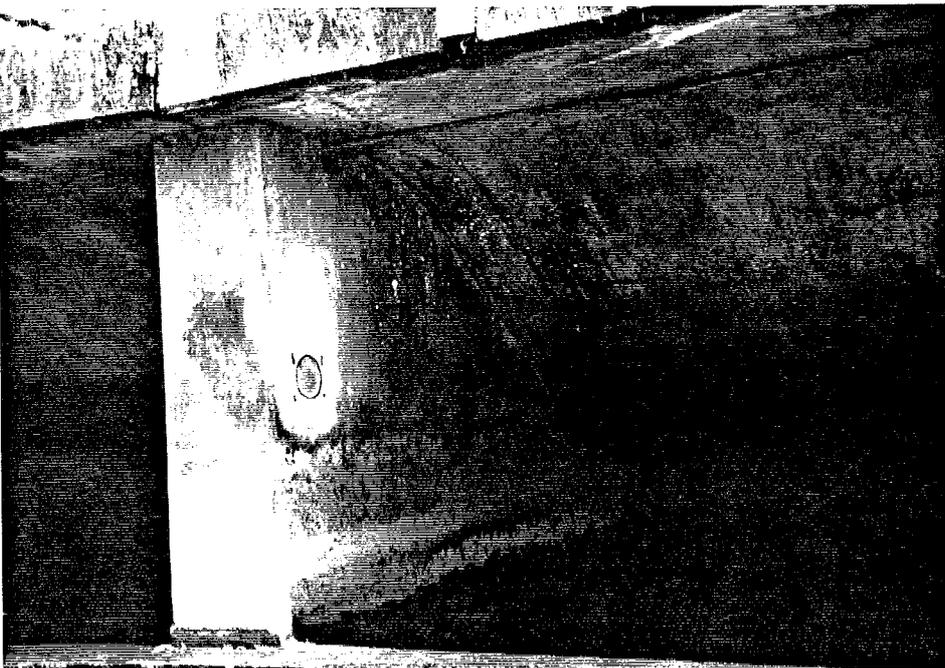
Photograph 36. Left face of Pier 4. Note leakage.



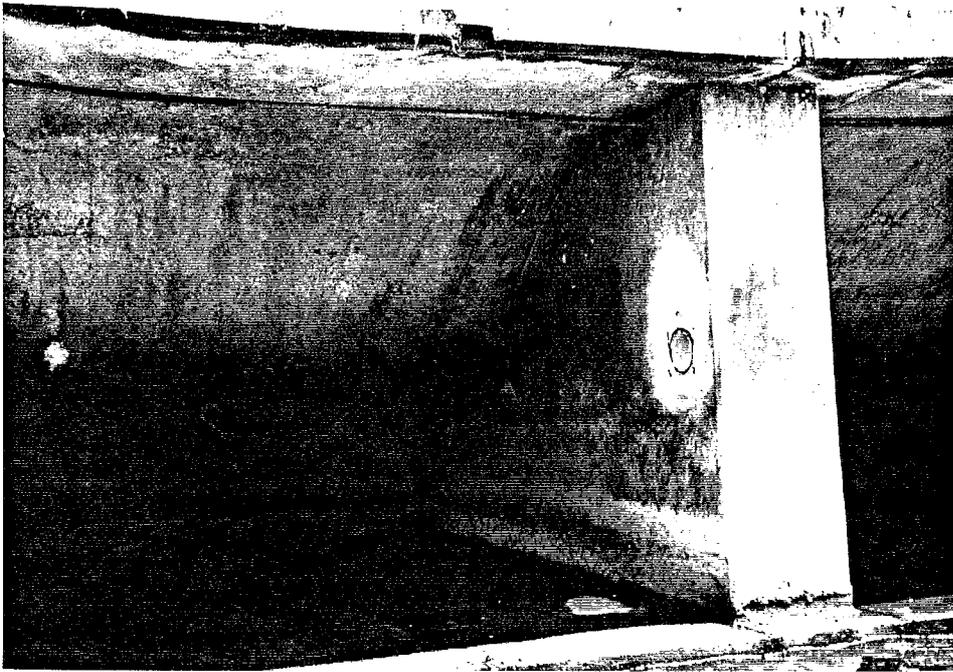
Photograph 37. Closeup view of Bay 4 leakage.



Photograph 37. Right face of Pier 5 & Bay 4 apron.



Photograph 38. Left face of Pier 5 & Bay 5 apron.



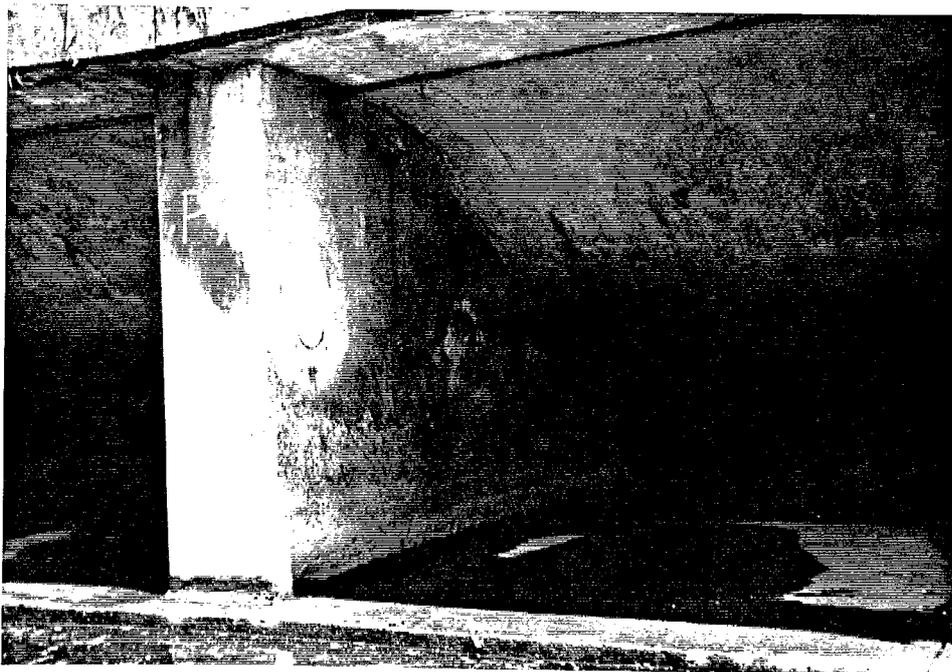
Photograph 40. Right face of Pier 6 & Bay 5 apron.



Photograph 41. Left face of Pier 6 & Bay 6 apron.



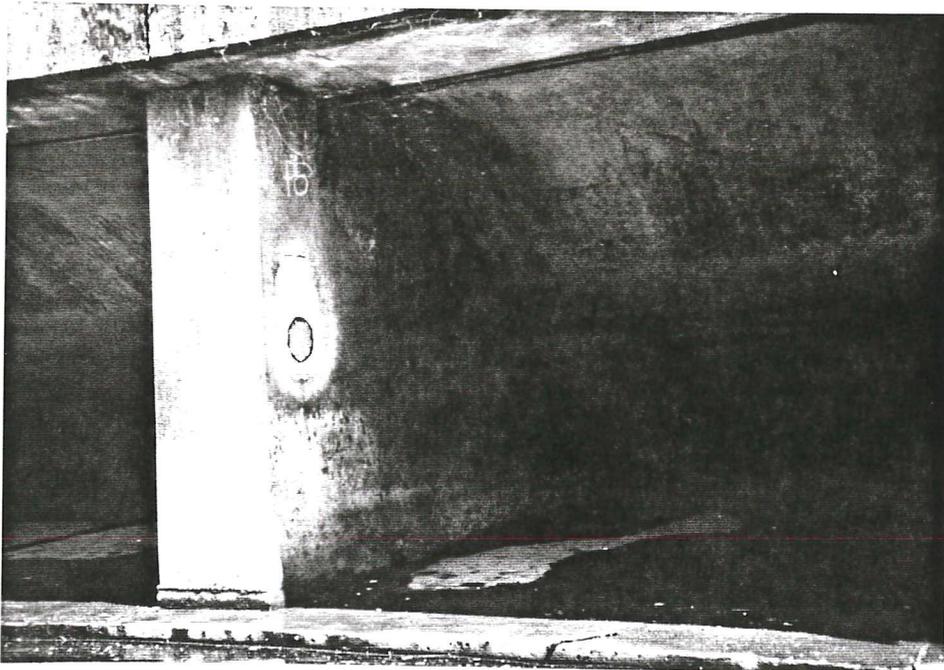
Photograph 42. Right face of Pier 7 & Bay 6 apron.



Photograph 43. Left face of Pier 7 & Bay 7 apron.



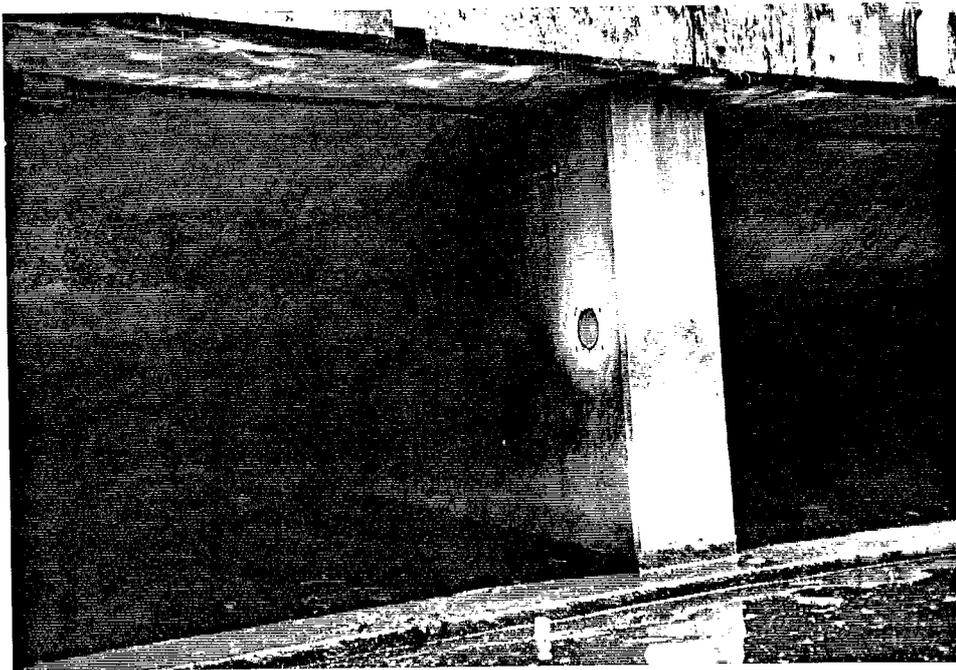
Photograph 44. Right face of Pier 8 & Bay 7 apron.



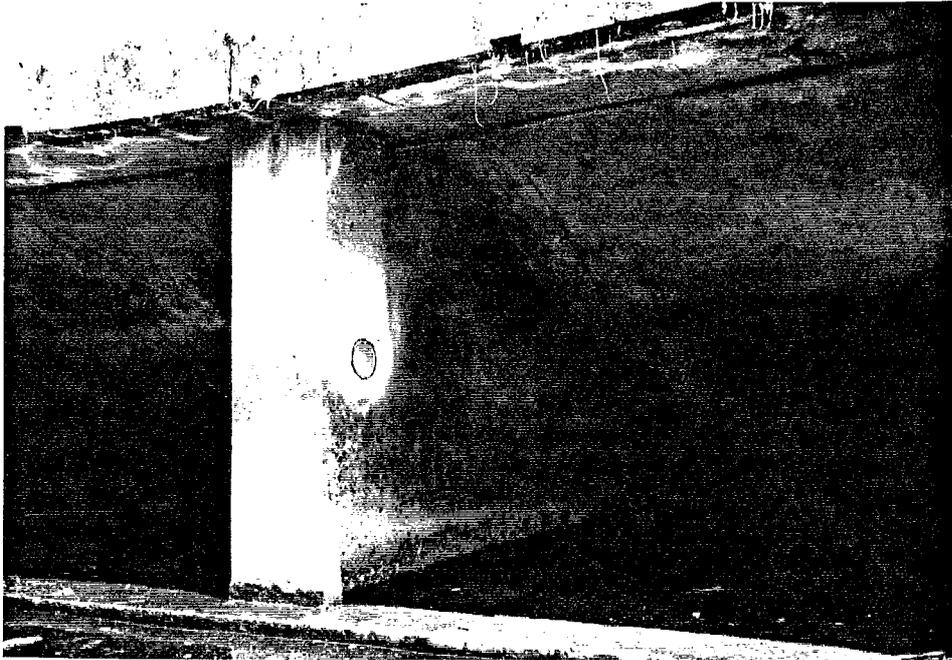
Photograph 45. Left face of Pier 8 & Bay 8 apron.



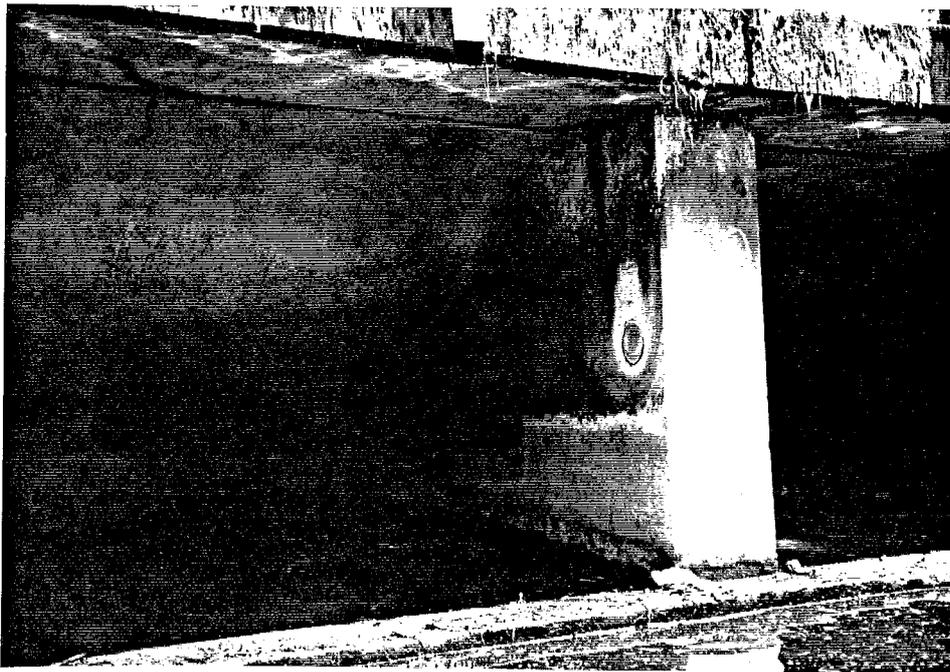
Photograph 46. Closeup view of Pier 8 unsound concrete.



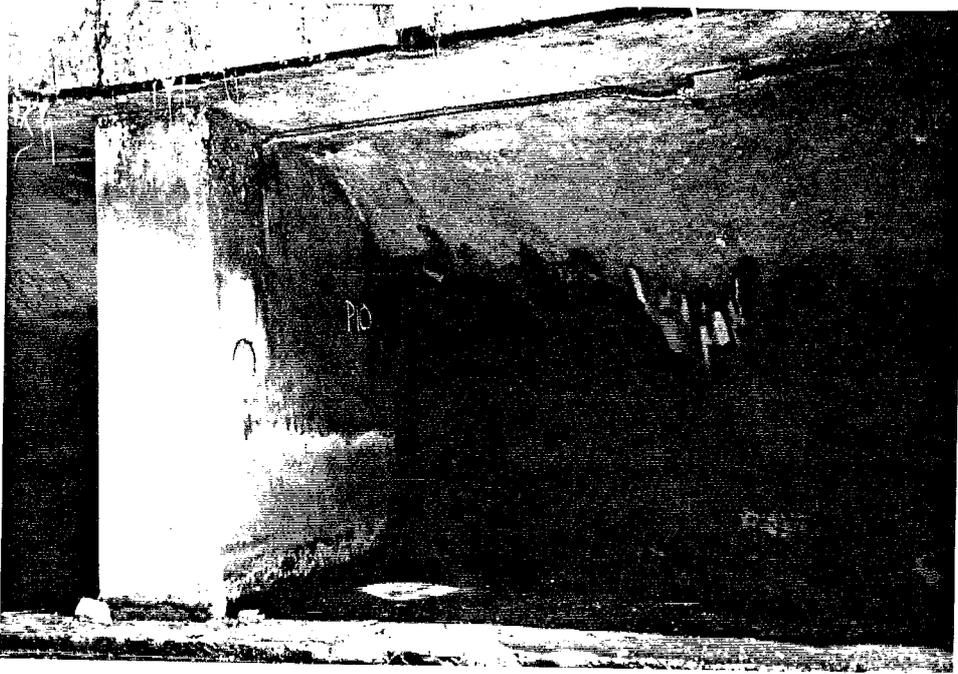
Photograph 47. Right face of Pier 9 & Bay 8 apron.



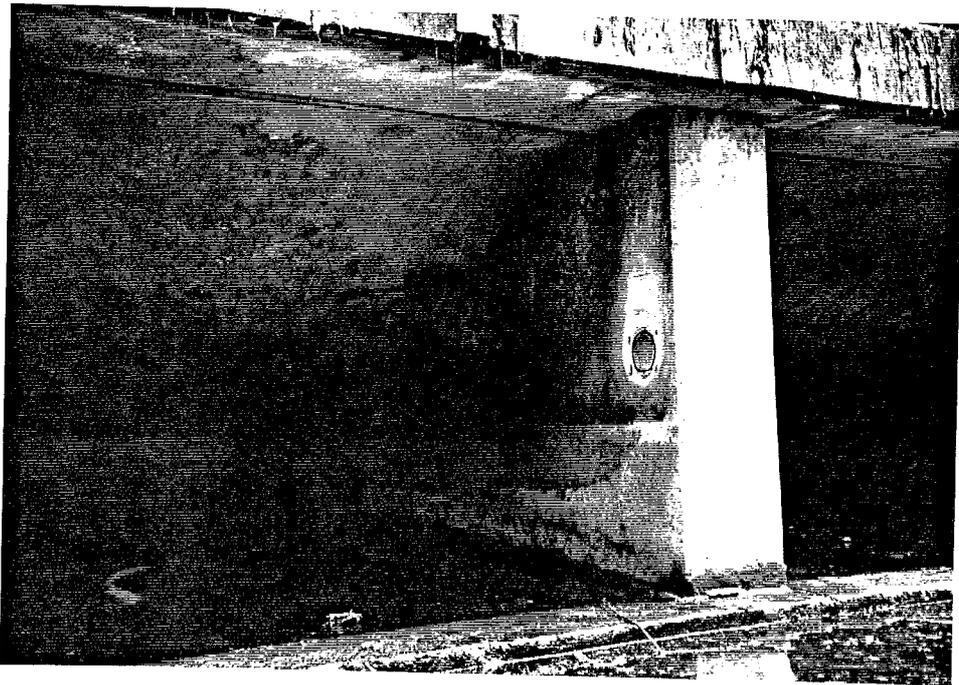
Photograph 48. Left face of Pier 9 & Bay 9 apron.



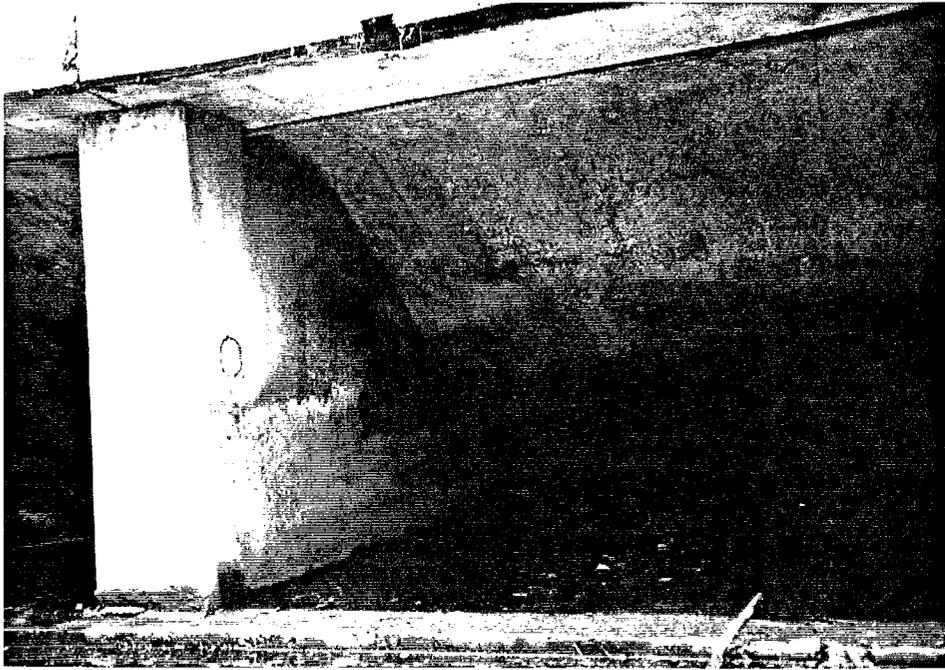
Photograph 49. Right face of Pier 10 & Bay 9 apron.



Photograph 50. Left face of Pier 10 & Bay 10 apron. Note leakage.



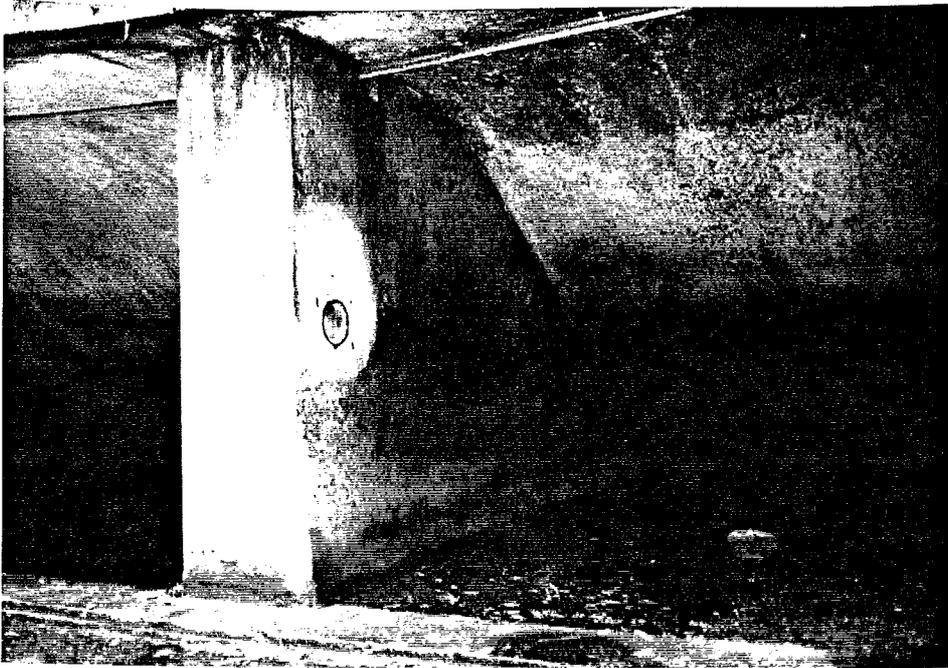
Photograph 51. Right face of Pier 11 & Bay 10 apron.



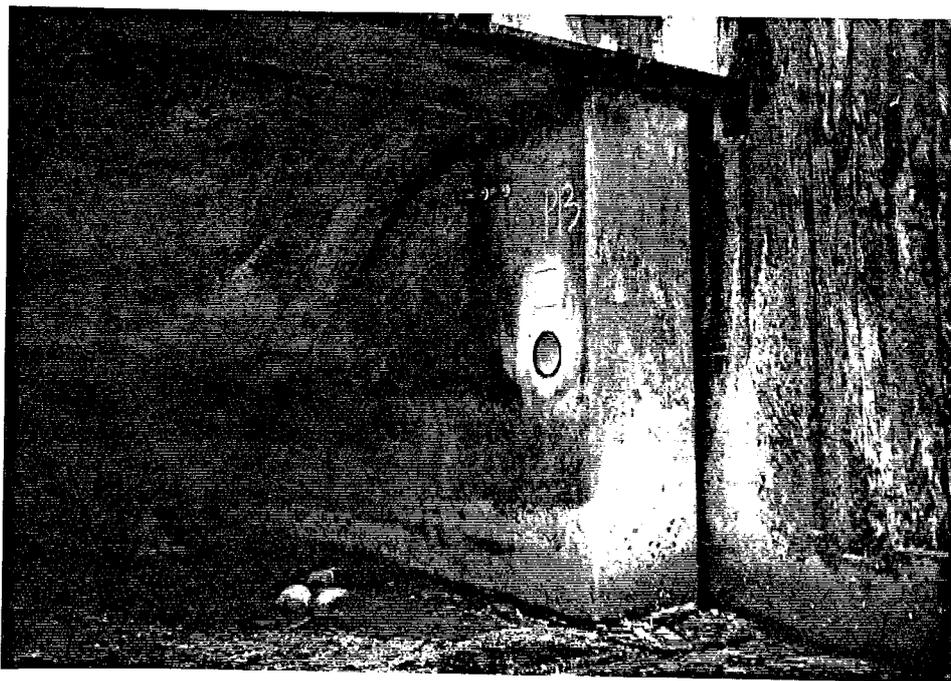
Photograph 52. Left face of Pier 11 & Bay 11 apron.



Photograph 53. Right face of Pier 12 & Bay 11 apron.



Photograph 54. Left face of Pier 12 & Bay 12 apron.



Photograph 55. Right face of Pier 13 & Bay 12 apron.

APPENDIX B
UNDERWATER INSPECTION REPORT

H2O, Inc.
2295 N. McKnight Road
St. Paul, MN 55109

Underwater Investigations
Rum River Dam

performed

for

Stanley Consultants, Inc.

Job Completed 29 July 1996

Location: Rum River, Anoka, Minnesota

H2O Job No. 96-0105

1.0 Introduction

H2O, Inc. performed an inspection of the Rum River Dam located on the Rum River in Anoka, Minnesota on July 29, 1996.

The observations of structural condition from the underwater investigation will be incorporated in a report prepared by Stanley Consultants Inc.

2.0 Scope of Work

Underwater inspections were performed of the following areas:

- a. Upstream portion of West Abutment
- b. Upstream Spillway Apron
- c. Forebay area
- d. Tainter Gate and upstream portion Tainter Gate Spillway
- e. Downstream portion of the Tainter Gate Spillway
- f. Stilling Basin

3.0 Field Investigation

The underwater investigations were performed by a H2O commercial diving team consisting of a supervisor, lead diver, and lead tender. All diving activities involved the use of full head helmet, surface supplied diving apparatus with two-way intercom communication between divers and surface personnel.

An underwater color video system was provided for topside observation and documentation of any area of interest to the engineer. The color underwater video camera provided an acceptable image when used.

Prior to diving operations a safety meeting was held and a lock-out procedure was established by the Site Engineer and verified prior to diving related activities by the H2O Diving Supervisor and Diver.

Visibility during the dives was fair to poor, the inspection being performed visually and by touch.

Pool elevation datum was not recorded by H2O at the time of the dives. Depth measurements were determined by using a pneumofathometer.

4.0 Background / General

The Rum River Dam is a concrete gravity dam with outlet works that consists of one gated spillway that empties into a stilling basin and an ungated spillway. The gated spillway is 20 feet wide by 110 feet long. The ungated spillway is 236 feet wide by 36 feet long with an end sill and baffle blocks. The upstream and downstream pool elevations were not determined by H2O during the time of the inspection.

5.0 Inspection Details

5.1 West Abutment (upstream)

The condition of the concrete of the upstream west abutment is very good, showing only normal aging. No noticeable cracks or spalls were observed.

5.2.1 Upstream Spillway Apron

The divers inspection in this area covered the bottom on lines centered 10 feet apart.

Accumulated bottom sediments cover all but between 6 and 10 feet of the spillway apron. The spillway apron was found to be covered by algae and muck, all of which was easily cleared away.

Overall, the concrete examined in the exposed areas of the spillway apron is in good condition. One area from approximately 125 feet to 160 feet from the west abutment exhibits minor surface weathering. This area extends beginning 3 feet from the spillway edge to 5 feet from the spillway edge. The depth of the weathering varied from 1/8 to 1/4 inch, otherwise there were no other observed abnormalities.

5.2.2 Bottom Contour Observations

Pool elevation datum was not recorded by H₂O at the time of the dives. Depth measurements were determined by using a pneumofathometer.

During the first phase of the inspection, which involved the west abutment and the western half of the spillway apron, the tainter gate was open allowing the reservoir to drain. The lowering of the upper pool elevation was necessary so that the tainter gate could remain closed with no flow over the spillway during the second phase of the inspection, which involved the eastern half of the spillway apron and the tainter gate outlet structure.

Due to the constant change in pool elevation during the course of the inspection, the collected measurements have been interpolated to reflect only general trends in the bottom contours.

In the area upstream of the spillway apron, the river bottom contour tends to be uniformly and consistently flat with no displacement or observed localized variations.

Beginning at 220' from the west abutment, the river bottom begins a consistent and gradual slope down to the elevation of the forebay apron, levels off across the face of the apron, then begins a gradual slope up to the river bank. The river bottom in front of the forebay apron consists of boulders at an elevation even with the apron.

The river bottom immediately downstream of the stilling basin consists of boulders at an elevation even with the apron.

5.3 Forebay area

The condition of the concrete of the east and west walls in the forebay area is good, again, showing only normal aging. No noticeable cracks or spalls were observed.

The steel inserts lining the stop log keyways appear solid and completely embedded in the concrete side walls. The surfaces of the steel underwater, have extensive areas of rust blisters and pitting. The size of the rust blisters averaged 1 inch in diameter and raised 1/4 to 3/8 inch. The pits average 1/8 inch deep. Considering the allowed design clearances for the stop logs, the rust blisters may effect the ability to easily seal the stop logs, and may hamper the installation or removal of the stop logs.

5.4 Tainter Gate and upstream portion of the Tainter Gate Spillway

The tainter gate appears to be in good overall condition. The condition of the steel in underwater portions of the gate is in good condition with no apparent abnormalities. The coating is intact without any remarkable defect, other than a few rust blisters.

The east and west end vertical rubber seals appear to be in good condition, The seals show no sign of cracking or embrittlement.

The lifting chains of the tainter gate appear to be out of adjustment. Beginning at the east side, there is an approximate 7/8 inch gap between the tainter gate bottom seal and the

concrete sill. The gap between the tainter gate seal and the concrete narrows until the seal meets the concrete about 1 foot from the west wall. The seal surface of the sill appears in good condition.

5.5 Downstream portion of the Tainter Gate Spillway

The condition of the concrete of the downstream portion of the tainter gate spillway is good, again, showing only normal aging.

The only noticeable crack was found on the west wall of the stilling basin in the area of the spillway. This crack is very slight, extending from the floor of the stilling basin to within 1.5 feet of the surface. The crack does not appear to be active, and exhibits no displacement.

The condition of the steel inserts lining the stop log keyways at the end of the tainter gate spillway is identical to the inserts in the forebay area. They appear solid and completely embedded in the concrete side walls. Again, the surfaces of the steel underwater, have extensive areas of rust blisters and pitting. The size of the rust blisters averaged 1 inch in diameter and raised 1/4 to 3/8 inch. The pits average 1/8 inch deep.

5.6 Stilling Basin

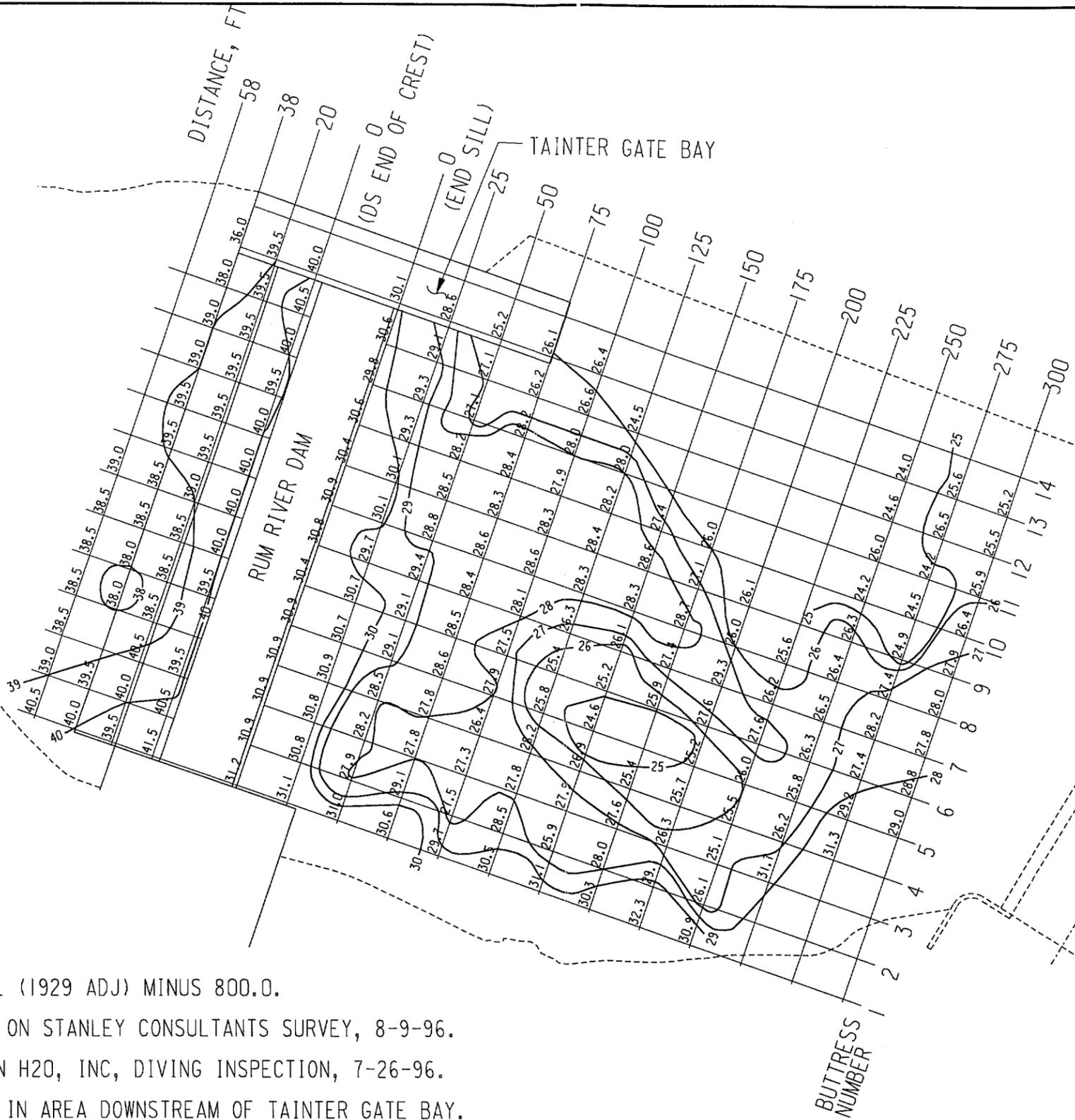
The condition of the concrete of the stilling basin is good, showing only normal aging and several areas of very minor surficial erosion with exposed aggregate on the basin floor. No noticeable cracks or spalls were observed. All construction joints appear uniform with no apparent displacement.

6.0 Conclusion

Inspection of the specified areas revealed no apparent deficiency which might effect the safe, proper operation of the facility.

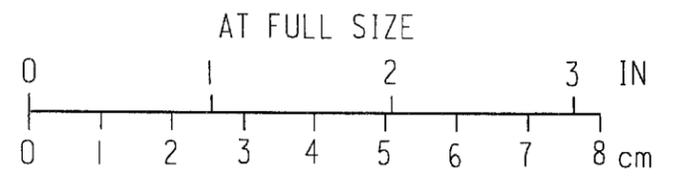


RUM RIVER



NOTES:

1. ALL ELEVATIONS REFER TO MSL (1929 ADJ) MINUS 800.0.
2. DOWNSTREAM SOUNDINGS BASED ON STANLEY CONSULTANTS SURVEY, 8-9-96.
3. UPSTREAM SOUNDINGS BASED ON H2O, INC, DIVING INSPECTION, 7-26-96.
4. NO SOUNDINGS WERE OBTAINED IN AREA DOWNSTREAM OF TAITNER GATE BAY. DIVING INSPECTION INDICATED NO SCOUR IN THIS AREA.



\$\$\$\$\$FILENAME\$\$\$\$\$ CADD BI-R1

REVISIONS	DWN.	APP.	APP.	DATE

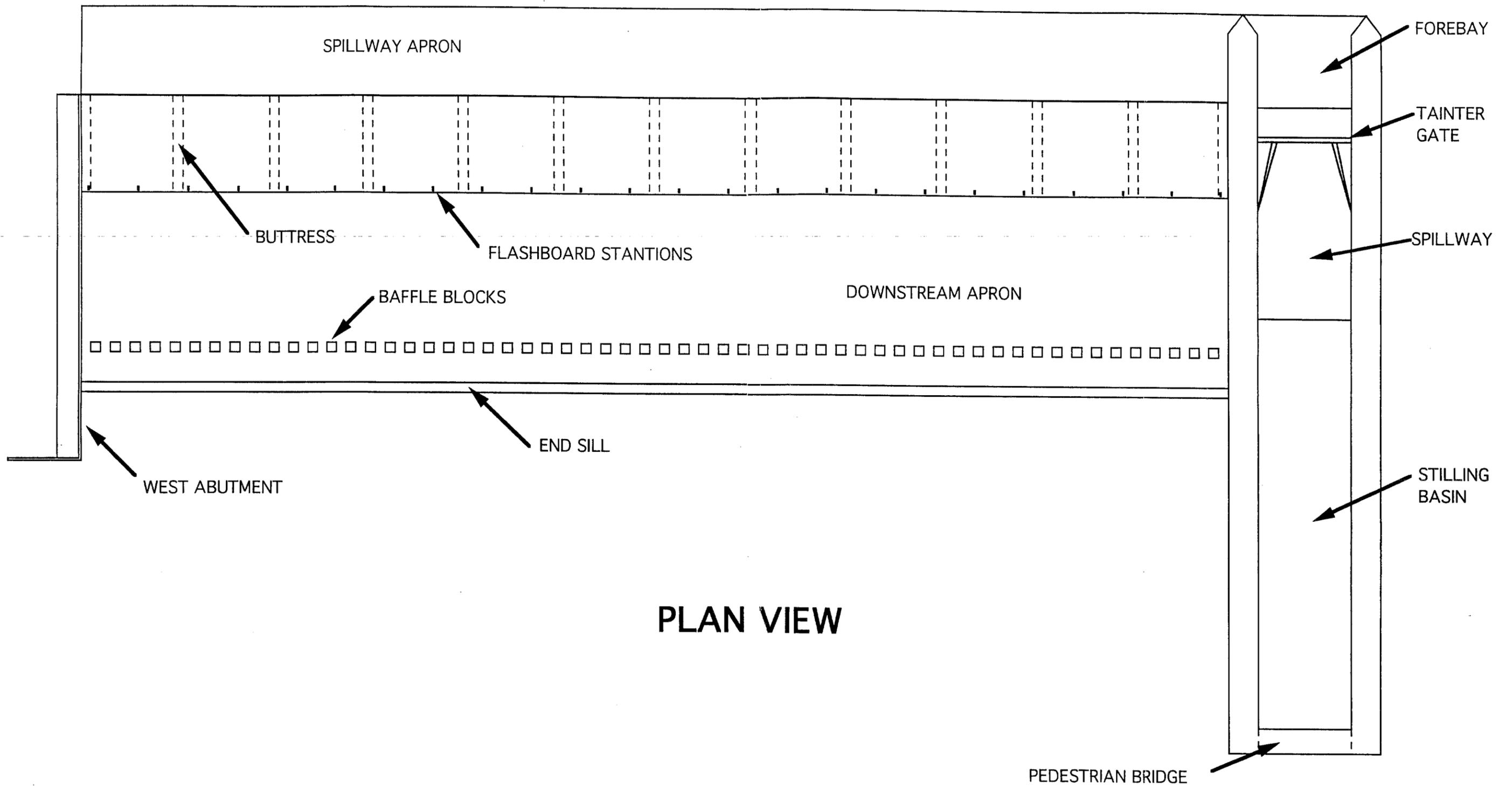
DESIGNED	
DRAWN	KM BURK
CHECKED	
APPROVED	
APPROVED	
DATE	

STANLEY CONSULTANTS
INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

CITY OF ANOKA
RUM RIVER DAM
ANOKA, MINNESOTA

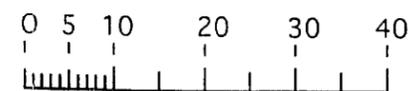
FIGURE 3-9
SOUNDINGS

SCALE 1"=60'-0"	
NO. 13177	REV.

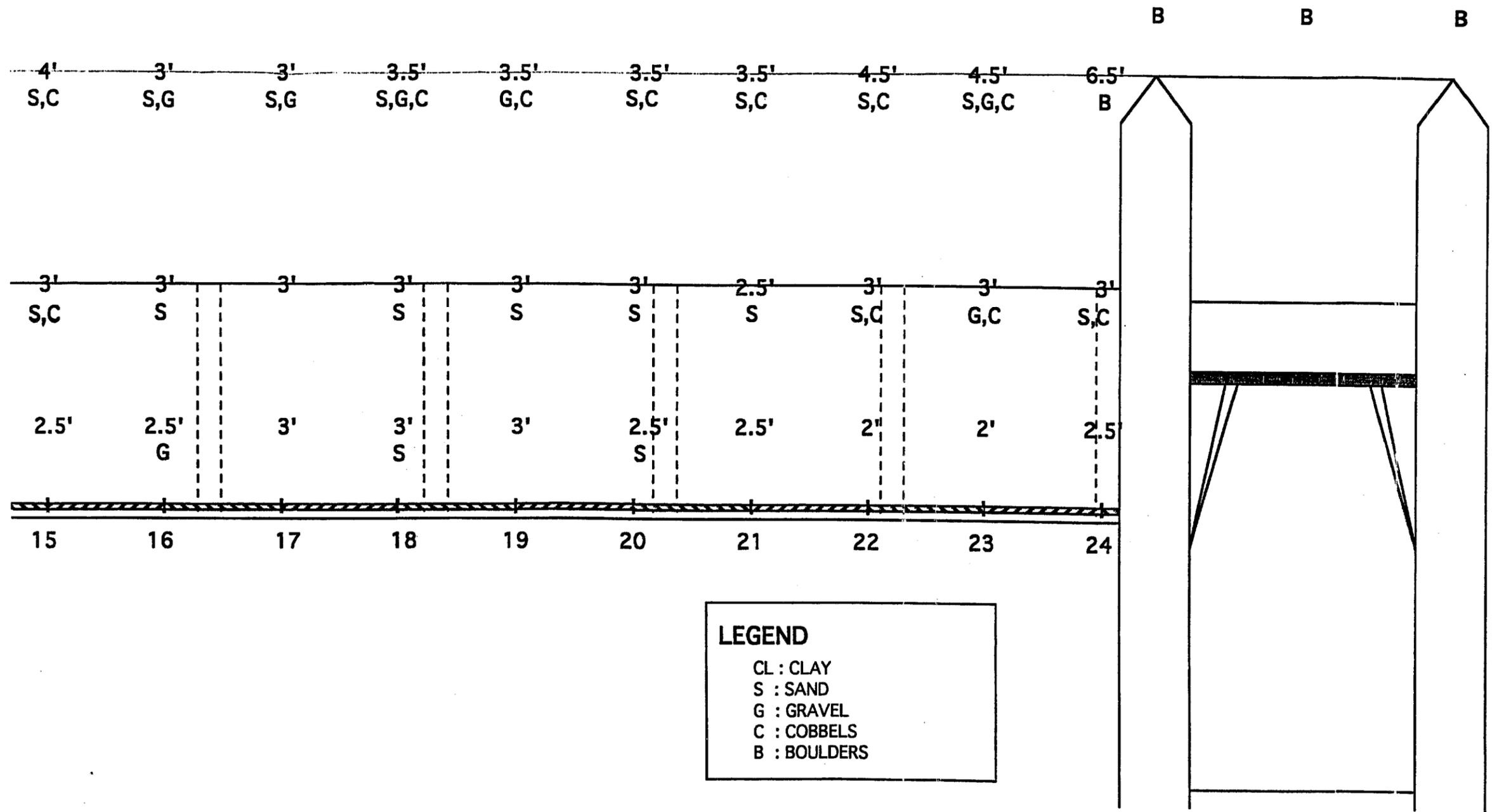


PLAN VIEW

SCALE: 1" = 20'



**RUM RIVER DAM
CITY OF ANOKA
ANOKA, MINNESOTA**



LEGEND
 CL : CLAY
 S : SAND
 G : GRAVEL
 C : COBBELS
 B : BOULDERS

SCALE: 1" = 10'

0 5 10 20

RUM RIVER DAM
CITY OF ANOKA
 ANOKA, MINNESOTA

ERVOIR
96

APPENDIX C

FLASHBOARD SYSTEM REPLACEMENT REPORT

EVALUATION REPORT

RUM RIVER DAM FLASHBOARD SYSTEM REPLACEMENT

CITY OF ANOKA, MINNESOTA

October 1996

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Table 2	Conceptual Cost Estimates
Table 3	Economic Analysis Cost Items

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Figure 3	Section - Steel Crest Gate System
Figure 4	Section - Obermeyer System
Figure 5	Plan - New Flashboard System
Figure 6	Profile - New Flashboard System

ATTACHMENT GATE MANUFACTURER INFORMATION

- Quote Solicitation
- Bridgestone System
- Steel-Fab System
- Sumitomo System
- Obermeyer System

1.0 INTRODUCTION

1.1 Background

The City of Anoka retained Stanley Consultants to provide engineering services to inspect and evaluate the condition of the Rum River Dam. The purpose of the inspection/evaluation is to document the current condition of the facility and to identify any repairs and/or modifications required to maintain the required serviceability of the facility.

The City also requested that alternatives to the current flashboard system be analyzed and evaluated as part of the evaluation work. SCI's scope of services included the formulation of alternatives to the flashboard system currently used to control the upstream pool level at the dam. Alternative formulation was to include hydrologic and hydraulic factors, structural dimensions and environmental considerations. Alternative development was to include conceptual design and layout drawings prepared in sufficient detail for use in determining unit quantities and preparing cost estimates. The various approved alternatives were to be compared and contrasted regarding their economics, impacts and consistency with long-term City of Anoka objectives. Regulatory, environmental, political and funding issues for each option will be considered.

1.2 Dam Description

The Rum River Dam in Anoka, Minnesota was constructed in 1969. The dam is a buttress type structure with 18-inch thick reinforced concrete apron supported by 2-foot wide intermediate piers spaced at 19'-9" on centers. The crest elevation of dam is 841.35. Water level control is provided by single 20-foot wide tainter gate with a crest elevation of 835.0. Normal pool is 845.0.

As shown on Figure 1, the existing flashboards are 3 stacked 4" x 12" timbers supported by vertical W4x13's spaced at 9'-10" and tension rods connected to the upstream face of the dam. The tension rods are designed to fail under a predetermined water load. The flashboard section of the dam is 236 ft long and the board system is 2'-10 5/8" high with a top elevation of 844.24.

1.3 Flashboard Requirements

The new flashboard system would not be required for incremental pool control, rather simply to be in an up or down position. Required operation is as follows. For river flows up to 2800 cfs (approximately a 1-year flood event), flashboards remain in up position and tainter gate is operated as required to maintain the pool at 845.0. For river flows in excess of 2800 cfs, pool levels increase and once headwater reaches 847.0, the flashboards go down. Flashboards remain down throughout winter season and are raised again following spring floods.

2.0 COST ESTIMATES

2.1 Gate System Manufacturer Quotes

Preliminary cost quotes for alternative flashboard systems were solicited from five companies. A list of these companies, their respective type of gate system, and their quoted conceptual costs are given in Table 1 below. In general, three types of applicable gate systems are available on the market as described below.

- Rubber Dam - As shown on Figure 2, consists of a tubular bladder that when inflated, retains water and when deflated, passes water. Control provided by air pressure supplied by compressor and air supply piping.
- Steel Crest Gate - As shown on Figure 3, consist of steel gate which rotates about hinge mounted on dam crest. Control provided by intermediate cylinders powered by hydraulic power unit and hydraulic line system.
- Obermeyer System - As shown on Figure 4, is somewhat of a hybrid between rubber dam and crest gate. Consists of hinged steel gate controlled by rubber bladder which is in turn controlled by air compressor.

TABLE 1. GATE MANUFACTURERS DATA

NAME	GATE TYPE	CONCEPTUAL GATE COST
Bridgestone	Rubber dam/pneumatic control	\$174,929
Obermeyer Hydro, Inc.	Steel gate/pneumatic control	\$153,000
Rodney Hunt	Steel crest gate/hydraulic control	(No Response)
Steel-Fab, Inc.	Steel crest gate/hydraulic control	\$297,000
Sumitomo Electric U.S.A, Inc.	Rubber dam/pneumatic control	\$300,000

The attachment to this report contains the original quote solicitation from SCI along with quotes received from the above companies.

2.2 Installation Costs

Based on requirements provided by each manufacturer, installation and other construction costs associated with each new gate system are described below.

- Crest Modifications - Includes demolition of concrete and addition of new concrete to dam crest to suit the crest to the respective gate system. Also includes installation of anchor bolts and/or dowels to secure new concrete onto the crest and to provide anchorage for new gate system.
- Control Building - A new control building is required to house control and monitoring equipment. It is anticipated that the control building will be a 10-foot square metal building located adjacent to the dam and will include heat, ventilation, lighting, power, and telephone.
- Control Conduits - New conduits must be installed to connect the control equipment within the control building to the gate system. Conduits for a rubber dam system

include pressure sensing piping and air supply/deflation piping. Conduits for steel crest gate systems include hydraulic piping or air supply/deflation piping and electrical conduit for side seal heaters.

- Gate System Installation & Testing - Includes the physical installation of the gate system followed by system testing.

Figures 5 and 6 show conceptual plan and profile views of a possible new gate system configuration. No cofferdam construction was assumed necessary as part of construction. It is anticipated that the new gate system can be installed by drawing down the pool and constructing a temporary safety system (handrail, etc.) along the crest of the dam.

2.3 Conceptual Cost Estimates

Conceptual cost estimates for three alternative gate systems are presented in Table 2. Costs include gate procurement, gate installation/construction, engineering/permitting, and construction/undeveloped design details contingencies.

TABLE 2. CONCEPTUAL COST ESTIMATES

ITEM	Manufacturer			
	Bridgestone	Obermeyer	Steel-Fab	Sumitomo
Gate System Procurement	\$175,000	\$153,000	\$297,000	\$300,000
Installation/Construction	183,000	178,000	238,000	215,000
Engineering	36,000	33,000	54,000	\$51,000
Total	\$394,000	\$364,000	\$589,000	\$566,000

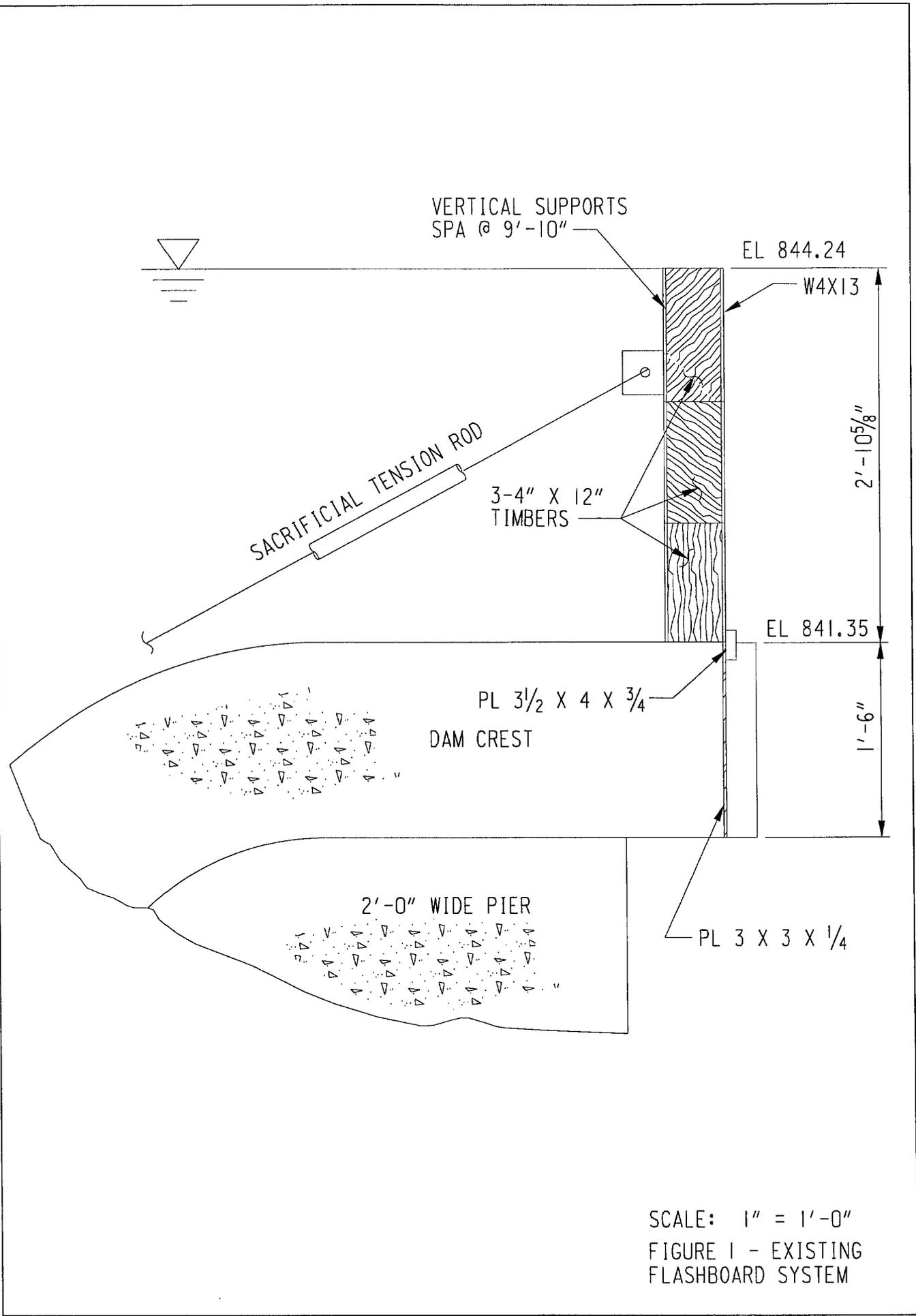
3.0 ECONOMIC EVALUATION

In order to evaluate the cost of replacing the existing flashboard, a present worth economic analysis was performed over a 30-year period. Cost items for both alternatives (existing system versus Obermeyer system) are summarized in Table 3. No annual costs for electrical power required for the replacement system were included.

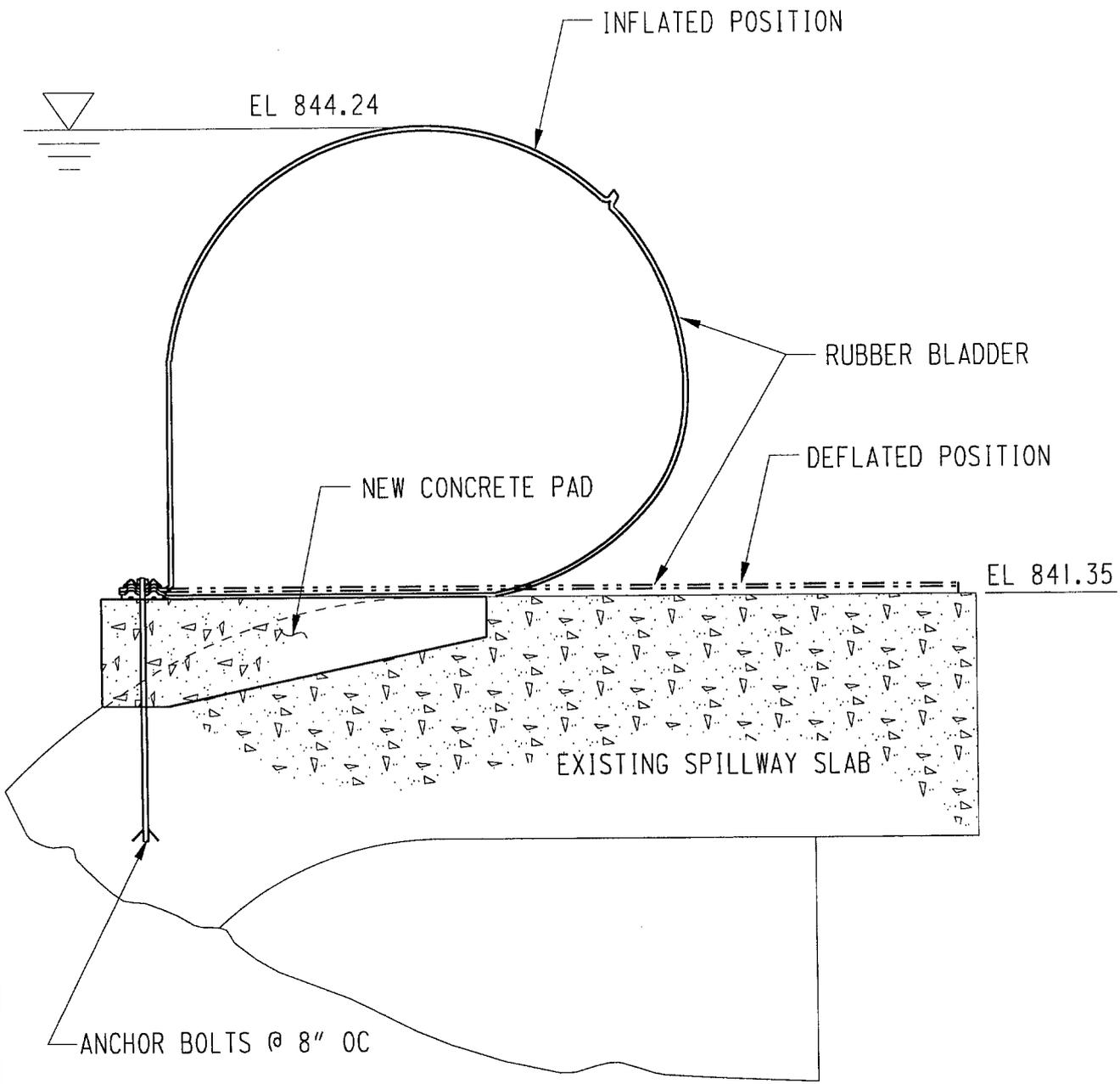
The analysis was performed on a present worth basis. The object was to determine which alternative resulted in the lower required expenditure by the City of Anoka over the 30 year evaluated life. All costs were escalated at 4 percent from the 1996 dollar estimates to the required year to account for inflation. The escalated payments were discounted at 2 percent above the inflation rate to give the net present value. Results indicate that the present worth cost for the existing system and replacement system are respectively \$127,000 and \$410,000. Given the history of the present flashboard system and its required function, it is recommended that the present flashboard system continue to be maintained by the City.

TABLE 3. ECONOMIC ANALYSIS COST ITEMS

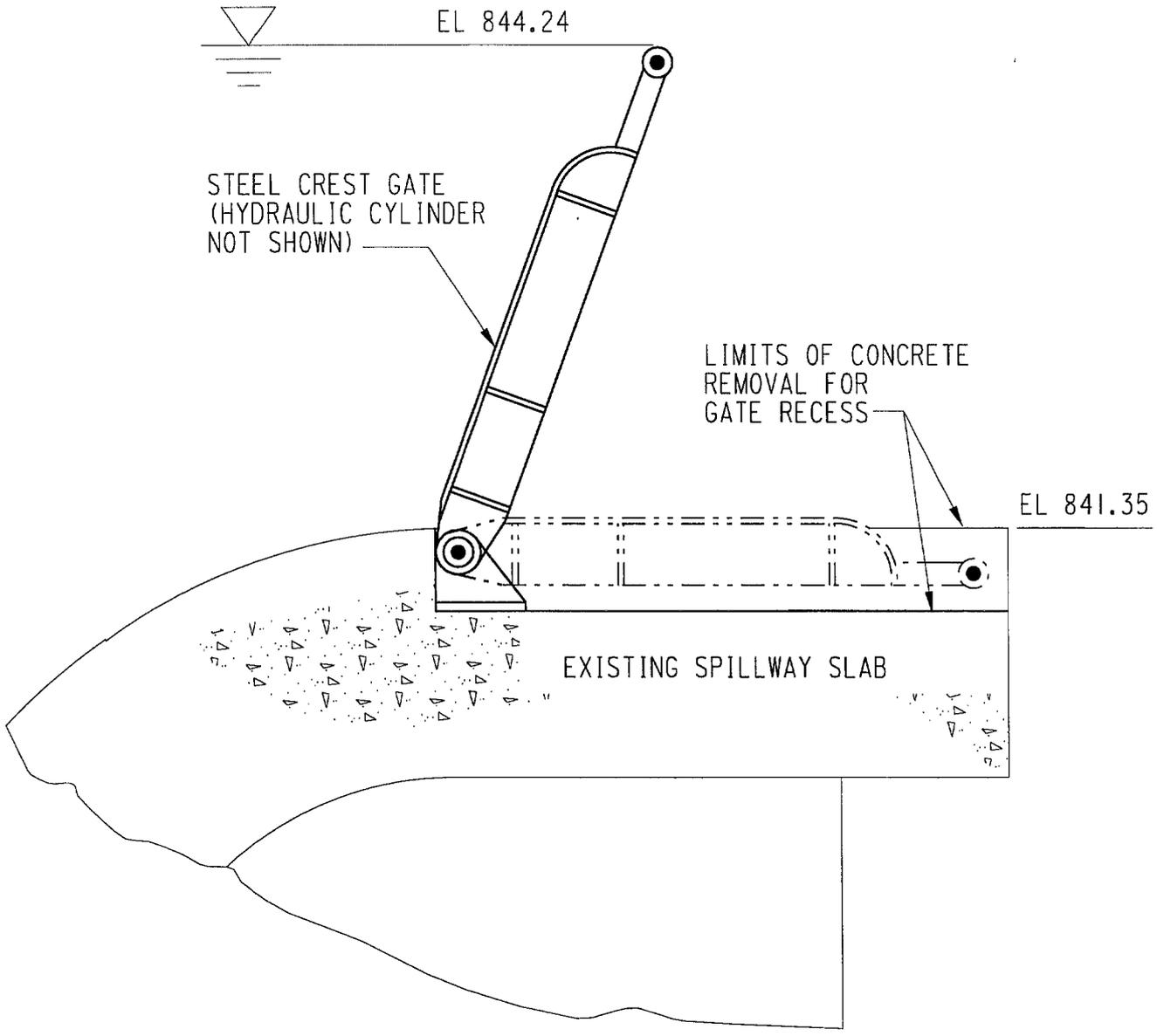
ITEM	Existing System		Replacement System	
	Cost, \$1996	Cycle, yr	Cost, \$1996	Cycle, yr
Initial Installation	0	--	364,000	--
Maintenance	5,000	1	1,000	1
System Replacement	9,500	10	--	30
Painting	0	--	30,000	15



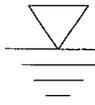
SCALE: 1" = 1'-0"
 FIGURE 1 - EXISTING
 FLASHBOARD SYSTEM



SCALE: 1" = 1'-0"
 FIGURE 2 - SECTION
 BRIDGESTONE RUBBER DAM



SCALE: 1" = 1'-0"
FIGURE 3 - SECTION
STEEL CREST GATE SYSTEM



EL 844.24

STEEL GATE

RUBBER BLADDER

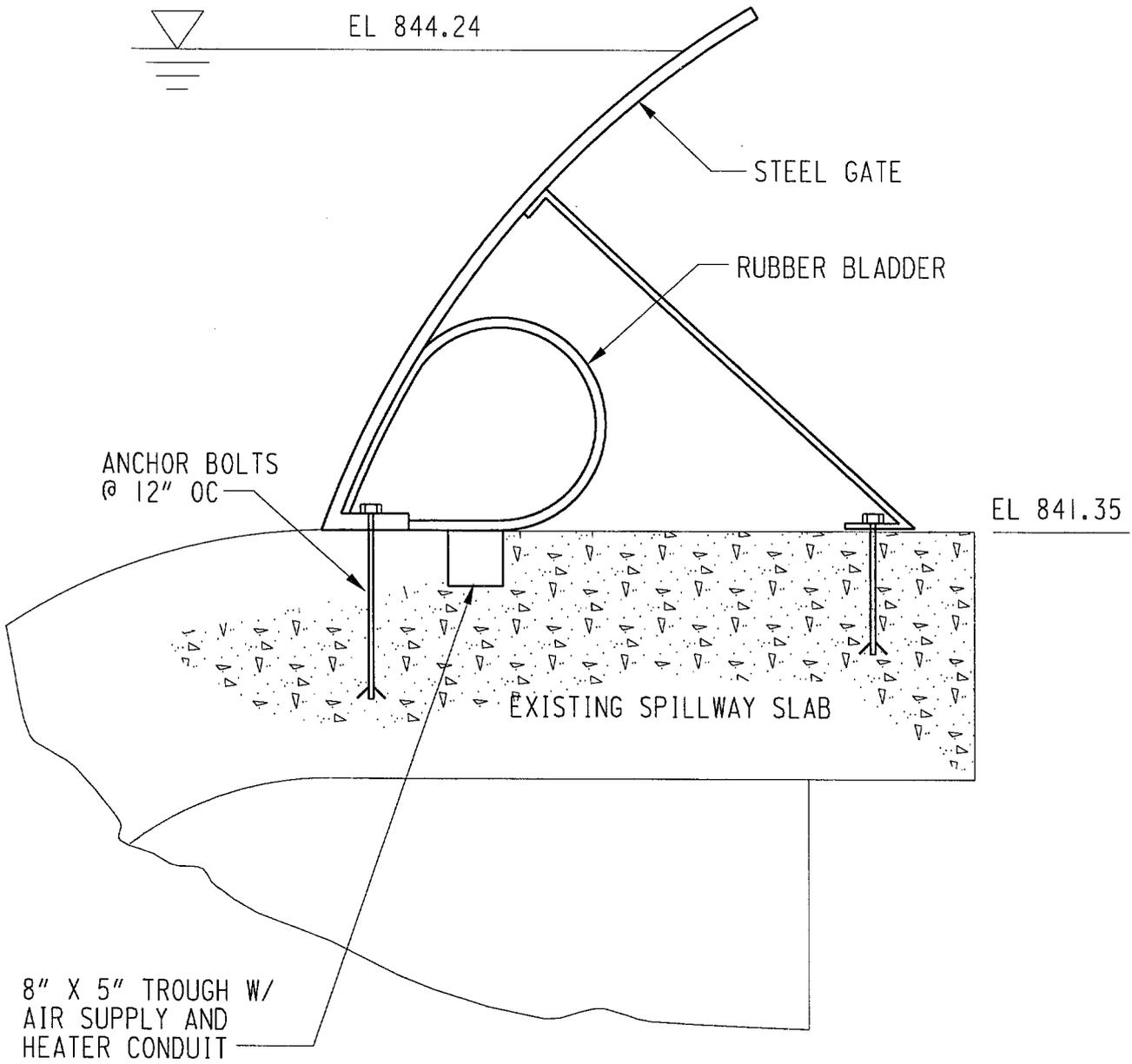
ANCHOR BOLTS
@ 12" OC

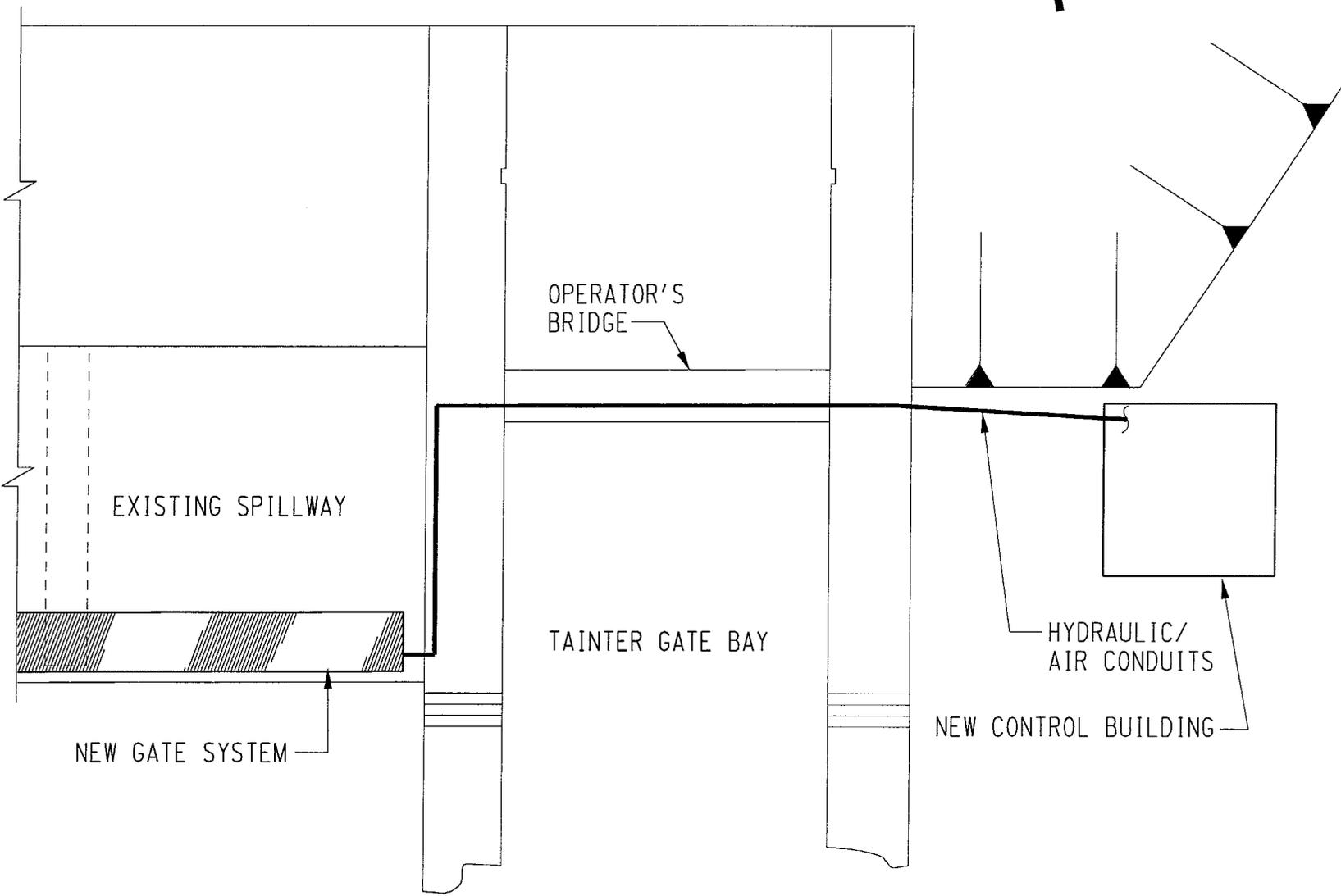
EL 841.35

EXISTING SPILLWAY SLAB

8" X 5" TROUGH W/
AIR SUPPLY AND
HEATER CONDUIT

SCALE: 1" = 1'-0"
FIGURE 4 - SECTION
OBERMEYER SYSTEM





OPERATOR'S
BRIDGE

EXISTING SPILLWAY

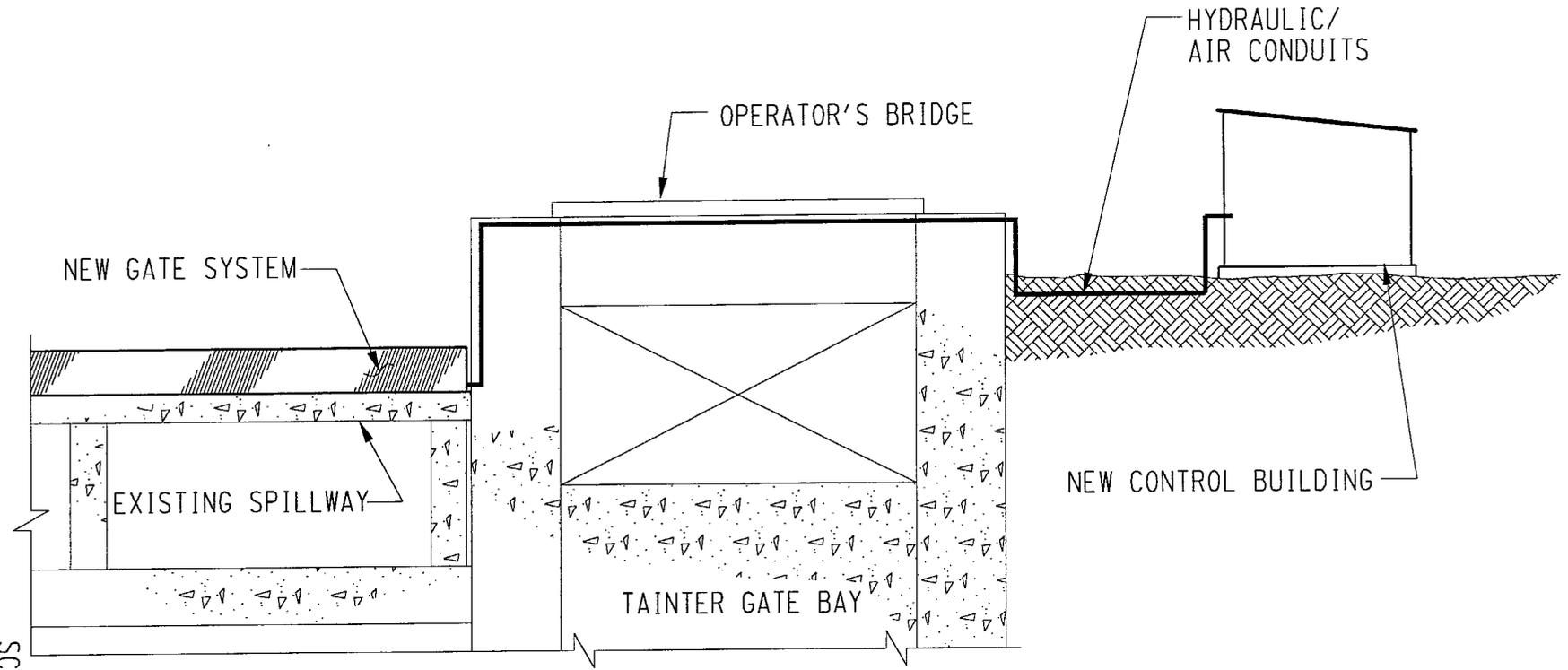
TAINTER GATE BAY

HYDRAULIC/
AIR CONDUITS

NEW CONTROL BUILDING

NEW GATE SYSTEM

SCALE: 1" = 10'-0"
FIGURE 5 - PLAN
NEW FLASHBOARD SYSTEM



SCALE: 1" = 10'-0"
 FIGURE 6 - PROFILE
 NEW FLASHBOARD SYSTEM

ATTACHMENT

GATE MANUFACTURER INFORMATION

- Quote Solicitation
- Bridgestone System
- Sumitomo System
- Steel-Fab System
- Obermeyer System

**RUM RIVER DAM
FLASHBOARD REPLACEMENT CRITERIA**

Location: Rum River - Anoka, Minnesota
Owner: City of Anoka, Minnesota
Dam Description: Ambursen (buttress) type dam with 18-inch thick reinforced concrete apron supported by 2-foot wide intermediate piers spaced at 19'-9" on centers. Crest elevation of dam is 841.35. Existing flashboards are 3 stacked 4" x 12" timbers supported by vertical W4x13's spaced at 9'-10" and tension rods connected to the upstream face of the dam. Water level control provided by single 20-foot wide tainter gate with a crest elevation of 835.0. Normal pool is 845.0.

Sketch of existing dam crest and flashboard system is attached.

Flashboard Requirements:

Length: 235 ft
Height: 2'-10 5/8"
Top Elevation: 844.24

Operation Requirements:

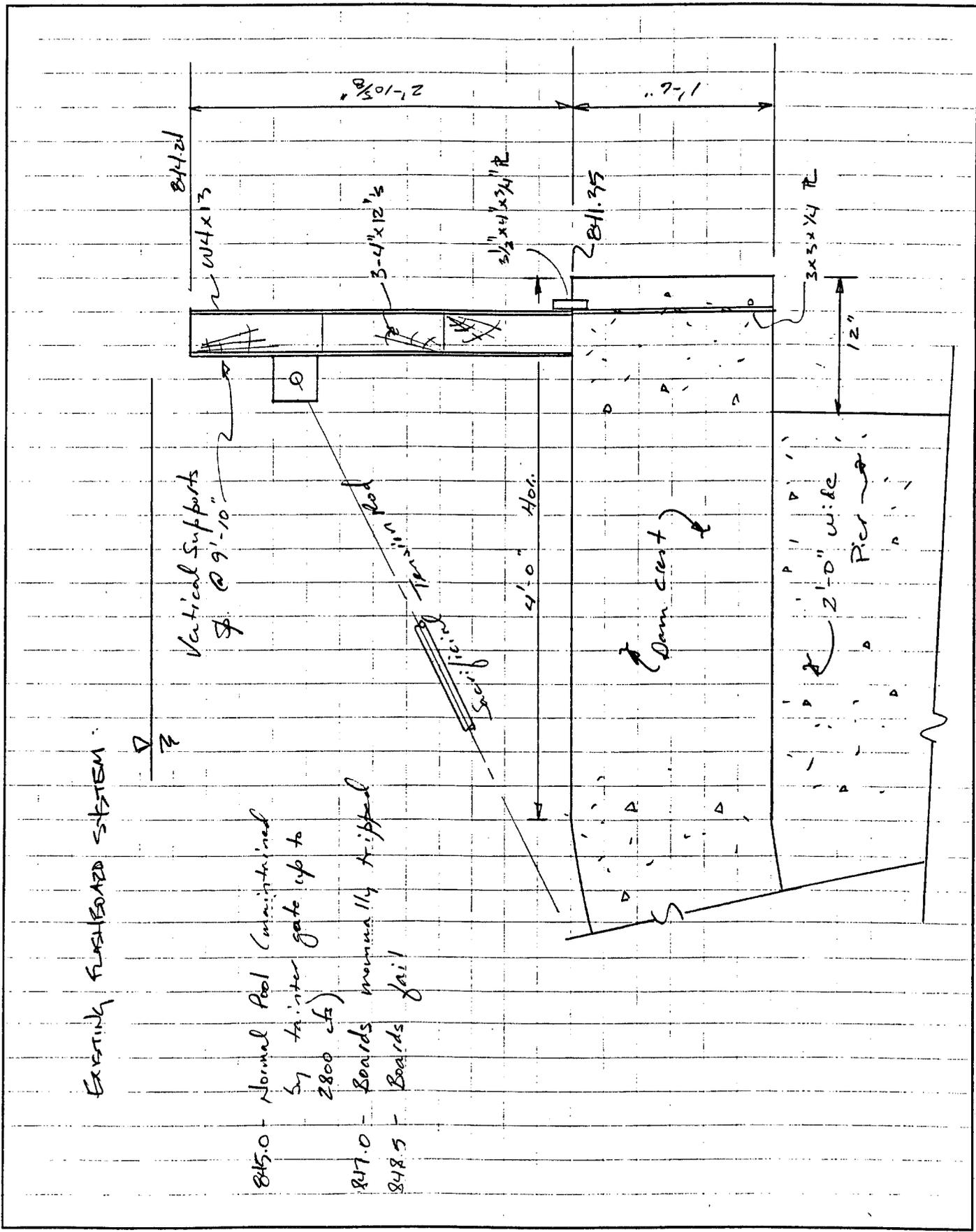
Flashboard system is not required for incremental pool control, rather simply to be in up or down position. Existing and required operation is as follows. For river flows up to 2800 cfs (approximately a 1-year event), flashboards remain in up position and tainter gate is operated as required to maintain the pool at 845.0. For river flows in excess of 2800 cfs, pool levels increase and the flashboard system must be down when or before headwater reaches 847.0. Flashboards remain down throughout winter season and are raised again following spring floods.

Computed by ZJU Date 6-11-96

Checked by _____ Date _____

Approved by _____ Date _____

Sheet No. _____ of _____



EXISTING FLASHBOARD SYSTEM

- 845.0 - Normal Pool (maintained by winter gate up to 2800 cfs)
- 847.0 - Boards manually tripped
- 848.5 - Boards fail



STANLEY CONSULTANTS

FAX COVER SHEET

Fax 612/546-4279

Suite 955 • 5775 Wayzata Blvd • Minneapolis, MN 55416

Tel. 612/546-3669

TO: Steve Graves
 FIRM/LOCATION: Bridgestone
 FAX NO: 615/231-6667
 FROM: Marty Weber
 SUBJECT: Rum River Dam
 Flashboard Replacement
 JOB/PROJECT NO: 13177

NO. OF PAGES,
 INCLUDING THIS SHEET: 3
 DATE: June 11, 1996

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MESSAGE:

Attached are cursory requirements for flashboard replacement project which is currently in feasibility phase. Please provide budgetary cost estimate to provide flashboard replacement system including gate system, power unit, control unit, pool level sensor, etc. Also please provide conceptual requirements for crest modifications, conduit sizing, etc. At this time it is not known if winter operation will be required, therefore (if applicable) please separate out costs for side seal heaters, etc.

Project is similar to Eau Galle Project which you provided information on last month. Please provide information by June 21, 1996 and call if you have any questions. Thank you for your cooperation.



STANLEY CONSULTANTS

FAX COVER SHEET

Fax 612/546-4279

Suite 955 • 5775 Wayzata Blvd • Minneapolis, MN 55416

Tel. 612/546-3669

TO: Rob Eckman
 FIRM/LOCATION: Obermeyer Hydro, Inc.
 FAX NO: 970/568-9845
 FROM: Marty Weber
 SUBJECT: Rum River Dam
 Flashboard Replacement
 JOB/PROJECT NO: 13177

NO. OF PAGES,
 INCLUDING THIS SHEET: 3
 DATE: June 11, 1996

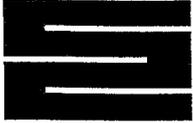
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Fax 612/546-4279

Suite 955 • 5775 Wayzata Blvd • Minneapolis, MN 55416

Tel. 612/546-3669

TO:	Fred Perry	NO. OF PAGES,	
FIRM/LOCATION:	Rodney Hunt	INCLUDING THIS SHEET:	3
FAX NO:	508/544-7206 4	DATE:	June 11, 1996
FROM:	Marty Weber	ORIGINALS WILL	
SUBJECT:	Rum River Dam	WILL NOT	x
	Flashboard Replacement	BE SENT TO YOU BY MAIL	
JOB/PROJECT NO:	13177		

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Project is similar to Eau Galle Project which you provided information on last month. Please provide information by June 21, 1996 and call if you have any questions. Thank you for your cooperation.


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FAX COVER SHEET

Fax 612/546-4279

Suite 955 • 5775 Wayzata Blvd • Minneapolis, MN 55416

Tel. 612/546-3669

		NO. OF PAGES,	
TO:	Bruce Harding	INCLUDING THIS SHEET:	3
FIRM/LOCATION:	Mooney & Associates	DATE:	June 11, 1996
FAX NO:	551-8810	ORIGINALS WILL	
	-----	WILL NOT	x
FROM:	Marty Weber	BE SENT TO YOU BY MAIL	
SUBJECT:	Rum River Dam		

	Flashboard Replacement		

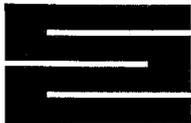
JOB/PROJECT NO:	13177		

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Project is similar to Eau Galle Project which you provided information on last month. Please provide information by June 21, 1996 and call if you have any questions. Thank you for your cooperation.



STANLEY CONSULTANTS

FAX COVER SHEET

Fax 612/546-4279

Suite 955 • 5775 Wayzata Blvd • Minneapolis, MN 55416

Tel. 612/546-3669

TO: Louis Bartolini

FIRM/LOCATION: Steel Fab

FAX NO: 508/343-7925

FROM: Marty Weber

SUBJECT: Rum River Dam
Flashboard Replacement

JOB/PROJECT NO: 13177

NO. OF PAGES,
INCLUDING THIS SHEET: 3

DATE: June 11, 1996

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Project is similar to Eau Galle Project which you provided information on last month. Please provide information by June 21, 1996 and call if you have any questions. Thank you for your cooperation.

June 11, 1996

Page 113

TO: Stanley Consultants
ATTN: **MR. MARTY WEBER**

BRIDGESTONE

Bridgestone Engineered Products Co.
555 Marriott Drive, Suite 830
Nashville, TN 37214
TEL: 615-231-6672 FAX: 615-231-6667

FAX: 612-546-4279

CC: -



RE: YOUR JUNE 11 FAX - RUBBER DAM BUDGETARY PRICE - RUM RIVER

Dear Mr. Weber,

Thank you for your inquiry today regarding the Bridgestone Rubber Dam. Please note requested budgetary price per page 3/3 and comments below:

- Price is for a single span 235ft long, approximately 12,000lbs in weight.
- The 6.1ft width of the Rubber Dam when deflated must be accommodated on a portion of the dam crest which is smooth and without obstructions. The drawing you provided shows 4.0ft of horizontal section. What does the crest look like further downstream?
- Due to ice conditions at site it is essential that the Rubber Dam have additional protective cover rubber, which is included in the price.
- Your fax requests that our price include a level sensor but the operation requirements indicate that the Rubber Dam will not be used for headwater level control but only as an up or down flashboard, which typically makes a level sensor unnecessary.
- Price includes Control System 5, which monitors and maintains a set air pressure and provides system alarms. This assures that the Rubber Dam will not deflate in the event of an accidental leak. Leaks can occur from bullet holes but should not be expected from the anchor system or natural causes (trees, ice, etc.). A small leak, such as a bullet hole, will have a very slow effect on the bladder as it holds a great volume of air at a relatively low pressure. If this control function is not needed the price can be reduced by about \$25,000.

(TUE) 6.11.96 15:19/ST. 15:18/NO.4060138421 P. 1

FROM

June 11, 1996

- Note that headwater level control function will be provided by 20ft wide tainter gate. However, should you wish, the Bridgestone Rubber Dam can be used for headwater level control as well.
- Crest modifications are limited to core drilling (or cutting a channel) across the dam crest to install anchor bolts at 200mm (7.8") centers and installing three flanges 2" - 4" in diameter at one pier. No pipe work is required along the crest of the dam.
- System can be used in winter if desired without modification or need for heaters.

Thank you for your inquiry Mr. Weber. The Bridgestone Rubber Dam has proven to be a solid performer at many sites similar to Rum River, including sites with heavy ice conditions. Please let me know how I may be of further service.

Very truly yours,



Stephen Graves

5/3

BRIDGESTONE RUBBER DAM PRICE ESTIMATE

Project: Rum River

Date: June 11, 1996

SPECIFICATIONS

Height: 2.88 feet	Length: 235 feet (on foundation)	Number of Spans: 1
Side Slope (V:H): Right = 1 : 0.5 Left = 1:0.5		Anchor: Single

PRICE

Price Estimate: US \$ 174,929	Price Basis: DDP
PRICE EXCLUDES FEDERAL, STATE, PROVINCIAL, LOCAL AND OTHER TAXES	

INCLUDED IN PRICE

Standard Equipment:
 Rubber Dam Body; Embedded Plates; Clamping Plates; Anchor Bolts; Spacer Pipes;
 Control Panel; Auto Deflation System; Design Documents, Drawings and Manuals.

Fixing Components:
 Clamping Plate: Galvanized ductile cast iron JIS FCD500/ASTM A536 GR.60
 Embedded Plate: Galvanized rolled steel JIS SS400/ASTM A36
 Anchor Bolt: Galvanized chrome molybdenum steel JIS SCM435/ASTM A29 GR.4235
 Nut: Galvanized carbon steel JIS S45C/ASTM A575 GR.1045

Control System: [5]
 Inner pressure of Rubber Dam is controlled in pre-set range by automatic air supply/exhaust function.

Automatic Deflation System:
 Float Type

Excluded From Price:
 Pipe runs between Rubber Dam(s) and control house, concrete and civil works, installation, site advisor.

PRICE CONDITIONS

Delivery : To job site within six months of purchase order and drawing approval.
Packing: Bridgestone standard (wooden case/roll), normally containerized.
Payment: Net 30 days
Validity: Until three months after date of this price estimation.

COMMENTS

In reply to June 11, 1996 inquiry from Mr. Marty Weber, Stanley Consultants.

MOONEY & ASSOCIATES, INC.

3025 Harbor Lane, Suite 318
Plymouth, MN 55447

Tel. 612-551-8811

Fax. 612-551-8810

FAX TO: Marty Weber
Stanley Consultants
Fax 546-4279

FROM: Bruce Harding
Date: 6-26-96
Total No. Pages: 2
(including cover)

Job / Reference: Rum River Dam

Flash board Replacement - Sumigate

Cost estimate \$ 300,000⁰⁰

See fax response from Sumitomo
that follows; concerns about
high water level.

ATTN: Mr. Bruce Harding MOONEY & ASSOCIATES, INC.	SUMITOMO ELECTRIC U.S.A., INC. LOS ANGELES OFFICE 21221 S. Western Ave., Suite 200 Torrance, CA 90501 Tel: (310) 782-0227 Fax: (310) 782-0211	
COPY:	FROM: Yasuo Nakazawa	
	DATE: June 25, 1996	PAGE: 1/1
	REF No.	
RE: RUM RIVER PROJECT		

Mr. Harding

I am sorry but I saw your fax yesterday because of my nearly 2 weeks business trip. (Actually I was in office on June 11, but I missed to see your fax then.)

The cost for rubber dam, 2.89'H x 235'W 1 span - for example, is roughly \$300,000. It is for the standard rubber dam including controls (without installation cost).

But please confirm its maximum water level (deflation water level). If it should be 848.5', the rubber dam application is very difficult for this project, because of too much over flow. If deflation water level is 847.0', the over flow is still more than 100% of the dam height, we have to study the dam design carefully for its feasibility. It "may" cost more than the above.

Sincerely


 Yasuo Nakazawa
 Assistant Manager-Marketing

STEEL-FAB, INC

P.O. BOX 2145

430 CRAWFORD STREET

FITCHBURG, MA 01420

F A X C O V E R

Date: July 9, 1996

To: Marty Weber
Company: Stanley Consultants

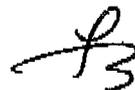
From: Louis Bartolini
Subject: Rum River Dam
Reference: Flashboard Replacement
CC:

Pages including this cover page: 7

Memo:

Based on your 235' crest, we are predicating our estimate on (5) 47' x 3' flashboard style, crest gates. The existing intermediate piers can be removed as the gates are designed using a gate to gate seal to minimize leakage. Our scope of supply would include the gate panels (each in one piece), horizontal seals, side seal plates (for the end piers), hydraulic cylinders (2 per gate) and (1) hydraulic power unit to operate the gates. Total price: \$297,000.

Please feel free to call me if you have any questions.



RUM RIVER SPILLWAY GATE PROPOSAL

**SUBMITTED TO
STANLEY CONSULTANTS**

**SUBMITTED BY
OBERMEYER HYDRO, INC.**

JUNE 19, 1996

COVER LETTER

1

PRICE PROPOSAL

2

SITE DRAWINGS

3

CONTROL AND COMPRESSOR

4

SALES AGREEMENT AND REFERENCE

5

OBERMEYER HYDRO, INC.

P.O. BOX 668 FT. COLLINS, COLORADO 80522 USA TEL 970-568-9844 FAX 970-568-9845

June 19, 1996

Mr. Marty Weber
Stanley Consultants
Suite 955
5775 Wayzata Blvd.
Minneapolis, MN 55416

RE: Rum River Dam

Obermeyer Hydro, Inc. would like to thank you and the city of Anoka, Minnesota for the opportunity to submit this proposal for the supply of spillway gates on Rum River Dam.

Included in this proposal, are several drawing depicting how the gate system will attach to the spillway and also showing the air supply and control equipment to be provided. I have also attached a reference list. If you, or the City, have any questions regarding how the Obermeyer system operates or how it withstands ice and debris, please don't hesitate to call anyone on the list.

If I can be of further service, or answer any questions, please don't hesitate to call or fax. We look forward to hearing more about this project and hopefully working with you in the near future.

Sincerely,

Obermeyer Hydro, Inc.

Robert Eckman, Vice President

Project Quotation Sheet

Owner: City of Anoka, Minnesota
Project: Rum River
Size: 235' x 2'-10 5/8"
Date: June 19, 1996

Obermeyer Hydro, Inc. is pleased to issue this proposal for the supply of pneumatic spillway gates for the Rum River Project. This quote is based on a spillway length of 235 feet and a damming height of 2'-10 5/8". Obermeyer Hydro will supply the following components for this project site:

- Steel Package: 235 linear feet of gate panel with clamp bars, hinge retainers, web retainers, splitters, j-seal type abutments, and related equipment. All ferrous steel components to be hot dip galvanized.
- Bladder Package: 235 linear feet of polyester reinforced air bladders complete with components to connect to contractor supplied air supply pipe.
- Air Supply Package: One Ingersoll-Rand air compressor and air dryer assembly. Package to include start up lubricants and all needed pre and after filters.
- Control Package: One automatic controller as shown in schematic on RR96114. Control system to use upstream bubbler system to sense pond level and use no electricity.
- Misc. Package: All stainless steel fasteners, anchor bolts, interpanel seals, engineering drawings and calculations, O & M manuals, and three days site installation supervision and technical training.

Obermeyer Hydro is pleased to offer this complete package for the sum total of USD 150,000.00 FOB Anoka, Minnesota. This price is valid for thirty days. Delivery schedule at this time is 10-12 weeks from date of purchase order.

In addition, Obermeyer Hydro can supply two heated abutment plates complete with controls for \$3000.00.

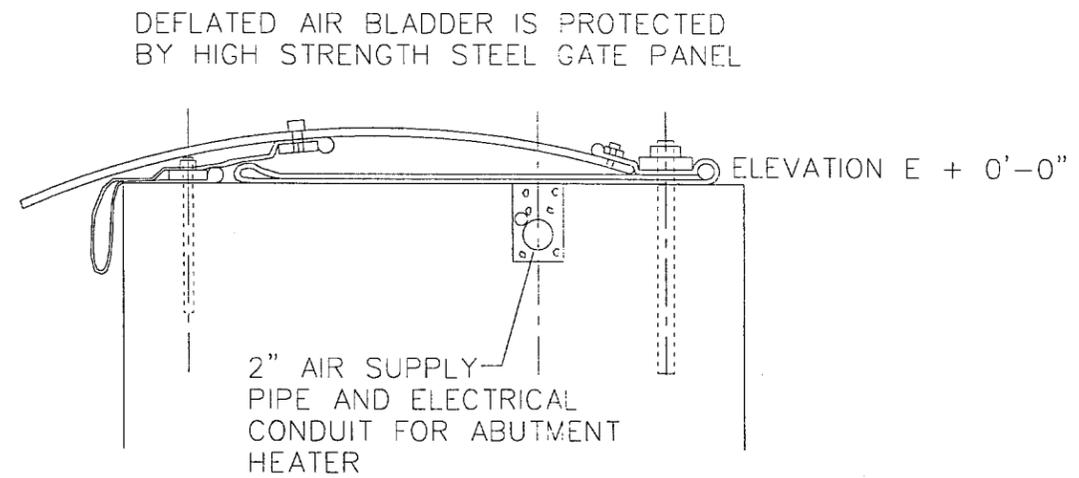
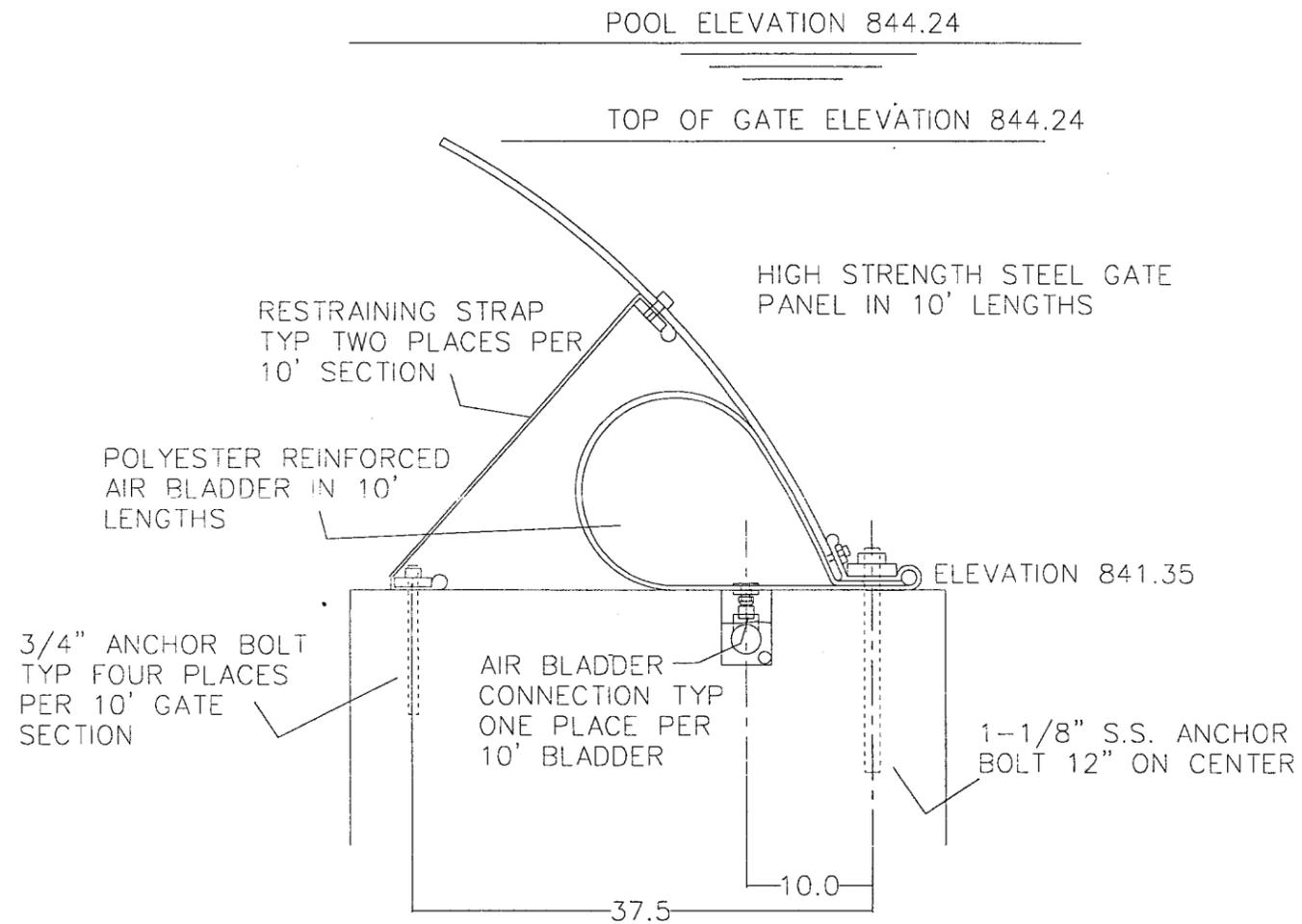
The above prices do not include the following items:

1. Interconnecting wiring or piping.
2. Enclosure for compressor and controls.
3. Installation except for above mentioned supervision and training.

4. Epoxy for anchor bolts.
5. Travel and lodging related to installation supervision.

As all parts are custom manufactured, a thirty five percent (35%) deposit will be required with the placement of an order. The balance, less five percent (5%) retainage shall be due upon the shipment of materials. The retainage shall be due within thirty days of installation or sixty days after shipment of materials, whichever comes first. Obermeyer Hydro reserves the right to invoice for partial shipments or for stored materials.

All parts manufactured by Obermeyer Hydro are guaranteed as outlined in the sales agreement in section five of this proposal. Items which are supplied, but not manufactured by Obermeyer Hydro are covered by the original manufacturer's warranty. Obermeyer Hydro reserves the right to void warranty if customer refuses installation supervision.



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**OBERMEYER
HYDRO ACCESSORIES, INC**

P.O. BOX 668
FORT COLLINS, COLORADO 80522
TEL 970-568-9844 FAX 970-568-9845



SCALE
NONE

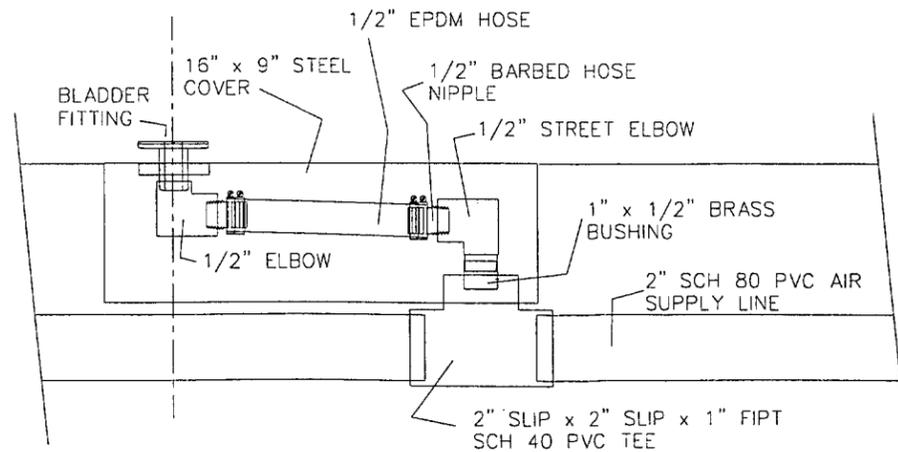
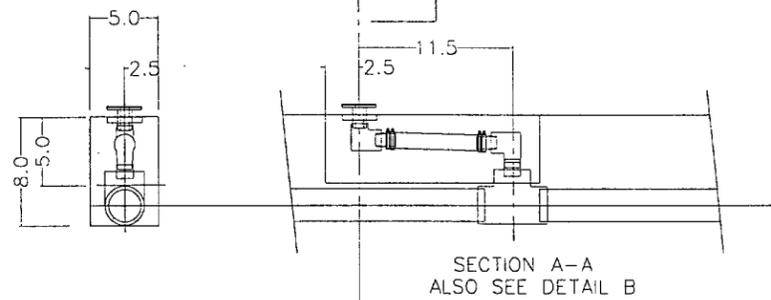
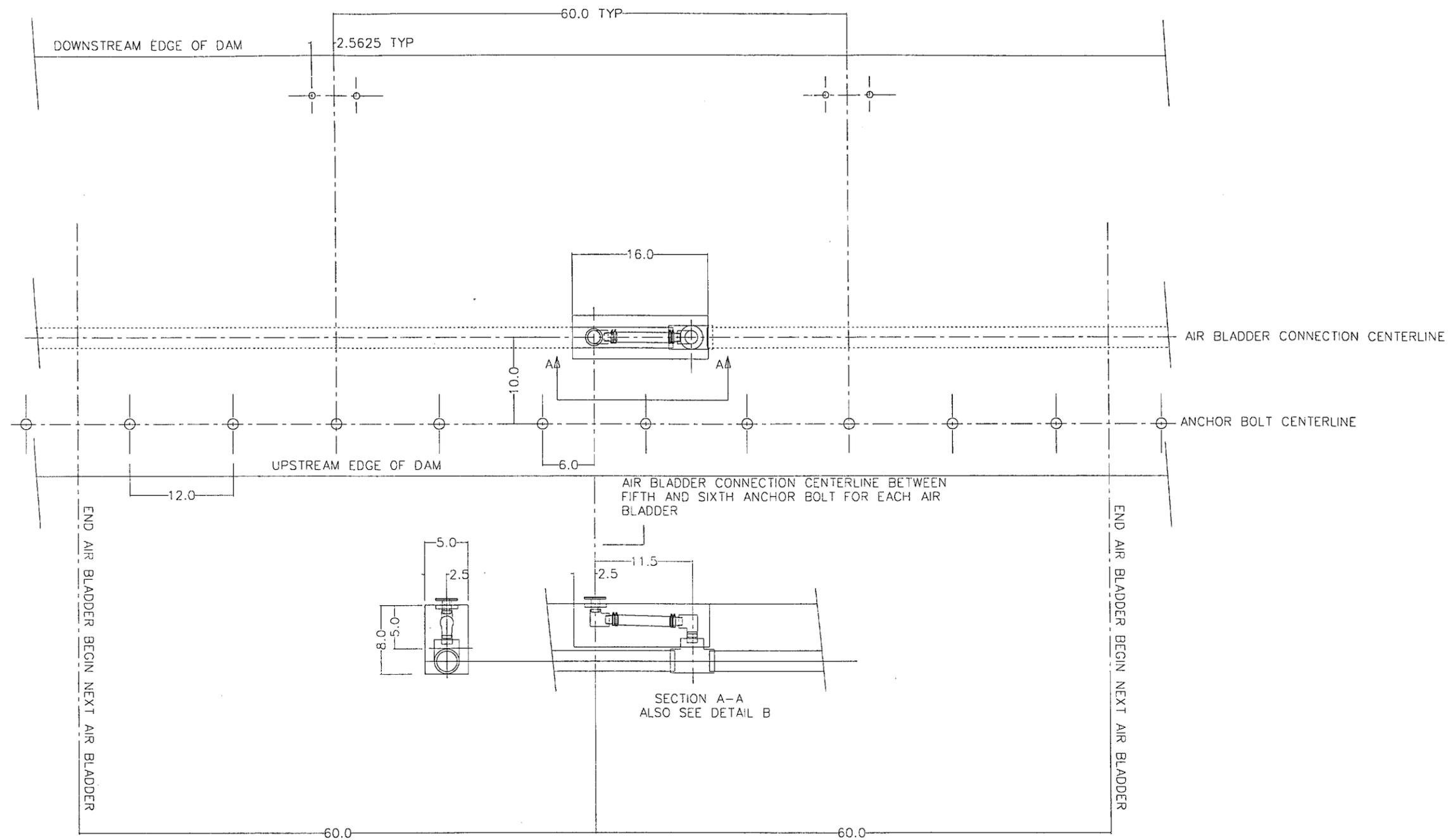
JOB
RUM RIVER

DWG. NO.
RR96111

DRAWING DESCRIPTION

SECTIONAL ELEVATION

DRAWN	DATE	REVISION	NO
RDE	6/19/96	PROPOSAL	1

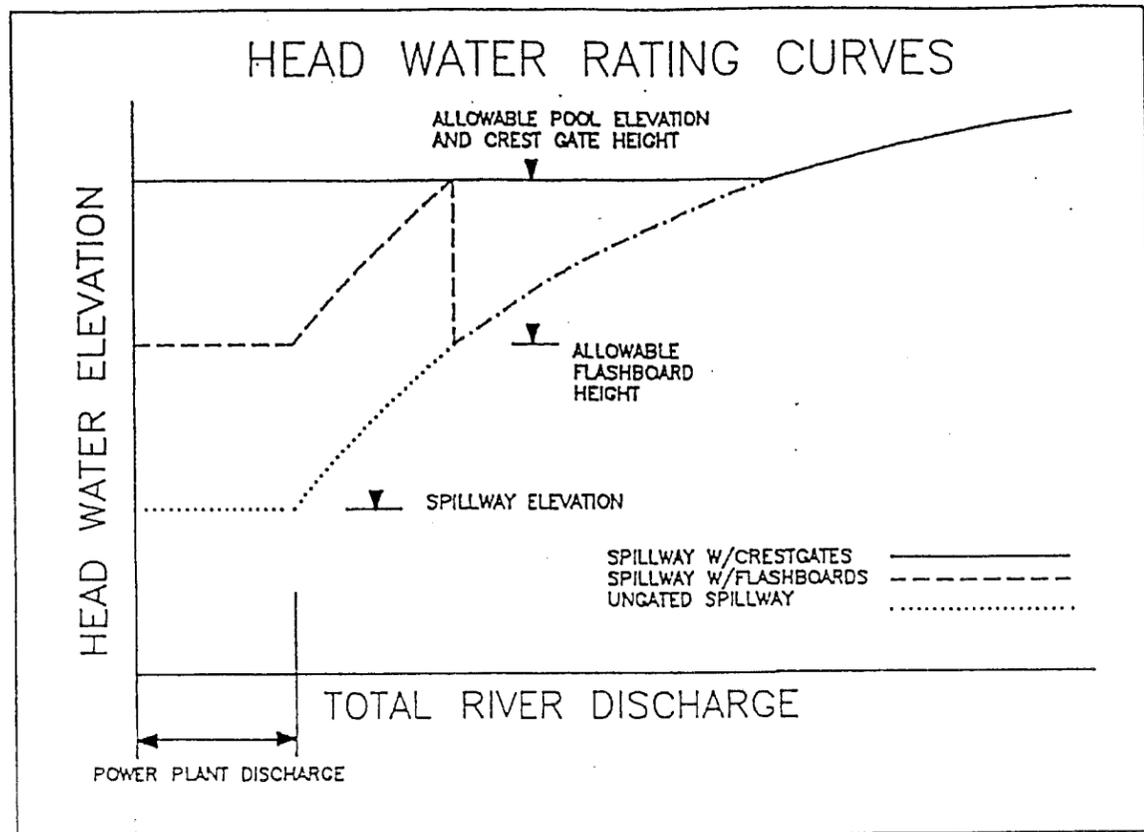


OBERMEYER HYDRO TO SUPPLY PARTS STARTING AT 1" x 1/2" BRASS BUSHING.

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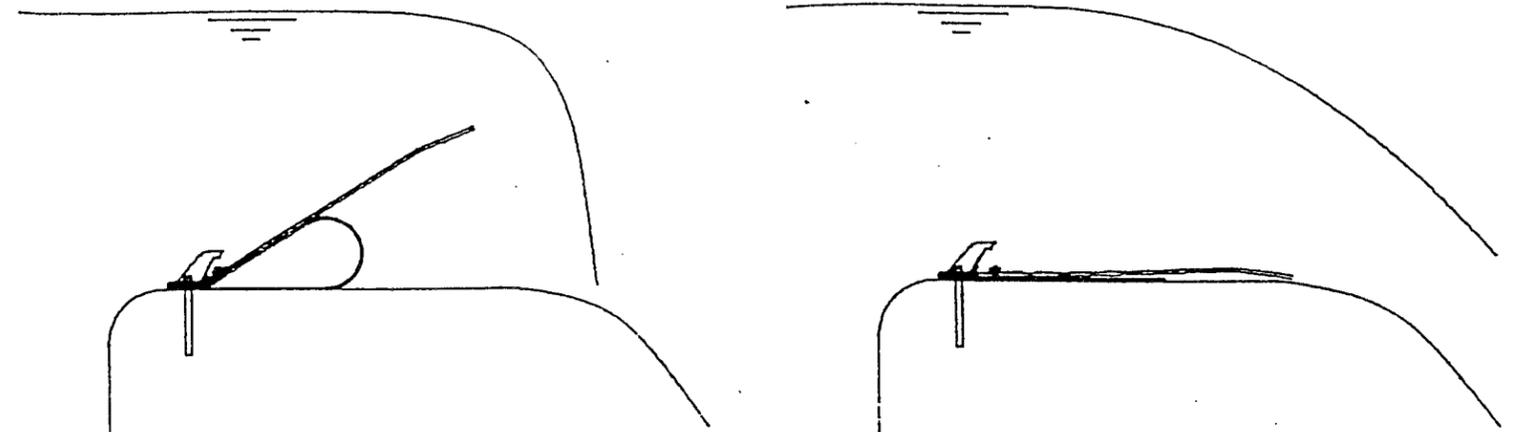
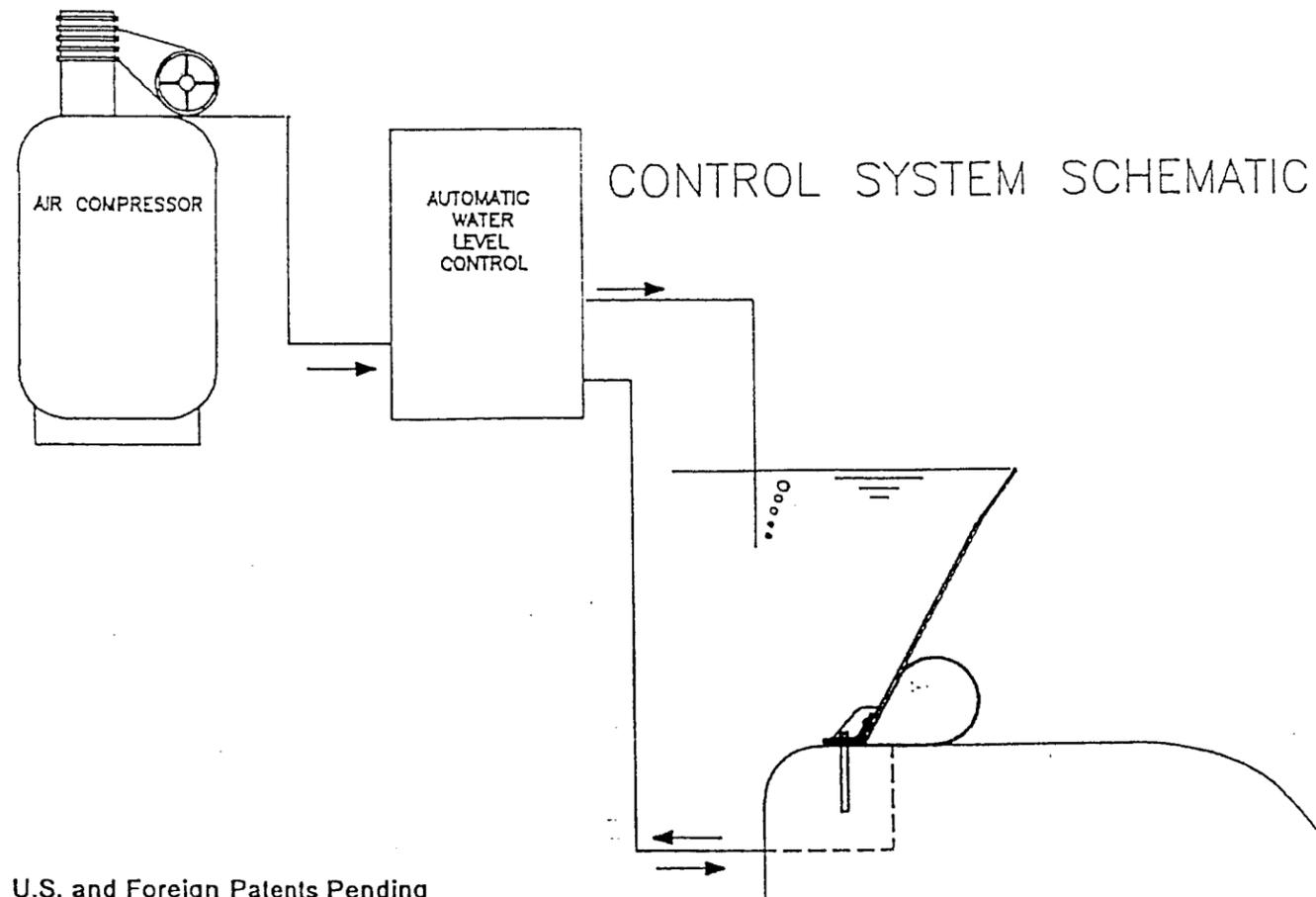
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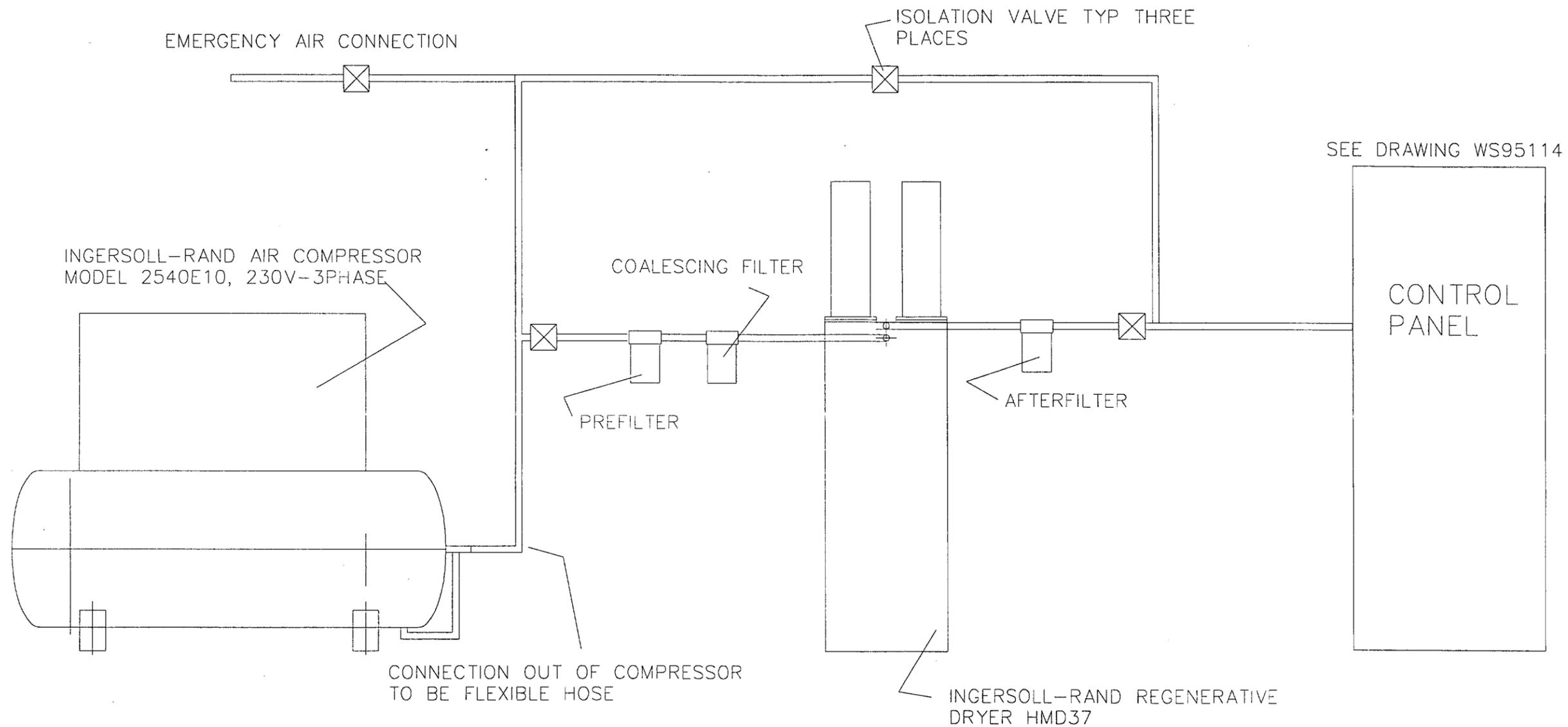
DRAWING DESCRIPTION		DRAWN	DATE	REVISION	NO
AIR CONNECTION DETAIL		RDE	6/19/96	PROPOSAL	1
OBERMEYER HYDRO ACCESSORIES, INC P.O. BOX 668 FORT COLLINS, COLORADO 80522 TEL 970-568-9844 FAX 970-568-9845					
SCALE	NONE				
JOB	RUM RIVER				
DWG. NO.	RR96112				



AUTOMATIC WATER LEVEL CONTROL

OHA Pneumatic Crest Gates are normally provided with an automatic water level control system. This control system inflates or deflates the air bladders as required in order to maintain a preset upstream water level over a wide range of spillway flow conditions. The OHA Control System is entirely pneumatic and uses no electrical power. It is, therefore, ideally suited for controlling pond level by lowering the gates if required during power failure and load rejection conditions. Stored power for both raising and lowering the gates in response to water level comes from the air receiver. Should the air receiver become exhausted after an extended power outage, the control system draws a small amount of air from the bladders to operate the water level detection system and to open the deflation valve as needed, so that the pond level set-point is not exceeded. Compressed air is provided by an electric motor driven air compressor connected to the control system through a desiccant dryer. Water level detection is by means of a bubbler pipe with air supplied from the control system.





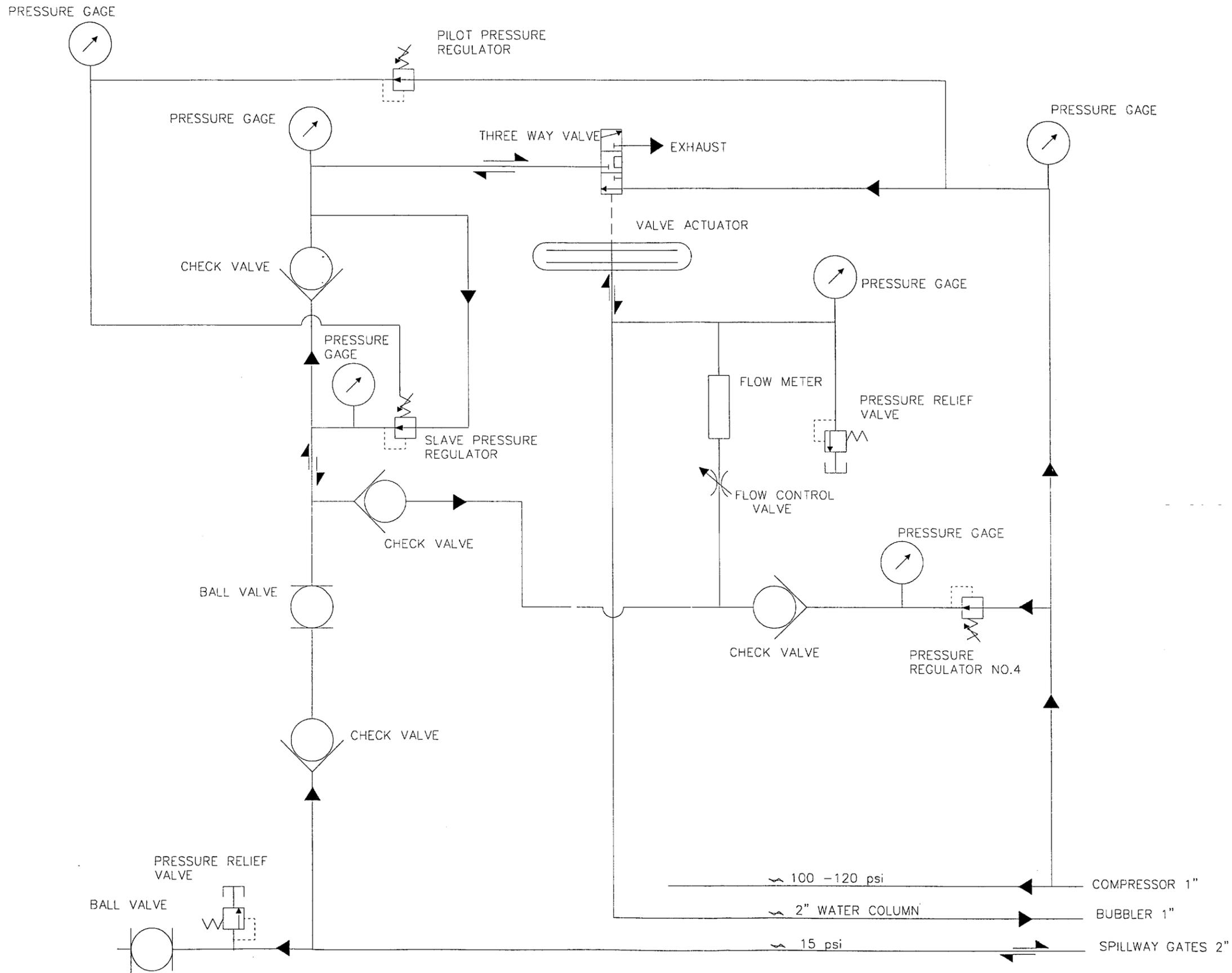
NOTES:

1. CONNECTING PIPE TO BE 1" SCH40 GALVANIZED PIPE
2. INCOPORATE UNIONS AS NEEDED TO SERVICE FILTERS AND DRYER
3. INLET AND OUTLETS TO COMPRESSOR AND DRYER ARE 1", INLET AND OUTLETS TO AIR FILTERS ARE 3/4"
4. COMPRESSOR VOLTAGES TO BE SPECIFIED BY END USER

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DRAWING DESCRIPTION		DRAWN	DATE	REVISION	NO
AIR SUPPLY SYSTEM		RDE	6/19/96	PROPOSAL	1
OBERMEYER HYDRO ACCESSORIES, INC <small>P.O. BOX 668 FORT COLLINS, COLORADO 80522 TEL 970-568-9844 FAX 970-568-9845</small>					
SCALE		NONE			
JOB		RUM RIVER			
DWG. NO.		RR96113			



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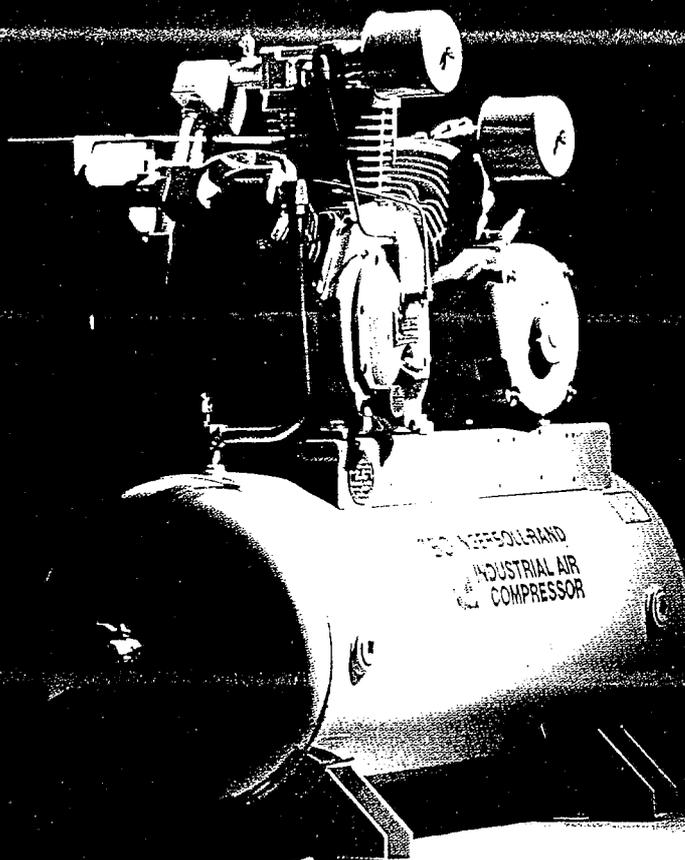
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DRAWING DESCRIPTION		DATE	REVISION	NO
CONTROL SCHEMATIC		6/19/96	PROPOSAL	1
SCALE		NONE		
JOB		RUM RIVER		
DWG. NO.		RR96114		

**OBERMEYER
HYDRO ACCESSORIES, INC**

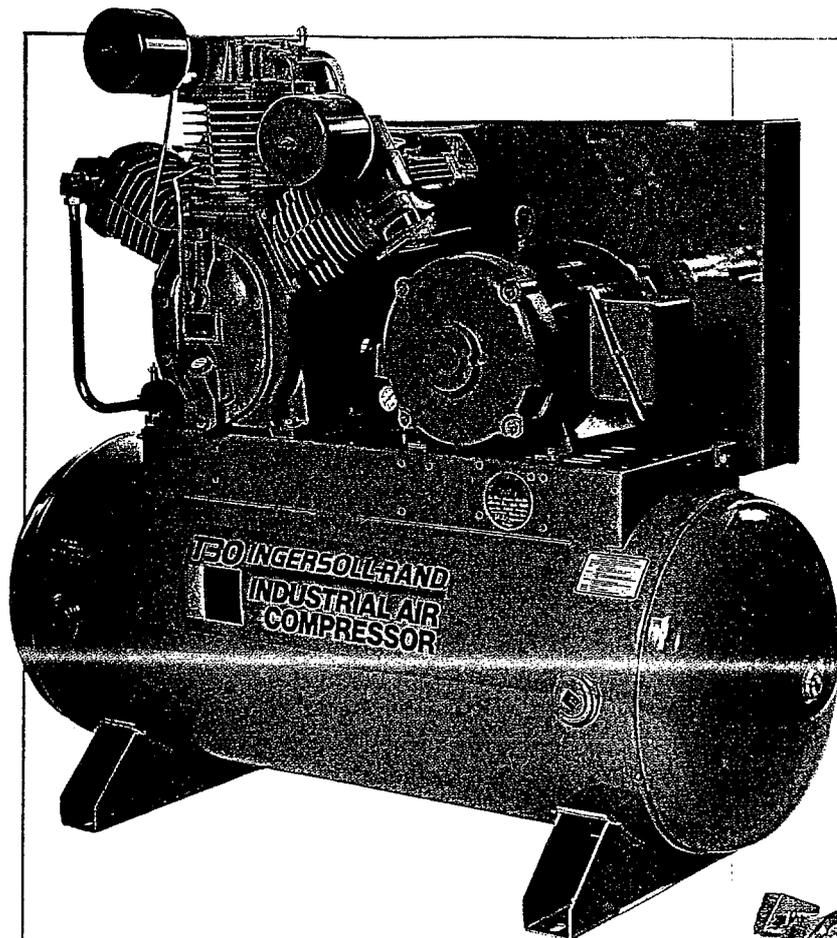
P.O. BOX 668
FORT COLLINS, COLORADO 80522
TEL 970-568-9844 FAX 970-568-9845

**Type-30® Two-Stage
Reciprocating Air Compressors
10-30 HP**



INGERSOLL-RAND®
AIR COMPRESSORS

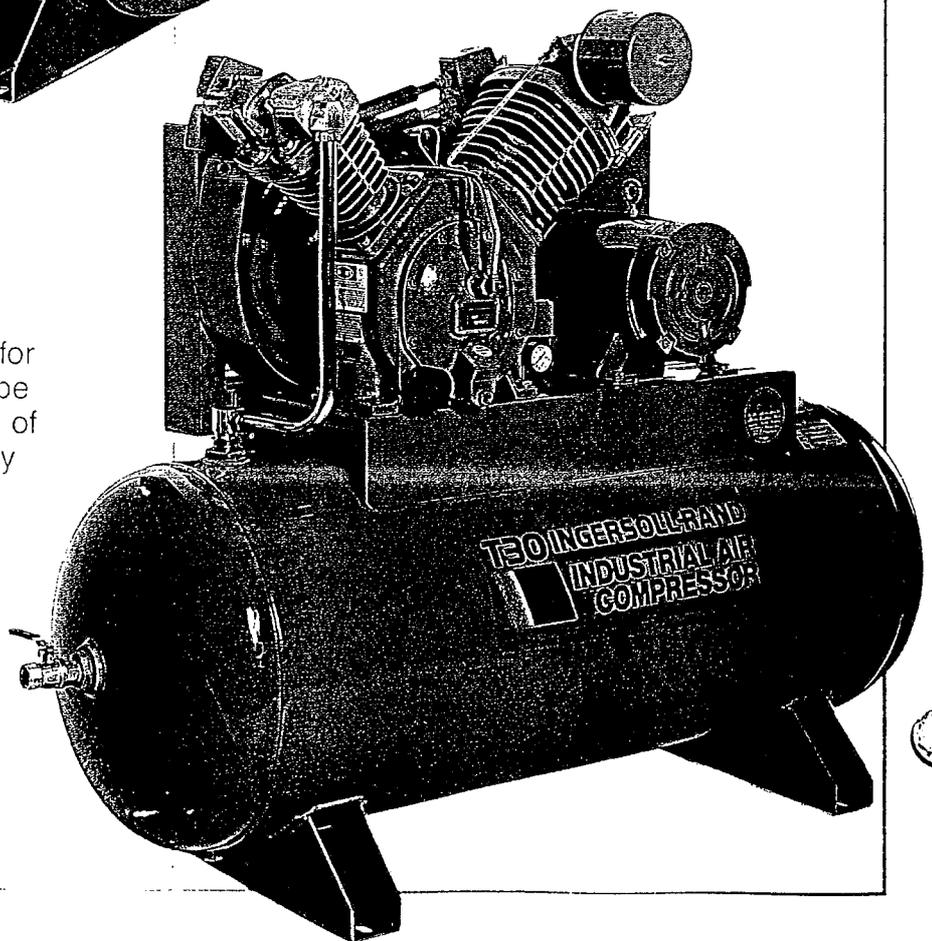
T-30 Model 3000 T-30 Model 7100



A compressor you can count on in the 10 to 30 hp class. No other compressor can match the Ingersoll-Rand Two-Stage reciprocating Type-30 for reliability, versatility and ease of installation.

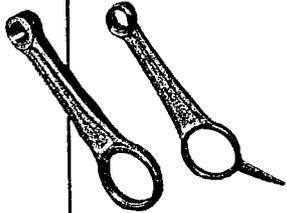
The Type-30 has proven reliability the world over. The tried and true design has made it the Number 1 seller in its horsepower range.

Count on the Type-30 to be there for you, when you need it. You won't be disappointed. After all, it's the pick of professionals—and—it's backed by the leader in long-lasting air compressors, INGERSOLL-RAND.



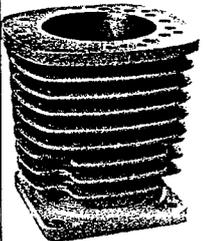
Features & Benefits

Connecting Rod



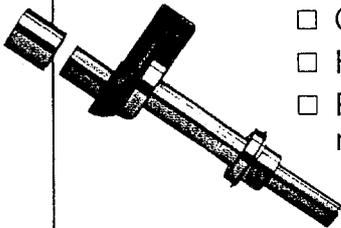
- One piece
- No adjustment required
- No bolts and nuts to come loose
- Integral splash lubrication dipper

Cylinder



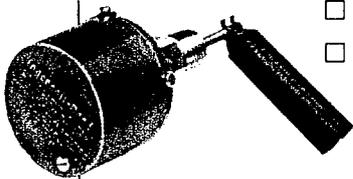
- Separate cast
- Heat of compression dissipated through deep radial fins

Crankshaft



- Overhung
- Heavy duty ball bearings
- Precision ground replaceable crankpin bushing

Low Oil Level Switch



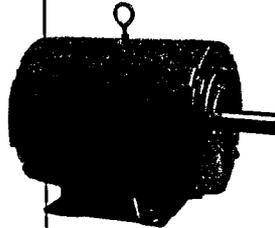
- Tamper proof switch
- Automatically stops compressor if oil level gets too low

Intercooler



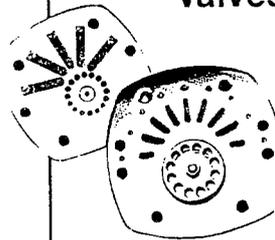
- Finned copper tubing dissipates heat six (6) times faster than bulk cast iron
- More efficient—uses less power

Motors

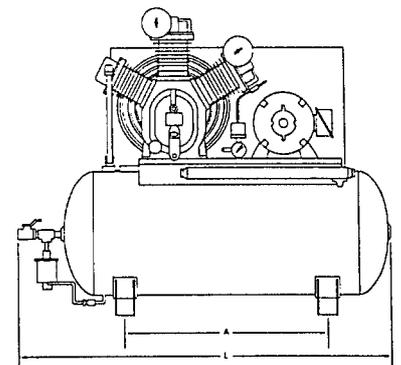
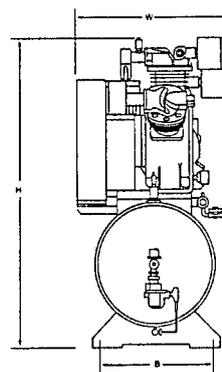


- 1800 RPM
- NEMA T frame
- ODP
- Class B insulation
- 1.15 service factor
- Self lubricated ball bearings

Valves



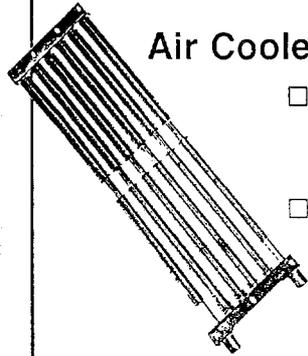
- Inlet finger valves
- Discharge concentric ring
- Low maintenance



Bolting Dimensions

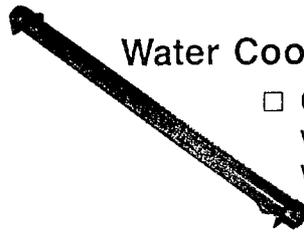
Receiver Size		A		B		C Bolt Size	
Gal	Litre	in	mm	in	mm	in	mm
80	304	39.5	1003	18.75	476	.62	16
120	454	42.0	1067	23.75	603	.62	16
240	909	42.0	1067	27.50	699	.75	19

Accessories & Options



Air Cooled Aftercooler

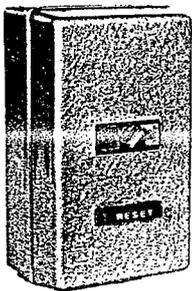
- Lowers package discharge temperature to within 25° of ambient
- Supplied with a safety valve to provide protection against over pressurization



Water Cooled Aftercooler

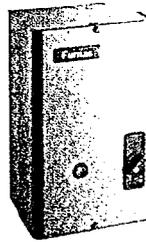
- Cools compressed air to within 15° of cooling water temperature

Magnetic Starter



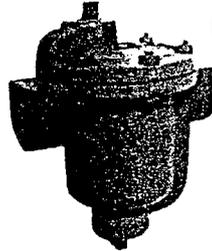
- Can be mounted or remotely mounted
- Recommended for motor protection
- NEMA sized components

Definite Purpose Starter



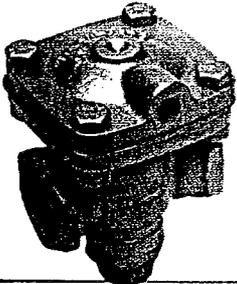
- Cost effective per load size

Automatic Condensation Drain



- Eliminates the need for manual draining of condensation in the air receiver

Automatic Water Valve



- Provides economical control of cooling water
- Will shut off cooling water when compressor is shut down

Dry Type Inlet Filter



- Four (4) micron filtration to 99.9% efficiency

Performance Data and Dimensions

Model No.	Receiver Size		Displacement		Length (l)		Width (w)		Height (h)		Shpg Wt		
	HP	gal	litre	cfm	m ³ /min	in	mm	in	mm	in	mm	lb	kg
T301180H	10	80	304	44	1.246	67	1702	28	711	52	1321	950	431
T3011120H	10	120	454	44	1.246	71	1803	28	711	67	1702	1050	476
T3015120H	15	120	454	60.5	1.713	88	2235	28	711	62	1600	1115	506
T3020120H	20	120	454	88	2.492	77	1956	33	838	61	1549	1390	631
T3025120H	25	120	454	103.4	2.928	77	1956	33	838	61	1549	1445	655
T3025240H	25	240	909	103.4	2.928	89	2261	33	838	67	1702	1930	875
T3025120H-125	25	120	454	121	3.427	77	1956	33	838	61	1549	1445	655
T3025240H-125	25	240	909	121	3.427	89	2261	33	838	67	1702	1930	875
T3030120H	30	120	454	121	3.427	77	1956	33	838	61	1549	1445	655
T3030240H	30	240	909	121	3.427	89	2261	33	838	67	1702	1930	875

Specifications

Frame The cylinder and crankshaft with bearings are frame (crankcase) supported. The frame is close grained cast iron, completely sealed against dirt to protect the running parts and provides a large oil sump. The frame has maximum accessibility due to the overhung type crankshaft.

Crankshaft is of stiff overhung construction with two liberally sized heavy duty ball bearings. Entire shaft is balanced with counter weights to ensure minimum running vibration.

Crankpin Bushing Precision ground replaceable wearing surface requires no alignment.

Connecting Rods are of the solid end precision type. There is no need for adjustment, no nuts to come loose. This sturdy one-piece construction, permitted by the overhung crankshaft design, results in maximum strength, minimum weight, and easy replacement.

Cylinders are separately cast and individually flange bolted in a balanced V-position on the frame ensuring 360 degrees cooling of the cylinder. The cylinders are precision honed for compatibility with the piston rings and employ deep radial fins to help remove the heat of compression. The cylinder heads are easily removable for inspection.

Pistons The low-pressure pistons are aluminum. A cast iron piston is used in the smaller high pressure cylinder (two-stage) to equalize mass and provide smooth running balance. Full-floating piston pins distribute wear evenly for long life.

Rings There are four piston rings for sealing compression and oil control. The taper-faced compression ring and beveled oil scraper ring provide quick seating. Two three-piece oil control rings maintain proper lubrication on cylinder wall.

Flywheel The fan-type flywheel produces a "cyclone" air blast to provide cooling for the deep finned cylinders and multi-tube intercoolers. Shrouds are used to direct the air blast. Flywheel is balanced to keep vibration to a minimum.

Intercooler Two-stage compressors use an intercooler. The intercooler between stages is of finned multi-tube construction to provide maximum cooling area. It is located directly in the

flywheel air blast to remove the heat of compression between stages keeping running temperatures and power needs to a minimum, and ensuring high air delivery for horsepower expended. Intercoolers are provided with safety valves to prevent overpressurization.

Lubrication Splash lubrication of running parts is simple and reliable. Lubrication dippers are integral with connecting rods and cannot come loose.

Centrifugal Unloader is automatic in operation as a function of speed. It is simple in construction and sealed in the frame against wear and dirt. The unloader bleeds air from intercooler and cylinders upon stopping, and prevents the compressor from starting against full load.

Inlet Filter A dry-type 10 micron inlet filter silencer is standard. Heavy duty dry-type 4 micron filter silencer is available as an option.

Valves Plate valve assemblies with quick-acting inlet fingers and a large bore discharge ring valve is utilized. Moving valve parts are manufactured from premium grade stainless steel. Valve components are easily removable for maintenance.

Drive is V-belt type with provision for easy takeup of belt slack. An easily removed totally enclosed OSHA type beltguard is standard equipment.

Base The compressor and motor are aligned on a heavy steel base. Receiver-mounted units are mounted on a sturdy foot-mounted receiver.

Motor Standard AC motors are 1800 rpm, NEMA T frame with drip-proof enclosure, Class B insulation, 1.15 Service Factor, and self-lubricated ball bearings. Standard three-phase motor voltages are 200, 230/460, and 575.

Receiver Receivers are ASME, National Board coded, and include pressure gauge, drain valve, service valve, and safety valve. An automatic condensate drain trap is available as an option.

Aftercooler An optional air-cooled aftercooler lowers package discharge air to within 25°F of ambient temperature. A safety valve is provided to protect against over-pressurization.

Controls Units are equipped for both automatic start and stop operation with NEMA 1 pressure switch and constant speed operation with reliable suction unloaders on compressor inlet.

OBERMEYER HYDRO, INC.

SALES AGREEMENT

NOTICES - All notices required by the contract will be sent to:

PURCHASER

COMPANY

Obermeyer Hydro, Inc
P.O. Box 668
Fort Collins, CO 80522
TEL: 303-568-9844
FAX: 303-568-9845

WARRANTY - Company warrants title to the product (s) and also warrants the product (s) on date of delivery to purchaser to be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THOSE EXPRESSLY STATED IN THIS CONTRACT.

If within five years from the date of initial operation, but not more than five years and six months from the date of shipment by Company of any item of the product (s), Purchaser discovers that such item was not as warranted and promptly notified Company in writing thereof, Company shall remedy such non-conformance by, at Company's option, adjustment or repair or replacement of the item or any affected part of the product (s). Company's liability shall be limited to a five year pro rata decreasing fraction of the purchase price of any component requiring warranty service or replacement. Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight in connection with the foregoing remedies. The same obligations and conditions shall extend to replacement parts furnished by Company thereunder. Company shall have the right of disposal of parts replaced by it. The Company shall not be liable for any repairs, replacements, or adjustments to the Product (s) or any costs of labor performed by the Purchaser or others without the Company's prior written approval.

The purchaser shall not operate the Product (s) which is considered to be defective, without first notifying the Company in writing of its intention to do so. Any such use of the Product (s) will be at the Purchaser's sole risk and liability unless Company gives Purchaser approval to operate the Product (s). Such approval will not be unreasonably withheld.

The effects of corrosion, erosion and normal wear and tear are specifically excluded from the Company's warranty.

Company's liability to Purchaser relating to the product (s) whether in contract or in tort arising out of warranties, representations, instructions, installations, or defects from any cause, shall be limited exclusively to correcting the product (s) and under the conditions as aforesaid.

Any separately listed item of the product (s) which is not manufactured by the Company shall be covered only by the express warranty of the manufacturer thereof.

PATENTS - Company shall pay costs and damages finally awarded in any suit against Purchaser or its vendees to the extent based on a finding that the design or construction of the product (s) as furnished infringes a United States patent (except infringement occurring as a result of incorporating a design or modification at Purchaser's request) provided that Purchaser promptly notifies Company of any charge of such infringement, and Company is given the right at its expense to settle such charge and to defend or control the defense of any suit based upon such charge. This paragraph sets forth Company's exclusive liability with respect to patents.

OBERMEYER HYDRO, INC.

DELAYS - If company suffers delay in performance due to any cause beyond its control, such as Acts of God, war, act of government, act or omission of Purchaser, fire, flood, strike or labor trouble, sabotage, delay in obtaining from others suitable services, materials, components, equipment, or transportation, the time of performance shall be extended a period of time equal to the period of the delay and its consequences. Company will give Purchaser notice in writing within a reasonable time after Company becomes aware of any such delay.

DELIVERY - Timely delivery at the designated point is contingent upon Purchaser's supplying to Company, when needed, all required technical information, including drawing approval, and all required commercial documentation. Company may make partial shipments. Company shall select method of transportation and route, unless terms are FOB point of shipment without freight allowed and Purchaser specifies the method and route. When delivery terms are FOB destination or freight allowed to destination, "destination" means common carrier delivery point (within the continental United States, excluding Alaska and Hawaii), nearest the final destination. For shipments outside the United States Company shall arrange for inland shipment to port of exit and shall cooperate with Purchaser's agents in making necessary arrangements for overseas shipment and preparing necessary shipping documents.

LIQUIDATED DAMAGES - The Purchaser's sole remedy for the Company's failure to deliver in a timely manner shall be Liquidated Damages in the amount of 0.1% of the contract price per day.

STORAGE - Any item of the product (s) on which manufacture or delivery is delayed by causes within the Purchaser's control or causes which affect Purchaser's ability to receive, the product (s) may be placed in storage by Company for Purchaser's account and risk.

TITLE AND INSURANCE - Title to the product (s) and risk of loss or damage shall pass to Purchaser upon tender of delivery, except that a security interest in the product (s) or any replacement shall remain in Company, regardless of mode of attachment to realty or other property, until the full price has been paid in cash. Purchaser agrees to do all acts necessary to perfect and maintain said security interest, and to protect the Company's interest by adequately insuring the product (s) against loss or damage from any external cause with Company named as insured or co-insured.

TAXES AND LICENSES - The price does not include any Federal, State or local property, license, privilege, sales, use, excise, gross receipts or other like taxes which may be now or hereafter applicable to, measured by, or imposed upon this transaction, the Product (s) its sale, its value or its use, or any services performed in connection therewith. Such taxes will be itemized separately to Purchaser, who shall make payment to the Company. The company will accept a valid exemption certificate from the Purchaser if applicable. If such exemption certificate is not recognized by the governmental taxing authority, Purchaser agrees to assume responsibility for payment of any taxes covered by such exemption certificate.

The Purchaser shall obtain all construction and other permits, licenses, inspections as may be required for the erection, construction and operation of the Purchaser's facilities.

SPECIAL SHIPPING DEVICES - The value of each special shipping device (oil barrel, reel, tarpaulin, cradle, crib and the like) used by Company to contain or protect the product (s) in

OBERMEYER HYDRO, INC.

shipment will be invoiced to the Purchaser as a separately stated addition to the contract price. If the Company's Proposal or quotation or other contract documents stipulate the return of any such device, it shall be returned by the Purchaser in good condition for credit, FOB Purchaser's plant, freight collect, within thirty (30) days after receipt by Purchaser.

Return of any such device as to which there is no stipulation but which has been separately invoiced is at the option of the Purchaser. If returned promptly in useable condition, FOB destination, freight prepaid, Company will grant purchaser a credit with the invoiced amount (except oil barrels, as to which arrangements for return and refund must be made by the Purchaser with the refiner).

The foregoing provisions as to special shipping devices shall not apply to any such device shipped outside the continental United States and Canada.

GENERAL - Company will comply with all laws applicable to Company. Installation, erection or servicing of the product (s) by Company, if specified or requested by Purchaser, shall be governed by the terms and conditions of Company(s) service agreement.

This document and the other documents specifically referred to as being a part hereof, constitute the entire contract on the subject matter, and shall not be modified except in writing signed by both parties. Assignment may be made only with written consent of the other party.

TERMINATION - The Company may terminate this agreement upon thirty (30) days prior written notice to Purchaser for any material breach of this contract by Purchaser. In the event of such termination, Purchaser shall pay out reasonable and proper termination charges as set out in a) and b) below.

a) Purchaser has it full remedies at law for a material breach of contract by the Company and damages, if any, will be recoverable as states in the contract. All payments due will be suspended until Purchaser has had a reasonable opportunity to complete the project. For all other stipulations Purchaser may terminate this contract upon thirty (30) days prior written notice to the Company and payment of reasonable and proper termination charges. Such charges will include a portion of the Purchase Order Price, adjusted as necessary reflecting the amount of work completed, man hours expended and materials acquired at the time of termination plus the expenses associated with the termination, including, but not limited to, any additional expenses incurred by reason of termination or cancellation of the Company's agreement with its suppliers and any applicable costs plus pro rata profits calculated on the full contract price.

b) All termination charges shall be due and payable within thirty (30) days after the date of the Company's invoice.

SUSPENSION - Purchaser may, by written notice to the Company, suspend the Company's performance, in whole or in part, or extend the work for reason of force majeure, inability to obtain local state or federal government licensing or approvals, or for any other reason, except that such right of suspension or extension with respect to any portion of the Product (s) which has been released by the Company for procurement or manufacture shall require the mutual agreement of the parties.

OBERMEYER HYDRO, INC.

In the event of any suspension or extension, other provisions of this contract, such as the price of the Product (s) and Services, shall be equitably adjusted to reflect the time of suspension, and any additional cost or expenses which may be occasioned to the Company hereby. At any time after suspension (s) ordered by the Purchaser has extended for a cumulative period of ninety (90) days, except to the extent that the Company may have previously consented to a suspension in excess of ninety (90) days, the Company may, upon giving Purchaser at least thirty (30) days prior written notice, terminate the contract and Purchaser shall pay reasonable and proper termination charges as set out in the Termination section a) and b).

TERMS - Payment shall be made by wire transfer or certified funds as follows: 35% upon placement of order, 60% prior to shipment, 5% shall be paid upon completion of installation or 60 days after shipping whichever occurs first.

SCOPE OF SUPPLY - The Company's Scope of Supply is listed on the attached Price Proposal which is hereby incorporated by reference.

PRICE - The price for this system FOB job site is _____.

GOVERNING LAW - The interpretation of this contract shall be governed by the laws of the State of Colorado, U.S.A..

OBERMEYER HYDRO, INC
P.O. BOX 668, FORT COLLINS, CO 80522

By _____

Henry K. Obermeyer, President

PURCHASER'S ACCEPTANCE

The foregoing Proposal is hereby accepted

(Name of Purchaser)

By _____

Title _____

Date _____

OBERMEYER HYDRO, INC.
INSTALLATION AND ORDER LIST

PROJECT NAME	LENGTH (FT)	HEIGHT (HT)	APPLICATION	INSTALL DATE	LOCATION	OWNER	CONTACT	TELEPHONE
BOW RIVER	19 x 4 BAYS							
	10	7.1	HYDROELECTRIC	FALL 96	ALBERTA	TRANS ALTA UTILITIES		
CLINTON WEIR	216	6				MONECO AGRA		
LEMHI 3	100	3.5	DIVERSION	SUMMER 96	MICHIGAN	U.S. ARMY CORPS OF ENGINEERS		
SOUTH PLATTE IRRIGATION	36		IRRIGATION DIVERSION	FALL 96	IDAHO	U.S. BUREAU OF REC.	DAN WILSON	208-378-5213
NINE MILE HED	224	4	IRRIGATION DIVERSION	APRIL 96	COLORADO	SOUTH PLATTE IRRIGATION CO	BILL BAKER	970-867-6221
LEMHI	140	10	HYDROELECTRIC	NOV 97	WASHINGTON	WASHINGTON WATER POWER	STEVE SHULTZ	509-482-4008
FOREST PORT	20	3	DIVERSION	JAN 96	IDAHO	U.S. BUREAU OF REC.	DAN WILSON	208-378-5213
SECHELT HYDRO	3.15 METER	19.5 METER	HYDROELECTRIC	JAN 96	NEW YORK	ALGONQUIN POWER	KEVIN WATSON	905-615-8900
	3.75 METER	4.9 METER		NOV 95	BRITISH COLUMBIA	CONWEST EXPLORATION	BRIAN ROBIN	416-362-6721
BAY CITY	224	10.5	IRRIGATION DIVERSION	AUG 95	TEXAS	LOWER COLORADO RIVER AUTH.	RICHARD FRITHIOFF	512-473-3333
CHERRY CREEK	50	3	RECREATION	AUG 95	COLORADO	PLATTE RIVER GREENWAY	JEFF SHOEMAKER	303-698-1322
	50	2						
NORWAY HYDRO	9	8	TRASH GATE	SEPT 95	INDIANA	NORTHERN INDIANA PUB. SER.	BILL HINDSLEY	219-583-1136
MCKEY CREEK	100	6	FISH SCREEN	JAN 96	OREGON	U.S. BUREAU OF RECL.	JOHN BILLINGSLEY	509-575-5946
BIG CREEK	50	5	DIVERSION	SEPT 95	ONTARIO	ONTARIO DEPT OF FISH	ANDREW HALLETT	705-941-3000
CENTRAL OREGON	24	3	DIVERSION	MARCH 95	OREGON	CENTRAL OREGON IRR. DIST.	BOB BEAL	503-385-7846
BIG CARP CREEK	20	3	FISH DIVERSION	MARCH 95	ONTARIO	ONTARIO DEPT OF FISH	ANDREW HALLETT	705-941-3000
PROSSER DIVERSION	10	4	TRASH GATE	NOV 94	WASHINGTON	U.S. BUREAU OF RECL.	BERNIE TAFOYA	509-575-5848
BEAR RIVER BIRD REF.	16	4	SOLAR POWER	AUG 94	UTAH	U.S. BUREAU OF RECL.	LEE BAXTER	801-379-1174
STRAWBERRY CANAL	5	5	IRRIGATION	AUG 94	UTAH	U.S. BUREAU OF RECL.	LEE BAXTER	801-379-1174
AKOLKOLEX HYDRO	27 METER	1 METER	HYDROELECTRIC	AUG 94	BRITISH COLUMBIA	CANADIAN HYDRO DEV.	ROSS KEATING	403-298-0250
ASHUELOT HYDRO	77	4.25	HYDROELECTRIC	AUG 94	VERMONT	HDI ASSOCIATES	MATT RUBIN	802-223-7141
SAYLORVILLE LAKE	430	6	FLOOD CONTROL	DEC 93	IOWA	U.S. ARMY CORPS ENGINEERS	DAVID WEHRLEY	309-788-6361
LAKE CONNELL DAM	14' x 7 BAYS	4	DIVERSION	OCT 93	ALASKA	KETCHIKAN PULP	KEN WEISGRAM	907-225-2151
LOWER ROBERTSON	16	7	HYDROELECTRIC	AUG 93	VERMONT	HDI ASSOCIATES	MATT RUBIN	802-223-7141
OAKDALE HYDRO	10' x 3 BAYS	2	HYDROELECTRIC	AUG 93	INDIANA	NORTHERN INDIANA PUB SER.	BILL HINDSLEY	219-583-1136
ELECTRON STATION	30	6	HYDROELECTRIC	AUG 93	WASHINGTON	PUGET POWER AND LIGHT	CARL SMITH	206-893-6218
BLACK RIVER HYDRO	70	4.25	HYDROELECTRIC	OCT 92	ONTARIO	CONWEST EXPLORATION	BRIAN ROBIN	416-362-6721
ENOUSBURG FALLS	165	2	HYDROELECTRIC	JUNE 92	VERMONT	VILLAGE OF ENOUSBURG FALLS	DWAIN WAYNE	603-228-1122
PEMBROKE HYDRO	153	4.25	HYDROELECTRIC	NOV 91	NEW HAMPSHIRE	NATIONAL HYDRO	ROBERT WINSHIP	617-357-9029
KIRBY DAM	80	4	HYDROELECTRIC	AUG 90	IDAHO	ATLANTA POWER CO	LYNN STEVENSON	208-764-2310
GITZLER HYDRO	93	4	HYDROELECTRIC	AUG 90	ONTARIO	CARLISLE POWER CO.	RICHARD KUIPER	519-756-2571
RAYMONDVILLE HYDRO	293	2	HYDROELECTRIC	AUG 89	NEW YORK	NIAGRA MOHAWK	JOE ZAGRABELNI	315-267-5234
MASCOMA HYDRO	120	3	HYDROELECTRIC	AUG 88	NEW HAMPSHIRE	DRESSER RAND CO.	TIM BUZZEL	603-448-3245

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