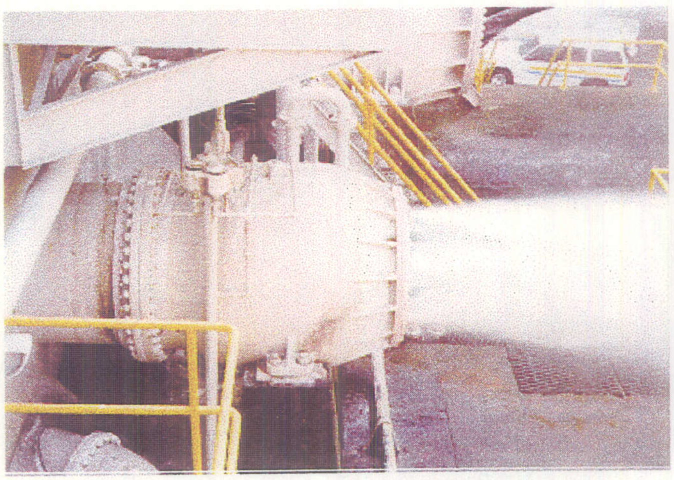
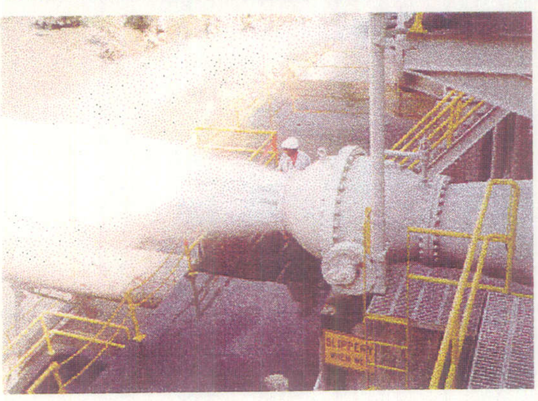
EQUIPMENT INSPECTION / EVALUATION REPORT

MORRIS DAM INLET/OUTLET WORKS MODERNIZATION

County of Los Angeles Department of Public Works





August 6, 1998

U. S. Bureau of Reclamation
Technical Service Center

WATER RESOURCES MANAGEMENT.....FOR THE FUTURE

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Evaluation Reports

DATE	PEER REVIEWER(S)	CODE
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	Printed Name	
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JAN -6 1999

D-8420

Emily Hasegawa
Los Angeles County Department of Public Works
Hydraulic Water Conservation Division
900 South Fremont Ave
PO Box 1460.
Alhambra CA 91803-1460

Subject: Clarification of Terms in Mechanical Examination Reports

Ms. Hasegawa,

In our Mechanical Evaluation Report submitted on October 28, 1998, we used several descriptive ratings to describe the condition of the equipment. The following is our interpretation of the terms:

- SATISFACTORY - *The equipment is in good condition, well maintained with appropriate wear considering age and location. No major repair or maintenance is currently required and equipment may be safely operated.*

- CONDITIONAL - *The equipment is structurally sound, but requires some maintenance or repairs. The equipment can be safely operated.*

- UNSATISFACTORY - *The equipment is presently structurally sound, but requires major repairs or maintenance. If possible the equipment should not be used for normal operations, but may be used in emergency conditions.*

- RESTRICTED - *The equipment may not be structurally sound and requires major repair, maintenance or removal from service. The equipment should not be used in normal operation, and use in an emergency situation may jeopardize the safety of personnel.*

If further clarification is warranted, please contact me and I will provide the necessary information.

Sincerely,

Ronald Arrington
Senior Mechanical Engineer, TSC

WBR:RMArrington:bc:303 445-2877:1/5/99
letter5.wpd

MECHANICAL EXAMINATION REPORT

Morris Dam Inlet/Outlet Works Modernization

County of Los Angeles Department of Public Works

Technical Service Center
Bureau of Reclamation
Denver, Colorado

October 1998

MORRIS DAM

INLET\OUTLET MODERNIZATION

July 1998

ASSESSMENT OF ELECTRICAL EQUIPMENT

. General

A site inspection was conducted on July 14, 1998 to assess the current condition of the electrical equipment and systems at Morris Dam and to provide recommendations regarding repair or replacement of electrical equipment at the dam. The incoming power and primary and emergency power systems were also inspected and evaluated. Recommendations provided are based on a general concept to modernize and automate this equipment for future safe and reliable long term operation. A more detailed conceptual design report will be provided at a later date which will provide specifics on a recommended plan to modernize and automate this facility. The inspection was conducted by Larry Rossi and Lisa Gamuciello from the Electrical Plant and Electrical System Groups out of the Bureau of Reclamation's Denver Office.

2. General Facility Condition

The electrical installations and equipment found throughout the dam were generally found to be very old (70 years or more), deteriorating, and in need of replacement. Some electrical equipment installations violated the present National Electrical Code and would be considered a safety hazard. Environmental hazards such as PCB's in the transformers and hazards such as lead or asbestos in the power cables may also have also been present.

Because of the age, poor condition, maintainability, safety, and environmental concerns of the older electrical installations within the dam; we recommend that these electrical installations be replaced in their entirety. Some of the electrical equipment or installations have been rebuilt or modified over the years and may be suitable in their present state or need minor work. Below, we have noted various electrical equipment or systems and have provided our recommendations regarding repair, rework, or replacement.

ELECTRICAL EQUIPMENT ASSESSMENT

1. Incoming Service Equipment-

a. Equipment condition: The incoming power and associated service equipment to the dam includes three outdoor, pole-mounted single-phase transformers each rated 50 kVA. The condition of this equipment is poor and parts of the installation appear to have been done improperly. When we have determined the required transformer ratings this equipment should be replaced by the owner, Edison Electric.

There are two "Lighting Transformers" in the dam. One is rated 25 kVA and the other is rated 15 kVA. These transformers have been leaking oil onto the floor. It is likely that the oil contains hazardous PCBs. It is not known why there are 2 transformers there and why they have different ratings. When we have determined the required transformer ratings this equipment must be replaced.

b. Repair or replacement recommendation: During the conceptual design phase, we will perform a study of all the existing loads within the dam and of the projected future loads associated with modernization of the various outlet valves and gates to determine the total power requirements of the dam. Based on this study, we will provide a recommended size of the new power transformers which will be required to service the dam and appurtenant structures.

2. Standby Power Equipment

a. Equipment condition: The standby engine-generator and transfer switch had recently been installed in appeared to be in good condition. No known operation or maintenance problems were noted by field personnel.

b. Repair or replacement recommendation: The existing size of the standby engine generator set will be examined in the conceptual design phase to determine whether it is sufficient to provide power to all standby power loads (ie essential equipment). Its present capacity of 125 amperes at 480 volts is about one-third of the primary source which is rated 400 amperes at 480 volts. Other electrical equipment located in the engine generator room such as lighting transformers, fuses, and old wiring was noted to be in poor condition and would need to be replaced.

3. 480- Volt Switching Equipment-

a. Equipment condition: Most of the 480-volt switching equipment for distribution of power within the dam is located either in the southeast pylon chamber or the guard valve(emergency valve) chamber. The switching equipment consists of screw-in type fuse assembles and disconnect switches. Many of the fuse sizes appeared to be oversized for the loads that they were feeding and did not provide adequate overcurrent protection.

b. Repair or replacement recommendation: All of these fuse and disconnect switches need to be replaced since they are old, in poor condition, improperly sized, and can not be maintained. This switching equipment will be replaced with 480 volt distribution panels that will centralize all of the power distribution within the dam and will also provide overcurrent protection for equipment serviced.

4. Cable and Conduit Systems

a. Equipment condition: The existing power cable for all old installations within the dam was noted to be in poor condition with signs of insulation damage and deterioration over the years. The power cable may also contain lead or asbestos which is considered to be an environmental hazard. Conduit systems were generally noted to be in good shape based on the exterior inspection but were not inspected internally for rust or other damage.

b. Repair or replacement recommendation: We recommend that all power cables be replaced based on their age and their present condition. Conduit systems would need to be reviewed on an individual basis whether they could be reused as part of the modernization work. Note that if cables contained asbestos, then the conduits containing these cables would also most likely have some asbestos particles which would need to be properly cleaned prior to reuse.

5. Motor Starters and Control Equipment-

a. Equipment condition: Motor starters and control equipment for the two domestic water pumps have recently been replaced and are in good condition. The probe control cable which provides water level signals to automatically control these pumps based on water level in the domestic water tank has been damaged and needs to be replaced.

The control equipment, starters, and associated probe control cable for the high pressure pumps is old and outdated and should be replaced. These high pressure pumps in conjunction with the high pressure tank serve a dual purpose to provide a high pressure piping system for the fire system and to provide a high pressure water source for operating any of the four dam outlet guard gates.

The motor operators and control equipment for the two 72-inch outlet guard butterfly-valves are old and outdated and should be replaced.

The motor starters and control equipment for the four Azusa Conduit slide gates have recently been replaced and appear to be in good conditions.

The tractor gate hoist control equipment is old and outdated and should probably be considered for replacement.
The existing motor starters and control equipment for the two dam sump pumps presently operate satisfactory and appear to be in fair condition.

b. Repair or replacement recommendation: Based on the age and condition of the control equipment found for various gates, valves, and pumps throughout the dam, we would recommend that all motor starters and associated control equipment be replaced with the exception of the Azusa Conduit outlet slide gates and the domestic water pumps which have be recently been updated. The dam sump pump control equipment could also be retained since it appears that this equipment is in fair condition.

The replacement control equipment would include combination motor starters and control panels which will provide better protection for equipment while providing indication and alarm status of operating equipment.

6. Communication and Monitoring System-

a. Equipment condition: The following items are being monitored on their current system: 6 piezometers, Reservoir Elevation, Right abutment flow (Leakage every 3 hours), Main abutment flow (Leakage every 3 hours), Reset event mode-used after earthquakes, Joint meters, and Crack meters. This system is called ADAS and was installed in Dec '97. The data is transferred by satellite to an office in Alhambra.

As part of the outlet works modernization, we would be recommending that all valves and gates be considered for remote operation and monitoring at the top of the dam as well as local operation at this equipment. If desired, valve or gate position and operating status could be added to the ADAS system.

b. Repair or replacement recommendation: Many of the existing telephones in the dam don't work because of deteriorated wiring. This entire system must be replaced.

7. Dam Lighting Systems-

a. Equipment condition: The existing lighting fixtures at the top of the dam are of pole mounted and have globes which contain compact fluorescent type lamps. These lights were controlled by a timer which had them come on for some portion of the night.

The existing lighting fixtures for the tractor gate house, engine-generator building, and inclined dam gallery have incandescent lamps with wire guards and were operated with a light switch.

Most of the lighting fixtures and associated wiring was very old and could use replacement.

b. Repair or replacement recommendation: Because of the age and condition of the existing lighting system, we would recommend replacement and/or major modifications to the existing system. The lighting systems can be enhanced or improved by using modern fixtures that have high intensity discharge such as metal halide or high pressure sodium lamps. These light sources provide greater light output per watt and longer lamp life. We would recommend that each specific area of the dam be reviewed more closely prior to the design phase to clearly identify lighting requirements.

Date of Examination 1: June 29 thru July 1, 1998
Examination Participants: Ron Arrington
Gary Rood

Date of Examination 2: July 14, 1998
Examination Participants: Gary Rood

Date of Examination 3: September 8 thru 10, 1998
Examination Participants: Gary Rood
Peter Hoffmann

Date of Examination 4: July 14, 1998
Examination Participants: Gary Rood
Bill McStraw
George Taylor

A. Operating Conditions During Examinations.

Reservoir Water Surface Elevation 1142.82 during examination 1.
Reservoir Water Surface Elevation 1123.19 during examination 2.
Reservoir Water Surface Elevation 1000.00 during examination 3.
Reservoir Water Surface Elevation 970.00 during examination 4.

B. Conclusions.

The following conclusions were reached from a review of available data and the field examinations:

1. All of the mechanical equipment at the facility has been well maintained.

2. Slide gate 3A performed satisfactorily during the balanced and unbalanced operations, did not show any signs of cavitation or corrosion damage on the gate leaf, interior body, or seat. The overall rating for this gate is **SATISFACTORY** (No maintenance or repairs to structure is currently required). This gate is capable of performing its intended designed service.

3. Slide gate 4A performed satisfactorily during the balanced and unbalanced operations, did not show any signs of cavitation or corrosion damage on the gate leaf, interior body, or seat. The overall rating for this gate is **SATISFACTORY** (No maintenance or repairs to structure is currently required). This gate is capable of performing its intended designed service.

4. Butterfly valve 1A performed satisfactorily during the balanced and unbalanced operations except the close limit switch requires adjustment. The upstream face of the disc and seat attachment bolts are badly corroded. There was no evidence of cavitation damage to the disc or interior valve body. The overall rating for this valve is **CONDITIONAL** (Valve safely operable, but some maintenance/repairs required). The valve is capable of performing its intended designed service.

5. Butterfly valve 6A performed satisfactorily during the balanced and unbalanced operations, except the close limit switch requires adjustment. There was no evidence of cavitation damage to the disc or interior valve body. The overall rating for this valve is **SATISFACTORY** (No maintenance or repairs to structure is currently required) The valve is capable of performing its intended designed service.

6. Needle valve 1, operated satisfactorily during the examination. The interior of the valve is badly corroded. The leakage from the valve indicates some damage to the seating surfaces. Due to its condition and reports of operational problems experienced with valve 6 an identical valve, this valve has been rated **UNSATISFACTORY** (Major structural repairs/replacement/maintenance required).

7. Needle valve 3, operated satisfactorily during the examination. The interior of the valve is in satisfactory condition. The leakage from the valve indicates some damage to the seating surfaces. Due to reports of operational problems experienced with valve 6, a valve of similar design, this valve has been rated **UNSATISFACTORY** (Major structural repairs/replacement/maintenance required).

8. Needle valve 4, operated satisfactorily during the examination. The interior of the valve is in satisfactory condition. The leakage from the valve indicates some damage to the seating surfaces. Because this valve is manually operated and not of the design of valve 6, it has been rated **SATISFACTORY** (No maintenance or repairs to structure is currently required).

9. Needle valve 6, operated satisfactorily during the examination. The interior of the valve is in satisfactory condition. The leakage from the valve indicates some damage to the seating surfaces. Due to reports of operational problems experienced with valve 6, this valve has been rated **RESTRICTED** (Gate should not be operated)

10. The coal tar epoxy lining in the interior of outlet conduits Nos. 3 and 4 was generally in very good condition. The ultrasonic measurements of the wall

thickness and the stress analysis indicated that the stresses did not exceed the allowable anywhere in the conduit. These conduits have been rated **SATISFACTORY** (No maintenance or repairs to structure is currently required). For detailed information see Outlet Pipe Inspection report in Section 15.

11. The coal tar epoxy lining in the interior of outlet conduit Nos. 6 was generally in very good condition except for three damaged areas 4 to 6 inches in diameter just upstream of the butterfly valve. The ultrasonic measurements of the wall thickness and the stress analysis indicated that the stresses did not exceed the allowable anywhere in the conduit. This conduit has been rated **SATISFACTORY** (No maintenance or repairs to conduit is currently required). For detailed information see Outlet Pipe Inspection report in Section 15.

12. The coal tar epoxy lining in the interior of outlet conduit Nos. 6 was generally in good condition except for an area from the butterfly valve to 20 feet downstream where the coating has completely deteriorated. There is a large amount of surface rusting but no significant pitting. The ultrasonic measurements of the wall thickness and the stress analysis indicated that the stresses did not exceed the allowable anywhere in the conduit. This conduit has been rated **CONDITIONAL** (Conduit safely operable, but some maintenance/repairs required). For detailed information, see Outlet Pipe Inspection report in Section 15.

13. Drum gate No. 1 is generally in good condition except for faceplate pitting on downstream and bottom faces, damaged or missing seals on downstream face plate, eroded paint coating on upstream faceplate, localized cracks in the concrete inside the gate chamber, and report of gate getting stuck in open position. This gate has been rated **CONDITIONAL** (Gate safely operable, but some maintenance/repairs required). For detailed information, see Drum Gate Inspection report in Section 14.

14. Drum gates No. 2 and 3 are generally in good condition except for faceplate pitting on downstream and bottom faces, damaged or missing seals on downstream face plate, eroded paint coating on upstream faceplate, and localized cracks in the concrete inside the gate chamber. These gates have been rated **CONDITIONAL** (Gate safely operable, but some maintenance/repairs required). For detailed information, see Drum Gate Inspection report in Section 14.

15. The Caterpillar gate is in satisfactory condition and is capable of performing its intended designed service.

16. Slide gates 2A and 5A were not operated and the interiors were not inspected; therefore, they were not given an evaluation rating.

C. Recommendations

1. The water-operated needle valves Nos. 1, 3, and 6 should be completely disassembled and overhauled to insure that clearances between moving parts within the needle valve and paradox valve are within specified tolerances. A strict maintenance program should be developed to include periodic overhauls at specified intervals.

2. The upstream face of the disc on Butterfly Valve No. 1A should be cleaned and repainted.

3. The interior of the pipe downstream of the butterfly valve on outlet No. 1 should be repainted to prevent additional corrosion and pitting damaged.

4. The following items are recommended for the drum gates:

   - Analyze remaining gate structure strength.
   - Repaint upstream face plate.
   - Replace and redesign seal system
   - Survey width of gate bay #1.

   Details and additional recommendations are listed in the Drum Gate Inspection report in Section 14.

D. General Description

Morris Dam is a concrete gravity dam located approximately 4 miles north of the city of Azusa, in San Gabriel Canyon. The dam was constructed in 1934 by the City of Pasadena for water supply. Ownership of the dam was transferred from Metropolitan Water District (MWD) to Los Angeles County Department of Public Works in 1995.

The dam was constructed in 17 monoliths or blocks separated by vertical contraction joints generally spaced at 50 feet apart. The dam has an open joint with a sliding plane between Block 8 and Block 9 to accommodate potential displacement along Fault X that was identified in the foundation excavation. The open joint or gallery runs nearly the full width and height of a portion of the dam. The aperture of the joint is about 4 feet. The upstream face of the dam at the joint is approximately 5 feet thick with a water stop system. The downstream face of the dam at the open joint is about 3 feet thick. Displacement of the dam along the open joint would crack the upstream and downstream shells and produce a limited but uncontrolled release of the reservoir through the joint system.

The reservoir is operated primarily for water conservation. Water surface elevations are allowed to fluctuate between 1130 and 1170 feet. A minimum water surface elevation of 1130 is maintained to reduce the movement of sediment towards the intake of the dam and prevent the possibility of sediment damaging the intake works.

The spillway is west of the dam and consists of three drum gates with a steep tapered chute downstream of the gates. In 1980 the dam crest and abutments were modified to allow for overtopping to provide additional spillway capacity to handle the probable maximum flood.

There are six outlets from the single trashrack protected intake structure near the center of the dam. A single 96- by 120-inch Caterpillar gate operated by overhead crane in the gate house at the crest of the dam, is used for shutoff of each outlet. There are two 96-inch diameter outlet conduits 1 and 6, at El. 975.0, two 48-inch conduits 3 and 4, at El. 975.0, and two 48-inch conduits 2 and 5 at El. 960.0. Conduits 1 and 6 have a 96-inch butterfly valves located in the gate chamber for emergency closure and 72-inch needle valves for regulating. The remaining outlets use bonneted slide gates located in the gate chamber for emergency closure and needle valves for regulating. The needle valves on outlets 2 and 5 have been removed for sluicing operations.

E. Examination Findings

Outlet Works Emergency Gates

The outlet works emergency gates and valves located in the gate chamber were examined. The bonneted slide gates on outlets 2 through 5 are hydraulically operated using high pressure water from a storage tank some 800 feet above the dam producing a static head of approximately 375 psi. The gate bodies of the lower gates 2 and 5 are embedded in concrete while gates 3 and 4 rest on a pedestal with only the bottom body flange embedded. The exterior of the gates were examined and found to be in good condition. The gates are well painted with few rust spots and there is no rusting or leakage through any of the gate body or cylinder flanges. There is minor leakage from the Victaulic coupling downstream from Gate 4A. The stem glands inside the bonnet cover were generally dry not showing any signs of leakage except on Gate 4A were there was minor leakage.

Gates 3A and 4A were operated under balanced head conditions and performed satisfactorily. Balanced operating times and pressures for the slide gates are as follows:

Gate 3A	Open	130 psi	1 minute 30 seconds
	Close	110 psi	1 minute 30 seconds
Gate 4A	Open	135 psi	2 minutes 20 seconds
	Close	110 psi	2 minutes 10 seconds

The gates are operated by opening the water pressure line leading to the gate cylinder, then shifting the fourway valve for the desired operation. The return flow from the cylinder is exhausted to drain. An unbalanced operation was performed on each gate by opening the regulating gate 25 percent then closing the emergency gate from the full open position. Each gate perform satisfactorily. Gates 2A and 5A were not operated during this examination because their regulating valves downstream have been removed. It was reported that Gate 2A, when operated under unbalanced head conditions, that the vibration was so severe it damaged the bypass valve which had to be replaced.

The exterior of butterfly valve 1A was examined and found to be in satisfactory condition. The valve was well painted with only minor rust spots and no signs of leakage from flanges or stem packings. The operating mechanism was well lubricated. On the interior of the valve, the upstream face of the disc was badly corroded, and 20 feet of the conduit immediately downstream of the valve has corroded. The interior of butterfly valve 6A was in satisfactory condition except for a small rust spot (about 6" diameter) at the top of the valve body.

Each butterfly valve was operated through a full open close cycle under balanced head conditions and they performed satisfactorily. The butterfly valves were both operated unbalanced from the full open to closed position with the regulating gate opened 25 percent. Each gate operated satisfactorily.

Balanced operating times for the butterfly valves is as follows:

Gate 1A	Open	4 minutes 50 seconds
	Close	4 minutes 55 seconds
Gate 6A	Open	4 minutes 45 seconds
	Close	4 minutes 45 seconds

The interior of the gates and conduits were examined and found to be in satisfactory condition. For details, see Outlet Pipe Inspection report located in Section 15.

Outlet Works Regulating Valves

All of the needle valves currently installed were examined. All of the needle valves have moderate leakage through the needle cone seats which indicate some damage to the seating surface and/or the needle cone. The exterior valve bodies were well painted with only minor rust spots. The interior of needle valve No. 1 is badly corroded. See photos in Section 2.

Each valve was operated for a full open close cycle under full reservoir head and they performed satisfactorily. It as reported that sometimes Valve 6A get stuck during operations and alterations in the operating procedure is required to free the valve.

Spillway Drum Gates

The controls for the three drum gates were examined during the first inspection. The reservoir water surface elevation was such that the gates could only be raised approximately one foot. At the time of the inspection, the gates were in the one foot raised position, and each gate was subsequently lowered for the examination. The No. 1 gate was then raised approximately one foot. The operation of each gate was satisfactory.

The interior and exterior of each drum gate was examined during the third and fourth inspection and found to be in satisfactory condition except for the corrosion and pitting on the upstream face, the damaged seals, and the problem with Gate No. 1 getting stuck in the raised position. Details of this examination is contained in Section 14.

Caterpillar Gate

The Caterpillar gate was inspected and then operated unbalanced by lowering the gate into outlet No. 6 with the regulating needle valve 25 percent open. The gate performed satisfactorily. Closing time for the gate was 61 minutes. Opening time for the gate was also 61 minutes.

F. Equipment Evaluation Summary Table

No.	DESCRIPTION	DATE INSP.	RATING	COMMENTS
1	72" Needle Valve	07/01/98 09/29/98	Unsatisfactory	Interior badly corroded Needs disassembly and check for clearances
1A	96" Butterfly Valve	07/01/98 09/29/98	Conditional	Upstream face of disc corroded Performed emergency closure test
2A	48" Slide Gate	07/01/98	Not Rated	Not operated Interior not inspected
3	48" Needle Valve	07/01/98 09/29/98	Unsatisfactory	Needs disassembly and check for clearances
3A	48" Slide Gate	07/01/98 09/29/98	Satisfactory	Performed emergency closure test
4	24" Pelton Needle Valve	07/01/98 09/29/98	Satisfactory	
4A	54" Slide Gate	07/01/98 09/29/98	Satisfactory	Performed emergency closure test

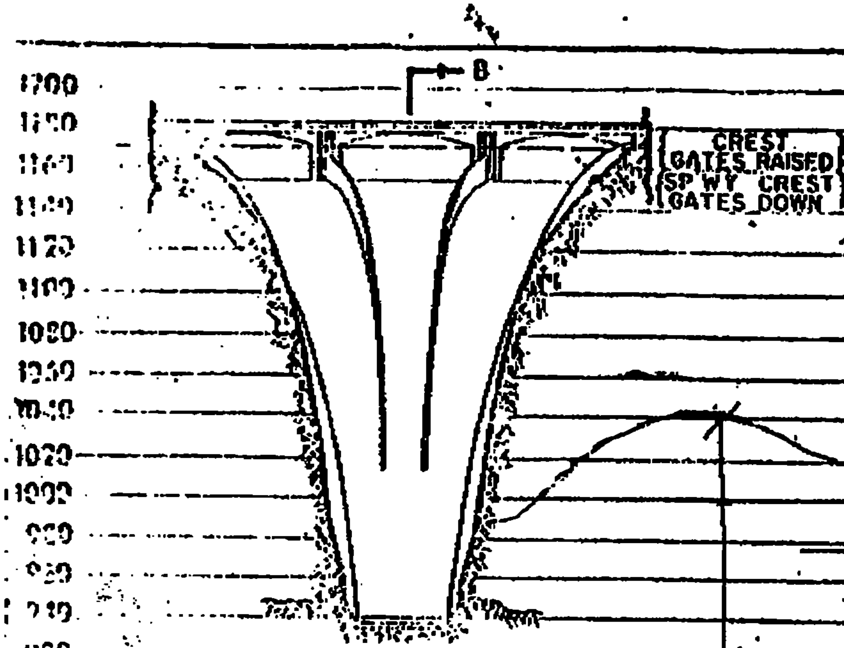
5A	48" Slide Gate	07/01/98	Not Rated	Not operated Interior not inspected
6	72" Needle Valve	07/01/98 09/29/98	Restricted	Reports of operational problems Needs disassembly and check for clearances
6A	96" Butterfly Valve	07/01/98 09/29/98	Satisfactory	Performed emergency closure test
	Conduit	09/29/98	Satisfactory	Pipe downstream BFV16A is corroded.
	Drum Gates	09/09/98 09/10/98 09/30/98	Conditional	Upstream face badly pitted Missing and damaged seals Gate 1 sticks in open position Needs analysis of upstream face.
	Caterpillar Gate	07/14/98	Satisfactory	Performed emergency closure test on single outlet

FAX

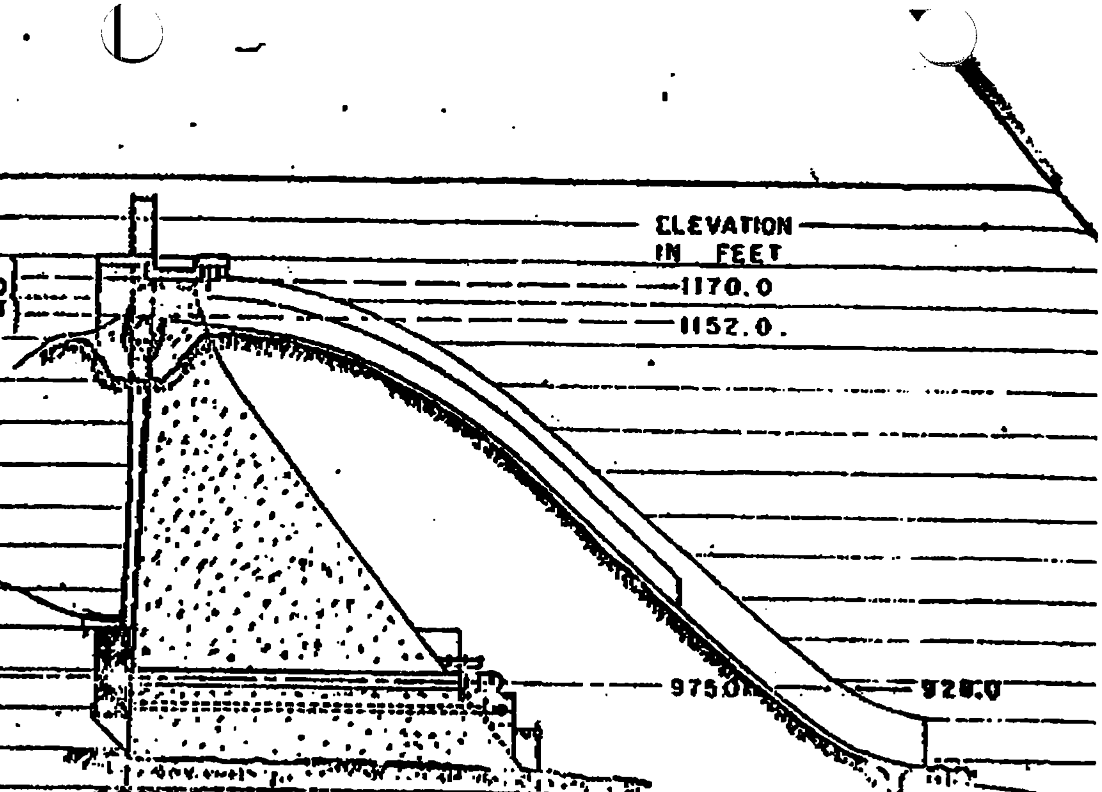
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
900 South Fremont Avenue Alhambra, CA 91803-1331

Date:	August 17, 1998		
To:	RON ARRINGTON BUREAU OF RECLAMATION	**Fax No:** **Tel:**	445-6469 (303) ~~238-9149~~ (303) 445-2877
From:	EMILY HASEGAWA HYDRAULIC WATER CONSERVATION DIVISION	**Fax No:** **Tel:**	(626) 457-5326 (626) 458-6304
Subject:	**MORRIS DAM INLET/OUTLET WORKS MODERNIZATION VALVE MAINTENANCE**	**Total Pages:**	5

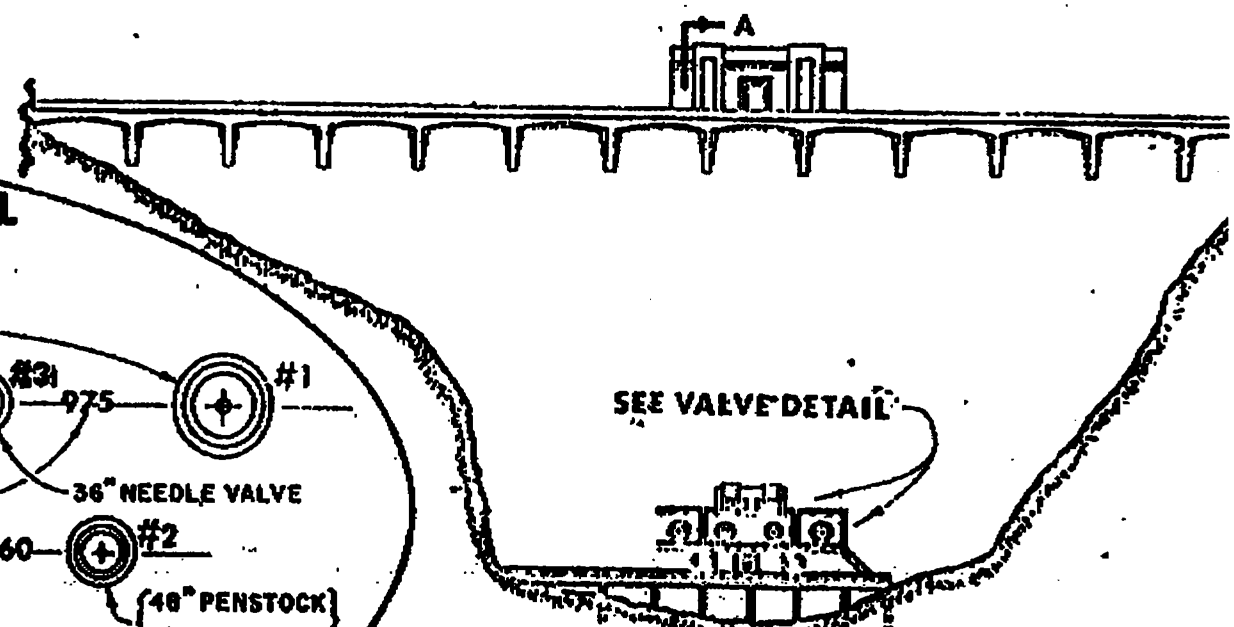
Attached is the most current valve maintenance for Morris Dam. The repairs were done by Metropolitan Water District prior to the Department taking over the Dam. Repairs were done during the period of 1993 through 1995.



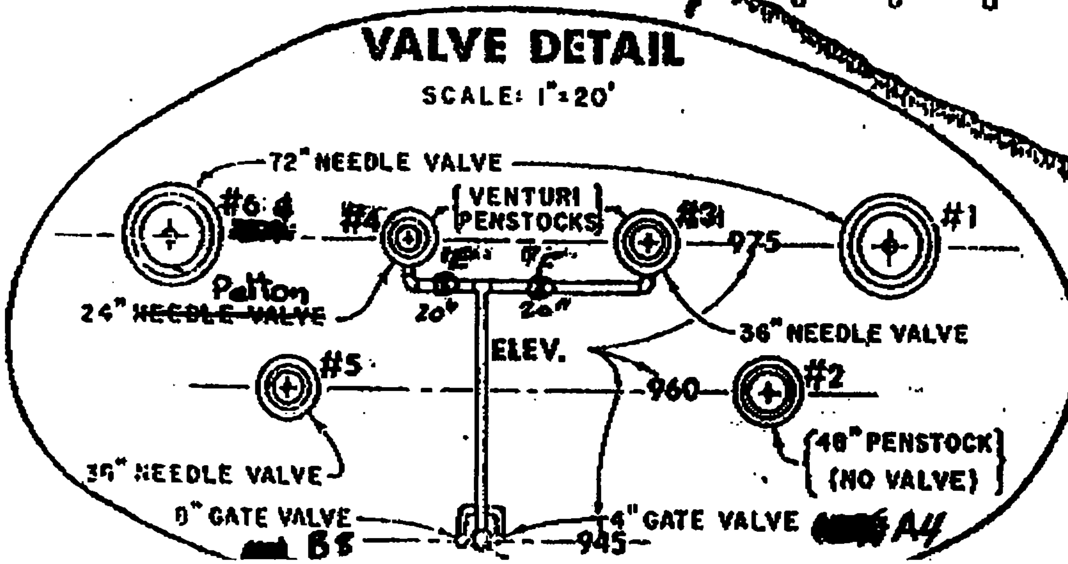
DOWNSTREAM ELEVATION OF SPILLWAY



COMPOSITE SECTION A-A AND B-B OF DAM AND SPILLWAY



DOWNSTREAM ELEVATION OF DAM



Attached #2

Note: MWD Staff completed the project without any contractors help.

Note: Answer to the Question 1, 2, 3, and 5.

V#	Description	Size	Elev.	Damage	Repair
3	48"X36" - 200# Needle Valve, geared, manually controlled, hydraulically operated, **Hardy-Tynes Needle mfg.**	36"	975'	The body and needle seats were heavily damaged by silt, and debris that resulted in the erosion of the brass seating surfaces. Also, the brass needle guide rails suffered erosion damage.	Valve was disassemble and repaired which included the valve being sand blasted inside and outside and re-coated inside and painted on the exterior. The needle and seat were re-welded and machined back to original specs. The 48" penstock 180 feet long was sand blasted and re-coated up to the 48" slide gate valve. All fasteners were replaced with Stainless Steel after drilling and re-tapping all bolt holes.
4	Original Valve replaced by 24"X36" - 200# Needle Valve, geared, manually operated. **Pelton** Eater Wheel Co. #30508 No. 4 Penstock.	24"	975'	The body and needle seats were heavily damaged by silt, and debris that resulted in the erosion of the brass seating surfaces.	Valve was disassembled, sand blasted inside and outside, re-coated and painted. The needle and seat were re-welded and machined to original specs. The 54" penstock 180 feet long was also sand blasted and relocated up to the 54" slide gate

					valve. All fasteners were replaced with Stainless Steel after drilling and re-tapping all bolt holes.
5	48"X36" - 200# Needle Valve, geared, manually controlled, hydraulically operated, Hardy-Tynes Mfg. Co. #2375. No. 5 Hardy-Tynes Needle	36"	960'	The body and needle seats were heavily damaged by silt, and debris that resulted in the erosion of the brass seating surfaces. Also, the brass needle guide rails suffered erosion damage.	Valve was disassemble and repair which included the Valve being sand Blasted inside and Outside and painted. The needle and seat were re-welded and machined to original specs. The 48" penstock 180 feet long was sand blasted and re-coated up to the 48" slide gate valve. All fasteners were replaced with Stainless Steel after drilling and re-tapping all bolt holes.
6	72"X96" - 200# Needle Valve, geared, manually controlled, hydraulically operated, Hardy-Tynes Mfg. Co. #2-375 - No. 6, penstock.	72"	975'	The body and needle seats were heavily damaged by silt, and debris that resulted in the erosion of the brass seating surfaces. Also, the brass needle guide rails suffered erosion damage.	This valve was too big to remove; Therefore, the needle and seat were removed in the field, and then taken to the machine shop at the Special Services for repair. Valve was re-welded, re-machined the needle and seat. The inside of the valve body was sand blasted and re-coated. All fasteners were replaced with Stainless Steel after drilling and re-tapping all bolt holes. Also the Operating outer shaft was replaced with

Note: Repairs were done during the period of 1993 THRU 95

					Stainless Steel.
6A	96" Butterfly valve, geared, motor, and manually operated, Hardy-Tynes Mfg. Co. Dated 1932.	96"	975	Erosion damage to the butterfly body at the pivot point by silt, debris, and sand.	These valves Sand Blasted and re-coated. Erosion damaged to the body was repaired.
A4	4"-175# Gate Valve, manually operated. Walworth.	4"	945'	This valve was impacted with silt, sand ,and debris preventing the valve to be operated.	Remove the packing and flush Bonnet and re-pack valve. In the brief: Disassemble, remove silt, replace packing, re-assemble.
C12	12"-150# Lub Plug Valve, geared, Walworth #V-37399.	12"	945'	This valve was impacted with silt, sand ,and debris preventing the valve to be operated.	Remove packing, Flush silts out, Grease Valve, Re-pack, Operate The Valve. In the brief: Disassemble, remove silt, replace packing, re-assemble.
E	20"-175 Gate Valve, Iowa Valve Co.	20"	965'	This valve was impacted with silt, sand ,and debris preventing the valve to be operated.	Remove the packing and flush Bonnet and re-pack valve. In the brief: Disassemble, remove silt, replace packing, re-assemble.
F	20"-175 Gate Valve, Iowa Valve Co.	20"	965'	This valve was impacted with silt, sand ,and debris preventing the valve to be operated.	Remove the packing and flush Bonnet and re-pack valve. In the brief: Disassemble, remove silt, replace packing, re-assemble.
B8	8" - 200# Gate Valve. Manually operated, Walworth.	8"	945'	This valve was impacted with silt, sand and preventing the valve to be operated.	Remove the packing and flush Bonnet and re-pack valve. In the brief: Disassemble, remove silt, replace packing, re-assemble.

MORRIS DAM - DATA SHEET

General Information

Facility:	Morris Dam	Constructed with City of Pasadena funds
Location:	San Gabriel Canyon, 5 miles North of Azusa	Drainage Area: 217 Square miles
Stream:	San Gabriel River	14.3 sq. mi. uncontrolled
Purpose:	Water Conservation	202.7 sq. mi. controlled by
Type:	Concrete Gravity	San Gabriel and Cogswell dams

Construction

Began:	April 1932	Dam construction: Bent Bros. Inc. & Winston Bros. Co.
Completed:	1935	Resident Engineer : V.L. Peugh and R.W. Spencer
Cost	$ 7,600,000.00	Design and computations: Pasadena Water Dept.
Cost per AF FC	$ -	Dedicated: May 26, 1934
Cost per AF Cons.	$ 192.38	Transfered to LACDPW: Nov. 7, 1995

Cost based on original capacity of 39,300 AF

Dimensions (ft)

Crest Height above original streambed:	245
Crest Height above foundation:	328
Crest Length:	800
Crest Width:	20
Height of parapet wall:	4

Excavation and Fill as Constructed

Total vol. of excavation: 609,000 CY
Total vol. of concrete: 513,956 CY

Outlets

Flood Operation Valves

Number	Type	Size [4]	Riser or Inlet Elev. (ft)	Valve ℄ Elev. (ft)	Max Discharge at Spillway (cfs) [5]
1	Hardie-Tynes Needle	96" x 72"	975.0	975.0	2125
1A	Butterfly	96"	971.0	960.0	-
2	Removed		-	960.0	-
2A	Slide Gate	48"	958.0	-	-
3	Hardie-Tynes Needle	48" x 36"	-	975.0	485
3A	Slide Gate	48"	973.0	-	-
4[1]	Pelton Needle	48" x 42"	-	975.0	279
4A	Slide Gate	54"	972.7	-	-
5[1]	~~Hardie-Tynes Needle~~	~~48" x 36"~~	Removed	~~960.0~~	545
5A	Slide Gate	48"	958.0	-	-
6	Hardie-Tynes Needle	96" x 72"	-	975.0	2125
6A	Butterfly	96"	974.0	-	-

Service Valves

A[3]	Gate Valve	4"	973.0	945.0	-
B[3]	Gate Valve	8"	973.0	945.0	-
C[3]	Plug Valve	12"	973.0	945.0	-
	Caterpillar Gate	96" x 120"	-		
Azusa Conduit Inlet	Slide Gate	48"	1160.0		
Azusa Conduit Inlet	Slide Gate	2' x 6'	1160.0 (2 gates)		
Azusa Conduit Diverison	Slide Gate	2' x 6'	1160.0 (2 gates)		

Spillway	Type	Sill Elev. (ft)	Length (ft)	Original Cap. at Spillway	Max Discharge at Assumed HWL(cfs)
1[2]	3 Drum gates	1152.0 Down 1170.0 Up	210.0	39,300 AF	80,000

Elevations (ft)

Original streambed: 930.0
Crest 1175.0
Top of parapet 1179.0
Assumed HWL: 1175.0

Remarks

[1] Venturi on penstock
[2] Spillway drum gates each 70 ft wide and 18ft high.
[3] Valves may be fed from either No. 3 or 4 penstock.
[4] Penstock diameter x outlet diameter
[5] With spillway gates at Elev. 1170

Latest state approval: August 24, 1966

Restricted Elevation(ft): None

MORR… DAM
VALVE SUMMARY TABLE

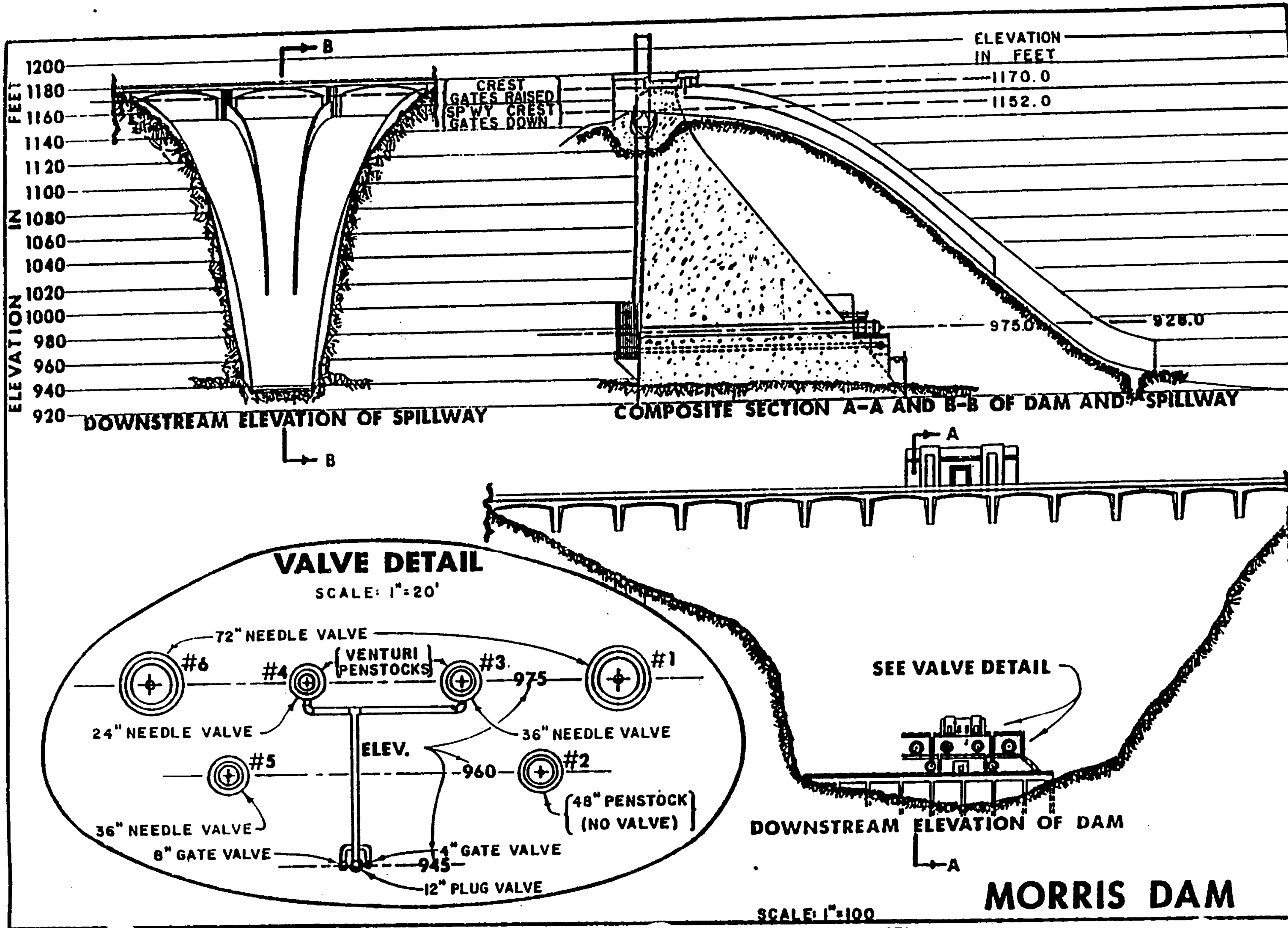
Valves	1	1A	2	2A	3	3A	4	4A	5	5A	6	6A	A
Outlet Function	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Flood Ops	Service
Type	Hardie-Tynes Needle	Butterfly	None	Slide Gate	Hardie-Tynes Needle	Slide Gate	Pelton Needle	Slide Gate	Hardie-Tynes Needle	Slide Gate	Hardie-Tynes Needle	Butterfly	Gate
Size	96"x72"	96"	--	48"	48"x36"	48"	48"x24"	54"	48"x46"	48"	96"x72"	96"	4"
CL Elevation	975.0	960.0	960.0	958.0	975.0	973.0	975.0	972.7	960.0	958.0	975.0	974.0	945.0
Year Installed	1932	1932	--	1932	1932	1932	1932	1932	1932	1932	1932	1932	1932
Overhaul Year			n/a		*	*		*	*		*		
Automated/ Manual	M	EMO	n/a	M	M	M	M	M	M	M	M	EMO	M
Intended Use		Backup to 1	--			Backup to 3		Backup to 4		Backup to 5		Backup to 6	Service to 3
Head	177' r'qd	192' r'qd		194' r'qd	192' r'qd	179' r'qd	192' r'qd	179' r'qd	192' rq'd	194' r'qd	192' r'qd	178' r'qd	207' r'qd
Operation Status			none										
Problems													
Cost to Replace													
Comments	needs balance valve to operate		taken out		needs balance valve to operate		needs balance valve to operate				needs balance valve to operate		

*= needs replacing; EMO= Electrical/Manual Operated; M= Manual

MORR... DAM
VALVE SUMMARY TABLE

Valves	B	C		Azuza	Azuza	Azuza
Outlet Function	Service	Service	Service	Service	Service	Service
Type	Gate	Plug	Caterpillar Gate	Slide Gate	Slide Gate	Slide Gate
Size	8"	12"	96"x120"	48"	2'x6'	2'x6'
CL Elevation	945.0	945.0	--	1160.0	1160.0	1160.0
Year Installed	1932	1932	1932	1932	1932	1932
Overhaul Year						
Automated/ Manual	M	M	M	M	M	M
Intended Use	Service to 4	Service to 3 & 4	Backup to 1A, 2A, 3A, 4A, 5A, 6A	Azuza Conduit	Azuza Conduit	Azuza Conduit
Head	207' r'qd	207' r'qd		8' rq'd	8' rq'd	8' rq'd
Operation Status						
Problems						
Cost to Replace						
Comments			Crane used to enable	Inlet	Inlet, 2 gates	Diversion, 2 gates

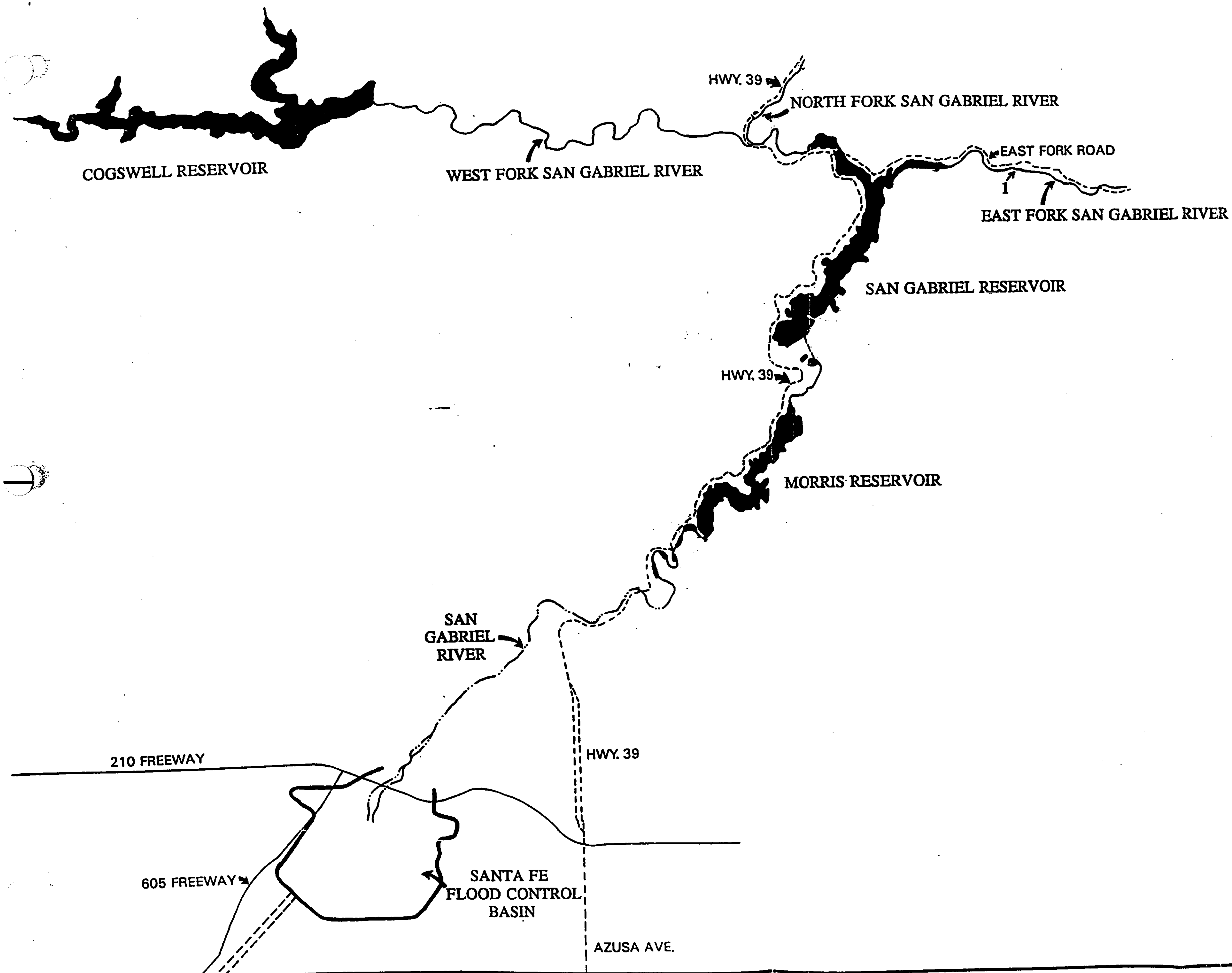
*= needs replacing; EMO= Electrical/Manual Operated; M= Manual



MORRIS DAM

SCALE: 1"=100
REVIEWED JAN, 1976

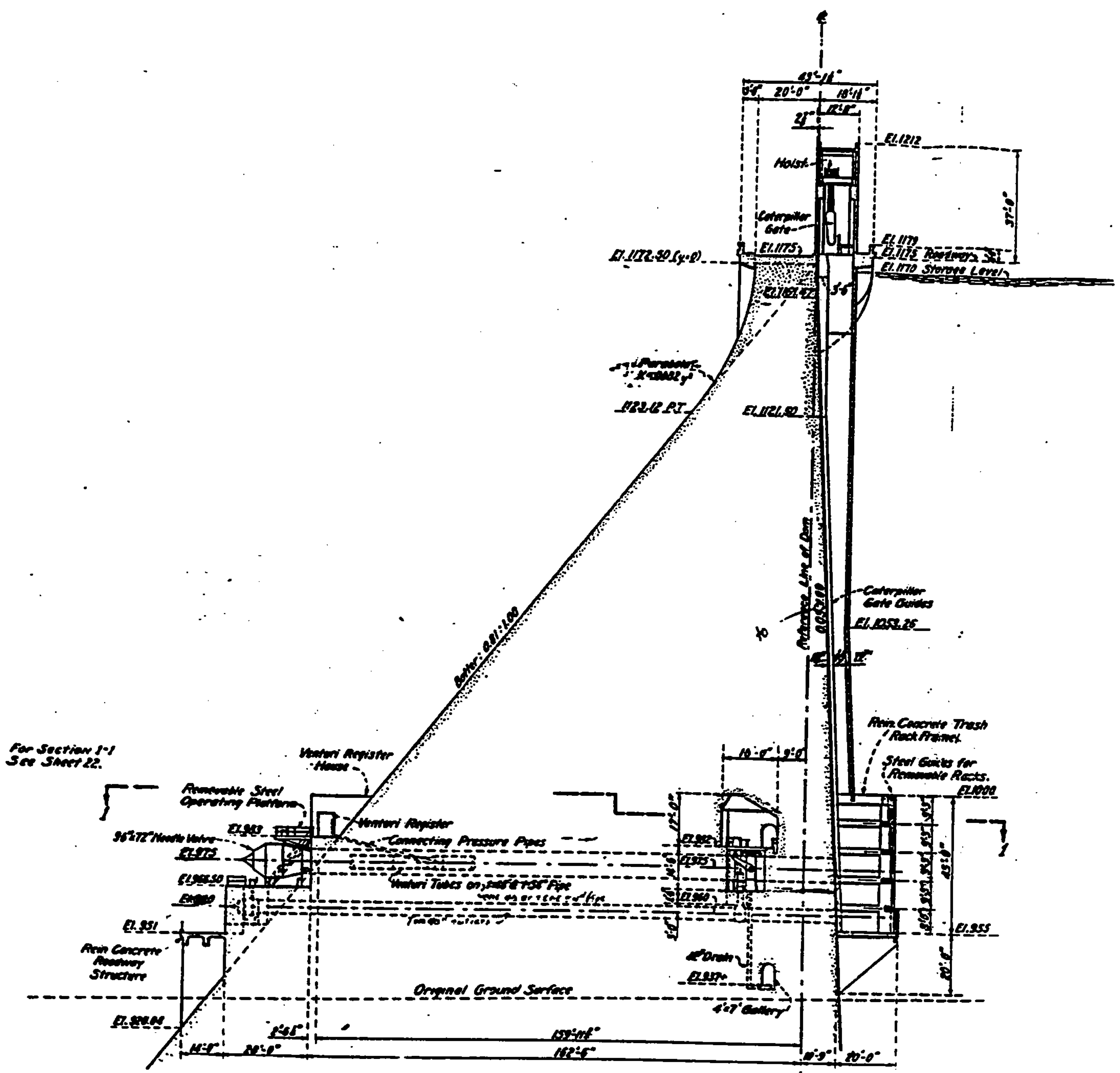
RVSD. JAN, 1974



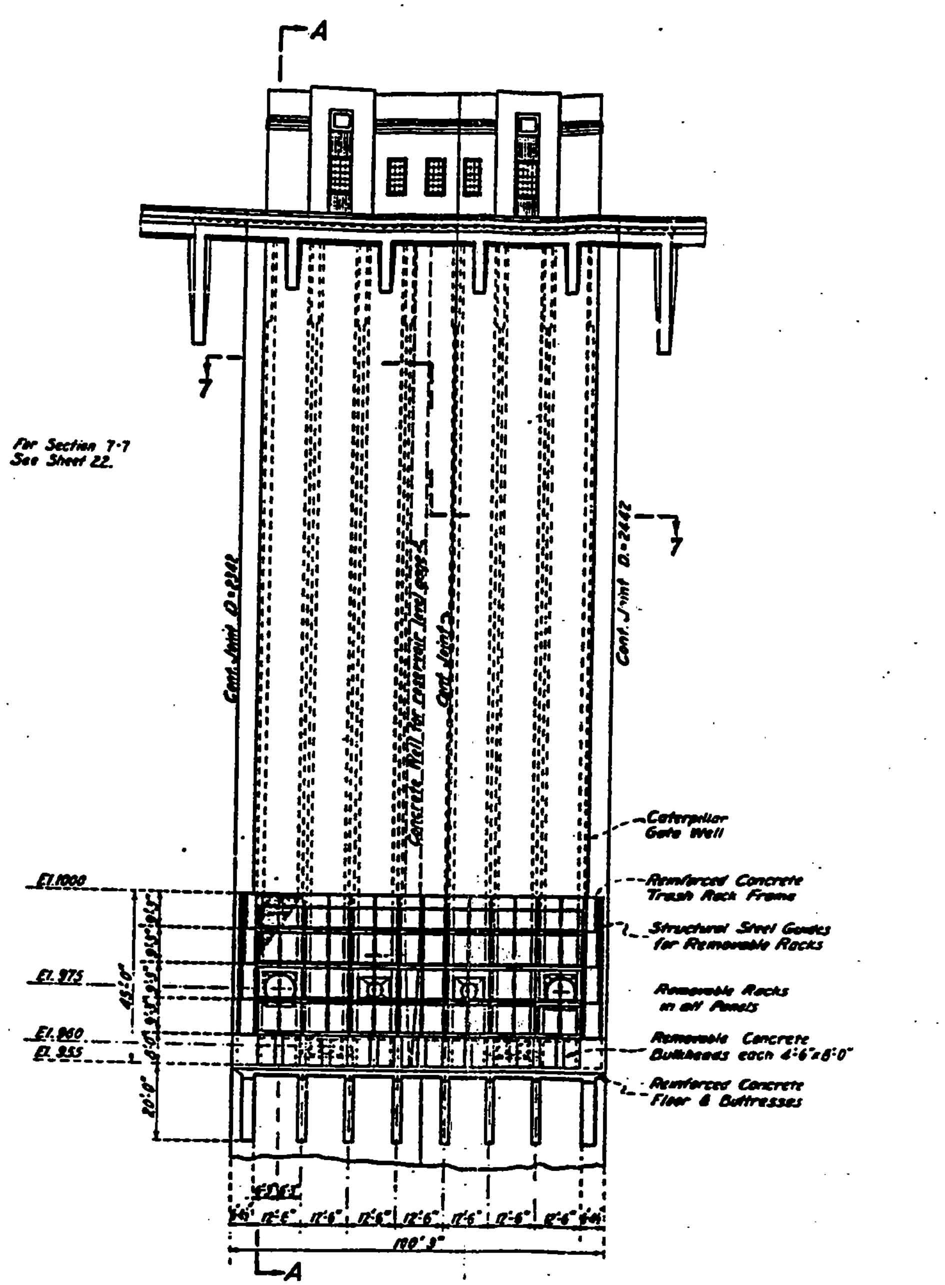
ATTACHMENT A

PROJECT LOCATION MAP

SOURCE: USGS 1:24,000 7.5' TOPOGRAPHIC QUADS: Azusa (1972); Baldwin Park (1981); Glendora (1971)



VERTICAL SECTION A-A
OF DAM AND OUTLETS



PART UPSTREAM ELEVATION

Scale of Feet: 1"=20'

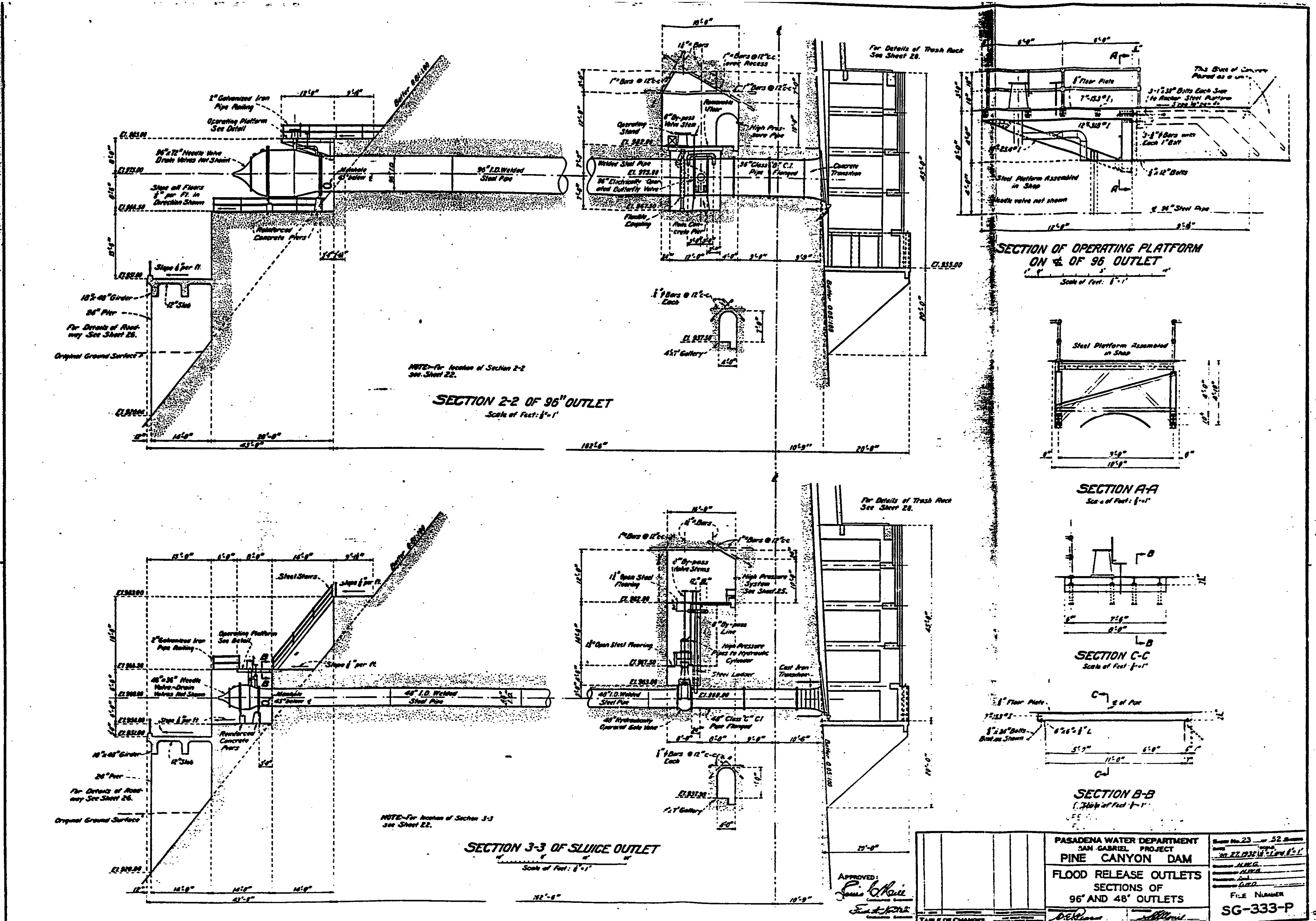
NOTE:–
For Sections 1-1 and 7-7
See Sheet 22.

CONTRACT DRAWING

APPROVED:

TABLE OF CHANGES	PASADENA WATER DEPARTMENT SAN GABRIEL PROJECT PINE CANYON DAM FLOOD RELEASE OUTLETS GENERAL LAYOUT	Sheet No 21 of 52 Sheets Date Jan 27, 1932 Scale 1"=20' File Number SG-331-P

J-1130

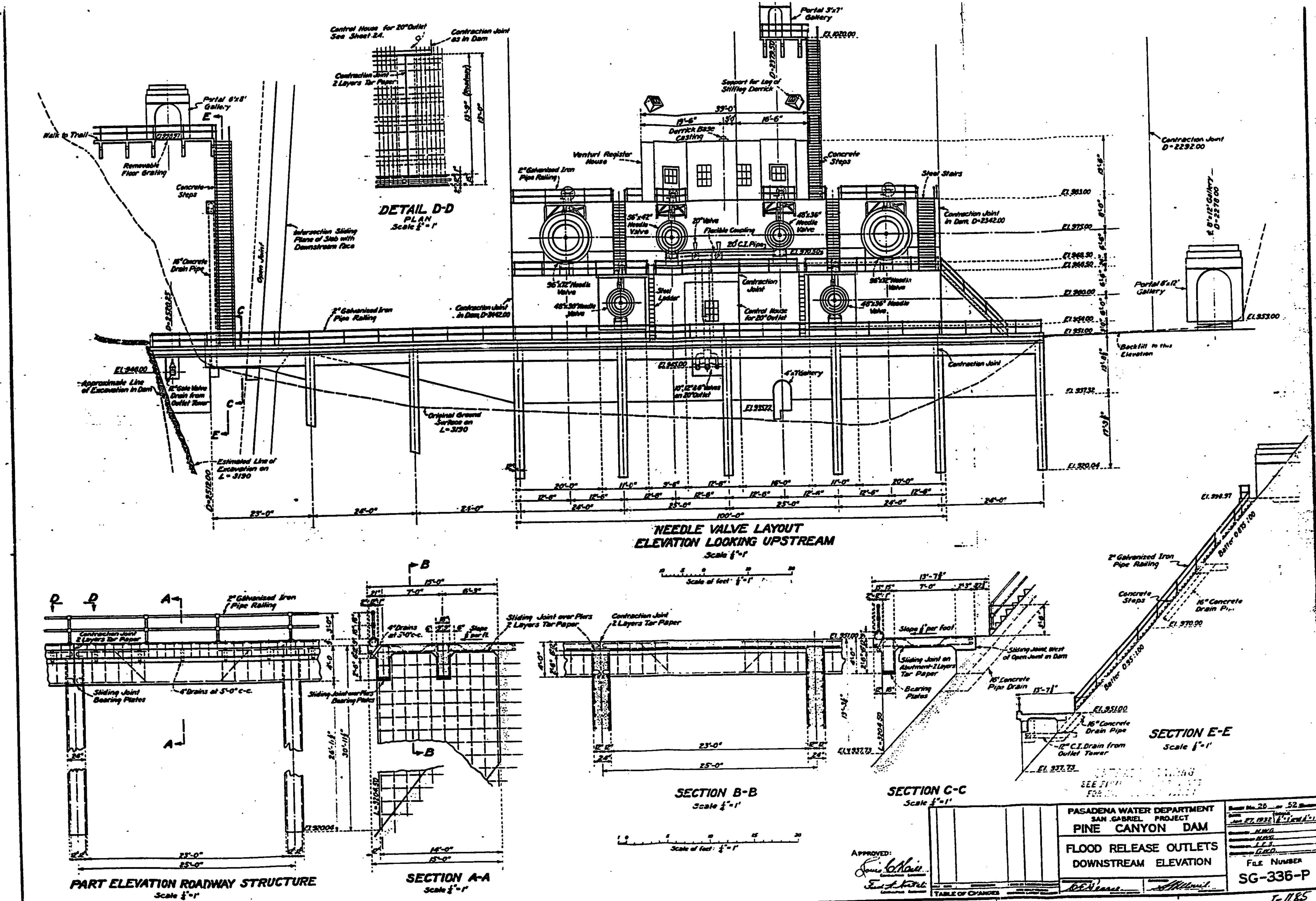


PASADENA WATER DEPARTMENT
SAN GABRIEL PROJECT
PINE CANYON DAM

FLOOD RELEASE OUTLETS
SECTIONS OF
96" AND 48" OUTLETS

Sheet No. 23 of 52 Sheets

FILE NUMBER
SG-333-P



APPROVED:

PASADENA WATER DEPARTMENT
SAN GABRIEL PROJECT
PINE CANYON DAM

FLOOD RELEASE OUTLETS
DOWNSTREAM ELEVATION

Sheet No. 26 of 52 Sheets

FILE NUMBER
SG-336-P

TABLE OF CHANGES

J-1185

J-1187

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

A. Overall Summary Sheet

Dam Morris Dam **Valve I.D.** 1

A1. Overall Rating - Needle Valve (Provide an overall general rating for the valve based on safe/unsafe operation and O&M required/not required)

a. VALVE GENERAL CONCLUSIONS:

Valve Needs Maintenance? ☐ None ☐ Minor ☒ Major ☐ Immediate
Valve Needs Repairs? ☐ None ☐ Minor ☒ Major ☐ Immediate
Restricted Valve Operations Recommended? ☒ No ☐ Yes (Describe..)
Recommendations Included in Checklist? ☐ No ☐ Yes (Describe...)

b. Needle VALVE OVERALL RATING:

☐ GOOD (Current valve condition/maintenance/safety is above average)
☐ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Valve safely operable, but some maintenance/repairs required)
☒ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Valve should not be operated)

Comments: Valve leaks through the needle seats and leakage through the air vent manifold

A2. Level 2 - General Summary of Needle Valve Condition: (Check or Circle as Appropriate)

a. OPERATION:
Was valve operated?: ☐ Yes: ☒ Not Operated (why?)
☐ Full Travel ☐ Partial Travel (How far ________)
Valve operation: ☐ Smooth ☐ Rough ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

b. STRUCTURAL: ☐ Satisfactory
☒ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☒ Other (Explain)

c. PROTECTIVE COATING: ☒ Original Paint ☐ Year of Last Paint Coat 1932
☐ Paint Satisfactory
☐ Requires minor local touch-up ☒ Severe localized damage (No. and location)_ ☐ Extensive

d. WELDED/BOLTED CONNECTIONS: ☒ Checked ☐ Unchecked
Bolted connections ☐ Okay
☐ Missing Bolts ☒ Corroded/Rusted Bolts ☐ No Threads Showing ☐ Deformed Bolts
☐ Many ☐ Some ☐ Few

e. VALVE SEAT SEALING: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☒ Moderate Leakage ☐ Heavy Leakage
:

Comments: Heavy corrosion, heavy rusting, and light cavitation on the entire surfaces

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

B. Inspection and Equipment Basic Information Sheet:

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Valve ___ for data in this section

1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 6/29	**5. Lead Inspector & Office: Ron Arrington USBR**	**6. Field Contact: Art Diaz / Jim McGowan**
4. Reservoir El.: 1144.27	**Phone #: 303-445-2877**	**Phone #: 626-334-2090**
7. Valve Centerline El.: 975.0	**8. Area Office & Contact: Emily Hasegawa**	**9. Water District & Contact: Steve Bradley**
10. Head on Valve: 169.27	**Phone #: 626-458-6304**	**Phone #:**
11. Others present: Gary Rood D-8420.		
12. Special circumstances, weather conditions, other:		

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 9/29	5. Lead Inspector & Office: Gary Rood USBR	6. Field Contact: Art Diaz / Jim McGowan
4. Reservoir El.: 970.00	Phone #: 303-445-3102	Phone #: 626-334-2090
7. Valve Centerline El.: 975.0	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Valve: 0.00	Phone #: 626-458-6304	Phone #:
11. Others present: Bill McStraw D-8450 and George Taylor D-8005.		
12. Special circumstances, weather conditions, other:		

B2. Description of Needle Valve and Appurtenant Equipment:

B1. Valve No. and Size: 1 - 72-inch	Size: Diameter 72-inch Design Head 177 Year Designed 1932

Number of Splitters 8
Valve Seat ☒ Bronze ☐ Stainless steel.
Valve Needle constructed of: ☐ Cast Iron ☒ Cast Steel ☐ Cast Bronze ☐ Other
Valve Body constructed of: ☒ Cast Iron ☐ Cast Steel ☐ Cast Bronze ☐ Other

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

B2 . Valve Operator:	Type: ☐ Hydraulic ☐ motor operated Screw-Lift Water operated Controls: ☐ Local ☐ Automatic ☐ Remote-Capability (From Where) ______		
B3. Guard Gate/ Stoplogs Capabilities:	Guard gate ☐ Yes ☐ No Size and type. 96" x 120" Caterpillar Gate 96" Butterfly valve	Stoplogs available (if required) ☐ Yes ☐ No No.of logs? ______ Size ______ ☐ Okay ☐ Not Useable (why?)	Bulkhead and/or Stoplogs Kept Onsite ☐ Yes ☐ No Last Used ☐ <1yr ☐ < 3yr ☐ < 10 yr
~~B4. Emergency Operation:~~	~~☐ Engine-Generator ☐ Other Device~~ ~~☐ Yes ☐ No ☐ Operable~~ ~~☐ Not Operable (why?)~~	~~Eng-Gen Operated at Inspection:~~ ~~☐ Yes ☐ No~~ ~~Last time (when)~~ ______	SOP Updated Recently ☐ Yes ☐ No
Comments:			

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the High Pressure Valve, Outlet Valve and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Interior of Valve Body ☒ Yes ☐ No: Upstream Side of Needle ☒ Yes ☐ No: Body Seats ☒ Yes ☐ No Valve Operator: ☐ Yes ☒ No Exterior of Valve Body ☒ Yes ☐ No Valve Indicator Connection ☐ Yes ☒ No Splitters ☒ Yes ☐ No Control house and valve chamber ☐ Yes ☒ No Valve Areas Not Available for Inspection: ☐ Yes Exterior of valve was inspected on (6/29/98)
Inspection of valve needle: Cavitated / Eroded / Other ☒ Yes ☐ No (Explain) Complete interior of valve. Location (use clock points looking D/S)
Inspection of interior of valve bodies: Cavitated / Eroded / Other ☒ Yes ☐ No (Explain) Location (use clock points looking U/S)
Inspection of splitters: Cavitated / Eroded / Other ☒ Yes ☐ No (Explain) Location (number clockwise starting at top looking U/S)
Inspection of valve seat: Cavitated / Eroded / Other ☐ Yes ☒ No (Explain) Location (use clock points looking U/S)
Inspection of interior valve body: ☐ Good ☐ Satisfactory ☒ Poor (Explain)
Comments: Heavy rust over complete surface of interior valve body. Some cavitation damage to needle surface.

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

C1. Structural Integrity of components including; Hoist, Leaf horizontal ribs, Leaf vertical ribs, Leaf face plate, Bonnet Cover, etc.

Structural Members Inspection:

a Exterior Body

- .Are flanges leaking? ☐ Yes ☒ No (Explain)
- Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
- Are flange bolts corroding? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Valve Pedestal

- Are there cracks in concrete pedestal? ☐ Yes ☒ No (Explain)
- Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
- Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
- Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on support or trunnion? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on support or trunnion? ☐ Yes ☒ No (Explain)

c. Needle

- Are there areas of scratches or gouges on U/S face of needle? ☐ Yes ☒ No (Explain)
- Are there rough areas or cavitation damage on U/S face or needle seat? ☒ Yes ☐ No (Explain)
- Are there missing screws or evidence of corrosion on plunger flange? ☐ Yes ☒ No (Explain)
- Are there scratches, gouges, or evidence of corrosion on plunger? ☒ Yes ☐ No (Explain)

e. Interior Body

- Are there scratches gouges on valve body seat? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on body or cylinder? ☒ Yes ☐ No (Explain)
- Are there areas of corrosion or cavitation damage on body or cylinder? ☒ Yes ☐ No (Explain)
- Is there oil leakage from cylinder gland? ☐ Yes ☐ No (Explain)

f. Splitters

- Is there damage to leading edge (U/S) of splitter? ☒ Yes ☐ No (Explain)
- Is there evidence of cavitation or damage at splitter/cylinder connection? ☒ Yes ☐ No (Explain)
- Is there evidence of cavitation or damage at splitter/body connection? ☒ Yes ☐ No (Explain)
- Are there damaged areas or areas missing paint on splitters? ☒ Yes ☐ No (Explain)
- Are there areas of corrosion or cavitation damage on splitters? ☒ Yes ☐ No (Explain)

VALVE STRUCTURAL RATING:

☐ **GOOD**
(Valve and Hoist structural condition is above average)
☐ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☒ **CONDITIONAL**
(Valve and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Valve/Hoist should not be operated for structural reasons.)

g. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

1 -Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - J:\WORKREQ\MORRIS\INSPECT\2NVVALV1.WPD

C2. Condition of Valve's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☒ Date Last Painted (Where?)

a. General Condition of Coating: ☐ Good ☐ Fair ☒ Poor Cause of Coating Failure: ☒ Age ☒ Corrosion/Erosion/Cavitation ☐ Rubbing ☒ Standing Water ☐ No Drains ☐ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**VALVE PAINT RATING:** ☐ GOOD (Valve's current paint coating is above average) ☐ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☒ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)
COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.	

C3. Performance and Condition of Valve Seats ...

a. Leakage Past Seats/sill ☐ Unknown ☐ No Leakage ☐ Insignificant ☒ Some ☐ Excessive (How much?) _50_ gpm. Leakage Acceptable? ☒ Yes ☐ No b. Condition of seats/sill: ☐ Unknown ☐ Good ☒ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... Seat screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ... c. Reason for Leakage: Seats/Sill: ☐ Damaged seat (which one?) ________ ☐ Damaged Sill ☒ Seat to Seat contact ☐ Seat Defect ☐ Stuck Debris ☐ Other	**VALVE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☒ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)
e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT VALVE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS	

C4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of valve operation?	☒ Yes	☐ No
b. Are discharge curves and operating diagrams current?	☒ Yes	☐ No
c. Posted operating instructions?	☐ Yes	☒ No
d. Does dam operator understand their use?	☒ Yes	☐ No
e. Are as-built drawings of valve/hoist available?	☐ Yes	☒ No
f. Are maintenance requirements understood?	☒ Yes	☐ No
g. SOP/DOC instructions and documents current?	☒ Yes	☐ No

C5. Performance of Valve Operation:

a. Was valve operated at inspection? ☒ Yes ☐ No

b. Is valve exercised according to SOP? ☒ Yes ☐ No

c. Is Valve operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe valve operation: (describe below)
☒ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last valve operation.

f. Valves as designed? ☒ Yes ☐ No (Why?)

g. Was this valve operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

VALVE RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Valve and hoist should not be operated without major repairs or restricted operation)

D. Valve Public Security:

Valve Installation Accessible by Public? ☒ Yes ☐ No *Describe ...* Vehicle access gate is locked, but accessible by pedestrian traffic

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

Photo 1 - Morris Dam - Needle Valve 1 - View of needle valve leakage under full head. 07/01/98

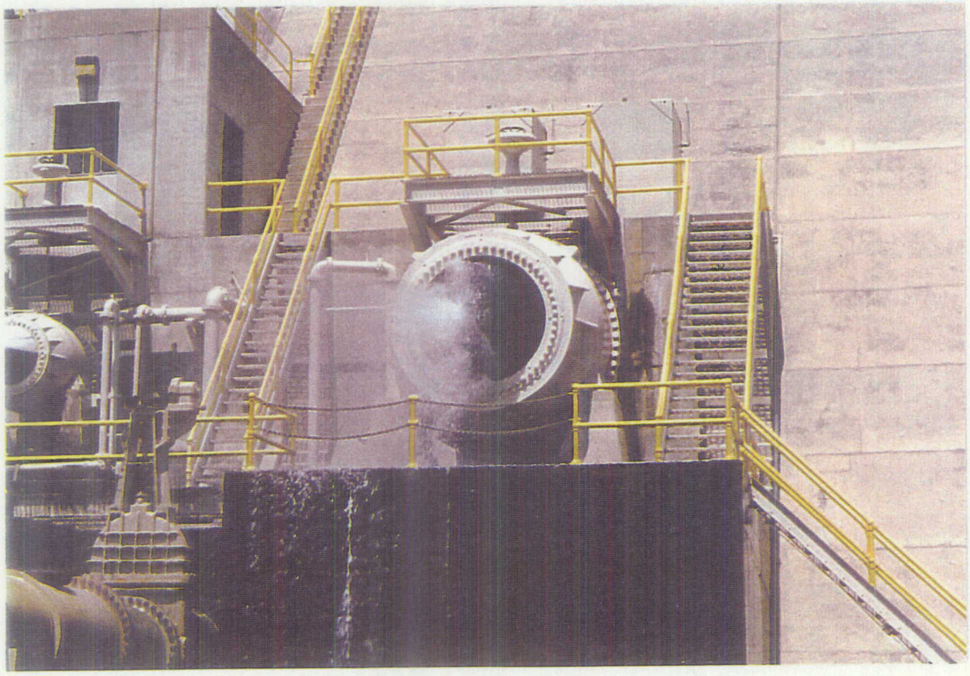


Photo 2 - Morris Dam - Needle Valve 1 - View of needle valve leakage under full head. 07/01/98

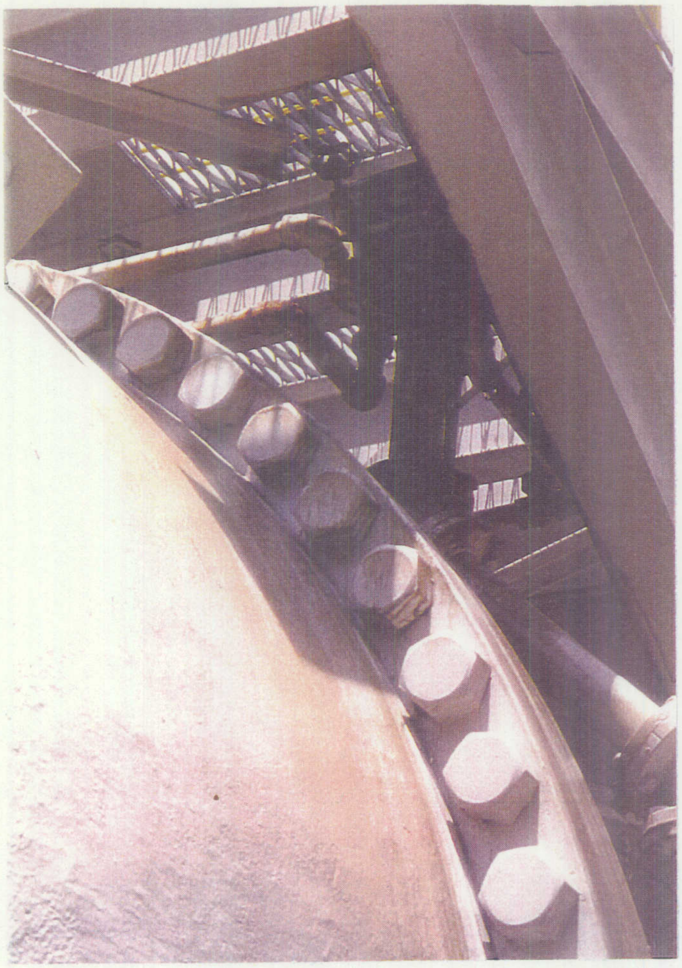


Photo 3 - Morris Dam - Needle Valve 1 - View of needle valve body flange and air vent manifold. 07/01/98

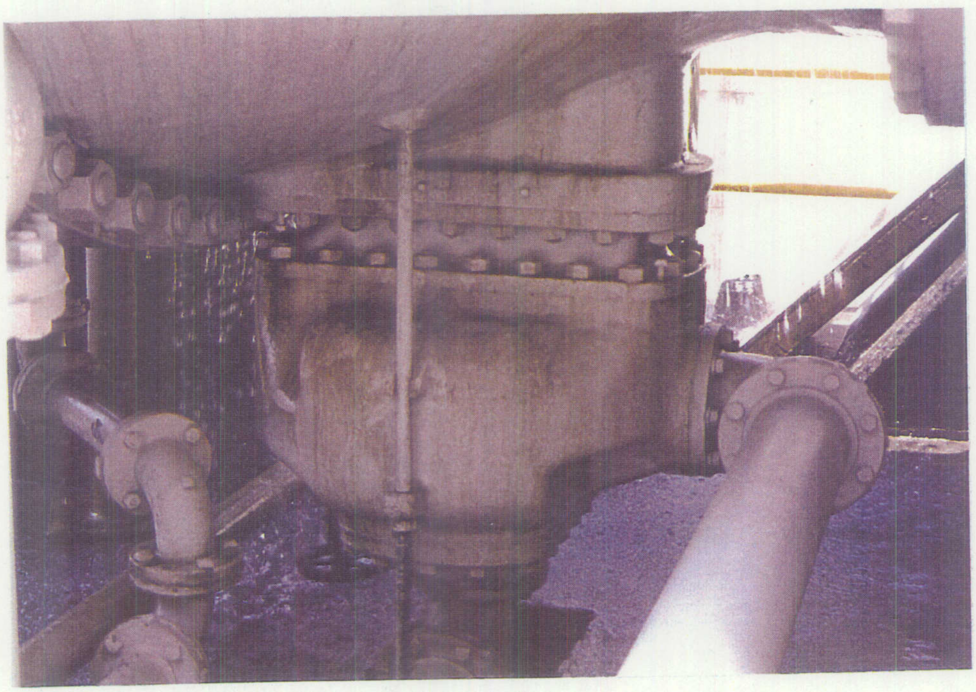


Photo 4 - Morris Dam - Needle Valve 1 - View of needle valve paradox valve and high pressure water pipe. Note leakage from valve is from air vent manifold at top. 07/01/98

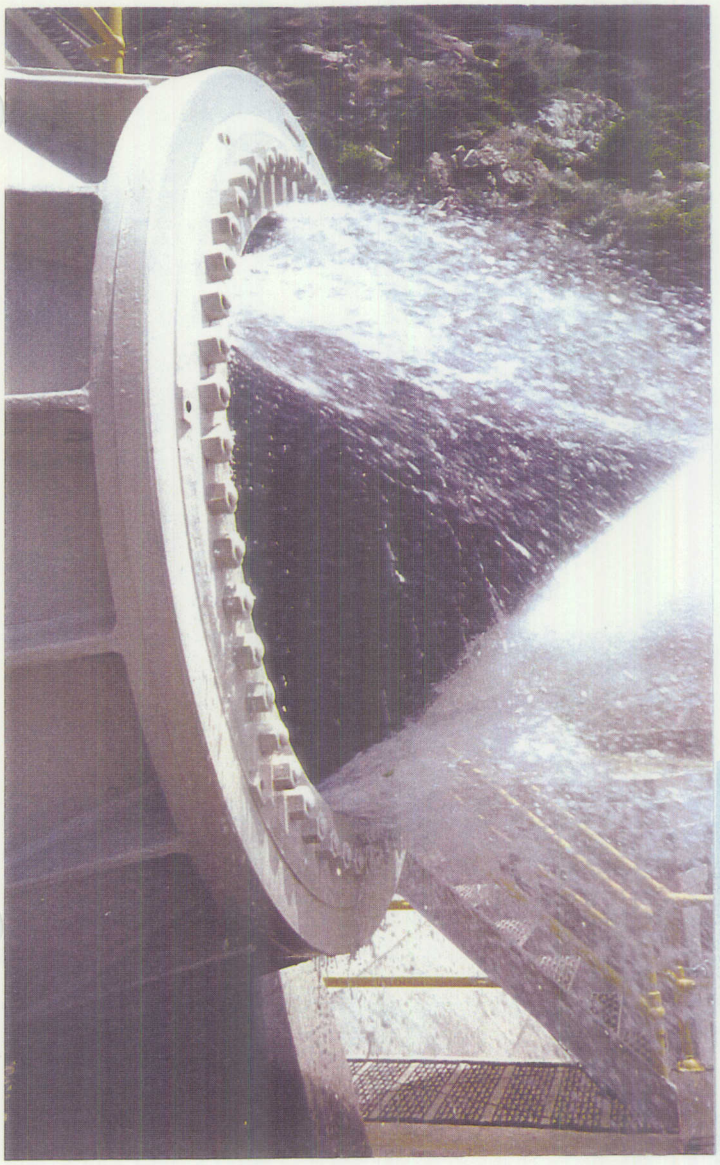


Photo 5 - Morris Dam - Needle Valve 1 - View of needle valve leakage at full head.
07/01/98

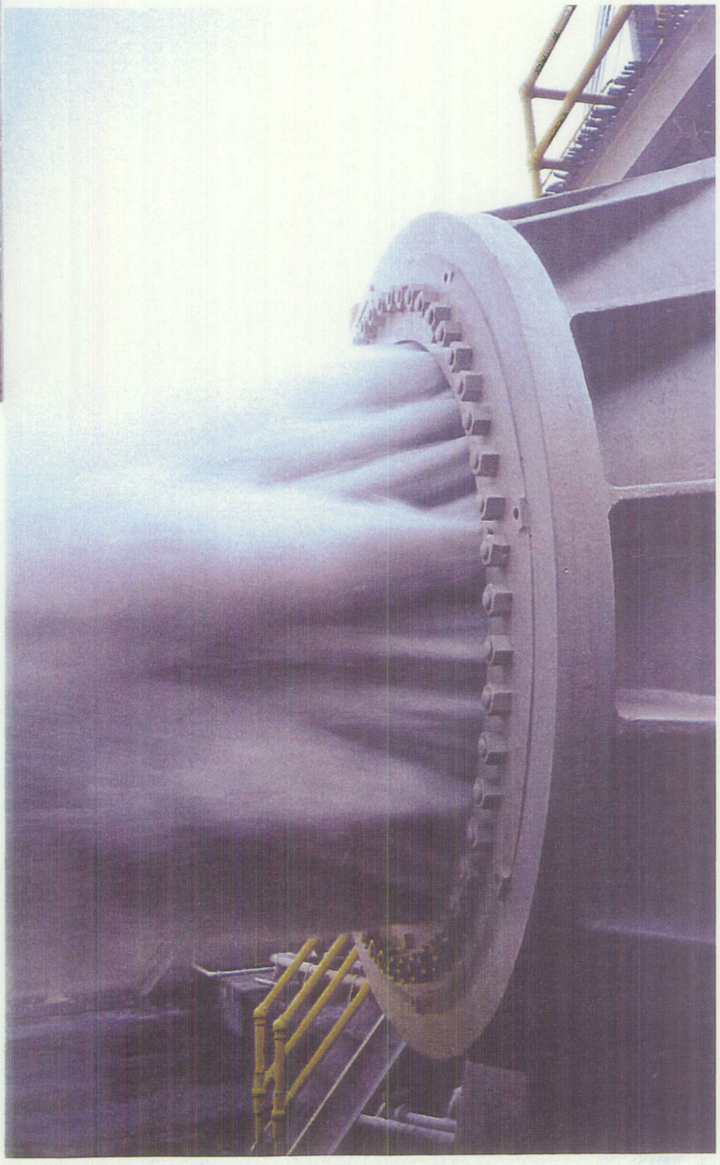


Photo 6 - Morris Dam - Needle Valve 1 - View of needle valve discharge at full head.
07/01/98

Photo 7 - Morris Dam - Needle Valve 1 - View of needle valve discharge under full head. 07/01/98

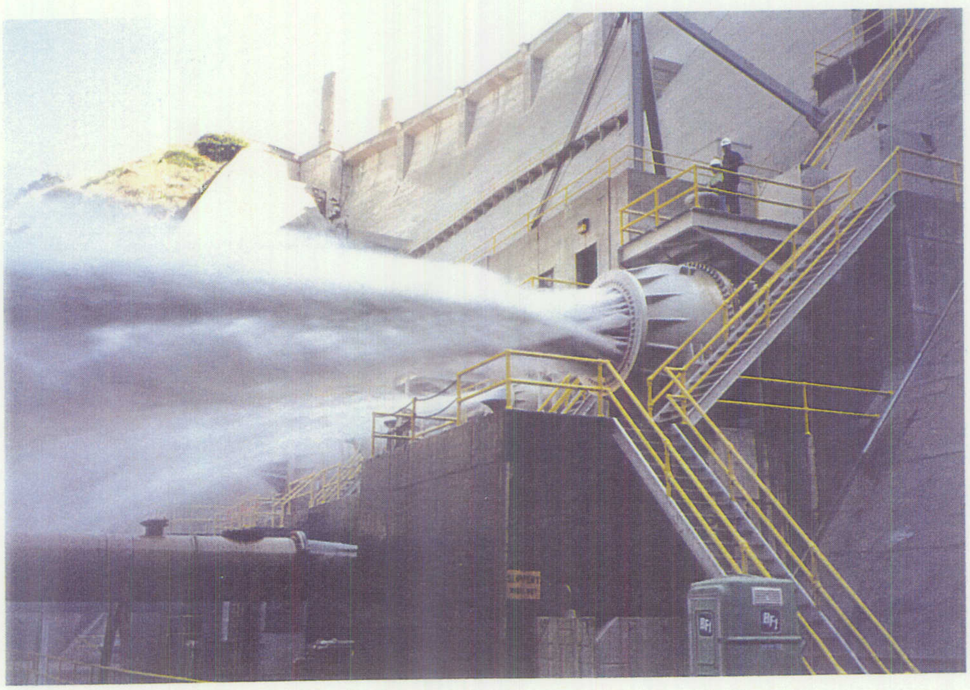


Photo 8 - Morris Dam - Needle Valve 1 - View of needle valve discharge under full head. 07/01/98

Photo 9 - Morris Dam - Needle Valve 1 - View of needle valve discharge under full head.
07/01/98

Photo 10 - Morris Dam - Needle Valve 1 - View of needle valve discharge under full head.
07/01/98

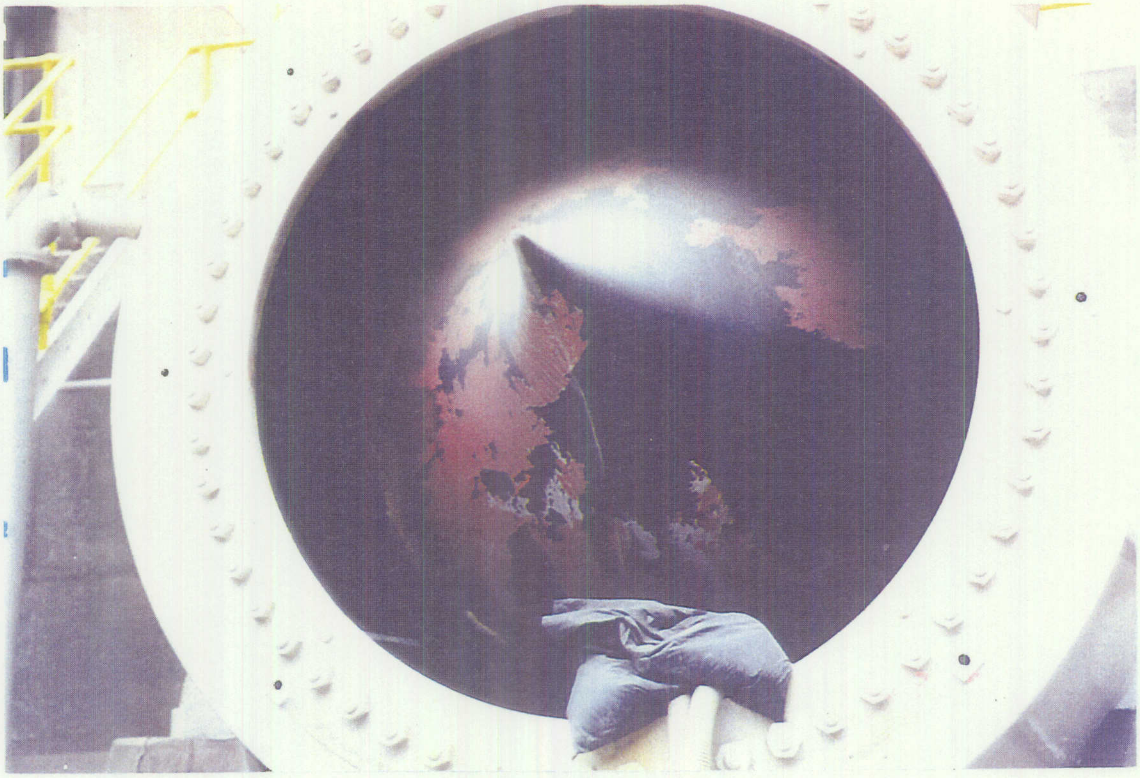


Photo 11- Morris Dam - Needle Valve 1 - View of needle and downstream flange.
09/29/98

Photo 12- Morris Dam - Needle Valve 1 - View corrosion on interior of access manhole cover
09/29/98

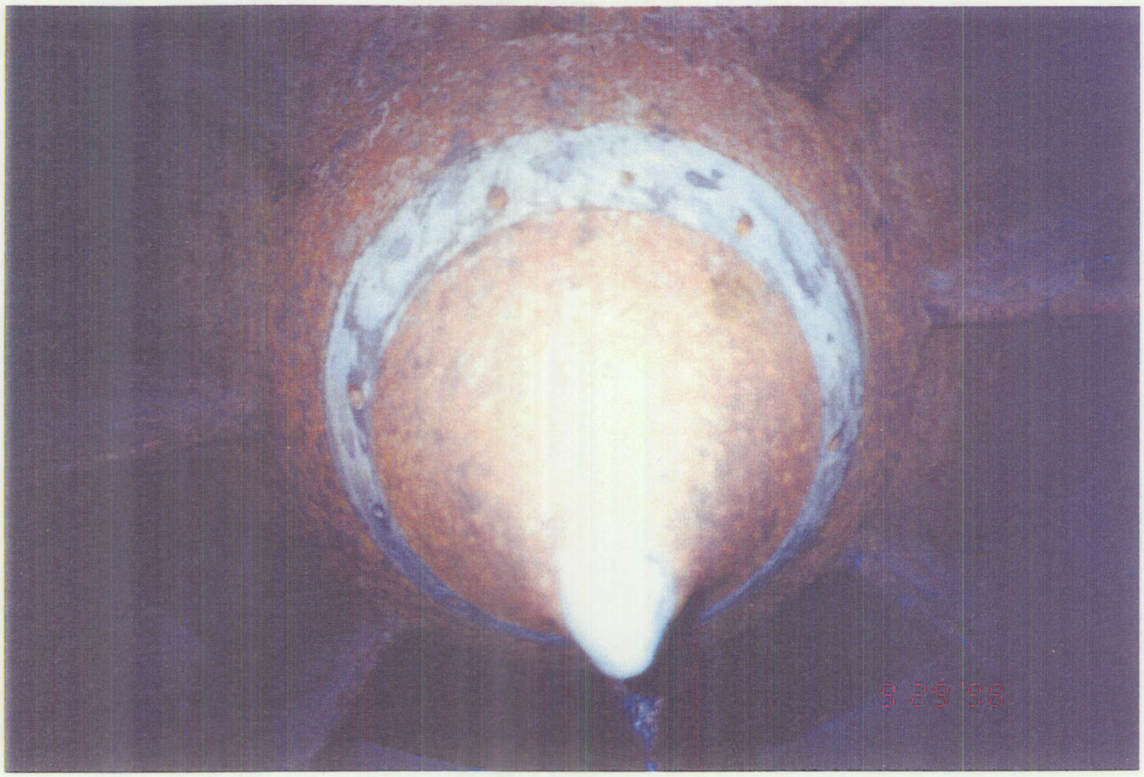


Photo 13- Morris Dam - Needle Valve 1 - View of corrosion on upstream body tip, bronze body tip ring, and valve body.

09/29/98

Photo 14- Morris Dam - Needle Valve 1 - Side view of corrosion on upstream body tip, bronze body tip ring, and valve body.

09/29/98

Photo 15- Morris Dam - Needle Valve 1 - View of corrosion on valve body and 12 o'clock splitter looking downstream.

09/29/98

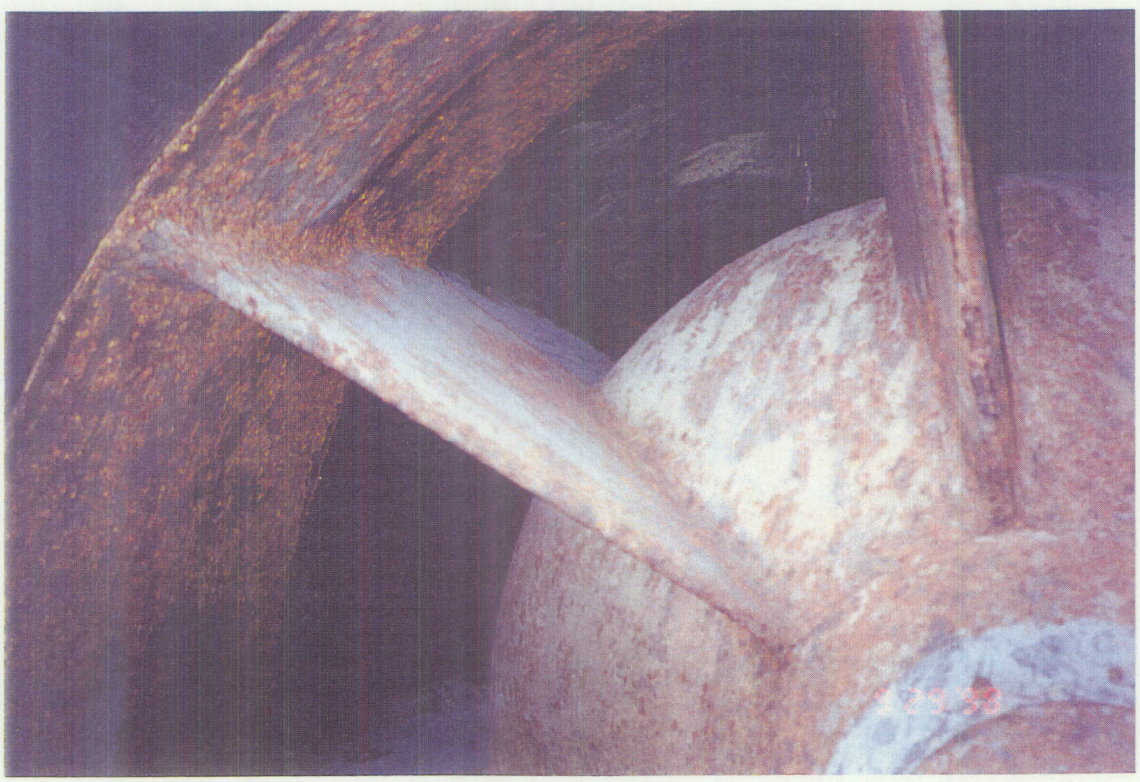


Photo 16- Morris Dam - Needle Valve 1 - View of corrosion on valve body and 1030 o'clock splitter looking downstream.

09/29/98

Photo 17- Morris Dam - Needle Valve 1 - View looking downstream of corrosion on inner valve body shell between 3 and 530 o'clock splitters.

09/29/98

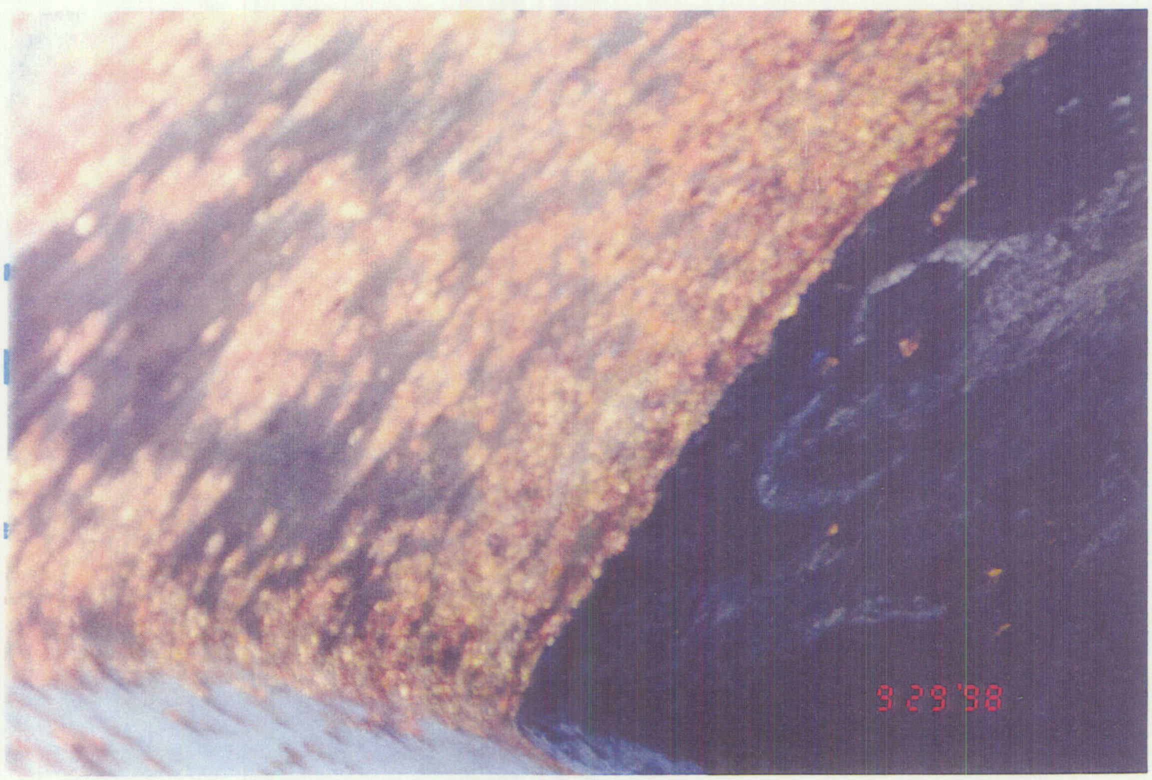


Photo 18 - Morris Dam - Needle Valve 1 - View of corrosion on valve body outer shell at interface with upstream transition.

09/29/98

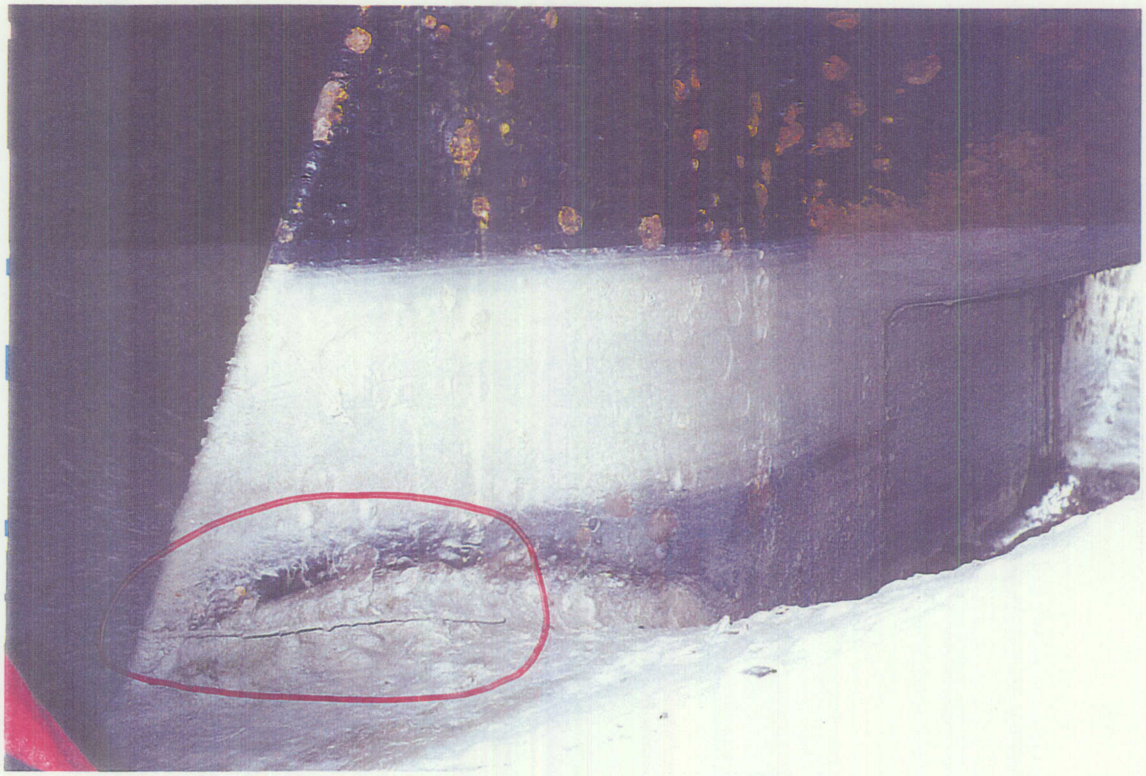


Photo 19- Morris Dam - Needle Valve 1 - View of crack in 6 o'clock splitter at upstream end at connection to outer valve body shell.

09/29/98

Butterfly Valve - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 G. Rood - ...\WORKREQ\MORRIS\INSPECT\2BFV1A.WPD

A. Overall Summary Sheet Dam Morris Dam Valve I.D. 1A

A1. Inspection Site Information:

A1. Name of Dam/Structure: Morris Dam		A2. Region: L A County Dept. Public Works
A3. Date of Inspection: 6/29 thru 7/1/98 A6. Centerline of pipe axis at valve El.: 960.0	A4. Field Contact: Art Diaz/ Jim McGowan Phone #: 626-334-2090	A5. Inspector: Ron Arrington Phone #: 303-445-2877
A7. Reservoir El: 1142.82 A10. Head at valve (feet) at time of inspection: 182.82	A8. Area Office: Emily Hasagawa Phone #: 626-458-6304	A9. Water District: Steve Bradley Phone #:
A11. Others present:		
A12. Special circumstances, weather conditions:		

A2. Inspection Site Information:

A1. Name of Dam/Structure: Morris Dam		A2. Region: L A County Dept. Public Works
A3. Date of Inspection: 9/29/98 A6. Centerline of pipe axis at valve El.: 975.0	A4. Field Contact: Art Diaz/ Jim McGowan Phone #: 626-334-2090	A5. Inspector: Gary Rood Phone #: 303-445-3102
A7. Reservoir El: 970.00 A10. Head at valve (feet) at time of inspection: 0.00	A8. Area Office: Emily Hasagawa Phone #: 626-458-6304	A9. Water District: Steve Bradley Phone #:
A11. Others present: Bill McStraw D-8450, and George Taylor D-8005		
A12. Special circumstances, weather conditions:		

B. Overall Rating of Butterfly Valve:

B1. VALVE'S OVERALL RATING: ☐ Satisfactory ☒ Conditional ☐ **Unsatisfactory**
B2. MAINTENANCE OR REPAIRS REQUIRED: ☐ None ☒ Minor ☐ Major
B3. RESTRICTED OPERATIONS REQUIRED: ☒ No ☐ Yes, Reference Section:
B4. FOLLOW-UP ANALYSIS REQUIRED: ☒ No ☐ Yes, Reference Section:
B5. COMMENTS/RECOMMENDATIONS: Complete interior circumference of the conduit downstream of the valve, for a distance of approximately 10-feet, the coating is completely gone and is rusted. The rust has destroyed the parent metal for a depth of approximately one-eighth inch.

Butterfly Valve - Individual ipment Inspection Checklist

Form - latest revision 10/19/98 G. Rood - ORKREQ\MORRIS\INSPECT\2BFV1A.WPD

C. Description of Butterfly Valve and Operator:

C1. Location of valve: Upstream of Needle Valve 1 in gate chamber	C2: Year valve installed: 1932
C3. Purpose of valve: Emergency closure	C4. Service: ☒ Open/Close only ☐ Throttling
C5. Pressure rating for cold water (psi.):	C6. Valve diameter (inches): 96"
C7. Type: AWWA C504: ☐ Yes ☒ No High-performance: ☐ Yes ☒ No	C8. Pressure class: ☐ AWWA C504 ☐ 25 ☐ 75 ☐ 150 ☐ 250 ☐ A ☐ B ☐ ANSI ☐ 150 ☐ 300
C9. Materials: Body: ☒ Carbon Steel ☐ Stainless Steel ☐ Other Shaft: ☐ Carbon Steel ☐ Stainless Steel ☐ Other Disc: ☒ Carbon Steel ☐ Stainless Steel ☐ Other Retainer: ☐ Carbon Steel ☐ Stainless Steel ☐ Other	C10. Outside of valve: ☒ Exposed ☐ Buried ☐ Submerged
C11. Exterior coating on valve: Satisfactory.	C12. Interior coating on valve: Conditional (see photos)
C13. Connection of valve: ☐ Wafer ☐ Lug ☒ Flanged	C14. Connection on nearby pipe to facilitate removal: ☐ Sleeve-type coupling ☐ Union ☐ Grooved-end coupling ☐ Flange ☒ Other: None
C15. Seats: Mounting of Seats: ☐ Bolted ☐ Glued ☐ Wedged Seat material: ☐ Rubber ☒ Metal ☐ Elastomer Type of elastomer: ____________ Year seats last replaced: ____________	C16. Orientation of stem ☒ Horizontal ☐ Vertical ☐ Diagonal
C17. Operator Type: ☐ Manual ☒ Electric Motor ☐ Hydraulic ☐ Pneumatic	C18. Position indicating system: ☒ Yes ☐ No

C19. Manual Operator Backup
Location on valve: Operating stand (See photo 10)
Type ☒ Handwheel ☐ Square-nut ☐ Lever
Number of turns fully open/close: ____________
Extension stem: ☒ Yes ☐ No
Floor stand and handwheel: ☒ Yes ☐ No
Motor declutch lever:
Use to engage manual operation: ☒ Yes ☐ No
Must use to restore motor operation: ☒ Yes ☐ No

C20. Motor Operator:
Motor Hp: ____________
Output rpm: ____________
Motor voltage: ☐ 115 ☐ 230 ☐ 460
Phase: ☐ DC ☐ Single ☐ 3
Emergency power: ☐ Engine-Generator Set ☐ None
Worm gear reduction ratio: ____________
Opening/closing speed (seconds): ____________

D. Inspection of Butterfly Valve (prior to operation):

D1. Valve: Exterior: ☒ Inspected ☐ Not inspected ☐ Outside of body corroded ☐ Cracked, broken, or missing parts ☐ Valve supports corroded Interior: ☒ Inspected ☐ Not inspected ☒ Inside of body corroded ☒ Cavitation or pitting on valve disk ☐ Wire-drawing ☒ Seat corroded, worn, or missing Connection: ☒ Inspected ☐ Not inspected ☐ Corroded ☐ Missing flange bolts Support: ☒ Inspected ☐ Not inspected ☐ Corroded ☐ Missing anchor bolts Comments/Description:	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☒ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)
D2. Leakage: ☐ Inspected ☒ Not inspected Estimated amount of leakage: ____________ Head on valve: ____________ Exterior: ☐ Leakage around flanges ☐ Leakage through stem ☐ Leakage through seal adjusting screws Interior: ☐ Leakage at disk and seat Comments/Description:	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)

D3. Coatings and linings: ☒ Inspected ☐ Not inspected Exterior (describe if box checked): ☒ Paint chipped, cracked or missing: ☐ Galvanizing chipped, cracked, or worn: ☐ Original coating Date of last recoating: ____________ Interior (describe if box checked): ☒ Paint chipped, cracked or missing: ☐ Galvanizing chipped, cracked, or worn: ☒ Original coating Date of last recoating: ____________ Comments/Description:	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☒ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)
D4. Controls: ☒ Inspected ☐ Not inspected ☐ Damaged or broken parts in control panel ☐ Contacts corroded, dirty, or loose ☐ Broken components on electrical equipment ☐ Damaged pushbuttons ☐ Frayed or damaged wiring, insulation, cable, or conduit ☐ Instructions missing or unclear Comments/Description: Valve could not be seated with the motor controls, required manual operation to seat valve.	☒ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)

D5. Motor operator: ☒ Inspected ☐ Not inspected General: ☐ Damaged or broken parts on operator ☐ Contracts corroded, dirty, or loose ☐ Frayed wiring or broken components on electrical equipment Motor: ☐ Discolored paint from overheating ☐ Frayed or burnt insulation ☐ Loose or damaged wiring ☐ Unstable or damaged mounting, loose bolts ☐ Missing bolts on the terminal box cover ☐ Damaged flexible conduit ☐ Corrosion or uncleanliness ☐ Condensation or drainage problem Frequency of lubrication: ____________ Last lubrication: ____________ Housings: ☐ Condensation pools ☐ Leakage through casting ☐ Leakage through seals or gaskets ☐ Damaged, loose or missing anchor bolts, cover bolts, hinges, cover plates ☐ Damaged or cracked castings or plate Gears: ☐ Uneven or excessive wear, evidence of pitting ☐ Poor dispersal of lubricant ☐ Broken gear teeth ☐ Misalignment of gears/shafting ☐ Corrosion Frequency of lubrication: ____________ Last lubrication: ____________ Comments/Description:	☒ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)
D6. Limit Switch: ☒ Inspected ☐ Not inspected ☐ Damaged or loose mounting bolts or bracket ☐ Corrosion or uncleanliness ☐ Missing bolts on the inspection cover ☐ Damaged flexible conduit ☐ Condensation or drainage problem Comments/Description:	☒ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)

E. Inspection of Butterfly Valve (during operation):

E1. Description of operational test (Ex.: Valve fully closed, opened to 30 degrees, took approx. 5 minutes, motor operator functioned smoothly):
- ☒ Full-travel, balanced head
- ☒ Emergency closure, full-travel,, unbalanced
  At 25% flow

E2. Manual operation: ☒ Operated ☐ Not operated ☐ Difficult to turn ☐ Binding ☐ Squeaks or other unusual noise ☐ Excessive time to operate. Time required: __________ ☐ Unable to operate ☐ Unable to disengage motor operator ☐ Missing handle or tee-wrench Comments/Description: Manual operation required to properly seat valve Arrow indicating direction of handle turn is incorrect	☒ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)
E3. Motor operation: ☒ Operated ☐ Not operated Gears: ☐ Chattering, loud or unusual noise during operation ☐ Binding Motor: ☐ Motor overheating ☐ Excessive motor current draw ☐ Loud or unusual noise from motor bearings during operation Controls: ☐ Control pushbuttons do not work Box: ☐ Space heater does not work Comments/Description:	☒ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)
E6. Position indication ☐ Position indication miscalibrated ☐ Position indication does not work Comments/Description:	☒ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)

E7. Limit switch ☒ Limit switch miscalibrated or requires adjustment of stops ☐ Limit switch does not work ☐ Limit switch space heater not functioning Comments/Description: Valve could not be seated with the motor controls, required manual operation to seat valve - limit switch requires adjustment.	☐ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☒ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)

F. Safety and Security:

F1. Overall safety and security:

Comments/Description:

Valve in gate chamber in interior of dam.

☒ SATISFACTORY SAFETY AND SECURITY
(No repairs or maintenance currently required)

☐ MINOR REPAIRS OR MAINTENANCE REQUIRED

☐ UNSATISFACTORY SAFETY AND SECURITY
(Major repairs, replacement, or maintenance required)

F2. Accessibility to public:
- ☐ Public can access valve
- ☐ Valve exposed to gunshot from distance
- ☐ Danger to public
  - ☐ Danger from water discharge
  - ☐ Danger from moving parts
  - ☐ Dangerous location for unauthorized people

F3. Vandalism
- ☐ Damage to valve or operator

F4. Security features:
- ☐ Fencing
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☒ Inside building
  - ☐ Existing and inadequate
- ☐ Lighting
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Locks on handwheel or operator
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☒ Attended by damtender
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Alarm system
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Warning signs
  - ☐ Not existing and needed
  - ☐ Existing and inadequate

F5. Tagging and lockout for maintenance or inspection

At valve

- ☐ No tagging

At control panel

- ☐ No tagging
- ☐ No lockout nor power disconnection

At remote control location

- ☐ Danger of unknown remote operation

INSPECTION COMMENTS

- Valve on bypass line is typically left in open position when outlet is filled, which may cause cavitation problems in bypass piping.
- Dam tender reported that the elbow on the bypass piping failed (photo 9) and required replacement.
- Indicating arrow for handwheel rotation on valve manual operating stand are incorrect.
- A large amount of coating damage and rust occurring immediately downstream, to 10-feet downstream, of the valve for the full circumference of the conduit.
- Interior-valve trunnion bolt connections are rusted.
- Leaf seats are corroded and rusted.
- Leaf connections (Bolted) are corroded and rusted.

Description of Butterfly Valves

A butterfly valve consists of a circular disk on a shaft through the middle of the water flow path. The shaft can be mounted vertically or horizontally and is supported by bearings at both ends of the valve body. The leaf rotates 90 degrees from open to closed by an operator connected to the shaft and mounted to the exterior of the valve body. Smaller valves are manually operated by a handwheel, crank, or tee-handle wrench on a square nut. Butterfly vaves are also operated by an electric motor and gear box, hydraulic oil operating system with a hydraulic cylinder on the valve, or pneumatic operating system with a pneumatic cylinder on the valve.

A few butterfly valves in Reclamation dams are rectangular or square shaped.

Around the disk of a butterfly valve is usually a bronze, rubber, or elastomer seat. The inside of the body also has a rubber or elastomeric seal in order to ensure a watertight connection when the valve is closed. Some butterfly valves have metal-to-metal seals in order to permit higher water velocity through the valve. With metal-to-metal seals, some leakage is unavoidable.

Most butterfly valves in Reclamation facilities are commercial products which either conform to AWWA C504 or are high-performance type. Some older large butterfly valves were designed in-house by Reclamation. Most butterfly valves should only be kept fully open or fully closed. If these valves are kept partially open, there is risk of cavitation or losing the seals. High-performance butterfly valves may be throttled down to an opening of 20 degrees.

Of primary importance, inspect the following:

- Cavitation on the valve leaf. The risk is greater if there is a high differential pressure across the valve. Cavitation usually will be greater on the downstream face. Cavitation will appear as pitting in the metal, or wire-drawing.
- Leakage through the valve. This usually is caused by eroded or missing rubber or elastomeric seals. Metal seated butterfly valves will inevitably have some leakage past the disk on the inside.
- Manual operation should be smooth and not inordinately difficult. Motor operators normally have a declutch lever in order to engage manual operation.
- Motor, hydraulic, and pneumatic operators should smoothly open and close the valve. Limit switches should shut off the motor as the valve is fully open or fully closed.
- There should be no oil leakage in a hydraulic operating system.

K R Smith
Revised 5/26/1998

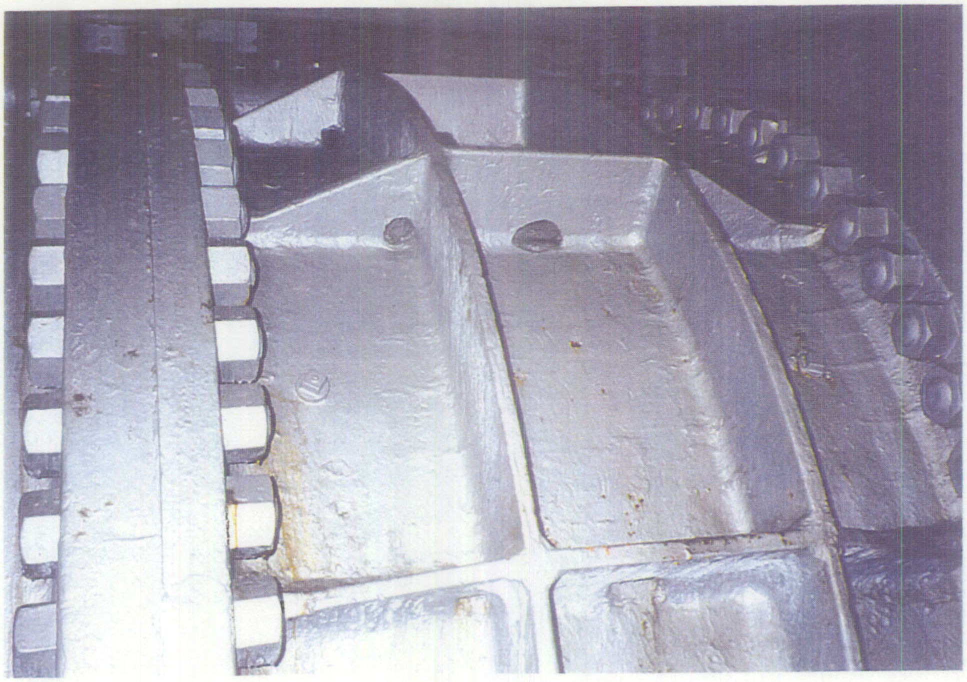


Photo 1 - Morris Dam - Butterfly Valve 1A - View of body and upstream flange. 07/01/98

Photo 2 - Morris Dam - Butterfly Valve 1A - View of valve body. 07/01/98

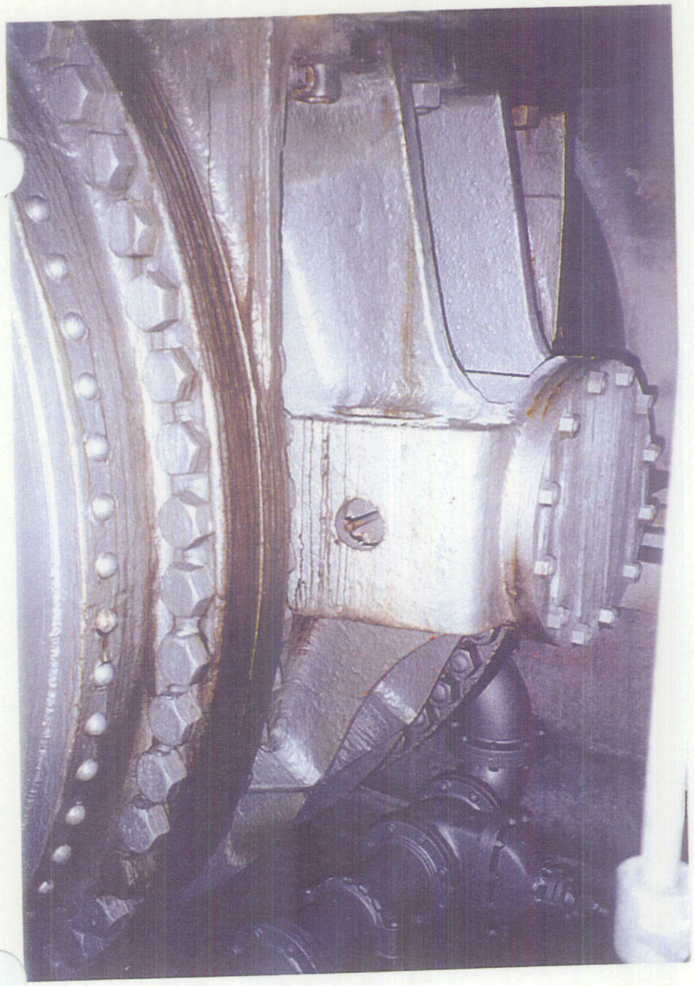


Photo 3 - Morris Dam - Butterfly Valve 1A -
View of valve trunnion housing. 07/01/98

Photo 4 - Morris Dam - Butterfly Valve 1A -
View of valve gear housing. 07/01/98

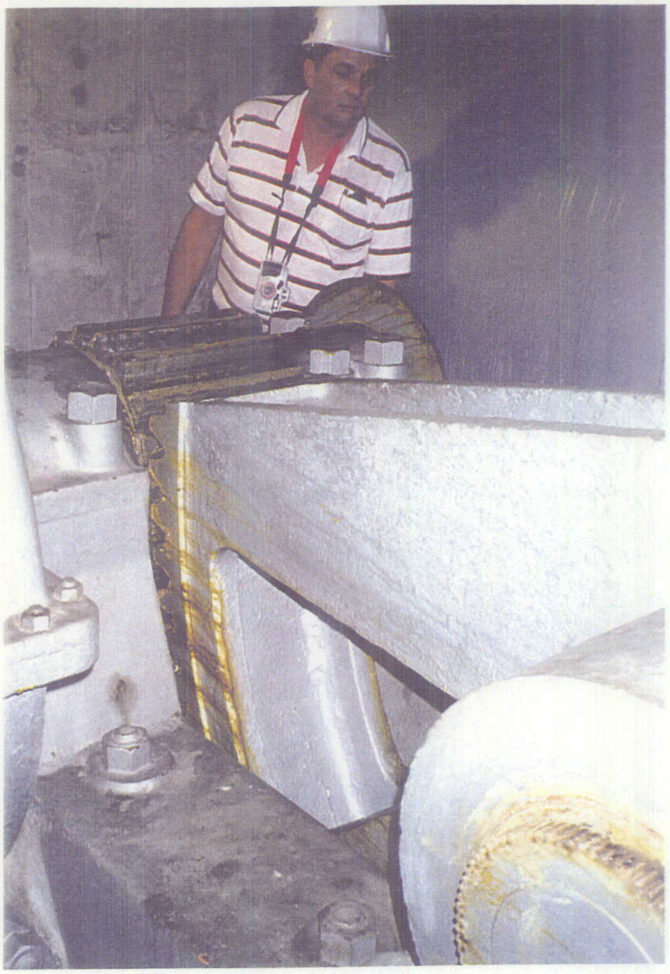


Photo 5 - Morris Dam - Butterfly Valve 1A - View of valve spur gear operating arm.
07/01/98

Photo 6 - Morris Dam - Butterfly Valve 1A - View of valve spur gear operating arm.
07/01/98

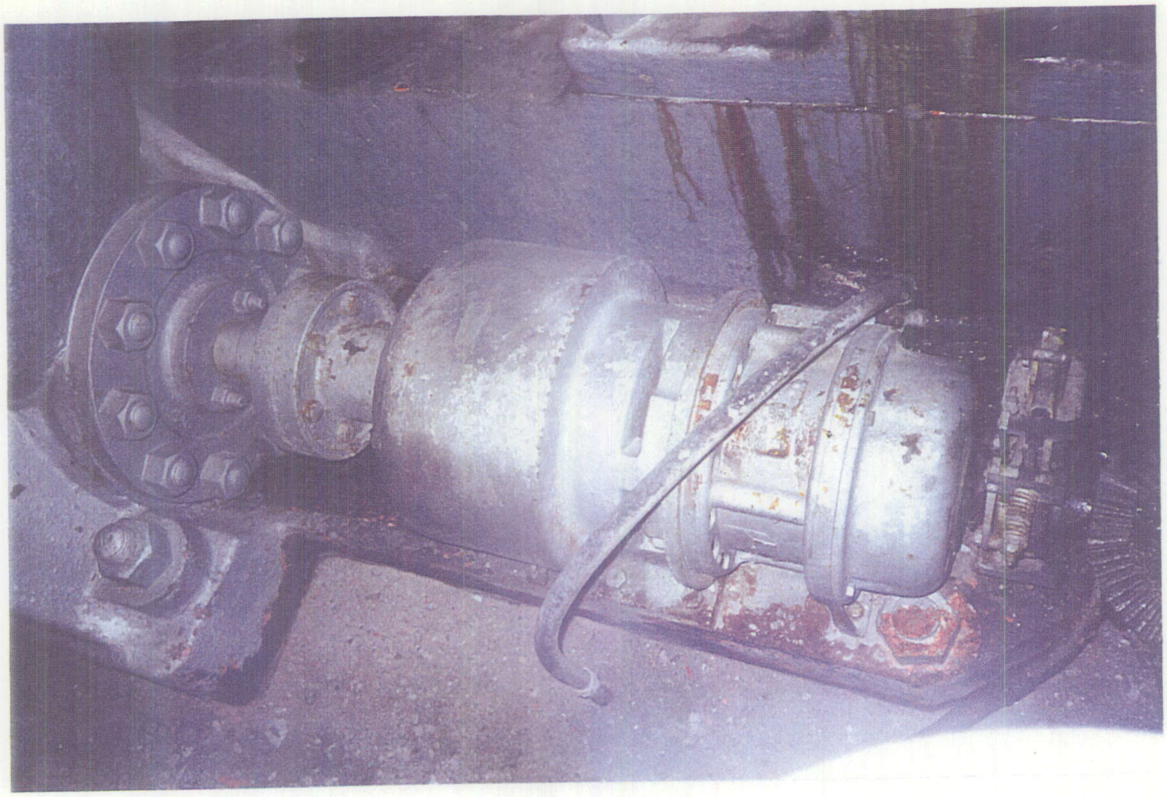


Photo 7 - Morris Dam - Butterfly Valve 1A - View of valve operator electric motor.
07/01/98

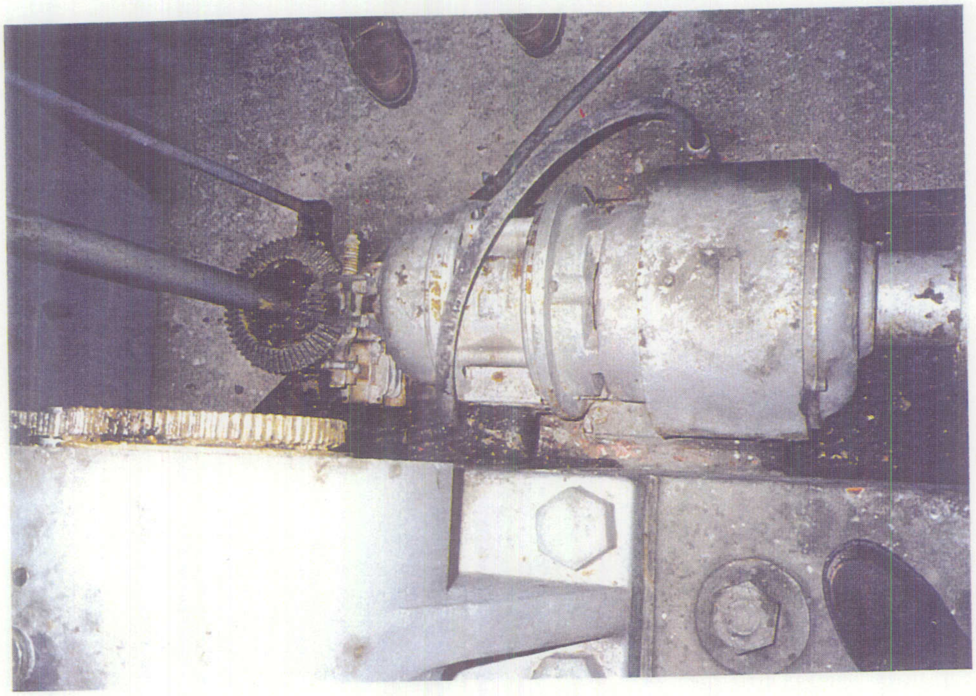


Photo 8 - Morris Dam - Butterfly Valve 1A - View of valve operator electric motor.
07/01/98

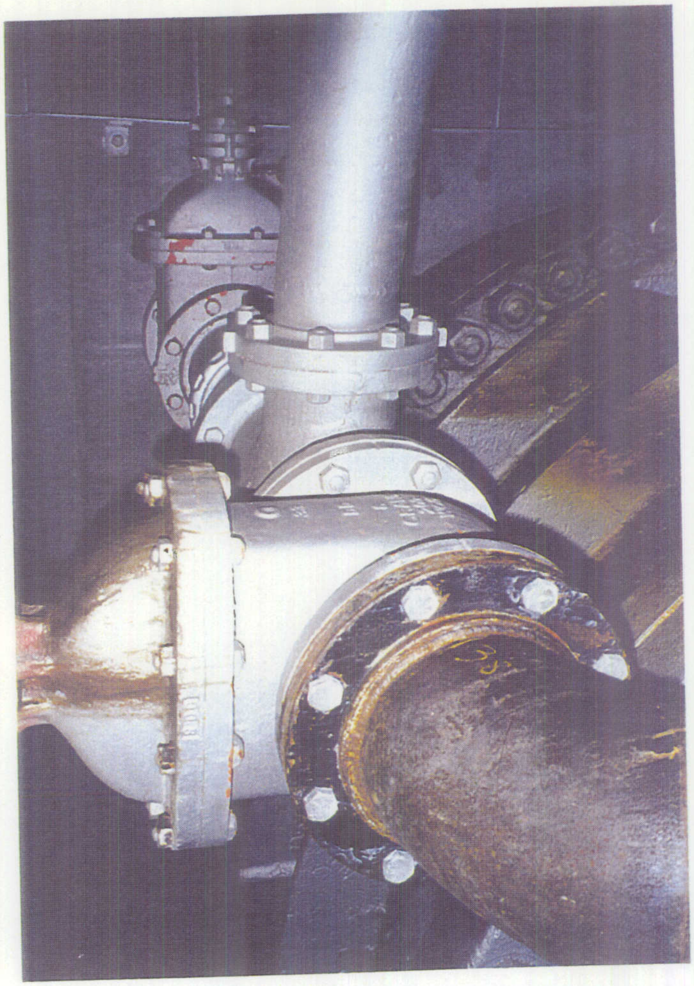


Photo 9 - Morris Dam - Butterfly Valve 1A - View of valve bypass piping and valves.
07/01/98

Photo 10 - Morris Dam - Butterfly Valve 1A - View of valve operating handwheel.
07/01/98

Photo 11- Morris Dam - Butterfly Valve 1A - View of upstream face of valve disc and seal.

09/29/98

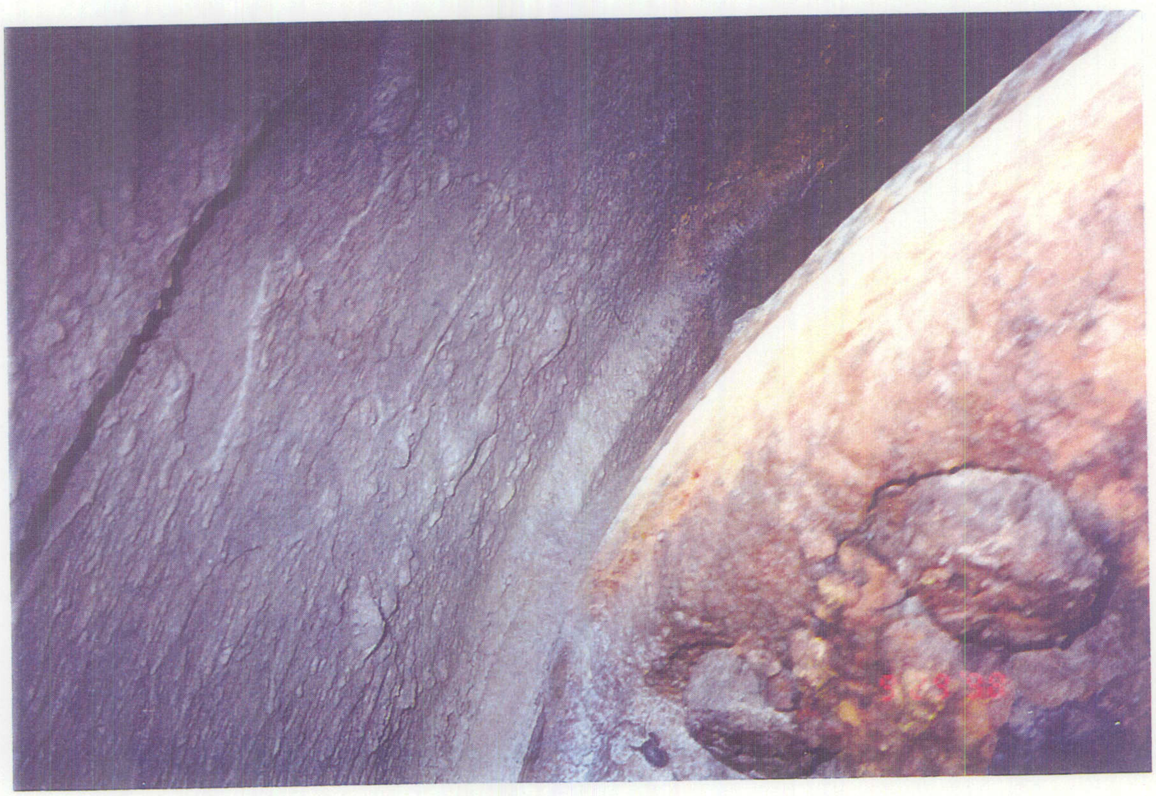


Photo 12 - Morris Dam - Butterfly Valve 1A - View of corrosion on seal bolts on upstream face of valve disc

09/29/98

Photo 13- Morris Dam - Butterfly Valve 1A - View of upstream face of valve disc at trunnion.

09/29/98

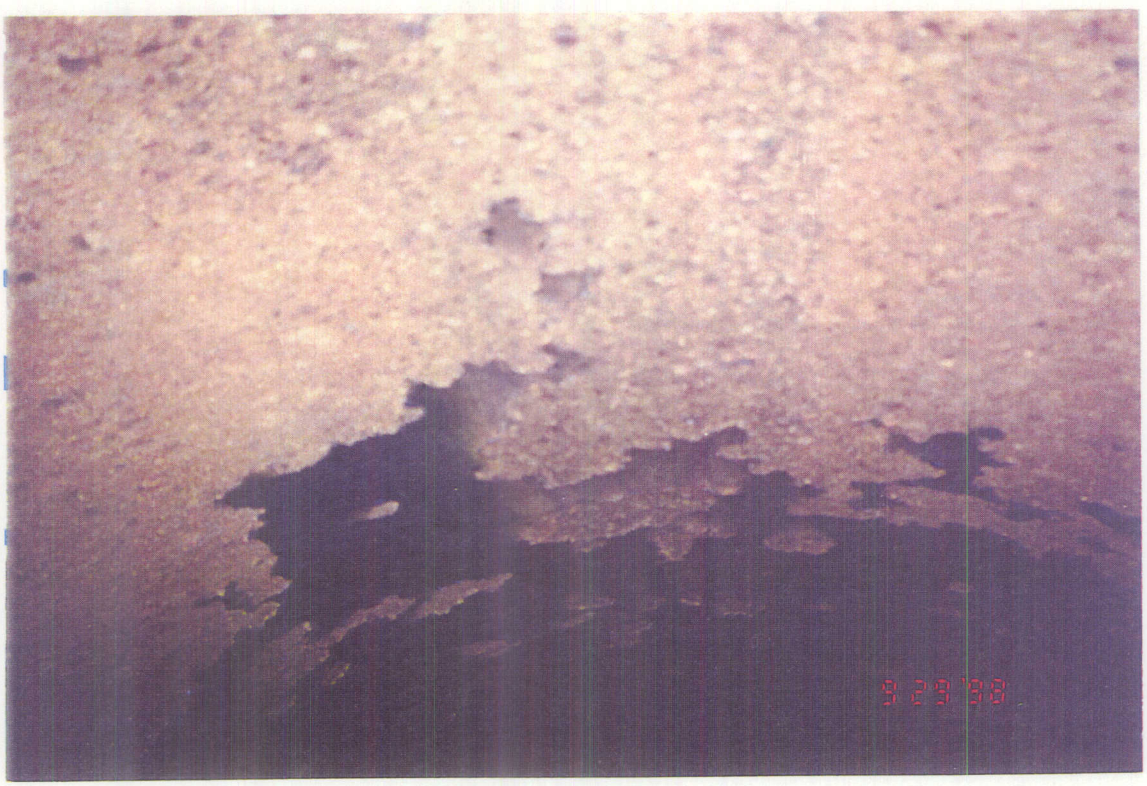


Photo 14 - Morris Dam - Butterfly Valve 1A - View of corrosion on pipe immediately downstream of disc seat.

09/29/98

1 - Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\sIGATE3a.WPD

A. Overall Summary Sheet Dam_Morris Dam_____ Gate I.D._2A_____

A1. Overall Rating - Slide Gates & Hydraulic Hoists (Provide an overall general rating for the gates and hoists based on safe/unsafe operation and O&M required/not required)

a. GATE GENERAL CONCLUSIONS:	b. Slide GATE OVERALL RATING:
Gate Needs Maintenance? ☐ None ☐ Minor ☐ Major ☐ Immediate Gate Needs Repairs? ☐ None ☐ Minor ☐ Major ☐ Immediate Restricted Gate Operations Recommended? ☐ No ☐ Yes (Describe..) Recommendations Included in Checklist? ☐ No ☐ Yes (Describe...)	☐ GOOD (Current gate condition/maintenance/safety is above average) ☐ SATISFACTORY (No maintenance or repairs currently required) ☐ CONDITIONAL (Gate safely operable, but some maintenance/repairs required) ☐ UNSATISFACTORY (Major repairs/replacement/maintenance required) ☐ RESTRICTED (Gate should not be operated) **c. HYDRAULIC HOIST OVERALL RATING:** ☐ GOOD (Current hoist condition/maintenance/safety is above average) ☐ SATISFACTORY (No maintenance or repairs currently required) ☐ CONDITIONAL (Hoist safely operable, but some maintenance/repairs required) ☐ UNSATISFACTORY (Major repairs/replacement/maintenance required) ☐ RESTRICTED (Hoist should not be operated)
Comments:	

A2. Level 2 - General Summary of Slide Gate, Outlet Gate and Hydraulic Hoist Condition: (Check or Circle as Appropriate)

a. Operation: Gate / Hoist Operated: ☐ Yes: ☐ Full Travel ☐ Partial Travel (How far _______) ☒ Not Operated (why?) Downstream gate removed for sluicing
b. Structural: ☐ Satisfactory ☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)
c. Protective Coatings: ☐ Original Paint ☐ Year of Last Paint Coat ______ ☐ Paint Satisfactory ☐ Requires minor local touch-up ☐ Severe localized damage (No. and location)_☐ Extensive
d. Weld/Bolted Connections: ☐ Chck ☐ Unchck Bolted connections ☐ Okay
(circle) (Missing Bolts) (Corroded/Rusted Bolts) (Loose Bolts) (Deformed Bolts) ☐ Many ☐ Some ☐ Few
e. Gate Leaf Sealing: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☐ Moderate Leakage ☐ Heavy Leakage
f. Concrete / Grout: Gate Chamber / Control House Condition? ☐ Satisfactory ☐ Spalling ☐ Hairline cracking (Hvy)(Mod)(Light)
g. Gate Operation: ☐ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other
h. Hoist Operation: ☐ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

Comments: Operated gate full cycle balanced and full close cycle unbalanced at 25% flow.

1 - Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\sIGATE3a.WPD

B. Inspection and Equipment Basic Information Sheet:

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Gate ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington, USBR	6. Field Contact: Art Diaz/Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Gate Sill El.:971.00	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Gate: 172.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		

B2. Description of Slide Gate, Hydraulic Hoist and Appurtenant Equipment:

Gate No.: 2A — Size: Width 48-inch Height 48-inch ☒ Guard / Emergency ☐ Regulating Design Head 194' Year Designed 1932

Type of Stem Bushing / Gland: ☒ Adjustable ☐ Non-Adjustable ☐ Condition (Describe if not satisfactory)
Type of Gate Hanger: ☐ Automatic ☐ Semi-Automatic ☒ Chain with hook ☐ Other (Describe) ☐ None
Semi-Automatic Gate Hanger Safety Studs: ☐ Number of replacements on hand ☐ Order more replacements
Size of Hoist Stem: ____________ inch diameter Hoist Stem Material: ______________
Gate Seats, Gate Sill, and Guides ☐ Bronze on Bronze ☐ Stainless steel on bronze ☐ Seats are/ are not equipped with greasing system.
Gate Leaf constructed of: ☐ Cast Iron ☐ Cast Steel ☐ Fabricated Steel ☐ Stainless Steel ☐ Other
Condition of leaf and seating surfaces: ☐ Poor ☐ Good ☐ Excellent ☐ Corroded ☐ Eroded ☐ Cavitated ☐ Other (Explain)

Gate Hoist Operator:	Type: ☒ Hydraulic hoist ☐ motor operated Screw-Lift **Comment:** Water-operated Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ______________		
Emergency Operation:	~~☐ Engine-Generator ☐ Hand pump Operable? ☐ Yes ☐ No (why?)~~	~~Eng-Gen Operated at Inspection: ☐ Yes ☐ No Last time (when)~~ ________	SOP Updated Recently ☐ Yes ☐ No
Comments:	Operates from static head from water tank		

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the Slide Gate, Outlet Gate and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Downstream Side of leaf	☐ Yes ☐ No:	Upstream Side of leaf	☐ Yes ☐ No:	Body Seats	☐ Yes ☐ No	Hoist:	☐ Yes ☐ No
Upstream / Downstream Bodies	☐ Yes ☐ No	Stem Connection	☐ Yes ☐ No	Bottom of leaf	☐ Yes ☐ No	Ring Seal	☐ Yes ☐ No

Gate Areas Not Available for Inspection:

Inspection of gate sill: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Inspection of gate bodies: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Comments: Inspection of interior of gates is scheduled for the weel of August 31, 1998

1 - Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\slGATE3a.WPD

Gate Inspectiom:

a Exterior Body

.Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Gate Support Gate body embedded in concrete

Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support? ☐ Yes ☒ No (Explain)

c. Hydraulic Hoist Water-operated

Is there water leakage from cylinder flanges? ☐ Yes ☒ No (Explain)
Is there water leakage from cylinder glands? ☐ Yes ☒ No (Explain)
Is there any water present in the bonnet cover or on the floor? ☐ Yes ☒ No (Describe)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint ? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on cylinder or heads? ☐ Yes ☒ No (Explain)

d. U/S Interior Body

Are there scratches or gouges on gate leaf? ☐ Yes ☐ No (Explain)
Are there scratches, gouges, cavitated , or damaged areas on the seal ring? ☐ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on the body? ☐ Yes ☐ No (Explain)
Are there areas of corrosion on the body? ☐ Yes ☐ No (Explain)

e. D/S Interior Body

Are there scratches or gouges on gate seats? ☐ Yes ☐ No (Explain)
Are there scratches, gouges, or corrosion on the gate stem? ☐ Yes ☐ No (Explain)
Are there exposed stem threads on bottom of stem nut? ☐ Yes ☐ No (Explain)
Are there missing screws or evidence of corrosion on the seal ring gland? ☐ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on the gate leaf or body ? ☐ Yes ☐ No (Explain)
Are there areas of corrosion on the gate leaf or body? ☐ Yes ☐ No (Explain)

GATE AND HOIST STRUCTURAL RATING:

☐ **GOOD**
(Gate and Hoist structural condition is above average)
☐ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Gate and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Gate/Hoist should not be operated for structural reasons.)

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f. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

D2. Condition of Gate's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☐ Date Last Painted (Where?)

a. General Condition of Coating: ☒ Good ☐ Fair ☐ Poor d. Rust: ☐ hvy ☐ mod ☐ light ____% b. Coating Failure: ☐ hvy ☐ mod ☐ light ____% c. Corrosion: ☐hvy ☐mod ☐light ____% d. Pitting: ☐ hvy ☐ mod ☐ light ____% e. Distribution and Location of Coating Deficiencies: ☐ All: Leaf U.S. Side: ☐ Yes ☐ No Leaf D.S. Side: ☐ Yes ☐ No Bonnet Cover: ☐ Yes ☐ No ☐ Hoist: ☐ Yes ☐ No Cause of Coating Failure: ☐ Age ☐ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☐ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**GATE PAINT RATING:** ☐ GOOD (Gate's current paint coating is above average) ☒ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☐ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)

COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.

D3. Performance and Condition of Gate Seal

a. Leakage past seal ☑ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☐ Excessive (How much?) __________gpm. Leakage Acceptable? ☐ Yes ☐ No b. Condition of ring seal: ☐ Unknown ☐ Good ☐ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... c. Reason for Leakage: ☐ Damaged ring seal ☐ Damaged or scratched leaf ☐ Leaf to seal contact ☐ Seal Defect ☐ Stuck Debris ☐ Other d. Condition of ring seal gland screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ...	**GATE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☐ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)

e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT GATE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS

Outlet filled at time of inspection.

D4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of gate and hoist operation?	☑ Yes	☐ No
b. Are discharge curves and operating diagrams current?	☐ Yes	☐ No N/A
c. Posted operating instructions?	☑ Yes	☐ No
d. Does dam operator understand their use?	☑ Yes	☐ No
e. Are as-built drawings of gate/hoist available?	☐ Yes	☑ No
f. Are maintenance requirements understood?	☑ Yes	☐ No
g. SOP/DOC instructions and documents current?	☑ Yes	☐ No

1 - Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

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D5. Performance of Gate and Hoist Operation:

a. Was gate and hoist operated at inspection? ☐ Yes ☒ No

b. Is gate and hoist exercised according to SOP? ☒ Yes ☐ No

c. Is gate and hoist operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe gate and hoist operation: (describe below)
☐ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last gate operation.

f. Gates and hoist operated as designed? ☐ Yes ☒ No (Why?) Gate and outlet used for sluicing

g. Has this gate and hoist been operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

GATE AND HOIST RATING:

☐ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Gate and hoist should not be operated without major repairs or restricted operation)

D6. Maintenance/Lubrication:

Type of greasing system: (describe)

Frequency of Lubrication:

Last Lubrication: (Date)

Lubricant type:

Top and side seat lubrication: ☐ n/a (why) ________ (No greasing system available)

Grease zircs/fittings (if applicable) damaged or unuseable: Repair Date.

COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT MAINTENANCE. POSSIBLE ACTIONS/RECOMMENDATIONS

E. Gate Public Security:

Gate Installation Accessible by Public? ☐ Yes ☒ No *Describe ...* In gate chamber in interior of dam

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

- Valve lower body is embedded in concrete.
- It was reported by dam tender that when valve was operated unbalanced (opened) that the vibration was so severe that the bypass filling line valve cracked and had to be replaced with a butterfly valve. (Noticed that gates had been operating with filling line open.)
- Downstream needle valve 2 has been removed and replaced with a gate valve and extension pipe for sluicing.

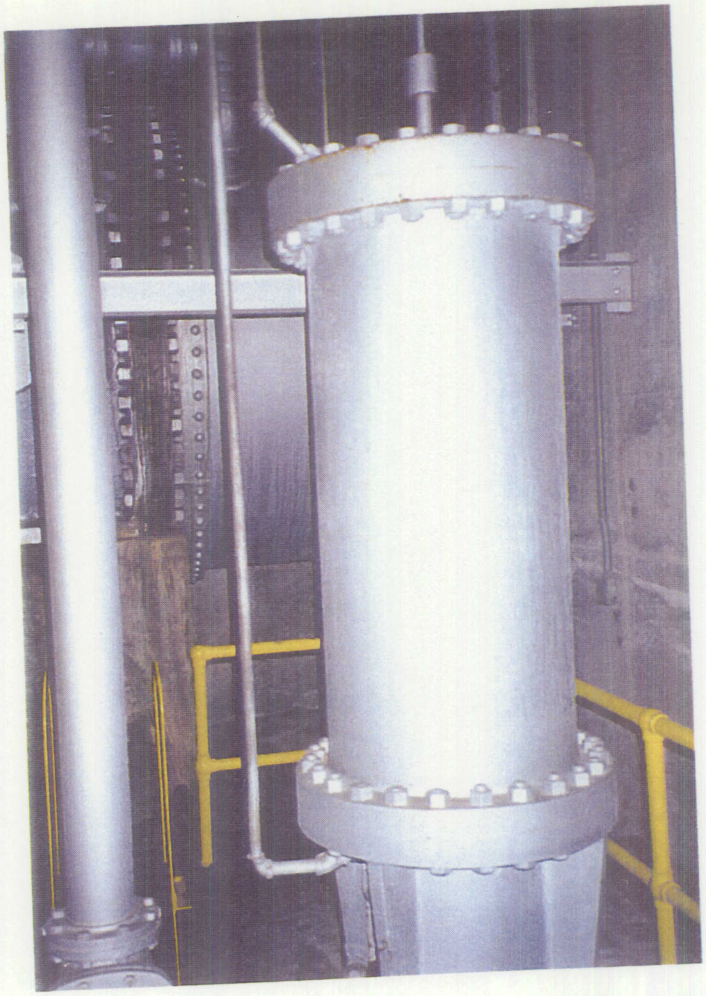

Photo 1 - Morris Dam - Slide Gate 2A - View of hoist and bonnet cover.
07/01/98

Photo 2 - Morris Dam - Slide Gate 2A - View of bonnet cover and body. Note lower body embedded in concrete.
07/01/98

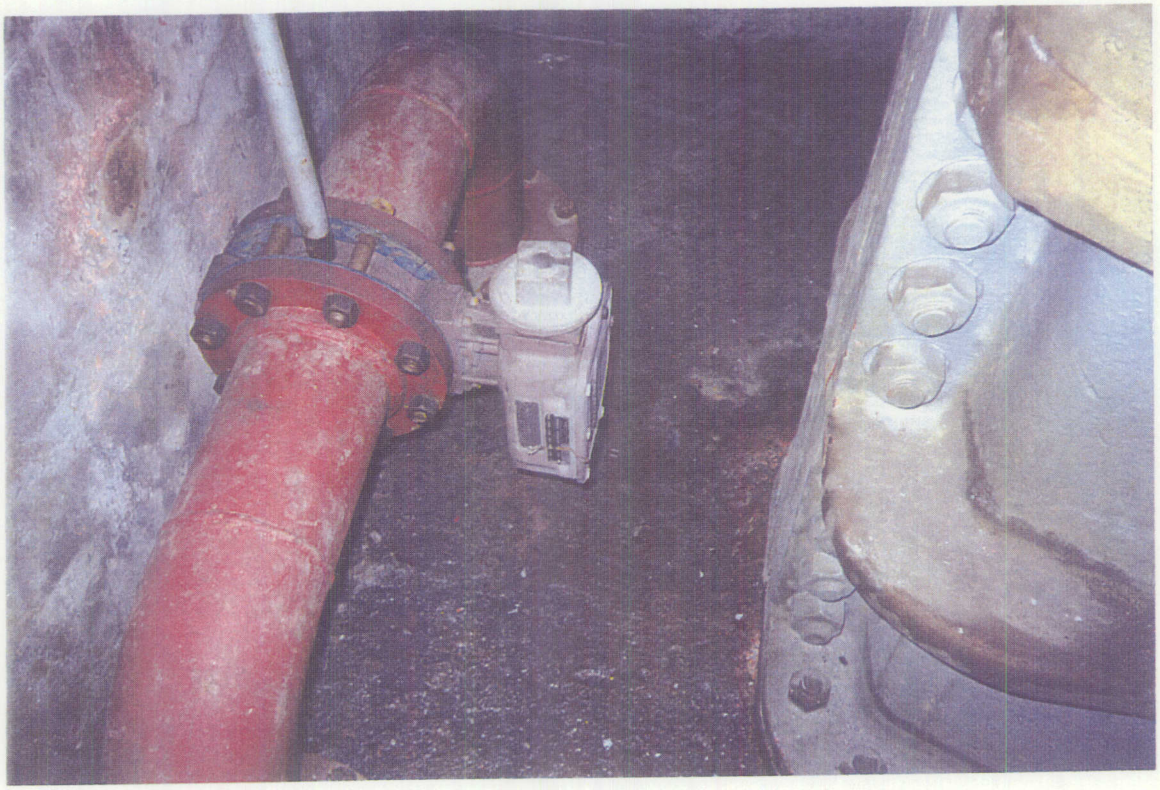

Photo 3 - Morris Dam - Slide Gate 2A - View of bypass pipe and bypass butterfly valve.
07/01/98

Photo 1 - Morris Dam - Valve 2 (removed) - View showing pipe extension on outlet used for sluicing. 07/01/98

Photo 2 - Morris Dam - Valve 2 (removed) - View showing pipe extension and gate valve on outlet used for sluicing. 07/01/98

Needle Valves - Individual Equipment Inspection Checklist

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A. Overall Summary Sheet

Dam Morris Dam **Valve I.D.** 3

A1. Overall Rating - Needle Valve

(Provide an overall general rating for the valve based on safe/unsafe operation and O&M required/not required)

a. VALVE GENERAL CONCLUSIONS:

Valve Needs Maintenance?	☐ None	☐ **Minor**	☐ Major	☐ Immediate
Valve Needs Repairs?	☐ None	☐ **Minor**	☐ Major	☐ Immediate
Restricted Valve Operations Recommended?		☐ No	☐ Yes (Describe..)	
Recommendations Included in Checklist?		☐ No	☐ Yes (Describe...)	

b. Needle VALVE OVERALL RATING:

- ☐ GOOD (Current valve condition/maintenance/safety is above average)
- ☐ SATISFACTORY (No maintenance or repairs currently required)
- ☐ CONDITIONAL (Valve safely operable, but some maintenance/repairs required)
- ☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
- ☐ RESTRICTED (Valve should not be operated)

Comments: Valve has excessive leakage through the needle seats.

A2. Level 2 - General Summary of Needle Valve Condition:

(Check or Circle as Appropriate)

a. OPERATION:

Was valve operated?: ☐ Yes: ☐ Not Operated (why?)
☐ Full Travel ☐ Partial Travel (How far ______)

Valve operation: ☐ Smooth ☐ Rough ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

b. STRUCTURAL: ☐ Satisfactory
☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)

c. PROTECTIVE COATING: ☐ Original Paint ☐ Year of Last Paint Coat ______
☐ Paint Satisfactory
☐ Requires minor local touch-up ☐ Severe localized damage (No. and location)_ ☐ Extensive

d. WELDED/BOLTED CONNECTIONS: ☐ Checked ☐ Unchecked

Bolted connections ☐ Okay
☐ Missing Bolts ☐ Corroded/Rusted Bolts ☐ No Threads Showing ☐ Deformed Bolts
☐ Many ☐ Some ☐ Few

e. VALVE SEAT SEALING: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☐ Moderate Leakage ☐ Heavy Leakage
:

Comments:

Needle Valves - Individual Equipment Inspection Checklist

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B. **Inspection and Equipment Basic Information Sheet:**

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Valve ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington USBR	6. Field Contact: Art Diaz / Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Valve Centerline El.: 975.0	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Valve: 170.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		
1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 8/29/98	**5. Lead Inspector & Office: Gary Rood USBR**	**6. Field Contact: Art Diaz / Jim McGowan**
4. Reservoir El.: 0.00	**Phone #: 303-445-3102**	**Phone #: 626-334-2090**
7. Valve Centerline El.: 975.0	**8. Area Office & Contact: Emily Hasegawa**	**9. Water District & Contact: Steve Bradley**
10. Head on Valve: 0.00	**Phone #: 626-458-6304**	**Phone #:**
11. Others present: Bill McStraw D-8450 and George Taylor D-8005		
12. Special circumstances, weather conditions, other:		

B2. Description of Needle Valve and Appurtenant Equipment:

B1. Valve No. and Size: 3 - 36-inch	Size: Diameter 36-inch Design Head 177 Year Designed 1932

Number of Splitters 6
Valve Seat ☒ Bronze ☐ Stainless steel.
Valve Needle constructed of: ☐ Cast Iron ☒ Cast Steel ☐ Cast Bronze ☐ Other
Valve Body constructed of: ☒ Cast Iron ☐ Cast Steel ☐ Cast Bronze ☐ Other

Needle Valves - Individual Equipment Inspection Checklist

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B2 . Valve Operator:	Type: ☒ Hydraulic ☐ motor operated Screw-Lift Water operated Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ____		
B3. Guard Gate/ Stoplogs Capabilities:	Guard gate ☒ Yes ☐ No Size and type. 96" x 120" Caterpillar Gate 48" Bonneted Slide Gate	Stoplogs available (if required) ☐ Yes ☒ No No.of logs? ____ Size ____ ☐ Okay ☐ Not Useable (why?)	Bulkhead and/or Stoplogs Kept Onsite ☐ Yes ☐ No Last Used ☐ <1yr ☐ < 3yr ☐ < 10 yr
Comments:			

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the High Pressure Valve, Outlet Valve and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Interior of Valve Body ☒ Yes ☐ No: Upstream Side of Needle ☒ Yes ☐ No: Body Seats ☒ Yes ☐ No Valve Operator: ☒ Yes ☐ No Exterior of Valve Body ☒ Yes ☐ No Valve Indicator Connection ☒ Yes ☐ No Splitters ☒ Yes ☐ No Control house and valve chamber ☒ Yes ☐ No Valve Areas Not Available for Inspection: Interior of valve inspected on 9/29/98
Inspection of valve needle: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (use clock points looking D/S)
Inspection of interior of valve bodies: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (use clock points looking U/S)
Inspection of splitters: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (number clockwise starting at top looking U/S)
Inspection of valve seat: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (use clock points looking U/S)
Inspection of exterior valve body: ☐ Good ☒ Satisfactory ☐ Poor (Explain)
Comments:

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV3.WPD

C1. Structural Integrity of components including; Hoist, Leaf horizontal ribs, Leaf vertical ribs, Leaf face plate, Bonnet Cover, etc.

Structural Members Inspection:

a Exterior Body

Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Valve Pedestal

Are there cracks in concrete pedestal? ☐ Yes ☒ No (Explain)
Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support or trunnion? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support or trunnion? ☐ Yes ☒ No (Explain)

c. Needle

Are there areas of scratches or gouges on U/S face of needle? ☐ Yes ☒ No (Explain)
Are there rough areas or cavitation damage on U/S face or needle seat? ☐ Yes ☒ No (Explain)
Are there missing screws or evidence of corrosion on plunger flange? ☐ Yes ☒ No (Explain)
Are there scratches, gouges, or evidence of corrosion on plunger? ☐ Yes ☒ No (Explain)

e. Interior Body

Are there scratches gouges on valve body seat? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body or cylinder? ☐ Yes ☒ No (Explain)
Are there areas of corrosion or cavitation damage on body or cylinder? ☐ Yes ☒ No (Explain)

f. Splitters

Is there damage to leading edge (U/S) of splitter? ☐ Yes ☒ No (Explain)
Is there evidence of cavitation or damage at splitter/cylinder connection? ☐ Yes ☒ No (Explain)
Is there evidence of cavitation or damage at splitter/body connection? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on splitters? ☐ Yes ☒ No (Explain)
Are there areas of corrosion or cavitation damage on splitters? ☐ Yes ☒ No (Explain)

VALVE STRUCTURAL RATING:

☐ **GOOD**
(Valve and Hoist structural condition is above average)
☒ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Valve and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Valve/Hoist should not be operated for structural reasons.)

g. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

C2. Condition of Valve's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☒ Date Last Painted (Where?)

a. General Condition of Coating: ☐ Good ☒ Fair ☐ Poor Cause of Coating Failure: ☐ Age ☐ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☒ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**VALVE PAINT RATING:** ☐ GOOD (Valve's current paint coating is above average) ☒ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☐ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)
COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.	

C3. Performance and Condition of Valve Seats ...

a. Leakage Past Seats/sill ☐ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☒ Excessive (How much?) _200_ gpm. Leakage Acceptable? ☐ Yes ☒ No b. Condition of seats/sill: ☐ Unknown ☐ Good ☒ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... Seat screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ... c. Reason for Leakage: Seats/Sill: ☐ Damaged seat (which one?) ______________ ☐ Damaged Sill ☐ Seat to Seat contact ☐ Seat Defect ☐ Stuck Debris ☐ Other	**VALVE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☒ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)
e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT VALVE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS	

C4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of valve operation?	☒ Yes	☐ No
b. Are discharge curves and operating diagrams current?	☒ Yes	☐ No
c. Posted operating instructions?	☐ Yes	☒ No
d. Does dam operator understand their use?	☒ Yes	☐ No
e. Are as-built drawings of valve/hoist available?	☐ Yes	☒ No
f. Are maintenance requirements understood?	☒ Yes	☐ No
g. SOP/DOC instructions and documents current?	☒ Yes	☐ No

C5. Performance of Valve Operation:

a. Was valve operated at inspection? ☒ Yes ☐ No

b. Is valve exercised according to SOP? ☒ Yes ☐ No

c. Is Valve operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe valve operation: (describe below)
☒ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last valve operation.

f. Valves as designed? ☒ Yes ☐ No (Why?)

g. Was this valve operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

VALVE RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Valve and hoist should not be operated without major repairs or restricted operation)

Needle Valves - Individu... Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV3.WPD

E. Valve Public Security:

Valve Installation Accessible by Public? ☒ Yes ☐ No *Describe ...* Vehicle access gate is locked, but accessible by pedestrian traffic Public Danger? ☐ Yes ☒ No *Describe ...* Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*
Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

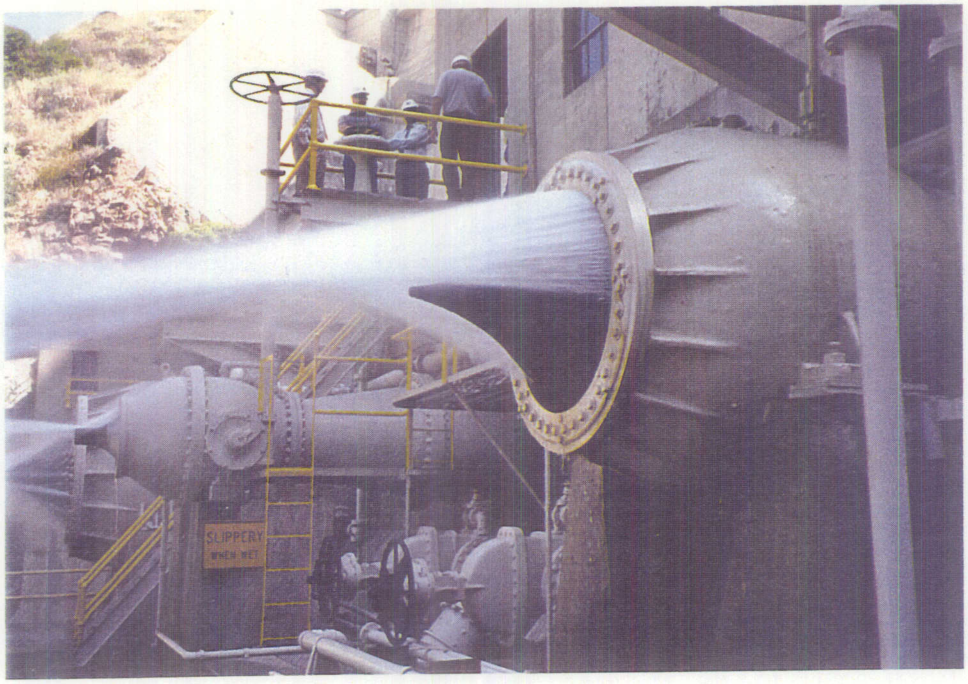

Photo 1 - Morris Dam - Needle Valve 3 - View showing needle valve body and leakage at full head. 07/01/98

Photo 2 - Morris Dam - Needle Valve 3 - View showing needle valve body and leakage at full head. 07/01/98

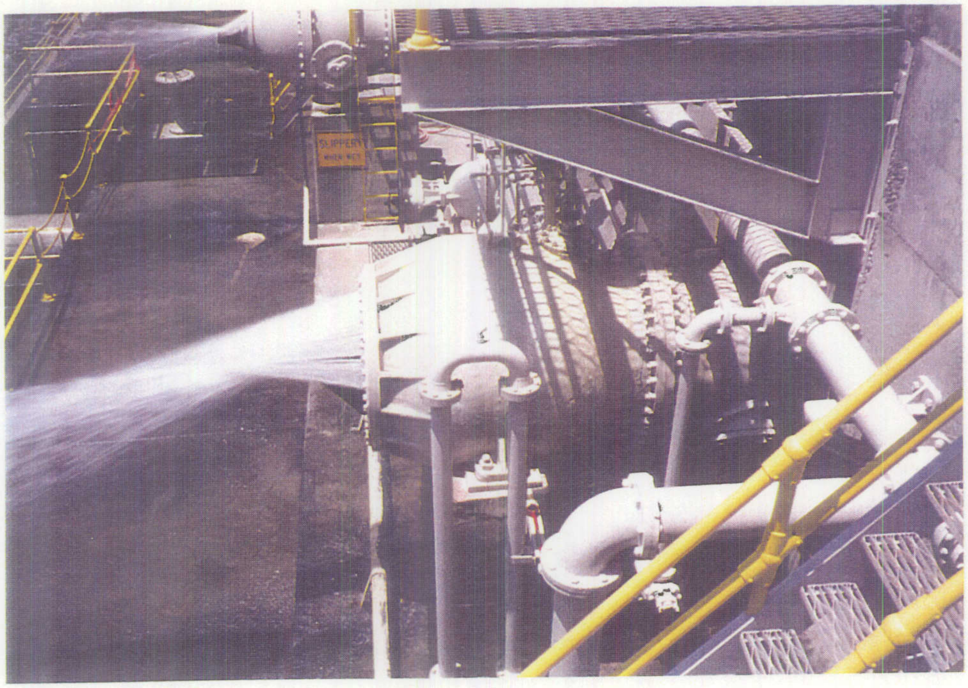

Photo 5 - Morris Dam - Needle Valve 3 - View showing needle valve body, piping, and leakage at full head. 07/01/98

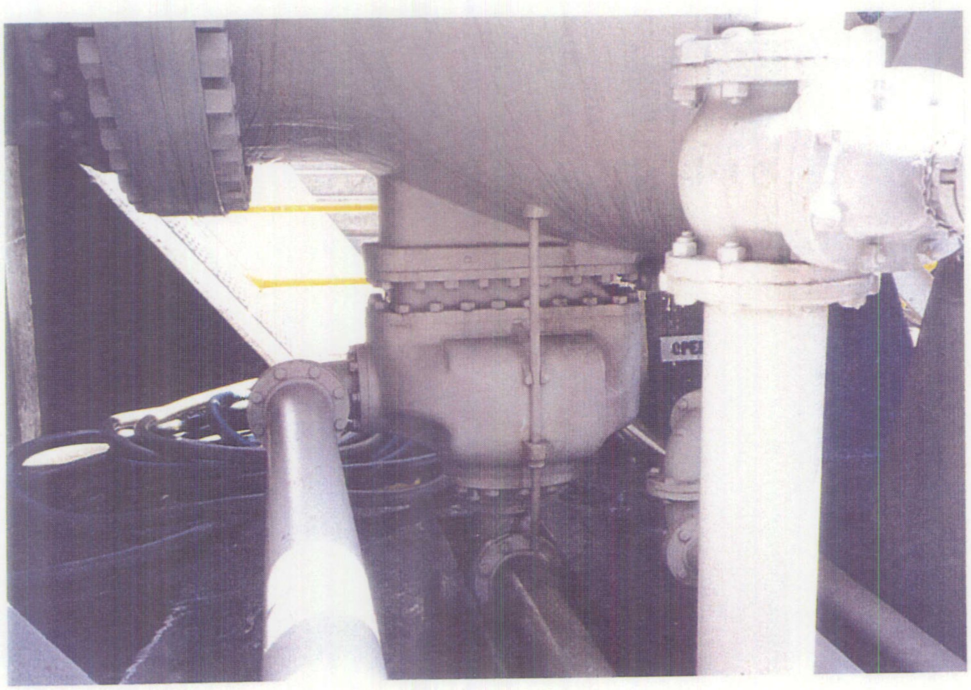

Photo 6 - Morris Dam - Needle Valve 3 - View showing needle valve paradox valve and piping. 07/01/98

Photo 3 - Morris Dam - Needle Valve 3 - View showing needle valve body, gooseneck piping, and leakage at full head. 07/01/98

Photo 4 - Morris Dam - Needle Valve 3 - View showing needle valve body, pedestal, and leakage at full head. 07/01/98

Photo 7 - Morris Dam - Needle Valve 3 - View showing needle valve body, pedestal, and leakage at full head. 07/01/98

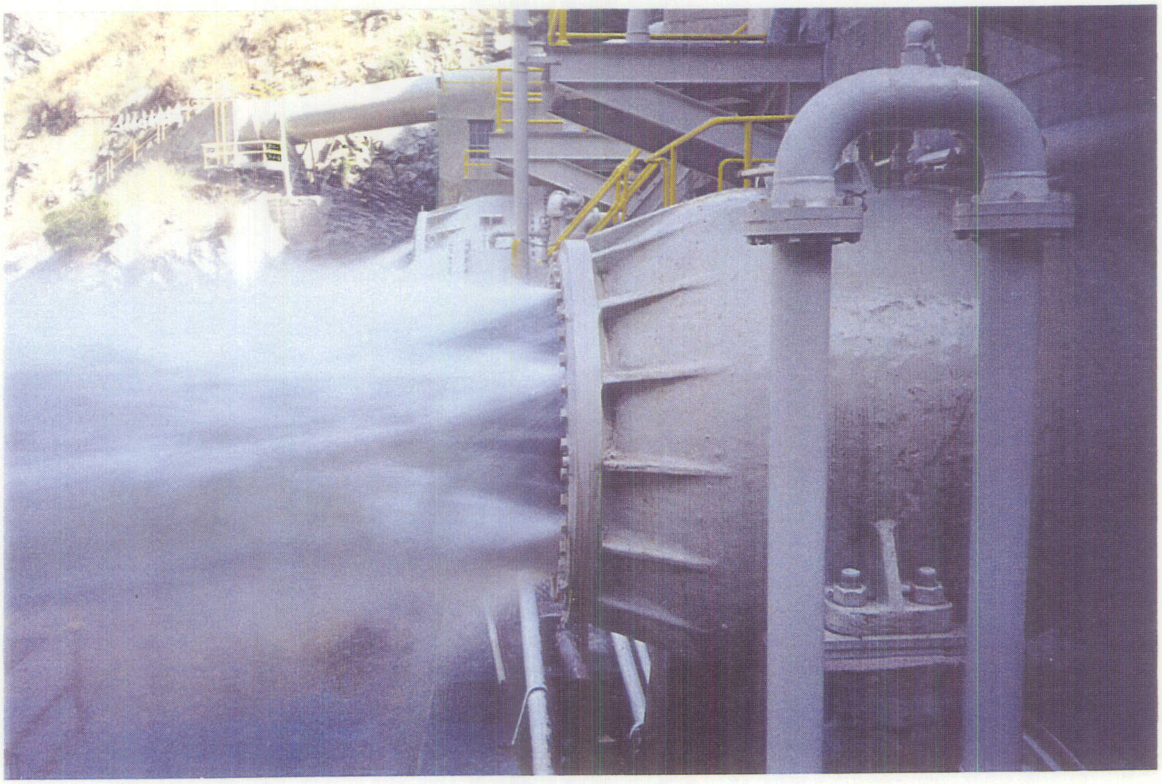

Photo 8 - Morris Dam - Needle Valve 3 - View showing needle valve gooseneck piping, and discharge at full head. 07/01/98

Photo 9- Morris Dam - Needle Valve 3 - View looking downstream of upstream body tip, valve body, and splitters.

09/29/98

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT3A.WPD

A. Overall Summary Sheet Dam Morris Dam Gate I.D. 3A

A1. Overall Rating - Slide Gates & Hydraulic Hoists (Provide an overall general rating for the gates and hoists based on safe/unsafe operation and O&M required/not required)

a. GATE GENERAL CONCLUSIONS:

Gate Needs Maintenance? ☐ None ☒ Minor ☐ Major ☐ Immediate
Gate Needs Repairs? ☐ None ☒ Minor ☐ Major ☐ Immediate
Restricted Gate Operations Recommended? ☒ No ☐ Yes (Describe..)
Recommendations Included in Checklist? ☐ No ☐ Yes (Describe...)

b. SLIDE GATE OVERALL RATING:

☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Gate safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Gate should not be operated)

c. HYDRAULIC HOIST OVERALL RATING:

☐ GOOD (Current hoist condition/maintenance/safety is above average)
☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Hoist safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Hoist should not be operated)

Comments:

A2. Level 2 - General Summary of Slide Gate, Outlet Gate and Hydraulic Hoist Condition: (Check or Circle as Appropriate)

a. Operation: Gate / Hoist Operated: ☒ Yes: ☒ Full Travel ☐ Partial Travel (How far _______) ☐ Not Operated (why?)
b. Structural: ☒ Satisfactory ☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)
c. Protective Coatings: ☐ Original Paint ☐ Year of Last Paint Coat ______ ☒ Paint Satisfactory ☐ Requires minor local touch-up ☐ Severe localized damage (No. and location) ☐ Extensive
d. Weld/Bolted Connections: ☒ Chck ☐ Unchck Bolted connections ☒ Okay
(circle) (Missing Bolts) (Corroded/Rusted Bolts) (Loose Bolts) (Deformed Bolts) ☐ Many ☐ Some ☐ Few
e. Gate Leaf Sealing: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☒ Moderate Leakage ☐ Heavy Leakage
f. Concrete / Grout: Gate Chamber / Control House Condition? ☒ Satisfactory ☐ Spalling ☐ Hairline cracking (Hvy)(Mod)(Light)
g. Gate Operation: ☒ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other
h. Hoist Operation: ☒ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

Comments: Operated gate full cycle balanced and full close cycle unbalanced at 25% flow

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT3A.WPD

B. Inspection and Equipment Basic Information Sheet:

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Gate ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington, USBR	6. Field Contact: Art Diaz/Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Gate Sill El.:971.00	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Gate: 172.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		
1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 9/29/98	5. Lead Inspector & Office: Gary Rood, USBR	**6. Field Contact: Art Diaz/Jim McGowan**
4. Reservoir El.: 970.00	Phone #: 303-445-3102	**Phone #: 626-334-2090**
7. Gate Sill El.:975.00	8. Area Office & Contact: Emily Hasegawa	**9. Water District & Contact: Steve Bradley**
10. Head on Gate: 0.00	Phone #: 626-458-6304	**Phone #:**
11. Others present: Bill McStraw D-8450 and George Taylor D-8005		
12. Special circumstances, weather conditions, other:		

B2. Description of Slide Gate, Hydraulic Hoist and Appurtenant Equipment:

Gate No.: 3A	Size: Width 48-inch Height 48-inch ☐ Guard / Emergency ☐ Regulating Design Head 194' Year Designed 1932

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT3A.WPD

Type of Stem Bushing / Gland: ☐ Adjustable ☐ Non-Adjustable ☐ Condition (Describe if not satisfactory)
Type of Gate Hanger: ☐ Automatic ☐ Semi-Automatic ☐ Chain with hook ☐ Other (Describe) ☐ None
Semi-Automatic Gate Hanger Safety Studs: ☐ Number of replacements on hand ☐ Order more replacements
Size of Hoist Stem: ____________ inch diameter Hoist Stem Material: ______________
Gate Seats, Gate Sill, and Guides ☐ Bronze on Bronze ☐ Stainless steel on bronze ☐ Seats are/ are not equipped with greasing system.
Gate Leaf constructed of: ☐ Cast Iron ☐ Cast Steel ☐ Fabricated Steel ☐ Stainless Steel ☐ Other
Condition of leaf and seating surfaces: ☐ Poor ☐ Good ☐ Excellent ☐ Corroded ☐ Eroded ☐ Cavitated ☐ Other (Explain)

Gate Hoist Operator:	Type: ☐ Hydraulic hoist ☐ motor operated Screw-Lift **Comment:** Water-operated Controls: ☐ Local ☐ Automatic ☐ Remote-Capability (From Where) ______________		
Emergency Operation:	~~☐ Engine-Generator ☐ Hand pump~~ ~~Operable? ☐ Yes ☐ No (why?)~~	~~Eng-Gen Operated at Inspection:~~ ~~☐ Yes ☐ No~~ ~~Last time (when)~~ __________	SOP Updated Recently ☐ Yes ☐ No
Comments:	Operates from static head from water tank		

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the Slide Gate, Outlet Gate and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Downstream Side of leaf ☐ Yes ☐ No:	Upstream Side of leaf ☐ Yes ☐ No:	Body Seats ☐ Yes ☐ No	Hoist: ☐ Yes ☐ No
Upstream / Downstream Bodies ☐ Yes ☐ No	Stem Connection ☐ Yes ☐ No	Bottom of leaf ☐ Yes ☐ No	

Gate Areas Not Available for Inspection: Upstream side of leaf and stem connection.

Inspection of gate sill: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Inspection of gate bodies: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Comments:

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT3A.WPD

C. Gate Inspectiom:

a Exterior Body

.Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Gate Support:

Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support? ☐ Yes ☒ No (Explain)

c. Hydraulic Hoist Water-operated

Is there water leakage from cylinder flanges? ☐ Yes ☒ No (Explain)
Is there water leakage from cylinder glands? ☐ Yes ☒ No (Explain)
Is there any water present in the bonnet cover or on the floor? ☐ Yes ☒ No (Describe)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint ? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on cylinder or heads? ☐ Yes ☒ No (Explain)

d. U/S Interior Body

Are there scratches or gouges on gate leaf? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on the body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on the body? ☐ Yes ☒ No (Explain)

e. D/S Interior Body

Are there scratches or gouges on gate seats? ☐ Yes ☒ No (Explain)
Are there scratches, gouges, or corrosion on the gate stem? ☐ Yes ☐ No (Explain)
Are there exposed stem threads on bottom of stem nut? ☐ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on the gate
leaf or body ? ☒ Yes ☐ No (Explain) Typical coating loss on bodies and leaf.
Are there areas of corrosion on the gate leaf or body? ☐ Yes ☒ No (Explain)

GATE AND HOIST STRUCTURAL RATING:

☐ **GOOD**
(Gate and Hoist structural condition is above average)
☒ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Gate and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Gate/Hoist should not be operated for structural reasons.)

f. **COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.**

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT3A.WPD

D2. Condition of Gate's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☒ Date Last Painted (Where?)

D3. Performance and Condition of Gate Seal

a. Leakage past seal ☒ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☐ Excessive
(How much?) __________gpm. Leakage Acceptable? ☒ Yes ☐ No
b. Reason for Leakage: ☐ Damaged ring seal ☐ Damaged or scratched leaf
☐ Leaf to seal contact ☐ Seal Defect ☐ Stuck Debris ☐ Other

GATE LEAKAGE RATING:

☐ GOOD
(No or insignificant amounts of leakage.)
☒ SATISFACTORY
(Little or tolerable amounts of leakage.)
☐ CONDITIONAL
(excessive leakage which can be tolerated until appropriate repairs can be made.)
☐ UNSATISFACTORY
(Excessive, Intolerable, or Leakage Causing damage.)
☐ **RESTRICTED** (Immediate repair required)

e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT GATE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS

Outlet filled at time of first inspection.
Reservoir drained at time of second inspection
No leakage concerns expressed by operators.

D4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of gate and hoist operation?	☒ Yes	☐ No
b. Are discharge curves and operating diagrams current?	☐ Yes	☐ No N/A
c. Posted operating instructions?	☒ Yes	☐ No
d. Does dam operator understand their use?	☒ Yes	☐ No
e. Are as-built drawings of gate/hoist available?	☐ Yes	☒ No
f. Are maintenance requirements understood?	☒ Yes	☐ No
g. SOP/DOC instructions and documents current?	☒ Yes	☐ No

D5. Performance of Gate and Hoist Operation:

a. Was gate and hoist operated at inspection? ☒ Yes ☐ No

b. Is gate and hoist exercised according to SOP? ☒ Yes ☐ No

c. Is gate and hoist operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe gate and hoist operation: (describe below)
☒ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last gate operation.

f. Gates and hoist operated as designed? ☒ Yes ☐ No (Why?)

g. Has this gate and hoist been operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

GATE AND HOIST RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Gate and hoist should not be operated without major repairs or restricted operation)

E. Gate Public Security:

Gate Installation Accessible by Public? ☐ Yes ☒ No *Describe ...* In gate chamber in interior of dam

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

Photo 1 - Morris Dam - Slide Gate 3A - View hoist, bonnet cover and platform. 07/01/98

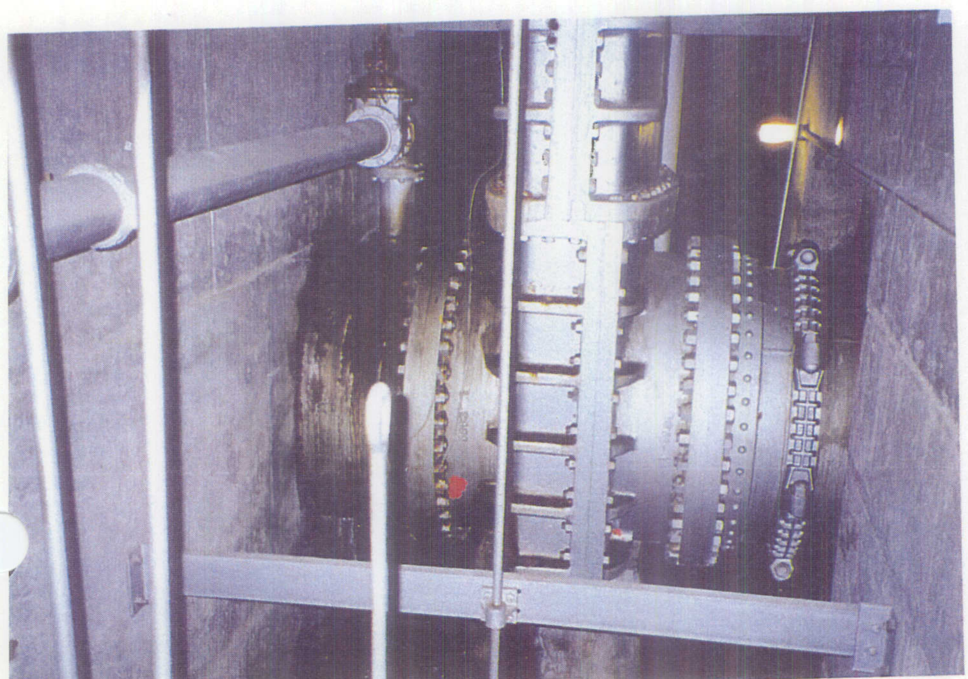

Photo 2 - Morris Dam - Slide Gate 3A - View of gate body, upstream and downstream flanges and Victaulic coupling.
07/01/98

Photo 3- Morris Dam - Slide Gate 3A - View looking at downstream face of gate leaf
09/29/98

Photo 4 - Morris Dam - Slide Gate 3A - View looking at downstream face of gate leaf.
09/29/98

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

A. Overall Summary Sheet Dam Morris Dam Valve I.D. 4

A1. Overall Rating - Needle Valve (Provide an overall general rating for the valve based on safe/unsafe operation and O&M required/not required)

a. VALVE GENERAL CONCLUSIONS:

Valve Needs Maintenance?	☐ None	☒ Minor	☐ Major	☐ Immediate
Valve Needs Repairs?	☐ None	☒ Minor	☐ Major	☐ Immediate
Restricted Valve Operations Recommended?	☒ No	☐ Yes (Describe..)		
Recommendations Included in Checklist?	☐ No	☐ Yes (Describe...)		

b. Needle VALVE OVERALL RATING:

☐ GOOD (Current valve condition/maintenance/safety is above average)
☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Valve safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Valve should not be operated)

Comments: Valve leaks through the needle seats.

A2. Level 2 - General Summary of Needle Valve Condition: (Check or Circle as Appropriate)

a. OPERATION:
Was valve operated?: ☒ Yes: ☐ Not Operated (why?)
☒ Full Travel ☐ Partial Travel (How far ________)
Valve operation: ☒ Smooth ☐ Rough ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

b. STRUCTURAL: ☒ Satisfactory
☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)

c. PROTECTIVE COATING: ☐ Original Paint ☐ Year of Last Paint Coat ______
☒ Paint Satisfactory
☒ Requires minor local touch-up ☐ Severe localized damage (No. and location)_ ☐ Extensive

d. WELDED/BOLTED CONNECTIONS: ☒ Checked ☐ Unchecked
Bolted connections ☒ Okay
☐ Missing Bolts ☒ Corroded/Rusted Bolts ☐ No Threads Showing ☐ Deformed Bolts
☐ Many ☐ Some ☐ Few

e. VALVE SEAT SEALING: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☒ Moderate Leakage ☐ Heavy Leakage
:

Comments:

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

B. **Inspection and Equipment Basic Information Sheet:**

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Valve ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington USBR	6. Field Contact: Art Diaz / Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Valve Centerline El.: 975.0	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Valve: 170.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		
1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 9/29/98	**5. Lead Inspector & Office: Gary Rood USBR**	**6. Field Contact: Art Diaz / Jim McGowan**
4. Reservoir El.: 970.00	**Phone #: 303-445-3102**	**Phone #: 626-334-2090**
7. Valve Centerline El.: 975.0	**8. Area Office & Contact: Emily Hasegawa**	**9. Water District & Contact: Steve Bradley**
10. Head on Valve: 0.00	**Phone #: 626-458-6304**	**Phone #:**
11. Others present: Bill McStraw D-8450 and George Taylor D-8005		
12. Special circumstances, weather conditions, other:		

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

B2. Description of Needle Valve and Appurtenant Equipment:

B1. Valve No.: 4	Size: Diameter 24-inch Design Head 177 Year Designed 1932		
Number of Splitters 4 Valve Seat ☒ Bronze ☐ Stainless steel. Valve Needle constructed of: ☐ Cast Iron ☒ Cast Steel ☐ Cast Bronze ☐ Other Valve Body constructed of: ☒ Cast Iron ☐ Cast Steel ☐ Cast Bronze ☐ Other			
B2 . Valve Operator:	Type: ☐ Hydraulic ☐ motor operated Screw-Lift ☒ Manual Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ________		
B3. Guard Gate/ Stoplogs Capabilities:	Guard gate ☒ Yes ☐ No Size and type. 96" x 120" Caterpillar Gate 48" Bonneted Slide Gate	Stoplogs available (if required) ☐ Yes ☒ No No.of logs? ______ Size ______ ☐ Okay ☐ Not Useable (why?)	Bulkhead and/or Stoplogs Kept Onsite ☐ Yes ☐ No Last Used ☐ <1yr ☐ < 3yr ☐ < 10 yr
Comments:			

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the High Pressure Valve, Outlet Valve and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Interior of Valve Body ☒ Yes ☐ No: Upstream Side of Needle ☒ Yes ☐ No: Body Seats ☒ Yes ☐ No Valve Operator: ☒ Yes ☐ No Exterior of Valve Body ☒ Yes ☐ No Valve Indicator Connection ☐ Yes ☒ No Splitters ☒ Yes ☐ No Control house and valve chamber ☒ Yes ☐ No Valve Areas Not Available for Inspection: ☒ Yes Interior of valve inspected (9/29/98)
Inspection of valve needle: Cavitated / Eroded / Other ☐ Yes ☒ No (Explain) Location (use clock points looking D/S)
Inspection of interior of valve bodies: Cavitated / Eroded / Other ☐ Yes ☒ No (Explain) Location (use clock points looking U/S)
Inspection of splitters: Cavitated / Eroded / Other ☐ Yes ☒ No (Explain) Location (number clockwise starting at top looking U/S)
Inspection of valve seat: Cavitated / Eroded / Other ☐ Yes ☒ No (Explain) Location (use clock points looking U/S)
Inspection of exterior valve body: ☐ Good ☒ Satisfactory ☐ Poor (Explain)
Comments:

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

C1. Structural Integrity of components including; Hoist, Leaf horizontal ribs, Leaf vertical ribs, Leaf face plate, Bonnet Cover, etc.

Structural Members Inspection:

a Exterior Body

Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Valve Pedestal

Are there cracks in concrete pedestal? ☐ Yes ☒ No (Explain)
Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support or trunnion? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support or trunnion? ☐ Yes ☒ No (Explain)

c. Needle

Are there areas of scratches or gouges on U/S face of needle? ☐ Yes ☒ No (Explain)
Are there rough areas or cavitation damage on U/S face or needle seat? ☐ Yes ☒ No (Explain)
Are there missing screws or evidence of corrosion on plunger flange? ☐ Yes ☒ No (Explain)
Are there scratches, gouges, or evidence of corrosion on plunger? ☐ Yes ☒ No (Explain)

e. Interior Body

Are there scratches gouges on valve body seat? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body or cylinder? ☐ Yes ☒ No (Explain)
Are there areas of corrosion or cavitation damage on body or cylinder? ☐ Yes ☒ No (Explain)

f. Splitters

Is there damage to leading edge (U/S) of splitter? ☐ Yes ☒ No (Explain)
Is there evidence of cavitation or damage at splitter/cylinder connection? ☐ Yes ☒ No (Explain)
Is there evidence of cavitation or damage at splitter/body connection? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on splitters? ☐ Yes ☒ No (Explain)
Are there areas of corrosion or cavitation damage on splitters? ☐ Yes ☒ No (Explain)

VALVE STRUCTURAL RATING:

☐ **GOOD**
(Valve and Hoist structural condition is above average)
☒ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Valve and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Valve/Hoist should not be operated for structural reasons.)

g. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

C2. Condition of Valve's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☒ Date Last Painted (Where?)

a. General Condition of Coating: ☒ Good ☐ Fair ☐ Poor Cause of Coating Failure: ☐ Age ☐ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☒ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**VALVE PAINT RATING:** ☐ GOOD (Valve's current paint coating is above average) ☒ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☐ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)
COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.	

C3. Performance and Condition of Valve Seats ...

a. Leakage Past Seats/sill ☐ Unknown ☐ No Leakage ☐ Insignificant ☒ Some ☐ Excessive (How much?) _75_ gpm. Leakage Acceptable? ☒ Yes ☐ No b. Condition of seats/sill: ☐ Unknown ☒ Good ☐ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... Seat screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ... c. Reason for Leakage: Seats/Sill: ☐ Damaged seat (which one?) ____________ ☐ Damaged Sill ☒ Seat to Seat contact ☐ Seat Defect ☐ Stuck Debris ☐ Other	**VALVE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☒ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)
e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT VALVE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS	

C4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of valve operation? ☒ Yes ☐ No
b. Are discharge curves and operating diagrams current? ☒ Yes ☐ No
c. Posted operating instructions? ☐ Yes ☒ No
d. Does dam operator understand their use? ☒ Yes ☐ No
e. Are as-built drawings of valve/hoist available? ☐ Yes ☒ No
f. Are maintenance requirements understood? ☒ Yes ☐ No
g. SOP/DOC instructions and documents current? ☒ Yes ☐ No

C5. Performance of Valve Operation:

a. Was valve operated at inspection? ☒ Yes ☐ No

b. Is valve exercised according to SOP? ☒ Yes ☐ No

c. Is Valve operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe valve operation: (describe below)
☐ Smooth ☒ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last valve operation.

f. Valves as designed? ☒ Yes ☐ No (Why?)

g. Was this valve operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

VALVE RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Valve and hoist should not be operated without major repairs or restricted operation)

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV4.WPD

D. Valve Public Security:

Valve Installation Accessible by Public? ☒ Yes ☐ No *Describe ...* Vehicle access gate is locked, but accessible by pedestrian traffic

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

Photo 1 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve body and leakage at full head. 07/01/98

Photo 2 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve body and leakage at full head. 07/01/98

Photo 3 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve body and leakage at full head. 07/01/98

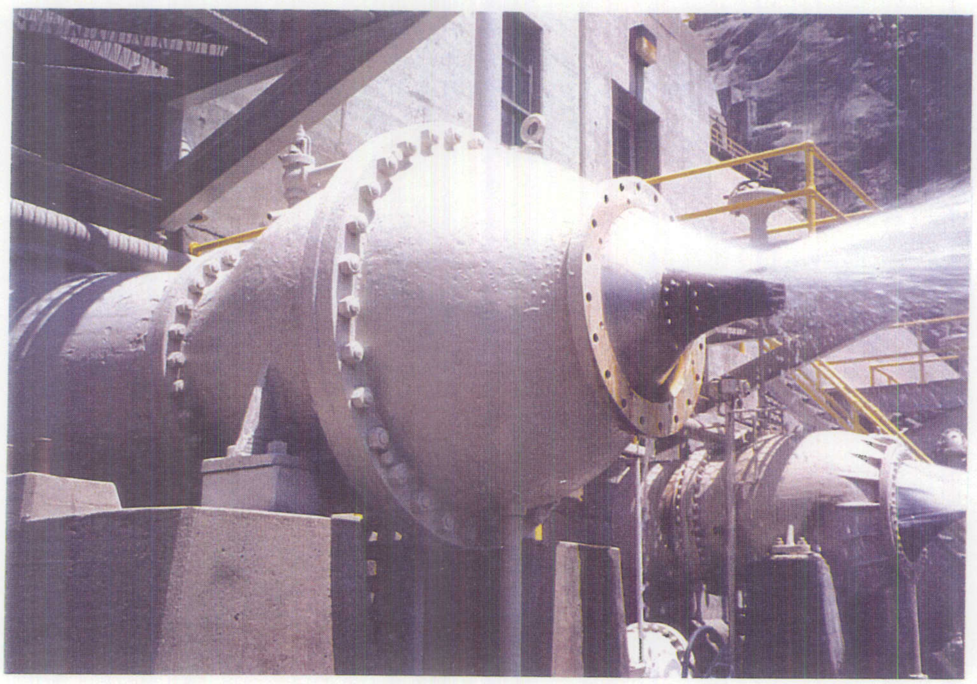

Photo 4 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve body and leakage at full head. 07/01/98

Photo 5 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve body and leakage at full head. 07/01/98

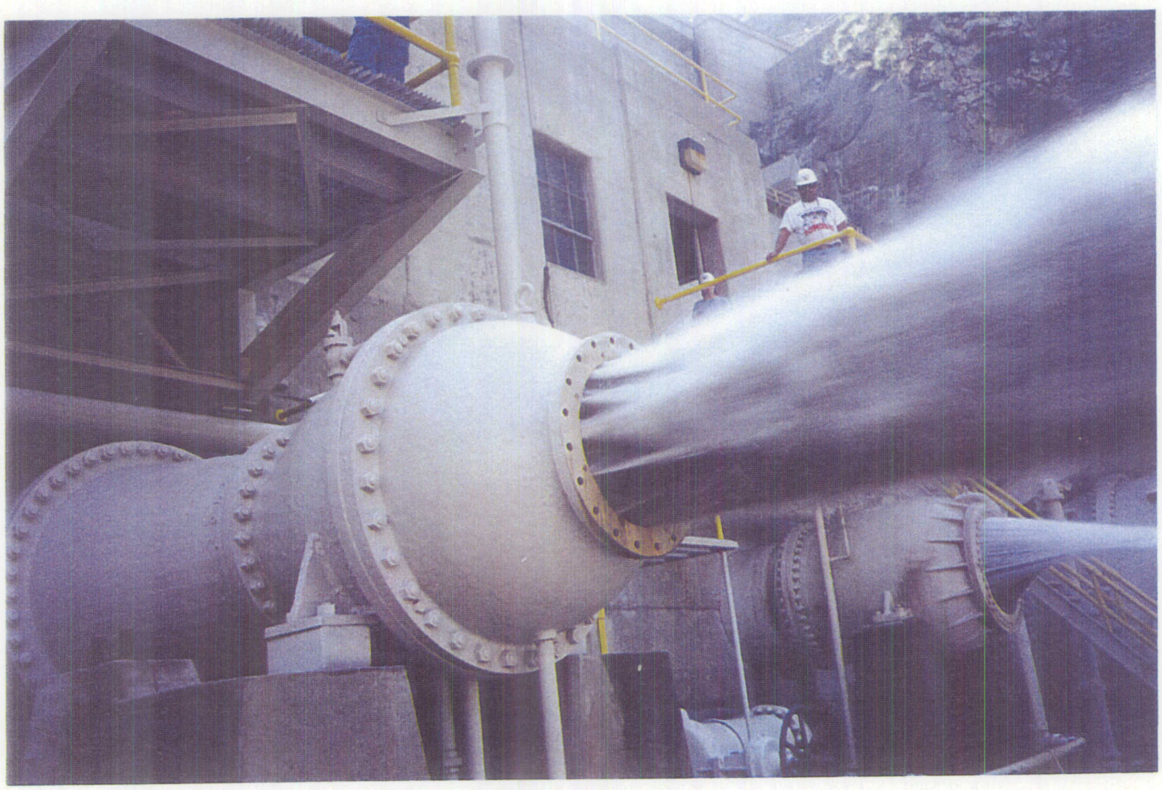

Photo 6 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve discharge at full head. 07/01/98

Photo 7 - Morris Dam - Pelton Needle Valve 4 - View showing needle valve operator and discharge at full head. 07/01/98

Photo 8 - Morris Dam - Pelton Needle Valve 4 - View showing valve hand-wheel operator. 07/01/98

Photo 9- Morris Dam - Pelton Needle Valve 4 - View of manhole cover removed for access into conduit.

09/29/98

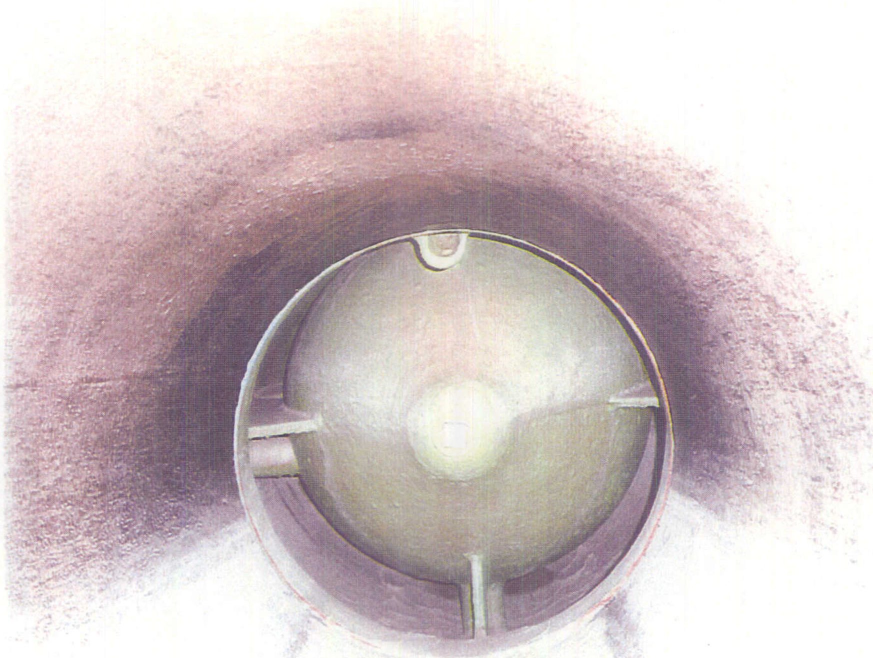

Photo 10 - Morris Dam - Pelton Needle Valve 4 - View looking downstream of upstream conduit and valve.

09/29/98

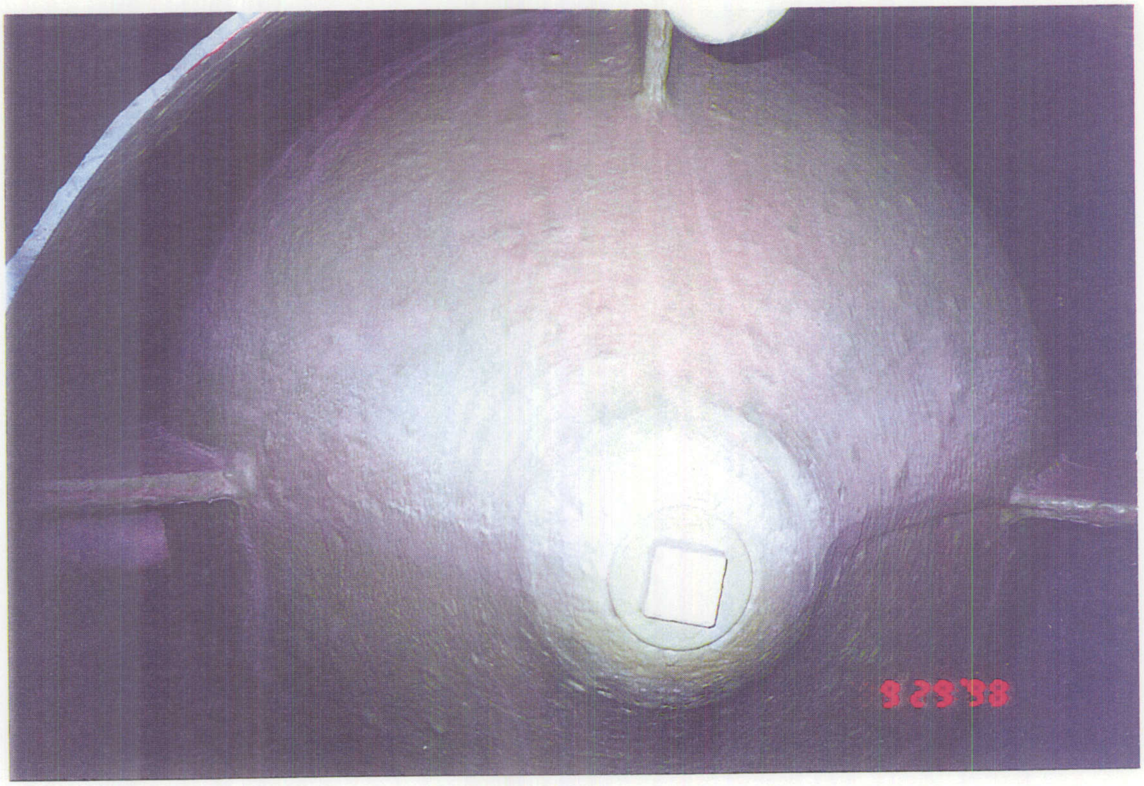

Photo 11- Morris Dam - Pelton Needle Valve 4 - View looking downstream of valve body.

09/29/98

Photo 12 - Morris Dam - Pelton Needle Valve 4 - View looking downstream of valve body.

09/29/98

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT4A.WPD

A. Overall Summary Sheet Dam Morris Dam Gate I.D. 4A

A1. Overall Rating - Slide Gates & Hydraulic Hoists (Provide an overall general rating for the gates and hoists based on safe/unsafe operation and O&M required/not required)

a. GATE GENERAL CONCLUSIONS:

Gate Needs Maintenance? ☐ None ☒ Minor ☐ Major ☐ Immediate
Gate Needs Repairs? ☐ None ☒ Minor ☐ Major ☐ Immediate
Restricted Gate Operations Recommended? ☒ No ☐ Yes (Describe..)
Recommendations Included in Checklist? ☒ No ☐ Yes (Describe...)

b. Slide GATE OVERALL RATING:

☐ GOOD (Current gate condition/maintenance/safety is above average)
☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Gate safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Gate should not be operated)

c. HYDRAULIC HOIST OVERALL RATING:

☐ GOOD (Current hoist condition/maintenance/safety is above average)
☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Hoist safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Hoist should not be operated)

Comments:

A2. Level 2 - General Summary of Slide Gate, Outlet Gate and Hydraulic Hoist Condition: (Check or Circle as Appropriate)

a. Operation: Gate / Hoist Operated: ☒ Yes: ☒ Full Travel ☐ Partial Travel (How far ______) ☐ Not Operated (why?)
b. Structural: ☒ Satisfactory ☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)
c. Protective Coatings: ☐ Original Paint ☐ Year of Last Paint Coat ______ ☐ Paint Satisfactory ☒ Requires minor local touch-up ☐ Severe localized damage (No. and location) ☐ Extensive
d. Weld/Bolted Connections: ☒ Chck ☐ Unchck Bolted connections ☒ Okay
(circle) (Missing Bolts) (Corroded/Rusted Bolts) (Loose Bolts) (Deformed Bolts) ☐ Many ☐ Some ☐ Few
e. Gate Leaf Sealing: ☐ Tight Seal-No Leakage ☒ Insignificant Leakage ☐ Moderate Leakage ☐ Heavy Leakage
f. Concrete / Grout: Gate Chamber / Control House Condition? ☒ Satisfactory ☐ Spalling ☐ Hairline cracking (Hvy)(Mod)(Light)
g. Gate Operation: ☒ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other
h. Hoist Operation: ☒ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

Comments: Operated gate full cycle balanced and full close cycle unbalanced at 25% flow.

B. Inspection and Equipment Basic Information Sheet:

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT4A.WPD

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Gate ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington, USBR	6. Field Contact: Art Diaz/Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Gate Sill El.: 970.45	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Gate: 172.77	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		

1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 9/29/98	**5. Lead Inspector & Office: Gary Rood, USBR**	**6. Field Contact: Art Diaz/Jim McGowan**
4. Reservoir El.: 970.00	**Phone #: 303-445-3102**	**Phone #: 626-334-2090**
7. Gate Sill El.: 970.45	**8. Area Office & Contact: Emily Hasegawa**	**9. Water District & Contact: Steve Bradley**
10. Head on Gate: 0.00	**Phone #: 626-458-6304**	**Phone #:**
11. Others present: Bill McStraw D-8450 and George Taylor D-8005		
12. Special circumstances, weather conditions, other:		

B2. Description of Slide Gate, Hydraulic Hoist and Appurtenant Equipment:

Gate No.: 4A	Size: Width 54-inch Height 54-inch ☐ Guard / Emergency ☐ Regulating Design Head 194' Year Designed 1932

Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\2SLGAT4A.WPD

Type of Stem Bushing / Gland: ☒ Adjustable ☐ Non-Adjustable ☐ Condition (Describe if not satisfactory)
Type of Gate Hanger: ☐ Automatic ☐ Semi-Automatic ☒ Chain with hook ☐ Other (Describe) ☐ None
Semi-Automatic Gate Hanger Safety Studs: ☐ Number of replacements on hand ☐ Order more replacements
Size of Hoist Stem: ____________ inch diameter Hoist Stem Material: ______________
Gate Seats, Gate Sill, and Guides ☒ Bronze on Bronze ☐ Stainless steel on bronze ☐ Seats are/ are not equipped with greasing system.
Gate Leaf constructed of: ☒ Cast Iron ☐ Cast Steel ☐ Fabricated Steel ☐ Stainless Steel ☐ Other
Condition of leaf and seating surfaces: ☐ Poor ☒ Good ☐ Excellent ☐ Corroded ☐ Eroded ☐ Cavitated ☐ Other (Explain)

Gate Hoist Operator:	Type: ☒ Hydraulic hoist ☐ motor operated Screw-Lift **Comment:** Water-operated Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ____________		
Emergency Operation:	~~☐ Engine-Generator ☐ Hand pump~~ ~~Operable? ☐ Yes ☐ No (why?)~~	~~Eng-Gen Operated at Inspection:~~ ~~☐ Yes ☐ No~~ ~~Last time (when)~~ ________	SOP Updated Recently ☐ Yes ☐ No
Comments:	Operates from static head from water tank		

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the Slide Gate, Outlet Gate and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Downstream Side of leaf	☒ Yes ☐ No:	Upstream Side of leaf	☐ Yes ☒ No:	Body Seats	☒ Yes ☐ No	Hoist:	☒ Yes ☐ No
Upstream / Downstream Bodies	☒ Yes ☐ No	Stem Connection	☐ Yes ☒ No	Bottom of leaf	☒ Yes ☐ No	Ring Seal	☐ Yes ☐ No

Gate Areas Not Available for Inspection: Upstream surface of leaf and stem connection.

Inspection of gate sill: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain)

Inspection of gate bodies: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain)

Comments: Inspection of interior of gates on September 29, 1998

B4. Gate Inspectiom:

a Exterior Body
- Are flanges leaking? ☒ Yes ☐ No (Explain) Downstream Victaulic coupling leaks
- Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
- Are flange bolts corroding? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Gate Support Bottom body flange embedded in concrete
- Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
- Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
- Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on support? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on support? ☐ Yes ☒ No (Explain)

c. Hydraulic Hoist Water-operated
- Is there water leakage from cylinder flanges? ☐ Yes ☒ No (Explain)
- Is there water leakage from cylinder glands? ☒ Yes ☐ No (Explain) Minor
- Is there any water present in the bonnet cover or on the floor? ☐ Yes ☒ No (Describe)
- Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
- Are flange bolts corroding? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint ? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on cylinder or heads? ☐ Yes ☒ No (Explain)

d. U/S Interior Body
- Are there scratches or gouges on gate leaf? ☐ Yes ☒ No (Explain)
- Are there scratches, gouges, cavitated , or damaged areas on the seal ring? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on the body? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on the body? ☐ Yes ☒ No (Explain)

e. D/S Interior Body
- Are there scratches or gouges on gate seats? ☐ Yes ☒ No (Explain)
- Are there scratches, gouges, or corrosion on the gate stem? ☐ Yes ☒ No (Explain)
- Are there exposed stem threads on bottom of stem nut? ☐ Yes ☒ No (Explain)
- Are there missing screws or evidence of corrosion on the seal ring gland? ☐ Yes ☒ No (Explain)
- Are there damaged areas or areas missing paint on the gate leaf or body ? ☐ Yes ☒ No (Explain)
- Are there areas of corrosion on the gate leaf or body? ☐ Yes ☒ No (Explain)

GATE AND HOIST STRUCTURAL RATING:

☐ **GOOD**
(Gate and Hoist structural condition is above average)
☒ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Gate and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Gate/Hoist should not be operated for structural reasons.)

f. **COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.**

C1. Condition of Gate's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☐ Date Last Painted (Where?)

a. General Condition of Coating: ☒ Good ☐ Fair ☐ Poor
d. Rust: ☐ hvy ☐ mod ☒ light ____%
b. Coating Failure: ☐ hvy ☐ mod ☒ light ____%
c. Corrosion: ☐hvy ☐mod ☒light ____%
d. Pitting: ☐ hvy ☒ mod ☐ light ____%
e. Distribution and Location of Coating Deficiencies:
☐ All: Leaf U.S. Side: ☐ Yes ☐ No Leaf D.S. Side: ☒ Yes ☐ No Bonnet Cover: ☐ Yes ☐ No ☐
Hoist: ☐ Yes ☒ No
Cause of Coating Failure: ☒ Age ☒ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☒ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...

GATE PAINT RATING:

☐ GOOD
(Gate's current paint coating is above average)
☒ SATISFACTORY
(Paint okay - no paint repairs currently required)
☐ CONDITIONAL
(Some paint maintenance/repairs recommended)
☐ UNSATISFACTORY
(Major paint repairs or replacement/maintenance is required)

COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.

C2. Performance and Condition of Gate Seal

a. Leakage past seal ☒ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☐ Excessive
(How much?) __________gpm. Leakage Acceptable? ☐ Yes ☐ No
b. Condition of ring seal: ☐ Unknown ☐ Good ☐ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe....
c. Reason for Leakage: ☐ Damaged ring seal ☐ Damaged or scratched leaf
☒ Leaf to seal contact ☐ Seal Defect ☐ Stuck Debris ☐ Other
d. Condition of ring seal gland screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ...

GATE LEAKAGE RATING:

☐ GOOD
(No or insignificant amounts of leakage.)
☒ SATISFACTORY
(Little or tolerable amounts of leakage.)
☐ CONDITIONAL
(excessive leakage which can be tolerated until appropriate repairs can be made.)
☐ UNSATISFACTORY
(Excessive, Intolerable, or Leakage Causing damage.)
☐ **RESTRICTED** (Immediate repair required)

e. **COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT GATE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS**

Outlet filled at time of inspection.

C3. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of gate and hoist operation? ☒ Yes ☐ No
b. Are discharge curves and operating diagrams current? ☐ Yes ☐ No N/A
c. Posted operating instructions? ☒ Yes ☐ No
d. Does dam operator understand their use? ☒ Yes ☐ No
e. Are as-built drawings of gate/hoist available? ☐ Yes ☒ No
f. Are maintenance requirements understood? ☒ Yes ☐ No
g. SOP/DOC instructions and documents current? ☒ Yes ☐ No

C4. Performance of Gate and Hoist Operation:

a. Was gate and hoist operated at inspection? ☒ Yes ☐ No

b. Is gate and hoist exercised according to SOP? ☒ Yes ☐ No

c. Is gate and hoist operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe gate and hoist operation: (describe below)
☒ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last gate operation.

f. Gates and hoist operated as designed? ☒ Yes ☐ No (Why?)

g. Has this gate and hoist been operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

GATE AND HOIST RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED
(Gate and hoist should not be operated without major repairs or restricted operation)

D. Gate Public Security:

Gate Installation Accessible by Public? ☐ Yes ☒ No *Describe ...* In gate chamber in interior of dam

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

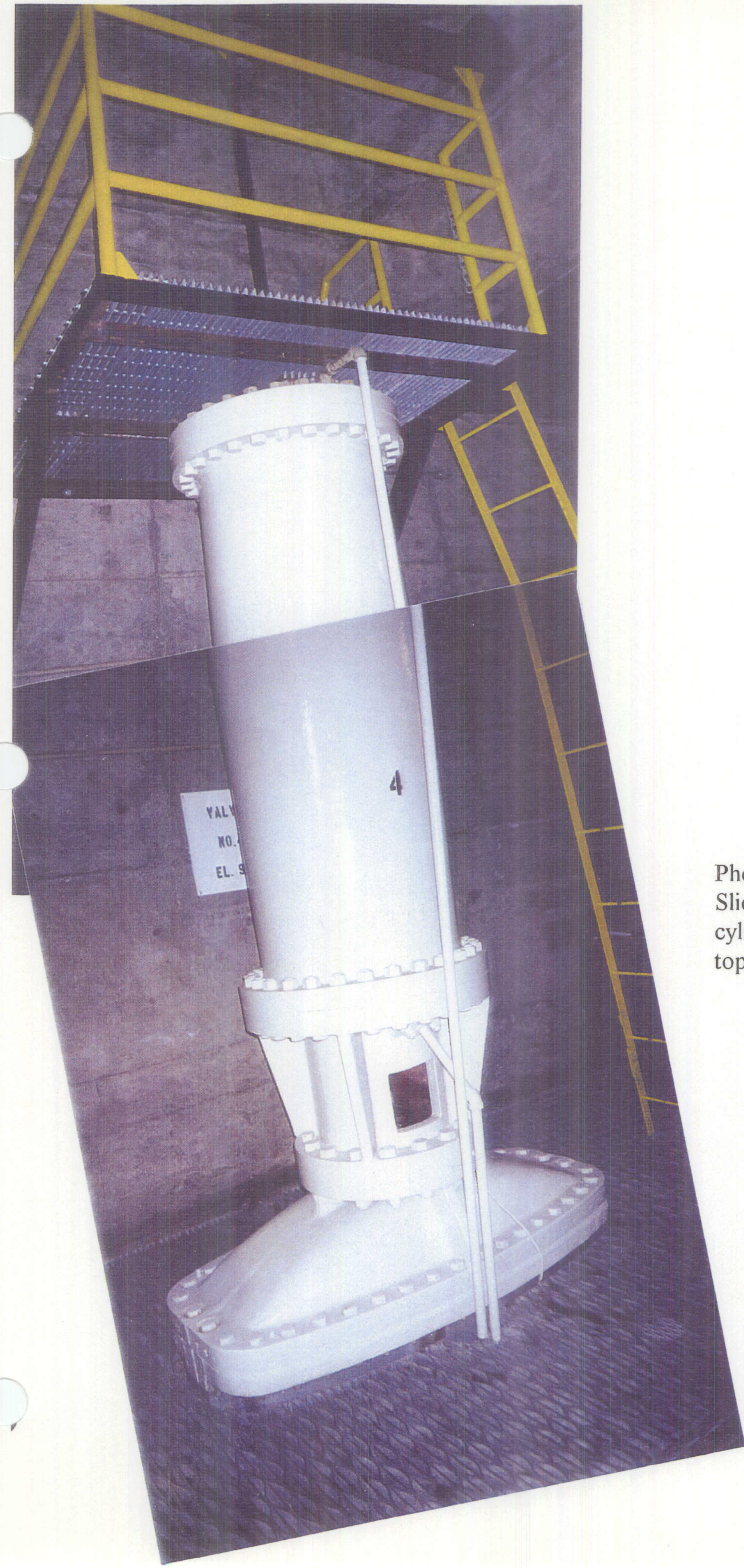

Photo 1 - Morris Dam - Slide Gate 4A - View of cylinder, bonnet cover, and top platform. 07/01/98

Photo 2 - Morris Dam - Slide Gate 4A - View of cylinder piston stem and bottom stem gland.
07/01/98

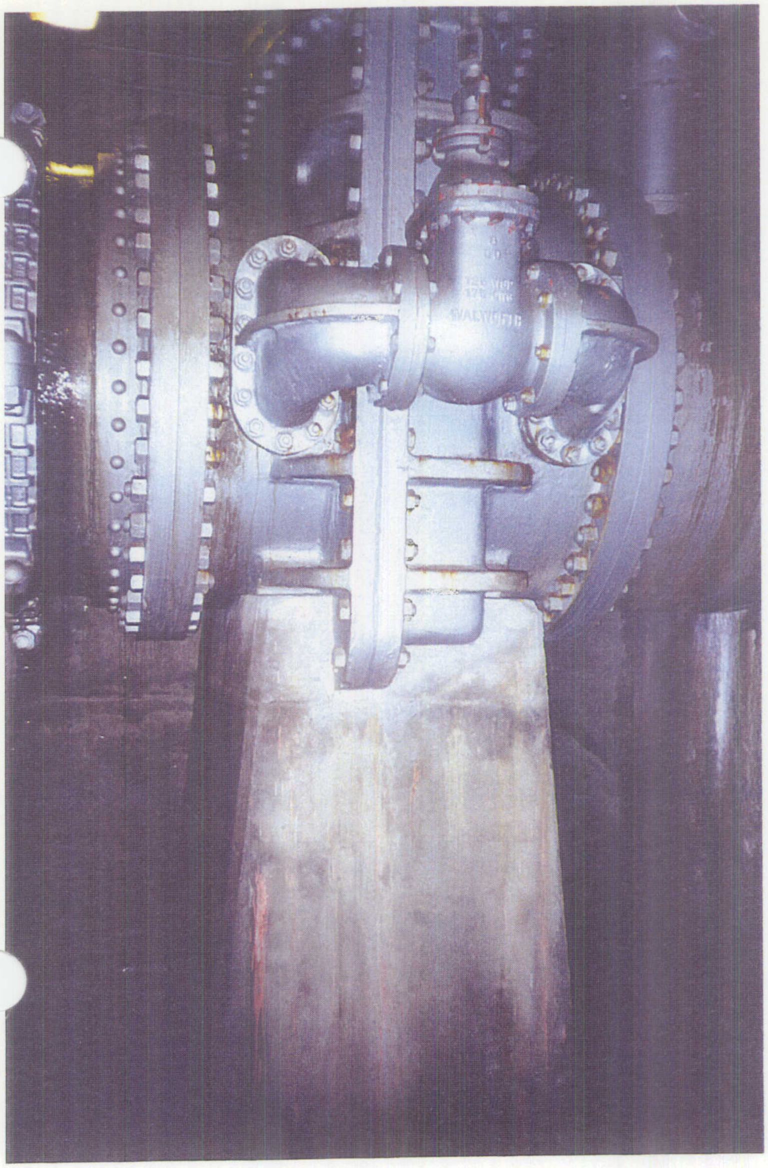

Photo 3 - Morris Dam - Slide Gate 4A - View of gate body, bypass valve and pedestal. Note bottom gate body flange embedded in pedestal.
07/01/98

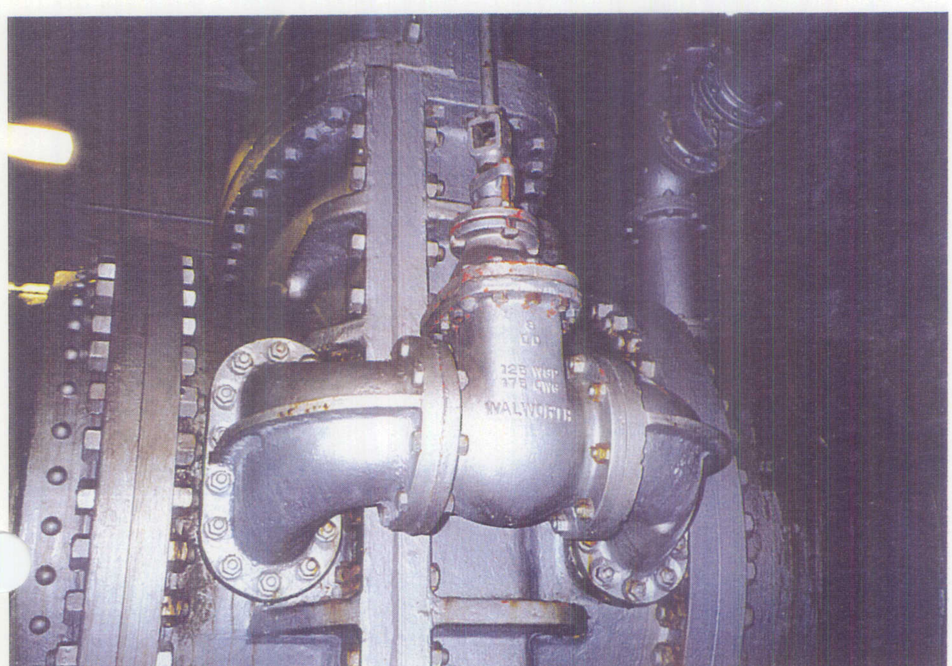

Photo 4 - Morris Dam - Slide Gate 4A - View of gate bypass piping and valve. 07/01/98

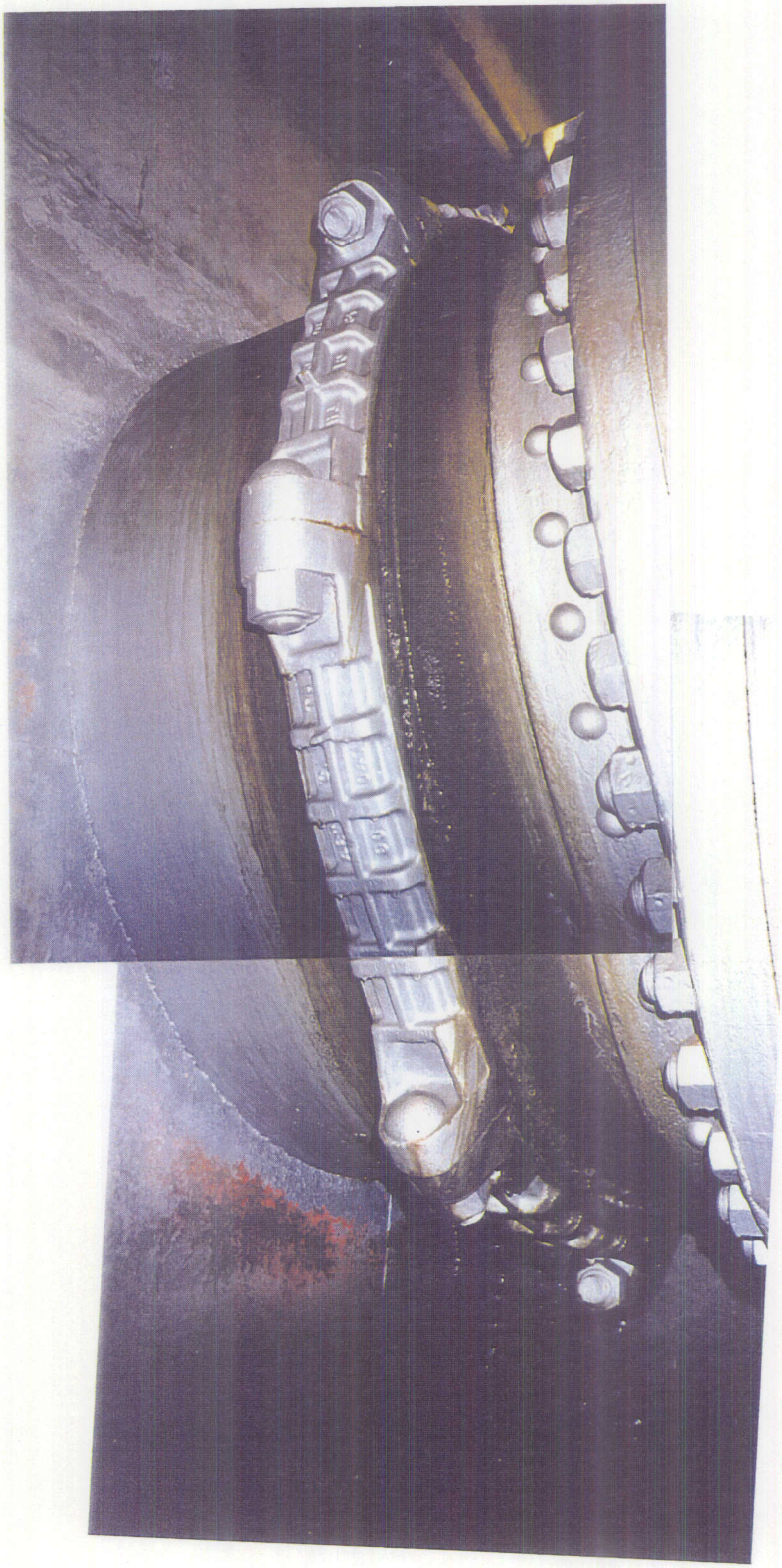

Photo 5 - Morris Dam - Slide Gate 4A - View left side of Victaulic coupling on pipe downstream from gate. Note minor leakage. 07/01/98

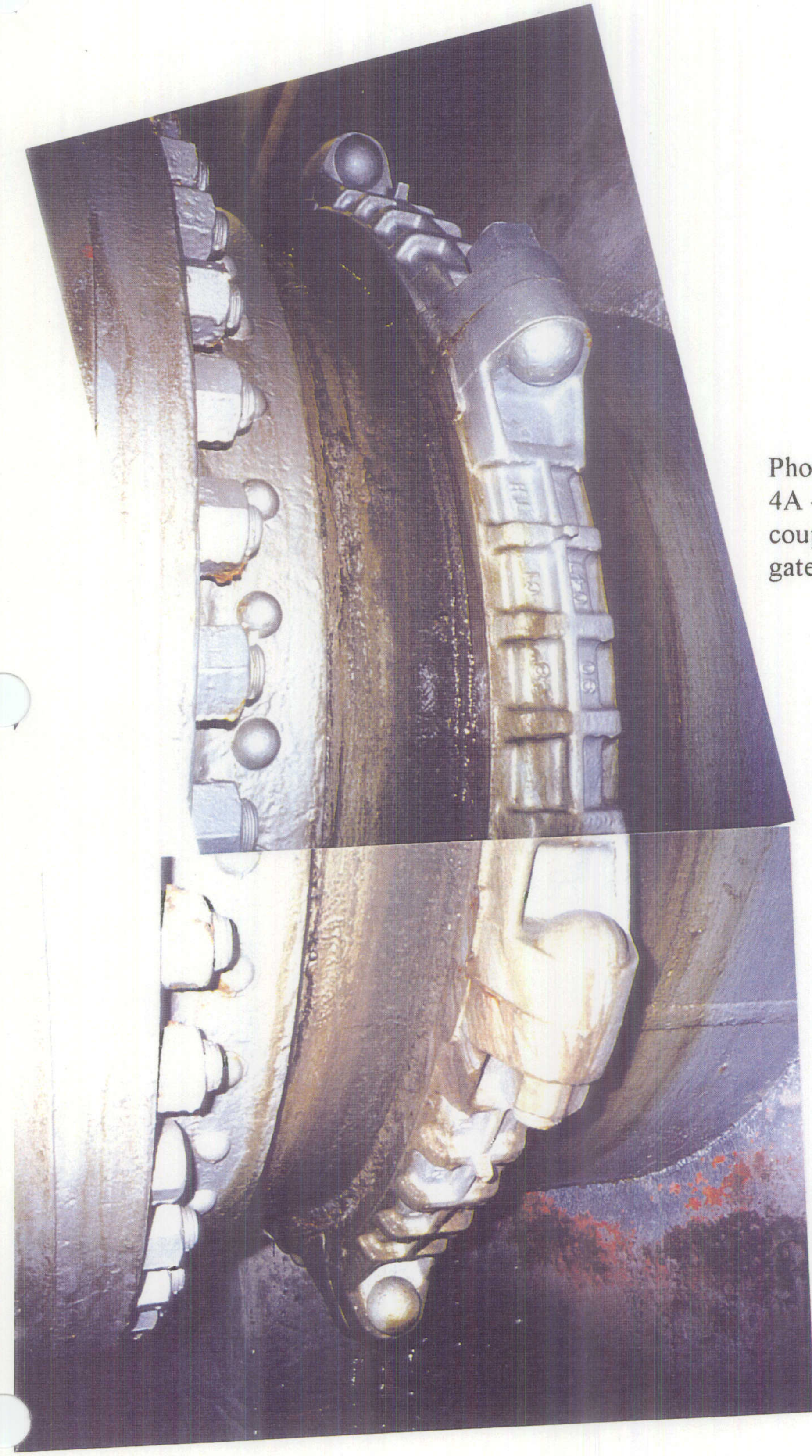

Photo 6 - Morris Dam - Slide Gate 4A - View right side of Victaulic coupling on pipe downstream from gate. Note minor leakage. 07/01/98

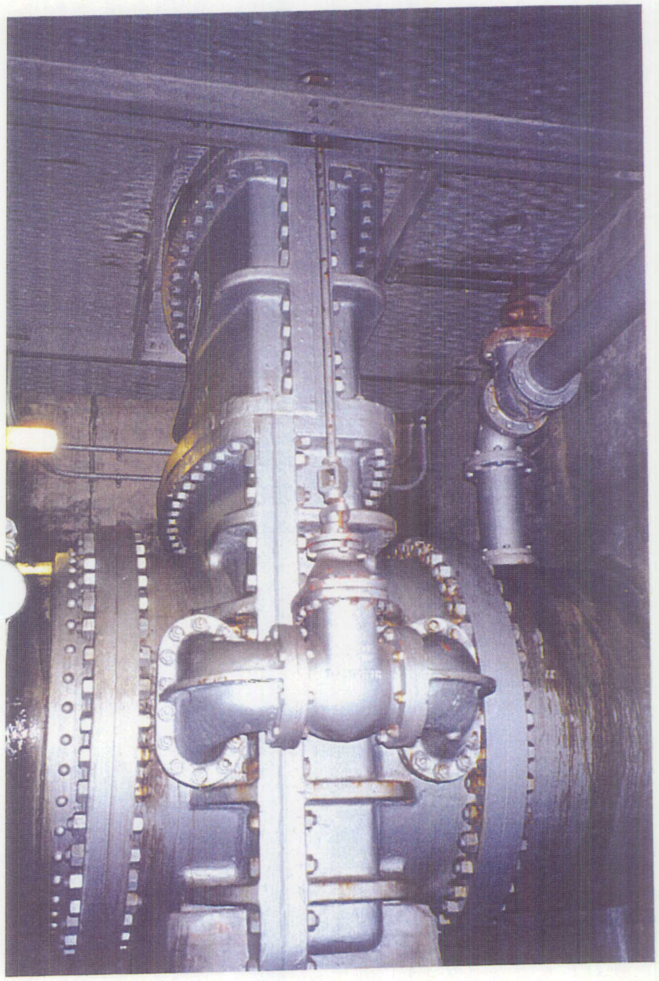

Photo 7 - Morris Dam - Slide Gate 4A - View of gate body and bypass piping and valve. Note upstream filling line at right side of photo.
07/01/98

Photo 8- Morris Dam - Slide Gate 4A - View of botton of gate leaf in the fully raised position.

09/29/98

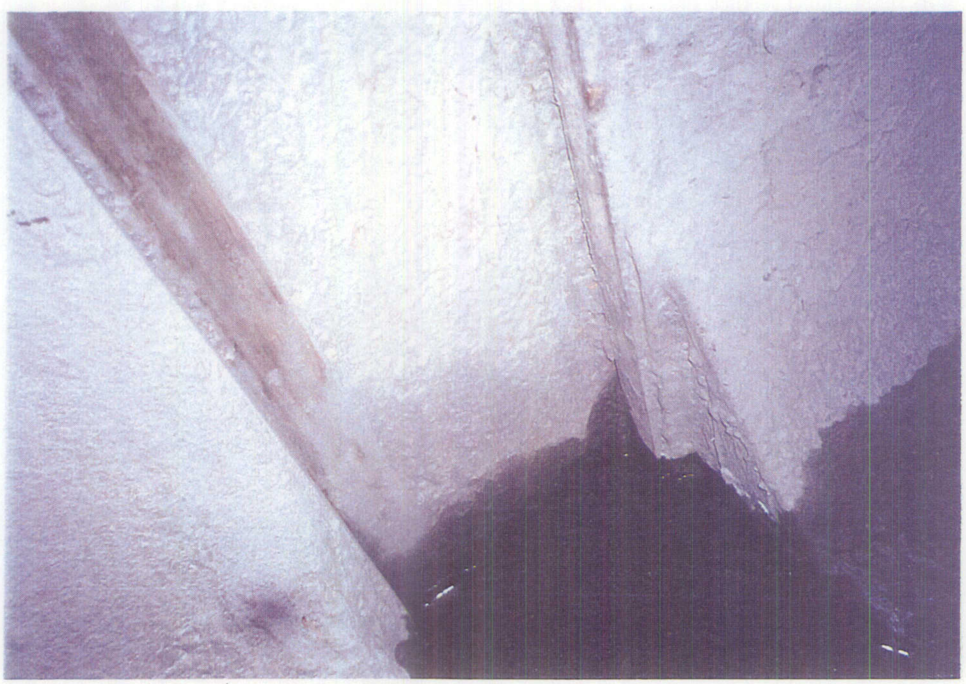

Photo 10 - Morris Dam - Slide Gate 4A - View of gate slot.

09/29/98

1 - Slide Gates and Hydraulic Hoists Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\slGATE3a.WPD

A. Overall Summary Sheet Dam Morris Dam Gate I.D. 5A

A1. Overall Rating - Slide Gates & Hydraulic Hoists (Provide an overall general rating for the gates and hoists based on safe/unsafe operation and O&M required/not required)

a. GATE GENERAL CONCLUSIONS:

Gate Needs Maintenance? □ None □ Minor □ Major □ Immediate
Gate Needs Repairs? □ None □ Minor □ Major □ Immediate
Restricted Gate Operations Recommended? □ No □ Yes (Describe..)
Recommendations Included in Checklist? □ No □ Yes (Describe...)

b. Slide GATE OVERALL RATING:

□ GOOD (Current gate condition/maintenance/safety is above average)
□ SATISFACTORY (No maintenance or repairs currently required)
□ CONDITIONAL (Gate safely operable, but some maintenance/repairs required)
□ UNSATISFACTORY (Major repairs/replacement/maintenance required)
□ RESTRICTED (Gate should not be operated)

c. HYDRAULIC HOIST OVERALL RATING:

□ GOOD (Current hoist condition/maintenance/safety is above average)
□ SATISFACTORY (No maintenance or repairs currently required)
□ CONDITIONAL (Hoist safely operable, but some maintenance/repairs required)
□ UNSATISFACTORY (Major repairs/replacement/maintenance required)
□ RESTRICTED (Hoist should not be operated)

Comments:

A2. Level 2 - General Summary of Slide Gate, Outlet Gate and Hydraulic Hoist Condition: (Check or Circle as Appropriate)

a. Operation: Gate / Hoist Operated: □ Yes: □ Full Travel □ Partial Travel (How far ______) □ Not Operated (why?) Downstream gate removed for sluicing
b. Structural: □ Satisfactory □ Unsatisfactory □ Deformed / Bent Members □ Missing / Broken members □ Other (Explain)
c. Protective Coatings: □ Original Paint □ Year of Last Paint Coat ______ □ Paint Satisfactory □ Requires minor local touch-up □ Severe localized damage (No. and location)_ □ Extensive
d. Weld/Bolted Connections: □ Chck □ Unchck Bolted connections □ Okay
(circle) (Missing Bolts) (Corroded/Rusted Bolts) (Loose Bolts) (Deformed Bolts) □ Many □ Some □ Few
e. Gate Leaf Sealing: □ Tight Seal-No Leakage □ Insignificant Leakage □ Moderate Leakage □ Heavy Leakage
f. Concrete / Grout: Gate Chamber / Control House Condition? □ Satisfactory □ Spalling □ Hairline cracking (Hvy)(Mod)(Light)
g. Gate Operation: □ Smooth Operation □ Rough Operation □ Noisy □ Vibrating □ Insufficient Power □ Other
h. Hoist Operation: □ Smooth Operation □ Rough Operation □ Noisy □ Vibrating □ Insufficient Power □ Other

Comments: Operated gate full cycle balanced and full close cycle unbalanced at 25% flow.

1 - Slide Gates and Hydraulic Hoists - Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\slGATE3a.WPD

B. Inspection and Equipment Basic Information Sheet:

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Gate ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington, USBR	6. Field Contact: Art Diaz/Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Gate Sill El.:971.00	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Gate: 172.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		

B2. Description of Slide Gate, Hydraulic Hoist and Appurtenant Equipment:

Gate No.: 5A	Size: Width 48-inch Height 48-inch ☒ Guard / Emergency ☐ Regulating Design Head 194' Year Designed 1932		
Type of Stem Bushing / Gland: ☒ Adjustable ☐ Non-Adjustable ☐ Condition (Describe if not satisfactory) Type of Gate Hanger: ☐ Automatic ☐ Semi-Automatic ☒ Chain with hook ☐ Other (Describe) ☐ None Semi-Automatic Gate Hanger Safety Studs: ☐ Number of replacements on hand ☐ Order more replacements Size of Hoist Stem: ___ inch diameter Hoist Stem Material: ___ Gate Seats, Gate Sill, and Guides ☐ Bronze on Bronze ☐ Stainless steel on bronze ☐ Seats are/ are not equipped with greasing system. Gate Leaf constructed of: ☐ Cast Iron ☐ Cast Steel ☐ Fabricated Steel ☐ Stainless Steel ☐ Other Condition of leaf and seating surfaces: ☐ Poor ☐ Good ☐ Excellent ☐ Corroded ☐ Eroded ☐ Cavitated ☐ Other (Explain)			
Gate Hoist Operator:	Type: ☒ Hydraulic hoist ☐ motor operated Screw-Lift **Comment:** Water-operated Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ___		
Emergency Operation:	~~☐ Engine-Generator ☐ Hand pump~~ ~~Operable? ☐ Yes ☐ No (why?)~~	~~Eng-Gen Operated at Inspection:~~ ~~☐ Yes ☐ No~~ ~~Last time (when)~~ ___	SOP Updated Recently ☐ Yes ☐ No
Comments:	Operates from static head from water tank		

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B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the Slide Gate, Outlet Gate and Hydraulic Hoist which were accessible at time of inspection.)

☐ All:	Downstream Side of leaf	☐ Yes ☐ No:	Upstream Side of leaf	☐ Yes ☐ No:	Body Seats	☐ Yes ☐ No	Hoist:	☐ Yes ☐ No
	Upstream / Downstream Bodies	☐ Yes ☐ No	Stem Connection	☐ Yes ☐ No	Bottom of leaf	☐ Yes ☐ No	Ring Seal	☐ Yes ☐ No

Gate Areas Not Available for Inspection:

Inspection of gate sill: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Inspection of gate bodies: Cavitated / Eroded / Other ☐ Yes ☐ No (Explain)

Comments: Inspection of interior of gates is scheduled for the weel of August 31, 1998

1 - Slide Gates and Hydraulic Hoists Individual Equipment Inspection Checklist

Form - latest revision 8/10/98 G.W.Rood - J:\WORKREQ\MORRIS\INSPECT\slGATE3a.WPD

Gate Inspectiom:

a Exterior Body

.Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Gate Support Gate body embedded in concrete

Are there cracks or missing pieces in grout pad? ☐ Yes ☒ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support? ☐ Yes ☒ No (Explain)

c. Hydraulic Hoist Water-operated

Is there water leakage from cylinder flanges? ☐ Yes ☒ No (Explain)
Is there water leakage from cylinder glands? ☐ Yes ☒ No (Explain)
Is there any water present in the bonnet cover or on the floor? ☐ Yes ☒ No (Describe)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint ? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on cylinder or heads? ☐ Yes ☒ No (Explain)

d. U/S Interior Body

Are there scratches or gouges on gate leaf? ☐ Yes ☐ No (Explain)
Are there scratches, gouges, cavitated , or damaged areas on the seal ring? ☐ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on the body? ☐ Yes ☐ No (Explain)
Are there areas of corrosion on the body? ☐ Yes ☐ No (Explain)

e. D/S Interior Body

Are there scratches or gouges on gate seats? ☐ Yes ☐ No (Explain)
Are there scratches, gouges, or corrosion on the gate stem? ☐ Yes ☐ No (Explain)
Are there exposed stem threads on bottom of stem nut? ☐ Yes ☐ No (Explain)
Are there missing screws or evidence of corrosion on the seal ring gland? ☐ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on the gate leaf or body ? ☐ Yes ☐ No (Explain)
Are there areas of corrosion on the gate leaf or body? ☐ Yes ☐ No (Explain)

GATE AND HOIST STRUCTURAL RATING:

☐ **GOOD**
(Gate and Hoist structural condition is above average)
☐ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Gate and Hoist safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Gate/Hoist should not be operated for structural reasons.)

f. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

D2. Condition of Gate's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☐ Date Last Painted (Where?)

a. General Condition of Coating: ☒ Good ☐ Fair ☐ Poor d. Rust: ☐ hvy ☐ mod ☐ light ____% b. Coating Failure: ☐ hvy ☐ mod ☐ light ____% c. Corrosion: ☐hvy ☐mod ☐light ____% d. Pitting: ☐ hvy ☐ mod ☐ light ____% e. Distribution and Location of Coating Deficiencies: ☐ All: Leaf U.S. Side: ☐ Yes ☐ No Leaf D.S. Side: ☐ Yes ☐ No Bonnet Cover: ☐ Yes ☐ No ☐ Hoist: ☐ Yes ☐ No Cause of Coating Failure: ☐ Age ☐ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☐ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**GATE PAINT RATING:** ☐ GOOD (Gate's current paint coating is above average) ☒ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☐ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)
COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.	

D3. Performance and Condition of Gate Seal

a. Leakage past seal ☐ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☐ Excessive (How much?) __________gpm. Leakage Acceptable? ☐ Yes ☐ No b. Condition of ring seal: ☐ Unknown ☐ Good ☐ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... c. Reason for Leakage: ☐ Damaged ring seal ☐ Damaged or scratched leaf ☐ Leaf to seal contact ☐ Seal Defect ☐ Stuck Debris ☐ Other d. Condition of ring seal gland screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ...	**GATE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☐ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)
e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT GATE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS Outlet filled at time of inspection.	

D4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of gate and hoist operation? ☐ Yes ☐ No
b. Are discharge curves and operating diagrams current? ☐ Yes ☐ No N/A
c. Posted operating instructions? ☐ Yes ☐ No
d. Does dam operator understand their use? ☐ Yes ☐ No
e. Are as-built drawings of gate/hoist available? ☐ Yes ☐ No
f. Are maintenance requirements understood? ☐ Yes ☐ No
g. SOP/DOC instructions and documents current? ☐ Yes ☐ No

D5. Performance of Gate and Hoist Operation:

a. Was gate and hoist operated at inspection? ☐ Yes ☒ No b. Is gate and hoist exercised according to SOP? ☒ Yes ☐ No c. Is gate and hoist operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?) d. Describe gate and hoist operation: (describe below) ☐ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other (Describe any operational problems/deficiency) e. Approx. date of last gate operation. f. Gates and hoist operated as designed? ☐ Yes ☒ No (Why?) Gate and outlet used for sluicing g. Has this gate and hoist been operated using back-up power or device? ☐ Yes ☐ No ☒ n/a	GATE AND HOIST RATING: ☐ SATISFACTORY (Either no or minor maintenance or repairs currently required) ☐ CONDITIONAL (Questionable operation & repairs/replacement/maintenance required) ☐ RESTRICTED (Gate and hoist should not be operated without major repairs or restricted operation)

D6. Maintenance/Lubrication:

Type of greasing system: (describe)

Frequency of Lubrication:

Last Lubrication: (Date)

Lubricant type:

Top and side seat lubrication: ☐ n/a (why) ________ (No greasing system available)

Grease zircs/fittings (if applicable) damaged or unuseable: Repair Date.

COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT MAINTENANCE. POSSIBLE ACTIONS/RECOMMENDATIONS

E. Gate Public Security:

Gate Installation Accessible by Public? ☐ Yes ☒ No *Describe ...* In gate chamber in interior of dam

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs

- Valve lower body is embedded in concrete.
- Downstream needle valve 5 has been removed and replaced with an extension pipe for sluicing.

Photo 1. - Morris Dam - Slide Gate 5A -View of gate stem and lower gland. 07/01/98

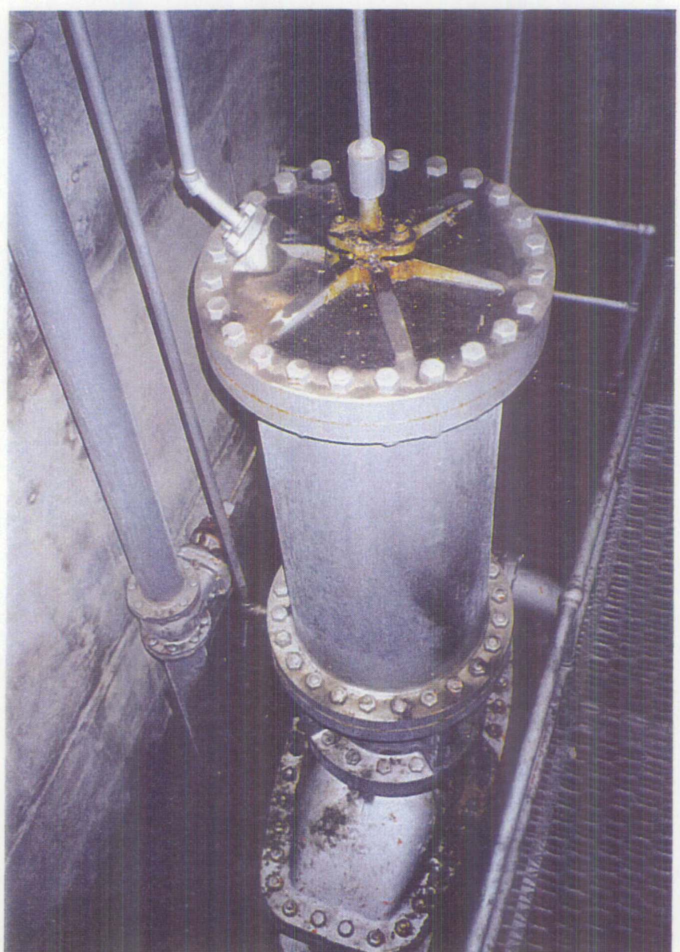

Photo 2. - Morris Dam - Slide Gate 5A - View of slide gate cylinder and bonnet cover. Note body of gate embedded. 07/01/98

Photo 1 - Morris Dam - Valve 5 (removed) - View showing pipe extension on outlet used for sluicing. 07/01/98

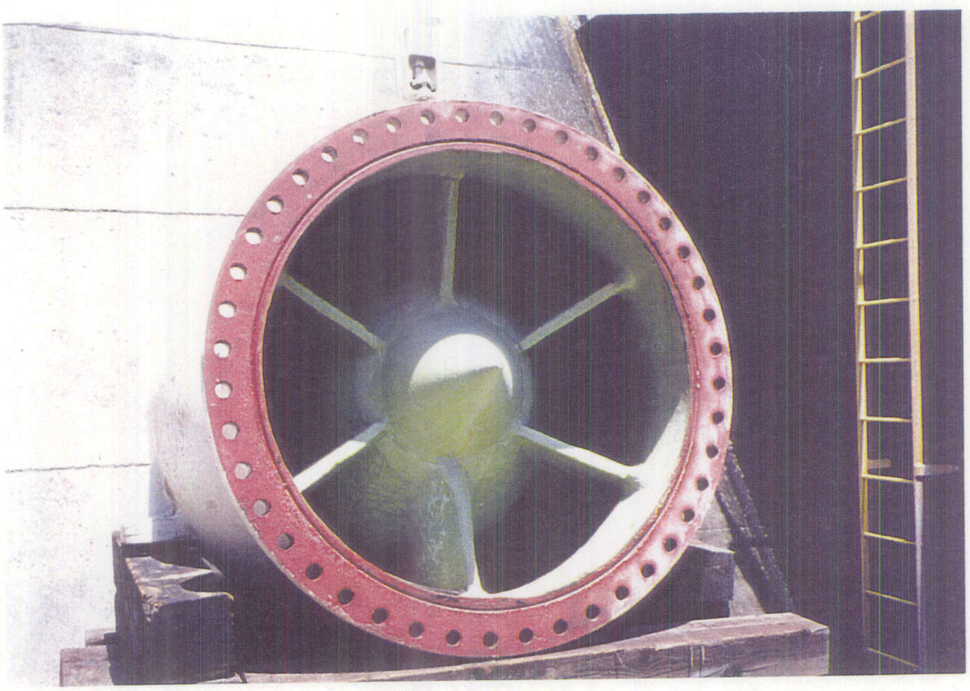

Photo 2 - Morris Dam - Valve 5 (removed) - View showing removed needle valve on outlet used for sluicing. 07/01/98

Needle Valves - Individu... Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV6.WPD

A. Overall Summary Sheet

Dam Morris Dam Valve I.D. 6

A1. Overall Rating - Needle Valve (Provide an overall general rating for the valve based on safe/unsafe operation and O&M required/not required)

a. VALVE GENERAL CONCLUSIONS:

Valve Needs Maintenance? ☐ None ☒ Minor ☐ Major ☐ Immediate
Valve Needs Repairs? ☐ None ☒ Minor ☐ Major ☐ Immediate
Restricted Valve Operations Recommended? ☒ No ☐ Yes (Describe..)
Recommendations Included in Checklist? ☒ No ☐ Yes (Describe...)

b. Needle VALVE OVERALL RATING:

☐ GOOD (Current valve condition/maintenance/safety is above average)
☐ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Valve safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☒ RESTRICTED (Valve should not be operated)

Comments: Valve leaks through the needle seats and leakage through the air vent manifold. Valve has a tendency to run away when operated.

A2. Level 2 - General Summary of Needle Valve Condition: (Check or Circle as Appropriate)

a. OPERATION:
Was valve operated?: ☒ Yes: ☐ Not Operated (why?)
☒ Full Travel ☐ Partial Travel (How far _______)
Valve operation: ☒ Smooth ☐ Rough ☐ Noisy ☐ Vibrating ☐ Insufficient Power ☐ Other

b. STRUCTURAL: ☒ Satisfactory
☐ Unsatisfactory ☐ Deformed / Bent Members ☐ Missing / Broken members ☐ Other (Explain)

c. PROTECTIVE COATING: ☐ Original Paint ☐ Year of Last Paint Coat ______
☒ Paint Satisfactory
☒ Requires minor local touch-up ☐ Severe localized damage (No. and location)_ ☐ Extensive

d. WELDED/BOLTED CONNECTIONS: ☒ Checked ☐ Unchecked
Bolted connections ☒ Okay
☐ Missing Bolts ☒ Corroded/Rusted Bolts ☐ No Threads Showing ☐ Deformed Bolts
☐ Many ☐ Some ☐ Few

e. VALVE SEAT SEALING: ☐ Tight Seal-No Leakage ☐ Insignificant Leakage ☒ Moderate Leakage ☐ Heavy Leakage
:

Comments:

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/23/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV6.WPD

B. **Inspection and Equipment Basic Information Sheet:**

B1. Inspection Site Information: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Valve ___ for data in this section

1. Name of Dam/Facility: Morris Dam		2. Region: Los Angeles County Department of Public Works
3. Date of Inspection: 6/29 thru 7/1/98	5. Lead Inspector & Office: Ron Arrington USBR	6. Field Contact: Art Diaz / Jim McGowan
4. Reservoir El.: 1145.47	Phone #: 303-445-2877	Phone #: 626-334-2090
7. Valve Centerline El.: 975.0	8. Area Office & Contact: Emily Hasegawa	9. Water District & Contact: Steve Bradley
10. Head on Valve: 170.47	Phone #: 626-458-6304	Phone #:
11. Others present:		
12. Special circumstances, weather conditions, other:		
1. Name of Dam/Facility: Morris Dam		**2. Region: Los Angeles County Department of Public Works**
3. Date of Inspection: 9/29/98	**5. Lead Inspector & Office: Gary Rood USBR**	**6. Field Contact: Art Diaz / Jim McGowan**
4. Reservoir El.: 970.00	**Phone #: 303-445-3102**	**Phone #: 626-334-2090**
7. Valve Centerline El.: 975.00	**8. Area Office & Contact: Emily Hasegawa**	**9. Water District & Contact: Steve Bradley**
10. Head on Valve: 0.00	**Phone #: 626-458-6304**	**Phone #:**
11. Others present: Bill McStraw D-8450 and George Taylor D-8005.		
12. Special circumstances, weather conditions, other:		

Needle Valves - Individual Equipment Inspection Checklist

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B2. Description of Needle Valve and Appurtenant Equipment:

B1. Valve No. and Size: 6 - 72-inch	Size: Diameter 72-inch Design Head 177 Year Designed 1932		
Number of Splitters 8 Valve Seat ☒ Bronze ☐ Stainless steel. Valve Needle constructed of: ☐ Cast Iron ☒ Cast Steel ☐ Cast Bronze ☐ Other Valve Body constructed of: ☒ Cast Iron ☐ Cast Steel ☐ Cast Bronze ☐ Other			
B2 . Valve Operator:	Type: ☒ Hydraulic ☐ motor operated Screw-Lift Water operated Controls: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ____		
B3. Guard Gate/ Stoplogs Capabilities:	Guard gate ☒ Yes ☐ No Size and type. 96" x 120" Caterpillar Gate 96" Butterfly valve	Stoplogs available (if required) ☐ Yes ☒ No No.of logs? ____ Size ____ ☐ Okay ☐ Not Useable (why?)	Bulkhead and/or Stoplogs Kept Onsite ☐ Yes ☐ No Last Used ☐ <1yr ☐ < 3yr ☐ < 10 yr
Comments:			

B3. Inspection / Accessibility: (Check the appropriate box(es) for the components of the High Pressure Valve, Outlet Valve and Hydraulic Hoist which were accessible at time of inspection.)

☐ All: Interior of Valve Body ☒ Yes ☐ No: Upstream Side of Needle ☒ Yes ☐ No: Body Seats ☒ Yes ☐ No Valve Operator: ☒ Yes ☐ No Exterior of Valve Body ☒ Yes ☐ No Valve Indicator Connection ☒ Yes ☐ No Splitters ☒ Yes ☐ No Control house and valve chamber ☒ Yes ☐ No Valve Areas Not Available for Inspection: ☐ Yes Interior of valve inspected on (9/29/98).
Inspection of valve needle: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (use clock points looking D/S)
Inspection of interior of valve bodies: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (use clock points looking U/S)
Inspection of splitters: ☒ Yes ☐ No Cavitated / Eroded / Other (Explain) Location (number clockwise starting at top looking U/S)
Inspection of valve seat: ☐ Yes ☒ No Cavitated / Eroded / Other (Explain) Location (use clock points looking U/S)
Inspection of exterior valve body: ☐ Good ☒ Satisfactory ☐ Poor (Explain)
Comments:

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV6.WPD

C1. Structural Integrity of components including; Hoist, Leaf horizontal ribs, Leaf vertical ribs, Leaf face plate, Bonnet Cover, etc.

Structural Members Inspection:

a Exterior Body

Are flanges leaking? ☐ Yes ☒ No (Explain)
Are flange bolts missing, no exposed threads? ☐ Yes ☒ No (Explain)
Are flange bolts corroding? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on body? ☐ Yes ☒ No (Explain)

b. Valve Pedestal

Are there cracks in concrete pedestal? ☒ Yes ☐ No (Explain)
Are there cracks or missing pieces in grout pad? ☒ Yes ☐ No (Explain)
Are there missing bolts or bolts with no exposed threads? ☐ Yes ☒ No (Explain)
Is there corrosion on bolts? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on support or trunnion? ☐ Yes ☒ No (Explain)
Are there areas of corrosion on support or trunnion? ☐ Yes ☒ No (Explain)

c. Needle

Are there areas of scratches or gouges on U/S face of needle? ☐ Yes ☒ No (Explain)
Are there rough areas or cavitation damage on U/S face or needle seat? ☒ Yes ☐ No (Explain)
Are there missing screws or evidence of corrosion on plunger flange? ☐ Yes ☒ No (Explain)
Are there scratches, gouges, or evidence of corrosion on plunger? ☒ Yes ☐ No (Explain)

e. Interior Body

Are there scratches gouges on valve body seat? ☐ Yes ☒ No (Explain)
Are there damaged areas or areas missing paint on body or cylinder? ☒ Yes ☐ No (Explain)
Are there areas of corrosion or cavitation damage on body or cylinder? ☒ Yes ☐ No (Explain)

f. Splitters

Is there damage to leading edge (U/S) of splitter? ☐ Yes ☒ No (Explain)
Is there evidence of cavitation or damage at splitter/cylinder connection? ☒ Yes ☐ No (Explain)
Is there evidence of cavitation or damage at splitter/body connection? ☒ Yes ☐ No (Explain)
Are there damaged areas or areas missing paint on splitters? ☒ Yes ☐ No (Explain)
Are there areas of corrosion or cavitation damage on splitters? ☒ Yes ☐ No (Explain)

VALVE STRUCTURAL RATING:

☐ **GOOD**
(Valve and Hoist structural condition is above average)
☐ **SATISFACTORY**
(No maintenance or repairs to structure is currently required)
☐ **CONDITIONAL**
(Valve and Hoist safe to operate, but some maintenance/repairs recommended)
☒ **UNSATISFACTORY**
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED**
(Valve/Hoist should not be operated for structural reasons.)

g. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

Needle Valves - Individual Equipment Inspection Checklist

Form - latest revision 10/20/98 R. Arrington - J:\WORKREQ\MORRIS\INSPECT\2NVVALV6.WPD

C2. Condition of Valve's Protective and Hoist (PAINT) Coatings: Original Paint: Yes ☐ No ☒ Date Last Painted (Where?)

a. General Condition of Coating: ☐ Good ☒ Fair ☐ Poor Cause of Coating Failure: ☐ Age ☐ Corrosion/Erosion/Cavitation ☐ Rubbing ☐ Standing Water ☐ No Drains ☒ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...	**VALVE PAINT RATING:** ☐ GOOD (Valve's current paint coating is above average) ☒ SATISFACTORY (Paint okay - no paint repairs currently required) ☐ CONDITIONAL (Some paint maintenance/repairs recommended) ☐ UNSATISFACTORY (Major paint repairs or replacement/maintenance is required)
COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.	

C3. Performance and Condition of Valve Seats ...

a. Leakage Past Seats/sill ☐ Unknown ☐ No Leakage ☐ Insignificant ☒ Some ☐ Excessive (How much?) _75_ gpm. Leakage Acceptable? ☒ Yes ☐ No b. Condition of seats/sill: ☐ Unknown ☐ Good ☒ Fair ☐ Poor - Cavitated/Eroded portions of seats/sill: Describe.... Seat screws: ☐ Missing ☐ Damaged ☐ Loose: Describe ... c. Reason for Leakage: Seats/Sill: ☐ Damaged seat (which one?) ______________ ☐ Damaged Sill ☒ Seat to Seat contact ☐ Seat Defect ☐ Stuck Debris ☐ Other	**VALVE LEAKAGE RATING:** ☐ GOOD (No or insignificant amounts of leakage.) ☐ SATISFACTORY (Little or tolerable amounts of leakage.) ☒ CONDITIONAL (excessive leakage which can be tolerated until appropriate repairs can be made.) ☐ UNSATISFACTORY (Excessive, Intolerable, or Leakage Causing damage.) ☐ **RESTRICTED** (Immediate repair required)
e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT VALVE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS	

C4. Operator's Capabilities and Standing Operating Procedures:

(Provide comment where applicable)

a. Dam operator knowledge of valve operation?	☒ Yes	☐ No
b. Are discharge curves and operating diagrams current?	☒ Yes	☐ No
c. Posted operating instructions?	☐ Yes	☒ No
d. Does dam operator understand their use?	☒ Yes	☐ No
e. Are as-built drawings of valve/hoist available?	☐ Yes	☒ No
f. Are maintenance requirements understood?	☒ Yes	☐ No
g. SOP/DOC instructions and documents current?	☒ Yes	☐ No

E7. Performance of Valve Operation:

a. Was valve operated at inspection? ☒ Yes ☐ No

b. Is valve exercised according to SOP? ☒ Yes ☐ No

c. Is Valve operated according to SOP and operating instructions ☒ Yes ☐ No (If no, WHY?)

d. Describe valve operation: (describe below)
☒ Smooth ☐ Free Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power
☐ Other (Describe any operational problems/deficiency)

e. Approx. date of last valve operation.

f. Valves as designed? ☒ Yes ☐ No (Why?)

g. Was this valve operated using back-up power or device? ☐ Yes ☐ No ☒ n/a

VALVE RATING:

☐ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL
(Questionable operation & repairs/replacement/maintenance required)

☒ RESTRICTED
(Valve and hoist should not be operated without major repairs or restricted operation)

h. Comments:
Although the valve operated smoothly during the examination, erratic operation has been experienced in the past. Valve has a tendency to run away when operated.

D. Valve Public Security:

Valve Installation Accessible by Public? ☒ Yes ☐ No *Describe ...* Vehicle access gate is locked, but accessible by pedestrian traffic

Public Danger? ☐ Yes ☒ No *Describe ...*

Has there been vandalism or evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe ...*

Security features? ☐ Fencing ☒ Locks on control buildings and control panels etc. ☐ Public warning signs
Valve operating handles are locked.

Photo 1 - Morris Dam - Needle Valve 6 - View showing needle valve leakage at full head. 07/01/98

Photo 2 - Morris Dam - Needle Valve 6 - View showing needle valve leakage at full head. 07/01/98

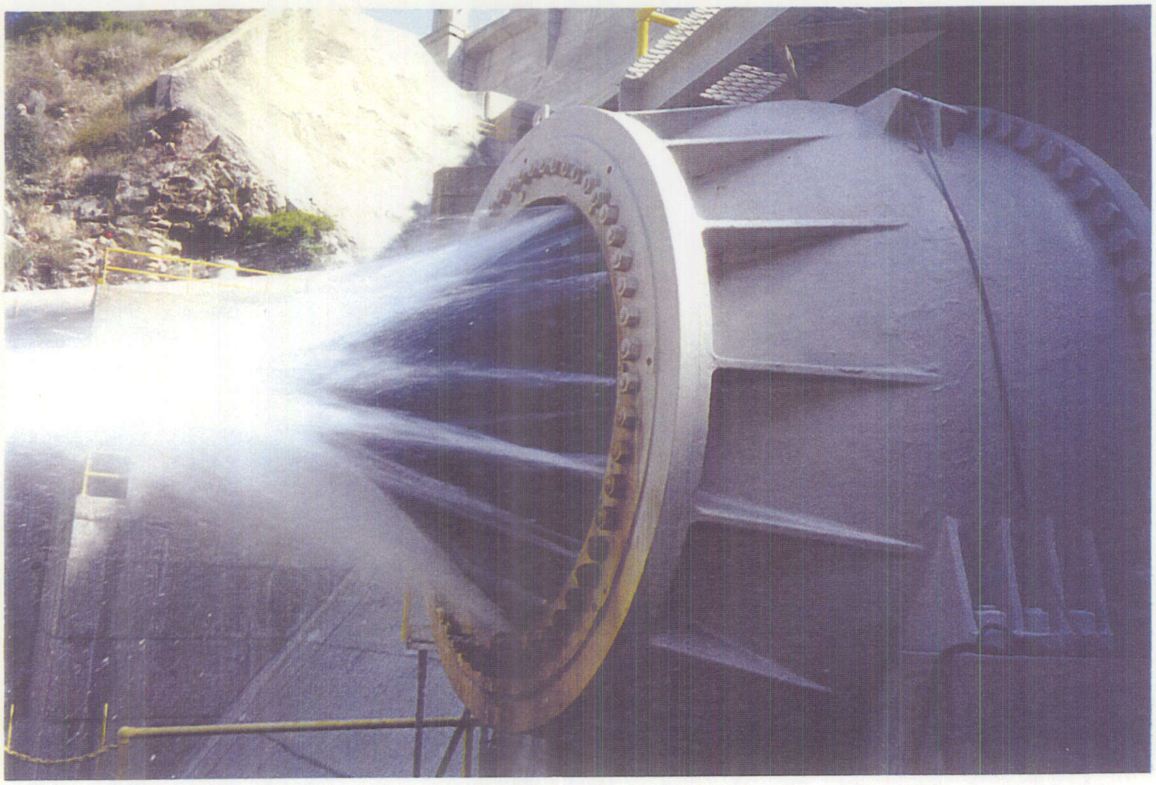

Photo 3 - Morris Dam - Needle Valve 6 - View showing needle valve leakage at full head.
07/01/98

Photo 4 - Morris Dam - Needle Valve 6 - View showing needle valve leakage at full head.
07/01/98

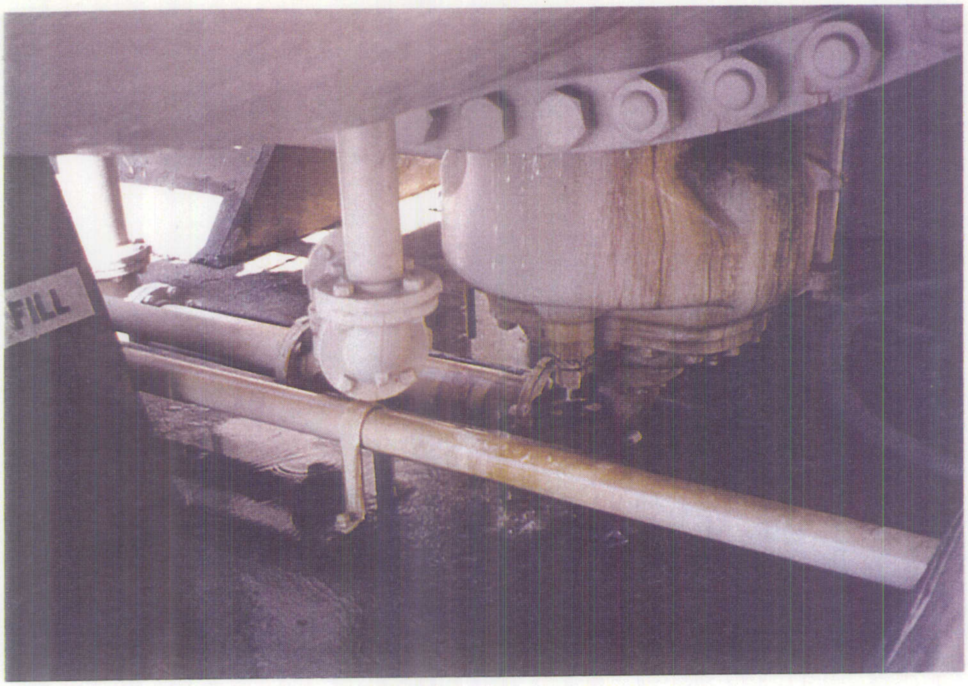

Photo 5 - Morris Dam - Needle Valve 6 - View showing needle valve paradox valve and piping. 07/01/98

Photo 6 - Morris Dam - Needle Valve 6 - View showing needle valve body flange and air vent manifold. Note leakage from manifold.
07/01/98

Photo 7 - Morris Dam - Needle Valve 6 - View showing needle valve discharge at full head. 07/01/98

Photo 8 - Morris Dam - Needle Valve 6 - View showing needle valve discharge at full head. 07/01/98

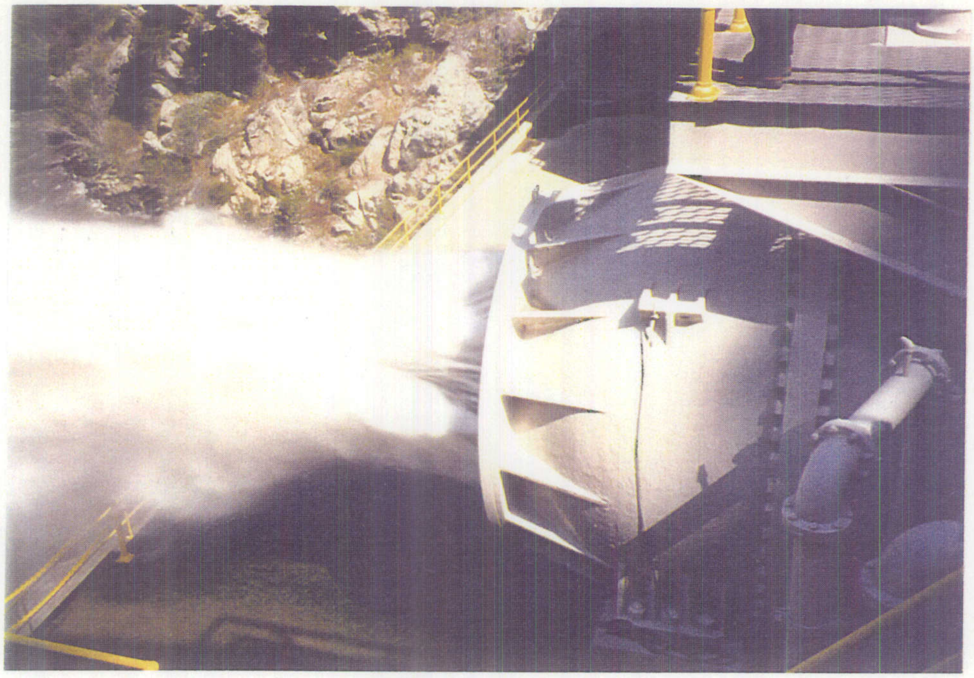

Photo 9 - Morris Dam - Needle Valve 6 - View showing needle valve discharge at full head. 07/01/98

Photo 10 - Morris Dam - Needle Valve 6 - View showing needle valve discharge at full head. 07/01/98

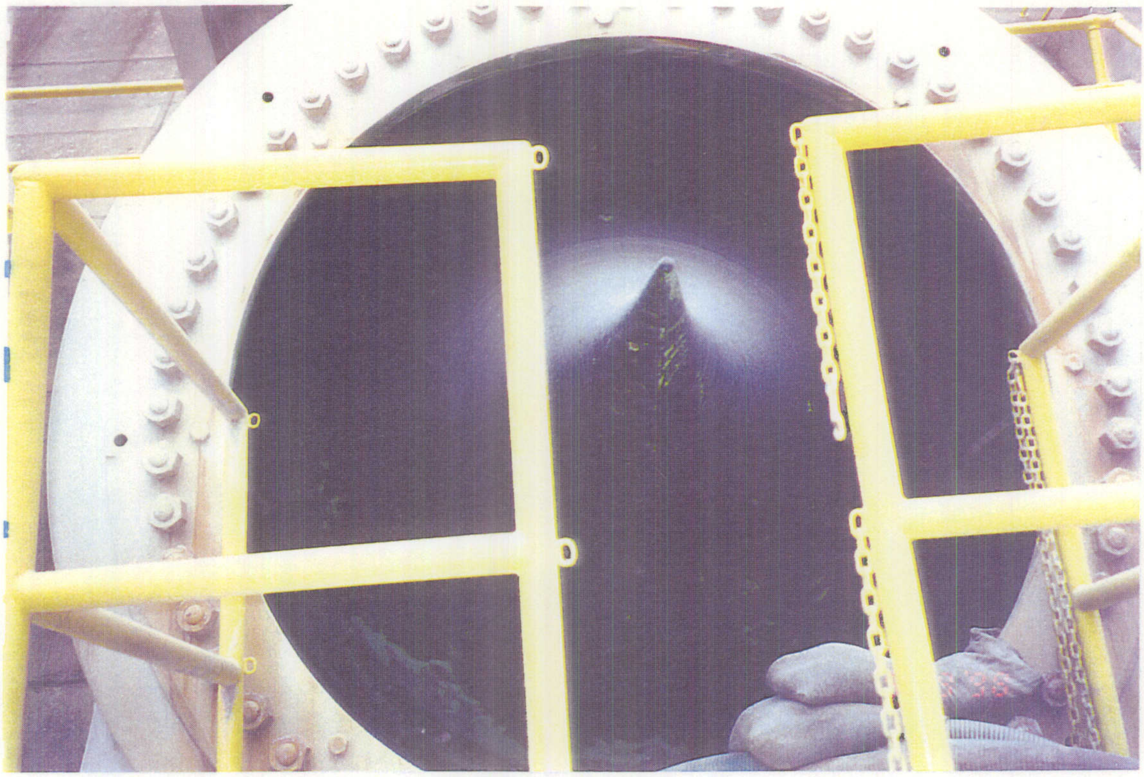

Photo 11- Morris Dam - Needle Valve 6 - View of needle and downstream flange.
09/29/98

Photo 12 - Morris Dam - Needle Valve 6 - View of crack in left (looking downstream) valve support pedestal.
09/29/98

Photo 13- Morris Dam - Needle Valve 6 - View looking downstream of body tip, valve body, and splitters.

09/29/98

Photo 14 - Morris Dam - Needle Valve 6 - View of area 6" x 24" x ½ deep of material loss 36" downstream of upstream flange between 1030 and 12 o'clock splitters

09/29/98

Butterfly Valve - Individual E[illegible]ipment Inspection Checklist

Form - latest revision 10/23/98 G. Rood - [illegible]ORKREQ\MORRIS\INSPECT\2BFV6A.WPD

A. Inspection Site Information: Valve # 6A

A1. Name of Dam/Structure: Morris Dam		A2. Region: L A County Dept. Public Works
A3. Date of Inspection: 6/29 thru 7/1/98	A4. Field Contact: Art Diaz/ Jim McGowan Phone #: 626-334-2090	A5. Inspector: Ron Arrington Phone #: 303-445-2877
A6. Centerline of pipe axis at valve El.: 975.00		
A7. Reservoir El: 1142.82	A8. Area Office: Emily Hasagawa Phone #: 626-458-6304	A9. Water District: Steve Bradley Phone #:
A10. Head at valve (feet) at time of inspection: 182.82		
A11. Others present:		
A12. Special circumstances, weather conditions:		
A1. Name of Dam/Structure: Morris Dam		A2. Region: L A County Dept. Public Works
A3. Date of Inspection: 9/29/98	A4. Field Contact: Art Diaz/ Jim McGowan Phone #: 626-334-2090	A5. Inspector: Gary Rood Phone #: 303-445-3102
A6. Centerline of pipe axis at valve El.: 975.00		
A7. Reservoir El: 970.00	A8. Area Office: Emily Hasagawa Phone #: 626-458-6304	A9. Water District: Steve Bradley Phone #:
A10. Head at valve (feet) at time of inspection: 0.00		
A11. Others present: Bill McStraw D-8450 and George Taylor D-8005.		
A12. Special circumstances, weather conditions:		

B. Overall Rating of Butterfly Valve:

B1.	VALVE'S OVERALL RATING: ☐ Satisfactory ☐ Conditional ☐ **Unsatisfactory**
B2.	MAINTENANCE OR REPAIRS REQUIRED: ☐ None ☐ Minor ☐ Major
B3.	RESTRICTED OPERATIONS REQUIRED: ☐ No ☐ Yes, Reference Section:
B4.	FOLLOW-UP ANALYSIS REQUIRED: ☐ No ☐ Yes, Reference Section:
B5.	COMMENTS/RECOMMENDATIONS:

C. Description of Butterfly Valve and Operator:

C1. Location of valve: Upstream of Needle Valve 6 in gate chamber	C2: Year valve installed: 1932
C3. Purpose of valve: Emergency closure	C4. Service: ☒ Open/Close only ☐ Throttling
C5. Pressure rating for cold water (psi.):	C6. Valve diameter (inches): 96"
C7. Type: AWWA C504: ☐ Yes ☒ No High-performance: ☐ Yes ☒ No	C8. Pressure class: ☐ AWWA C504 ☐ 25 ☐ 75 ☐ 150 ☐ 250 ☐ A ☐ B ☐ ANSI ☐ 150 ☐ 300
C9. Materials: Body: ☒ Carbon Steel ☐ Stainless Steel ☐ Other Shaft: ☐ Carbon Steel ☐ Stainless Steel ☐ Other Disc: ☒ Carbon Steel ☐ Stainless Steel ☐ Other Retainer: ☐ Carbon Steel ☐ Stainless Steel ☐ Other	C10. Outside of valve: ☒ Exposed ☐ Buried ☐ Submerged
C11. Exterior coating on valve: Good	C12. Interior coating on valve: Good
C13. Connection of valve: ☐ Wafer ☐ Lug ☒ Flanged	C14. Connection on nearby pipe to facilitate removal: ☐ Sleeve-type coupling ☐ Union ☐ Grooved-end coupling ☐ Flange ☒ Other: None
C15. Seats: Mounting of Seats: ☒ Bolted ☐ Glued ☐ Wedged Seat material: ☐ Rubber ☒ Metal ☐ Elastomer Type of elastomer: ________ Year seats last replaced: ________	C16. Orientation of stem ☒ Horizontal ☐ Vertical ☐ Diagonal
C17. Operator Type: ☐ Manual ☒ Electric Motor ☐ Hydraulic ☐ Pneumatic	C18. Position indicating system: ☒ Yes ☐ No

C19. Manual Operator: Backup
Location on valve: Operating stand
Type ☐ Handwheel ☐ Square-nut ☐ Lever
Number of turns fully open/close: ____________
Extension stem: ☐ Yes ☐ No
Floor stand and handwheel: ☐ Yes ☐ No
Motor declutch lever:
Use to engage manual operation: ☐ Yes ☐ No
Must use to restore motor operation: ☐ Yes ☐ No

C20. Motor Operator:
Motor Hp: ____________
Output rpm: ____________
Motor voltage: ☐ 115 ☐ 230 ☐ 460
Phase: ☐ DC ☐ Single ☐ 3
Emergency power: ☐ Engine-Generator Set ☐ None
Worm gear reduction ratio: ____________
Opening/closing speed (seconds): ____________

D. Inspection of Butterfly Valve (prior to operation):

D1. Valve:

Exterior: ☐ Inspected ☐ Not inspected
- ☐ Outside of body corroded
- ☐ Cracked, broken, or missing parts
- ☐ Valve supports corroded

Interior: ☐ Inspected ☐ Not inspected
- ☐ Inside of body corroded
- ☐ Cavitation or pitting on valve disk
- ☐ Wire-drawing
- ☐ Seat corroded, worn, or missing

Connection: ☐ Inspected ☐ Not inspected
- ☐ Corroded
- ☐ Missing flange bolts

Support: ☐ Inspected ☐ Not inspected
- ☐ Corroded
- ☐ Missing anchor bolts

Comments/Description:

☐ SATISFACTORY CONDITION
(No repairs or maintenance currently required)

☐ MINOR REPAIRS OR MAINTENANCE REQUIRED

☐ UNSATISFACTORY CONDITION
(Major repairs, replacement, or maintenance required)

Butterfly Valve - Individual [illegible]ipment Inspection Checklist

Form - latest revision 10/20/98 G. Rood - [illegible]ORKREQ\MORRIS\INSPECT\2BFV6A.WPD

D2. Leakage: ☐ Inspected ☒ Not inspected Estimated amount of leakage: ____________ Head on valve: ____________ Exterior: ☐ Leakage around flanges ☐ Leakage through stem ☐ Leakage through seal adjusting screws Interior: ☐ Leakage at disk and seat Comments/Description:	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☒ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)
D3. Coatings and linings: ☒ Inspected ☐ Not inspected Exterior (describe if box checked): ☐ Paint chipped, cracked or missing: ☐ Galvanizing chipped, cracked, or worn: ☐ Original coating Date of last recoating: ____________ Interior (describe if box checked): ☐ Paint chipped, cracked or missing: ☐ Galvanizing chipped, cracked, or worn: ☐ Original coating Date of last recoating: ____________ Comments/Description:	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☒ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)
D4. Controls: ☒ Inspected ☐ Not inspected ☐ Damaged or broken parts in control panel ☐ Contracts corroded, dirty, or loose ☐ Broken components on electrical equipment ☐ Damaged pushbuttons ☐ Frayed or damaged wiring, insulation, cable, or conduit ☐ Instructions missing or unclear Comments/Description: Valve could not be seated with the motor controls, required manual operation to seat valve.	☒ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)

D5. Motor operator: ☐ Inspected ☐ Not inspected

General:
- ☐ Damaged or broken parts on operator
- ☐ Contracts corroded, dirty, or loose
- ☐ Frayed wiring or broken components on electrical equipment

Motor:
- ☐ Discolored paint from overheating
- ☐ Frayed or burnt insulation
- ☐ Loose or damaged wiring
- ☐ Unstable or damaged mounting, loose bolts
- ☐ Missing bolts on the terminal box cover
- ☐ Damaged flexible conduit
- ☐ Corrosion or uncleanliness
- ☐ Condensation or drainage problem

Frequency of lubrication: ____________
Last lubrication: ____________

Housings:
- ☐ Condensation pools
- ☐ Leakage through casting
- ☐ Leakage through seals or gaskets
- ☐ Damaged, loose or missing anchor bolts, cover bolts, hinges, cover plates
- ☐ Damaged or cracked castings or plate

Gears:
- ☐ Uneven or excessive wear, evidence of pitting
- ☐ Poor dispersal of lubricant
- ☐ Broken gear teeth
- ☐ Misalignment of gears/shafting
- ☐ Corrosion

Frequency of lubrication: ____________
Last lubrication: ____________

Comments/Description:

☐ SATISFACTORY CONDITION
(No repairs or maintenance currently required)

☐ MINOR REPAIRS OR MAINTENANCE REQUIRED

☐ UNSATISFACTORY CONDITION
(Major repairs, replacement, or maintenance required)

D6. Limit Switch: ☐ Inspected ☐ Not inspected ☐ Damaged or loose mounting bolts or bracket ☐ Corrosion or uncleanliness ☐ Missing bolts on the inspection cover ☐ Damaged flexible conduit ☐ Condensation or drainage problem Comments/Description: Valve could not be seated with the motor controls, required manual operation to seat valve.	☐ SATISFACTORY CONDITION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY CONDITION (Major repairs, replacement, or maintenance required)

E. Inspection of Butterfly Valve (during operation):

E1. Description of operational test (Ex.: Valve fully closed, opened to 30 degrees, took approx. 5 minutes, motor operator functioned smoothly):

- ☐ Full-travel, balanced head
- ☐ Emergency closure, full-travel,, unbalanced At 25% flow

E2. Manual operation: ☐ Operated ☐ Not operated ☐ Difficult to turn ☐ Binding ☐ Squeaks or other unusual noise ☐ Excessive time to operate. Time required: ____________ ☐ Unable to operate ☐ Unable to disengage motor operator ☐ Missing handle or tee-wrench Comments/Description: Manual operation required to properly seat valve Indicating arrows for handwheel direction is incorrect.	☐ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)
E3. Motor operation: ☐ Operated ☐ Not operated Gears: ☐ Chattering, loud or unusual noise during operation ☐ Binding Motor: ☐ Motor overheating ☐ Excessive motor current draw ☐ Loud or unusual noise from motor bearings during operation Controls: ☐ Control pushbuttons do not work Box: ☐ Space heater does not work Comments/Description:	☐ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)

E6. Position indication ☐ Position indication miscalibrated ☐ Position indication does not work Comments/Description:	☐ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)
E7. Limit switch ☐ Limit switch miscalibrated or requires adjustment of stops ☐ Limit switch does not work ☐ Limit switch space heater not functioning Comments/Description: Limit switch needs adjustment - Manual operation required to properly seat valve	☐ SATISFACTORY OPERATION (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY OPERATION (Major repairs, replacement, or maintenance required)

F. Safety and Security:

G1. Overall safety and security: Comments/Description: Valve in gate chamber in interior of dam.	☐ SATISFACTORY SAFETY AND SECURITY (No repairs or maintenance currently required) ☐ MINOR REPAIRS OR MAINTENANCE REQUIRED ☐ UNSATISFACTORY SAFETY AND SECURITY (Major repairs, replacement, or maintenance required)
G2. Accessibility to public: ☐ Public can access valve ☐ Valve exposed to gunshot from distance ☐ Danger to public ☐ Danger from water discharge ☐ Danger from moving parts ☐ Dangerous location for unauthorized people	
G3. Vandalism ☐ Damage to valve or operator	

G4. Security features:
- ☐ Fencing
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Inside building
  - ☐ Existing and inadequate
- ☐ Lighting
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Locks on handwheel or operator
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Attended by damtender
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Alarm system
  - ☐ Not existing and needed
  - ☐ Existing and inadequate
- ☐ Warning signs
  - ☐ Not existing and needed
  - ☐ Existing and inadequate

G5. Tagging and lockout for maintenance or inspection

At valve
- ☐ No tagging

At control panel
- ☐ No tagging
- ☐ No lockout nor power disconnection

At remote control location
- ☐ Danger of unknown remote operation

INSPECTION COMMENTS

- Valve on bypass line is typically left in open position when outlet is filled, which may cause cavitation problems in bypass piping.

- Indicating arrow for handwheel rotation on valve manual operating stand are incorrect.

Description of Butterfly Valves

A butterfly valve consists of a circular disk on a shaft through the middle of the water flow path. The shaft can be mounted vertically or horizontally and is supported by bearings at both ends of the valve body. The leaf rotates 90 degrees from open to closed by an operator connected to the shaft and mounted to the exterior of the valve body. Smaller valves are manually operated by a handwheel, crank, or tee-handle wrench on a square nut. Butterfly vaves are also operated by an electric motor and gear box, hydraulic oil operating system with a hydraulic cylinder on the valve, or pneumatic operating system with a pneumatic cylinder on the valve.

A few butterfly valves in Reclamation dams are rectangular or square shaped.

Around the disk of a butterfly valve is usually a rubber or elastomer seat. The inside of the body also has a rubber or elastomeric seal in order to ensure a watertight connection when the valve is closed. Some butterfly valves have metal-to-metal seals in order to permit higher water velocity through the valve. With metal-to-metal seals, some leakage is unavoidable.

Most butterfly valves in Reclamation facilities are commercial products which either conform to AWWA C504 or are high-performance type. Some older large butterfly valves were designed in-house by Reclamation. Most butterfly valves should only be kept fully open or fully closed. If these valves are kept partially open, there is risk of cavitation or losing the seals. High-performance butterfly valves may be throttled down to an opening of 20 degrees.

Of primary importance, inspect the following:

- Cavitation on the valve leaf. The risk is greater if there is a high differential pressure across the valve. Cavitation usually will be greater on the downstream face. Cavitation will appear as pitting in the metal, or wire-drawing.
- Leakage through the valve. This usually is caused by eroded or missing rubber or elastomeric seals. Metal seated butterfly valves will inevitably have some leakage past the disk on the inside.
- Manual operation should be smooth and not inordinately difficult. Motor operators normally have a declutch lever in order to engage manual operation.
- Motor, hydraulic, and pneumatic operators should smoothly open and close the valve. Limit switches should shut off the motor as the valve is fully open or fully closed.
- There should be no oil leakage in a hydraulic operating system.

K R Smith
Revised 5/26/1998

Photo 1- Morris Dam - Butterfly Valve 6A - View looking upstream of downstream surface of disc.

09/29/98

Photo 2 - Morris Dam - Butterfly Valve 6A - View looking upstream of upstream surface of disc.

09/29/98

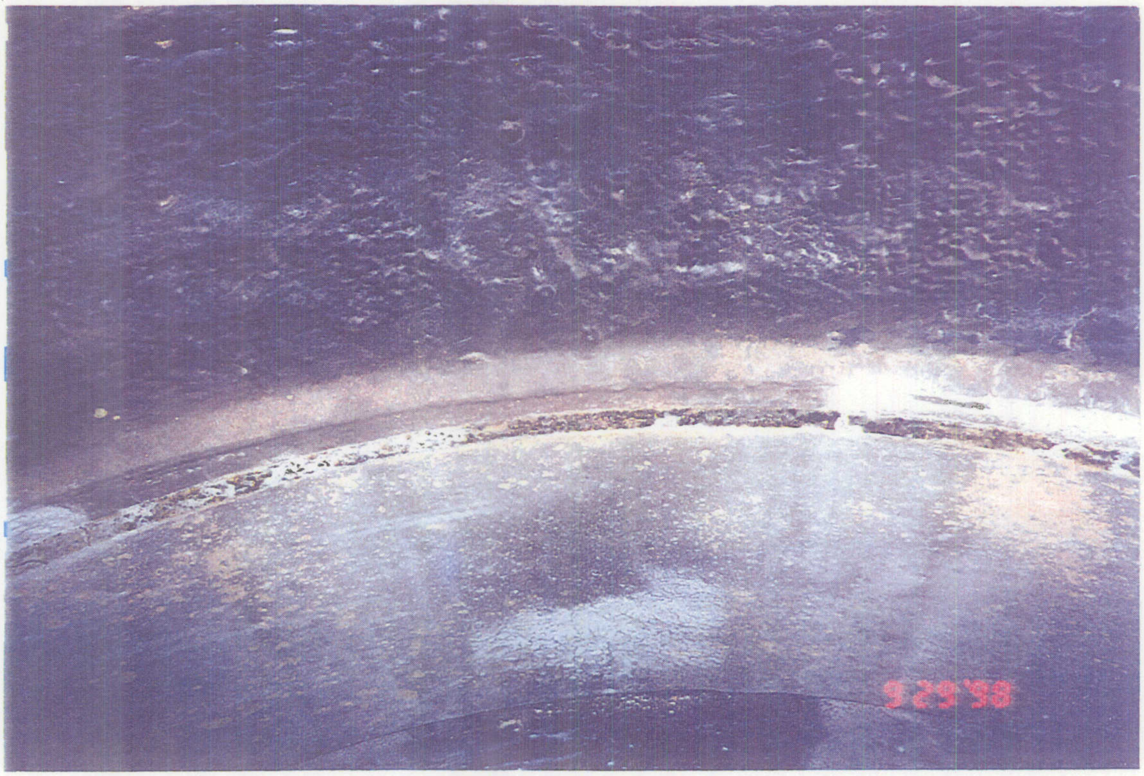

Photo 3- Morris Dam - Butterfly Valve 6A - View looking downstream of body disc seat at pipe crown.

09/29/98

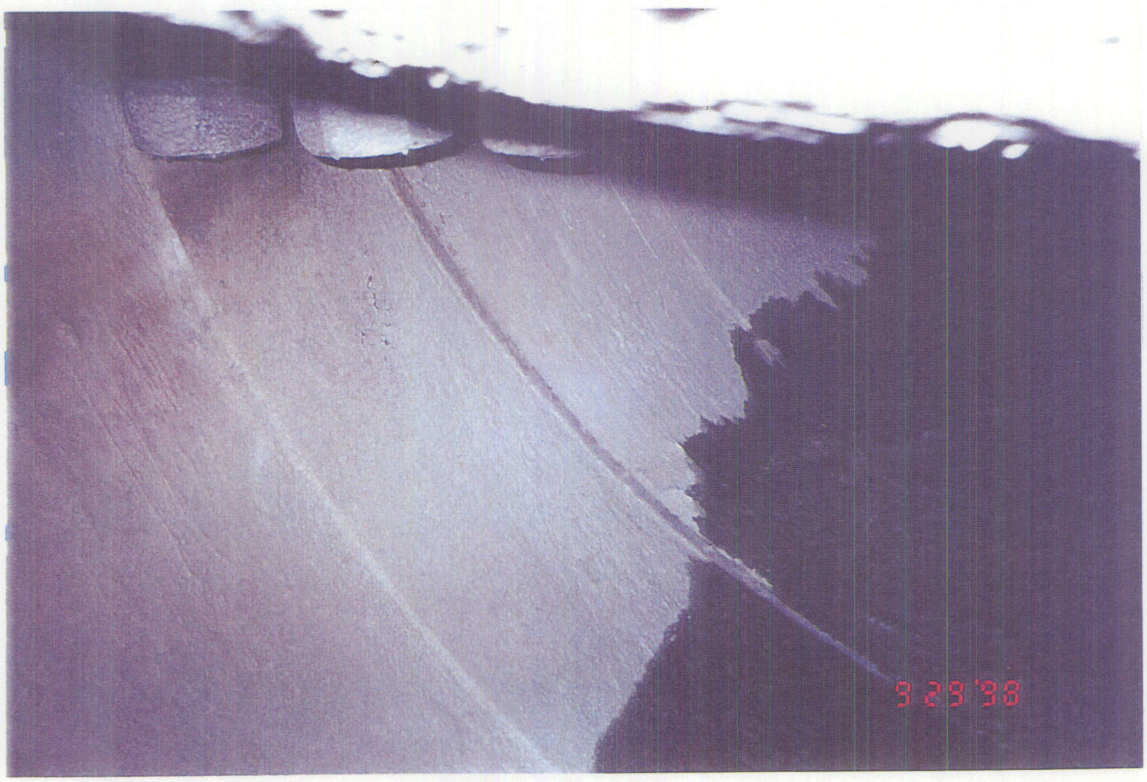

Photo 4 - Morris Dam - Butterfly Valve 6A - View looking downstream of body disc seat at pipe invert.

09/29/98

Photo 5- Morris Dam - Butterfly Valve 6A - View looking upstream of downstream surface of right disc trunnion.

09/29/98

Photo 6 - Morris Dam - Butterfly Valve 6A - View looking upstream of upstream surface of right disc trunnion.

09/29/98

Photo 7- Morris Dam - Butterfly Valve 6A - View looking upstream of downstream surface of left disc trunnion.

09/29/98

Photo 8 - Morris Dam - Butterfly Valve 6A - View looking upstream of upstream surface of left disc trunnion.

09/29/98

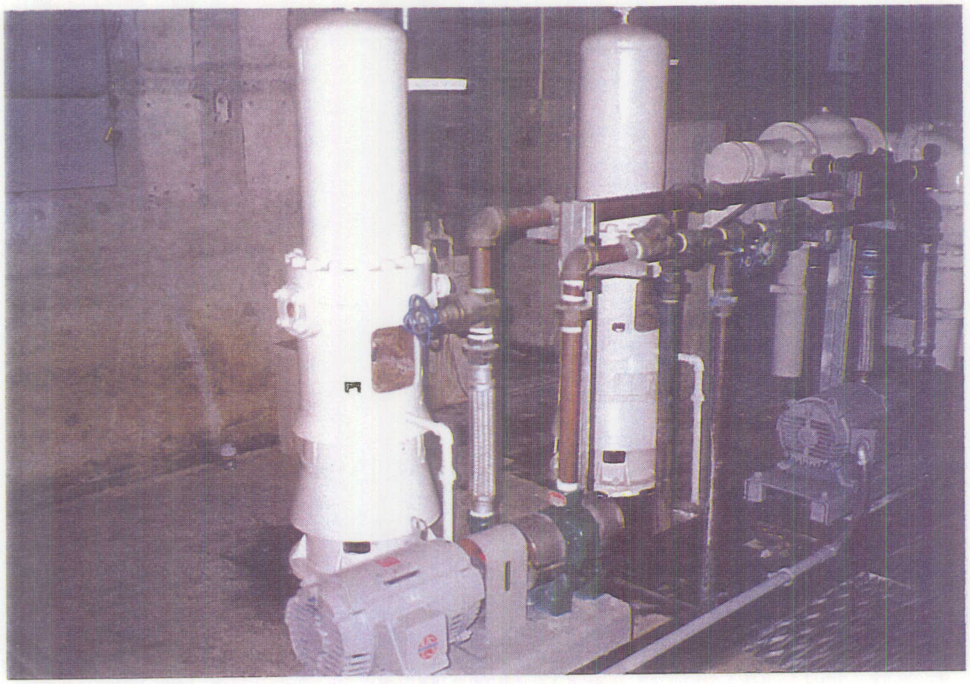

Photo 1 - Morris Dam - Miscellaneous Piping - View of booster pump piping for slide gate operating system located in gate chamber. 06/30/98

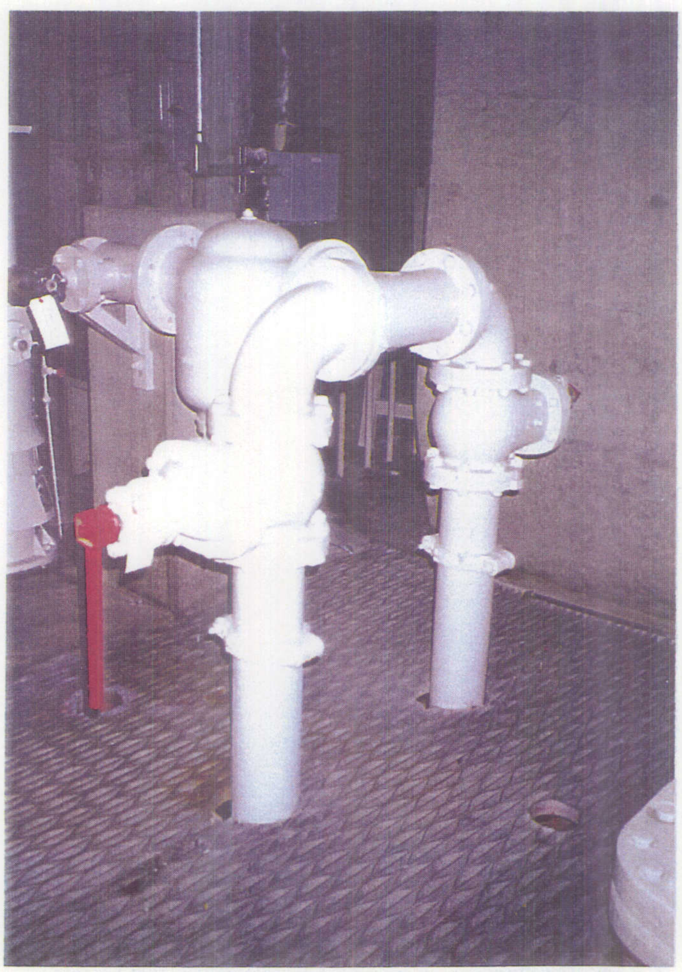

Photo 2 - Morris Dam - Miscellaneous Piping - View of booster pump piping for slide gate operating system located in gate chamber. 06/30/98

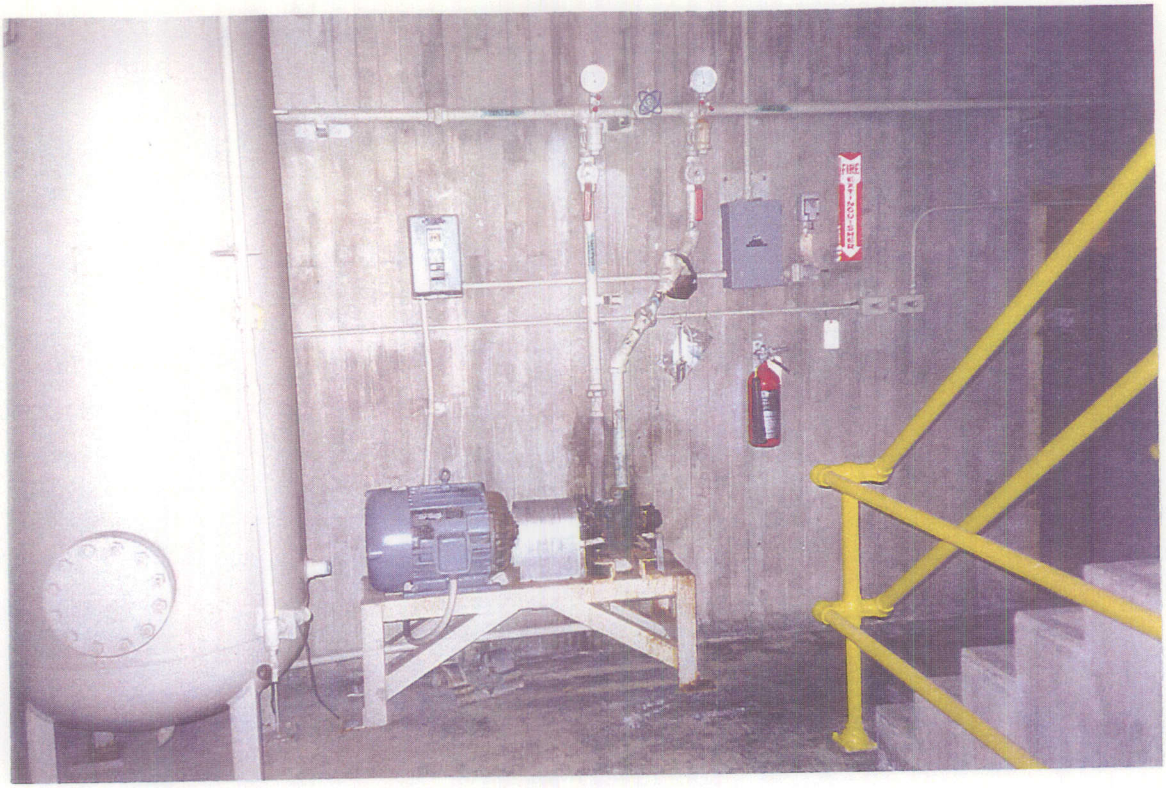

Photo 3 - Morris Dam - Miscellaneous Piping - View of booster pump used to fill high pressure water tank. 06/30/98

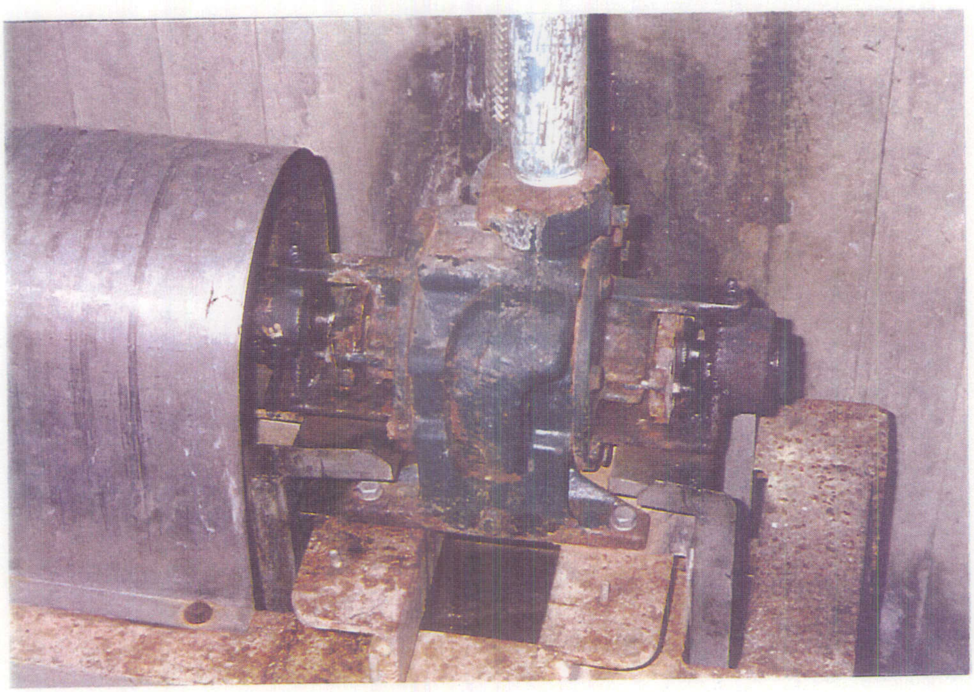

Photo 4 - Morris Dam - Miscellaneous Piping - View of booster pump used to fill high pressure water tank. 06/30/98

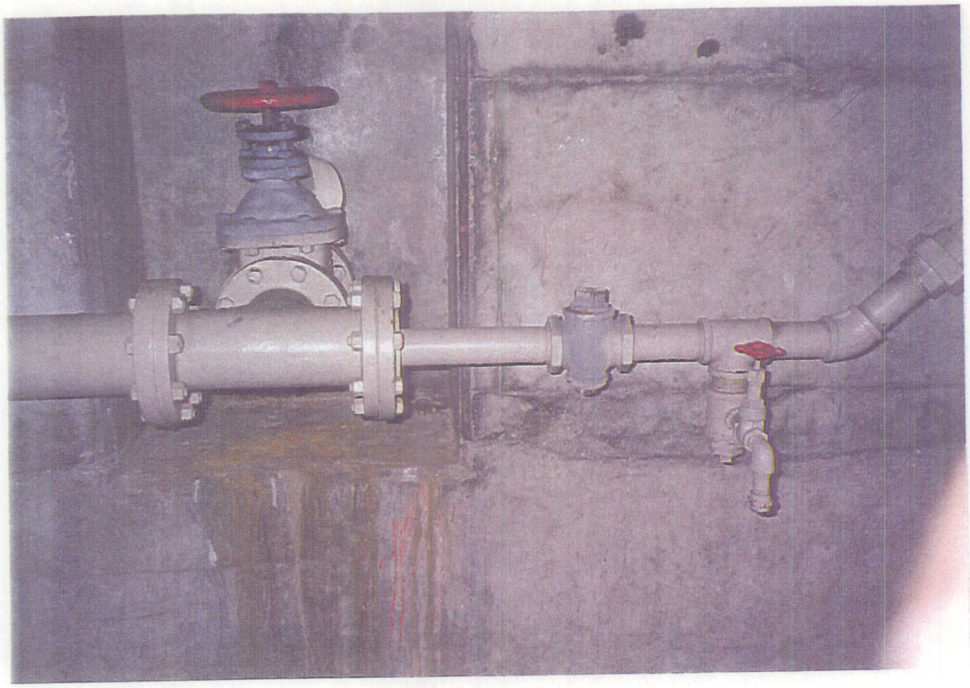

Photo 5 - Morris Dam - Miscellaneous Piping - View of high pressure feed line valve in slide gate control piping. 06/30/98

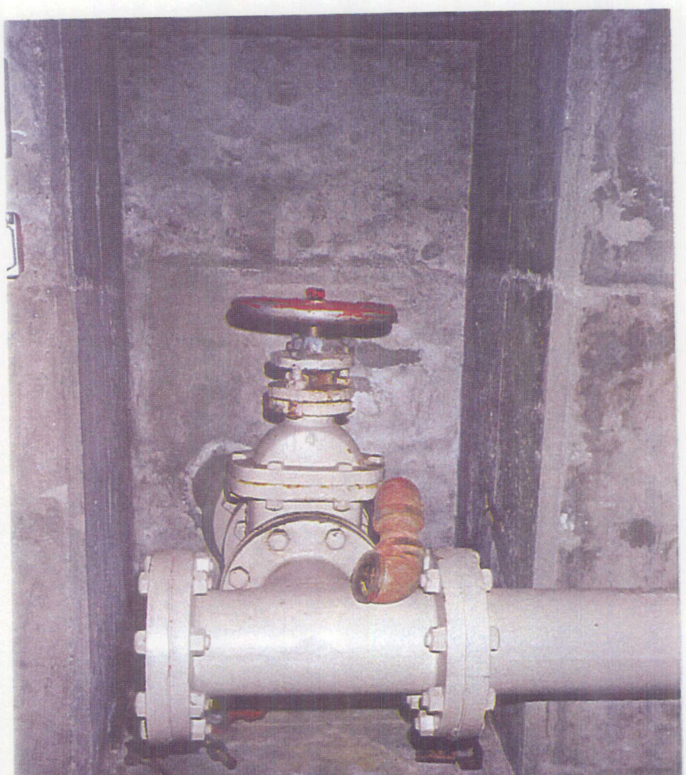

Photo 6 - Morris Dam - Miscellaneous Piping - View of high pressure feed line valve in slide gate control piping. 06/30/98

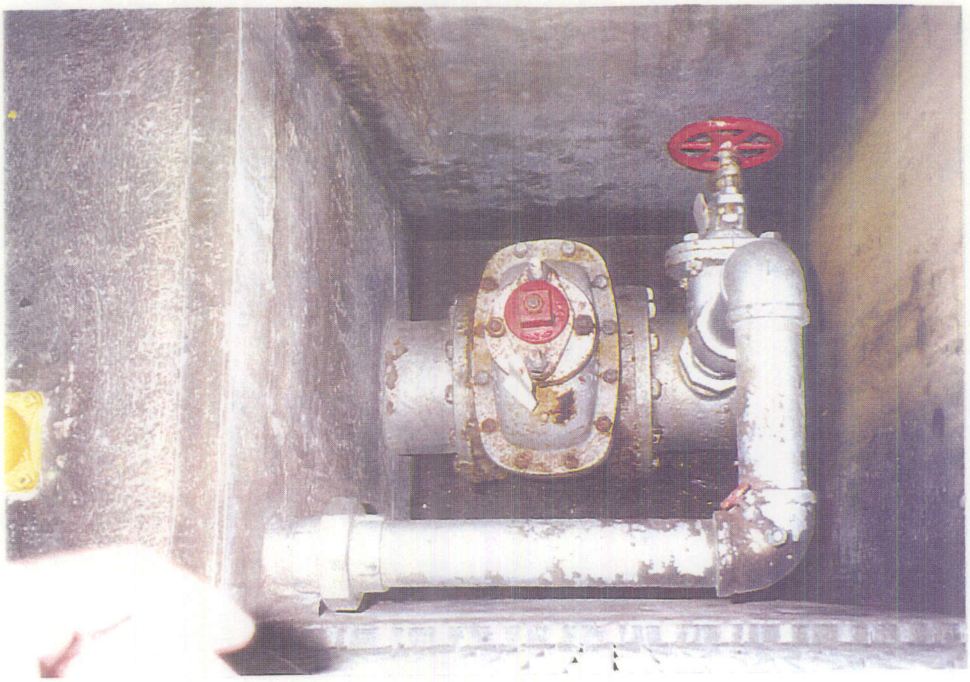

Photo 7 - Morris Dam - Miscellaneous Piping - View of shutoff valve on feed line to slide gate control piping. 06/30/98

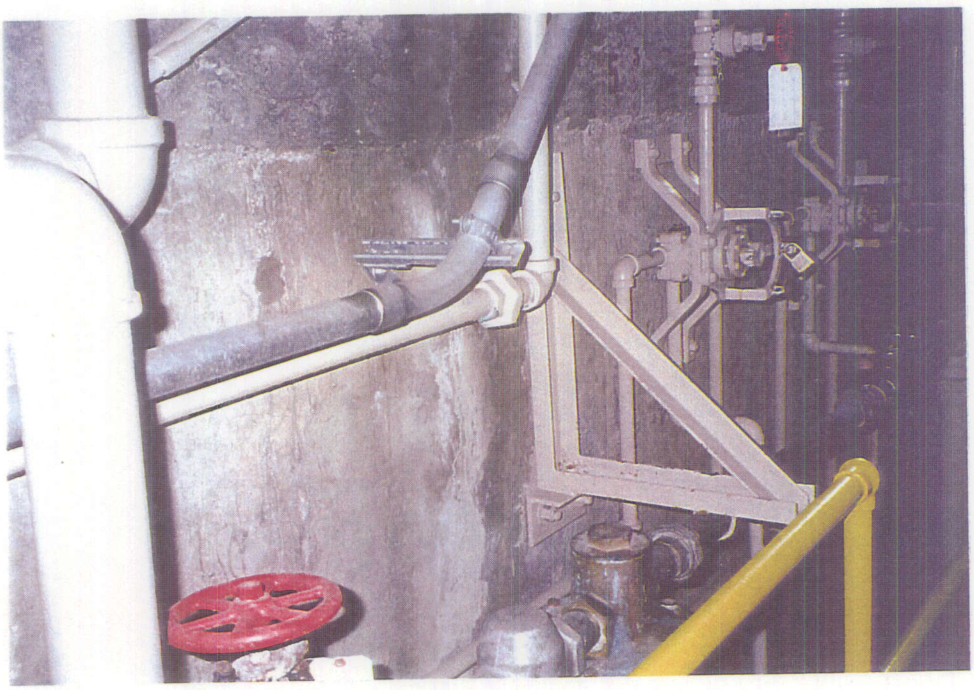

Photo 8 - Morris Dam - Miscellaneous Piping - View of slide gate control piping. 06/30/98

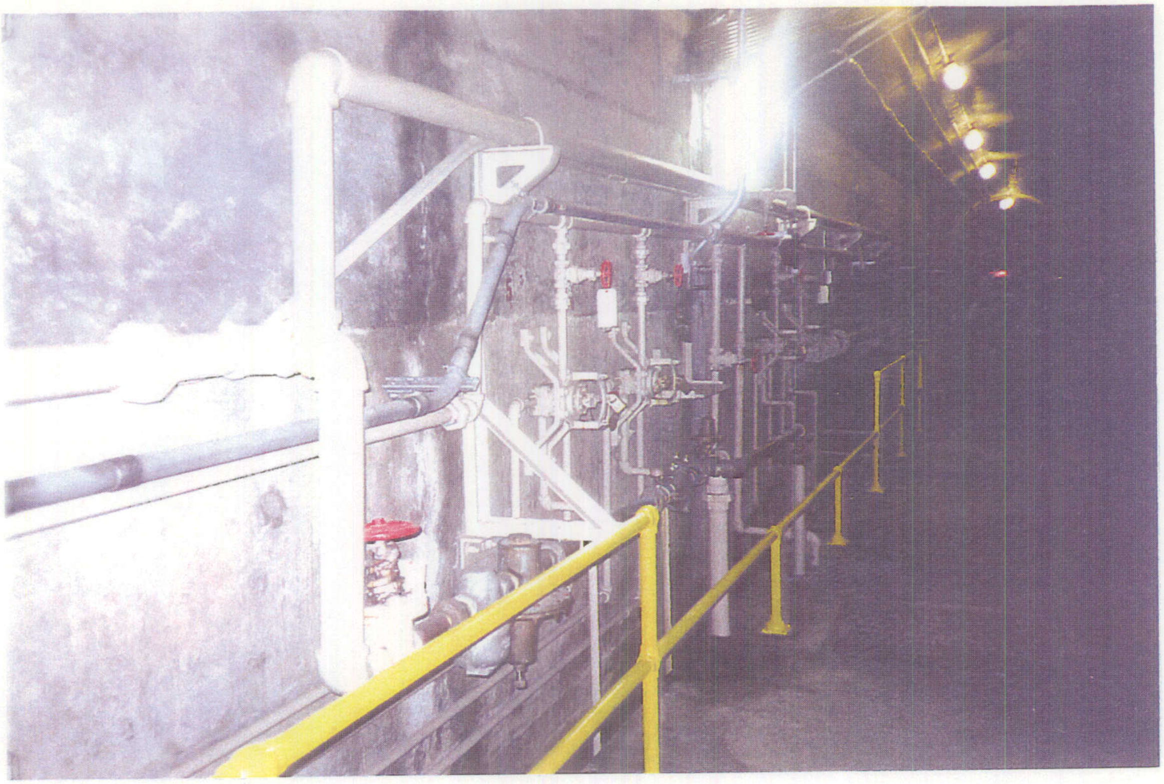

Photo 9 - Morris Dam - Miscellaneous Piping - View of slide gate control piping.
06/30/98

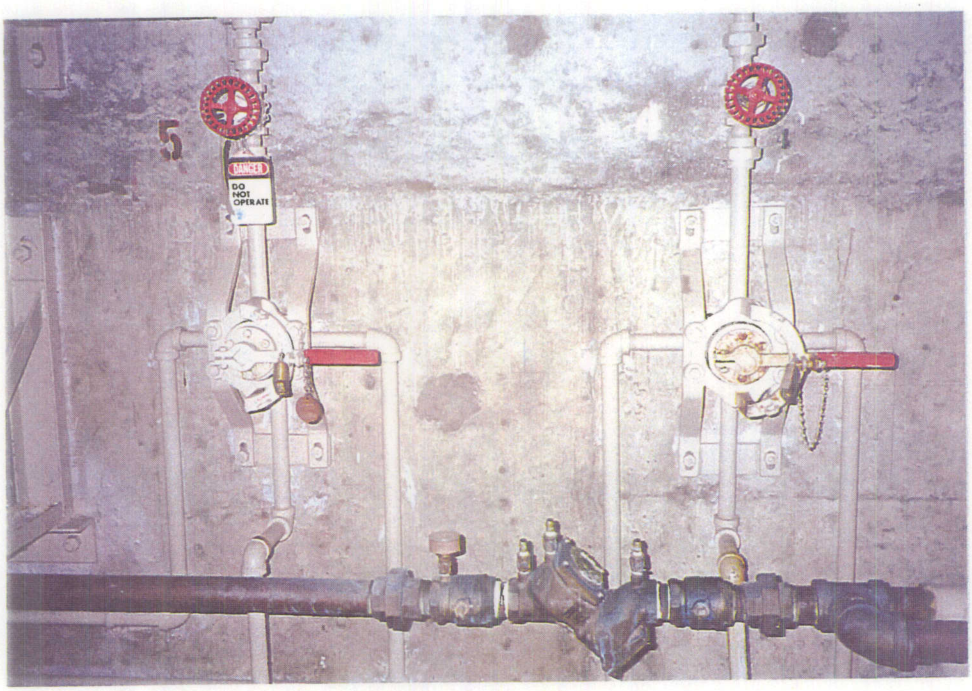

Photo 10 - Morris Dam - Miscellaneous Piping - View of slide gate control piping.
06/30/98

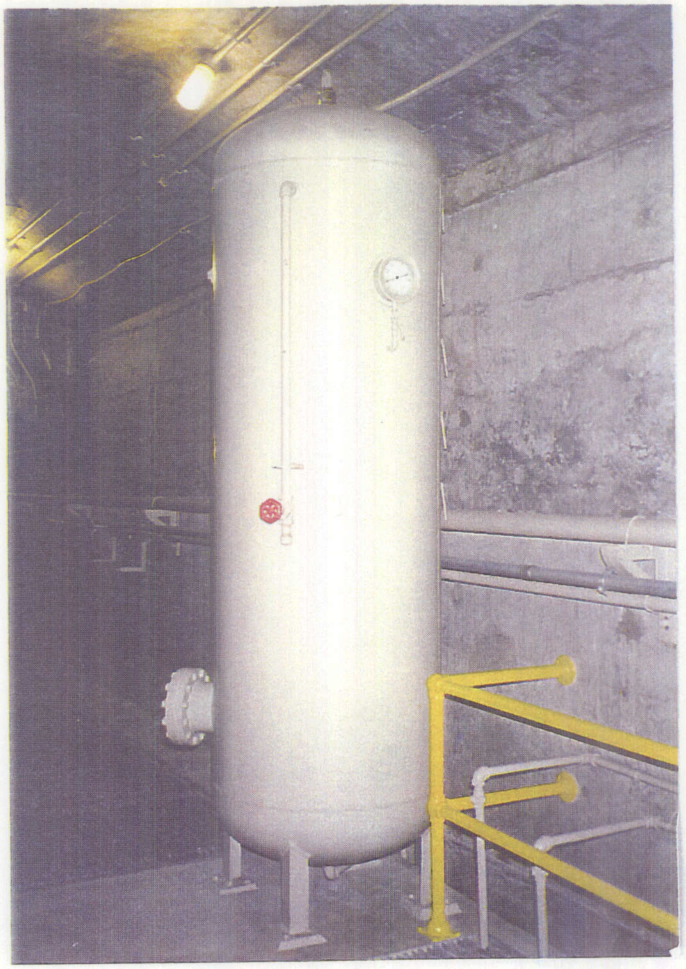

Photo 11 - Morris Dam - Miscellaneous Piping - View of abandoned accumulator tank in gate chamber. 06/30/98

Photo 12 - Morris Dam - Miscellaneous Piping - View of piping in gallery from gate chamber. 06/30/98

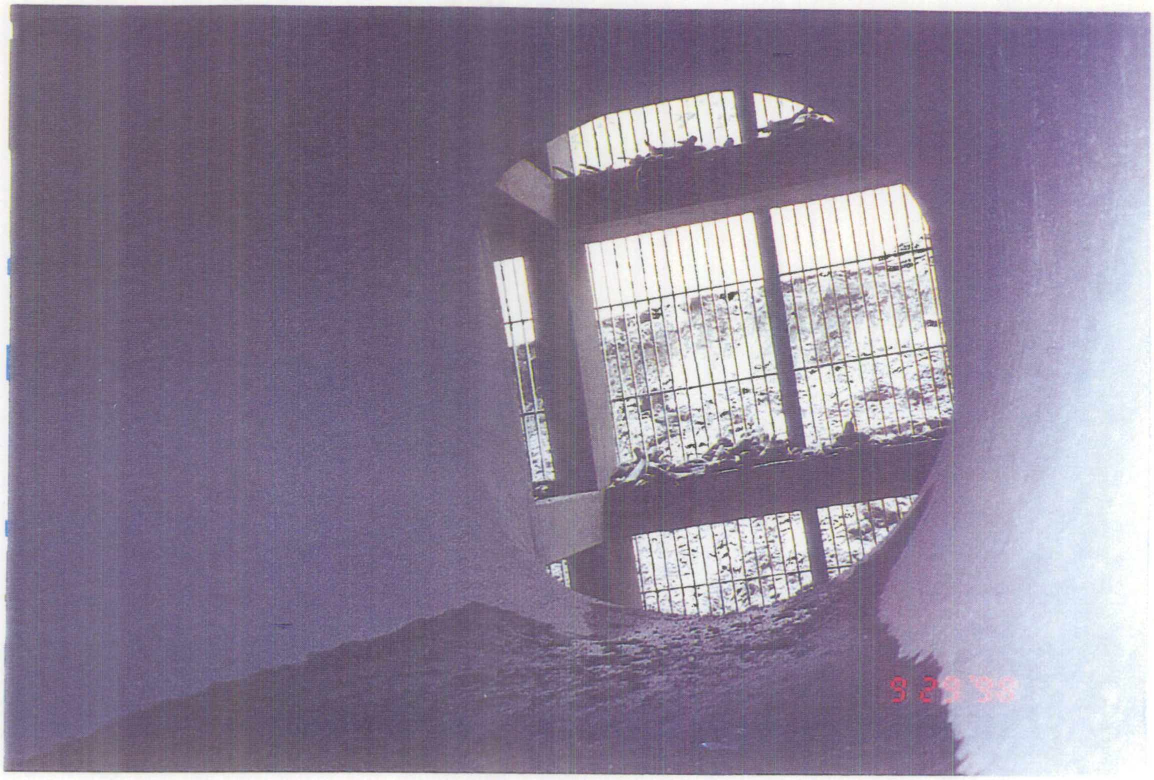

Photo 13- Morris Dam - Miscellaneous Piping - View looking upstream of trashrack structure.

09/29/98

Photo 14 - Morris Dam - Miscellaneous Piping - View looking upstream of trashrack structure.

09/29/98

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

Form - latest revision 8/11/98 DL Read. - J:\WORKREQ\SEED\RMGATES.WPD

A. Overall Summary Sheet

Dam __Morris Dam__ Gate I.D. __96' x 120' Caterpillar Gate__

A1. Overall Rating - Caterpillar Gate Structure (Provide an overall general rating for the gate's structure based on safe/unsafe operation and the O&M required/not required)

a. GATE STRUCTURE GENERAL CONCLUSIONS:

Gate Needs Maintenance? ☒ None ☐ Minor ☐ Major ☐ Immediate
Gate Needs Repairs? ☒ None ☐ Minor ☐ Major ☐ Immediate
Restricted Gate Operations Recommended? ☒ No ☐ Yes (Describe..)
Recommendations Included in Checklist? ☐ No ☐ Yes (Describe...)

b. Caterpillar GATE STRUCTURE OVERALL RATING:

☐ GOOD (Current gate condition/maintenance/safety is above average)
☒ SATISFACTORY (No maintenance or repairs currently required)
☐ CONDITIONAL (Gate safely operable, but some maintenance/repairs required)
☐ UNSATISFACTORY (Major repairs/replacement/maintenance required)
☐ RESTRICTED (Gate should not be operated)

Comments:

A2. Level 2 - General Summary of Gate Condition: (Check or Circle as Appropriate)

a. Operation: Gate Operated: ☒ Yes: ☒ Full Travel ☐ Partial Travel (How far _______) ☐ Not Operated (why?)
b. Structural: ☒ Chck ☐ Unchck ☒ Satisfactory ☐ Defoed/Bent Members ☐ Missing members
c. Protective Coatings: ☐ Original Paint ☐ Year of Last Paint Coat __1996__ ☐ Paint Satisfactory ☐ Requires minor local touch-up ☐ Severe localized damage (No. and location)_ ☐ Extensive
d. Welded/Riveted/Bolted Connections: ☒ Chck ☐ Unchck Bolted connections ☒ Okay Riveted connections ☐ Okay
(circle) (Missing Bolts) (Corroded/Rusted Bolts) (Loose Bolts) (Defoed Bolts) ☐ Many ☐ Some ☐ Few
(circle) (Missing Rivets) (Corroded/Rusted Rivets) (Loose Rivets) (Defoed Rivets) ☐ Many ☐ Some ☐ Few
e. Sealing: ☒ Chck ☐ Unchck ☐ Tight Seal-No Leakage ☒ Insignificant Leakage ☐ Moderate Leakage ☐ Heavy Leakage
f. Gate Operation: ☒ Chck ☐ Unchckd ☒ Smooth Operation ☐ Rough Operation ☐ Noisy ☐ Vibrating ☐ Insufficient Power

A3. Future Gate O&M Plans: (Known Plans for Gate Maintenance or Gate Modifications (Budgeted Within Next 2 or 3 Years) for Gate.)

a. Replace Top, Side or Bottom Seal Assemblies? ☐ Yes ☒ No When?/Which ones? ...
b. New Paint Coating? ☐ Total ☐ Partial ☐ Local Repair When?/What areas? ...
c. Rehab rollers/links? ☐ Yes ☒ No When?/Which rollers/pins? ...
e. Update SOP paragraphs? When?/In regards to what? ...
f. Perfo Maintenance? If yes, ☐ Touch-up paint? ☐ Lubrication? ☐ Replace bolts ? ☐ Clean? ☒ Exercise?
g. Other "near future" plans for gate? Describe ...

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

Form - latest revision 8/11/98 DL Read. - J:\WORKREQ\SEED\RMGATES.WPD

B. Inspection and Equipment Basic Infoation Sheet: **Dam**__________ **Gate I.D.**______

B1. Inspection Site Infoation: ☐ Basic Checklist Inspection Info Similar to Other Equipment. See Hoist/Gate for data in this section

A1. Name of Dam/Facility: Morris Dam		A2. Region: Los Angeles County Department of Public Works
A3. Date of Inspection: 7-14-98	A5. Lead Inspector & Office: Gary Rood, USBR	A6. Field Contact: Art Diaz/Jim McGowan
A4. Reservoir El.: 1123.19	Phone #: 303-445-3102	Phone #: 626-334-2090
A7. Gate Sill El.: 955.0	A8. Area Office & Contact: Emily Hasagawa	A9. Water District & Contact: Steve Bradley
A10. Head on Gate: 148.19	Phone #: 626-458-6304	Phone #:
A11. Others present:		
A12. Special circumstances:		

B2. Description of Gate and Appurtenant Equipment:

B1. Gate Size:	Size: Width 96" Height 120" ☐ Roller/Coaster ☐ Stoney ☒ Caterpillar ☐ Tractor Design Head 215' Year Designed 1932		
No. of Roller trains/side: 1 Roller dia.: ____ inch diameter Roller Material: ____ Type of Bushing: ☐ Self-lubricating ☐ Bronze, not lubricated ☐ Graphite-Insert ☐ None Side Seal: ☐ Music-note ☐ double-stem ☐ Other - Cladding: ☐ teflon ☐ brass ☐ none			
B2 . Gate Hoist Operator:	Type: ☒ Wire Rope ☐ Chain ☐ Hydraulic Operation: ☒ Local ☐ Automatic ☐ Remote-Capability (From Where) ____		
B3. Emergency Operation:	☒ Engine-Generator ☐ Other Device ☐ Yes ☐ No ☐ Operable ☒ Not Operable (why?)	Eng-Gen Operated at Inspection: ☐ Yes ☒ No Last time (when) ____	SOP Updated Recently ☐ Yes ☐ No

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

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B3. Inspection Accessibility: (Check the appropriate box(es) for the components of the Gate which were readily accessible at time of inspection.)

☐ All Downstream Side ☐ Yes ☐ No: Upstream Side ☐ Yes ☐ No: Seals ☐ Yes ☐ No Hoist: ☐ Yes ☐ No
Hoist Connections ☐ Yes ☐ No Inspected Inside Enclosed Faceplate ☐ Yes ☐ No ☐ n/a ☐ Inspection Done from Deck and Embankments Only

Gate Areas Not Available for Inspection:

☐ Climbing Team Inspection Required for Thorough Inspection

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

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E. Areas of Gate Inspection Sheets:

E1. Structural Integrity of Gate's As, Horizontal Beams, Rib Stiffeners, Skinplate, Braces, etc.

Structural Members Integrity/Deflections/Defoations:

a. Major Structural Member: Faceplate Horizontal Girder Vertical Girder
☐ Bent ☐ Buckled ☐ Missing ☐ Badly Corroded ☐ Loose ☐ Other

b. Minor structural members ☐ Bent ☐ Buckled ☐ Missing ☐ Badly Corroded ☐ Loose ☐ Other

Structural Overloading:
☐ All Rollers Contact Track ☒ yes ☐ no (which ones & why not?)
☐ Flat spots on Rollers (Siezed Rollers) ☐ yes ☒ no (which tracks & why?)
☐ Gate Modification (how??)
☐ Free Gate Movement ☒ free ☐ racked ☐ wedged
☐ Gate Centered on tracks ☒ yes ☐ no
☐ Gate Guides Operable ☒ clearance okay ☐ clearance too tight

GATE STRUCTURAL RATING:

☐ GOOD
(Gate's structural condition is above average)
☒ SATISFACTORY
(No maintenance or repairs to is currently required)
☐ CONDITIONAL (See ___________)
(Gate safe to operate, but some maintenance/repairs recommended)
☐ **UNSATISFACTORY** (See ________)
(Major structural repairs/replacement/maintenance required)
☐ **RESTRICTED** (See ________)
(Gate should not be operated for structural reasons.)

c. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT STRUCTURAL INTEGRITY. POSSIBLE ACTIONS/RECOMMENDATIONS.

E2. Condition of Gate's Protective (PAINT) Coatings: Original Paint: Yes ☐ No ☐ Date Last Painted (When?)

a. General Condition of Coating: ☒ Good ☐ Fair ☐ Poor
d. Rust: ☐ hvy ☐ mod ☐ light ____%
b. Coating Failure: ☐ hvy ☐ mod ☐ light ____%
c. Corrosion: ☐hvy ☐mod ☐light ____%
e. Pitting: ☐ hvy ☐ mod ☐ light ____%
f. Distribution and Location of Coating Deficiencies:
g. ☐ All U.S. Side: Yes ☐ No ☐ D.S. Side: Yes ☐ No ☐ Pin Bearing: Yes ☐ No ☐
Cause of Coating Failure: ☐ Age ☐ Debris/Mud/Droppings ☐ Rubbing ☐ Standing Water
☐ No Drains ☐ Constant Leak ☐ Poor Paint ☐ unknown ☐ Other. Explain ...

GATE PAINT RATING:

☐ GOOD
(Gate's current paint coating is above average)
☒ SATISFACTORY
(Paint okay - no paint repairs currently required)
☐ CONDITIONAL (See ___________)
(Gate safely operable, but some paint maintenance/repairs recommended)
☐ UNSATISFACTORY (See ________)
(Major paint repairs or replacement/maintenance is required)
☐ **RESTRICTED** (See ________)
(Gate should not be operated because of the protective coating ocndition.)

h. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT PROTECTIVE COATINGS. POSSIBLE ACTIONS/RECOMMENDATIONS.

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

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E3. Condition of Gate's Bolted/Welded/Riveted Connections, Structural Connections

a. Bolts Inspected? ☒ Yes ☐ No ☐ N/A

Bolts ☒ Satisfactory ☐ Needs Replacement ☐ Needs Maintenance
☐ Needs Repair ☐ Missing ☐ Loose ☐ Corroded.

b. Rivets Inspected? ☒ Yes ☐ No ☐ N/A

Rivets ☒ Satisfactory ☐ Needs Replacement ☐ Needs Maintenance
☐ Needs Repair ☐ Missing ☐ Loose ☐ Corroded.

Elaborate:

c. General Condition of Welds: Inspected? ☐ Yes ☐ No
☐ Satisfactory ☐ Unsatisfactory

GATE CONNECTION RATING:

☐ GOOD
(Integrity of bolts/welds above average or in near new condition.)
☒ SATISFACTORY
(Bolts/welds appear satisfactory)
☐ CONDITIONAL (See ___________)
(Gate safely operable, but integrity of some non-critical bolts or welds is questionable)
☐ UNSATISFACTORY (See ________)
(Operation of gate questionable, due to failed critical bolts/weld)
☐ RESTRICTED (See ________)
(Gate should not be operated due to numerous failed bolts or welds)

d. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT THE WELDED, RIVETED, AND BOLTED CONNECTIONS. POSSIBLE ACTIONS/RECOMMENDATIONS.

E5 Perfoance and Condition of Gate's Sealing: Side and Bottom Seal Description ...

a. Leakage Past Seals ☒ Unknown ☐ No Leakage ☐ Insignificant ☐ Some ☐ Excessive
(How much?) __________gpm. Leakage Acceptable? ☒ Yes ☐ No

b. Condition of seals: ☒ Unknown ☐ Good ☐ Fair ☐ Poor - Missing portions of seal?
Describe ...

c. Seals Contact: Right Side Seal: ☐ Yes ☐ No Left Side Seal: ☐ Yes ☐ No
Bottom Seal: ☐ Yes ☐ No Top Seal: ☐ Yes ☐ No

d. Reason for Leakage: Seals: ☐ Plugged pilot holes (where?)____________
☐ Damaged seal (which one?) ____________
☐ No seal/wallplate contact
☐ Wallplate Defect
☐ Stuck Debris ☐ Other

GATE LEAKAGE RATING:

☐ GOOD
(No or insignificant amounts of leakage.)
☒ SATISFACTORY
(Little or tolerable amounts of leakage.)
☐ CONDITIONAL (See ___________)
(excessive leakage which can be tolerated until appropriate repairs can be made.)
☐ UNSATISFACTORY (See ________)
(Excessive, Intolerable, or Leakage Causing damage.)
☐ **RESTRICTED** (See ________)

e. COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT GATE SEALING. POSSIBLE ACTIONS/RECOMMENDATIONS
Gate sealing surface was not examined at this time due to water surface elevation.

Caterpillar Gate Structure - In dual Equipment Inspection Checklist

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E6. Operator's Capabilities and Standing Operating Procedures: (Provide comment where applicable)

a. Dam operator knowledge of gate operation?	☒ Yes	☐ No	-
b. Are discharge curves and operating diagrams current?	☐ Yes	☐ No	- N/A
c. Are discharge curves understandable?	☐ Yes	☐ No	- N/A
d. Are as-built drawings of gate available?	☐ Yes	☒ No	-
e. Are maintenance requirements understood?	☒ Yes	☐ No	-
f. SOP/DOC instructions and documents current?	☐ Yes	☐ No	-

E7. Perfoance of Gate Hoist Operation: (Use Hoist Checklist for more detailed inspection)

a. Was Gate Operated at Inspection? ☒ Yes ☐ No (why?)

b. Is gate exercised annually? ☒ Yes ☐ No (how often?)

~~c. Is Gate Overtopping Allowed? ☐ No ☐ Yes (how much? ______ ft.)~~

d. Describe Gate Operate: (describe below)
☒ Smooth? ☒ Free Operation? ☐ Rough Operation? ☐ Noisy? ☐ Vibrating? ☐ Insufficient Power?

e. Approx. Date of Last Gate Operation (When?) At inspection 7-14-98

f. Gates Operated As Designed? ☒ Yes ☐ No (Why?)

g. Has this Gate Been Operated Using a Back-up Power or Device? ☒ Yes ☐ No ☐ n/a

h. Hoist Connections: Inspected? ☒ Yes ☐ No ☐ N/A ☒ Satisfactory ☐ Unsatisfactory
☐ Needs Maintenance ☐ Needs Repair ☐ Missing ☐ Loose ☐ Corroded. Explain:

GATE HOIST RATING:

☒ SATISFACTORY
(Either no or minor maintenance or repairs currently required)

☐ CONDITIONAL (See ___________)
(Questionable operation & repairs/replacement/maintenance required)

☐ RESTRICTED (See ________)
(Gate should not be operated without major repairs or restricted operation)

Caterpillar Gate Structure - Individual Equipment Inspection Checklist

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E8. Maintenance/Repair:

Type of Roller Bushing: (describe)

Roller Trains Last Repaired/Maintained and Operating Freely: (when?) 1996

COMMENTS/PROBLEMS FROM INSPECTOR AND/OR FIELD PERSONNEL ABOUT MAINTENANCE. POSSIBLE ACTIONS/RECOMMENDATIONS
When the Los Angeles County Public Works Department took over the facility, the Caterpillar gate was rehabilitated and all rollers and roller chains were free and lubricated.

F1. Gate Public Security: ☒ Gate, Hoist, and Controls are not accessible to the public, and present neither hazard or security issue

Gate Installation Accessible by Public? ☐ Yes ☒ No *Describe* ... Gate is located in gate house at crest of dam.

Public Danger? ☐ Yes ☒ No *Describe* ...

Has there been vandalism of evidence of vandalism? ☐ Yes ☒ No ☐ n/a *Describe* ...

Security features?

Fencing: ☒ Adequate ☐ Existing but not Effective ☐ Not Existing, but Not Needed ☐ Not Existing, but Recommended.

Lighting: ☒ Adequate ☐ Existing but not Effective ☐ Not Existing, but Not Needed ☐ Not Existing, but Recommended.

Locks on hoists and control panels: ☒ Adequate ☐ Existing but not Effective ☐ Not Existing, but Not Needed ☐ Not Existing, but Recommended.

Public warning signs: ☒ Adequate ☐ Existing but not Clear ☐ Not Existing, but Not Needed ☐ Not Existing, but Recommended

Dangerous Access by Public:

Other:

Things to Know - Caterpillar Gates (G)

Description and Uses: • A Caterpillar gate is also known as a coaster gate (note: stoney, coaster, tractor, and caterpillar are similar variations all which utilize roller chains) • Gs are used on spillways, outlet works, conduits, and tunnels in locations where loads are too high for wheel-mounted gates. • A G is a rectangular gate leaf , stiffened with horizontal beam members, double vertical girders, roller trains, and a gate frame, track and sealing surfaces. • Their width and height are defined as the horizontal and vertical dimensions of the gate opening at the plane of sealing, not the distance between seal centerlines. • G are used for emergency closure of conduits, penstocks; and for bulkheading of same for maintenance and inspection. They have been used for regulating low-head flows.

Principal Components: • Gate leaf (faceplate, stiffeners, girders) • Track base • Track • Seals • Bushings • Seal seats.

Operator and Noal Operation: • Gate operators are wire-rope or chain hoists or hydraulic hoists. See and use the checklist for the Hydraulic Power Unit. • G close under their own weight by gravity, requiring no external power. Caterpillar gates close to open. • Hoist operator designed to lift the sum of gate weight, roller friction, and hydraulic downpull.

Design Loads and Factors of Safety:

Suitable Test and Exercising: • Full travel under balanced, no-flow, conditions • Closure test under unbalanced, full head or any head attainable test. (6-year interval)

Problem Areas:

Inspection: 1. : Is the gate overloaded beyond its design intent for any reason? Has the maintained its original shape? Are there any structural elements which are defoed, bent, missing? Is the protective paint coating intact; or has it failed. Is corrosion taking place? **2. Rollers:** Are all the rollers effective by making contact with the track? Are the rollers in alignment within a single plane? 4. Can the rollers turn freely? Are there flat spots on the rollers or galled areas of the tracks (indicating siezed rollers)? Are the rollers pitted, or galled? **3. Seals:** Is there leakage past the seals? Are the seals in contact with the seal seat? Is the actuation slot or are the pilot holes plugged with rust or debris? Are the seals old, weathered, torn, effective. **4. Guides** Are the guides doing their job to keep the gate aligned and centered in its slot with the rollers on the track, and the seals on the seal seats?

Photo 1 - Morris Dam - Caterpillar Gate - View showing wire rope and lifting frame.
07/14/98

Photo 2- Morris Dam - Caterpillar Gate - View showing gate and lifting frame.
07/14/98

Photo 3 - Morris Dam - Caterpillar Gate - View showing Caterpillar Gate.
07/14/98

Photo 4 - Morris Dam - Caterpillar Gate - View showing gate roller train.
07/14/98

Morris Dam
L.A. County - Public Works Department
70' x 18' Drum Gate Inspection - September 9 and 10, 1998
October 21, 1998

Table of Contents

Morris Dam - Preliminary Recommendations
L.A. County - Public Works Department
70' x 18' Drum Gate Inspection - September 9 and 10, 1998
November 2, 1998

A. **Introduction**

1. **General**. - Three 70'x18' drum gates at Morris Dam, designed in 1933, were installed in 1935 to control reservoir water through the spillway. As a part of an overall program to rehabilitate the mechanical equipment at the dam, in September, 1998, both the inside and outside of each drum gate was inspected.

   Except as noted below, each of the three drum gates is generally in good condition, and with rehabilitation, the drums gates will be satisfactory for continued future operation. Recommendations for drum gate rehabilitation are listed in Section B - Drum Gate Recommendations.

2. **Summary of Drum Gate Observations** - As noted above, each of the three drum gates is in good condition. However, the inspection team did note drum gate deficiencies. Summarized below and detailed further in later sections are those deficient areas, and which most notably include;

   • **Faceplate Pitting**. - Extensive pitting (1/16th - 1/8th) on the downstream and bottom face plates, resulting in loss of faceplate steel material and possible loss of faceplate strength. (e.g., see b&w photos 4 thru 6, Gate #2, page 2).

   • **Damaged Seals.** - Torn or missing sections of "J-seals" on the downstream faceplate, resulting in high velocity leakage past the seals, which in turns damages paint coating. (e.g. see b&w photo 13, Gate #1, page 7).

   • **Damaged Paint**. - Damaged protective paint coating on the upstream faceplate surfaces due to erosion by high velocity leakage past the seals, and possibly leading to further corrosion on the faceplate. (e.g. b&w photo 2, Gate #3, page 1).

   • **Localized Concrete Cracks**. - Localized cracks in the concrete inside the gate chamber require monitoring to ensure further movement and cracking is not occurring which could jeopardize the gate chamber. (e.g. see b&w photo 7, Gate #2, page 4)

   • **Gate Interference** - Minor points of interference between the rotating upstream faceplate and the fixed seal cover shields, resulting in scratched and damaged metalwork, leading to corrosion, and may have recently played a role in causing Gate #1 (the east gate) to bind and become non-operable. (e.g. see b&w photos 10 and 11, Gate #1, page 5)

   • **Stuck Gate No. 1 (East Gate).** - It was reported that during normal operation Gate #1 became stuck in the nearly fully raised (closed) position on August 6, 1996 with reservoir elevation at El. 1169.5 feet, and as a consequence the gate was unable to lower under its own weight even when water inside the chamber was drained. The cause for this sticking or wedging of the gate caused the gate to be inoperable and should be corrected as discussed further below.

B. **Drum Gate Recommendations**. -

1. **Analyze Remaining Gate Structure Strength.** - Due to extensive loss of faceplate steel material over the life of the drum gates, the structural integrity of the drum gates should be analyzed to ascertain the degree of compromise which the loss of faceplate material may

have affected the structural factors of safety. If the structural analysis shows that the pitted upstream and bottom faceplates have significantly compromised the structural factors of safety, then the faceplates should be replaced or reinforced.

2. **Repaint Upstream Faceplates**. - The protective paint coating on the upstream faceplate of each of the three drum gates has been abraded and eroded, and with the exception of the evidence of the red primer, the paint is completely gone. (e.g. see b&w photos 5 & 6, Gate #1, page 3. The abraded paint is likely a result of leakage past the seals. Because the upstream faceplate is badly pitted to depths of 1/16" tp 1/8", and because the gate surface is either continually submerged or goes through periods of being wetted and dry, it is vulnerable to corrosion. Sandblast and re-coat the upstream faceplate.

3. **Replace "J" seals.** Many sections and segments of the existing hollow bulb seal attached to the downstream faceplate and are missing, torn, or are overstressed at the root of the bulb. Field personnel mentioned that the in-kind seals accessible from the spillway have been ordered for Gate #1 alone. Remove and replace seal components at the following locations: a). On the left and right end seals attached to the downstream faceplate which are accessible from the spillway (e.g. see color photo 22, Gate #2, page 11) b). On the upstream faceplate seal fixed to the spillway crest and c) those seals attached to upstream faceplate accessible from inside the gate chamber. (e.g. see b&w photo 3, gate #2, page 2)

4. **Redesign Seal System.** The original curved rubber-covered, copper-bronze spring seals have been discarded and retrofitted with hollow bulb, music-note ("J") seals. This seal modification is not effective. Seals bulbs appear oversized, the hollow bulb appears too flexible, and seal bulb orientation appears installed opposite to that for good sealing. The design of this modified sealing system could be improved to provide better sealing and longer-lasting seals. (e.g. see small color photo 22, gate #2, page 11)

5. **Monitor Cracks in Concrete Chamber.** - Monitor the concrete cracks which occurred on the inside of the gate chambers to check for any further deterioration or movement.

6. **Adjust Gate Stop Screws.** - On Gate #1 (east gate), adjust the gate stop bolts at the spillway crest to ensure that all bolts are in uniform contact with gate's stop angle in the fully raised (closed) position. (e.g. see b&w photo 4, gate #2, page 2, or b&w photos 4 and 5, Gate #1, page 2)

7. **Survey Width of Gate Bay #1**. - It was reported that when Drum Gate #1 (the east drum gate) was raised to the nearly fully raised (closed) position, the gate became wedged and, subsequently would not lower (open) when the gate chamber was closed. One possible cause for the wedged gate is that one or both of the concrete piers and/or embedded steel wallplates have moved inwards toward the centerline of the bay, enough so, that the design clearance between the edge of the faceplates and the wallplates was lost and the gate wedged between the wallplates. To confirm whether or not this might indeed be the case, the width of the pier bays should be surveyed at several locations over the height of the wallplates to determine gate clearance or whether pier movement has occurred.

8. **Trim Shield Guard Plates**. - Although the crest cover plates, part 29, on the East Gate (#1) were removed in 1996, and a 1/4" of the edge was machined to eliminate interference and provide additional clearance if necessary the shield guards to eliminate any interference and scrapping of the shield's edge on the upstream faceplate.

9. **Determine Cause of Wallplate Gouges**. - Evaluate and correct the cause for the gouged pair of concentric arcs which occur on the upstream end of the wall plates.

10. **Modify Shield Guard.** - Modify the rightmost shield guard on Gate #1, (east gate) to

provide clearance between the guard and the seal stop bar welded to the upstream faceplate, and eliminate the scrapping which has occurred on the seal stop bar. The end shield guard has been notched out to accommodate the side seal assembly, and the notch needs to be increased in width parallel to the faceplate.

11. **Grind and Re-weld Gate #3 Bottom Faceplate Weld** - Grind and re-weld the butt weld located on the upper two bottom faceplate sections on gate #3, (west gate). Grind and re-weld the butt weld occurring at the edge of the bottom and end plates.

12. **Repaint Embedded Wallplates.** - Sandblast and re-coat the embedded wallplates to obtain a smooth sealing surface for the end seals. Consider modifying the steel wallplates with a stainless steel, clad sealing surface.

13. **Identify and Correct Cause for Gate # 1 Sticking.** - On August 6, 1996, Gate # 1 (East Gate) became stuck in the nearly fully raised position, and subsequently would not lower under its own weight. Although, the exact cause of the sticking is unknown, it is speculated that the sticking is related to wedging or interference of the gate with components fixed on the spillway. The sticking problem should be identified and corrected. The width of Gate #1 bay should be surveyed to ensure no movement of the pier walls has occurred causing the gate to wedge between the wall plates. The section of shield guard attached to the upstream edge at the center of the spillway crest and which is causing the approx. 2-inch wide band of gouging and marking of the upstream faceplate (located approx 30 feet from the left end) should be machined to provide additional clearance and eliminate the gouging. Also, the segment of shield guard located at the rightmost end of shield guard installation should be machined to provide additional clearance with the ½-inch side seal stop bar.

14. **Repair Coal Tar Coating Inside Gates.** - Inside Gate #3, the coal tar enamel protective coating, primarily located on the inside surface of the downstream faceplate is locally damaged in several areas. To prevent corrosion on those surfaces, the localized damaged areas should be cleaned and sandblasted to bare metal and a new protective coating applied.

15. **Drill Drain Holes Inside Gates.** - Inside each of the drum gates, water is ponding in nearly all the webs of the main horizontal stiffeners (W12x31 wide flange beams) on the faceplates. When the gate is in any position, this water does not have a chance to drain and be removed from the gate, and will accelerate failure of the protective coating or damage to the faceplates. Drain holes sized ½-inch to 1-inch in diameter should be drilled in the webs at locations which provide the best drainage of the structural members.

16. **Provide Operating Instructions and Schematic.** - Apparently, operating instructions for the drum gates do not exist. Although, the dam tenders have excellent operating knowledge of the drum gates; because of the complicated nature of the controls and operation of the drum gates. Written operating instructions should be developed with the appropriate corresponding operating diagram or schematic. The operating diagram should be posted in the gate chamber for quick and convenient reference. The diagram should be annotated to identify the associated piping, valving, cabling, and their functions.

C. **Inspection Background.** - The three drum gates at Morris Dam were inspected on two separate occasions covering 3 days in September, 1998.

1. **Inspection Participants and Dates**. - The first drum gate inspection was conducted on September 9 and 10, 1998 by Gary Rood and Pete Hoffmann of the U.S. Bureau of Reclamation. The inspection covered the three exterior faceplates surfaces (upstream, bottom, and downstream faceplates), as well as the condition of the inside of each concrete gate chamber. The drum gates were in the fully lowered (open) position, and the chambers were dry at the time of the inspection. Entry into the chamber for each gate was through

the 24-inch diameter access hatchways, one on the upstream of the gate and one on the downstream side.

A second drum gate exam was performed on September 30, 1998 by Gary Rood, and assisted by Bill McStraw, and George Taylor; each with the U.S Bureau of Reclamation. The second inspection was confined to the inside of the drum gate structure, and the condition of their respective structural members and protective coating. The inside of each of the three drum gates was entered and inspected by walking along the upper level bracing the gate length, then dropping to a lower level returning length of the gate.

2. **Site conditions.** - At the time of the drum gate inspections, the weather was warm and clear. The reservoir had just been drained completely in preparation for a contract to begin sluicing sediment from the reservoir. The drum gates were in their fully open (lowered) position. The dam tenders had removed the built-up sediment and cleaned the bottom of the concrete gate chambers. Both 24-inch diameter access hatchways into each chamber were open. Both hatchways to the inside of the gate on the downstream faceplates were opened to allow for natural ventilation. Before the beginning of the second inspection, the dam tenders had pumped the accumulated water from the bottoms of Gates # 2 and #3. Safety procedures for entering the various confined spaces were developed and followed.

3. **Acknowledgments.** - We wish to thank the Hydraulic Water Conservation Division of the Los Angeles County Department of Public Works for their help in coordinating and assisting with an efficient and safe inspection, and providing background information and drawings for the drum gates, especially; Emily Hasegawa, Civil Engineering Assistance, and Jeff Bartizal, Safety Coordinator, Flood Maintenance Division for his suggestions towards improved safety. In addition, we appreciate the work the dam tenders, Art Diaz and Jim Blair, did in preparing the gate chamber by removing the sediment and stringing electrical lights for better inspection, opening hatches, pumping water out of the drum gates, and providing access into the confined areas.

4. **Items Not Inspected.** - Due to problems with inaccessibility and logistics, two critical areas of the drum gates were not able to be inspected. The first was a complete and thorough inspection of the drum gate hinge system (See Dwg. SG-579-P), including; the 32 - 4.25" diameter hinge pins, their bushings and lubrication system, sealing system, anchorage, and embedded hinge assembly. The second was a complete and thorough inspection of the drum gate controls (See Dwg. SG-800-P), including; the float control and cabling system, the 30" internal differential needle valve, and isolation valves.

Both of these systems are critical to the safe and proper operation of the drum gates. A visual inspection of these individual components is difficult and would require breaking down the equipment. However, some inferences may be drawn from their performance based on their recent past operations.

All the drum gates are operated (opened and closed) on a regular basis. Other than the "sticking" problem with Gate #1 (east gate) there were no operational and verbal reports identifying issues which might point to serious problems either with the hinge system, or with the control system. Nor with the very limited access to the controls or hinge assemblies were there any visual clues to problems. It is not felt that the "sticking" problem with Gate #1 is not connected with the hinge or control system, but rather to some interference problem.

D. **Summary of Areas of Satisfactory Gate Condition.** - Those areas and components of the drum gates which are in satisfactory condition include the following:

(a) Gate structural members - The structural members inside each of the drum gates are in good condition. None show signs of structural distress. When sighted along a plane, structural members appear in-plane and straight. They do not show signs of overloading or overstressing. Structural members and the associated bracing did not appear deflected, buckled, twisted, or distorted.

(b) Welds - As viewed from the exterior of the drum, the faceplate welds, and end plate welds appear in good condition, with the exception of the two upper faceplate panels on Gate #3 as described further.

(c) Paint - The protective paint coating on the exterior surfaces of both the downstream and bottom faceplates for each of the three drum gates is generally in very good condition.

(d) Cantilever bracing - Although pitted, the various bracing which supports the cantilevered portions of the upstream and bottom faceplates do not appear distressed. (e.g. see b&w photo 16, Gate #1, page 8, or b&w photo 15, gate #2, page 8).

(e) Concrete - The general condition of the concrete inside the concrete gate chamber is in good, including the floors of the concrete chamber and the upstream and downstream walls of the concrete chamber. One exception is the occurrence of localized concrete cracking in the end walls of the concrete gate chamber as described elsewhere. (e.g. see b&w photo 24, gate #1, or b&w photo 1, gate #3, page 1)

(f) Inlet and outlet pipes - Those portions which are visible from the inside the gate chamber appear satisfactory, including the condition of the coal tar enamel coating.

(g) Downstream faceplate - The downstream face plates are in good condition. No pitting or damaged paint was observed to be occurring on any of the three drum gates.

(h) Clamp bars and bolts - The clamp bars and bolts for the music-note seals appear satisfactory.

E. **Description of Drum Gate Deficiencies. -**

1. **Pitting on the Upstream and Bottom Faceplates -** Each of the three drum gates exhibited extensive pitting and loss of steel material on both their upstream and bottom faceplates (cover plates) as a result of pitting due to corrosion over the years. Pitting to depths of 1/16-inch to 3/32-inch is occurring uniformly over the entire faceplate areas. Fortunately, because the protective paint coat on the 7/16-inch thick bottom faceplate is generally in very good condition, it does not appear that any further deterioration or deepening of the pitting is occurring on the bottom faceplate. On the other hand, because the coating on the ½-inch thick upstream faceplate has eroded and abraded, further corrosion and pitting is probably making that situation worse.

2. **Damaged Paint On Upstream Faceplates** - On each of the three drum gates, the protective coating on the upstream faceplate has eroded and abraded, in many cases, down to the primer paint and/or down to bare steel. It is likely the damaged paint is due to high velocity water leaking from the chamber and past the seals. The seals are possibly ineffective.

3. **Gate #1 Stop Screws Not in Contact. -** The mechanism to prevent the drum gates from raising completely out of their gate chambers is a stop angle (Angle 4"x3"x5/8" by 70' long) welded along the bottom edge of the upstream faceplate which comes into bearing contact with a series of adjustable stop screws located at the spillway crest. By observing the stop angle for the dirt and water marks due to stop screw bearing on the angle, it can be noted

which stop screws are not in contact by the absence of mark. This uneven loading of the stop angle is likely contributing to leakage past the seals. In fact, it was noticed on Gate #1 that at nearly all locations on the upstream faceplate where the stop screw is **not** making contact with the stop angle, a conspicuous 3-foot wide band of rust and corrosion is occurring. All stop screws should be adjusted for even bearing on the stop angle.

On Gate #1, there are approximate 16 stop screws out of 34 total stop screws which are not making contact with the stop angle. On Gate #2, there are approximate 3 stop screws out of 34 stop screws which do not make contact with the stop angle. On Gate #3 (the west gate) it appears that all stop screws do make contact with the stop angle.

4. **Cracks in Gate Chambers. -** Although, the condition of the concrete in the gate chambers is generally good, including; the floors of the chambers and the upstream and downstream walls of the chamber, there existed in each of the three chambers one to three cracks. All the concrete cracks are horizontal and are located in either the left or right end walls of the gate chamber. It is speculated that these cracks may have occurred at the same time that the mid-1960's earthquake caused the concrete cracking around the doorway entrance to the Gate #2 controls at elevation. In Gate #1 chamber (east gate chamber), there I In Gate #2 chamber (middle gate chamber), there are three horizontal cracks located on the right wall on the upstream side of the gate, and there is one horizontal crack located on the left wall just below the access hatch. In Gate #3 chamber (west gate chamber), there are two horizontal cracks located at the left end wall of the upstream side of the gate.

5. **Seal Segments Missing or Torn. -** The music-note replacement seals on the drum gates are damaged and as a consequence, leakage past the seals is occurring which in turn damages the paint coating on the upstream faceplate and embedded wallplates, leading to corrosion. As discussed elsewhere, the replacement seals for drum gates do not appear to be the most suitable for the installation and as a result, many seal segments are either torn, ripped, rotted, or over deflected. The seals should be replaced, however before replacing the seals in-kind, a preliminary layout, and design should be considered to either refine the existing seal system, or develop a improved sealing system.

6. **Gate #1 Sticking Problem vs. Interference Points.** On August 6, 1998, with the reservoir elevation at El. 1169.5 feet, it was noticed that the drum gate #1 was stuck and would not lower. Although, water inside the gate chamber was partially drained, the gate would not lower under its own weight.

   On Gate #1, the inspection noted three locations where a gouge or mark on the drum gate itself is indicating interference with a component fixed to the spillway. These points of interference could have played a role in contributing to the reason that Gate #1 recently became stuck in its nearly fully raised position. Those areas of interference include:

   • On Gate #1, at a location 30 feet as measure from the left side of the gate chamber is a 2-inch wide gouge and band of rust. Most likely, this is indicating the corresponding shield guard interferes with the u/s faceplate.

   • A significant scrap mark was noticed on the side of the ½" bar used as the stop of the side seals. The scrap mark, although not exactly located in a spot corresponding with the point at which Gate No. 1 became stuck on 8/6/96.

7. **A Badly Pitted Gate #3 Bottom Faceplate Weld.** - All the butt welds between steel plates visually inspected along the upstream, bottom, and downstream faceplates, as well as the end plates at either ends of the drum gates appear satisfactory, with the exception of a portion of weld located on the bottom faceplate, Gate #3. (See b&w photos 9&10 - Gate #3, page 5, and refer to original drawing SG-589-P - OUTSIDE PLANS OF DRUM GATE.)

F. rum Gate Inspection Observations - Listed below in tabu orm are observations and comments specific to individual ga

Inspection Observations and Comments			
Inspection Feature	**Drum Gate #1 (east gate)**	**Drum Gate #2 (middle gate)**	**Drum Gate #3 (west gate)**
1. Upstream Faceplate Condition (as inspected from inside gate chamber)			
a. Faceplate Pitting, Corrosion, & Coating	Extensive, uniform pitting over faceplate. Paint coating thin over entire surface. Sandblast and paint entire upstream exterior surface. Analysis the remaining faceplate strength. Correct gouging problem as given below in b. Faceplate Rust Band and Gouges. Adjust stop screws as reported below in below in c. Stop Angles and Stop Screws. Correct water leakage problem which results in high velocity water spray and erodes and abrades the paint coating.	Faceplate protective coating okay on lower 8-foot section, followed by a 12-inch band of rust across width of gate, and coating completely gone on upper half faceplate. Correct gouging problem as given below in b. Faceplate Rust Band and Gouges. Adjust stop screws as reported below in below in c. Stop Angles and Stop Screws. Correct water leakage problem which results in high velocity water spray and erodes and abrades the paint coating.	Paint on the lower half of the upstream faceplate is in excellent condition. It appears recently painted, although there is no recollection to this fact. However, just above stop angle along the 70' length is a 5-inch wide band where the paint/primer has completely been scrubbed off by high velocity leakage water. Uniform loss of material could be occurring within this area, and not show signs. The red primer is evident indicating the paint top coat has eroded probably due to high velocity leakage water.
b. Faceplate Rust Bands & Gouges	Located 30' from left end is a 2-inch wide gouge on u/s faceplate, probably due to interference shield guard. Trim shield guard.	No circumferential rust bands as in Gate #1, but a 12" band of longitudinal rust over entire 70' width occurs just above the good paint (approx. 8' from bottom).	There is one full-arc length scrap and 6 or 7 additional 5' long scraps on U/S faceplate indicating interference with shield guards. Trim corresponding shield guards to provide clearance.

Inspection Feature	Drum Gate #1 (east gate)	Drum Gate #2 (middle gate)	Drum Gate #3 (west gate)
c. **Stop angles & Screw Stops** See Dwg SG-581-P	Stop angle is straight and in good condition. 16 (out of 34) stop screws do not make contact with stop angle. Adjust all stop screws for even bearing. (From left - bolt nos., 9,11,13,151,6,.17,18, 19, 20, 21,22,23,24,26,32, and 33)	Stop angle straight & satisfactory. Three (3) (out of 34) screw stops (#30,31,&32 as counting from left end) not making contact with stop angle. Adjust all stop screws for even bearing.	All screw stops appear to be making contact with stop angle Condition of stop angle is good..
d. **Seals/clamp bar/bolts**	Left U/S side seal torn. Right U/S seal is rotted and torn, and seal appears to ride on concrete surface instead of steel. Replace both. Clamp bar and bolts are satisfactory. **But - scrap marks on side of the ½" side seal stop bar indicates interference with notch of shield guard (see b. above). Scrap marks & possible interference may be reason Gate No. 1 was stuck.**	Left U/S side seal ripped and torn. Right U/S side seal is okay, except for 1'-6" length of torn seal. Replace both sides with a redesigned seal. Clamp bar and bolts are satisfactory.	U/S right end seals are good, but U/S left end seals are torn beginning halfway up the faceplate. Replace both sides with a redesigned seal.
e. **Chamber Concrete Condition Cracking Inside Chamber, upstream side of lowered gate.**	Concrete floor and walls are in good condition. No horizontal cracks one either the left or right end walls.	Concrete floor and walls are in good condition. Three horizontal cracks are located on the right end wall, each with a 1/4" gap.	Concrete floor and walls are in good condition. Two horizontal crack located on chamber (left end) wall near drain pipe.
f. **Faceplate joint welds**	D/S Faceplate joint welds all appear sound.	D/S Faceplate joint welds all appear sound.	D/S Faceplate joint welds all appear sound.
2. **Bottom Faceplate Condition** (as inspected from inside gate chamber, downstream of gate in lowered position.)			
g. **Faceplate Pitting, Corrosion, & Coating**	Paint in good condition. Extensive faceplate pitting and pockmarking due to past corrosion. Analyze remaining faceplate strength vs. factor of safety.	Paint on bottom faceplate is excellent. Corrosion is not occurring, but ~3/32" deep pitting, uniformly over entire faceplate has occurred in the past.	Coating in good condition - and no corrosion. Historic extensive pitting uniformly covers entire bottom faceplate, and bracing.

Inspection Feature	Drum Gate #1 (east gate)	Drum Gate #2 (middle gate)	Drum Gate #3 (west gate)
h. **Drain cock**	1-inch drain cock appear a bit rusted, but was operated successfully. Replace with new valve.	1-inch drain cock appear a bit rusted, but was operated successfully. Replace with new valve.	1-inch drain cock appear a bit rusted, but was operated successfully. Replace with new valve.
i. **Chamber Concrete Condition Cracking Inside Chamber, downstream side of lower gate.**	A 12' long x 1/8" gap horizontal crack, located 5' above floor on right side end wall. Caulk and monitor crack for possible future propagation.	One horizontal crack located just below access hole Minor concrete spalling is occurring under ejector piping.	There are 2 horizontal cracks on the left end chamber wall located at the elevation of the 30" dia. drain pipe. Crack gap is 1/4"
j. **Faceplate Joint Welds**	Bottom faceplate joint welds appear sound on Gate #1.	Bottom faceplate joint welds appear sound on Gaιe #2.	All gate #3 welds okay, except butt weld on upper two panels near gate center. Welds are very badly pitted, but are not cracked. Grind and reweld.
k. **Upstream Cantilever bottom and side braces.** (See Dwg. SG-589-P)	Gate #1 - Braces satisfactory but pitted. Braces show no signs of overloading or structural distress.	Gate #2 - Bracing along both side cantilever portion and bottom cantilever lip are satisfactory.	Gate #3 - Bracing is extensively pitted, but shows no signs of structural distress.
l. **Bottom Rail Gate Rest. 60" railroad rail, A.S.C.E.** (See Dwg. SG-584-P)	There are five (5) "supply" 2"x4" holes counted in web of rail. Consider adding 3 new cut-outs to match that of Gate #3.	Approx seven (7) "supply cut-out holes in web of rail. Satisfactory.	There are nine (9) "supply" cut-out holes counted in the web of the rail which also appear bigger in size than Gate #1. Satisfactory.
m. **End Section Gate Plates** (See Dwg. SG-586-P)	The plates at both ends of the gate are sound, the paint is good, no signs of pitting, and the welds at plate joints are good.	The plates and their welds located the ends of the gate are in good condition without signs of corrosion. Their orange color suggests that maybe only the primer coat was painted.	End plates are in good condition. But, at the bottom to end plate welded edge joint (right side), the weld is abnormally pitted. Grind and Reweld.

Inspection Feature	Drum Gate #1 (east gate)	Drum Gate #2 (middle gate)	Drum Gate #3 (west gate)
3. Downstream Faceplate Condition (as inspected from the outside atop the faceplate)			
n. **Faceplate Pitting, Corrosion, & Coating**	Paint in excellent condition. Faceplate free of any pits/corrosion. Faceplate local pucker at 2 locations where hydraulic ram was used to bear on gate when freeing.	Paint in excellent condition. Faceplate free of any pits/corrosion.	Paint in excellent condition. Faceplate free of any pits/corrosion.
o. **Seals/Clamp bar/bolts**	Satisfactory	Satisfactory	Satisfactory
p. **Access Hatchways**	Appears satisfactory	Appears satisfactory	Appears satisfactory
q. **Embedded Wallplates in Piers.**	Structurally okay, but paint coating has failed. Repaint. On left one there are 2 concentric gouge marks. Identify and correct cause.		
r. **Shield Guard Plates**. (See Dwg. SG-594-P)	In 1996, shield guards were removed, trimmed and replaced. Although, their installation appears satisfactory, gouge marks on u/s faceplate indicates that further trimming is required.	No report of guard modifications. Visual appearance is okay.	
4. Drum Gate Interior			
s. **Main Horizontal Faceplate Stiffeners.** See Dwg. SG-584-P	Members: *For each gate* - main structural members are in satisfactory condition and show no visual signs of structural distress. The members are straight and remain in plane. Their cross-sectional positions appear to be the same as when originally installed, and have not distorted, deflected, buckled, twisted, or shows signs of local buckling.		
t. **Main Internal Bracing Members**. See Dwg SG-587-P.	Bracing: *For each gate* - in a similar manner to the structural members, the structural bracing is satisfactory. The bracing is straight and has not buckled or deflected from its originally installed position. The bracing is not loose or missing.		
u. **End Sections on Gate**. See Dwg SG-586-P.	Interior end plates: *For each gate* - The steel plates which enclose both ends of the drum gate appear in structurally satisfactory. The coal tar enamel coating is intact and has not failed and it is assumed therefore that corrosion is not a problem.		

Inspection Feature	Drum Gate #1 (east gate)	Drum Gate #2 (middle gate)	Drum Gate #3 (west gate)
v. **Condition of Coal Tar Enamel**	Coating throughout inside of drum gate in good condition.	Coating, generally satisfactory throughout the interior surfaces, although some locations exist with failed coating.	Coating is generally satisfactory. However, coating in Gate #3 is in worst condition than #1 or #2. Several locations exist of localized failed coating, especially occurring on the interior surface of the d/s facepalte.
5. Leakage Water			
w. **Gate Leakage**	Drum Gate No. 1 had the least amount of water in the bottom. A visual rough approximation of the depth of water was 1 foot. Drum Gate No.	Again, as a rough visual approximation the depth is about 3 feet of water.	Drum Gate No. 3 (the west gate) had the most water accumulated in the bottom, roughly 5 feet of water depth.

Comments Regarding Gate Leakage. - Although the two access hatchway on the downstream faceplate of each gate had been opened for several weeks, and a portion of any rainfall occurring during that time would have drained into the hatchway would have contributed to the accumulation of water, it is not felt that rainfall through open hatchways is the sole contributor. If it were the sole contributor than each drum gate would contain approximately the same amount of water, which was not the case.

It is assumed there some water leakage into the drum gates must be occurring, either past the rubber gaskets of the four hatchways which access each of the drum gates, or through a non-water-tight joint.

To drain any water which may accumulate inside the drum gates, the original gate design included an ejector system, utilizing high pressure water running through a piped system which runs through the gates and end trunnion pins to create a venturi effect resulting in a low pressure which sucks the water from the bottom of the gate when the gate is in its fully open (lowered) position. Because of the geometry of the bottom (pressure) faceplate, this system can work to drain the gate, when the gate is in any position. But draining the water is not automatic, and draining becomes more of a maintenance procedure.

G. Conclusion and Discussion.

1. **Conclusion**. With relatively straight-forward repairs and rehabilitation of the three existing 70'x18' drum gates, including; structural analysis of the existing faceplate condition, new protective coating on the upstream faceplate, a new and possibly redesigned gate sealing system; the existing drum gates will continue to be structurally sound and function effectively to control reservoir flow.

2. **Drum Gate Structural Strength.** The pitting of both the upstream and the bottom drum gate faceplates, which occurred well in the past, is of some concern to the overall structural strength of the drum gates. The pitting is extensive, uniform, and varies in depth from 1/16" deep to 1/8" deep.

   The original drawings specifies that upstream faceplate thickness be ½" (0.50 inch) thick, and that the bottom faceplate be 7/16" (.4375 inch) thick. Based on these thicknesses and on an average pit depth of 3/32", this pitting has resulted in a loss of steel material of 23% to 27% of the original faceplate thickness. The impact which the pitting has on the faceplate strength it is not known, since the original drum gate structural calculations are available for a review. It should be noted, however, that with many historical gate designs it was common practice to include specifically for corrosion allowance, an additional 1/16 inch thicker faceplate than that needed for the design. If this were the case, then the original gate designer has anticipated correctly that corrosion was likely, and thus the factors of safety are not compromised even with the loss of material.

   Actual ultra-sonic faceplate thickness measurements were taken by Bill McStraw of the U.S.B.R. during the second drum gate inspection, September 30, 1998. He sampled eleven random locations on both the upstream and bottom faceplates (His report nomenclature differs slightly from that used here) Gates #1 and #3. The text of his reports is reproduced at the end of the report. Note, his reference to "downstream" faceplate in fact refers to the downstream side of the gate chamber and refers more correctly to bottom faceplate, as used in this report).

   The maximum thickness sampled on each of the four faceplates slightly exceeds the thickness specified on the original drawings. It is entirely possible that the actual fabricated faceplate thickness might be greater than that specified (as a minimum); and if true, the extra material would represent the equivalent of a corrosion allowance. Also based on his sampling, McStraw reported the following percent loss of faceplate material:

   • Gate #1 - upstream faceplate: "approximately 8 percent based on the wall thickness of 0.500 inches specified on the original drawings

   • Gate #1 - bottom faceplate: "approximately 6 percent based on the wall thickness of 0.4375 inches specified on the original drawings.

   • Gate #3 - upstream faceplate: "approximately 10 percent based on the wall thickness of 0.5000 inches specified on the original drawings."

   • Gate #3 - bottom faceplate: "approximately 8.6 percent based on the wall thickness of 0.4375 inches specified on the original drawings."

   However, the McStraw report does point out "Thickness measurements were difficult to obtain at some locations due to the irregular, uneven surfaces which prevented good contact with the ultrasonic transducer. Some of the pits looked to be approximately 1/8-inch deep."

   Over the years, the drum gates have been subjected to and withstood the maximum reservoir loadings. Inspection of the structural members inside the gates show no signs of structural distress. It is possible that the gates may have been originally over designed.

   Without up-to-date structural analysis calculations, it can not be known for certain to what degree the gates are stressed, and to what degree the factors of safety may or may not be comprised by the loss of faceplate steel material to corrosion. A structural analysis of the gate is warranted, based on the cost of rehabilitating the gates for decades of additional operational life. An analysis helps reveal strength deficiencies, to possibly update the gate in accordance with the latest codes, and to check for possible earthquake loadings.

3. Drum Gate Seal System. - The original drum gate sealing system (See drawing SG-594-P) has been abandoned and retrofitted with music note seals. The reasons for this change are unknown. Were the original seals ineffective or damaged? Why were the original seals replaced with a similar design? The original seals certainly would be complicated and expensive to fabricate, and require the reservoir to be drawn down. Was it an emergency situation which dictated the use of the music-note seal?

   In any case, the present hollow, music-note, side seals located on the edges upstream and downstream faceplates do not appear to have been the best choice. Many seal segments are damaged, torn, and missing, perhaps for the following reasons:

   • The hollow bulb, although theoretically capable of providing more effective sealing due to its flexibility, in fact, may be too flexible and flimsy, and is a contributing factor to the premature material failure.

   • The seal bulb appears oversized for the space available for installation, and hence requires the bulb and stem to rotate and deflect excessively resulting in unnecessary stresses, also leading to early failure.

   • On the downstream faceplate, the installation and orientation of the side seal bulb appears to be backward (although, it appears to be a more convenient installation) from that which would provide the more effective direction for sealing.

   • The seal bulbs as installed on the upstream faceplate in some cases must ride on the rougher concrete surfaces instead of the smoother embedded steel sealing surfaces. This is as consequence of the retrofit from the original design to the music note seals.

   The presently damaged and possibly ineffective hollow, music-note seals results in a high-velocity water spray which contributes to the eroding and abrading of the protective paint coating on the upstream faceplate and embedded wallplates which in turn contributes to the corrosion and loss of steel material. A lesser secondary consequence of the damaged seals is the reduced capacity of the seals to hold the hydrostatic pressure inside the gate chamber, and affects the buoyancy of the drum gates. The reservoir supply to the gate chamber is greater than the leakage past the seals, and currently the damaged seals is not a significant problem in this regard.

   The seals should be replaced; however, rather than replacing the seals, in-kind with similar hollow bulb, music-note seals, the seal design should be reconsidered for both material and sizes and possibly the geometry. At a minimum, if the music-note seal concept is retained; a solid bulb, Teflon-clad, neoprene material, and smaller bulb should be considered.

4. Drum Gate Sticking. As previously noted, Gate #1, when operated to a nearly fully raised position became stuck and would not lower, even under its own weight.

H. **Drum Gate Description.** - The table below provides a quick reference to sizes and descriptions of some notable drum gate components and characteristics, as taken from the original drum gate drawings. Exact sizes and shapes of the structural members were not necessarily verified in the field.

   1. **Seal System Modifications.** - The original sealing system designed for the drum gates has been discarded (circa mid 1960s) and retrofitted with modified system using with a hollow bulb, music-note ("J") seals. The original gate sealing system was a set of curved rubber-covered, copper-bronze spring seals, as shown on drawings SG-582 & 628-P. It is not known whether drawings exist for the new "music-note" sealing system.

2. **Shield Guard Modifications** - As mentioned previously, in 1996, for Gate #1, the shield guards attached to the spillway crest were removed and their edges trimmed by machining to provide clearance between their edge and the upstream faceplate of the gate. Previously, there was no clearance, and the shield edges were contacting, scrapping, and damaging the upstream faceplate and it paint. From the inspection of the upstream faceplate inside the gate chamber, it appears there are still some point contact between the guard and faceplate which should be corrected by trimming the guard.

3. **Scheduled Future Drum Gate Modifications.** - During the inspection it was reported that the music-note seals will be partially replaced, and that new seals had been ordered for Gate #1 only. The replacement seals are only for the two sides of the downstream side seals and the upstream crest seal.

4. **Quick Reference Table.** -

Drum Gate Component - Quick Reference Table			
Overall Drum Gate Dimensions		**Faceplate Information**	
Gate Height	70 feet	Upstream faceplate thickness	½"
Gate Width	18 feet	Downstream faceplate thickness	7/16"
Gate Radius	21' - 9"	Bottom faceplate thickness	7/16"
Gate Hinge Description (see Dwg SG-579-P)		**Gate Elevations** (see Dwg SG-800-P)	
Pin Material	Cold Finished Steel	Top of gate Fully Raised Position, el.	El. 1170.00'
Pin length	11 inch long	Crest Elevation	El. 1152.00'
Pin diameter	4.25 inch dia.	Hinge Pin Centerline Elevation	El. 1149.25'
No. of Pins	32 pins per gate	Control Gallery Elevation	El. 1136.00'
Pin Bushing	Stainless steel, 7/8" wall thickness	Bottom of Gate Chamber Elevation	El. 1129.00'
		Intake (Inlet Pipe) Centerline El.	1145.00 - Gate #11136.00 - #2 & #3
		Inlet (Supply Pipe) Centerline El.	El. 1130.17'
		Discharge (Outlet Pipe) Centerline El.	El. 1133.00'
Gate Controls (See Dwg SG-800-P for Gate Control Schematic)			
Inlet (Supply) Pipe: Allows water into the gate chamber. The east gate #1 has a reservoir intake at El. 1145', but the middle and west gates (#2 & #3) have reservoir intakes at El. 1136'. Each intake is a trashrack ed opening at the face of the dam and plumbed though the dams using 16-inch diameter CI pipe. The supply water into the chamber is controlled by a 20 inch, manually-operated, gate valve located in the El. 1136 control gallery. The inlet piping for each gate is located on the east side of the chamber with its bottom edge aligned with the floor of the chamber and physically located beneath the 30-inch diameter discharge piping.			

Drum Gate Component - Quick Reference Table	
Outlet (Discharge/Drain) Pipe: The outlet piping controls the draining or discharging of water from the gate chamber and thus controls the position of the drum gate. The discharge piping is 30-inch diameter cast iron piping. The discharge openings are located on the east side of each gate chamber near the access hatchways, and physically located above the 24" supply piping. Discharge (draining) flow out of the chamber is controlled by a 30-inch diameter, float- (or manual) operated internal differential needle valve located in the El. 1136' control gallery.	
Vent (Overflow) Pipe: Steel: (See Dwg. SG-800-P). The chamber intake is located on the left side near the top on the downstream side of the gate chamber at approx. El. 1147' and is plumbed thru the concrete bay piers and vents off the backside of the pier at El. 1170.50'	
Gate Structural Members (see Dwgs SG-584 & 585 - P)	
Number of Structural Gate Frames	36 main structural frames on 24 inch centers.
D/S Faceplate Horizontal Members	W 12x31.8 structural steel on approx. 2'-6" centers
D/S Faceplate Vertical Members	W 12x31.8 (wide flange) structural steel
U/S Faceplate Horizontal Members	W 12x31.8 (wide flange) structural steel
U/S Faceplate Vertical Ribbing	Channels - C12x25 on faceplate braced against W12x 31.8 beams using W12x31.8 braces.
Internal Triangular Main Bracing	H beam - 5" deep by 18.9#. on 24" centers
Cross bracing on main bracing	Angles 3"x3"x1/2"
Bracing for cantilever portion of upstream faceplate	Side Cantilever portions - W5x12.25, wide flange.
Bracing supported by bottom faceplate	Bottom lip portion - W5x12.25, wide flange.
Miscellaneous Gate Components	
Rail stop supporting gate when gate wis in fully opened position.	A 60" railroad rail, A.S.C.E. at bottom of gate chamber bearing against the Bar 5"x1/2" "striking bar" on bottom of gate. (See Dwg Sg-584-P)
Stop angle on gate when fully closed.	Angle 4"x3"x5/8" by 70' long across bottom edge of upstream faceplate. (See Dwg Sg-584-P).
Adjustable Gate Screw Stops	34 - 1.75" dia. bronze, part 36, See Dwg SG-581 & 594 - P.
Crest Cover Plates	A steel casting. See, part 29 on drawing SG-582-P
Hinge Cover Plates	See drawing SG-580-P.
Ejector Piping	3" dia piping on left and right ends of gate, piped from end hinge. See Dwgs. SG-627-P and SG-800-P.
Access hatchway at El. 1136"	Two entryways - each 24-inch diameter.

Drum Gate Component - Quick Reference Table	
Original Design Clearances Between Moving Part (see Dwgs SG - 594)	
Clearance between end edges of downstream faceplate and embedded wallplates:	- 1 inch
Clearance between upstream faceplate and edge of Crest Cover plates, part 29:	- 0.75 inch
Clearance between edge of stop angle and embedded 15" channel when fully raised	- 1 inch
Clearance between Hinge Cover plates and hub of hinge pin casting:	- 1 inch
Space between pier wall and end plates on drum gates:	- 24 inches

I. **Faceplate Thickness Sampling. The McStraw Report. -** The following is Bill McStraw's report of finding for the informal ultra-sonic faceplate thickness survey which he performed on Gates #1 and #3. Note his use of "downstream faceplate" refers to the bottom faceplate which is located on the downstream side of the gate in the gate chamber.

Morris Dam - Drum Gate Thickness Measurements
(by Bill McStraw)

Listed below are the thickness measurements obtained during the drum gate inspections performed on September 30, 1998. Thickness measurements were taken randomly at various locations for both the upstream and downstream skin plates of drum gates No. 1 and No. 3. Thickness measurements were difficult to obtain at some locations due to the irregular, uneven surfaces which prevented good contact with the ultrasonic transducer. Some of the pits looked to be approximately 1/8-inch deep.

Drum Gate 1

Upstream side (Thickness in inches)	Downstream side (Thickness in inches)
0.5100	0.4800
0.5100	0.4800
0.4900	0.4500
0.5000	0.4700
0.4900	0.4300
0.4600	0.4500
0.4900	0.4800
0.5000	0.4600
0.5000	0.4600
0.4900	0.4600
0.4900	0.4100

Lower bound value for upstream side = 0.4600 inches which represents a decrease in wall thickness of approximately 10 percent based on the skin plate having an original wall thickness of approximately 0.5100 inches. This represents a decrease in wall thickness of approximately 8 percent based on the wall thickness of 0.5000 inches specified on the original drawings.

Lower bound value for the downstream side = 0.4100 inches which represents a decrease in wall thickness of approximately 15 percent based on the skin plate having an original wall thickness of approximately 0.4800 inches. This represents a decrease in wall thickness of approximately 6 percent based on the wall thickness of 0.4375 inches specified on the original drawings.

Drum Gate 3

Upstream side (Thickness in inches)	Downstream side (Thickness in inches)
0.5250	0.4800
0.5250	0.4800
0.5500	0.4400
0.5100	0.4400
0.4500	0.4400
0.5500	0.4600
0.4700	0.4400
0.4900	0.4400
0.5300	0.4000
0.4900	0.4500
0.4800	0.4500

Lower bound value for upstream side = 0.4500 inches which represents a decrease in wall thickness of approximately 18 percent based on the skin plate having an original wall thickness of approximately 0.5500 inches. This represents a decrease in wall thickness of approximately 10 percent based on the wall thickness of 0.5000 inches specified on the original drawings.

Lower bound value for the downstream side = 0.4000 inches which represents a decrease in wall thickness of approximately 17 percent based on the skin plate having an original wall thickness of approximately 0.4800 inches. This represents a decrease in wall thickness of approximately 8.6 percent based on the wall thickness of 0.4375 inches specified on the original drawings.

******** (End of Bill McStraw's Report) ******

********** (End of Drum Gate Inspection Report) **********

MECHANICAL EXAMINATION REPORT

Morris Dam Drum Gate Rehabilitation

County of Los Angeles Department of Public Works

Technical Service Center
Bureau of Reclamation
Denver, Colorado

November, 1998

Morris Dam Drum Gate Inspection

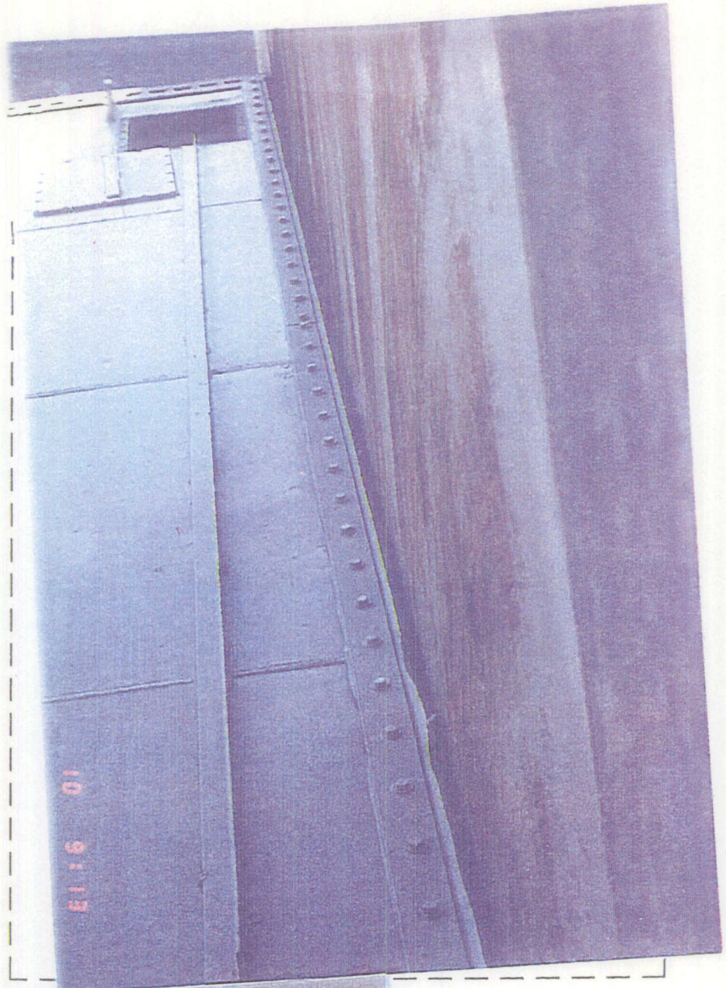


Photo 1. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, left side. View of wallplate and damaged hollow bulb seal. Sept 10, 1998.

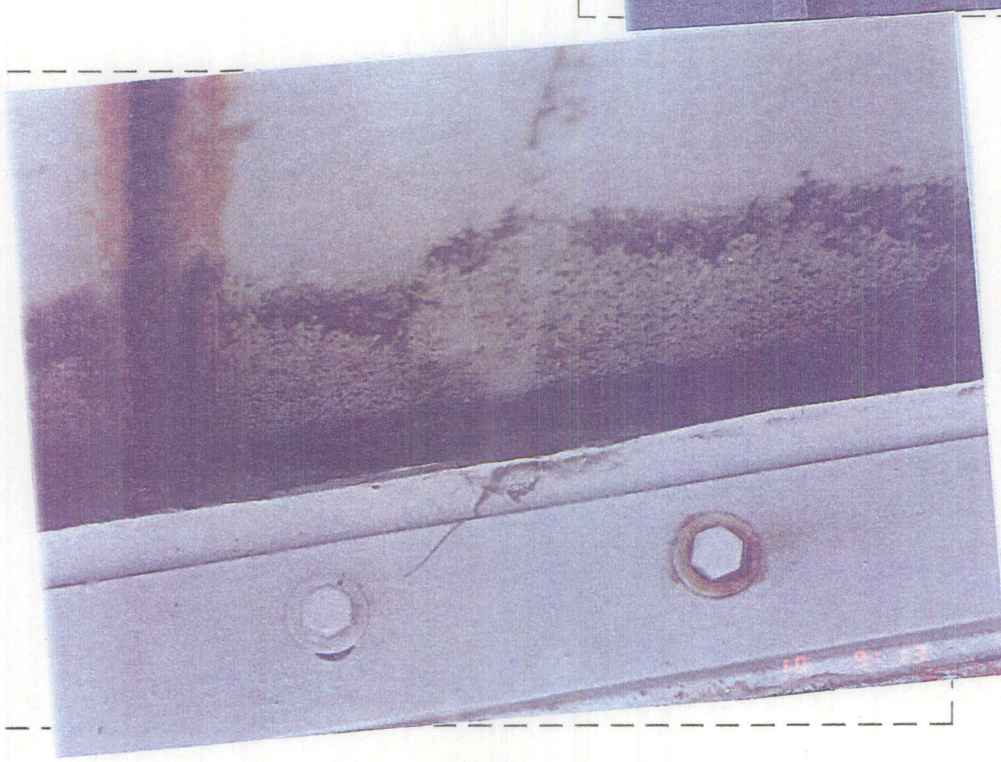


Photo 2. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, left side. Closeup of torn seal and wallplate. Note portion of gouged concentric arc on upper left of photo. - Sept 10, 1998.

Photo 3. - Morris Dam - 70' x 18' Drum Gates - Gate bay #1, View upwards towards temporary bracket on face of spillway bridge for hydraulic ram. - Sept 10, 1998.

Photo 4. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, left side. View of wallplate and damaged hollow bulb seal. - Sept 10, 1998.

Photo 5. - Morris Dam - 70' x 18' Drum Gates - Gate #1, left side embedded wallplate. View of wallplate and faded, painted reservoir elevation marks to show maximum raised height of gate #1 at point where gate became stuck (approx. El. 1167.5') - Sept 10, 1998.

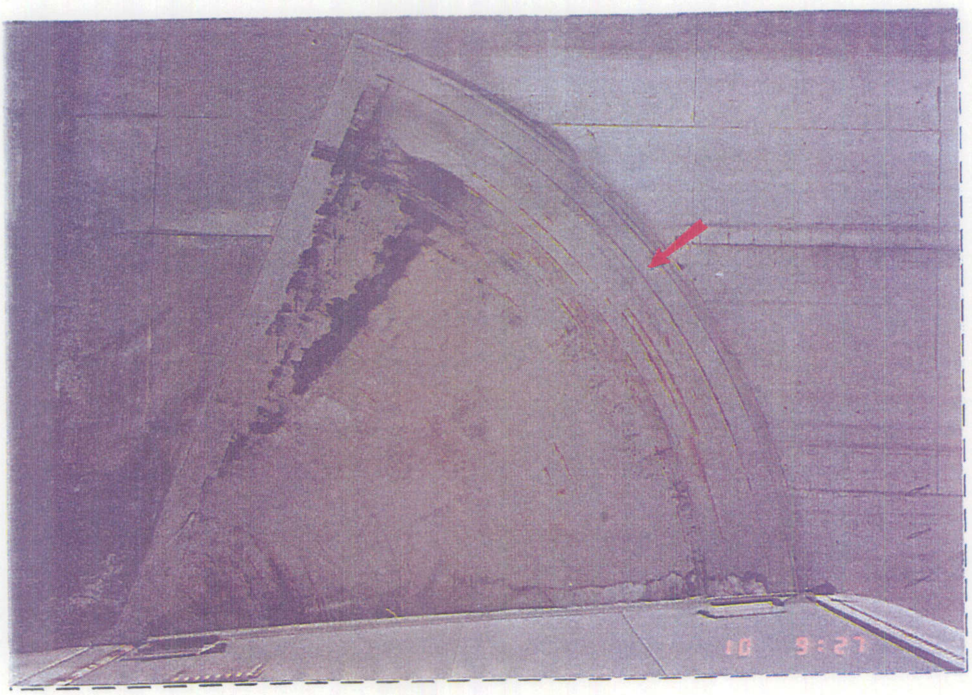


Photo 6. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, right side. View of embedded wallplate. Note - the pair of concentric gouge marks (arrow) in wallplate can be seen near the upstream edge of wallplate. - Sept 10, 1998.

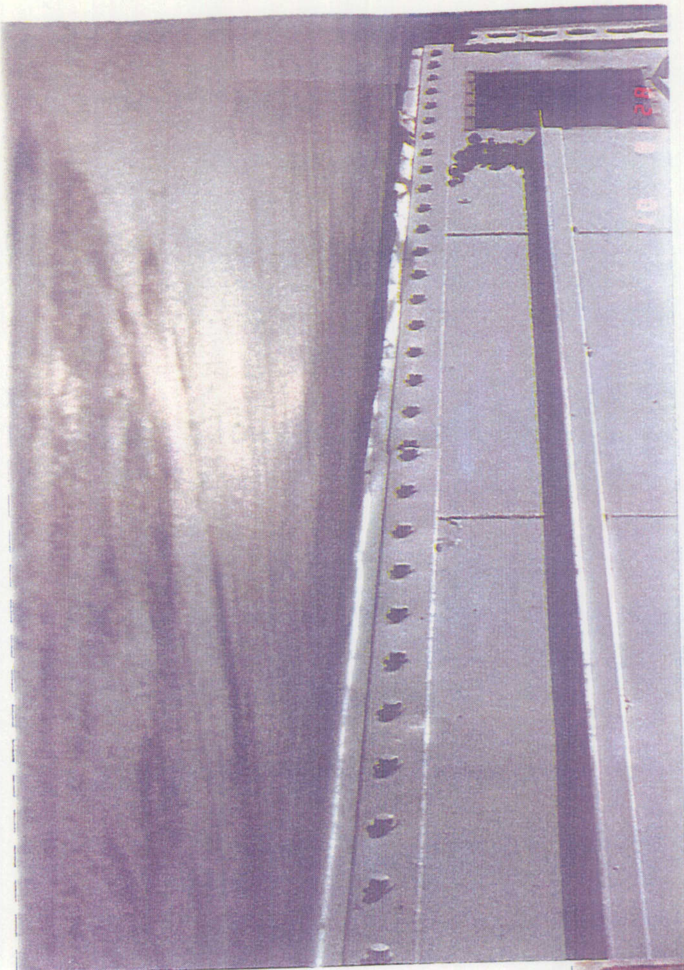


Photo 7. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, right side. View of damaged hollow bulb seal and embedded wallplate. View is from hinge looking upstream. - Sept 10, 1998.

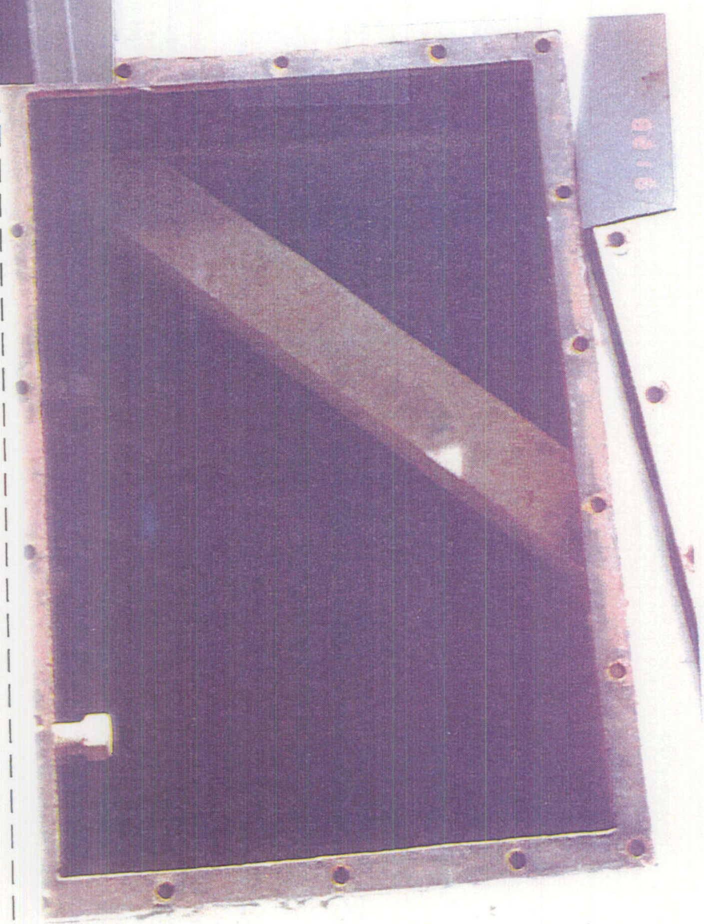


Photo 8. - Morris Dam - 70' x 18' Drum Gates - Gate #1, downstream faceplate, right side. View of inside hatchway seen in Photo #7. View of bracing supporting the cantilever portion of the upstream faceplate. - Sept 10, 1998.

Photo 9. - Morris Dam - 70' x 18' Drum Gates - Gate #1, View looking from right towards left of gate along gate hinge. Downstream skinplate seen to the left of hinge and spillway concrete seen to right of hinge. - Sept 10, 1998.

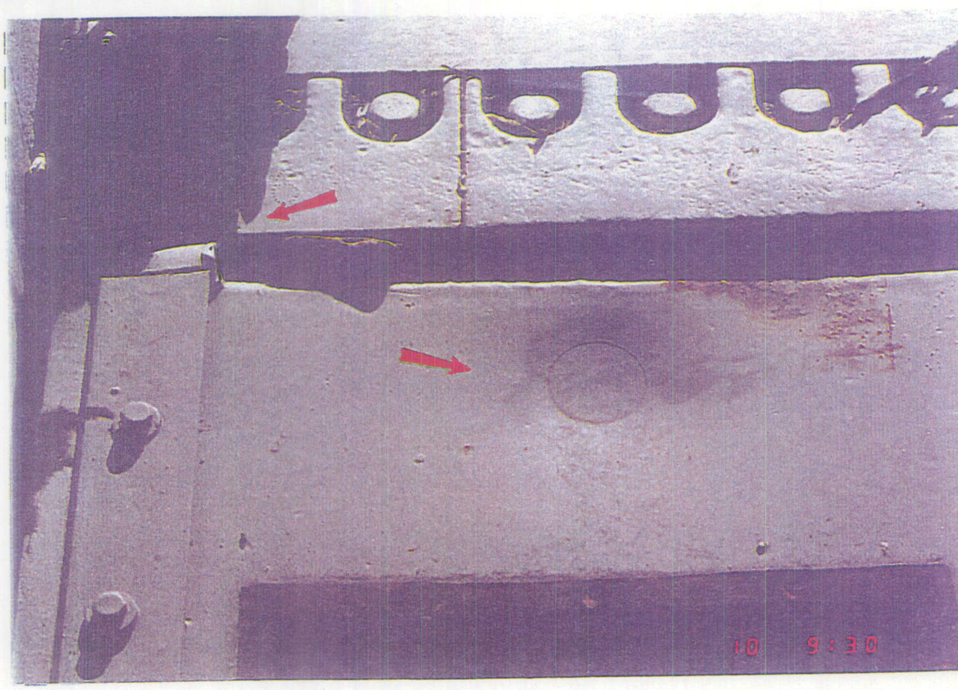


Photo 10. - Morris Dam - 70' x 18' Drum Gates - Gate #1, View immediately upstream of hatch (Photo 8). Right pointing arrow shows local buckling caused by hydraulic ram used to unwedge gate. Left pointing arrow shows edge of shield guard which is interfering with the small 1/4" thick bar just to the left. - Sept 10, 1998.

Photo 11. - Morris Dam - 70' x 18' Drum Gates - Gate #1, View from downstream faceplate looking up towards spillway bridge at bracket used for ram. Note concrete cracking at intersection of bridge of pier wall. - Sept 10, 1998.

Photo 12. - Morris Dam - 70' x 18' Drum Gates - Gate #1, right side of gate. View inside gate hatch. Arrow parallel to 3" ejector piping points towards bottom of gate (when in the closed position). Note coal tar enamel on structural members. - Sept 10, 1998.

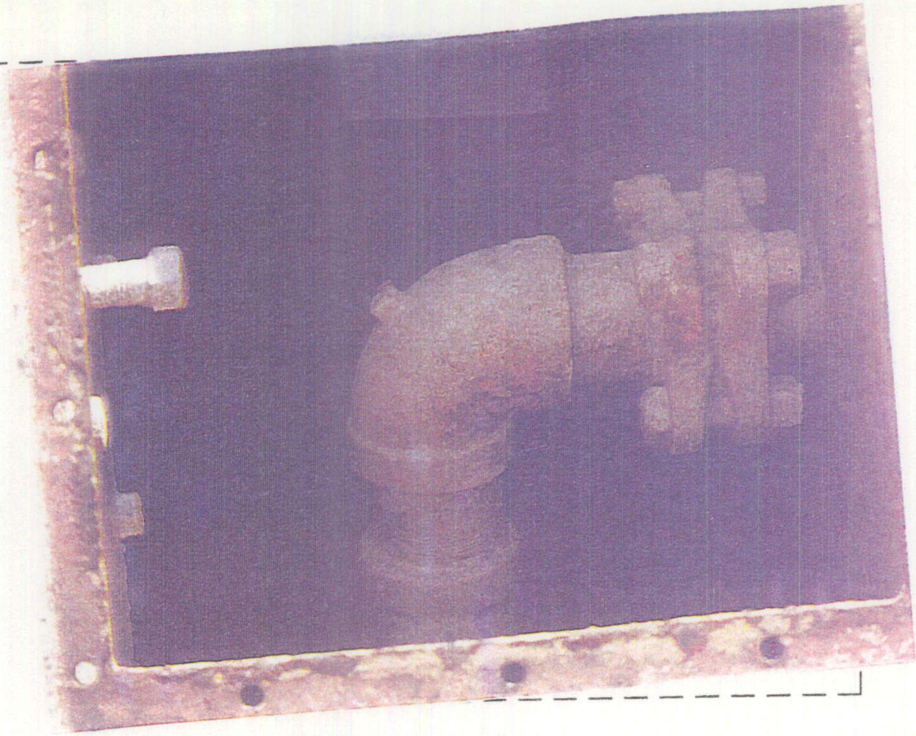


Photo 13. - Morris Dam - 70' x 18' Drum Gates - Gate #1, right side of gate. View of ejector piping exiting gate from the right and plumbed to the hinge at the bottom. - Sept 10, 1998.

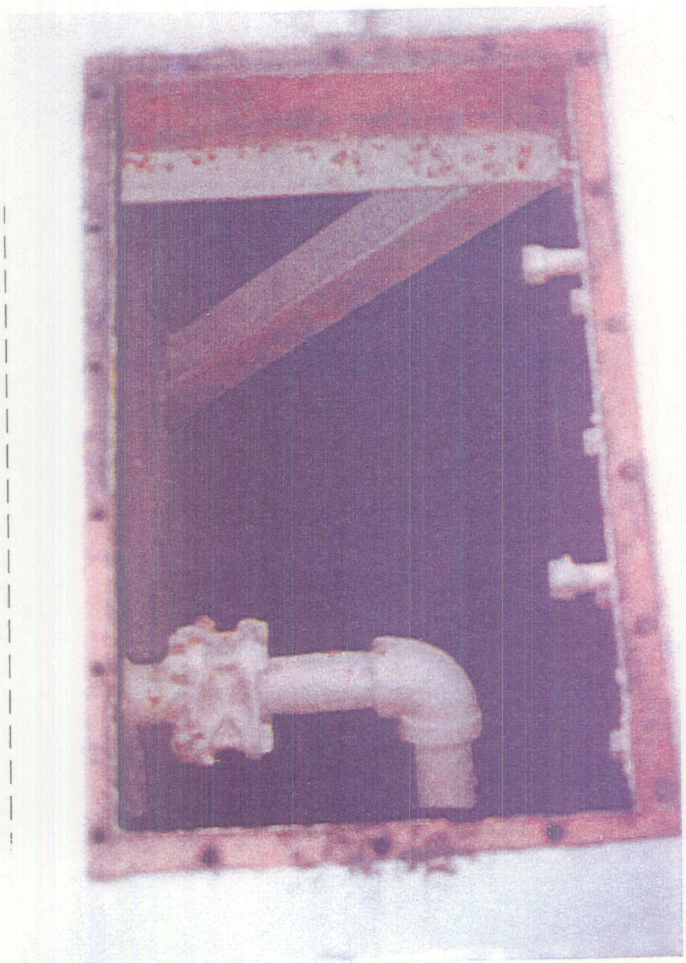


Photo 14. - Morris Dam - 70' x 18' Drum Gates - Gate #2, left side of gate. View of ejector piping exiting gate from the left and plumbed to the hinge at the bottom. Note brace for cantilevered portion of downstream faceplate. - Sept 10, 1998.

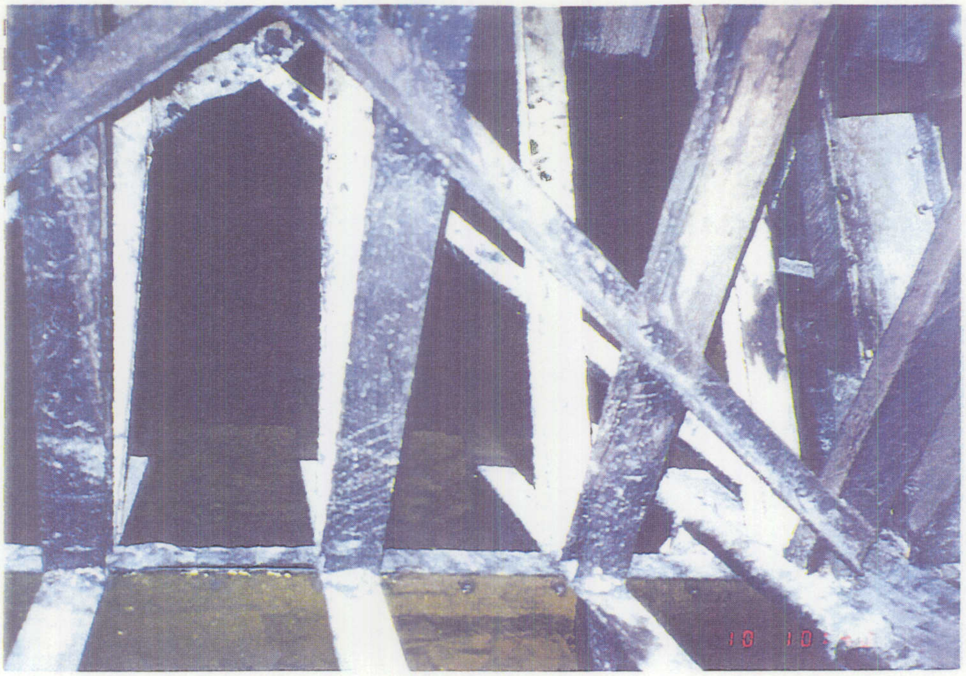


Photo 15. - Morris Dam - 70' x 18' Drum Gates - Gate #2, left side of gate. View inside hatch, looking down towards bottom of gate. Note water ponding in webs of structural members. Gate #2 contained approx 3' of water. - Sept 10, 1998.

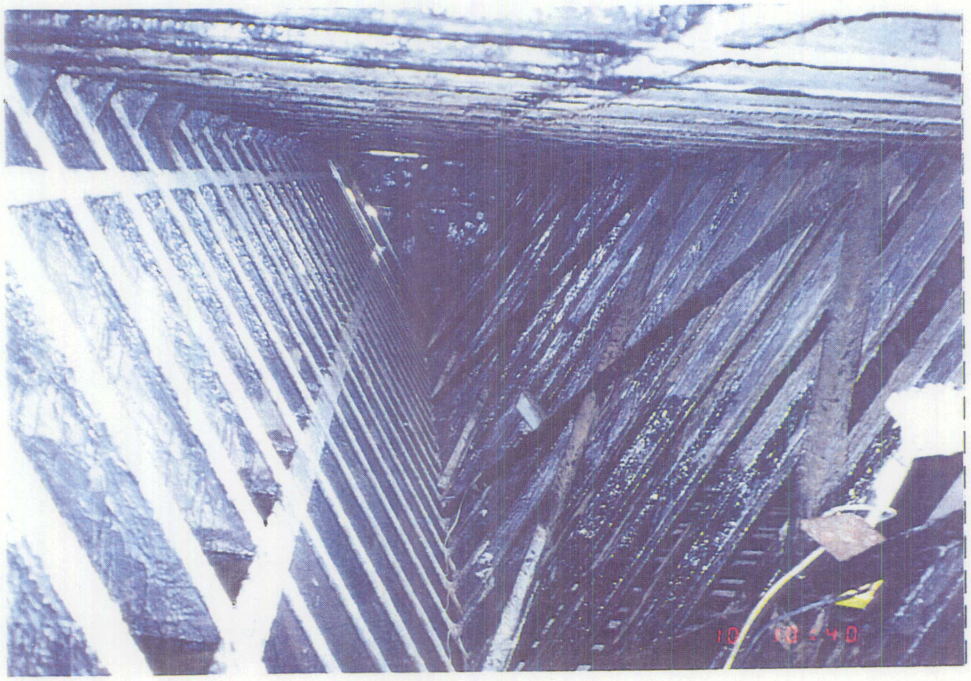


Photo 16. - Morris Dam - 70' x 18' Drum Gates - Gate #2, View from hatchway looking from left side of gate looking 70' towards right side of gate. Top of photo are structural members for d/s face, left side photo are members for bottom face, and right side of photo are members for upstream face. - Sept 10, 1998.

Photo 17. - Morris Dam - 70' x 18' Drum Gates - Gate #2 - downstream faceplate, left side of gate. View of wallplate and end seal. Note missing portion of end seal. - Sept 10, 1998.

Photo 18. - Morris Dam - 70' x 18' Drum Gates - Gate #2 - downstream faceplate, right side of gate. View of wallplate and end seal. Note missing portion of end seal. Right arrow points to pair of concentric gouge marks. Up arrow points to arcs scrapped by seal guard. - Sept 10, 1998.

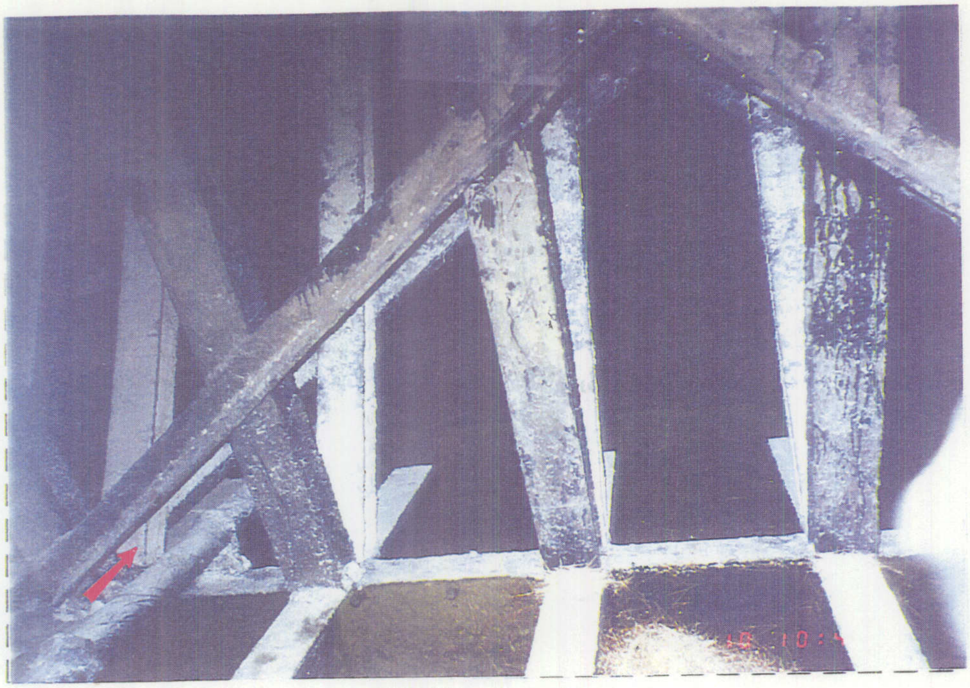


Photo 19. - Morris Dam - 70' x 18' Drum Gates - Gate #2 -View of internal bracing inside gate at right hatchway. Note ponding water inside webs of structural members for bottom faceplate, and note 3" ejector piping on right. Arrow points towards bottom of gate. - Sept 10, 1998.

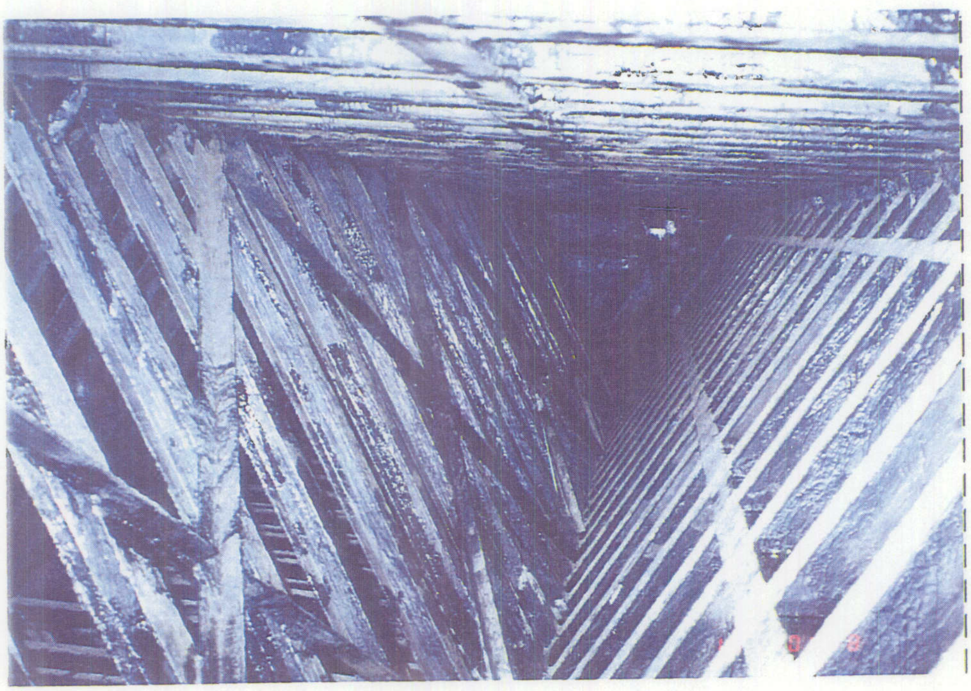


Photo 20. - Morris Dam - 70' x 18' Drum Gates - Gate #2, View from hatchway (Photo 18) from right side of gate looking 70' towards left side of gate. Top of photo are structural members for d/s face, left side photo are mid-bracing members, right side of photo are bottom face members. - Sept 10, 1998.

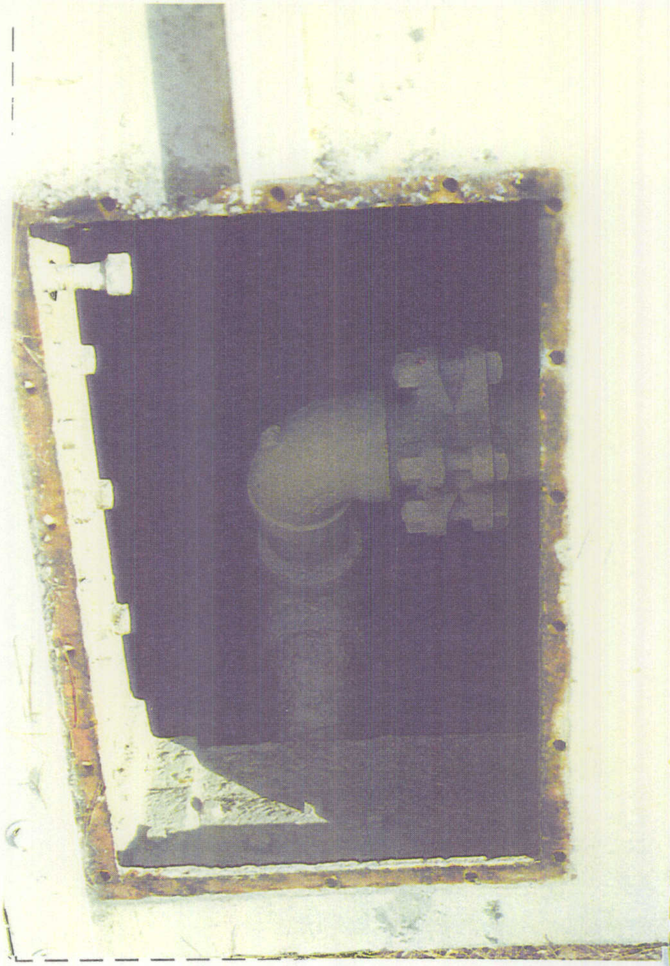


Photo 21. - Morris Dam - 70' x 18' Drum Gates - Gate #2, right side. View of ejector piping though hatchway (Photo 18). - Sept 10, 1998.

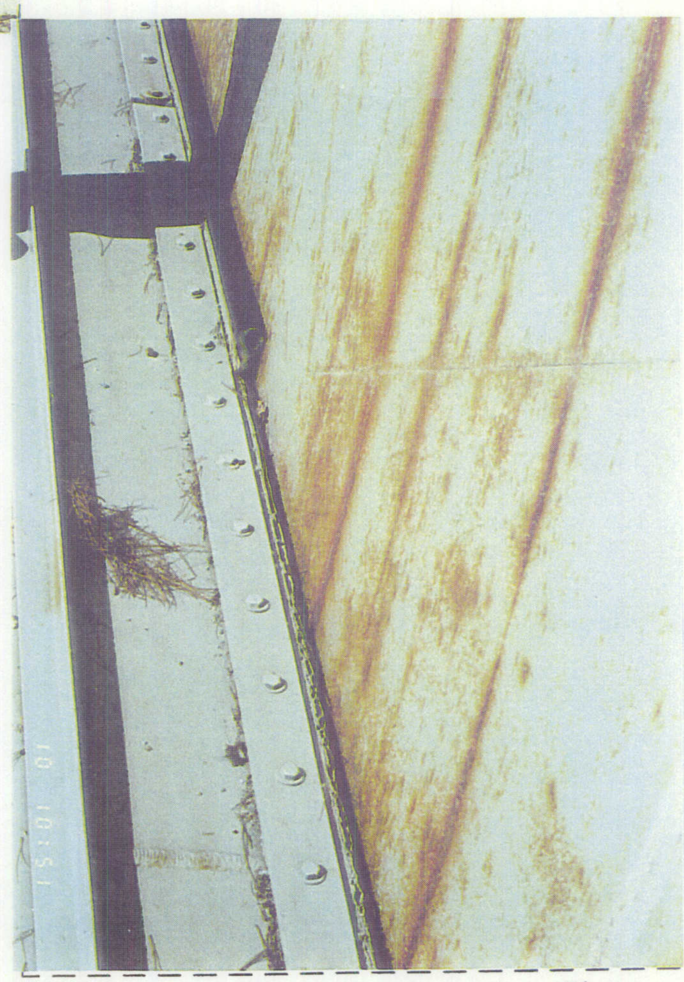


Photo 22. - Morris Dam - 70' x 18' Drum Gates - Gate #2, Right side of gate. View of missing seal (Photo 18). Note oversized hollow bulb seal with excessive stem deflection. Seals are circa '60s retrofit from original seals. Seals bulbs are not oriented/installed for effective sealing. - Sept 10, 1998.

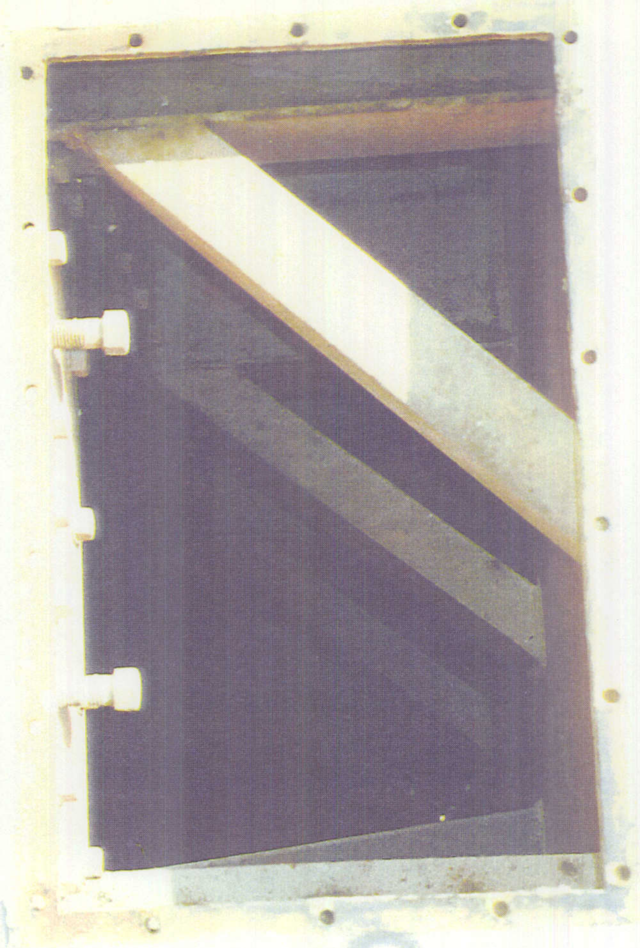


Photo 23. - Morris Dam - 70' x 18' Drum Gates - Gate #2, Right side of gate. Bracing for cantilevered portion of upstream faceplate, and portions of horizontal stiffener beams. - Sept 10, 1998.

Photo 24. - Morris Dam - 70' x 18' Drum Gates - Gate #3, Left side of gate. Wallplate and end seals with missing portion. Note rust "arcs" due to scrapping by seal guards. - Sept 10, 1998.

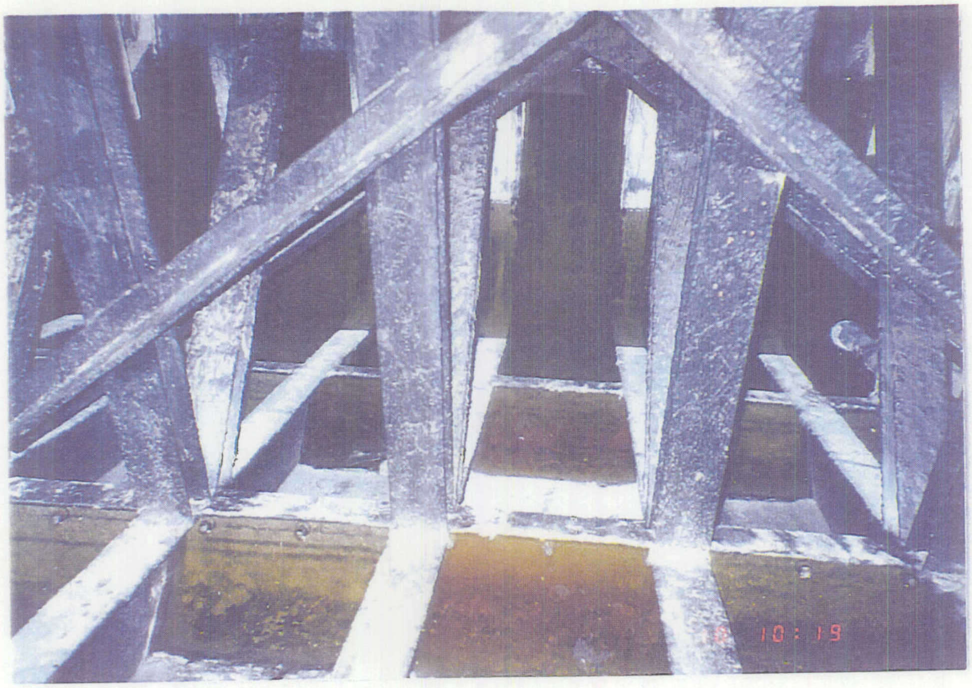


Photo 25. - Morris Dam - 70' x 18' Drum Gates - Gate #3, Left side of gate. View inside gate through hatch (Photo 24) looking along bottom faceplate. Note ponding water in webs of beams, and depth of water (approx 5'), and coal tar coating on structural members. - Sept 10, 1998.

Photo 26. - Morris Dam - 70' x 18' Drum Gates - Gate #3, Left side of gate. View inside gate through hatch (Photo 24). Note 3" ejector piping on right (piping is plumbed towards bottom of gate), and mid-bracing at top of photo. - Sept 10, 1998.

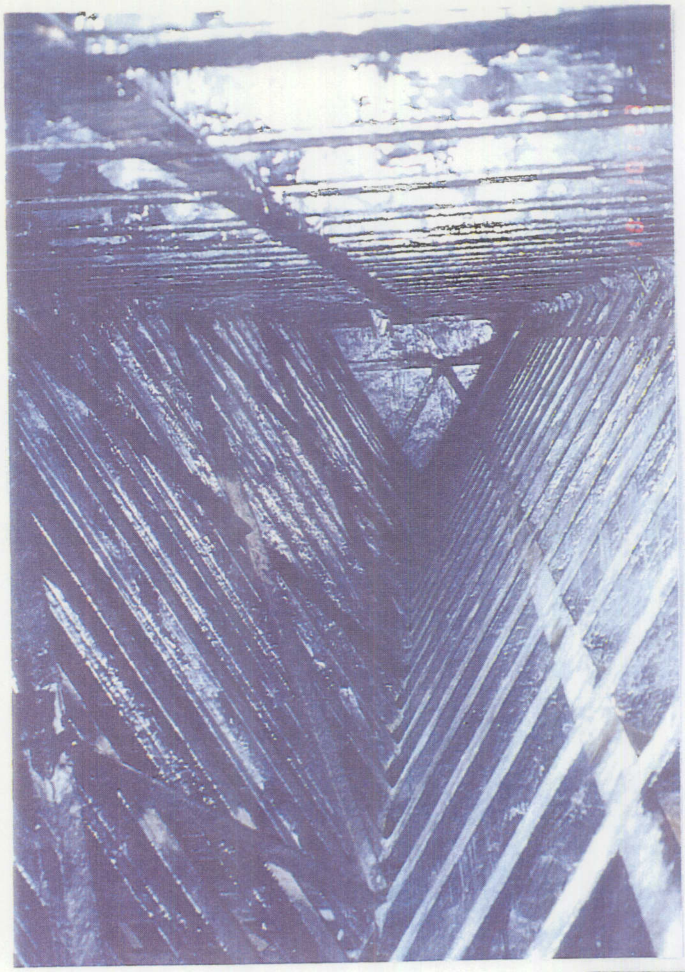


Photo 27. - Morris Dam - 70' x 18' Drum Gates - Gate #3, View from right side of gate, looking 70' towards left side of gate. Top of photo are members for downstream face, left side of photo are the internal braces, right side of photo are structural members for bottom faceplate. - Sept 10, 1998.

Photo 28. - Morris Dam - 70' x 18' Drum Gates - Gate #3, right side of gate. Wallplate and end seal with missing portion (Photo 29) - Sept 10, 1998.

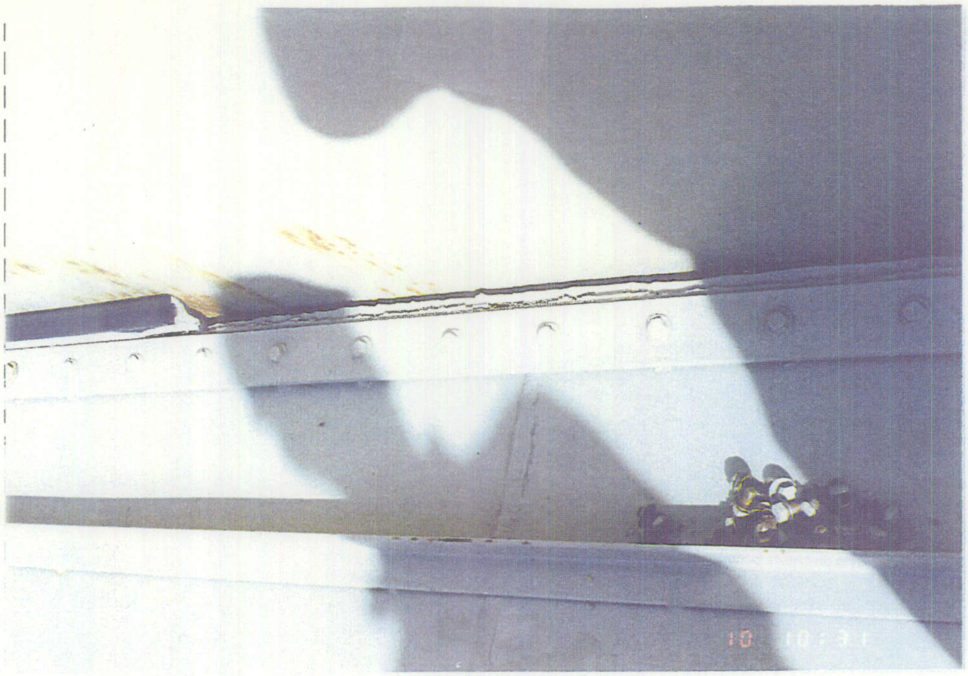


Photo 29. - Morris Dam - 70' x 18' Drum Gates - Gate #3, right side of gate. Missing portion of sea (Photo 28) - Sept 10, 1998.

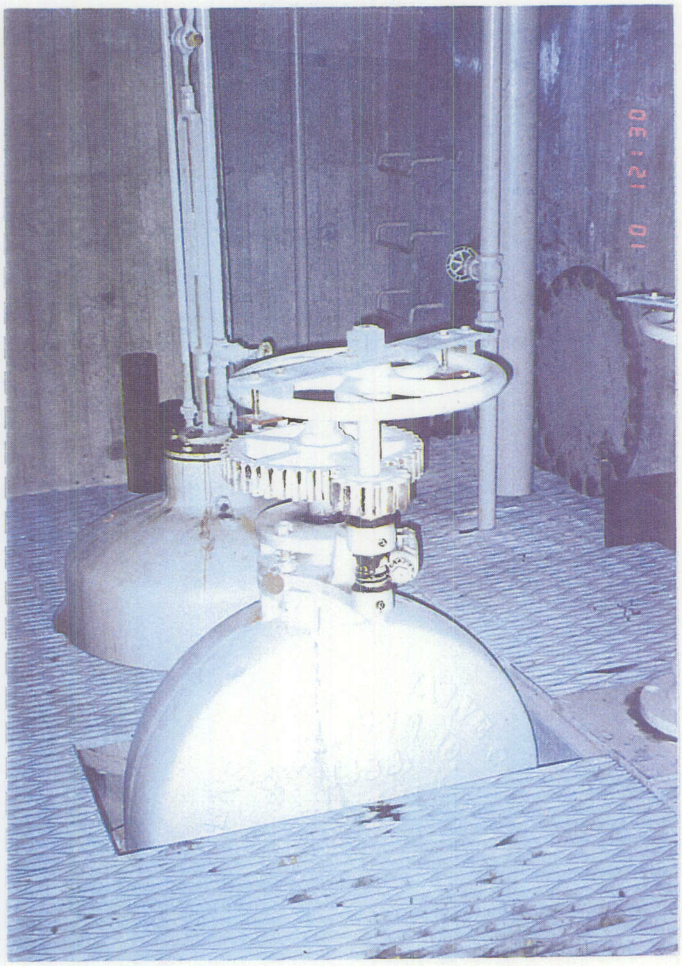


Photo 30. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate Controls, needle valve and butterfly valve for 30" drain line. - Sept 10, 1998.

Photo 31. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate Controls, gate valve for 19" supply line. - Sept 10, 1998.

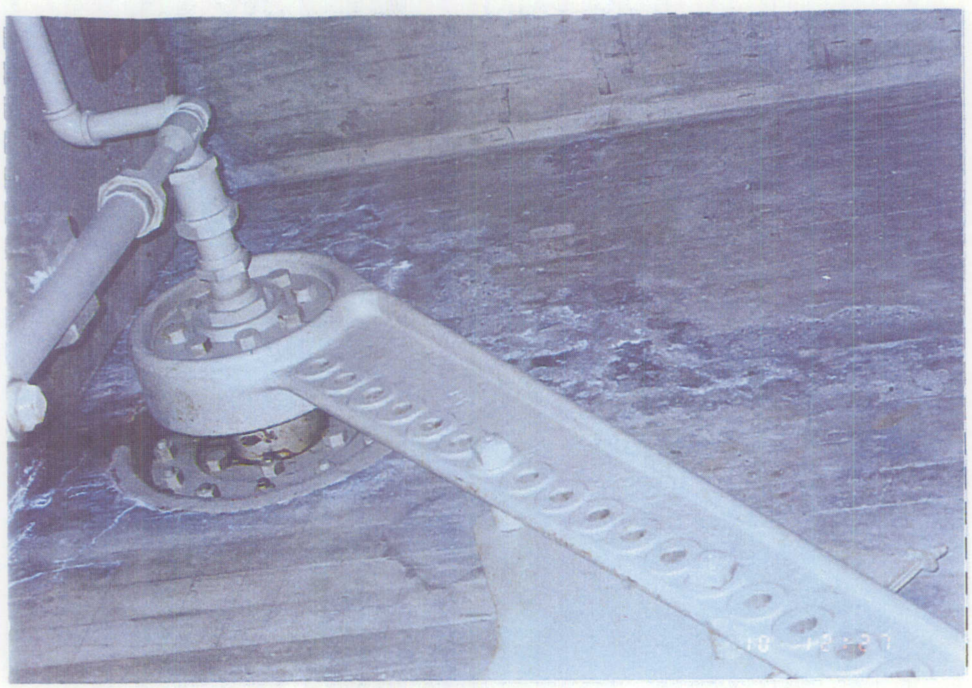


Photo 32. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate controls. Hinge and position indicator. - Sept 10, 1998.

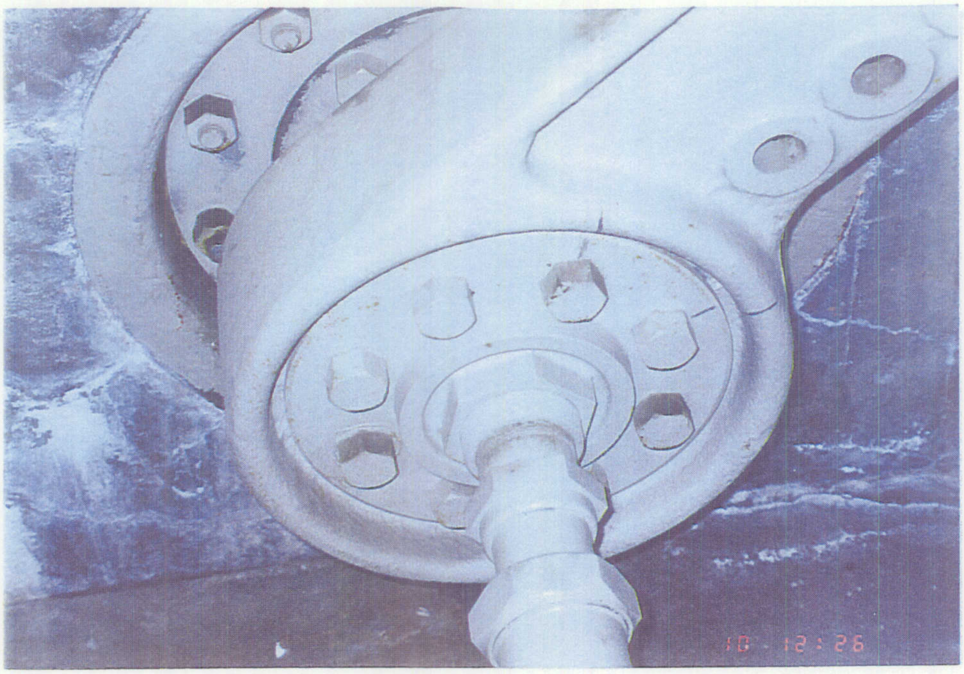


Photo 33. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate controls Close up of hinge and ejector piping. - Sept 10, 1998.

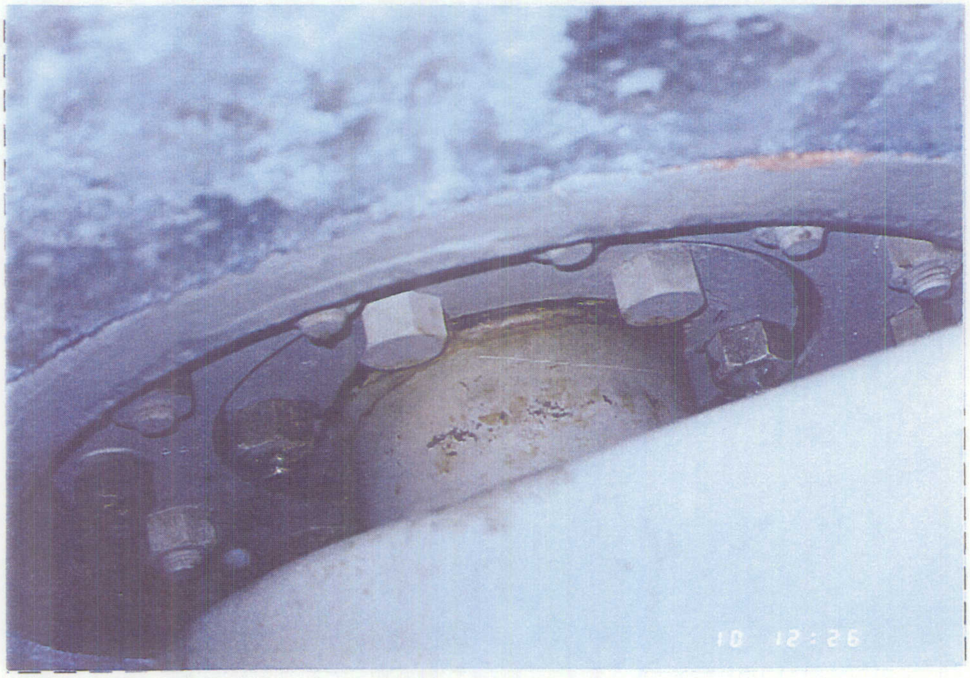


Photo 34. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate control room. Close up of hinge. - Sept 10, 1998.

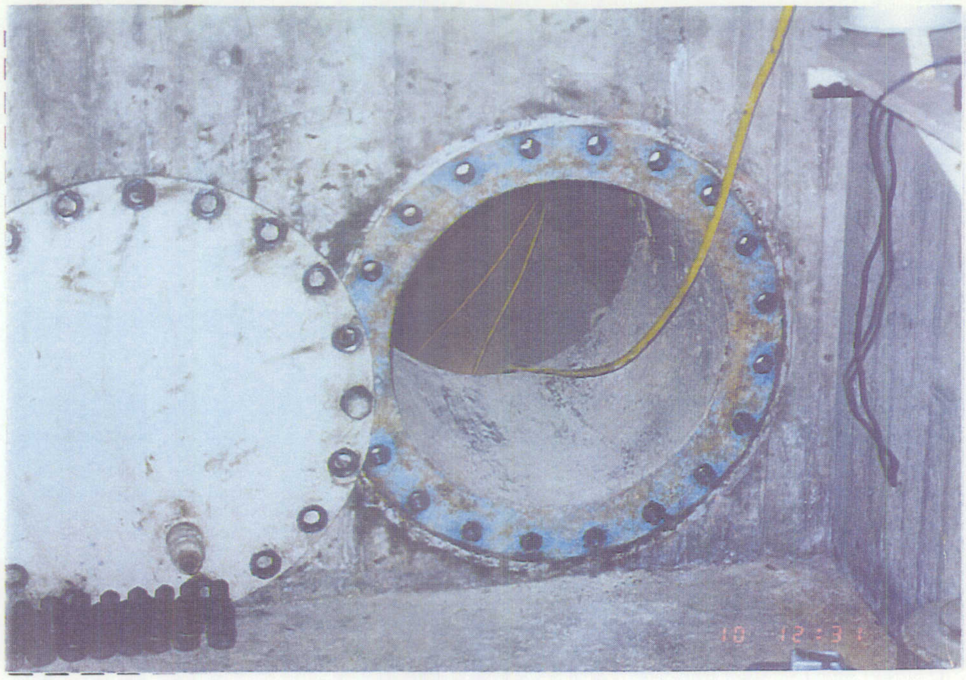


Photo 35. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate control room -24" Access entryway into upstream side of gate chamber. - Sept 10, 1998.

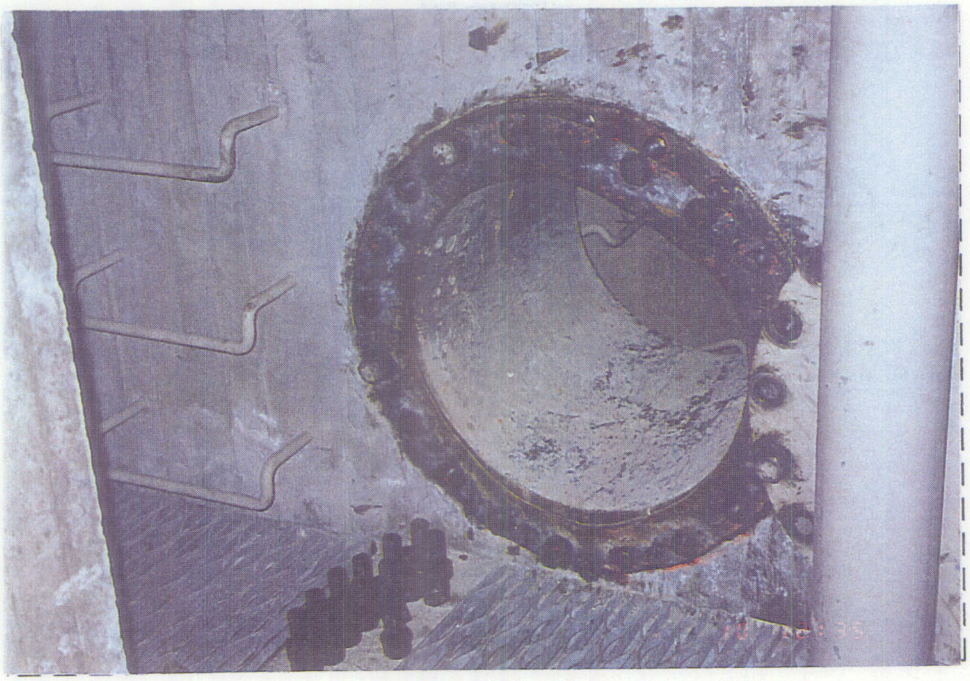


Photo 36. - Morris Dam - 70' x 18' Drum Gates - Gate #1 (East Gate), Gate control room, 24" Access entry way into downstream side of gate chamber. - Sept 10, 1998.

Morris Dam
Drum Gate 1
East

Photo 1 - Morris Dam - 70' x 18' Drum Gate #1 - Left wall of concrete gate chamber wall, showing 30" discharge outlet and 20" supply inlet.- (9/10/98).

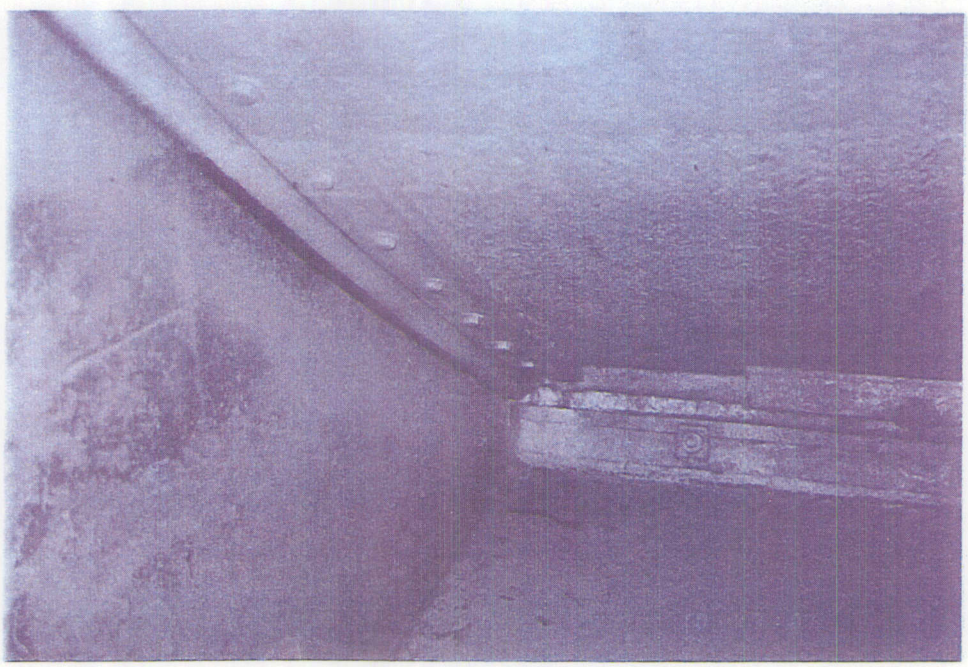


Photo 2 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Upstream side of gate chamber. Left chamber wall, left end of upstream faceplate, and music-note seal near bottom of gate - (9/10/98).

Photo 3 - Morris Dam - 70' x 18' Drum Gate #1 - Inside gate chamber, left side of upstream faceplate, looking towards top of chamber, music-note seal and clamp bar.- (9/10/98).

Photo 4 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Upstream of dry gate chamber, gate lowered and resting on rail (at bottom) bottom edge of upstream faceplate, looking towards right side of gate along the stop angle. Note the 5" wide band where high velocity water has scrubbed coating from steel.. - (9/10/98).

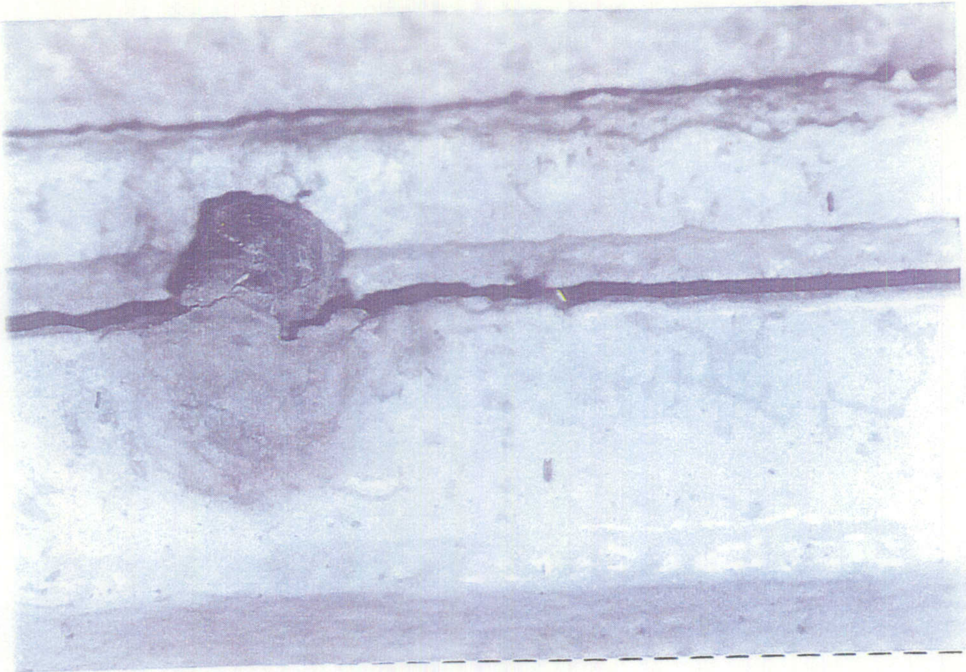


Photo 5 - Morris Dam - 70' x 18' Drum Gate #1 - Upstream side of gate chamber, gate lowered, looking at bearing portion of stop angle at the mark left by the stop screws indicating screw bears on angle.- (9/10/98).

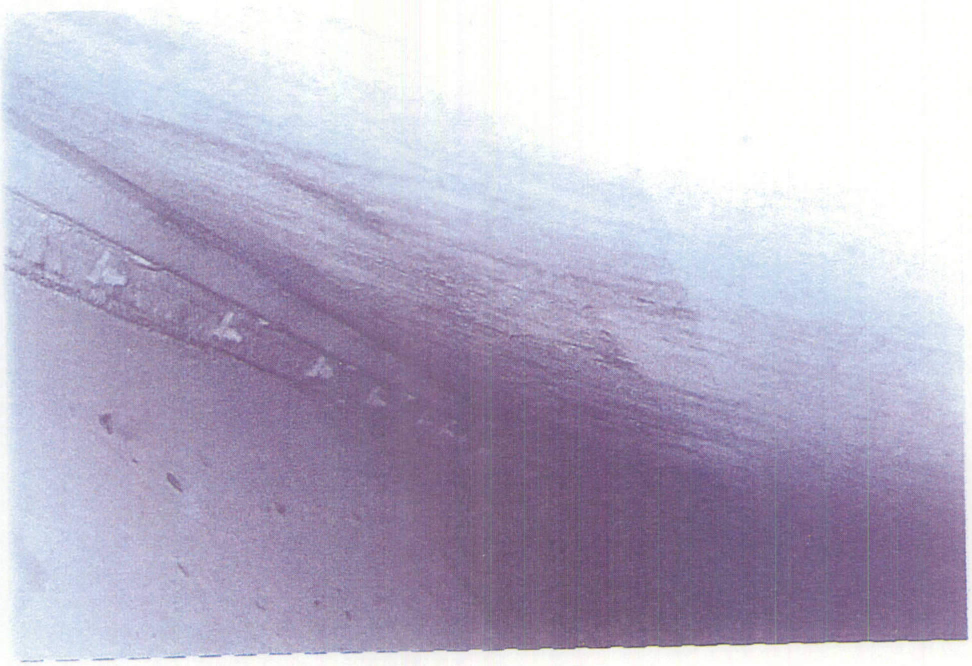


Photo 6 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Upstream side of gate chamber and u/s faceplate. Coating thin on faceplate. View of stop angle and rail.. - (9/10/98).

Photo 7 - Morris Dam - 70' x 18' Drum Gate #1 - View of upstream faceplate inside gate chamber. Note areas of missing paint.- (9/10/98).

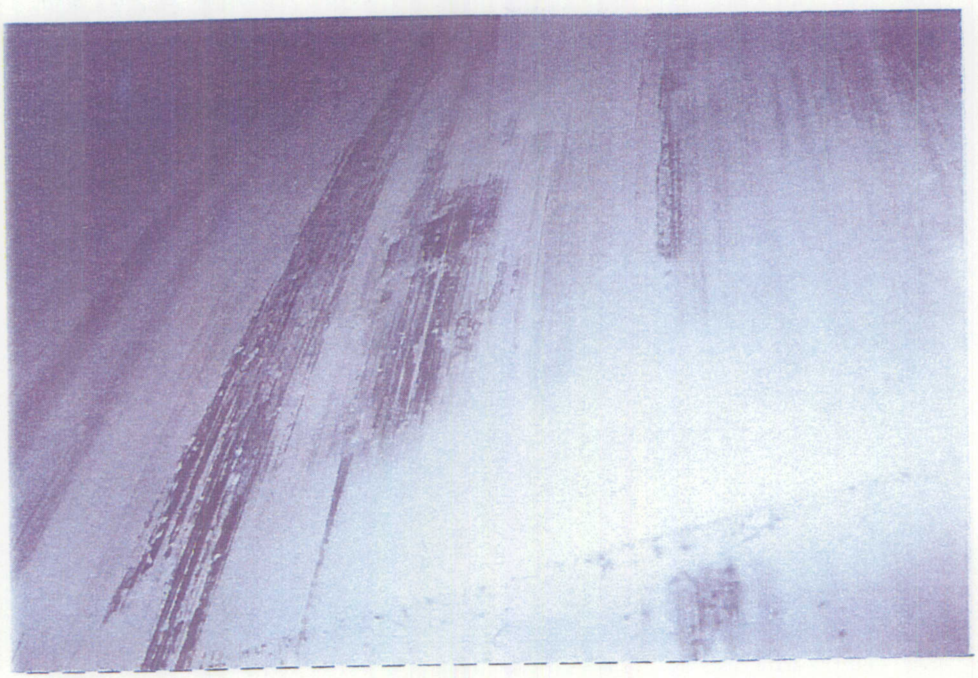


Photo 8 - Morris Dam - 70' x 18' Drum Gate #1 (east) - View of upstream faceplate inside gate chamber. Note areas of missing paint.. - (9/10/98).

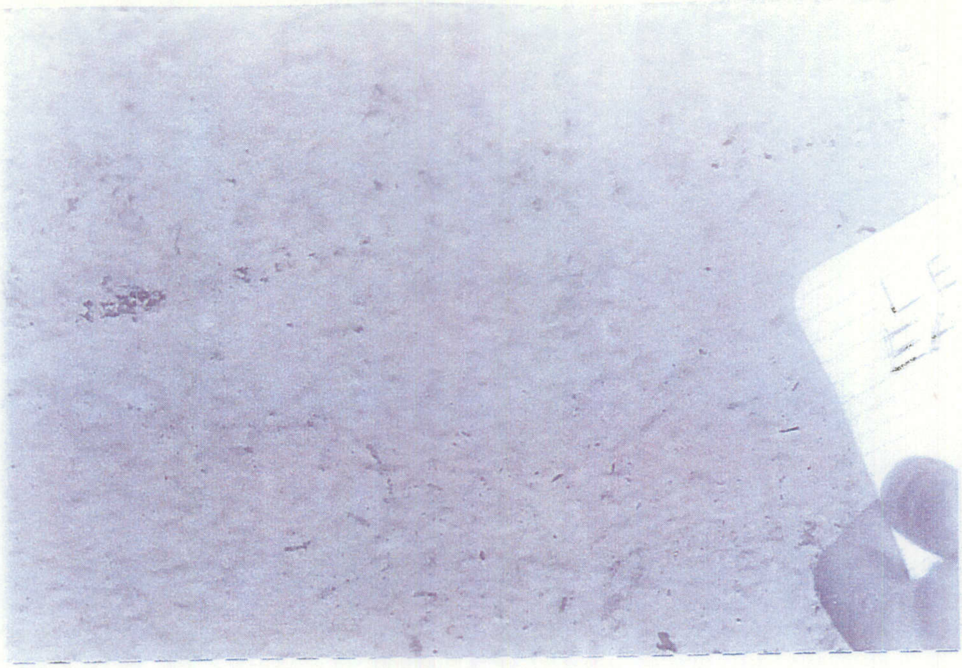


Photo 9 - Morris Dam - 70' x 18' Drum Gate #1 - Closeup of u/s faceplate. Note extensive pitting and loss of material.- (9/10/98).

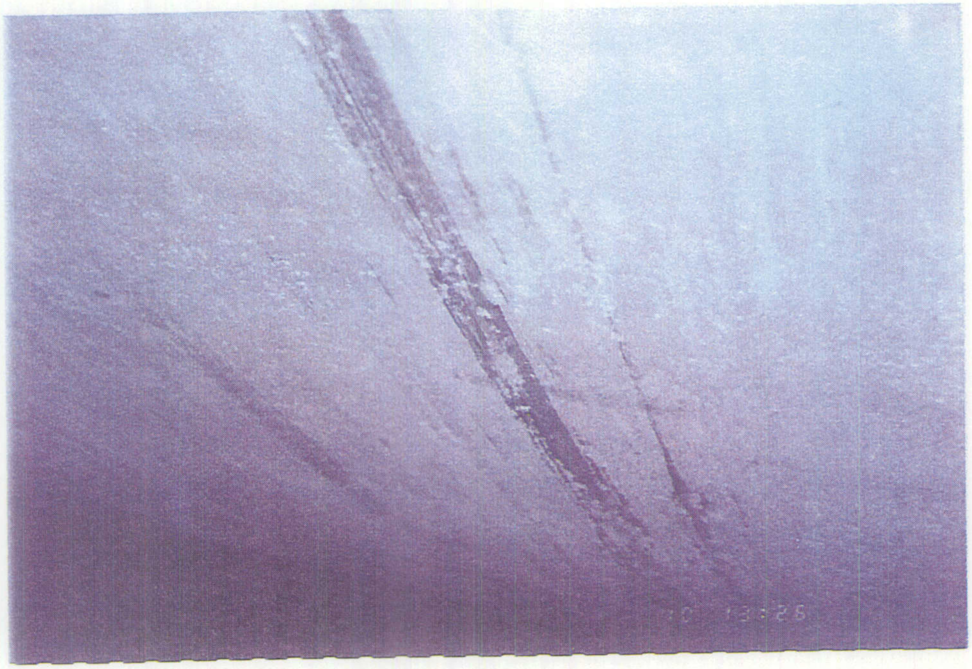


Photo 10 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Upstream faceplate at midpoint. Note 2" wide scrapping/gouging marks, Probably caused by shield guard (next photo). - (9/10/98).

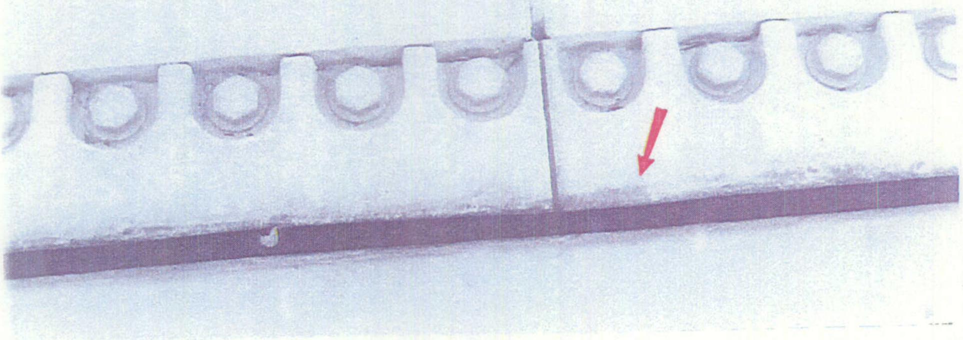


Photo 11 - Morris Dam - 70' x 18' Drum Gate #1 - Spillway crest, Gate #1, Looking down at shield guard. Arrow points at suspected scrapped edge causing marks shown on previous photo.- (9/10/98).

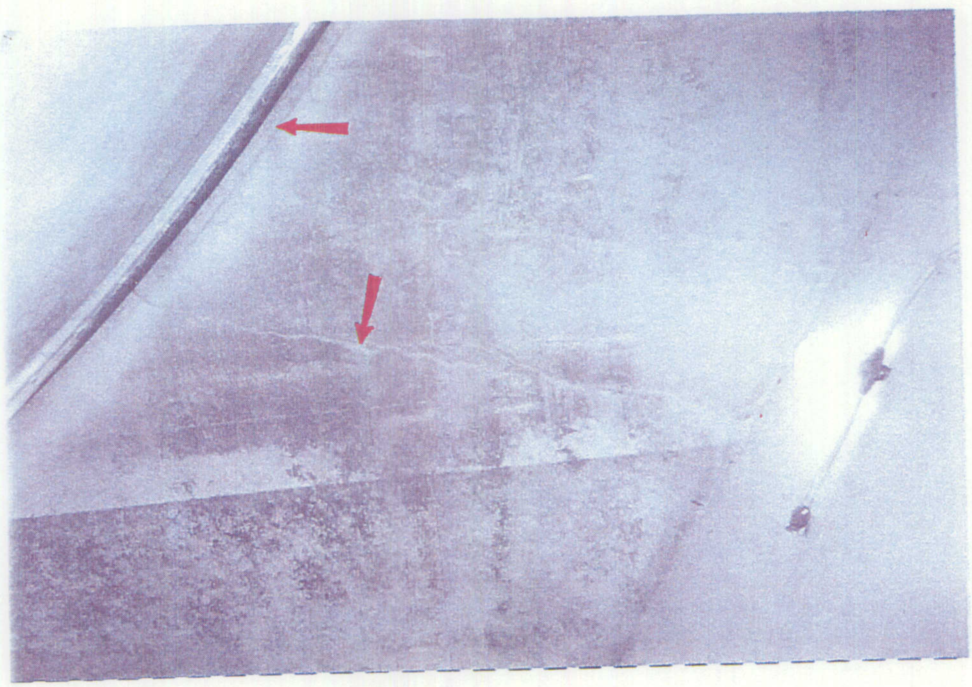


Photo 12 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Upstream side of gate chamber and of gate. Looking at right end chamber wall. Arrow (down) points at crack in wall. Left arrow points to right side upstream music not end seals.. - (9/10/98).

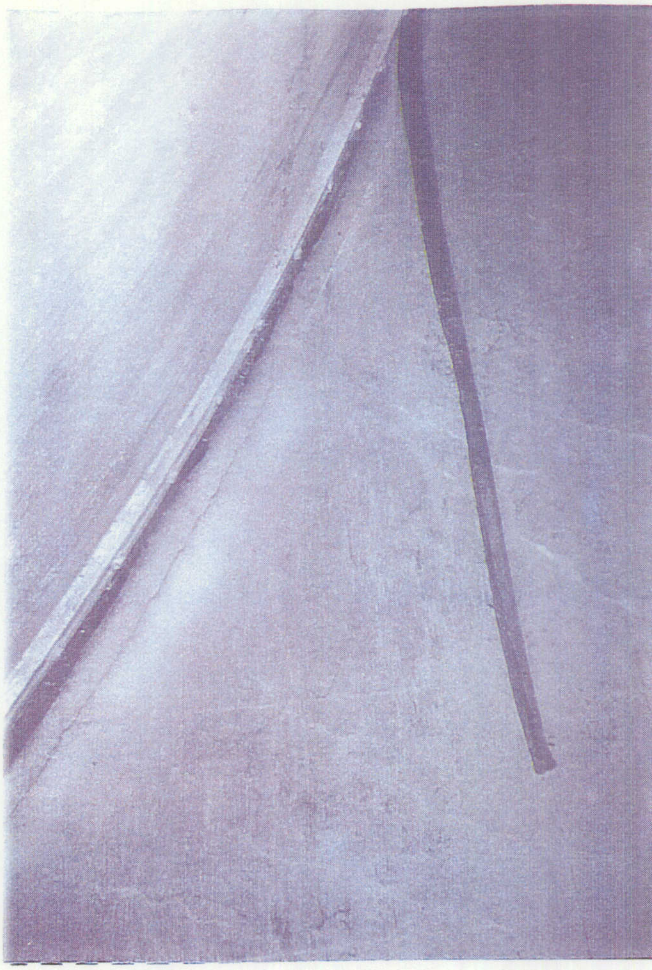


Photo 13 - Morris Dam - 70' x 18' Drum Gate #1 - Upstream side of gate chamber, right end of upstream faceplate, right end chamber wall and right side end seals. Note music note seal rotted and bulb torn from stem.- (9/10/98).

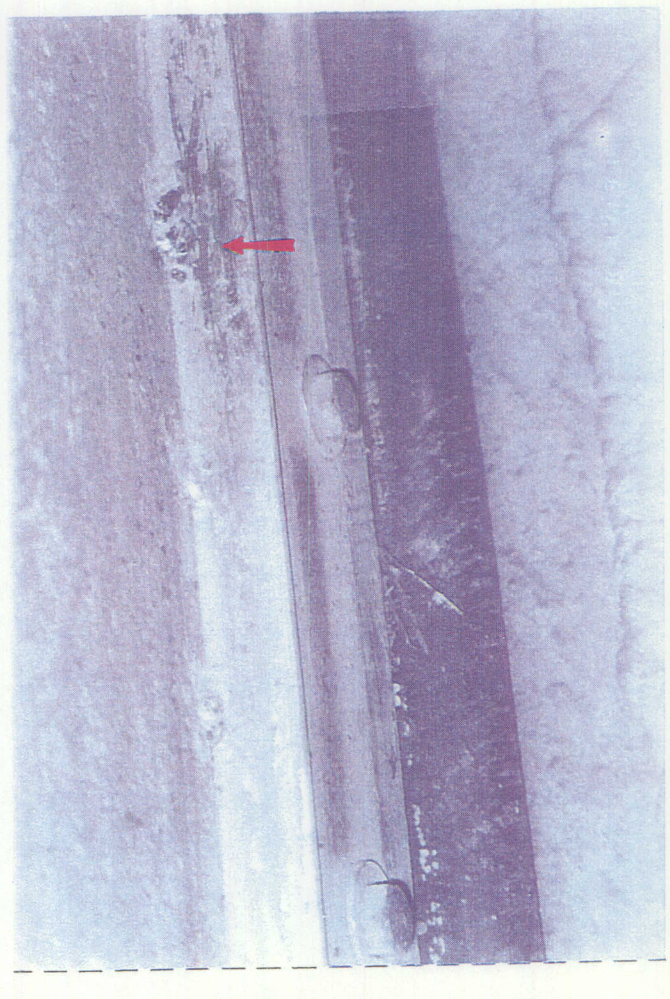


Photo 14 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Right side end music note seals. View of scrap mark on side of ½" seal stop bar. Scrap mark indicates possible interference with edge of shield guard, (next photo).. - (9/10/98).

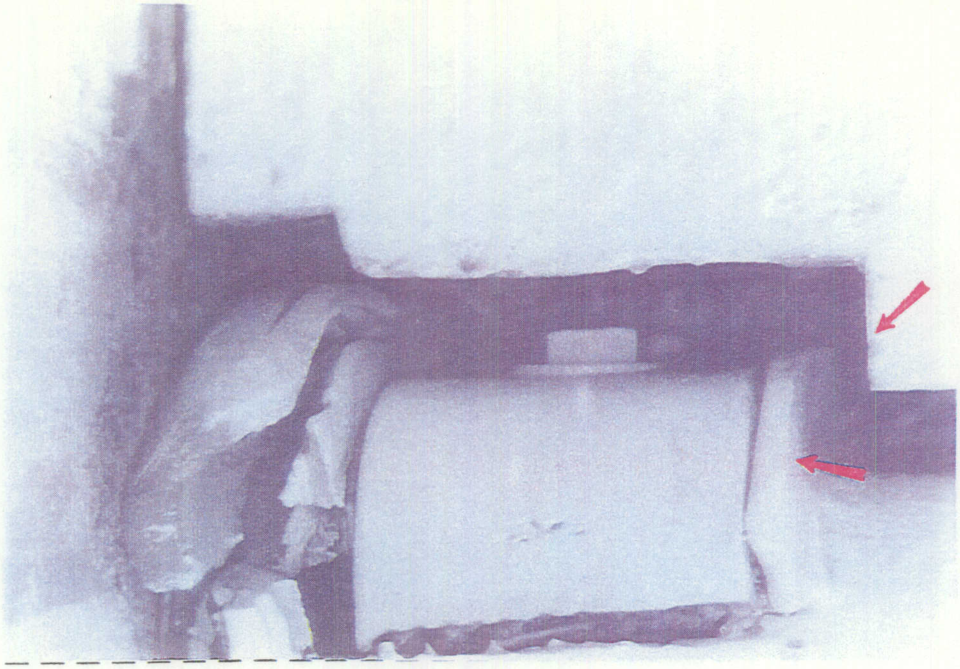


Photo 15 - Morris Dam - 70' x 18' Drum Gate #1 - Top of spillway crest, right end, Gate #1, looking down at rt. side end seal assembly, & rightmost notched shield guard. Left arrow points to ½" seal stop bar referred to in previous photo. Upper arrow points to probably cause of scrapping- (9/10/98).

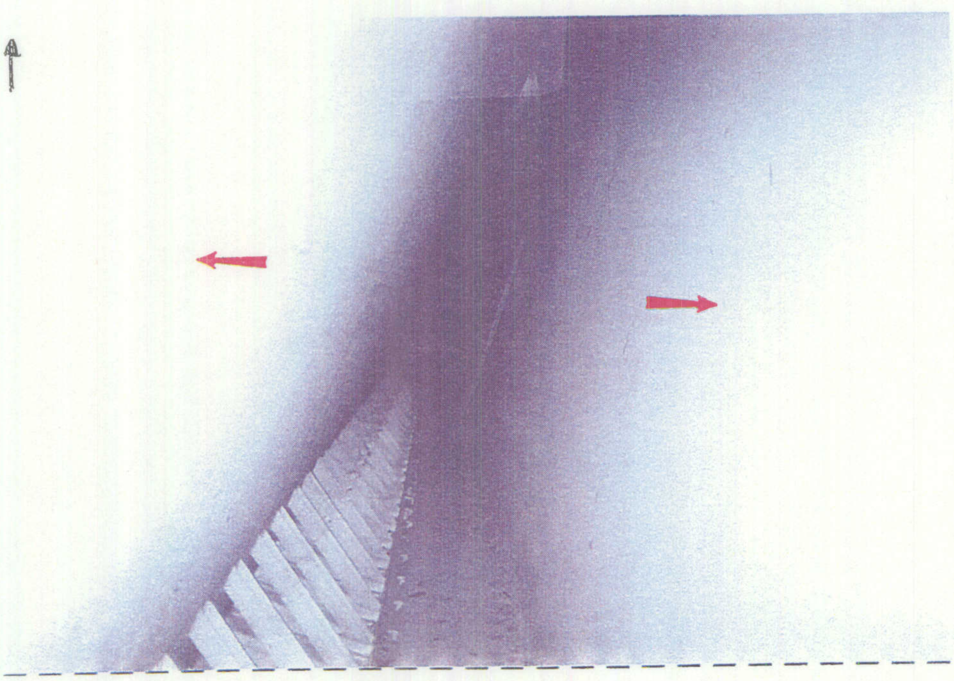


Photo 16 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Downstream side gate chamber. Left arrow points to bottom steel faceplate, right arrow points to d/s concrete chamber wall. Looking towards left end of gate. Braces support bottom cantilever portion of u/s faceplate.. - (9/10/98).

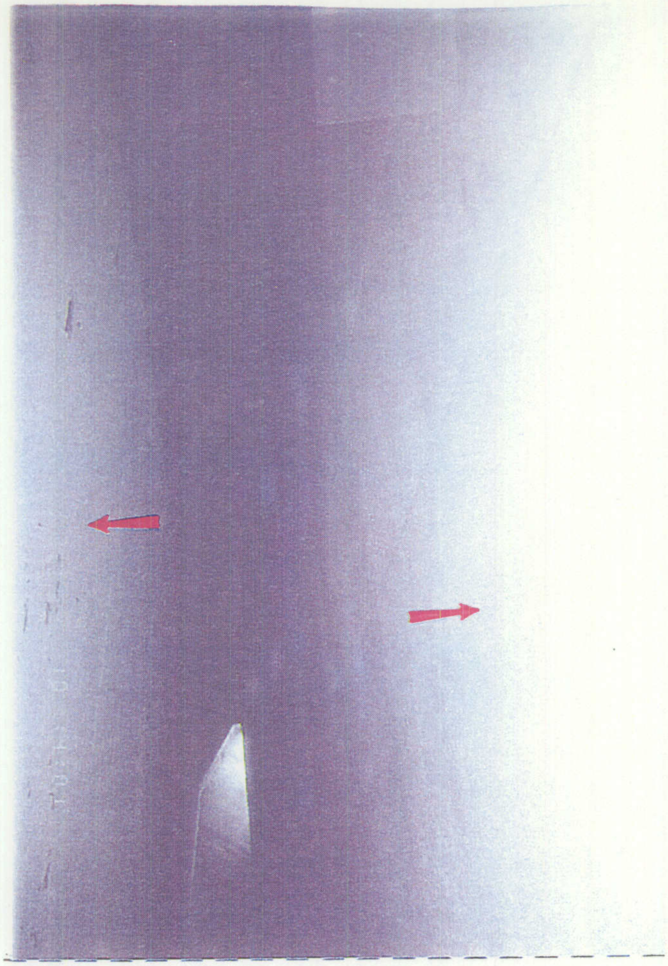


Photo 17 - Morris Dam - 70' x 18' Drum Gate #1 - D/S side of chamber, looking up and towards right end of gate. Right arrow points to bottom faceplate, left arrow point to concrete d/s wall. Light is from hatch at right end.- (9/10/98).

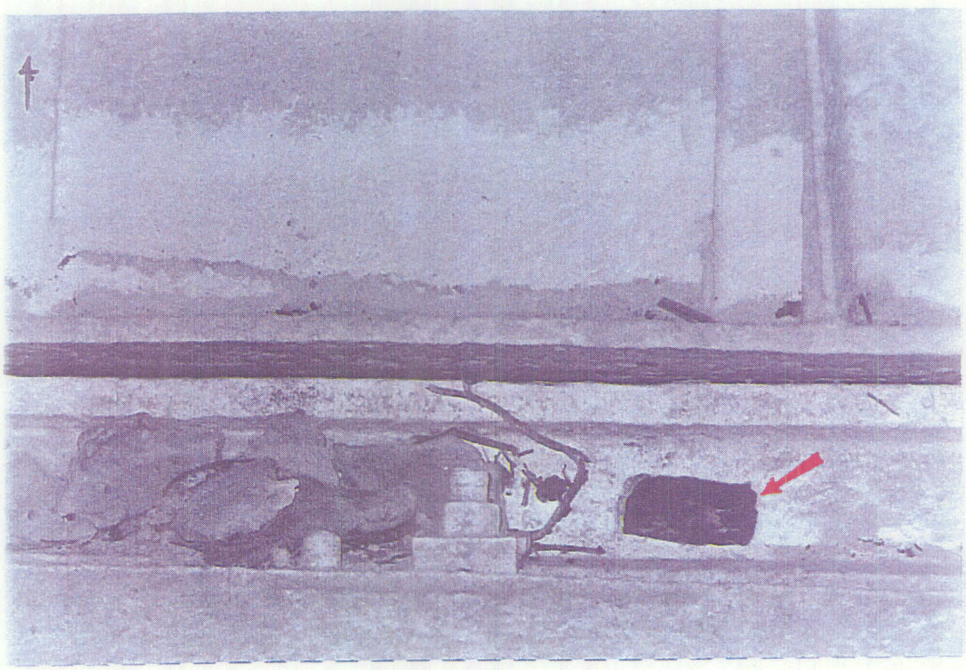


Photo 18 - Morris Dam - 70' x 18' Drum Gate #1 (east) - D/S side of chamber, Gate resting in lowered position on rail. Left arrow points to supply hole cut in web of rail. (next photo). - (9/10/98).

Photo 19 - Morris Dam - 70' x 18' Drum Gate #1 - Strike plate on bottom of gate resting on rail. Arrow points to cut out supply hole (previous photo).- (9/10/98).

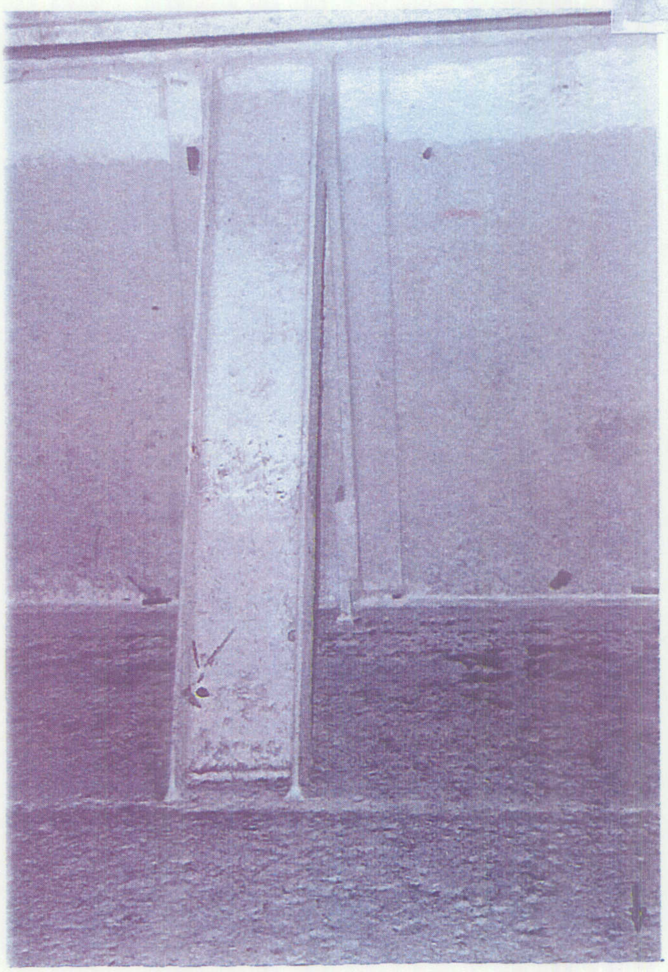


Photo 20 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Typical brace on cantilevered portion. Braces are generally well coated, but pitted. - (9/10/98).

Photo 21 - Morris Dam - 70' x 18' Drum Gate #1 - Right side of Gate #1, cantilevered portion of u/s faceplate. Paint is generally good, brace structure is satisfactory, but braces are pitted. Left arrow points to right chamber wall. Right arrow point end plates - satisfactory.- (9/10/98).

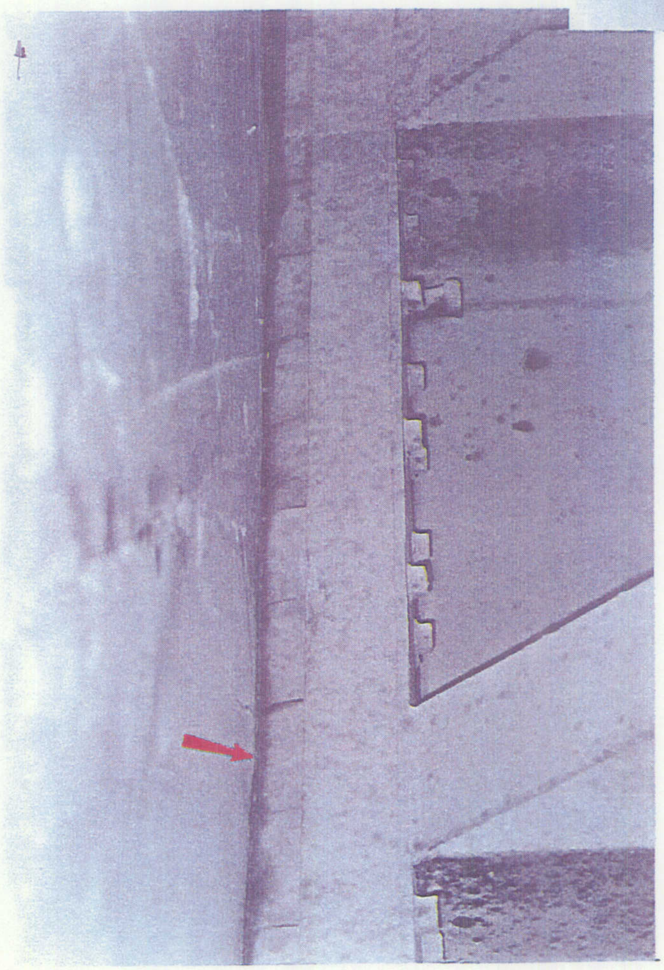


Photo 22 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Closeup of right end seal shield in contact with right embedded wallplate.. - (9/10/98).

Photo 23 - Morris Dam - 70' x 18' Drum Gate #1 - Left end cantilever portion, showing braces. Light at top is hatch through top of d/s faceplate.- (9/10/98).

Photo 24 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Arrow points to crack in right chamber wall, d/s side, 5' above floor x 12' long.. - (9/10/98).

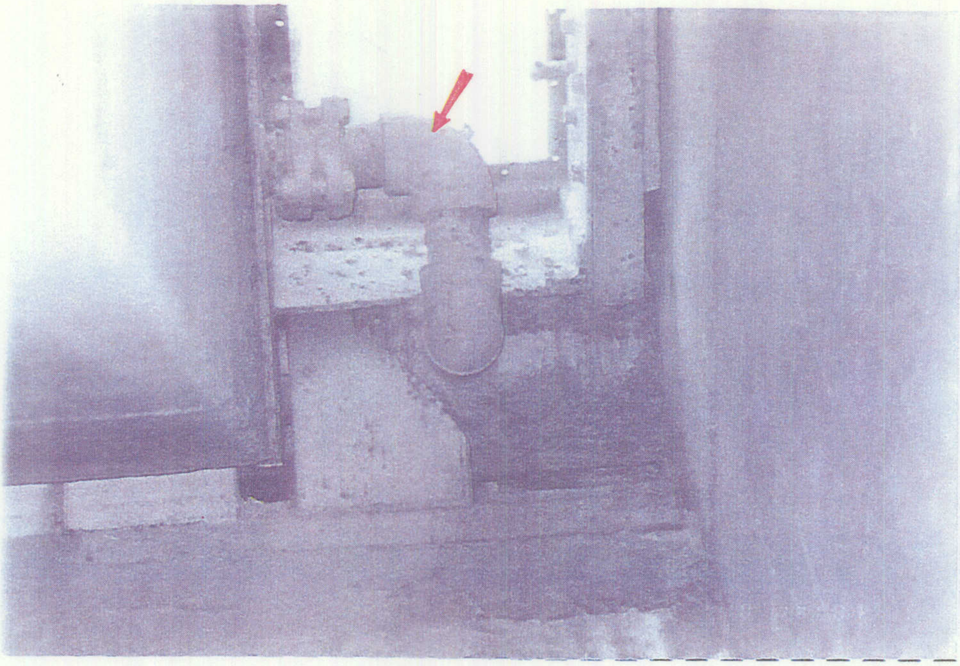


Photo 25 - Morris Dam - 70' x 18' Drum Gate #1 - Ejector (high pressure) piping through to drain water from gate - right side of gate.- (9/10/98).

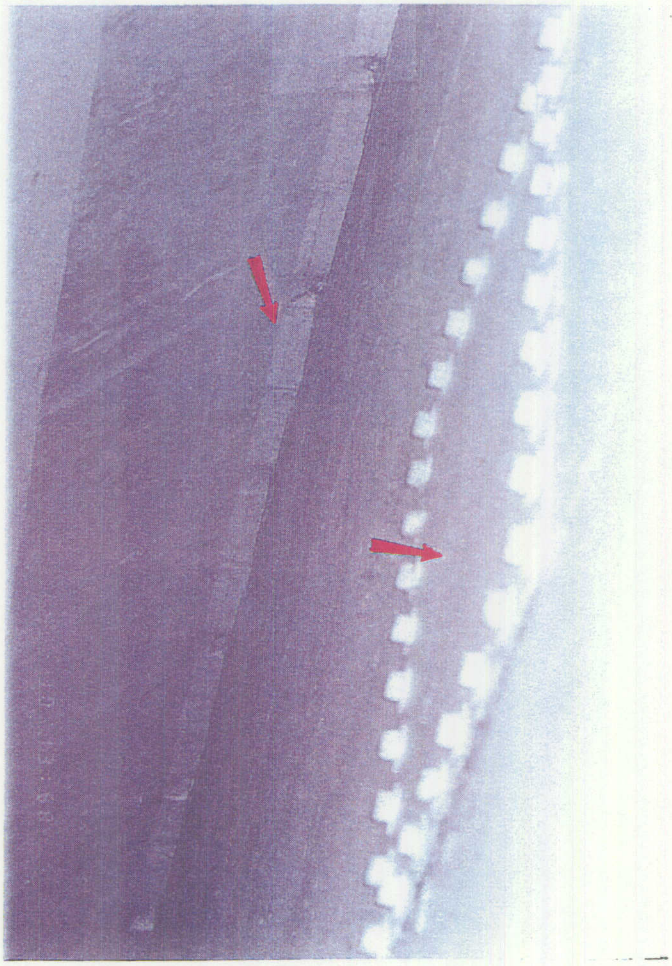


Photo 26 - Morris Dam - 70' x 18' Drum Gate #1 (east) - Right arrow - bottom faceplate. Looking up towards gate hinges (arrow). (9/10/98).

Morris Dam
Drum Gate 1
East, Interior

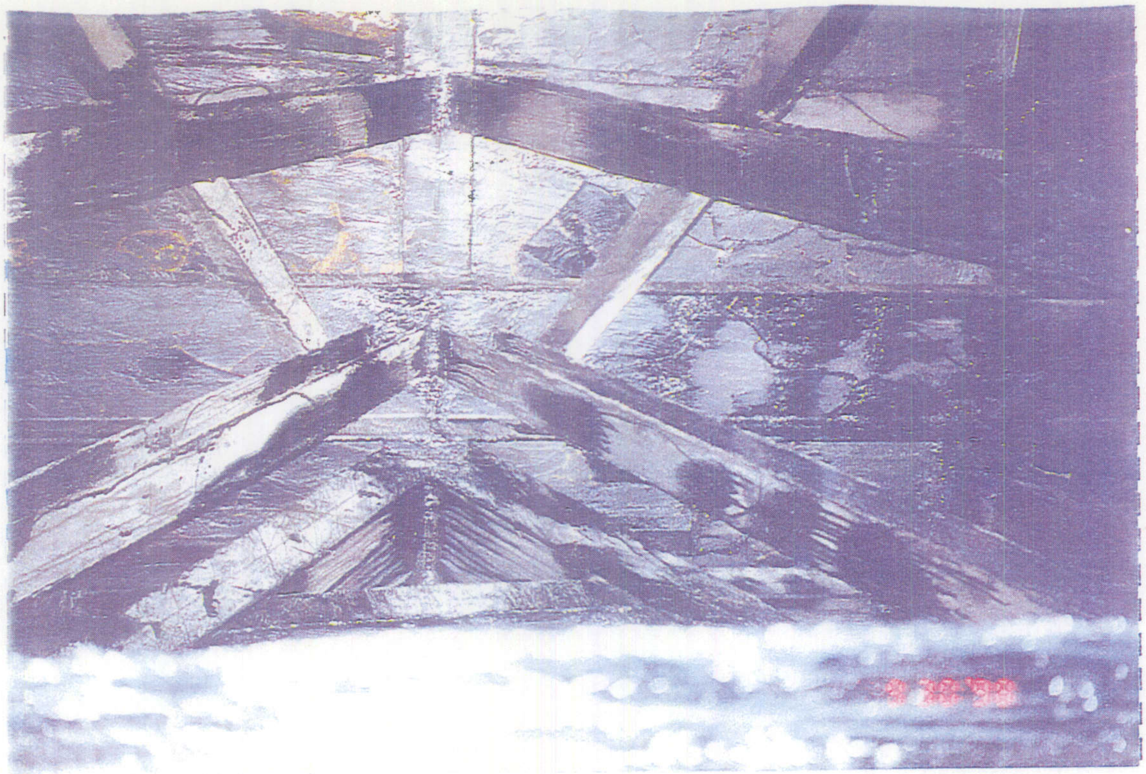


Photo 1 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Inside gate, looking up towards downstream faceplate along apex of internal bracing connection.- (9/30/98).

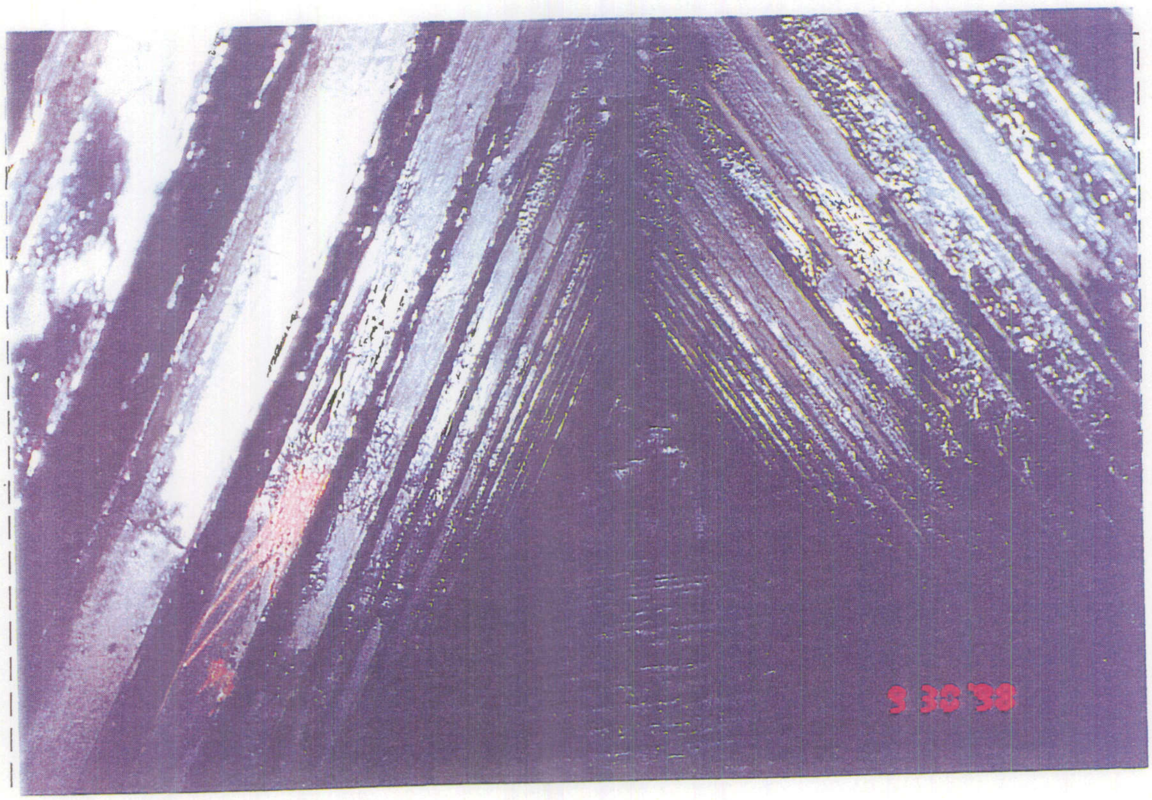


Photo 2 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Inside gate, looking left through middle of internal bracing at upper level. (9/30/98).

Photo 3 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Looking towards right through middle of internal bracing, upper level.- (9/30/98).

Photo 4 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Looking right, lower level. Bottom faceplate at photo left, and upstream members at right of photo. (9/30/98).

Photo 5 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Lower level, looking towards left end with bottom faceplate/members at right of photo, and upstream faceplate at left of photo.- (9/30/98).

Photo 6 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Lower leve, looking towards left end, with bottom faceplate on right of photo. Note ponding water in all horizontal webs. Upstream members at left of photo. (9/30/98).

Photo 7 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Looking up, middle of gate at splice joint which connects the two halves of gate along downstream faceplate.- (9/30/98).

Photo 8 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Slice connection between two halves of ate on upstream faceplate. (9/30/98).

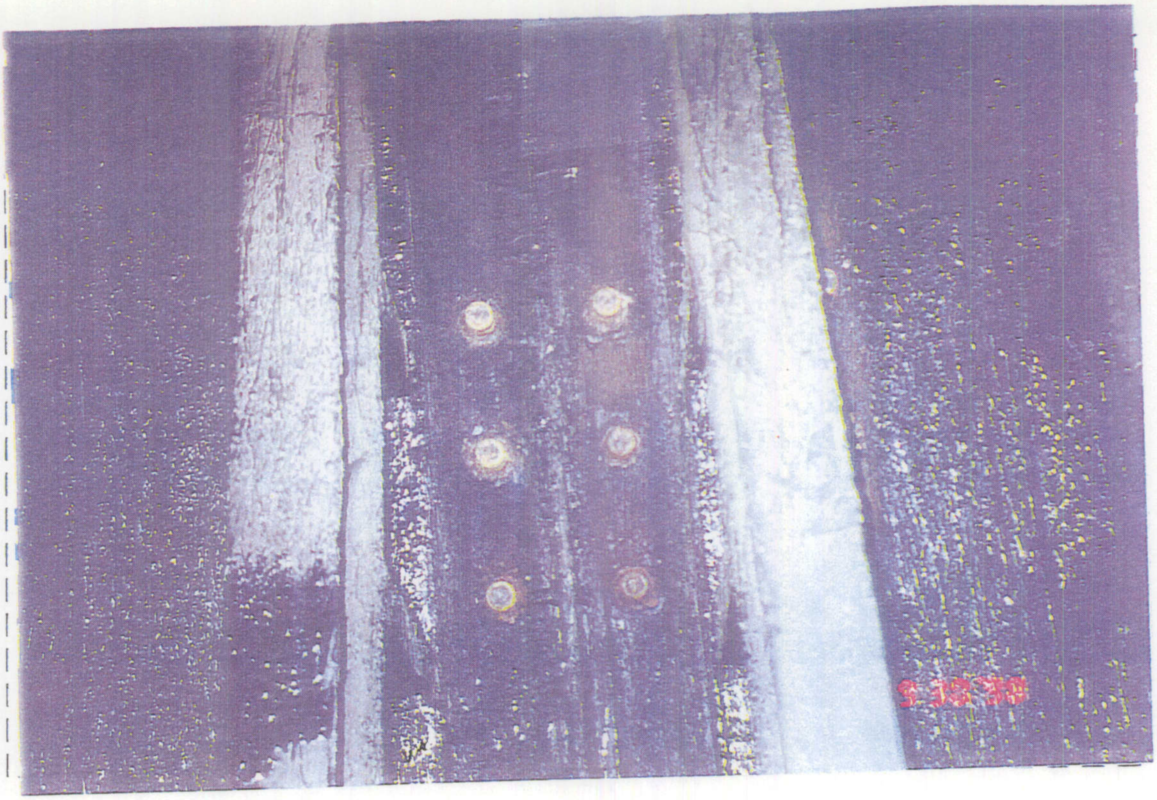


Photo 9 - Morris Dam - 70' x 18' Drum Gate #1 (interior)- Field splice connection between two halves of gate on bottom faceplate.

Morris Dam
Drum Gate 2
Middle

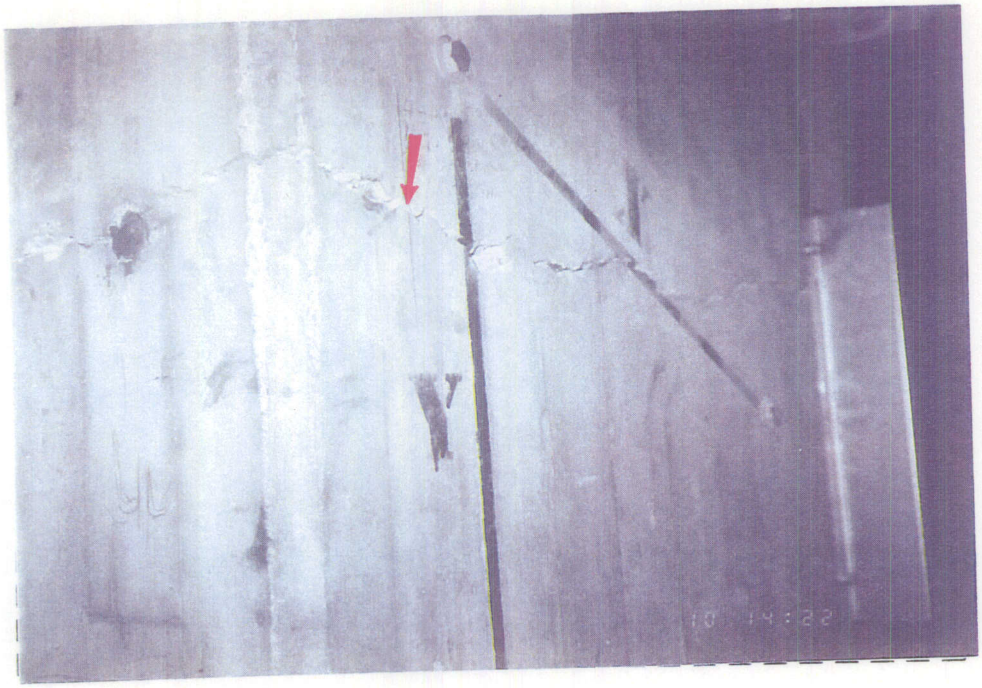


Photo 1 - Morris Dam - 70' x 18' Drum Gate #2 - Doorway entrance, El. 1136. to controls, Gate #2. Cracking due to earthquake (4/14/65) in concrete column. Crack movement is monitored. - (9/10/98).

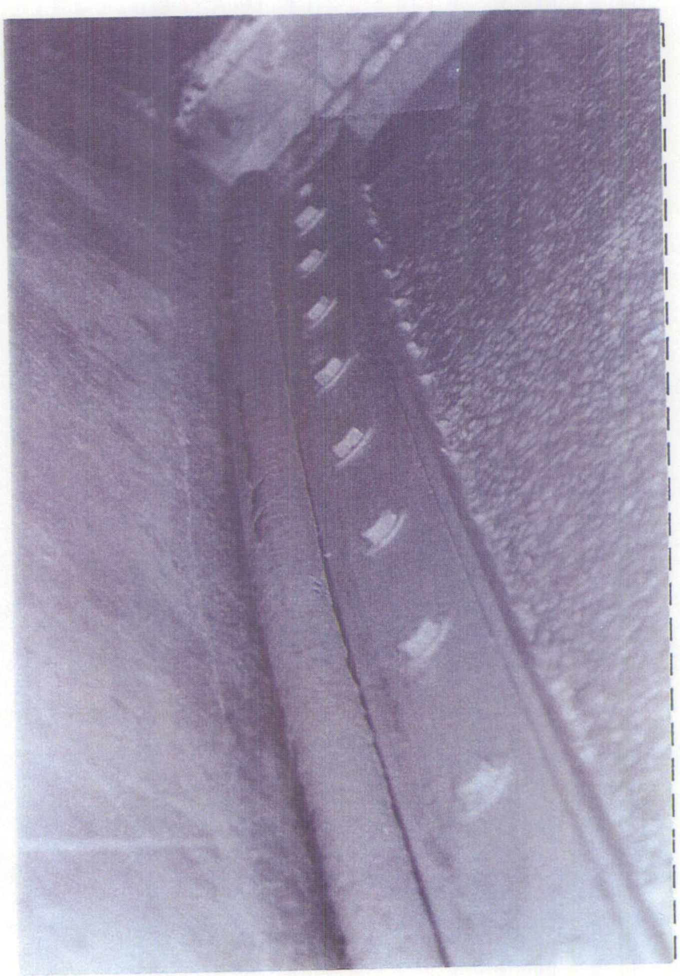


Photo 2 - Morris Dam - 70' x 18' Drum Gate #2 - U/S faceplate, u/s side of chamber, left side of gate, looking towards top of chamber. Note torn hollow music not seal. . - (9/10/98).

Photo 3 - Morris Dam - 70' x 18' Drum Gate #2 - U/S faceplate, u/s side of gate, looking towards top of gate. seal and clamp bar. Note extensive pitting over faceplate. - (9/10/98).

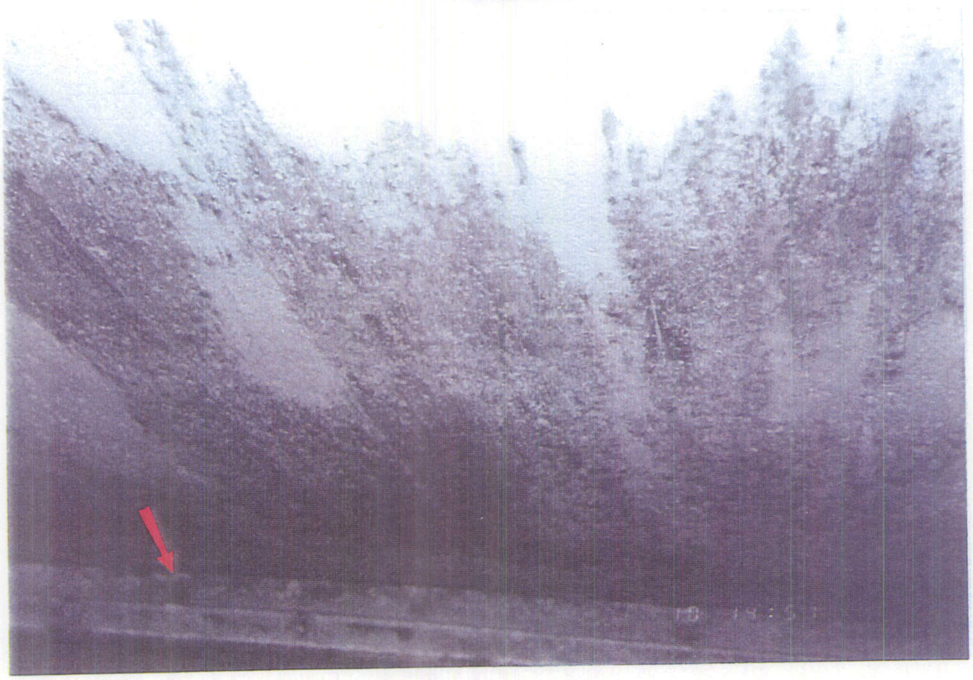


Photo 4 - Morris Dam - 70' x 18' Drum Gate #2 - U/S faceplate, u/s side of chamber, looking towards floor. Note stop screw mark (arrow) on stop angle (arrow), and note failed paint coating and pitting.. - (9/10/98).

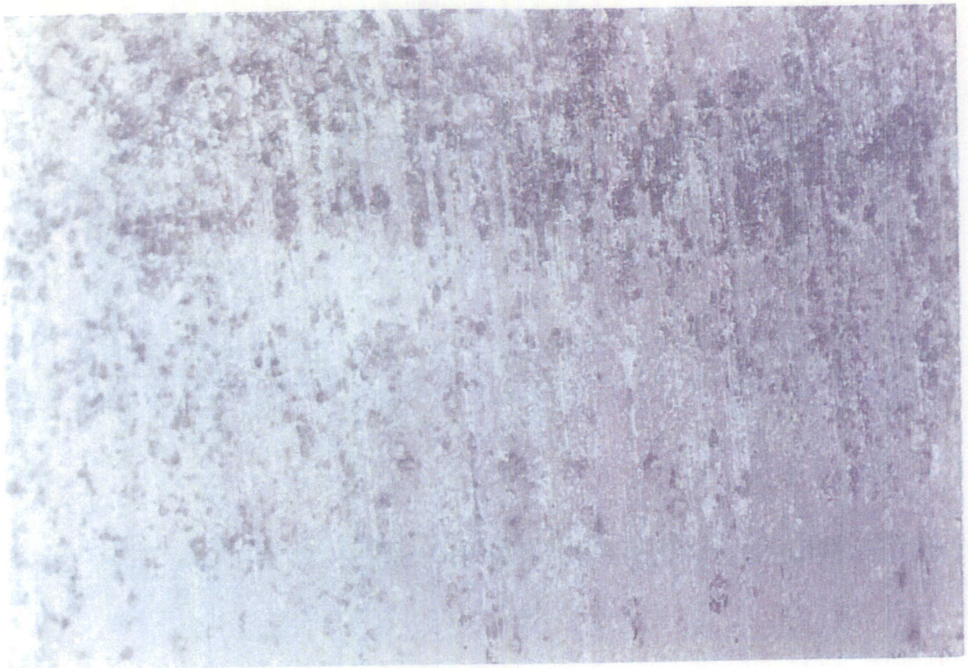


Photo 5 - Morris Dam - 70' x 18' Drum Gate #2 - Closeup of u/s faceplate. Note pitting.- (9/10/98).

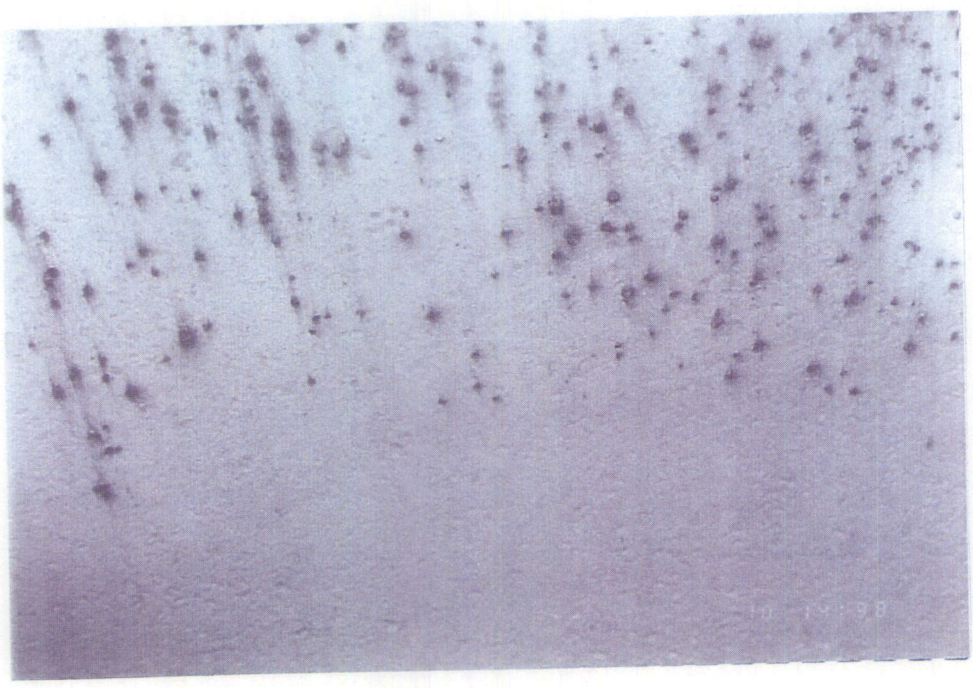


Photo 6 - Morris Dam - 70' x 18' Drum Gate #2 - 2nd closeup of u/s faceplate showing rust nodules and pitting.. - (9/10/98).

Photo 7 - Morris Dam - 70' x 18' Drum Gate #2 - Right end chamber wall and right side seal assembly. Note cracks. Down arrow (next photo) points to horizontal crack Right arrow is 2nd crack (2nd following photo)- (9/10/98).

Photo 8 - Morris Dam - 70' x 18' Drum Gate #2 - Closeup of crack of lower (down) arrow previous photo.. - (9/10/98).

Photo 9 - Morris Dam - 70' x 18' Drum Gate #2 - Closeup of crack upper (right) arrow, two previous photos.- (9/10/98).

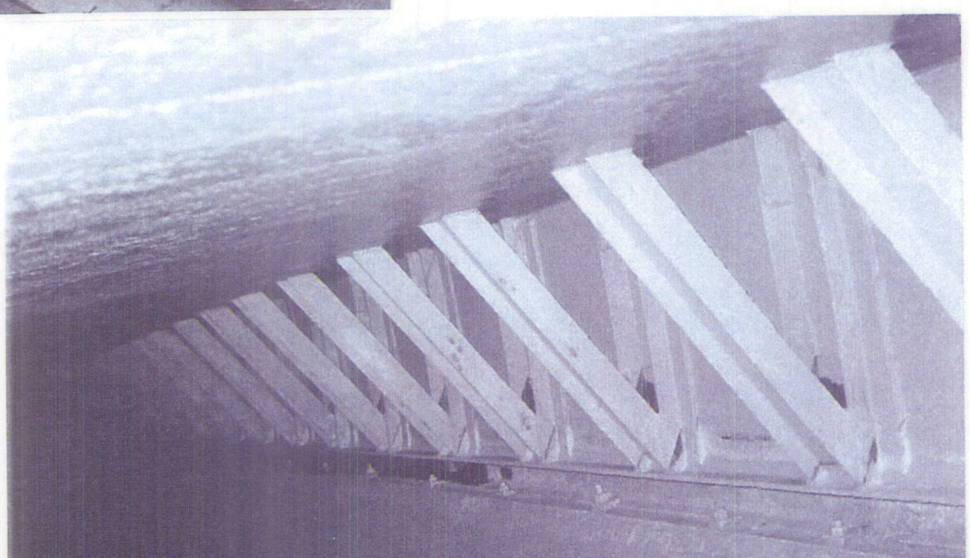


Photo 10 - Morris Dam - 70' x 18' Drum Gate #2 - D/S of gate chamber, looking towards right end of gate. Bottom faceplate on right of photo. Cantilevered bottom portion of u/s faceplate with braces. Braces look sound but pitted.. - (9/10/98).

Photo 11 - Morris Dam - 70' x 18' Drum Gate #2 - One drain cock located on left side of gate . Rust on cantilever is from drain.- (9/10/98).

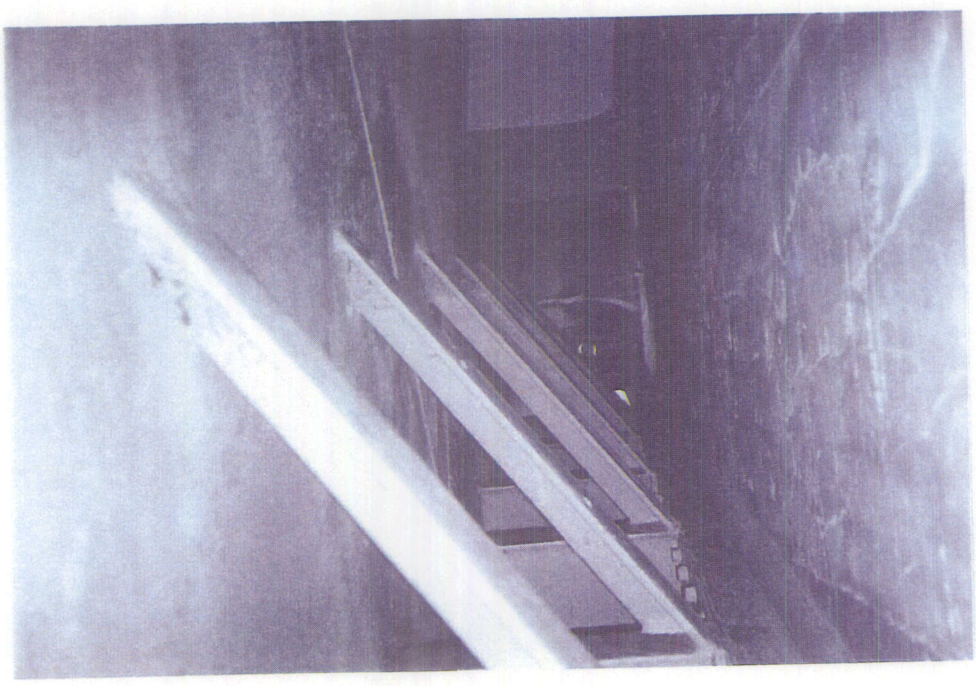


Photo 12 - Morris Dam - 70' x 18' Drum Gate #2 - D/S side of gate chamber, looking towards left side of gate. Bracing on cantilevered portion of u/s faceplate.. - (9/10/98).

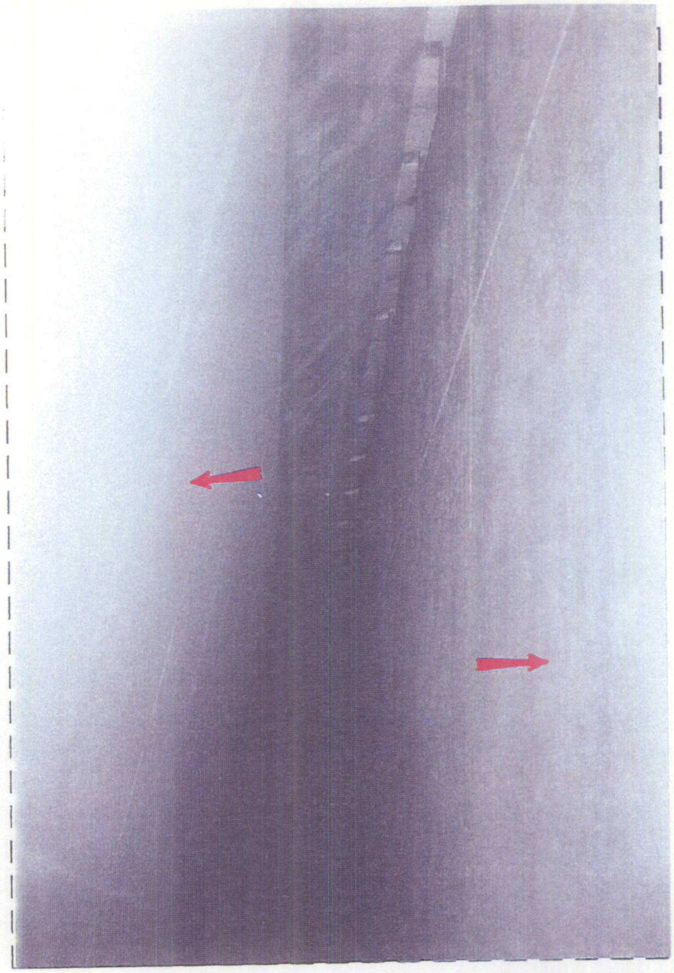


Photo 13 - Morris Dam - 70' x 18' Drum Gate #2 - D/S of gate chamber. Left arrow point to concrete chamber wall, right arrow point to bottom faceplate. Top of picture is looks towards hinge assembly.- (9/10/98).

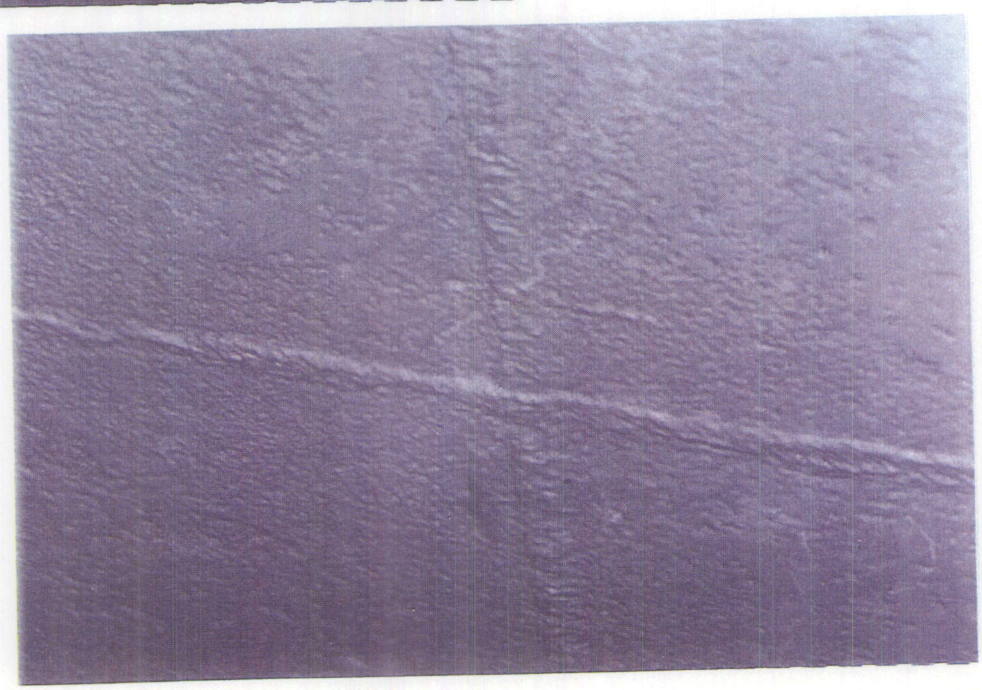


Photo 14 - Morris Dam - 70' x 18' Drum Gate #2 - Bottom faceplate at intersection of vertical and horizontal welds, typical. Welds okay. Note extensive pitting over faceplate.. - (9/10/98).

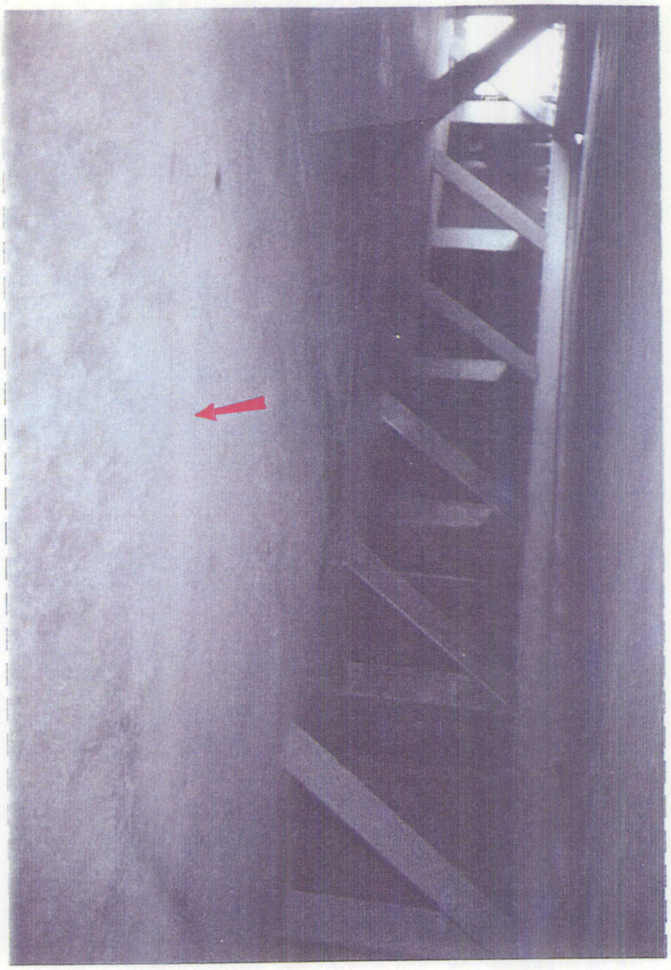


Photo 15 - Morris Dam - 70' x 18' Drum Gate #2 - Left side of gate, viewed from d/s side of gate chamber. Cantilevered portion of u/s faceplate. Note end plates on drum gate in good condition, bracing in good condition, but pitted. Looking towards top. Lift is hatch to spillway.- (9/10/98).

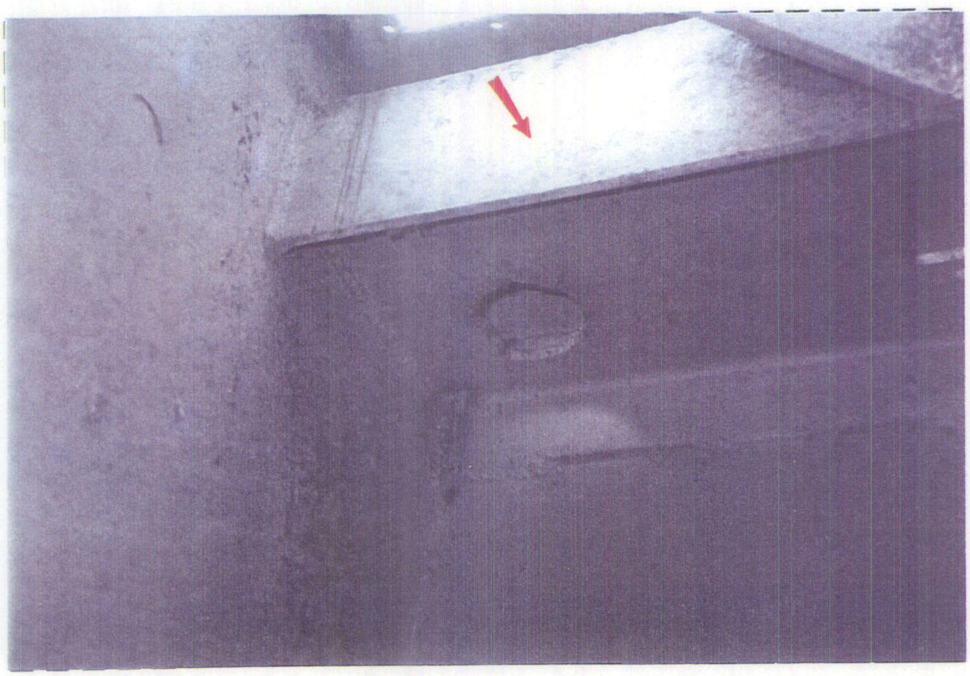


Photo 16 - Morris Dam - 70' x 18' Drum Gate #2 - Left side of gate, cantilevered segment. Portion of horizontal u/s faceplate beam (W12x31.8) Note drain hole in corner. - (9/10/98).

Photo 17 - Morris Dam - 70' x 18' Drum Gate #2 - D/S of chamber, looking upwards to hatch. Note 12" vent on left chamber wall (arrow) and ejector piping leading to inside of gate.- (9/10/98).

Photo 18 - Morris Dam - 70' x 18' Drum Gate #2 - D/S side of chamber, looking upwards through hatch to spillway. Ejector piping leading to right trunnion.. - (9/10/98).

Morris Dam
Drum Gate 2
Middle, Interior

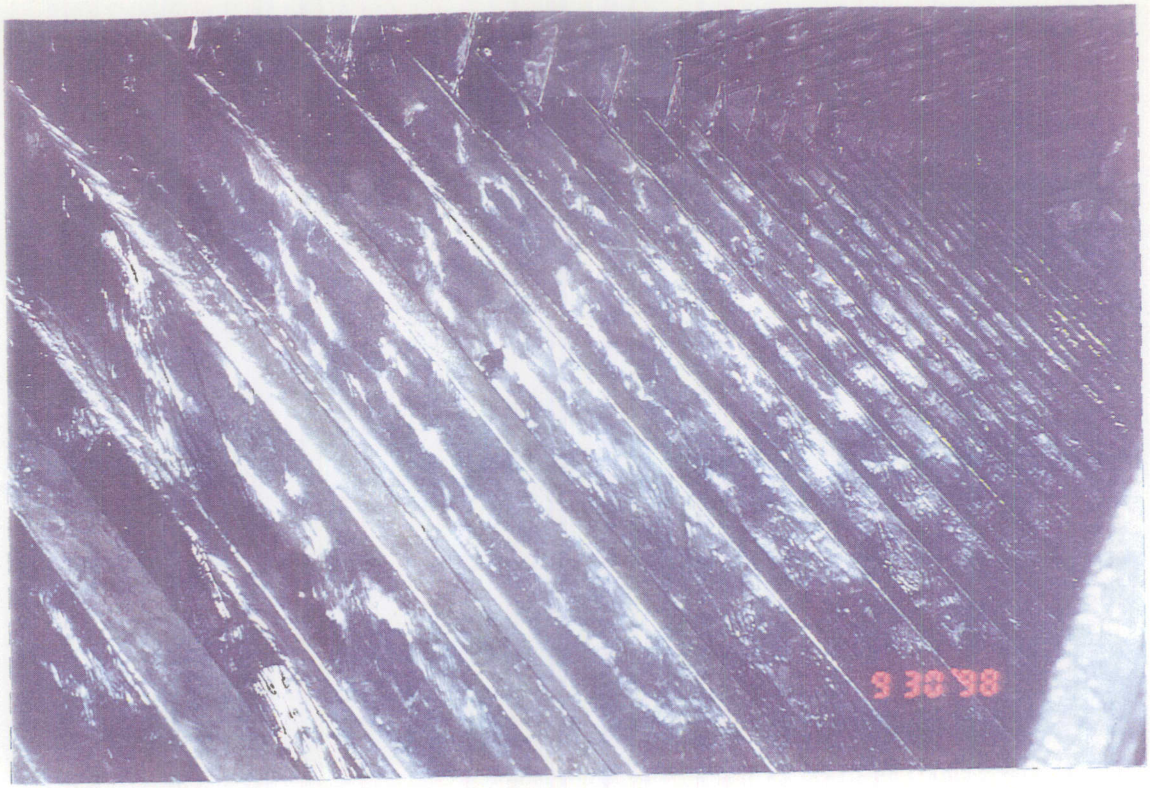


Photo 1 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, looking left at u/s faceplate structural members.- (9/30/98).

Photo 2 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Typical - foreground - portion of internal bracing. Background - bottom faceplate & W12x31.8 stiffeners. (9/30/98).

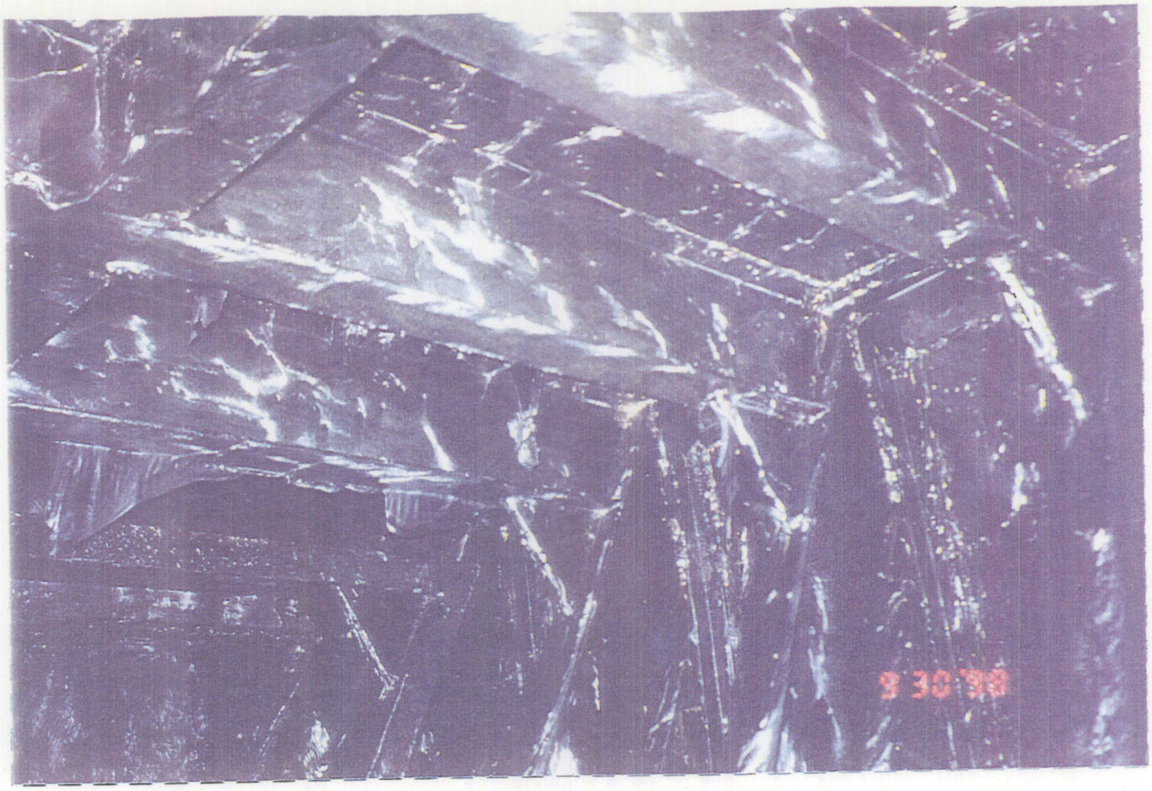


Photo 3 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Looking up at downstream faceplate. Coating is in good condition.- (9/30/98).

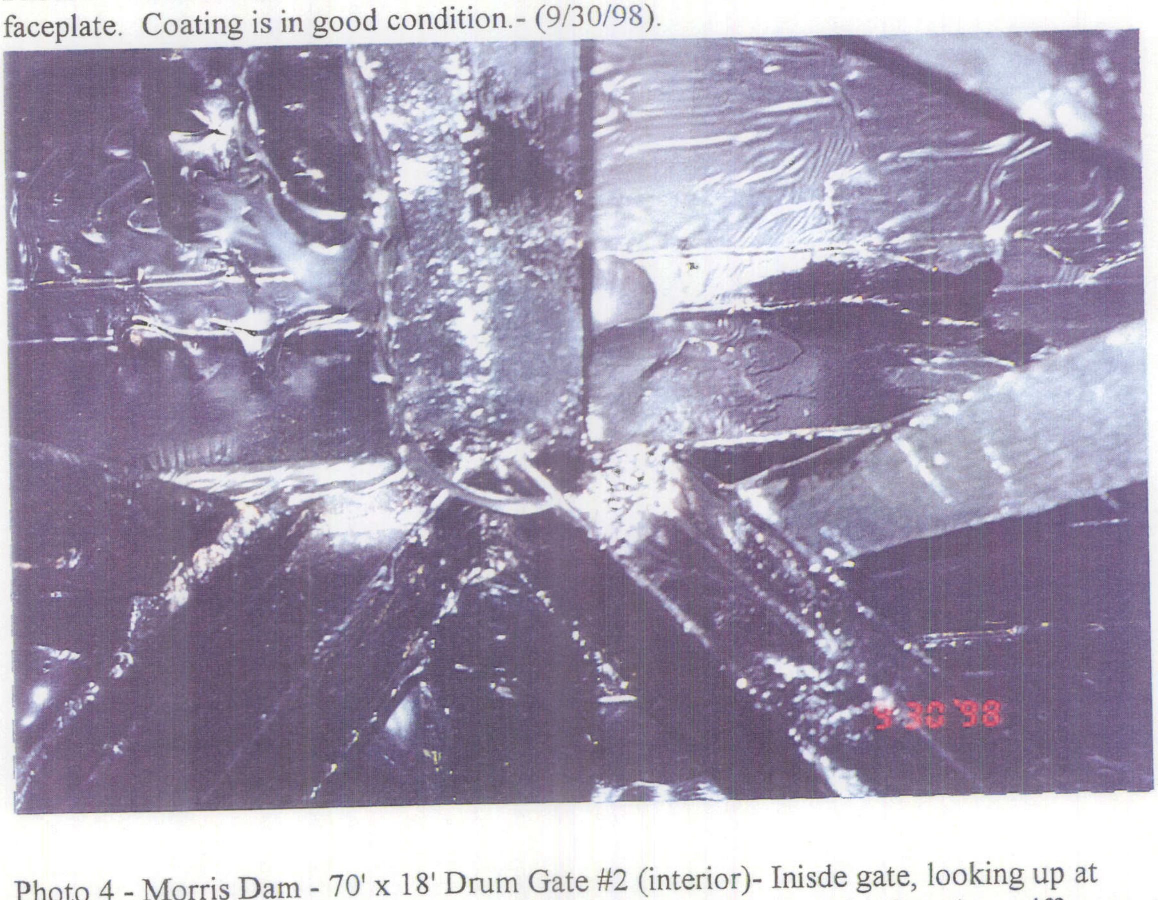


Photo 4 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inisde gate, looking up at downstream faceplate and apex of internal bracing intersection with faceplate stiffeners. (9/30/98).

Photo 5 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, looking up at hinge corner. Top of photo is downstream faceplate. Lower portion of photo is bottom faceplate.- (9/30/98).

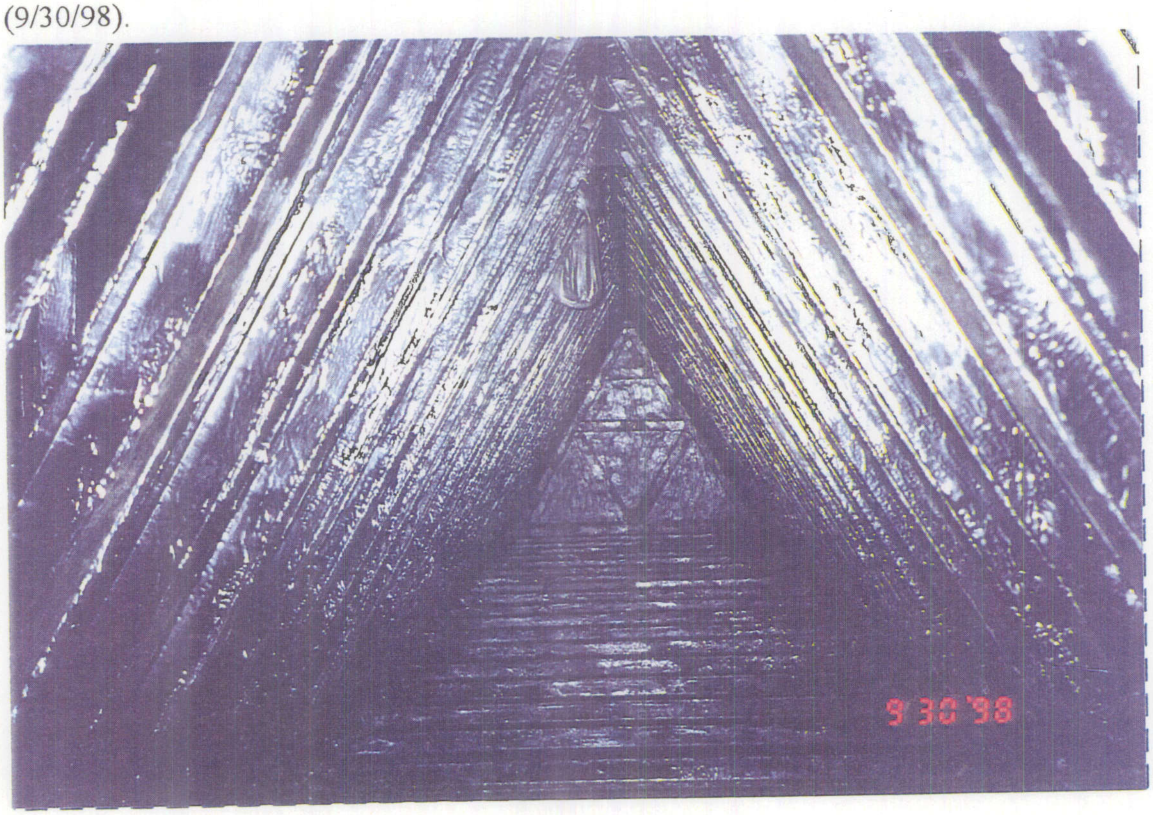


Photo 6 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Looking to left of gate through middle of triangular internal bracing at upper level of gate. (9/30/98).

Photo 7 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Looking to right of gate at bottom level of gate. Bottom faceplate/members at left of photo. Upstream facepalte/members right of photo.- (9/30/98).

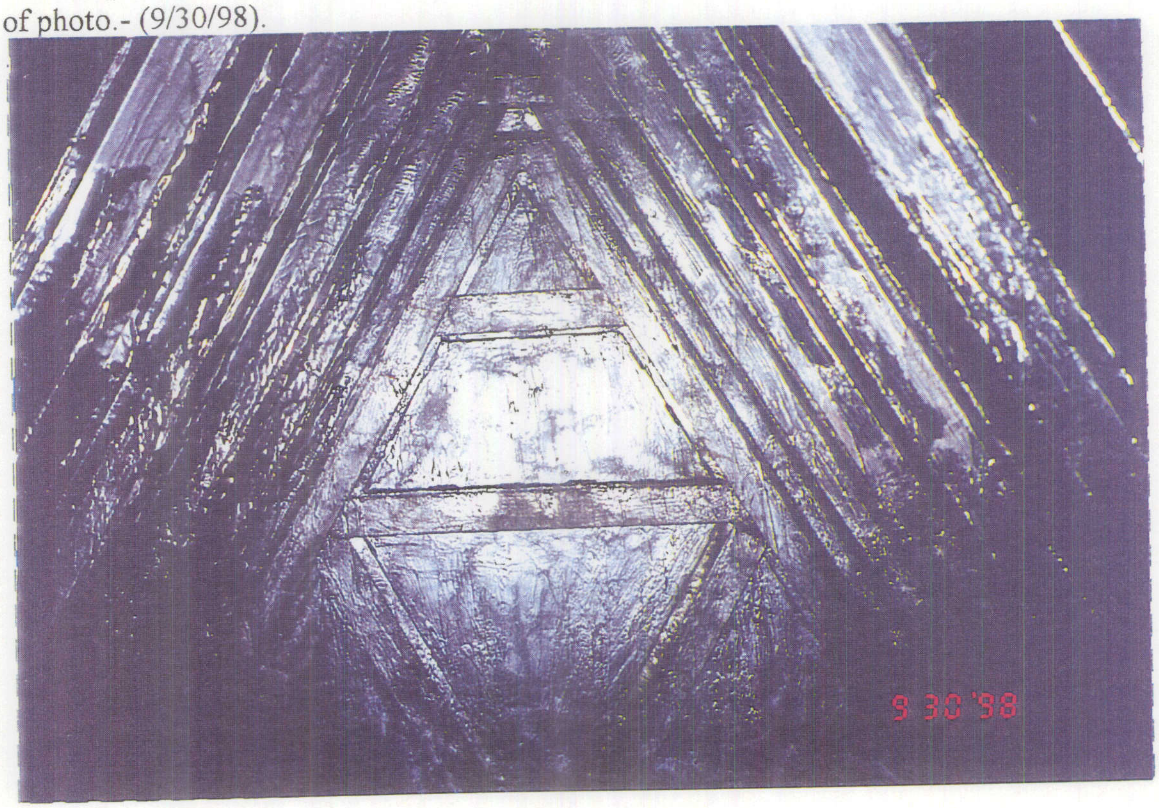


Photo 8 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, looking at left end plates of gate. (9/30/98).

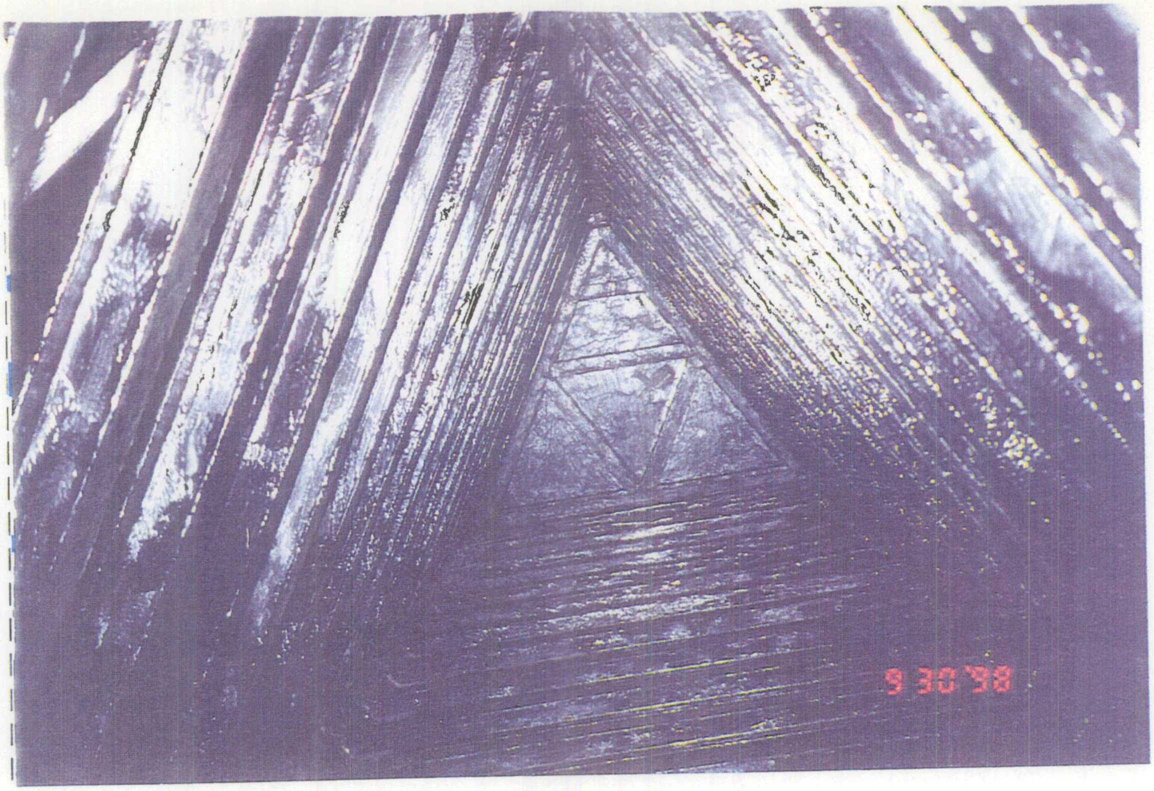


Photo 9 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, upper level, looking at right end of gate through middle of internal brace members.- (9/30/98).

Photo 10 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, lower level at right end of gate. (9/30/98).

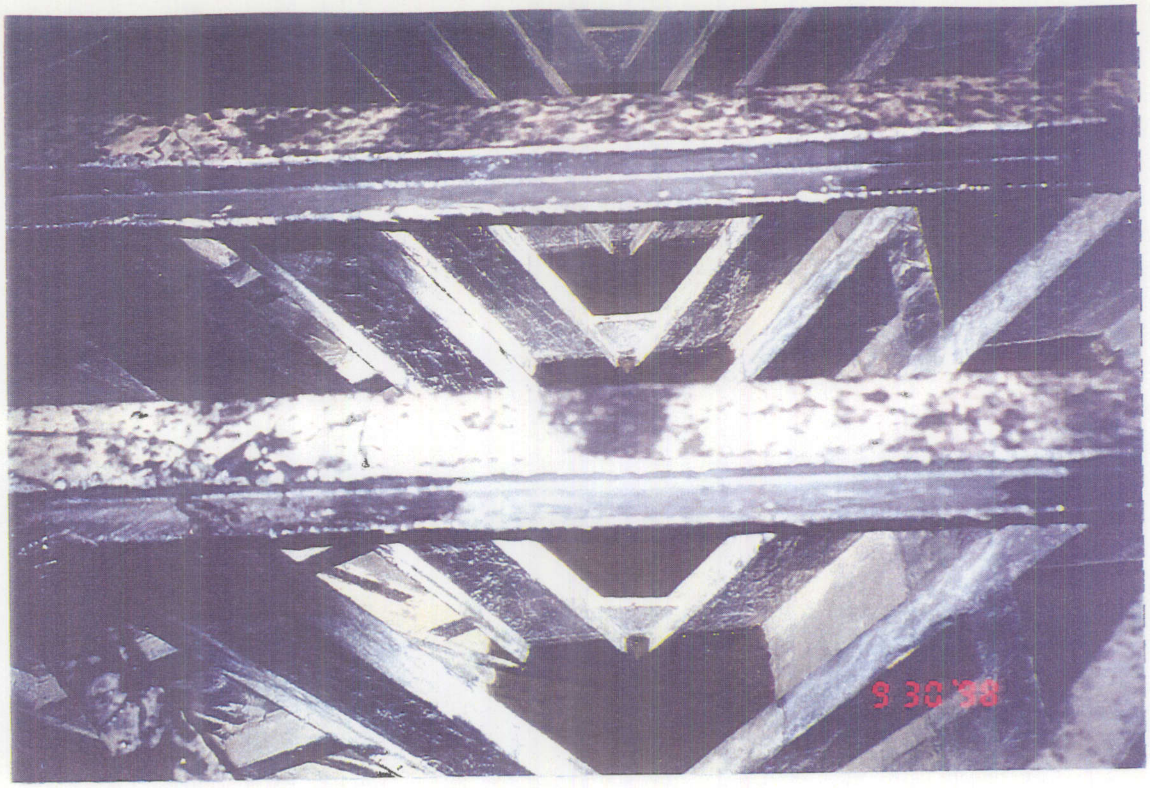


Photo 11 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, looking at bottom of gate when standing on internal bracing.- (9/30/98).

Photo 12 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Closeup of bottom corner of gate from vantage of previous photo. (9/30/98).

Photo 13 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, lower level, looking to right end of gate. Note good condition of coating and structural members.- (9/30/98).

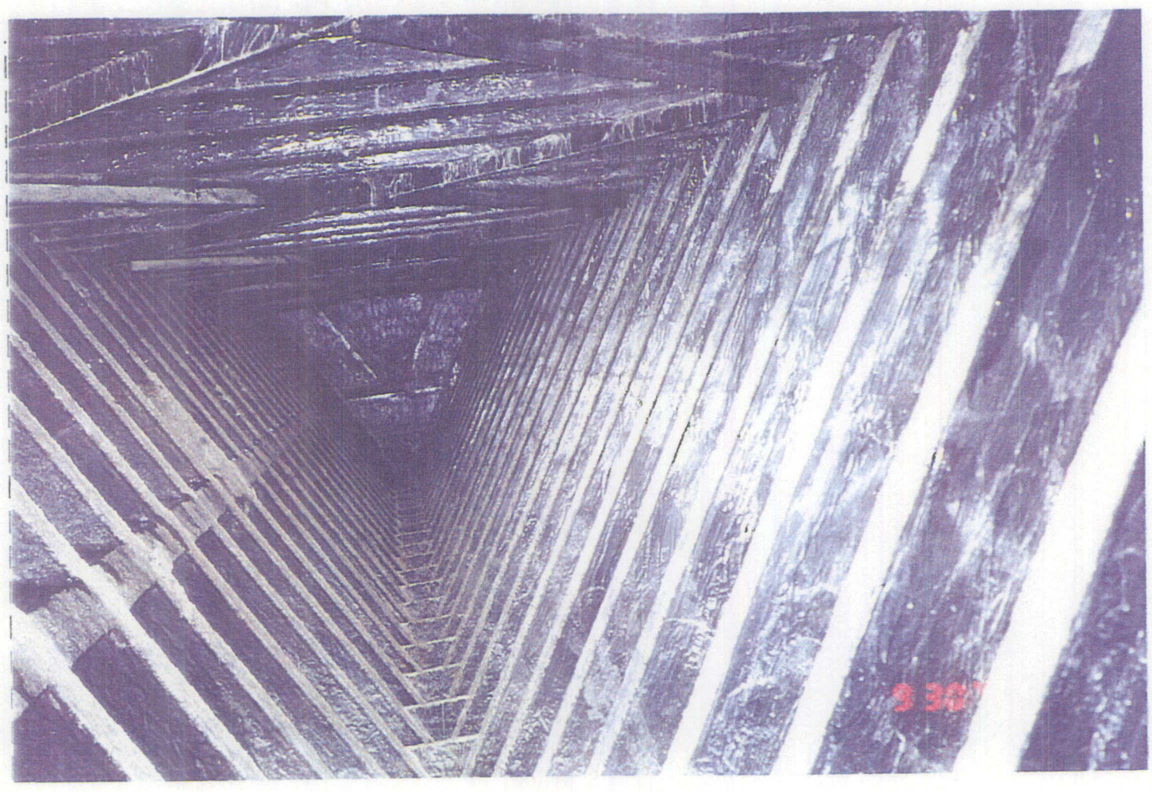


Photo 14 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Inside gate, lower level, looking to right end of gate. Internal bracing at top of photo. (9/30/98).

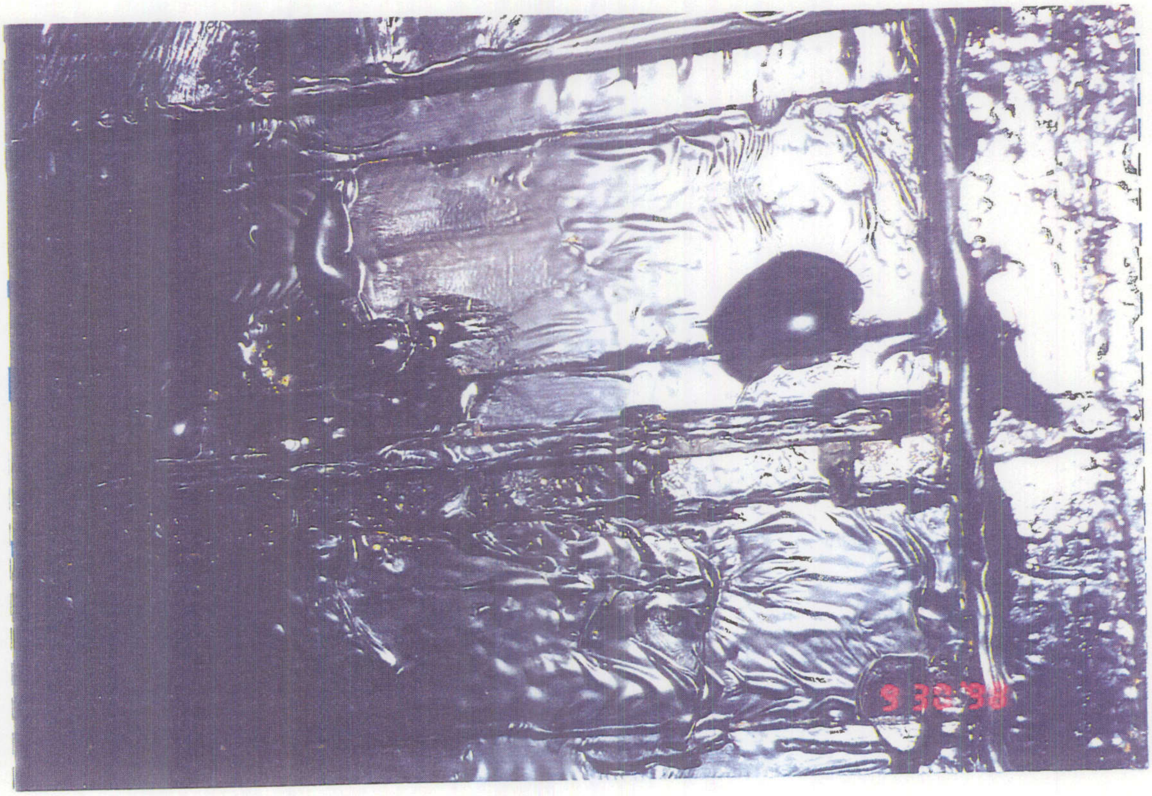


Photo 15 - Morris Dam - 70' x 18' Drum Gate #2 (interior)- Closeup of coal tar epoxy coating. Generally in good condition. Coating was applied thick, but uneven.

Morris Dam
Drum Gate 3
West

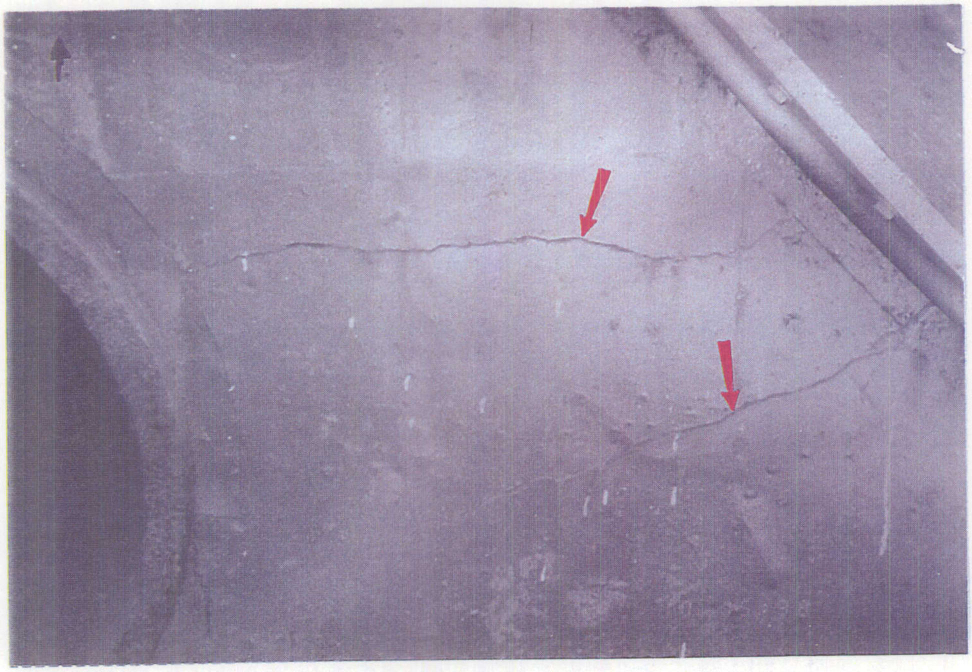


Photo 1 - Morris Dam - 70' x 18.' Drum Gate #3 - Two cracks on left end concrete chamber wall, u/s of gate at 30" discharge pipe.- (9/10/98).

Photo 2 - Morris Dam - 70' x 18' Drum Gate #3 - Upstream faceplate. Down arrow points to upper extent of good paint. Other arrow points to left upstream side seal assembly.. - (9/10/98).

Photo 3 - Morris Dam - 70' x 18.' Drum Gate #3 - Upstream faceplate, left side of gate and left end seal assembly. Note paint on lower 7' portion is good, but note pitting.- (9/10/98).

Photo 4 - Morris Dam - 70' x 18' Drum Gate #3 - Upstream faceplate, upstream gate chamber. Left arrow points to scrap mark on faceplate indicating shield guard interference.. - (9/10/98).

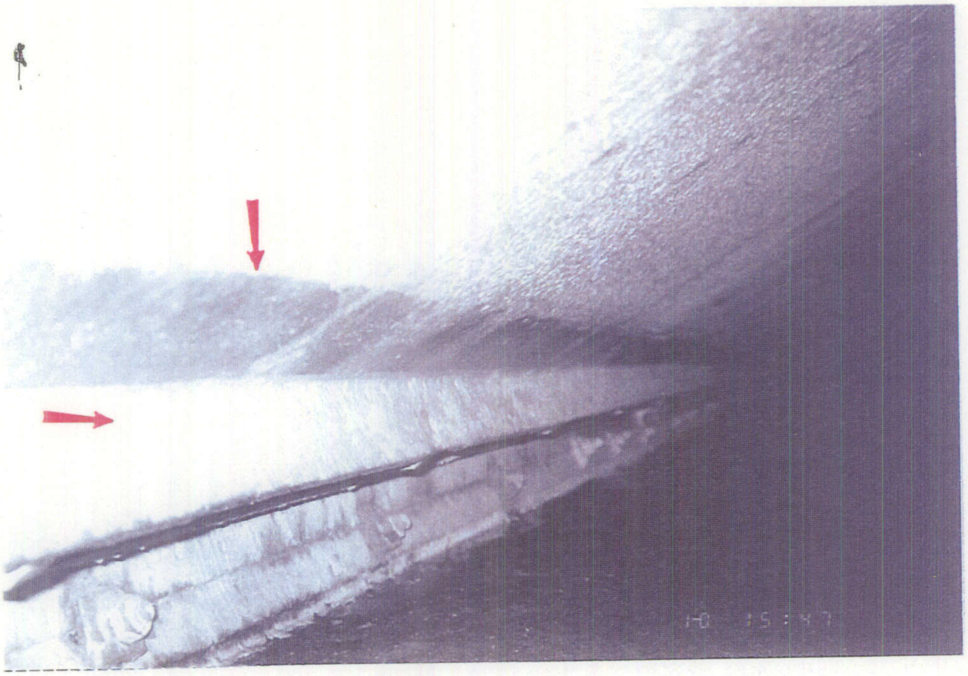


Photo 5 - Morris Dam - 70' x 18.' Drum Gate #3 - Upstream faceplate near bottom of gate. Right arrow points along stop angle. (Stop rail shown clipped to concrete.) Down arrow points to 5" band where paint has been completely eroded. A 7' arc above band, paint is good.- (9/10/98).

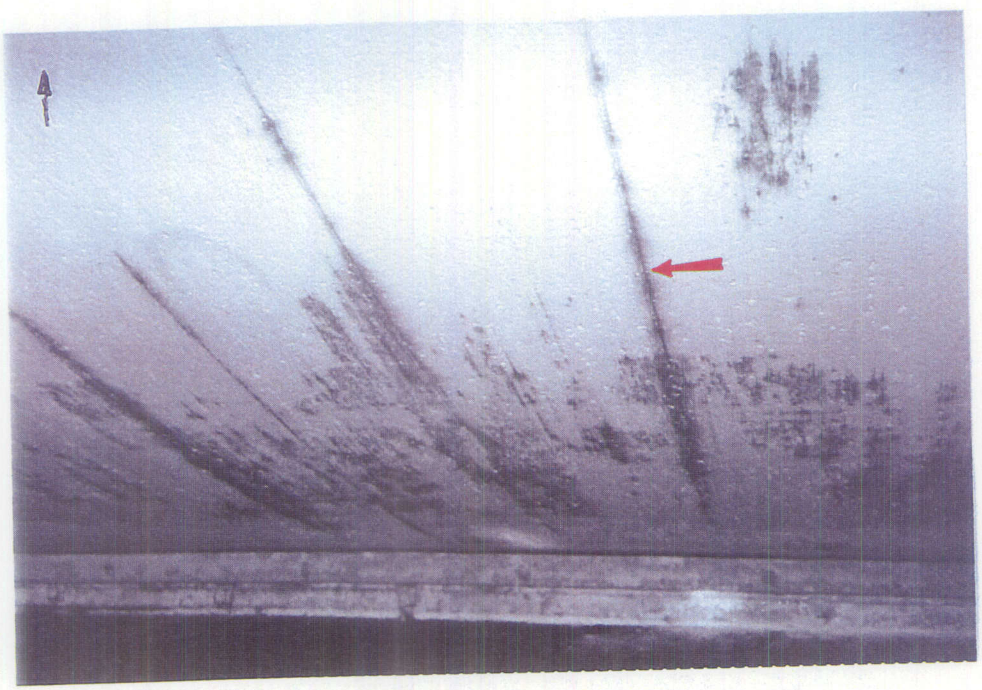


Photo 6 - Morris Dam - 70' x 18' Drum Gate #3 - Upstream faceplate, looking towards bottom edge. Left arrow points to scrap mark.. - (9/10/98).

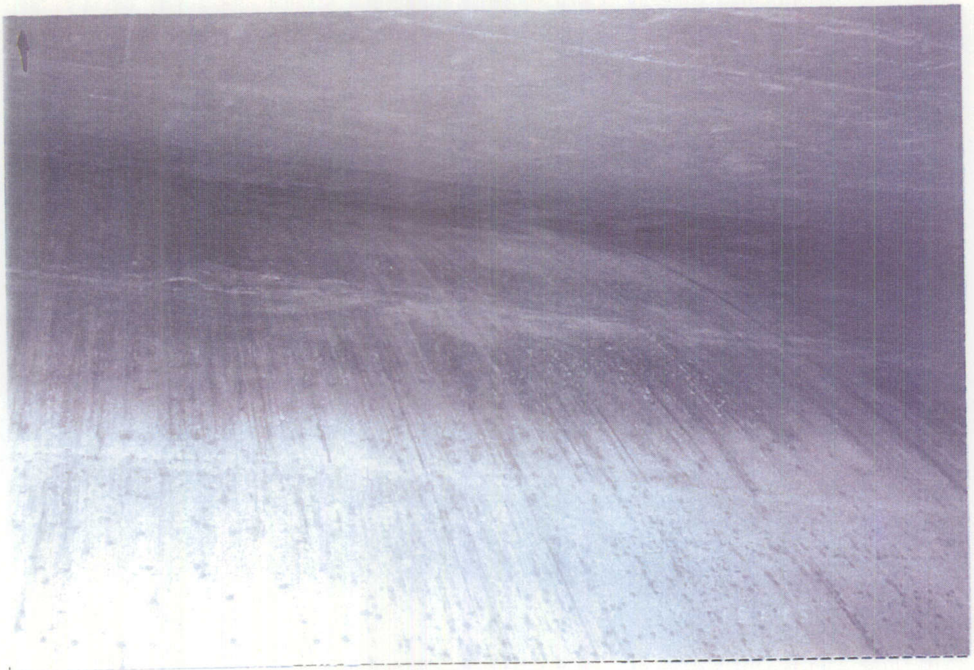


Photo 7 - Morris Dam - 70' x 18.' Drum Gate #3 - Upstream faceplate, looking upwards to top. Note extensive faceplate pitting.- (9/10/98).

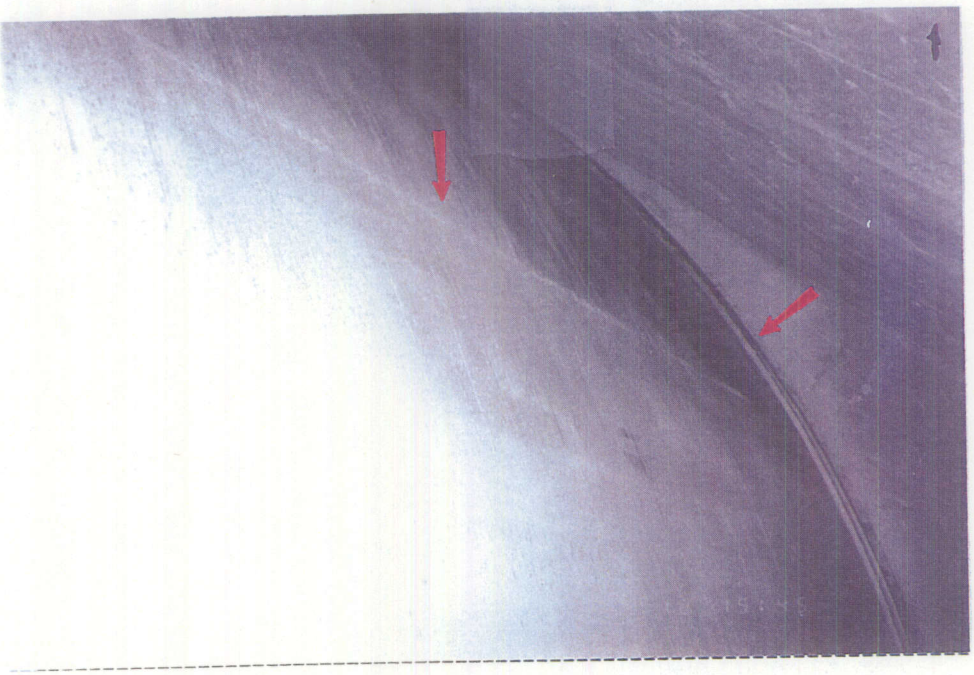
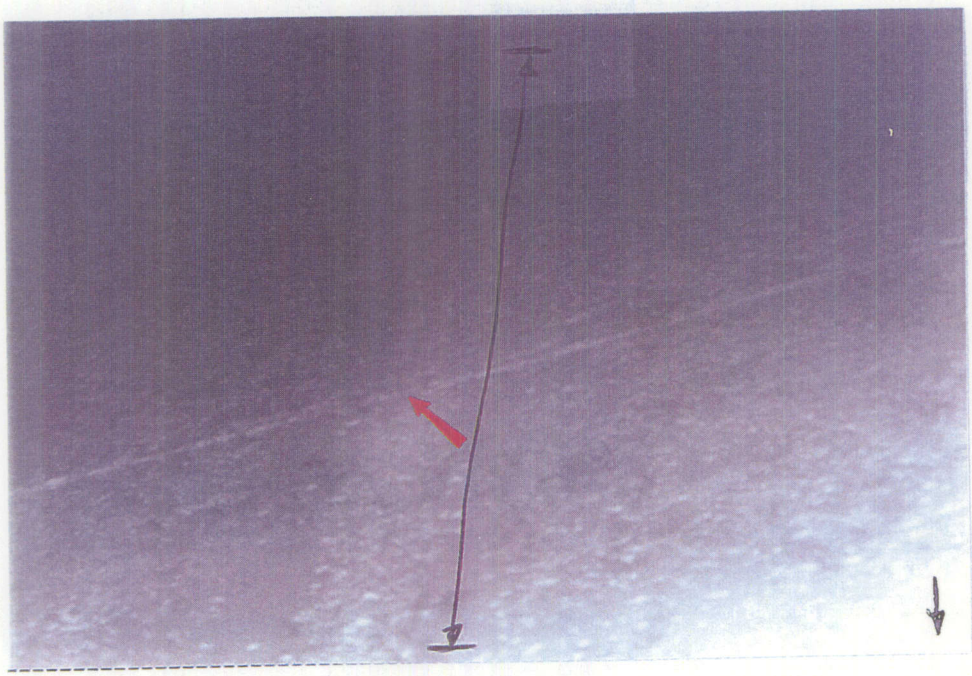


Photo 8 - Morris Dam - 70' x 18' Drum Gate #3 - Upstream faceplate, looking up and towards right chamber end wall. Left arrow points to left end seal assembly. Down arrow points to upper boundary of good paint.. - (9/10/98).

Photo 9 - Morris Dam - 70' x 18.' Drum Gate #3 - Bottom faceplate. Note extensive pitting on faceplate. Arrow points to intersection of horizon/vert plate butt weld. Note vertical weld has no crown, and is extremely pitted. Grind and reweld.- (9/10/98).



7

Photo 10 - Morris Dam - 70' x 18' Drum Gate #3 - Bottom faceplate. Arrow points to same intersection as previous photo. Note, extent of pitted weld. Weld joint is discernable, but replaced by a band of pitting.. - (9/10/98).

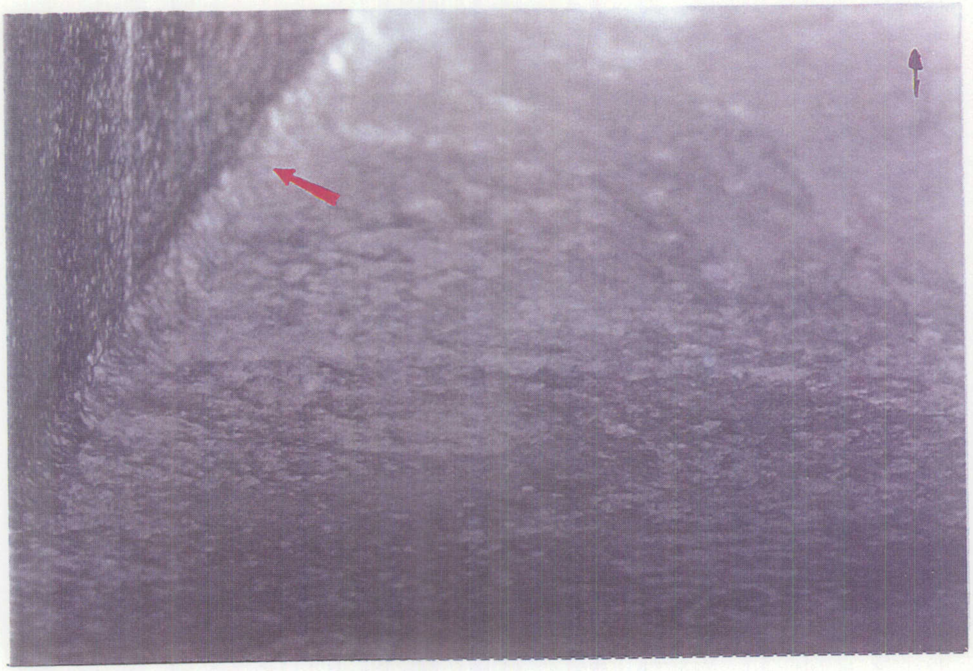


Photo 11 - Morris Dam - 70' x 18.' Drum Gate #3 - Arrow points to edge of bottom faceplate and right side end plates. The edge weld is badly corroded and should be ground and reweld.- (9/10/98).

Photo 12 - Morris Dam - 70' x 18' Drum Gate #3 - Looking up at hatch to spillway, and portion of ejector high pressure water piping.. - (9/10/98).

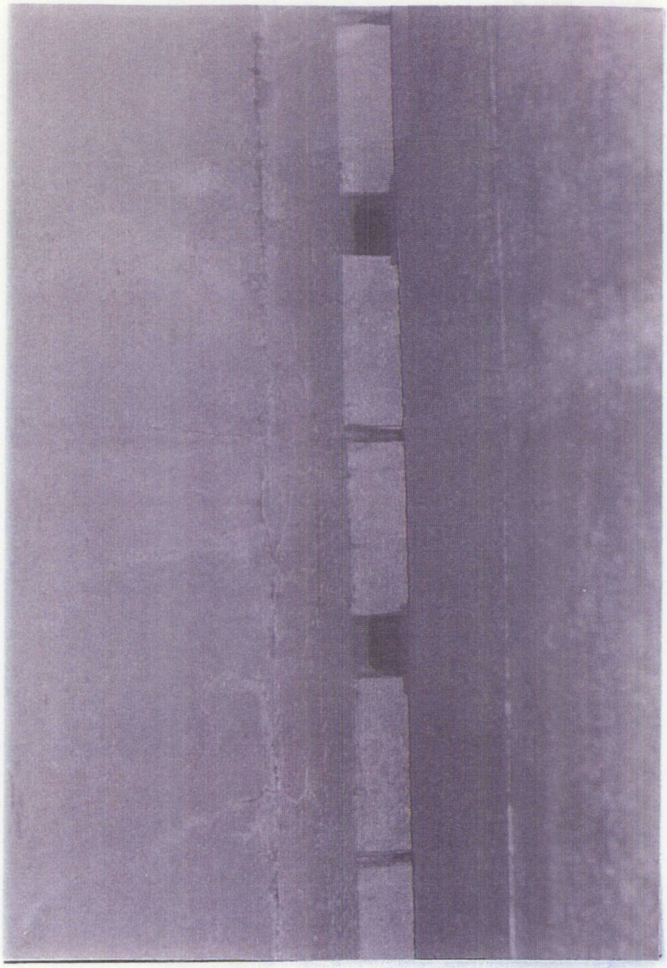


Photo 13 - Morris Dam - 70' x 18.' Drum Gate #3 - Downstream side of gate chamber. Looking up towards gate hinges. Photo right is bottom faceplate. Photo left is concrete downstream gate chamber.- (9/10/98).

Photo 14 - Morris Dam - 70' x 18' Drum Gate #3 - Doorway entrance to Gate #3 controls. Marks monitor crack on concrete column due to (4/6/65) earthquake.. - (9/10/98).

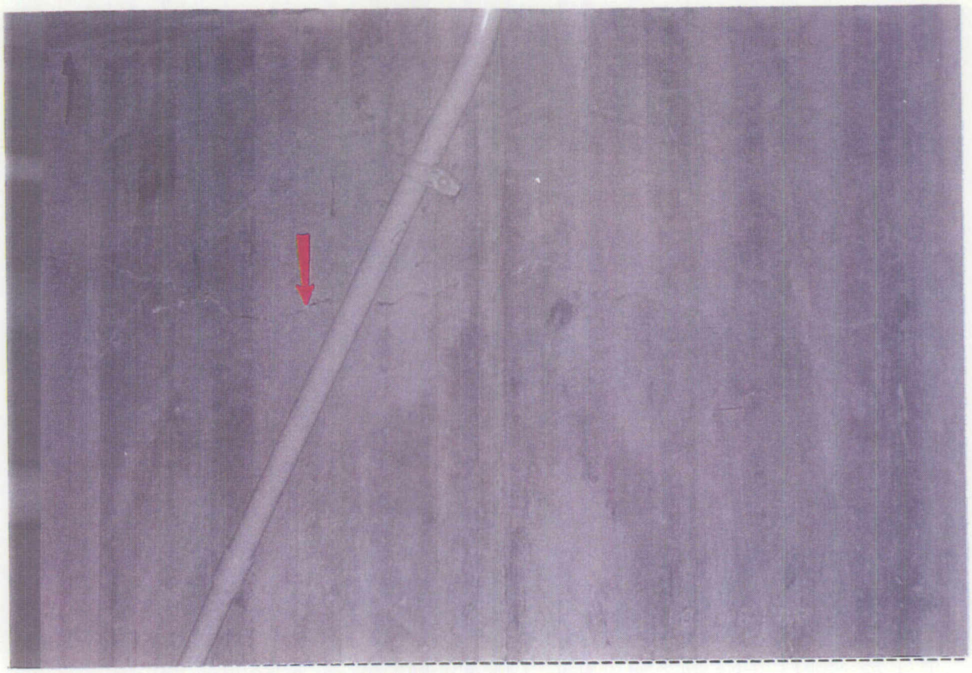


Photo 15 - Morris Dam - 70' x 18.' Drum Gate #3 - Down arrow points to full width horizontal crack on left side chamber end wall due to (4/6/65) earthquake. Crack is not monitored.

Morris Dam
Drum Gate 3
West, Interior

Photo 1 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, left side, looking up towards hatch.- (9/30/98).

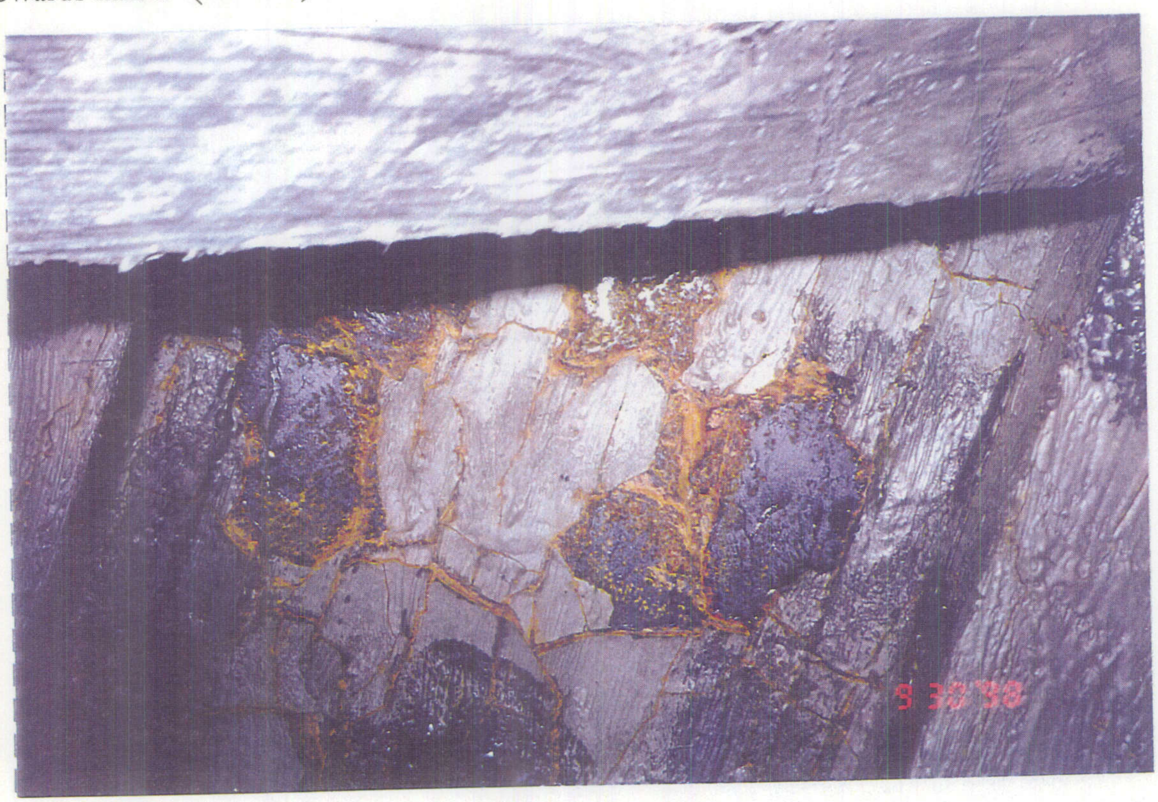


Photo 2 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Poor condition of coal tar enamel on inside surface of downstream facepalte. Gate #3 d/s faceplate was in worst condition for localized coating damage. (9/30/98).

Photo 3 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Localized coal tar coating damage on downstream faceplate.- (9/30/98).

Photo 4 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Localized damage on downstream faceplate. (9/30/98).

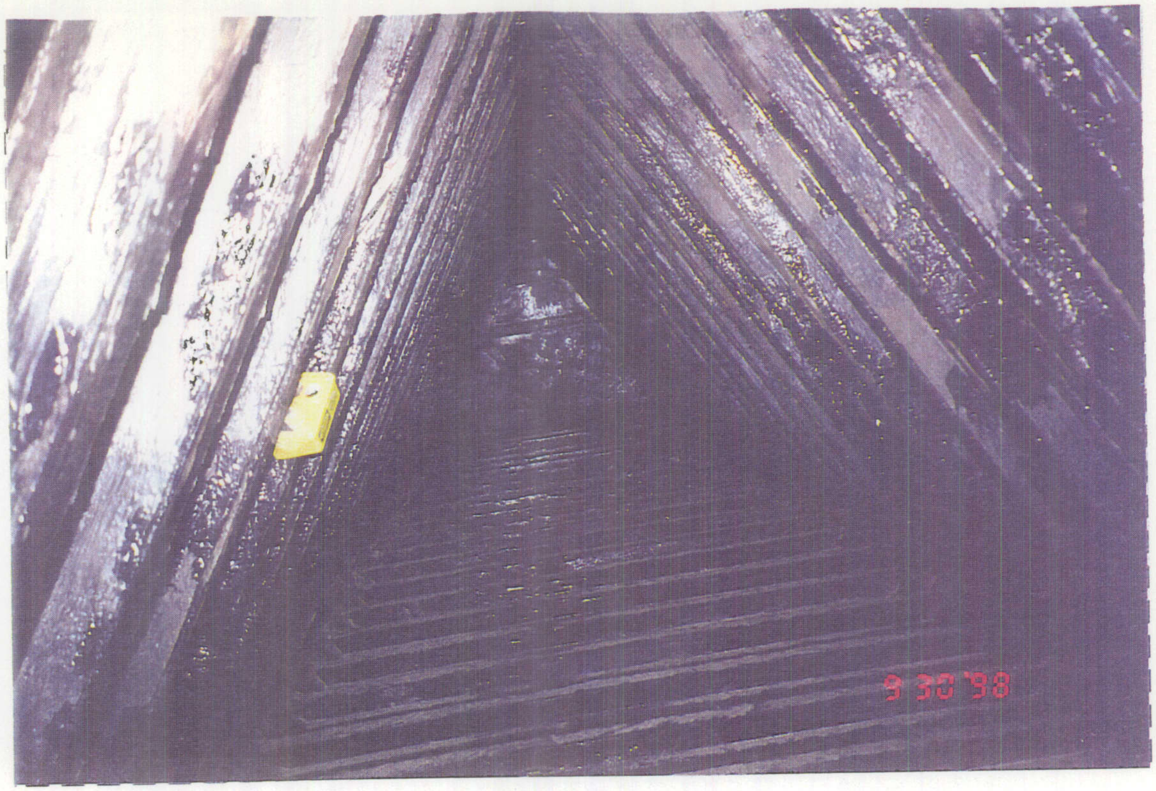


Photo 5 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, looking toward right end through middle of internal bracing - upper level.- (9/30/98).

Photo 6 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Right side, end plates of gate. Note water ponding in web of girder. Coating in good condition. (9/30/98).

Photo 7 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, looking towards left end of gate, upper level. Upstream structural members at left of photo, downstream structural members at top of photo.- (9/30/98)

sPhoto 8 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, upper level, looking towards left end, through middle of internal bracing (9/30/98).Photo 9 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, looking right, upper level. Downstream faceplate/members at top of photo. Upstream structural members at right of photo.-(9/30/98)

Photo 9 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, looking right, upper level. Downstream faceplate/members at top of photo. Upstream structural members at right of photo.

Photo 10 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Inside gate, bottom corner at right end. Flexible pump hose to drain pipe, and fixed ejector piping. Bottom faceplate/members left of photo, and upstream members right of photo. (9/30/98)

.Photo 11 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Closeup of photo above, showing remainder of leakage water in bottom of gate.- (9/30/98).

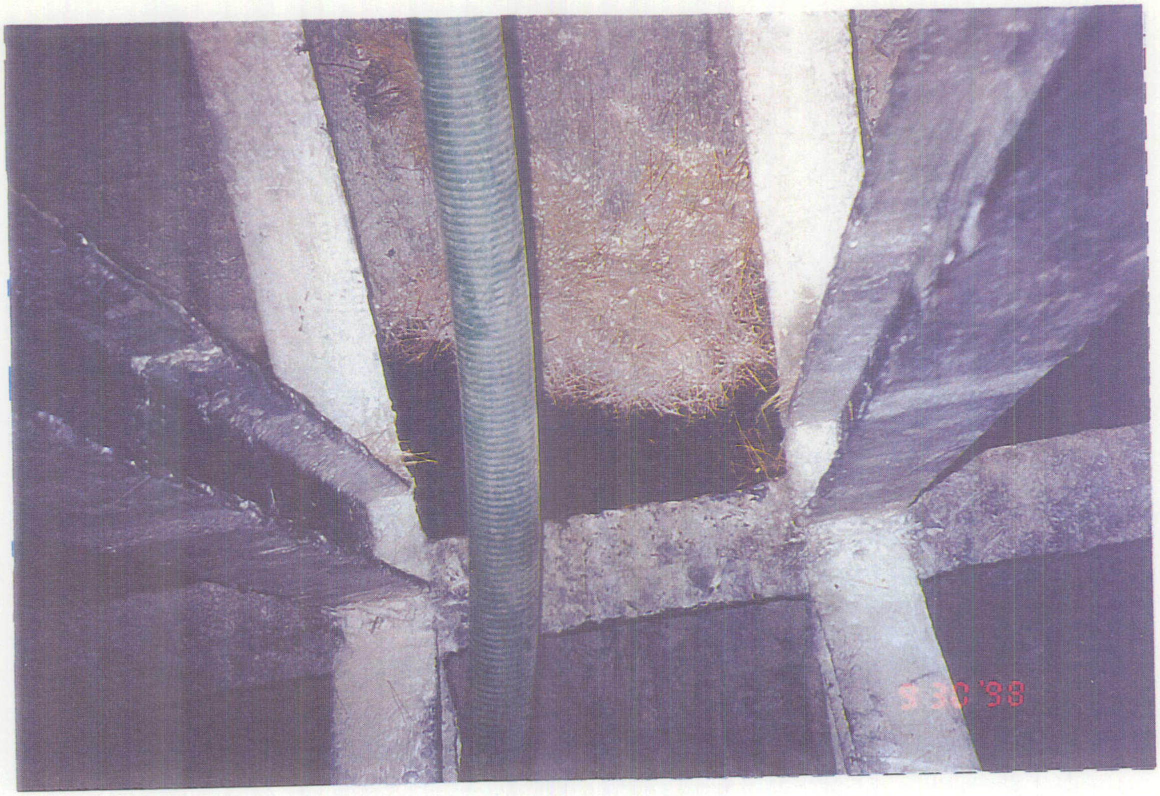


Photo 12 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Debris inside gate. (9/30/98).

Photo 13 - Morris Dam - 70' x 18' Drum Gate #3 (interior)- Typical view of inside surface of bottom faceplate hatch.

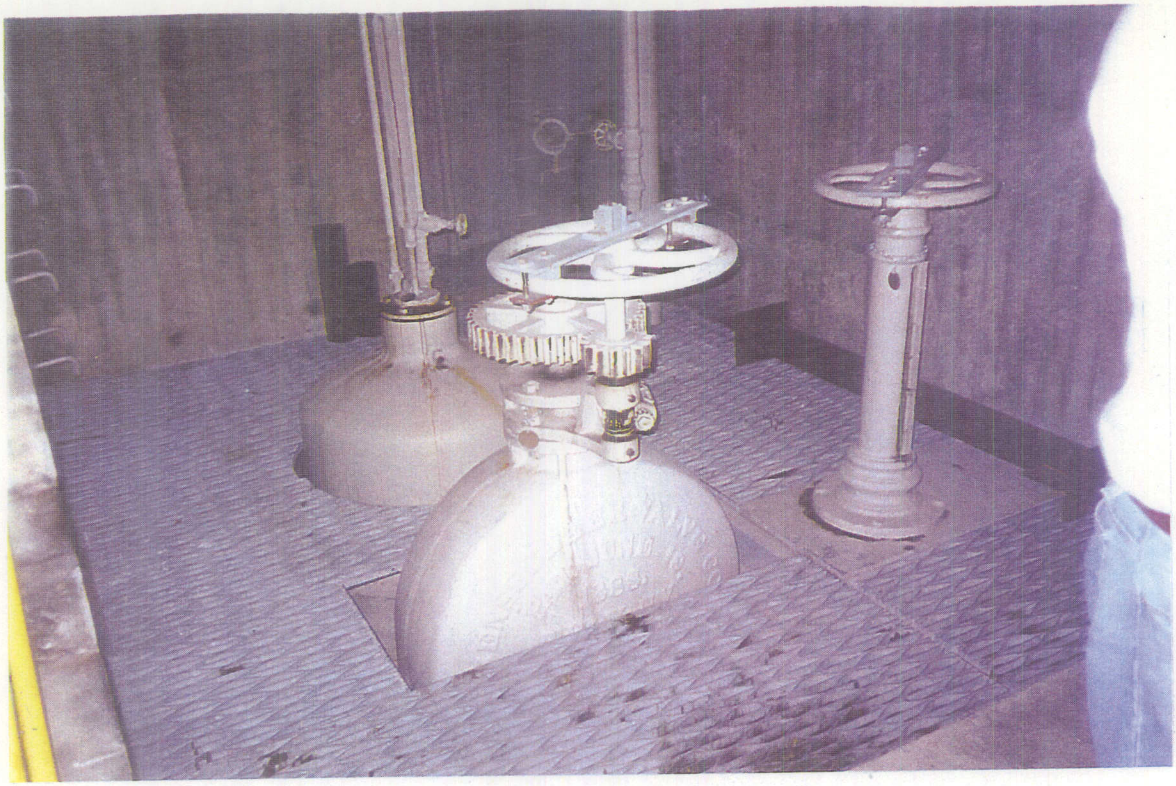


Photo 1 - Morris Dam - Drum Gates - View of control valves for drum gate. 06/30/98

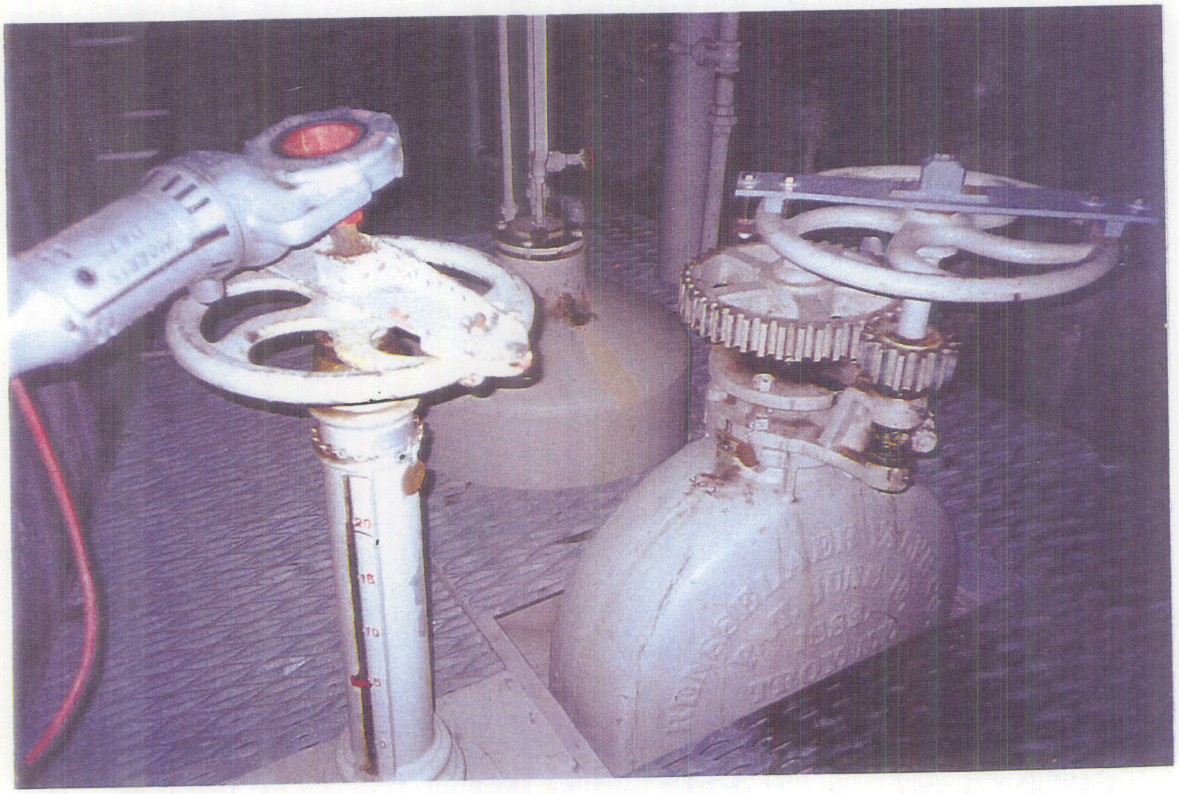


Photo 2 - Morris Dam - Drum Gates - View of control valves for drum gate. 06/30/98

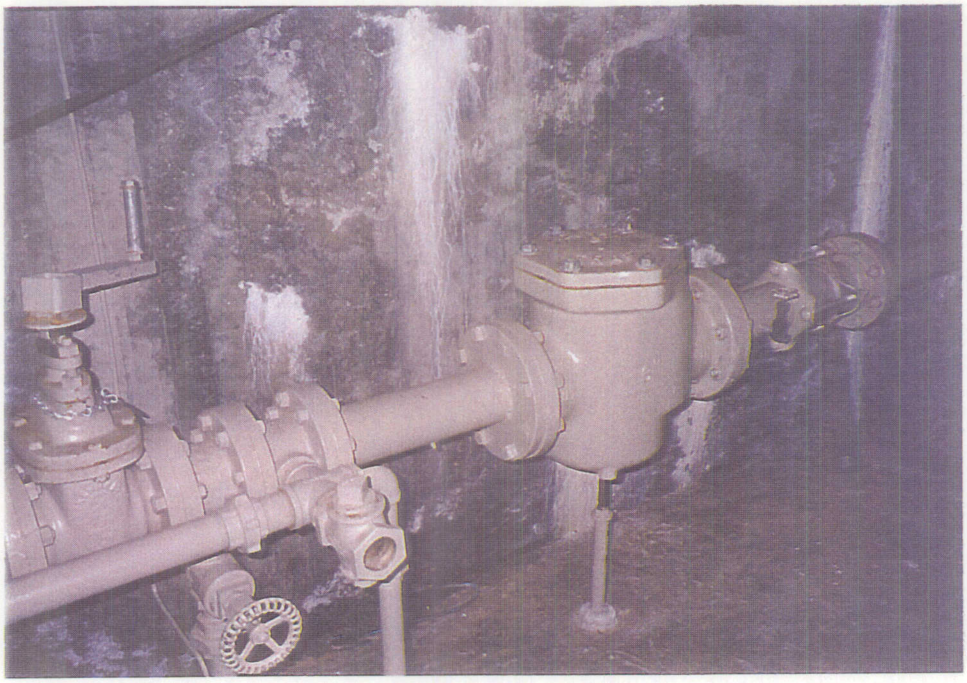


Photo 3 - Morris Dam - Drum Gates - View of drum gate control piping.
06/30/98

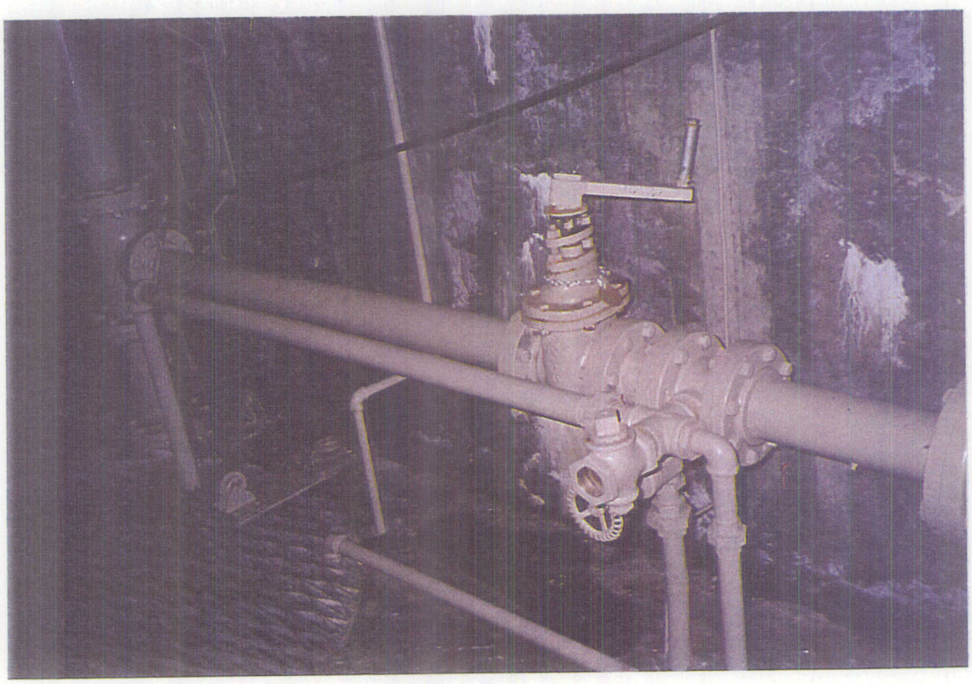


Photo 4 - Morris Dam - Drum Gates - View of drum gate control piping.
06/30/98

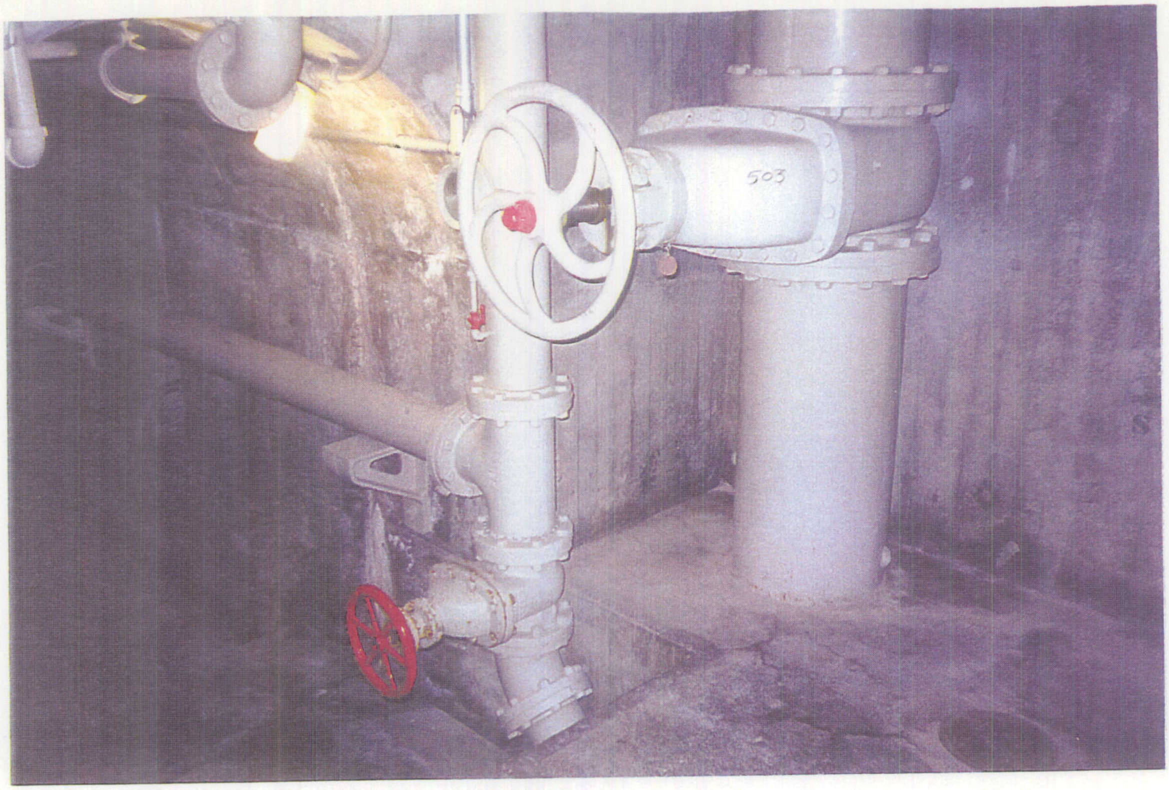


Photo 5 - Morris Dam - Drum Gates - View of gate valve in drum gate control piping.
06/30/98

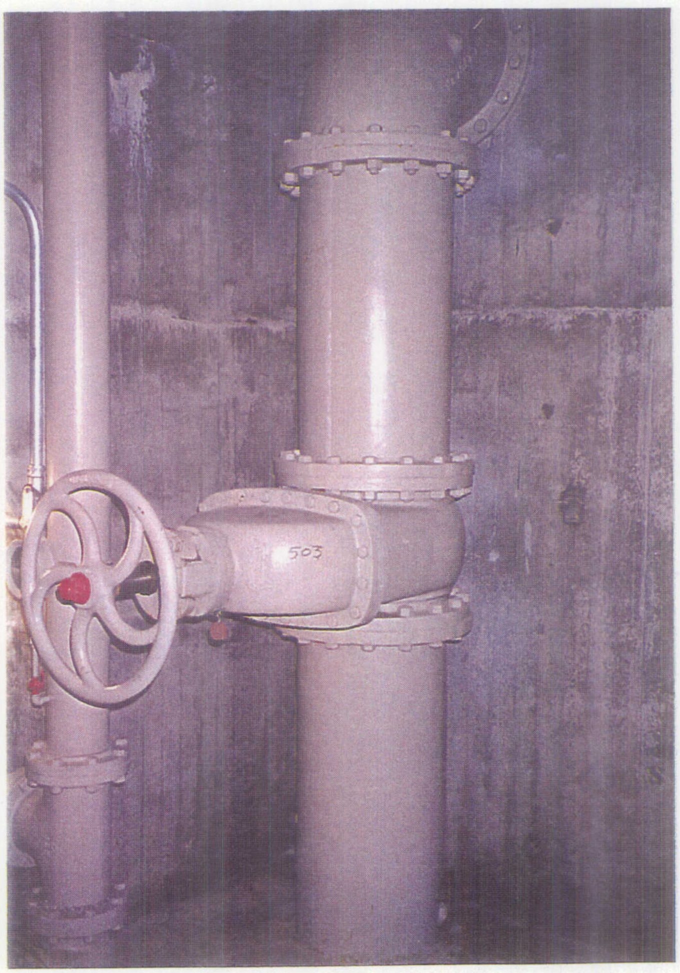


Photo 6 - Morris Dam - Drum Gates - View of gate valve in drum gate control piping.
06/30/98

Photo 7 - Morris Dam - Drum Gates -
View of gate valve in drum gate control piping. 06/30/98

Photo 8 - Morris Dam - Drum Gates - View of drum gate position indicator.
06/30/98

OUTLET PIPE INSPECTION
AND
SAFETY ASSESSMENT PROGRAM

MORRIS DAM - OUTLET PIPES
SAN GABRIEL PROJECT, CALIFORNIA

REVIEW REPORT

County of Los Angeles
Department of Public Works

Hydroelectric Research and Technical Services Group
Technical Service Center

U.S. Department of the Interior
Bureau of Reclamation
Denver, Colorado

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1.0 SUMMARY AND RECOMMENDATIONS

General

On September 28-October 1, 1998, the Morris Dam flood release outlet pipes were inspected. During the exam the following tasks were performed:

A) The condition of the exposed exterior coatings and the interior linings of the outlet pipes was inspected.

B) The wall thickness of the steel outlet pipes was determined by ultrasonic testing.

C) Appurtenances where the outlet works and piping connected to the outlet works change in diameter or where the water flow changes in direction were inspected.

Summary

The Morris Dam outlet pipes are generally in very good condition. Listed below are a summary and items of concern that were noted during the inspection:

A) Inspection of the interior of the Morris Dam outlet pipe Nos. 1, 3, 4, and 6 was performed on September 29, 1998. The outlet pipes are lined with what appears to be a coal tar epoxy lining. The entire length of the steel outlet pipes between the emergency gates/valves and the needle valves was examined. The interior of outlet pipe Nos. 2 and 5 was not inspected due to the large amount of silt and mud that was probably located inside the pipes. Outlet pipe No. 2 was being used for sluicing at the time of this examination.

The coal tar epoxy lining was generally in very good condition for all the outlet pipes. Damaged areas of coal tar epoxy lining were observed in outlet pipe Nos. 1 and 6.

The coal tar epoxy in outlet pipe No. 1 is in good condition except for the upstream end of the outlet pipe (photograph 1). The coal tar epoxy coating has completely deteriorated upstream of the butterfly valve to a distance approximately 20 feet downstream of the butterfly valve. There is a large amount of surface rusting occurring at these locations but there was no significant pitting observed (photographs 2 and 3). There are a number of small-diameter areas with significant amount of coating loss and rust occurring throughout the entire length of the outlet pipe (photograph 4). The rust was removed at several of these locations and there is no evidence of significant corrosion pitting occurring. It should be noted that outlet pipe No. 1 is rarely operated due to undercutting of the road adjacent to the stilling basin. It appears that the stagnant water in the outlet pipe is very aggressive in accelerating the corrosion process at defects located in the coal tar epoxy lining.

The coal tar epoxy lining in outlet pipe No. 6 was in very good condition (photograph 7). There are three damaged areas of coal tar epoxy lining located at the top of the outlet pipe just upstream of the butterfly valve leaf. The damaged areas are approximately 4 to 6 inches in diameter with a significant amount of coating loss and surface rust occurring (photograph 8). The rust was removed at these locations and there is no evidence of significant corrosion pitting occurring. Outlet pipe No. 6 is used quite extensively for operational releases.

The exposed exterior surfaces of the outlet pipes and bypass pipes located inside the gate chamber are coated with aluminum paint. The paint is generally in satisfactory condition. There are some large areas on several of the outlet pipes in which the aluminum paint has completely deteriorated, especially at the flexible joint locations; however, there is no evidence of corrosion damage.

The exterior surfaces of the outlet pipes exposed to sunlight are coated with what appears to be an enamel paint that is beige in color. The paint is generally in good condition with only some minor surface defects observed on each outlet pipe.

B) Detailed measurements of the steel outlet pipe wall thickness were taken using ultrasonic measurement techniques. From these measurements a general steel pipe wall thinning effect was determined. Various stress analyses for the hoop stress from internal pressure were performed. Based upon the results of these analyses, the calculated stresses do not exceed the allowable stresses anywhere in the outlet pipes, by at least a factor of 1.54.

C) No problems were noted for the appurtenances or pipe connections.

Recommendations:

1. To prevent any additional wall thinning which would reduce current safety margins, the interior of the outlet works steel pipes should be examined every 3 to 5 years in order to monitor the condition of the existing coal tar epoxy lining. Repair of the damaged areas of coal tar enamel should be performed to arrest any further wall thinning due to corrosion and prevent extensive pitting damage.

2. The damaged areas of aluminum paint on the exposed exterior surfaces of the outlet pipes located inside the gate chamber should be cleaned and repainted to prevent the occurrence of any corrosion damage.

2.0 INTRODUCTION

This report describes the results of the flood release outlet pipes inspection that was performed for the Morris Dam outlet works on September 28-October 1, 1998.

2.1 Outlet Works Description

The flood release outlet system consists of six outlets with one common trashrack structure on the upstream face of the dam. The flood outlets have a maximum capacity of nearly 7000 second feet at full reservoir head. There is one 54-inch-diameter and one 48-inch-diameter outlet at elevation 975.00, each equipped with venturi meters, that are provided for normal flood releases. There are also two 96-inch-diameter outlets at elevation 975.00 that are provided for occasional large releases. There are also two 48-inch-diameter outlets provided at elevation 960.00 for the primary purpose of sluicing any silt from beneath the other four flood release outlets. Almost the entire lengths of the outlet pipes are encased in concrete.

Each of the outlets is currently equipped with a free-discharge, hydraulic-balanced needle valve at the downstream face of the dam, which is used for normal regulation. Hydraulic-operated slide gates are provided as emergency gates for the 54-inch-diameter and each of the 48-inch-diameter outlet pipes and are located in a gallery near the upstream face of the dam. Electric-operated butterfly valves are provided on both of the 96-inch-diameter outlet pipes for emergency use.

An 8-foot by 10-foot tractor gate is provided on the upstream face of the dam and is the emergency gate for any of the six outlet pipes in the event maintenance needs to be performed on any of the emergency gates or valves. This gate is operated by a 100-ton traveling hoist located in a hoist house at the crest of the dam. Each of the outlets has a mouth belled to an 8-foot by 10-foot gate frame to fit the tractor gate leaf. The 48-inch and 54-inch pipes are connected to the 8-foot by 10-foot tractor gate seats by cast iron, bell-mouthed transitions. The bell mouths for the 96-inch-diameter outlets are formed holes in the mass concrete of the dam.

Each of the six flood outlet pipes consists of electrically welded steel pipe downstream from the emergency gates in the operating gallery. The 96-inch pipes have a wall thickness of 0.5000 inch and the 54-inch and 48-inch pipes have a wall thickness of 0.3750 inch. The pipe upstream of the emergency gates is fabricated from A.W.W.A. cast iron flanged pipe.

A manhole is located just upstream of the water-operated needle valves on each outlet pipe to provide access to the interior of the outlet pipes.

A 20-inch bypass pipe connection is provided on outlet pipe Nos. 3 and 4 and is used for flushing silt out of the bottom of the outlet pipes.

The exterior surfaces of the outlet pipes that are embedded in mass concrete were not coated. The exposed exterior surfaces of the outlet pipes are coated with enamel paint. The interior of the steel outlet pipes is lined with bituminous coal tar epoxy lining.

A general plan, sections, and details of the outlet pipes are shown on drawings SG-331-P through SG-334-P (copies included with this report).

Information on fabrication of the outlet pipes and pipe material is not available. It would be safe to assume that for the time period that the outlet pipes were fabricated, it is most likely that the outlet pipes were fabricated with ASTM A7 steel plate.

The specified minimum tensile strength for ASTM A7 material was listed as 55,000 psi, and the specified minimum yield strength was shown to be 27,500 psi.

Flanged joints are used to connect the outlet pipes to the needle valves, slide gates, and butterfly valves.

2.2 Inspection Procedure

The following steps were included in the inspection procedure:

A) Visual examination of both the interior and exposed exterior of the outlet pipes.

B) Perform ultrasonic examinations to determine any wall thinning.

C) Perform a detailed examination of items or possible problem areas that were observed during the visual inspection.

D) Perform a stress analysis based on wall thinning data to determine acceptability and operating safety margins for the outlet pipes.

3.0 INITIAL (VISUAL) ASSESSMENT

An initial visual assessment was performed to determine the current physical condition and geometry of the Morris Dam outlet pipes. Information from this initial assessment was used to identify areas or items that will require a more detailed assessment.

3.1 Outlet Pipes

A visual examination of the outlet pipes was performed. The interior of outlet pipe Nos. 1, 3, 4, and 6 was examined and the exterior surfaces of the exposed portions of all the outlet pipes were inspected.

3.1.1 Interior Surfaces

Inspection of the interior of the Morris Dam outlet pipe Nos. 1, 3, 4, and 6 was performed on September 29, 1998. The outlet pipes are lined with what appears to be a coal tar epoxy lining. The entire length of the steel outlet pipes between the emergency gates/valves and the needle valves was examined. The interior of outlet pipe Nos. 2 and 5 was not examined due to the large amount of silt and mud that was probably located inside the pipes. Outlet pipe No. 2 was being used for sluicing at the time of this examination.

<u>Outlet Pipe No. 1</u>

There was approximately 4-6 inches of water located on the invert of the outlet pipe at the time of the inspection. The coal tar epoxy lining was generally in satisfactory condition except for the upstream end of the outlet pipe (photograph 1). The coal tar epoxy coating has completely deteriorated upstream of the butterfly valve to approximately 20 feet downstream of the butterfly valve. There is a large amount of surface rusting occurring at these locations but there was no significant pitting observed (photographs 2 and 3). There are a number of small-diameter areas with significant amount of coating loss and rust occurring throughout the entire length of the outlet pipe (photograph 4). The rust was removed at several of these locations and there is no evidence of significant corrosion pitting occurring. It should be noted that outlet pipe No. 1 is rarely operated due to undercutting of the road adjacent to the stilling basin. It appears that the stagnant water in the outlet pipe is very aggressive in accelerating the corrosion process at defects located in the coal tar epoxy lining.

Outlet Pipe No. 2

The interior of outlet pipe No. 2 was not examined during this inspection. Outlet pipe No. 2 was being used for sluicing operations at the time of this inspection.

Outlet Pipe No. 3

There was approximately 4 inches of water located on the invert of the outlet pipe at the time of the inspection. The coal tar epoxy lining was in very good condition with no evidence of coating damage or rusting observed (photograph 5).

Outlet Pipe No. 4

There was approximately 4 inches of water located on the invert of the outlet pipe at the time of the inspection. The coal tar epoxy lining was in very good condition with no evidence of coating damage or rusting observed (photograph 6).

Outlet Pipe No. 5

The interior of outlet pipe No. 5 was not examined during this inspection due to the large amount of mud and silt that was probably located inside the steel pipe.

Outlet Pipe No. 6

There was approximately 4-6 inches of mud and water located on the invert of the outlet pipe at the time of the inspection. The coal tar epoxy lining was in very good condition (photograph 7). There are three damaged areas of coal tar epoxy lining located at the top of the outlet pipe just upstream of the butterfly valve leaf. The damaged areas are approximately 4 to 6 inches in diameter with a significant amount of coating loss and surface rust occurring (photograph 8). The rust was removed at these locations and there is no evidence of significant corrosion pitting occurring. Outlet pipe No. 6 is used quite extensively for operational releases.

3.1.2 Exterior Surfaces

Inspection of the exterior of all six Morris Dam outlet pipes was performed on September 29, 1998.

The exposed exterior surfaces of the outlet pipes and bypass pipes located inside the gate chamber are coated with aluminum paint. The paint is generally in satisfactory condition. There are some large areas on several of the outlet pipes in which the aluminum paint has completely deteriorated, especially at the flexible joint locations; however, there is no evidence of corrosion damage.

The exterior sections of the outlet pipes exposed to sunlight are coated with what appears to be a beige-colored enamel paint. The paint is generally in good condition with only some minor surface defects observed on each outlet pipe (photographs 9-12).

3.2 Restrained Joints

The welded joints were closely examined for cracks in the base metal or welds. The welds are in excellent condition with no evidence of discontinuities.

3.3 Unrestrained joints

Bolted Flanged Connections - Each outlet pipe has bolted flanged joint connections located on the upstream side of the 18-inch-diameter manhole. The bolted flanged connections are used to connect the outlet pipe to the needle valve assemblies. The bolted flanged connections are in excellent condition with no evidence of corrosion. The flanged connections are well coated with enamel paint. Flanged connections are also used to connect the slide gates and butterfly valves to the outlet pipes. These connections also appear to be in good condition.

Flexible Couplings - Each outlet pipe is provided with a flexible coupling located inside the gate chamber just downstream of each emergency gate/valve. The coupling facilitates removal and installation of the emergency gates and valves and also allows movement due to temperature differences. The couplings are in good condition with no evidence of movement.

3.4 Appurtenances

Appurtenances include such items as wye branches, bifurcations, transitions, bends, tees, elbows, and reducers. These items are inspected because these are areas where the water flow changes velocity and/or direction. These areas have a higher probability of experiencing lining and cavitation damage.

There is a venturi tube provided on outlet pipe Nos. 3 and 4. The tubes were in good condition with no evidence of lining damage or cavitation damage.

3.5 Penetrations

There are several penetrations or connections that are associated with the Morris Dam outlet pipes. These include:

A) 8-Inch Bypass Pipe Connections - An 8-inch bypass pipe is provided on each outlet works pipe at the emergency gate/valve location (photograph 13). This line fills the outlet pipe section located between the emergency gate/valve and the needle valve in order to provide balanced head on both sides of the emergency gate/valve. The 8-inch bypass pipe connections appear to be in good condition and were functioning properly at the time of this inspection.

B) 20-Inch Bypass Pipe Connection - A 20-inch bypass pipe connection is located on outlet pipe Nos. 3 and 4, just upstream of the 18-inch manhole connections. This connection allows the silt to be flushed out of the outlet pipes. The 20-inch pipe connections are in good condition (photograph 14).

C) 18-Inch Manhole Connections - An 18-inch-diameter manhole is provided on each outlet pipe for access to the outlet pipe interior (photographs 15 and 16). The manholes are located just upstream of the needle valve assemblies. The manhole connections are well coated with enamel paint and are in good condition.

3.6 Vibration

The outlet pipes were not in operation during this inspection. According to plant personnel, vibration has not been a problem associated with operation of the outlet works.

3.7 Geotechnical Considerations

There are no signs of movement or settlement of the Morris Dam outlet pipes. There was damage noted on the concrete pedestals for several of the needle valve assemblies. Cracks were observed in the grout caps for two of the concrete pedestals for the needle valves (photographs 17 and 18).

4.0 DETAILED ASSESSMENT

Several items were identified during the initial assessment that warranted more detailed assessment. These items included ultrasonic examination of the outlet pipe shells. The data accumulated are presented in the following applicable sections.

4.1 Outlet Pipe Shell

Ultrasonic examination of each outlet pipe shell was performed using a Panametrics Epoch III ultrasonic thickness/flaw detector. Calibration waveforms and data for measurements of the steel outlet pipes are shown in figure 4-1. Several measurement locations were selected for each individual pipe diameter and wall thickness. The thickness measurements were taken at various locations about the circumference of the outlet pipe shells. The results of the data were incorporated into spreadsheets for statistical analysis as seen in tables 4-1 through 4-6. Results of the tables are expressed both in terms of the magnitude of deviations in measured wall from specified wall thickness, and as a percentage of the nominal specified wall thickness.

The thickness measurements and wall thinning values for steel outlet pipe No. 1 are shown in table 4-1. The final results of table 4-1 indicate an actual increase of 1.00 percent representing all shell sections, and a decrease of 5.00 percent for the lower bound thickness value.

The thickness measurements and wall thinning values for the steel outlet pipe No. 2 are shown in table 4-2. The final results of table 4-2 indicate a decrease of 2.265 percent representing all shell sections, and a decrease of 8.00 percent for the lower bound thickness value.

The thickness measurements and wall thinning values for steel outlet pipe No. 3 are shown in table 4-3. The final results of table 4-3 indicate an actual increase of 1.33 percent representing all shell sections, and an increase of 1.33 percent for the lower bound thickness value.

The thickness measurements and wall thinning values for the steel outlet pipe No. 4 are shown in table 4-4. The final results of table 4-4 indicate an actual increase of 2.13 percent representing all shell sections, and an increase of 1.33 percent for the lower bound thickness value.

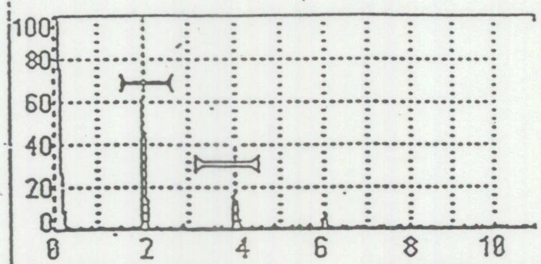
The thickness measurements and wall thinning values for steel outlet pipe No. 5 are shown in table 4-5. The final results of table 4-5 indicate a decrease of 1.197 percent representing all shell sections, and a decrease of 4.00 percent for the lower bound thickness value.

The thickness measurements and wall thinning values for the steel outlet pipe No. 6 are shown in table 4-6. The final results of table 4-6 indicate a decrease of 2.25 percent representing all shell sections, and a decrease of 5.00 percent for the lower bound thickness value.

For conservatism, the lower bound wall thickness value of an 8.00 percent decrease in wall thickness will be employed for stress calculations for the Morris Dam steel outlet pipes.

FIGURE 4-1
Calibration Data for Steel Outlet Pipes

FILE: CALBR97_.STL 12/01/97 __:__
ID>001 ePEAK 1.000in



AMPLITUDE MAX 100%	CURRENT 40%
MIN DEPTH 1.000	ePEAK 1.000 in
REF 24.6+ 0.0dB	RANGE 4.999 in
VEL 0.2320 in/us	PULSER LOW
ANGLE 00.0°	DAMPING 50 Ω
THICK 0.000 in	PULSE-ECHO MODE
ZERO 0.871 us	FULLWAVE RECTIFY
REJ 0 %	DELAY 0.000 in

Gate	Start	Width	Level	Alarm
1	0.767	0.564	69 %	OFF
2	0.620	0.658	31 %	OFF

Calibration Data

TABLE 4-1

MORRIS DAM OUTLET PIPE NO. 1

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.5000	0.4750	-0.0250	-0.0050	-0.0250	-5.00
	0.5000	0.4750	-0.0250			-5.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
2	0.5000	0.5000	0.0000	0.0200	0.0000	0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
	0.5000	0.5250	0.0250			5.00
3	0.5000	0.5000	0.0000	0.0000	0.0000	0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00

Measured-Nominal Wall Statistics for all Liner Sections (30 Data Points)

Average Change in Wall Thickness in Inches: +0.0050 inch

Average Change in Wall Thickness in Percentage: +1.00%

Lower Bound Value: -5.00%

TABLE 4-2

MORRIS DAM OUTLET PIPE NO. 2

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.2500	0.2300	-0.0200	-0.0080	-0.0200	-8.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2500	0.0000			0.00
2	0.3750	0.3700	-0.0050	-0.0050	-0.0050	-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33

Measured-Nominal Wall Statistics for all Manifold Sections (20 Data Points)

Average Change in Wall Thickness in Inches: -0.0065 inch

Average Change in Wall Thickness in Percentage: -2.265 %

Lower Bound Value: -8.00 %

TABLE 4-3

MORRIS DAM OUTLET PIPE NO. 3

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.3750	0.3800	0.0050	0.0050	0.0050	1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33

Measured-Nominal Wall Statistics for all Manifold Sections (10 Data Points)

Average Change in Wall Thickness in Inches: +0.0050 inch

Average Change in Wall Thickness in Percentage: +1.33 %

Lower Bound Value: +1.33 %

TABLE 4-4

MORRIS DAM OUTLET PIPE NO. 4

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.3750	0.3800	0.0050	0.0080	0.0050	1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3900	0.0150			4.00
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3900	0.0150			4.00
	0.3750	0.3900	0.0150			4.00
	0.3750	0.3800	0.0050			1.33
	0.3750	0.3800	0.0050			1.33

Measured-Nominal Wall Statistics for all Manifold Sections (10 Data Points)

Average Change in Wall Thickness in Inches: +0.0080 inch

Average Change in Wall Thickness in Percentage: +2.13 %

Lower Bound Value: +1.33 %

TABLE 4-5

MORRIS DAM OUTLET PIPE NO. 5

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.2500	0.2600	0.0100	0.0000	-0.0100	4.00
	0.2500	0.2600	0.0100			4.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2500	0.0000			0.00
	0.2500	0.2400	-0.0100			-4.00
	0.2500	0.2500	0.0000			0.00
2	0.3750	0.3600	-0.0150	-0.0090	-0.0150	-4.00
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3600	-0.0150			-4.00
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3600	-0.0150			-4.00
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3700	-0.0050			-1.33
	0.3750	0.3600	-0.0150			-4.00

Measured-Nominal Wall Statistics for all Manifold Sections (20 Data Points)

Average Change in Wall Thickness in Inches: -0.0005 inch

Average Change in Wall Thickness in Percentage: -1.197 %

Lower Bound Value: -4.00 %

TABLE 4-6

MORRIS DAM OUTLET PIPE NO. 6

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
1	0.5000	0.5400	0.0400	0.0360	0.0000	8.00
	0.5000	0.5600	0.0600			12.00
	0.5000	0.5600	0.0600			12.00
	0.5000	0.5600	0.0600			12.00
	0.5000	0.5200	0.0200			4.00
	0.5000	0.5200	0.0200			4.00
	0.5000	0.5300	0.0300			6.00
	0.5000	0.5200	0.0200			4.00
	0.5000	0.5500	0.0500			10.00
	0.5000	0.5000	0.0000			0.00
2	0.5000	0.5200	0.0200	0.0000	-0.0100	4.00
	0.5000	0.4900	-0.0100			-2.00
	0.5000	0.4900	-0.0100			-2.00
	0.5000	0.4900	-0.0100			-2.00
	0.5000	0.4900	-0.0100			-2.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.4900	-0.0100			-2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
3	0.5000	0.5100	0.0100	0.0090	0.0000	2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5200	0.0200			4.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5200	0.0200			4.00

TABLE 4-6 (Continued)

MORRIS DAM OUTLET PIPE NO. 6

Measurement Location	Specified Nom. Wall Thickness (IN)	Meas. UT Wall (IN)	Wall-Thin Delta Meas.-Nom. (IN)	Avg. Delta (IN)	Greatest Wall-Thin Meas.-Nom. (IN)	Wall-Thin Delta Meas.-Nom. (%)
4	0.5000	0.5200	0.0200	0.0000	-0.0250	4.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.5100	0.0100			2.00
	0.5000	0.4750	-0.0250			-5.00
	0.5000	0.4750	-0.0250			-5.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00
	0.5000	0.5000	0.0000			0.00

Measured-Nominal Wall Statistics for all Liner Sections (40 Data Points)

Average Change in Wall Thickness in Inches: +0.0113 inch

Average Change in Wall Thickness in Percentage: +2.25 %

Lower Bound Value: -5.00 %

5.0 ANALYSIS AND EVALUATION

Outlet Pipe

Stress analysis was performed for critical regions in the outlet pipe for hoop pressure stresses of the steel outlet pipe sections. These stresses are compared to allowable stresses to compute margins of safety. The following criteria was used for the stress analysis:

Data

Maximum Reservoir Water Surface = 1170.00 ft
Centerline Elevation of outlet discharge pipe Nos. 1, 3, 4, and 6 = 975.00 ft. and for outlet pipe Nos. 2 and 5 = 960.00 ft.

The maximum static head at outlet pipe Nos. 1, 3, 4, and 6 = 195.0 ft. = 84.5 psi.

The maximum static head at outlet pipe Nos. 2 and 5 = 210.0 ft. = 91.0 psi.

Allowable Stresses

For steel pipe stress analysis, the basic allowable stress for general primary membrane stress is either one-third of the ultimate tensile strength or two-thirds of the yield strength, whichever is smaller. This criteria gives the following values for allowable stress:

Information on fabrication of the outlet pipes and pipe material is not available. It would be safe to assume that for the time period that the outlet pipes were fabricated, it is most likely that the outlet pipes were fabricated with ASTM A7 steel plate with the following characteristics:

ASTM A7

Ultimate Tensile Strength = 55,000 psi
Yield Strength = 27,500 psi

Allowable stress from (1/3)(Ultimate Tensile Strength) = 18,333 psi

Allowable stress from (2/3)(Yield Strength) = 18,333 psi.

Joint Efficiency Factors

No data are available concerning the inspection of the welded connections for the steel outlet pipes. It is assumed that hydrostatic tests and spot radiograph inspection of the welded connections were required during the initial fabrication and installation of the outlet pipes, thus allowing the use of a joint efficiency factor of 0.80 for welded connections.

Joint Efficiency Reduction Factor for Welded Joints of outlet pipe manifold = 0.80

Applying a joint efficiency factor of 0.80 for welded joints gives a minimum allowable stress of (18,333 psi)(0.80) = 14,667 psi for ASTM A7 parent material.

Internal Pressure Stresses

Hoop pressure stress was calculated for straight section shells, using the following equation:

$$O_H = \frac{pR}{t}$$

Where O_H = hoop stress
p = pressure
R = inner radius
t = wall thickness

The results are shown in table 5-1 for various wall thinning and load cases, for the highest hoop pressure stress (lowest elevation) for each shell size.

Table 5-1 is for the steel outlet pipes fabricated from ASTM A7 material, with 8.00 percent wall thinning in the shell away from welded joints, and a 0.80 joint efficiency for welded joints. Hoop stresses meet the parent metal allowable stresses for all shell sizes for regions away from and including welded joints by a factor of 1.54.

TABLE 5-1

Pressure Hoop Stress Results for Parent Metal (ASTM A7) Away from Welded Joints, Adjusted for General Shell Thinning of 8.00% and a Joint Efficiency of 0.80

Decrease from Specified Nominal Wall = 8.00%

2/3 Lower Bound Yield Strength for Parent Metal = 18,333 psi

1/3 Lower Bound Ultimate Tensile Strength for Parent Metal = 18,333 psi

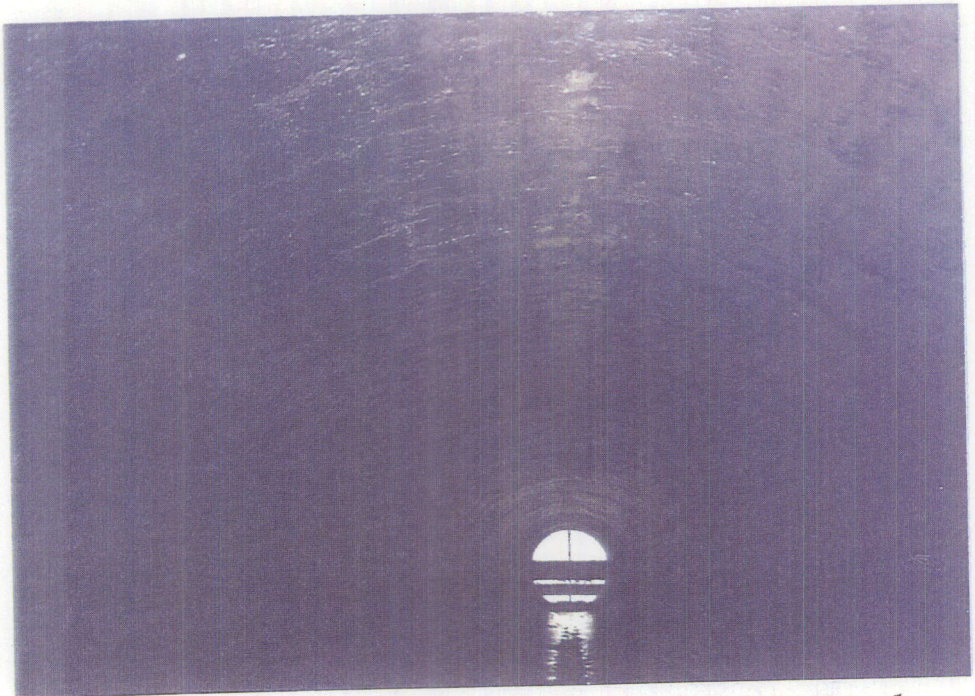
Joint Efficiency for Welded Joints = 0.80

Minimum Allowable Stress = 1/3 Lower Bound Ultimate Tensile Strength for Parent Metal with Joint Efficiency Applied = (18,333)(0.80) = 14,667 psi.

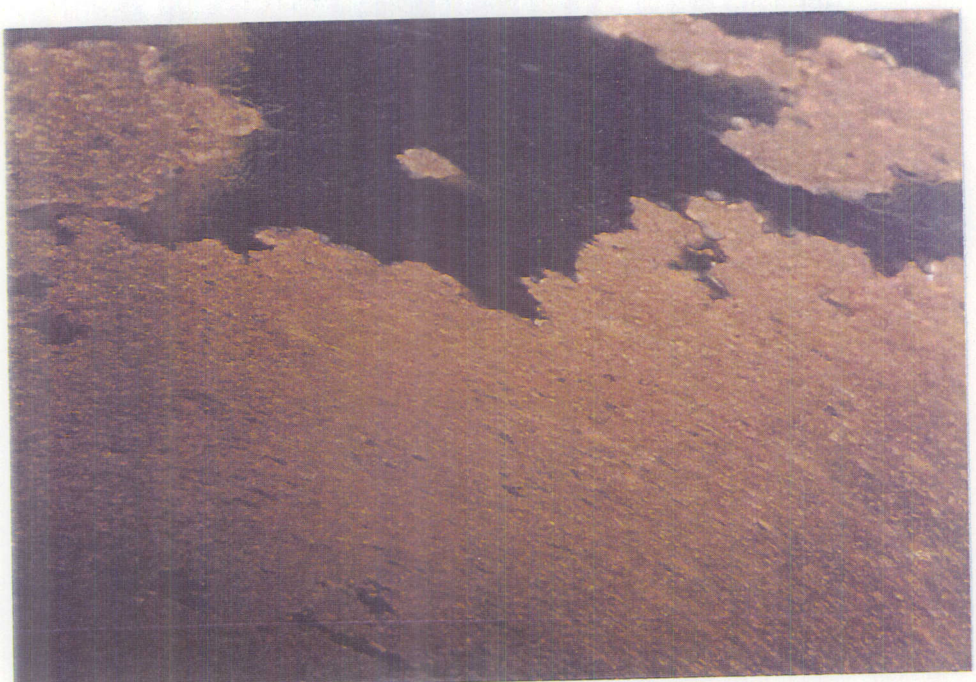
Maximum Water Surface Elevation = 1170.00 ft.

Inside Diameter (IN)	Specified Nom. Wall Thickness (IN)	Adjusted Wall Thickness (IN)	Elev. (FT)	Press. Head (FT)	Fluid Press. (PSI)	Static Shell Hoop Stress (PSI)	Adjusted Shell Hoop Stress (PSI)	Ratio Adjusted Hoop Stress vs. Minimum Allowable Stress (14,667 psi) (PSI)
48	0.2500	0.2300	960	210.0	91.0	8736	9496	0.6474
48	0.3750	0.3450	960	210.0	91.0	5824	6330	0.4316
54	0.3750	0.3450	975	195.0	84.5	6084	6613	0.4509
96	0.5000	0.4600	975	195.0	84.5	8112	8817	0.6012

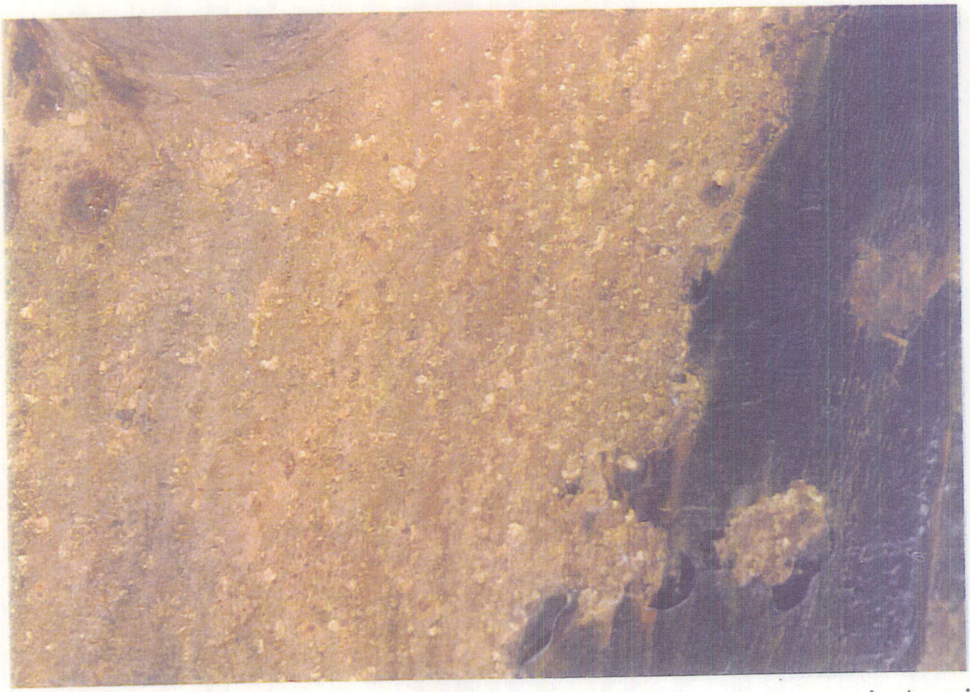
6.0 PHOTOGRAPHS



Photograph 1 - Interior of outlet pipe No. 1.

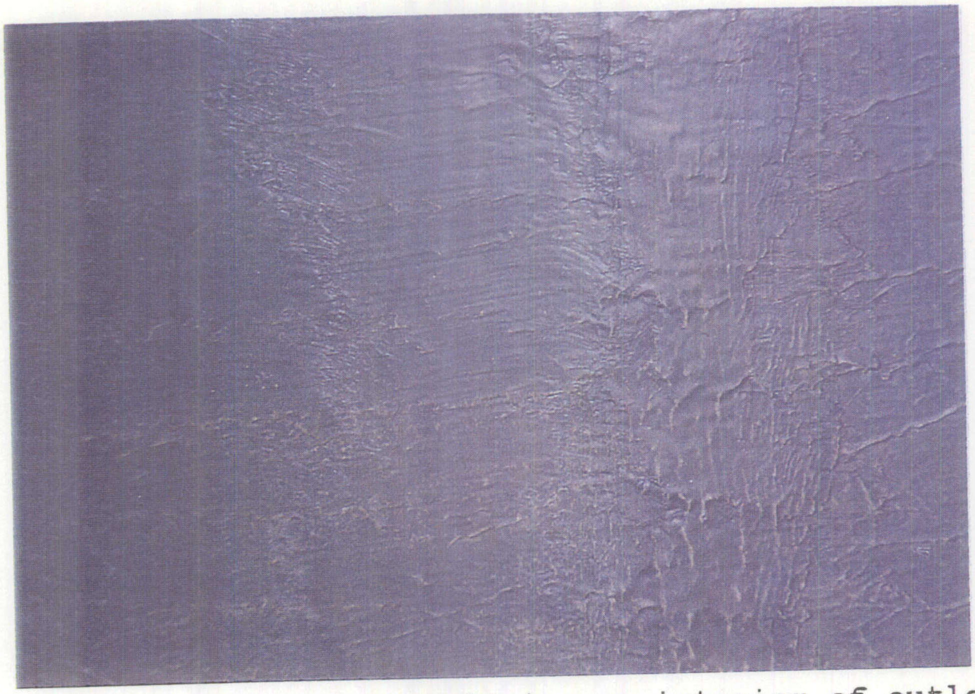


Photograph 2 - Damage to coal tar epoxy lining located on the interior of outlet pipe No. 1 just downstream of the butterfly valve leaf.

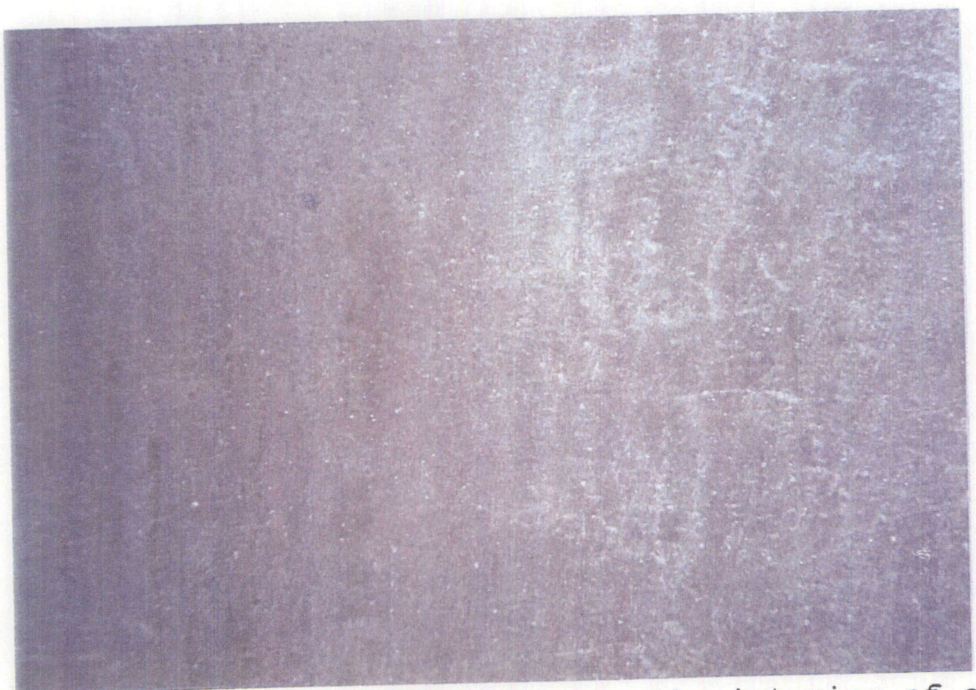


Photograph 3 - Damage to coal tar epoxy lining on interior of outlet pipe No. 1.

Photograph 4 - Damage to coal tar epoxy lining on interior of outlet pipe No. 1.

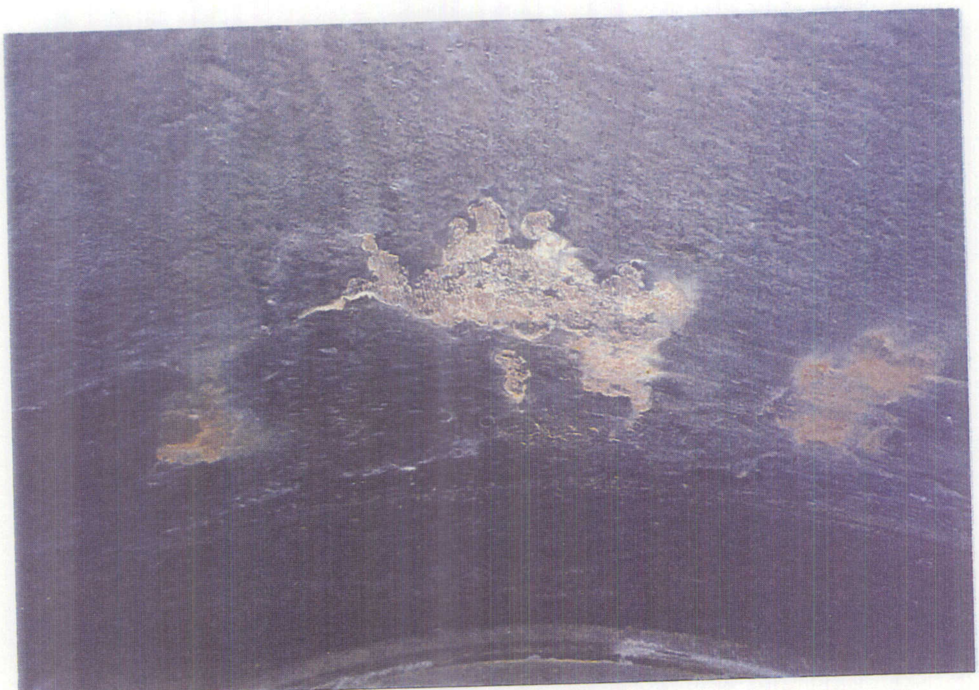


Photograph 5 - Coal tar epoxy lining on interior of outlet pipe No. 3.



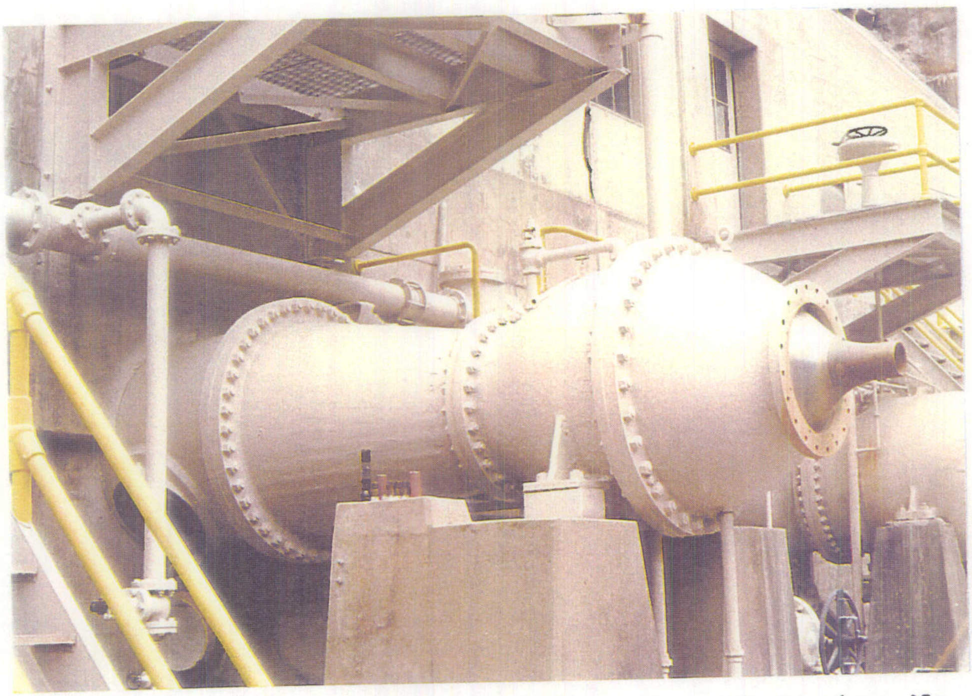
Photograph 6 - Coal tar epoxy lining on the interior of outlet pipe No. 4.

Photograph 7 - Coal tar epoxy lining on interior of outlet pipe No. 6. Note 96-inch butterfly valve leaf.



Photograph 8 - Damaged coal tar epoxy lining located at top of outlet pipe just downstream of the 96-inch butterfly valve leaf.

Photograph 9 - Exposed section of outlet pipe No. 2. Note sediment being discharged during sluicing operations.



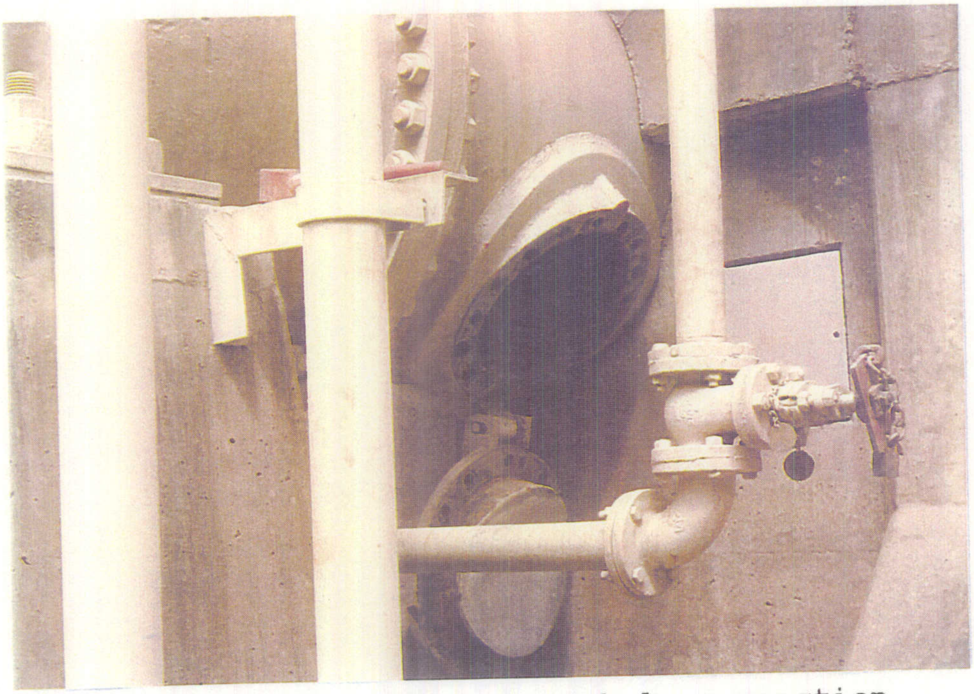
Photograph 10 - Exposed sections of outlet pipe No. 3.

Photograph 11 - Exposed sections of outlet pipe No. 5.

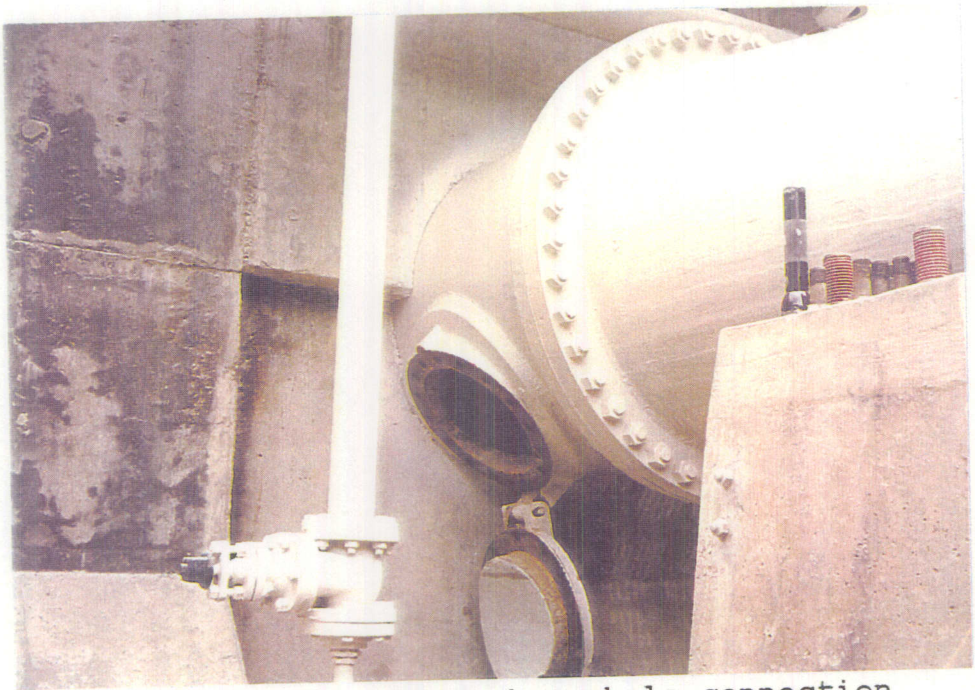
Photograph 12 - Exposed sections of outlet pipe No. 6.

Photograph 13 - 8-Inch bypass pipe connection.

Photograph 14 - 20-Inch bypass pipe connection located on outlet pipe No. 4.

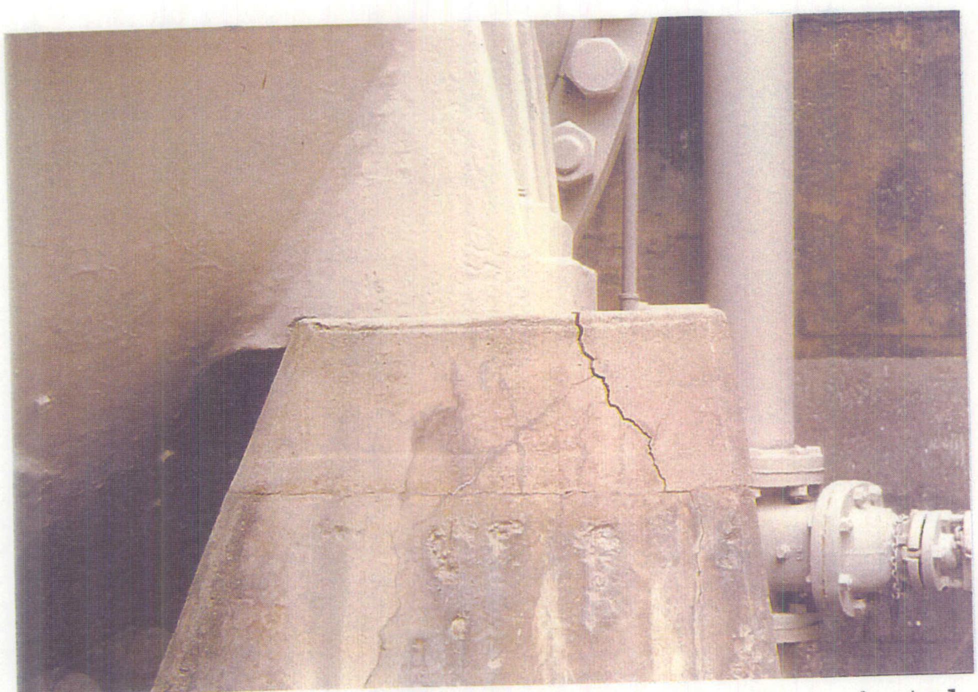


Photograph 15 - 18-Inch manhole connection.



Photograph 16 - 18-Inch manhole connection.

Photograph 17 - Damage to grout cap of concrete pedestal support for needle valve assembly.



Photograph 18 - Damage to grout cap of concrete pedestal support for needle valve assembly.

7.0 DRAWINGS

Listed below and included in this section are the drawings that were referenced and used during this examination:

1. PF500906 - Pine Canyon Dam - Conduit Control House - Manhole for Steel Pipe
2. PF501079 - Morris Dam - By-Pass Operating Diagram - Emergency Valve Chamber
3. PF501243 - Pine Canyon Dam - Layout and Details for 20" Outlet
4. PF501244 - Pine Canyon Dam - By-Pass Lines in Emergency Valve Operating Chamber
5. PF501327 - Pine Canyon Dam - Flood Outlet Details
6. PF501393 - Pine Canyon Dam - Flood Release Outlets - 96" and 54" Outlets
7. PF501394 - Pine Canyon Dam - Flood Release Outlets - 48" Outlets
8. PF501395 - Pine Canyon Dam - Flood Release Outlets - Emergency Valve Chamber and 20" Outlet
9. PF501964 - Pine Canyon Dam - Flood Release Outlets - General Layout
10. PF501965 - Pine Canyon Dam - Flood Release Outlets - Sectional Plan
11. PF501966 - Pine Canyon Dam - Flood Release Outlets - Sections of 96" and 48" Outlets
12. PF501967 - Pine Canyon Dam - Flood Release Outlets - Sections of 54" and 20" Outlets
13. PF501968 - Pine Canyon Dam - Flood Release Outlets - Emergency Valve Chamber
14. PF501969 - Pine Canyon Dam - Flood Release Outlets - Downstream Elevation

OUTLET PIPE INSPECTION
AND
SAFETY ASSESSMENT PROGRAM

MORRIS DAM OUTLET PIPES
SAN GABRIEL PROJECT, CALIFORNIA

William D. McStraw, Mechanical Engineer

Roger Cline, Peer Reviewer

Concurred:

Bert Milano, Manager
Hydroelectric Research and Technical Services Group

Los Angeles County Department of Public Works

Morris Dam
Inlet/Outlet Rehabilitation Project

Morris Dam River Intake Modification Study

B&V Project 96231
B&V File C.1.8.1

BLACK & VEATCH
Corporation

April 27, 2004

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Figures are located are at the end of their respective sections:

APPENDIX

1.0 INTRODUCTION

1.1 Background and Purpose

Morris Dam and Reservoir is a flood control and water conservation facility owned and operated by the Los Angeles County Department of Public Works (Department). The Department would like to increase water conservation capacity at Morris Dam by lowering the minimum pool from elevation 1100 to elevation 1060. Lowering the pool elevation has created concerns regarding the migration of sediment deposit towards the dam's face. These sediments, which are currently stored in the upper reaches of the reservoir, could potentially impact the existing trashracks and intake structure.

Potential hazards that might occur if the racks were to be completely buried by debris include:

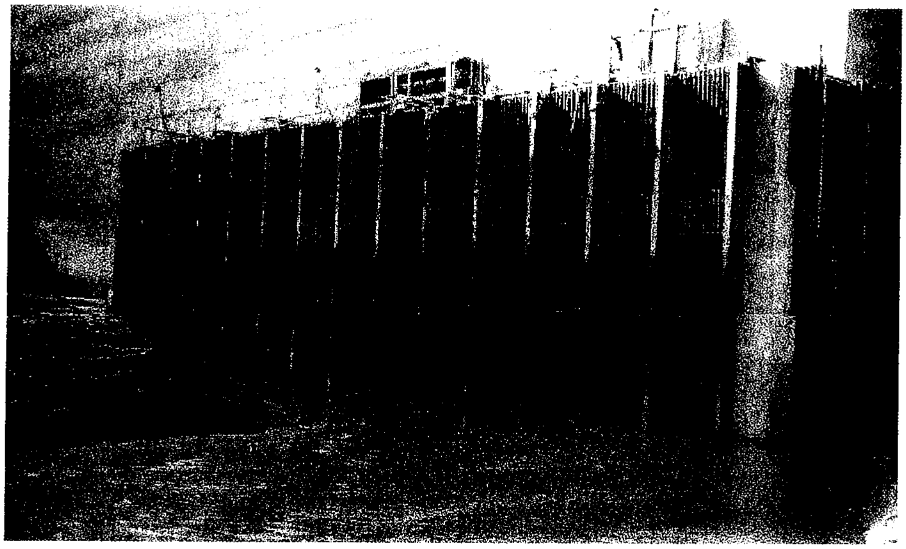
- Large hydrostatic head might force enough sediment through the plates on the rack to effectively fill the interior of the trashrack with sediment.
- Larger debris might accumulate on the exterior faces of the trashrack limiting the amount of water that could pass to the interior of the intake structure.
- The combination of a trashrack full of sediment with a limited supply of water could result in operational problems with the valves.
- The rack and penstocks might become filled with sediment rendering the valves inoperable.

The purpose of this reconnaissance level feasibility study is to evaluate possible modifications to the existing intake structure to mitigate operation problems associated with sediment build up.

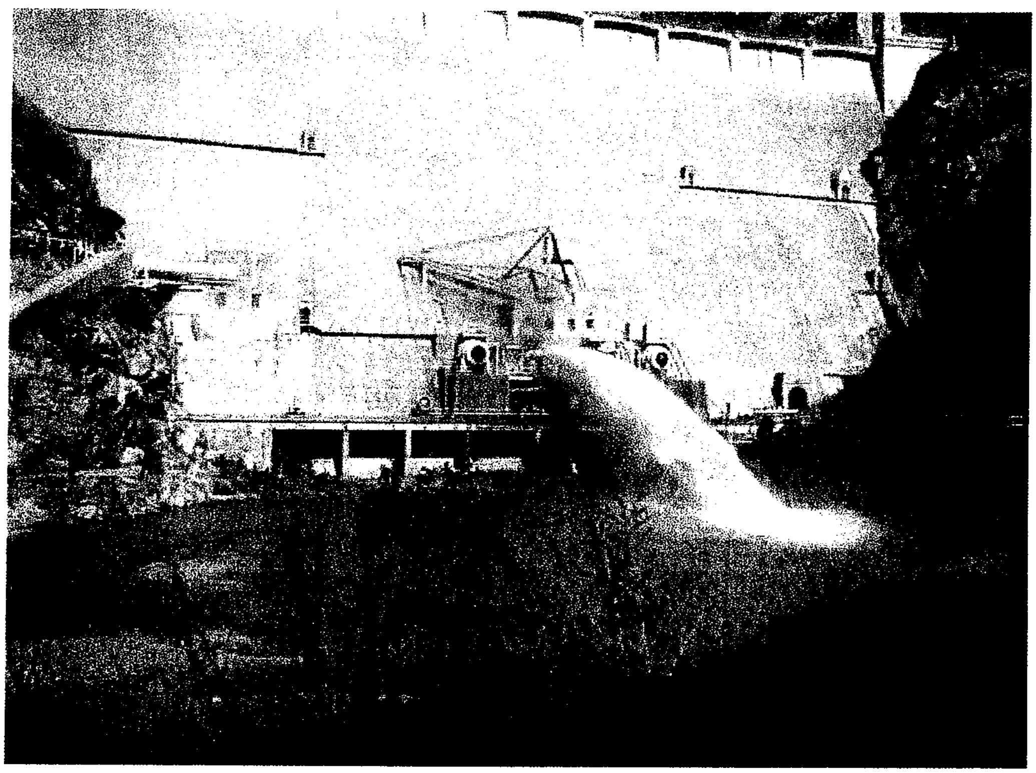
1.2 Description of Existing Features

Morris dam is a concrete gravity dam with a structural height of 328 feet (lowest point of foundation to crest) and a crest length of approximately 800 feet. The crest of the dam is at elevation 1175.00 (245 feet above streambed) and accommodates a 20-foot wide roadway.

There are six outlets to the river numbered 1 through 6 (east to west), from a single trashrack-protected intake structure located near the center of the dam. Photograph No. 1 shows the trashrack structure and photograph No. 2 shows the outlets on the downstream face of the dam. Outlet Nos. 1 and 6 are 96-inch diameter steel-lined conduits with intakes at centerline elevation 975.00 feet. Outlet Nos. 2 and 5 are 48-inch diameter steel-lined conduits with intakes at centerline elevation 960.00. Outlet No. 3 is a 48-inch diameter steel-lined conduit with intake at centerline elevation 975.00 feet. Outlet No. 4 is a 54-inch diameter steel-lined conduit with intake at centerline elevation 975.00 that transitions to a 48-inch diameter steel-lined conduit further downstream. The Department is currently in the process of rehabilitating the River Outlet Structure, whereby Outlet Nos. 1, 2, and 5 will be closed off with a bulkhead and retired in-place. The other three outlets will be rehabilitated with new regulating discharge valves.



Photograph No. 1 Trashrack & Intake Structure



Photograph No. 2 Morris Dam Outlets

A concrete spillway structure is located west of the dam and consists of three overflow weir section each 70-feet long with crests at elevation 1152.00. Each bay, numbered 1 through 3 (east to west) has a drum gate that can be raised to elevation 1170.00, thus maintaining the normal maximum water surface at elevation 1170.00.

No. 1). The design suggestions were identified by a prefix abbreviation of "DS". Table 2-2 summarizes the alternative ideas developed by the team.

Table 2-2. Modification Alternatives Developed During the Creative Phase

Alt ID	Description	Acceptability Rank	Potential Cost Impact Rank	Total Rank
ST-1	Department's Preliminary Concept No. 1	4	5	9
ST-2	Department's Preliminary Concept No. 2	4	5	9
ST-3	Department's Preliminary Concept No. 3	4	5	9
ST-4	Department's Preliminary Concept No. 4	4	1	5
ST-5	Alt ST-4 but using sheet pile as barrier	4	3	7
ST-6	Alt ST-4 but using concrete cutoff wall as barrier	4	0	4
ST-7	Alt ST-2 but fabricate the risers from steel.	4	1	5
ST-8	Build an inclined barrier in front of the existing intake structure which would hold back the sediment.	2	5	7
ST-9	Replicate a similar structure on top of the existing intake structure	4	1	5
ST-10	Stiffen the existing trashracks to resist more sediment loading	2	5	7
ST-11	Install a sediment cleaning machine for the existing intake structure	1	0	1
ST-12	New structural debris barrier around the existing intake structure	3	4	7
ST-14	New intake tower piped over to the portal box. This tower would be independent of the dam and would be free-standing within the reservoir. The existing intake structure would be sealed off into a submerged box.	3	0	3
ST-15	Utilize the existing MWD intake tower as an intake for the river outlets and pipe the water over to the existing submerged intake structure. Seal the existing intake into a box structure.	3	1	4
ST-16	Utilize the MWD tower and conduit and install a new downstream flow regulating valve.	5	5	10
ST-17	Build a new intake tower that is attached to the dam. The new tower would be piped over to the existing intake which would be sealed off.	4	1	5
DS-1	Do Nothing	1	5	6
DS-2	Mining the sediment from the reservoir	1	0	1
DS-3	Let the intake plug and then conduct an emergency dredge of the reservoir	1	5	6
DS-4	Put instruments on the intake structure and monitor the delta pressure (load) from the sediment to be able and measure when the sediment is building up to level that may cause damage	5	2	7

2.3.3 Analysis Phase. The next step in the modified VE process was to analyze the alternatives developed in the creative phase. The workshop team members implemented the SIRRS ranking procedure described above to develop the ranking for the Acceptability and the Potential Cost

Impact, and the results of each are presented in Table 2-2. When evaluating the potential cost impacts of each alternative, these were compared against the perceived costs associated with the Department's Preliminary Concept No. 3 (modification alternative ST-3). Concept No. 3 has the least relative capital cost as compared with the other three preliminary concepts; therefore, the workshop team decided to use Concept No. 3 as the gauge for evaluating the potential for cost impacts.

2.3.4 Development Phase. The workshop team reviewed the cumulative ranking (see Table 2-2) of each alternative and discovered a number of the options were ranked very high. One alternative received a perfect ranking of 10, and several received a ranking of 9. The objective of the workshop was to build consensus among the team members and select two alternatives to be carried forward for development in the reconnaissance level feasibility study.

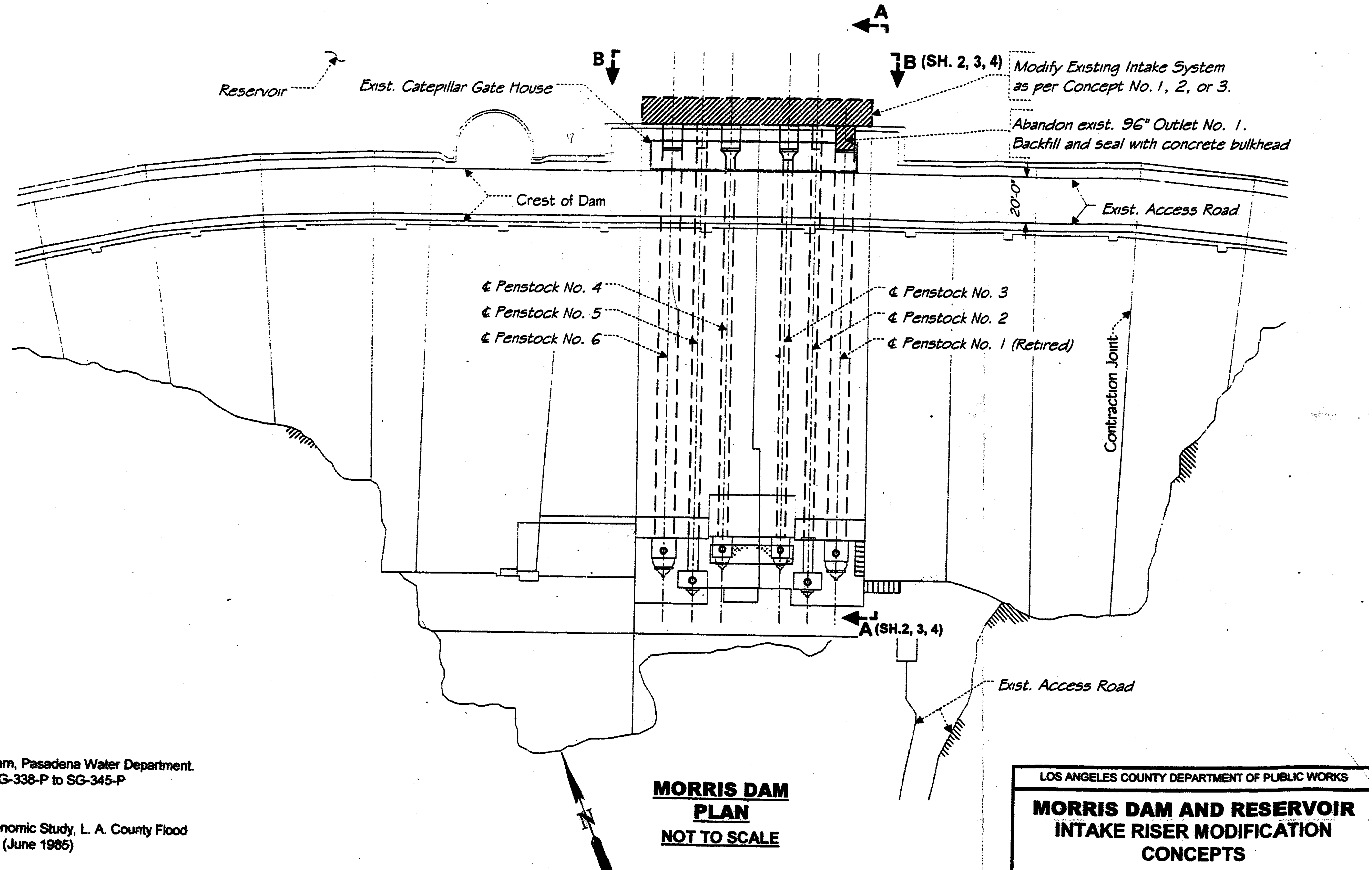
The workshop team selected alternatives ST-3 and ST-16 to be carried forward to the next level of the study. Each team member drafted these alternatives onto forms provided during the workshop and their sketches, notes, and observations are presented in Appendix A of this study.

2.4 Workshop Recommendations

The conclusions from the workshop were that two alternatives would be carried forward for further evaluation. The workshop recommended the following:

- Alternative A – Workshop Alternative ST-3 should be carried forward.
- Alternative B – Workshop Alternative ST-16 should be carried forward.

Alternatives A and B are further described in Section 3 of this study.



MORRIS DAM
PLAN
NOT TO SCALE

DRAFTER: O. GALANG
DESIGNER: O. GALANG, L. HERRERA

REFERENCES

1. Pine Canyon Dam, Pasadena Water Department. Drawing Nos. SG-338-P to SG-345-P (Jan. 27, 1932)

2. Morris Dam Economic Study, L. A. County Flood Control District. (June 1985)

Thomas Bros. Pg. 539, C7

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

MORRIS DAM AND RESERVOIR
INTAKE RISER MODIFICATION
CONCEPTS

GENERAL PLAN

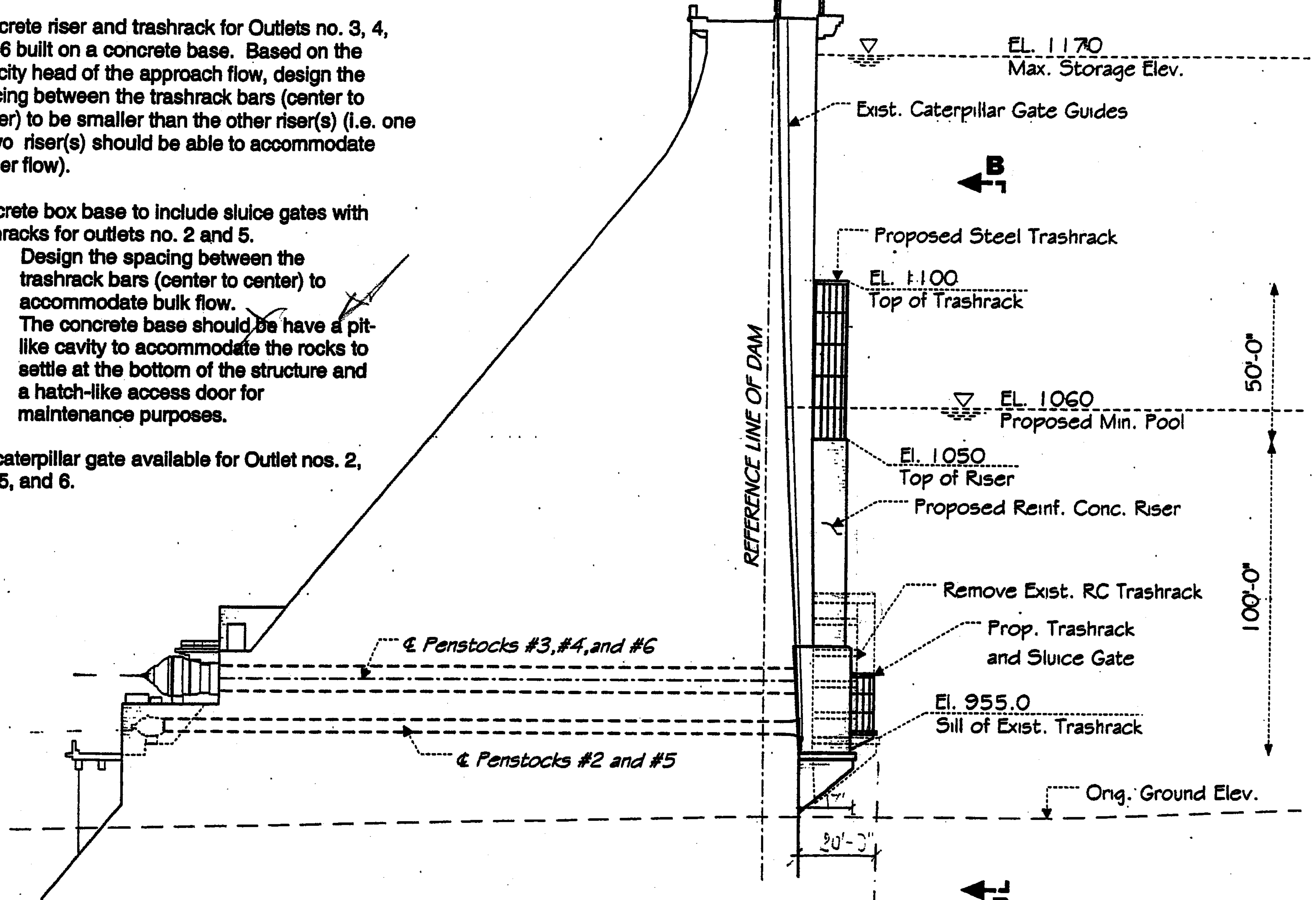
MORRISDAMRISER PLAN SH1 VSD | SHEET 1 OF 5

1. Remove existing reinforced concrete trashrack.

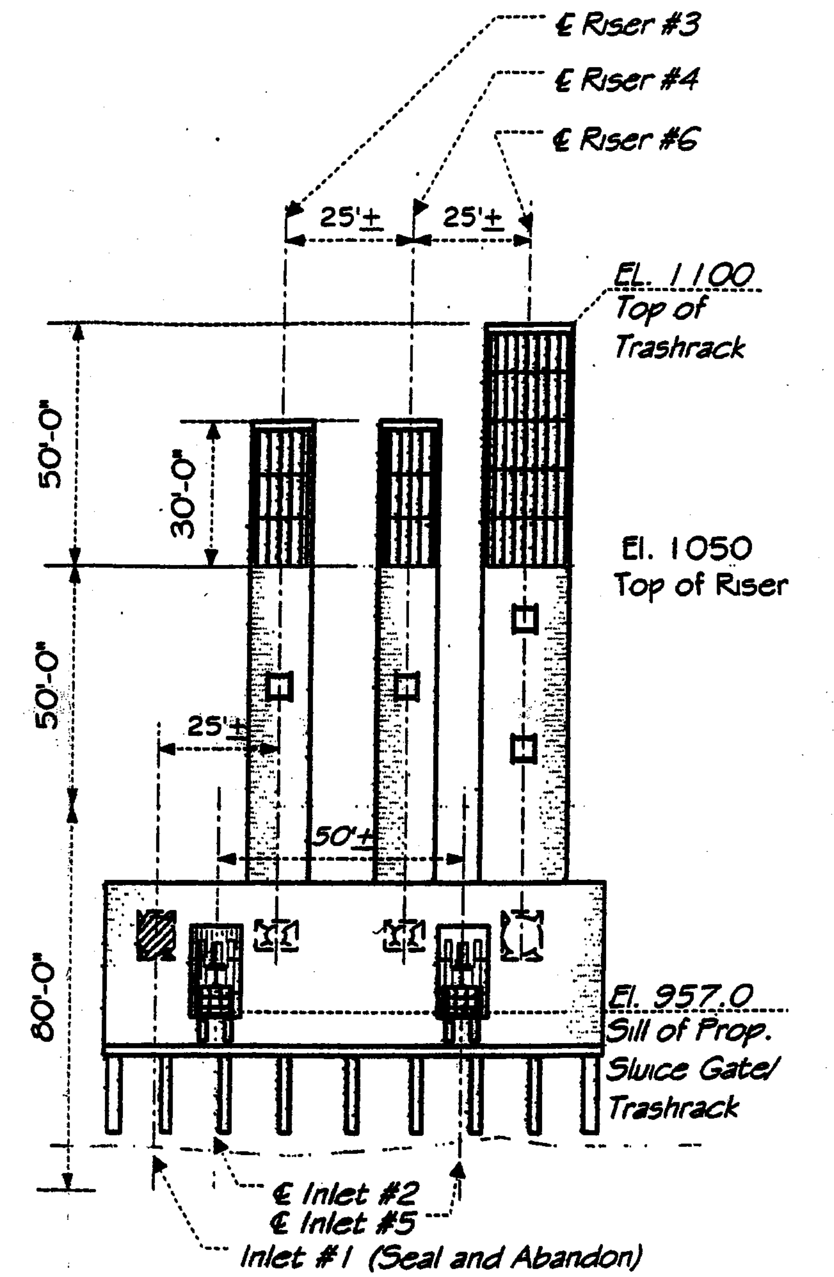
2. Concrete riser and trashrack for Outlets no. 3, 4, and 6 built on a concrete base. Based on the velocity head of the approach flow, design the spacing between the trashrack bars (center to center) to be smaller than the other riser(s) (i.e. one or two riser(s) should be able to accommodate bulkier flow).

3. Concrete box base to include sluice gates with trashracks for outlets no. 2 and 5.
   - Design the spacing between the trashrack bars (center to center) to accommodate bulk flow.
   - The concrete base should ~~be~~ have a pit-like cavity to accommodate the rocks to settle at the bottom of the structure and a hatch-like access door for maintenance purposes.

6. The caterpillar gate available for Outlet nos. 2, 3, 4, 5, and 6.



SECTION A-A (SH. 1)
MORRIS DAM ELEVATION
NOT TO SCALE



SECTION B-B (SH. 1)
NOT TO SCALE

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

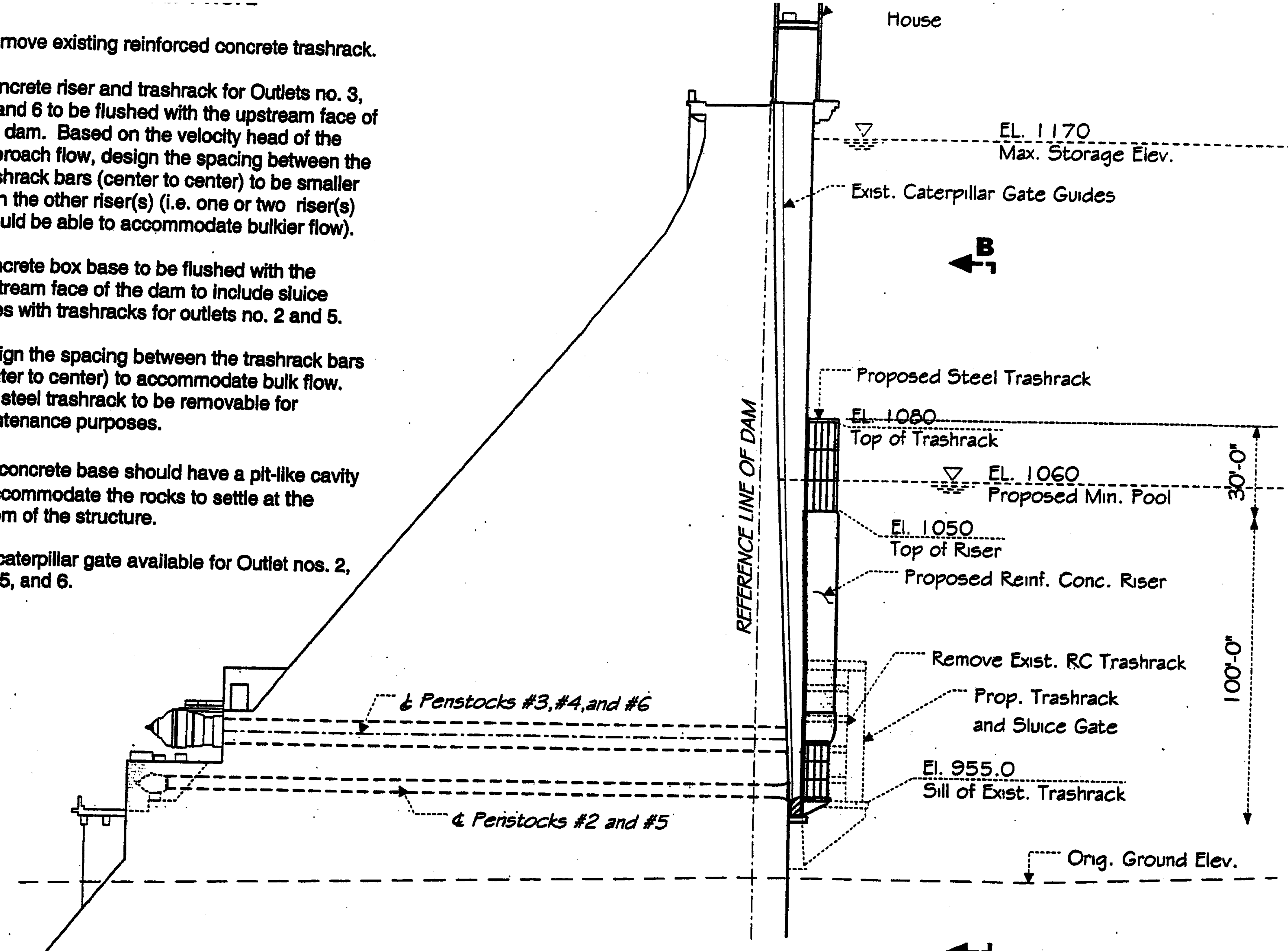
MORRIS DAM AND RESERVOIR
INTAKE RISER MODIFICATION
CONCEPT NO. 1

ELEVATION AND SECTION

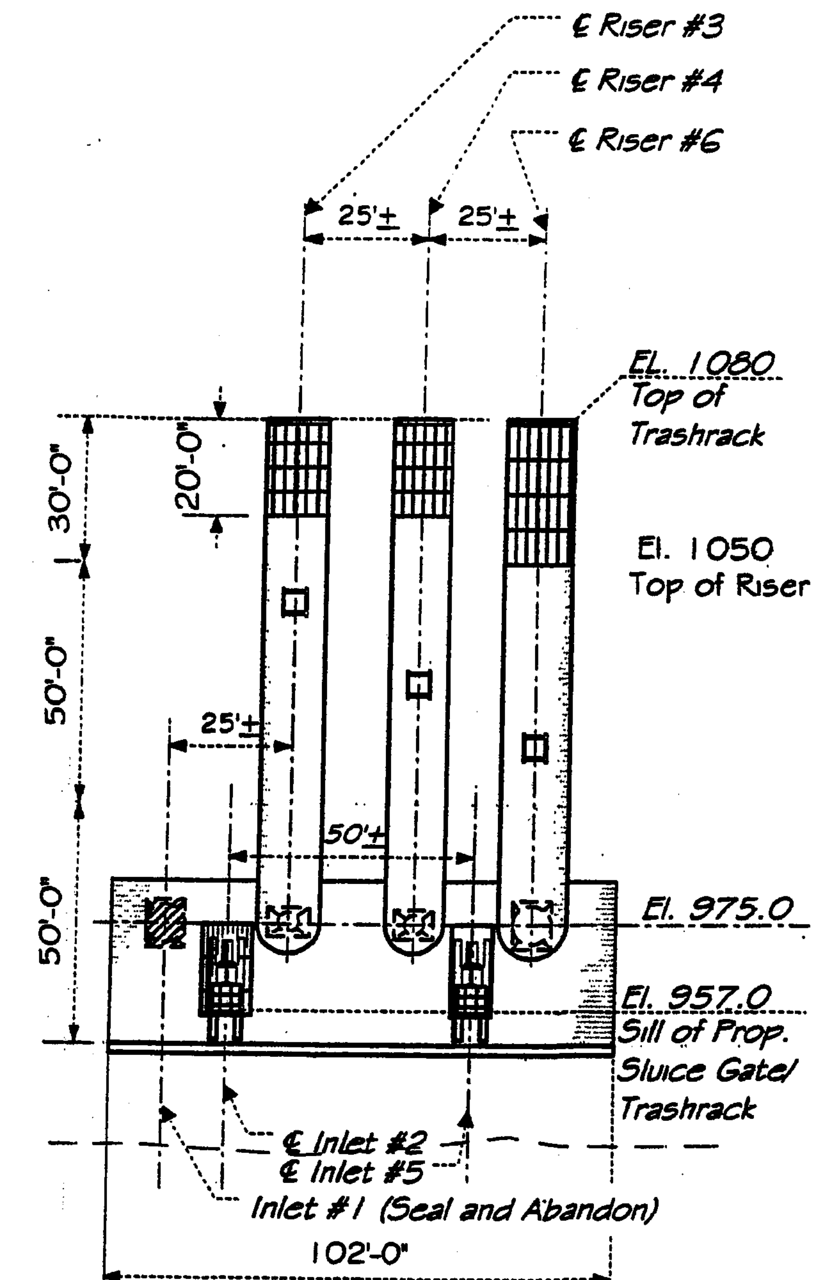
MORRISDAMRISER C-1 P-2.VSD | SHEET 2 OF 5

DESIGNER: O. GALANG, L. HERRERA
DRAFTER: O. GALANG

1. Remove existing reinforced concrete trashrack.
2. Concrete riser and trashrack for Outlets no. 3, 4, and 6 to be flushed with the upstream face of the dam. Based on the velocity head of the approach flow, design the spacing between the trashrack bars (center to center) to be smaller than the other riser(s) (i.e. one or two riser(s) should be able to accommodate bulkier flow).
3. Concrete box base to be flushed with the upstream face of the dam to include sluice gates with trashracks for outlets no. 2 and 5.
4. Design the spacing between the trashrack bars (center to center) to accommodate bulk flow. The steel trashrack to be removable for maintenance purposes.
5. The concrete base should have a pit-like cavity to accommodate the rocks to settle at the bottom of the structure.
6. The caterpillar gate available for Outlet nos. 2, 3, 4, 5, and 6.



SECTION A-A (SH. 1)
MORRIS DAM ELEVATION
NOT TO SCALE



SECTION B-B (SH. 1)
NOT TO SCALE

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

MORRIS DAM AND RESERVOIR
INTAKE RISER MODIFICATION
CONCEPT NO. 2

ELEVATION AND SECTION

MORRISDAMRISER C-2 SH2b.VSD | SHEET 3 OF 5

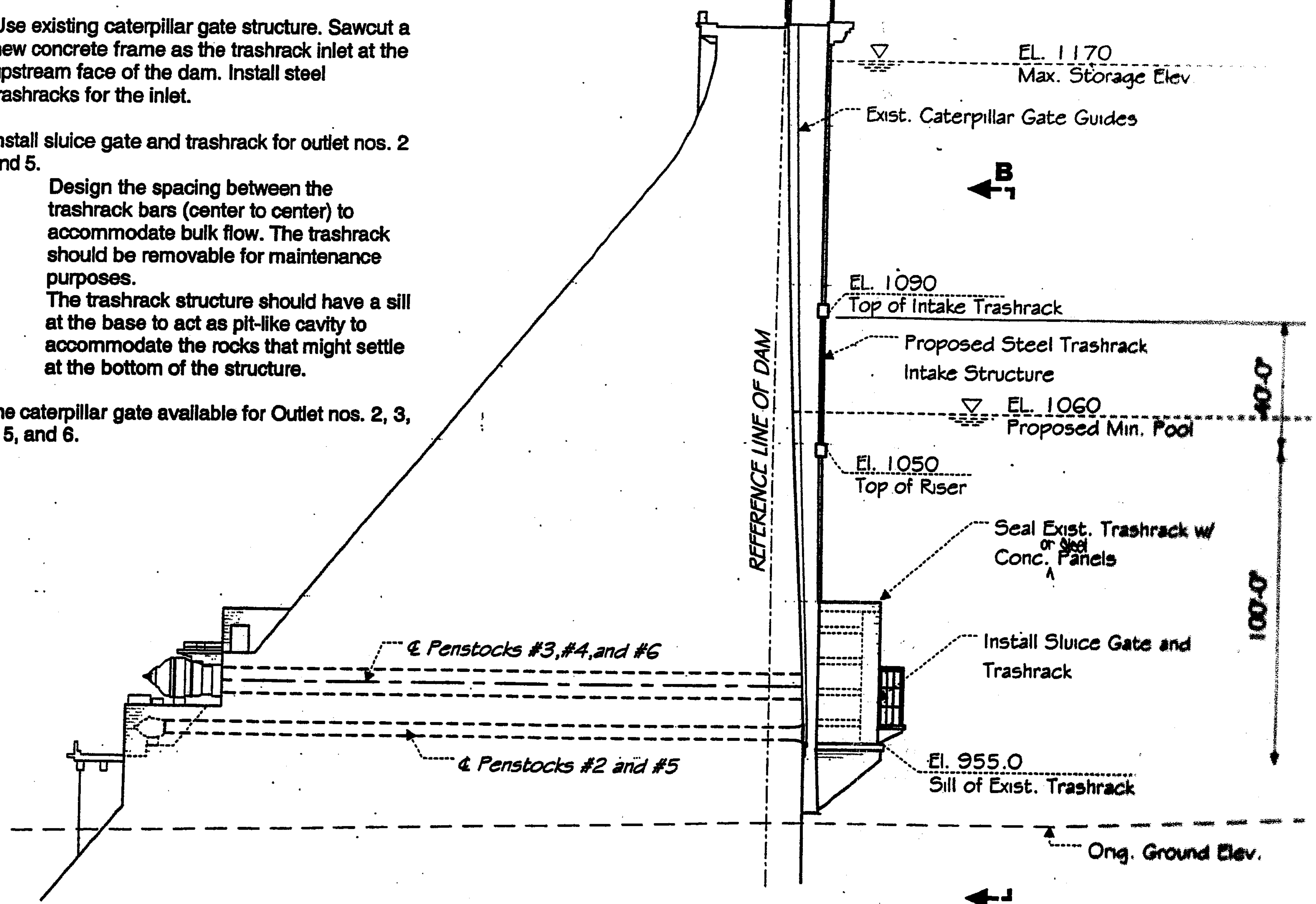
DRAFTER: O. GALANG
DESIGNER: O. GALANG, L. HERRERA

1. Use existing trashrack structure. Seal the structure with concrete or steel panels.

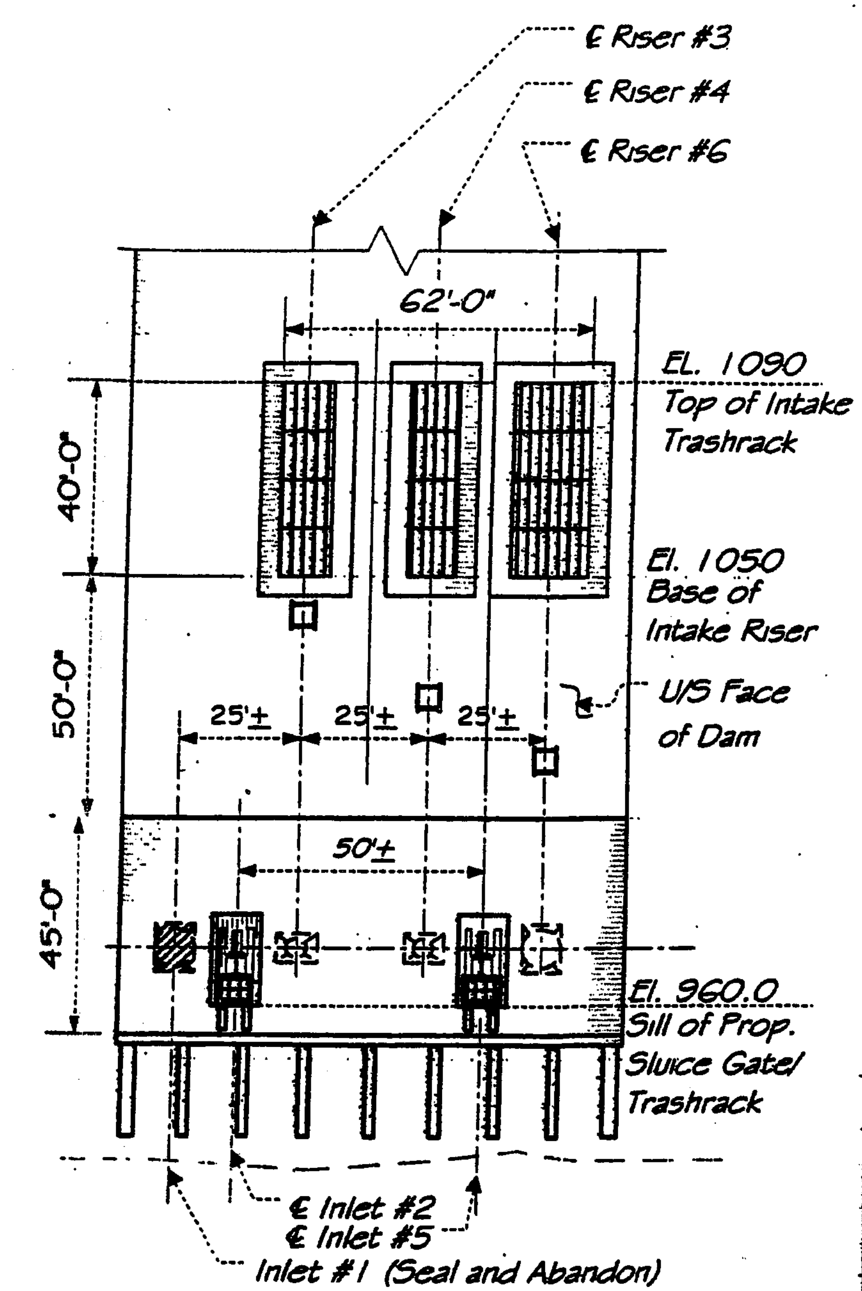
2. Use existing caterpillar gate structure. Sawcut a new concrete frame as the trashrack inlet at the upstream face of the dam. Install steel trashracks for the inlet.

3. Install sluice gate and trashrack for outlet nos. 2 and 5.
   - Design the spacing between the trashrack bars (center to center) to accommodate bulk flow. The trashrack should be removable for maintenance purposes.
   - The trashrack structure should have a sill at the base to act as pit-like cavity to accommodate the rocks that might settle at the bottom of the structure.

4. The caterpillar gate available for Outlet nos. 2, 3, 4, 5, and 6.



SECTION A-A (SH. 1)
MORRIS DAM ELEVATION
NOT TO SCALE



SECTION B-B (SH. 1)
NOT TO SCALE

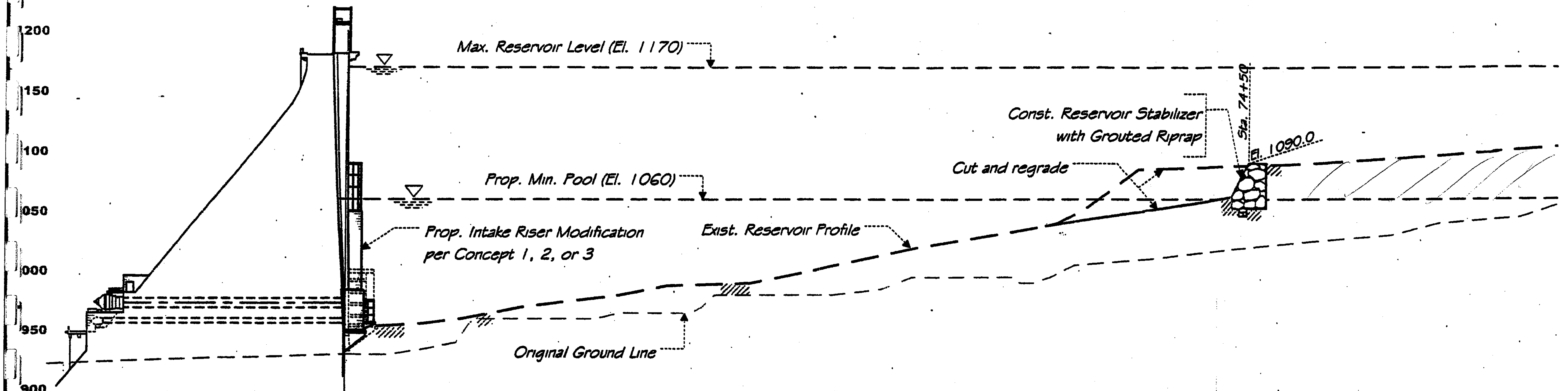
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
MORRIS DAM AND RESERVOIR INTAKE RISER MODIFICATION CONCEPT NO. 3
ELEVATION AND SECTION
MORRISDAMRISER C-3b SH4.VSD — SHEET 4 OF 5

DRAFTER: O. GALANG
DESIGNER: O. GALANG

CONCEPT NO. 4

1. Use Concept no. 1, 2, or 3 for the riser and trashrack configuration of the inlet structure.

2. Construct a reservoir stabilizer using boulders and grouted riprap at approximately 7500 linear feet from the upstream face of the dam.



MORRIS DAM AND RESERVOIR PROFILE

NOT TO SCALE

REFERENCES

1. "Morris Dam and Reservoir: Comments on Operating Plan. L. A. County Flood Control District File No. 560.41, (August 15, 1984).

DESIGN	O. GALANG, L. HERRERA, J. BABAUTA
	O. GALANG

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

MORRIS DAM AND RESERVOIR INTAKE RISER MODIFICATION CONCEPT NO. 4

RESERVOIR PROFILE

MORRISDAMRISER C-4 SH5.VSD | SHEET 5 OF 5

3.0 ALTERNATIVE ANALYSIS

3.1 Overview

This section of the study describes the two alternatives which were selected in Section 3 to be further evaluated.

3.2 Alternative A - Cut New Openings in Caterpillar Gate Wet Well Walls

3.2.1 Facility Arrangement for Alternative A. Alternative A is the Department's Preliminary Concept No. 3. Concept No. 3 is shown on Sheet No. 4 of 5 of the Departments Preliminary Concept Drawings which are included with this study (see Section 2). This intake modification alternative includes the following structural modifications to the existing intake structure:

- Construction of new intake openings with trashracks in face of Caterpillar gate well face for Outlets No. 1, 3, 4 and 6.
- Installation of new intakes for Outlets No. 2 and 5 on face of existing intake structure.
- Removal of trashrack panels on existing intake structure and installation of bulkheads (steel or concrete) to seal intake structure faces.
- Outlet No. 1 abandoned by installation of permanent bulkhead (plug).

3.2.2 Hydraulics. Considering each intake only furnishes water to its outlet results in a maximum approach velocity of 4.41 ft/sec for Outlet No. 6. Considering flows to outlets to be separated is overly conservative, the actual case would be that all intakes are connected to the existing intake which would become a sealed collector box. This arrangement would allow flow for all outlets to share all available intakes. An approach velocity of 2.14 ft/sec would result with Outlets No. 3, 4 and 6 discharging at their maximum rates with their combined flows uniformly entering through their combined trashrack areas. The use of all intakes is advantageous because approach velocity is a measure of trashrack head loss and the potential for high head loss when the racks become partially clogged due to accumulated debris. Intake head loss is a significant issue for intake modification Alternative A. The existing intake structure is a frame consisting of reinforced concrete beams and columns. The Caterpillar gate well structure consists of relatively thin reinforced concrete walls. The original design of these structures did not consider high unbalanced hydrostatic pressures being present. The design of the existing intake provided a large amount of trashrack area to limit approach velocities. To reduce approach velocities for Alternative A, additional intake area would be provided by constructing an intake above Outlet No. 1 similar to that described for Outlets No. 3, 4 and 6. With this increased intake area the maximum approach velocity for combined flow reduces to 1.61 ft/sec.

3.2.3 Civil/Structural.

3.2.3.1 New Intakes for Outlets No. 3, 4 and 6. New intakes for Outlets No. 1, 3, 4 and 6 would be constructed by modifying the existing Caterpillar gate well structure which runs down the face of the dam to where it connects to the top of the existing intake structure. Openings would be cut into the reservoir face of the gate well structure to allow water to enter the gate wells for Outlets No. 1, 3, 4 and 6. This arrangement is shown in Figure 3-1. Width of openings that would be cut into the 12' thick concrete wall of the gate well structure are limited by the clear space between partition walls (11'-6" for Outlets No. 3 and 4, 12'-0" for Outlet No. 1 and 6). Edges of openings would be strengthened by reinforced concrete edge beams across top and bottom of opening and steel edge beams at sides. Steel edge beams would also provide support for sides of new trashrack panels. Trashrack panels would span vertically over horizontal steel beams installed across opening. Face of trashrack would be flush with face of gate well structure to allow debris to either move horizontally or vertically with being trapped against structure. After water passes through trashracks it would turn downward and would be conveyed through the gate well until it enters the existing intake structure which would form a common collector for water coming through all intakes. All outlets would take water from the existing intake structure which would be sealed to form a box as described below.

3.2.3.2 New Intakes for Outlets No. 2 and 5. New intakes for Outlets No. 2 and 5 would be constructed on reservoir side face of existing intake structure as shown on Figure 4-2. Structural support for the new intakes would be provided by reinforced concrete cantilever beams attached to and projecting out from the existing intake structure. These cantilever beams would support a reinforced concrete slab that forms the floor of the new intakes. The existing intake wall face that would be adjacent to the new intakes would be modified by removal of existing trashracks and bulkheads and the forming of a reinforced concrete wall face. This new concrete wall face would be designed for the new intake trashrack structure to attach to. The trashrack for the new intakes would consist of steel bar rack panels attached to a structural steel frame. The new concrete walls would have openings for sluice gates that would be provided to control the flow from the new intakes into the existing intake. Controls and Hydraulic power unit for cylinders mounted on top of the sluice gates would be located on top of dam. Piping would be routed within the Caterpillar gate well to connect the gate operation equipment with the gate cylinder.

3.2.3.3 Sealing of Existing Intake Structure. The existing intake structure would be sealed so that only water passing through the new intakes for Outlets No. 2, 3, 4, 5, and 6 would enter it. The existing intake structure would be sealed by removing its trashrack panels and covering the remaining openings with either fabricated steel bulkheads or precast concrete bulkheads. Bulkheads would not be water tight but would seal sufficiently to prevent significant amounts of sediment from being drawn into the structure.

3.2.3.4 Outlet No. 1 Abandonment. Outlet No. 1 would be abandoned and a permanent bulkhead (plug) installed in water passageway near its inlet. The bulkhead would be reinforced concrete with rebar dowels drilled and grouted into sides of water passageway to anchor the bulkhead against hydrostatic pressure of the reservoir at flood level. Continuous water stop would be provided around circumference of bulkhead to minimize leakage. After bulkhead is in place guard valve in outlet pipe and control valve at end of the outlet pipe can be removed or set in their open positions to prevent pressurization of outlet pipe.

3.2.4 Mechanical. Outlets No. 2 and 5 would have new slide gates and new hydraulic cylinder actuators installed upon a new intake structure. The hydraulic cylinders would be powered from the new Hydraulic Power Unit (HPU) associated with Design Package No. 1. The gates and cylinders would be of similar design as those associated with Design Package No. 2.

3.2.5 Electrical. New instrumentation and control panels would be supplied with the new gate operators for Outlets No. 2 and 5.

3.2.6 Opinion of Construction Cost. Table 3-1 outlines probable opinion of construction cost for Alternative A.

The construction of this alternative would need a construction crane to lower materials into place. It likely is impossible to locate a crane on the dam crest and be able to boom-out over the top of the existing Caterpillar Gate House. It also is unlikely the crane could be located on the north side of Caterpillar Gate House deck. Based on this it is likely a construction crane would need to be staged in front of the intake structure. This would require a new road constructed from Highway 39 to the intake and a substantial work area developed. This would require the reservoir to be drained for an extended period to allow the sediment to sufficiently dry. It is unknown what level of construction would be required to accomplish this; however, is viewed to require a significant amount of resources. A lump sum of $300,000 was added to the estimate to address this construction method. A more detailed study is required to investigate this construction methodology.

Table 3-1 Opinion of Construction Cost - Alternative A

Construction Work Item	Quantity	Unit	Unit cost	Item Cost ($)	Subtotal
Reservoir Roadway Access Improvement					
and Work Pad Improvments	1	LS	300,000.00	300,000	
					300,000
Demolition - Trashrack Structure					
Steel Trashrack Removal	94,500	LB	0.25	23,625	
Concrete Demo. and Removal	5	CY	500.00	2,500	
					26,125
Inlet #1 Closure					
Concrete Demo. and Removal	8	CY	500.00	4,000	
Water Stop (chip and epoxy grout in place)	35	LF	50.00	1,750	
#5 Dowels (drill and epoxy grout in place)	50	Each	30.00	1,500	
Purchase Ready Mix Concrete for Plug	35	CY	90.00	3,150	
Form, Set and Tie Rebar, Pour and Finish Concrete	35	CY	300.00	10,500	
					20,900
Trashrack Structure (replacement/modifications)					
Reinforced Concrete					
Walls	10	CY	450.00	4,500	
Slabs	9	CY	500.00	4,700	
Beams and Columns	10	CY	550.00	5,500	
Pre-Cast Concrete Panels (8" thick)	125	CY	600.00	75,000	
					89,700
Inlet #2 & #5					
Reinforced Concrete Structure	21	CY	500.00	10,500	
Sluice Gates With Operators	2	Each	75,000.00	150,000	
Mechanical Piping Installation	1	LS	25,000.00	25,000	
Steel Support Structure for Trashracks	12,750	LB	1.50	19,125	
Steel Trashracks	31,850	LB	2.00	63,700	
					268,325
Inlet #3 & #4					
Access & Work Area Scaffolding	1	LS	50,000.00	50,000	
Saw Cutting	200	LF	320.00	64,000	
Concrete Demo. and Removal (above grade)	40	CY	500.00	20,000	
Reinforced Concrete Horizontal Edge Beams	15	CY	600.00	9,000	
Steel Support Structure for Trashracks	11,600	LB	1.50	17,400	
Steel Trashracks	23,000	LB	2.00	46,000	
					206,400
Inlet #1 & #6					
Access & Work Area Scaffolding	1	LS	50,000.00	50,000	
Saw Cutting	200	LF	320.00	64,000	
Concrete Demo. and Removal (above grade)	45	CY	500.00	22,500	
Reinforced Concrete Horizontal Edge Beams	16	CY	600.00	9,600	
Steel Support Structure for Trashracks	12,100	LB	1.50	18,150	
Steel Trashracks	24,000	LB	2.00	48,000	
					212,250
Savings if steel bulkhead installed as part of DP1 is deemed acceptable.					-20,900

Total Estimated Direct Construction Cost	$1,102,800
Contingency @ 25%	$275,700
Total Construction Cost	$1,378,500
CEQA Studies*	$0
Subtotal	$1,378,500
Indirect Costs @ 25%	$344,600
Total Project Capital Cost	**$1,723,100**

*CEQA Studies not necessary per County

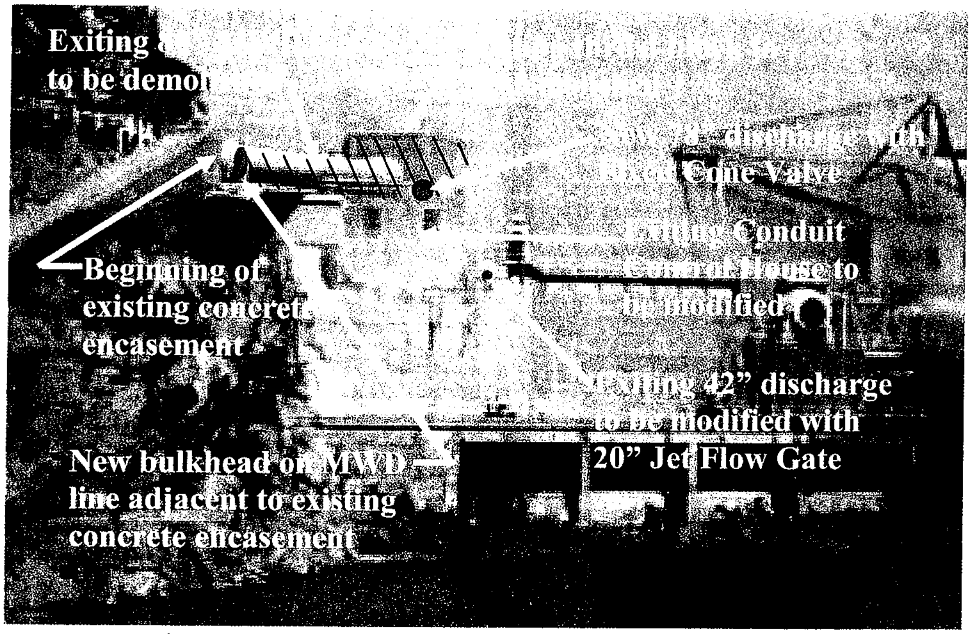
3.3 Alternative B – New River Outlet Valves on Existing MWD Conduit

3.3.1 Facility Arrangement for Alternative B. Alternative B consists of modifying the existing MWD tower on the upstream face of the dam, utilizing the existing 108-inch diameter MWD Conduit through the dam, and construct a new outlet with two new control valves on the downstream side of the dam. Figure 3-3 illustrates the overall Alternative B site layout.

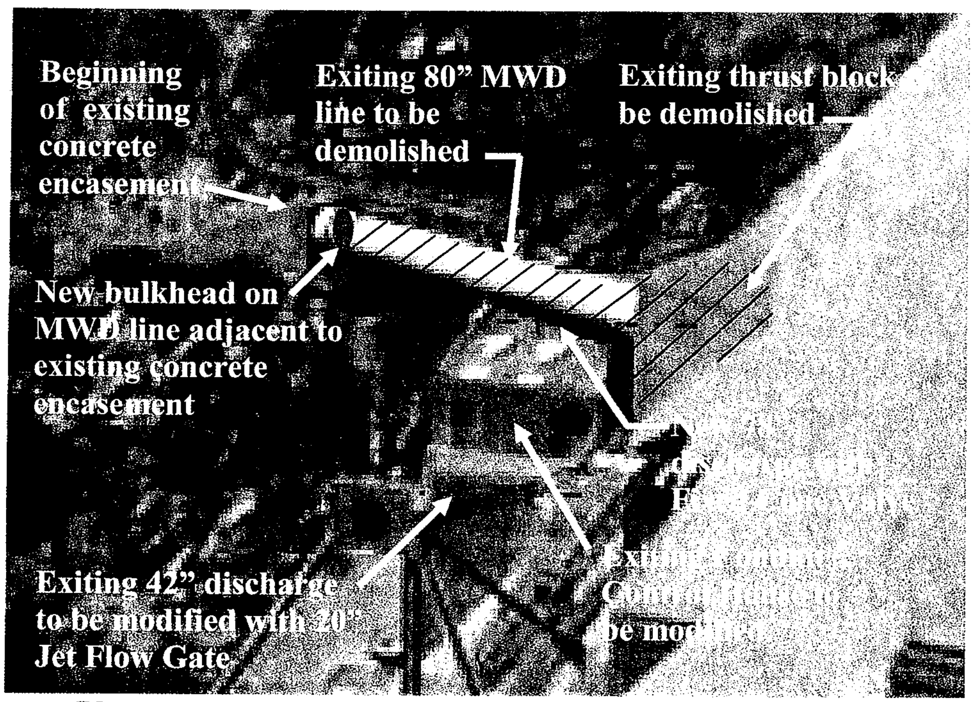
The existing MWD Conduit through the dam was originally planned as a connection of MWD's Colorado River Aqueduct (CRA) System to Morris Dam and the reservoir would be used to store Colorado River within the Los Angeles area. MWD owned the project from circa 1940 to 1995, and abandoned the concept of using Morris Dam for storage during this period. The existing conduit that passes through the dam was sealed off via an in-line bulkhead near the point where the conduit exists the dam's face. The conduit on the downstream side of this bulkhead contains potable water and serves as the source of domestic water for the dam. The upstream side of this bulkhead is maintained in the dry because the upstream side of the conduit is shut off to the reservoir by a 9- by 9-feet slide gate which is closed. This gate is located at the portal entrance to the MWD Conduit and is at the base of the MWD Intake Tower attached to the face of the dam.

The purpose of this alternative is to modify this existing conduit system and convert it into a river outlet conduit. A summary of the modifications follows (also refer to Photographs 4 and 5 and Figures 3-3 through 3-5:

- Changes to the plumbing of the conduit on the downstream face of the dam. The existing in-line bulkhead will be cut out and relocated to another location on the existing MWD conduits system. Domestic water to the dam will still be supplied by MWD through this existing conduit.
- Remove the downstream fitting and thrust block, and install new large diameter piping to extend the conduit out over the top of the existing Conduit Control House.
- The existing MWD conduit has a 42-inch diameter outlet near the existing Conduit Control House. This outlet will be modified to have a new 20-inch diameter jet flow gate which would be used to pass low flows used for water conservation.
- The existing MWD conduit would be modified to have a new 78-inch diameter fixed cone valve with an integral discharge hood to pass large flood flows.
- The upstream MWD Intake Tower would be modified to provide intake water to the conduit and would be protected with new trashrack structure.



**Photograph No. 4 – Downstream Face of Dam
Facing North**



Photograph No. 5 – Downstream Face of Dam Facing West

3.3.2 Hydraulics. The existing 108-inch MWD conduit is located at nominal elevation 1005 (the conduit centerline varies slightly from 1004.50 feet at the upstream end to 1003.84 at the downstream end). The hydraulics of this conduit were evaluated for various valve sizes and a

78-inch[1] fixed cone valve was judged to nearly have the same hydraulic capacity as the sum of Outlets No. 3, 4, and 6 once they are rehabilitated within the scope of Design Package No. 1. In addition to this large regulating valve, there is an opportunity to install a small low-flow valve on an existing 42-inch outlet from the existing 108-inch diameter conduit. This study proposes to install a 20-inch jet flow gate to be used for releasing water conservation flows.

The hydraulics of this configuration are summarized in Table 3-2

Table 3-2. Hydraulic Capacity of New Regulating Valves at Normal Maximum Reservoir Elevation 1170.00

Item	Net head at Valve[2] (feet)	Discharge (cfs)
78" Fixed Cone Valve	132.9	2390
20" Jet Flow Gate	173.6	189

3.3.3 Civil/Structural.

3.3.3.1 MWD Tower Modification. The existing face of the MWD tower includes gated 2'x 8' openings at nine separate elevations ranging from 1161.75 to 999.25. To accommodate the proposed new minimum pool elevation, openings between elevations 1095.50 and 1037.75 would be utilized. At this elevation a new trashrack would be constructed. To ensure an appropriate approach velocity through the proposed trashrack, the area of the openings between the before mentioned elevations would be increased. Two possibilities have been considered to increase the opening area. These include creating additional rectangular openings adjacent to the existing openings or drilling circular holes through the face of the tower. Figure 3-5 illustrates modification of the MWD Tower with new rectangular openings. The existing gates at the elevations not utilized for this Alternative would be evaluated to ensure efficient closure.

3.3.3.2 Outlet Modification. The existing MWD Conduit is reduced from 108-inches to 80-inches just outside of the downstream face of the dam. The MWD water line then runs along the north bank of the river where it drops underneath the river and resurfaces at the opposite side of the river bank. Alternative B proposes to demolish an approximately 45-foot long section of the existing MWD water line from the ~~trust~~ thrust block on the downstream face of the dam to the point where

[1] This study evaluated using a 78-inch fixed cone valve so the maximum outflow would be nearly equal to the summation of the outflow from rehabilitated Outlets No. 3, 4, and 6. An alternative would be to use a 72-inch valve with an estimated normal maximum discharge of 2090-cfs. A 72-inch valve would match Outlet No. 6, i.e., if after the rehabilitation of the River Outlet Structure in Design Package No. 1 the Department proceeds forward with modifying the MWD Conduit, then relocating the valve from Outlet No. 6 to the new outlet would be most economical.

[2] Net head is associated with a single valve in operation.

concrete encasement of the line begins. Photographs No. 4 and No. 5 illustrate demolition of existing facilities.

The proposed new discharge line (see Figure 3-4) would continue along the same alignment as the 108-inch section through the dam. The new reducer and 78-inch pipe would cross the existing Conduit Control House where it would be encased by a new concrete support block. The 78-inch fixed cone valve would be cantilevered from the support block. The support block would extend from the base concrete surface of the dam at elevation 972.50 through the interior of the existing Conduit Control House, which is essentially abandoned except for two 20-hp domestic water pumps. These pumps would remain at their current location. The east side of the conduit control house would remain intact to protect the existing domestic water pumps, piping, and electrical raceway.

The concrete encasement surrounding the existing 42-inch line would be jack-hammered out to expose the piping and allow for removal of a portion of this line. In its place a 42-inch to 20-inch reducer and 20-inch piping will be installed. Similar to the 78-inch line a cast-in-place concrete support block will be constructed down to the existing concrete of the dam. This support block would also support the cantilevered 20-inch jet flow gate.

The actuators of both the 78-inch fixed cone valve and the 20-inch jet flow gate would be supported on a new grated platform at approximately elevation 992.83.

To maintain domestic water service to the dam a new bulkhead would be placed on the existing MWD water line. At the bulkhead a new smaller domestic water outlet line would be installed and routed to the existing domestic water pumps located in the existing Conduit Control House.

3.3.4 Mechanical. The proposed new outlet valves include a 78-inch fixed cone valve with an integral discharge hood and a 20-inch jet flow gate.

3.3.5 Electrical. New raceway and cable would be run from the Motor Control Center (MCC) associated with Design Package No. 1 within the Emergency Gate Chamber within the dam to the new 78-inch fixed cone valve actuator and the new 20-inch jet flow gate actuator. The existing electrical system supplying the domestic water pumps would remain intact.

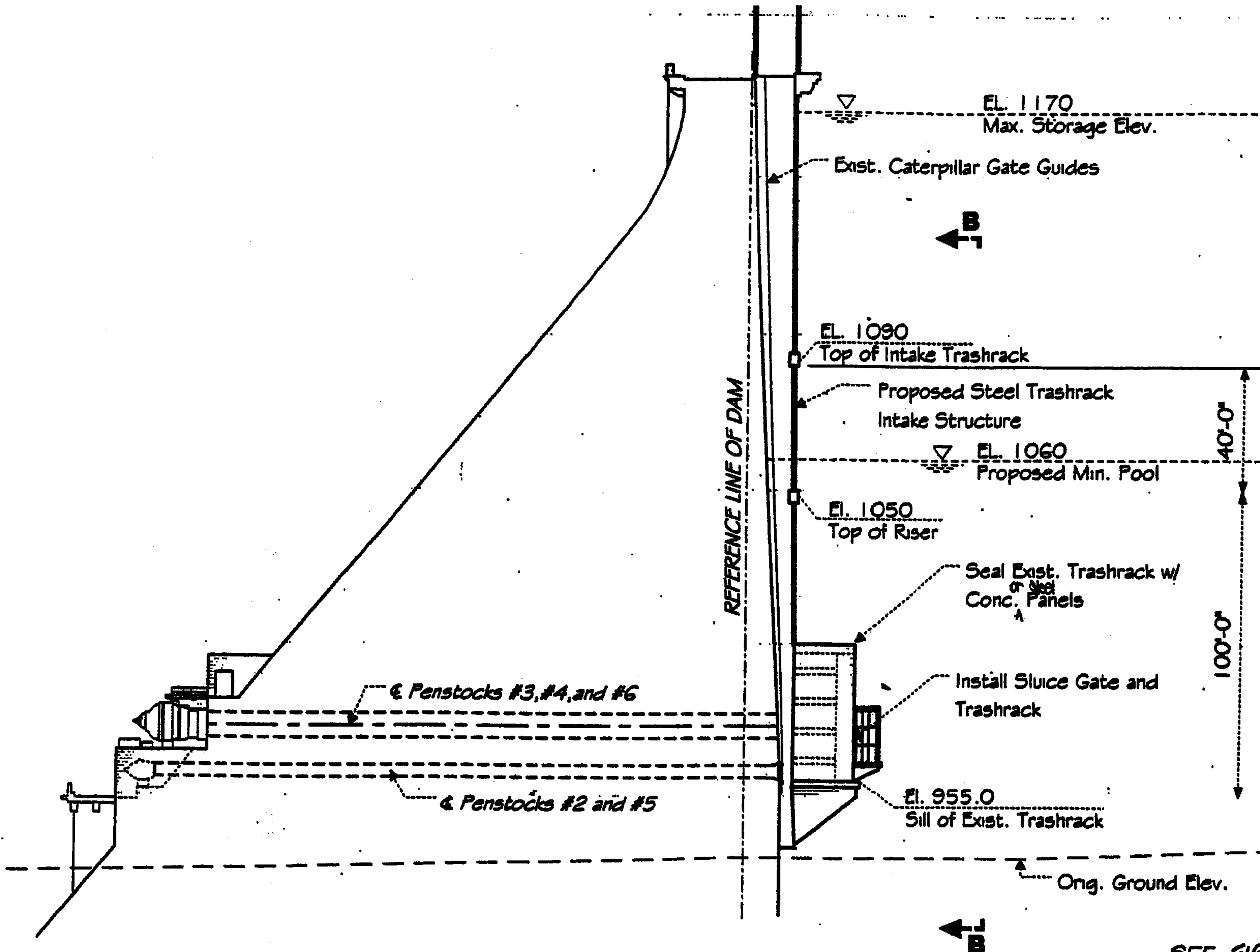
3.3.6 Opinion of Construction Cost. Table 3-3 outlines probable opinion of construction cost for Alternative B.

Table 3-3 Opinion of Construction Cost - Alternative B

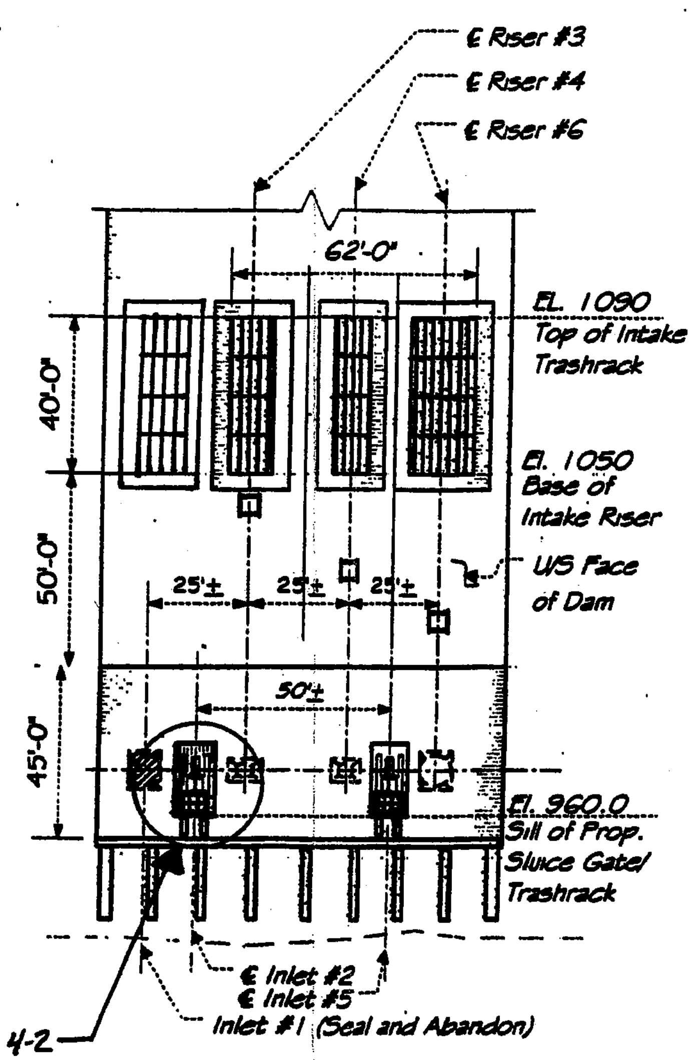
Construction Work Item	Quantity	Unit	Unit cost	Item Cost ($)	Subtotal
Demolition - Thrust Block & Existing MWD Water Line					
Access & Work Area Scaffolding	1	LS	15,000.00	15,000	
Pipe Demo. And Removal	45	LF	350.00	15,750	
Concrete Demo. and Removal	10	CY	500.00	5,000	
					35,750
Demolition - Conduit Control House					
Interior of Building Demo. And Removal	1	LS	2,500.00	2,500	
Sawcutting	73	LF	10.00	730	
Roof Demolition	5	CY	500.00	2,616	
Concrete Demo. and Removal	32	CY	500.00	16,000	
					21,846
MWD Tower Modification					
Access & Work Area Scaffolding	1	LS	50,000.00	50,000	
Sawcut New Openings	360	LF	320.00	115,200	
Remove demo Concrete	32	CY	150.00	4,800	
Steel Support Structure for Trashracks	29,000	LB	1.50	43,500	
Steel Trashracks	72,500	LB	2.00	145,000	
Inspection of 9'x9' gate	1	LS	5,000.00	5,000	
Rehabiliation of 9'x9' gate	1	LS	50,000.00	50,000	
Evaluation of 2'x8' gates	12	LS	3,000.00	36,000	
					413,500
Rehab of 108" conduit					
Sandblasting and Painting	3,800	SF	30.00	114,000	
					114,000
Domestic Water Line					
Bulkhead Existing Line	1,350	LB	2.00	2,700	
Bulkhead Installation	1	LS	1,000.00	1,000	
New Piping & Installation	1	LF	63.00	63	
					3,763
78-Inch Fixed Cone Valve and Piping					
New Piping & Installation	26,700	LB	2.00	53,400	
Concrete Support Block	100	CY	525.00	52,500	
Replace Conduit Control House Roof Slab	6	CY	2,625.00	15,750	
Valve Procurement	1	LS	275,000.00	275,000	
Valve Installation	1	LS	31,000.00	31,000	
					427,650
20-Inch Jet Flow Gate and Piping					
New Piping & Installation	5,640	LF	2.00	11,280	
Concrete Support Block	10	CY	525.00	5,250	
Valve Procurement	1	LS	79,000.00	79,000	
Valve Installation	1	LS	31,000.00	31,000	
					126,530
Electrical Raceway and Conductor					
RGS Conduit	300	LF	35.00	10,500	
Cable	300	LF	6.00	1,800	
					12,300
Valve Actuator Access Platform					
Grated platform Fab & Del	250	SF	53.00	13,250	
Guardrail	90	LF	32.00	2,880	
Misc Metal Installation	1	LS	5,000.00	5,000	
					21,130

Total Estimated Direct Construction Cost	$1,176,469
Contingency @ 25%	$294,100
Total Construction Cost	$1,470,569
CEQA Studies*	$0
Subtotal	$1,470,569
Indirect Costs @ 25%	$367,600
Total Project Capital Cost	$1,838,169

*CEQA Studies not necessary per County



SECTION A-A (SH. 1)
MORRIS DAM ELEVATION
NOT TO SCALE



SECTION B-B (SH. 1)
NOT TO SCALE

BLACK & VEATCH Corporation
800 WILSHIRE BLVD SUITE 600
LOS ANGELES, CA., 90017

B&V PROJECT NO. 96231

DATE	MK	DESCRIPTION	BY	CHK	APP

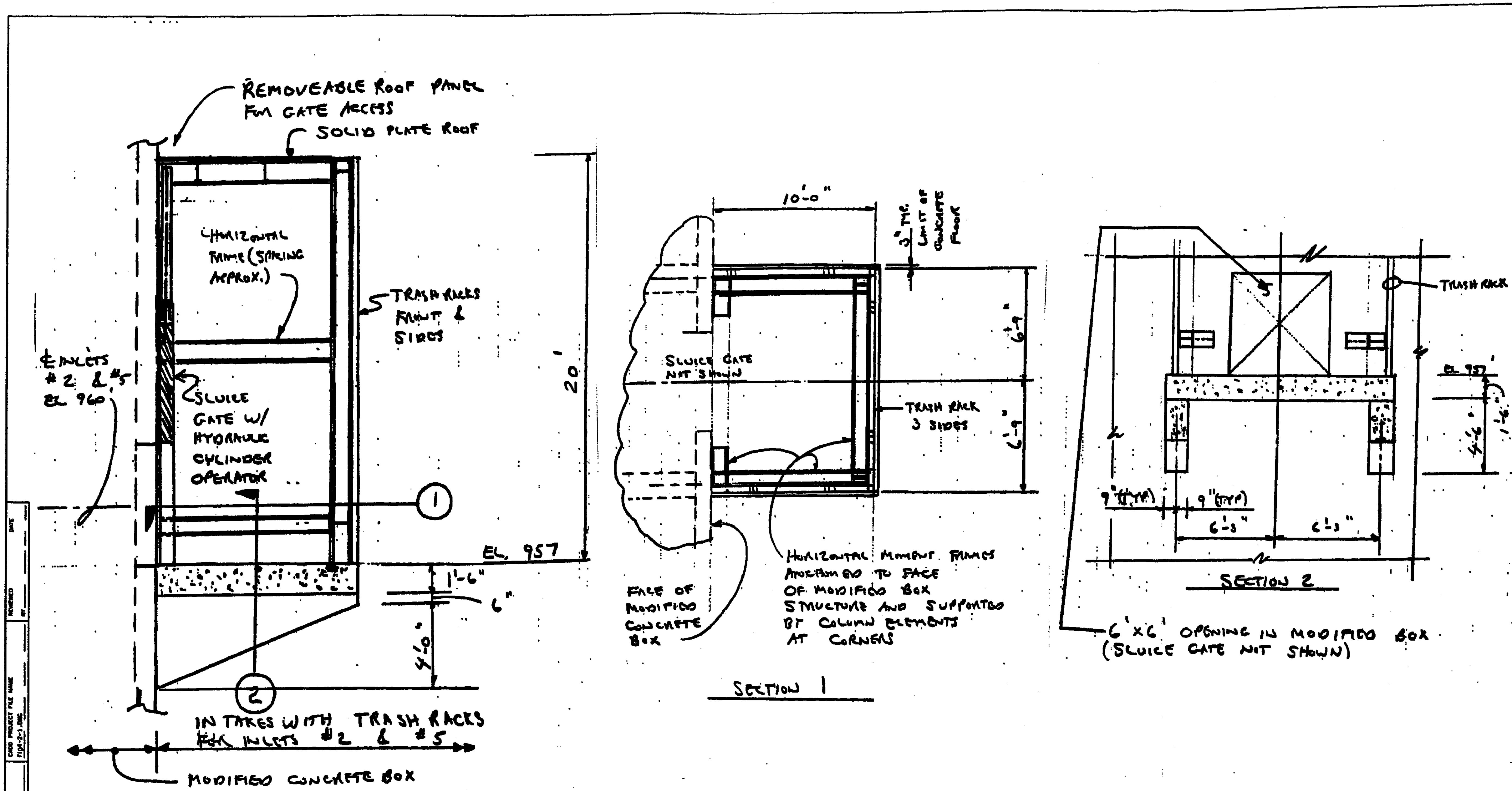
DRAFTER | DESIGNER | CHECKER | CADD PROJECT FILE NAME fig4-2-1.DWG | REVIEWED BY | DATE

BASE MAP INFORMATION FROM DEPARTMENT DRAWING PF501313

FIGURE 3-1 | REV

MORRIS DAM INLET/OUTLET REHABILITATION PROJECT
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
INTAKE MODIFICATION STUDY
ALTERNATIVE A
NEW INTAKE OPENINGS

JOB | DWG | SHEET OF



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800 WILSHIRE BLVD SUITE 600
LOS ANGELES, CA. 90017

B&V PROJECT NO. 96231

DATE	MK	DESCRIPTION	BY	CHK	APP

PROJECT ENGINEER | DATE

FIGURE 3-2

REV

MORRIS DAM INLET/OUTLET REHABILITATION PROJECT
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
INTAKE MODIFICATION STUDY
ALTERNATIVE A
OUTLET NO 2 & 5 MODIFICATION

JOB | DWG. | SHEET OF

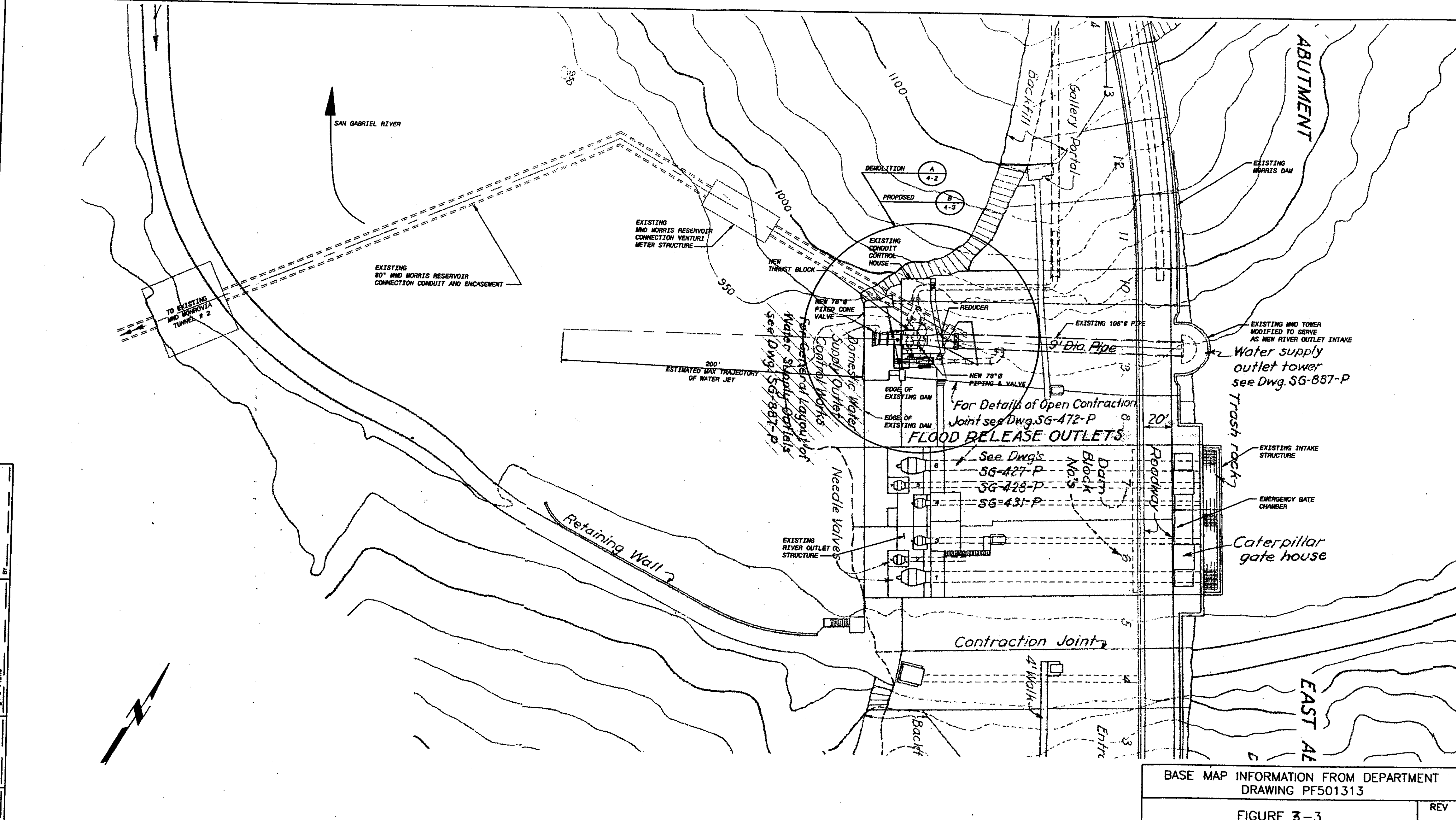

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			fig4-2-1.DWG		

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LOS ANGELES, CA., 90017

B&V PROJECT NO. 96231

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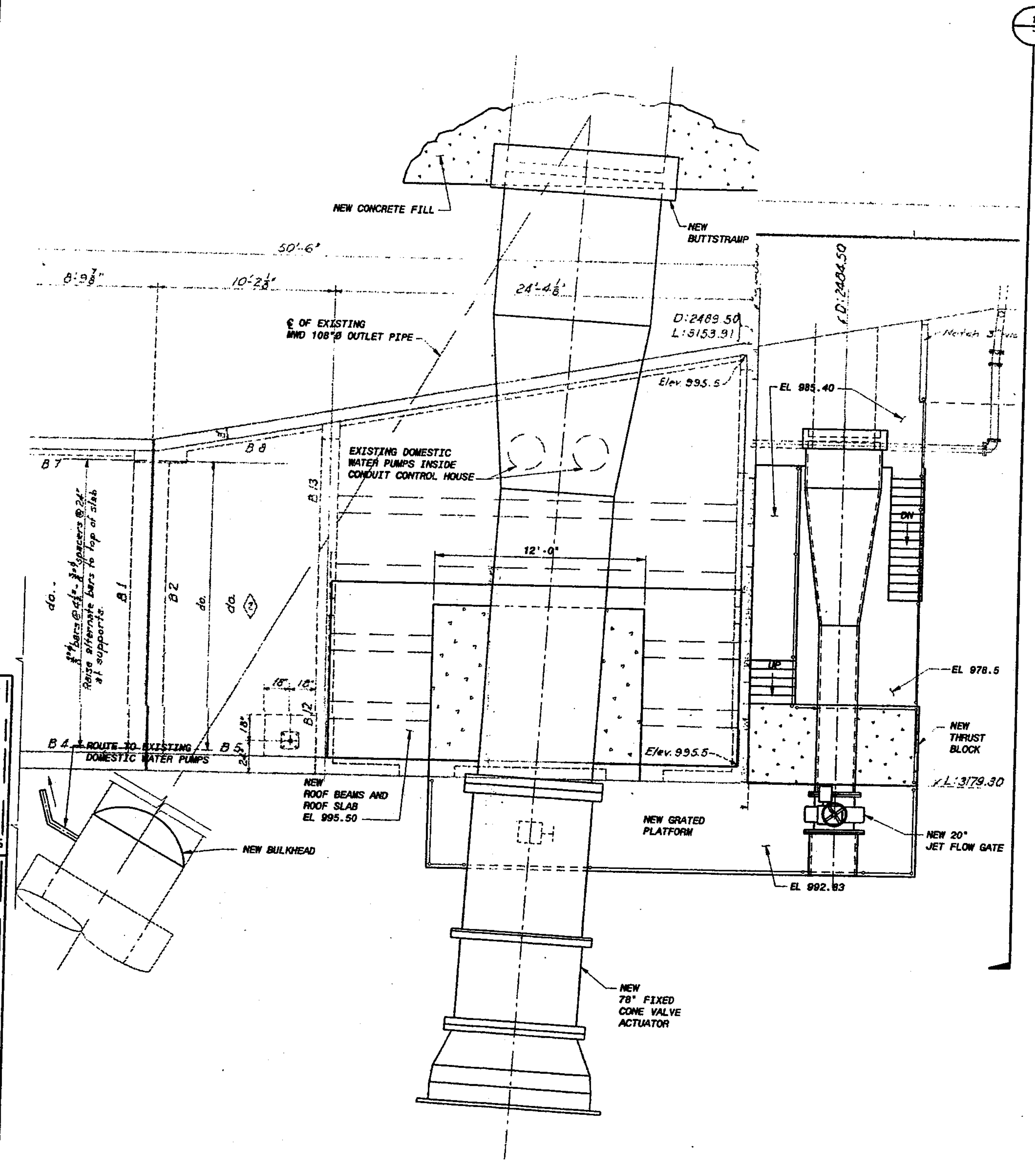
BASE MAP INFORMATION FROM DEPARTMENT DRAWING PF501313

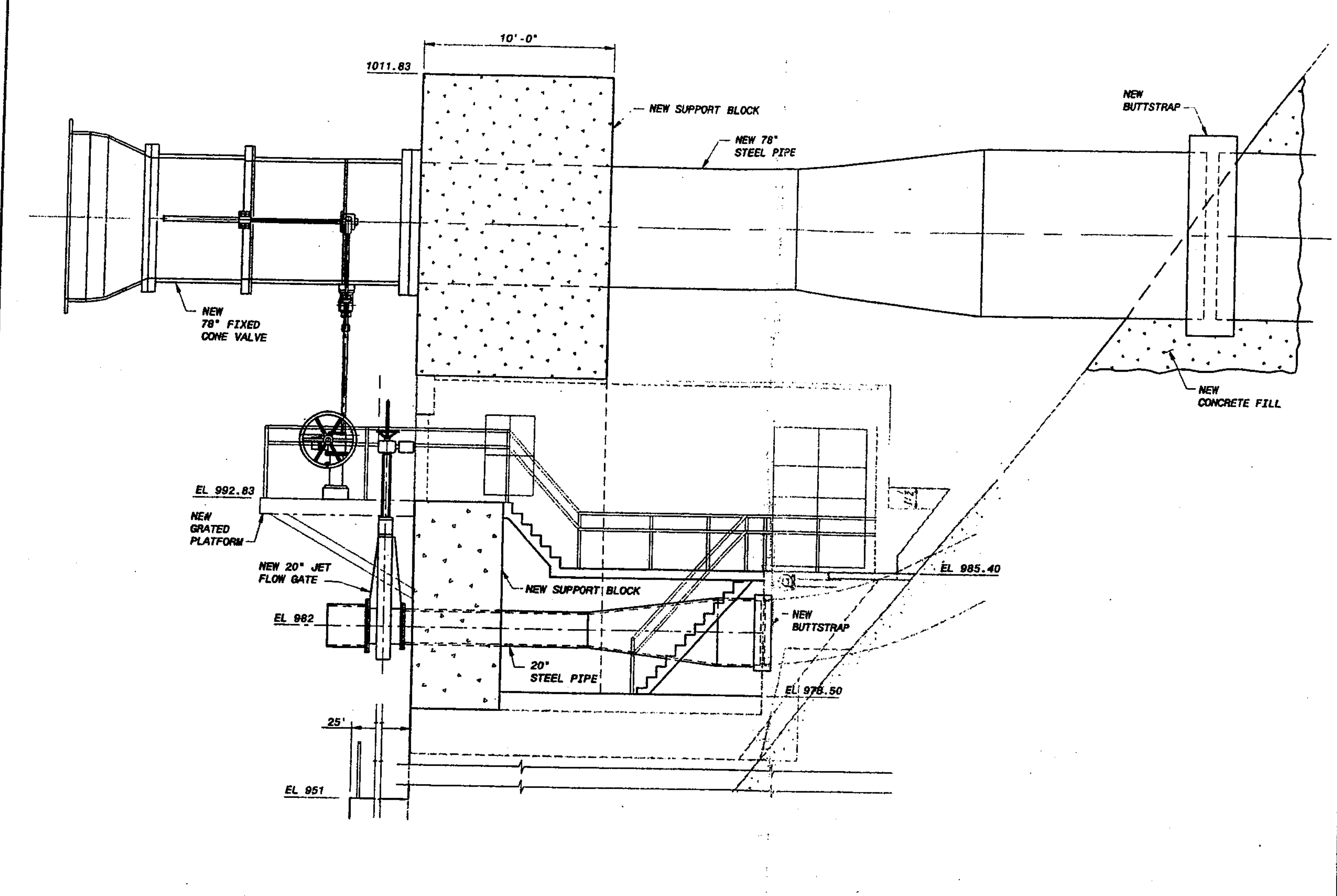
FIGURE 3-3 | REV

MORRIS DAM INLET/OUTLET REHABILITATION PROJECT
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
INTAKE MODIFICATION STUDY
ALTERNATIVE B
OVERALL PROJECT SITE PLAN

JOB | DWG. | SHEET | OF



PLAN VIEW B 4-1
NO SCALE



ELEVATION 1
NO SCALE

DRAFTER	DESIGNER	CHECKER	CADD PROJECT FILE NAME	REVIEWED BY	DATE
			fig4-2-1.DWG		

BLACK & VEATCH Corporation
800 WILSHIRE BLVD SUITE 600
LOS ANGELES, CA., 90017

B&V PROJECT NO. 96231

DATE	MK	DESCRIPTION	BY	CHK	APP

PROJECT ENGINEER — DATE

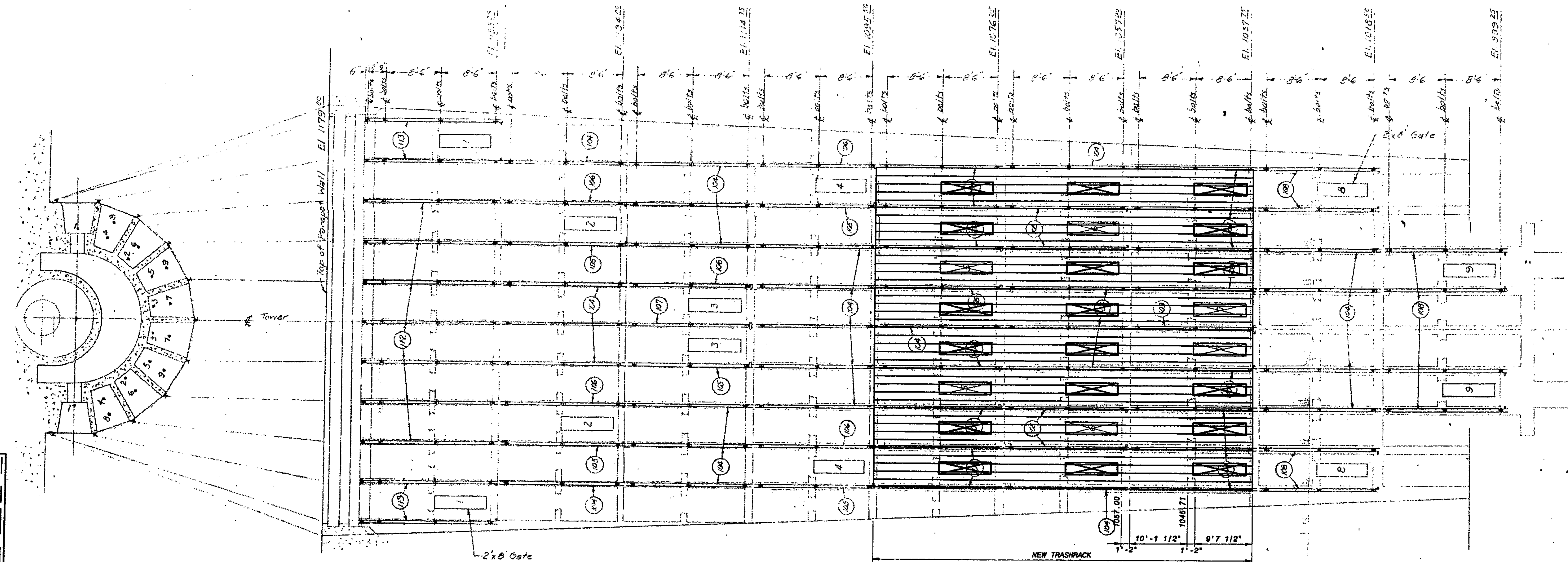
BASE MAP INFORMATION FROM DEPARTMENT DRAWING PF501251

FIGURE 3-4 — REV

MORRIS DAM INLET/OUTLET REHABILITATION PROJECT
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
INTAKE MODIFICATION STUDY

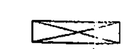
ALTERNATIVE B
PLAN AND ELEVATION OF PROPOSED
OUTLET VALVES AT CONDUIT CONTROL HOUSE

JOB | DWG. | SHEET OF



DEVELOPED ELEVATION OF TOWER
NO SCALE

LEGEND FOR OPENINGS IN TOWER



EXISTING

NEW

DESIGNER	CHECKER	CADD PROJECT FILE NAME	REVIEWED BY	DATE
		fig4-2-1.DWG		

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800 WILSHIRE BLVD SUITE 600
LOS ANGELES, CA., 90017

B&V PROJECT NO. 96231

DATE	MK	DESCRIPTION	BY	CHK	APP

PROJECT ENGINEER | DATE

BASE MAP INFORMATION FROM DEPARTMENT DRAWING PF502075

FIGURE 3-5 | REV

MORRIS DAM INLET/OUTLET REHABILITATION PROJECT
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
INTAKE MODIFICATION STUDY

ALTERNATIVE B
MWD TOWER MODIFICATION

JOB	DWG .	SHEET	OF

STRUCTURAL CALCULATIONS

Morris Dam Intake Structure
As-Built
Steel Trash Racks on Front and Side Faces
Allowable Differential Hydrostatic Pressure Loading

As-Built Trash Rack Description:

- Material: ASTM A9-29 (yield stress = 30 ksi)
- Coating: ASTM A123-30 (hot-dip galvanizing)
- Bars: 1/2" x 4"
- End Plates: 1/2" x 31/2" (provides lateral support to bars)
- Cross Bars: 1" diameter @ third points (provides lateral support to bars)
- Span: 9'-3" vertical (support to support)

Allowable Bending Stress:

- Specification: American Institute of Steel Construction (AISC), Allowable Stress Design (ASD)
- Chapter F - Beams and Other Flexural Members
- Section F1.3 – Members With Compact or Noncompact Sections with Unbraced Lengths Greater Than Lc
- l = (9'-3") / 3 = 37 " (lateral unsupported length of bar)
- Bar Weak Axis Moment of Inertia, I = 4" x (.5")^3 / 12 = .041667 in.^4
- Bar Cross Section Area, A = 4" x .5" = 2.00 in.^2
- r_t = (I / A) ^.5 = .144338 in.
- $l / r_t = 256.3$
- Applicable Equation: F1-7

$$\text{Fb} = \frac{170x10\text{^}3xCb}{(l/rt)\text{^}2} = 2.59 \text{ ksi} \qquad (\text{Cb} = 1.0)$$

As-built Trash Rack Allowable Differential Pressure Loading:

- W (psf) = differential pressure on trash rack face
- 1 Foot width of trash rack
- L = 9.25'
- Maximum bending moment = WL^2/8 = 10.70W
- Number of bars per foot of width = 12" / 5" ctrs. = 2.4 bars
- Sx = 2.4 x .5" x (4")^2 / 6 = 3.20 in^3
- Allowable bending moment = Fb x Sx = 8.29 kip-in = 690.83 lb-ft = 10.70W
- **Maximum Allowable W =** 690.83 lb-ft / 10.70 = 64.56 psf = **1.0 feet of water**

Morris Dam Intake Structure
Modification Options
For
Steel Trash Racks on Front and Side Faces
To Increase Allowable Differential Hydrostatic Pressure Loading

Option 1

- Install additional cross bars to reduce lateral unsupported bar length such that Fb = .6 Fy = 18.00 ksi
- Required cross bar spacing = 14.0 in.
- Allowable bending moment = Fb x Sx = 57.60 kip-in = 4800.00 lb-ft = 10.70W
- **Maximum Allowable W =** 4800.00 lb-ft / 10.70 = 448.60 psf = **7.2 feet of water**

Option 2

- Install S10x25.4 horizontal cross beam support to reduce trash rack spans to 9.25'/2
- L = 4.625'
- Maximum bending moment = WL^2/8 = 2.6738W
- Fb = 2.59 ksi
- Sx = 3.20 in^3
- Allowable bending moment = Fb x Sx = 8.29 kip-in = 690.83 lb-ft = 2.6738W
- **Maximum Allowable W =** 690.83 lb-ft / 2.6738 = 258.37 psf = **4.1 feet of water**

Option 3

- Install two S12x31.8 horizontal cross beam supports to reduce trash rack spans to 9.25'/3
- L = 3.083'
- Maximum bending moment = .1WL^2 = .9505W
- Fb = 2.59 ksi
- Sx = 3.20 in^3
- Allowable bending moment = Fb x Sx = 8.29 kip-in = 690.83 lb-ft = .9505W
- **Maximum Allowable W =** 690.83 lb-ft / .9505 = 726.81 psf = **11.6 feet of water**

Option 4

- Install 3/8" ASTM A36 cover plate welded to upstream face of trash rack bars to convert trash rack to a bulkhead. Welding required to assure composite action and to provide full lateral support of bars.
- Upstream (compression face)
  S = 10.88 in^3
  Fb = 21.6 ksi
- Downstream Face (tension face) **Controls**
  S = 2.66 in^3
  Fb = 18.00 ksi
- Maximum allowable moment = Fb x S = 47.88 kip-in = 3990 lb-in = 10.70W
- **Maximum allowable W** = 3990lb-ft / 10.70 = 372.90 psf = **6.0 feet of water**

Option 5

- Options 2 and 4 combined
- W18x55 horizontal cross beam support
- L = 4.625'
- Maximum bending moment = WL^2/8 = 2.6738W
- Controlling S = 2.66 in^3
- Controlling Fb = 18.00 ksi
- Maximum allowable moment = Fb x S = 47.88 kip-in = 3990 lb-in = 2.6738W
- **Maximum allowable W** = 3990lb-ft / 2.6738 = 1492.26 psf = **23.9 feet of water**

BLACK & VEATCH

96231-C.1.9

8400 Ward Parkway
P. O. Box 8405
Kansas City, Missouri 64114 USA

Tel: (913) 458-2000

Black & Veatch Corporation

ATTACH No. 4 (4 sheets)

FAX NUMBER: (913) 458-3730

FACSIMILE TRANSMISSION

TO: John Hollenbeck B&V PROJECT: 96231.0137

COMPANY: B&V - Los Angeles B&V FILE: ______

FAX NUMBER: (213) 312-3399

TELEPHONE NUMBER: (213) 312-3300

FROM: Jim Richter PAGE 1 OF 4

TELEPHONE NUMBER: (913) 458- 3948 DATE: 10/23/02

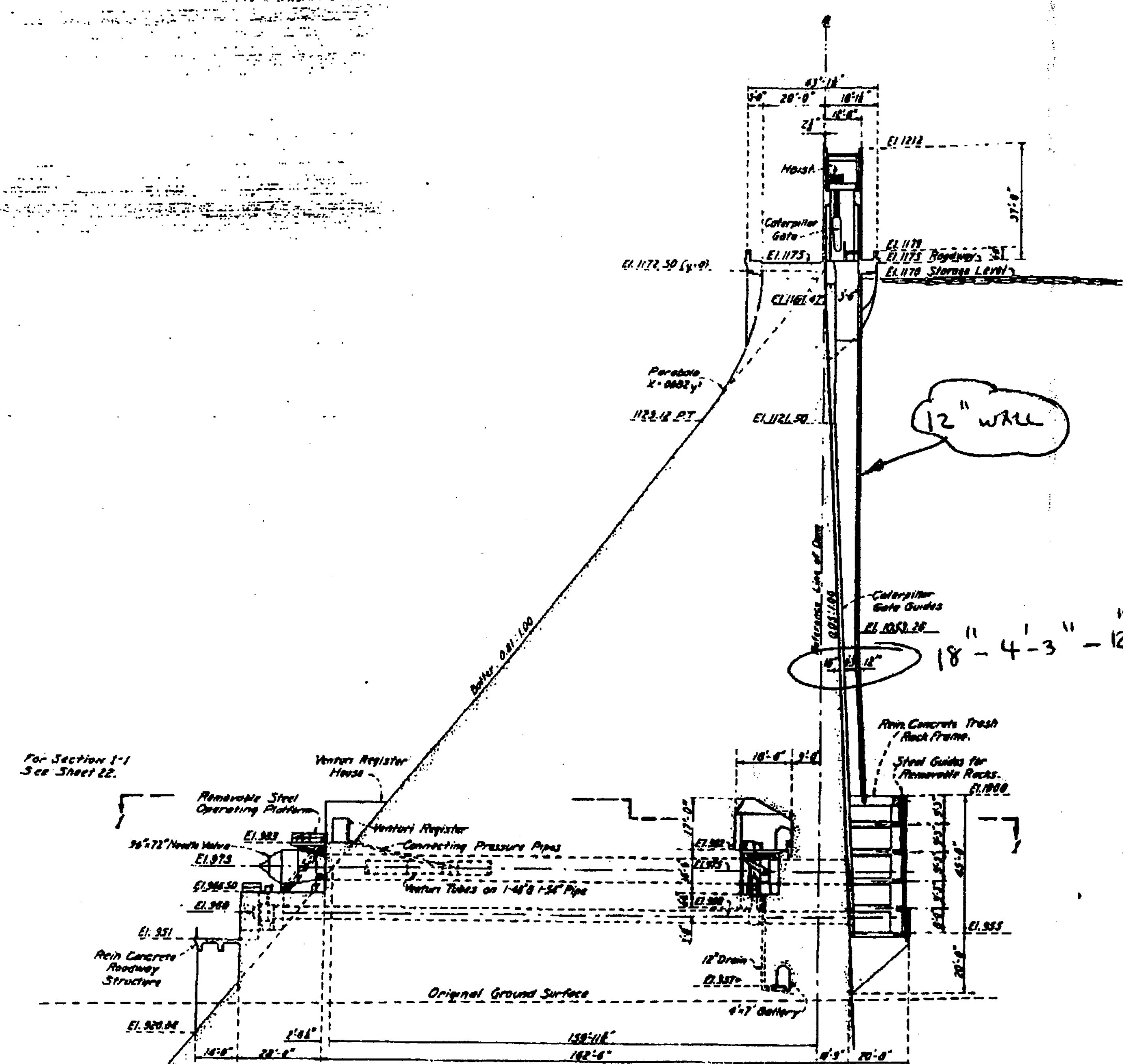
NOTE TO RECEIVING OPERATOR
In the event of incomplete transmission, please call sender or (913) 458-3165.

SUBJECT: MORRIS DAM CONCEPTS

MESSAGE:

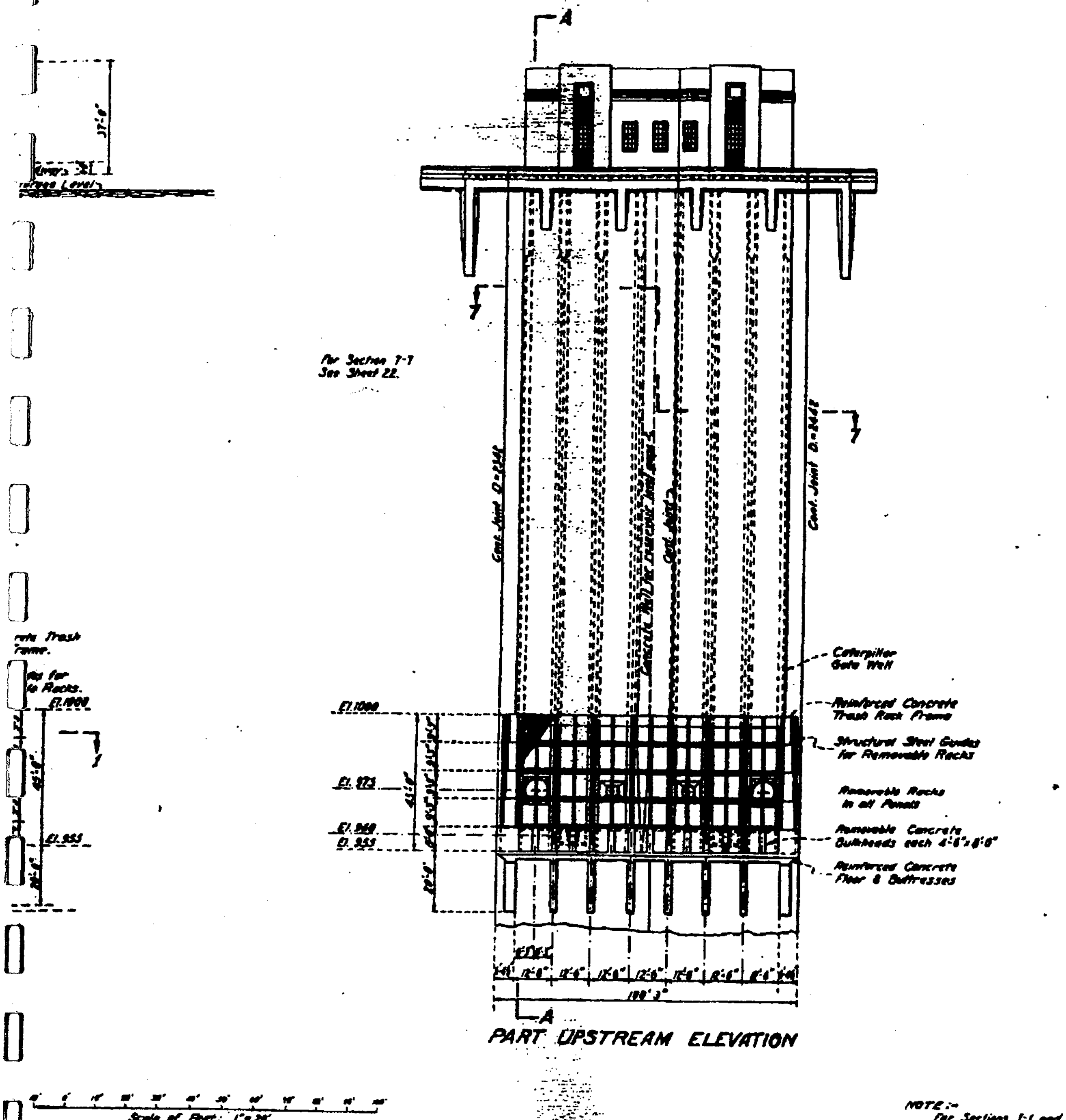
The attached sheets are copied from Morris Dam Construction Drawings for Catepiller Gate Well Structure. They show the 12" walls I talked to you about

2/4



VERTICAL SECTION A-A
OF DAM AND OUTLETS

3/4



PART UPSTREAM ELEVATION

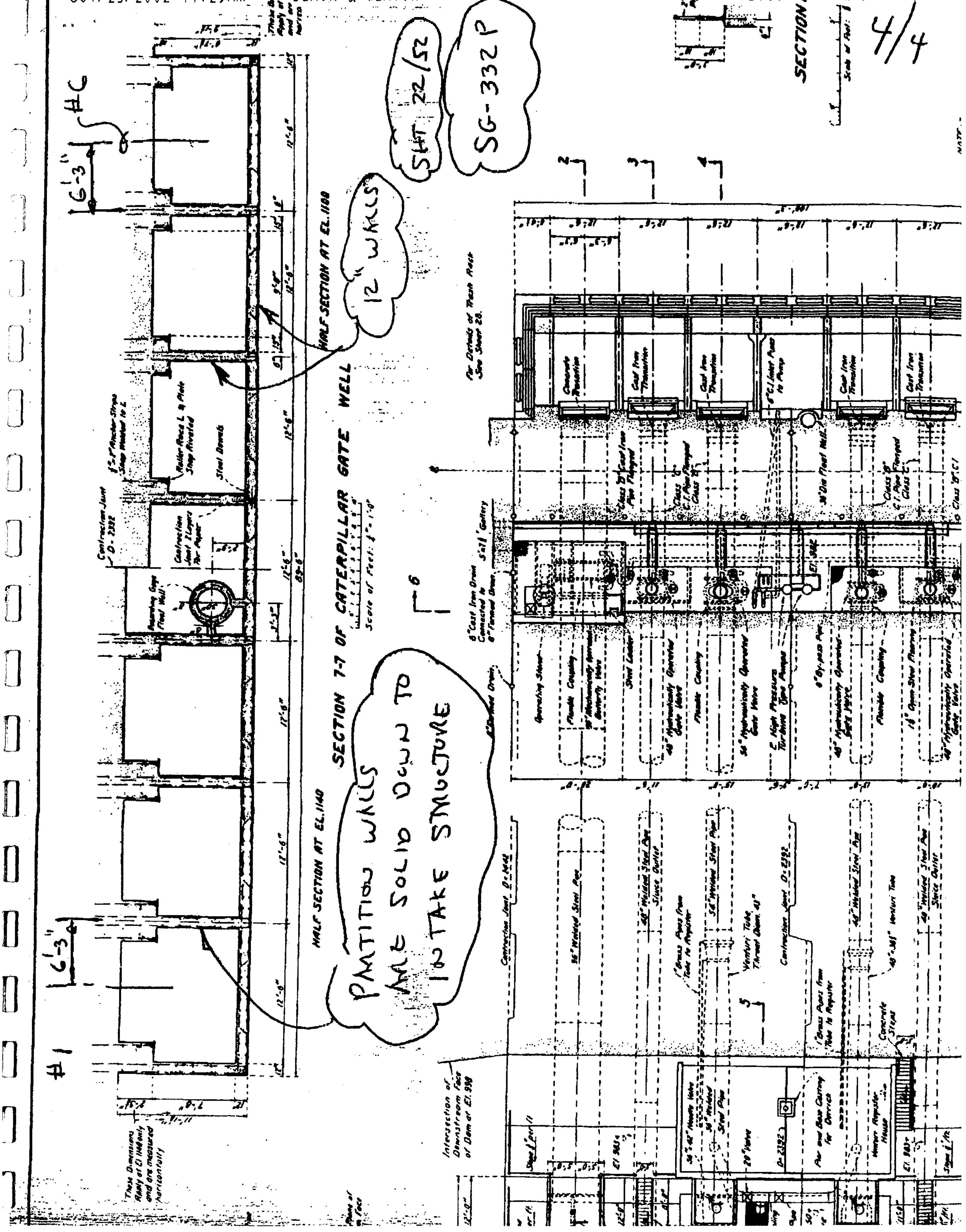
NOTE:-
For Sections 1-1 and 7-7
See Sheet 22.

SHEET 21/52

APPROVED:

PASADENA WATER DEPARTMENT SAN GABRIEL PROJECT PINE CANYON DAM	Sheet No. 21 of 52 Sheets
FLOOD RELEASE OUTLETS GENERAL LAYOUT	FILE NUMBER SG-331-P

TABLE OF CHANGES


4/4
SHT 22/52
SG-332P
12" WALLS
PARTITION WALLS ARE SOLID DOWN TO INTAKE STRUCTURE
#1
#C
6'-3"
6'-3"
SECTION 7-7 OF CATERPILLAR GATE WELL
Scale of Feet: 1/8" = 1'-0"
HALF SECTION AT EL. 1188
HALF SECTION AT EL. 1140
12'-6"
89'-6"
Contraction Joint D-2392
Contraction Joint 2 Layers Tar Paper
Roller Race L & Plate Stop Riveted
Steel Dowels
Measuring Gage Float Well
For Details of Trash Rack See Sheet 28.
Concrete Transition
Cast Iron Transition
8" C.I. Inlet Pipe to Pump
30" Dia. Float Well
36" Welded Steel Pipe
48" Welded Steel Pipe Sluice Outlet
58" Welded Steel Pipe
Contraction Joint D-2392
Venturi Tube, Throat Diam. 43"
Concrete Steps
Intersection of Downstream Face of Dam at El. 938
These Dimensions Apply at El. 1140 only and are measured horizontally
SECTION A-A

BLACK & VEATCH

8400 Ward Parkway
P. O. Box 8405
Kansas City, Missouri 64114 USA

Tel: (913) 458-2000

Black & Veatch Corporation

96231- C.1.9.1

FAX NUMBER: (913) 458-3730

FACSIMILE TRANSMISSION

TO: John Hollenbeck B&V PROJECT: 96231.0137

COMPANY: B&V Los Angeles B&V FILE:

FAX NUMBER: (213) 312-3399

TELEPHONE NUMBER: (213) 312-3300

FROM: Jim Richter PAGE 1 OF 6

TELEPHONE NUMBER: (913) 458- 3948 DATE: 10/24/02

NOTE TO RECEIVING OPERATOR
In the event of incomplete transmission, please call sender or (913) 458-3165.

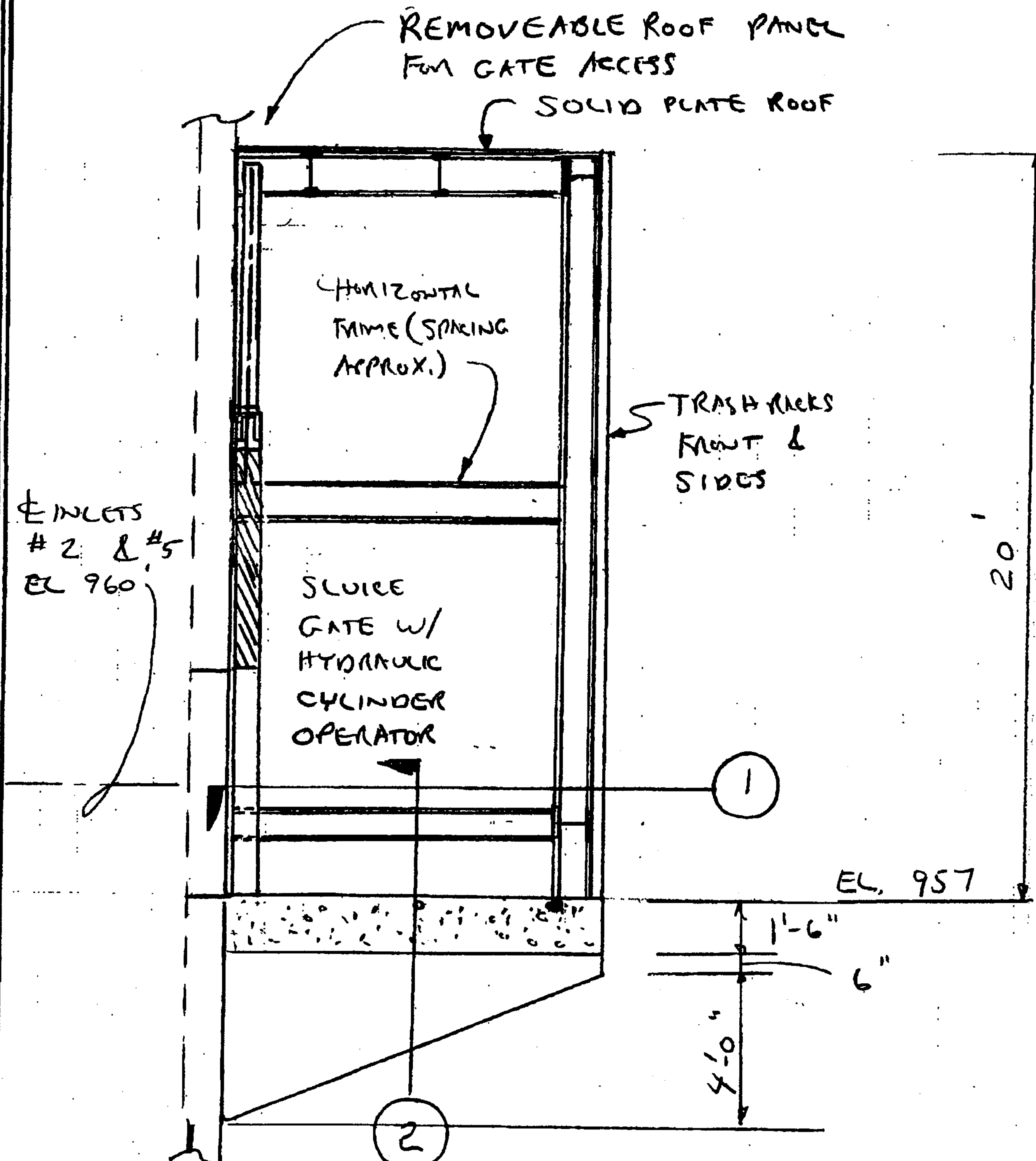
SUBJECT: Intake Riser Modifications - Morris Dam

MESSAGE:

Attached are backup (calc. & sketches) for Inlet #2 & #5 Intakes which are common for Concepts No. 1, 2, 3.

BLACK & VEATCH

Owner	... DEPT. OF PUBLIC WORKS	Computed by	
Plant	MORRIS DAM Unit	Date	10/24 2002
Project No.	96231.0137 File No.	Verified By	
Title	INTAKE RISER MODIFICATIONS	Date	20
	INTAKES FOR INLETS #2 & #5	Page	1 of 5



INTAKES WITH TRASH RACKS FOR INLETS #2 & #5

MODIFIED CONCRETE BOX

DO NOT WRITE IN THIS SPACE

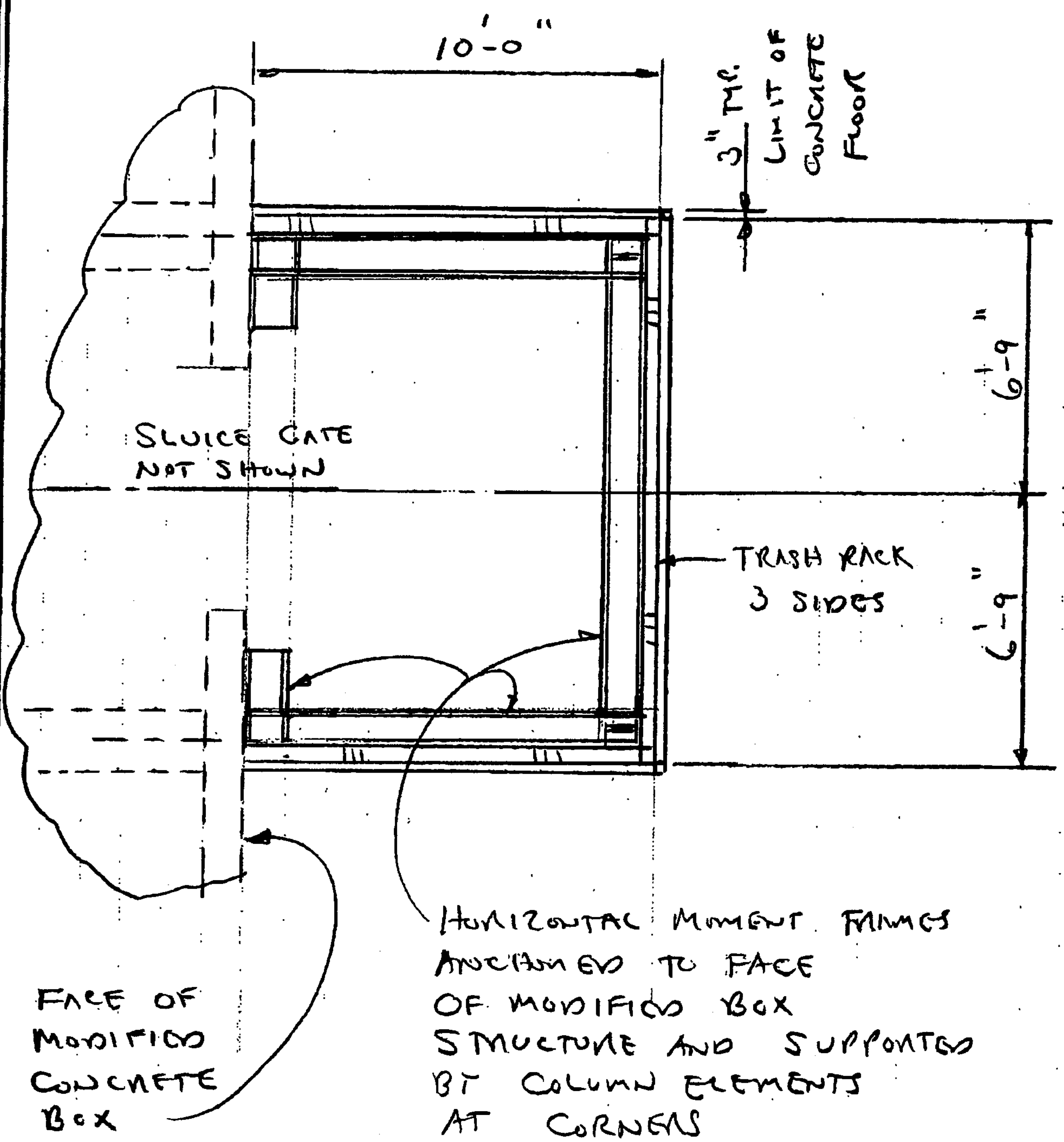
PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

BLACK & VEATCH

Owner	[illegible] COUNTY DOPW	Computed By	[illegible]
Plant	MORRIS DAM Unit	Date	10/24 2002
Project No.	96231.0137 File No.	Verified By	
Title	INTAKE RISER MODIFICATIONS	Date	20
	INTAKES FOR INLETS #2 & #5	Page	2 of 5

DO NOT WRITE IN THIS SPACE



SECTION 1

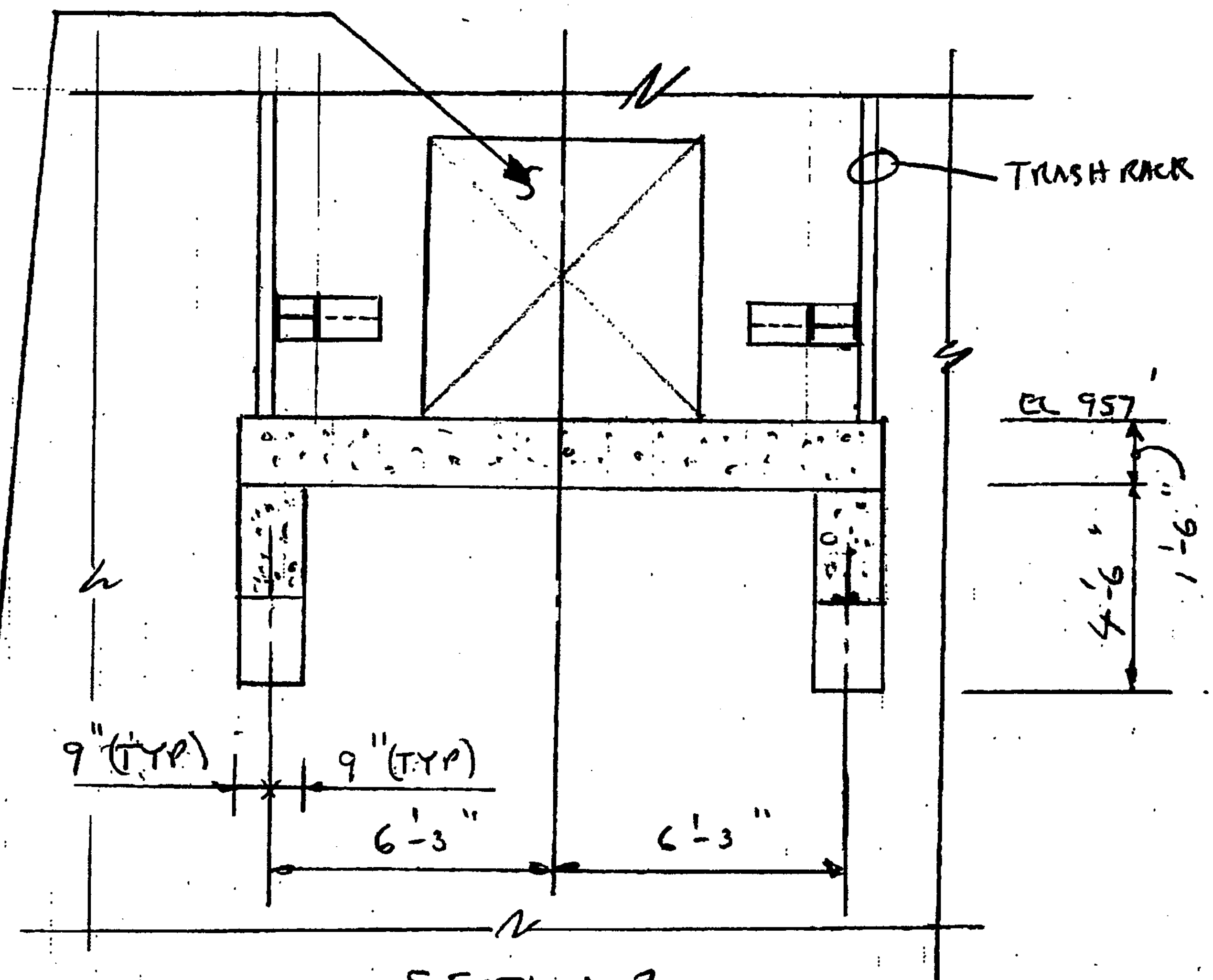
1/4" = 1'-0"

PGN-172B

BLACK & VEATCH

Owner [illegible]TY DGPW Computed by [illegible]
Plant MORRIS DAM Unit Date 10/24 20 02
Project No. 96231.0137 File No. Verified By
Title INTAKE RISER MODIFICATIONS Date 20
INTAKES FOR RISERS #2 & #5 Page 3 of 5

DO NOT WRITE IN THIS SPACE



SECTION 2
1/4" = 1'-0"

6' x 6' OPENING IN MODIFIED BOX
(SLUICE GATE NOT SHOWN)

PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

QUANTITY TAKEOFF FOR INLET #2 + #5 INTAKES

OPENING AND STRENGTHENING AROUND OPENING CONSIDERED PART OF BOX MODIFICATION

INLET #5 INTAKE SAME AS #2 INTAKE

BUTTRESSES : 2 PER INTAKE
FACE AREA = $25\ FT^2$
THICKNESS = 1.5'
VOL. = $(2)(25\ FT^2)(1.5') \times 1/27 = 2.8$ CY

FLOOR SLAB 1 PER INTAKE
PLAN DIM. = 10.25 x 14'
THICKNESS = 1.5'
VOL. = $1.5' \times 10.25' \times 14' \times 1/27 = 7.8$ CY

TOTAL CONCRETE FOR INLET #2 + #5 INTAKES
$= 2(2.8 + 7.8) = 21.2$ CY

USE 21 CY

TRASH RACK FACE AREA
$= ((2)(9.58') + 12.67')(20') = 637\ FT^2$/INTAKE

$= 2 \times 637 = 1274\ FT^2$ FOR BOTH INTAKES

EST. WT. OF STEEL SUPPORT FRAMES = 10 PSF x AREA
" " " " TRASH RACK = 25 " x "

FRAME WT. = 10 PSF X $1274\ FT^2$ = 12740 LBS
USE 12750 LBS

TRASH RACK WT. = 25 PSF x $1274\ FT^2$ = 31850 LBS

DO NOT WRITE IN THIS SPACE

PGN-172B

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BLACK & VEATCH

Owner ... COUNTY DOPW Computed by ...
Plant MORRIS DAM Unit ______ Date 10/25 20 02
Project No. ______ File No. ______ Verified By ______
Title INTAKE RISER MODIFICATIONS Date ______ 20 ___
INTAKES FOR INLETS #2 & #5 Page 5 of 5

2 - 72" x 72" HEAVY DUTY CAST
- IRON SLUICE GATES.
- SELF CONTAINED
- FLUSH BOTTOM
- HYDRAULIC CYLINDER OPERATOR
- COMMON HYDRAULIC POWER UNIT LOCATED AT TOP OF DAM WITH PIPING CONNECTIONS.

DO NOT WRITE IN THIS SPACE

PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

HYDRAULIC CALCULATIONS

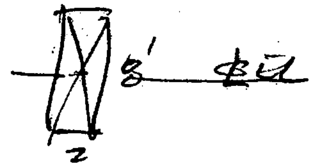
BLACK & VEATCH

Owner: County DPW
Plant: Morris Dam Unit:
Project No. 96231 File No.
Title: Intake Study Calculations

Computed By: JR Hollenbeck
Date: 12-17 2002
Verified By:
Date: 20
Page 1 of 5

Hyd capacity of Flow Through MWD Tower

2 x 8' Opngs



Level #5 - 2 @ ℄ EL 1081.00

Level #6 - 2 @ ℄ EL 1061.75

Level #7 - 2 @ ℄ EL 1042.50

$Q = 0.7A\sqrt{2gH}$

HWEL	$H^{\#}5$	$H^{\#}6$	$H^{\#}7$	Q_5	Q_6	Q_7	Q_{TOT}
1170	89'	108.25	127.5	1695	1870	2030	5595
1150.5 E (DSOD DO Criteria)	69.5'	88.75'	108.0	1499	1693	1868	5060 >> Q_{DSOD}
~~1060~~ 1060	–	Weir Flow h = 2.25	17.5	0	36 $Q = CLh^{3/2}$ Let C = 2.64 L = 4	752	= 788

$Q_{SG\,Hydro}$ = 250 cfs > Q_{min} ← OK

$Q_{spreading}$ ≅ 400 max > Q_{min} ← OK

DO NOT WRITE IN THIS SPACE

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REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

If just the bay infront of the opening was open, what would the rack approach velocity be?

Q_{TOT} is >> $Q_{req'd}$ if $Q_{req'd} = Q_3+Q_4+Q_6$ of the existing river outlets

Say $Q_{TOT, Needed}$ = 3110 cfs = Existing Rehabilit. Capacity

∴ Ratio down the Q through each level

$Q_{Level \#5} = \frac{3100}{5595}(1695) = 942$ cfs ⇒ Rack Velocit 12.8 fps

$Q_{Level \#6} = 3100/5595(1870) = 1036$ cfs 14.13 fps

$Q_{Level \#7} = 3100/5595(2030) = 1128$ cfs 15.38 fps

Let Net rack Area to Gross Area = 0.75

at each level, gross rack area is:

Circular width ~ 4.95'
Height (Less the horiz support beam) ~ 19.75'

∴ $A_g = 4.95(19.75) = 97.76$ ft²

$A_n = 0.75 A_g$ ⇒ 73.3 ft²

BLACK & VEATCH

Owner
Plant Unit
Project No. File No.
Title

Computed By
Date 20
Verified By
Date 20

The velocity through the rack placed in front of each opening is too high. Will need to penetrate the wall with more openings to reduce the rack velocity.

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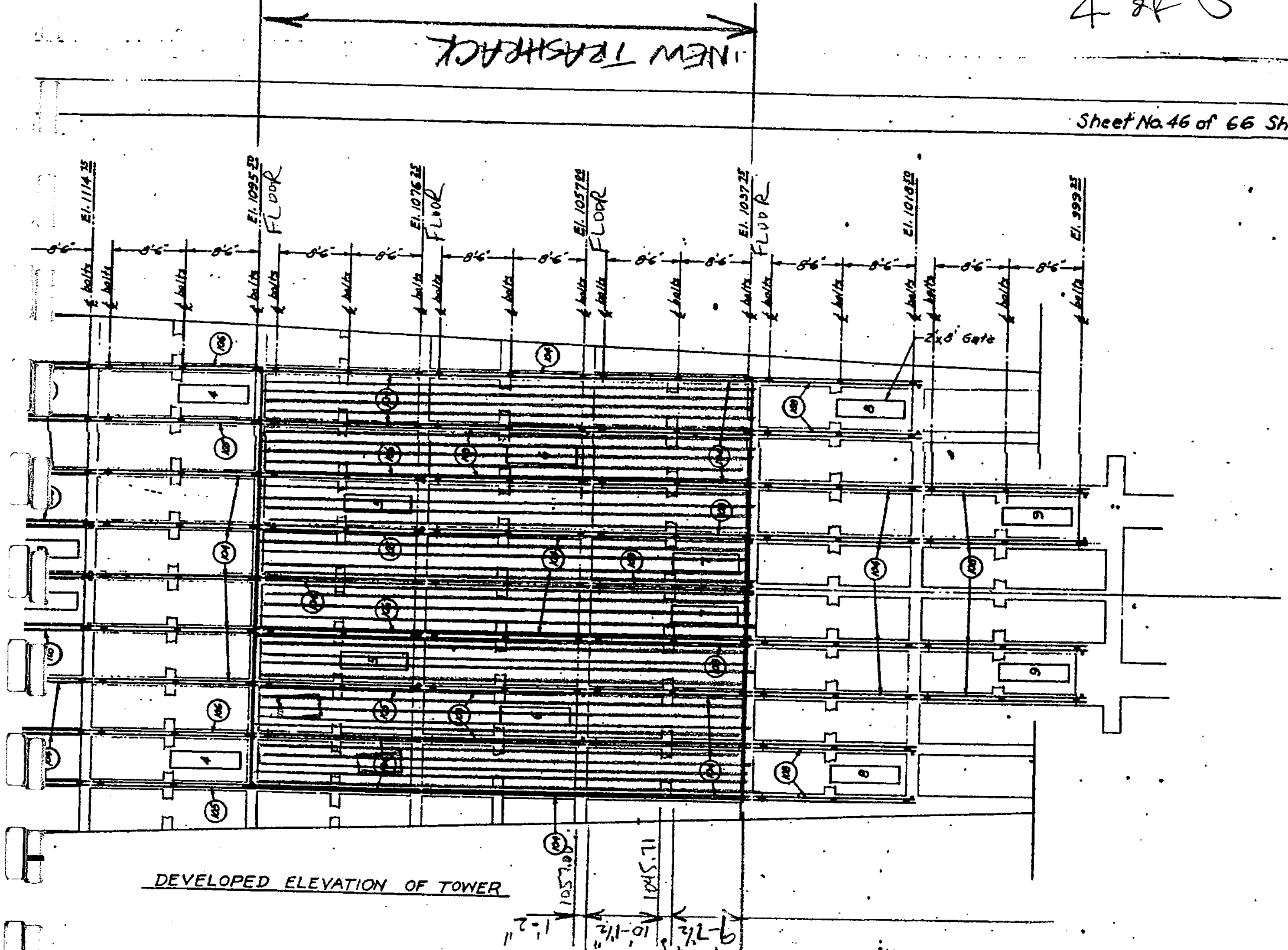
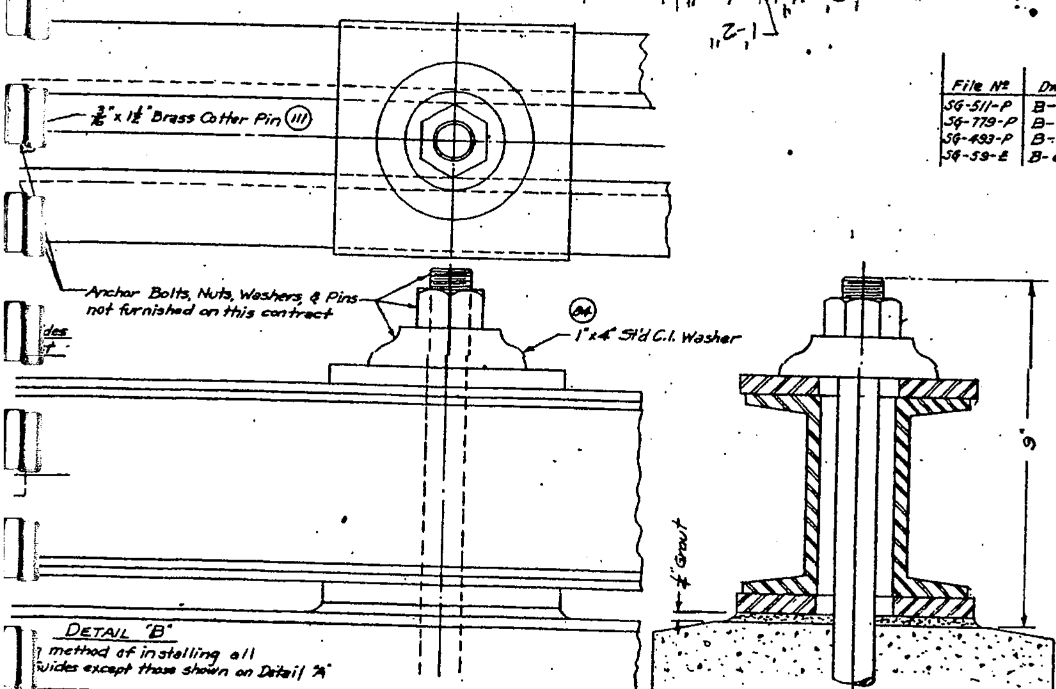
PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

Sheet No. 46 of 66 Sheets



DEVELOPED ELEVATION OF TOWER



DETAIL "B"
method of installing all guides except those shown on Detail "A"

File No.	Dwg No.	REFERENCE DRAWINGS
SG-511-P	B-647	Details of Screen Guides below #1 Gates
SG-779-P	B-680	" " " in Top Row
SG-493-P	B-652	General Assembly below El. 1168
SG-59-E	B-678	Elevation and Sections showing Concrete Construction

CONTRACT DWG.
FINAL RECORD
AS CONSTRUCTED
Sept. 21, 1934.
Construction Engineer

PASADENA WATER DEPARTMENT
SAN GABRIEL PROJECT

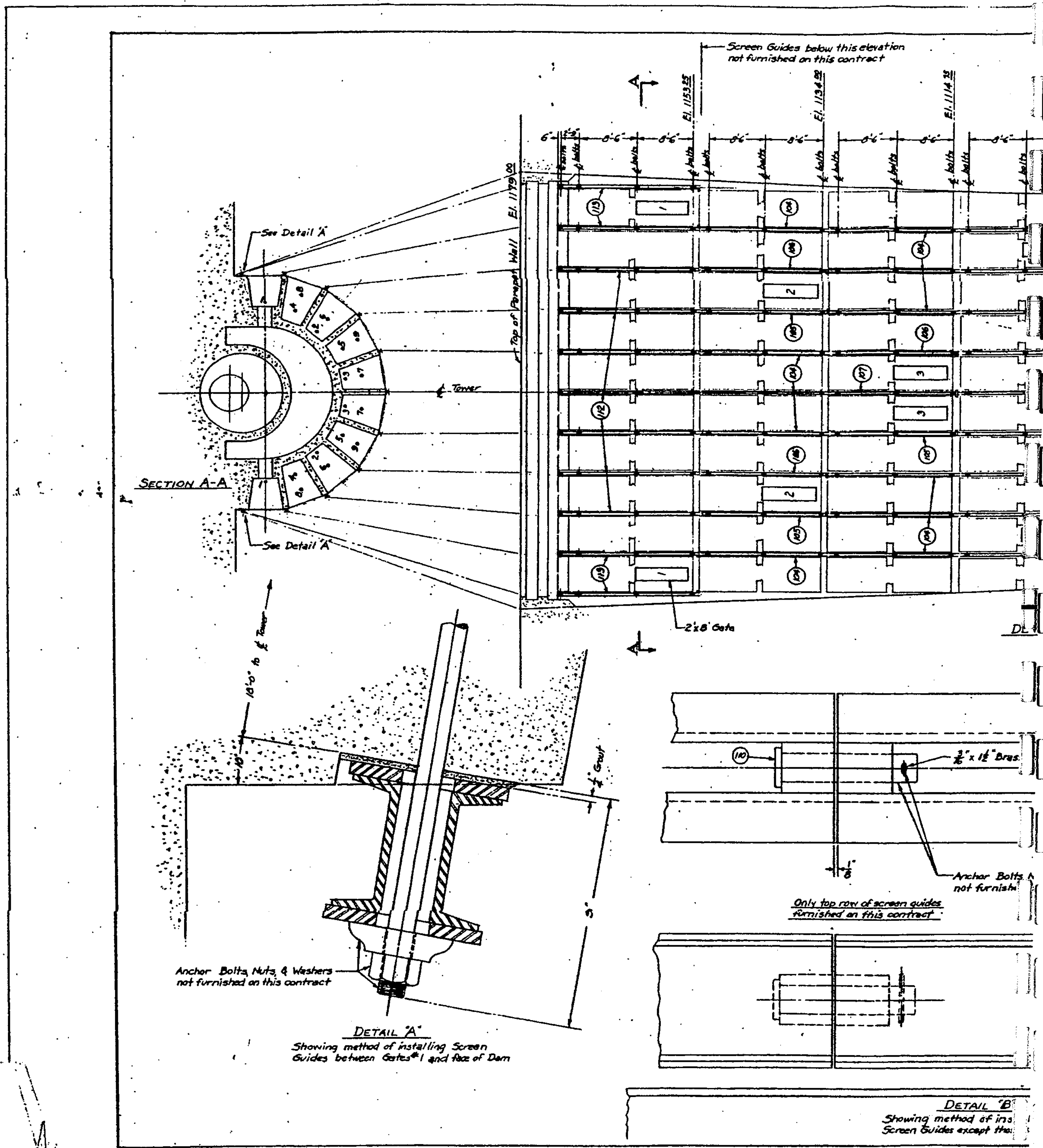
PINE CANYON DAM
OUTLET TOWER
SCREEN GUIDE ASSEMBLY

Drawn D.I.M. Recommended
Traced
Checked C.S.G. Approved

77-E | Pasadena, Calif. 12-10-32 | B-679

FILE No. SG-778-P

D.M.C.



MICROFILMED
NOV 3 1966 NOV 22 1966

5 of 5

BLACK & VEATCH

Owner County DPW Computed By JRH
Plant Morris Dam Unit ____ Date ____ 20__
Project No. 96231 File No. ____ Verified By ____
Title Intake Study Calculations Date ____ 20__

Analyze the existing trashrack design to evaluate Anet / Agross ratio.

Evaluate one panel, Part 1

Gross h = 9'-3" (SG-465-P, PF501417)
" w = 6'-3" (" , ")

$A_g = 9.25(6.25) = 57.8125\ SF$

Rack Bars = 1/2" x 4" (SG-466-P, PF501418)
Panel Dims:
W = 6'-1½" " "
H = 9'-3" " "
No Bars = 15 " "
End Bars = ½" x 3½" " "
Lateral Support = 1" ϕ Rod " "

$A_{Bars} = \frac{1/2''}{12''/ft}(15)(9.25') = 5.781\ SF$

$A_{ends} = \frac{1/2''}{12}(6.125')(2) = 0.510\ SF$

$A_{laterals} = \frac{1''}{12}(6.125)(3) = 1.531\ SF$

$\Sigma = 7.822\ SF$

$A_n = A_g - A_{steel} = 57.8125 - 7.822 = 49.990\ SF$

$A_n/A_g = \frac{49.99}{57.81} = 0.865$

If structural opt 3 was implemented, it would add 5.104 SF of steel.

DO NOT WRITE IN THIS SPACE

PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL

$\therefore$ $A_{steel} = 7.822 + 5.104 = 12.926$ SF

$A_n = 57.8125 - 12.926 = 44.8865$ SF

$$A_n/A_g = \frac{44.8865}{57.8125} = 0.7764$$

For conservative hydraulics, let's judge the A_n/A_g ratio = 0.75

DO NOT WRITE IN THIS SPACE

PGN-172B

REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED, INITIALED, AND DATED BY THE RESPONSIBLE INDIVIDUAL.

Alternative A (Concept No. 3) Intake Approach Velocities

Outlet No.	Maximum Discharge (cfs)	Trash Rack Gross Area (ft^2)	Approach velocity (ft/sec)
3	195	460	0.42
4	680	460	1.48
6	2,115	480	4.41
Combined 3 + 4 + 6	2,990	1,400	2.14
Addition of Intake Above Outlet No. 1	0	460	0.00
Combined 1 + 3 + 4 + 6	2,990	1,860	1.61

Los Angles County Department of Public Works
Morris Dam and Reservoir

Outlet Losses & Discharges With Pool At Maximum Storage Level, Elev. 1170'

Outlet #	2	
Static Head =	210	feet
pipe diameter =	4.00	feet
pipe length =	180	feet
trial & error		
Initial Q =	665	cfs
V =	52.92	ft/sec
Inlet Headloss Coef. =	0.70	
Guard Valve Headloss Coef. =	0.20	
Venturi Headloss Coef. =	0.00	
Sum Fittings Headloss =	39.14	feet
Hazen-Williams "C" Value =	80	
Pipe Headloss =	49.97	feet
Total Headloss =	89.10	feet
Head At Needle Valve Inlet	120.90	feet
Needle Valve Discharge Coef. (full open) =	0.6	
Needle Valve Body Dia. =	4.00	feet
Needle Valve Discharge =	665	cfs

Outlet #	3	
Static Head =	195	feet
pipe diameter =	4.00	feet
pipe length =	180	feet
trial & error		
Initial Q =	609	cfs
V =	48.46	ft/sec
Inlet Headloss Coef. =	0.70	
Guard Valve Headloss Coef. =	0.20	
Venturi Headloss Coef. =	0.50	
Sum Fittings Headloss =	51.06	feet
Hazen-Williams "C" Value =	80	
Pipe Headloss =	42.46	feet
Total Headloss =	93.52	feet
Head At Needle Valve Inlet	101.48	feet
Needle Valve Discharge Coef. (full open) =	0.6	
Needle Valve Body Dia. =	4.00	feet
Needle Valve Discharge =	610	cfs

Outlet #	4	
Static Head =	195	feet
pipe diameter =	4.50	feet
pipe length =	180	feet
trial & error		
Initial Q =	831	cfs
V =	52.25	ft/sec
Inlet Headloss Coef. =	0.70	
Guard Valve Headloss Coef. =	0.20	
Venturi Headloss Coef. =	0.50	
Sum Fittings Headloss =	59.35	feet
Hazen-Williams "C" Value =	90	
Pipe Headloss =	34.20	feet
Total Headloss =	93.55	feet
Head At Needle Valve Inlet	101.45	feet
Needle Valve Discharge Coef. (full open) =	0.6	
Needle Valve Body Dia. =	4.67	feet
Needle Valve Discharge =	831	cfs

Outlet #	5	
Static Head =	210	feet
pipe diameter =	4.00	feet
pipe length =	180	feet
trial & error		
Initial Q =	665	cfs
V =	52.92	ft/sec
Inlet Headloss Coef. =	0.70	
Guard Valve Headloss Coef. =	0.20	
Venturi Headloss Coef. =	0.00	
Sum Fittings Headloss =	39.14	feet
Hazen-Williams "C" Value =	80	
Pipe Headloss =	49.97	feet
Total Headloss =	89.10	feet
Head At Needle Valve Inlet	120.90	feet
Needle Valve Discharge Coef. (full open) =	0.6	
Needle Valve Body Dia. =	4.00	feet
Needle Valve Discharge =	665	cfs

Outlet #	6	
Static Head =	195	feet
pipe diameter =	8.00	feet
pipe length =	180	feet
trial & error		
Initial Q =	2601	cfs
V =	51.75	ft/sec
Inlet Headloss Coef. =	0.70	
Guard Valve Headloss Coef. =	0.70	
Venturi Headloss Coef. =	0.00	
Sum Fittings Headloss =	58.21	feet
Hazen-Williams "C" Value =	80	
Pipe Headloss =	21.30	feet
Total Headloss =	79.51	feet
Head At Needle Valve Inlet	115.49	feet
Needle Valve Discharge Coef. (full open) =	0.6	
Needle Valve Body Dia. =	8.00	feet
Needle Valve Discharge =	2601	cfs

# 2 Discharge =	665	cfs
# 3 Discharge =	610	cfs
# 4 Discharge =	831	cfs
# 5 Discharge =	665	cfs
# 6 Discharge =	2601	cfs
Total Discharge =	5372	cfs

Intake Modification Study
Calculations
Drawdown

Morris Dam Rehabilitation Project

1170	<---Full Storage EL
975	<--- Zero Storage EL
195	<--DIFF
1150.5	<--- 10 % Head Drop

Starting Reservoir Elevation:	1152.0 ft
Ending Reservoir Elevation:	1134.3 ft
Reservoir Capacity @ EL 1152.0:	22,463 acre-ft
Reservoir Capacity @ EL 1134.3:	17,353 acre-ft

Drawdown Time:	10 days
Drawdown Discharge:	511 acre-ft/days
(in cfs):	258 cfs

	Discharge @ EL 1170 (cfs)	Discharge EL 1134.3 (cfs)
72" FCV	2,195	1,983
42" FCV	720	650
20" JFG	192	174
Total:	3,107	2,807

Average Avail Outflow: 2,957 cfs

Average Antecedence Inflow: 2,700 cfs <----Equal to the 4.245 yr flood for WYs 1934-66
4.143 yr flood (skiping 50, 55, 59-61)

Say Equal to the 4 Year Return Flood

Summary:

Required Discharge (cfs)	to drop from EL	to EL	for the given time (days)
482	1170	1150.5	7
337	1170	1150.5	10
368	1152	1134.3	7
258	1152	1134.3	10

Elevation (ft)	Storage Capacity (acre-ft)		
960	-	975	10
975	10	1,000	252
1,000	252	1,020	873
1,020	873	1,040	2,181
1,040	2,181	1,060	4,096
1,060	4,096	1,080	6,674
1,080	6,674	1,100	9,854
1,100	9,854	1,120	13,719
1,120	13,719	1,140	18,802
1,140	18,802	1,152	22,463
1,152	22,463	1,160	25,107
1,160	25,107	1,170	28,695
1,165	26,901	<-- Used to Check Interpolation	

Feasibility Study for Intake Modification at Morris Dam.   **MWD Tower Outlet - FIXED CONE VALVE**

Concept No. 1   Rack Sill El 1050 ft-msl   Rack top EL 1100 ft-msl   Rack H = 50 ft   Avg Width 39.04 ft   Gross A 1952 ft^2   An / Ag = 0.75 Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0
Slide Gate	0.7				
Enlargement	0				

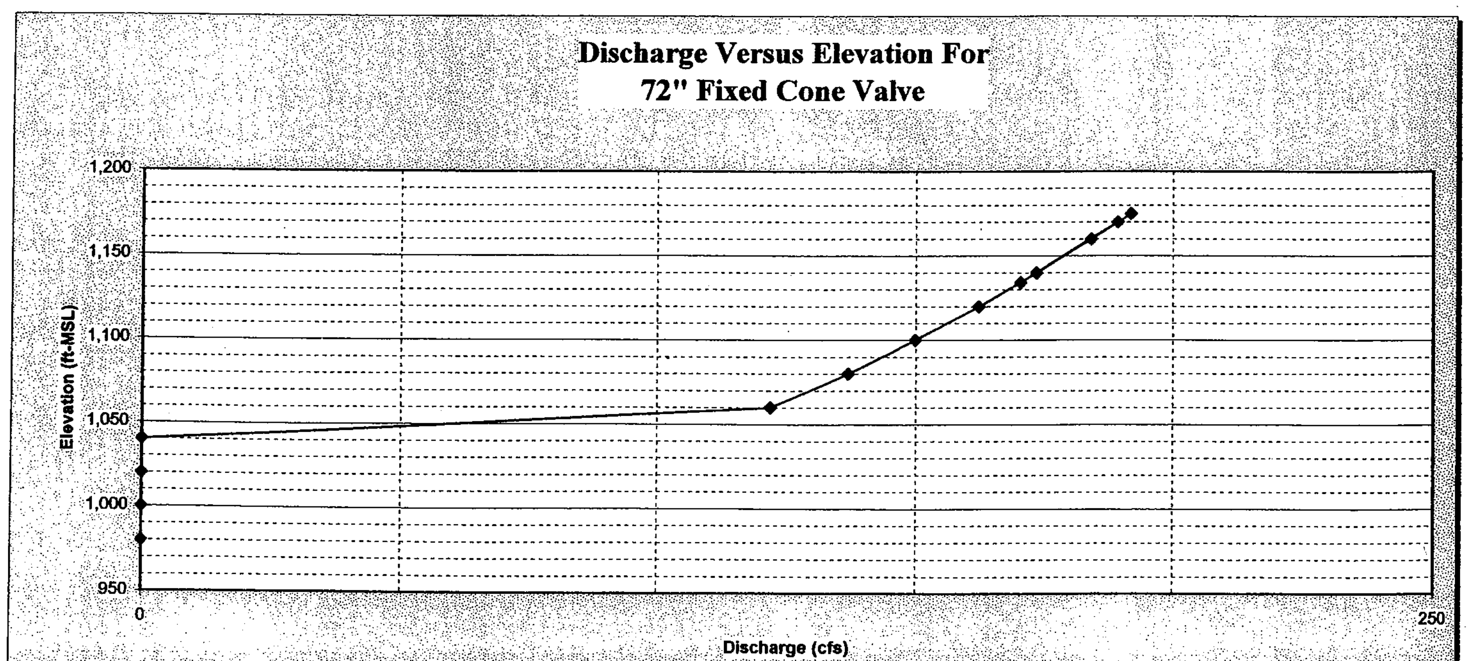
Centerline Elevation of Fixed-Cone Valve : 982 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	0.00	0.00001	0.00
d/s dia =	0.00	0.00001	0.00

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Trashrack Net Area (sq ft)	Trashrack Net Vel (fps)	Trashrack Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Headloss (ft)	Venturi Losses Sum K	Headloss (ft)	Fixed Cone Valve Diameter (ft)	Area (sf)	Reducer Losses near Ex Sum K	Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Q (cfs)	Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	9.00	63.62	9.00	63.62	0.00	150.00	112	0.00	1.2	0.00	0.00	0.00	1.67	2.18	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	9.00	63.62	9.00	63.62	0.00	150.00	112	0.00	1.2	0.00	0.00	0.00	1.67	2.18	0.13	0.00	0.82	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	9.00	63.62	9.00	63.62	0.00	150.00	112	0.00	1.2	0.00	0.00	0.00	1.67	2.18	0.13	0.00	0.82	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	9.00	63.62	9.00	63.62	0.00	150.00	112	0.00	1.2	0.00	0.00	0.00	1.67	2.18	0.13	0.00	0.82	0.00	0.00	0.00
1,060	121.85	72.04	292.80	0.42	0.00	9.00	63.62	9.00	63.62	1.92	150.00	112	0.02	1.2	0.07	0.00	0.00	1.67	2.18	0.13	5.87	0.82	72.04	121.85	55.85
1,080	136.58	90.51	878.40	0.16	0.00	9.00	63.62	9.00	63.62	2.15	150.00	112	0.02	1.2	0.09	0.00	0.00	1.67	2.18	0.13	7.38	0.82	90.51	136.58	62.61
1,100	149.87	108.98	1464.00	0.10	0.00	9.00	63.62	9.00	63.62	2.36	150.00	112	0.03	1.2	0.10	0.00	0.00	1.67	2.18	0.13	8.88	0.82	108.98	149.87	68.70
1,120	162.08	127.46	1464.00	0.11	0.00	9.00	63.62	9.00	63.62	2.55	150.00	112	0.03	1.2	0.12	0.00	0.00	1.67	2.18	0.13	10.39	0.82	127.46	162.08	74.29
1,140	173.43	145.93	1464.00	0.12	0.00	9.00	63.62	9.00	63.62	2.73	150.00	112	0.04	1.2	0.14	0.00	0.00	1.67	2.18	0.13	11.90	0.82	145.93	173.43	79.49
1,160	184.08	164.40	1464.00	0.13	0.00	9.00	63.62	9.00	63.62	2.89	150.00	112	0.04	1.2	0.16	0.00	0.00	1.67	2.18	0.13	13.40	0.82	164.40	184.08	84.37
1,170	189.18	173.64	1464.00	0.13	0.00	9.00	63.62	9.00	63.62	2.97	150.00	112	0.04	1.2	0.16	0.00	0.00	1.67	2.18	0.13	14.15	0.82	173.64	189.18	86.71
1,134	170.27	140.66	1464.00	0.12	0.00	9.00	63.62	9.00	63.62	2.68	150.00	112	0.04	1.2	0.13	0.00	0.00	1.67	2.18	0.13	11.47	0.82	140.66	170.27	78.05
1,170	189.18	173.64	1464.00	0.13	0.00	9.00	63.62	9.00	63.62	2.97	150.00	112	0.04	1.2	0.16	0.00	0.00	1.67	2.18	0.13	14.15	0.82	173.64	189.18	86.71
1,175	191.68	178.26	1464.00	0.13	0.00	9.00	63.62	9.00	63.62	3.01	150.00	112	0.04	1.2	0.17	0.00	0.00	1.67	2.18	0.13	14.53	0.82	178.26	191.68	87.86

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Discharge Versus Elevation For 72" Fixed Cone Valve

Feasibility Study for Intake Modification at Morris Dam. **OUTLET NO. 6 - 72" FIXED CONE VALVE**

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1100 ft-msl	Rack H =	50 ft	Avg Width	39.04 ft	Gross A	1952 ft^2	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 2	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	39.06667 ft	Gross A	1172 ft^3	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	12 ft	Gross A	480 ft^4	An / Ag =	0.75	Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0
Slide Gate	0.4				
Enlargement	0				

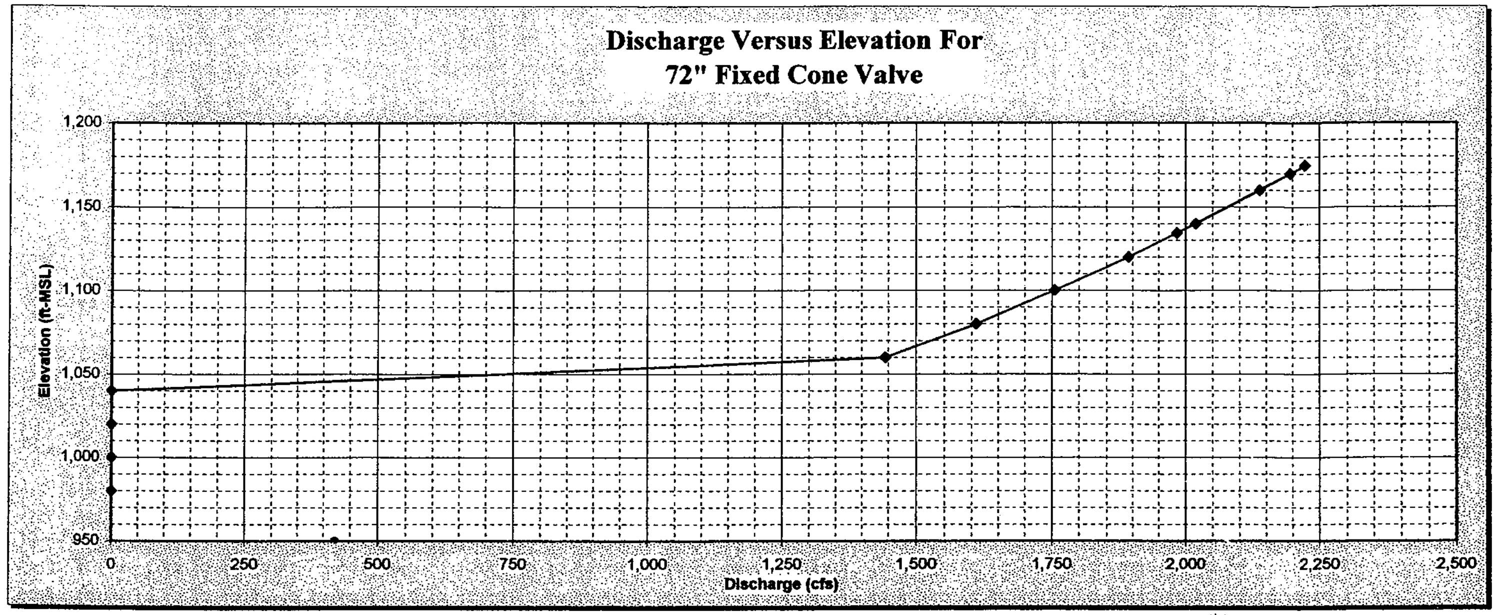
Centerline Elevation of Fixed-Cone Valve : 975 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	8.00	96	50.27
d/s dia =	8.00	96	50.27

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Net Area (sq ft)	Trashrack Net Vel (fps)	Trashrack Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Headloss (ft)	Venturi Losses Sum K	Headloss (ft)	Fixed Cone Valve Diameter (ft)	Area (sf)	Reducer Losses near Ex Sum K	Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Q (cfs)	Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	292.80	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	878.40	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.82	98.42	1464.00	1.20	0.01	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.42	1,755.82	62.10
1,120	1891.75	114.25	1464.00	1.29	0.01	8.00	50.27	8.00	50.27	37.64	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.25	1,891.75	66.91
1,140	2018.62	130.09	1464.00	1.38	0.02	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.54	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.09	2,018.62	71.39
1,160	2138.04	145.94	1464.00	1.46	0.02	8.00	50.27	8.00	50.27	42.54	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.94	2,138.04	75.62
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,134	1983.28	125.58	1464.00	1.35	0.02	8.00	50.27	8.00	50.27	39.46	255.00	112	10.05	0.9	21.76	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.58	1,983.28	70.14
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,175	2223.44	157.83	1464.00	1.52	0.02	8.00	50.27	8.00	50.27	44.23	255.00	112	12.42	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.83	2,223.44	78.64
CONCEPT NO. 2 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	293.00	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	879.00	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.66	98.41	879.00	2.00	0.03	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.41	1,755.66	62.09
1,120	1891.58	114.23	879.00	2.15	0.04	8.00	50.27	8.00	50.27	37.63	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.23	1,891.58	66.90
1,140	2018.45	130.07	879.00	2.30	0.05	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.53	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.07	2,018.45	71.39
1,160	2137.86	145.91	879.00	2.43	0.05	8.00	50.27	8.00	50.27	42.53	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.91	2,137.86	75.61
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,134	1983.11	125.56	879.00	2.26	0.04	8.00	50.27	8.00	50.27	39.45	255.00	112	10.05	0.9	21.75	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.56	1,983.11	70.14
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,175	2223.24	157.80	879.00	2.53	0.05	8.00	50.27	8.00	50.27	44.23	255.00	112	12.41	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.80	2,223.24	78.63
CONCEPT NO. 3 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1428.08	65.11	90.00	15.87	2.15	8.00	50.27	8.00	50.27	28.41	255.00	112	5.47	0.9	11.28	0.00	0.00	6.00	28.27	0.13	0.99	0.78	65.11	1,428.08	50.51
1,080	1606.30	82.37	270.00	5.95	0.30	8.00	50.27	8.00	50.27	31.96	255.00	112	6.80	0.9	14.27	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.37	1,606.30	56.81
1,100	1754.47	98.27	360.00	4.87	0.20	8.00	50.27	8.00	50.27	34.90	255.00	112	8.01	0.9	17.03	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.27	1,754.47	62.05
1,120	1890.30	114.08	360.00	5.25	0.24	8.00	50.27	8.00	50.27	37.61	255.00	112	9.20	0.9	19.76	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.08	1,890.30	66.86
1,140	2017.07	129.89	360.00	5.60	0.27	8.00	50.27	8.00	50.27	40.13	255.00	112	10.37	0.9	22.50	0.00	0.00	6.00	28.27	0.13	1.97	0.78	129.89	2,017.07	71.34
1,160	2136.40	145.72	360.00	5.93	0.30	8.00	50.27	8.00	50.27	42.50	255.00	112	11.53	0.9	25.25	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.72	2,136.40	75.56
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,134	1981.76	125.38	360.00	5.50	0.26	8.00	50.27	8.00	50.27	39.43	255.00	112	10.04	0.9	21.72	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.38	1,981.76	70.09
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,175	2221.73	157.59	360.00	6.17	0.33	8.00	50.27	8.00	50.27	44.20	255.00	112	12.40	0.9	27.30	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.59	2,221.73	78.58

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Feasibility Study for Intake Modification at Morris Dam.

OUTLET NO. 6 - 72" FIXED CONE VALVE

Concept No. 1	Rack Sill El	1050	ft-msl	Rack top EL	1100	ft-msl	Rack H =	50	ft	Avg Width	39.04 ft	Gross A	1952 ft^2	An / Ag =	0.75 Assumed for unblocked condition
Concept No. 2	Rack Sill El	1050	ft-msl	Rack top EL	1080	ft-msl	Rack H =	30	ft	Avg Width	39.06667 ft	Gross A	1172 ft^3	An / Ag =	0.75 Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050	ft-msl	Rack top EL	1090	ft-msl	Rack H =	40	ft	Avg Width	12 ft	Gross A	480 ft^4	An / Ag =	0.75 Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0
Slide Gate	0.4				
Enlargement	0				

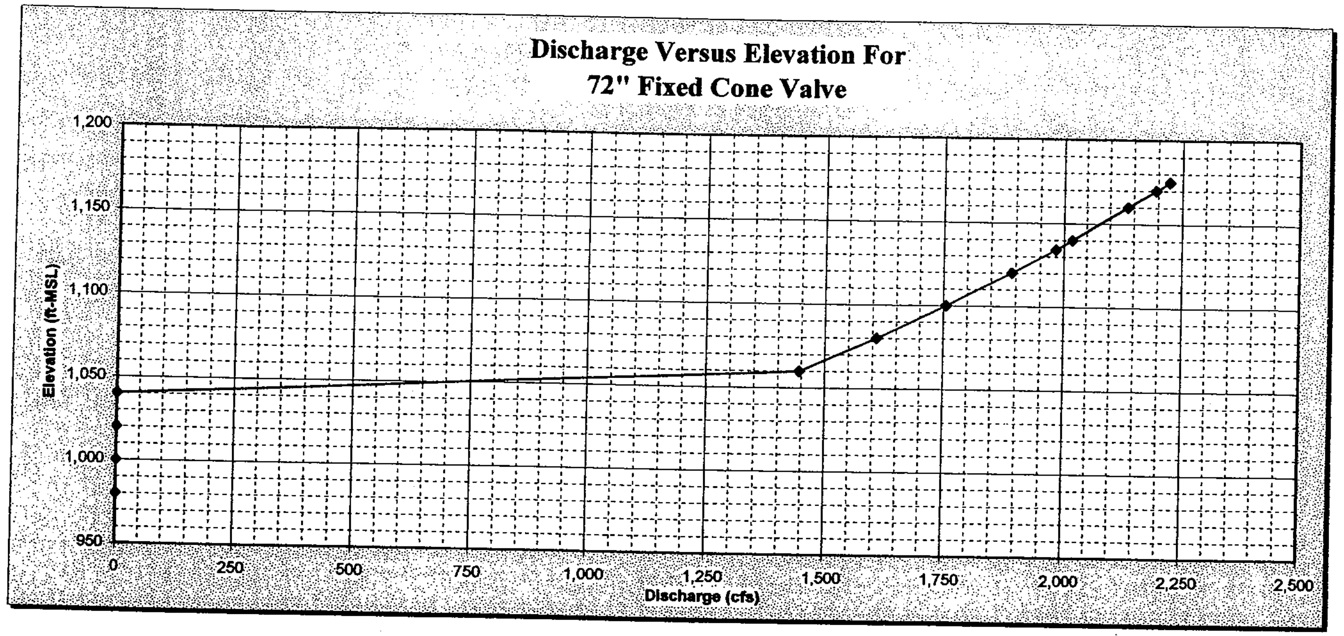
Centerline Elevation of Fixed-Cone Valve : 975 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	8.00	96	50.27
d/s dia =	8.00	96	50.27

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Net Area (sq ft)	Trashrack Net Vel (fps)	Trashrack Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Entrance Minor Losses Headloss (ft)	Venturi Losses Sum K	Venturi Losses Headloss (ft)	Fixed Cone Valve Diameter (ft)	Fixed Cone Valve Area (sf)	Reducer Losses near Ex Sum K	Reducer Losses near Ex Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Fixed-Cone Valve Q (cfs)	Fixed-Cone Valve Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	292.80	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	878.40	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.82	98.42	1464.00	1.20	0.01	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.42	1,755.82	62.10
1,120	1891.75	114.25	1464.00	1.29	0.01	8.00	50.27	8.00	50.27	37.64	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.25	1,891.75	66.91
1,140	2018.62	130.09	1464.00	1.38	0.02	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.54	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.09	2,018.62	71.39
1,160	2138.04	145.94	1464.00	1.46	0.02	8.00	50.27	8.00	50.27	42.54	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.94	2,138.04	75.62
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,134	1983.28	125.58	1464.00	1.35	0.02	8.00	50.27	8.00	50.27	39.46	255.00	112	10.05	0.9	21.76	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.58	1,983.28	70.14
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,175	2223.44	157.83	1464.00	1.52	0.02	8.00	50.27	8.00	50.27	44.23	255.00	112	12.42	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.83	2,223.44	78.64
CONCEPT NO. 2 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	293.00	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	879.00	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.66	98.41	879.00	2.00	0.03	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.41	1,755.66	62.09
1,120	1891.58	114.23	879.00	2.15	0.04	8.00	50.27	8.00	50.27	37.63	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.23	1,891.58	66.90
1,140	2018.45	130.07	879.00	2.30	0.05	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.53	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.07	2,018.45	71.39
1,160	2137.86	145.91	879.00	2.43	0.05	8.00	50.27	8.00	50.27	42.53	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.91	2,137.86	75.61
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,134	1983.11	125.56	879.00	2.26	0.04	8.00	50.27	8.00	50.27	39.45	255.00	112	10.05	0.9	21.75	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.56	1,983.11	70.14
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,175	2223.24	157.80	879.00	2.53	0.05	8.00	50.27	8.00	50.27	44.23	255.00	112	12.41	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.80	2,223.24	78.63
CONCEPT NO. 3 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1428.08	65.11	90.00	15.87	2.15	8.00	50.27	8.00	50.27	28.41	255.00	112	5.47	0.9	11.28	0.00	0.00	6.00	28.27	0.13	0.99	0.78	65.11	1,428.08	50.51
1,080	1606.30	82.37	270.00	5.95	0.30	8.00	50.27	8.00	50.27	31.96	255.00	112	6.80	0.9	14.27	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.37	1,606.30	56.81
1,100	1754.47	98.27	360.00	4.87	0.20	8.00	50.27	8.00	50.27	34.90	255.00	112	8.01	0.9	17.03	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.27	1,754.47	62.05
1,120	1890.30	114.08	360.00	5.25	0.24	8.00	50.27	8.00	50.27	37.61	255.00	112	9.20	0.9	19.76	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.08	1,890.30	66.86
1,140	2017.07	129.89	360.00	5.60	0.27	8.00	50.27	8.00	50.27	40.13	255.00	112	10.37	0.9	22.50	0.00	0.00	6.00	28.27	0.13	1.97	0.78	129.89	2,017.07	71.34
1,160	2136.40	145.72	360.00	5.93	0.30	8.00	50.27	8.00	50.27	42.50	255.00	112	11.53	0.9	25.25	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.72	2,136.40	75.56
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,134	1981.76	125.38	360.00	5.50	0.26	8.00	50.27	8.00	50.27	39.43	255.00	112	10.04	0.9	21.72	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.38	1,981.76	70.09
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,175	2221.73	157.59	360.00	6.17	0.33	8.00	50.27	8.00	50.27	44.20	255.00	112	12.40	0.9	27.30	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.59	2,221.73	78.58

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Feasibility Study for Intake Modification at Morris Dam.

OUTLET NO. 3 - 20" JET FLOW GATE

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	38.53333 ft	Gross A	1156 ft^2	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 2	Rack Sill El	1060 ft-msl	Rack top EL	1080 ft-msl	Rack H =	20 ft	Avg Width	38.55 ft	Gross A	771 ft^3	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	11.5 ft	Gross A	460 ft^4	An / Ag =	0.75	Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0.05
Slide Gate	0.2				
Enlargement	0				

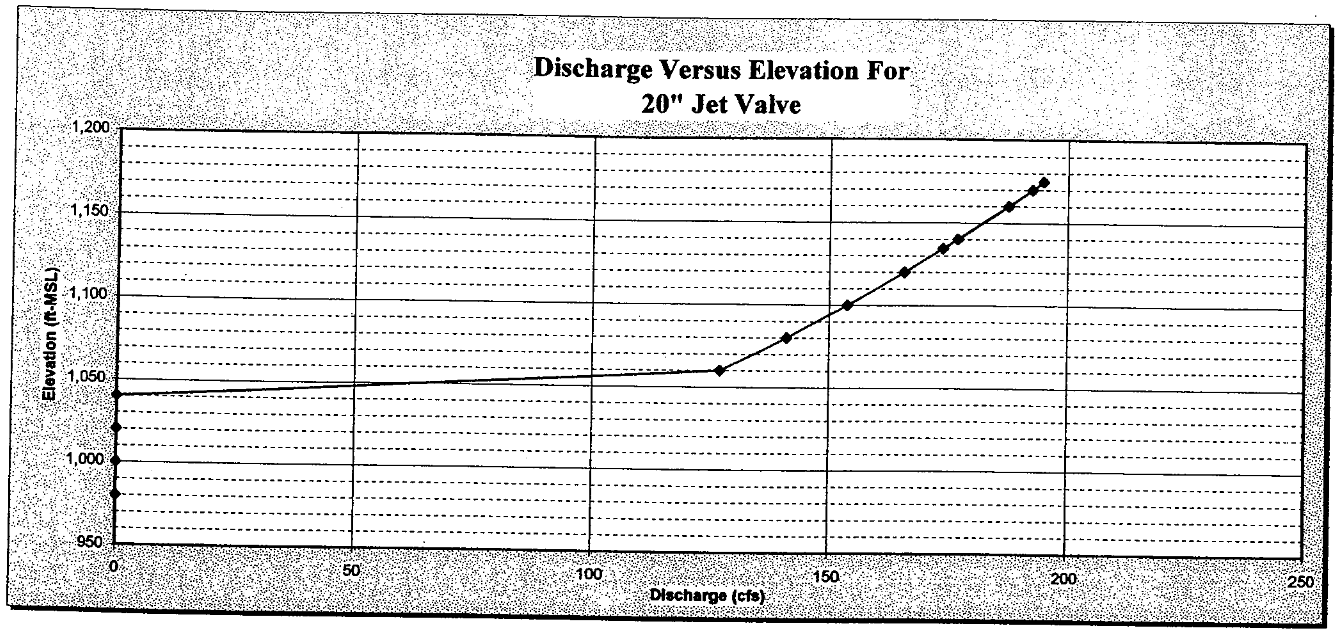
Centerline Elevation of Fixed-Cone Valve : 975 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	3.58	43	10.08

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Net Area (sq ft)	Trashrack Net Vel (fps)	Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Headloss (ft)	Venturi Losses Sum K	Headloss (ft)	20" Jet-Flow Gate Diameter (ft)	Area (sf)	Reducer Losses near Ex Sum K	Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Q (cfs)	Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,060	126.77	77.36	289.00	0.44	0.00	4.00	12.57	4.00	12.57	10.09	255.00	112	1.80	0.7	1.11	0.05	0.12	1.67	2.19	0.13	4.61	0.82	77.36	126.77	57.88
1,080	140.93	95.59	867.00	0.16	0.00	4.00	12.57	4.00	12.57	11.21	255.00	112	2.19	0.7	1.37	0.05	0.15	1.67	2.19	0.13	5.70	0.82	95.59	140.93	64.34
1,100	153.78	113.83	867.00	0.18	0.00	4.00	12.57	4.00	12.57	12.24	255.00	112	2.58	0.7	1.63	0.05	0.18	1.67	2.19	0.13	6.78	0.82	113.83	153.78	70.21
1,120	165.65	132.08	867.00	0.19	0.00	4.00	12.57	4.00	12.57	13.18	255.00	112	2.95	0.7	1.89	0.05	0.21	1.67	2.19	0.13	7.87	0.82	132.08	165.65	75.63
1,140	176.72	150.32	867.00	0.20	0.00	4.00	12.57	4.00	12.57	14.06	255.00	112	3.33	0.7	2.15	0.05	0.24	1.67	2.19	0.13	8.96	0.82	150.32	176.72	80.68
1,160	187.14	168.57	867.00	0.22	0.00	4.00	12.57	4.00	12.57	14.89	255.00	112	3.70	0.7	2.41	0.05	0.27	1.67	2.19	0.13	10.05	0.82	168.57	187.14	85.44
1,170	192.14	177.70	867.00	0.22	0.00	4.00	12.57	4.00	12.57	15.29	255.00	112	3.89	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.59	0.82	177.70	192.14	87.72
1,134	173.64	145.12	867.00	0.20	0.00	4.00	12.57	4.00	12.57	13.82	255.00	112	3.22	0.7	2.08	0.05	0.23	1.67	2.19	0.13	8.65	0.82	145.12	173.64	79.27
1,170	192.14	177.70	867.00	0.22	0.00	4.00	12.57	4.00	12.57	15.29	255.00	112	3.89	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.59	0.82	177.70	192.14	87.72
1,175	194.59	182.26	867.00	0.22	0.00	4.00	12.57	4.00	12.57	15.49	255.00	112	3.98	0.7	2.61	0.05	0.29	1.67	2.19	0.13	10.86	0.82	182.26	194.59	88.84
CONCEPT NO. 2 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,060	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,080	140.87	95.51	578.25	0.24	0.00	4.00	12.57	4.00	12.57	11.21	265.00	112	2.28	0.7	1.37	0.05	0.15	1.67	2.19	0.13	5.69	0.82	95.51	140.87	64.31
1,100	153.72	113.74	578.25	0.27	0.00	4.00	12.57	4.00	12.57	12.23	265.00	112	2.67	0.7	1.63	0.05	0.18	1.67	2.19	0.13	6.78	0.82	113.74	153.72	70.18
1,120	165.58	131.97	578.25	0.29	0.00	4.00	12.57	4.00	12.57	13.18	265.00	112	3.07	0.7	1.89	0.05	0.21	1.67	2.19	0.13	7.86	0.82	131.97	165.58	75.60
1,140	176.65	150.20	578.25	0.31	0.00	4.00	12.57	4.00	12.57	14.06	265.00	112	3.46	0.7	2.15	0.05	0.24	1.67	2.19	0.13	8.95	0.82	150.20	176.65	80.65
1,160	187.07	168.44	578.25	0.32	0.00	4.00	12.57	4.00	12.57	14.89	265.00	112	3.85	0.7	2.41	0.05	0.27	1.67	2.19	0.13	10.04	0.82	168.44	187.07	85.40
1,170	192.07	177.56	578.25	0.33	0.00	4.00	12.57	4.00	12.57	15.28	265.00	112	4.04	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.58	0.82	177.56	192.07	87.69
1,134	173.57	145.01	578.25	0.30	0.00	4.00	12.57	4.00	12.57	13.81	265.00	112	3.35	0.7	2.07	0.05	0.23	1.67	2.19	0.13	8.64	0.82	145.01	173.57	79.24
1,170	192.07	177.56	578.25	0.33	0.00	4.00	12.57	4.00	12.57	15.28	265.00	112	4.04	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.58	0.82	177.56	192.07	87.69
1,175	194.52	182.12	578.25	0.34	0.00	4.00	12.57	4.00	12.57	15.48	265.00	112	4.13	0.7	2.60	0.05	0.29	1.67	2.19	0.13	10.85	0.82	182.12	194.52	88.80
CONCEPT NO. 3 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.00	12.57	4.00	12.57	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,060	126.76	77.34	86.25	1.47	0.02	4.00	12.57	4.00	12.57	10.09	255.00	112	1.80	0.7	1.11	0.05	0.12	1.67	2.19	0.13	4.61	0.82	77.34	126.76	57.87
1,080	140.93	95.59	258.75	0.54	0.00	4.00	12.57	4.00	12.57	11.21	255.00	112	2.19	0.7	1.37	0.05	0.15	1.67	2.19	0.13	5.70	0.82	95.59	140.93	64.34
1,100	153.78	113.83	345.00	0.45	0.00	4.00	12.57	4.00	12.57	12.24	255.00	112	2.58	0.7	1.63	0.05	0.18	1.67	2.19	0.13	6.78	0.82	113.83	153.78	70.21
1,120	165.65	132.07	345.00	0.48	0.00	4.00	12.57	4.00	12.57	13.18	255.00	112	2.95	0.7	1.89	0.05	0.21	1.67	2.19	0.13	7.87	0.82	132.07	165.65	75.63
1,140	176.72	150.32	345.00	0.51	0.00	4.00	12.57	4.00	12.57	14.06	255.00	112	3.33	0.7	2.15	0.05	0.24	1.67	2.19	0.13	8.96	0.82	150.32	176.72	80.68
1,160	187.14	168.57	345.00	0.54	0.00	4.00	12.57	4.00	12.57	14.89	255.00	112	3.70	0.7	2.41	0.05	0.27	1.67	2.19	0.13	10.05	0.82	168.57	187.14	85.44
1,170	192.14	177.70	345.00	0.56	0.00	4.00	12.57	4.00	12.57	15.29	255.00	112	3.89	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.59	0.82	177.70	192.14	87.72
1,134	173.64	145.12	345.00	0.50	0.00	4.00	12.57	4.00	12.57	13.82	255.00	112	3.22	0.7	2.08	0.05	0.23	1.67	2.19	0.13	8.65	0.82	145.12	173.64	79.27
1,170	192.14	177.70	345.00	0.56	0.00	4.00	12.57	4.00	12.57	15.29	255.00	112	3.89	0.7	2.54	0.05	0.28	1.67	2.19	0.13	10.59	0.82	177.70	192.14	87.72
1,175	194.59	182.26	345.00	0.56	0.00	4.00	12.57	4.00	12.57	15.49	255.00	112	3.98	0.7	2.61	0.05	0.29	1.67	2.19	0.13	10.86	0.82	182.26	194.59	88.84

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Feasibility Study for Intake Modification at Morris Dam.

OUTLET NO. 4 - 42" FIXED CONE VALVE

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	38.53333 ft	Gross A	1156 ft^2	An / Ag =	0.75 Assumed for unblocked condition
Concept No. 2	Rack Sill El	1060 ft-msl	Rack top EL	1080 ft-msl	Rack H =	20 ft	Avg Width	38.55 ft	Gross A	771 ft^3	An / Ag =	0.75 Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	11.5 ft	Gross A	460 ft^4	An / Ag =	0.75 Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0.05
Slide Gate	0.2				
Enlargement	0				

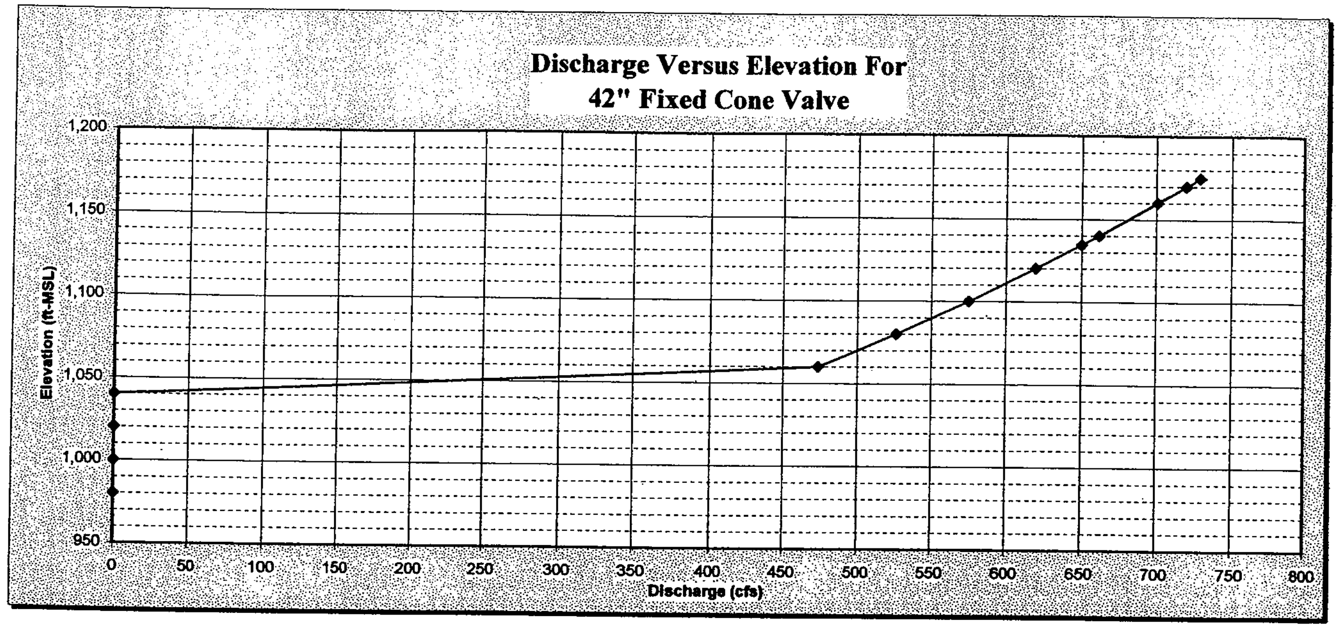
Centerline Elevation of Fixed-Cone Valve : 975 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	3.58	43	10.08
d/s dia =	4.00	48	12.57

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Net Area (sq ft)	Trashrack Net Vel (fps)	Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Headloss (ft)	Venturi Losses Sum K	Headloss (ft)	Fixed Cone Valve Diameter (ft)	Area (sf)	Reducer Losses near Ex Sum K	Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Q (cfs)	Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,060	473.25	61.75	289.00	1.64	0.02	4.50	15.90	4.50	15.90	29.76	255.00	112	11.62	0.7	9.62	0.05	1.71	3.50	9.62	0.13	0.27	0.78	61.75	473.25	49.19
1,080	526.62	76.47	867.00	0.61	0.00	4.50	15.90	4.50	15.90	33.11	255.00	112	14.16	0.7	11.92	0.05	2.12	3.50	9.62	0.13	0.33	0.78	76.47	526.62	54.74
1,100	575.10	91.19	867.00	0.66	0.00	4.50	15.90	4.50	15.90	36.16	255.00	112	16.67	0.7	14.21	0.05	2.52	3.50	9.62	0.13	0.40	0.78	91.19	575.10	59.77
1,120	619.87	105.94	867.00	0.71	0.00	4.50	15.90	4.50	15.90	38.97	255.00	112	19.15	0.7	16.51	0.05	2.93	3.50	9.62	0.13	0.46	0.78	105.94	619.87	64.43
1,140	661.66	120.71	867.00	0.76	0.00	4.50	15.90	4.50	15.90	41.60	255.00	112	21.61	0.7	18.81	0.05	3.34	3.50	9.62	0.13	0.52	0.78	120.71	661.66	68.77
1,160	701.01	135.49	867.00	0.81	0.01	4.50	15.90	4.50	15.90	44.08	255.00	112	24.04	0.7	21.12	0.05	3.75	3.50	9.62	0.13	0.59	0.78	135.49	701.01	72.86
1,170	719.89	142.89	867.00	0.83	0.01	4.50	15.90	4.50	15.90	45.26	255.00	112	25.25	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.89	719.89	74.82
1,134	650.02	116.50	867.00	0.75	0.00	4.50	15.90	4.50	15.90	40.87	255.00	112	20.91	0.7	18.16	0.05	3.23	3.50	9.62	0.13	0.51	0.78	116.50	650.02	67.56
1,170	719.89	142.89	867.00	0.83	0.01	4.50	15.90	4.50	15.90	45.26	255.00	112	25.25	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.89	719.89	74.82
1,175	729.15	146.59	867.00	0.84	0.01	4.50	15.90	4.50	15.90	45.85	255.00	112	25.86	0.7	22.85	0.05	4.06	3.50	9.62	0.13	0.64	0.78	146.59	729.15	75.79
CONCEPT NO. 2 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,060	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,080	525.21	76.06	578.25	0.91	0.01	4.50	15.90	4.50	15.90	0.00	265.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,100	573.58	90.71	578.25	0.99	0.01	4.50	15.90	4.50	15.90	33.02	265.00	112	14.65	0.7	11.85	0.05	2.11	3.50	9.62	0.13	0.33	0.78	76.06	525.21	54.59
1,120	618.24	105.39	578.25	1.07	0.01	4.50	15.90	4.50	15.90	36.06	265.00	112	17.24	0.7	14.14	0.05	2.51	3.50	9.62	0.13	0.39	0.78	90.71	573.58	59.62
1,140	659.94	120.08	578.25	1.14	0.01	4.50	15.90	4.50	15.90	38.87	265.00	112	19.80	0.7	16.42	0.05	2.92	3.50	9.62	0.13	0.46	0.78	105.39	618.24	64.26
1,160	699.20	134.80	578.25	1.21	0.01	4.50	15.90	4.50	15.90	41.49	265.00	112	22.35	0.7	18.71	0.05	3.32	3.50	9.62	0.13	0.52	0.78	120.08	659.94	68.59
1,170	718.04	142.16	578.25	1.24	0.01	4.50	15.90	4.50	15.90	43.96	265.00	112	24.87	0.7	21.01	0.05	3.73	3.50	9.62	0.13	0.59	0.78	134.80	699.20	72.67
1,134	648.32	115.89	578.25	1.12	0.01	4.50	15.90	4.50	15.90	45.15	265.00	112	26.12	0.7	22.16	0.05	3.94	3.50	9.62	0.13	0.62	0.78	142.16	718.04	74.63
1,170	718.04	142.16	578.25	1.24	0.01	4.50	15.90	4.50	15.90	40.76	265.00	112	21.62	0.7	18.06	0.05	3.21	3.50	9.62	0.13	0.50	0.78	115.89	648.32	67.39
1,175	727.28	145.84	578.25	1.26	0.01	4.50	15.90	4.50	15.90	45.15	265.00	112	26.12	0.7	22.16	0.05	3.94	3.50	9.62	0.13	0.62	0.78	142.16	718.04	74.63
								4.50	15.90	45.73	265.00	112	26.75	0.7	22.73	0.05	4.04	3.50	9.62	0.13	0.63	0.78	145.84	727.28	75.59
CONCEPT NO. 3 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	1.67	2.19	0.13	0.00	0.82	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	4.50	15.90	4.50	15.90	0.00	255.00	112	0.00	0.7	0.00	0.05	0.00	3.50	9.62	0.13	0.00	0.78	0.00	0.00	0.00
1,060	472.59	61.58	86.25	5.48	0.26	4.50	15.90	4.50	15.90	29.71	255.00	112	11.59	0.7	9.60	0.05	1.71	3.50	9.62	0.13	0.27	0.78	61.58	472.59	49.12
1,080	526.54	76.44	258.75	2.03	0.04	4.50	15.90	4.50	15.90	33.11	255.00	112	14.16	0.7	11.91	0.05	2.12	3.50	9.62	0.13	0.33	0.78	76.44	526.54	54.73
1,100	575.05	91.18	345.00	1.67	0.02	4.50	15.90	4.50	15.90	36.16	255.00	112	16.67	0.7	14.21	0.05	2.52	3.50	9.62	0.13	0.40	0.78	91.18	575.05	59.77
1,120	619.81	105.92	345.00	1.80	0.03	4.50	15.90	4.50	15.90	38.97	255.00	112	19.15	0.7	16.51	0.05	2.93	3.50	9.62	0.13	0.46	0.78	105.92	619.81	64.42
1,140	661.61	120.69	345.00	1.92	0.03	4.50	15.90	4.50	15.90	41.60	255.00	112	21.60	0.7	18.81	0.05	3.34	3.50	9.62	0.13	0.52	0.78	120.69	661.61	68.77
1,160	700.95	135.47	345.00	2.03	0.04	4.50	15.90	4.50	15.90	44.07	255.00	112	24.04	0.7	21.11	0.05	3.75	3.50	9.62	0.13	0.59	0.78	135.47	700.95	72.86
1,170	719.83	142.87	345.00	2.09	0.04	4.50	15.90	4.50	15.90	45.26	255.00	112	25.25	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.87	719.83	74.82
1,134	649.96	116.48	345.00	1.88	0.03	4.50	15.90	4.50	15.90	40.87	255.00	112	20.90	0.7	18.15	0.05	3.23	3.50	9.62	0.13	0.51	0.78	116.48	649.96	67.56
1,170	719.83	142.87	345.00	2.09	0.04	4.50	15.90	4.50	15.90	45.26	255.00	112	25.25	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.87	719.83	74.82
1,175	729.10	146.57	345.00	2.11	0.04	4.50	15.90	4.50	15.90	45.84	255.00	112	25.86	0.7	22.84	0.05	4.06	3.50	9.62	0.13	0.64	0.78	146.57	729.10	75.78

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Feasibility Study for Intake Modification at Morris Dam.

OUTLET NO. 6 - 72" FIXED CONE VALVE

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1100 ft-msl	Rack H =	50 ft	Avg Width	39.04 ft	Gross A	1952 ft^2	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 2	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	39.06667 ft	Gross A	1172 ft^3	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	12 ft	Gross A	480 ft^4	An / Ag =	0.75	Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0
Slide Gate	0.4				
Enlargement	0				

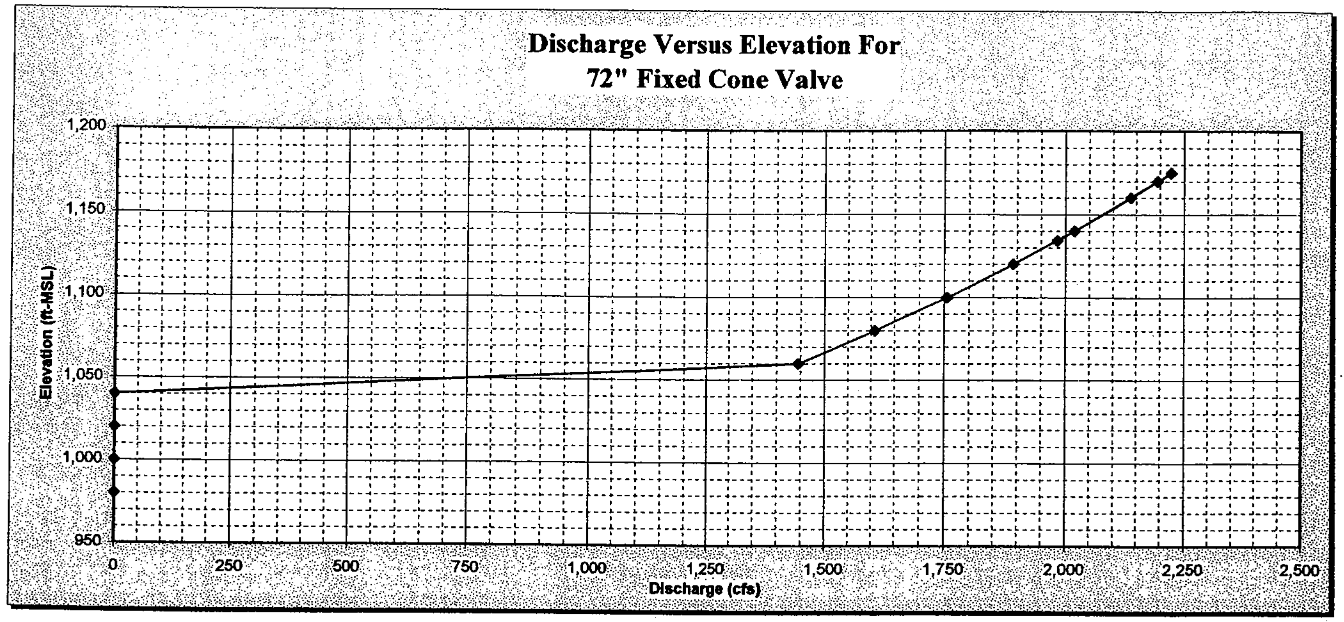
Centerline Elevation of Fixed-Cone Valve : 975 ft

Percent Blockage of Trashrack= 0%

	(ft)	(inches)	(Area)
venturie dia=	8.00	96	50.27
d/s dia =	8.00	96	50.27

Reservoir Elevation (ft)	Qtrial (cfs)	Hnet (ft)	Net Area (sq ft)	Trashrack Net Vel (fps)	Trashrack Headloss (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses (Hazen-Williams) Length (ft)	C	Headloss (ft)	Entrance Minor Losses Sum K	Entrance Minor Losses Headloss (ft)	Venturi Losses Sum K	Venturi Losses Headloss (ft)	Fixed Cone Valve Diameter (ft)	Fixed Cone Valve Area (sf)	Reducer Losses near Ex Sum K	Reducer Losses Headloss (ft)	Cd	Fixed-Cone Valve Net Head (ft)	Q (cfs)	Velocity (fps)
CONCEPT NO. 1 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	292.80	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	878.40	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.82	98.42	1464.00	1.20	0.01	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.42	1,755.82	62.10
1,120	1891.75	114.25	1464.00	1.29	0.01	8.00	50.27	8.00	50.27	37.64	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.25	1,891.75	66.91
1,140	2018.62	130.09	1464.00	1.38	0.02	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.54	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.09	2,018.62	71.39
1,160	2138.04	145.94	1464.00	1.46	0.02	8.00	50.27	8.00	50.27	42.54	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.94	2,138.04	75.62
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,134	1983.28	125.58	1464.00	1.35	0.02	8.00	50.27	8.00	50.27	39.46	255.00	112	10.05	0.9	21.76	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.58	1,983.28	70.14
1,170	2195.34	153.87	1464.00	1.50	0.02	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.87	2,195.34	77.64
1,175	2223.44	157.83	1464.00	1.52	0.02	8.00	50.27	8.00	50.27	44.23	255.00	112	12.42	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.83	2,223.44	78.64
CONCEPT NO. 2 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1444.81	66.64	293.00	4.93	0.21	8.00	50.27	8.00	50.27	28.74	255.00	112	5.59	0.9	11.55	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.64	1,444.81	51.10
1,080	1608.41	82.59	879.00	1.83	0.03	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.59	1,608.41	56.89
1,100	1755.66	98.41	879.00	2.00	0.03	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.41	1,755.66	62.09
1,120	1891.58	114.23	879.00	2.15	0.04	8.00	50.27	8.00	50.27	37.63	255.00	112	9.21	0.9	19.79	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.23	1,891.58	66.90
1,140	2018.45	130.07	879.00	2.30	0.05	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.53	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.07	2,018.45	71.39
1,160	2137.86	145.91	879.00	2.43	0.05	8.00	50.27	8.00	50.27	42.53	255.00	112	11.55	0.9	25.28	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.91	2,137.86	75.61
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,134	1983.11	125.56	879.00	2.26	0.04	8.00	50.27	8.00	50.27	39.45	255.00	112	10.05	0.9	21.75	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.56	1,983.11	70.14
1,170	2195.15	153.84	879.00	2.50	0.05	8.00	50.27	8.00	50.27	43.67	255.00	112	12.13	0.9	26.65	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.84	2,195.15	77.64
1,175	2223.24	157.80	879.00	2.53	0.05	8.00	50.27	8.00	50.27	44.23	255.00	112	12.41	0.9	27.34	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.80	2,223.24	78.63
CONCEPT NO. 3 RATING CURVE COMPUTATION																									
980	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,000	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,020	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,040	0.00	0.00	0.00	0.00	0.00	8.00	50.27	8.00	50.27	0.00	255.00	112	0.00	0.9	0.00	0.00	0.00	6.00	28.27	0.13	0.00	0.78	0.00	0.00	0.00
1,060	1428.08	65.11	90.00	15.87	2.15	8.00	50.27	8.00	50.27	28.41	255.00	112	5.47	0.9	11.28	0.00	0.00	6.00	28.27	0.13	0.99	0.78	65.11	1,428.08	50.51
1,080	1606.30	82.37	270.00	5.95	0.30	8.00	50.27	8.00	50.27	31.96	255.00	112	6.80	0.9	14.27	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.37	1,606.30	56.81
1,100	1754.47	98.27	360.00	4.87	0.20	8.00	50.27	8.00	50.27	34.90	255.00	112	8.01	0.9	17.03	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.27	1,754.47	62.05
1,120	1890.30	114.08	360.00	5.25	0.24	8.00	50.27	8.00	50.27	37.61	255.00	112	9.20	0.9	19.76	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.08	1,890.30	66.86
1,140	2017.07	129.89	360.00	5.60	0.27	8.00	50.27	8.00	50.27	40.13	255.00	112	10.37	0.9	22.50	0.00	0.00	6.00	28.27	0.13	1.97	0.78	129.89	2,017.07	71.34
1,160	2136.40	145.72	360.00	5.93	0.30	8.00	50.27	8.00	50.27	42.50	255.00	112	11.53	0.9	25.25	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.72	2,136.40	75.56
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,134	1981.76	125.38	360.00	5.50	0.26	8.00	50.27	8.00	50.27	39.43	255.00	112	10.04	0.9	21.72	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.38	1,981.76	70.09
1,170	2193.65	153.63	360.00	6.09	0.32	8.00	50.27	8.00	50.27	43.64	255.00	112	12.11	0.9	26.62	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.63	2,193.65	77.58
1,175	2221.73	157.59	360.00	6.17	0.33	8.00	50.27	8.00	50.27	44.20	255.00	112	12.40	0.9	27.30	0.00	0.00	6.00	28.27	0.13	2.39	0.78	157.59	2,221.73	78.58

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



Feasibility Study for Intake Modification at Morris Dam.

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	38.53333 ft	Gross A	1156 ft^2	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 2	Rack Sill El	1030 ft-msl	Rack top EL	1080 ft-msl	Rack H =	50 ft	Avg Width	15.42 ft	Gross A	771 ft^3	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	11.5 ft	Gross A	460 ft^4	An / Ag =	0.75	Assumed for unblocked condition

Losses Tabulation:

Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	venturi	0.05
Slide Gate	0.2				
Enlargement	0				

Note: Assummed No losses through trashrack

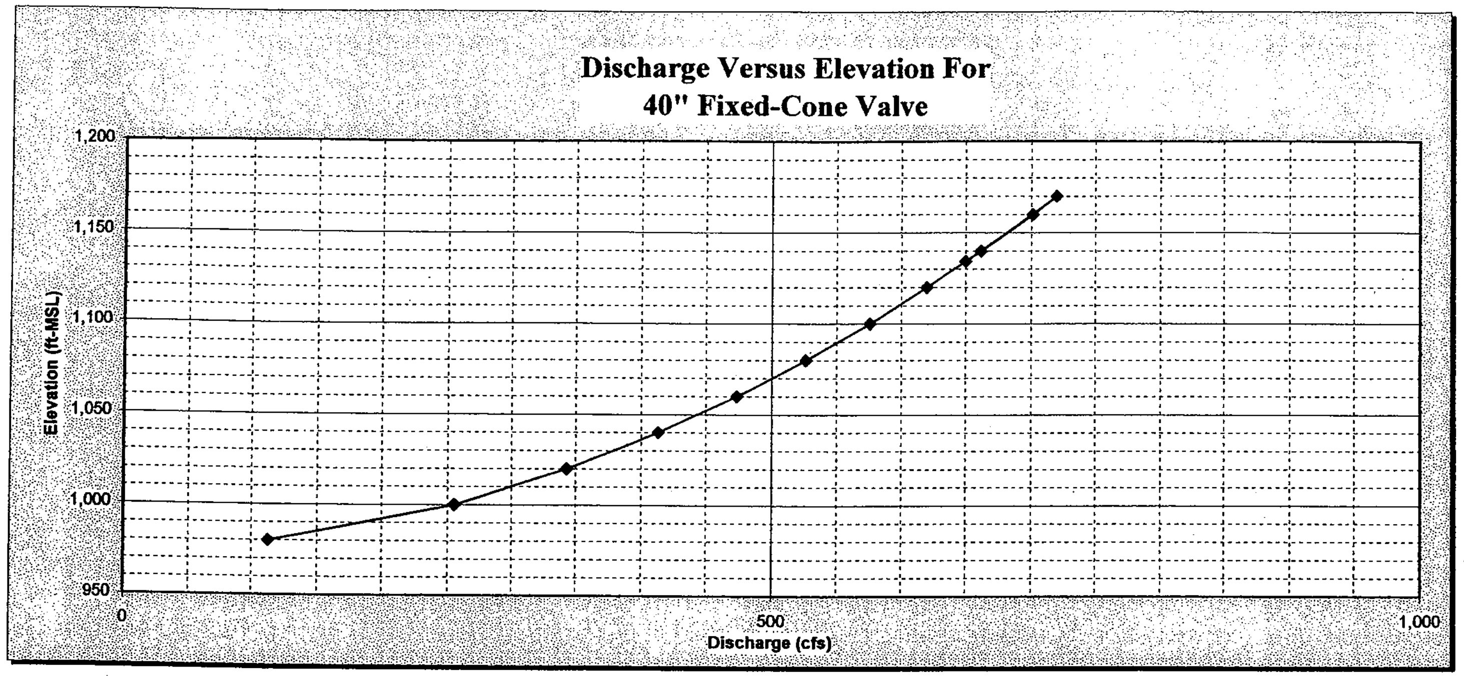
Centerline Elevation of
Fixed-Cone Valve : 975 ft

	(ft)	(inches)	(Area)
venturie dia=	3.58	43	10.08
d/s dia =	4.00	48	12.57

72 "	Dia =	6.00	ft
42 "	Dia =	3.50	ft

Reservoir Elevation (ft)	Qtrial (cfs)	H (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses Length (ft)	Pipe Length Losses C	Pipe Length Losses Headloss (ft)	Entrance Minor Losses Sum K	Entrance Minor Losses Headloss (ft)	Venturi Losses Sum K	Venturi Losses Headloss (ft)	Fixed-Cone Valve Diameter (ft)	Fixed-Cone Valve Area (sf)	Reducer Losses near Exit Sum K	Reducer Losses near Exit Headloss (ft)	Fixed-Cone Valve C	Fixed-Cone Valve Net Head (ft)	Fixed-Cone Valve Q (cfs)	Fixed-Cone Valve Velocity (fps)	Q-Qtrial	Qadj
980	112.96	3.52	4.50	15.90	4.50	15.90	7.10	255.00	112	0.82	0.7	0.55	0.05	0.10	3.50	9.62	0.13	0.02	0.78	3.52	112.96	11.74	0.00	112.96
1,000	255.00	17.93	4.50	15.90	4.50	15.90	16.03	255.00	112	3.70	0.7	2.79	0.05	0.50	3.50	9.62	0.13	0.08	0.78	17.93	255.00	26.50	0.00	255.00
1,020	343.23	32.48	4.50	15.90	4.50	15.90	21.58	255.00	112	6.42	0.7	5.06	0.05	0.90	3.50	9.62	0.13	0.14	0.78	32.48	343.23	35.67	0.00	343.23
1,040	413.32	47.10	4.50	15.90	4.50	15.90	25.99	255.00	112	9.05	0.7	7.34	0.05	1.30	3.50	9.62	0.13	0.20	0.78	47.10	413.32	42.96	0.00	413.32
1,060	473.31	61.77	4.50	15.90	4.50	15.90	29.76	255.00	112	11.63	0.7	9.63	0.05	1.71	3.50	9.62	0.13	0.27	0.78	61.77	473.31	49.20	0.00	473.31
1,080	526.63	76.47	4.50	15.90	4.50	15.90	33.11	255.00	112	14.16	0.7	11.92	0.05	2.12	3.50	9.62	0.13	0.33	0.78	76.47	526.63	54.74	0.00	526.63
1,100	575.11	91.20	4.50	15.90	4.50	15.90	36.16	255.00	112	16.67	0.7	14.21	0.05	2.52	3.50	9.62	0.13	0.40	0.78	91.20	575.11	59.78	0.00	575.11
1,120	619.87	105.95	4.50	15.90	4.50	15.90	38.98	255.00	112	19.15	0.7	16.51	0.05	2.93	3.50	9.62	0.13	0.46	0.78	105.95	619.87	64.43	0.00	619.87
1,140	661.67	120.71	4.50	15.90	4.50	15.90	41.60	255.00	112	21.61	0.7	18.81	0.05	3.34	3.50	9.62	0.13	0.52	0.78	120.71	661.67	68.77	0.00	661.67
1,160	701.02	135.50	4.50	15.90	4.50	15.90	44.08	255.00	112	24.04	0.7	21.12	0.05	3.75	3.50	9.62	0.13	0.59	0.78	135.50	701.02	72.86	0.00	701.02
1,170	719.90	142.90	4.50	15.90	4.50	15.90	45.26	255.00	112	25.26	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.90	719.90	74.83	0.00	719.90
1,134	650.03	116.50	4.50	15.90	4.50	15.90	40.87	255.00	112	20.91	0.7	18.16	0.05	3.23	3.50	9.62	0.13	0.51	0.78	116.50	650.03	67.56	0.00	650.03
1,170	719.90	142.90	4.50	15.90	4.50	15.90	45.26	255.00	112	25.26	0.7	22.27	0.05	3.96	3.50	9.62	0.13	0.62	0.78	142.90	719.90	74.83	0.00	719.90

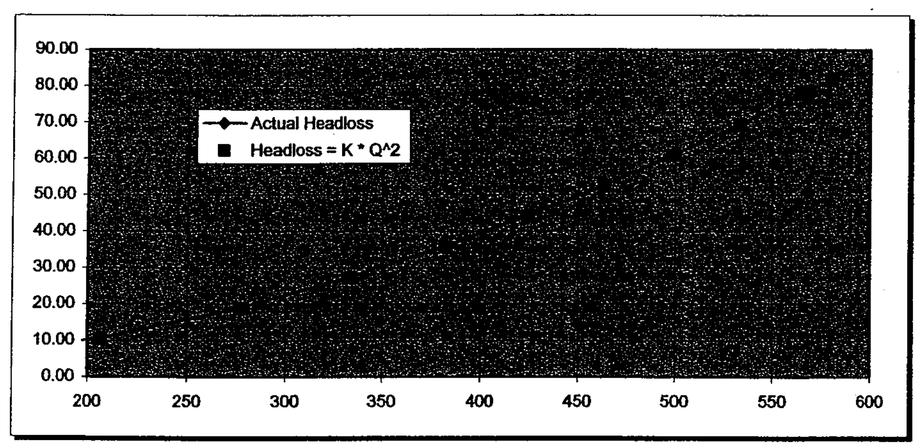
Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100



K = 2.44E-04

HL = K * Q^2

Qtrial (cfs)	net Head (ft)	HL (ft)	Q^2	HL
92	2.85	2.15	8,466	2.07
207	14.36	10.64	42,671	10.41
278	25.91	19.09	77,015	18.79
334	37.49	27.51	111,426	27.19
382	49.09	35.91	145,880	35.59
425	60.69	44.31	180,368	44.01
464	72.30	52.70	214,882	52.43
499	83.93	61.07	249,417	60.86
533	95.55	69.45	283,970	69.29
564	107.18	77.82	318,540	77.72
580	113.00	82.00	335,830	81.94
567	108.35	50.95	322,002	78.57
580	113.00	82.00	335,830	81.94



Feasibility Study for Intake Modification at Morris Dam.

Concept No. 1	Rack Sill El	1050 ft-msl	Rack top EL	1100 ft-msl	Rack H =	50 ft	Avg Width	39.04 ft	Gross A	1952 ft^2	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 2	Rack Sill El	1050 ft-msl	Rack top EL	1080 ft-msl	Rack H =	30 ft	Avg Width	39.06667 ft	Gross A	1172 ft^3	An / Ag =	0.75	Assumed for unblocked condition
Concept No. 3	Rack Sill El	1050 ft-msl	Rack top EL	1090 ft-msl	Rack H =	40 ft	Avg Width	12 ft	Gross A	480 ft^4	An / Ag =	0.75	Assumed for unblocked condition

Losses Tabulation:

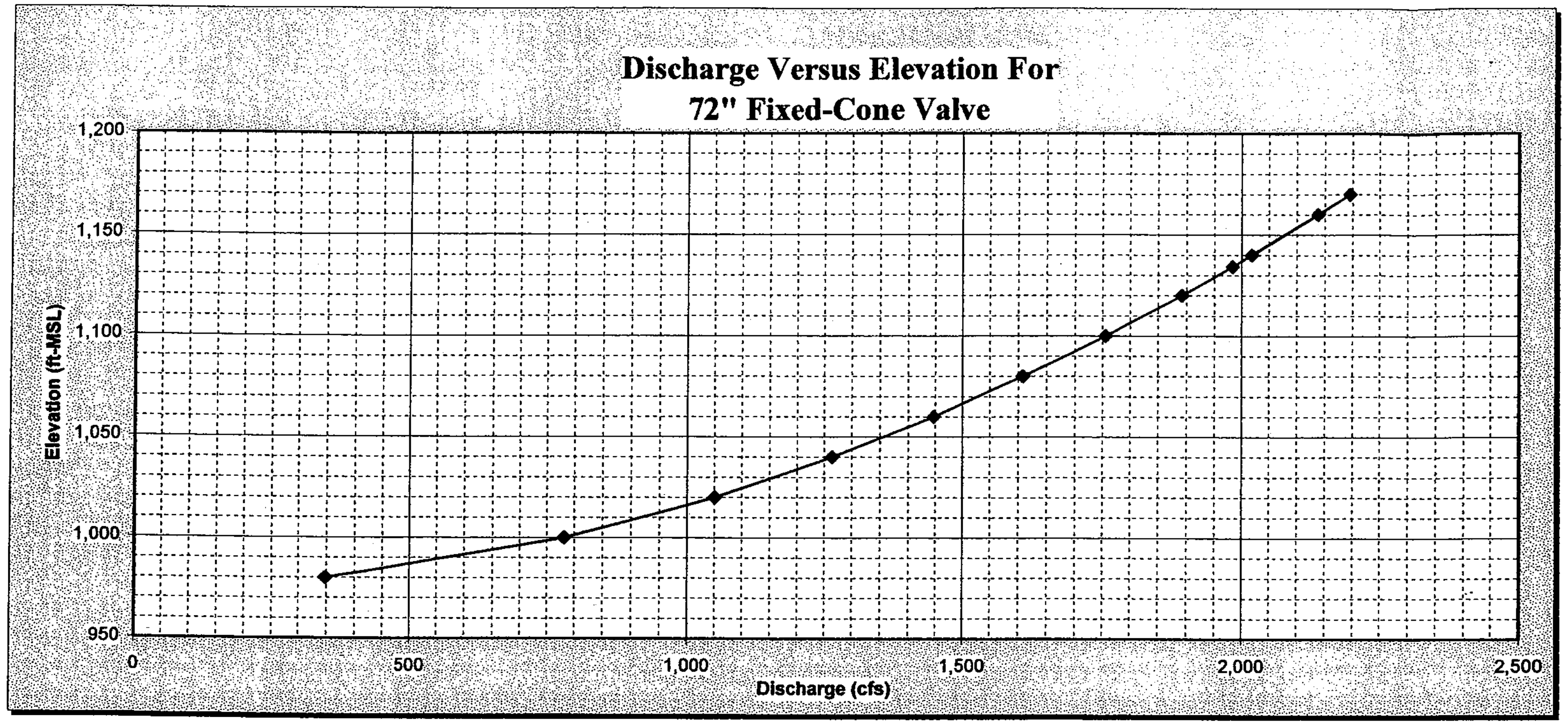
Entrance	K	Exit	K	Misc.	K
Entrance	0.5	Reducer	0.13	WYE	0
BF Valve	0.4			misc.	0
Enlargement	0			Bend	0

Note: Assummed No losses through trashrack

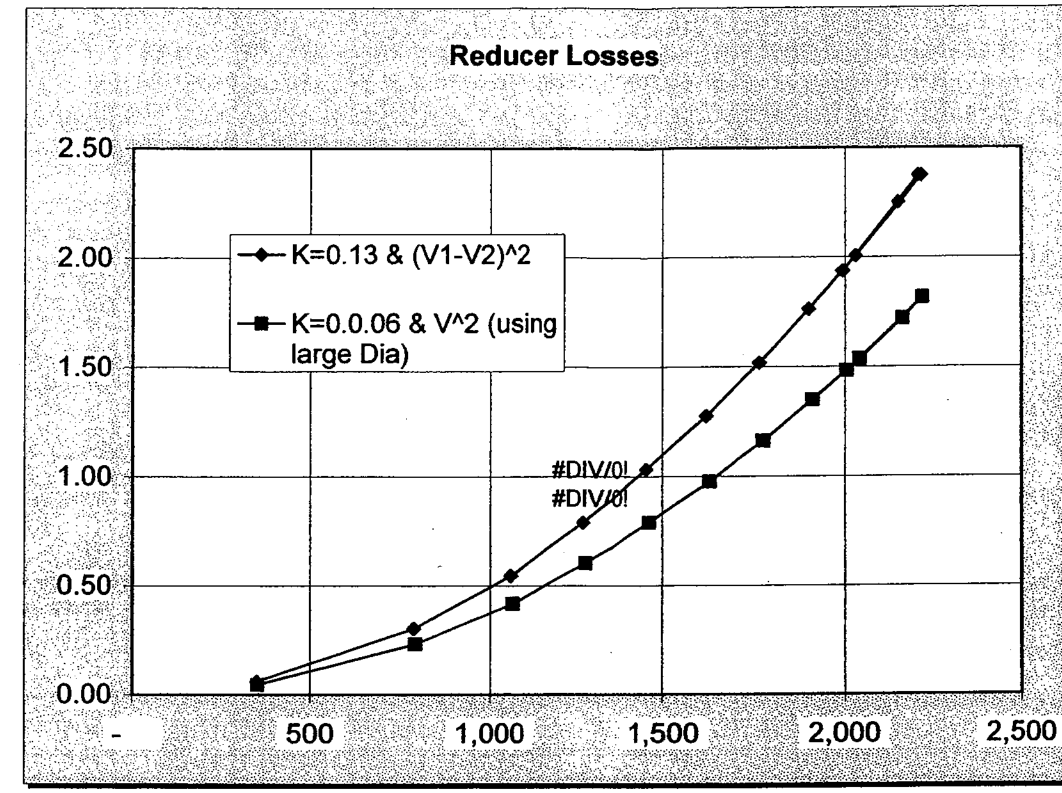
Centerline Elevation of
Fixed-Cone Valve : 975 ft

Reservoir Elevation (ft)	Qtrial (cfs)	H (ft)	Entrance Pipe Dia. (ft)	Entrance Area (sf)	Conduit Pipe Dia. (ft)	Conduit Area (sf)	Conduit Velocity (fps)	Pipe Length Losses Length (ft)	Pipe Length Losses C	Pipe Length Losses Headloss (ft)	Entrance Minor Losses Sum K	Entrance Minor Losses Headloss (ft)	Misc. Minor Losses Sum K	Misc. Minor Losses Headloss (ft)	Fixed-Cone Valve Diameter (ft)	Fixed-Cone Valve Area (sf)	Reducer Losses near Exit Sum K	Reducer Losses near Exit Headloss (ft)	Fixed-Cone Valve C	Fixed-Cone Valve Net Head (ft)	Fixed-Cone Valve Q (cfs)	Fixed-Cone Valve Velocity (fps)
980	348.13	3.87	8.00	50.27	8.00	50.27	6.93	255.00	112	0.40	0.9	0.67	0.00	0.00	6.00	28.27	0.13	0.06	0.78	3.87	348.13	12.31
1,000	782.03	19.53	8.00	50.27	8.00	50.27	15.56	255.00	112	1.80	0.9	3.38	0.00	0.00	6.00	28.27	0.13	0.30	0.78	19.53	782.03	27.66
1,020	1050.85	35.25	8.00	50.27	8.00	50.27	20.91	255.00	112	3.10	0.9	6.11	0.00	0.00	6.00	28.27	0.13	0.53	0.78	35.25	1,050.85	37.17
1,040	1264.15	51.02	8.00	50.27	8.00	50.27	25.15	255.00	112	4.37	0.9	8.84	0.00	0.00	6.00	28.27	0.13	0.77	0.78	51.02	1,264.15	44.71
1,060	1446.59	66.81	8.00	50.27	8.00	50.27	28.78	255.00	112	5.61	0.9	11.57	0.00	0.00	6.00	28.27	0.13	1.01	0.78	66.81	1,446.59	51.16
1,080	1608.63	82.61	8.00	50.27	8.00	50.27	32.00	255.00	112	6.82	0.9	14.31	0.00	0.00	6.00	28.27	0.13	1.25	0.78	82.61	1,608.63	56.89
1,100	1755.91	98.43	8.00	50.27	8.00	50.27	34.93	255.00	112	8.02	0.9	17.05	0.00	0.00	6.00	28.27	0.13	1.49	0.78	98.43	1,755.91	62.10
1,120	1891.84	114.26	8.00	50.27	8.00	50.27	37.64	255.00	112	9.21	0.9	19.80	0.00	0.00	6.00	28.27	0.13	1.73	0.78	114.26	1,891.84	66.91
1,140	2018.72	130.10	8.00	50.27	8.00	50.27	40.16	255.00	112	10.38	0.9	22.54	0.00	0.00	6.00	28.27	0.13	1.97	0.78	130.10	2,018.72	71.40
1,160	2138.15	145.95	8.00	50.27	8.00	50.27	42.54	255.00	112	11.55	0.9	25.29	0.00	0.00	6.00	28.27	0.13	2.21	0.78	145.95	2,138.15	75.62
1,170	2195.45	153.88	8.00	50.27	8.00	50.27	43.68	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.88	2,195.45	77.65
1,134	1983.38	125.59	8.00	50.27	8.00	50.27	39.46	255.00	112	10.05	0.9	21.76	0.00	0.00	6.00	28.27	0.13	1.90	0.78	125.59	1,983.38	70.15
1,170	2195.45	153.88	8.00	50.27	8.00	50.27	43.68	255.00	112	12.13	0.9	26.66	0.00	0.00	6.00	28.27	0.13	2.33	0.78	153.88	2,195.45	77.65

Spreadsheet Works best with: "Tools/Options/Calculation" set on "Automatic" and with "Iterations" set at 100

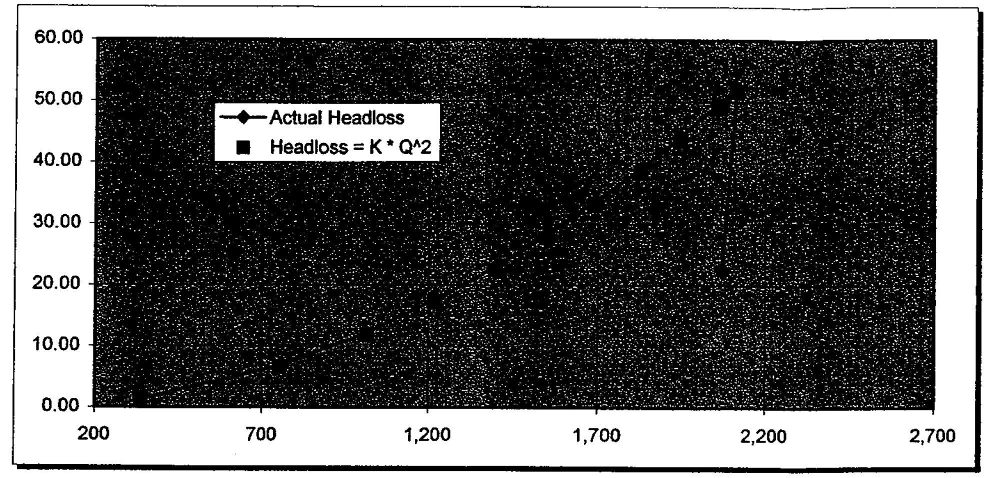


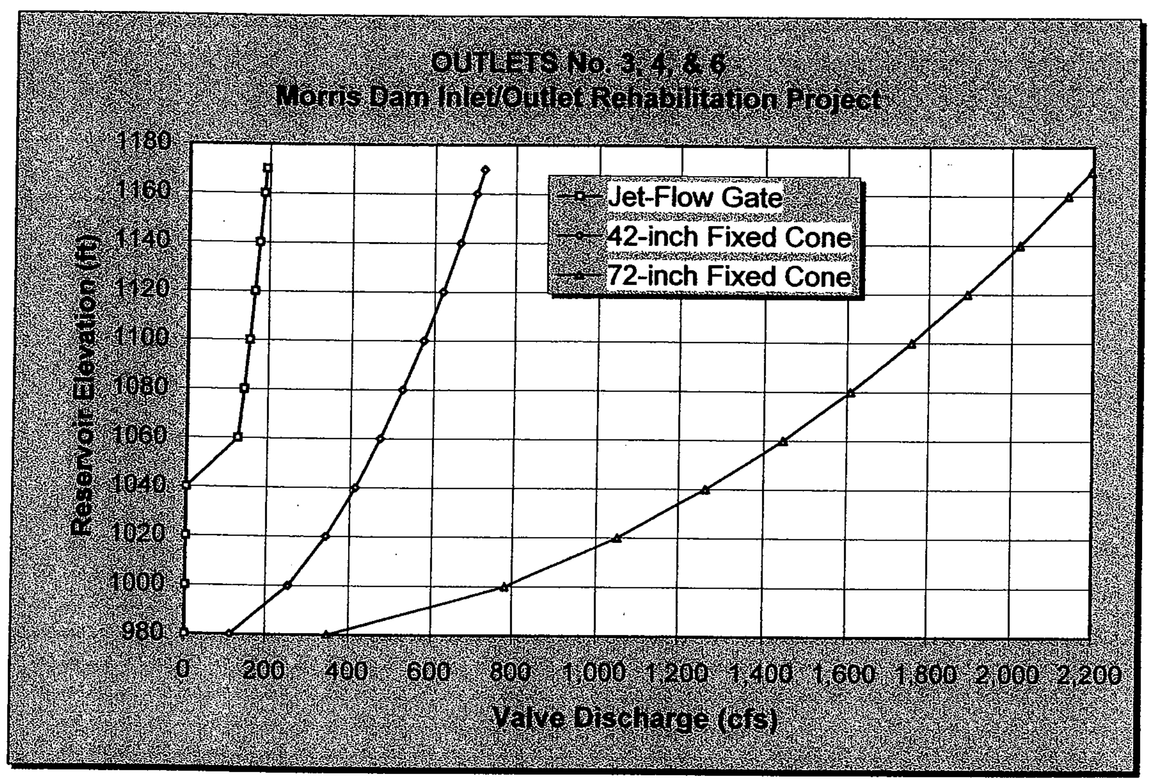
K = 1.16E-05

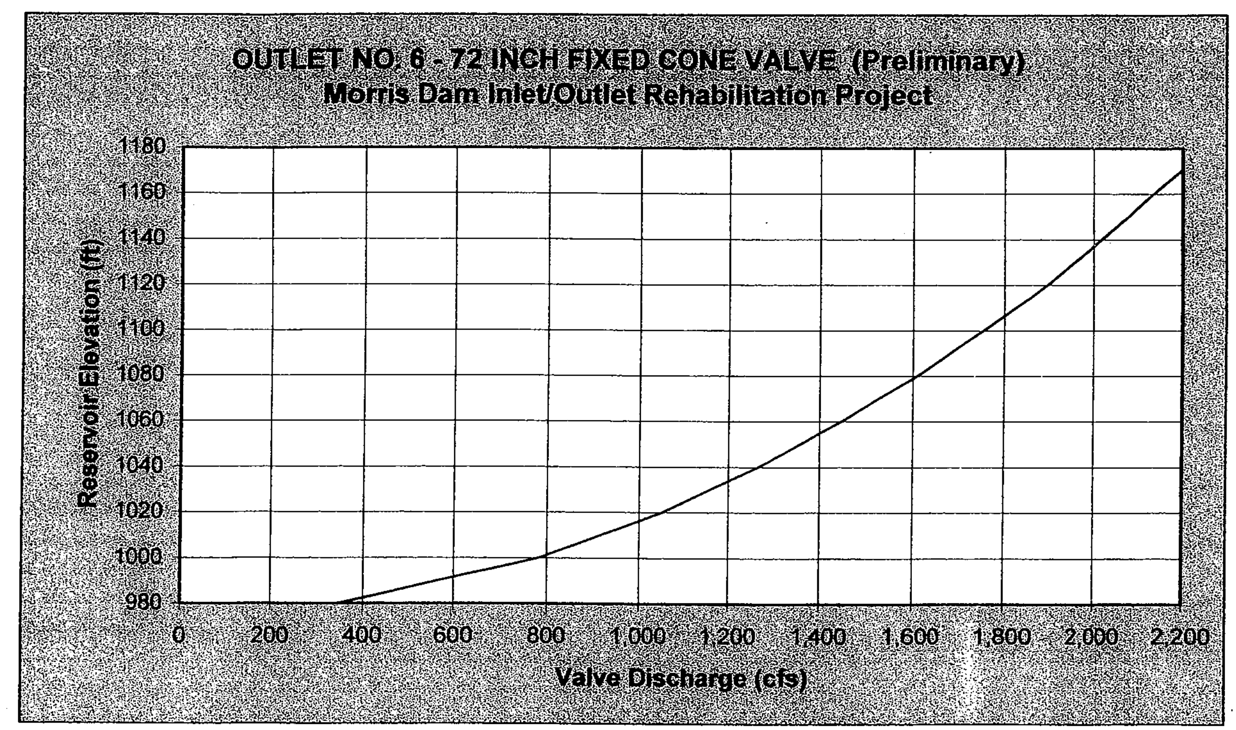


HL = K * Q^2

Qtrial (cfs)	net Head (ft)	HL (ft)	Q^2	HL
337	3.62	1.38	113,283	1.31
755	18.18	6.82	569,461	6.58
1,013	32.78	12.22	1,026,887	11.86
1,219	47.41	17.59	1,484,904	17.15
1,394	62.04	22.96	1,943,311	22.45
1,550	76.69	28.31	2,402,010	27.74
1,691	91.34	33.66	2,860,941	33.04
1,822	106.00	39.00	3,320,063	38.35
1,944	120.66	44.34	3,779,348	43.65
2,059	135.33	49.67	4,238,775	48.96
2,114	142.66	52.34	4,468,536	51.61
2,070	136.79	22.51	4,284,782	49.49
2,114	142.66	52.34	4,468,536	51.61





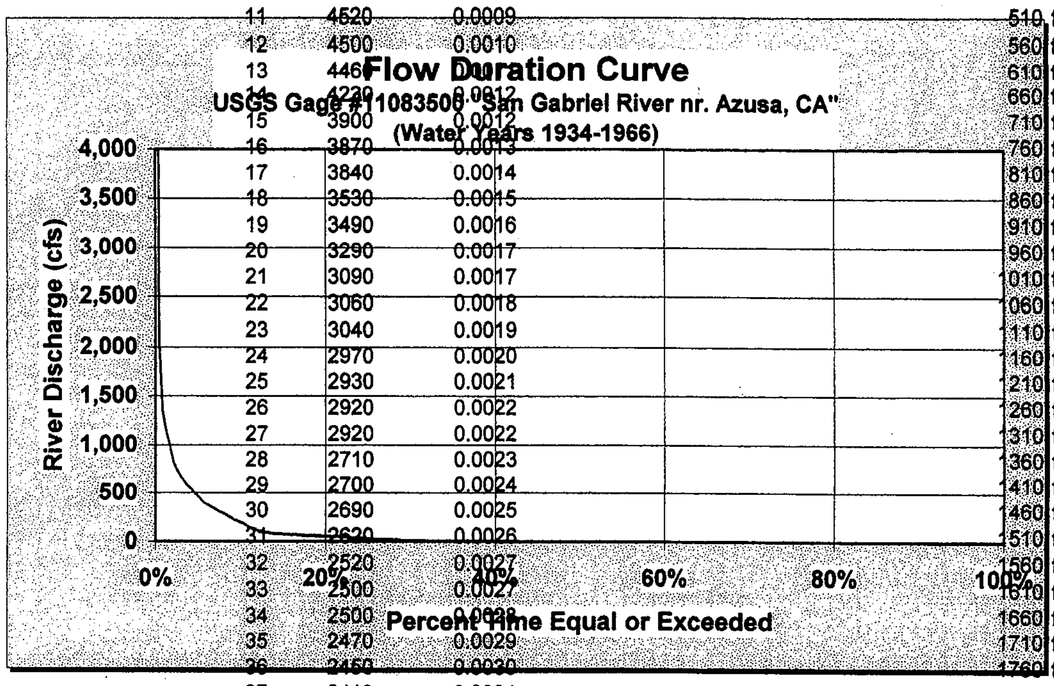


Rio Valenciano flows for Water Years 1971-1998 (w/ adjusted D.A.)

Overall Average Q = 92

days = 12,053

Rows to skip = 50



Date	Flow (cfs)	n	ranked mean daily discharge	% of time equal or exceeded
03/03/38	21700	1	21700	0.0001
03/02/38	12700	2	12700	0.0002
01/24/43	10400	3	10400	0.0002
01/23/43	10100	4	10100	0.0003
03/04/38	8620	5	8620	0.0004
11/23/65	7260	6	7260	0.0005
03/05/43	6070	7	6070	0.0006
01/25/43	5190	8	5190	0.0007
03/09/38	4940	9	4940	0.0007
03/06/43	4590	10	4590	0.0008
03/05/38	4520	11	4520	0.0009
03/04/43	4500	12	4500	0.0010
03/08/38	4460	13	4460	[illegible]
11/24/65	4230	14	4230	0.0012
03/06/38	3900	15	3900	0.0012
03/05/41	3870	16	3870	0.0013
03/07/38	3840	17	3840	0.0014
01/18/52	3530	18	3530	0.0015
03/04/41	3490	19	3490	0.0016
01/26/43	3290	20	3290	0.0017
03/14/41	3090	21	3090	0.0017
03/07/41	3060	22	3060	0.0018
03/06/41	3040	23	3040	0.0019
03/10/38	2970	24	2970	0.0020
12/31/46	2930	25	2930	0.0021
12/29/46	2920	26	2920	0.0022
12/30/46	2920	27	2920	0.0022
02/23/44	2710	28	2710	0.0023
03/14/38	2700	29	2700	0.0024
03/13/38	2690	30	2690	0.0025
04/06/38	2620	31	2620	0.0026
02/26/43	2520	32	2520	0.0027
04/07/38	2500	33	2500	0.0027
03/15/41	2500	34	2500	0.0028
04/05/58	2470	35	2470	0.0029
04/06/58	2450	36	2450	0.0030
04/05/38	2410	37	2410	0.0031
01/01/34	2380	38	2380	0.0032
03/15/38	2380	39	2380	0.0032
04/08/38	2320	40	2320	0.0033
03/08/41	2320	41	2320	0.0034
04/09/38	2290	42	2290	0.0035
02/25/43	2270	43	2270	0.0036
03/07/43	2270	44	2270	0.0037
03/08/43	2240	45	2240	0.0037
03/09/43	2230	46	2230	0.0038
11/25/65	2160	47	2160	0.0039
03/13/41	2140	48	2140	0.0040
12/30/65	2120	49	2120	0.0041
02/22/44	2070	50	2070	0.0041
02/24/43	2060	51	2060	0.0042
04/10/38	2010	52	2010	0.0043
12/28/46	1970	53	1970	0.0044
03/12/38	1950	54	1950	0.0045
01/17/52	1940	55	1940	0.0046
03/16/41	1930	56	1930	0.0046
03/16/38	1920	57	1920	0.0047
03/16/44	1920	58	1920	0.0048
02/23/43	1910	59	1910	0.0049
03/15/44	1900	60	1900	0.0050
04/02/44	1900	61	1900	0.0051
04/03/44	1900	62	1900	0.0051
04/04/44	1900	63	1900	0.0052
04/05/44	1900	64	1900	0.0053
01/19/52	1870	65	1870	0.0054
04/07/58	1820	66	1820	0.0055
04/08/58	1810	67	1810	0.0056
03/10/43	1780	68	1780	0.0056
02/20/37	1770	69	1770	0.0057
03/18/38	1760	70	1760	0.0058
03/19/38	1750	71	1750	0.0059
03/09/41	1720	72	1720	0.0060
03/17/44	1690	73	1690	0.0061
04/04/38	1640	74	1640	0.0061
11/26/65	1640	75	1640	0.0062
03/11/38	1620	76	1620	0.0063
11/22/65	1620	77	1620	0.0064
02/24/44	1610	78	1610	0.0065
03/03/44	1610	79	1610	0.0066
02/19/37	1600	80	1600	0.0066
03/17/37	1550	81	1550	0.0067
03/16/37	1530	82	1530	0.0068
01/27/43	1530	83	1530	0.0069
02/15/62	1520	84	1520	0.0070
01/01/47	1500	85	1500	0.0071
03/24/37	1470	86	1470	0.0071
03/03/43	1460	87	1460	0.0072
02/21/37	1450	88	1450	0.0073
03/20/38	1420	89	1420	0.0074
04/09/58	1420	90	1420	0.0075
02/03/43	1410	91	1410	0.0075
05/03/41	1390	92	1390	0.0076
02/27/43	1380	93	1380	0.0077
03/06/44	1380	94	1380	0.0078
03/19/37	1370	95	1370	0.0079
03/24/38	1360	96	1360	0.0080
04/14/41	1360	97	1360	0.0080
02/12/62	1350	98	1350	0.0081
01/01/66	1350	99	1350	0.0082
12/07/65	1340	100	1340	0.0083
01/02/66	1340	101	1340	0.0084
01/04/66	1340	102	1340	0.0085
04/02/38	1330	103	1330	0.0085

starting row	cell id	cell id	ranked mean daily discharge (cms)	% of time equal or exceeded
10	f10	g10	21,700	0.0001
60	f60	g60	2,060	0.0042
110	f110	g110	1,340	0.0084
160	f160	g160	1,140	0.0125
210	f210	g210	1,000	0.0167
260	f260	g260	825	0.0208
310	f310	g310	748	0.0250
360	f360	g360	677	0.0291
410	f410	g410	626	0.0333
460	f460	g460	576	0.0374
510	f510	g510	545	0.0416
560	f560	g560	497	0.0457
610	f610	g610	465	0.0499
660	f660	g660	425	0.0540
710	f710	g710	386	0.0582
760	f760	g760	370	0.0623
810	f810	g810	346	0.0665
860	f860	g860	329	0.0706
910	f910	g910	308	0.0748
960	f960	g960	291	0.0789
1010	f1010	g1010	274	0.0830
1060	f1060	g1060	252	0.0872
1110	f1110	g1110	229	0.0913
1160	f1160	g1160	213	0.0955
1210	f1210	g1210	196	0.0996
1260	f1260	g1260	181	0.1038
1310	f1310	g1310	156	0.1079
1360	f1360	g1360	136	0.1121
1410	f1410	g1410	129	0.1162
1460	f1460	g1460	109	0.1204
1510	f1510	g1510	98	0.1245
1560	f1560	g1560	93	0.1287
1610	f1610	g1610	88	0.1328
1660	f1660	g1660	84	0.1370
1710	f1710	g1710	80	0.1411
1760	f1760	g1760	78	0.1453
1810	f1810	g1810	76	0.1494
1860	f1860	g1860	74	0.1536
1910	f1910	g1910	72	0.1577
1960	f1960	g1960	70	0.1619
2010	f2010	g2010	69	0.1660
2060	f2060	g2060	66	0.1702
2110	f2110	g2110	63	0.1743
2160	f2160	g2160	61	0.1785
2210	f2210	g2210	60	0.1826
2260	f2260	g2260	60	0.1868
2310	f2310	g2310	57	0.1909
2360	f2360	g2360	56	0.1951
2410	f2410	g2410	53	0.1992
2460	f2460	g2460	52	0.2034
2510	f2510	g2510	51	0.2075
2560	f2560	g2560	49	0.2116
2610	f2610	g2610	48	0.2158
2660	f2660	g2660	46	0.2199
2710	f2710	g2710	43	0.2241
2760	f2760	g2760	41	0.2282
2810	f2810	g2810	38	0.2324
2860	f2860	g2860	36	0.2365
2910	f2910	g2910	34	0.2407
2960	f2960	g2960	32	0.2448
3010	f3010	g3010	30	0.2490
3060	f3060	g3060	26	0.2531
3110	f3110	g3110	24	0.2573
3160	f3160	g3160	22	0.2614
3210	f3210	g3210	22	0.2656
3260	f3260	g3260	21	0.2697
3310	f3310	g3310	20	0.2739
3360	f3360	g3360	19	0.2780
3410	f3410	g3410	18	0.2822
3460	f3460	g3460	15	0.2863
3510	f3510	g3510	14	0.2905
3560	f3560	g3560	11	0.2946
3610	f3610	g3610	10	0.2988
3660	f3660	g3660	10	0.3029
3710	f3710	g3710	9	0.3071
3760	f3760	g3760	9	0.3112
3810	f3810	g3810	8	0.3154
3860	f3860	g3860	8	0.3195
3910	f3910	g3910	8	0.3237
3960	f3960	g3960	8	0.3278
4010	f4010	g4010	8	0.3320
4060	f4060	g4060	7	0.3361
4110	f4110	g4110	7	0.3402
4160	f4160	g4160	7	0.3444
4210	f4210	g4210	7	0.3485
4260	f4260	g4260	7	0.3527
4310	f4310	g4310	6	0.3568
4360	f4360	g4360	6	0.3610
4410	f4410	g4410	6	0.3651
4460	f4460	g4460	5	0.3693
4510	f4510	g4510	5	0.3734
4560	f4560	g4560	5	0.3776
4610	f4610	g4610	4	0.3817
4660	f4660	g4660	4	0.3859
4710	f4710	g4710	4	0.3900
4760	f4760	g4760	4	0.3942
4810	f4810	g4810	4	0.3983
4860	f4860	g4860	4	0.4025
4910	f4910	g4910	3	0.4066
4960	f4960	g4960	3	0.4108
5010	f5010	g5010	3	0.4149
5060	f5060	g5060	2	0.4191
5110	f5110	g5110	2	0.4232

Peak Average Daily Flow - San Gabriel River nr Azusa, CA

Ave(logQ):	2.461
Std. Dev.	1.276
g :	-1.226

n	Annual Qpeak Date	Qpeak (cfs)	Log Pearson Type III Analysis: log Q	Std. Dev. log Q	Skew
1	1934	2380	3.377	0.838	0.768
2	1935	460	2.663	0.041	0.008
3	1936	224	2.350	0.012	-0.001
4	1937	1770	3.248	0.619	0.488
5	1938	21700	4.336	3.518	6.598
6	1939	316	2.500	0.002	0.000
7	1940	506	2.704	0.059	0.014
8	1941	3870	3.588	1.270	1.431
9	1942	370	2.568	0.012	0.001
10	1943	10400	4.017	2.422	3.768
11	1944	2710	3.433	0.945	0.919
12	1945	980	2.991	0.281	0.149
13	1946	937	2.972	0.261	0.133
14	1947	2930	3.467	1.012	1.018
15	1948	1170	3.068	0.369	0.224
16	1949	61	1.785	0.456	-0.308
17	1950	7.9	0.898	2.444	-3.820
18	1951	47	1.672	0.622	-0.491
19	1952	3530	3.548	1.181	1.284
20	1953	1190	3.076	0.378	0.232
21	1954	960	2.982	0.272	0.142
22	1955	9.9	0.996	2.147	-3.146
23	1956	43	1.633	0.685	-0.566
24	1957	650	2.813	0.124	0.044
25	1958	2470	3.393	0.868	0.809
26	1959	0.1	-1.000	11.978	-41.454
27	1960	0.1	-1.000	11.978	-41.454
28	1961	7.5	0.875	2.515	-3.988
29	1962	1520	3.182	0.520	0.375
30	1963	27	1.431	1.060	-1.091
31	1964	22	1.342	1.251	-1.399
32	1965	276	2.441	0.000	0.000
33	1966	7260	3.861	1.960	2.744

Sum log Q	SD log Q	g
81.210	1.276	-1.226

N
33

Ave(log Q)
2.461

Return Period yr	K	Q
2	0.1989	**518**
5	0.8424	**3,434**
10	1.0801	**6,904**
25	1.2710	**12,097**
50	1.3647	**15,931**
100	1.4319	**19,404**
200	1.4814	**22,443**
500	1.5279	**25,728**
1,000	1.5530	**27,701**

Peak Average Daily Flow - San Gabriel River nr Azusa, CA
(w/o WY's 1950, 55, 59-61 flow years)

n	Annual Qpeak Date	Qpeak (cfs)	log Q	Std. Dev. log Q	Skew
1	1934	2380	3.377	0.254	0.128
2	1935	460	2.663	0.044	-0.009
3	1936	224	2.350	0.273	-0.143
4	1937	1770	3.248	0.141	0.053
5	1938	21700	4.336	2.142	3.135
6	1939	316	2.500	0.139	-0.052
7	1940	506	2.704	0.028	-0.005
8	1941	3870	3.588	0.511	0.365
9	1942	370	2.568	0.093	-0.028
10	1943	10400	4.017	1.309	1.498
11	1944	2710	3.433	0.314	0.176
12	1945	980	2.991	0.014	0.002
13	1946	937	2.972	0.010	0.001
14	1947	2930	3.467	0.353	0.210
15	1948	1170	3.068	0.038	0.007
16	1949	61	1.785	1.183	-1.286
17	1951	47	1.672	1.442	-1.731
18	1952	3530	3.548	0.455	0.307
19	1953	1190	3.076	0.041	0.008
20	1954	960	2.982	0.012	0.001
21	1956	43	1.633	1.536	-1.904
22	1957	650	2.813	0.004	0.000
23	1958	2470	3.393	0.270	0.140
24	1962	1520	3.182	0.095	0.029
25	1963	27	1.431	2.078	-2.996
26	1964	22	1.342	2.342	-3.585
27	1965	276	2.441	0.187	-0.081
28	1966	7260	3.861	0.976	0.965

Log Pearson Type III Analysis

Sum log Q	SD log Q	g
80.441	0.777	-0.408

N
28

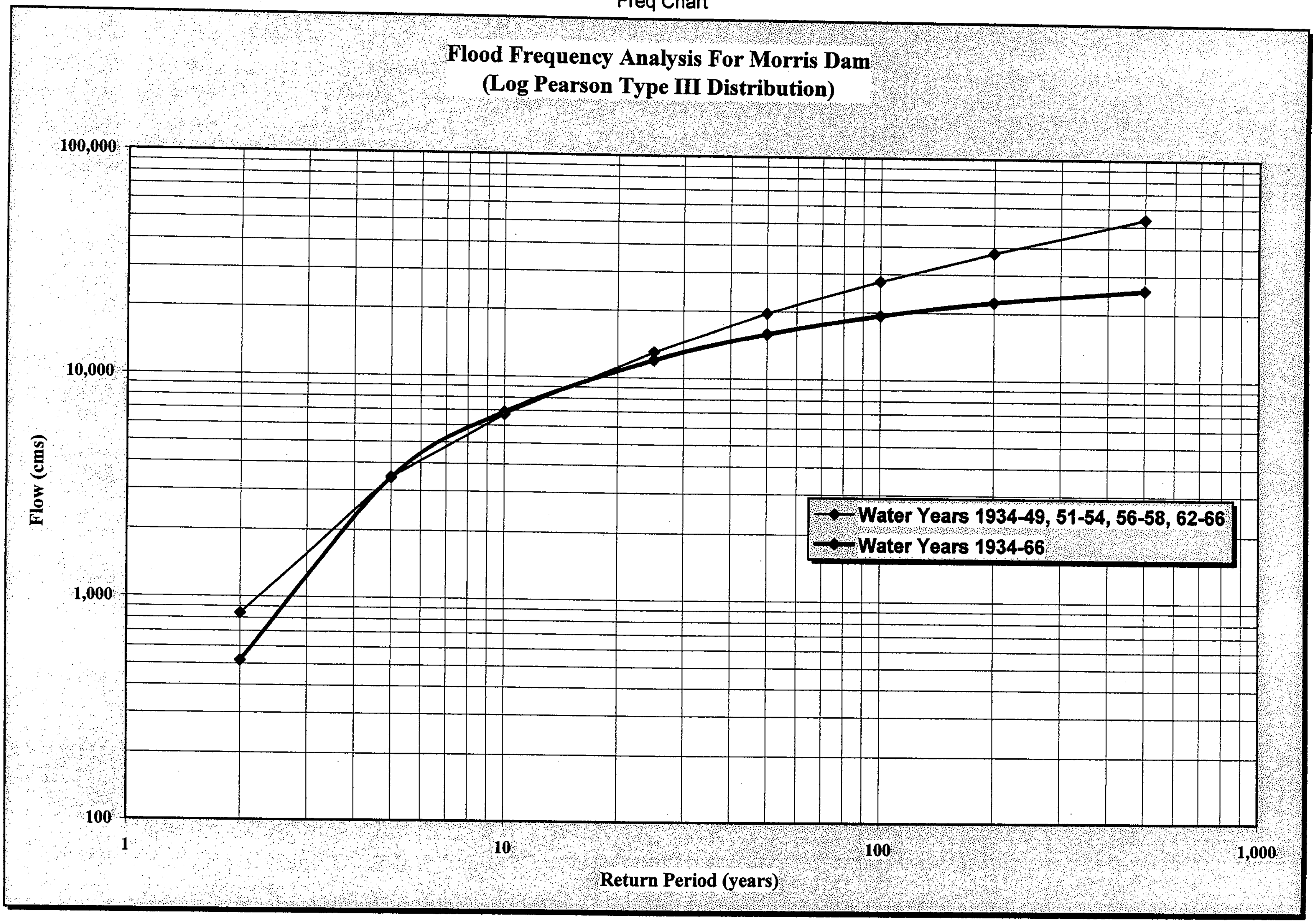
Ave(log Q)
2.873

	Ave(logQ):	2.873
	Std. Dev.	0.777
	g :	-0.408
Return Period yr	**K**	**Q**
2	0.0674	**842**
5	0.8551	**3,443**
10	1.2297	**6,728**
25	1.6027	**13,111**
50	1.8292	**19,657**
100	2.0228	**27,786**
200	2.1933	**37,692**
500	2.3898	**53,563**
1,000	2.5216	**67,794**

Using formulas from Chow's "Applied Hydrology":

k = -0.068057

w	z	Kt	Q
1.17741	0.00000	0.06774	**842**
1.79412	0.84146	0.85438	**3,439**
2.14597	1.28173	1.22959	**6,727**
2.53727	1.75108	1.60321	**13,121**
2.79715	2.05419	1.83048	**19,701**
3.03485	2.32679	2.02572	**27,933**
3.25525	2.57624	2.19696	**37,940**
3.52551	2.87851	2.39517	**54,080**
3.71692	3.09052	2.52825	**68,610**


Flood Frequency Analysis For Morris Dam
(Log Pearson Type III Distribution)
Flow (cms)
100,000
10,000
1,000
100
1
10
100
1,000
Return Period (years)
Water Years 1934-49, 51-54, 56-58, 62-66
Water Years 1934-66

#	US	GEOLOGICSURVEY												
#	DAILY	MEAN	DISCHARGE DATA											
#														
#	Station	name	:	San	Gabriel	R	Nr	Azusa	Ca					
#	Station	number:	11083500											
#	latitude	(ddmmss).	341011											
#	longitude	(dddmmss)	1175316											
#	state	code..........	6											
#	county..........Los		Angeles											
#	hydrologic	unit	code..............	18070106										
#	basin	name.........San		Gabriel										
#	drainage	area	(square	miles)............	214									
#	contributing	drainage	area	(square	miles).....									
#	gage	datum	(feet	above	NGVD).......	867.59								
#	base	discharge	(cubic	ft/sec)................										
#	WATSTOREparameter		code..............		60									
#	WATSTOREstatistic		code..............		3									
#	Discharge	is	listed	in	the	table	in	cubic	feet	per	second.			
#														
#	Daily	mean	discharge	data	were	retrieved	from	the						
#	National	Water	Information	System	files	called	ADAPS.							
#														
#	Format	of	table	is	as	follows.								
#	Lines	starting	with	the	#	character	are	comment	lines	describing	the	data		
#	included	in	this	file.	The	next	line	is	a	row	of	tab-delimitecolumn		
#	names	that	are	Date	and	Discharge.	The	next	line	is	a	row	of	tab-delimited
#	data	type	codes	that	describe	a	10-charact	date	(10d)	and	an			
#	8-character-	numeric	value	for	discharge	(8n).	All	following	lines	are				
#	rows	of	tab-delimited	data	values	of	date	(year.mont	and	discharge.				
#	A	value	of	E	or	e	in	the	Flags	field	indicates	that	the	discharge for
#	this	day	was	estimated.	Any	other	values	shown	in	this	field	are	irrelevant.	
#														
#	NOTE	this	file	was	requested	from	the	NWIS-W	software	package				
#	on	Mon	Jun		12 17:26:40		2000							
#	Dates	are	now	in	YYYY.MM.DDformat.									
#														
#	#NAME?	Range	In	File---										
#	1	1933.10.01-1966.09.30			Min:	0								
Date	Discharge	Flags			Max:	21700								
10s	8n	2s												

10/1/1933	0
10/2/1933	0
10/3/1933	0
10/4/1933	0
10/5/1933	0
10/6/1933	0
10/7/1933	0
10/8/1933	0
10/9/1933	0
10/10/1933	0
10/11/1933	0
10/12/1933	0
10/13/1933	0
10/14/1933	0
10/15/1933	0
10/16/1933	0
10/17/1933	0
10/18/1933	0
10/19/1933	0
10/20/1933	0
10/21/1933	0
10/22/1933	0
10/23/1933	0
10/24/1933	0
10/25/1933	0
10/26/1933	0
10/27/1933	0
10/28/1933	0
10/29/1933	0
10/30/1933	0
10/31/1933	0
11/1/1933	0
11/2/1933	0
11/3/1933	0
11/4/1933	0
11/5/1933	0
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11/7/1933	0
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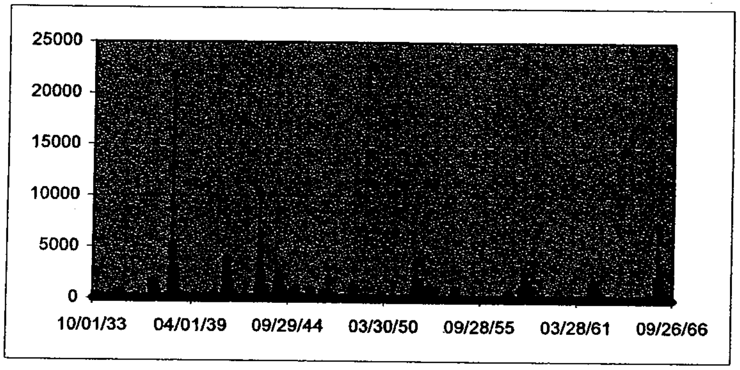
11/9/1933	0
11/10/1933	0
11/11/1933	0
11/12/1933	0
11/13/1933	0
11/14/1933	0
11/15/1933	0
11/16/1933	0
11/17/1933	0
11/18/1933	0
11/19/1933	0



12328.00

wy	max	beg row	end row	beg cell	end cell	Leap Year
1934	2,380	41	405	b41	b405	0
1935	460	406	770	b406	b770	0
1936	224	772	1136	b772	b1136	1
1937	1,770	1137	1501	b1137	b1501	0
1938	21,700	1502	1866	b1502	b1866	0
1939	316	1867	2231	b1867	b2231	0
1940	506	2233	2597	b2233	b2597	1
1941	3,870	2598	2962	b2598	b2962	0
1942	370	2963	3327	b2963	b3327	0
1943	10,400	3328	3692	b3328	b3692	0
1944	2,710	3694	4058	b3694	b4058	1
1945	980	4059	4423	b4059	b4423	0
1946	937	4424	4788	b4424	b4788	0
1947	2,930	4789	5153	b4789	b5153	0
1948	1,170	5155	5519	b5155	b5519	1
1949	61	5520	5884	b5520	b5884	0
1950	8	5885	6249	b5885	b6249	0
1951	47	6250	6614	b6250	b6614	0
1952	3,530	6616	6980	b6616	b6980	1
1953	1,190	6981	7345	b6981	b7345	0
1954	960	7346	7710	b7346	b7710	0
1955	10	7711	8075	b7711	b8075	0
1956	43	8077	8441	b8077	b8441	1
1957	650	8442	8806	b8442	b8806	0
1958	2,470	8807	9171	b8807	b9171	0
1959	0	9172	9536	b9172	b9536	0
1960	0	9538	9902	b9538	b9902	1
1961	8	9903	10267	b9903	b10267	0
1962	1,520	10268	10632	b10268	b10632	0
1963	27	10633	10997	b10633	b10997	0

Frequency Factors

These tables are used as a look-up for the log Pearson type III analysis

Skew Coeff.	Return Period (years) 2	5	10	25	50	100	200	500	1,000
3.0	-0.396	0.42	1.18	2.278	3.152	4.051	4.970	6.20506	7.15235
2.8	-0.384	0.46	1.21	2.275	3.114	3.973	4.847	6.01858	6.91505
2.6	-0.368	0.499	1.238	2.267	3.071	3.889	4.718	5.82629	6.67191
2.4	-0.351	0.537	1.262	2.256	3.023	3.8	4.584	5.62818	6.42292
2.2	-0.33	0.574	1.284	2.24	2.97	3.705	4.444	5.42426	6.16816
2.0	-0.307	0.609	1.302	2.219	2.912	3.605	4.298	5.21461	5.90776
1.8	-0.282	0.643	1.318	2.193	2.848	3.499	4.147	4.99937	5.64190
1.6	-0.254	0.675	1.329	2.163	2.78	3.388	3.990	4.77875	5.37087
1.4	-0.225	0.705	1.337	2.128	2.706	3.271	3.828	4.55304	5.09505
1.2	-0.195	0.732	1.34	2.087	2.626	3.149	3.661	4.32263	4.81492
1.0	-0.164	0.758	1.34	2.043	2.542	3.022	3.489	4.08802	4.53112
0.8	-0.132	0.78	1.336	1.993	2.453	2.891	3.312	3.84981	4.24439
0.6	-0.099	0.8	1.328	1.939	2.359	2.755	3.132	3.60872	3.95567
0.4	-0.066	0.816	1.317	1.88	2.261	2.615	2.949	3.65660	3.66608
0.2	-0.033	0.83	1.301	1.818	2.159	2.472	2.763	3.12169	3.37703
0.0	0	0.842	1.282	1.751	2.054	2.326	2.576	2.87816	3.09023
-0.2	0.033	0.85	1.258	1.68	1.945	2.178	2.388	2.63672	2.80786
-0.4	0.066	0.855	1.231	1.606	1.834	2.029	2.201	2.39942	2.53261
-0.6	0.099	0.857	1.2	1.528	1.72	1.88	2.016	2.16884	2.26780
-0.8	0.132	0.856	1.166	1.448	1.606	1.733	1.837	1.94806	2.01739
-1.0	0.164	0.852	1.128	1.366	1.492	1.588	1.664	1.74062	1.78572
-1.2	0.195	0.844	1.086	1.282	1.379	1.449	1.501	1.55016	1.57695
-1.4	0.225	0.832	1.041	1.198	1.27	1.318	1.351	1.37981	1.39408
-1.6	0.245	0.817	0.994	1.116	1.166	1.197	1.216	1.23132	1.23805
-1.8	0.282	0.799	0.945	1.035	1.069	1.087	1.097	1.10465	1.10743
-2.0	0.307	0.777	0.895	0.959	0.98	0.99	0.995	0.99800	0.99900
-2.2	0.33	0.752	0.844	0.888	0.9	0.905	0.907	0.90854	0.90885
-2.4	0.351	0.725	0.795	0.823	0.83	0.832	0.833	0.83320	0.83328
-2.6	0.368	0.696	0.747	0.764	0.768	0.769	0.769	0.76920	0.76922
-2.8	0.384	0.666	0.702	0.712	0.714	0.714	0.714	0.71428	0.71428
-3.0	0.396	0.636	0.66	0.666	0.666	0.667	0.66666	0.66667	0.66667

-3.0	0.396	0.636	0.66	0.666	0.666	0.667	0.667	0.66667	0.66667
-2.8	0.384	0.666	0.702	0.712	0.714	0.714	0.714	0.71428	0.71428
-2.6	0.368	0.696	0.747	0.764	0.768	0.769	0.769	0.76920	0.76922
-2.4	0.351	0.725	0.795	0.823	0.83	0.832	0.833	0.83320	0.83328
-2.2	0.33	0.752	0.844	0.888	0.9	0.905	0.907	0.90854	0.90885
-2.0	0.307	0.777	0.895	0.959	0.98	0.99	0.995	0.99800	0.99900
-1.8	0.282	0.799	0.945	1.035	1.069	1.087	1.097	1.10465	1.10743
-1.6	0.245	0.817	0.994	1.116	1.166	1.197	1.216	1.23132	1.23805
-1.4	0.225	0.832	1.041	1.198	1.27	1.318	1.351	1.37981	1.39408
-1.2	0.195	0.844	1.086	1.282	1.379	1.449	1.501	1.55016	1.57695
-1.0	0.164	0.852	1.128	1.366	1.492	1.588	1.664	1.74062	1.78572
-0.8	0.132	0.856	1.166	1.448	1.606	1.733	1.837	1.94806	2.01739
-0.6	0.099	0.857	1.2	1.528	1.72	1.88	2.016	2.16884	2.26780
-0.4	0.066	0.855	1.231	1.606	1.834	2.029	2.201	2.39942	2.53261
-0.2	0.033	0.85	1.258	1.68	1.945	2.178	2.388	2.63672	2.80786
0.0	0	0.842	1.282	1.751	2.054	2.326	2.576	2.87816	3.09023
0.2	-0.033	0.83	1.301	1.818	2.159	2.472	2.763	3.12169	3.37703
0.4	-0.066	0.816	1.317	1.88	2.261	2.615	2.949	3.60872	3.95567
0.6	-0.099	0.8	1.328	1.939	2.359	2.755	3.132	3.65660	3.66608
0.8	-0.132	0.78	1.336	1.993	2.453	2.891	3.312	3.84981	4.24439
1.0	-0.164	0.758	1.34	2.043	2.542	3.022	3.489	4.08802	4.53112
1.2	-0.195	0.732	1.34	2.087	2.626	3.149	3.661	4.32263	4.81492
1.4	-0.225	0.705	1.337	2.128	2.706	3.271	3.828	4.55304	5.09505
1.6	-0.254	0.675	1.329	2.163	2.78	3.388	3.990	4.77875	5.37087
1.8	-0.282	0.643	1.318	2.193	2.848	3.499	4.147	4.99937	5.64190
2.0	-0.307	0.609	1.302	2.219	2.912	3.605	4.398	5.21461	5.90776
2.2	-0.33	0.574	1.284	2.24	2.97	3.705	4.444	5.42426	6.16816
2.4	-0.351	0.537	1.262	2.256	3.023	3.8	4.584	5.62818	6.42292
2.6	-0.368	0.499	1.238	2.267	3.071	3.889	4.718	5.82629	6.67191
2.8	-0.384	0.46	1.21	2.275	3.114	3.973	4.847	6.01858	6.91505
3.0	-0.396	0.42	1.18	2.278	3.152	4.051	4.970	6.20506	7.15235

FREQUENCY FACTORS - K

These tables are used as a look-up for the log Pearson type III analysis

2 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.396	-2.8	0.384
-2.8	0.384	-2.6	0.368
-2.6	0.368	-2.4	0.351
-2.4	0.351	-2.2	0.330
-2.2	0.33	-2.0	0.307
-2.0	0.307	-1.8	0.282
-1.8	0.282	-1.6	0.245
-1.6	0.245	-1.4	0.225
-1.4	0.225	-1.2	0.195
-1.2	0.195	-1.0	0.164
-1.0	0.164	-0.8	0.132
-0.8	0.132	-0.6	0.099
-0.6	0.099	-0.4	0.066
-0.4	0.066	-0.2	0.033
-0.2	0.033	0.0	0.000
0.0	0	0.2	-0.033
0.2	-0.033	0.4	-0.066
0.4	-0.066	0.6	-0.099
0.6	-0.099	0.8	-0.132
0.8	-0.132	1.0	-0.164
1.0	-0.164	1.2	-0.195
1.2	-0.195	1.4	-0.225
1.4	-0.225	1.6	-0.254
1.6	-0.254	1.8	-0.282
1.8	-0.282	2.0	-0.307
2.0	-0.307	2.2	-0.330
2.2	-0.33	2.4	-0.351
2.4	-0.351	2.6	-0.368
2.6	-0.368	2.8	-0.384
2.8	-0.384	3.0	-0.396
3.0	-0.396	3.0	-3.960

2.25 -0.3353 <-- Used to Check Interpolation

25 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.666	-2.8	0.712
-2.8	0.712	-2.6	0.764
-2.6	0.764	-2.4	0.823
-2.4	0.823	-2.2	0.888
-2.2	0.888	-2.0	0.959
-2.0	0.959	-1.8	1.035
-1.8	1.035	-1.6	1.116
-1.6	1.116	-1.4	1.198
-1.4	1.198	-1.2	1.282
-1.2	1.282	-1.0	1.366
-1.0	1.366	-0.8	1.448
-0.8	1.448	-0.6	1.528
-0.6	1.528	-0.4	1.606
-0.4	1.606	-0.2	1.680
-0.2	1.68	0.0	1.751
0.0	1.751	0.2	1.818
0.2	1.818	0.4	1.880
0.4	1.88	0.6	1.939
0.6	1.939	0.8	1.993
0.8	1.993	1.0	2.043
1.0	2.043	1.2	2.087
1.2	2.087	1.4	2.128
1.4	2.128	1.6	2.163
1.6	2.163	1.8	2.193
1.8	2.193	2.0	2.219
2.0	2.219	2.2	2.240
2.2	2.24	2.4	2.256
2.4	2.256	2.6	2.267
2.6	2.267	2.8	2.275
2.8	2.275	3.0	2.278
3.0	2.278	3.0	2.278

2.25 2.2440 <-- Used to Check Interpolation

	2	5	10	25	50	100	200	500	1000
-3.0	0.396	0.636	0.66	0.666	0.666	0.667	0.667	0.66667	0.66667
-2.8	0.384	0.666	0.702	0.712	0.714	0.714	0.714	0.71428	0.71428
-2.6	0.368	0.696	0.747	0.764	0.768	0.769	0.769	0.76920	0.76922
-2.4	0.351	0.725	0.795	0.823	0.83	0.832	0.833	0.83320	0.83328
-2.2	0.33	0.752	0.844	0.888	0.9	0.905	0.907	0.90854	0.90885
-2.0	0.307	0.777	0.895	0.959	0.98	0.99	0.995	0.99800	0.99900
-1.8	0.282	0.799	0.945	1.035	1.069	1.087	1.097	1.10465	1.10743
-1.6	0.245	0.817	0.994	1.116	1.166	1.197	1.216	1.23132	1.23805
-1.4	0.225	0.832	1.041	1.198	1.27	1.318	1.351	1.37981	1.39408
-1.2	0.195	0.844	1.086	1.282	1.379	1.449	1.501	1.55016	1.57695
-1.0	0.164	0.852	1.128	1.366	1.492	1.588	1.664	1.74062	1.78572
-0.8	0.132	0.856	1.166	1.448	1.606	1.733	1.837	1.94806	2.01739
-0.6	0.099	0.857	1.2	1.528	1.72	1.88	2.016	2.16884	2.26780
-0.4	0.066	0.855	1.231	1.606	1.834	2.029	2.201	2.39942	2.53261
-0.2	0.033	0.85	1.258	1.68	1.945	2.178	2.388	2.63672	2.80786
0.0	0	0.842	1.282	1.751	2.054	2.326	2.576	2.87816	3.09023
0.2	-0.033	0.83	1.301	1.818	2.159	2.472	2.763	3.12169	3.37703
0.4	-0.066	0.816	1.317	1.88	2.261	2.615	2.949	3.60872	3.95567
0.6	-0.099	0.8	1.328	1.939	2.359	2.755	3.132	3.65660	3.66608
0.8	-0.132	0.78	1.336	1.993	2.453	2.891	3.312	3.84981	4.24439
1.0	-0.164	0.758	1.34	2.043	2.542	3.022	3.489	4.08802	4.53112
1.2	-0.195	0.732	1.34	2.087	2.626	3.149	3.661	4.32263	4.81492
1.4	-0.225	0.705	1.337	2.128	2.706	3.271	3.828	4.55304	5.09505
1.6	-0.254	0.675	1.329	2.163	2.78	3.388	3.990	4.77875	5.37087
1.8	-0.282	0.643	1.318	2.193	2.848	3.499	4.147	4.99937	5.64190
2.0	-0.307	0.609	1.302	2.219	2.912	3.605	4.398	5.21461	5.90776
2.2	-0.33	0.574	1.284	2.24	2.97	3.705	4.444	5.42426	6.16816
2.4	-0.351	0.537	1.262	2.256	3.023	3.8	4.584	5.62818	6.42292
2.6	-0.368	0.499	1.238	2.267	3.071	3.889	4.718	5.82629	6.67191
2.8	-0.384	0.46	1.21	2.275	3.114	3.973	4.847	6.01858	6.91505
3.0	-0.396	0.42	1.18	2.278	3.152	4.051	4.970	6.20506	7.15235

5 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.636	-2.8	0.666
-2.8	0.666	-2.6	0.696
-2.6	0.696	-2.4	0.725
-2.4	0.725	-2.2	0.752
-2.2	0.752	-2.0	0.777
-2.0	0.777	-1.8	0.799
-1.8	0.799	-1.6	0.817
-1.6	0.817	-1.4	0.832
-1.4	0.832	-1.2	0.844
-1.2	0.844	-1.0	0.852
-1.0	0.852	-0.8	0.856
-0.8	0.856	-0.6	0.857
-0.6	0.857	-0.4	0.855
-0.4	0.855	-0.2	0.850
-0.2	0.85	0.0	0.842
0.0	0.842	0.2	0.830
0.2	0.83	0.4	0.816
0.4	0.816	0.6	0.800
0.6	0.8	0.8	0.780
0.8	0.78	1.0	0.758
1.0	0.758	1.2	0.732
1.2	0.732	1.4	0.705
1.4	0.705	1.6	0.675
1.6	0.675	1.8	0.643
1.8	0.643	2.0	0.609
2.0	0.609	2.2	0.574
2.2	0.574	2.4	0.537
2.4	0.537	2.6	0.499
2.6	0.499	2.8	0.460
2.8	0.46	3.0	0.420
3.0	0.42	3.0	0.420

2 0.6090 <-- Used to Check Interpolation

50 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.666	-2.8	0.714
-2.8	0.714	-2.6	0.768
-2.6	0.768	-2.4	0.830
-2.4	0.83	-2.2	0.900
-2.2	0.9	-2.0	0.980
-2.0	0.98	-1.8	1.069
-1.8	1.069	-1.6	1.166
-1.6	1.166	-1.4	1.270
-1.4	1.27	-1.2	1.379
-1.2	1.379	-1.0	1.492
-1.0	1.492	-0.8	1.606
-0.8	1.606	-0.6	1.720
-0.6	1.72	-0.4	1.834
-0.4	1.834	-0.2	1.945
-0.2	1.945	0.0	2.054
0.0	2.054	0.2	2.159
0.2	2.159	0.4	2.261
0.4	2.261	0.6	2.359
0.6	2.359	0.8	2.453
0.8	2.453	1.0	2.542
1.0	2.542	1.2	2.626
1.2	2.626	1.4	2.706
1.4	2.706	1.6	2.780
1.6	2.78	1.8	2.848
1.8	2.848	2.0	2.912
2.0	2.912	2.2	2.970
2.2	2.97	2.4	3.023
2.4	3.023	2.6	3.071
2.6	3.071	2.8	3.114
2.8	3.114	3.0	3.152
3.0	3.152	3.0	3.152

2 2.9120 <-- Used to Check Interpolation

10 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.66	-2.8	0.702
-2.8	0.702	-2.6	0.747
-2.6	0.747	-2.4	0.795
-2.4	0.795	-2.2	0.844
-2.2	0.844	-2.0	0.895
-2.0	0.895	-1.8	0.945
-1.8	0.945	-1.6	0.994
-1.6	0.994	-1.4	1.041
-1.4	1.041	-1.2	1.086
-1.2	1.086	-1.0	1.128
-1.0	1.128	-0.8	1.166
-0.8	1.166	-0.6	1.200
-0.6	1.2	-0.4	1.231
-0.4	1.231	-0.2	1.258
-0.2	1.258	0.0	1.282
0.0	1.282	0.2	1.301
0.2	1.301	0.4	1.317
0.4	1.317	0.6	1.328
0.6	1.328	0.8	1.336
0.8	1.336	1.0	1.340
1.0	1.34	1.2	1.340
1.2	1.34	1.4	1.337
1.4	1.337	1.6	1.329
1.6	1.329	1.8	1.318
1.8	1.318	2.0	1.302
2.0	1.302	2.2	1.284
2.2	1.284	2.4	1.262
2.4	1.262	2.6	1.238
2.6	1.238	2.8	1.210
2.8	1.21	3.0	1.180
3.0	1.18	3.0	1.180
2	1.3020	<-- Used to Check Interpolation	

100 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.667	-2.8	0.714
-2.8	0.714	-2.6	0.769
-2.6	0.769	-2.4	0.832
-2.4	0.832	-2.2	0.905
-2.2	0.905	-2.0	0.990
-2.0	0.99	-1.8	1.087
-1.8	1.087	-1.6	1.197
-1.6	1.197	-1.4	1.318
-1.4	1.318	-1.2	1.449
-1.2	1.449	-1.0	1.588
-1.0	1.588	-0.8	1.733
-0.8	1.733	-0.6	1.880
-0.6	1.88	-0.4	2.029
-0.4	2.029	-0.2	2.178
-0.2	2.178	0.0	2.326
0.0	2.326	0.2	2.472
0.2	2.472	0.4	2.615
0.4	2.615	0.6	2.755
0.6	2.755	0.8	2.891
0.8	2.891	1.0	3.022
1.0	3.022	1.2	3.149
1.2	3.149	1.4	3.271
1.4	3.271	1.6	3.388
1.6	3.388	1.8	3.499
1.8	3.499	2.0	3.605
2.0	3.605	2.2	3.705
2.2	3.705	2.4	3.800
2.4	3.8	2.6	3.889
2.6	3.889	2.8	3.973
2.8	3.973	3.0	4.051
3.0	4.051	3.0	4.051
2	3.6050	<-- Used to Check Interpolation	

200 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.667	-2.8	0.714
-2.8	0.714	-2.6	0.769
-2.6	0.769	-2.4	0.833
-2.4	0.833	-2.2	0.907
-2.2	0.907	-2.0	0.995
-2.0	0.995	-1.8	1.097
-1.8	1.097	-1.6	1.216
-1.6	1.216	-1.4	1.351
-1.4	1.351	-1.2	1.501
-1.2	1.501	-1.0	1.664
-1.0	1.664	-0.8	1.837
-0.8	1.837	-0.6	2.016
-0.6	2.016	-0.4	2.201
-0.4	2.201	-0.2	2.388
-0.2	2.388	0.0	2.576
0.0	2.576	0.2	2.763
0.2	2.763	0.4	2.949
0.4	2.949	0.6	3.132
0.6	3.132	0.8	3.312
0.8	3.312	1.0	3.489
1.0	3.489	1.2	3.661
1.2	3.661	1.4	3.828
1.4	3.828	1.6	3.990
1.6	3.990	1.8	4.147
1.8	4.147	2.0	4.398
2.0	4.398	2.2	4.444
2.2	4.444	2.4	4.584
2.4	4.584	2.6	4.718
2.6	4.718	2.8	4.847
2.8	4.847	3.0	4.970
3.0	4.970	3.0	4.970

2 4.3980 <-- Used to Check Interpolation

500 year

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.66667	-2.8	0.714
-2.8	0.71428	-2.6	0.769
-2.6	0.76920	-2.4	0.833
-2.4	0.83320	-2.2	0.909
-2.2	0.90854	-2.0	0.998
-2.0	0.99800	-1.8	1.105
-1.8	1.10465	-1.6	1.231
-1.6	1.23132	-1.4	1.380
-1.4	1.37981	-1.2	1.550
-1.2	1.55016	-1.0	1.741
-1.0	1.74062	-0.8	1.948
-0.8	1.94806	-0.6	2.169
-0.6	2.16884	-0.4	2.399
-0.4	2.39942	-0.2	2.637
-0.2	2.63672	0.0	2.878
0.0	2.87816	0.2	3.122
0.2	3.12169	0.4	3.609
0.4	3.60872	0.6	3.657
0.6	3.65660	0.8	3.850
0.8	3.84981	1.0	4.088
1.0	4.08802	1.2	4.323
1.2	4.32263	1.4	4.553
1.4	4.55304	1.6	4.779
1.6	4.77875	1.8	4.999
1.8	4.99937	2.0	5.215
2.0	5.21461	2.2	5.424
2.2	5.42426	2.4	5.628
2.4	5.62818	2.6	5.826
2.6	5.82629	2.8	6.019
2.8	6.01858	3.0	6.205
3.0	6.20506	3.0	6.205

2 5.2146 <-- Used to Check Interpolation

1000 yr

Skew Coeff	Frequency Factor	Used for Interpolation	
-3.0	0.66667	-2.8	0.714
-2.8	0.71428	-2.6	0.769
-2.6	0.76922	-2.4	0.833
-2.4	0.83328	-2.2	0.909
-2.2	0.90885	-2.0	0.999
-2.0	0.99900	-1.8	1.107
-1.8	1.10743	-1.6	1.238
-1.6	1.23805	-1.4	1.394
-1.4	1.39408	-1.2	1.577
-1.2	1.57695	-1.0	1.786
-1.0	1.78572	-0.8	2.017
-0.8	2.01739	-0.6	2.268
-0.6	2.26780	-0.4	2.533
-0.4	2.53261	-0.2	2.808
-0.2	2.80786	0.0	3.090
0.0	3.09023	0.2	3.377
0.2	3.37703	0.4	3.956
0.4	3.95567	0.6	3.666
0.6	3.66608	0.8	4.244
0.8	4.24439	1.0	4.531
1.0	4.53112	1.2	4.815
1.2	4.81492	1.4	5.095
1.4	5.09505	1.6	5.371
1.6	5.37087	1.8	5.642
1.8	5.64190	2.0	5.908
2.0	5.90776	2.2	6.168
2.2	6.16816	2.4	6.423
2.4	6.42292	2.6	6.672
2.6	6.67191	2.8	6.915
2.8	6.91505	3.0	7.152
3.0	7.15235	3.0	7.152

2 5.9078 <-- Used to Check Interpolation

Los Angeles County Department of Public Works

Morris Dam
Inlet/Outlet Rehabilitation Project

FINAL

Design Summary Report
Design Package 1

BLACK & VEATCH
Corporation

In Association With

URS Greiner Woodward Clyde

August 2004

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REFERENCES

1. *Equipment Inspection /Evaluation Report, Morris Dam Inlet/Outlet Works Modernization*, United States Bureau of Reclamation, August 6, 1998.
2. *New Sluice Tunnel and Sediment Sluice Flume, Design Summary Report for Design Package No. 2, Morris Dam Inlet/Outlet Rehabilitation Project*, Black & Veatch and URS Corporation, December 2002.

1.0 INTRODUCTION

1.1 BACKGROUND

The U.S. Bureau of Reclamation (Bureau) in 1998 performed an inspection and evaluation of the Morris Dam Inlet/Outlet Works (Ref 1). The Bureau identified several deficiencies that may impact the Department's ability to safely operate the facility. These deficiencies include:

(a) Structural and operational concerns with the spillway gates.

(b) Electrical distribution equipment that is old, damaged, in poor condition, improperly sized, unable to be maintained, and possibly presenting environmental hazards.

(c) Operational deficiencies with the outlet valves.

As concluded by the Bureau, the safety hazards, operational difficulties, and intense maintenance requirements warrant replacement and automation of the valves. In addition, the construction of a new control house, where the new programmable logic control operation system will be located to remotely operate the outlet works, is needed to complete the rehabilitation.

1.2 PREVIOUS INVESTIGATIONS

- Black & Veatch, *Morris Dam Inlet/Outlet Rehabilitation, Trip Inspection Memorandum.* April, 2000.
- U.S. Bureau of Reclamation. *Morris Dam Inlet/Outlet Rehabilitation, Final Conceptual Design.* April, 1999.
- U.S. Bureau of Reclamation. *Equipment Inspection/Evaluation Report, Morris Dam Inlet/Outlet Works Modernization..* August, 1998.

1.3 EXISTING PROJECT DESCRIPTION

Morris Dam, formerly known as Pine Canyon Dam, is located approximately 4 miles north of Azusa, California in San Gabriel Canyon. The dam was constructed for water supply in 1934 by the City of Pasadena and sold to Metropolitan Water District of Southern California (Metropolitan) in 1935. Ownership of the dam was transferred from Metropolitan to the Los Angeles County Department of Public Works (Department) in 1995.

The dam is a concrete gravity dam with a straight center section and curved ends to fit the topography of the abutments. It has a structural height of 328 feet (lowest point of foundation to crest) and a crest length of approximately 800 feet. The crest of the dam is at elevation 1175 feet (245 feet above streambed) and accommodates a 20-foot wide roadway. The dam was constructed in blocks with contraction joints generally spaced at 50-foot intervals. A three-foot wide open contraction joint located approximately 280 feet from the west (right) end of the dam was constructed above Fault "X" that was identified in the foundation excavation.

There are six outlets to the river numbered 1 through 6 (east to west), from a single trashrack-protected intake structure located near the center of the dam. Outlet Nos. 1 and 6 are 96-inch diameter steel-lined conduits with intakes at centerline elevation 975 feet. Outlet Nos. 2 and 5 are 48-inch diameter steel-lined conduits with intakes at centerline elevation 960 feet. Outlet No. 3 is a 48-inch diameter steel-lined conduit with intake at centerline elevation 975 feet. Outlet No. 4 is a 54-inch diameter steel-lined conduit with intake at centerline elevation 975 feet that transitions to a 48-inch steel-lined conduit further downstream.

Outlet Nos. 1 and 6 have 96-inch butterfly valves located in a gate chamber for emergency closure and 72-inch needle valves located on the downstream face for regulating flows. Outlet Nos. 2, 3, 4, and 5 have bonneted slide gates located in the gate chamber for emergency closure and needle valves located on the downstream face for regulating flows; however, the needle valves on Outlet Nos. 2 and 5 have been removed for sluicing operations. Outlet Nos. 3 and 4 also have 20-inch diameter outlets that join together to form a low flow conduit. A single 96-inch by 120-inch caterpillar gate, operated by an overhead crane, is used to shut off flows during inspection and maintenance of the valves.

The concrete spillway structure is located west of the gravity dam and consists of three overflow weir sections each 70-feet long with crests at elevation 1152.0. Each bay, numbered 1 through 3 (east to west) has a drum gate that can be raised to elevation 1170.0. The concrete spillway chute drops 213 feet from the top of the weir, discharging at elevation 939.0. A three span bridge supports the 20-foot wide access road over the spillway.

Pertinent data for the Morris Dam Project is listed below on Table 1-1.

Table 1-1 General Data, Morris Dam

Location:	San Gabriel Canyon 4 miles north of Azusa, California.
Stream:	San Gabriel River
Purpose:	Water conservation
Type of Dam:	Concrete gravity dam
History:	Constructed in 1934 by the City of Pasadena
Owner:	1934-1995 Metropolitan 1995-Present Los Angeles County Department of Public Works
Height:	245 feet above original streambed 328 ft above foundation

Crest Length:	800 ft
Crest Width:	20 ft
Crest Elevation:	1175 ft

Table 1-1 General Data, Morris Dam (continued)

Top of Parapet:	1179 ft			
Normal WS Range	1100 ft (low) – 1170 ft (high)			
Normal Maximum HWL:	1175 ft			
Storage/Area Normal HWL:	Original: 39,300 acre-feet storage, 417 acres Present: 28,695 acre-feet storage, 371 acres			
Special Construction:	Blocks with contraction joints spaced 50-ft (generally) 3-ft wide open contraction joint approx. 280-ft from the west end of dam			
Intake:	Single trashrack-protected structure near center of the dam			
Outlets to River:	Outlet #	Diameter	Elevation	Details
6 Outlets (Numbered 1-6 East to West)	1, 6	96-inch	975 ft	Upstream: Electric motor operated Butterfly valves
	2, 5	48-inch	960 ft	Downstream: Needle valves removed
	3	48-inch	975 ft	
	4	54- to 48-inches	975 ft	
	3 or 4	20-inch	945 ft	Low flow Manifold Outlet Valves Range from 4-, 6-, 8-, and 12-inches
Other Outlets: MWD Connection		108-inch	1004.5 ft	This outlet has been retired. The MWD Tower is out of commission, and the 108" connection is bulkheaded off.
Spillway	Three 70-ft long overflow ogee weir sections • Crest elevation with drum gates down is EL 1152.00 • 213 feet drop from top of weir • Discharge at elevation 939 ft			

Spillway Gates	Three 70-ft long by 18-ft high Drum Gates (Numbered 1-3 East to West) • Elevation 1170 ft (Up) • Elevation 1152 ft (Down)
Bridge	Three Span bridge supports 20-ft wide road over the spillway.

1.4 PROJECT OBJECTIVES

The objectives of the Morris Dam Inlet/Outlet Rehabilitation Project are as follows:

- Rehabilitate the dam's inlet and outlet works to improve both safety and reliability. Automate the dam's inlet and outlet works to improve operational efficiency.
- Rehabilitate the projects electrical system to increase capacity for additional improvements and bring it into compliance with the National Electrical Code (NEC).
- Construct new control house where the new programmable logic control operation system will be located to remotely operate the outlet works.

Brief descriptions of the features associated with the rehabilitation are presented in the following subsections.

1.4.1 Rehabilitate/Automate Drum Gates

The Bureau's inspection noted that the drum gates need numerous rehabilitation measures including seal replacement, recoating, and faceplate analysis and possible strengthening. Rehabilitation of the drum gate seals will include replacement of the rubber "J" seals, which were installed as backup to the original seals, with new seals similar in design to the original seals. It has been reported that Drum Gate No. 1 can stick in the up (closed) position and has had to be manually lowered. The following actions are planned for rehabilitating and automating the drum gates:

- Develop specifications for recoating the inside and outside of the gates.
- Perform a structural analysis to evaluate the significance of gate skin plate corrosion and develop appropriate rehabilitation measures, if necessary.
- Automate the gates by installing electric motor operators on the gate chamber's intake valves and replace the gate chamber's drain valves with electric motor operated valves.
- Indicate valve position, gate chamber pressure, gate position, and reservoir level in the operation system for the gates from the new control house.

1.4.2 Rehabilitate/Automate River Outlet Works

Rehabilitation and automation of the river outlet works to improve both safety and reliability will be accomplished as follows:

- Outlets Number 1, 2, and 5 will be retired. The downstream end of Outlet No. 1, 2 and 5 will have a new 2:1 semi-ellipsoidal steel bulkhead hinged at the springline installed to seal off the outlet. Outlet No. 2 currently has a hydraulically operated slide gate at the downstream end, and this gate and gate operator will be removed. All outlets will have sacrificial cathodic protection anodes installed inside the conduits. The conduits will be retired in the charged conditions, i.e., they will be full of water but sealed off on the downstream end. Their upstream guard valve/gate will be in the closed position

- The discharge end of Outlet No. 3 will be rehabilitated with a new 20-inch jet flow gate. The discharge of this outlet will be directed 15-degrees to the west to help elevate erosion problems that have occurred at the access road to the toe of the dam.
- The discharge end of Outlet No. 4 will be rehabilitated with a new 42-inch fixed cone valve with an integral discharge hood.
- The discharge end of Outlet No. 6 will be rehabilitated with a new 72-inch fixed cone valve with an integral discharge hood.
- The slide gates upstream of Outlet Nos. 2, 3, 4 and 5 will be replaced with oil-hydraulic cylinder operators to provide both local and remote control, and to be compatible with other valve operators. The gate leafs and seats will be rehabilitated with new parts and new paint.
- The 96-inch diameter butterfly valves upstream of Outlet Nos. 1 and 6 will have their controls rehabilitated to provide local and remote control. The mechanical features of the valve (operators, disc, etc) will not be rehabilitated during this construction.

1.4.3 Rehabilitate Electrical System

The existing electrical system will be rehabilitated to support the loads resulting from the outlet works rehabilitation. This includes:

- Upgrading the incoming power supply from Southern California Edison (SCE) from 150 kVA to 500 kVA.
- Replacing the standby diesel engine generator with a new 300kW diesel-driven engine generator
- Designing a new 480V power distribution system.
- Replacing all existing cables and exposed conduits. Some existing embedded conduits will be reused, while others will be replaced.
- Replacing the existing lighting and telephone systems.
- Designing new instrumentation and control for the project.

1.4.4 New Control House

The new control house will be located on the right abutment of the dam. This location is termed "the area between the dam and spillway" on the original Morris Dam construction drawings. The building will be "L" shaped with a control room that overlooks the downstream face of the dam. The building will have a control room, a break room, a restroom, a shower, a relief room, and a storage room. The storage room is to store tool and other maintenance items. It is not designed to hold vehicle loads.

The new control house will have central air and heat in the usable areas, thermostat controlled exhaust fans in the storage area, and a waste holding tank sized to require emptying no less than once a month. The exterior of the building will be stucco colored to match the color of the pylons at the abutment of the dam. The architectural features of the pylons will be used in the aesthetics of the new control house. Site grading will be required around the new control house, along with paving requirements. The building foundation will be drilled caissons a minimum of 5-feet into bedrock. The precast concrete waste holding tank will be 2,500 gallons and rated for H20 loading

1.5 ISSUES RELATED TO PROJECT IMPLEMENTATION

1.5.1 General Constraints

(a) The removal, replacement, and repair of conduits, valves, or appurtenant work (including drum gate structures) shall only be performed between April 15 and October 15.

1.5.2 Constraints During Valve and Gate Rehabilitation

1.5.2.1 Outlet Valves

(a) All six conduits are provided with an upstream intake. A single caterpillar gate is provided to inspect and repair guard valves upstream of the flow control valves.

(b) Work that has to be performed on any of the guard valves will have to be done on a sequential basis, as there is only one caterpillar gate.

(c) The removal of control valves can be done sequentially or simultaneously with the constraint of required downstream flow releases. This scheduling will have to be coordinated with the Department Reservoir operation plan. The sequence of rehabilitation is outlined in the Construction Methods Evaluation prepared by Black & Veatch in March 2001.

1.5.2.2 Drum Gate Seals and Drum Gate Chamber Discharge Control Valve

(a) This activity will be dependent on the Department's Reservoir Operation Plan.

(b) Estimates will have to be made for the time required to remove and replace gate seals, if the seals are to be replaced. The installation contractor will have to know the amount of time he has to perform the work and the decision at all gates must be rehabbed simultaneously or sequentially.

1.5.3 Constraints During New Sluiceway Construction

The construction contractor's schedule for work on the upstream face of Morris Dam will be limited by the yearly hydrologic cycle of the San Gabriel River. Actual dates may be adjusted depending on hydrologic conditions but the Contract Documents will be developed to show the following limitations on the schedule:

- November 15 – April 15: Schedule no work that requires that the reservoir be dewatered (inflow from storms during this period are likely to overwhelm any diversion capability).
- April 15 – July 15: Schedule no work that requires the reservoir to be dewatered (this period is reserved for the Department to draw down the reservoir and make beneficial use of the water discharged).
- July 15 – November 15: Period of time when the contractor can schedule work requiring a dewatered reservoir. Summer storm events remain a risk. The contractor will be provided hydraulic and hydrologic data allowing for the development of a plan to prevent or minimize costs and lost time associated with such events.

1.5.4 Environmental Issues

An initial study (IS) and a negative declaration (ND) will be prepared to identify the potential biological impact of the project.

2.0 BASIC DESIGN CRITERIA AND LOADING CONDITIONS

2.1 HYDROLOGIC/HYDRAULIC DESIGN CRITERIA

2.1.1 Operating Levels

Probable Maximum Flood (PMF)	204,000 cfs
PMF high water level	1186.40 ft
Normal Max (Top of Spillway Gates)	1170.00 ft
Spillway Crest	1152.00 ft
Normal Low Water Surface	1100.00 ft
Centerline of Outlets 1, 3, 4 & 6	975.00 ft
Centerline of Outlets 2 & 5	960.00 ft

2.1.2 Flood Flows

Flood flows of record for Morris Dam are shown below on Table 2-1. Flow data was derived from USGS gaging station No. 11083500 ("San Gabriel River near Azusa, CA", Water Years 1933-1966) using a Log-Pearson Type III distribution.

Table 2-1 Flood Flows

Event	Outflow (cfs)
2-year	720
5-year	4,400
10-year	10,600
25-year	25,800
50-year	44,800
100-year	72,200

2.1.3 Outlet Works Capacity

Outlet No.	Original Regulating Valve	Original Capacity @ HWEL = 1170.00 (cfs)	New Regulating Valve	Proposed Capacity @ HWEL = 1170.00 (cfs)
1	Hardie Tynes Needle	2,125	Blind flange (retired)	none
2	Hardie Tynes Needle	545	Manual slide gate (retired)	none
3	Hardie Tynes Needle	485	20-inch jet flow gate (Cd = 0.84 full open)	163
4	Pelton Needle	279	42-inch fixed cone valve (Cd = 0.78 full open)	679
5	Hardie Tynes Needle	545	Blind flange	none
6	Hardie Tynes Needle	2,125	72-inch fixed cone valve (Cd = 0.78 full open)	2,114
	TOTAL:	**6,104**		**2,956**[2]
Spillway	54,900 cfs @ WSEL 1170			Unchanged
(gates down)	79,500 cfs @ WSEL 1175			Unchanged

2.1.4 Area Capacity Table

The area capacity information for Morris Reservoir is shown below on Table 2-2 for the original design and current conditions.

[2] The DSOD requirement is to draw down the reservoir 10 percent of its head in seven to ten days. This means an average discharge of 360 to 515 cfs in excess of the inflow.

Table 2-2 Area Capacity for Morris Reservoir

Elevation (ft)	Designed Values		Current Values	
	Storage Capacity (acre-feet)	Surface Area (acres)	Storage Capacity (acre-feet)	Surface Area (acres)
960	375	21	0	0
975	625	25	10.1	3
1000	1,625	60	252	18
1020	3,000	83	873	44
1040	5,100	120	2,181	81
1060	8,000	162	4,096	110
1080	11,500	208	6,674	145
1100	16,800	256	9,854	171
1120	21,800	292	13,719	222
1140	27,700	335	18,802	286
1152	32,600	367	22,463	317
1160	35,300	386	25,107	340
1170	39,300	417	28,695	371

2.2 STRUCTURAL CRITERIA

2.2.1 General

Unless otherwise specified in these criteria, the structural design was in accordance with the following documents:

- ACI 318-95, Building Code Requirements for Reinforced Concrete.
- AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, ninth edition, 1995.
- Uniform Building Code (UBC), 1997 edition.
- California Code of Regulations, Title 24 (or California Building Standards Code), Part 2, the California Building Code.
- America Welding Society (AWS) AWS D1.1 – Structural Welding Code
- Strength Design for Reinforced Concrete Hydraulic Structures, Technical Engineering and Design Guides as Adapted from the US Army Corps of Engineers, No. 2, ASCE.

2.2.2 Materials

Concrete	Structural	f'c = 4,000 psi @ 28 days
	Pipe blocking, encasement concrete fill, and duct bank	f'c = 3,000 psi @ 28 days
Grout	Grout	f'c = 5,000 psi @ 28 days
Reinforcing Steel		ASTM A615, Grade 60
Structural Steel	Structural Steel	ASTM A36
	Structural Tubing	ASTM A500, Grade B
	Steel Pipe	ASTM A53, Type E or S, Grade B ASTM A500, Grade B, C, or D ASTM A501
	High-Strength Bolts	ASTM A325, Type 3
	Anchor Bolts	ASTM A307 or ASTM A36
	Welding	AWS D1.1, Table 3.1, 70 ksi filler Material
Steel Decking	Floor and Roof	steel sheet ASTM A653SQ, Galvanized

2.2.3 Concrete Design, Detailing and Construction Requirements

Shrinkage and Temperature Reinforcement

- ACI 318-95
- ASCE, Strength Design for Reinforced Concrete Hydraulic Structures

Ultimate Strength Design

Load factor, hydrostatic fluid pressure. Appropriate section of:

- ACI 318-95
- ASCE, Strength Design of Reinforced Concrete Hydraulic Structures

Minimum Concrete Cover

- ACI 318-95 and appropriate sections of ASCE, Strength Design of Reinforced Concrete Hydraulic Structures

2.2.4 Design Loads

Structures were designed to support and resist the loads and forces listed below.

Dead Loads

The vertical load due to actual weight of all permanent elements of the structure and equipment. Unit weights were assumed as follows:

Concrete	150 lb/ft^3
Steel	490 lb/ft^3
Water	62.4 lb/ft^3

Live Loads

All vertical loads other than dead loads. The basis live loads were assumed as follows unless otherwise determined by the lead structural engineer:

Roof	20 lb/ft^2
Warehouse Floor	250 lb/ft^2
Stair Stringers and Stair Treads	100 lb/ft^2 or 300 lb concentrated load

Equipment and Loads

Floor live loads above are intended to represent general equipment loads. Detail design was based on weight and location of actual equipment. Horizontal and vertical accelerations for design of equipment anchorage and support was based on the data developed in "Morris Dam, Additional Seismic Stability Study," Morrison-Knudsen Engineers, Inc., November 1988. Seismic compliance reports for equipment support are a requirement of the Contractor, and shall be based on a horizontal acceleration of 0.7g and a vertical acceleration of 0.47g. Equipment that is supported with the use of vibration isolators shall utilize a horizontal acceleration of 1.4g and a vertical acceleration of 0.94g.

Wind Loads

Wind design is in accordance with Section 2311 and referenced tables of UBC. The basic wind speed of 80 mph, Exposure C, and Importance Factor of 1.15 was used unless otherwise determined by the lead structural engineer.

Seismic Load

The following seismic parameters were used for the structural design of the Control House.

Seismic Zone Factor (Z) = 0.4	Seismic Coefficient (Ca) = 0.715
Seismic Importance Factor = 1.25	Seismic Coefficient (Cv) = 1.024

Lateral seismic forces due to reservoir water was determined by the Westergaard formula.

Load Combinations

D = Dead Load
L = Live Load
F = Hydrostatic pressure
W = Wind pressure
E = Seismic load
H = Static soil pressure

Load Factor Design

Load Case	Design Load
I	1.4D + 1.7L + 1.7F + 1.7H
II	0.9D + 1.7H
III	0.75 (1.4D + 1.7L + 1.7F + 1.7H + 1.7W)
IV	0.75 (1.4D + 1.7L + 1.7F + 1.7H + 1.87E)

Hydraulic structures were designed for an additional factor of 1.3 applied in accordance with ASCE, Strength Design for Reinforced Concrete Hydraulic Structures. Appropriate increases in allowable stress are as follows:

Load Case	Working Stress Design	Increase in Allowable Stress for Hydraulic Structures
I	D + L + F + H	---
III	D + L + F + H + W D +F + H + W	1/3
IV	D + L + F + H + E or D + L + H + E	1/3

Deflections

For floors and roofs, the maximum allowable deflections are:

Members under live load only	L/360
Members under dead load and live load	L/240

Where L = center-to-center span of the structural member, in the same units as deflection.

2.2.5 Drum Gates

Drum gates were analyzed using the ASCE Allowable Stress Design Method of Design of Hydraulic Steel Structures – Technical Engineering and Design Guide No. 22. The gates were considered Type B Hydraulic Steel Structures (HSS), and for this type structure the allowable stress of 0.83 times that allowed by the American Institute of Steel Construction Allowable Stress Design Manual of Steel Construction, 9th edition.

2.3 MECHANICAL CRITERIA

2.3.1 Mechanical Criteria

2.3.1.1 Fixed Cone Valve and Bulkhead Design Criteria

Items to be included for the specification and purchase of the fixed cone valve includes the follow information:

Hydraulics

(a) Reservoir operating water levels.

(b) Profile drawing and dimensions of the intake, conduit from the intake to the connection to the fixed cone valves.

(c) Centerline of the valves and the discharge angle of the valves, if any.

(d) A calculated and an agreed upon hydraulic loss coefficient of the intakes and conduits to the entrance of each valve where $H_L = K \times Q^2/2g$.

Fixed Cone Valve Hood Design and Transition Section

(a) Fixed cone valves will be provided on Outlets No. 4 and 6.

(b) Valve to be furnished with an integral hood furnished integral with the valve or with a hood furnished by others located separately from the valve. The exact location of a separate hood to be specified by the valve manufacturer.

(c) If a separate hooded structure is to be provided, it will be important to evaluate the additional weight that maybe required for a steel lined concrete hood that would be located just downstream of the valve. The existing concrete substructure will have to be evaluated to ensure there will be no problems with this additional load.

(d) The supplier of the valve shall provide a transition section between the existing flanges just downstream of the dam face where connections were made for the Needle cone valves.

(e) The length of the transition section shall be established based on the extent of the probable discharge plume to the discharge area of the dam.

Fixed Cone Valve Characteristics

(a) The valve on each conduit shall have the following guaranteed discharge coefficient at full open:

Jet Flow Gate – 0.84

Fixed Cone Valve – 0.78

(b) Valve vane arrangement shall be based on a proven design based on passed performance of similar sizes of valves under similar head and flow conditions. The manufacturer shall have been in the in the business of manufacturing this type of valve throughout the last 10 years.

(c) An agreed upon vibration safety factor for the number of vanes in the valve and ratios of the valve vanes thickness and shell thickness shall be made using guidelines presented in the report "Vane Failures of Hollow Cone Valves" by Albert Mercer, 1970, International Association for Hydraulic Research, Stockholm.

(d) The valve manufacturer shall submit results of earlier model data and prototype flow discharge characteristic as a function of head and flow for 10 degrees of opening to 100 percent open.

Valve Operation

(a) The valves are to be opened and closed by electric motor driven gear train actuator.

(b) Remote and local manual controls shall be provided.

Bulkheads

(a) Bulkheads shall be placed on Outlets No. 1, 2, and 5.

(b) The bulkheads shall be designed to ASME Pressure Boiler & Vessel Code VIII based on maximum reservoir Elevation 1179 feet.

Contracts for Procurement and Installation

(a) The procurement and installation of the valves will be the responsibility of the general contractor for Design Package Number 1.

(b) The contractor will be responsible for the removal of the existing valves and associated piping.

2.3.1.2 Automation of 96-inch Diameter Emergency Guard Butterfly Valves

- Add limit switches to provide for remote control of the Butterfly valves on Outlets No. 1 and 6.
- Replace the existing manually operated bypass valve with new valve and electric motor operators.
- Grating platform above the butterfly valves will require modification to provide space for the electric motor operators.
- Motor operator shall be manufactured by Limitorque.

2.3.1.3 Rehabilitation of 48- and 54-inch Emergency Guard Slide Gates

Mechanical Design Criteria

Type	Existing Bonneted Slide Gates
Number of Gates	(3) 48-inch and (1) 54-inch
Operating Speed	Approximately 12 inches per minute
New Operator	Oil-Hydraulic
Hydraulic operation	850 psi maximum System Pressure NFPA Hydraulic Cylinder Stainless steel piston stem NFPA Hydraulic power unit with two pumps and motors
Design of Replacement parts	Stem packings, stem nut, operator support minimum of 40% of yield Strength or 25% UTS (Steel, stainless steel, bronze)
Operating head	195 feet (54-inch and upper 48-inch) 210 feet (lower 48-inch)

The following criteria was used to calculate the operating loads for the slide gates:

- Coefficient of friction: 0.60
- Downpull will be calculated based on dimensions of gate leaf
- Weight of moving parts will be calculated
- Additional 20 percent will be added to cover contingencies

Operation Criteria

Operation .... Local/Remote

Local Operation by operation of selector switch and appropriate OPEN-STOP-CLOSE pushbutton to activate hydraulic control system. Remote operation by operation of appropriate OPEN-STOP-CLOSE command.

2.3.1.4 20-inch Jet-Flow Gates

Mechanical Design Criteria

Number of gates .... (1) Outlet Works

Operating Speed .... Approximately 6 inches per minute

Operator .... Electric Motor-Operator
480 Volts, 3 Phase
Stainless Steel Gate Stem

Design .... Handbook of Applied Hydraulics
Minimum of 40% of Yield Strength or 25% of UTS
(Steel, stainless steel, bronze)

Operating head .... 195 feet (outlet works)

Operation Criteria

Initiation .... Local/Remote

Manual Operation .... Handwheel on motor-operator

Local operation by operation of selector switch and appropriate OPEN-STOP-CLOSE pushbutton to actuate electric motor-operator. Remote operation by operation of appropriate OPEN-STOP-CLOSE command.

2.3.1.5 Drum Gate Flow Control Valves

Gate Chamber Valve Arrangements

(a) The gate chamber discharge valve shall be an 18-inch V-ported knife gate valve with and elbow and reducer section. The valve assembly be installed in the space vacated by the old 30-inch angle needle valve. The valve supplier provide the necessary transition sections both upstream and downstream of the valve. The manufacturer will be given information of the existing mating conditions for the valves but shall be responsible for mating with the existing flange permanently installed. If transitions section are necessary either upstream or downstream, the valve supplier shall provide the necessary sections.

(b) The gate chamber inlet valve shall be a 16-inch diameter eccentric plug valve. The valve assembly shall be installed in the space vacated by the old 16-inch gate valve. The Contractor shall provide the necessary transition sections both upstream and downstream of the valve.

Valve Controls and Operation

(a) The valves will be electric motor operated.

(b) The valves shall be provided with local and remote control with programmed logic to select the valve opening to position the drum gate at the desired position as a function of the reservoir water level elevation.

(c) The valves shall be provided with a valve position transmitter for monitoring the status of the valve and for the automatic operation of the drum gate.

2.3.1.6 Drum Gate Seals

Seal Evaluations

(a) As noted in the Investigation Report, the rubber "J" seals that were installed as backup seals to the original gate seals have been wedged and torn. The seals are located on the ends of the gate, at the gate hinge, and at the spillway crest in front of the upstream face of the drum gate. Although not conclusive, the damaged rubber "J" seals could be the cause for the jamming of Gate No. 1.

(b) It was noted in the Inspection Report that there were sections of gate seals that had been damaged or badly worn.

(c) Furthermore, there are spring loaded joint seals, at the end corners of the gates, with bronze pads mounted between the springs. There were no indications of damage to these seals as there are no scratch marks or gouges on the painted surfaces of the pier walls where these seals contact and rotate.

Gate Seals Replacement

(a) The decision was made to replace the original gate seals and the backup rubber "J" seals and replaced this seal combination with a completely new set of stainless steel metal seals similar in shape of the original gate seals. The seals will be design to give the similar spring characteristic and contact pressure as the original spring material. New rubber sealing strips shall be provide with the new seals. The rubber sealing strips shall be cut to conform to the shape of the curvature at the ends of each of the drum gates. The end rubber seals shall not be straight pieces of rubber bent into a curved configuration to avoid the pitching of the rubber. The rubber sealing strips shall attach to the metal seals by stainless steel pope rivets.

(b) The old clamp and filler bars, shim plates and bolts and cap screws shall be replaced with a complete net set of material.

2.4 ELECTRICAL CRITERIA

2.4.1 Codes and Standards

The electrical design complies with the following codes and standards, as last revised at the date of the proposal for the project:

- National Electrical Code of the National Fire Protection Association
- National Electrical Safety Code, ANSI C2
- California Code of Regulations (CCR), Title 8, Electrical Safety Orders
- California Code of Regulations (CCR), Title 24, California Building Code
- State of California, General Order No. 128, Rules for Construction of Underground Electric Supply and Communication Systems
- Laws and Regulations of the County of Los Angeles

The following industry standards and publications were used as applicable:

- ANSI – American National Standards Institute
- NEMA – National Electrical Manufacturers Association
- UL – Underwriters Laboratories
- IEEE – Institute of Electrical and Electronics Engineers
- IES – Illumination Engineers Society
- ICEA – Insulated Cable Engineers Association

The appropriate sections were referenced in the equipment specifications. Where there was a conflict among the above governing codes and standards, the most stringent provision as determined by the Department shall govern the design.

2.4.2 Equipment and Circuit Tag Numbering System

Equipment tag numbers are assigned in accordance with the following system. A typical equipment tag number will conform to the standard form ABB-CCC-DD, where:

A = Design Package Number (1 or 2)

BB = System Code (see below)

CCC = Equipment Type

DD = Sequential Number

A list of system codes that were used on the project includes:

AC = Azusa Conduit

CH = Control House

CO = Control System

CP = Cathodic Protection

CR = Cranes & Hoists

DG = Drum Gates

DR = Drainage

DW = Domestic Water

EP = Primary Electric Power (480V)

ES = Secondary Electric Power (120/208V)

FW = Fire Water

HP = Hydraulic Power

HV = Heating, Ventilation, & Air Conditioning

RO = River Outlets

RS = Reservoir

ST = Sluice Tunnel

UP = Uninterruptible Power

VM = Video Monitoring

WW = Waste Water

Input/Output (I/O) points for the control system were assigned based on the equipment number that the point is associated with followed by a two-digit suffix indicating what the point represents.

Circuit numbers were assigned per the standard form ABB-CDD, where:

A = Design Package Number (1 or 2)

BB = System Code as described above

C = Circuit Type (P for Power, C for Control, or L for Low Voltage Instrumentation & Communications)

DD = Sequential Number

Circuit routing and raceway design was done with the Black & Veatch Cable and Raceway Management System (CARMS). This proprietary database program contains information for all circuits and raceways on the project, and allows the designer to quickly and correctly route cables and size conduits and trays. The program offers other valuable information to the user such as total lengths of each type of cable and conduit needed for construction.

Wiring diagrams were created with the Black & Veatch Cable Termination Program, which is another proprietary database linked with the CARMS program. Cable and Equipment information is entered only in the CARMS program, and any changes made in CARMS are automatically updated in the Cable Termination Program. This new program provides a higher level of flexibility and reliability in the design of the wiring diagrams.

3.0 SPECIFIC DESIGN FEATURES

3.1 NEW CONTROL HOUSE CONSTRUCTION

3.1.1 Location

The new Control House will be constructed at the southeast corner of the existing parking lot area, and will overhand the existing slope. This will maximize the parking area atop the dam.

3.1.2 Basic Layout

The Control House will contain a main control room with an Operator's Console equipped with the Operator's Workstation and Engineer's Workstation. The Control House will also contain a break room, a kitchen area, a bathroom with shower, and a storage room. The basis layout shown in contract drawing DP1-A101.

3.1.3 Architectural Design and Related Issues

3.1.3.1 Space Programming

The building area shall be approximately 960 square feet with the following divisions:

- Control Room: 16' x 17'-6" or 280 square feet.
- Break Room: 12' x 14'-2" or 170 square feet.
- Relief Quarters: 10' x 10'-10" or 108.3 square feet.
- Bathroom with shower: 11'-10" x 10'-6" or 124.3 square feet.
- Storage Room: 16'x 20' or 320 square feet.

3.1.3.2 Aesthetics

The Control House shall blend with the existing structures by having similar design features, architectural elements, and matching colors and finishes.

3.1.3.3 Accessibility

The Control House shall be fully accessible to the physically disabled. Accessibility considerations shall include, but not limited to, path of travel from the parking area to the building, parking, drinking fountain, kitchen and toilet room design, access through room and spaces, and interior and exterior signage programs.

3.1.3.4 Building Code Requirements

The Control House shall be in full compliance with all governing codes and regulations including, but not limited to, the current editions of Uniform Building Code, Uniform Mechanical Code, Uniform Plumbing Code, National Electrical Code, California State Title, 24 relating to energy conservation and accessibility, and The Americans with Disability Act.

3.1.4 Building Systems, Materials and Finishes

Subject to approval by the Department, the following building systems, materials, and finishes shall be applied to the Control House Building:

Exterior Material and Finish

Roof: Three-ply fiberglass built-up roof with cap sheet.

Exterior Wall: Lath and plaster. Finished to match adjacent towers.

Doors: Steel 3' x 6'-8" doors with 16 gage steel frame.

Windows: Operable aluminum casement with view section.

Light Fixtures: Match existing fixtures.

Interior Material and Finish

Walls: 5/8" gypsum wallboard throughout. Moisture resistant boards where required by code and in moisture sensitive areas, orange peel texture.

Ceiling: Acoustic ceiling tiles in all rooms except the bathroom and shower, whereas in these areas ½" moisture resistance gypsum wallboard will be used.

Floor Materials: Durable low maintenance carpet will be used throughout except in the bathroom where 1/8" gage sheet vinyl floor will be used. Covered base in all moisture sensitive areas.

Paint: Low sheen water based paint for Control Room and Relief Quarters; semi-gloss enamel paint elsewhere.

Insulations

Roof: R-30 fiberglass.

Exterior Walls: R-19 fiberglass

Interior Walls: R-11 fiberglass.

Under Floor Cavity: R-19 fiberglass.

Appliances

Refrigerator

Microwave oven

4 Burner Electric Cook Top

Garbage Disposal

Structural System

Foundation: Drilled piers, concrete grade beams, and retaining walls with footings where required. Design Bearing capacity of 1,000 pounds per square foot.

Floor Material: Concrete.

Floor Framing: Metal deck over steel beams and steel joints.

Wall system: Steel structural studs.

Roof Framing: Steel deck over steel joists

Lateral Resistance: Steel braced frame system.

Heating, Venting, and Air Conditioning

Air Conditioning: 3-ton heat pump unit, ground mounted.

Exhaust fans: 100 to 200 cpm units as required.

Plumbing

Toilet Fixture: Accessible floor mounted tank type unit.

Lavatory: Accessible wall mounted porcelain china unit.

Water Heater: 30-gallon capacity commercial unit.

Floor Drain for Toilet/Shower Room.

Kitchen Sink: Stainless steel, single compartment unit.

Garbage disposal: 3/4 HP unit.

Electrical

New 100-amp, 480/277-volt power panel and 150-amp, 120/208-volt lighting panel.

Fluorescent lighting per NEC and Title 24 requirements.

Electrical outlets per NEC requirements. Ground Fault Interrupted (GFI) receptacles at locations as required by NEC.

Waste Holding Tank

The 2,500 gallon precast concrete tank rated for H-20 loading will be installed underground beneath the parking lot. The tank is sized to be emptied no less than once per month. A 4" Cast Iron Soil Sewer pipe will run from the control house to the tank inlet.

3.2 DRUM GATE REHABILITATION

3.2.1 DRUM GATE STRUCTURAL ANALYSIS

Corrosion of drum gate skin plates has lead to concern that this corrosion may pose a structural integrity problem with the gates. A structural analysis was performed to evaluate the significance of gate skin plate corrosion. The corrosion was quantified during USBR's 1998 inspection.

The drum gate skin plates are supported by internal framing (frames at 24-inch centers) and subjected to hydrostatic pressure loading. Skin plates were analyzed using both hand calculations and computer structural analysis software with plate element capability. The analysis focused on the skin plate; however, a section of the gate including 2 or 3 frames was analyzed using computer structural analysis software to evaluate frame stresses. Plate end restraint conditions and load pressure diagrams were selected to closely match actual conditions. Plate thickness used in analysis reflected corrosion loss determined from gate inspections. By use of appropriate analysis method, plate stresses was determined to allow comparison with allowable values. Hand calculations used accepted plate formulas for plates stressed below their elastic limit such as those compiled in R. J. Roark's Formulas for Stress and Strain, McGraw-Hill Book Company. In cases where plate continuity over several supports combined with varying hydrostatic pressure loading warrants a more detailed analysis, sections of the skin plate were analyzed with computer structural analysis software with plate element capability (such as RISA-3D). This analysis was be part of the analysis described above for frame evaluation.

Drum gate stresses determined by analysis were evaluated using Allowable Stress Design Method (ASD) of Design of Hydraulic Steel Structures – Technical Engineering and Design Guide No. 22 published by ASCE. This manual is adapted from the U. S. Army Corps of Engineers' Engineering Manual, EM 1110-2-2105, Design of Hydraulic Steel Structures. The drum gates are considered Type B Hydraulic Steel Structures (HSS). For Type B HSS, the allowable stress is 0.83 times that allowed by the American Institute of Steel Construction's (AISC) (1989) Allowable Stress Design Manual of Steel Construction, 9th Edition.

3.2.2 SEAL REPLACEMENT DESIGN

The new seals shall be shaped identically to the original seal configuration. The new seal will be fabricated of stainless steel plate conforming to the requirements of ASTM 666-95 type 301 or 302, ½ hardness cold rolled. The nominal seal thickness shall be 3/64"

The seal will be designed to have the equivalent deflection characteristic and contact pressure as the origin seals.

The rubber portion of he new seals will be of natural molded rubber containing reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizer to meet the physical properties stated in the specification.

The rivets attaching the rubber portion of the seals to the metal portion of the seals shall be the pop rivet type with stainless steel rivet and stainless steel mandrel both of 300 stainless steel, 5/32" nominal diameter flat heads. The grip length from passed experience has indicated a length of 3/8". This length shall be re-verified to establish an acceptable compression of the washer back against the rubber pad.

The clamp and filler bars and shim plates shall be fabricated from ASTM A36.

The corresponding nuts and washers shall be stainless steel 304 conforming to ASTM F593 and F594

3.2.3 GATE AUTOMATION

The Morris Dam Spillway contains three drum gates that are used to control the level of the upstream reservoir. Associated with each gate are intake and outlet valves respectively to and from the gate chamber, a gate chamber pressure transmitter and a drum gate position transmitter. Drum gate position, or height, is controlled by raising and lowering the water level in the drum gate chamber through modulation of the position of the outlet valve, hence controlling the discharge out of the gate chamber.

3.3 RIVER OUTLET REHABILITATION

3.3.1 RETIREMENT OF OUTLETS NO. 1, 2 AND 5

Outlets No. 1 and 5 will be demolished up to the flange located 3' from the face of the dam. A new steel pipe section will be connected to the existing flange supported by a new saddle pipe support. The Outlets will be sealed with a new semi-ellipsoidal bulkhead hinged at the spring line. A 6" drain valve with knife gate valve with chain will be located adjacent to the flange connection. Air and vacuum valves to vent the pipe will be placed on the new steel pipe sections with the valves located on the above deck. Within the emergency gate chamber the hydraulic cylinder will be removed and the associated piping will be removed and capped at the source.

After removal of the regulating equipment, the semi-elliposidal bulkheads will be installed.

The guard valve (Outlet No. 1) and slide gates (Outlets No. 2 and 5) leak significantly. Retirement of these outlets will involve lining the interior with a new coating system and installation of sacrificial anodes. The guard valves or slide gates will be closed, but eventually the conduits will fill and be fully charged because of the leakage around the discs. A balanced head across the guard valves and slide gates is desirable when periodically exercising them.

3.3.2 REHABILITATION OF OUTLETS NO. 4 AND 6

The existing regulating valves on Outlets No. 4 and 6 will be removed and replaced with new fixed cone valves. The 54-inch slide gate for Outlet No. 4 will be rehabilitated. One each 40- and 72-inch diameter fixed cone valves with electric motor-operators and integral discharge hoods are designed for Outlets No. 4 and 6, respectively. The design details the removal of the existing equipment and any modifications to the existing conduit and support structure. Local and remote control will be provided for the electric motor-operators at Outlet Nos. 4 and 6 and for the 96-inch butterfly guard valve on Outlet No. 6 .

As with Outlet No. 1, the removal of the 42-inch and 96-inch needle valves at Outlet Nos. 4 and 6 will require that the valves be dismantled at the site.

Installation of the fixed cone valves shall be done under the supervision of the fixed cone valve supplier. The installation contractor shall be required to have had previous experience in installing valves of this type. Testing of these valves should be done at the specified design reservoir water level, if at all practical.

3.3.3 REHABILITATION OF OUTLET NO. 3

The existing regulating valve on Outlet No. 3 will be removed and replaced with a new jet-flow gate. One 20-inch diameter jet-flow gate with an electric motor-operator and a discharge guide will be designed for Outlet No. 3. The design details the removal of the existing equipment and any modifications to the existing conduit and support structure. Local and remote control will be provided for the 48-inch slide gate that serves as the guard gate for the 48-inch conduit.

The removal of the 36-inch needle valve may require the valve be dismantled at the site. The automation of the 48-inch slide gate will require the use of the caterpillar gate located upstream and at the top of the dam.

Testing of the jet-flow gate will be performed with a minimum specified reservoir elevation.

3.3.4 MISCELLANEOUS RELATED WORK

3.3.4.1 Review of Valve Supports

Existing valve supports (embedded steel anchorages and concrete pedestals) were analyzed to determine their adequacy for support of rehabilitated and new valve equipment. New steel anchorage embedments and new concrete pedestals were designed to provide the necessary support capacity. Concrete pedestal modifications includes anchorage of pedestal to dam mass concrete if .

3.3.4.2 Miscellaneous Metals Work At Outlet

Miscellaneous metals work at the outlet will consist of steel embedments and platforms. Embedded steel anchorages installed in concrete support structures will be provided for new and rehabilitated valves and operators and for new platform supports. Exposed anchorage steel will be hot dipped galvanized. Existing steel platforms will be modified and new platforms will be provided to facilitate access to valves and operators for operation, inspection and maintenance. Platform work will include support steel, grating, handrail, stairs and ladders. Support steel will be coated with appropriate paint. Grating, handrail, stairs and ladders will be hot dipped galvanized.

3.4 ELECTRICAL, INSTRUMENTATION AND CONTROL

3.4.1 ELECTRICAL SYSTEM

The incoming 480V service from Southern California Edison (SCE) is currently sized for 150 kVA. To accommodate the additional electrical load at the dam, this service will be upgraded to 500 kVA. The incoming service upgrade will require new transformers and a new transformer mounting platform. This work will be accomplished by SCE apart from the construction contracts.

The existing service disconnect switch, CT box, and meter are located in the old Transformer Room in the Diesel Generator Building. These will be replaced with a new 600-amp metering panel in approximately the same location. The metering panel will be designed to meet the requirements of SCE. A new 600-amp automatic transfer switch (ATS) will be placed adjacent to it.

The existing 75 kVA emergency diesel generator will be replaced with a new one rated for 375 kVA, 300 kW, and 0.8 power factor.

Three new 480V Motor Control Centers (MCCs) will be furnished and located as follows:

1. 1EP-MCC-01 will be located in the "Transformer Room" next to the diesel generator room, on the north wall. 1EP-MCC-01 will be connected to the load side of the ATS, and shall feed 1EP-MCC-02 and 1EP-MCC-03. It will also feed the Azusa Conduit Slide Gates, the MWD Outlet Tower Screen Hoist, Diesel Generator Auxiliaries, and new Power Panels in the Diesel Generator Room and Caterpillar Gate House.
2. 1EP-MCC-02 will be located in the corridor just east of the emergency gate chamber, on the south wall. It will feed the Guard and Sluice Gates HPU, 96" Guard Valves, Outlet Valves and Gates, Sump Pumps, Conduit Control House 3-ton Hoist, Domestic Water Pumps, Fire Water Pumps, and two Power Panels to be located at the east and west ends of the Emergency Gate Chamber. Power cables to this MCC will be routed from 1EP-MCC-01 through new conduits up over the parapet and down along the stairs to the Emergency Gate Chamber.
3. 1EP-MCC-03 will be located in the Spillway Chambers on the second floor from the bottom, in the room on the north side of the east chamber. It will feed the Drum Gate Inlet and Outlet Valves, the Fire Water Booster Pump, new Power Panels for the Control House and Spillway Chambers, and a new transformer for the cottage. Power cables to this MCC will be routed from 1EP-MCC-01 through new conduits up over and along the inside of the parapet to the southeast pylon, and through new conduits mounted to the existing handrail along the crest of the dam. New concrete duct bank will be installed to carry the cables from the southwest pylon to the spillway chambers.

By having three MCCs rather than just one, the number and length of power cables will be reduced because each MCC will be located nearer to the loads it will feed. A shorter distance to the loads will also result in less voltage drop, and smaller cables may be used.

Lockout/tagout provisions will be provided for all electrically-operated equipment at the MCCs. Each breaker and motor circuit protector in the MCCs will be padlockable in the "off" position. Separate disconnect switches will also be provided at each motor, giving the maintenance person a disconnecting means that is within sight of the motor. For motor operated valves and gates, the local disconnect switches will be intrinsic to the motor operators. Separate disconnect switches will also be provided for the hoists in the Caterpillar Gate House and Conduit Control House.

3.4.2 CONTROL SYSTEM

The control system will include a Programmable Logic Controller (PLC), Operator's Workstation, Engineer's Workstation, Alarm Printer, and Graphics/Reports Printer, all located in the new Control House. The PLC shall be fed from a small Uninterruptible Power Supply (UPS), also in the Control House. Three sets of Remote I/O Racks will be provided, one inside a spare section of each of the three MCCs. These I/O Racks will contain I/O points for the loads inside the MCCs, as well as any other instrumentation in the general area. Since the majority of the I/O points for the system will likely come from the MCCs, it makes sense to locate the I/O Racks as close to the MCCs as possible. By specifying an empty section in each MCC, the wiring may be done internally. Internal wiring could possibly be done at the MCC factory, saving time and labor in the field.

The PLC will be installed in the control room of the new Control House in an electronics cabinet. The PLC cabinet will also house the Department's existing Geomation MCU used for their Dams Automated Data Acquisition System (DADAS). The existing DADAS presently communicates with the Department's headquarters through both a satellite phone link and telephone line. The data from the new control system will be sent to headquarters through a new dedicated digital-grade telephone line to the Engineer's Workstation. An existing level transmitter in the Caterpillar Gate House is wired to the Geomation MCU. An analog output from the Geomation MCU will be hard-wired to send the reservoir level signal to the new PLC.

The following equipment will be controlled and monitored by the new PLC:

1. Drum Gate Inlet and Outlet Valves (six).
2. River Outlet No. 3 – 20-inch Jet Flow Gate, 48-inch Guard Slide Gate, and Bypass Valve.
3. River Outlet No. 4 – 40-inch Fixed Cone Valve, 54-inch Guard Slide Gate, and Bypass Valve.
4. River Outlet No. 6 – 72-inch Fixed Cone Valve, 96-inch Guard Butterfly Valve, and Bypass Valve.
5. Domestic Water Pumps.
6. Fire Water and Booster Pumps.

Each of the equipment listed above will have the capability of being controlled locally (at the equipment) or remotely (from the control room). A key-operated local-remote switch at the local control panel will allow the operator to choose which location will have control of the equipment.

The following equipment will be controlled locally only:

1. River Outlet No. 1 – 96-inch Guard Butterfly Valve.
2. River Outlet No. 2 – 48-inch Guard Slide Gate.
3. River Outlet No. 5 – 48-inch Guard Slide Gate.
4. Azusa Conduit Slide Gates (four).
5. Sluice Tunnel Slide Gate.
6. Sump Pumps.

The following local control panels will be provided:

1. One panel for the Azusa Conduit Slide Gates, to be located outside near the gate operators.
2. One panel for each Drum Gate (total of three), to be located in the Spillway Chambers.
3. One panel for the three Outlet Valves/Gates and Sluice Gate, to be located inside the Venturi Register House.
4. One panel for the six Guard Valves/Gates, to be located in the Emergency Gate Chamber.
5. One panel for the Domestic Water Pumps, to be located in the Conduit Control House.
6. One panel for the Fire Water Pumps, to be located in the Emergency Gate Chamber.
7. One panel for the Fire Water Booster Pump, to be located near the pump.

Each panel will contain one or more Local/Remote switches, which will be key-operated to prevent unauthorized operation of the equipment. Control devices will be installed on a swing panel inside the control panel. The control panels will be padlockable to prevent unauthorized tampering.

3.4.3 LIGHTING SYSTEM

The existing lighting system at the dam will be completely replaced, with the exception of the ornamental lights and poles along the crest of the dam. These fixtures will have their sockets and lamps replaced, and will be rewired to the new lighting panels.

The new lighting system was designed in accordance with the Illuminating Engineering Society (IES) Handbook, which provides guidelines for foot-candle levels for various applications.

Lighting inside the dam tunnels was designed for an average of five foot-candles, and lighting in the spillway chambers, emergency gate chamber, and existing buildings was designed to provide an average of twenty foot-candles. Light fixture quantity, spacing, and layout was designed with the help of *Visual 2.0* software from Lithonia Corporation.

The light fixtures inside the dam are currently fitted with a mini-fluorescent lamp made by General Electric. Through conversations with sales representatives of General Electric, it has been learned that these lamps are designed for residential or commercial use, and are not intended to be installed inside an enclosed fixture unless the power is less than about 15 watts. Using a lamp greater than 15 watts inside an enclosed fixture will greatly reduce the expected life of the lamp. Using 15-watt lamps would result in too many fixtures to obtain the lighting levels required. An open-style fixture may be used with larger wattage lamps, but this is not recommended from a safety point of view. Fixtures and lamps in tight spaces could be easily damaged, and they could not be used in any wet locations. Furthermore, most open-style fixtures are impractical for this application. Therefore, the mini-fluorescent lamps and existing fixtures will be replaced.

New fixtures inside the dam will be corrosion-resistant industrial fluorescent type. Fluorescent fixtures are more efficient and longer lasting than incandescent fixtures. The large quantity of fixtures required to light the inside of the dam means that efficiency and life expectancy are important concerns. Fluorescent fixtures also have excellent color rendition, and obtain full light output upon energizing much quicker than High Intensity Discharge (HID) fixtures. They are preferred over HID fixtures for indoor lighting because of these reasons.

New outdoor fixtures will be HID for their efficiency and high light output. Types of HID fixtures include Metal Halide, Mercury Vapor, High Pressure Sodium, and Low Pressure Sodium. A comparison of various types of HID fixtures is shown in Table 3-1.

Table 3-1 HID Lighting Fixture Comparison

Type of Fixture	Color Rendition	Efficiency	Fixture Cost
Metal Halide	Very Good	Fair	High
Mercury Vapor	Good	Poor	Low
High Pressure Sodium	Fair	Good	Medium
Low Pressure Sodium	Very Poor	Very Good	Medium to High

High Pressure Sodium fixtures offer the best combination of color rendition, efficiency, and fixture cost for this application. They are also very common and replacement fixtures and lamps may be easily obtained. Therefore, High Pressure Sodium fixtures will be used for all new outdoor lighting.

Areas that will require new or additional lighting include:

1. Corridors in the Open Joint.
2. The Azusa Conduit Gate area outdoors.
3. The parking lot for the new Control House.
4. The parking area at the base of the dam.
5. The area at the base of the dam outside the Shaft No. 1 Pumphouse.
6. The upstream and downstream sides of the spillway, lit from the crest.
7. Outside the portals leading to stairs inside the dam and spillway chambers.

The lighting system will be powered from new 480/277V, 3-phase, 4-wire power panels. Each power panel will be fed from one of the 480V MCCs, and each will feed a separate 480-208/120V, three-phase dry type transformer and 120/208V, 3-phase, 4-wire lighting panel. The following sets of new power and lighting panels will be provided:

1. One set in the Standby Generator Room for lighting along the crest of the dam, the Azusa Conduit Structure, and the Standby Generator Room.
2. One set in the new Control House for lighting in the building and parking lot outside.
3. One set in the Spillway Chambers near 1EP-MCC-03, for lighting in the chambers and along the spillway bridge outside.
4. One set on the east side of the Emergency Gate Chamber for interior and exterior lighting on the east half of the dam.
5. One set on the west side of the Emergency Gate Chamber for interior and exterior lighting on the west half of the dam.
6. One power panel in the Caterpillar Gate House for interior and exterior lighting on the structure. The existing lighting panel and transformer on the outside of the Caterpillar Gate House will be kept in place and fed from the new power panel.

Battery-powered emergency lighting will also be required to allow personnel inside the dam to find their way out in the event of a power outage. Light fixtures with battery back-up will be provided as required to illuminate egress routes during the time before the diesel generator restores power, or in the event that it fails to start.

Exit lighting is also required to assist personnel in finding their way out of the dam. Illuminated exit signs will be provided at various tunnel and corridor intersections for this purpose. Exit lights will be self-luminous type with tritium-filled gas tubes.

3.4.4 TELEPHONE SYSTEM

The existing control house has only two incoming phone lines, plus a third line for the cottage. The service will be upgraded from three to six lines for the following uses:

1. Control House Telephone.
2. Control House Fax Machine.
3. Cottage Telephone.
4. Operator's personal computer.
5. Engineer's personal computer.
6. Telephone at Engineer's work space.

In addition to these lines, a separate dedicated digital-grade telephone line will be required for communication between the control system and the Department's headquarters in Alhambra.

The existing telephone line from the Metropolitan Water District (MWD) will be connected to a new telephone on the Operator's Console in the Control Room.

Two telephone signaling stations will be installed, one along the crest and one at the base of the dam. Each signaling station will consist of a horn and strobe light, and will signal whenever an incoming call is received. The call may be answered from any phone at the dam by dialing the main extension. If the call is not answered within three or four rings, it will be sent to an automated system that allows the caller to choose an extension to dial. Separate phones around the dam will each have their own extension. Phones in areas of high noise will be installed in a sound attenuated vestibule. New telephones will be installed at the following locations:

1. Control House Break Room.
2. Control Room Operator's Console - Operator's Phone.
3. Control Room Operator's Console - Engineer's Phone.
4. Control Room Operator's Console - MWD Phone.
5. Spillway Chambers, west end.
6. Spillway Chambers, east end.
7. Standby Generator Room.
8. Emergency Gate Chamber.
9. Venturi Register House.
10. Caterpillar Gate House.
11. Conduit Control House.
12. Main Corridor Entrance at the base of the dam on the east side.

3.4.5 INSTRUMENTATION

New level transmitters will be installed in the Domestic Water Tank and Fire Water Tank, located up on the west abutment hill, for control of the Domestic and Fire Water Pumps. A pressure transmitter will be installed on each Drum Gate Chamber, to measure the water pressure inside the chamber. Each Drum Gate will also have a cable extension position transmitter installed to measure the gate's angular position. Inlet pressure switches will be installed for the Domestic Water Pumps and Fire Water Booster Pump. The Open Joint Sump will have a float-type level switch installed to alarm on high water level. The Control House wastewater holding tank will also have a float-type level switch installed to indicate when the tank is full.

River Outlets 3, 4, and 6 will each have a differential pressure switch installed across its respective Guard Valve or Gate. The switch will close a contact when differential pressure has equalized across the Guard Valve/Gate, allowing it to open.

3.4.6 CATHODIC PROTECTION

A cathodic protection system will be required to protect the flanged penstocks from corrosion. The cathodic protection system will include sacrificial anodes on the interior of the pipes.

3.4.7 CCTV SYSTEM

A single video camera with pan-tilt-zoom control will be installed on the concrete structure for the 80" MWD conduit near the Conduit Control House to provide the operators with a view of the dam outlets. Its signal will be wired to the Operator's personal computer in the control room. The operator will be able to control the camera remotely from the control room.

3.4.8 CABLE AND RACEWAY

Existing exposed conduits inside the dam will be replaced wherever new wiring will be installed. Certain existing conduits are lead, and special care must be taken in removing them. The existing cables may also contain lead or asbestos. Specifications will be provided by the Department to instruct the Contractor in removal of these hazardous materials.

Demolition drawings have been prepared showing all equipment and materials to be removed by the Contractor. These drawings have been prepared by importing existing drawings into Microstation and adding hash marks over the equipment and materials to be removed.

New raceways inside the dam will consist of rigid galvanized steel (RGS) conduits for exposed locations. Some existing embedded conduits will be used for routing new cables, while new embedded conduits will be installed wherever existing embedded conduits are unable to be re-used.

3.4.9 GROUNDING

All exposed non-current carrying metallic parts of new electrical equipment, raceway systems, and the neutral of all wiring systems will be grounded in accordance with the requirements of NEC, state, and other applicable codes. The raceway will be bonded to metallic structural components such as structural steel, handrails, piping, etc. wherever feasible to ensure the integrity of the ground network and minimize ground resistance. All new electrical equipment will also be bonded to ground in the same manner.

3.5 AZUSA CONDUIT

3.5.1 Performance Parameters

The existing slide gates at the Azusa Conduit Outlet Structure will be rehabilitated with new seats and guides and new electric motor-operators. The motor-operators will be capable of operating the side gates at the rate of approximately 1 foot per minute. The capacity of the Azusa Conduit slide gates will remain unchanged.

3.5.2 Local control

The electric motor-operators will be operated by means of a local control panel near the Azusa Conduit structure.