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OPERATION AND MAINTENANCE MANUAL, MELVERN LAKE, MARAIS DES CYGN--ETC(U)
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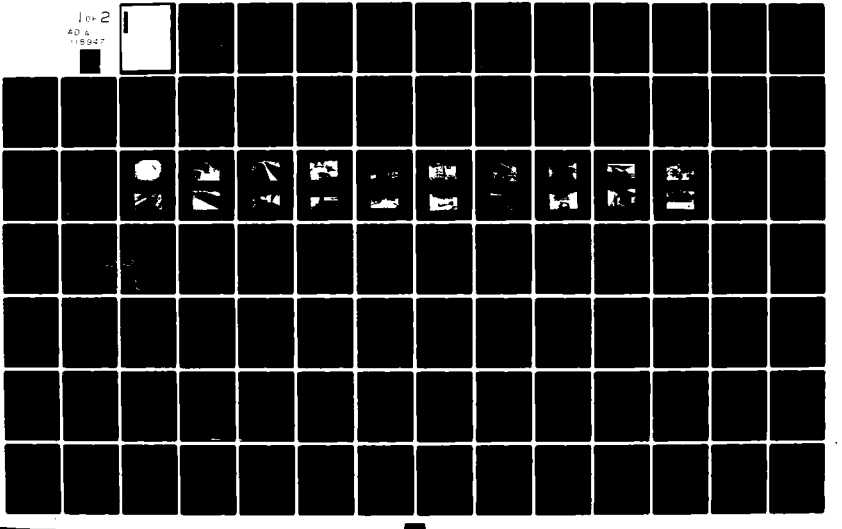


US ARMY, CORPS OF ENGINEERS

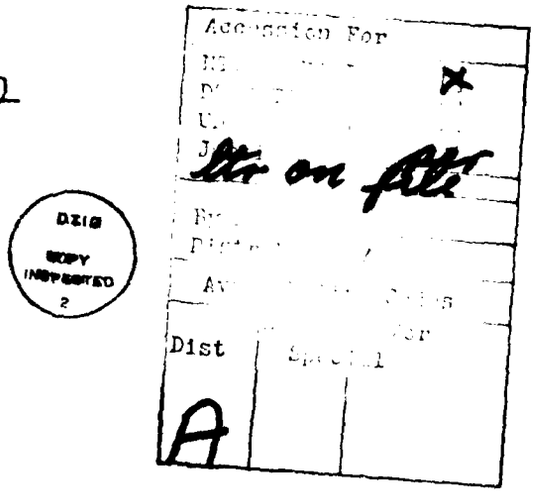
OPERATION AND MAINTENANCE MANUAL

MELVERN LAKE
Marais des Cygnes River, Kansas

APPENDIX V

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

August 1982



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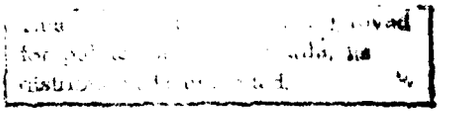

OPERATION AND MAINTENANCE MANUAL
MELVERN LAKE
MARAIS DES CYGNES RIVER, KANSAS

APPENDIX V
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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DRAWINGS

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KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
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MELVERN LAKE
MARAIS DES CYGNES RIVER, KANSAS

APPENDIX V
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

CHAPTER 1
GENERAL

1-01. Location. Melvern Lake is located 4 miles west of Melvern, Kansas. The dam crosses the Marais des Cygnes River (Osage River in Missouri) in Sections 1, 2 and 12, T18S, R15E, and Section 35, T17S, R15E, in Osage County. See Plate No. 1.

1-02. Project Authorization. Melvern Lake was authorized by Federal flood control legislation and constructed by the US Army Corps of Engineers, Kansas City District. This project was authorized by the Flood Control Act of 1954 (Public Law 780, of the 83d Congress).

1-03. Project Purpose. The purposes for which Melvern Lake was constructed are flood control, water supply, improved water quality, public recreation, and benefits to fish and wildlife.

1-04. Purpose and Scope of the Report. The purpose of this Embankment Criteria and Performance Report is to assemble information on the embankment conditions of the project. It provides a summary record of significant design data, design assumptions, design computations, specification requirements, construction equipment, construction procedures, construction experience, field control and record control test data and embankment performance as monitored by instrumentation during construction and during initial lake filling. This report is intended to provide in one volume the significant information needed by engineers to (1) familiarize themselves with the project, (2) re-evaluate the embankment in the event unsatisfactory performance occurs, and (3) provide guidance for designing comparable future projects.

Pertinent Data

1-05. General.

Location of the Project	On Marais des Cygnes River, 4 miles upstream of Melvern, Kansas
Operating Agency	Corps of Engineers Project Manager onsite
Purpose	Flood control, water supply, water quality, recreation, and fish and wildlife
Authorization	Flood Control Act of 1954, Public Law 83-780, Water Supply Act of 1958, Title II Public Law 85-500
Closure of Dam	2 October 1970
Began Multipurpose Operations	January 1975
Cost of Project Dam & Reservoir	$26,230,000 (1963)

Basin

Drainage area above Dam	349 square miles
Approximate Length of Lake	13 miles
Average Width of Lake	1 mile
Channel Capacity:	
Dam to confluence with 110-mile Creek	9,000 sec.-feet
Zero damage flow in above reach	7,000 sec.-feet
Fee Taking Line, elevation m.s.l.	1,062.0 feet
Maximum Discharge of Record at Melvern, Kansas, 11 July 1951	68,500 c.f.s.

Dam and Embankment

Type	Rolled earthfill
Fill Quantity	8,000,000 cubic yards
Crest Elevation	1078.0 feet
Top Width	30 feet
Maximum Base Width	915 feet

Dam and Embankment --con.

Length	9,750 feet
Maximum Height above Streambed	123 feet
Freeboard	5 feet
Type and Number of Instrumentation Devices:	
Air Operated Earth Pressure Cells (Goetzl Cells)	5 each
Sonic Transducer Boxes	6 each
Piezometers in Conduit	24 each
Alinement Lines	2 each
Air Operated Pore Pressure Cells	31 each
Open Tube Piezometers	33 each
Settlement Devices	3 each
Settlement Monuments (on crest)	9 each

Reservoirs

Pool	Elevation of Top of Zone (ft., m.s.l.)	Surface Area (Acres)	Storage Allocation Initial (ac.-ft.)	Storage Allocation 100-year (ac.-ft.)
Surcharge	1073.0			
Flood Control	1057.0	13,950	209,000	200,000
Multipurpose	1036.0	6,930	154,000	137,000
Gross Storage		---	363,000	337,000
Sedimentation Reserve				26,000*

*Initial distribution 1/3 (9,000 acre-feet) to the flood control zone and 2/3 (17,000 acre-feet) to the multipurpose zone.

Spillway

Location	2,000 feet beyond left abutment
Type	Uncontrolled
Crest Elevation	1057.0 feet
Width	200 feet
Discharge Capacity at Elevation 1073.0 feet	35,500 c.f.s.
Side Slopes	1 on 2.5

Outlet Works

Location	Dam Station 45+00 near right abutment
Type	Single Horseshoe, 11.5 feet diameter
Invert Elevation of Conduit	Intake 962.0 feet Outlet 952.0 feet
Length of Conduit	Portal to Portal 855 feet Conduit only 767 feet
Capacity at Elevation 1057.0	Two service gates fully open - 7,100 c.f.s.
Capacity at Elevation 1036.0	Two service gates fully open - 6,300 c.f.s.
Service Gate No., Size, Type	Two 6- by 12-foot, hydraulically operated slide gates with 2- by 2-foot low flow gate
Emergency Gate No., Size, Type	Two 6- by 12-foot, hydraulically operated slide gates
Stilling Basin	30- by 84-foot single rectangular

1-06. List of Contracts.

Project	Contract No.	Construction Dates Begun	Accepted
Relocation of State Highway	67-C-0015	28 Oct 66	5 Nov 73
Right Abutment Access Roads	67-C-0164	29 May 67	3 Jul 68
Construction of Melvern Dam	68-C-0012	10 Aug 67	21 May 73

List of Contracts. --con.

Project	Contract No.	Construction Dates Begun	Accepted
Construction of Administrative Facilities	68-C-0018	31 Aug 67	4 Oct 68
Relocation, Rearrangement or Alteration of Facilities	68-C-0021	22 Jan 68	3 Nov 72
Alteration of Gas Pipeline	70-C-0014	9 Apr 70	13 Apr 71
Relocation, Removal and Alteration of Powerlines	70-C-0047	29 Jun 70	6 Nov 72
Relocation, Removal of Electrical Powerlines	71-C-0003	12 Jul 70	15 Aug 73
Relocation, Alteration, and Removal of Telephone Lines	71-C-0016	8 Jan 71	9 Sep 72
Relocation and Alteration of Telephone Facilities	71-C-0017	23 Jun 71	5 Oct 72
Osage County Road Relocation and Sun Dance Public Use Area Development, Phase I	71-C-0018	26 Aug 70	13 Dec 72
Clearing, Stage I	71-C-0135	17 May 71	10 Feb 72
Construction of Public Use Area Development, Phase I	72-C-0005	6 Aug 71	2 Jun 72

List of Contracts. --con.

Project	Contract No.	Construction Dates Begun	Accepted
Construction of Osage County Road Relocation, Phase II	72-C-0086	11 Feb 72	1 May 74
Lake Clearing, Stage II	72-C-0108	28 May 72	29 Sep 72

1-07. Project Features. The project consists of three principal features; (1) rolled earthfill embankment, (2) controlled outlet works, and (3) uncontrolled service spillway. See Plate No. 2. The embankment extends 9,750 feet across the valley and rises 123 feet above the streambed. The controlled outlet works consists of an intake tower, a conduit extending through the embankment, a stilling basin, and approach and outlet channels. The control tower is equipped with two hydraulically operated slide gates and two emergency gates to regulate the flow through the dam. The single horseshoe conduit 11.5 feet in diameter, is 767 feet long and has a discharge capacity of 7,100 cubic feet per second at full pool. The stilling basin is constructed to reduce the velocity of water released through the conduit before flowing into the outlet channel. The uncontrolled, 200 feet wide emergency service spillway is located in a small draw on the left abutment. The spillway concrete control sill, 25 feet in breadth, extends across the entire spillway width and is anchored to the limestone below. The spillway crest elevation 1057.0 controls the full pool reservoir which has a storage capacity of 337,000 acre-feet. The Melvern Lake multipurpose pool elevation is 1036 feet, with a surface area of 6,930 acres extending upstream approximately 13 miles from the damsite to a point in the streambed near the Lyon-Osage County line north of Reading, Kansas. The flood pool elevation, 1057.0 feet, has a surface area of 13,950 acres. The dam is situated just downstream from where Elm Creek, 142-Mile Creek, Duck Creek, and Hill Creek all converge to form the main stem of the Marais des Cygnes River. The general flow of the Marais des Cygnes River is eastward toward the Kansas-Missouri state line. In western Missouri, it is joined by a number of other streams to form the Osage River, which flows into the Missouri River just east of Jeferson City, Missouri. The Osage River, together with its Marais des Cygnes River tributary, drains a watershed area of 15,300 square miles in east-central Kansas and west-central Missouri. Three hundred and forty-nine (349) square miles of this watershed comprise the drainage area for Melvern Lake.

1-08. Embankment Description. The embankment is approximately 9,750 feet in length, with a maximum height above the streambed of 123 feet, and an average height above the flood plain of 100 feet. Elevation of top of dam is 1078.0, which includes freeboard allowance of 5.0 feet above the maximum spillway design flood. Crest elevation of the uncontrolled service spillway is at full pool elevation 1057.0, 21.9 feet below top of dam. The rolled fill embankment consists of impervious, pervious, random, and berm zones. The centrally located impervious zone includes a cutoff trench extending to bedrock. The upstream and downstream random and berm zones were designed to make uses of material from required excavations and near by borrow. A downstream inclined and horizontal pervious drain are provided for seepage control. In order to decrease the length of the conduit and provide better seepage control, the embankment around the conduit was constructed entirely of impervious except for the pervious drain. The top width of the embankment is 30 feet, and accommodates a 30-foot wide service road. For the typical valley section an upstream slope of 1V on 3H has been used from the crest (elevation 1078.0) to elevation 1041.0, followed by a 1V on 8H slope to elevation 1015.0, then a 1V on 4H slope to the ground surface. The downstream valley slope is a 1V on 2.5H from the crest to elevation 1048.0, followed by a 1V on 6H slope to elevation 1008.0, then 1V on 4H to the ground. The conduit section upstream slopes are 1V on 3H to elevation 1048.0, 1V on 5H to elevation 988.0, and 1V on 3.5H to the ground surface. The downstream conduit slopes are 1V on 2.5H to elevation 1048.0 and 1V on 5H to the service road behind the stilling basin.

1-09. History of Construction Contract. The basic embankment and outlet works construction was accompished in one stage, beginning in August 1967, and final acceptance of the work was made 21 May 1973. Excavation and embankment placement ws done by the prime contractor, Cook Construction Company of Jackson, Mississippi. The drilling and grouting for the grout curtain was accomplished by subcontractor, Golden Drilling Company of Golden, Colorado. The concrete structures for outlet works and stilling basin were done by subcontractor, Bushman Construction Company of Grand Island, Nebraska. All work during construction was done under the supervision of the Resident Engineer's office, Melvern Dam and Reservoir, Mr. Kenneth A. Rowen, Resident Engineer. Initially Mr. Reuben J. Vig was the Project Geologist followed by Mr. John Doty. Mr. Marty Mueller was the chief embankment inspector. Total bid price of the construction contract was $9,834,632; total final payment was $10,056,206.10. There were a total of 45 modifications to the contract.

1-10. Significant Operational Events. The only significant operational events since project completion have been associated with

pool levels. The first event was the first filling of the reservoir, beginning in March 1973 and continuing in June 19.. when the pool rose to elevation 1040.0. (Multipurpose pool elevation 1036.0 was reached in April 1975.) The second event occurred on 27 June 1977 when the pool reached a maximum elevation of 1047.07, 11.07 feet above the normal fool. The project stored 246,650 acre-feet of flood water and prevented significant flood damaged downstream. Slow release of the storage continued until the pool was again at the normal level. The embankment, outlet works, and riprap protection performed satisfactorily during these two events.

CHAPTER 2
SITE GEOLOGY

2-01. Geologic Structure. The Melvern Lake is located within the Osage Plains section of the Central Lowlands Physiographic Province. The topography is that of a dissected plain developed on unequally resistant shale and limestone formations. The gently rolling topography has valleys which are comparatively wide in reference to the height of the surrounding hills. The hills have moderate to steep slopes and are about 100 to 150 feet above the valley floor. Kansas is in the Central Stable Region of North America, an extension of the Canadian Shiels. A thin mantle of sedimentary rocks consisting of many thin units lying nearly parallel to one another cover the Pre-Cambrian complex. The Melvern damsite lies in the southwestern part of the structure province called the Forest City Basin. The proximity of the Basinal axis, the Brownville Syncline to the Nemaha Anticline produces an asymmetrical profile. The beds on the west flank are relatively steep while the beds on the east flank rise gently toward the Ozark Dome in Missouri. The gradual westward dip of 20 to 30 feet per mile from the Ozark Dome to the Brownville Syncline forms the structure called the Prairie Plains Homocline. Melvern damsite is located on the Homocline. Pleistocene deposits in Kansas consist chiefly of fluvial deposits. Glacial sediments left by the retreating ice sheet occurs only in the northeastern section of Kansas. The fluvial deposits in the streambeds and flood plain of the valleys consist of clay, silt, sand and gravel. These deposits are of Wisconsin and Recent age. The embankment fill was obtained from the unconsolidated deposits of Recent and Pleistocene age. This material consists of residual, colluvial, and fluvial deposits. The major source of material for the embankment was obtained from the alluvial deposits of the flood plain in the upstream and downstream borrow areas. See Plate Nos. 11, 12 and 13 for geologic information. Preliminary investigations for the Melvern damsite were made during the fall and winter of 1940-41, and included 23 borings, as part of a study on the Marais des Cygnes basin. Investigations include a total of 327 additional borings consisting of auger, drive, push (undisturbed) and core (primarily NX 2-1/8 inches), made during the period from September 1963 through September 1966. Refraction seismograph and electrical resistivity studies were also used for investigations. Foundation borings for the embankment, spillway and outlet works structures were obtained. Many of the embankment foundation borings were assigned to obtain undisturbed samples for triaxial testing of bedrock members. The siting of the spillway and intake tower structures were dependent primarily on the position of certain limestone members. During construction, about 20 test pits were dug in the borrow areas by a bulldozer. The purpose was to obtain additional information for delineating the type of borrow material available for the embankment. Embankment observation devices were installed during the fall of 1967 and spring of 1968. A total of 39 holes were drilled; 24 for pore pressure devices; 12 for piezometers; and 3 for settlement plates.

CHAPTER 3
EMBANKMENT DESIGN AND CONSTRUCTION

3-01. Foundation and Abutment Treatment. The foundation for the cutoff trench was excavated to firm bedrock. Considerable more excavation was required than originally estimated, due to highly weathered and jointed limestone. Vertical joints in the limestone varied from hairline up to 1 foot in width. The larger joints were filled with a very soft, moist, fat clay which was not considered to be a suitable material. Badly weathered limestone was removed until the joint openings were closer spaced and contained a sufficient cover of firm shale above it. A modification was made to the contract to place filter gravel against exposed ledges of limestone on the downstream side of the cutoff trench. The purpose was to prevent piping of impervious fill through any passageways in the limestone. No leakage problems were anticipated and leakage around the ends of the abutments would require long passage for the water. Extension of the grout line at both ends of the abutment could be accomplished easily at little expense requiring no drilling in the embankment fill. The shale of the Tecumseh A was very soft and moist in the vicinity of station 37+00 and some trouble was encountered in cleaning the foundation before placing impervious backfill. Artesial pressure was encountered in grout holes in this area. The artesian elevation is at or above multipurpose pool of 1036.0.

3-02. Seepage Control.

a. General. Seepage beneath the embankment is controlled by the impervious cutoff and bedrock grouting under the embankment impervious zone. Seepage through the embankment is controlled by an inclined and horizontal pervious drain.

b. Underseepage. A cutoff trench was determined necessary because of the possible permeability and interconnection of the lower foundation lenses and strata as interpreted from borings; the borderline factors of safety against uplift pressure at the downstream embankment toe, and the inability to design relief wells to relieve excess pressures in the semipervious thin lensed water bearing strata.

c. Through-seepage. Several different geometric configurations for the pervious zone were considered. The adopted design was the most economical scheme considered fully adequate. An alternate material considered for use in the horizontal portion of the adopted design was 3 feet of grizzled rock mixed with 18 inches of grizzly fines. The cost of this alternate was $330,000 more and was not considered as desirable as the natural sand that was used. Because the pervious material was costly, extensive studies were undertaken to obtain maximum seepage

control with minimum pervious material. Positioning of the inclined pervious was the result of stability studies which balanced overall embankment size and required quantities for pervious material. The selected position utilized the maximum stability for the smallest embankment and pervious drain size. The inclined pervious location assures the saturation line is kept well within the downstream slope and provides filter protection against failure due to embankment cracking for the most frequent pool elevations.

3-03. Slope Protection.

a. General. Two graded riprap layers were placed on the embankment. The 30-inch layer which was placed above elevation 1037.0 and on the 1V on 5H conduit slope, was underlain with a 12-inch spall layer and 12-inch spall layer and 12-inch bedding layer. The 24-inch graded riprap layer on the 1V on 8H slope was placed over a 9-inch spall layer and 6-inch bedding layer the riprap and embankment. A 5-foot layer of limestone was placed on the 1 on 8 slope between elevations 1015.0 and 1027.0 (10-year drawdown). A 3-foot layer of limestone and shale was placed between the natural ground and elevation 1015.0. A 36-inch graded riprap layer (with 12-inch spalls and 12-inch bedding) was placed in the stilling basin area of the outlet channel. Stone for riprap was not blasted or quarried between 1 October and 1 April. Type "C" (36-inch) riprap in the closure area was stockpiled and allowed to dry for a period of 3 months prior to placement. To facilitate drying, the stockpile did not exceed 6 feet in height.

b. Placement. The better quality rock material was used for the graded riprap. Poorer quality materials (limestone and shale) were used between the bottom of the riprap and natural ground. The poorer quality rock provided protection while the reservoir was being filled and in case lower drawdown occurs. Each layer of slope protection was placed in one operation to the full layer thickness. To provide increased erosion protection on the berm, a minimum 5-foot layer of fat clay was placed immediately underlying the slope protection. Since fat clay was in ample supply in the borrow area and was a short haul, its use at this location was cost effective.

c. Gradations. The 5-foot layer of limestone fill was hard durable limestone with a maximum allowable size of 30 inches. Fifty percent of the rock was between 6 inches and 12 inches, with 5 to 20% passing the 2-inch screen. The 3-foot layer of limestone and shale on the 1 on 4 slope between natural ground and elevation 1003.0 was a well graded mixture of Jackson Park Shale from required excavation. Between elevation 1003.0 and 1015.0 the shale-limestone contained a uniform distribution of limestone and shale from the Ozawakie Limestone Zone "A" spillway excavation. The source of stone for riprap, bedding and spalls

was the Cook Construction Company Quarry located 1-1/2 miles southwest of Melvern, Kansas, NW 1/4 Section 16, T18S, R16E, Osage County. A 16-foot ledge of the Plattsmouth Limestone from the Oredd Formation, Shawnee Group was approved. Stone protection materials were a reasonably uniform material graded from coarse to fine within and between the following limits:

Sieve Size	Percent by weight passing
Bedding	
2-inch	Maximum allowable size
1/2-inch	75-95
No. 10	35-50
No. 40	5-20
Spalls	
8-inch	Maximum allowable size
4-inch	70-90
1 1/2-inch	15-40
1-inch	0-15

Weight in pounds per stone	Percent of total weight lighter than
Type "A" Riprap (24-inch)	
700	Maximum allowable size
500	85-95
200	30-50
50	0-10
Type "B" Riprap (30-inch)	
1,600	Maximum allowable size
1,300	85-95

600	30-10
100	0-10

Type "C" Riprap (36-inch)

2,400	Maximum allowable size
1,800	85-95
600	30-50
50	0-10

3-04. Diversion and Closure. During the initial period of outlet works construction, a levee was built for protection against floods. The river was temporarily diverted into a diversion channel around the approach walls and intake tower, through the embankment area and along the downstream embankment toe. The embankment to the left of the diversion channel ws constructed to a minimum elevation of 1041.0, the outlet works completed, and right bank embankment was constructed to elevation 1060.0. Diversion of the river through the outlet works began 15 September 1970. The general plan of making final diversion and closure is shown on Plate No. 7 and involved the following sequence of operations:

a. Removal of downstream channel plug and outlet works protection levee leaving the upstream river channel plug until last.

b. Construction of the diversion dike to elevation 979.0.

c. Foundation excavation and cleanup in closure area.

d. Construction of the initial upstream cofferdam to elevation 1000.0.

e. Construction of remainder of the upstream cofferdam to elevation 1015.0 and placement of the downstream cofferdam to elevation 972.0.

f. Completion of the closure embankment to an effective elevation of 1041.0 by March 1971. Details of the various operations and selection of cofferdam elevations are discussed in subsequent paragraphs.

3-05. Time of Diversion. The period of 1 August to 31 March was selected for diversion and closure. The river was diverted through the outlet works on 15 September 1970 and actual closure of the dam began on 2 October 1970. The upstream cofferdam was constructed to elevation 1015.0 in order to provide protection against flows during the closure period.

3-06. Diversion Dike. The diversion dike was located at the upstream edge of the cofferdam. It had a top width of 15 feet at elevation 979.0. Most of the material was stockpiled adjacent to the riverbank for quick placement at the start of diversion. The resultant dumped fill was sufficiently impervious to reduce the flow without the addition of special blanketing material on the upstream slope other than channel fill. During diversion channel construction muck and silt were removed from beneath the diversion dike and replaced with impervious material. To reach elevation 979.0 the diversion dike required the placement of about 9,000 cubic yards.

3-07. Upstream Cofferdam. A top width of 50 feet was established, which was adequate for a two-way haul road and to allow room for quickly raising the cofferdam if high water occurred. The cofferdam top elevation was 1015.0 and the base width 475 ft. Because the compaction control during the cofferdam construction was difficult and hurried, it was considered to locate the cofferdam slightly outside the upstream embankment slope. However, since the cofferdam was constructed entirely of random material (no berm material), it was finally decided to locate it so the upstream slope coincided with the upstream embankment slope. After the diversion dike construction, muck and silt were removed from beneath the cofferdam, beginning at the upstream end and continuing downstream as the diversion channel drained. The cofferdam was completed as fast as practical by placement of rolled random material, concentrating initially in the upstream area required for initial protection to elevation 1000.0. Impervious channel fill upstream of the cofferdam was placed concurrently with cofferdam construction in order to lengthen the seepage path beneath the cofferdam in the event high water occurred.

3-08. Downstream Cofferdam. Construction of the downstream cofferdam (elevation 972.0) was delayed until the water had drained out of the closure area. This cofferdam was outside the embankment limits; therefore, only traffic compaction was required.

CHAPTER 4
EMBANKMENT SPECIFICATION REQUIREMENTS

4-01. General. Significant types of materials that were placed in the embankment were impervious, random, berm, pervious, and rockfill. Materials were placed in the appropriate embankment zone as determined during the excavation. No material suitable for pervious or impervious was to be placed in the random zone unless it was apparent that there would be a surplus of the appropriate material for the required fill

4-02. Description, Placement, and Density Control of Embankment Material. The embankment specifications were based on guide specifications and experience on similar embankments built throughout the Kansas City District. The compaction specifications was a procedural one in that it specified the equipment and procedure to be used and the conditions of moisture and the material type necessary for compaction. The assumption was that if these procedures were used and the conditions met then the required density would be attained.

4-03. Compaction Equipment.

a. Tamping Rollers. The tamping rollers consisted of heavy duty, double drum units with a drum diameter not less than 60 inches and an individual drum length of not less than 60 inches. The drums were ballasted with liquid or sand and liquid. Each drum had staggered feet uniformly spaced over the cylindrical surface such as to provide approximately three tamping feet for each two square feet of drum surface. The tamper feet were to be seven to nine inches in clear projection from the cylindrical surface of the roller and have a face area of not less than 7 nor more than 10 square inches. The roller was equipped with cleaner bars, so designed and attached as to prevent the accumulation of material between the tamping feet, and these cleaner bars were maintained at their full length throughout the period of roller use. The weight of the roller were not less than 3,500 pounds per foot of linear drum length empty. The design and operation of the tamping roller were subject to approval. The allowable roller was self-propelled, speed was 2-1/2 to 5 miles per hour. The self-propelled sheepsfoot Model 50-55 roller manufactured by R. G. Le Tourneau, Inc. was the approved sheepsfoot roller.

b. Rubber-tired Roller. The rubber-tire rollers has a minimum of four wheels equipped with pneumatic tires. The tires were of such size and ply that they were maintained at tire pressures between 80 and 100 pounds per square inch for a 25,000 pound wheel load during rolling operations. The roller wheels were locatd abreast and so designed that each wheel carried approximately equal load in traversing uneven ground.

The spacing of the wheels were such that the distance between the nearest edges of adjacent tires were not greater than 50 percent of the tire width of a single tire at the operating pressure for a 25,000 pound wheel load. The wheel suspension was designed for traveling over rough and uneven ground. The roller had a rigid steel frame provided with a body suitable for ballast loading such that the load per wheel may be varied as direted from 18,000 to 25,000 pounds. The roller had to be fitted with cleaner bars if they would increase the equipment efficiency. The entire assembly (roller plus motivating equipment) had to be capable of executing a 180-degree turn on a 25-foot radius. The roller had to be towed at speeds not to exceed 5 miles per hour. The Grace 50 ton Model Mo. W18R, rubber-tired roller was approved for this operation.

c. Vibratory Rollers. The vibratory rollers has a total static weight of not less than 10,000 pounds with at least 90 percent of this weight transmitted to the ground through a single smooth drum when standing on level ground. The drum had a diameter of not less than 48 inches and a width between 60 and 72 inches, and the weight of the drum, shaft and internal machinery was not less than 6,500 pounds. The frequency of vibration during operation was within 1,100 and 1,500 vibrations per minute, and the dynamic or vibrating force at the operating frequency was not less than 15,000 pounds. The roller produced a total minimum compactive effort of 25,000 pounds (dynamic or vibrating force plus the static weight of the roller). The roller was towed at speeds not to exceed 1.5 miles per hour by a suitable crawler-type tractor, or be self-propelled. For self-propelled rollers, in which steering was accomplished through the use of rubber tire wheels, the tire pressure was not to exceed 40 pounds per square inch. The roller was operated in the forward direction except as otherwise approved for the equipment to be used. The Seishuc Model VP-10 was approved for use in compacting the pervious material.

4-04. Moisture Control: Impervious. The moisture content was required to be as uniform as practicable throughout any one layer of material. The upper limit of moisture content was that which permitted excavating, hauling, placing, and proper compaction without excessive deformation of the embankment but was not more than three percent above the optimum value at maximum density. The lower limit of moisture content was not more than two percent below the optimum value. The optimum water content was determined as specified for standard compaction test in Corps of Engineers Manual EM 1110-2-1906 dated 10 May 1965, Appendix VI. Material that had a moisture content greater than specified was spread on the embankment and permitted to dry, assisted by discing or harrowing, if necessary, until moisture content was reduced to within the specified limits. Each layer of material that had a moisture content less than specified was sprinkled on the fill and worked with harrows, discs, or other approved methods until the moisture content was within

the range specified and uniform distribution of moisture was obtained.

4-05. Pervious. The material was wetted as directed, to facilitate compaction. The amount of water added essentially produced saturation when the material was being compacted. Water was applied by power spray, which uniformly wet the material without erosion or ponding.

4-06. Random. Moisture content was controlled the same as impervious.

4-07. Berm. Moisture content was limited to the extent required to permit even routing of the hauling equipment.

CHAPTER 5
INSTRUMENTATION

5-01. General. Instrumentation was installed for the following purposes.

a. To measure pore pressures during construction in foundation overburden clays and shales.

b. To measure pore pressures during construction in compacted embankment material.

c. To measure hydrostatic pressures and establish underseepage gradients in basal gravels after completion of the project.

d. To measure total earth forces on the side and back of the intake tower.

e. To measure foundation settlement during and after construction.

f. To measure combined foundation and embankment settlement upon completion of the project.

Instrumentation to determine foundation excess hydrostatic pressures was limited to the area where the embankment exceeds 50 feet in height. All initial installations were done by hired labor crews who were experienced in similar installations. Extensions as necessary were accomplished by the Contractor.

5-02. Location. The location of all devices are shown in Plate No.14. They are also shown in cross sections at stations where devices have been concentrated.

a. Devices to check excess hydrostatic pressures in foundation shales are located at stations 44+00 and 84+00 to check the pressure in the Doniphan shale and at station 56+00 to check the Jackson Park shale. They are set in the weathered shale about 10 feet below the top of bedrock.

b. To check possible pore pressure buildup in the foundation clays during construction, devices were grouped at stations 54+00, 60+00, 72+00 and 80+00, with additional isolated devices at other locations. At each of these stations, the devices were located under the embankment both upstream and downstream of centerline and at the downstream toe to measure possible lateral transfer pressure. The group at stations 72+00

and 80+00 are in the area where the lowest "Q" strengths were measured. Those at station 60+00 measured the possible pressure buildup in the typical valley foundation prior to closure and the group at station 54+00 measured pressures during the rapid construction of the closure area.

c. Embankment pore pressure devices included 5 installations near the bottom of the cutoff trench backfill since these were subjected to the maximum loading. Additional devices were installed at various locations and elevations throughout the embankment.

d. Devices to measure hydrostatic pressures in the foundation basal sands and gravels were located generally at the same stations as the foundation clay pore pressure installations. Because of the unknown continuity and permeability of these foundation gravels, these devices furnished information on possible construction pore pressures if they happened to fall in discontinuous or perched pervious pockets.

e. Five total pressure devices were installed on the intake tower to measure the earth forces transmitted to the tower. Two devices were installed on the side of the tower and three on the back.

f. Three settlement plates were installed at the original ground surface in the valley at stations 53+50, 60+00 and 75+00 to measure foundation settlement during and after construction.

g. Settlement monuments were established along crest of the dam after construction to measure the total embankment and foundation settlement which occurs after construction.

5-03. Pressure Cell and Piezometer Devices. Pneumatically operated pressure cells included both Warlam cells and Shannon-Wilson (Slope Indicator Co.) cells. The Casagrande type (open-tube) were used for the upstream devices to avoid carrying the tubes required by the pneumatic devices through the impervious section of the embankment. The pneumatic devices were used for two reasons: Their response time should be faster than the open-tube devices, especially in clay or shale and they eliminate the construction difficulty of extending pipes up through the embankment. Furthermore, the mortality rate in past installations of the Casagrande type had been quite high because of settlement drag on the pipe, coupling failures and leakage. It was felt that much of this could be avoided with the pneumatic device. A monitor box for reading the Warlam and Shannon-Wilson cells is located at the downstream toe where a number of the lines are collected at one location for reading. The installation details for both pneumatic cells and Casagrande type piezometer are shown on Plate No. 15. Past experience has shown that the principal problems in installations of the Casagrande type in getting a

positive seal at the tip to prevent pressures from escaping along the sides of the drill hole and in providing means to eliminate drag on the pipe above the tip during settlement. Granular bentonite was used to provide a seal in installations where the drill hole was dry. Bentonite balls (Pi-pellets) manufactured by Joy Drilling Co., 700 Whittier St., Bronx, N.Y., were substituted for the granular bentonite where conditions were such that the installation must be made under water. The use of bentonite balls for under water installations has been found to be very satisfactory since they maintain their structure long enough to be tamped. Above the seal, a protective pipe with double bell couplings (slip joints) was installed outside the reading pipe or tubes to prevent settlement drag on the reading pipe. An annular space outside the protective pipe was filled with bentonite to eliminate excessive drag.

5-04. Settlement. The consolidation data and foundation conditions at Melvern were similar to that at Pomona Dam. The accumulated settlement during the embankment construction was observed by periodically reading the settlement plates. Melvern foundation reacted as that at Pomona in that the foundation layer settlement was about 80 percent complete at the end of construction. The dam was overbuilt a foot to compensate for the settlement which occurs after construction.

5-05. Settlement Plates. The three settlement plates were set on original foundation material to monitor embankment settlement with respect to the foundation and any foundation consolidation. The settlement plates are at stations 53+50, 60+00, and 75+00. The 3-inch galvanized steel pipes extend from the foundation bedrock vertically to 3-1/2 feet above the embankment surface and are protected by 6-inch galvanized pipes with caps.

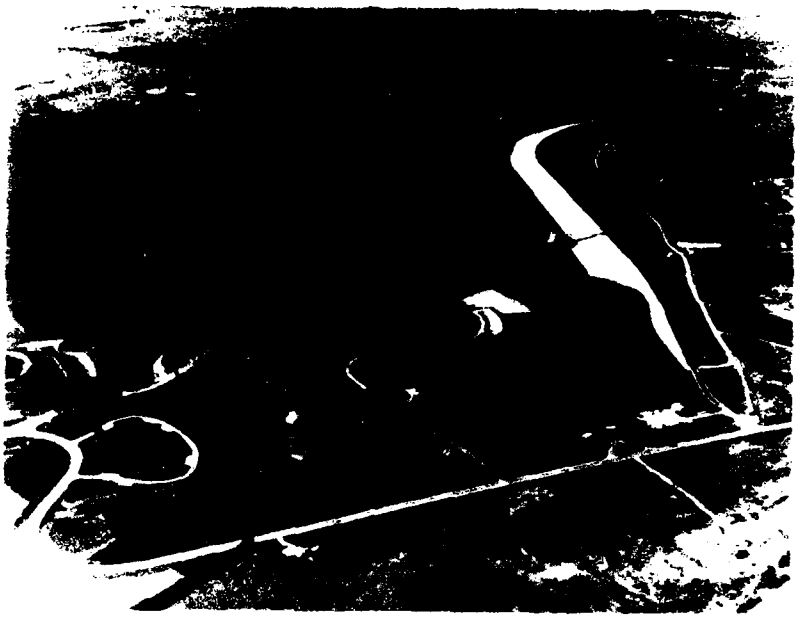
5-06. Settlement Monuments. There are nine 1/2-inch reinforcing rod settlement monuments along the downstream side of the dam crest. The monuments are buried 6 feet in the embankment and extend vertically to within a foot of the dam crest where they are protected by a galvanized pipe and cap. See Plate No. 15 for details. These monuments monitor the combined consolidation of the embankment and foundation. These monuments are read annually. Settlement was essentially complete by 1975. See Plate No. 16 for readings.

5-07. Alinement Lines. Permanent alinement monuments on 200-foot centers were installed in two lines, one on the upstream and the other on the downstream slope of the embankment. The upstream line is set at elevation 1039.6, 3.6 feet above multi-purpose pool, and may be underwater during flood water storage periods. The alinement monuments are used to monitor horizontal and/or vertical movement of the extent embankment slope. See Plates No. 68 and 69 for readings.

5-08. Prototype Test Installation Testing Equipment. The piezometers, sonic transducers, and pressure transducers were installed in the conduit for use by the Waterways Experimental Station in their studies conforming theoretical and actual water velocity design relationships. Twenty-four piezometers and four sonic transducers fittings are monitored in a manometer well located adjacent to the stilling basin. The five pressure transducers are monitored from the intake tower.

PHOTOGRAPHS

PHOTOGRAPHS

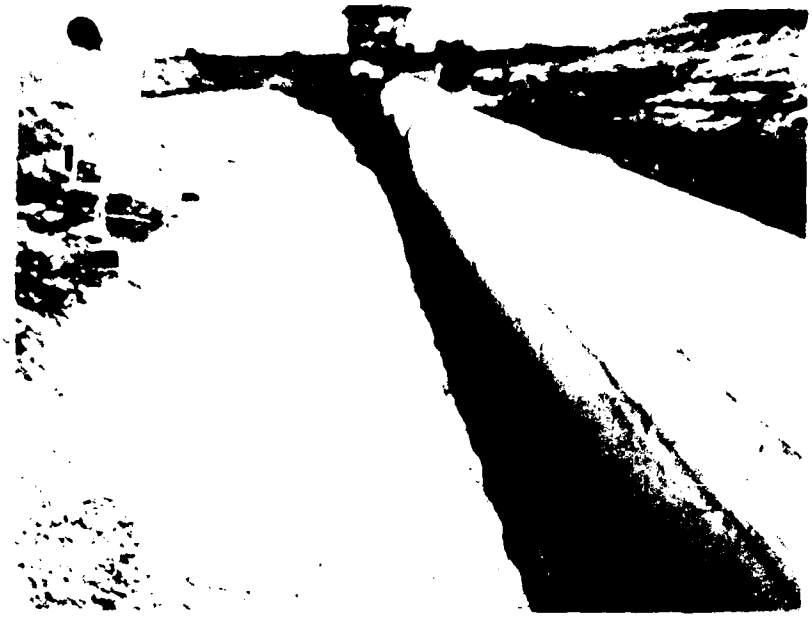


1. Melvern Lake, Construction Photo, Neg. No. 375
(Overall view of Melvern Lake)

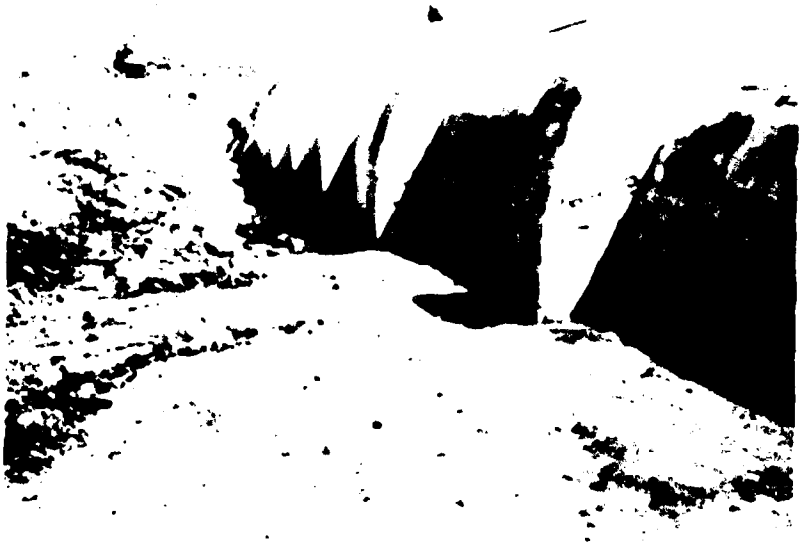
2. Melvern Lake, Construction Photo, Neg. No. 86612-6
(Placing impervious backfill in cutoff trench)

3. Melvern Lake, Construction Photo, Neg. No. 694-R1 -24 (Station 50+50, River Bank, looking up station cutoff trench)

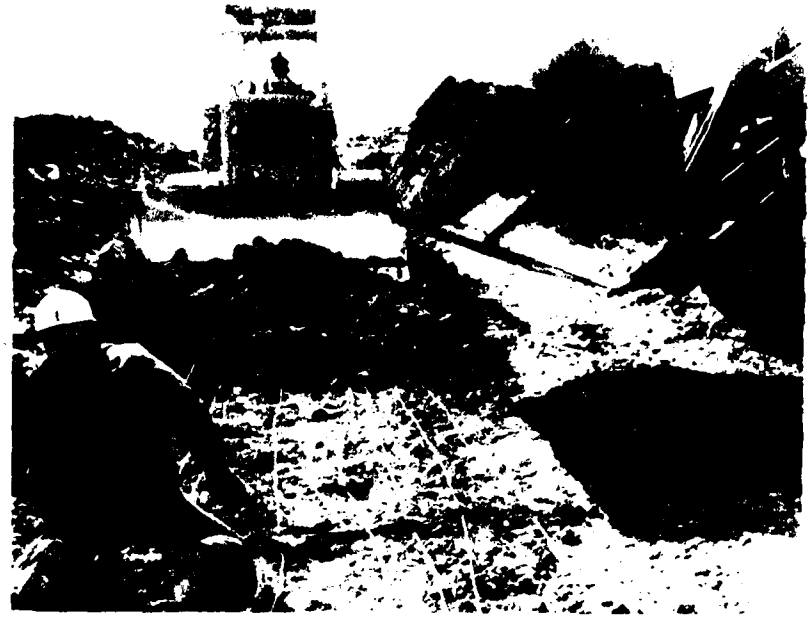
4. Melvern Lake, Construction Photo, Neg. No. 694-R1-23 (Impervious backfill in cutoff trench)



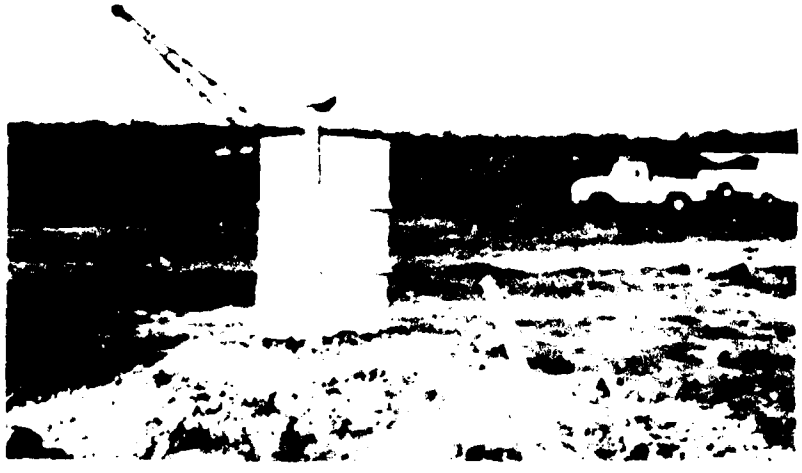
5. Melvern Lake, Construction Photo, Neg. No. 694-R1-3
(Excavation for conduit before placement of backfill)



6. Melvern Lake, Construction Photo, Neg. No. 694-R1-6
Backfill material at seepage and alinement collars
on conduit

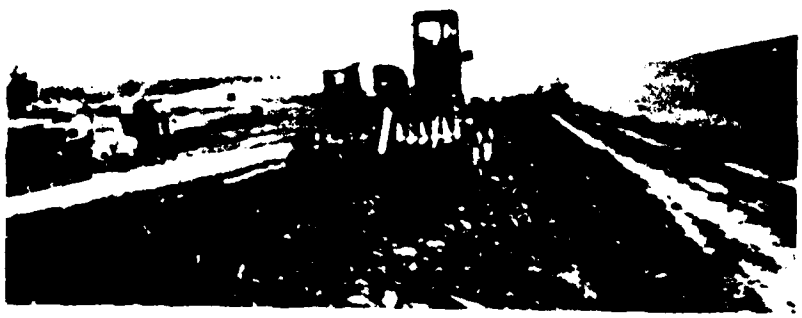


7. Melvern Lake, Construction Photo, Neg. No. 85149-1 (Backfill placement in tubing ditch for embankment pressure cells)



8. Melvern Lake, Construction Photo, Neg. No. 694-R1-15 (Typical piezometer and pore pressure extension backfill)

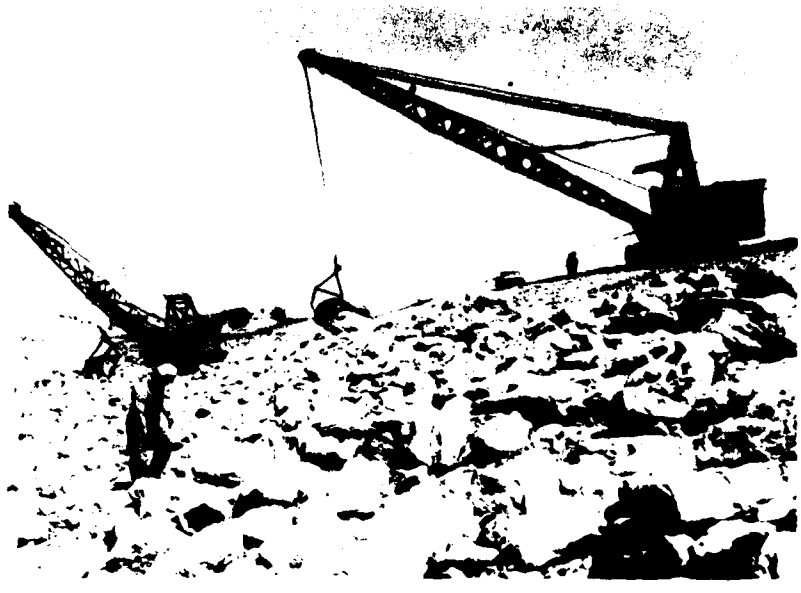
9. Melvern Lake, Construction Photo, Neg. No. 694-R2-16 (Typical piezometer and pore pressure devices protection during embankment placement)



10. Melvern Lake, Construction Photo, Neg. No. 694-R1-10 (Self-propelled tamping roller on embankment fill)

11. Melvern Lake, Construction Photo Neg. No. 87531-11 (Placement of fill material in old river channel for beginning of closure)

12. Melvern Lake, Construction Photo Neg. No. 87531-10 (Foundation excavation and cleanup in old river channel downstream)



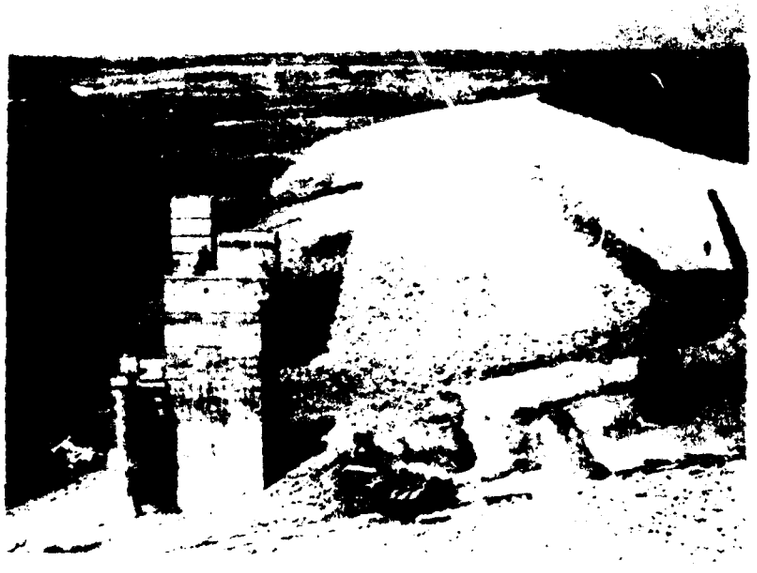
13. Melvern Lake, Construction Photo Neg. No. 88982 (Placement of slope protection on the upstream embankment)

14. Melvern Lake, Construction Photo Neg. No. 694-R1-5 (General view of slope protection on the upstream embankment)

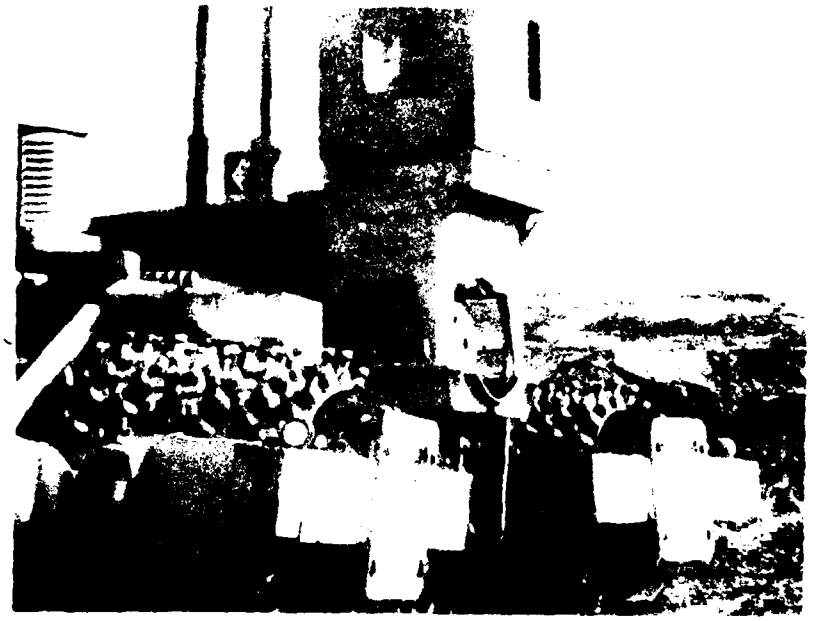
15. Melvern Lake, Construction Photo Neg. No. 88987-6 (General view of embankment slope protection near Station 75+00)

16. Melvern Lake, Construction Photo Neg. No. 88752 (General view of embankment and both valley and downstream borrow areas)

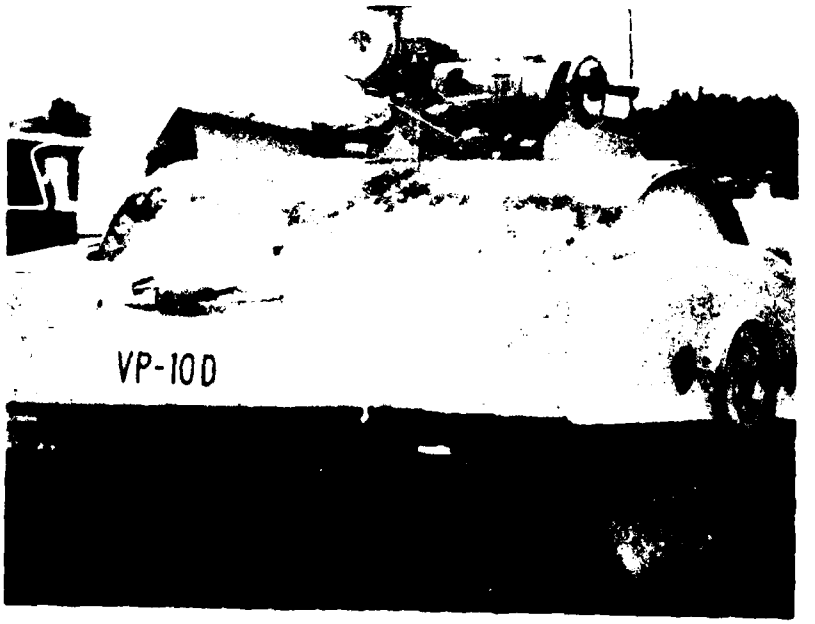
17. Melvern Lake, Construction Photo Neg. No. 694-R1-4 (General view of the outlet channel)



18. Melvern Lake, Construction Photo Neg. No. 88987-7 (View of intake tower and embankment)



19. Melvern Lake, Construction Photo Neg. No. 694-R1-21 (Self-propelled tamping roller)

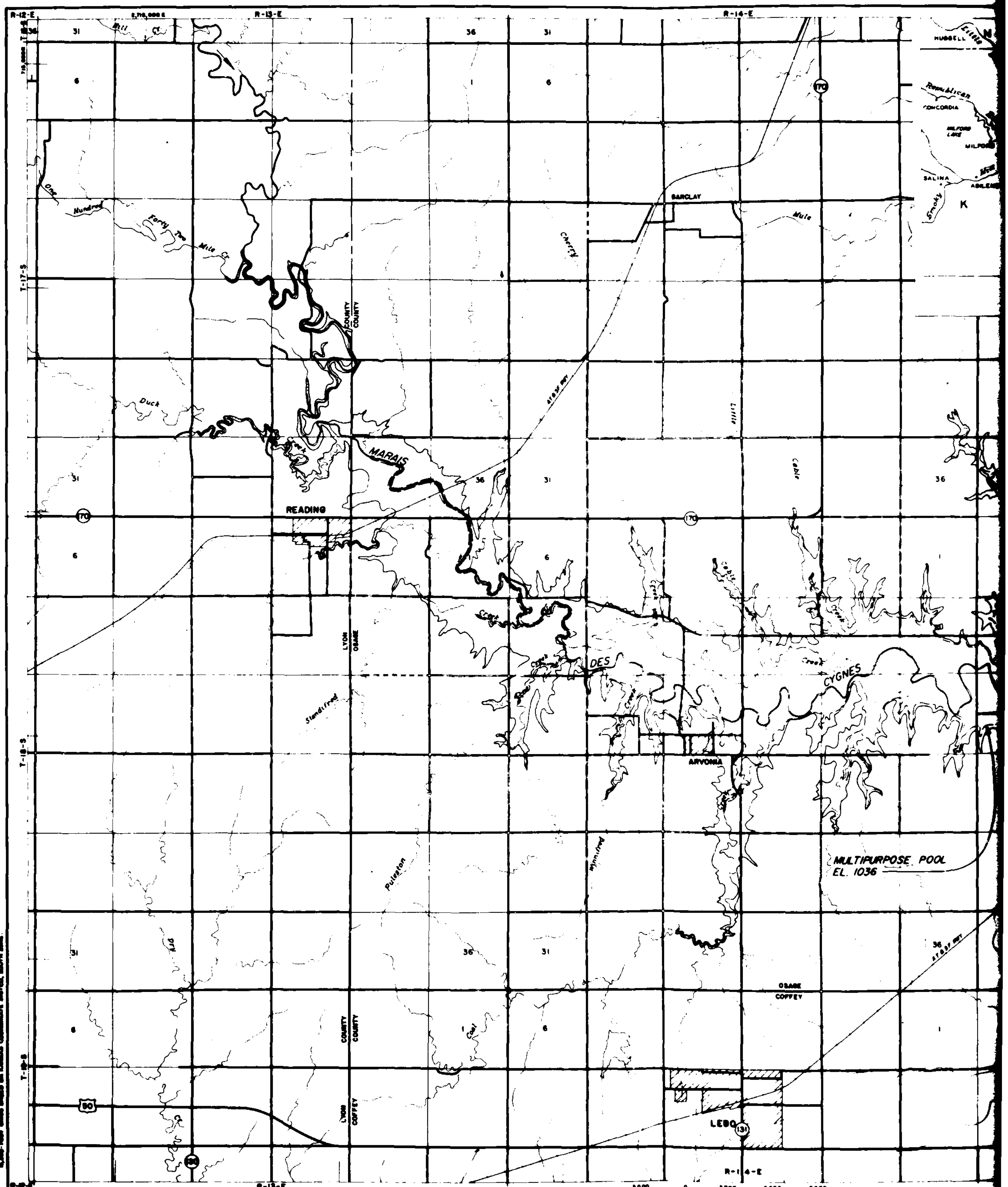


20. Melvern Lake, Construction Photo Neg. No. 694-R1-22 (Vibratory steel drum roller)

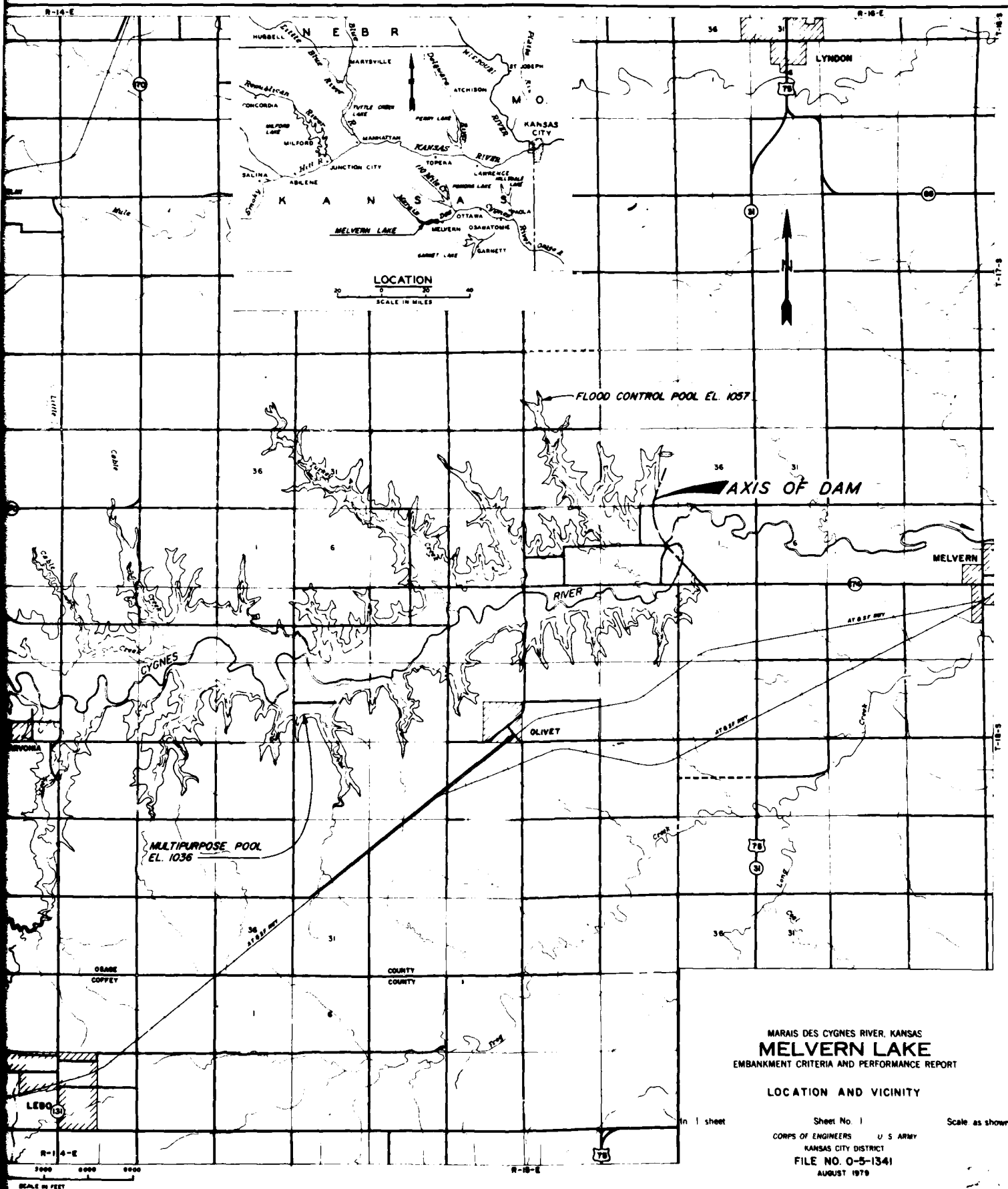
DRAWINGS

DRAWINGS

REVISIONS
July 1964



NOTE



MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

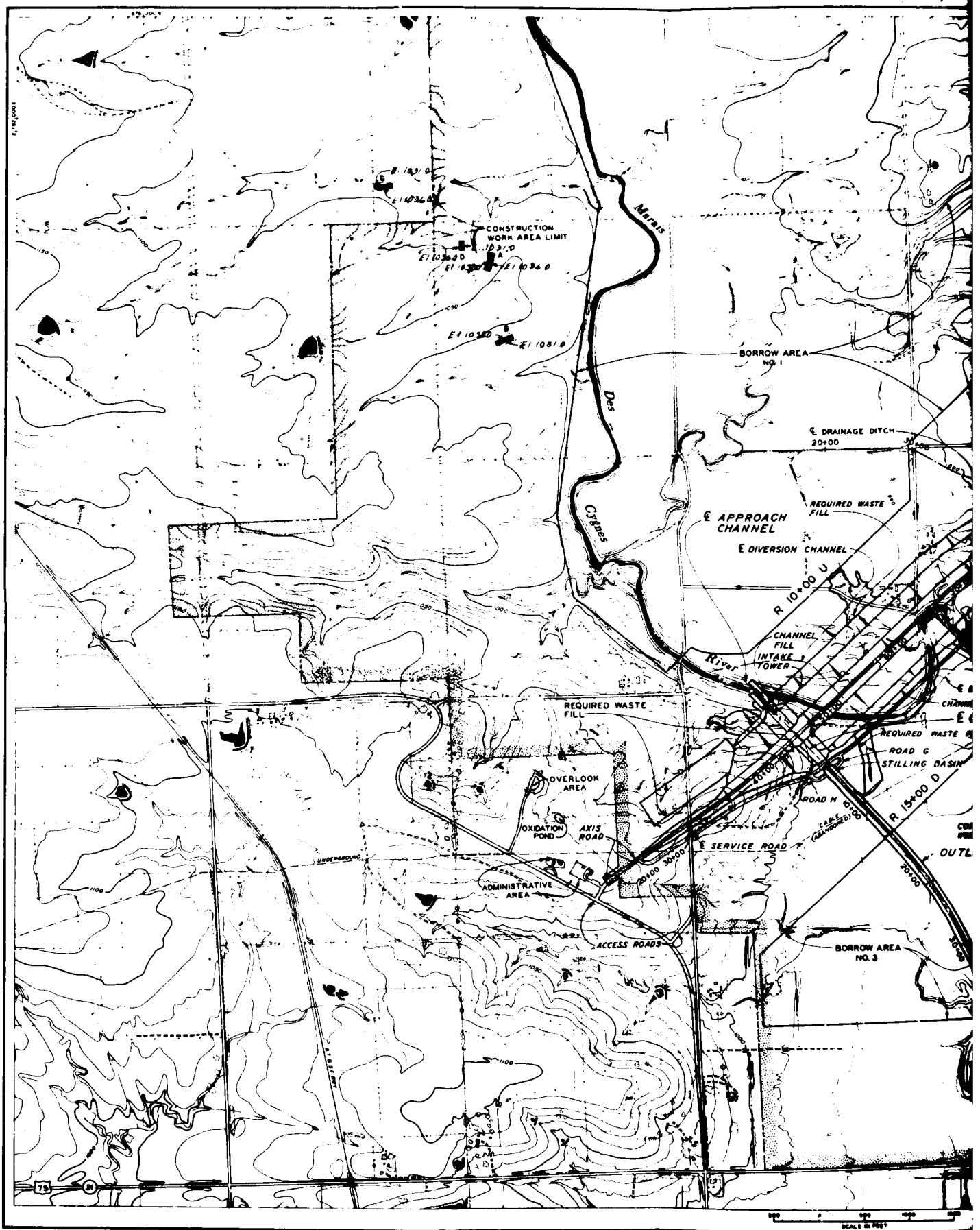
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

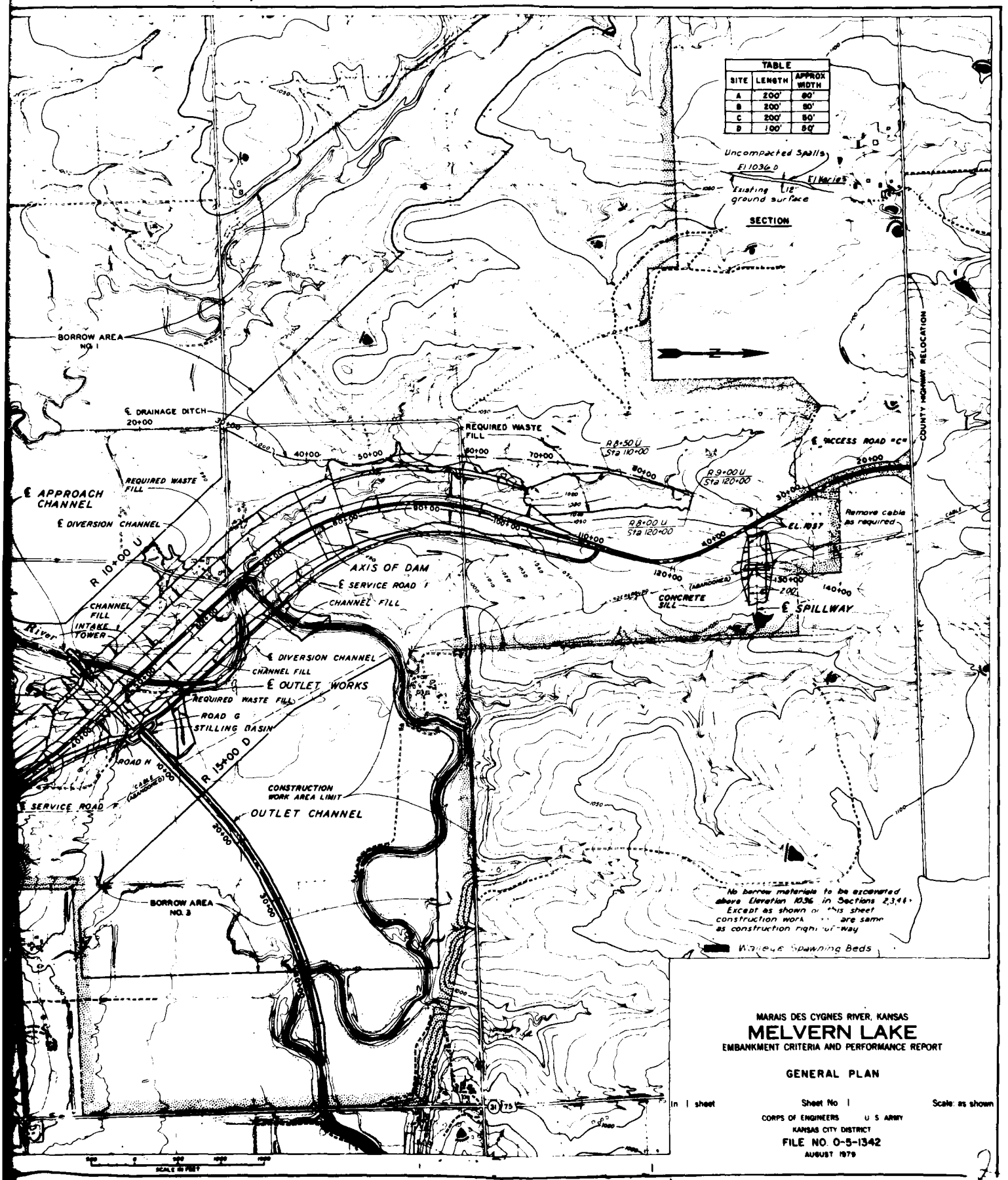
LOCATION AND VICINITY

in 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1341
AUGUST 1979

PLATE NO. 1


CONSTRUCTION WORK AREA LIMIT
Des Cypres Marais
BORROW AREA NO. 1
℄ DRAINAGE DITCH
20+00
℄ APPROACH CHANNEL
REQUIRED WASTE FILL
℄ DIVERSION CHANNEL
R 10+00 U
CHANNEL FILL
INTAKE TOWER
River
REQUIRED WASTE FILL
OVERLOOK AREA
OXIDATION POND
AXIS ROAD
ROAD G
STILLING BASIN
ROAD H
R 15+00 D
℄ SERVICE ROAD F
ADMINISTRATIVE AREA
ACCESS ROADS
BORROW AREA NO. 3
OUTL
SCALE IN FEET



MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

GENERAL PLAN

In 1 sheet | Sheet No 1 | Scale: as shown

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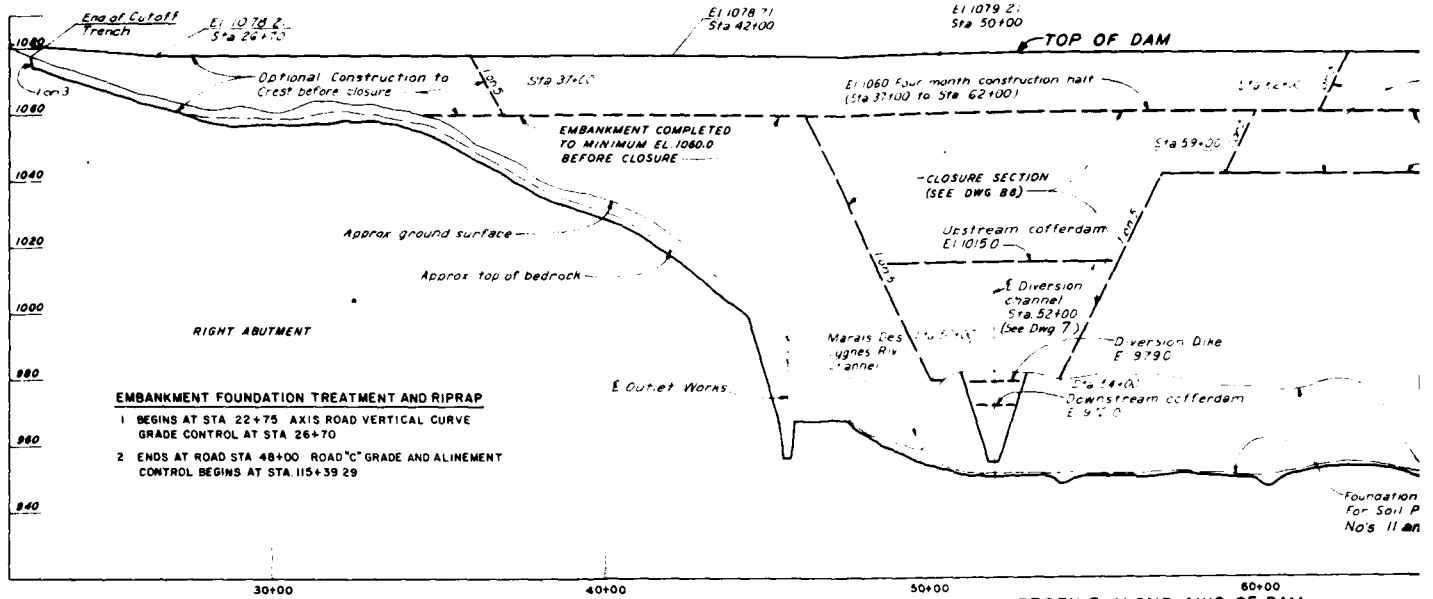
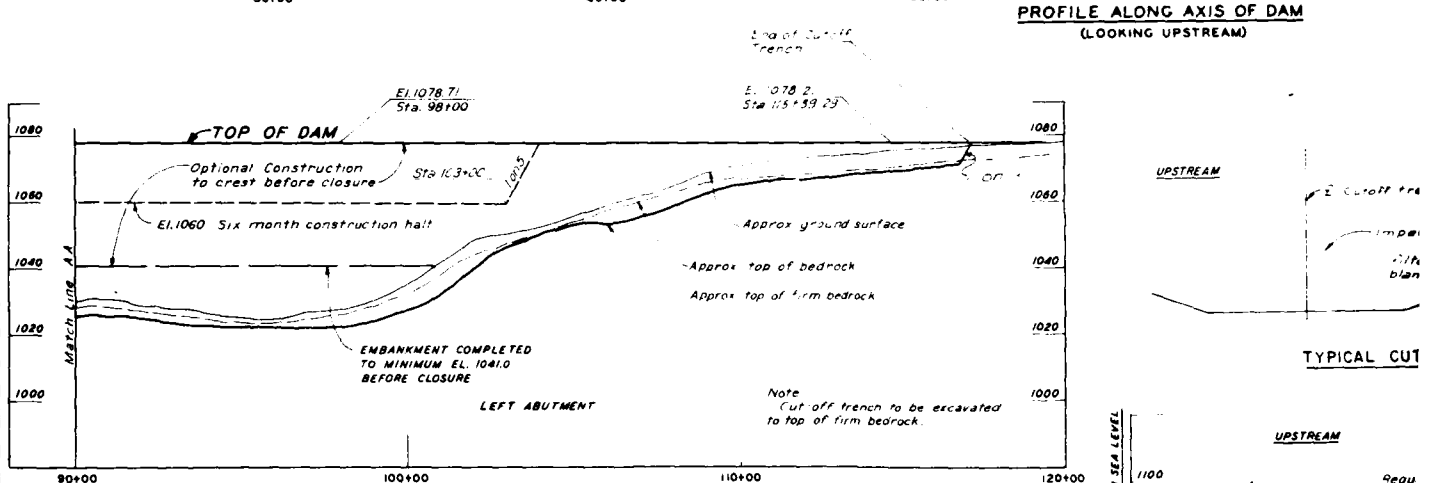
KANSAS CITY DISTRICT
FILE NO. 0-5-1342
AUGUST 1979

PLATE NO. 2

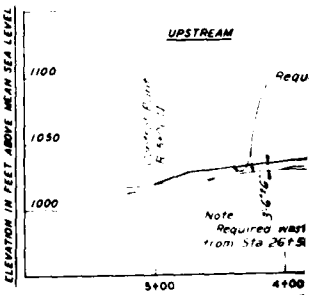


PROFILE ALONG AXIS OF DAM
(LOOKING UPSTREAM)



PROFILE ALONG AXIS OF DAM
(LOOKING UPSTREAM)

TYPICAL CUT



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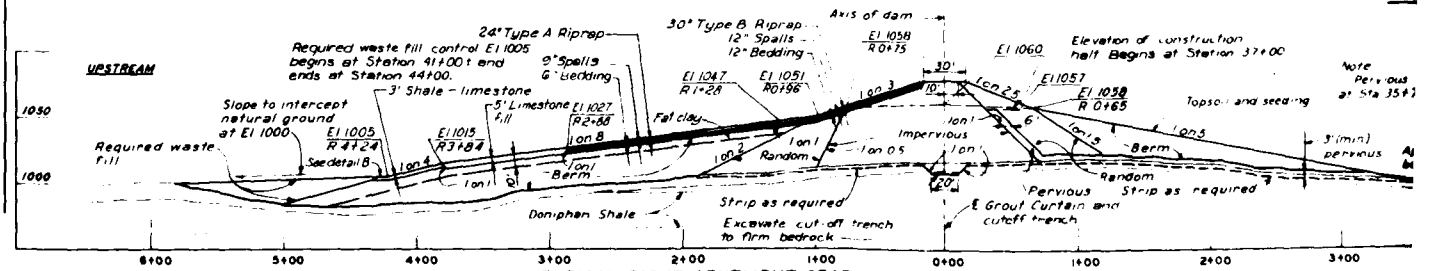
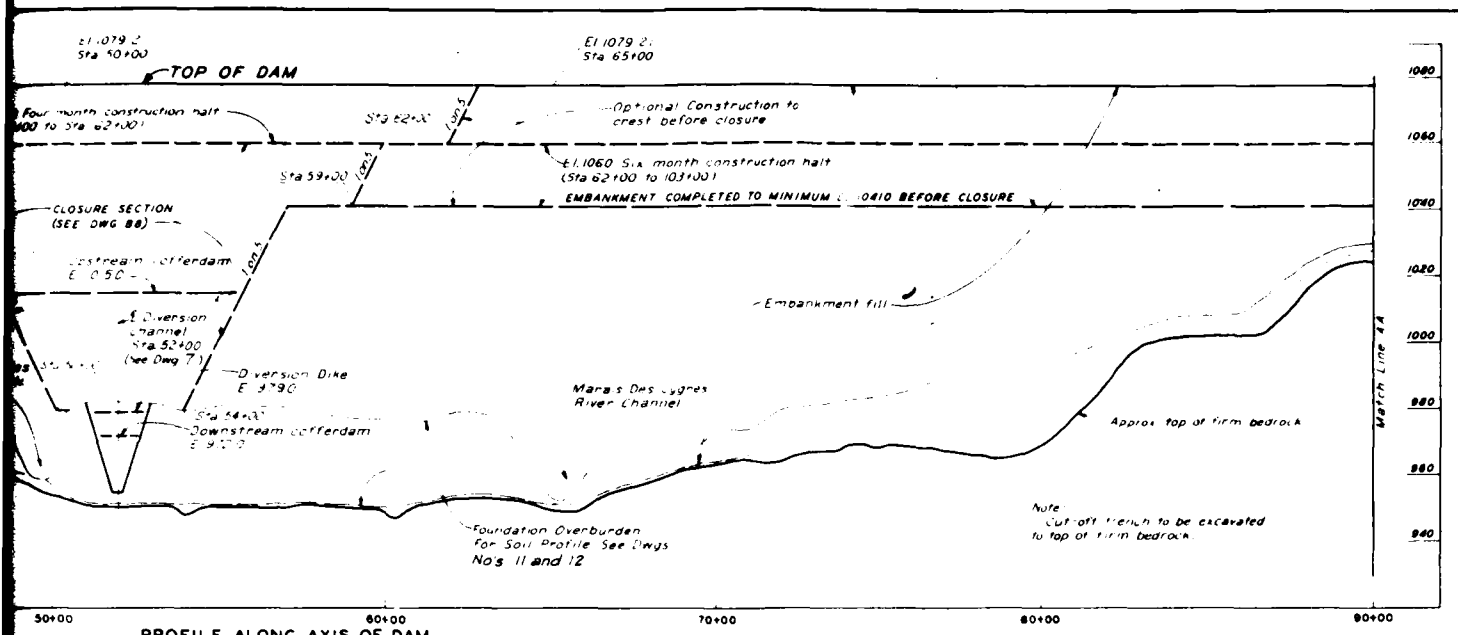
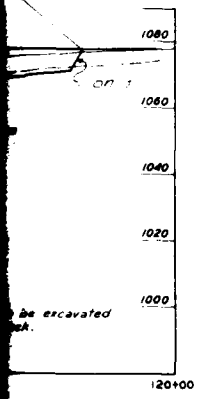
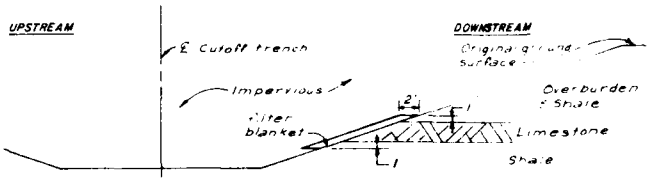


TYPICAL RIGHT ABUTMENT SECTION STA 35+50± TO STA 44+00U AND 44+50D
SECTION AT STA 43+00±



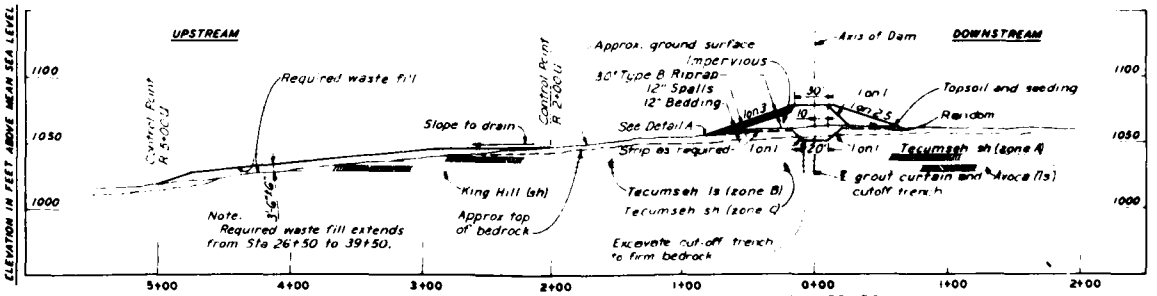
PROFILE ALONG AXIS OF DAM
(LOOKING UPSTREAM)



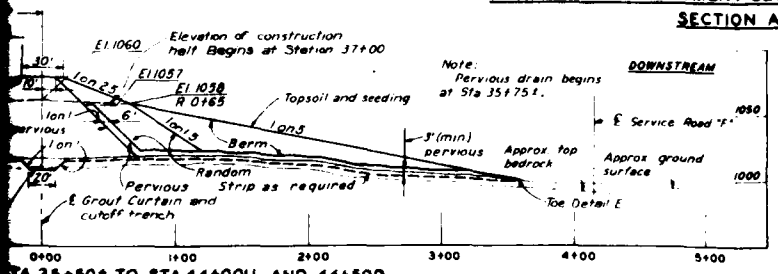


TYPICAL CUTOFF TRENCH CROSS SECTION
NOT TO SCALE

LOCATION WHERE FILTER BLANKET WAS PLACED			
STA	TO STA	STA	TO STA
30+35	34+50	82+75	83+65
37+50	38+70	83+65	86+10
40+00	41+36	88+11	94+25
44+30	43+98	96+31	98+07
46+00	46+20	99+20	100+25
49+00	49+66	102+75	107+00
81+00	81+26		



TYPICAL RIGHT ABUTMENT SECTION STA 22+50± TO STA 35+50±



SECTION AT STA 34+50±

TA 35+50± TO STA 44+00U AND 44+50D

+00±

Note
for Top of Dam detail see Drawing No 6

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

AXIS OF DAM PROFILE AND EMBANKMENT SECTIONS RIGHT ABUTMENT

In 1 sheet | Sheet No 1 | Scale as shown

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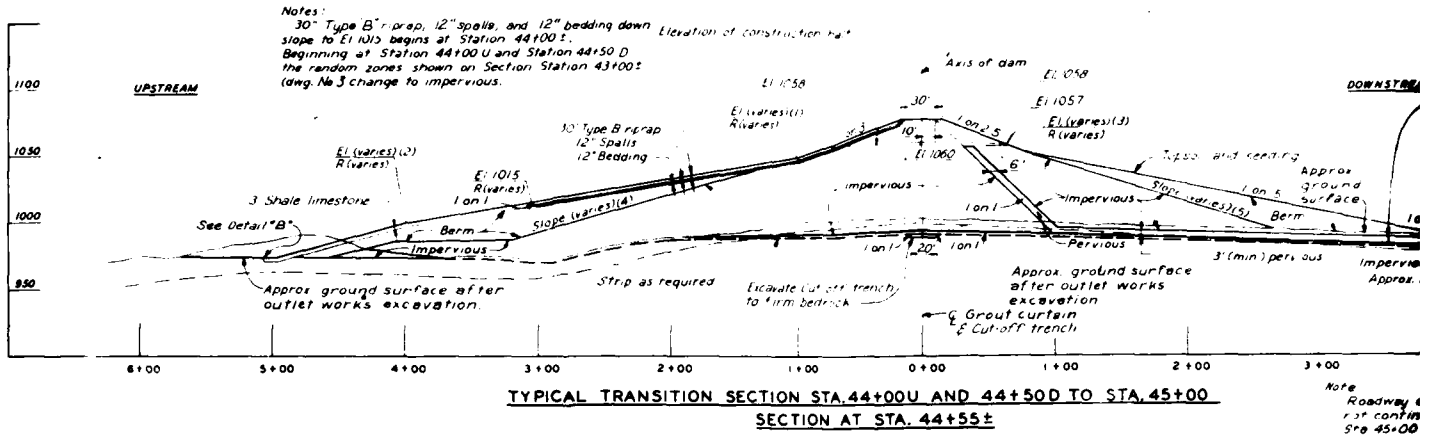
KANSAS CITY DISTRICT
FILE NO 0-5-1343
AUGUST 1979

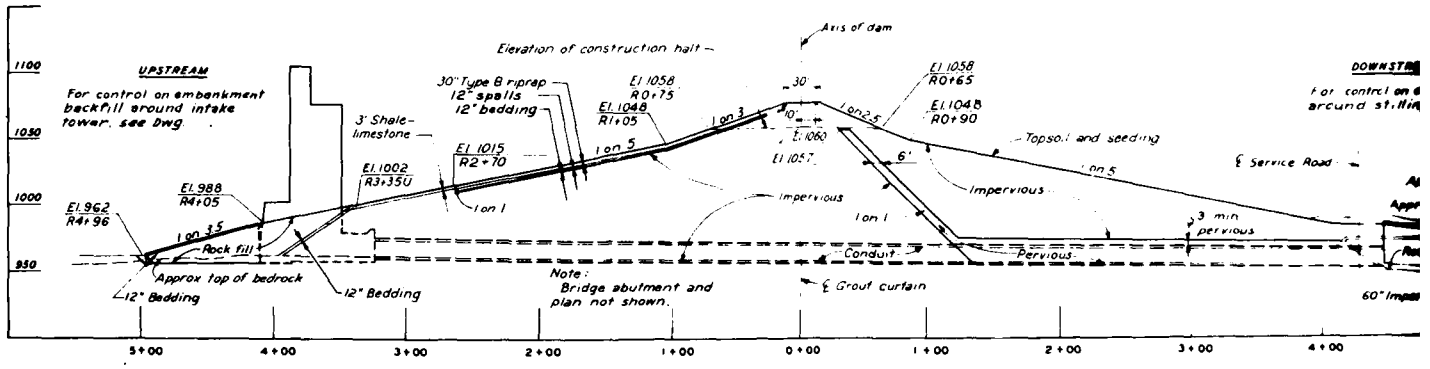
2

PLATE NO. 3

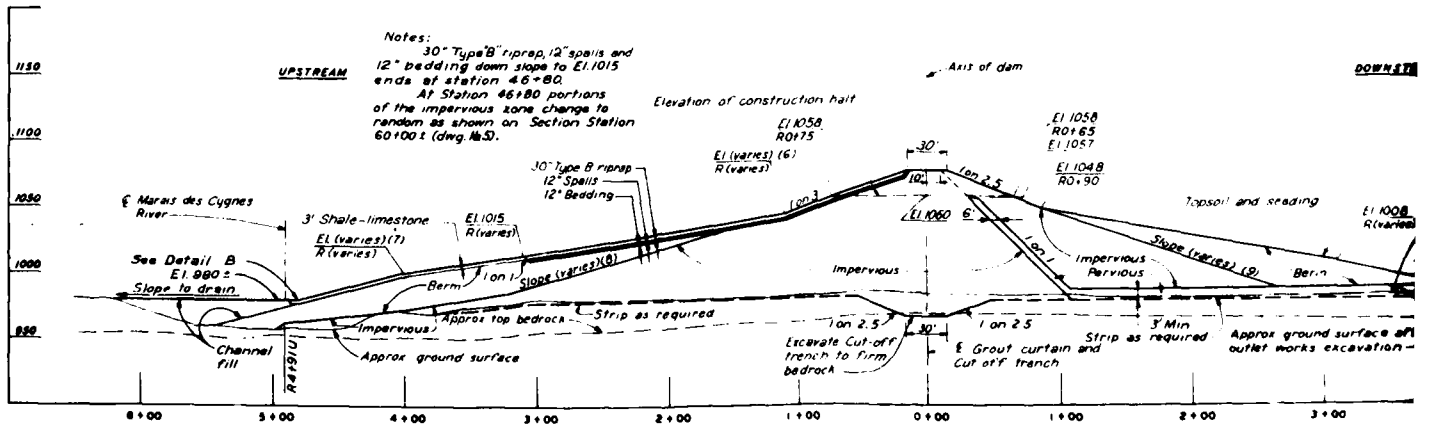
ELEVATION IN FEET ABOVE MEAN SEA LEVEL



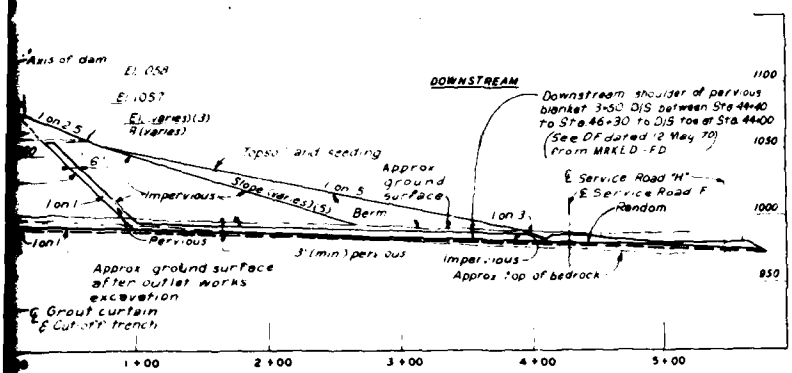
TYPICAL TRANSITION SECTION STA. 44+00U AND 44+50D TO STA. 45+00
SECTION AT STA. 44+55±



TYPICAL CONDUIT SECTION STA. 45+00 TO STA. 46+00
SECTION AT STA. 45+50±



TYPICAL TRANSITION SECTION STA. 46+00 TO STA. 46+80
SECTION AT STA. 46+50±

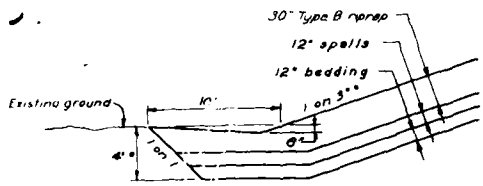


ND 44+50D TO STA. 45+00

3+55±

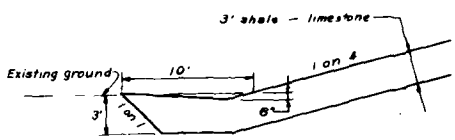
Notes:
(1) Control point varies linearly from El. 1051, R. 0+96U at Station 44+00 to El. 1048, R. 1+05 U at Station 45+00.
(2) Control point varies linearly from El. 1015, R. 3+84 U at Station 44+00 to El. 988, R. 4+05 U at Station 45+00.
(3) Control point varies linearly from El. 1058, R. 0+65 D at Station 44+50. to El. 1048, R. 0+90 D at Station 45+00.
(4) Slope varies linearly from 1 on 2 at station 44+00 to 1 on 5 at station 45+00.
(5) Slope varies linearly from 1 on 1.5 at station 44+50 to 1 on 5 at station 45+00.

Note
Roadway embankment is not continous between Sta 45+00 and Sta 46+00.

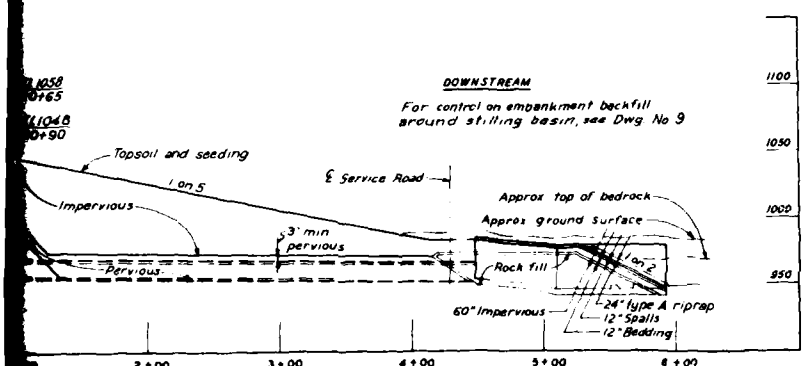


* To bedrock if less then a depth of 4ft
* Embankment slope at toe may be 1 on 8 and may have different layer thicknesses.

DETAIL "A"
Not to scale

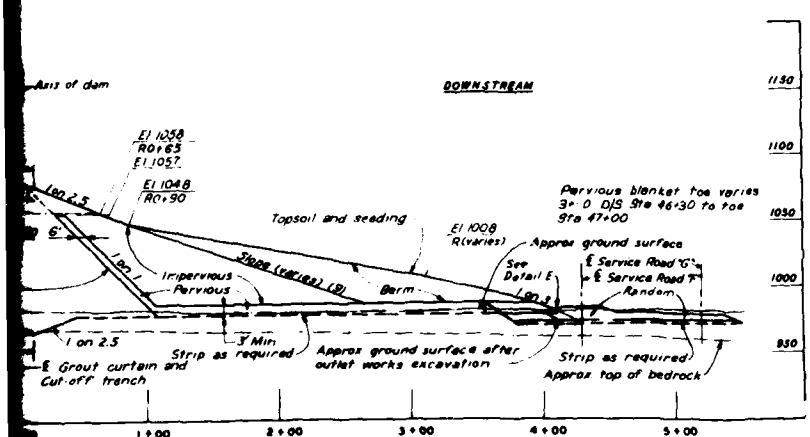


DETAIL "B"
Not to scale



00 TO STA. 46+00

+50±



+00 TO STA. 46+80

+50±

Notes:
(6) Control point varies linearly fro . El. 1048, R. 1+05 U at Station 46+00 to El. 1041, R. 1+26 U at Station 46+80.
(7) Control point varies linearly from El. 988, R. 4+05 U at Station 46+00 to El. 1015, R. 3+34 at Station 46+80.
(8) Slope varies linearly from 1 on 5 at station 46+00 to 1 on 2 at station 46+80.
(9) Slope varies linearly from 1 on 5 at station 46+00 to 1 on 1.5 at station 46+80.
(10) for top of dam detail see dwg No 6

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT SECTIONS CONDUIT AND TRANSITIONS

In 1 sheet | Sheet No. 1 | Scale as shown

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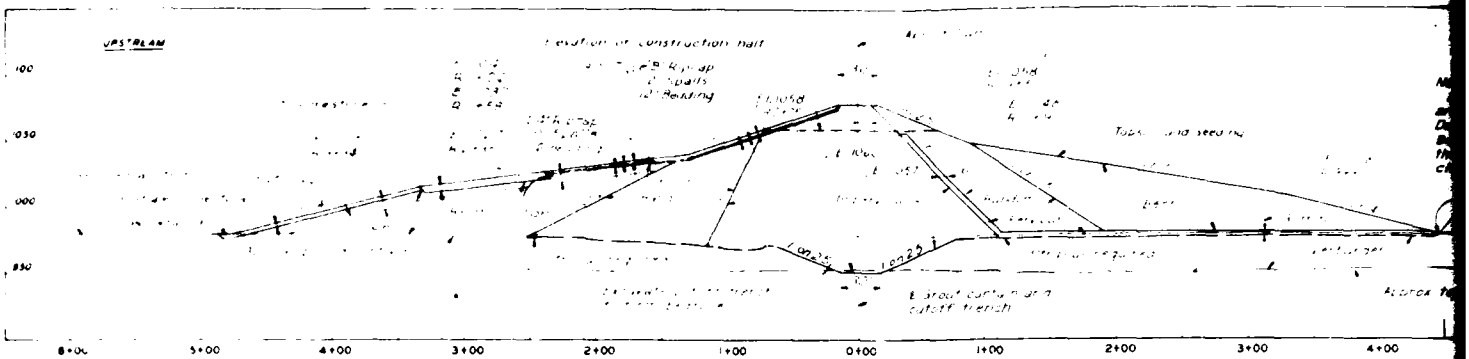
KANSAS CITY DISTRICT
FILE NO. 0 5 1344
AUGUST 1970

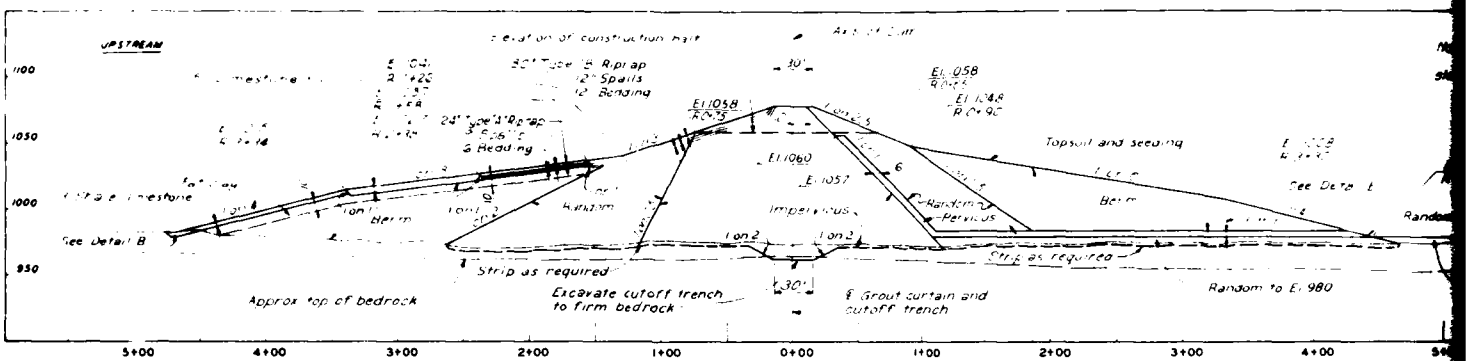
2

PLATE NO. 4



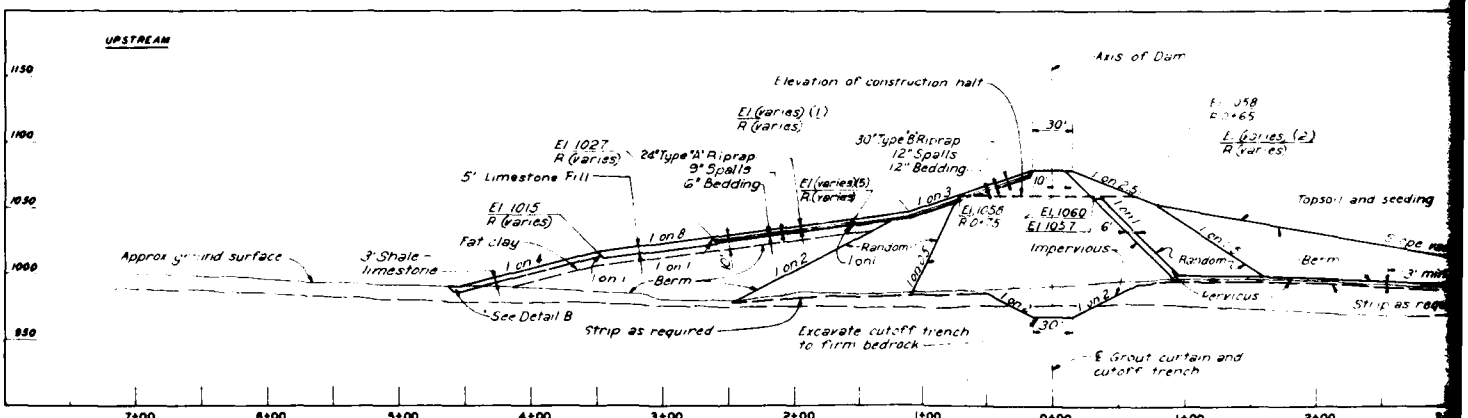
TYPICAL VALLEY SECTION - STA. 46+80 TO STA. 63+00

SECTION AT STA. 60+00±



TYPICAL VALLEY SECTION - STA. 63+00 TO STA. 76+00

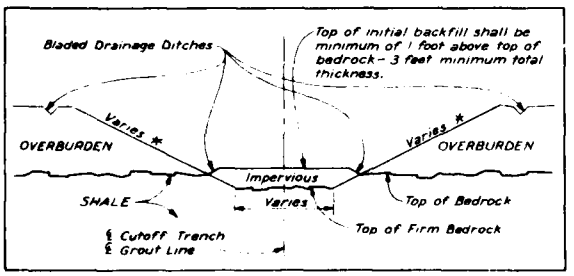
SECTION AT STA. 70+00±



TYPICAL TRANSITION SECTION - STA. 76+00 TO STA. 80+00

SECTION AT STA. 78+00±

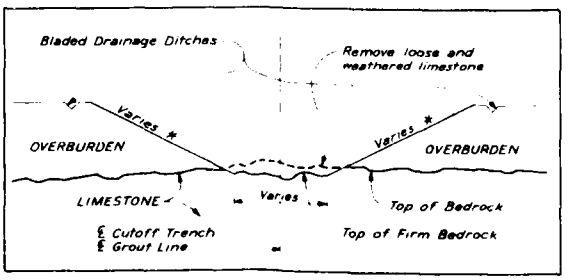
ELEVATION IN FEET ABOVE MEAN SEA LEVEL



CUTOFF TRENCH DETAIL

BASE IN SHALE

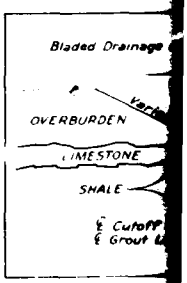
Not to Scale

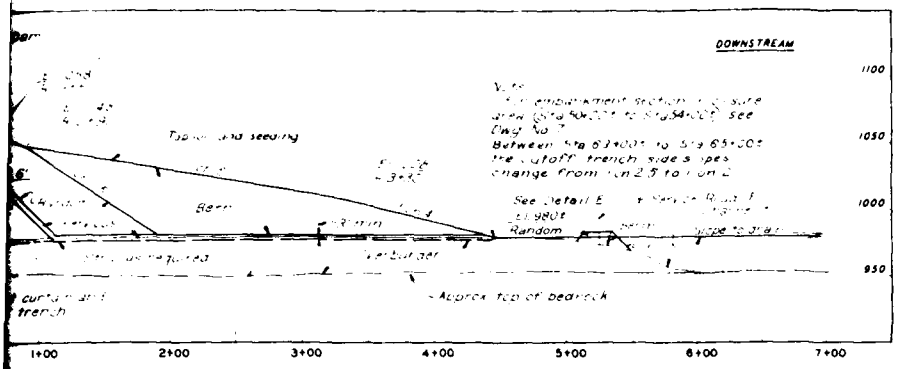


CUTOFF TRENCH DETAIL

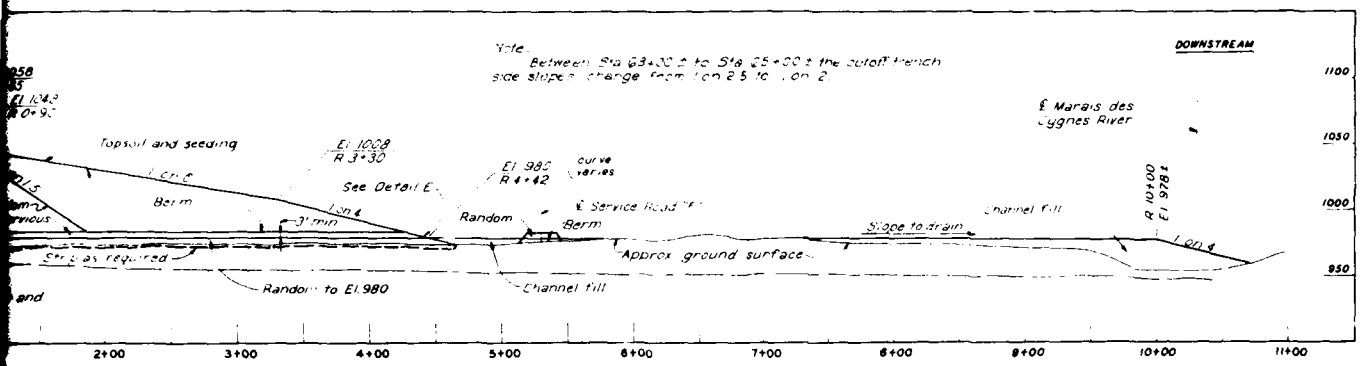
BASE IN LIMESTONE

Not to Scale



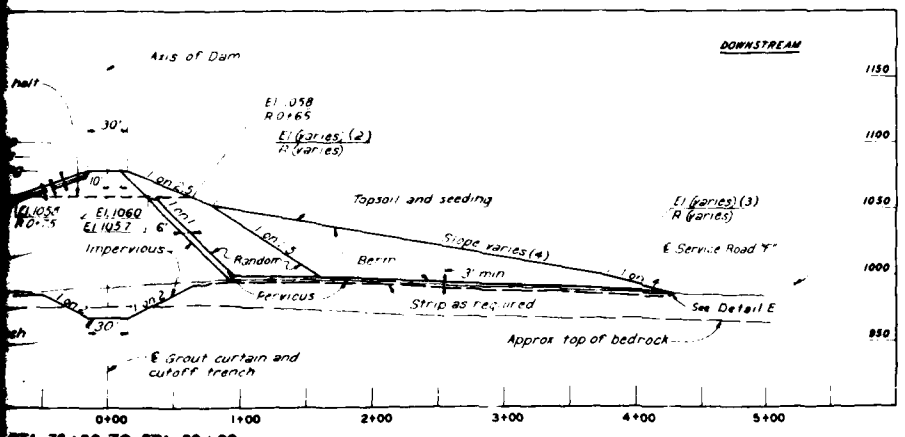


TO STA. 63+00



AL VALLEY SECTION - STA. 63+00 TO STA. 76+00

SECTION AT STA. 70+00±



STA. 76+00 TO STA. 80+00

78+00±

Notes

(1) Control point varies linearly from El 1041, R1+26U at station 76+00 to El 1051, R0+96U at station 80+00.

(2) Control point varies linearly from El 1048, R0+90D at station 76+00 to El 1058, R0+65D at station 80+00.

(3) Control point varies linearly from El 1008, R3+30D at station 76+00 to ground surface (elevation 908 ±, range 4±15±D) at station 80+00.

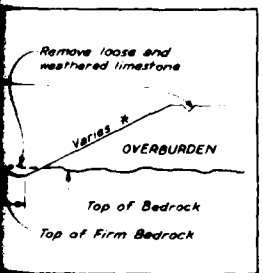
(4) Slope varies linearly from 1on 6 at station 76+00 to 1on 3 at station 80+00.

(5) Control point varies linearly from El 1037, R 1+58 at Station 76+00 to El 1047, R 1+28 at Station 80+00.

GENERAL NOTE

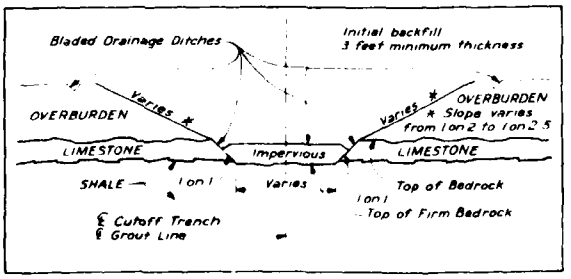
River channels existing within the embankment area shall be mucked to remove unsuitable materials and the river banks shall be excavated to 1 on 3 within Range 2+00 upstream to 2+00 downstream then transitioned to 1 on 2 at Range 3+00 up and 3+00 down and maintained 1 on 2 to the embankment toe.

For top of dam detail see drawing No. 6



DETAIL

STONE



CUTOFF TRENCH DETAIL

BASE THROUGH LIMESTONE IN SHALE

Not to Scale

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT SECTIONS VALLEY AND TRANSITION

In 1 sheet | Sheet No 1 | Scale as shown

CORPS OF ENGINEERS U S ARMY

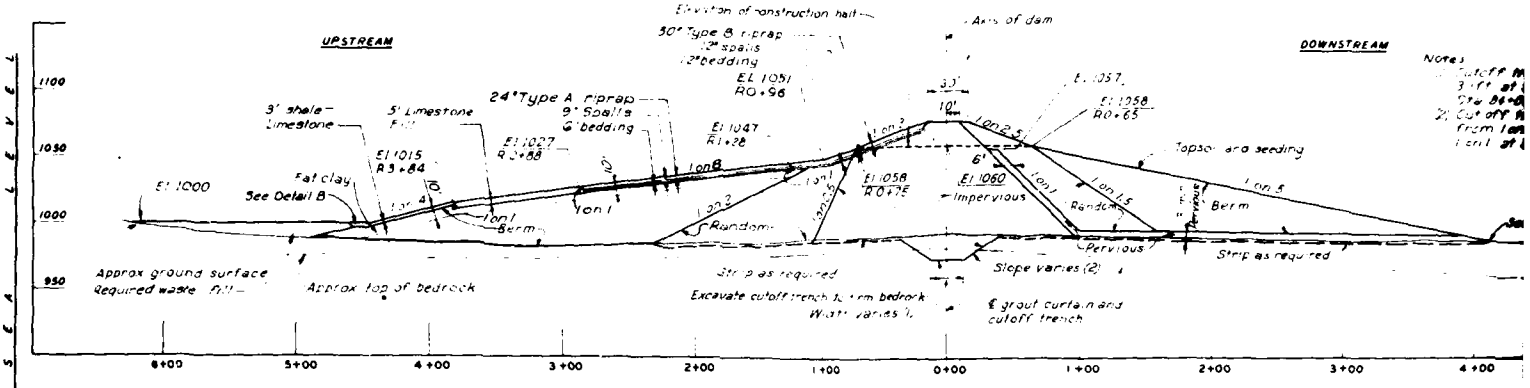
KANSAS CITY DISTRICT

FILE NO. 0-5-1345

AUGUST 1979

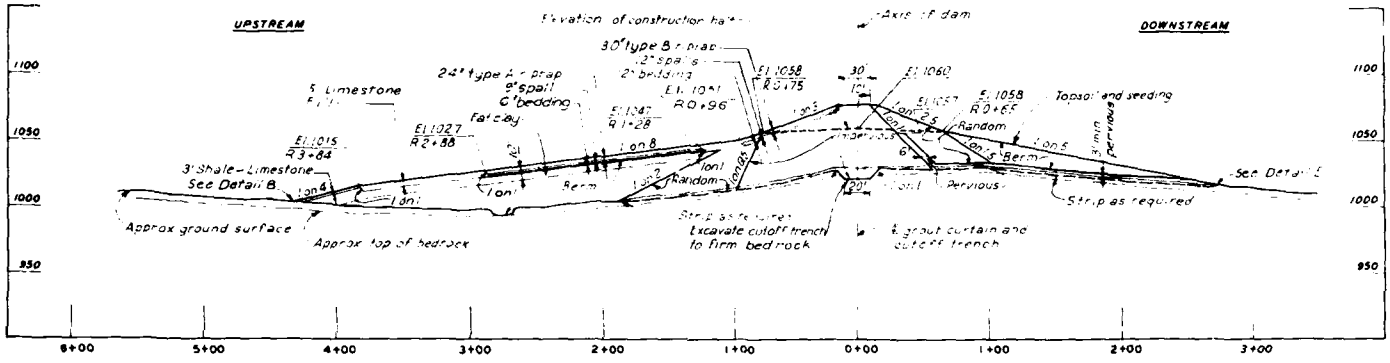
2

PLATE NO 5



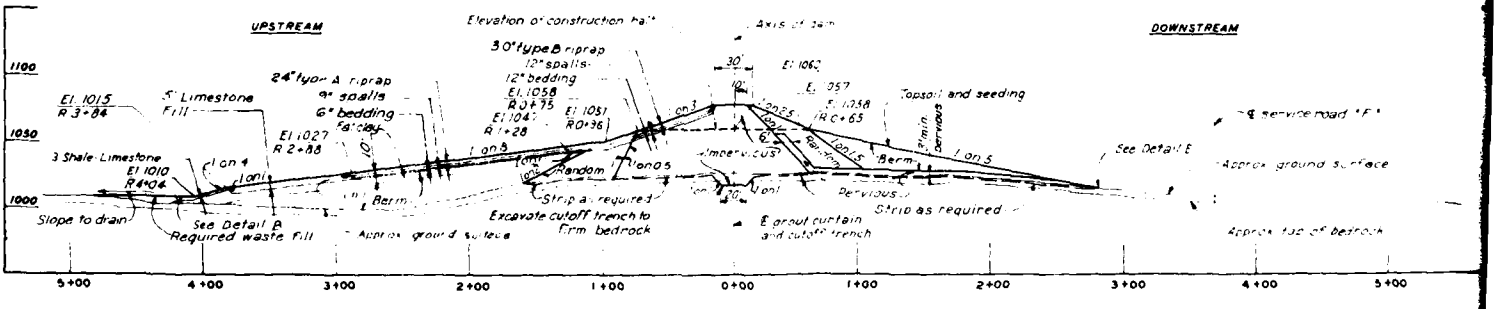
TYPICAL TERRACE SECTION-STA. 80+00 TO STA. 84+00

SECTION AT STA. 82+00±



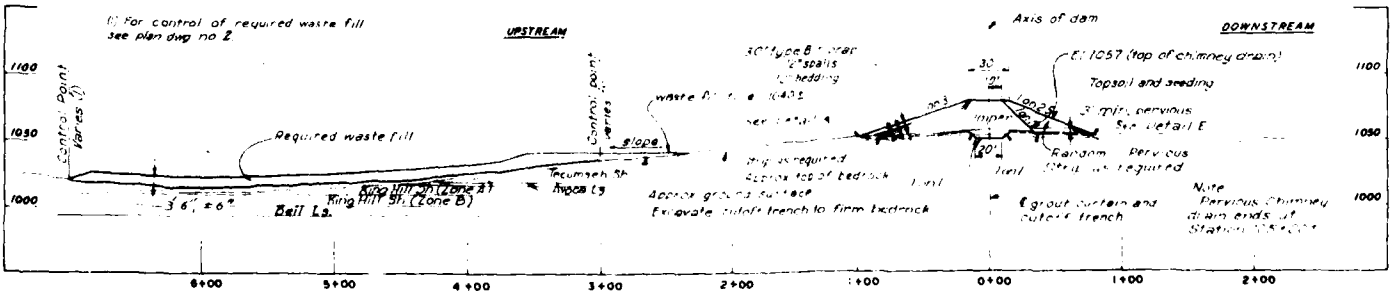
TYPICAL TERRACE SECTION-STA. 84+00 TO STA. 92+00±

SECTION AT STA. 90+00±



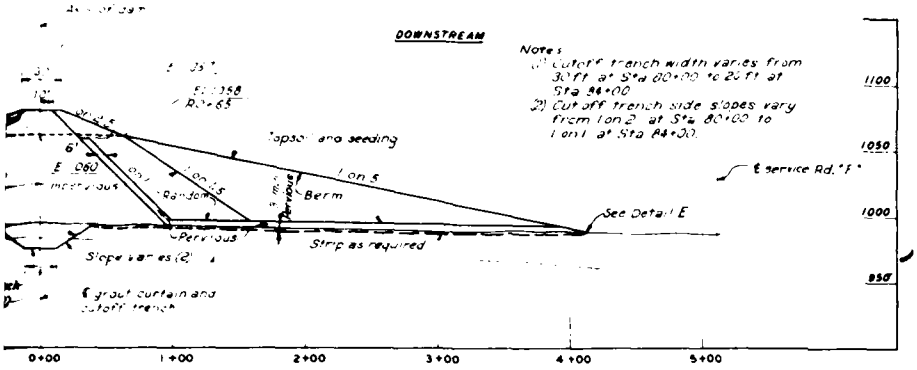
TYPICAL TERRACE SECTION-STA. 92+00± TO STA. 101+00±

SECTION AT STA. 97+00±



TYPICAL LEFT ABUTMENT SECTION-STA. 101+00± TO STA. 120+00

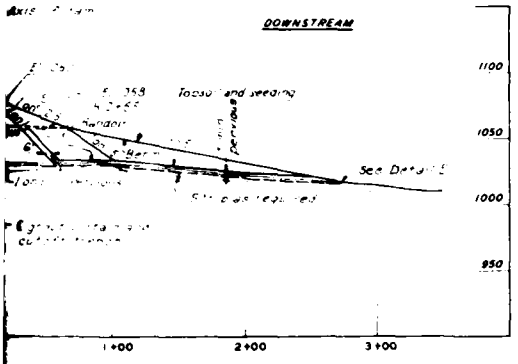
SECTION AT STA. 105+00±

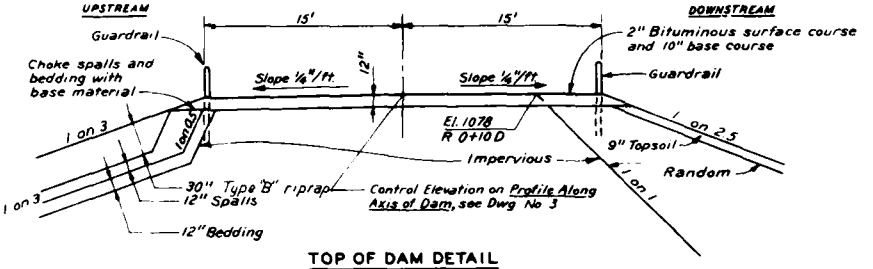


SCHEDULE OF GUARDRAIL For top of dam				
Station	to Station	Side	Length	Remarks
24+00	45+36±	Left	2162.5'±	
45+64±	110+00	Left	6462.5'±	
24+00	110+00	Right	8600'	

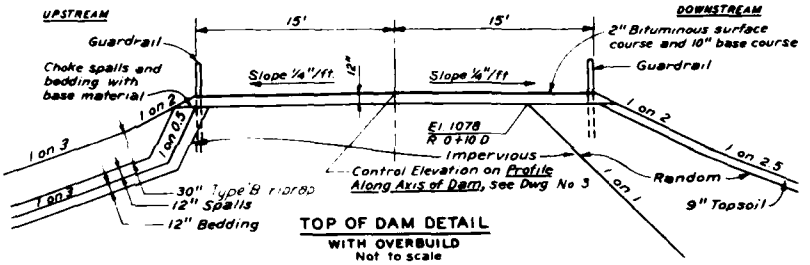
STA 80+00 TO STA 84+00

AT STA 82+00±



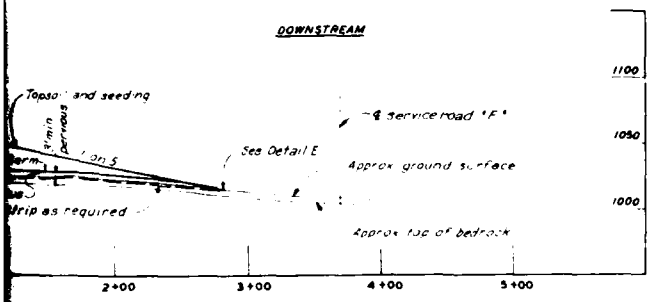


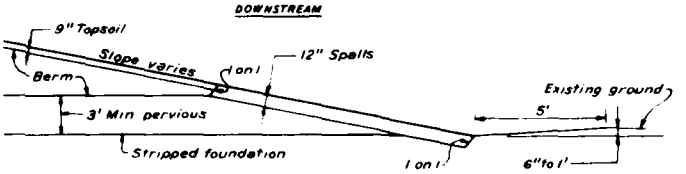
TOP OF DAM DETAIL
NO OVERBUILD
Not to scale



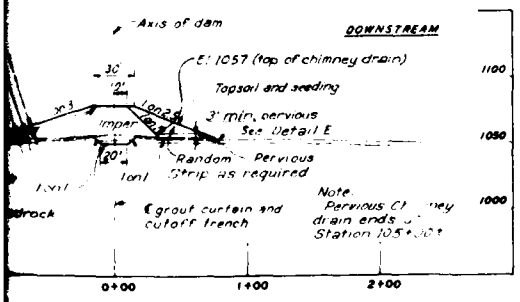
TOP OF DAM DETAIL
WITH OVERBUILD
Not to scale

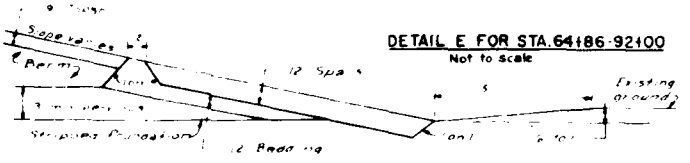
+00±





O STA 101+00±





DETAIL E FOR STA. 64+86-92+00
Not to scale

DETAIL F FOR STA. 92+00 TO 105+50
STA. 35+75 TO 44+00-47+00 TO 63+50

STA. 120+00

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

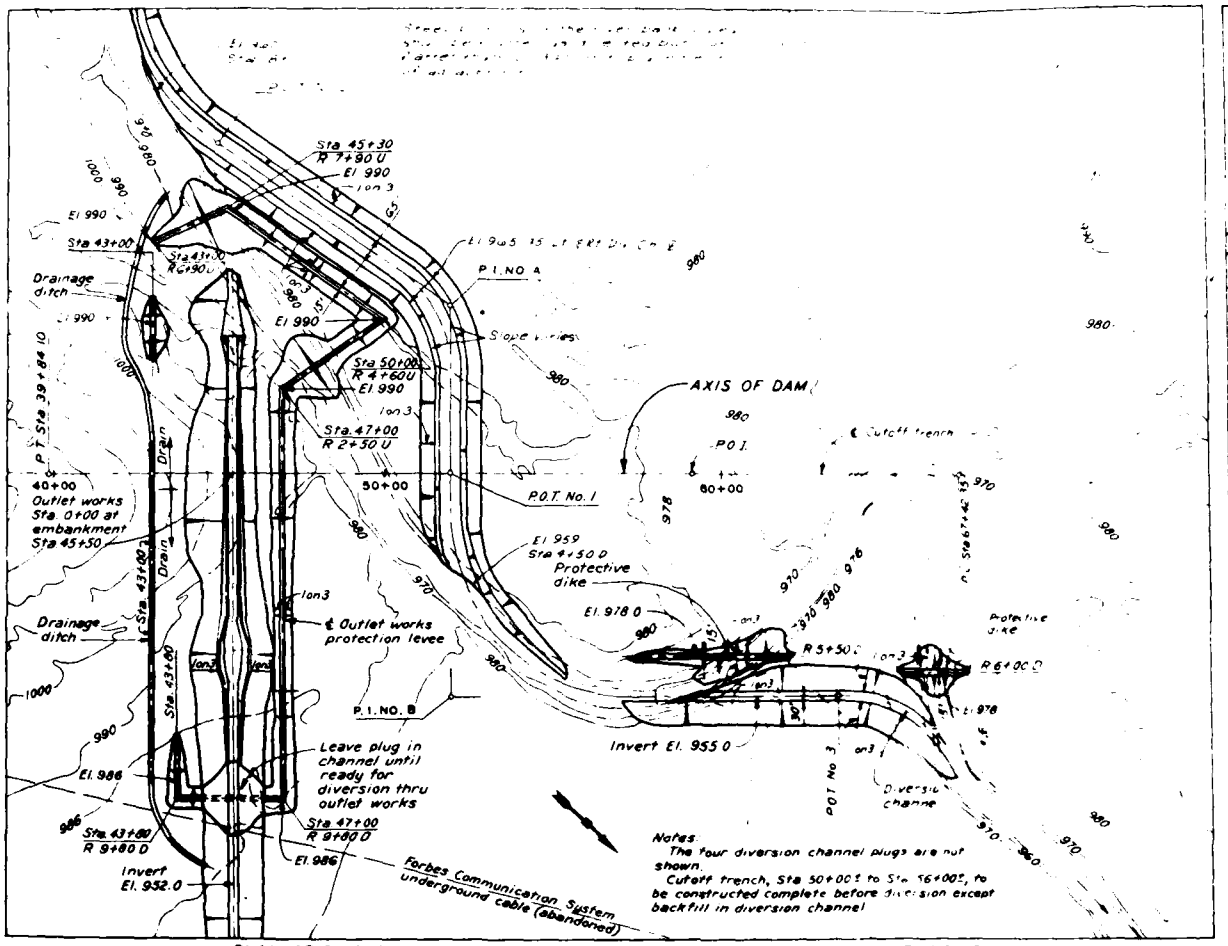
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT SECTIONS TERRACE AND LEFT ABUTMENT

In 1 sheets | Sheet No 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1346
AUGUST 1979

PLATE NO. 6

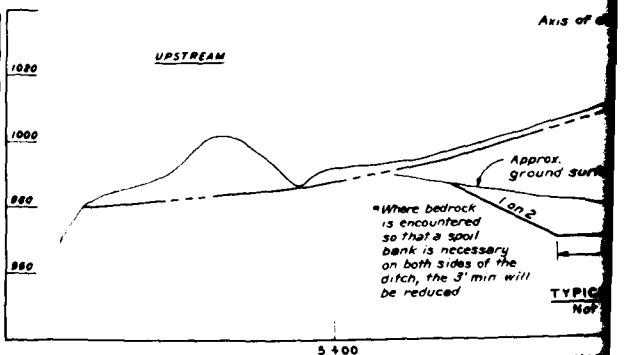


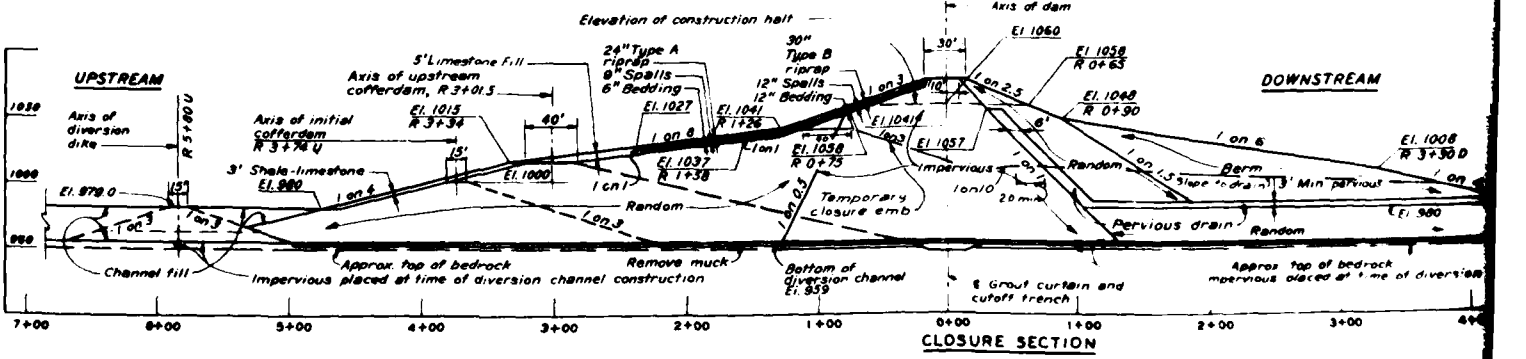
PLAN OF DIVERSION CHANNEL, OUTLET WORKS EXCAVATION AND PROTECTIVE DIKE

SCALE IN FEET 200 0 200 400

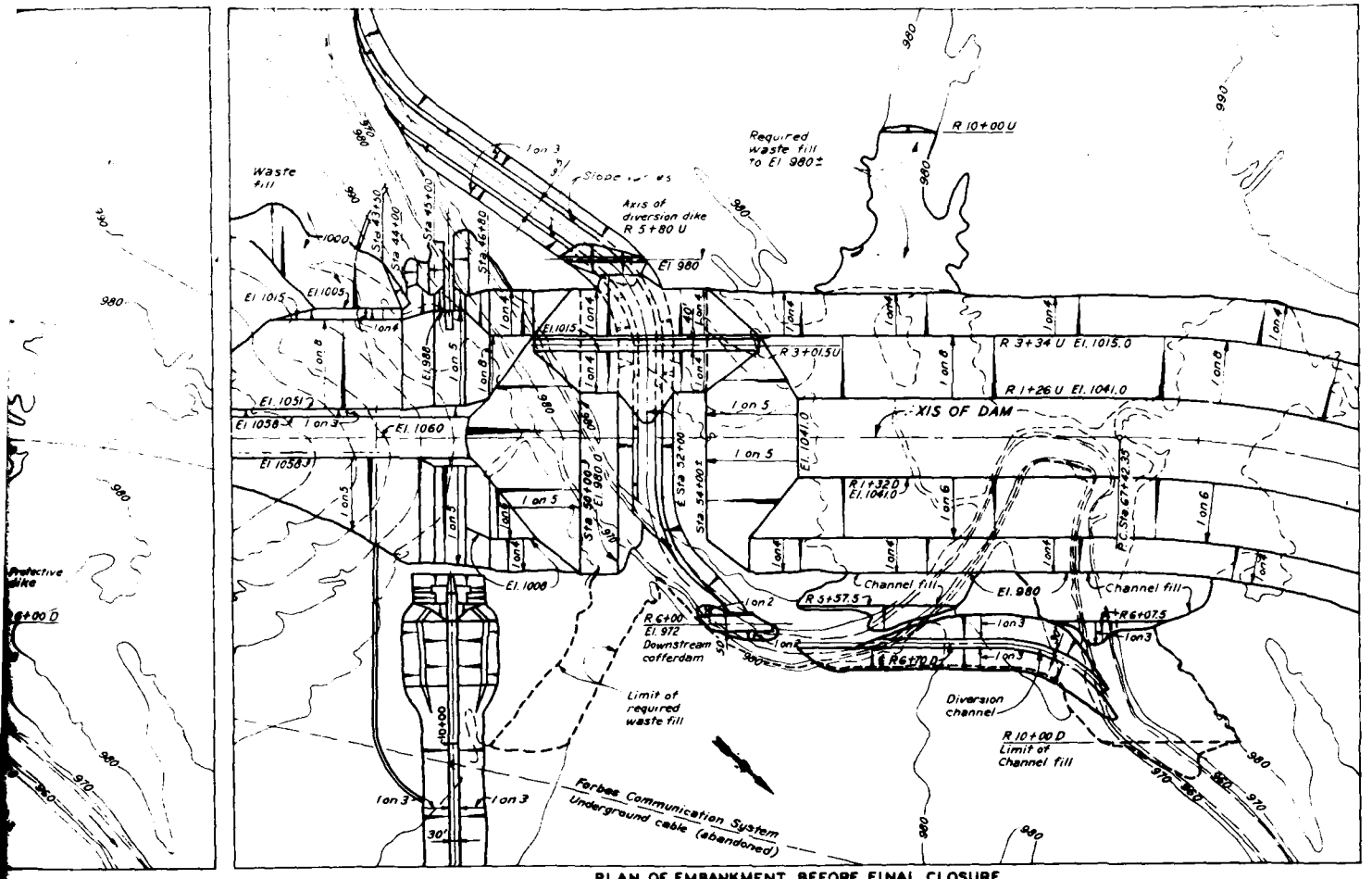
ALINEMENT DATA

P. I.	LATITUDE	DEPARTURE	AZIMUTH	DISTANCE	STATION	P.C. STATION	P.T. STATION	Δ	D	T	R	L
					(UPSTREAM DIVERSION)							
P.O.T. No. 1					Dam Sta. 52+00 = Sta. 0+00 Diversion Channel							
			137° 0' 0"	713.95								
P.O.I.				(Dam)	59+13.95	(Line P.O.T. No.2 to P.I. A intercepts Dam Axis)						
P.O.T. No. 1												
			47°0' 0"	509.20								
A							3+12.37 U	6+74.37 U	34°34'11"	15°10' 0"	196.43	370.66	362.00
P.O.T. No. 2			332°05'49"	833.00								
					13+30.34 U							
			26°05'49"	—		(Swing to river)			7°30'0"		764.49	
					(DOWNSTREAM DIVERSION)							
P.O.T. No. 1					Dam Sta. 52+00 = Sta. 0+00 Diversion Channel							
			227° 0' 0"	675.00								
B							14+19.77 D	9+80.74 D	90° 0' 0"	10°20' 0"	555.23	555.23	870.87
P.O.T. No. 3			137° 0' 0"	1,170.00								
					16+03.51 D							
			47° 0' 0"	—		(Swing to river)			12°30' 0"		459.28	



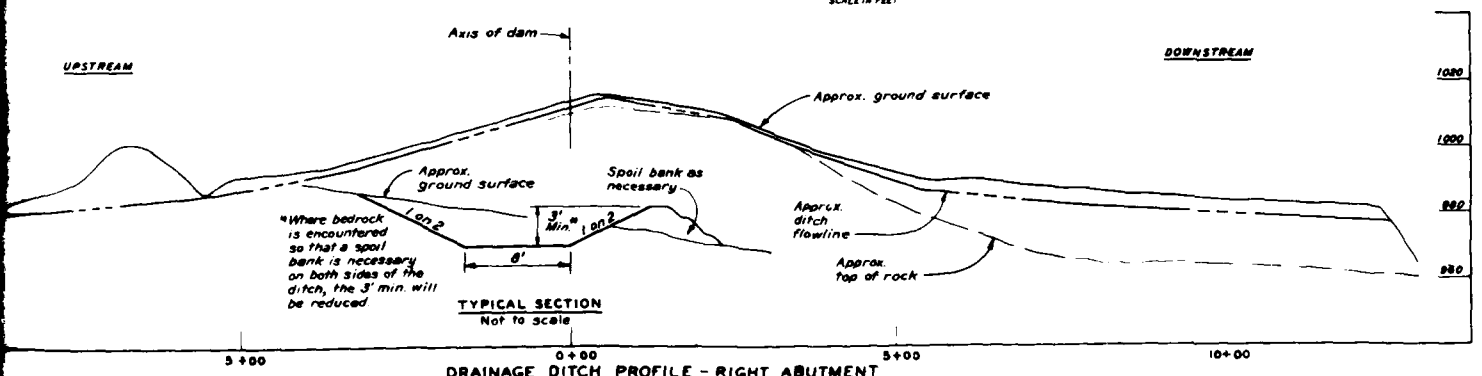


CLOSURE SECTION



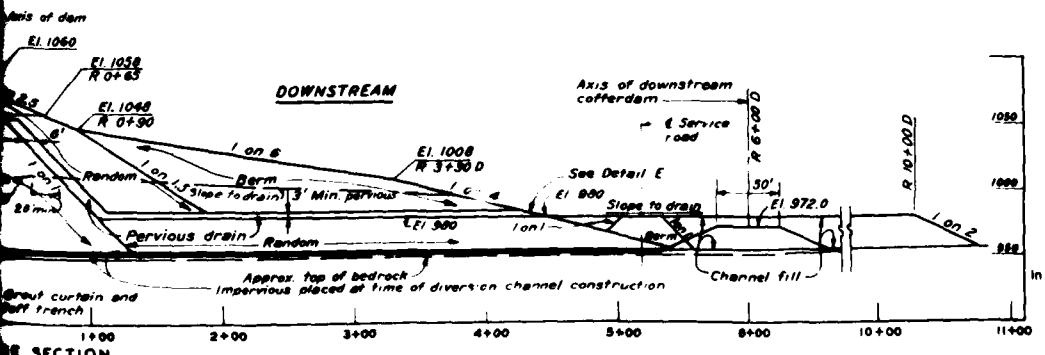
PLAN OF EMBANKMENT BEFORE FINAL CLOSURE

SCALE IN FEET



TYPICAL SECTION
Not to scale

DRAINAGE DITCH PROFILE - RIGHT ABUTMENT



E SECTION

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

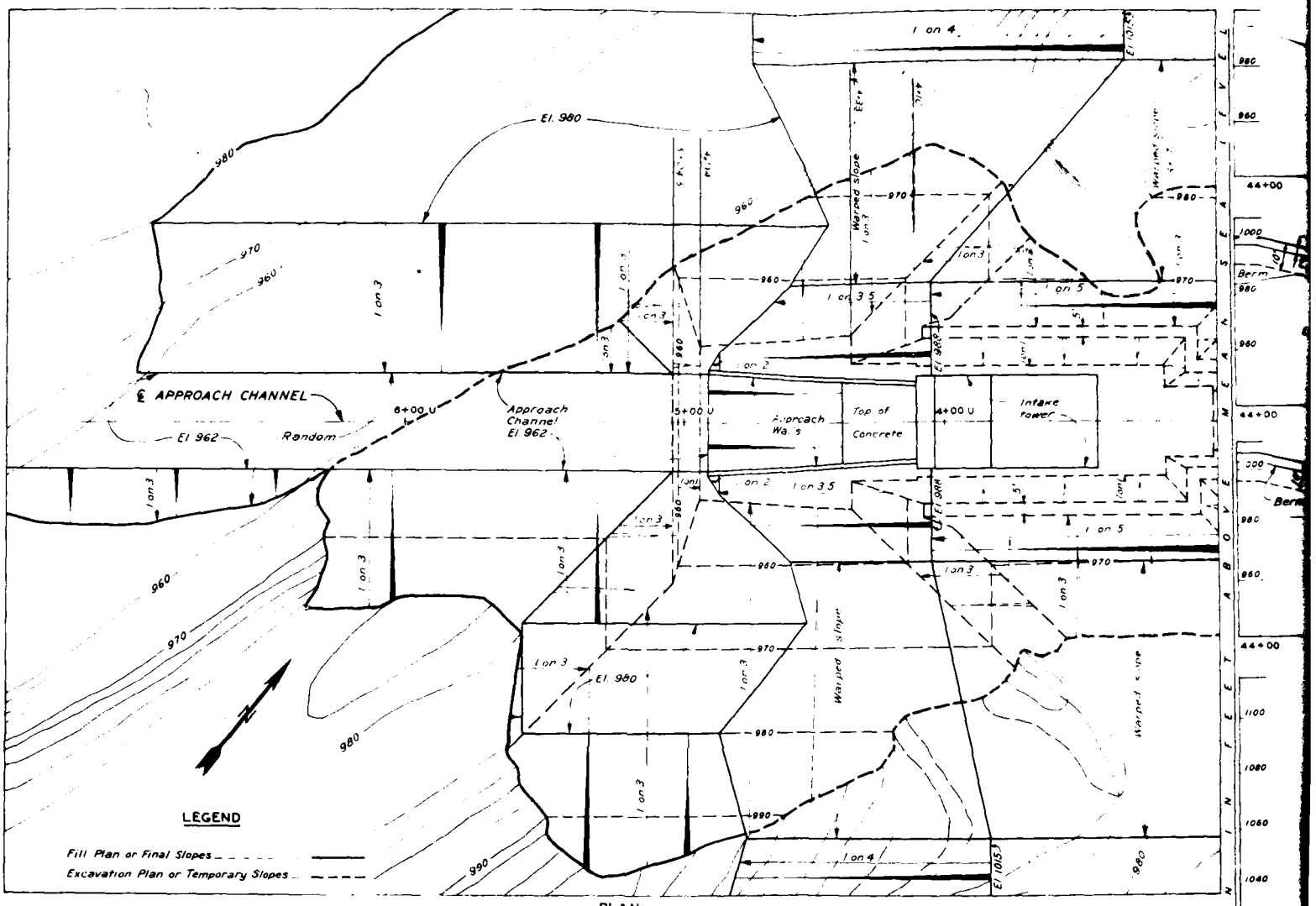
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

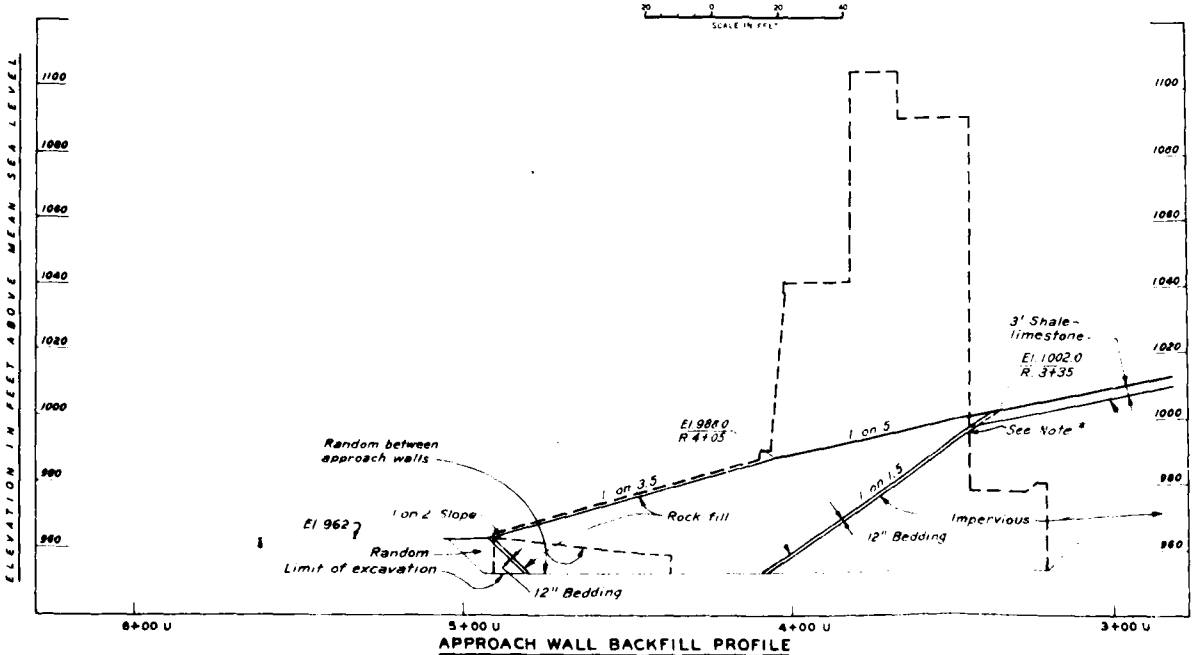
DIVERSION AND CLOSURE

in 1 sheet | Sheet No. 1 | Scale: as shown

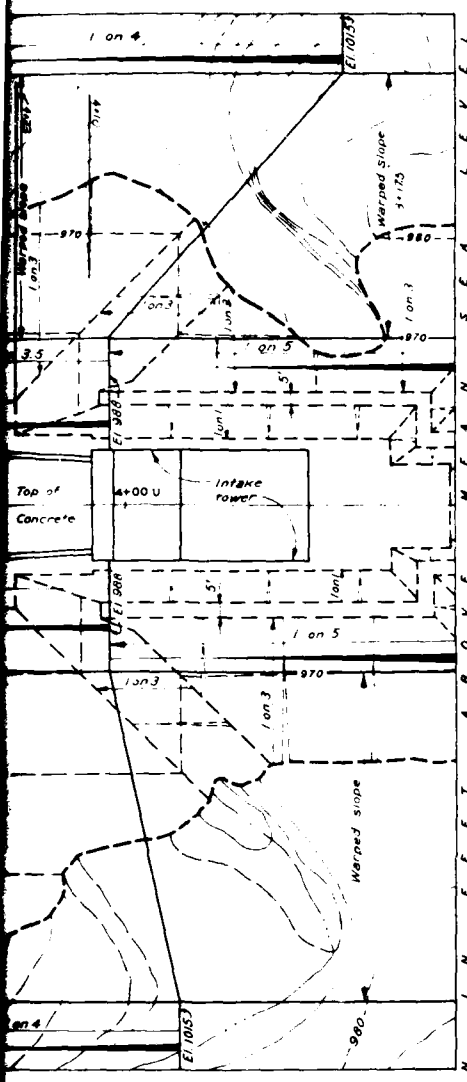
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1347
AUGUST 1979

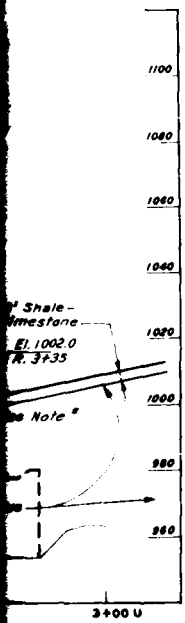
PLATE NO. 7



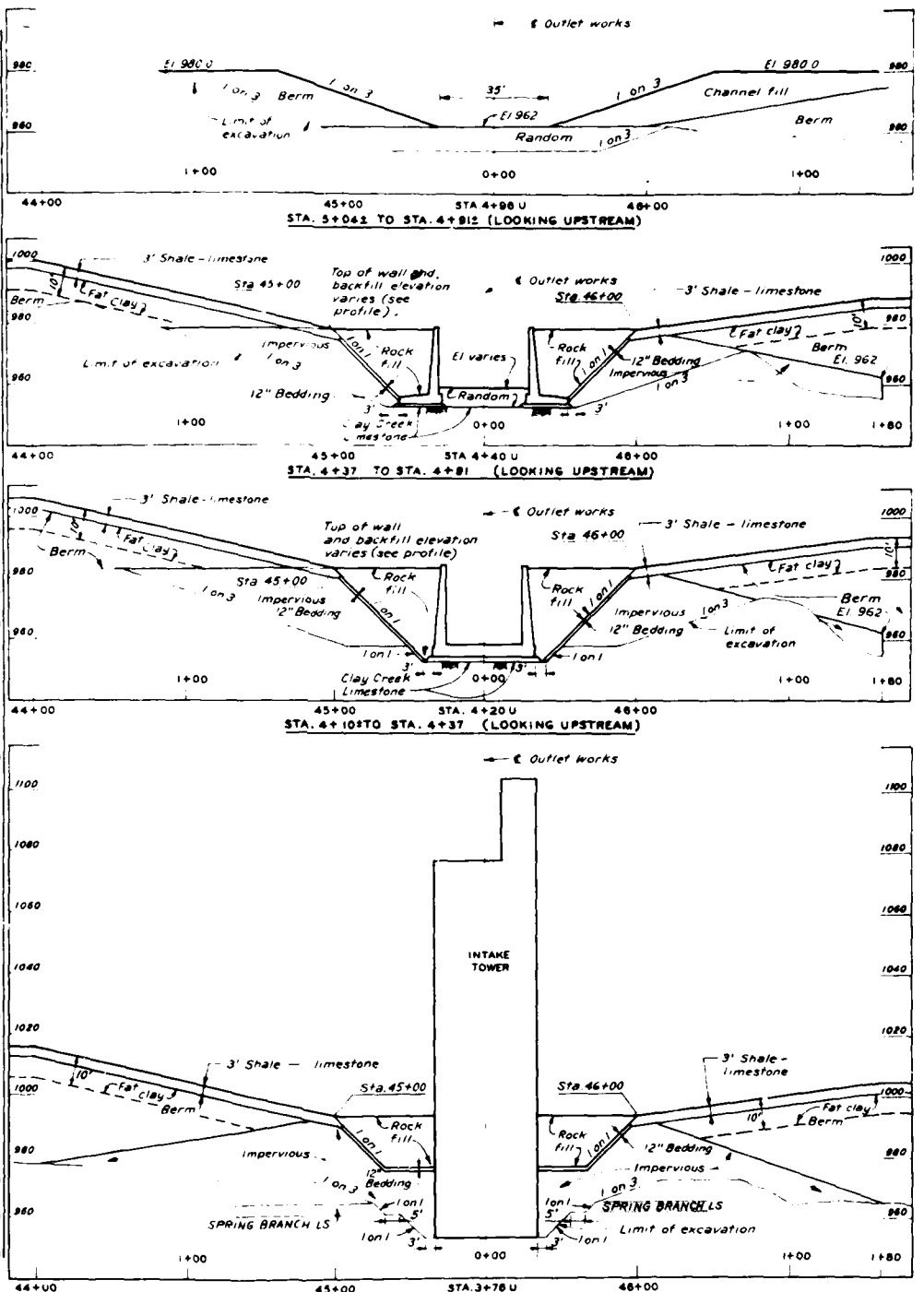


APPROACH WALL BACKFILL PROFILE





*Note
Bedding not placed directly behind tower. Between air vents.



TYPICAL SECTIONS

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT TRANSITION DETAILS INTAKE TOWER AREA

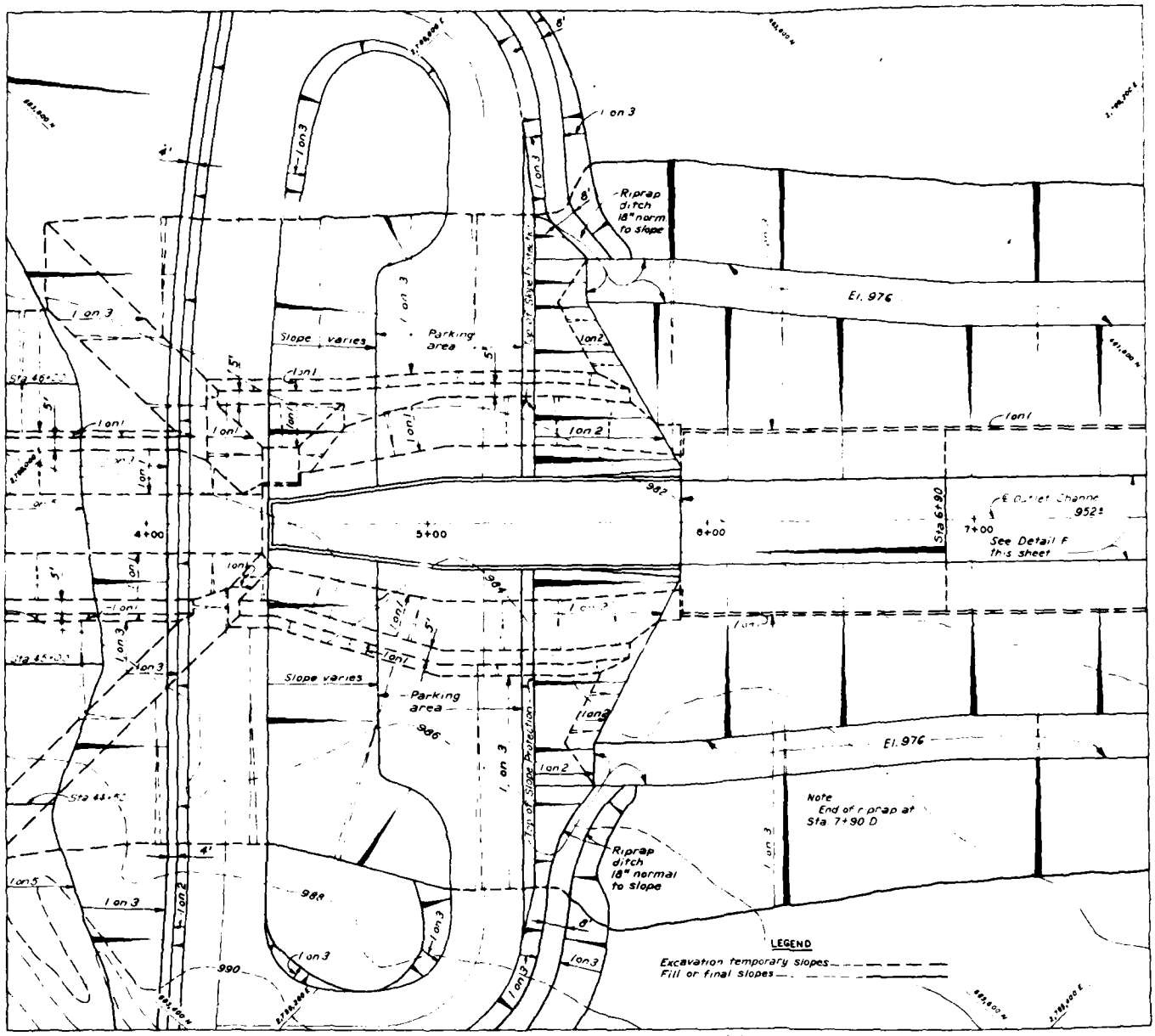
In 1 sheet | Sheet No. 1 | Scale, as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1348

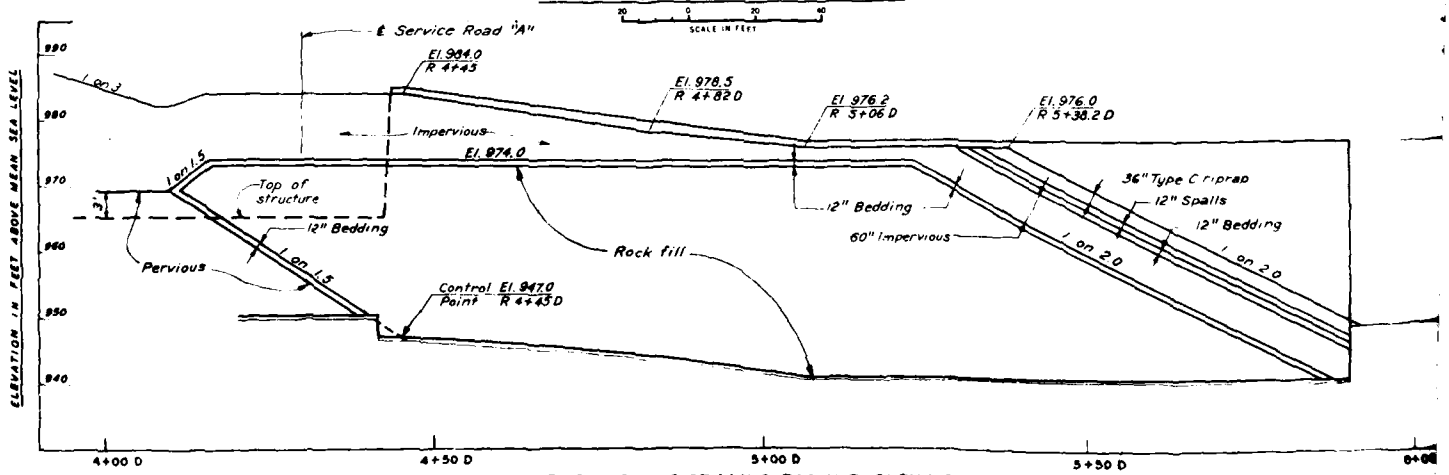
AUGUST 1979

PLATE NO. 8

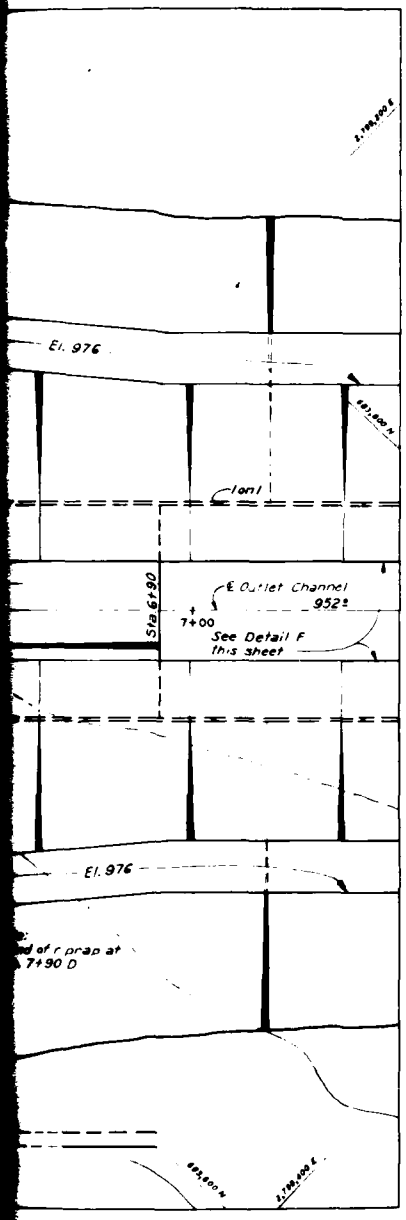


PLAN OF STILLING BASIN EXCAVATION

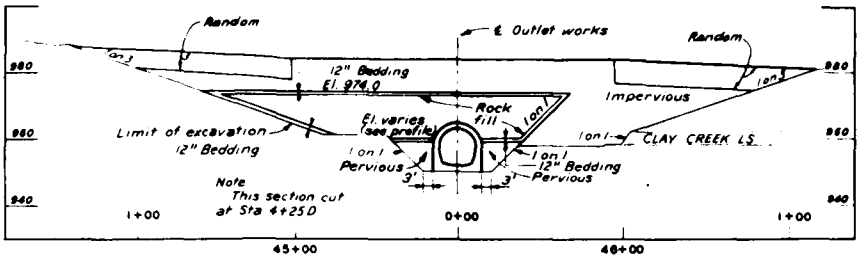
SCALE IN FEET



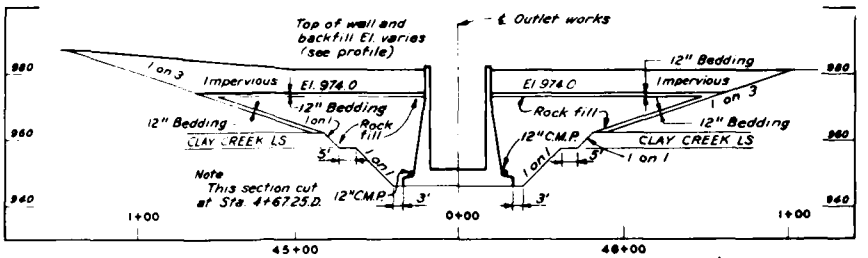
PROFILE SHOWING STILLING BASIN BACKFILL DETAILS



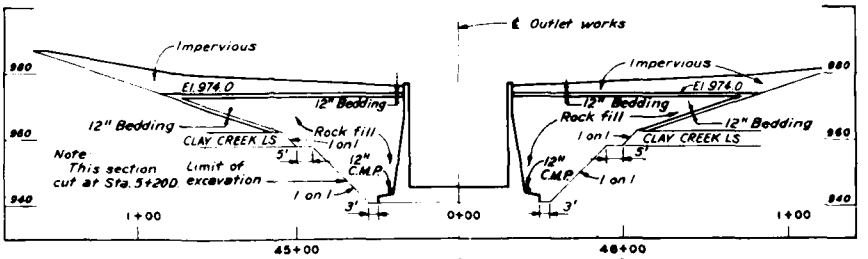
ELEVATION IN FEET ABOVE MEAN SEA LEVEL



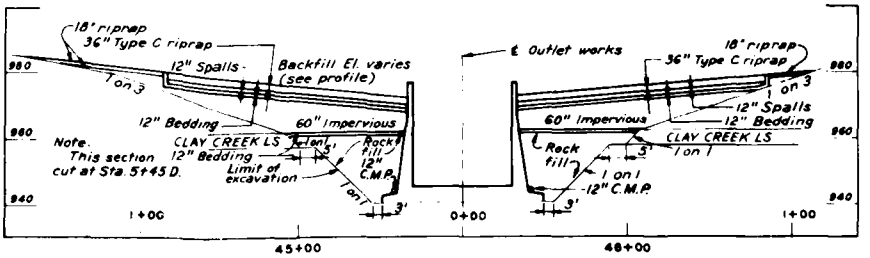
STA. 4+10± TO STA. 4+40± (LOOKING UPSTREAM)



STA. 4+40± TO STA. 5+06 (LOOKING UPSTREAM)

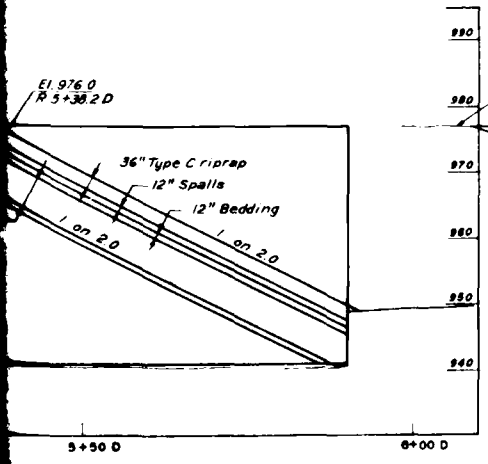


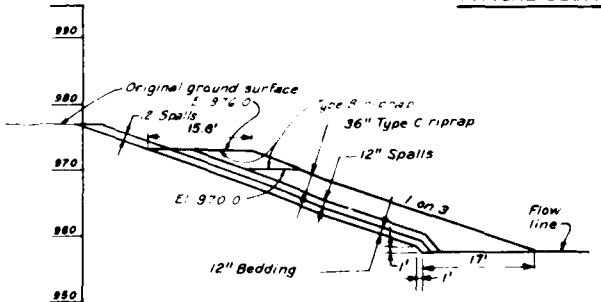
STA. 5+06 TO STA. 5+23± (LOOKING UPSTREAM)



STA. 5+38 TO STA. 5+91 (LOOKING UPSTREAM)

TYPICAL SECTIONS





DETAIL F
Scale 1" = 20'

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT TRANSITION DETAILS STILLING BASIN AREA

In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1349
AUGUST 1979

PLATE NO. 9

GENERALIZED GEOLOGIC COLUMN

SYSTEM	GROUP	FORMATION	MEMBER	THICKNESS	SYMBOL	GENERAL DESCRIPTION
QUATERNARY	Wisconsinan & Recent		[illegible]	5 to 35	Soils designation	RECENT [illegible] over [illegible] clayey sandy gravel [illegible] very soft clay lenses WISCONSINAN [illegible] gravel at base
QUATERNARY	Illinoian & Kansan		Terrace Gravels	0 to 6	Soils designation	CLAYEY GRAVEL [illegible] sand [illegible] clay matrix [illegible] younger deposits may be [illegible]
			Undifferentiated fault zone sediments	[illegible]	Standard [illegible] symbol see legend	LIMESTONE & SHALE [illegible] thin limestones separated by a thin [illegible] shale and thick clay shale. Limestones comparable with Ervine Creek and Rock Bluff in lithology. Shale [illegible] carbonaceous [illegible] calcareous very soft to soft [illegible] checks slightly on exposure gray SHALE [illegible] clayey to occasionally silty [illegible] occasionally calcareous with limestone and siltstone partings to bands [illegible] carbonaceous with occasional coal bed very soft to soft occasionally moderately dipping beds and conglomerate bands slickensides checks moderately to rapidly on exposure gray to gray green
PENNSYLVANIAN	SHAWNEE	DEER CREEK	Ervine Creek	10 ±	EC	LIMESTONE Thin bedded with shale partings occasionally argillaceous moderate [illegible] hard to hard dense numerous fractures badly weathered due shallow depth where drilled pitted and vuggy with possible cavities light gray weathers to yellow brown
			Larsh Burroak	4 to 8 Avg 4 5'	LB	SHALE Fissile occasionally laminated with siltstone moderately calcareous carbonaceous very clayey top 6 inches soft to very soft checks on exposure dark gray weathers yellow tan
			Rock Bluff	1 to 2' Avg 1 5'	RB	LIMESTONE Medium to thin bedded, occasional argillaceous partings, hard, dense to lithographic, numerous high angle fractures, tight, stained, occasionally pitted, blue gray weathers light tan
			Oskaloosa	7 to 25 5 Avg 8 5'	Ok	SHALE Platy to fissile clayey, occasionally carbonaceous and micaceous moderately calcareous with occasional limestone nodules and bands to beds numerous silty and sandy laminae, soft, numerous high angle fractures, many slickensides lower half, checks rapidly on exposure, light gray to greenish-gray weathers tan
			Ozawkie Zone A	6 to 11 Avg 7 5'	Oz_a	LIMESTONE Thin to medium bedded, frequently nodular with green shale in upper half, slightly argillaceous, moderately hard, dense, occasional fractures, weathers soft with occasional pits, light gray, weathers tan
			Ozawkie Zone B	4' to 8' Avg 6'	Oz_b	SHALE Clayey, slightly silty, weakly calcareous with occasional limestone nodules and lamina, soft, numerous fractures, occasional slickensides, checks rapidly on exposure, gray green, unweathered and weathered.
			Ozawkie Zone C	7' to 8' Avg 7'	Oz_c	LIMESTONE Medium bedded with shale partings and indistinct banding moderately hard to hard, finely crystalline to dense, occasional high angle fractures, some pitted and mineralized, light gray to grayish-tan unweathered and weathered
		TECUMSEH	Zone A	17' to 20' Avg 19'	Te_a	SHALE Indistinct lamina of siltstone and sandstone, upper half moderately calcareous, silty, occasionally sandy and micaceous lower half weakly calcareous, clayey, soft to occasionally moderately hard, occasional fractures, occasionally swells checks rapidly on exposure, dark gray to greenish-gray weathers brown
			Zone B	2 5' to 3 5' Avg 3'	Te_b	LIMESTONE Massive with indistinct laminae slightly argillaceous hard to moderately hard, dense, light bluish-gray to tannish gray weathers tan
			Zone C	5' to 7' Avg 6'	Te_c	SHALE Fissile to platy clayey, non calcareous to occasionally weakly calcareous, soft, occasional low angle fractures with slickensides, checks rapidly on exposure, dark gray weathers tan
		LECOMPTON	Avoca	3' to 4' Avg 3 5'	Av	LIMESTONE Medium bedded, transitional from shale at top, slightly argillaceous, moderately hard to hard, very finely crystalline to dense, occasional fractures, light gray to bluish gray weathers brown

SYSTEM	GROUP	FORMATION	MEMBER	THICKNESS	SYMBOL	GENERAL DESCRIPTION
		LECOMPTON	[illegible]	4 [illegible] Avg	[illegible]	SHALE [illegible] limestone moderately hard with [illegible] pseudo [illegible] weathers to orange [illegible] marker
			[illegible]	[illegible] Avg	[illegible]	SHALE Platy with [illegible] moderately hard [illegible] gray
			[illegible]	Avg	[illegible]	LIMESTONE [illegible] medium bedded with shale partings [illegible] argillaceous moderately hard [illegible] dense [illegible] bluish gray weathers brownish gray [illegible] marker
			[illegible]	2	[illegible]	SHALE Fissile to platy clayey carbonaceous [illegible] calcareous [illegible] occasionally weakly calcareous soft [illegible] a high angle fracture black
			Big Springs	[illegible] to [illegible] Avg	BS	LIMESTONE Massive transitional [illegible] slightly argillaceous moderately hard to hard dense [illegible] occasional fractures light bluish gray weathers brownish gray
			Doniphan	[illegible] Avg	Dn	SHALE Laminated numerous limestone partings [illegible] nodular beds calcareous silty with occasional clayey zones soft with many very soft partings many low angle slickensides in lower half checks on exposure gray to greenish gray Zone of very abundant mollusks near middle marker
PENNSYLVANIAN	SHAWNEE		Spring Branch	3 to 5' Avg 4'	SB	LIMESTONE Massive to thick bedded transitional top and bottom, slightly argillaceous hard to moderately hard dense light gray to bluish gray weathers gray
		KANWAKA	Stull	1' to 9' Avg 7 0	St	SHALE Laminated with siltstone and sandstone clayey calcareous micaceous, soft, checks on exposure dark gray with light gray lamina, weathers tannish gray.
			Clay Creek	4' to 6' Avg 4 5'	CC	LIMESTONE Massive, transitional top and bottom slightly argillaceous hard dense numerous fine high angle fractures, often healed bluish gray to tannish gray, weathers gray to tan
			Jackson Park	33' to 41' Avg 37'	JP	SHALE & SANDSTONE Upper [illegible] 25 ft is interlaminated shale and sandstone, non calcareous to weakly calcareous, clayey to slightly silty, micaceous, carbonaceous soft, dark gray with light gray lamina Middle 2-13 ft is a lenticular sandstone massive micaceous, moderately calcareous occasionally shaly and carbonaceous occasionally slightly salty moderately hard to slightly friable, fine grained, light gray Lower 7 10 ft is interlaminated shale and sandstone carbonaceous, micaceous, moderately calcareous with limestone lamina to beds, soft to moderately hard, gray Basal 8 11 ft is shale, platy to fissile, with discontinuous limestone lamina, clayey moderately calcareous soft, occasionally fractured, checks on exposure dark gray
		OREAD	Kereford	10' to 11' Avg 10 5'	Ke	LIMESTONE Thin bedded with shale partings occasionally nodular slightly argillaceous, moderately hard, dense, several fractures, light gray
			Heumader	8' to 9' Avg 8 5'	Hm	SHALE Platy to fissile with indistinct siltstone laminae, clayey soft, checks slightly on exposure, dark gray
			Plattsmouth	22 5' ±	Pl	LIMESTONE Thin to medium bedded with shale partings, slightly argillaceous, moderately hard to hard finely crystalline gray to tannish gray
			Heebner	4 9'	He	SHALE soft, platy to fissile carbonaceous dark gray to black
			Leavenworth	1 5'	Lv	LIMESTONE moderately hard dense usually single bed, light gray to gray
			Snyderville	10 5'	Sn	SHALE soft, Silty occasional limestone laminae gray
			Toronto	15 7'	To	LIMESTONE moderately hard dense medium to thick bedded argillaceous, occasional shale laminae gray to gray green
	DOUGLAS	LAWRENCE		80'	La	SHALE soft to moderately hard occasional siltstone laminae and sandstone lenses dark gray

LEGE[illegible]

LEGEN[illegible]

Plasticity index [illegible]
Liquid limit [illegible]
Effective size mm [illegible] maximum diameter [illegible] weight [illegible]
Hole number [illegible]
*Offset for Station and Range
Vertical Angle and Direction
Moisture content per cent [illegible]
Dry density pounds per cubic foot
Unconfined compressive strength [illegible]
Elevation and date water level observed
Unified soil classification determined [illegible]
Field Classification Only
No Sample [illegible]
No Recovery (overburden) [illegible]
Per cent lost drill water [illegible]
Lost core (bedrock) [illegible]
Depth of hole [illegible]
Per cent core recovered in bedrock
Drilling completion date [illegible]
Diameter of sample [illegible]

*Offset from profile or section may be [illegible] Landward or Riverward [illegible] or Right [illegible]

UNIFIED [illegible]

GW	Well graded gravels [illegible] mixtures [illegible]		[illegible]
GP	Poorly graded gravels [illegible] mixtures little [illegible]		[illegible]
GM	Silty gravels gravel sand [illegible] mixtures		[illegible]
GC	Clayey gravels gravel [illegible] mixtures		[illegible]
SW	Well-graded sands gravelly sands [illegible] little or no fines	MH	[illegible] fine sandy [illegible]
SP	Poorly graded sands or gravelly sands little or no fines	CH	[illegible] clays [illegible] high plasticity fat clays
SM	Silty sands sand-silt mixtures	[illegible]	[illegible] clays of medium to high plasticity organic [illegible]
SC	Clayey sands sand-clay mixtures	Pt	Peat and other highly organic s[illegible]

Classification from actual laboratory tests where [illegible] are shown.
Dual classification, where used is in accordance with the Unified S[illegible]
For details on the Unified Soil Classification System See Waterways [illegible]
Technical Memorandum No. 3-357 dated March 1953 and revised [illegible]

[illegible]REVIAT[illegible]

alt	alternating	dol	dolomite dolomitic
ang	angular	ext	extremely
an	anhydrite	f	fine finely
ar	argillaceous	fe	iron
bdd	bed bedded bedding	fld	filled
bdr	bedrock	fm	firm
bky	blocky	fos	fossil fossiliferous
bl	blue	frac	fractures fractured
bld	boulder	frag	fragments fragmented
blk	black	fr	friable
brec	breccia brecciated	fs	fissile
brn	brown	gr	grain
[illegible]	coarse	gra	gradation
calc	calcareous	grn	green
carb	carbonaceous	grv	gravel gravelly
cav	cavity	gry	gray
cbl	cobble	gyp	gypsum
cht	chert	ha	high angle
circl	circulation	hd	hard
cly	clay clayey	hld	healed
cmtd	cemented	hor	horizontal
col	columnar	inbd	interbedded
conc	concretions	incl	inclusions
cong	conglomerate	inlam	interlaminated
crm	crumbly	irr	irregular
d	dense	jt (js)	joints (joints)
dk	dark	la	low angle
dmp	damp	lam	laminated laminae

BORINGS WITH PZ NUMBER DESIGNATION HAVE PIEZOMETERS I[illegible]

LEGEND

LEGEND FOR LOGS OF BORINGS

- Plasticity index
- Liquid limit
- Effective size (mm): maximum diameter [illegible] smallest 10 per cent by weight
- Hole number
- *Offset (or Station and Range)
- Vertical Angle and Direction
- Moisture content, per cent
- Dry density, pounds per cubic foot
- Unconfined compressive strength tons per square foot
- Elevation and date water level observed
- Unified soil classification determined in laboratory
- Field Classification Only
- No Sample
- No Recovery (overburden)
- Per cent lost drill water
- Lost core (bedrock)
- Depth of hole
- Per cent core recovered in bedrock
- Drilling completion date
- Diameter of sample

Example log: DC 30; 20' Riv; 30° SW; UC 44, D 95, M 24; D 10 0.10; w 10-7-60; CH, SP, ML, FC, NS, NR; L.D.W. 25%, Ls; L.C. 0.8', Sh; 100.0'; 95.6%; 10-6-60; 4" soils, 2⅛" bedrock

*Offset from profile or section may be Upstream or Downstream (U or D), Landward or Riverward (Lwd or Riv), or Right or Left [illegible] as defined

TYPE OF EXPLORATION

CODE DESIGNATION

- D Drive sample [illegible]
- [illegible] Core hole
- TP Test pit [illegible] 24" or larger diameter
- [illegible] Undisturbed [illegible]
- A Auger hole [illegible] auger less than 24" diameter
- NS [illegible] installed or rock bitted
- [illegible]

MAP SYMBOL

- ● Vertical boring
- 30° ◆ Inclined boring showing direction and vertical angle

BEDROCK UNIT THICKNESS

Parting	[illegible]
Band	[illegible]
Thin Bed	[illegible]
Medium bed	[illegible]
Thick bed	[illegible]
Massive	[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM

Symbol	Description	Symbol	Description
GW	Well graded gravels, gravel-sand mixtures, little or no fines	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
GP	Poorly graded gravels or gravel-sand mixtures, little or no fines	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
GM	Silty gravels, gravel-sand-silt mixtures	OL	Organic silts and organic silty clays of low plasticity
GC	Clayey gravels, gravel-sand-clay mixtures	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
SW	Well-graded sands, gravelly sands, little or no fines	CH	Inorganic clays of high plasticity, fat clays
SP	Poorly graded sands or gravelly sands, little or no fines	OH	Organic clays of medium to high plasticity, organic silts
SM	Silty sands, sand-silt mixtures	Pt	Peat and other highly organic soils
SC	Clayey sands, sand-clay mixtures		

Classification from actual laboratory tests where LL and PI are shown.
Dual classification, where used, is in accordance with the Unified Soil Classification [illegible]
For details on the *Unified Soil Classification System*, See Waterways Experiment Station Technical Memorandum No. 3-357 dated March 1953 and revised in 19[illegible]0

TERMS FOR CONSISTENCY OF SOIL AND HARDNESS OF BEDROCK

SOIL

Consistency	Estimated Unconfined Compressive Strength Tons per square foot
Very soft	< .25
Soft	.25 - 0.5
Medium	0.5 - 1.0
Stiff	1.0 - 2.0
Very stiff	2.0 - 4.0
Hard	> 4.0

BEDROCK

SCALE OF HARDNESS

Very soft or plastic	Can be indented easily [illegible]
Soft	Can be scratched with [illegible]
Moderately hard	Can be scratched easily [illegible] cannot be scratched with [illegible]
Hard	Difficult to scratch with [illegible]
Very Hard	Cannot be scratched with [illegible]

ABBREVIATIONS

alt	alternating	dol	dolomite, dolomitic	lea	leached	[illegible]	[illegible]
ang	angular	ext	extremely	lig	lignite	[illegible]	scattered
an	anhydrite	f	fine, finely	ls	limestone	[illegible]	[illegible]
ar	argillaceous	fe	iron	[illegible]	light	[illegible]	[illegible]
bdd	bed, bedded, bedding	fld	filled	[illegible]	loose	[illegible]	[illegible]
bdr	bedrock	fm	firm	L.C.	lost core	[illegible]	siltstone
bky	blocky	fos	fossil, fossiliferous	L.D.W.	lost drill water	[illegible]	slightly
bl	blue	frac	fractures, fractured	med	medium	sics	siliceous
bld	boulder	frag	fragments, fragmented	mic	micaceous	slks	slickensides
blk	black	fri	friable	min	mineralized	so	soft
brec	breccia, brecciated	fsl	fissile	mod	moderate, moderately	sol	solution, solutionized
brn	brown	gr	grain	mot	mottled	ss	sandstone
c	coarse	gra	gradation	mss	massive	st	stained, staining
calc	calcareous	grn	green	mst	moist	stf	stiff
carb	carbonaceous	grv	gravel, gravelly	mtl	material	sty	stylolitic
cav	cavity	gry	gray	mtx	matrix	v	very
cbl	cobble	gyp	gypsum	nod	nodules	vert	vertical
cht	chert	ha	high angle	num	numerous	vgy	vuggy
circl	circulation	hd	hard	occ	occasionally, occasional	w	water
cl (y)	clay, (clayey)	hld	healed	op	open	w	with
cmtd	cemented	hor	horizontal	org	organic	wea	weathered
col	columnar	inbd	interbedded	pit	pit, pitted, pitting	wht	white
conc	concretions	incl	inclusions	pl	plastic	x-bdd	cross bedded
cong	conglomerate	inlam	interlaminated	pla	platy	xln	crystalline
crm	crumbly	irr	irregular	pln	plane	y	yellow
d	dense	jt (s)	joints, (joints)	ptg (s)	parting, (partings)		
dk	dark	la	low angle	qtz	quartzite, quartz		
dmp	damp	lam	laminated, laminae	rnd	round, rounded		

When used as log symbol first letter is capitalized

BORINGS WITH PZ NUMBER DESIGNATION HAVE PIEZOMETERS INSTALLED IN THEM.

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

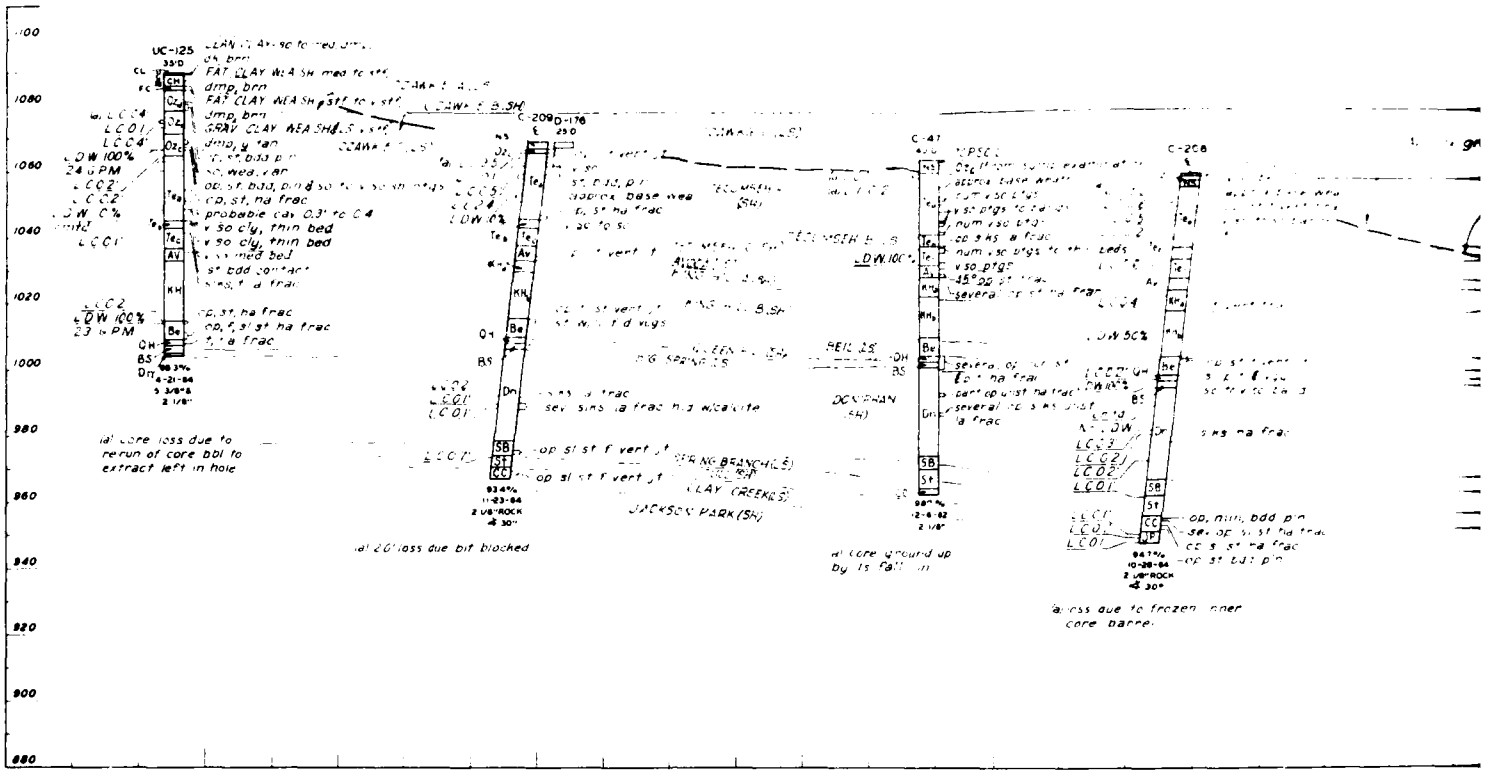
GENERALIZED GEOLOGIC COLUMN AND LEGEND

In 1 sheets | Sheet No. 1 | Scale: as shown

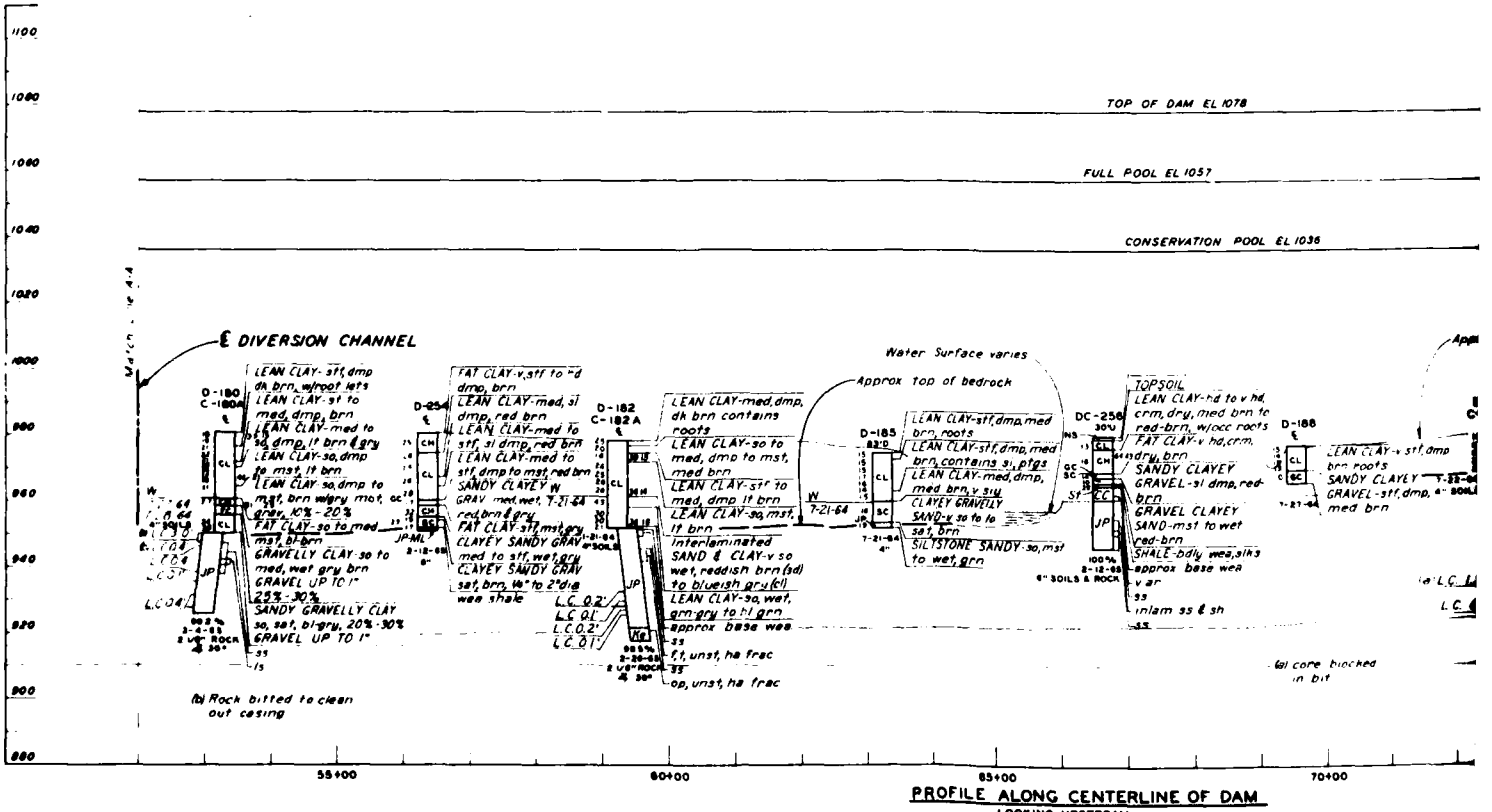
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. O-5-1350
AUGUST 1979

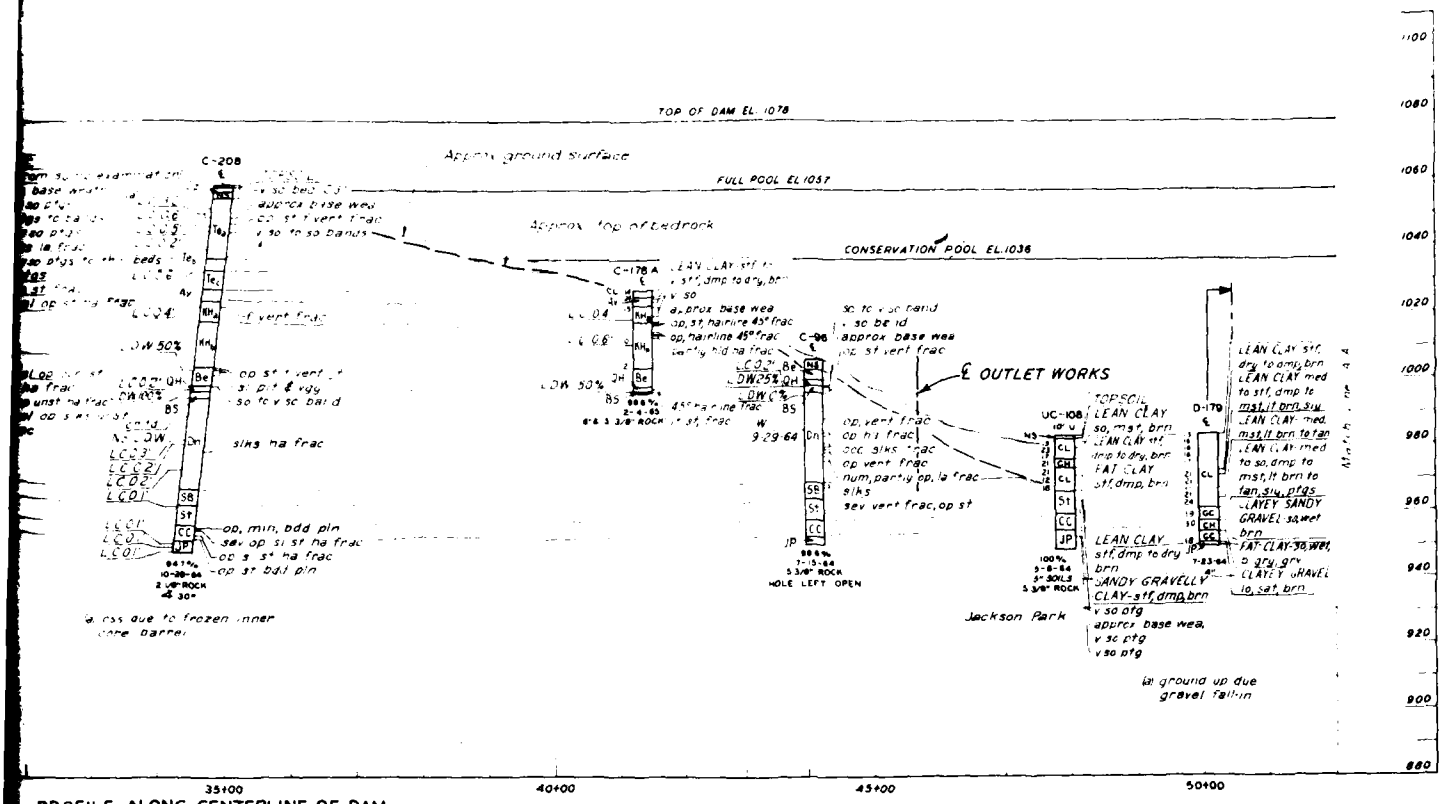
PLATE NO. 10



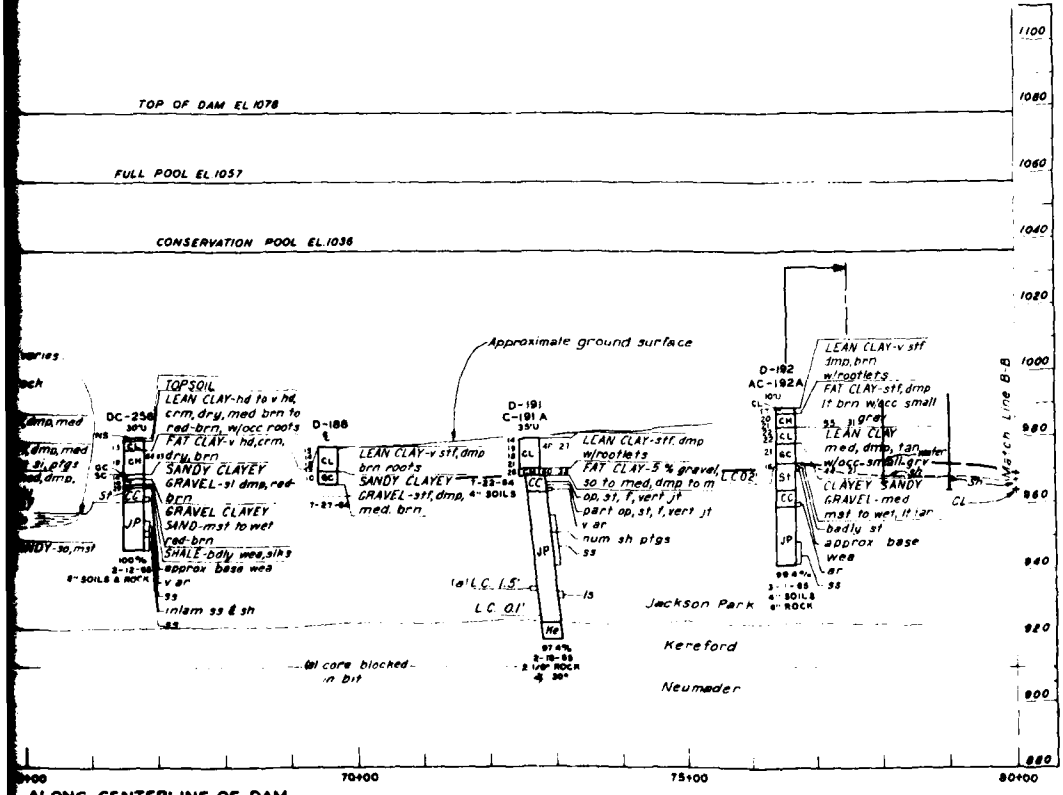
PROFILE ALONG CENTERLINE OF DAM
LOOKING UPSTREAM



PROFILE ALONG CENTERLINE OF DAM
LOOKING UPSTREAM



PROFILE ALONG CENTERLINE OF DAM
LOOKING UPSTREAM



ALONG CENTERLINE OF DAM
LOOKING UPSTREAM

NOTES
For legend and geologic column see Dwg. No. 10
For excavation detail see Dwg. No. 7
For grouting detail see Dwg. No. 13
Water levels shown where available

MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

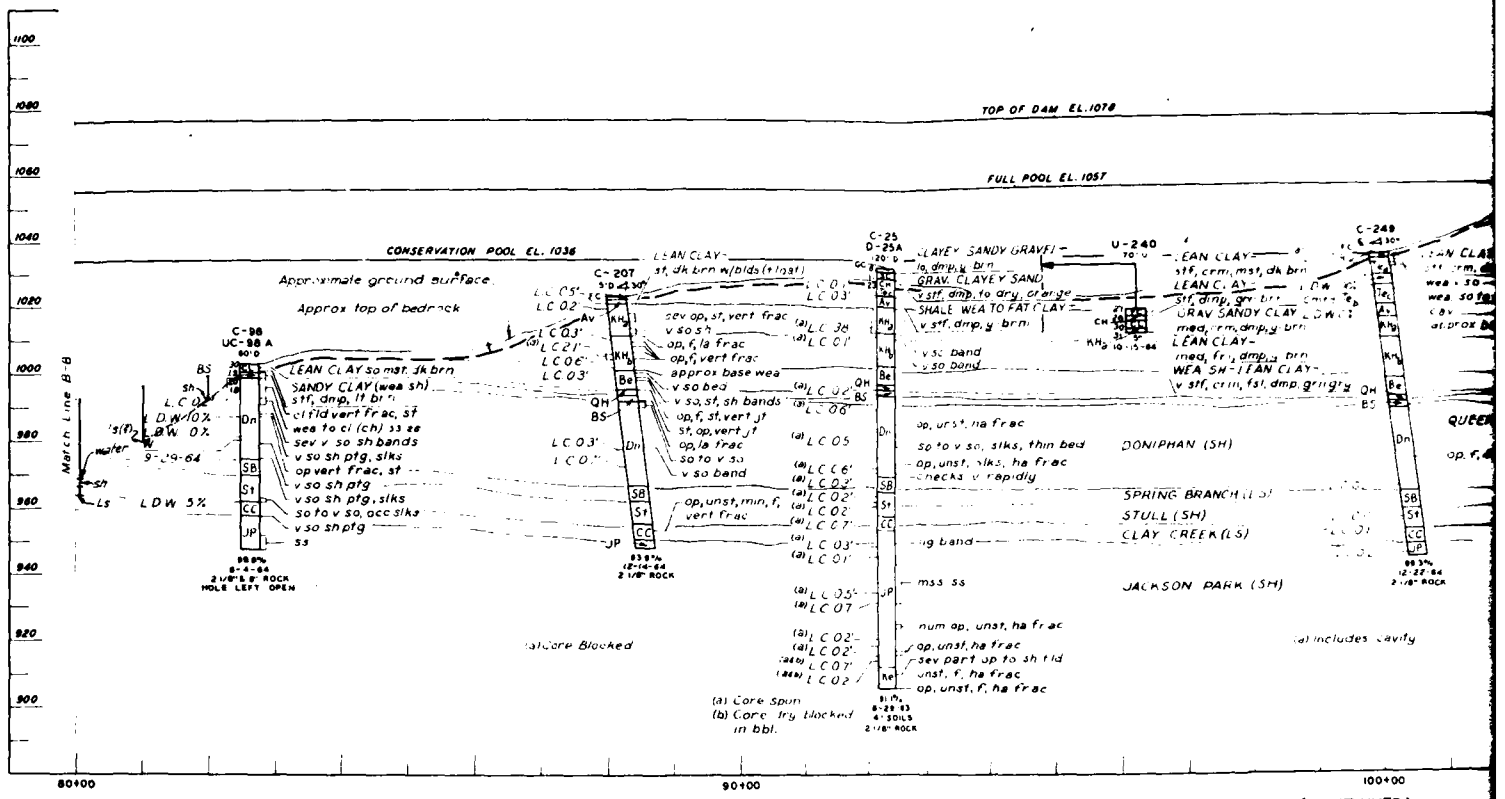
LOGS OF EXPLORATIONS AXIS OF DAM

In 1 sheet | Sheet No 1 | Scale as shown

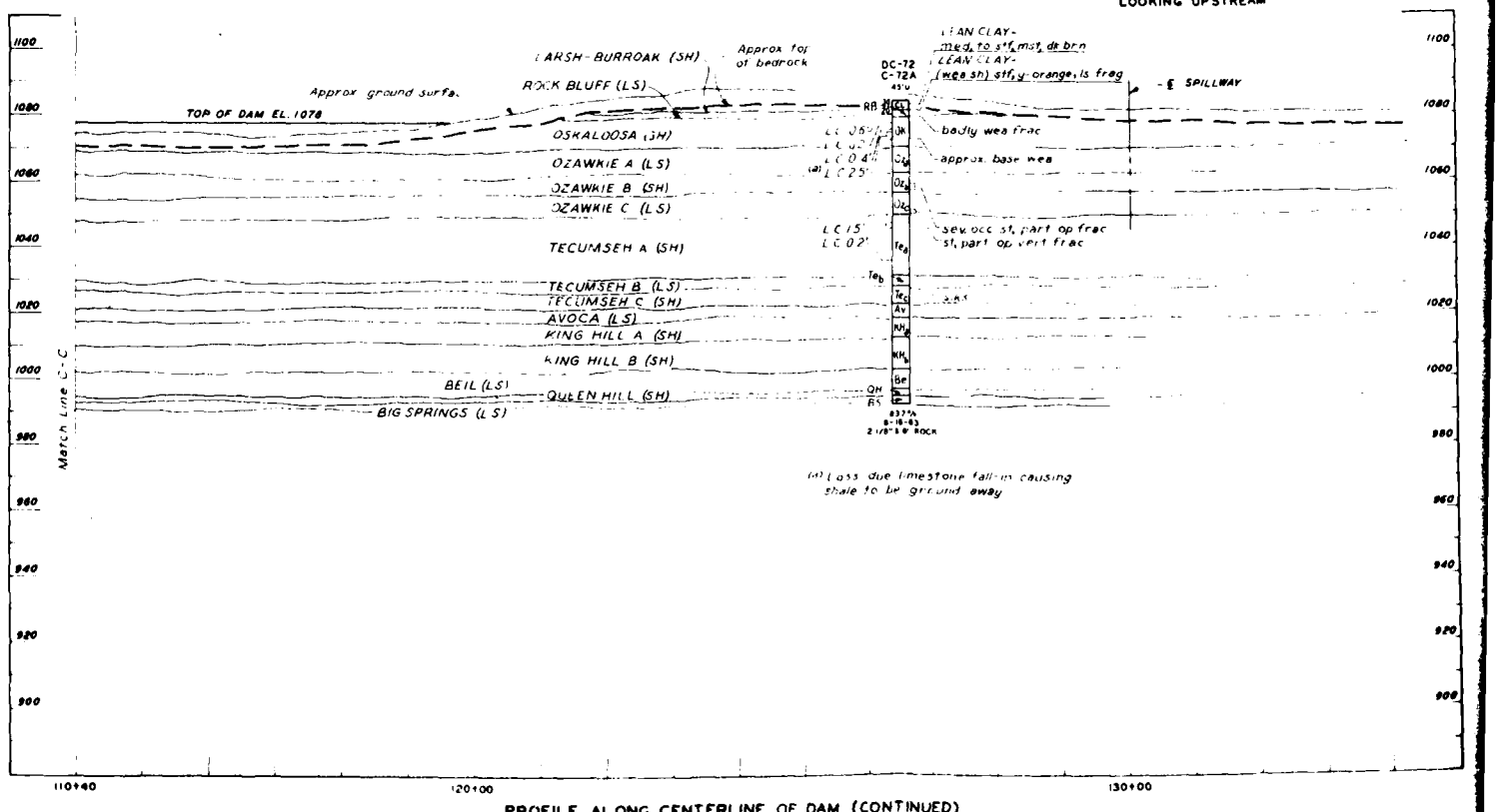
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1351
AUGUST 1979

2

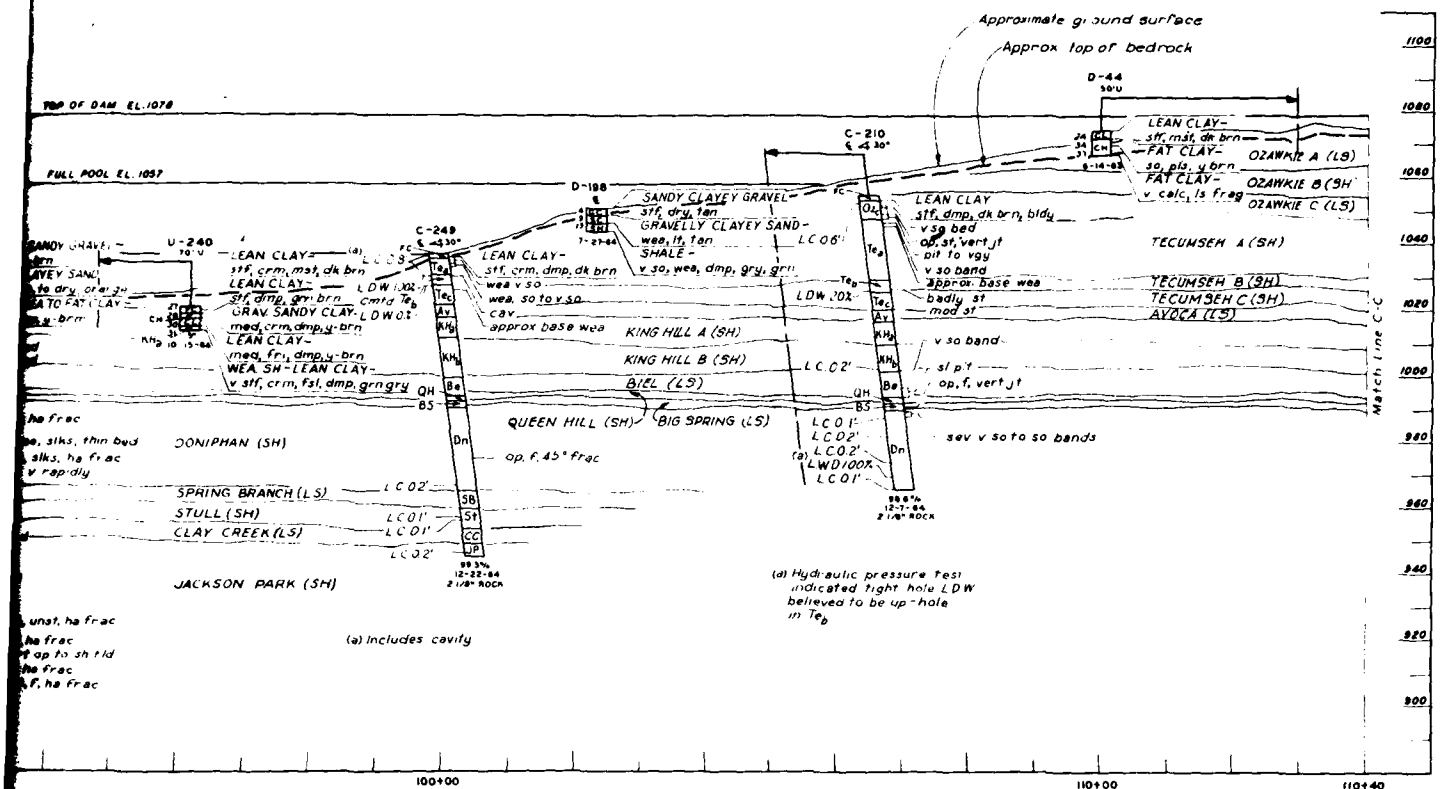
PLATE NO 11



PROFILE ALONG CENTERLINE OF DAM (CONTINUED)
LOOKING UPSTREAM



PROFILE ALONG CENTERLINE OF DAM (CONTINUED)
LOOKING UPSTREAM

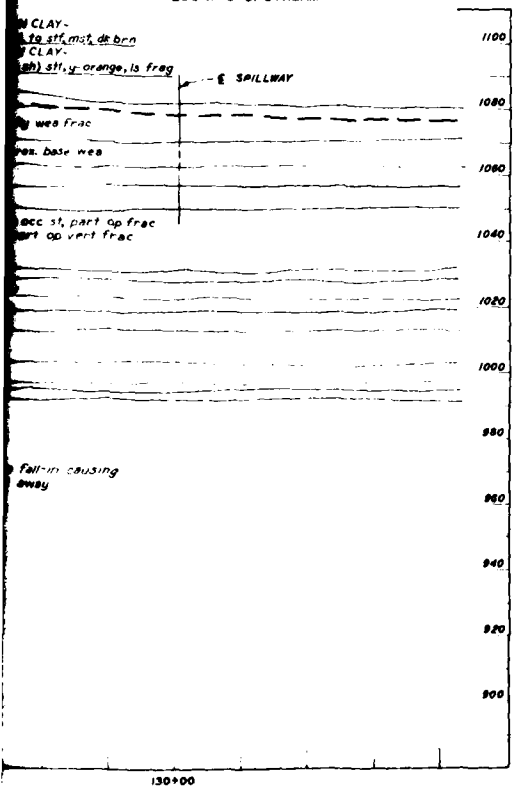


(a) Includes cavity

(a) Hydraulic pressure test indicated tight hole LDW believed to be up-hole in Te_b

PROFILE ALONG CENTERLINE OF DAM (CONTINUED)

LOOKING UPSTREAM



NOTES:

For geologic column and legend see Dwg. No. 10.
For excavation detail see Dwg. No. 3.
For grouting detail see Dwg. No. 13.
Water levels shown where available.

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

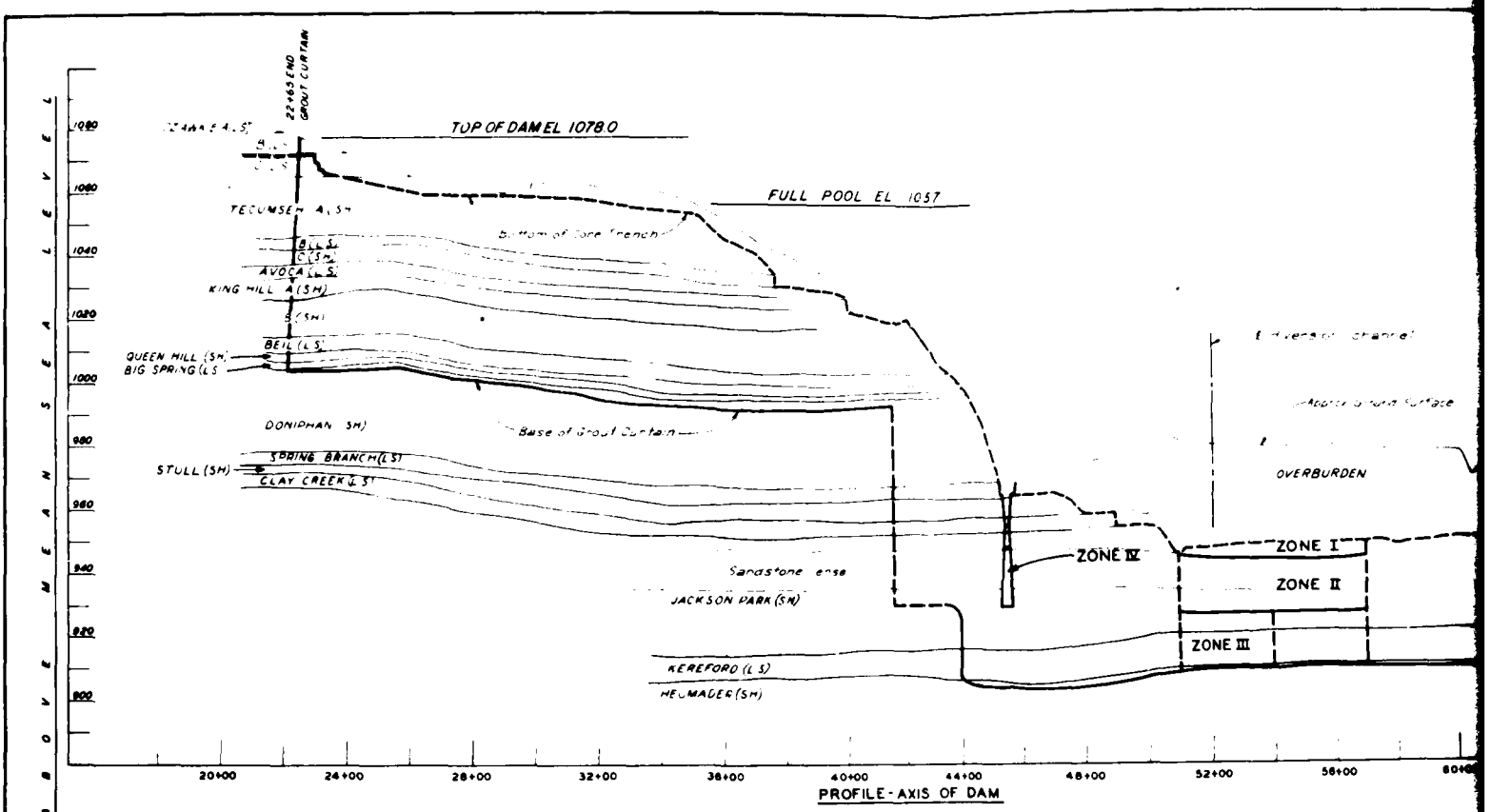
LOGS OF EXPLORATIONS AXIS OF DAM

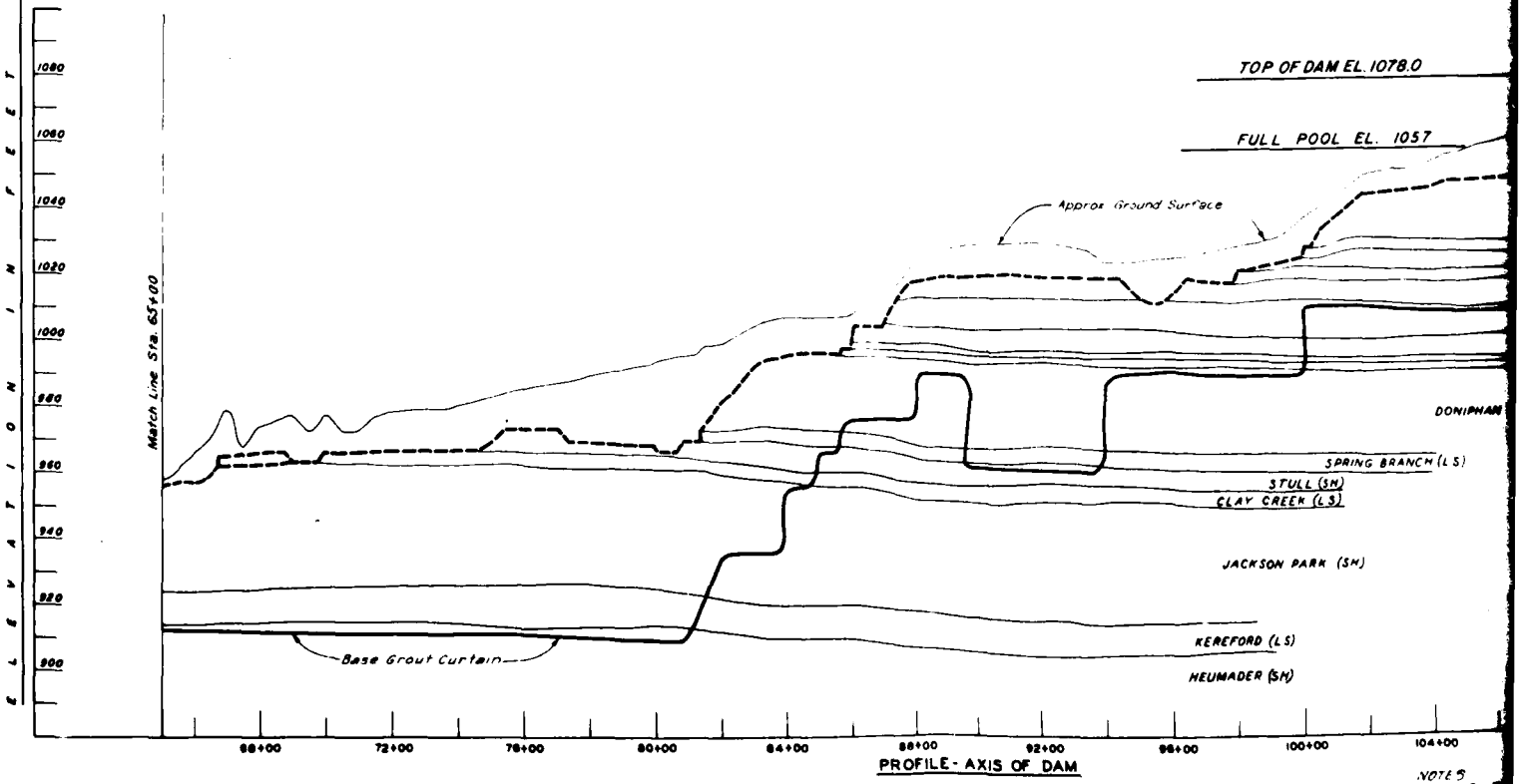
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1352
AUGUST 1979

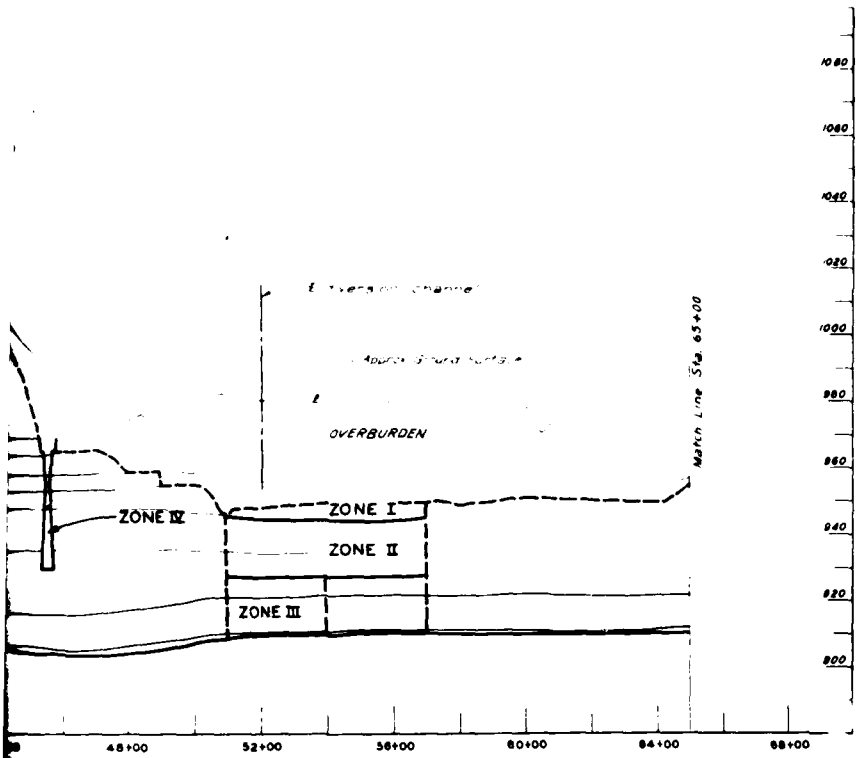
2

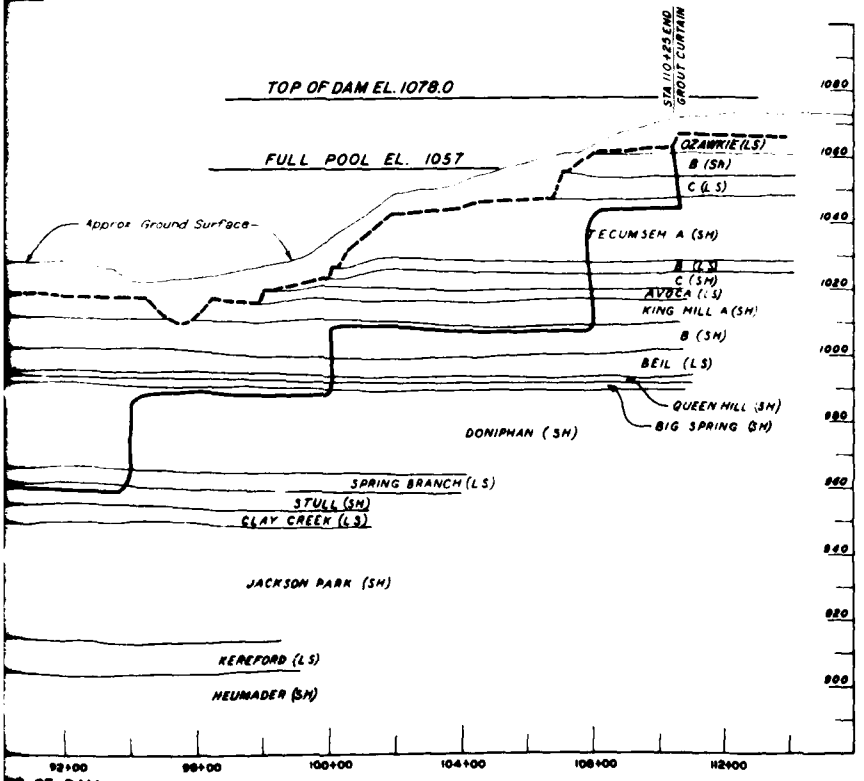
PLATE NO. 12


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1080
1060
1040
1020
1000
980
960
940
920
900
22+65 END GROUT CURTAIN
TOP OF DAM EL 1078.0
FULL POOL EL 1057
TECUMSEH A (SH)
KING HILL A (SH)
BELL (LS)
QUEEN HILL (SH)
BIG SPRING (LS)
DONIPHAN (SH)
STULL (SH)
SPRING BRANCH (LS)
CLAY CREEK (LS)
Base of Grout Curtain
Sandstone ense
JACKSON PARK (SH)
KEREFORD (LS)
HEUMADER (SH)
OVERBURDEN
ZONE I
ZONE II
ZONE III
ZONE IV
20+00
24+00
28+00
32+00
36+00
40+00
44+00
48+00
52+00
56+00
PROFILE - AXIS OF DAM


ELEVATION IN FEET
1080
1060
1040
1020
1000
980
960
940
920
900
Match Line Sta. 65+00
TOP OF DAM EL. 1078.0
FULL POOL EL. 1057
Approx Ground Surface
DONIPHAN
SPRING BRANCH (LS)
STULL (SH)
CLAY CREEK (LS)
JACKSON PARK (SH)
KEREFORD (LS)
HEUMADER (SH)
Base Grout Curtain
68+00
72+00
76+00
80+00
84+00
88+00
92+00
96+00
100+00
104+00
PROFILE - AXIS OF DAM

NOTES



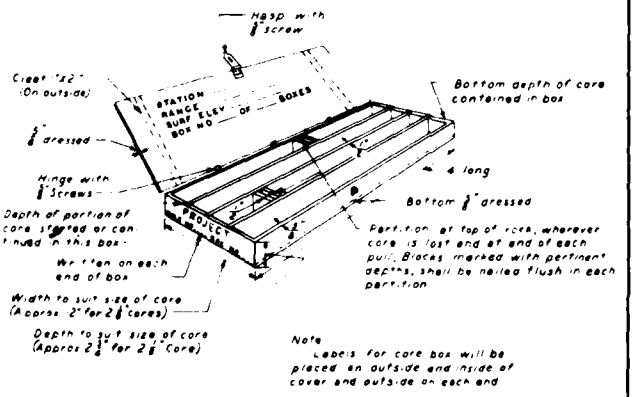


OF DAM

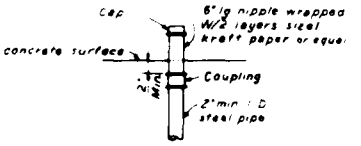
NOTES

Profile along cutoff trench shown on Dwg No. 3

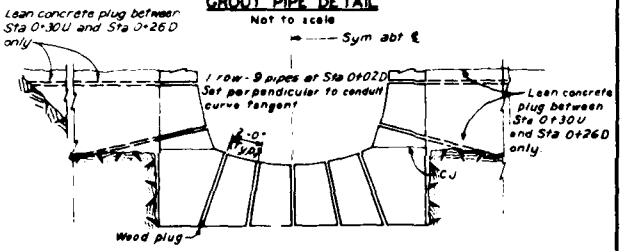
Area below conduit regrouted by Zone IV



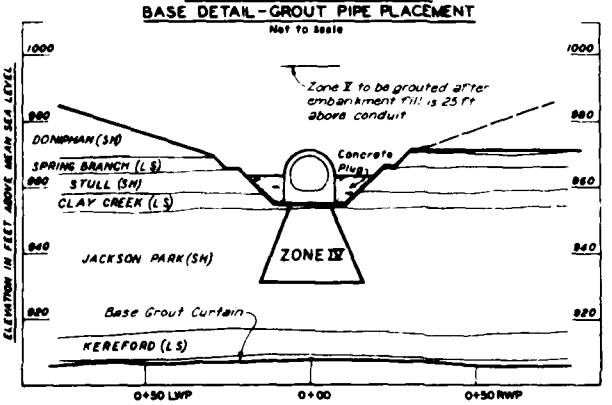
CORE BOX DETAILS
(FOR EXPLORATORY DRILLING)



GROUT PIPE DETAIL
Not to scale



CONDUIT SECTION GROUTING BASE DETAIL - GROUT PIPE PLACEMENT
Not to scale



OUTLET WORKS - CROSS SECTION STA. 0+00
(LOOKING UPSTREAM)

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

CURTAIN GROUTING

In 1 sheet | Sheet No. 1 | Scale as shown

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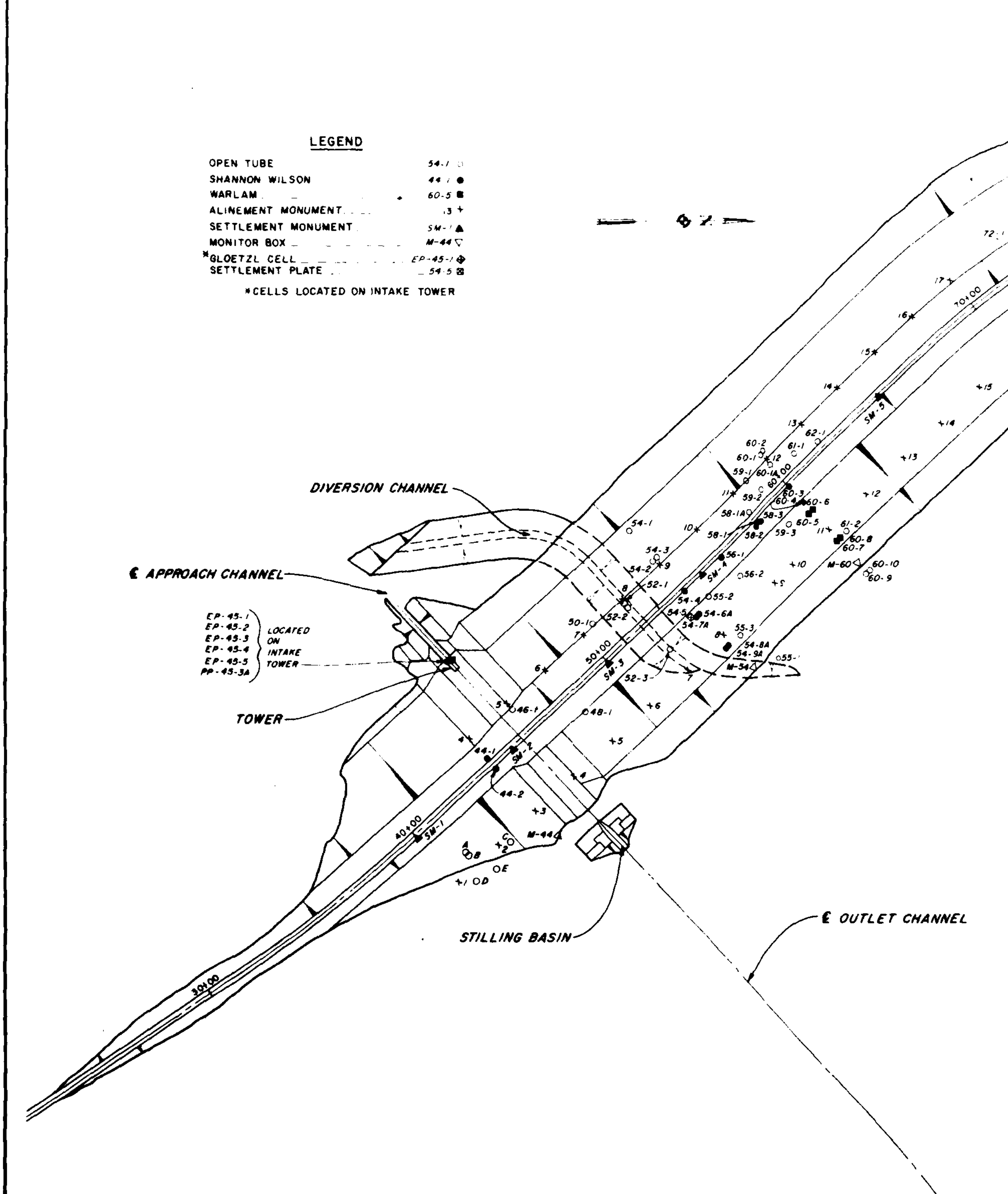
KANSAS CITY DISTRICT
FILE NO. 0-5-1353
AUGUST 1979

2

PLATE NO. 13



SCHEDULE OF OB[...]

NUMBER	STATION	RANGE
SM 1	40+00	[illegible]+85 Dn
PP 44	44+00	[illegible] Up
PP 44 2	44+00	0+20 Dn
SM 2	45+00	0+18.5 Dn
PP 45 3A	45+65	3+44 Up
EP 45	45+65	[illegible]+6[illegible]
EP 45 2	45+65	5+80
EP 45 3	45+65	3+40
EP 45 4	45+65	3+50
EP 45 5	45+65	[illegible]
PP 46	46+00	[illegible]+00 U/S
PP 48	48+00	[illegible] D/S
SM 3	50+00	[illegible]+85 Dn
PP 50	50+50	[illegible]+30 U/S
PP 52	52+00	[illegible]+00 U/S
PP 52 2	52+00	0+8[illegible] D/S
PP 52 3	52+00	[illegible]+50 D/S
PP 54 [illegible]	53+50	[illegible]+00 Dn
PP 54 7A	53+75	[illegible]+25 D/S
PP 54 9A	53+75	3+00 D/S
PP 54 6A	53+85	1+25 D/S
PP 54 8A	53+85	3+00 D/S
PP 54	54+00	3+00 Up
PP 54 2	54+00	1+50 Up
PP 54 4	54+00	0+20 Dn
PP 54 6	54+00	1+25 Dn
PP 54 8	54+00	3+00 Dn
PP 54 3	54+[illegible]	[illegible]+50 Up
PP 54 [illegible]	54+10	[illegible]+25 Dn
PP 54 9	54+[illegible]	3+00 Dn
PP 55 2	54+50	[illegible]+00 D/S
PP 55 3	54+50	3+00 D/S
PP 55	55+00	4+[illegible]0 D/S
PP 56	56+00	[illegible]+20 Dn
PP 56 2	56+00	[illegible]+25 D/S
PP 58 3	57+95	0+25 Dn
PP 58 2	57+97	0+30 D/S
PP 58	58+00	0+25 D/S
PP 58 [illegible]A	58+00	0+20 U/S
PP 59	58+75	1+25 U/S
PP 59 2	59+00	0+35 U/S
PP 59 3	59+00	1+25 D/S
SM 4	55+00	0+85 D/S

NOTES

\# Alinement traverses and [...]

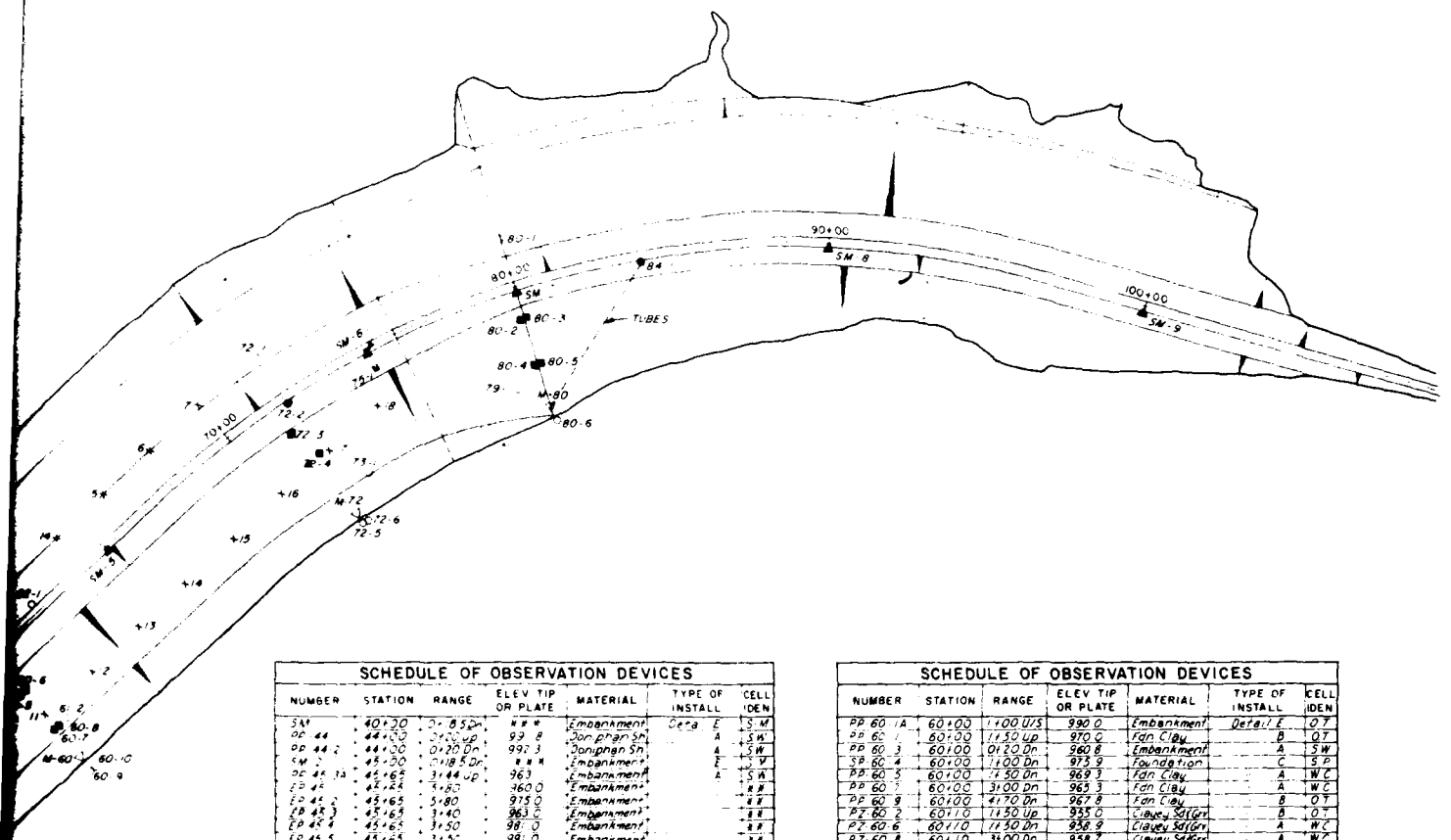
\## Cells located on intake tower [...]

\### Installation is controlled by [...]

(1) Replaced by S.W. cells, but [...]
Monitor box M 54 Location [...]

S P — Settlement plate
S W — Shannon Wilson
O T — Open tube
W C — Warlam cel[...]
S M — Settlement monum[...]

(2) Compacted impervious fill [...]



SCHEDULE OF OBSERVATION DEVICES

NUMBER	STATION	RANGE	ELEV TIP OR PLATE	MATERIAL	TYPE OF INSTALL	CELL IDEN	
SM*	40+20	0+18.5 Dn	***	Embankment	Detail E	SM	
PP 44	44+00	0+20 up	993.8	Jonathan Sh	A	SW	
PP 44 2	44+00	0+20 Dn	993.3	Doniphan Sh	A	SW	
SM 45	45+30	0+18.5 Dn	***	Embankment	E	SM	
PP 45 3A	45+65	3+44 up	963	Embankment	A	SW	
PP 45	45+65	5+80	960.0	Embankment		**	
PP 45 2	45+65	5+80	975.0	Embankment		**	
PP 45 3	45+65	3+40	963.5	Embankment		**	
PP 45 4	45+65	3+50	981.0	Embankment		**	
PP 45 5	45+65	3+50	991.0	Embankment		**	
PP 46	46+00	1+00 U/S	990.0	Embankment	B	OT	
PP 48	48+00	1+00 U/S	970.0	Fan Clay	B	OT	
SM 1	50+00	0+18.5 Dn	***	Embankment	E	SM	
PP 50	50+50	1+30 U/S	964.2	Fan Clay	B	OT	
PP 52	52+00	1+00 U/S	965.0	Embankment	B	OT	(2)
PP 52 2	52+00	0+18.5 D/S	000.0	Embankment	B	OT	(2)
PP 52 3	52+00	1+00 D/S	965	Embankment	B	OT	(2)
PP 54 5	53+50	1+00 Dn	977.9	Fan Clay	C	SP	
PP 54 7A	53+75	1+25 D/S	952.8	Clayey Sd(Grv	A	SW	
PP 54 9A	53+75	3+00 D/S	954.0	Clayey Sd(Grv	A	SW	
PP 54 9A1	53+85	1+25 D/S	967.0	Fan Clay	A	SW	
PP 54 9A2	53+85	3+00 D/S	968.1	Fan Clay	A	SW	
PP 54	54+00	3+00 Up	964.6	Fan Clay	B	OT	
PP 54 2	54+00	1+50 Up	957.0	Fan Clay	B	OT	
PP 54 4	54+00	0+20 Dn	960.0	Embankment	A	SW	
PP 54 6	54+00	1+25 Dn	967.0	Fan Clay	A	WC	(1)
PP 54 8	54+30	3+20 Dn	968.5	Fan Clay	A	WC	(1)
PP 54 3	54+10	1+50 up	954.0	Clayey Sd(Grv	B	OT	
PP 54 9	54+10	1+25 Dn	950.9	Clayey Sd(Grv	A	WC	(1)
PP 54 9	54+10	3+00 Dn	950.4	Clayey Sd(Grv	A	WC	(1)
PP 55 2	54+50	1+00 D/S	967.0	Fan Clay	B	OT	
PP 55 3	54+50	3+00 D/S	968.0	Fan Clay	B	OT	
PP 55	55+00	4+70 D/S	955.1	Clayey Sd(Grv	B	OT	
PP 56	56+00	0+70 Dn	944.5	Jackson Pk Sh	A	SW	
PP 56 2	56+00	1+25 D/S	000.0	Embankment	B	OT	
PP 58 1	57+95	0+25 Dn	95.5	Clayey Sd(Grv	A	SW	
PP 58 2	57+97	0+30 D/S	954.4	Fan Clay	A	SW	
PP 58	58+00	0+25 D/S	961.5	Embankment	A	SW	
PP 58 1A	58+00	0+20 U/S	960.0	Embankment	B	OT	
PP 59 1	58+75	1+25 D/S	969.0	Fan Clay	B	OT	
PP 59 2	59+00	0+55 U/S	1020.0	Embankment	B	OT	
PP 59 3	59+00	1+25 D/S	1000.0	Embankment	B	OT	
SM 6	55+00	0+18.5 D/S	***	Embankment	E	SM	

SCHEDULE OF OBSERVATION DEVICES

NUMBER	STATION	RANGE	ELEV TIP OR PLATE	MATERIAL	TYPE OF INSTALL	CELL IDEN
PP 60 1A	60+00	1+00 U/S	990.0	Embankment	Detail E	OT
PP 60 1	60+00	1+50 Up	970.0	Fan Clay	B	OT
PP 60 3	60+00	0+20 Dn	960.8	Embankment	A	SW
SP 60 4	60+00	1+00 Dn	975.9	Foundation	C	SP
PP 60 5	60+00	1+50 Dn	969.3	Fan Clay	A	WC
PP 60 7	60+00	3+00 Dn	965.3	Fan Clay	A	WC
PP 60 9	60+00	4+70 Dn	967.8	Fan Clay	B	OT
PZ 60 2	60+10	1+50 Up	955.0	Clayey Sd(Grv	B	OT
PZ 60 6	60+10	1+50 Dn	958.9	Clayey Sd(Grv	A	WC
PZ 60 8	60+10	3+00 Dn	958.7	Clayey Sd(Grv	A	WC
PZ 60 10	60+10	4+70 Dn	958.6	Clayey Sd(Grv	B	OT
PP 61 2	60+50	3+00 D/S	966.0	Fan Clay	B	OT
PP 61	61+00	0+55 U/S	1020.0	Embankment	B	OT
PP 62	62+00	0+20 U/S	960.0	Embankment	B	OT
SM 5	65+00	0+18.5 Dn	***	Embankment	E	SM
PP 72	72+00	1+30 Up	971.0	Fan Clay	B	OT
PP 72 2	72+00	0+20 Dn	975.9	Embankment	A	SW
PP 72 3	72+00	0+80 Dn	972.4	Fan Clay	A	WC
PP 72 4	72+00	2+00 Dn	970.0	Fan Clay	A	WC
PP 72 5	72+00	4+60 Dn	968.0	Fan Clay	B	OT
PZ 72 6	72+10	4+60 Dn	950.0	Clayey Sd(Grv	B	OT
PZ 73 1	73+00	5+50 D/S	979.5	Embankment	B	OT
SP 75 1	75+00	0+60 Dn	981.6	Foundation	C	SP
SM 6	75+00	0+18.5 Dn	***	Embankment	E	SM
PP 79	79+00	3+00 D/S	994.0	Emb(Pervious)	B	OT
PZ 80	80+00	1+50 Up	979.0	Clayey Sd(Grv	B	OT
PP 80 2	80+00	1+00 Dn	986.0	Fan Clay	A	WC
PP 80 4	80+00	2+50 Dn	985.0	Fan Clay	A	WC
PP 80 6	80+00	4+30 Dn	974.0	Fan Clay	B	OT
SM 7	80+00	0+18.5 Dn	***	Embankment	E	SM
PZ 80 3	80+10	1+00 Dn	973.5	Clayey Sd(Grv	A	WC
PZ 80 5	80+10	2+50 Dn	972.0	Clayey Sd(Grv	A	WC
PP 84 1	84+00	0+10 Dn	991.4	Doniphan Sh	A	SW
SM 8	90+00	0+18.5 Dn	***	Embankment	E	SM
SM 9	100+00	0+18.5 Dn	***	Embankment	E	SM
A	41+00	1+80 Dn	1025.9	Fan Clay	B	OT
B	41+00	2+00 Dn	998.0	Bell Ls	B	OT
C	42+50	3+70 Dn	1006.9	Spng	B	OT
D	40+30	2+90 Dn	998.4	Bell Ls	B	OT
E	41+30	3+10 Dn	999.4	Bell Ls	B	OT

NOTES

* Alinement traverses and alinement pipes not included in this scheldule

** Cells located on intake tower (gloetzl)

*** Installation is controlled by Top of Dam elev see Detail E

(1) Replaced by S.W. cells, but still connected at Monitor box M 54 Locations not shown on plan

S P	Settlement plate
S W	Shannon-Wilson
O T	Open Tube
W C	Warlam cell
S M	Settlement monument

(2) Compacted impervious fill in Diversion Channel

℄ OUTLET CHANNEL

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT OBSERVATION DEVICES

In 1 sheets | Sheet No. 1 | Scale as shown

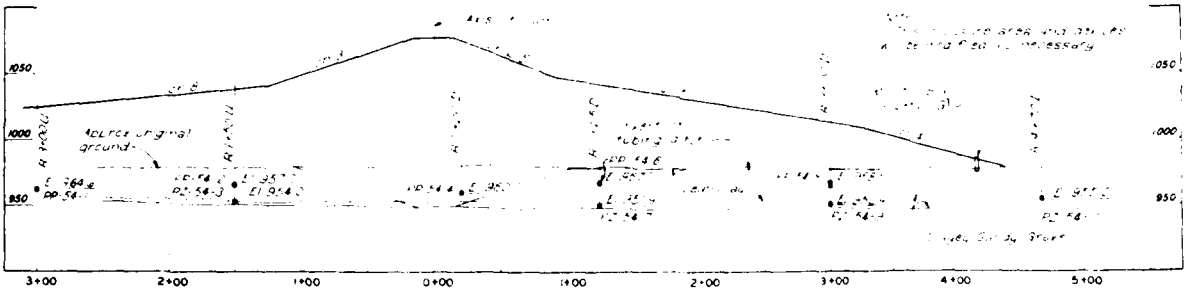
CORPS OF ENGINEERS U S ARMY

KANSAS CITY DISTRICT

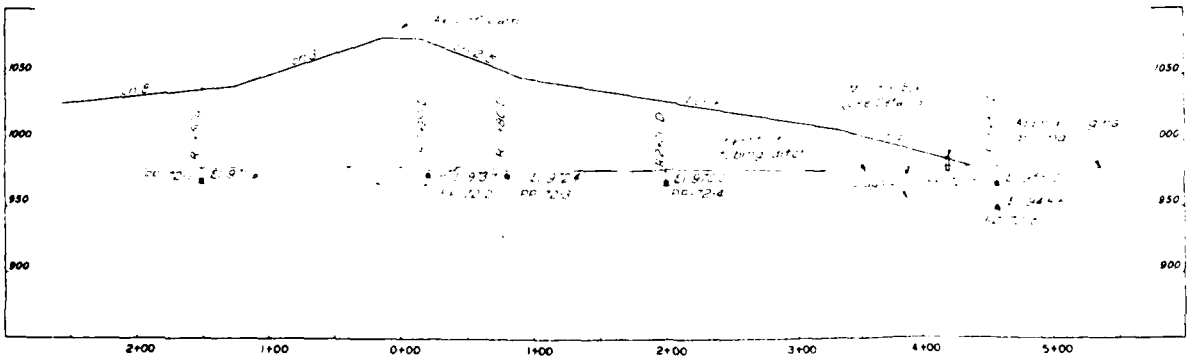
FILE NO. 0-5-1354

AUGUST 1979

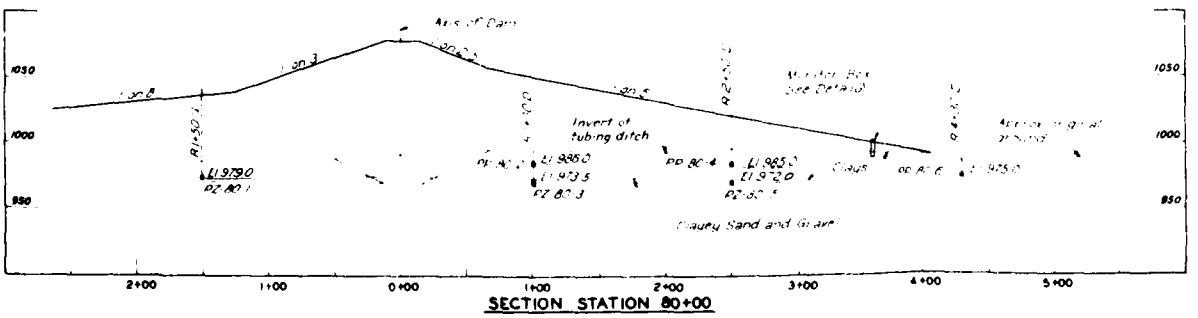
PLATE NO. 14



SECTION STATION 54+00

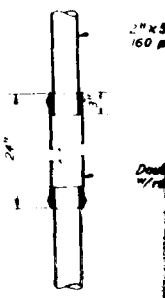


SECTION STATION 72+00

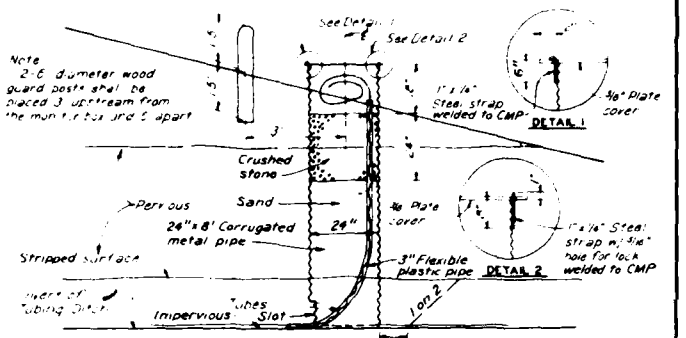


SECTION STATION 80+00

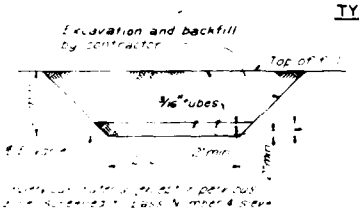
ELEVATION IN FEET ABOVE MEAN SEA LEVEL



PROTECTIVE PIPE COUPLING DETAIL
DETAIL F



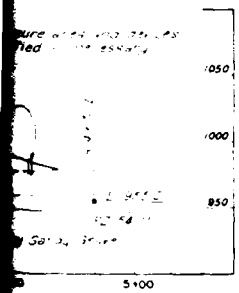
MONITOR BOX DETAIL G
TYPICAL SECTION
Not to Scale

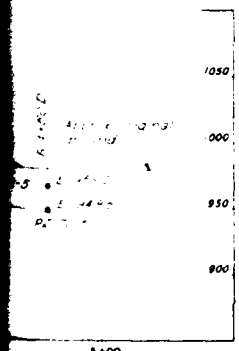


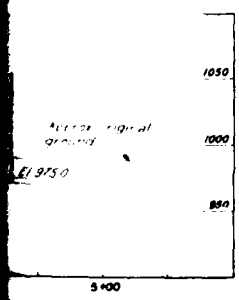
TUBING DITCH DETAIL

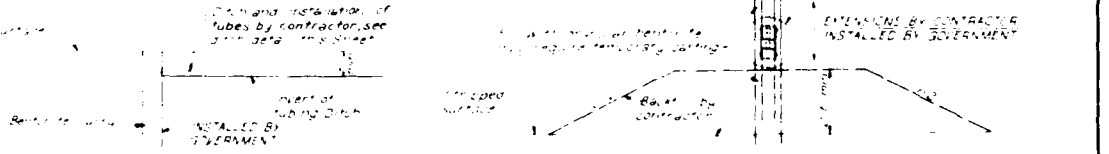
SCHEDULE OF MONITOR BOX INSTALLATION

BOX NO	STATION	RANGE AT ℄	APPROX EL TOP OF BOX
44	44+30	2+80	998.0
54	54+15	4+22	986.0
62	62+00	4+22	986.0
72	72+00	4+22	986.0
80	80+30	3+85	995.0

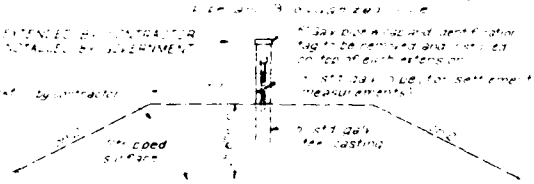




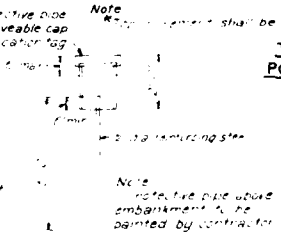




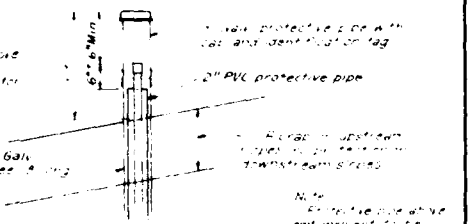
TYPICAL PIEZOMETER AND PORE PRESSURE EXTENSION
DETAIL B



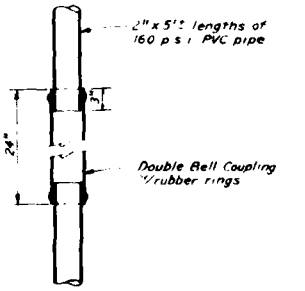
SETTLEMENT PLATE EXTENSION
DETAIL C



SETTLEMENT MONUMENT
DETAIL E



FINAL PIEZOMETER EXTENSION
DETAIL D



PROTECTIVE PIPE COUPLING DETAIL
DETAIL F
Not to Scale

NOTES
All PVC plastic pipe shall meet the requirements of ASTM Spec. No D-1785-60T type I
Double Bell Couplings shall be similar to Johns-Manville Double Bell Couplings
Alinement pipes extended above the embankment are to be painted by contractor.
See Plate C-15 for location of Piezometer Cells on Control Tower

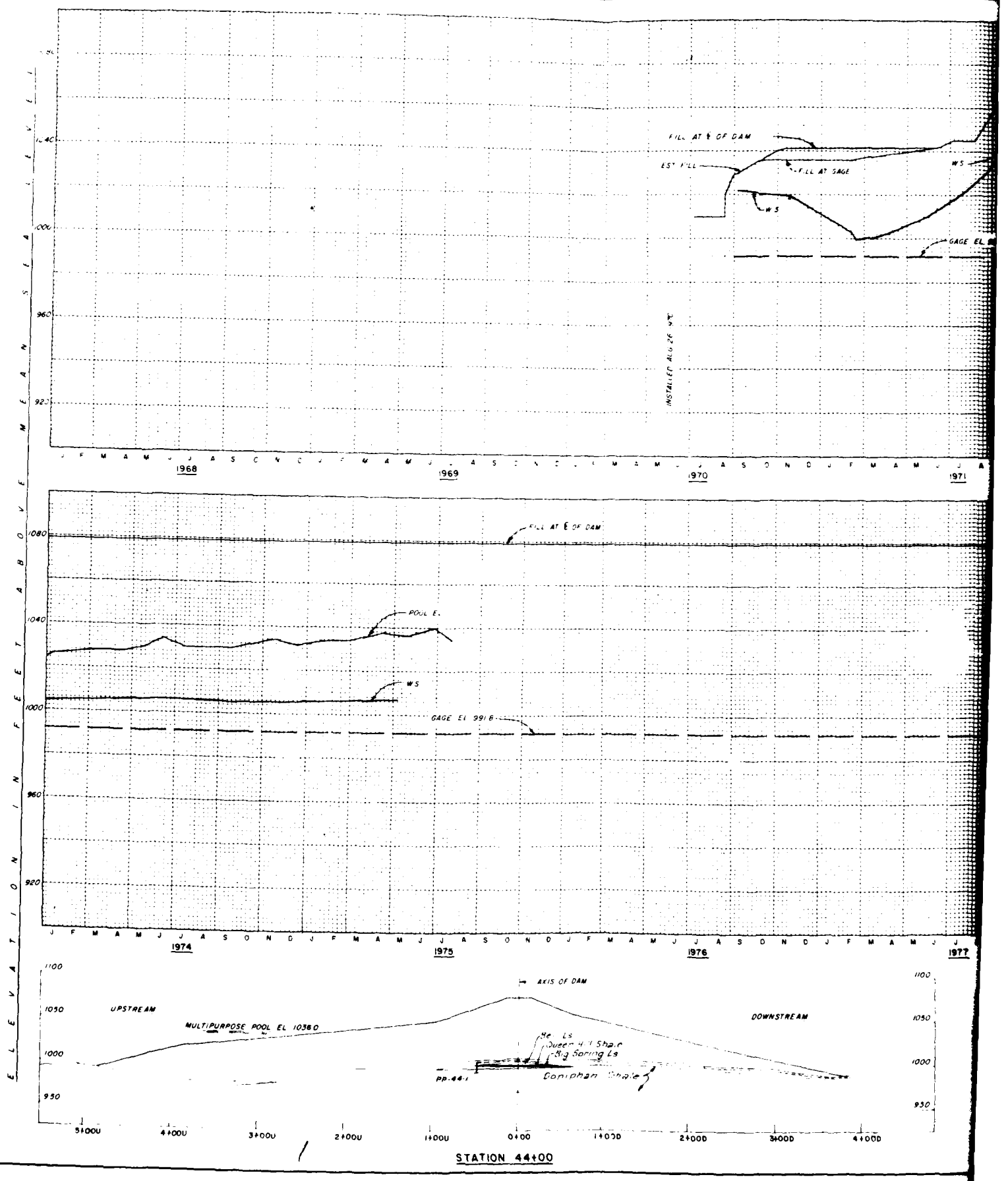
MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

EMBANKMENT OBSERVATION DEVICES

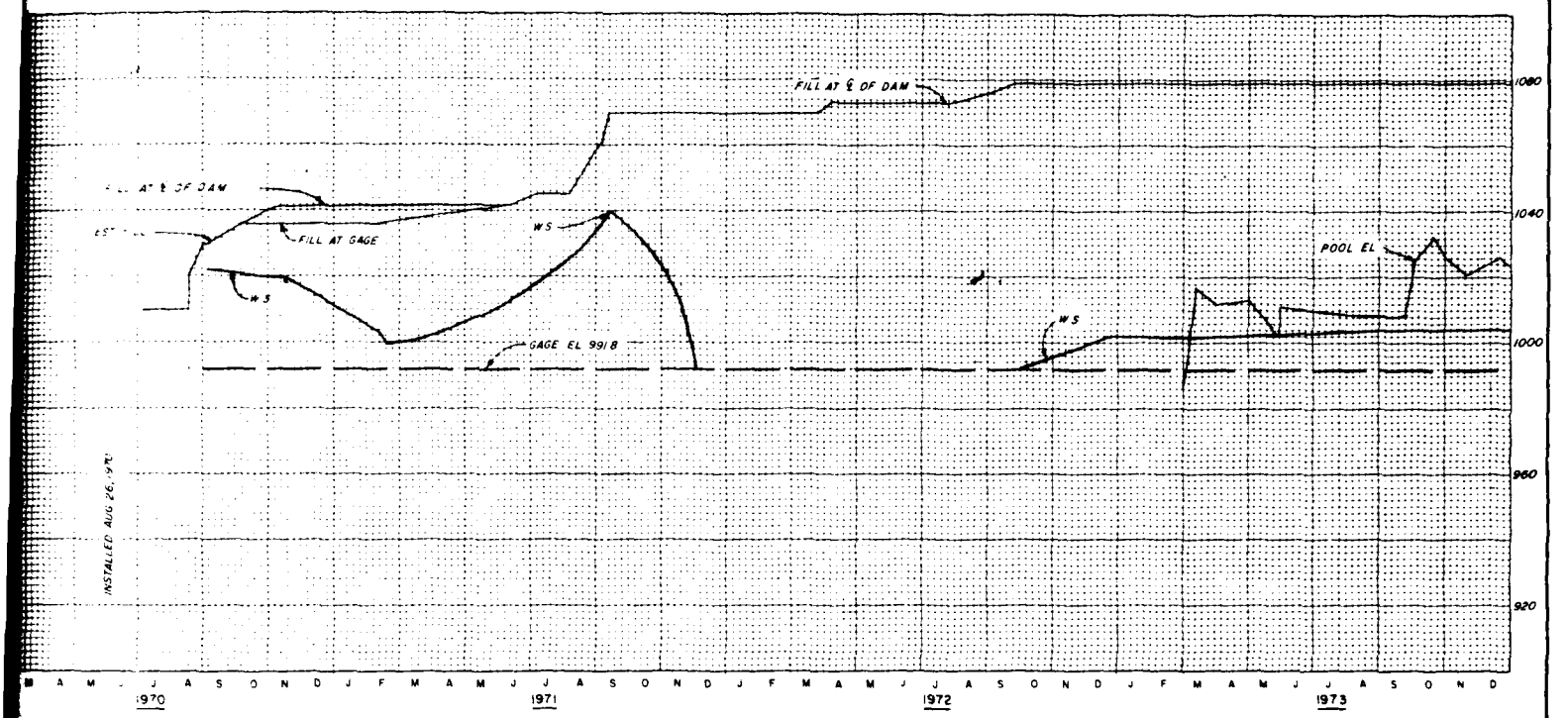
In 1 sheet | Sheet No. 1 | Scale as shown

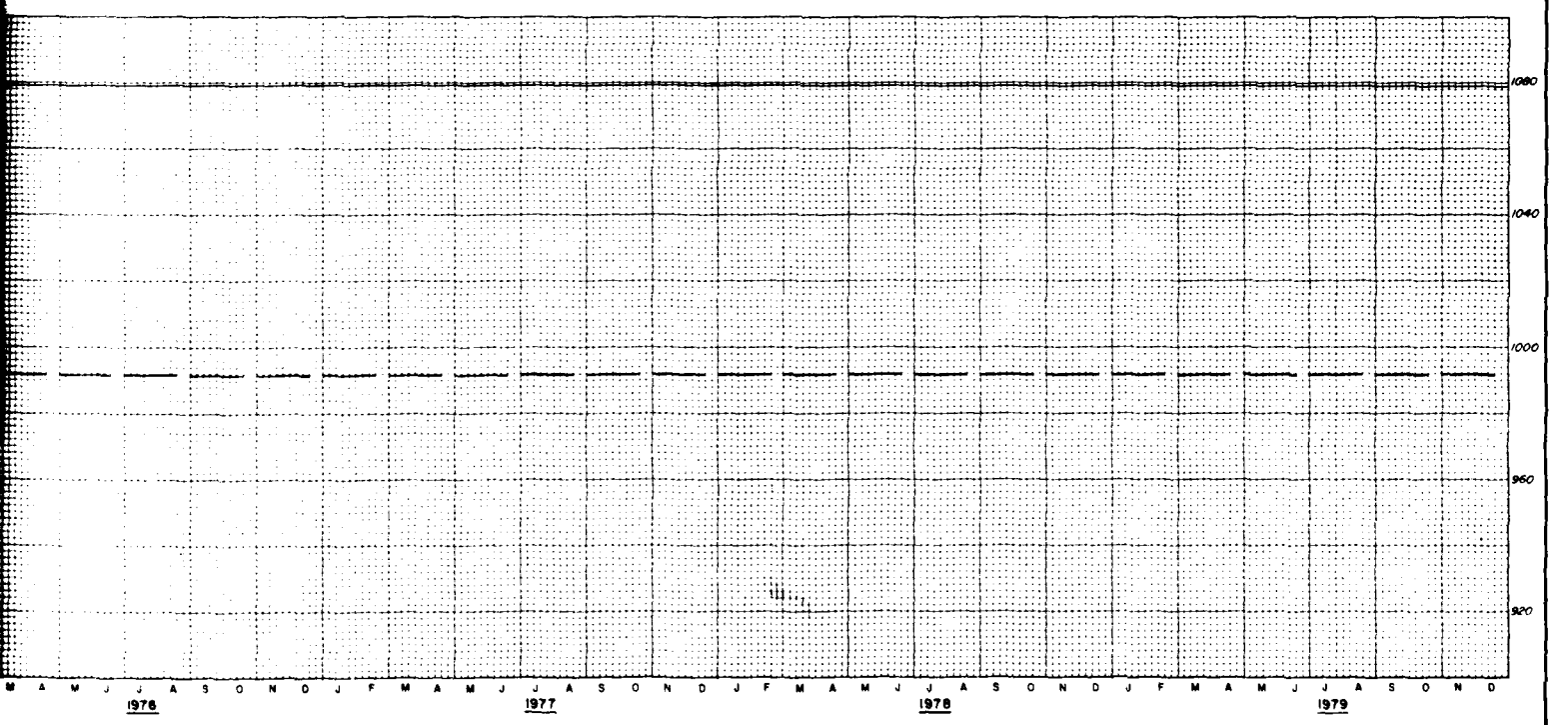
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO 0-5-1355
AUGUST 1979

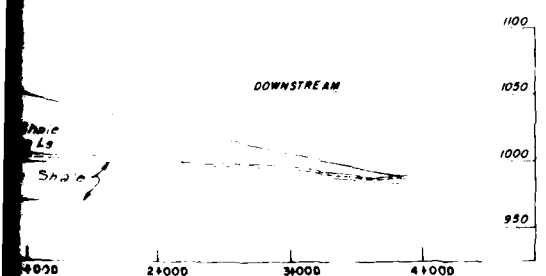
PLATE NO. 15



STATION 44+00







NOTE:
NOT READ FOR THIS REPORT.

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS

PP-44-1 (SHANNON - WILSON CELL)

In 1 sheet | Sheet No. 1 | Scale as shown

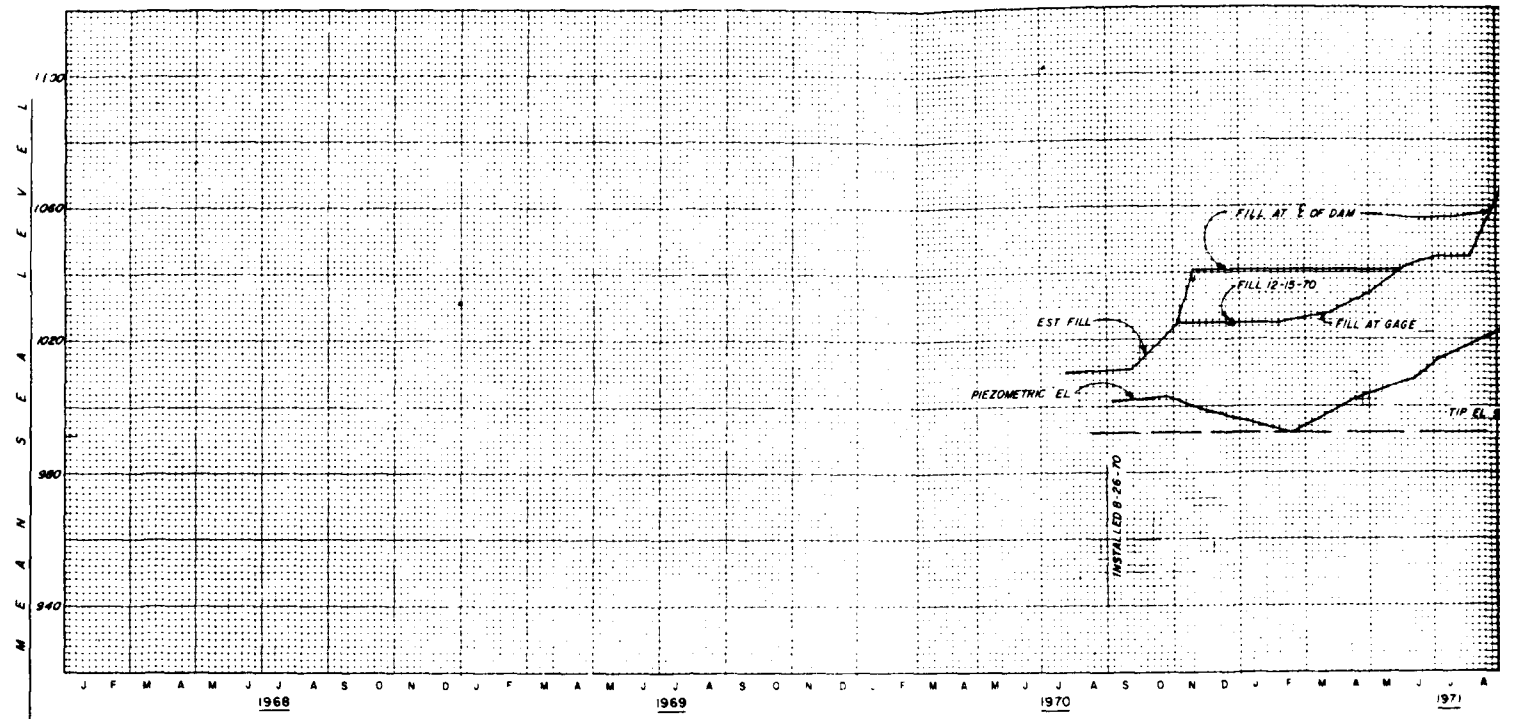
CORPS OF ENGINEERS U. S. ARMY

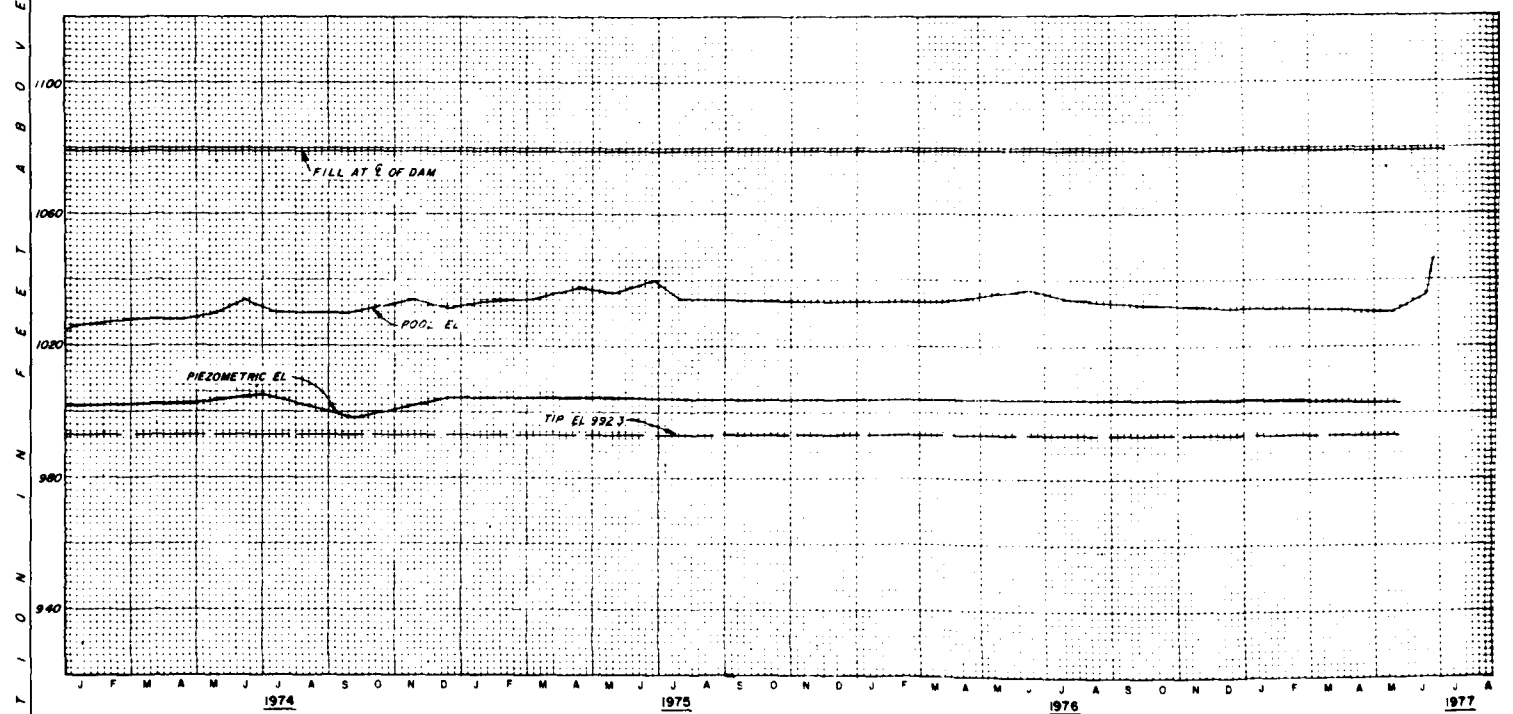
KANSAS CITY DISTRICT

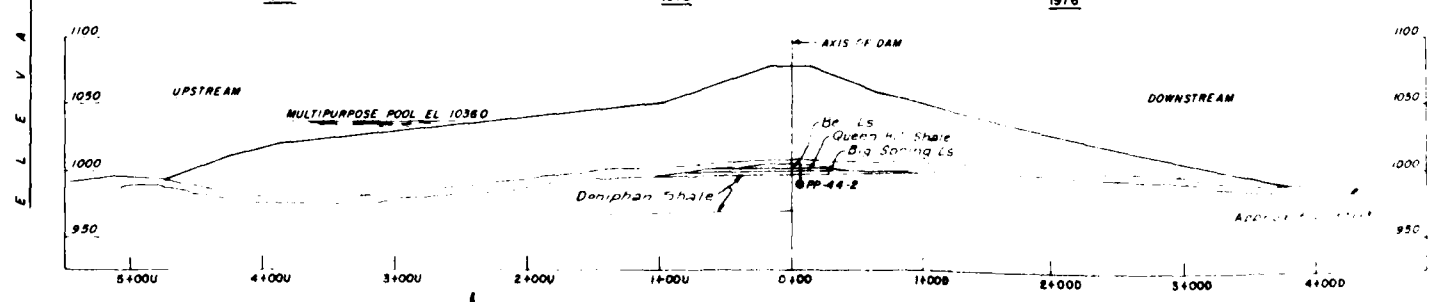
FILE NO. 0-5-1264

AUGUST 1975

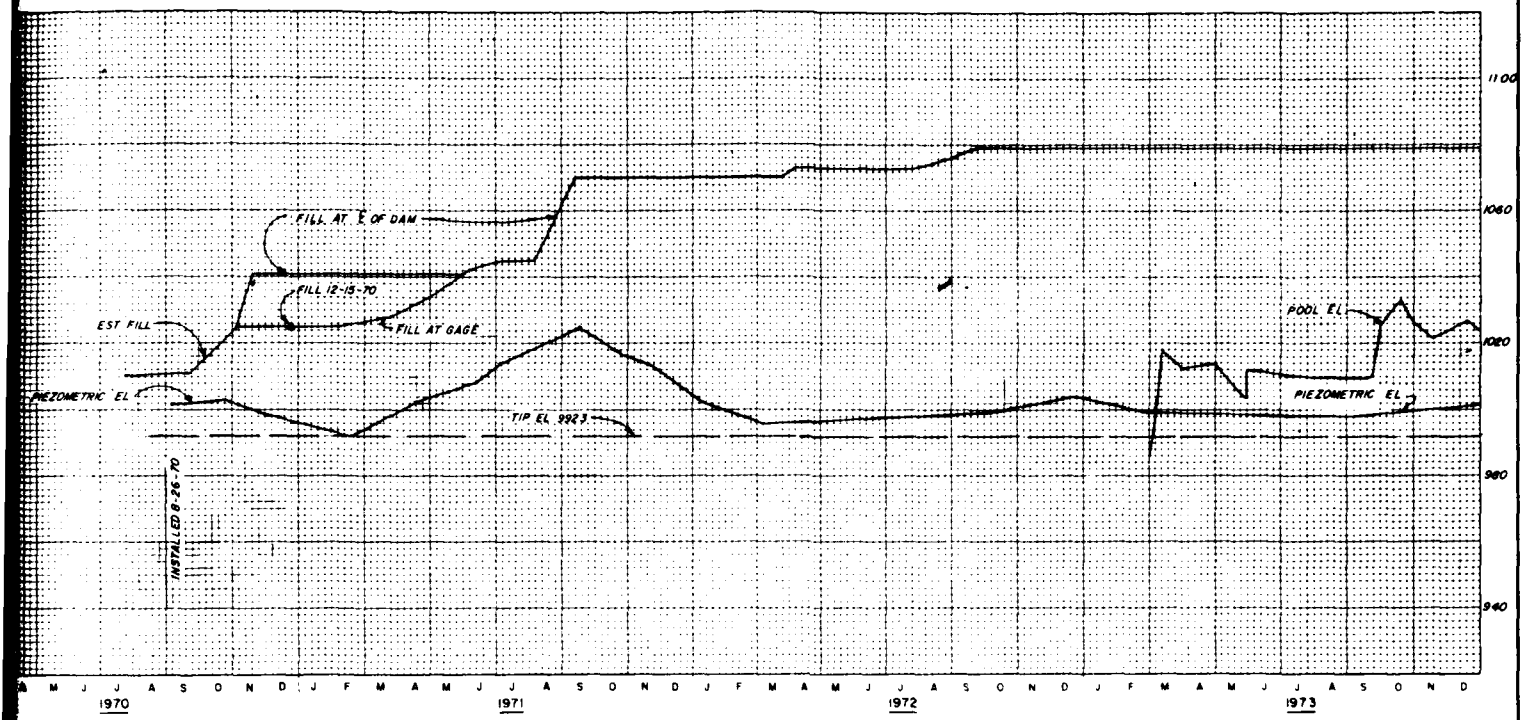
PLATE NO. 16

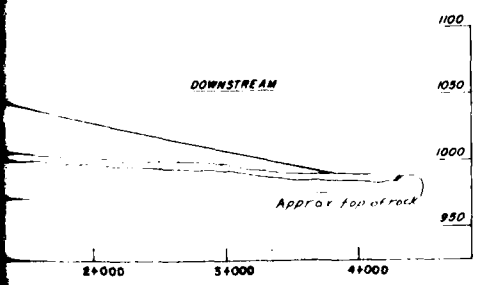






STATION 44+00





LEGEND

OPEN TUBE ..... ○

PNEUMATIC CELLS . ●

NOTE
NOT READ FOR THIS REPORT
Revised August 1975

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-44-2 (SHANNON-WILSON CELL)

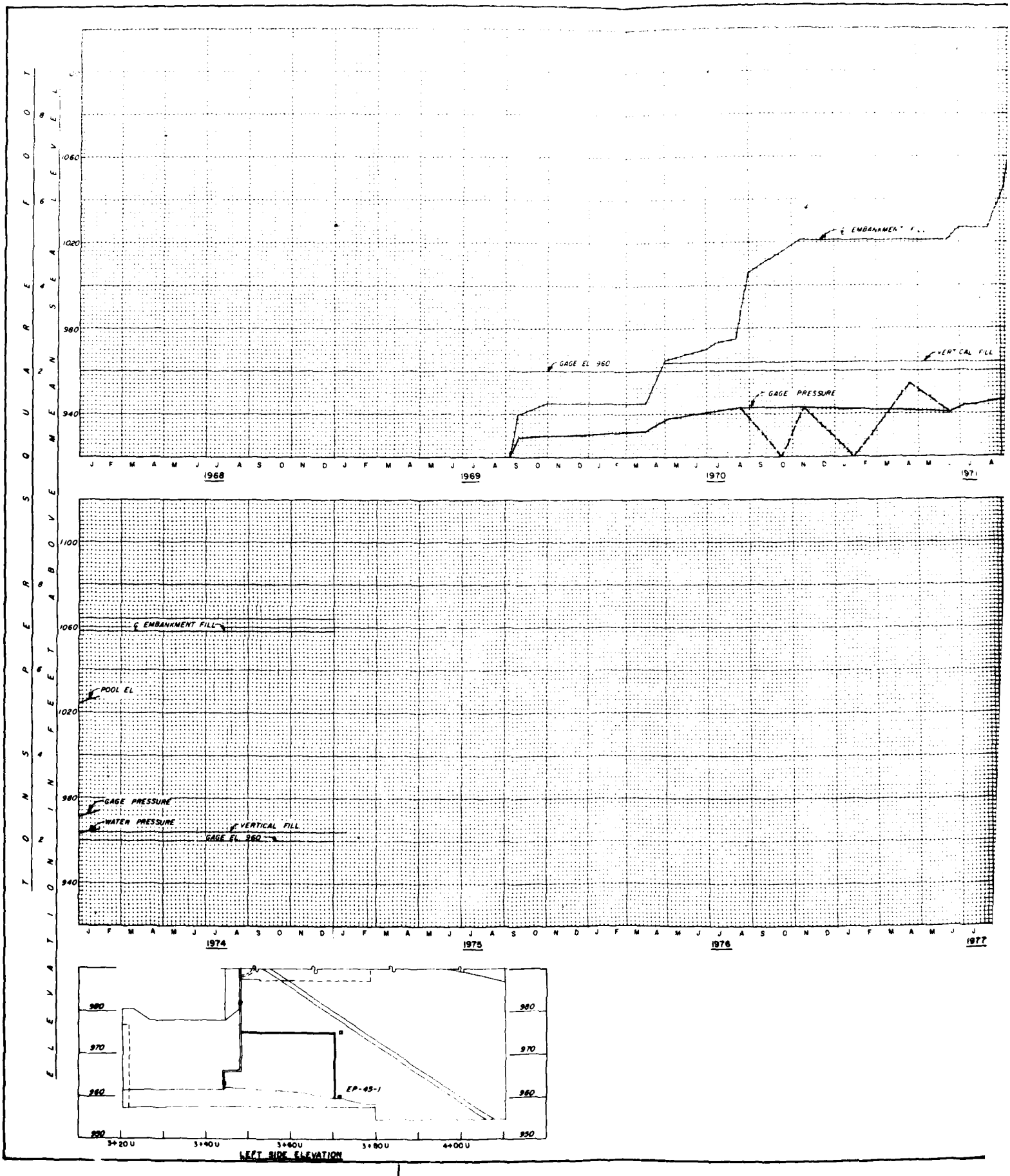
In 1 sheet | Sheet No. 1 | Scale as shown

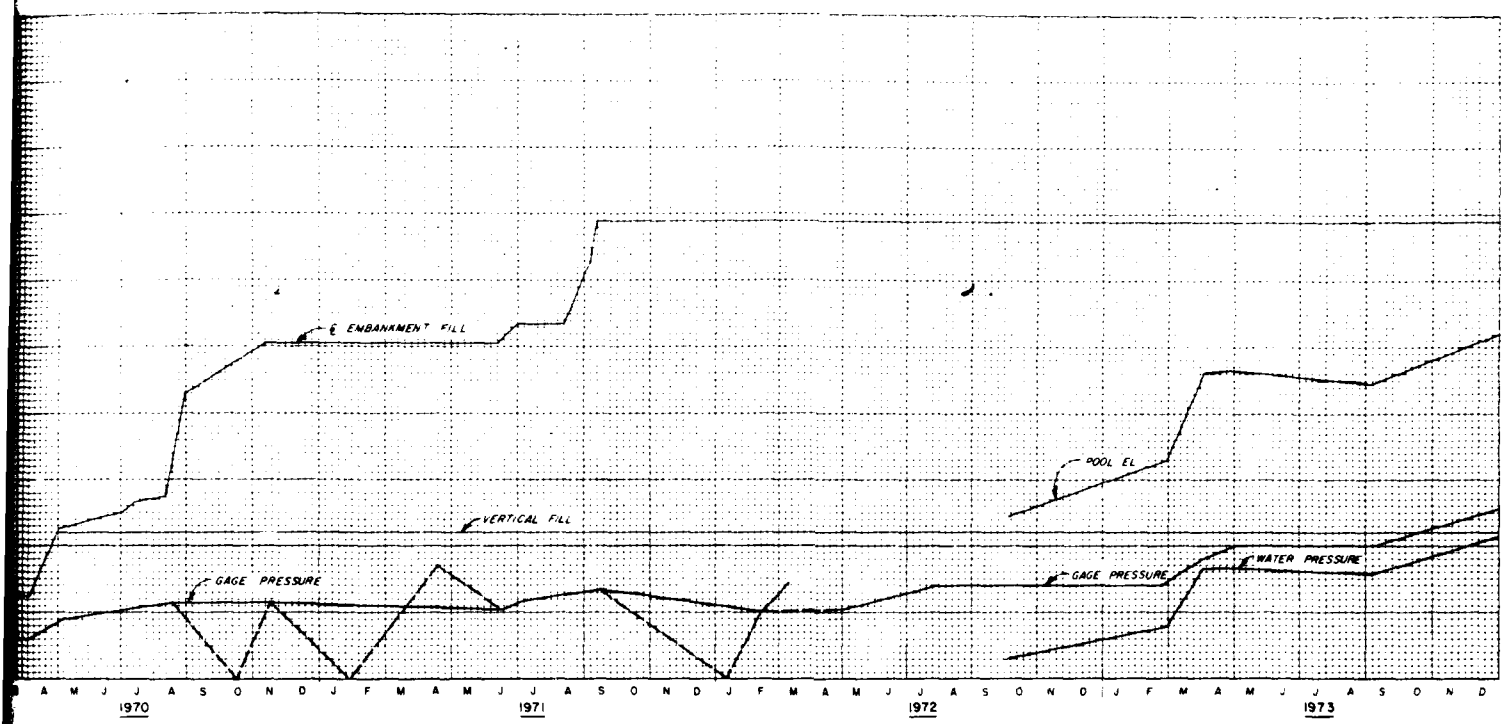
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

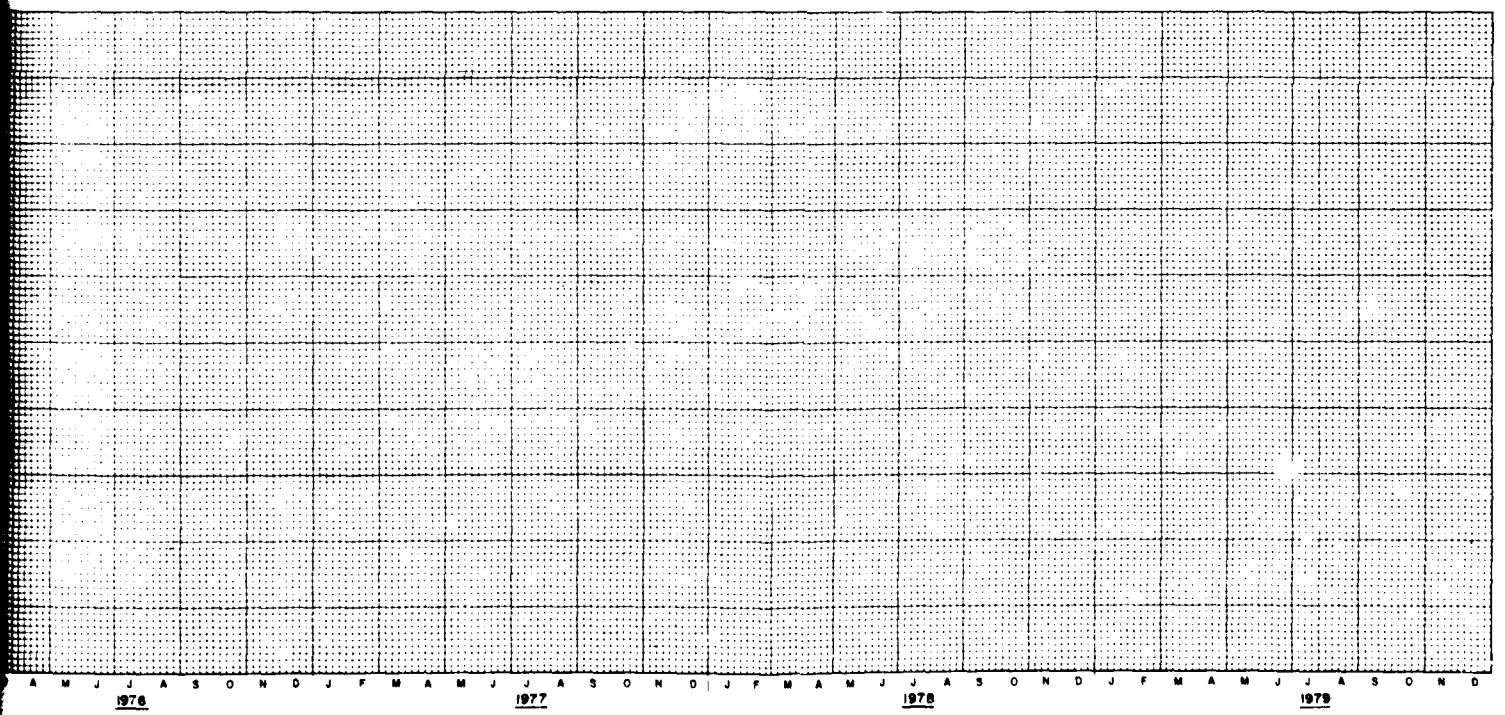
FILE NO. 0-5-1265
AUGUST 1975

2

PLATE NO 17


ELEVATION IN FEET ABOVE SEA LEVEL
1060
1020
980
940
℄ EMBANKMENT FILL
GAGE EL 960
VERTICAL FILL
GAGE PRESSURE
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1968
1969
1970
1971
ELEVATION IN FEET ABOVE SEA LEVEL
1100
1060
1020
980
940
℄ EMBANKMENT FILL
POOL EL
GAGE PRESSURE
WATER PRESSURE
VERTICAL FILL
GAGE EL 960
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1974
1975
1976
1977
990
970
960
950
EP-45-1
3+20 U
3+40 U
3+60 U
3+80 U
4+00 U
LEFT SIDE ELEVATION





NOTE
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

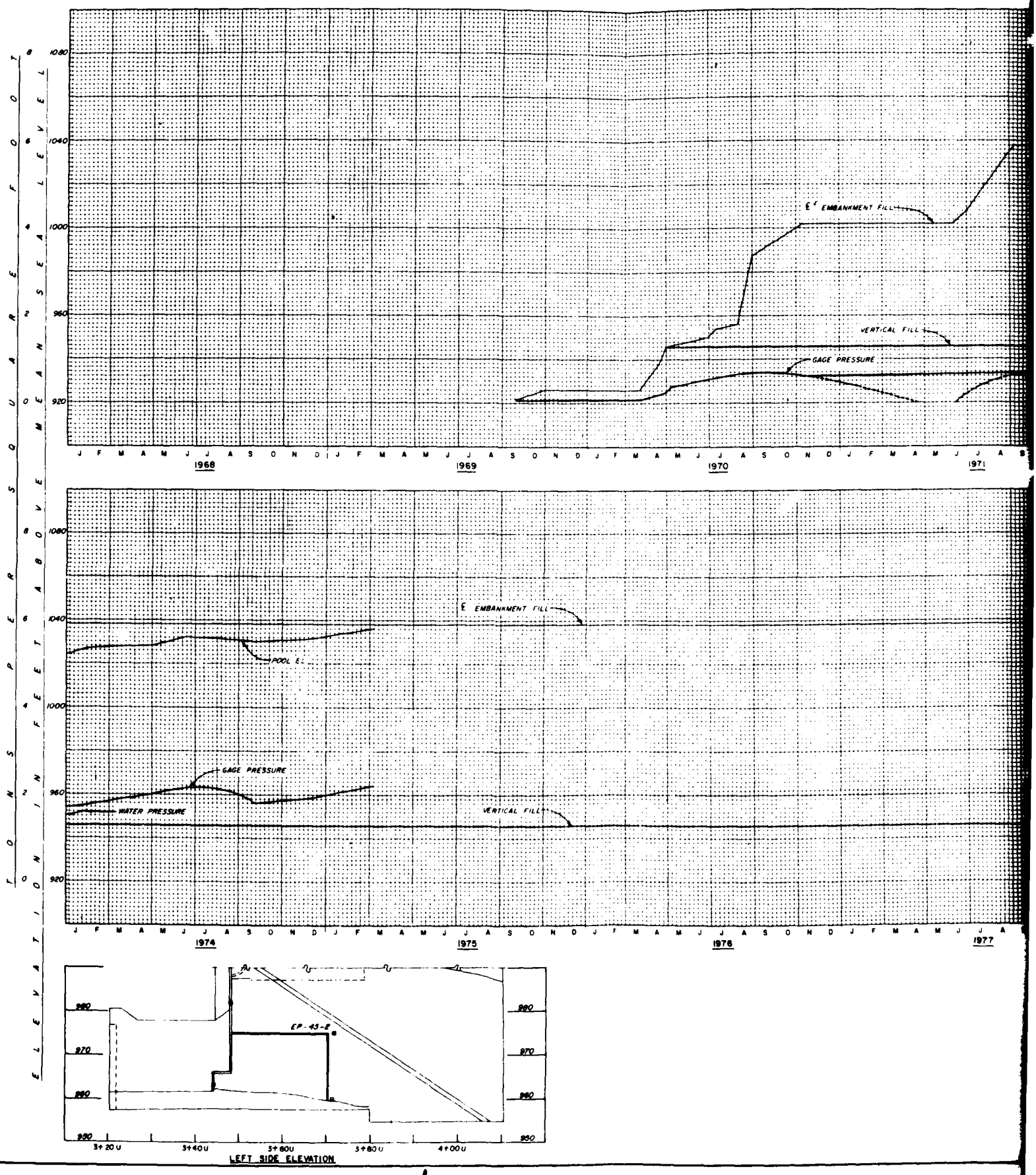
INSTRUMENTATION PLOTS
EP-45-1 (GLOETZL CELL)

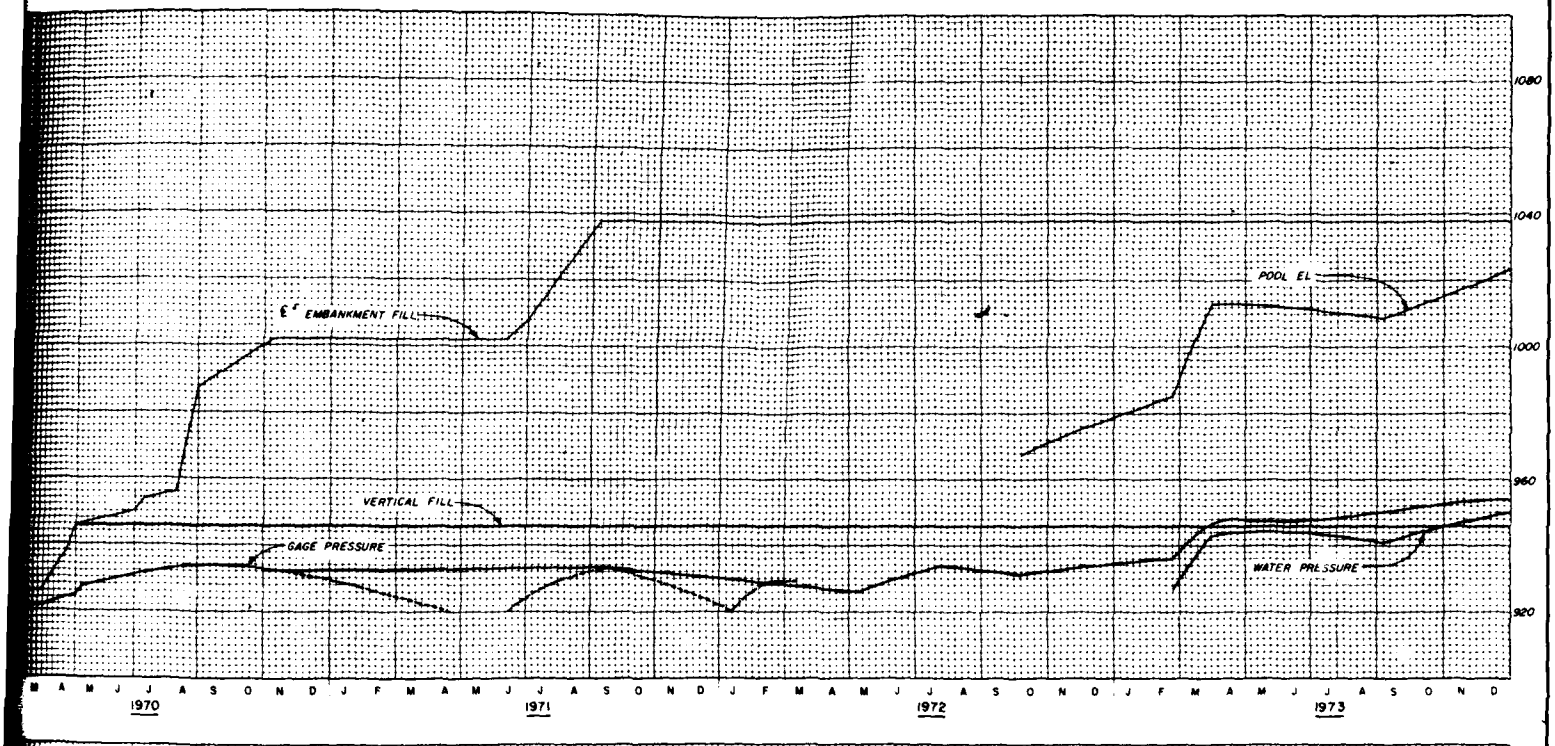
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1266
AUGUST 1975

PLATE NO. 18


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1080
1040
1000
960
920
E' EMBANKMENT FILL
VERTICAL FILL
GAGE PRESSURE
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1968
1969
1970
1971
E EMBANKMENT FILL
POOL EL
GAGE PRESSURE
WATER PRESSURE
VERTICAL FILL
1974
1975
1976
1977
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
990
970
960
950
EP-45-E
3+20 U
3+40 U
3+60 U
3+80 U
4+00 U
LEFT SIDE ELEVATION



NOTE
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
EP-45-2 GLOETZEL CELL

In 1 sheet | Sheet No 1 | Scale as shown

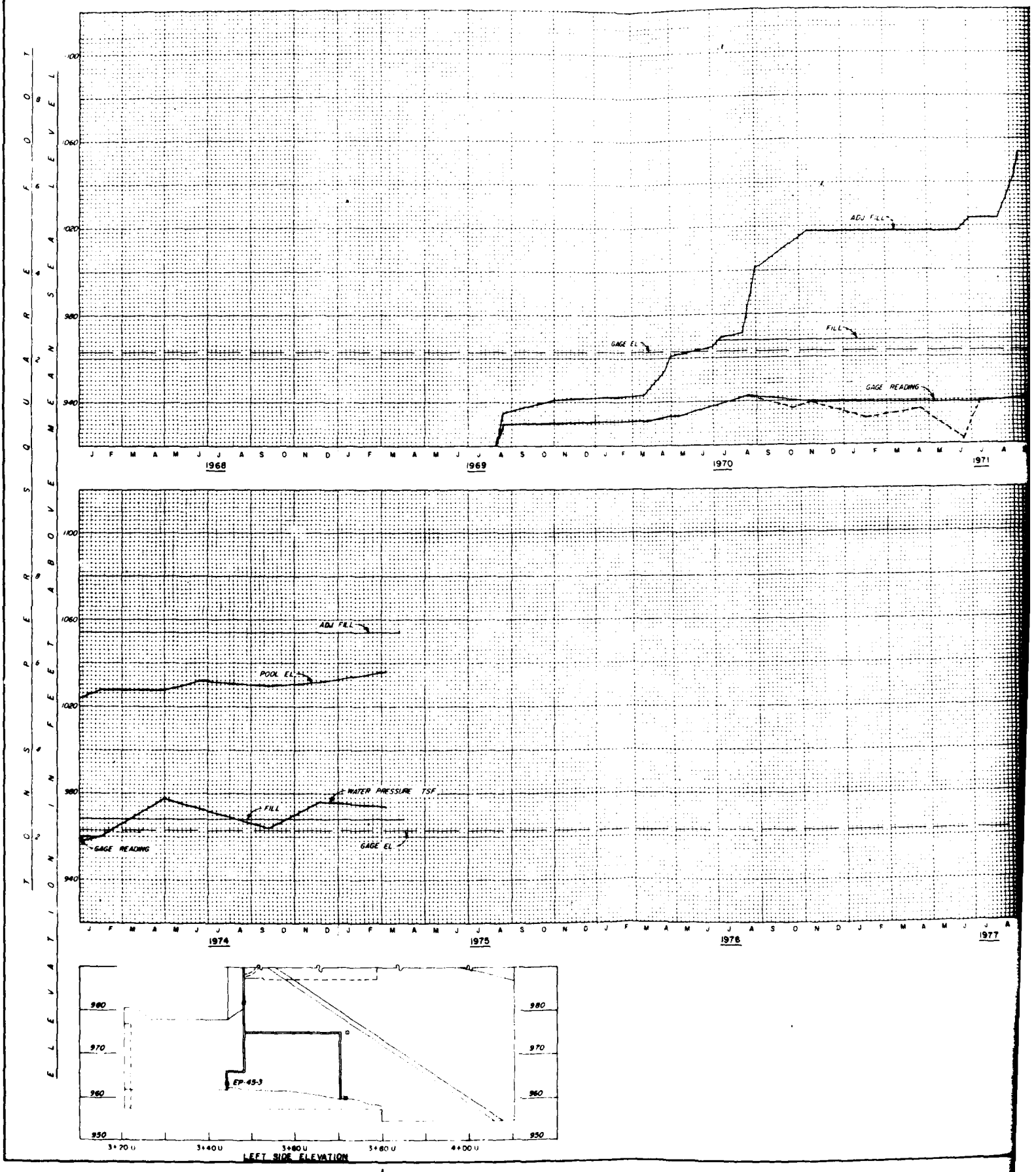
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT

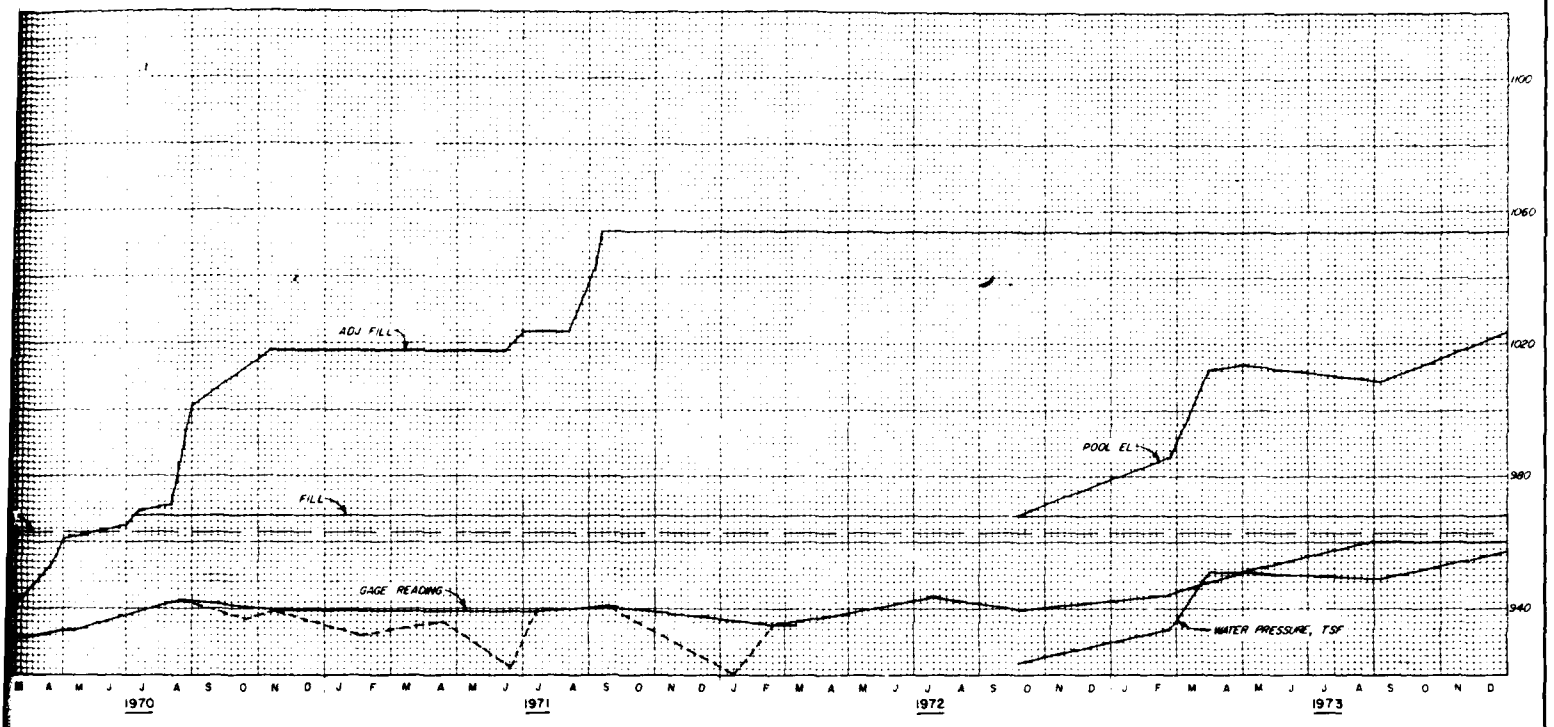
FILE NO. 0-5-1267

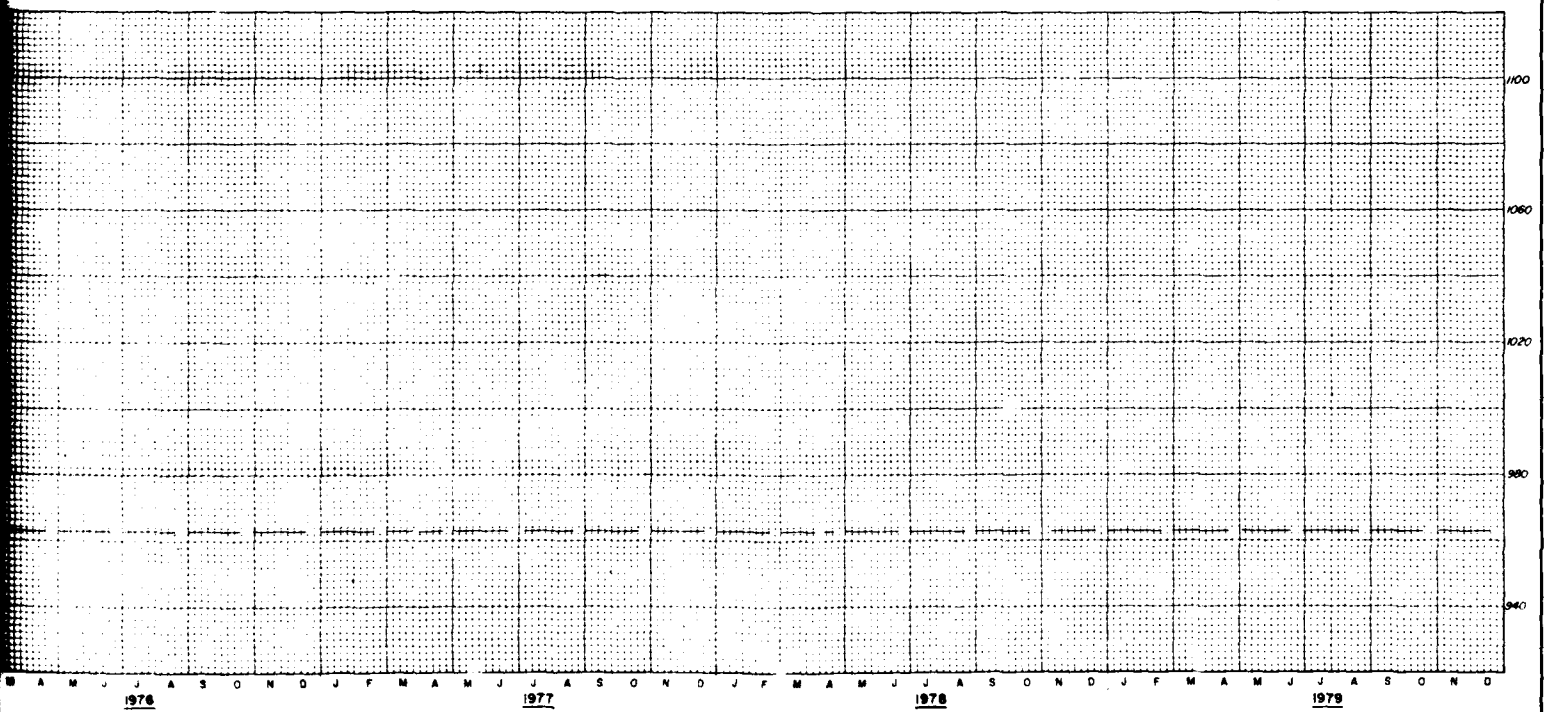
AUGUST 1975

2

PLATE NO. 19


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1000
1060
1020
980
940
ADJ FILL
FILL
GAGE EL
GAGE READING
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1968
1969
1970
1971
1100
1060
1020
980
940
ADJ FILL
POOL EL
WATER PRESSURE TSF
FILL
GAGE READING
GAGE EL
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1974
1975
1976
1977
980
970
960
950
EP-45-3
3+20 U
3+40 U
3+60 U
3+80 U
4+00 U
LEFT SIDE ELEVATION





NOTE:
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
EP-45-3(GLOETZL CELL)

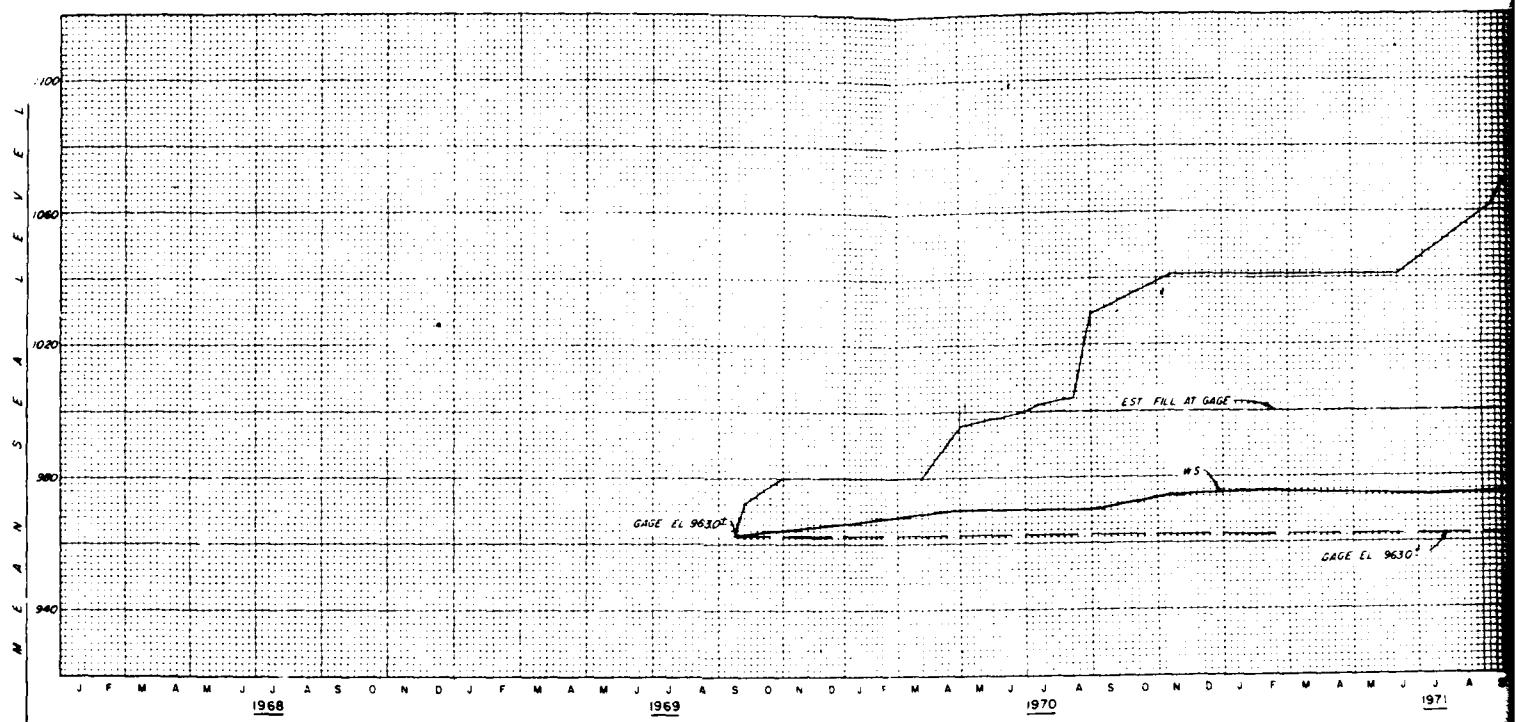
In 1 sheet | Sheet No. 1 | Scale as shown

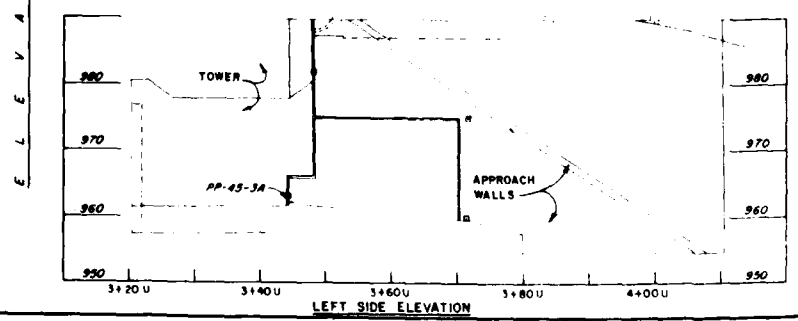
C[illegible] ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1268
AUGUST 1975

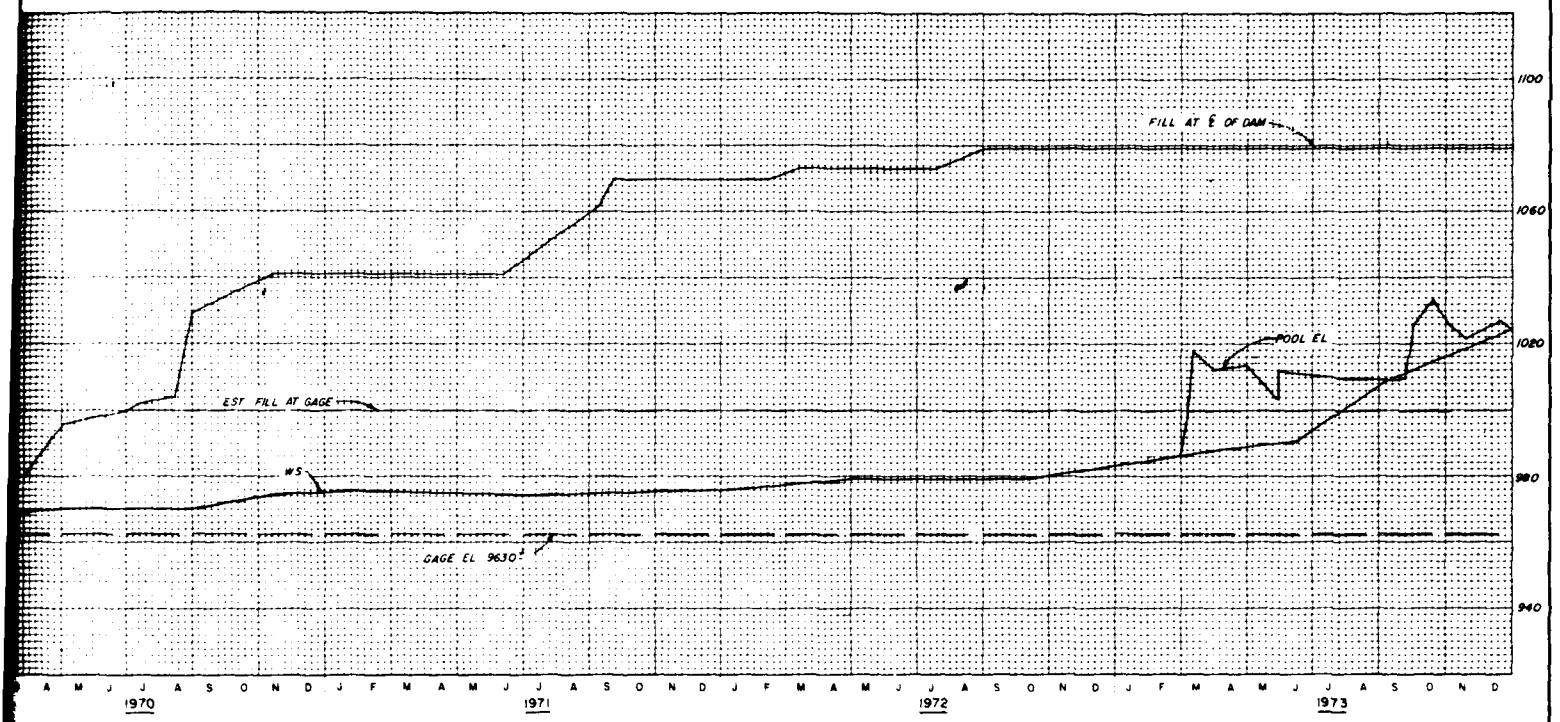
2

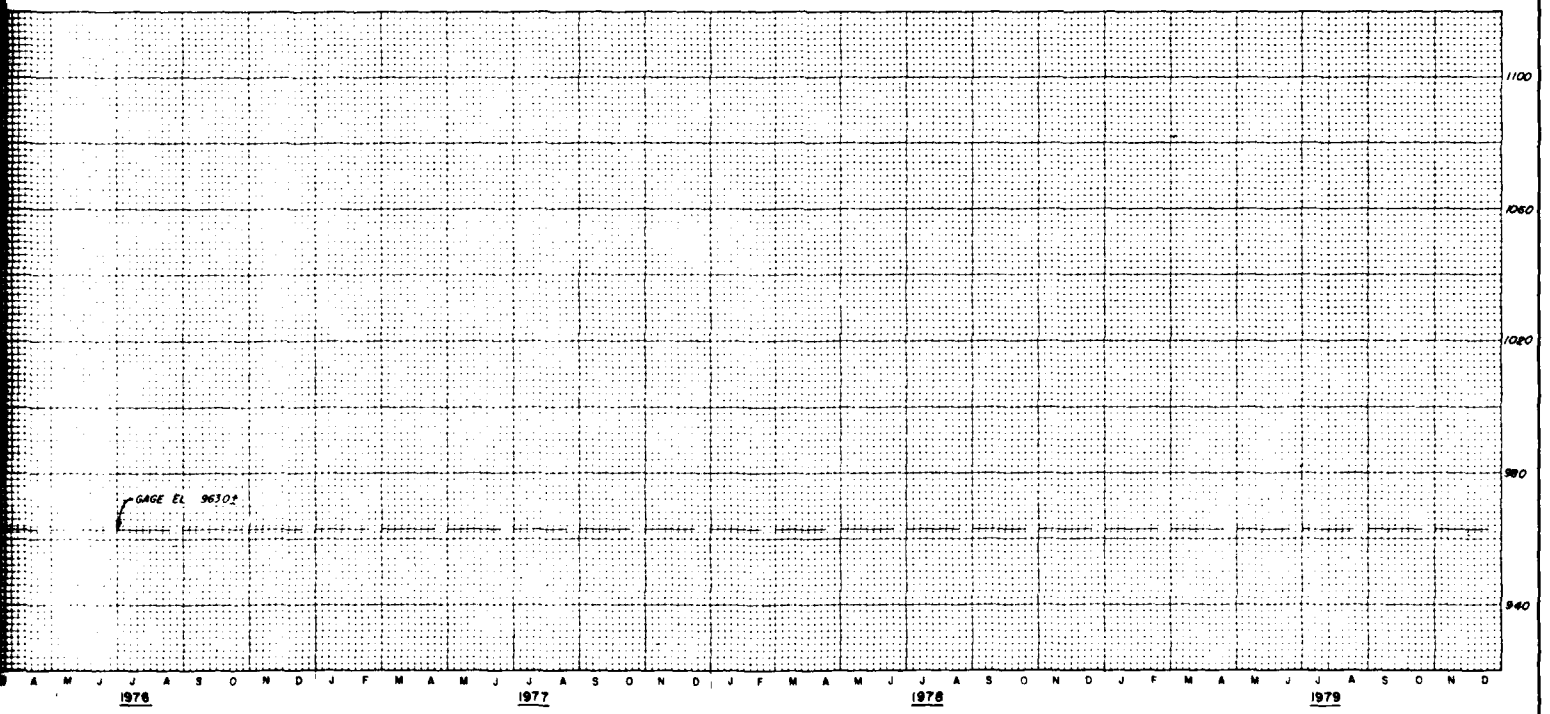
PLATE NO. 20





LEFT SIDE ELEVATION





NOTE
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-45-3A (SHANNON-WILSON CELL)

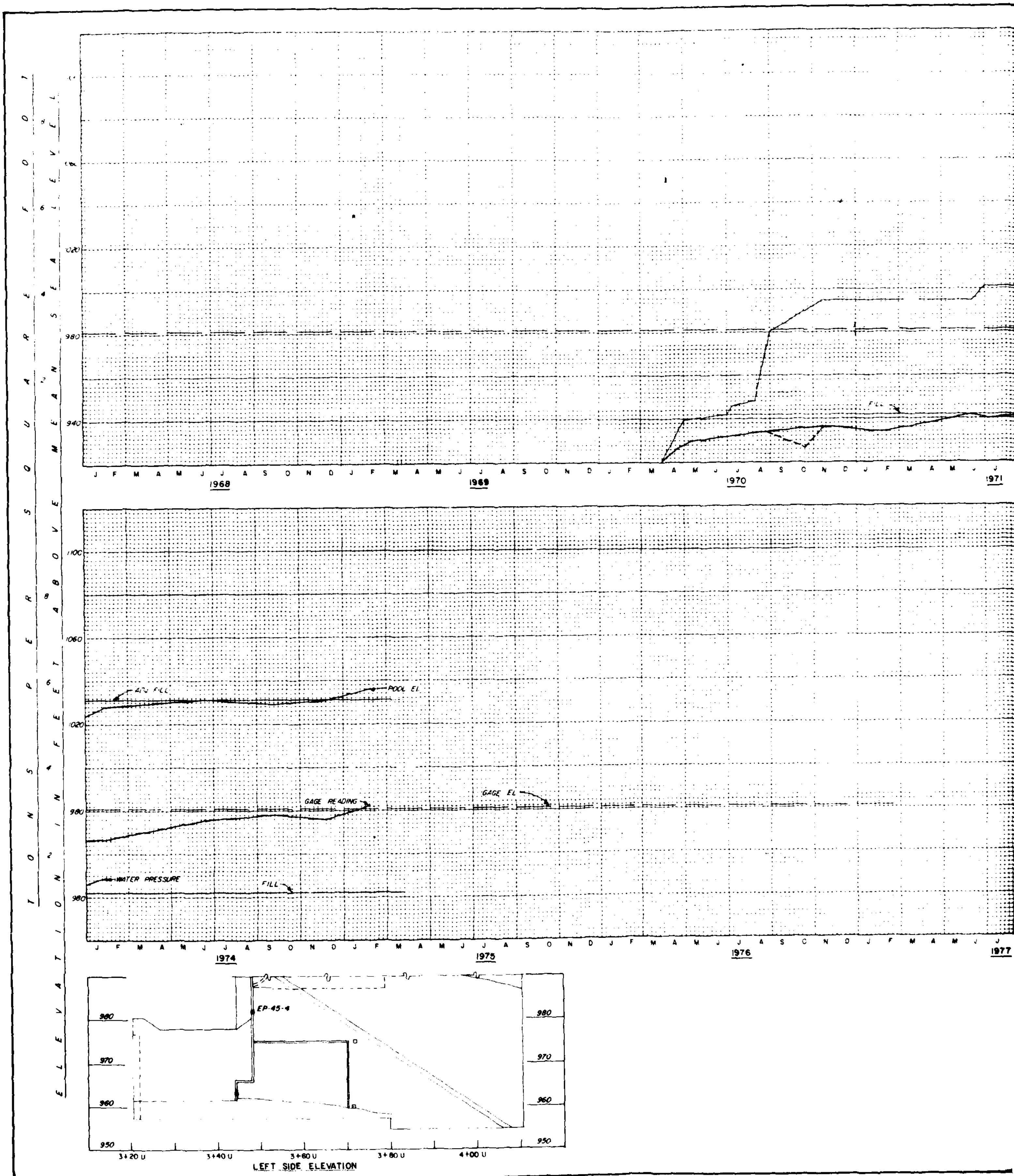
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

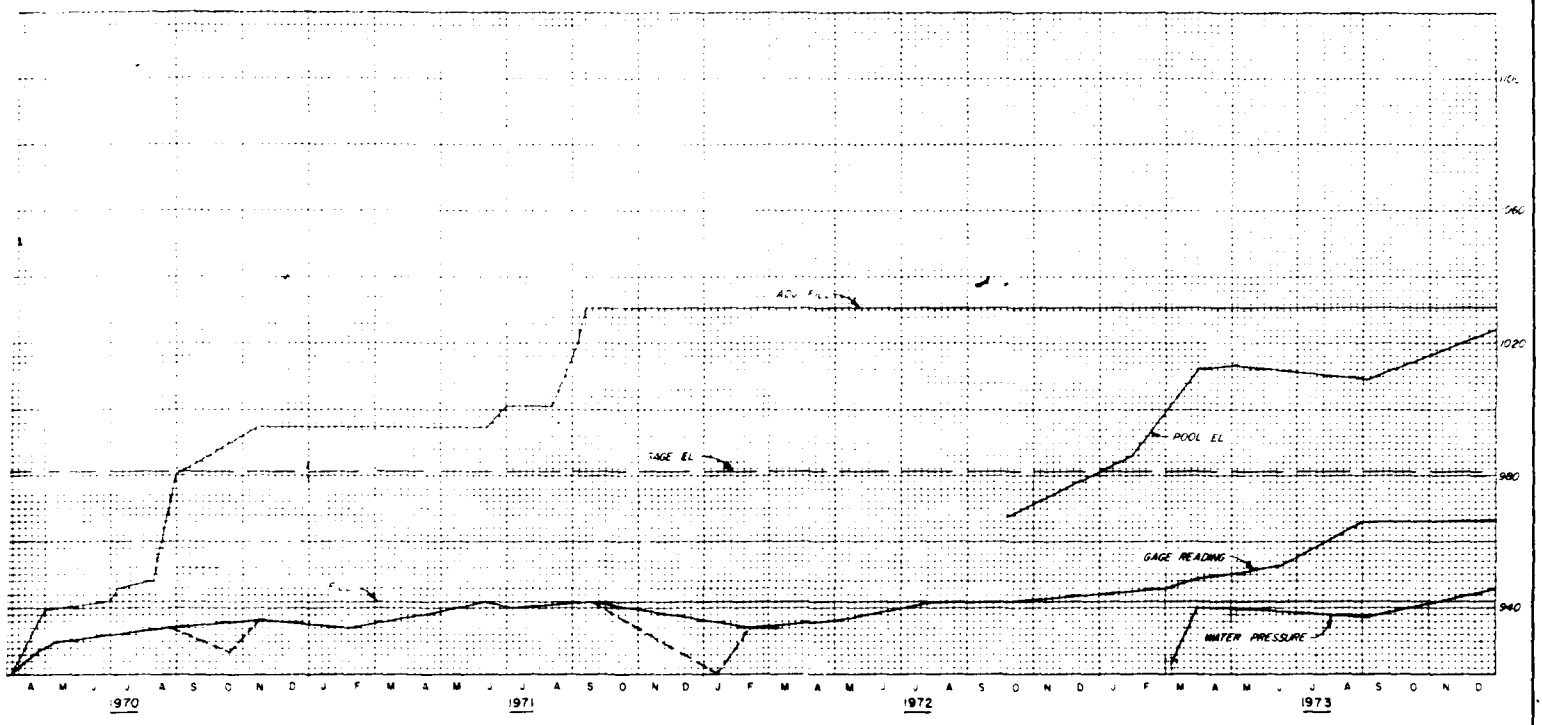
FILE NO. 0-5-1269

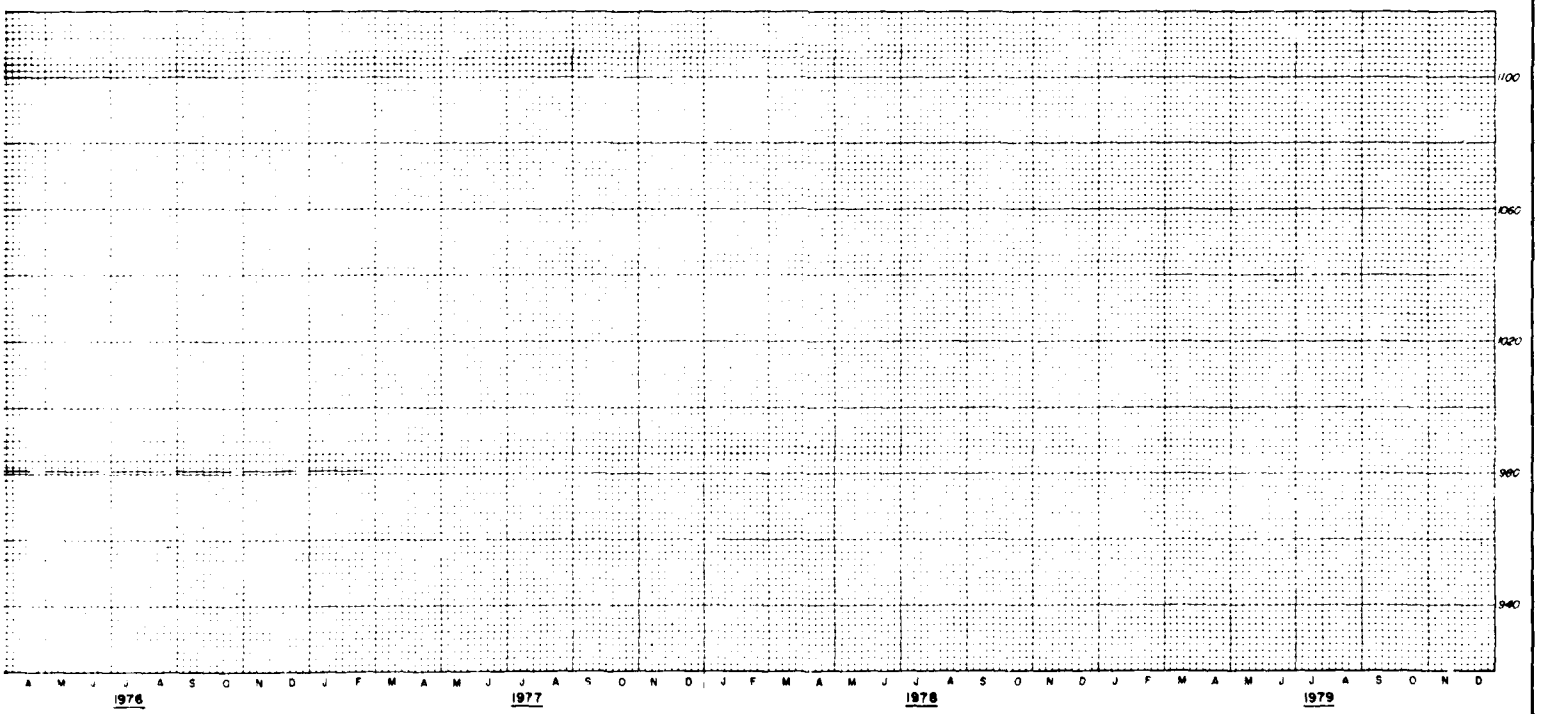
AUGUST 1975

PLATE NO 21



ELEVATION IN FEET ABOVE MEAN SEA LEVEL
TONS PER SQUARE FOOT
1020
980
940
FILL
1968
1969
1970
1971
1100
1060
1020
980
POOL EL
GAGE READING
GAGE EL
WATER PRESSURE
FILL
1974
1975
1976
1977
EP-45-4
980
970
960
950
3+20 U
3+40 U
3+60 U
3+80 U
4+00 U
LEFT SIDE ELEVATION





NOTE:
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
EP-45-4 (GLOETZL CELL)

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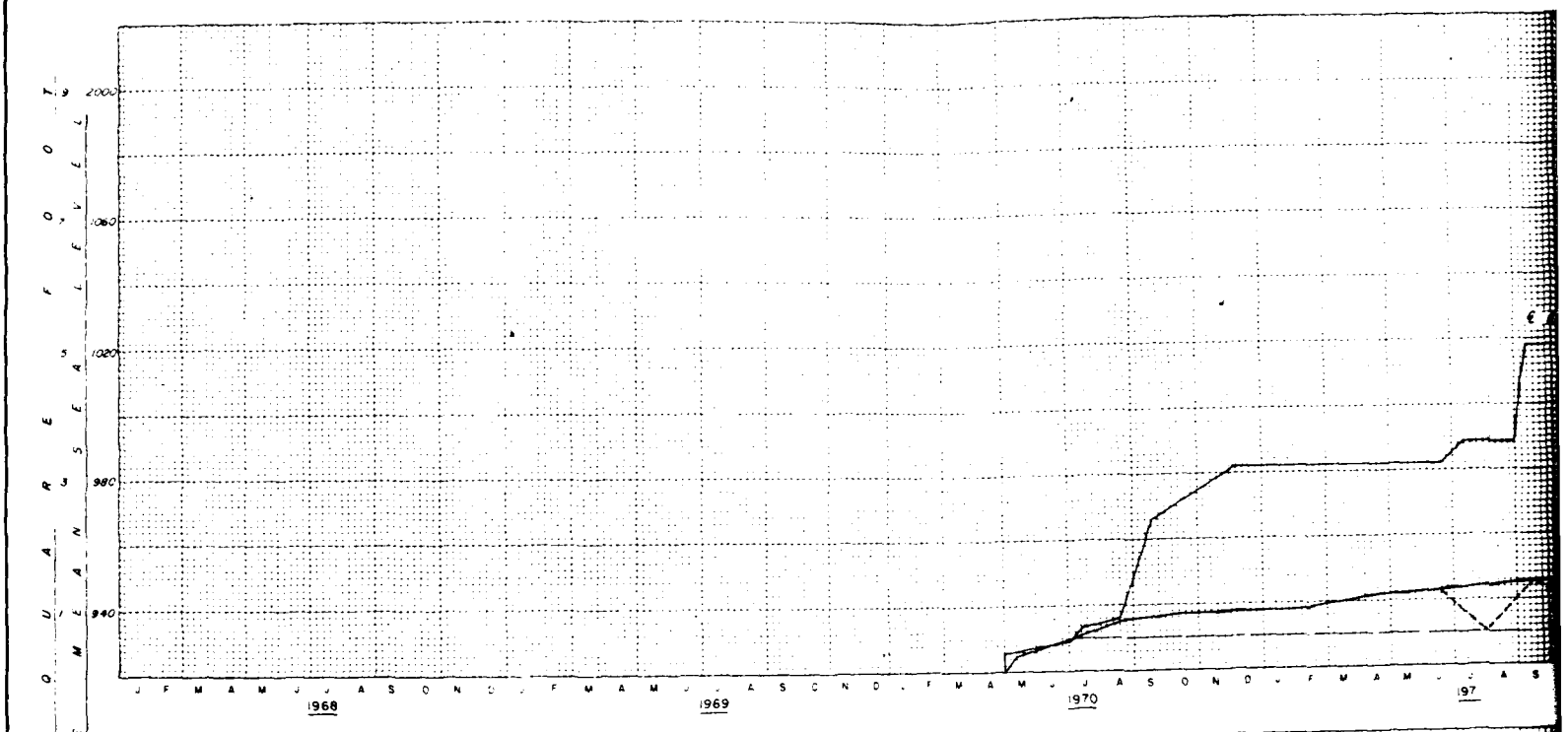
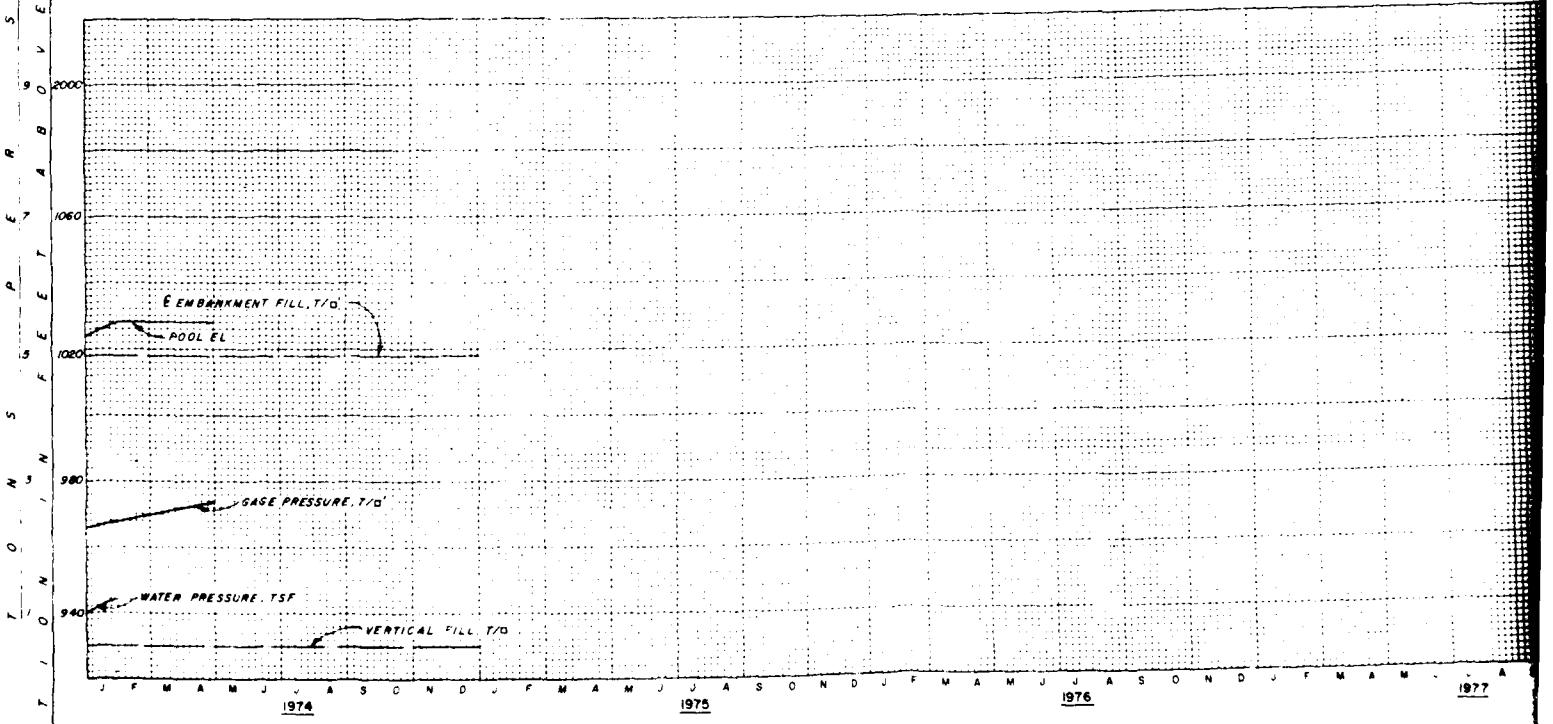
CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY DISTRICT

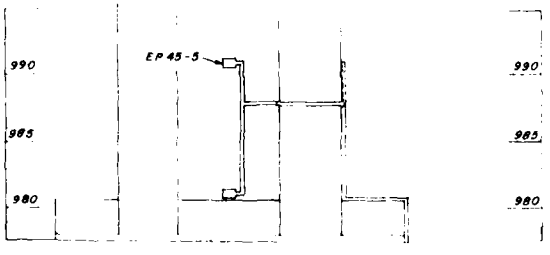
FILE NO. 0-5-1270

AUGUST 1975

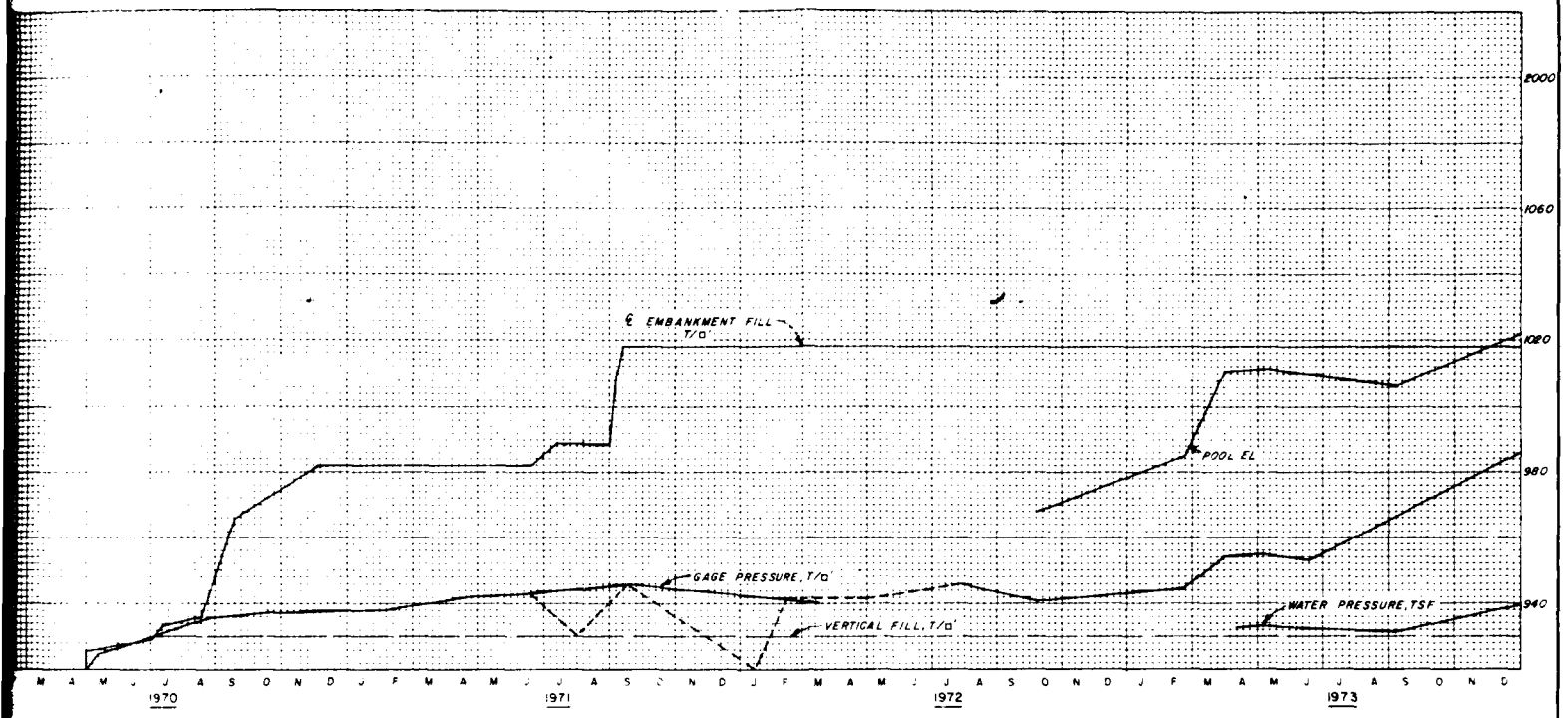
PLATE NO. 22

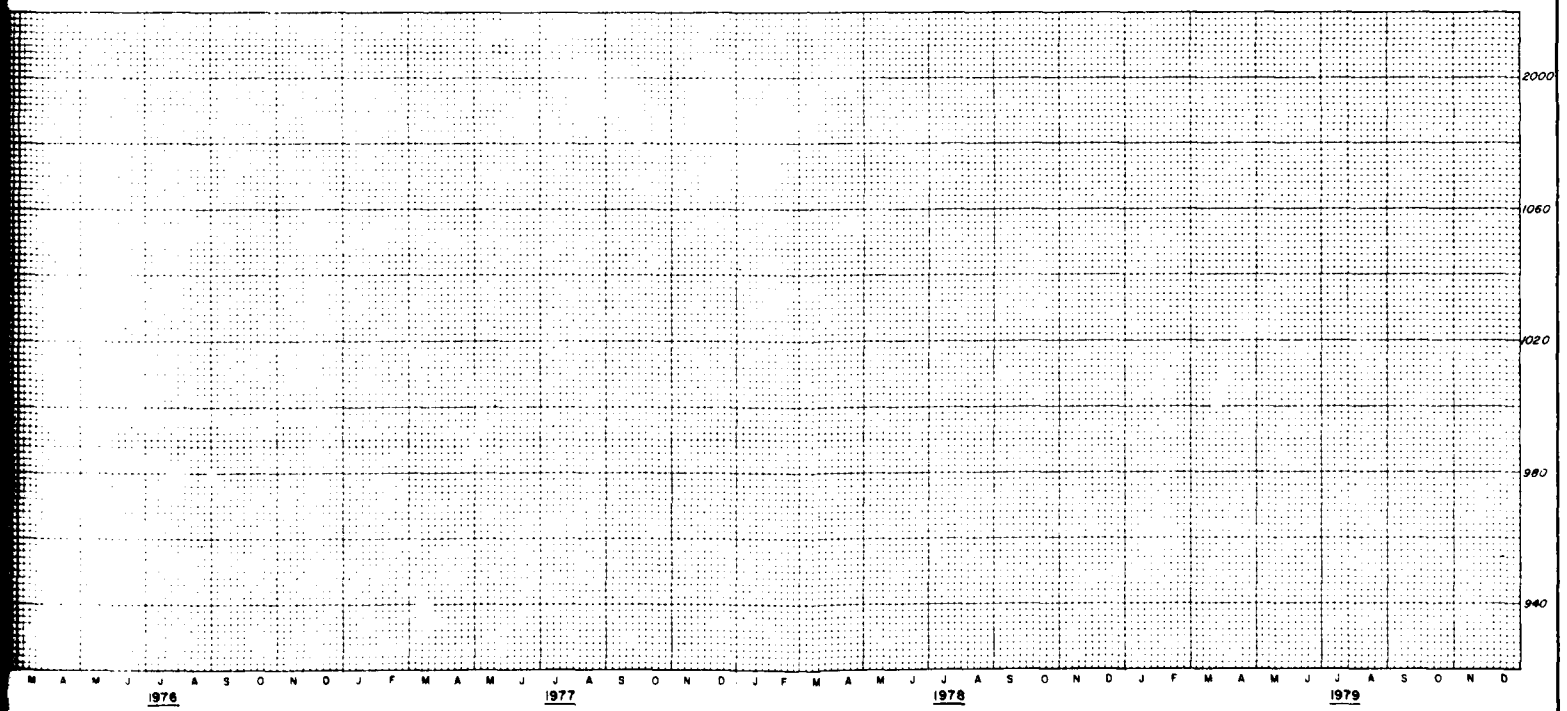






DOWNSTREAM ELEVATION





NOTE
NOT READ FOR THIS REPORT

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
EP 45-5 (GLOETZL CELL)

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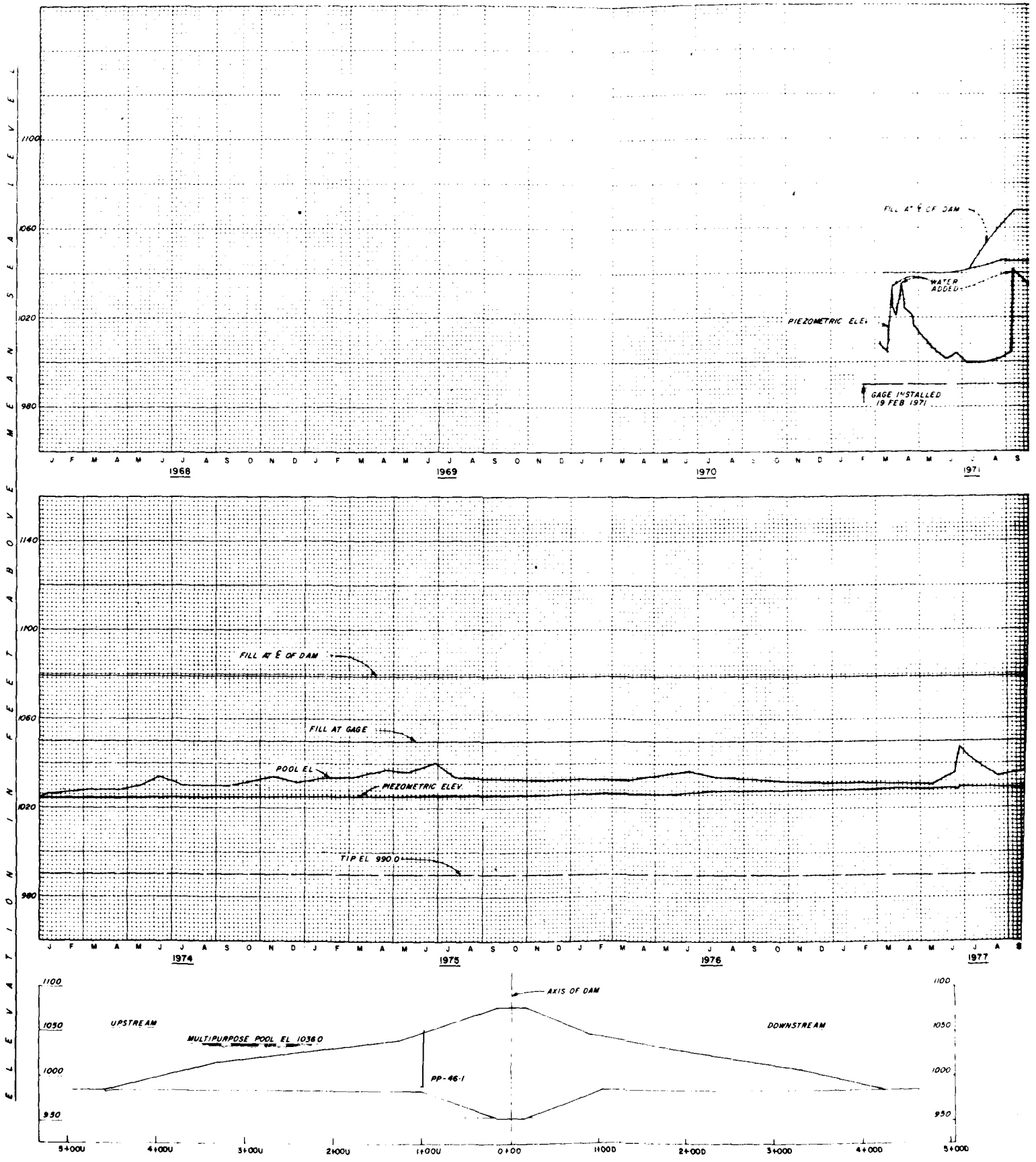
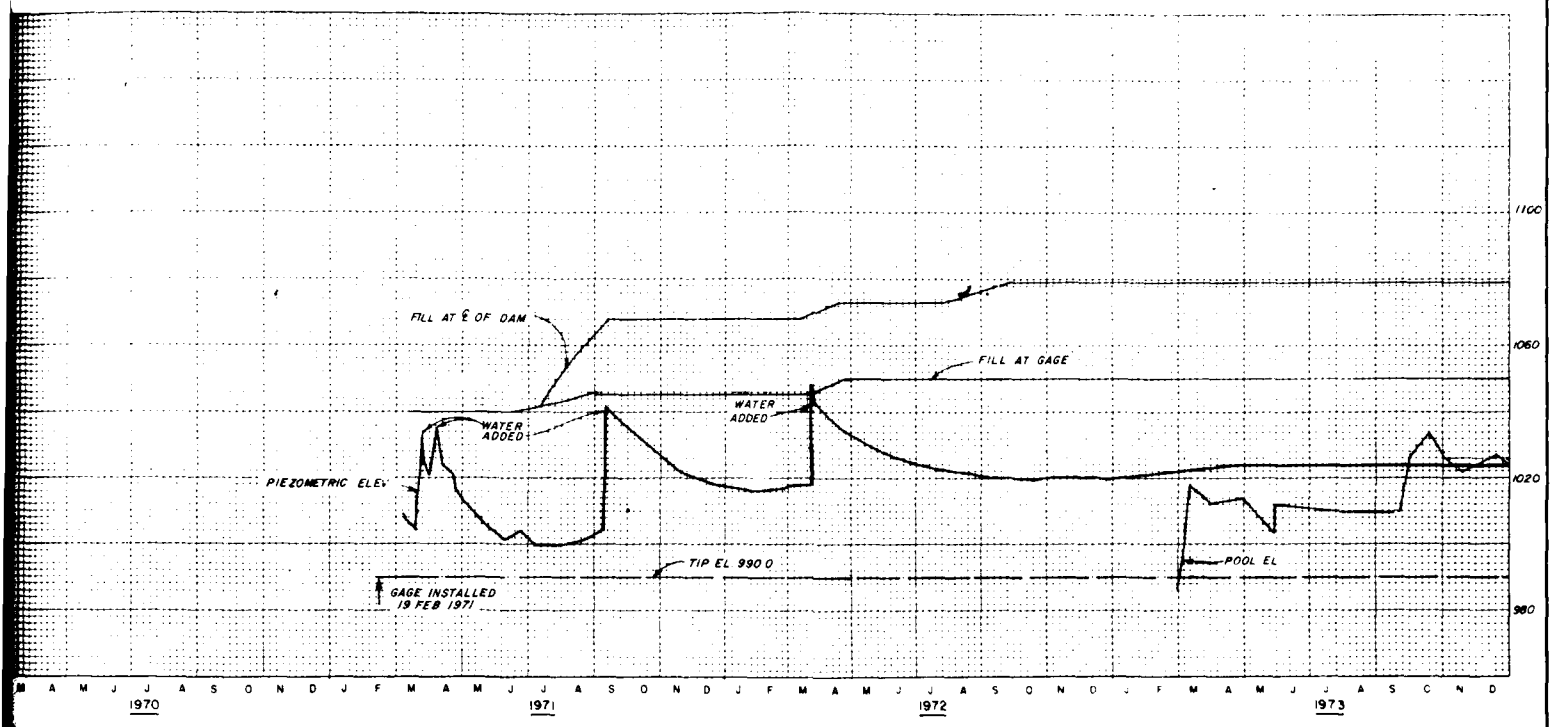
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1271
AUGUST 1975

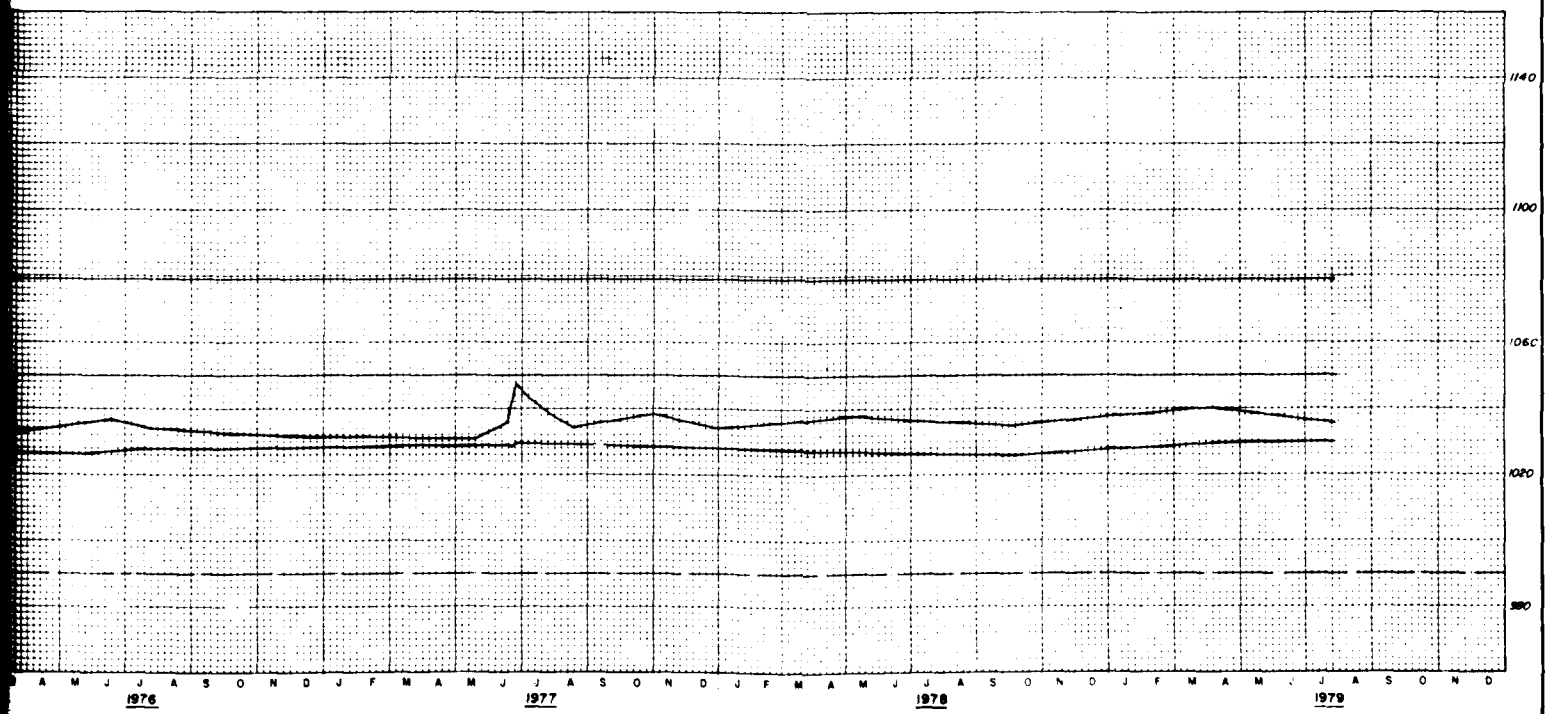
2

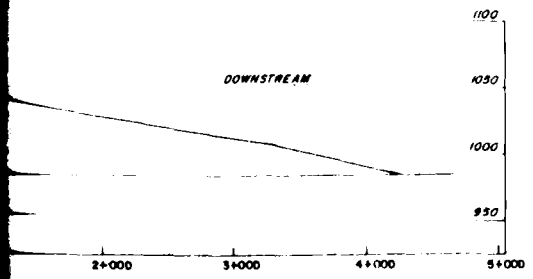
PLATE NO. 23



STATION 46+00







LEGEND

OPEN TUBE . . . . . ○

PNEUMATIC CELLS . ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-46-I (OPEN TUBE)

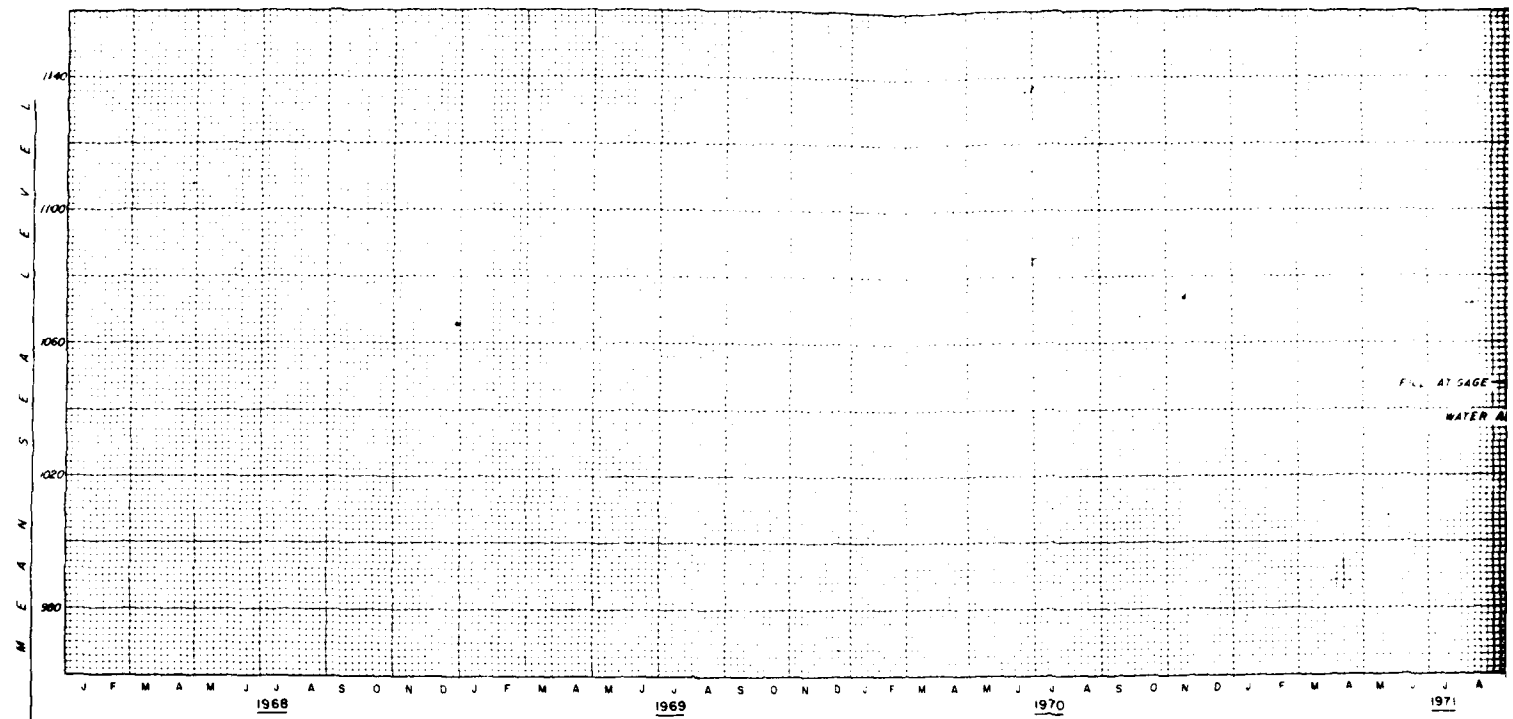
In 1 sheet | Sheet No. 1 | Scale as shown

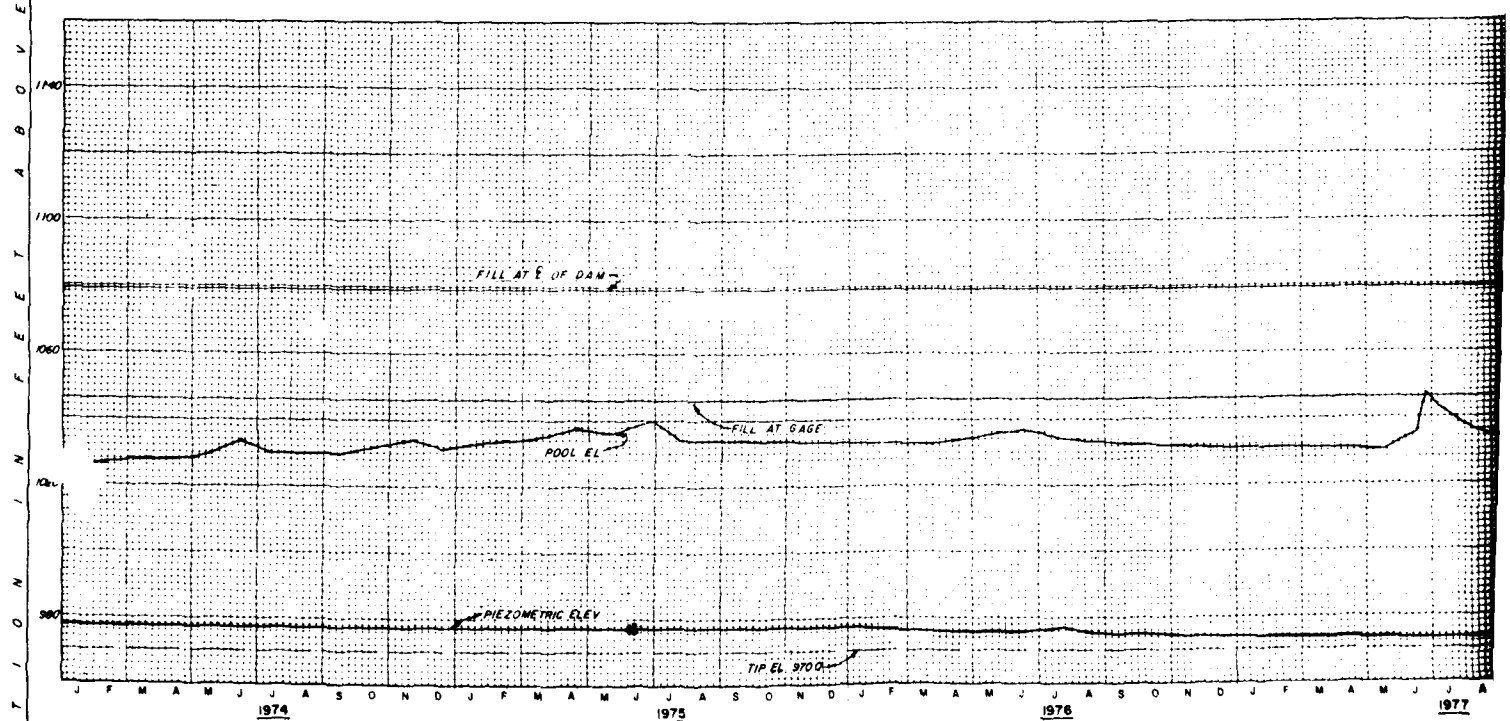
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

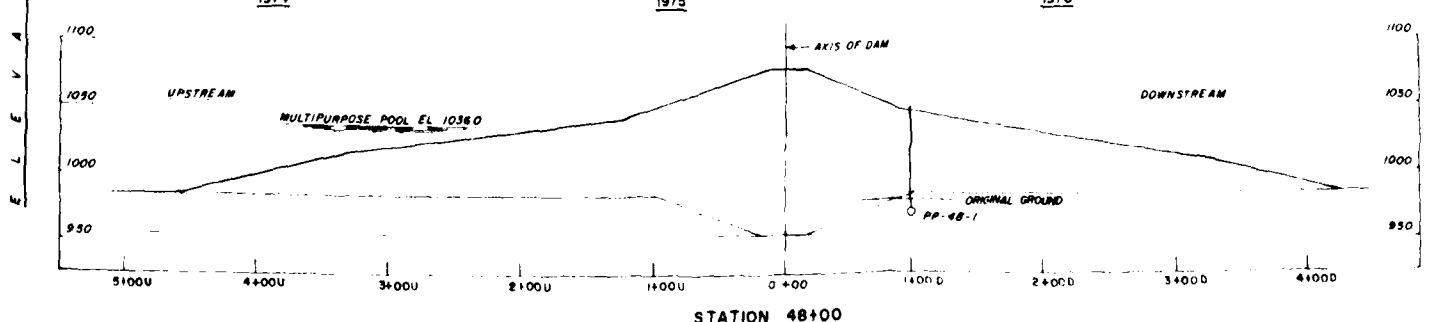
FILE NO. 0-5-1272

AUGUST 1975

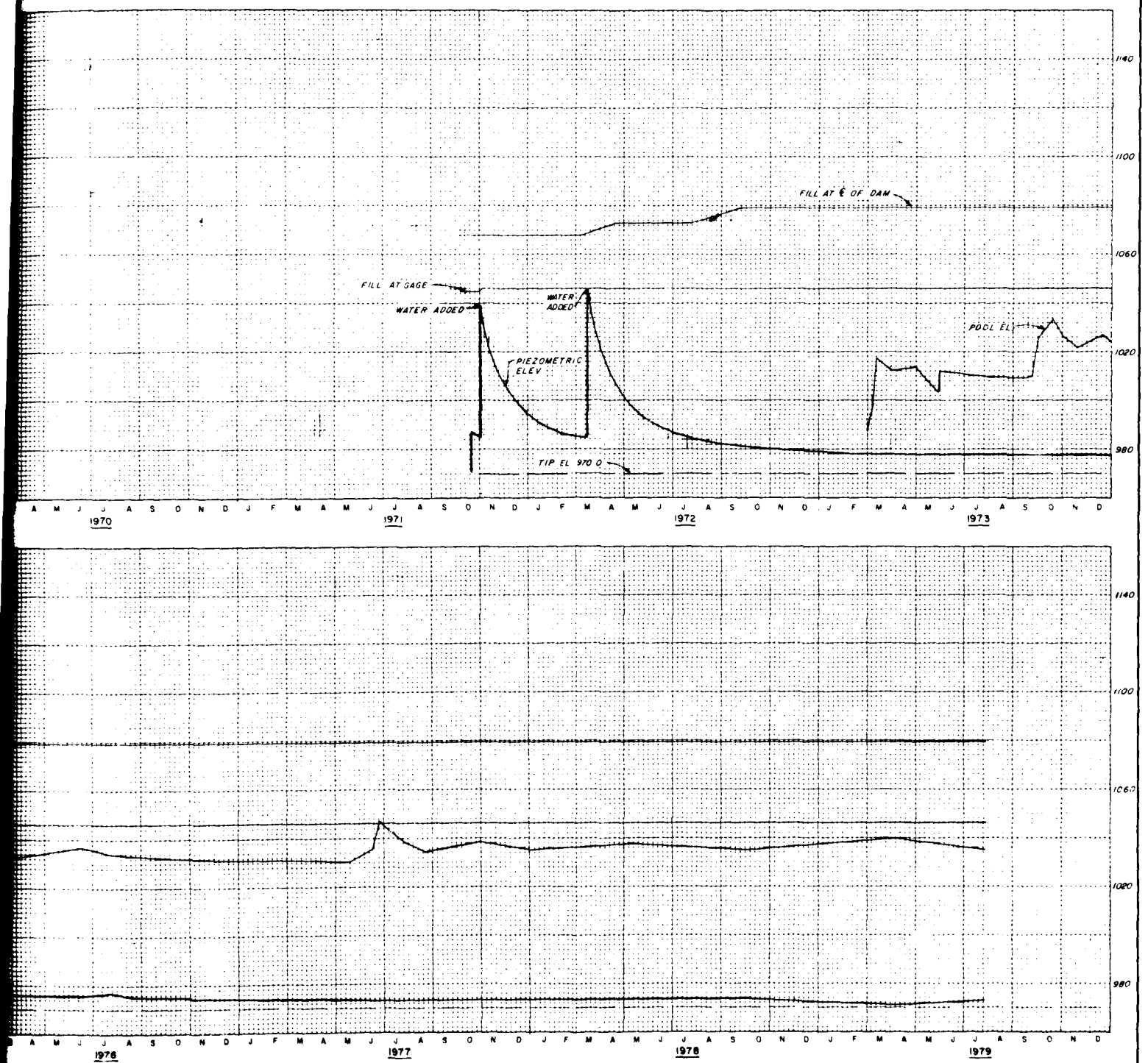
PLATE NO. 24

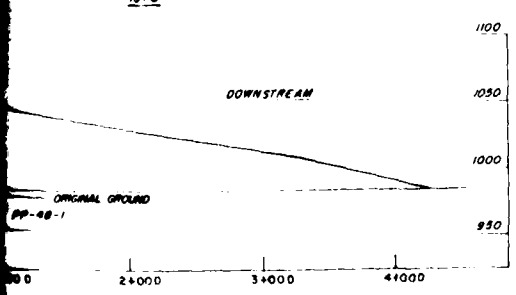






STATION 48+00





LEGEND

OPEN TUBE ---------O

PNEUMATIC CELL ---------●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-48-1 (OPEN TUBE)

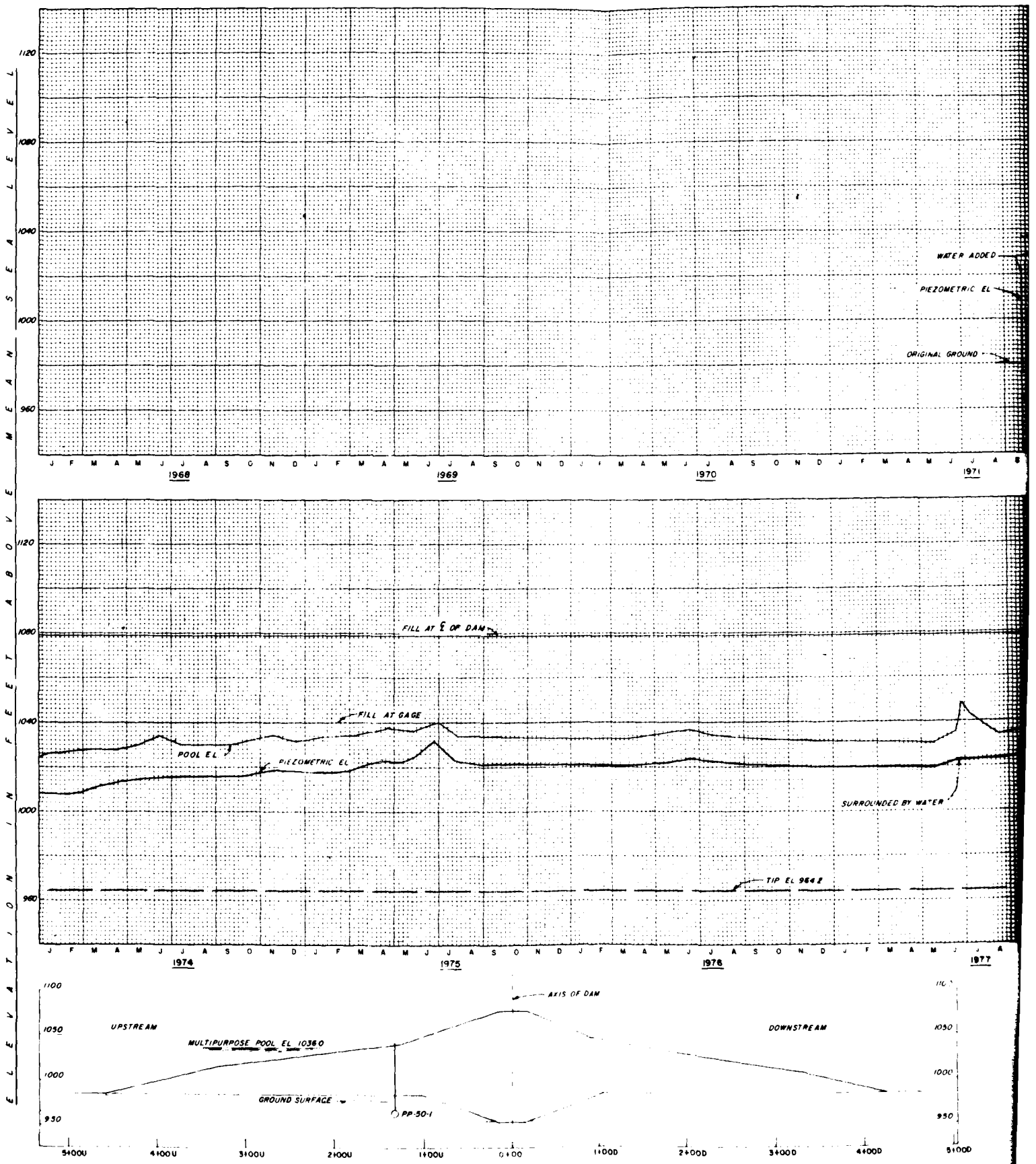
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

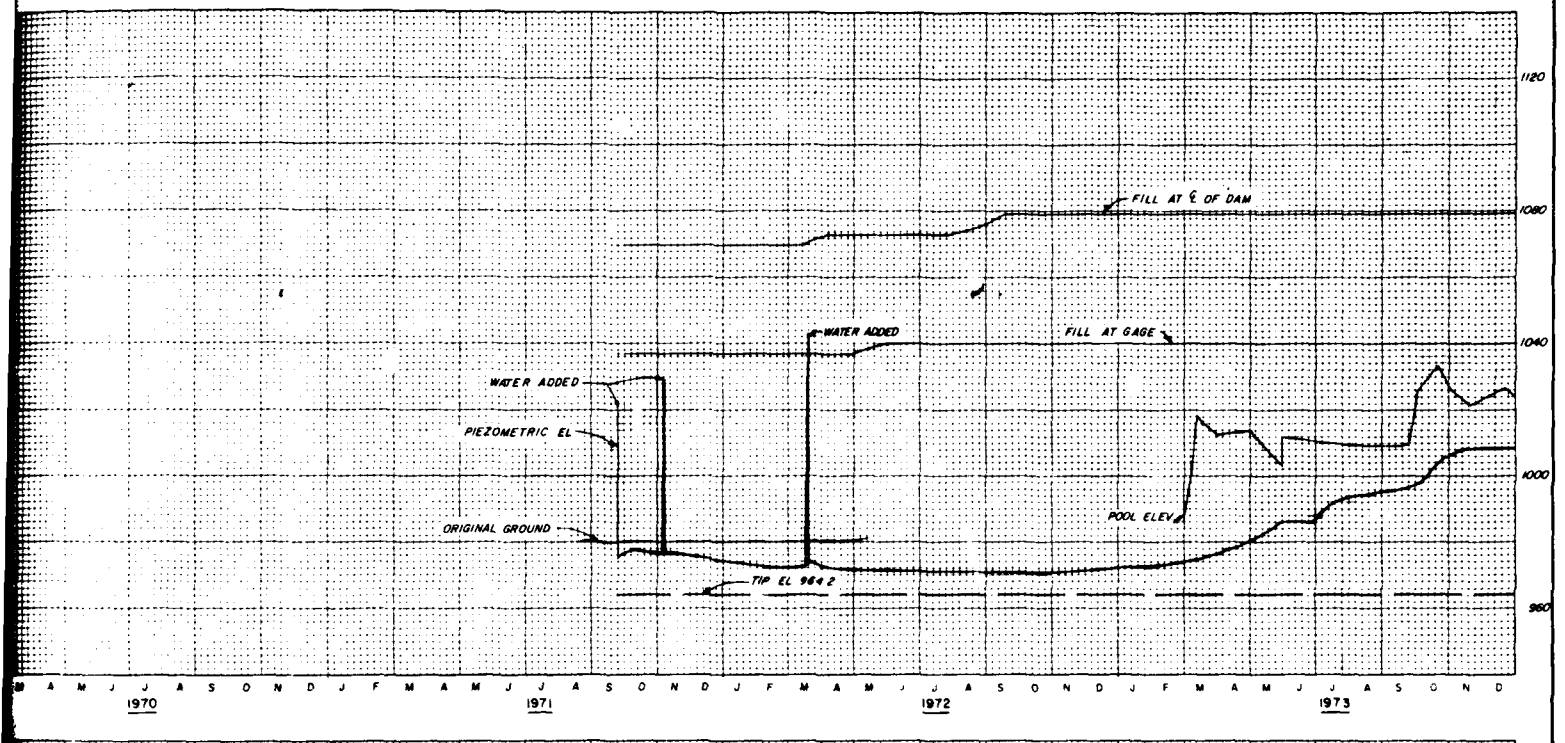
FILE NO. 0-5-1273

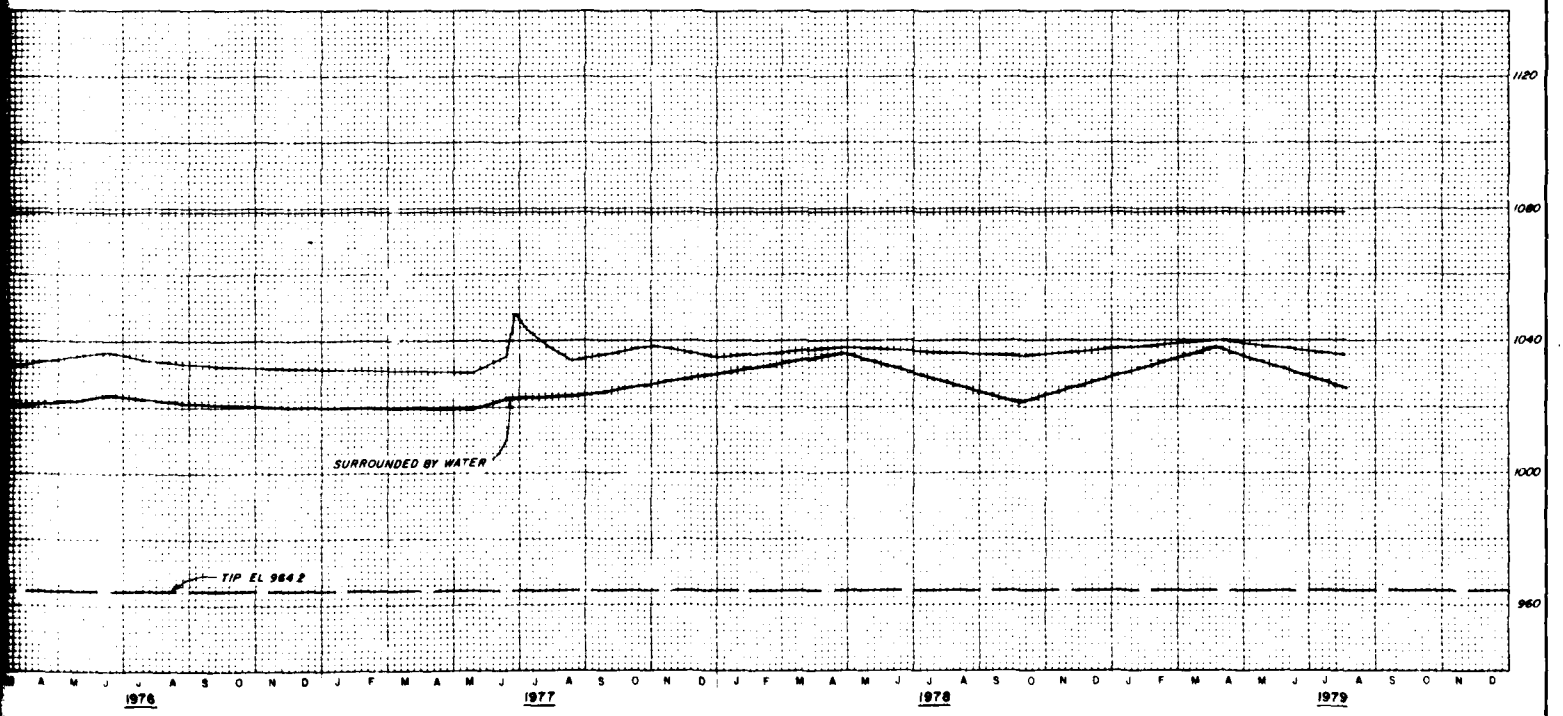
AUGUST 1975

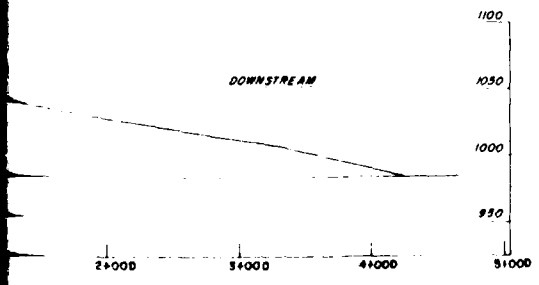
PLATE NO. 25



STATION 50+50







LEGEND

OPEN TUBE . . . . . ○

PNEUMATIC CELLS . . . ●

Revised August 1976

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS PP-50-1 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

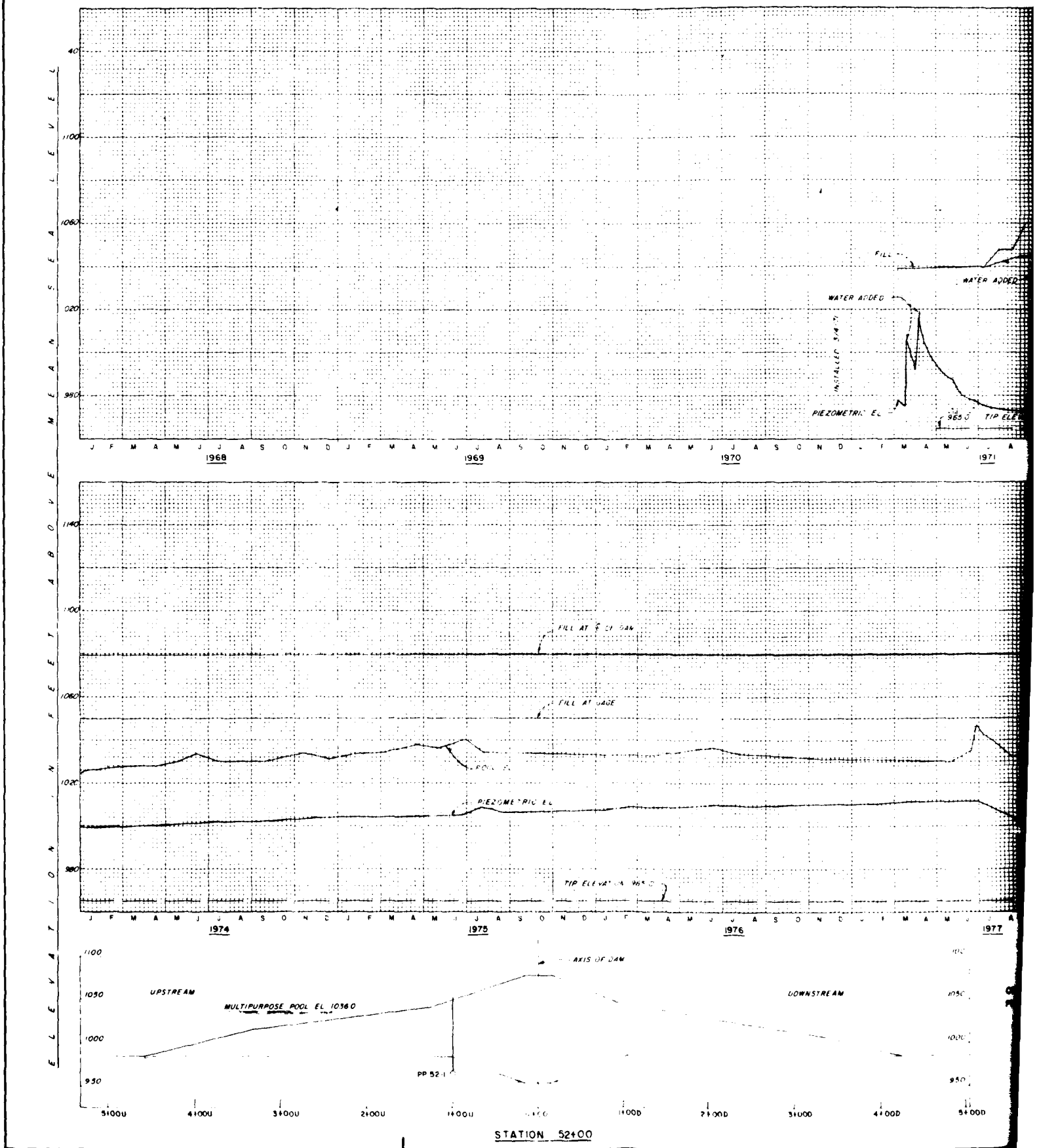
CORPS OF ENGINEERS U. S. ARMY

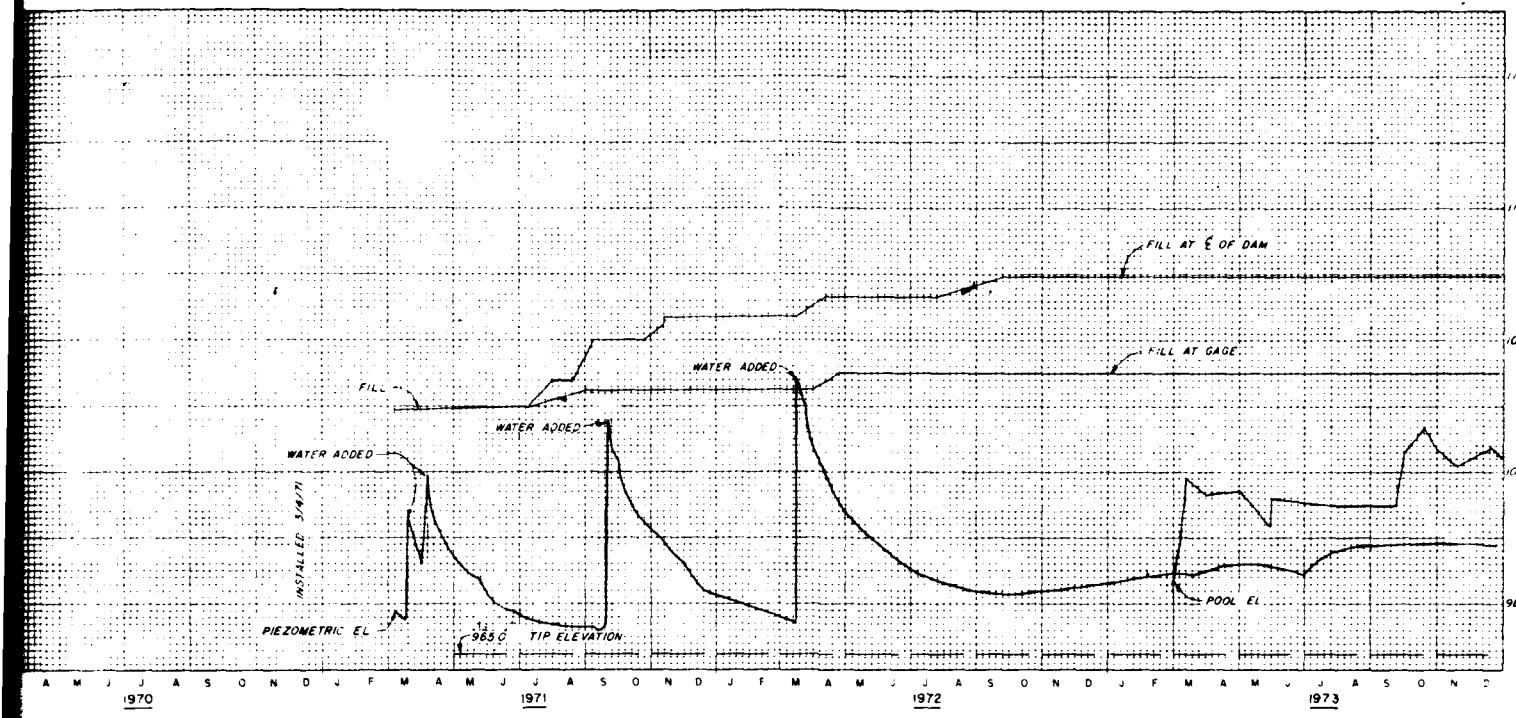
KANSAS CITY DISTRICT

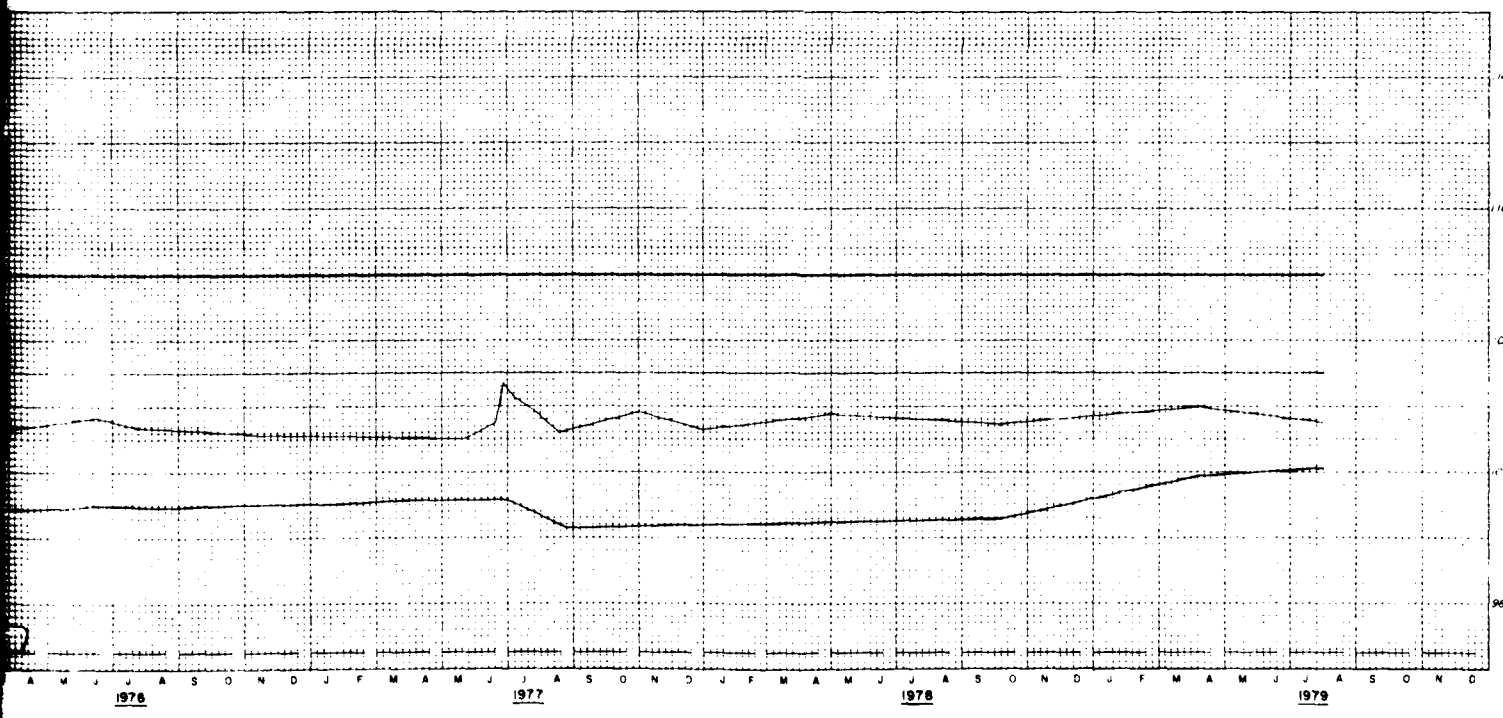
FILE NO. 0-5-1274

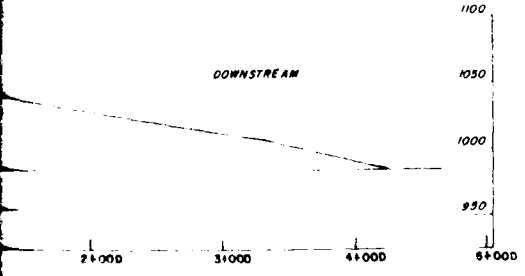
AUGUST 1975

PLATE NO. 26


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1140
1100
1060
1020
980
940
WATER ADDED
WATER ADDED
INSTALLED 3/4 '71
PIEZOMETRIC EL
965.0
TIP ELEV
FILL AT EL OF DAM
FILL AT GAGE
POOL EL
PIEZOMETRIC EL
TIP ELEVATION 965.0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1968
1969
1970
1971
1974
1975
1976
1977
1100
1050
1000
950
UPSTREAM
MULTIPURPOSE POOL EL 1036.0
PP 52-1
AXIS OF DAM
DOWNSTREAM
5+000U
4+000U
3+000U
2+000U
1+000U
1+000D
2+000D
3+000D
4+000D
5+000D
STATION 52+00







LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

Revised August 1975

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-52-1 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

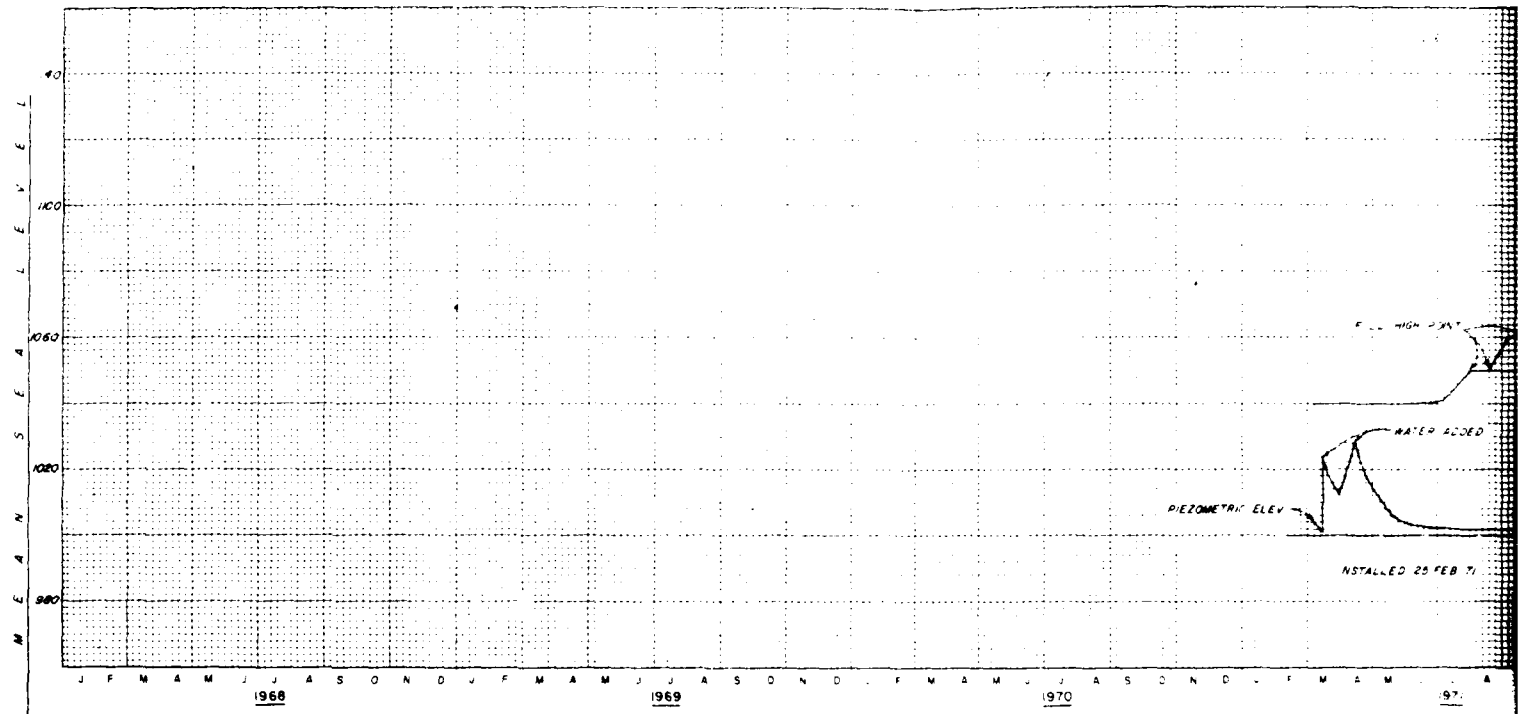
CORPS OF ENGINEERS, U.S. ARMY
KANSAS CITY DISTRICT

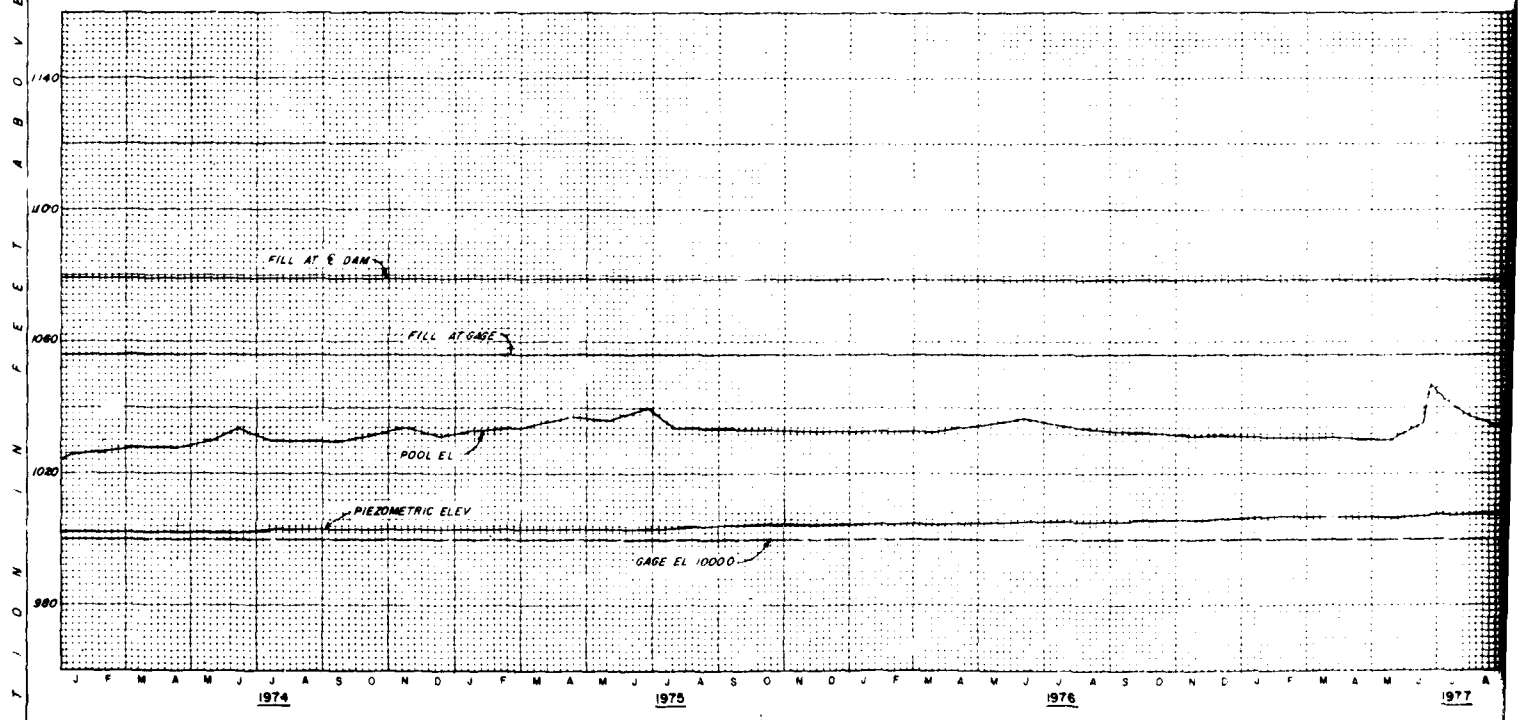
FILE NO. 0-5-1275

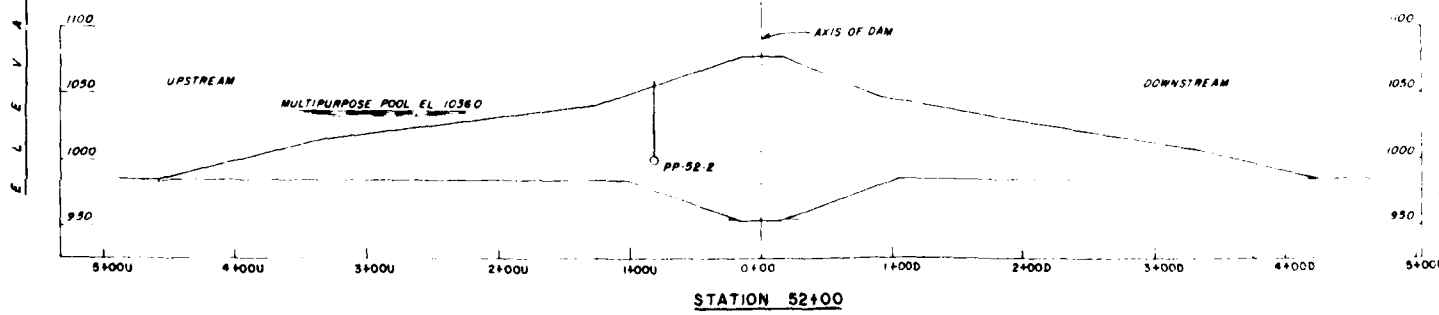
AUGUST 1975

2

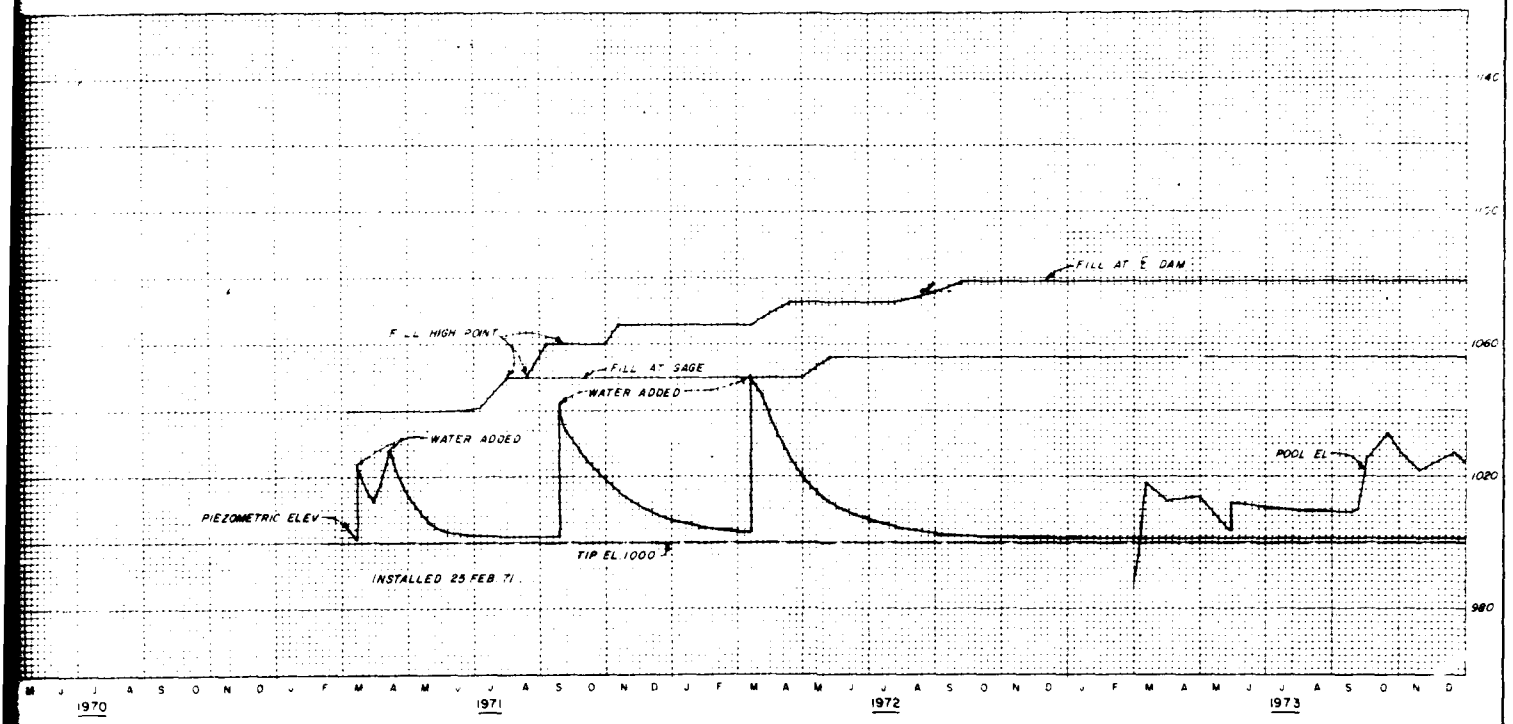
PLATE NO. 27

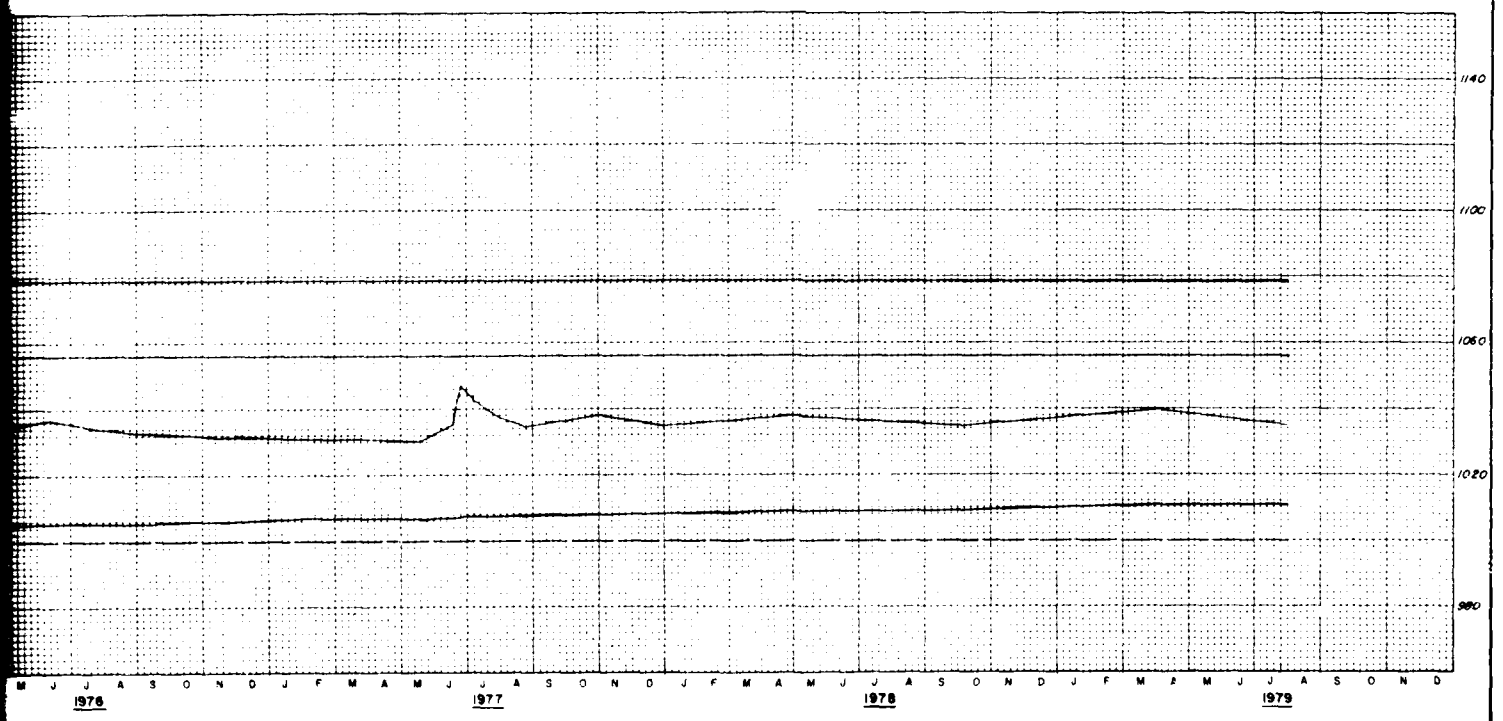


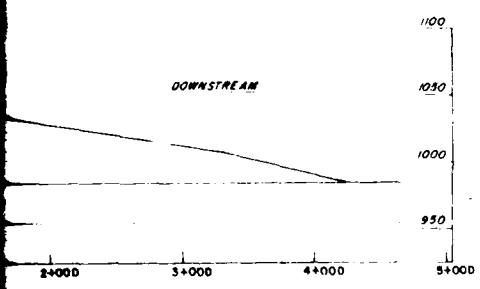




STATION 52+00







LEGEND

OPEN TUBE ..... O

PNEUMATIC CELL ----- ●

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

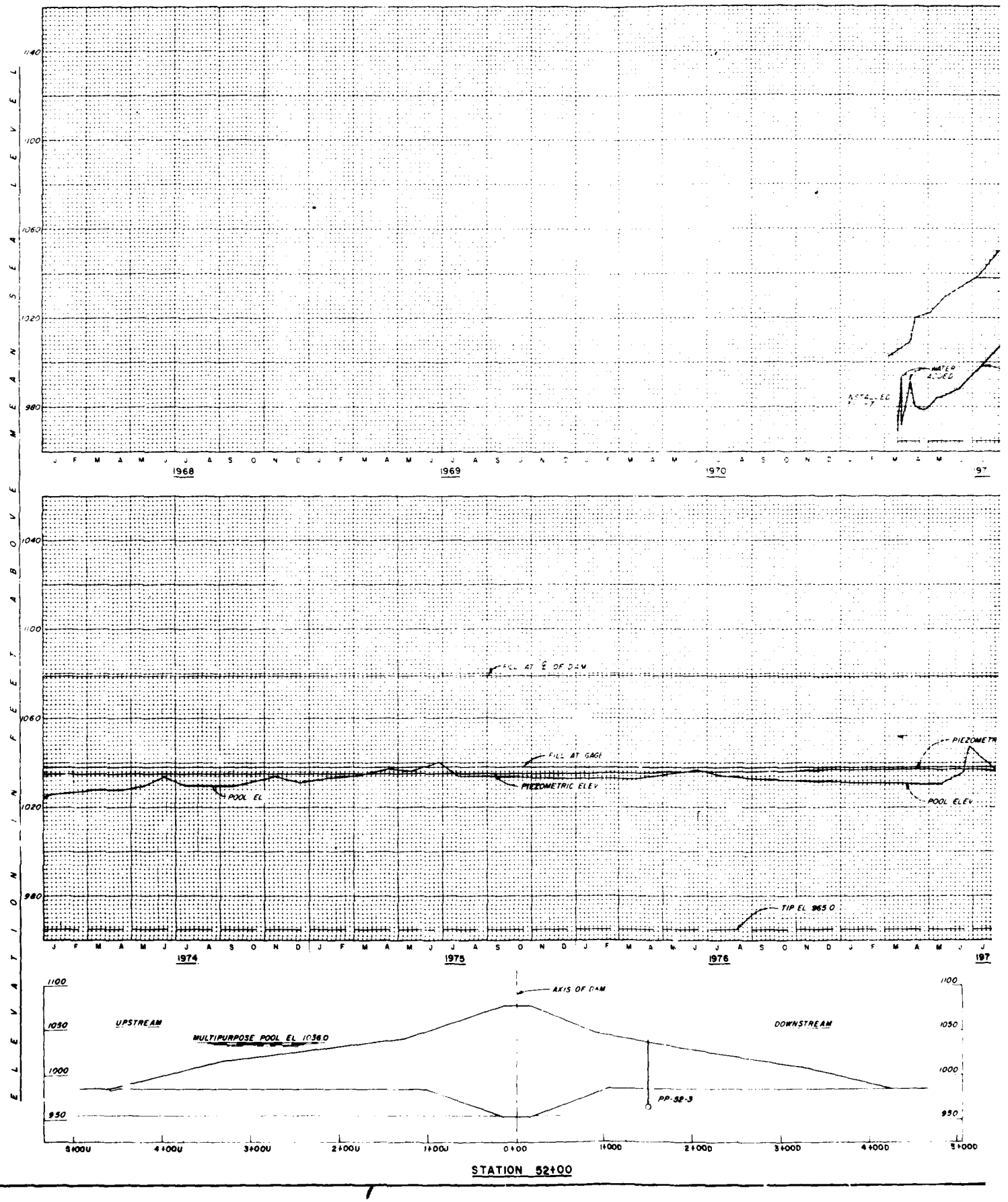
INSTRUMENTATION PLOTS
PP-52-2 (OPEN TUBE)

In 1 sheet | Sheet No 1 | Scale as shown

CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1276
AUGUST 1975

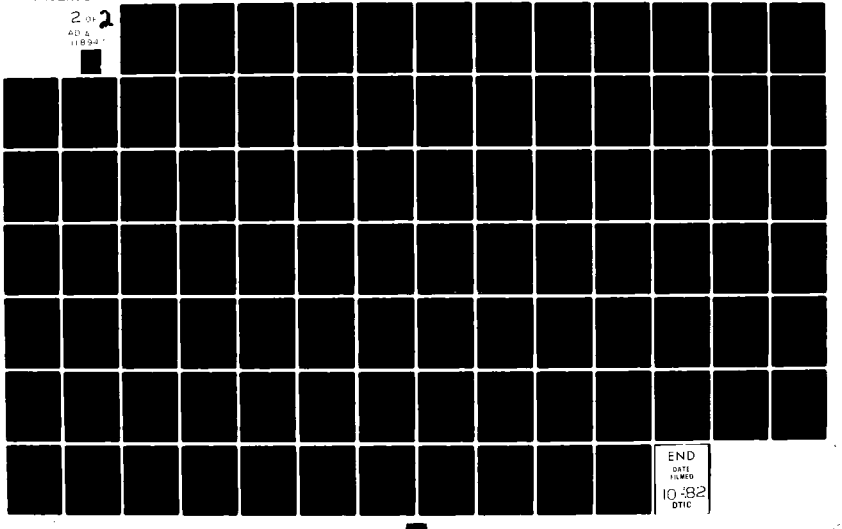
PLATE NO 28

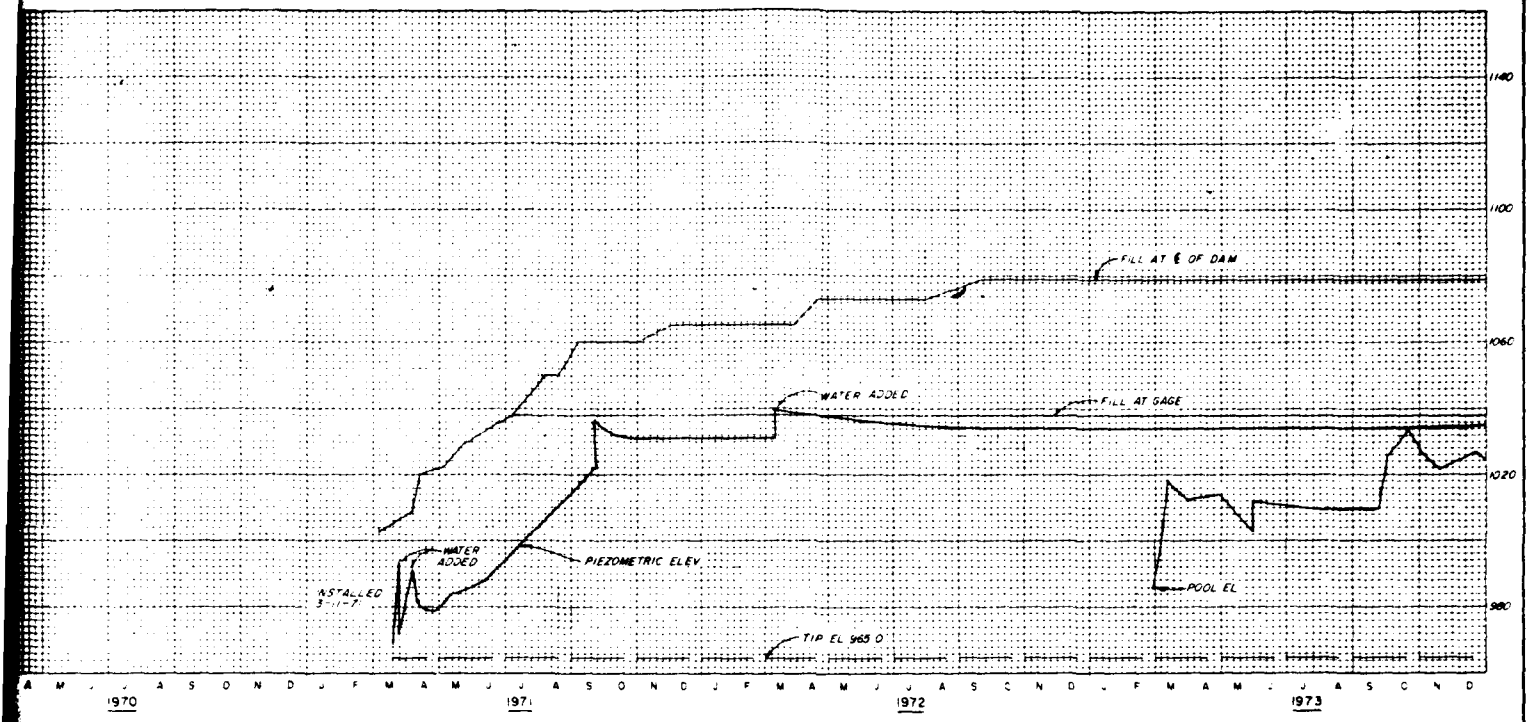


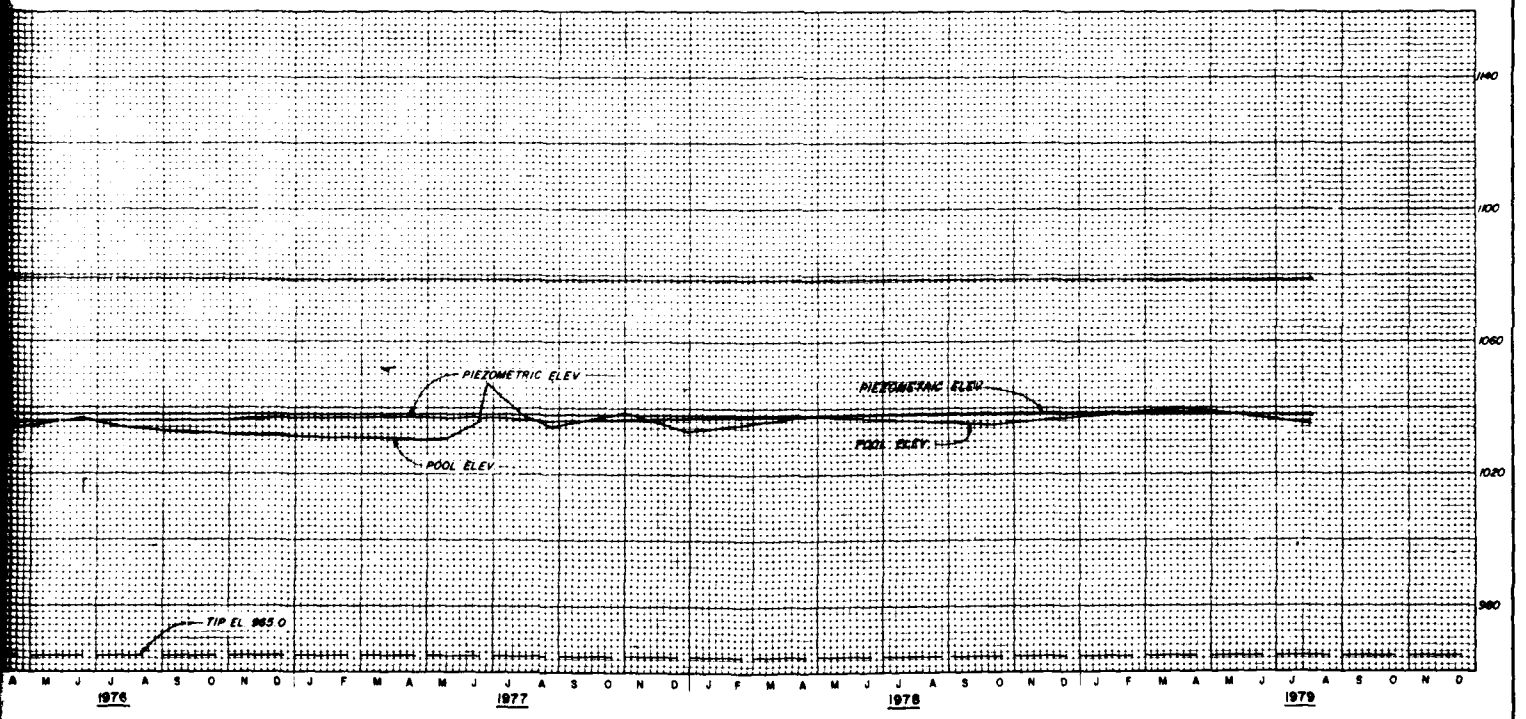
STATION 52+00

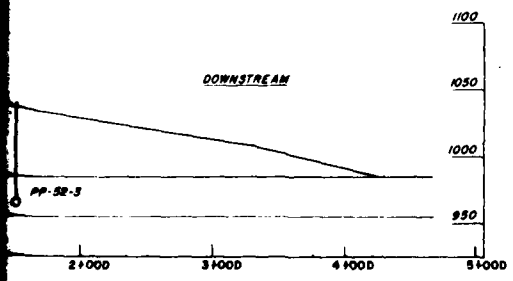
AD-A118 947 CORPS OF ENGINEERS KANSAS CITY MO KANSAS CITY DISTRICT F/G 13/2
OPERATION AND MAINTENANCE MANUAL, MELVERN LAKE, MARAIS DES CYGN--ETC(U)
AUG 82

UNCLASSIFIED NL









LEGEND

OPEN TUBE _____ ○

PNEUMATIC CELL _____ ●

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-52-3 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

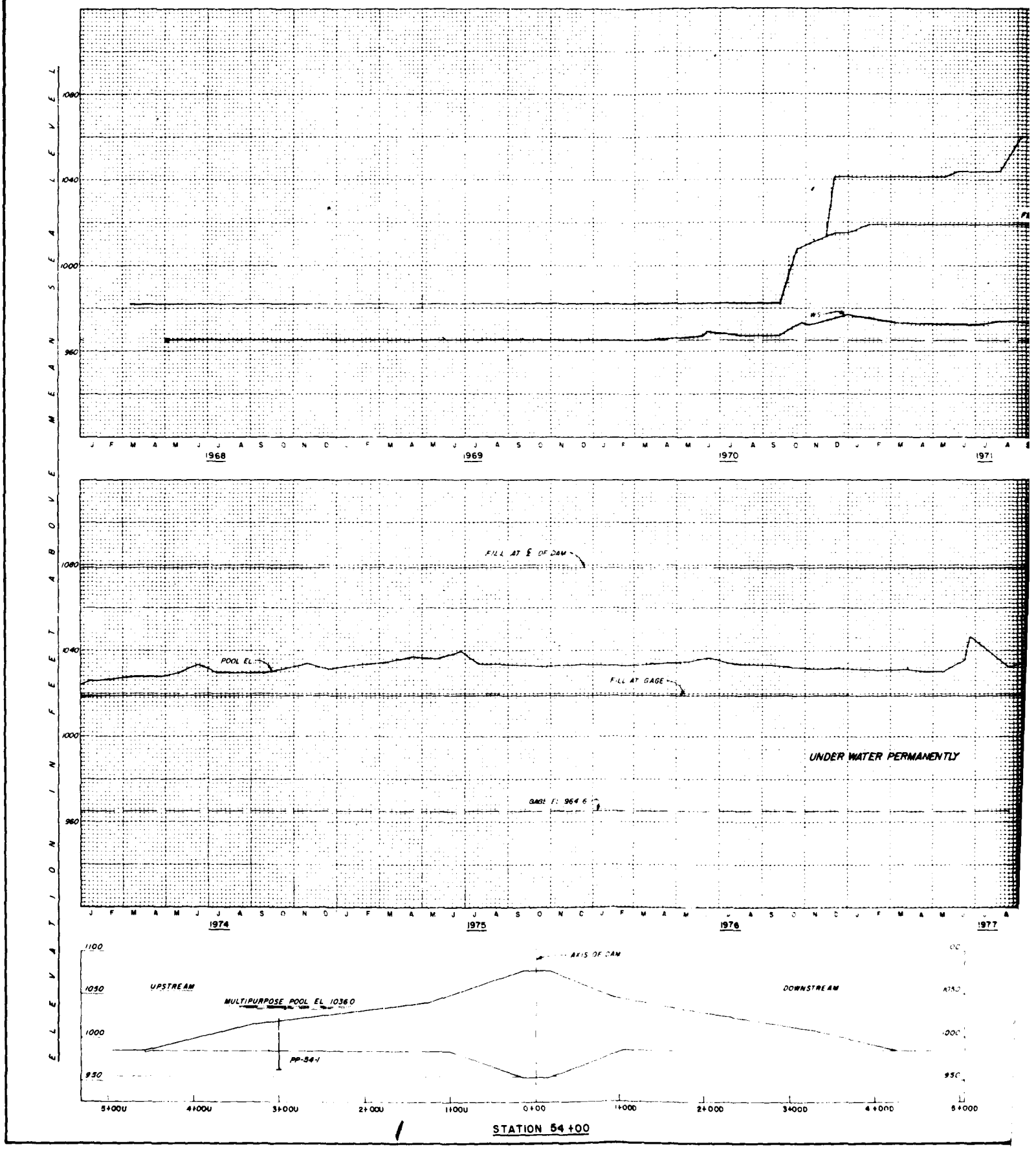
CORPS OF ENGINEERS U. S. ARMY

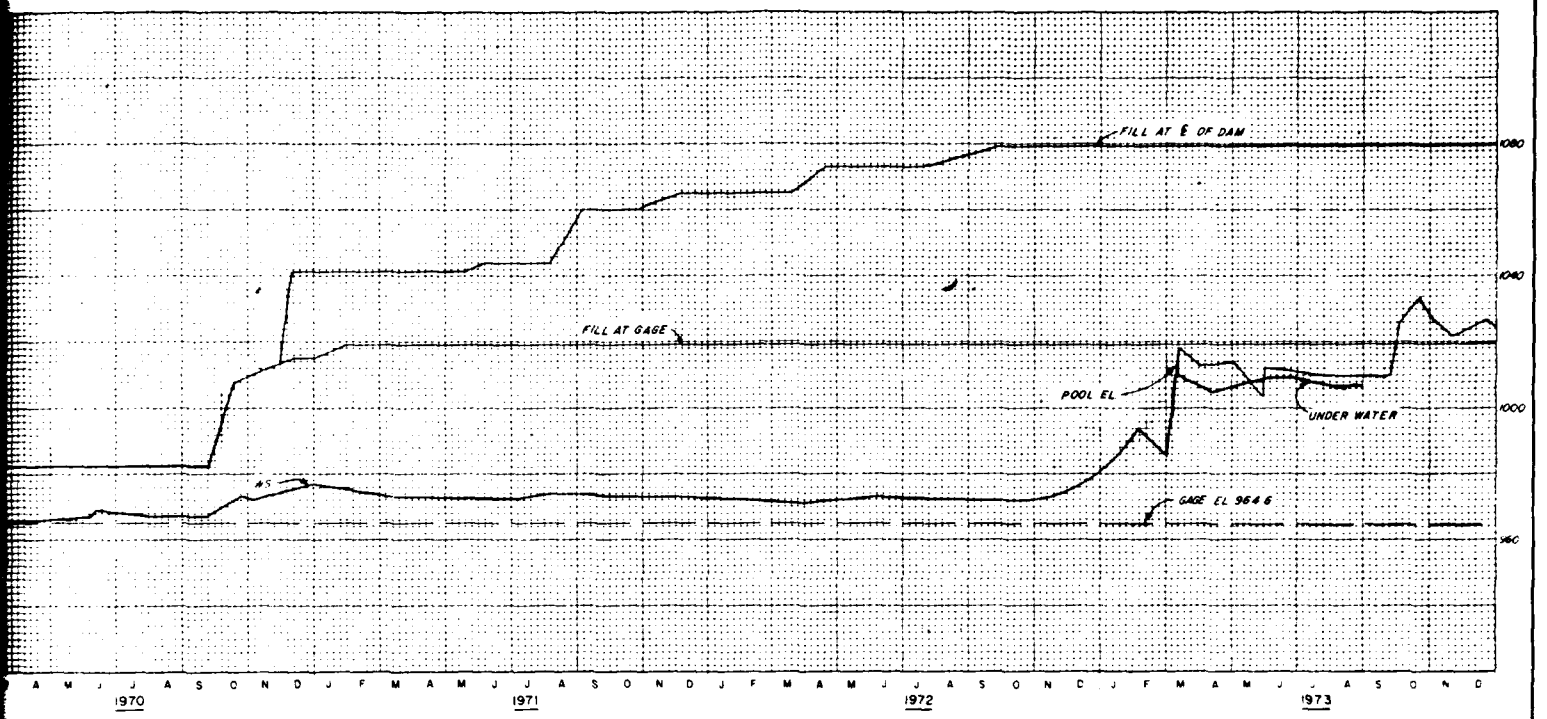
KANSAS CITY DISTRICT

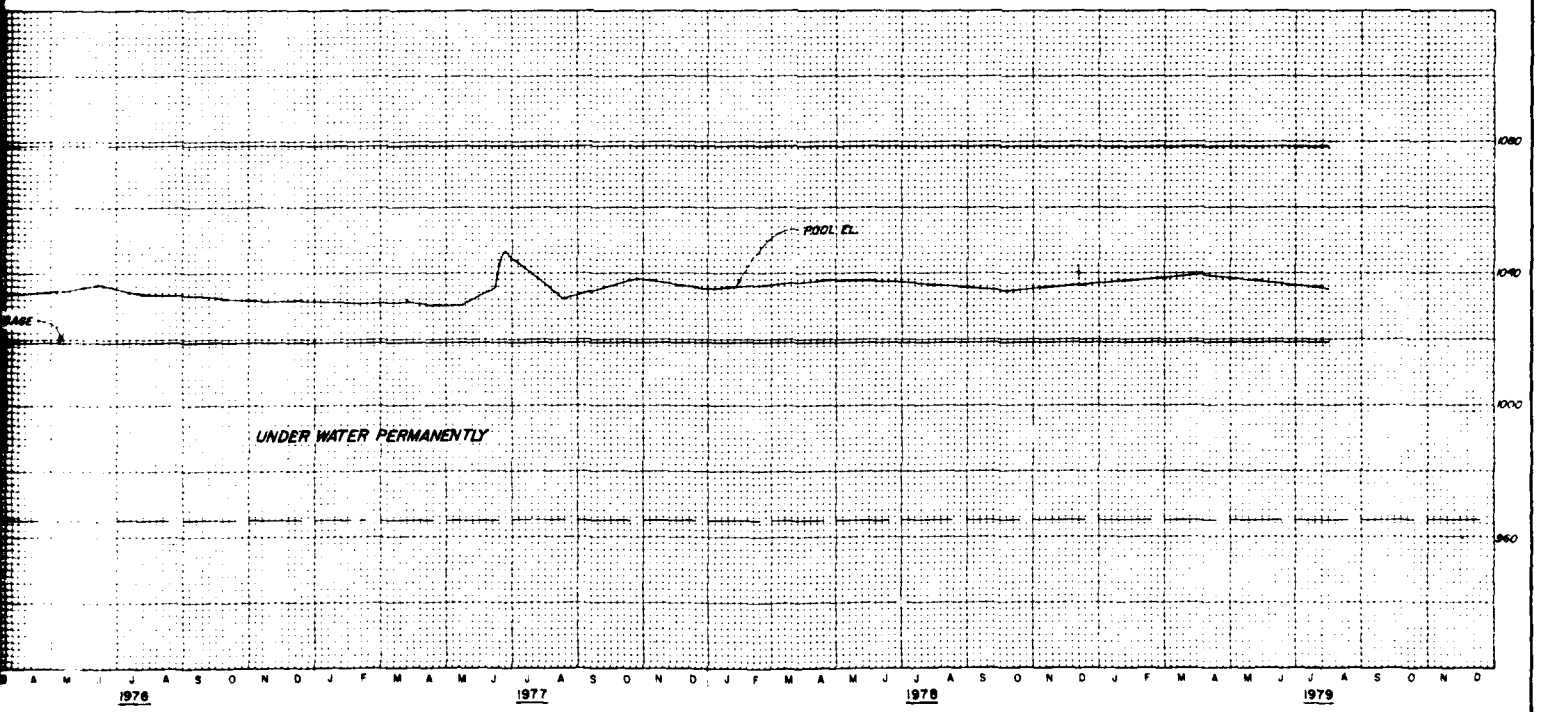
FILE NO. 0-5-1277

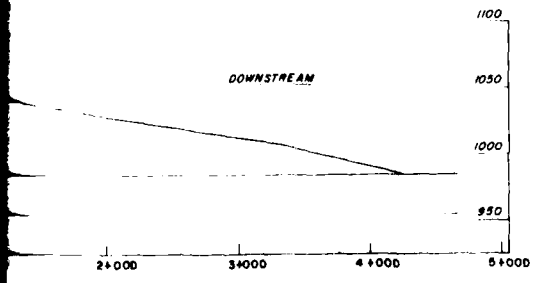
AUGUST 1975

PLATE NO. 29


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1080
1040
1000
960
WS
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1968
1969
1970
1971
FILL AT ℄ OF DAM
POOL EL
FILL AT GAGE
UNDER WATER PERMANENTLY
GAGE EL 964.6
1974
1975
1976
1977
1100
1050
1000
950
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-54-1
5+000U
4+000U
3+000U
2+000U
1+000U
0+00
1+000
2+000
3+000
4+000
5+000
STATION 54+00







Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-54-1 (OPEN TUBE)

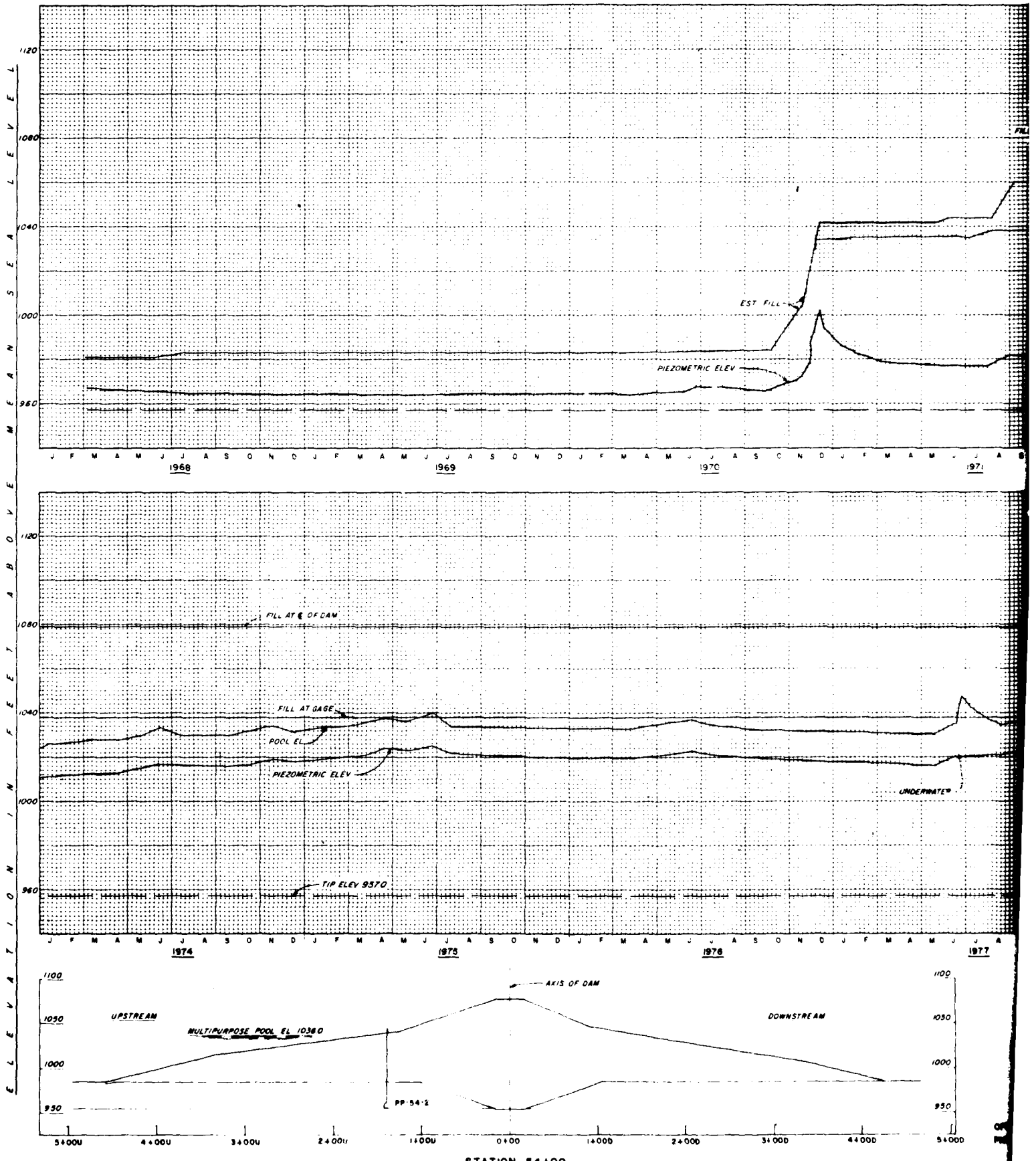
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

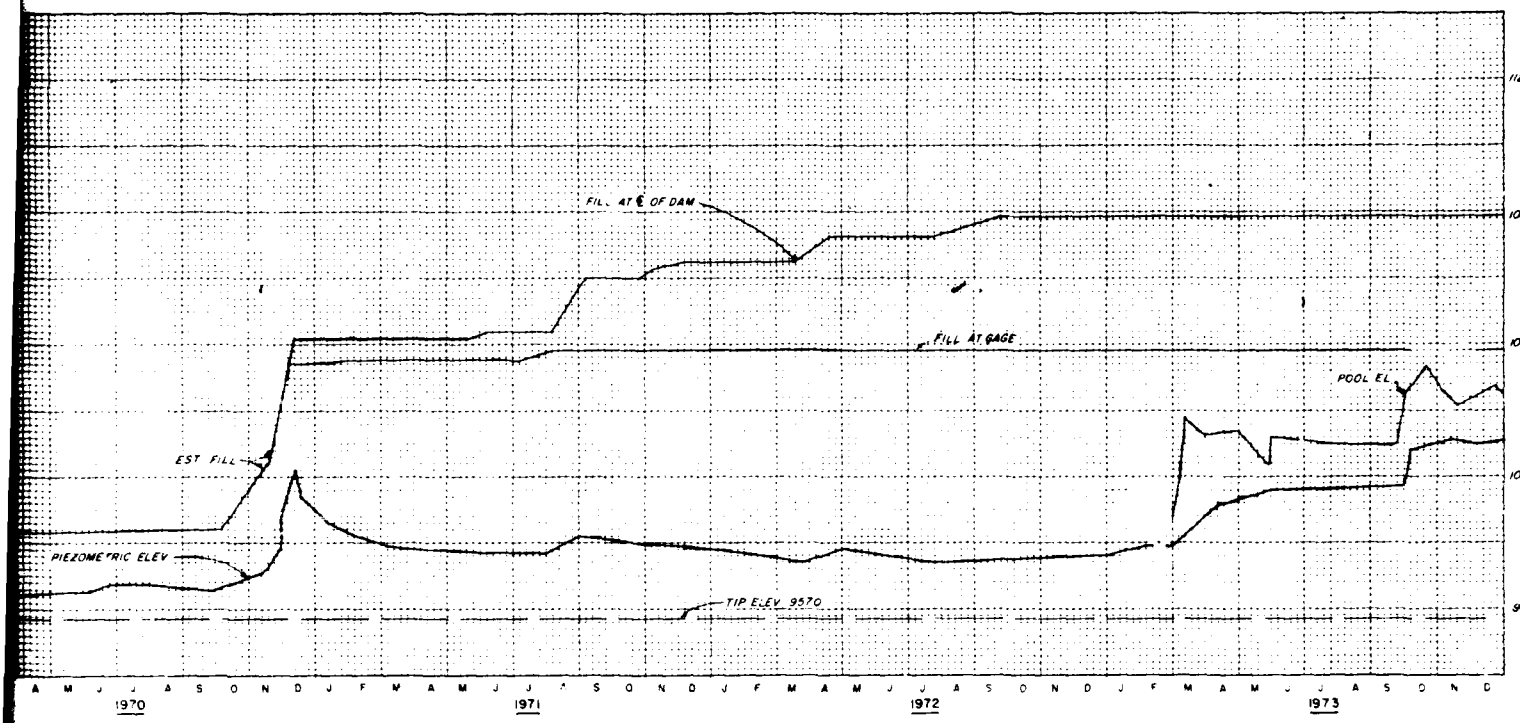
FILE NO. O-5-1278

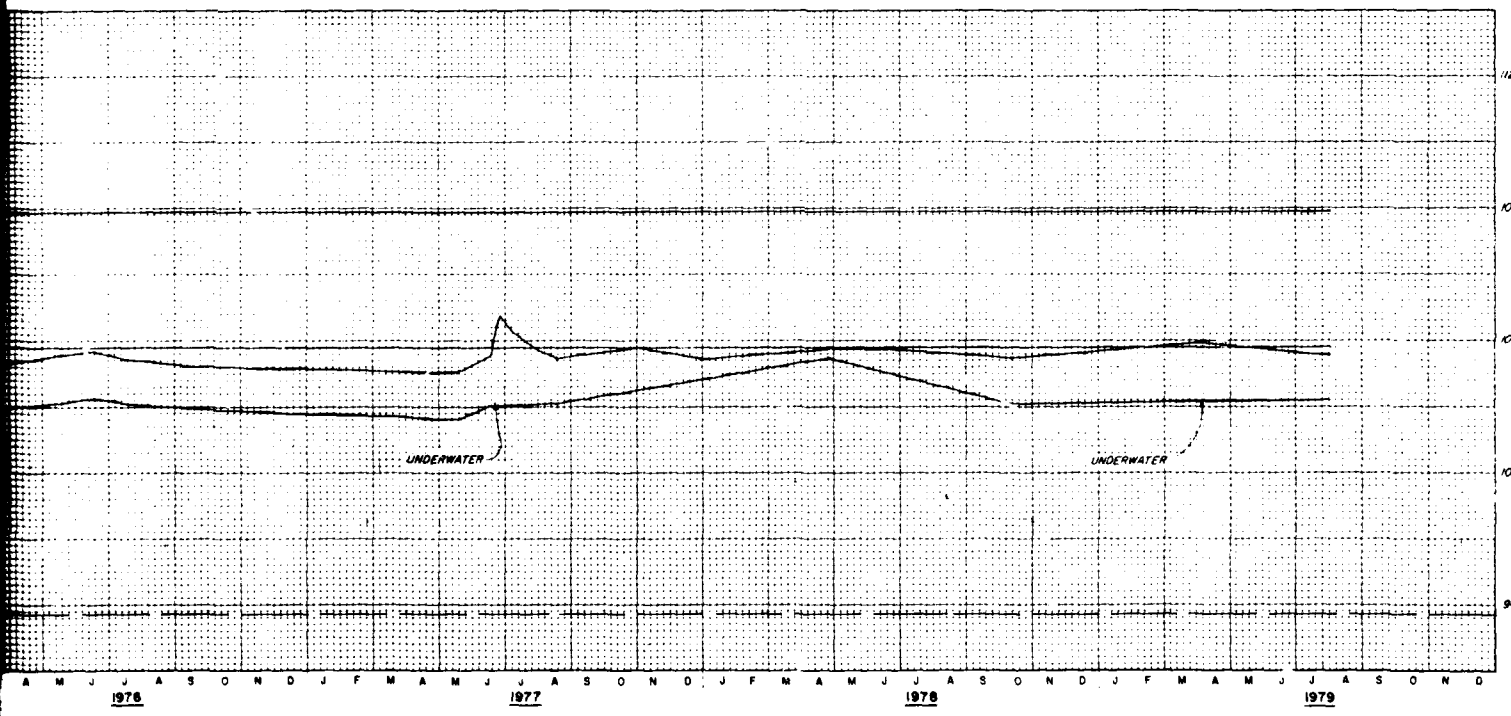
AUGUST 1975

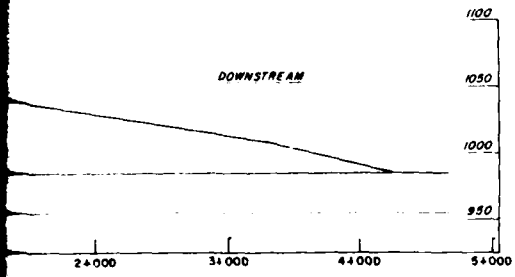
PLATE NO. 30



STATION 54+00







LEGEND

OPEN TUBE _____ O

PNEUMATIC CELL _____ ●

Revised August 1970

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-54-2 (OPEN TUBE)

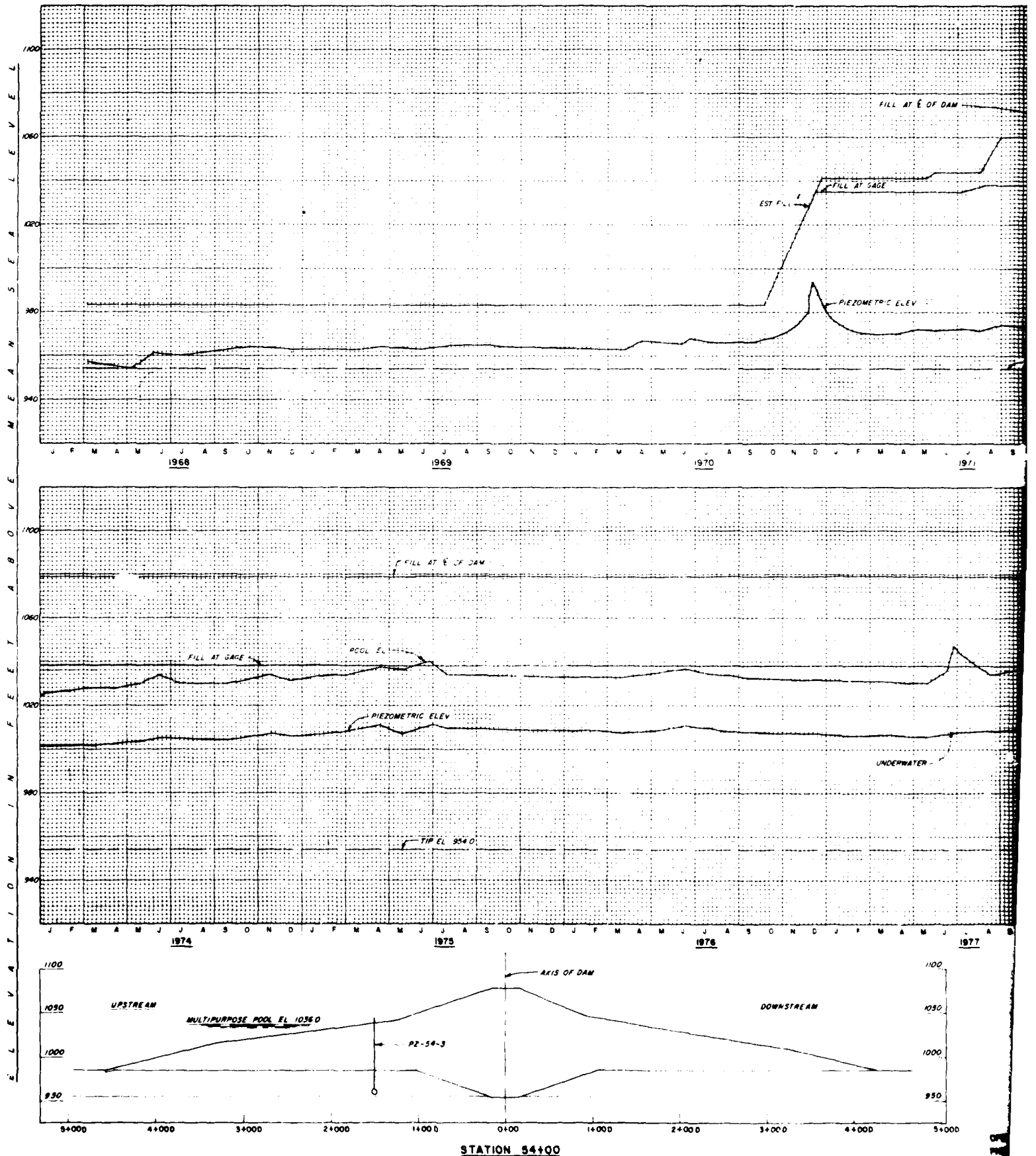
In 1 sheet | Sheet No. 1 | Scale as shown

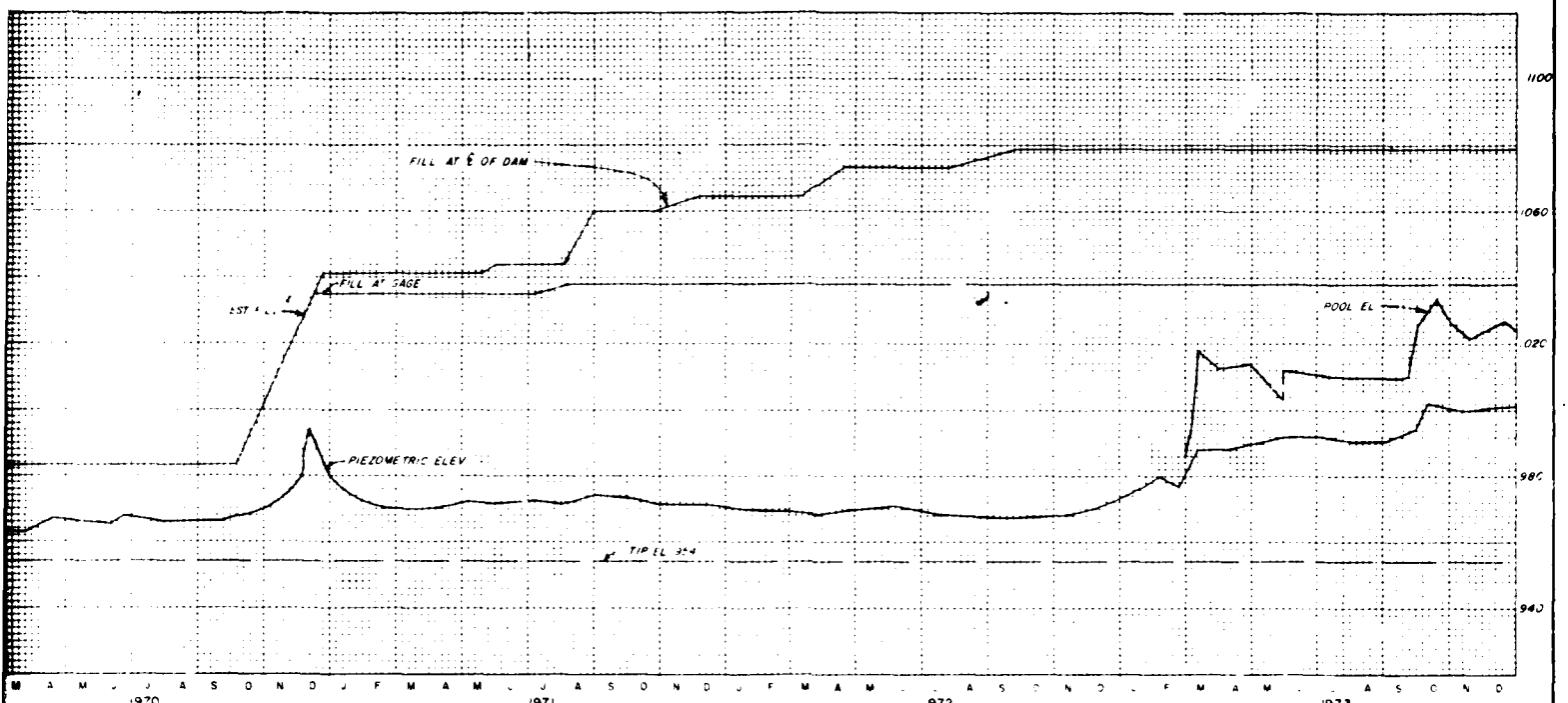
CORPS OF ENGINEERS, U. S. ARMY
KANSAS CITY DISTRICT

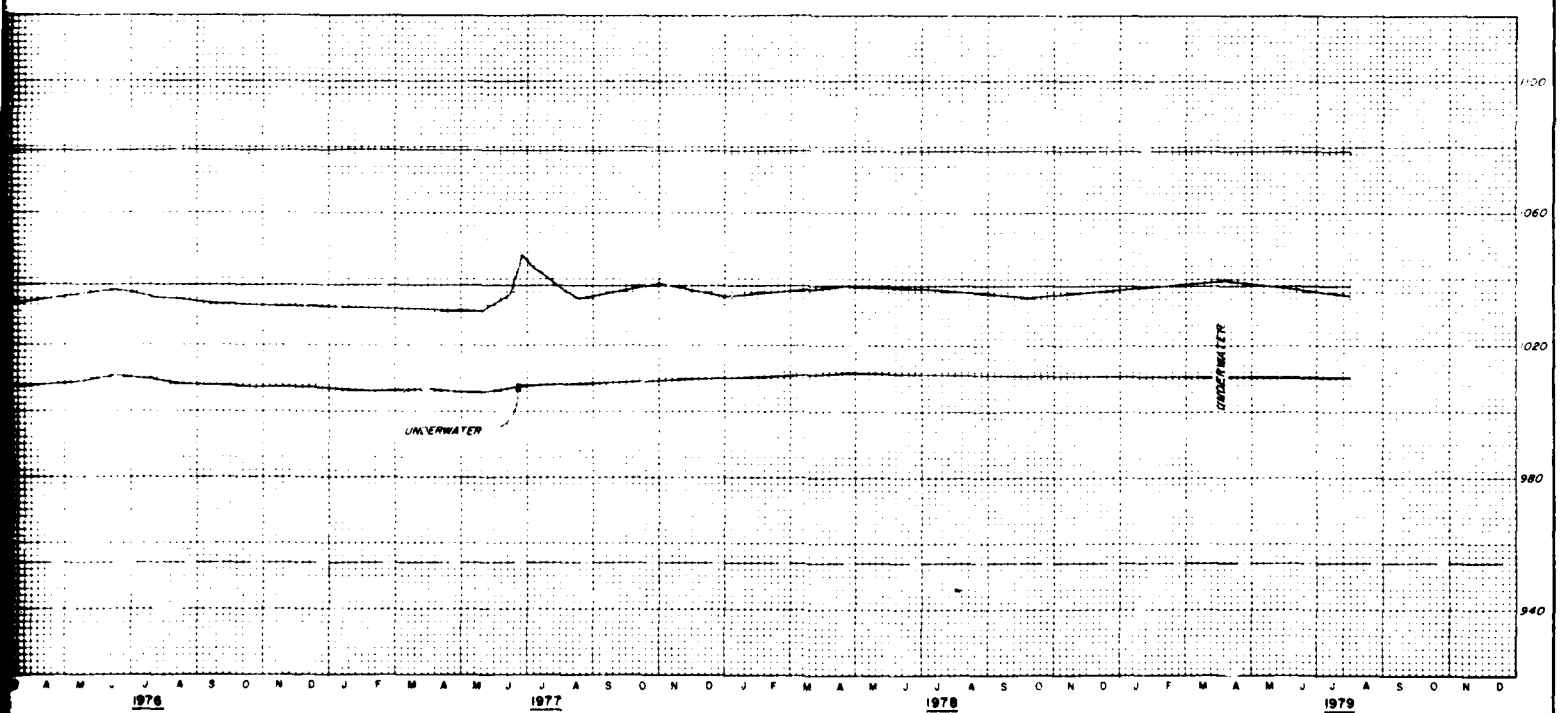
FILE NO. 0-5-1279

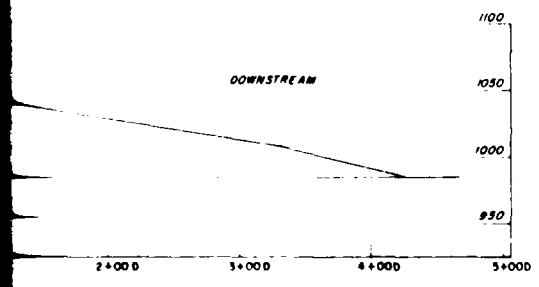
AUGUST 1975

2 PLATE NO 31


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1100
1060
1020
980
940
FILL AT E OF DAM
FILL AT GAGE
EST FILL
PIEZOMETRIC ELEV
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1968
1969
1970
1971
FILL AT E OF DAM
FILL AT GAGE
POOL EL
PIEZOMETRIC ELEV
UNDERWATER
TIP EL 954.0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1974
1975
1976
1977
1100
1050
1000
950
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1056.0
P2-54-3
5+000
4+000
3+000
2+000
1+000
0+00
1+000
2+000
3+000
4+000
5+000
STATION 54+00







LEGEND

OPEN TUBE . . . . . O

PNEUMATIC CELLS . . . . . ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS PZ-54-3 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

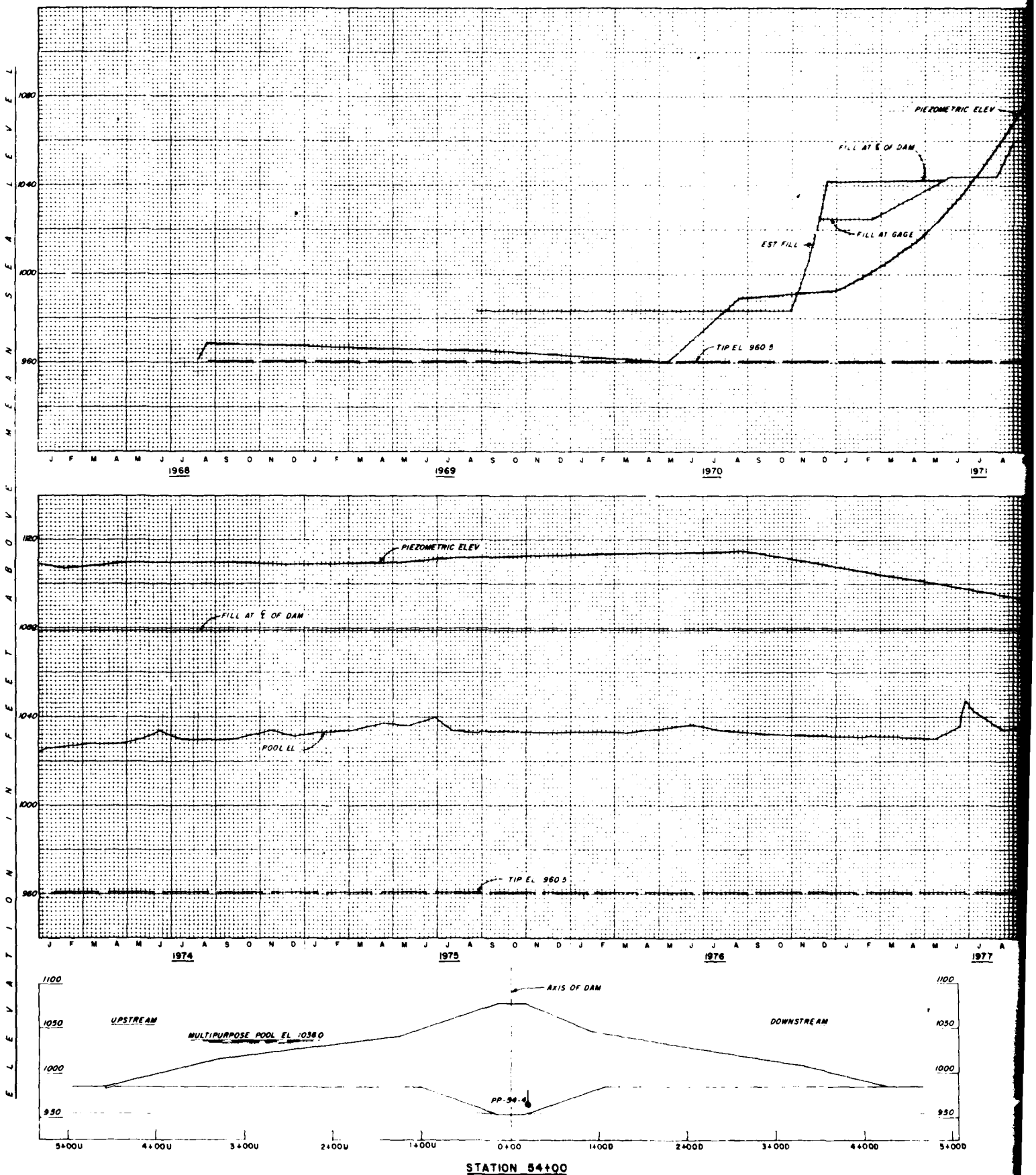
CORPS OF ENGINEERS U. S. ARMY

KANSAS CITY DISTRICT

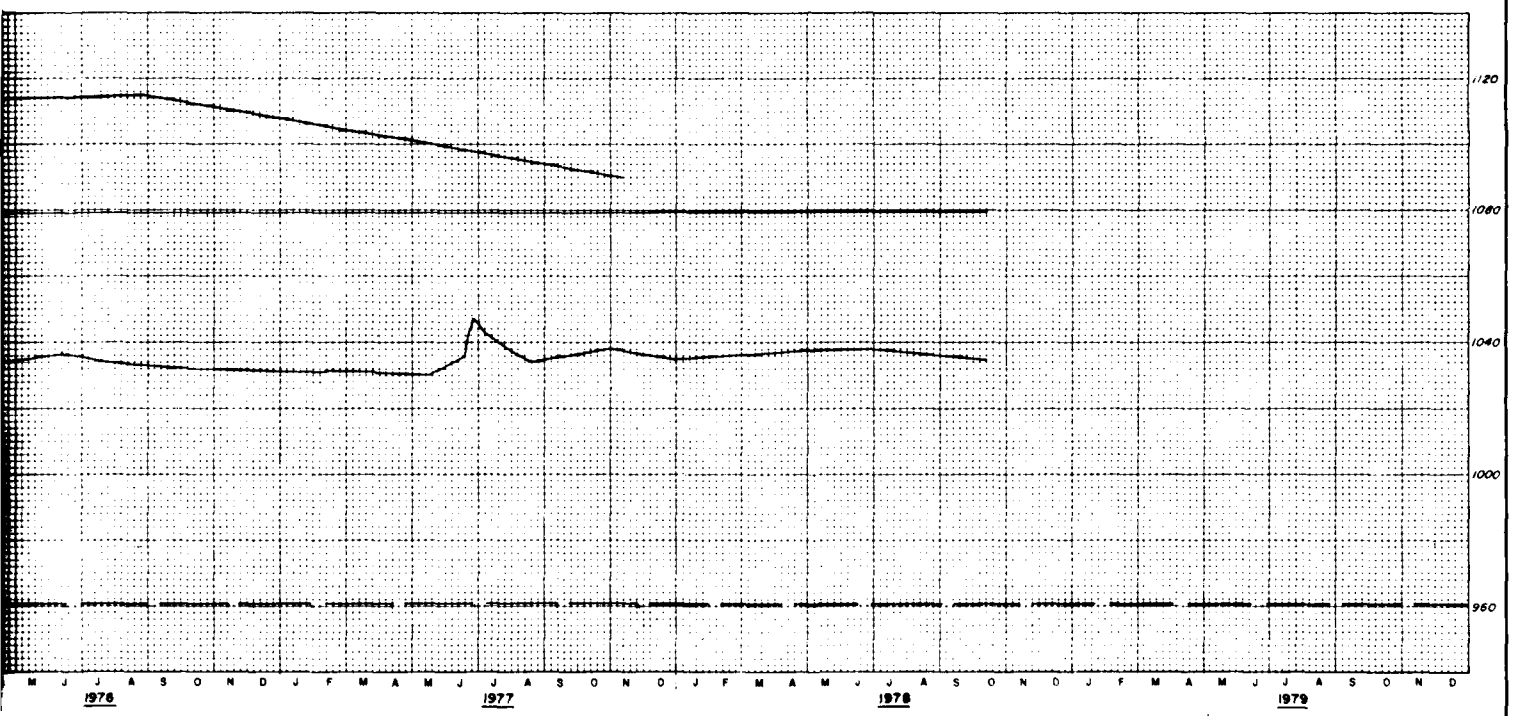
FILE NO. 0-5-1280

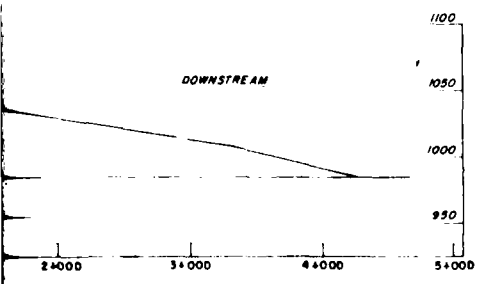
AUGUST 1975

PLATE NO 32



STATION 54+00





LEGEND

OPEN TUBE _ _ _ _ _ _ _ _ O
PNEUMATIC CELL _ _ _ _ _ ●

Revised August 1976

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

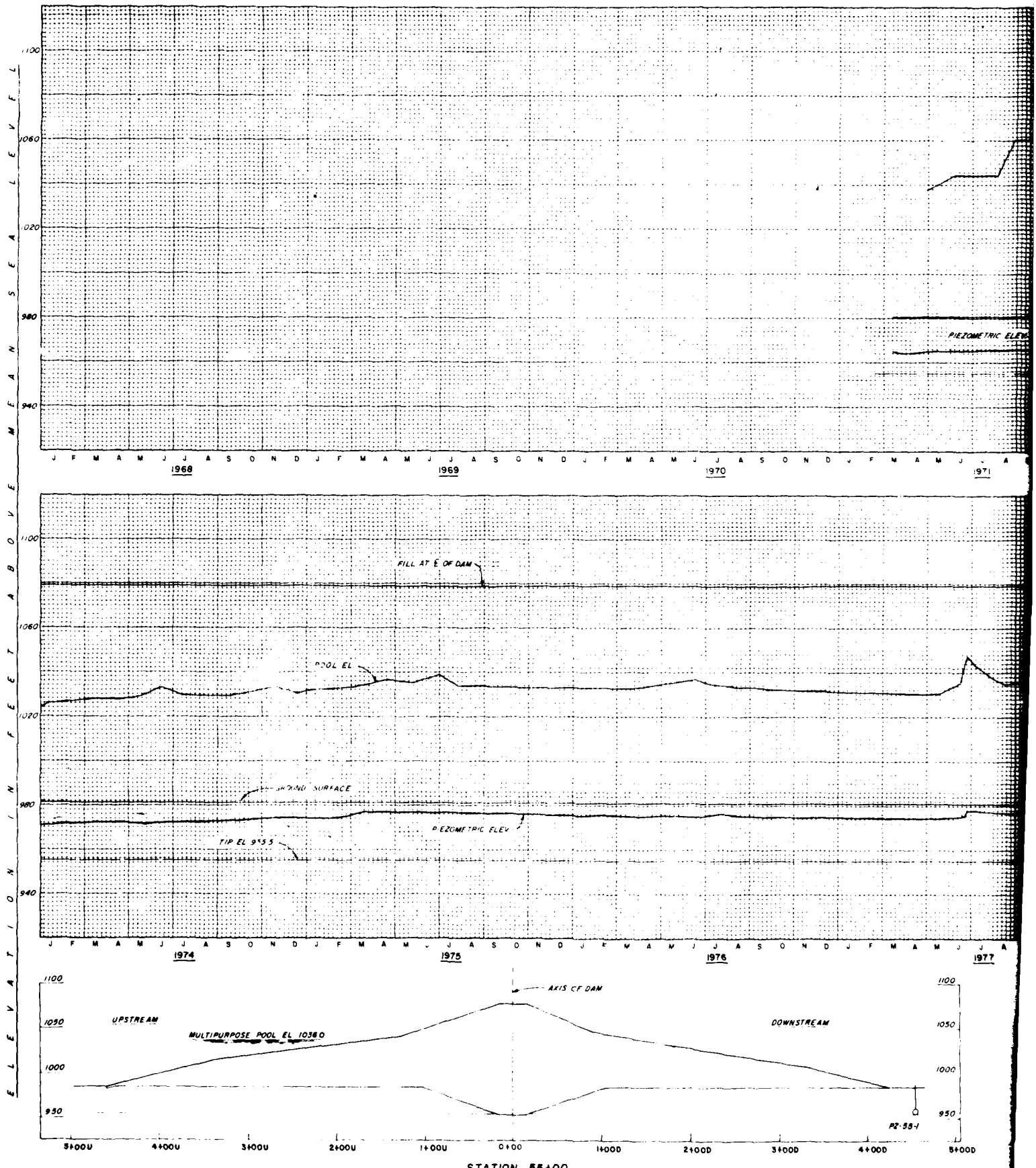
INSTRUMENTATION
PP-54-4 (SHANNON-WILSON CELL)

In 1 sheet | Sheet No. 1 | Scale as shown

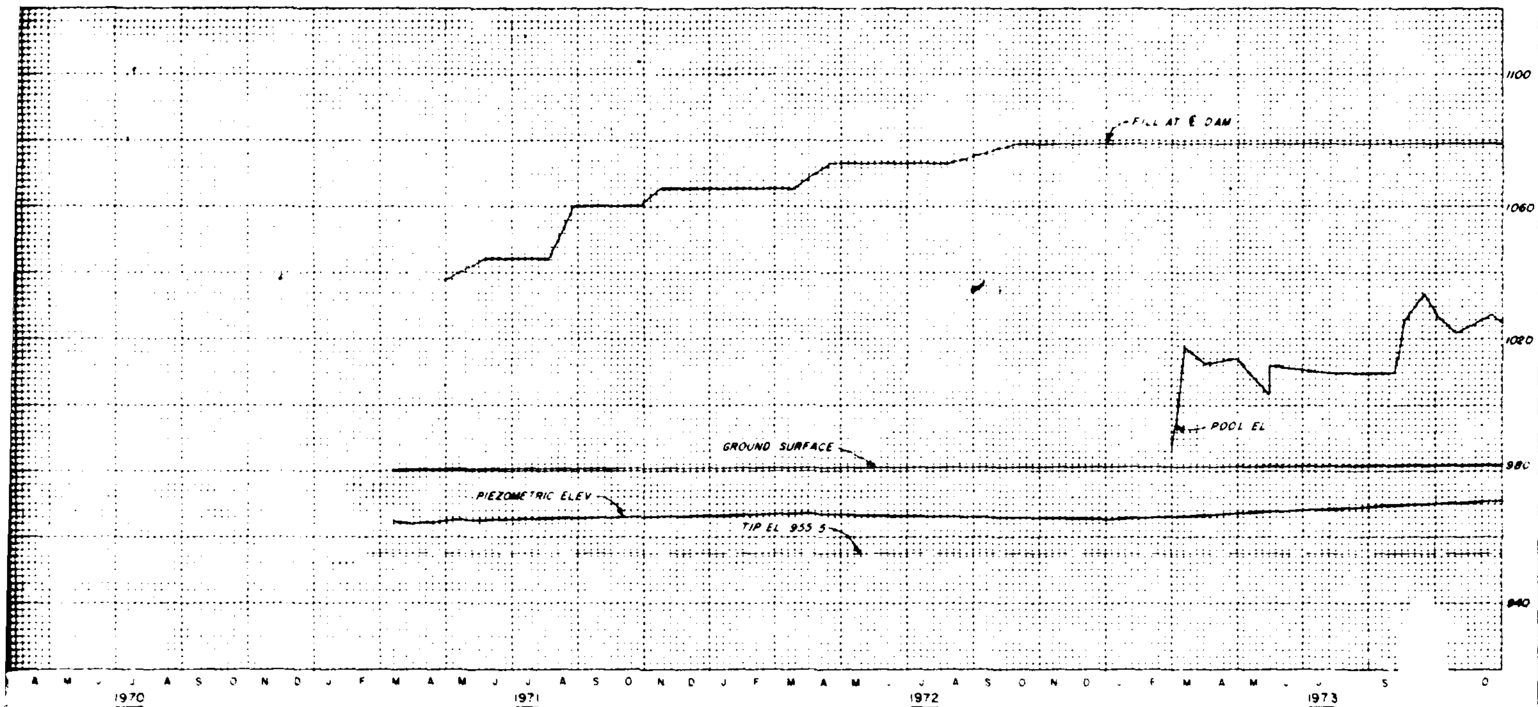
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

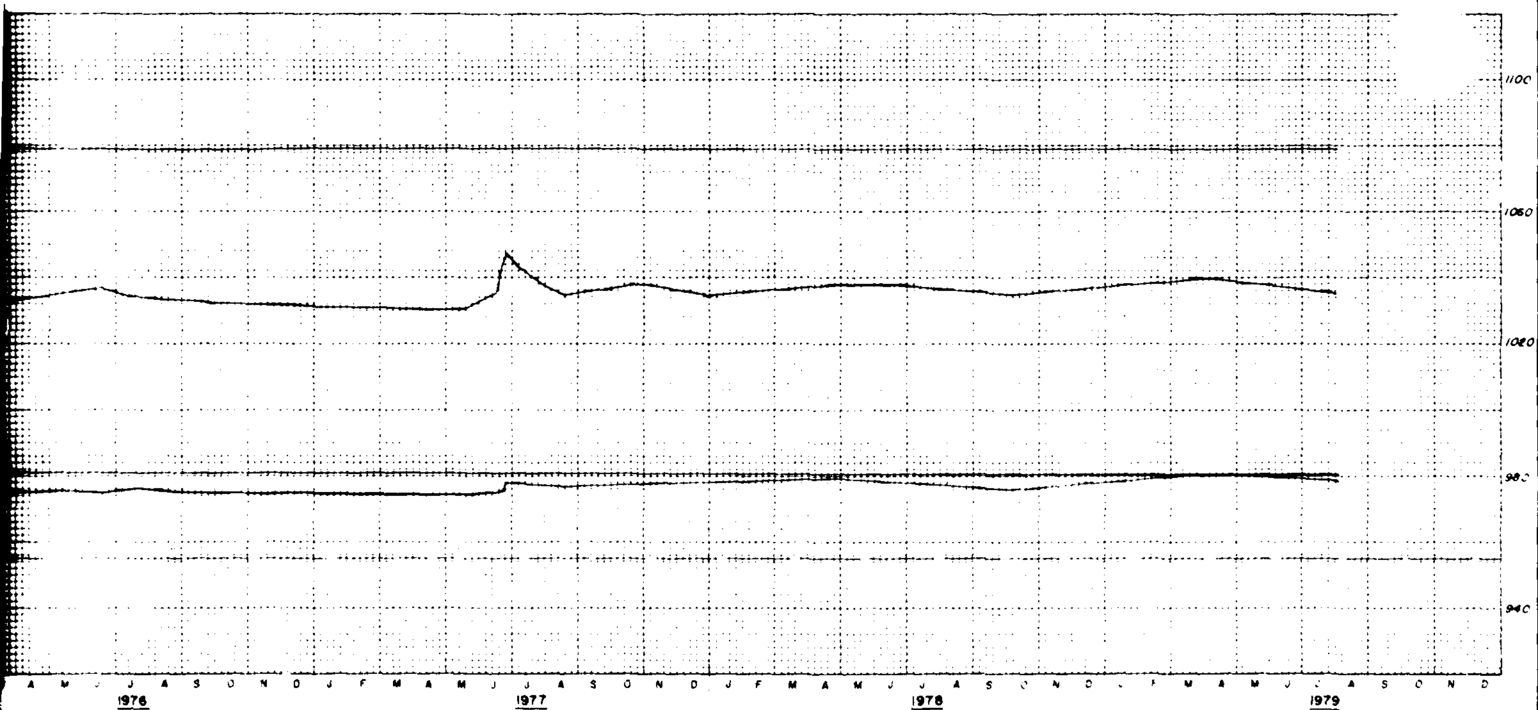
FILE NO. 0-5-1281
AUGUST 1975

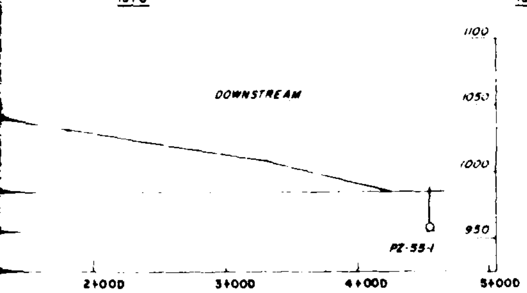
2 PLATE NO. 33



STATION 55+00







LEGEND

OPEN TUBE .... o
PNEUMATIC CELL .... •

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

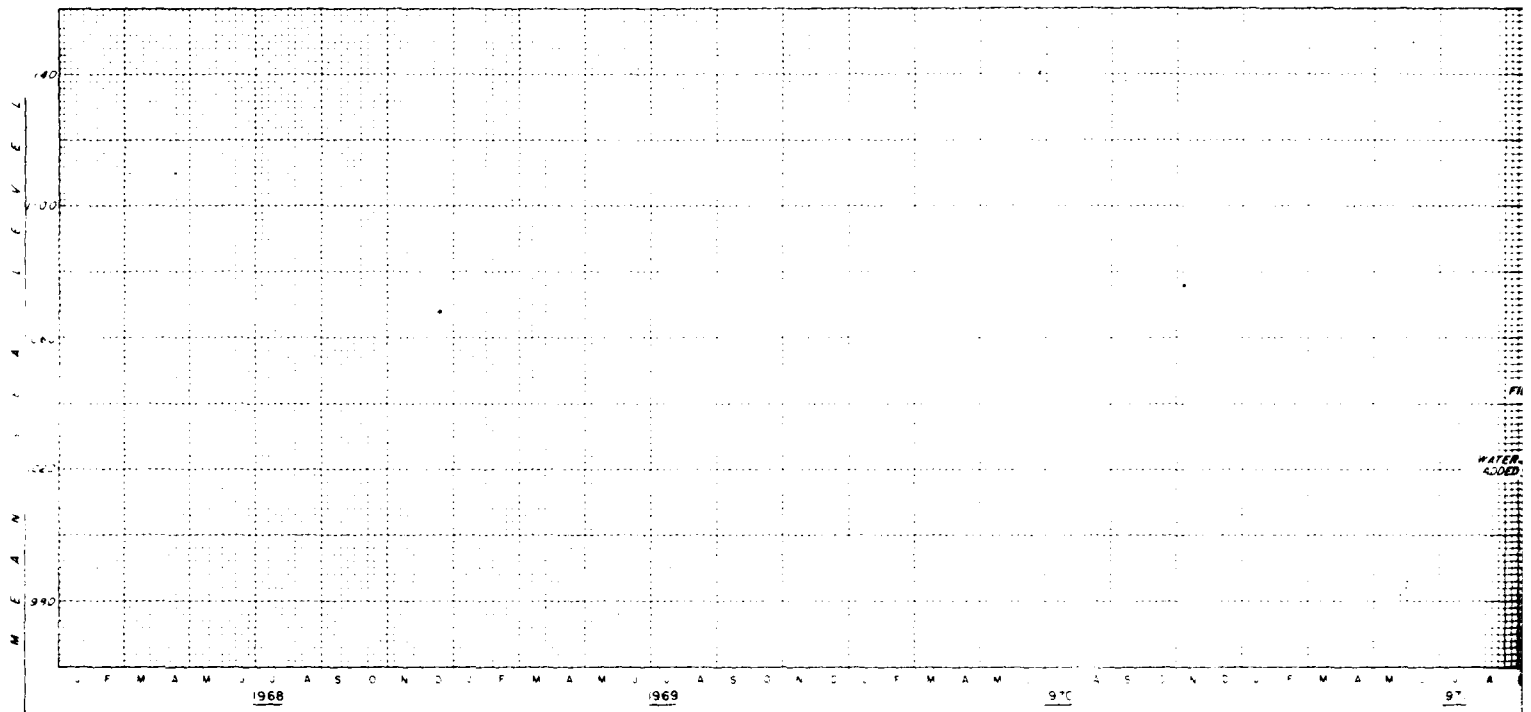
INSTRUMENTATION PLOTS
PZ-55-1 (OPEN TUBE)

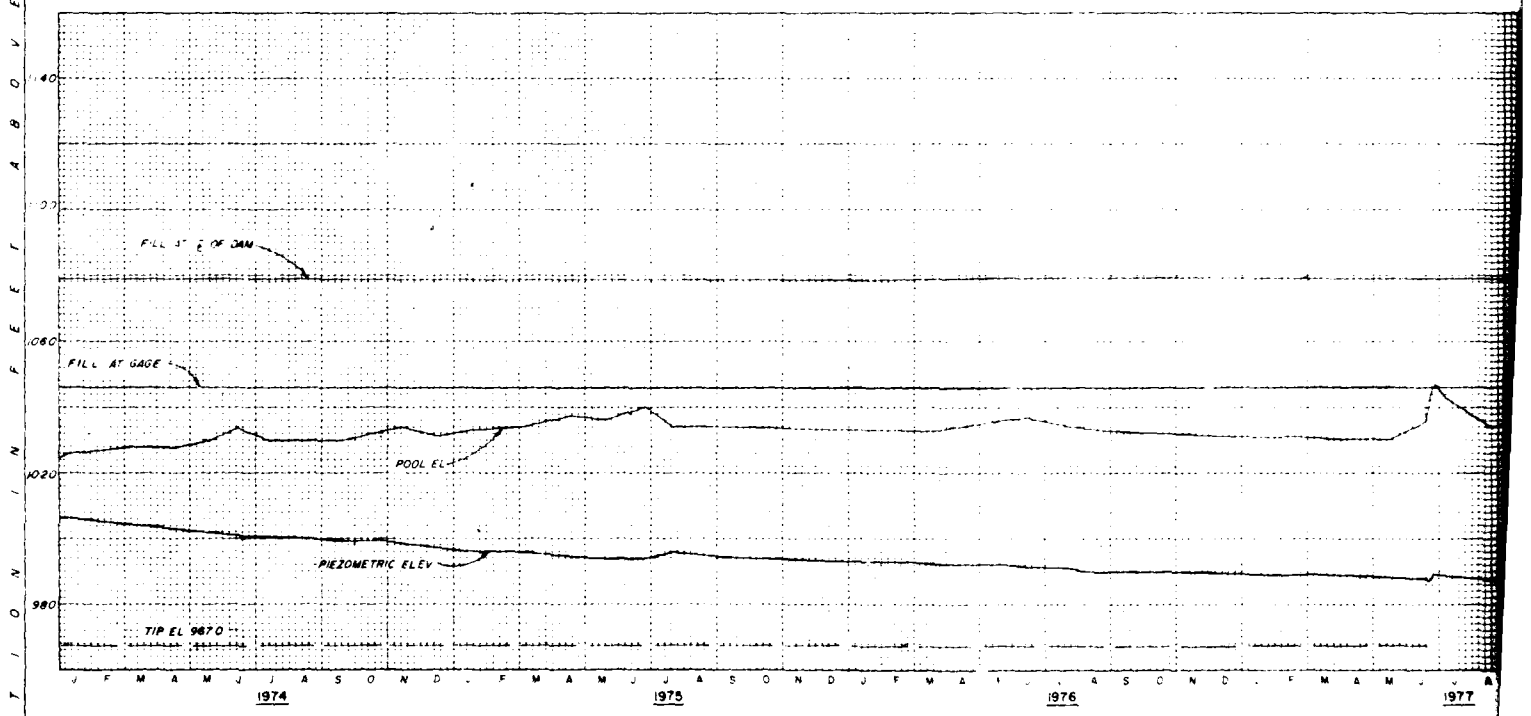
In 1 sheet | Sheet No. 1 | Scale as shown

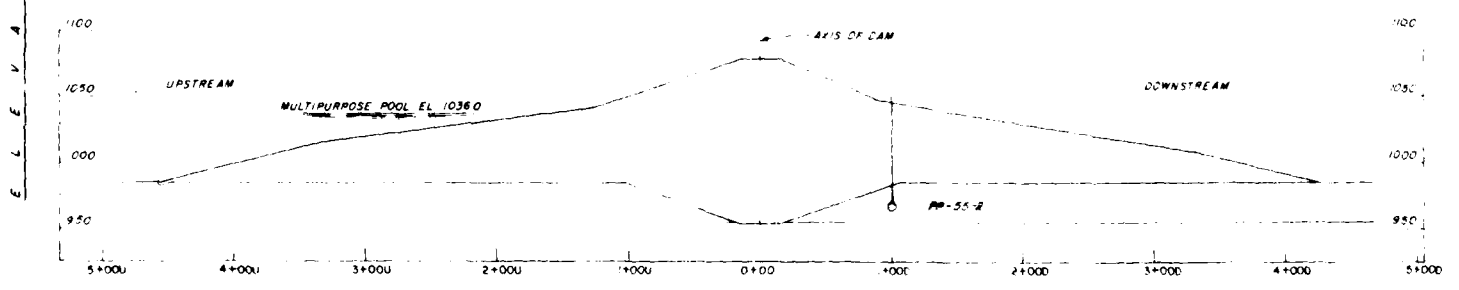
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1282
AUGUST 1975

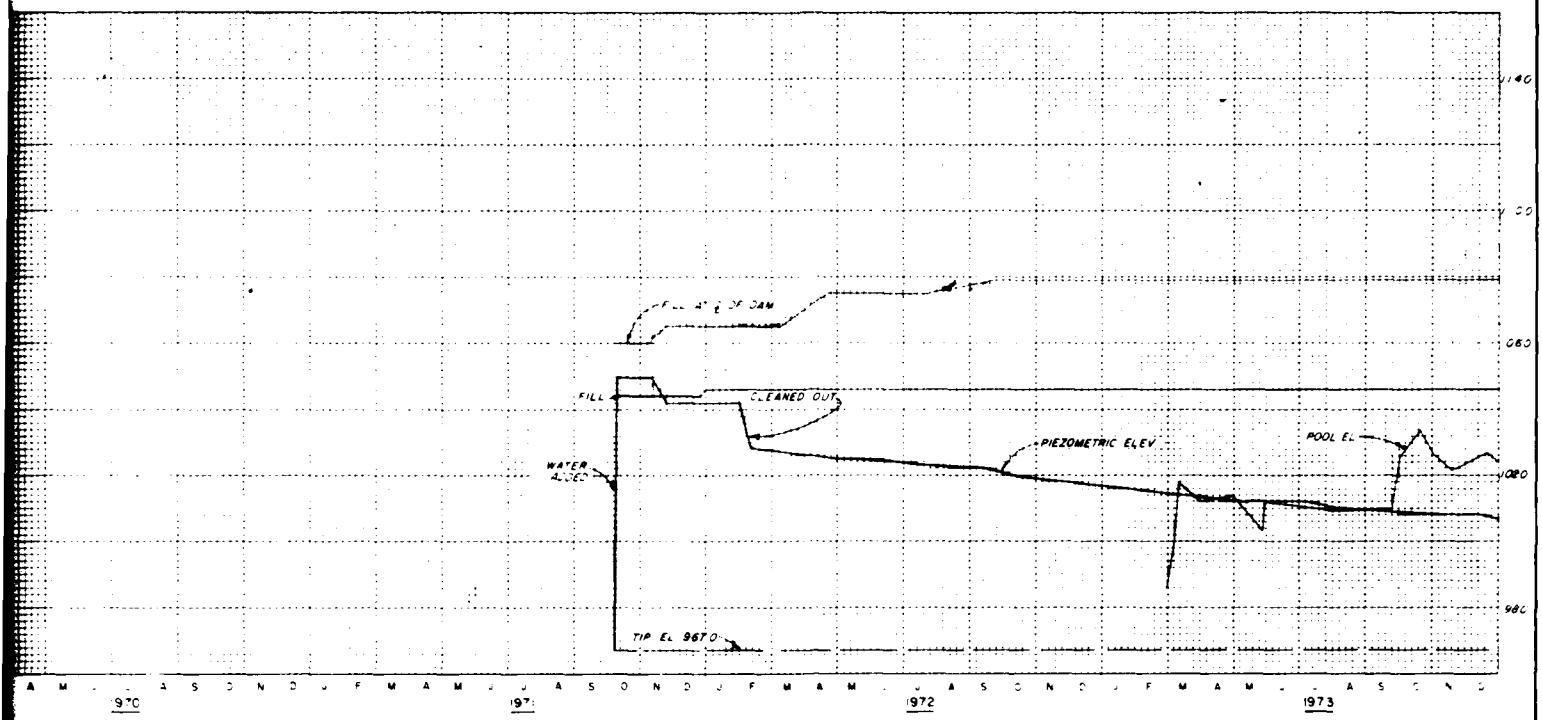
PLATE NO 34

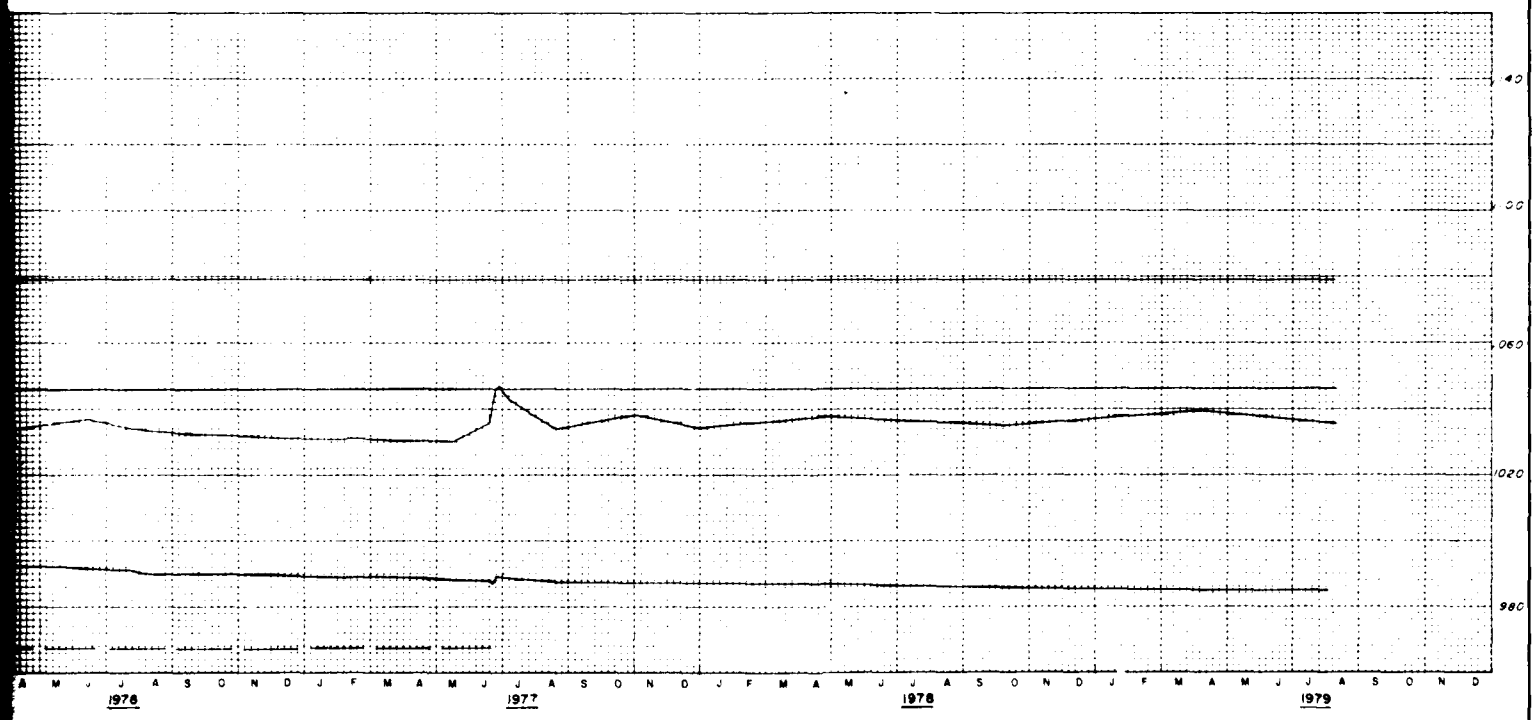


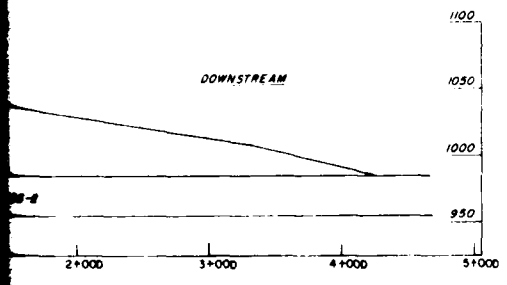




STATION 54+50







LEGEND

OPEN TUBE ----------○

PNEUMATIC CELL ----------●

Revised August 1975

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-55-2 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

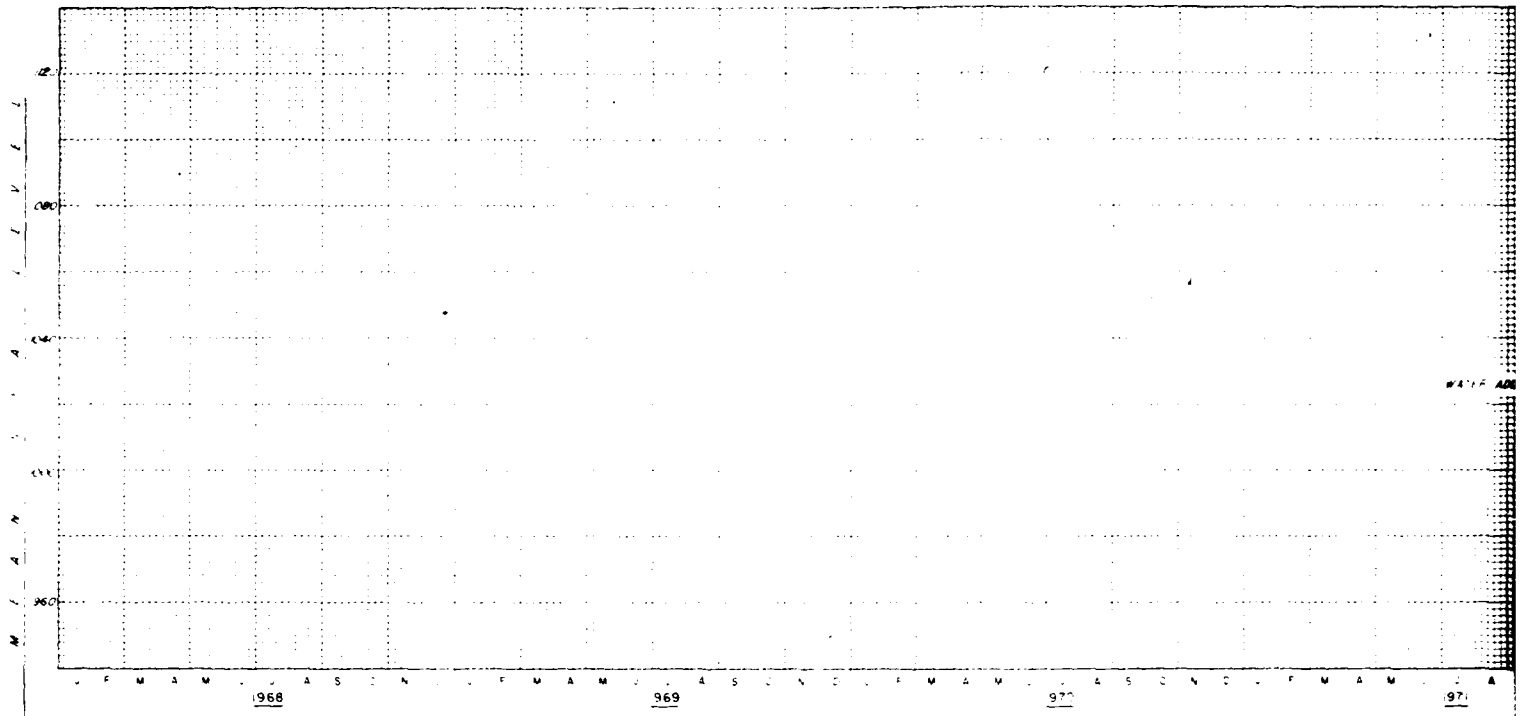
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

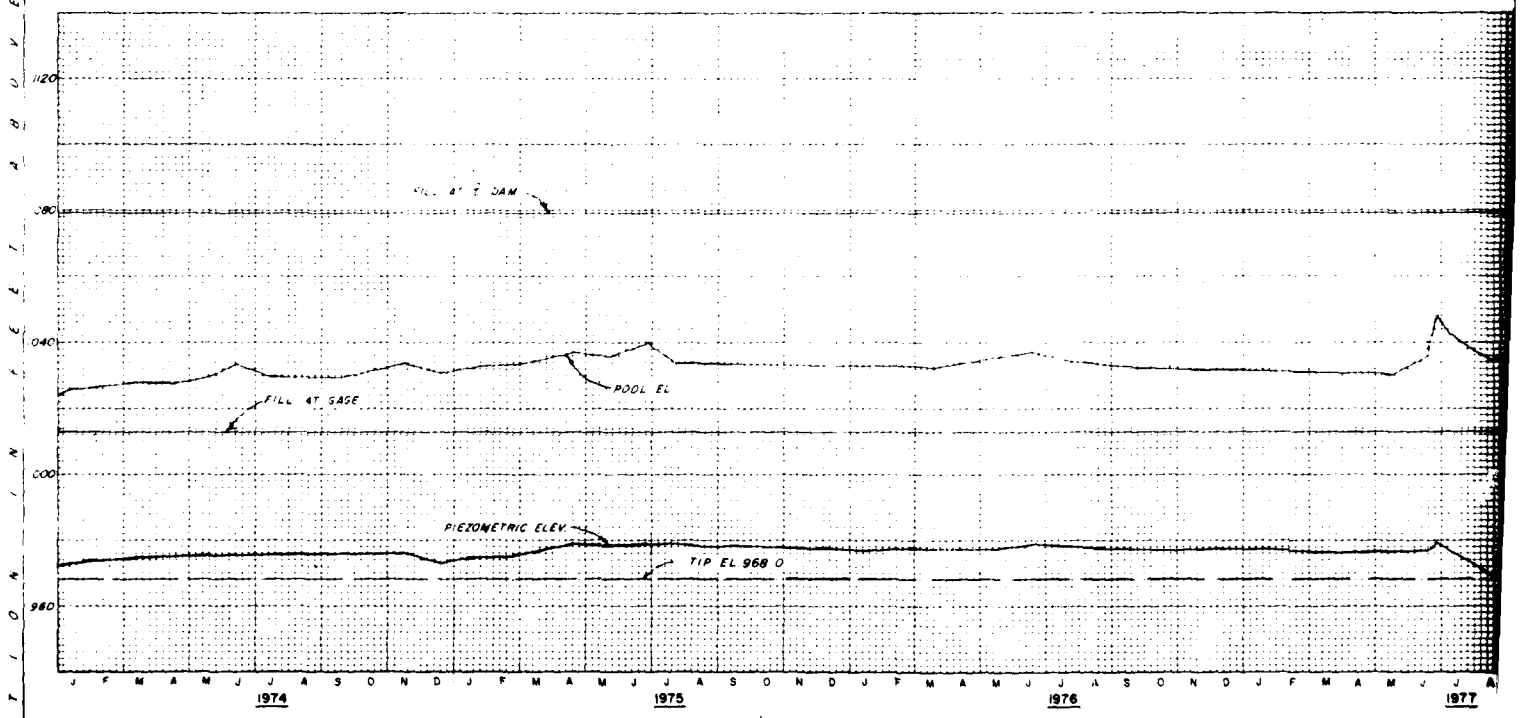
FILE NO. 0-5-1283

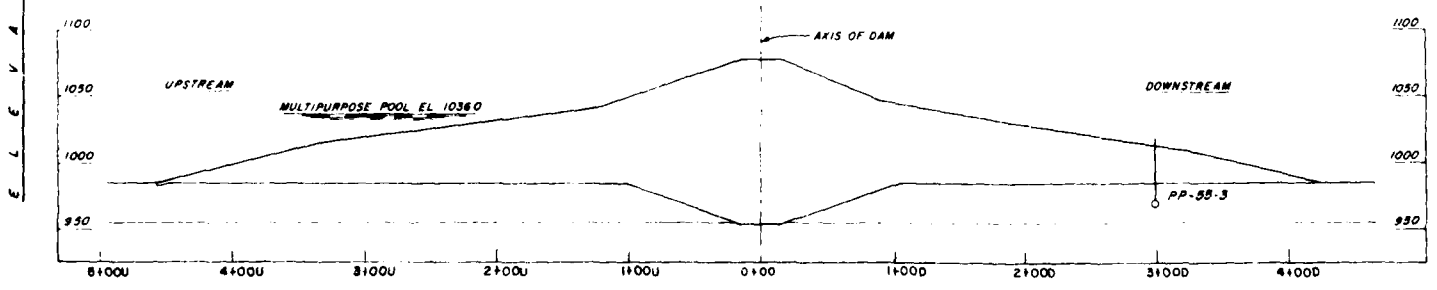
AUGUST 1975

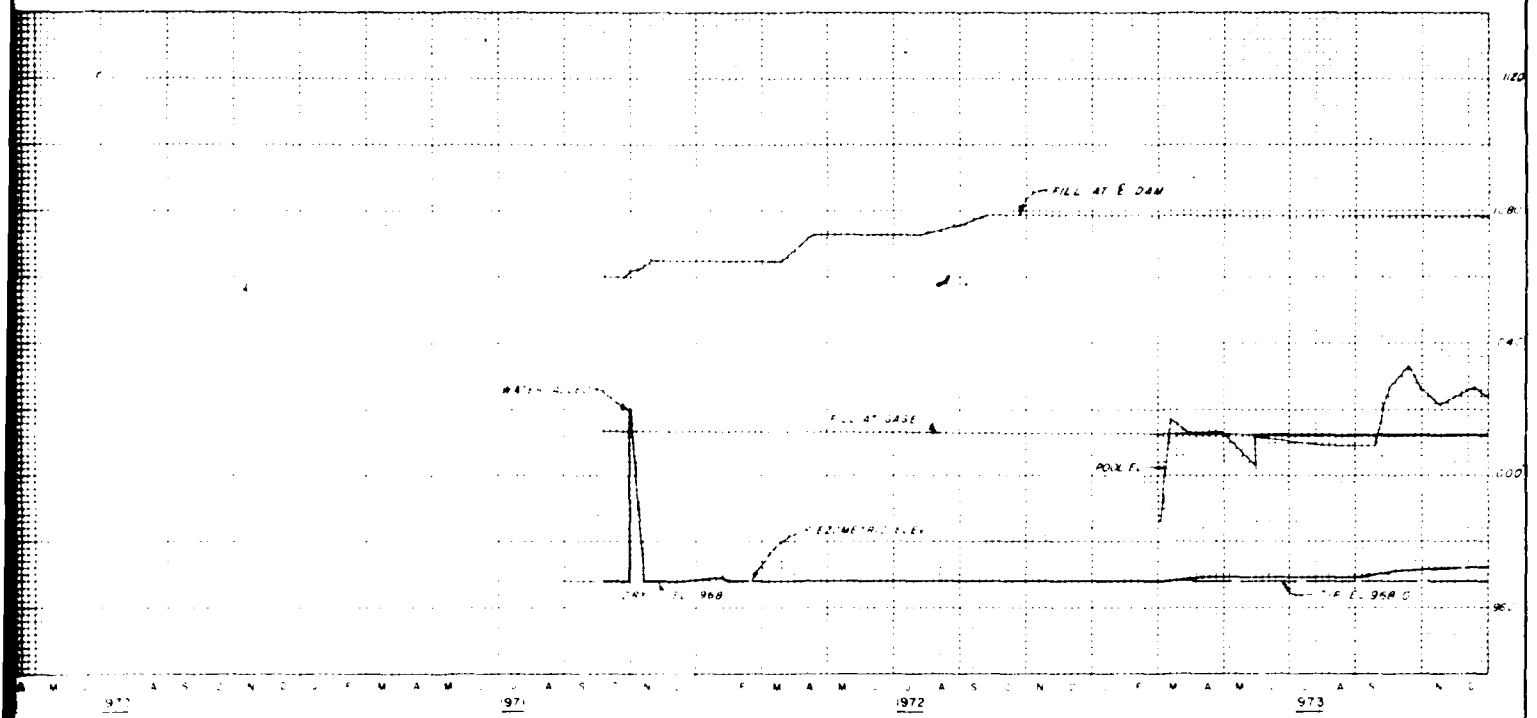
2

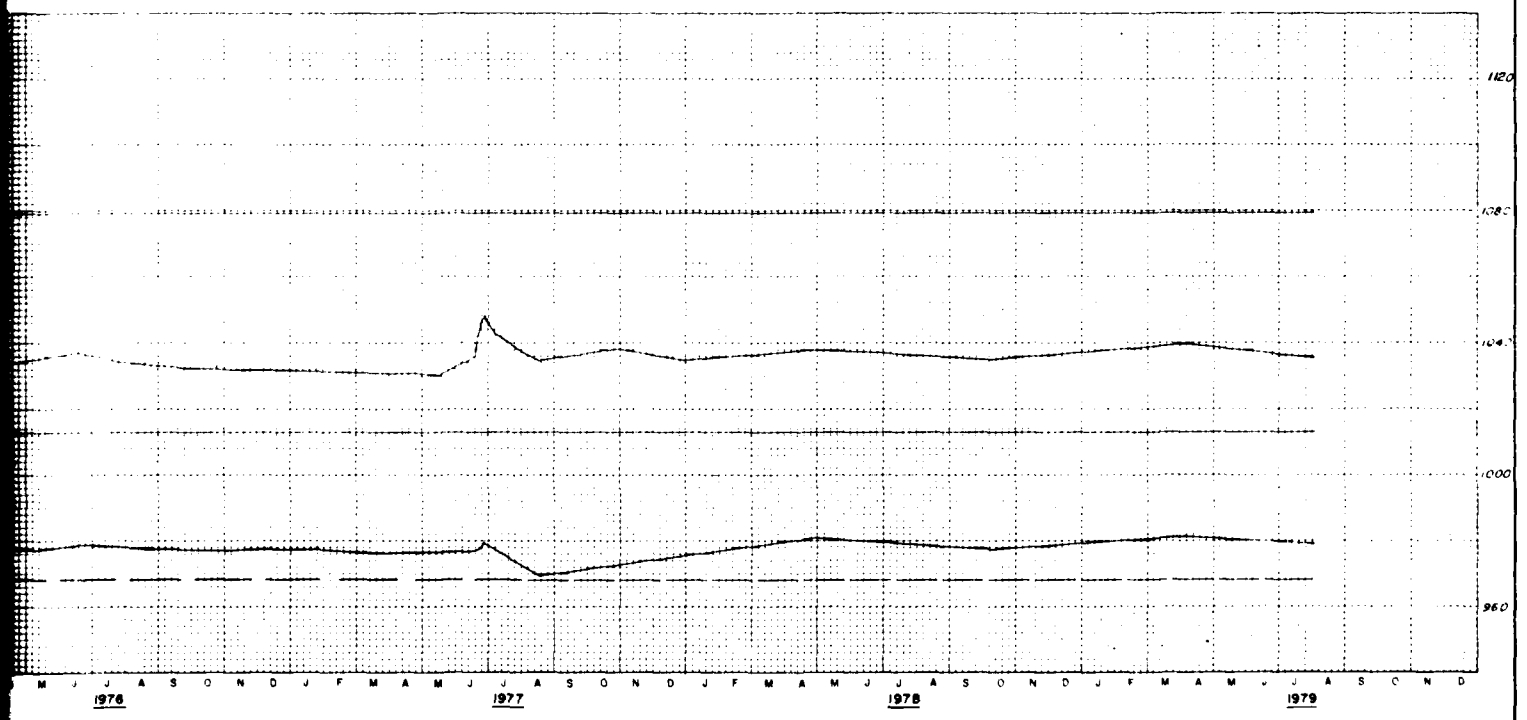
PLATE NO. 35

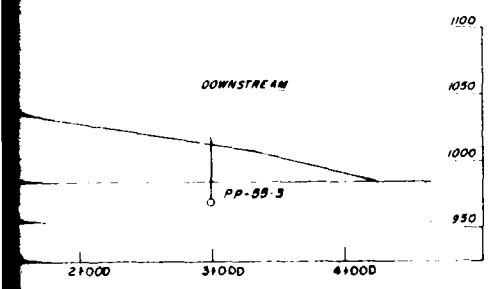

ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1120
1080
1040
1000
960
1968
1969
1971


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1120
1080
1040
1000
960
FILL AT DAM
POOL EL
FILL AT GAGE
PIEZOMETRIC ELEV.
TIP EL 968.0
1974
1975
1976
1977


ELEVATION
1100
1050
1000
950
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-58-3
5+00U
4+00U
3+00U
2+00U
1+00U
0+00
1+00D
2+00D
3+00D
4+00D







LEGEND

OPEN TUBE ----------o

PNEUMATIC CELL----------●

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP55-3 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U.S. ARMY

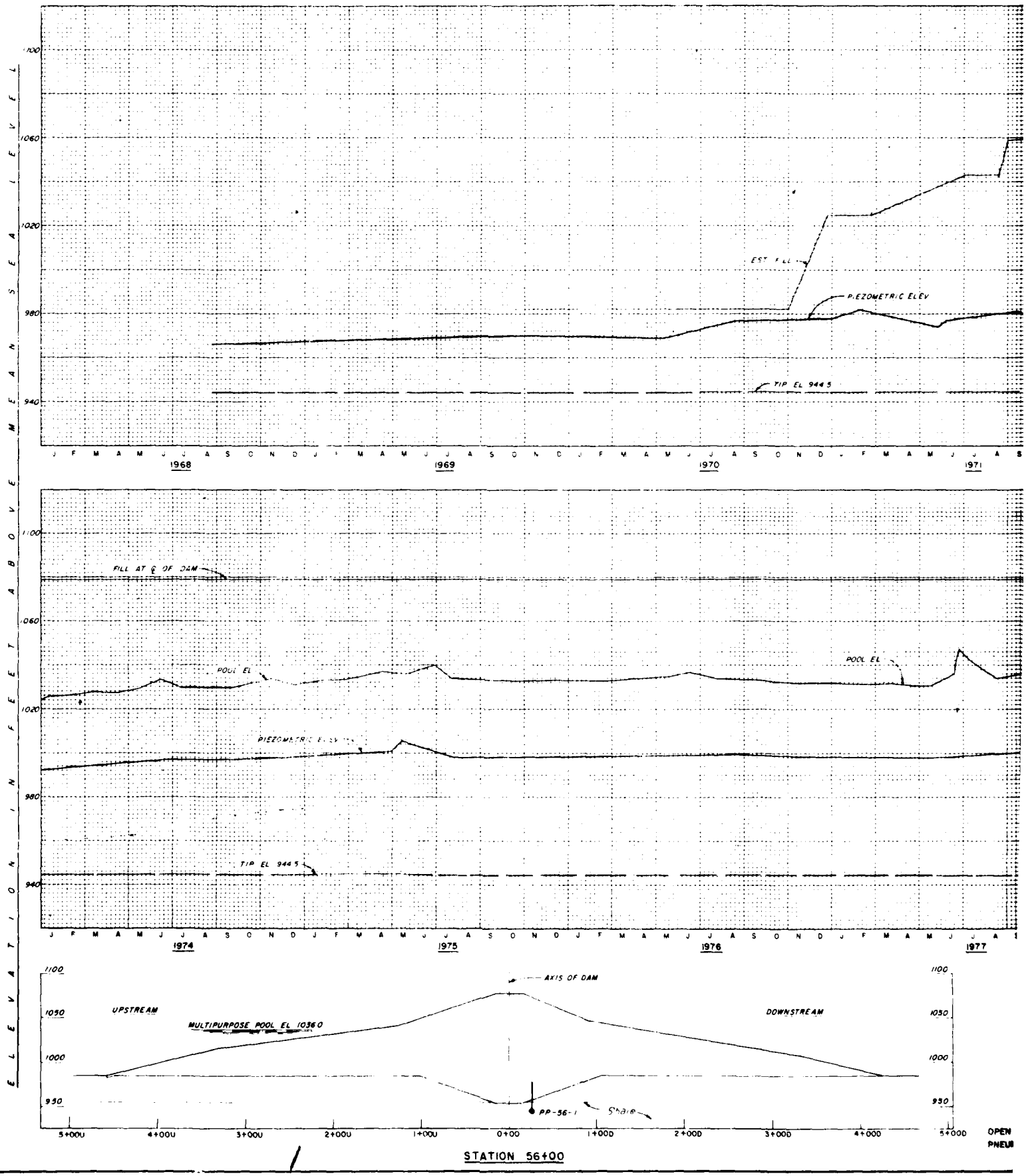
KANSAS CITY DISTRICT

FILE NO 0-5-1284

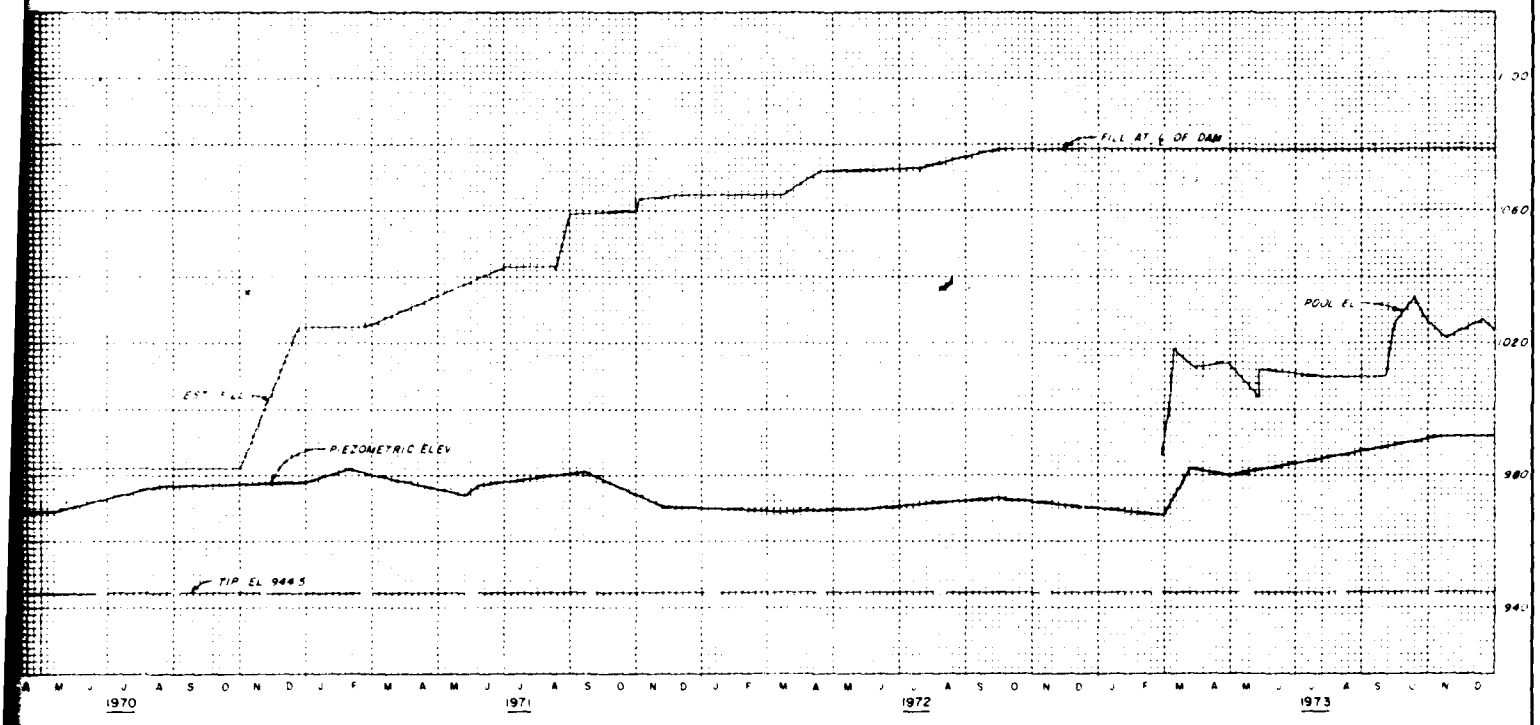
AUGUST 1975

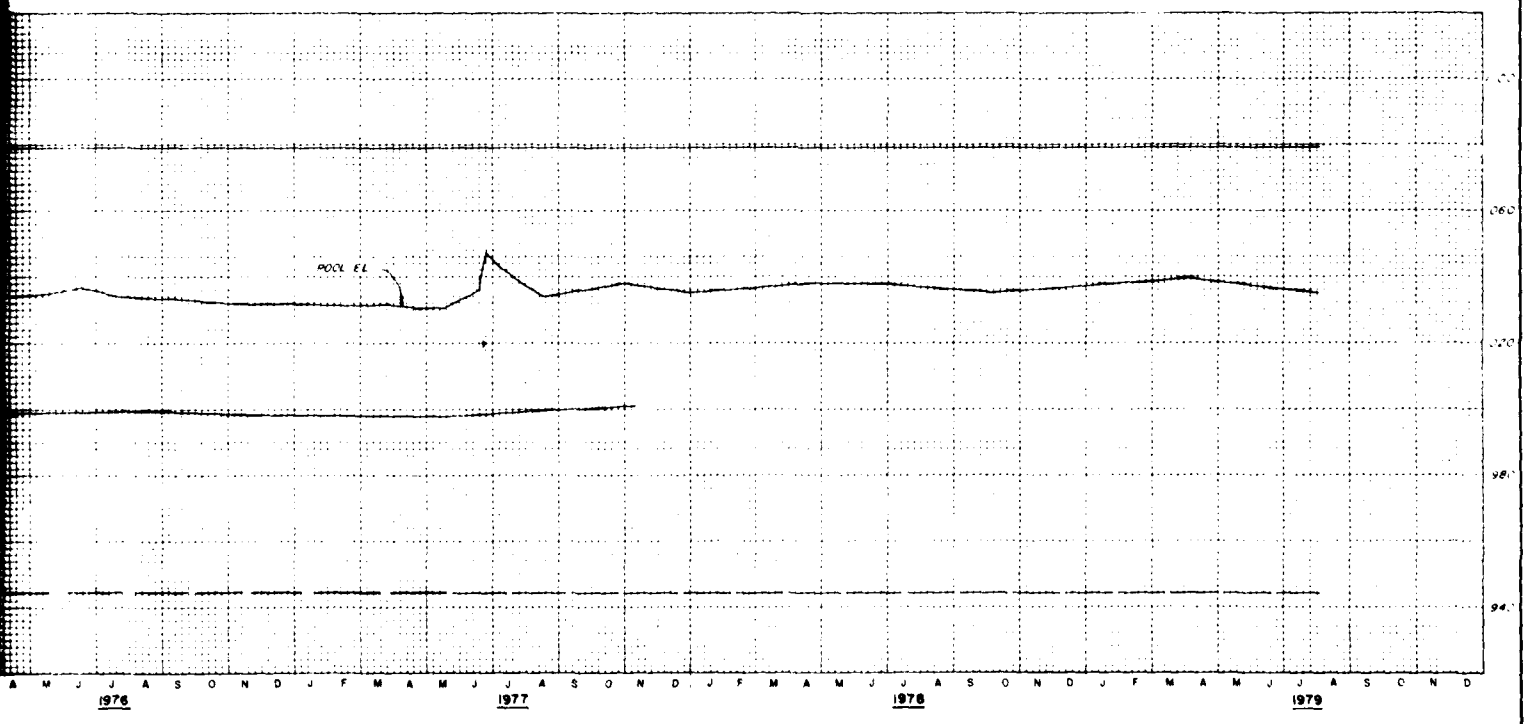
2

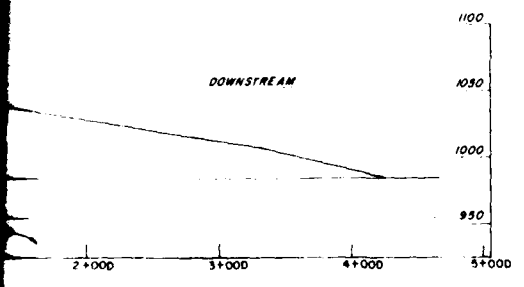
PLATE NO. 36



STATION 56+00







LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-56-1 (SHANNON-WILSON CELL)

In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY

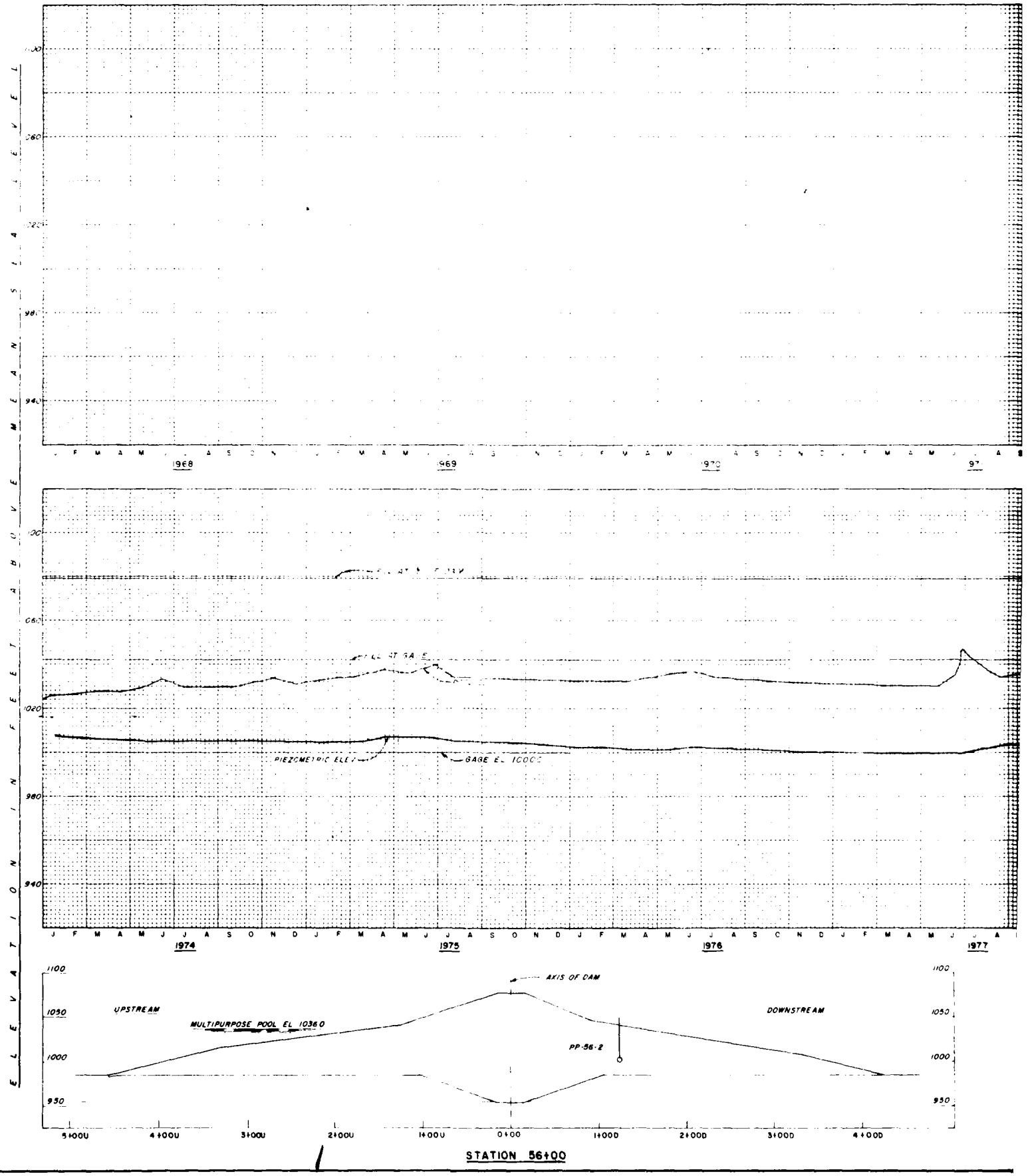
KANSAS CITY DISTRICT

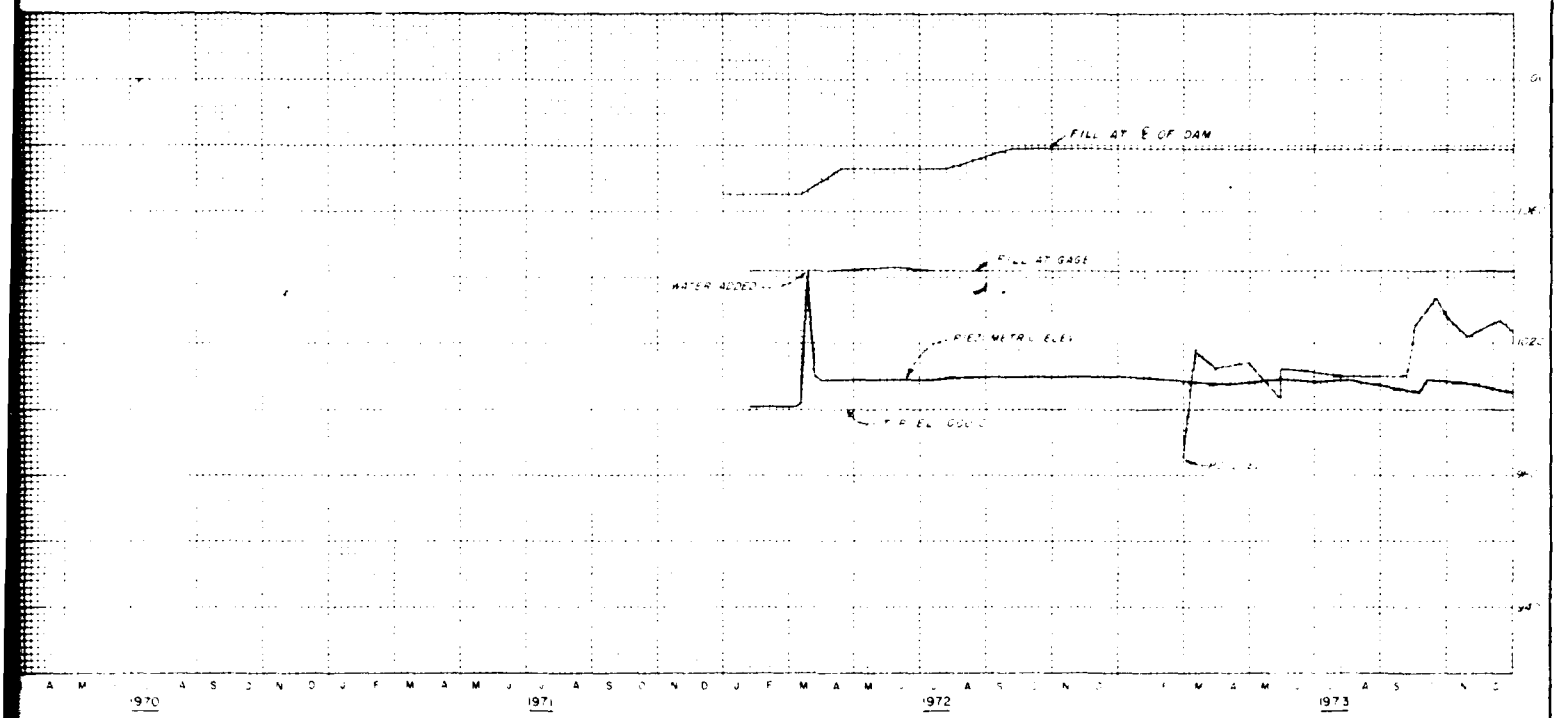
FILE NO. 0-5-1285

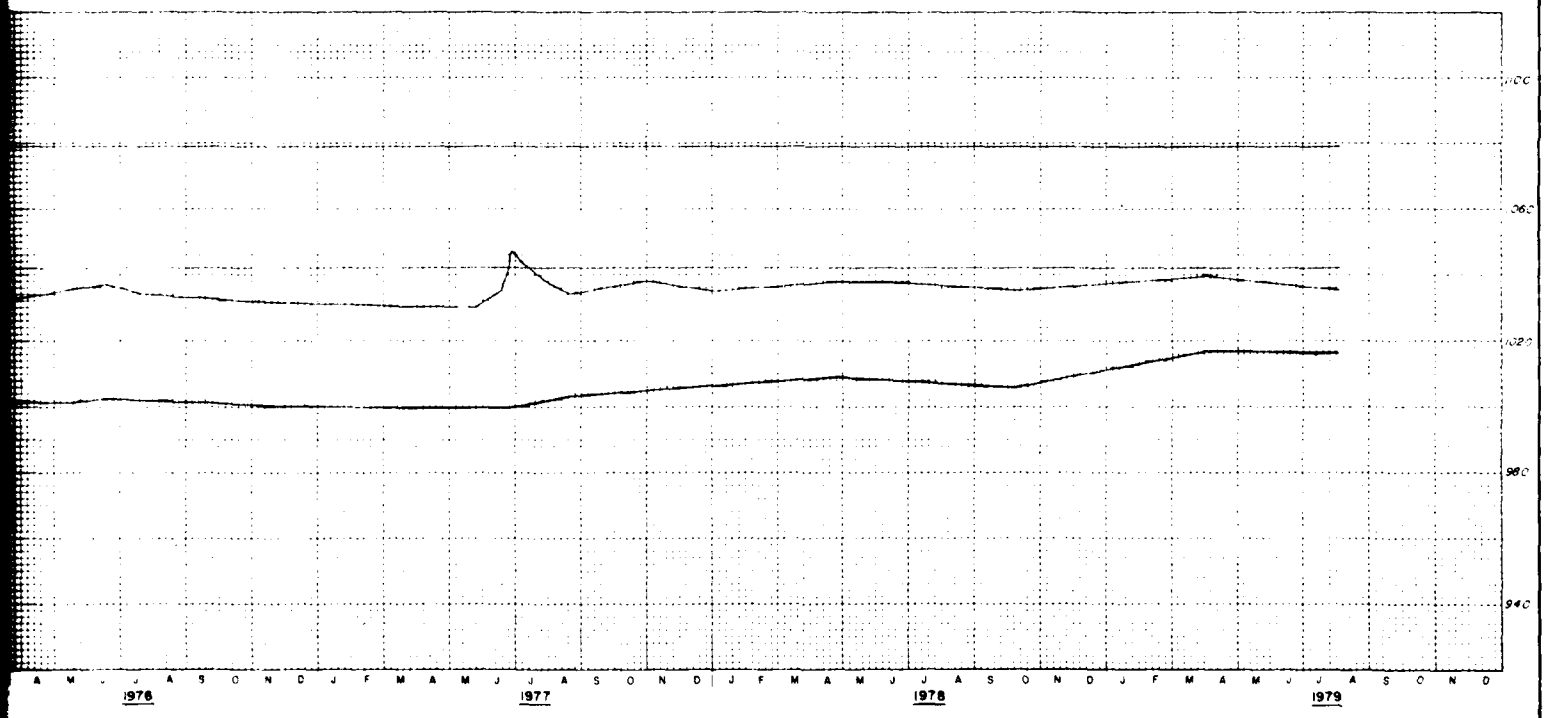
AUGUST 1975

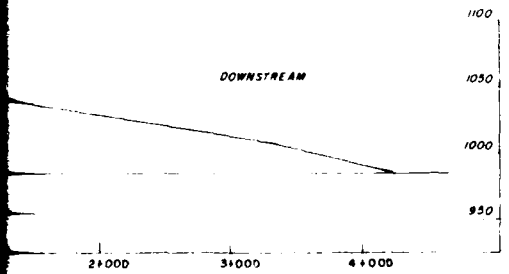
2

PLATE NO. 37


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1060
1020
980
940
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1968
1969
1970
1971
1100
1050
1000
950
PIEZOMETRIC ELEV.
GAGE EL. 1000
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1974
1975
1976
1977
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-56-2
5+00U
4+00U
3+00U
2+00U
1+00U
0+00
1+00D
2+00D
3+00D
4+00D
STATION 56+00







LEGEND

OPEN TUBE ..... o

PNEUMATIC CELL ..... ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-56-2 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

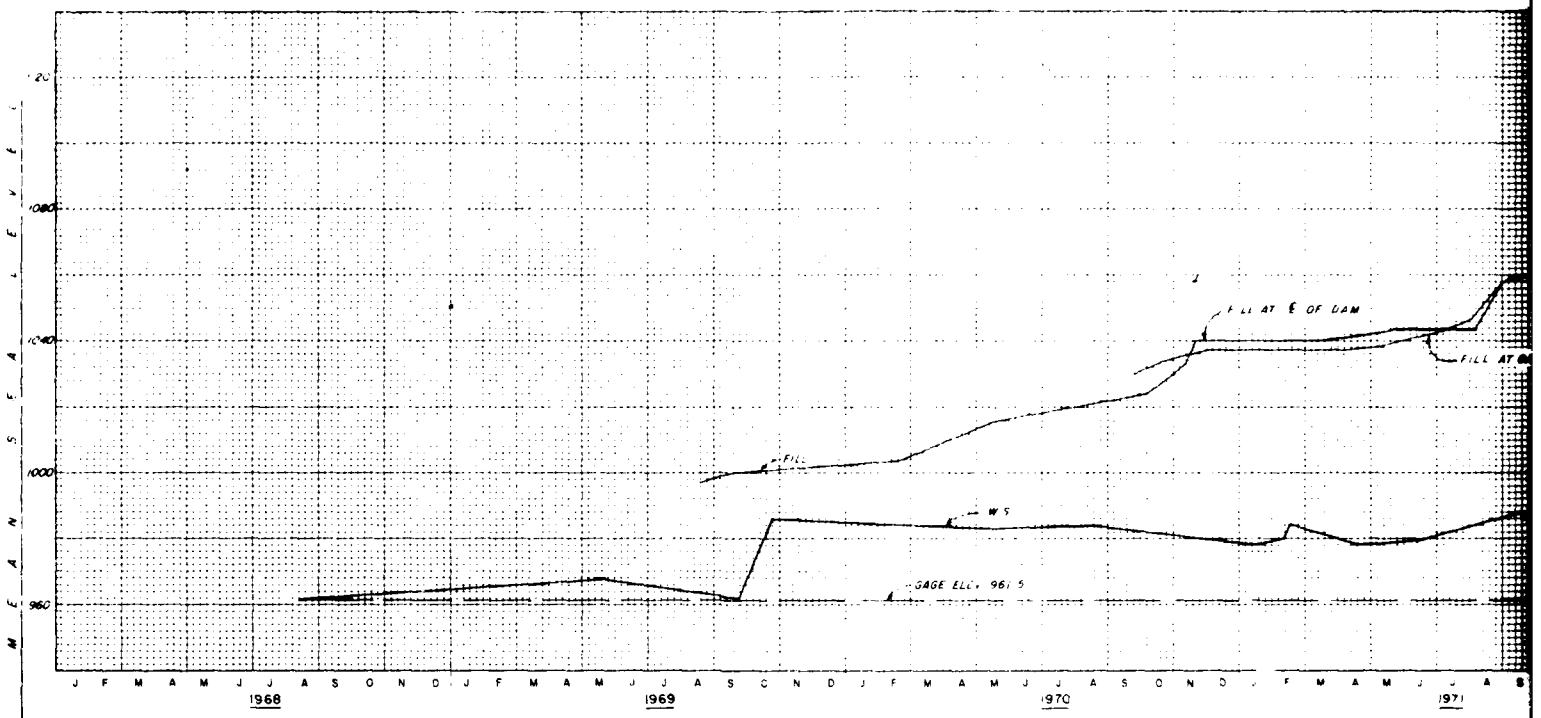
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

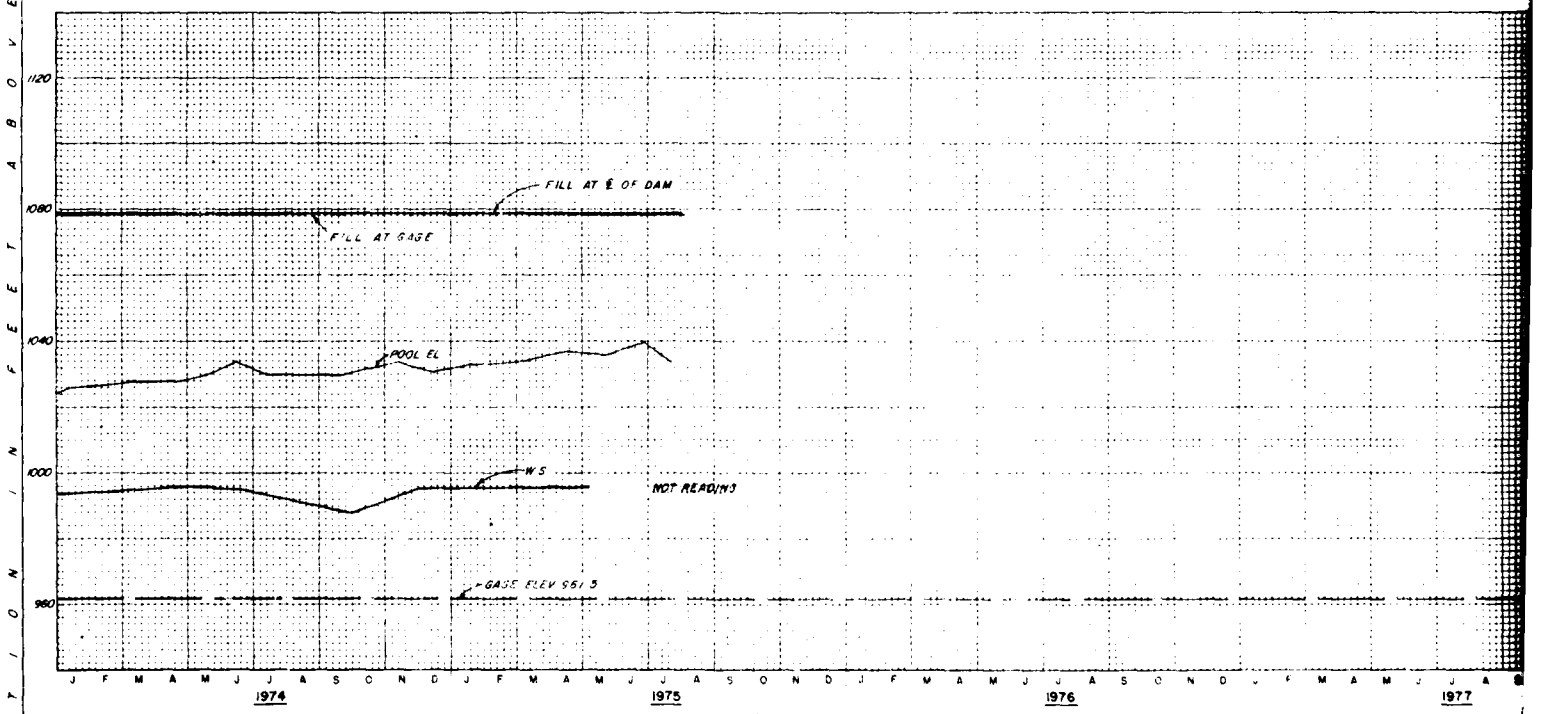
FILE NO 0-5-1286

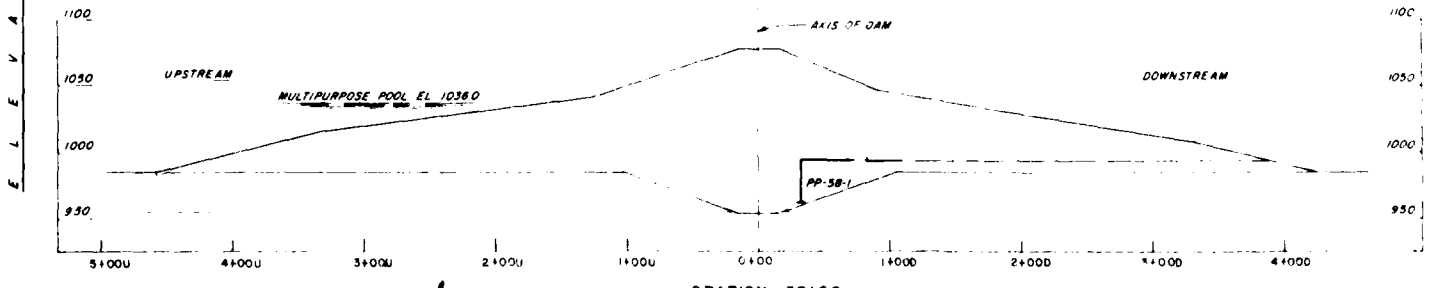
AUGUST 1975

2

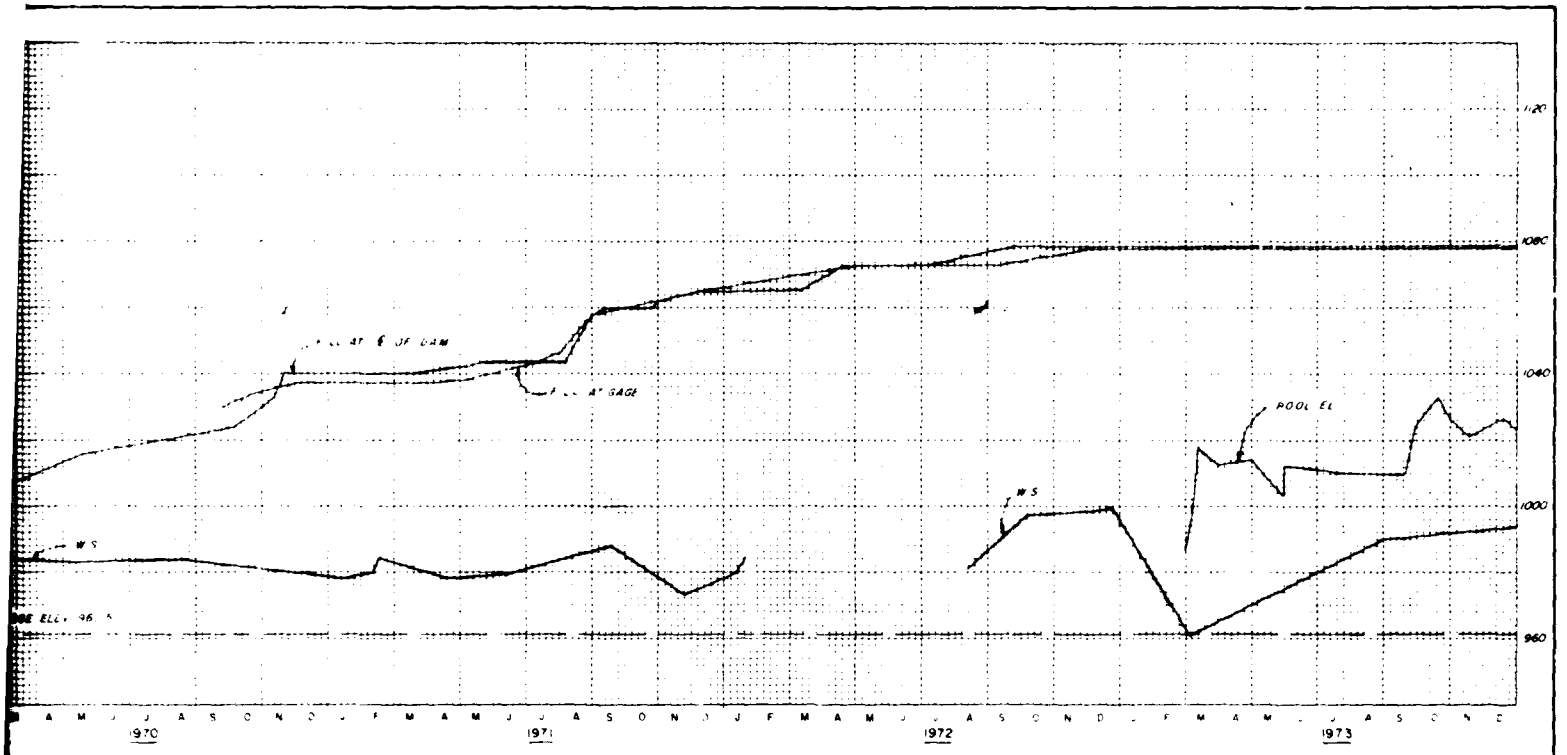
PLATE NO 38

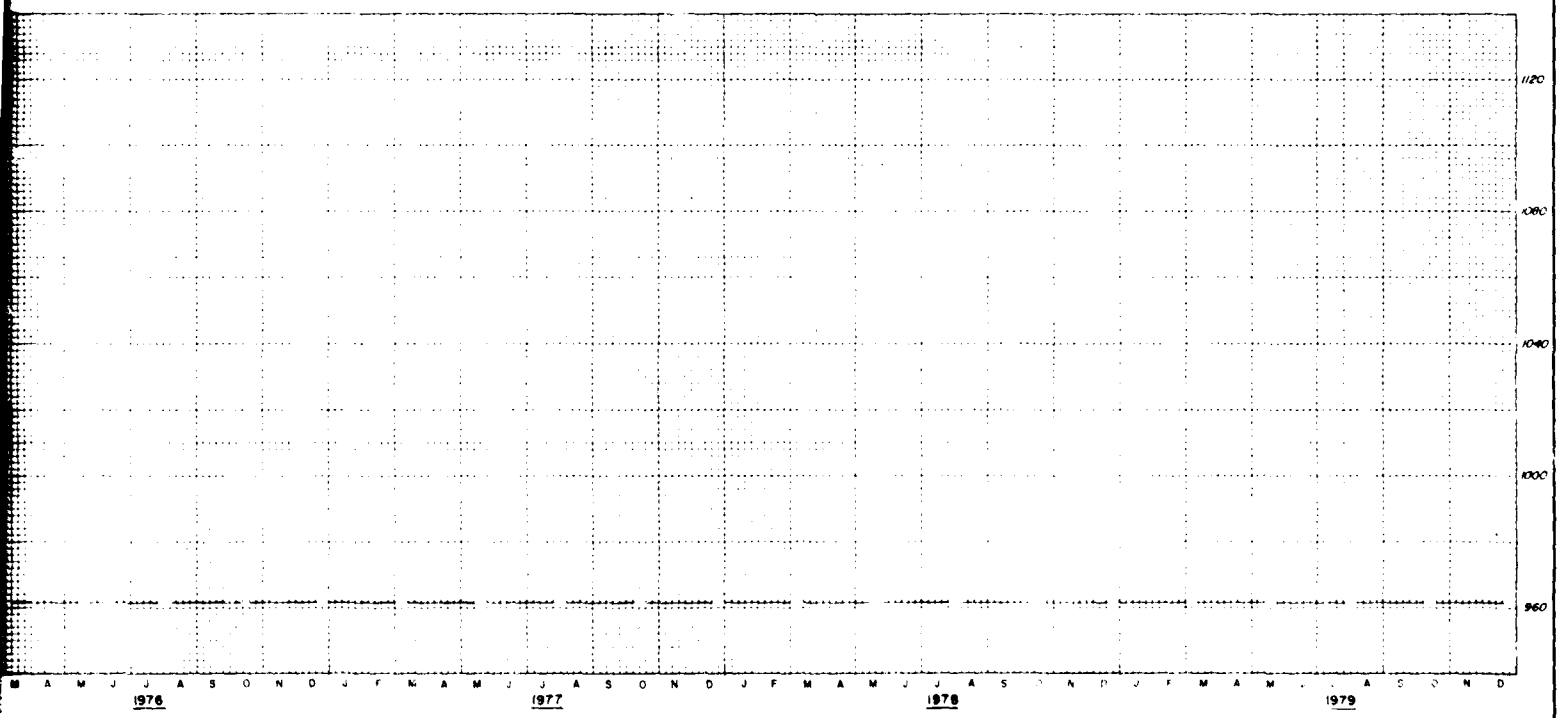


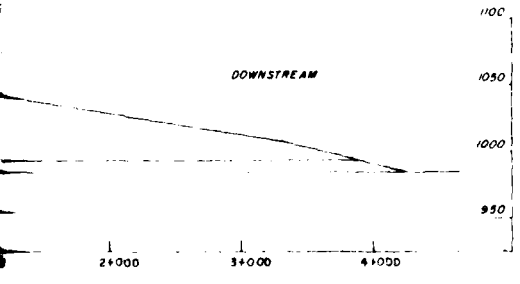




STATION 58+00







MARAIS DES CYGNE RIVER KANSAS

MELVERN LAKE

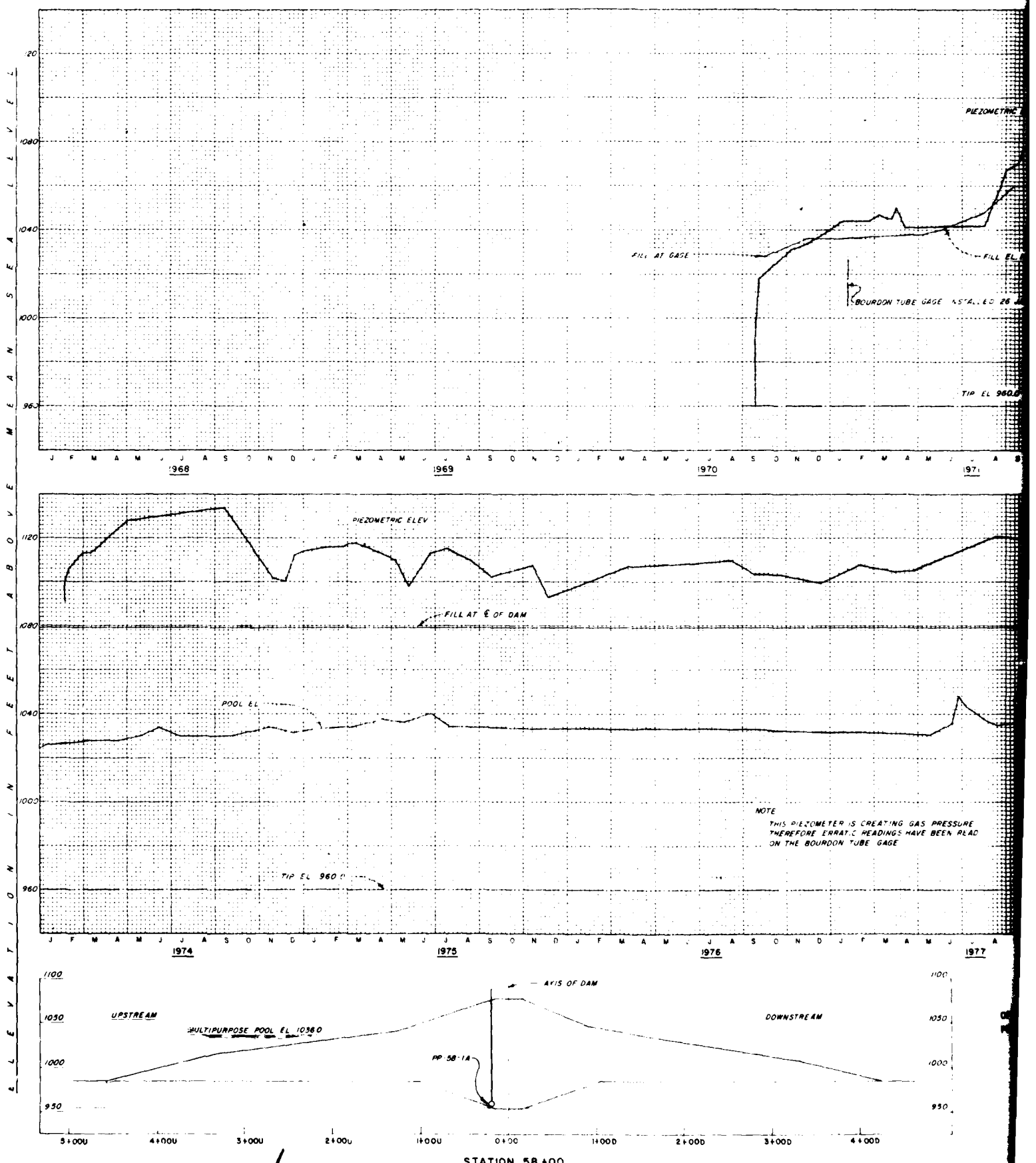
INSTRUMENTATION PLOTS
PP-58-1 (SHANNON-WILSON CELL)

FILE NO 0-5-1287

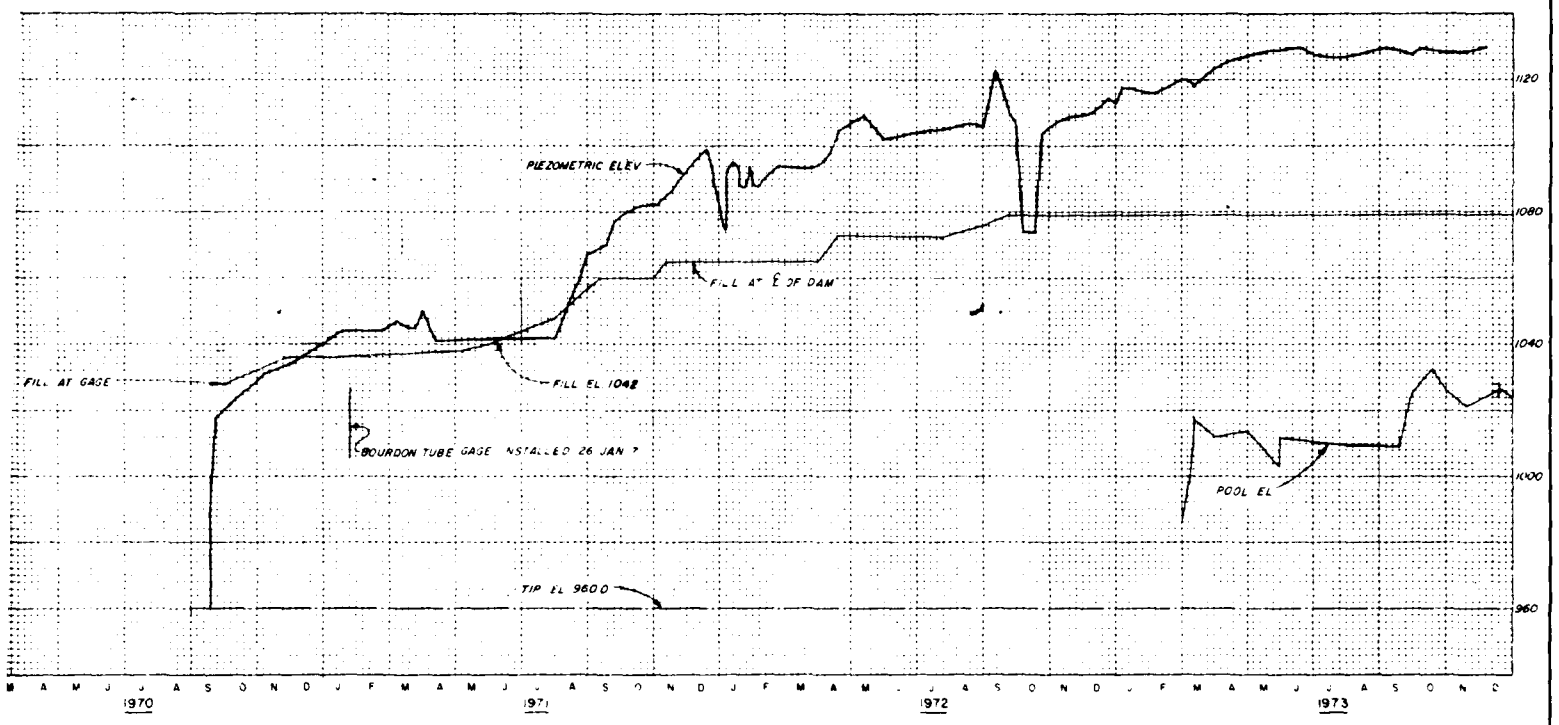
AUGUST 1975

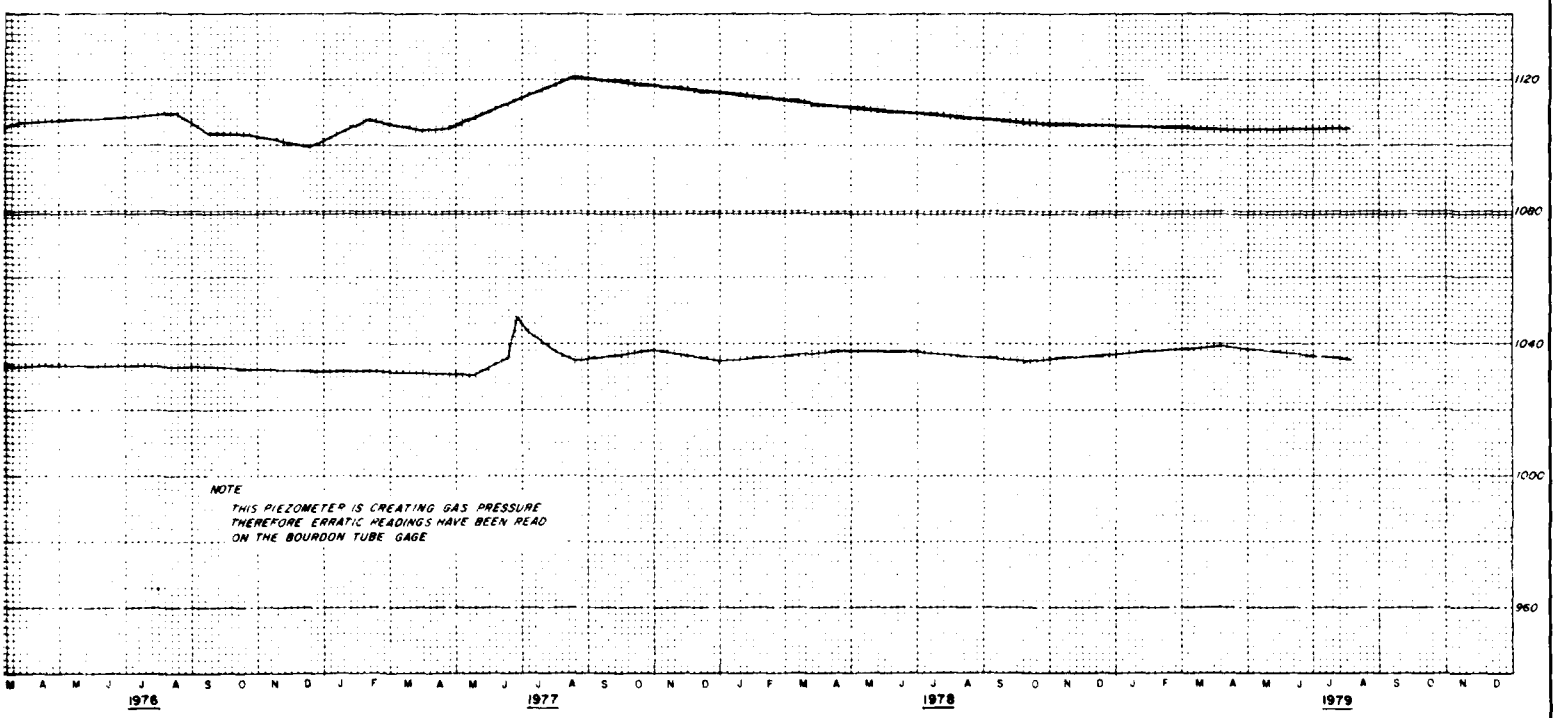
2

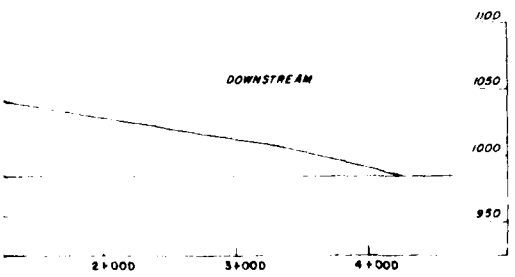
PLATE NO 39



STATION 58+00







LEGEND

OPEN TUBE ..... ○

PNEUMATIC CELL ..... ●

Revised August 1976

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS

PP-58-1A (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY

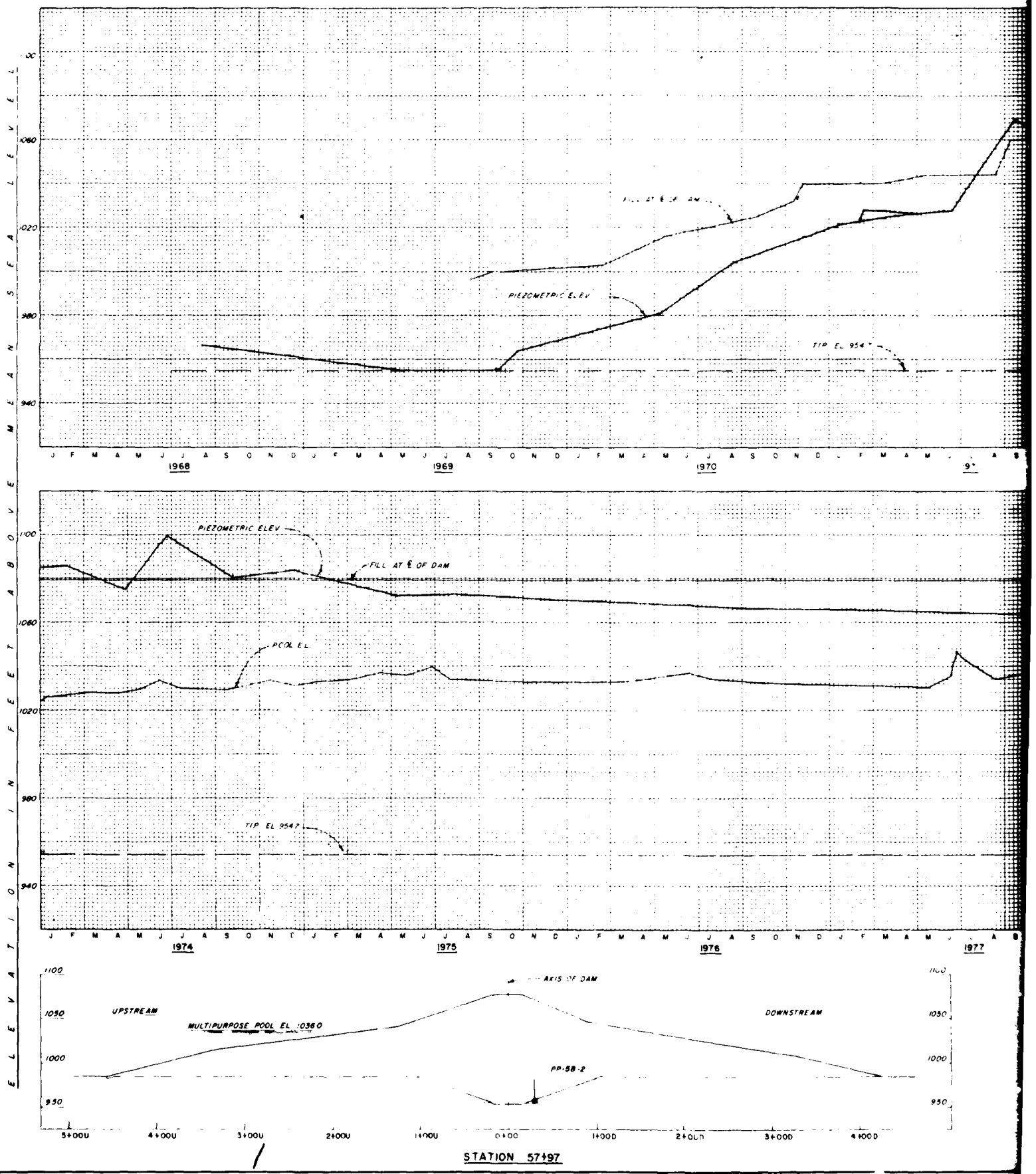
KANSAS CITY DISTRICT

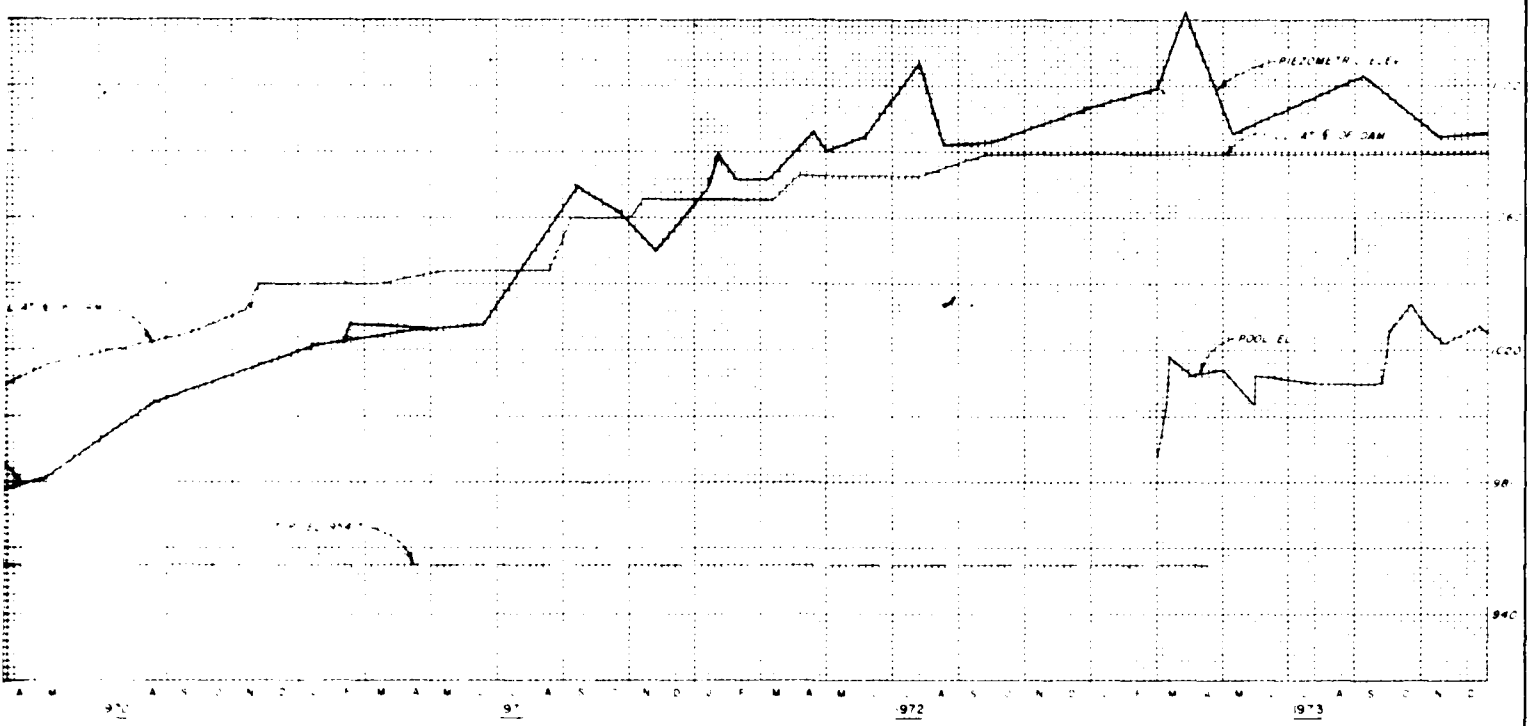
FILE NO. 0-5-1288

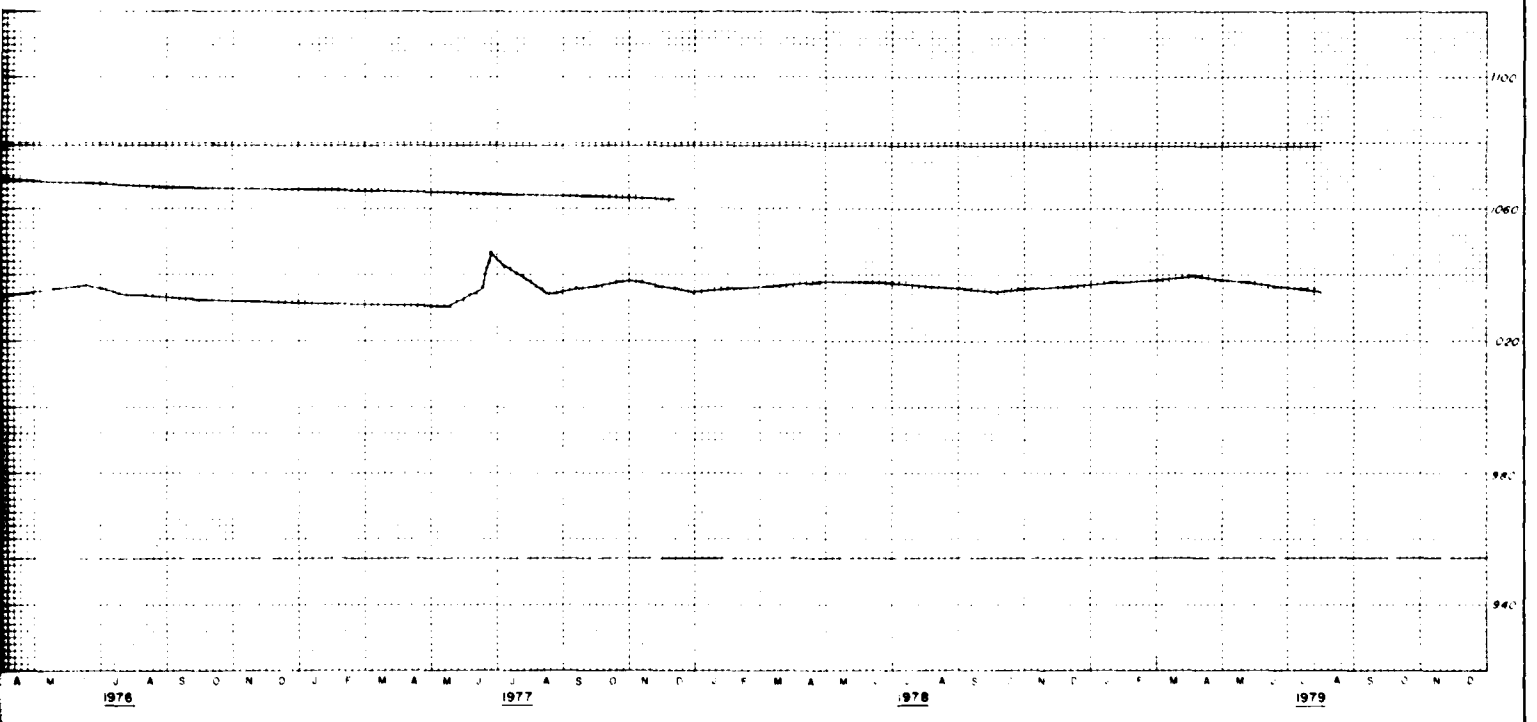
AUGUST 1975

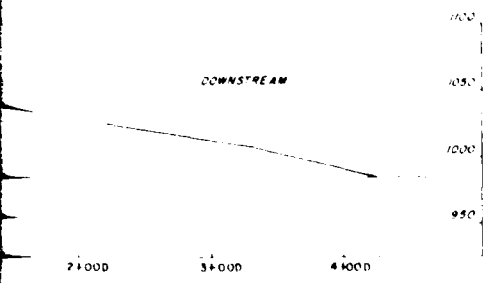
2

PLATE NO 40


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1100
1060
1020
980
940
PIEZOMETRIC ELEV
FILL AT E OF DAM
TIP EL 9547
POOL EL
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1968
1969
1970
1974
1975
1976
1977
UPSTREAM
MULTIPURPOSE POOL EL 1036.0
AXIS OF DAM
DOWNSTREAM
PP-58-2
1050
1000
950
5+000U
4+000U
3+000U
2+000U
1+000U
0+00
1+000D
2+000D
3+000D
4+000D
STATION 57+97







LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-58-2 (SHANNON WILSON CELL)

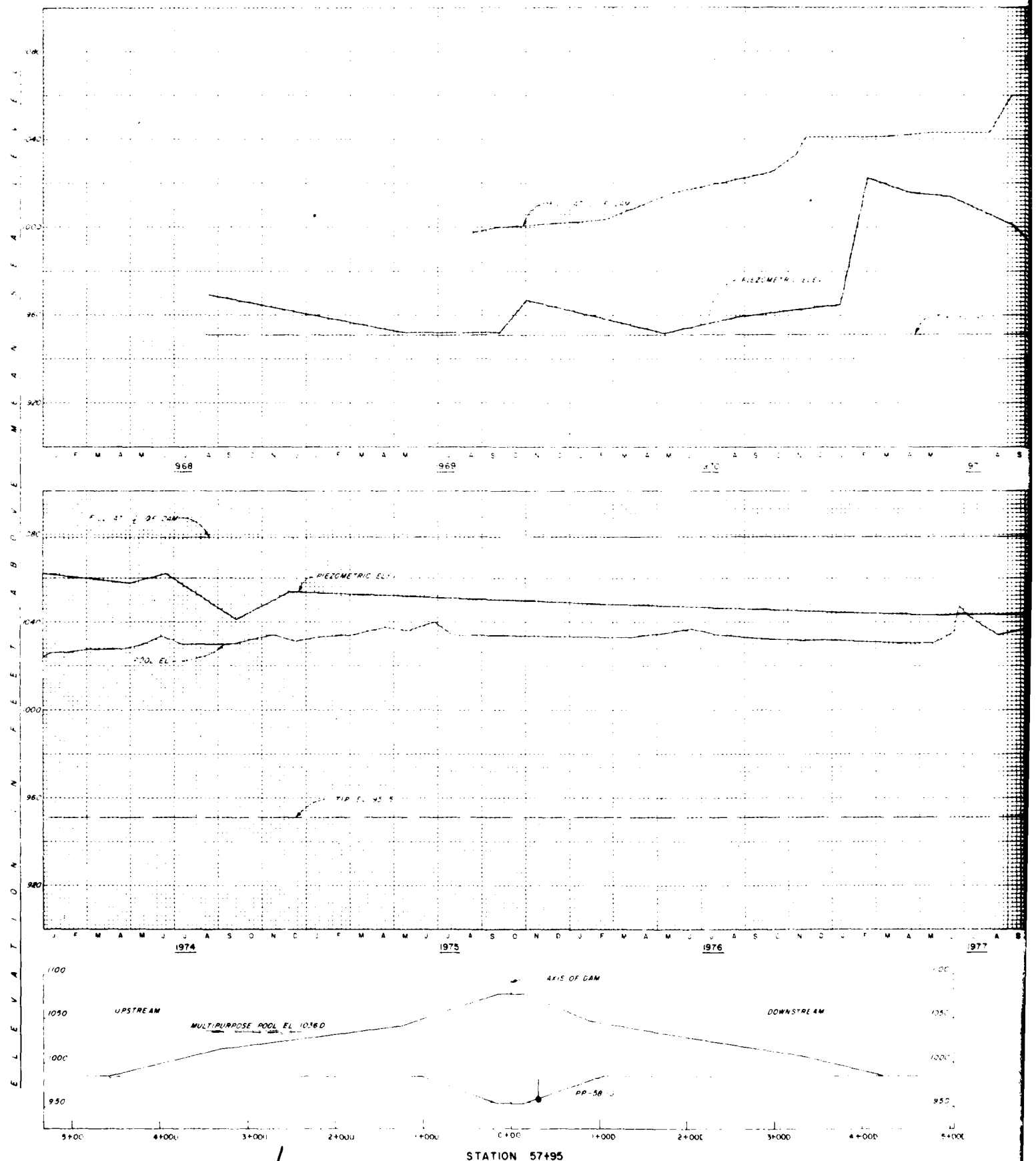
Sheet No. 1

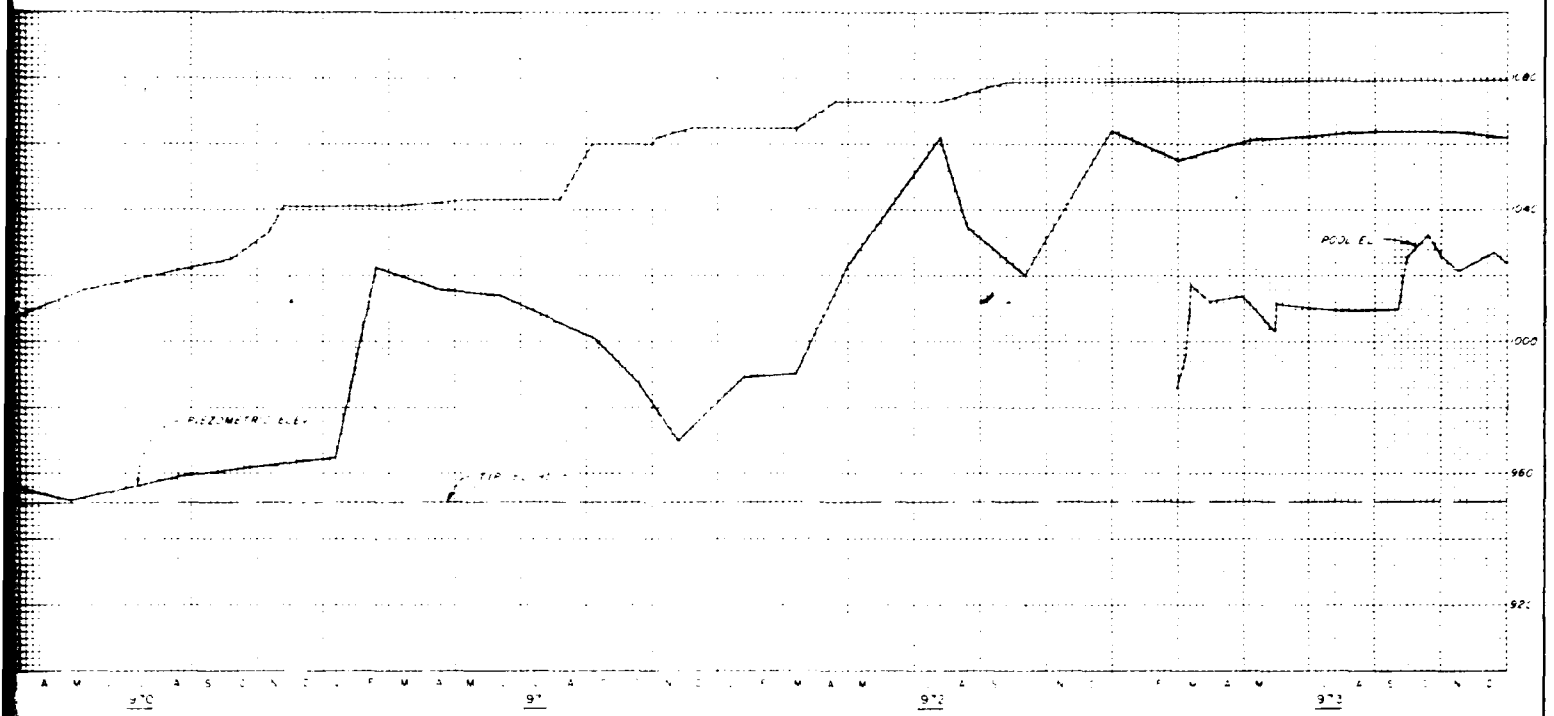
CORPS OF ENGINEERS, U.S. ARMY
KANSAS CITY DISTRICT

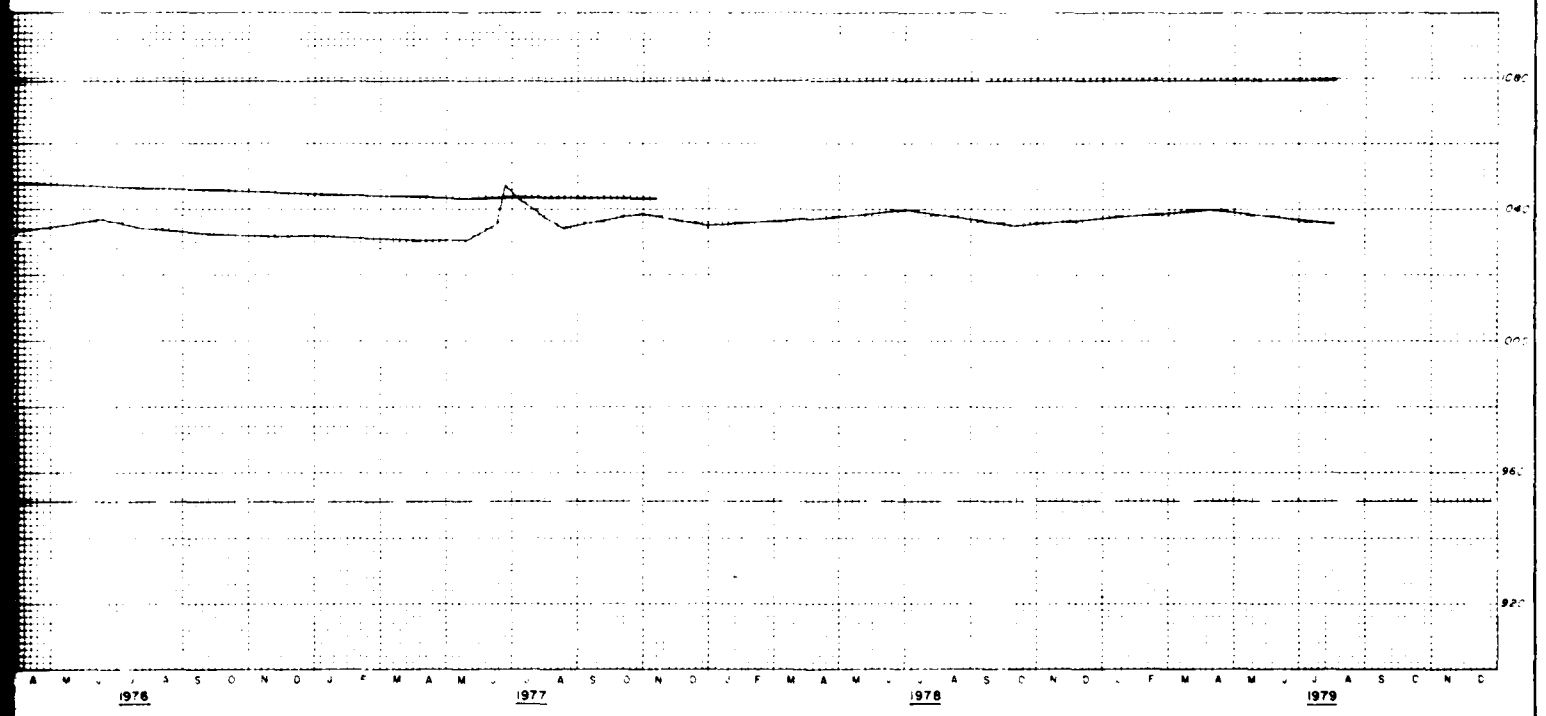
FILE NO. 0-5-1289

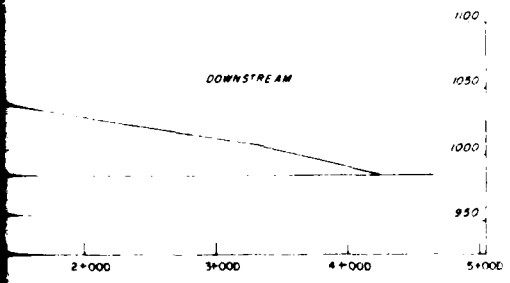
AUGUST 1975

PLATE NO. 41


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
PIEZOMETRIC EL.
1968
1969
1974
1975
1976
1977
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL. 1036.0
PP-58
STATION 57+95







LEGEND

OPEN TUBE

PNEUMATIC CELL

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-58-3 (SHANNON-WILSON CELL)

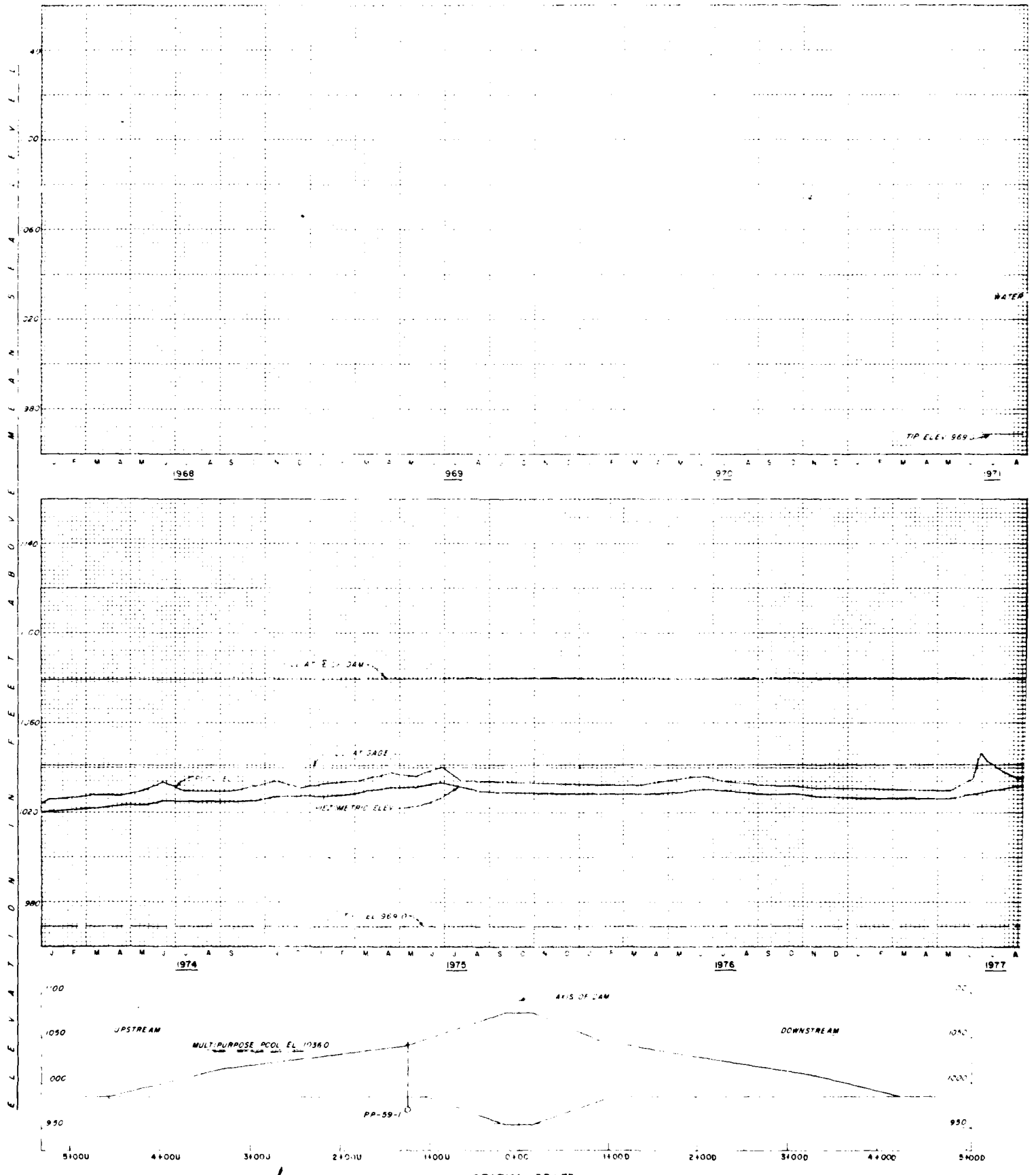
in 1 sheet Sheet No. 1 Scale as shown

KANSAS CITY DISTRICT

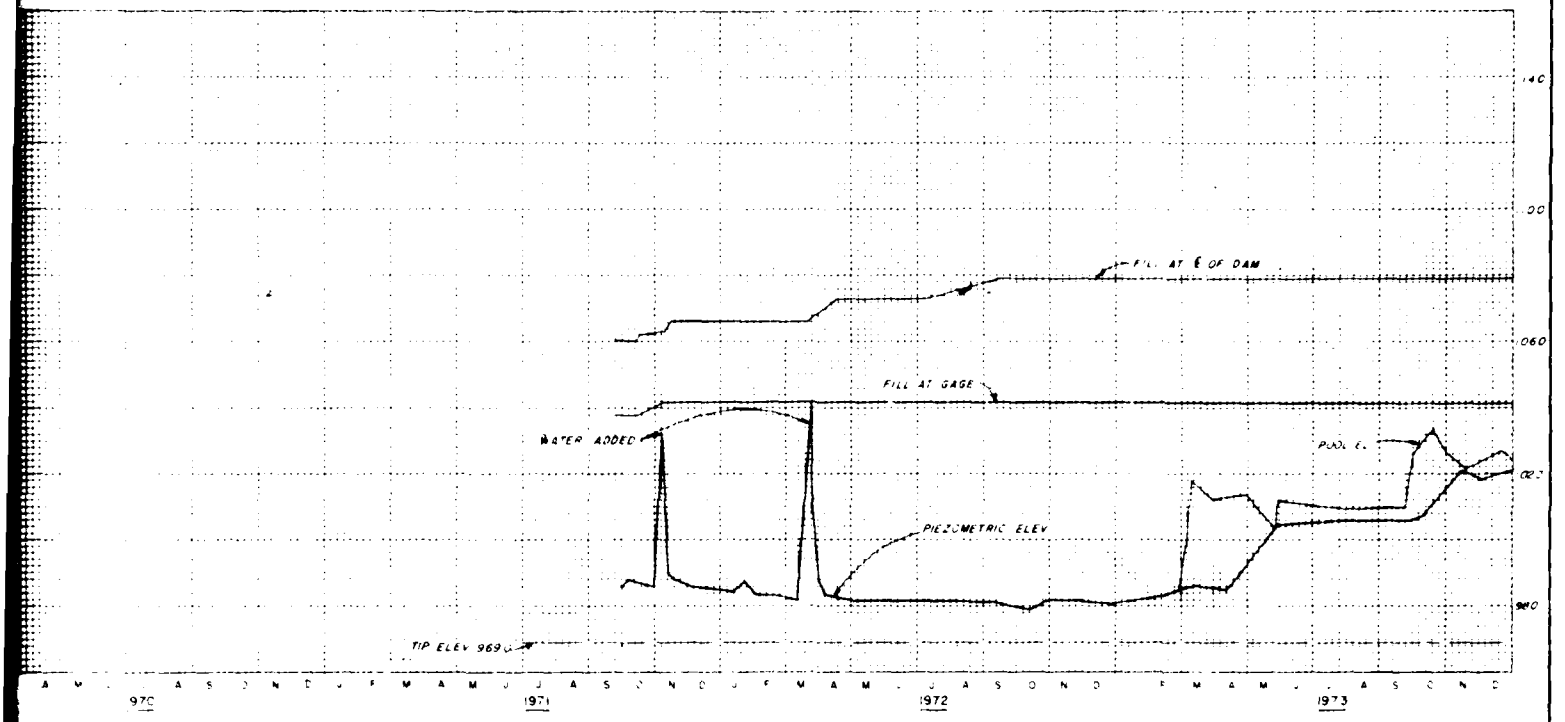
FILE NO 0-5-1290

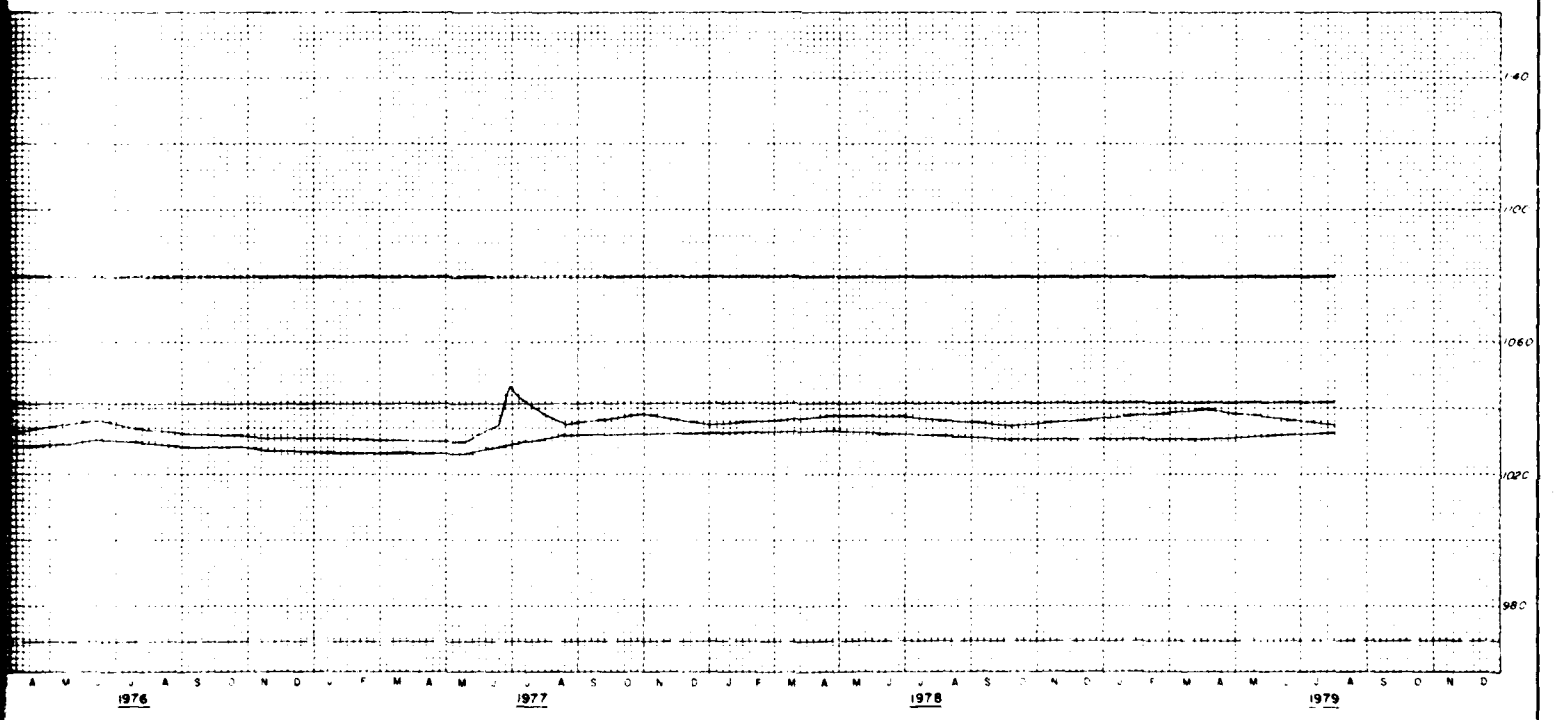
AUGUST 1975

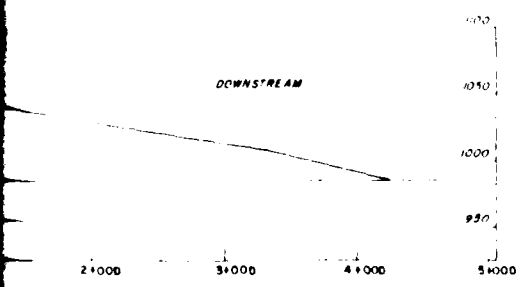
PLATE NO 42



STATION 58+75







LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-59-1 (OPEN TUBE)

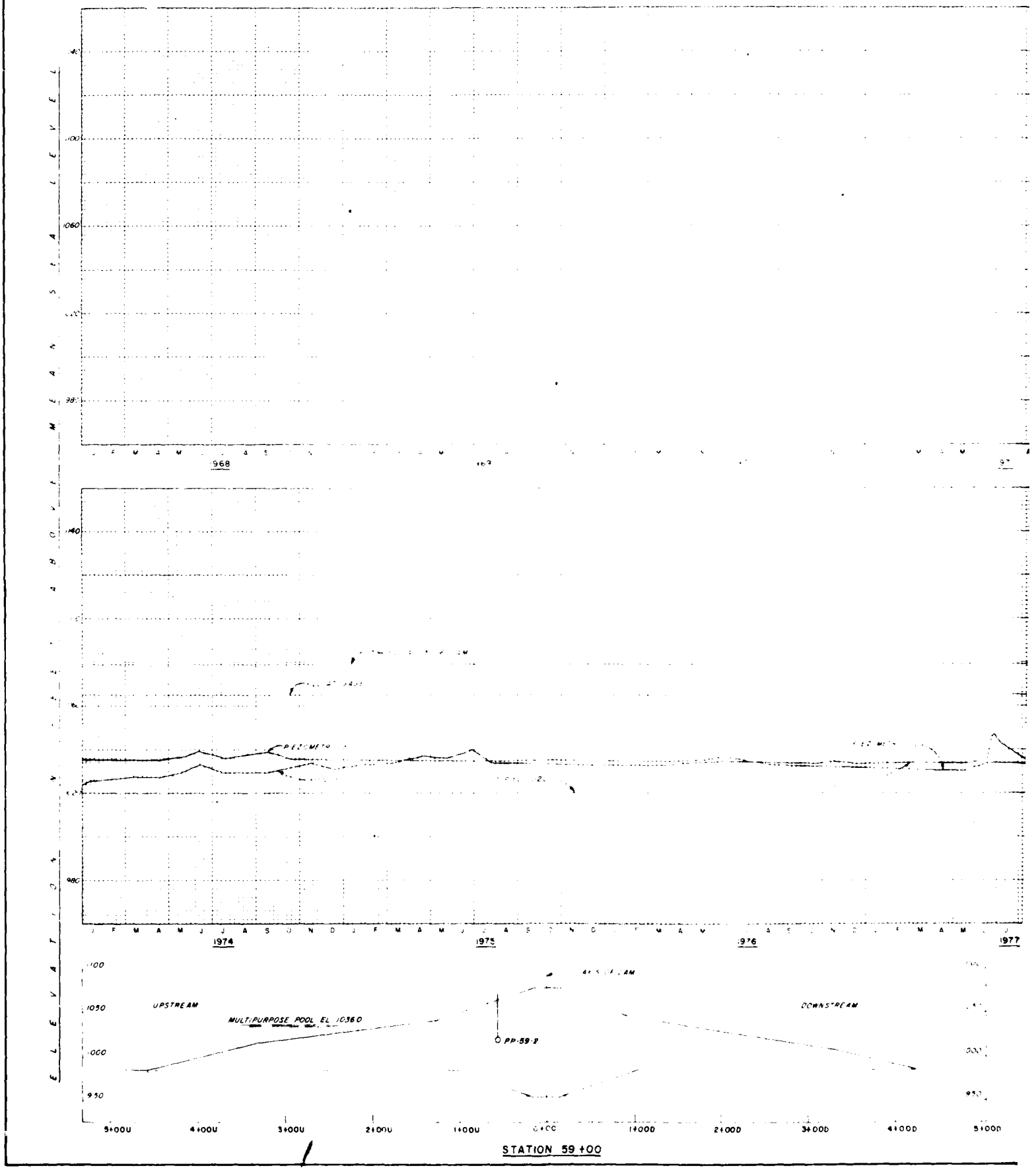
In 1 Sheet | Sheet No. 1 | Scale as shown

[illegible] ENGINEERS, U. S. ARMY
KANSAS CITY, MISSOURI

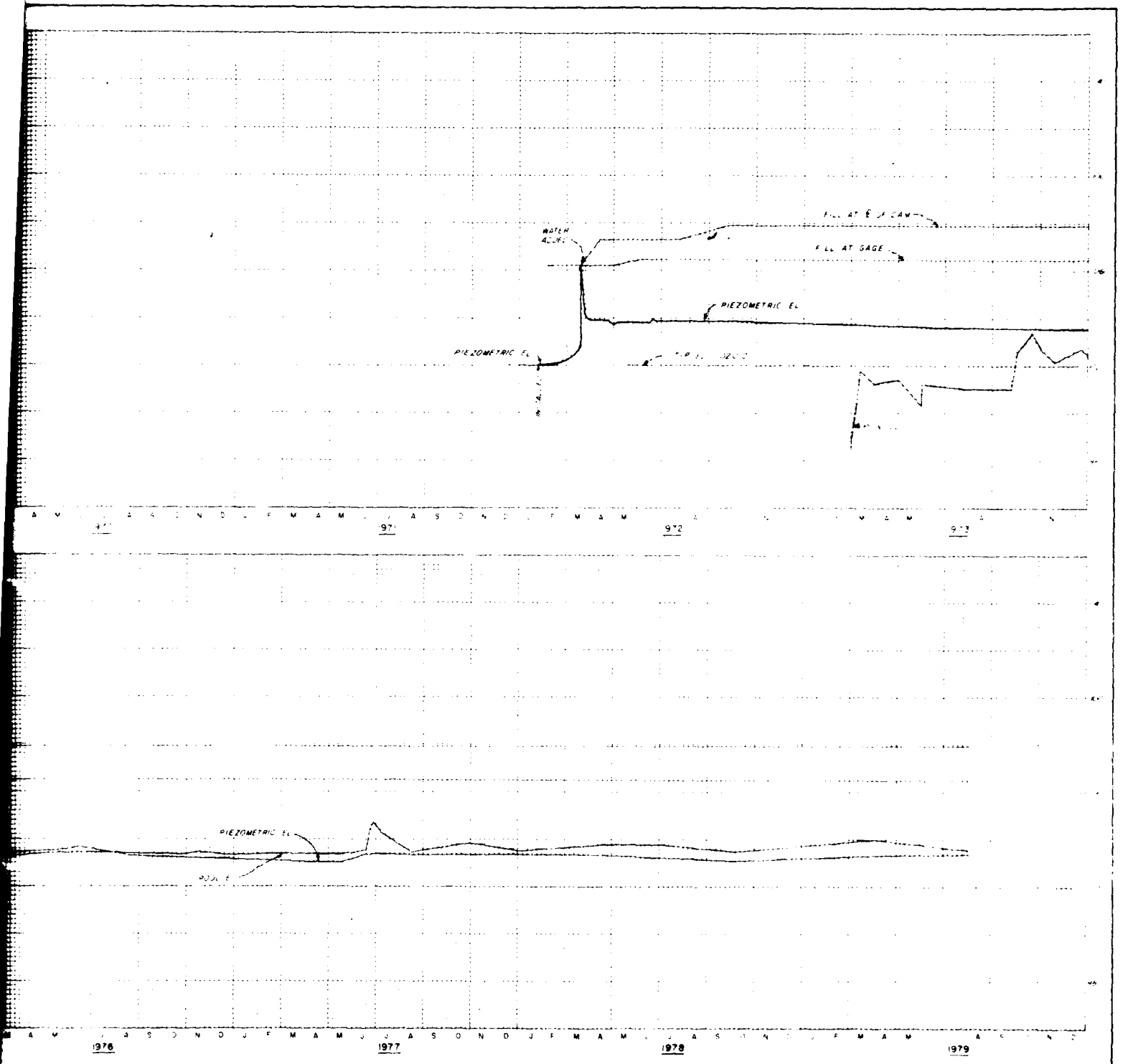
FILE NO 0-5-1291

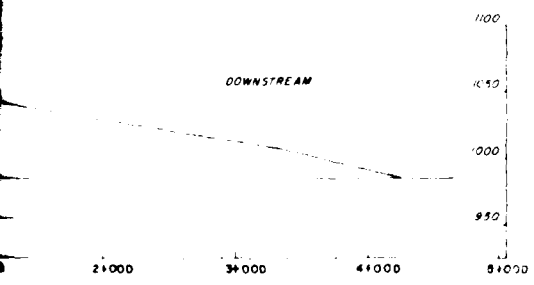
AUGUST 1975

PLATE NO 43



STATION 59+00





LEGEND

OPEN TUBE ..... O

PNEUMATIC CELL ..... ●

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-59-2 (OPEN TUBE)

FILE NO 0-5-1292
AUGUST 1975

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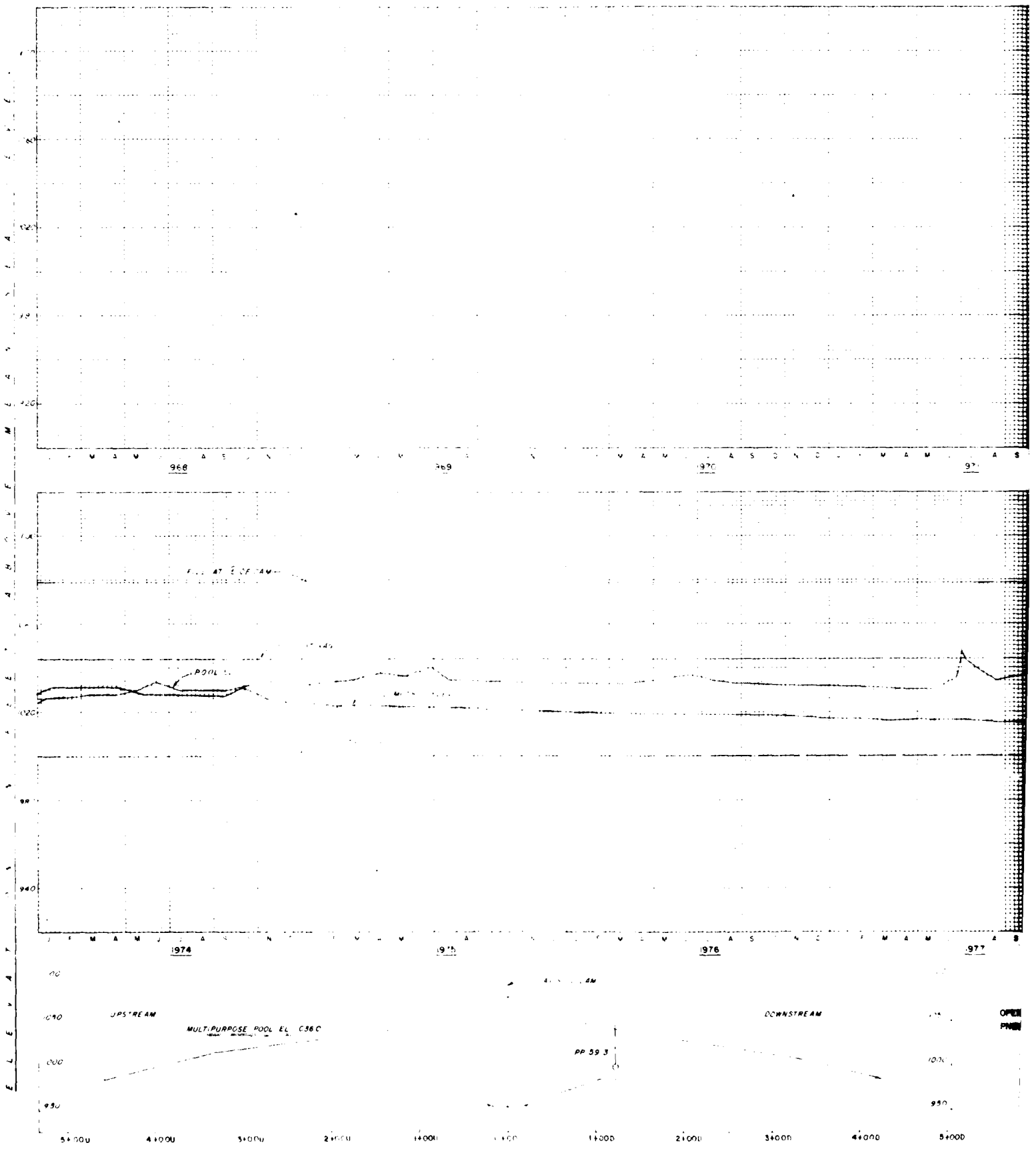
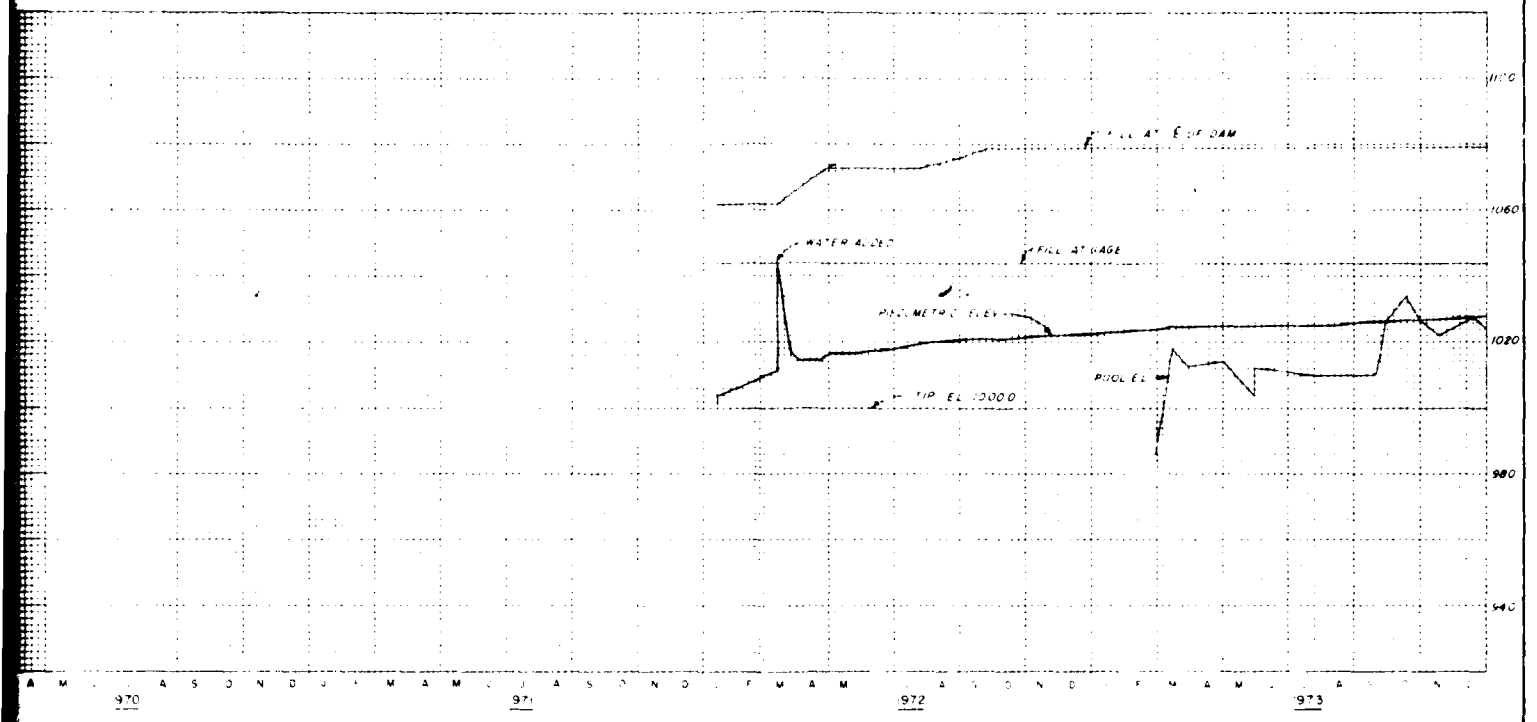
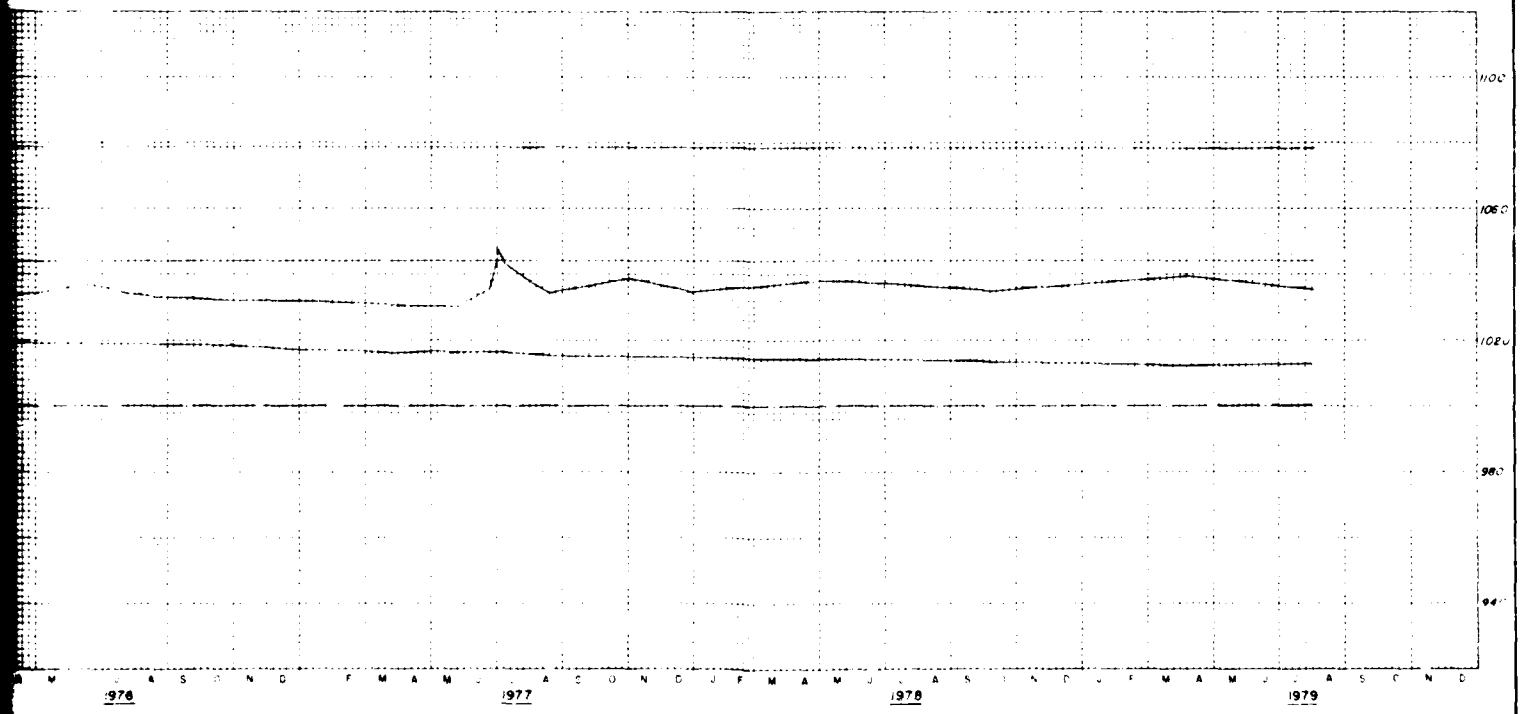
PLATE NO 44



STATION 59+00





LEGEND

OPEN TUBE

PNEUMATIC CELL

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

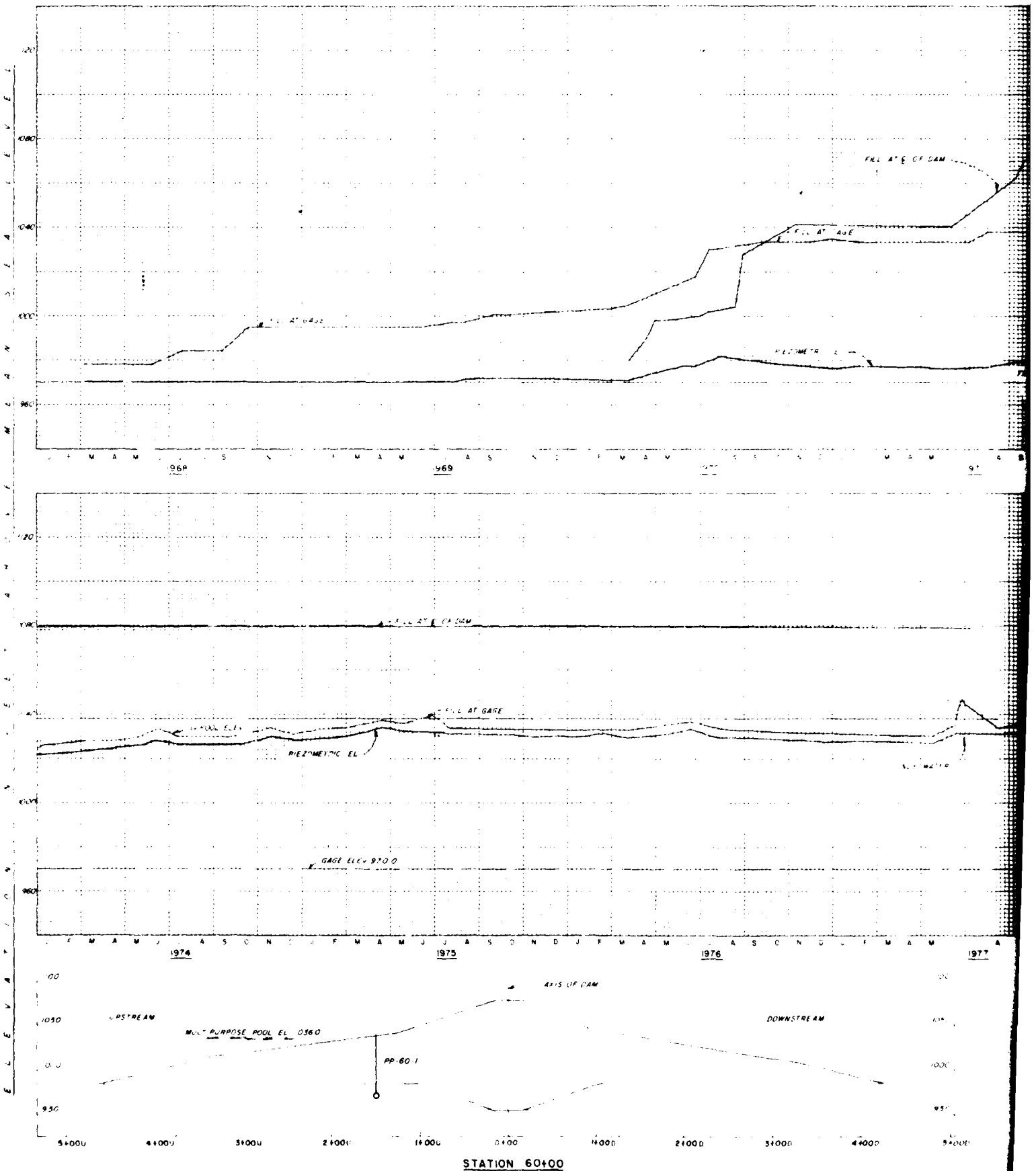
INSTRUMENTATION PLOTS
PP.59-3 (OPEN TUBE)

Sheet

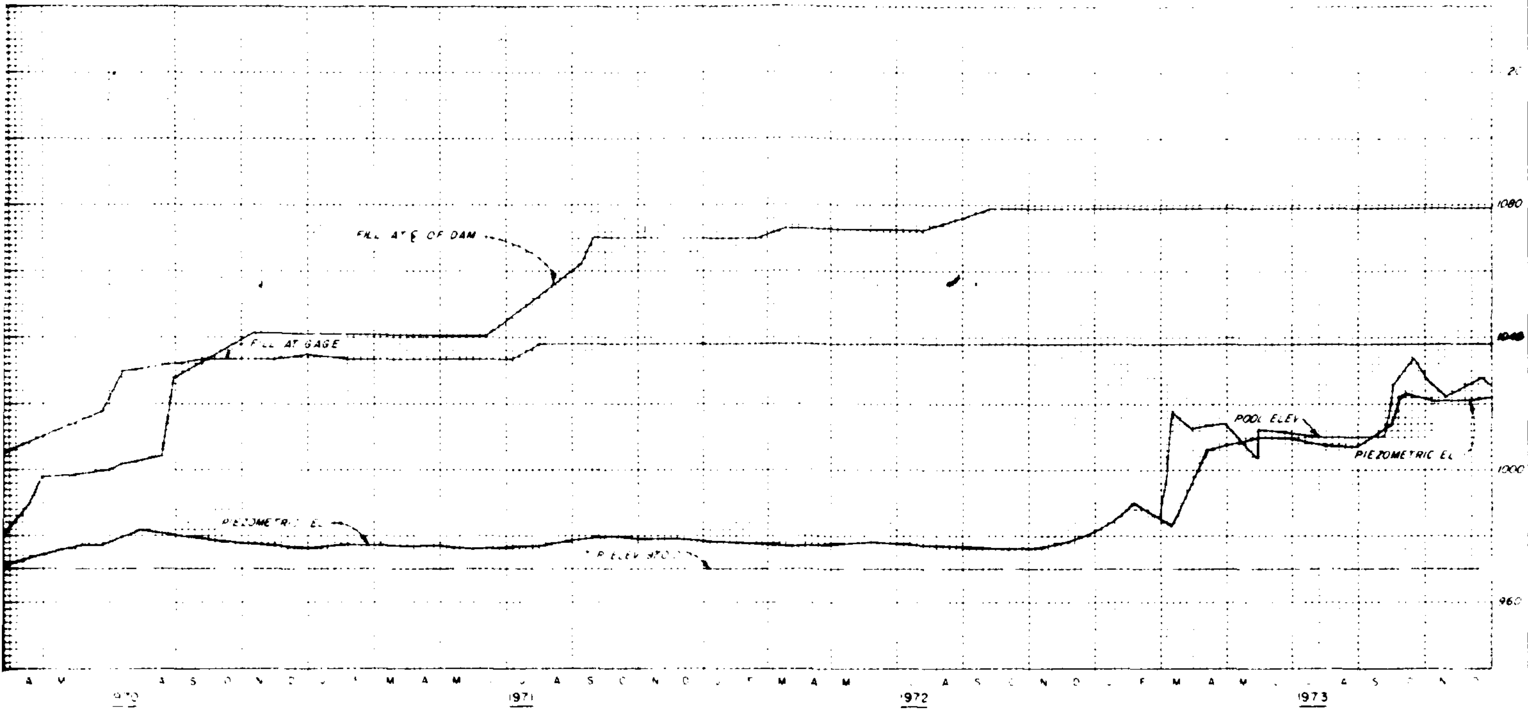
Scale as Shown

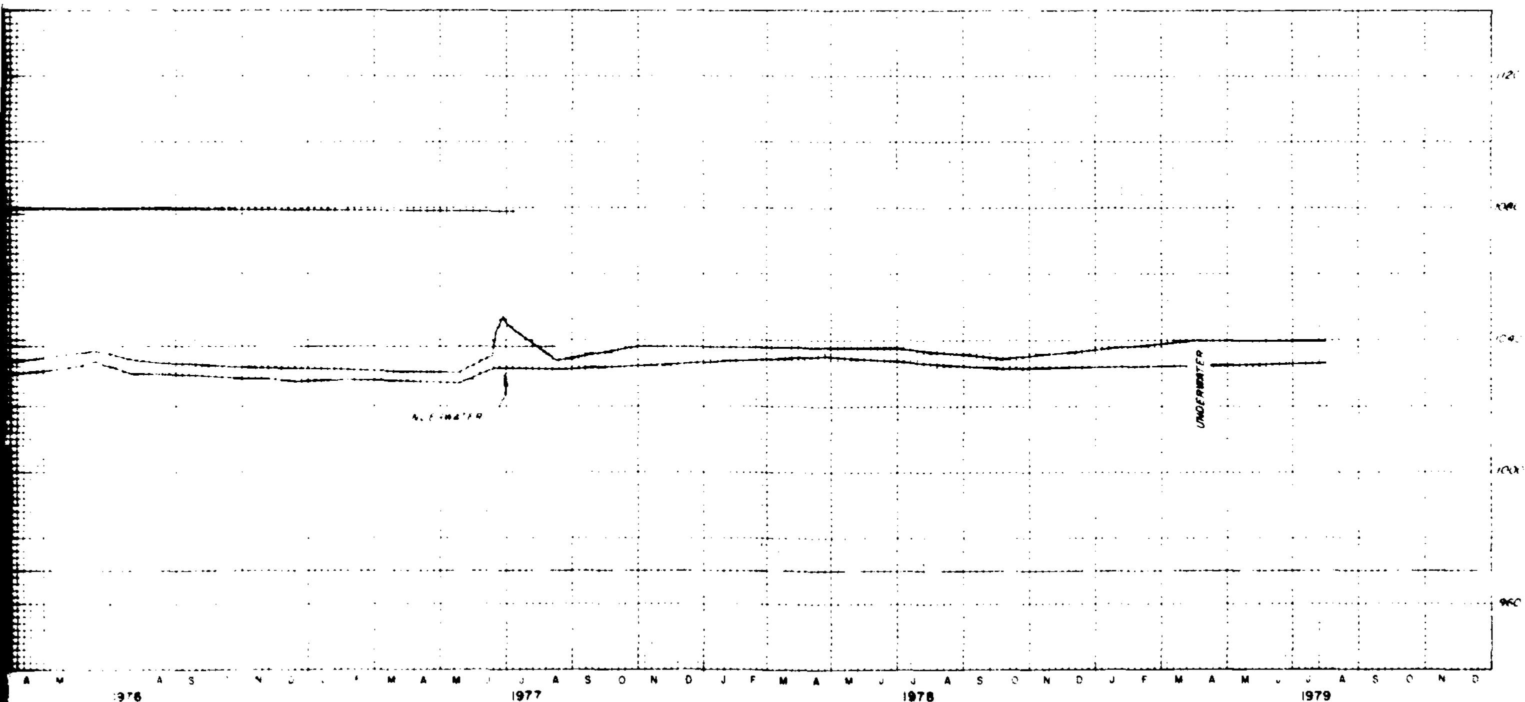
FILE NO 0-5-1293

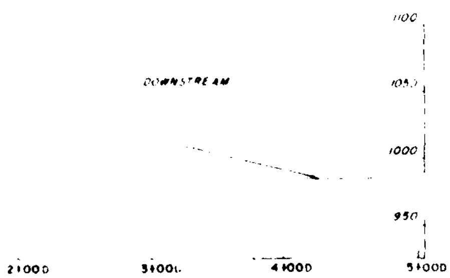
PLATE NO. 45



STATION 60+00







LEGEND

OPEN TUBE .... o

PNEUMATIC CELL .... ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-1 (OPEN TUBE)

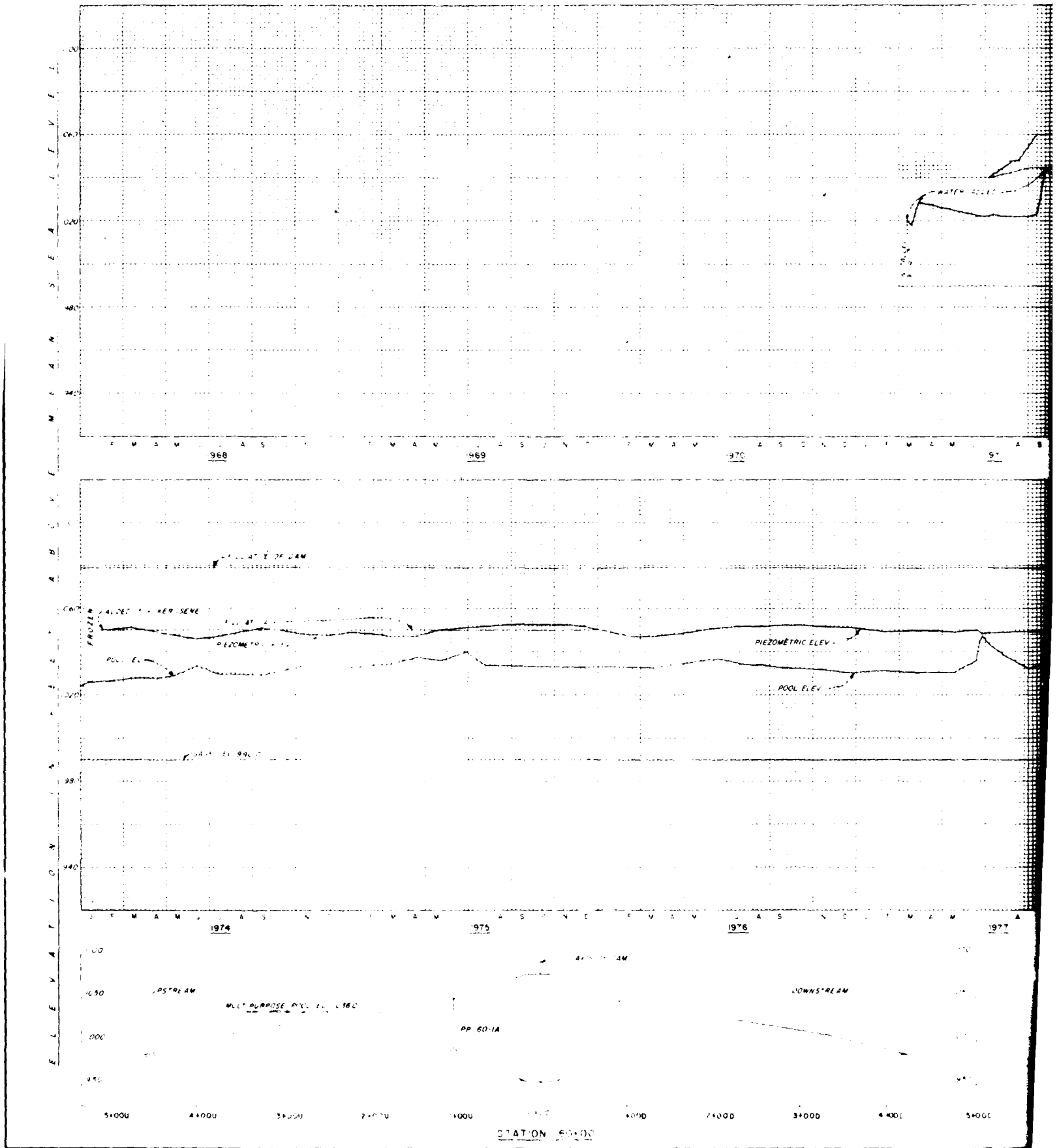
In 1 sheet   Sheet No. 1   Scale as shown

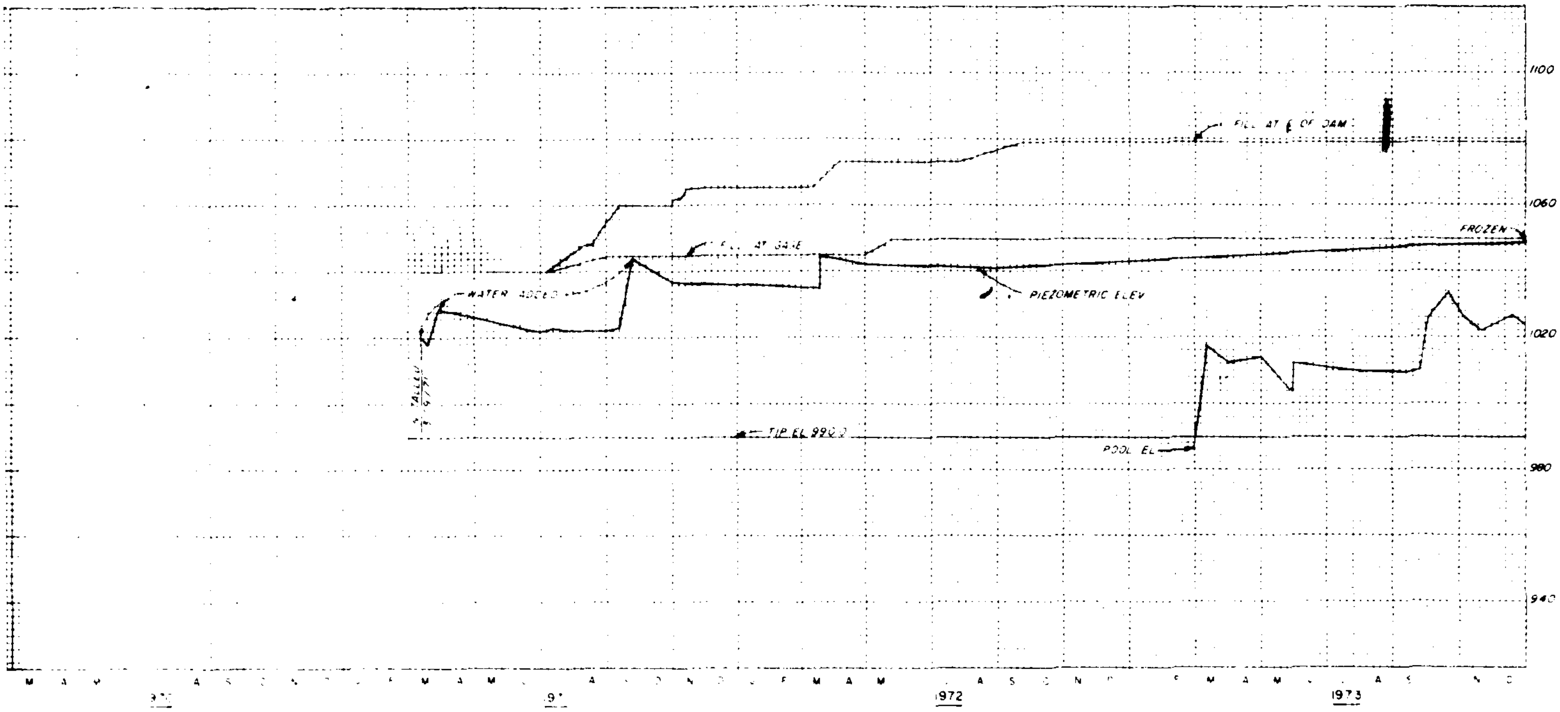
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

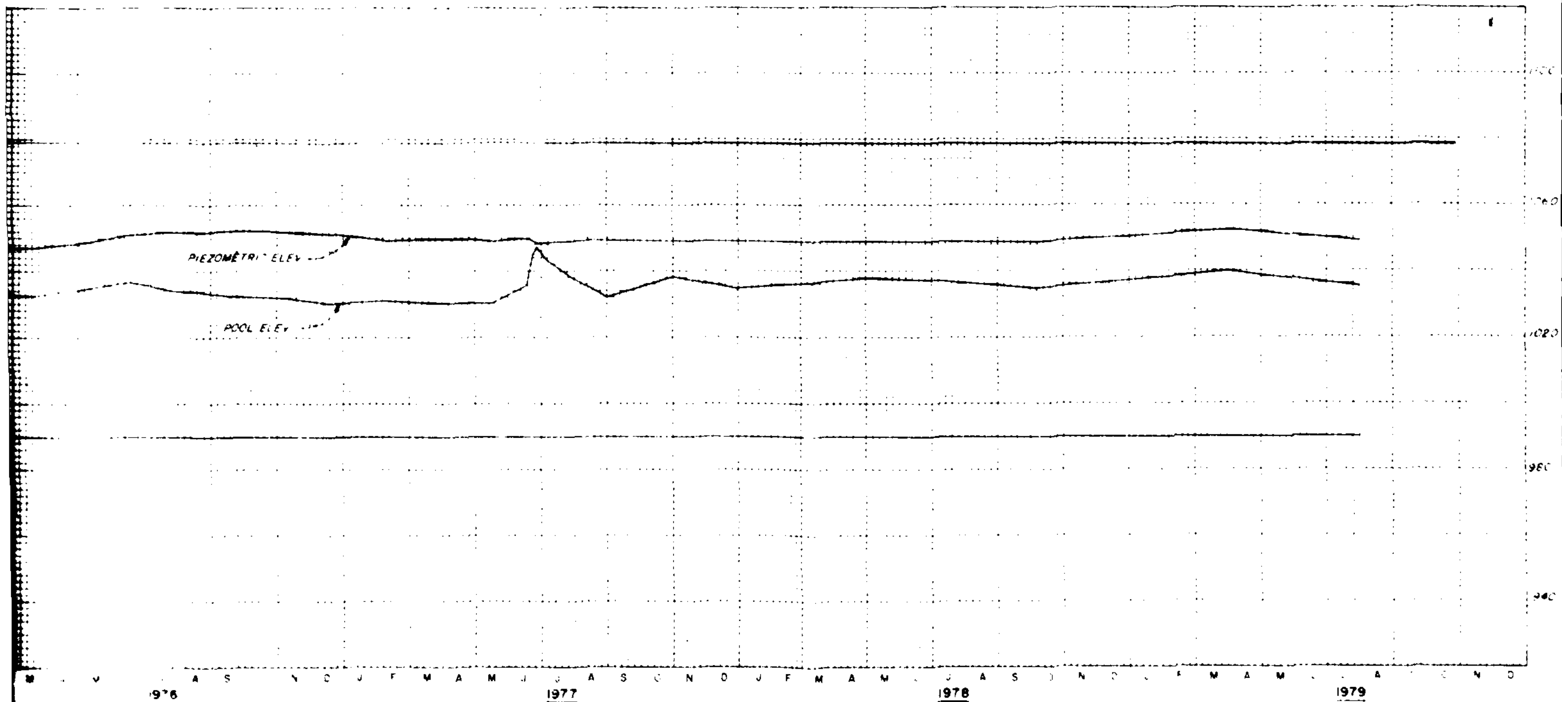
FILE NO 0-5-1294
AUGUST 1975

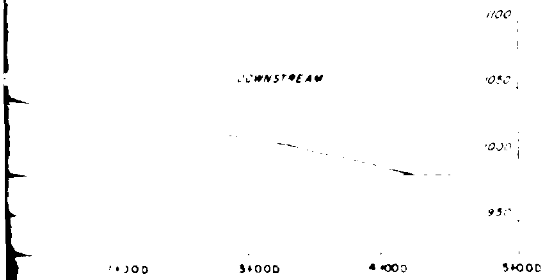
2

PLATE NO 46


ELEVATION IN FEET MEAN SEA LEVEL
1968
1969
1970
1974
1975
1976
1977
PIEZOMETRIC ELEV.
POOL ELEV.
UPSTREAM
DOWNSTREAM
PP 60-1A
STATION







LEGEND

OPEN TUBE ○

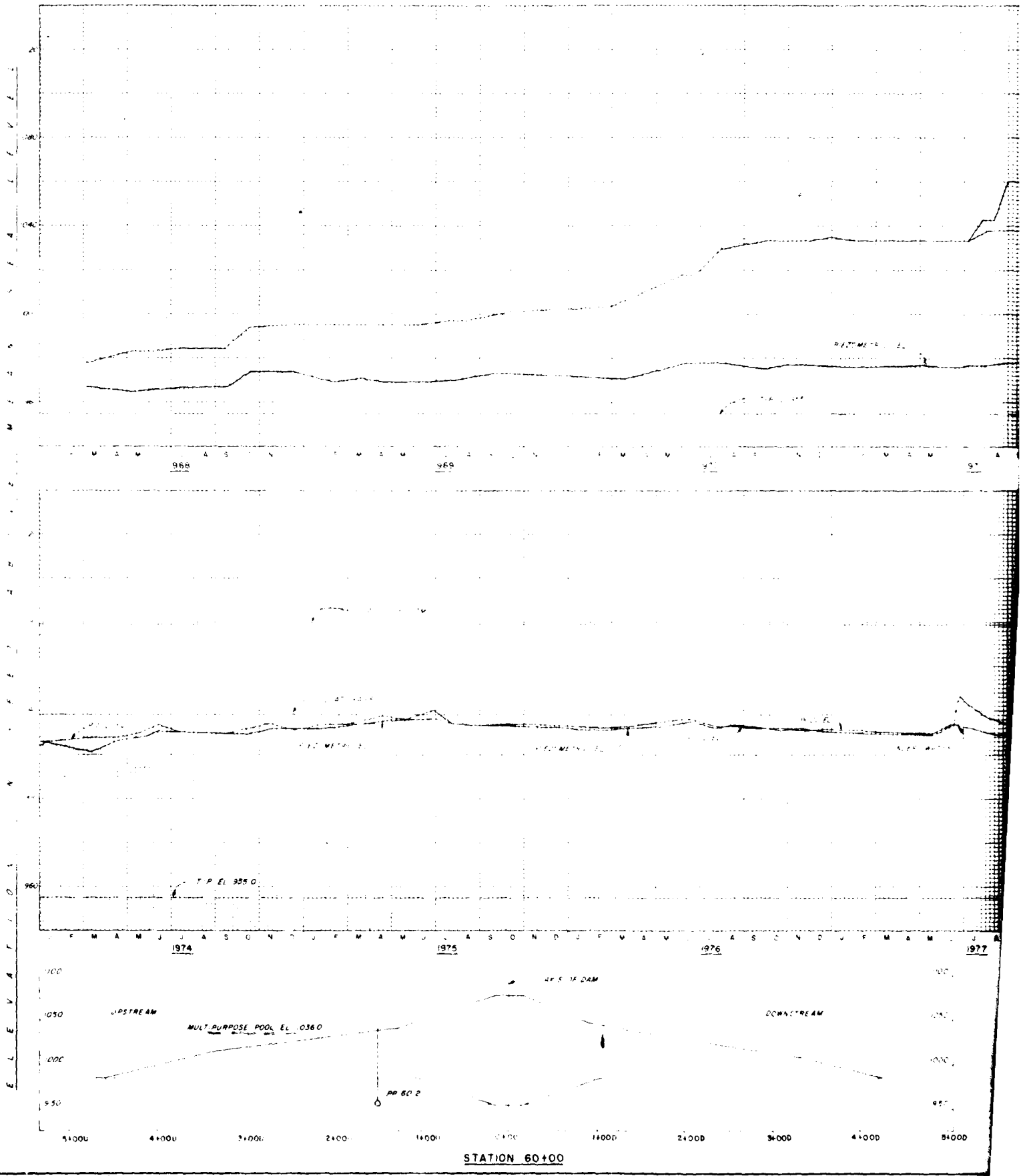
PNEUMATIC CELL ●

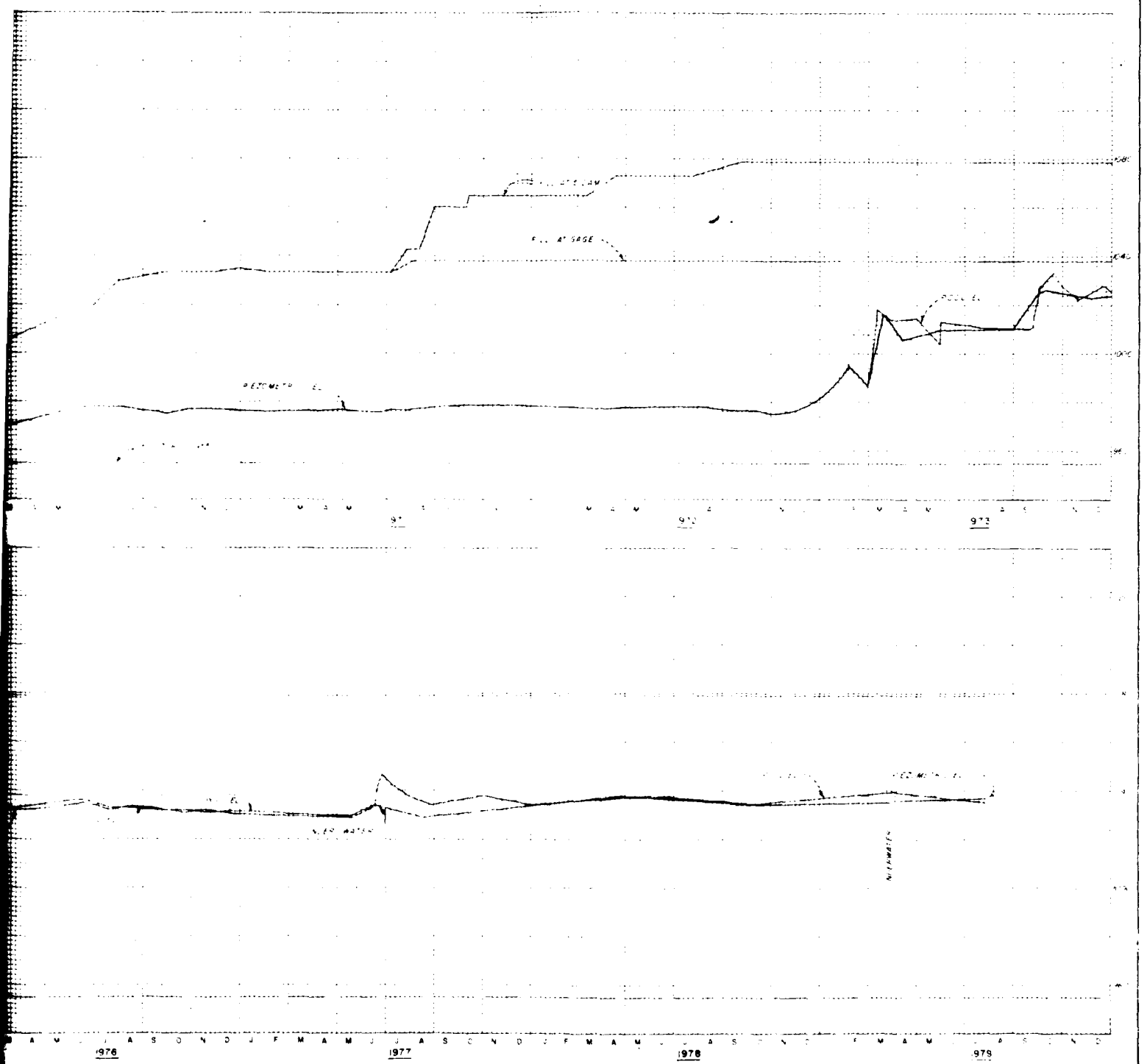
MARAIS DES CYGNES RIVER KANSAS

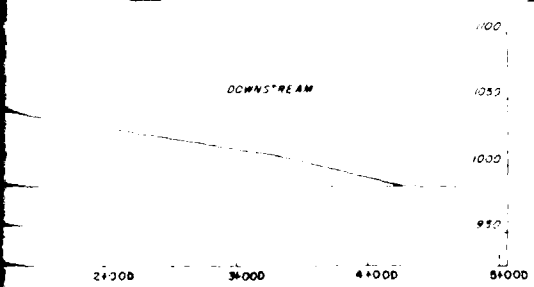
MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-1A (OPEN TUBE)

FILE NO 0-5-1295


ELEVATION IN FEET
1974
1975
1976
1977
T P EL 955.0
UPSTREAM
MULT PURPOSE POOL EL 1036.0
PP 60.2
DOWNSTREAM
STATION 60+00





LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

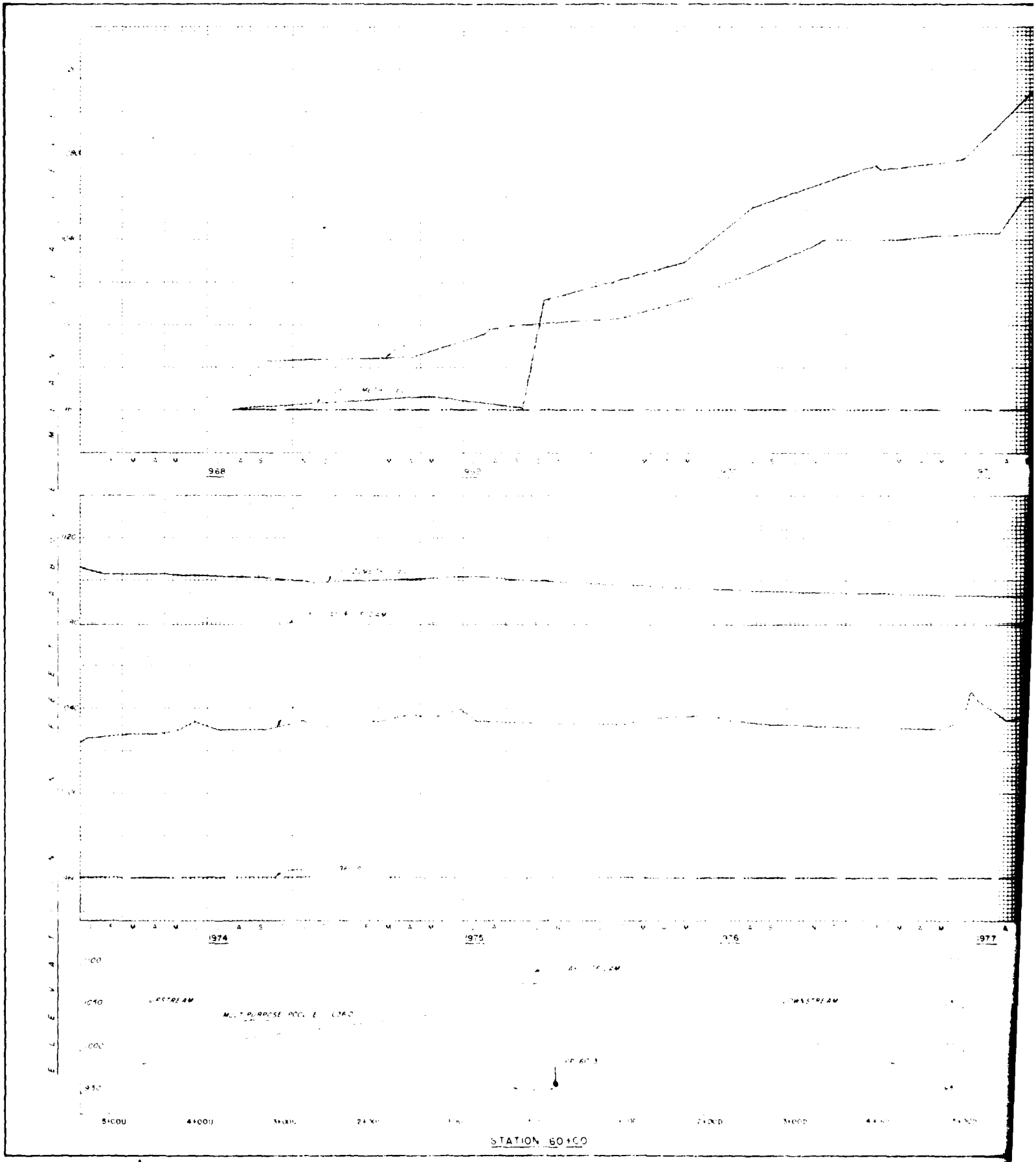
MARAIS DES CYGNES RIVER, KANSAS

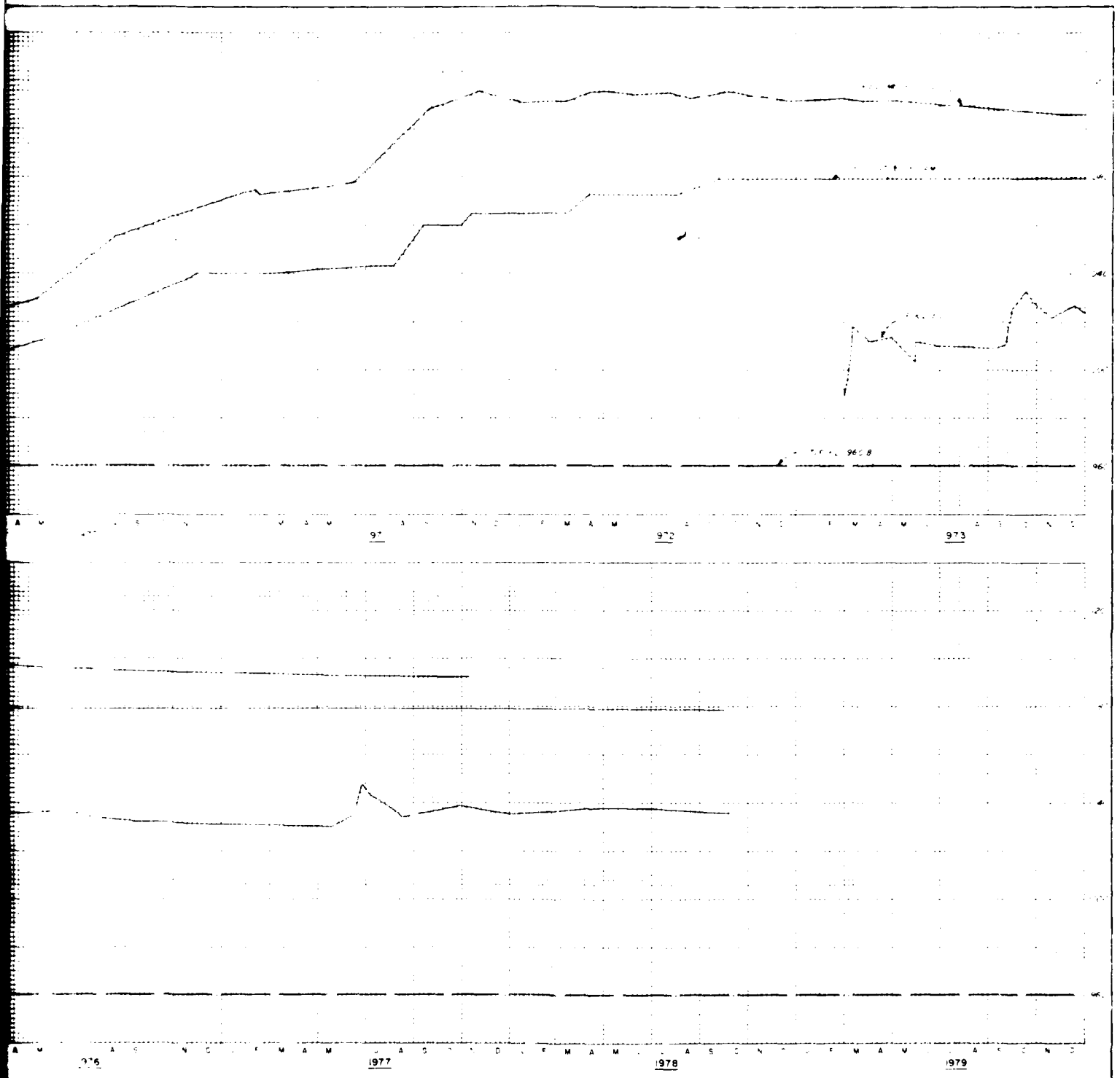
MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-2 (OPEN TUBE)

FILE NO 0-5-1296
AUGUST 1975

PLATE NO 4R


ELEVATION IN FEET
1968
1974
1975
1976
1977
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL
STATION 60+00



LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER, KANSAS

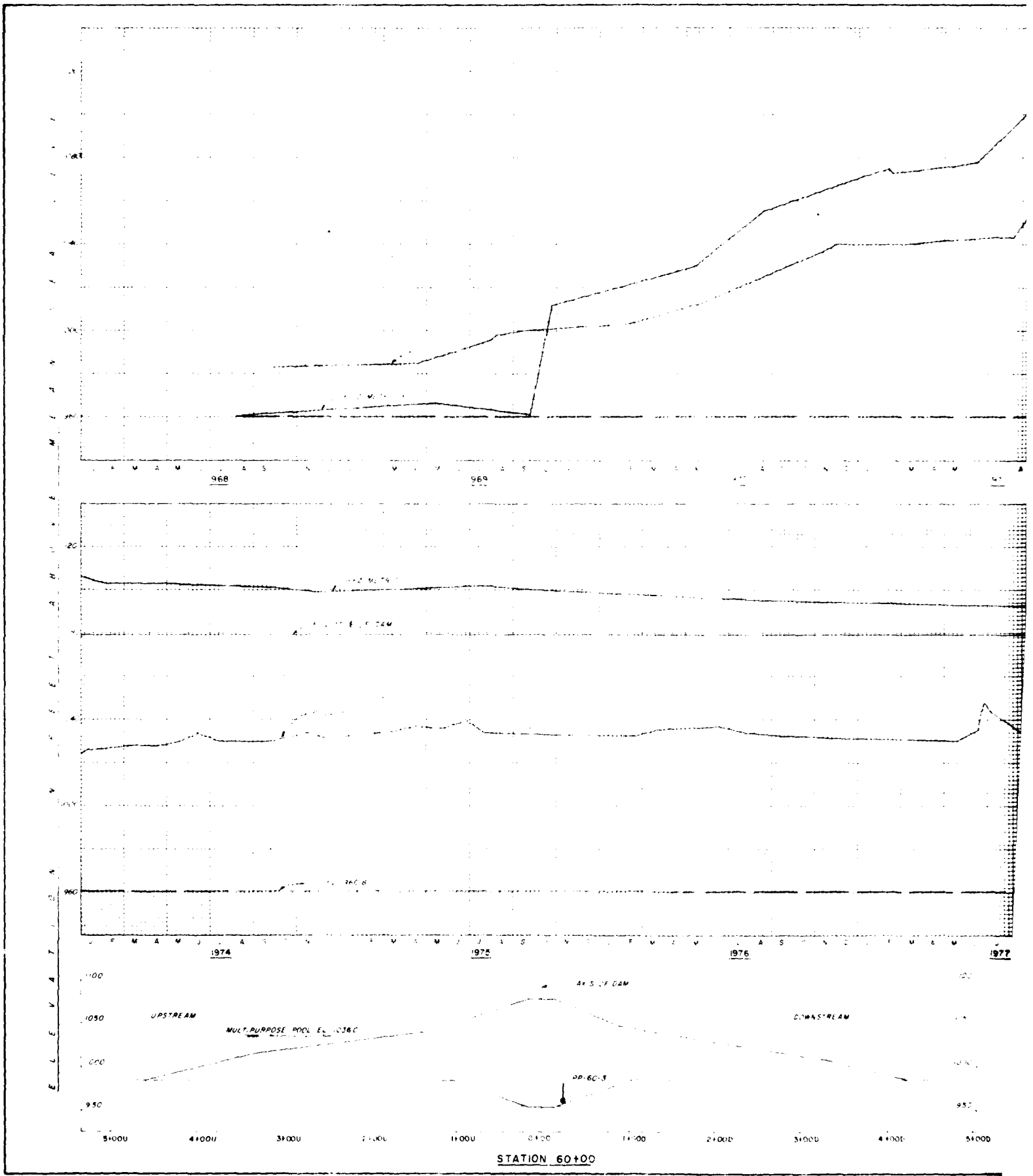
MELVERN LAKE

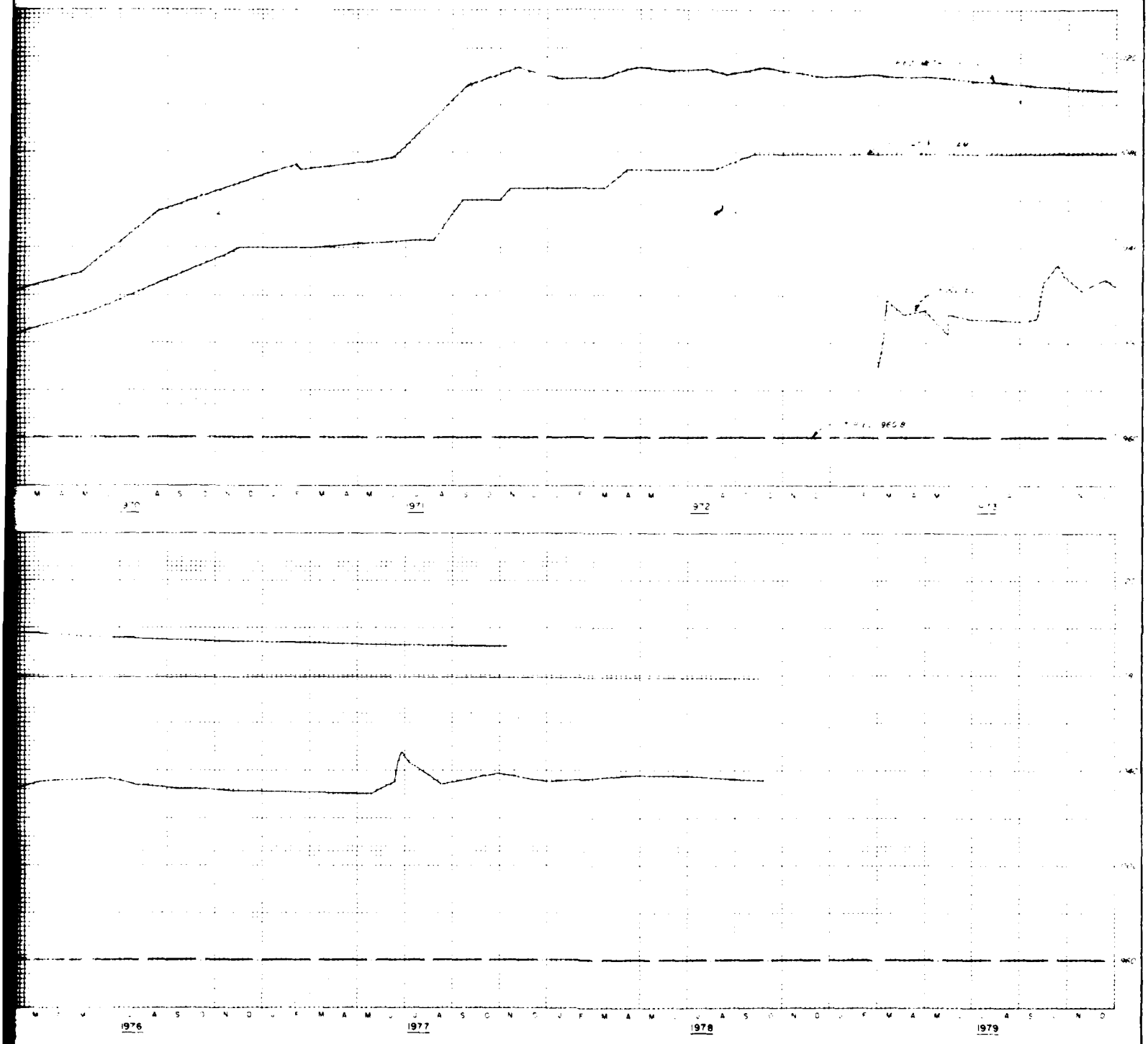
INSTRUMENTATION PLOTS
PP-60-3 (SHANNON-WILSON CELL)

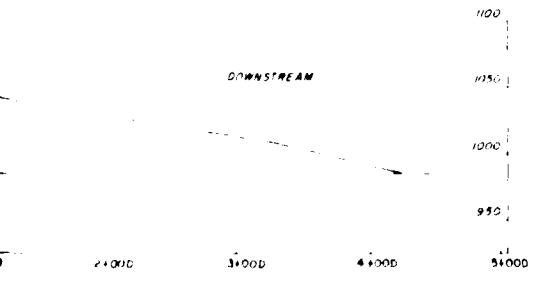
FILE NO 0-5-1297

AUGUST 1975

PLATE NO 49


ELEVATION
1968
1969
1974
1975
1976
1977
UPSTREAM
DOWNSTREAM
MULT. PURPOSE POOL EL. 1036
AXIS OF DAM
BP-60-3
STATION 60+00





LEGEND

OPEN TUBE

PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-3 (SHANNON-WILSON CELL)

Sheet No. 1

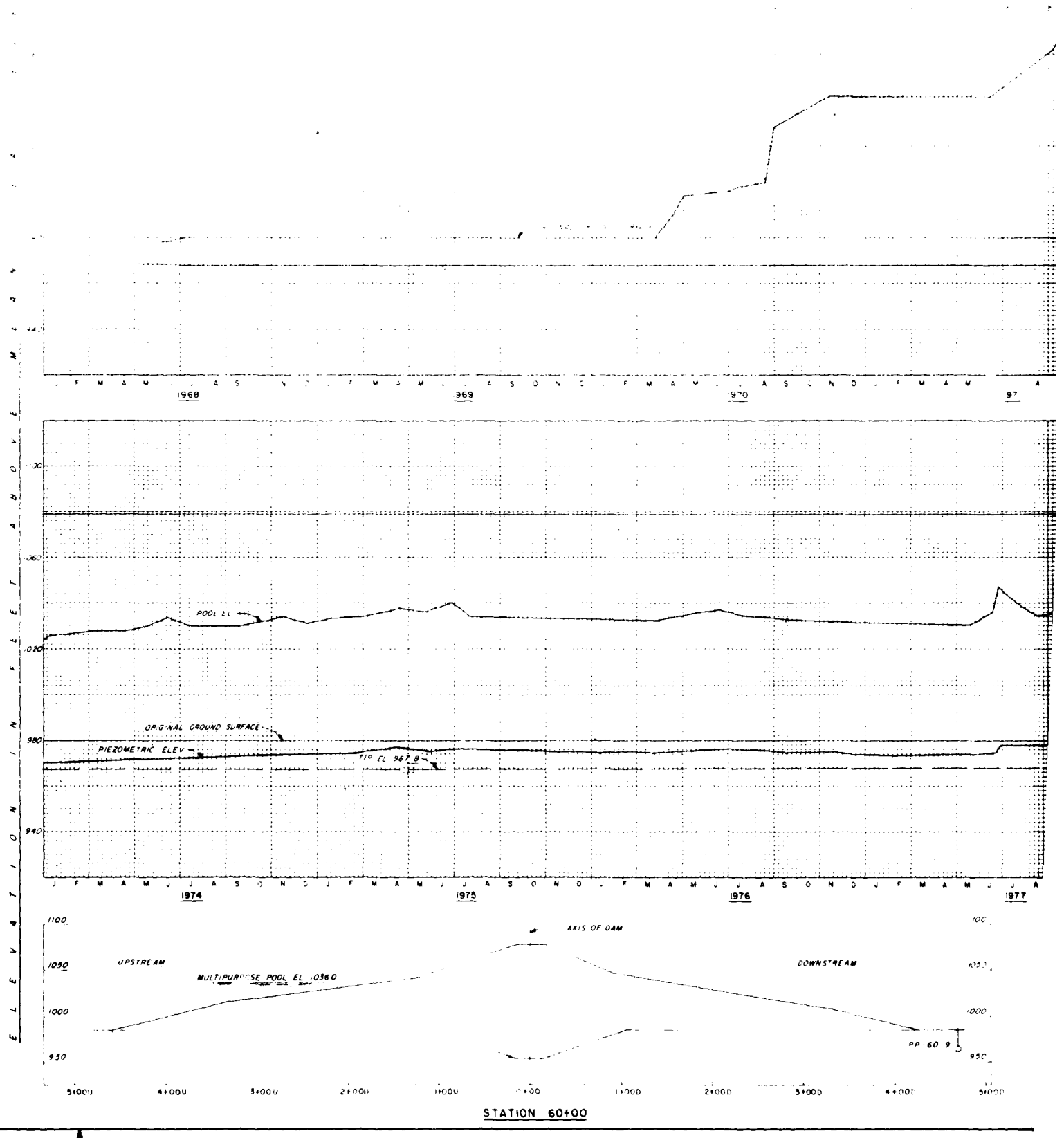
KANSAS CITY DISTRICT

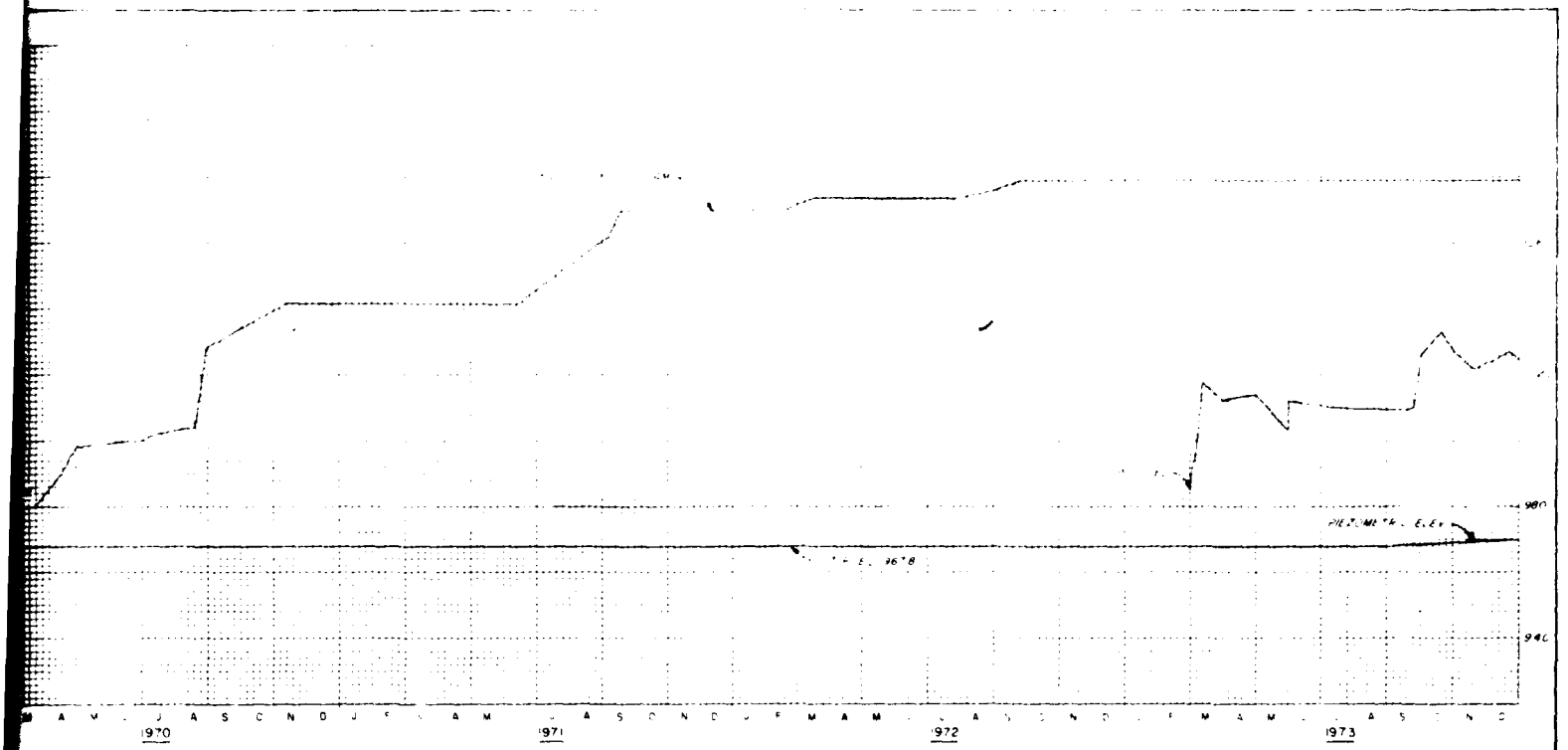
FILE NO. 0-5-1297

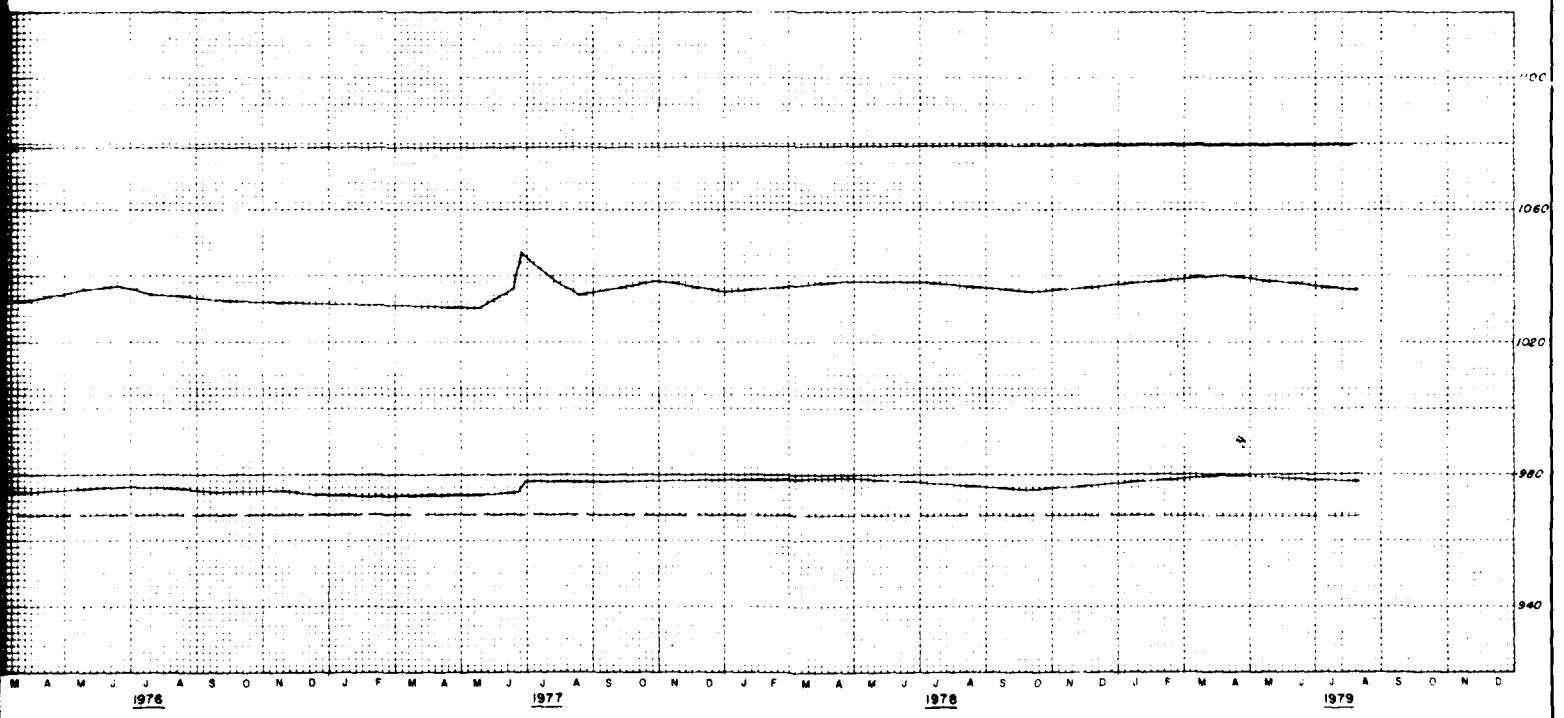
AUGUST 1975

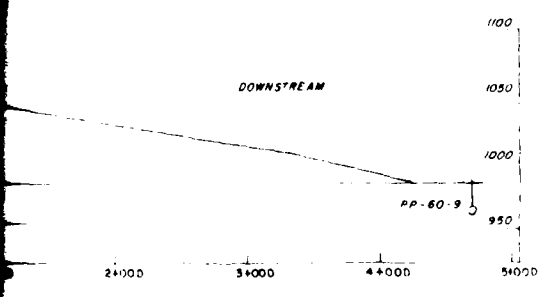
2

PLATE NO. 49


ELEVATION IN FEET ABOVE MEAN
1968
1969
1970
1974
1975
1976
1977
POOL EL
ORIGINAL GROUND SURFACE
PIEZOMETRIC ELEV
TIP EL 967.8
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-60-9
STATION 60+00







LEGEND

OPEN TUBE ..O

PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-9 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

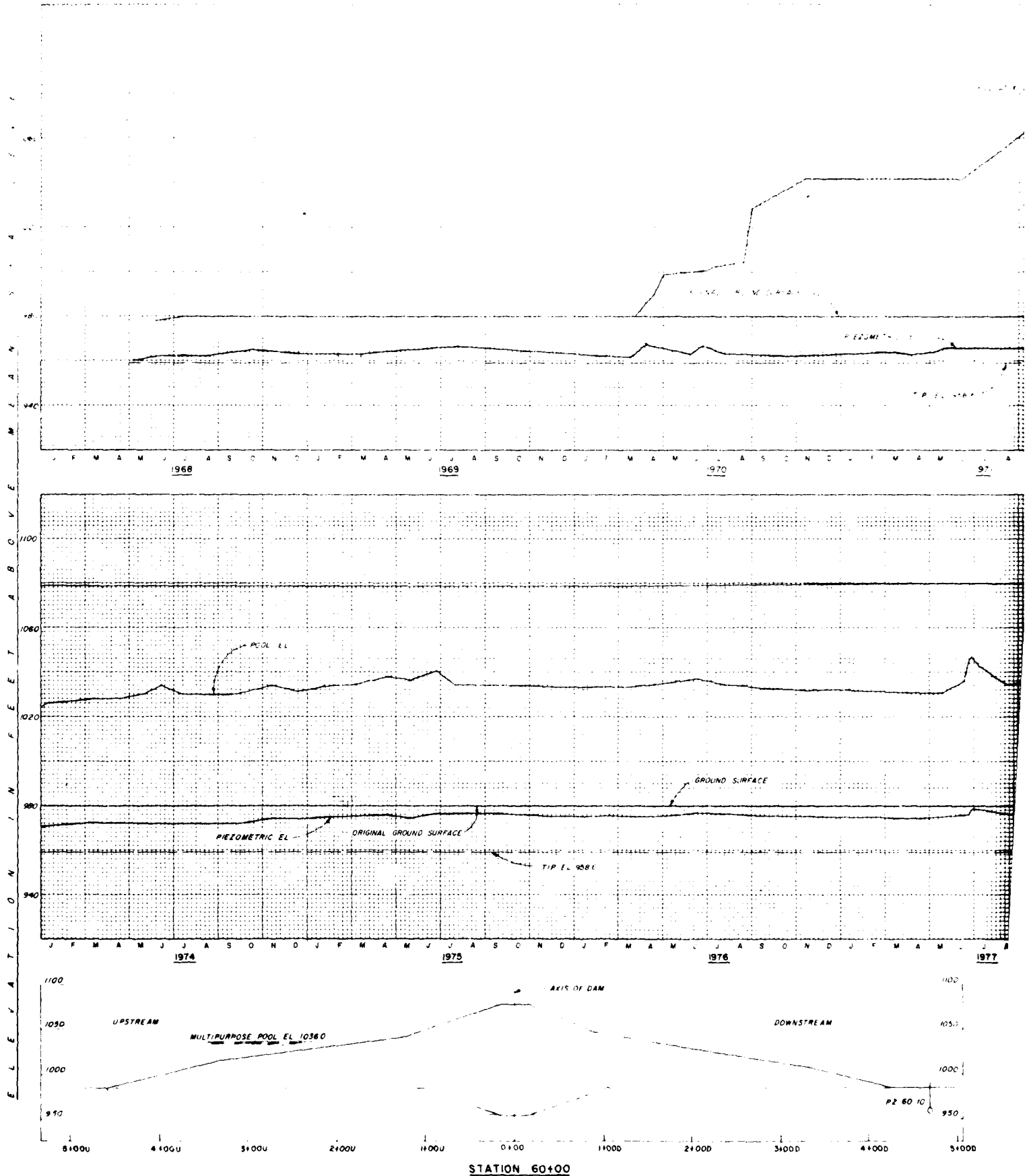
CORPS OF ENGINEERS U.S. ARMY

KANSAS CITY DISTRICT

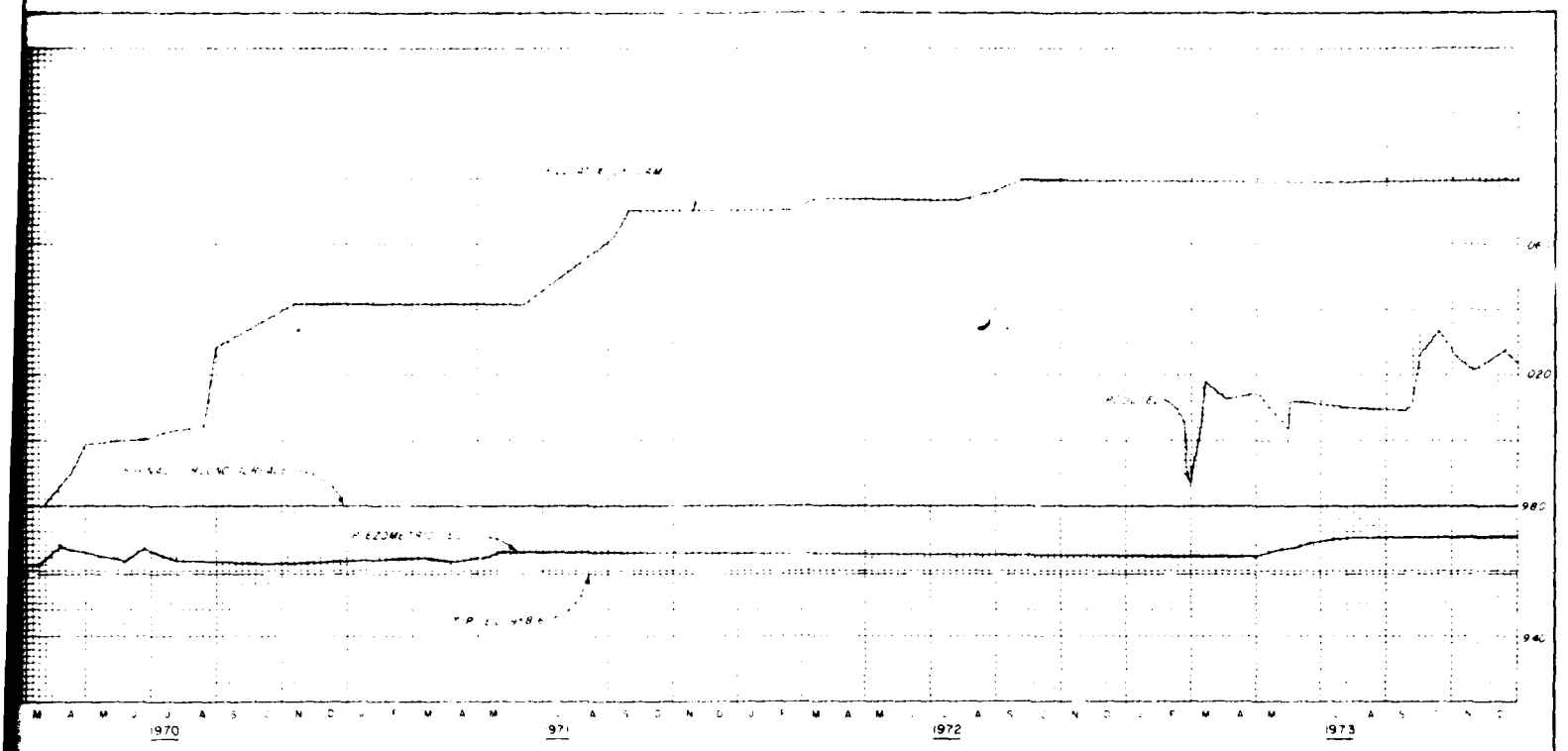
FILE NO. 0-5-1298

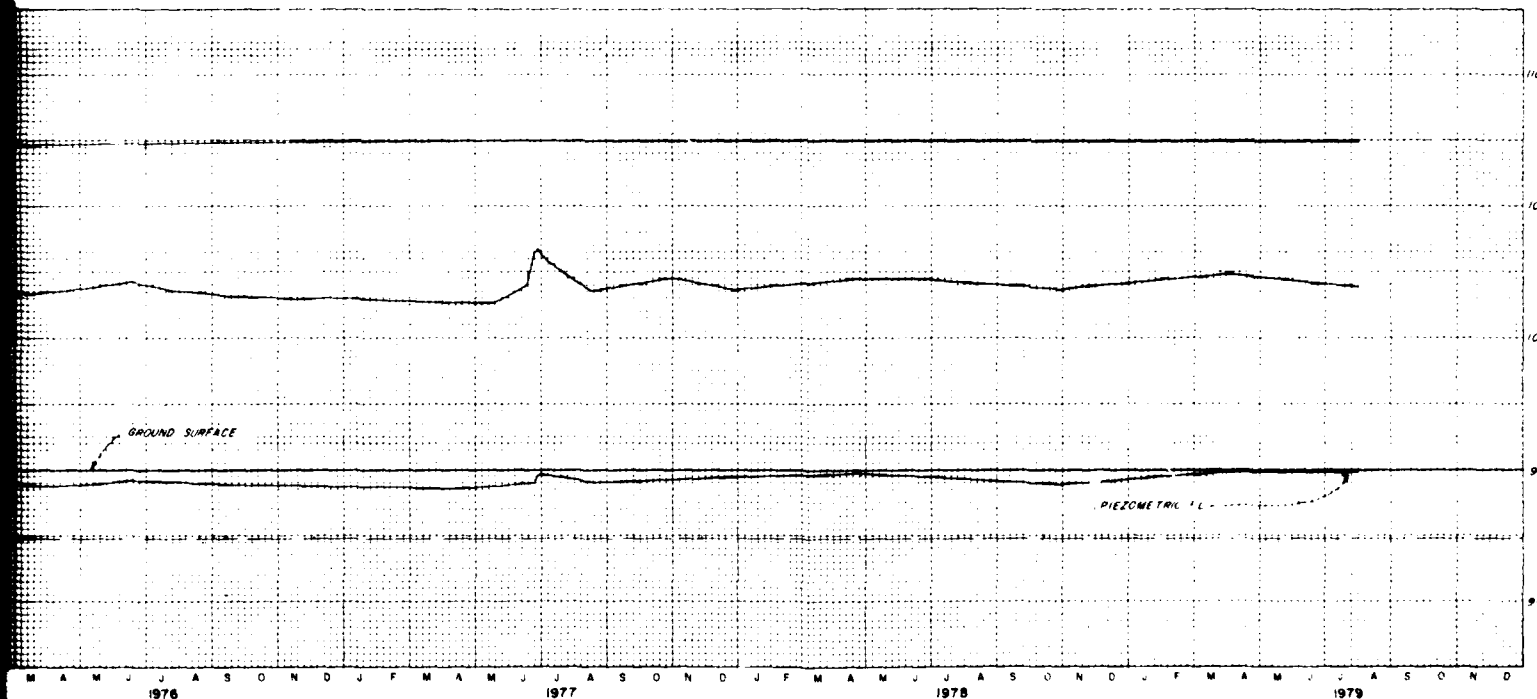
AUGUST 1975

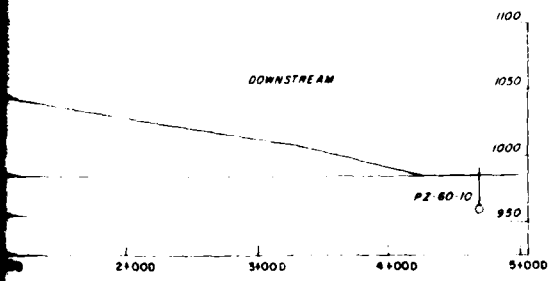
PLATE NO 50



STATION 60+00







LEGEND

OPEN TUBE ..... O
PNEUMATIC CELL ..... ●

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

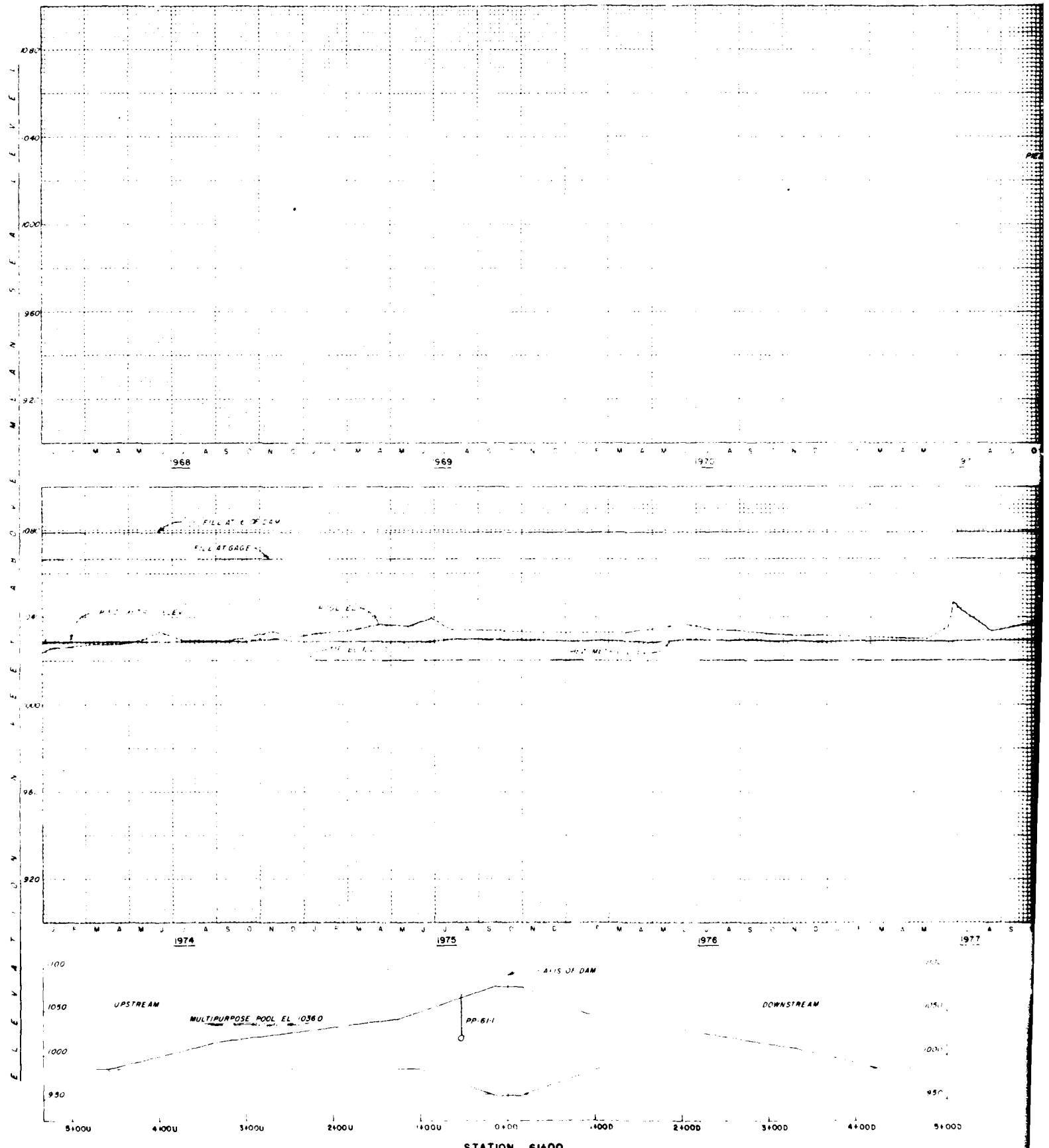
INSTRUMENTATION PLOTS
PZ-60-10 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

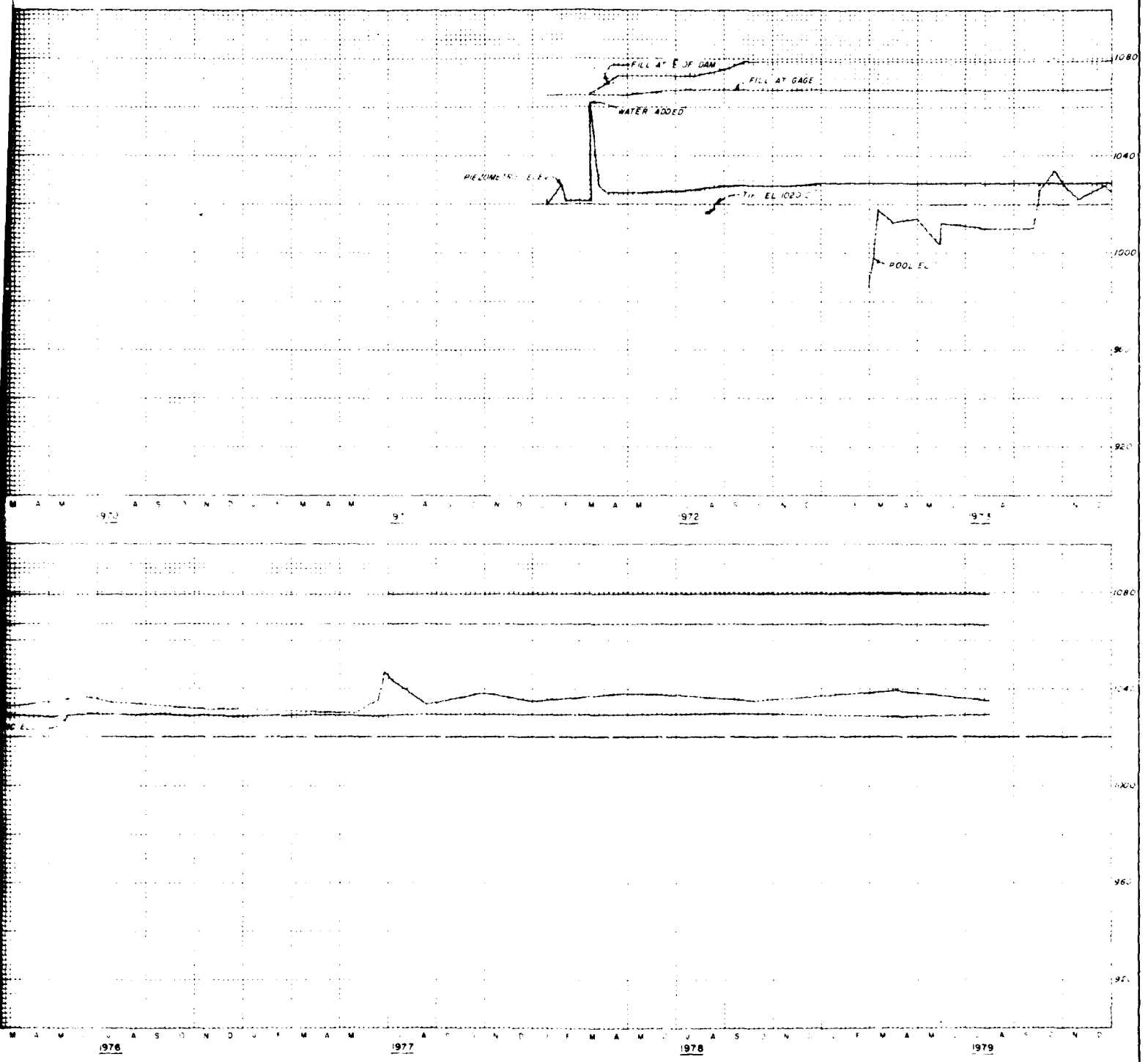
CORPS OF ENGINEERS, U.S. ARMY
KANSAS CITY DISTRICT

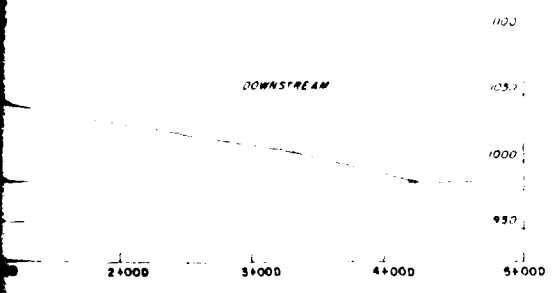
FILE NO 0-5-1299
AUGUST 1975

PLATE NO 51



STATION 61+00





LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

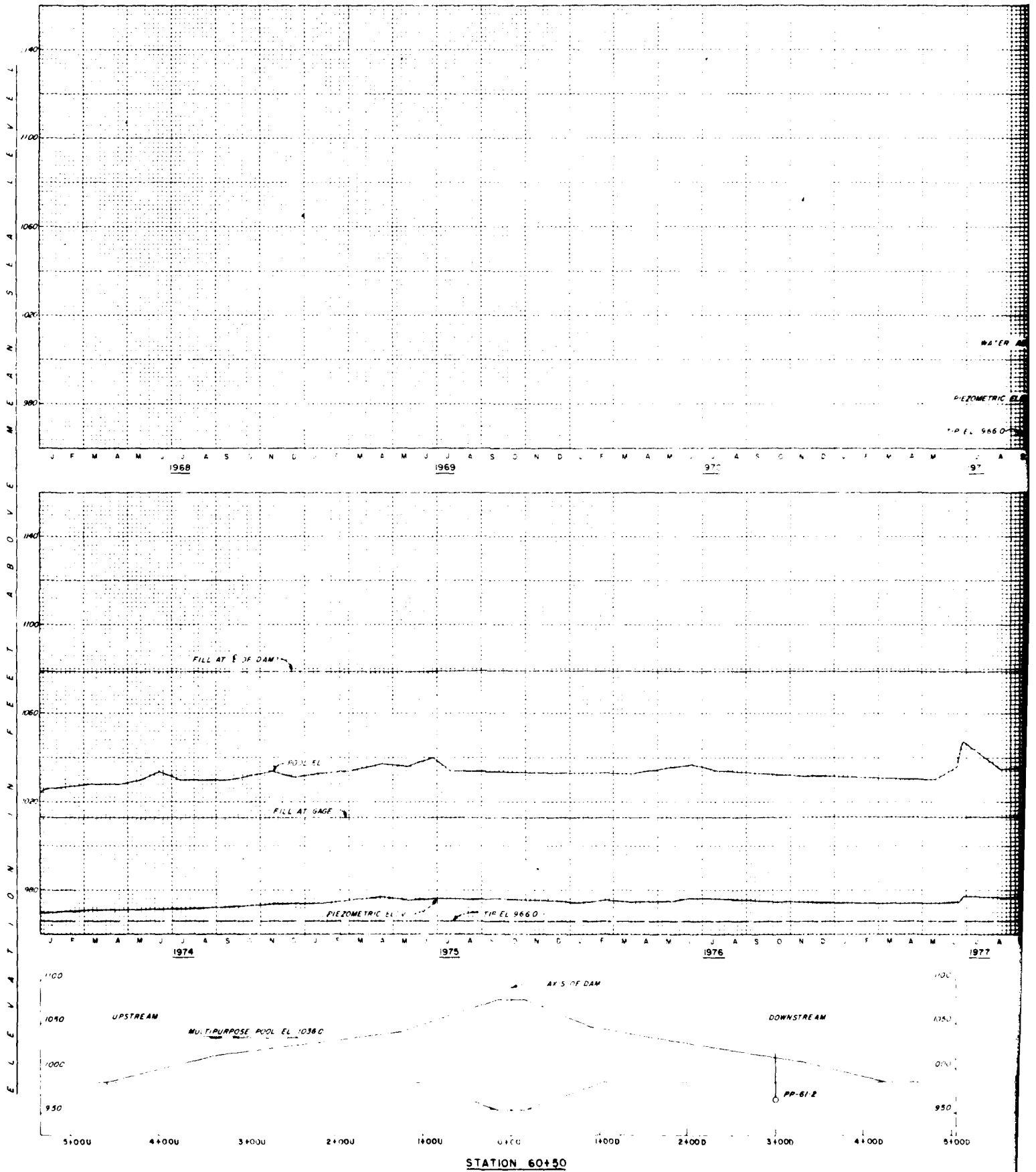
INSTRUMENTATION PLOTS
PP-61-1 (OPEN TUBE)

Sheet No. 2 Scale as Shown

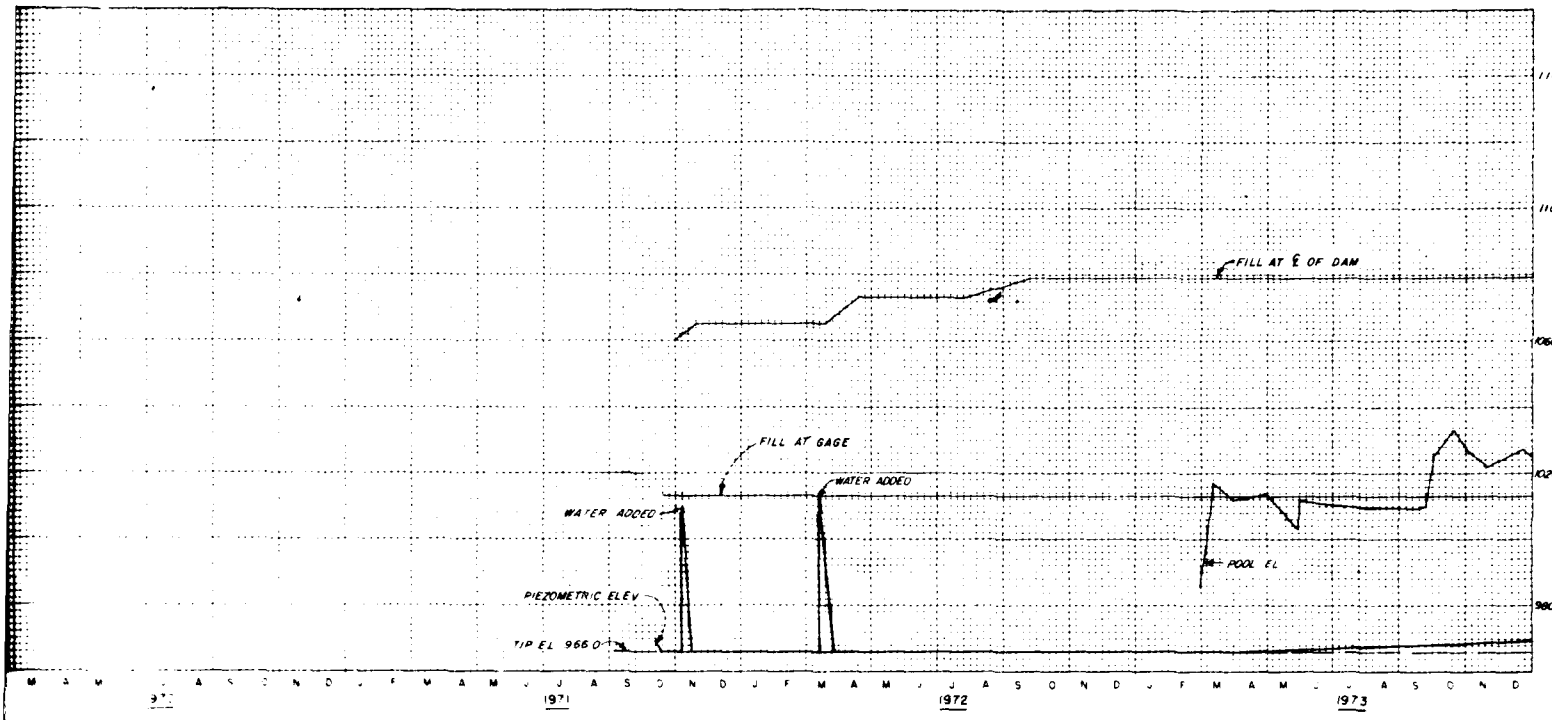
FILE NO 0-5-1300
AUGUST 1975

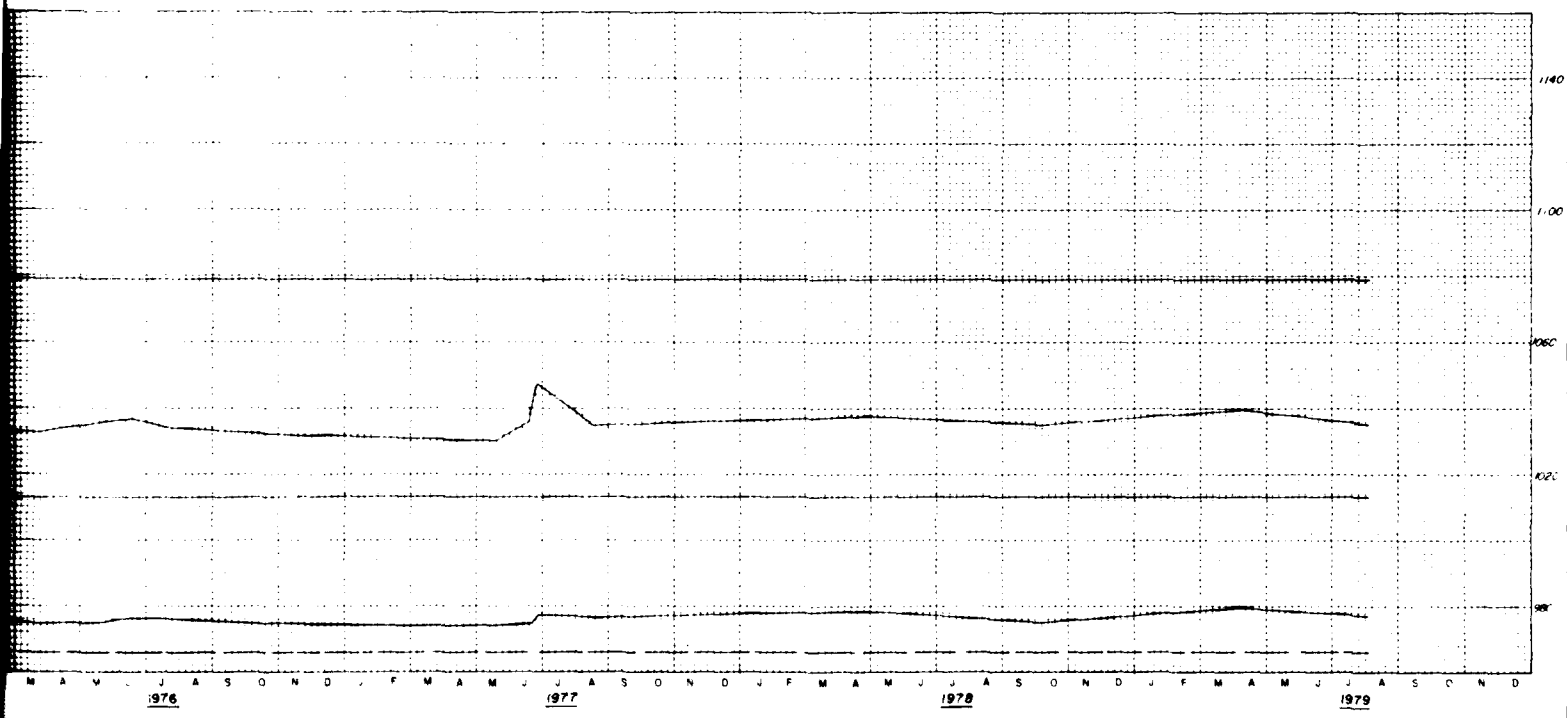
2

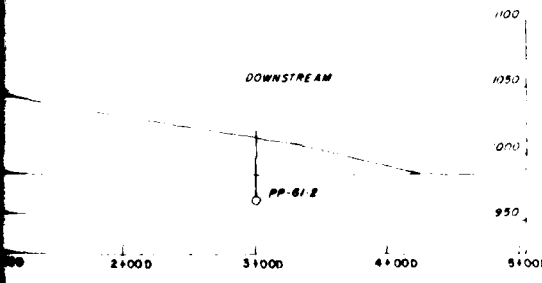
PLATE NO 52



STATION 60+50







LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

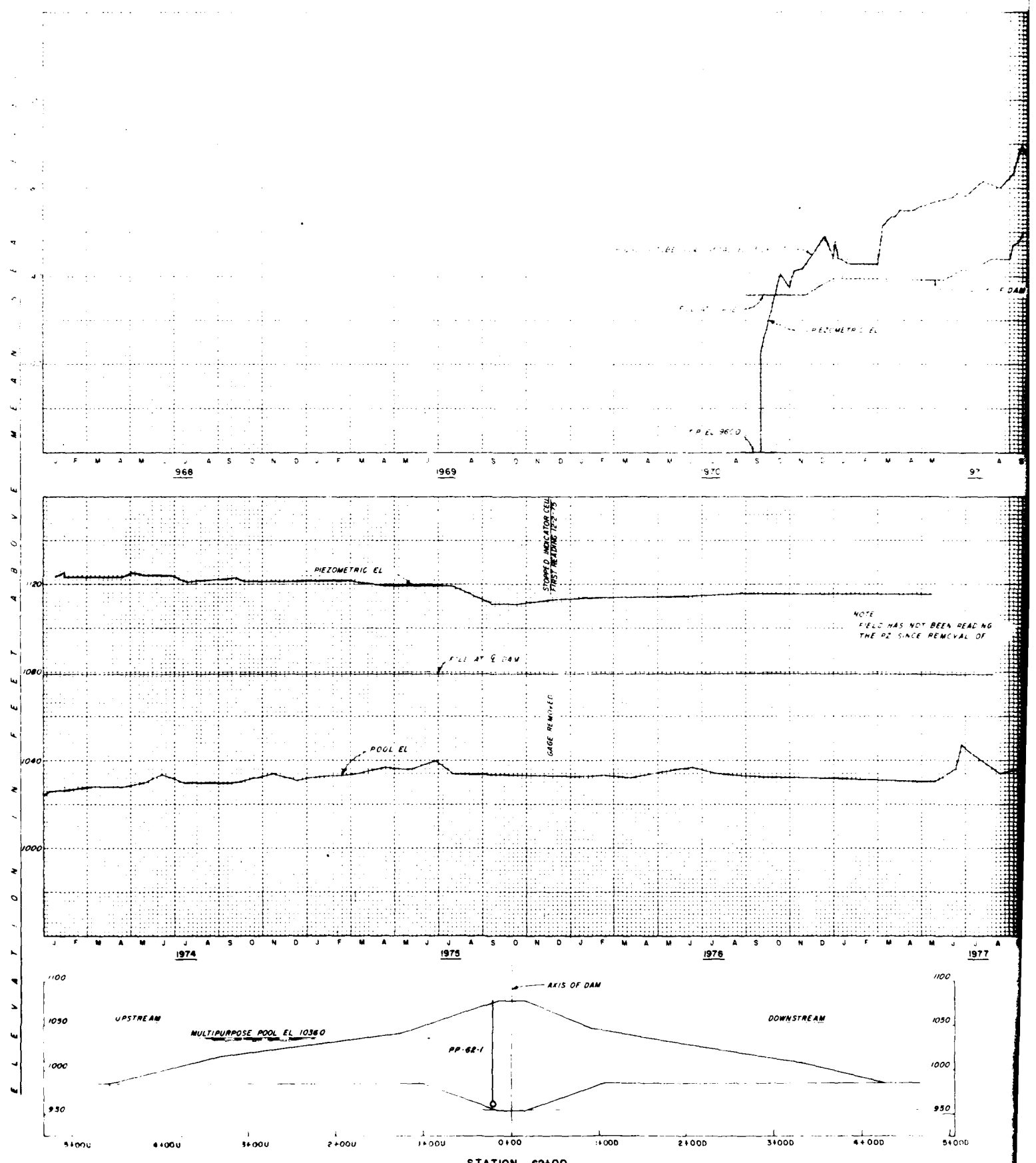
MARAIS DES CYGNES RIVER KANSAS

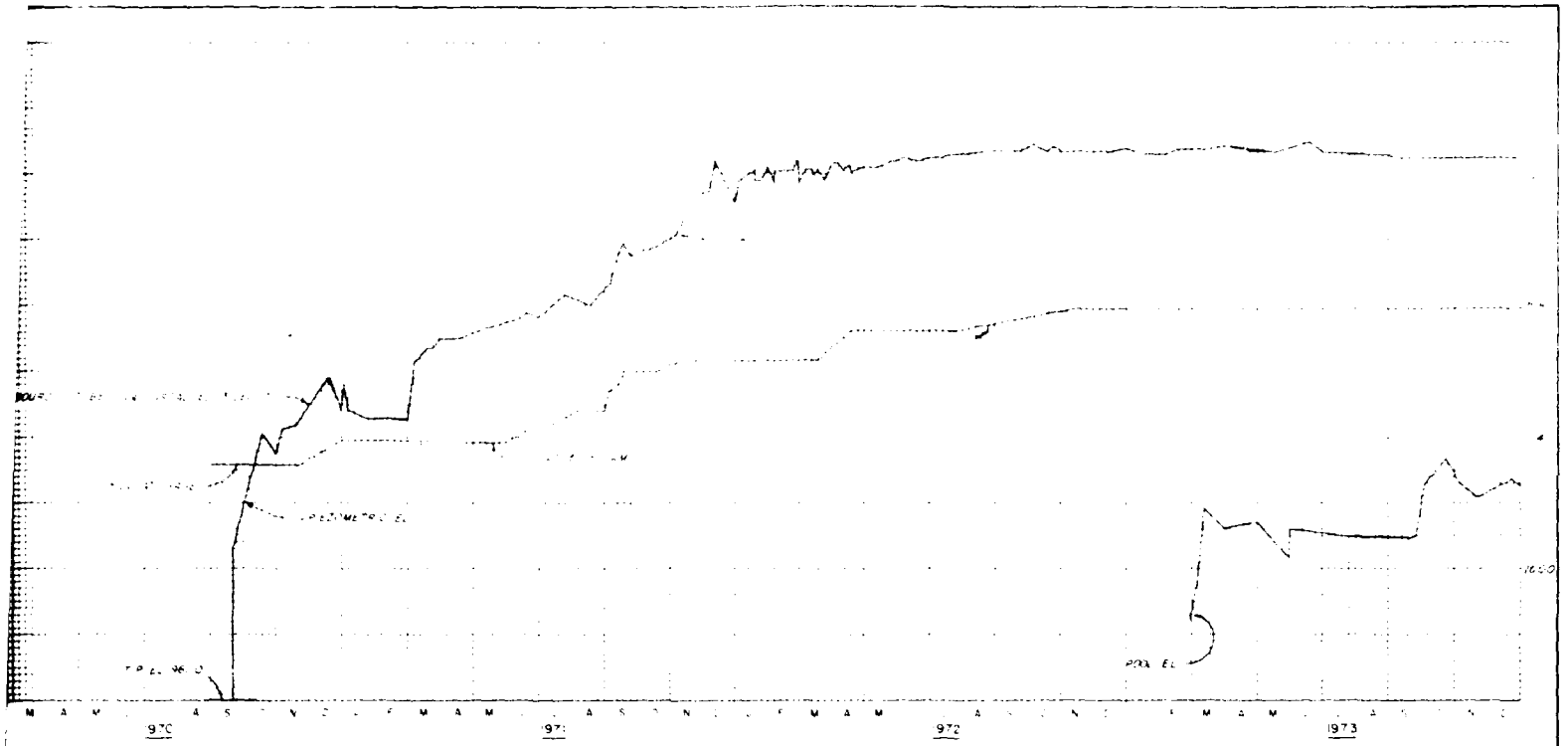
MELVERN LAKE

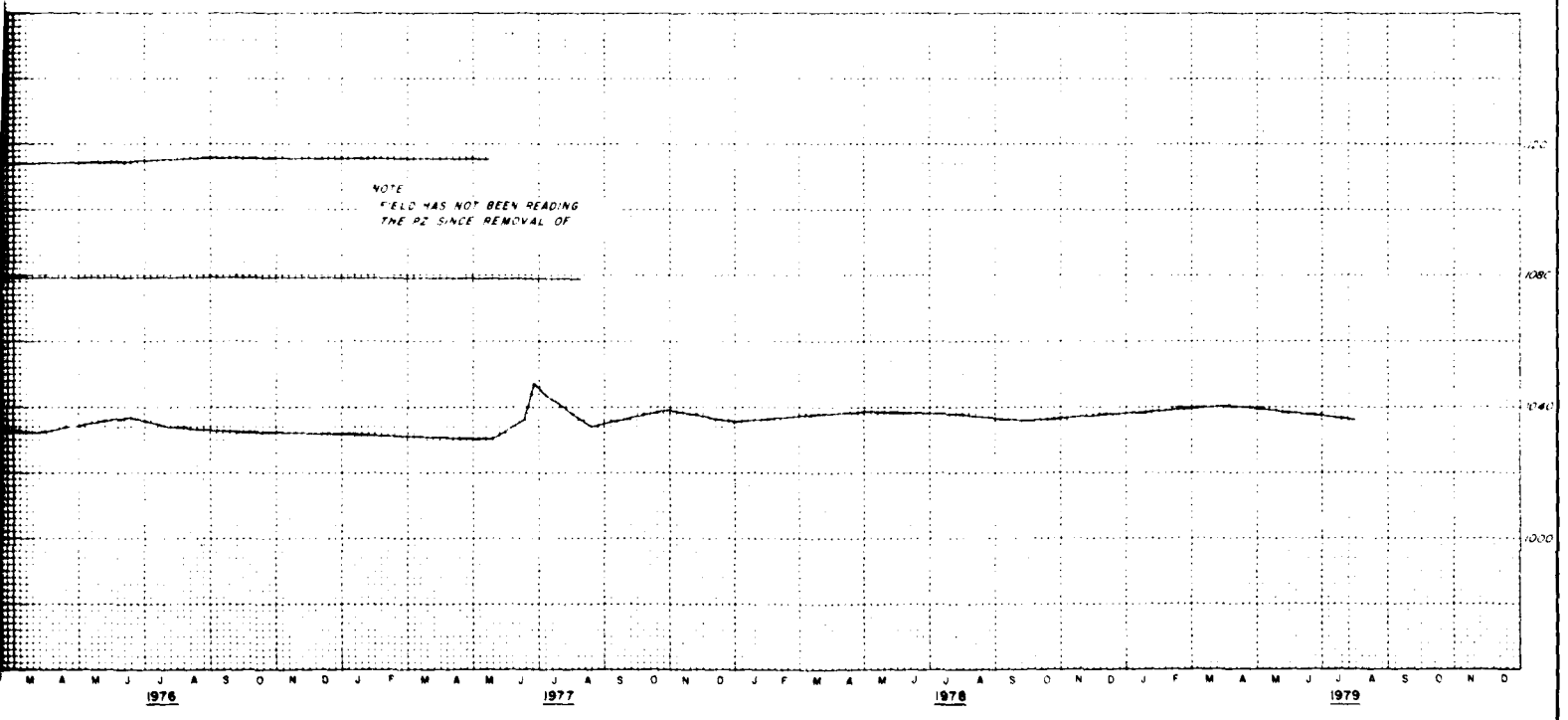
INSTRUMENTATION PLOTS
PP-61-2 (OPEN TUBE)

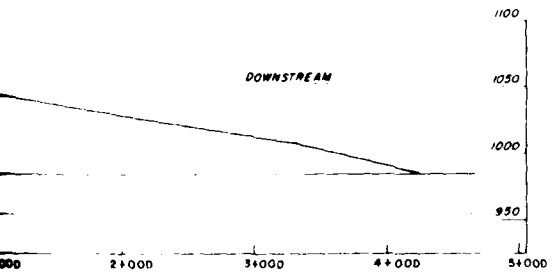
FILE NO 0-5-1301

PLATE NO 53


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
PIEZOMETRIC EL
TOP EL 960.0
1968
1969
1970
PIEZOMETRIC EL
STOPPED INDICATOR CELL FIRST READING 12-2-75
NOTE
FIELD HAS NOT BEEN READING THE PZ SINCE REMOVAL OF
POOL EL
GAGE REMOVED
1974
1975
1976
1977
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-62-1
STATION 62+00







LEGEND

OPEN TUBE ..... O
PNEUMATIC CELL ..... ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS PP-62-1 (OPEN TUBE)

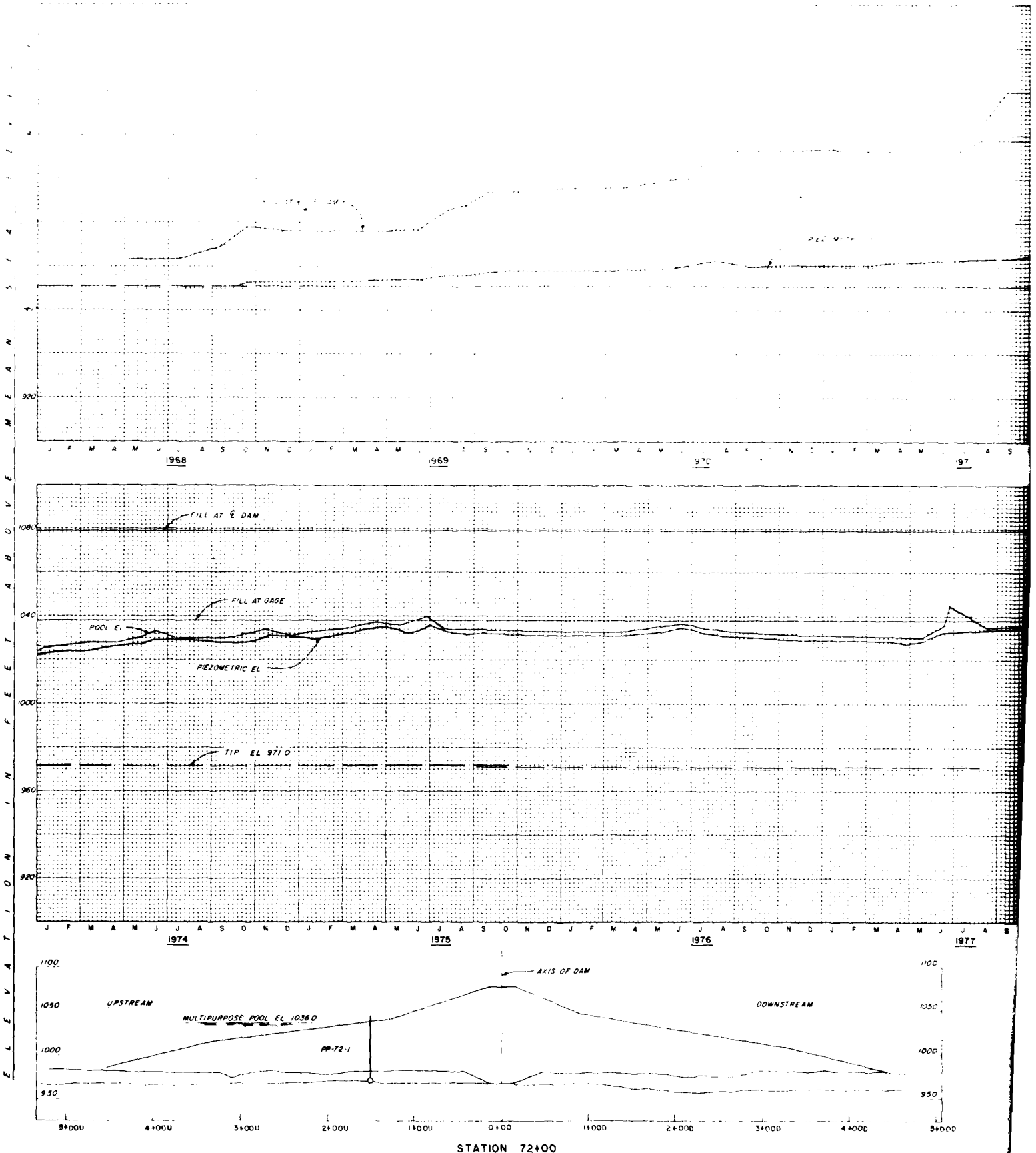
In 1 sheet | Sheet No. 1 | Scale as shown

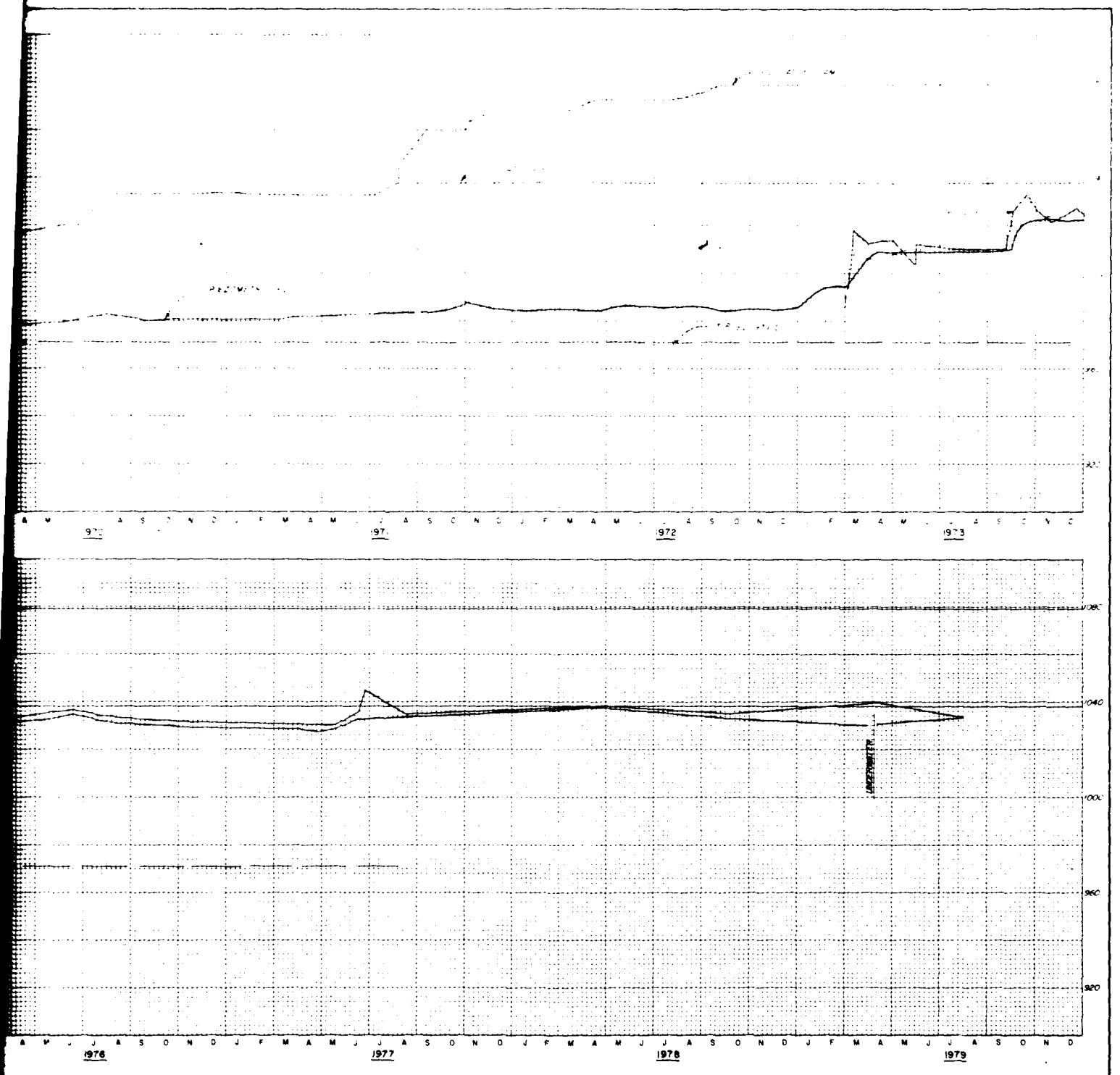
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

FILE NO 0-5-1302

AUGUST 1975

PLATE NO. 54


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
920
1968
1969
1974
1975
1976
1977
FILL AT ℄ DAM
1080
FILL AT GAGE
040
POOL EL
PIEZOMETRIC EL
1000
TIP EL 971.0
960
920
1100
1050
1000
950
UPSTREAM
MULTIPURPOSE POOL EL 1036.0
PP-72-1
AXIS OF DAM
DOWNSTREAM
5+000U
4+000U
3+000U
2+000U
1+000U
0+00
1+000
2+000
3+000
4+000
5+000
STATION 72+00



LEGEND

OPEN TUBE ..... O

PNEUMATIC CELL ..... ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS

PP-72-1 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

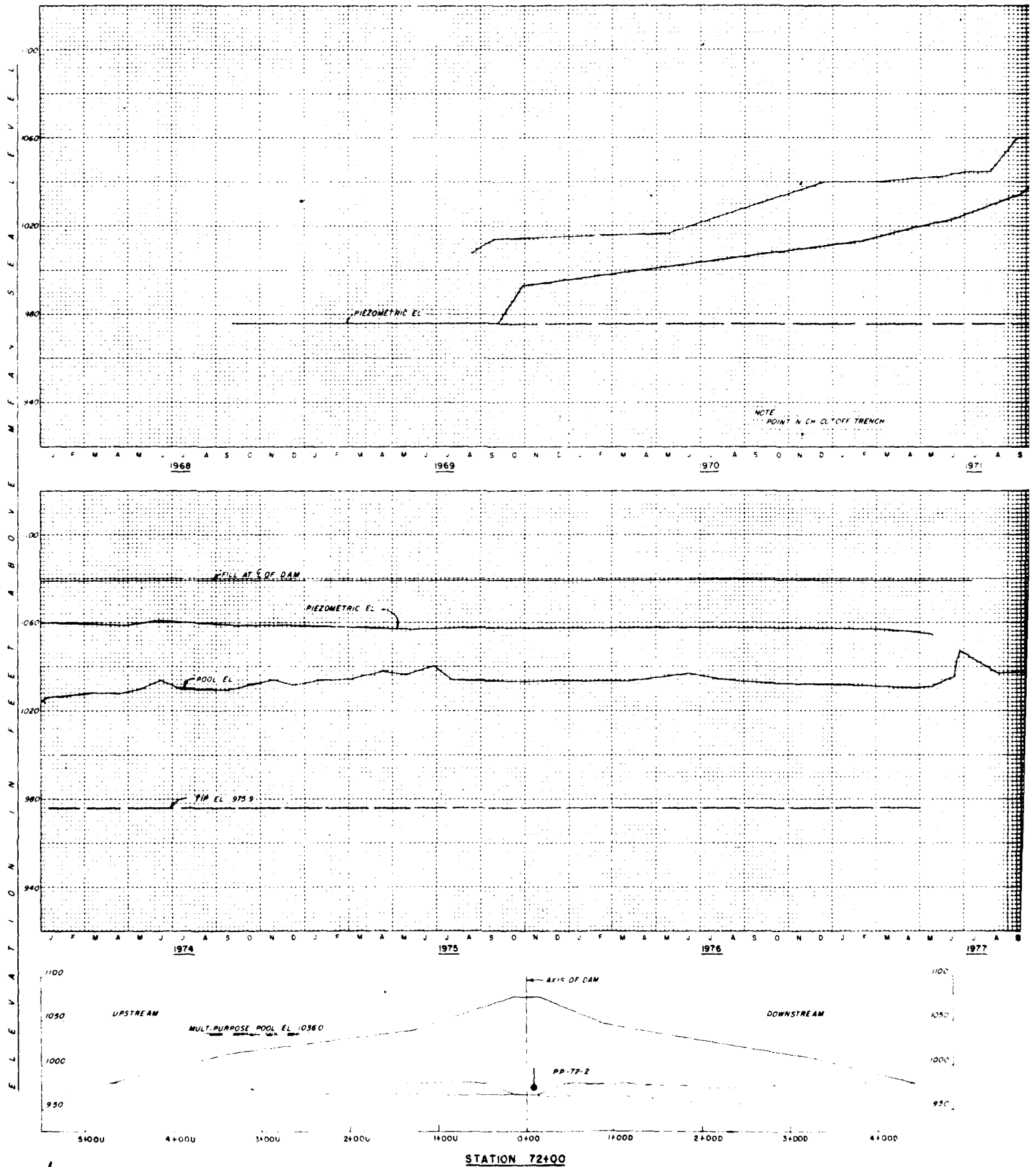
CORPS OF ENGINEERS U. S. ARMY

KANSAS CITY DISTRICT

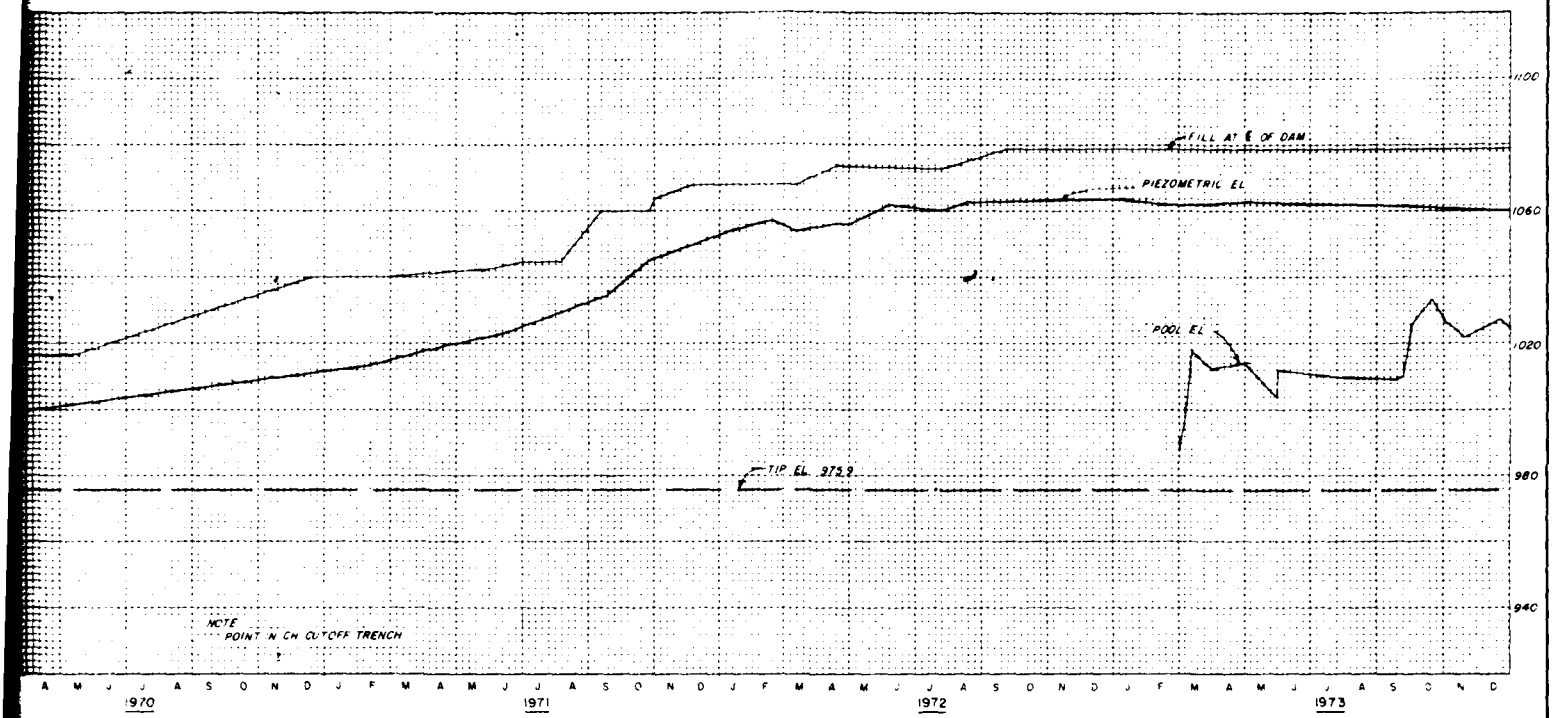
FILE NO. 0-5-1303

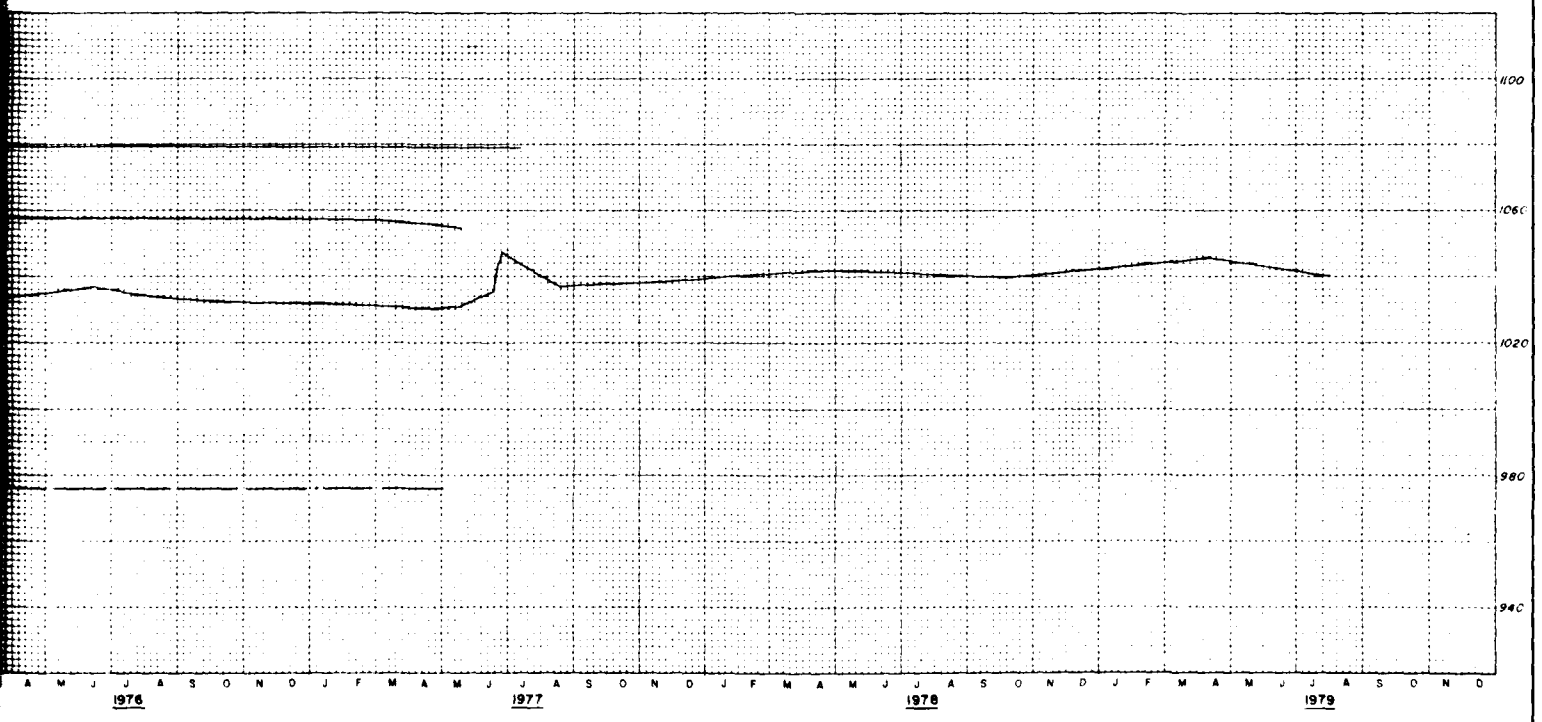
AUGUST 1975

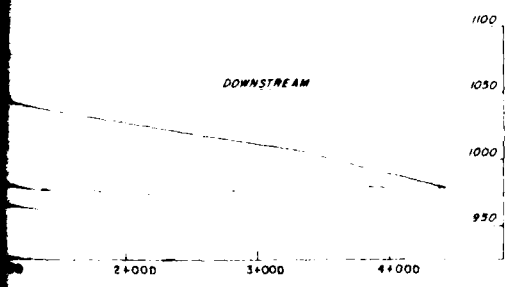
PLATE NO. 55



STATION 72+00







LEGEND

OPEN TUBE ..... O
PNEUMATIC CELL ..... ●

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

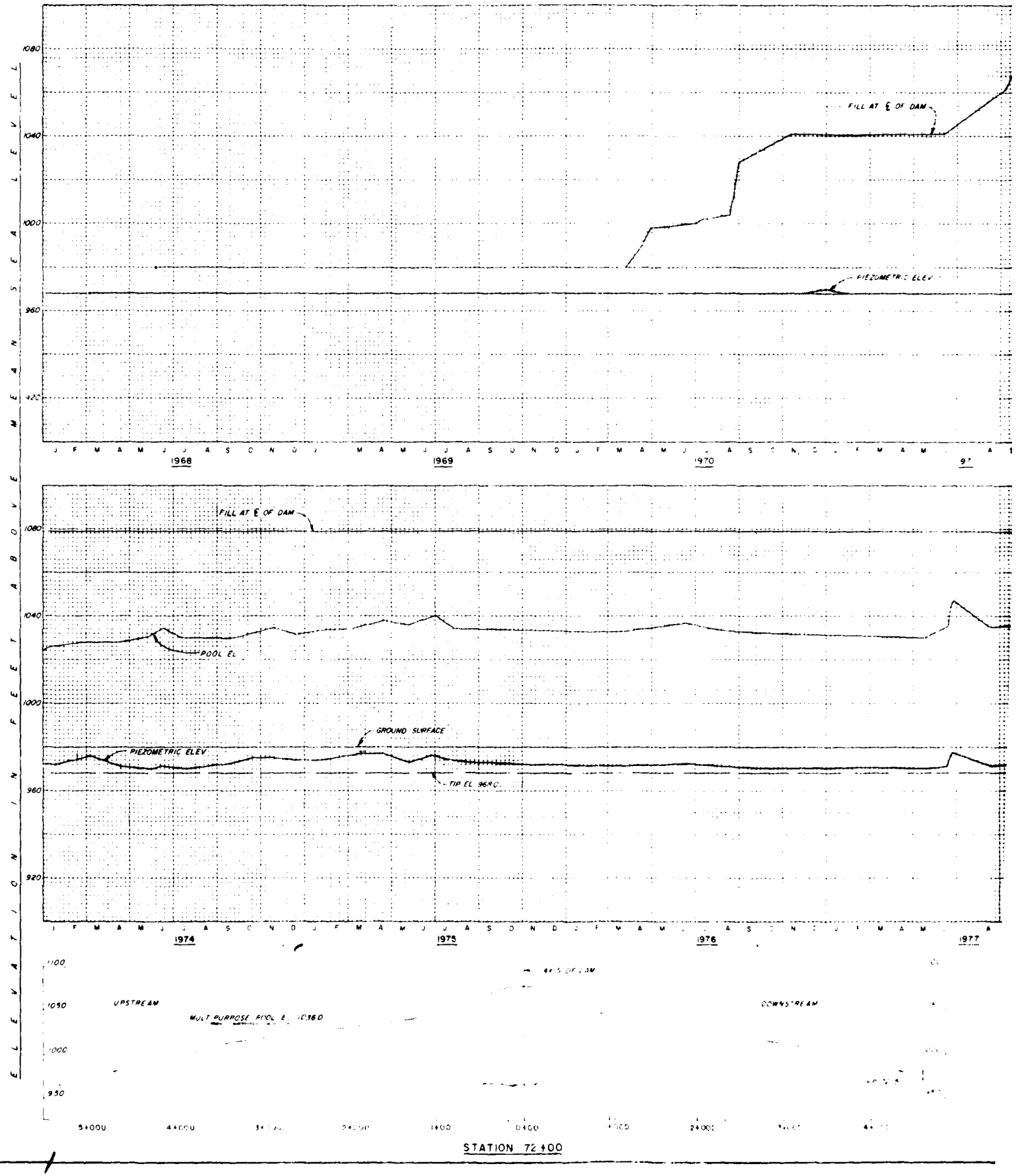
INSTRUMENTATION PLOTS
PP-72-2 (SHANNON-WILSON CELL)

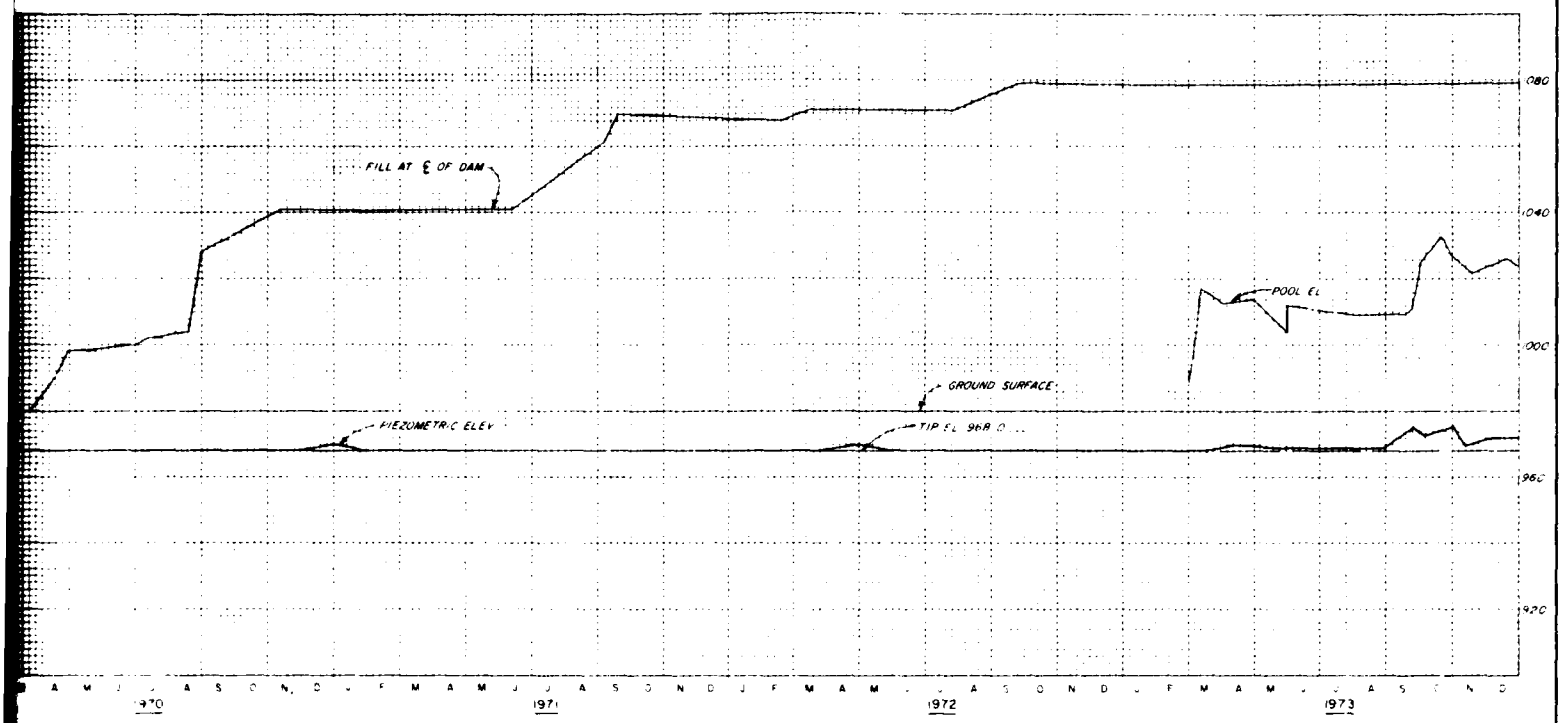
In 1 sheet | Sheet No. 1 | Scale as shown

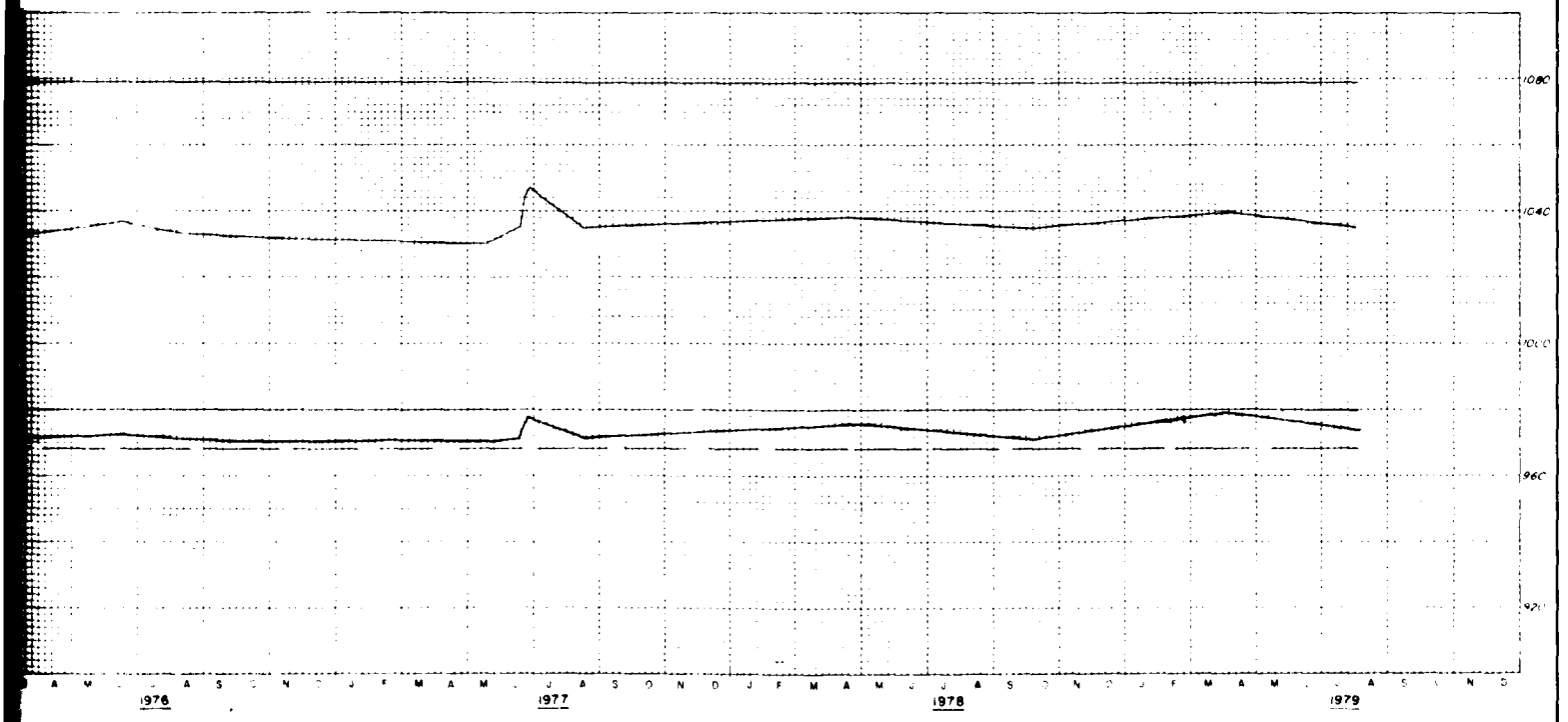
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

FILE NO 0-5-1304
AUGUST 1975

PLATE NO. 56


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1080
1040
1000
960
920
FILL AT ℄ OF DAM
PIEZOMETRIC ELEV.
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M A
1968
1969
1970
FILL AT ℄ OF DAM
POOL EL.
GROUND SURFACE
PIEZOMETRIC ELEV.
TIP EL. 969.0
1974
1975
1976
1977
UPSTREAM
DOWNSTREAM
MULT PURPOSE POOL E
1050
950
STATION 72+00





LEGEND

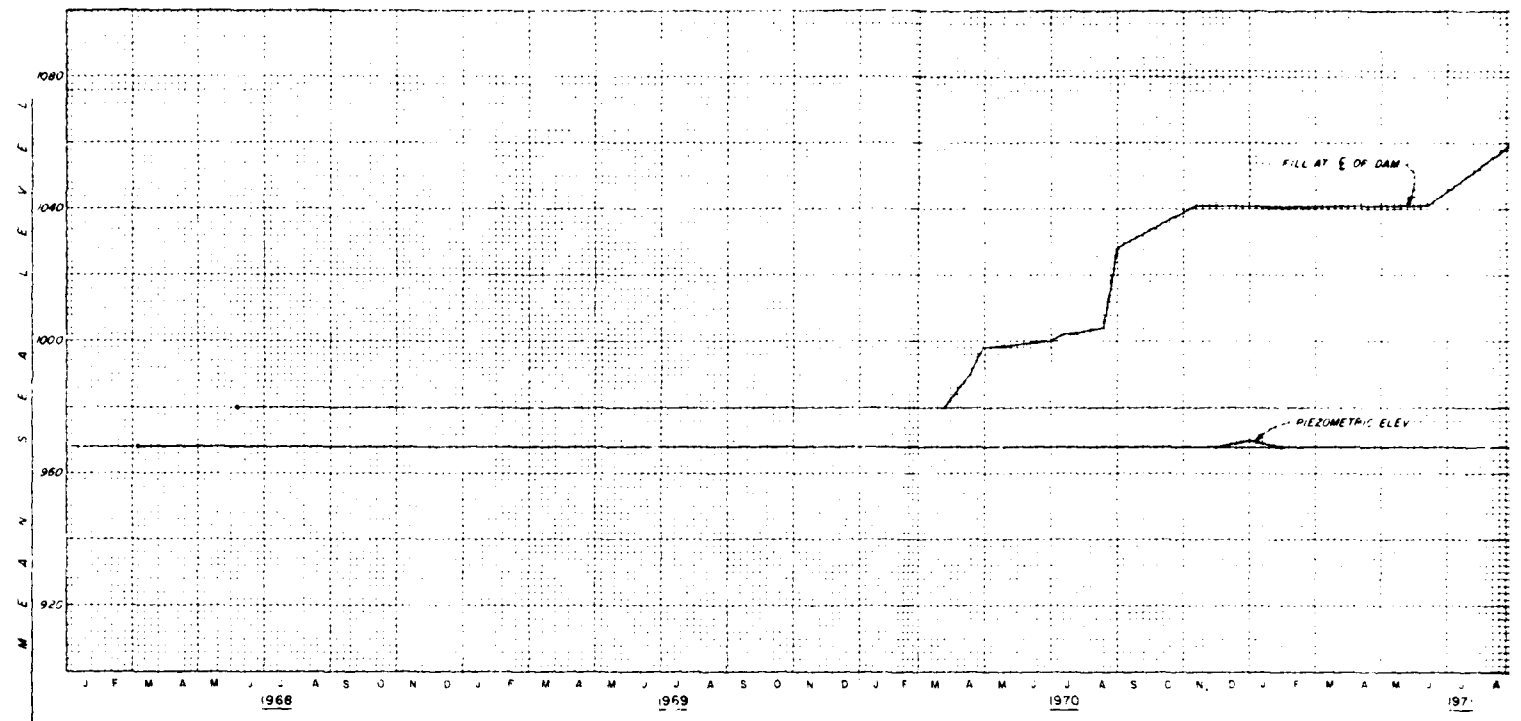
OPEN TUBE

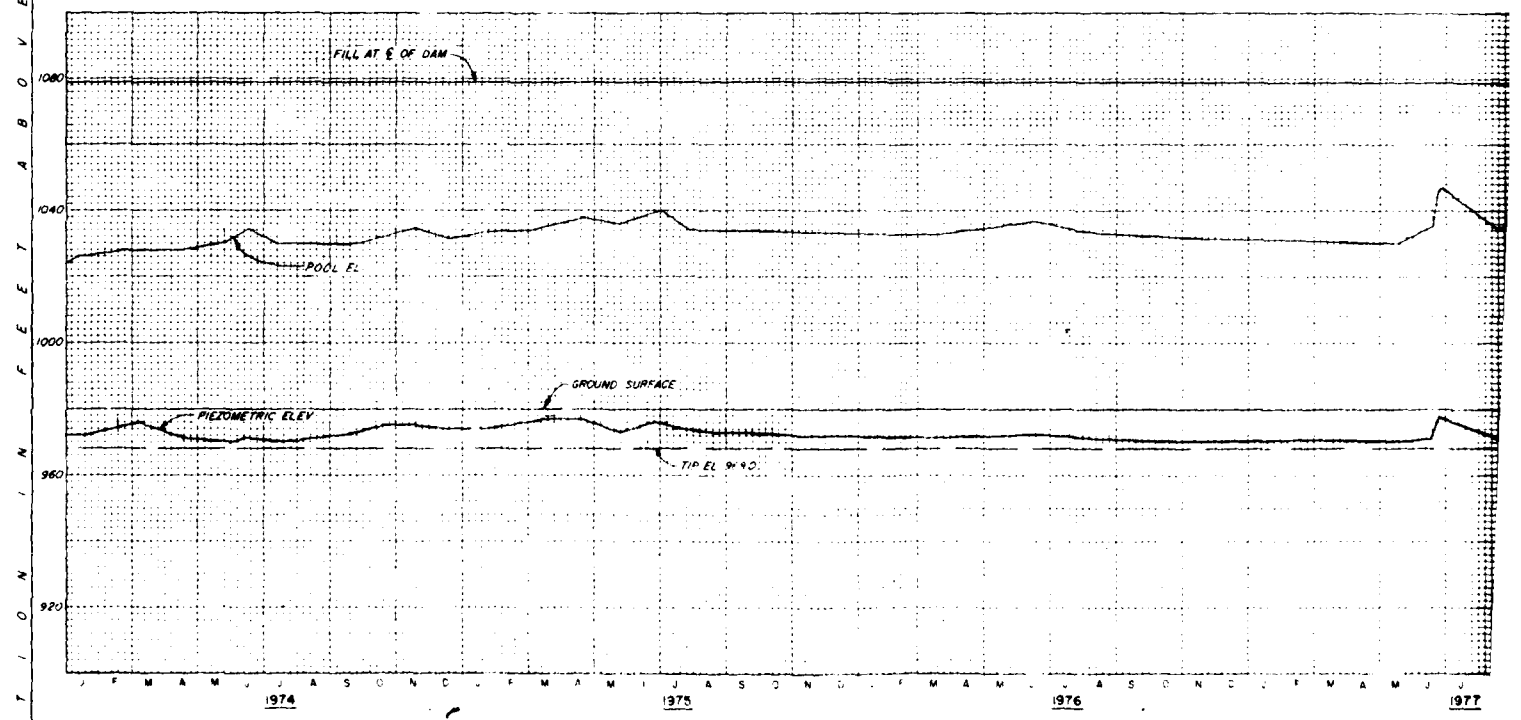
PNEUMATIC CELL ●

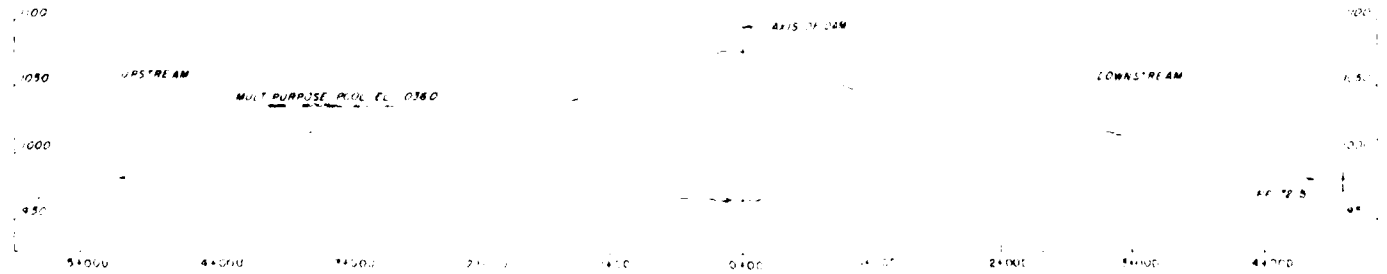
MELVERN LAKE

INSTRUMENTATION PLOTS
PP 72-5 (OPEN TUBE)

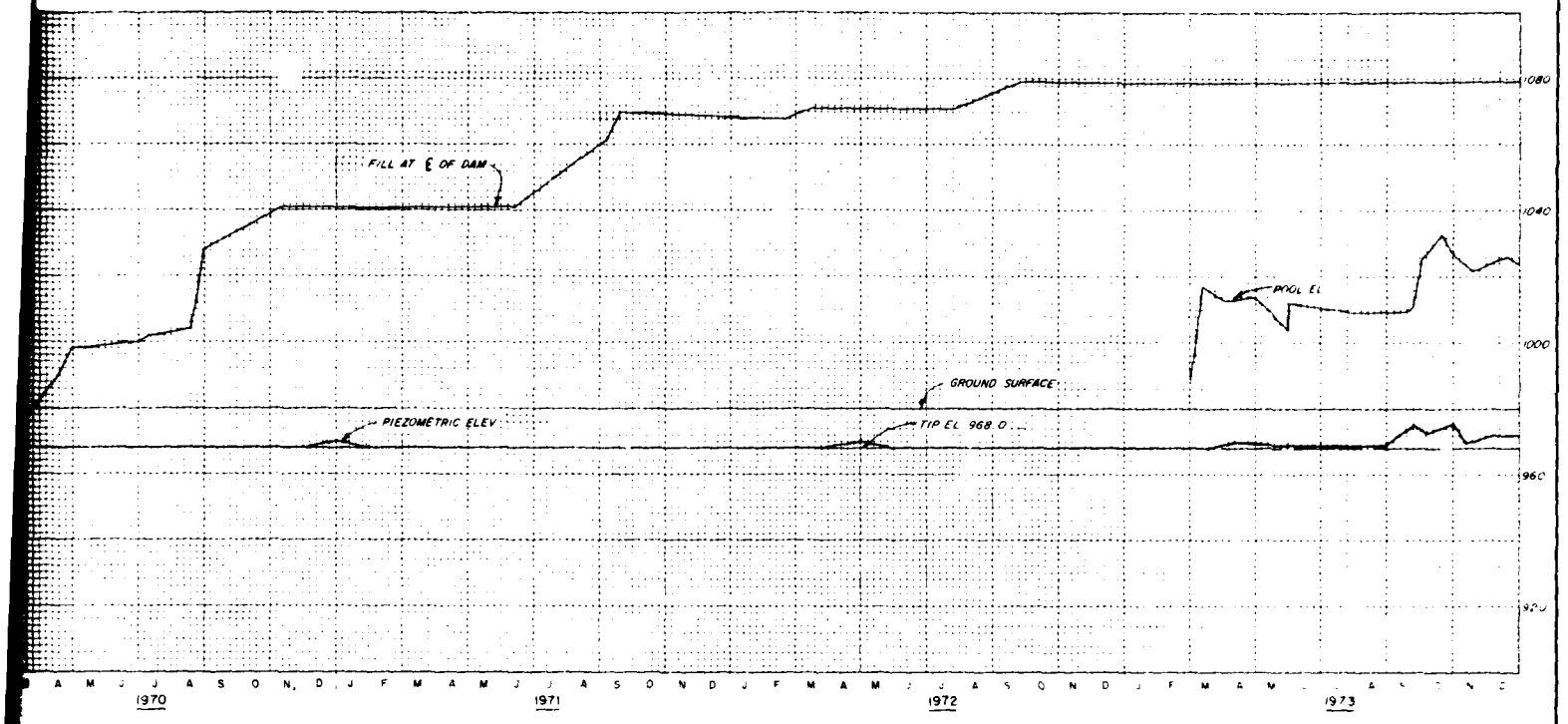
FILE NO 0-5-1305

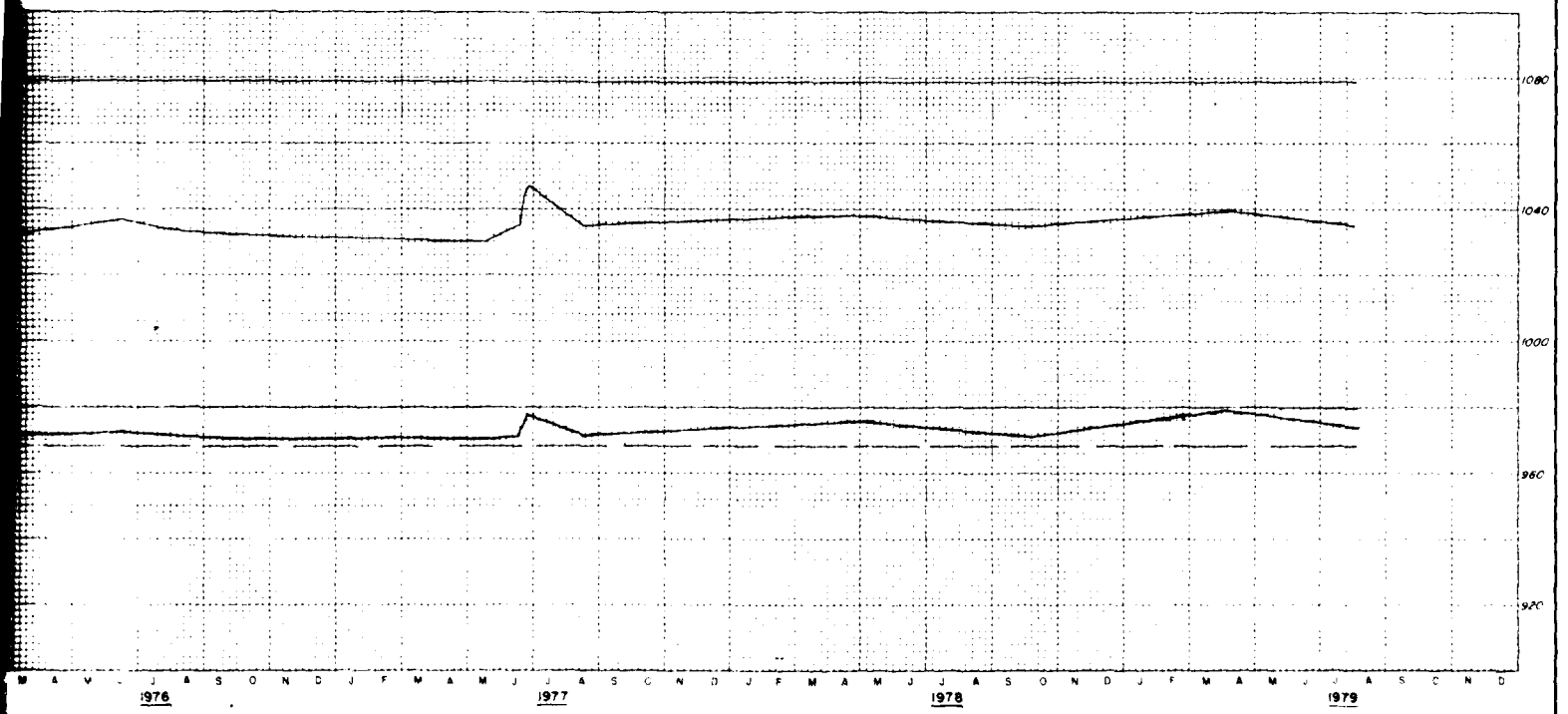


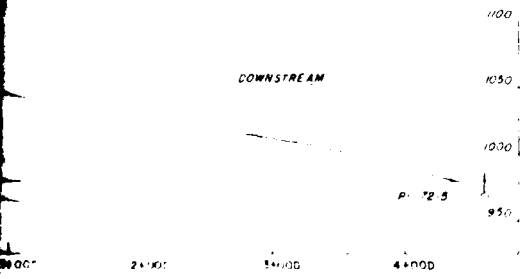




STATION 72+00







LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP 72-5 (OPEN TUBE)

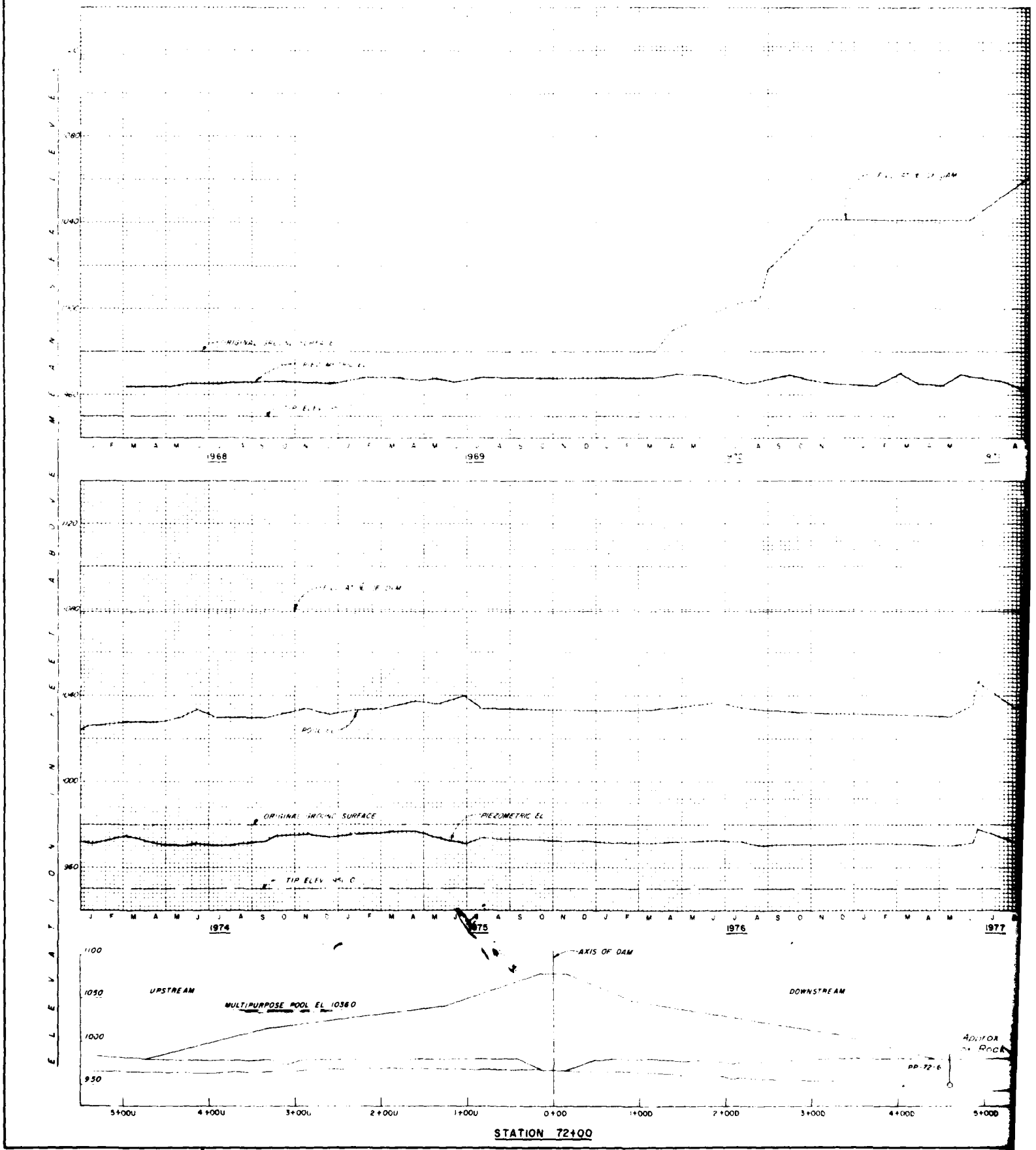
In 1 Sheet

Scale as shown

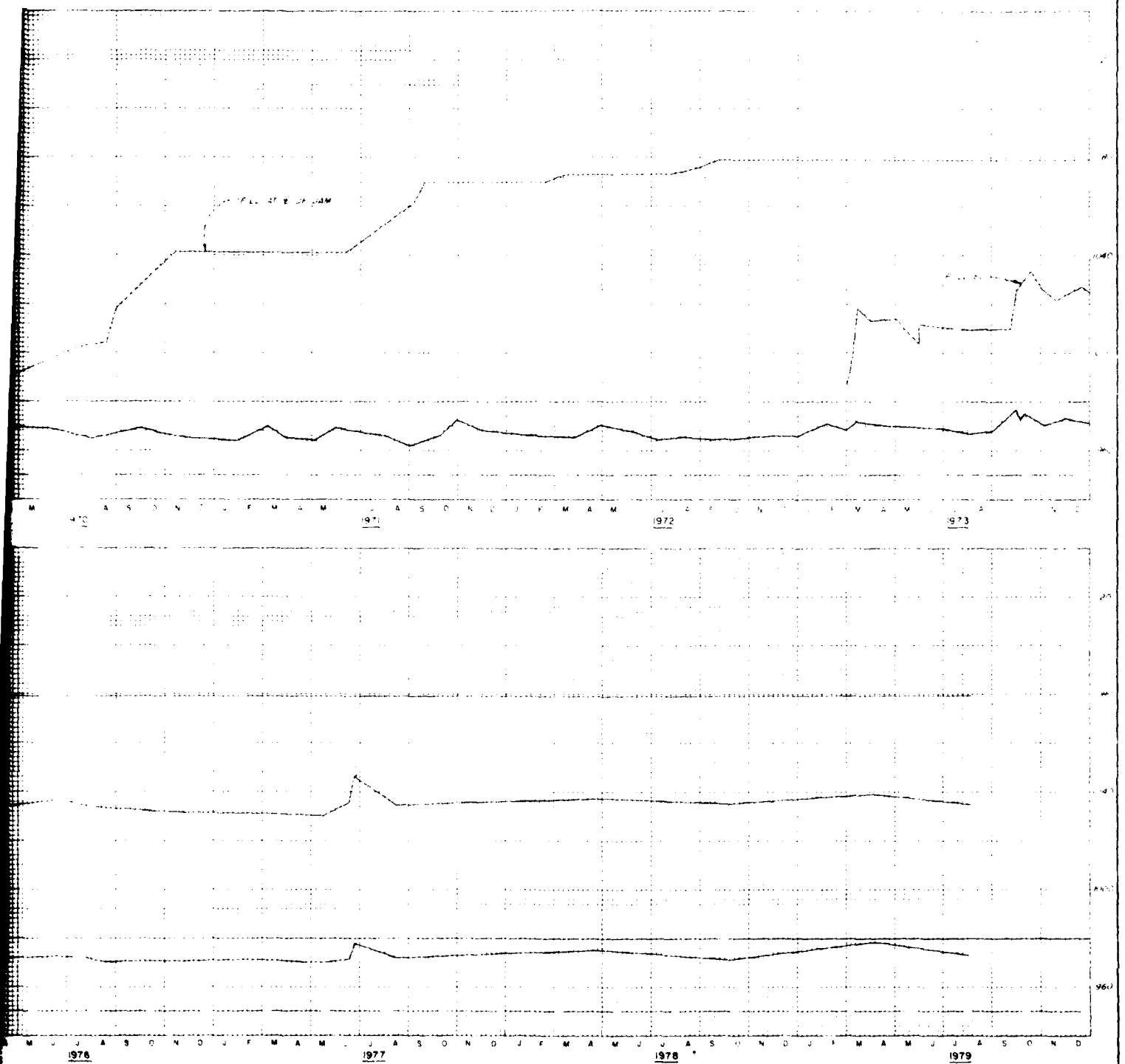
FILE NO 0-5-1305

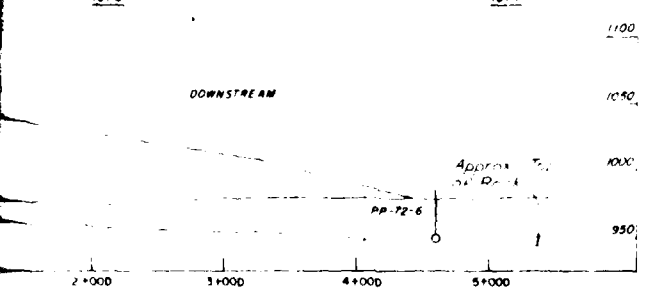
AUGUST 1975

PLATE NO 57



STATION 72+00





LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-72-6 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY

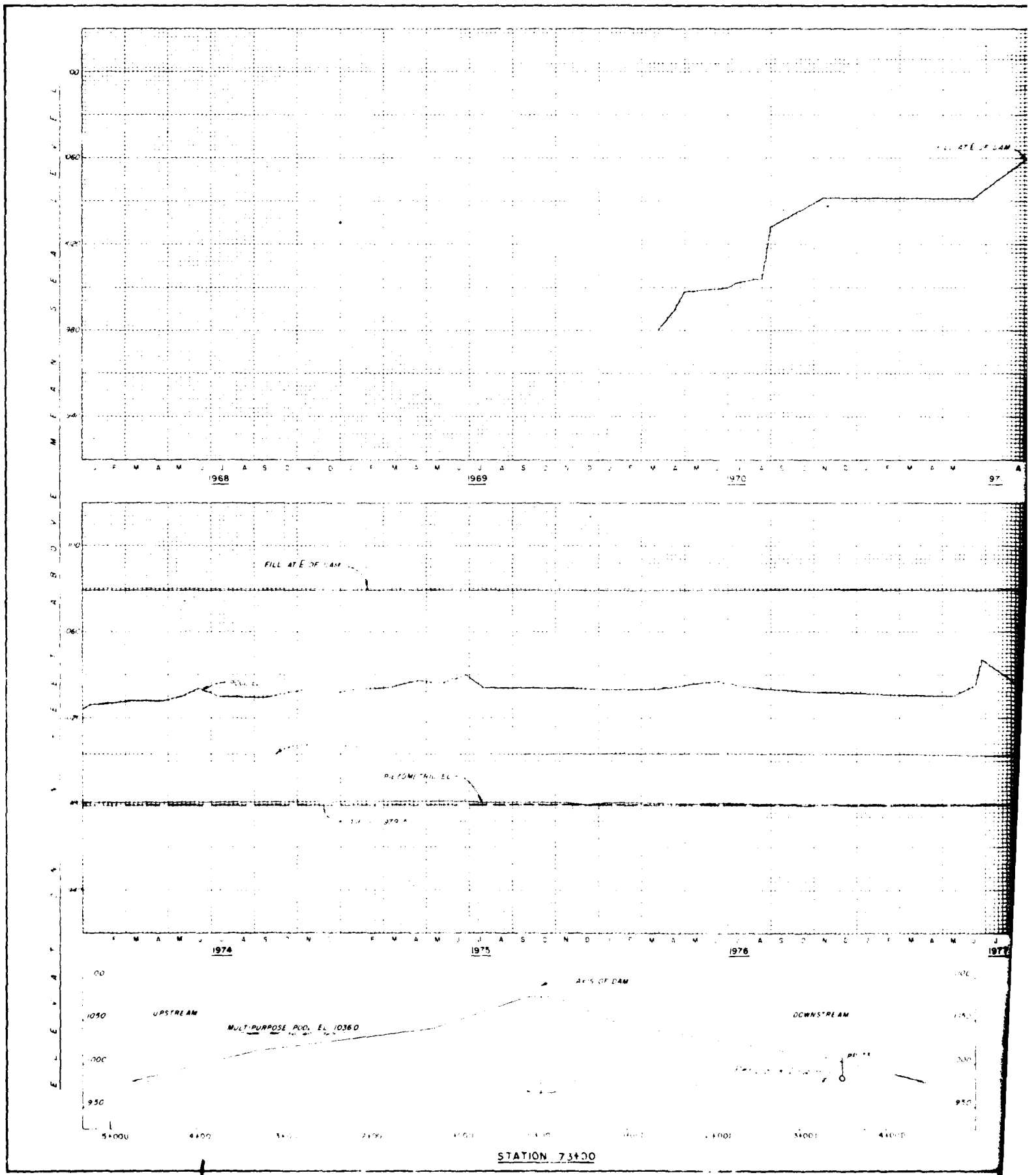
KANSAS CITY DISTRICT

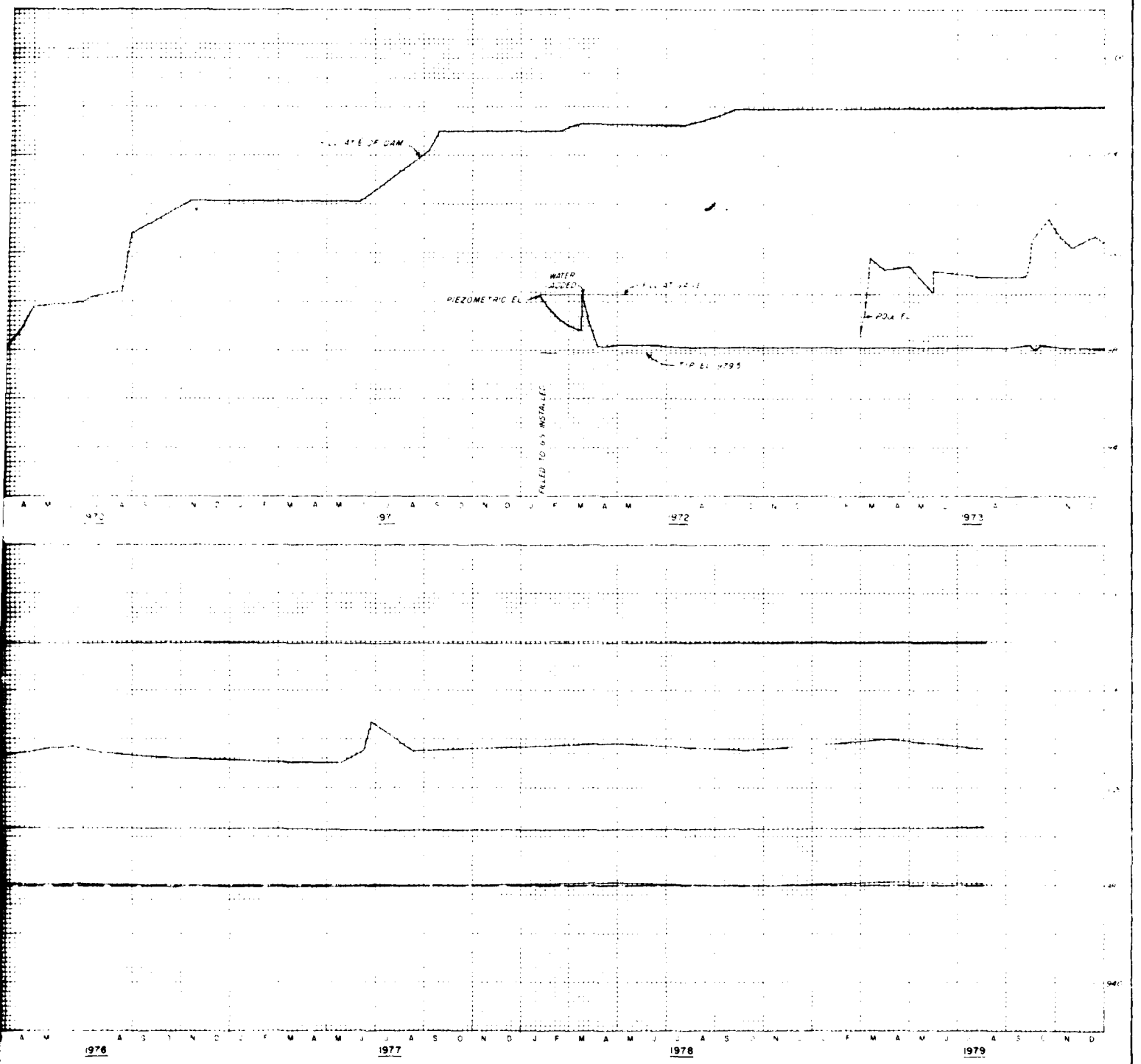
FILE NO 0-5-1306

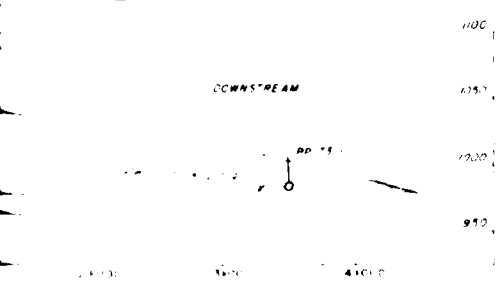
AUGUST 1975

2

PLATE NO 58


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1060
980
1968
1969
1970
1974
1975
1976
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTIPURPOSE POOL EL 1036.0
950
5+000
4+000
3+000
2+000
1+000
0+00
STATION 73+00





LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

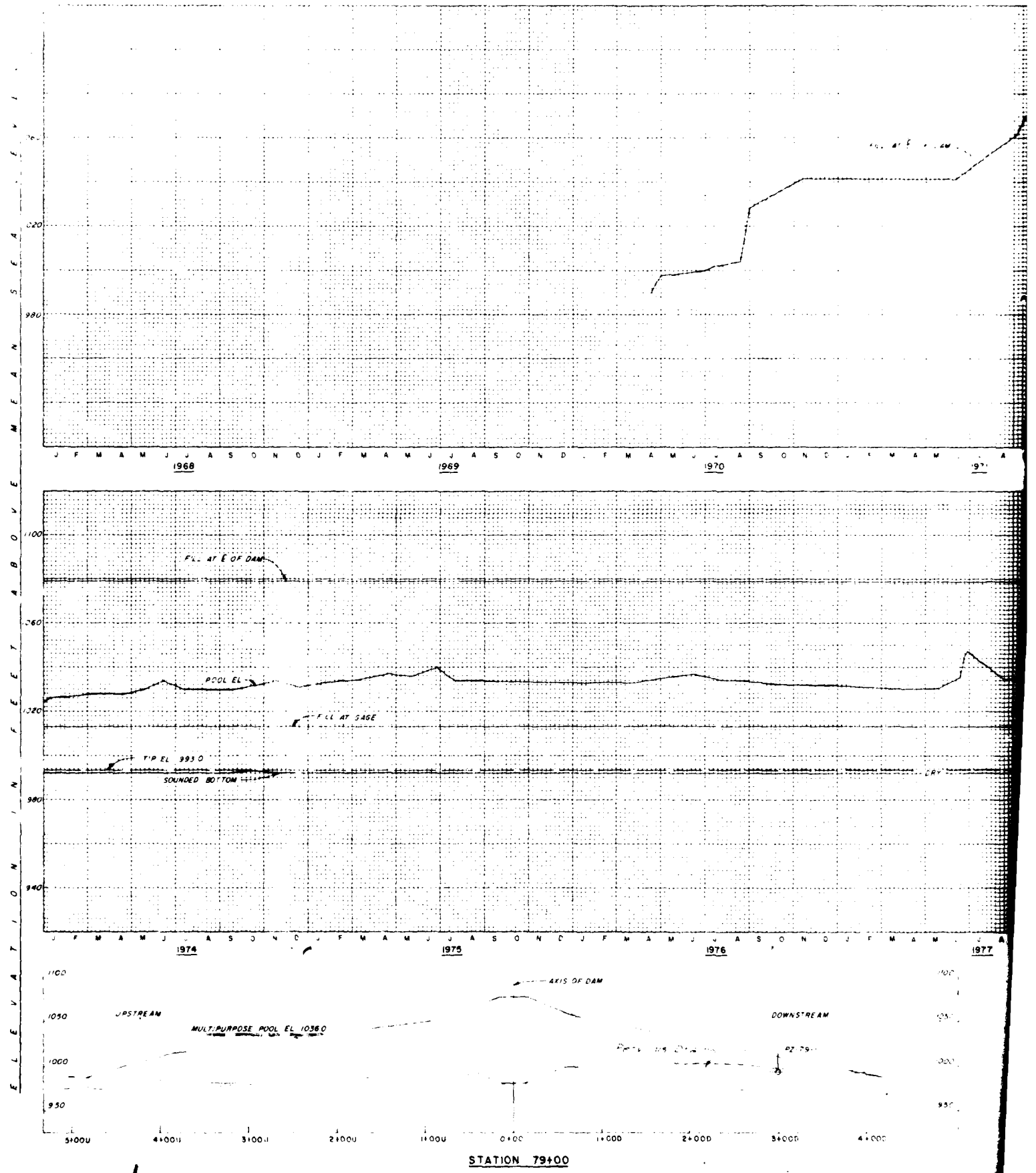
MISSOURI - YUNE - RIVER KANSAS

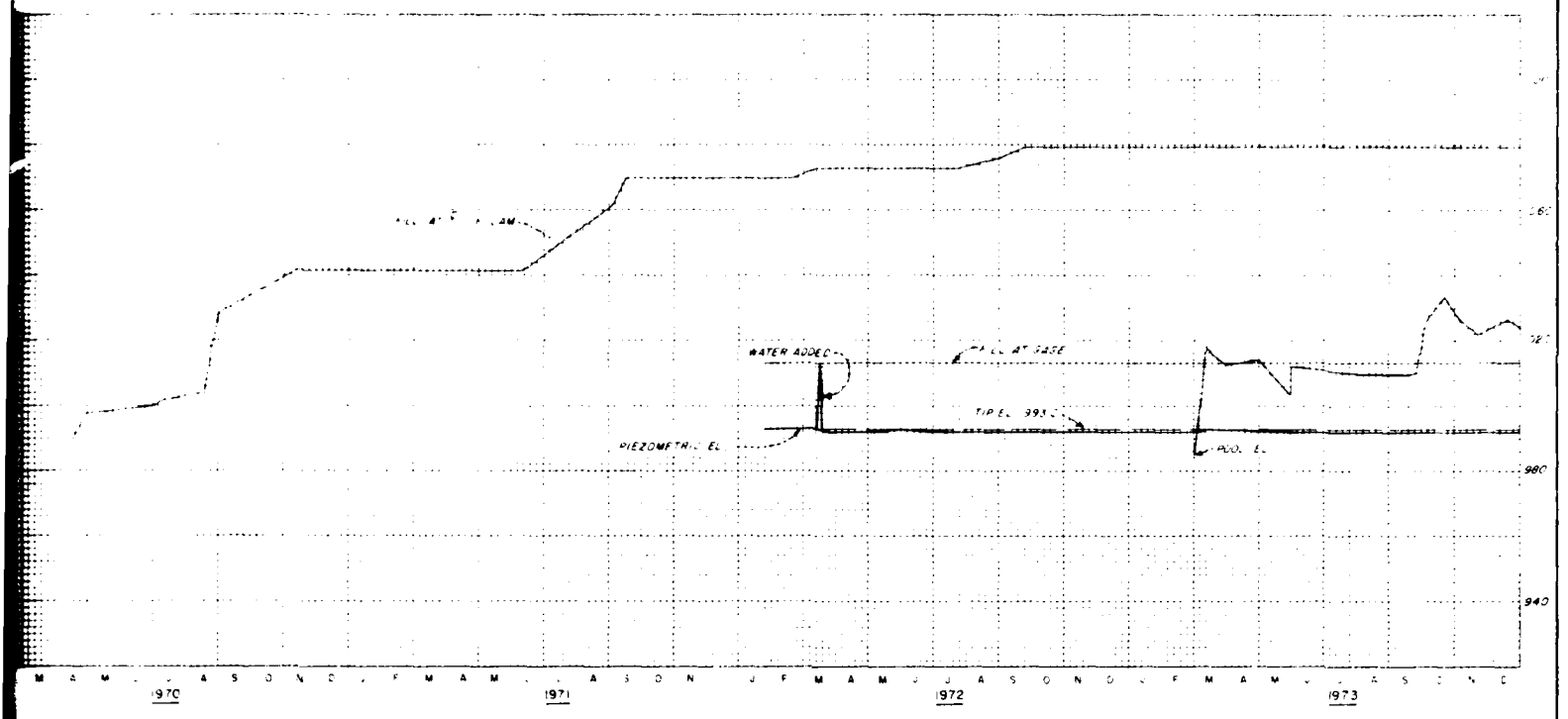
MELVERN LAKE

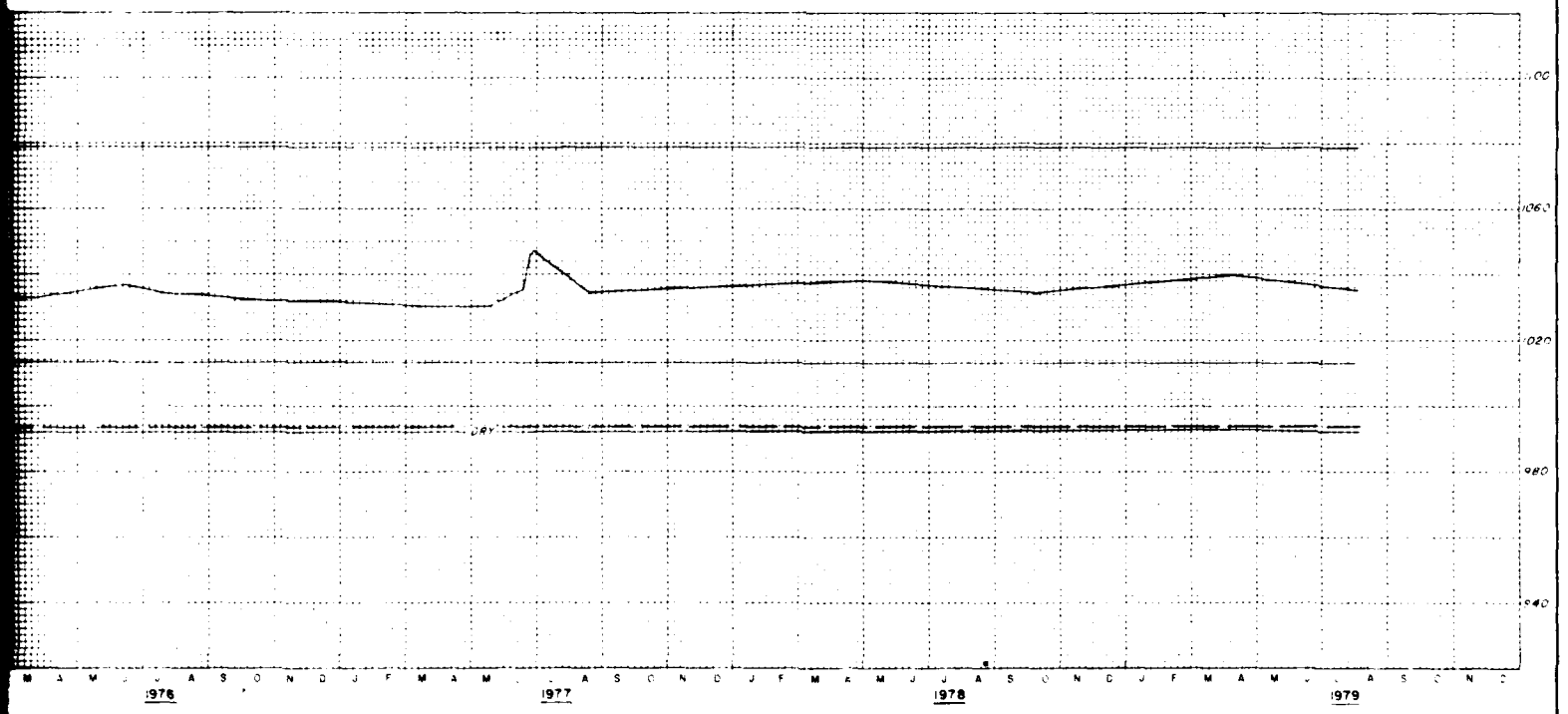
INSTRUMENTATION PLOTS
PP-73-1 (OPEN TUBE)

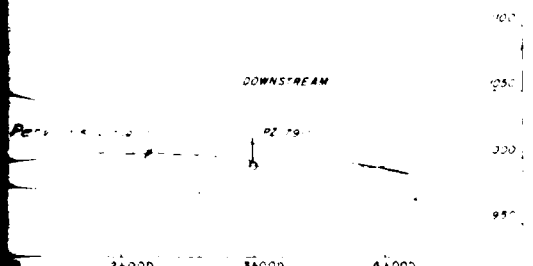
FILE NO 0-5-1307
AUGUST 1975

PLATE NO 59


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1100
1060
1020
980
940
1968
1969
1970
1974
1975
1976
1977
FILL AT E OF DAM
POOL EL
FILL AT SAGE
TIP EL 993.0
SOUNDED BOTTOM
DRY
AXIS OF DAM
UPSTREAM
DOWNSTREAM
MULTI-PURPOSE POOL EL 1036.0
PZ 79-
1050
1000
950
5+000
4+000
3+000
2+000
1+000
0+00
1+000
2+000
3+000
4+000
STATION 79+00







LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

MARAIS DES CYGNES RIVER KANSAS

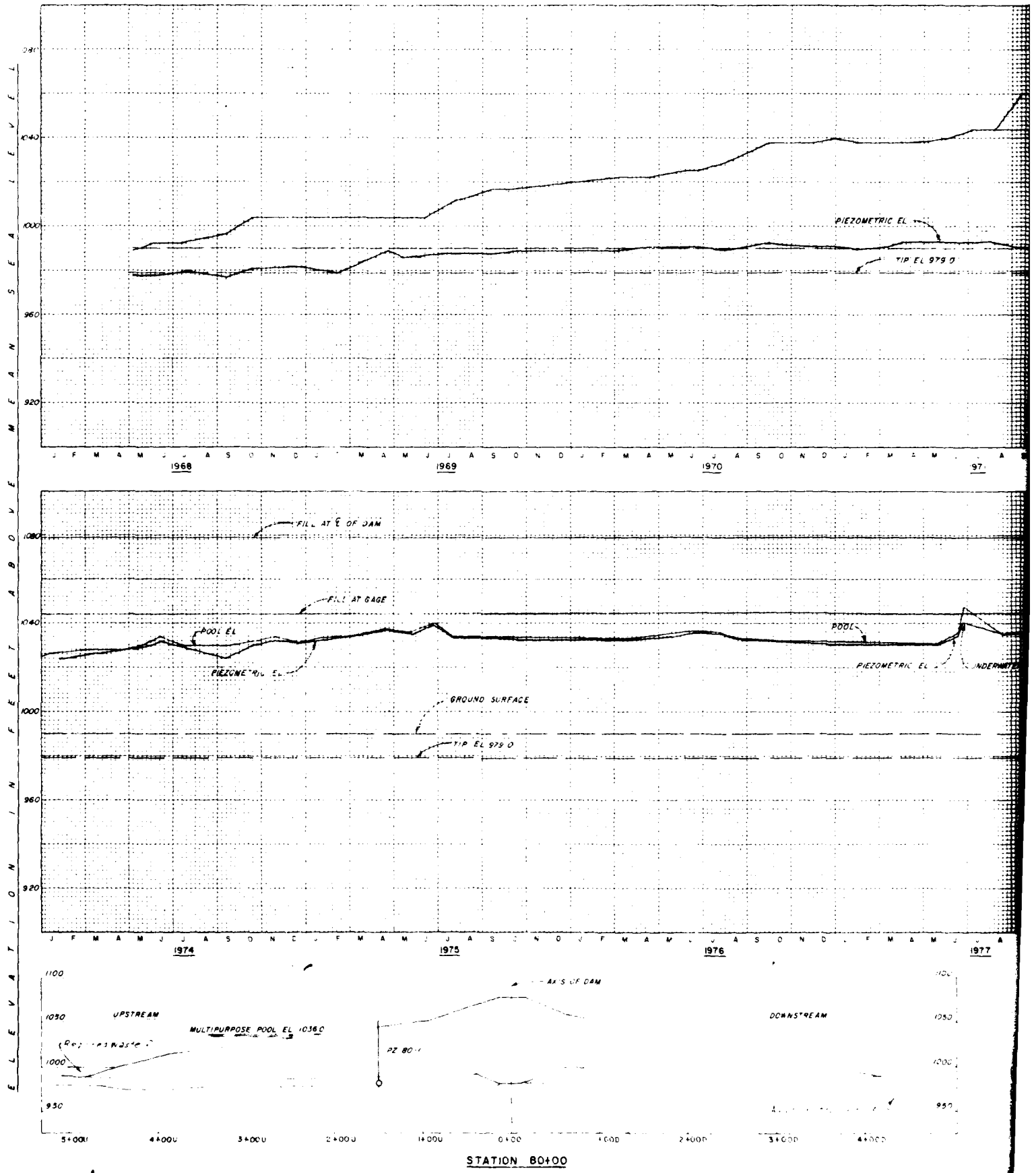
MELVERN LAKE

INSTRUMENTATION PLOTS
PZ-79-1 (OPEN TUBE)

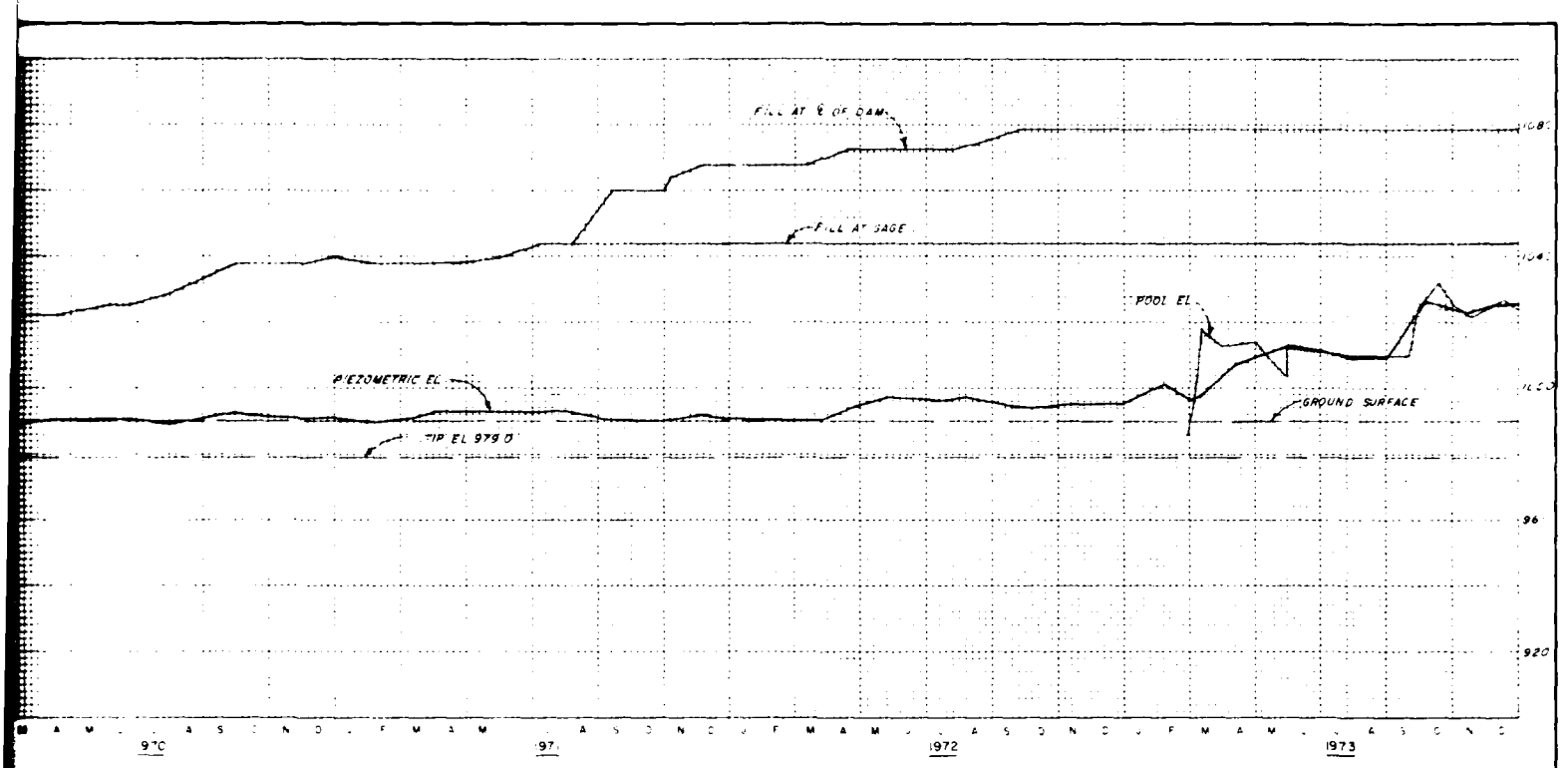
In 1 sheet | Sheet No. | Scale as shown

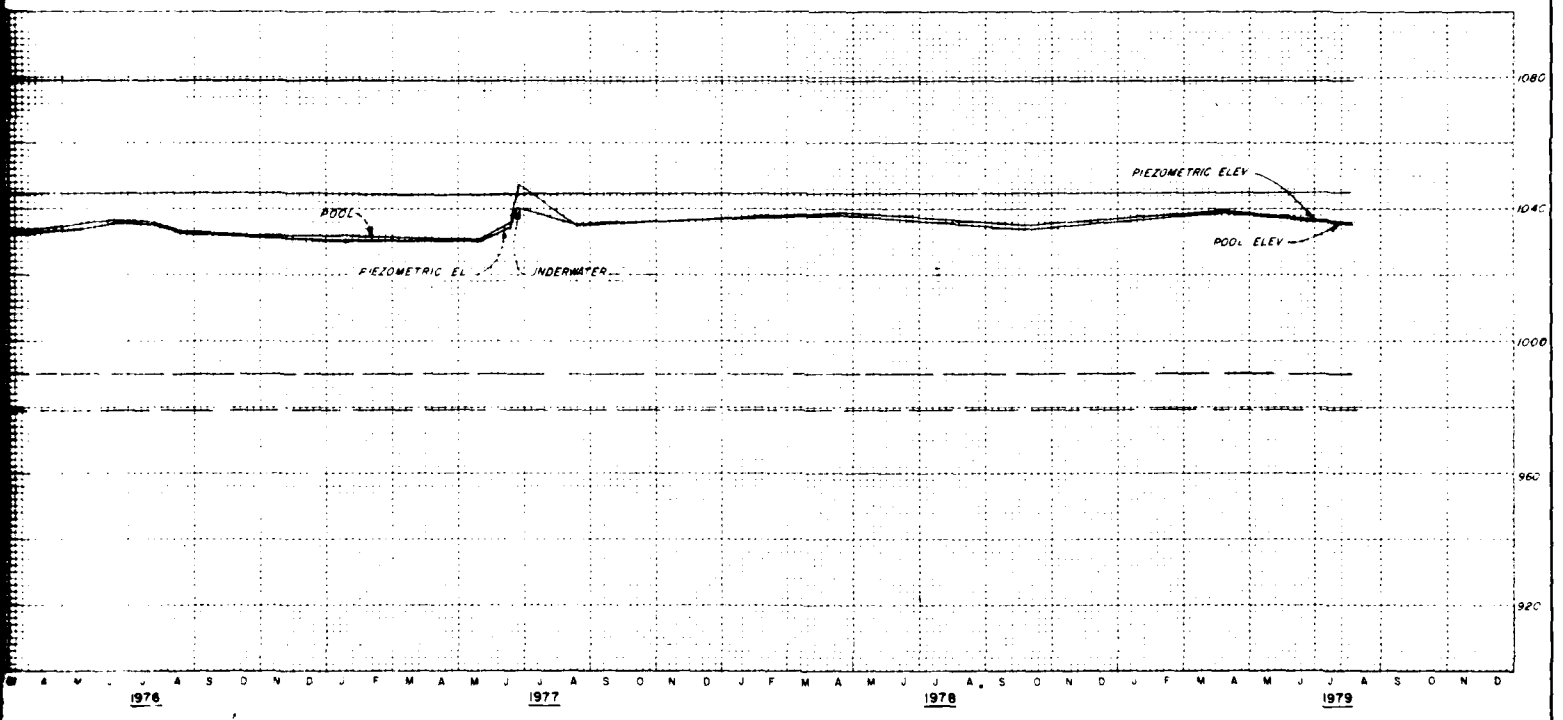
FILE NO 0-5-1308

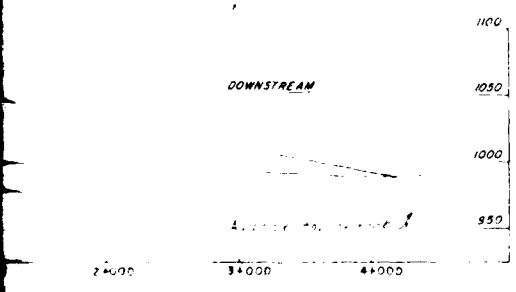
PLATE NO 60



STATION 80+00







LEGEND

OPEN TUBE ——— ○

PNEUMATIC CELL ——— ●

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

INSTRUMENTATION PLOTS
PZ 80-1 (OPEN TUBE)

In 1 sheet

Sheet No. 1

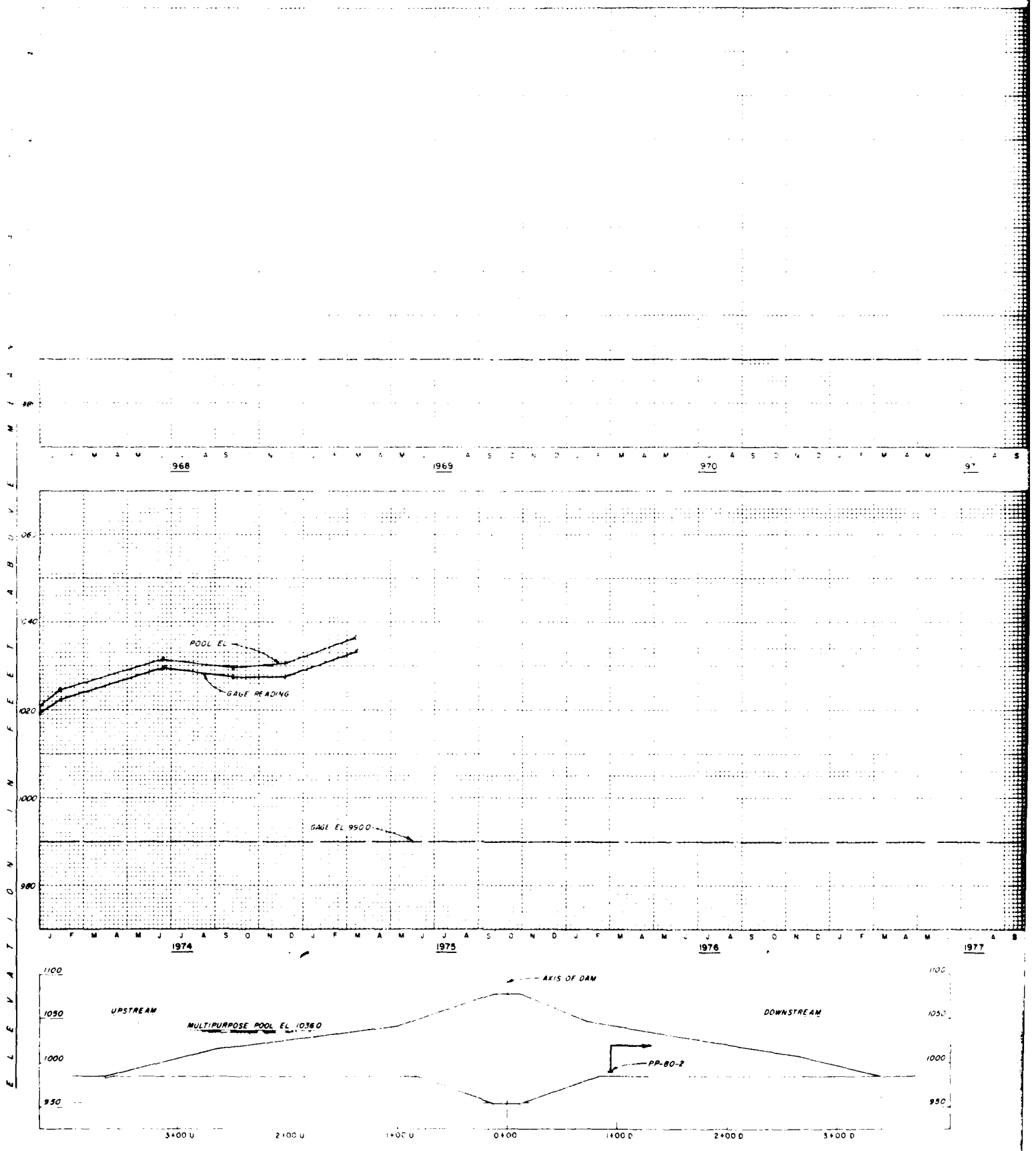
Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

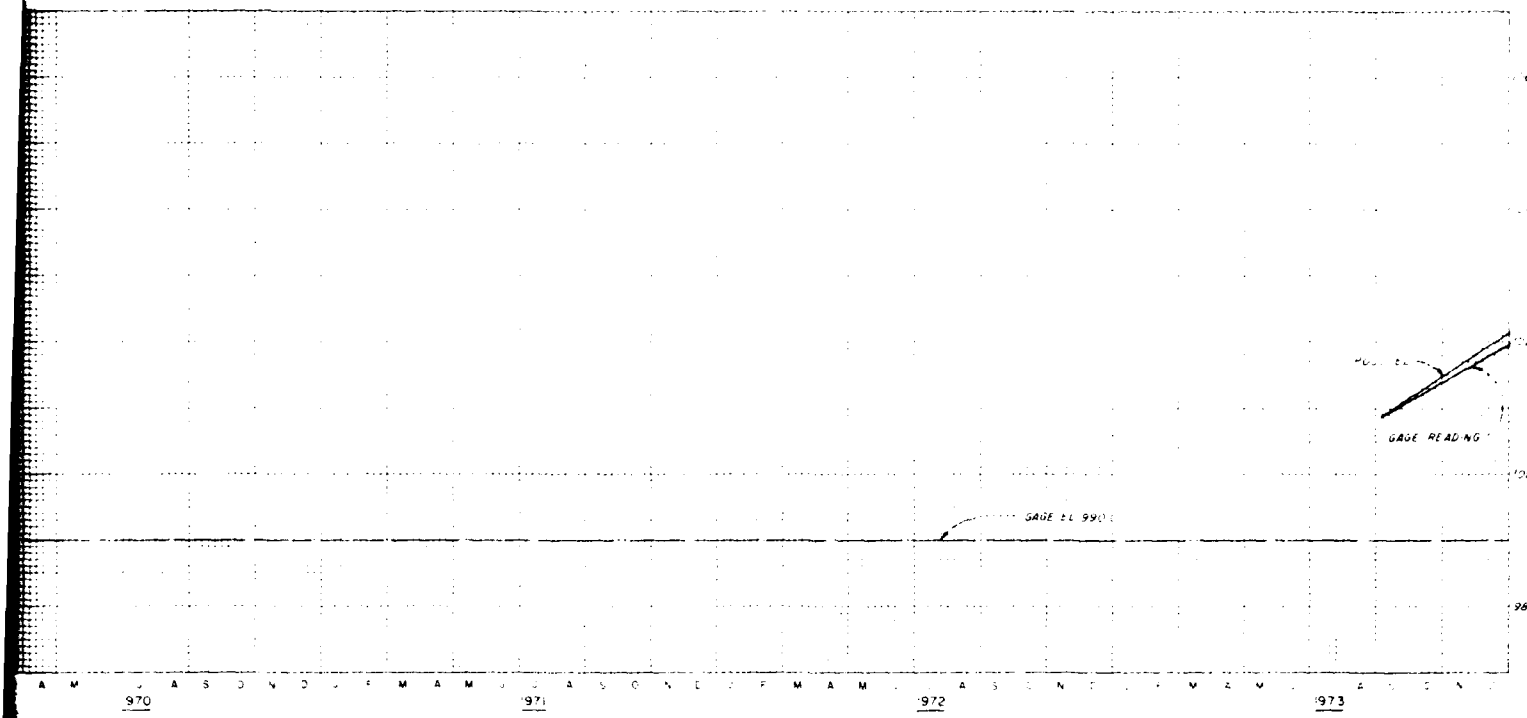
FILE NO. 0-5-1309

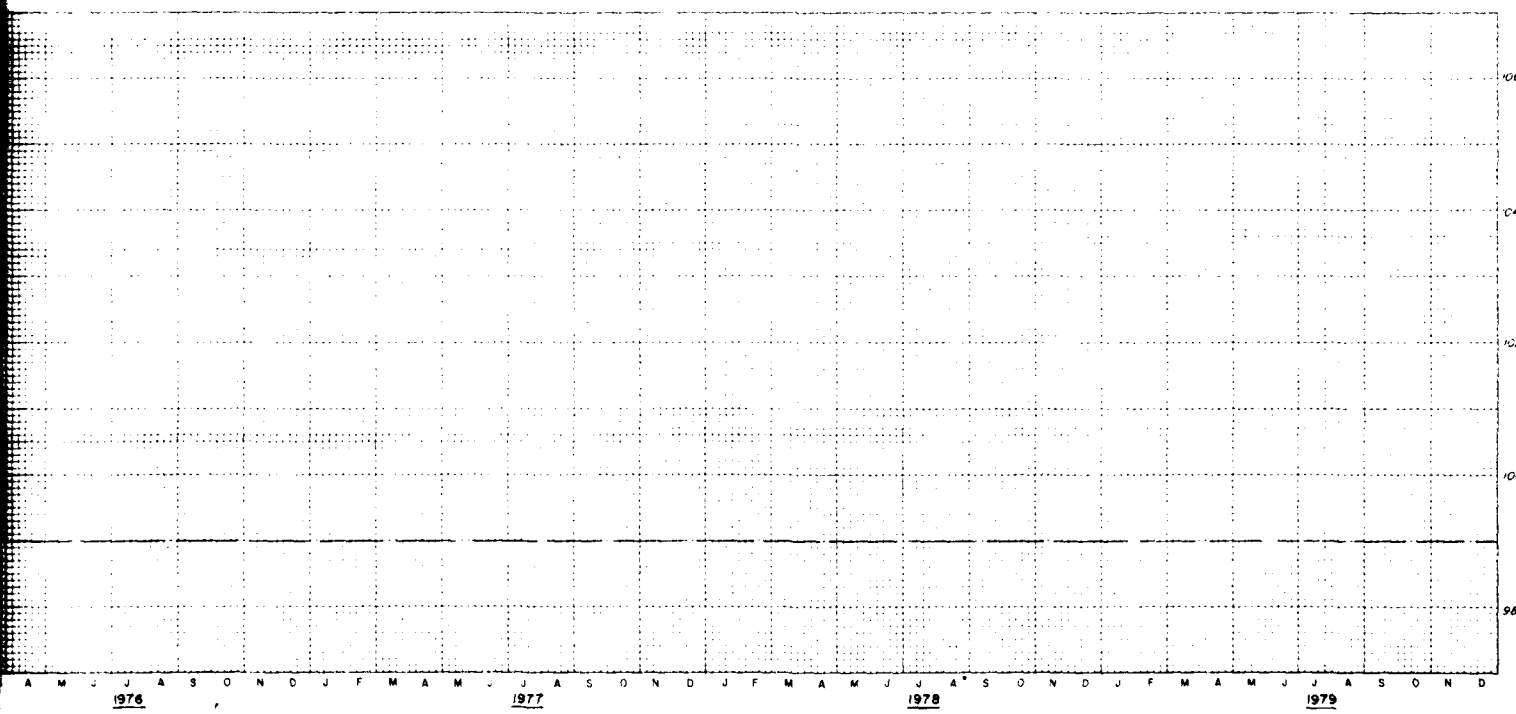
AUGUST 1975

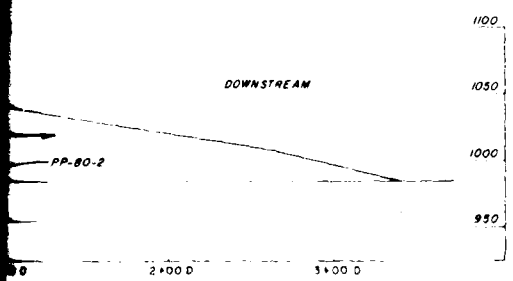
PLATE NO 61



STATION 80+00







NOTE
45-6 = GAGE ON THE 4" FLANGE AT MONITOR BOX

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

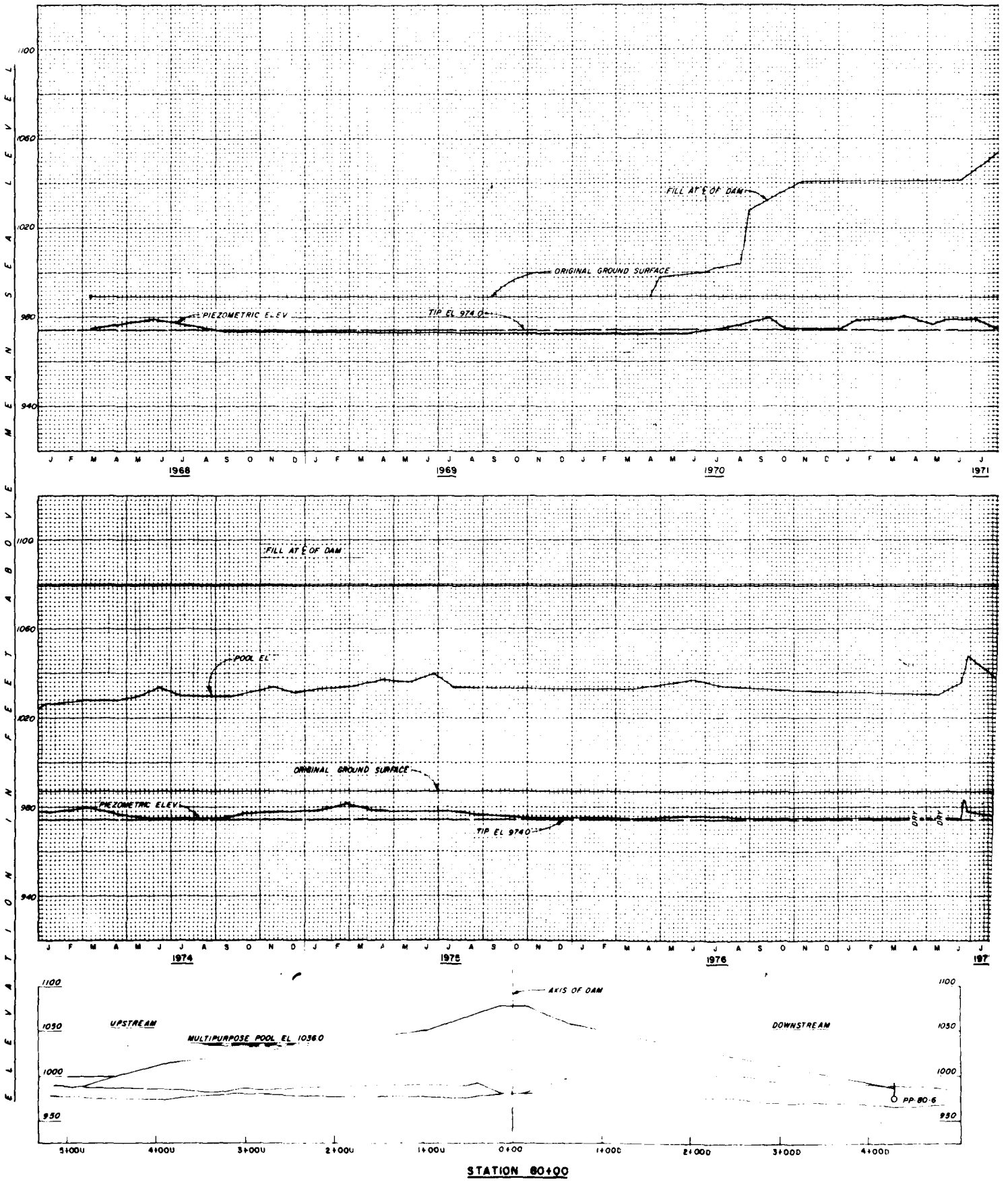
INSTRUMENTATION PLOTS
PP-80-2 (INSIDE TOWER)

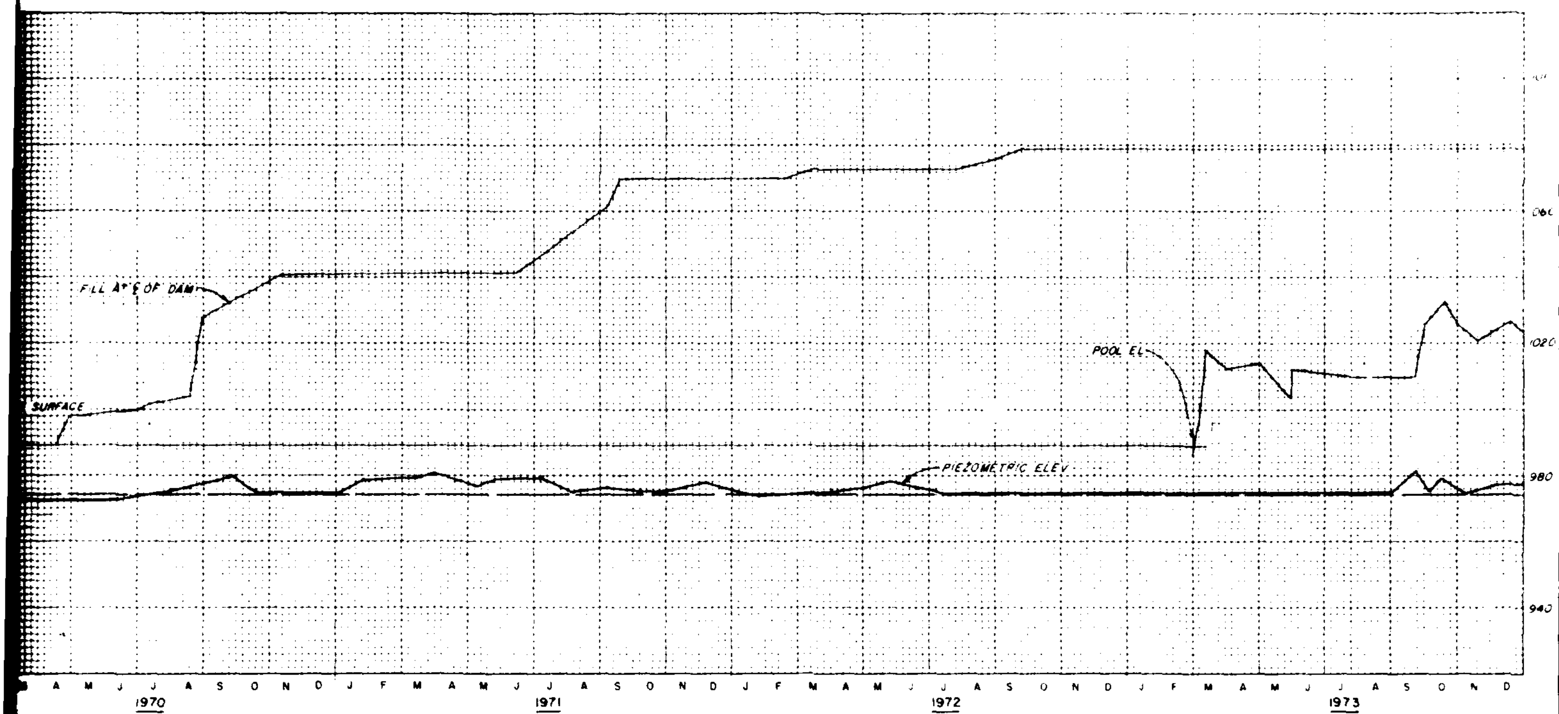
In 1 sheet | Sheet No 1 | Scale as shown

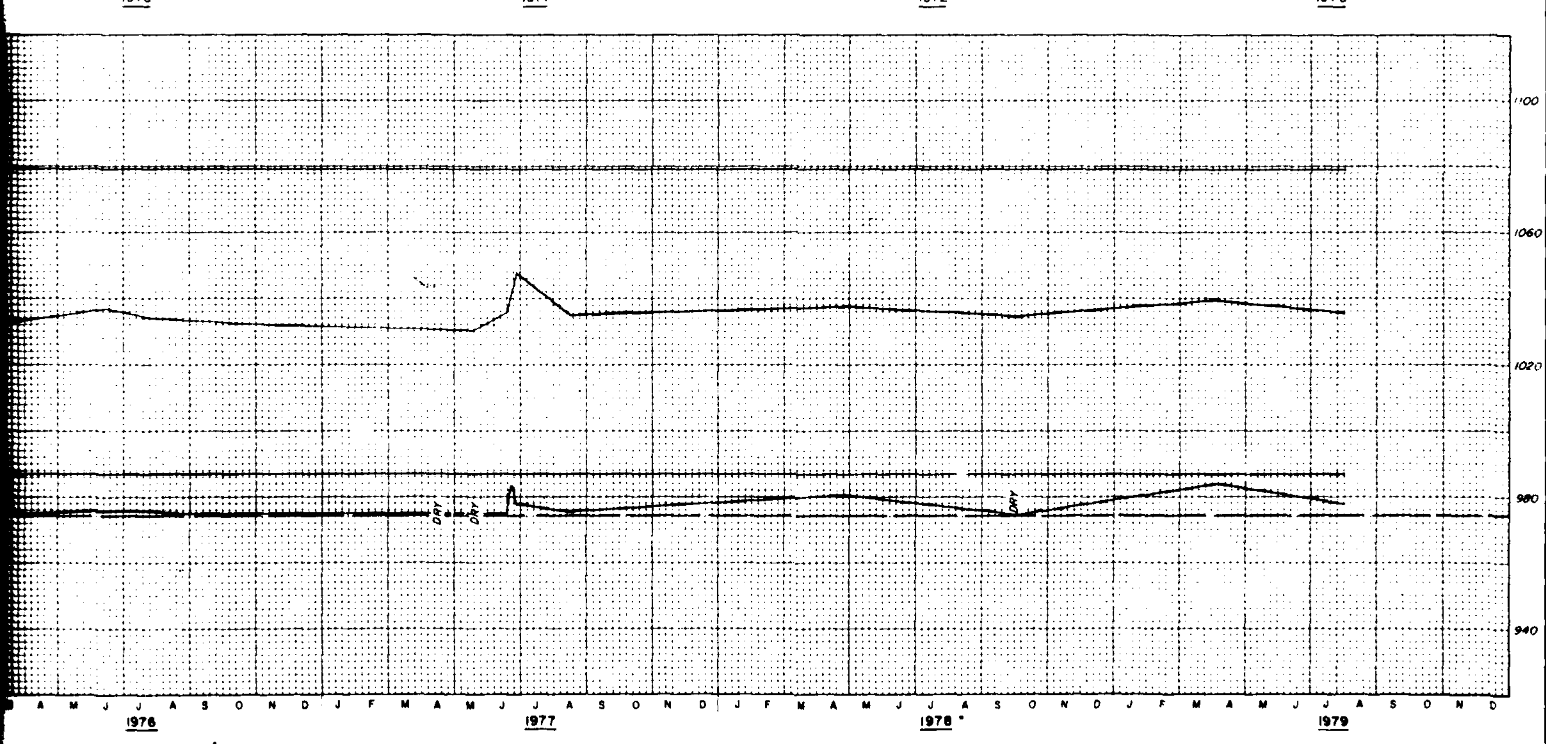
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT

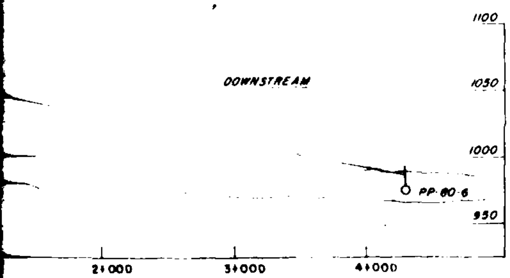
FILE NO. 0-5-1310
AUGUST 1975

PLATE NO 62


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1100
1060
1020
980
940
FILL AT E OF DAM
ORIGINAL GROUND SURFACE
PIEZOMETRIC ELEV
TIP EL 974.0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1968
1969
1970
1971
FILL AT E OF DAM
POOL EL
ORIGINAL GROUND SURFACE
PIEZOMETRIC ELEV
TIP EL 974.0
DRY
DRY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1974
1975
1976
1977
1100
1050
1000
950
AXIS OF DAM
UPSTREAM
MULTIPURPOSE POOL EL 1036.0
DOWNSTREAM
PP 80-6
5+000U
4+000U
3+000U
2+000U
1+000U
0+00
1+000
2+000
3+000
4+000
STATION 80+00







LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

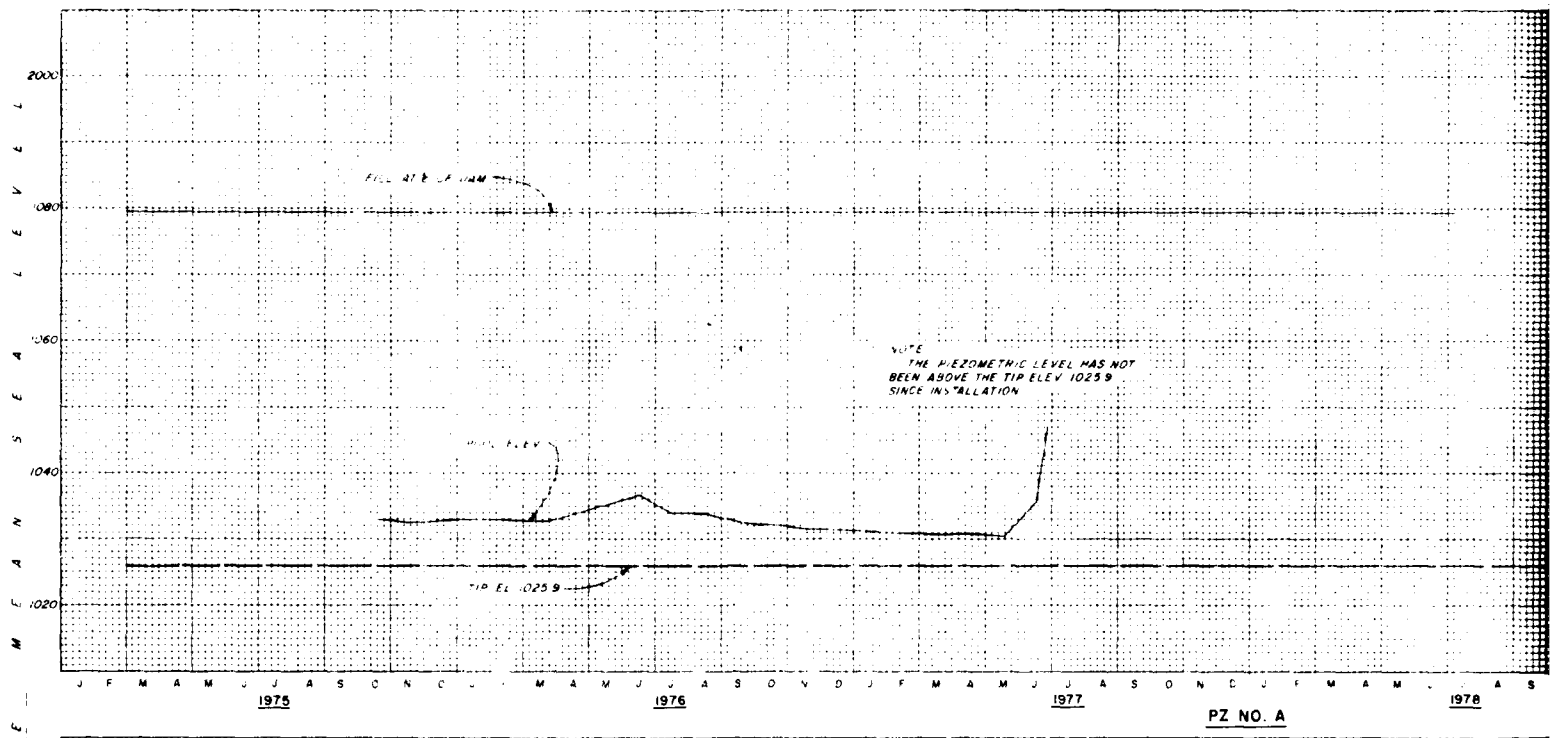
INSTRUMENTATION PLOTS
PP-80-6 (OPEN TUBE)

In 1 sheet | Sheet No. 1 | Scale as shown

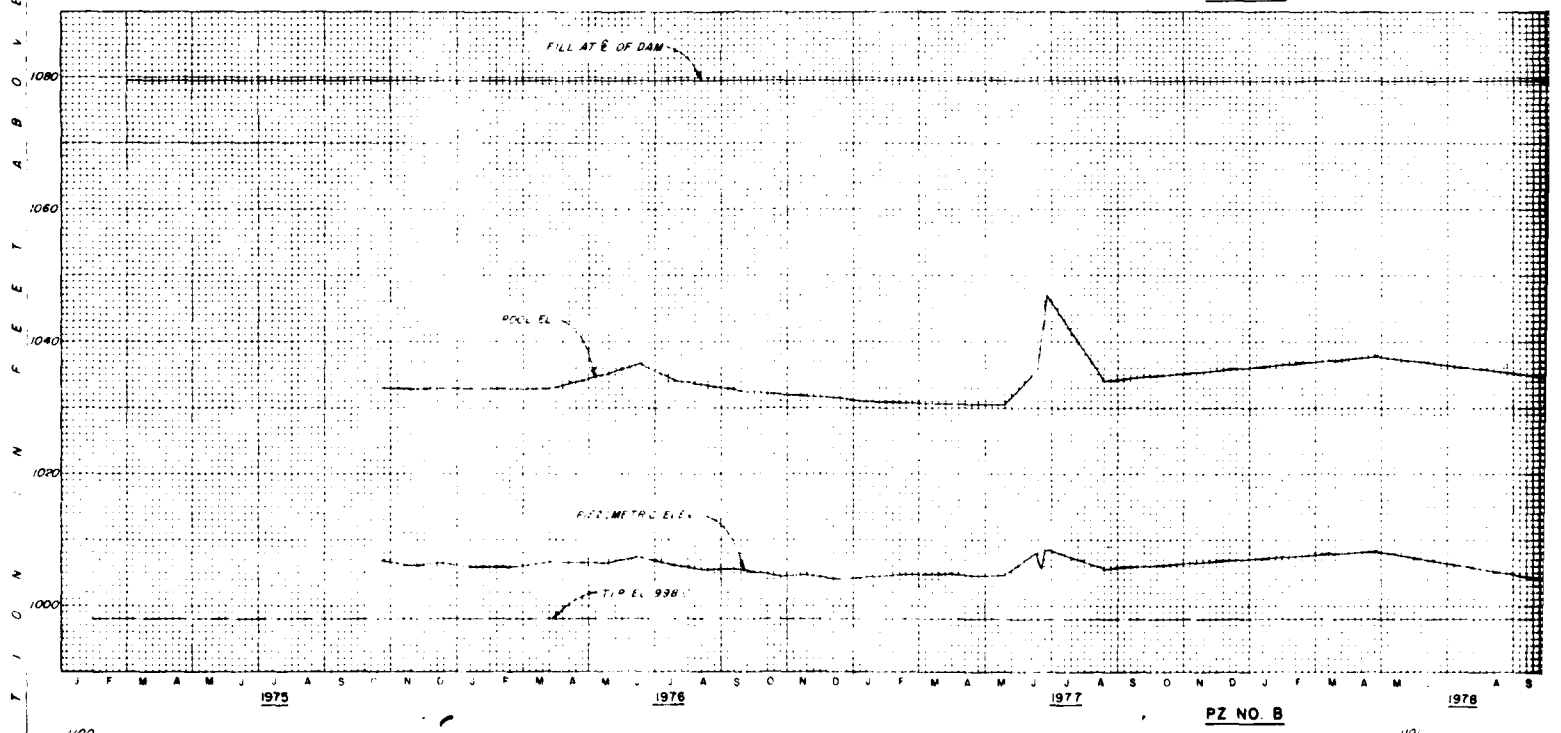
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO. O-5-1311
AUGUST 1975

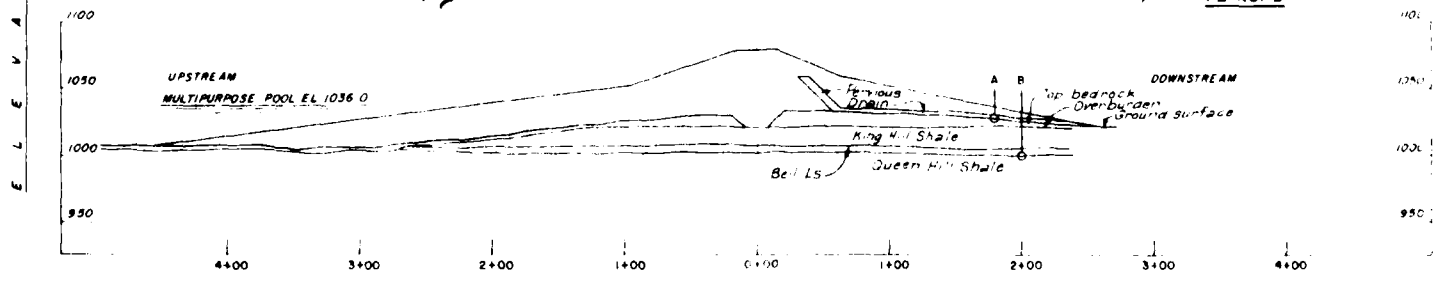
PLATE NO. 63



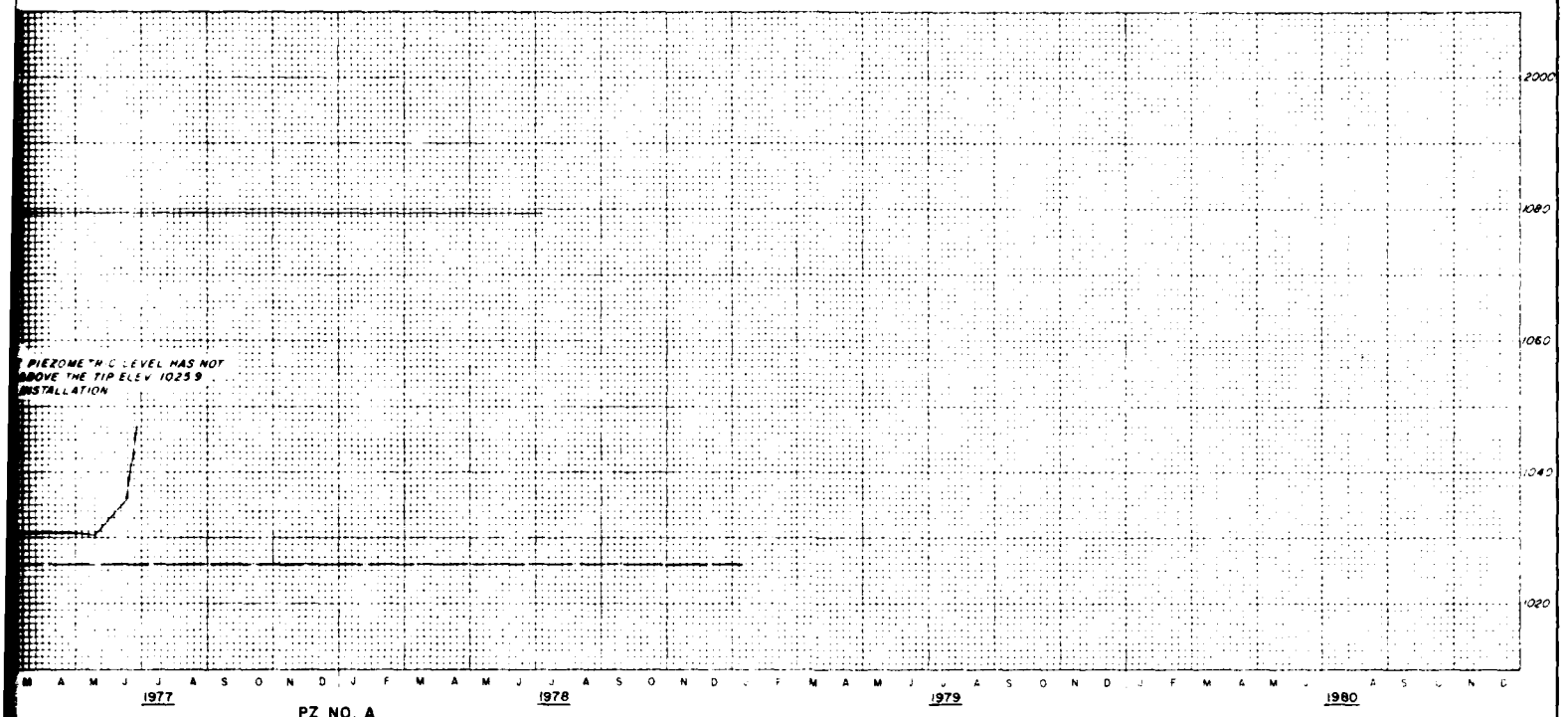
PZ NO. A



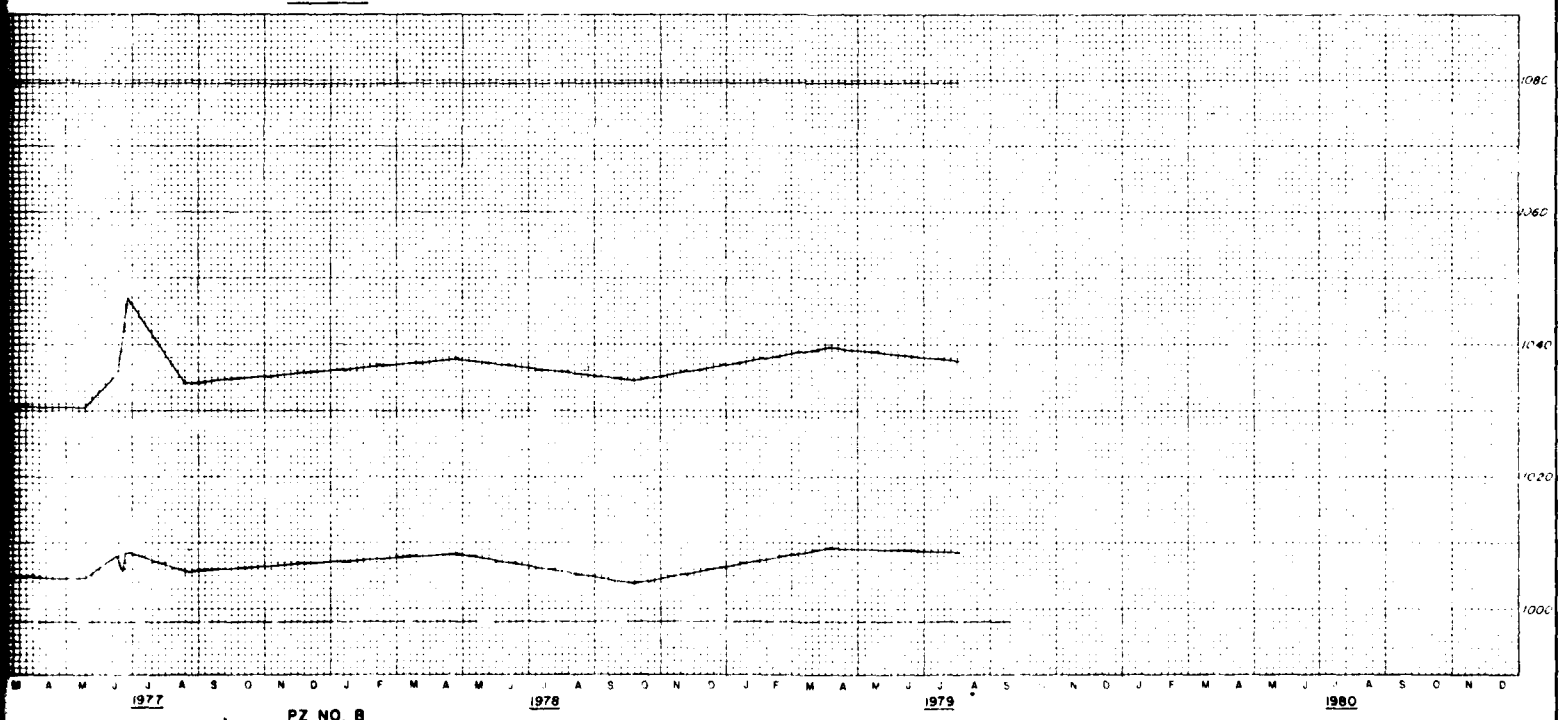
PZ NO. B



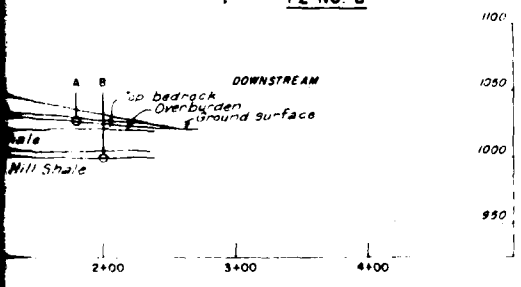
STATION 41+00



PZ NO. A



PZ NO. B



LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

PIEZOMETER PLOTS PZ NO'S A & B

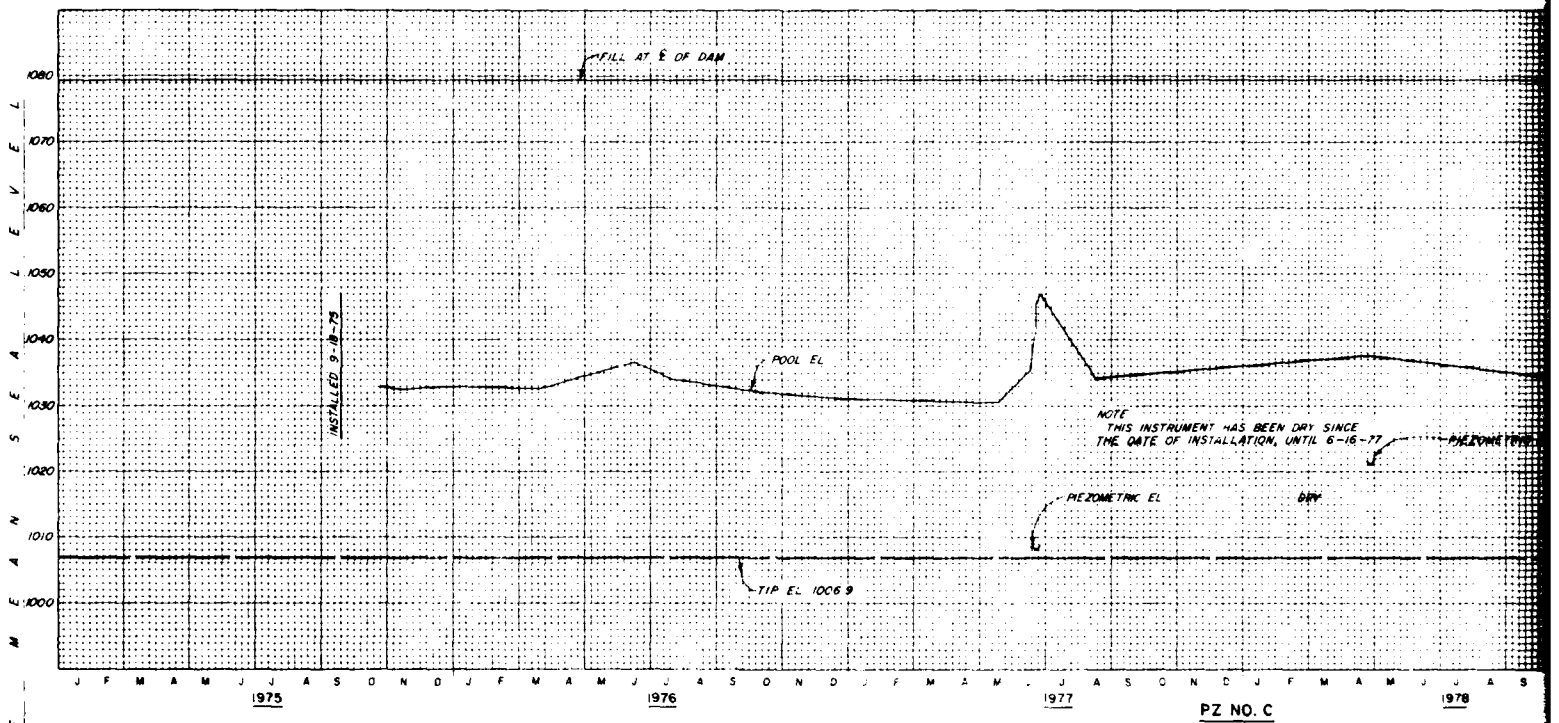
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

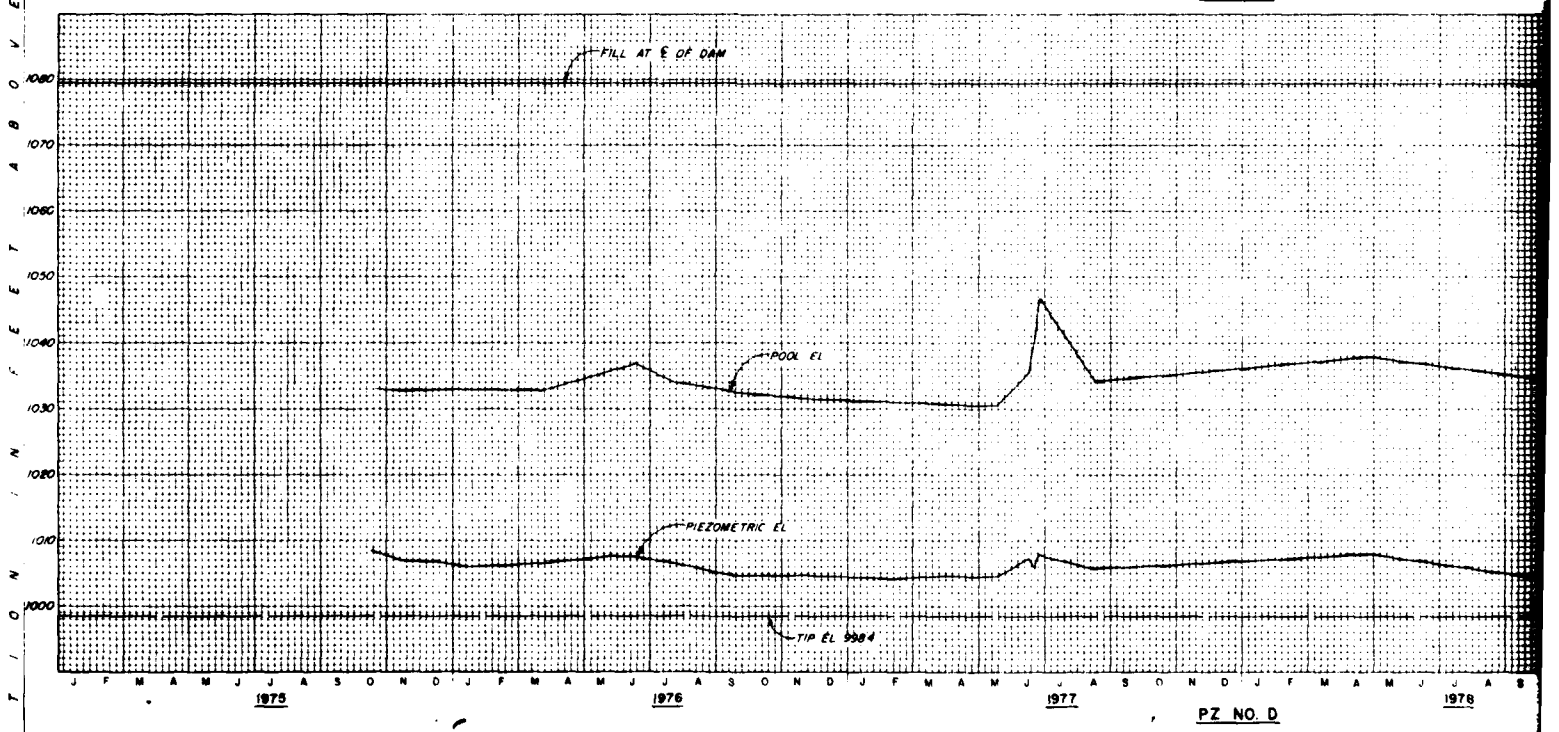
FILE NO 0-5-1007

AUGUST 1977

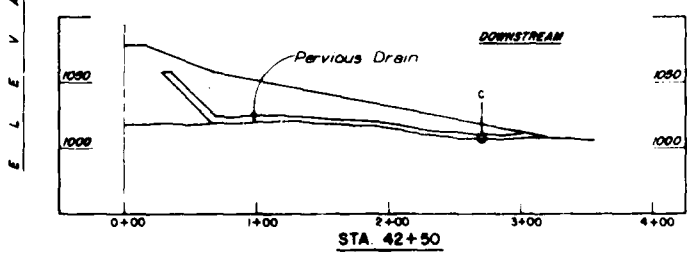
PLATE NO 64



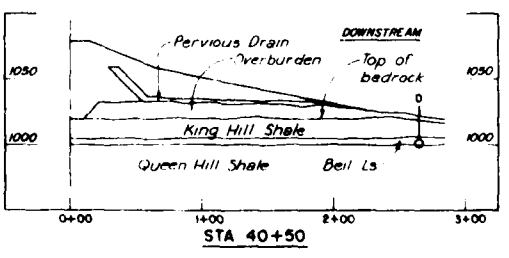
PZ NO. C



PZ NO. D



STA. 42+50

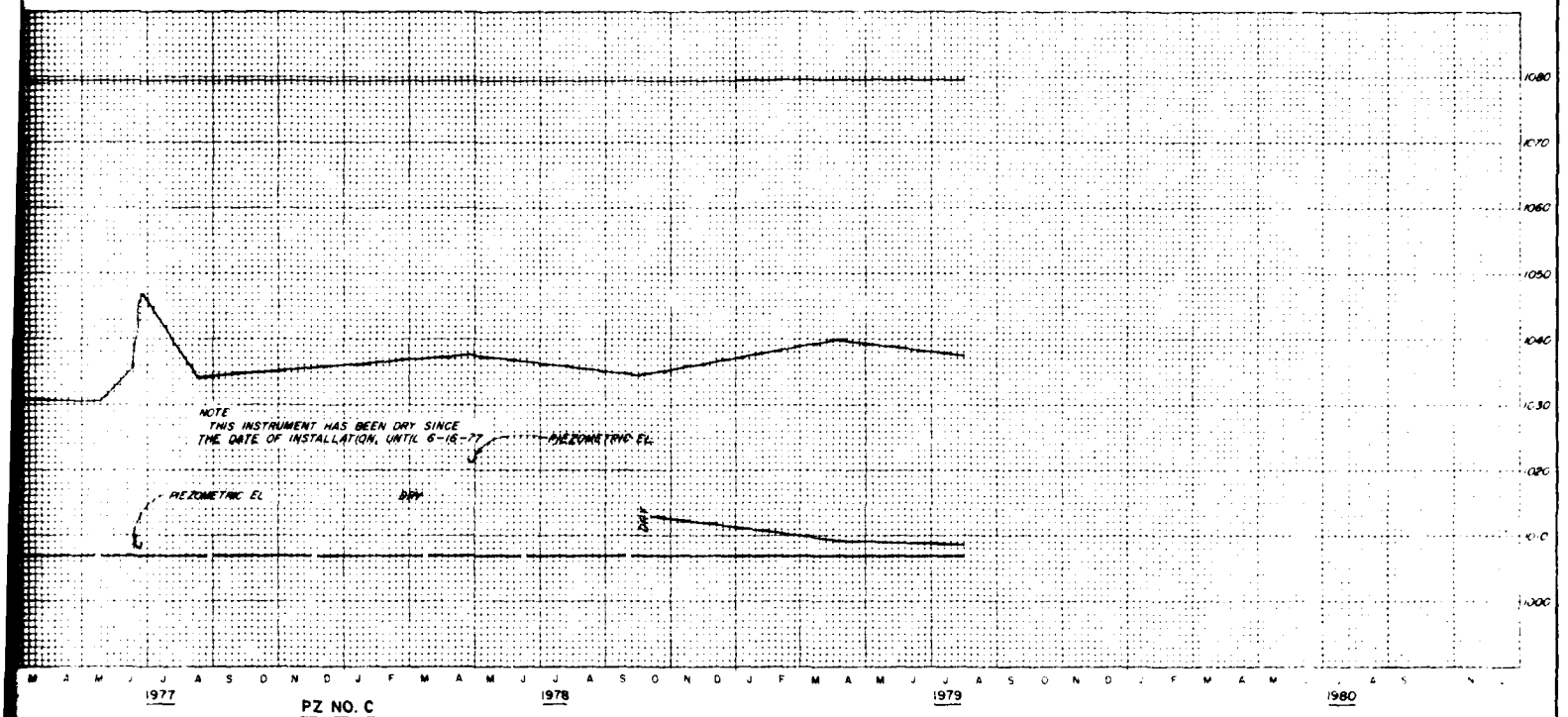


STA. 40+50

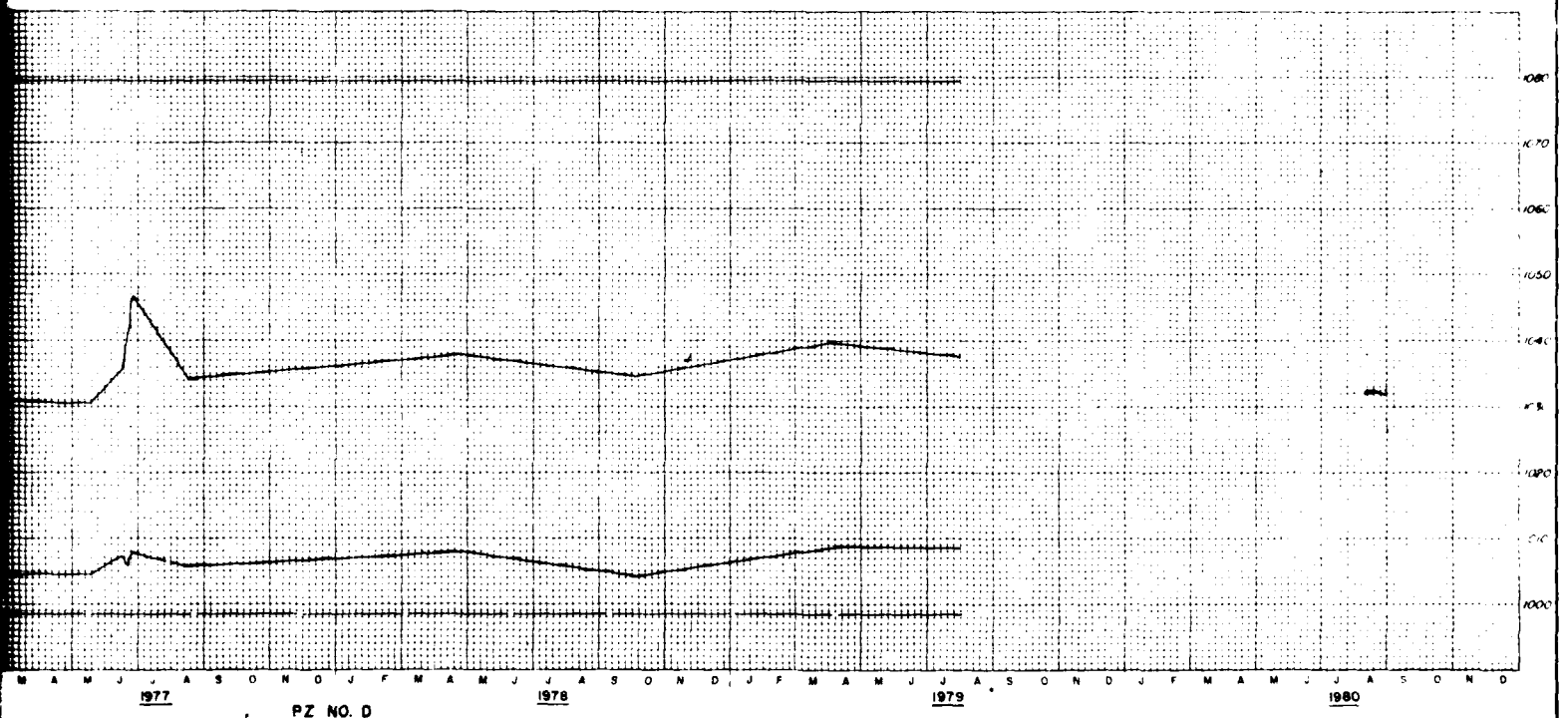
LEGEND

OPEN TUBE

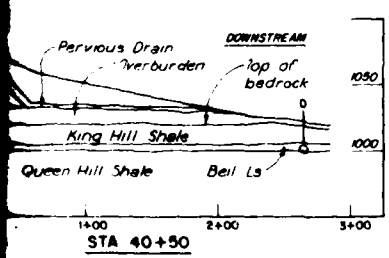
PNEUMATIC CELL



PZ NO. C



PZ NO. D



STA 40+50

LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

Revised August 1979

MARAIS DES CYGNES RIVER KANSAS

MELVERN LAKE

PIEZOMETER PLOTS PZ NO'S C&D

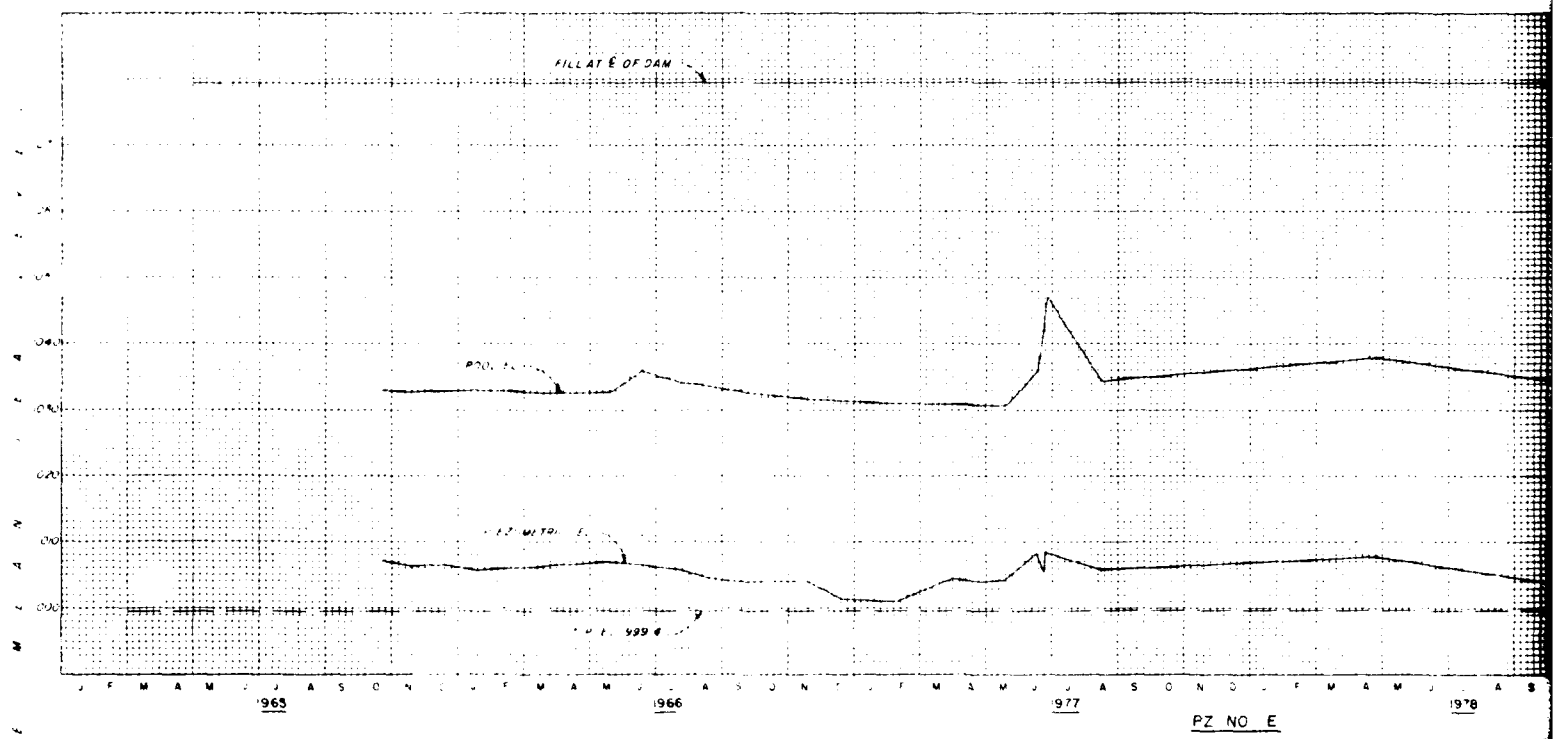
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

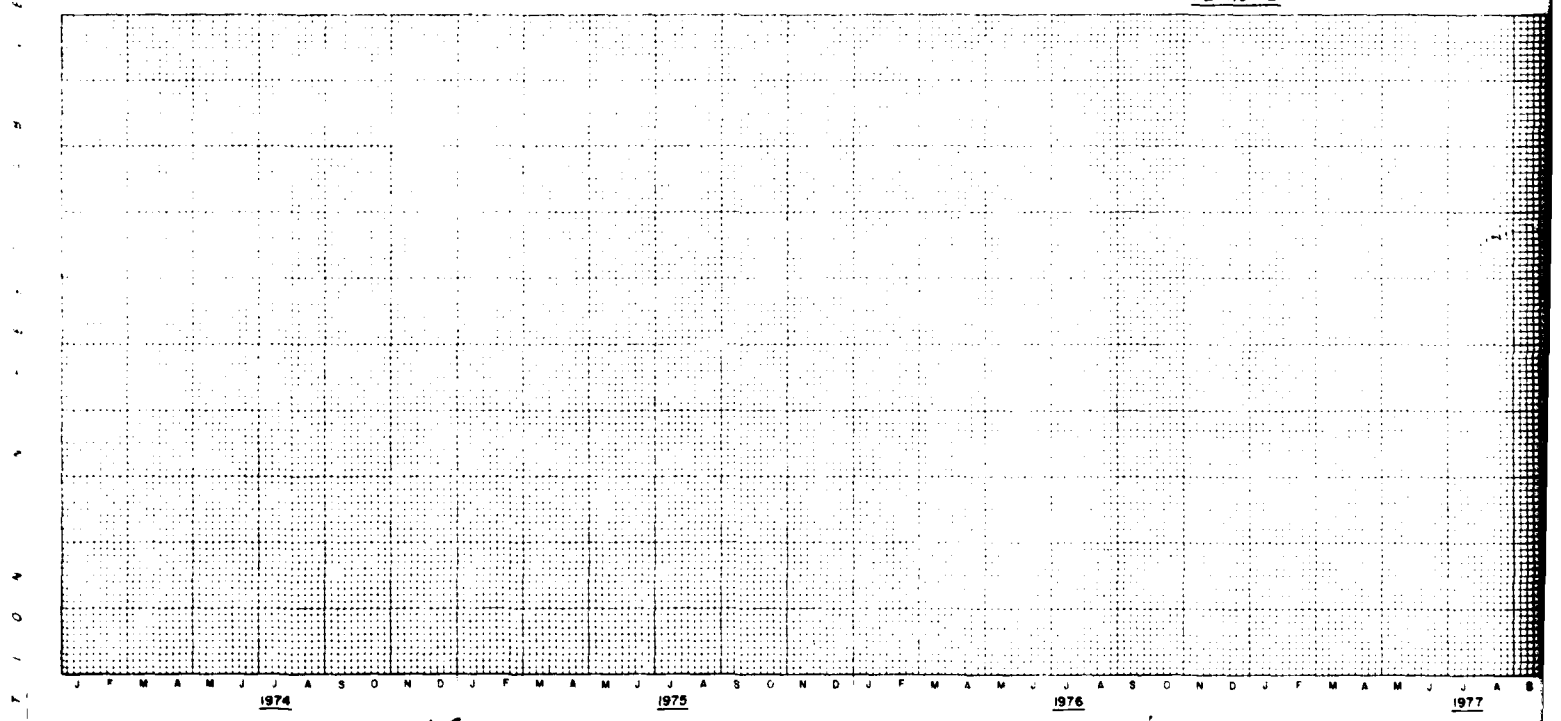
FILE NO. 0-5-1008

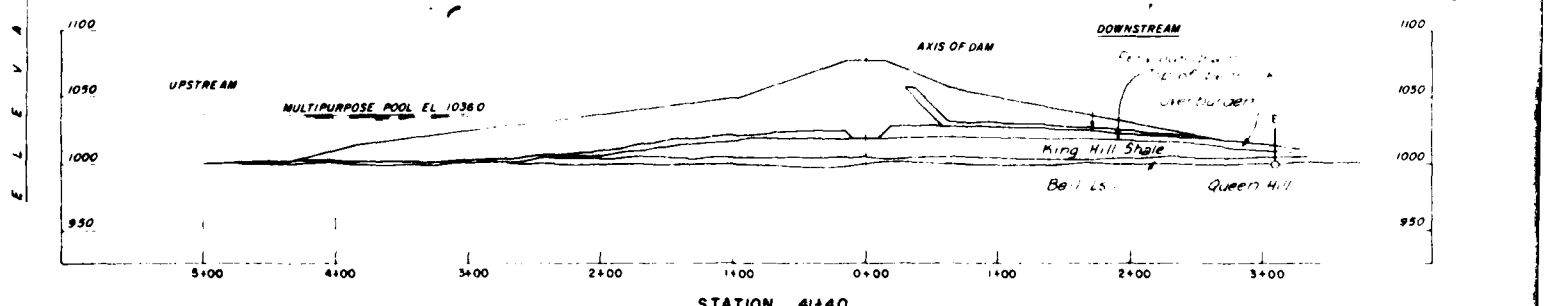
AUGUST 1977

PLATE NO. 65

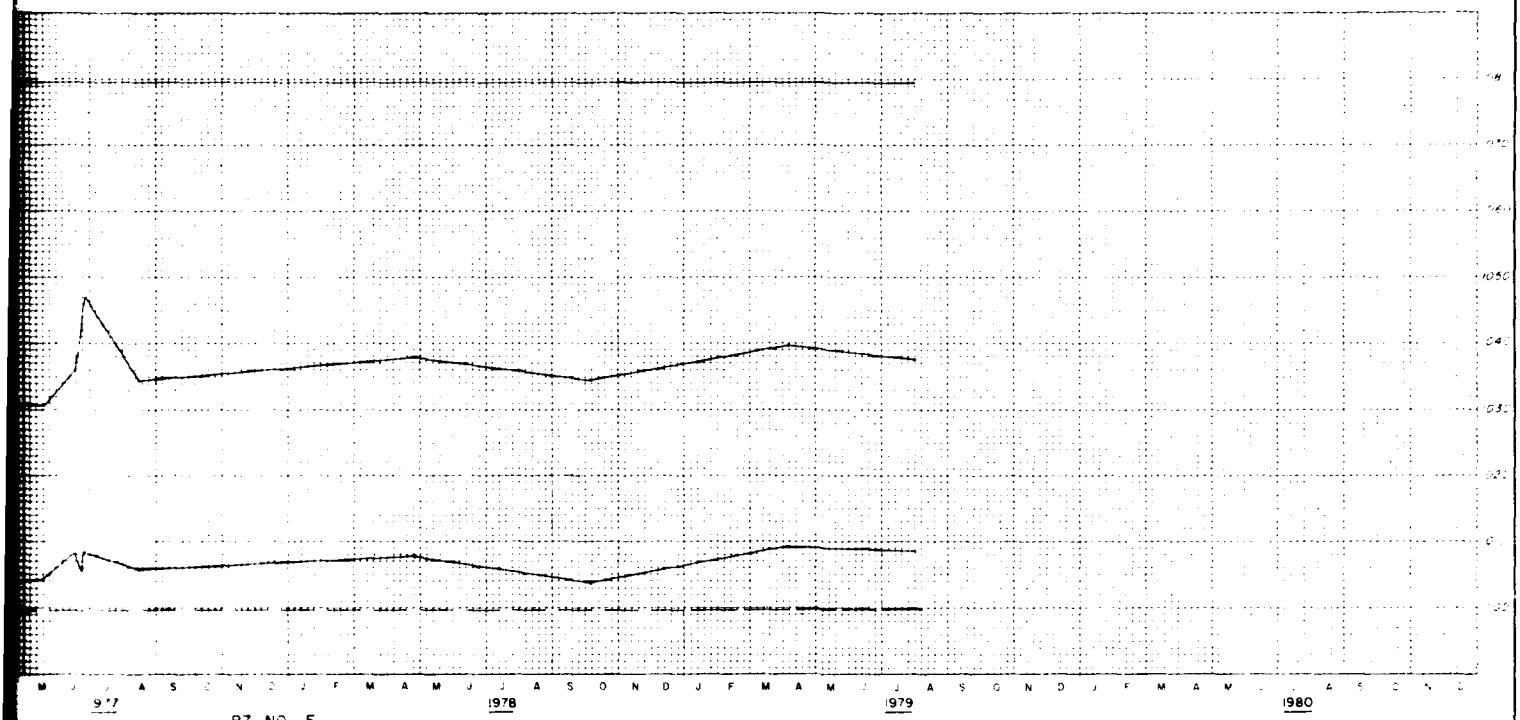


PZ NO E

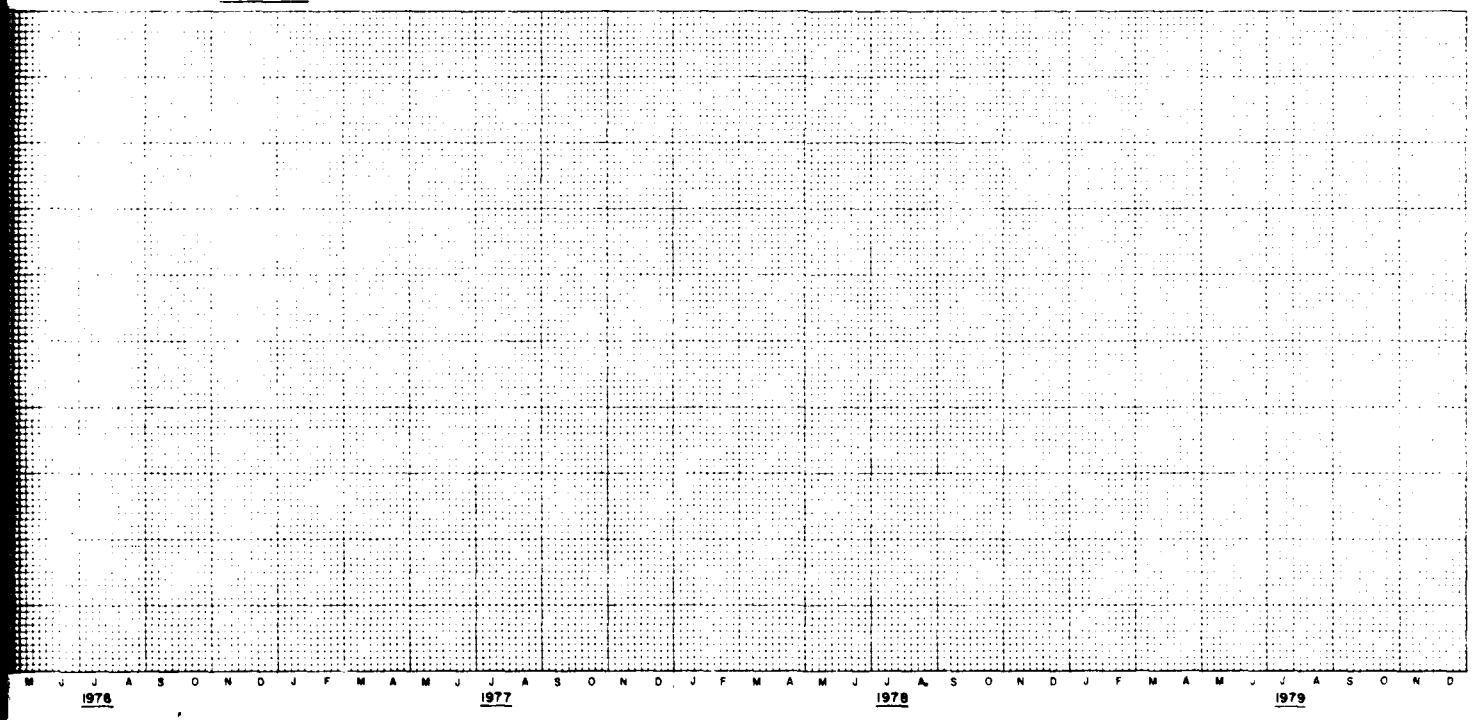


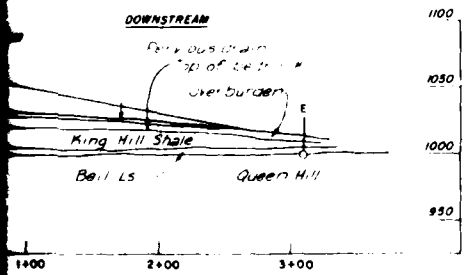


STATION 41+40



PZ NO E





LEGEND

OPEN TUBE ----------o

PNEUMATIC CELL ----------●

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

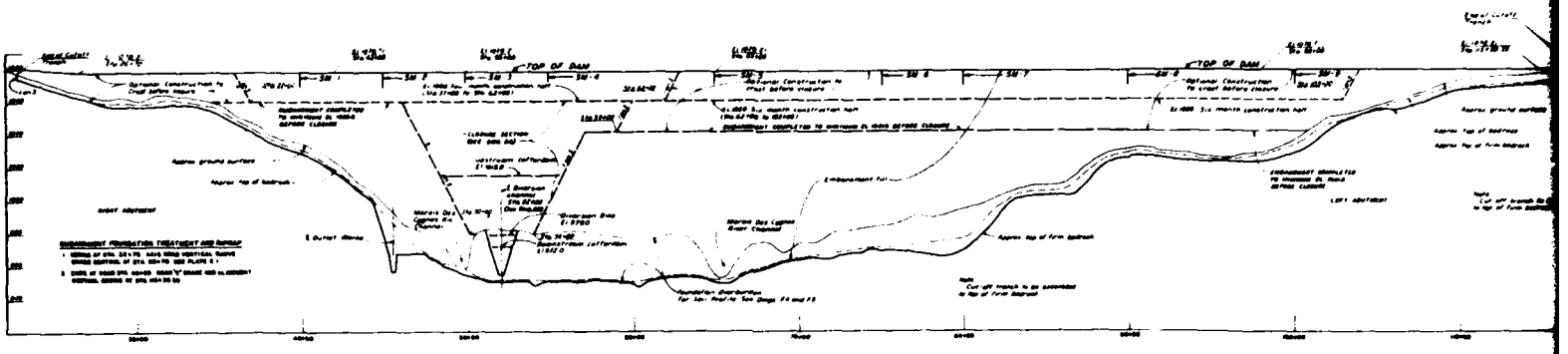
PIEZOMETER PLOTS
PZ NO. E

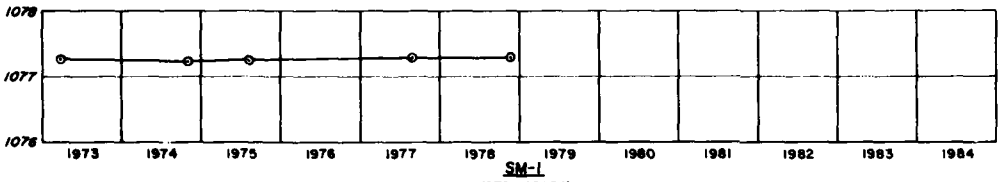
In 1 sheet | Sheet No. 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1006
AUGUST 1977

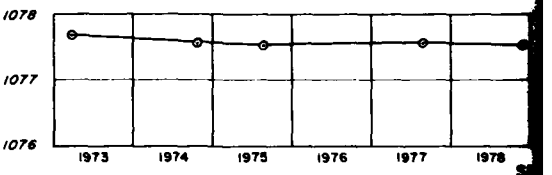
2

PLATE NO. 66

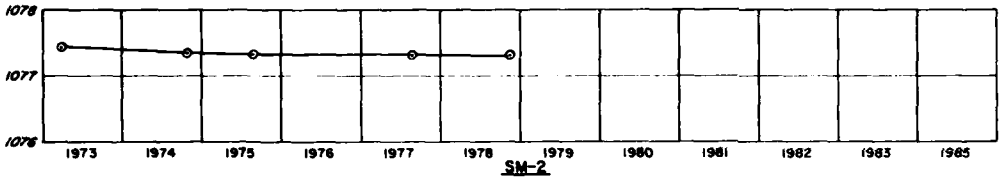




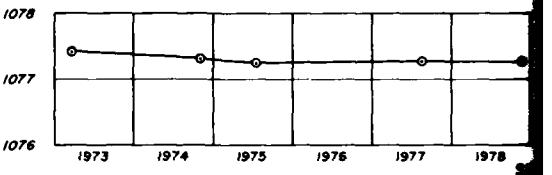
SM-1
(STA. 40+00)



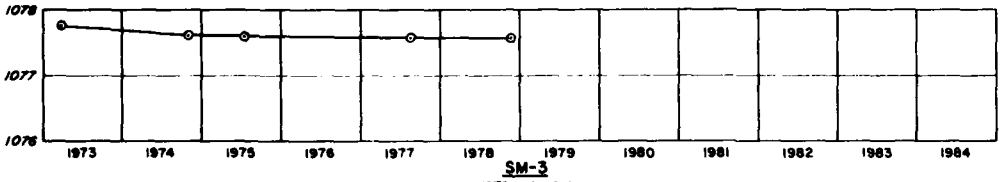
(STA.



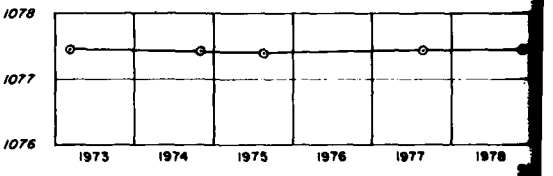
SM-2
(STA. 45+00)



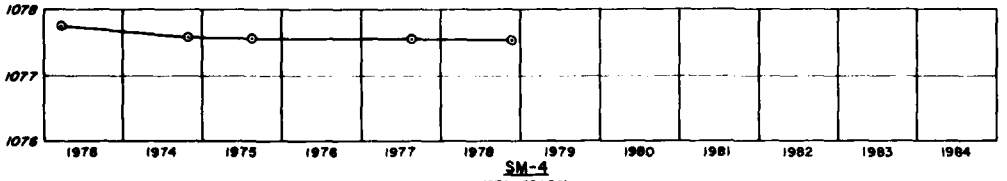
(STA.



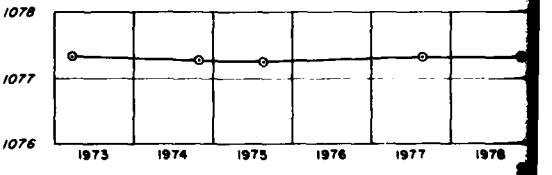
SM-3
(STA. 50+00)



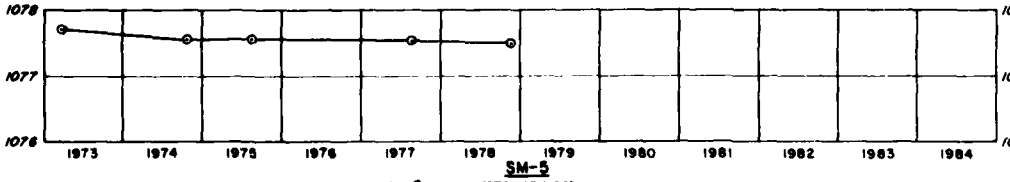
(STA.



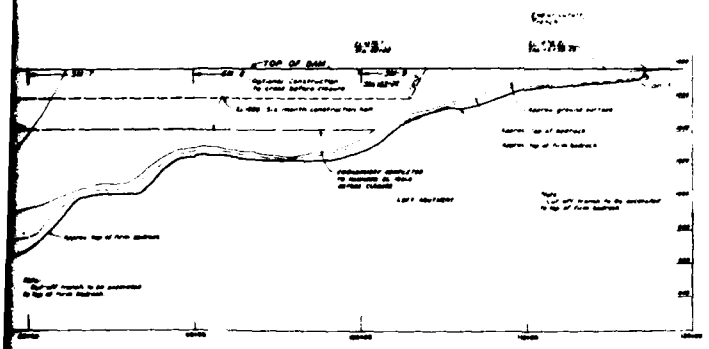
SM-4
(STA. 55+00)

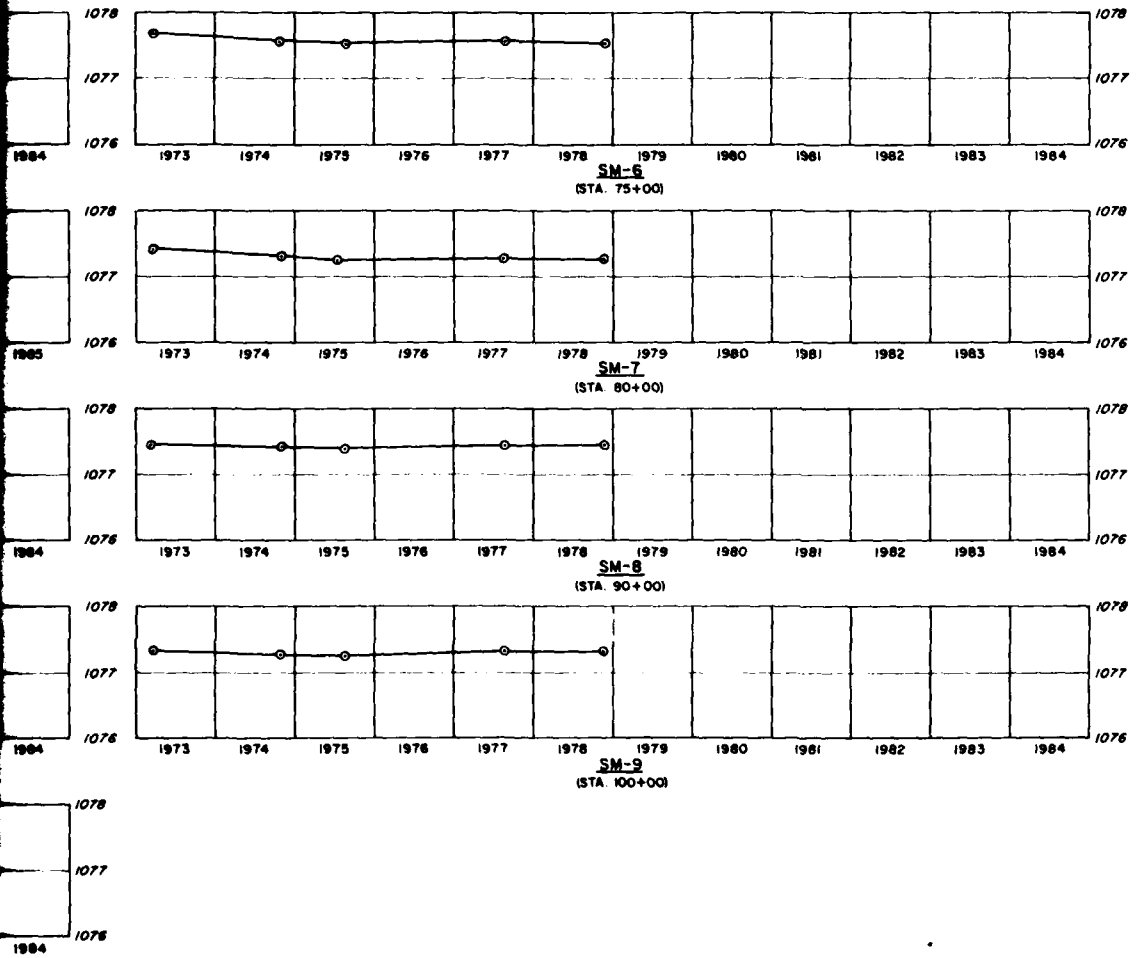


(STA.



SM-5
(STA. 65+00)





MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

SETTLEMENT MONUMENT PLOTS
SM-1 THRU SM-9

In 1 sheets | Sheet No. 1 | Scale as shown

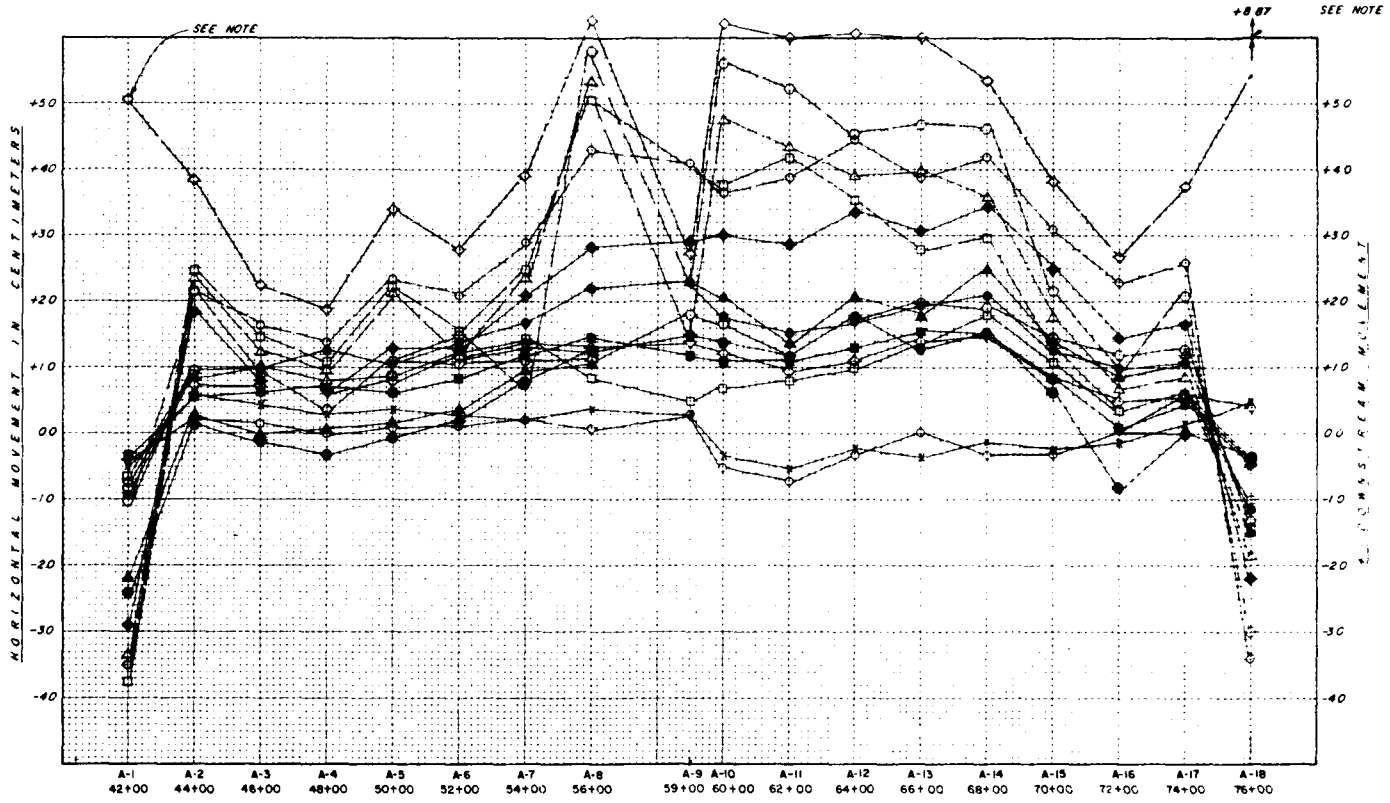
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

FILE NO 0-5-1356

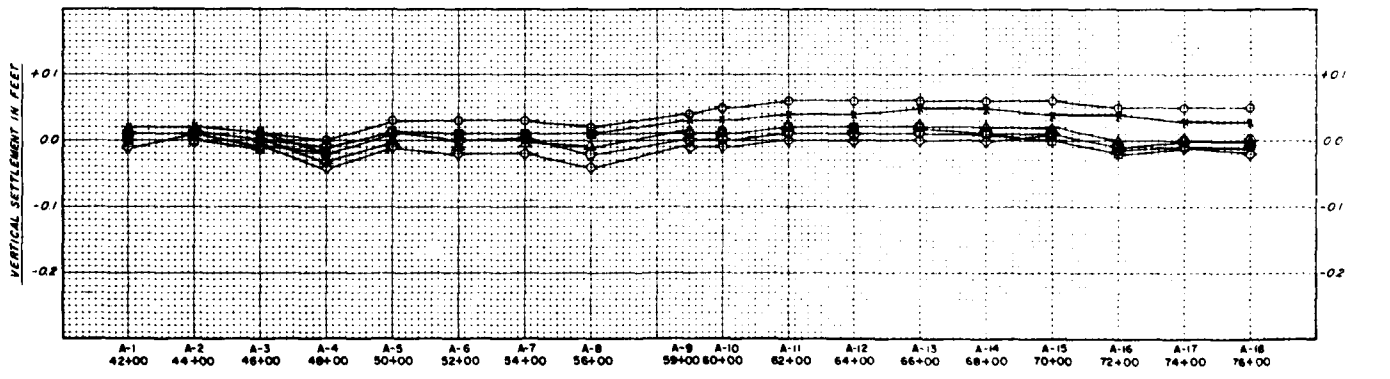
AUGUST 1979

2

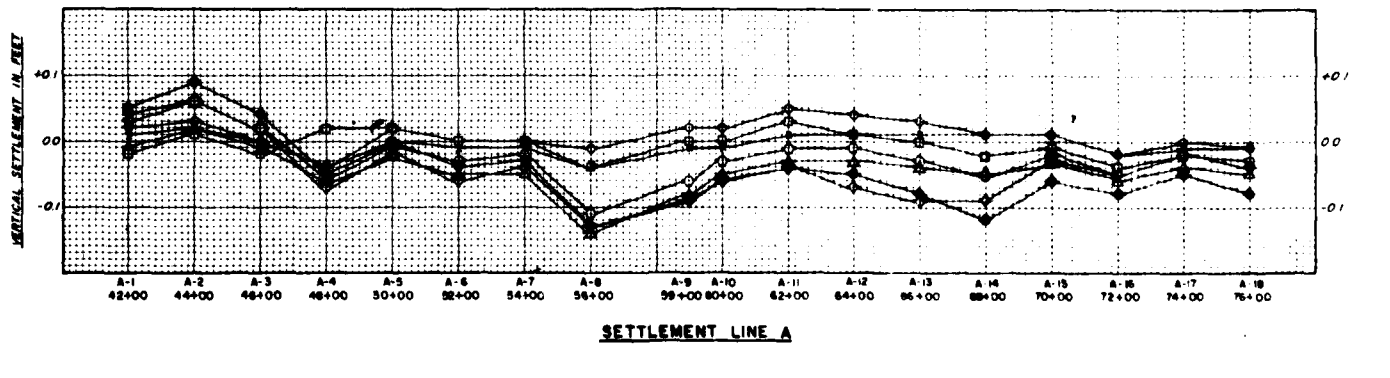
PLATE NO 67



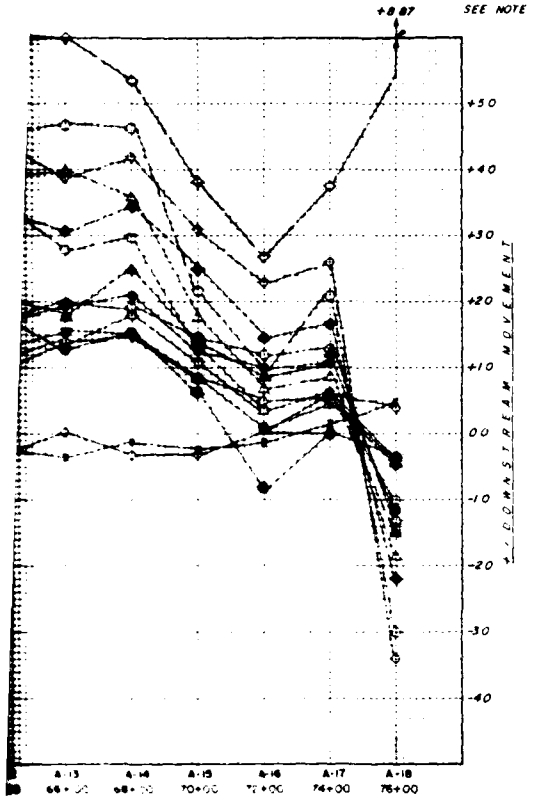
ALINEMENT MONUMENT LINE A RANGE 2+50 DOWNSTREAM



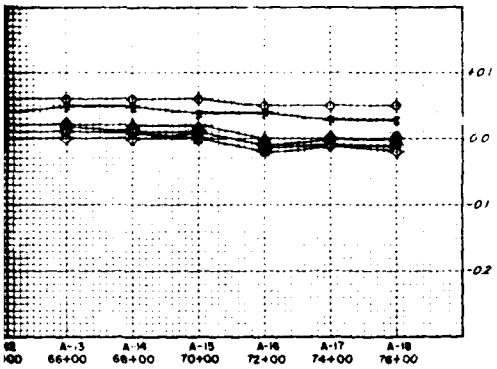
SETTLEMENT LINE A

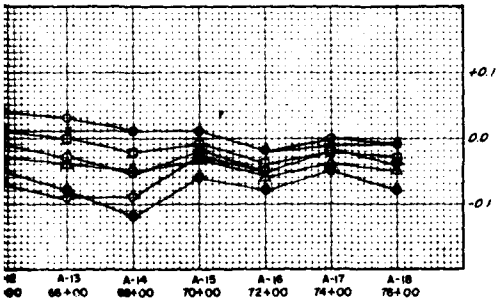


SETTLEMENT LINE A



NSTREAM





LEGEND

- ORIGINAL SURVEY 11-5-71
- SECOND SURVEY 11-22-71
- THIRD SURVEY 12-8-71
- FOURTH SURVEY 1-10-72
- FIFTH SURVEY 1-18-72
- SIXTH SURVEY 2-29-72
- SEVENTH SURVEY 3-30-72
- EIGHTH SURVEY 5-2-72
- NINTH SURVEY 6-2-72
- TENTH SURVEY 10-12-72
- ELEVENTH SURVEY 11-17-72
- TWELFTH SURVEY 3-8-73
- THIRTEENTH SURVEY 9-12-73
- FOURTEENTH SURVEY 10-24-74
- FIFTEENTH SURVEY 8-6-75
- SIXTEENTH SURVEY 8-5-77
- SEVENTEENTH SURVEY 11-30-78

NOTE:
ALINEMENT WAS RAN ON NOV. 8 & 9 AND AGAIN ON NOV. 30 AND DEC. 1.
BETWEEN THESE READINGS, THE INSTRUMENT PLATES WERE RESET ON MONUS B-4, B-17, A-1, AND A-18.
THE READINGS ON THESE PARTICULAR MONUMENTS SHOW EXPLAINABLE DIFFERENCES FROM PREVIOUS READINGS. THESE PLATES WERE ACTUALLY INSTALLED WRONG IN 1969 AND WERE NEVER CHANGED
THE READINGS ON THE ALINEMENT MONUMENTS WERE BASICALLY THE SAME ON NOV. 8 & 9 AND NOV. 30 & DEC. 1

LEGEND

- ORIGINAL SURVEY 1-20-72
- SECOND SURVEY 2-20-72
- THIRD SURVEY 3-29-72
- FOURTH SURVEY 4-24-72
- FIFTH SURVEY 5-1-72
- SIXTH SURVEY 6-22-72
- SEVENTH SURVEY 10-11-72

LEGEND

- ORIGINAL SURVEY 1-20-72
- EIGHTH SURVEY 11-21-72
- NINTH SURVEY 3-7-72
- TENTH SURVEY 9-13-73
- ELEVENTH SURVEY 10-24-74
- TWELFTH SURVEY 8-1-75
- THIRTEENTH SURVEY 8-10-77
- FOURTEENTH SURVEY 11-30-78

Revised August 1[illegible]
MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
PERIODIC INSPECTION

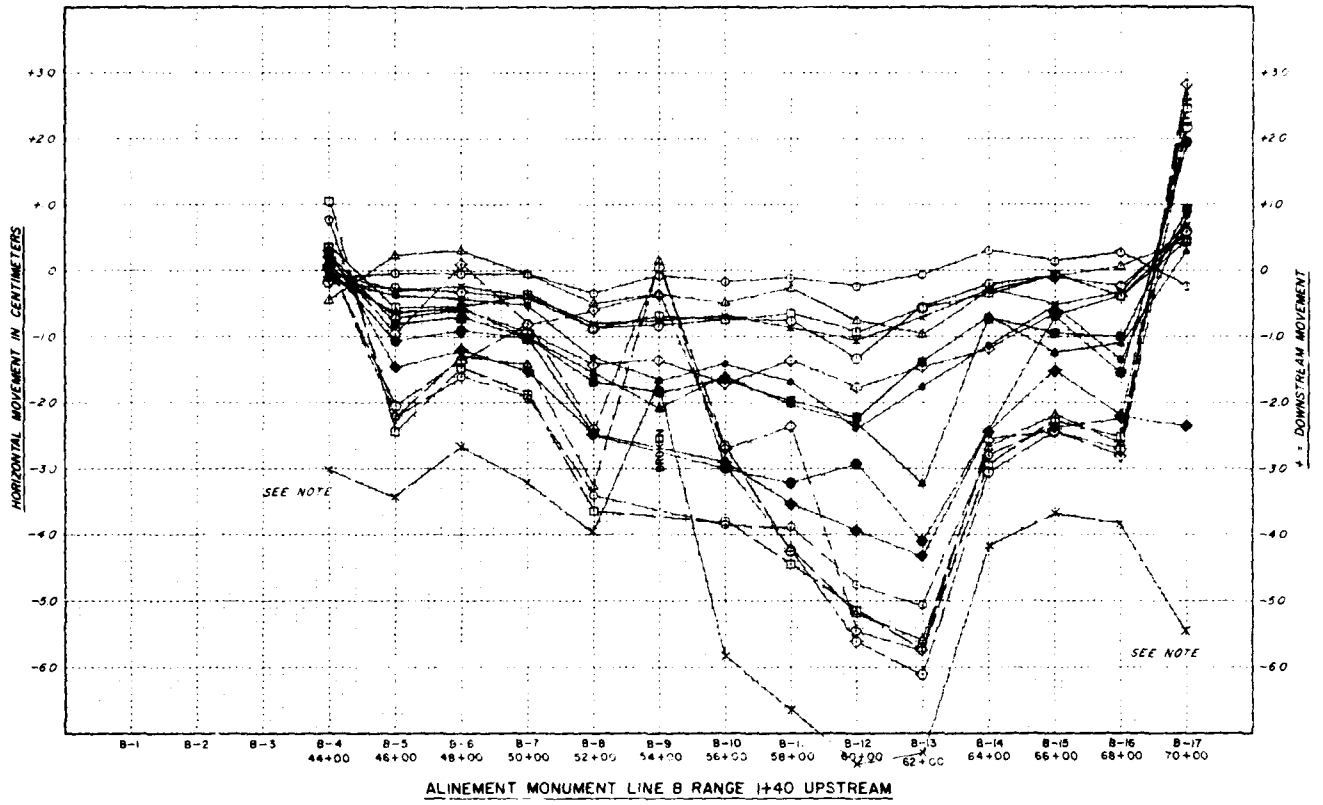
ALINEMENT MONUMENTS LINE A

In 1 sheet | Sheet No. 1 | Scale: as shown

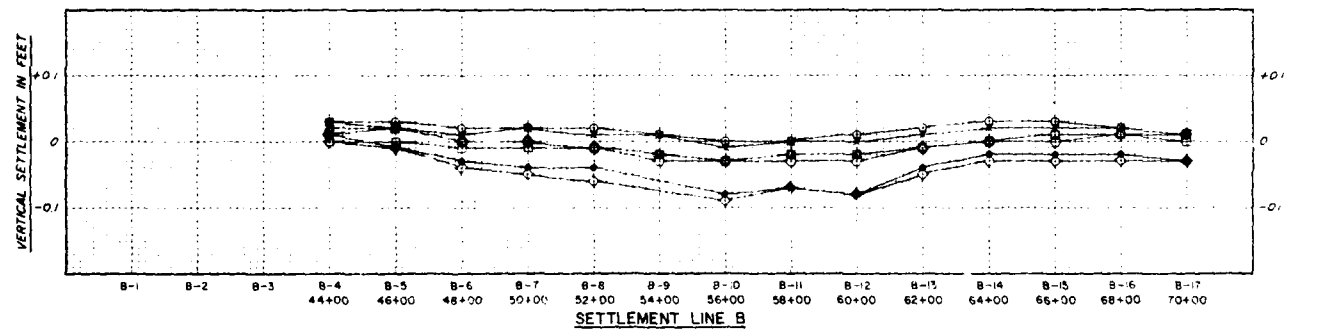
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1318

2

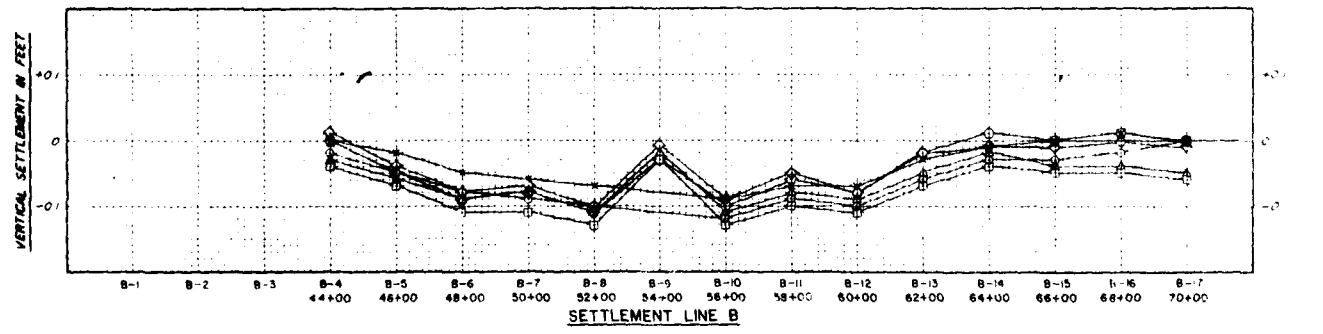
PLATE NO. 68



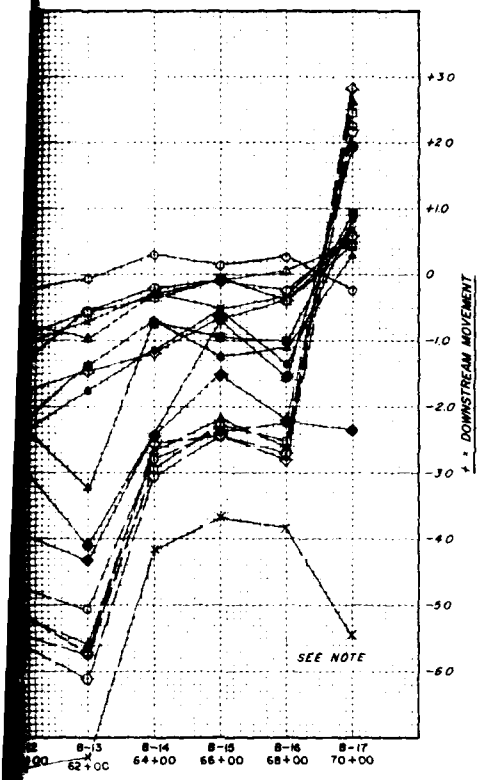
ALINEMENT MONUMENT LINE B RANGE 1+40 UPSTREAM



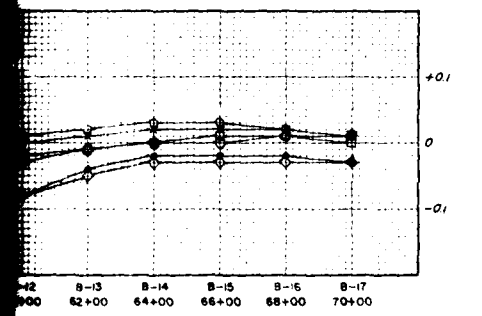
SETTLEMENT LINE B

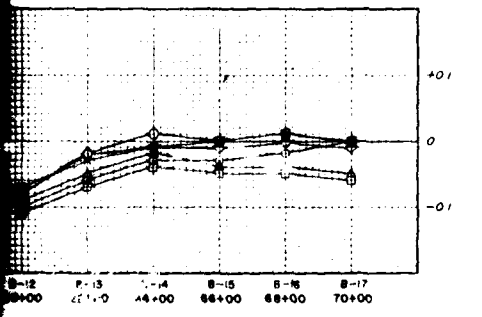


SETTLEMENT LINE B



EAM





LEGEND

- ORIGINAL SURVEY 11-4-71
- SECOND SURVEY 11-23-71
- THIRD SURVEY 12-8-71
- FOURTH SURVEY 1-10-72
- FIFTH SURVEY 1-18-72
- SIXTH SURVEY 2-23-72
- SEVENTH SURVEY 3-30-72
- EIGHTH SURVEY 4-26-72
- NINTH SURVEY 5-2-72
- TENTH SURVEY 6-21-72
- ELEVENTH SURVEY 10-11-72
- TWELFTH SURVEY 11-15-72
- THIRTEENTH SURVEY 3-5-73
- FOURTEENTH SURVEY 9-12-73
- FIFTEENTH SURVEY 10-24-74
- SIXTEENTH SURVEY 8-7-75
- SEVENTEENTH SURVEY 8-9-77
- EIGHTEENTH SURVEY 11-30-78

NOTES:

ALINEMENT WAS RAN ON NOV 8 & 9 AND AGAIN ON NOV. 30 AND DEC 1.

BETWEEN THESE READINGS, THE INSTRUMENT PLATES WERE RESET ON MONUS B-4, B-17, A-1, AND A-18.

THE READINGS ON THESE PARTICULAR MONUMENTS SHOW EXPLAINABLE DIFFERENCES FROM PREVIOUS READINGS. THESE PLATES WERE ACTUALLY INSTALLED WRONG IN 1969 AND WERE NEVER CHANGED.

THE READINGS ON THE ALINEMENT MONUMENTS WERE BASICALLY THE SAME ON NOV. 8 & 9 AND NOV 30 & DEC 1

LEGEND

- ORIGINAL SURVEY 1-20-72
- SECOND SURVEY 2-22-72
- THIRD SURVEY 3-29-72
- FOURTH SURVEY 4-24-72
- FIFTH SURVEY 5-1-72
- SIXTH SURVEY 6-21-72
- SEVENTH SURVEY 10-11-72
- EIGHTH SURVEY 11-20-72

LEGEND

- ORIGINAL SURVEY 1-20-72
- NINTH SURVEY 3-7-73
- TENTH SURVEY 9-13-73
- ELEVENTH SURVEY 10-24-74
- TWELFTH SURVEY 8-1-75
- THIRTEENTH SURVEY 8-9-77
- FOURTEENTH SURVEY 11-7-78

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

PERIODIC INSPECTION

ALINEMENT MONUMENT
LINE B

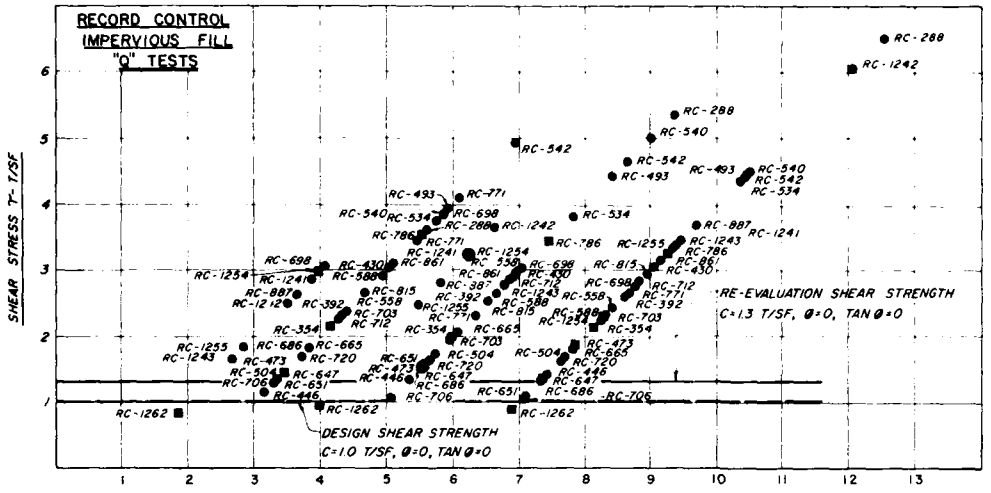
In 1 sheet | Sheet No. 1 | Scale as shown

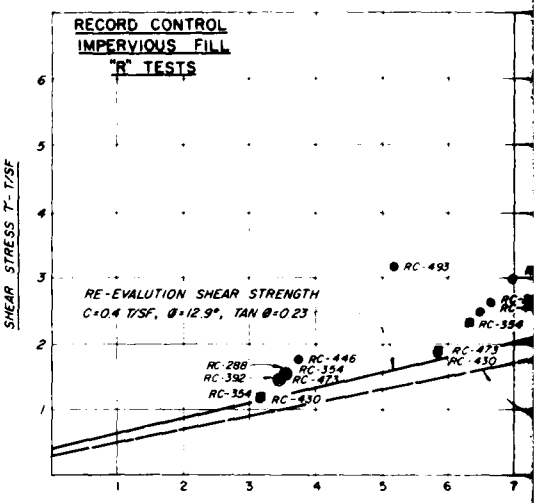
CORPS OF ENGINEERS, U.S. ARMY
KANSAS CITY DISTRICT

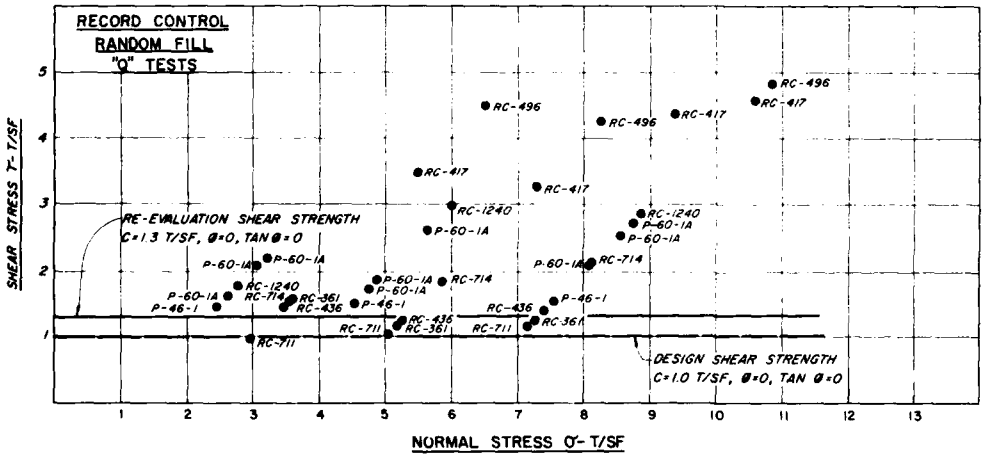
FILE NO 0-5-1319

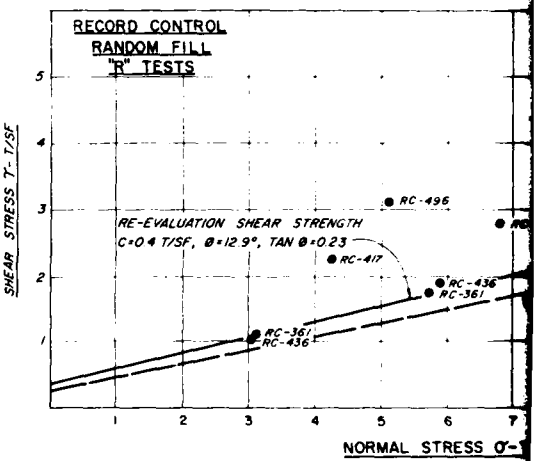
2

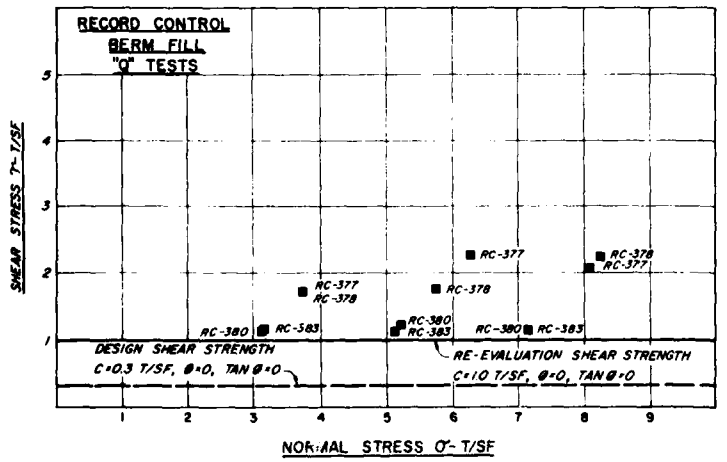
PLATE NO 69

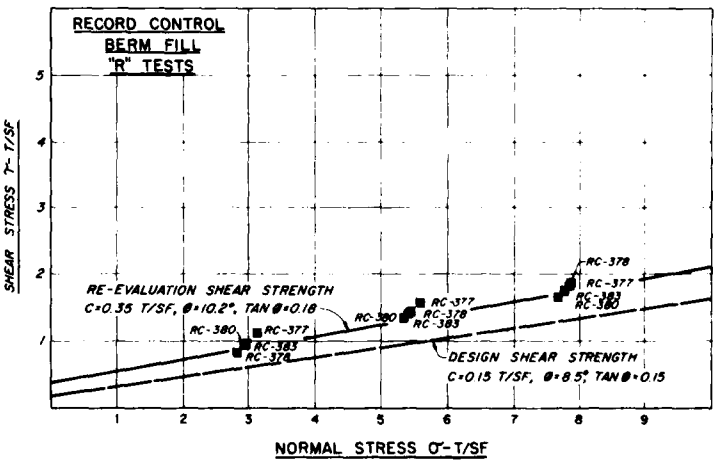

RECORD CONTROL
IMPERVIOUS FILL
"Q" TESTS
SHEAR STRESS T- T/SF
NORMAL STRESS σ- T/SF
RE-EVALUATION SHEAR STRENGTH
C=1.3 T/SF, Ø=0, TAN Ø=0
DESIGN SHEAR STRENGTH
C=1.0 T/SF, Ø=0, TAN Ø=0

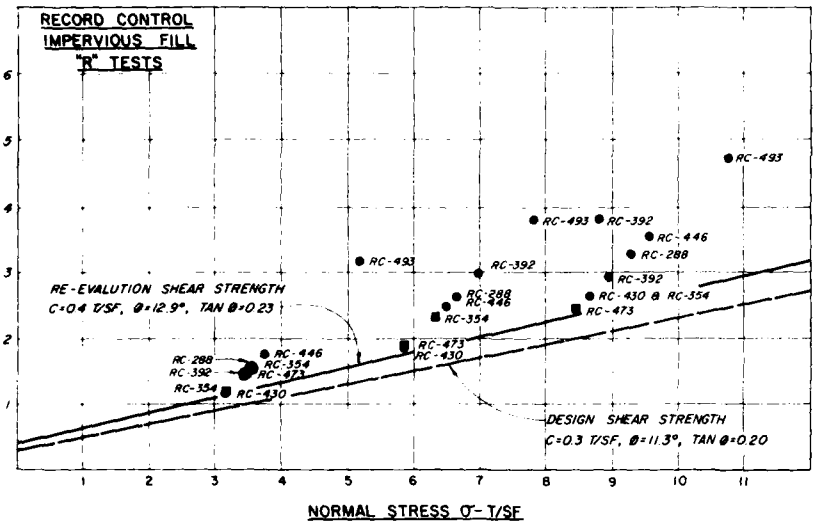

RECORD CONTROL
IMPERVIOUS FILL
"R" TESTS
SHEAR STRESS T- T/SF
RE-EVALUTION SHEAR STRENGTH
C=0.4 T/SF, Ø=12.9°, TAN Ø=0.23
NORMAL STRESS σ-

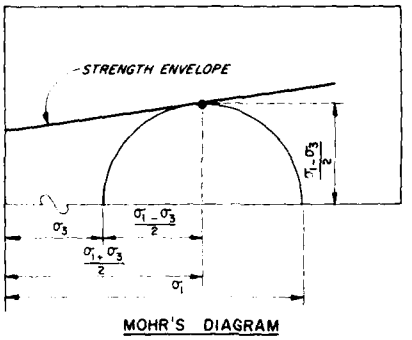

RECORD CONTROL
RANDOM FILL
"Q" TESTS
SHEAR STRESS T- T/SF
RE-EVALUATION SHEAR STRENGTH
C=1.3 T/SF, Ø=0, TAN Ø=0
DESIGN SHEAR STRENGTH
C=1.0 T/SF, Ø=0, TAN Ø=0
NORMAL STRESS σ- T/SF

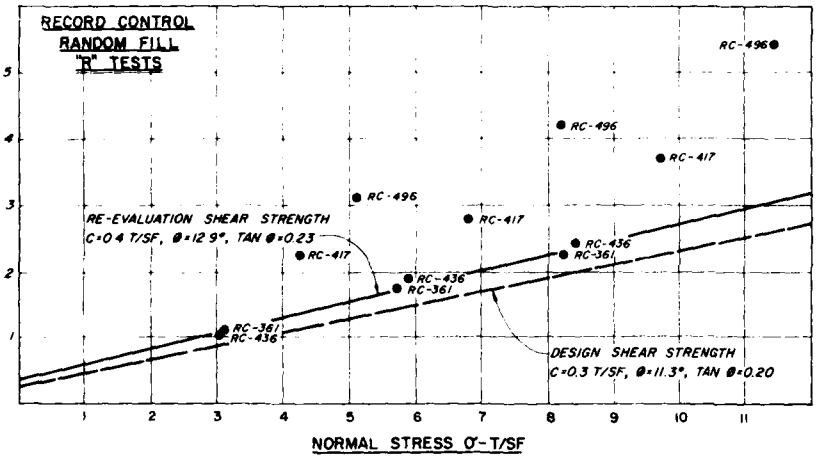

RECORD CONTROL
RANDOM FILL
"R" TESTS
SHEAR STRESS T- T/SF
RE-EVALUATION SHEAR STRENGTH
C=0.4 T/SF, Ø=12.9°, TAN Ø=0.23
NORMAL STRESS σ-

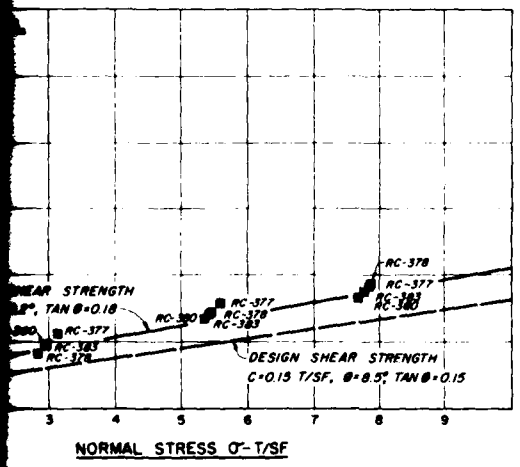

RECORD CONTROL
BERM FILL
"Q" TESTS
SHEAR STRESS T- T/SF
DESIGN SHEAR STRENGTH
C=0.3 T/SF, Ø=0, TAN Ø=0
RE-EVALUATION SHEAR STRENGTH
C=1.0 T/SF, Ø=0, TAN Ø=0
NORMAL STRESS σ- T/SF


RECORD CONTROL
BERM FILL
"R" TESTS
SHEAR STRESS T- T/SF
RE-EVALUATION SHEAR STRENGTH
C=0.35 T/SF, Ø=10.2°, TAN Ø=0.18
DESIGN SHEAR STRENGTH
C=0.15 T/SF, Ø=8.5°, TAN Ø=0.15
NORMAL STRESS σ- T/SF









LEGEND

LEAN CLAY ●

FAT CLAY ■

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

RECORD CONTROL "Q" AND "R" TESTS EMBANKMENT MATERIALS

In 1 sheets | Sheet No 1 | Scale as shown

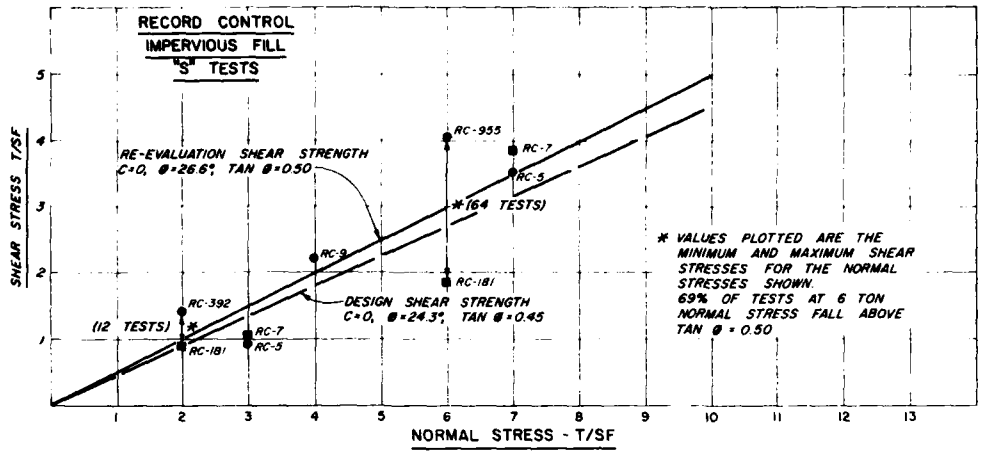
CORPS OF ENGINEERS U S ARMY

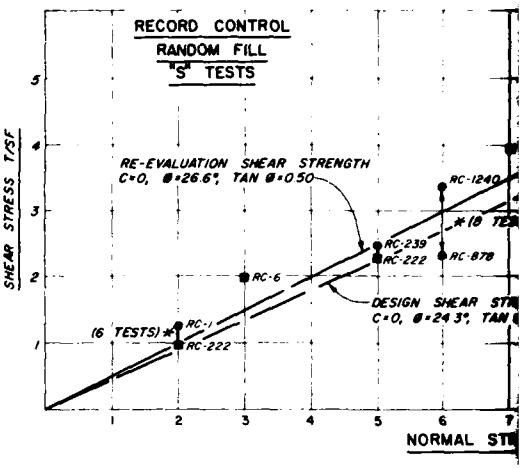
KANSAS CITY DISTRICT

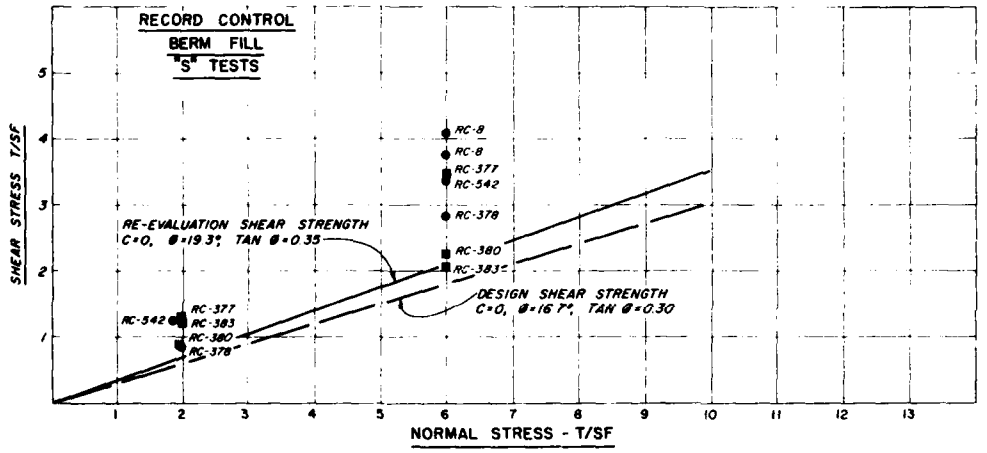
FILE NO 0-5-1312

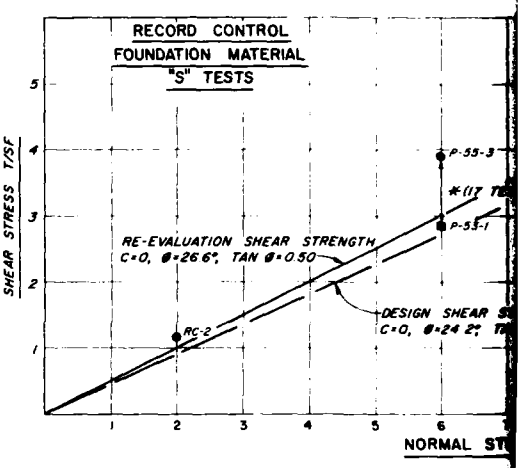
AUGUST 1975

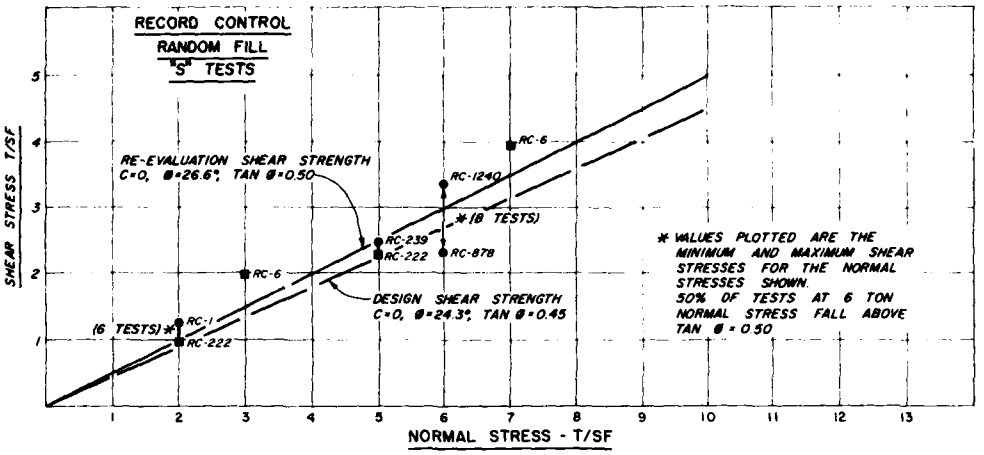
PLATE NO. 70

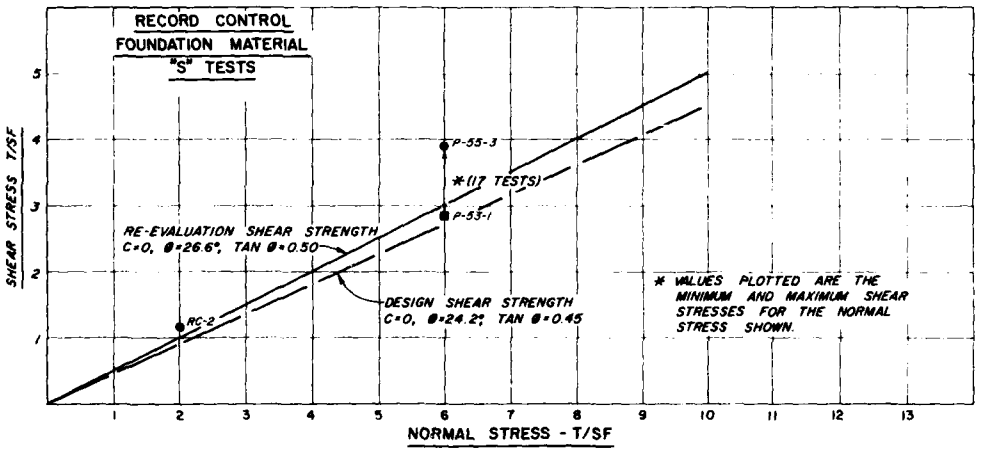

RECORD CONTROL
IMPERVIOUS FILL
"S" TESTS
SHEAR STRESS T/SF
NORMAL STRESS - T/SF
RE-EVALUATION SHEAR STRENGTH
C=0, ∅=26.6°, TAN ∅=0.50
DESIGN SHEAR STRENGTH
C=0, ∅=24.3°, TAN ∅=0.45
(12 TESTS)
(64 TESTS)
RC-955
RC-7
RC-5
RC-9
RC-181
RC-392
RC-7
RC-5
RC-181
* VALUES PLOTTED ARE THE MINIMUM AND MAXIMUM SHEAR STRESSES FOR THE NORMAL STRESSES SHOWN.
69% OF TESTS AT 6 TON NORMAL STRESS FALL ABOVE TAN ∅ = 0.50


RECORD CONTROL
RANDOM FILL
"S" TESTS
SHEAR STRESS T/SF
NORMAL STRESS
RE-EVALUATION SHEAR STRENGTH
C=0, ∅=26.6°, TAN ∅=0.50
DESIGN SHEAR STRENGTH
C=0, ∅=24.3°, TAN
(6 TESTS)
RC-1240
RC-239
RC-222
RC-878
RC-6
RC-1
RC-222


RECORD CONTROL
BERM FILL
"S" TESTS
SHEAR STRESS T/SF
NORMAL STRESS - T/SF
RE-EVALUATION SHEAR STRENGTH
C=0, ∅=19.3°, TAN ∅=0.35
DESIGN SHEAR STRENGTH
C=0, ∅=16.7°, TAN ∅=0.30
RC-8
RC-8
RC-377
RC-542
RC-378
RC-380
RC-383
RC-542
RC-377
RC-383
RC-380
RC-378


RECORD CONTROL
FOUNDATION MATERIAL
"S" TESTS
SHEAR STRESS T/SF
NORMAL ST
RE-EVALUATION SHEAR STRENGTH
C=0, ∅=26.6°, TAN ∅=0.50
DESIGN SHEAR S
C=0, ∅=24.2°, T
P-55-3
P-55-1
RC-2





LEGEND

LEAN CLAY ●

FAT CLAY ■

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

RECORD CONTROL
"S" TESTS
EMBANKMENT MATERIALS

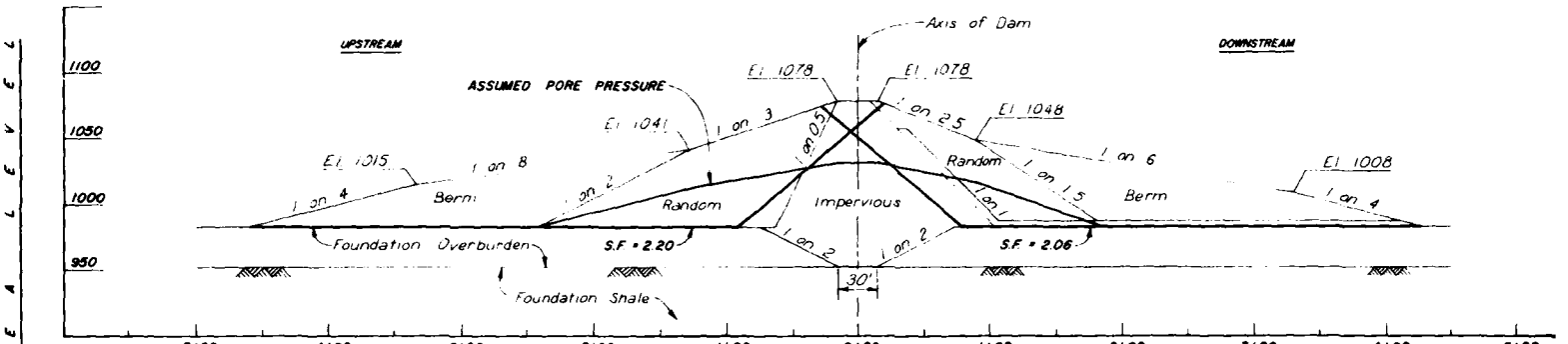
In 1 sheets | Sheet No 1 | Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

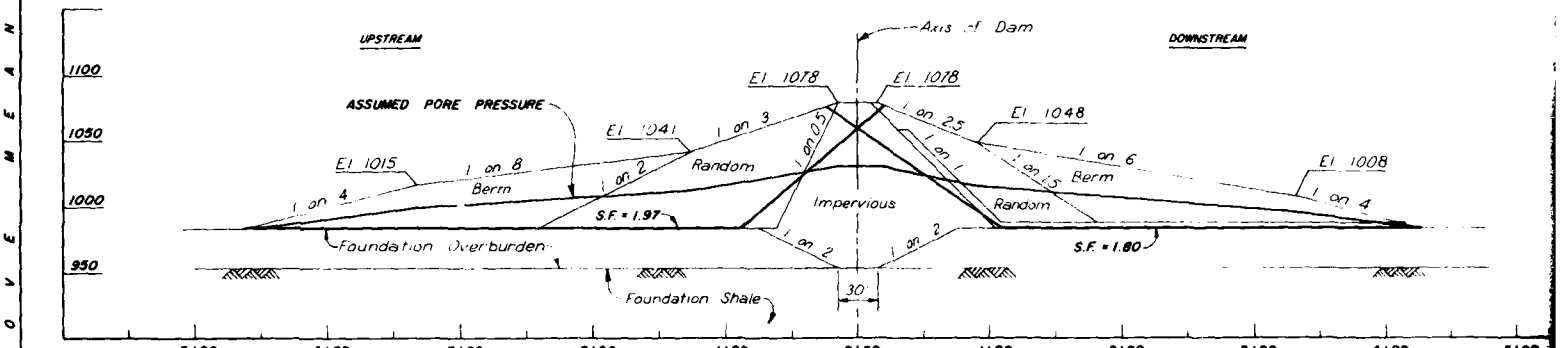
FILE NO 0-5-1313

AUGUST 1975

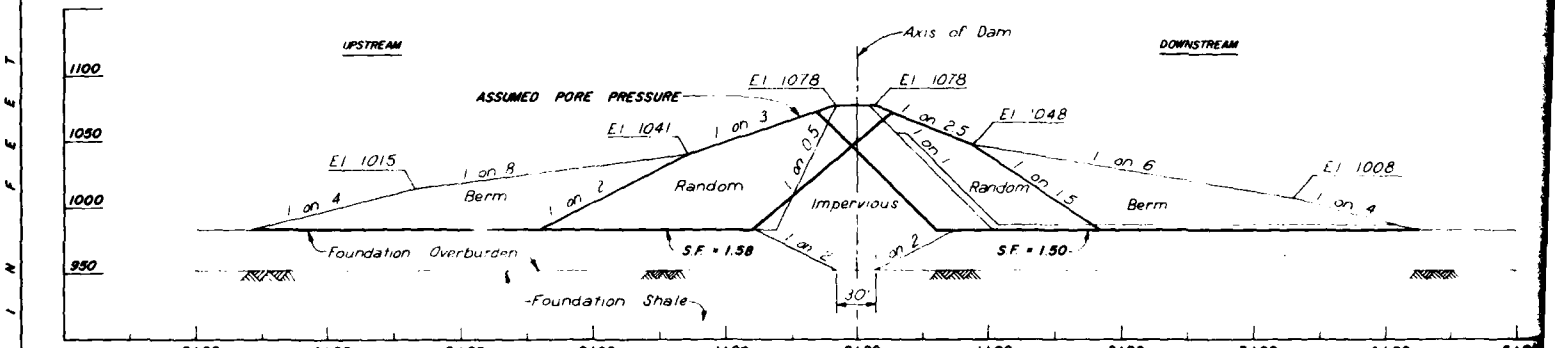
PLATE NO 71



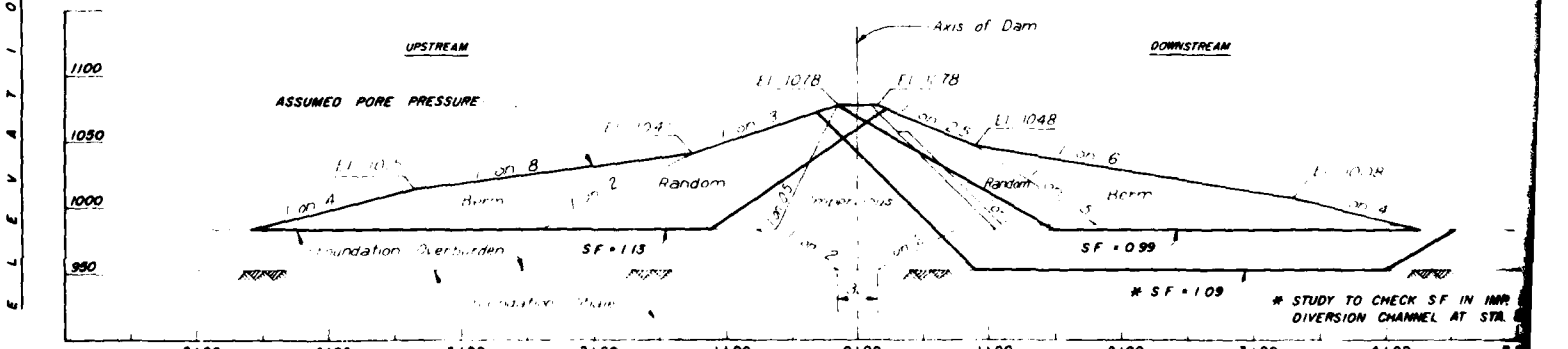
STUDY WITH 25% PORE PRESSURE IN IMPERVIOUS AND RANDOM FILL
"S" STRENGTH



STUDY WITH 25% PORE PRESSURE IN ALL ZONES
"S" STRENGTH

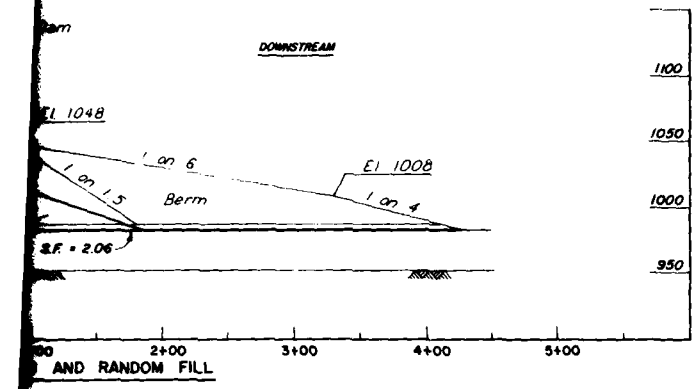


STUDY WITH 50% PORE PRESSURE IN IMPERVIOUS AND RANDOM FILL
"S" STRENGTH

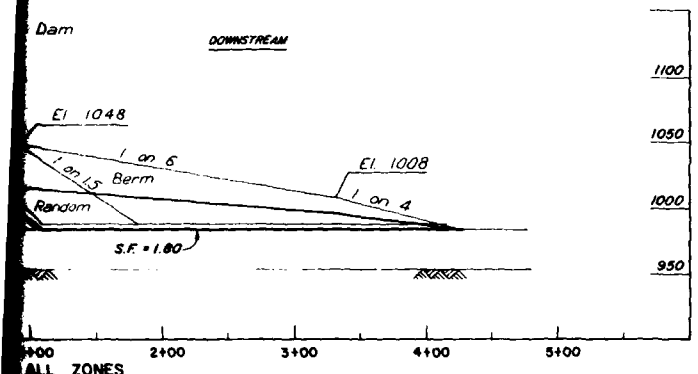


* STUDY TO CHECK S.F. IN IMP
DIVERSION CHANNEL AT STA.

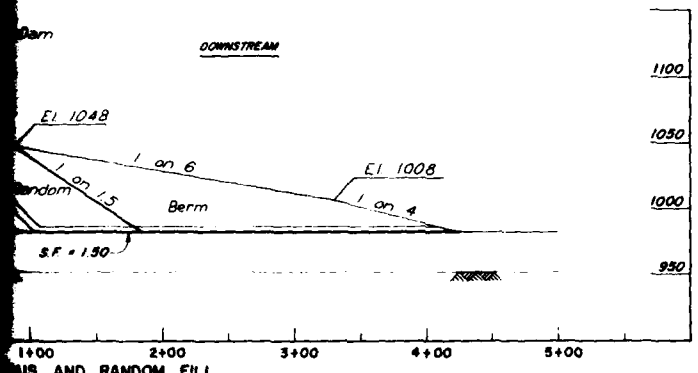
STUDY WITH 50% PORE PRESSURE IN ALL ZONES
"S" STRENGTH



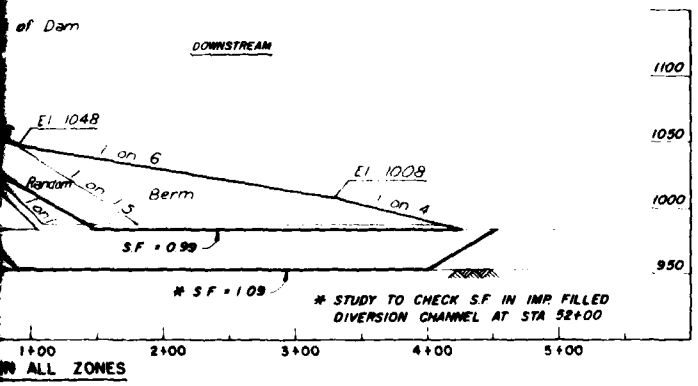
AND RANDOM FILL



ALL ZONES



US AND RANDOM FILL



STUDY TO CHECK S.F. IN IMP. FILLED DIVERSION CHANNEL AT STA 52+00

ALL ZONES

PHYSICAL SOIL CONSTANTS

MATERIAL	UNIT WEIGHT P/C.F		DESIGN SHEAR STRENGTHS (RECORD CONTROL)								
			Q			R			S		
	SAT.	DRAINED	C,(TSF)	ø	TAN ø	C,(TSF)	ø	TAN ø	C,(TSF)	ø	TAN ø
IMPERVIOUS AND RANDOM	125	120	1.30	0.00	0.00	0.40	12.9°	0.23	0.00	26.6°	0.50
BERM	115	110	1.00	0.00	0.00	0.35	10.2°	0.18	0.00	19.3°	0.35
FOUNDATION OVERBURDEN	120	115	0.60	0.00	0.00	0.30	11.3°	0.20	0.00	26.6°	0.50
FOUNDATION SHALE	120	115	0.60	5.7°	0.10	0.40	11.3°	0.20	0.00	21.8°	0.40

Revised August 1979

MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

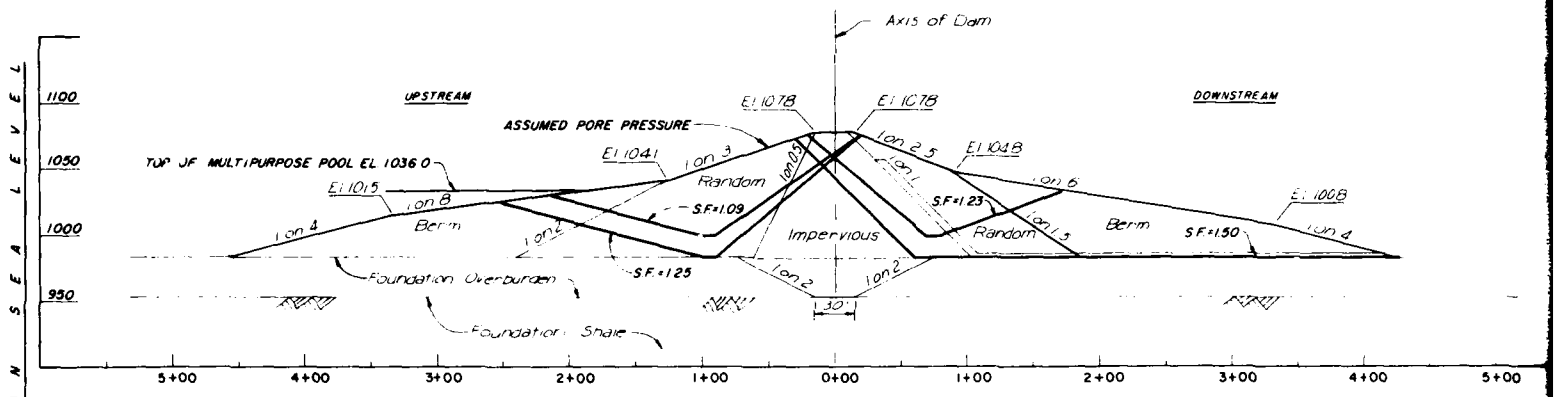
RE-EVALUATION
STABILITY STUDIES
EMBANKMENT AND FOUNDATION

In 2 sheets | Sheet No 1 | Scale as shown

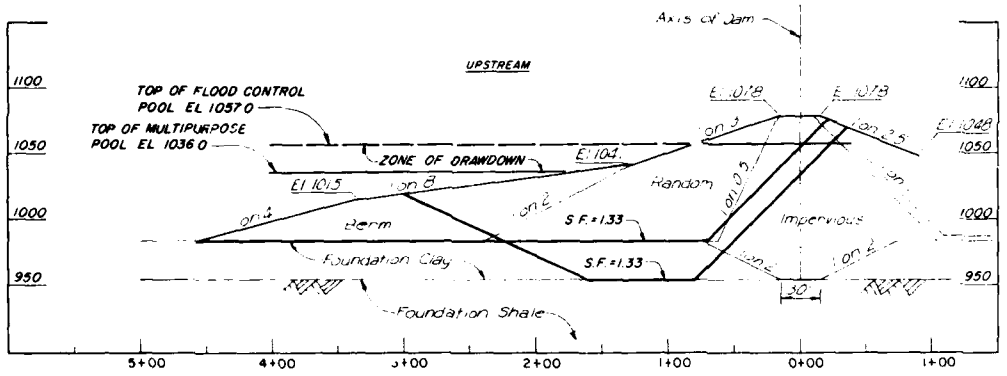
CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. D-5-1314
AUGUST 1975

2

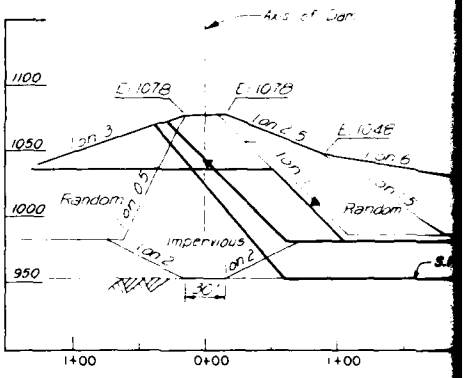
PLATE NO 72



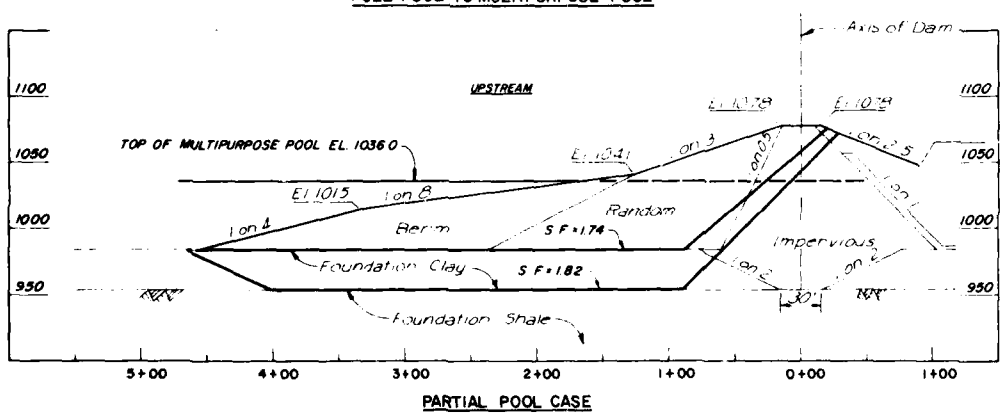
STUDY WITH LAKE AT ELEVATION 1036.0 AND 50% PORE PRESSURE IN IMPERVIOUS AND RANDOM FILL – "S" STRENGTH



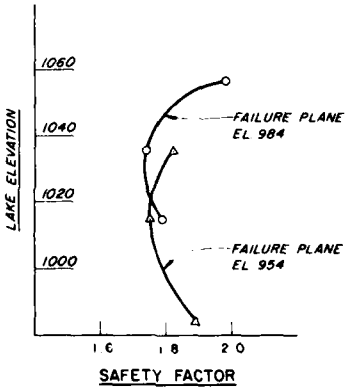
RAPID DRAWDOWN CASE
FULL POOL TO MULTIPURPOSE POOL



STEA
LAKE

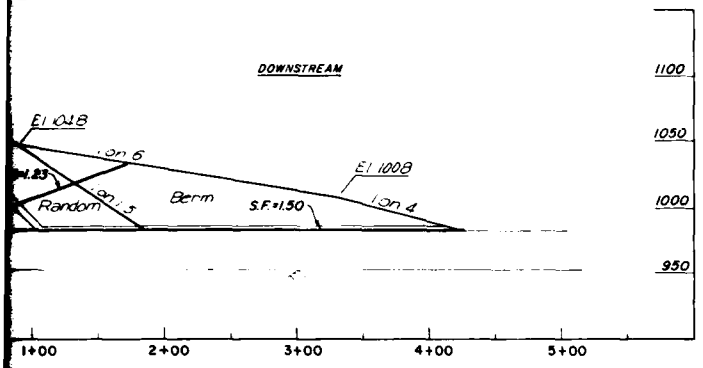


PARTIAL POOL CASE

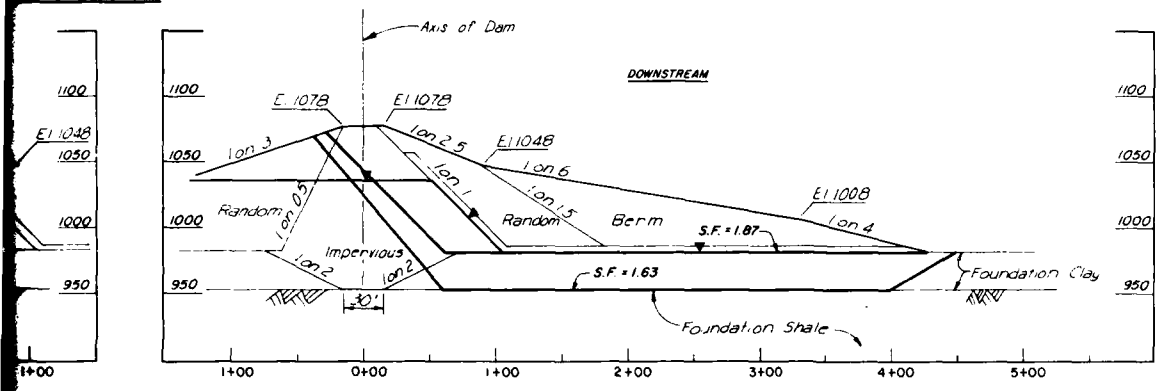


SAFETY FACTOR

Dam

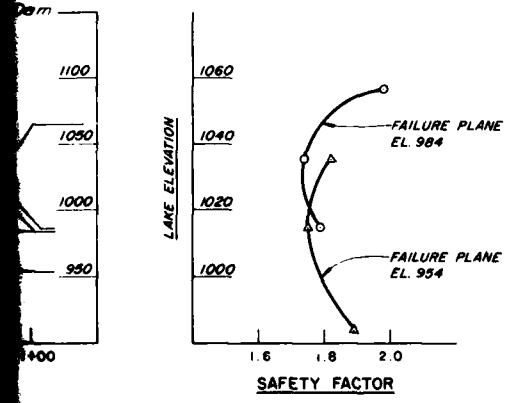


ND 50% PORE
L - "S" STRENGTH



STEADY SEEPAGE CASE
LAKE ELEVATION 1036.0

Dam



SAFETY FACTOR

Revised August 1979
MARAIS DES CYGNES RIVER, KANSAS

MELVERN LAKE

RE-EVALUATION
STABILITY STUDIES
EMBANKMENT AND FOUNDATION

In 2 sheets | Sheet No 2 | Scale as shown

CORPS OF ENGINEERS U S ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1315
AUGUST 1975

2

PLATE NO. 73