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OPERATION AND MAINTENANCE MANUAL, MELVERN LAKE, MARAIS DES CYGN--ETC(U)
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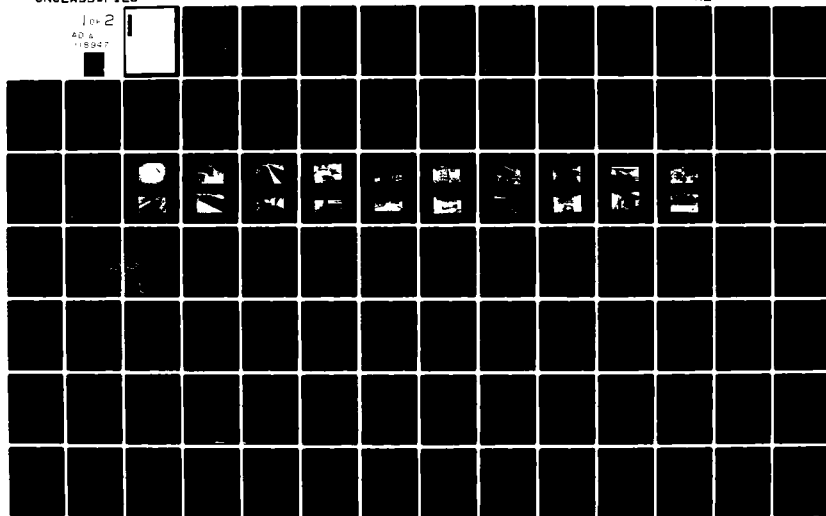
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US ARMY, CORPS OF ENGINEERS

OPERATION AND MAINTENANCE MANUAL

MELVERN LAKE
Marais des Cygnes River, Kansas

APPENDIX V

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

August 1982



Accession For	
NO.	X
Dist.	
U.S.	
Jr on file	
Ex.	
Dist.	
AV.	1915
Dist.	For
Special	
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DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS

for publication in the Journal of the
distribution of the Journal of the

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

APPENDIX V
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106

MELVERN LAKE
MARAI 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	3 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

<u>Pool</u>	<u>Elevation of Top of Zone (ft., m.s.l.)</u>	<u>Surface Area (Acres)</u>	<u>Storage Allocation</u>	
			<u>Initial (ac.-ft.)</u>	<u>100-year (ac.-ft.)</u>
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.

<u>Project</u>	<u>Contract No.</u>	<u>Construction Dates</u>	
		<u>Begun</u>	<u>Accepted</u>
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.

<u>Project</u>	<u>Contract No.</u>	<u>Construction Dates</u>	
		<u>Begun</u>	<u>Accepted</u>
Construction of Administrative Facilities	68-C-0018	31 Aug 67	4 Oct 68
Relocation, Rearrange- ment 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, Altera- tion, and Removal of Telephone Lines	71-C-0016	8 Jan 71	9 Sep 72
Relocation and Alter- ation 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.

<u>Project</u>	<u>Contract No.</u>	<u>Construction Dates</u>	
		<u>Begun</u>	<u>Accepted</u>
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 Jefferson 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 use 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 accomplished in one stage, beginning in August 1967, and final acceptance of the work was made 21 May 1973. Excavation and embankment placement was 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 1975 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 pool. The project stored 246,650 acre-feet of flood water and prevented significant flood damage 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 Shields. 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. Artesian 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 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:

<u>Sieve Size</u>	<u>Bedding</u>	<u>Percent by weight passing</u>
2-inch		Maximum allowable size
1/2-inch		75-95
No. 10		35-50
No. 40		5-20

	<u>Spalls</u>	
8-inch		Maximum allowable size
4-inch		70-90
1 1/2-inch		15-40
1-inch		0-15
<u>Weight in pounds per stone</u>		<u>Percent of total weight lighter than</u>

	<u>Type "A" Riprap (24-inch)</u>	
700		Maximum allowable size
500		85-95
200		30-50
50		0-10

	<u>Type "B" Riprap (30-inch)</u>	
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 was 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 tamping 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 located 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 directed 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)



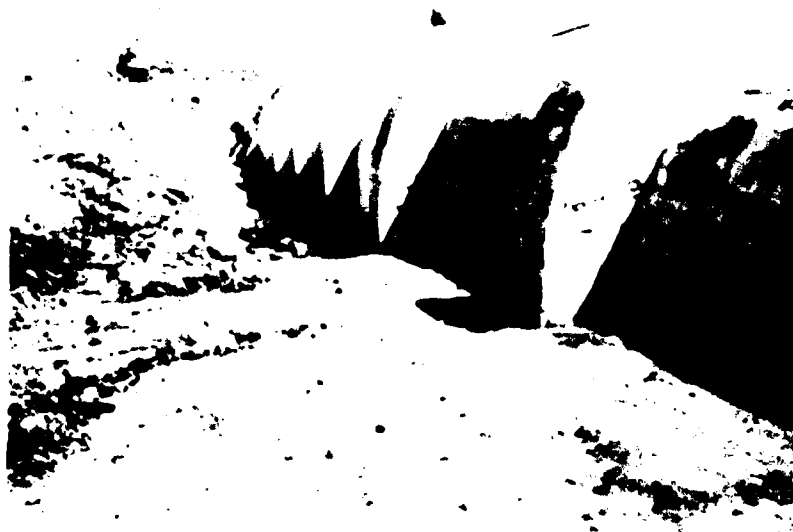
3. Melvern Lake, Construction Photo, Neg. No. 694-R1 -24
(Station 50+50, River Bank, looking up station
cutoff trench)



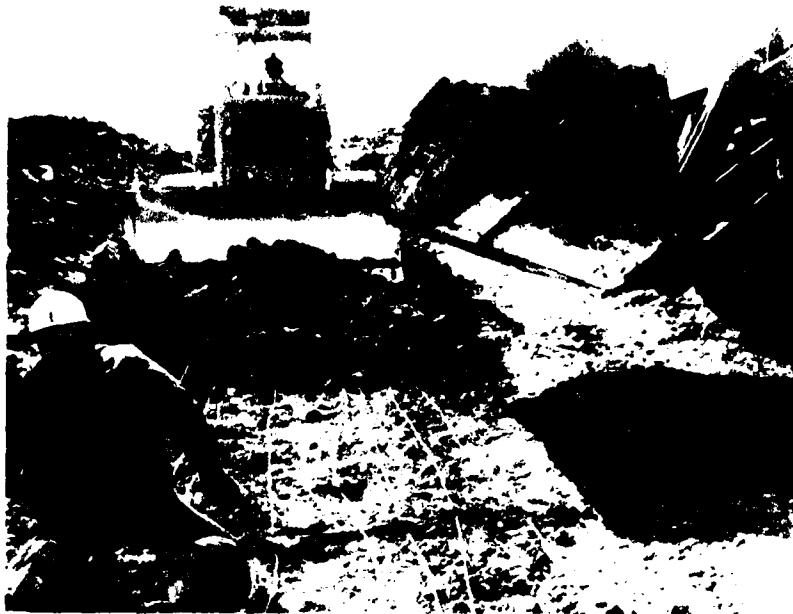
4. Melvern Lake, Construction Photo, Neg. No. 694-R1-23
(Impervious backfill in cutoff trench)



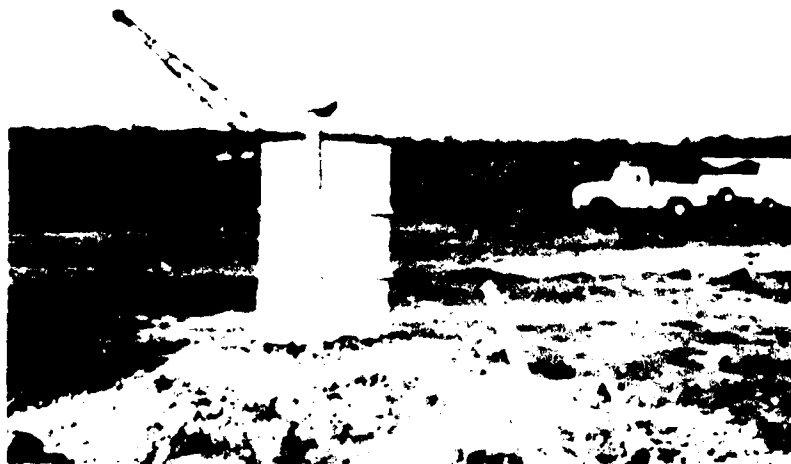
5. Melvern Lake, Construction Photo, Neg. No. 694-R1-3
(Excavation for conduit before placement of backfill)



6. Melvern Lake, Construction Photo, Neg. No. 694-R1-6
Backfill material at seepage and alignment 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)



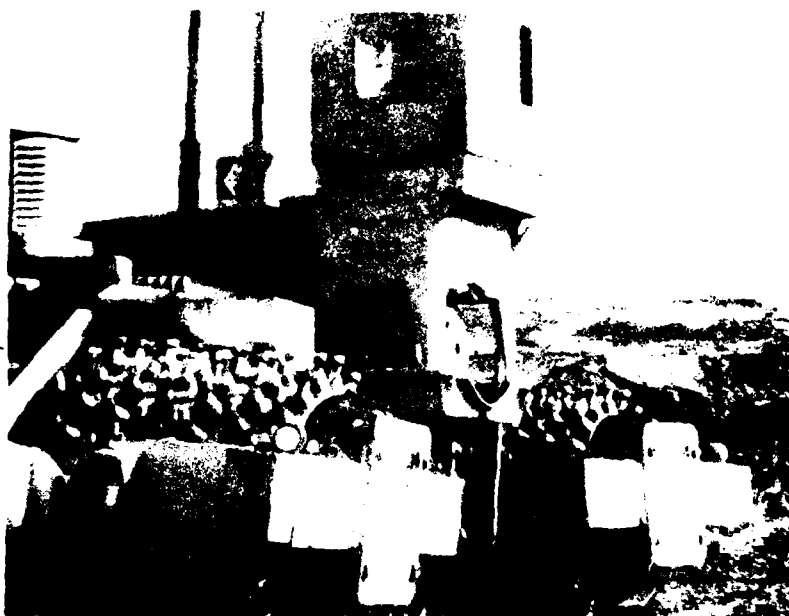
16. Melvern Lake, Construction Photo Neg. No. 88752
(General view of embankment and both valley and
downstream borrow areas)



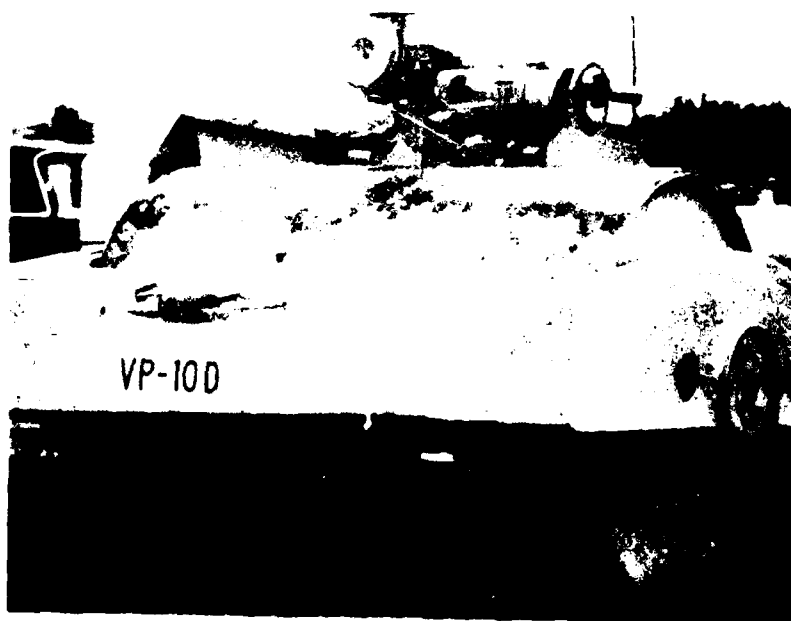
17. Melvern Lake, Construction Photo Neg. No. 694-R1-4
(General view of the outlet channel)



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)

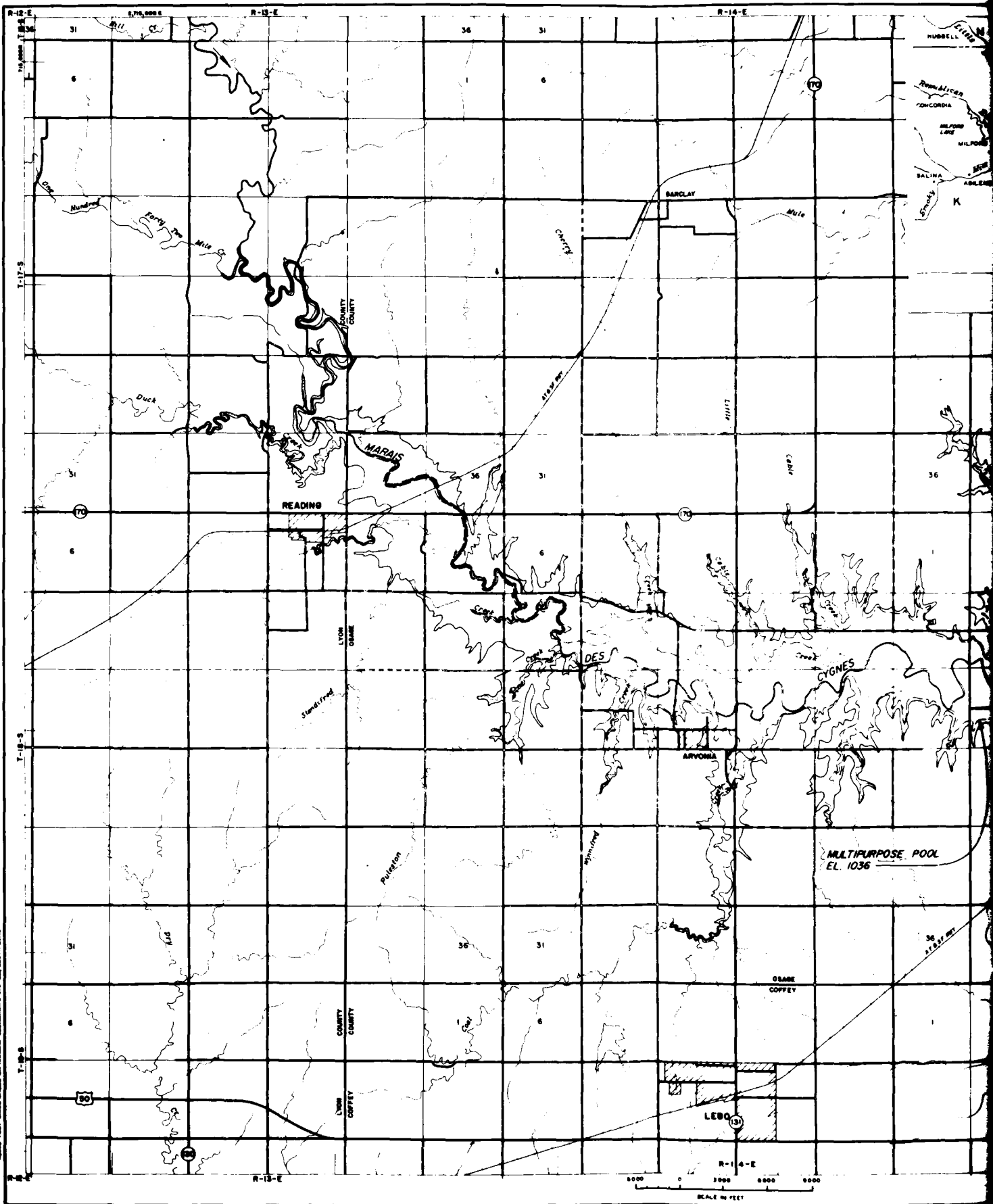


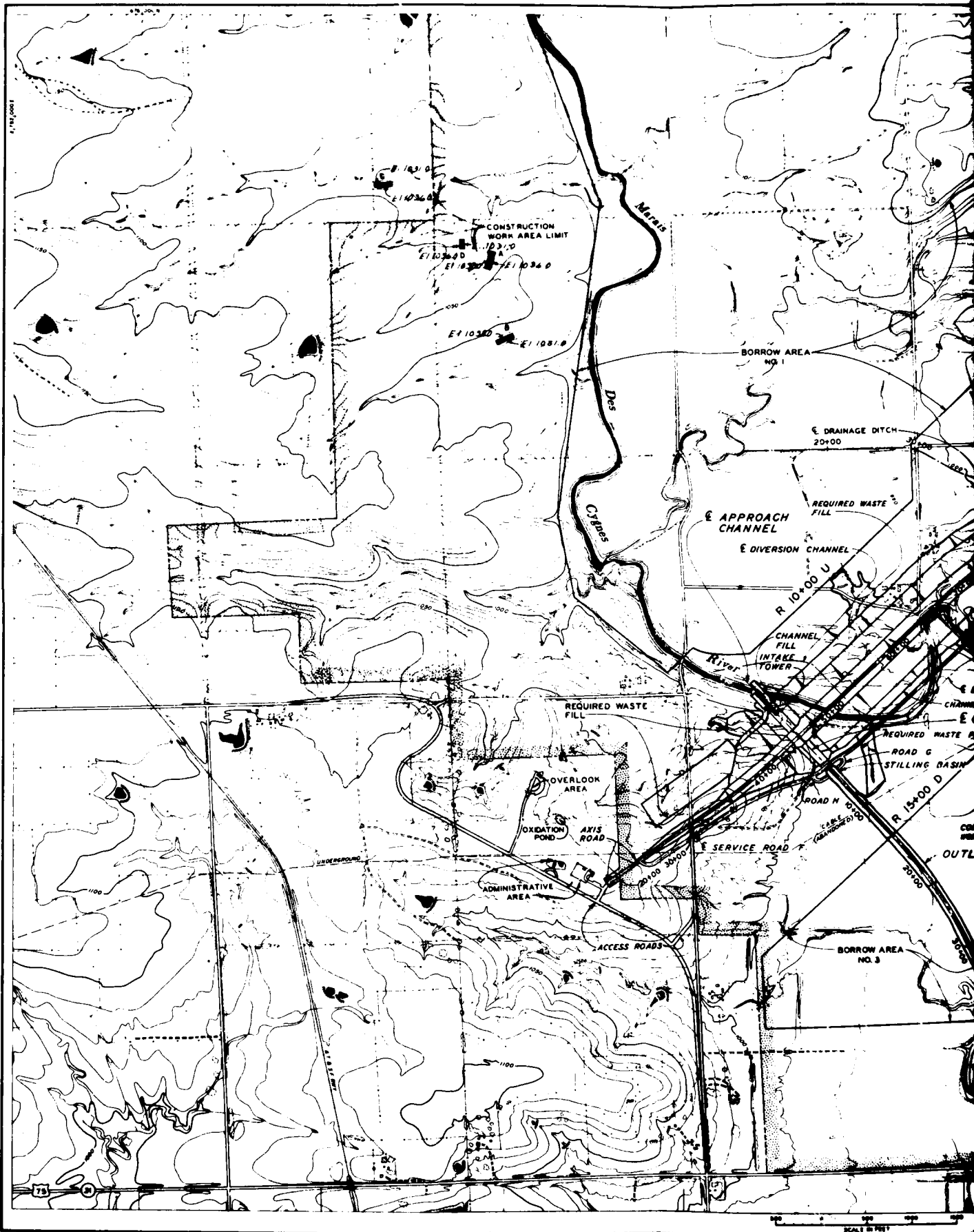
20. Melvern Lake, Construction Photo Neg. No. 694-R1-22
(Vibratory steel drum roller)

DRAWINGS

DRAWINGS

REVISIONS
July 1964





NOTE: This map was prepared by the Corps of Engineers, Mobile District, Mobile, Alabama, and is not to be used for any other purpose without the written permission of the Corps of Engineers, Mobile District.

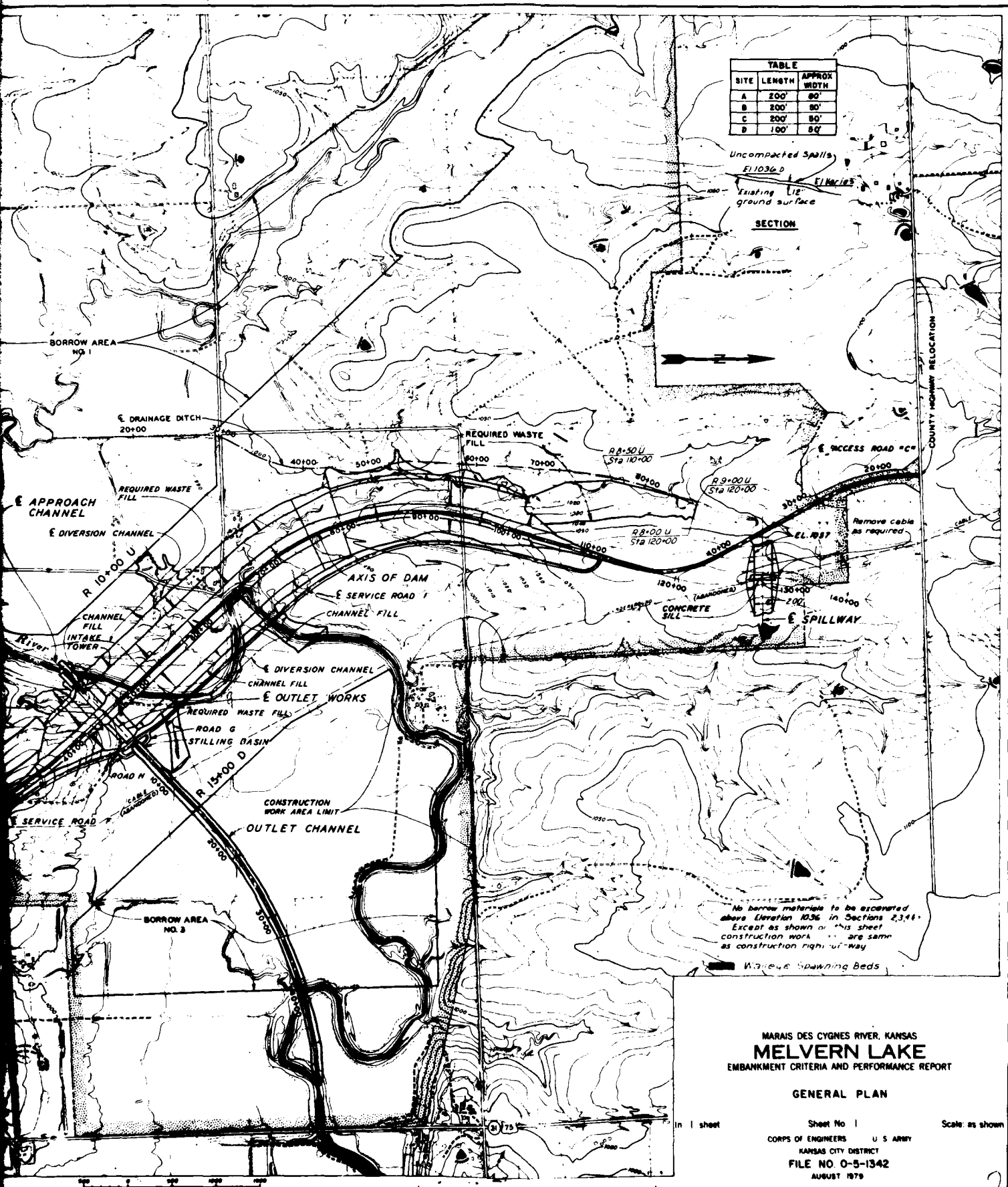
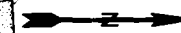
SCALE IN FEET

TABLE		
SITE	LENGTH	APPROX WIDTH
A	200'	80'
B	200'	80'
C	200'	80'
D	100'	50'

Uncompacted Spalls
F10360

Existing 12' ground surface

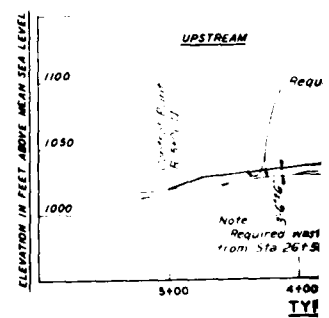
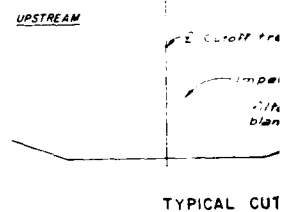
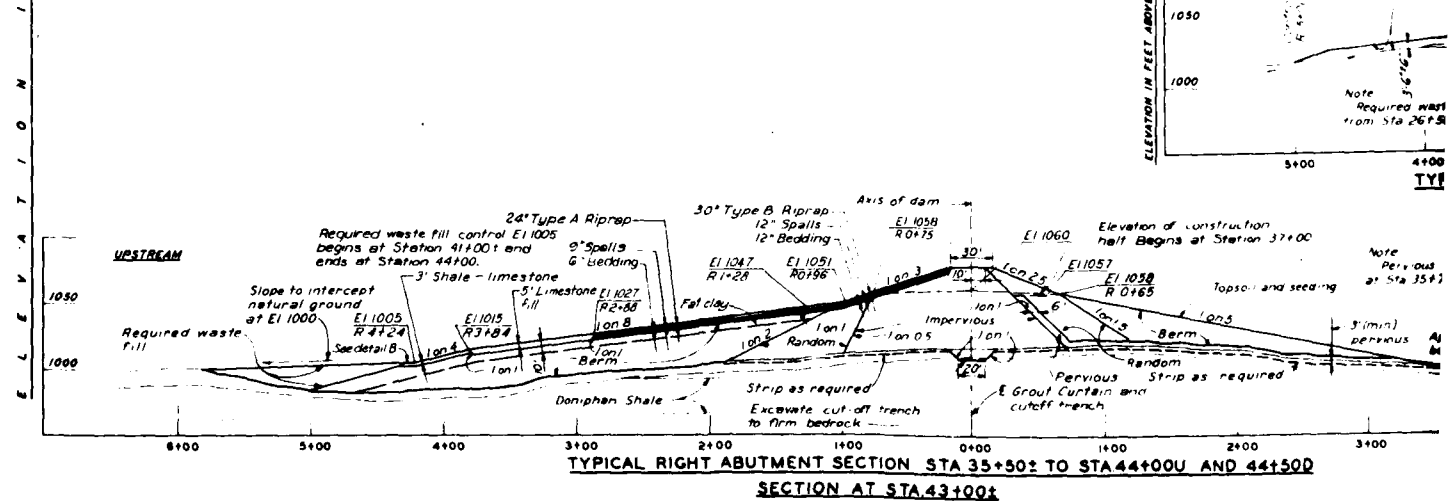
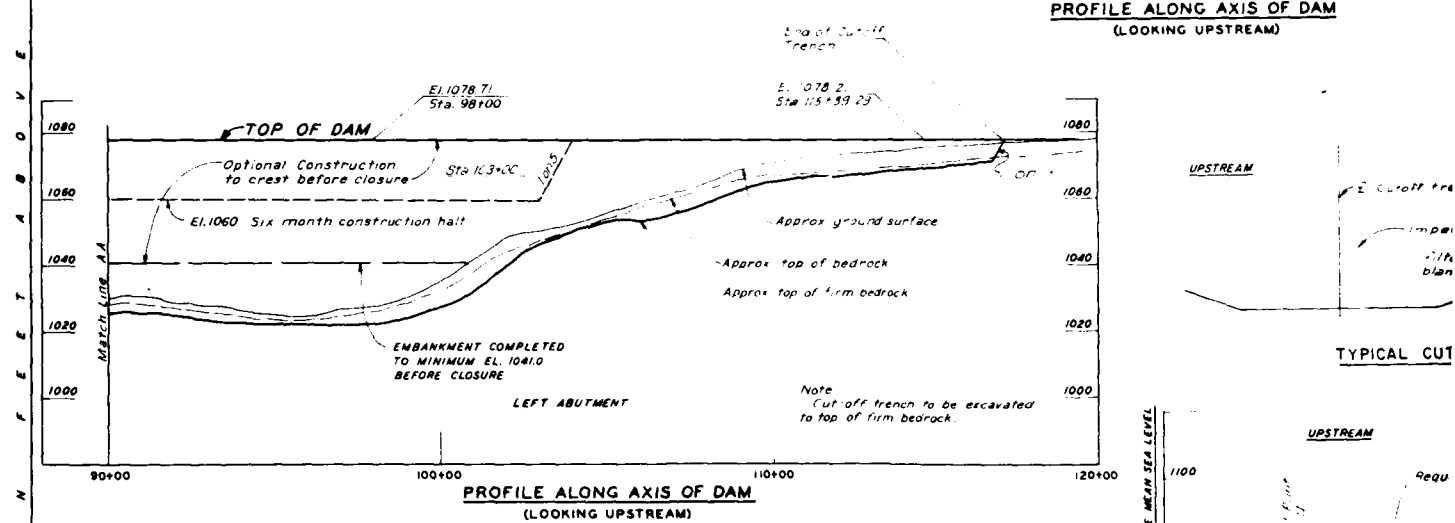
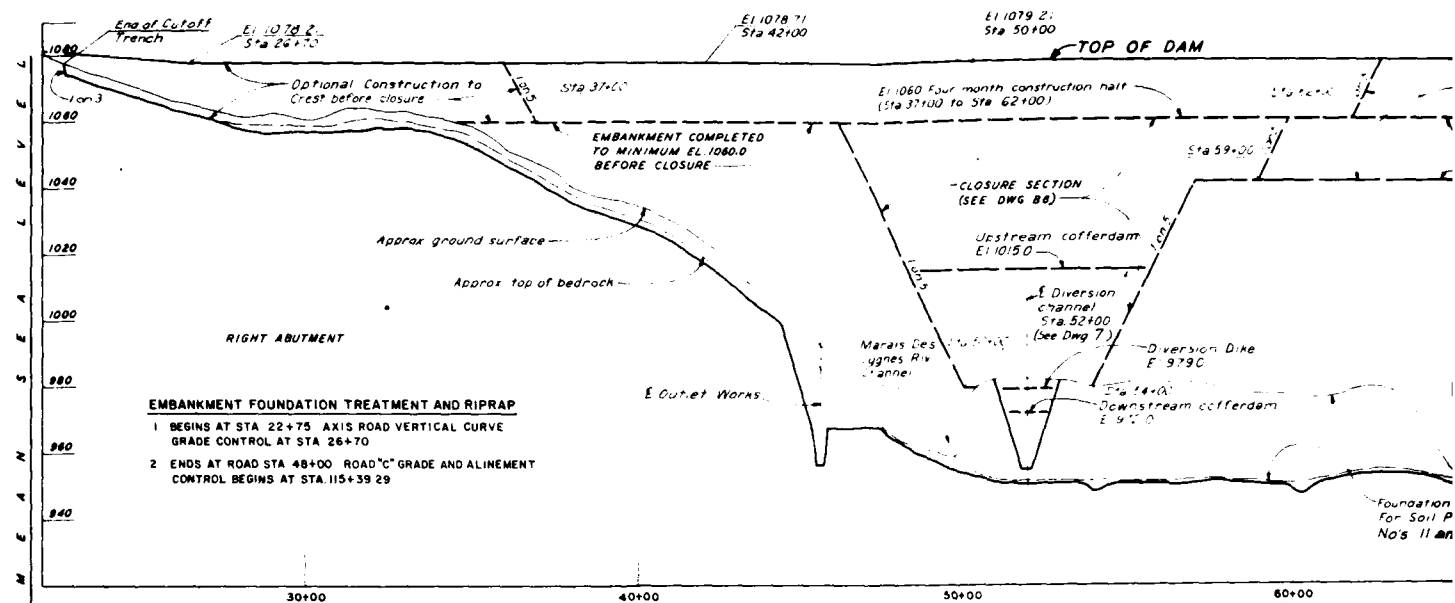
SECTION

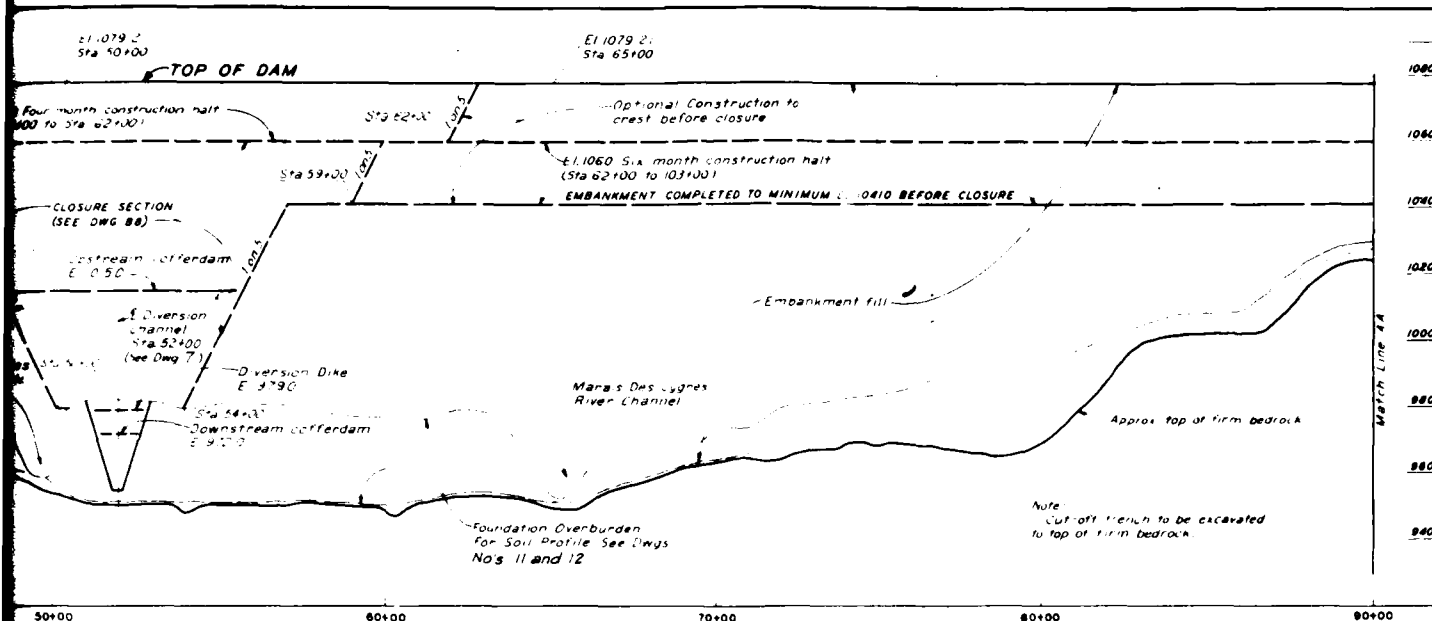


MARAIS DES CYGNES RIVER, KANSAS MELVERN LAKE EMBANKMENT CRITERIA AND PERFORMANCE REPORT

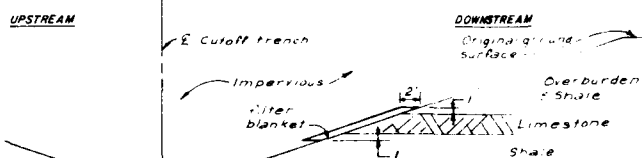
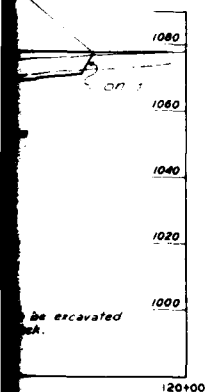
GENERAL PLAN

In 1 sheet
Sheet No. 1
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1342
AUGUST 1979
Scale: as shown



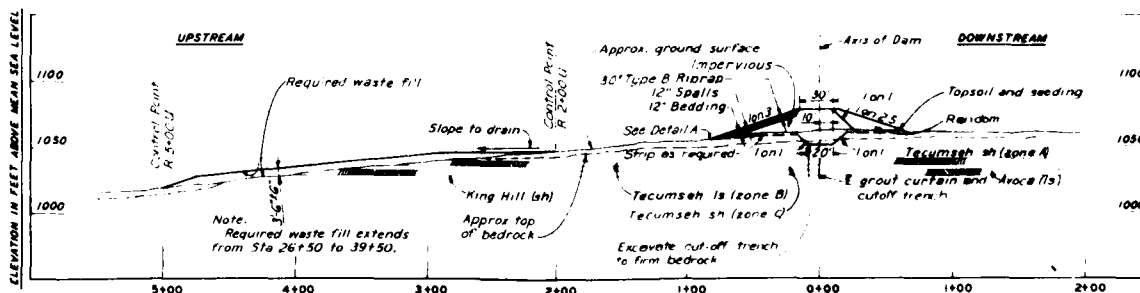


PROFILE ALONG AXIS OF DAM
(LOOKING UPSTREAM)



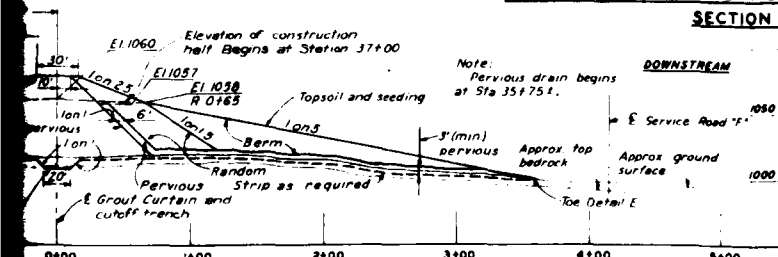
TYPICAL CUTOFF TRENCH CROSS SECTION
NOT TO SCALE

LOCATION WHERE FILTER BLANKET WAS PLACED			
STA	TO	STA	TO
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+99	96+31	98+07
46+00	46+20	99+20	100+25
48+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



SECTION AT STA 35+50 TO STA 44+00 AND 44+50

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

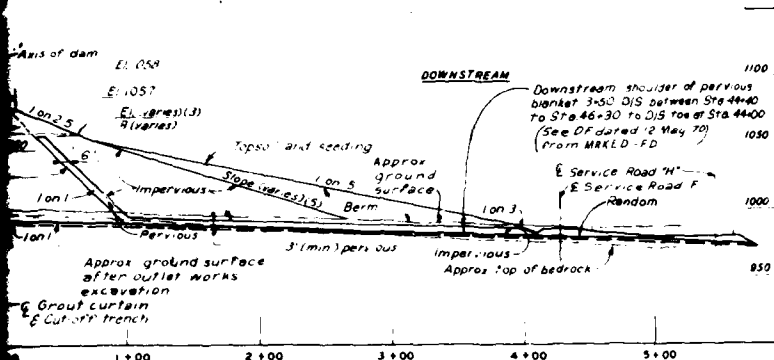
AXIS OF DAM PROFILE AND
EMBANKMENT SECTIONS
RIGHT ABUTMENT

In 1 sheet

Sheet No. 1

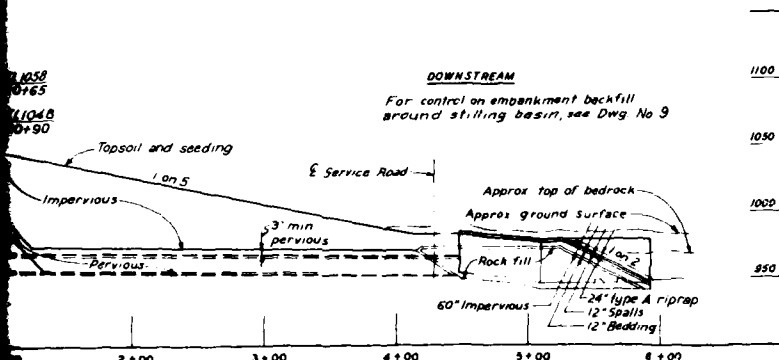
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CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO 0-5-1343
AUGUST 1979

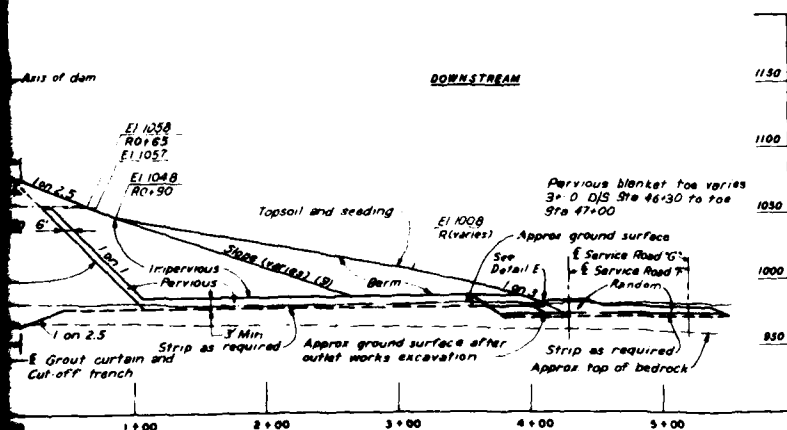


AND 44+50 TO STA. 45+00
 8+55±

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



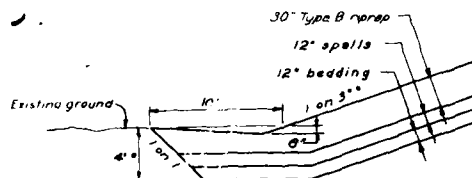
45+00 TO STA. 46+00
 1+50±



46+00 TO STA. 46+80
 1+50±

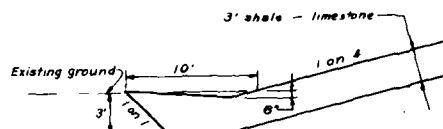
Notes:

- (1) Control point varies linearly from El. 1051, R. 0+96U at Station 44+00 to El. 1048, R. 105U at Station 45+00.
- (2) Control point varies linearly from El. 1015, R. 3+84U at Station 44+00 to El. 988, R. 4+05U at Station 45+00.
- (3) Control point varies linearly from El. 1058, R. 0+65D at Station 44+50 to El. 1048, R. 0+90D 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.



* To bedrock if less than
 a depth of 4 ft
 * 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

Notes:

- (6) Control point varies linearly from El. 1048, R. 1+05U at Station 46+00 to El. 1041, R. 1+26U at Station 46+80.
- (7) Control point varies linearly from El. 988, R. 4+05U at Station 46+00 to El. 1015, R. 3+34U 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

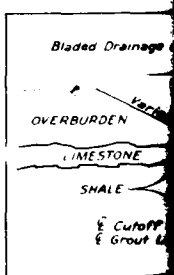
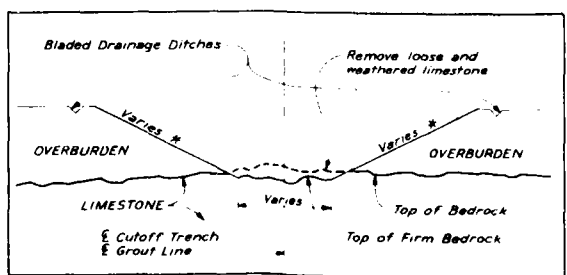
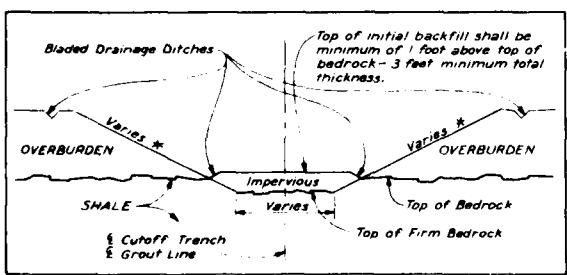
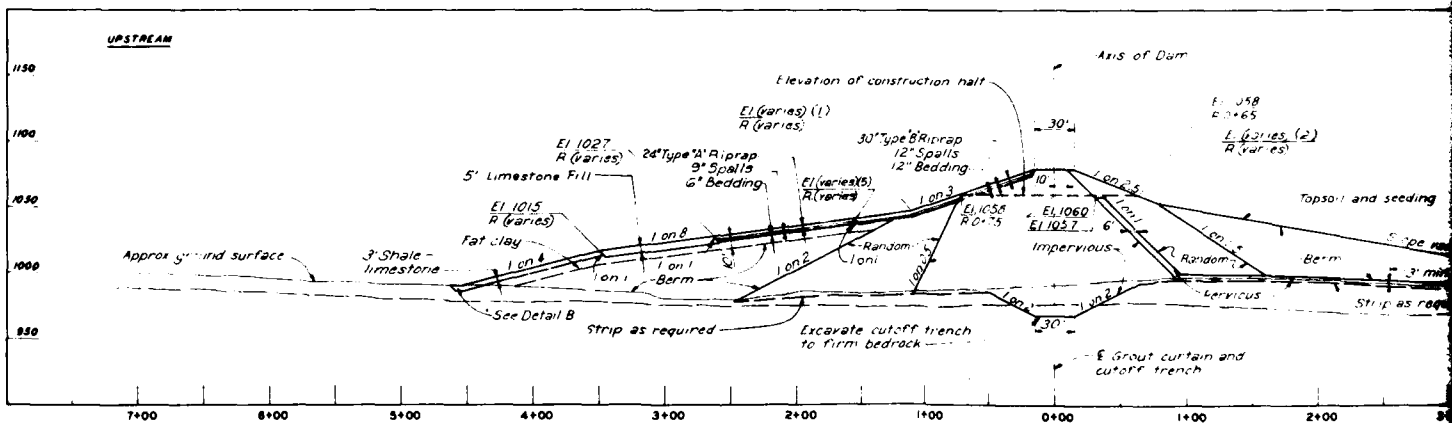
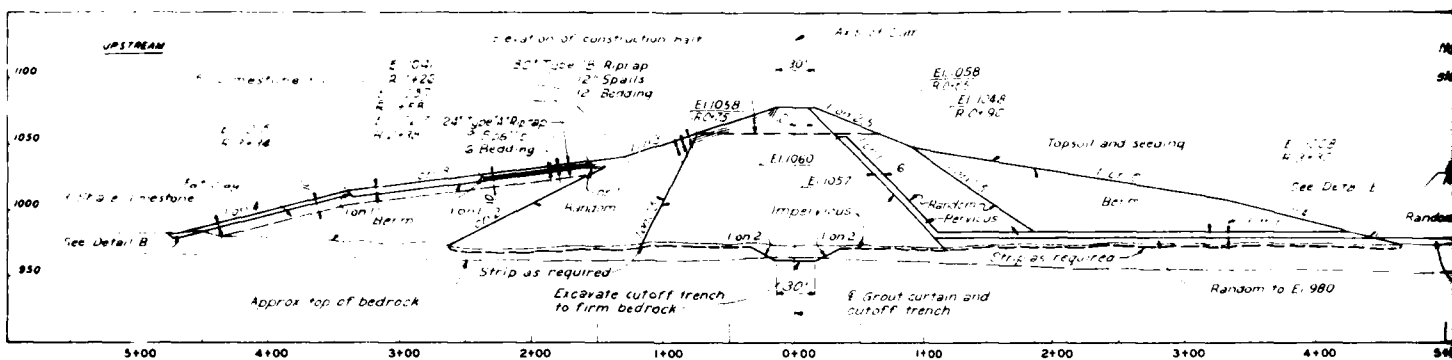
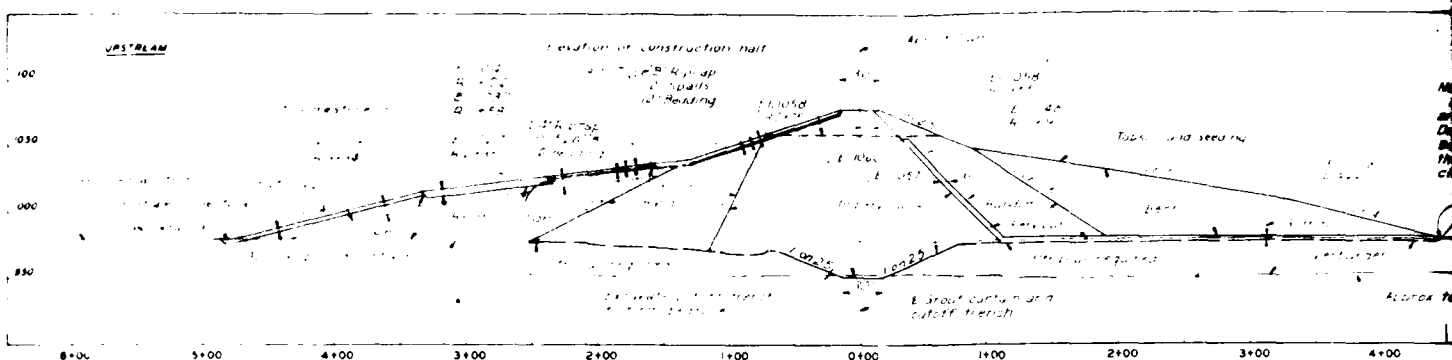
MARAS DES CYGNES RIVER, KANSAS MELVERN LAKE EMBANKMENT CRITERIA AND PERFORMANCE REPORT EMBANKMENT SECTIONS CONDUIT AND TRANSITIONS

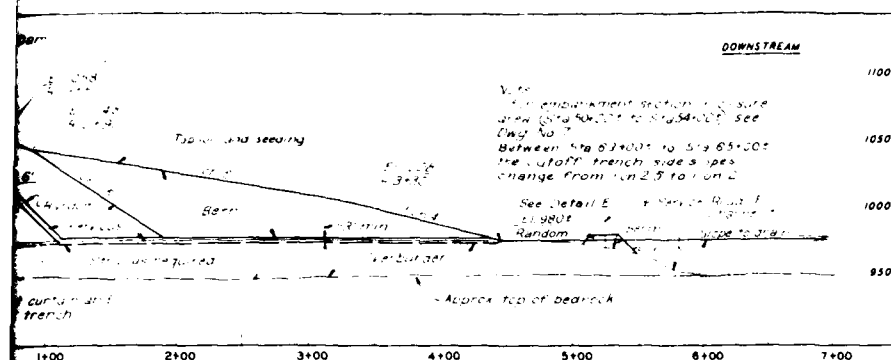
In 1 sheet

Sheet No. 1
 CORPS OF ENGINEERS U S ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0 5 1344
 AUGUST 1979

Scale as shown

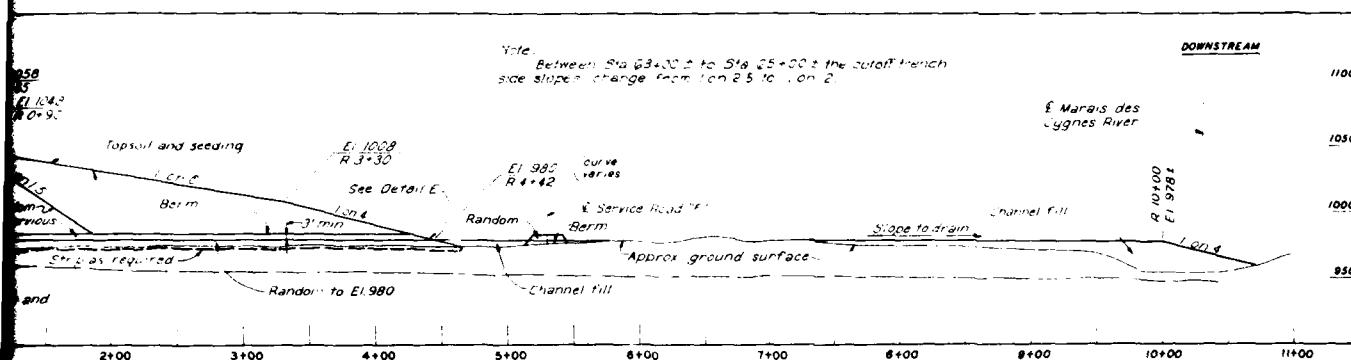
ELEVATION IN FEET ABOVE MEAN SEA LEVEL





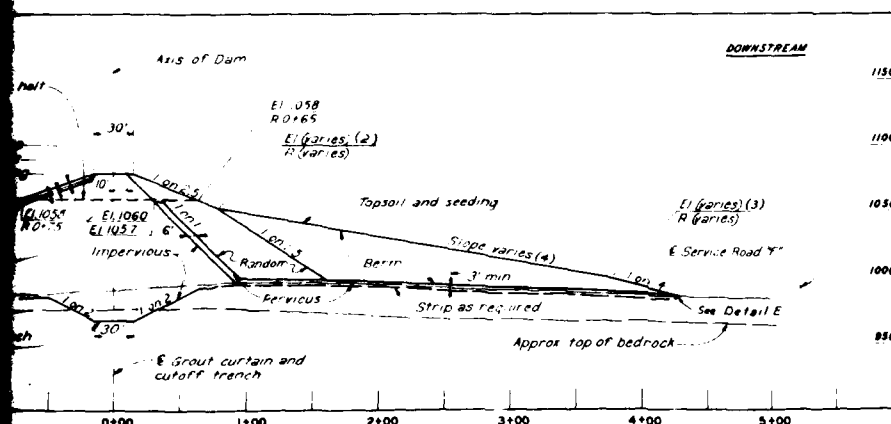
0 TO STA. 63+00

104-1



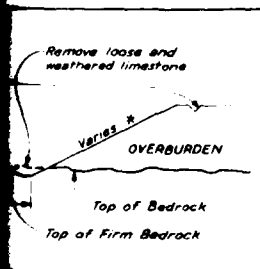
VALLEY SECTION - STA. 63+00 TO STA. 76+00

SECTION AT STA. 70+00±



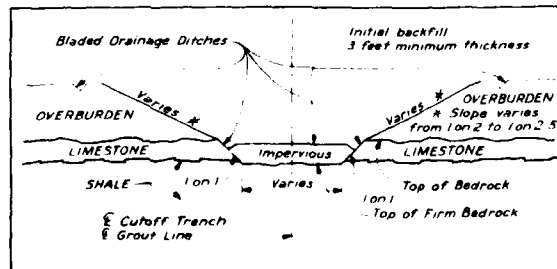
STA. 76+00 TO STA. 80+00

78+00±



DETAIL

STONE



CUTOFF TRENCH DETAIL

BASE THROUGH LIMESTONE IN SHALE

Not to Scale

Notes

- (1) Control point varies linearly from El. 1041, R 1+260 at station 16+00 to El. 1051, R 0+960 at station 80+00.
- (2) Control point varies linearly from El. 1048, R 0+900 at station 16+00 to El. 1058, R 0+650 at station 80+00.
- (3) Control point varies linearly from El. 1028, R 3+300 at station 76+00 to ground surface elevation 985 (range 4+1510) at station 80+00.
- (4) Slope varies linearly from 1 on 2 at station 76+00 to 1 on 1.5 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. 104-2

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

EMBANKMENT SECTIONS
VALLEY AND TRANSITION

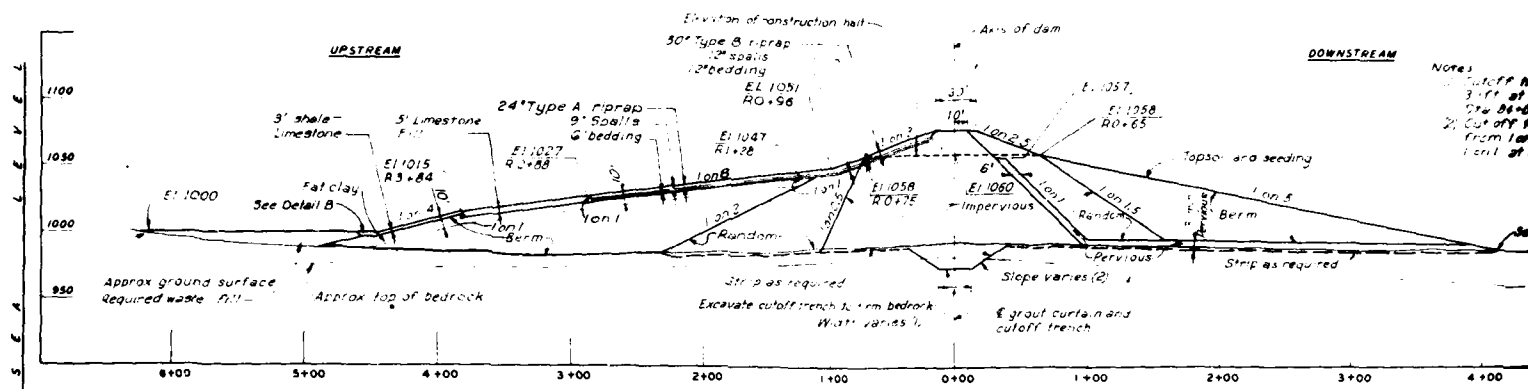
In 1 sheet

Sheet No. 1

Scale as shown

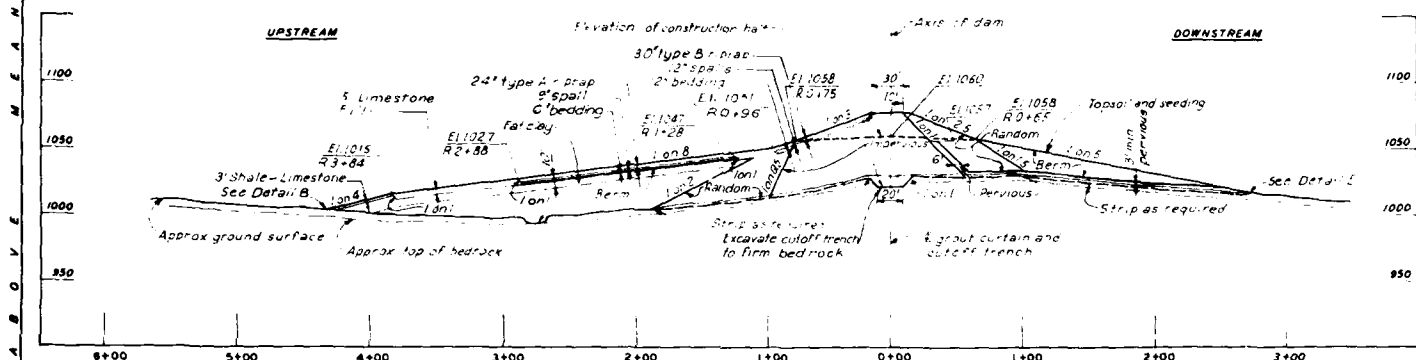
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KANSAS CITY DISTRICT
FILE NO. 0-5-1345
AUGUST 1979

PLATE NO. 5



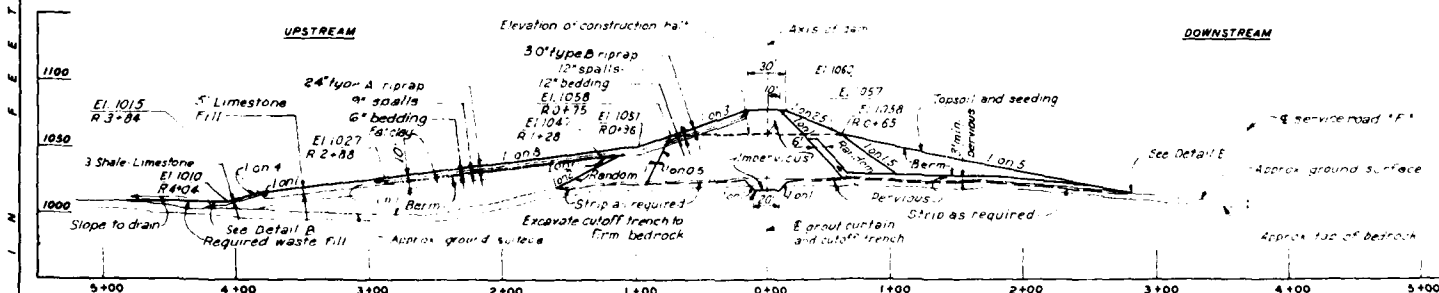
TYPICAL TERRACE SECTION-STA. 80+00 TO STA. 84+00

SECTION AT STA. 82+00±



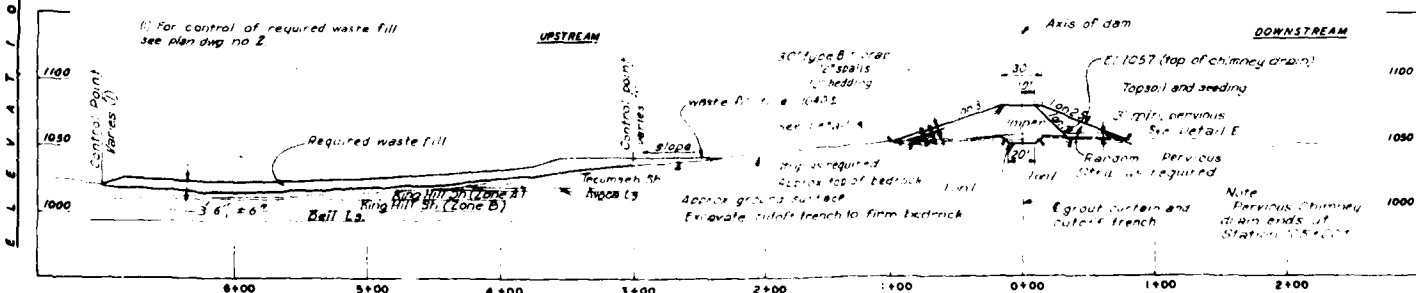
TYPICAL TERRACE SECTION-STA. 84+00 TO STA. 92+00±

SECTION AT STA. 90+00±



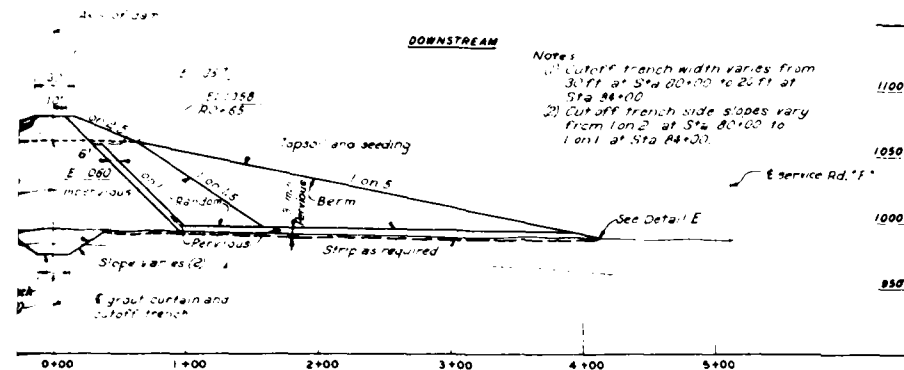
TYPICAL TERRACE SECTION-STA. 92+00± TO STA. 101+00±

SECTION AT STA. 97+00±



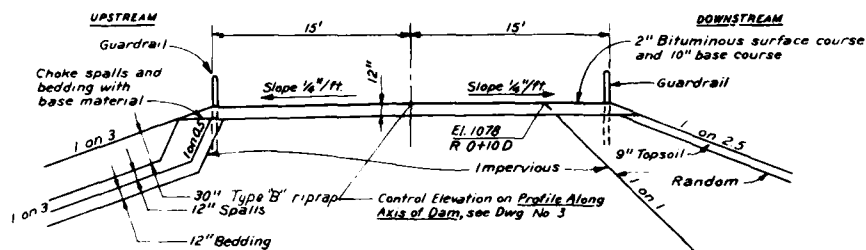
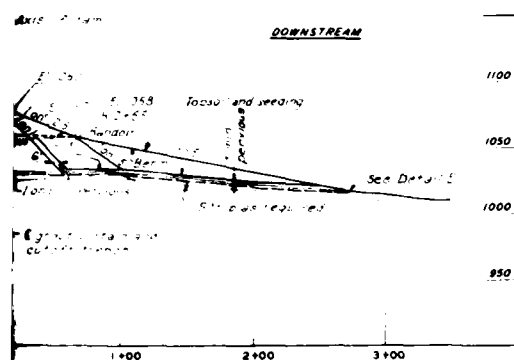
TYPICAL LEFT ABUTMENT SECTION-STA. 101+00± TO STA. 120+00

SECTION AT STA. 105+00±

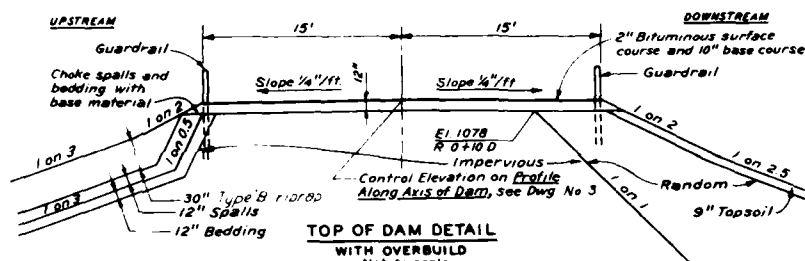


SCHEDULE OF GUARDRAIL For top of dam				
Station to Station	Side	Length	Remarks	
24+00 to 45+36±	Left	21625±		
45+64± to 110+00	Left	64625±		
24+00 to 110+00	Right	8600'		

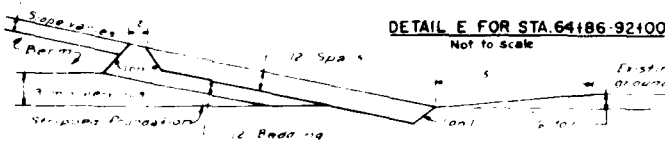
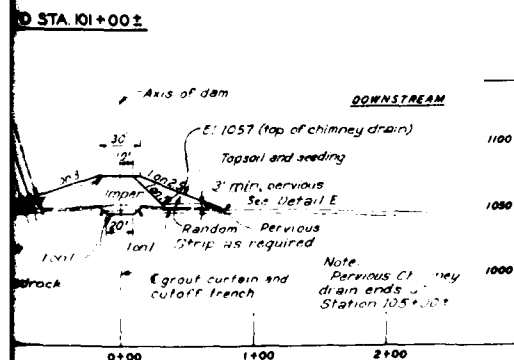
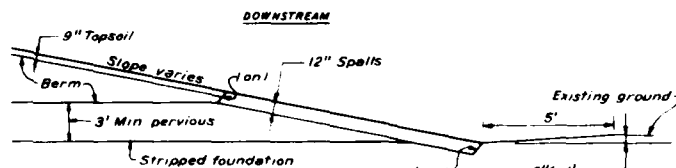
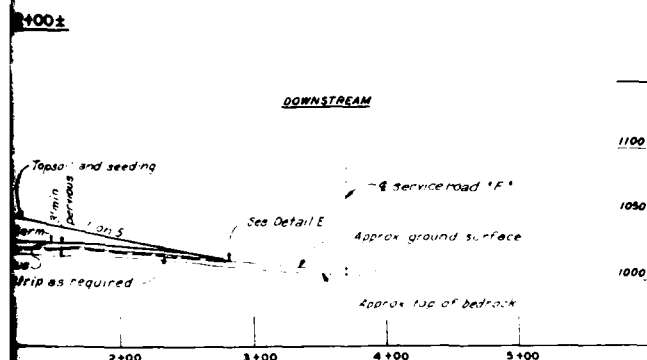
STA 80+00 TO STA 84+00
AT STA 82+00±



TOP OF DAM DETAIL
 NO OVERBUILD
 Not to scale



TOP OF DAM DETAIL
 WITH OVERBUILD
 Not to scale



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

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

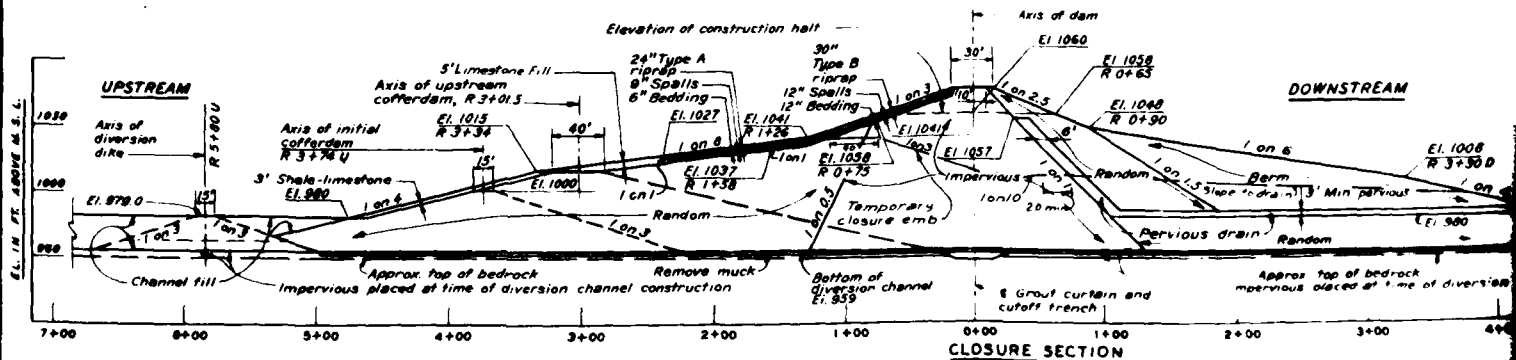
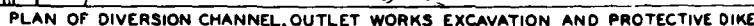
EMBANKMENT SECTIONS
 TERRACE AND LEFT ABUTMENT

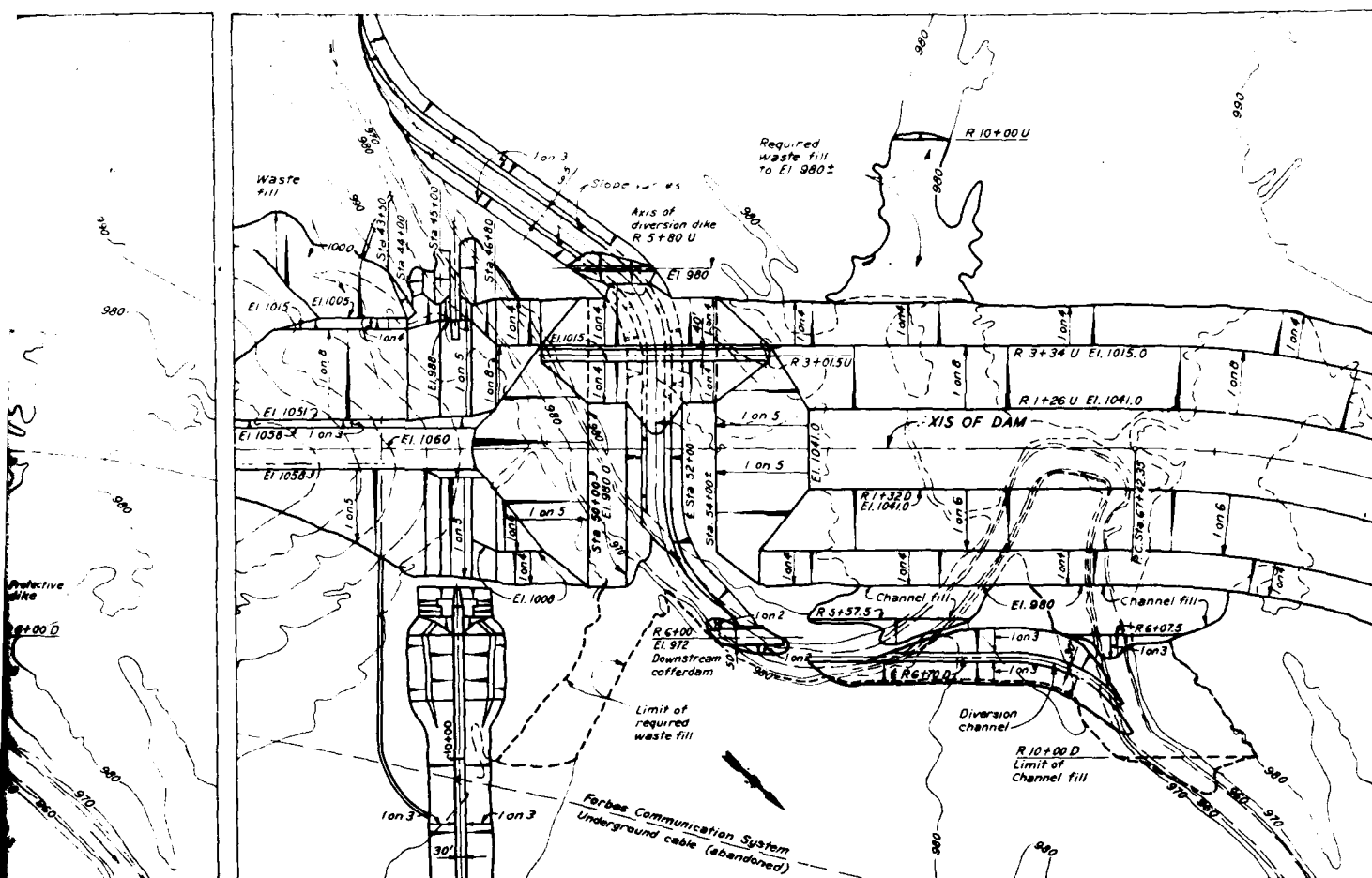
In 1 sheets

Sheet No. 1

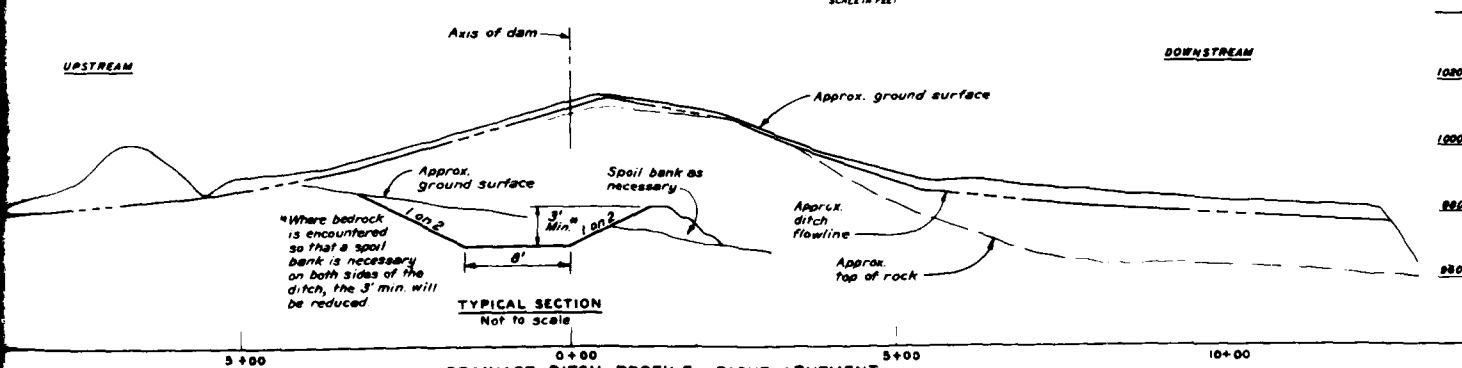
Scale as shown

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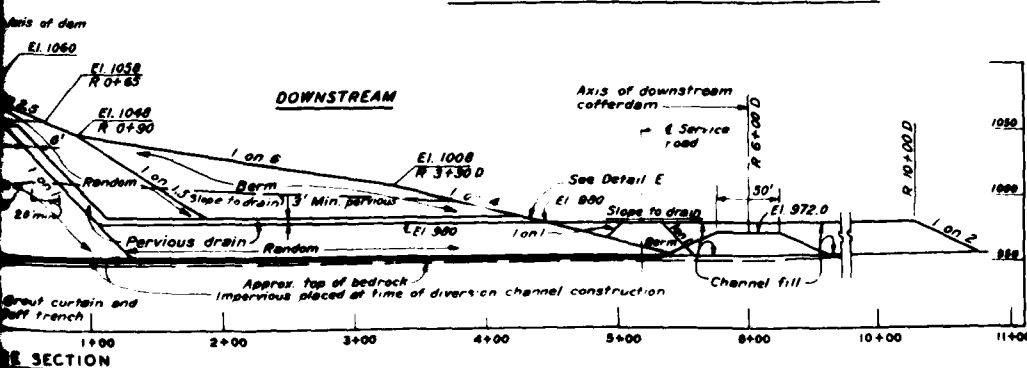




PLAN OF EMBANKMENT BEFORE FINAL CLOSURE



DRAINAGE DITCH PROFILE - RIGHT ABUTMENT

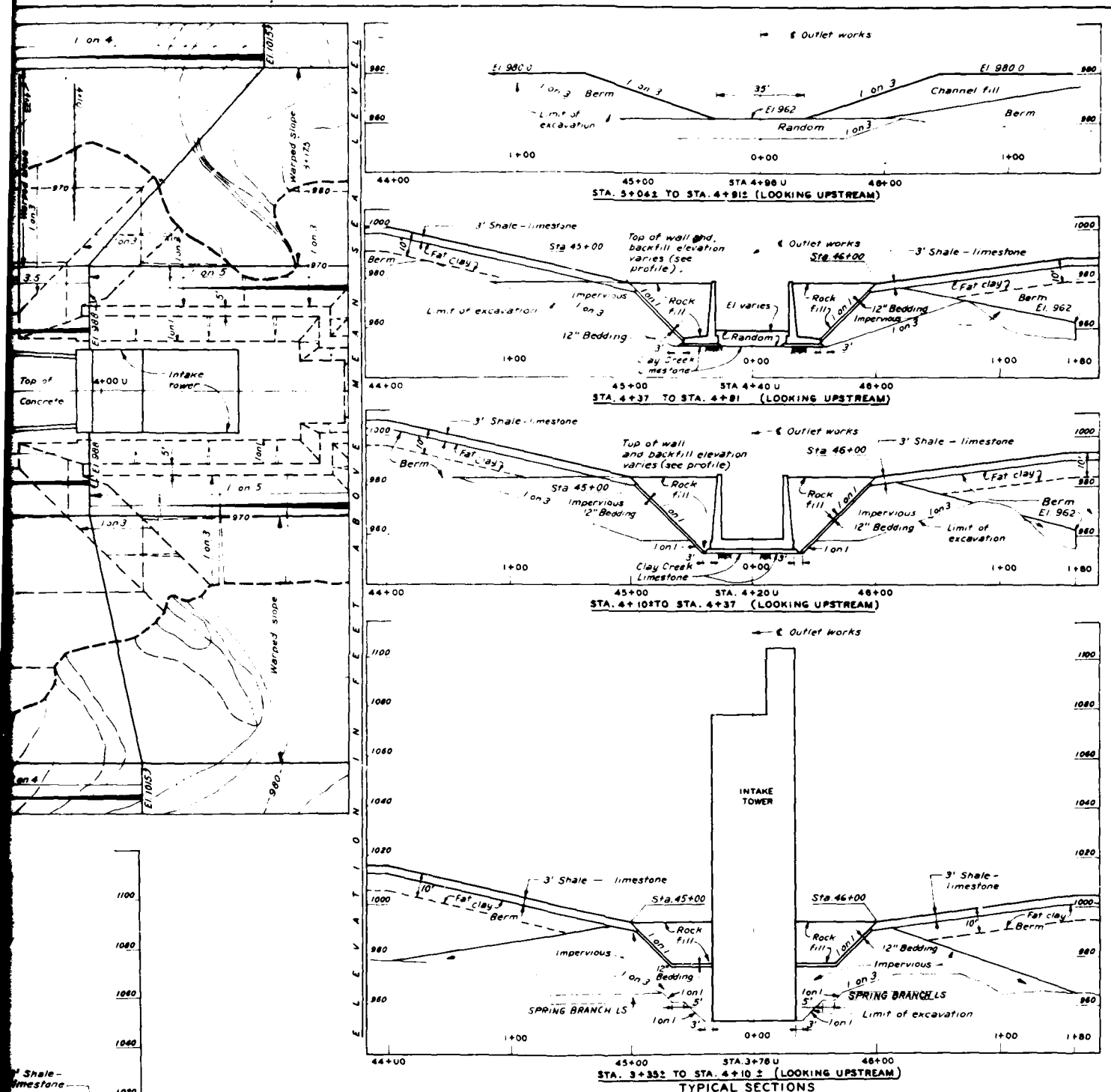


MARAS DES CYGNES RIVER, KANSAS
MELVERN LAKE
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

DIVERSION AND CLOSURE

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KANSAS CITY DISTRICT
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AUGUST 1979

Scale: as shown



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

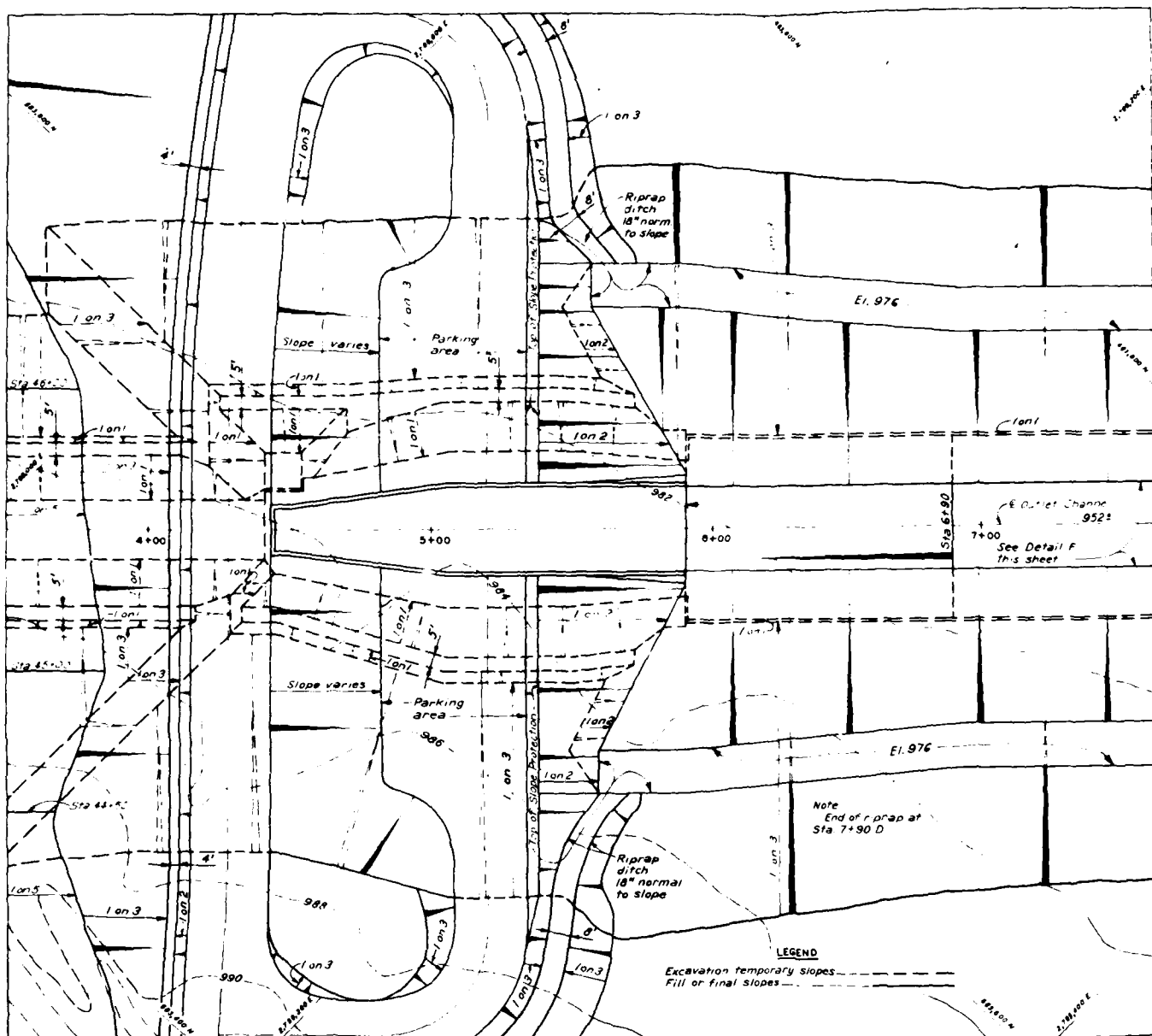
MARAI DES CYGNES RIVER, KANSAS
MELVERN LAKE
 EMBANKMENT CRITERIA AND PERFORMANCE REPORT
 EMBANKMENT TRANSITION DETAILS
 INTAKE TOWER AREA

In 1 sheet

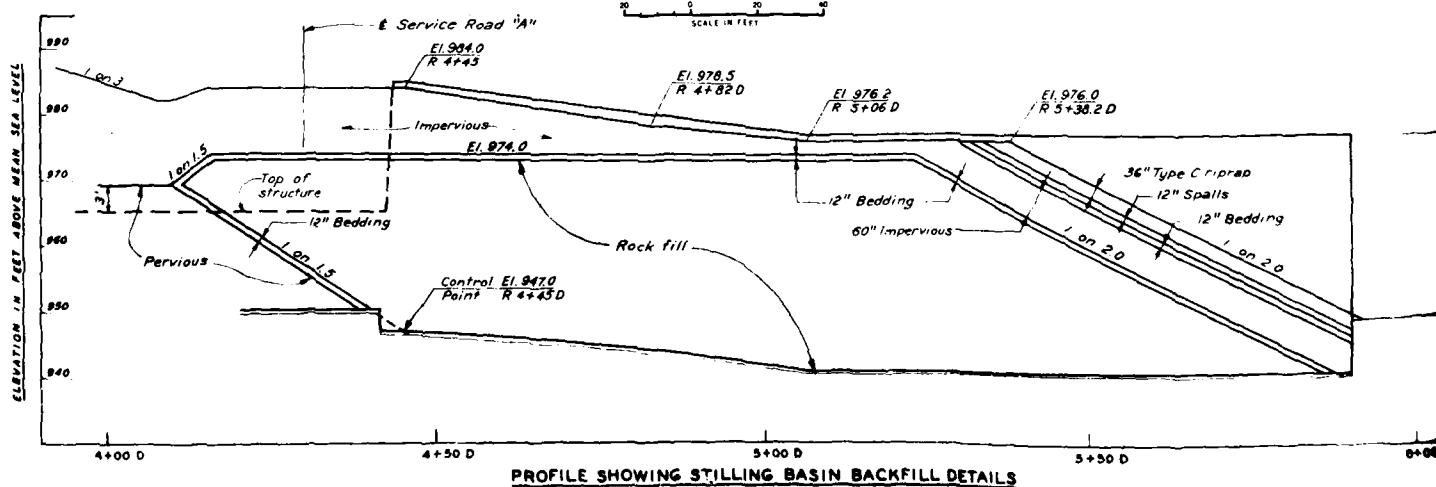
Sheet No. 1

Scale as shown

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 KANSAS CITY DISTRICT
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 AUGUST 1979

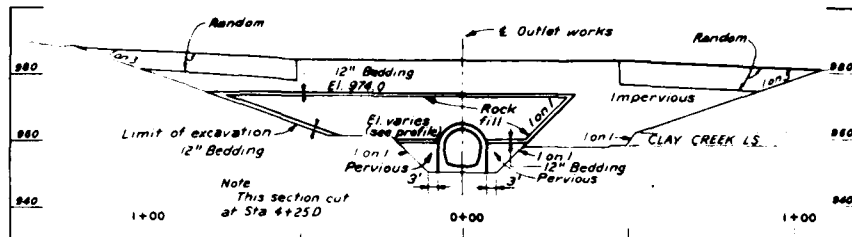


PLAN OF STILLING BASIN EXCAVATION

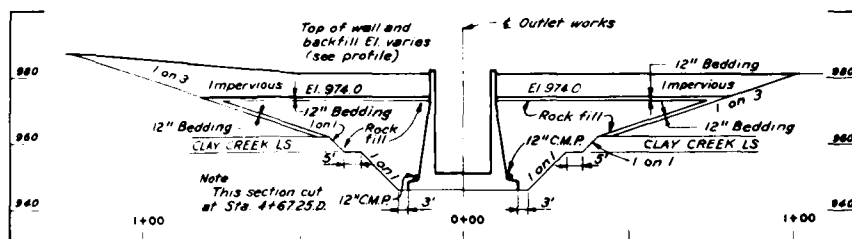


PROFILE SHOWING STILLING BASIN BACKFILL DETAILS

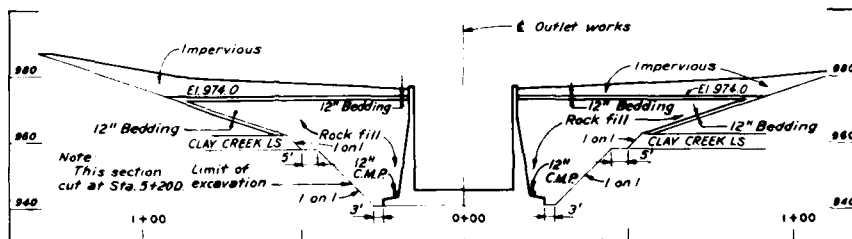
ELEVATION IN FEET ABOVE MEAN SEA LEVEL



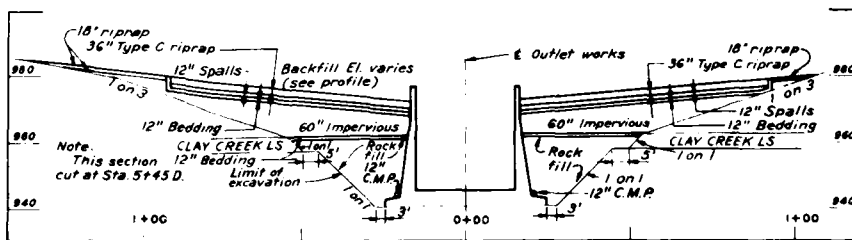
STA. 4+10 TO STA. 4+40 (LOOKING UPSTREAM)



STA. 4+40 TO STA. 5+08 (LOOKING UPSTREAM)

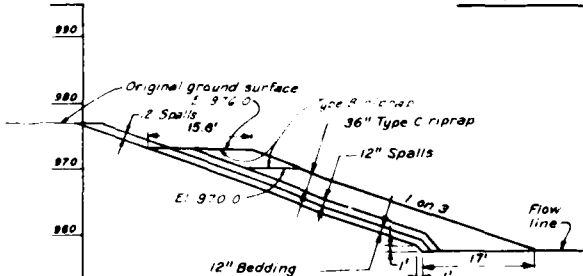
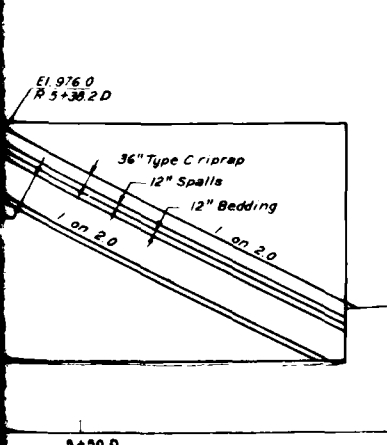
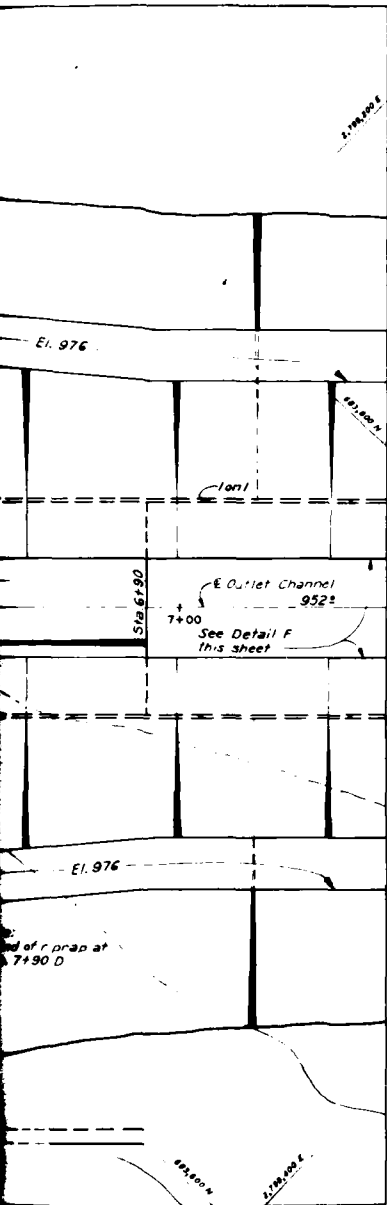


STA. 5+08 TO STA. 5+23 (LOOKING UPSTREAM)



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
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1349
AUGUST 1978

Scale as shown

[illegible]

LEGEND: 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840

- Plasticity index
- Liquid limit
- Effective size mm, maximum diameter
- Flow number
- Offset for Station and Range
- vertical: Angle and Direction
- Moisture content: percent
- Dry density: pounds per cubic foot
- Unconfined compressive strength

Elevation and date water level observed _____

Unified soil classification determined in lab _____

Field classification (dry) _____

No Sample _____

No Recovery (overburden) _____

Per cent lost drill water _____

Lost core (bedrock) _____

Depth of hole _____

Per cent core recovered (bedrock) _____

Drilling complete - date _____

Diameter of sample _____

*Notes from profile or section may be included in this section.

*Sampling and use of Right of Way _____

J. H. B. J. & J. H. B. J.

- | | | | |
|-----------|---|---|---|
| GW | Well graded gravel with sand | Well graded gravel with sand | Well graded gravel with sand |
| GP | Poorly graded gravel with sand | Poorly graded gravel with sand | Poorly graded gravel with sand |
| GM | Silty gravel with sand | Silty gravel with sand | Silty gravel with sand |
| GC | Clayey gravel with sand | Clayey gravel with sand | Clayey gravel with sand |
| SW | Well graded sands with little or no fines | Well graded sands with little or no fines | Well graded sands with little or no fines |
| SP | Poorly graded sands with little or no fines | Poorly graded sands with little or no fines | Poorly graded sands with little or no fines |
| SM | Silty sands | Silty sands | Silty sands |
| SC | Clayey sands | Clayey sands | Clayey sands |

Classification from actual laboratory tests where C_u and P_u are not available. Dual classification, where used, is in accordance with the Unified Soil Classification System. For details on the Unified Soil Classification System, see Waterways Experiment Station Technical Memorandum No. 3-357 dated March 1948 and revised.

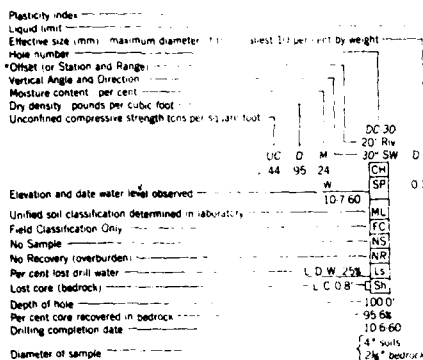
• -REVIAI

- [illegible]

BORINGS WITH PZ NUMBER DESIGNATION HAVE PIEZOMETERS IN

LEGEND

LEGEND FOR LOGS OF BORINGS



*Offset from profile or section may be Upstream or Downstream or Up Landward or Riverward (L or R) or Right or Left (R or L) as defined.

TYPE OF EXPLORATION

CODE DESIGNATION

- Drive sampler
- Core hole
- Test hole (smaller than 4" diameter)
- Test hole (4" or larger diameter)
- Undisturbed water from
- Auger hole (smaller than 4" diameter)
- Auger hole (4" or larger diameter)
- Finished or drilled
- Core hole (smaller than 4" diameter)

MAP SYMBOL

- Vertical boring
- Inclined boring showing direction and vertical angle

BEDROCK UNIT TYPE

- Bedding
- Bed
- Thin bed
- Medium bed
- Thick bed
- Massive

UNIFIED SOIL CLASSIFICATION SYSTEM

GW	Well graded gravels, gravel sand mixtures, little or no fines	ML	Inorganic silts and very fine sand, mixtures, little or no fines
GP	Poorly graded gravels, gravel sand mixtures, little or no fines	CL	Inorganic clays of low to medium plasticity, gravelly clay sand mixtures, little or no fines
GM	Silty gravels, gravel sand mixtures	OL	Organic silts and organic soils, clays of low plasticity
GC	Clayey gravels, gravel sand mixtures	MLH	Inorganic silts, micaceous 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	PH	Peat and other highly organic soils
SC	Clayey sands, sand clay mixtures		

Classification from actual laboratory tests where U and P are shown.
Dual classification, where used, is in accordance with the Unified Soil Classification System.
For details on the Unified Soil Classification System, See Waterways Experiment Station Technical Memorandum No. 3-357 dated March 1953 and revised in 1960.

TERMS FOR CONSISTENCY OF SOIL AND HARDNESS OF BEDROCK

Consistency	Estimated Unconfined Compressive Strength (tons per square foot)
Very soft	< 1.25
Soft	1.25 - 2.5
Medium	2.5 - 10
Stiff	10 - 20
Very stiff	20 - 40
Hard	> 40

BEDROCK

SCALE OF HARDNESS	Can be scratched with
Very soft or plastic	Can be scratched easily with finger nail
Soft	Can be scratched with fingernail
Moderately hard	Can be scratched easily with pocket knife
Hard	Can be scratched with steel nail
Very Hard	Cannot be scratched with steel nail

ABBREVIATIONS

alt	alternating	dol	dolomite, dolomitic	lea	leached	st	stone
ang	angular	ext	extreme	lg	light	str	stratified
an	anhydrite	f	fine, fine y	ls	limestone	sw	weathered
ar	argillaceous	fe	iron	lgn	lignite	wh	white, white
bdd	bed, bedded, bedding	fd	filled	c	core	whl	white, white
bdr	bedrock	fm	firm	l.c.	lost drill water	st	stone
bky	blocky	fos	fossil, fossiliferous	LDW	lost drill water	sl	silt, slightly
bl	blue	frac	fractures, fractured	med	medium	sic	siliceous
bid	boulder	frag	fragments, fragmented	mic	micaceous	sils	sickenides
blk	black	fr	frable	min	mineralized	so	soft
brec	breccia, brecciated	fsl	fossile	mod	moderate, moderately	sol	solution, solutionized
brn	brown	gr	grain	mot	mottled	ss	sandstone
c	coarse	grd	gradation	mss	massive	st	stained, staining
calc	calcareous	grn	green	mst	most	stf	stiff
carb	carbonaceous	grv	gravel, gravelly	mtl	material	sty	stylobitic
cav	cavity	grs	gray	mtz	matrix	v	very
cbl	cobble	gpn	gypsum	nod	nodules	vert	vertical
cht	chert	ha	high angle	num	numerous	vdy	vuggy
circ	circulation	hd	hard	occ	occasionally, occasional	w	water
clay	clay, clayey	he	healed	op	open	w	with
cmt	cemented	hor	horizontal	org	organic	we	weathered
col	columnar	ibd	interbedded	pif	pit, pitted, pitting	wh	white
conc	concretions	inc	inclusions	pl	plastic	x bdd	cross bedded
cong	conglomerate	inlam	interlaminate	pla	platy	ch	crystalline
crm	crumbly	irr	irregular	pin	plane	y	yellow
d	dense	it (s)	irregular, (s) points	plg (s)	parting, (s) partings		
dk	dark	la	low angle	qtz	quartzite, quartz		
dmp	damp	lgn	laminated, laminae	rnd	round, rounded		

When used as log symbol first letter is capitalized

BORINGS WITH P2 NUMBER DESIGNATION HAVE PIEZOMETERS INSTALLED IN THEM.

MARAS 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

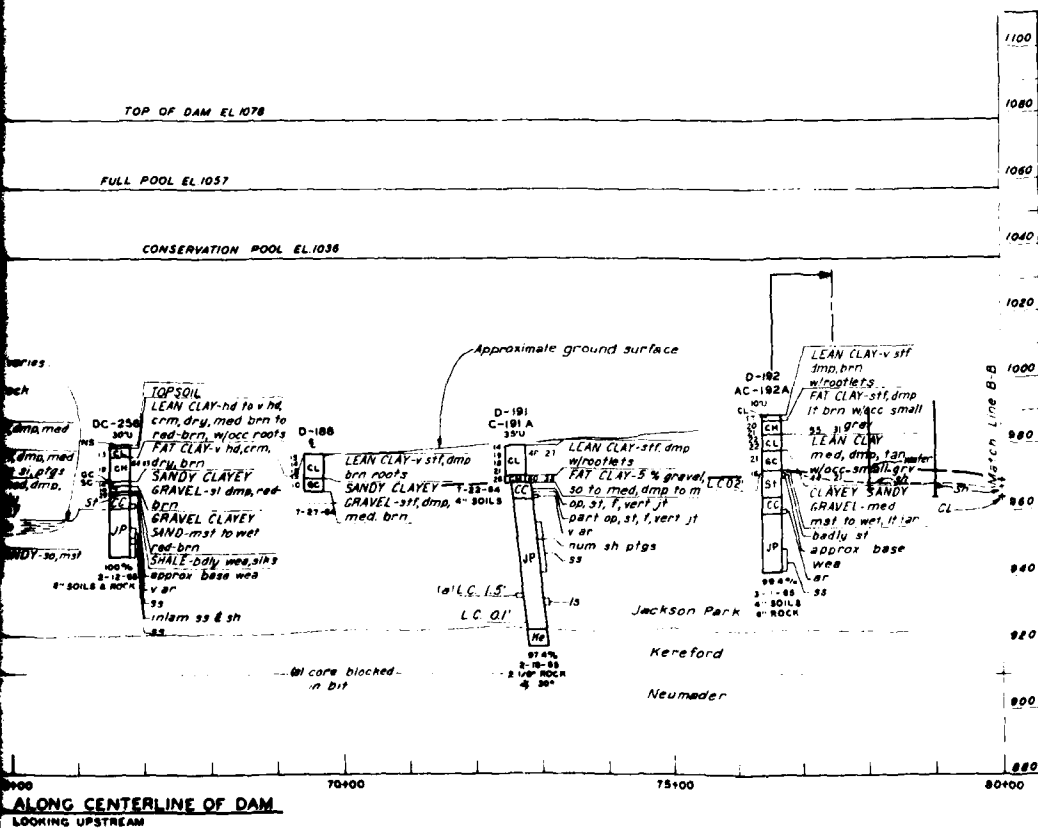
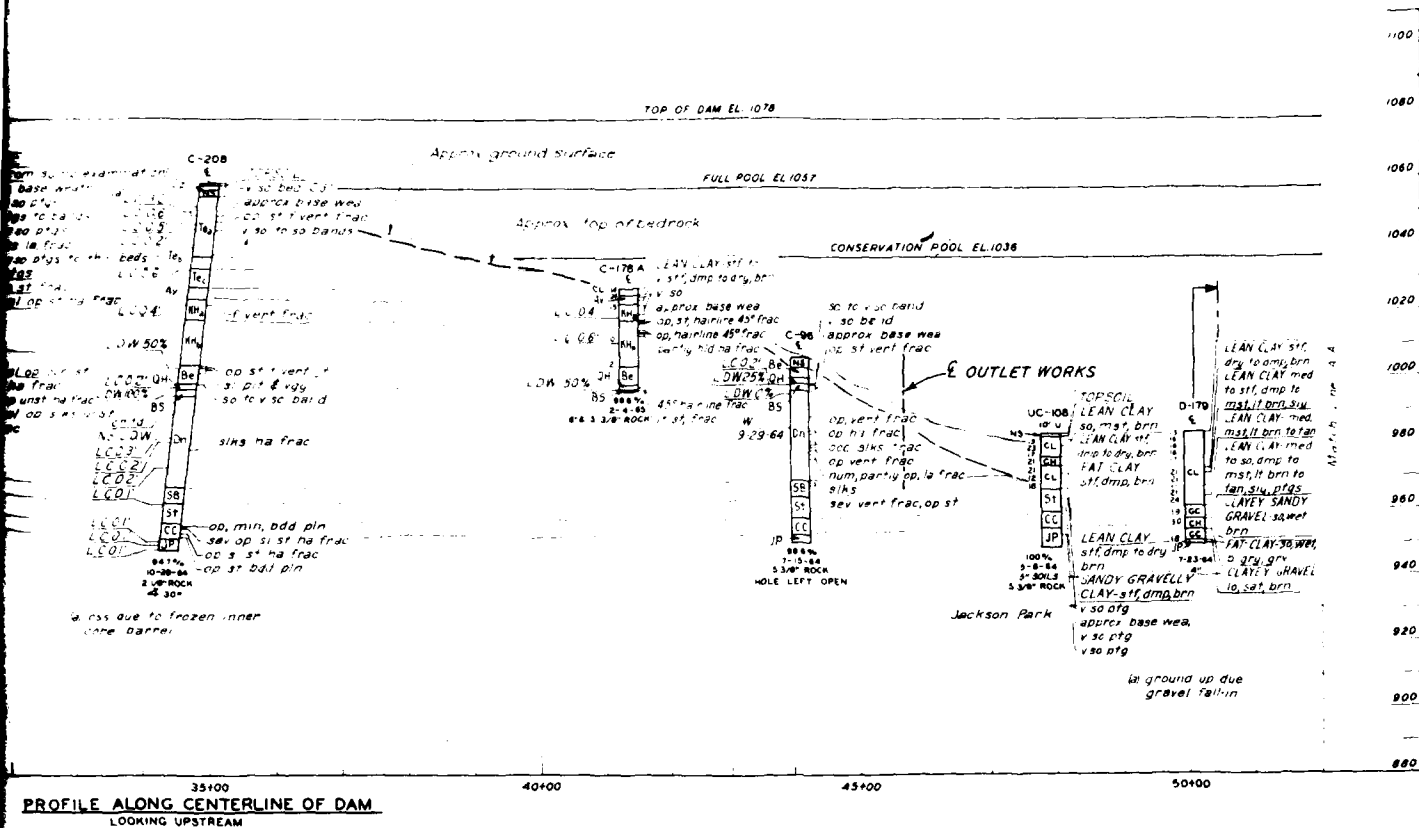
CORPS OF ENGINEERS U.S. ARMY

KANSAS CITY DISTRICT

FILE NO. 0-5-1350

AUGUST 1979

PLATE NO. 10



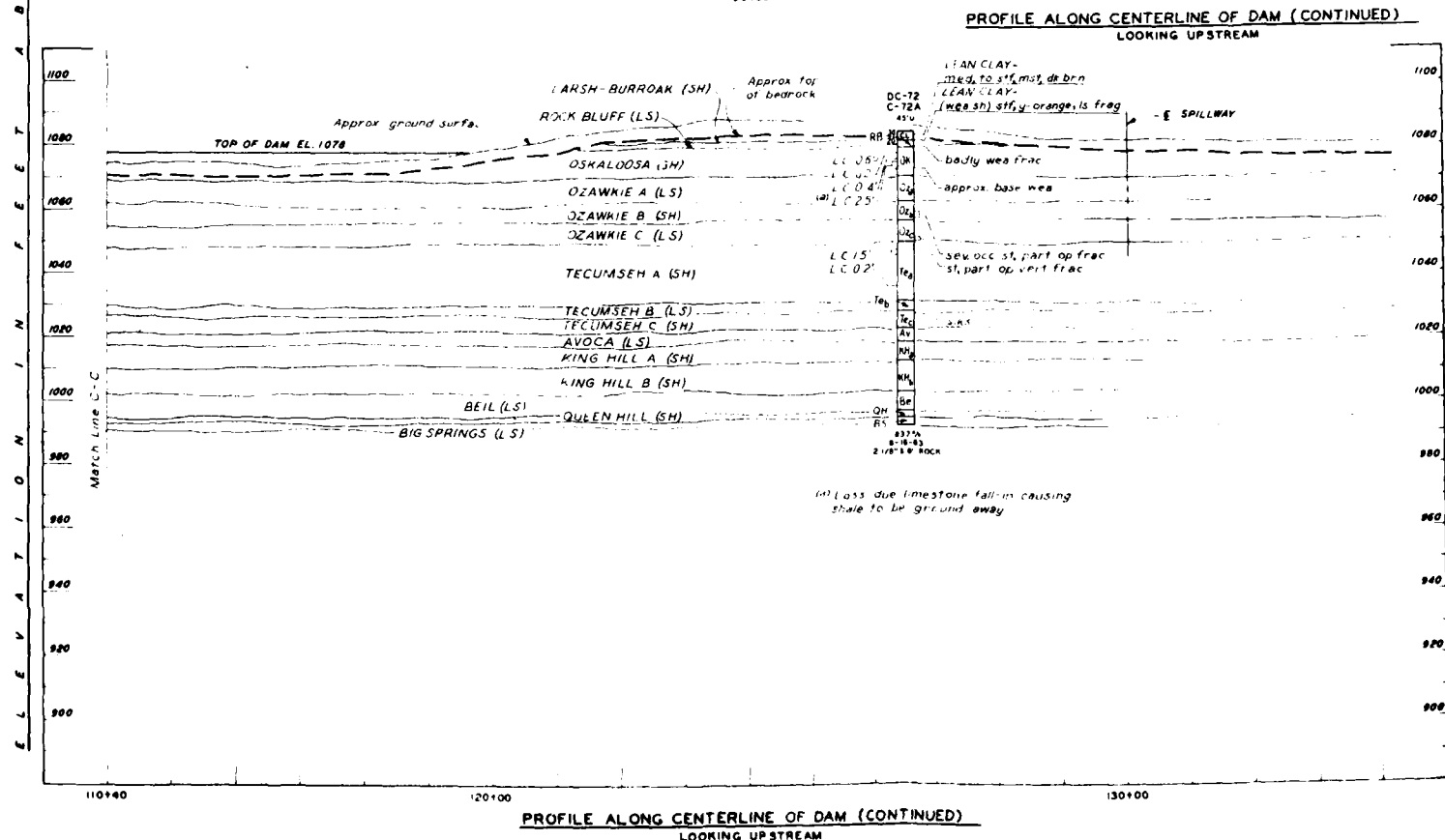
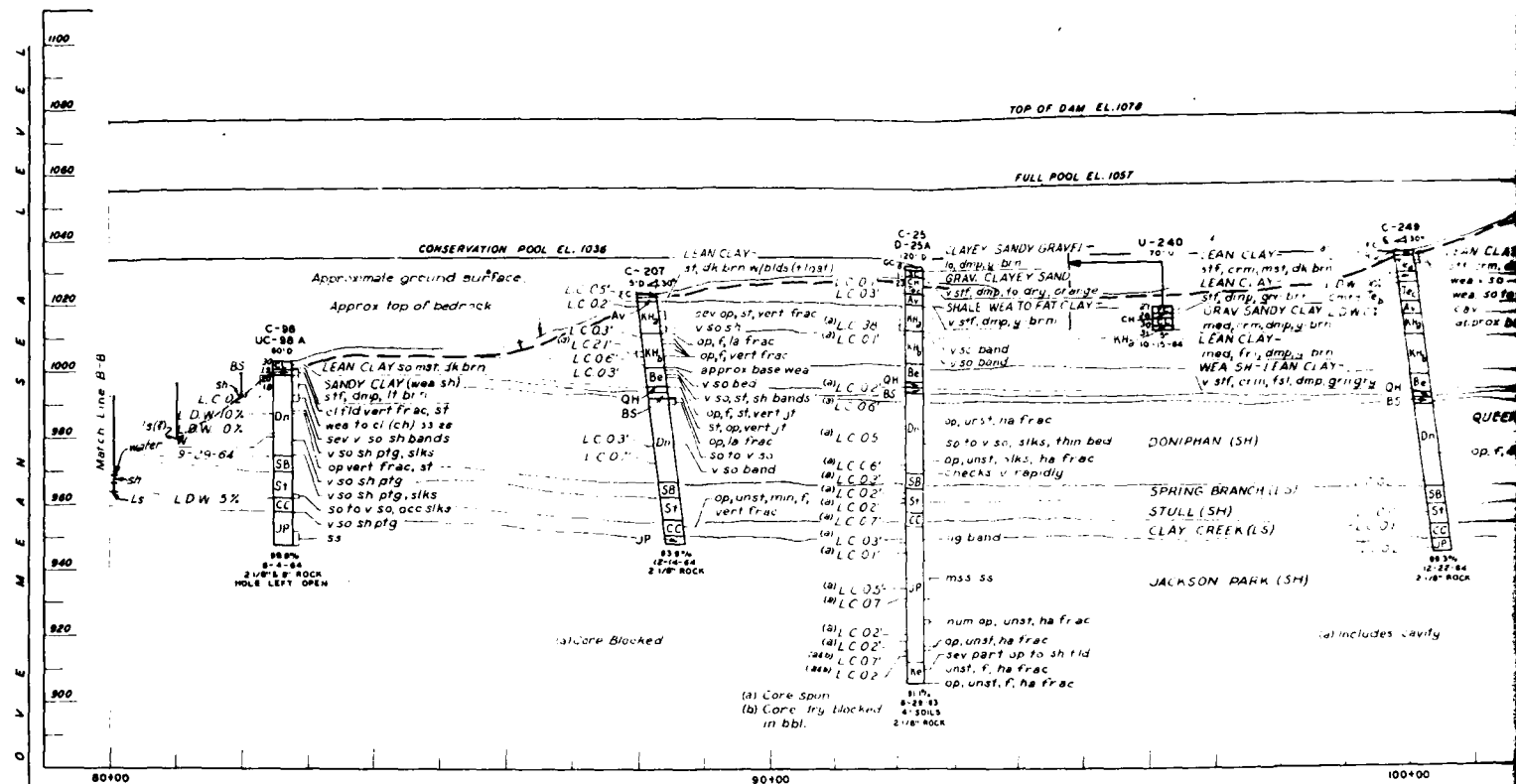
NOTES
 For legend and geologic column
 see Dwg. No. 10
 For excavation detail see Dwg. No. 7
 For grading detail see Dwg. No. 13
 Water levels shown where available

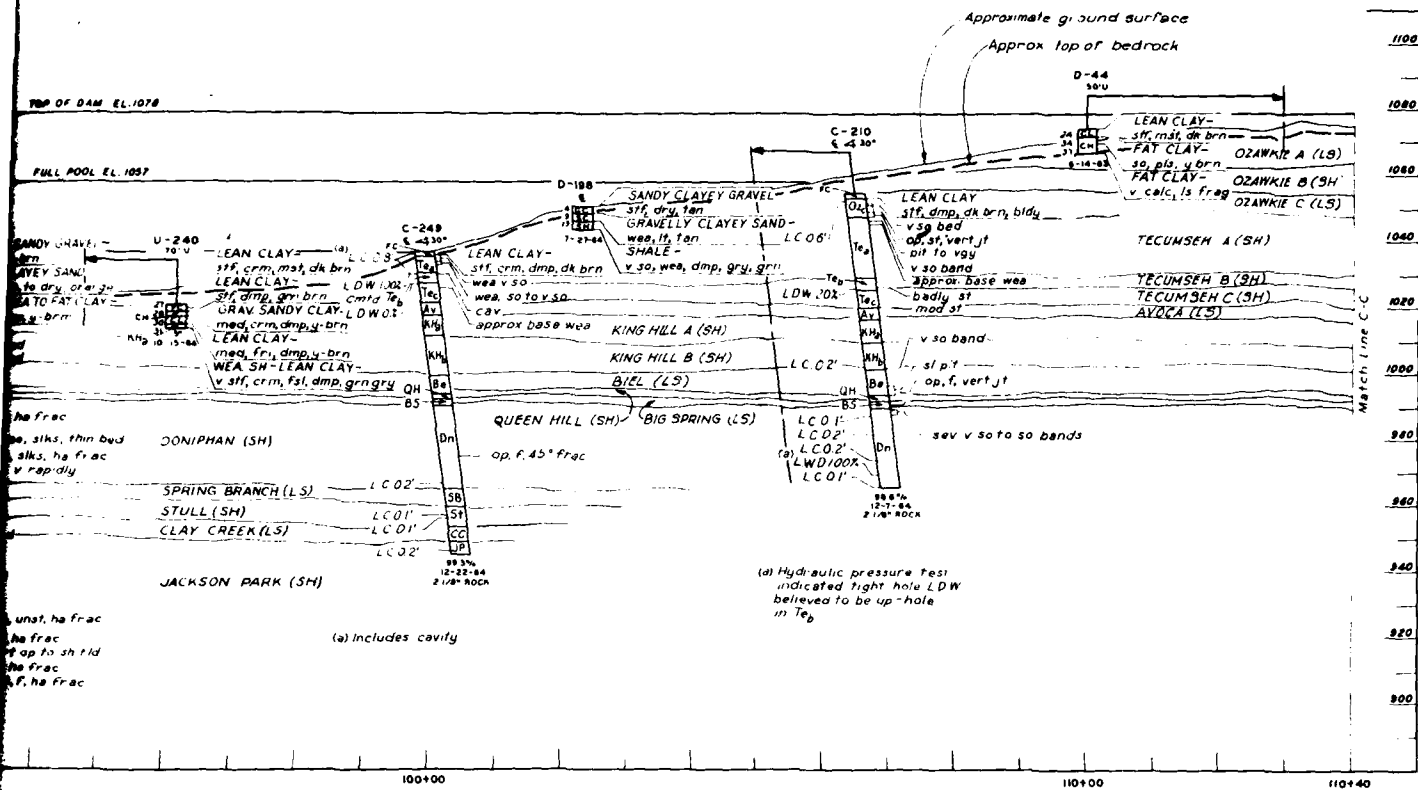
MARAI DES CYGNES RIVER, KANSAS
MELVERN LAKE
 EMBANKMENT CRITERIA AND PERFORMANCE REPORT

LOGS OF EXPLORATIONS
 AXIS OF DAM

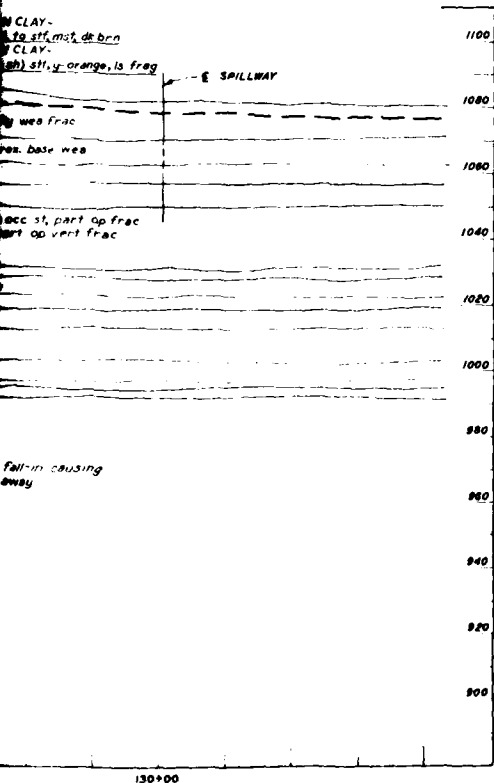
Sheet No. 1
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 KANSAS CITY DISTRICT
 FILE NO. O-5-1351
 AUGUST 1979

Scale as shown





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.

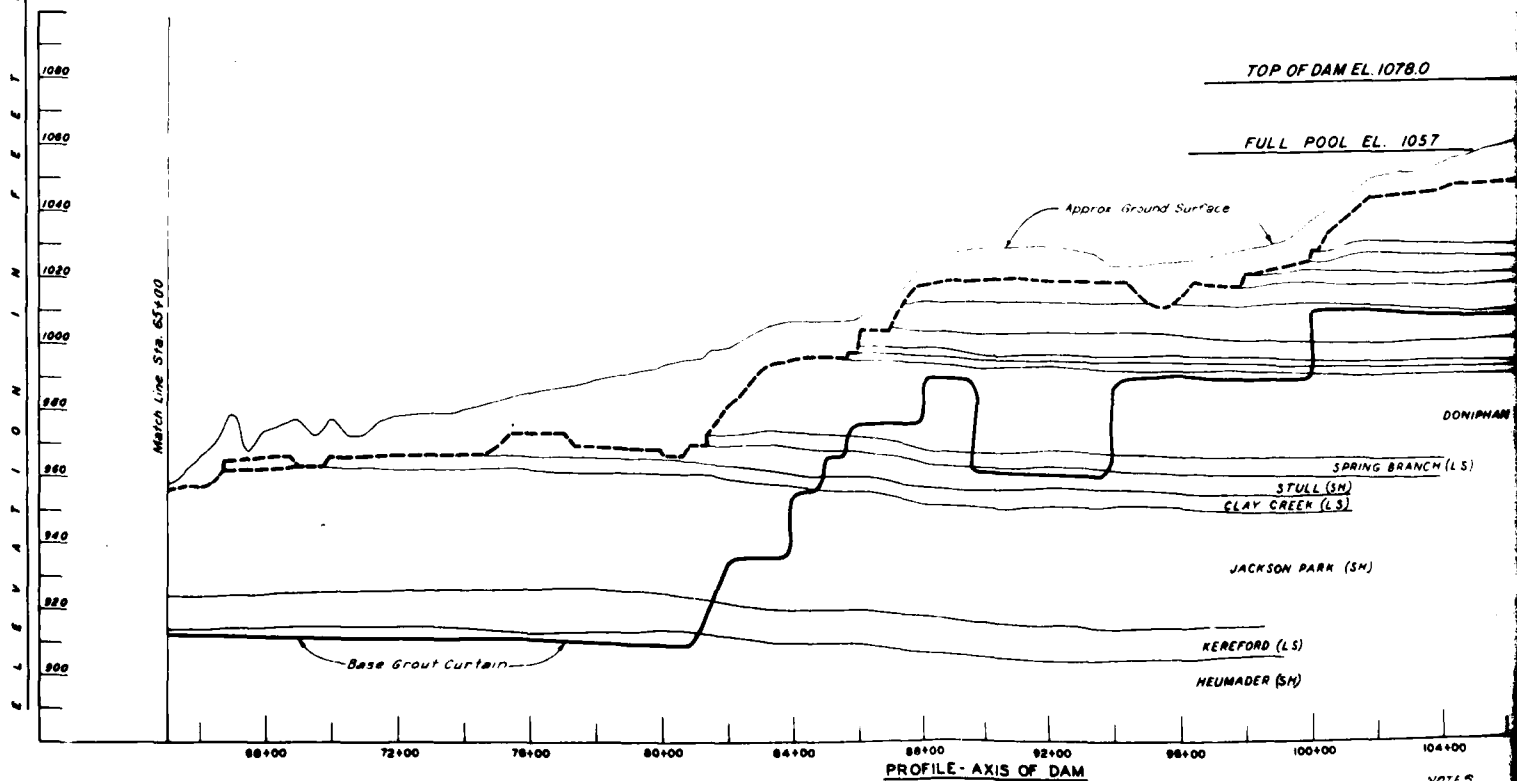
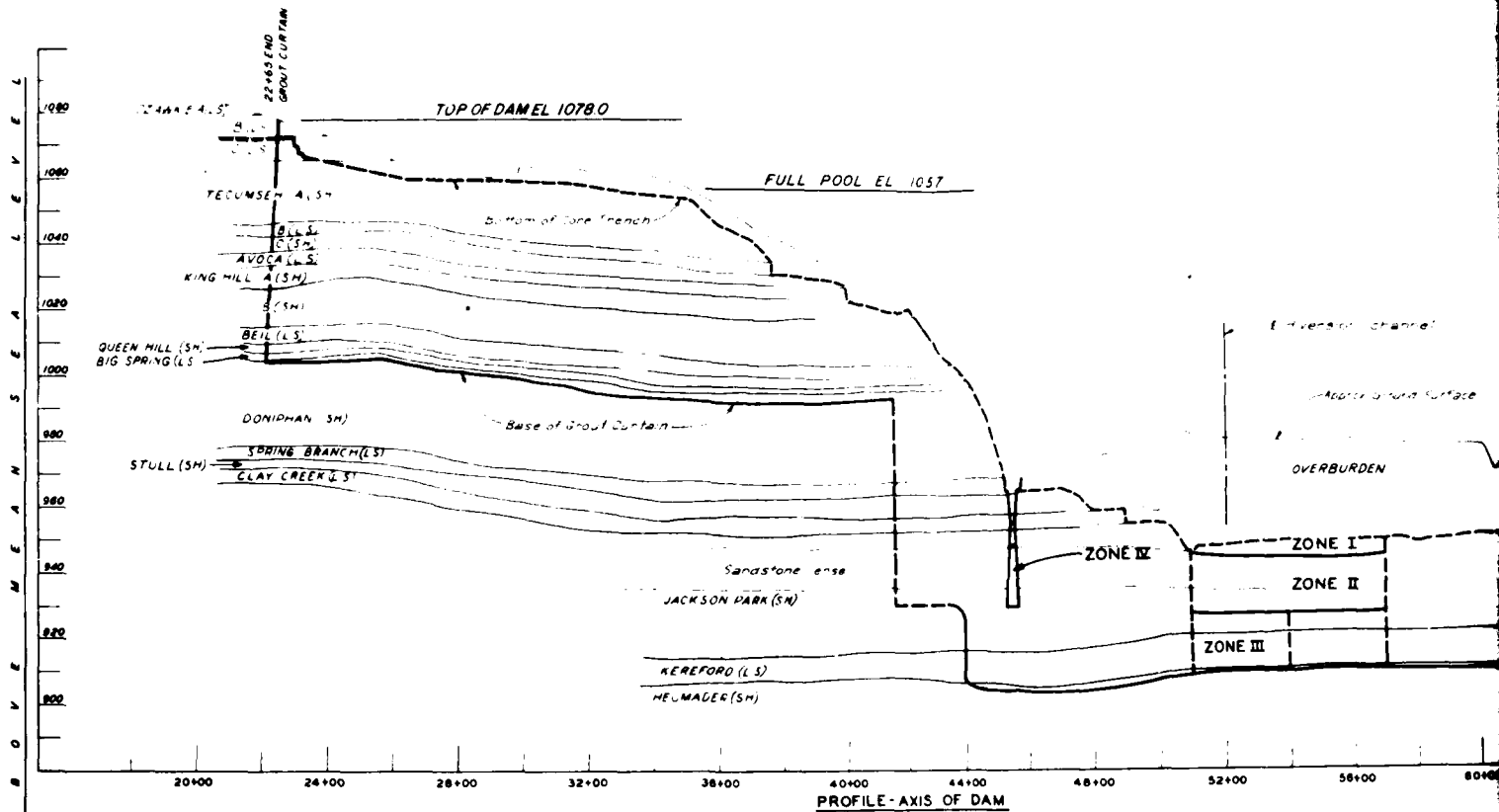
MARAS DES CYGNES RIVER, KANSAS
MELVERN LAKE
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

LOGS OF EXPLORATIONS
AXIS OF DAM

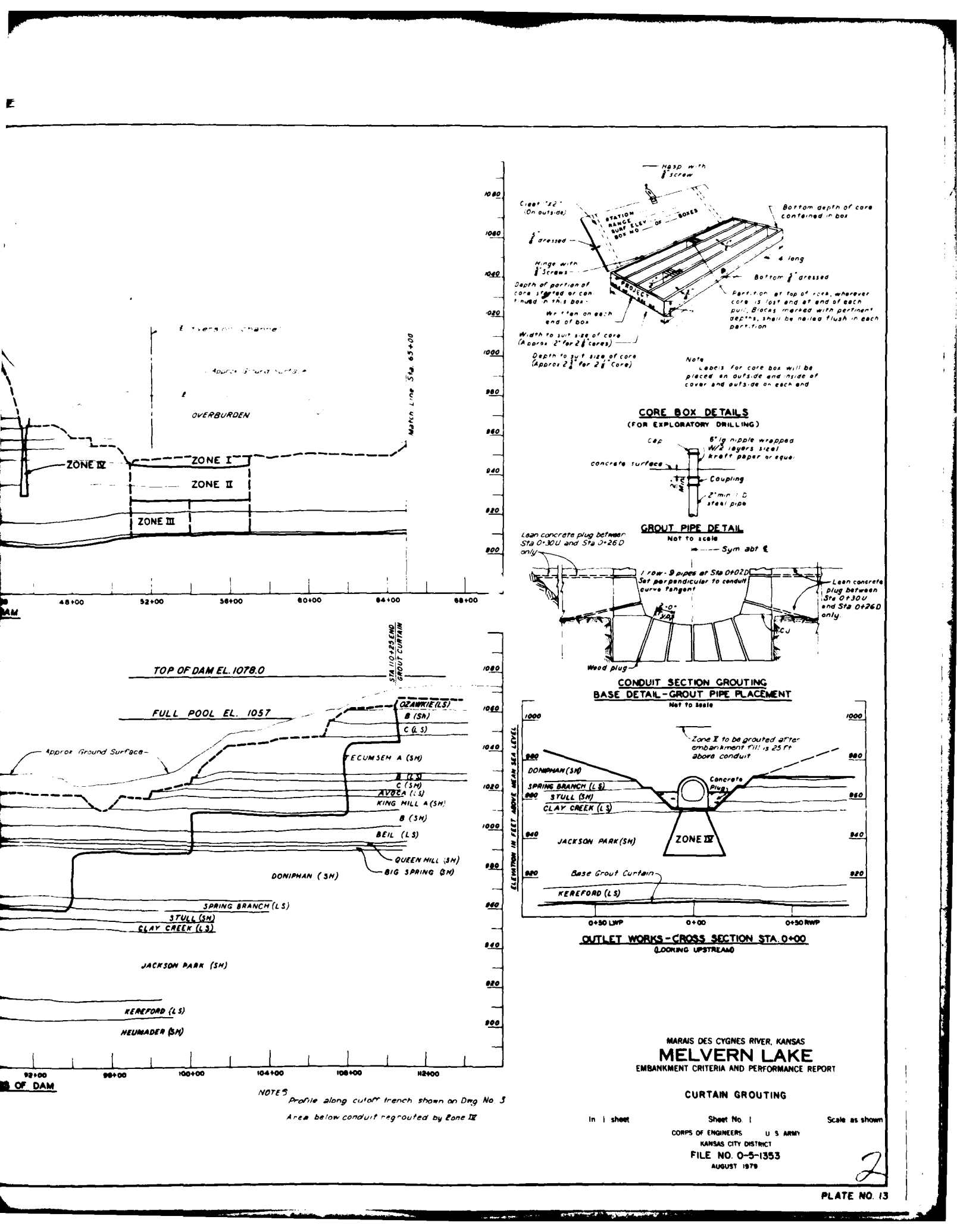
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KANSAS CITY DISTRICT
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AUGUST 1979

Scale as shown



NOTES
Prof.
Area



E

DAM

OF DAM

NOTES
Profile along cutoff trench shown on Dwg No. 3
Area below conduit regouted by Zone IX

In 1 sheet

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

CURTAIN GROUTING

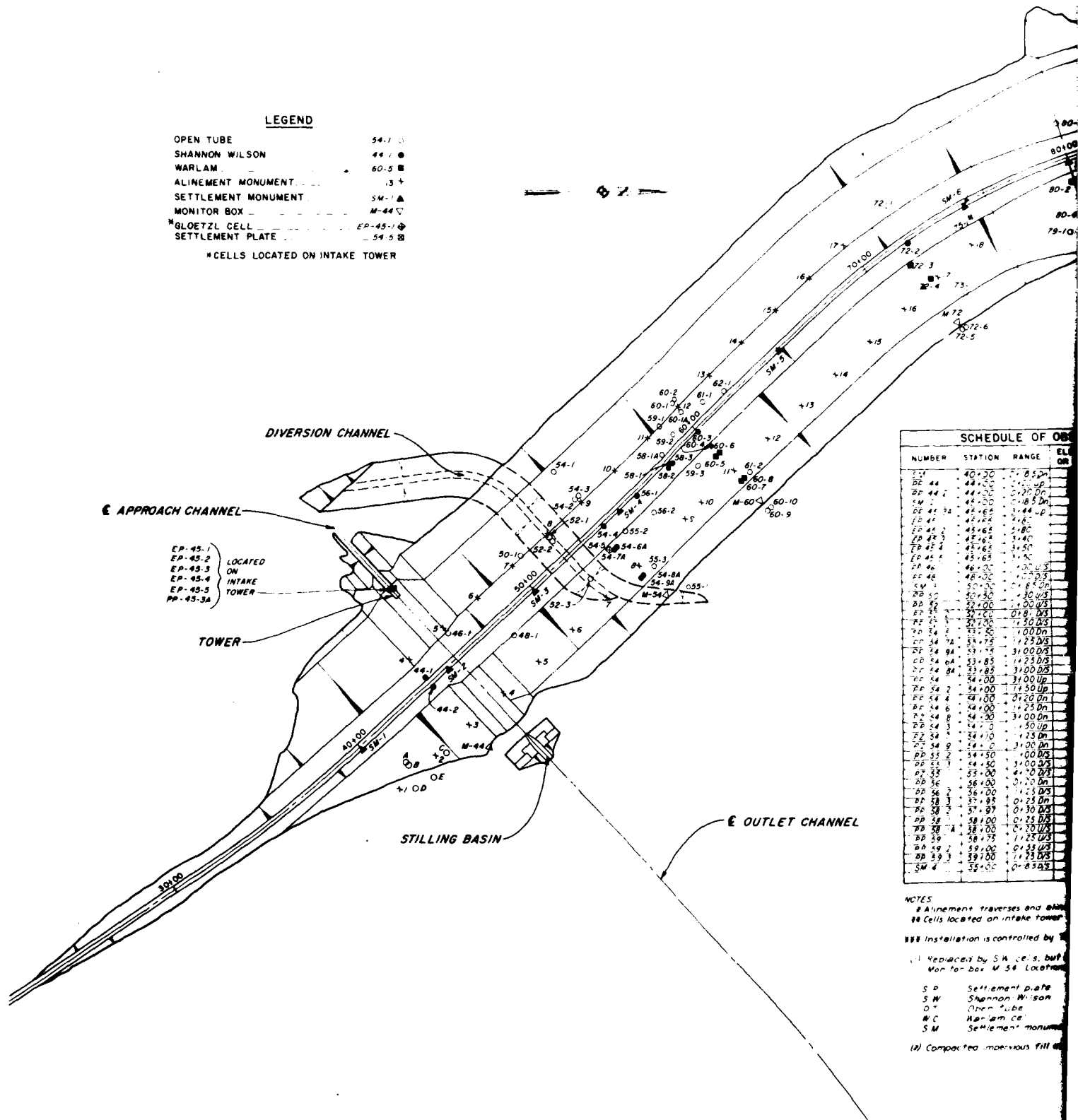
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KANSAS CITY DISTRICT
FILE NO. 0-5-1353
AUGUST 1978

Scale as shown

LEGEND

OPEN TUBE	54-1
SHANNON WILSON	44-1
WARLAM	60-5
ALIGNMENT MONUMENT	13
SETTLEMENT MONUMENT	SM-1
MONITOR BOX	M-44
GLOETZL CELL	EP-45-1
SETTLEMENT PLATE	54-5

* CELLS LOCATED ON INTAKE TOWER



NUMBER	STATION	RANGE	EL. ON
1	40+30	0-850	
2	44+00	0-850	
3	44+00	0-850	
4	44+00	0-850	
5	44+00	0-850	
6	44+00	0-850	
7	44+00	0-850	
8	44+00	0-850	
9	44+00	0-850	
10	44+00	0-850	
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97	44+00	0-850	
98	44+00	0-850	
99	44+00	0-850	
100	44+00	0-850	

NOTES

1. Alignment traverses and above

2. Cells located on intake tower

3. Installation is controlled by

4. Replaced by S.W. cells, but

5. Monitor box M-54 Location

S.P. Settlement plate

S.W. Shannon Wilson

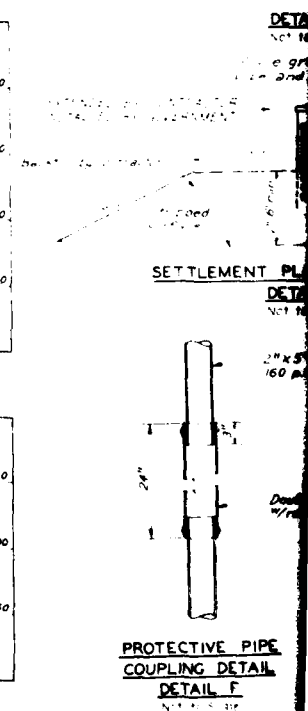
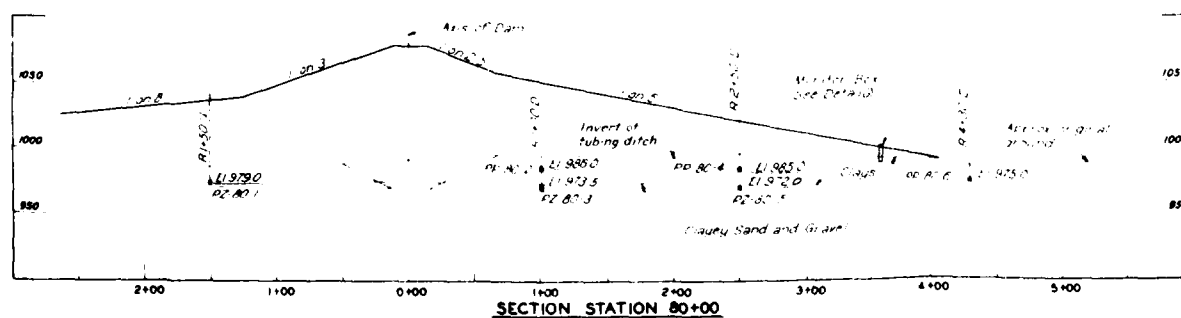
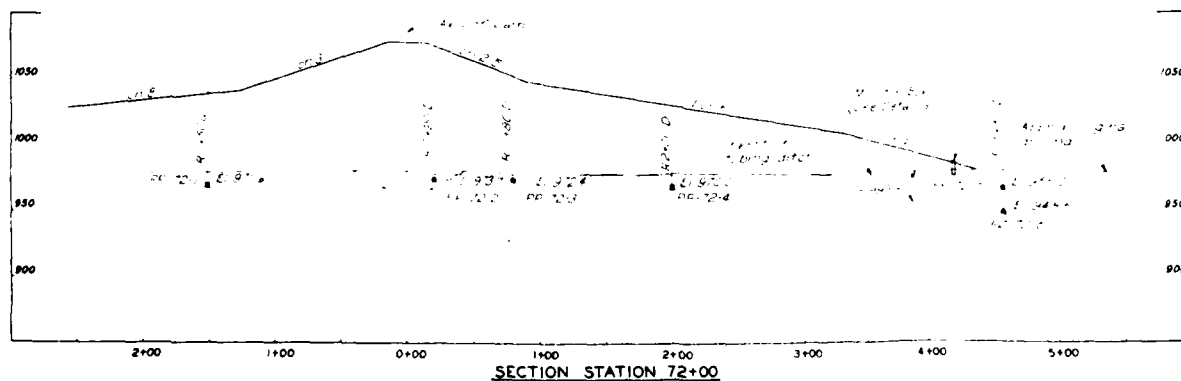
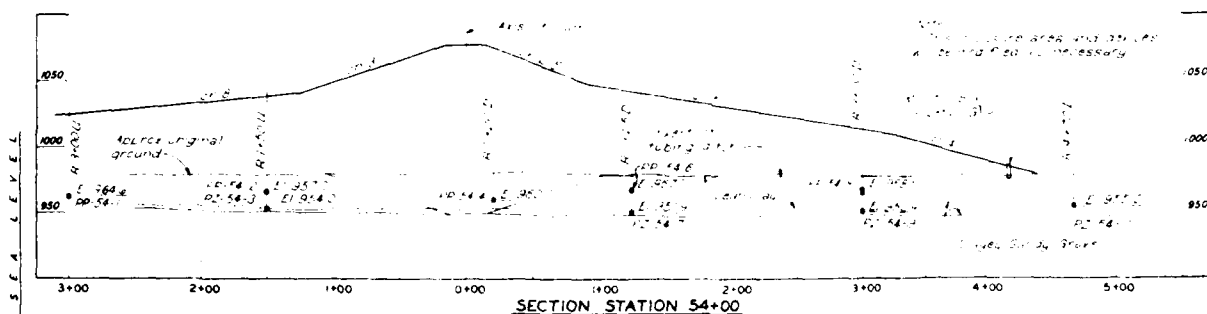
O.T. Open Tube

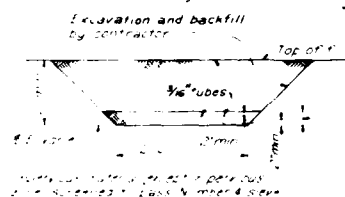
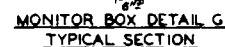
M.C. Warlam cell

S.M. Settlement monument

(2) Compacted impervious fill

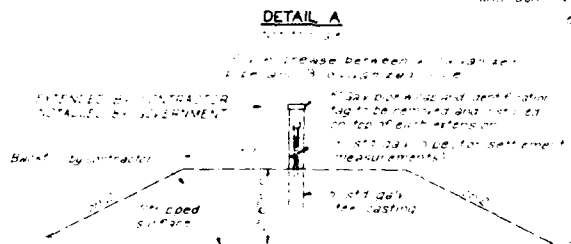
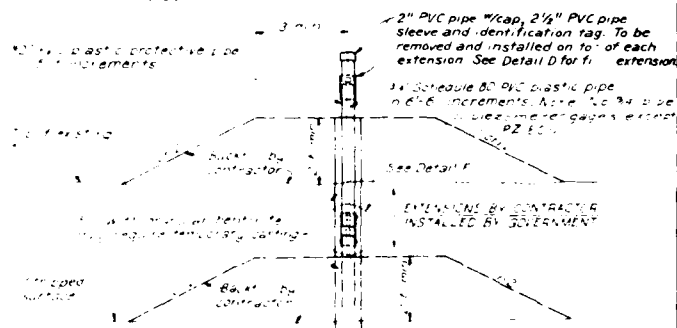
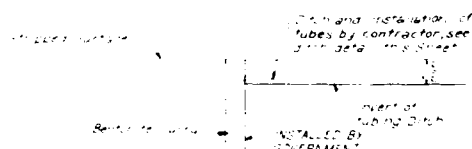
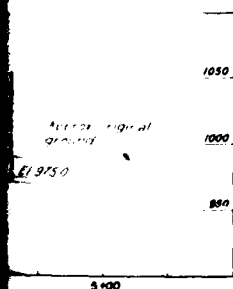
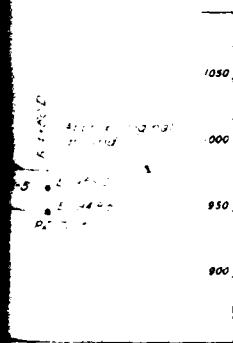
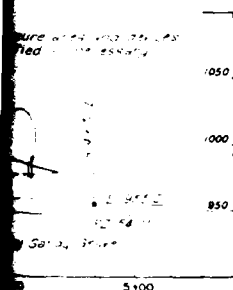
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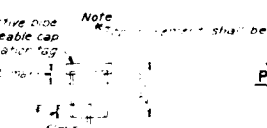


TUBING DITCH DETAIL

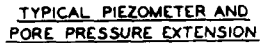
SCHEDULE OF MONITOR BOX INSTALLATION			
BOX NO	STATION	RANGE AT L	APPROX EL TOP OF BOX
44	44+00	3+40	935.0
54	54+00	4+22	986.0
64	64+00	4+22	986.0
72	72+00	4+22	986.0
82	82+00	3+85	995.0



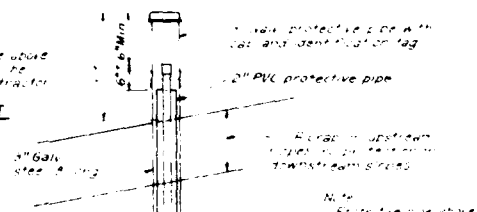
SETTLEMENT PLATE EXTENSION



SETTLEMENT MONUMENT

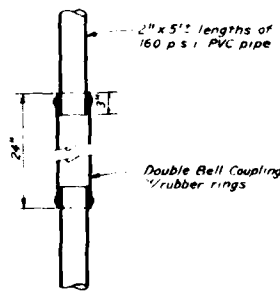


DETAIL E



FINAL PIEZOMETER EXTENSION

DETAIL D



PROTECTIVE PIPE
CORROSION DETAIL

COUPLING DETAIL

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
Alignment pipes extended above the embankment are to be painted by contractor
See Plate C-1 for location of boundary bells on Contractor's form

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

EMBANKMENT OBSERVATION DEVICES

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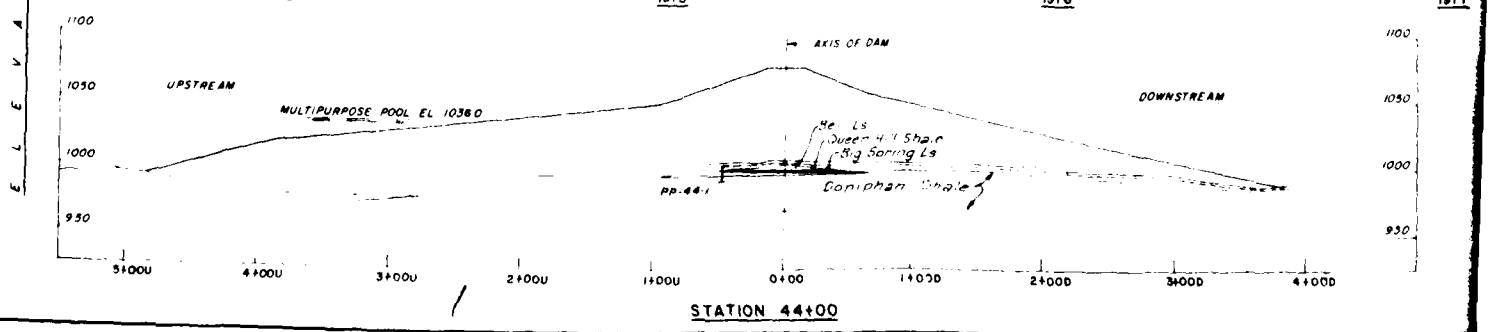
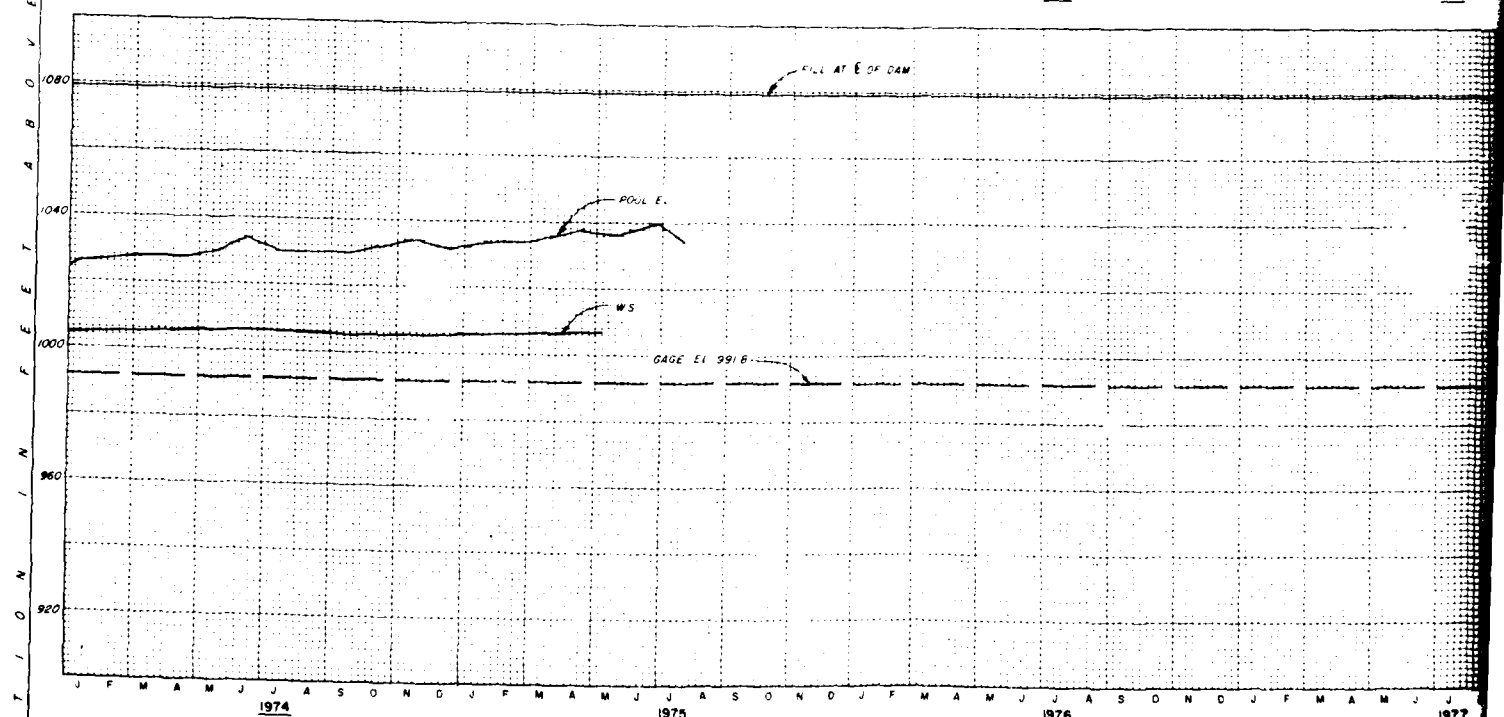
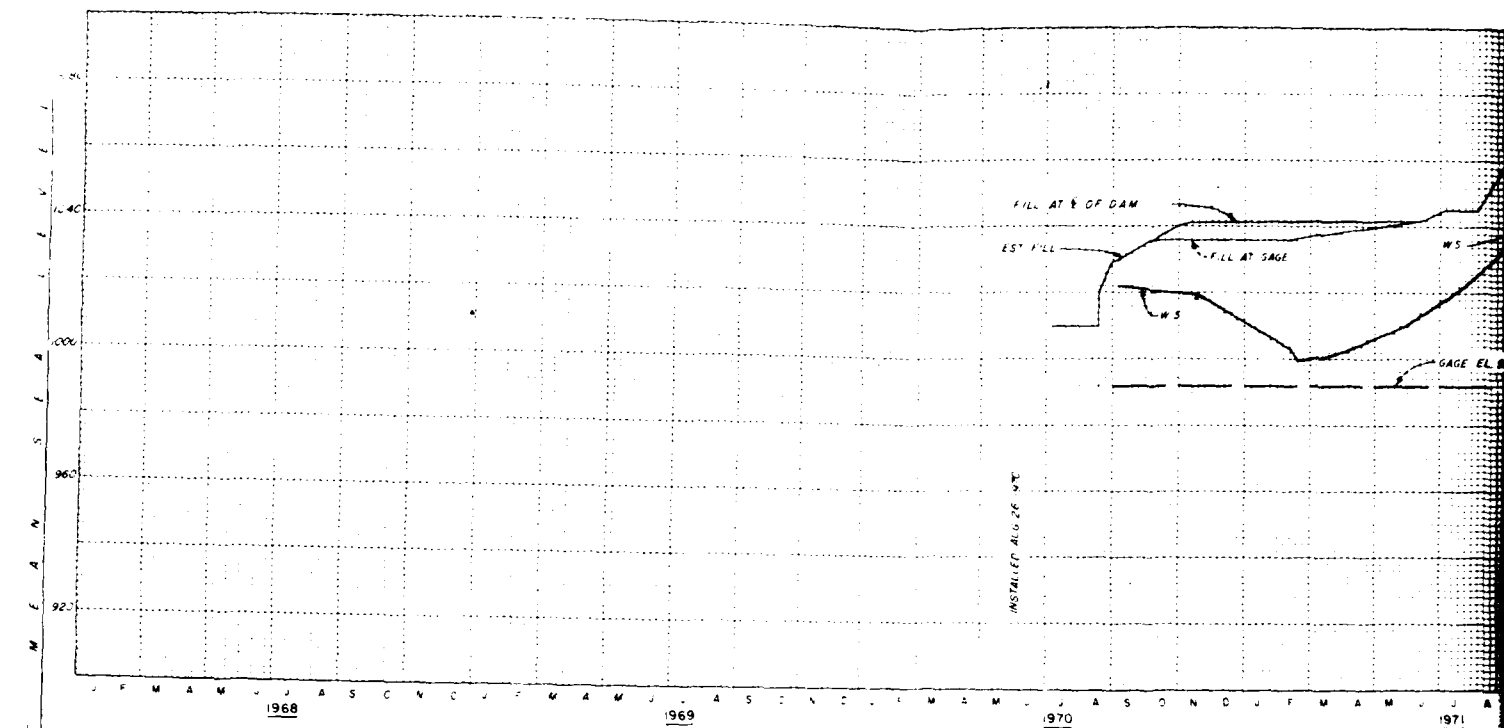
Scale as shown

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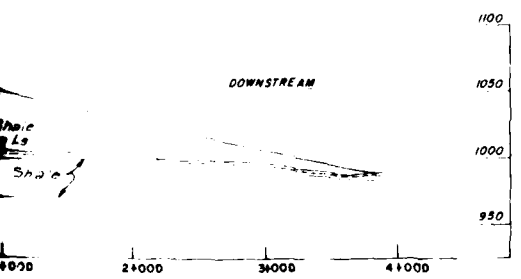
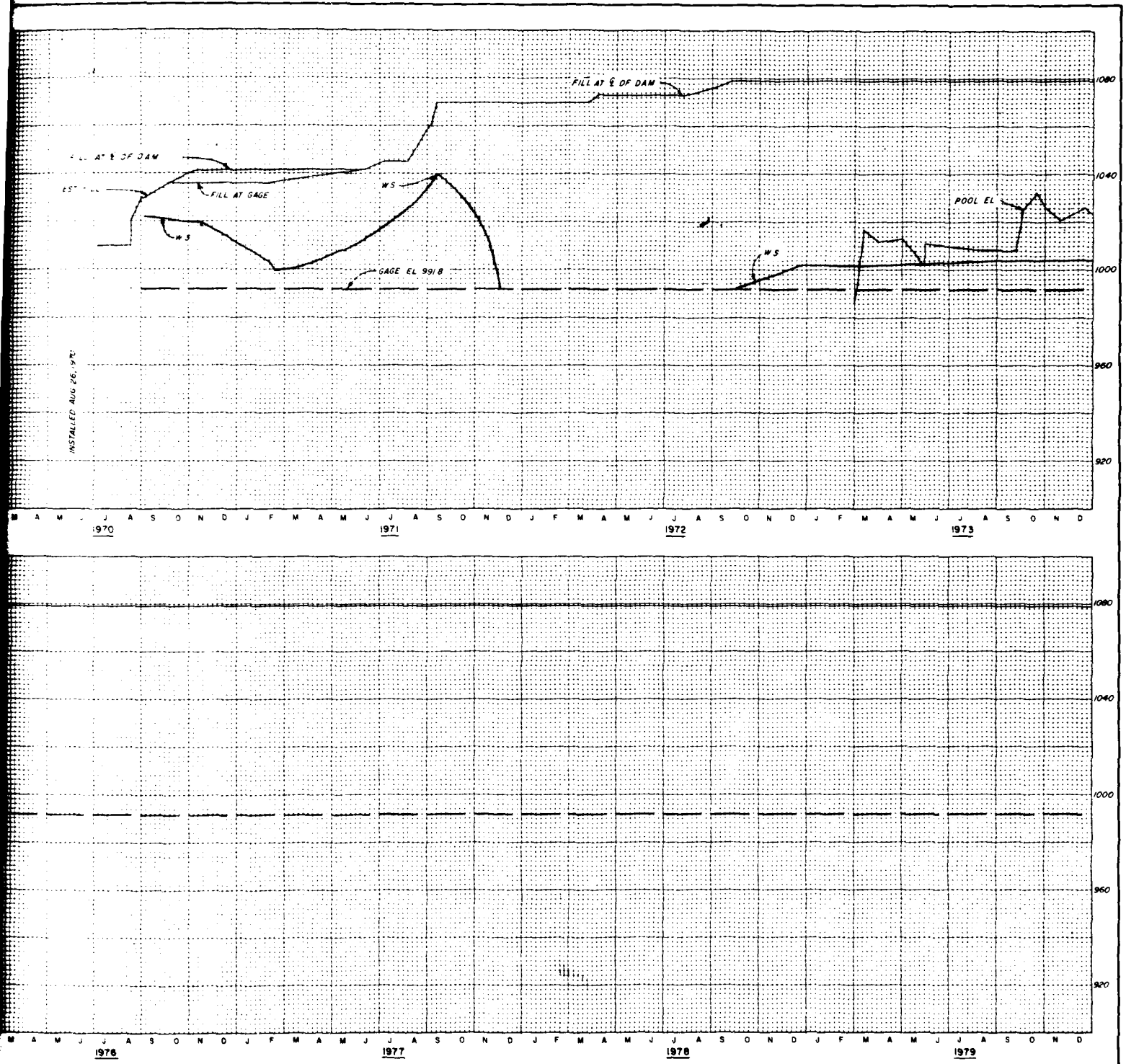
KANSAS CITY DISTRICT

FILE NO 0-5-1355

AUGUST 1979

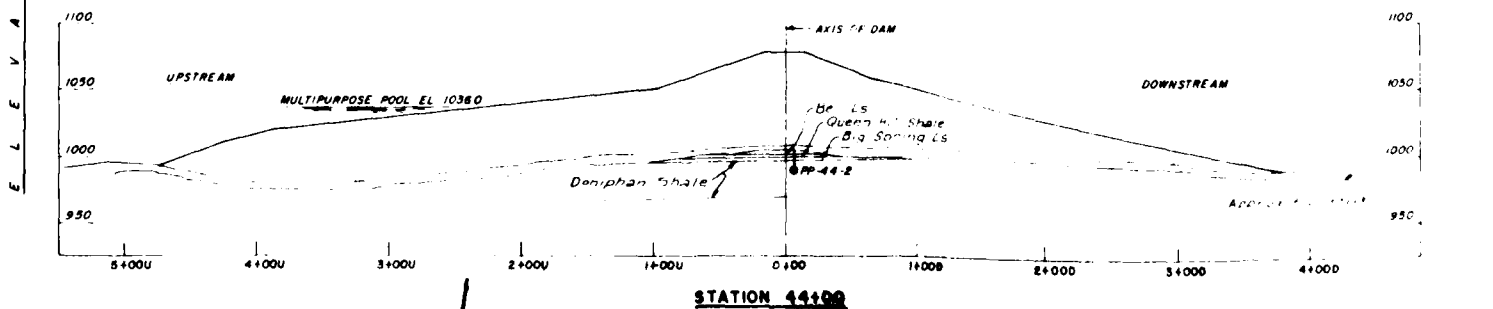
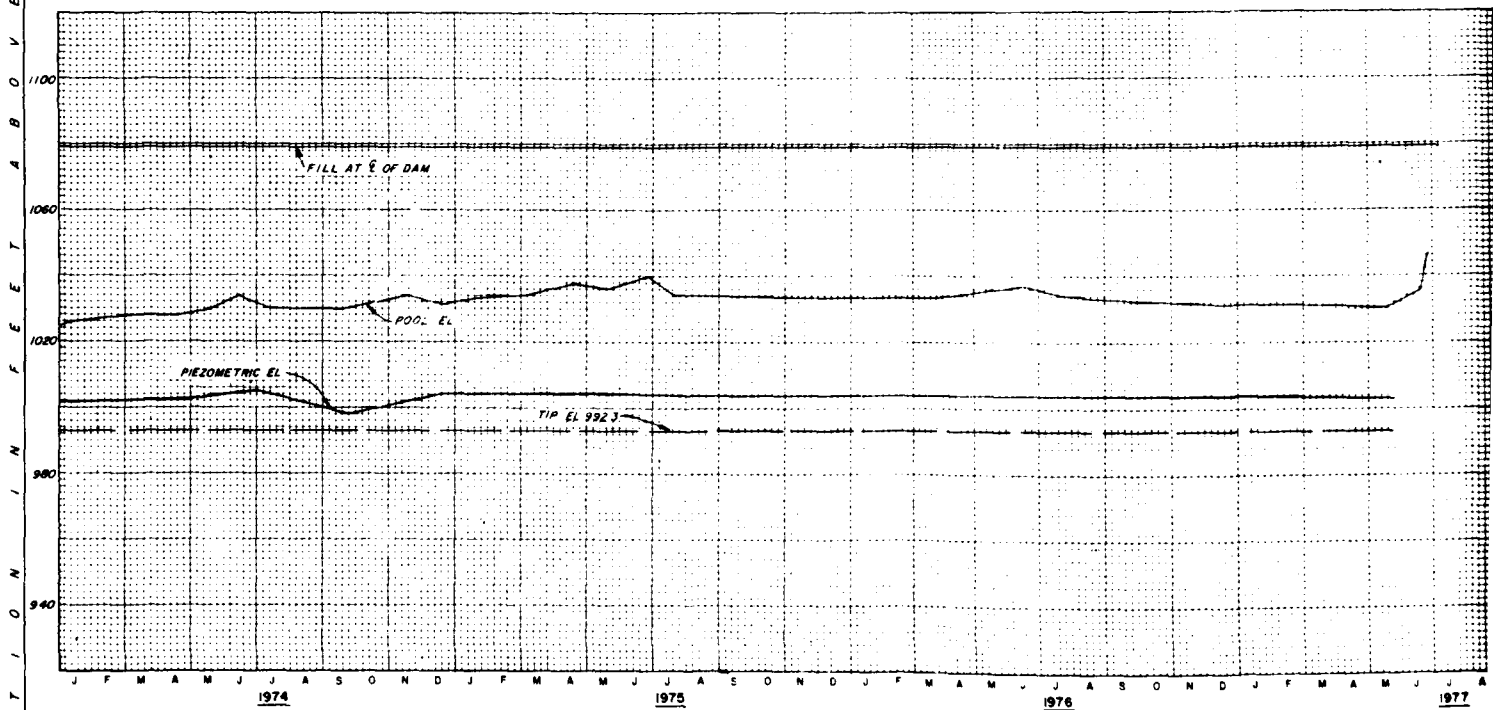
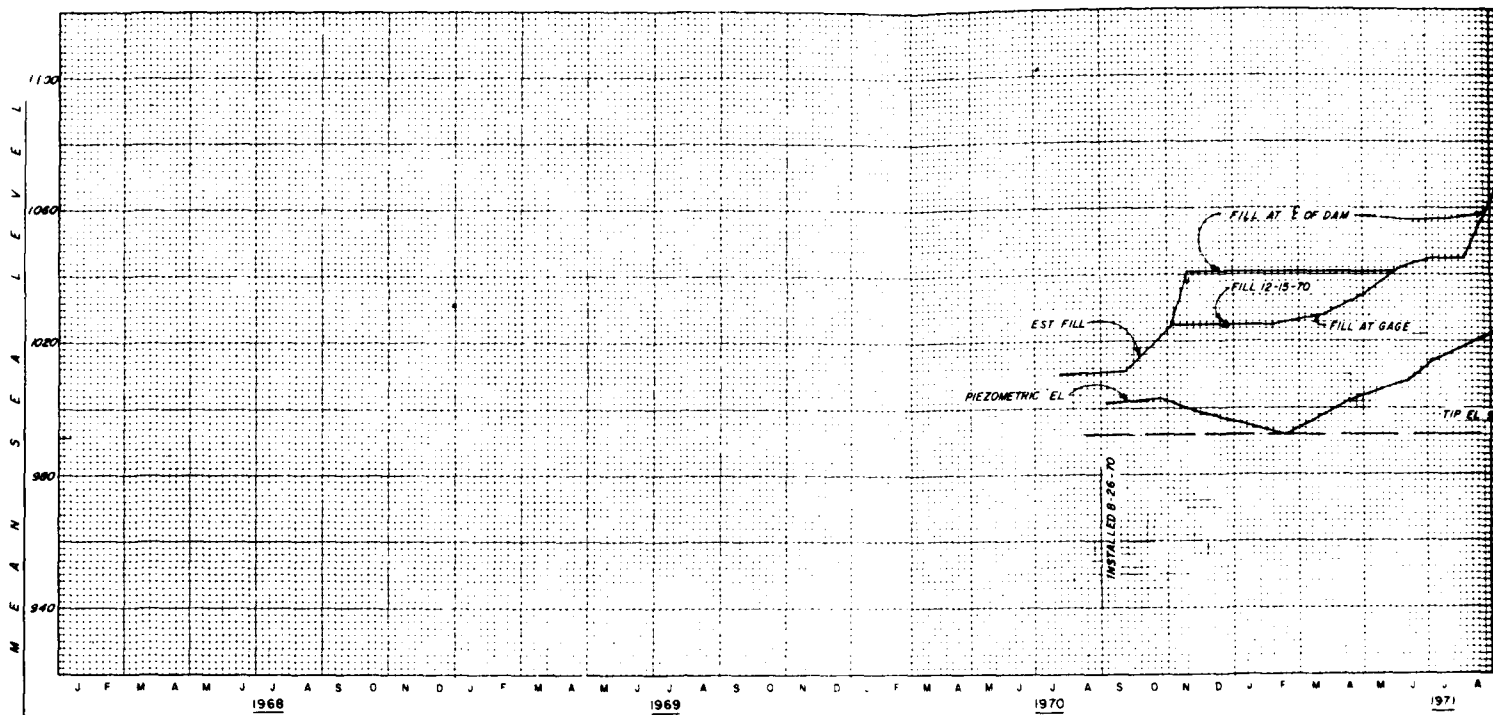


STATION 44+00

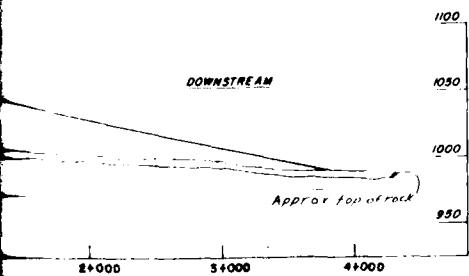
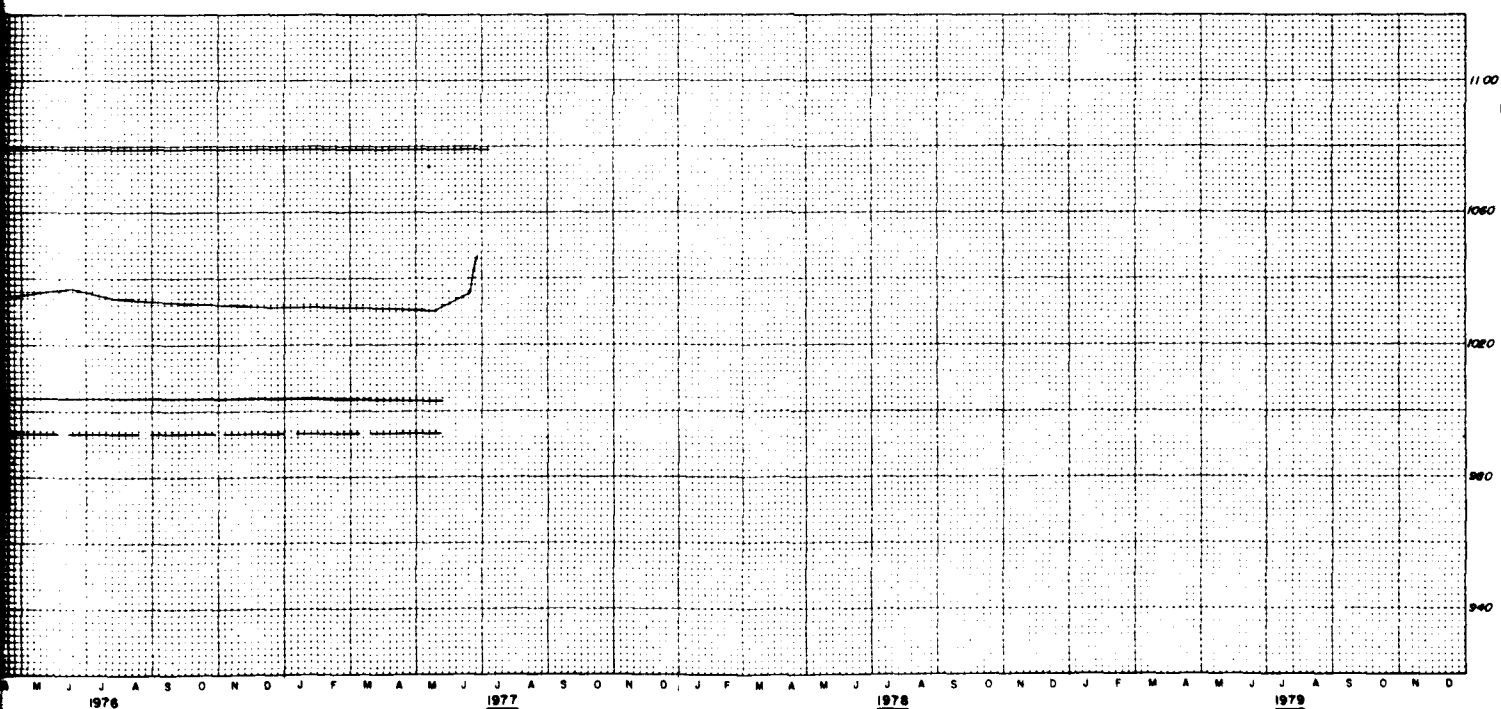
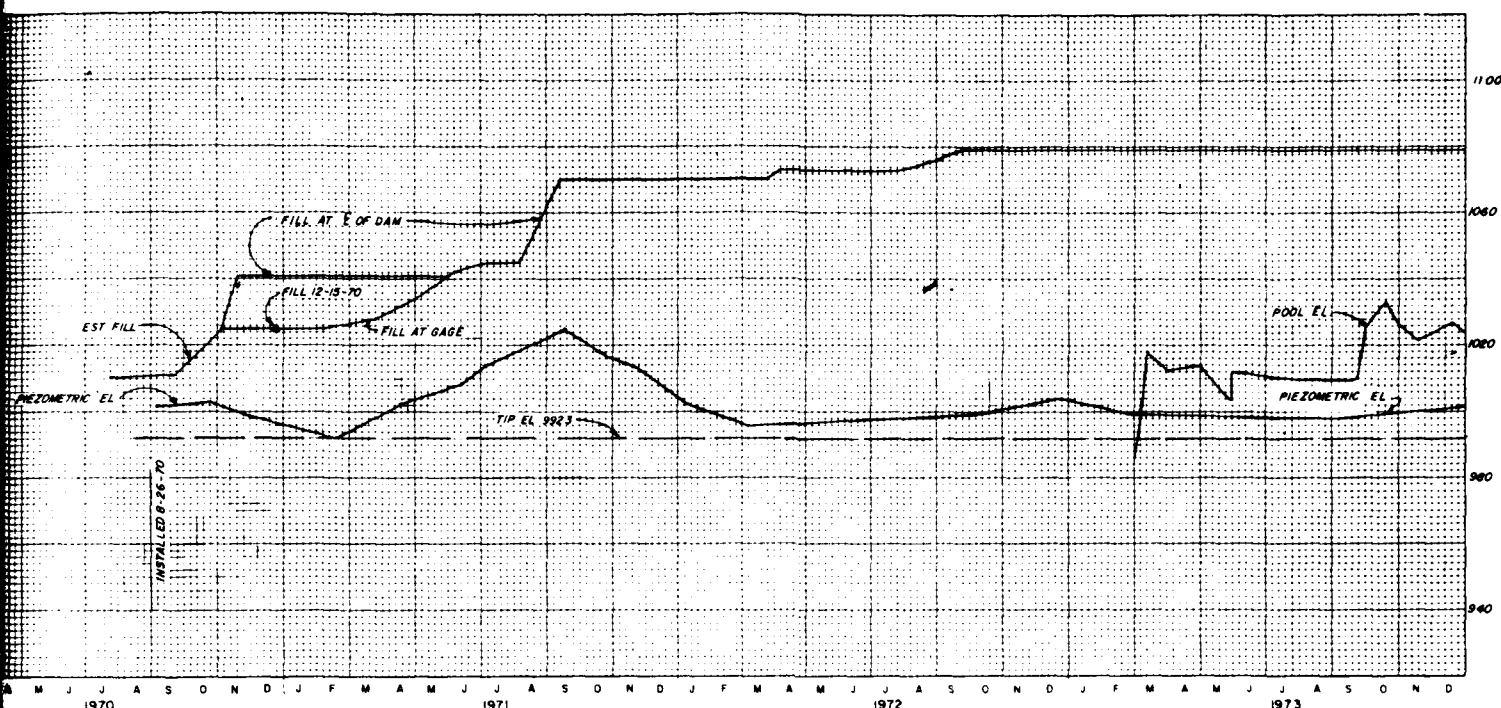


NOTE:
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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
 INSTRUMENTATION PLOTS
 PP-44-1 (SHANNON-WILSON CELL)

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 KANSAS CITY DISTRICT
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STATION 44+00

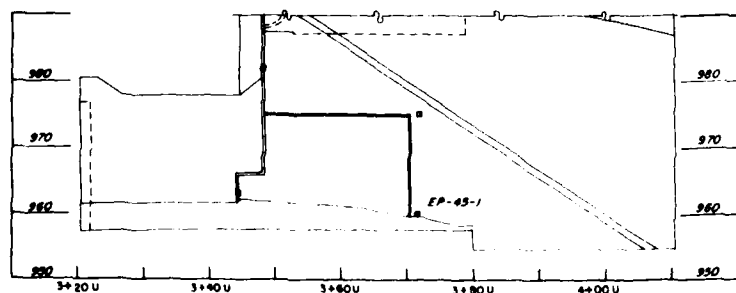


LEGEND
 OPEN TUBE ○
 PNEUMATIC CELLS ●

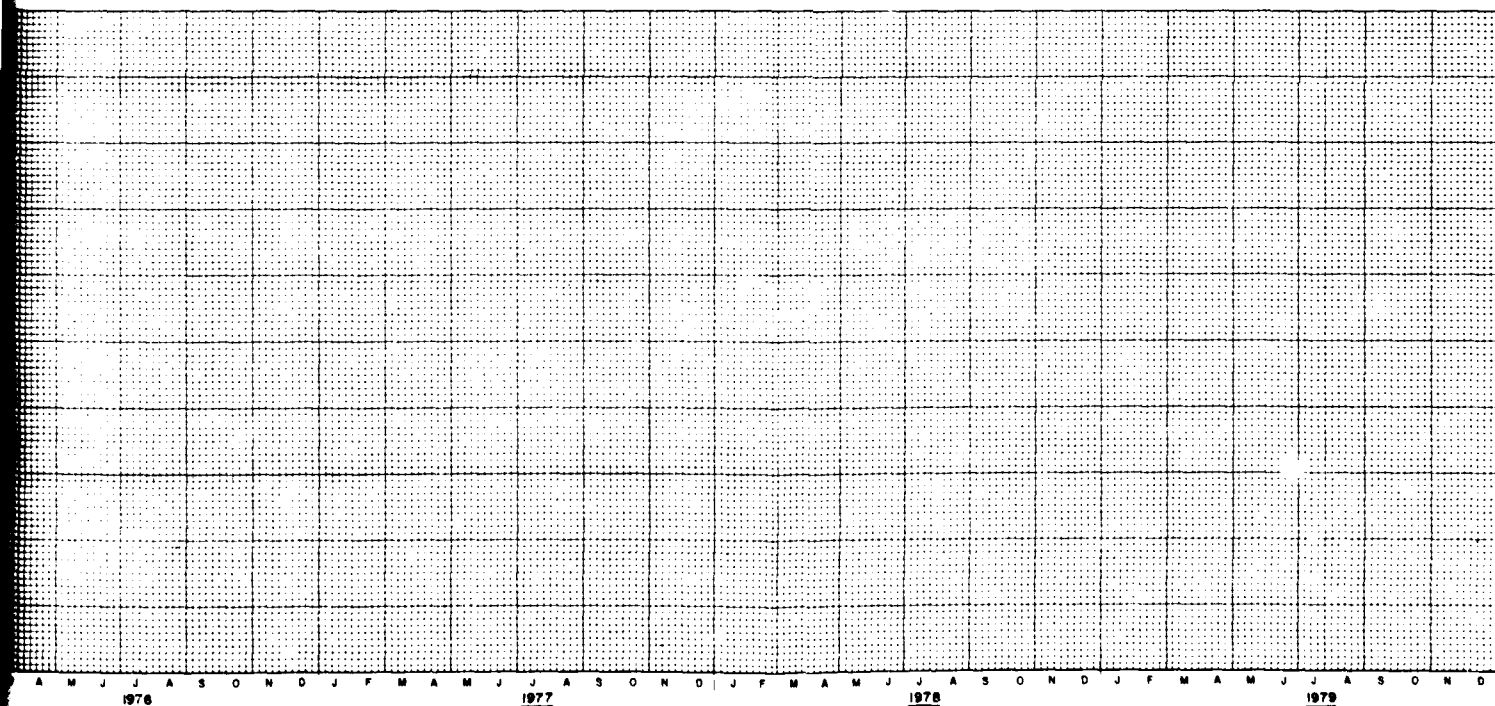
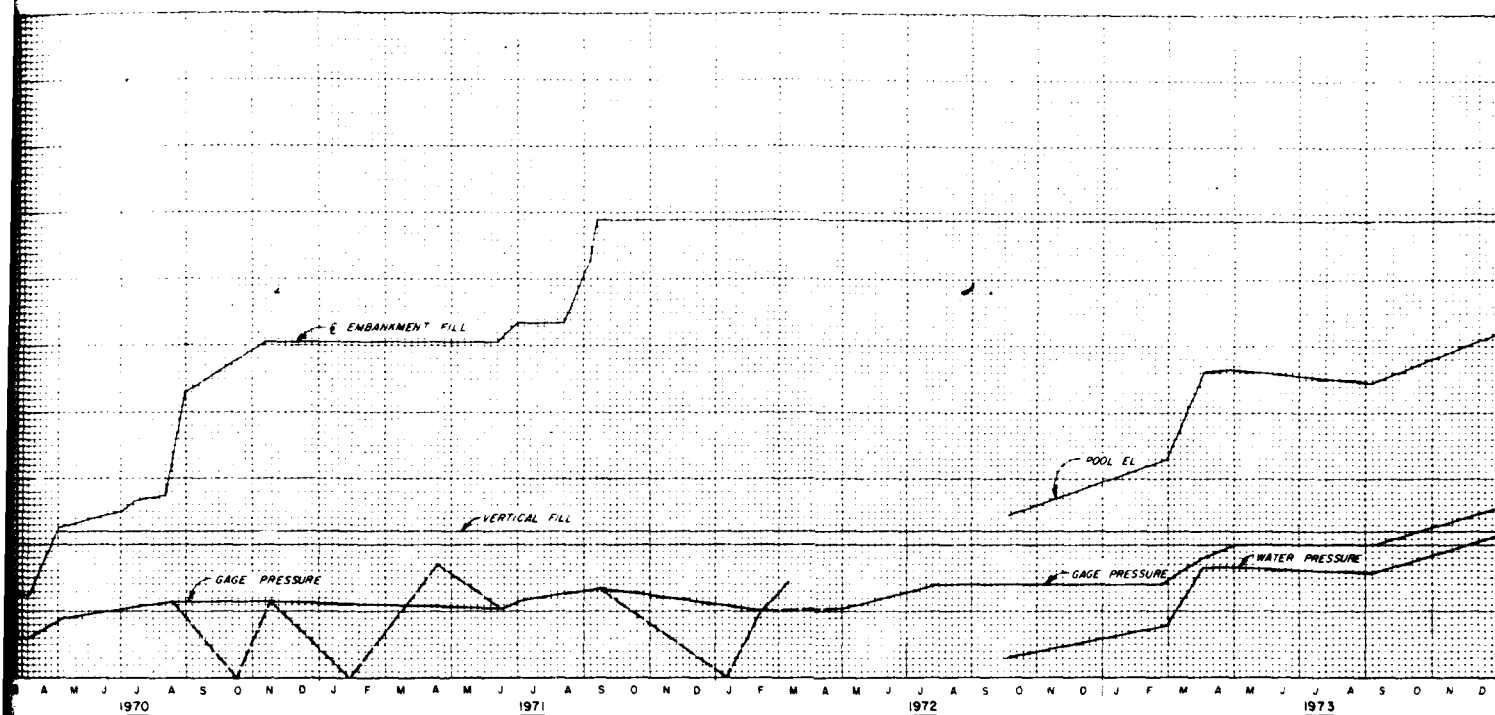
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 KANSAS CITY DISTRICT
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2



3400
LEFT SIDE ELEVATION



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MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

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EP-45-1 (GLOETZL CELL)

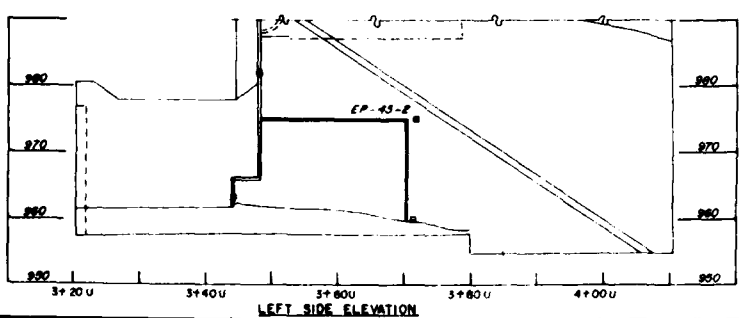
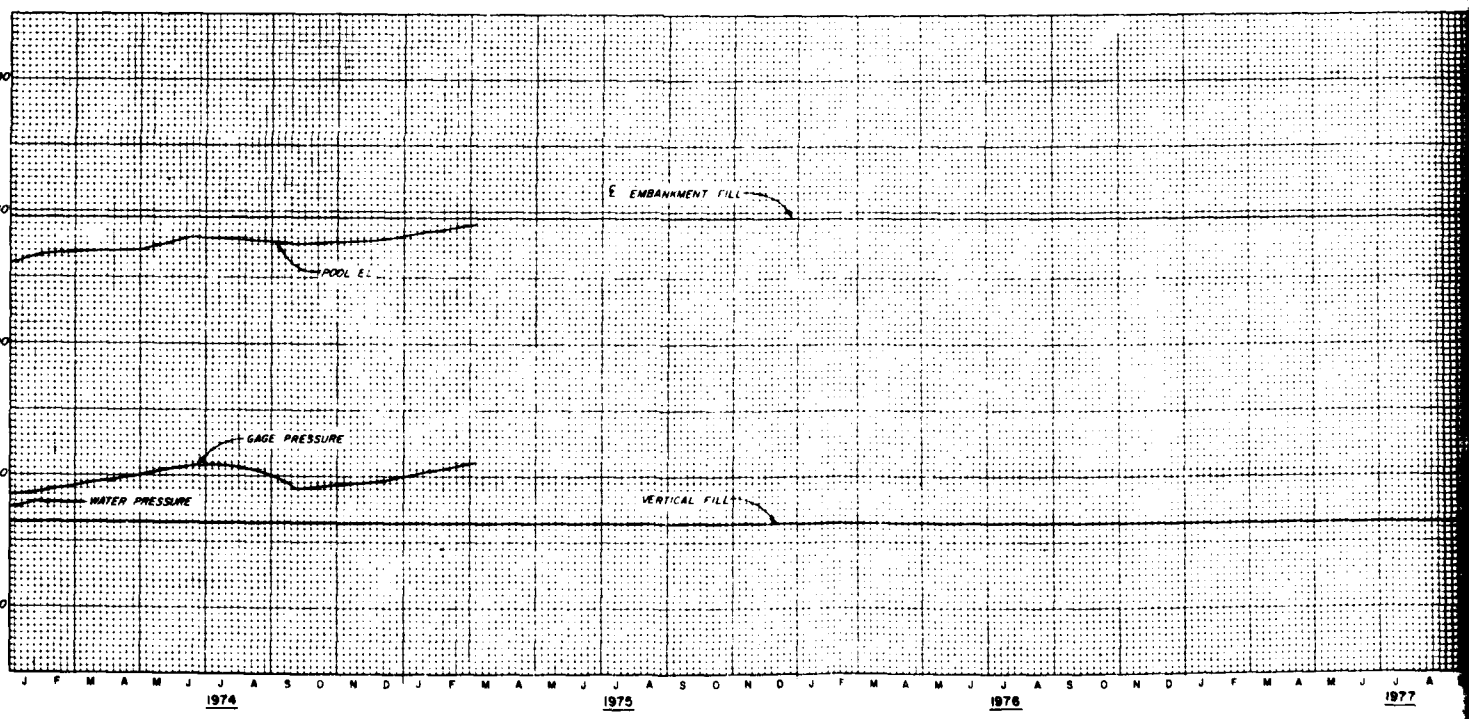
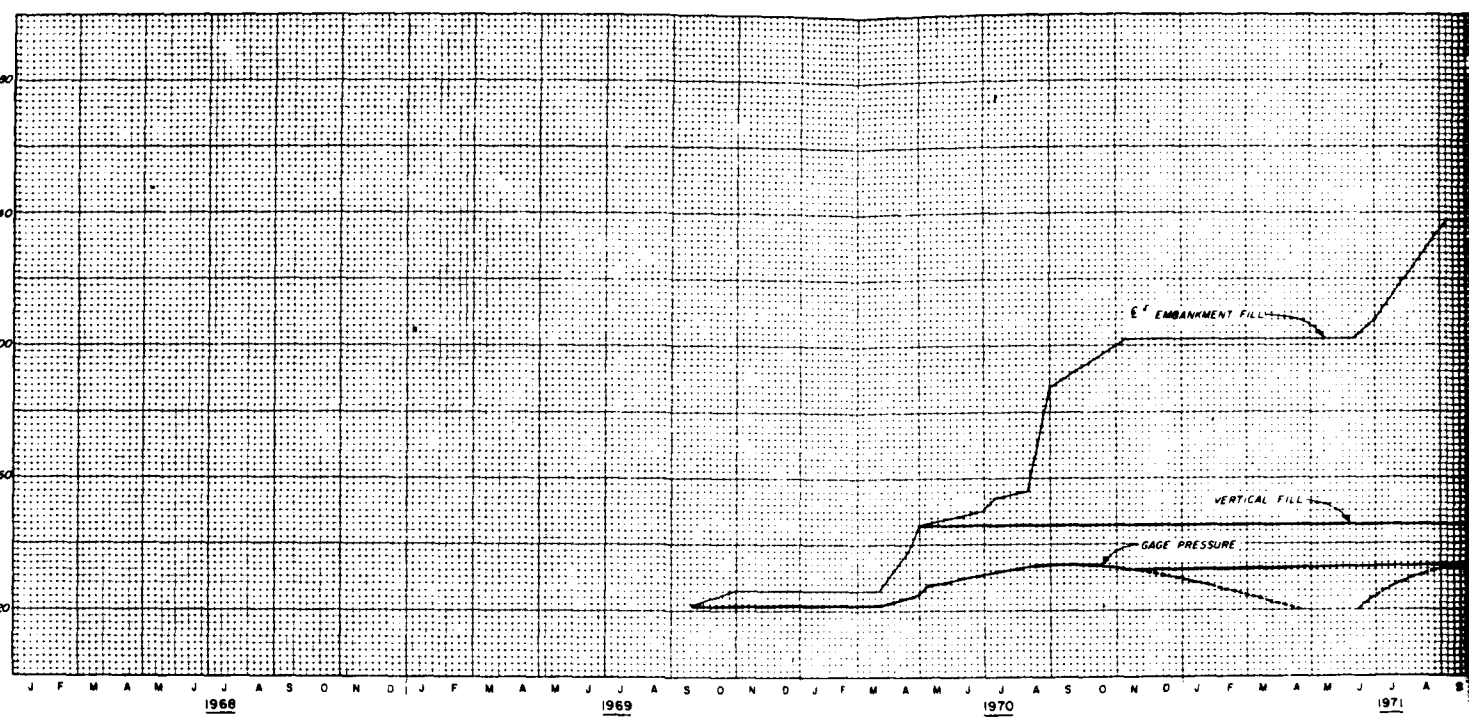
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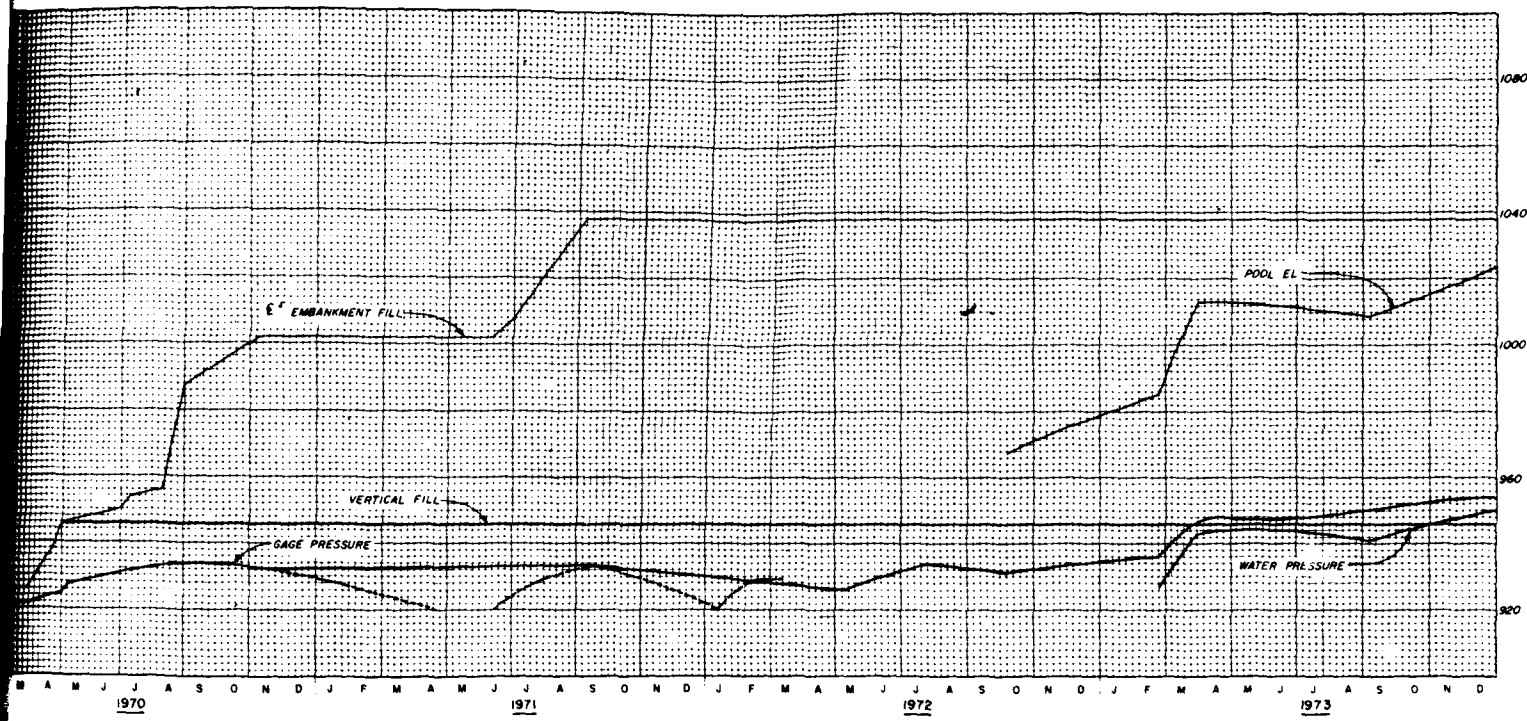
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KANSAS CITY DISTRICT

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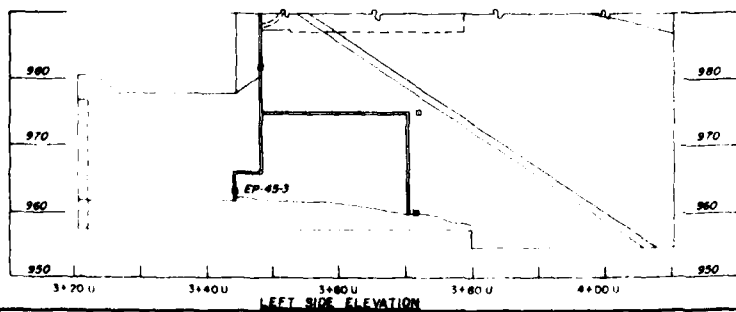
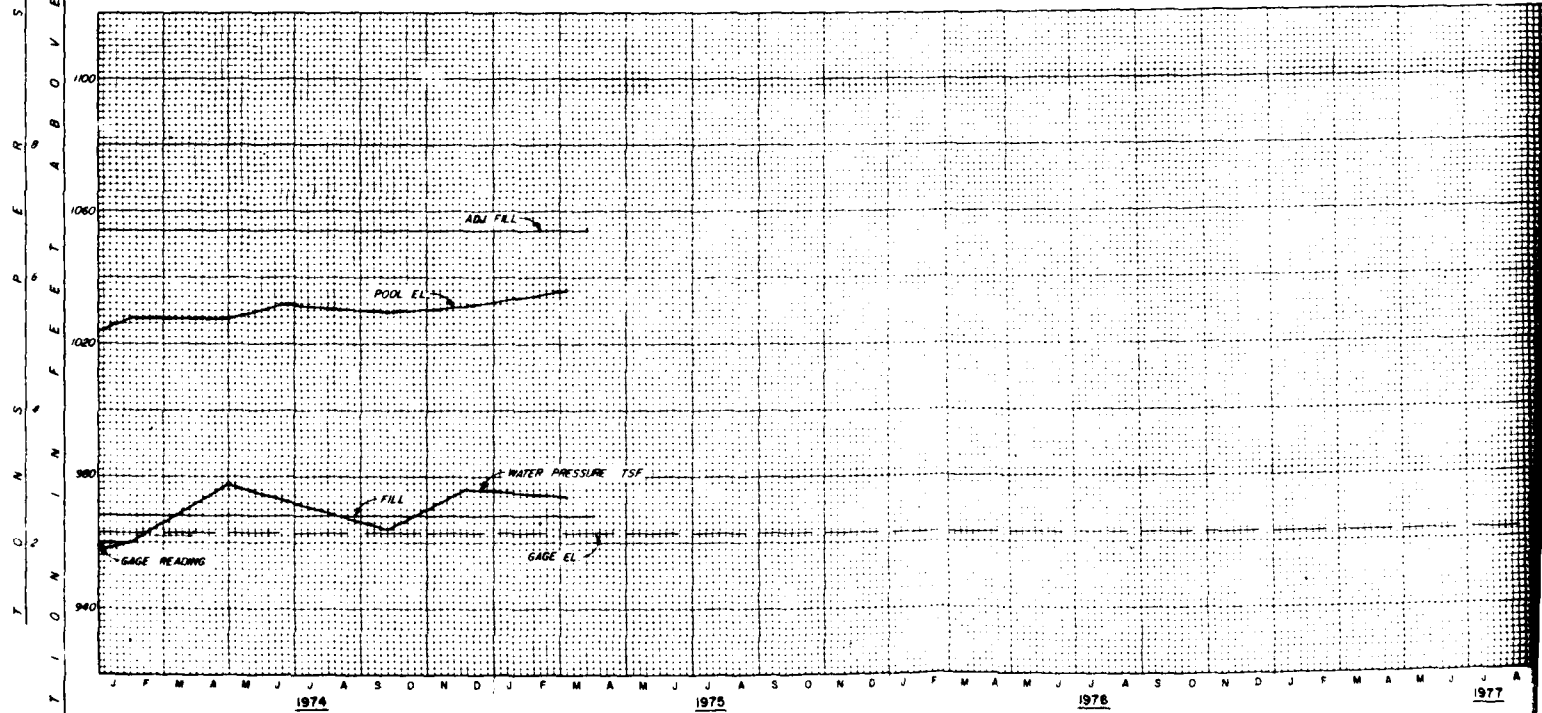
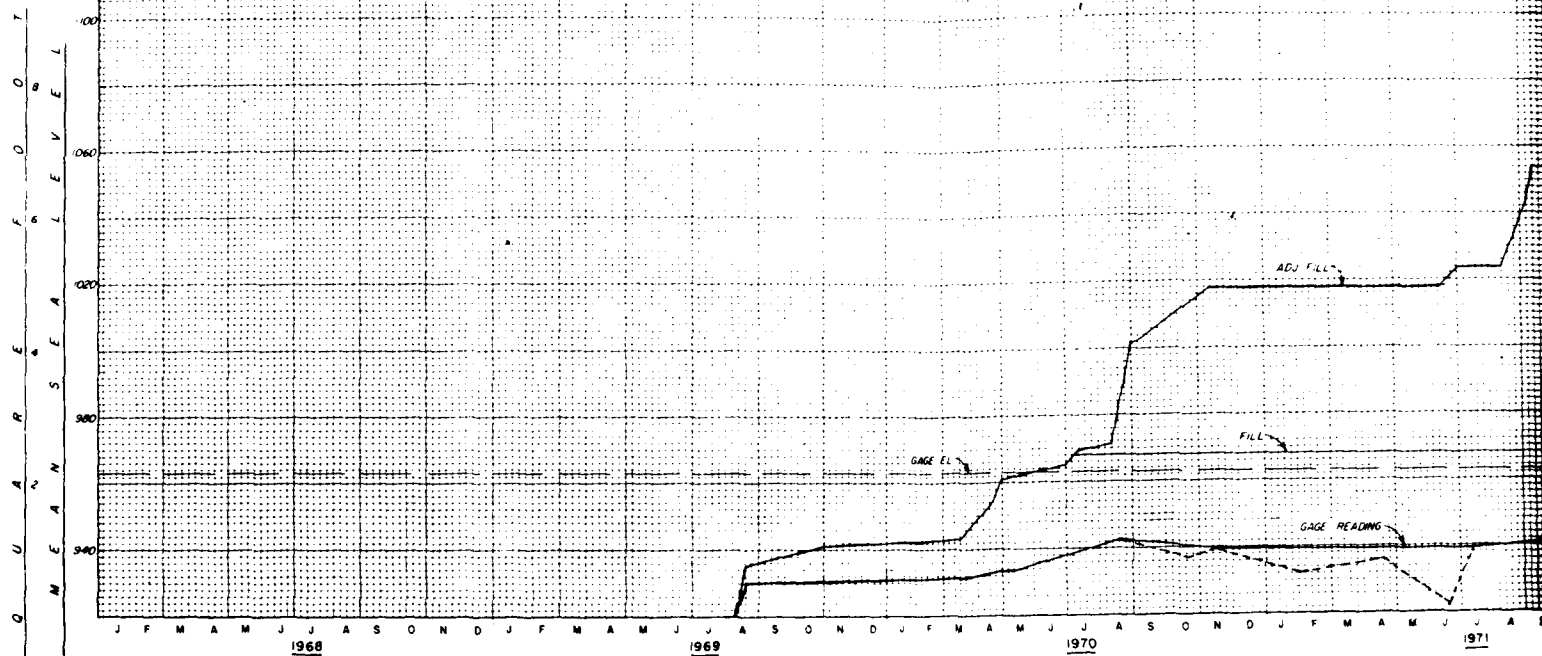


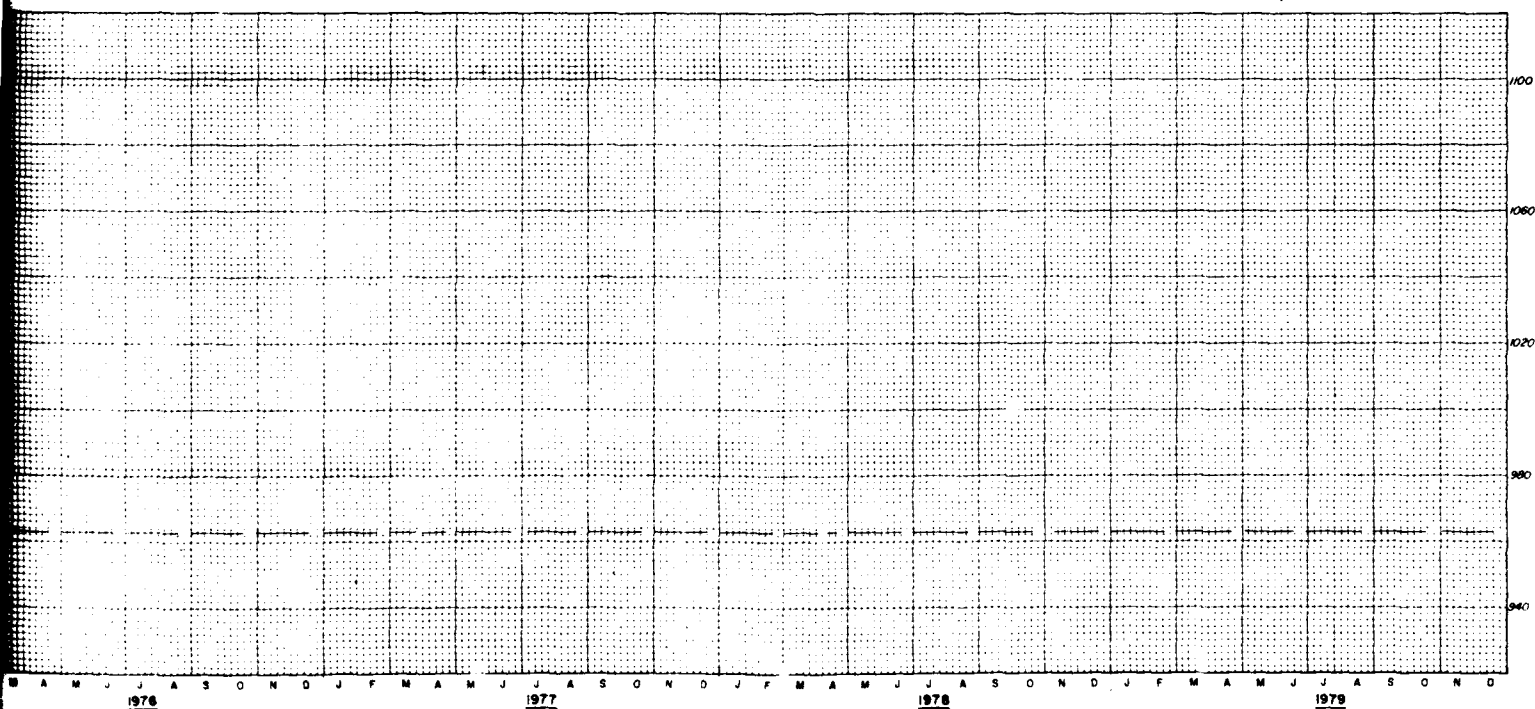
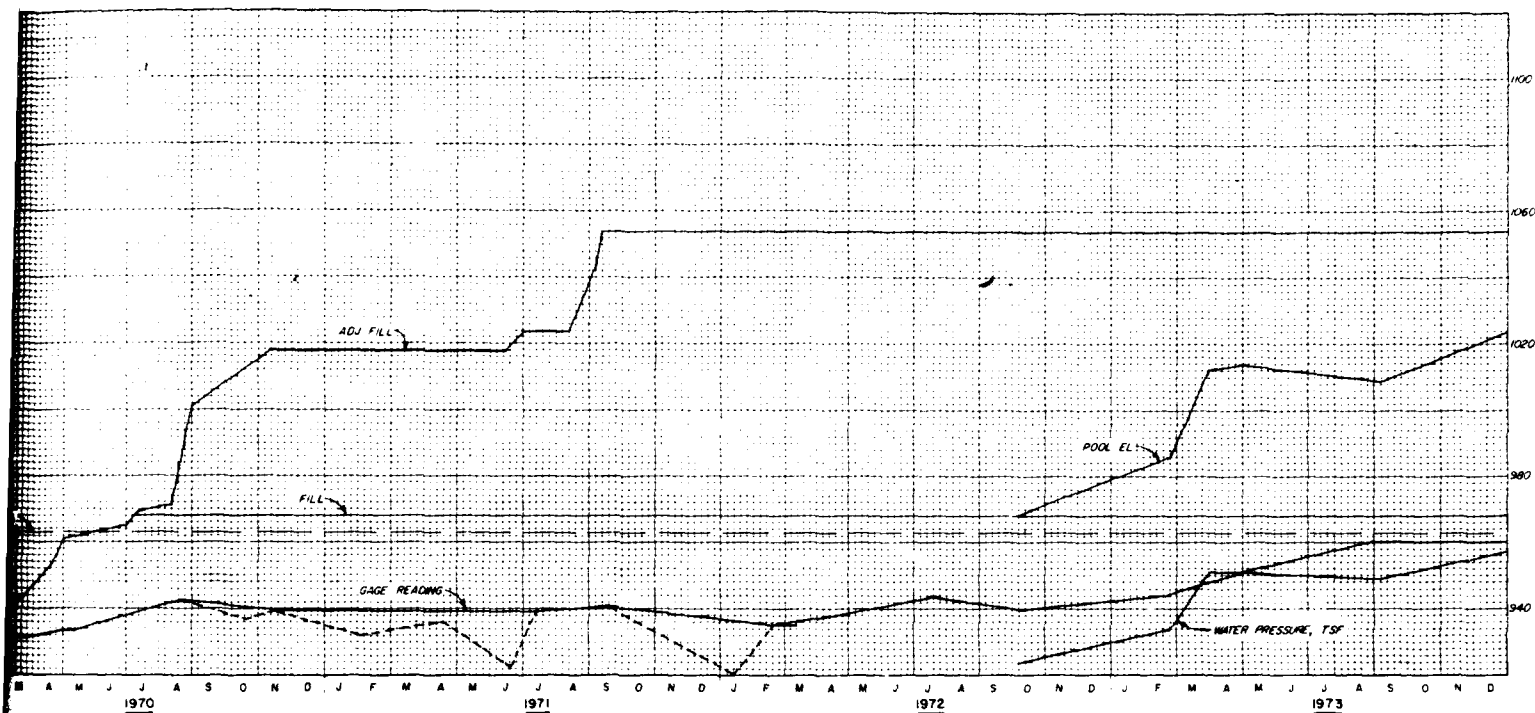
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MELVERN LAKE

INSTRUMENTATION PLOTS
 EP-45-2 GLOETZEL CELL

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 KANSAS CITY DISTRICT
FILE NO. 0-5-1267
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2





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INSTRUMENTATION PLOTS
EP-45-3(GLOETZL CELL)

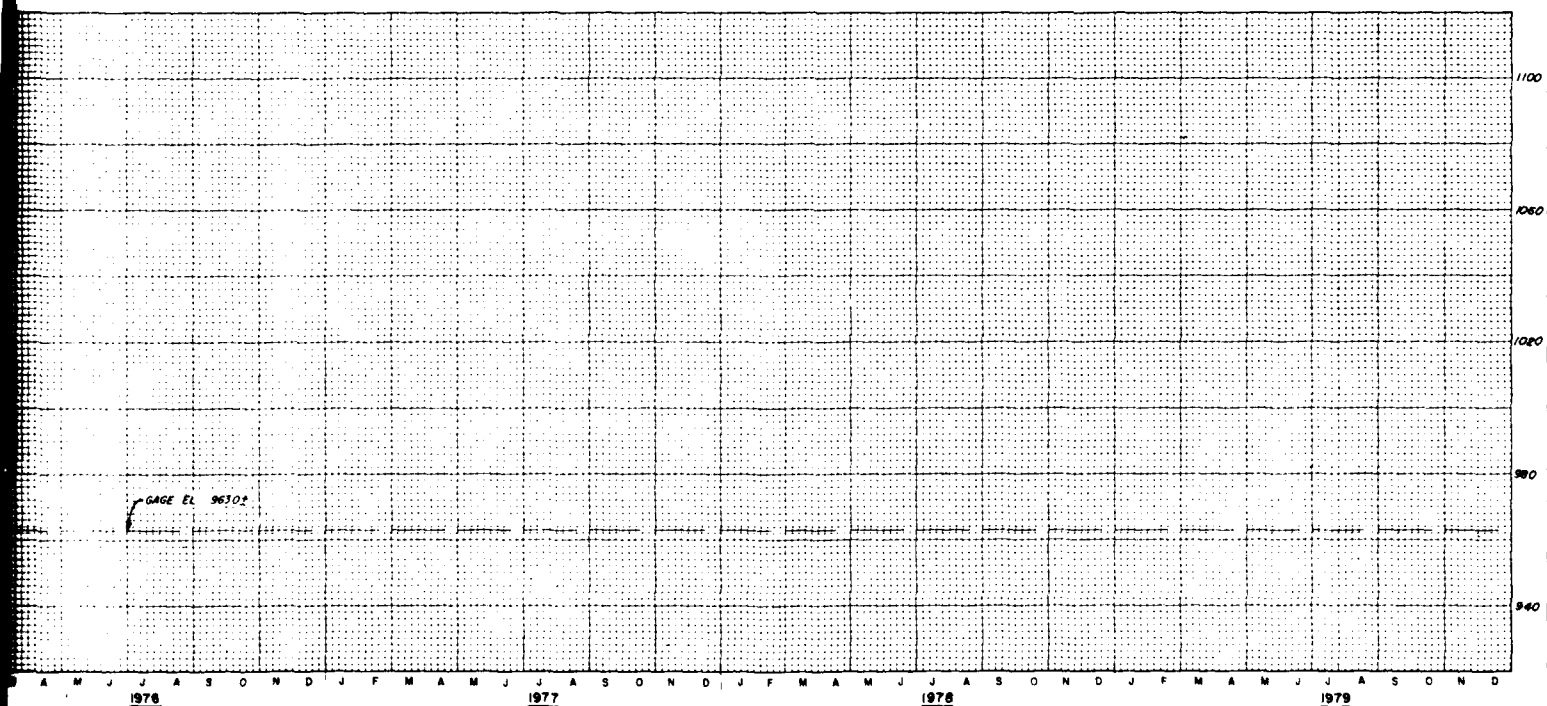
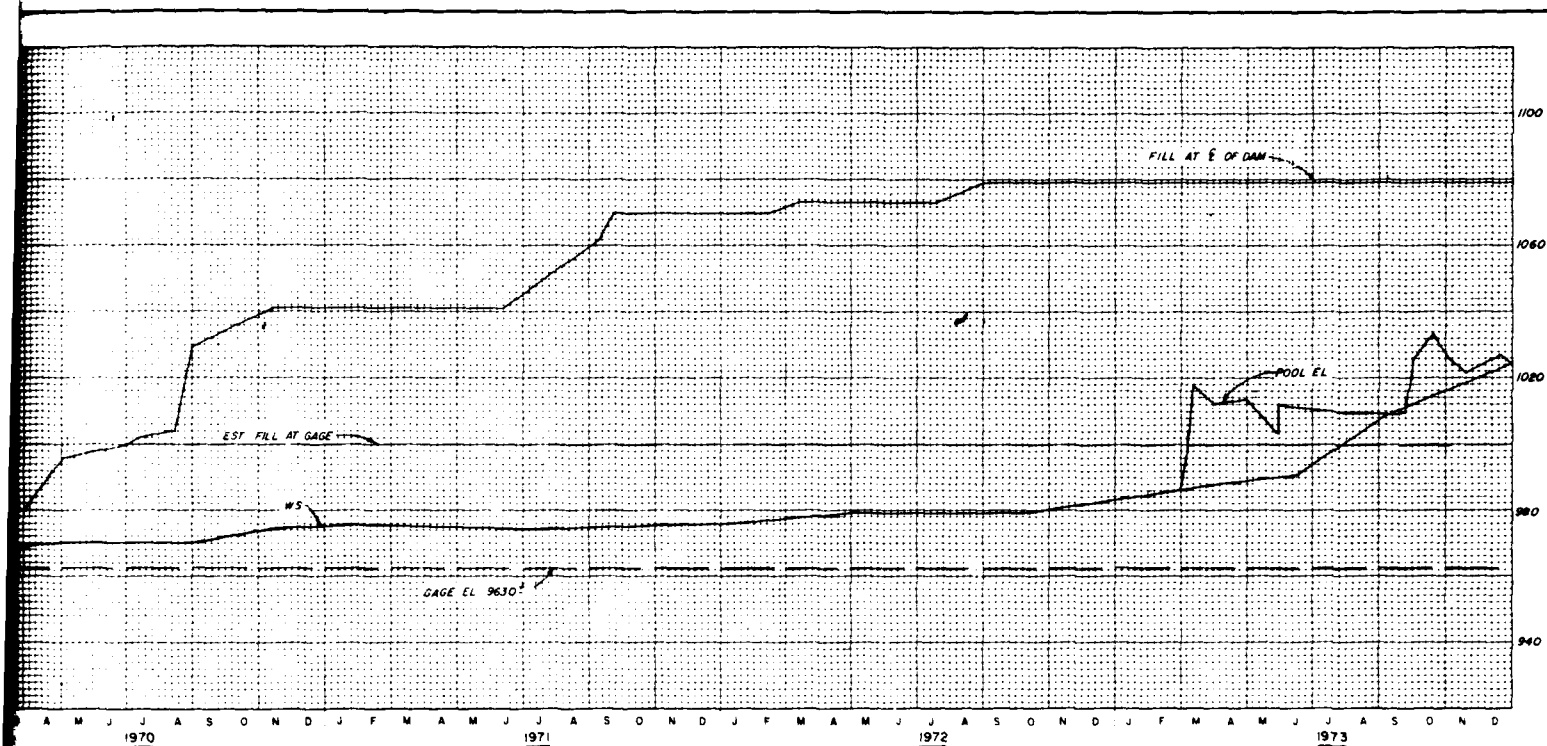
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KANSAS CITY DISTRICT

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MELVERN LAKE

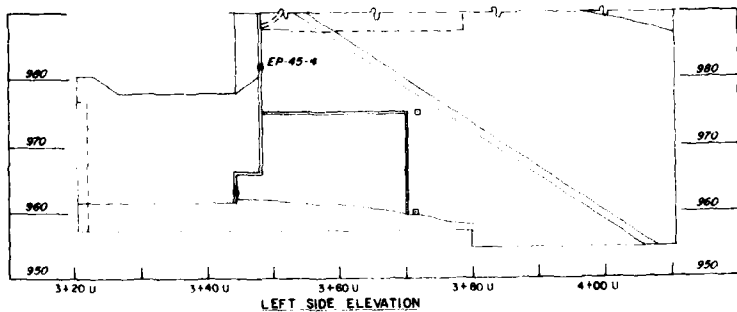
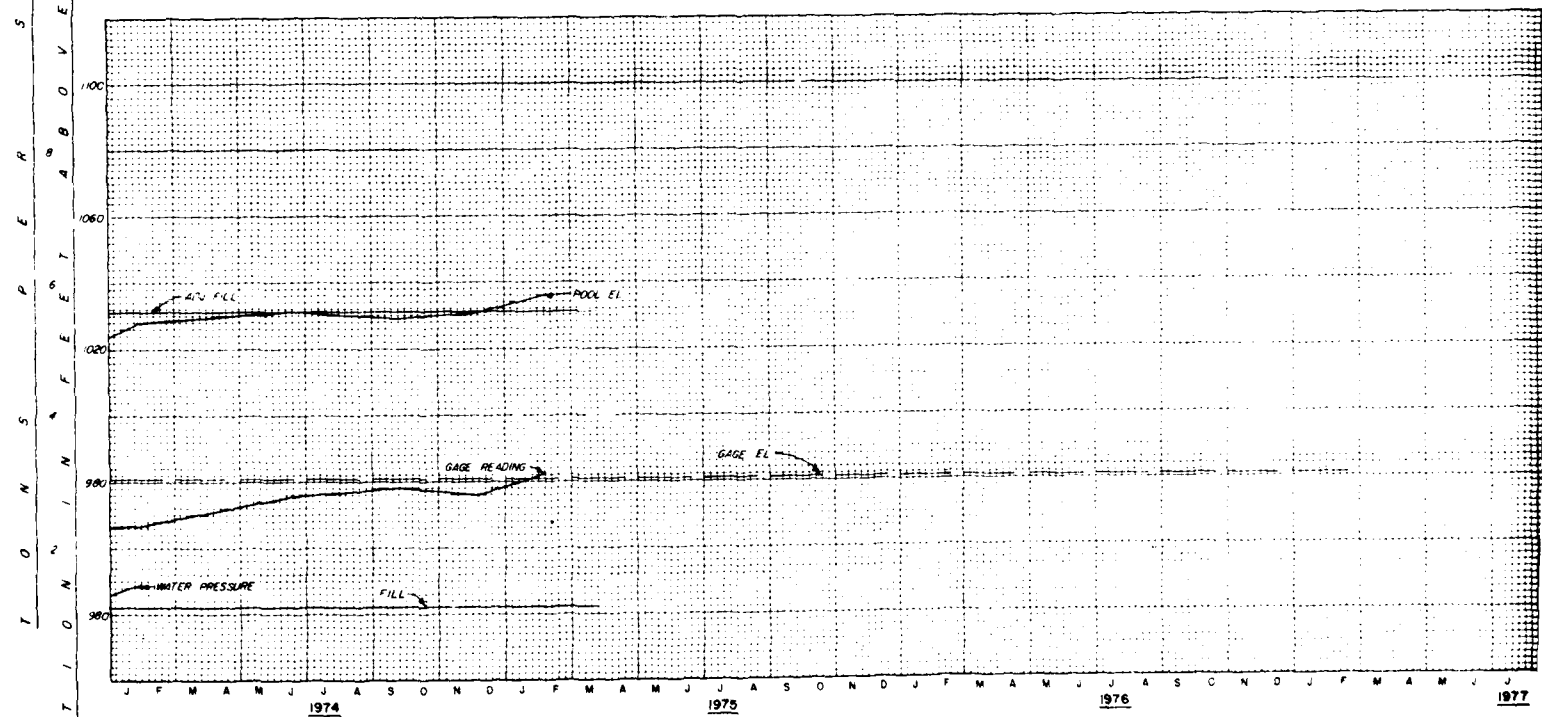
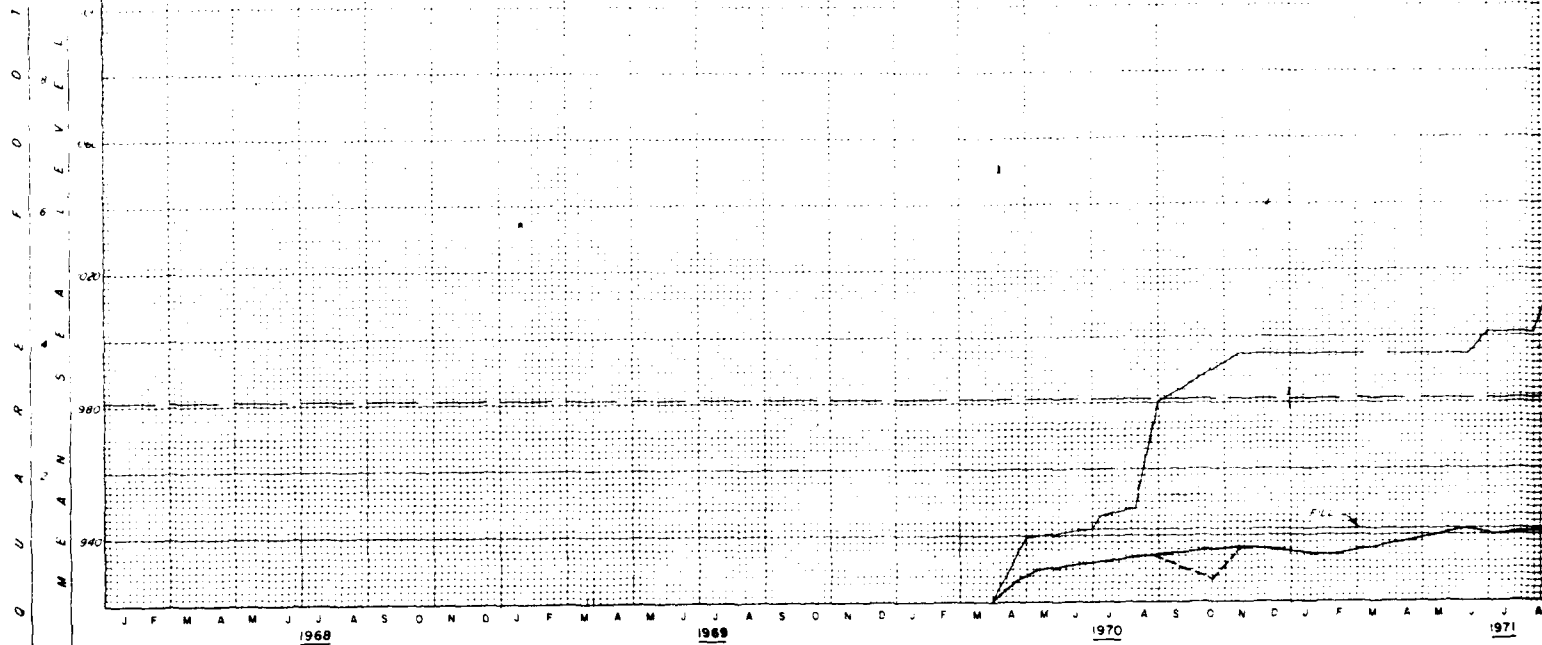
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PP-45-3A (SHANNON-WILSON CELL)

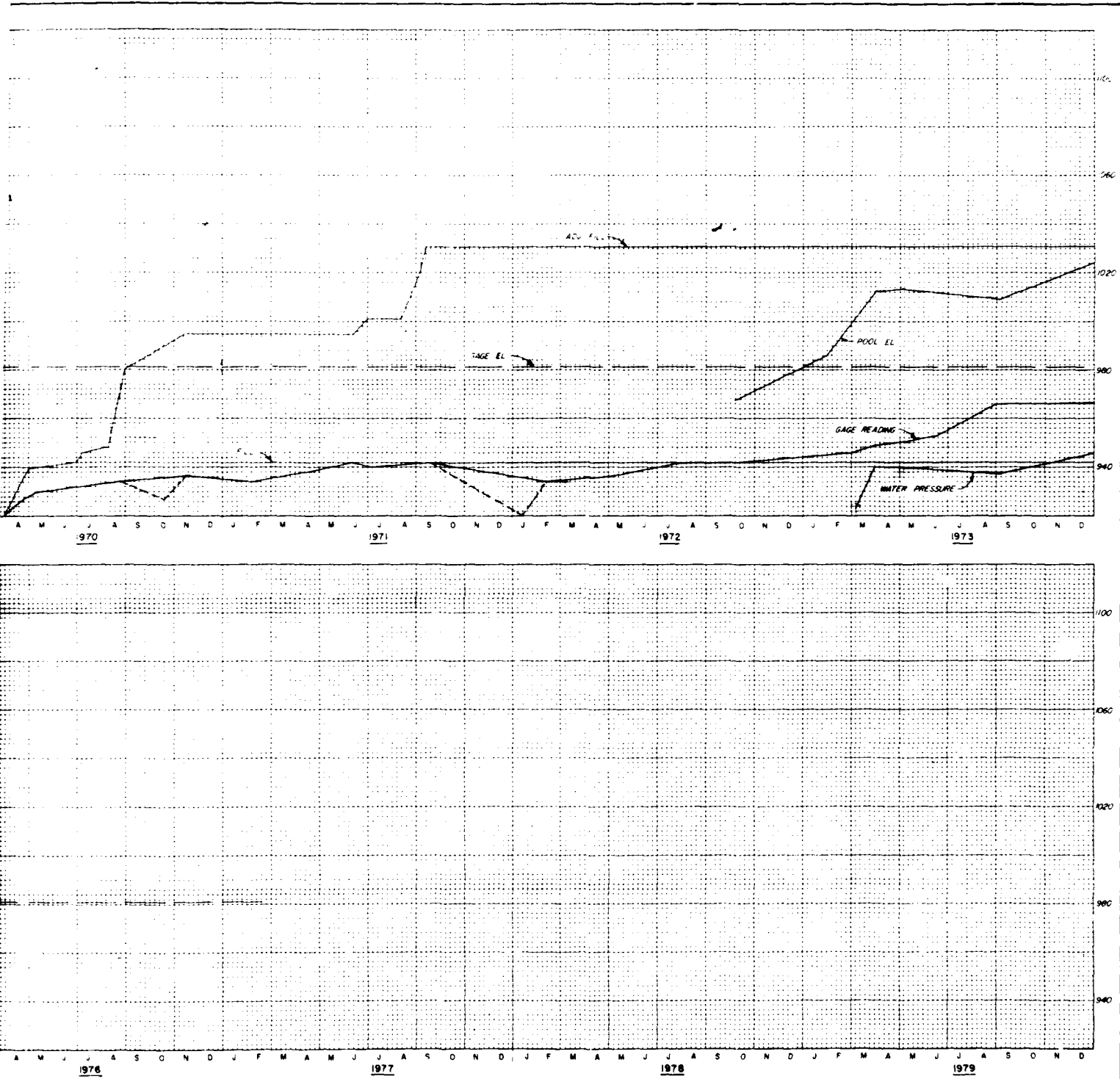
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KANSAS CITY DISTRICT

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AUGUST 1975

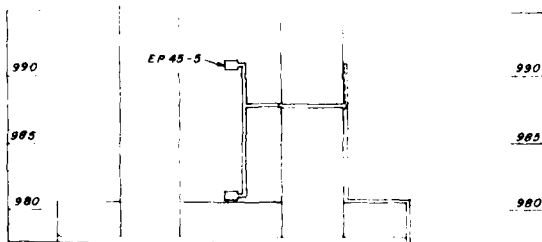
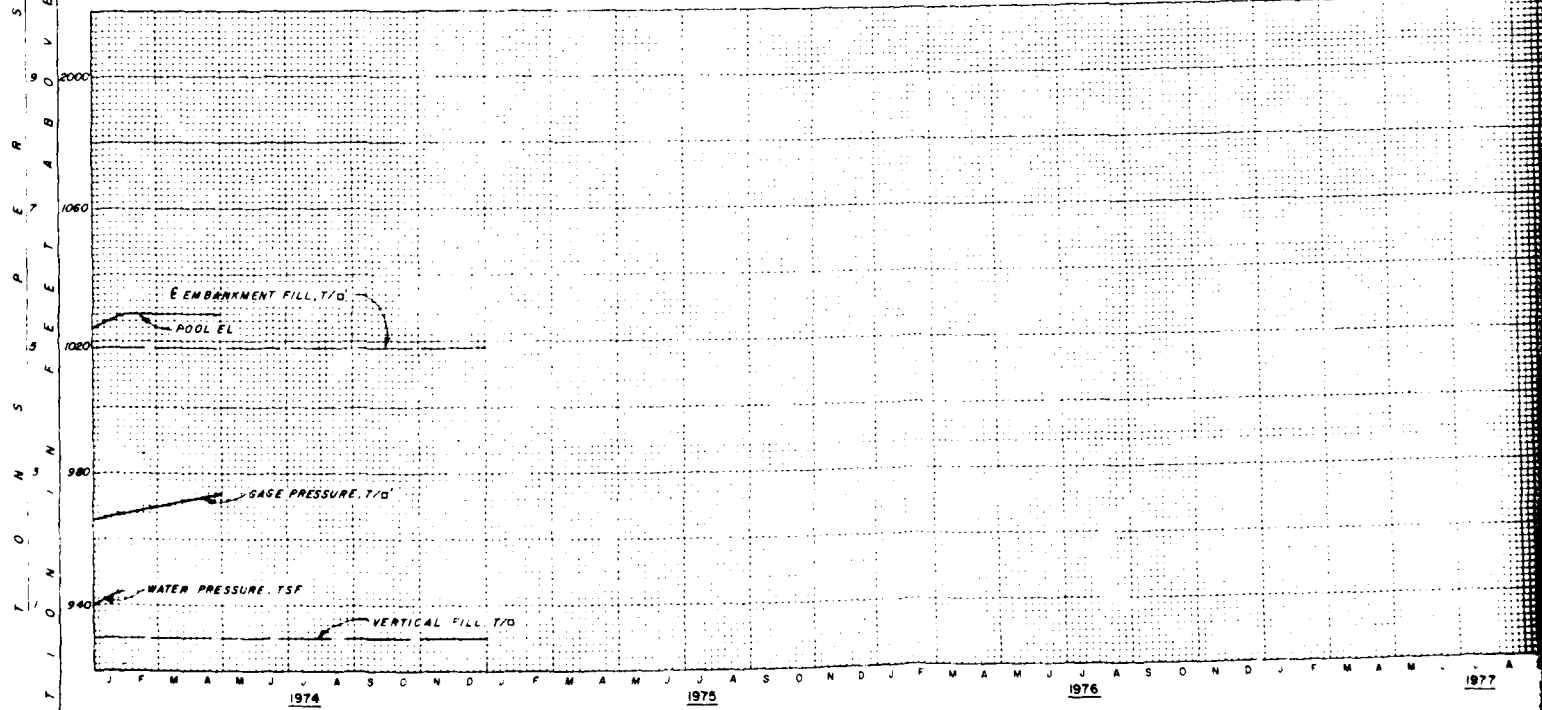
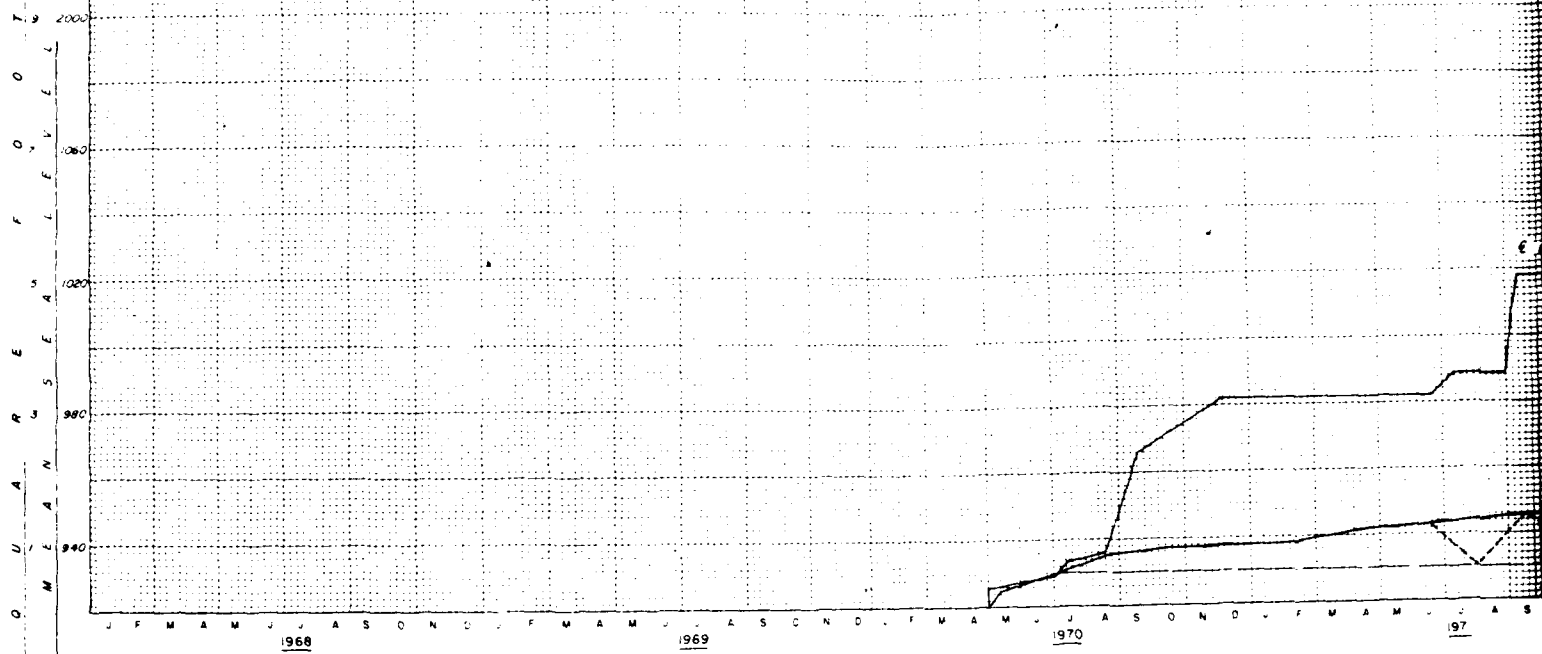




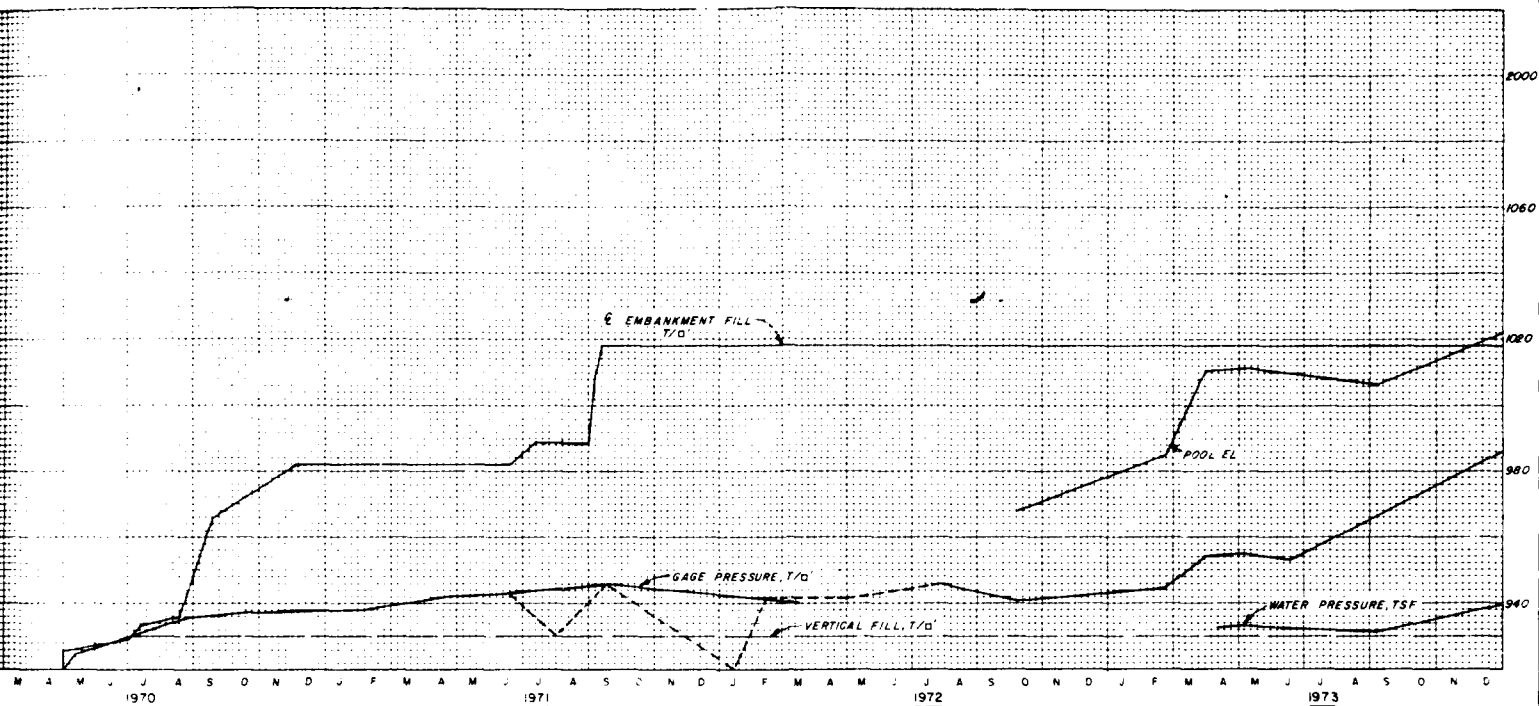
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MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
EP-45-4 (GLOETZL CELL)

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KANSAS CITY DISTRICT
FILE NO. O-5-1270
AUGUST 1975



DOWNSTREAM ELEVATION

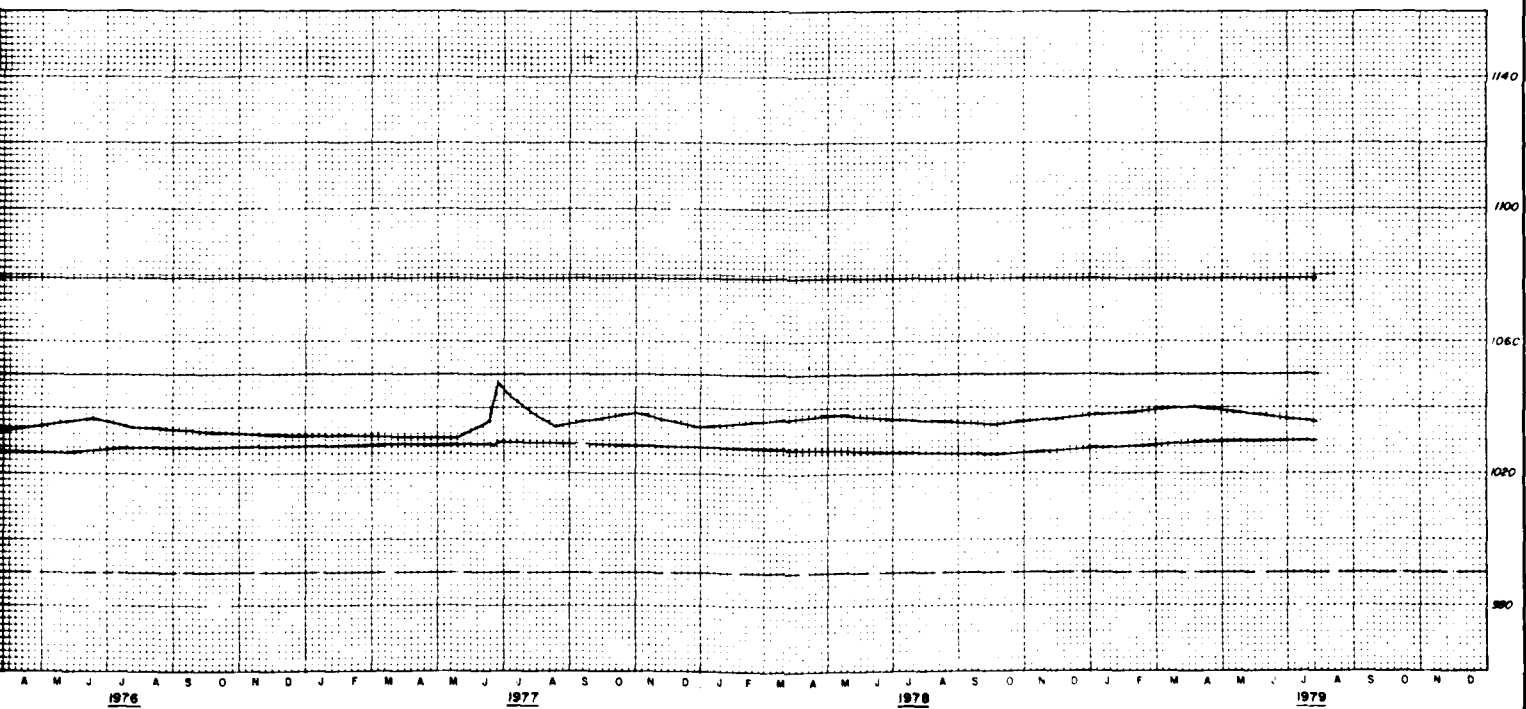
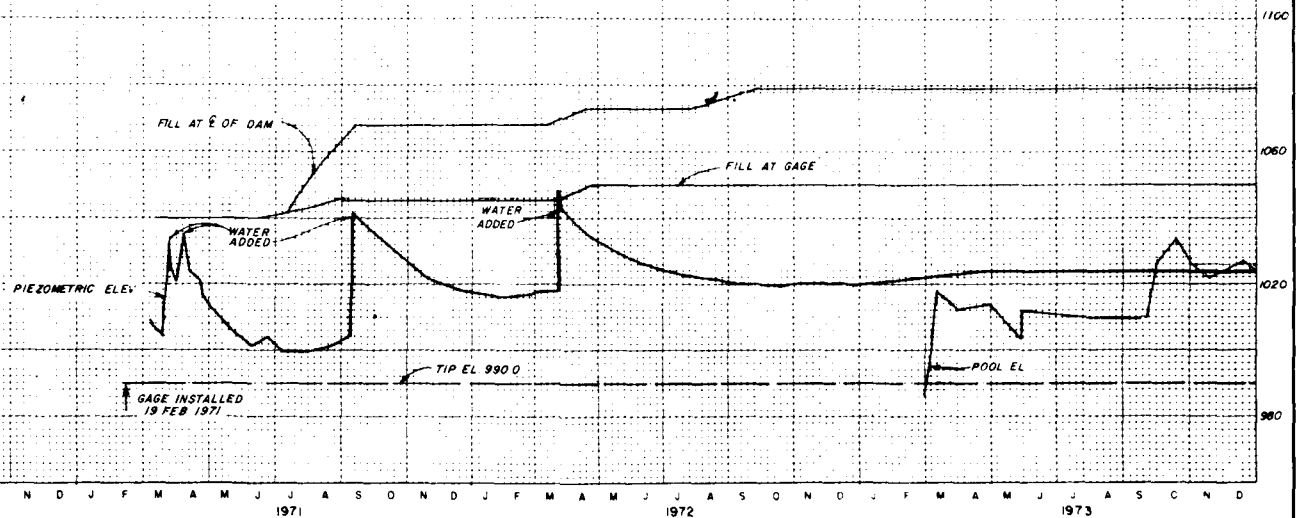


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MELVERN LAKE
INSTRUMENTATION PLOTS
EP 45-5 (GLOETZL CELL)

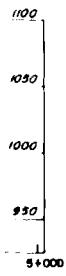
In 1 sheet

Sheet No. 1
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1271
AUGUST 1975

Scale as shown



DOWNSTREAM



LEGEND
 OPEN TUBE ○
 PNEUMATIC CELLS ●

Rev sea August 1979
 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

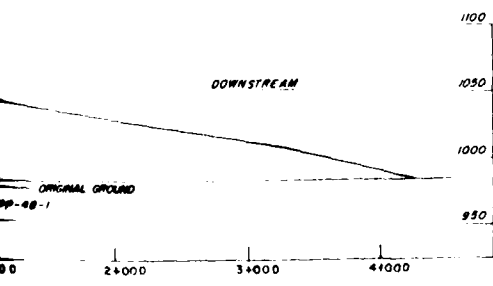
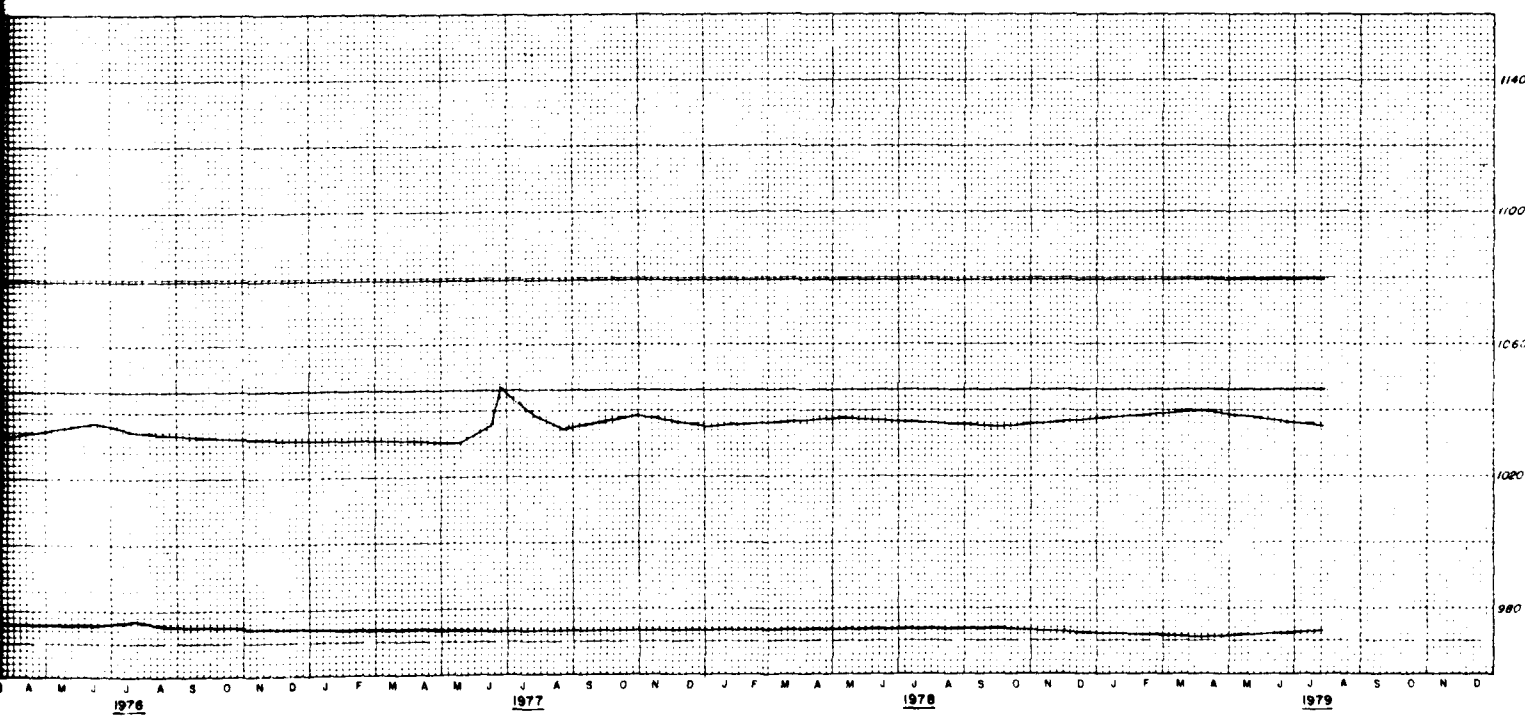
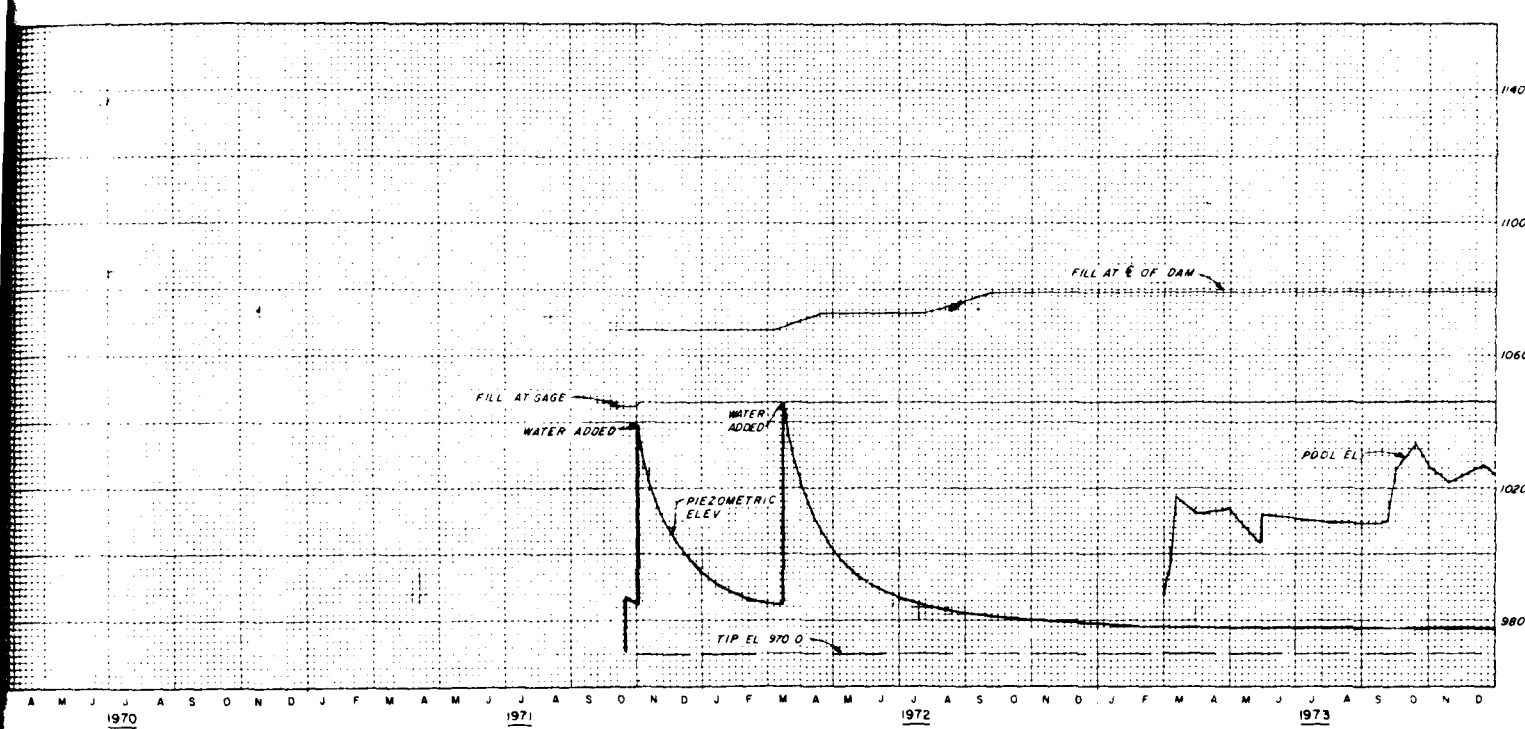
INSTRUMENTATION PLOTS
 PP-46-1 (OPEN TUBE)

In 1 sheet

Sheet No 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO 0-5-1272
 AUGUST 1975



LEGEND
 OPEN TUBE ○
 PNEUMATIC CELL ●

Revised August 1979
 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-48-1 (OPEN TUBE)

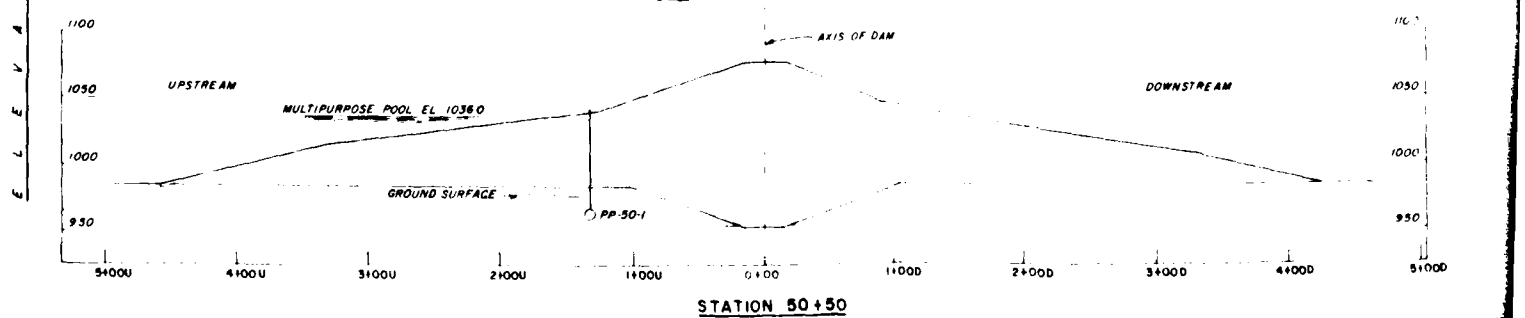
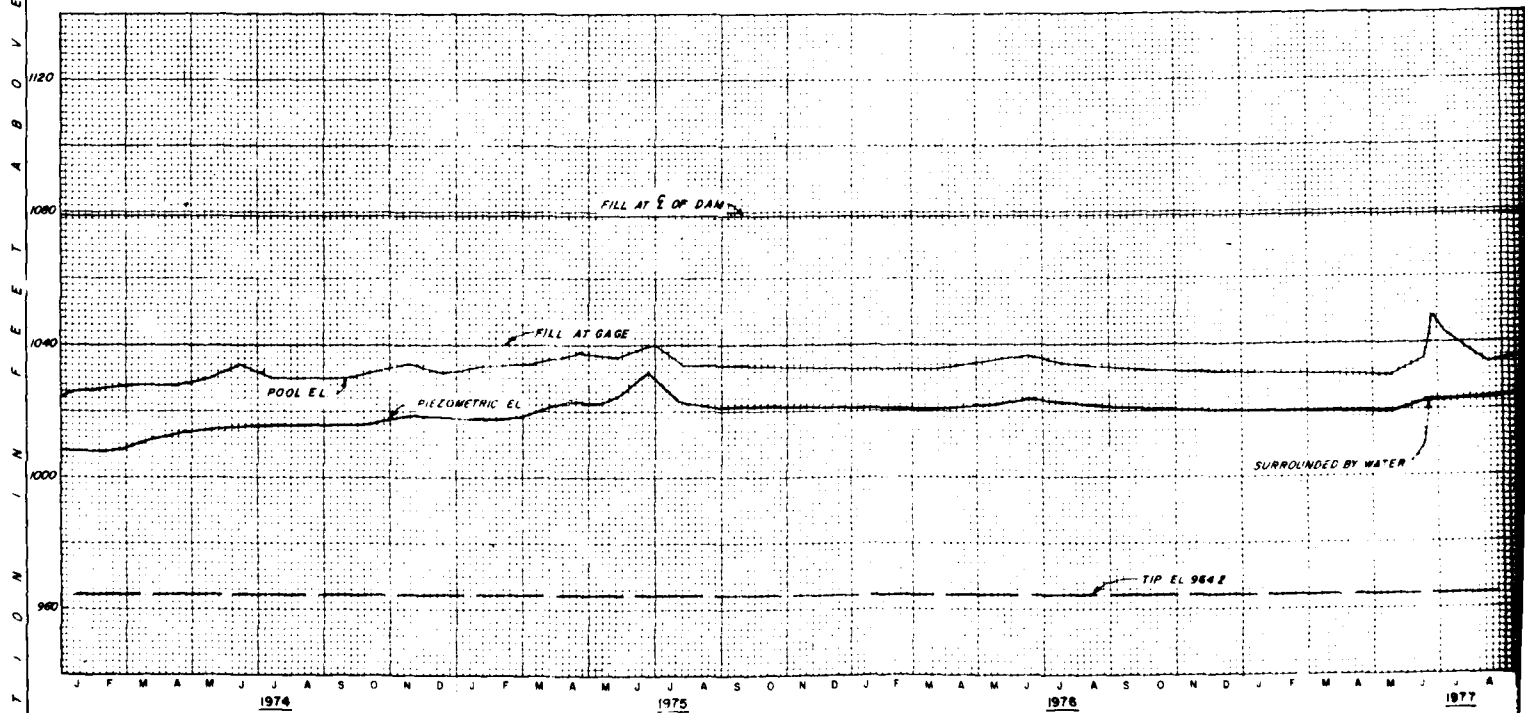
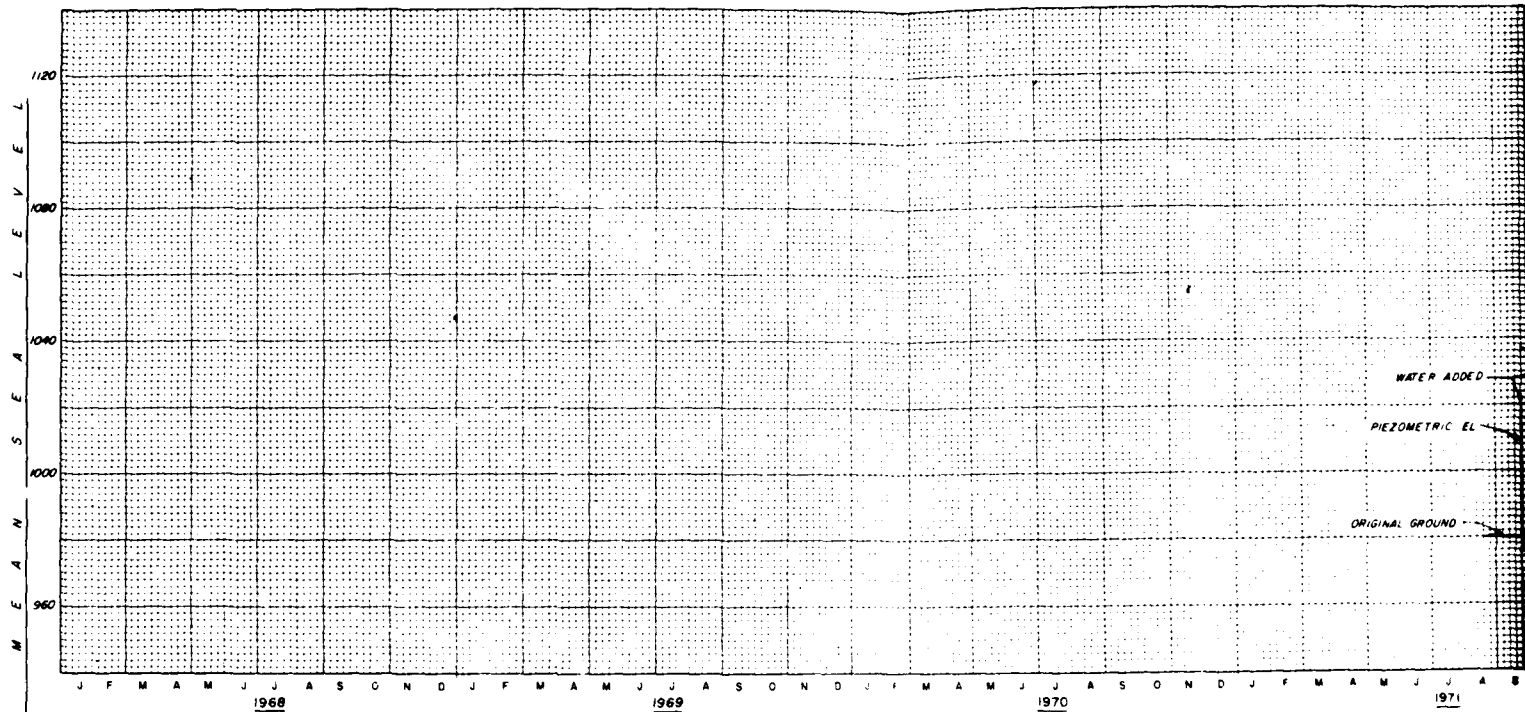
In 1 sheet

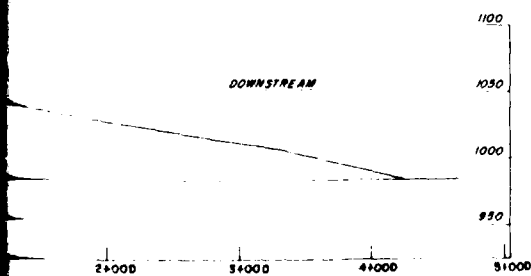
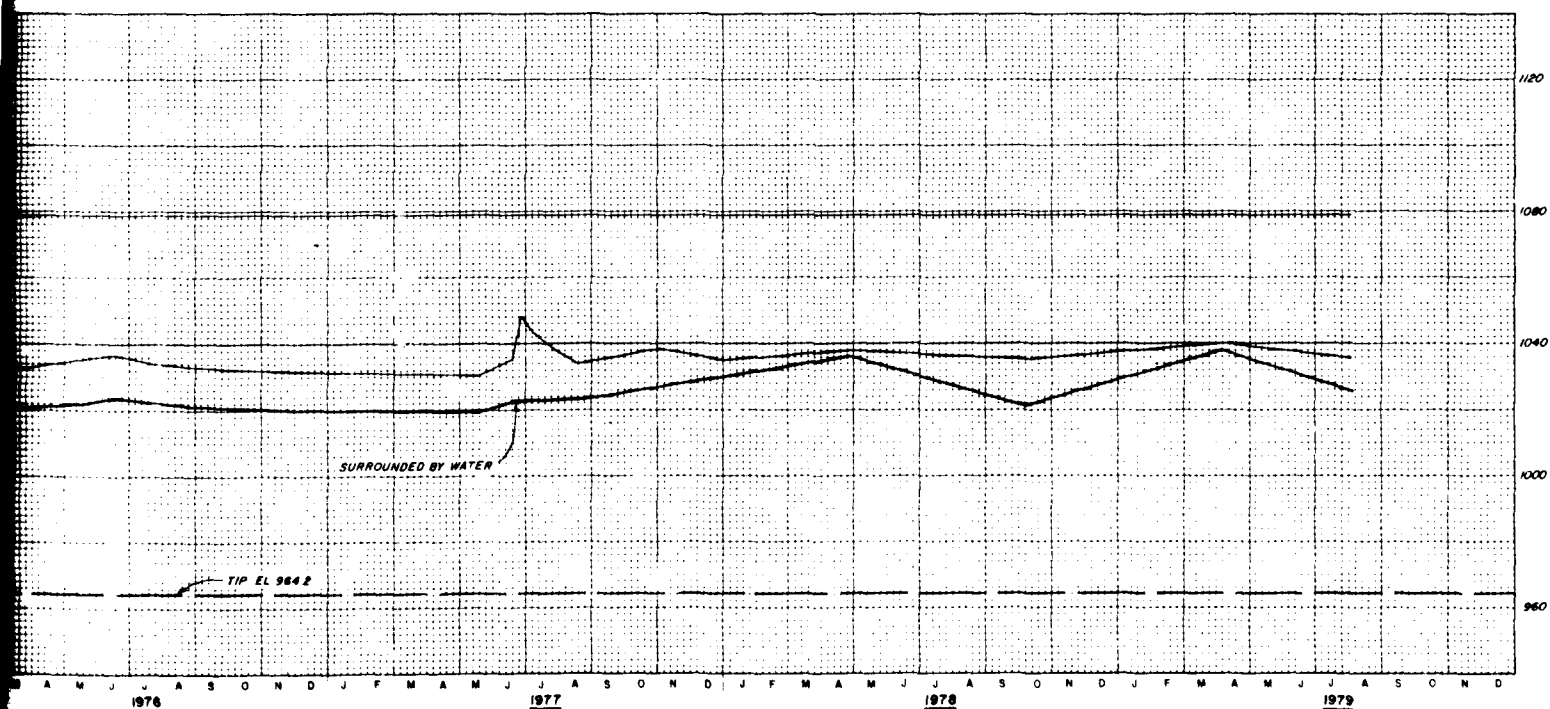
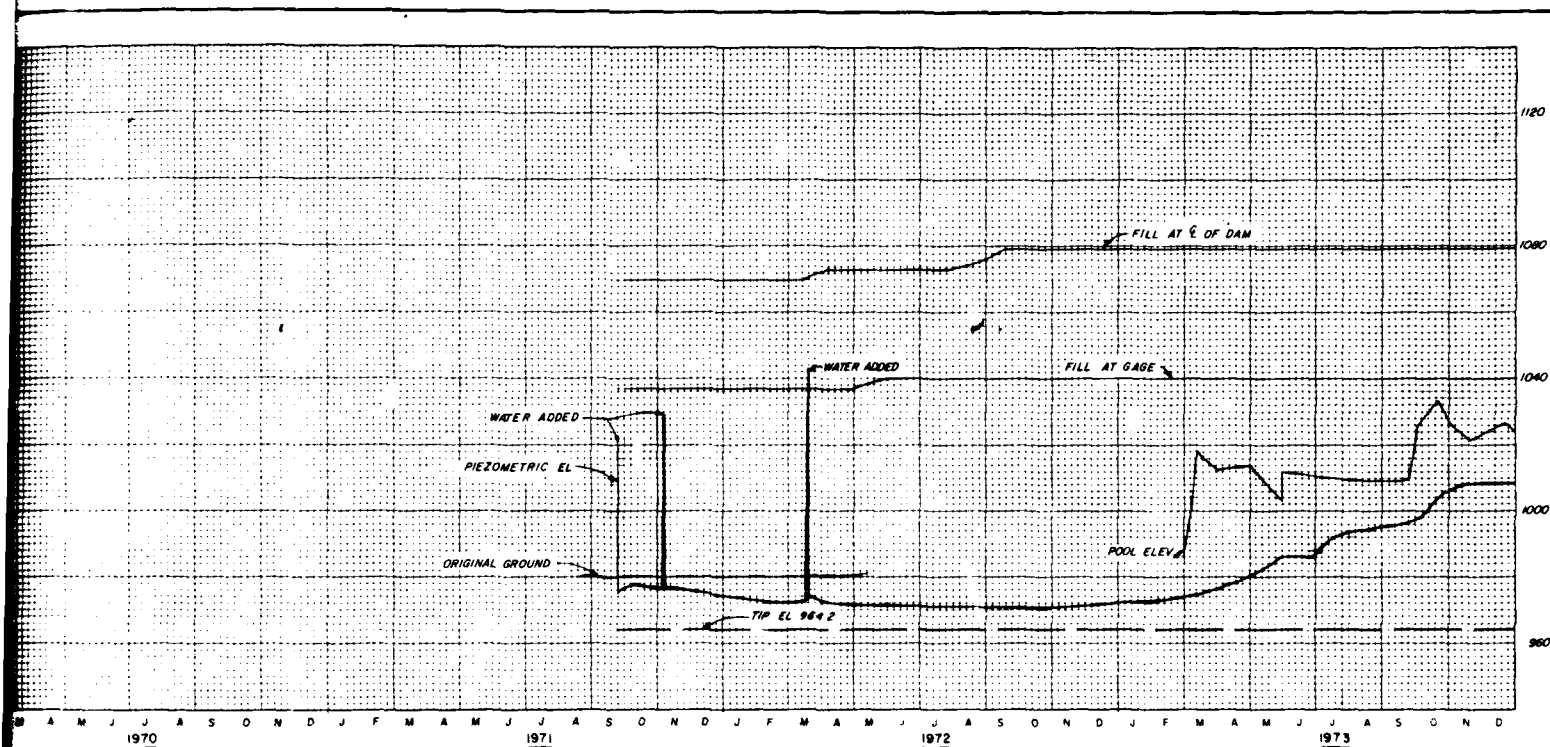
Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT

FILE NO. O-5-1273
 AUGUST 1975





LEGEND
 OPEN TUBE ○
 PNEUMATIC CELLS ●

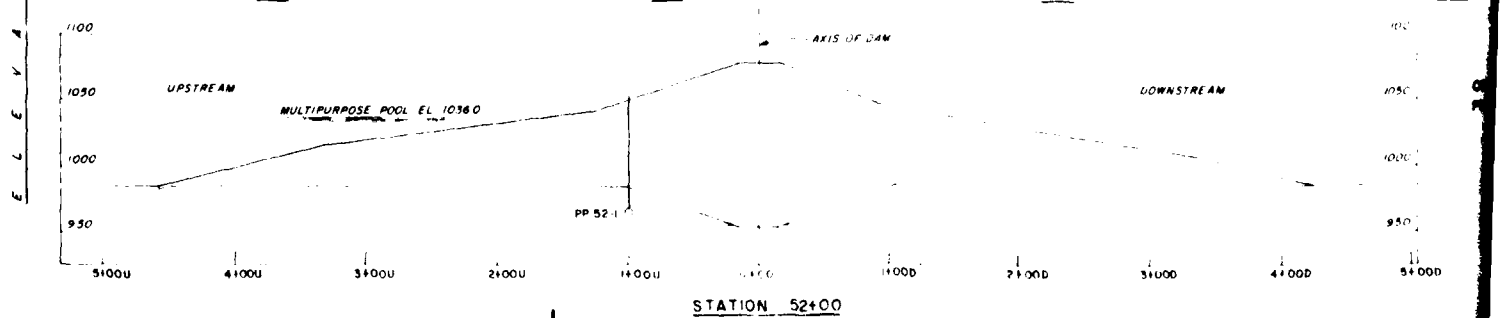
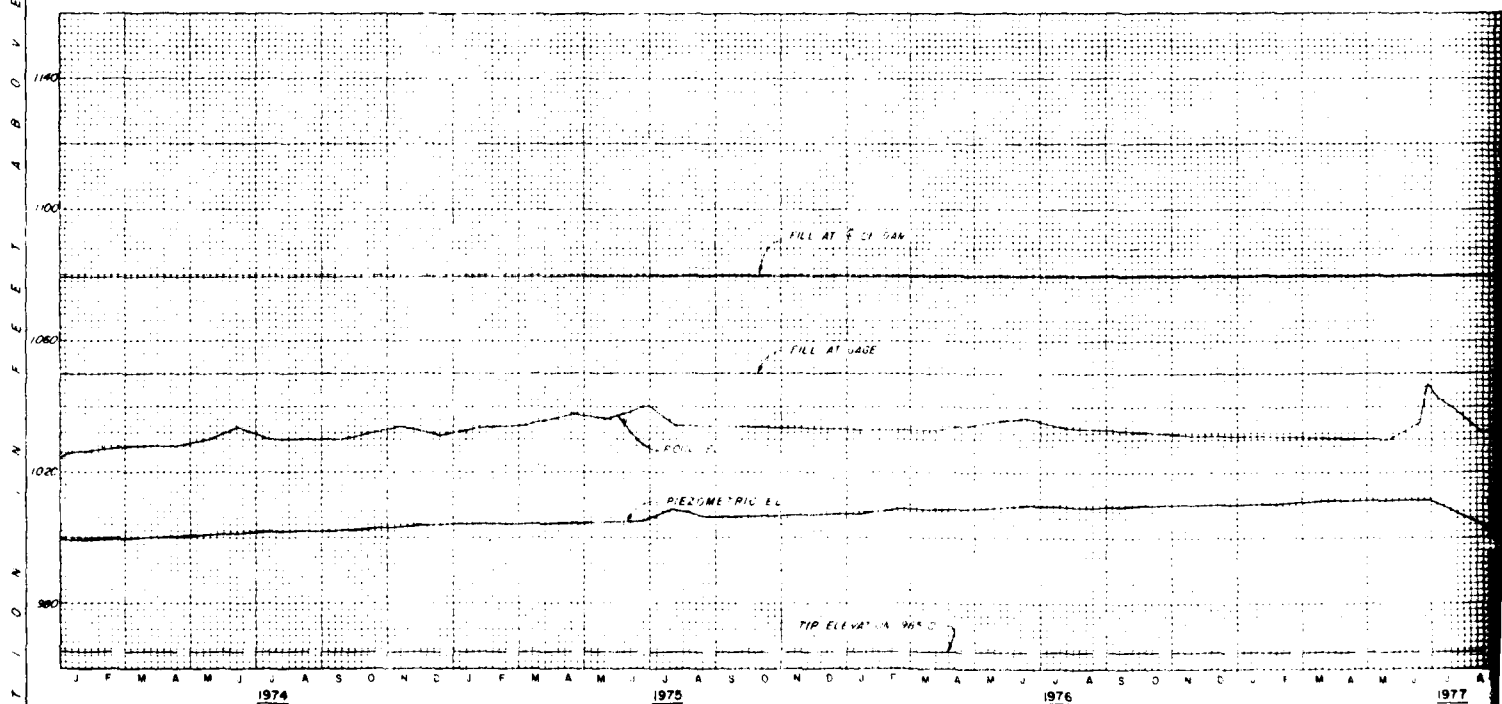
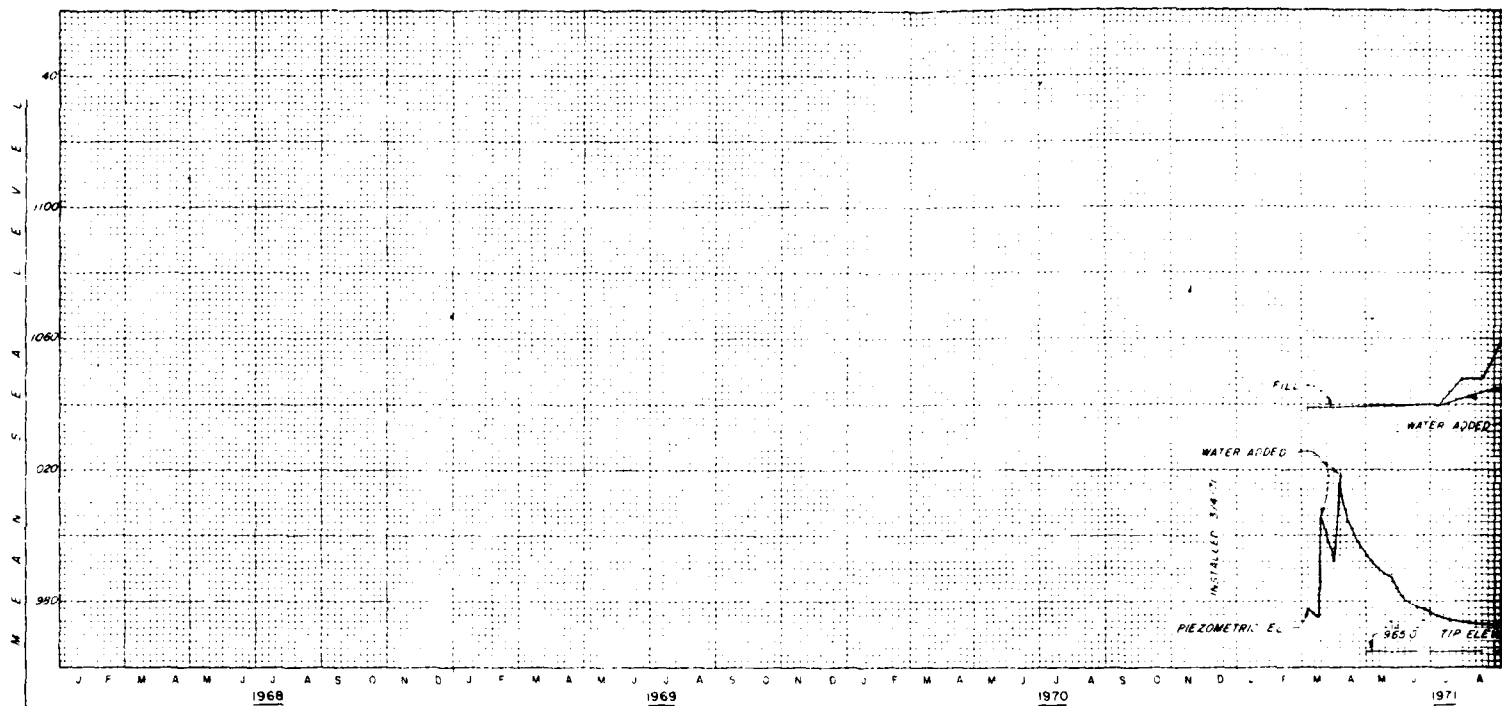
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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

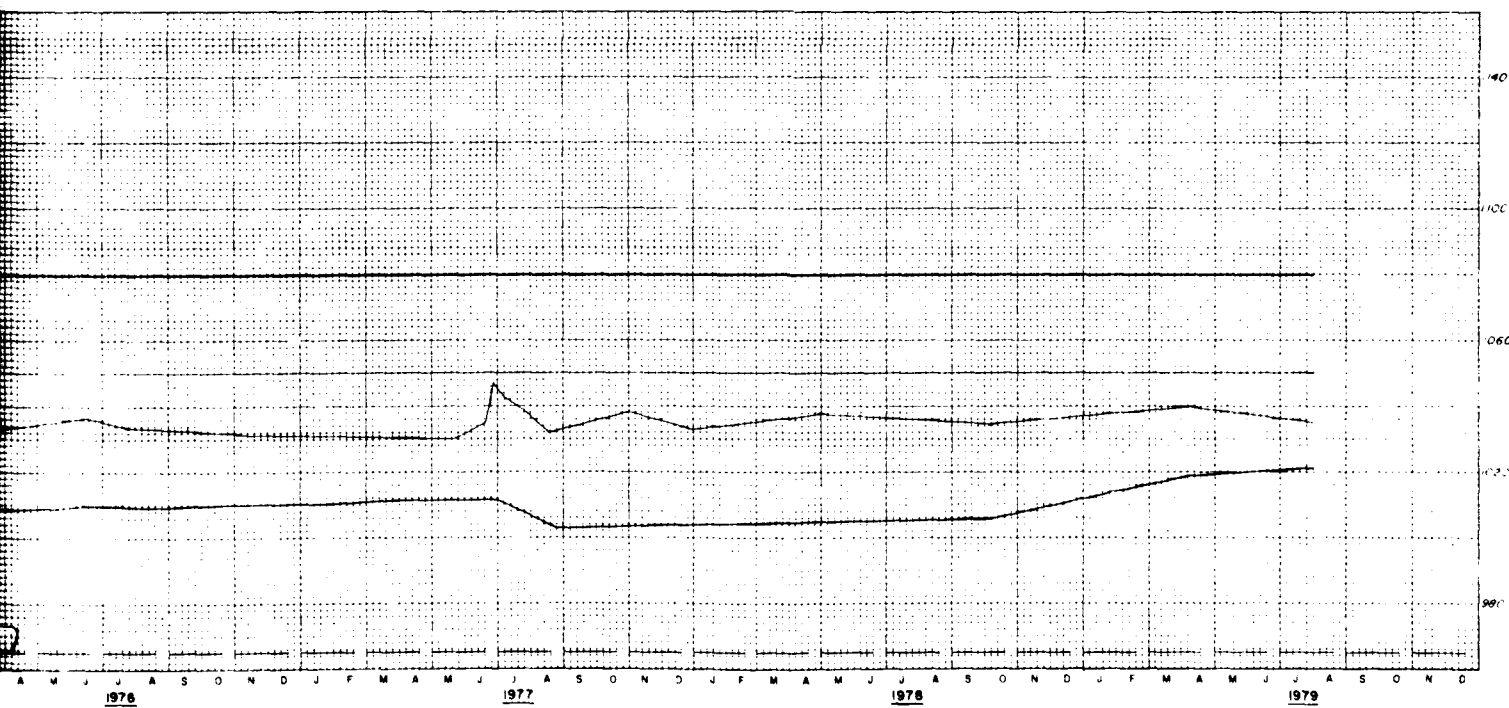
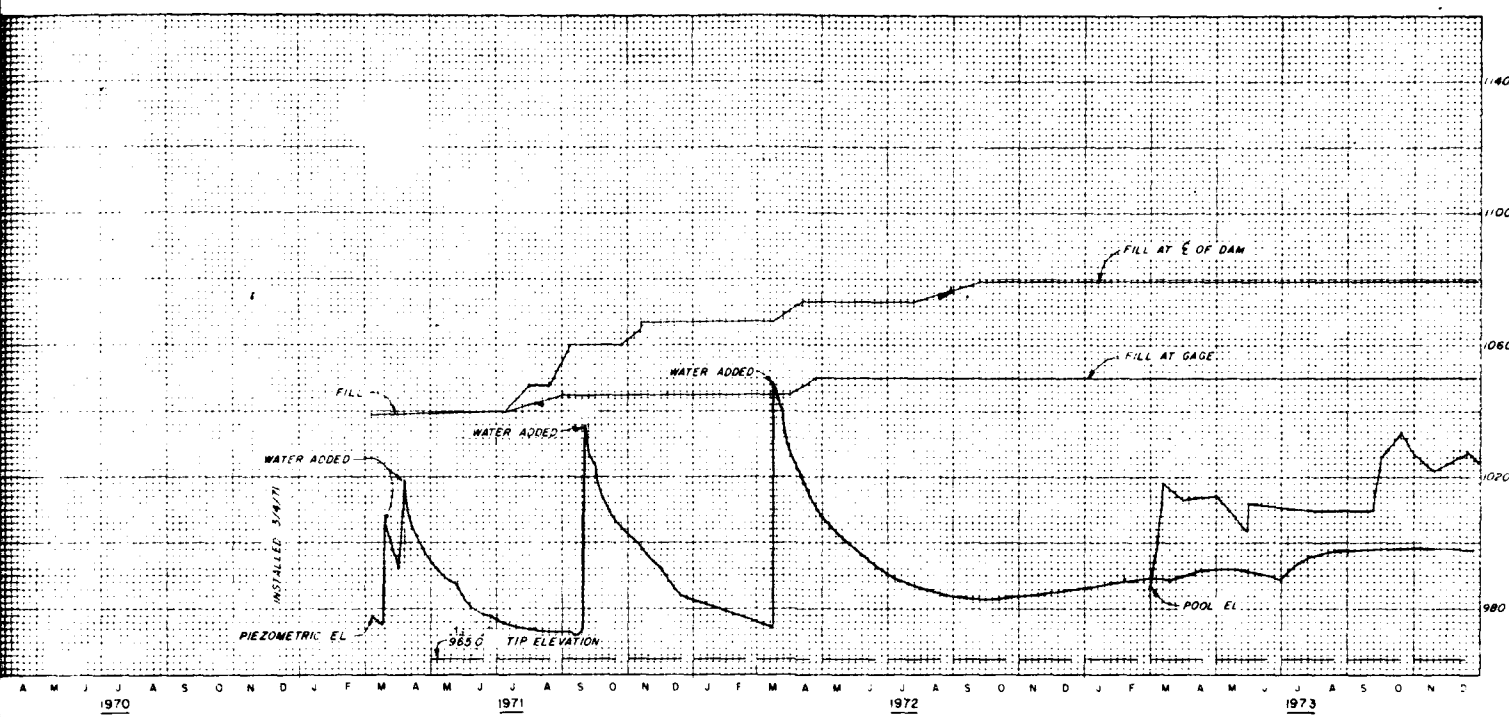
INSTRUMENTATION PLOTS
 PP-50-1 (OPEN TUBE)

In 1 sheet

Sheet No. 1
 CORPS OF ENGINEERS, U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1274
 AUGUST 1975

Scale as shown





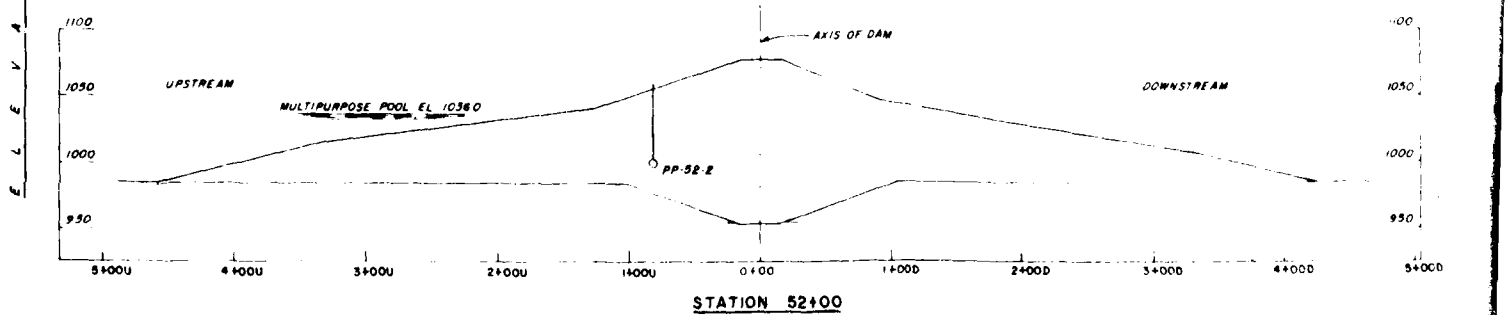
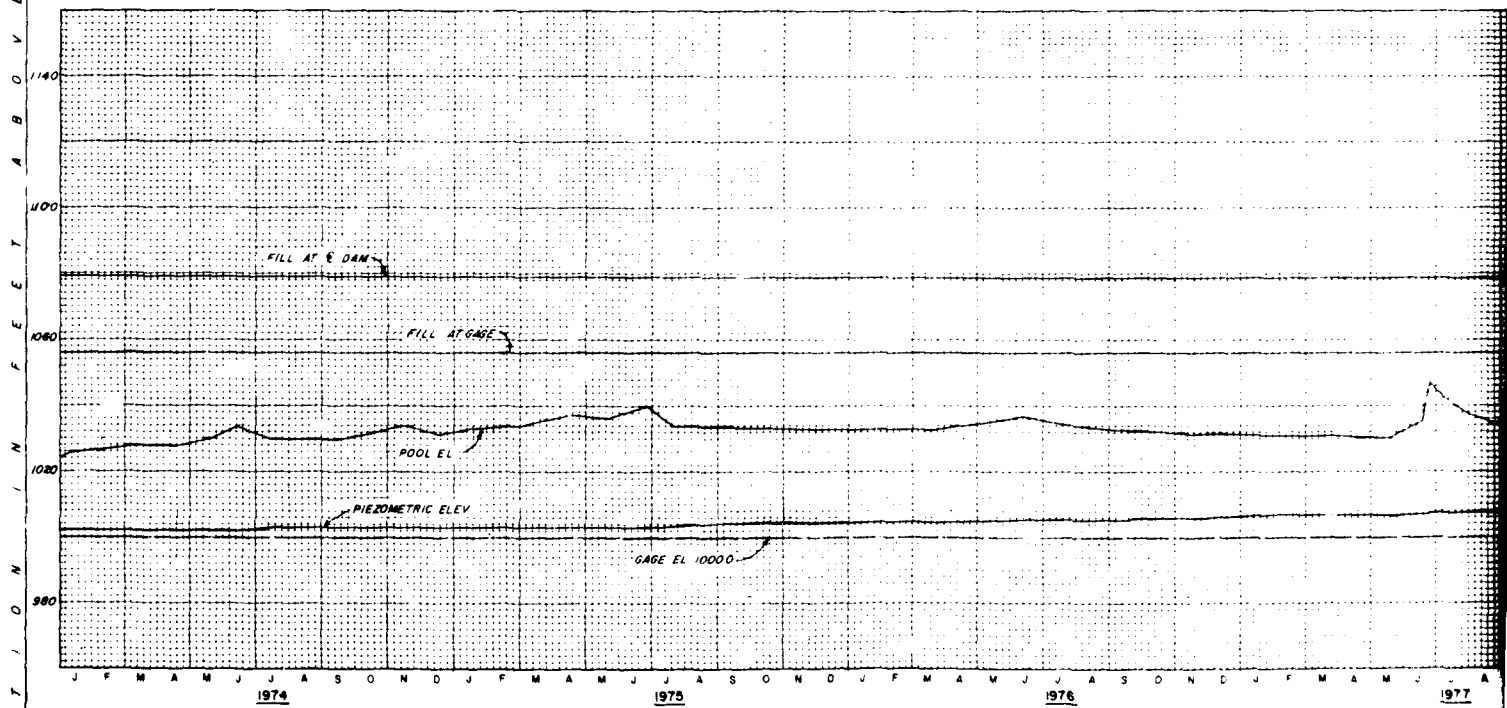
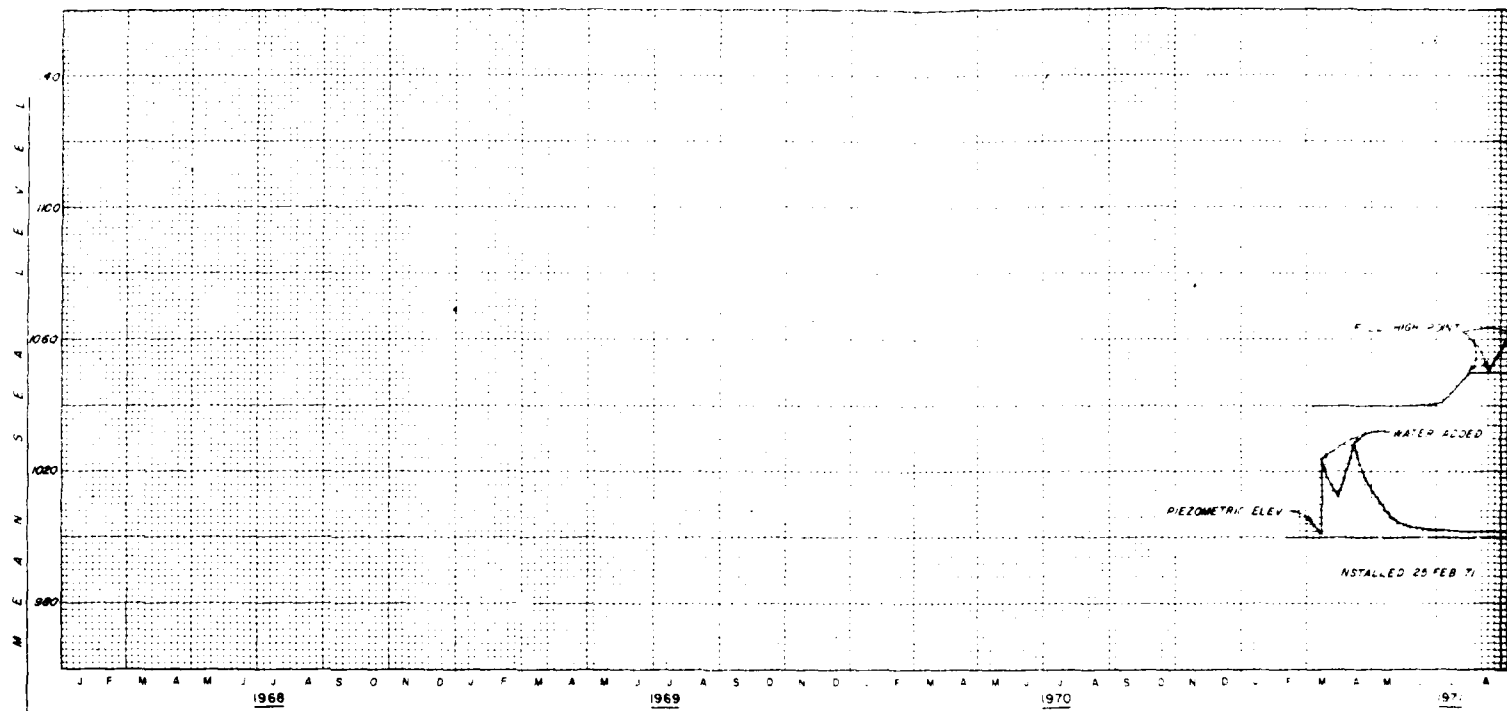
LEGEND
 OPEN TUBE ○
 PNEUMATIC CELL ●

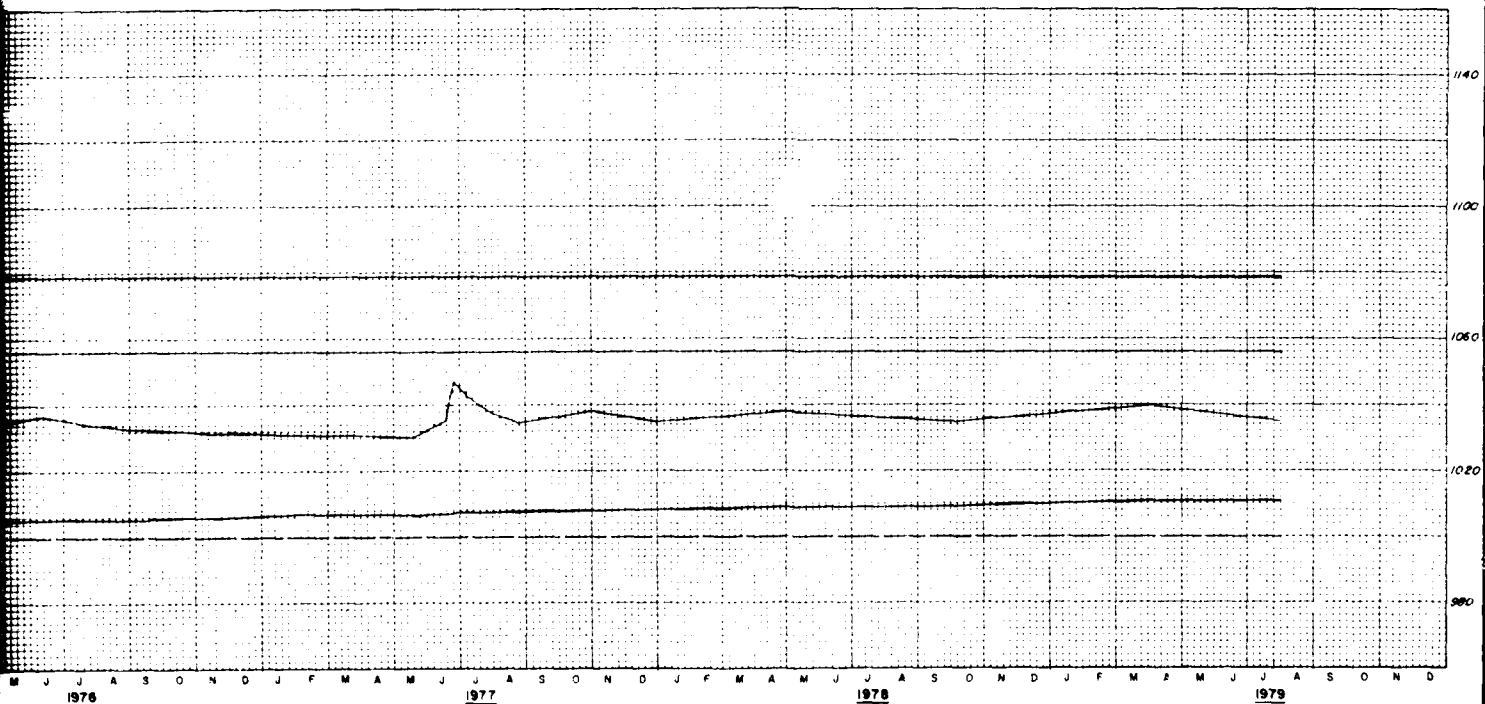
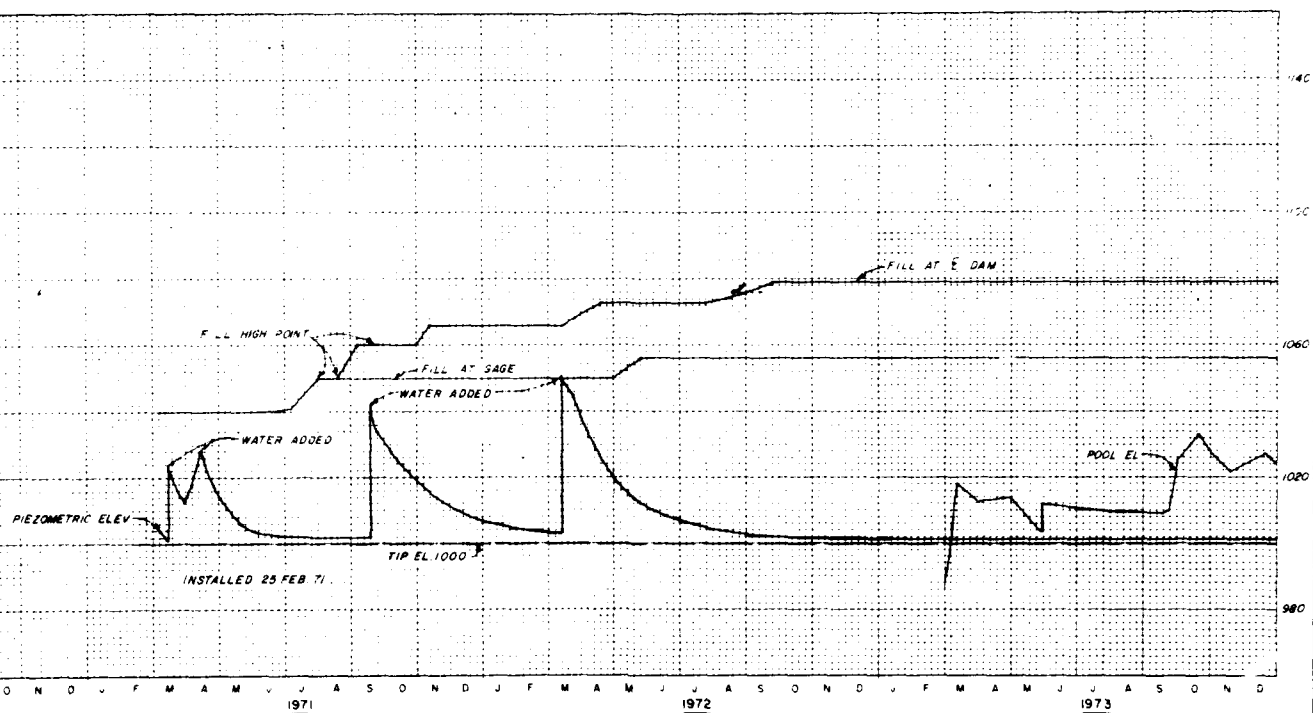
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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-52-1 (OPEN TUBE)

In 1 sheet Sheet No. 1 Scale as shown

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 KANSAS CITY DISTRICT
 FILE NO. 0-5-1275
 AUGUST 1975





DOWNSTREAM



LEGEND

- OPEN TUBE ———— ○
- PNEUMATIC CELL ———— ●

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MELVERN LAKE

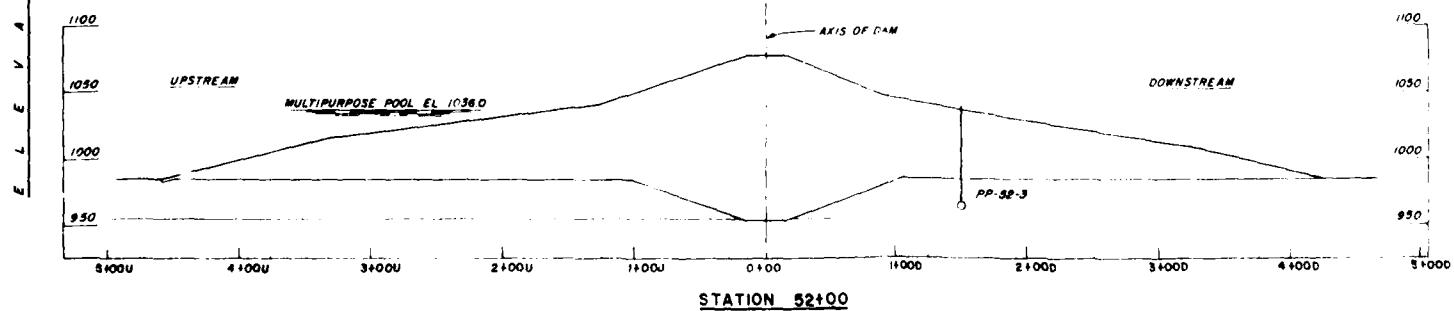
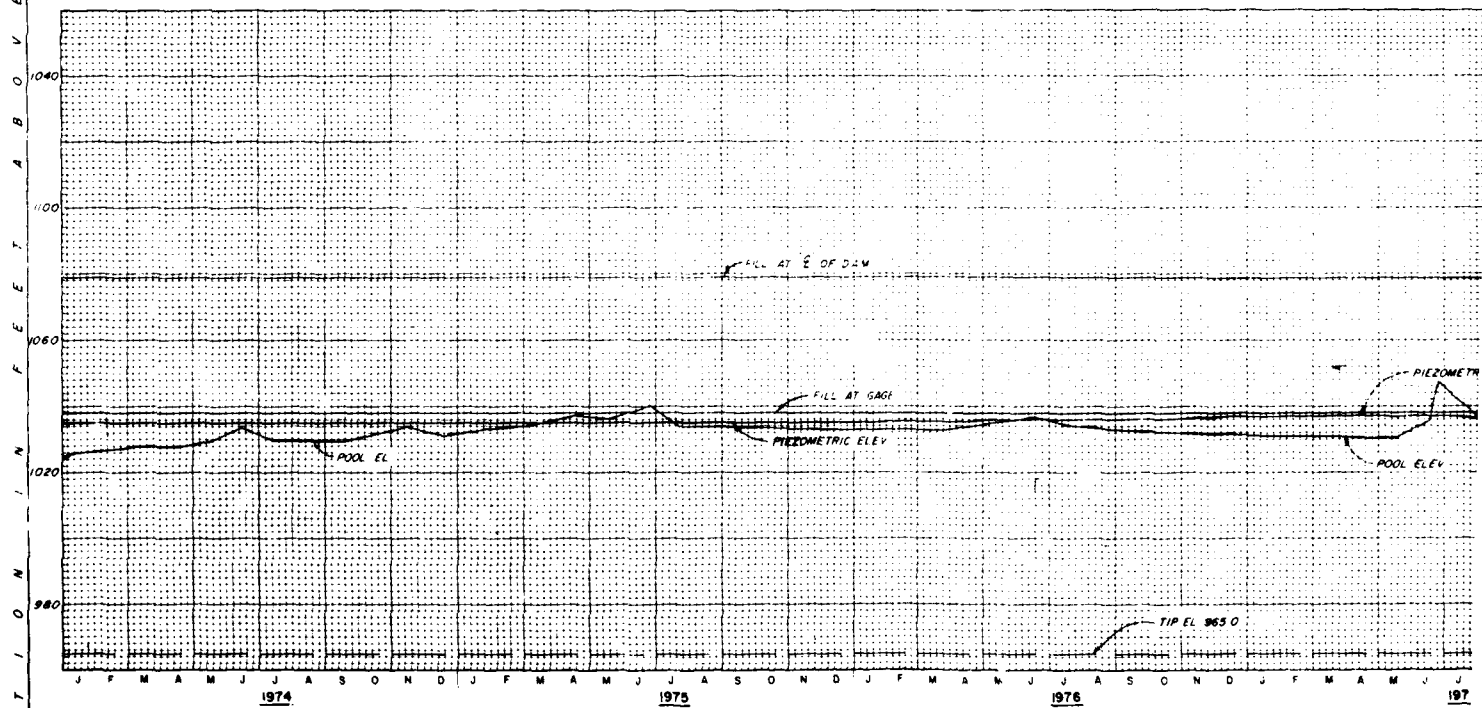
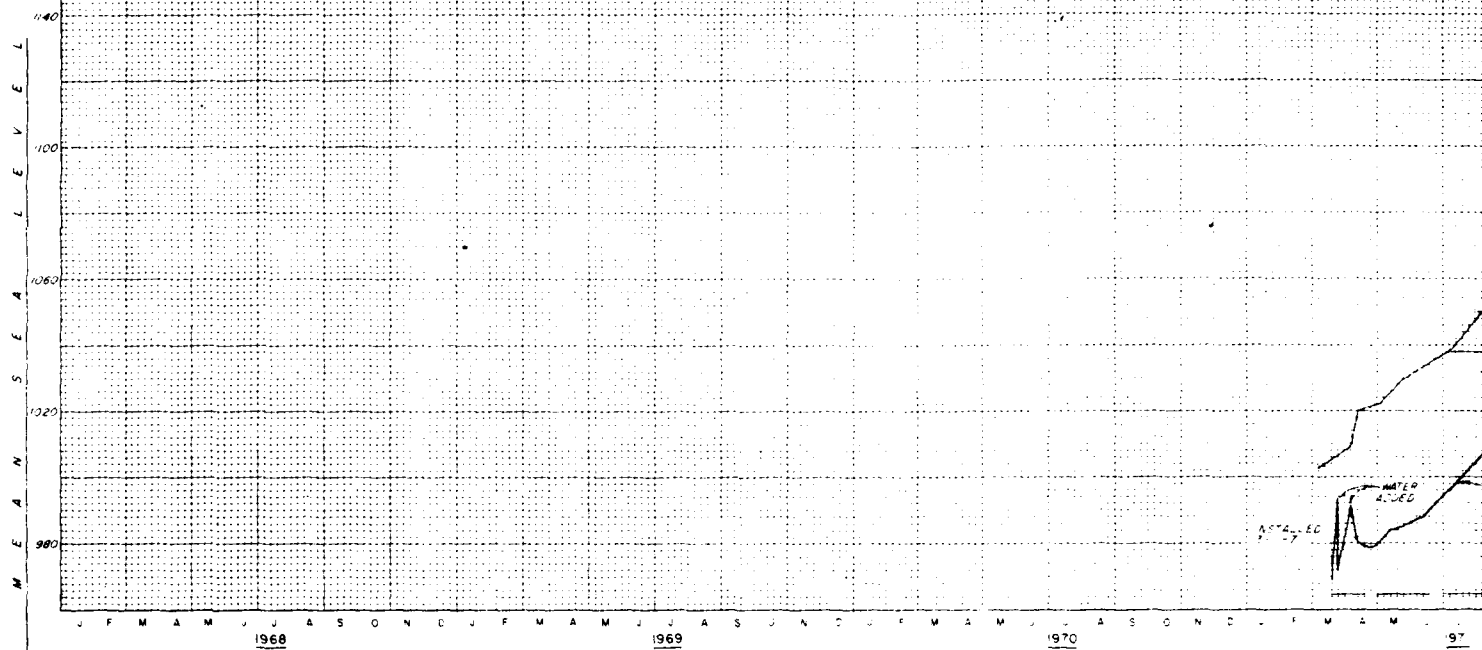
INSTRUMENTATION PLOTS
PP-52-2 (OPEN TUBE)

In 1 sheet

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CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

Scale as shown

FILE NO. 0-5-1276
AUGUST 1975



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CORPS OF ENGINEERS KANSAS CITY MO KANSAS CITY DISTRICT
OPERATION AND MAINTENANCE MANUAL, MELVERN LAKE, MARAIS DES CYGN--ETC(U)
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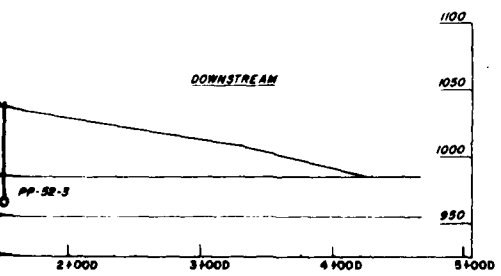
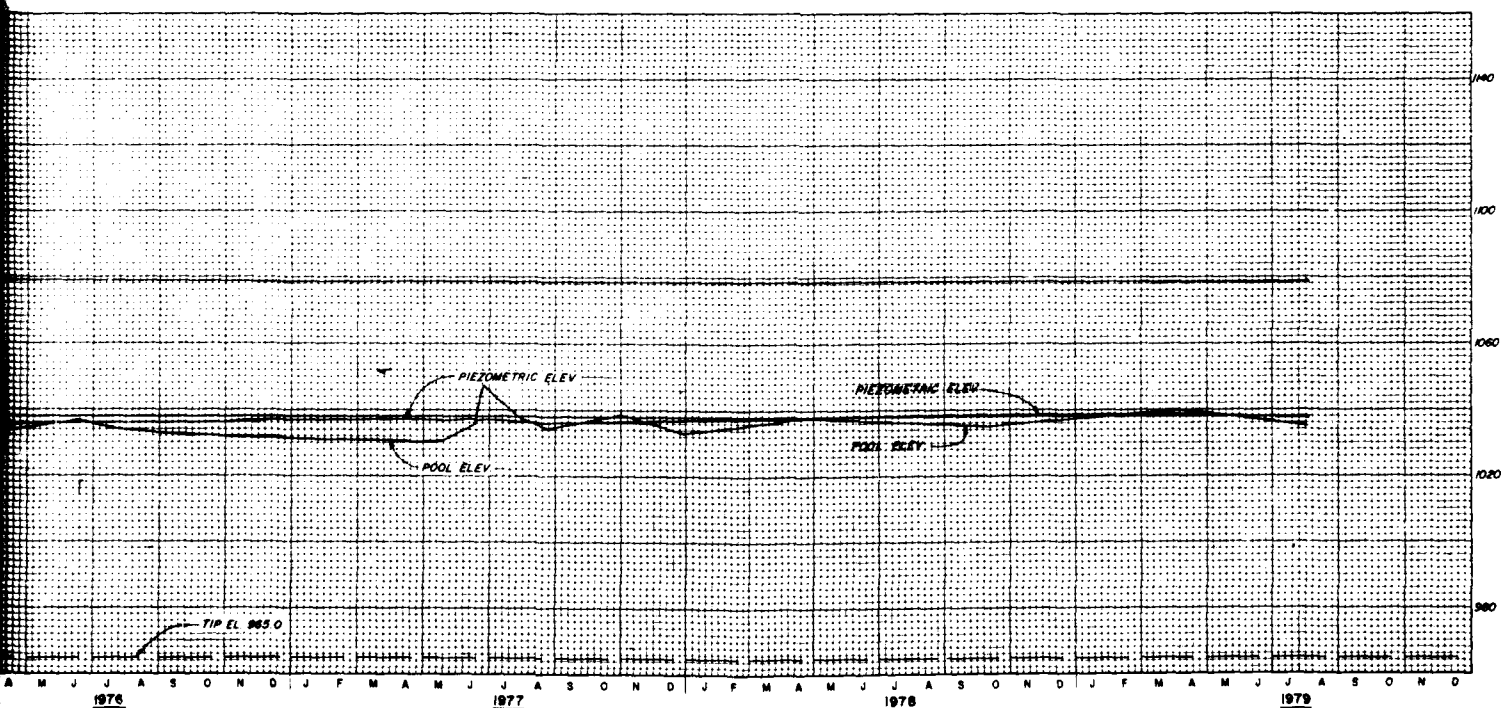
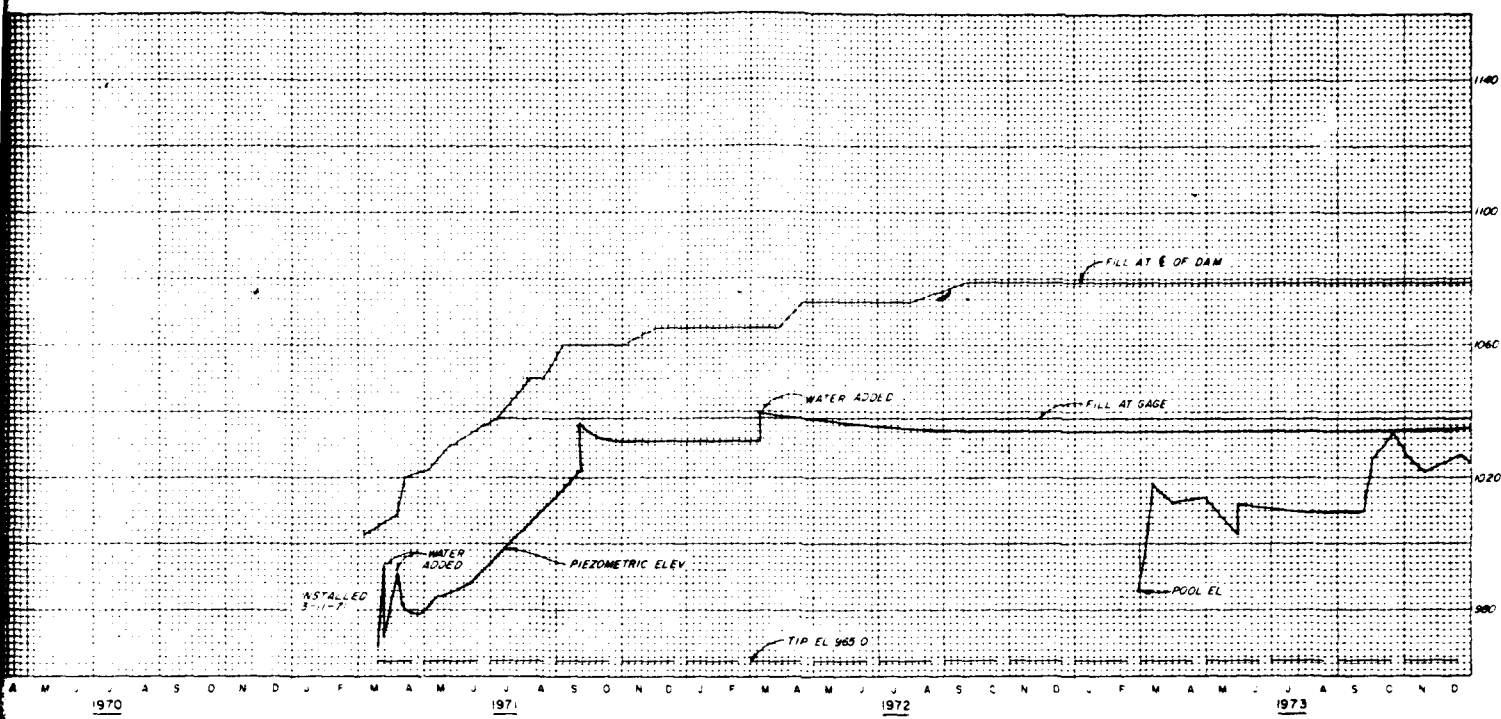
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LEGEND
 OPEN TUBE ——— ○
 PNEUMATIC CELL ——— ●

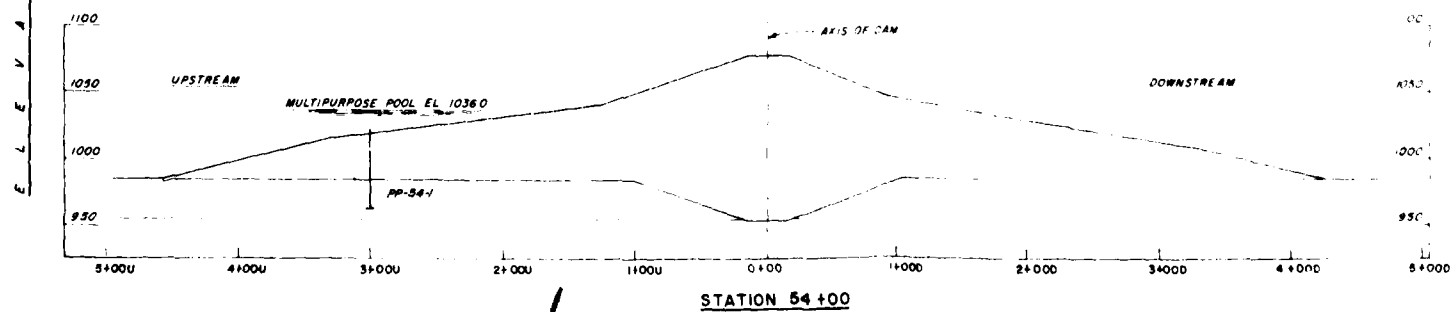
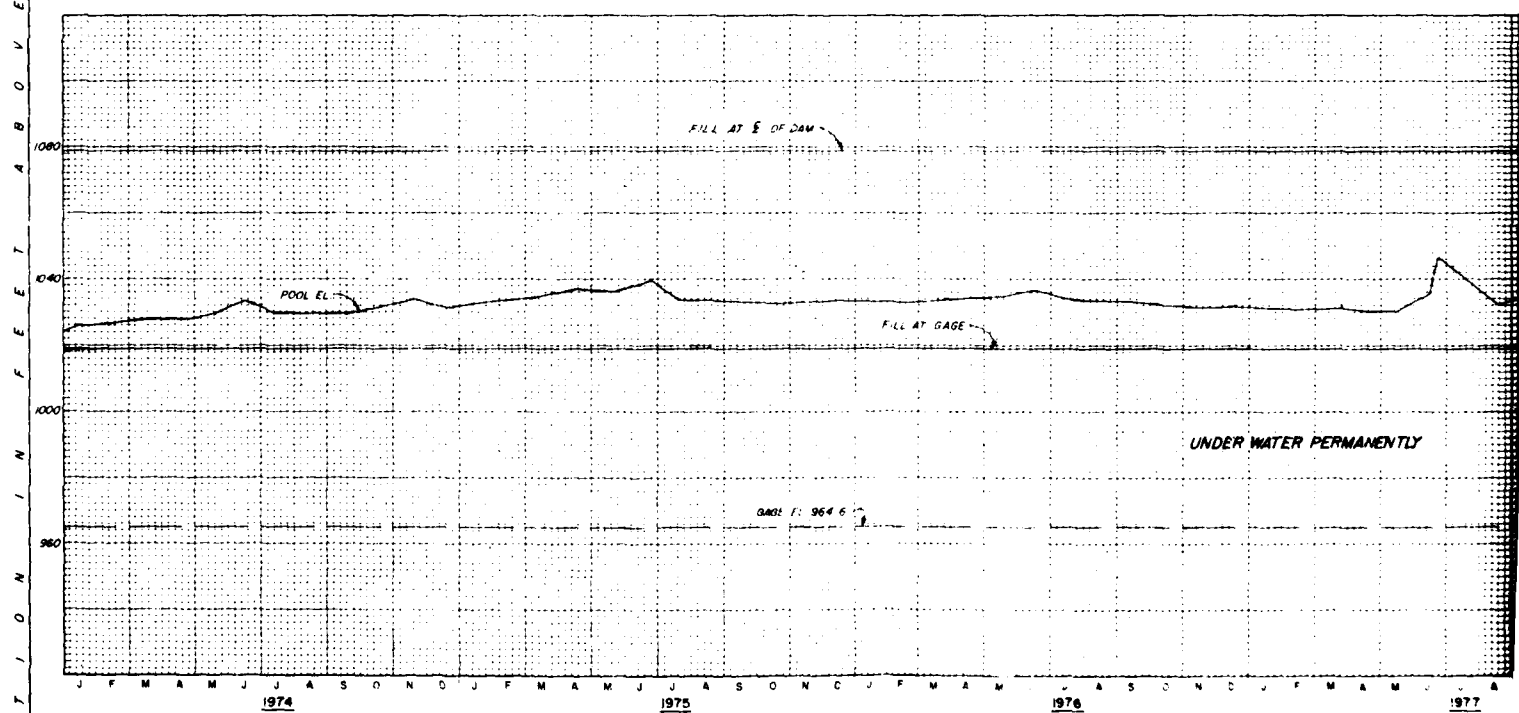
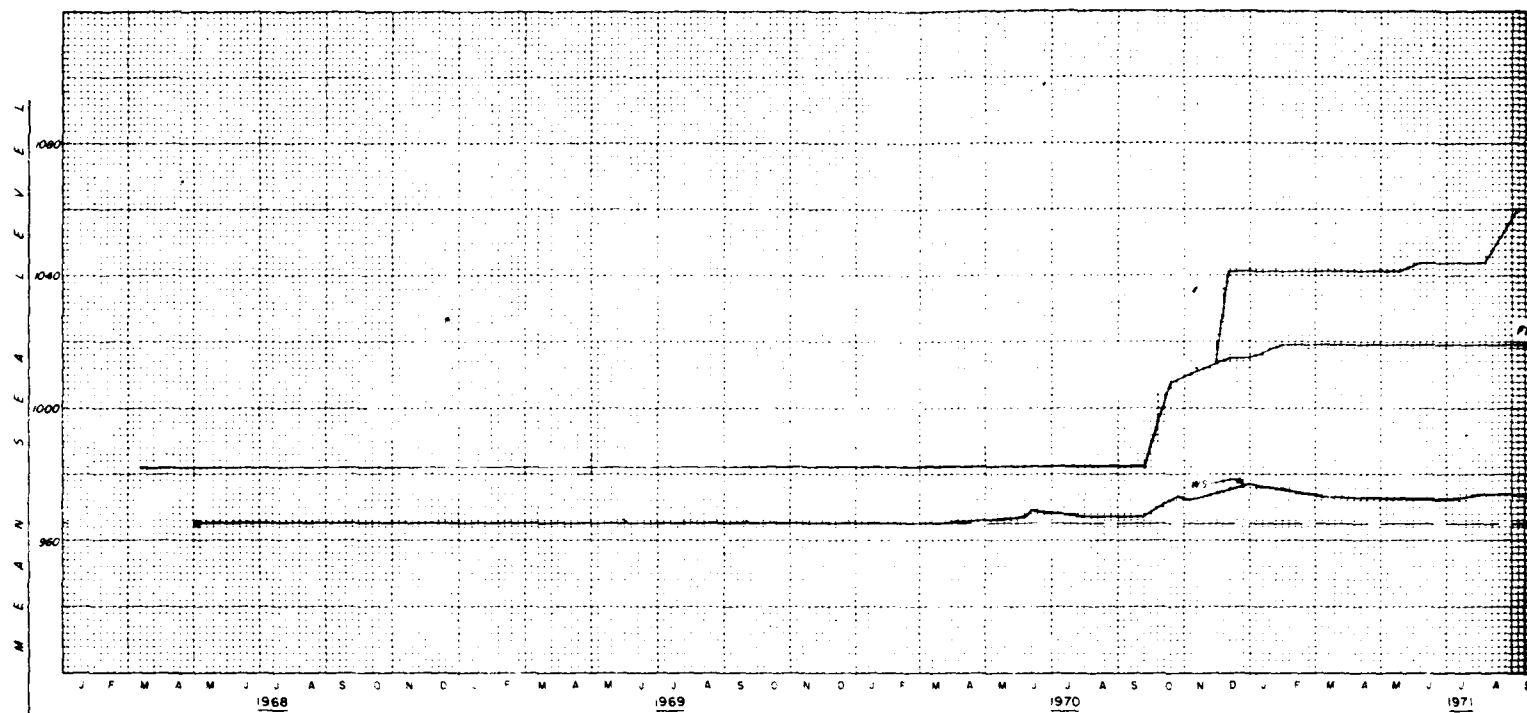
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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

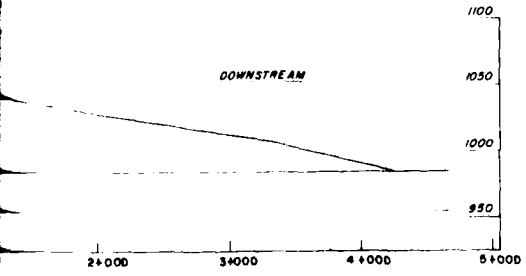
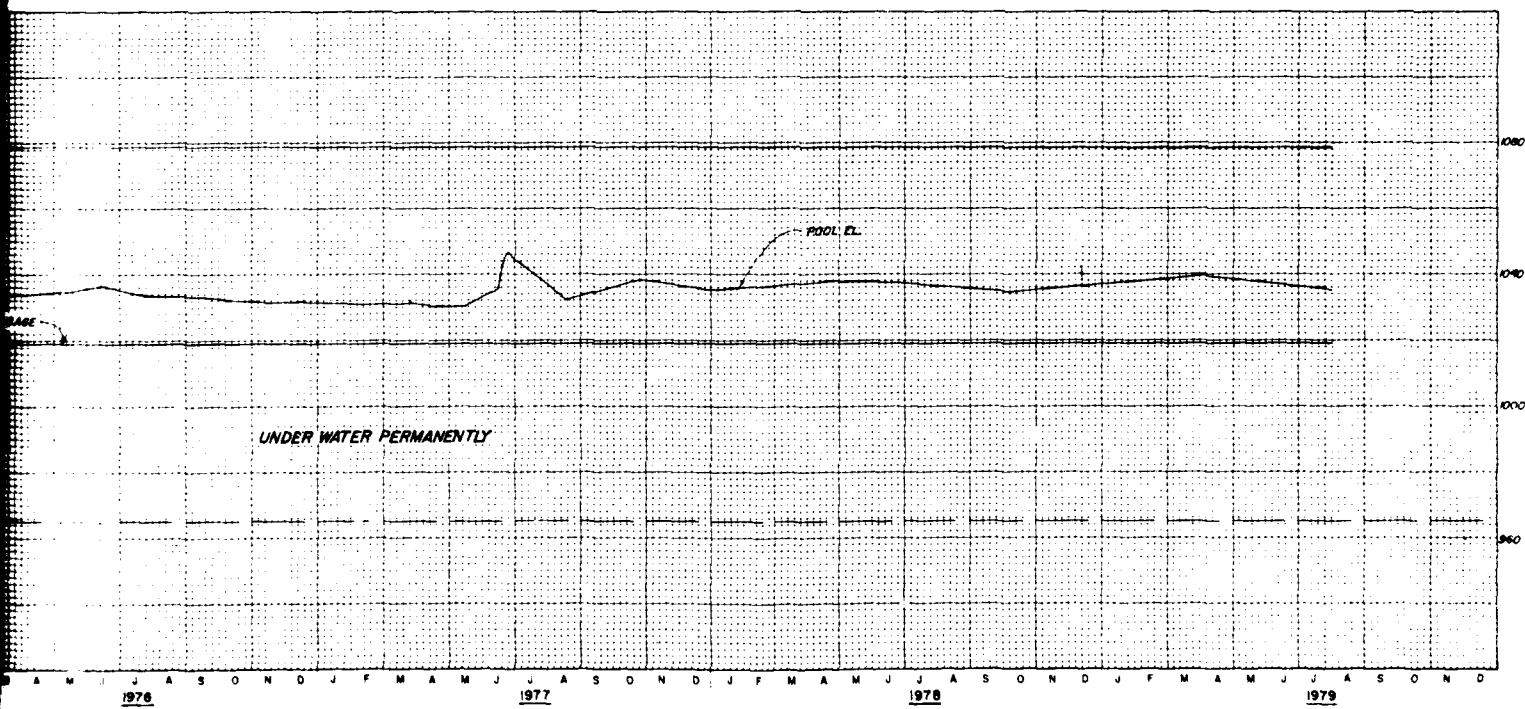
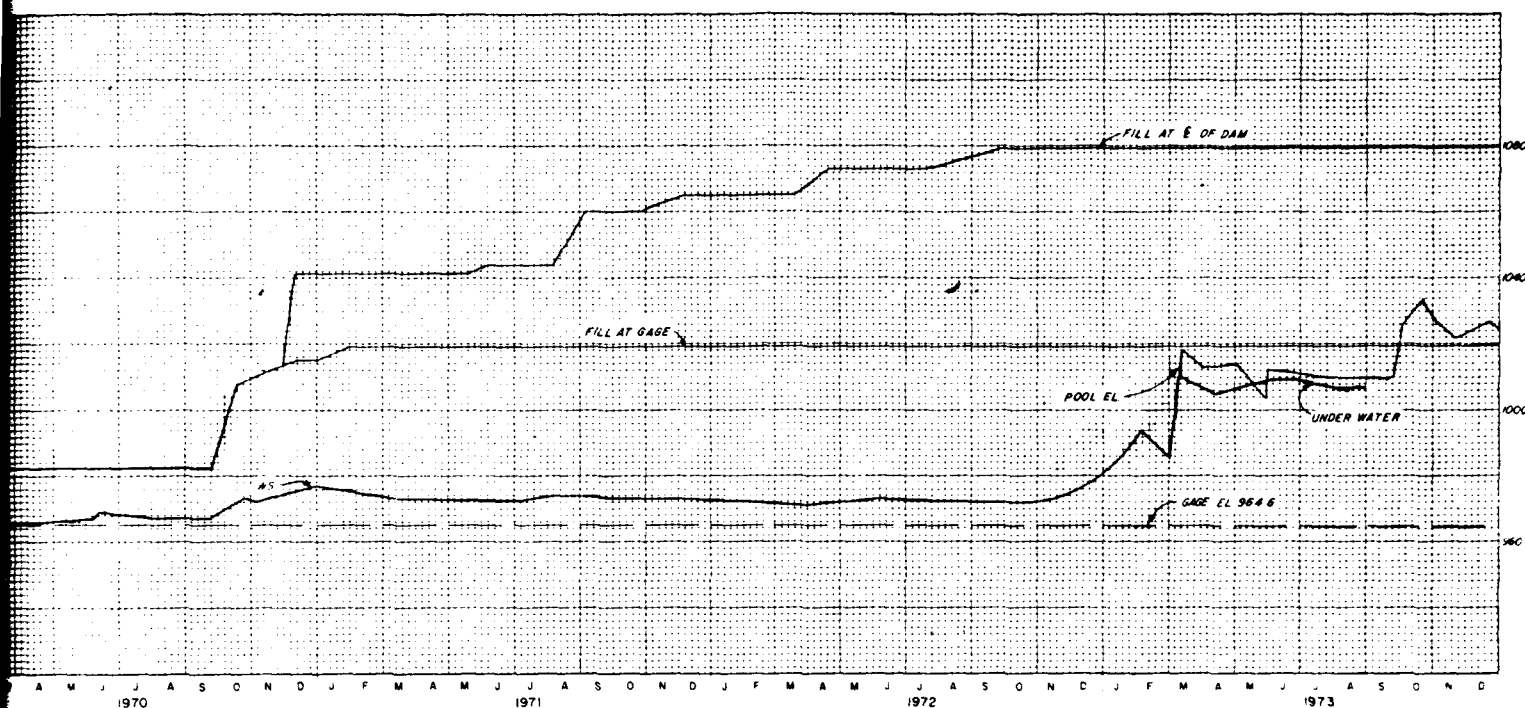
INSTRUMENTATION PLOTS
 PP-52-3 (OPEN TUBE)

In 1 sheet

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 KANSAS CITY DISTRICT
 FILE NO. O-5-1277
 AUGUST 1975

Scale as shown

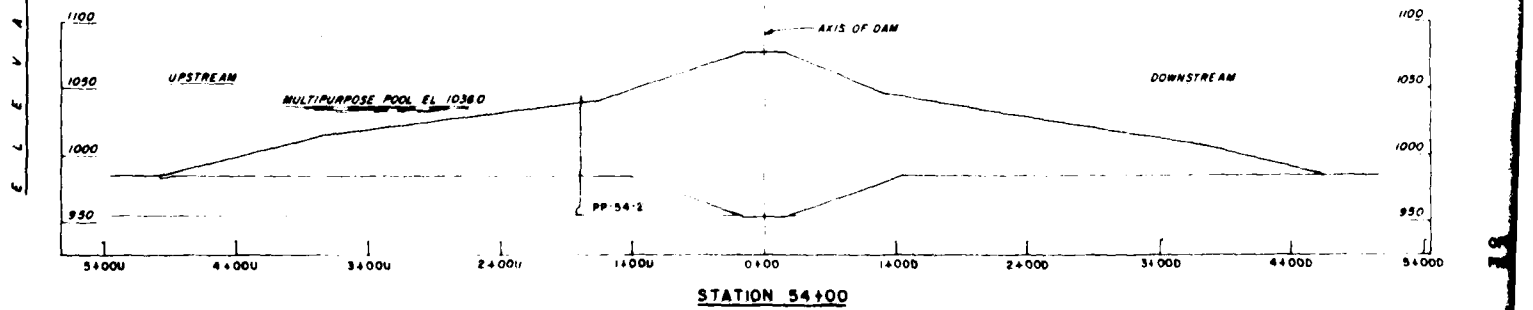
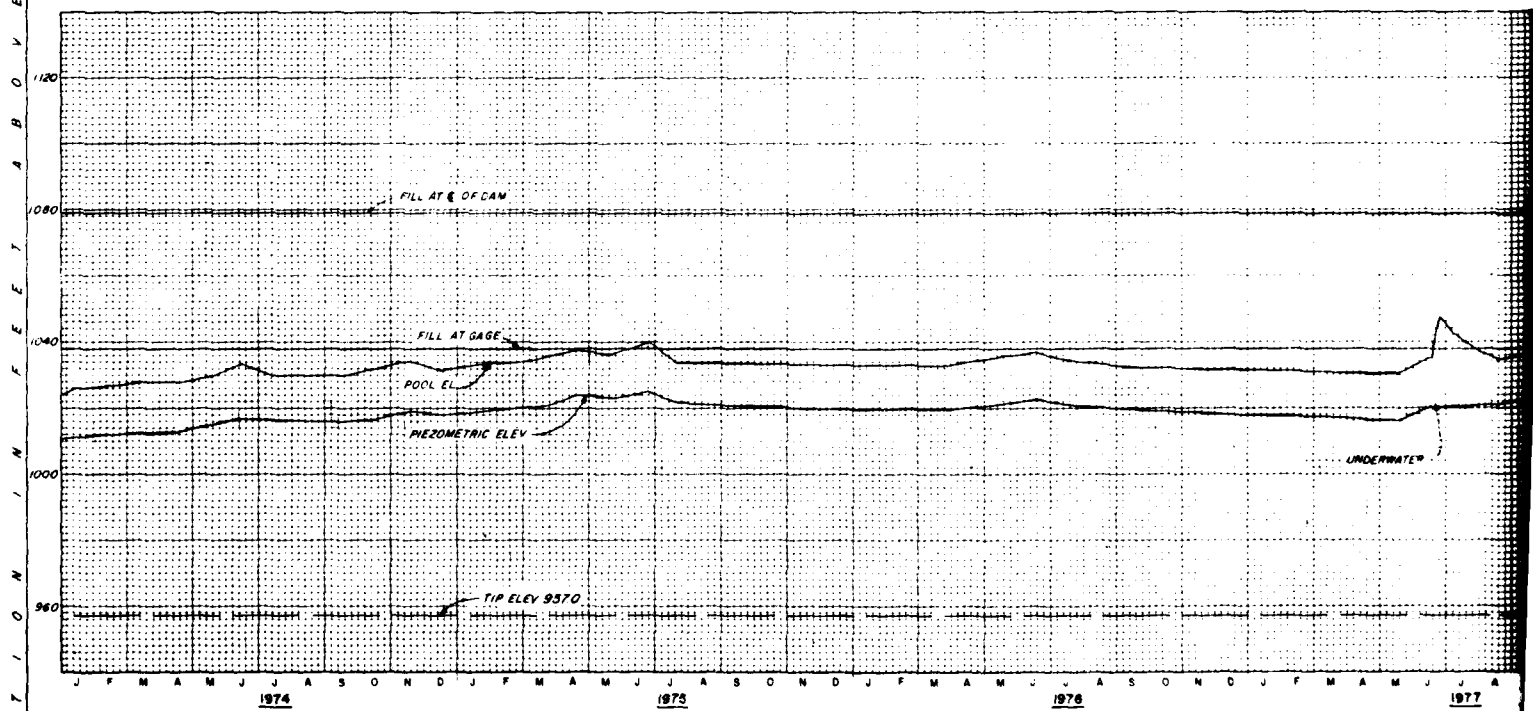
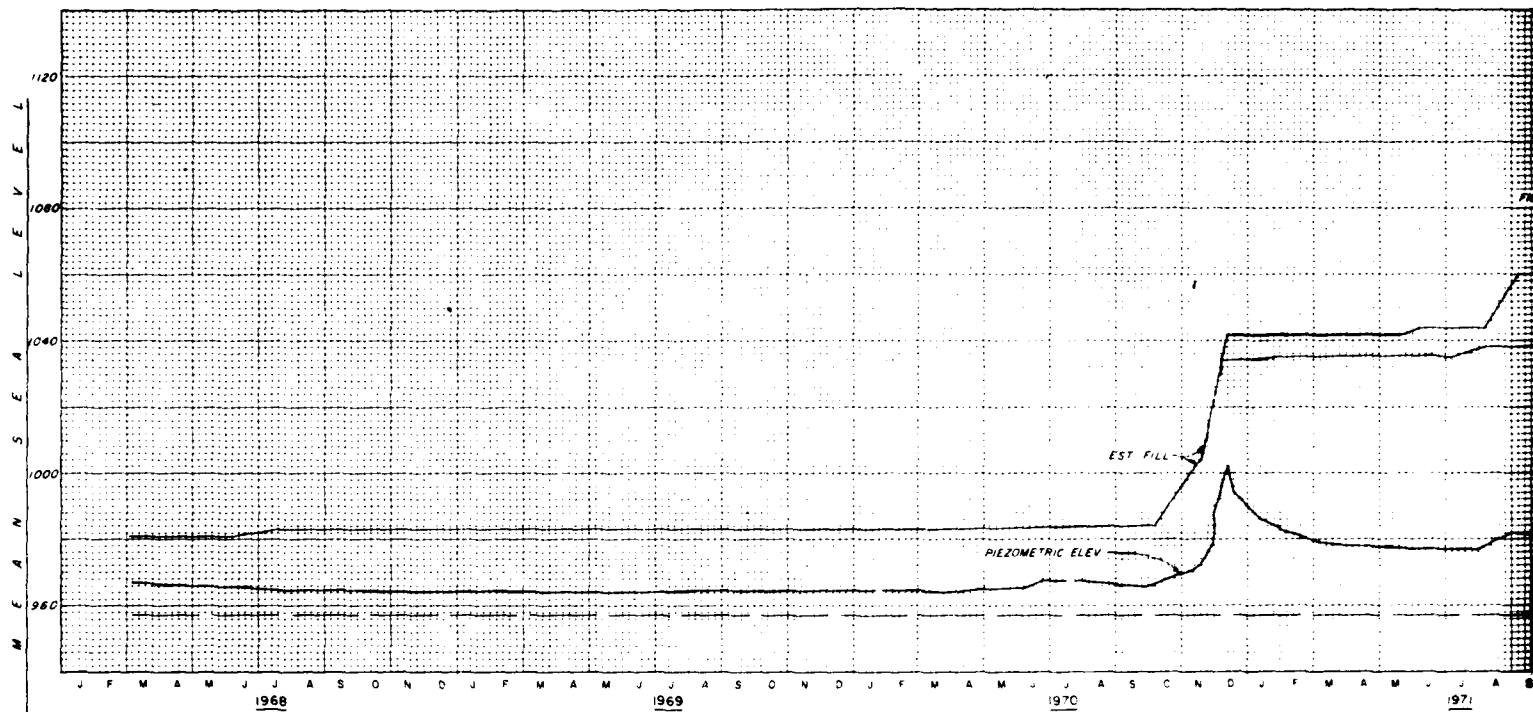


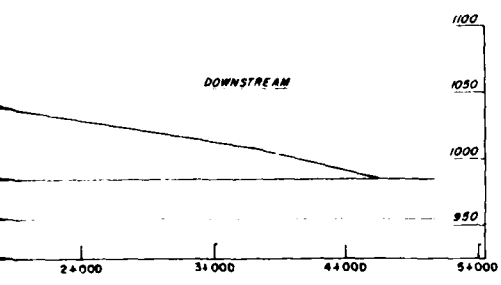
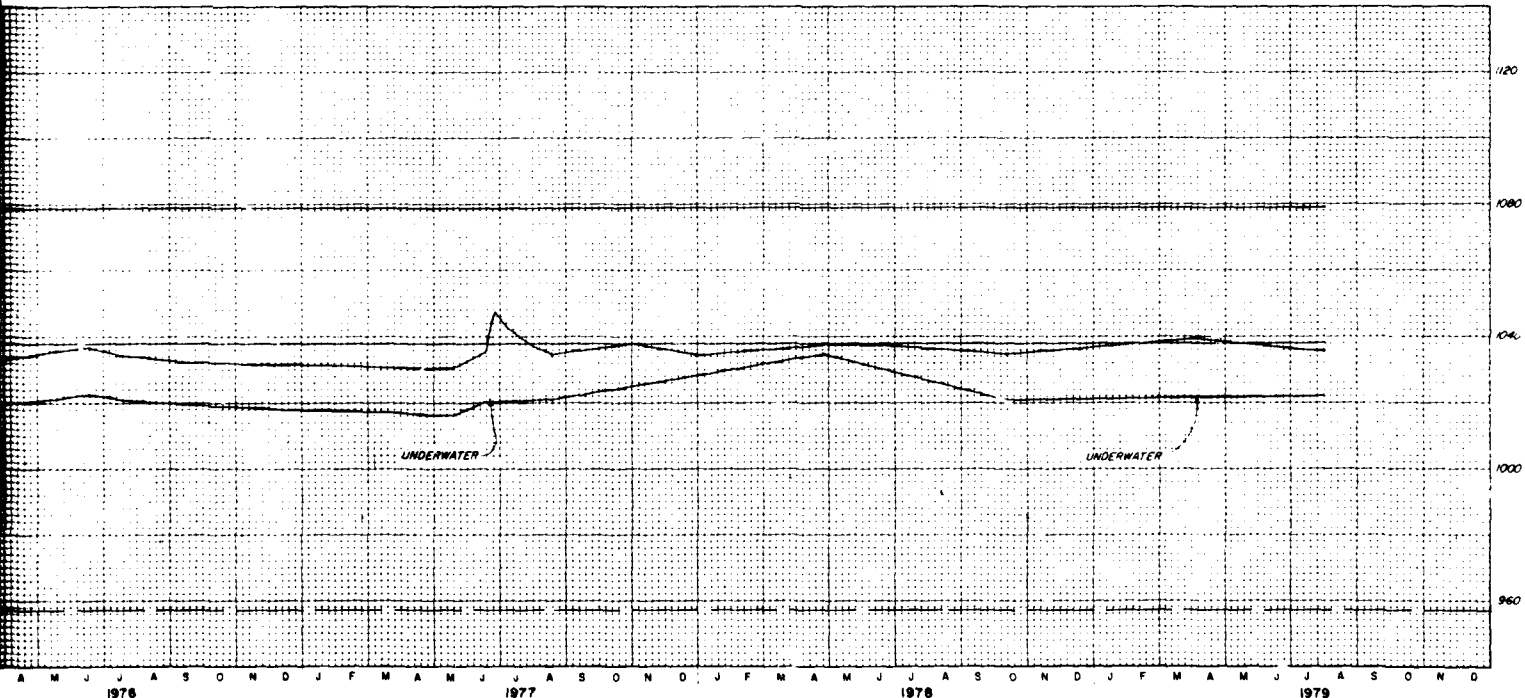
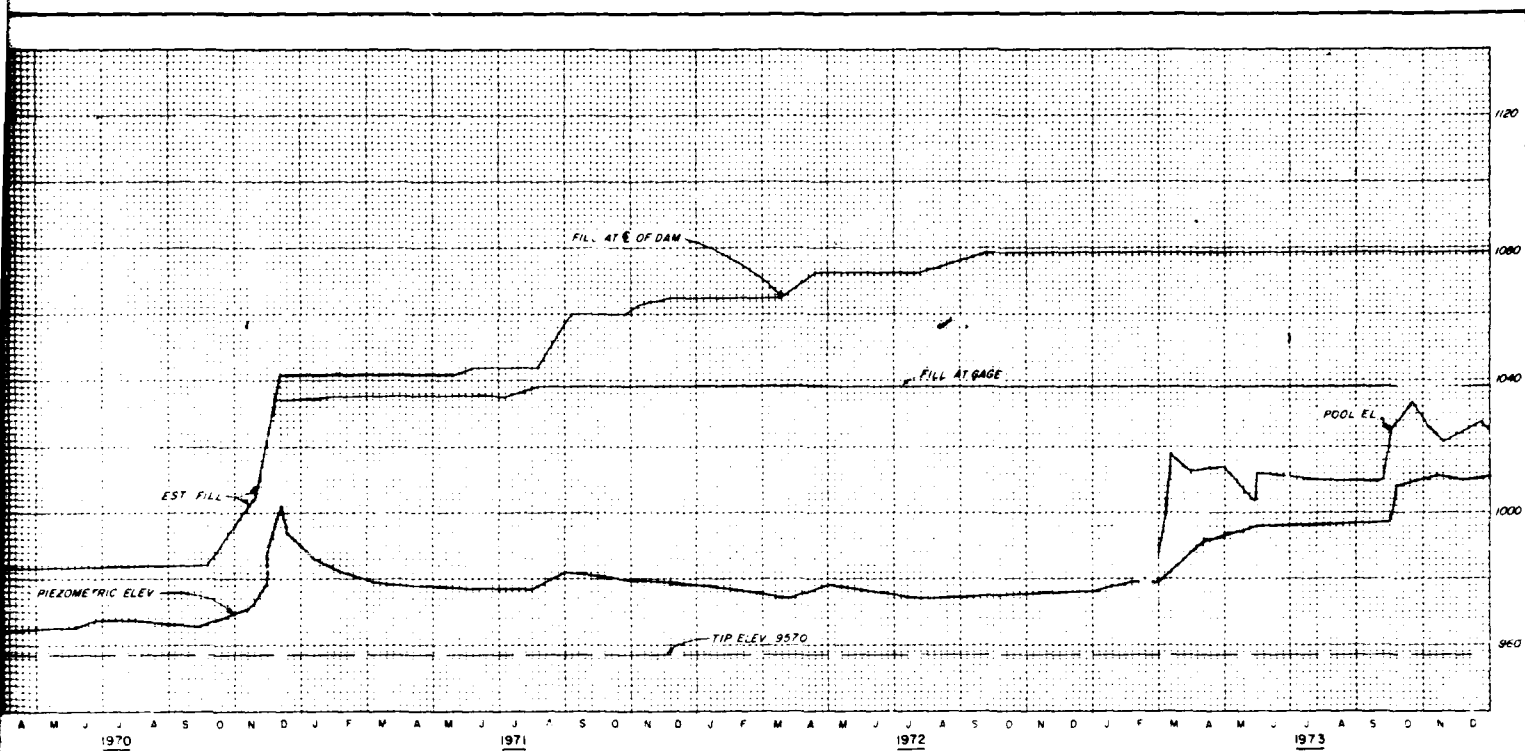


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MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-54-1 (OPEN TUBE)

In 1 sheet
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 KANSAS CITY DISTRICT
 FILE NO. 0-5-1278
 AUGUST 1975





LEGEND
 OPEN TUBE ———— ○
 PNEUMATIC CELL ———— ●

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MELVERN LAKE

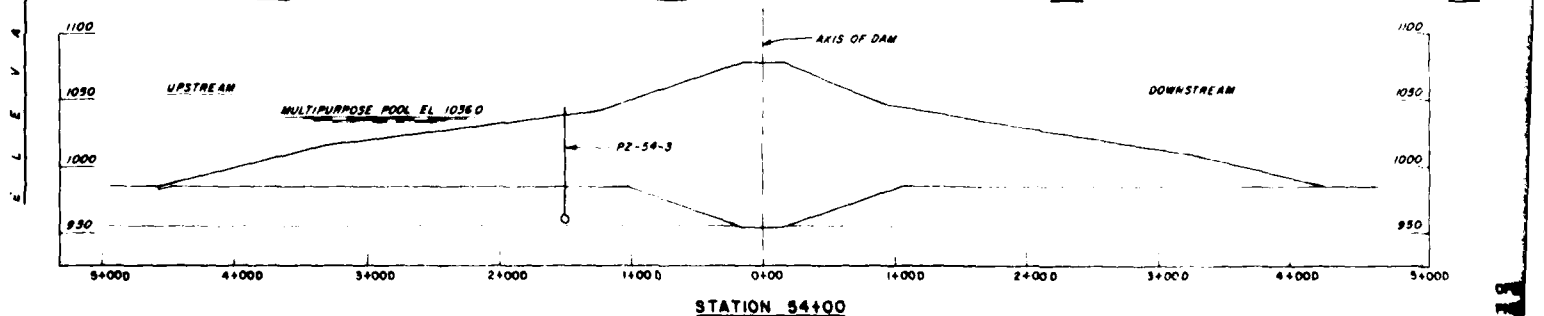
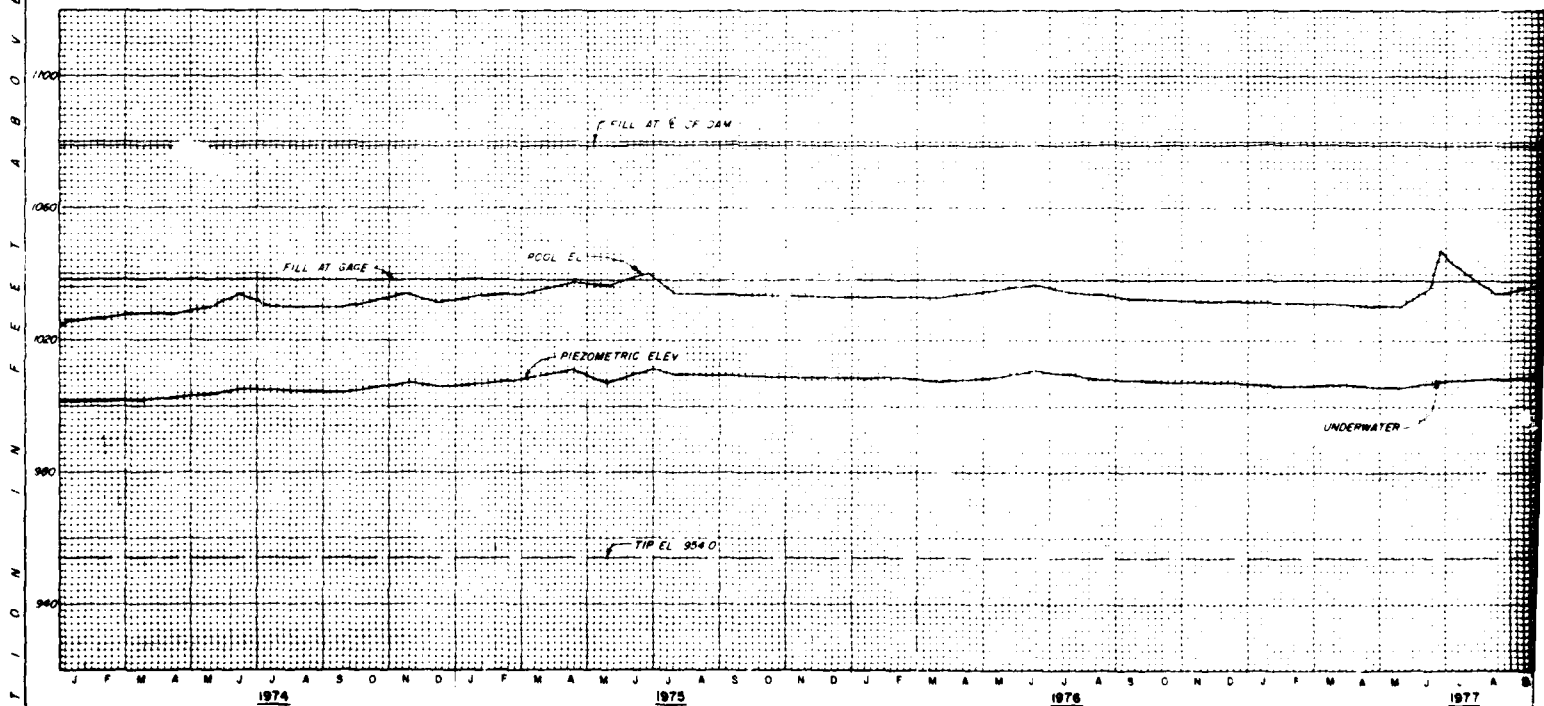
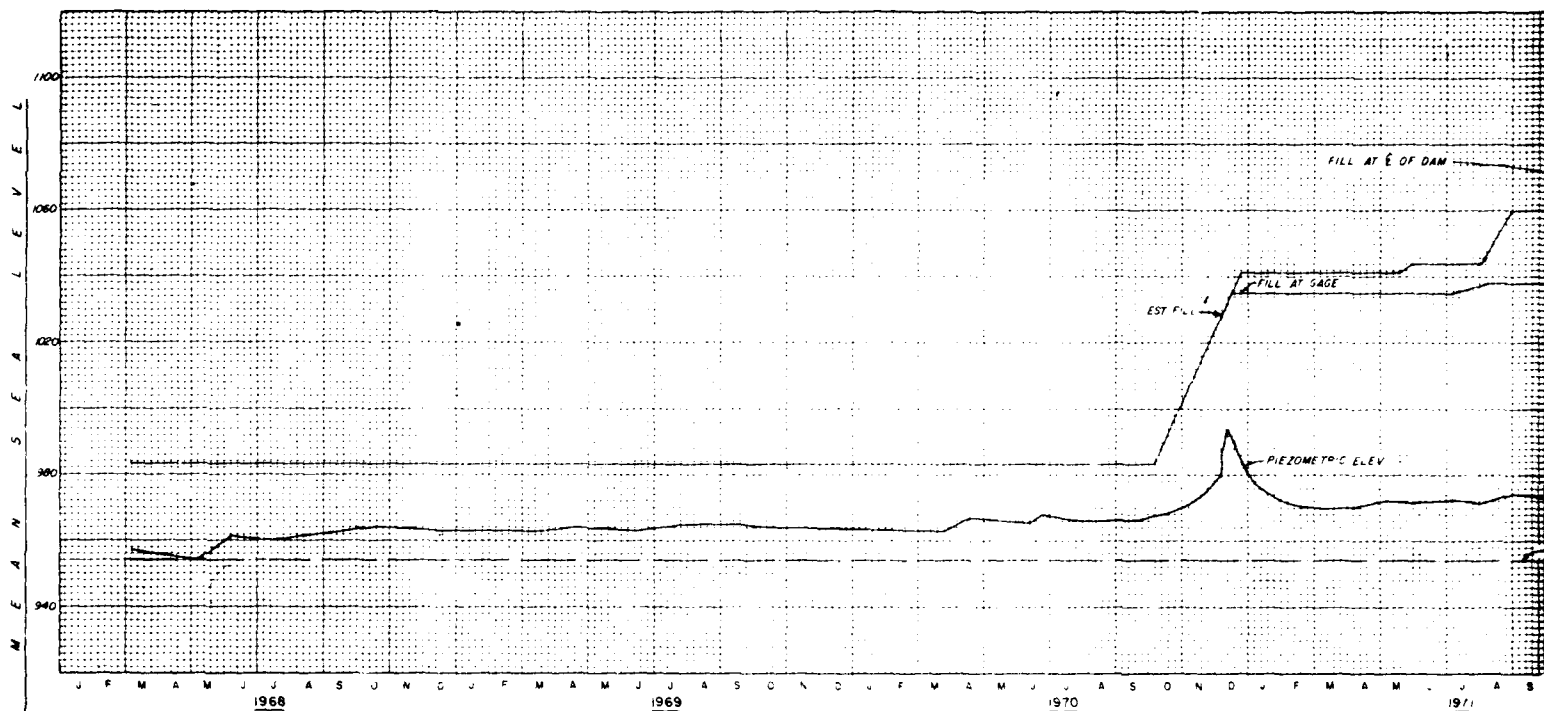
INSTRUMENTATION PLOTS
PP-54-2 (OPEN TUBE)

In 1 sheet

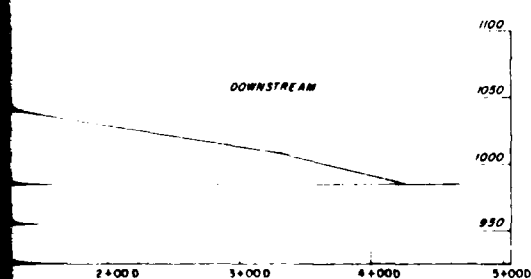
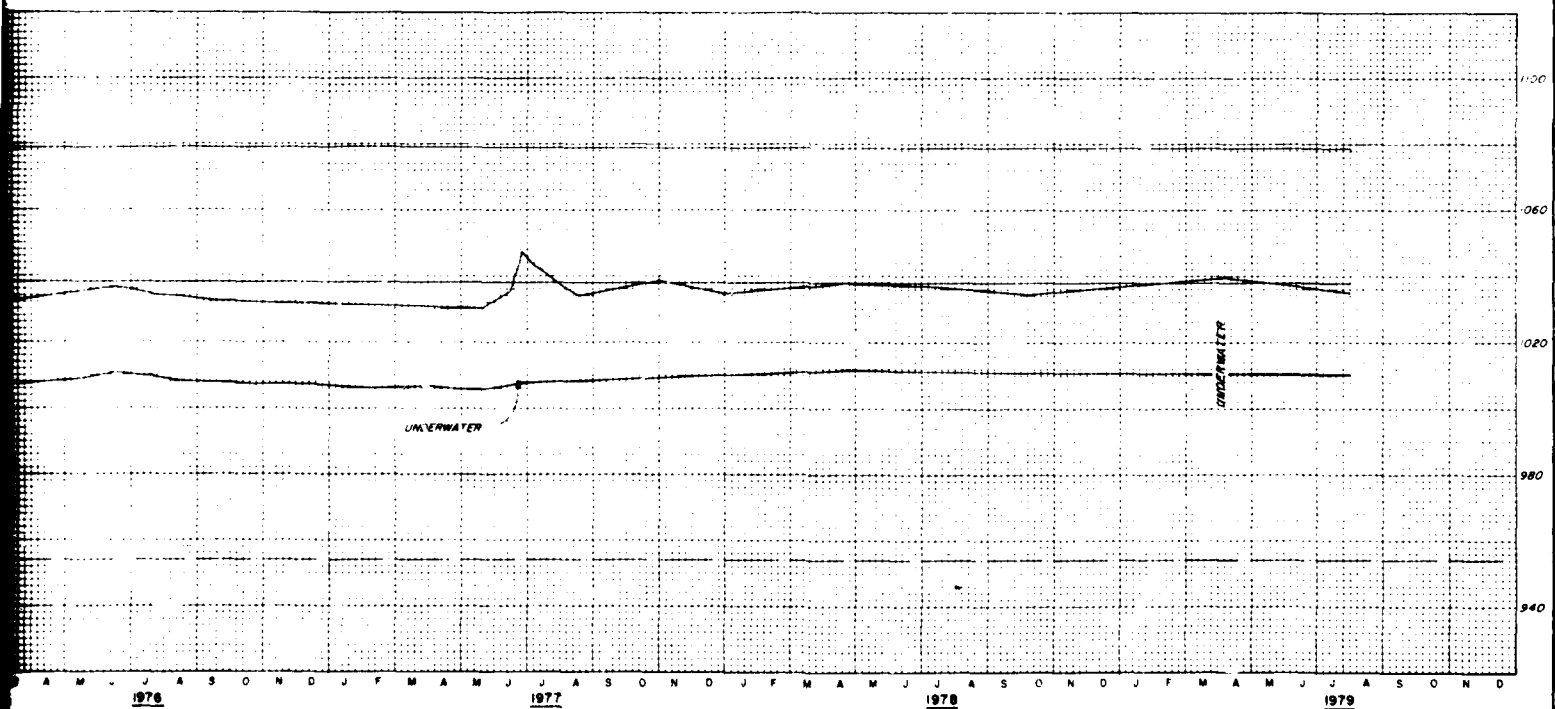
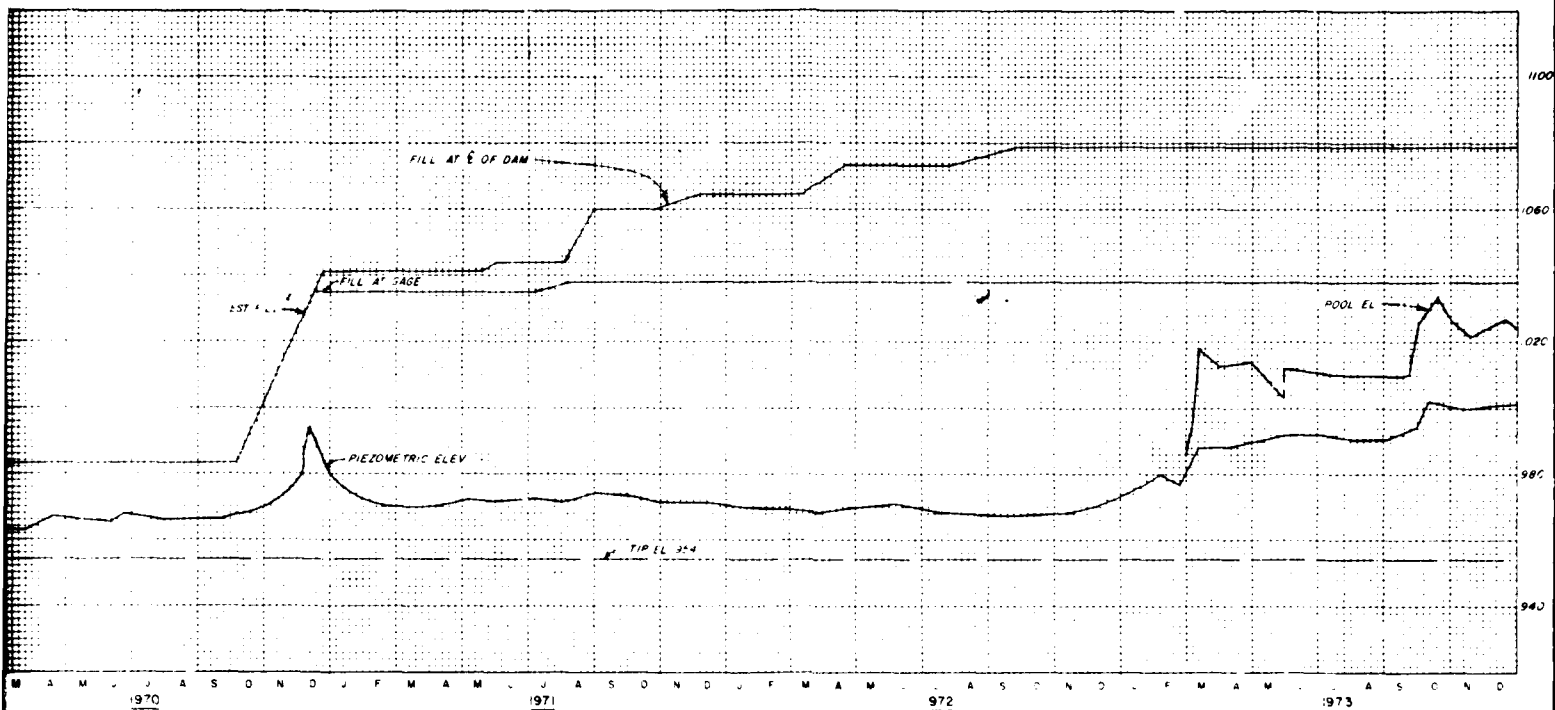
Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1279
 AUGUST 1975



STATION 54+00



LEGEND
 OPEN TUBE (○)
 PNEUMATIC CELLS (●)

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 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

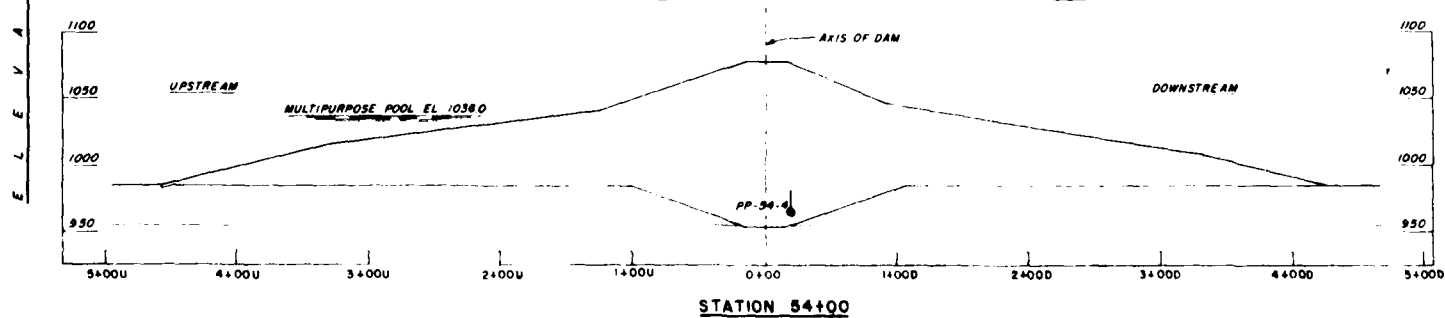
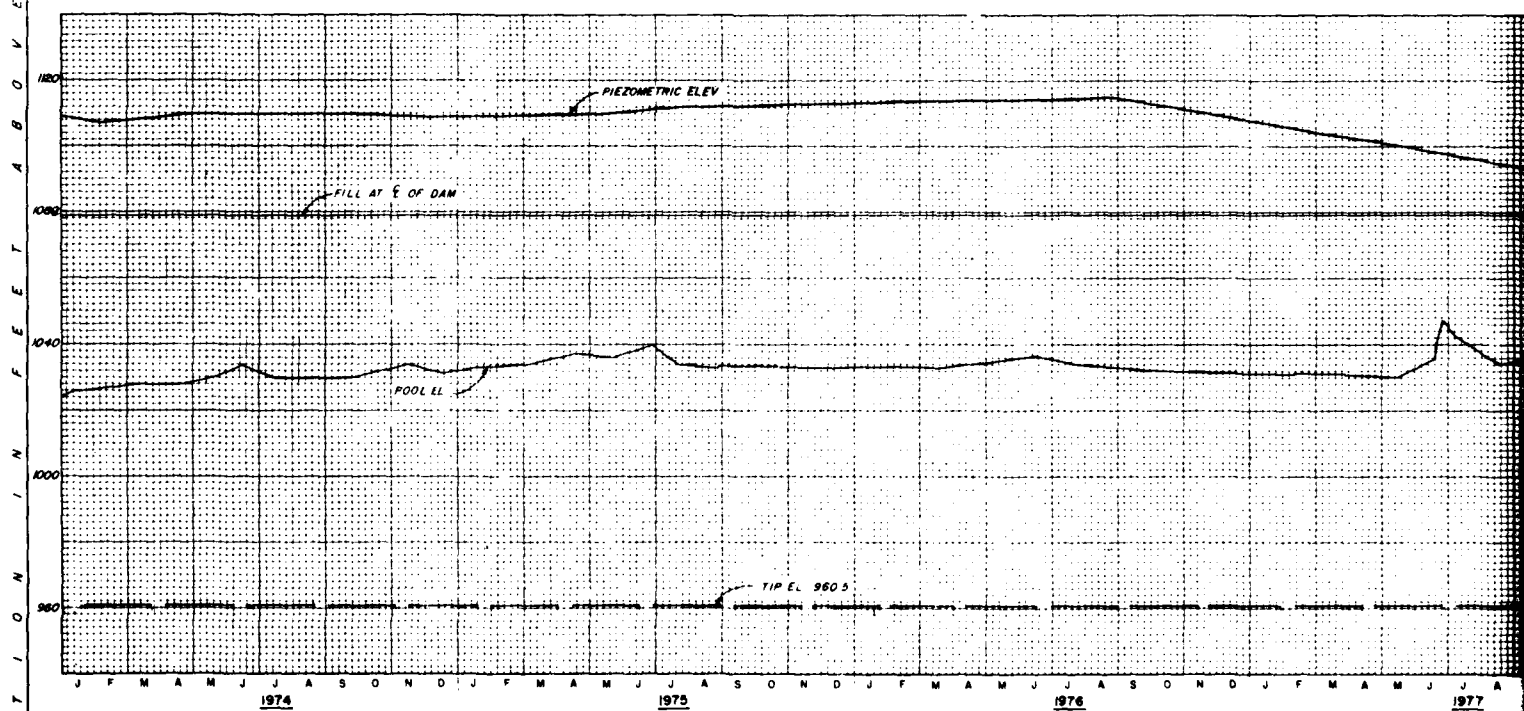
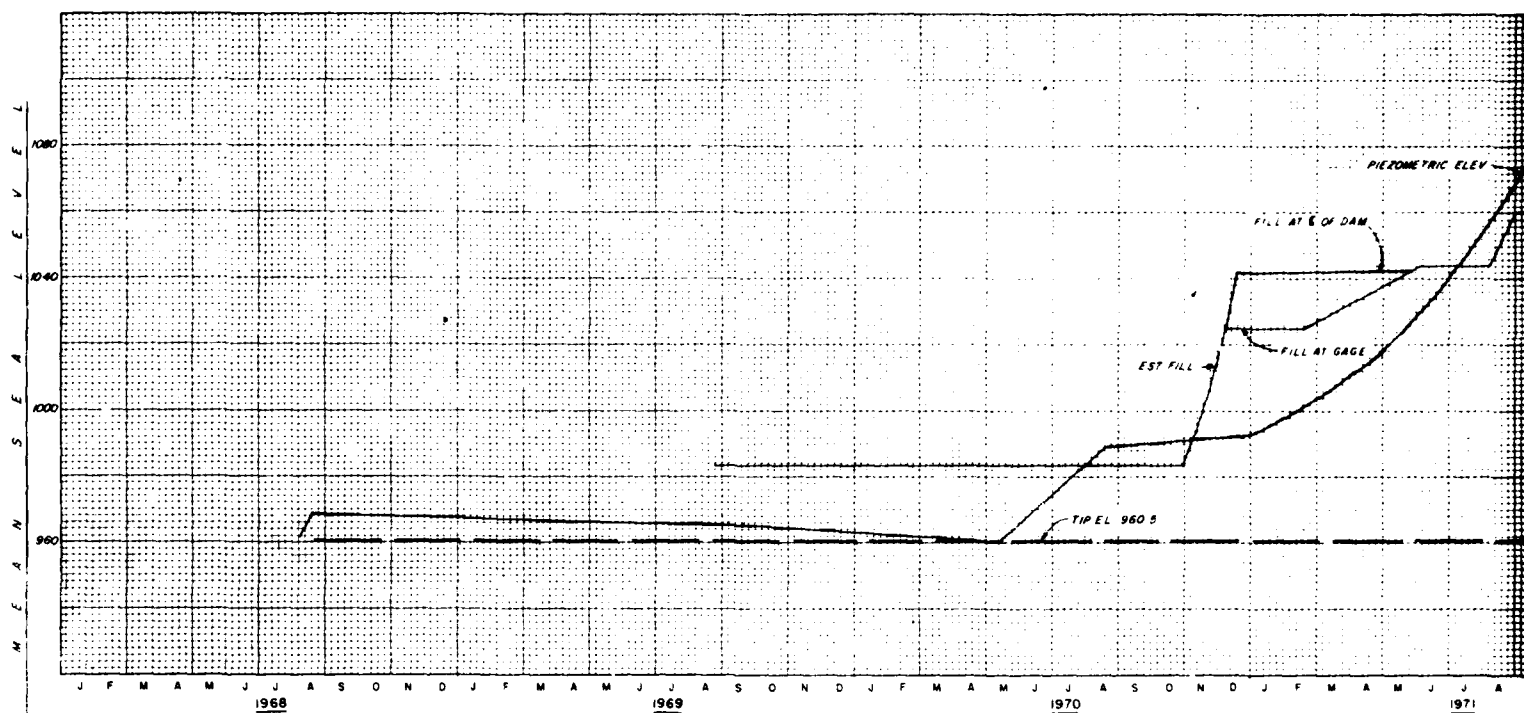
INSTRUMENTATION PLOTS
 PZ-54-3 (OPEN TUBE)

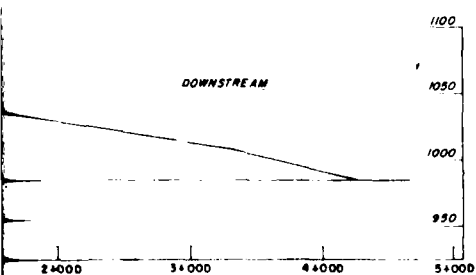
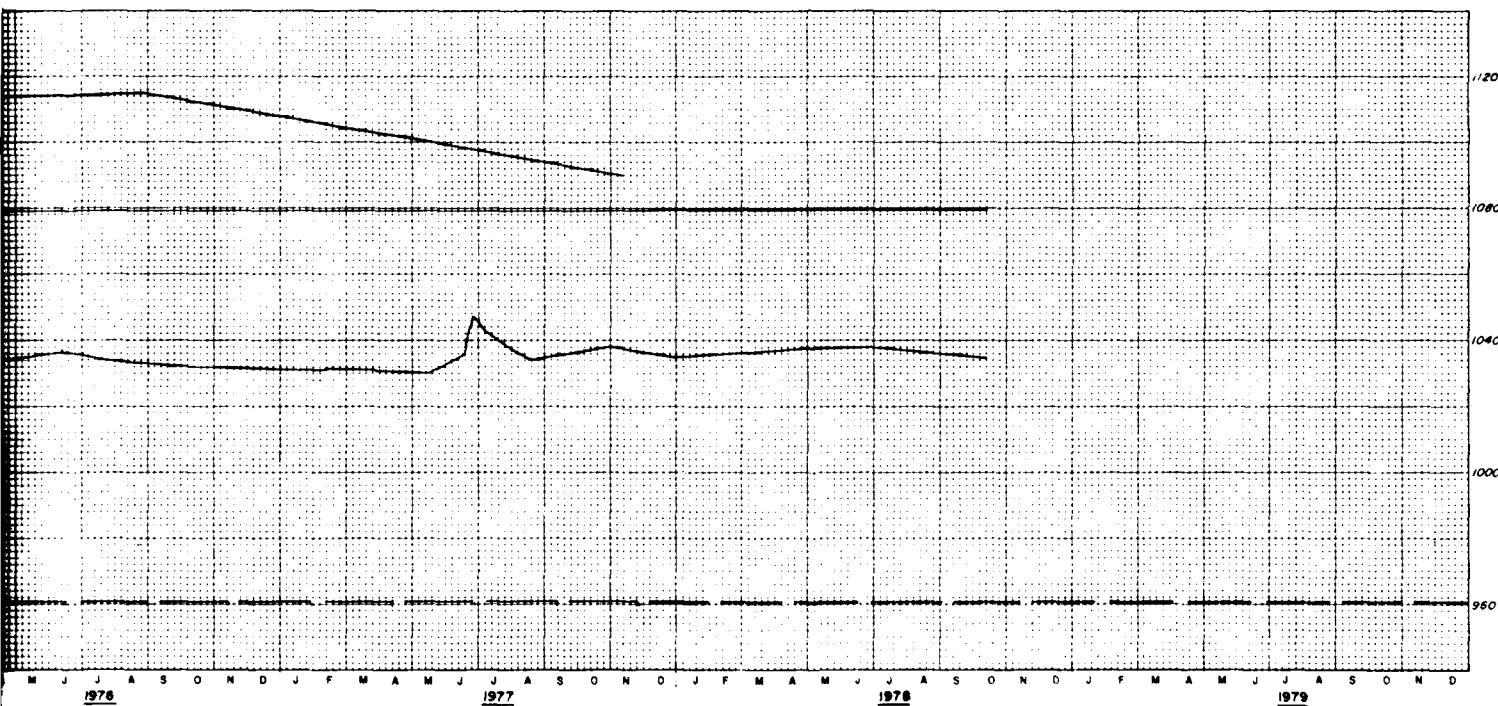
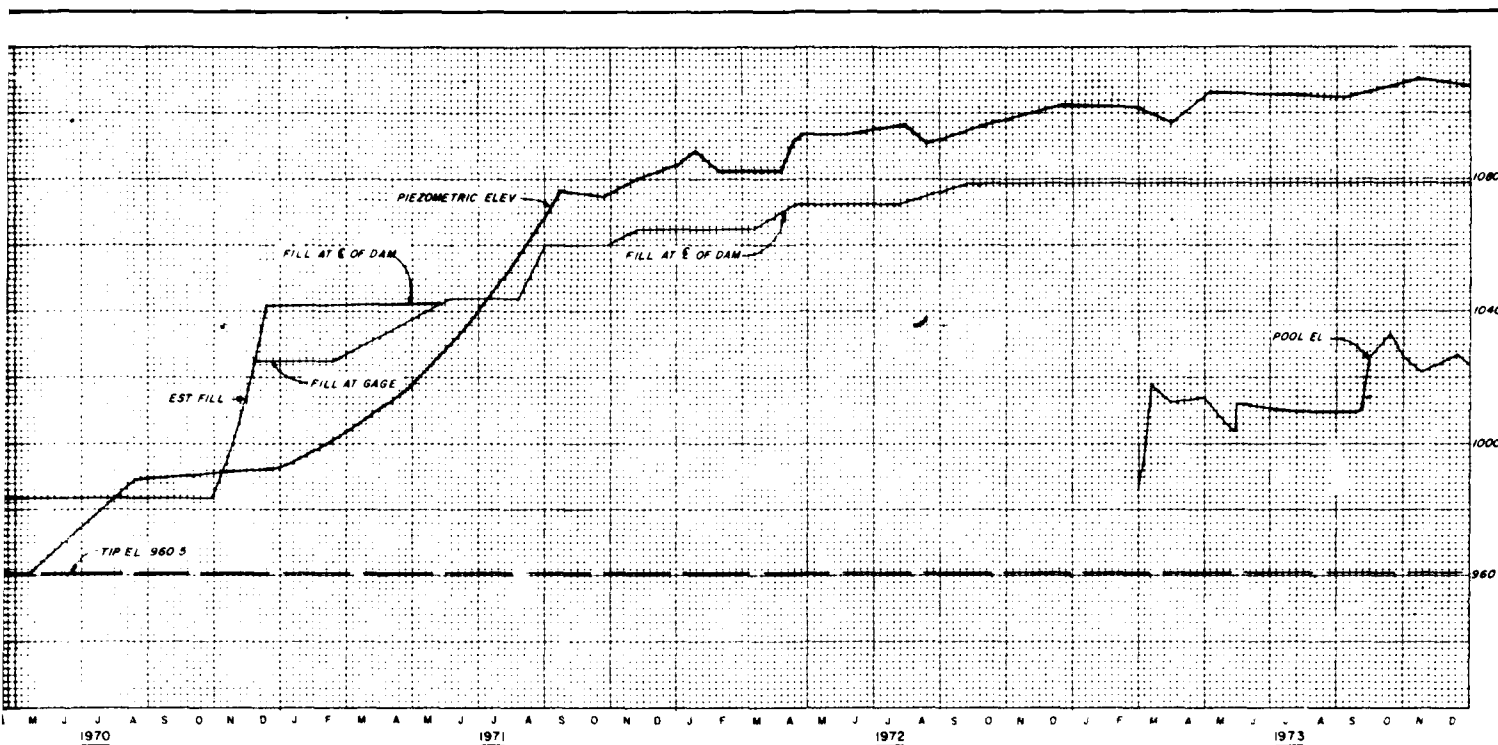
In 1 sheet

Sheet No 1
 CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT

Scale as shown

FILE NO. 0-5-1280
 AUGUST 1975





LEGEND

OPEN TOBE ————○

PNEUMATIC CELL ————●

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MELVERN LAKE

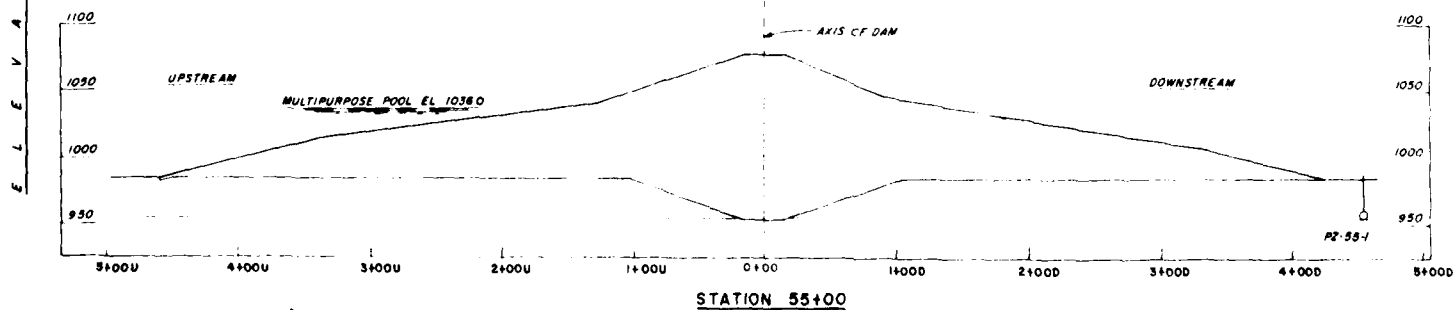
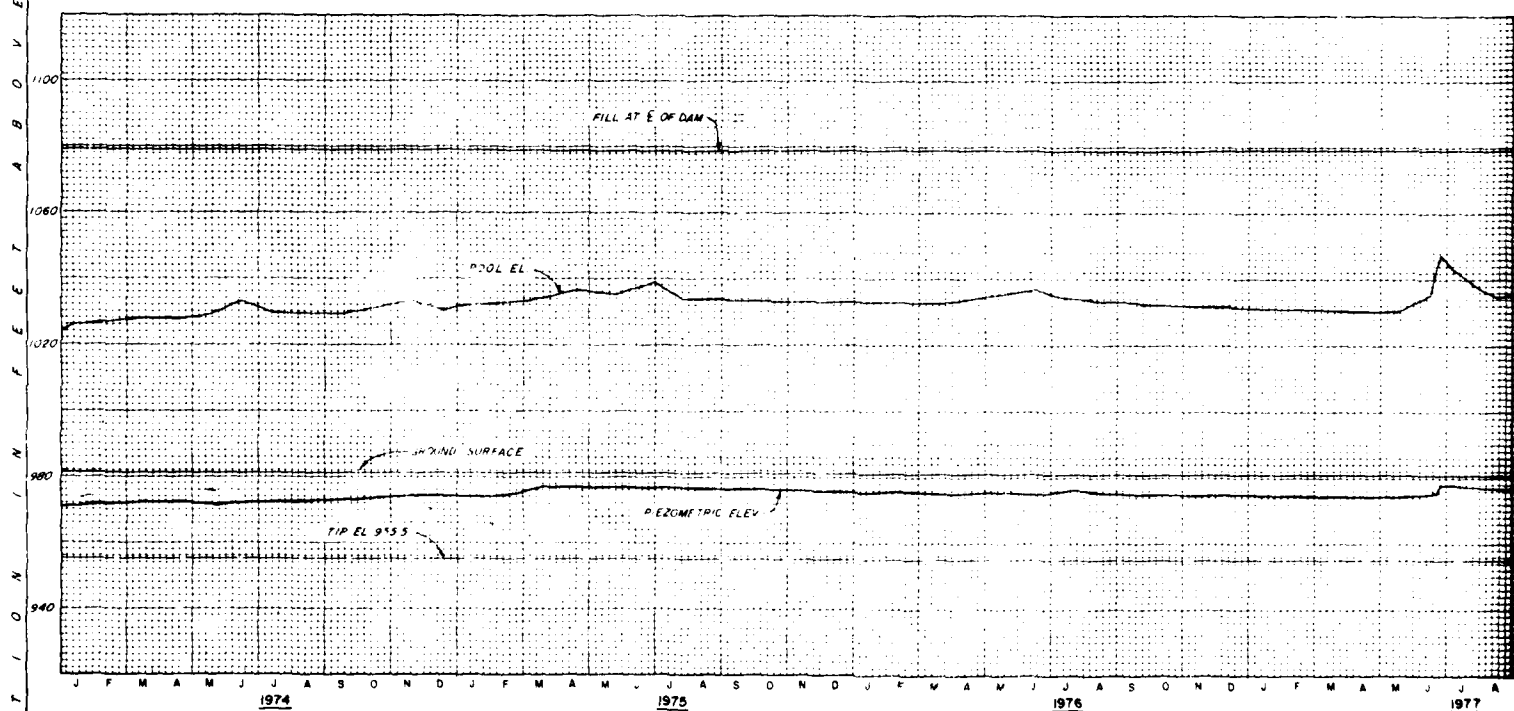
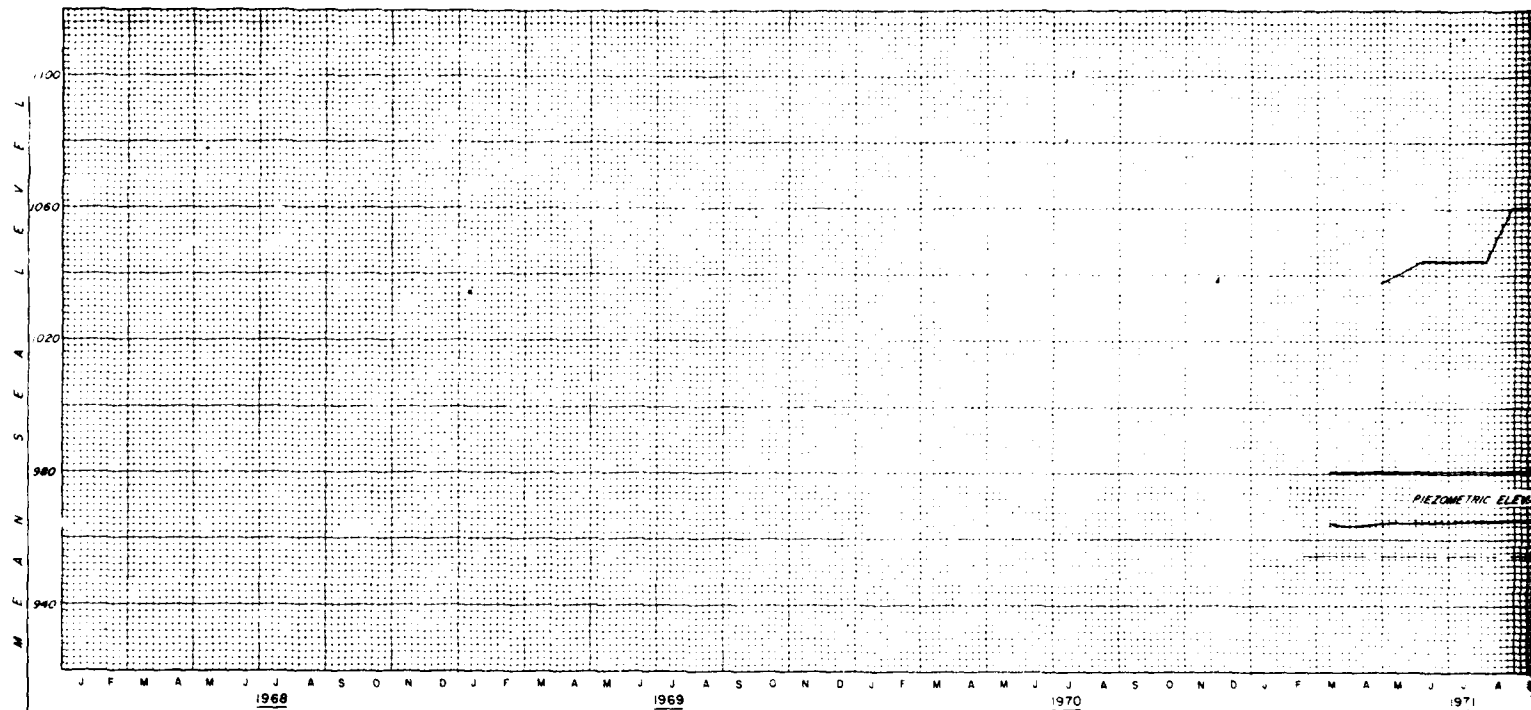
INSTRUMENTATION
PP-54-4 (SHANNON-WILSON CELL)

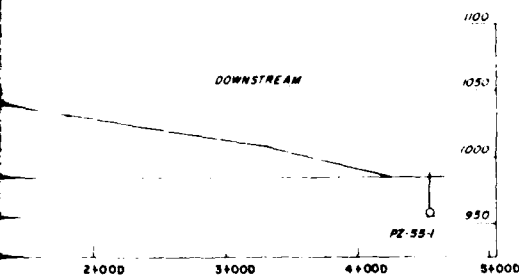
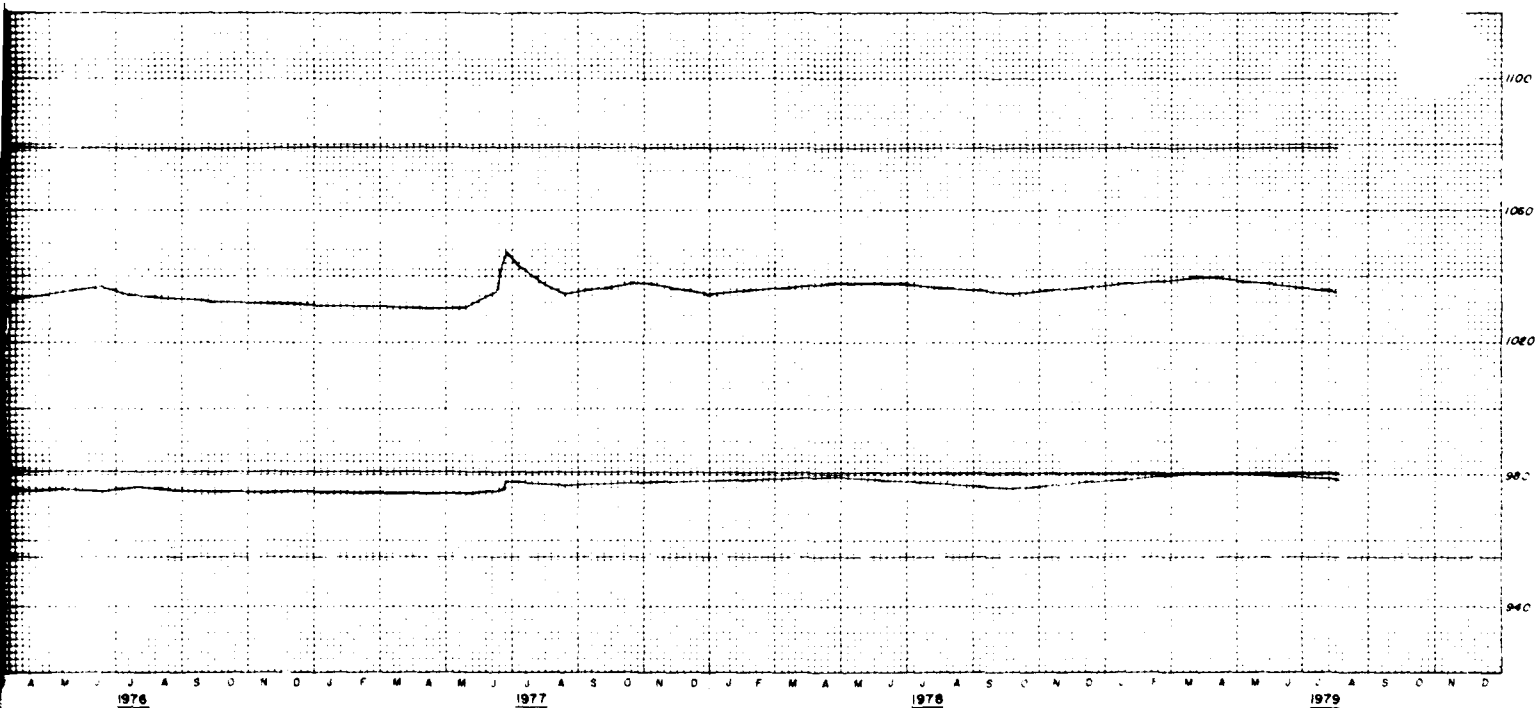
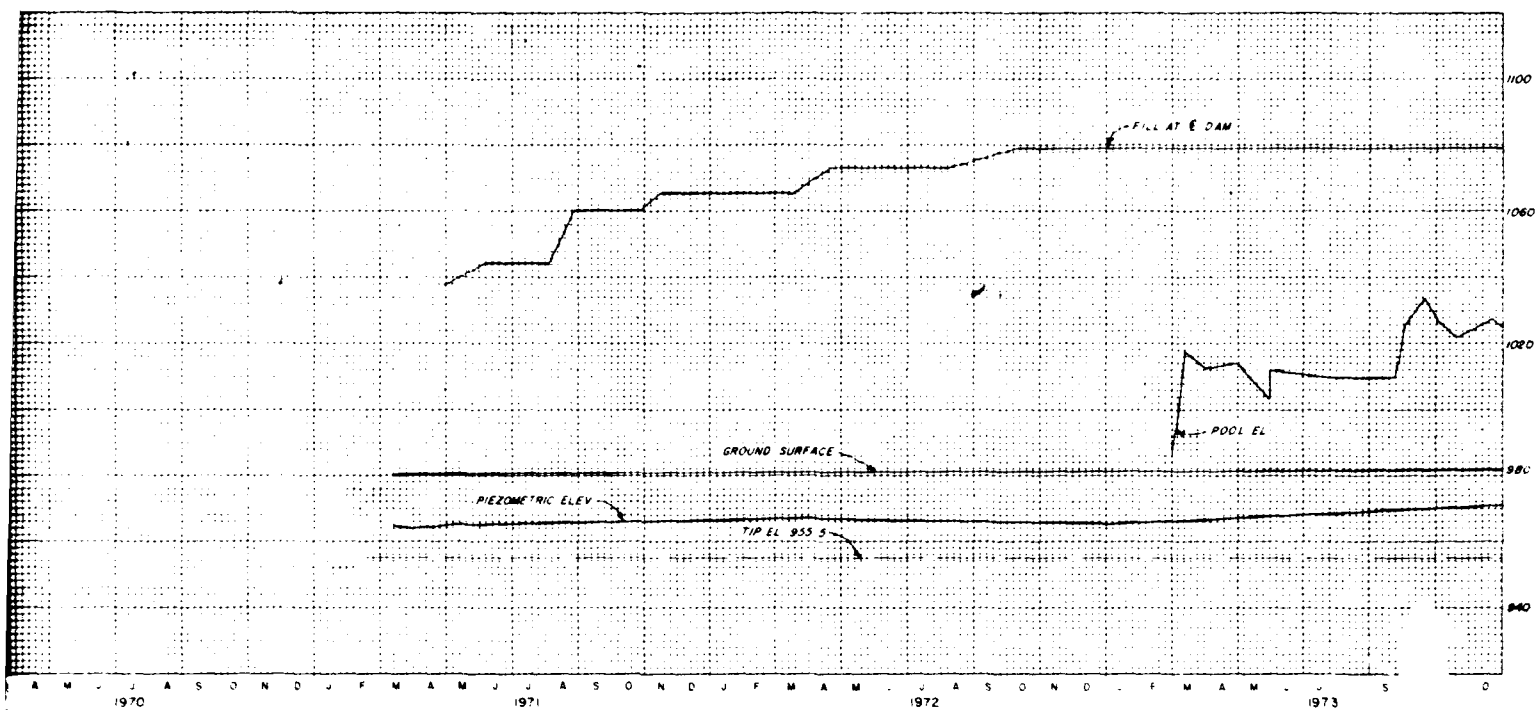
In 1 sheet

Sheet No. 1
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

Scale as shown

FILE NO. 0-5-1281
AUGUST 1975





LEGEND

OPEN TUBE ————○
PNEUMATIC CELL ————●

SEP 22 AUGUST 1975
MARQUIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
PZ-55-1 (OPEN TUBE)

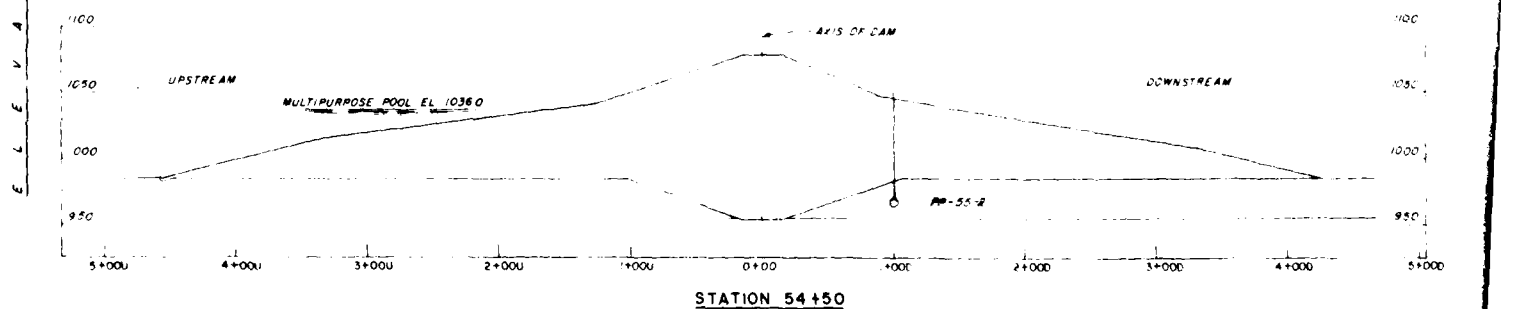
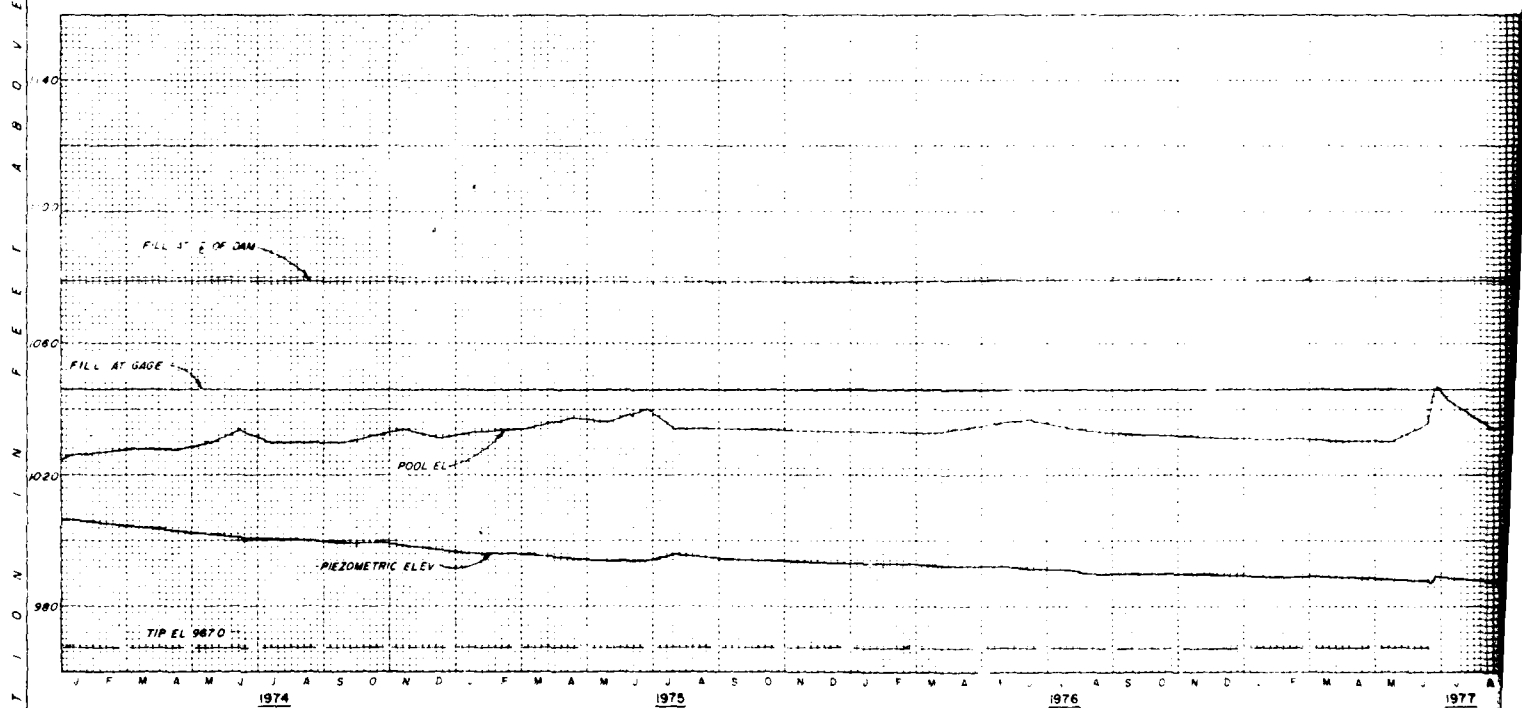
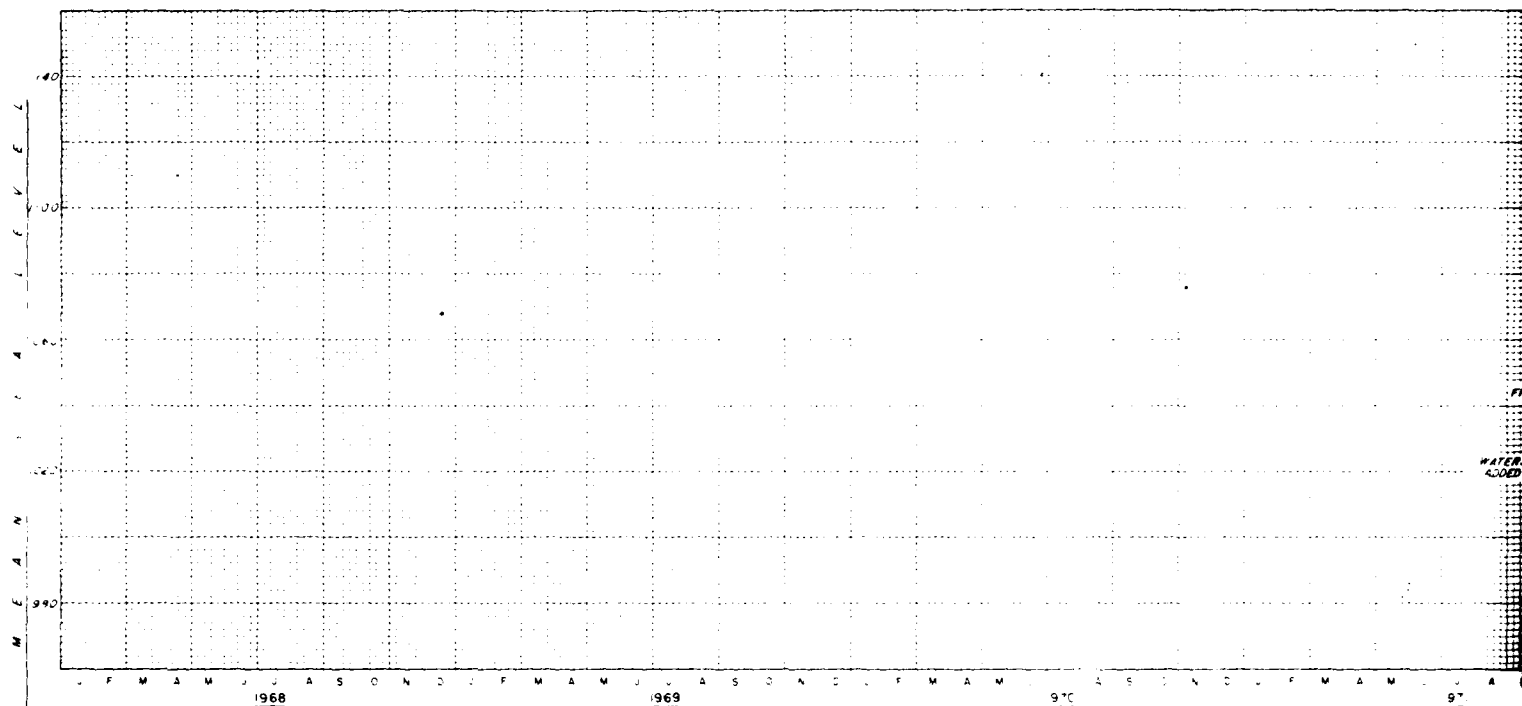
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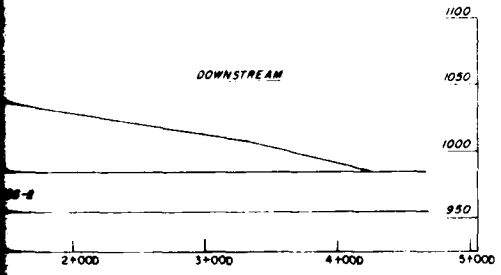
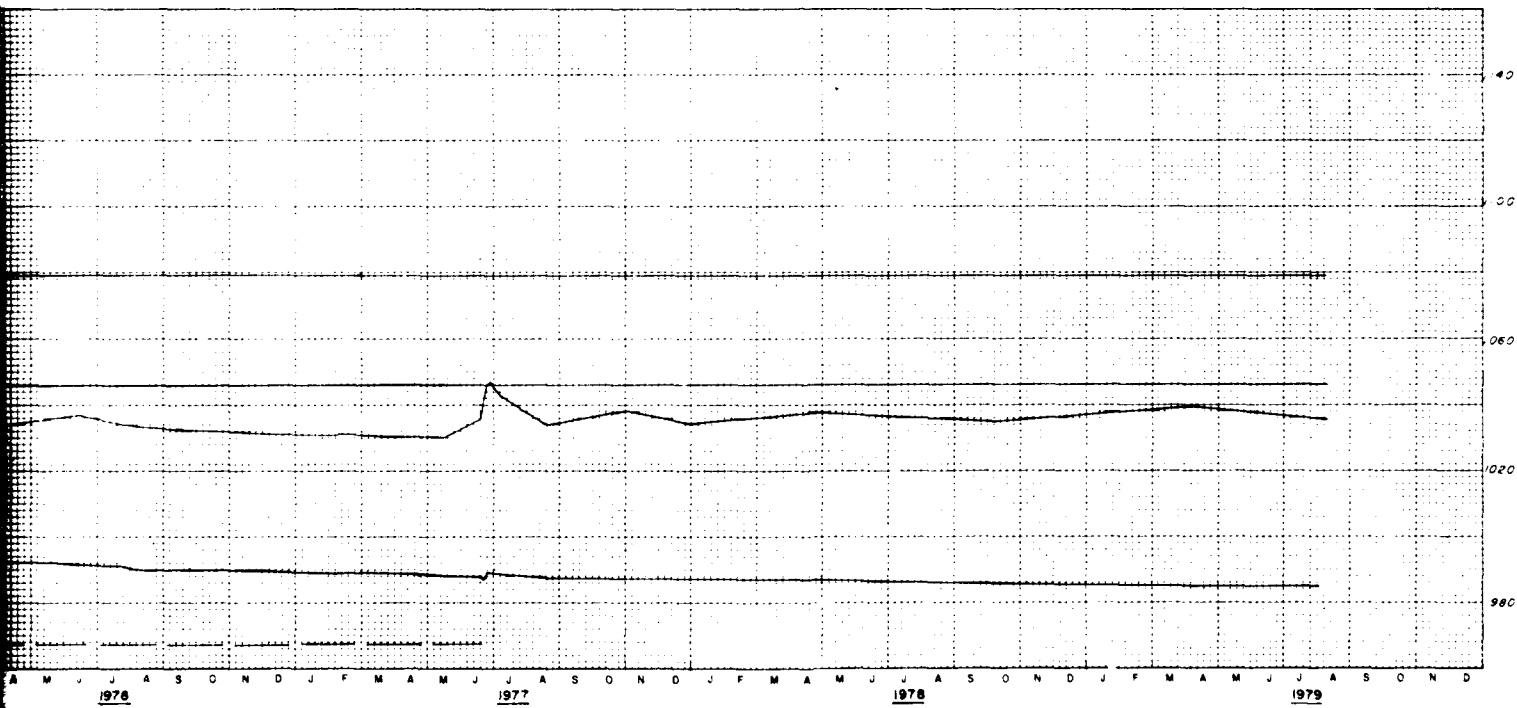
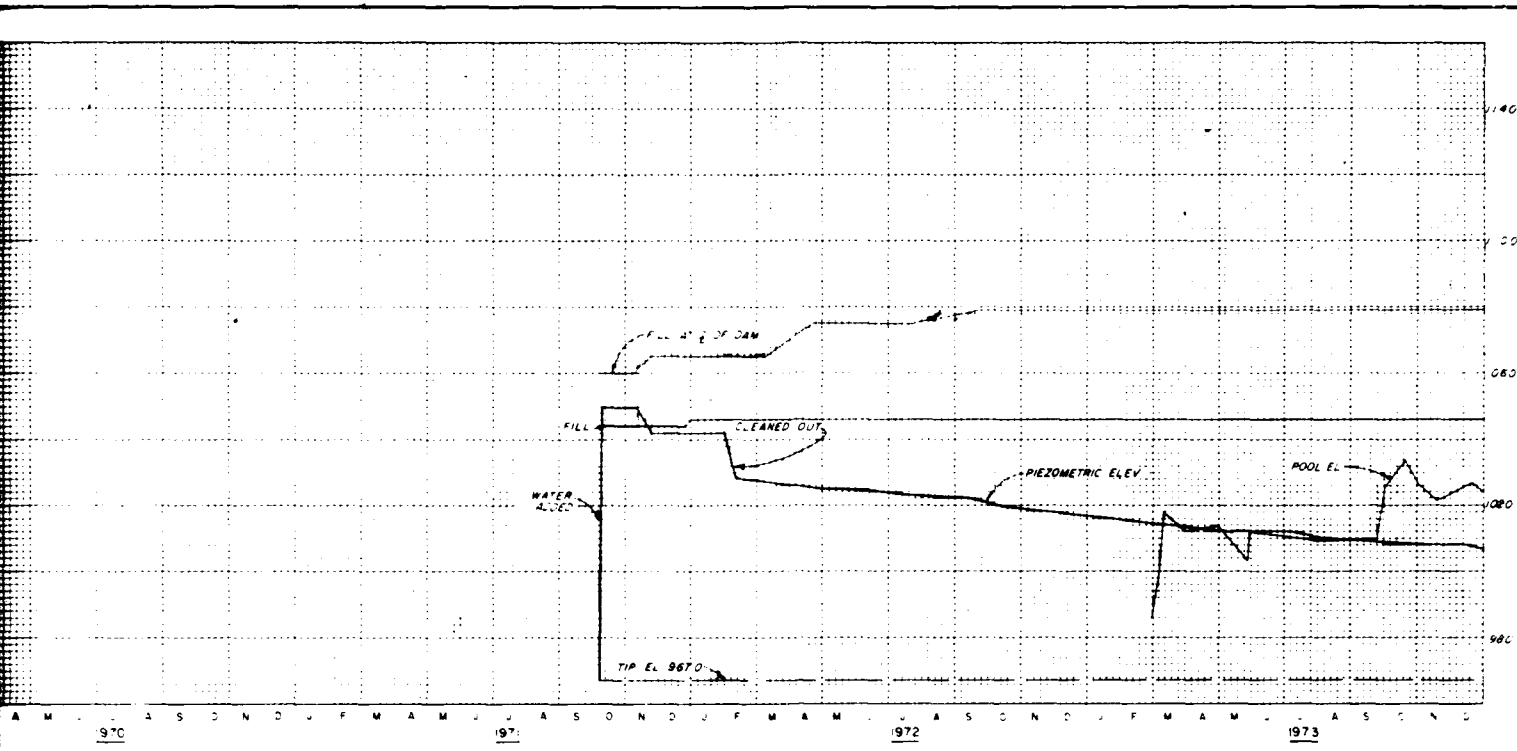
Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

FILE NO. 0-5-1282
AUGUST 1975



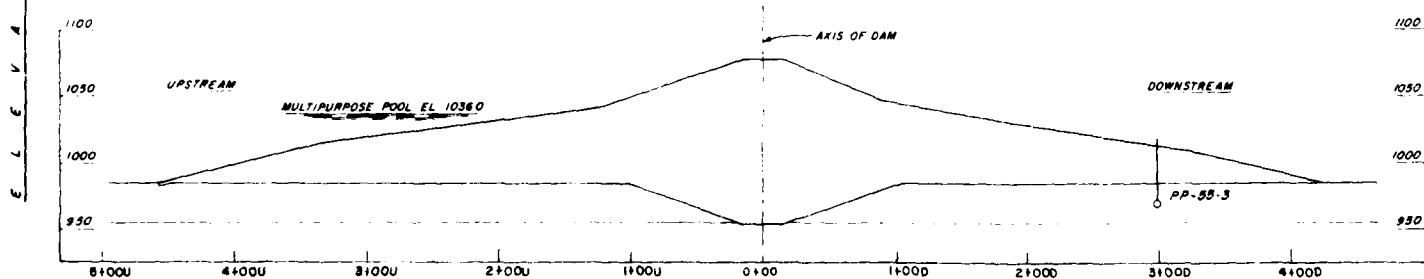
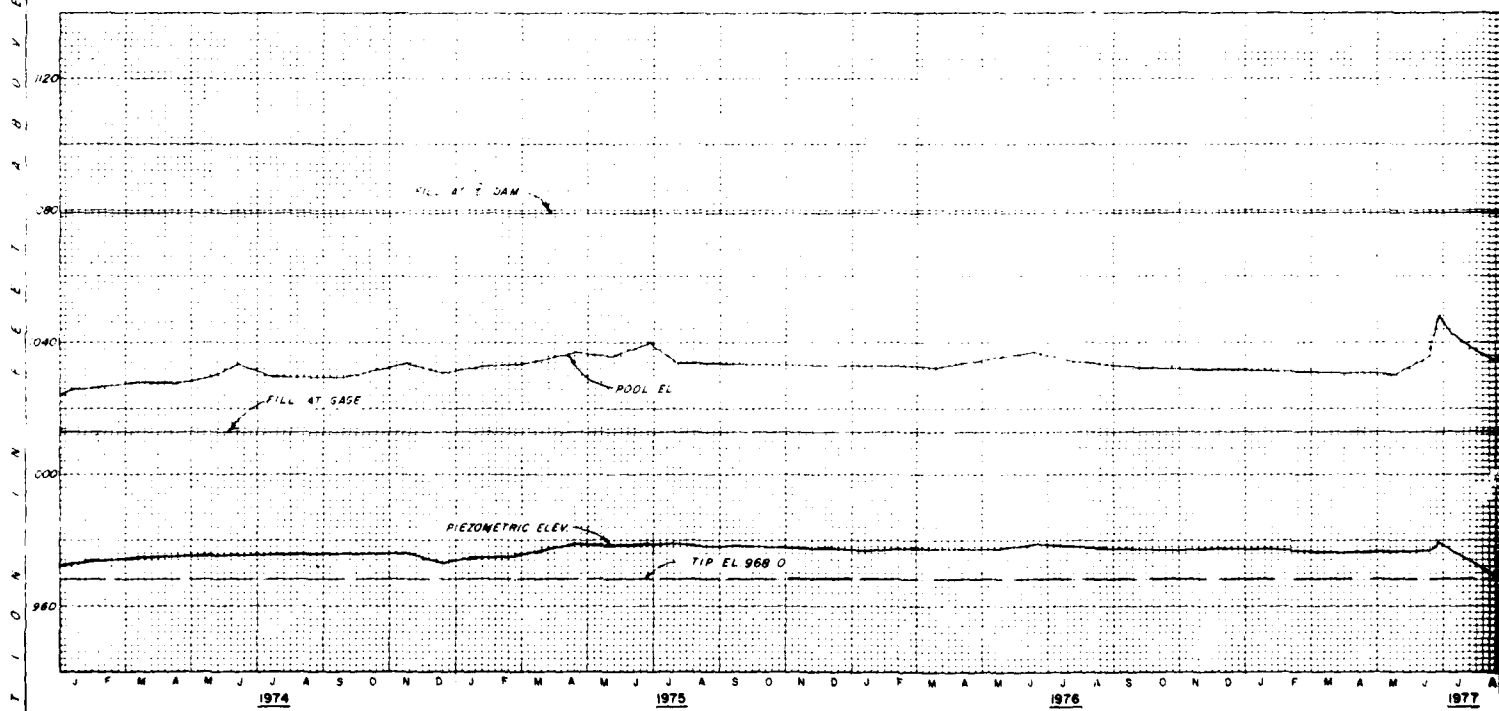
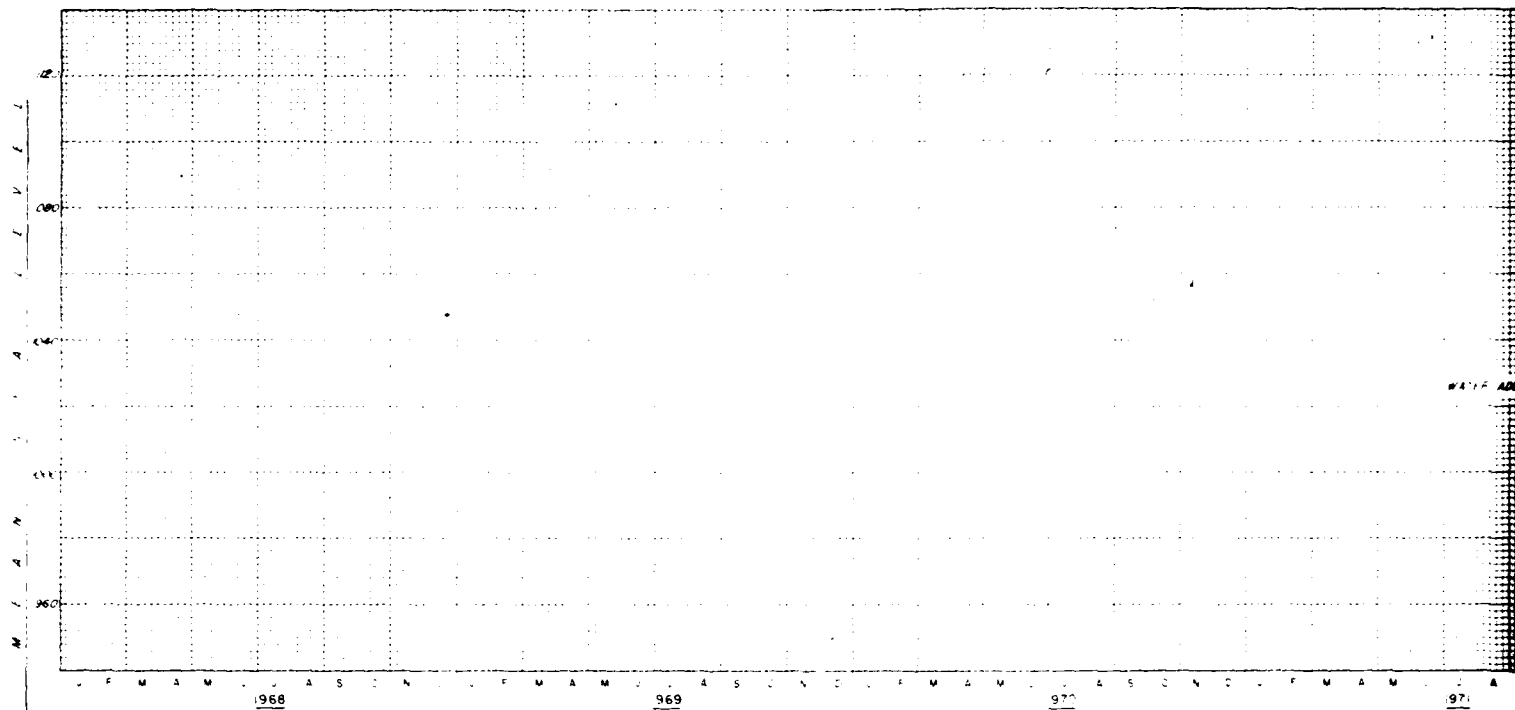


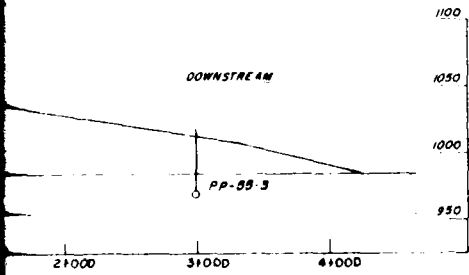
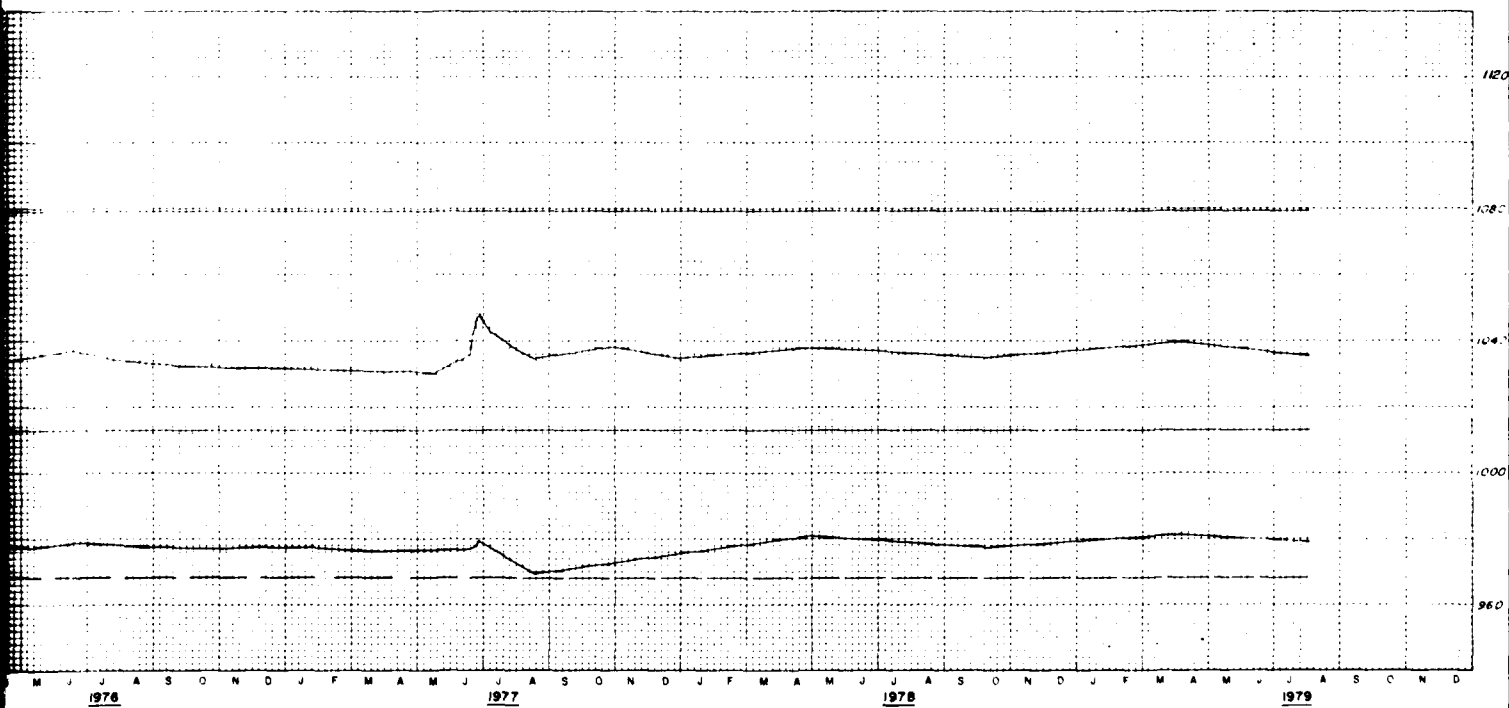
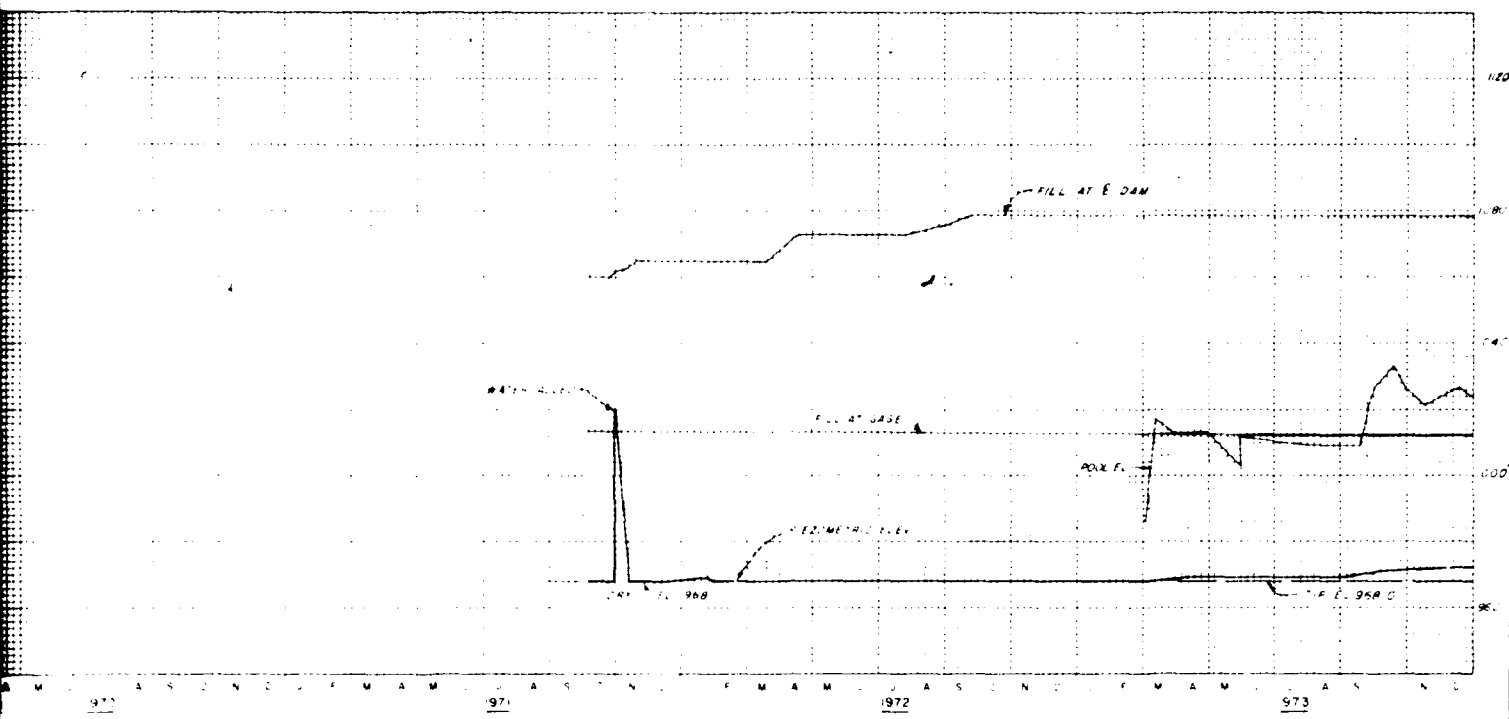
LEGEND
 OPEN TUBE ————○
 PNEUMATIC CELL ————●

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 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-55-2 (OPEN TUBE)

In 1 sheet
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 KANSAS CITY DISTRICT
 FILE NO. 0-5-1283
 AUGUST 1975
 Scale as shown





LEGEND
 OPEN TUBE ————○
 PNEUMATIC CELL ————●

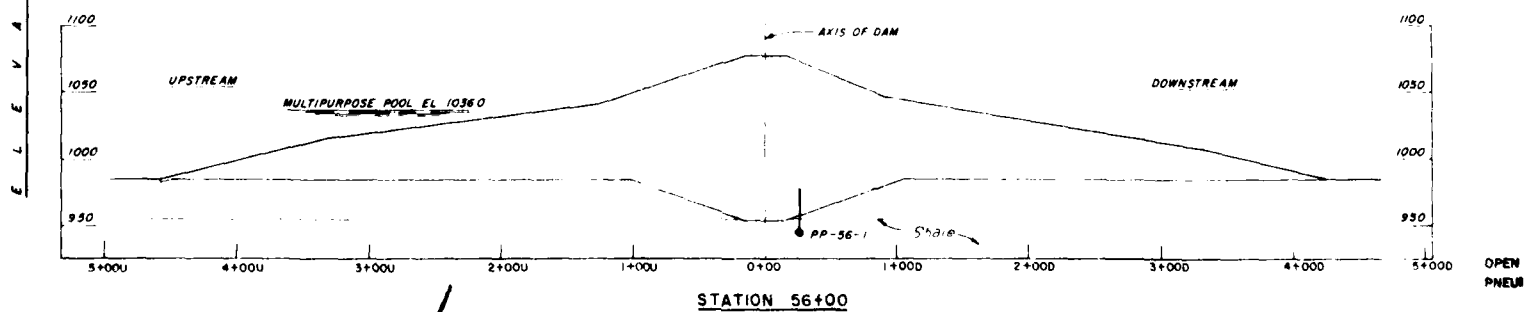
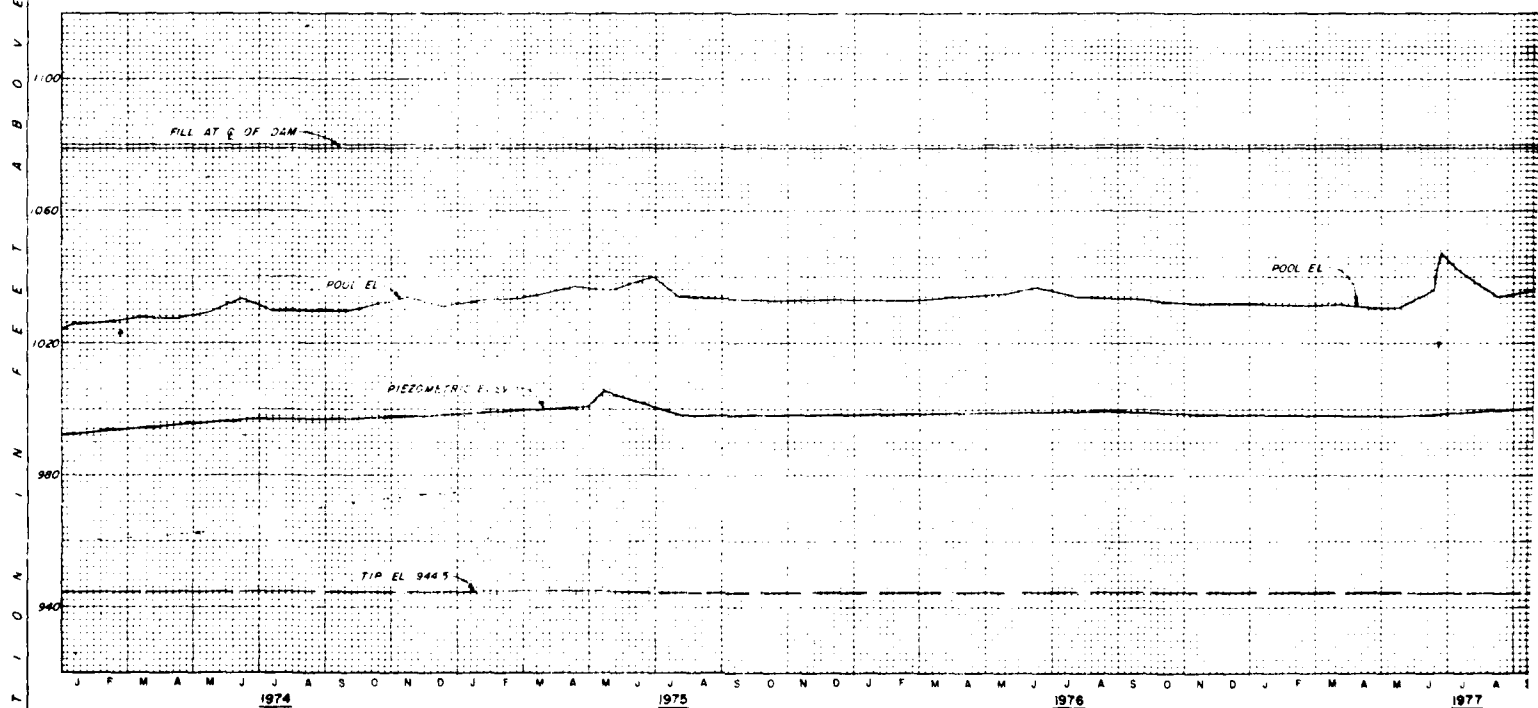
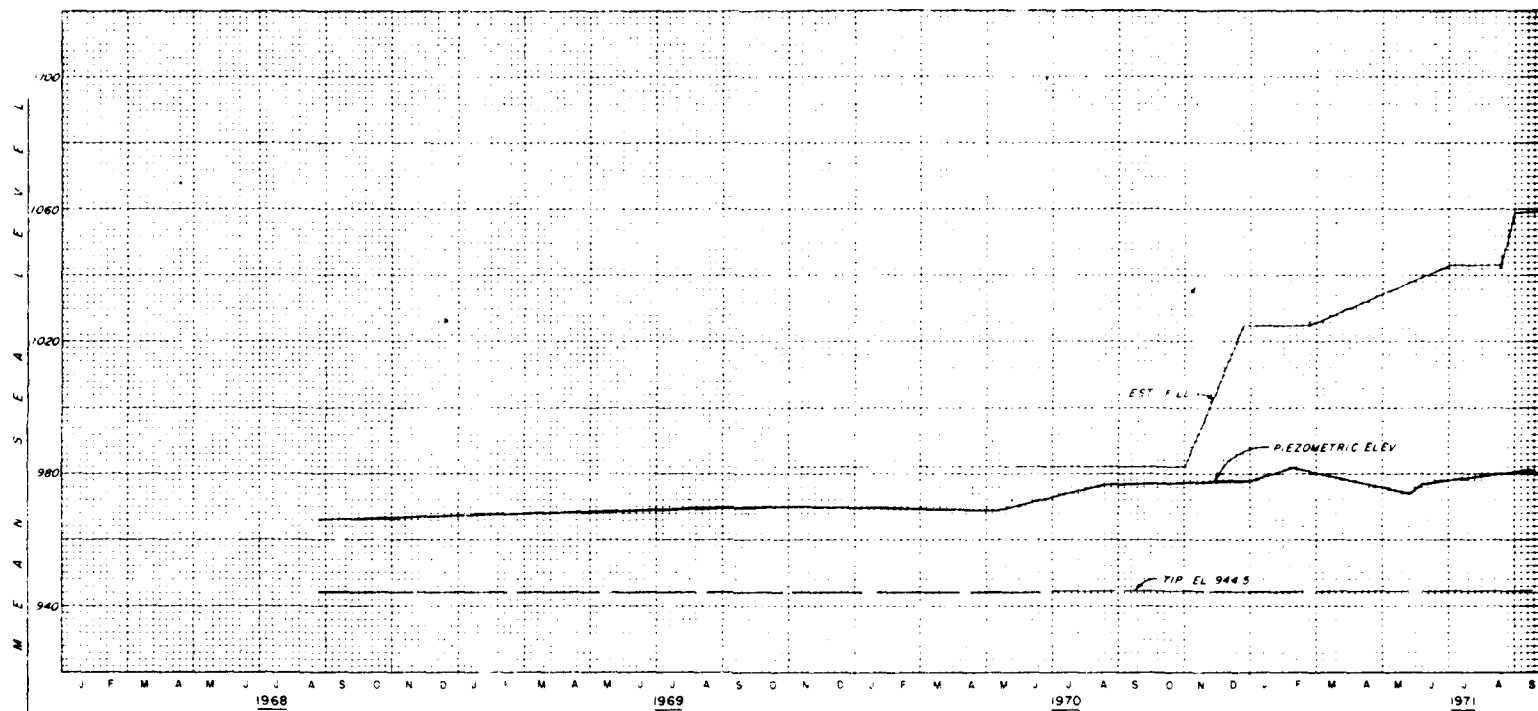
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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

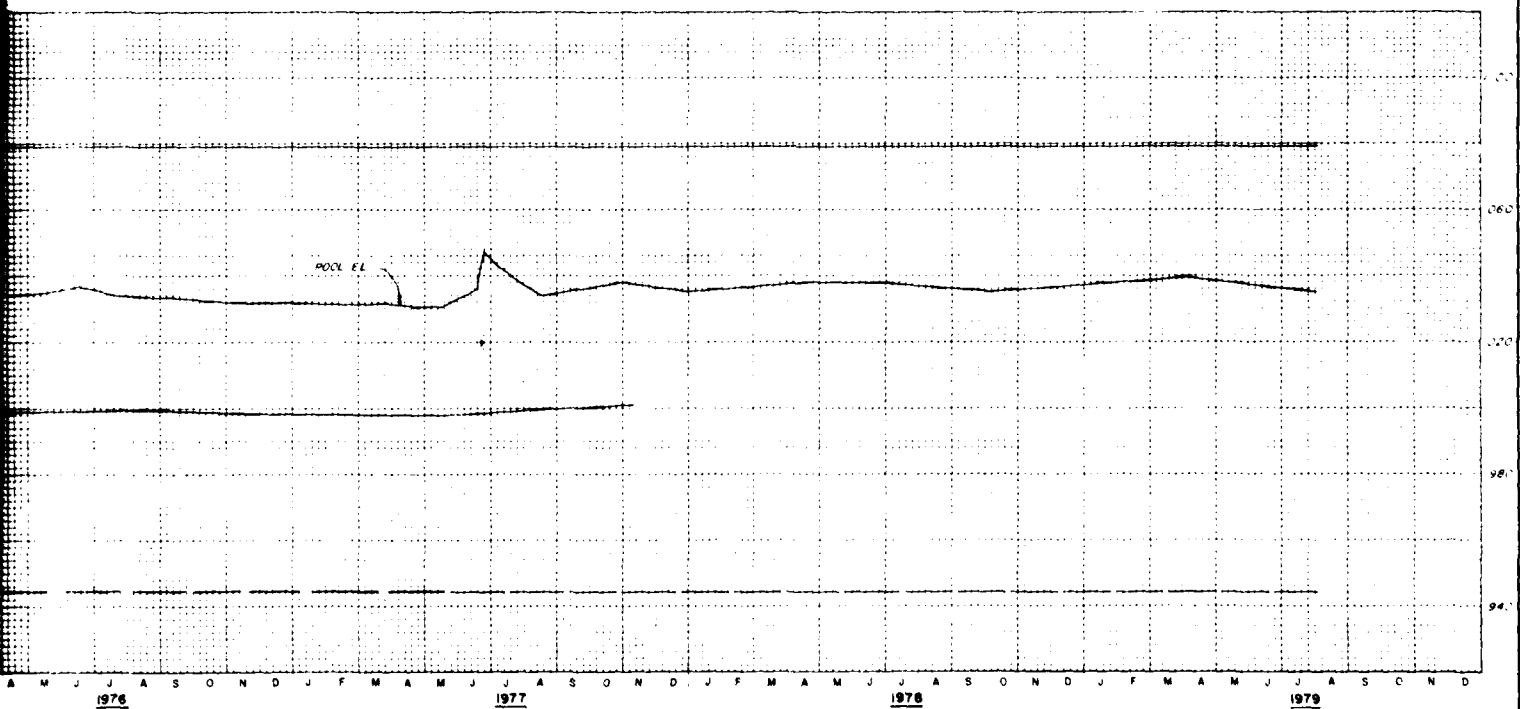
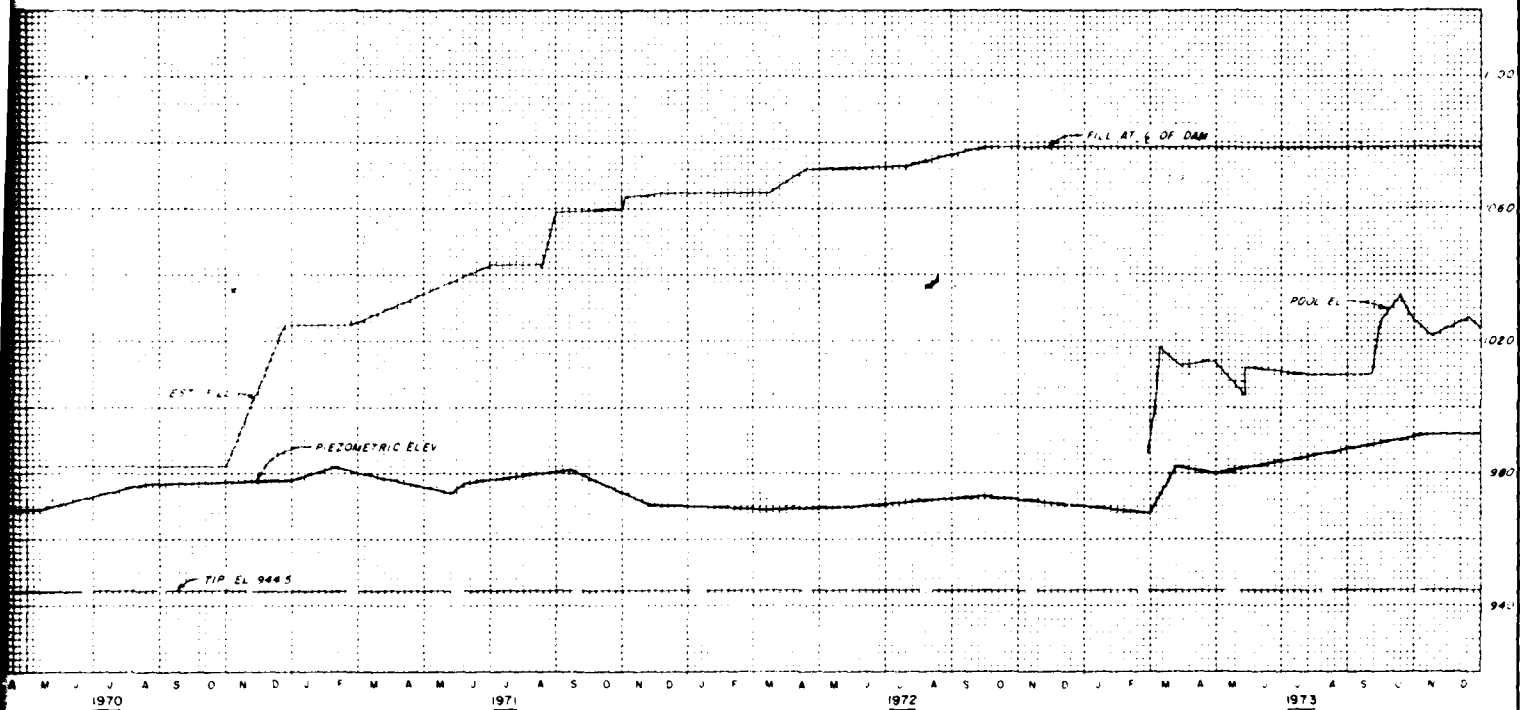
INSTRUMENTATION PLOTS
 PP55-3 (OPEN TUBE)

In 1 sheet

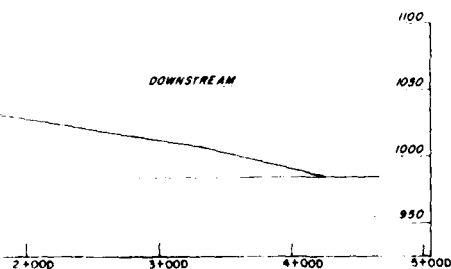
Sheet No. 1
 CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO 0-5-1284
 AUGUST 1975

Scale as shown





DOWNSTREAM



LEGEND
 OPEN TUBE
 PNEUMATIC CELL

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 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

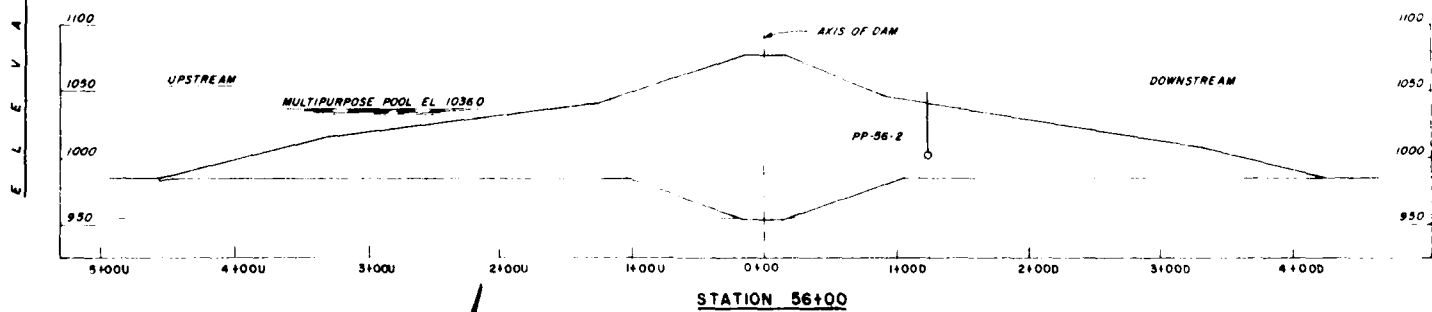
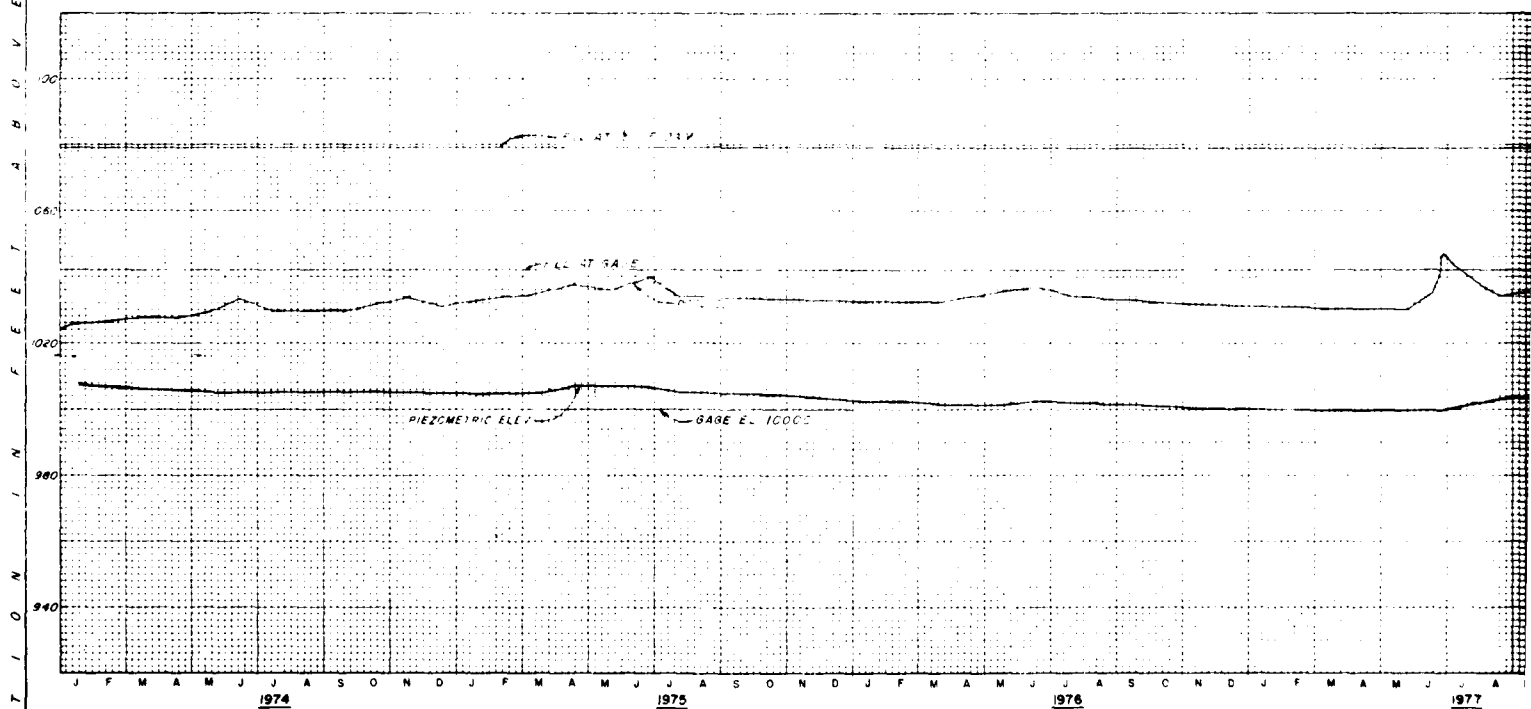
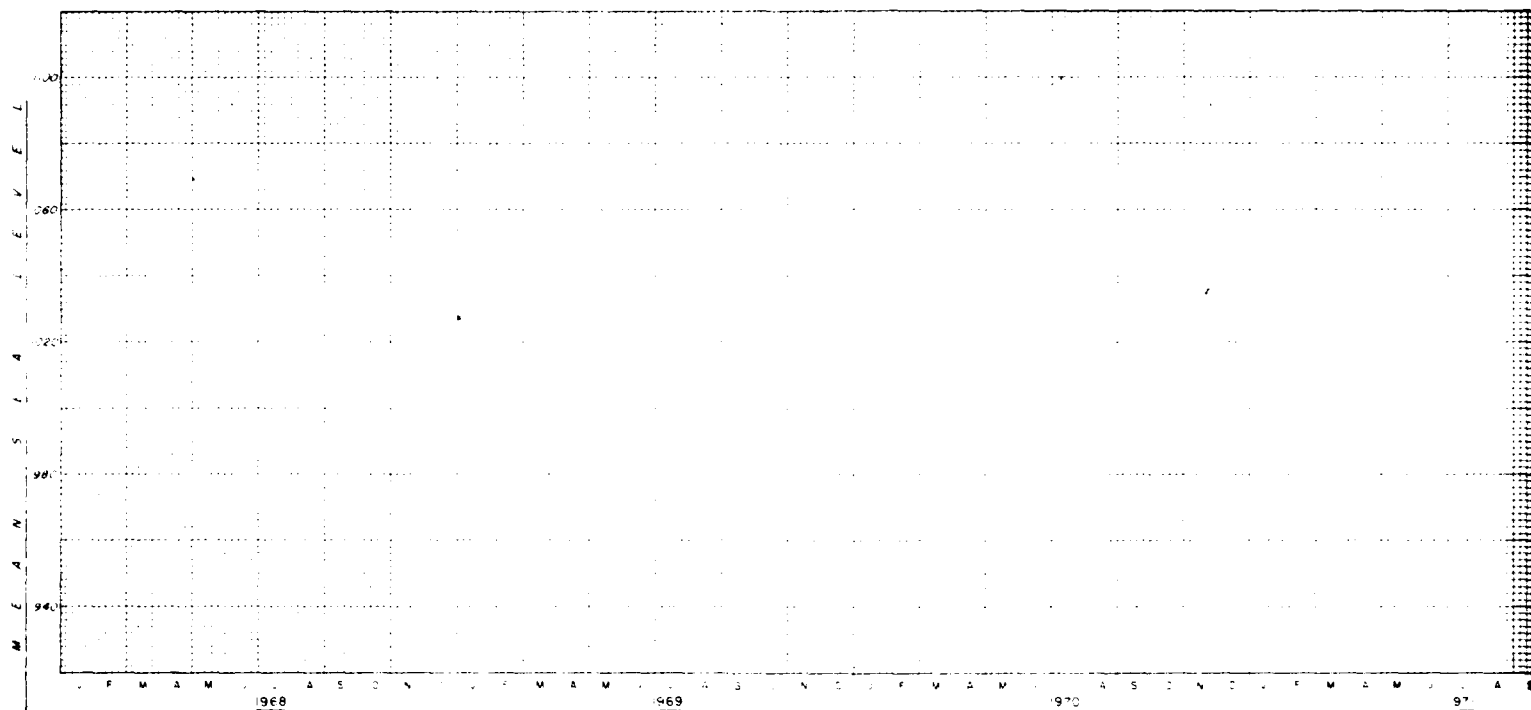
INSTRUMENTATION PLOTS
 PP-56-1 (SHANNON-WILSON CELL)

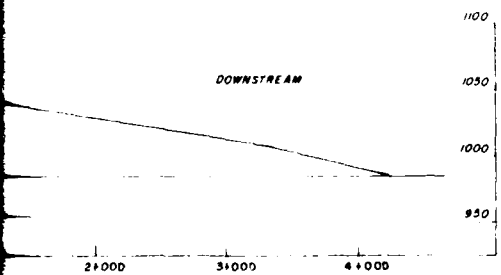
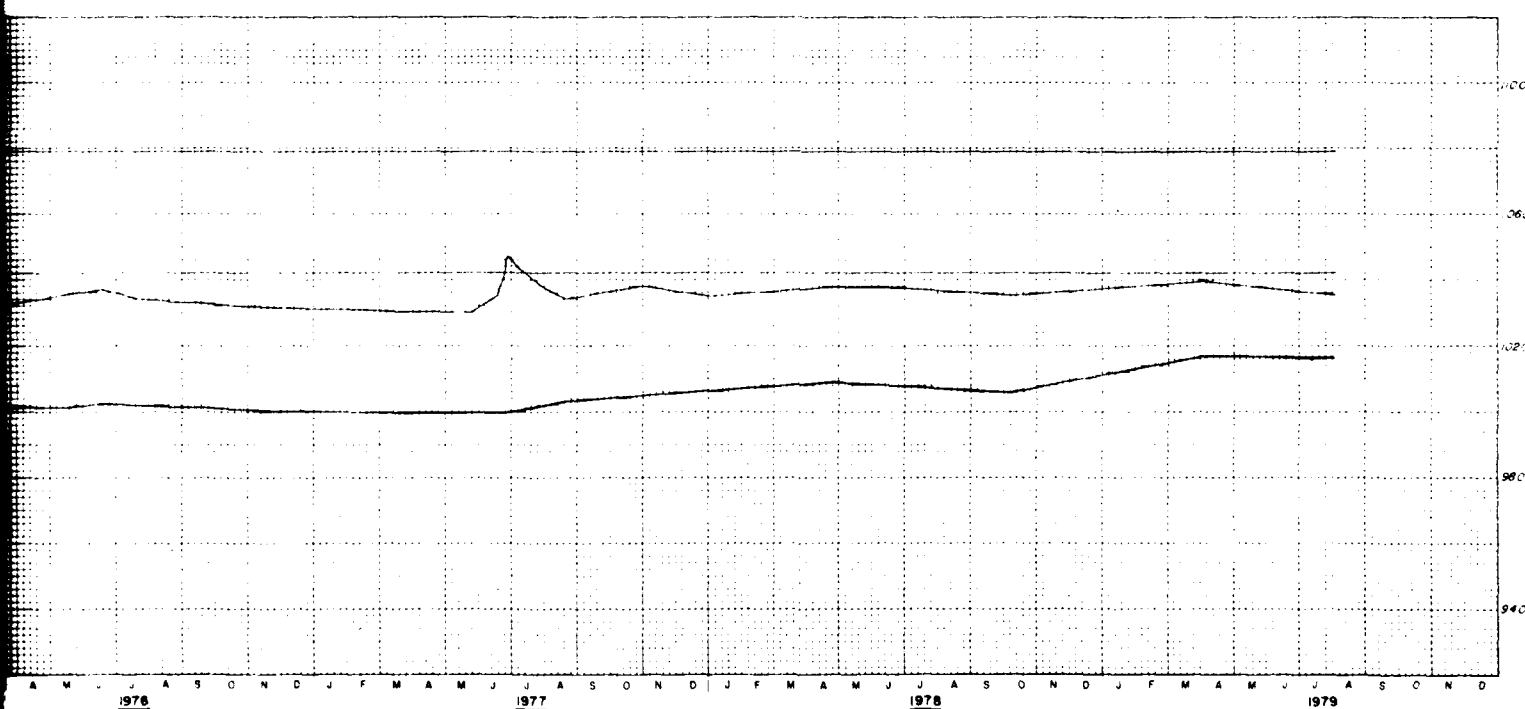
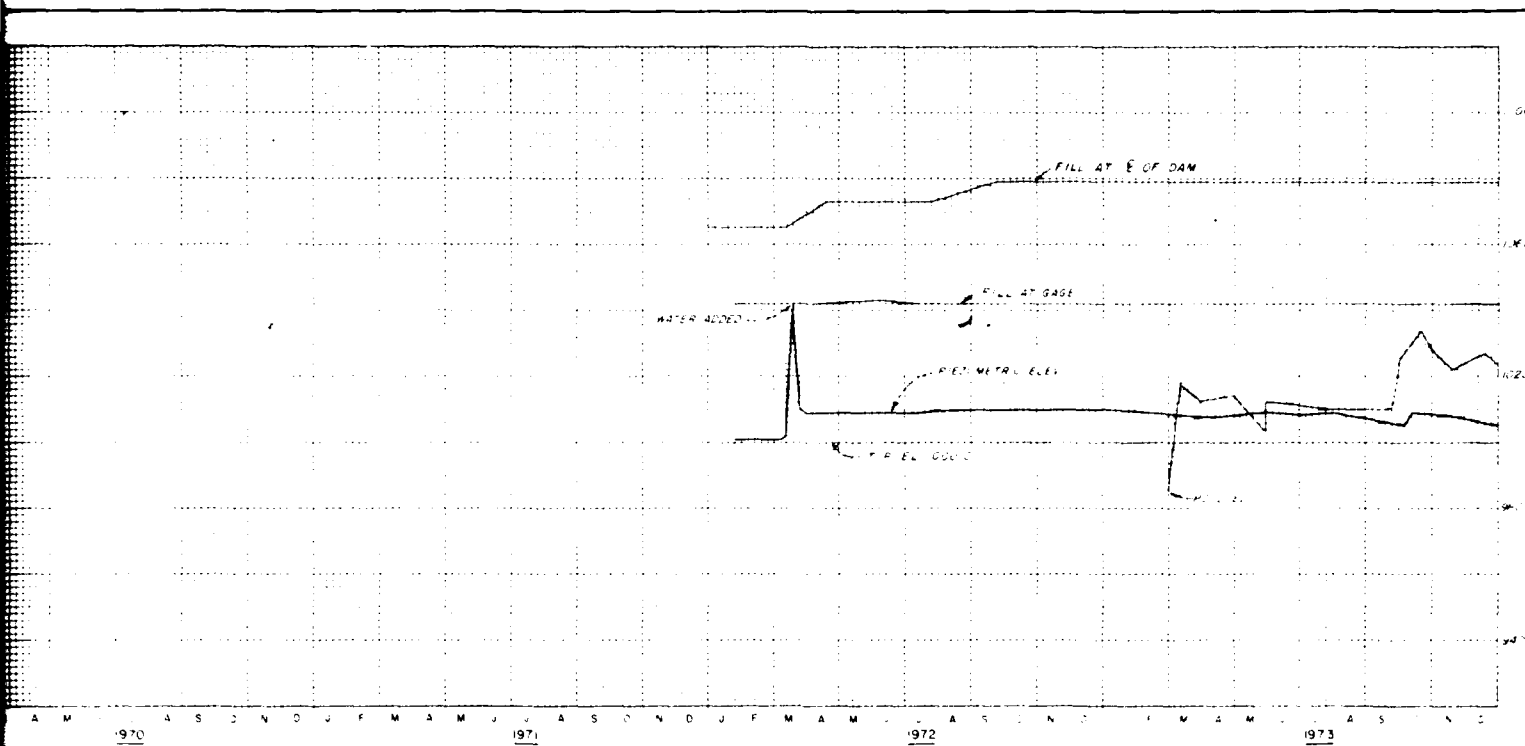
In 1 sheet

Sheet No. 1
 CORPS OF ENGINEERS U. S. ARMY
 KANSAS CITY DISTRICT

Scale as shown

FILE NO. 0-5-1285
 AUGUST 1979





LEGEND
 OPEN TUBE ———— ○
 PNEUMATIC CELL ———— ●

Revised August 1979
 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

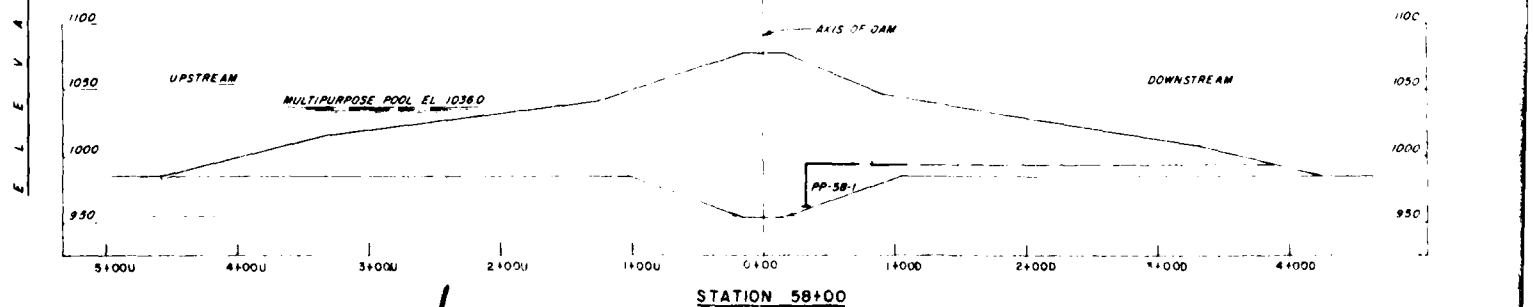
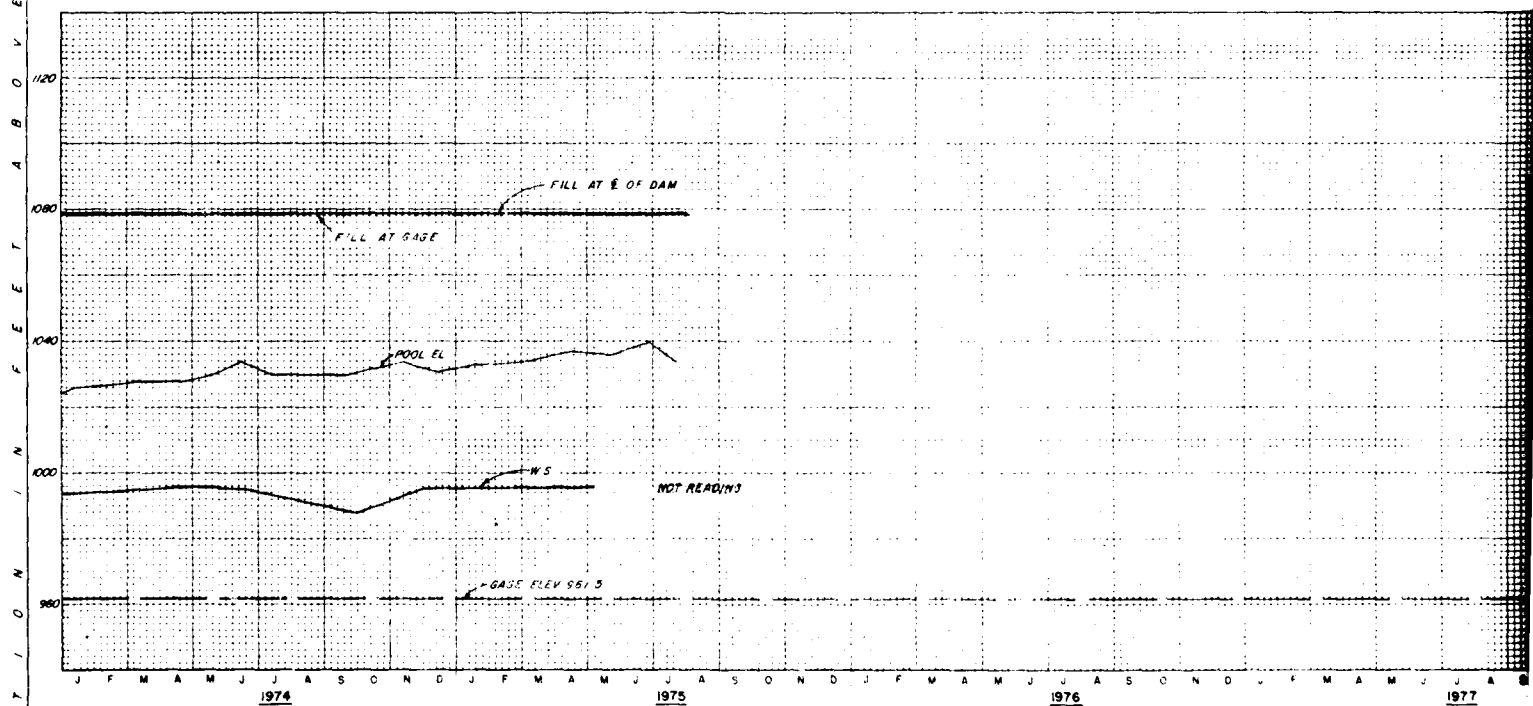
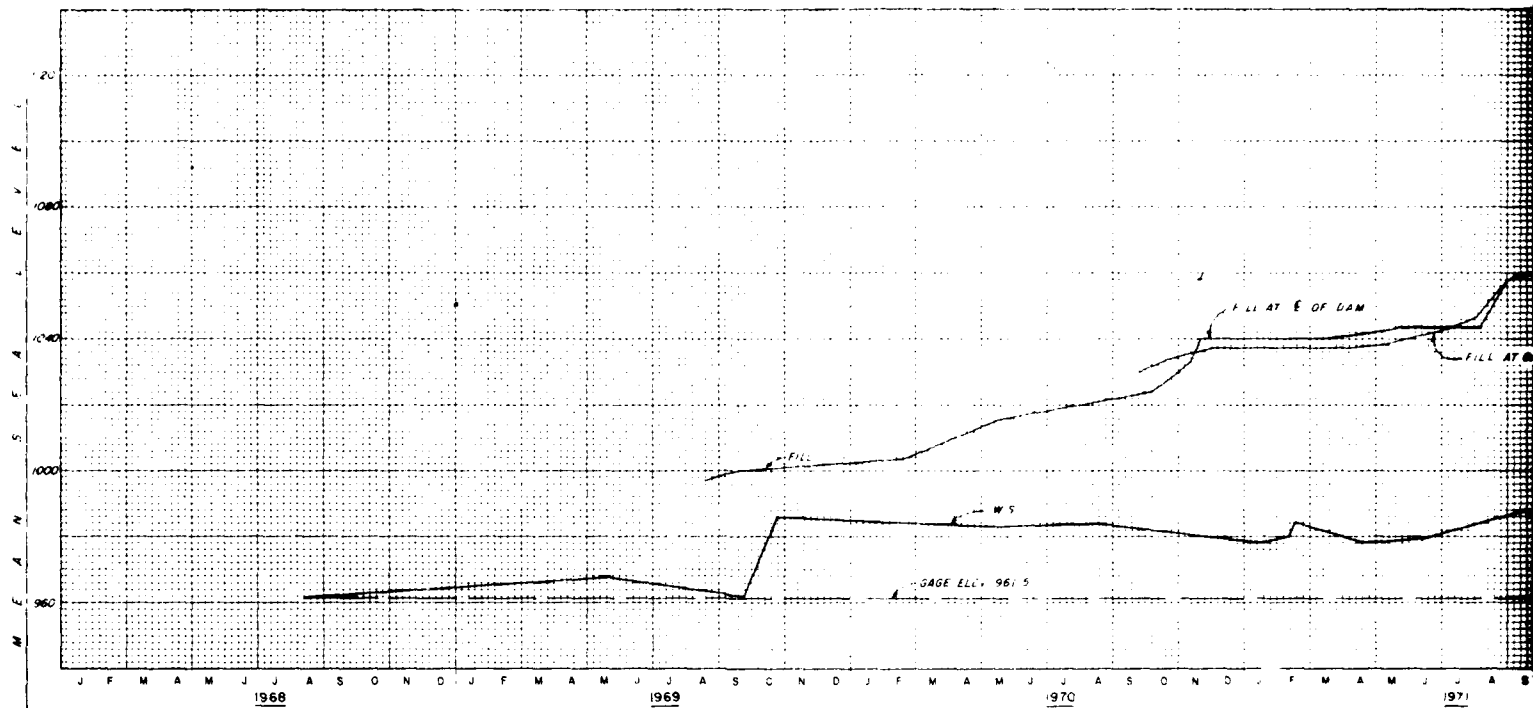
INSTRUMENTATION PLOTS
 PP-56-2 (OPEN TUBE)

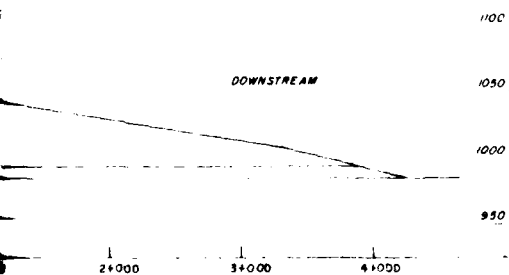
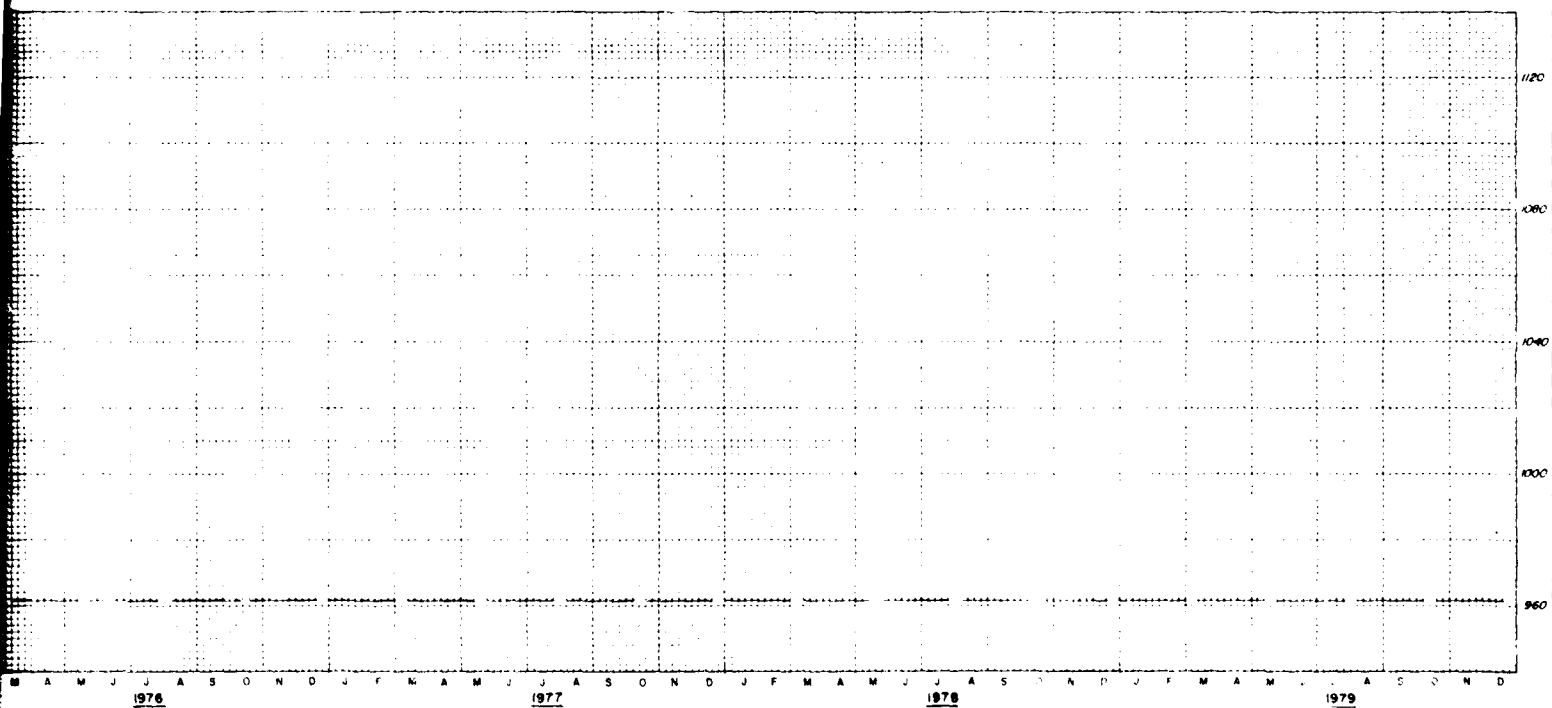
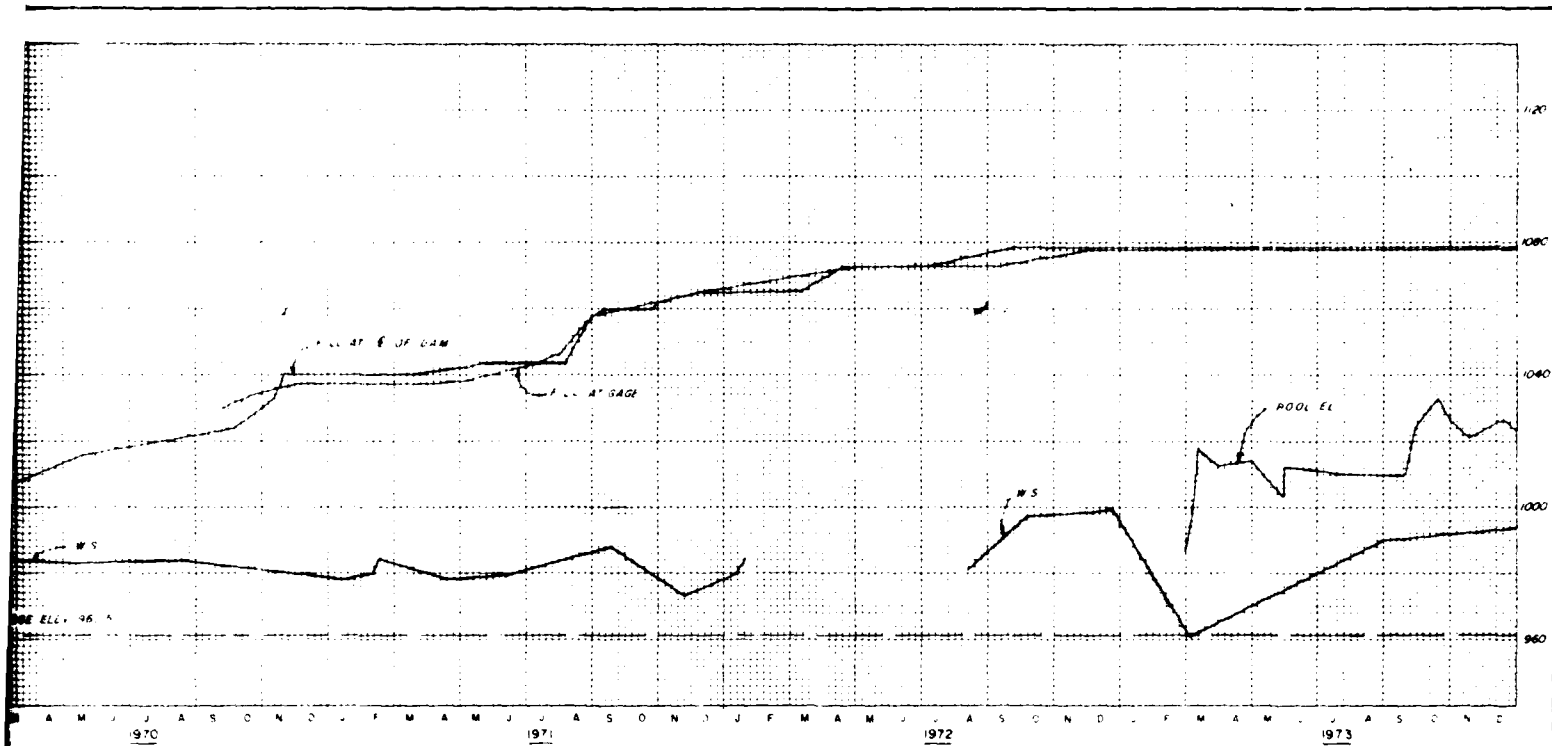
In 1 sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO 0-5-1286
 AUGUST 1975





MARSH DES CYGNE RIVER KANSAS
MELVERN LAKE

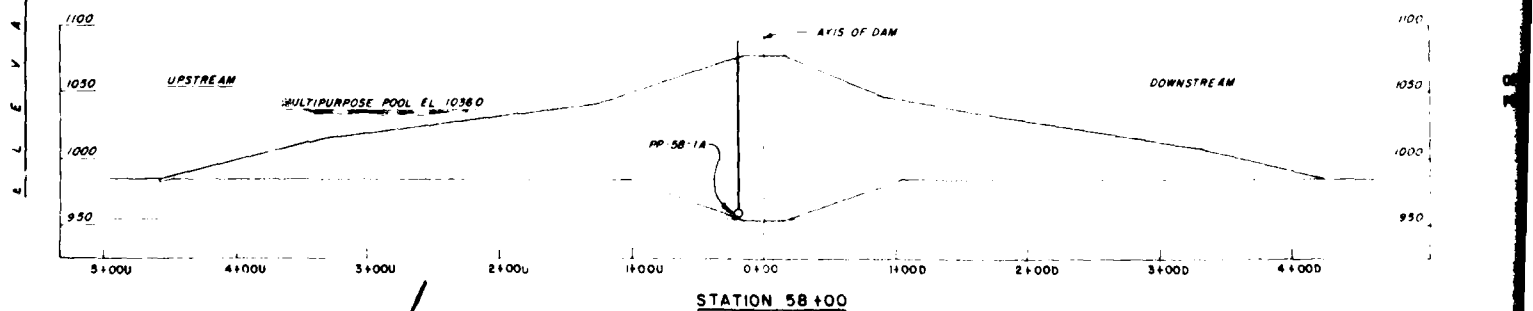
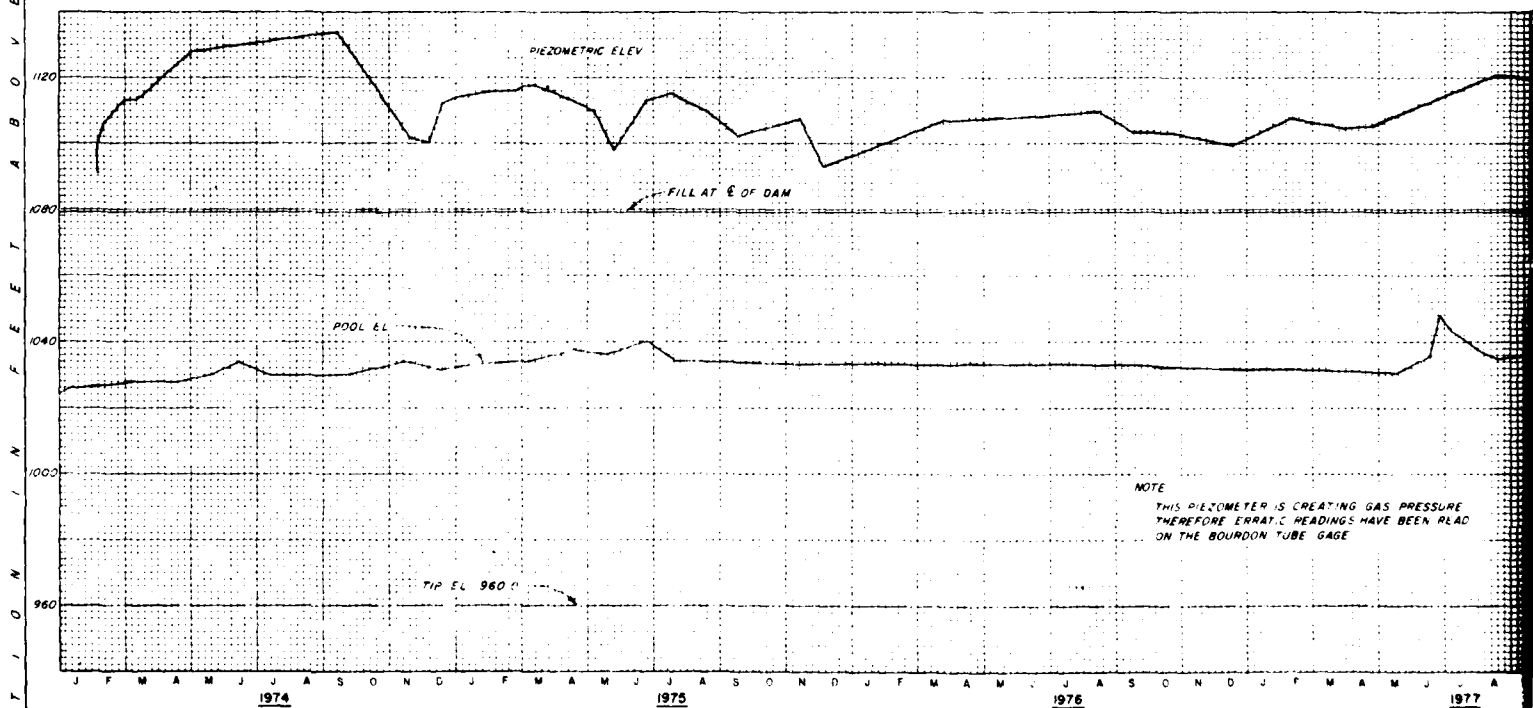
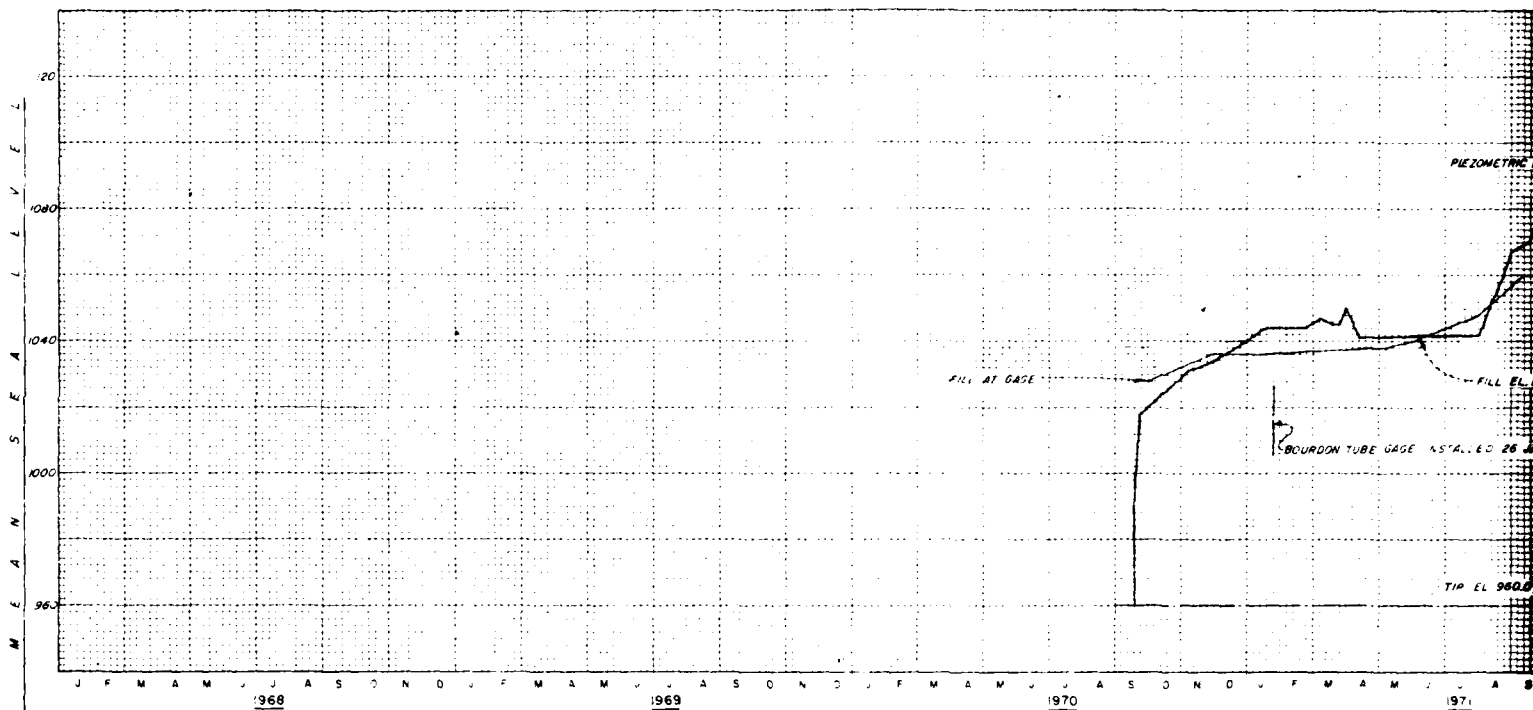
INSTRUMENTATION PLOTS
PP-58-1 (SHANNON-WILSON CELL)

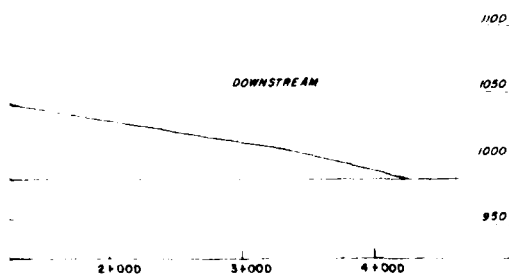
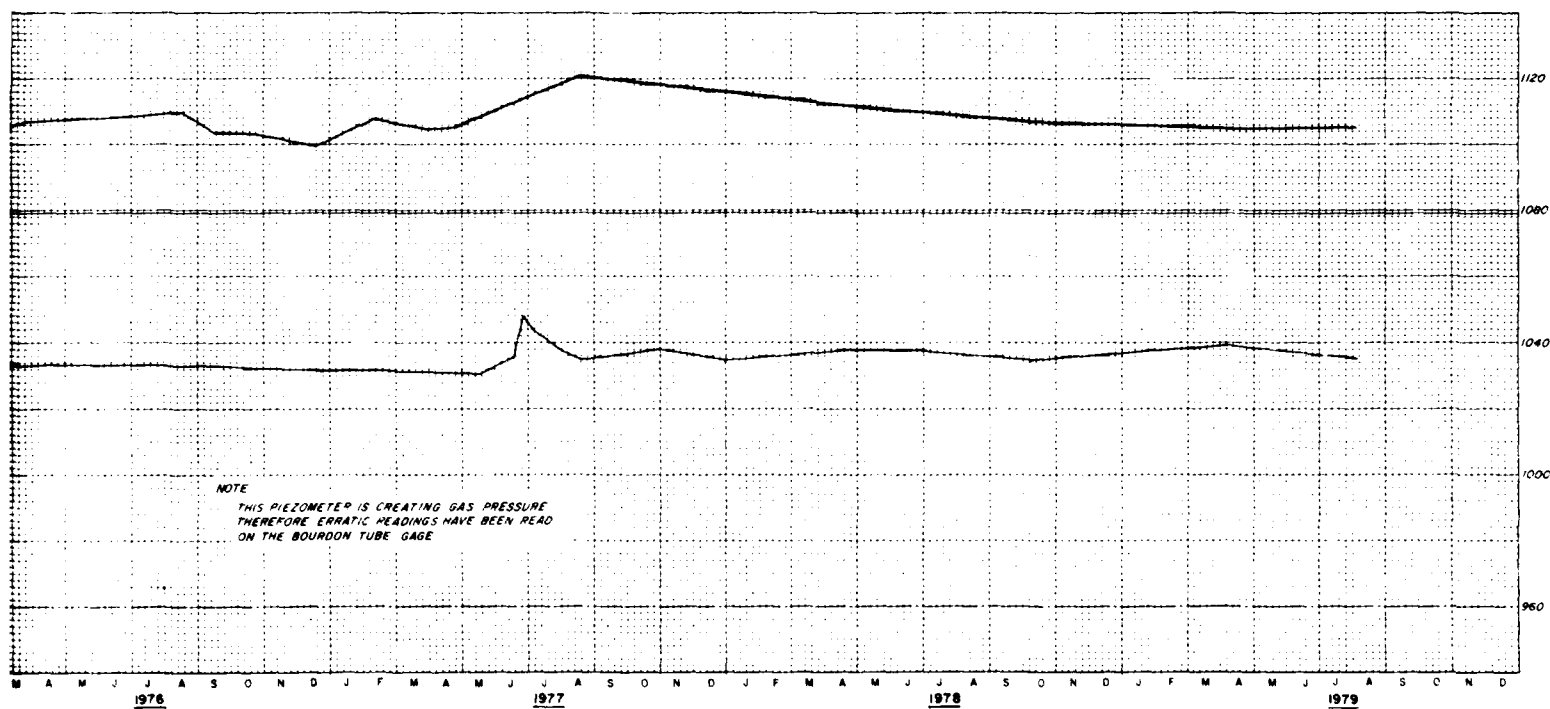
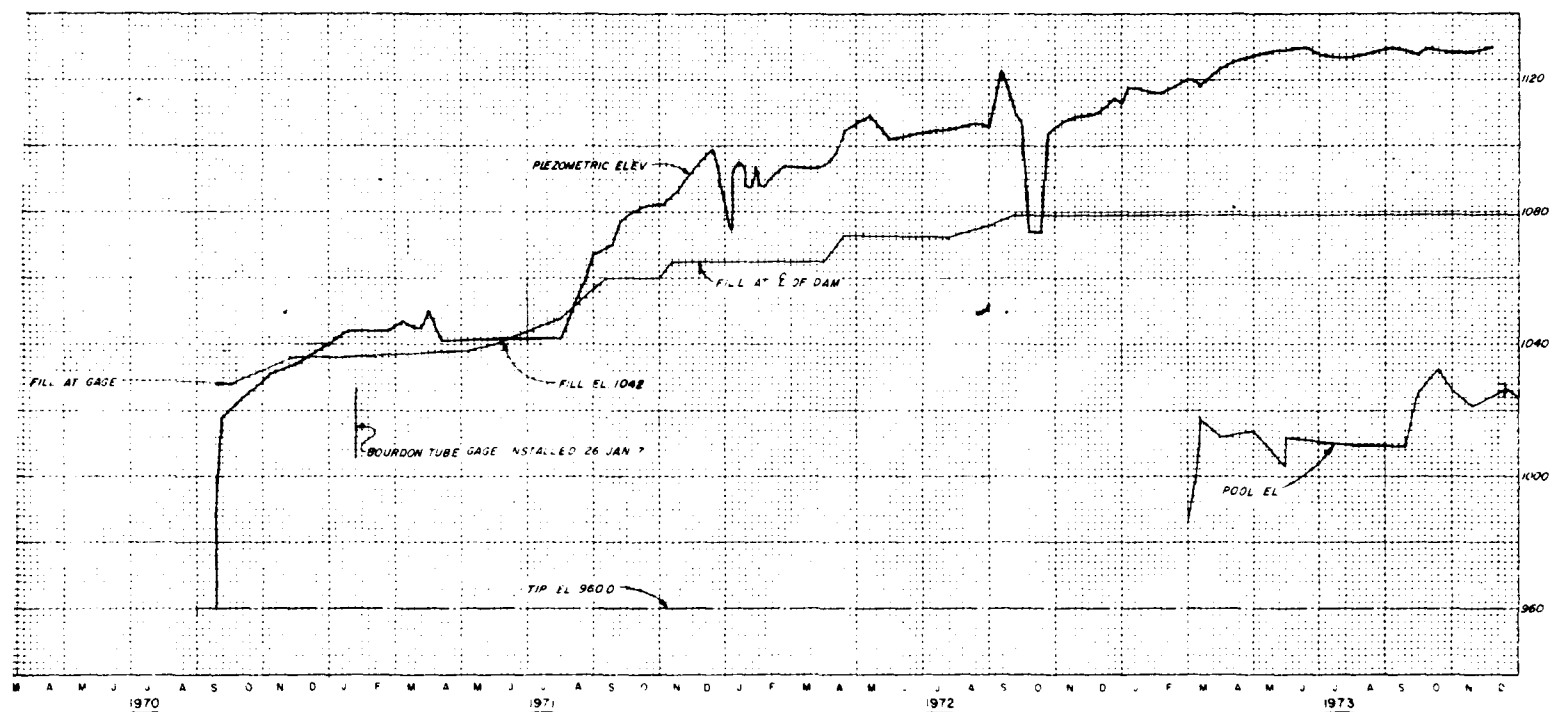
In 1 sheet

Sheet No. 1

Scale: as shown

FILE NO. O-5-1287
AUGUST 1975





LEGEND
 OPEN TUBE ○
 PNEUMATIC CELL ●

Revised August 979
 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

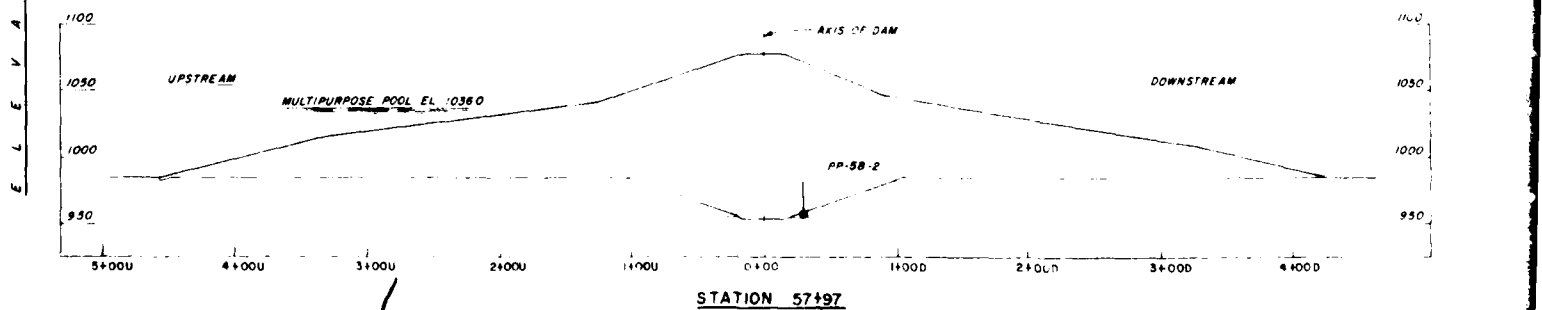
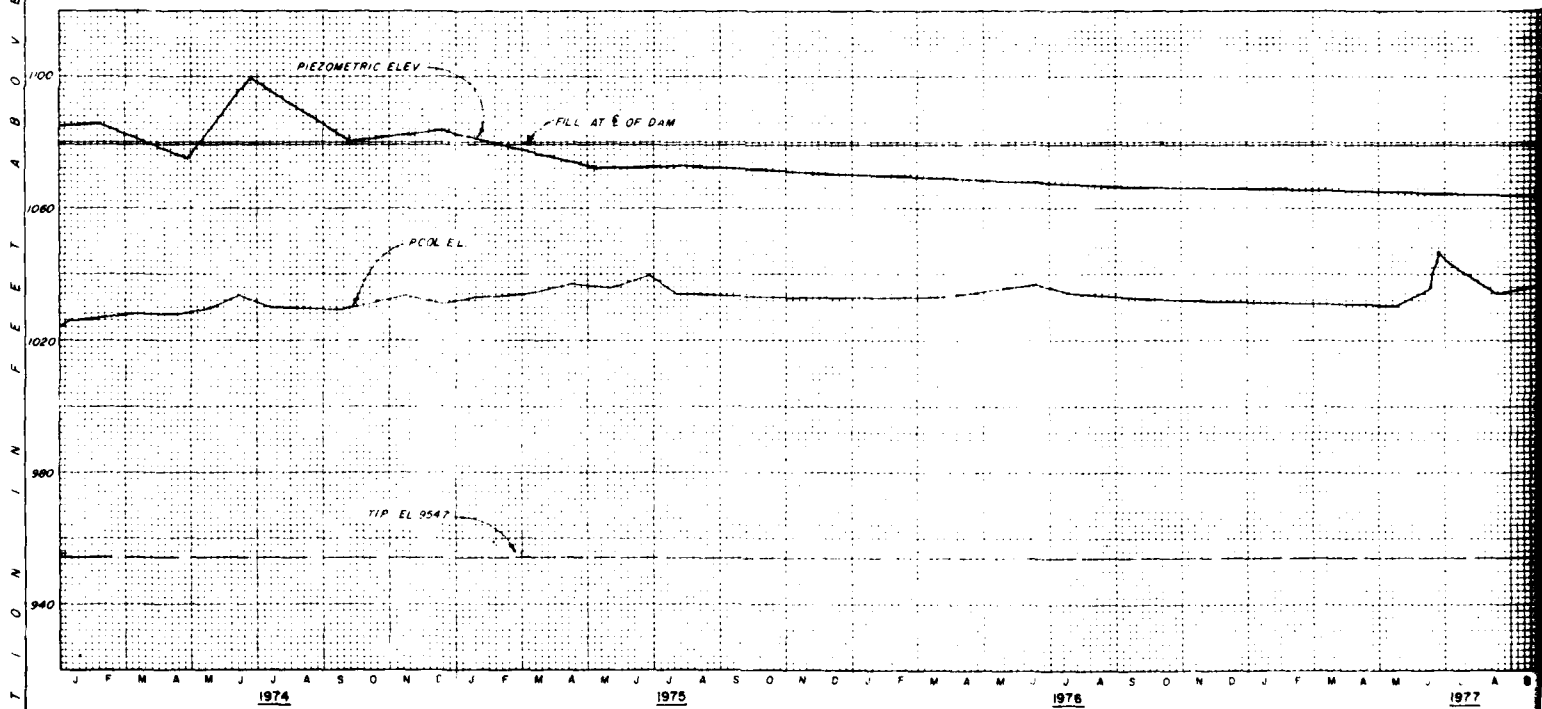
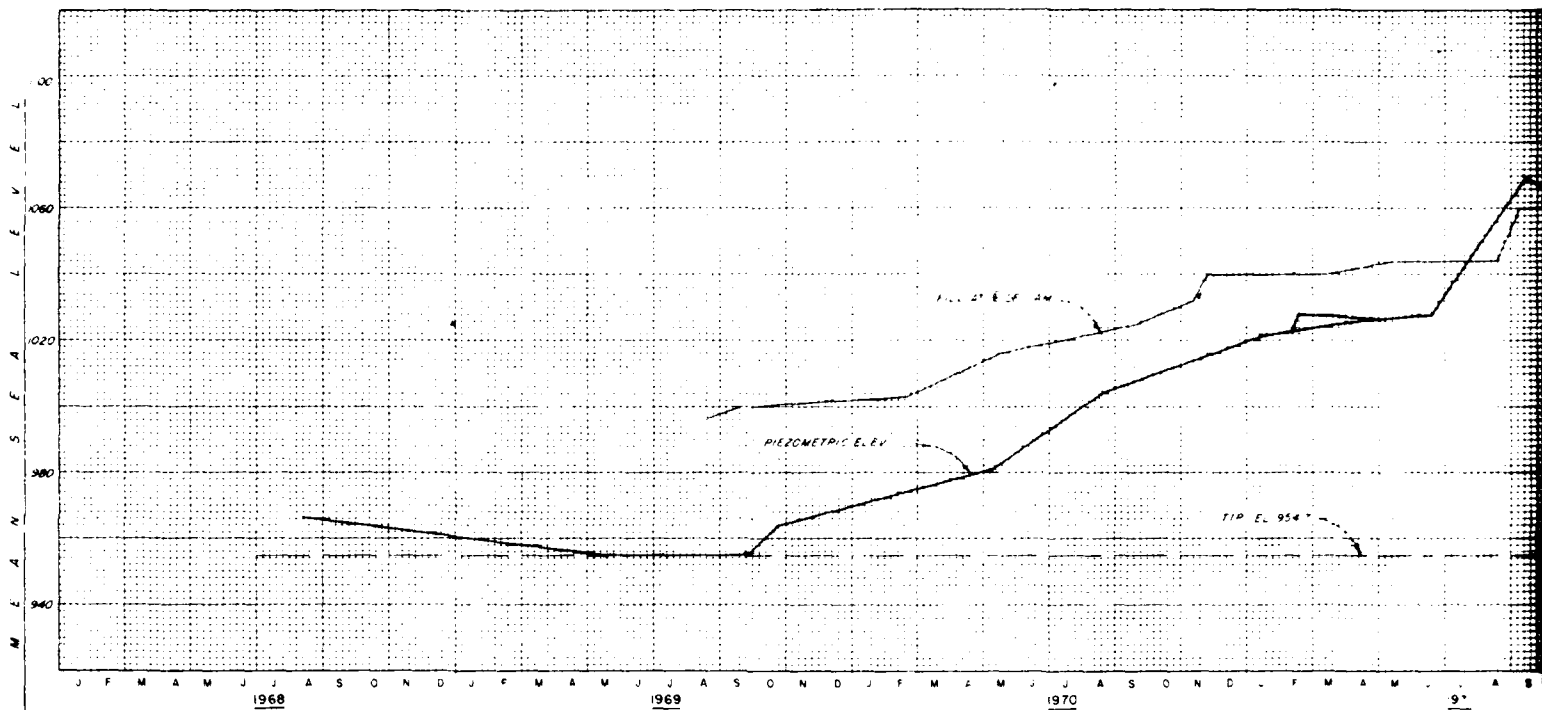
INSTRUMENTATION PLOTS
 PP-58-1A (OPEN TUBE)

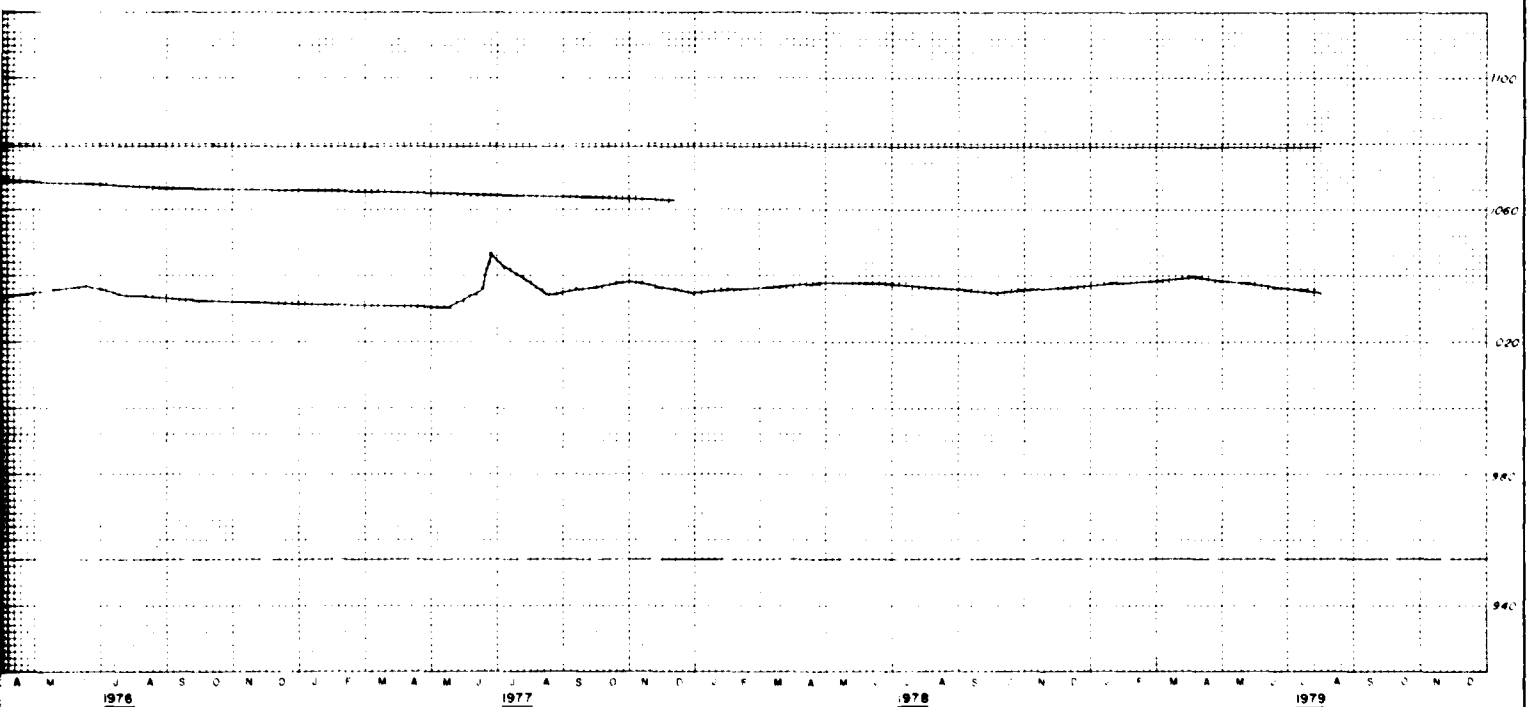
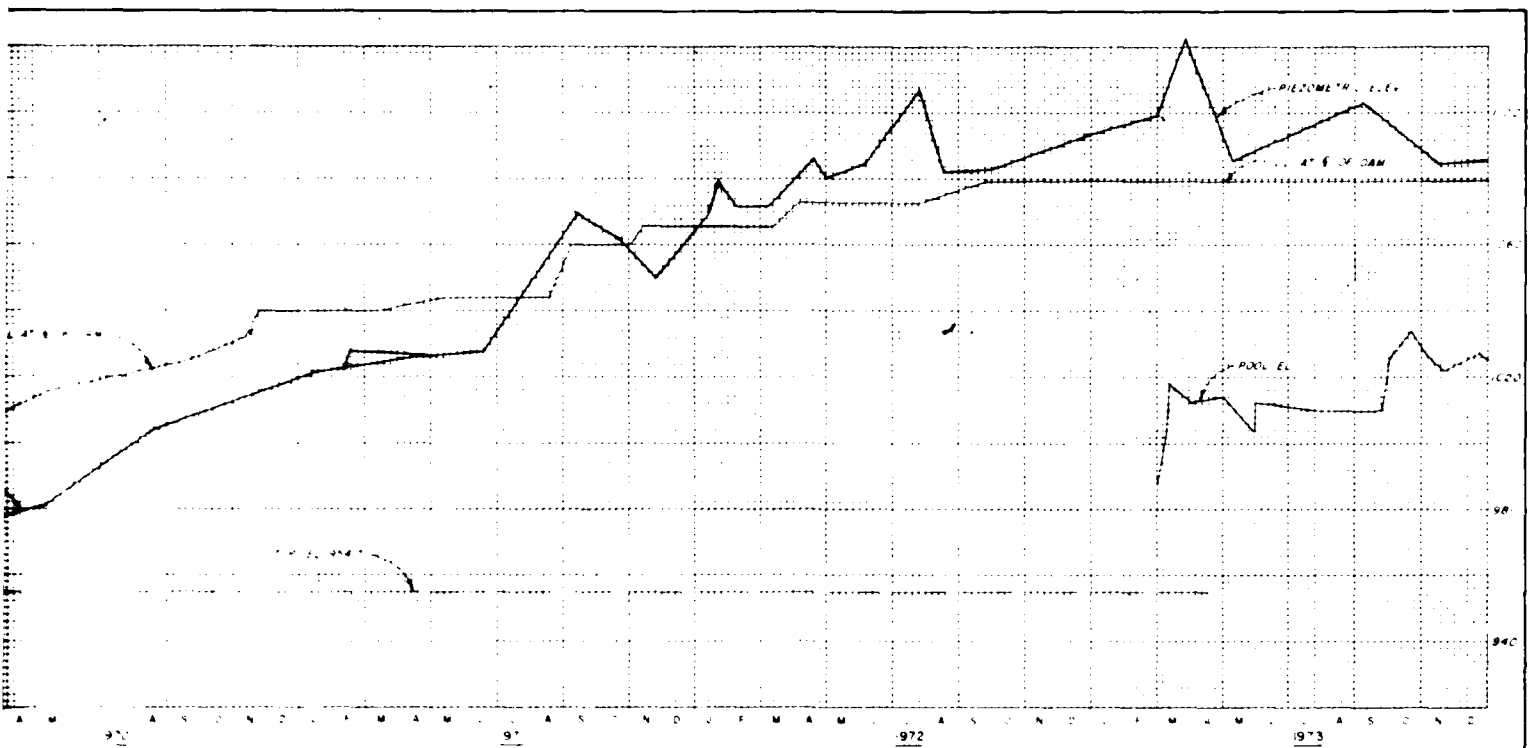
In 1 sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U. S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1288
 AUGUST 1975





DOWNSTREAM

LEGEND
 OPEN TUBE
 PNEUMATIC CELL

Revised August 1975
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

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

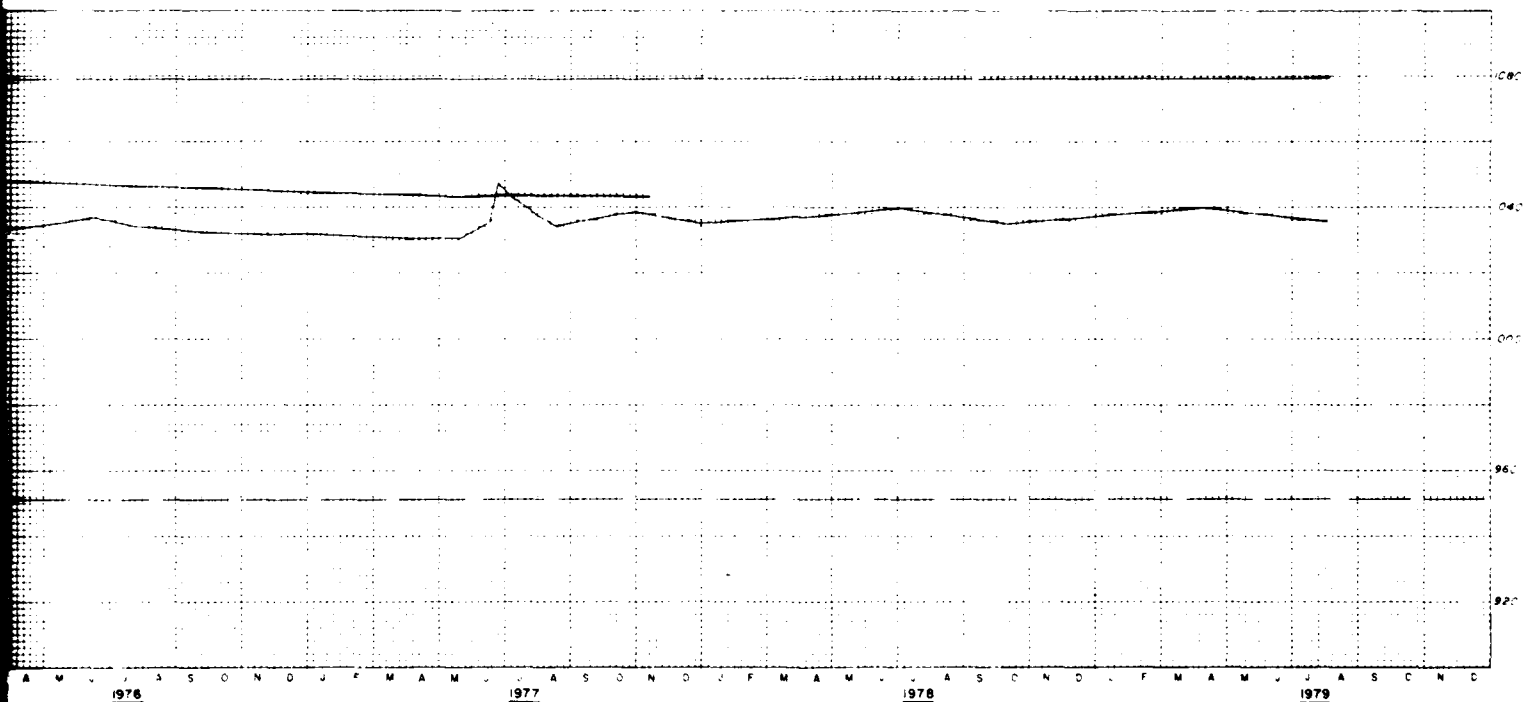
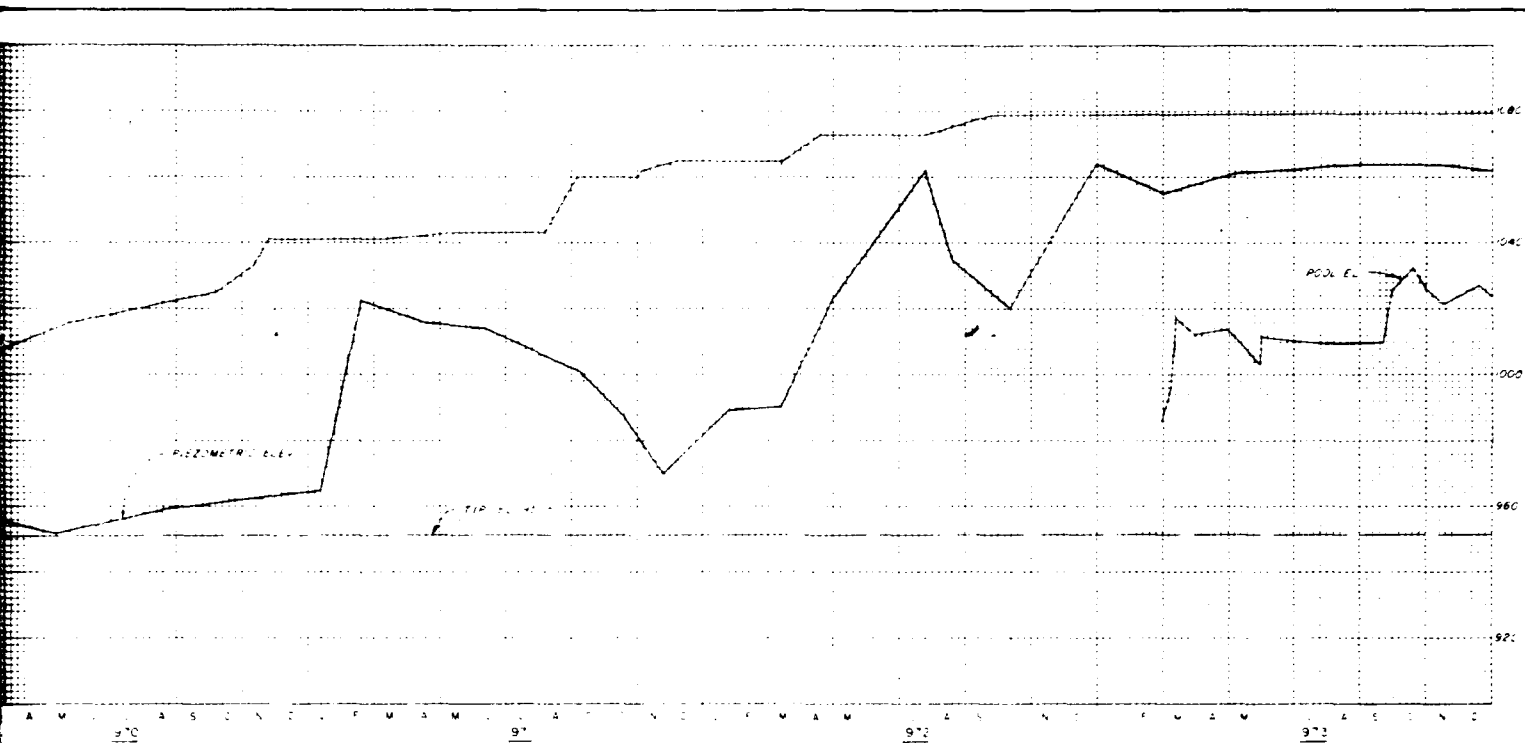
in 1 sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT

FILE NO 0-5-1289
 AUGUST 1975



DOWNSTREAM

1100
1050
1000
950
5+000

LEGEND

OPEN TUBE

PNEUMATIC CELL

2+000 3+000 4+000

Revised August 1979
MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

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

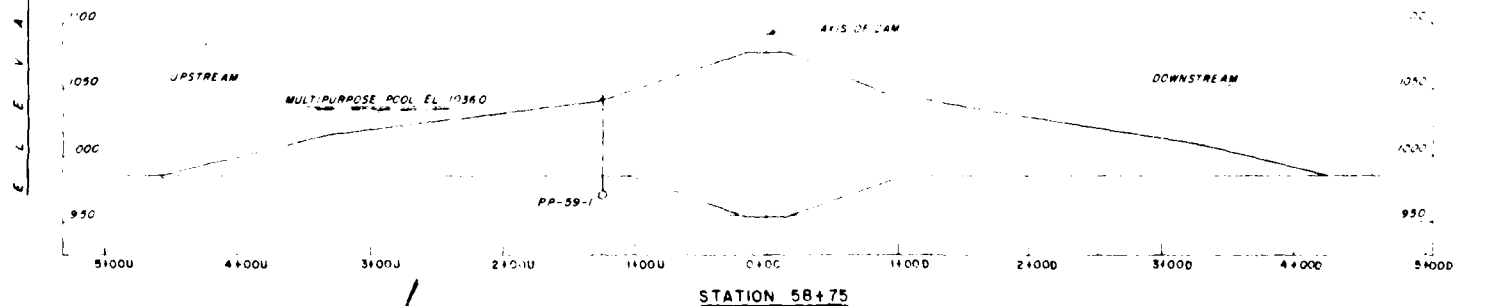
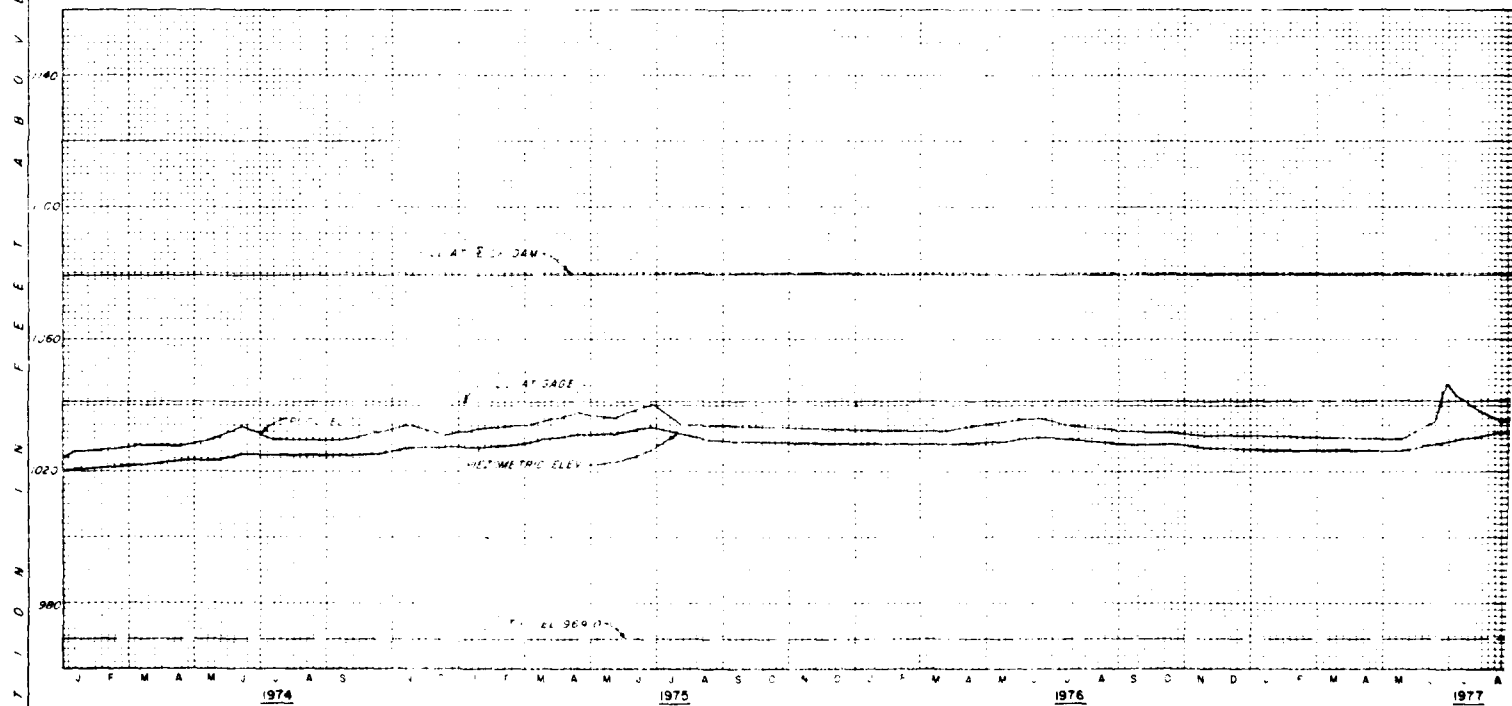
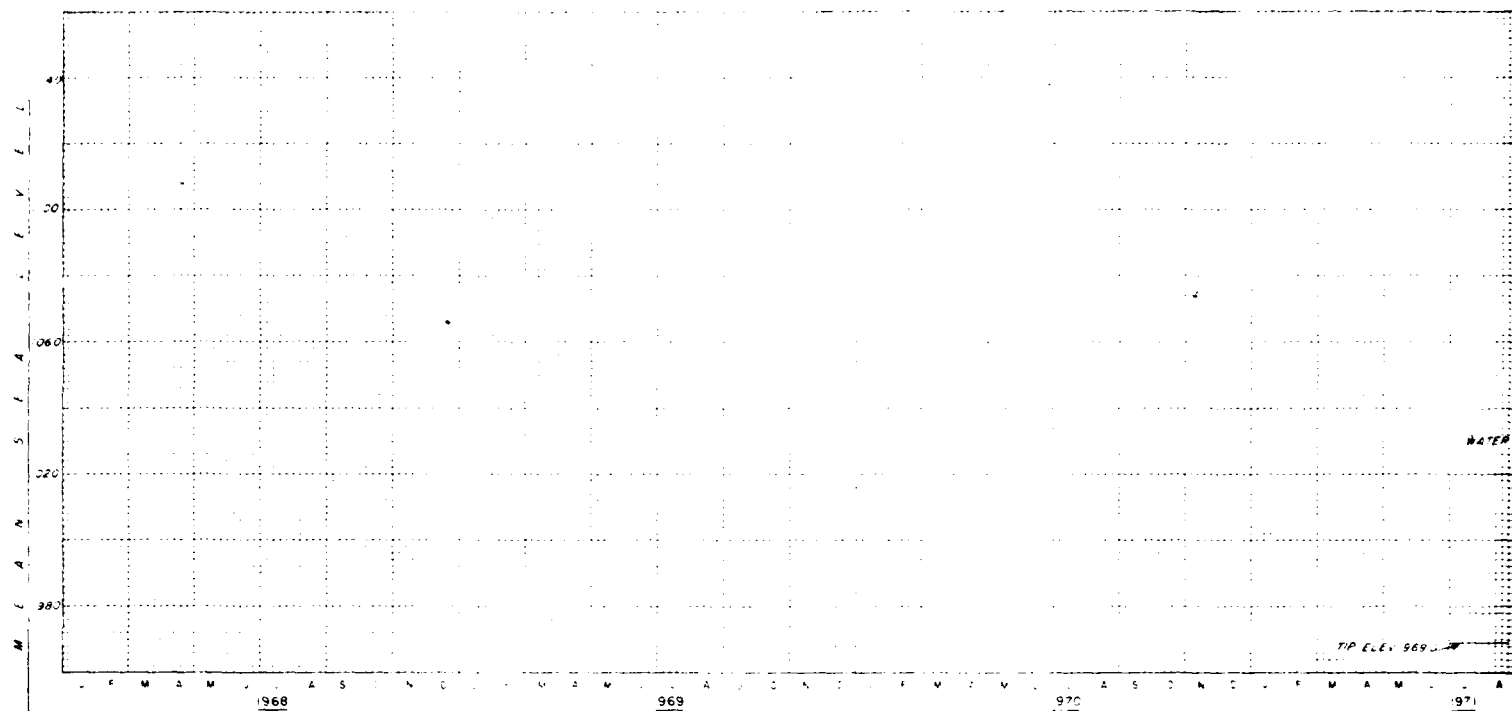
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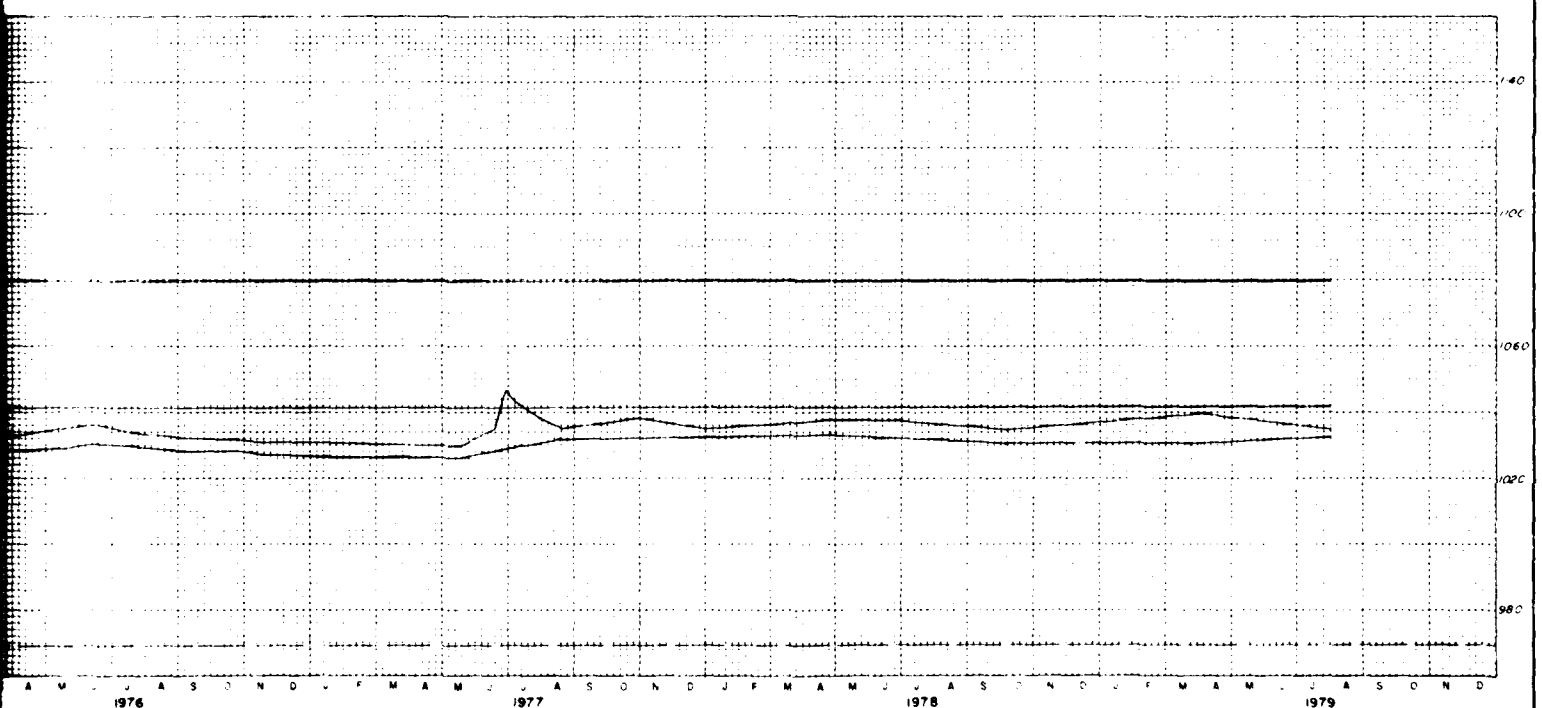
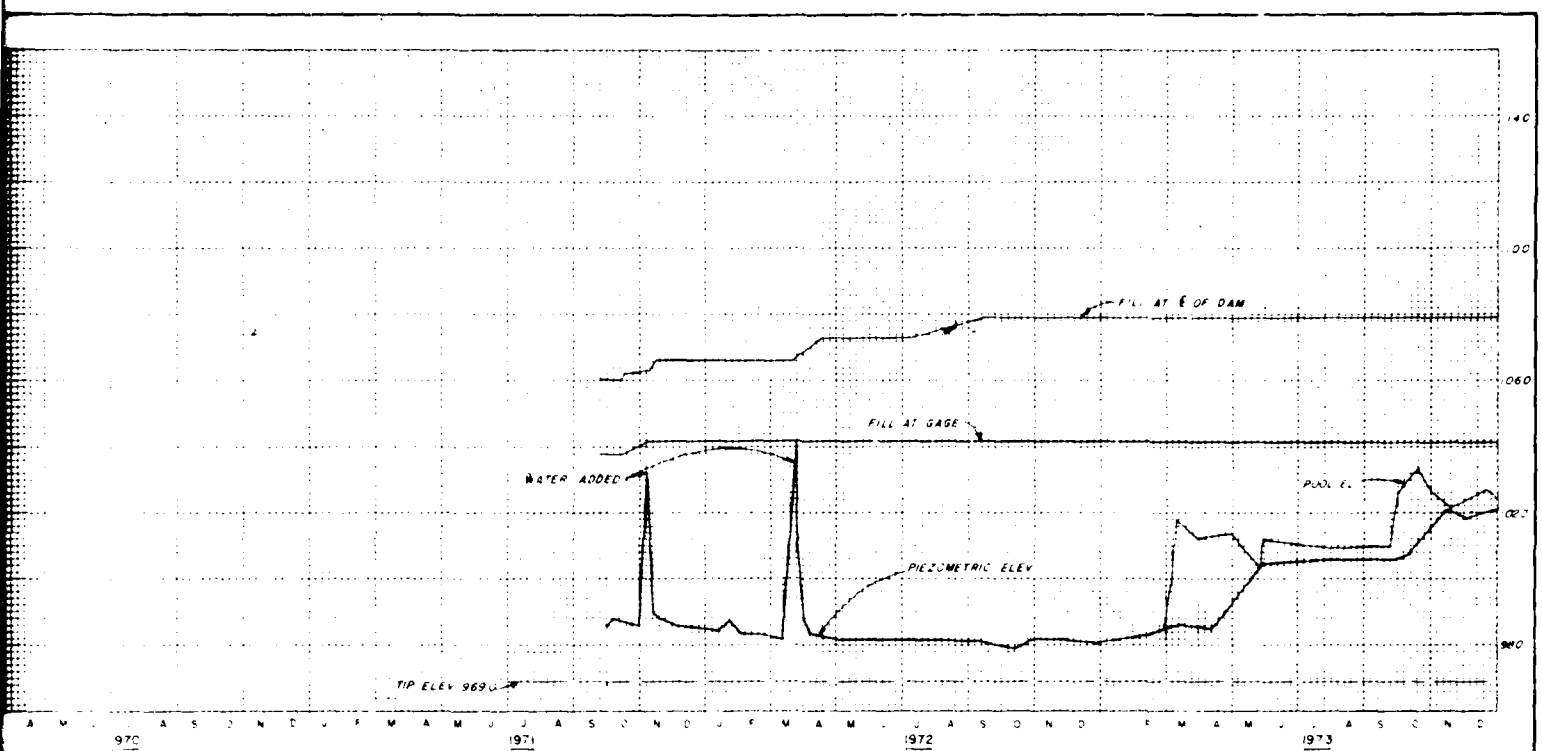
Sheet No. 1

Scale as shown

CORPUS ENGINEERS, INC. KANSAS CITY, MISSOURI

FILE NO C-5-1290
AUGUST 1975





DOWNSTREAM

LEGEND
 OPEN TUBE)
 PNEUMATIC CELL ●

MELVERN LAKE

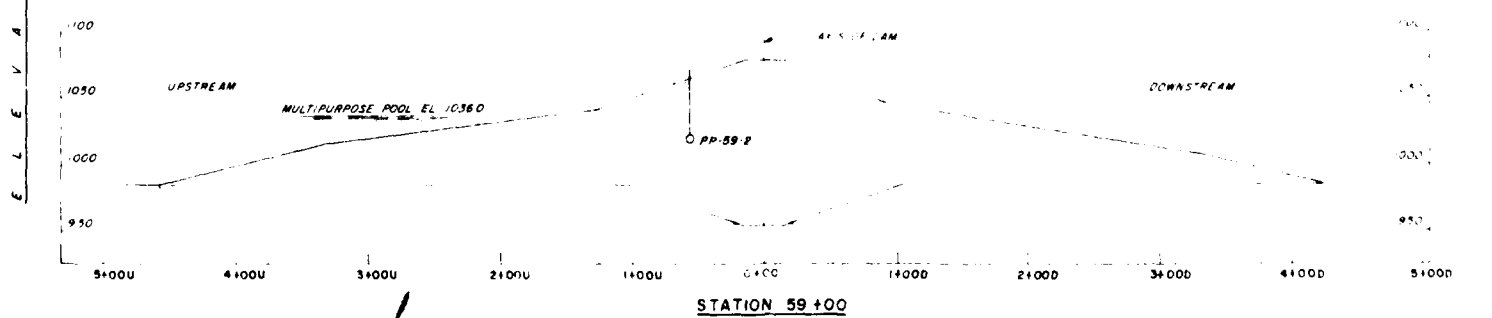
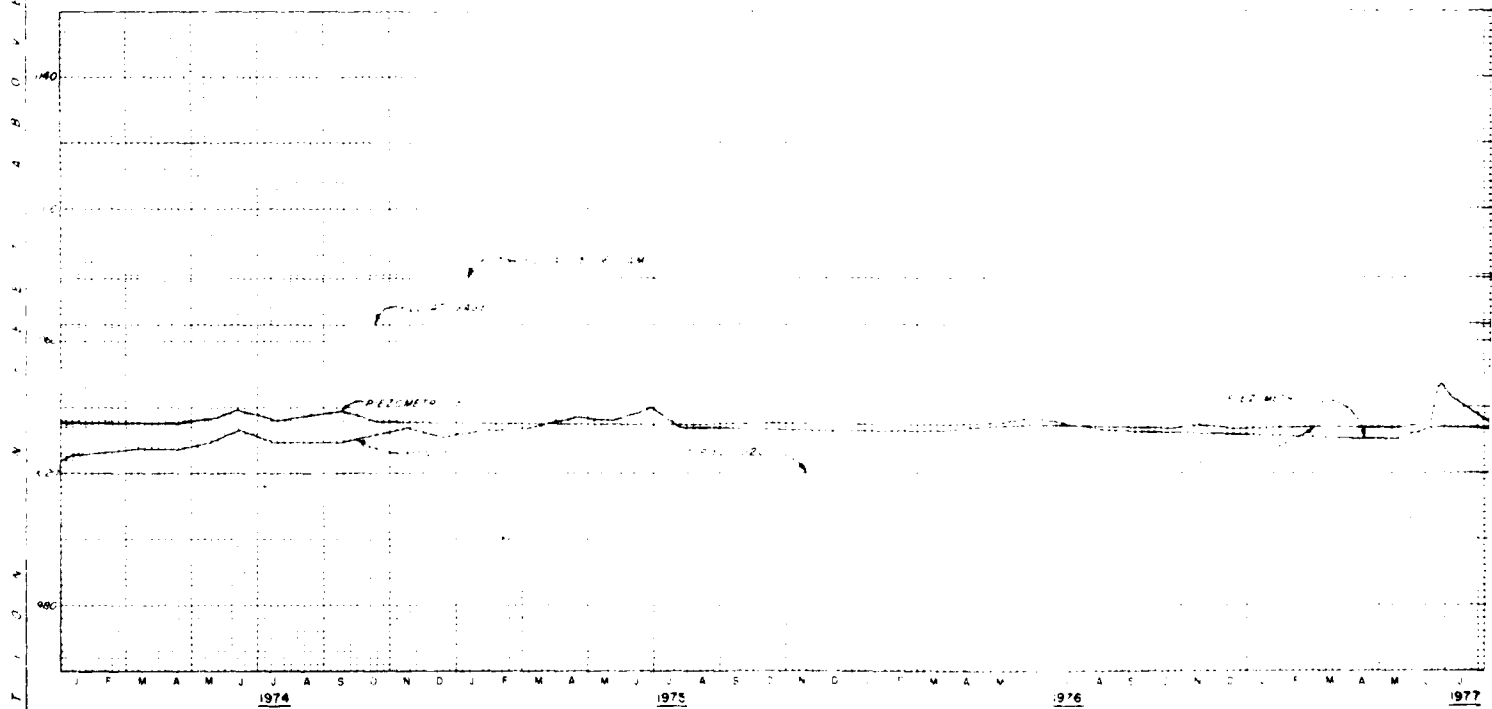
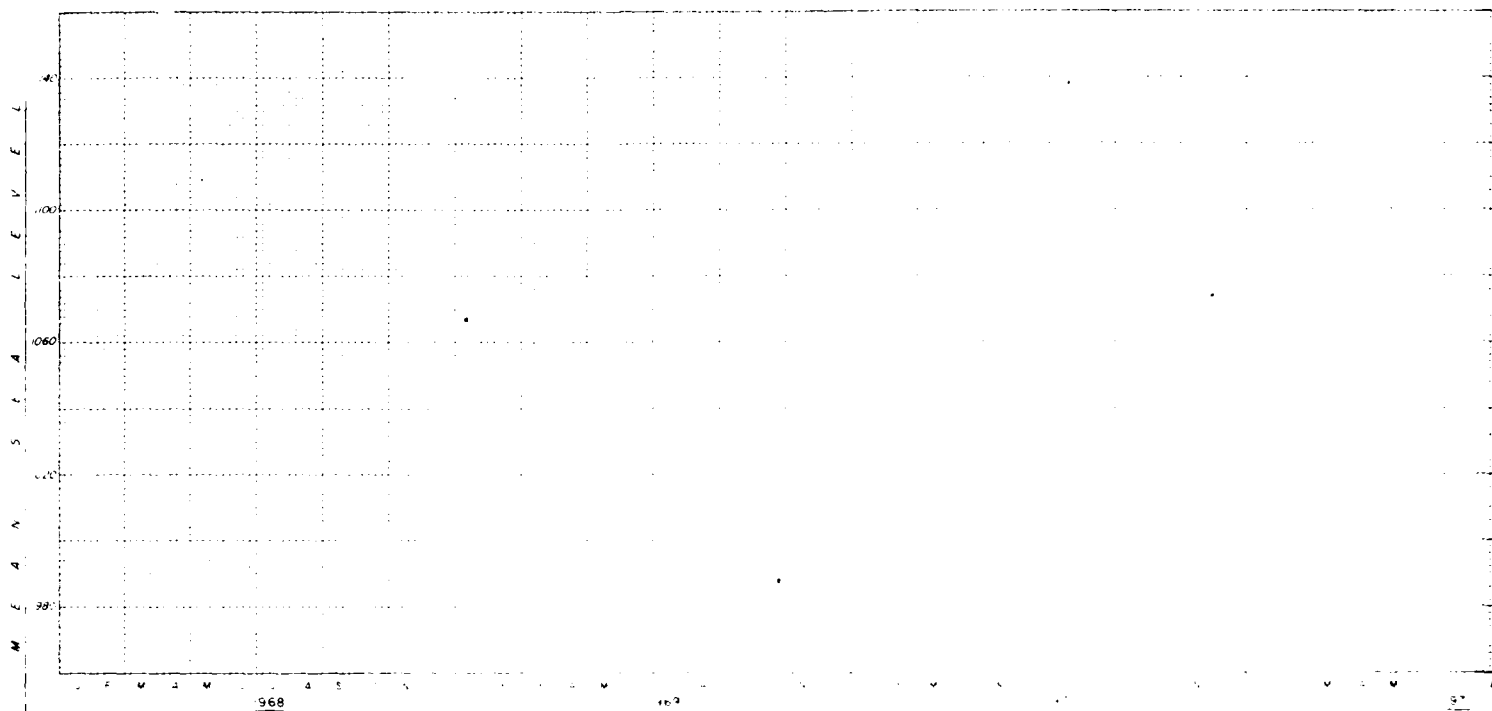
INSTRUMENTATION PLOTS
 PP-59-1 (OPEN TUBE)

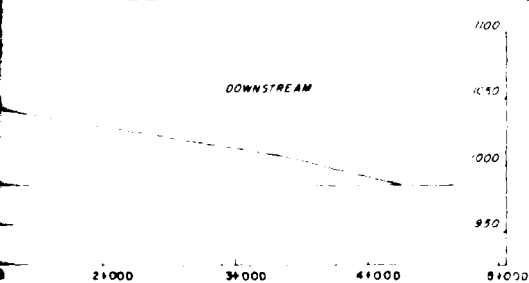
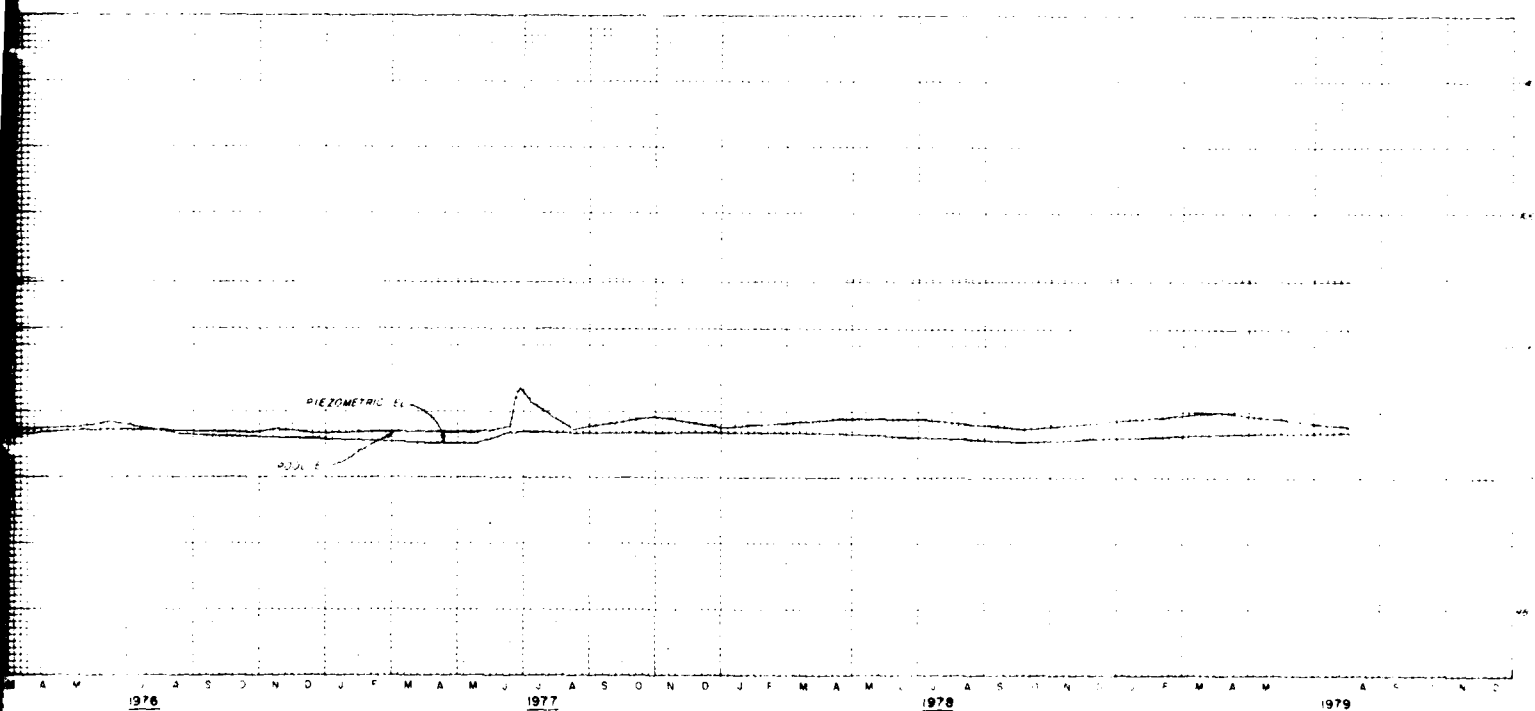
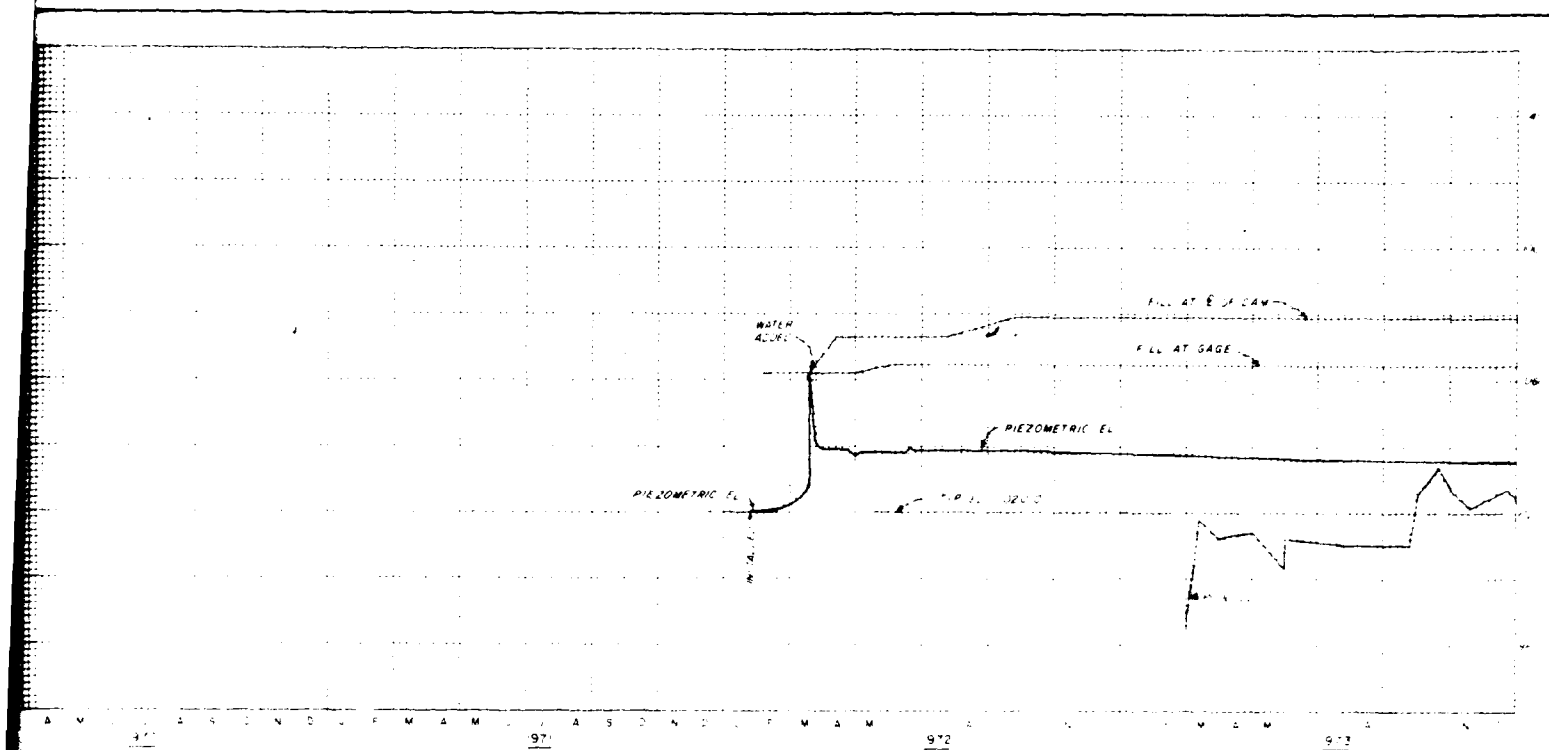
In 1 sheet

Sheet No. 1

Scale as shown

KANSAS ENGINEERS & ARCHITECTS
 KANSAS CITY, MISSOURI
 FILE NO. 0-5-1291
 AUGUST 1975





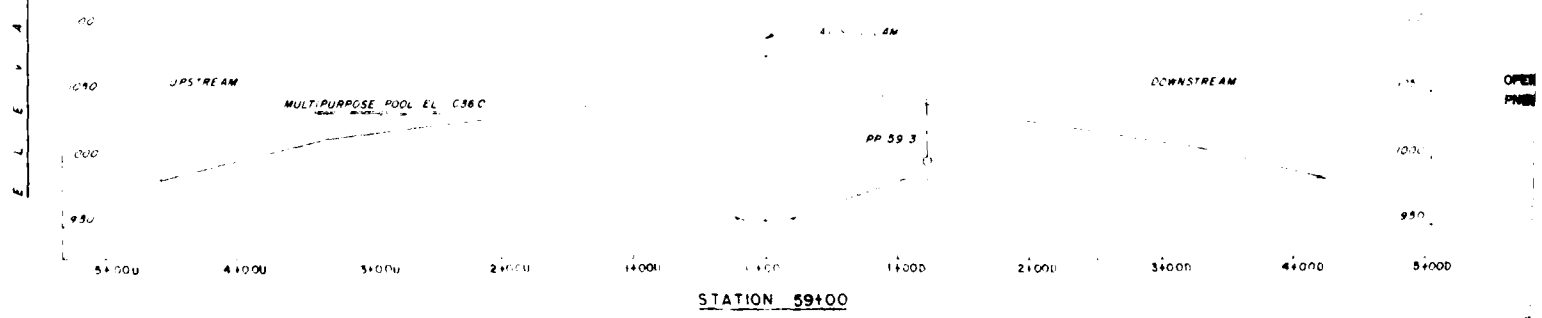
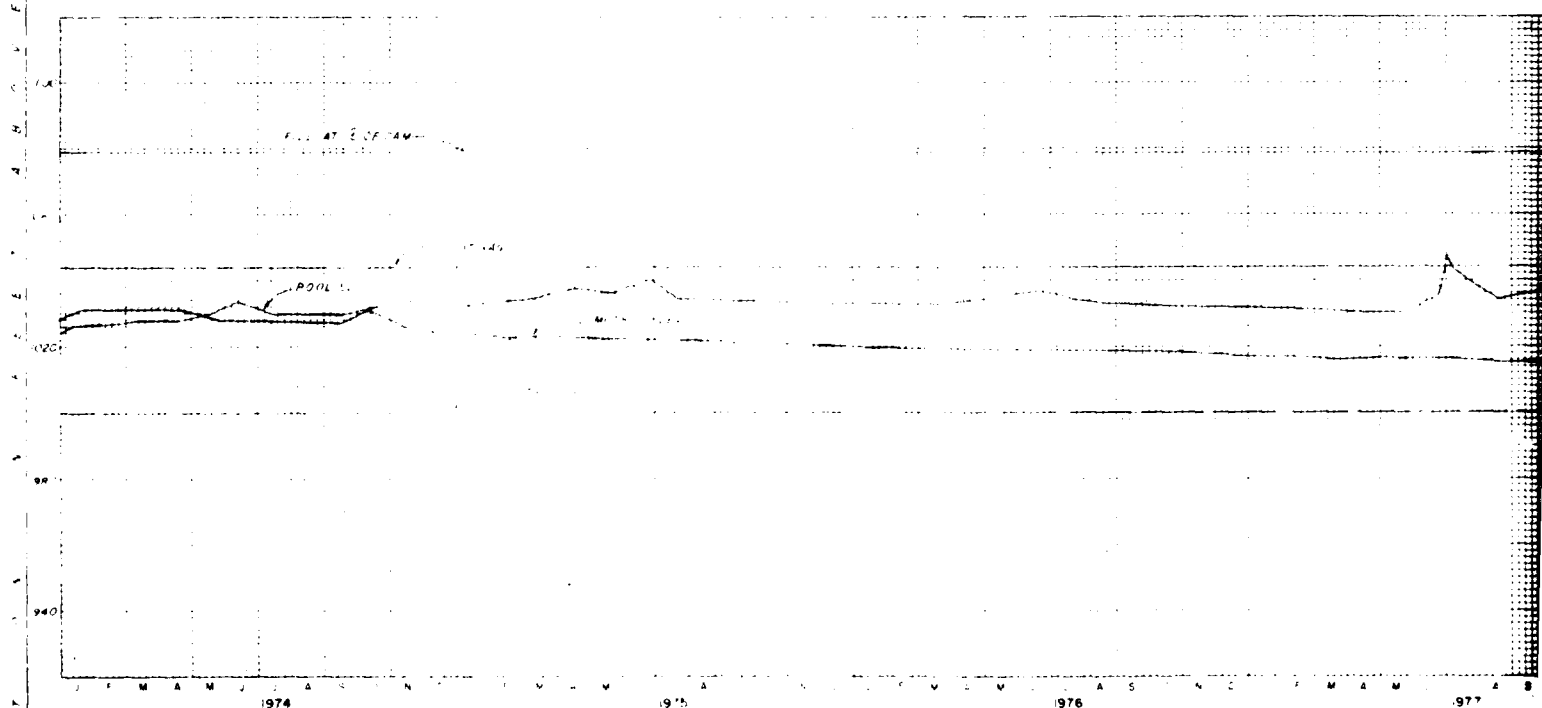
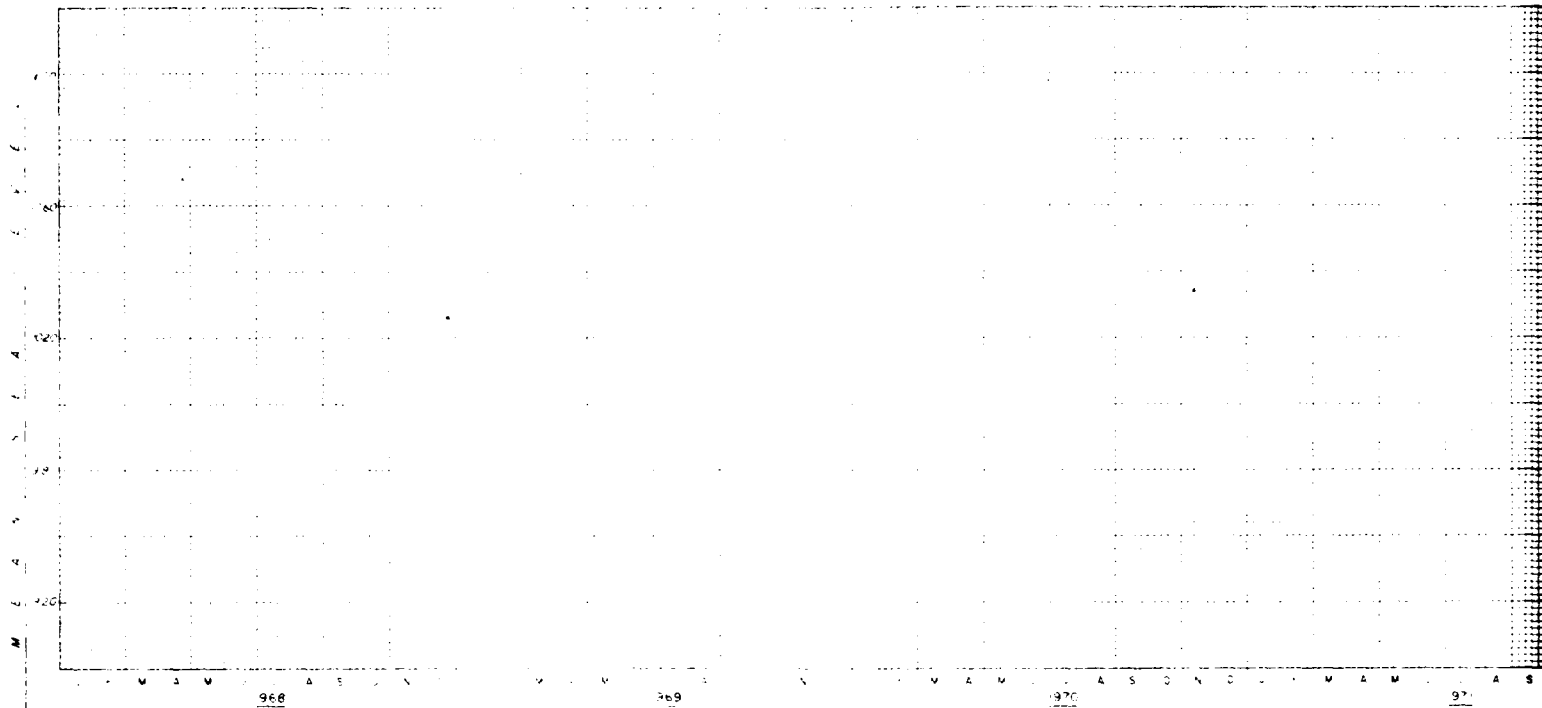
LEGEND
 OPEN TUBE O
 PNEUMATIC CELL •

MAHARISHI ENGINEERING CO.
 MAHARISHI ENGINEERING CO.
MELVERN LAKE

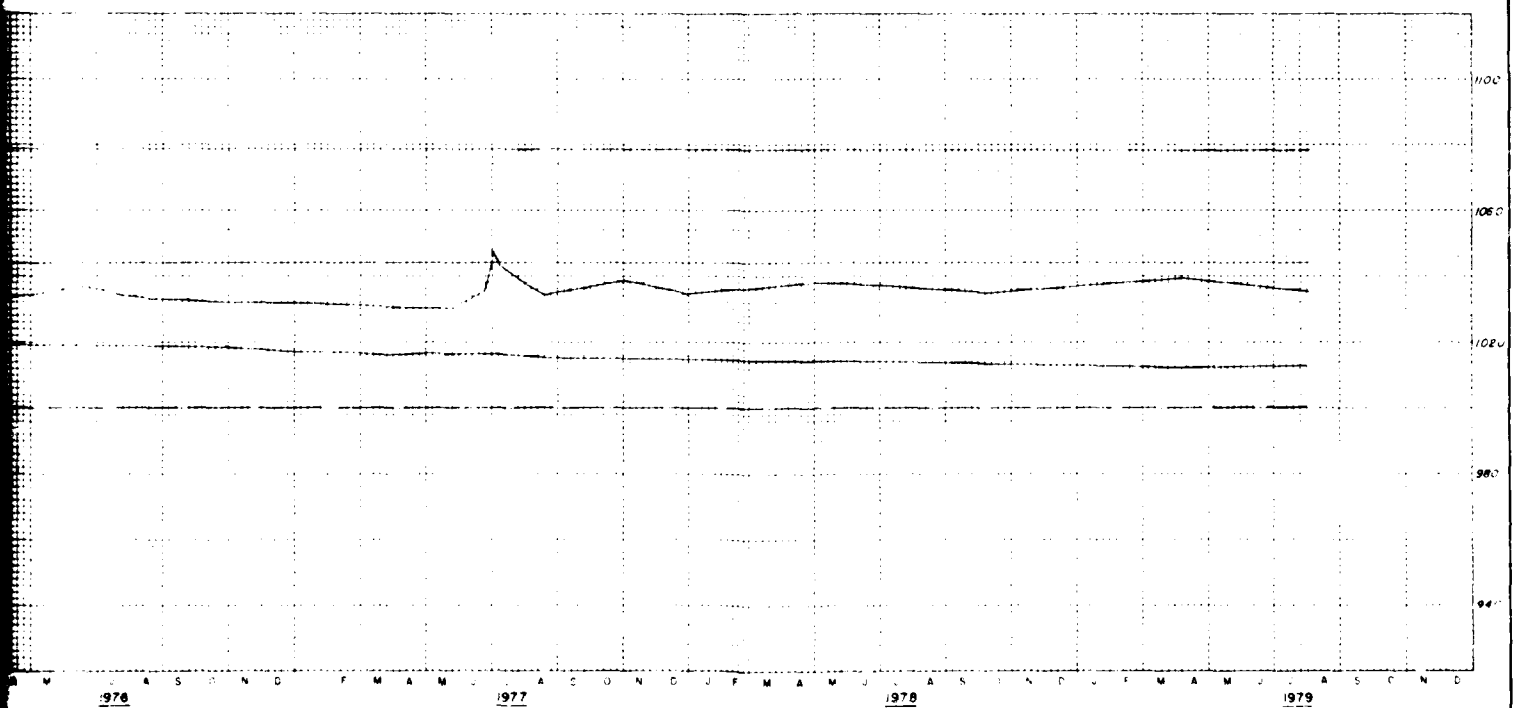
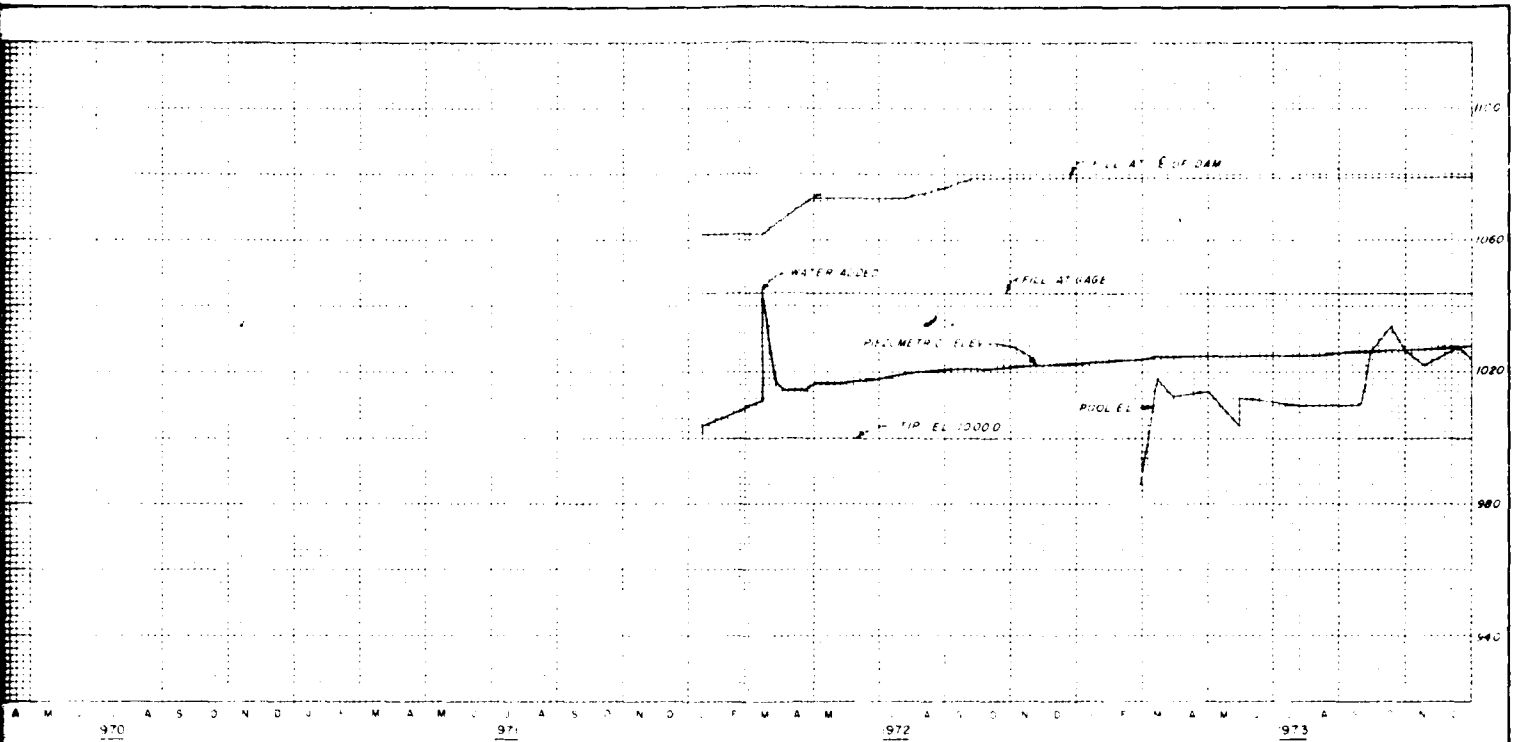
INSTRUMENTATION PLOTS
 PP-59-2 (OPEN TUBE)

Sheet No. 1
 MAHARISHI ENGINEERING CO.
 KAN. AR. 100-10000

FILE NO. 0-5-1292
 AUGUST 1975



STATION 59+00



DOWNSTREAM

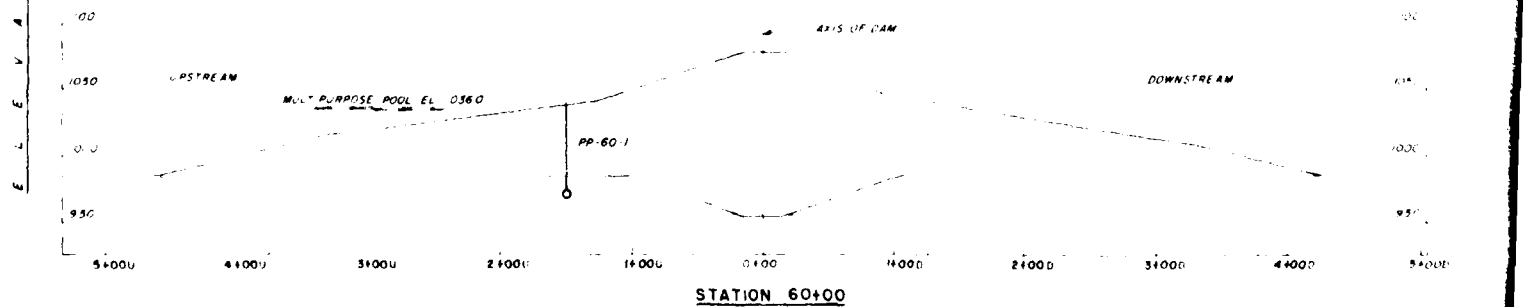
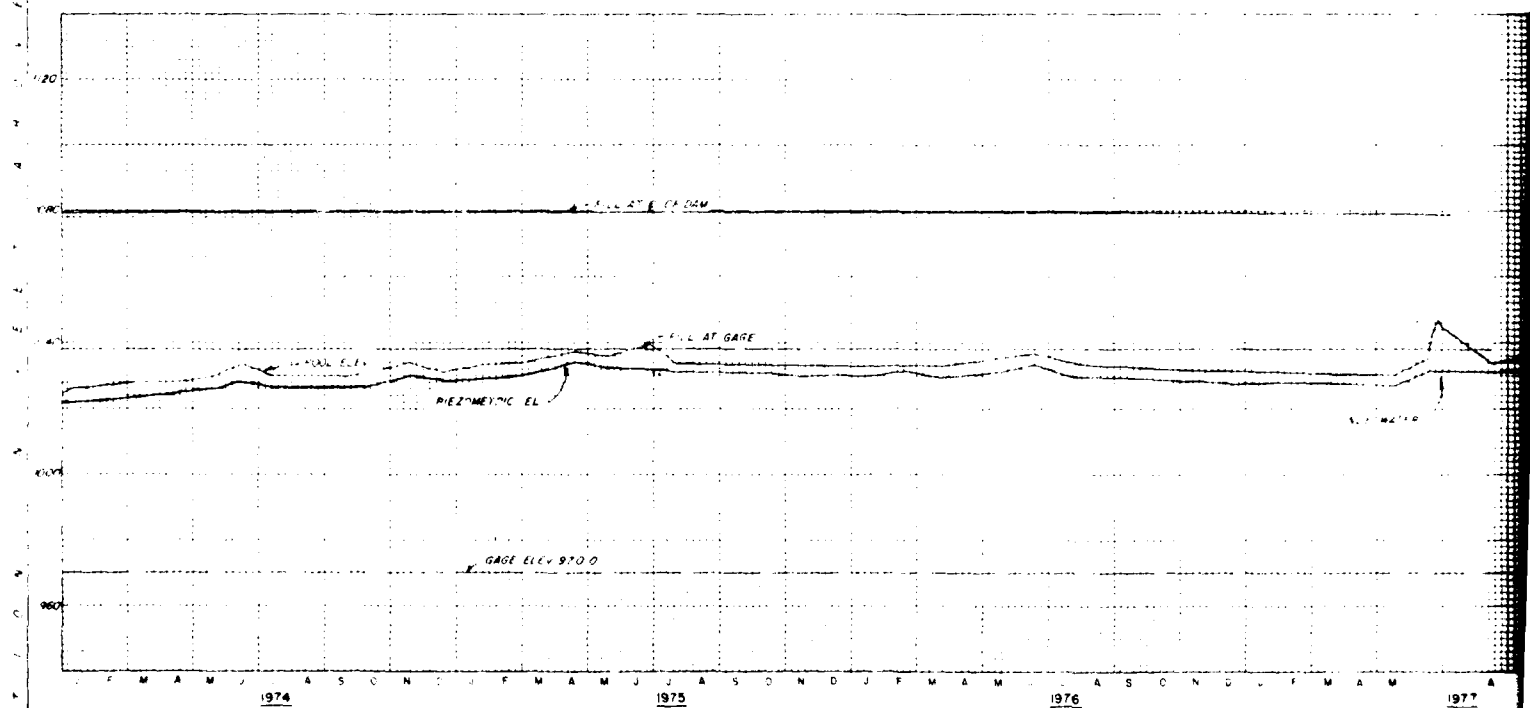
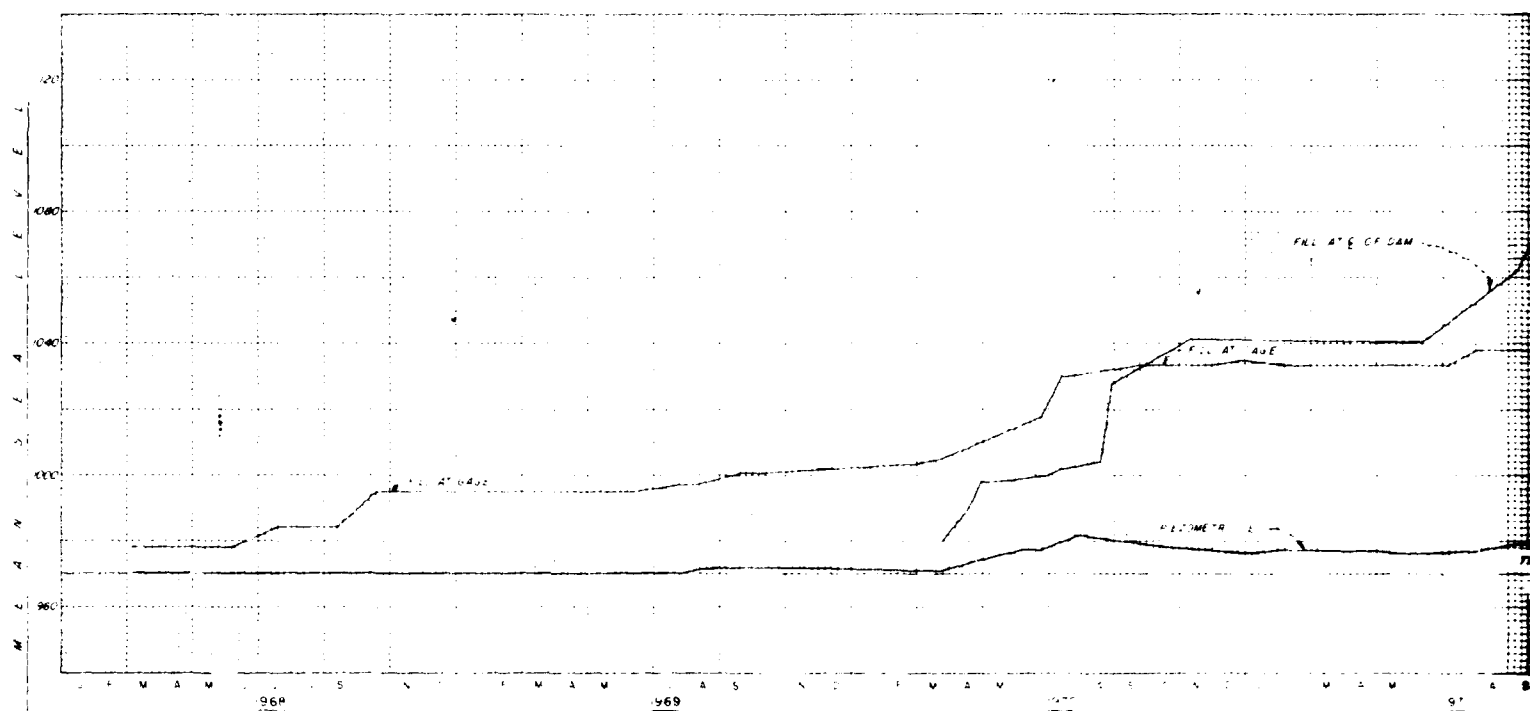
LEGEND

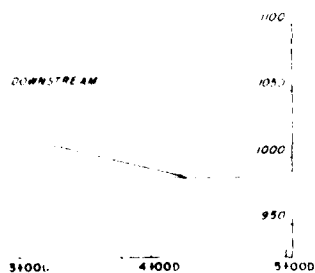
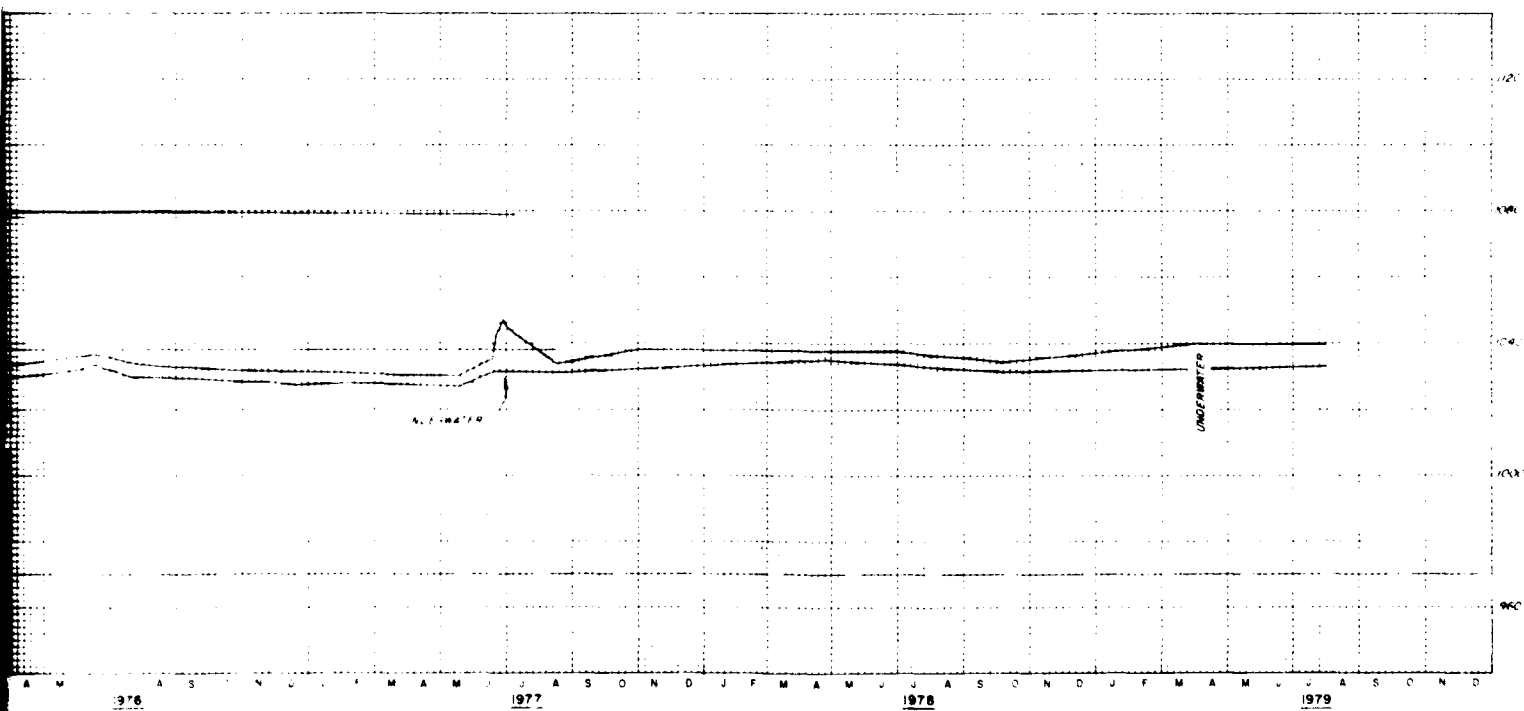
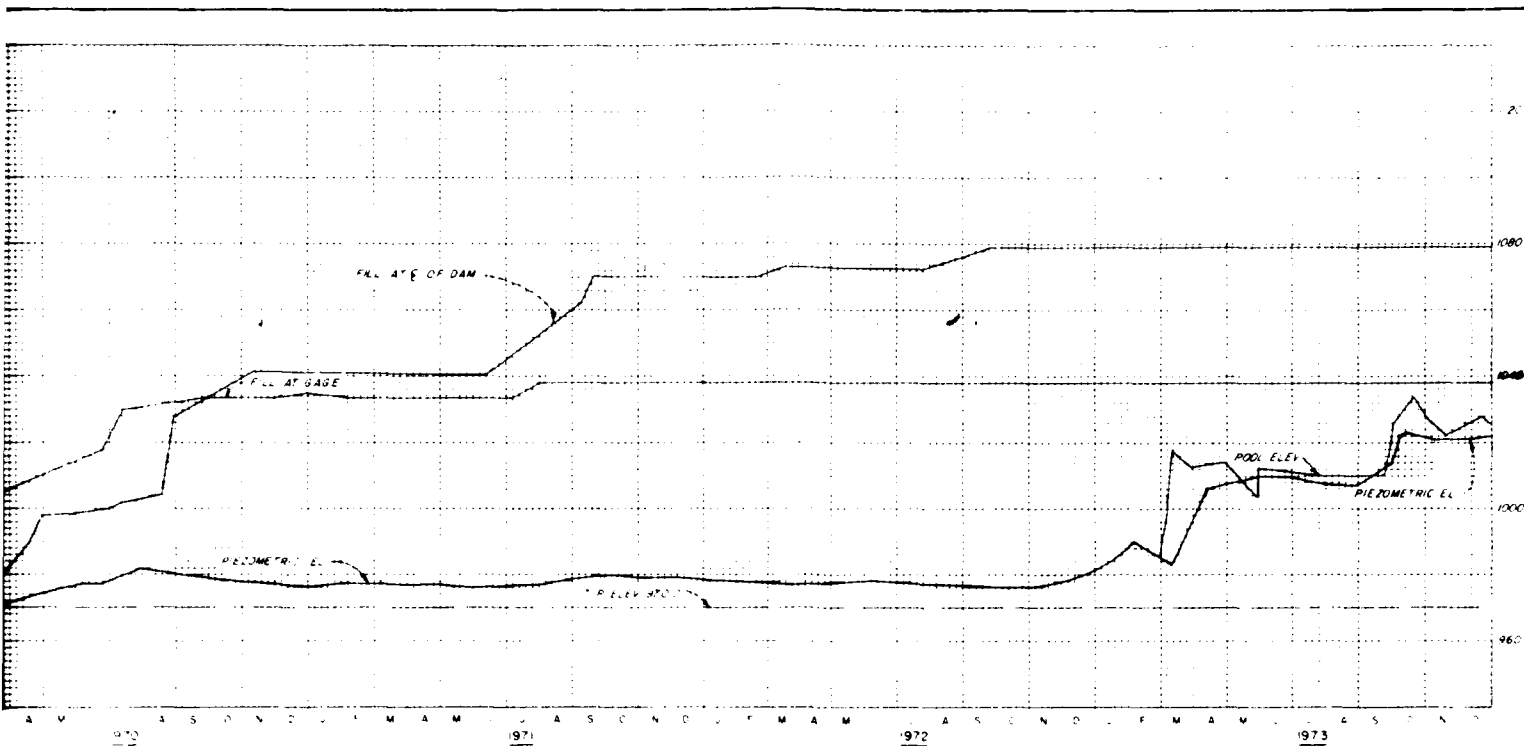
OPEN TUBE 
PNEUMATIC CELL 

Scale: 1 inch = 10 feet
MAHARIS DES YGNES RIVER KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
PP.59-3 (OPEN TUBE)

FILE NO 0-5-1293
AUGUST 1979





LEGEND
 OPEN TUBE — ○
 PNEUMATIC CELL — ●

Revised August 1975
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

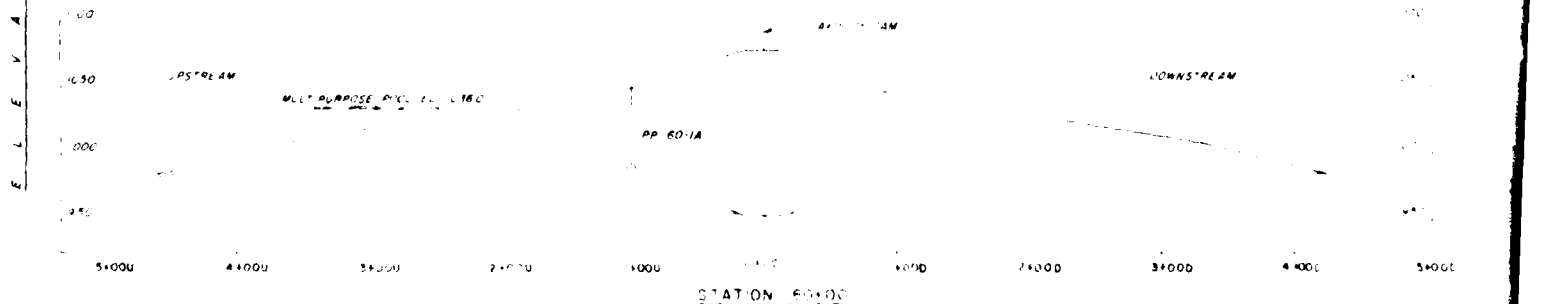
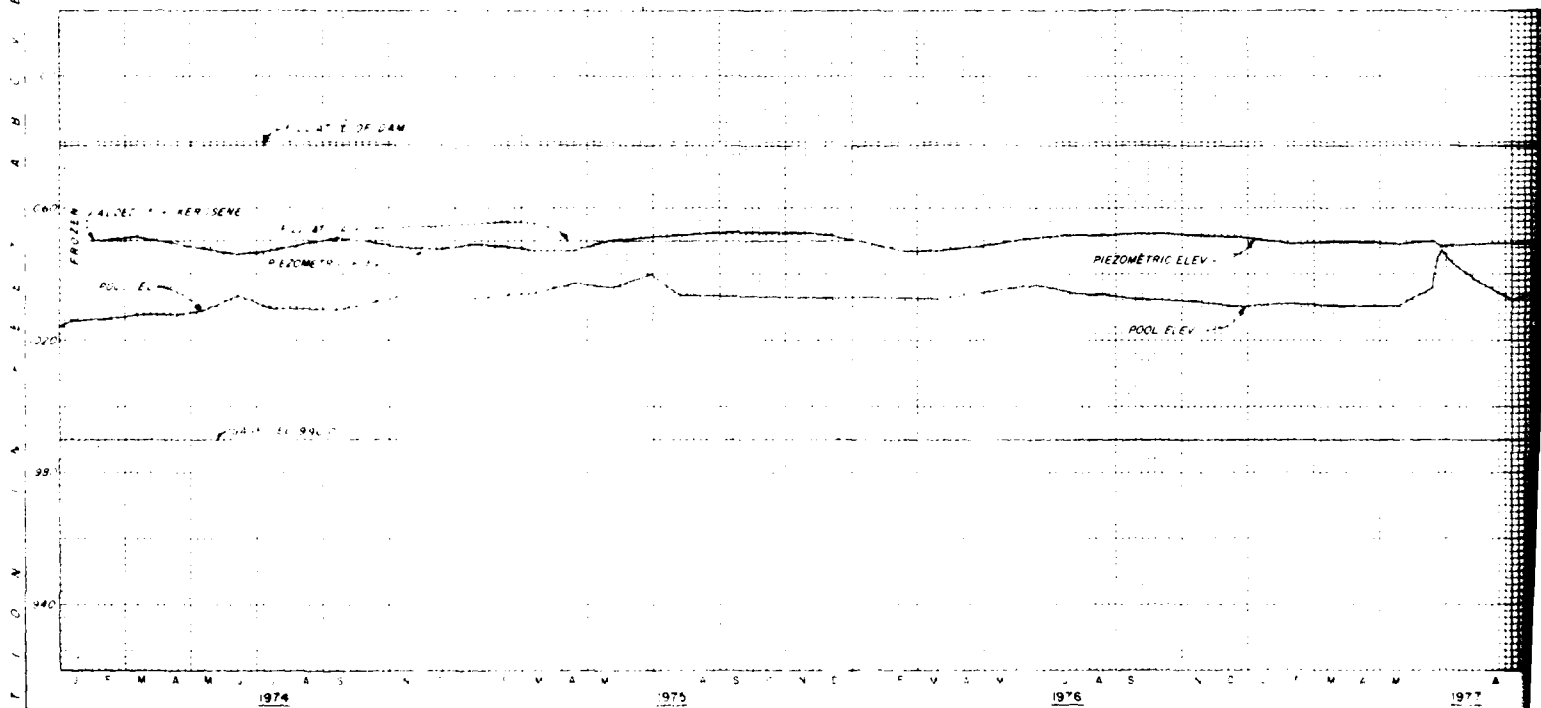
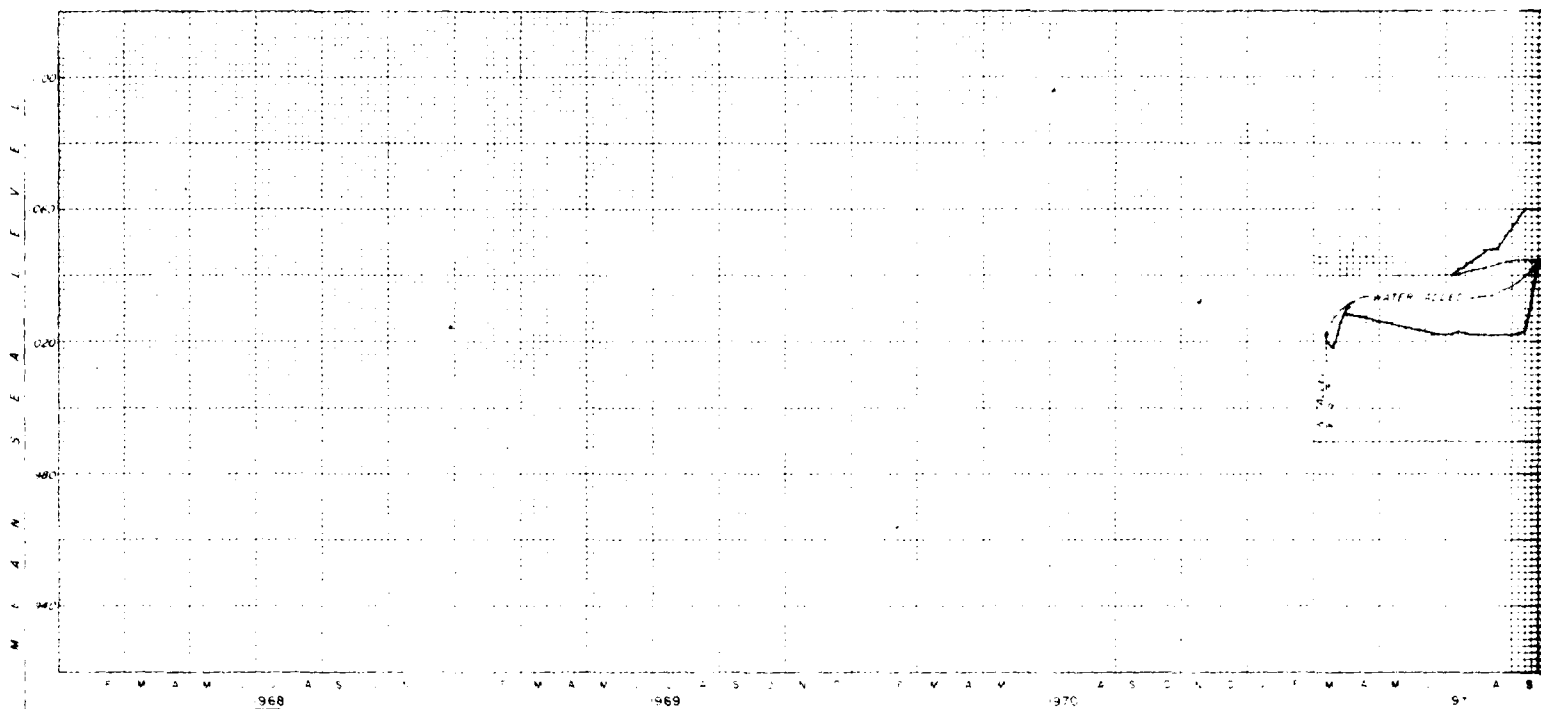
INSTRUMENTATION PLOTS
 PP-60-1 (OPEN TUBE)

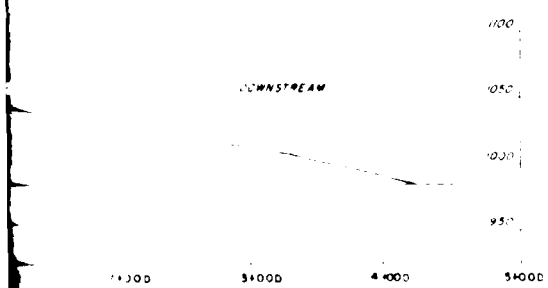
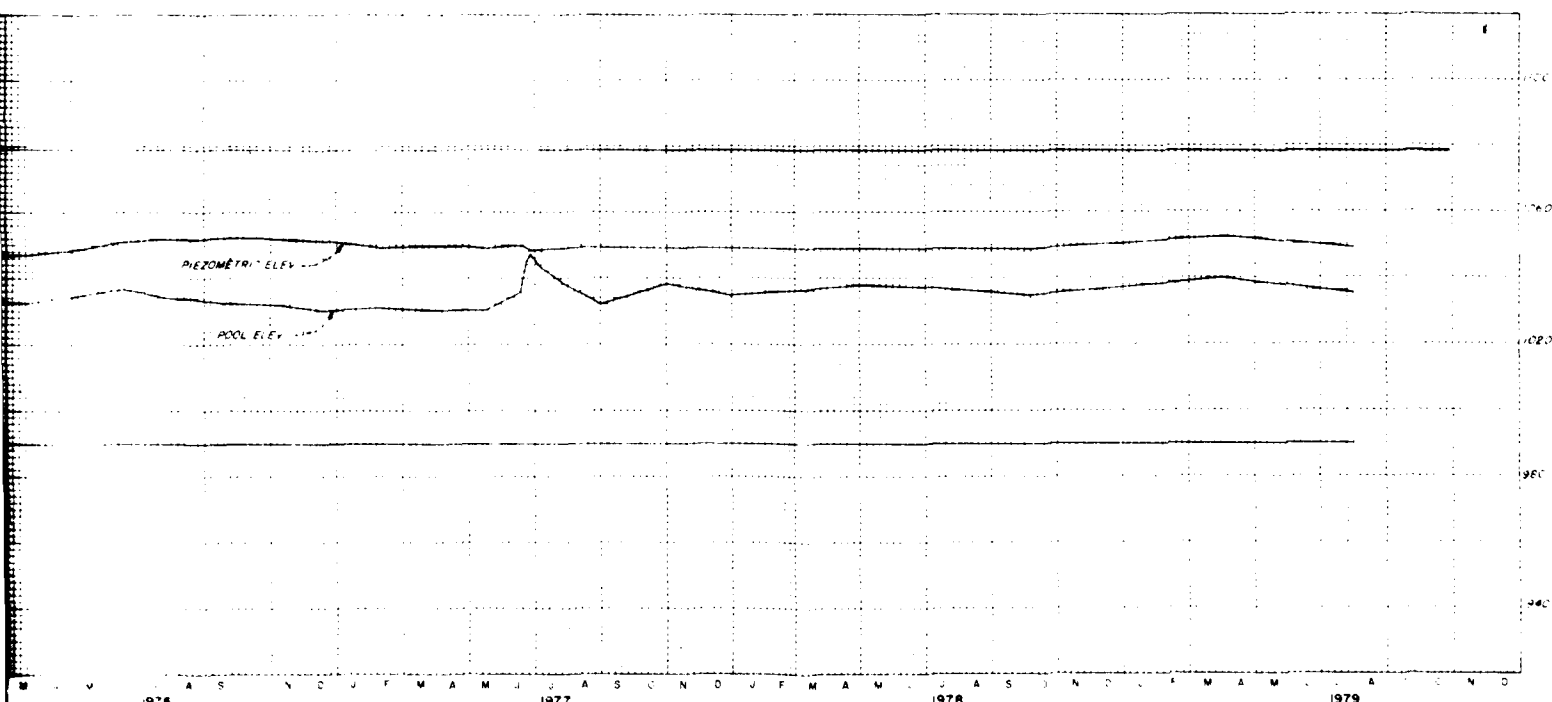
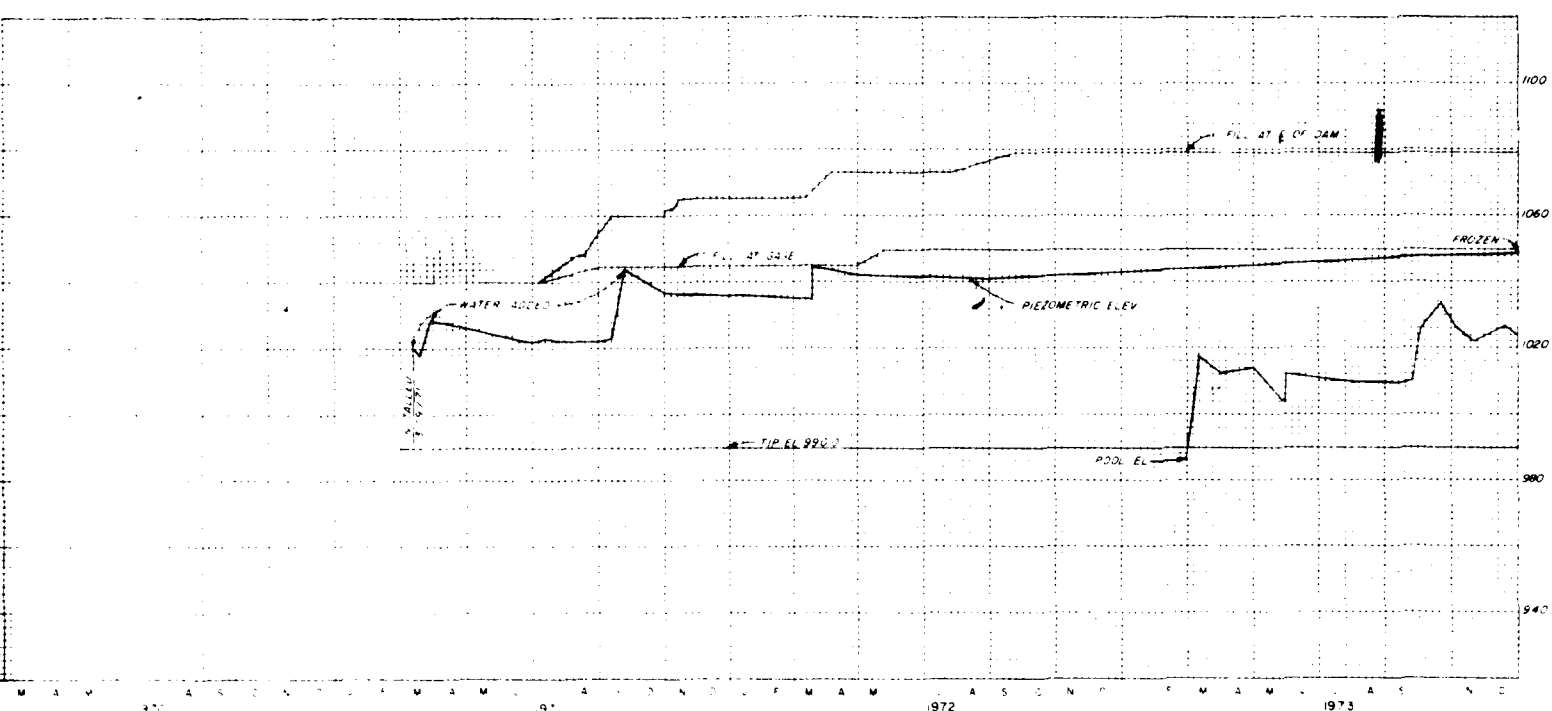
In 1 Sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS DISTRICT
 FILE NO. O-5-1294
 AUGUST 1975





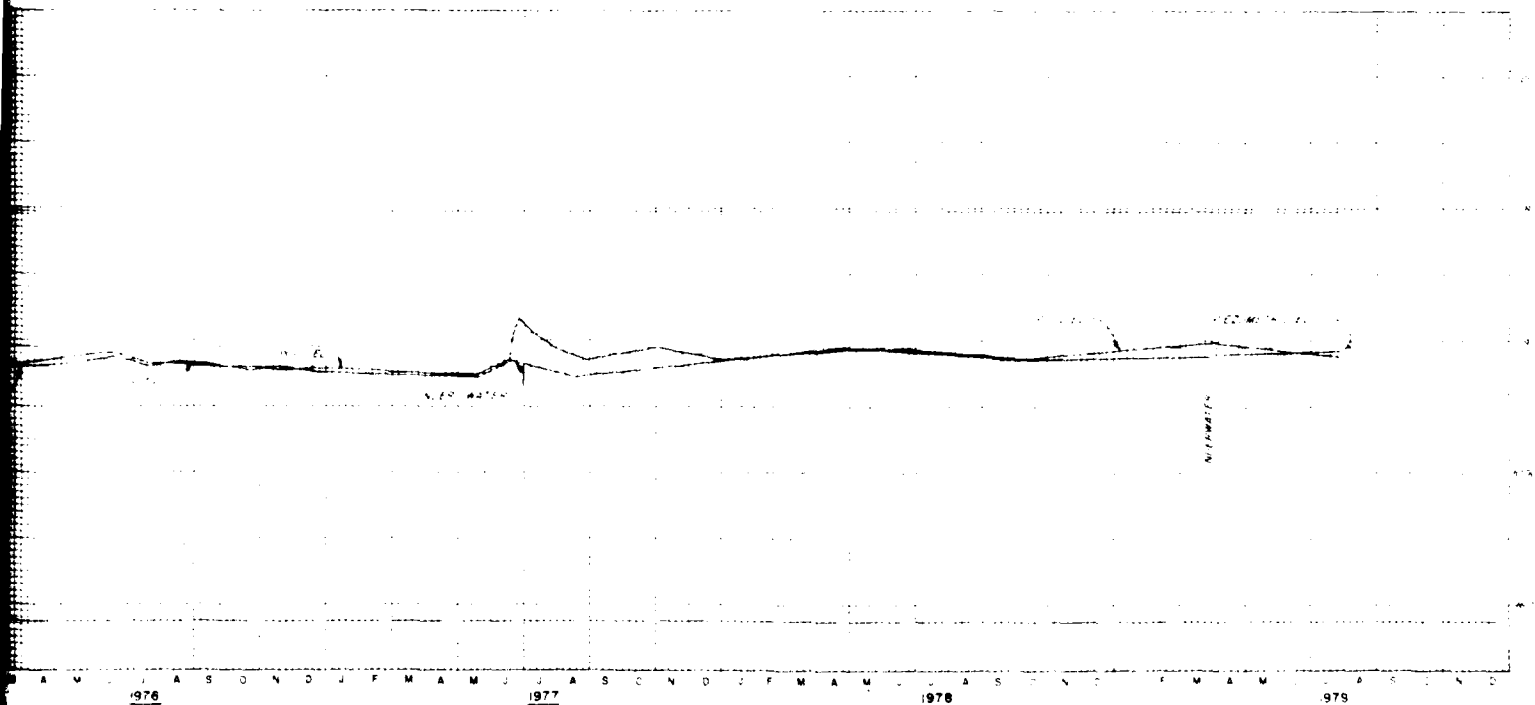
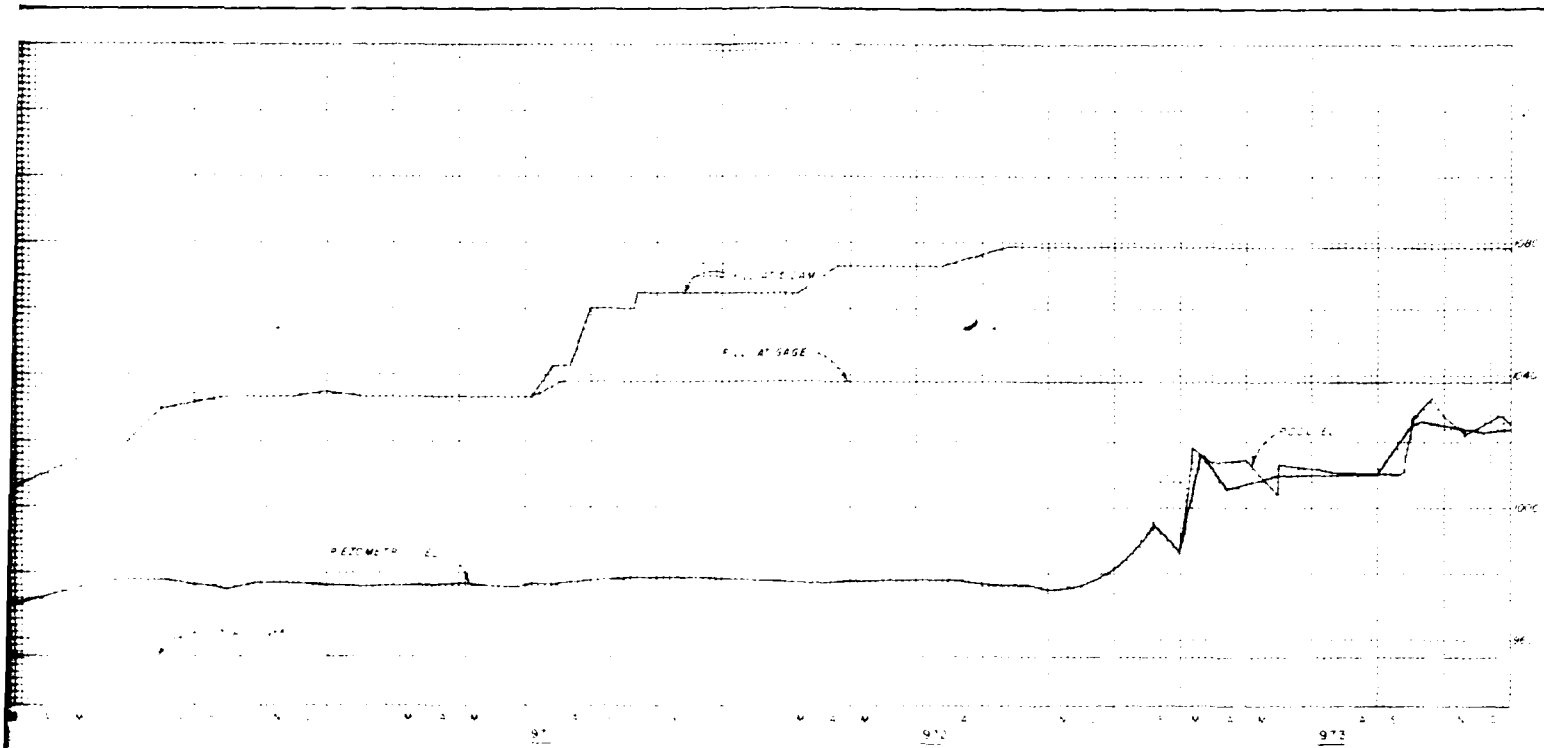
LEGEND
 OPEN TUBE ○
 PNEUMATIC CELL ●

MARSH DES LYGNES RIVER KANSAS
MELVERN LAKE

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

Sheet No. 1
 ENGINEER: KANSAS STATE ENGINEER
 FILE NO. 0-5-1295
 AUGUST 1974

2



DOWNSTREAM

LEGEND

OPEN TUBE ○

PNEUMATIC CELL ●

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-60-2 (OPEN TUBE)

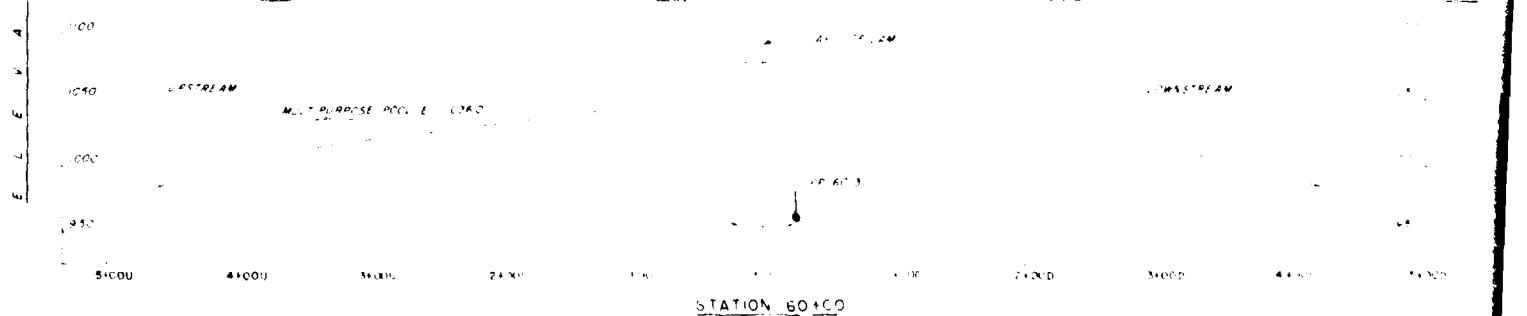
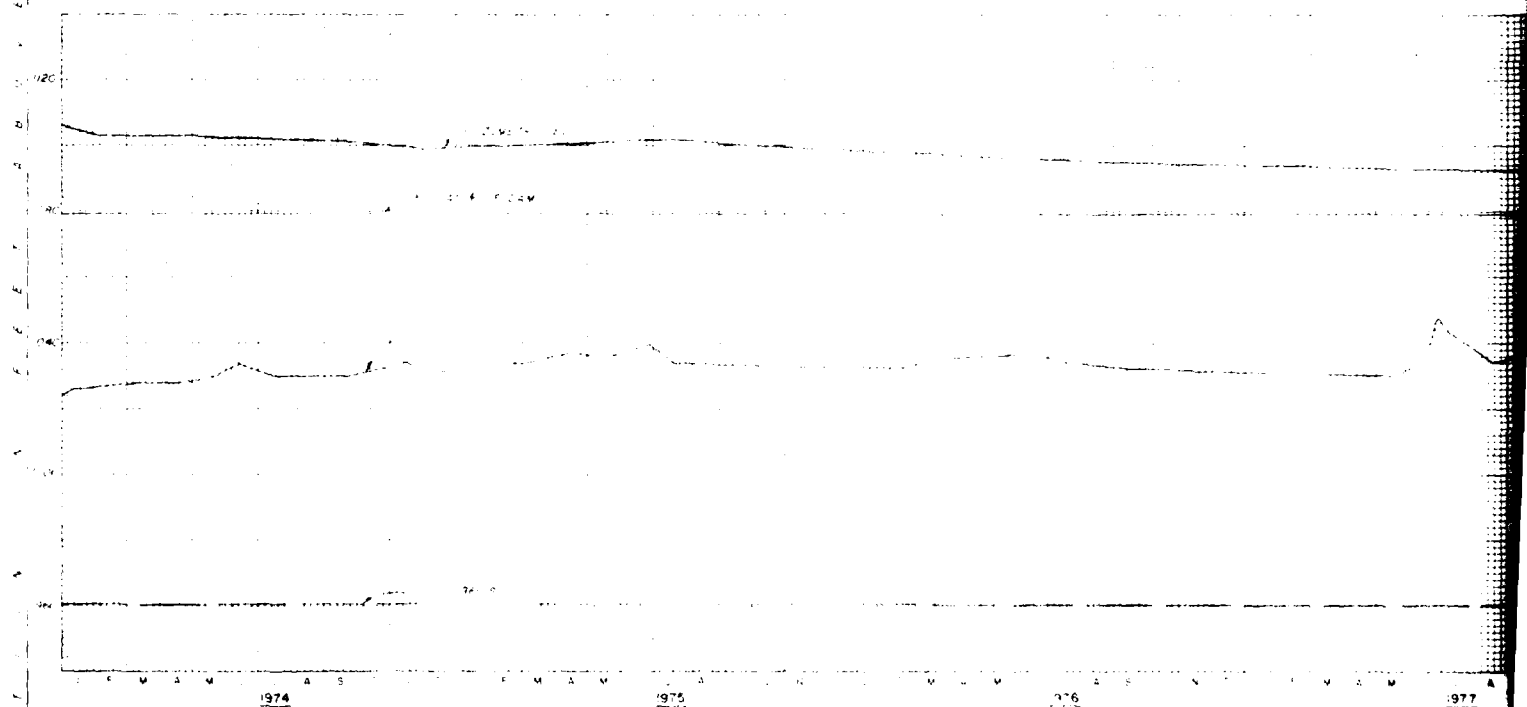
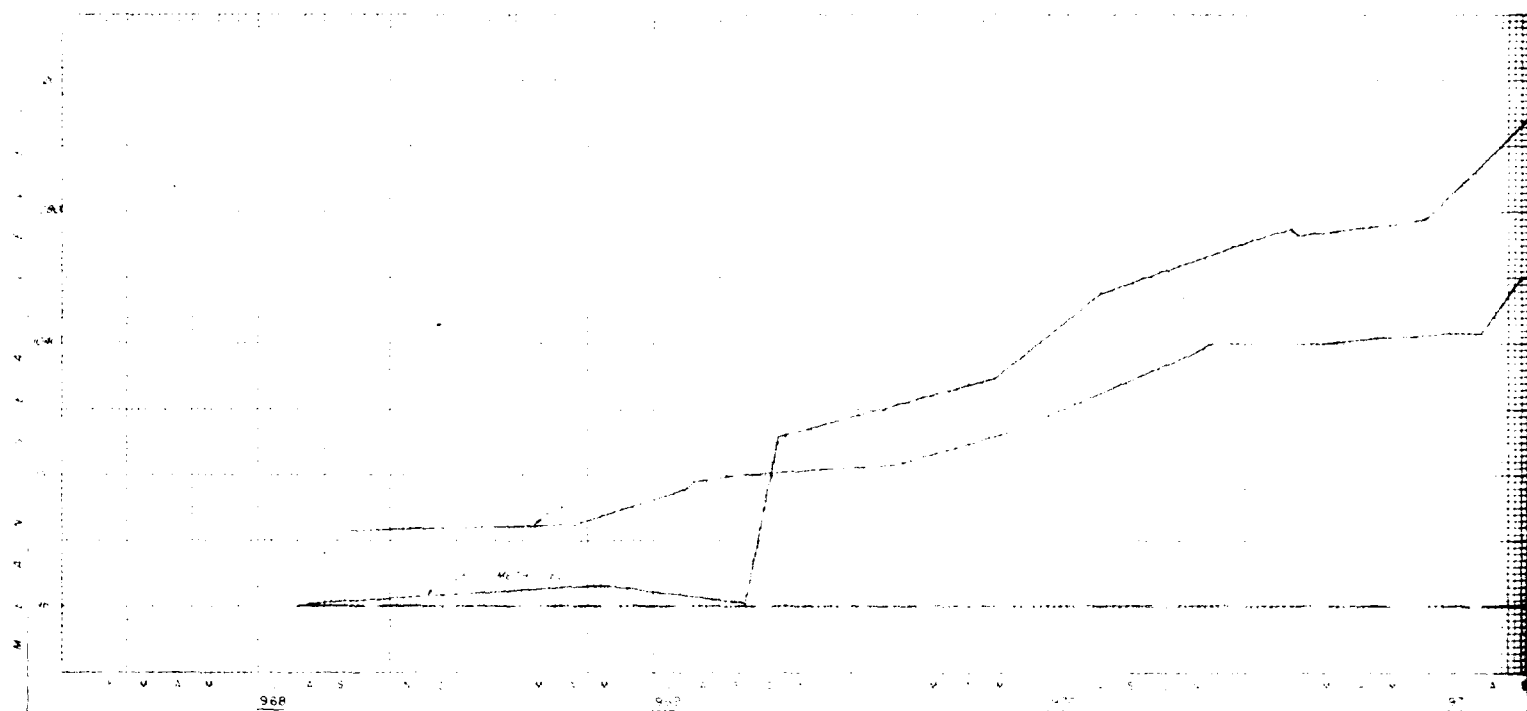
Sheet No. 1

Sheet No. 2

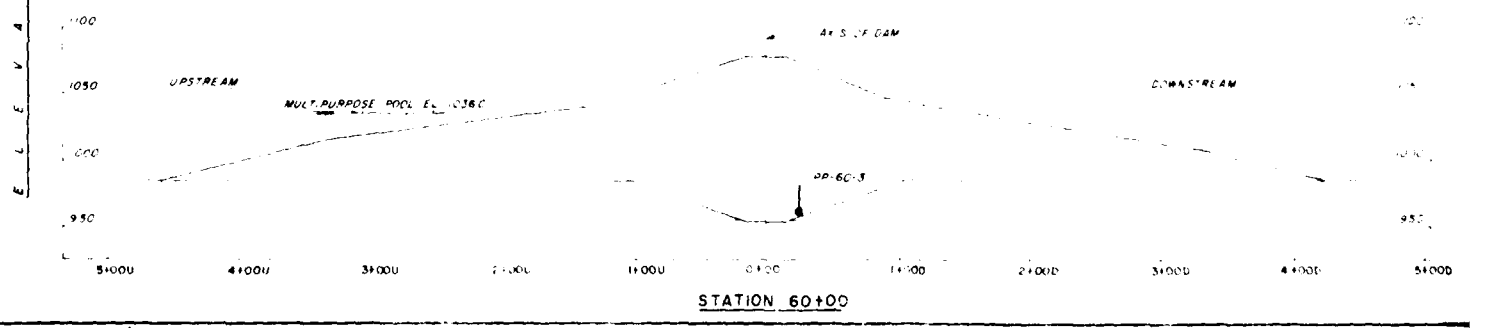
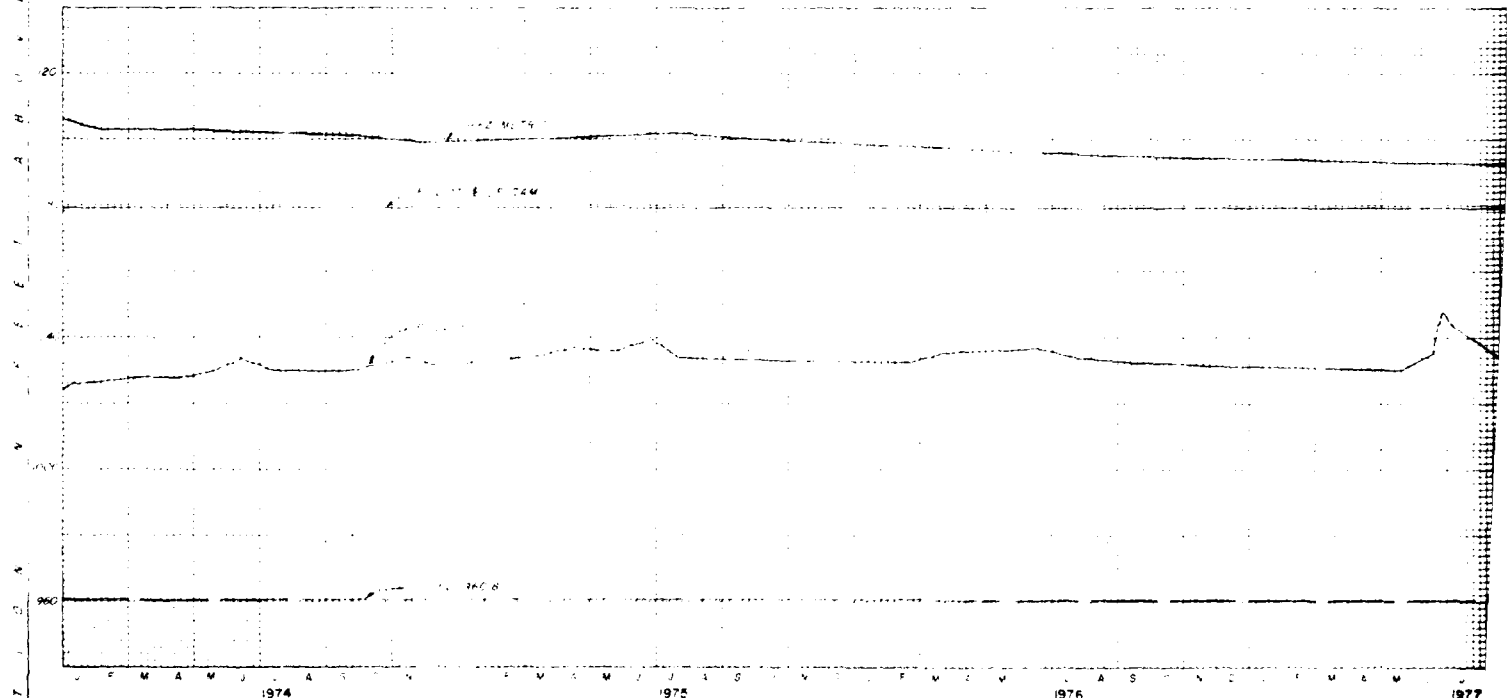
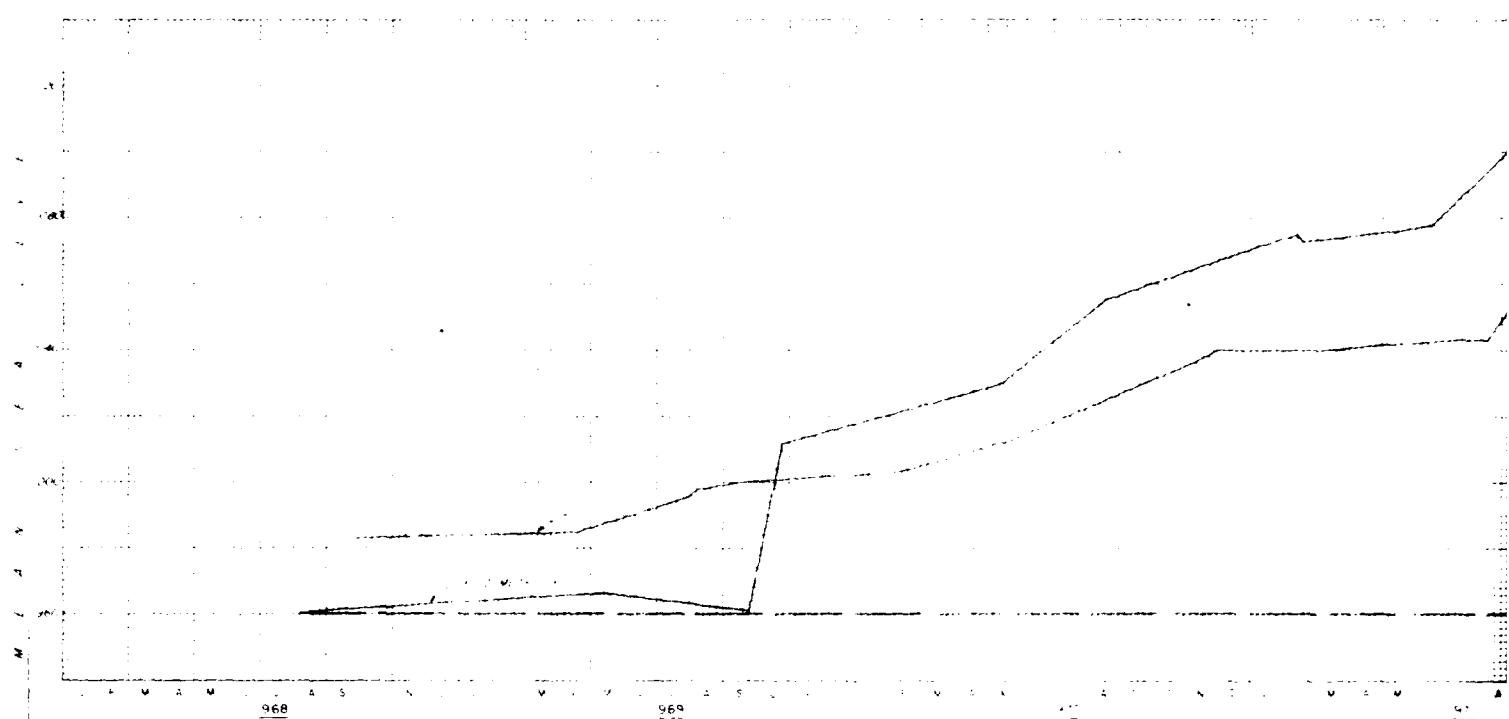
Sheet No. 3

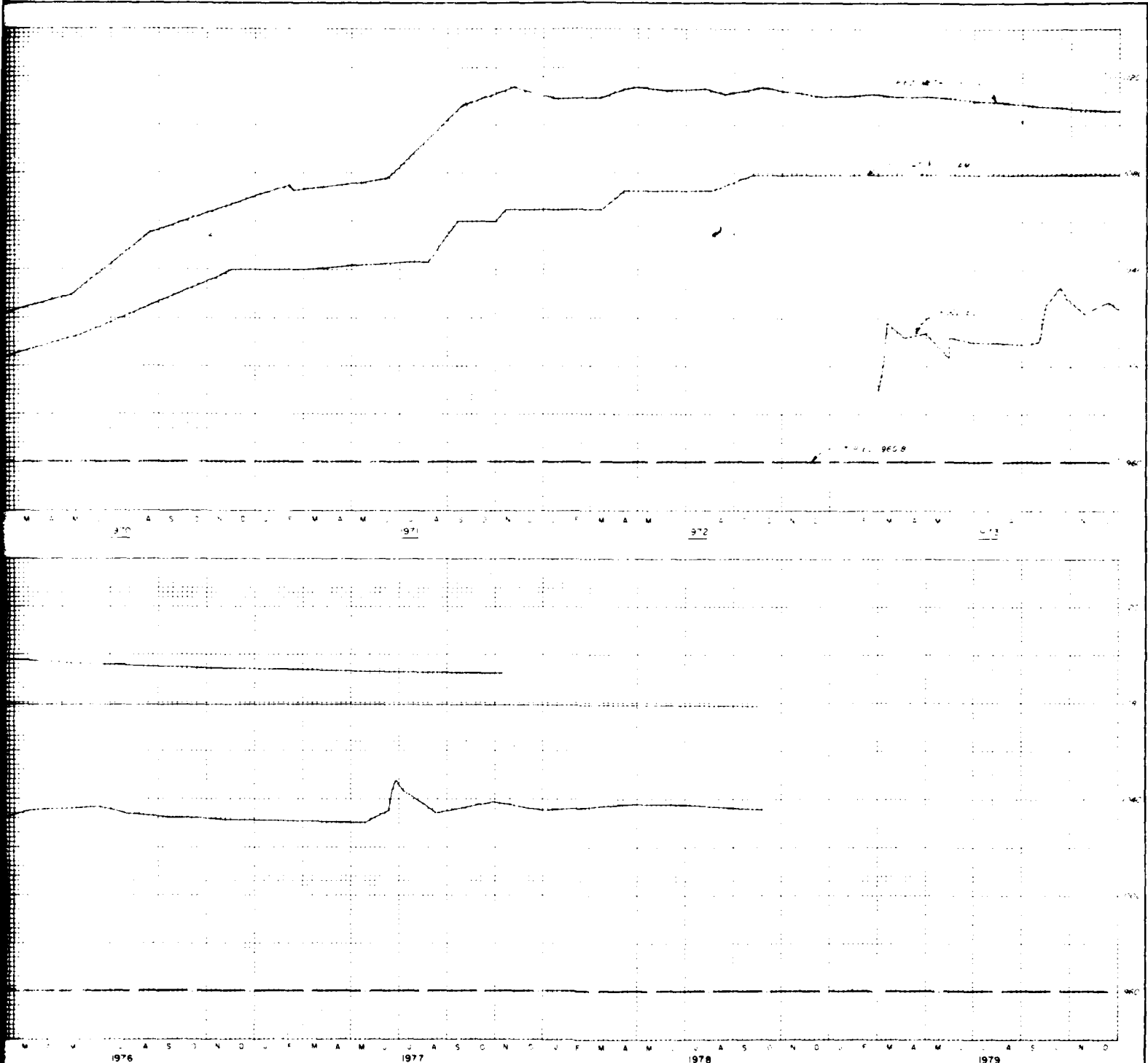
CORPORAL ENGINEER, U.S. ARMY
KANSAS DISTRICT

FILE NO 0-5-1296
AUGUST 1975



STATION 60+00





DOWNSTREAM

1100
1050
1000
950
900

LEGEND

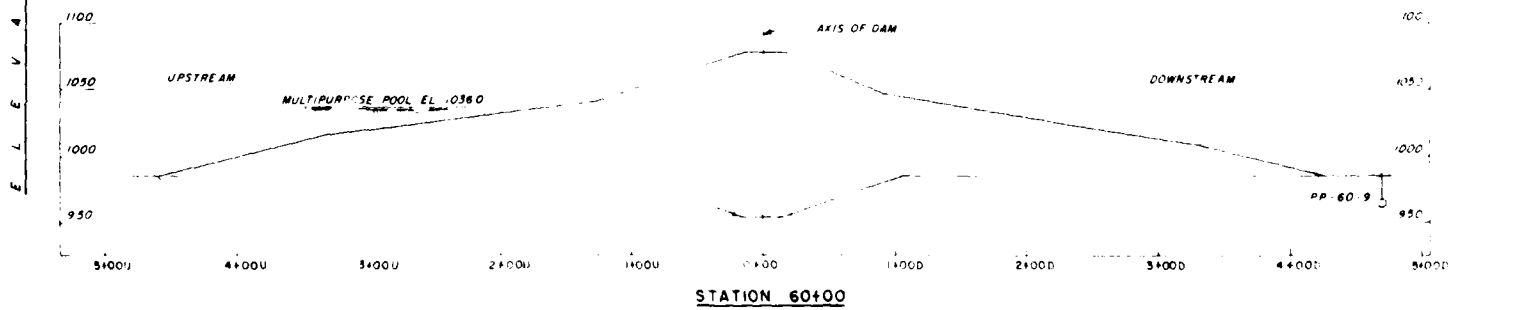
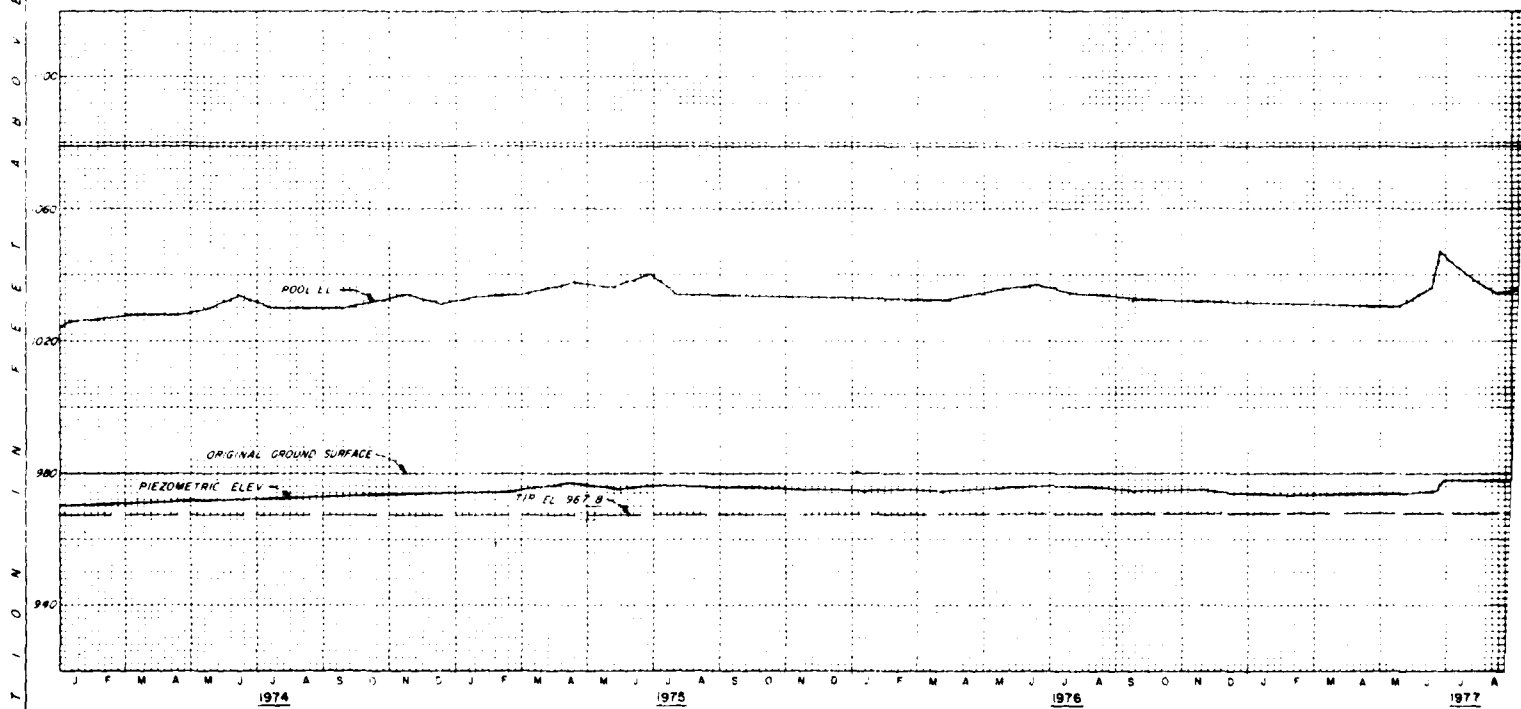
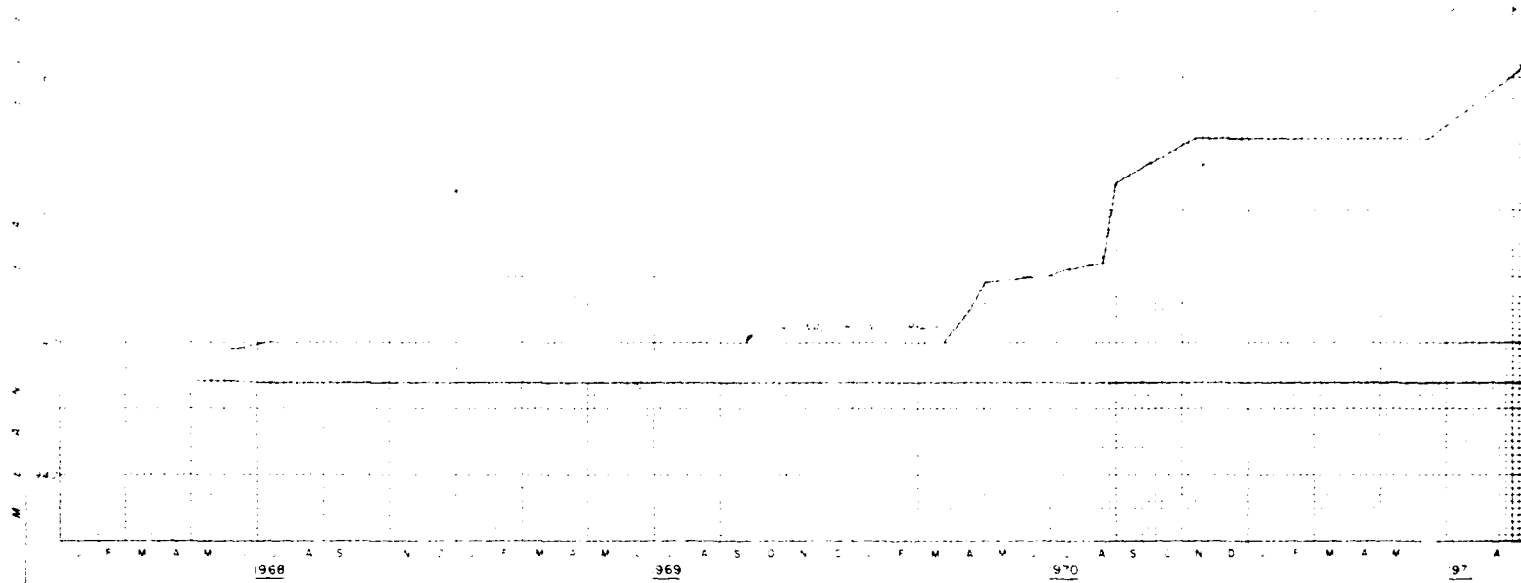
OPEN TUBE
PNEUMATIC CELL

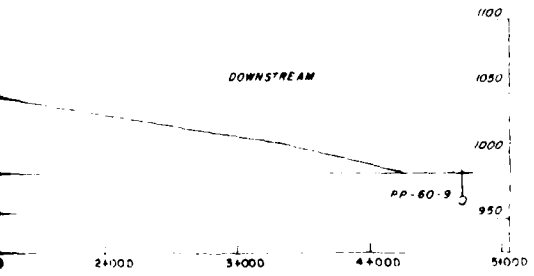
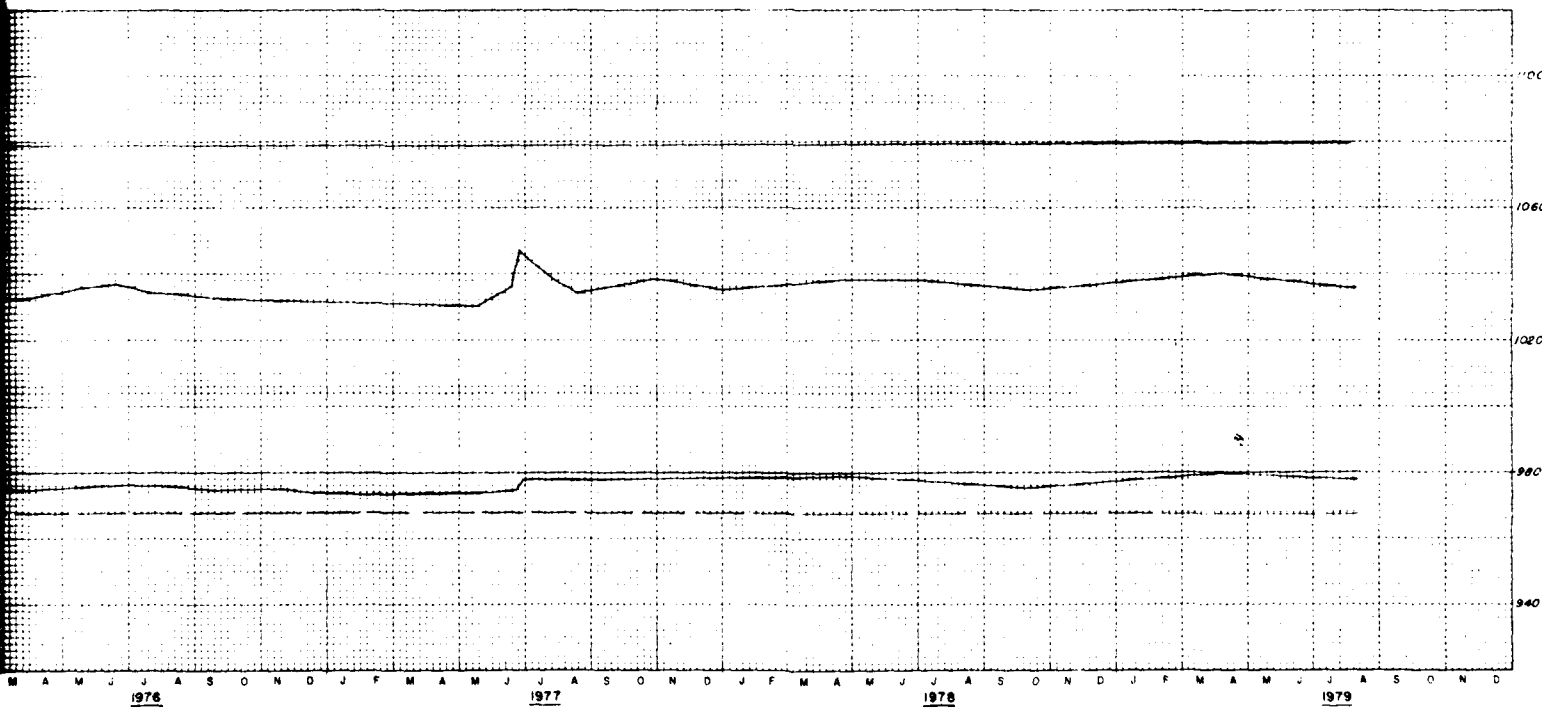
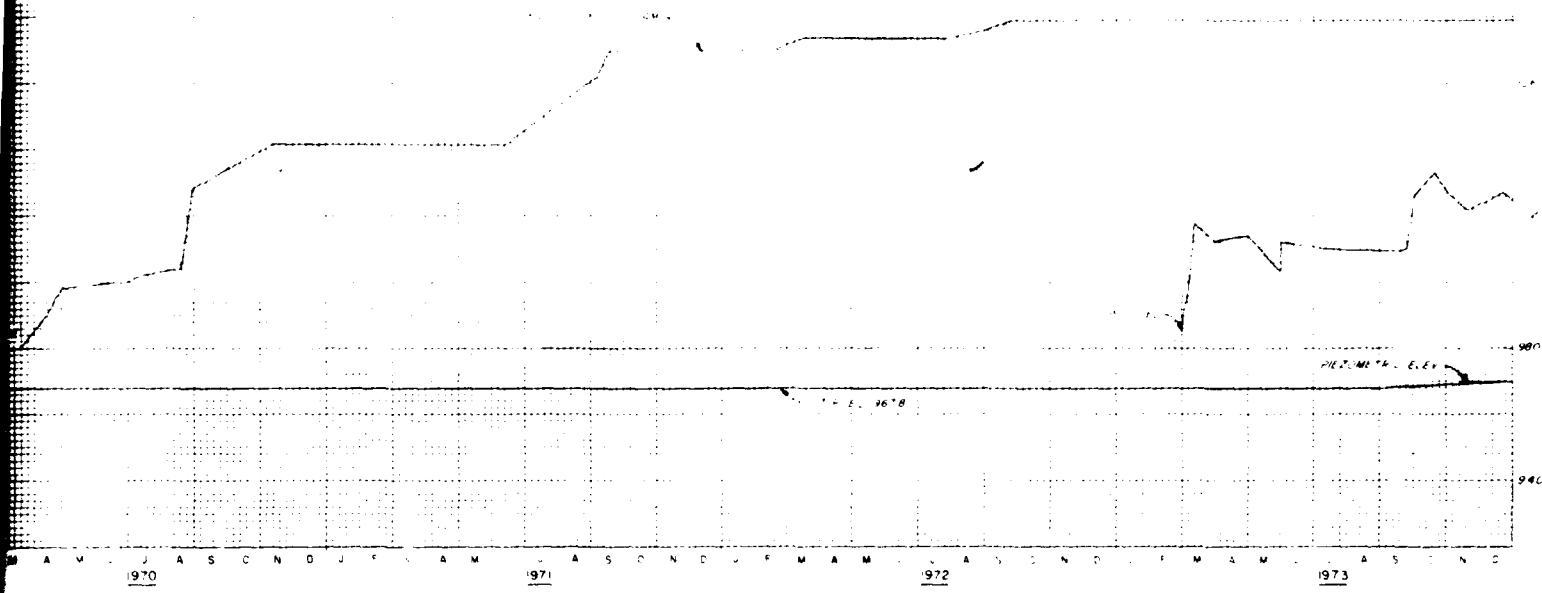
MELVERN LAKE

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

SHEET NO. 1
KANSAS STATE ARMY
KANSAS CENTER

FILE NO. 0-5-1297
AUGUST 1975





LEGEND
 OPEN TUBE — ○
 PNEUMATIC CELL — ●

Revised August 1979
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-60-9 (OPEN TUBE)

In 1 sheet

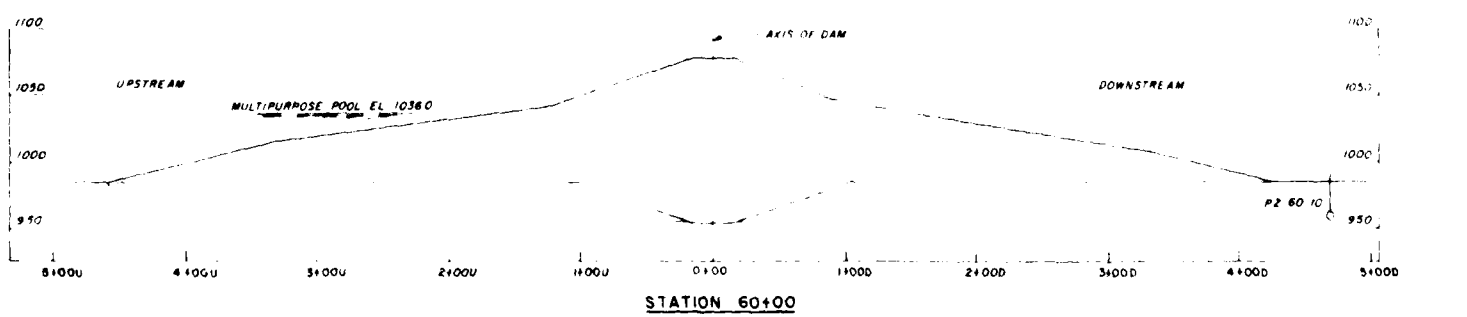
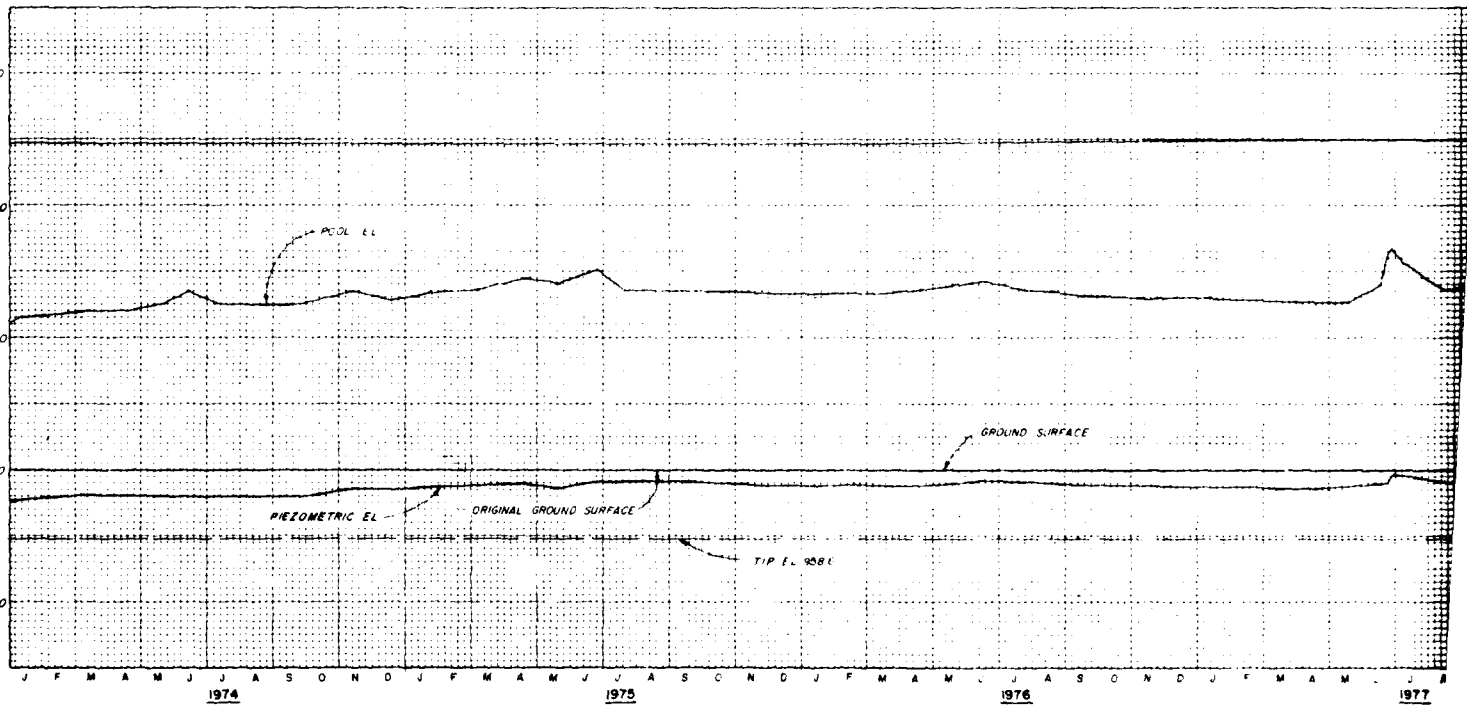
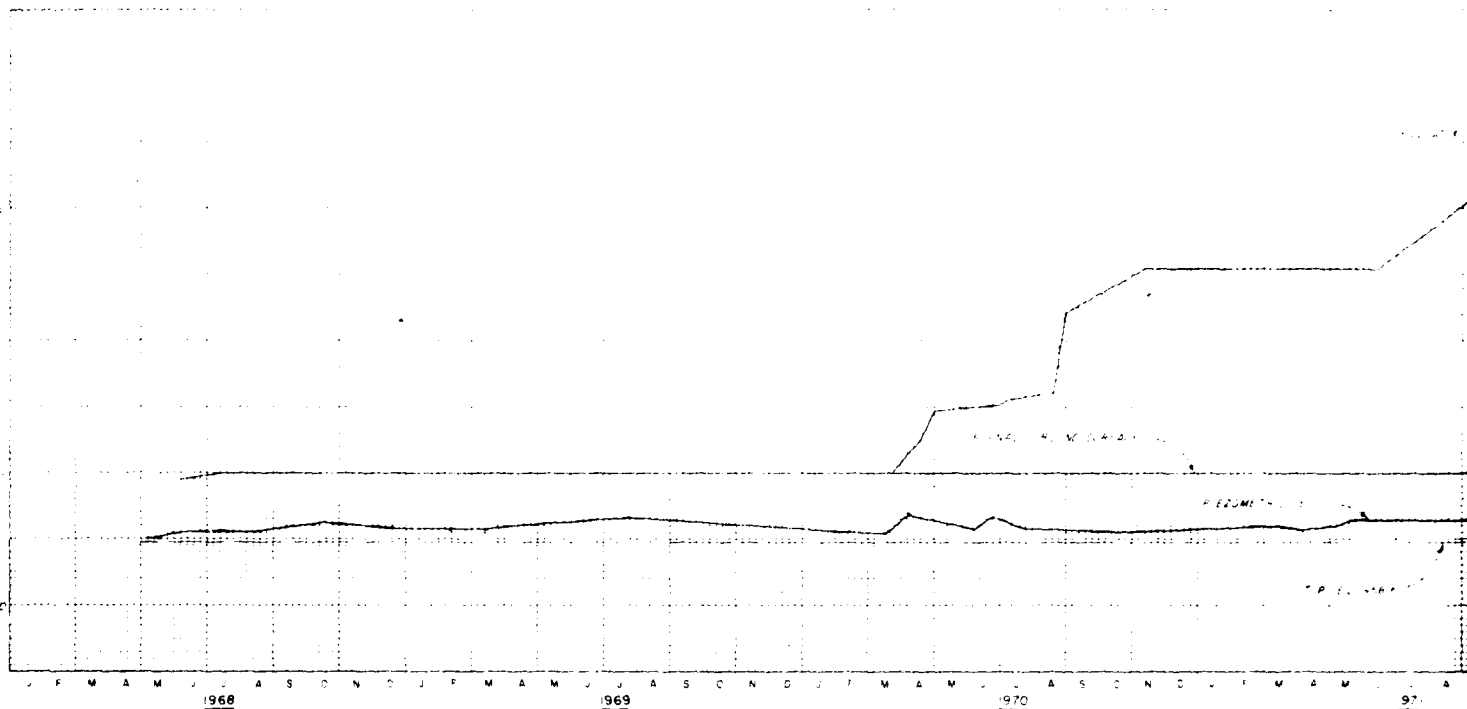
Sheet No. 1

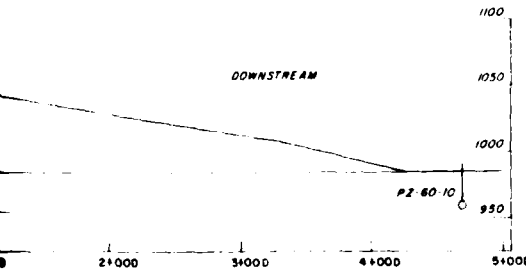
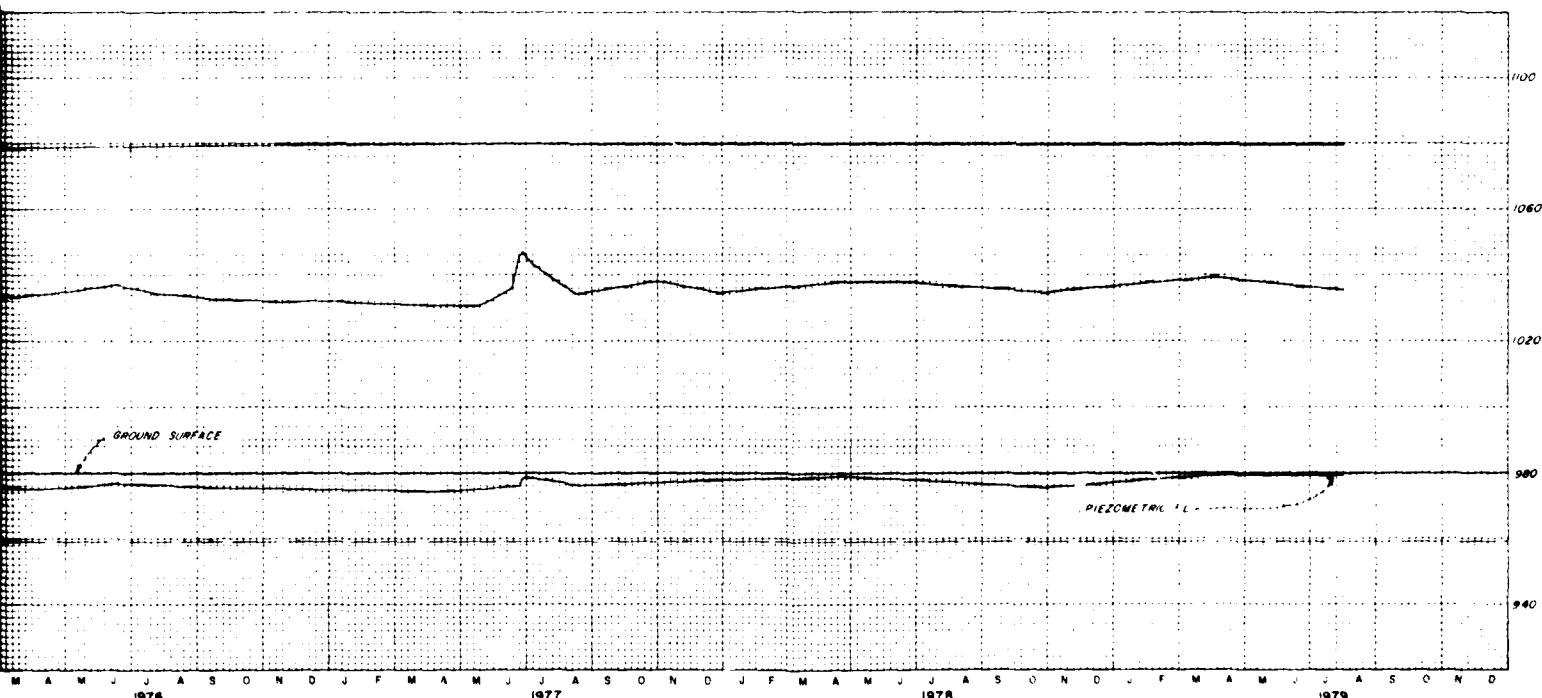
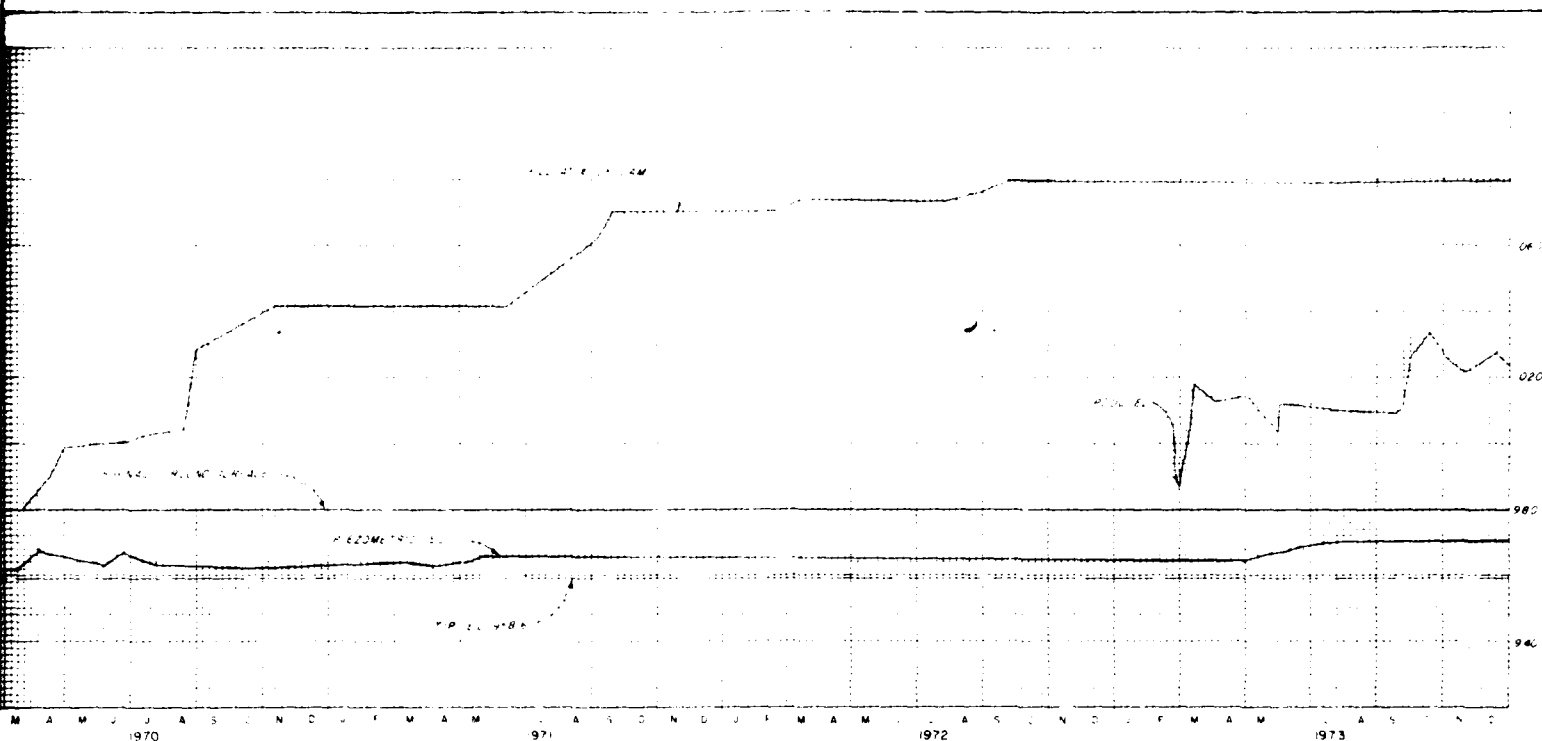
Scale as shown

CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT

FILE NO. 0-5-1298
 AUGUST 1975

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LEGEND
 OPEN TUBE O
 PNEUMATIC CELL ●

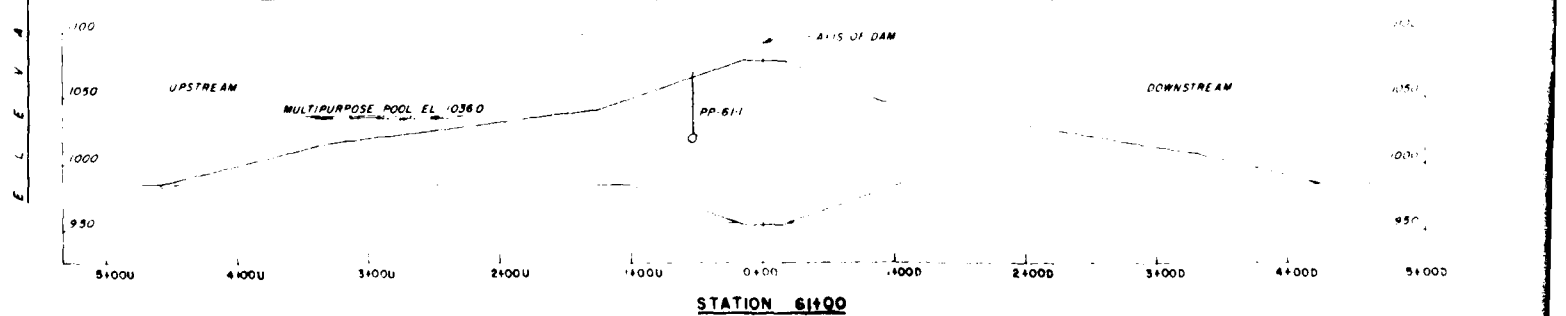
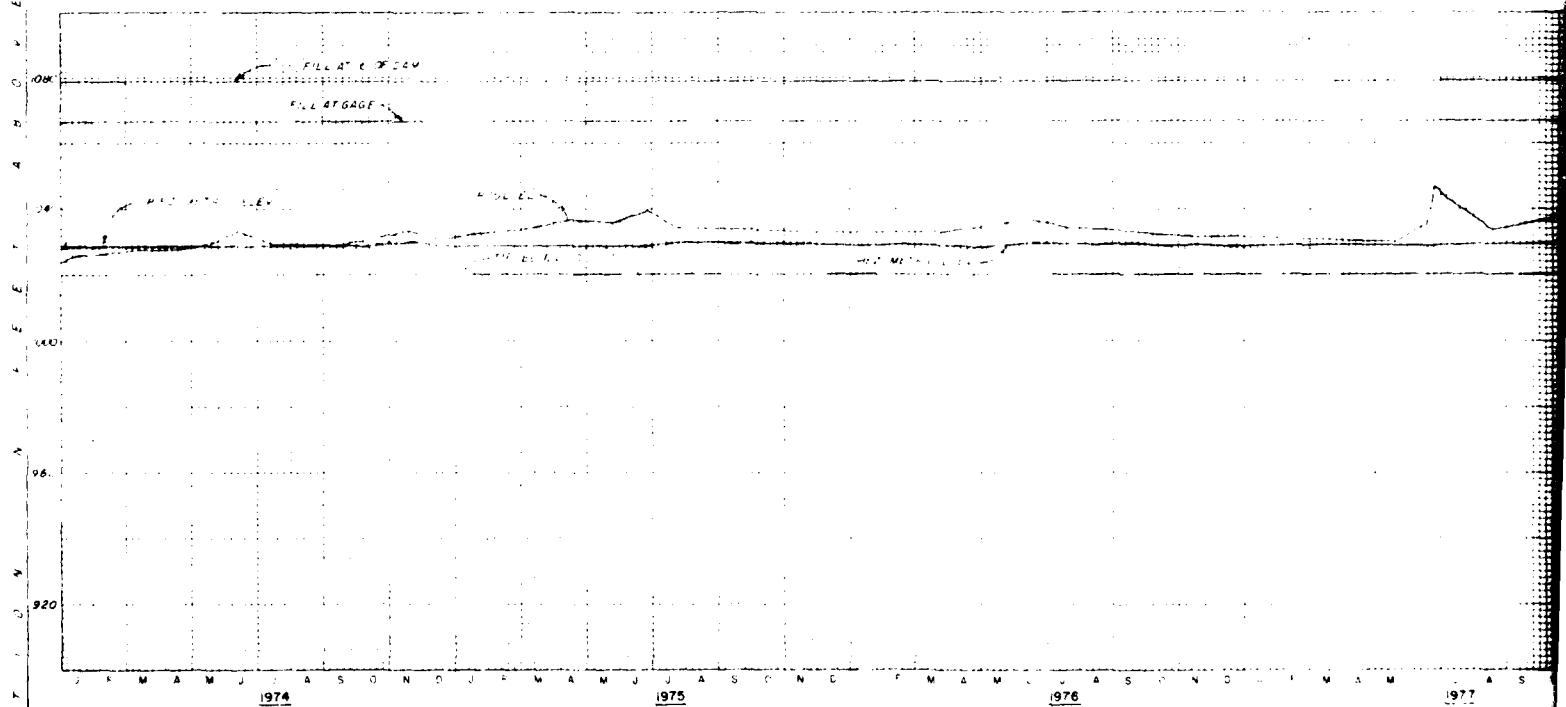
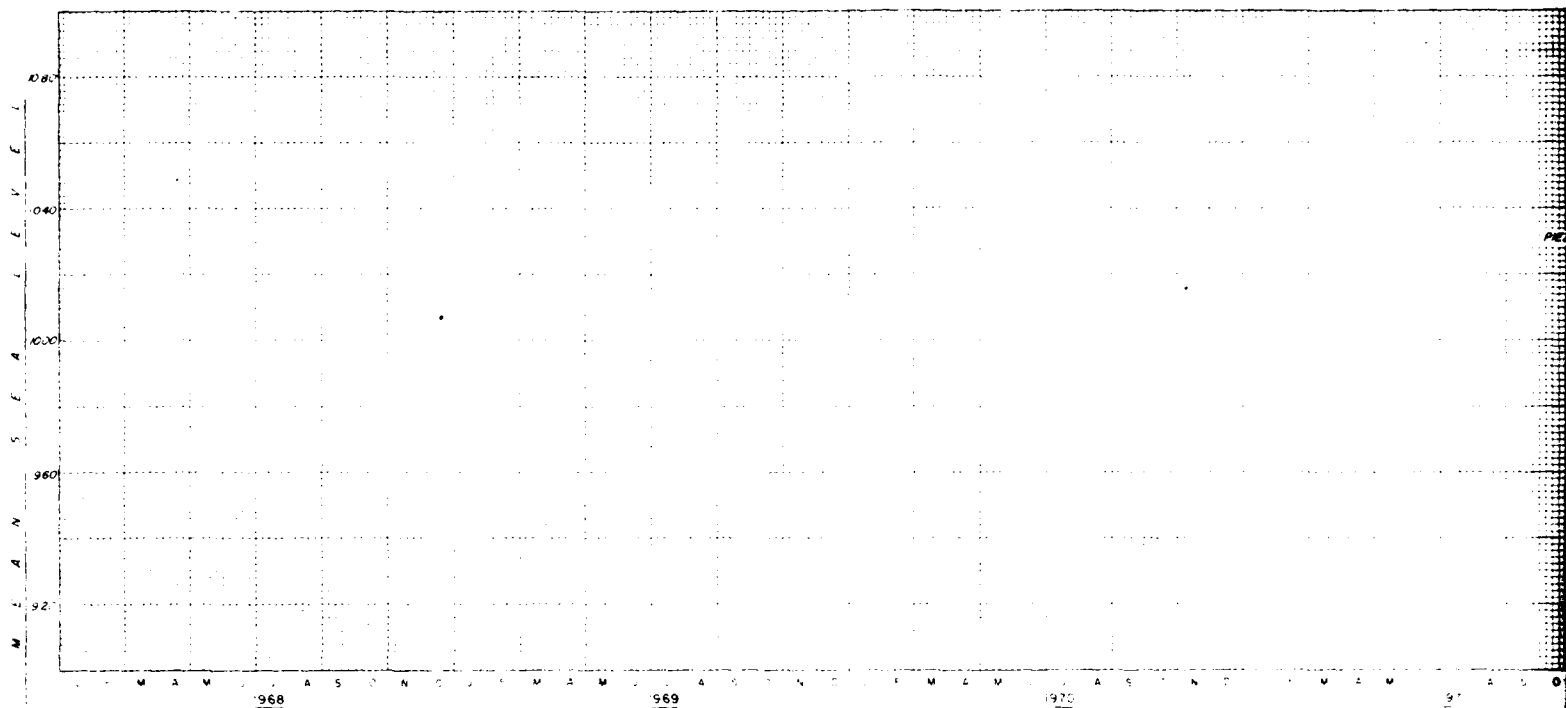
MARSH DES CYGNES RIVER, KANSAS
MELVERN LAKE

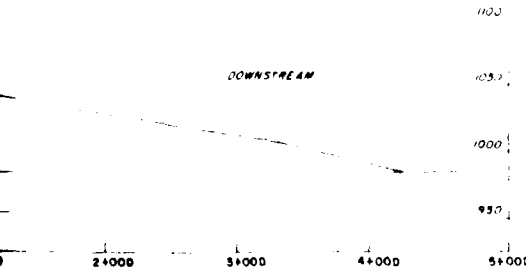
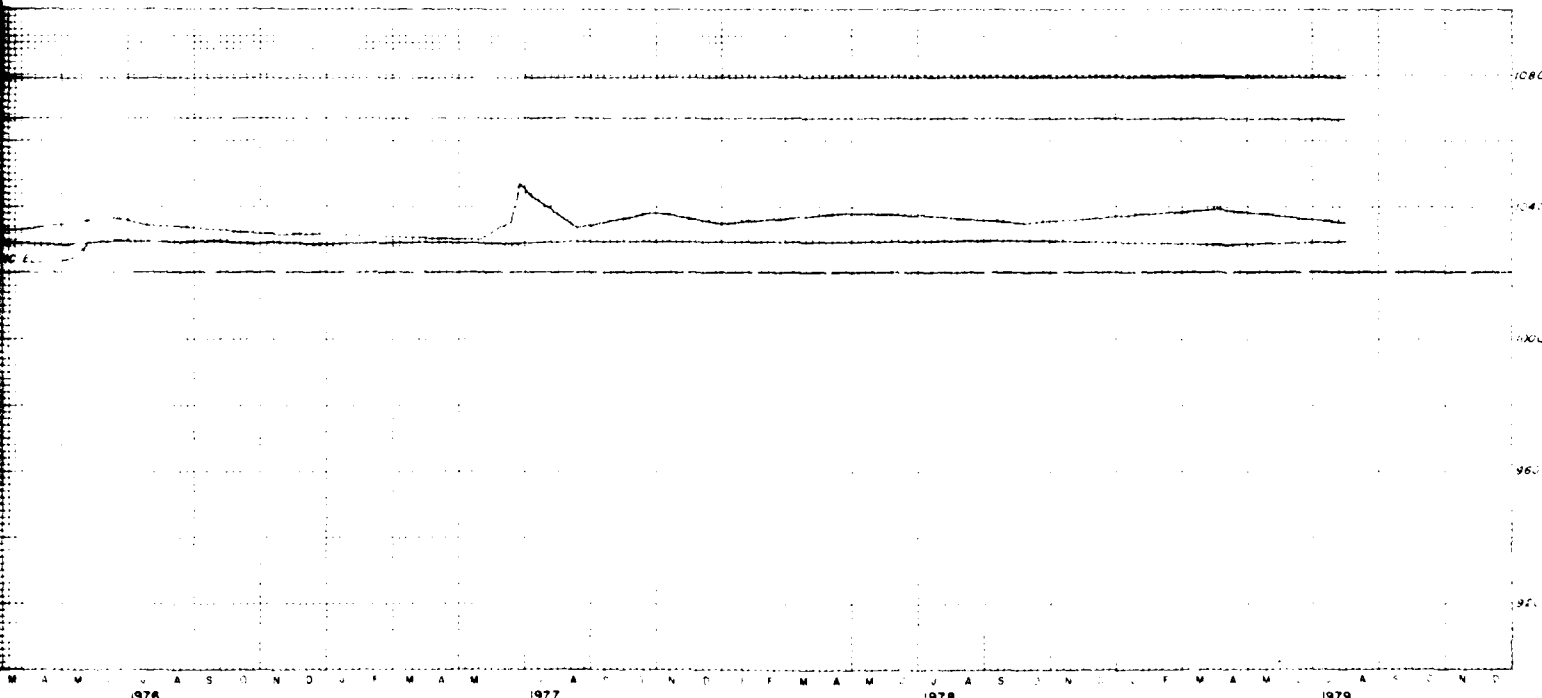
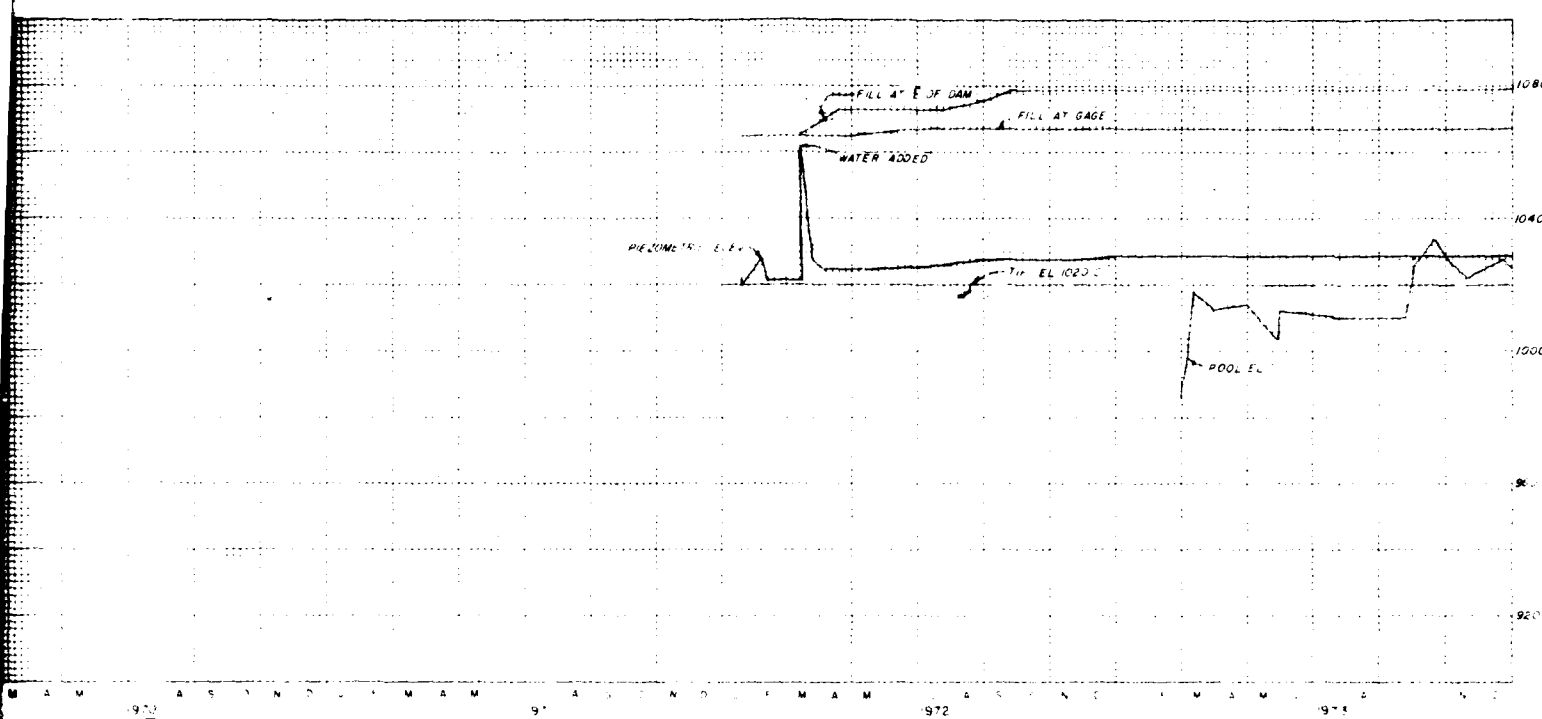
INSTRUMENTATION PLOTS
 PZ-60-10(OPEN TUBE)

Sheet No. 1
 CORPS OF ENGINEERS, U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO 0-5-1299
 AUGUST 1975

In 1 sheet

Scale as shown





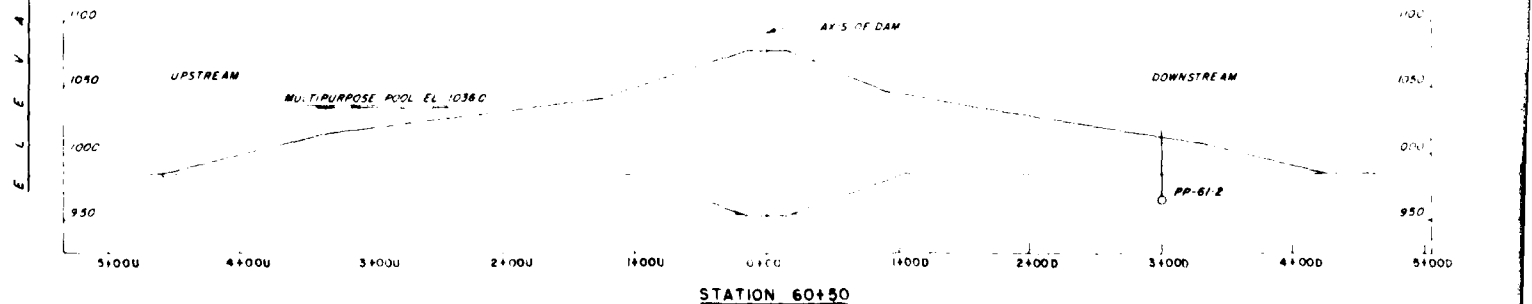
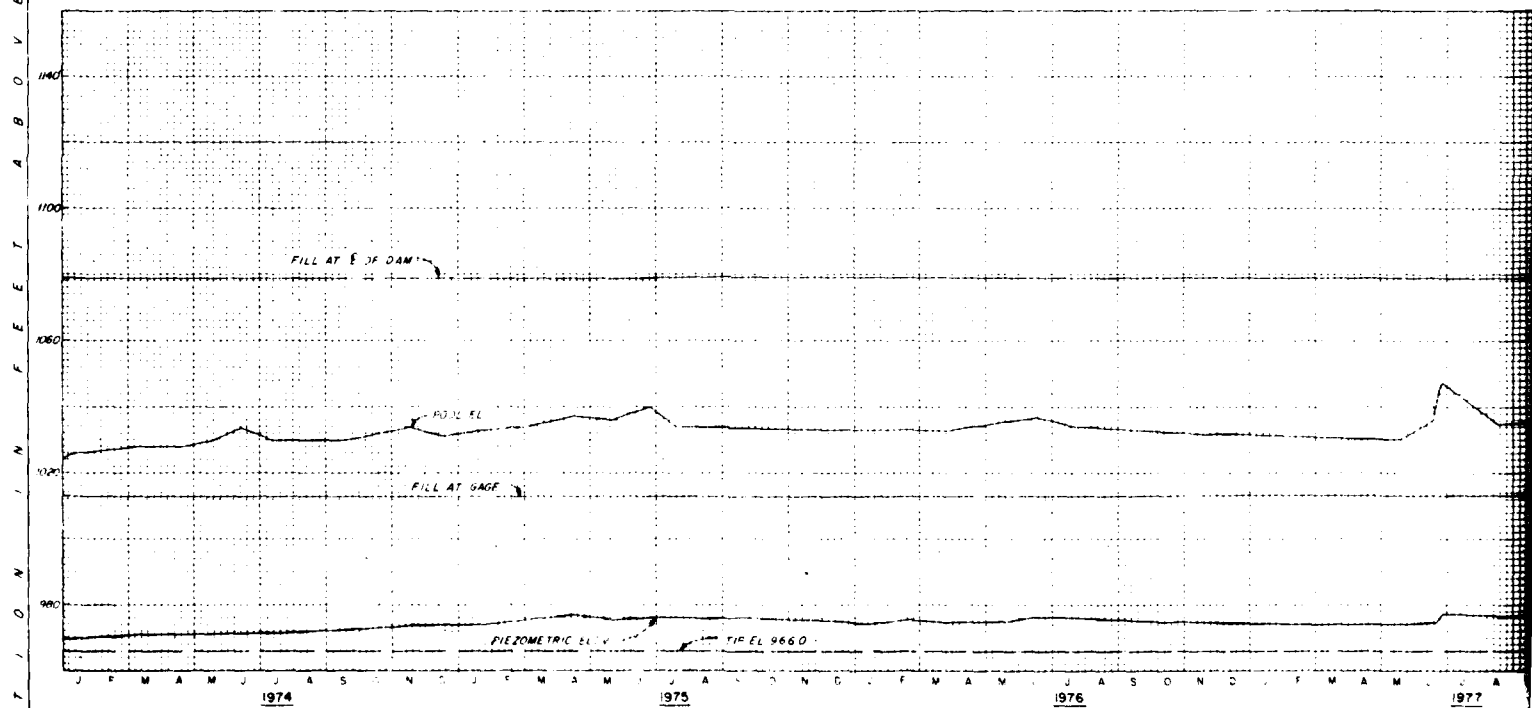
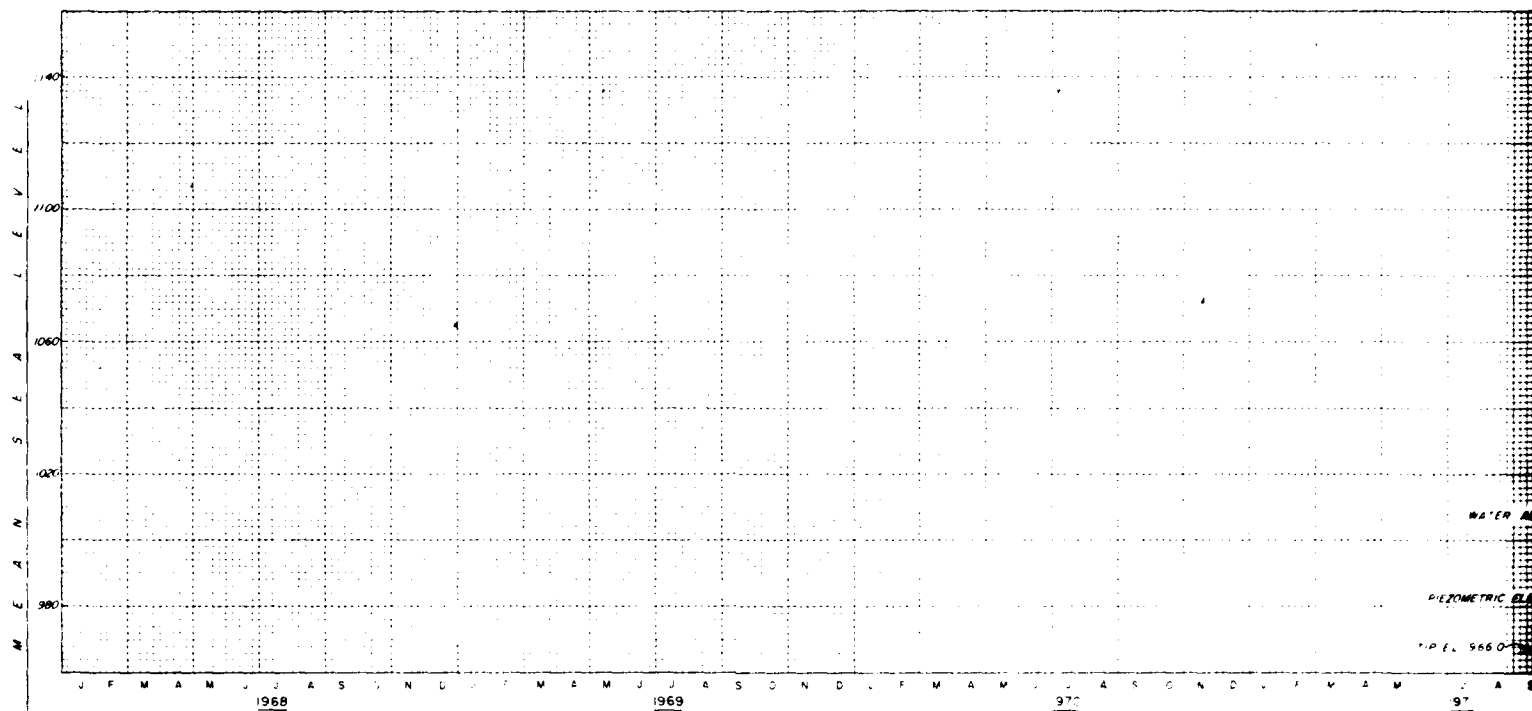
LEGEND

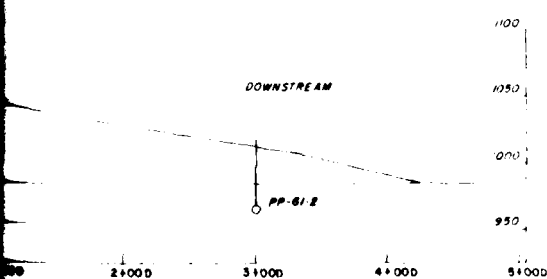
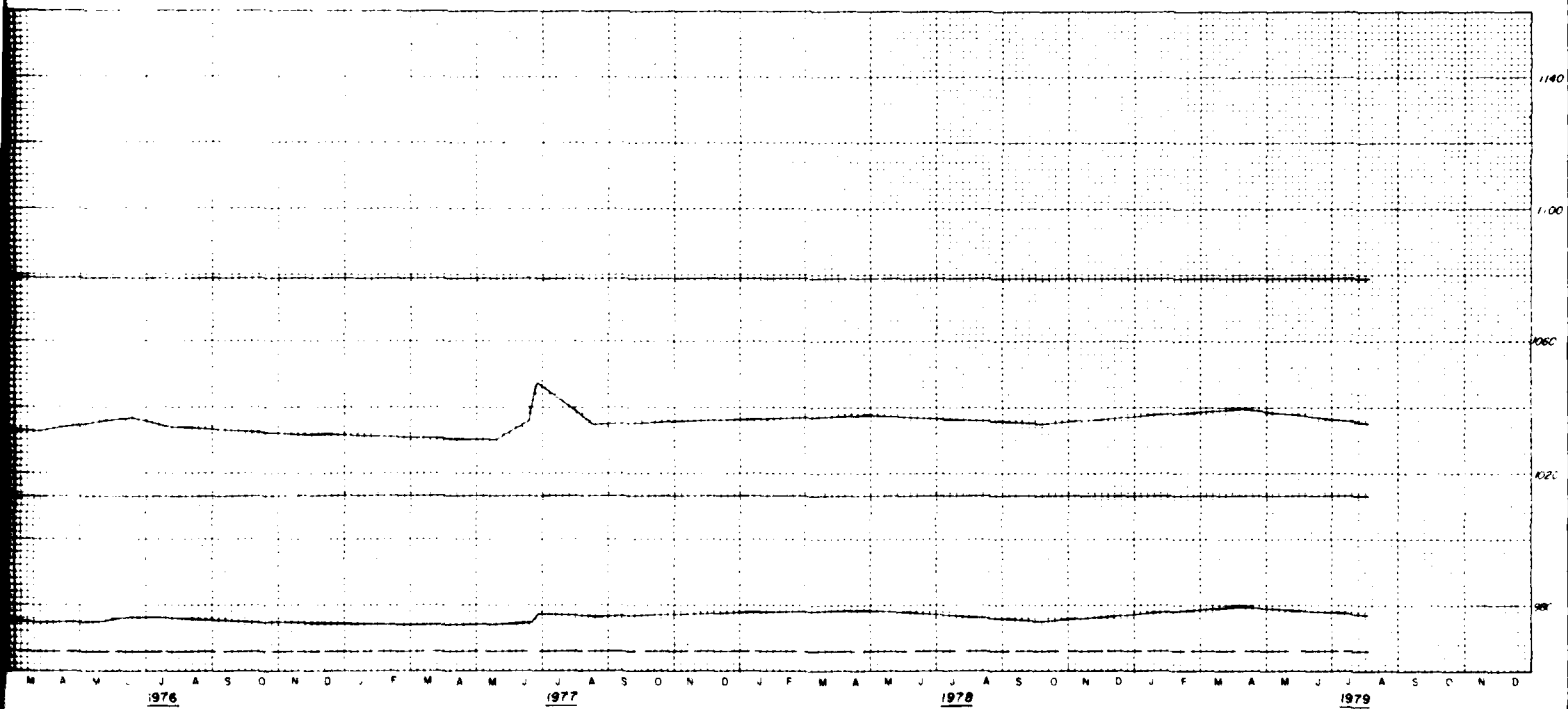
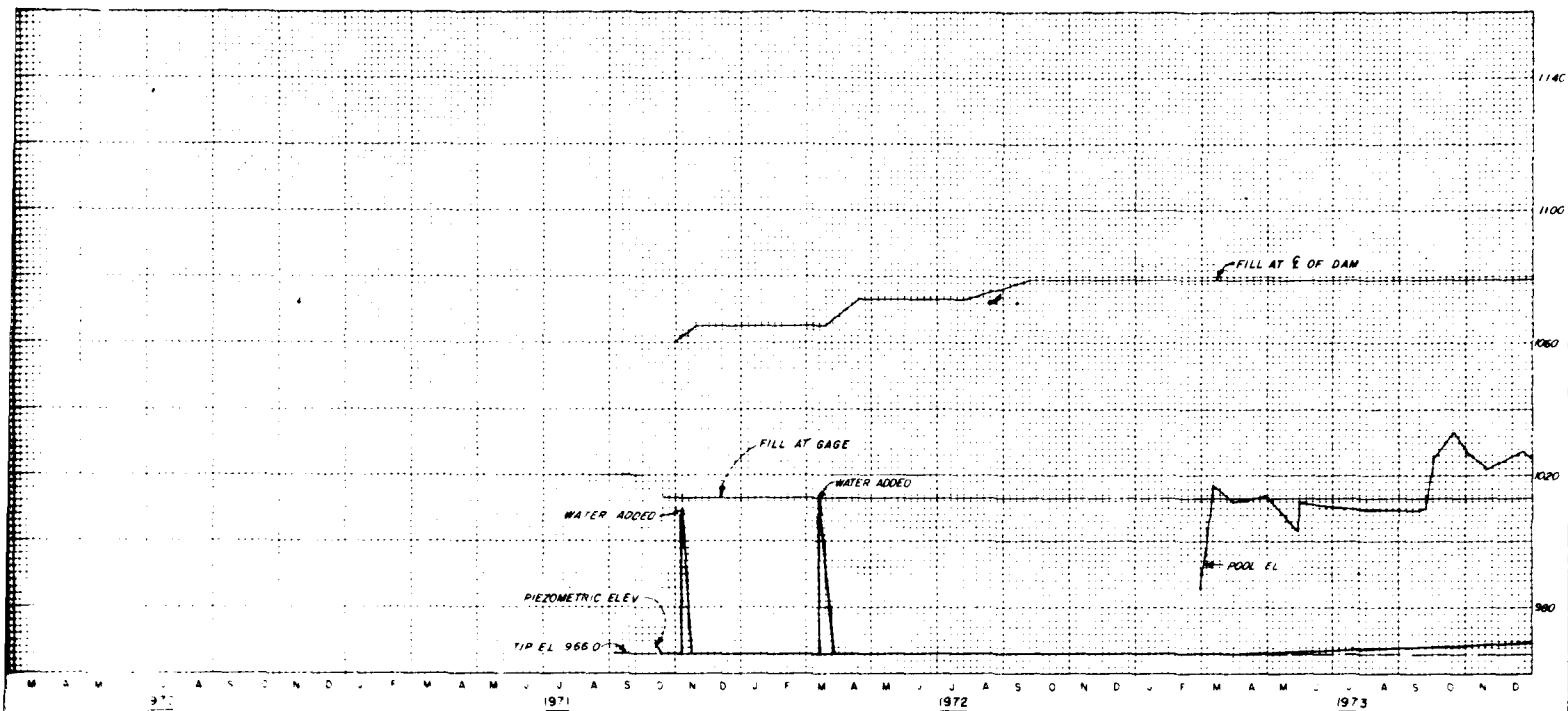
- OPEN TUBE
- PNEUMATIC CELL

MELVERN LAKE

INSTRUMENTATION PLOTS
PP-61-1 (OPEN TUBE)

Sheet No. 1
Scale as shown
FILE NO 0-5-1300
AUGUST 1975





LEGEND

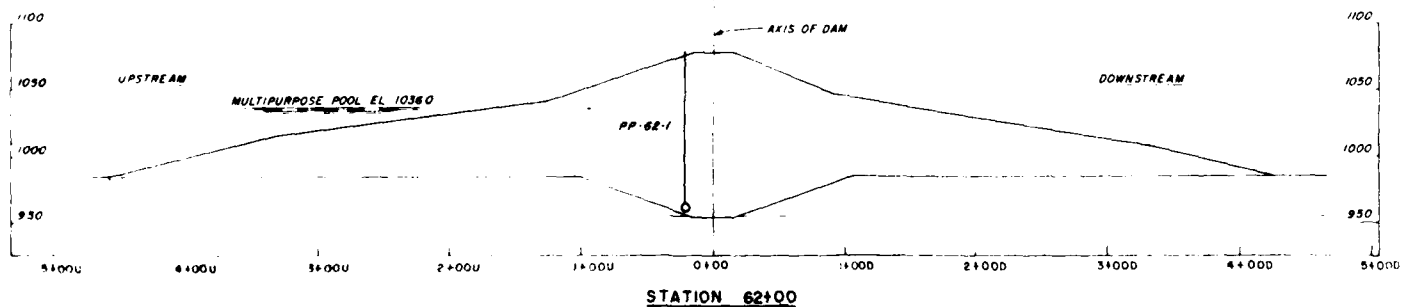
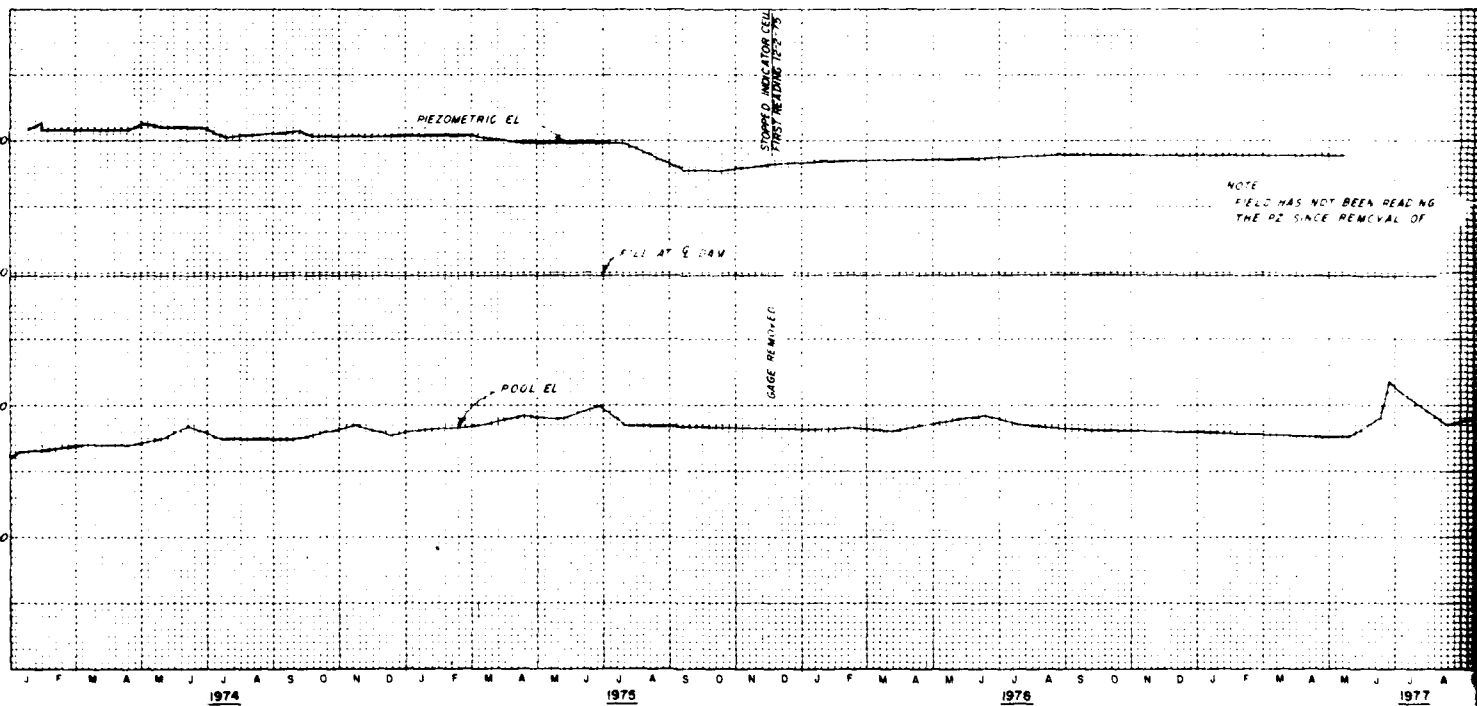
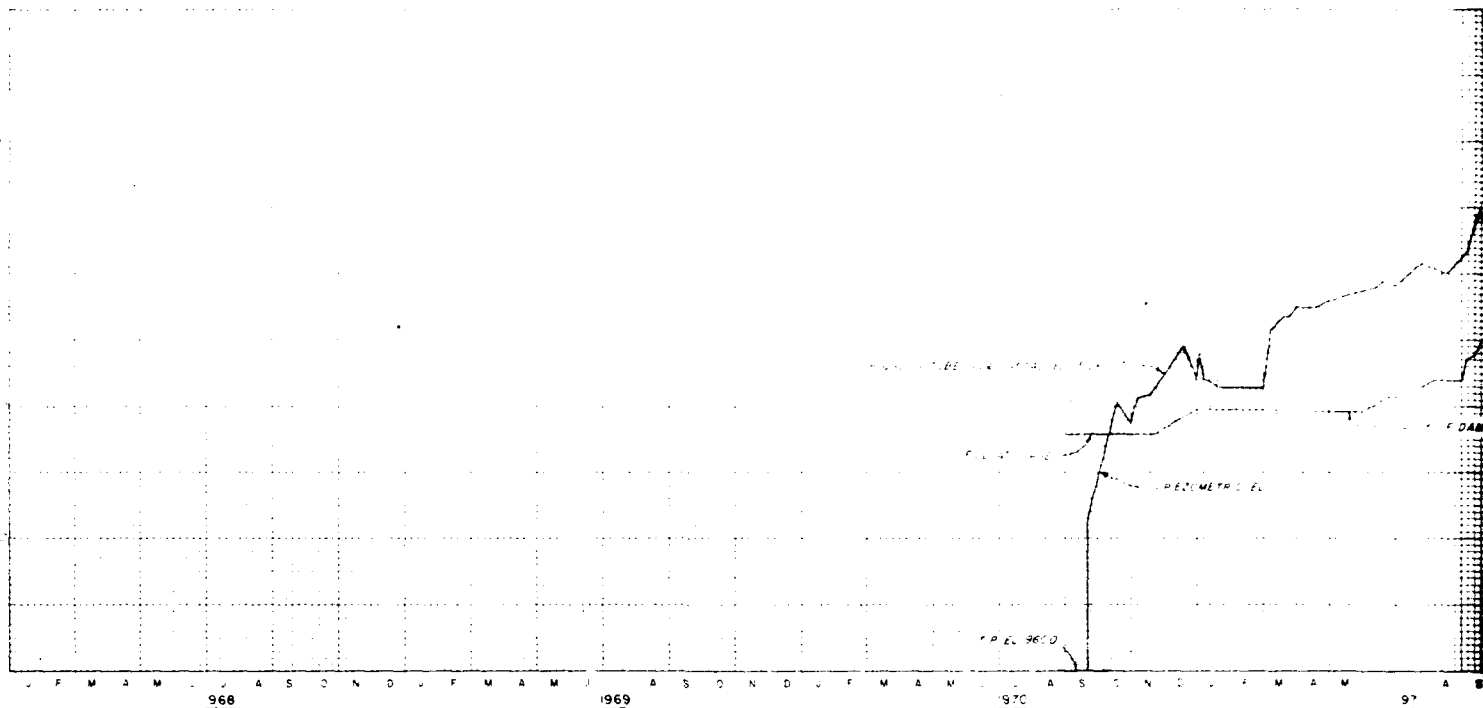
OPEN TUBE ○
PNEUMATIC CELL ●

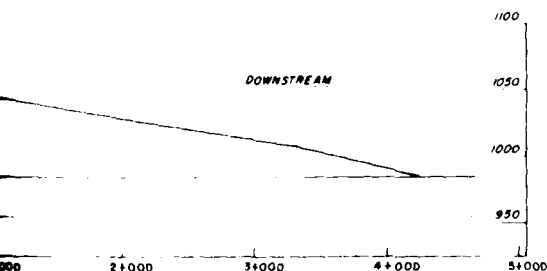
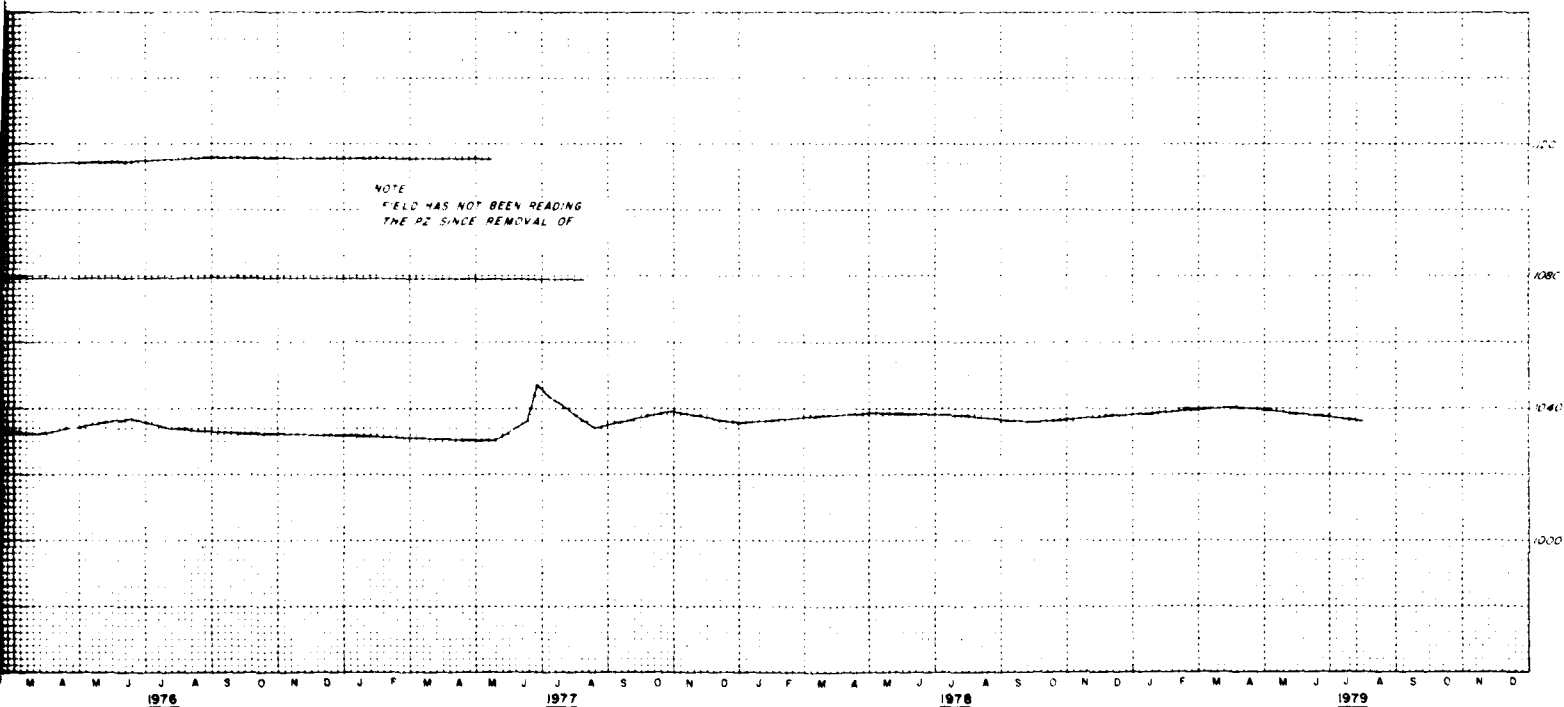
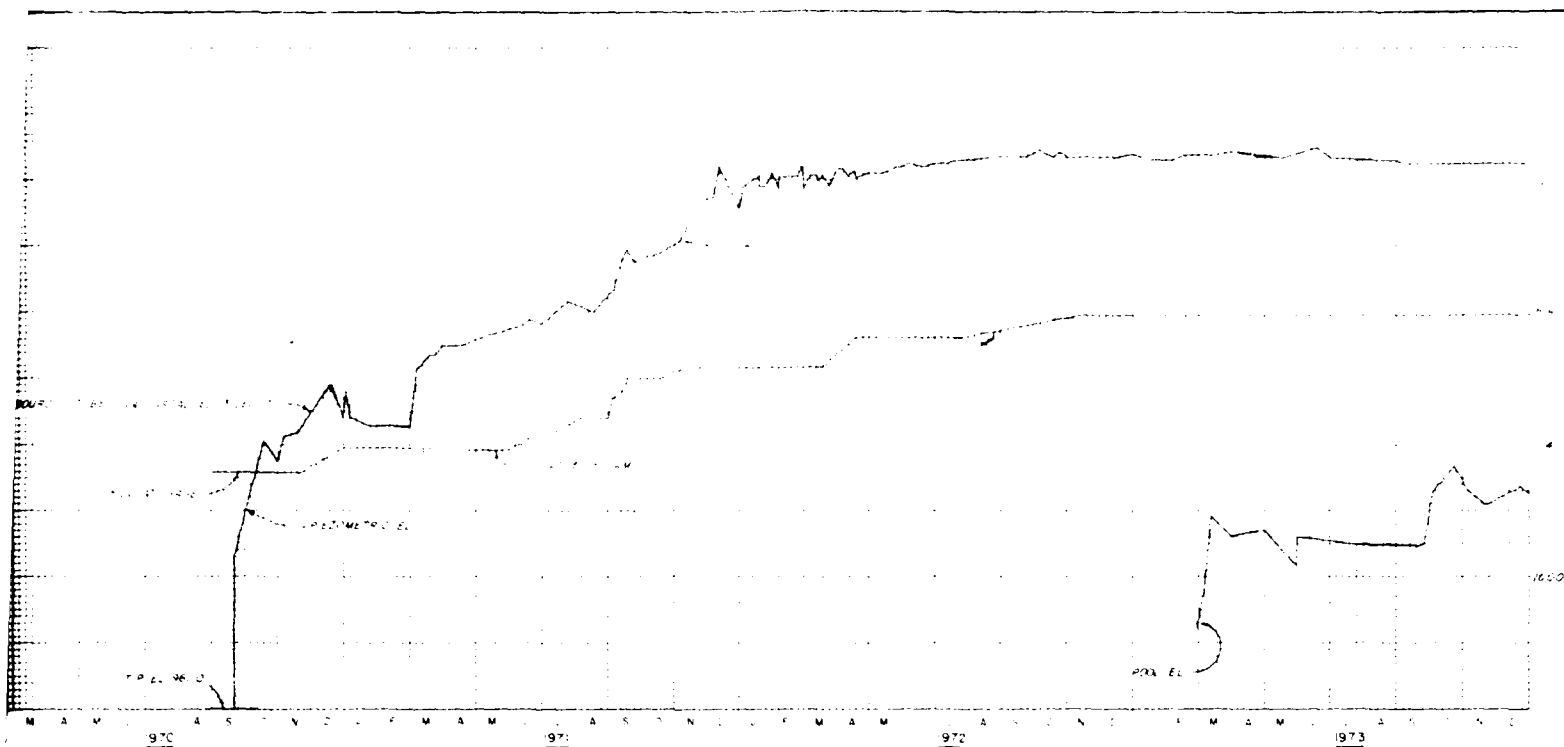
MELVERN LAKE

INSTRUMENTATION PLOTS
PP-61-2 (OPEN TUBE)

FILE NO 0-5-1301
AUGUST 1974

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LEGEND

OPEN TUBE O
PNEUMATIC CELL ●

Revised August 1979
MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
PP-62-1 (OPEN TUBE)

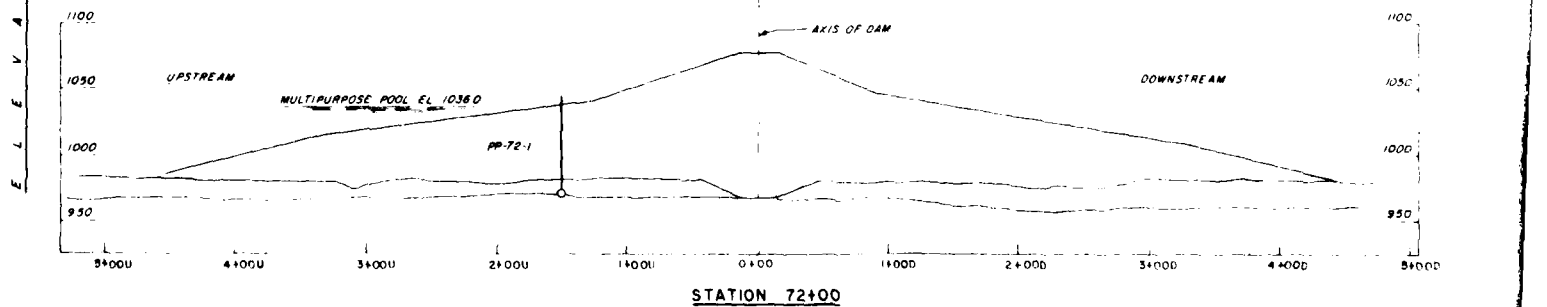
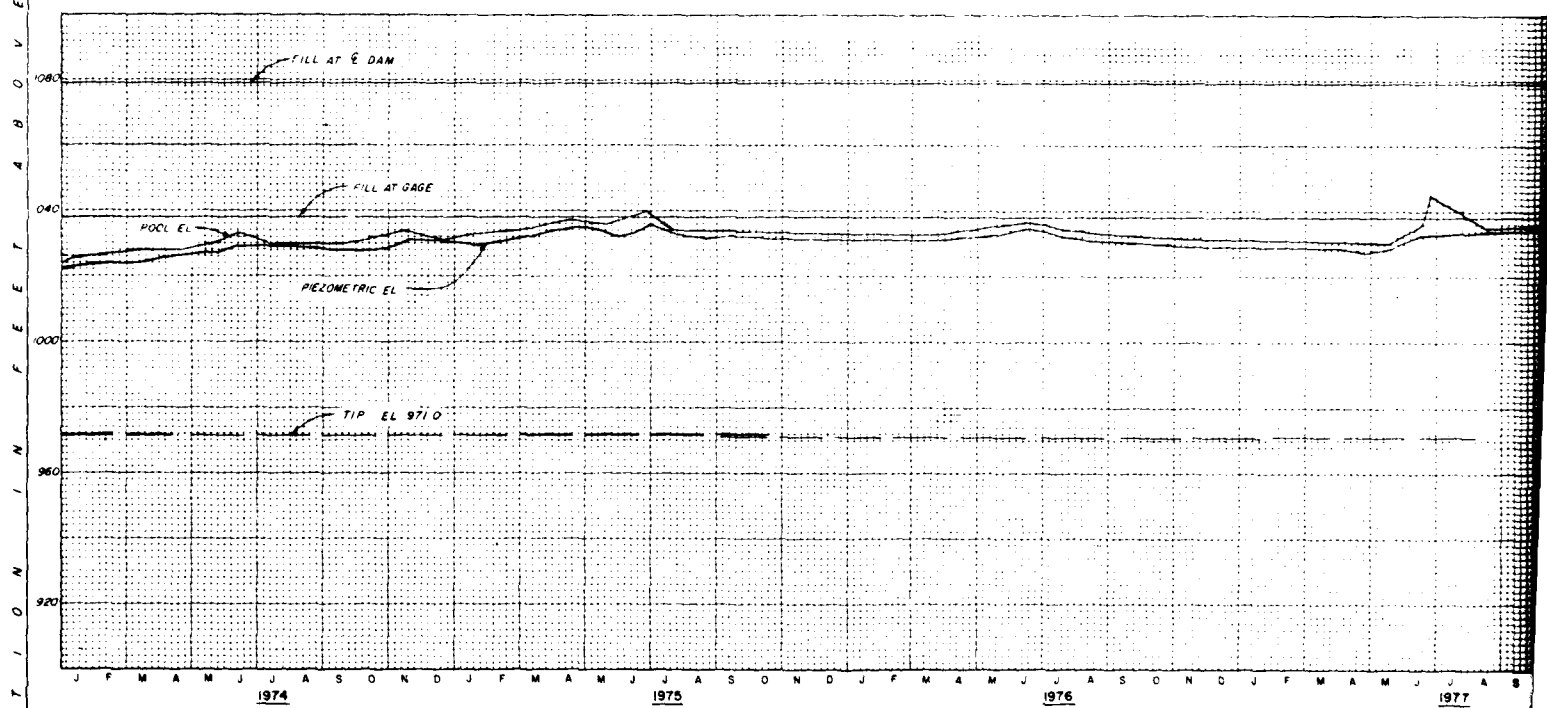
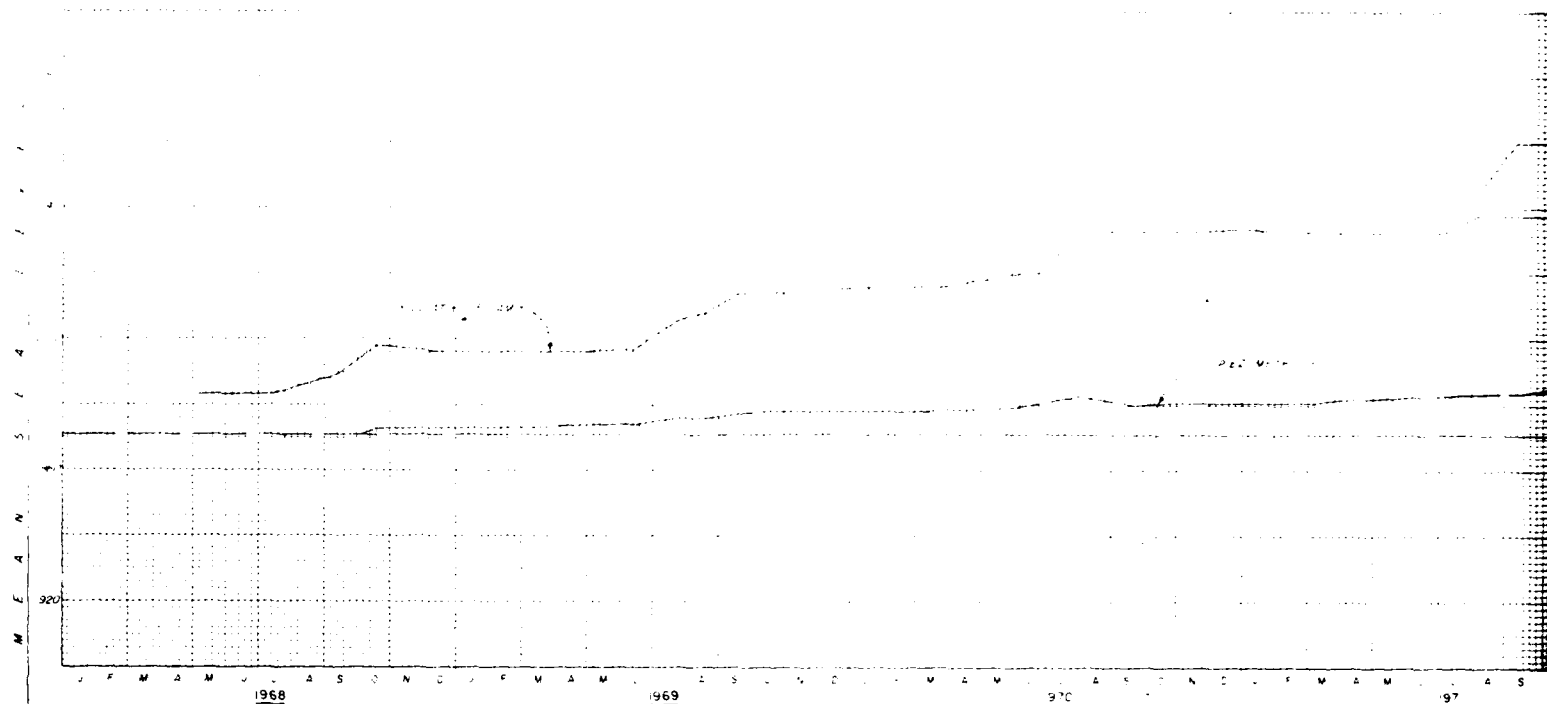
In 1 sheet

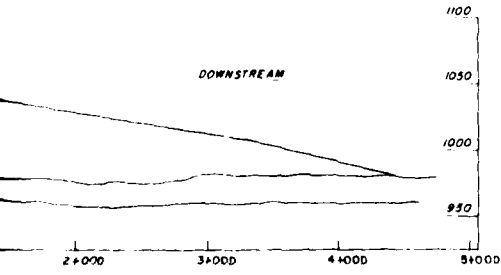
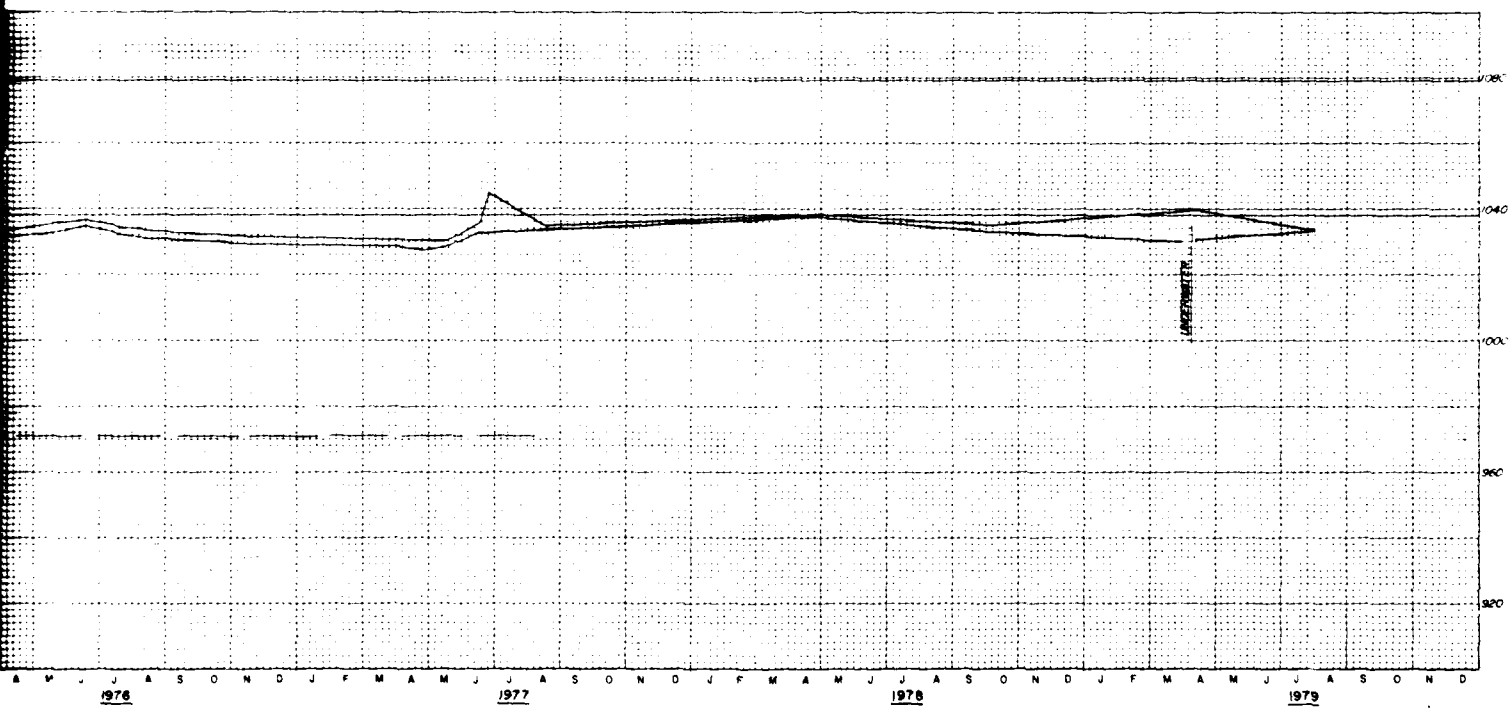
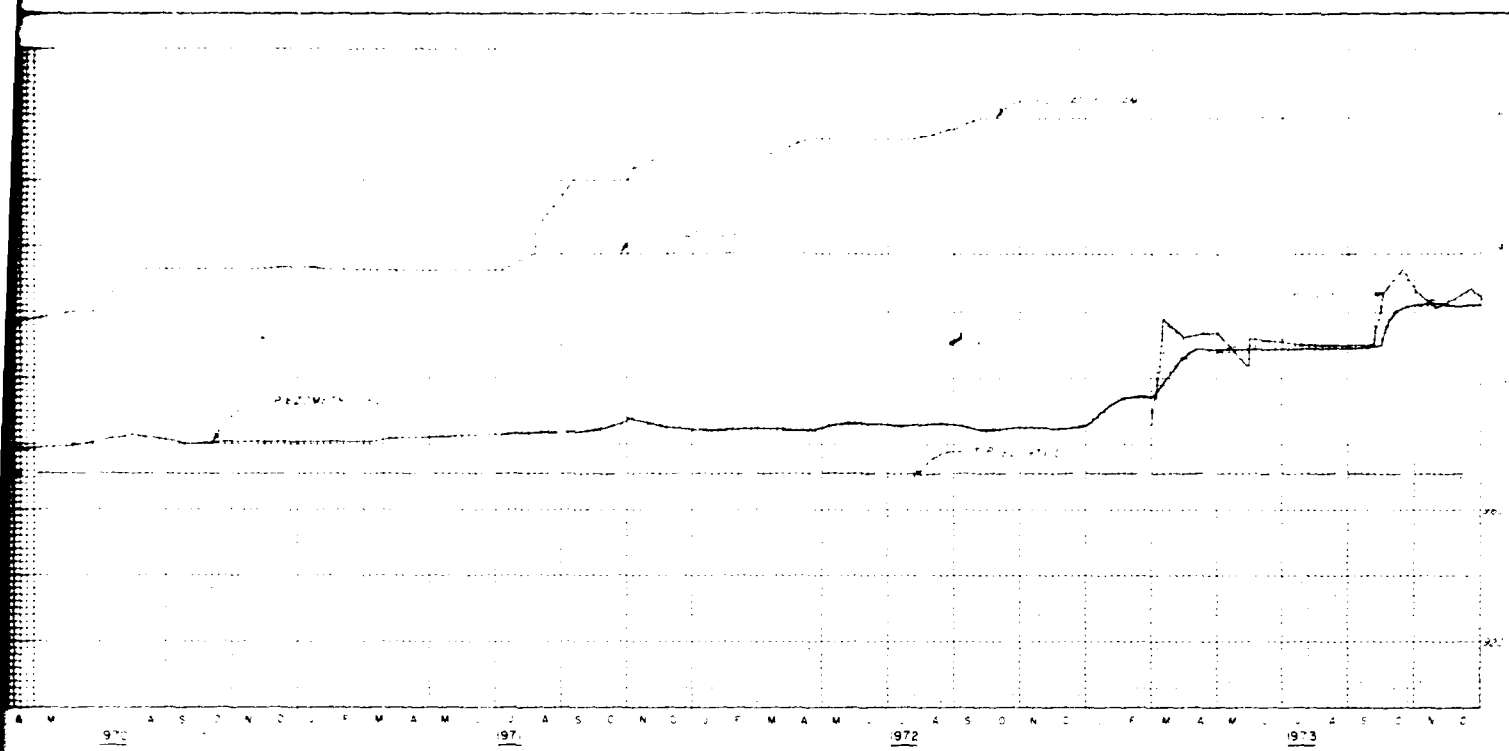
Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

FILE NO 0-5-1302
AUGUST 1975





LEGEND
 OPEN TUBE — ○
 PNEUMATIC CELL — ●

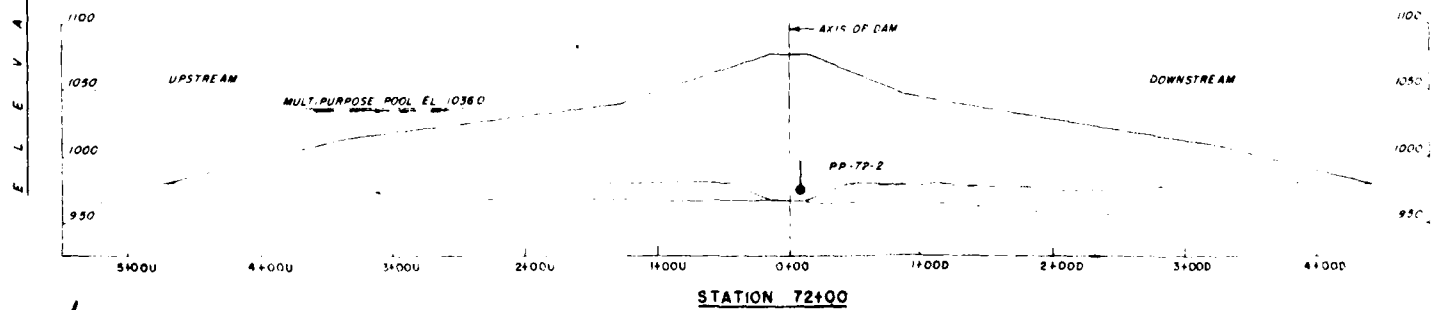
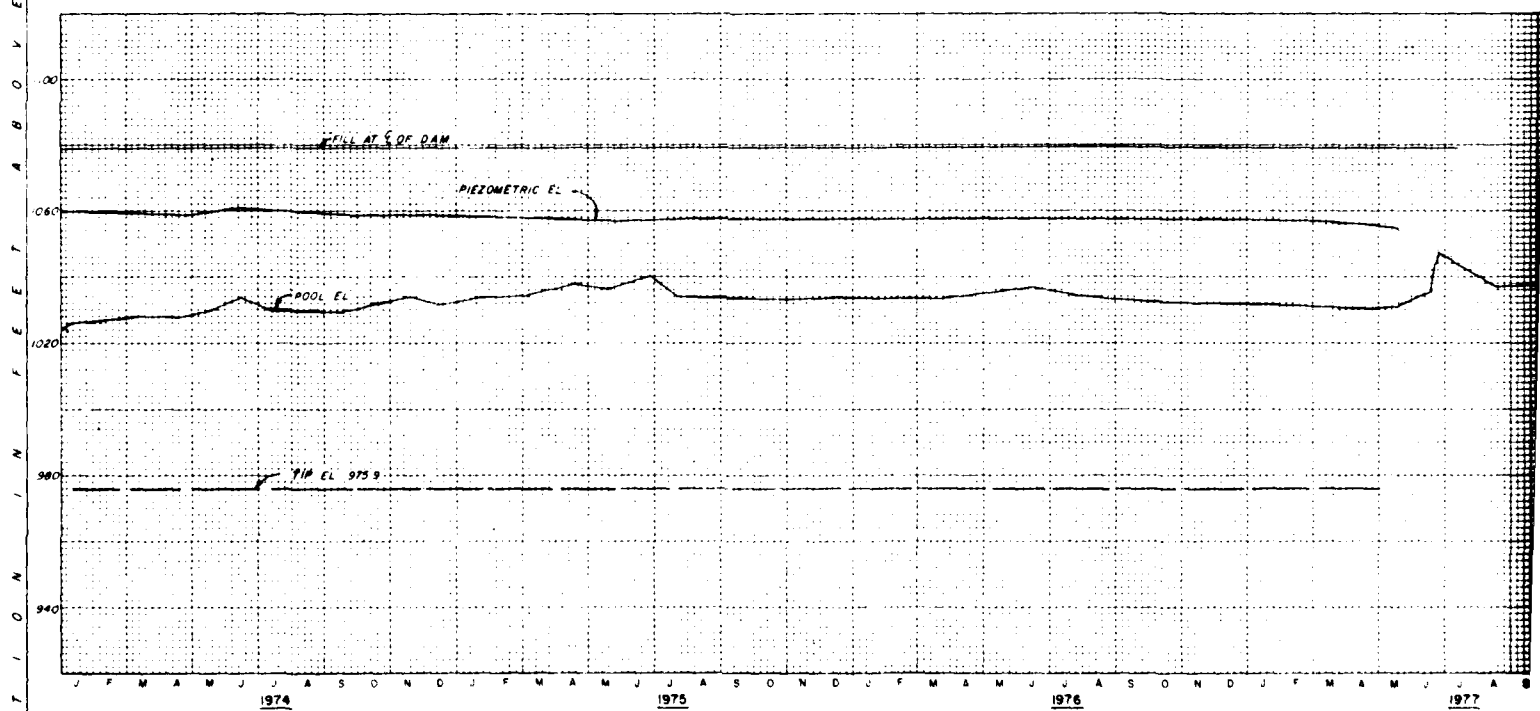
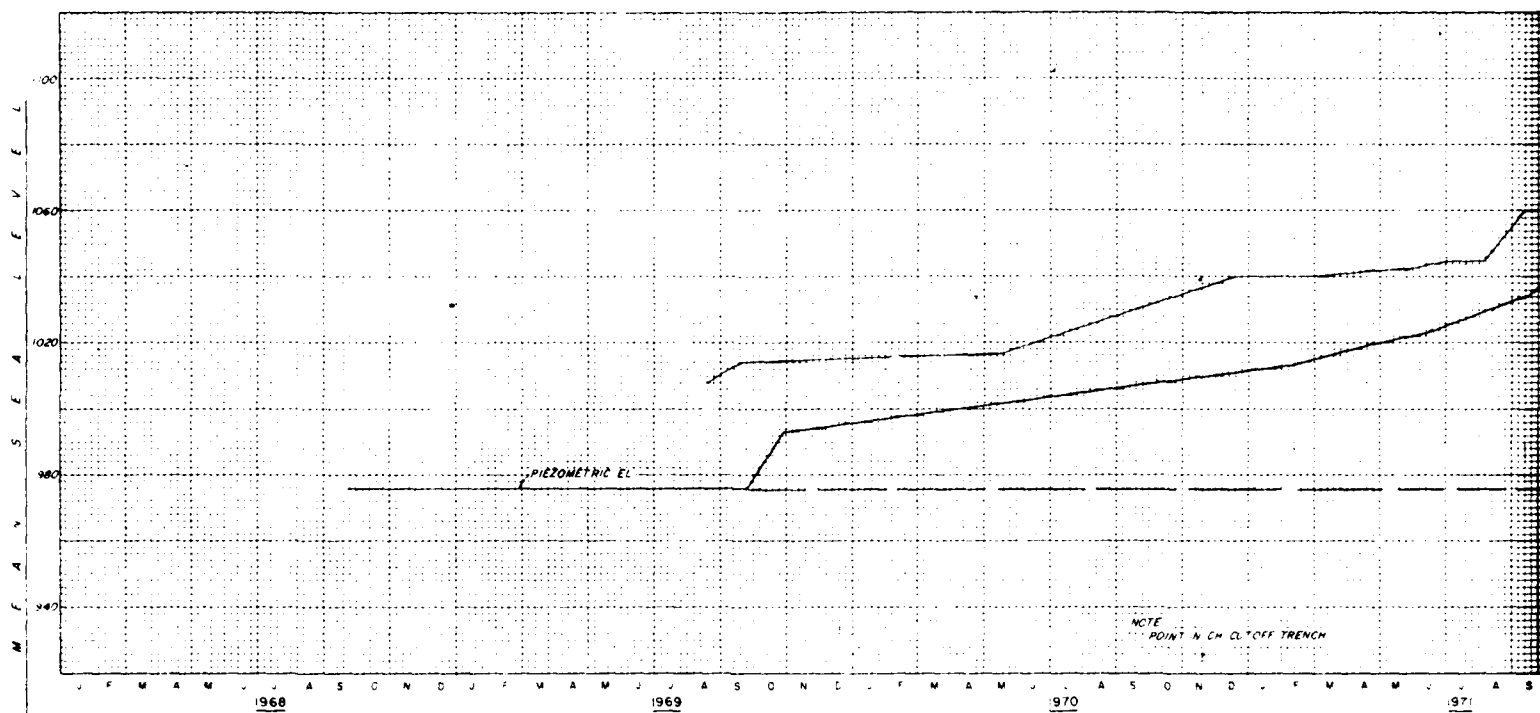
Revised August 1979
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

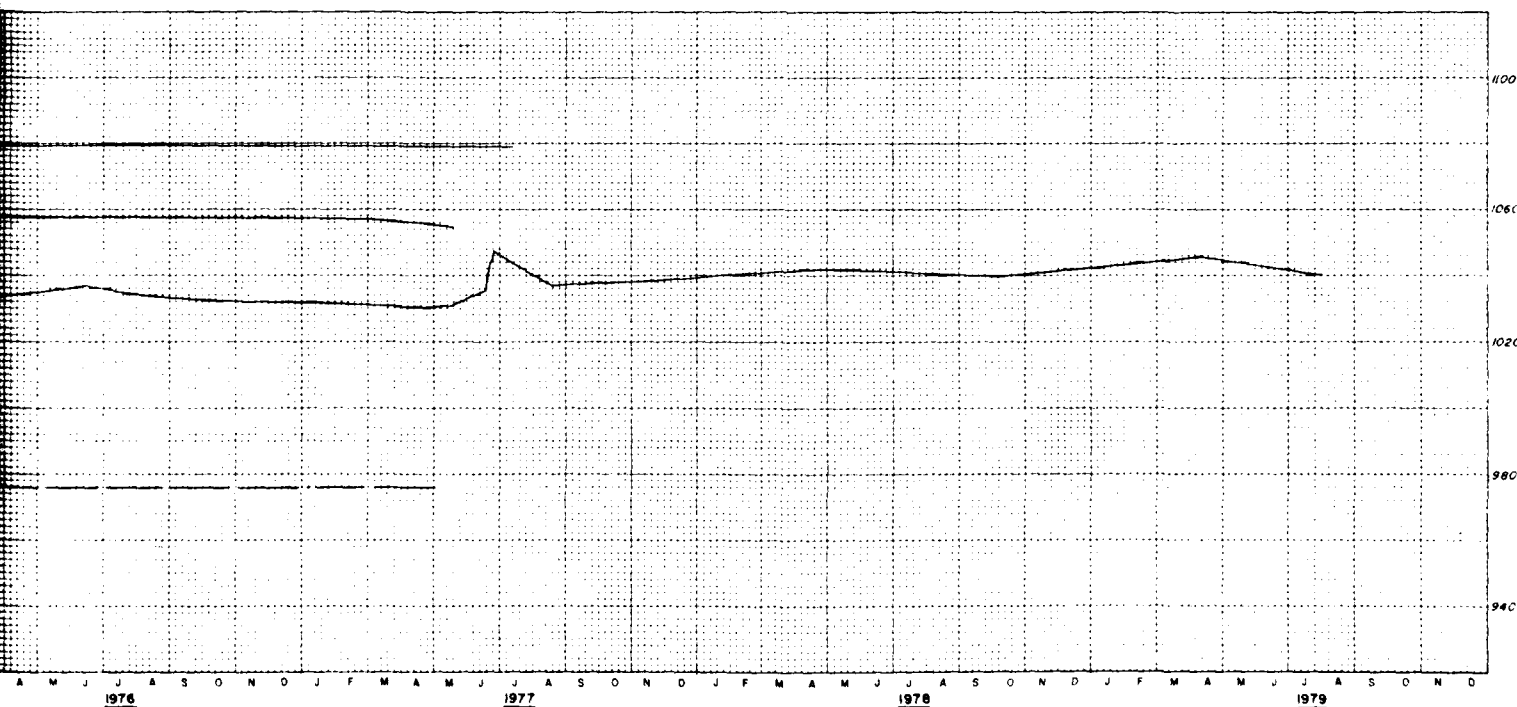
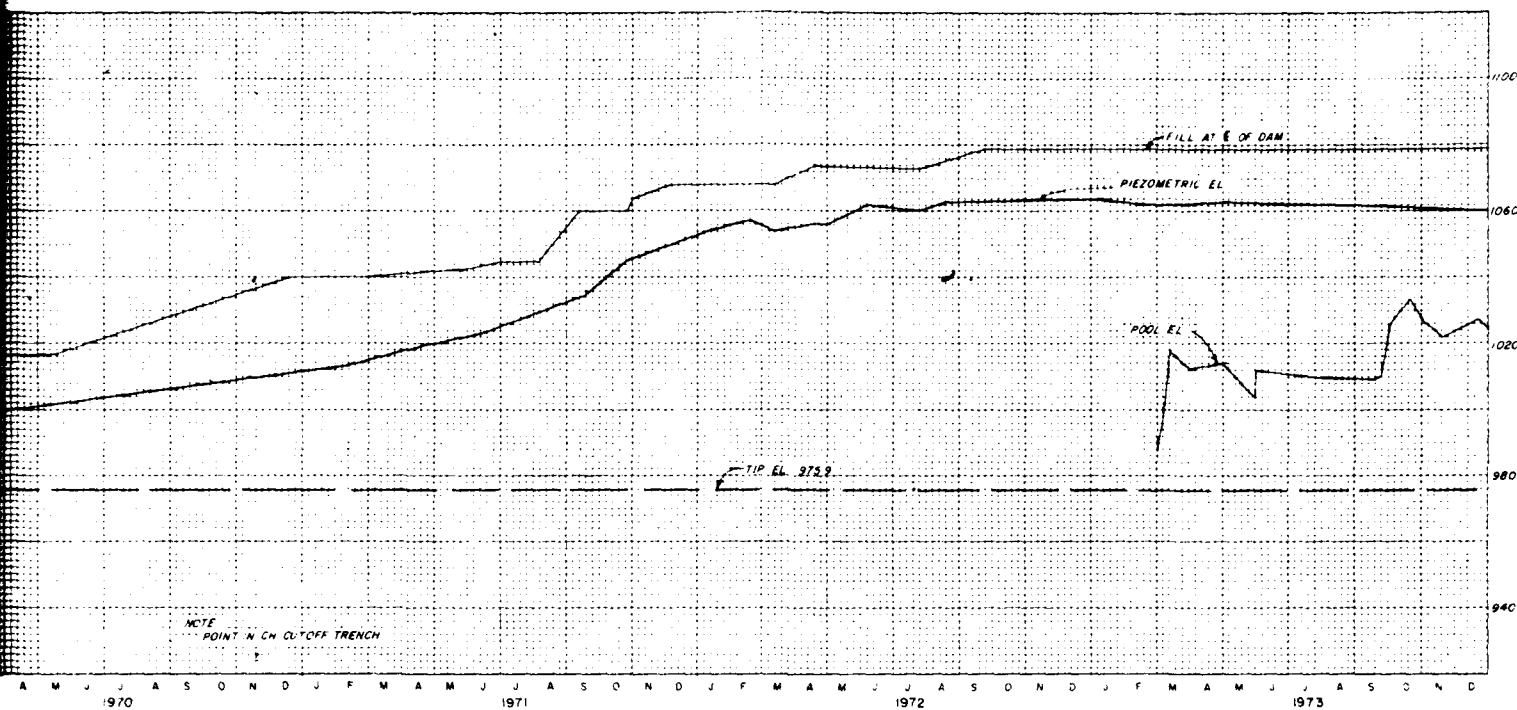
INSTRUMENTATION PLOTS
 PP-72-1 (OPEN TUBE)

In 1 sheet

Sheet No. 1
 CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1303
 AUGUST 1975

Scale as shown





DOWNSTREAM

LEGEND

OPEN TUBE ○
PNEUMATIC CELL ●

MELVERN LAKE

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

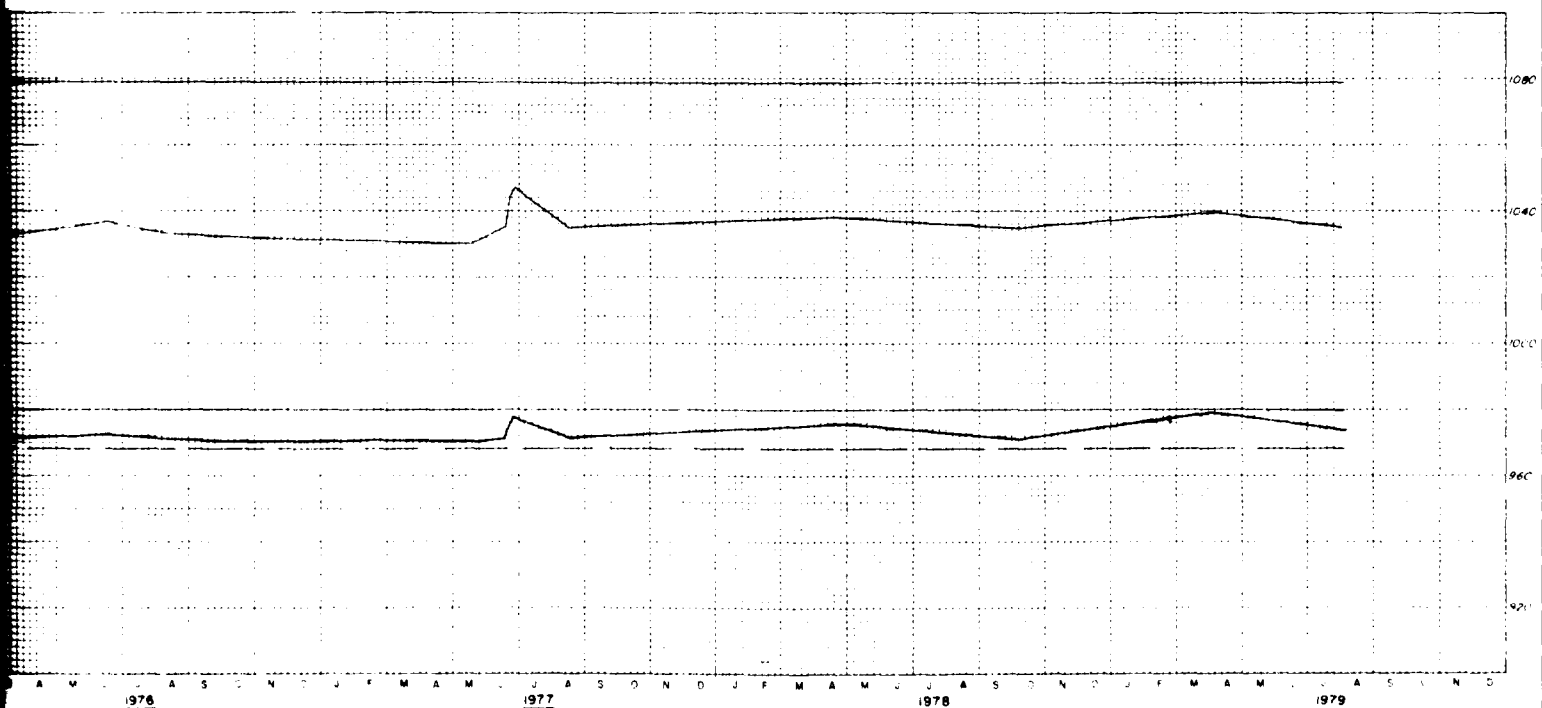
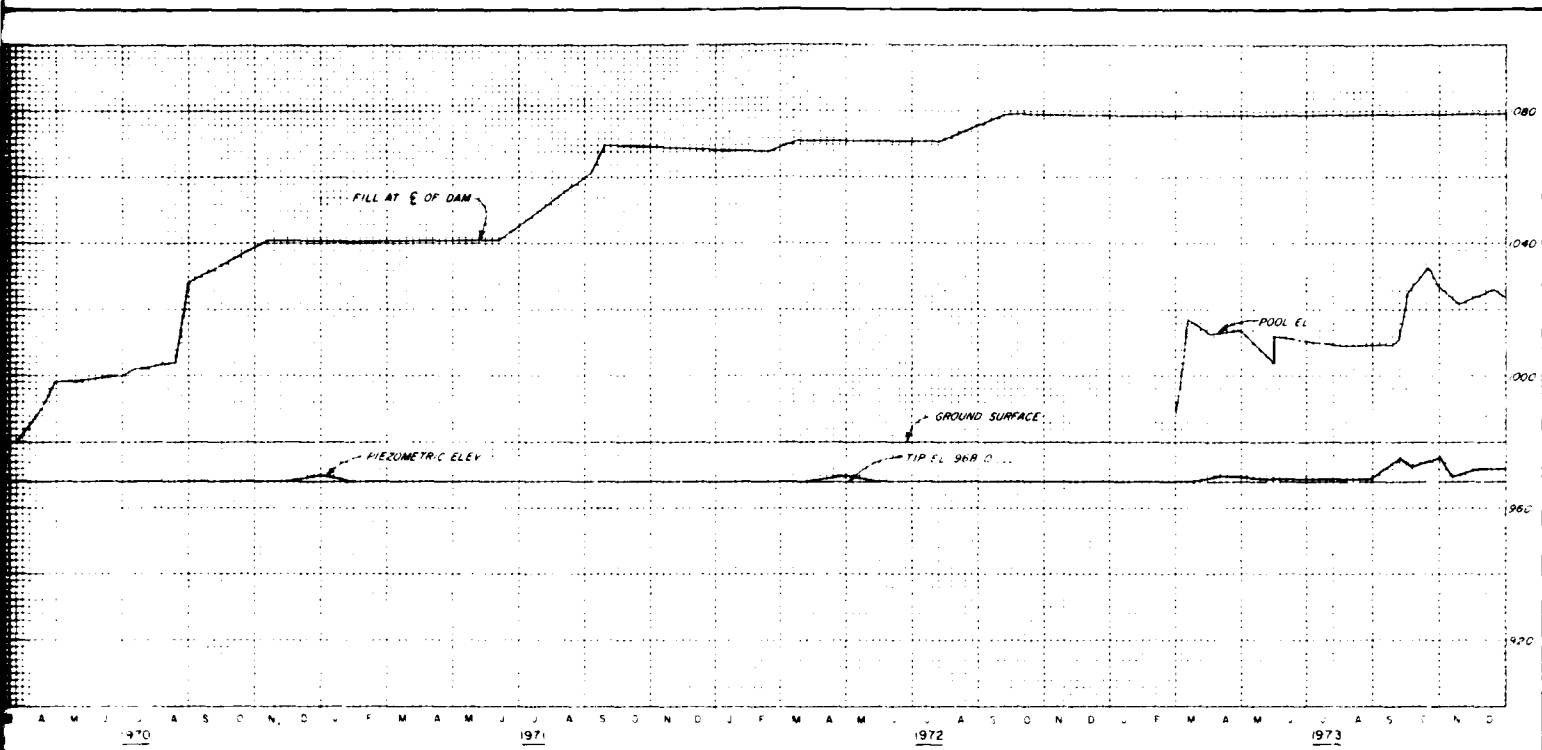
In 1 sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT

FILE NO 0-5-1304
AUGUST 1975



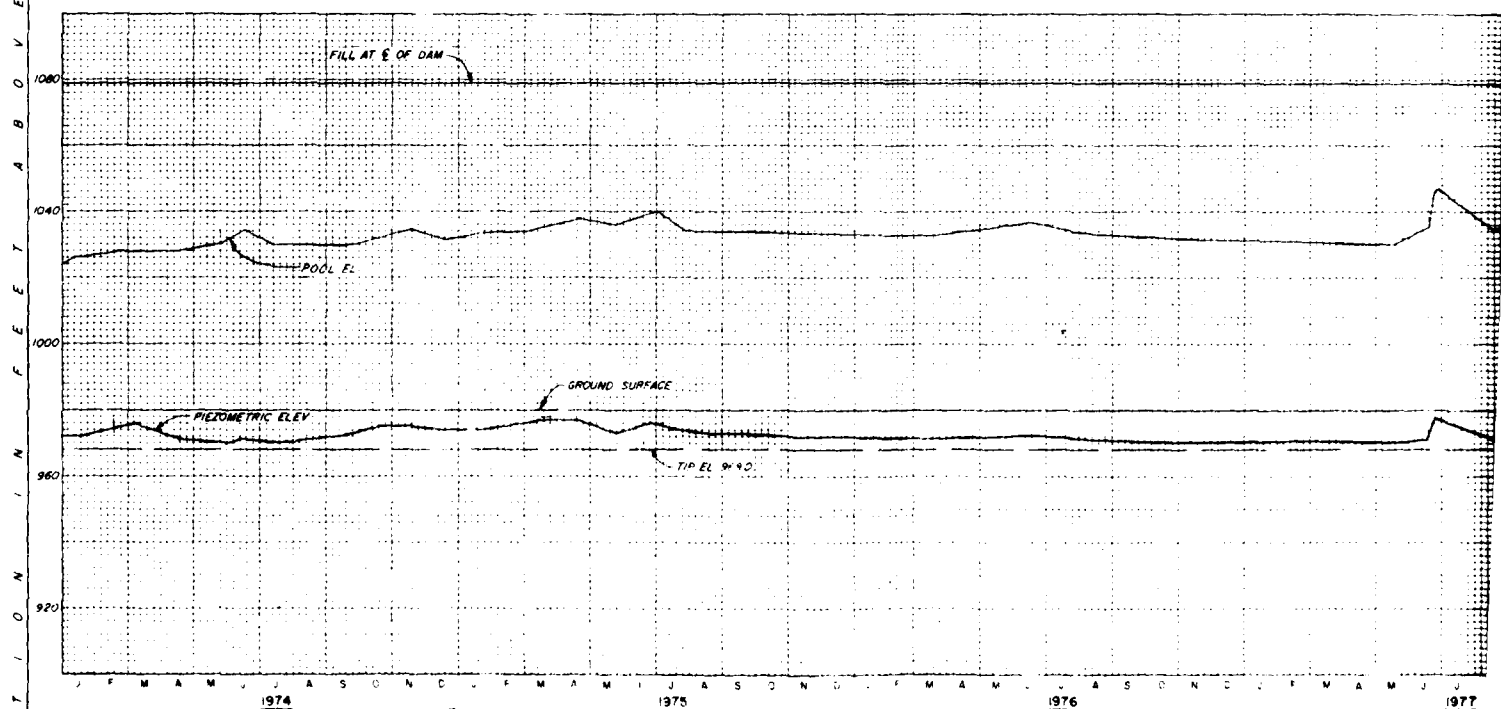
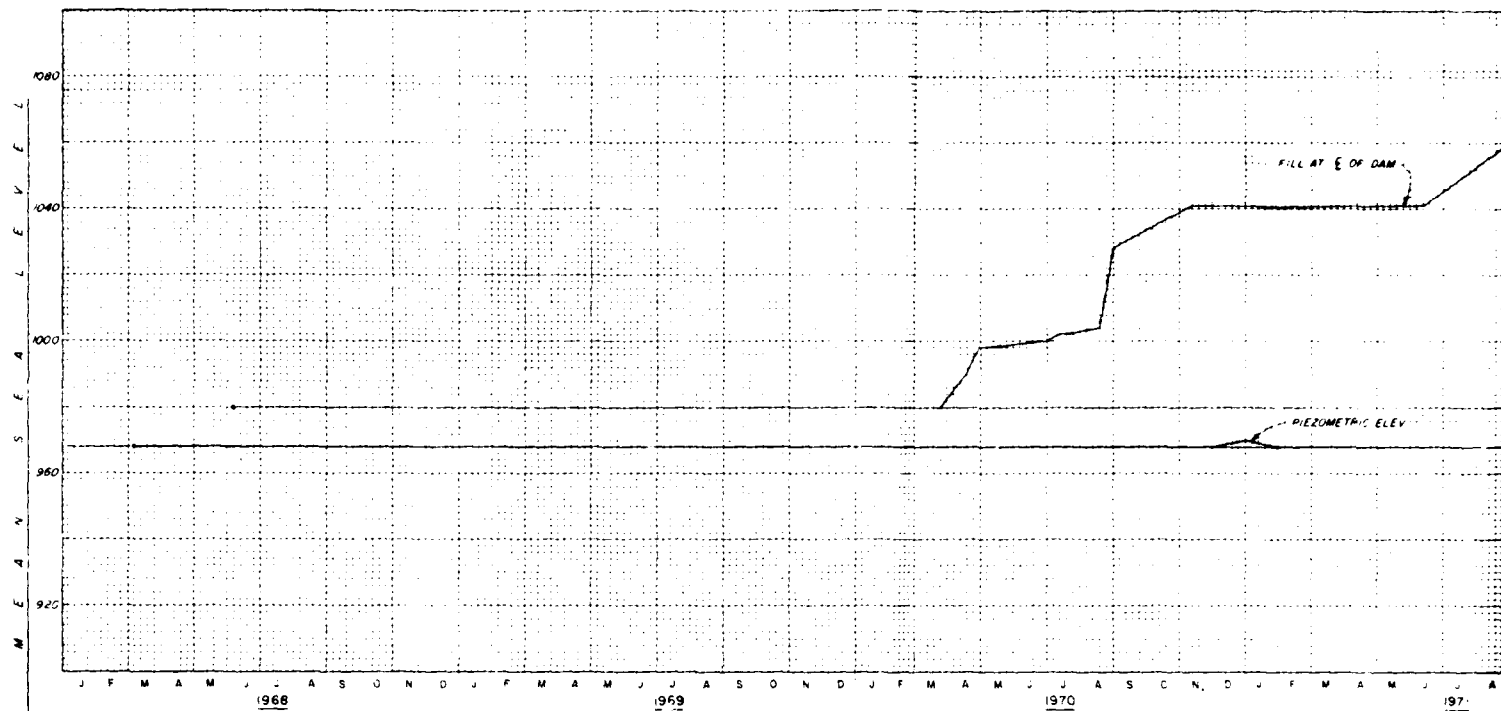
LEGEND

OPEN TUBE
PNEUMATIC CELL

MELVERN LAKE

INSTRUMENTATION PLOTS
PP 72-5 (OPEN TUBE)

FILE NO. 0-5-1305

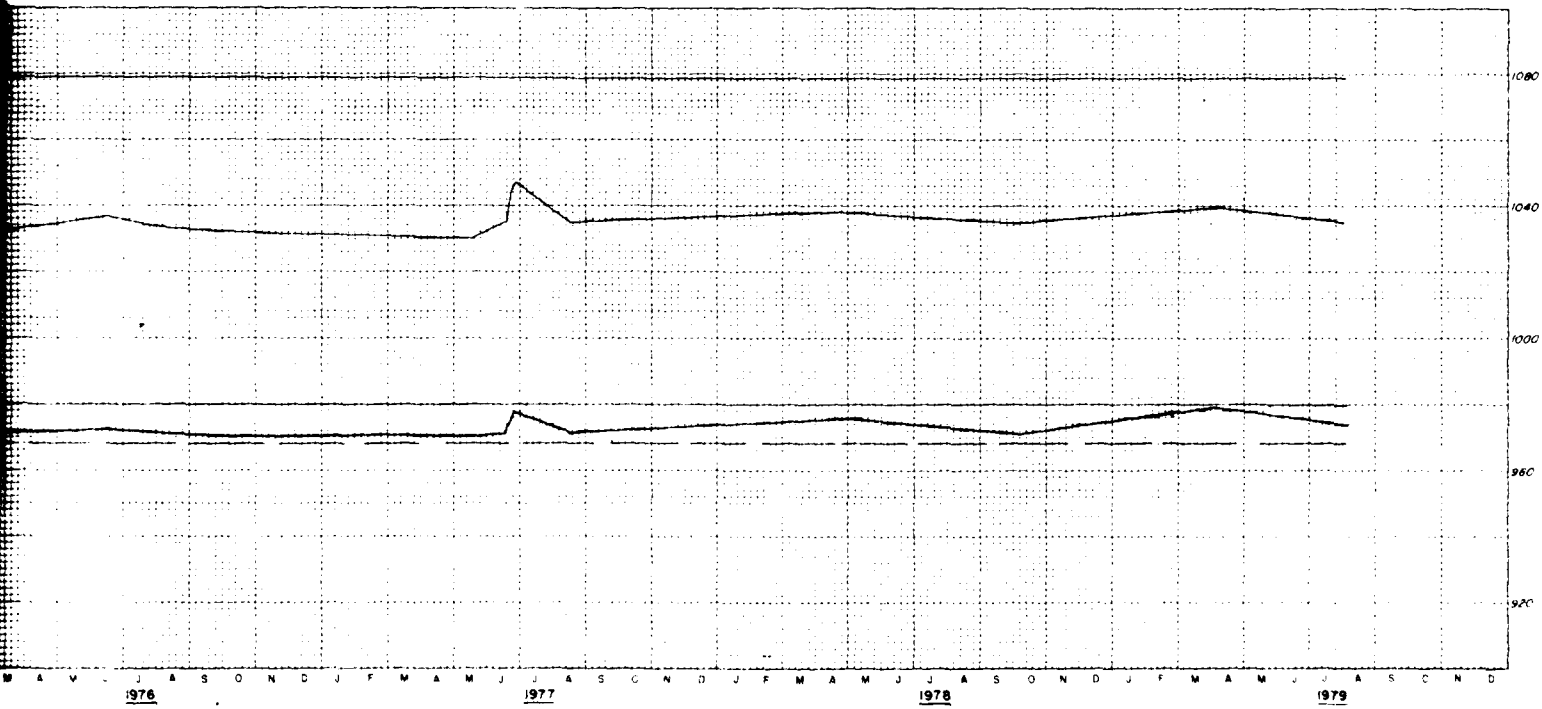
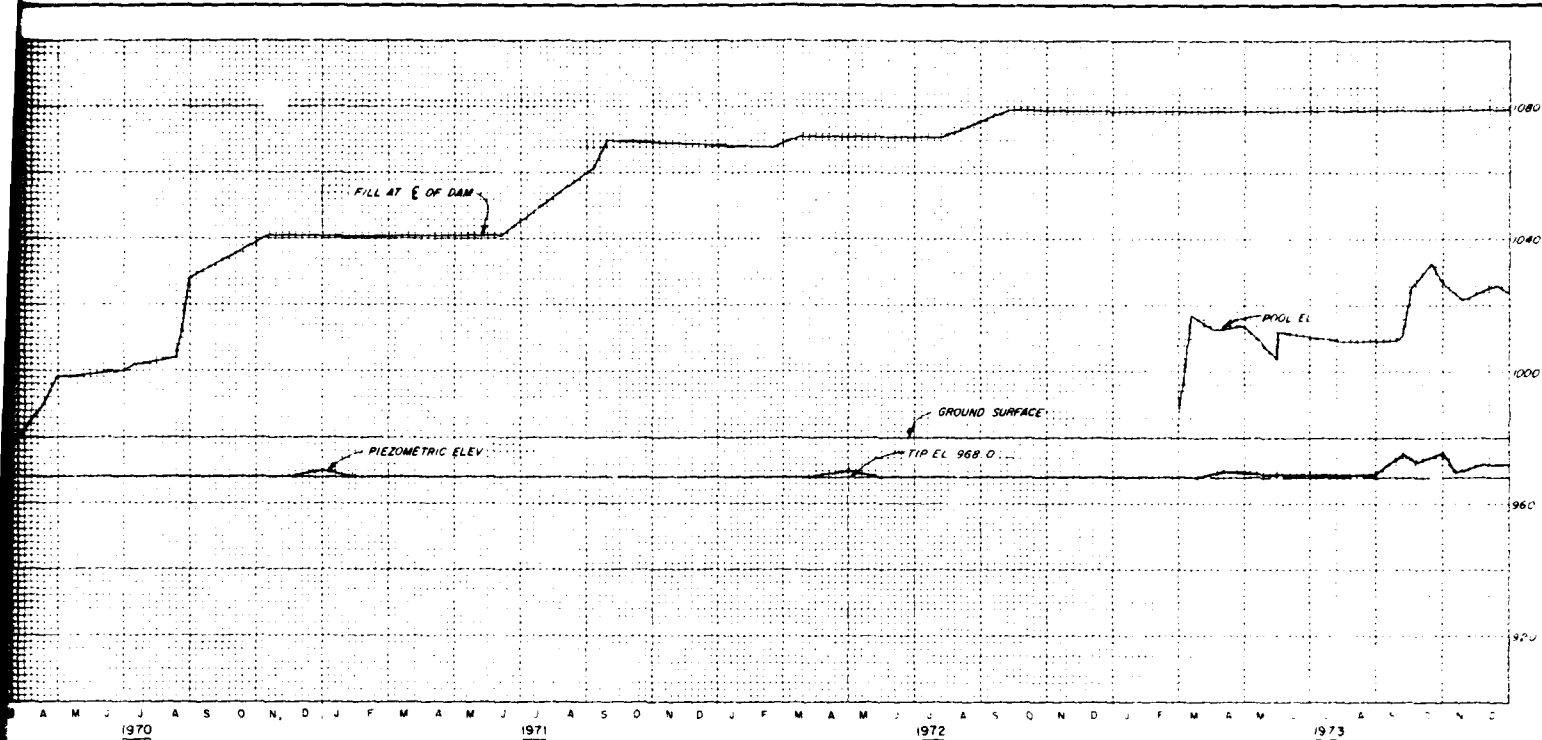


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STATION 72+00



DOWNSTREAM

P-72-5

LEGEND

OPEN TUBE
PNEUMATIC CELL

MAHAIS DESIGNER RIVER KANSAS
MELVERN LAKE

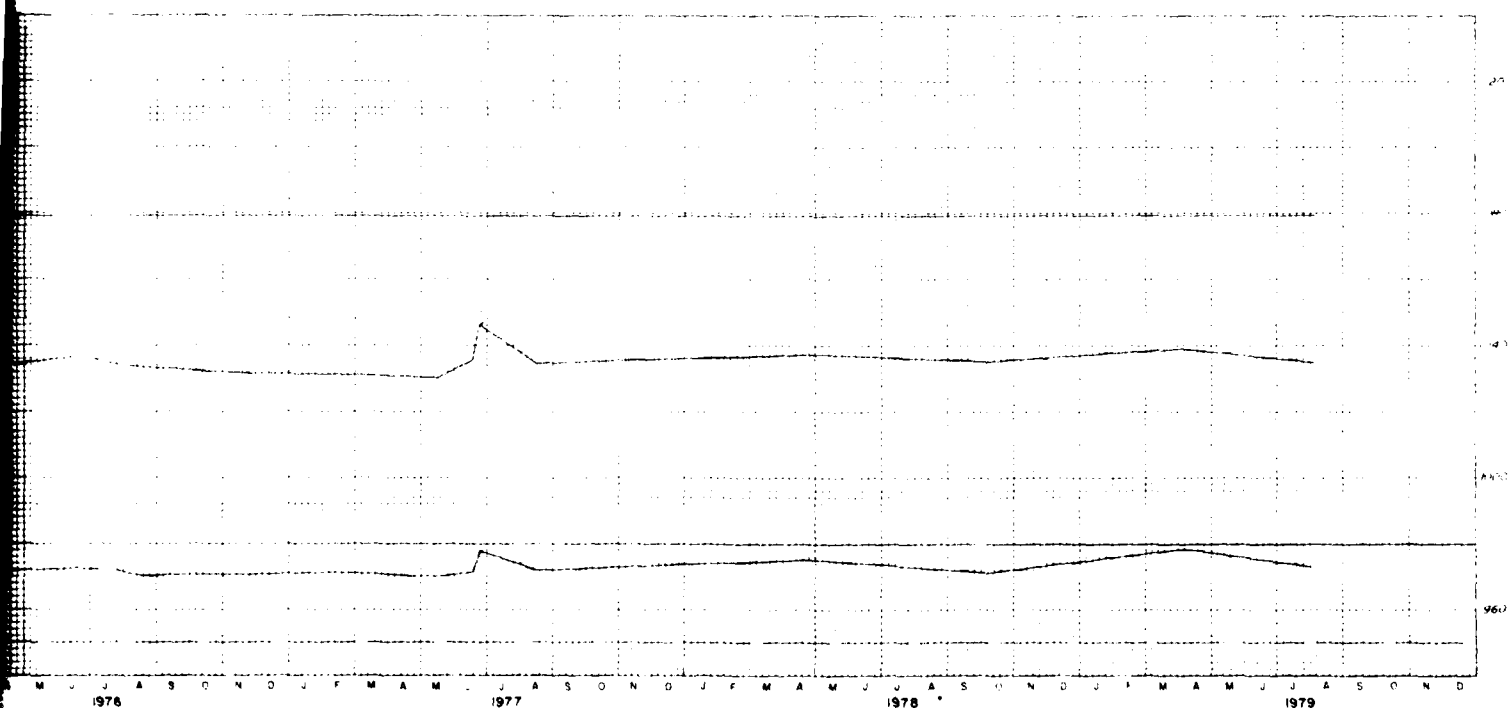
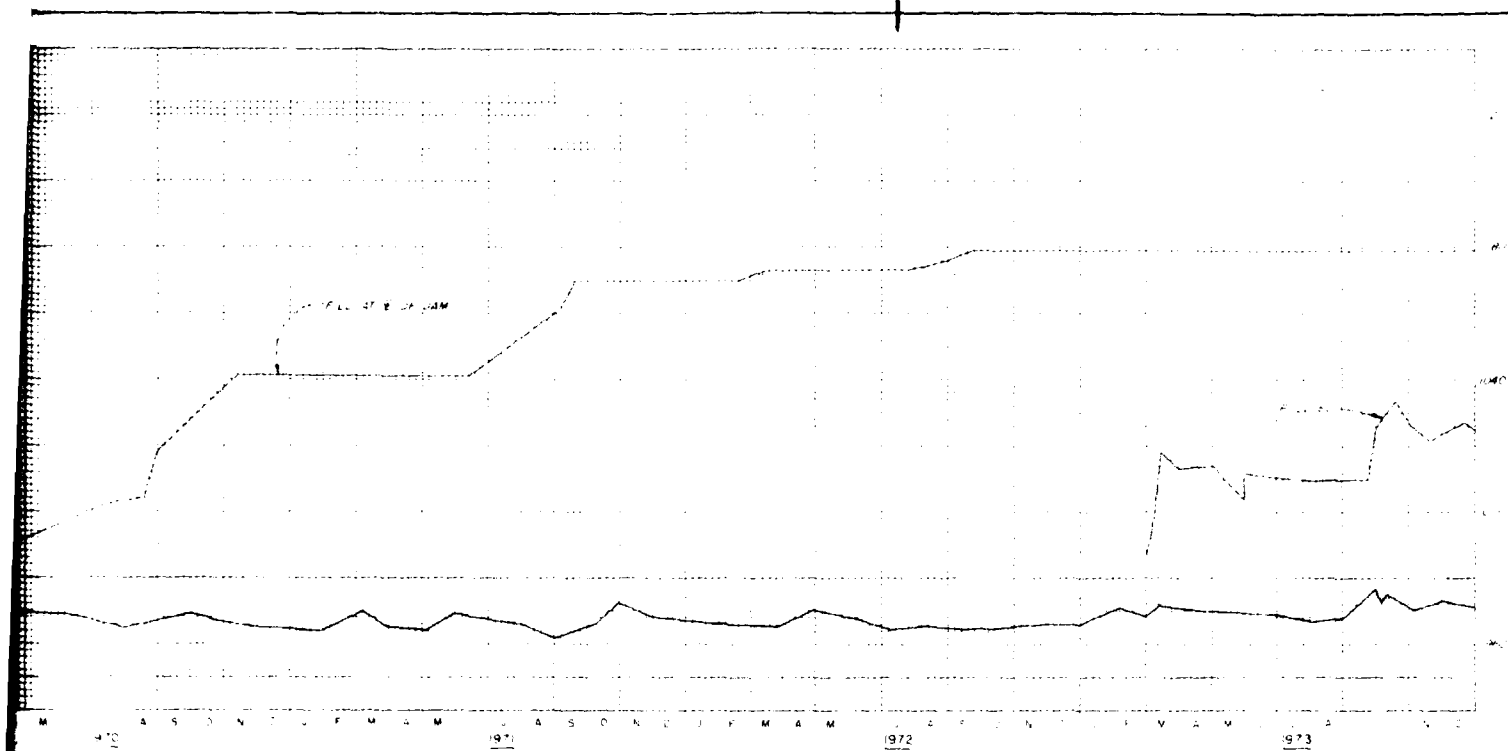
INSTRUMENTATION PLOTS
PP 72-5 (OPEN TUBE)

In 1 Sheet

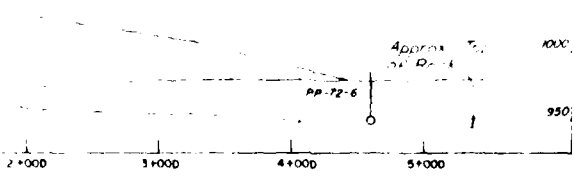
PROJECT NO. 1
BUREAU OF REVENUE
KANSAS STATE DEPT.

FILE NO 0-5-1305
AUGUST 1978

SCALE AS SHOWN



DOWNSTREAM



LEGEND

- OPEN TUBE ○
- PNEUMATIC CELL ●

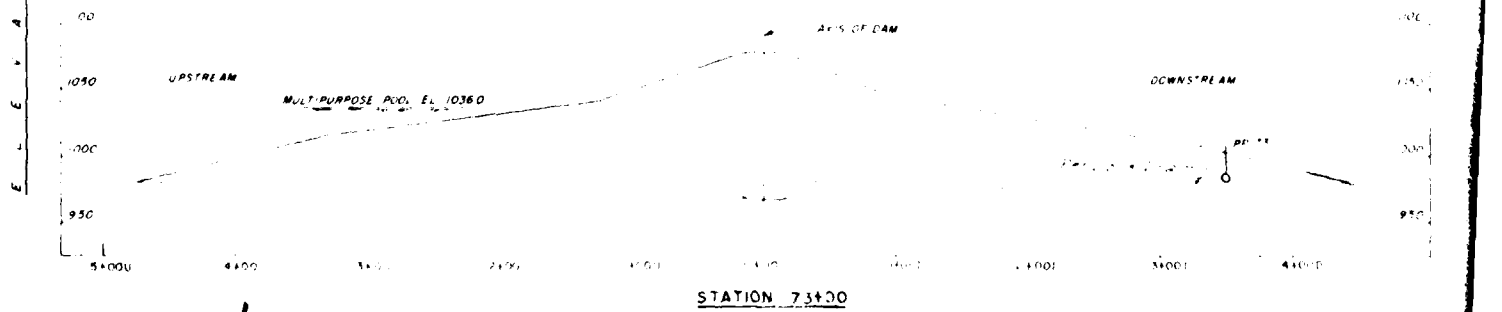
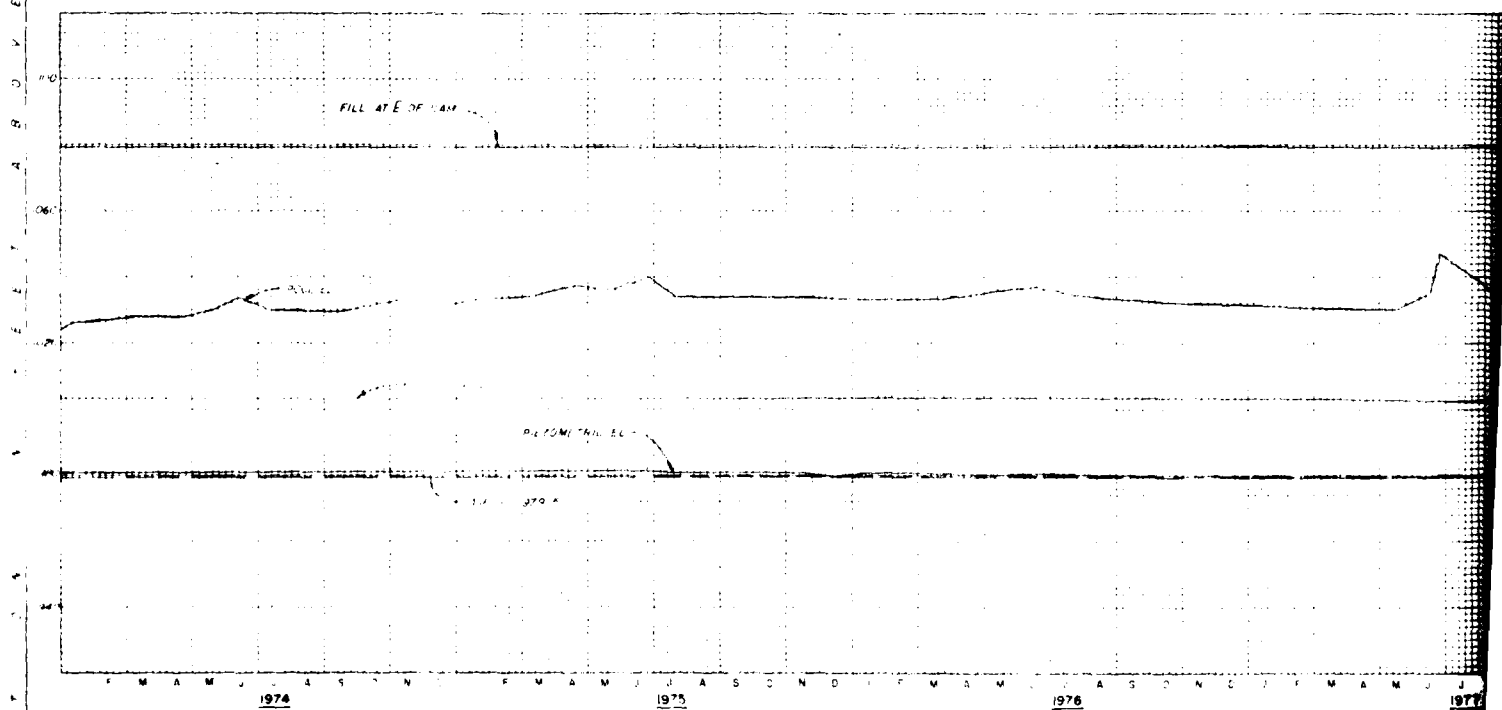
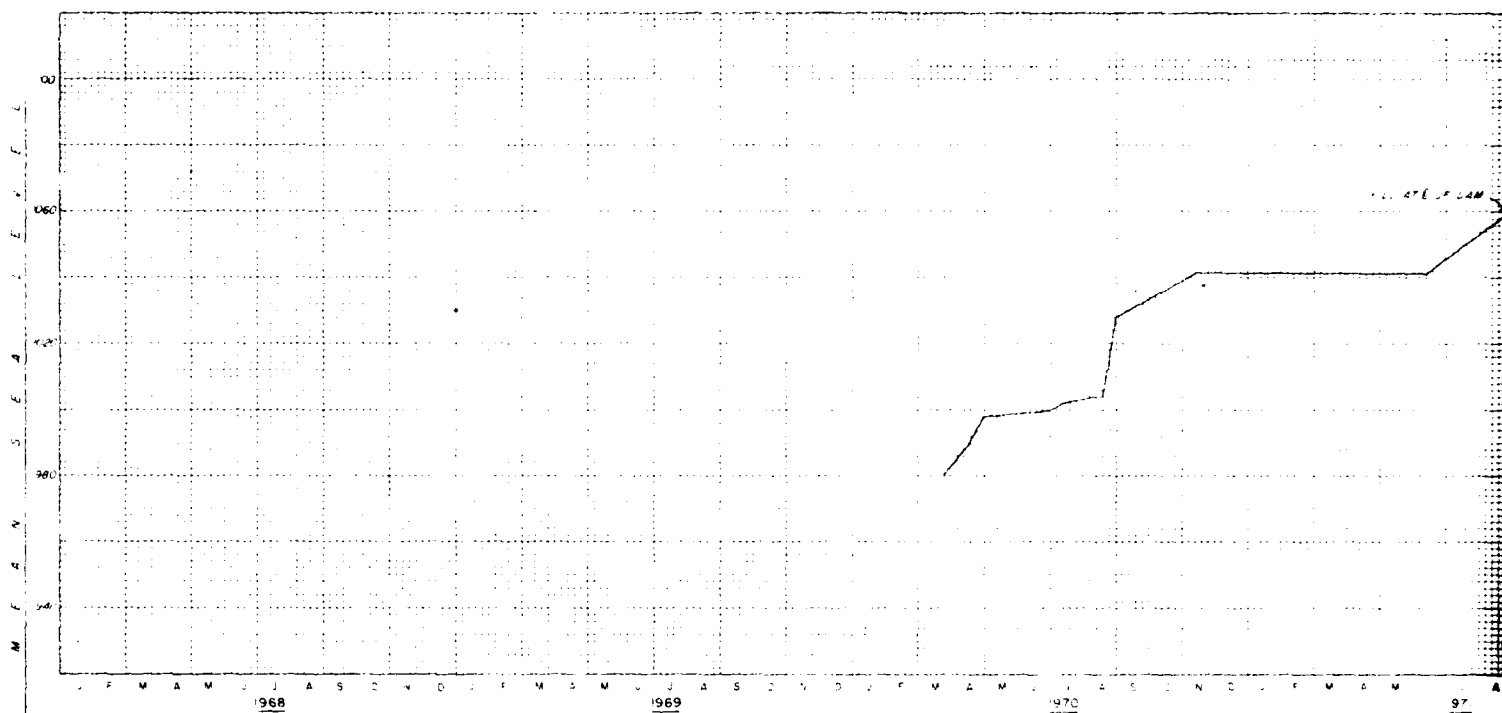
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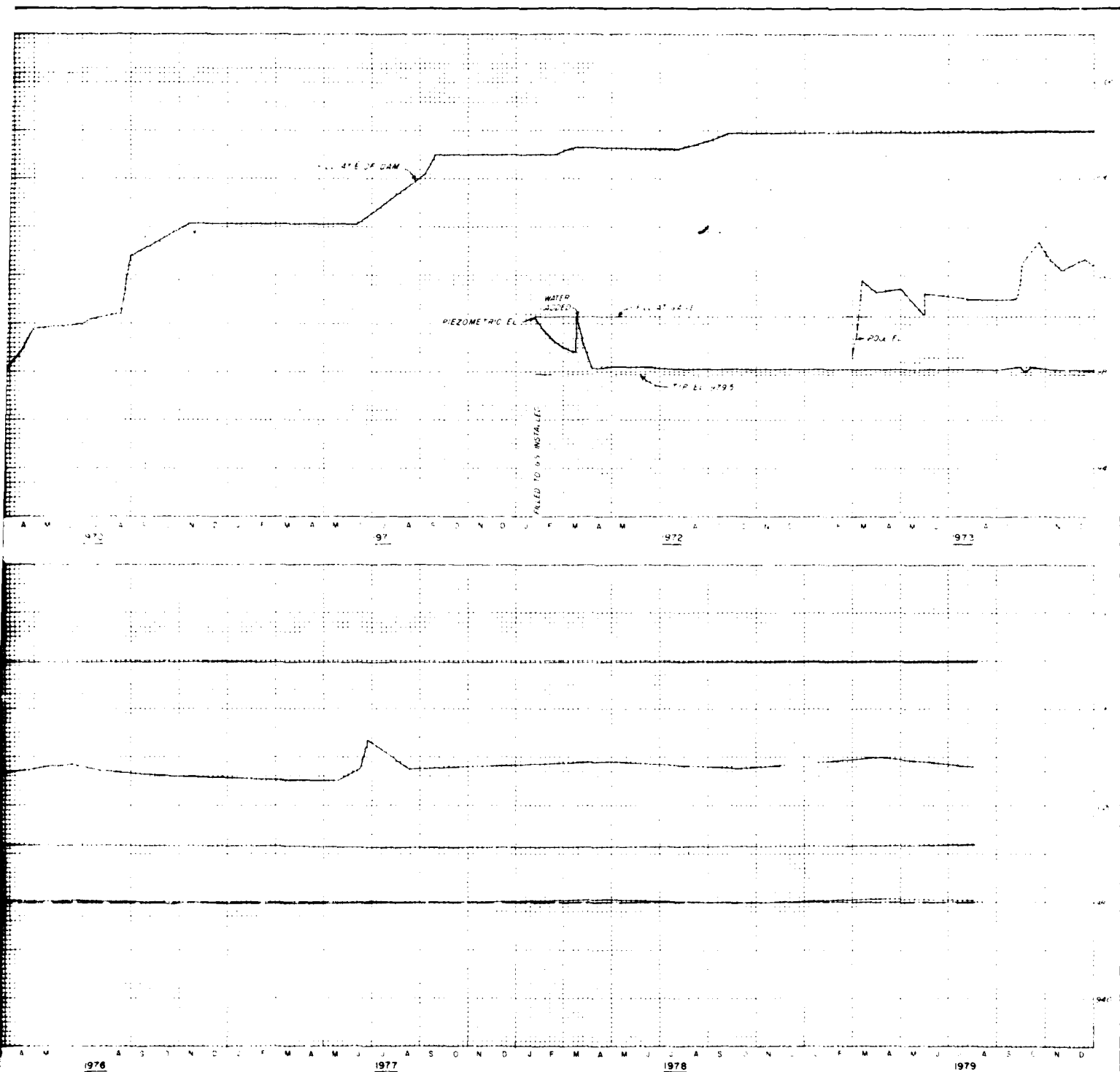
Revised August 1979
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
PP-72-6 (OPEN TUBE)

Sheet No. 1
 CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
FILE NO 0-5-1306
 AUGUST 1975

Scale as shown



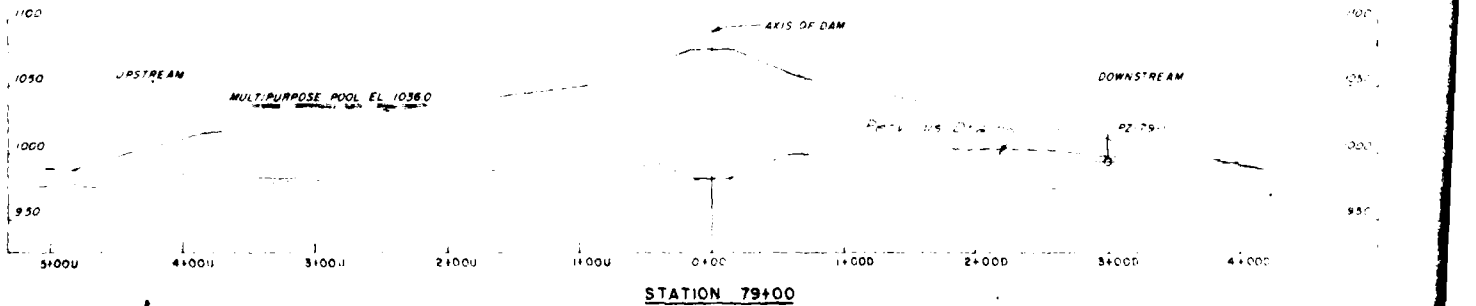
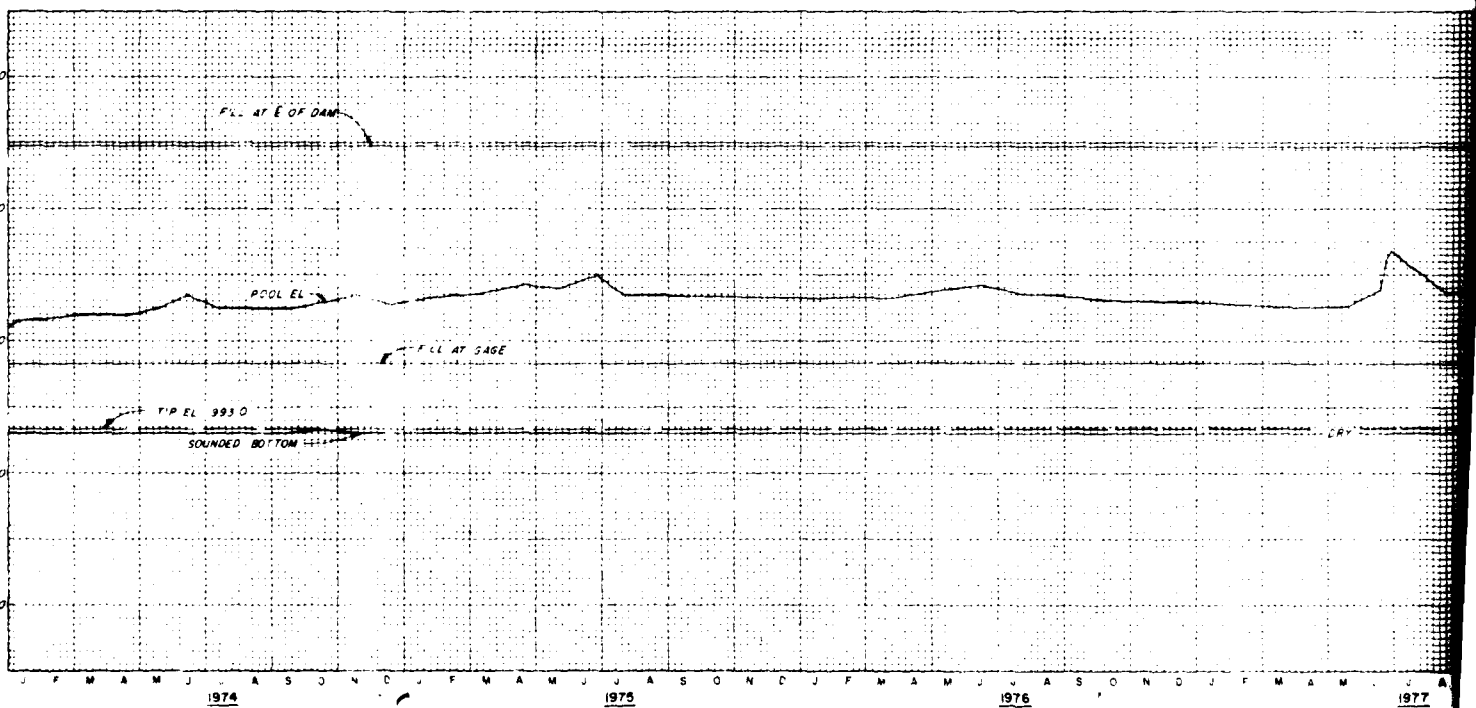
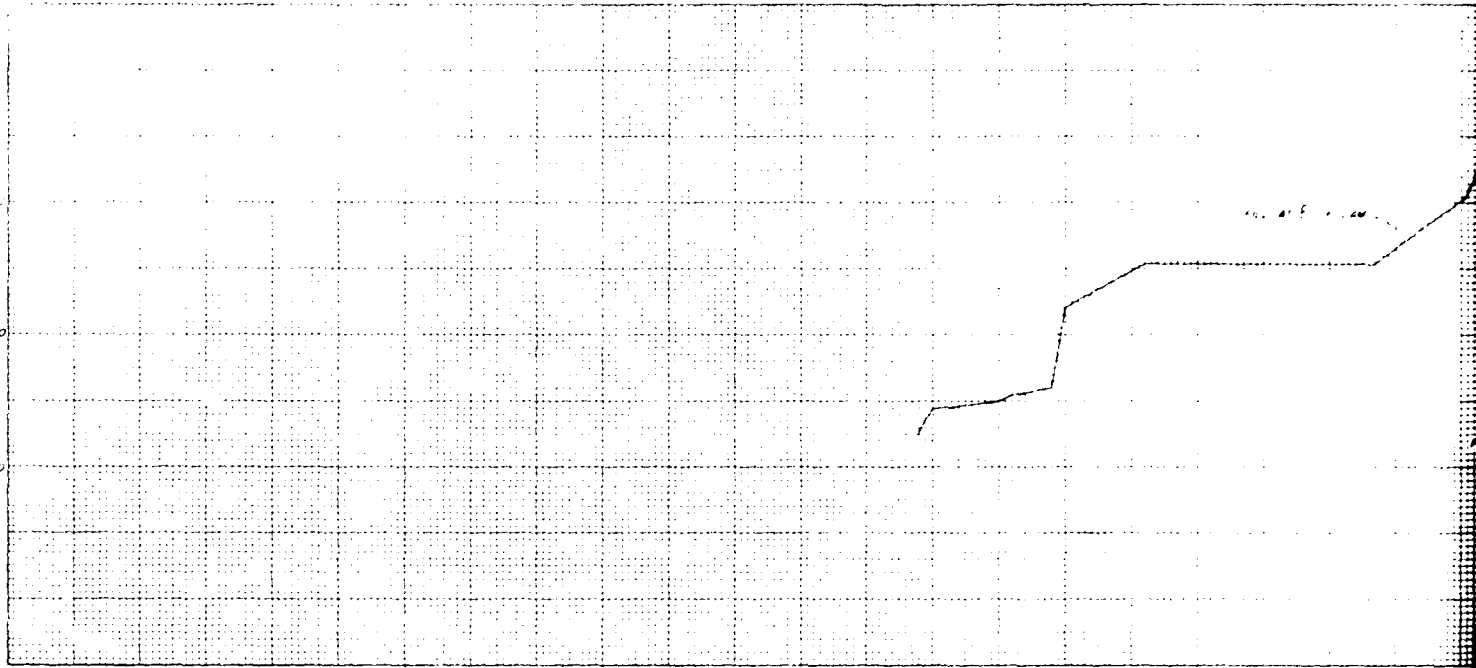


MELVERN LAKE

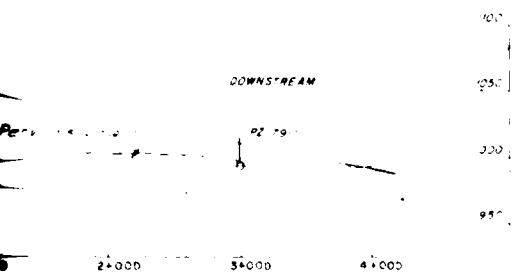
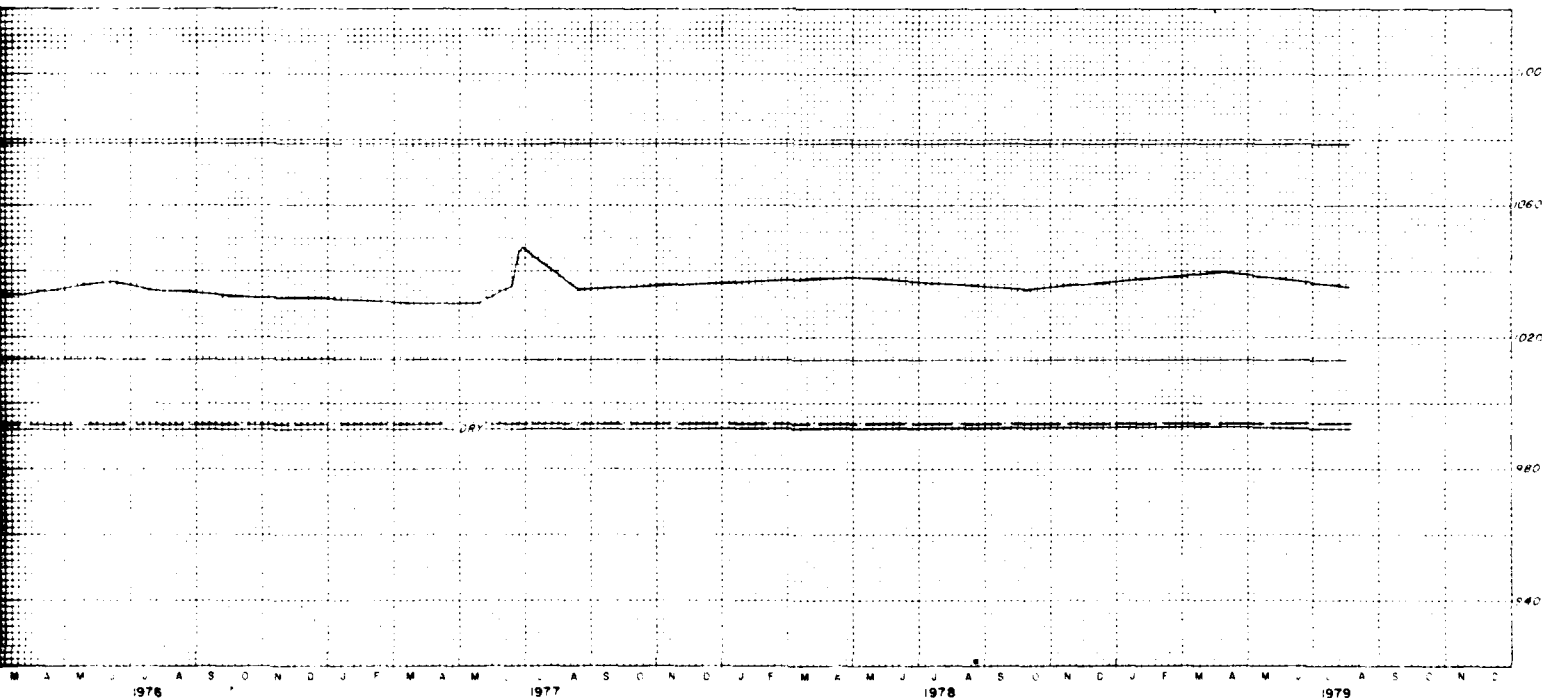
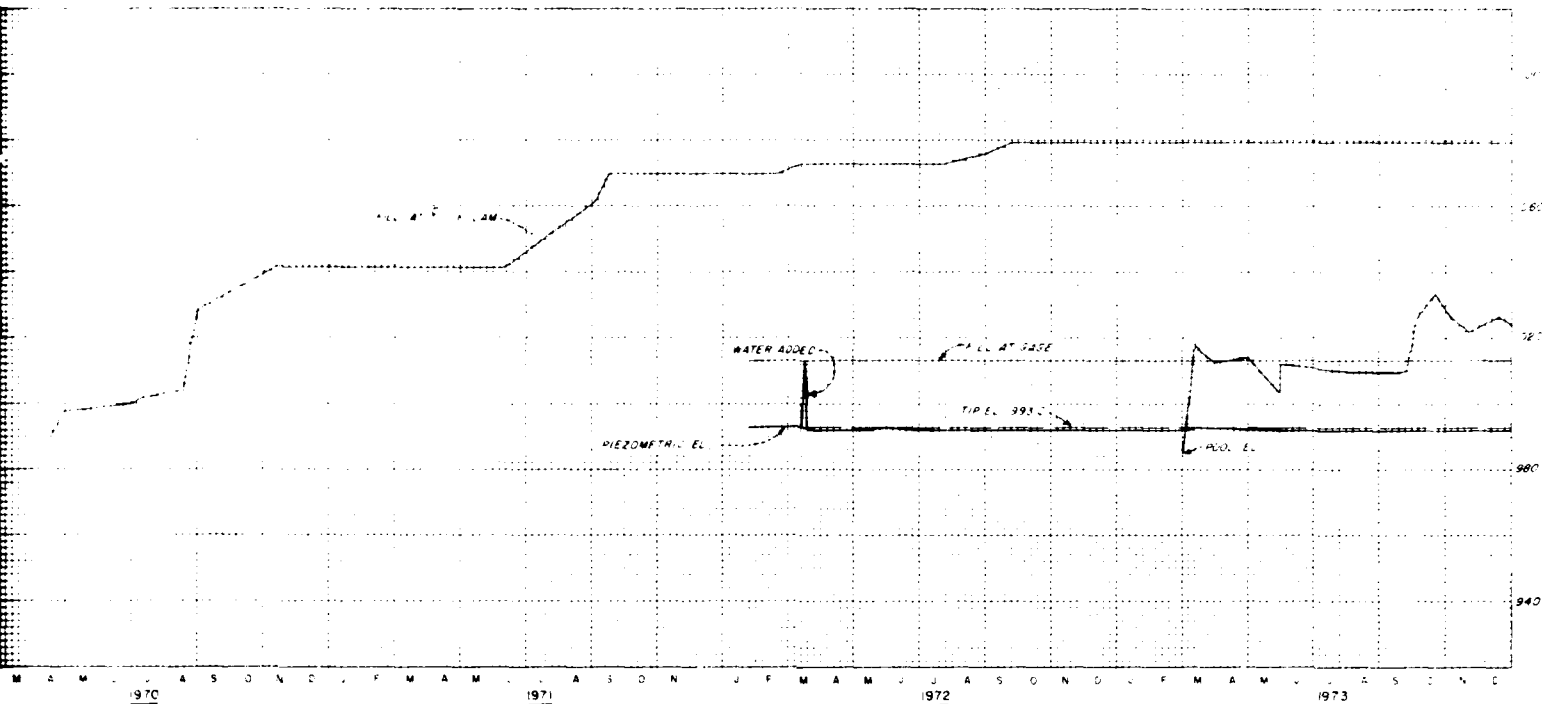
INSTRUMENTATION PLOTS
PP-73-1 (OPEN TUBE)

FILE NO 0-5-1307
AUGUST 1975

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STATION 79+00



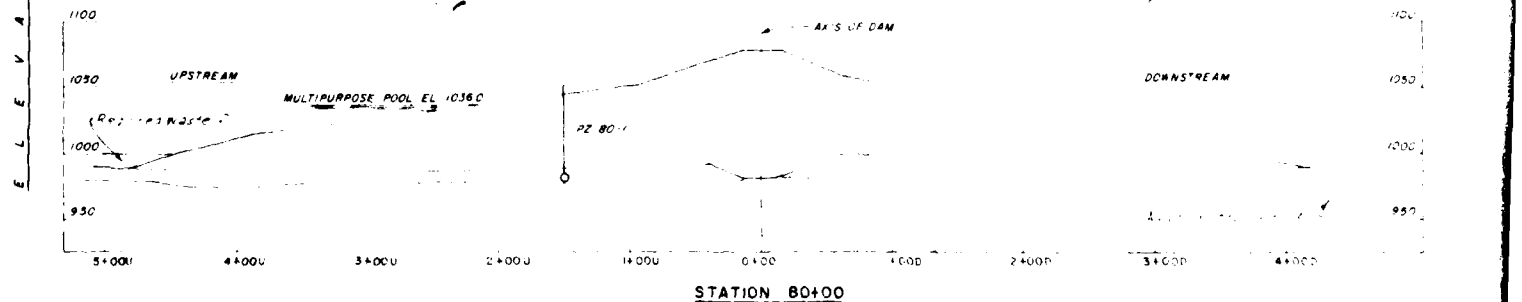
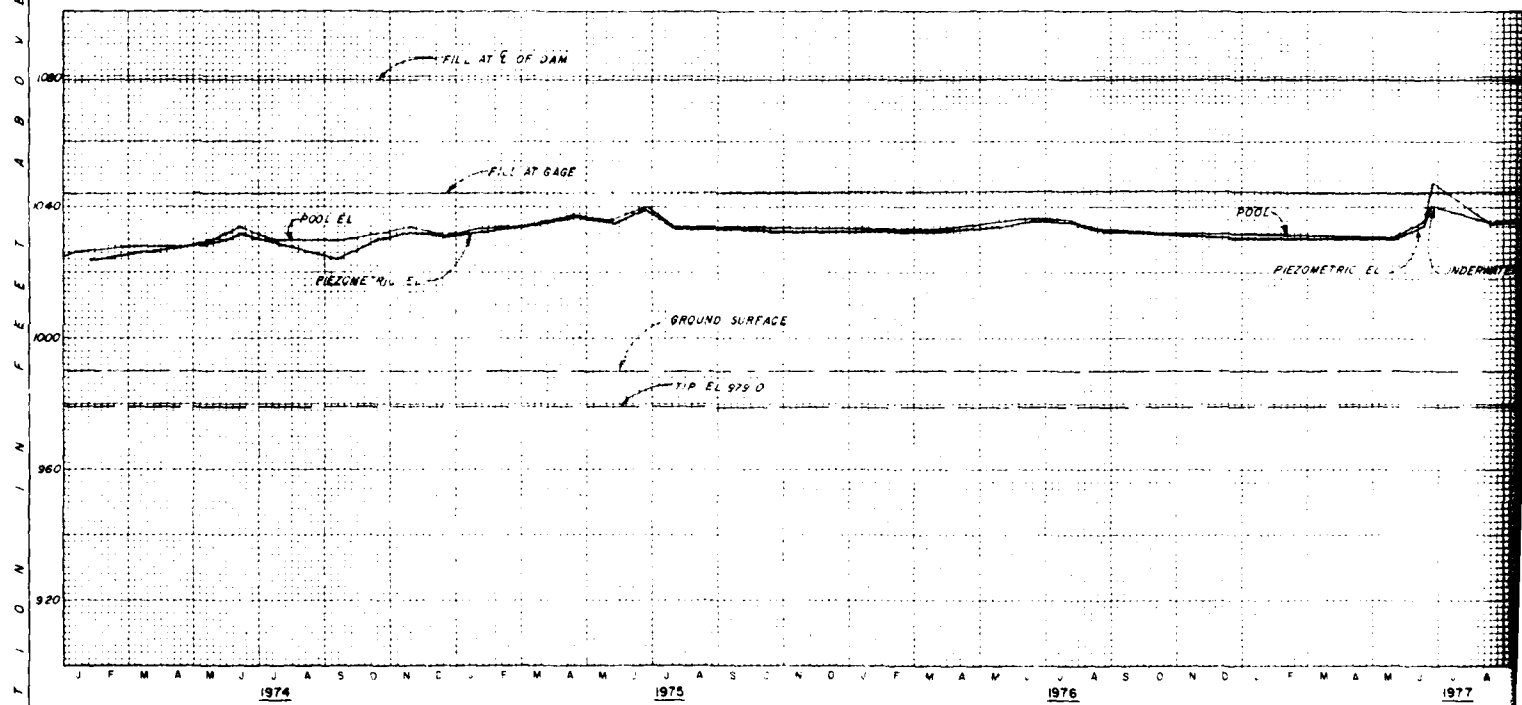
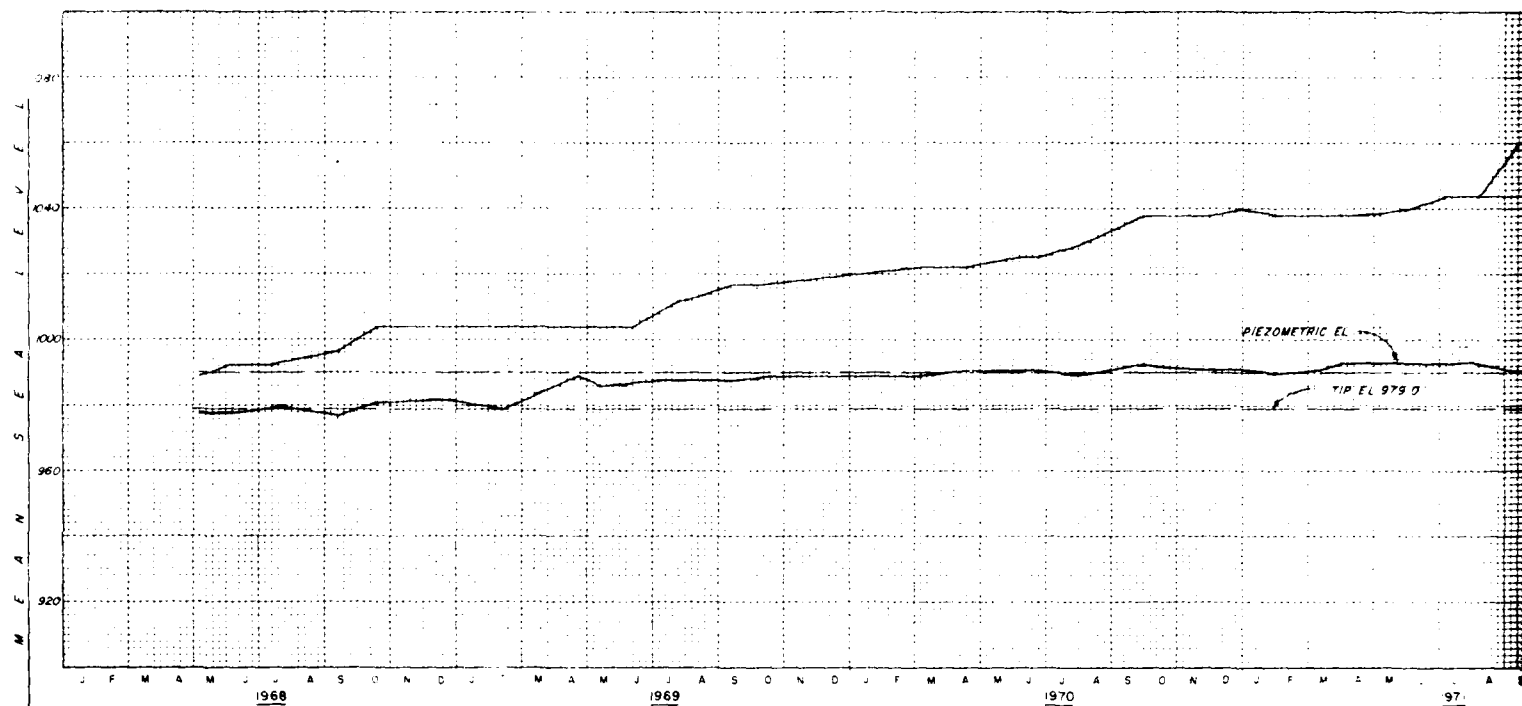
LEGEND
 OPEN TUBE ○
 PNEUMATIC CELL ●

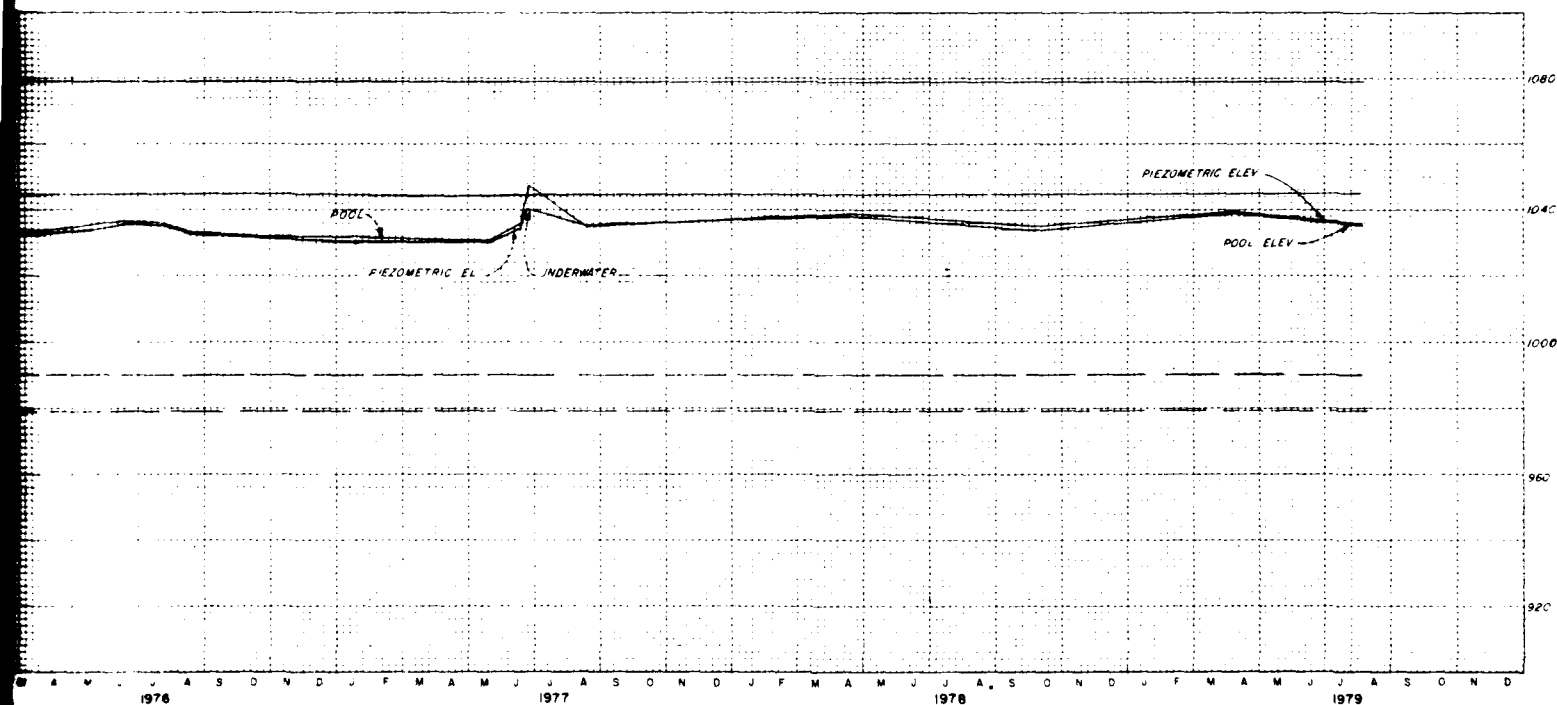
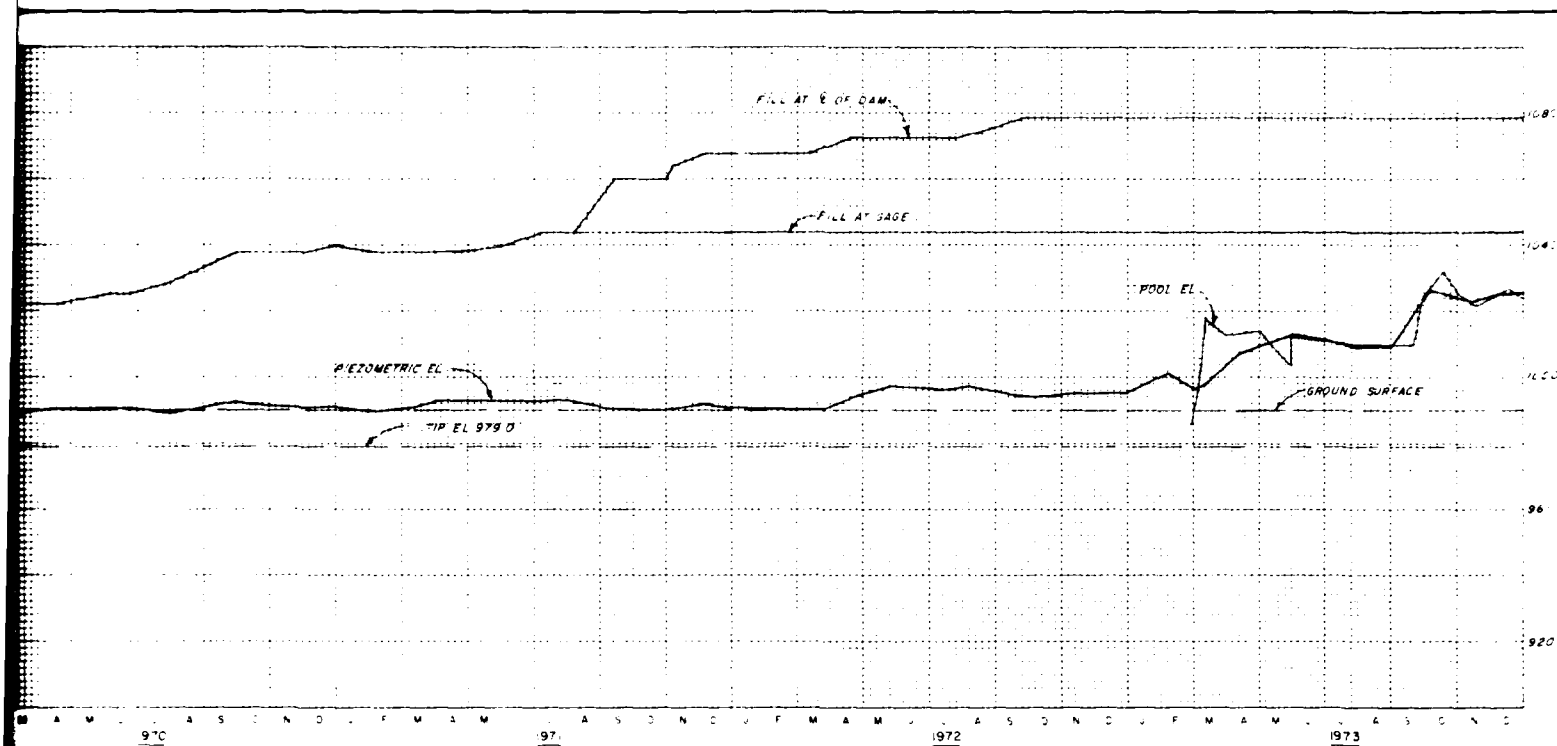
August 1978
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
PZ-79-1 (OPEN TUBE)

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

FILE NO 0-5-1308
 AUGUST 1978





DOWNSTREAM

LEGEND

OPEN TUBE ————○———
PNEUMATIC CELL ————●———

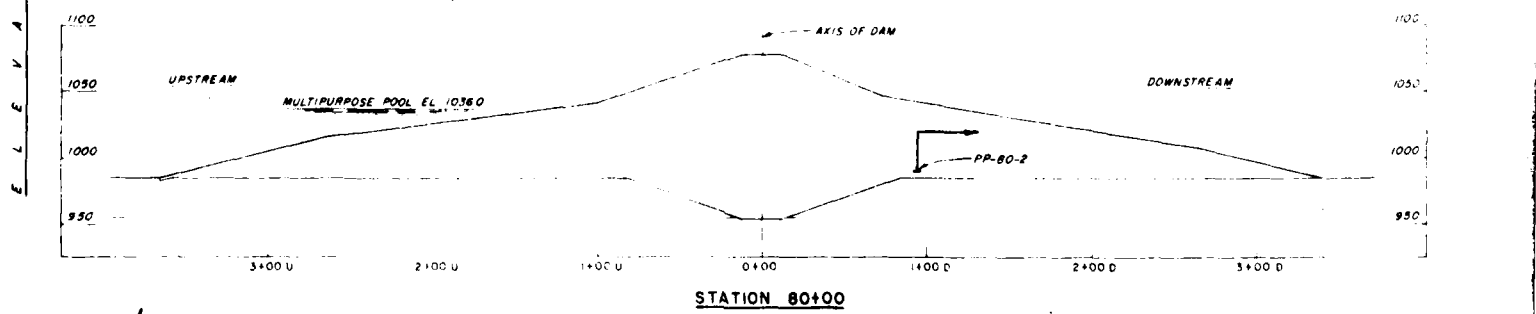
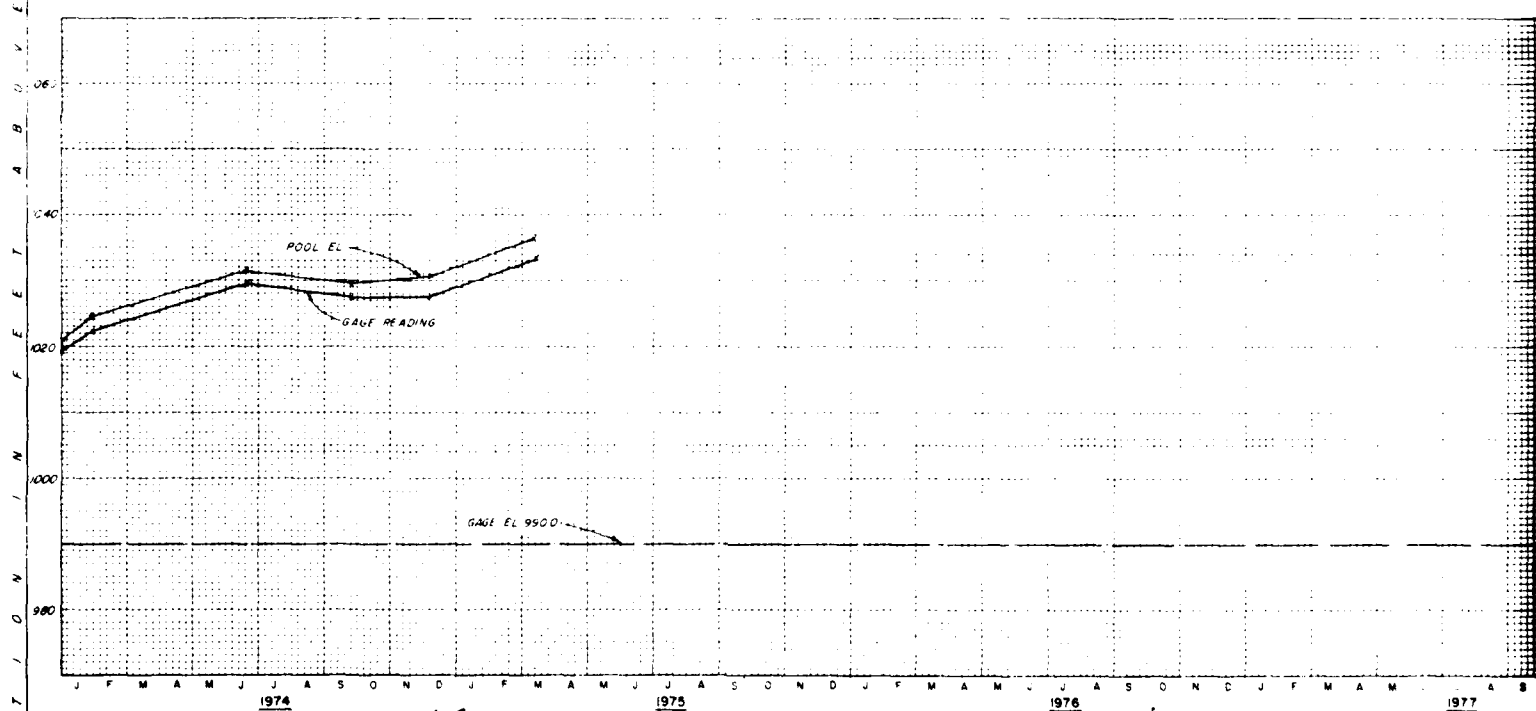
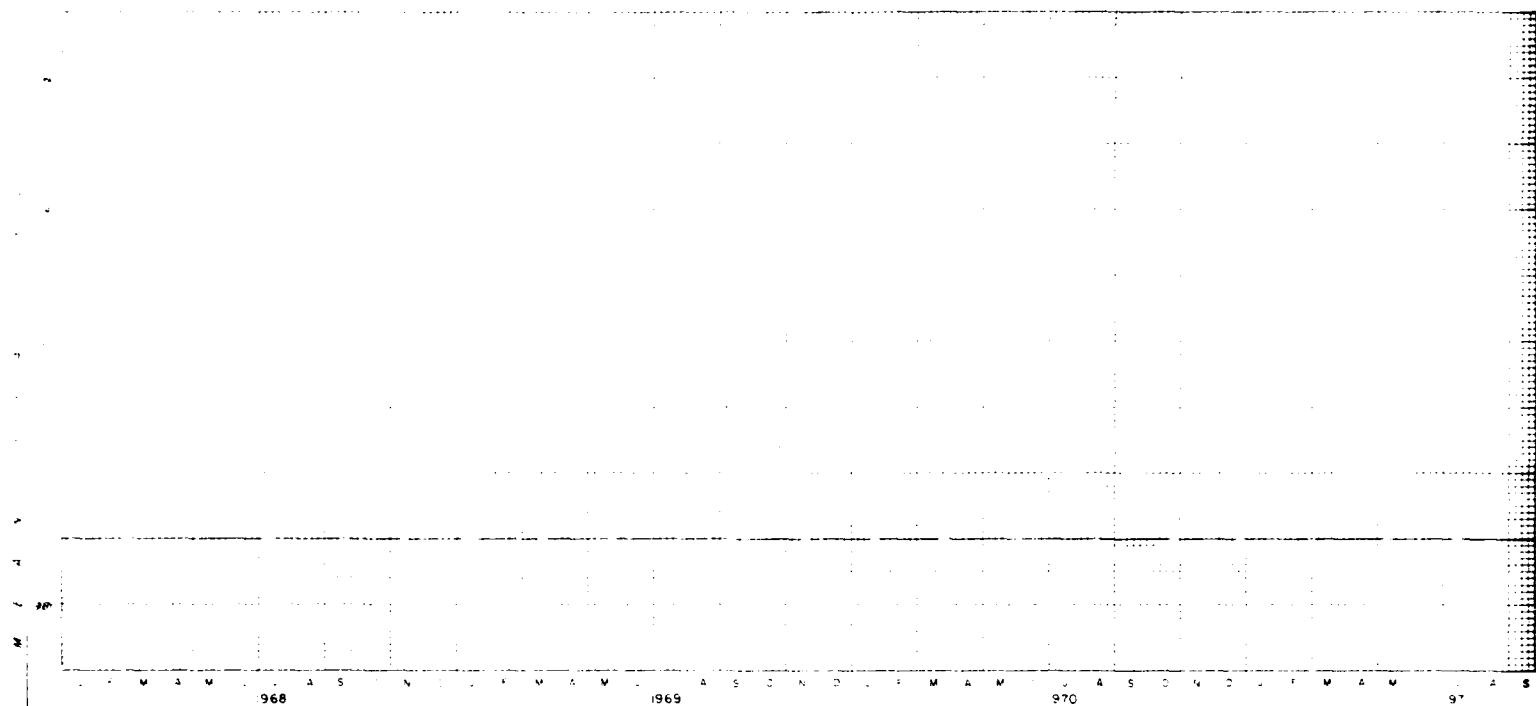
Revised August 1975
MARAI DES CYGNES RIVER KANSAS
MELVERN LAKE

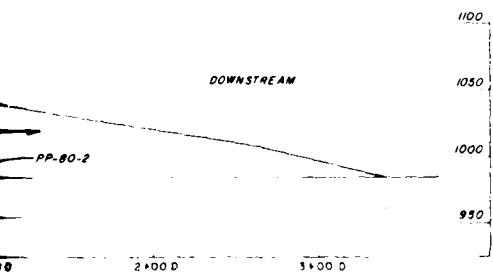
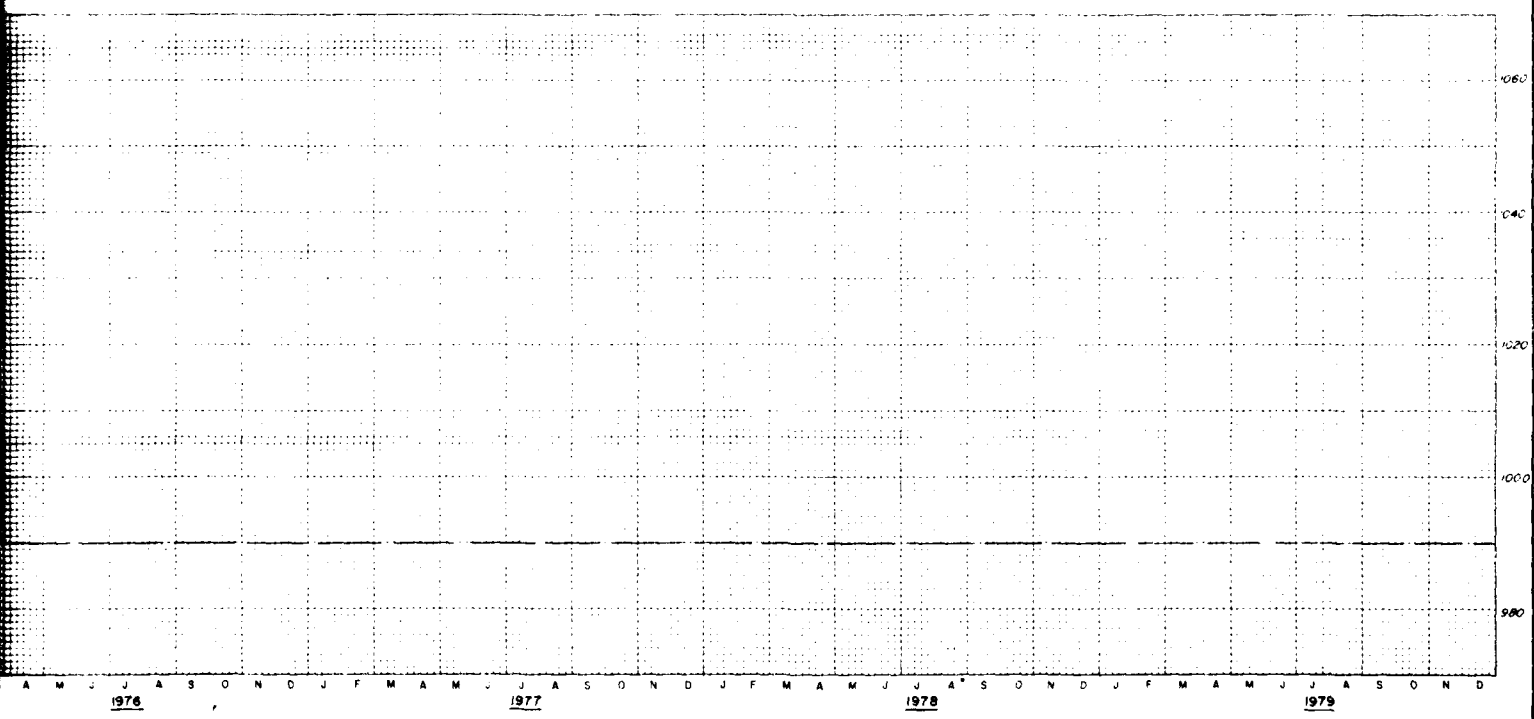
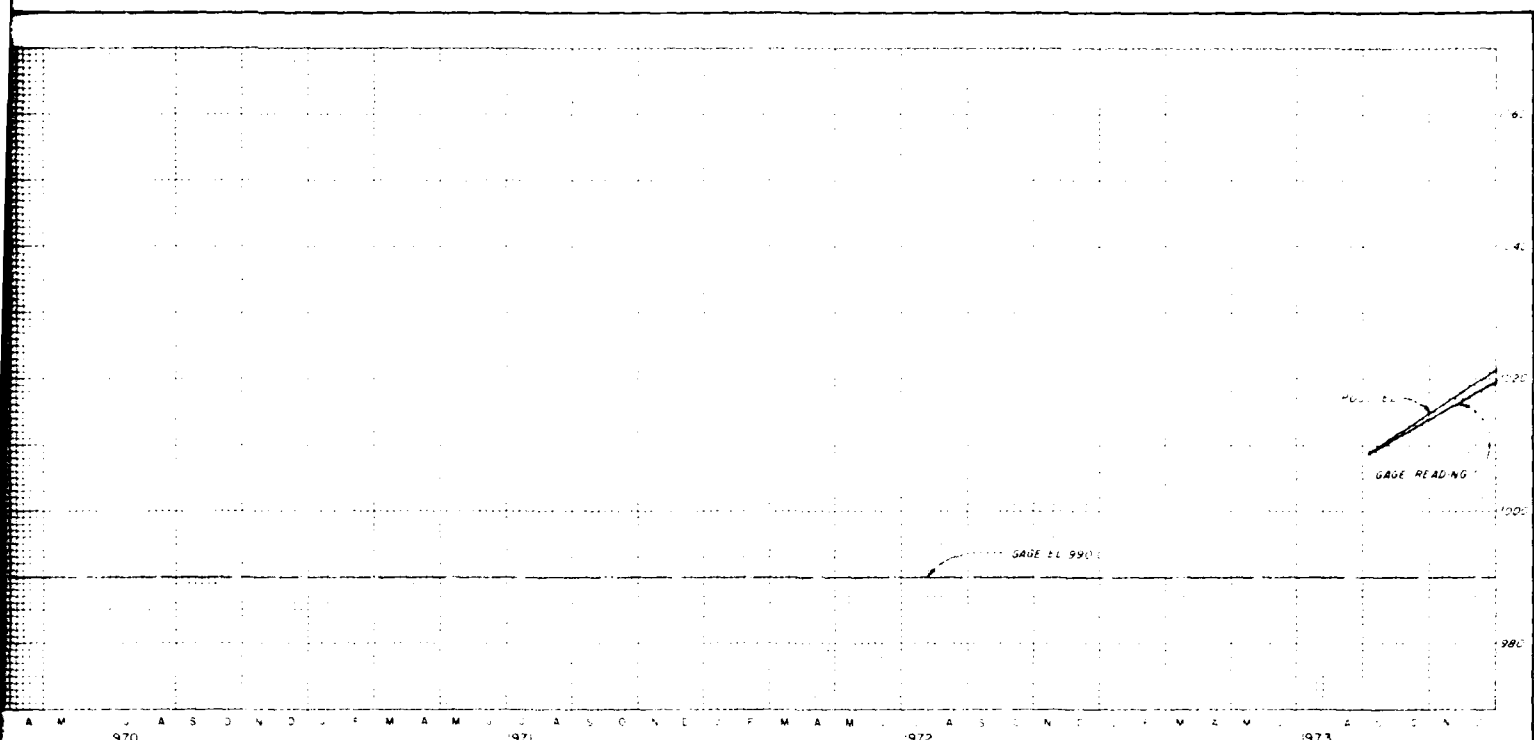
INSTRUMENTATION PLOTS
PZ 80-1 (OPEN TUBE)

In 1 sheet

Scale as shown

Plot No. 1
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1309
AUGUST 1975





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

Revised August 1979
MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

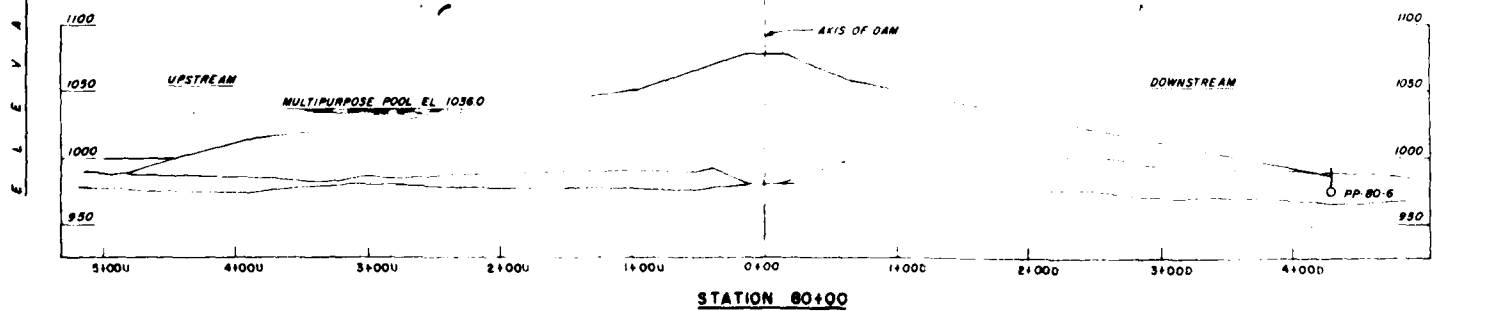
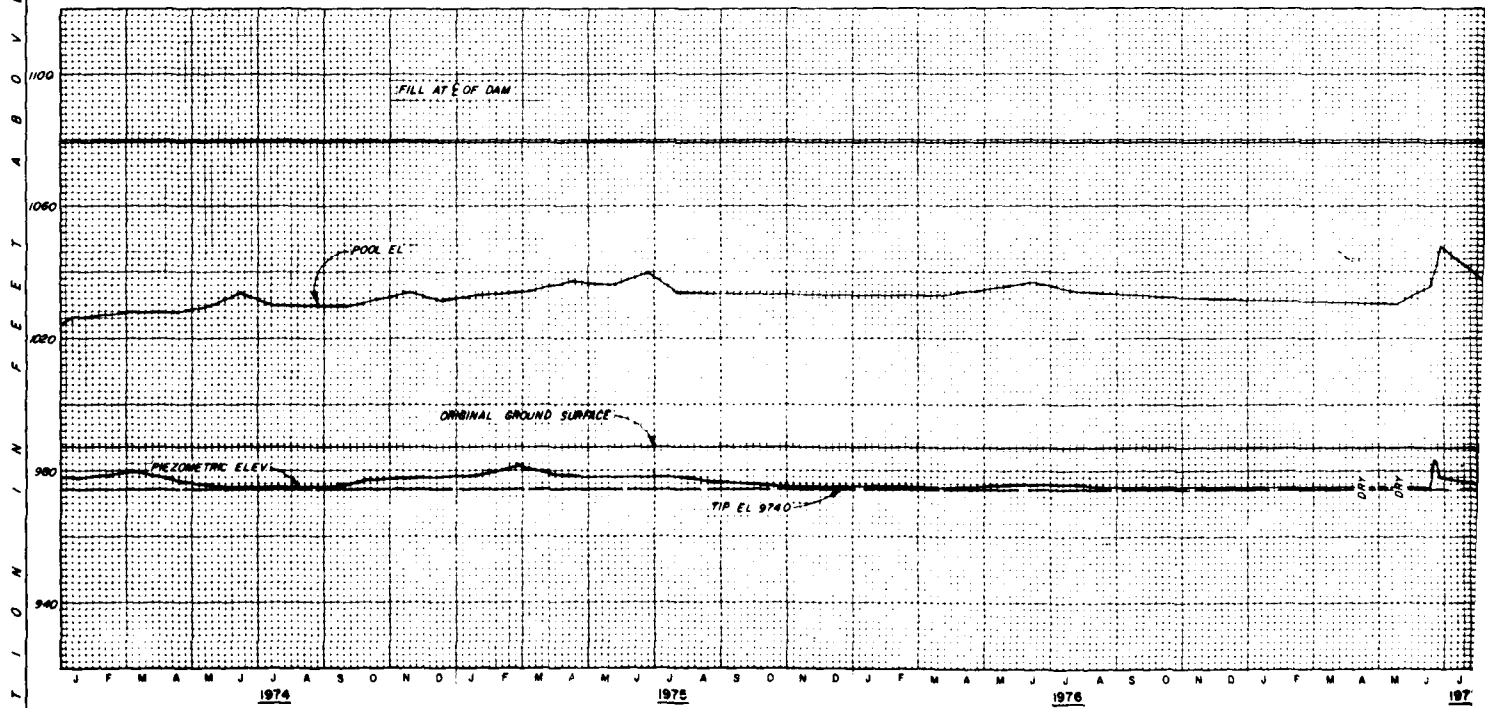
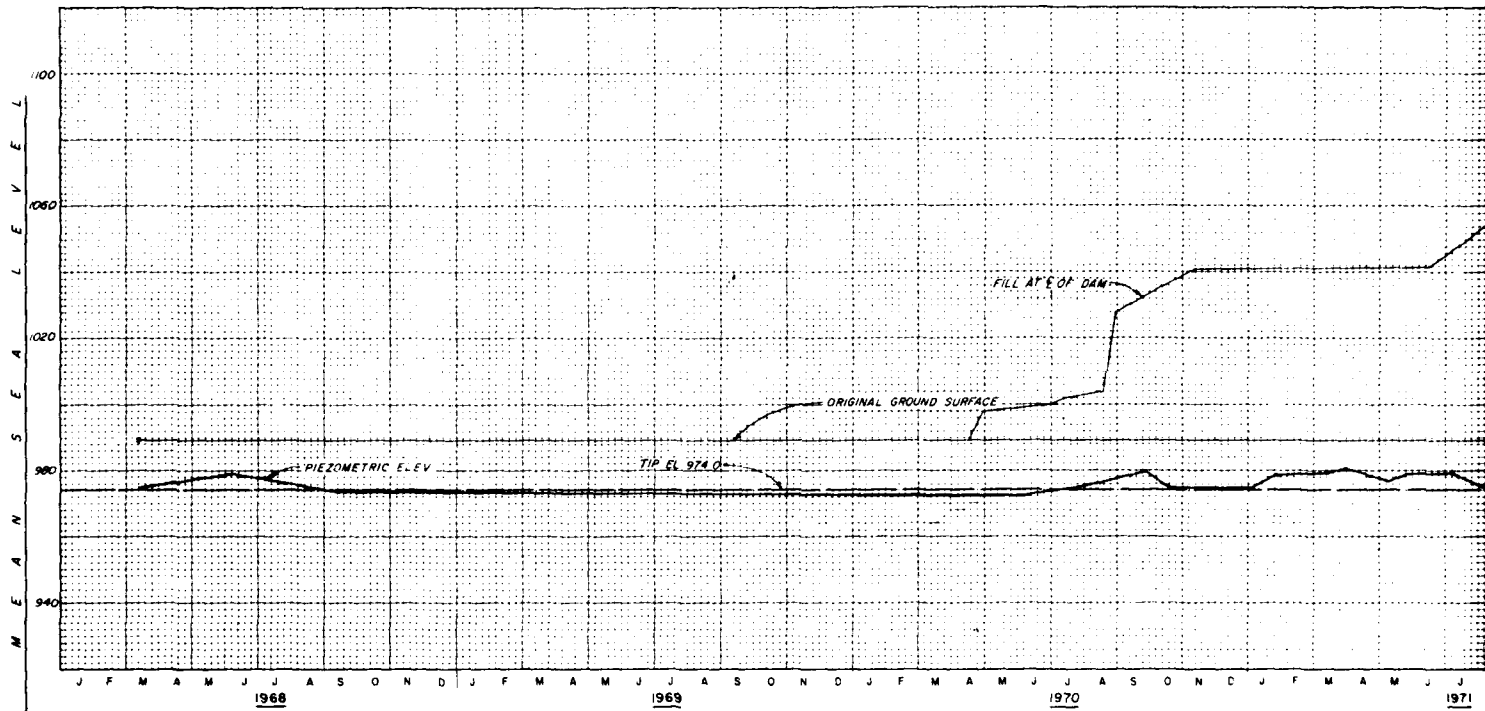
INSTRUMENTATION PLOTS
PP-80-2 (INSIDE TOWER)

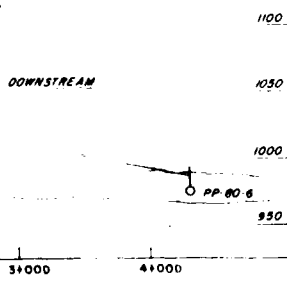
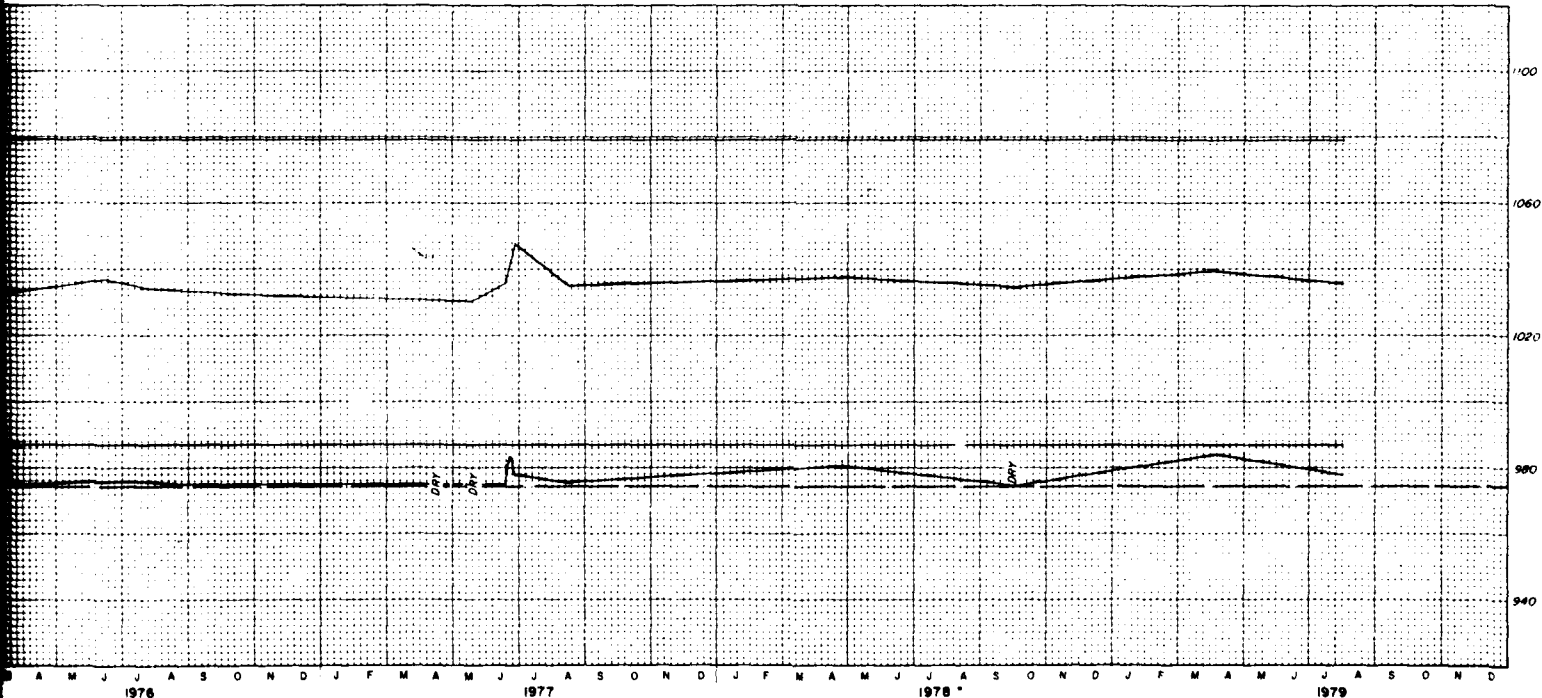
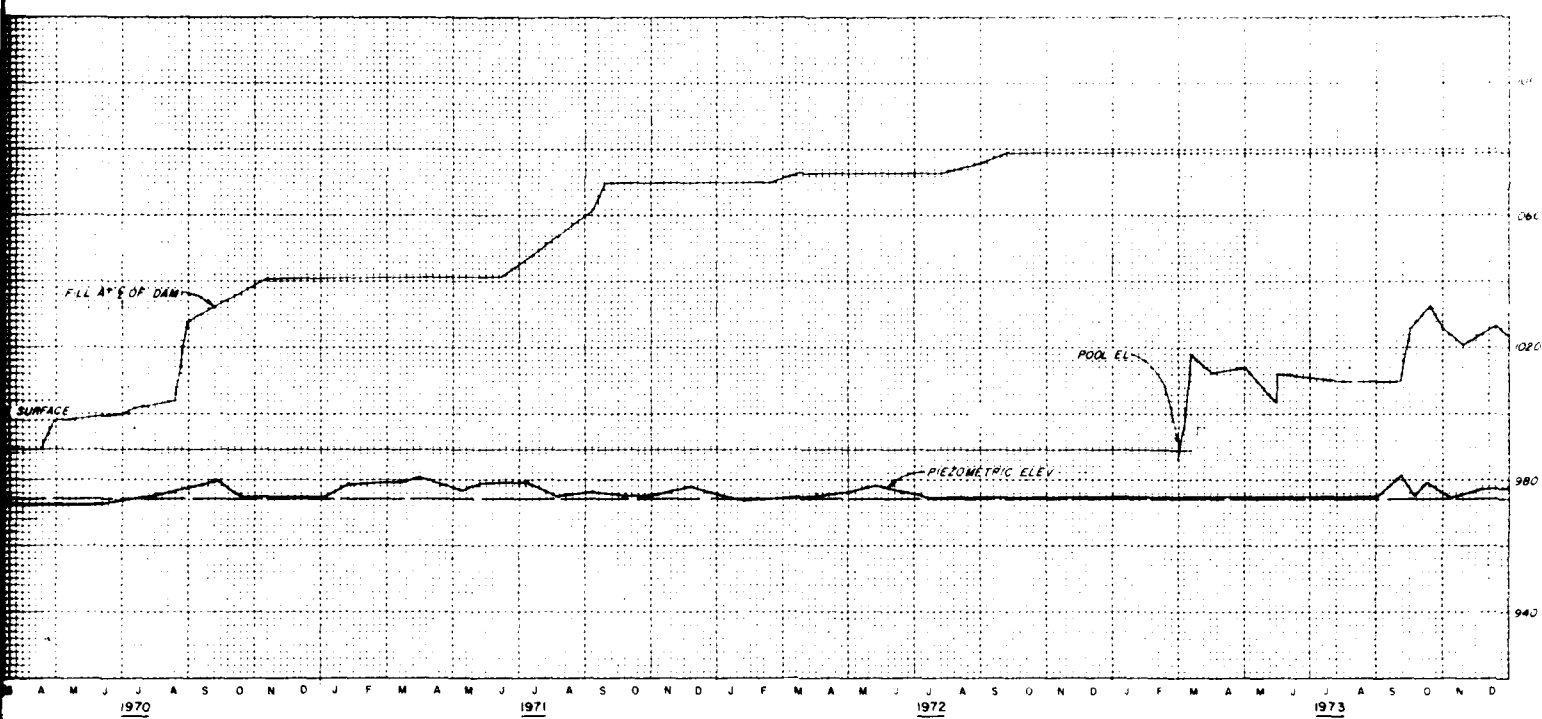
In 1 sheet

Sheet No. 1

Scale as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1310
AUGUST 1975





LEGEND
 OPEN TUBE ——— ○
 PNEUMATIC CELL ——— ●

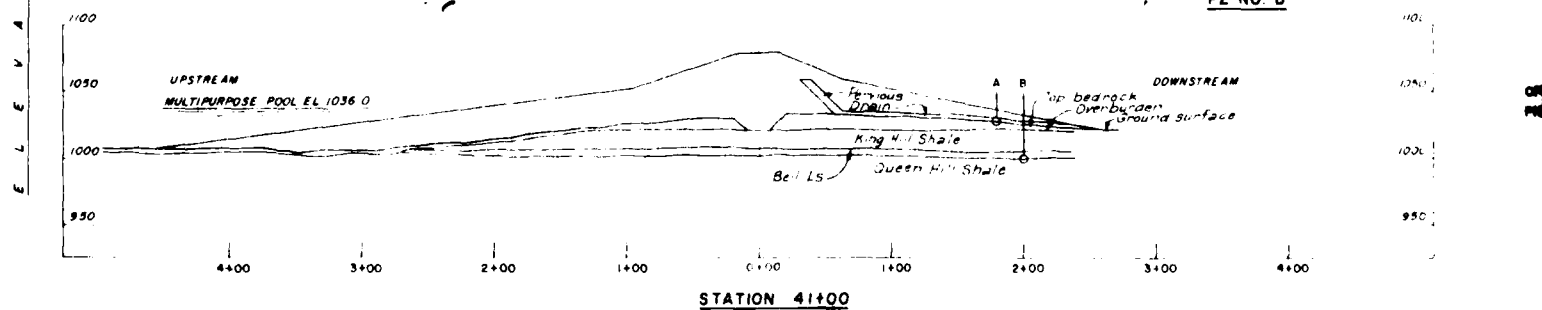
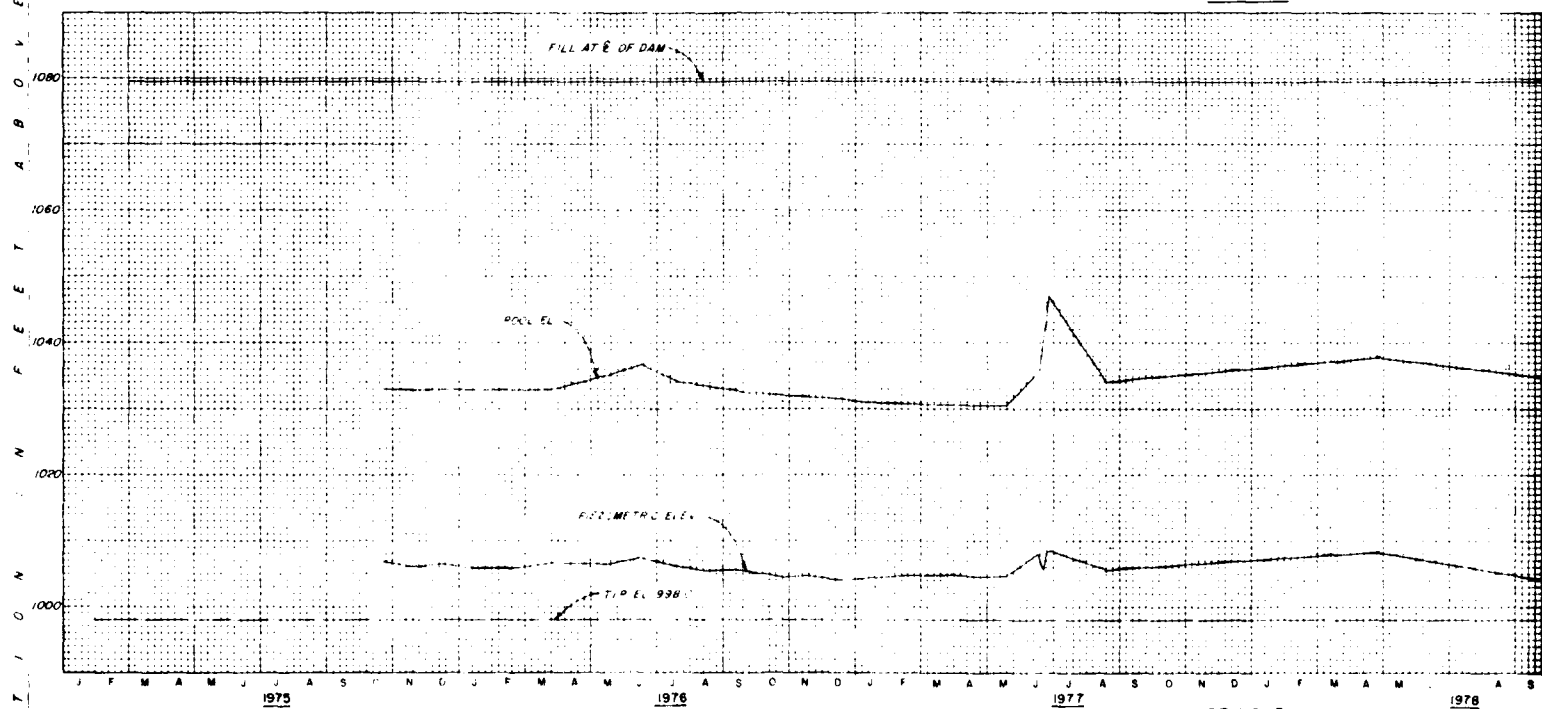
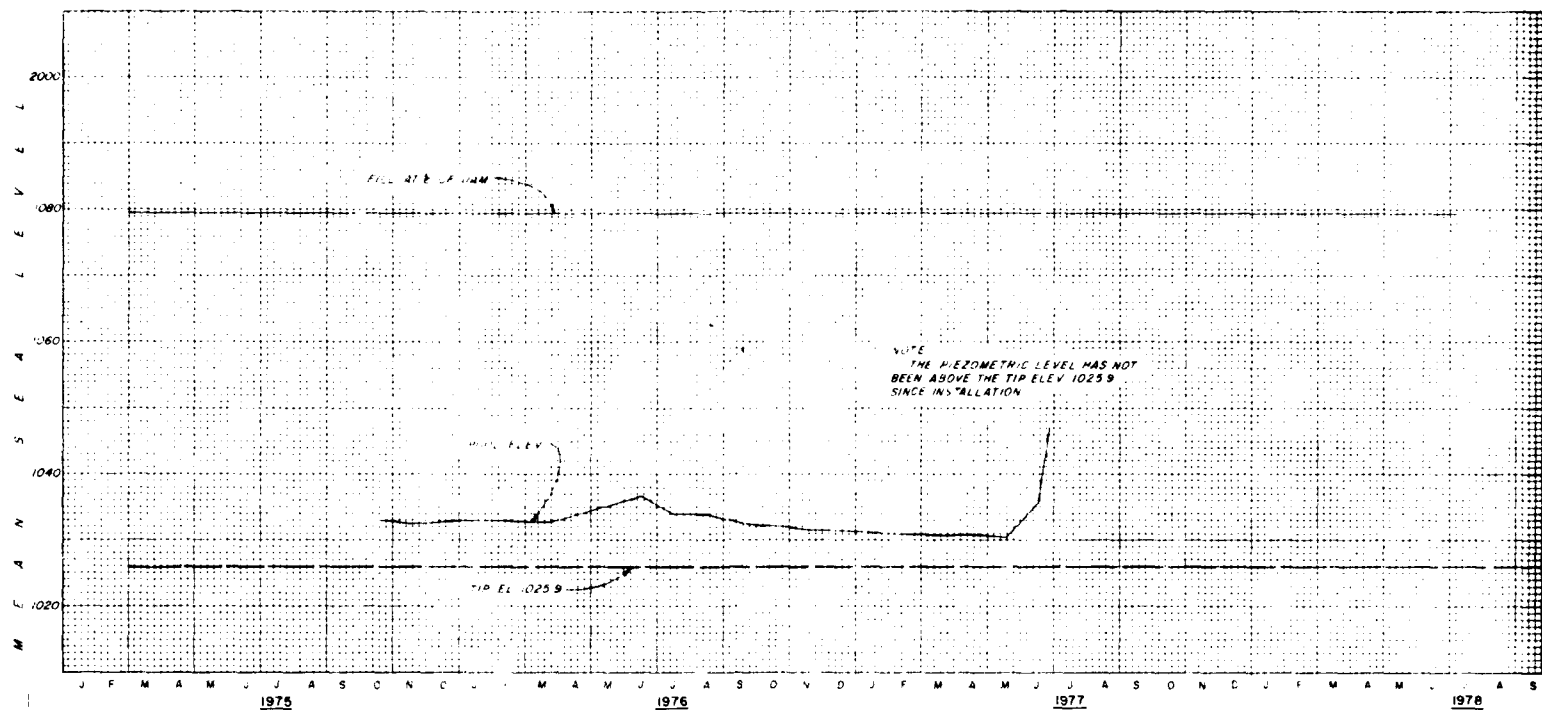
Revised August 1979
 MARAIS DES CYGNES RIVER KANSAS
MELVERN LAKE

INSTRUMENTATION PLOTS
 PP-80-6 (OPEN TUBE)

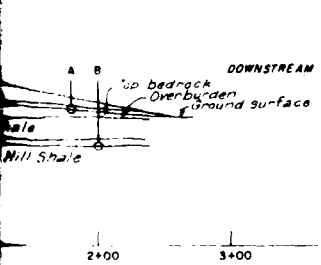
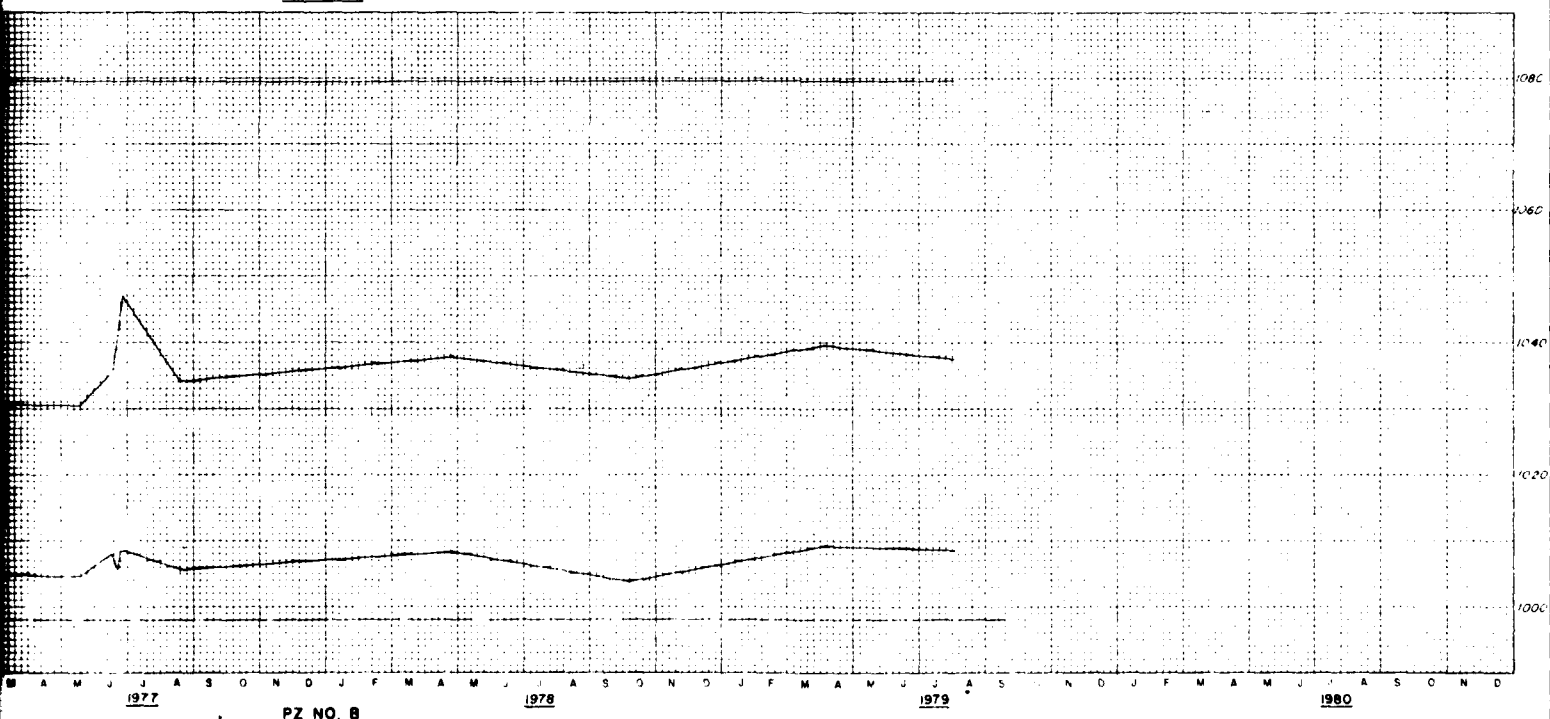
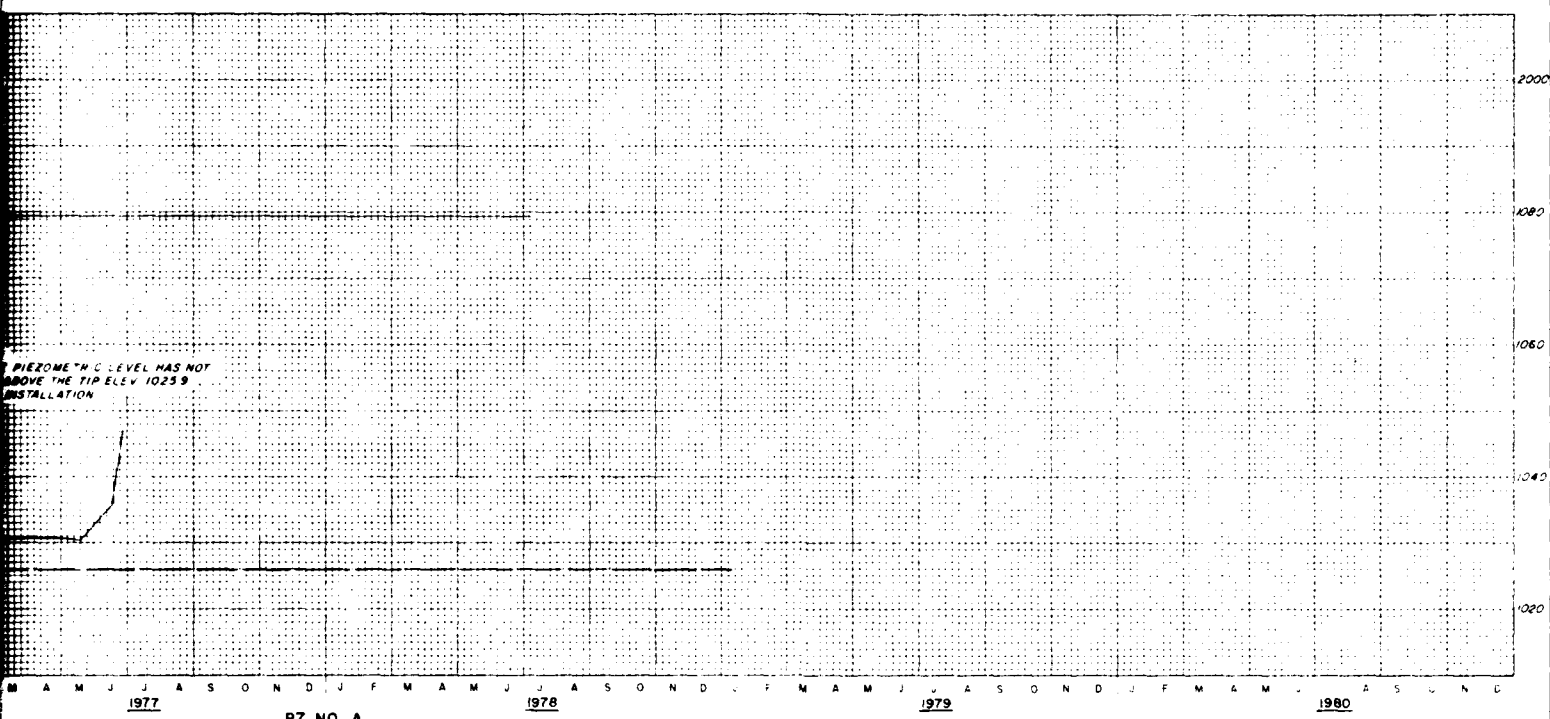
In 1 sheet

Sheet No 1
 CORPS OF ENGINEERS U.S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1311
 AUGUST 1975

Scale as shown



PIEZOMETER LEVEL HAS NOT
ABOVE THE TIP ELEV. 1023.9
INSTALLATION



LEGEND
OPEN TUBE — ○
PNEUMATIC CELL — ●

Revised August 479
MARAIS DES LYGNES RIVER, KANSAS
MELVERN LAKE

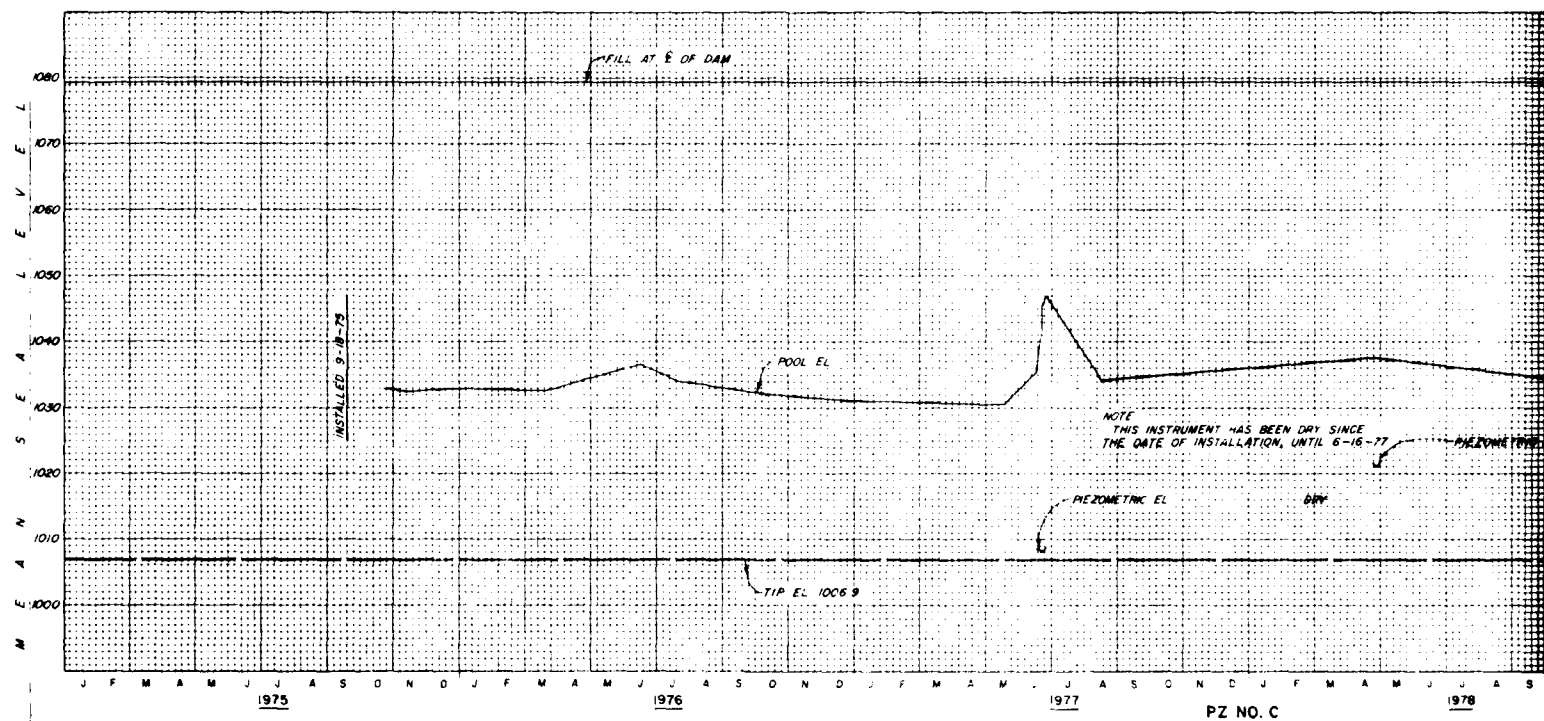
PIEZOMETER PLOTS
PZ NO'S A & B

In 1 sheet

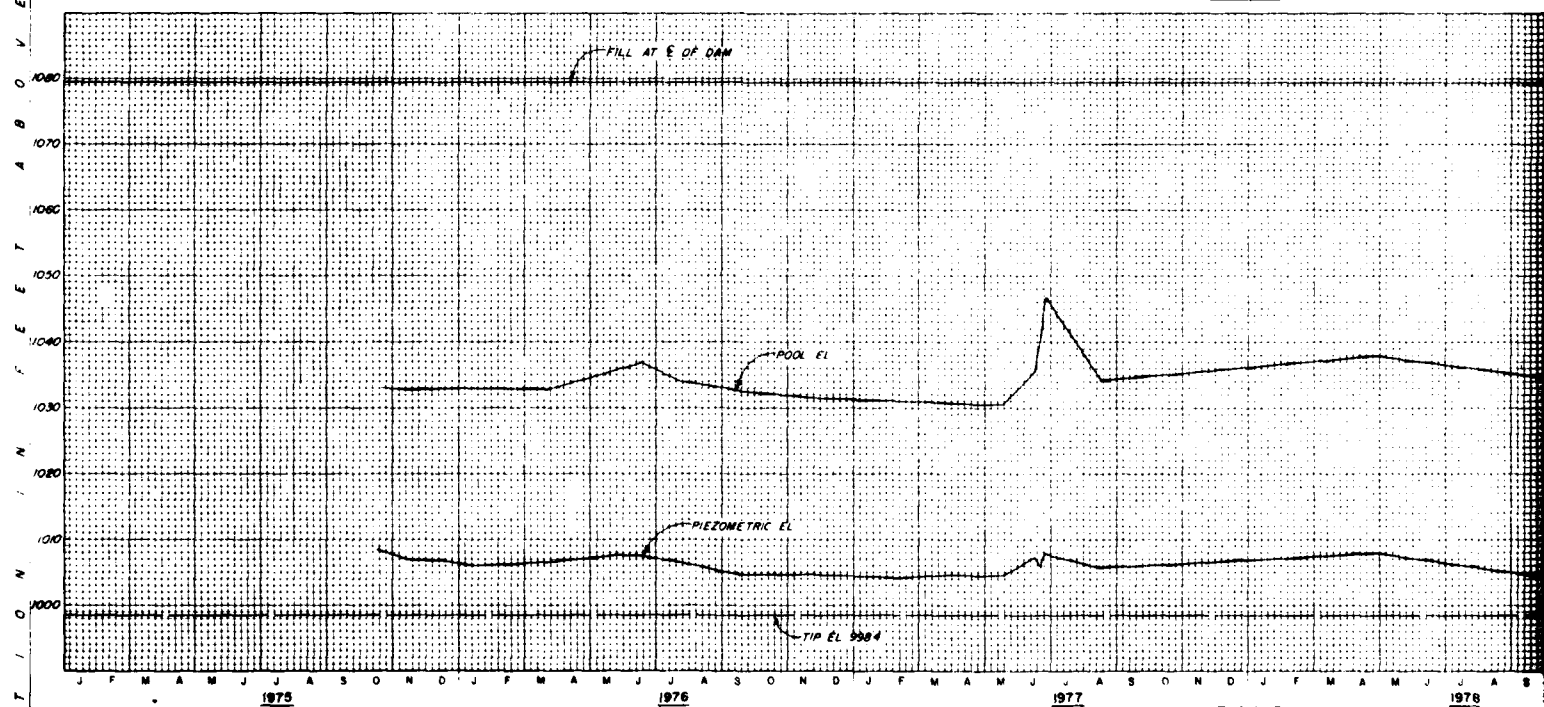
Sheet No. 1

Scale as shown

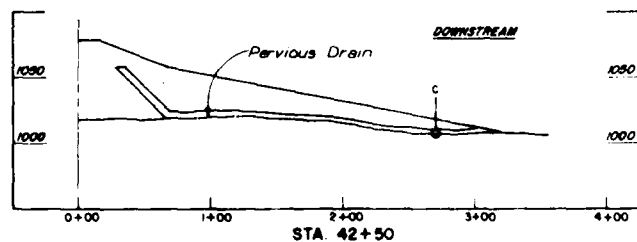
ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1007
AUGUST 1977



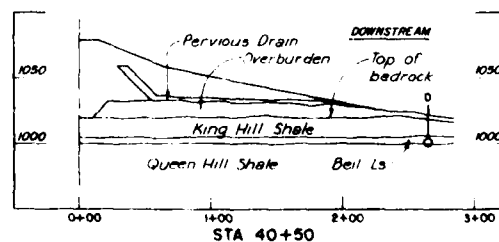
PZ NO. C



PZ NO. D

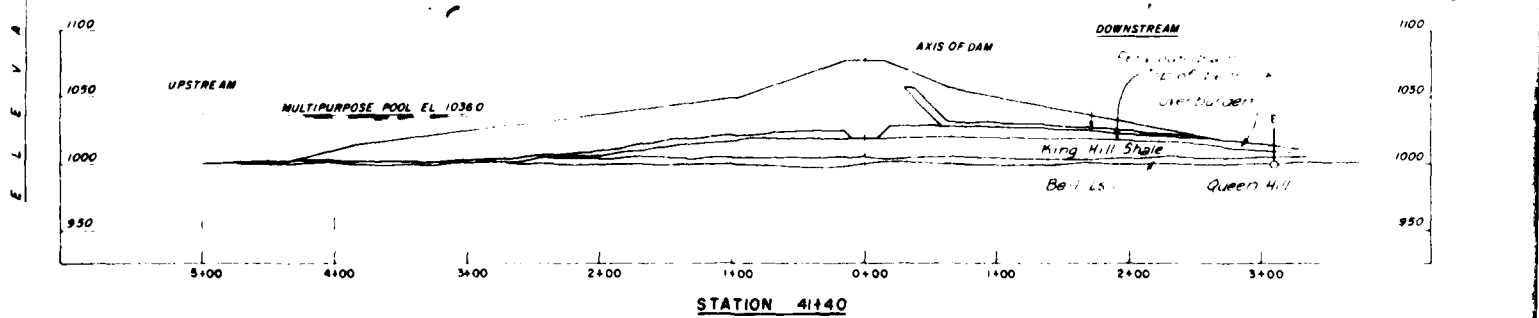
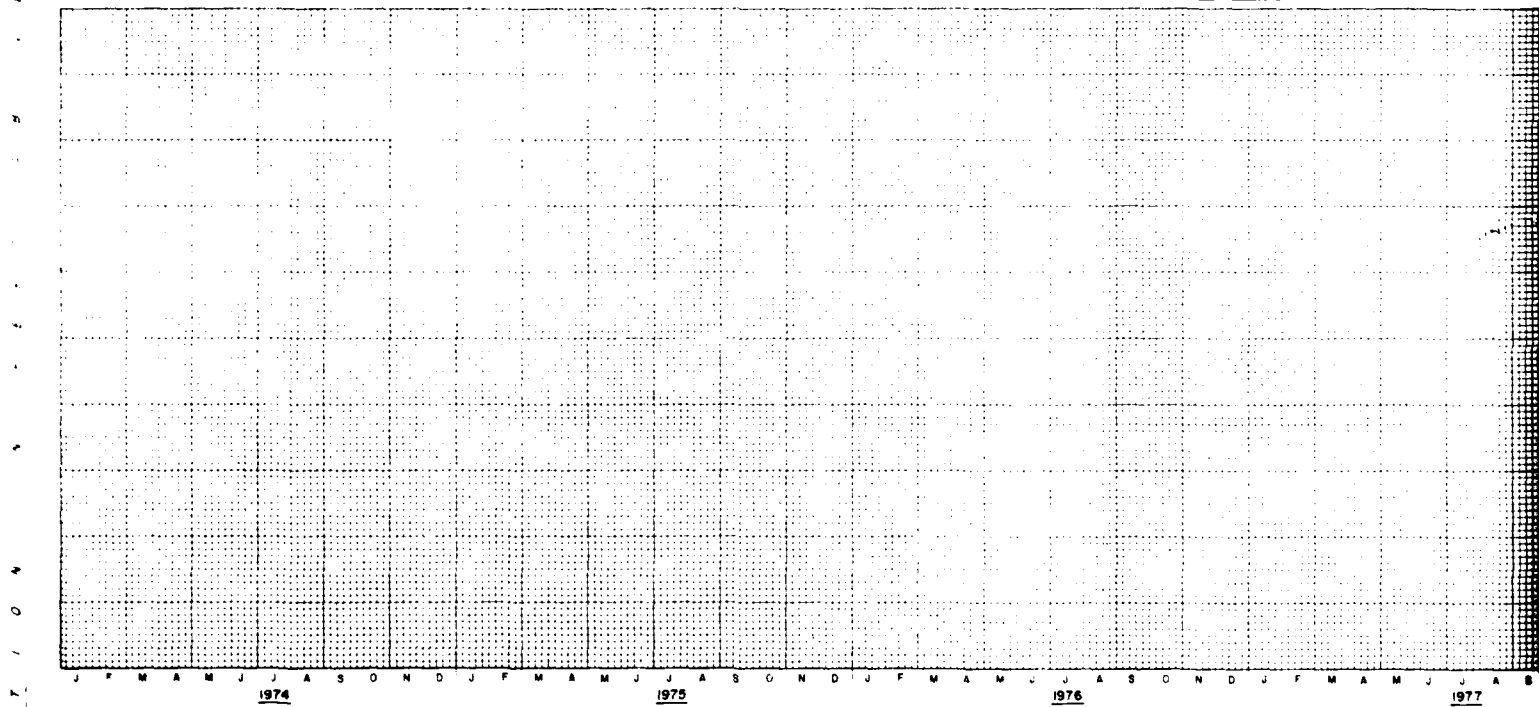
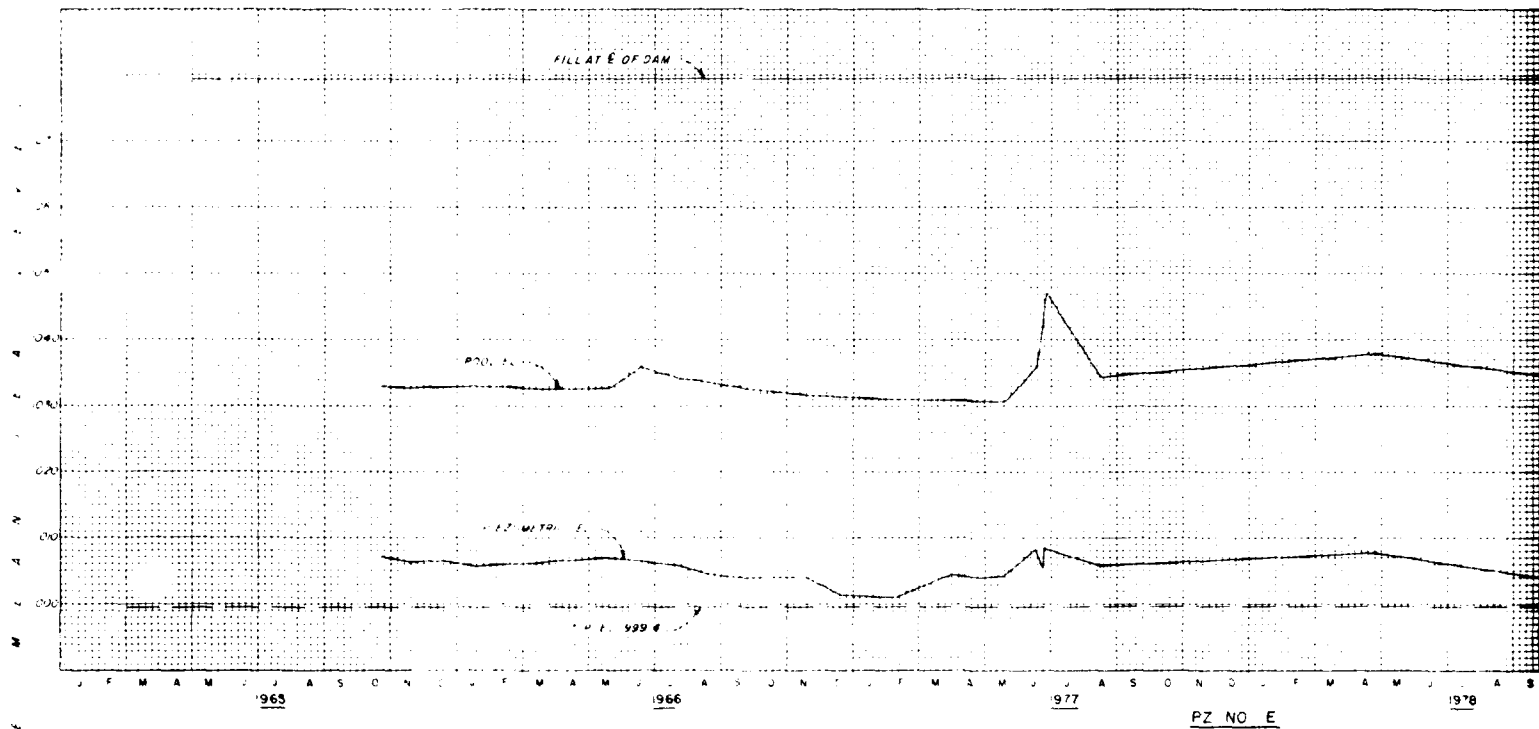


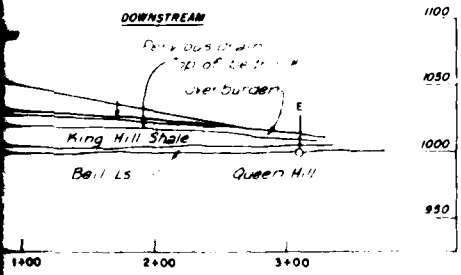
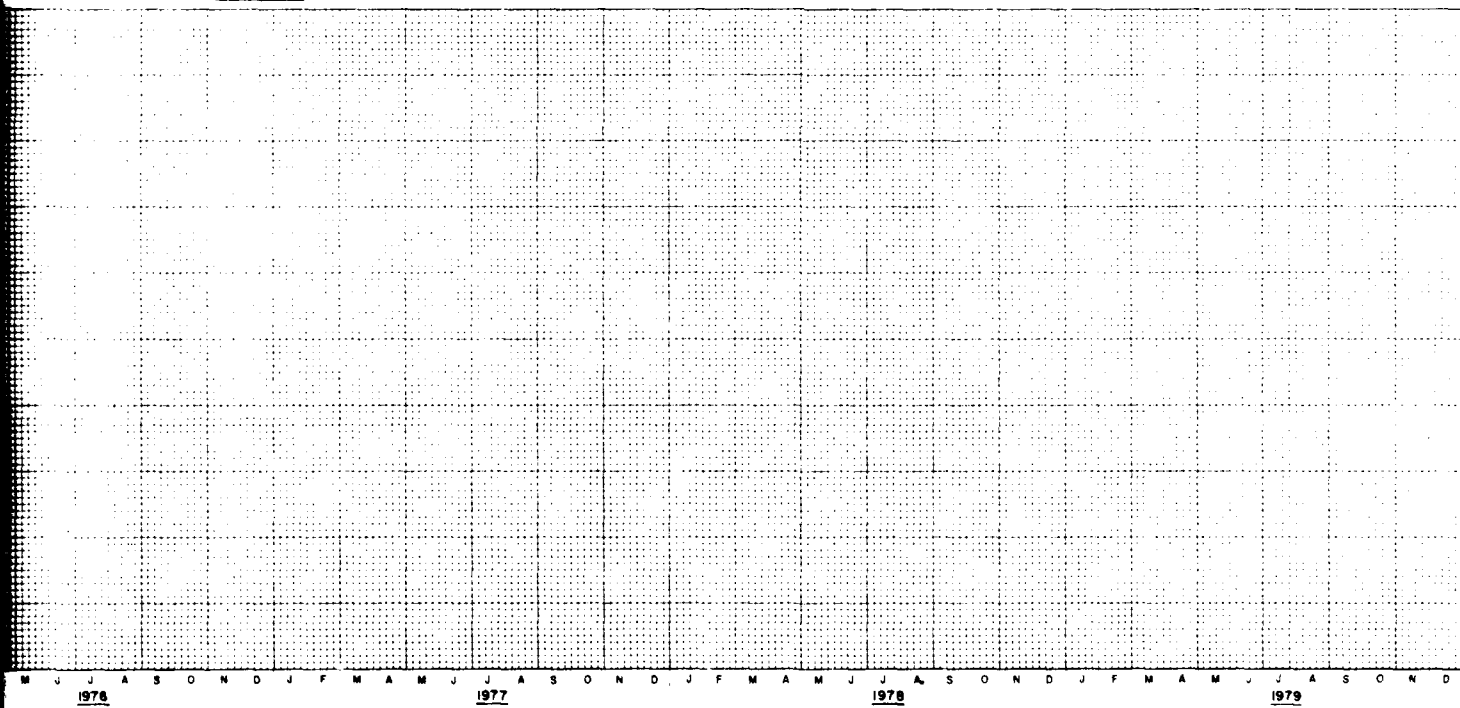
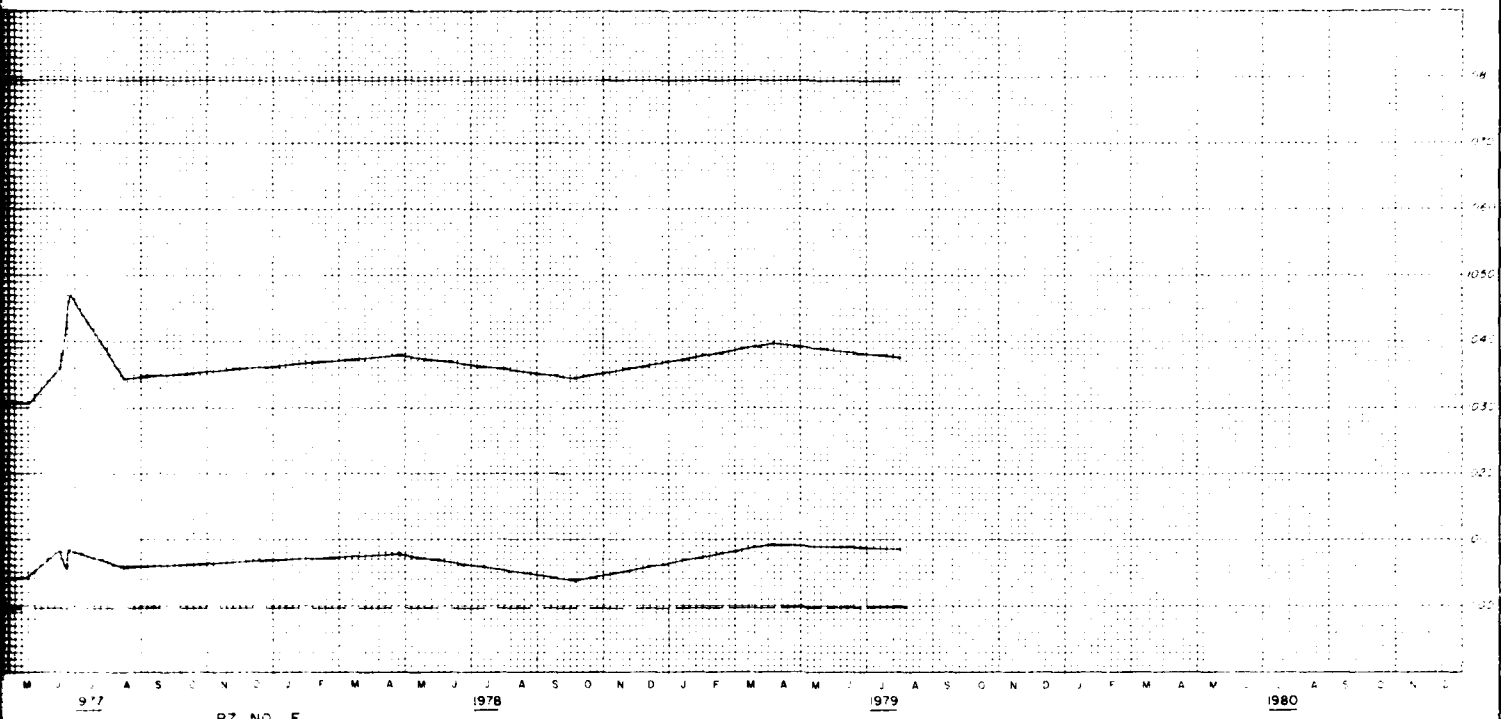
STA. 42+50



STA. 40+50

LEGEND
OPEN TUBE
PNEUMATIC CELL





LEGEND
 OPEN TUBE ————
 PNEUMATIC CELL - - - -

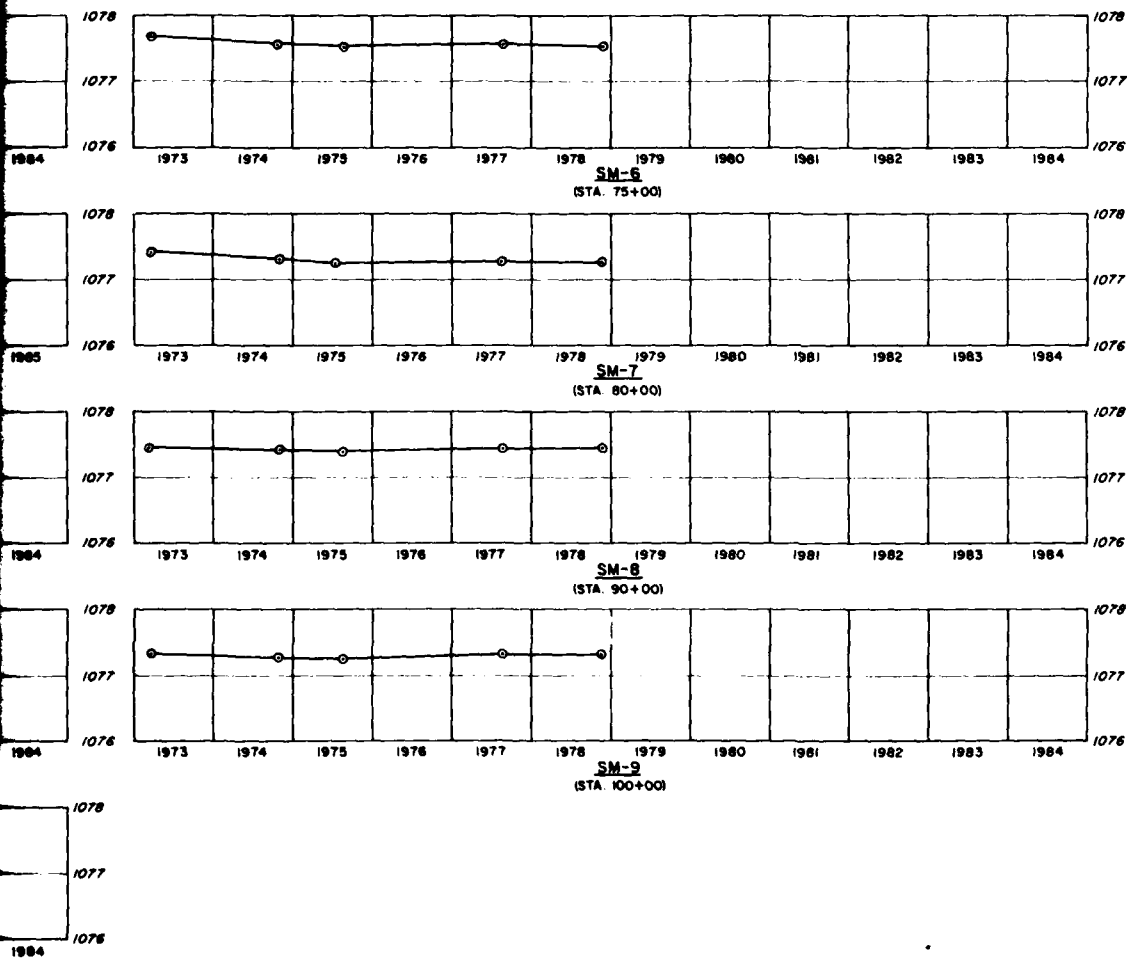
Revised August 1979
 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

PIEZOMETER PLOTS
 PZ NO. E

In 1 sheet

Sheet No. 1
 CORPS OF ENGINEERS U. S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. 0-5-1006
 AUGUST 1977

Scale as shown



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

SETTLEMENT MONUMENT PLOTS
SM-1 THRU SM-9

In 1 sheets

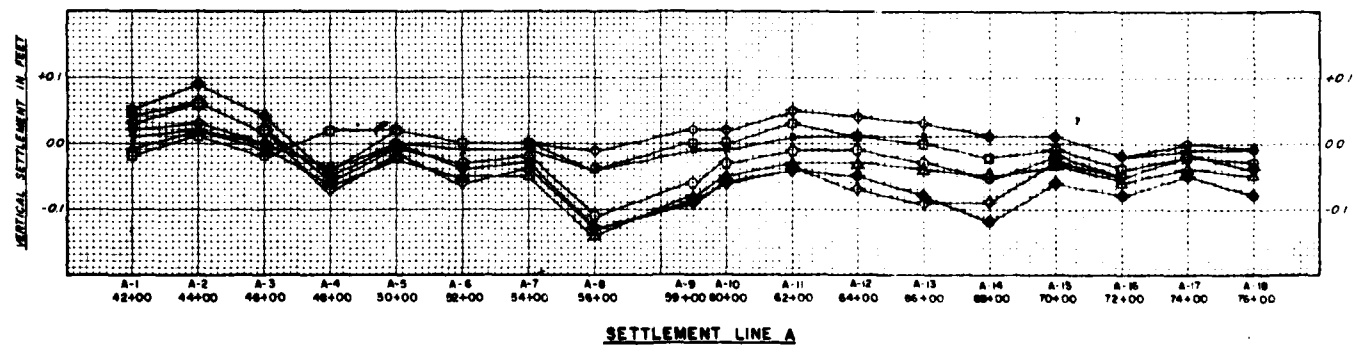
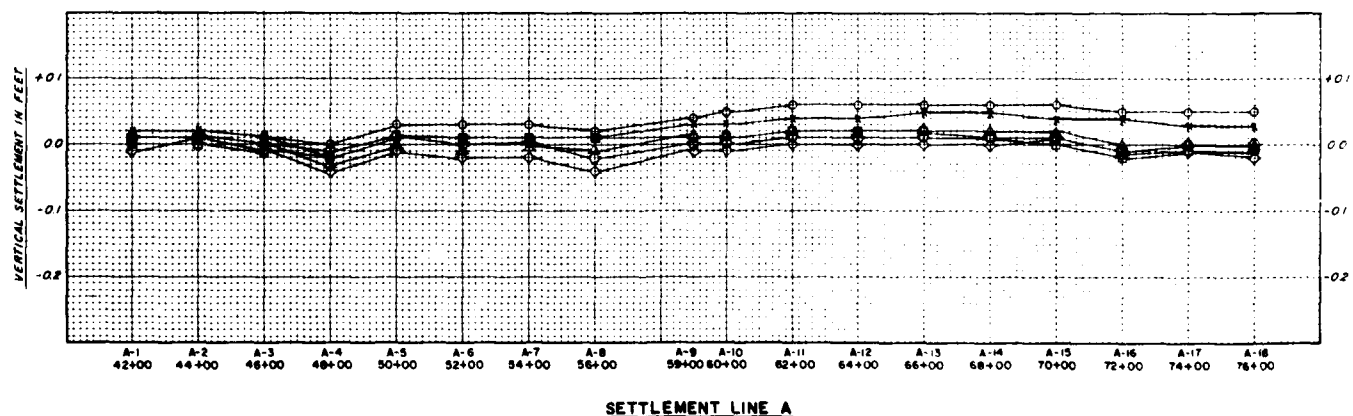
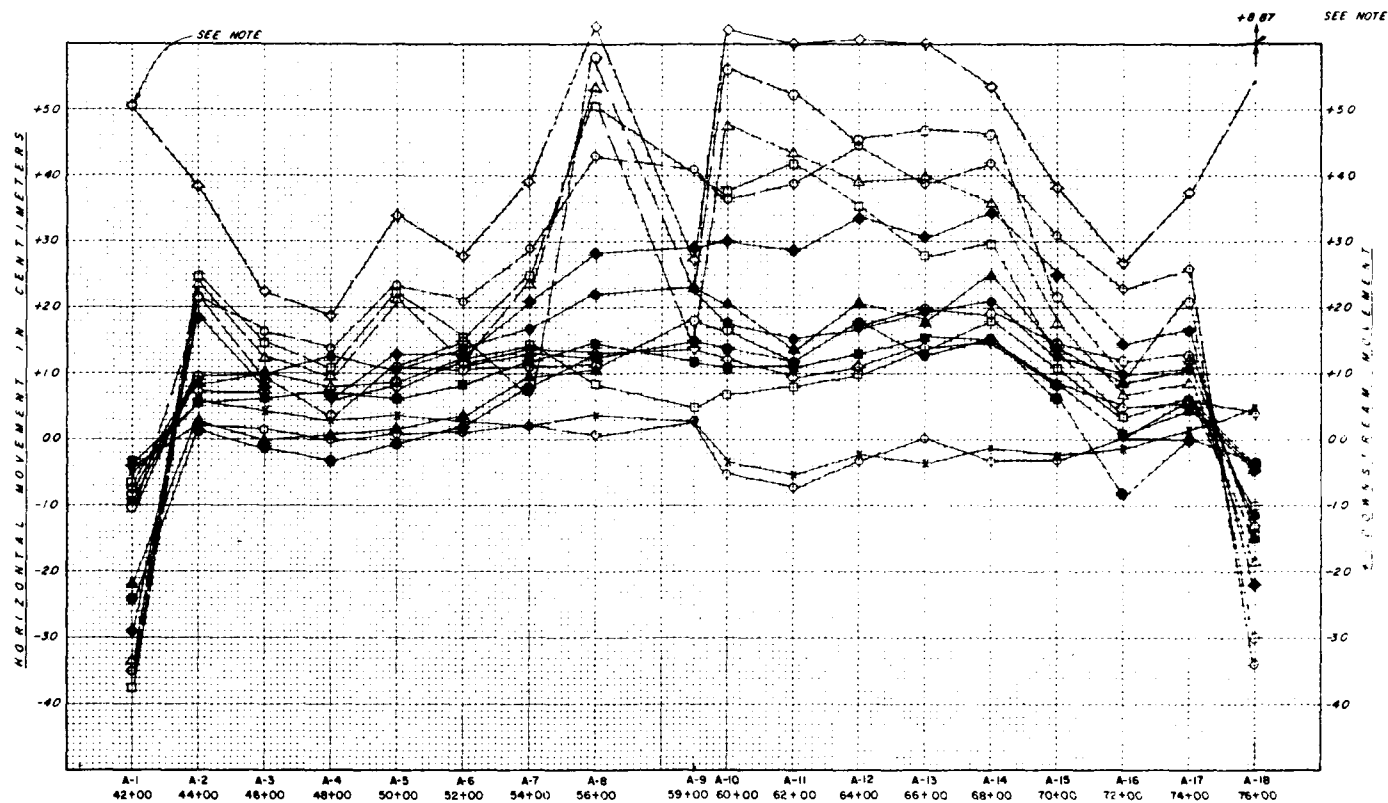
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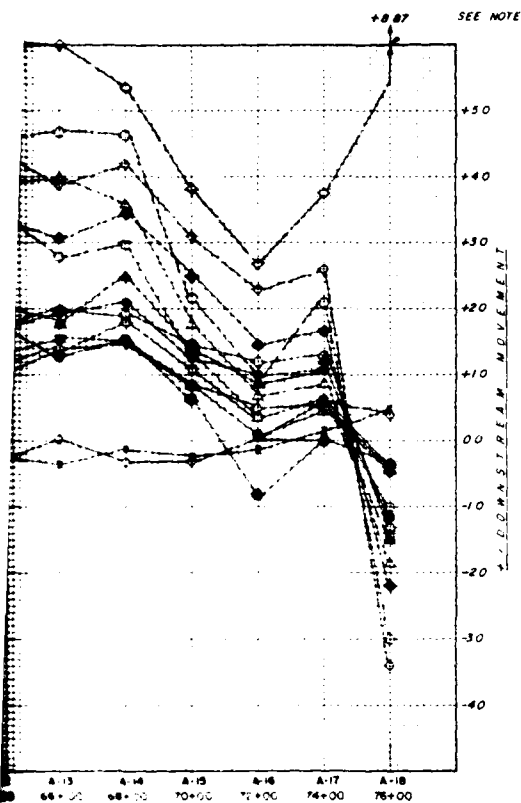
Scale as shown

CORPS OF ENGINEERS U S ARMY

FILE NO 0-5-1356

AUGUST 1979





LEGEND

- ORIGINAL SURVEY 11-5-71
- SECOND SURVEY 11-22-71
- THIRD SURVEY 12-8-71
- △ FOURTH SURVEY 1-10-72
- x 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:

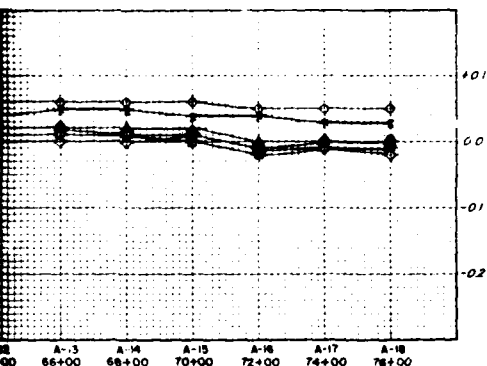
ALINEMENT WAS RAN ON NOV. 8 & 9 AND AGAIN ON NOV. 30 AND DEC. 1. BETWEEN THESE READINGS, THE INSTRUMENT PLATES WERE RESET ON MONUS 8-4, 8-17, A-1, AND A-18.

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.

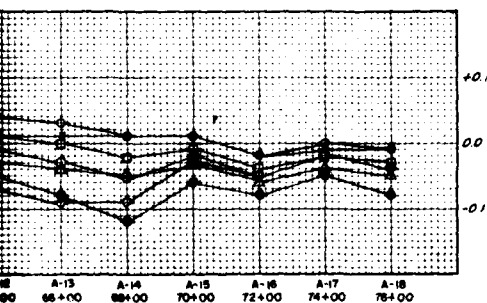
LEGEND

- ORIGINAL SURVEY 1-20-72
- x 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
- x 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



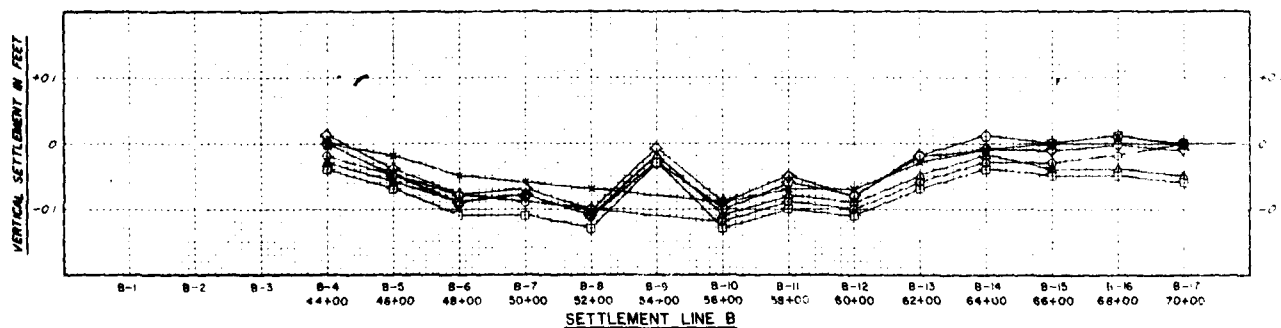
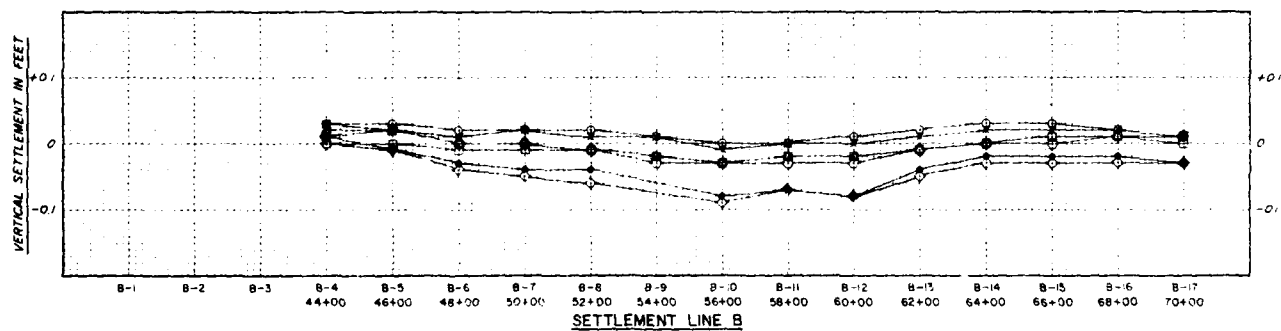
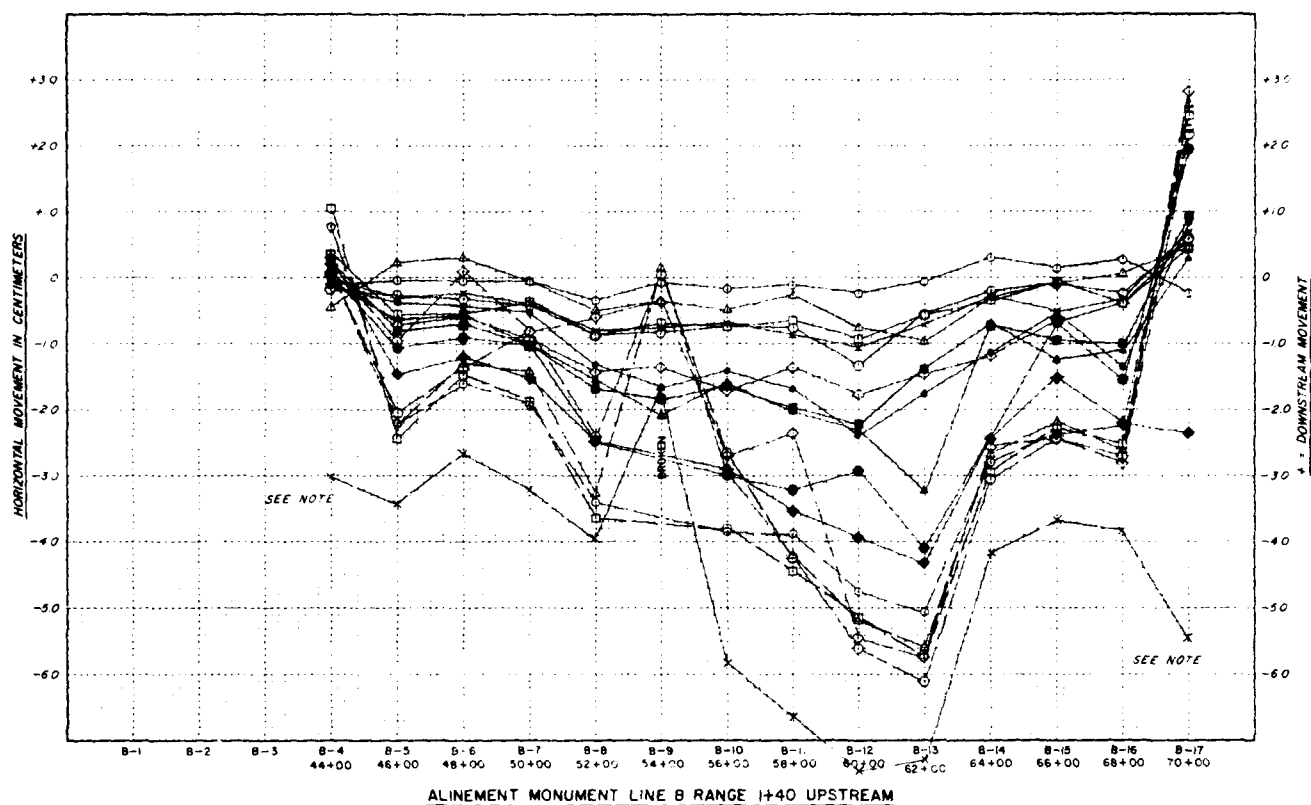
Revised August 15
MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
PERIODIC INSPECTION

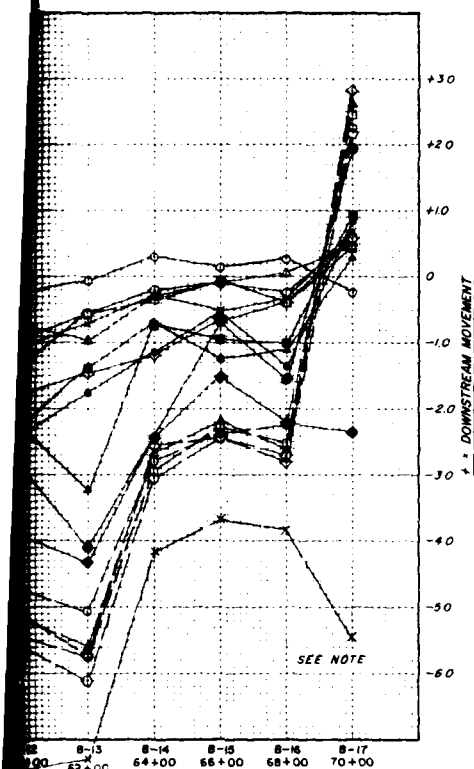
ALINEMENT MONUMENTS
LINE A

In 1 sheet

Sheet No. 1
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO. 0-5-1318

Scale as shown





LEGEND

- ORIGINAL SURVEY 11-4-71
- SECOND SURVEY 11-23-71
- THIRD SURVEY 12-8-71
- △ FOURTH SURVEY 1-10-72
- x 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
- x EIGHTEENTH SURVEY 11-30-78

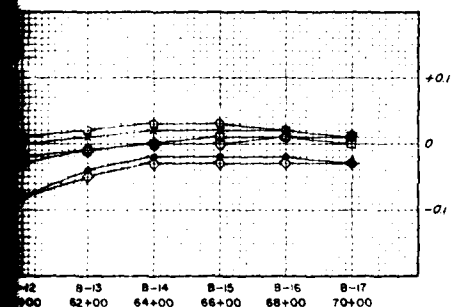
NOTES:

ALINEMENT WAS RUN 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.

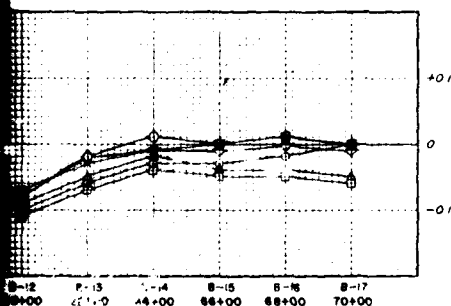
THE READINGS ON THESE PARTICULAR MONUMENTS SHOW EXPLAINABLE DIFFERENCES FROM PREVIOUS READINGS THESE PLATES WERE ACTUALLY INSTALLED WRONG IN 1969 AND WERE NEVER CHANGED.

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
- x 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
- x 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

MAINTAINED August 1979
MARAI DES CYGNES RIVER, KANSAS
MELVERN LAKE
PERIODIC INSPECTION

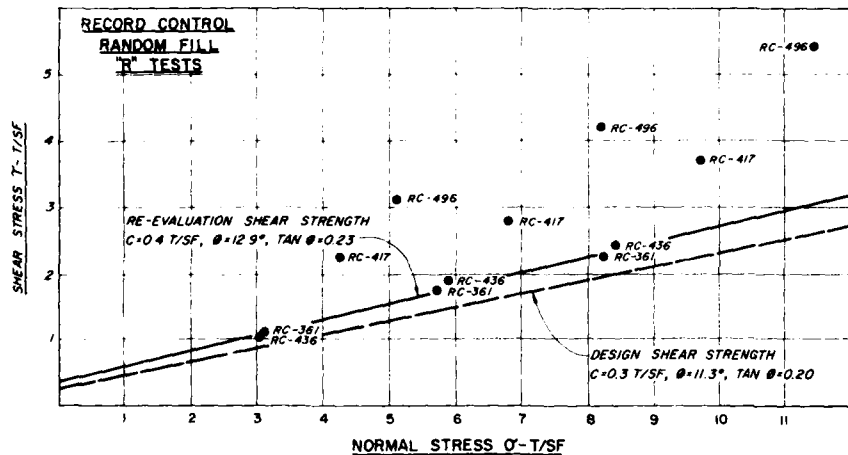
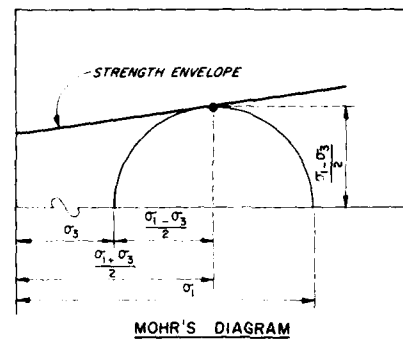
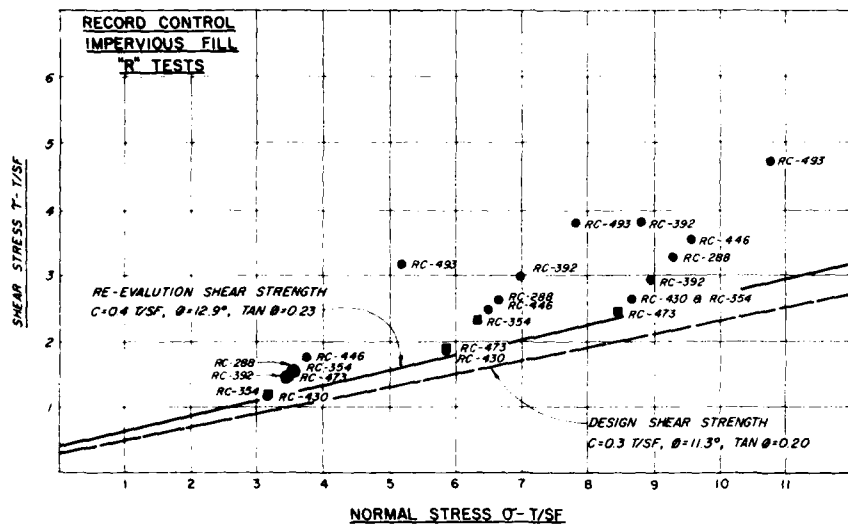
ALINEMENT MONUMENT
LINE B

In 1 sheet

Sheet No. 1

Scale as shown

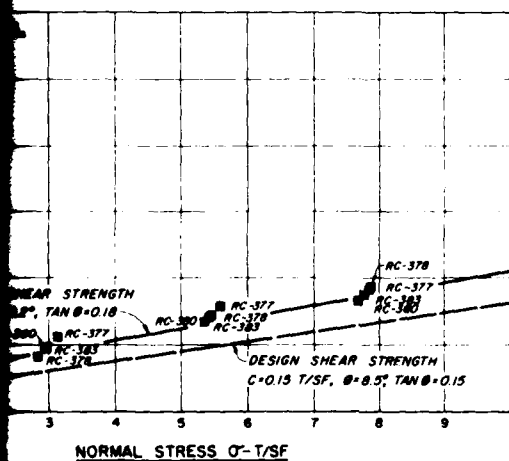
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO 0-5-1319



LEGEND

LEAN CLAY ●

FAT CLAY ■



Revised August 1979
MARAI DES CYGNES RIVER, KANSAS
MELVERN LAKE

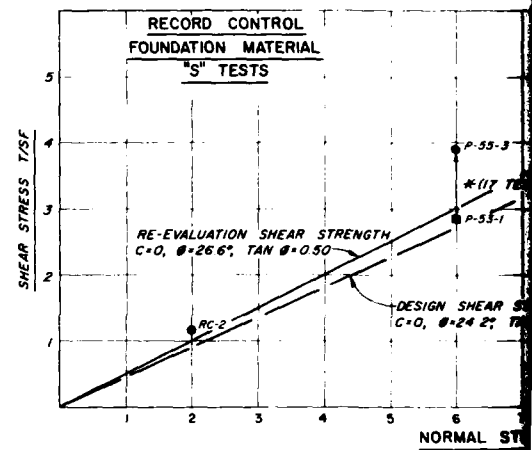
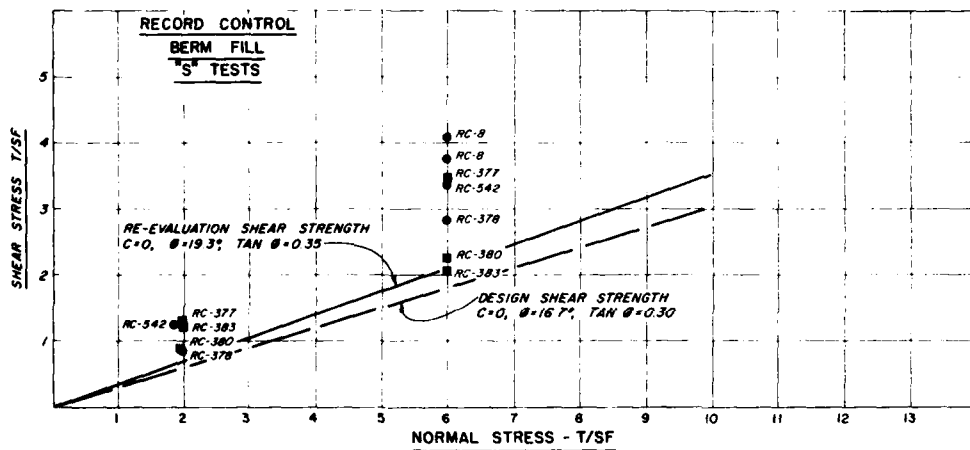
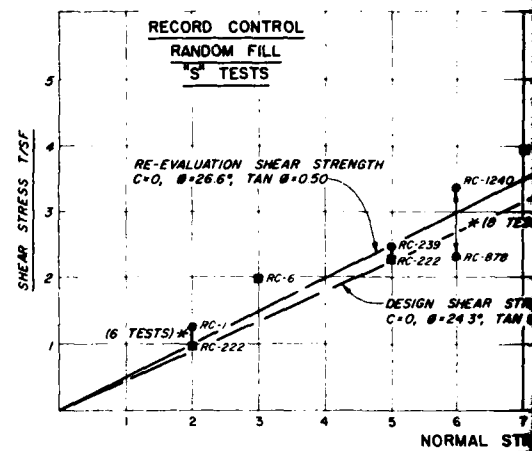
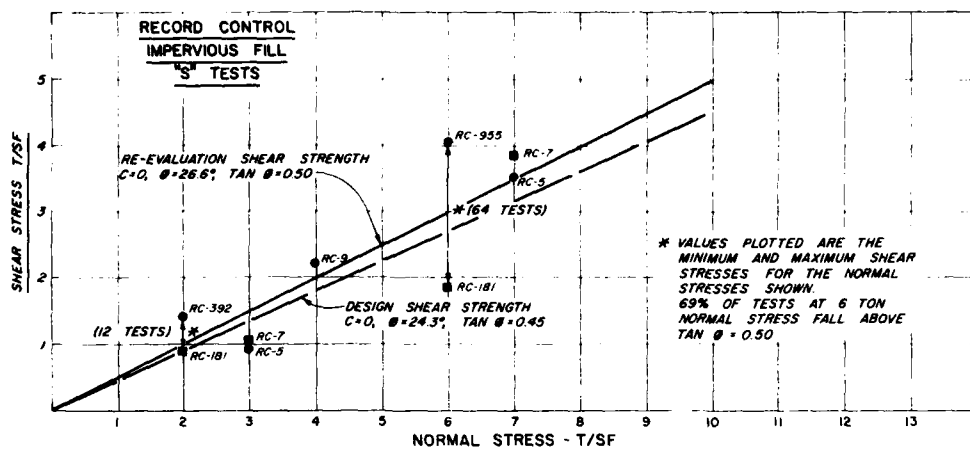
RECORD CONTROL
"O" AND "R" TESTS
EMBANKMENT MATERIALS

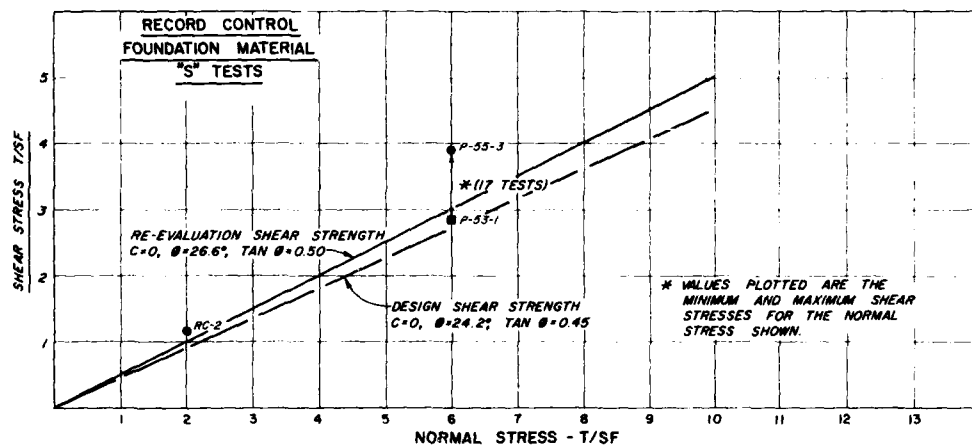
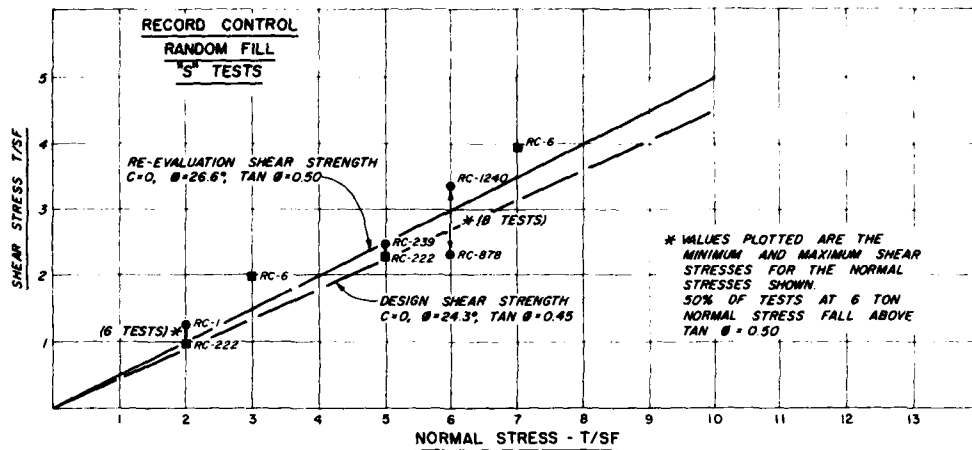
In 1 sheets

Sheet No. 1
CORPS OF ENGINEERS U.S. ARMY
KANSAS CITY DISTRICT
FILE NO 0-5-1312
AUGUST 1975

Scale as shown

PLATE NO. 70





LEGEND

LEAN CLAY ●
FAT CLAY ■

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MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE

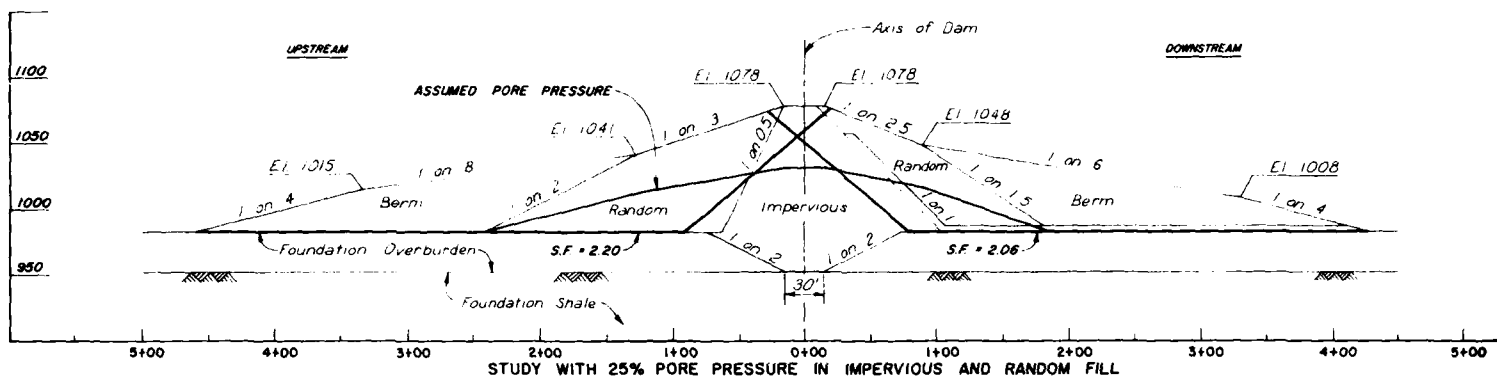
**RECORD CONTROL
"S" TESTS
EMBANKMENT MATERIALS**

In 1 sheets

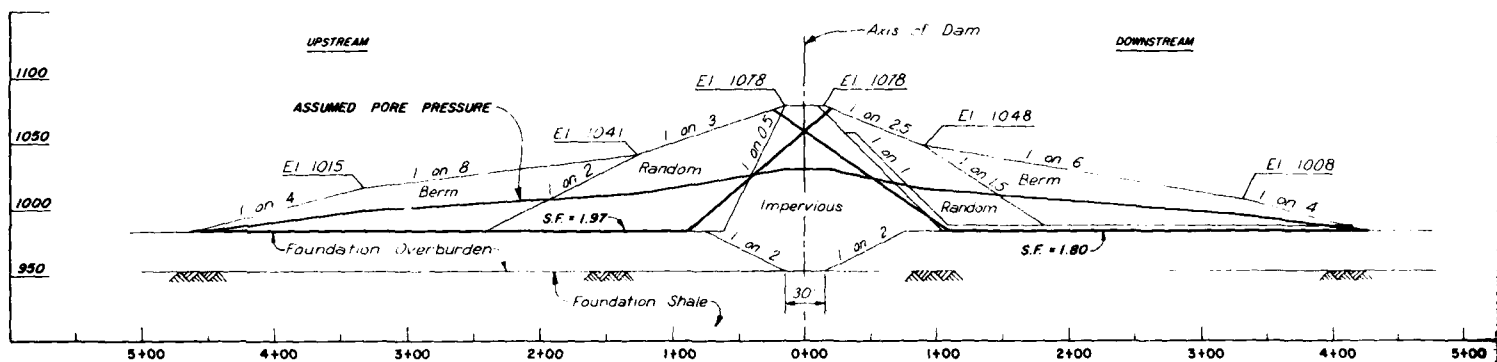
Sheet No. 1

Scale as shown

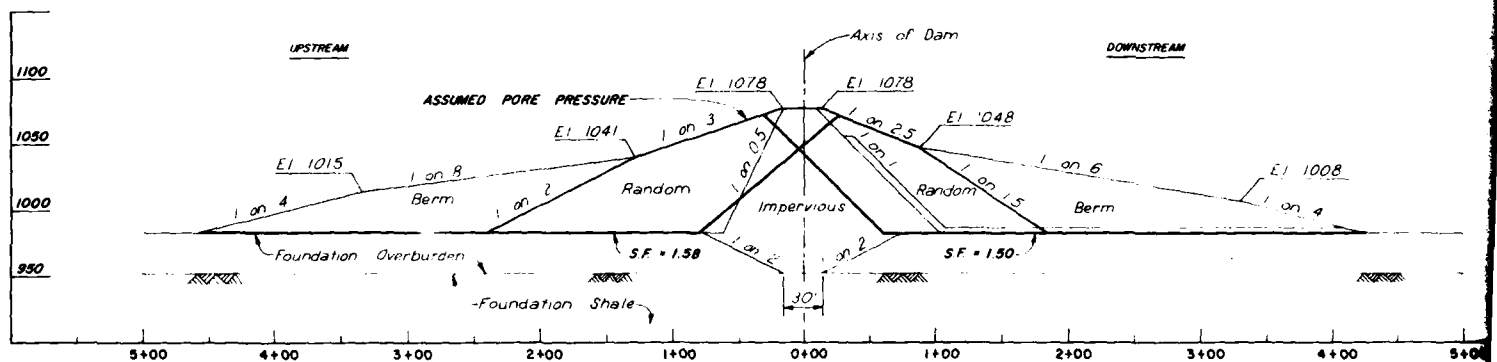
CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT
FILE NO 0-5-1313
AUGUST 1975



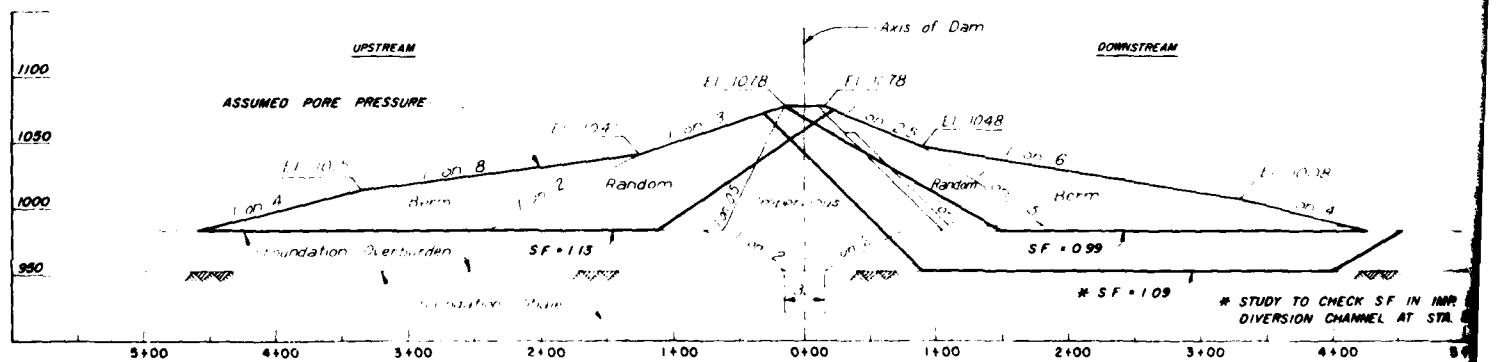
STUDY WITH 25% PORE PRESSURE IN IMPERVIOUS AND RANDOM FILL



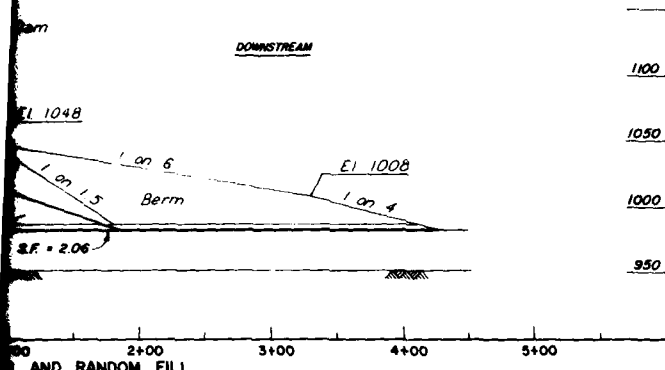
STUDY WITH 25% PORE PRESSURE IN ALL ZONES
"S" STRENGTH



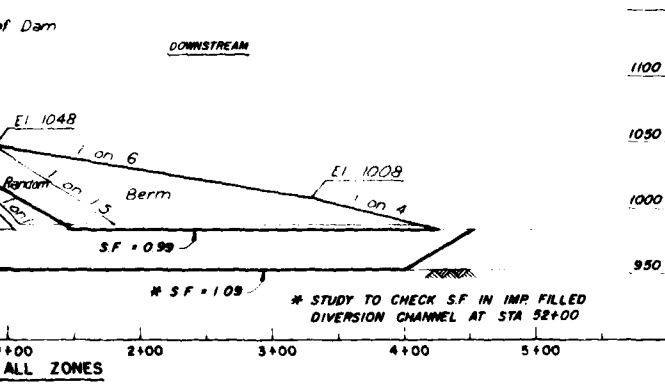
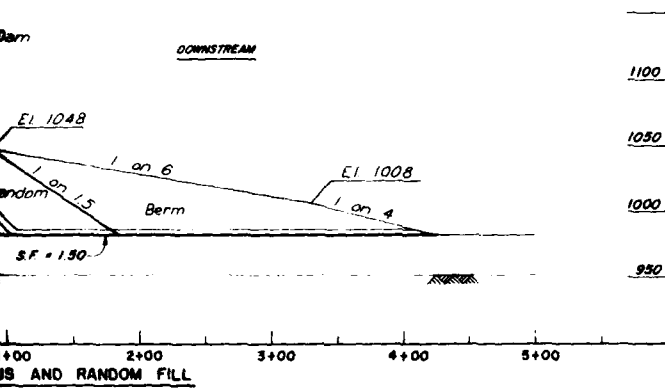
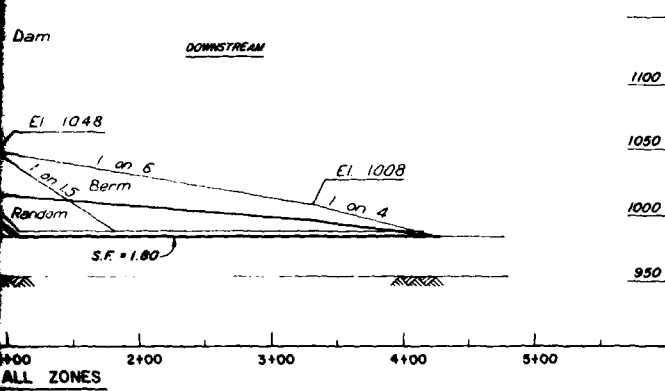
"S" STRENGTH



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

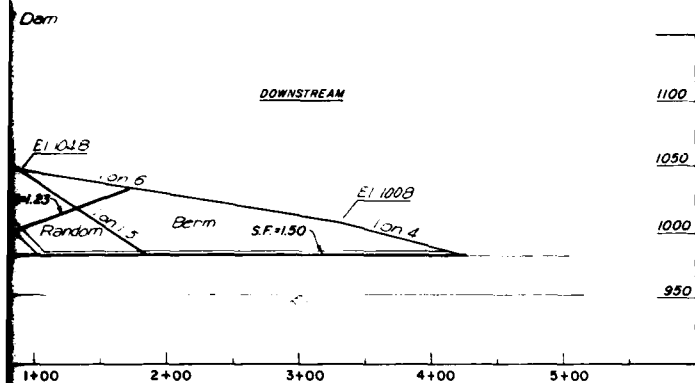


PHYSICAL SOIL CONSTANTS											
MATERIAL	UNIT WEIGHT		DESIGN SHEAR STRENGTHS (RECORD CONTROL)								
	SAT	DRAINED	C (TSF)	φ	TAN φ	C (TSF)	φ	TAN φ	C (TSF)	φ	TAN φ
IMPERVIOUS AND RANDOM	125	120	1.30	0.00	0.00	0.40	12.9°	0.23	0.00	26.6°	0.50
BERM	115	110	1.00	0.00	0.00	0.35	10.2°	0.16	0.00	19.3°	0.35
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

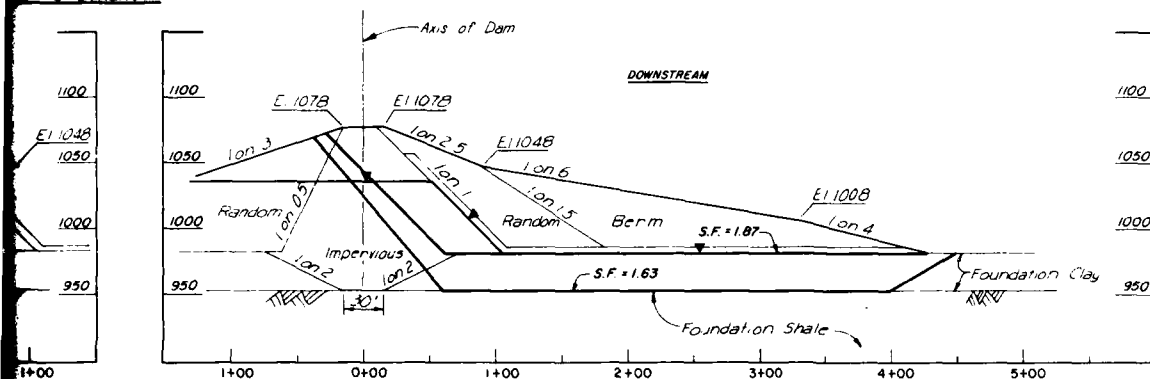


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 MARAIS DES CYGNES RIVER, KANSAS
MELVERN LAKE
 RE-EVALUATION
 STABILITY STUDIES
 EMBANKMENT AND FOUNDATION

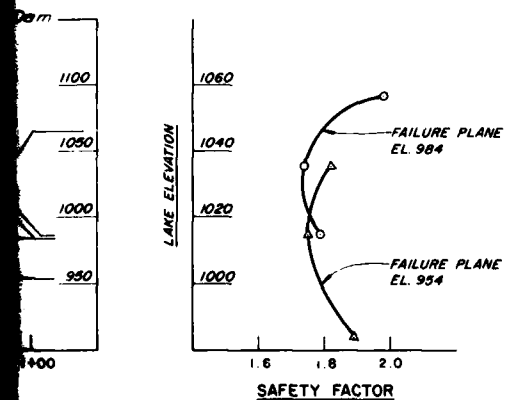
In 2 sheets
 Sheet No. 1
 Scale as shown
 CORPS OF ENGINEERS U. S. ARMY
 KANSAS CITY DISTRICT
 FILE NO. O-5-1314
 AUGUST 1975



AND 50% PORE
EL - "S" STRENGTH



STEADY SEEPAGE CASE
LAKE ELEVATION 1036.0



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MARAI DES CYGNES RIVER, KANSAS
MELVERN LAKE

RE-EVALUATION
STABILITY STUDIES
EMBANKMENT AND FOUNDATION

In 2 sheets

Sheet No 2
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KANSAS CITY DISTRICT
FILE NO. 0-5-1315
AUGUST 1975

Scale, as shown

**D
FI**