WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Hydrogeologic Data for the Smith Canyon Area
Franklin County, Washington

by
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Scope of Report

This open file Report is intended to serve as a repository for Hydrogeologic data collected for an area known as Smith Canyon located easterly of the city of Pasco, in Franklin County, Washington.

The data collection began in early 1973 in response to reported well interference in the overburden aquifer within the basalt confines of Smith Canyon. This report only presents data collected by the Department of Ecology, Eastern Regional Office and covers only a portion of the much larger drainage area of Smith Canyon.

The boundaries of the study, as shown on plate one, are generally from the Town of Eltopia to Sagemoor Falls and was determined by the concentration of irrigation withdrawals and water level declines in response to these withdrawals.

Geology

Smith Canyon was formed by catastrophic erosion of Saddle Mountain Basalts by the Lake Missoula floods. Approximately 12000 to 15000 years ago Glacial Lake Missoula developed when a lobe of Cordilleran ice moved south down the Purcell Trench and blocked the Clarkfork Valley, near Pend Oreille Lake in the Idaho Panhandle. This ice damming caused impounded water to reach heights of several thousand feet above the valley floor. When this ice dam broke many cubic miles of water rushed westward onto the Columbia Plateau overwhelming the existing river valley drainages. Proof of at least seven different episodes of flooding have been documented by various investigators.

Esquatzel Coulee, Smith Canyon and its tributary canyon Ryegrass Coulee are examples of the unbelievable power of the flood waters as they headed south from Spokane towards the Pasco Basin.

This immense volume of flood water scoured the basalt surface forming these canyons and coulees. Concurrent with this channel erosion hydraulic damming at the Columbia River Gorge restricted flood waters forming an immense lake which carried icebergs and erratics that were released when the ice melted. The floods were the sources of the thick deposits of cross bedded sands and gravels of the Pasco Basin. These beds are called the Spokane flood gravels. These flood waters probably further excavated a pre-existing drainage pattern, however, the filling of the canyon with poorly sorted sands and gravels can be directly attributed to the change in gradient caused by hydraulic damming at the Columbia River Gorge.

Climate

Smith Canyon is semi-arid with an average annual precipitation of 7.5. inches. The majority of the precipitation occurs during the winter as snowfall. The total precipitation averages 9.7 inches annually. The mean temperature is 53.9°F with maximum summer temperatures exceeding 100°F The minimum winter temperature can fall below 0°F but commonly falls with the range of 20° to 40°F.

Most crop lands are irrigated in this arid area because of lack of natural precipitation, sandy soils and sporadic summer rainfall. The South Columbia Basin Irrigation District supplies surface water from the Columbia Basin Project west of the study area. This surface water source is available along the western margin of Smith Canyon but is not presently in use within the study area.

Within the study area irrigation water is withdrawn from wells. The regional water table in the general Pasco area, including Smith Canyon, has risen due to importation of surface water. In Smith Canyon wells have been drilled into the Pasco sands and gravels to extract ground water for irrigation, municipal, industrial, domestic and stockwater uses. In addition to ground water withdrawn from the gravel overburden a few wells have penetrated the Saddle Mountain basalts and pump ground water from the fractured basalt interflow zones. These basalt wells are commonly artesian with depth to water increasing from land surface with increasing well depth.

Hydrology

A general understanding of the recent geologic history of the Pasco Basin is important as it defines the hydrologic characteristics of the Smith Canyon area. A review of well logs within the study area indicates that all overburden wells penetrated Pasco sands and gravels. Basalt bedrock is encountered at varying depths. The sediments are thinnest at the canyon margins with wells intercepting bedrock at 70 feet or less from land surface. The wells drilled towards the center of the canyon penetrate 120 feet to 200 feet of overburden before hitting bedrock. The water table in the overburden has a southerly gradient of approximately 3 feet per mile from Eltopia to Sagemoor Falls.

The average production from a properly constructed overburden well is 1500 to 2000 gallons per minute. The coefficients of storage and transmissivity of the sand and gravel is very high. The drawdown from pumping is in the range of a few feet during the irrigation season. A typical well is 150 feet in depth with an early season static water level of 90 feet to 100 feet below land surface. The pump intake is set at the bottom of the screened portion of the well and the available drawdown is in the range of 30 to 50 feet. The recorded change in dynamic level in these overburden wells does not exceed 10 feet over the pumping season.

A few of the wells on the canyon margins have gone dry because of the decline of the regional water table. These wells were only 60 feet to 70 feet in depth with early season static water levels of approximately 40 feet. They were redrilled into the Saddle Mountain basalts to a depth of 650 feet to 1,000 feet. The basalt wells are capable of production capacities similar to the overburden wells with a lower storage coefficient and transmissivities. The basalt wells are artesian and the effects of pumping large quantities of ground water can be seen in monitoring wells far removed from the pumped well. There does not appear to be a seasonal decline in the basalt aquifer system and all wells presently monitored return to their pre-irrigation static water levels prior to the next irrigation season. The static water levels in these basalt wells are somewhat deeper than the overburden wells and are considered to be hydraulically separated from the water table wells by intervening layers of a dense basalt aquitard. However, there is an unquantified vertical leakage from the overburden which produces some recharge for these basalt aquifers.

History of Irrigation Developement

Prior to the issuance of the first irrigation permits in 1974, the land in the canyon was utilized for range land.

The first overburden well was drilled early in 1974 and by 1985 there were 5500 acres under irrigation within the study area. The primary source of water for this irrigation is the Pasco sand and gravel aquifer.

The first wells were drilled on the Eastern margin of the Canyon and were less than 70 feet in depth. As developement progressed and wells were drilled into the thicker sediments in the center of the Canyon these shallower wells along the eastern margin began to experience pumping interference to the extent that they could not sustain the required production towards the end of the irrigation season. Eventually, the regional water table dropped below the completed depth in these wells, and as previously stated, they were then drilled and completed into the basalt.

Figure 1 is a graph of the annual development of irrigated lands withdrawing ground water from the shallow water table aquifer from 1974 to closure of the area to further shallow aquifer withdrawals in 1985. Figure 1 also shows a hydrograph of a well located in 11/31-31B and is typical of most of the overburden wells and shows a fairly stable water table until late 1984 at which time very distinct water level declines were first noted. As a result of these declines, The Department of Ecology issued regulatory Orders in the fall of 1987 to 25% of the Junior appropriators to cease withdrawal of ground water during the 1988 irrigation season. However, through negotiations with the parties involved a voluntary regulation program was set up and will continue through the 1991 irrigation season. Withdrawal was reduced by 17 to 20 percent each irrigation season resulting in a reduced rate of declines. It is not likely that the additional 600 acres issued in 1984 could have caused these declines and there is, in all probability, a second factor contributing to the declining water table.

It is interesting to compare the regional water level changes in Esquatzel Coulee, located adjacent to and west of Smith Canyon, to hydrographs of the regional water table in Smith Canyon from early 1974 to 1990.

Hydrograph #32 shows the trend in surface water flows in Esquatzel Coulee as measured at the United States Geological Survey gauge located in Section 8, Township. 10 N., Range 30 E.W.M. Hydrographs 27, 28, 30 and 31 are of monitoring wells operated by the United States Bureau of Reclamation near the town of Eltopia. These wells monitor the ground water table associated with the Esquatzel Coulee drainage. Hydrograph #12 is of the typical overburden irrigation well previously mentioned in

11/31-31B. Note the similarity in the four hydrographs. This similarity can be explained, in part, by the fact that the regional water table of Esquatzel Coulee is at a higher elevation than the water table in Smith Canyon. It is thought that ground water flows through a sediment filled gap in the basalts at Eltopia and follows the southerly gradient of Smith Canyon to its confluence with the Columbia River.

Further evidence of this ground water interconnection between Esquatzel and Smith Canyon Coulees can be seen in four observation wells at the head of Smith Canyon east of Eltopia. Hydrographs 25 and 26 are from the center most wells of these four observation wells. These wells are far removed from the pumping center in the study area but still display the same decline trends as Esquatzel Coulee and the study area.

Apparently this interconnection between Coulees exists. It follows then that reduced Columbia Basin Irrigation Project return flows with corresponding water table declines in Esquatzel Coulee will affect recharge to Smith Canyon. This will reduce the availability of ground water below what is needed to sustain the present irrigation development.

The natural recharge area for the Pasco sands and gravels in Smith Canyon is about 30,000 acres. Using a annual recharge of 1"/year this would equal a recharge from perception (PRECIPITATION) equal to 2500 acre feet per year. Present pumping may be as high as 15,000 acre feet per year leaving a net shortage of 12,500 acre feet per year. This would result in a decline of approximately 17" per year in the Pasco sands and gravels aquifer in Smith Canyon. These declines are mitigated by the recharge received from the Columbia Basin Irrigation Project via Esquatzel Coulee. If it were not for this external source there would only be enough water in the Pasco sands and gravels aquifer in Smith Canyon to irrigate approximately 1000 to 1200 acres.

In any extent, a combination of ground water withdrawals and reduced recharge to Smith Canyon has resulted in drastic declines of the Smith Canyon regional water table. These declines have rendered shallow wells inoperative, and if allowed to continue, will adversely affect additional wells.

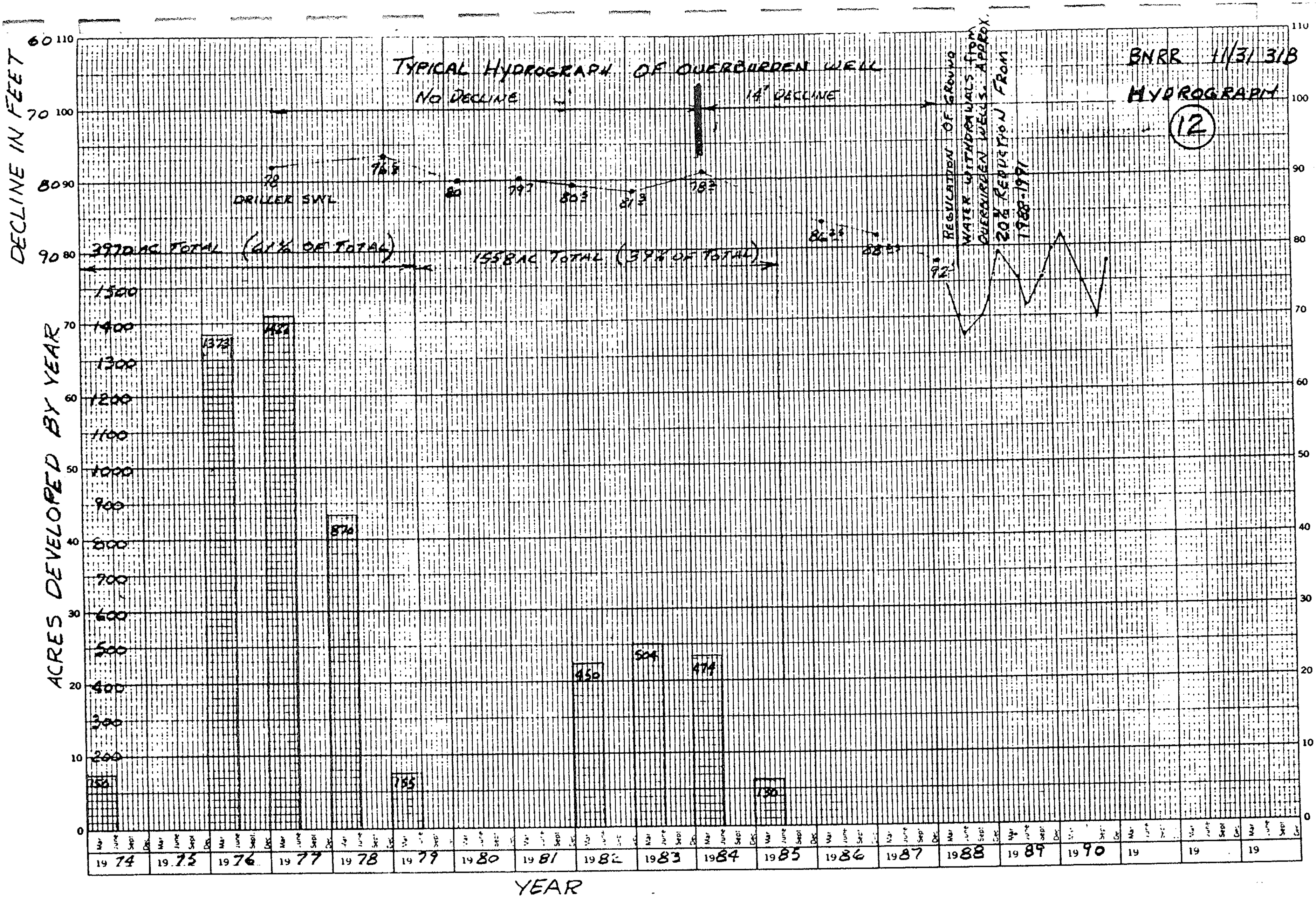

Figure 1: Typical hydrograph of overburden well and acres developed by year.

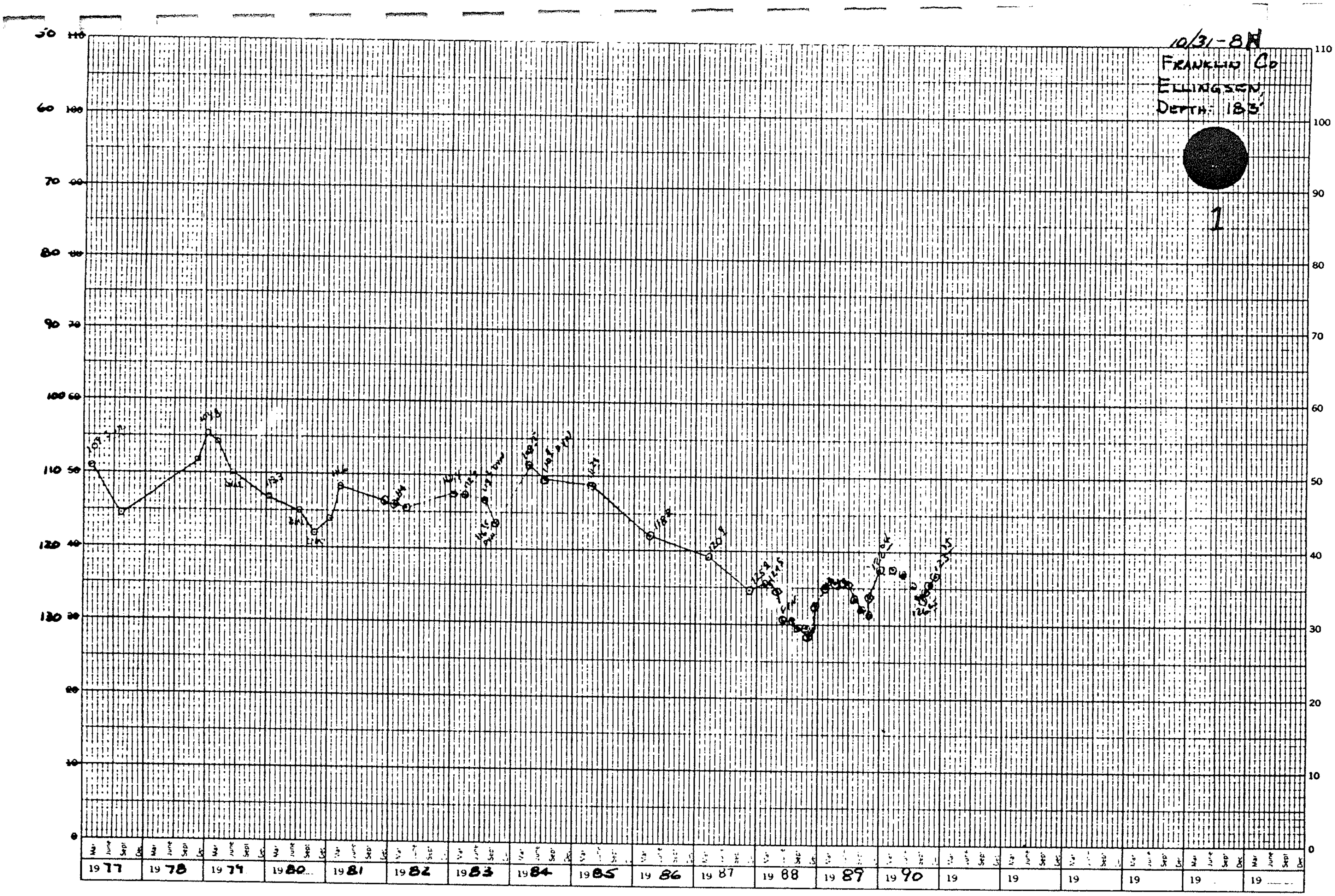

Figure 2: Hydrograph of Ellingsen well #1 - depth 183.0'

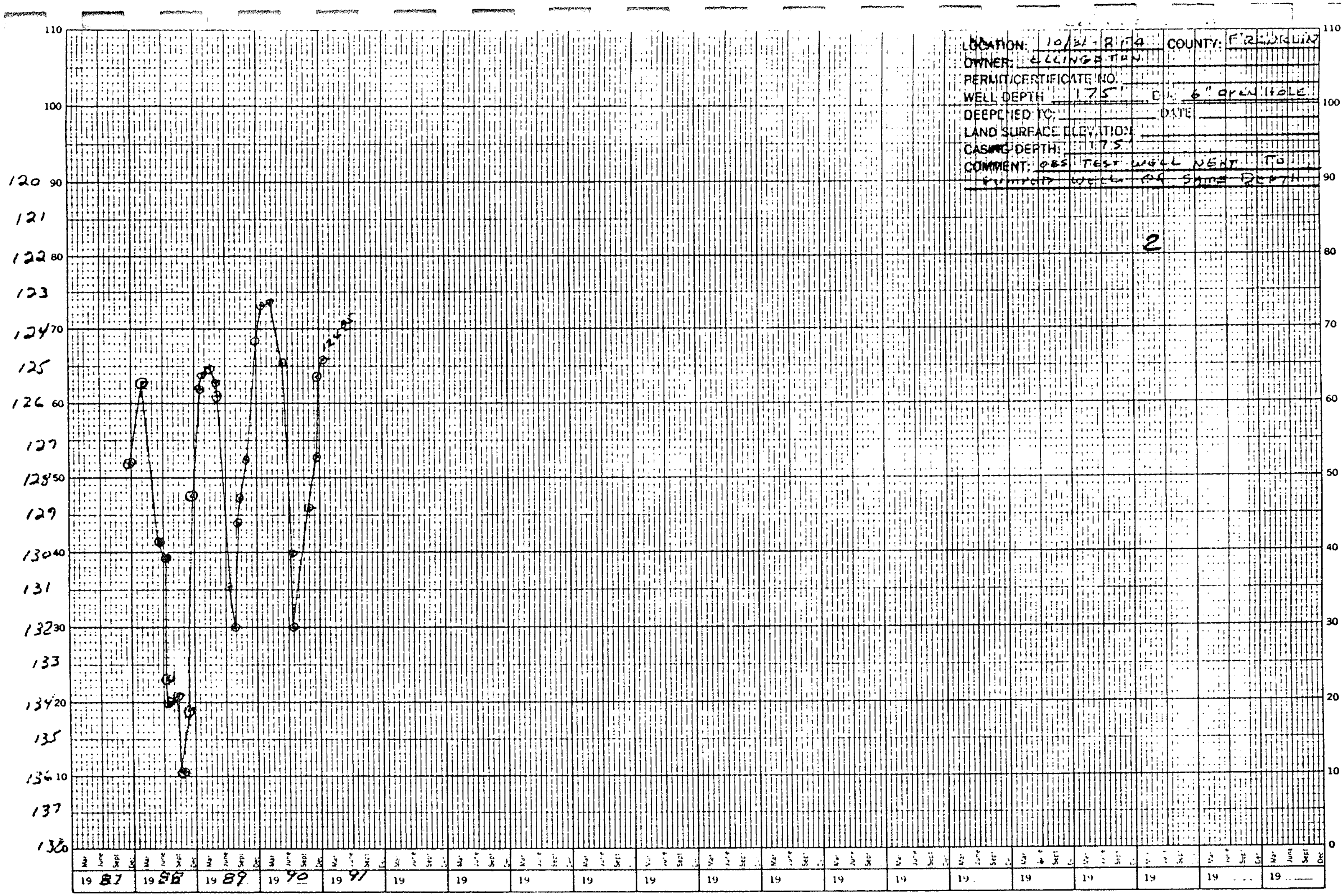

Figure 3: Hydrograph of Ellingsen well #2 - depth 175.0'

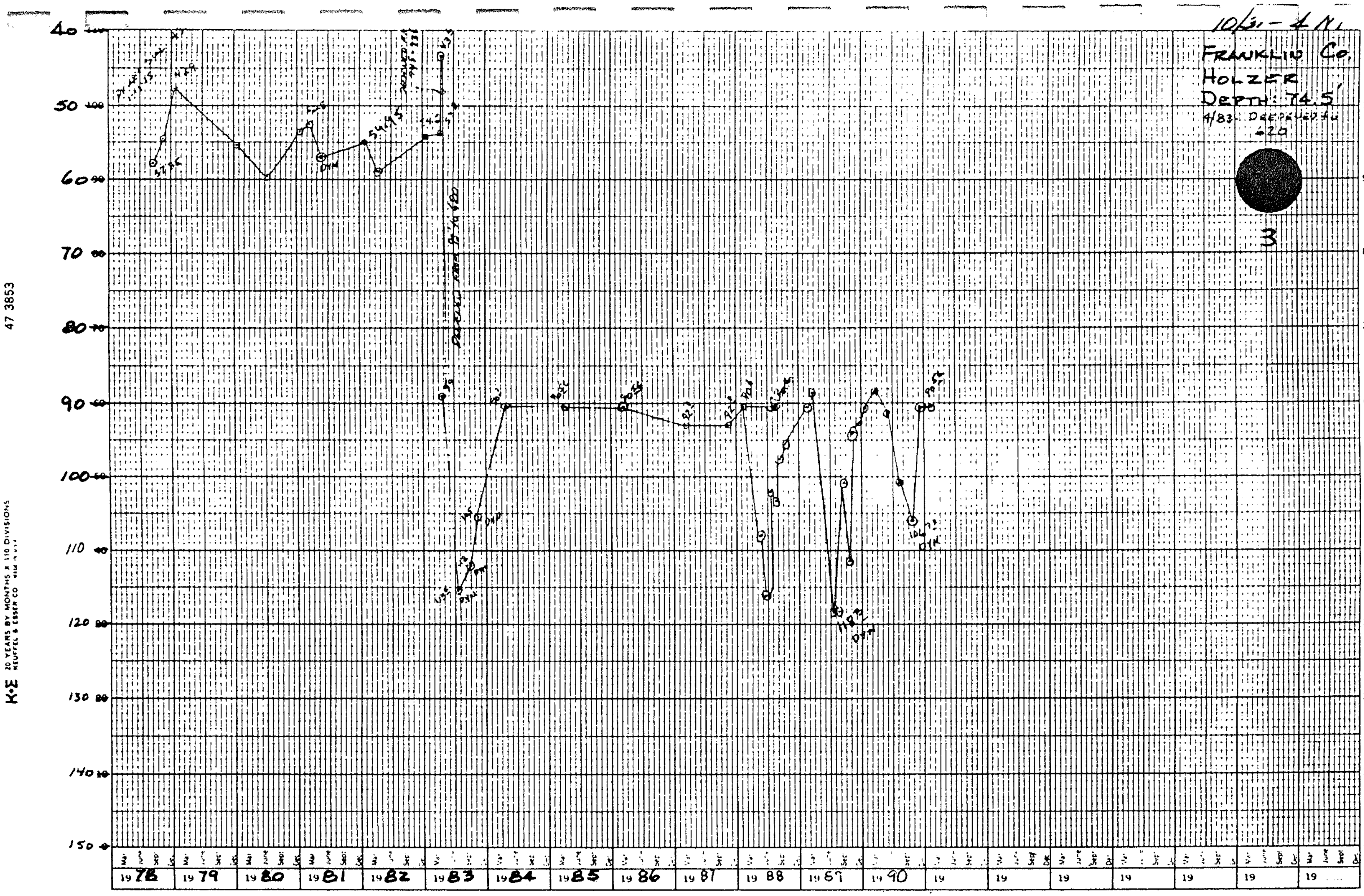

Figure 4: Hydrograph of Holzer well #3 - depth 74.5' and redrilled to a depth of 620.0' in 1983

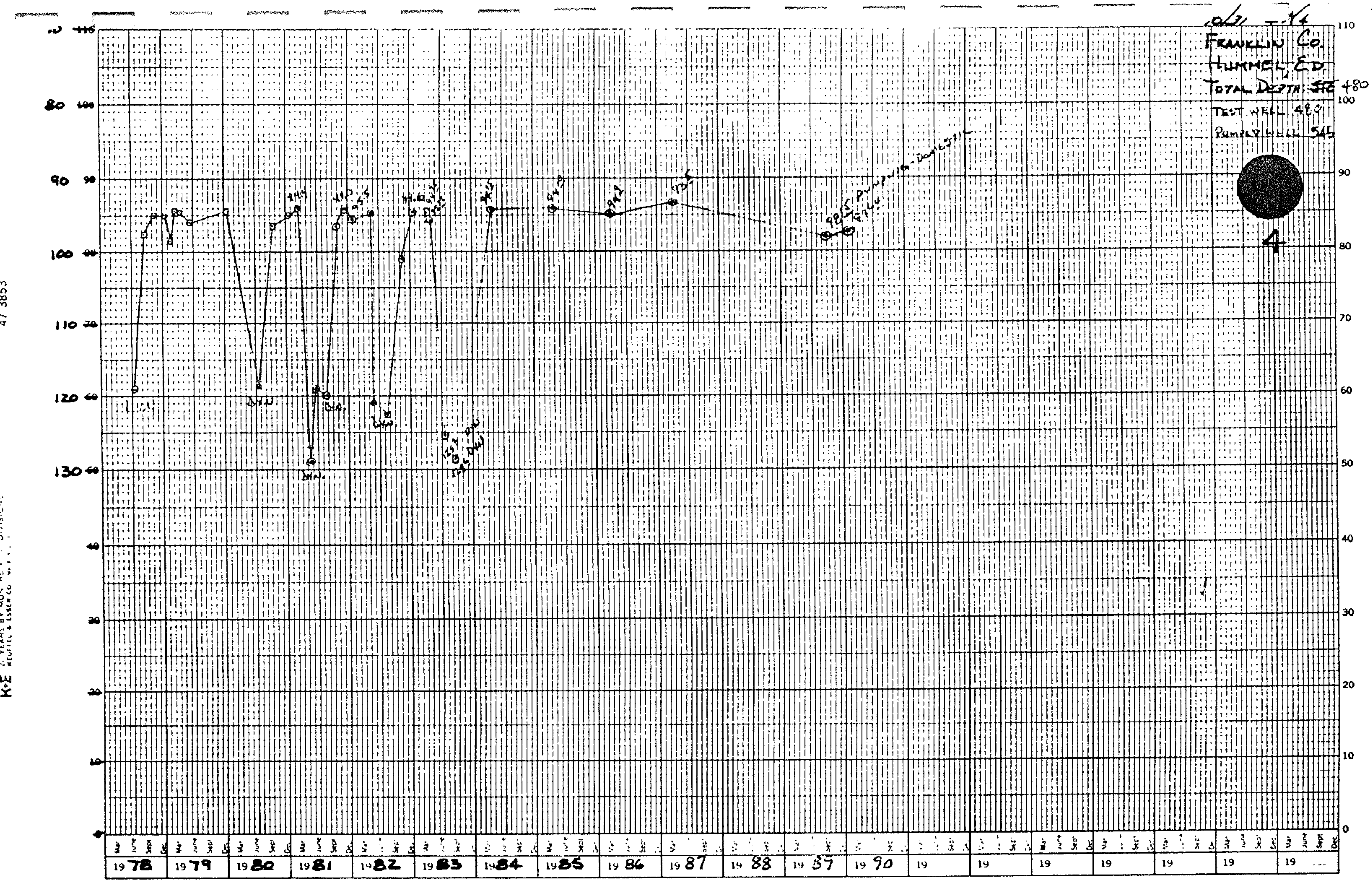

Figure 5: Hydrograph of Ed Hummel well #4 - depth 545.0'

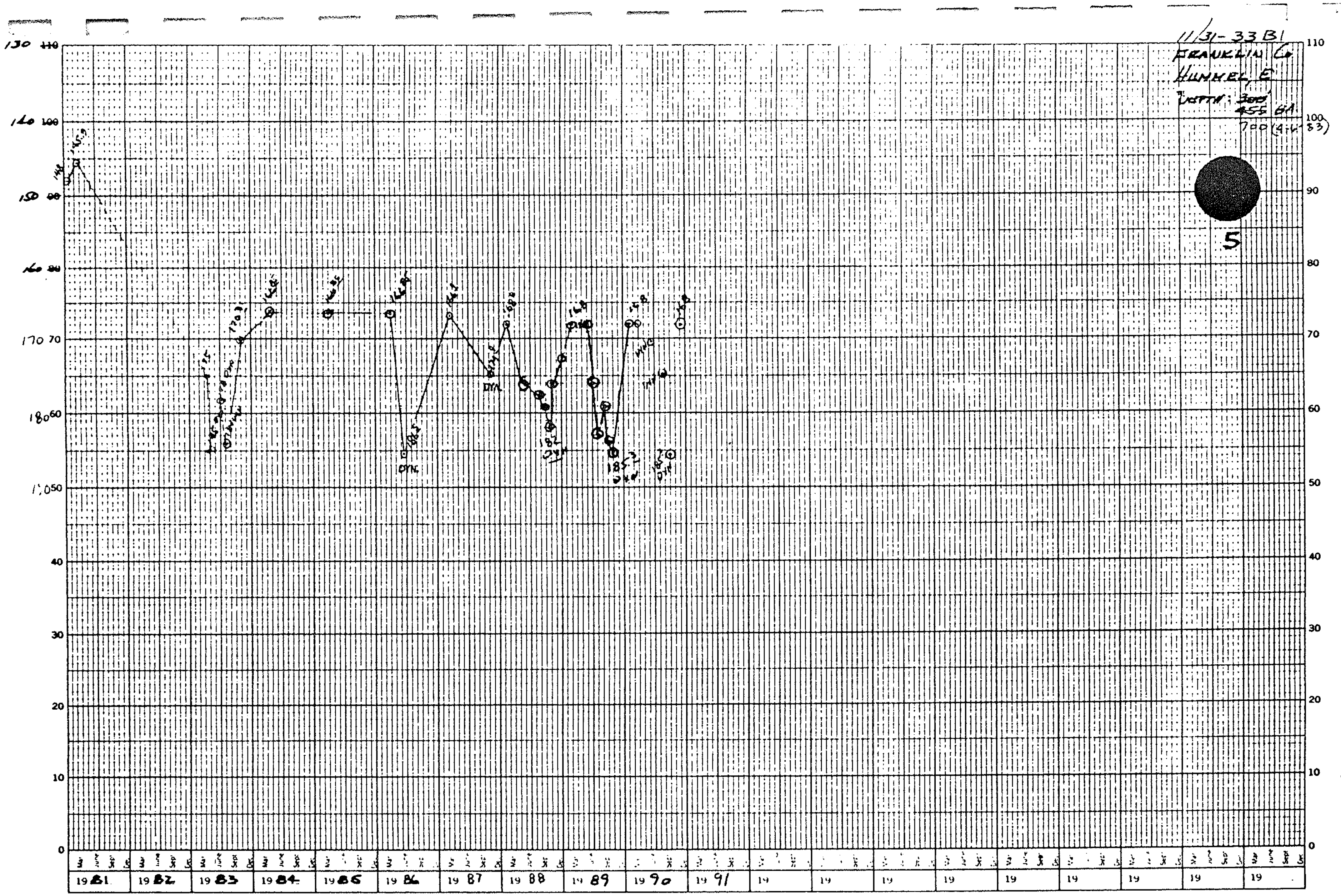

Figure 6: Hydrograph of Ed Hummel well #5 - depth 700.0'

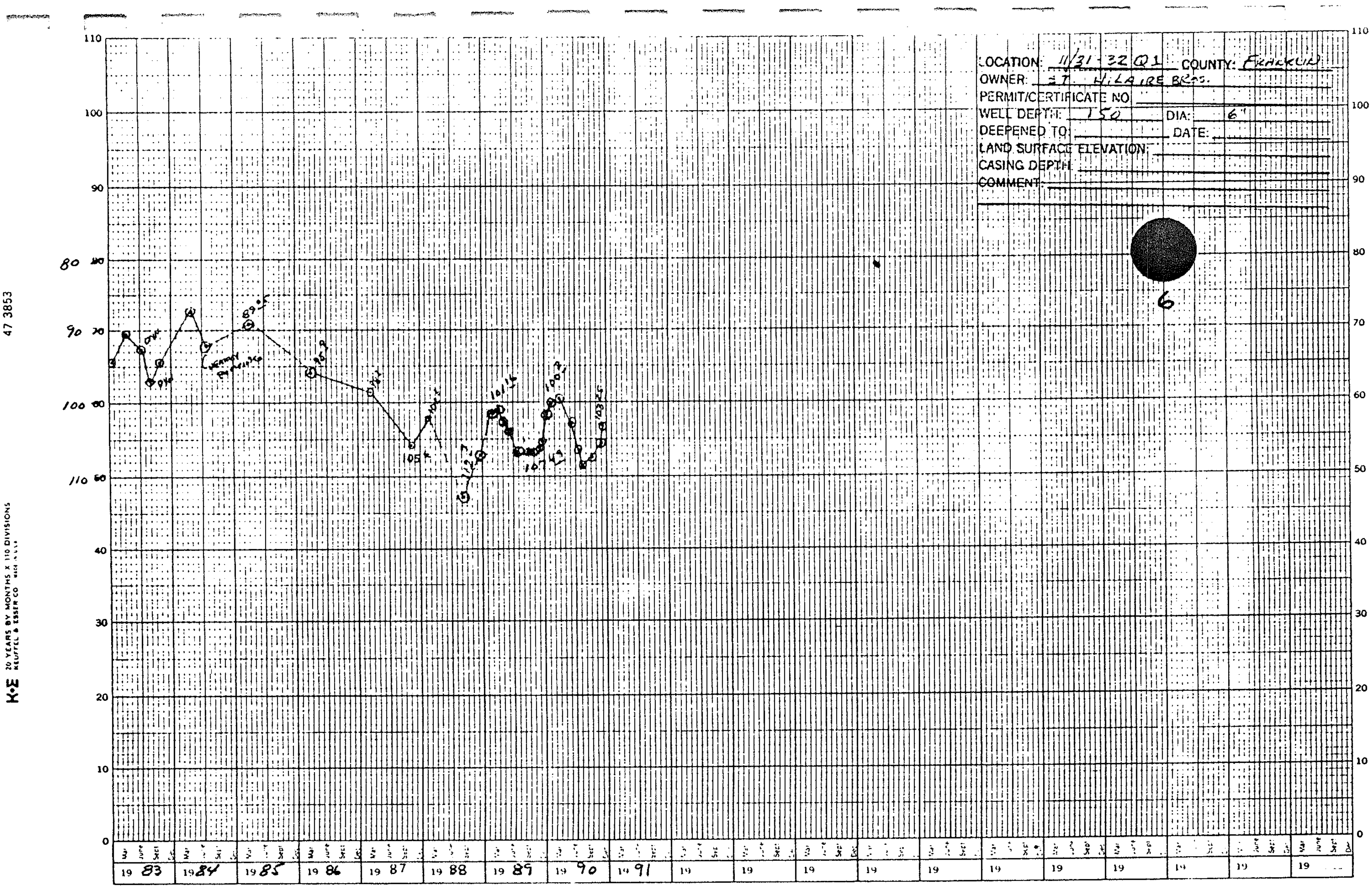

Figure 7: Hydrograph of St. Hilaire well #6 - depth 150.0'

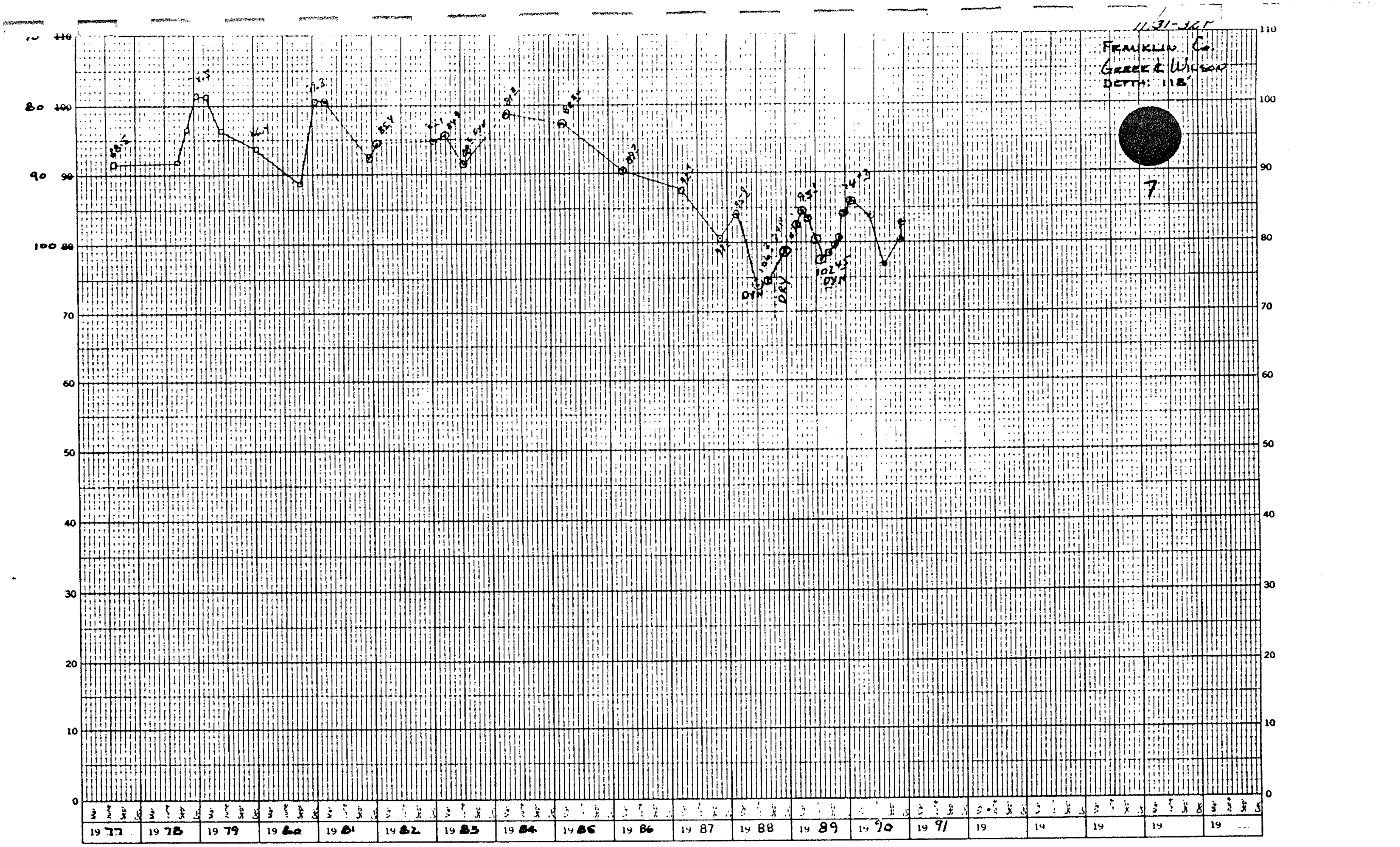

Figure 8: Hydrograph of Greer & Wilson well #7 - depth 150.0'

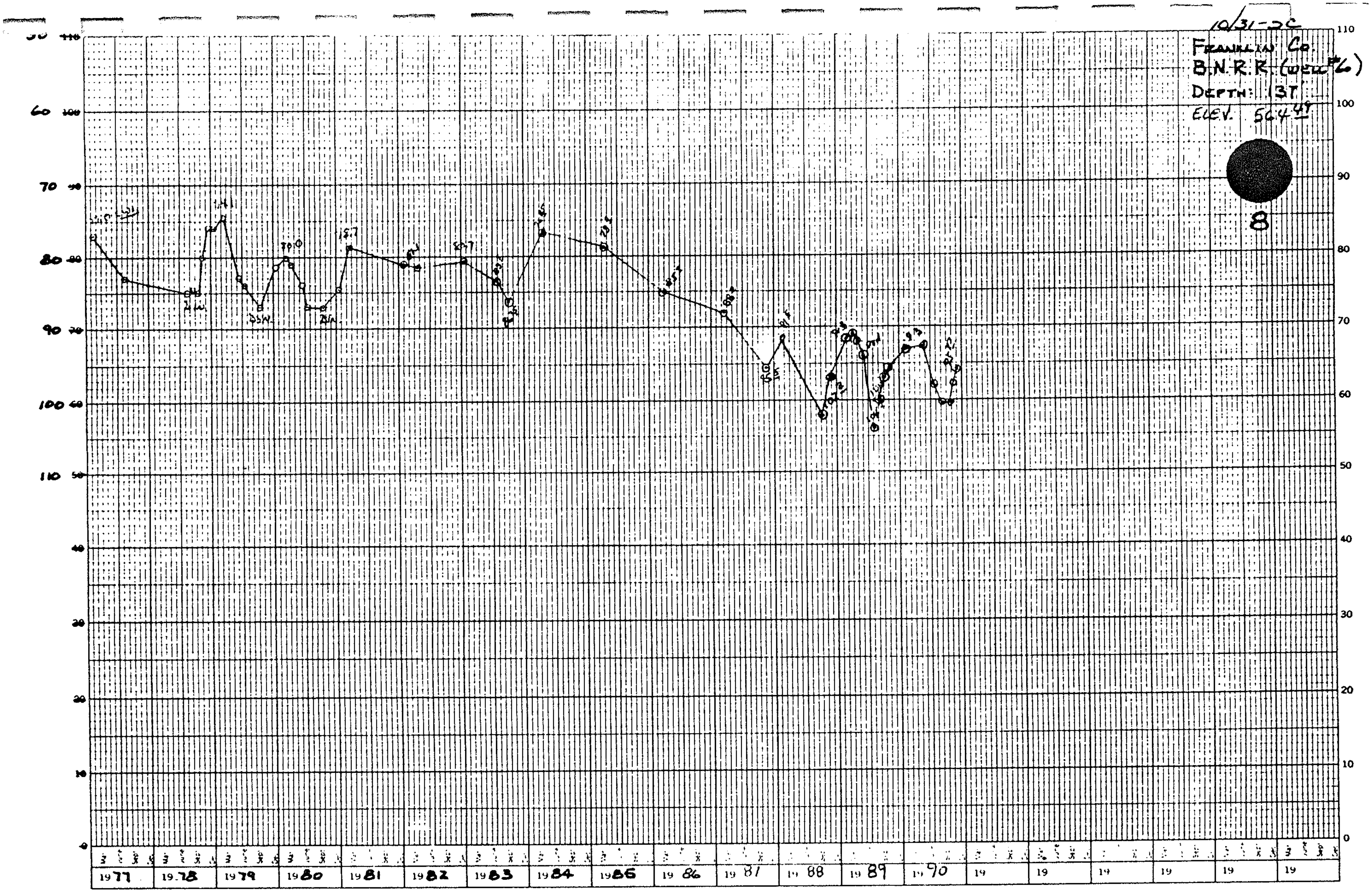

Figure 9: Hydrograph of Burlington Northern Railroad well #8 - depth 137.0'

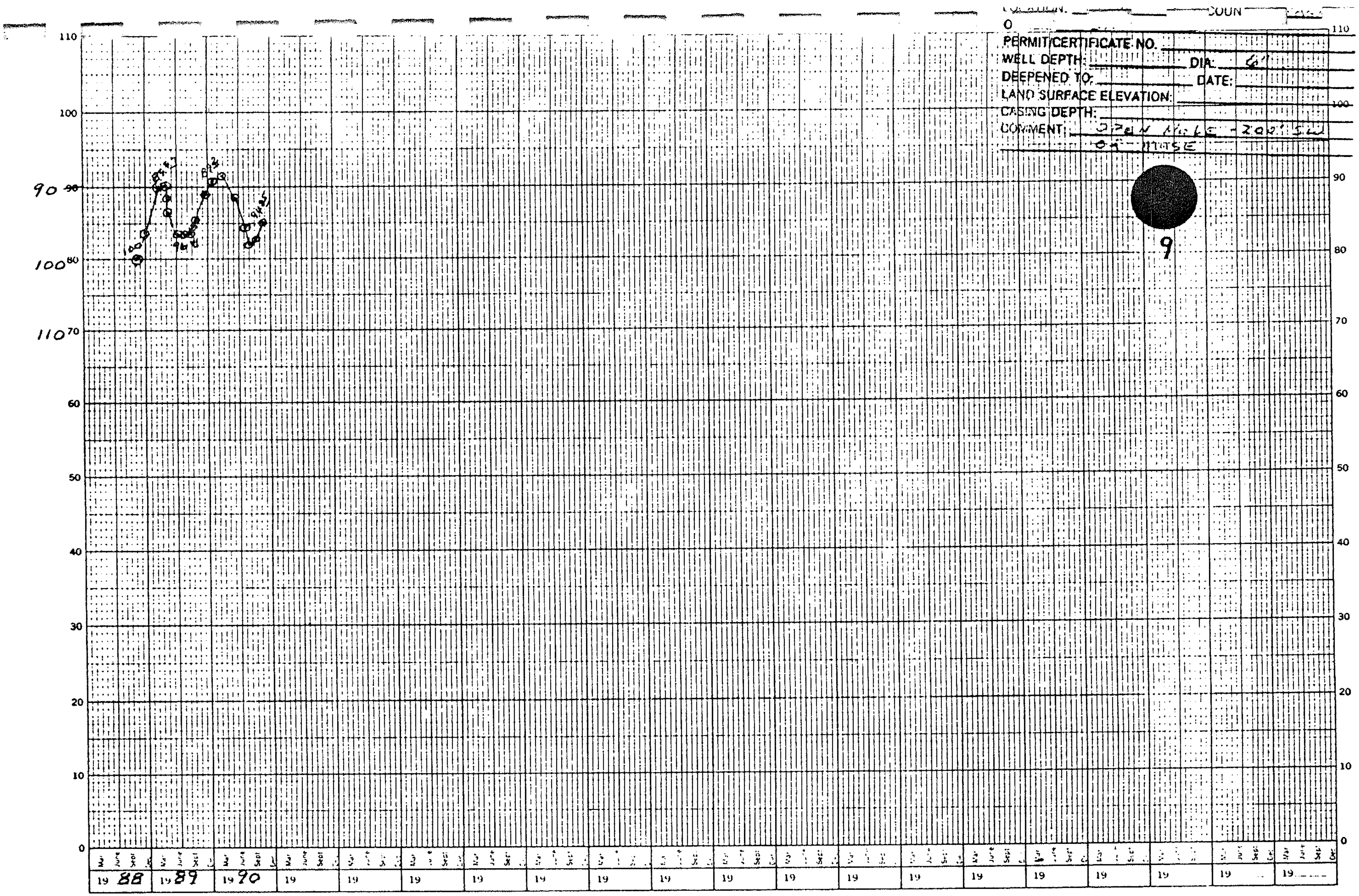

Figure 10: Hydrograph of Burlington Northern well #9 - depth unknown

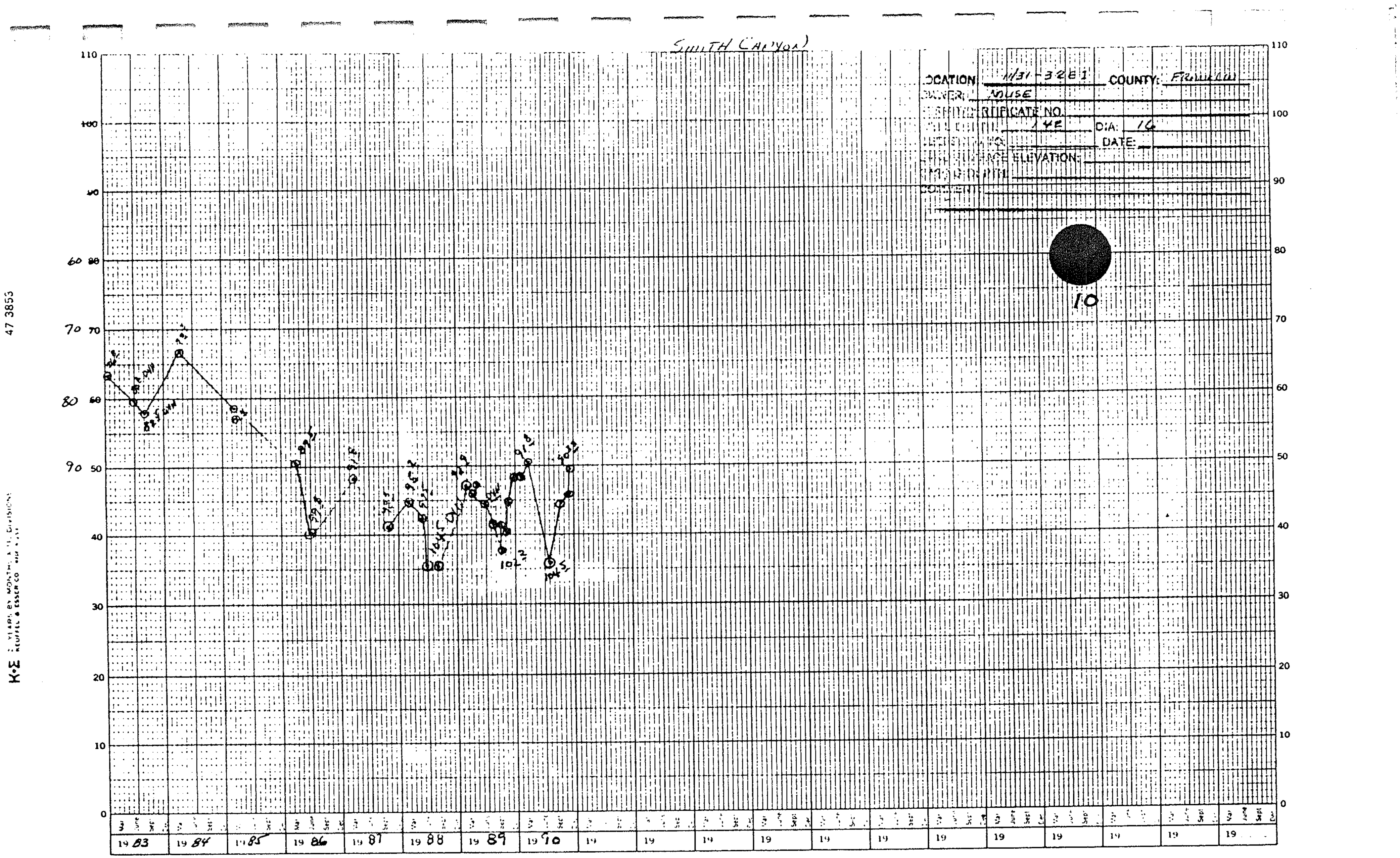

Figure 11: Hydrograph of Muse well #10 - depth 142.0'

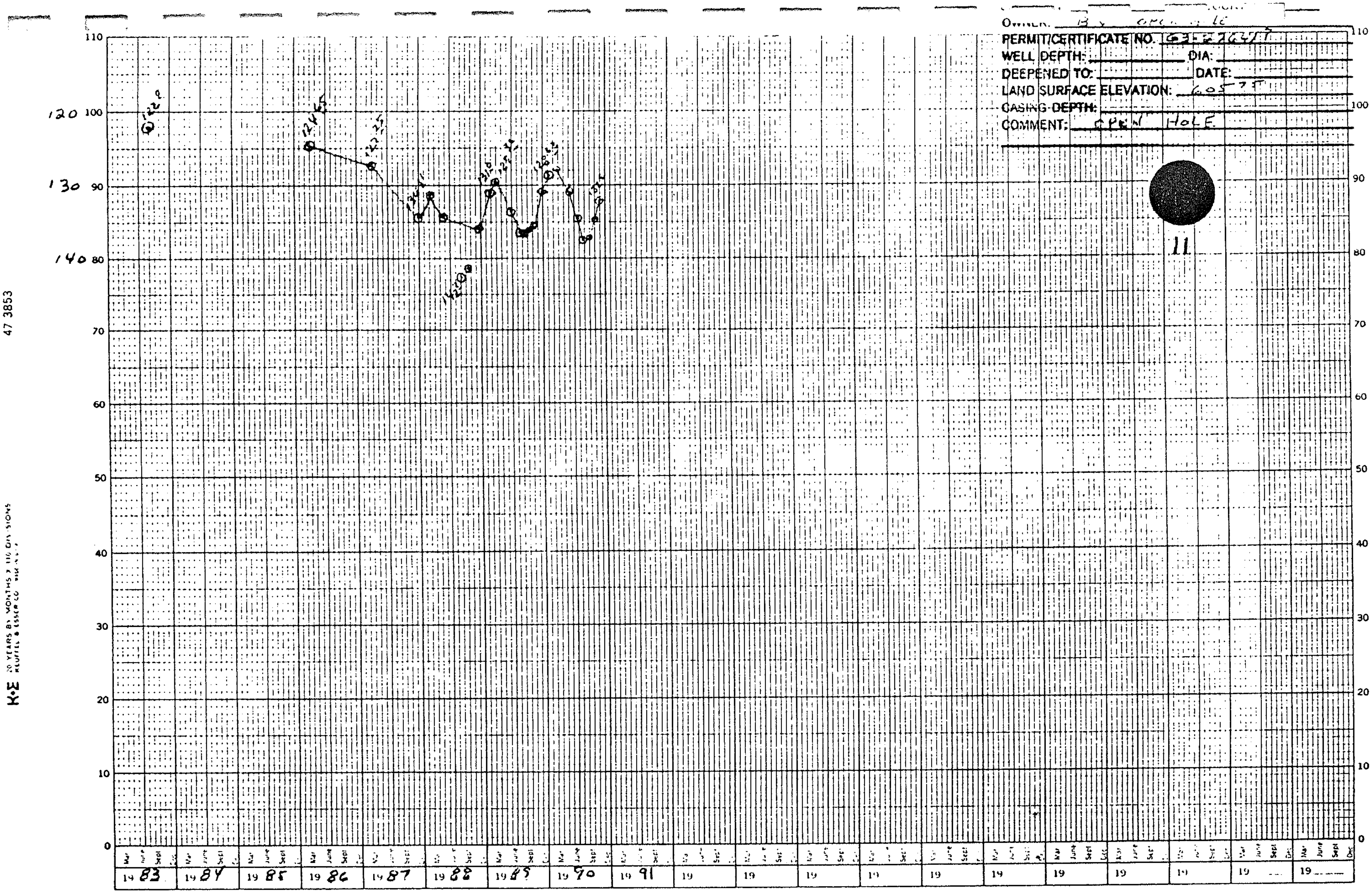

Figure 12: Hydrograph of Burlington Northern well #11 - depth unknown

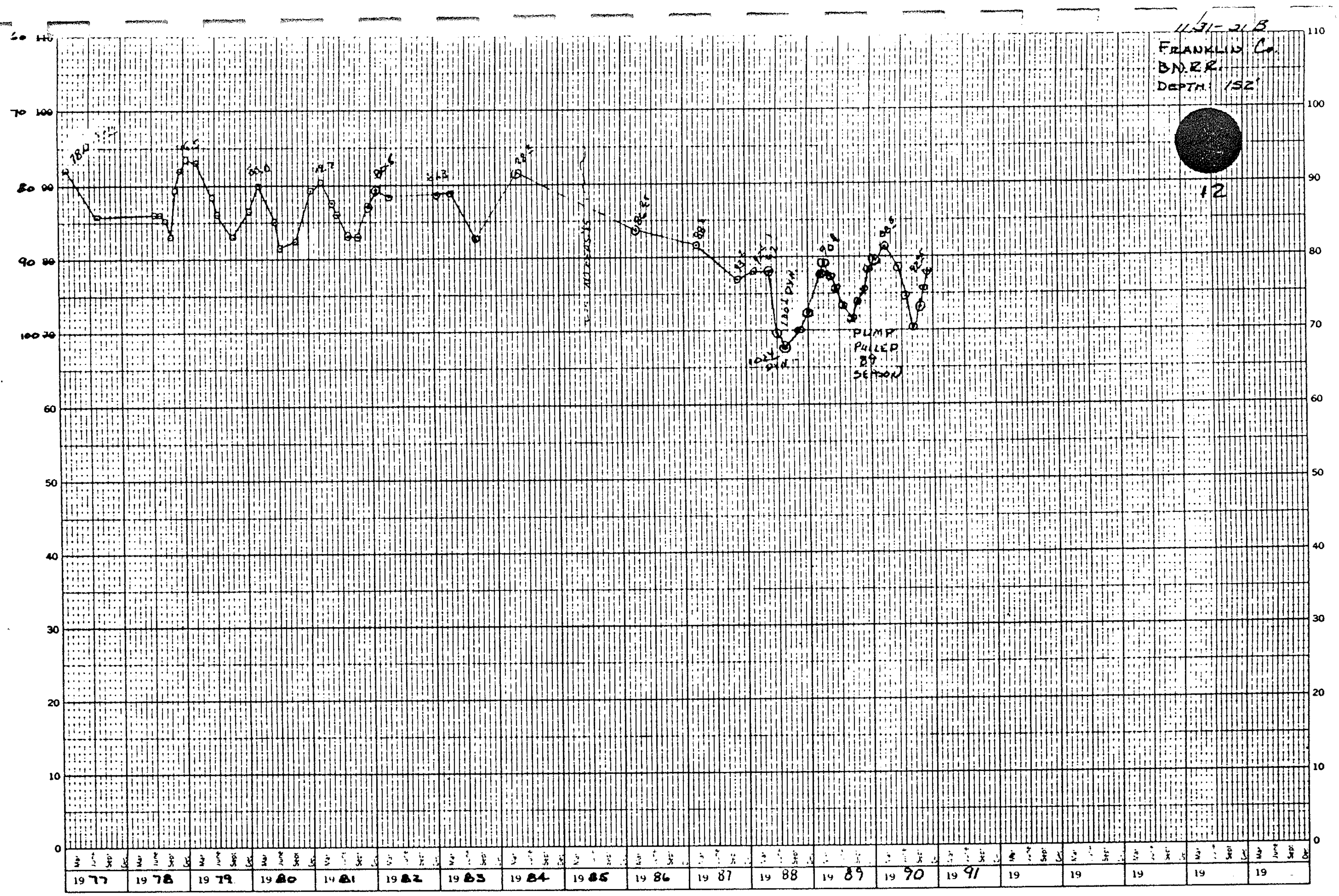

Figure 13: Hydrograph of Burlington Northern Railroad well #12 - depth 152.0'

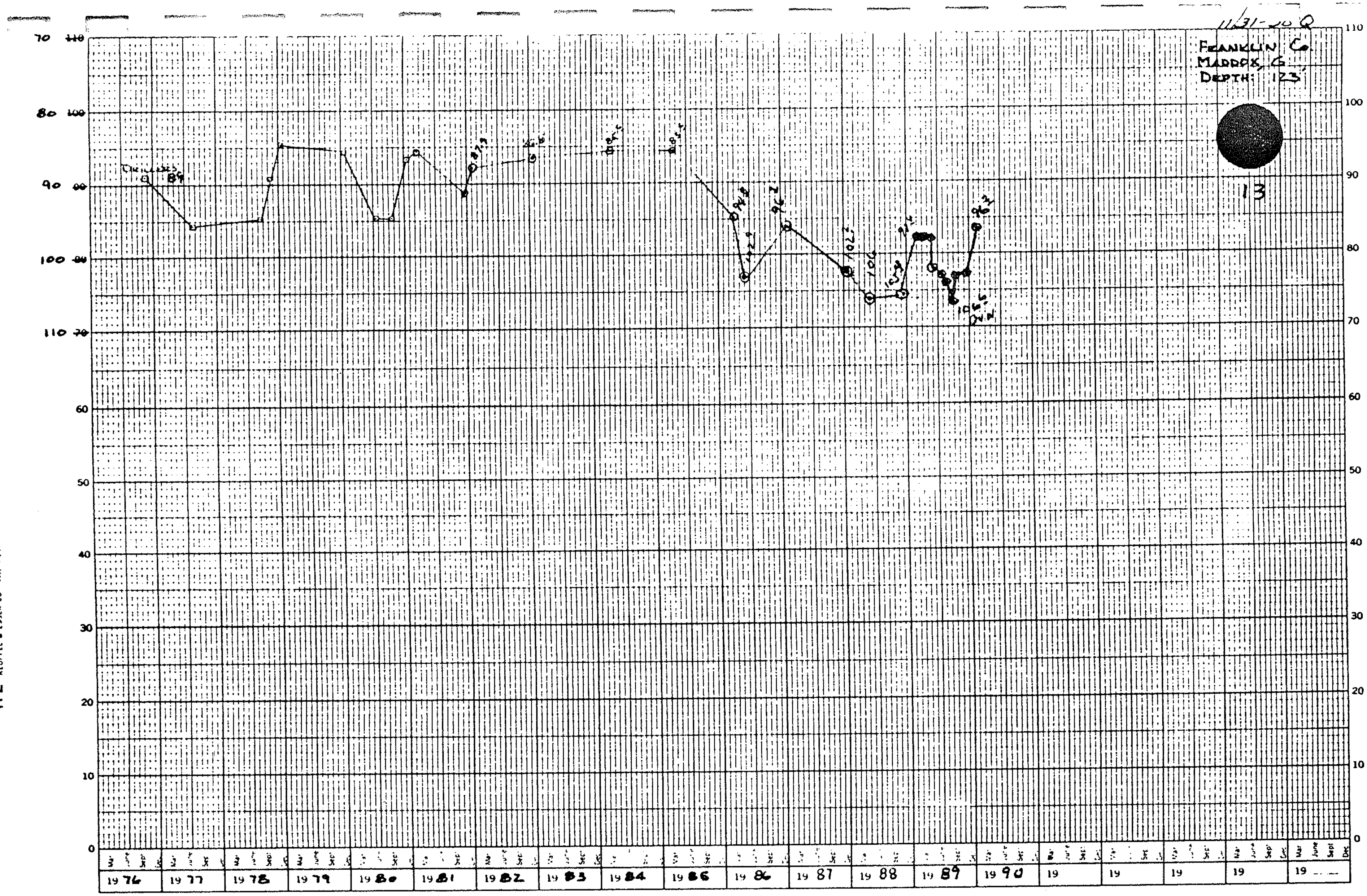

Figure 14: Hydrograph of G. Maddox well #13 - depth 123.0'

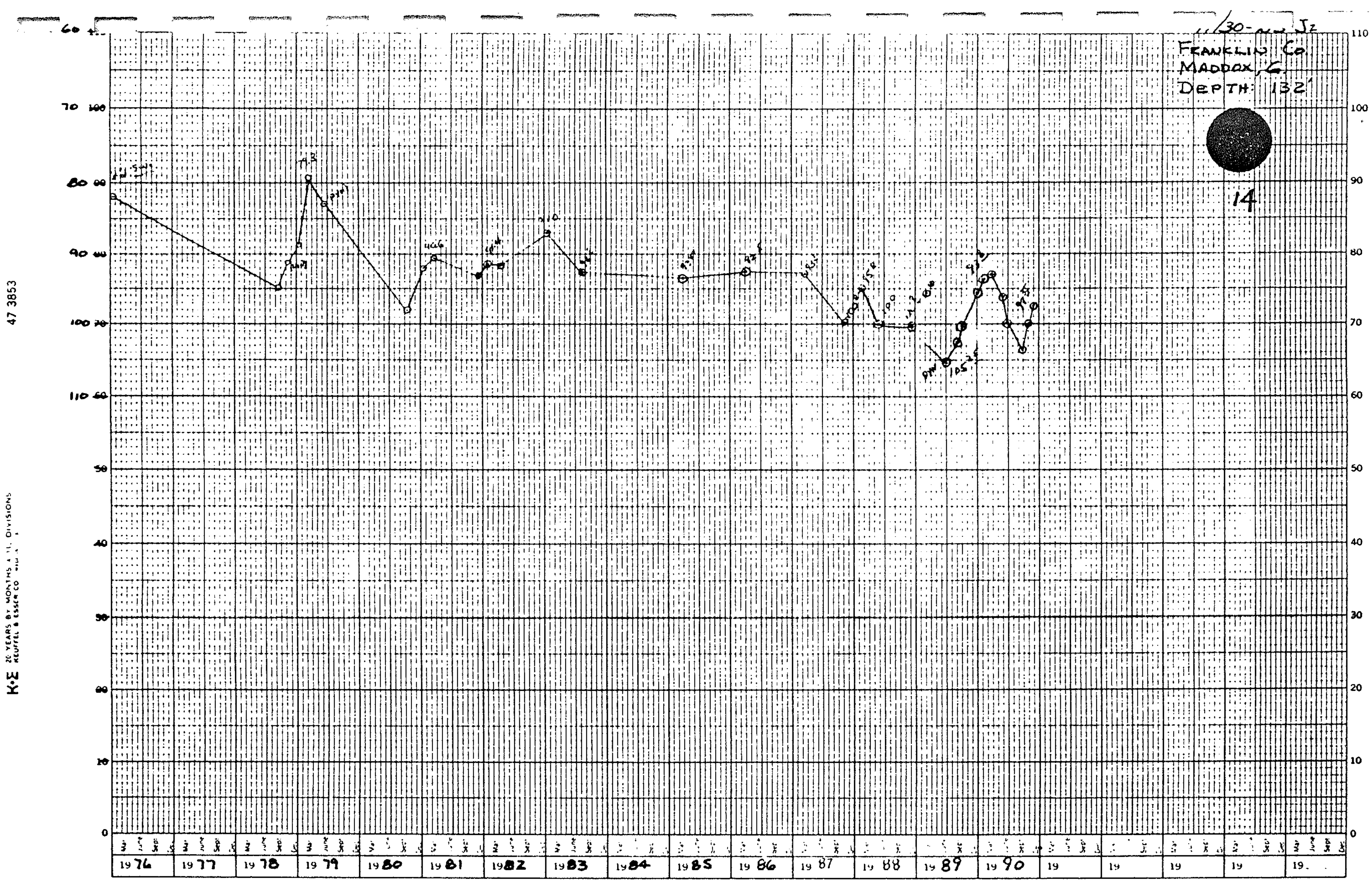

Figure 15: Hydrograph of G. Maddox well #14 - depth 132.0'

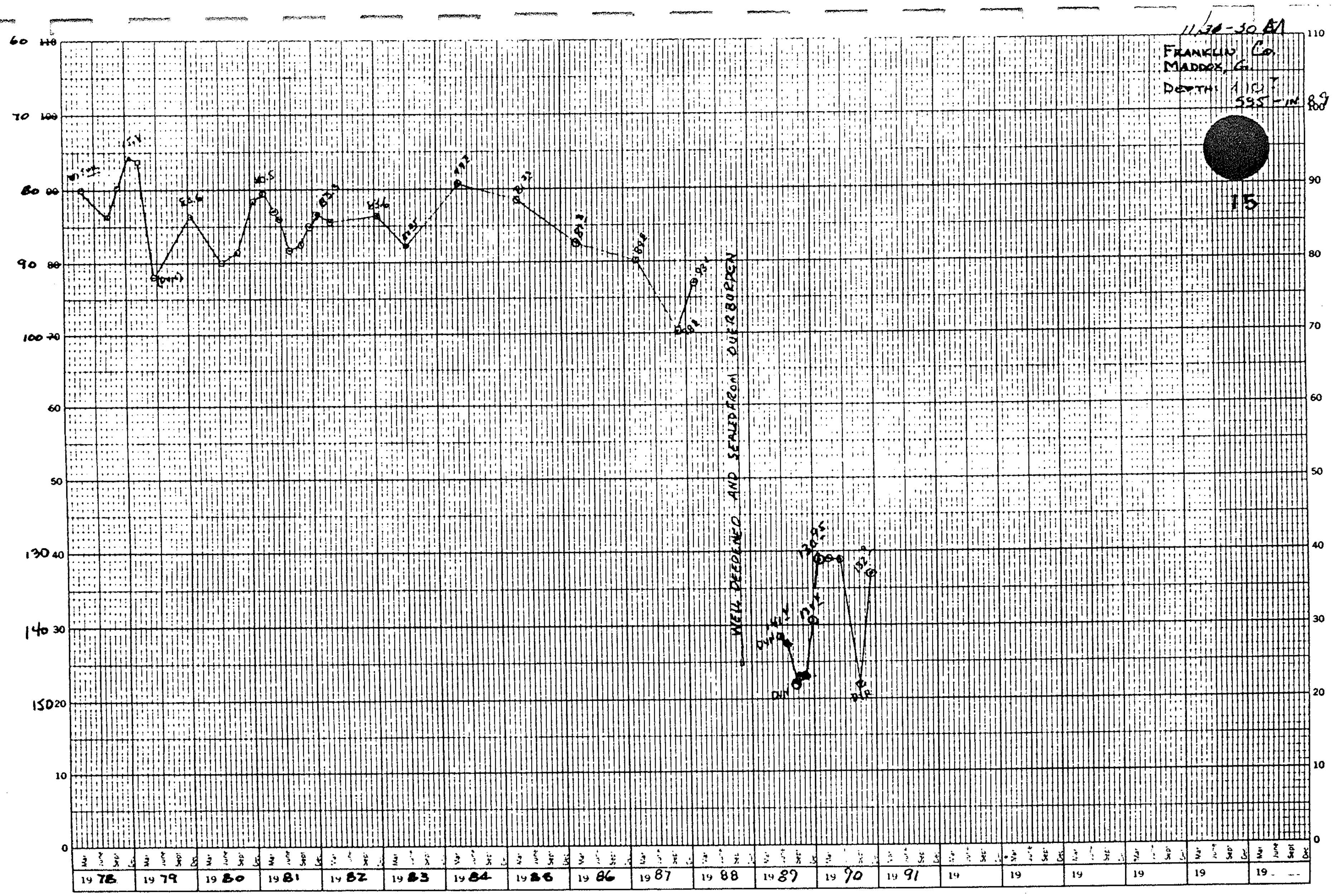

Figure 16: Hydrograph of G. Maddox well #15 - depth 410.0'

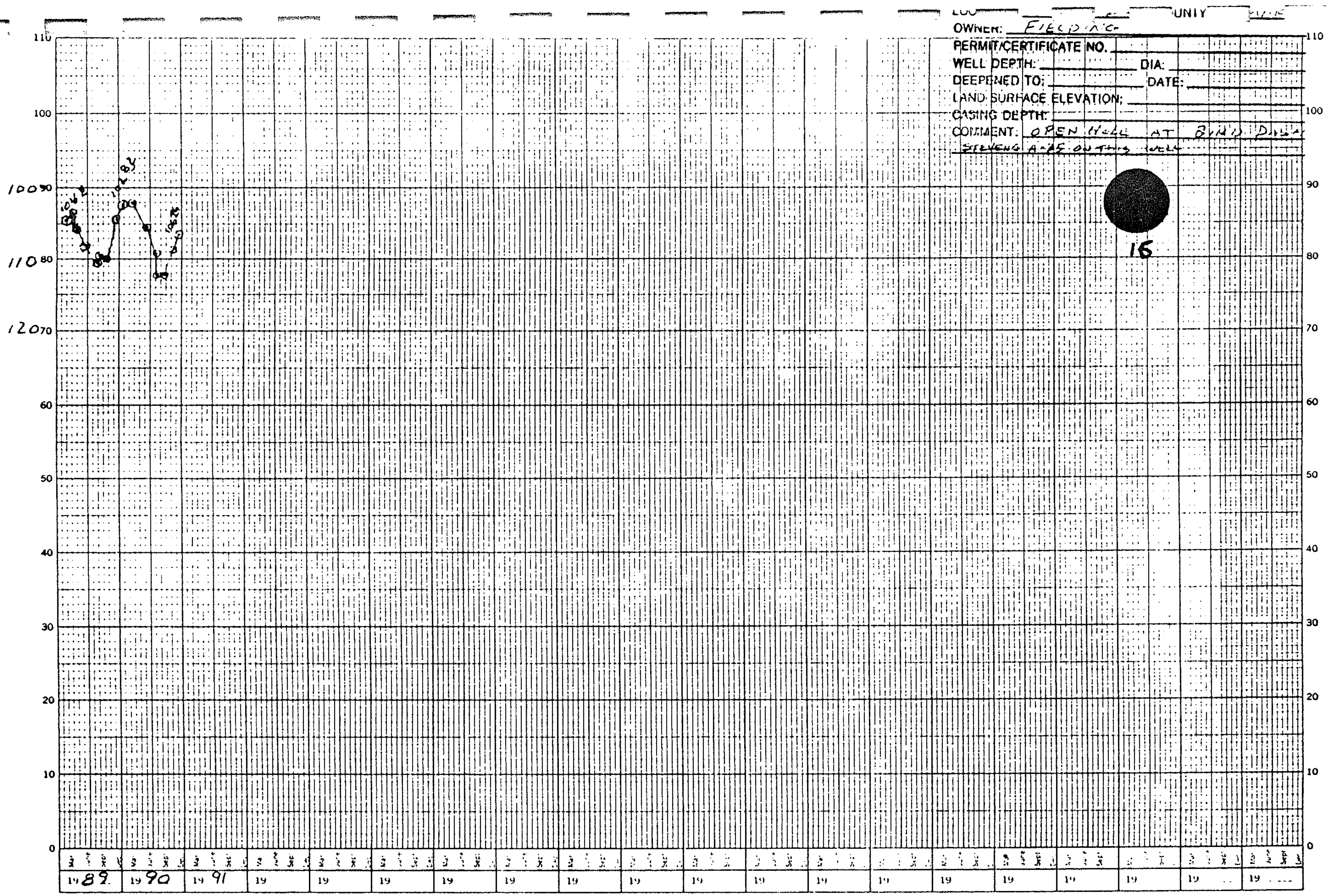

Figure 17: Hydrograph of Fielding well #16 - depth unknown

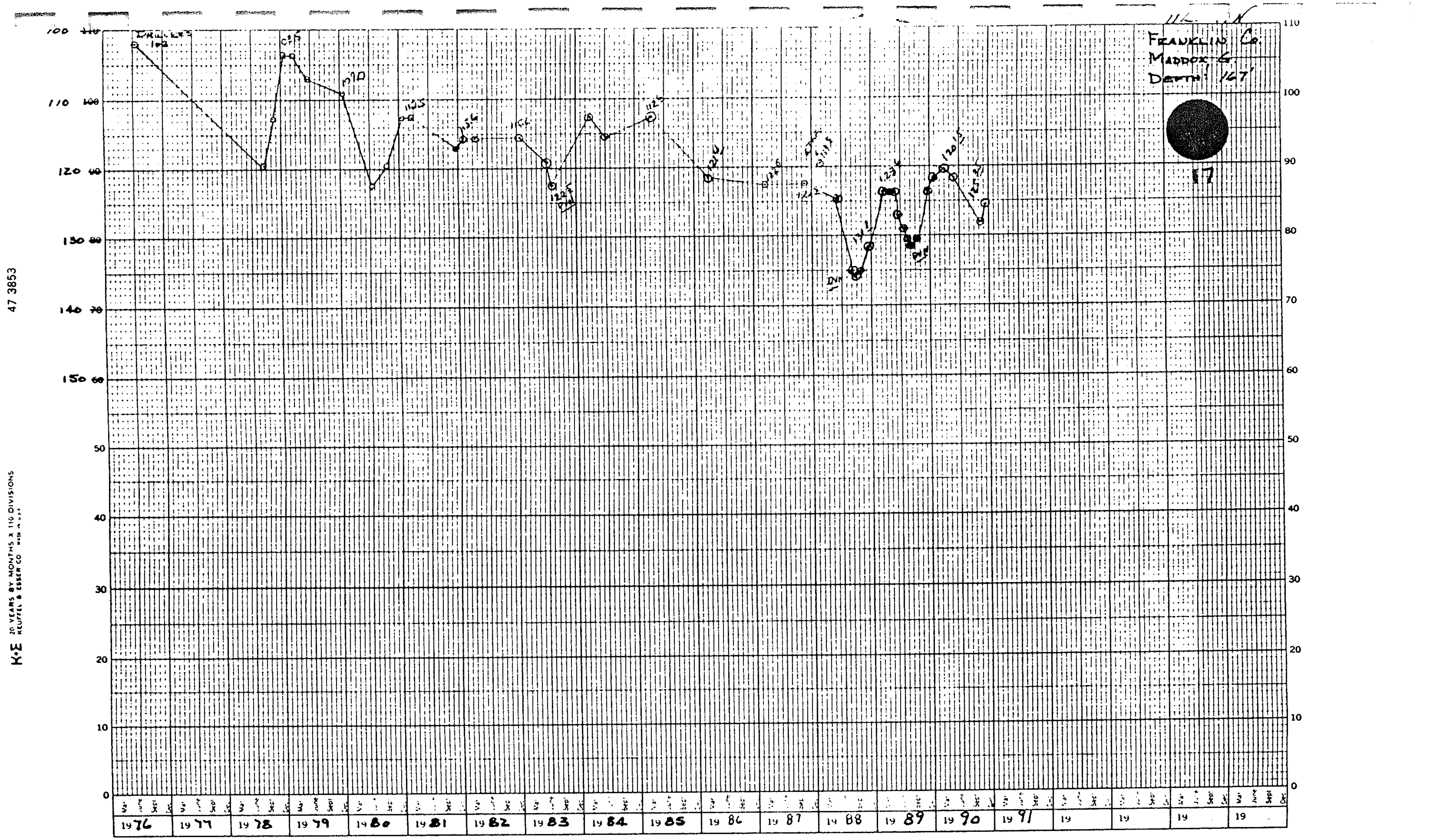

Figure 18: Hydrograph of G. Maddox well #17 - depth 167.0'

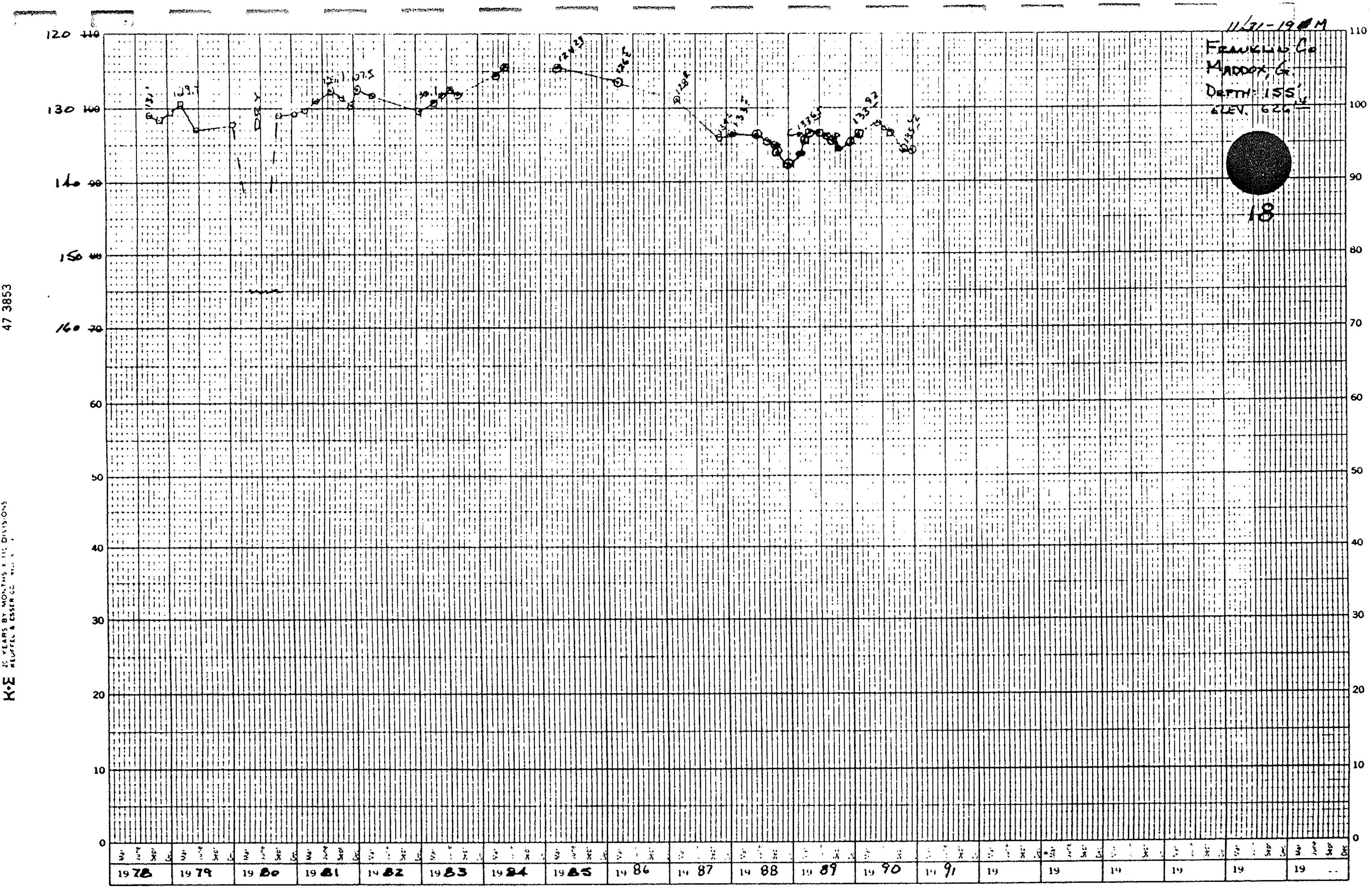

Figure 19: Hydrograph of G. Maddox well #18 - depth 155.0'

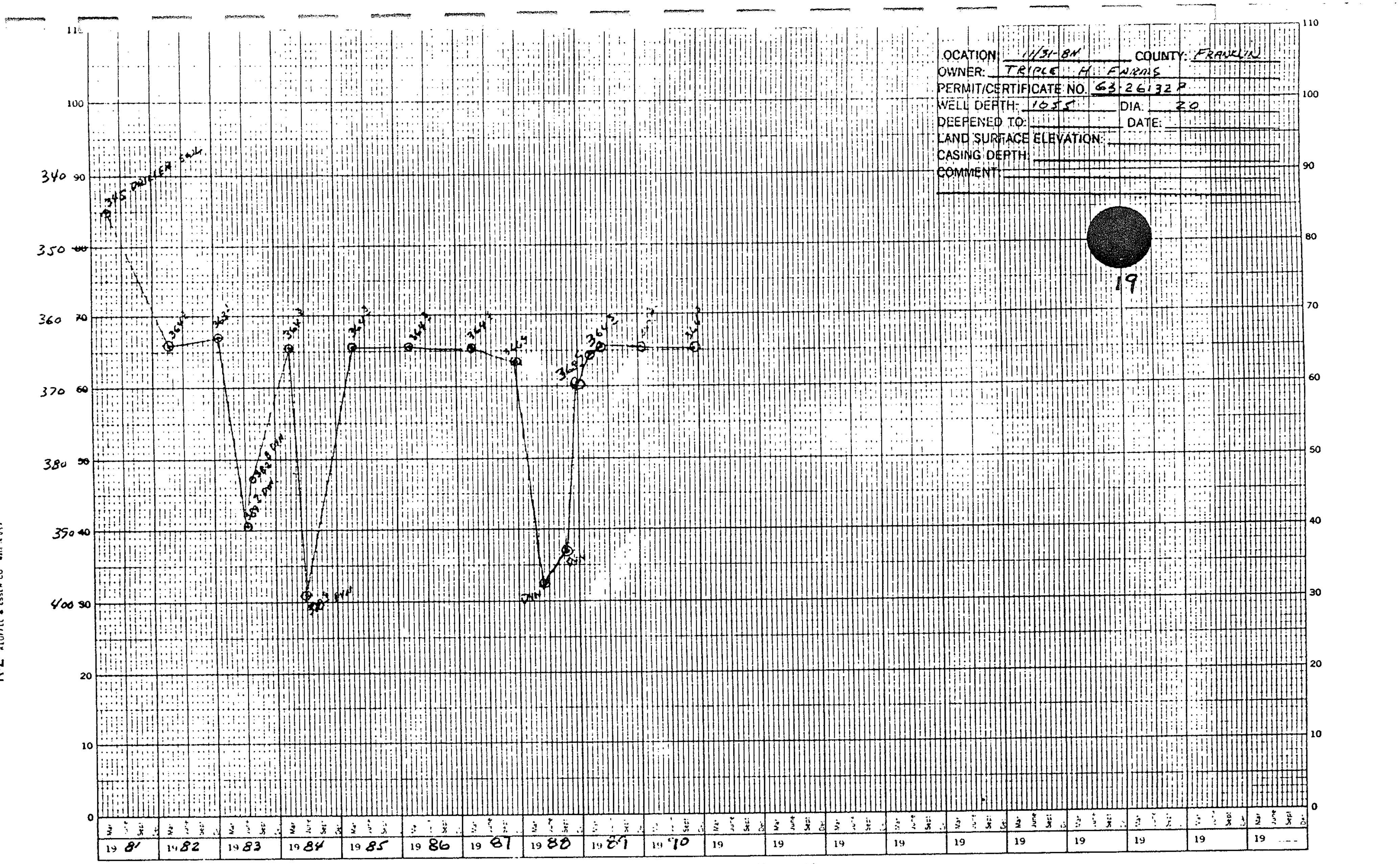

Figure 20: Hydrograph of Triple H Farms well #19 - depth 1055.0'

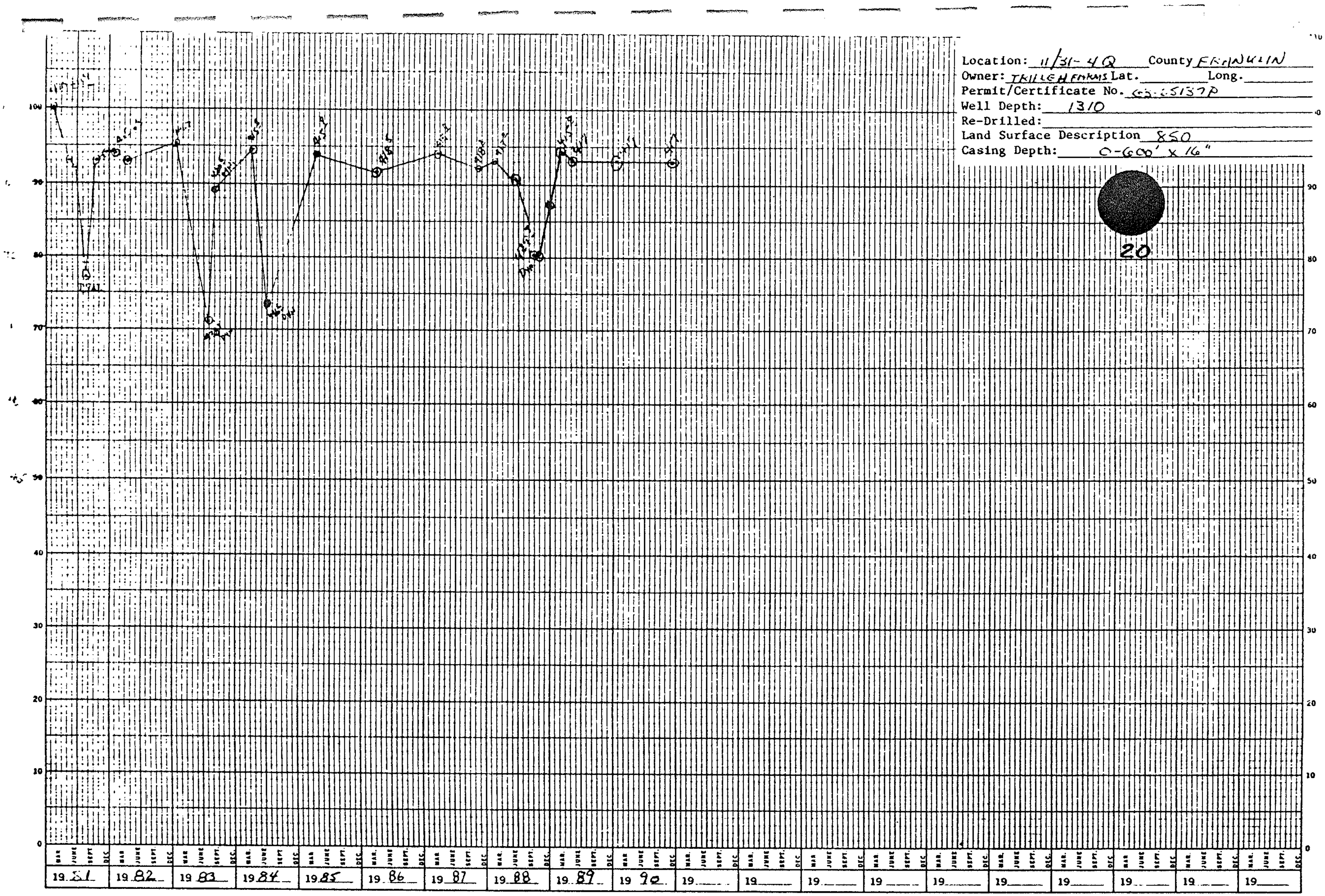

Figure 21: Hydrograph of Triple H Farms well #20 - depth 1310.0'

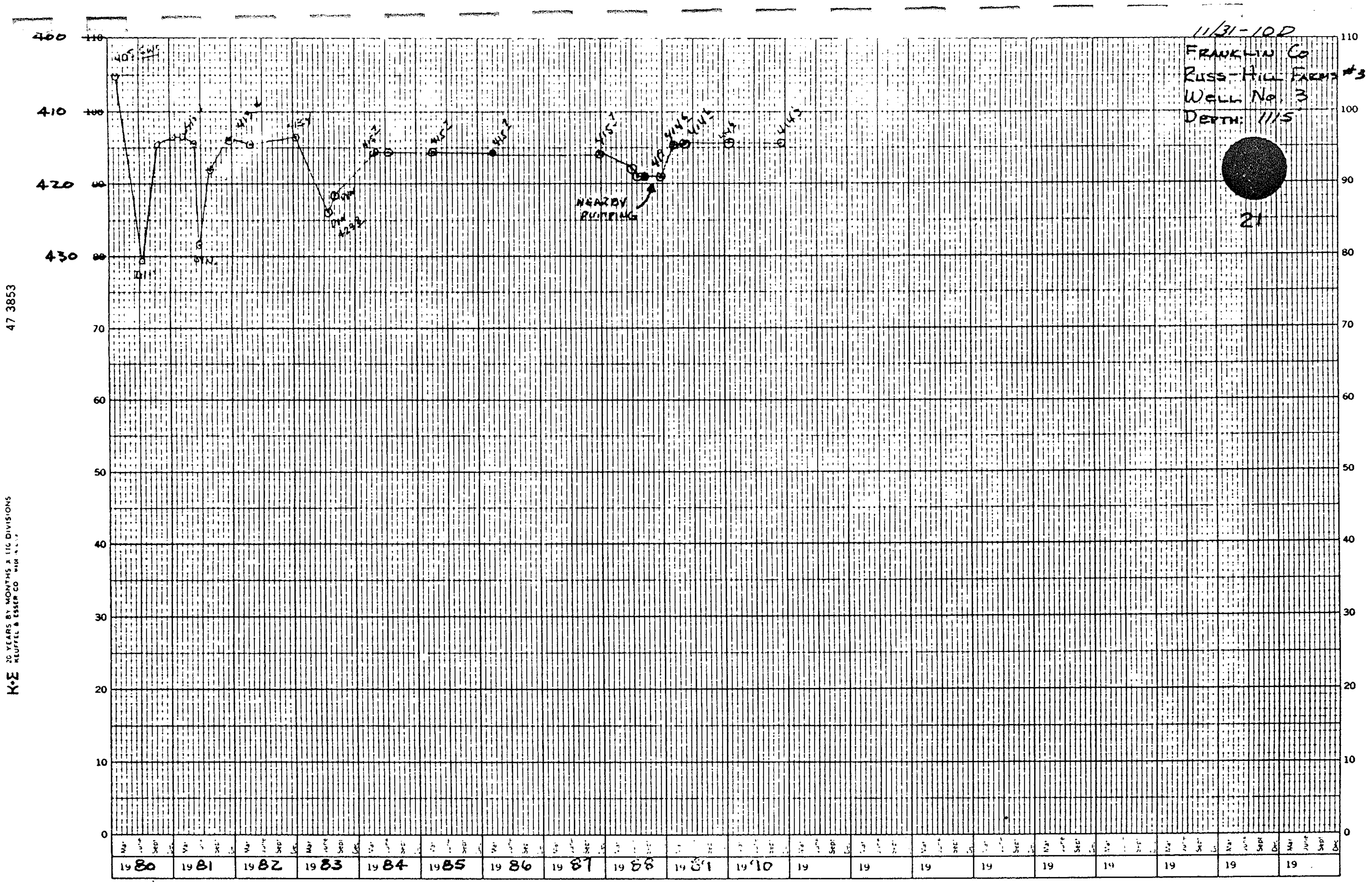

Figure 22: Hydrograph of Russ-Hill Farms well #21 - depth 1115.0'

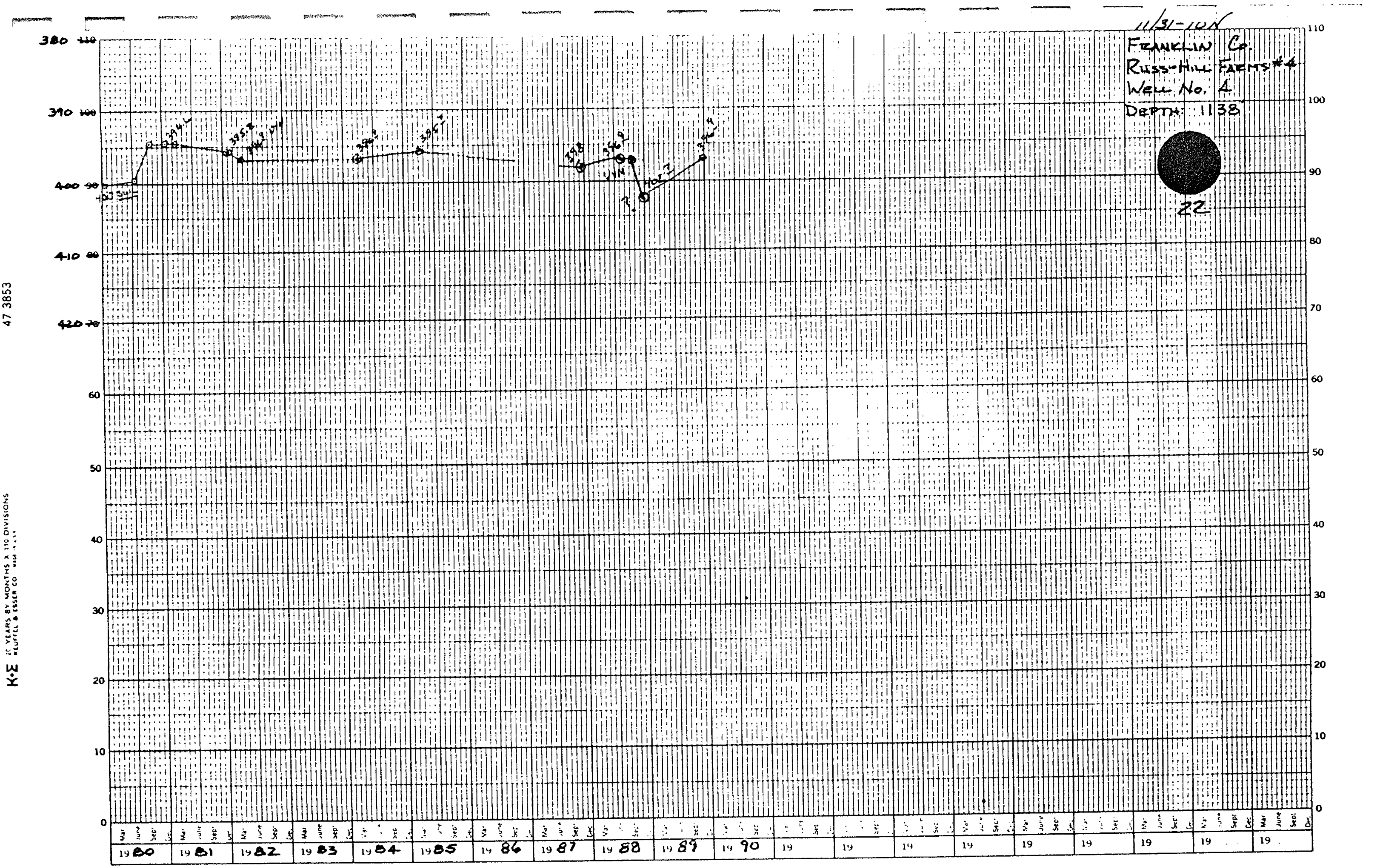

Figure 23: Hydrograph of Russ-Hill Farms well #22 - depth 1138.0'

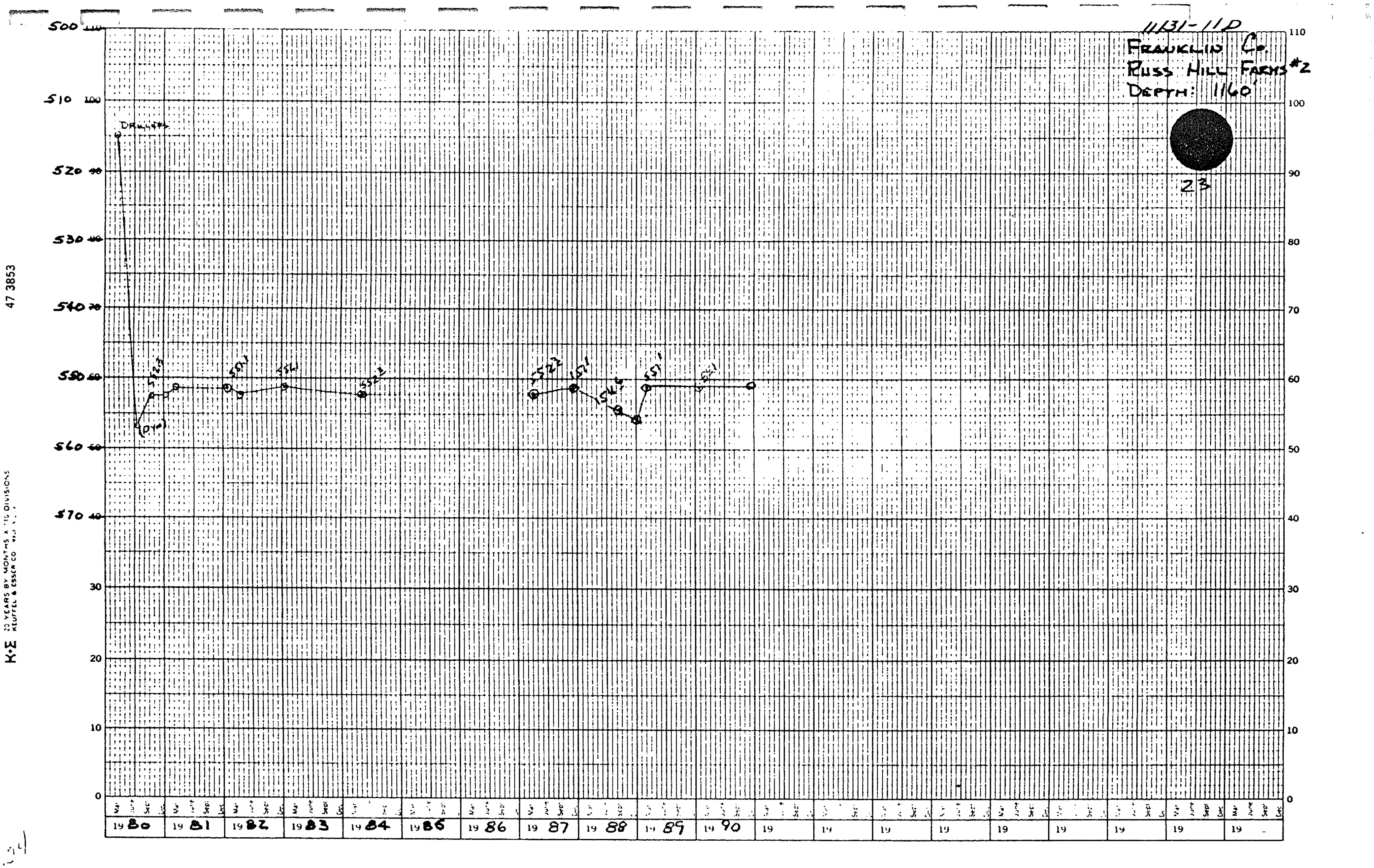

Figure 24: Hydrograph of Russ-HIll Farms well #23 - depth 1160.0'

Figure 25: Hydrograph of Russ-Hill Farms well #24 - depth 975.0'

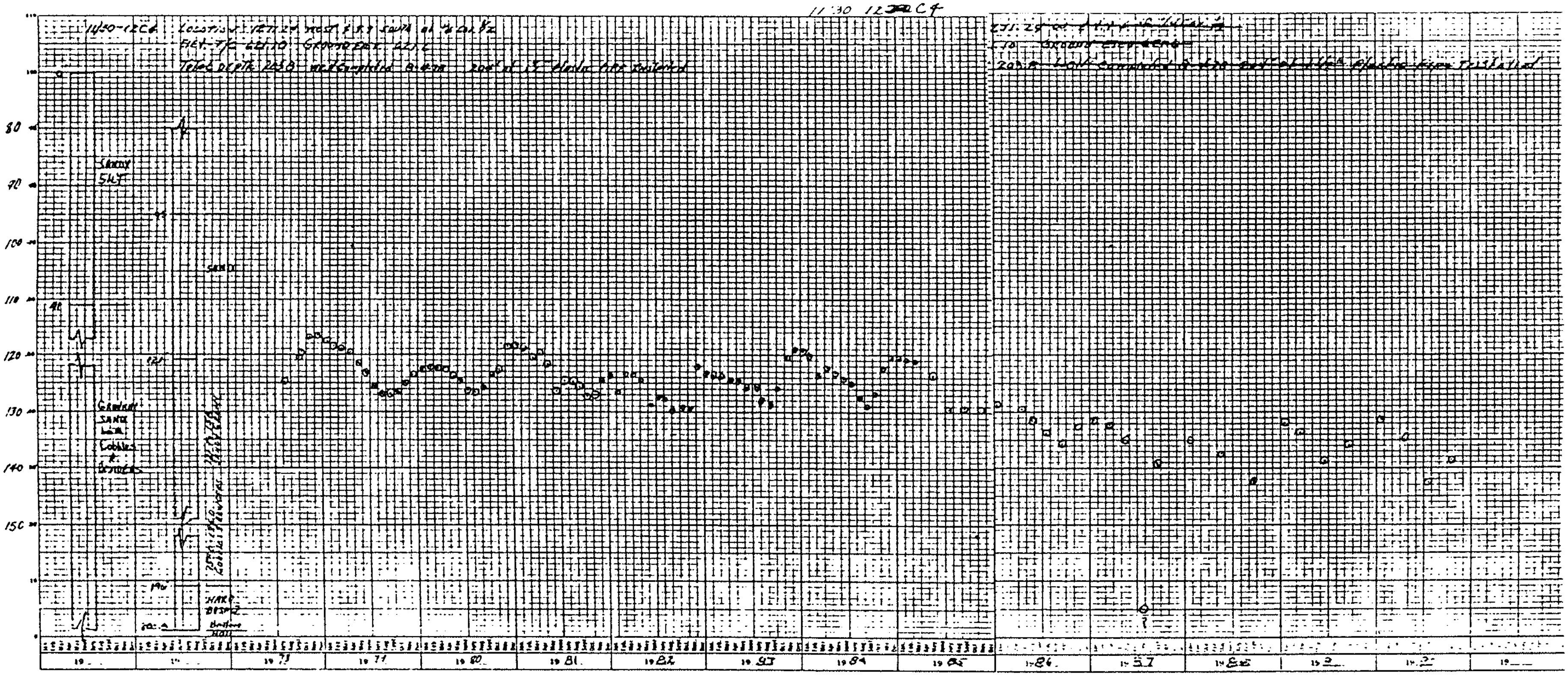

Figure 26: Hydrograph of well #25 - depth 203.8'

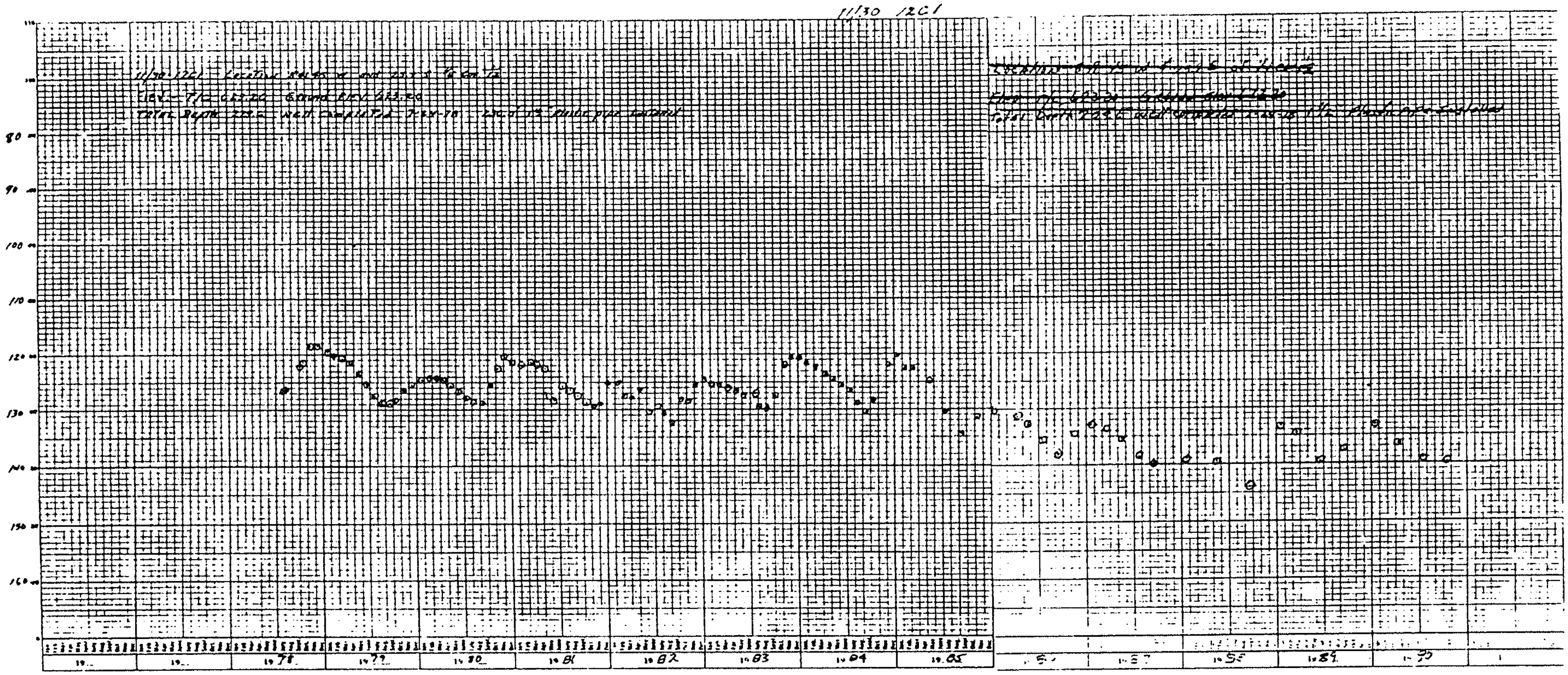

Figure 27: Hydrograph of well #26 - dpeth 229.6'

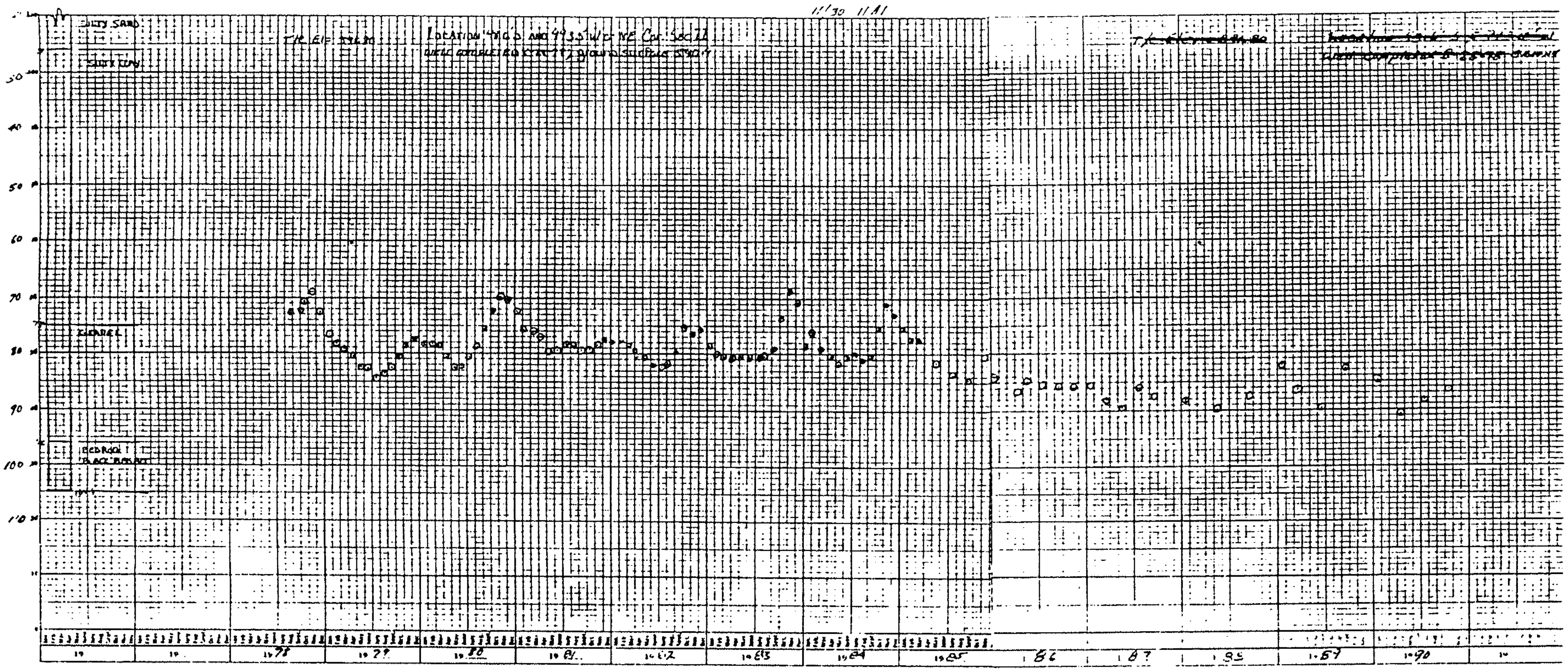

Figure 28: Hydrograph of well #27 - depth unknown

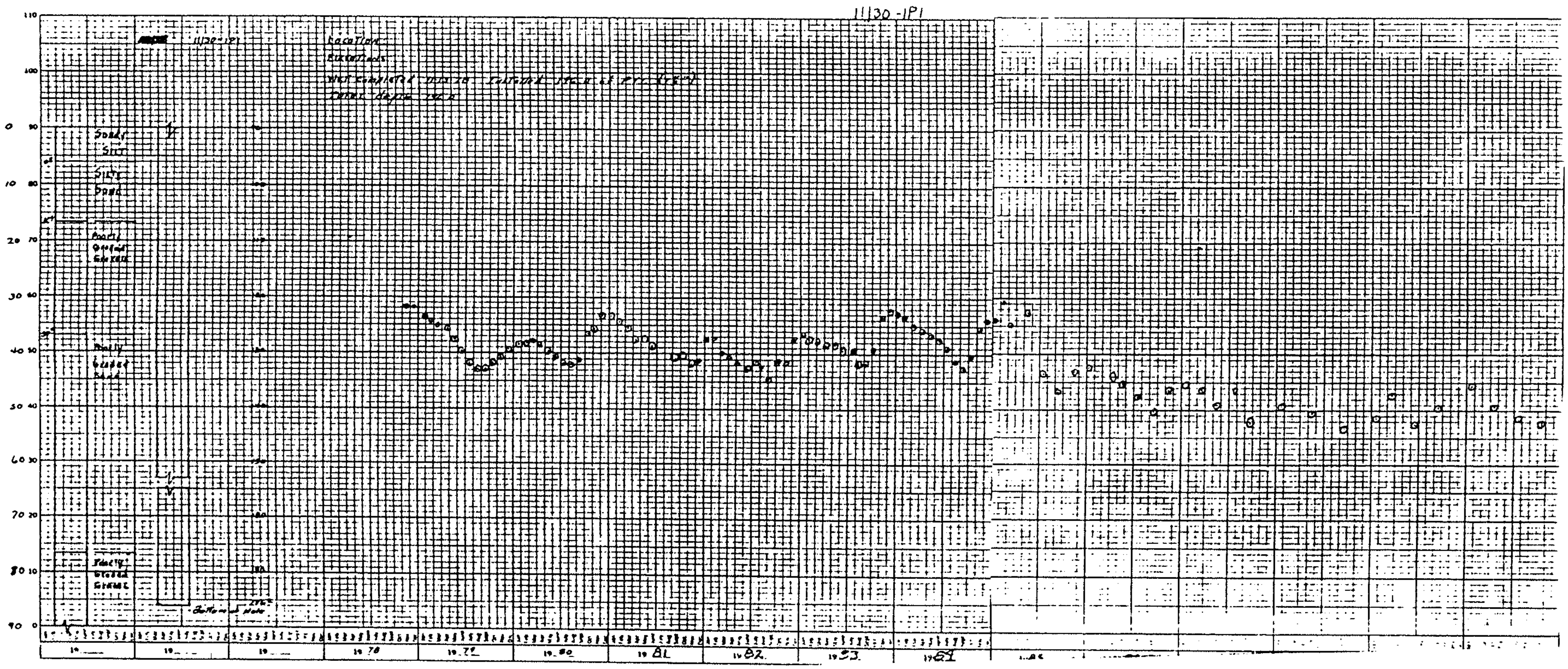

Figure 29: Hydrograph of well #28 - depth 196.0'

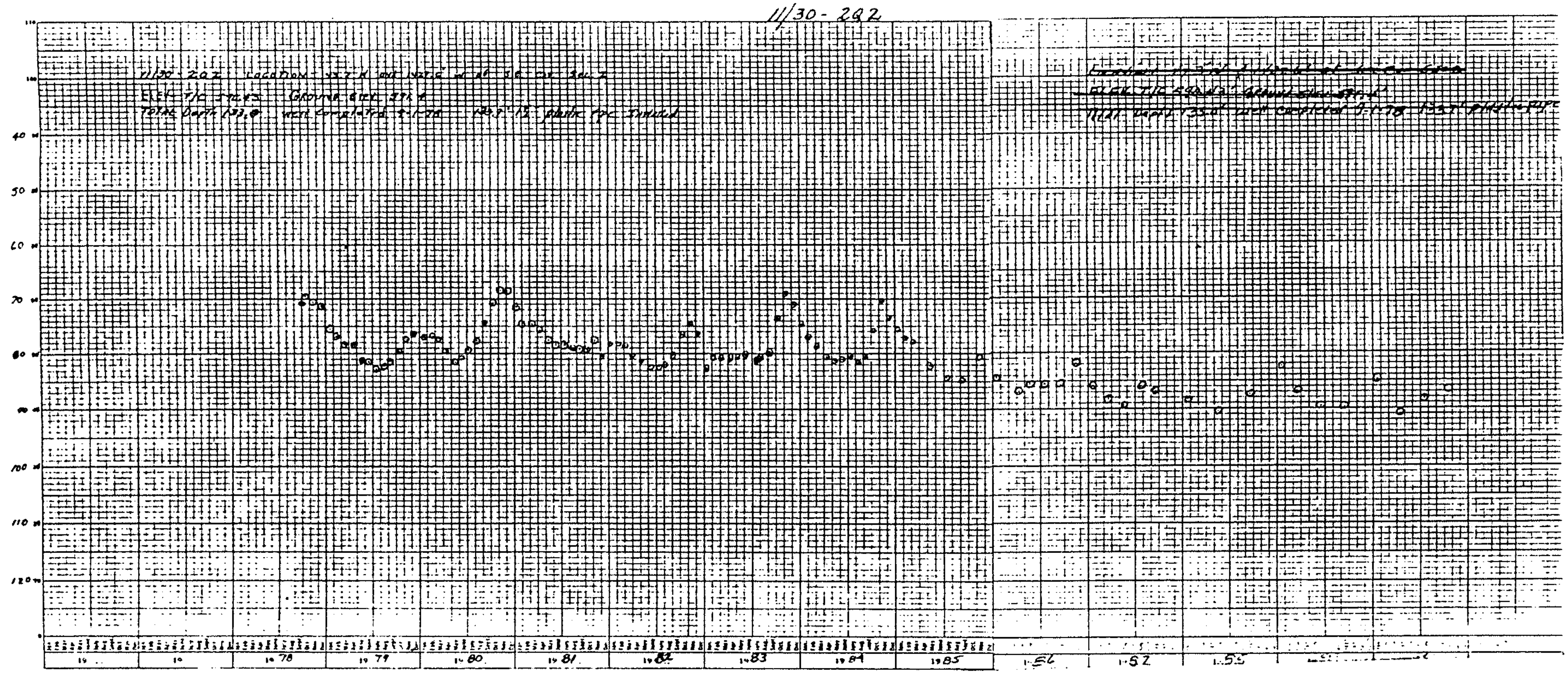

Figure 30: Hydrograph of well #29 - depth 133.0'

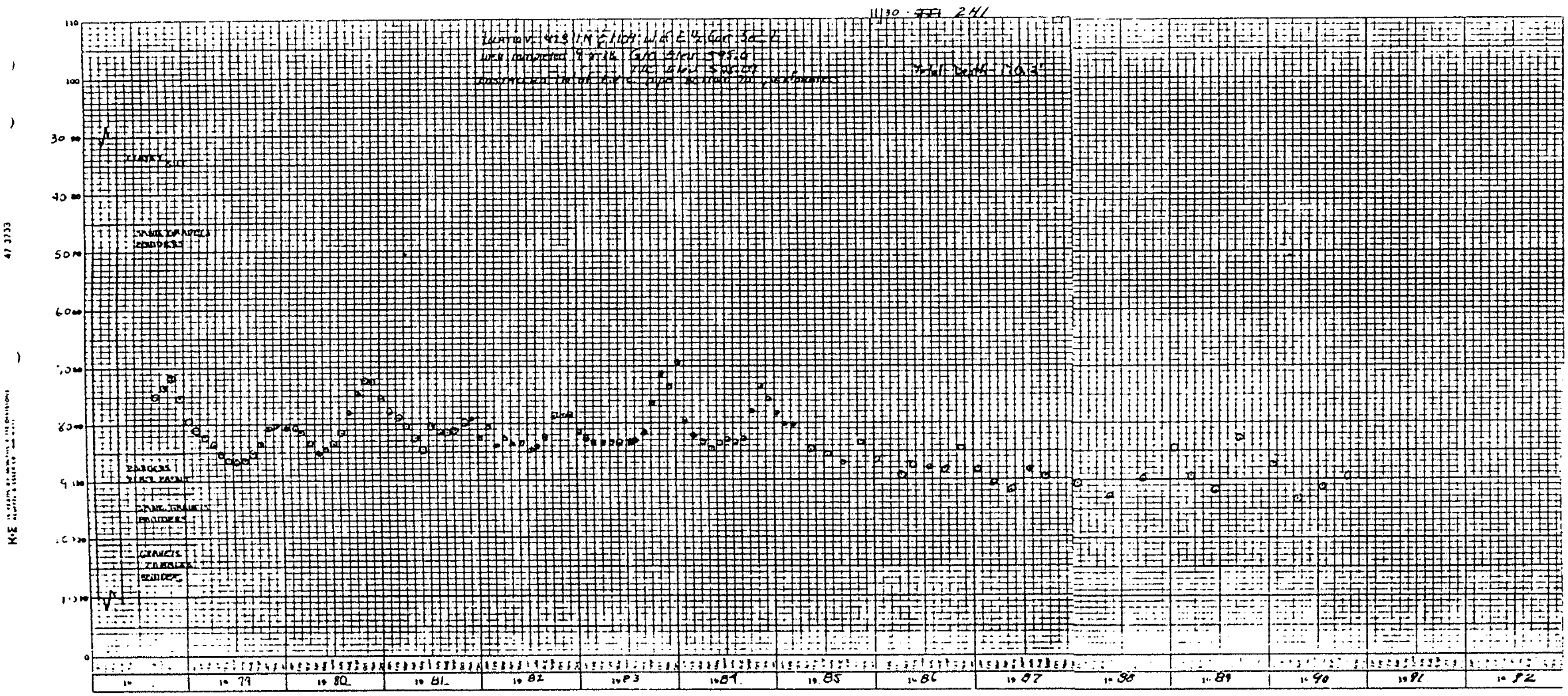

Figure 31: Hydrograph of well #30 - depth 170.2'

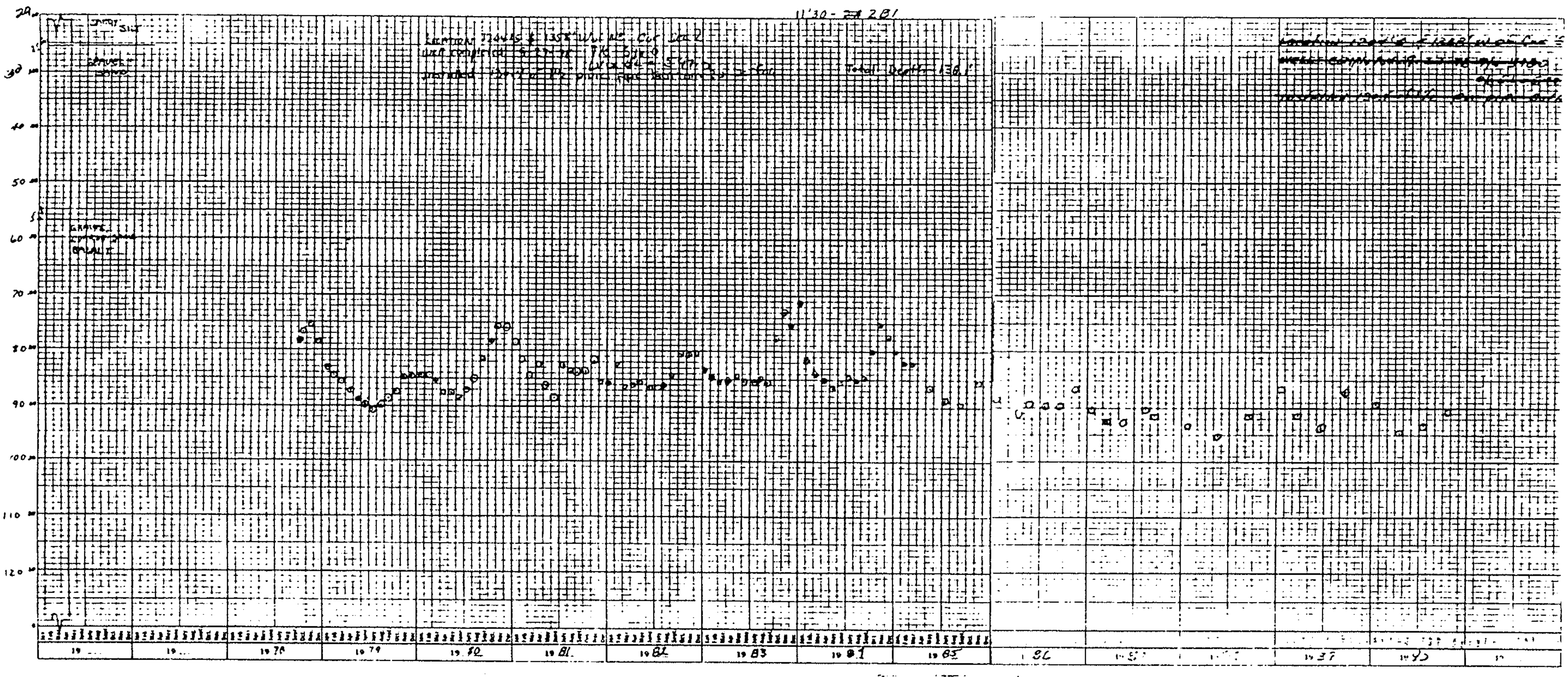

Figure 32: Hydrograph of well #31 - depth 138.1'

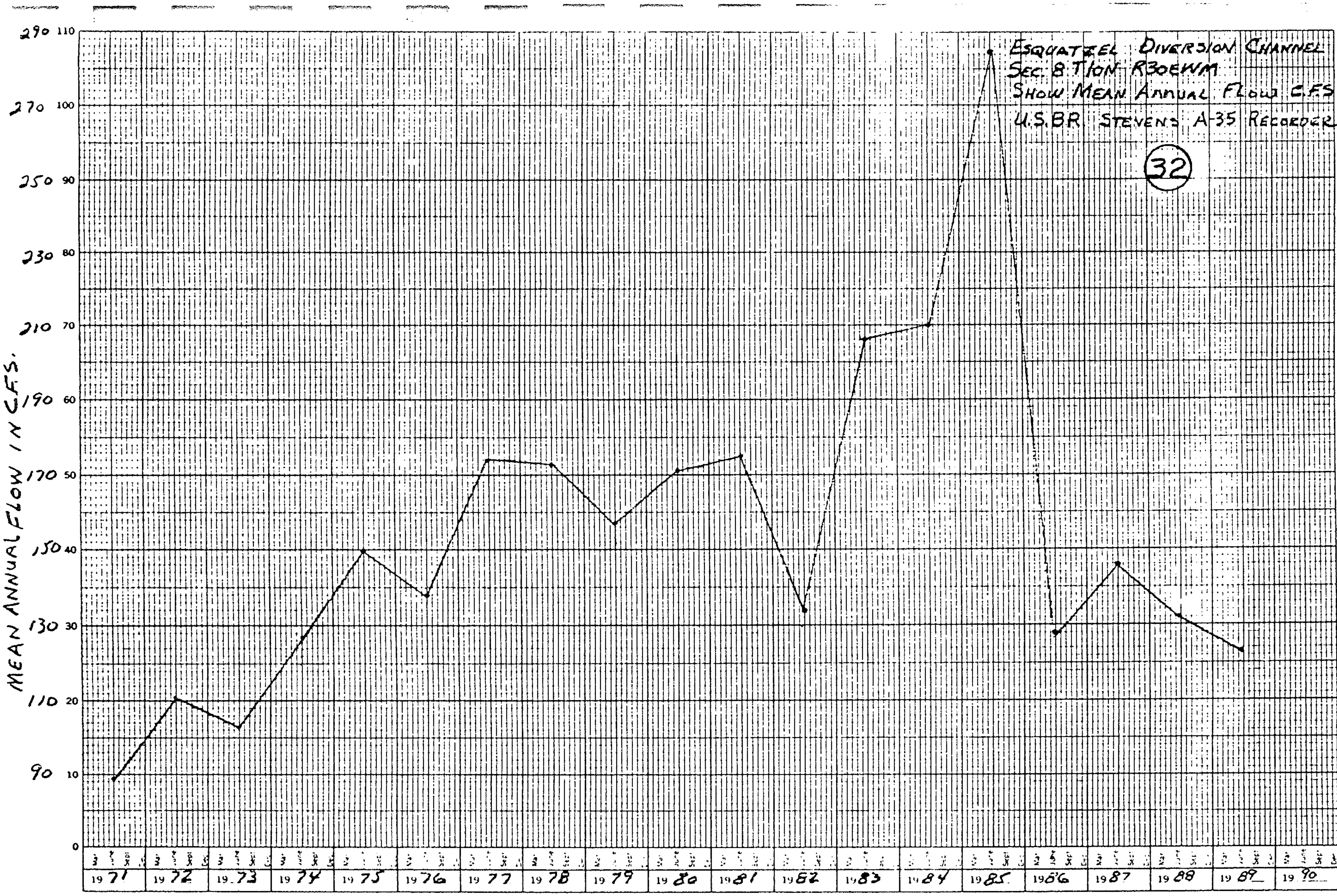

Figure 33: Mean annual flow c.f.s. Esquatzed Diversion Channel Sec. 8 T. 10N. R. 30 E.W.M.