TENNESSEE-TOMBIGBEE WATERWAY CANAL SECTION EFFECT ON ADJACENT BOTTOMLAND HARDWOODS

Ross L. Ulmer
Soil Conservation Service, Jackson, MS

Introduction

Landowners, environmentalists, and project management personnel have all expressed concern as to what effect the Canal Section, with its operating water level above the adjacent floodplain surface, would have on the bottomland hardwoods. This paper presents a summary of a seven (7) year study by the Soil Conservation Service for the Corps of Engineers - Mobile District. The study was made in the bottomland hardwood floodplain adjacent to the Lock D Canal Section pool from 1982 through 1989 covering the pre-pool and full pool operating conditions.

Construction of the Canal and its navigation pool created a water surface 10 to 18 feet above the adjacent floodplain in the study area. The potential for soil saturation and associated vegetation stress was considered fairly high when one considers the alluvial sands and gravels lying beneath the floodplain.

The study area lies to the west of the Lock D Canal Section levee and is considered representative of floodplain conditions within the 'Canal Section.' Seven (7) study sites were mutually selected with the Corps for distance from the levee and for location along the floodplain (see Figure 1).

The initial study intent was to measure the alluvial aquifer water levels, the groundwater levels, the soil moisture, and the vegetative growth. Measurements were made once a month to provide a clear track of seasonal changes to be distinguished from pre- and post-pool changes. Instrumentation to make these measurements was installed starting in May of 1982.

1. Piezometers were installed to the bottom of the alluvial aquifer, 29 to 39 feet below the floodplain surface, to measure any water level change from pre- to post-pool conditions.

2. Piezometers were also installed at the 2-foot, 3-foot, 5-foot, and 10-foot depth to monitor the groundwater water table changes. A close tracking of the 2-foot, 3-foot, and 5-foot piezometer was observed and measurements for the 2-foot and 3-foot piezometers were discontinued.

3. Tensiometers were installed at each site at the 12-inch, 18-inch, 24-inch, and 36-inch depths, but had to be removed during the winter time to avoid freeze damage leaving a void in the data plots. The tensiometers were removed at the end of 1983 and no longer used for the study.

4. Soil moisture blocks were installed in 1989 at the 12-inch, 24-inch, and 36-depths replacing the tensiometers.

5. Nuclear moisture probe was also installed in 1984 to measure the total amount of soil moisture at each site. Measurements were made at I-foot intervals to a depth of 10 feet. This instrument is considered to be the most accurate and most reliable.

6. All vegetation on the half acre tract at each site was identified and counted at the beginning and end of the study. Changes due to disease, insect, wind, or other damage were noted during the data collection visits to the sites.

7. Selected mature trees were identified and marked on the half acre tracts. The tree height and diameter at breast height (DBH) were measured at the beginning, at two-year intervals, and at the end of the study to help identify any changes in growth habits from the pre- to post-pool conditions.

8. Rainfall was measured at the Lock D construction site and operations office and is provided as a reference for comparing normal, dry, and wet years.

Interim Reports for 1982 through 1989 are available from the Corps of Engineers office in Mobile. (1)

Data Presentation

The most effective way to explain the study is to look at a continuous plot of the data. Figure 2 provides a quick and easy comparison of the seasonal data variations and the respective rainfall distribution plotted along the top.

Study site No. 2 is located about 620 feet west of the canal levee centerline. The pre-pool alluvial piezometer water levels clearly show a seasonal wet winter/dry summer pattern. The post-pool piezometer

water levels are noticeably higher than pre-pool levels, but the seasonal pattern continues at the higher level.

The soil moisture tension and total soil moisture values continue the seasonal fluctuations during both the pre- and post-pool periods, unaffected by the Canal being filled with water. Some slight variation of minimum values can be seen but is attributed to rainfall variations rather than the Canal pool.

Study sites No. 1 through 7 all experience this same seasonal fluctuation pattern to a greater or lesser degree. Study sites No. 1 through 6 show a higher post-pool alluvial piezometer water level pattern than observed under pre-pool conditions. Only study site No. 7 remains without change. Site No. 7, however, is in a unique situation by having a small, perennial stream between it and the Canal. The alluvial sands and gravels reach to within five (5) feet of the ground surface allowing any excess artesian pressure to be released into the stream before reaching site No. 7. Also the perennial stream, about 200 feet away, will quickly replenish water depleted by vegetation consumption.

The Canal Pool influence extends from about 1000 feet to 1500 feet outside (west) of the Canal levee centerline (See figure 3). This would be for typical 'dry' and 'wet' periods, respectively. The influence appears to be diminished to about 1.0 foot of additional artesian head at the 1300 foot distance which will be about 0.5 foot below natural ground. This diminished influence is the result of aquifer material resistance to flow between the canal and study site 3.

The clay soil material supporting the vegetative growth is about 10 feet thick except at study site 7 and provides an effective barrier against the alluvial artesian pressure influencing vegetative growth. This is confirmed by the pre- and post-pool lowering of groundwater water table below the alluvial aquifer artesian water level. This lowering would not be possible without the clay barrier protecting the vegetative growth area from direct artesian pressure.

An additional check was made to compare vegetation consumptive use with water supply available from nearby stream or slough. U.S. Forest Service had identified a consumptive water use for mature woodland at 0.30 inches per day or about 8,170 gal/day/acre. (2) A 4-foot soil depth was selected to correspond to the shallow (2 foot deep) root systems observed from trees that had fallen over. Using a 2 feet/day (horizontal) movement of moisture through the soil on all 4 sides of an acre of land (each 208 feet long) only about 3,070 gal/day/acre are provided. This assumes water is available on all four sides of the one acre plot, which is highly unlikely. Even moisture contribution from beneath the one acre plot could contribute only 8,700 gal/day/acre at most. Piezometers, however, clearly show that the groundwater water table declines and that vegetative consumptive use is greater than water movement through the soil.

An interesting epilogue to this phenomena is the rapid rebound noted in the fall of the year following the first frost. The frost dates are noted in the rainfall section at the top of figure 2. Moisture is available to the vegetation but takes some time to get there.

As noted earlier, our concern was to identify any effect or changes in vegetation growth rates resulting from full canal pool. The continued measurements from the beginning of the study in 1982 to its conclusion in 1989 show only normal growth rates for the selected trees. Some slight growth variations were noted but considered to be well within the yearly variations of rainfall. It was quite interesting to note that at individual sites, some tree species had a slight growth increase while other tree species had growth decreases.

Conclusion

The main concerns of the study were to identify if the canal impoundment would impact and be detrimental to the bottomland hardwood and associated vegetation outside the Tennessee-Tombigbee Waterway containment levee and to quantify the extent of the impact and help identify vegetative changes.

The study conclusion is that there is no impact and, therefore, no vegetative changes.

References

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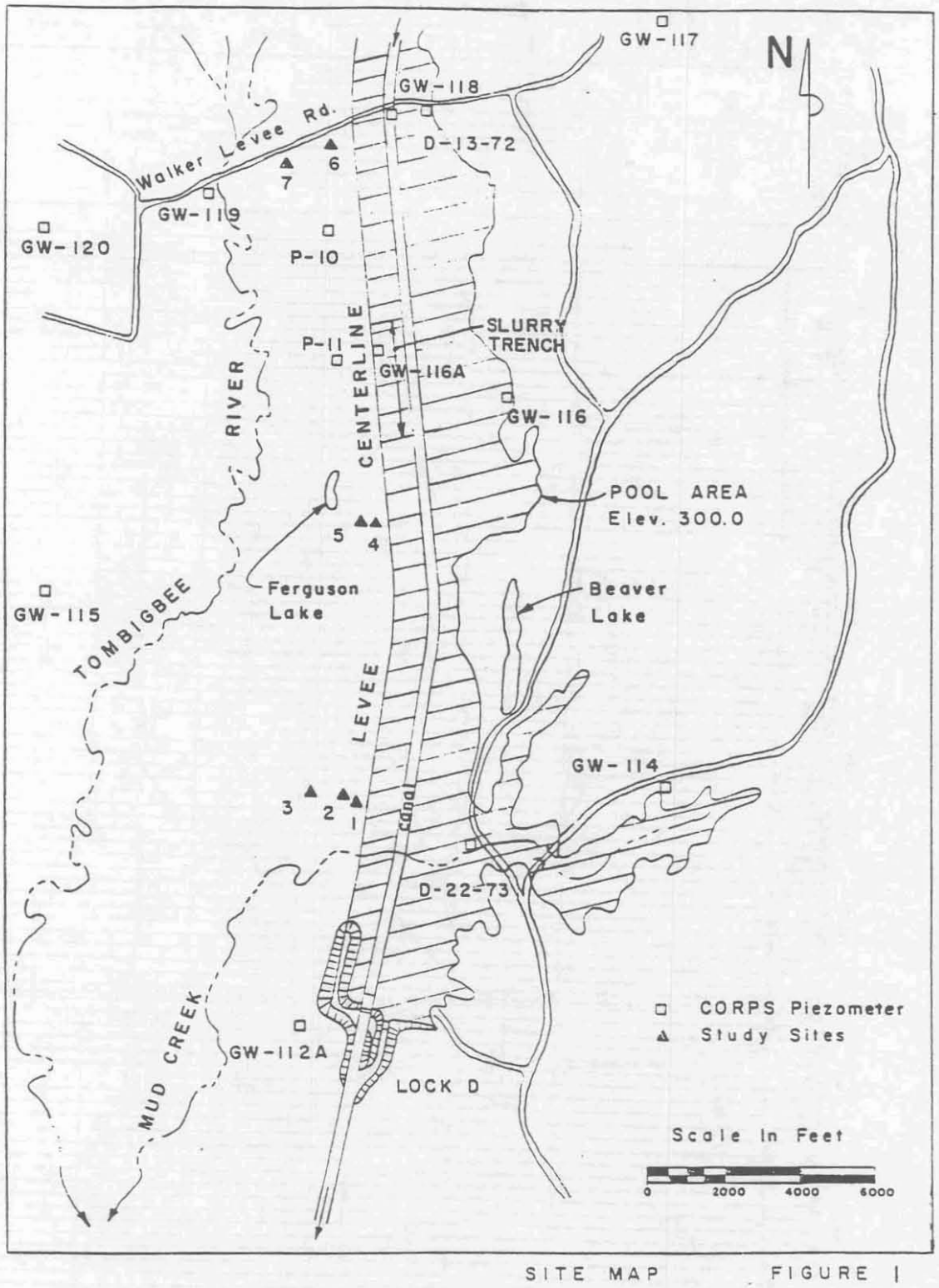
USDA - Soil Conservation Service, January 1990. "1989 Final Report, Tennessee - Tom bigbee Waterway Vegetative Response to Waterlogging of Soils, Monroe & Itawamba Counties, Mississippi."

2. Broadfoot, W. M., 1960. "Soil-Water Shortages and a Means of Alleviating Resulting Influences on Southern Hardwoods," U.S. Forest Service.



SITE MAP FIGURE 1

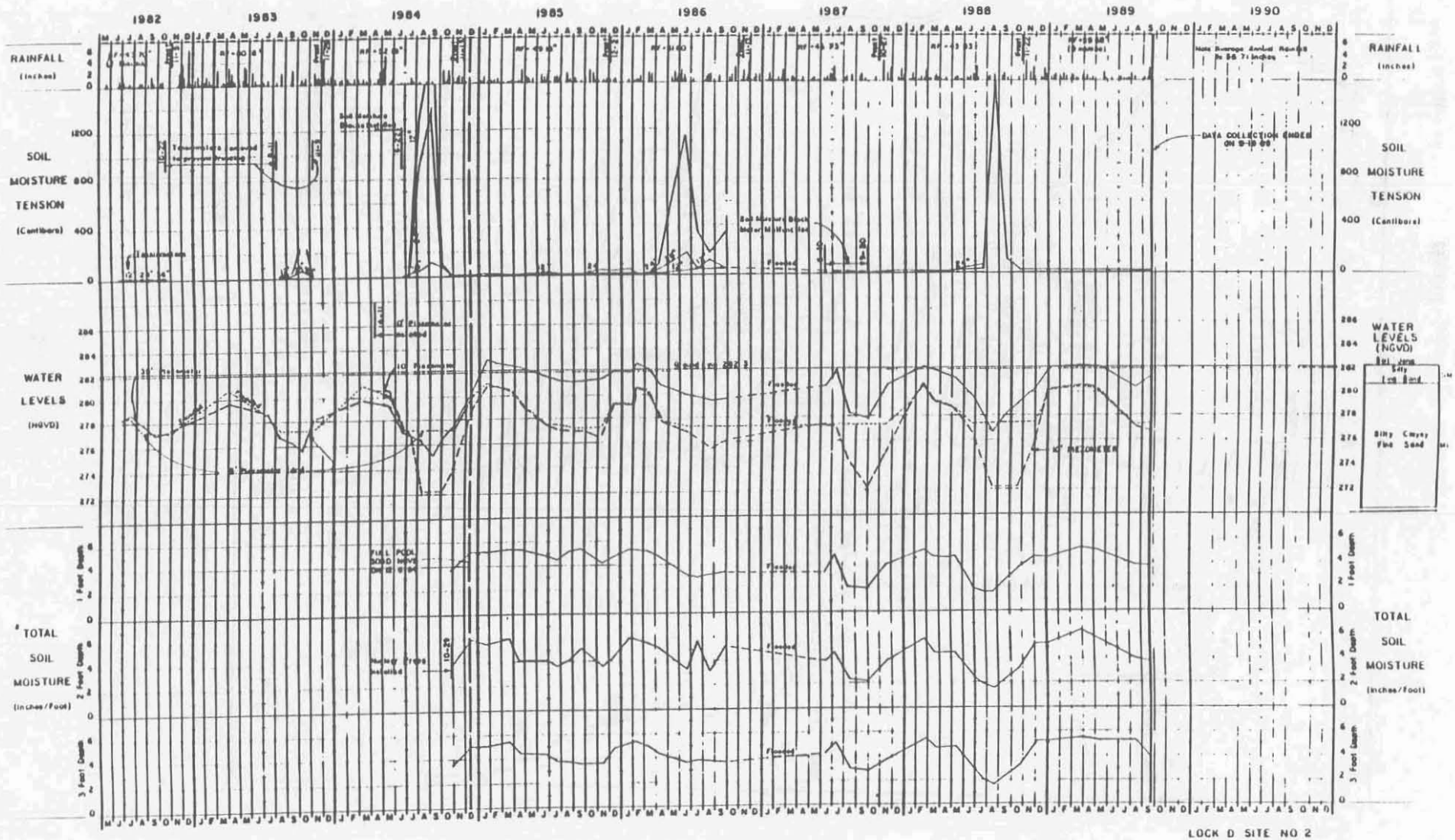

1982
1983
1984
1985
1986
1987
1988
1989
1990
RAINFALL
(inches)
SOIL
MOISTURE
TENSION
(Centibars)
DATA COLLECTION ENDED ON 9-10-89
WATER
LEVELS
(NGVD)
6' PIEZOMETER
Silty Clayey Fine Sand
TOTAL
SOIL
MOISTURE
(inches/Foot)
1 Foot Depth
2 Foot Depth
3 Foot Depth
LOCK D SITE NO 2

FIGURE NO. 2

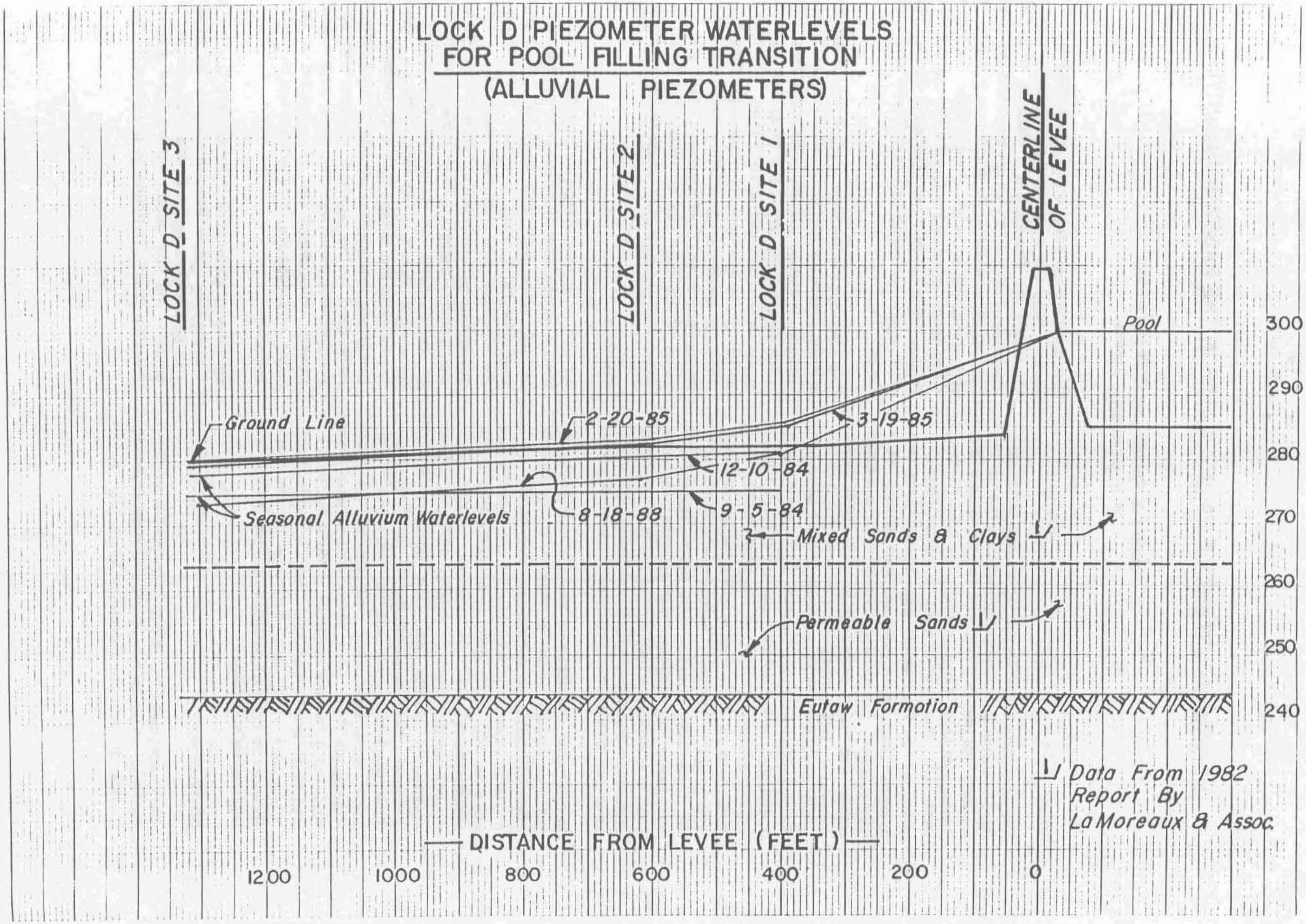

LOCK D PIEZOMETER WATERLEVELS
FOR POOL FILLING TRANSITION
(ALLUVIAL PIEZOMETERS)
LOCK D SITE 3
LOCK-D SITE 2
LOCK D SITE 1
CENTERLINE OF LEVEE
Pool
Ground Line
2-20-85
3-19-85
12-10-84
8-18-88
9-5-84
Seasonal Alluvium Waterlevels
Mixed Sands & Clays 1/
Permeable Sands 1/
Eutaw Formation
1/ Data From 1982 Report By LaMoreaux & Assoc.
DISTANCE FROM LEVEE (FEET)
1200
1000
800
600
400
200
0
300
290
280
270
260
250
240

FIGURE NO. 3