UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SIMULATIONS OF WATER-LEVEL DRAWDOWNS IN PROPOSED WELL-FIELD AREAS, DADE COUNTY, FLORIDA

OPEN-FILE REPORT 76-651

Prepared in cooperation with the
MIAMI-DADE WATER AND SEWER AUTHORITY

Tallahassee, Florida
September 1976

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SIMULATIONS OF WATER-LEVEL DRAWDOWNS IN PROPOSED WELL-FIELD AREAS, DADE COUNTY, FLORIDA

By

Howard Klein

ABSTRACT

Electrical analog model simulations of hydraulic conditions in the Biscayne aquifer were made at proposed inland well-field sites in Dade County. Simulated drawdowns of water levels after 7 months of continuous pumping at 50, 100, and 150 million gallons per day (2.2, 4.4, and 6.6 cubic meters per second) were obtained at each site. Simultaneous pumping of each of the sites at 50 million gallons per day (2.2 cubic meters per second) showed that after 7 months pumping there would be interference between proposed well fields.

INTRODUCTION

At a water-resources hearing in Miami in April 1975, the Board of County Commissioners of Dade County directed the Miami-Dade Water and Sewer Authority to select areas in inland parts of the county for well fields which would serve all future municipal demands. The Water and Sewer Authority then selected five sites, in all, for consideration as potential areas from which substantial well-field yields could be obtained. Two hydrologic criteria were used in selecting the five sites: (1) The sites are sufficiently remote from existing well fields so that interference between well fields will be minimal at design capacities, and (2)

The sites are in intercanal areas rather than adjacent to canals so that maximum quantities of water from aquifer storage will be utilized and diversion of water from primary canals to pumping wells will be minimized. The rationale for the second criterion is that the locations will pose the least interference with the ability to manage the surface water so as to direct water through the canals to the coast in sufficient quantities to retard seawater intrusion.

To assist the Water and Sewer Authority in decisionmaking concerning the practicability of developing a water supply at each of the five sites selected, the U. S. Geological Survey, through its cooperative program with that agency, investigated the potential effects of applying a hydraulic stress, of given magnitude, at each. By means of an electrical analog model, a simulated withdrawal of known magnitude was applied at each of the five sites, and the resulting drawdowns determined. This report presents maps showing the extent of these drawdowns.

- -

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below:

Multiply English unit	By	To obtain metric unit
mile (mi)	1.609	kilometer (km)
million gallons per day (Mgal/d)	.04381	cubic meter per second (m^3/s)

RESULTS

The first phase of the investigation, which began in July 1975, utilized an electrical analog model to simulate hydraulic conditions in the Biscayne aquifer in the vicinity of the proposed sites (Fig. 1). The analog model is a tool for estimating the responses of the hydrologic system to natural or manmade stresses. The system that was modeled is the highly permeable, nonartesian Biscayne aquifer and the related network of canals and other water-control facilities. The model is represented by a network of electrical resistors and capacitors that is analogous to the areal variations in hydrologic properties of the aquifer, and, in analogy, approximates the shape of the aquifer (Appel, 1973). Because of lack of data on the water transmitting and water storing properties of the aquifer in many parts of the county, particularly in the interior, estimates of transmissivity had to be made in the design of the model, and a uniform storage coefficient of 0.2 was applied throughout the county. Also few data were available concerning the degree of interconnection between the aquifer and the primary canals. Therefore, the model should be considered idealized, and the simulations that are obtained are considered approximations.

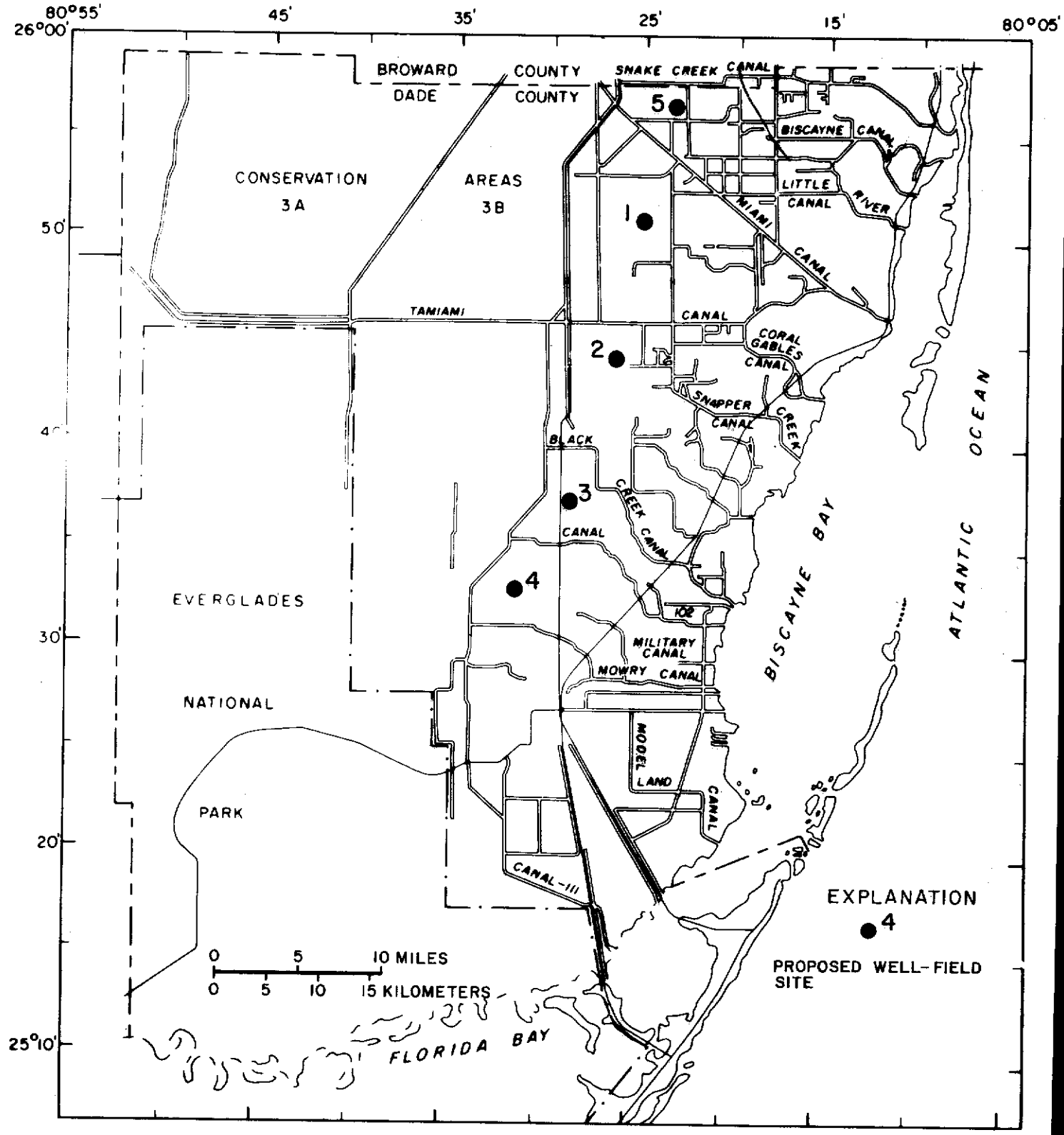


FIGURE 1.--Location of proposed well-field sites.

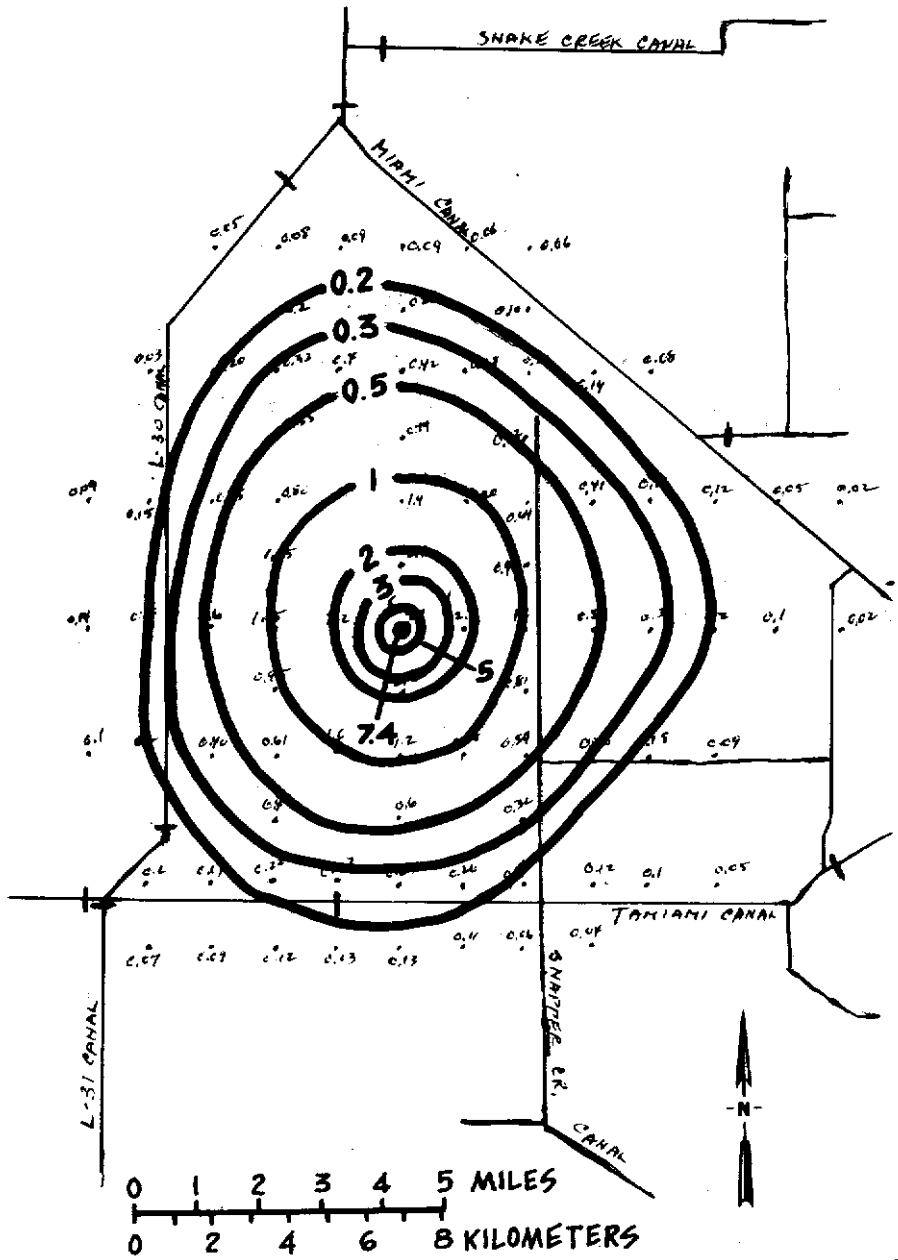


FIGURE 2.--Simulated drawdown after 7 months of continuous pumping at Site 1; withdrawal rate, 50 million gallons per day.

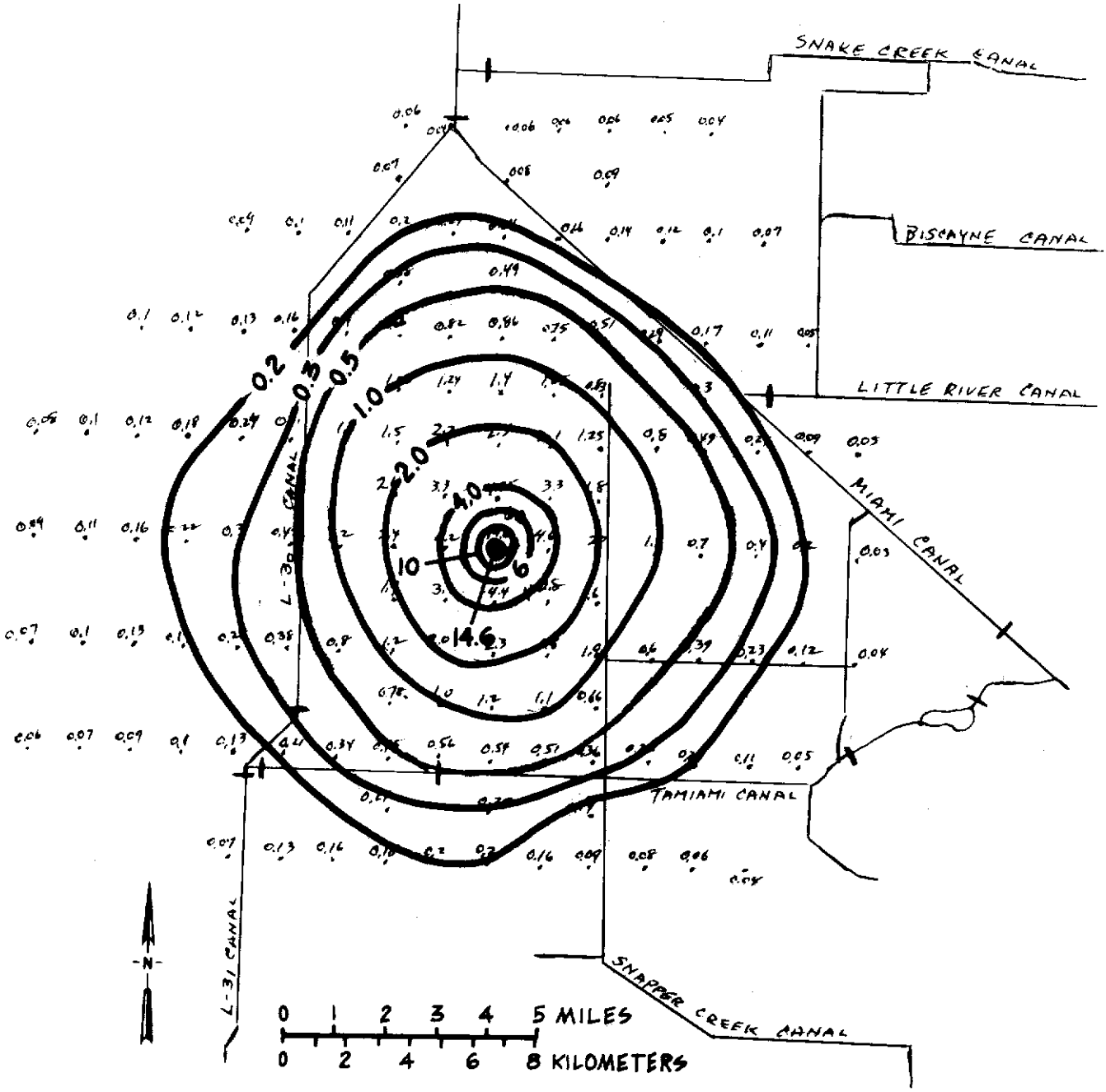
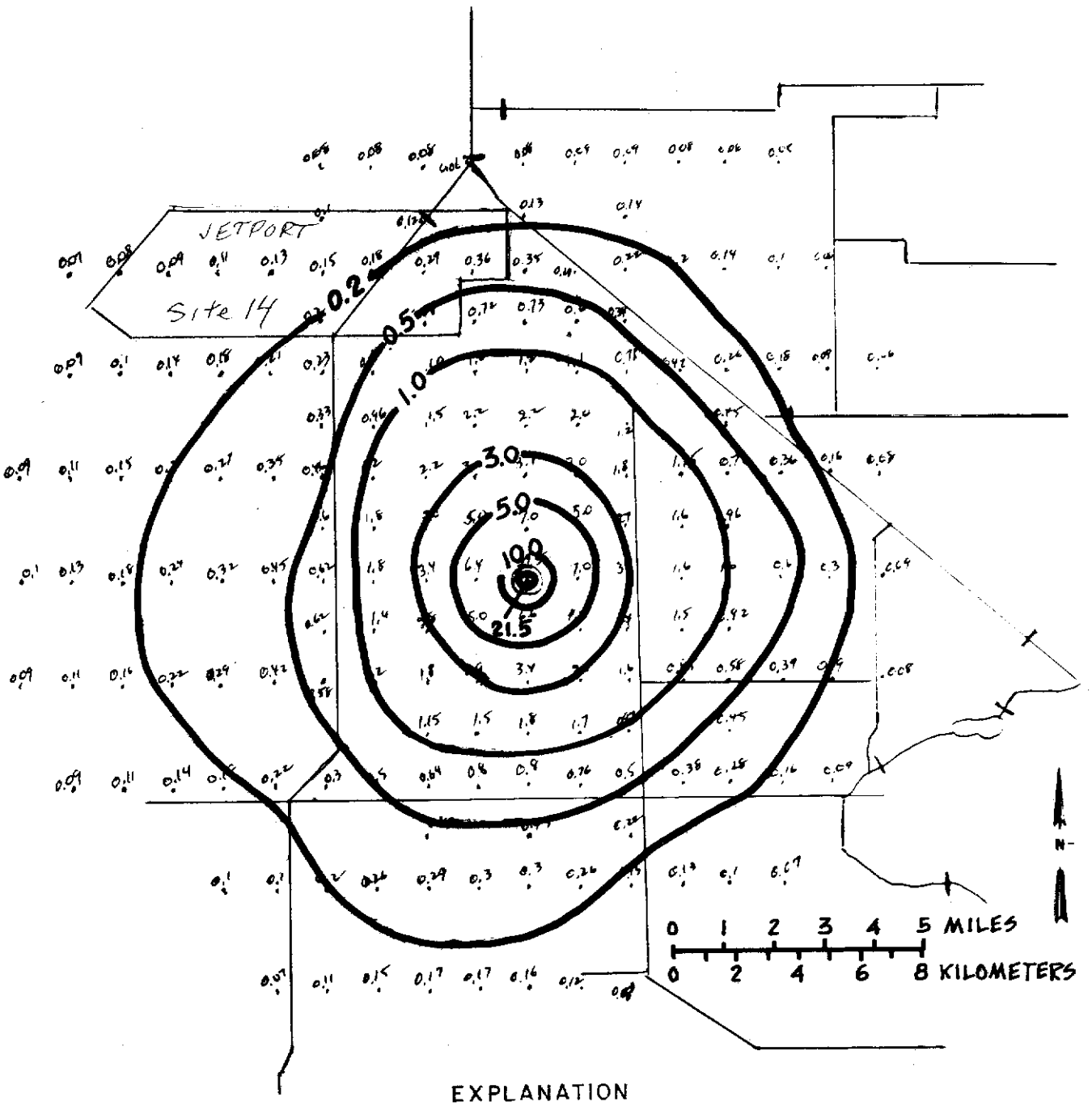


FIGURE 3.--Simulated drawdown after 7 months of continuous pumping at Site 1; withdrawal rate, 100 million gallons per day.



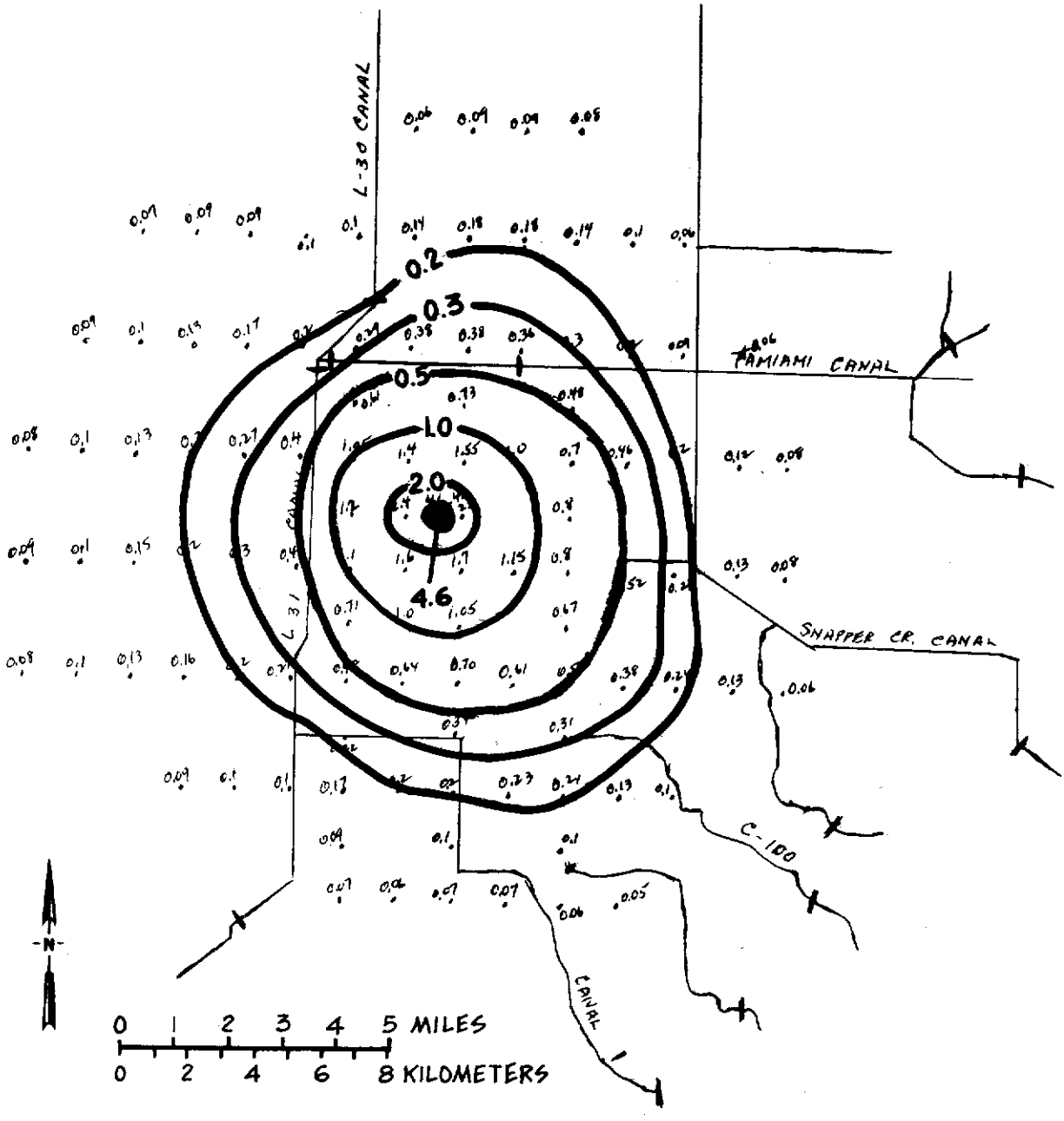
EXPLANATION

—2— LINE OF EQUAL DRAWDOWN, IN FEET. INTERVAL VARIES.

•0.6 POINT ON MODEL SHOWING DRAWDOWN, IN FEET.

CANAL AND CONTROL STRUCTURE.

FIGURE 4.--Simulated drawdown after 7 months of continuous pumping at Site 1; withdrawal rate, 150 million gallons per day.



EXPLANATION

2

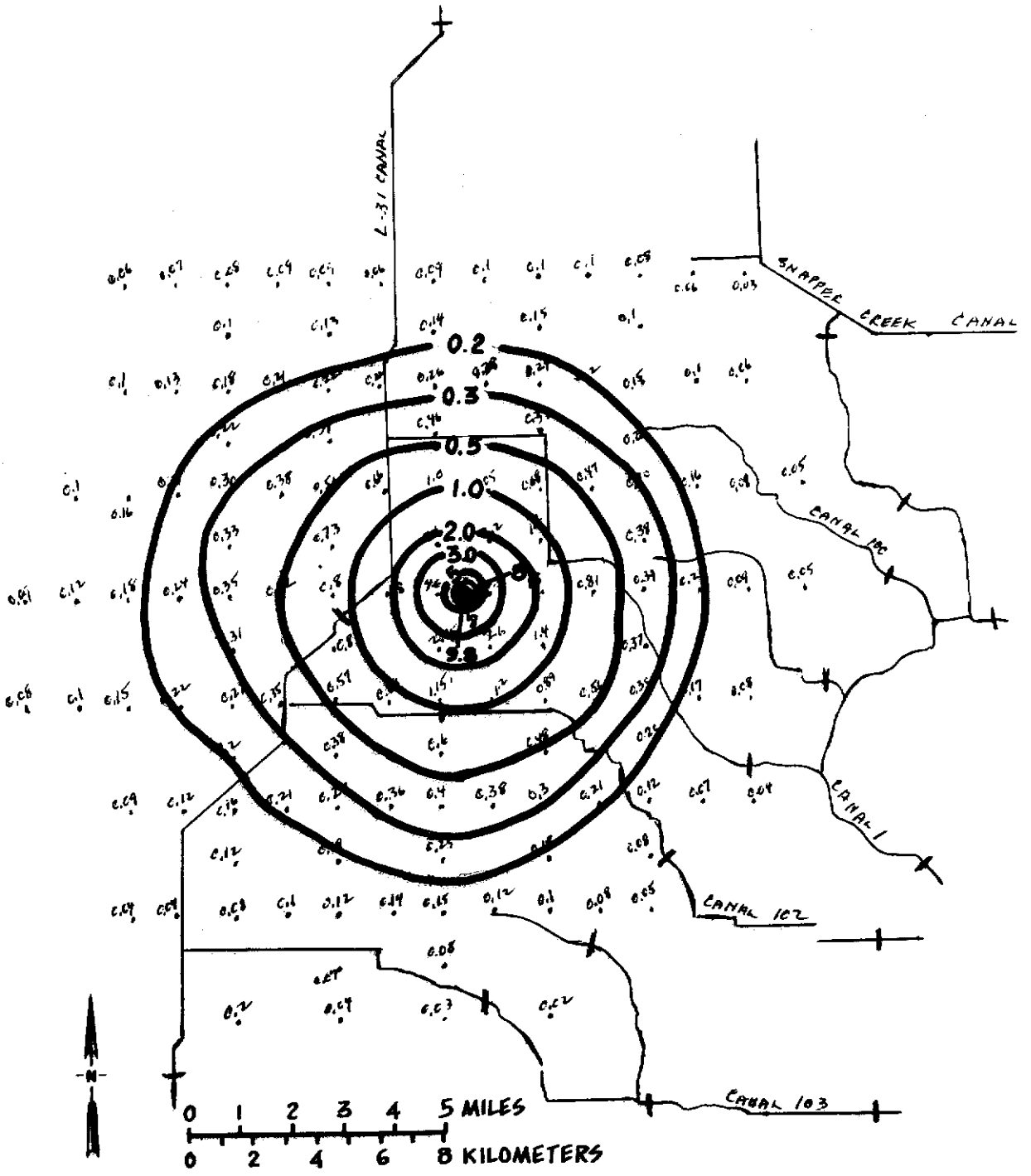
LINE OF EQUAL DRAWDOWN, IN FEET. INTERVAL VARIES.

• 0.6

POINT ON MODEL SHOWING DRAWDOWN, IN FEET.

CANAL AND CONTROL STRUCTURE.

FIGURE 5.--Simulated drawdown after 7 months of continuous pumping at Site 2; withdrawal rate, 50 million gallons per day.



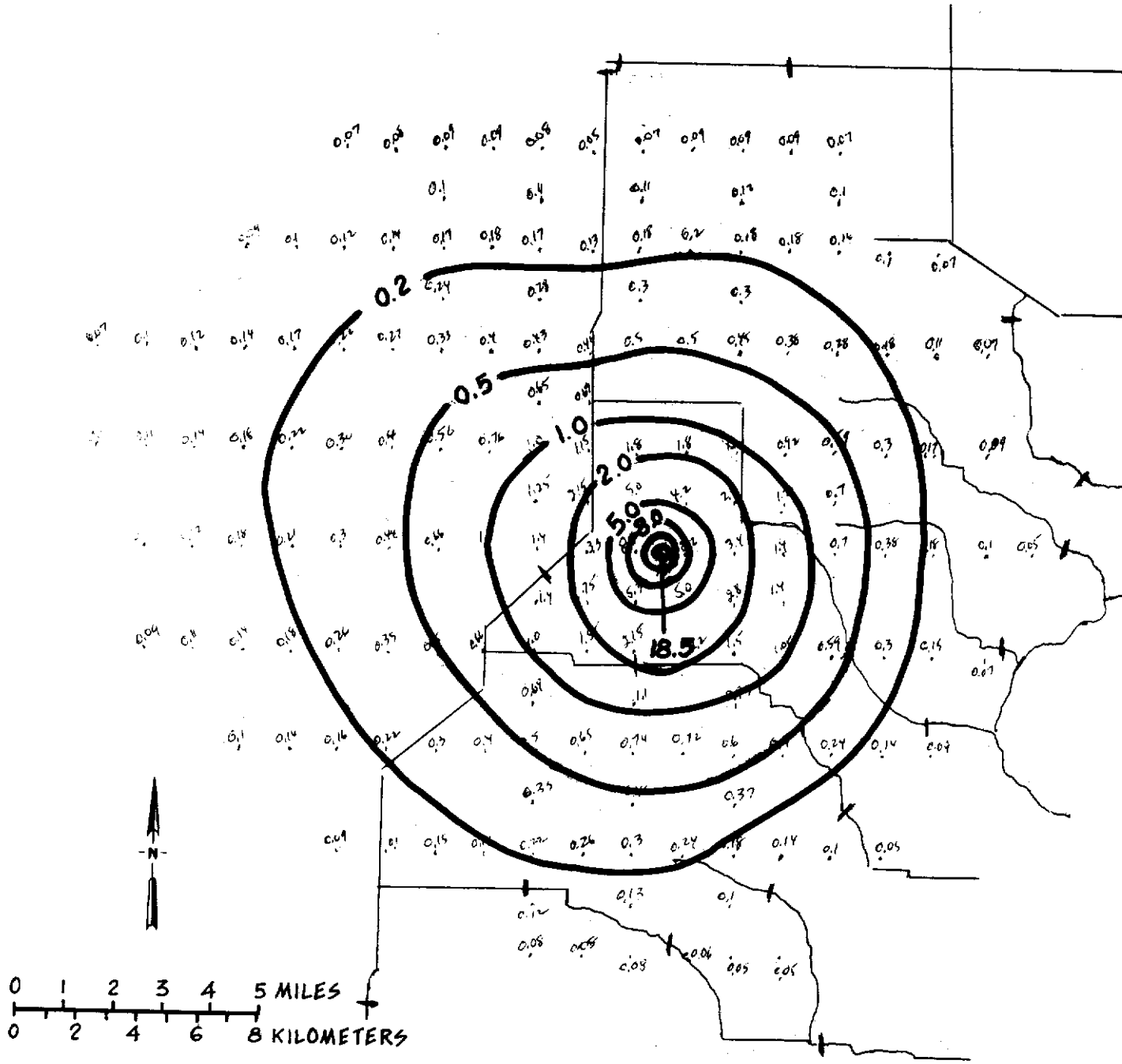
EXPLANATION

—2— LINE OF EQUAL DRAWDOWN, IN FEET. INTERVAL VARIES.

•0.6 POINT ON MODEL SHOWING DRAWDOWN, IN FEET.

CANAL AND CONTROL STRUCTURE.

FIGURE 6.--Simulated drawdown after 7 months of continuous pumping at Site 3; withdrawal rate, 50 million gallons per day.



EXPLANATION

—— 2 ——

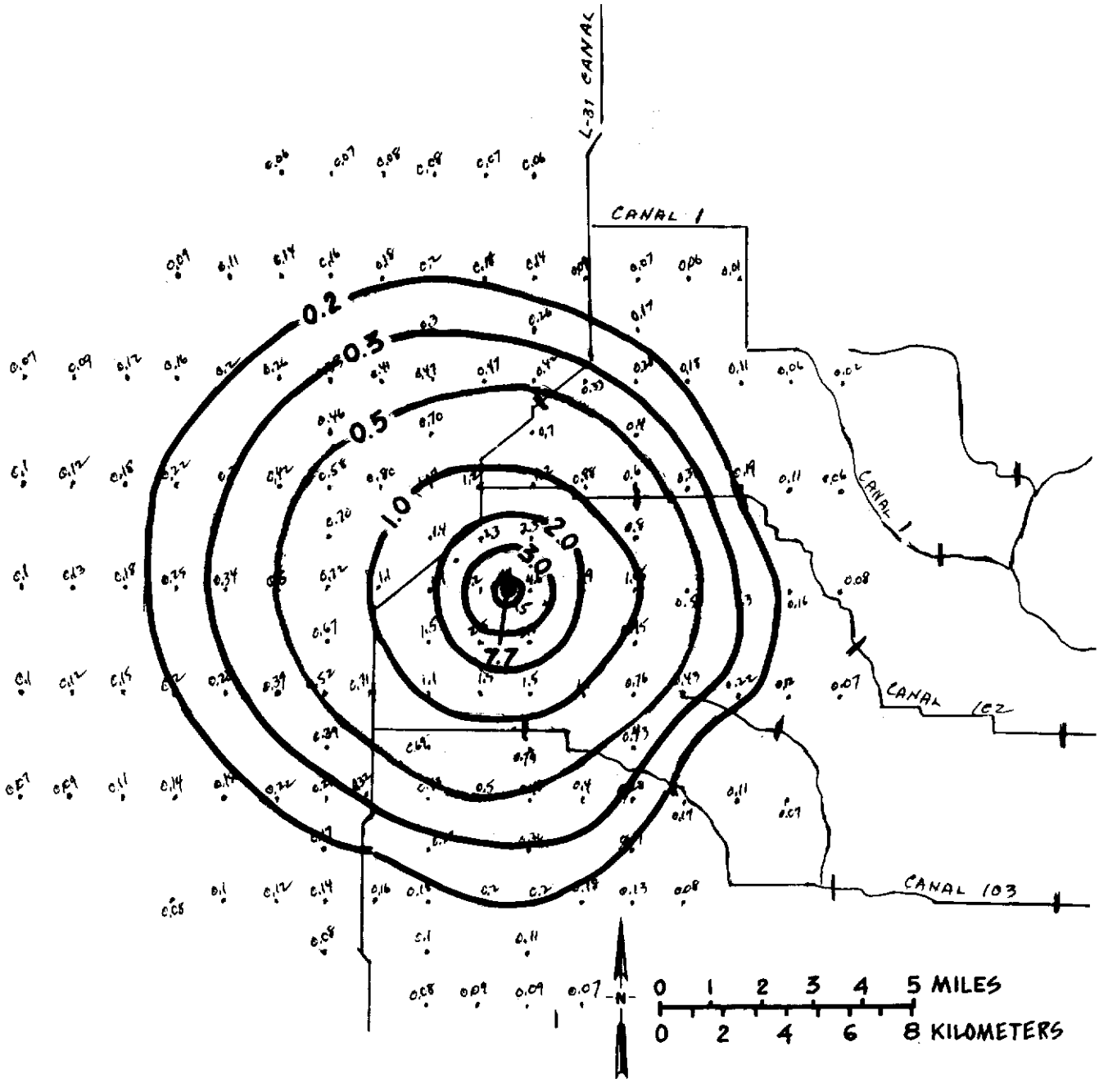
LINE OF EQUAL DRAWDOWN, IN FEET. INTERVAL VARIES.

• 0.6

POINT ON MODEL SHOWING DRAWDOWN, IN FEET.

CANAL AND CONTROL STRUCTURE.

FIGURE 7.--Simulated drawdown after 7 months of continuous pumping at Site 3; withdrawal rate, 100 million gallons per day.



EXPLANATION

2

LINE OF EQUAL DRAWDOWN, IN FEET. INTERVAL VARIES.

0.6

POINT ON MODEL SHOWING DRAWDOWN, IN FEET.

CANAL AND CONTROL STRUCTURE.

FIGURE 8.--Simulated drawdown after 7 months of continuous pumping at Site 4; withdrawal rate, 50 million gallons per day.

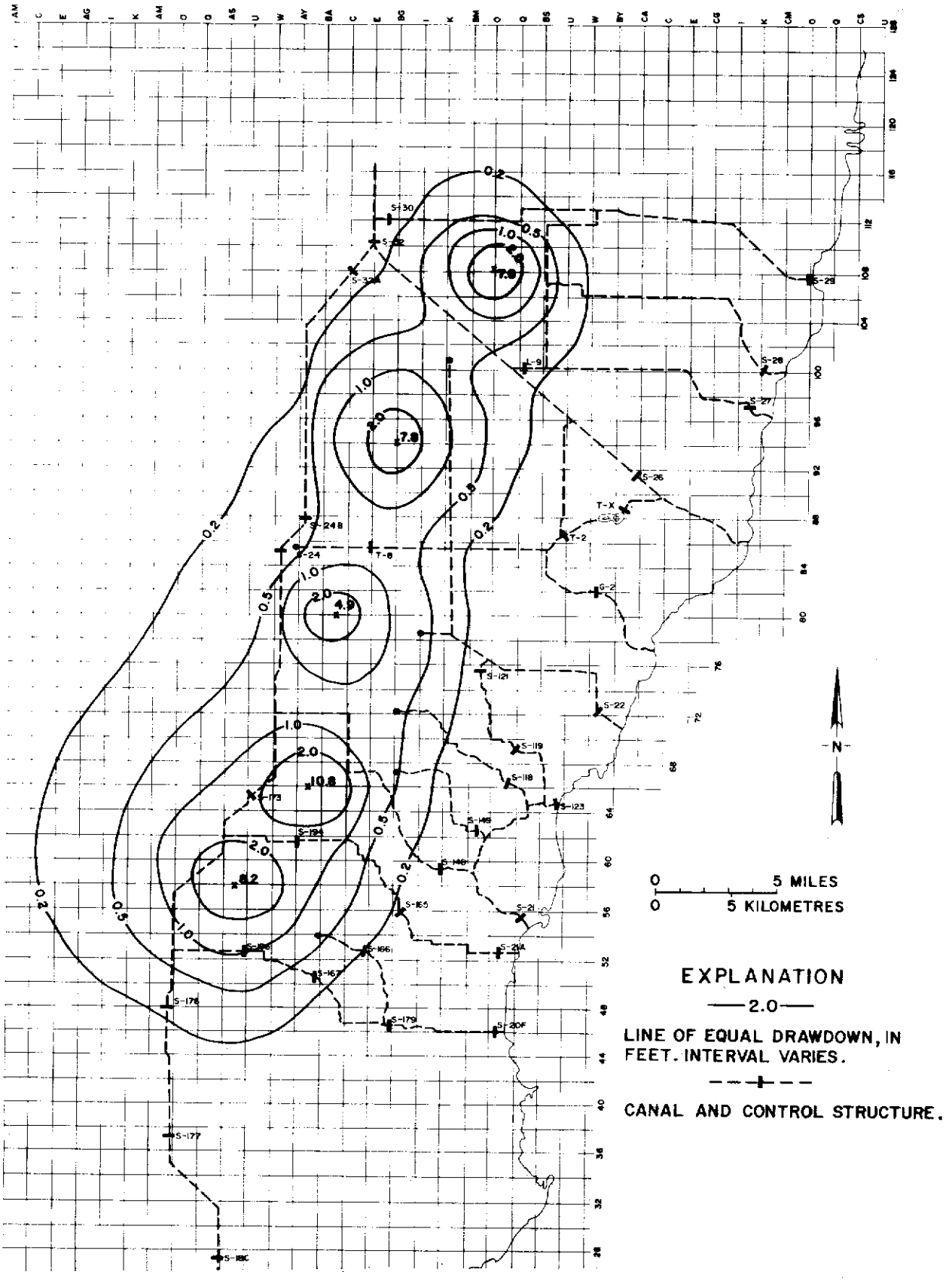


FIGURE 9.--Simulated drawdown after 7 months of continuous pumping at all sites; withdrawal rate 50 million gallons per day each.

The simulated drawdowns obtained from the model represent the water levels at sites 1-4 after 7 months of continuous pumping at each well field selected, at rates of 50, 100, and 150 million gallons per day (2.2, 4.4, and 6.6 m^3/s). Selected representations of these simulated drawdowns are shown in Figures 2-8. Assumptions are made that all pumping at each site is from a single large-capacity well and that no rainfall has occurred during the 7-month pumping period. Built into the model are the following assumed conditions: (1) as water levels decline the losses by evapotranspiration are reduced; and (2) as the drawdown effect of pumping expands to intersect the canals, infiltration from canals takes place.

Another simulation was made to show the drawdown effect at the end of 7 months caused by simultaneous pumping at all the proposed sites. The pumping rate applied at each site was 50 million gallons per day (2.2 m^3/s). The pattern of the contours in Figure 9 shows that there is interference between well fields.

Electrical measurements obtained from the model indicate that diversion of water from canals constitutes the following contributions to the total pumpage at each site: The model indicates that the percent of canal contribution changes very little at the different pumping rates.

Site number	Canal contribution (percent)
1	54
2	57
3	48
4	37
5	65

REFERENCE

Appel, C. A., 1973, Electrical-analog model study of a hydrologic system in southeast Florida: U. S. Geol. Survey open-file rept. 51 p.