

INTRODUCTION

Ground water is the sole source of freshwater for domestic, industrial, and agricultural use on Cape Cod, Massachusetts. Ground water also discharges from the aquifer into environmentally important ponds and streams. Defense-related activities at the Massachusetts Military Reservation on western Cape Cod have contaminated parts of the aquifer with fuels, solvents, and other chemicals. The altitude of the water table in the unconfined sand and gravel aquifer in the towns of Bourne, Sandwich, Mashpee, Barnstable, Mashpee, and Falmouth on March 23-25, 1993 was mapped in order to aid efforts to remediate the contamination and protect water supplies.

The Cape Cod regional ground-water-flow system is characterized by six separate flow cells, or water-table mounds (LeBlanc and others, 1986). The study area shown on this map includes the western and central parts of the westernmost flow cell, which is the largest of the six cells and underlies the most populated area of Cape Cod.

Ground water in the flow cell moves continually through the sand and gravel aquifer from recharge to discharge areas. The average annual recharge over the study area is about 20 to 22 inches (LeBlanc and others, 1986; Barlow and Hess, 1993). A total of 33 public-supply wells at 29 sites were pumped intermittently during the measurement period in the towns of Bourne, Sandwich, Barnstable, Mashpee, and Falmouth. Annual pumpage from the public-supply wells represents about 6 percent of the total recharge. Annual ground-water discharge to rivers is about 41 percent of the total recharge, and the remaining 53 percent of the total recharge discharges to the ocean (J.P. Masterson, U.S. Geological Survey, written commun., 1994). Water-level and streamflow data were collected by the U.S. Geological Survey, the Hazardous Waste Remediation Actions Program (HAZWAP), ABI Environmental Services, Inc., Camp Dresser & McKee Federal Programs Corp., and the Cape Cod Commission. This effort was part of the Installation Restoration Program of the National Guard Bureau at the Massachusetts Military Reservation.

DATA COLLECTION

Water Levels

Water levels were measured during March 23-25, 1993, in 125 observation wells and at 15 ponds. Water levels and pond altitudes were measured to an accuracy of 0.01 foot relative to the measuring point; the altitudes of the measuring points had been surveyed previously to sea level datum. Water-level measurements have been measured monthly or bimonthly at 16 observation wells in the study area since as early as 1966. Water levels measured in March 1993 fall within two standard deviations of their respective means, indicating that the water levels on this map are representative of typical hydrologic conditions for the western part of Cape Cod. Historic water-level fluctuations are shown for three selected wells in figure 1. These fluctuations are caused by seasonal and long-term variations in recharge (LeBlanc and others, 1986).

Streamflow

In addition to the water-level data, 22 measurements of streamflow discharge were made on the Coonamessett, Backus, Bourne, Childs, Quashnet, Mashpee, and Santuit Rivers during March 22-24, 1993 (table 1). Streamflow measurements made on March 24 may have been affected by precipitation; about 2 inches of precipitation occurred between March 24 and 25, 1993. Therefore, 12 additional streamflow measurements were made on the Coonamessett, Backus, Bourne, and Childs Rivers during June 16-18, 1993, when there was no precipitation (table 1). The mean daily flow at the continuous gaging station on the Quashnet River (site P) was 13.8 cubic feet per second for the period from October 1, 1988 through September 30, 1991. Streamflow measured at the gaging station on March 23, 1993 was 18.8 cubic feet per second (site P, table 1). This flow is higher than, but within two standard deviations of, the mean daily flow at this site (Barlow and Hess, 1993).

WATER-TABLE ALTITUDE

The altitude of the water table ranged from 0 along the coast to 69.35 feet above sea level in the town of Sandwich. The water-table contours indicate that ground water flows radially outward from the center of the ground-water mound in the towns of Sandwich and Bourne. Ground water discharges to the Cape Cod Canal and Cape Cod Bay to the north, Buzzards Bay to the west, Nantucket and Vineyard Sounds to the south, the Bass River in Yarmouth to the east (beyond map extent), and to other rivers and ponds within the map extent. Although pumping lowers water levels around the wells, the scale of the map and the distance between observation wells are too large to show individual cones of depression. The water-table contours are representative of the hydraulic heads measured in wells that are screened at or near the top of the saturated zone. Hydraulic heads measured in wells that penetrate to greater depths within the aquifer may be different than hydraulic heads near the water table because of vertical hydraulic gradients. Ground-water flow on Cape Cod generally is horizontal. Vertical hydraulic gradients predominate in areas of ground-water recharge and at points of ground-water discharge, such as at streams, ponds, pumping wells, and the ocean (LeBlanc and others, 1986). Pond water-level altitudes also were used to delineate the water-table contours. The ponds are hydraulically connected to the aquifer and represent the water-table position. The upstream inflection of water-table contours at the rivers indicates that ground water is discharging to the rivers. U.S. Geological Survey topographic maps were used to estimate the position of the water-table contours near streams in areas where no data were available.

REFERENCES CITED

Barlow, P.M., and Hess, K.M., 1993. Simulated hydrologic responses of the Quashnet River stream-aquifer system to proposed ground-water withdrawals, Cape Cod, Massachusetts: U.S. Geological Survey Water-Resources Investigations Report 93-4064, 52 p.

LeBlanc, D.R., Guswa, J.H., Frimpter, M.H., and Lundquist, C.J., 1986. Ground-water resources of Cape Cod, Massachusetts: U.S. Geological Survey Hydrologic Investigations Atlas 692, 4 sheets, scale 1:48,000.

EXPLANATION

- SALINE SURFACE WATER, AUTUMN 1976-- Specific conductance greater than 1,000 microsiemens per centimeter (from LeBlanc and others, 1986)
- WATER-TABLE CONTOUR-- Shows altitude in feet above sea level. Dashed where inferred. Contour interval is 5 feet
- OBSERVATION WELL -- Number indicates altitude of water table in feet above sea level. Alphabetic code is U.S. Geological Survey well number for observation wells included in long-term monitoring network and in figure 1
- RESERVOIR PUMPING STATION
- PUBLIC-SUPPLY WELL
- POUND ALTITUDE--Altitude used to construct the water-table map
- STREAMFLOW MEASUREMENT SITE--Letter code refers to site identifier, table 1
- CONTINUOUS-RECORD GAGING STATION--Letter code refers to site identifier, table 1

ALTITUDE AND CONFIGURATION OF THE WATER TABLE, WESTERN CAPE COD AQUIFER, MASSACHUSETTS, MARCH 1993

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1995

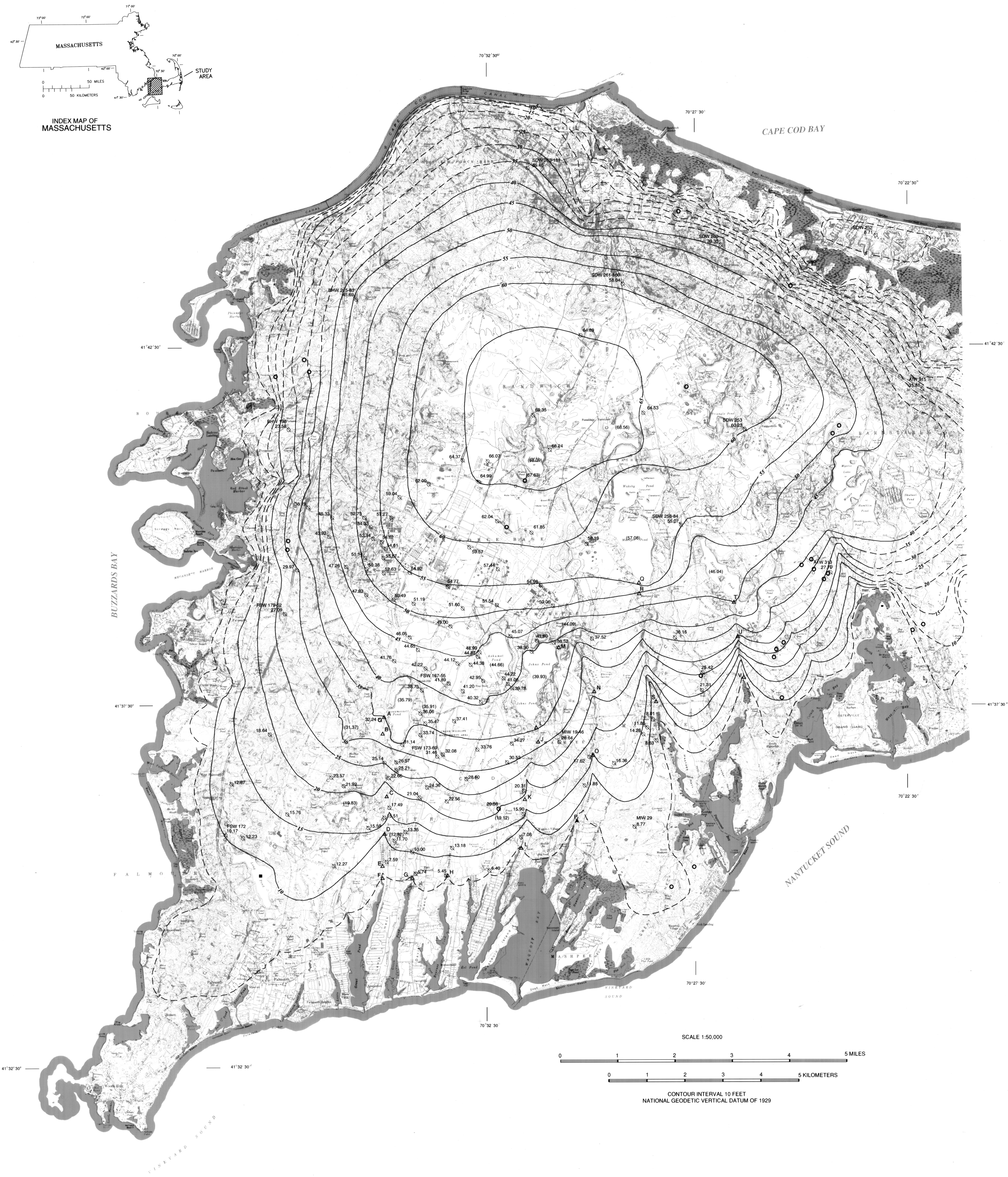


Table 1. Instantaneous discharge of streams at 22 sites measured during March 22-24, and June 16-18, 1993

Site Identifier (See map)	Site name	Date	Instantaneous discharge, in cubic feet per second
COONAMESSETT RIVER			
A	Below weir at Coonamessett Pond	3-24-93	0.23
B	At culvert north of Hatchville Road	6-17-93	.71
C	At Sandwich Road	3-24-93	.48
D	At John Parker Road	6-17-93	.72
E	At outlet of last set of bogs	3-24-93	11.7
F	At Route 28	6-17-93	7.0
G	At Route 28	3-24-93	14.5
H	At Route 28	6-17-93	5.5
I	At Route 28	3-24-93	16.8
J	At Route 28	6-17-93	10.1
K	At Route 28	3-24-93	16.6
L	At Route 28	6-17-93	11.7
BACKUS RIVER (Ashmet Valley)			
M	At Route 28	3-24-93	7.0
N	At Route 28	6-16-93	1.6
O	At Route 28	3-24-93	4.2
P	At Route 28	6-16-93	1.5
CHILD'S RIVER			
Q	At Route 151	3-23-93	4.1
R	At Route 151	6-18-93	4.7
S	At Old Barnstable Road	3-24-93	4.3
T	At Old Barnstable Road	6-17-93	6.6
U	At bogs east of Falmouth Beagle Club	3-24-93	8.4
V	At Barrows Road	6-16-93	10.1
W	At Barrows Road	3-24-93	12.9
X	At Barrows Road	6-16-93	8.2
QUASHNET RIVER			
Y	At Johns Pond outlet	3-23-93	.04
Z	At Old Barnstable Road	3-23-93	9.2
AA	At fish ladder, 0.6 mile downstream from Route 151	3-23-93	12.4
AB	Gaging Station (No. 011058837) at Waquoit Village	3-23-93	18.8
MASHPEE RIVER			
AC	At Mashpee Pond outlet	3-22-93	11.9
AD	At Route 130	3-22-93	14.6
AE	At Route 28	3-22-93	22.9
SANTUIT RIVER			
AF	At Santuit Pond outlet	3-22-93	4.2
AG	At Route 28	3-22-93	6.0
AH	At culvert on Kings Road	3-22-93	8.7

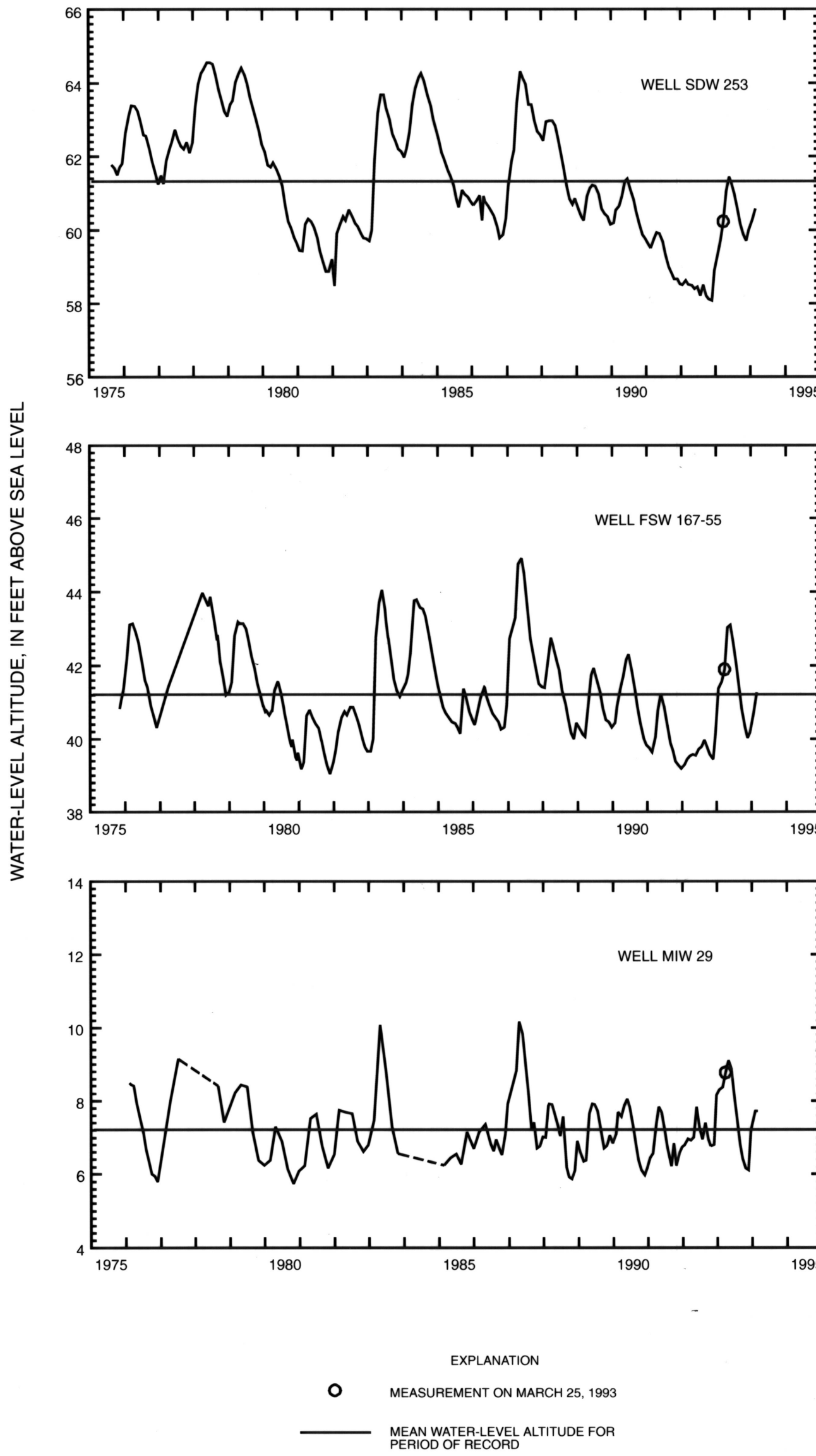


Figure 1. Historical water-level fluctuations for U.S. Geological Survey network observation wells SDW 253, FSW 167-55, and MIW 29 for 1975-93. (Locations of wells are shown on map).