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WATER-LEVEL DECLINES IN WELLS TAPPING LOWER HILLSIDE AQUIFERS, ANCHORAGE, ALASKA

By

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INTRODUCTION

The lower Hillside-Abbott area of Anchorage, as defined in figure 1, relies on local ground water for most uses. Rapid population growth has resulted in an increase in water use in the area, currently estimated at 1.5-2.0 million gallons per day (mgd). Evidence from three long-term observation wells in the area, and from reports of residential well failures indicate that area-wide water-level declines are occurring. A proposal by the Anchorage Water and Wastewater Utility (AWWU) to pump 0.75 mgd from a well near Hanshew Junior High School represents a significant increase in water extraction in the area, and a preliminary analysis suggests that the effects of such a withdrawal would be significant and widespread. This report summarizes existing data pertinent to current and projected water-level declines in the lower Hillside-Abbott area of Anchorage.

GEOLOGY

The lower Hillside-Abbott area of Anchorage is underlain by unlithified Quaternary deposits ranging from about 50 ft to as much as 700 ft in thickness (Dearborn and Barnwell, 1975). These deposits consist predominantly of silty glacial or marine sediments, with interlayered sand and gravel units that constitute aquifers. Individual aquifers are typically a few feet thick and of restricted lateral extent, although at some locations in the lower Hillside, productive aquifers have been tapped by wells that have been tested at rates of 1200 gallons per minute (gpm). Detailed mapping of specific aquifers has not occurred.

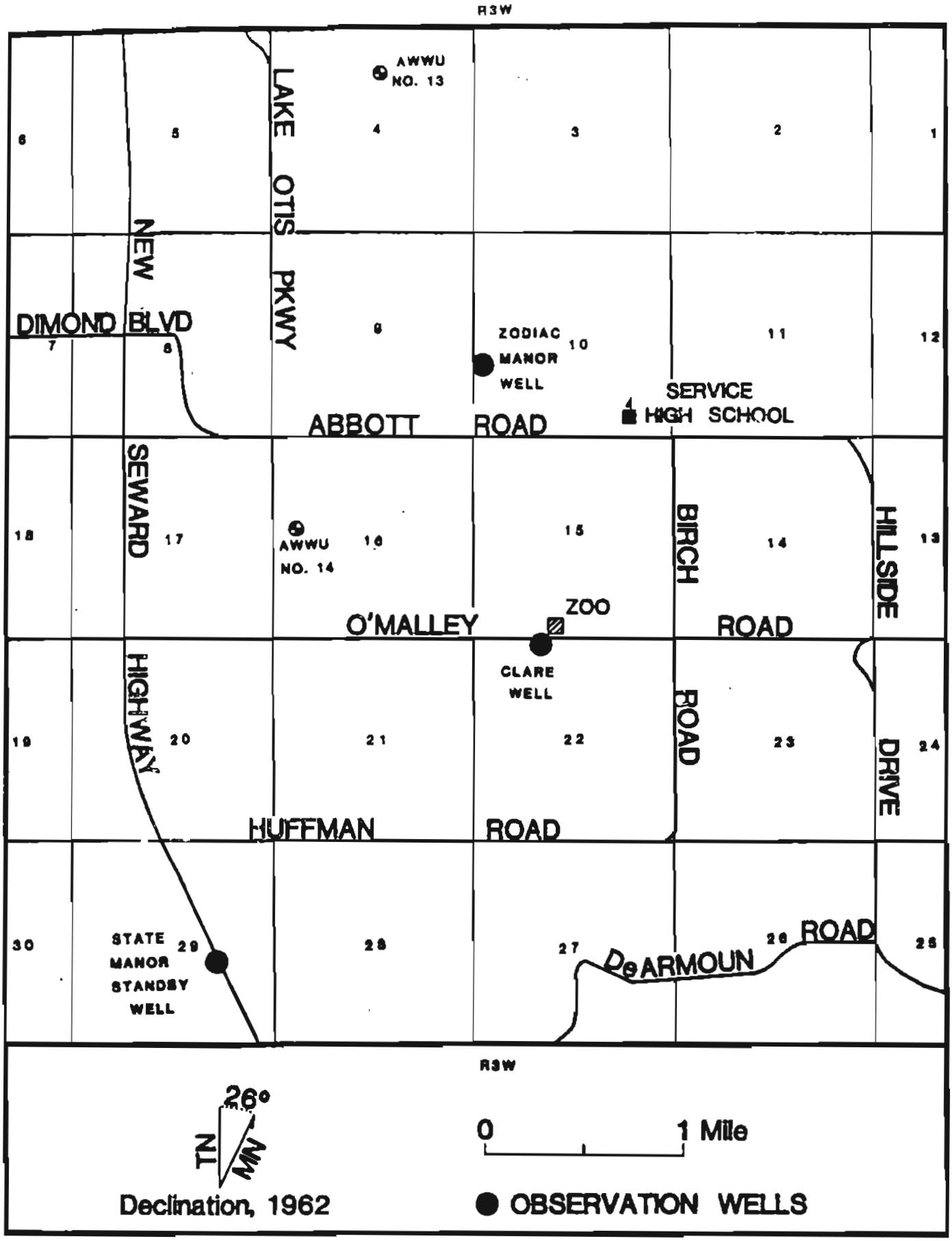

Figure 1. Location of lower Hillside-Abbott area of Anchorage, with locations of observation wells.

Where unlithified deposits are less than about 50-100 ft thick, underlying metamorphic rocks of Mesozoic or Paleozoic age constitute significant aquifers for residential use. Because water-use from bedrock aquifers is not expected to increase at a high rate in the near future and water-level declines are not as pronounced as they are in the lower Hillside-Abbott area (Updike and others, 1984), bedrock aquifers located generally east of Hillside Drive and south of DeArmoun Road are not discussed in this report.

WATER-LEVEL TRENDS

The locations of three wells in which periodic water-level observations have been made by the U.S. Geological Survey are shown in figure 1. The longest period of record is available for the Clare well, a residential well in use near the Alaska Zoo (fig. 2). The long-term average rate of water-level decline observed at this well is about 1 ft/yr. In late 1984, this well was deepened 12 ft because the static water level in the well was only several feet above the bottom of the well, and the well was not capable of supplying water for residential use.

A hydrograph for the State Manor standby well (fig. 3) exhibits non-uniform trends through the period of record, but has a long-term average rate of decline of about 1.8 ft/yr. Since 1980, its water level has declined at a rate of about 4.8 ft/yr.

The water level in the Zodiac Manor well (fig. 4), although only observed since 1980, have shown a fairly uniform declining trend of about 2.3 ft/yr. This well is slightly deeper than the average domestic well in Zodiac

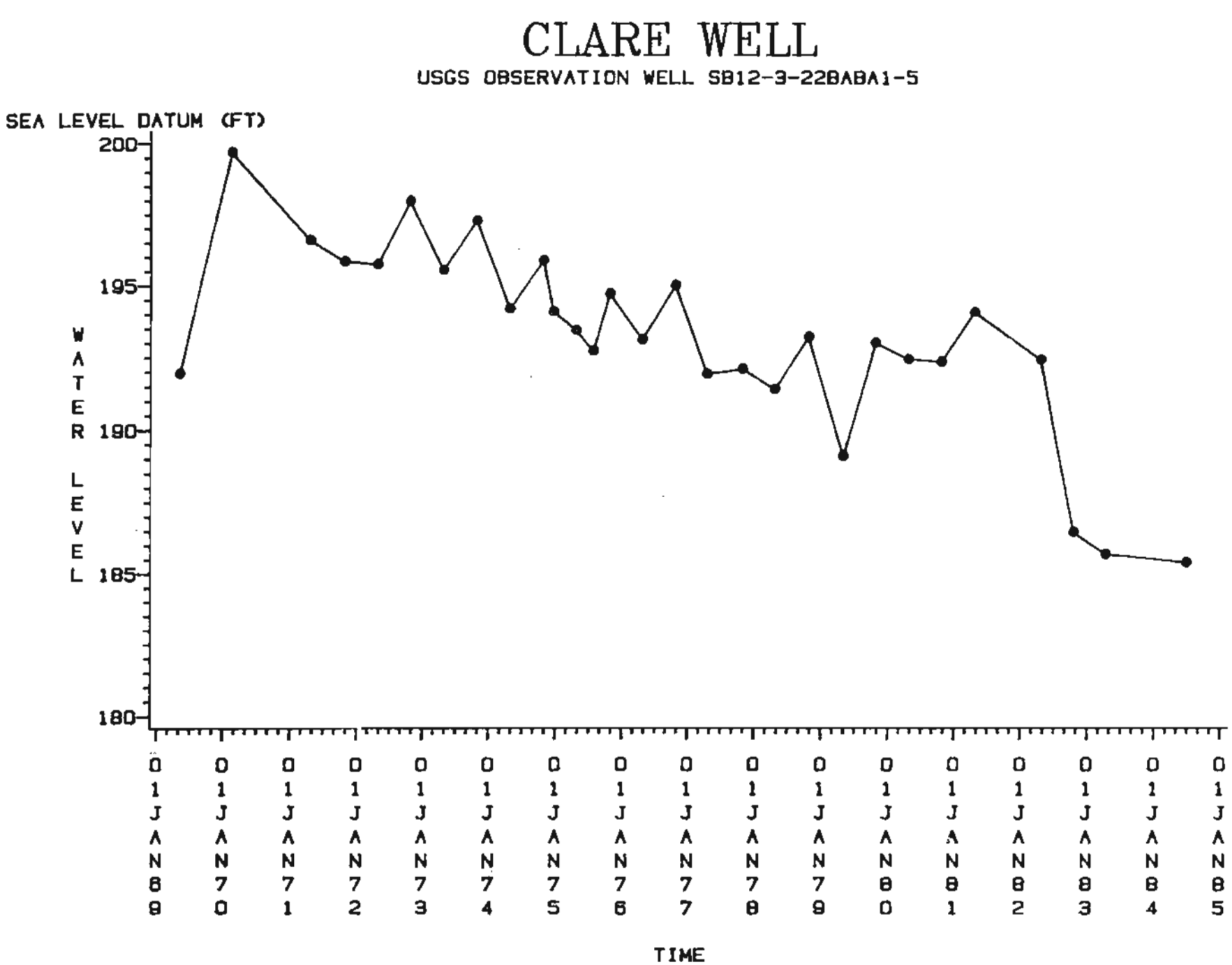

Figure 2. Water-level data from the Clare observation well.

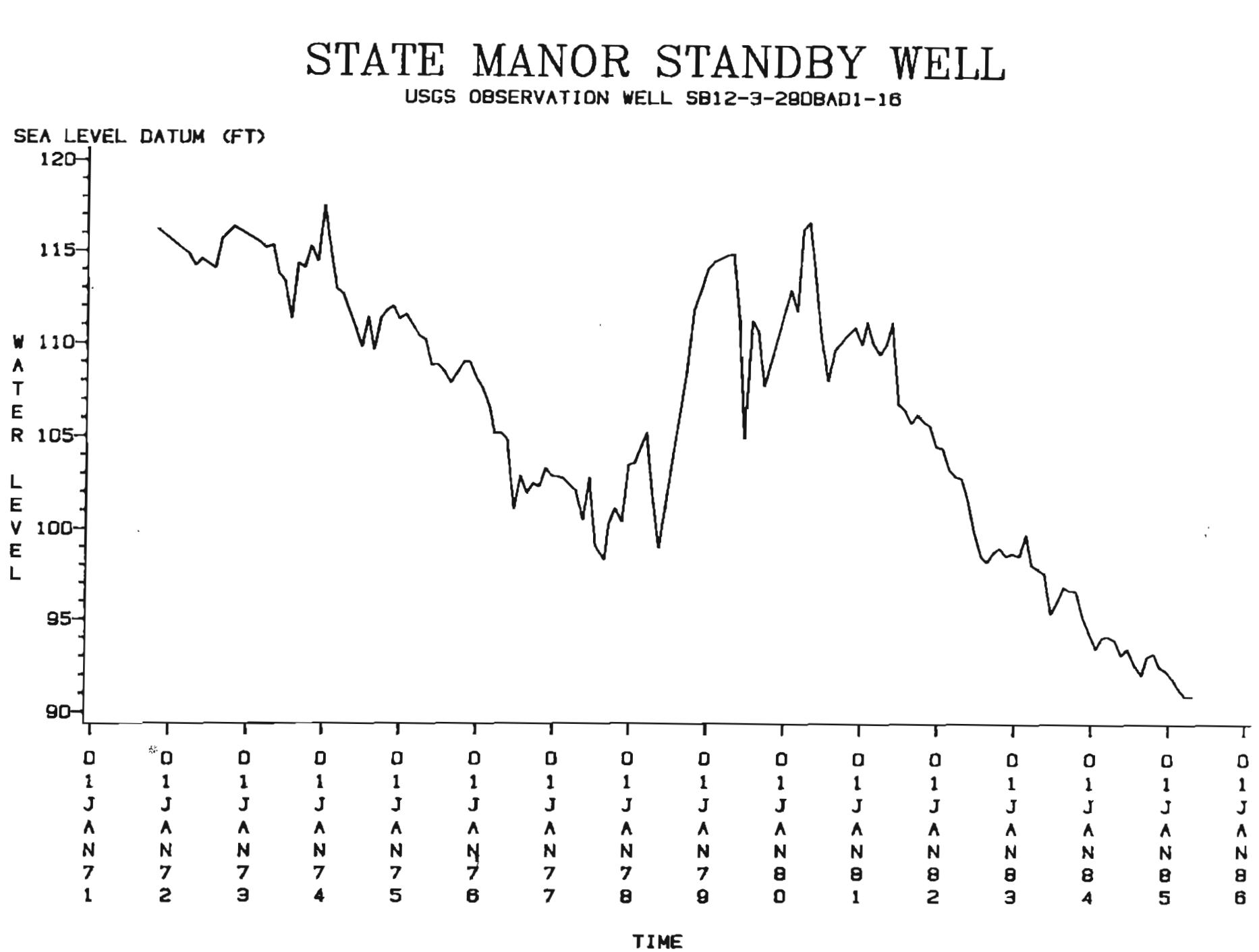

Figure 3. Water-level data from the State Manor standby observation well.

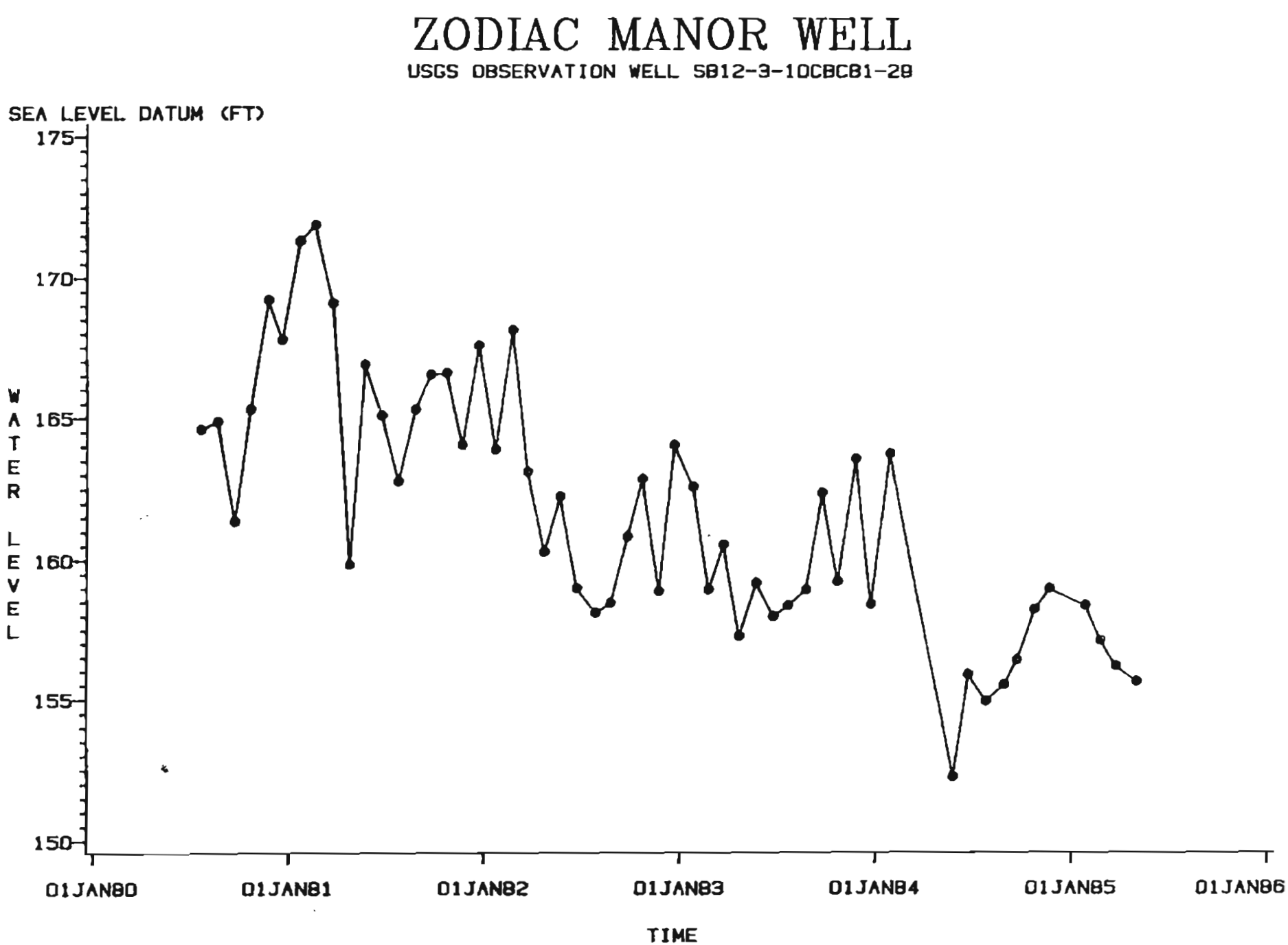

Figure 4. Water-level data from the Zodiac Manor observation well.

Manor subdivision, where many domestic wells have low tolerances to water-level declines.

To summarize, measurements in three observation wells representing aquifers in a broad area of the lower Hillside-Abbott area, document water-level declines of 1 ft/yr to as much as 4.8 ft/yr.

PROBLEMS RELATED TO DECLINING WATER LEVELS

Most domestic wells in the lower Hillside-Abbott area are completed with open-ended well casing in gravelly water-bearing strata. The reported static water level in most wells for which records exist was between ten and sixty feet above the bottom of the well at the time of well construction. Drilling records exist for more than 200 wells that had less than 25 ft of water above the bottom of the well at the time they were drilled. If area-wide water levels continue to drop, some of these wells, and others for which no record exists, can be expected to cease delivering water, a condition termed a well failure in this report. In some cases, the pump setting in a well can be lowered to at least temporarily solve the problem, but for many wells, the well must be deepened or a new well drilled to restore a water supply. The number of wells susceptible to failure is difficult to estimate because drilling records exist for less than half of all wells, and existing records are commonly inaccurate or represent hydrologic conditions that no longer exist.

Information on well failures in the lower Hillside-Abbott area is sparse, preventing quantitative estimates of well failure rates. Figure 5 shows the locations of 13 well failures known to have occurred since 1983

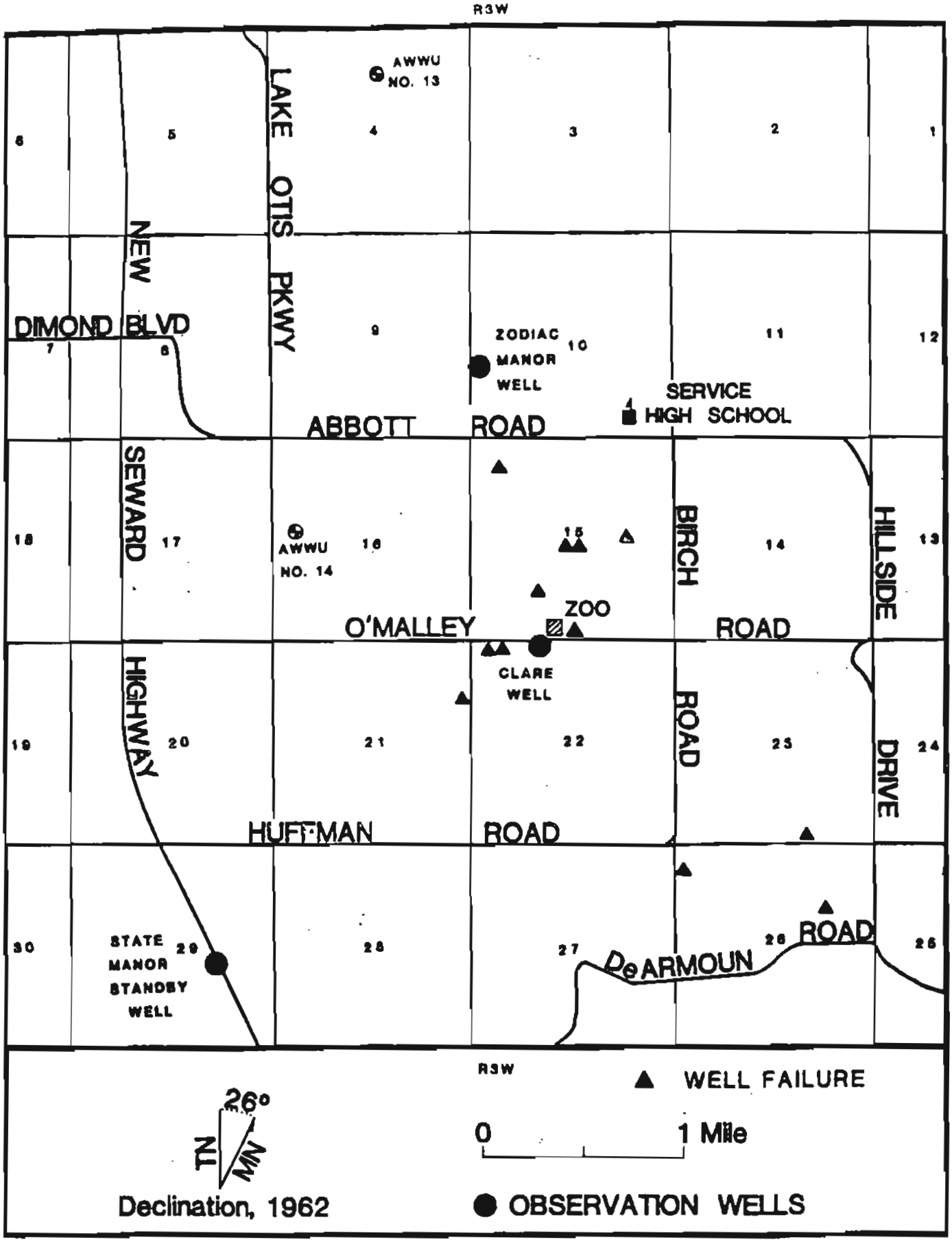

Figure 5. Locations of reported well failures in the lower Hillside-Abbott area.

that are attributed to a general water-level decline. The actual number of well failures that have occurred in the Hillside-Abbott area is suspected to be much greater than 13.

WATER USE

Actual water-use data in the lower Hillside-Abbott area are practically non-existent. However, because water use in predominantly residential areas such as the Hillside is closely related to population, estimates of water use can be made. Using a per capita use figure of 100 gallons per person per day, and 1983 population figures, water-use totals per section of land in 1983 are estimated as shown in figure 6. According to figures for U.S. census tract 28.01 (oral commun., Community Planning Department, Municipality of Anchorage, 7-13-84), population (and presumably water use) increased about 50 percent between 1980 and 1983.

Application has been made to the Alaska Division of Land and Water Management for a permit to extract 0.75 mgd of water from AWWU well no. 14 in section 16 of T12N R3W. Considering existing estimated water-use in a 9 sq mi area centered on section 16, this proposed pumping represents a 55 percent increase in water extraction. Additionally, a golf course is under construction in section 16, and current plans call for drilling a well capable of supplying water during the summer months for grass watering and water-trap maintenance. Continued population growth in the lower Hillside-Abbott area is expected to result in continued increases in water use from private wells and community water systems at an unknown rate.

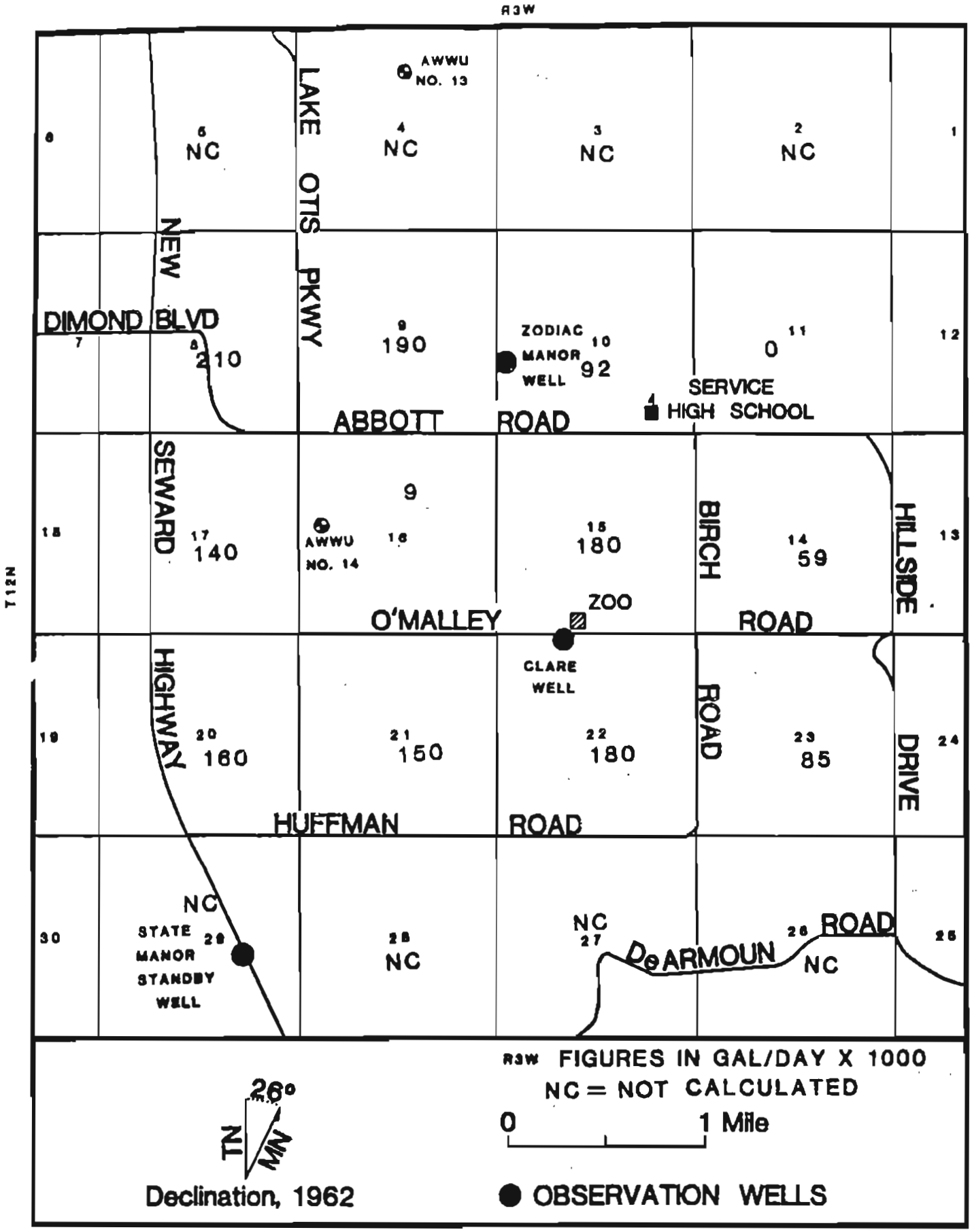

Figure 6. Estimated water use by section in 1983 in the lower Hillside-Abbott area.

EFFECTS OF INCREASING WATER USE

A preliminary two-dimensional ground-water flow model has been constructed for the lower Hillside-Abbott area. The model is based on the Prickett and Lonnquist (1971) code, modified by Walton (1983). The model has been calibrated with existing data to simulate both the natural steady-state ground-water flow system and historic water-level declines estimated to be about 20 ft over much of the lower Hillside-Abbott area. Transmissivity values used in the model for the Quaternary aquifer system range from 27 to 8000 ft^2/day, and a storativity value of 0.001 was used. These values are consistent with data obtained from a limited number of aquifer tests conducted in the area. Simulation of pumping at a rate of 0.73 mgd at AWWU well no. 14 results in about 20 ft of drawdown occurring at a 1 mi radius of the well after long-term pumping. Cursory examination of surrounding well records indicates that numerous wells would be significantly affected by such drawdown.

The preliminary model projections of the effects of increasing water use presented above are useful as a general indication of the magnitude of anticipated effects. Of key importance, however, is that the declining water-level trends at existing observation wells show no signs of leveling off or reversing, and that hundreds of wells in the lower Hillside-Abbott area have fairly low tolerances to water-level declines. Existing reports of well failures represent an under-reporting of actual well failures, and significant potential may exist for large numbers of future well failures.

CURRENT PROBLEMS

At the present time, the areal extent of declining water levels and associated well problems is not clearly defined. Nor have pumping wells been identified that are the most significant contibutors to current water-level declines. Although estimates of future water-level declines and well failure rates are important to water management, a shortage of information regarding current water levels and hydraulic characteristics of the aquifer system dictates that only crude estimates can presently be made. Increasing conflicts between existing water users in the area and developers of new ground-water supplies suggest that state and municipal water managers may be forced to take an increasingly active role in selecting and providing water supplies for continued growth in the lower Hillside-Abbott area of Anchorage.

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