STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

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Report of Investigations 87-12

WATER-LEVEL DECLINES IN WELLS TAPPING LOWER HILLSIDE AQUIFERS ANCHORAGE, ALASKA (1985)

By
L.L. Dearborn and J.A. Munter

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WATER-LEVEL DECLINES IN WELLS TAPPING LOWER HILLSIDE AQUIFERS, ANCHORAGE, ALASKA (1985)

by
L.L. Dearborn[1] and J.A. Munter[2]

INTRODUCTION

The lower Hillside-Abbott area of Anchorage (fig. 1) relies on local ground water for most of its water supply. Rapid population growth in the area resulted in an increase in water use, which in 1987 reached about 1.5 to 2 million gallons per day (mgd). Evidence from three long-term observation wells and from reports of residential well failures indicates that areawide water-level declines are occurring. Further, Anchorage Water and Wastewater Utility (AWWU) has submitted a proposal to pump 0.72 mgd from a well near Hanshew Junior High School. A preliminary analysis suggests that the effects of such a withdrawal would be significant and widespread.[3] In this report, we summarize the existing data pertinent to current (July 1985) and projected water-level declines in the lower Hillside-Abbott area.[4]

GEOLOGY

The lower Hillside-Abbott area is underlain by unlithified Quaternary deposits that range from about 50- to 700-ft thick (Dearborn and Barnwell, 1975). The deposits consist predominantly of silty glacial or marine sediments with interlayered sand and gravel units that form aquifers. Individual aquifers are typically a few feet thick and are restricted laterally, which results in relatively low yields to wells [$\leq$20 gallons per minute (gpm)]. At some locations in the lower Hillside, productive aquifers have been tested at 1,200 gpm. Specific aquifers have not been mapped in detail.

In the southeast corner of the study area near Hillside Drive and DeArmoun Road, the Quaternary deposits are less than about 50- to 100-ft thick (Dearborn and Barnwell, 1975), and are underlain by metamorphic rocks of Mesozoic or Paleozoic age that form significant aquifers for residential use. These aquifers, however, are not the subject of this investigation 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 in aquifers of this type as they are in aquifers found in the Quaternary deposits west of Birch Road (Updike and others, 1984).

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[2]DGGS, P.O. Box 772116, Eagle River, Alaska 99577.
[3]As of October 7, 1987, a decision concerning the water-rights application submitted by AWWU was still pending (G.J. Prokosch, Alaska Division of Land and Water Management, oral commun., 1987).
[4]Additional information regarding water-level declines in the lower Hillside-Abbott area is contained in Munter (1987).

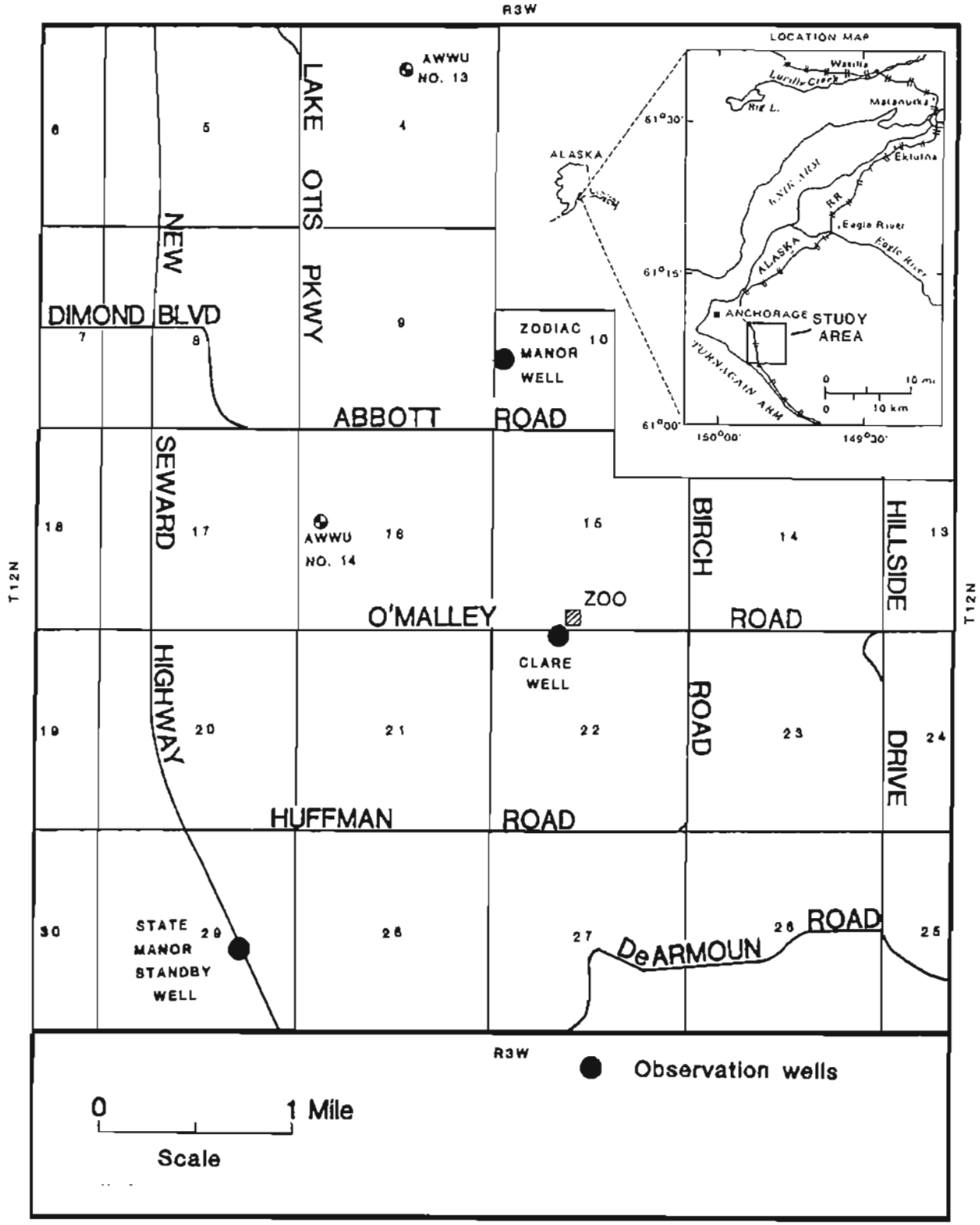

Figure 1. Locations of observation wells in lower Hillside-Abbott area, Anchorage.

WATER-LEVEL TRENDS

Figure 1 shows the locations of three wells in which periodic water-level observations have been made by the U.S. Geological Survey. The longest period of record (15 yr) is 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. During late 1984, the Clare well was deepened 12 ft because the static water level in the well was only several feet above the bottom of the well; thus, the well was not capable of supplying sufficient quantities of water for residential use.

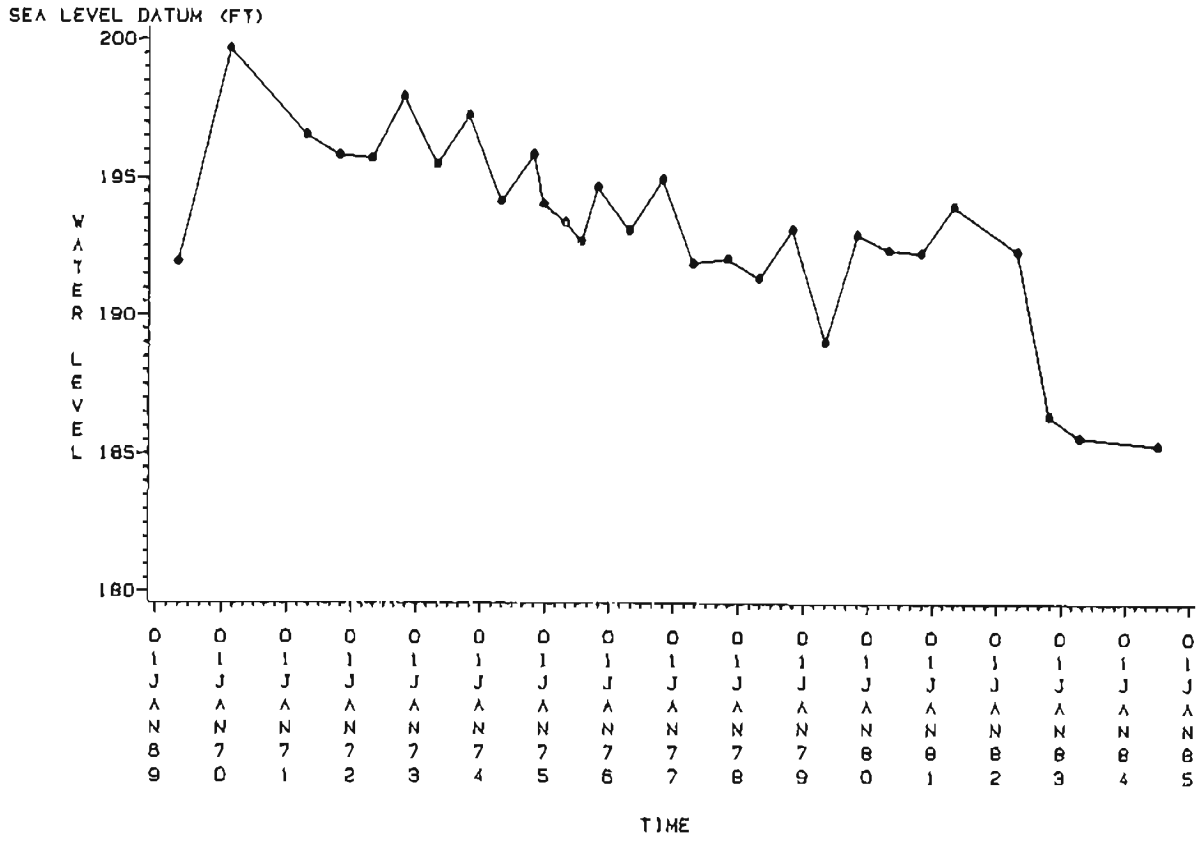

Figure 2. Water-level data from Clare observation well (U.S. Geological Survey observation well SB12-3-22BABA1-5). See figure 1 for location of well.

A hydrograph for the State Manor standby well (fig. 3) exhibits a non-uniform trend throughout 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, has shown a fairly uniform declining trend of about 2.3 ft/yr. This well is slightly deeper than the average domestic well in Zodiac Manor subdivision.

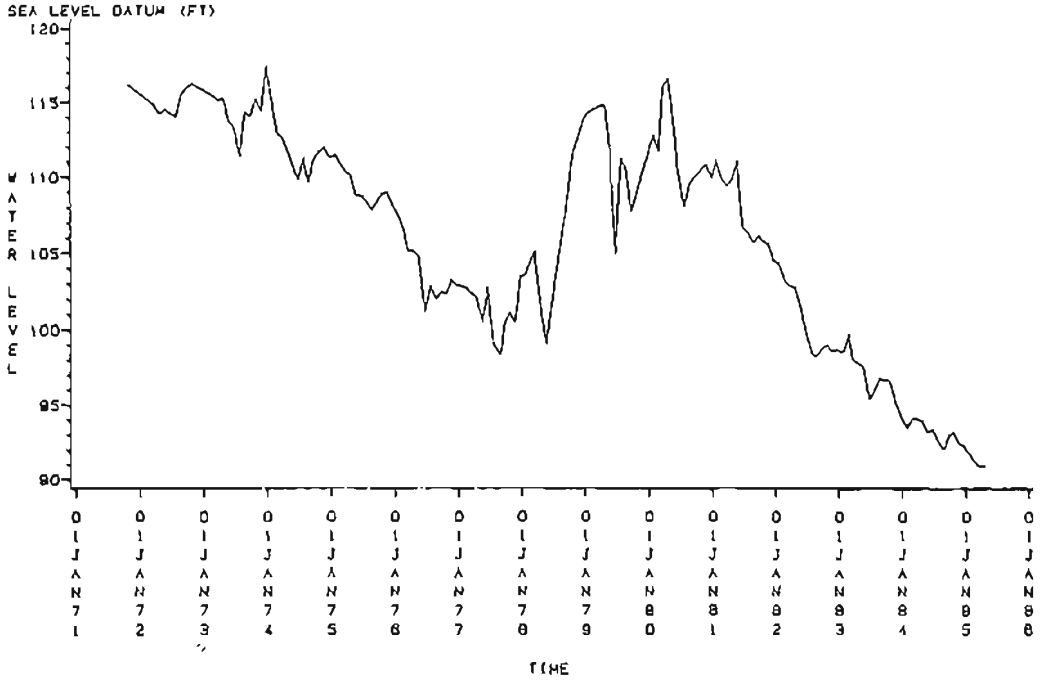

Figure 3. Water-level data from State Manor standby observation well (U.S. Geological Survey observation well SB12-3-29DBAD1-16). See figure 1 for location of well.

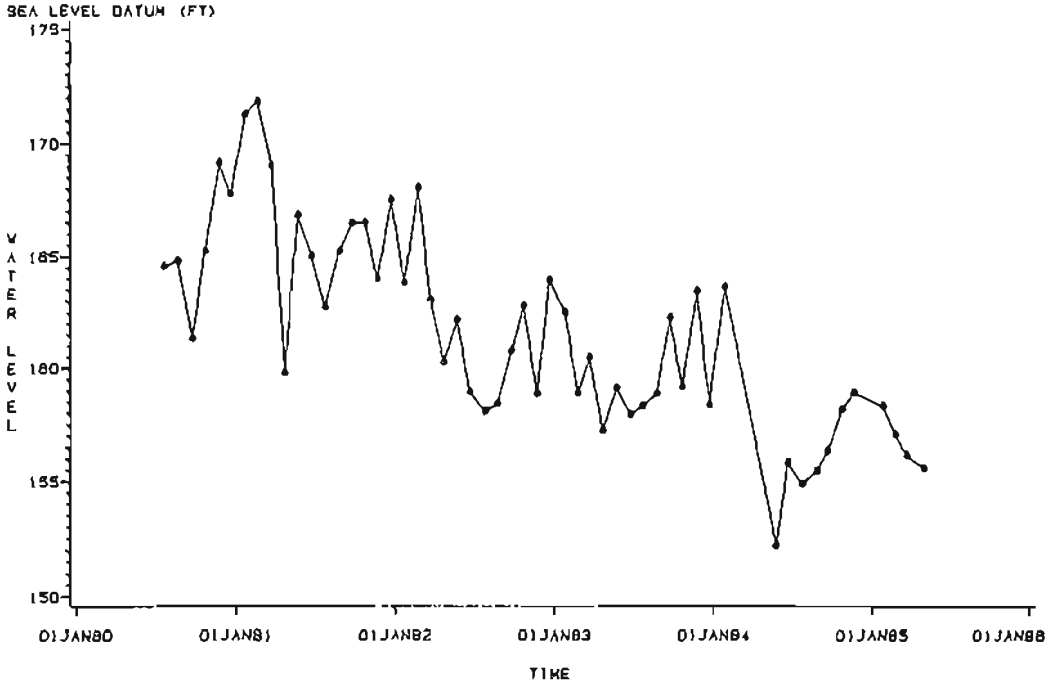

Figure 4. Water-level data from Zodiac Manor observation well (U.S. Geological Survey observation well SB12-3-10CBCB1-29). See figure 1 for location of well.

To summarize, measurements from three observation wells that represent aquifers in a broad area of the lower Hillside-Abbott area document water-level declines of 1 to 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. At the time of well construction, the reported static water level in most wells for which records can be found was between 10 and 60 ft above the bottom of the well. Drilling records exist for more than 200 wells that had <25 ft of water above the bottom of the well at the time they were drilled. If areawide water levels continue to drop, these wells and others can be expected to cease delivering water, a condition termed well failure. In some cases, the pump setting in a well can be lowered to solve the problem, although it may be only a temporary solution if water levels continue to decline. 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.

Because information on well failures in the lower Hillside-Abbott area is sparse, rates of well failures cannot be quantified. Between 1983 and 1985, 13 well failures attributable to a general water-level decline were reported from the lower Hillside-Abbott area (fig. 5). The actual number of well failures, however, is suspected to be much greater than 13.

WATER USE

Water-use data in the lower Hillside-Abbott area are practically nonexistent. Estimates of water use can be made, however, because water use in predominantly residential areas, such as the Hillside, is closely related to population. Using a per capita use figure of 100 gal/person/day and 1983 population figures, water-use totals per section of land were estimated and are shown in figure 6. According to figures from the 1980 U.S. census (Community Planning Department, Municipality of Anchorage, oral commun., 1984), population and presumably water use in the area 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 0.72 mgd of water from AWWU well 14 in sec. 16, T. 12 N., R. 3 W. Considering existing estimated water use in a 9-mi^2 area centered on sec. 16, this proposed pumping would represent a 55-percent increase in water extraction. Continued population growth in the lower Hillside-Abbott area is expected to result in continued increases in water use at an unknown rate from private wells and community water systems.

EFFECTS OF INCREASING WATER USE

A preliminary two-dimensional ground-water flow model has been constructed for the lower Hillside-Abbott area. The model, based on the Prickett and Lonnquist (1971) code modified by Walton (1984), has been

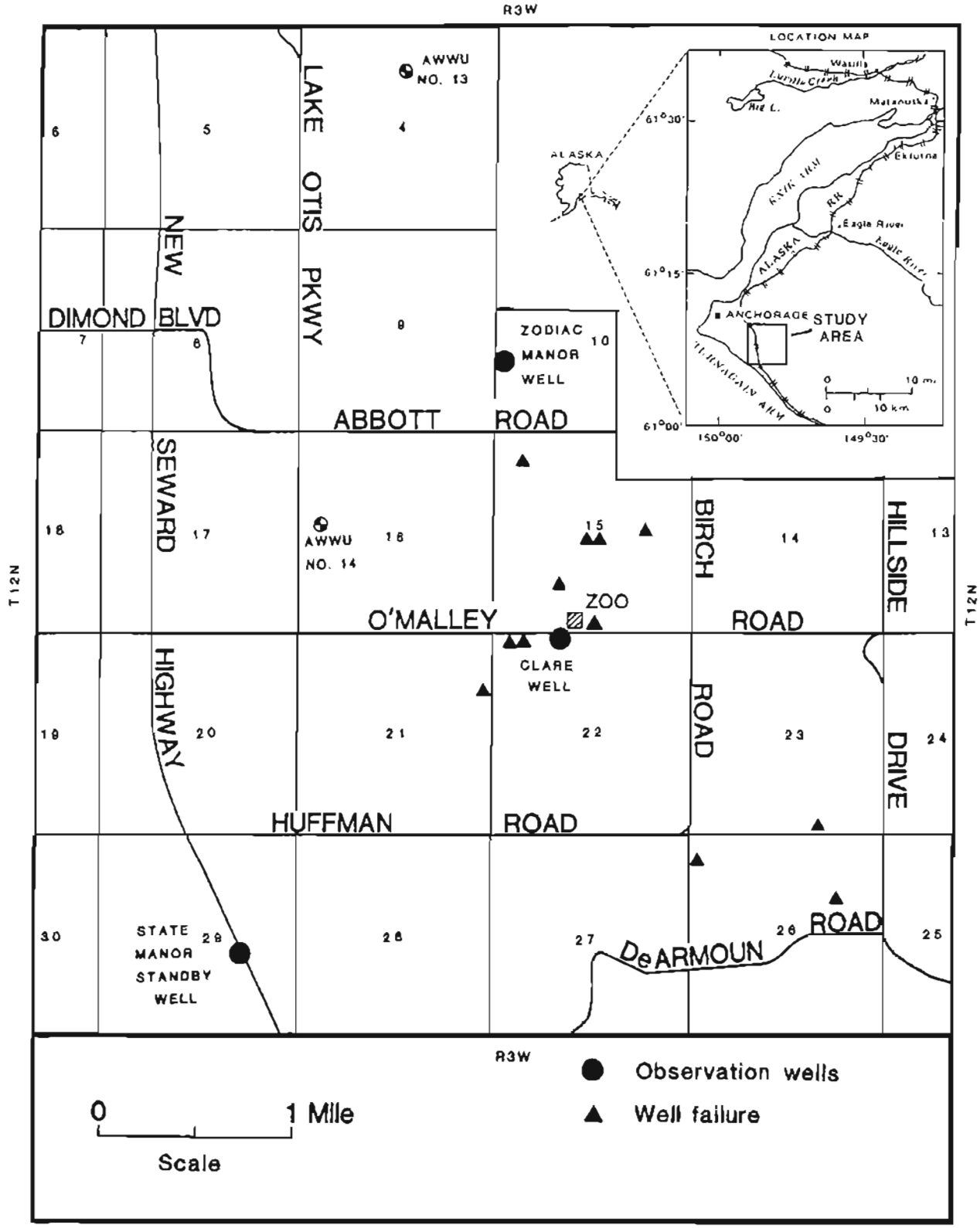

Figure 5. Locations of reported well failures, lower Hillside-Abbott area.

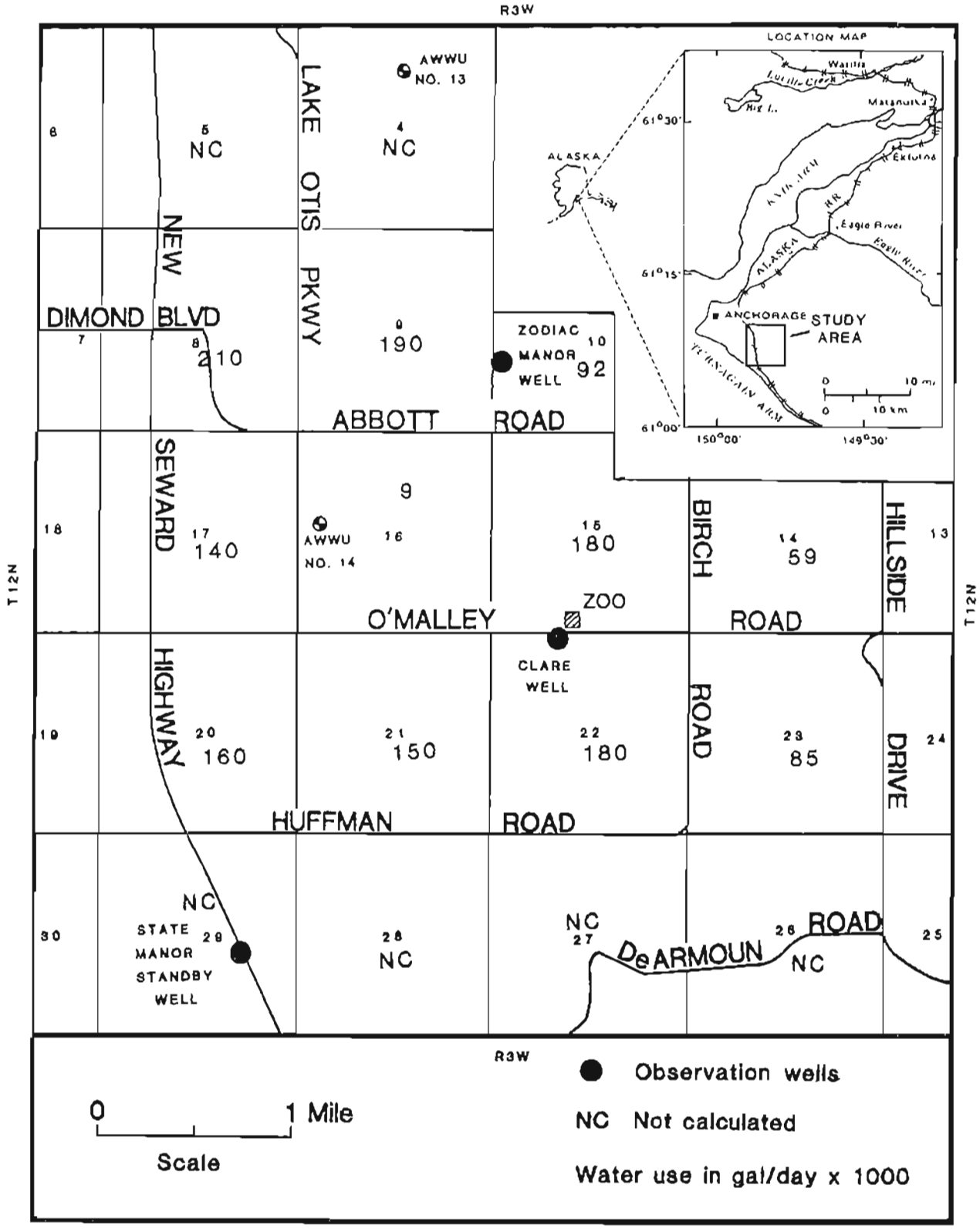

Figure 6. Estimated water use by section, lower Hillside-Abbott area, 1983.

calibrated with existing data to simulate both the natural steady-state ground-water flow system and historic water-level declines; the declines are about 20 ft over much of the lower Hillside-Abbott area (figs. 2, 3, and 4). Transmissivity values used in the model range from 27 to 8,000 ft^2/day; the storativity value, 0.001. These values are consistent with data obtained from a limited number of aquifer tests conducted in the area. Simulation of long-term pumping at a rate of 0.72 mgd from AWWU well 14 resulted in about 20 ft of drawdown at a 1-mi radius from the well. Cursory examination of records of surrounding wells indicates that numerous wells would be significantly affected by such a drawdown.

The preliminary model presented above is useful as a general indicator of the effects of increased water use. 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 underreporting of actual well failures, and significant potential may exist for large numbers of future well failures.

CURRENT PROBLEMS

At the present time (July 1985), the areal extent of declining water levels and associated well problems is not clearly defined nor have the most significant contributors to current water-level declines been identified. Only crude estimates can presently be made of future water-level declines and well-failure rates because of a shortage of information regarding current water levels and hydraulic characteristics of the aquifer system. 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 the lower Hillside-Abbott area of Anchorage.

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