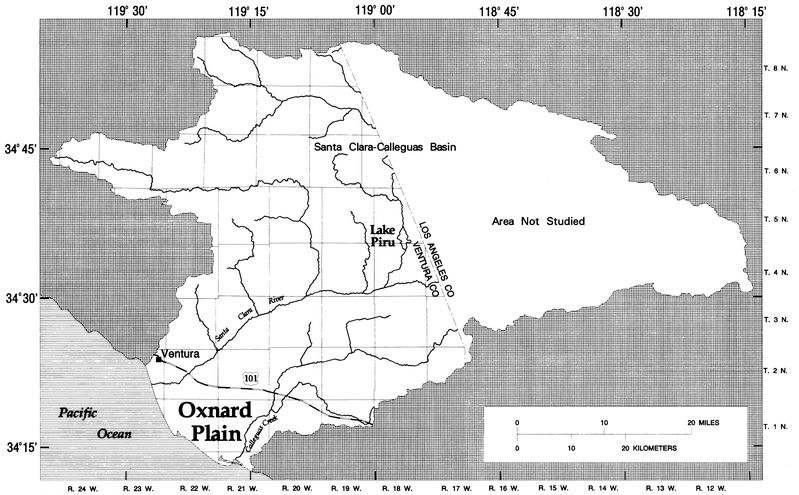
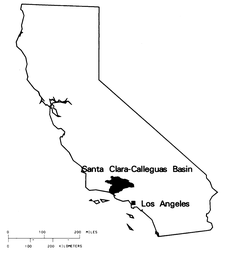
Open-File Report 93-147



Coastline Digitized From U.S. Geological Survey 1:24,000 Orthophotoquad Maps; Oxnard, 1986, Point Mugu, 1976, and Ventura, 1987.
Rivers, Roads, and Towns Digitized From U.S. Geological Survey 1:100,000 Maps; Cuyama, 1981, Lancaster, 1981, Los Angeles, 1979, and Santa Barbara, 1982.
Basin Boundary Digitized From California Department of Water Resources 1:24,000 Names and Areal Code Numbers of Hydrologic Areas in the Southern District, 1964.

Figure 1. Location of the Santa Clara-Calleguas Basin, California.



INTRODUCTION

The Santa Clara-Calleguas Basin is located in Ventura and Los Angeles Counties, California (fig. 1). Previous studies (Izbicki, 1991, and Stamos and others, 1992) indicated that leakage of water through failed casings or seals of abandoned water wells is a source of contamination to underlying aquifers. Leakage of water through abandoned wells is a problem--particularly near the coast, where the shallow "perched" aquifer underlying the Oxnard Plain generally contains ground water of poor quality. In some areas, the ground water is more saline (chloride concentration as high as 21,000 milligrams per liter) than seawater. Also, concentrations of nitrate and other contaminants in other areas exceed the U.S. Environmental Protection Agency (1991) maximum contaminant levels for drinking water.

To determine the extent of the problem of leakage of water through abandoned wells in the Santa Clara-Calleguas Basin, there is a need to identify the number and location of abandoned wells. Field inventories are most commonly used to identify abandoned wells. However, an inventory of the Santa Clara-Calleguas Basin would be time consuming and expensive because the basin covers more than 2,010 square miles and contains more than 4,800 wells. This report describes the use of an existing geographic information system (GIS) to estimate the number and location of abandoned water wells in the Santa Clara-Calleguas Basin. This study was funded as part of the U.S. Geological Survey's Southern California Regional Aquifer-System Analysis (RASA) program.

HYDROGEOLOGY

The Santa Clara-Calleguas Basin contains a complex system of freshwater-bearing aquifers more than 1,000 feet thick. These aquifers underlie the valley floors and coastal plains, occupying about 320 square miles of the study area. Most wells in the study area are located in these areas. Prior to ground-water development, hydrologic heads (water levels) in aquifers underlying the Oxnard Plain were as much as 20 feet above land surface, and ground water moved upward from deeper aquifers to discharge at land surface or into the Pacific Ocean. As a result of pumping, water levels in deeper aquifers declined, causing a reversal in the normal direction of ground-water flow. This has created water-quality problems in aquifers underlying the Oxnard Plain--especially near the coast, where freshwater aquifers are overlain by a shallow unconfined aquifer known as the "perched" aquifer. The perched aquifer contains poor-quality ground water, which in some areas is more saline than seawater. Water levels in the perched aquifer have remained above sea level during pumping conditions, creating the potential for saline water from this aquifer to move downward through failed well casings and leaking sanitary seals around wells, thereby contaminating underlying aquifers (Stamos and others, 1992).

USE OF A GEOGRAPHIC INFORMATION SYSTEM TO IDENTIFY ABANDONED WELLS

A comprehensive GIS for the study area has been developed as part of the RASA program from data obtained from local, State, and Federal agencies. The GIS covers that part of the Santa Clara-Calleguas Basin in Ventura County and includes a master well data base, a well-construction data base, and a pumpage data base. The number and location of abandoned wells were estimated by analyzing these three data bases.

Master Well Data Base

The master well data base stores records of wells in the study area according to their location in the rectangular subdivision of public land (State well number). For example, in the well number 001N021W29D003S, the first four characters indicate the township (T. 1 N.), the next four characters indicate the range (R. 21 W.), the next number indicates the section (sec. 29), and the letter following the section number indicates a quarter-quarter section or 40-acre area (D). Within each quarter-quarter section, the wells are numbered serially, as indicated by the final digit. In this example, the well is the third well officially numbered in the quarter-quarter section. The final "S" indicates that the well is referenced to the San Bernardino base line and meridian.

In the 1960's, wells reported drilled in the study area were field inventoried and their locations were recorded on maps. The master well data base includes all these wells and all wells drilled since the 1960's. Wells that could not be located in the field are assumed to be abandoned. Many of these wells were covered by new development (roads, buildings, and fields) and may not have been properly sealed to prevent leakage through the well bore.

The data base does not include the wells that were not field inventoried, even though they have been assigned a State well number. Therefore, if serial numbers for a particular 40-acre subdivision are missing in the data base (for example, if the first serial number is 002 instead of 001), the missing serial numbers are assumed to represent abandoned wells.

Using this approach, 878 wells were identified as abandoned (fig. 2*A*). Analysis of the master well data base alone cannot identify all abandoned wells because many wells were abandoned after the 1960's.

Well-Construction Data Base

The well-construction data base includes information on wells that have been reported abandoned, capped, or unused since the 1960's. On the basis of this information, 170 wells were identified as abandoned (fig. 2*B*). This estimate is low because many well owners do not report their abandonment of wells.

Pumpage Data Base

In the study area, all well owners are required to report pumpage of more than 24 acre-feet per year, and this information is stored in the pumpage data base by well number. If the pumpage record of an individual well in the data base ends, the well is assumed to be abandoned for the purposes of this study. On this basis, 167 wells were identified as abandoned (fig. 2*C*). This analysis may overestimate the number of abandoned wells since the 1960's because the pumpage from some wells that still are active (not abandoned) might be less than 24 acre-feet--the quantity required to be reported.

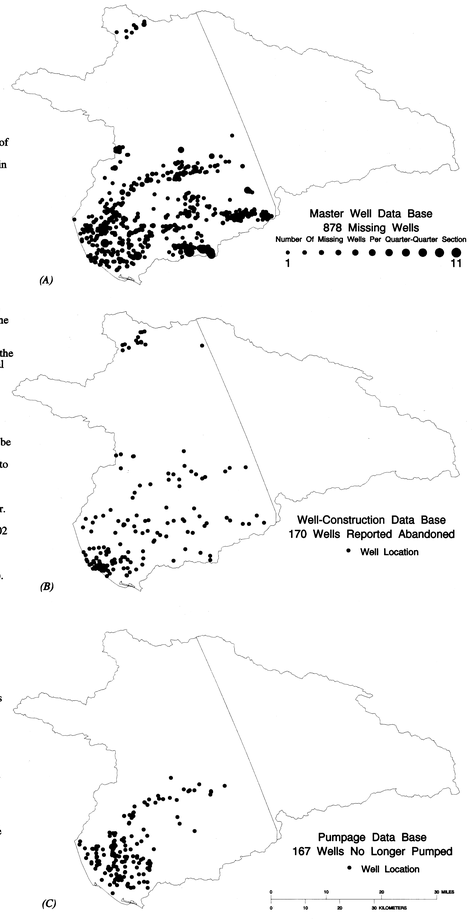


Figure 2. Location of wells identified as abandoned in the (*A*) master well data base, (*B*) well-construction data base, and (*C*) pumpage data base.

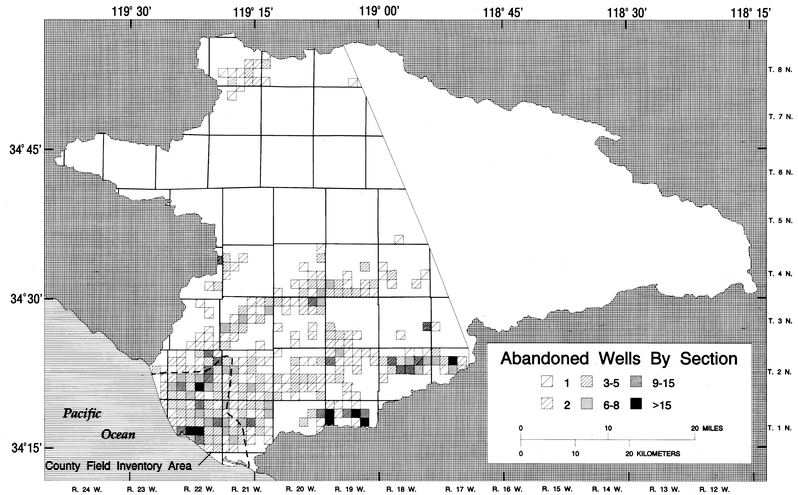


Figure 3. Number of wells abandoned by section.

Comparison Of GIS And Field Inventory Methods

To verify the effectiveness of the GIS analysis to identify abandoned wells, the results were compared with those from a comprehensive field inventory previously completed by Ventura County on a small part (87 square miles) of the study area (Ventura County Resource Management Agency, 1980). The County's field inventory identified 238 abandoned wells (fig. 3). In contrast, the GIS analysis identified about 100 wells for the same area. This difference is attributed primarily to the fact that many wells constructed prior to the 1960's were not reported, and therefore were never entered into the data base.

CONCLUSIONS

An analysis of the master well, well-construction, and pumpage data bases for Ventura County identified 1,215 wells as abandoned. Most of the abandoned wells are located on the Oxnard Plain. However, abandoned wells can be found throughout the study area. Although the GIS analysis is not as accurate as a field inventory, the results provide a relatively rapid and inexpensive technique to identify areas where leakage through abandoned wells may be a potential source of ground-water contamination.

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Use Of A Geographic Information System To Identify Abandoned Wells

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1993