Prepared in cooperation with the
SANTA CRUZ COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 79-1065

SUMMARY

Ground-water recharge potential was classified for the Santa Cruz Coastal Area, North-Central Area, and Soquel-Aptos Area in Santa Cruz County, Calif. The classification was based on three data elements that affect recharge: slope, soils, and geology. The three elements were mapped separately in the study areas, and a numerical map for each element based upon an arbitrary rating scheme, was made. The three maps were then composited into a single numerical map. The final map was made from the composite map using a classification system that ranked the numbers into areas of good, fair, and poor recharge potential. It was found that most of the Santa Cruz Coastal Area and the North-Central Area have a poor recharge potential. Much of the Soquel-Aptos Area was mapped as having a good to fair recharge potential.

INTRODUCTION

Ground water is the principal source of water supply in Santa Cruz County, Calif. The aquifers are replenished by local rainfall, either by direct infiltration from the land surface or by seepage from creeks. Areas where replenishment takes place are called recharge areas, and knowledge of recharge conditions is desirable for development and management of the ground-water resources. The quantity and quality of water recharging a ground-water system are major factors determining the quantity and quality of ground water in the areas of withdrawal.

Purpose and Scope

The purpose of this study, made in cooperation with the Santa Cruz County Flood Control and Water Conservation District, was to map and classify the ground-water recharge areas in three parts of Santa Cruz County: Santa Cruz Coastal Area, North-Central Area, and Soquel-Aptos Area (fig. 1). The mapping is needed to guide management actions to prevent reduction in recharge potential and pollution of recharge water.

The study was limited to the classification of land surfaces and earth materials in the three designated areas on the basis of their ability to permit recharge. Quantitative determinations of rates, volumes, and quality of recharge and recharge by subsurface flow from adjacent areas were beyond the scope of the study.

The Association of Monterey Bay Area Governments has contracted with private consultants to delineate the recharge areas in the San Lorenzo Area and the Pajaro Valley Area (fig. 1). The consultants' mapping, together with that presented in this report, will complete the recharge-area mapping of Santa Cruz County.

Conversion Factors

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

Inch-pound units	Multiply by	Metric
ft (feet)	0.3048	meters
inches	25.4	millimeters
in/hr (inches per hour)	25.4	millimeters per hour
mi (miles)	1.609	kilometers
mi^2 (square miles)	2.590	square kilometers

Use the following to convert degrees Fahrenheit (°F) to degrees Celsius (°C): Temp °C = (temp °F-32)/1.8.

Location and General Features

Santa Cruz County borders on the Pacific Ocean and Monterey Bay (fig. 1), about 50 mi south of San Francisco. It is an area of mountains, valleys, and terraces. Altitudes range from sea level to about 3,000 ft.

The area has a mild climate characterized by dry summers and wet winters. About 90 percent of the annual precipitation occurs from November through April. The average annual precipitation ranges from about 20 inches along the coast to about 60 inches over the higher mountains. The average annual temperature in the city of Santa Cruz is about 57°F. Agriculture and tourism are the mainstays of the county's economy.

The Santa Cruz Coastal Area covers about 100 mi^2 and includes a number of small coastal drainage basins between the city of Santa Cruz and Point Año Nuevo. The area extends northward to San Mateo County and eastward to the San Lorenzo Area.

The North-Central Area covers about 30 mi^2 and extends southward from the Santa Cruz-Santa Clara County boundary to the Zayante fault, westward to the San Lorenzo Area, and eastward to the Pajaro Valley Area.

The Soquel-Aptos Area covers about 50 mi^2 and extends southward from the Zayante fault to Monterey Bay, westward to the San Lorenzo Area, and eastward to the Pajaro Valley Area.

FACTORS INFLUENCING GROUND-WATER RECHARGE

Several physical factors control the movement of water from land surfaces and streambeds into underlying aquifers. These factors determine whether an area is a good, fair, or poor recharge area. Abundance of rainfall

provides no guarantee that a recharge area is a good one. The surficial materials of the area must be able to absorb rainfall and allow transmission of the water through the soil zone and into an aquifer, where it can be tapped for a water supply.

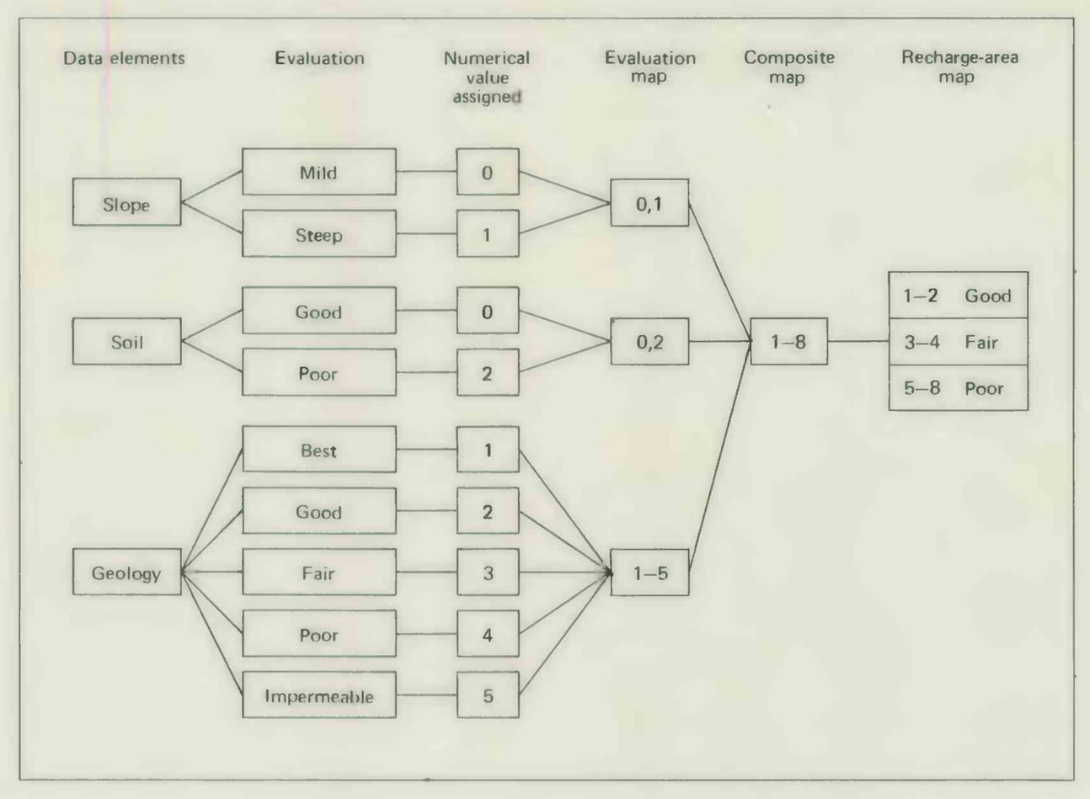
The three most important physical elements that control the direct infiltration of precipitation into the ground are slope of the land surface, type of soil, and geology of the material underlying the soil zone. The slope (gradient) of the land surface is important to ground-water recharge because it controls, in part, how long rain will remain in contact with the soil at the point where it falls. Flat or mild slopes allow a relatively long resident time; steep slopes cause the rainfall to run off quickly. The longer the resident time, the better the chance for ground-water recharge to occur. The type of soil is important because it determines how much rainfall will be absorbed and transmitted to the underlying aquifers. The geology of material underlying the soil zone is important because to constitute an aquifer, the material must be able to receive, store, and transmit water.

Recharge from stream seepage is controlled by the same three elements that control recharge by direct infiltration of precipitation: (1) slope of the streambed; (2) type of surface material of the streambed; and (3) geology of the aquifer materials that underlie the streambed.

There are a number of other elements that affect ground-water recharge. Among these are landcover, such as vegetation and paving, rainfall duration and intensity, the angle at which the rain hits the land surface, and soil-moisture conditions prior to rainfall. Unlike the three basic elements used in the classification, these elements are transitory, and some are subject to alteration by man. They tend to influence the amount of recharge but not so much the movement of recharge water from unaltered land surfaces or streambeds into underlying aquifers. Consequently, they were considered by the authors to be of only secondary importance and were not included in the classification scheme in this report.

CLASSIFICATION OF RECHARGE AREAS

The recharge delineations shown in figure 2 are the result of classification of three basic-data elements--slope, soils, and geology--evaluated separately for their effects on recharge. A numerical system was developed by the authors to facilitate the evaluation. According to their judgment, the numerical system relates and weights the degree to which each data element influences recharge potential in this area. A separate numerical recharge evaluation map was prepared for slope, soils, and geology for each of the study areas. These three maps were then composited into a single numerical map. A classification system related the numbers on the composite map to good, fair, or poor recharge areas. The flow diagram shown below illustrates the method used to incorporate the three basic-data elements into the final recharge classification map.



Following are the criteria used in the recharge evaluation and the corresponding numerical values that were assigned to the three data elements:

1. Slopes--Slopes up to 15 percent were considered mild and assigned a numerical value of 0. Slopes over 15 percent were considered steep and assigned a value of 1. These mild and steep classifications are based on criteria used by the U.S Soil Conservation Service (1977). In general, steep slopes cause rapid runoff of precipitation and reduce the recharge potential.

2. Soils--The recharge potential of soils was evaluated by analyzing those factors that influence the absorption into, and movement of water through, the soil zone. Infiltration rate, surface roughness, internal structure, and lithology were the most important factors considered. Soil infiltration was considered rapid if the rate was greater than 0.6 in/hr (Estrada, 1976, p. 14). If it was less than this value, the infiltration rate was considered slow. Soils that were judged to have a good recharge potential were given a numerical value of 0. Those that were judged poor recharge soils were given a value of 2. In the final recharge evaluation, therefore, soil effects were given twice the numerical weight of slope effects because the authors considered soils to be more important to ground-water recharge than slope. The evaluation of soils was based on studies done by the U.S. Soil Conservation Service (1977).

3. Geology--Each geologic formation in the three areas was hydrologically evaluated as to its ability to receive, store, and transmit water according to data from Hickey (1968), Muir (1972), Akers and Jackson (1977), and Johnson (U.S. Geological Survey, written commun., 1979). Each formation was assigned a numerical value that ranged from 1 for the best aquifers to 5 for those formations considered impermeable. Faults, fractures, crushed zones, and stream channels were taken into consideration in the evaluation of the formations. The permeability evaluation of faults depended primarily on the amount of fault gouge present. Those faults without gouge were considered as being permeable, and, conversely, those with gouge poorly permeable.

THE SANTA CRUZ COASTAL, NORTH-CENTRAL, AND SOQUEL-APTOS RECHARGE AREAS

The areas mapped as having a good, fair, and poor potential for recharge in the Santa Cruz Coastal Area, North-Central Area, and Soquel-Aptos Area are shown in figure 2. Following is a brief discussion of each of the study areas.

Santa Cruz Coastal Area

The headwaters of the creeks in the Santa Cruz Coastal Area are in steep, heavily forested mountains. Along the coast, the mountains are separated from sandy beaches by a sloping marine terrace about half a mile wide.

The area depends almost completely on ground water for its water supply. Most of the water is used for irrigation. Some surface water and springs are developed, but most water from these sources is exported to the city of Santa Cruz.

Ground-water recharge is from precipitation that enters the aquifers through direct infiltration on the surface and stream seepage. There is probably little or no subsurface inflow from adjacent areas. Most of this area is classified as having a poor recharge potential. The amount of recharge is unknown.

Most of the ground water occurs in the alluvium along the major creeks, such as Scott and Waddell Creeks in the marine terraces, and in the Santa Margarita Sandstone of Miocene age. Some ground water is found in the Santa Cruz Mudstone of Miocene age, in the metamorphic rocks (mostly marble) in the vicinity of Bonnie Doon, and in the quartz diorite on Ben Lomond Mountain. The direction of ground-water movement is westward.

North-Central Area

The North-Central Area is mountainous and almost completely dependent on ground water for its water supply. Most of the water is used for domestic purposes; a small amount is used for irrigation and light industry.

Ground-water recharge is from precipitation that enters the aquifers through direct infiltration on the land surface and stream seepage. Some ground water probably enters the area by subsurface inflow from the San Lorenzo Area to the northeast. Most of this

area is classified as having a poor recharge potential. The amount of recharge is unknown.

The area is underlain mostly by formations of early Tertiary age which yield only small amounts of ground water to wells. Ground water moves generally southeast into Pajaro Valley; a small amount moves south through the Zayante fault zone.

Soquel-Aptos Area

The terrain in the Soquel-Aptos Area is mountainous in the north with rolling hills and well-developed marine terraces along the coast. The terraces are abruptly terminated along the coastline by high cliffs.

The area is almost completely dependent on ground water for its water supply. Water uses are domestic, agricultural and light industrial.

Ground-water recharge is from precipitation that enters the aquifers through direct infiltration on the land surface and stream seepage. Some ground water probably enters the area by subsurface inflow from the San Lorenzo Area. Most of the area is classified as having good to fair recharge potential, but the amount of recharge is unknown.

Most of the ground water occurs in the alluvium along Soquel Creek and Aptos Creek, in the marine terraces, in the Aromas Sand of Pleistocene age, and in the Purisima Formation of latest Miocene and Pliocene age. The Purisima Formation is the principal aquifer and yields most of the water pumped by wells. Ground water flows principally toward Monterey Bay; some moves southeast into Pajaro Valley.

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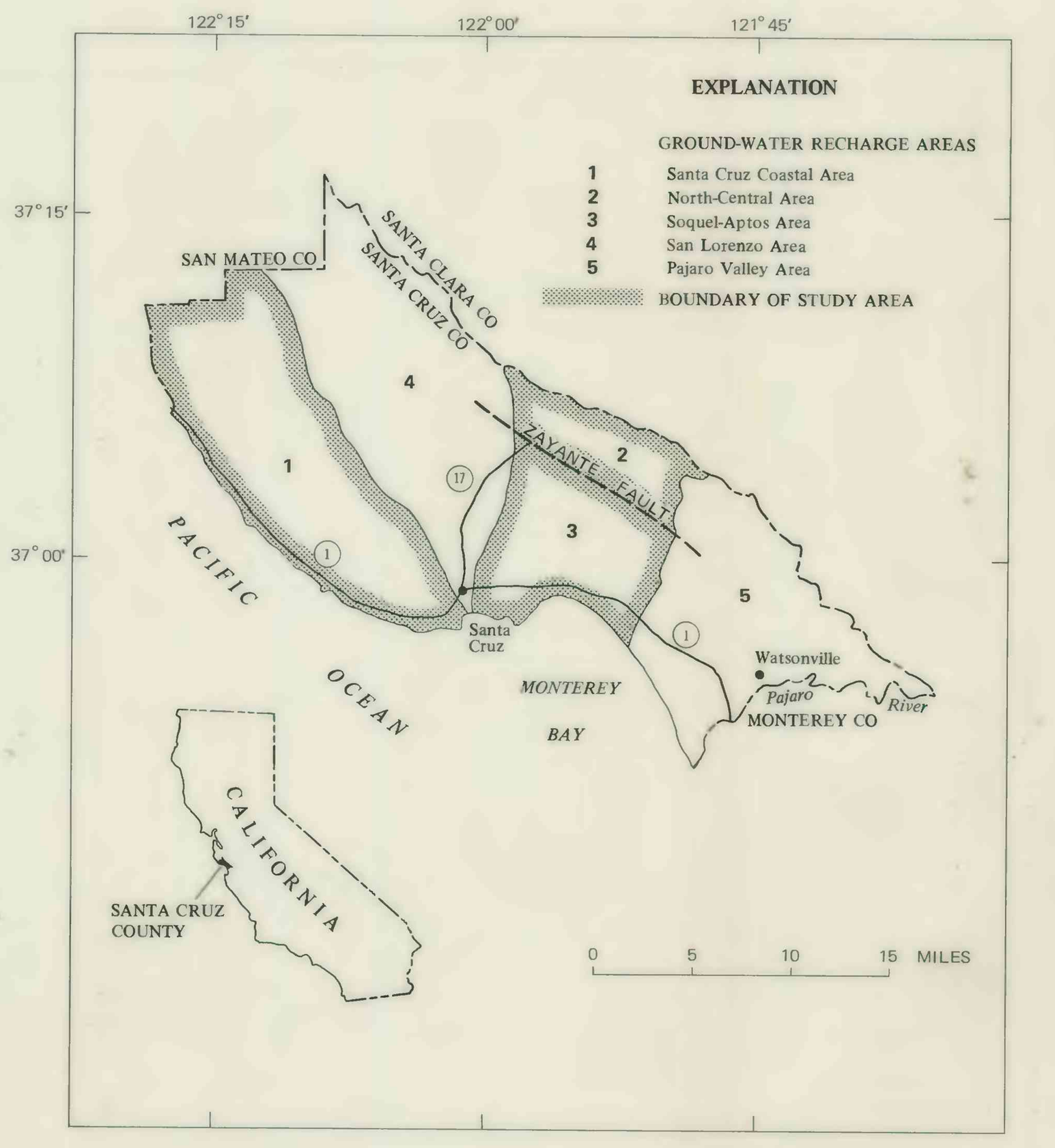

FIGURE 1.–Location map.

FIGURE 2.–Good, fair, and poor potential for ground-water recharge.

CLASSIFICATION OF GROUND-WATER RECHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA

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