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USE OF U.S. GEOLOGICAL SURVEY EARTH-SCIENCE PRODUCTS BY SELECTED REGIONAL AGENCIES IN THE SAN FRANCISCO BAY REGION, CALIFORNIA

by

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W. J. Kockelman

ABSTRACT

An inventory of the use of U.S. Geological Survey (USGS) products in studies, plans, implementation, and other planning activities was made for seven selected regional agencies in the San Francisco Bay region -- a region of over five million people. This inventory was designed to determine and document the use of over 100 earth-science products prepared as a part of the San Francisco Bay Region Environment and Resources Planning Study (SFBRS).

The inventory showed that: (1) all seven agencies have staff members who are familiar with SFBRS products and make frequent use of them; (2) all seven agencies have prepared planning documents citing SFBRS products; (3) the types of planning applications most often indicated were water-quality and physical resources studies, potential site evaluation, and general reference; (4) almost 80 percent of the over 100 SFBRS products were used at least once, and eleven of the products were used 20 or more times each for various regional planning activities; and (5) at least 46 other USGS products were also used for various regional planning activities.

During the inventory, over 50 regional agency officials, employees, and consultants were interviewed and asked -- among other things -- to indicate any problems they had noted in the use of the SFBRS products, to suggest improvements, and to identify any additional earth-science information needed or desired. The responses showed that: (1) the scales commonly used for "work" maps were 1:62,500 or larger, and for "implementation" maps were 1:24,000 or larger; (2) two agencies have a geologist on their planning staff, others have staff members with training or experience in earth-science or engineering, and all had the benefit of geotechnical services from outside their agency; (3) all seven agencies experienced some problems in using the products, primarily because the scale was too small or the detail not great enough; (4) all seven agencies expressed interest in the topical interpretive reports in preparation and a need or desire for additional earth-science, enginering, or other related information; (5) six of the seven agencies suggested specific improvements to future products -- primarily larger scale or more detail and less technical or more interpretive information; and (6) all seven agencies received educational, advisory or review services from USGS personnel.

Fifteen selected examples of the application of SFBRS products to various regional planning activities are discussed and illustrated. These examples include six planning studies, five plans, two implementation activities, and two other types of activities.

From the inventory and responses to the interviews, it is concluded that the selected regional agencies in the bay region are familiar with, make frequent use of, and will continue to use SFBRS products for a wide range of regional planning activities.

Suggestions to ensure more effective use of earth-science information in the future include: (1) monitoring and analyzing new State and Federal laws or regulations and emerging critical issues so as to anticipate and respond to regional earth-science information needs; (2) creating a users advisory committee to help identify critical issues and needs; (3) providing engineering interpretations and land- and water-use capability ratings to make earth-science information more readily usable; (4) giving priority to areas impacted by development; (5) providing earth-science information at the larger scale and greater detail commonly used and needed by regional agencies; (6) releasing earth-science information faster and according to a formal distribution pattern; and (7) providing educational, advisory, and review services in connection with any earth-science information designed for planners and decisionmakers.

INTRODUCTION

The San Francisco Bay Region Environment and Resources Planning Study (SFBRS) was an experimental program begun in 1970 and completed in 1976 by the U.S. Geological Survey (USGS) in cooperation with the U.S. Department of Housing and Urban Development (HUD).

The nine-county study area has over 7,416 square miles of land and water and houses over five million people. (See fig. 1.) The goal of the program was to identify and provide the basic and interpreted earth-science information needed in making land-use decisions for regional planning, to provide a comprehensive array of data at a regional scale, and to test and evaluate the ways in which these data are being used in the planning and decisionmaking processes.

The study has resulted in the preparation, publication, and distribution of the following earth-science information products: 71 basic data contributions, six technical reports, eight interpretive reports, three photographic and topographic products, and 15 other products. Several additional interpretive reports are now being prepared for publication. These products are listed in appendixes A, B, C, D, and E, respectively.

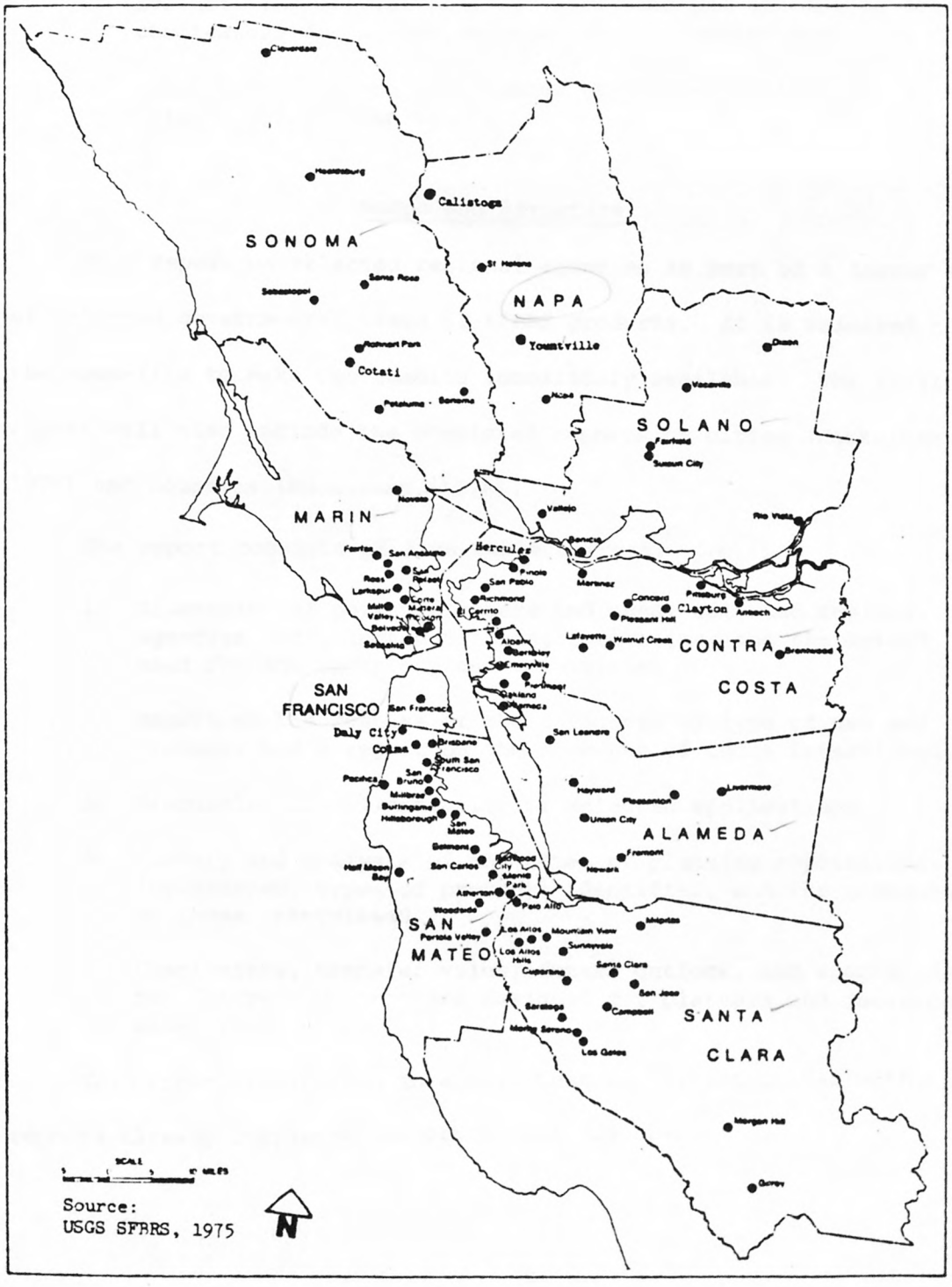
Both the original "Program Design" (U.S. Geological Survey,1971) and the "Plan for Completion of Study" (U.S. Geological Survey, 1974) called for a report on the application of the earth-science products to planning. This report partially fulfills that requirement.

Purpose and Objectives

The general purpose of this report is to provide the U.S. Geological Survey and the U.S. Department of Housing and Urban Development with a measure of how the SFBRS products are used for planning and decisionmaking and the effectiveness of such uses. This report has the following objectives:

FIGURE 1

Nine-county San Francisco Bay Region



1. Determine and document the use of SFBRS products by selected regional agencies for planning and plan implementation.

2. Evaluate the effectiveness of such uses and attempt to determine the reasons for nonuse, misuse, or ineffective use.

3. Suggest ways to achieve greater or more effective use of earth-science information in the future.

Scope and Structure

This report on selected regional agencies is part of a larger study of selected governmental users of SFBRS products. It is released to the open-file to make the results immediately available. The final report will also include the completed reports on cities (Kockelman, 1975) and counties (Kockelman, 1976).

The report consists of five subject areas:

1. Discussion of potential users and uses; selected regional agencies and selected planning activities; and the method used for the inventory and interviews.

2. Report on the results of the inventory by type of use and product; and a report on the comments of those interviewed.

3. Discussion and illustration of selected applications.

4. Summary and analysis of the types of planning applications inventoried, types of products identified, and the comments of those interviewed.

5. Conclusions, transfer value, future outlook, and suggestions for future USGS programs designed for planners and decision-makers.

This report is written in a form that can be integrated with the reports already completed on cities and counties.

Acknowledgments

Preparation of this report required the support, cooperation, and assistance of many people. It is not practicable to acknowledge the help of everyone here, but the courteous cooperation received from regional officials, employees, and consultants is acknowledged. The review and comments of D. R. Nichols, E. A. Imhoff, A. M. Spieker, Paula Gori, and C. C. Campbell are appreciated.

POTENTIAL USERS AND USES

Planning is the rational process of preparing plans and programs directed toward achieving certain goals or solving or abating existing and anticipated problems. Everyone prepares plans either formally or informally, consciously or unconsciously.

Scientific data and interpretations concerning physical resources, physical hazards, and existing physical development are necessary for any intelligent physical planning. Almost all individuals, firms, and institutions involved in physical planning are potential users of earth-science information, such as that provided by the SFBRS. Thus, many units and agencies of local, regional, State, and Federal government are potential users of earth-science information, and many have a responsibility to the public not only to use such information, but to make a serious effort to obtain it.

Such potential users of SFBRS products have been confirmed by an independent study by a planning consultant (Spangle, 1972); an examination of the SFBRS mailing lists; a review of the records of requests for SFBRS products; a perusal of 24 SFBRS quarterly progress reports (USGS & HUD, 1970 - 1976); and background interviews with 44 members of USGS and HUD. Each of these sources indicated numerous uses by various government agencies in the bay region including regional agencies. These sources are described in greater detail in the report on cities (Kockelman, 1975).

REGIONAL AGENCIES AND THEIR PLANNING ACTIVITIES

There are over twenty regional governmental agencies in the San Francisco Bay region. The responsibilities of these agencies range from comprehensive areawide planning for all nine counties to a specific area of jurisdiction such as the bay or a single-purpose assignment such as transportation planning. The implementation powers of the agencies range from project review and comment under the A-95 areawide clearinghouse review process, through granting or denial of development permits, to the allocation of funds for the construction of facilities.

The following criteria were used in selecting the seven agencies inventoried and interviewed for this report:

1. Possession of planning and plan implementation powers
2. Application of earth-science information that is transferable to other regions
3. Jurisdiction in three or more counties

Although the California Coastal Commission is a State agency, it was selected because its jurisdiction is less than statewide, it is responsible for overseeing the activities of two regional commissions whose areas of jurisdiction include parts of the San Francisco Bay region, and its adopted plan and implementation activities are based upon or include the studies, conclusions and recommendations prepared by the regional commissions. The results of the inventories and interviews of the State and regional commissions are combined in this report.

The responsibilities and activities of each selected regional agency related to studies, plans, implementation and other planning activities that require earth-science information are discussed in this section of the report.

Association of Bay Area Governments

The 94-member Association of Bay Area Governments (ABAG) was formed in 1961 as a council of governments (COG) under the California Joint Exercise of Powers Act (Calif. Government Code, 1977, Sec. 6500 and following) to find solutions to regional problems through voluntary cooperation. The Association's functions, membership, and organization are set forth in its Bylaws (ABAG, 1977a). Sedway and Cooke (1975) have made a perceptive study of regional planning enabling laws, joint powers agreements, COG's clearinghouse review, and ABAG; an assessment of the planning process; and a list of COG deficiencies.

At present, 87 out of 93 cities and seven out of nine counties in the San Francisco Bay region are members of ABAG; and 25 special districts, regional agencies, and other government agencies are non-voting, cooperating members. Although only seven counties are members, ABAG's area of jurisdiction includes other bay region counties; its water quality planning area includes five counties and parts of four others, and its solid waste planning area covers all nine counties (ABAG, 1977c). The larger ABAG planning area is coterminous with the SFBRS area shown on figure 1.

The Association is organized "for the permanent establishment of a forum for discussion and study of metropolitan area problems of mutual interest and concern ... and for the development of policy and action recommendations" (ABAG, 1977a). Current planning programs include comprehensive regional planning, environmental management, land and resource protection, earthquake preparedness, and land use/transportation corridor evaluation (ABAG, 1977b). These programs include both planning studies and adopted plans and policies which require earth-science

information. The environmental management program includes the water-quality and solid-waste management planning required by Section 208 of the Federal Water Pollution Control Act (U.S. Code, 1977, Title 33, Sec. 1288 and following).

Studies undertaken by the Association have addressed such problems as ground-water contamination, earthquake intensity and related costs, lake-water quality, delta outflow effects, physical resources, regional geology, and the evaluation of sites for selected uses. Regional plan elements prepared by ABAG have included water-supply management, water-quality management, ocean coastline, solid-waste management and open space.

The Association is without specific statutory authority to implement its plans and must rely upon the review of plans and projects and the persuasion and acquiesence of its members. As the federally designated areawide clearinghouse for the bay region, ABAG reviews and comments upon local applications for Federal assistance programs, Federal development projects,and environmental impact statements required for Federal projects.

Other activities requiring earth-science information that are performed by the Association include environmental analysis, community assistance, environmental impact statement or report review, and maintaining a digitized information system.

Bay Conservation and Development Commission

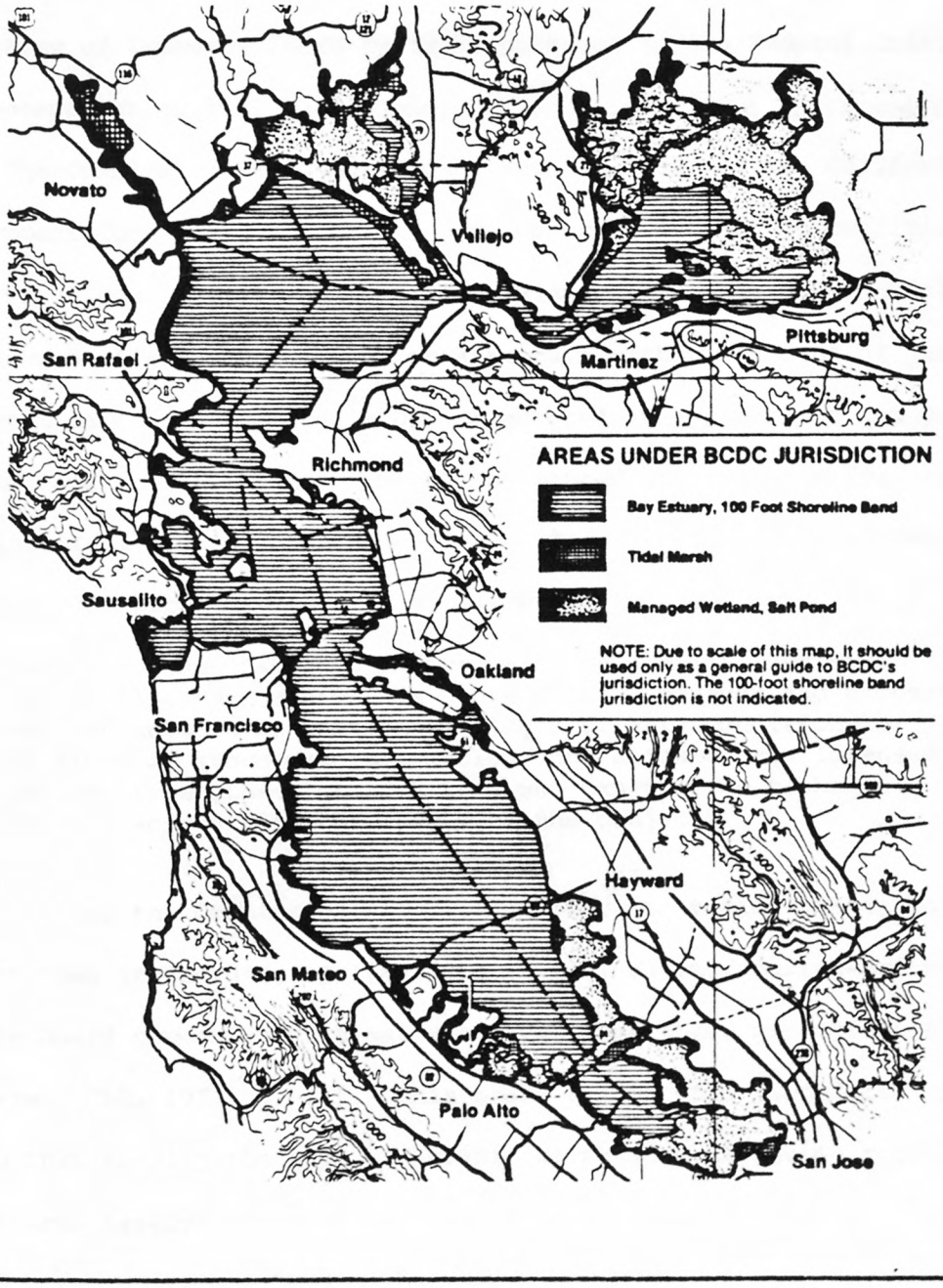
The 27-member San Francisco Bay Conservation and Development Commission (BCDC) was established by the California Legislature in 1965 to protect the bay from uncoordinated haphazard filling and to encourage proper shoreline development, and arrangements for public access. In 1969, the Legislature reestablished the BCDC, gave it regulatory powers, and extended its area of jurisdiction. The Legislature's findings and declarations and BCDC's membership, organization, powers and duties, are set forth in the McAteer-Petris Act (Calif. Government Code, 1977, Sec. 66600 and following). The Act requires the Commission to create a citizen's advisory committee of not more than 20 members of whom at least one must be a geologist.

Section 66610 of the California Government Code (1977) specifies the Commission's area of jurisdiction, namely, the San Francisco Bay system including San Pablo and Suisun Bays; all sloughs, marshlands, tidelands, and submerged lands; a 100-foot strip inland from the bay system; diked saltponds; managed wetlands; and certain named waterways. The areas under BCDC's jurisdiction are shown on figure 2.

In 1965, the Legislature required the Commission to make a study of the bay and prepare a plan for its conservation. In 1969, the Legislature found and declared that BCDC had "made a detailed study of all the characteristics of the bay, including: the quality, quantity, and movement of bay waters, [and] ecological balance of the bay ... and that on the basis of the study ... prepared a comprehensive and enforceable plan for the conservation of the water of the bay and the development of its shoreline ..." (Calif. Government Code, 1977, Sec. 66603).

FIGURE 2

Area of Jurisdiction
Bay Conservation and Development Commission



From "Applying For Permits" (BCDC, 1976)

Some of the studies conducted by the Commission have addressed the effects of tides and currents, sedimentation aspects, fill safety, public access, marsh protection, boundary measurements, and geology. In addition to the plan for the bay, BCDC has prepared public-access and marsh-protection plan elements. The plan for the bay was approved by the U.S. Secretary of Commerce February 1977, pursuant to the Federal Coastal Zone Management Act of 1972 (U.S. Code, 1977, Title 16, Sec. 1451 and following).

The Commission is authorized by Section 66632 of the California Government Code (1977) to grant, deny,or grant subject to conditions, permits to place, fill, extract materials, or make any substantial change in the use of any water, land, or structure within its area of jurisdiction. Pursuant to this authority, BCDC has adopted an application and permit system, and prescribed the content and procedures required for obtaining "administrative" and "major" permits. The "application for permit" procedure (BCDC, 1975) provides that the applicant must:

> Describe steps taken to assure that any project involving fill will afford reasonable protection to persons and property against hazards of unstable geologic or soil conditions or of flood or storm waters. Include the names of any licensed geologist, engineer,or architect who can provide technical details and certify the safety of the project.

In addition, the Commission has provided for two review boards to assist them in deciding applications -- one, an engineering-criteria review board concerned with seismic safety,has three geologists as members (BCDC, 1977, p. 11). This board has adopted procedures (BCDC, 1972) that specify the type of seismic safety investigation required of an applicant, namely:

The approach and degree of investigation proposed or completed by the applicant will define the hazards inherent in the site (liquefaction, slope instability, ground shaking, settlement, fault displacement, etc.), and the types and degrees of risk, (approximate number of people in the area, the value of the property, storage of toxic substances, etc.).

Other planning activities requiring earth-science information performed by the Commission include analyzing environmental impacts, and preparing and reviewing environmental impact reports.

Coastal Commissions

The 12-member California Coastal Commission (CCC) and the six regional commissions were originally established by passage of a citizen initiative measure -- Proposition 20 in the November 7, 1972, election -- to preserve, protect,and, where possible, restore the resources of the coastal zone. The Legislature's findings and declarations and the membership, organization, powers,and duties of both the State and regional commissions are set forth in the California Coastal Act (Calif. Public Resources Code, 1977, Sec. 30000 and following). The Act constitutes California's coastal zone management program for purposes of the Federal Coastal Zone Management Act of 1972 (U.S. Code, 1977, Title 16, Sec. 1451 and following).

Two regional commissions -- Central and North Central -- have areas of jurisdiction that include part of the San Francisco Bay region. Their areas of jurisdiction -- "coastal zone" -- is defined as "that land and water area ... extending seaward to the state's outer limit of jurisdiction, including all offshore islands, and extending inland generally 1,000 yards from the mean high tide line of the sea ... " but not including the area of jurisdiction of the San Francisco Bay Conservation and Development Commission. The inland boundary is general and may, in significant coastal estuarine, habitat, and recreational areas, extend to the first major ridgeline paralleling the sea or five miles whichever is less, and in urban areas the zone may extend less than 1,000 yards (Calif. Public Resources Code, 1977, Sec. 30103). The State Commission has adopted a new detailed jurisdiction map at a scale of 1:24,000 which shows adjustments to the inland boundary. The new area of jurisdiction of the State and two regional

commissions within the San Francisco Bay region is shown on figure 3.

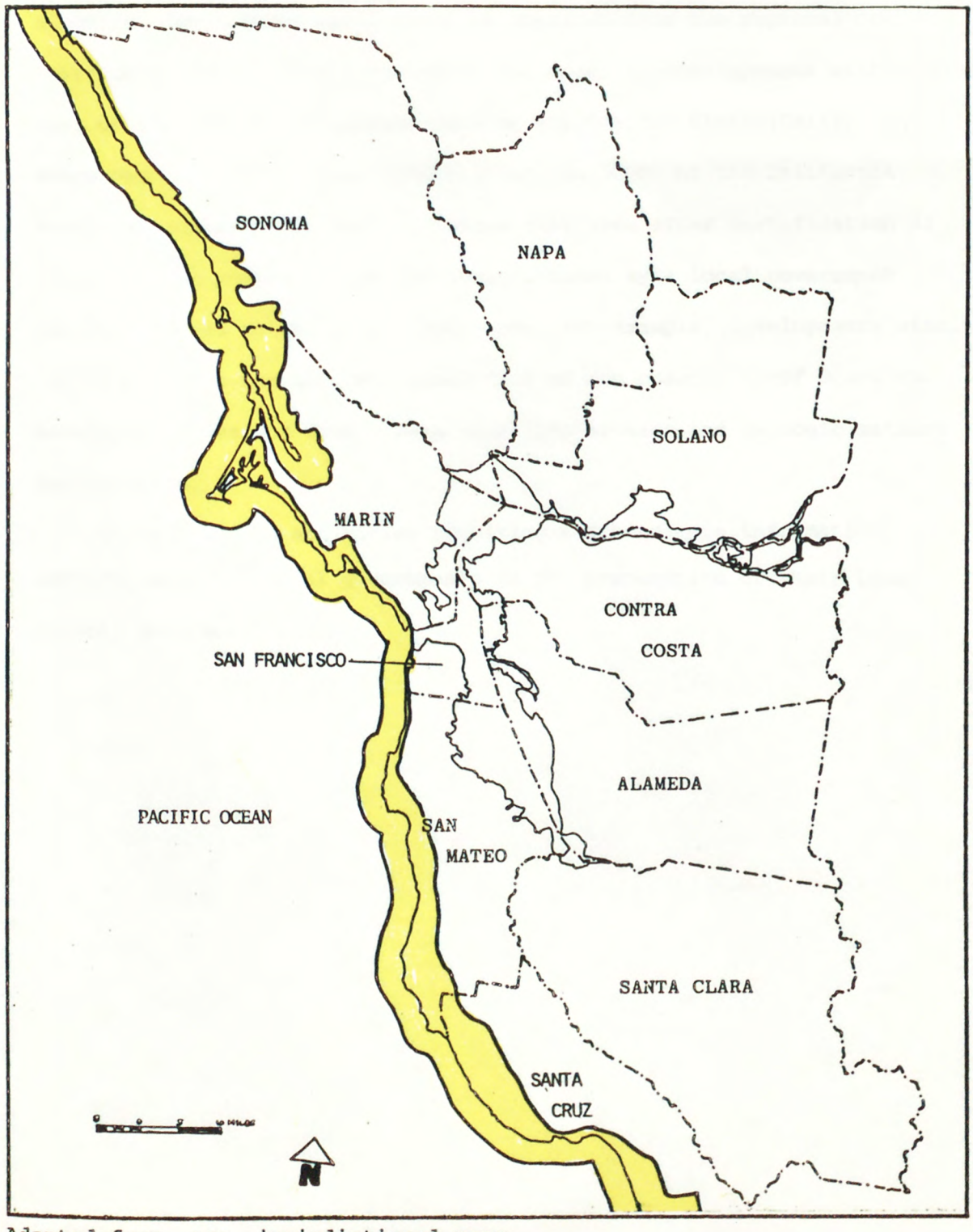
Under the citizen initiative measure, the State Commission was directed to prepare, adopt, and submit to the Legislature a coastal plan based upon detailed studies of all factors that significantly affect the coastal zone. Consequently, the two regional commissions whose territory included parts of the San Francisco Bay region, conducted studies of the marine environment, coastal land environment, coastal geology, and geologic hazards.

After extensive public hearings, a coastal plan was transmitted to the Governor and Legislature on December 1, 1975, and incorporated into the California Coastal Act of 1976. The new act provices that new development shall minimize risks to life and property in areas of high geologic and flood hazards, and neither create nor contribute significantly to erosion or geologic instability (Calif. Public Resources Code, 1977, Sec. 30253), and that oil and gas "development is performed safely and consistent with the geologic conditions of the well site" (Calif. Public Resources Code, 1977, Sec. 30262(a)).

While the studies and plan were underway, the regional commissions were authorized by the Legislature to approve, deny, or approve with conditions, permits for any development in the coastal zone. After the studies had been completed and the plan adopted, successor commissions were created and authorized to approve, deny, or approve with conditions, coastal development permits if the local government involved had not established coastal development permit procedures or obtained certification of its local coastal program (Calif. Public Resources Code 1977, Sec. 30600). Section 30600 and following, of the California Public Resources Code (1977) sets forth the authority, procedures, vested rights,

FIGURE 3

Area of Jurisdiction
California Coastal Commissions



Adapted from CCC jurisdictional maps

approvals, and emergency measures for coastal development permits.

Even if the local government has established permit procedures, a coastal development permit must be obtained from the regional or State commissions in certain cases, for example, developments within 300 feet of the top of the seaward face of any coastal bluff (Calif. Public Resources Code, 1977, Sec. 30601). Section 30603 of the California Public Resources Code (1977) provides that even after certification of local coastal programs, certain actions taken by a local government may be appealed to the State Commission, for example, developments within 300 feet of the top of the seaward face of any coastal bluff where the development does not comply with shoreline erosion and geologic setback requirements.

Other planning activities requiring earth-science information include assisting local governments in the preparation of their local coastal programs.

Metropolitan Transportation Commission

The 19-member Metropolitan Transportation Commission (MTC) was created by the California Legislature in 1970 to provide comprehensive coordinated transportation planning for the nine-county San Francisco Bay region. The Commission's membership, organization, powers,and duties are set forth in the Metropolitan Transportation Commission Act (Calif. Government Code, 1977, Sec. 66500 and following). The Commission's nine-county area of jurisdiction is coterminous with the SFBRS area shown on figure 1.

The Commission prepares, adopts, and revises annually a regional transportation plan which includes the national system of interstate and defense highways, the California freeway and expressway system, other highways within the State system, transbay bridges,and mass transit systems.

In developing the regional transportation plan, the Commission is required to consider the "ecological, economic and social impact of existing and future regional transportation systems upon ... housing, ... environment, [and] land-use policies ...." (Calif. Government Code, 1977, Sec. 66509(b)). Studies undertaken in preparing and updating the transportation plan include natural process inventories, highway corridor evaluations, transportation route alternatives, and visual landscape relationships. In addition, MTC conducted a comprehensive, policy-oriented evaluation of the San Francisco Bay Area Rapid Transit (BART) system. The BART Impact Program covers the entire range of potential impacts, including impact on land use and the environment (MTC, 1973).

The Commission has certain implementation powers, for example, the construction of transbay bridges; the construction or operation of a public multicounty transit system using an exclusive right-of-way; and approval of local applications for Federal and State grants containing transportation elements (Calif. Government Code, 1977, Secs. 66514, 66515, and 66520). In addition, the Commission administers the State Transportation Development Act funds (MTC, 1976).

In 1975, the California Legislature authorized MTC to adopt toll schedules for toll bridges within its area of jurisdiction and to allocate those funds generated beyond that needed for operation, debt service, and other costs. These funds may be allocated, for example, to public transportation system operators and to the State Department of Transportation to implement MTC's transit plans in the vicinity of toll bridges (Calif. Streets and Highways Code, 1977, Sec. 30880 and following).

Other planning activities requiring earth-science information performed by the Commission include analyzing environmental impacts and preparing and reviewing environmental impact reports.

Regional Water Quality Control Board

The State Water Resources Control Board and the present regional water quality control boards were created by the Legislature in 1967 and 1969, respectively, as the State agencies with primary responsibility for the coordination and control of water quality. The Legislature's findings and declarations and the membership, organization, powers,and duties of the nine-member Regional Water Quality Control Board, San Francisco Bay region, (RWQCB) are set forth in the Porter-Cologne Water Quality Control Act (Calif. Water Code, 1977, Sec. 13000 and following).

Section 13200(b) of the California Water Code (1977) specifies the RWQCB's area of jurisdiction,which generally corresponds with the boundaries of the natural drainage areas of the San Francisco Bay system,and covers almost all of the nine-county San Francisco Bay region. The Board's area of jurisdiction is shown on figure 4.

Section 13240 of the California Water Code (1977) requires each regional board to formulate and adopt a water-quality control plan including water-quality objectives which will ensure the reasonable protection of beneficial uses and the prevention of nuisances. The RWQCB has prepared such a plan for its area of jurisdiction.

The regional boards are required by Section 13241 of the California Water Code (1977) to consider the following factors in establishing water-quality objectives:

Past, present, and probable future beneficial uses of water

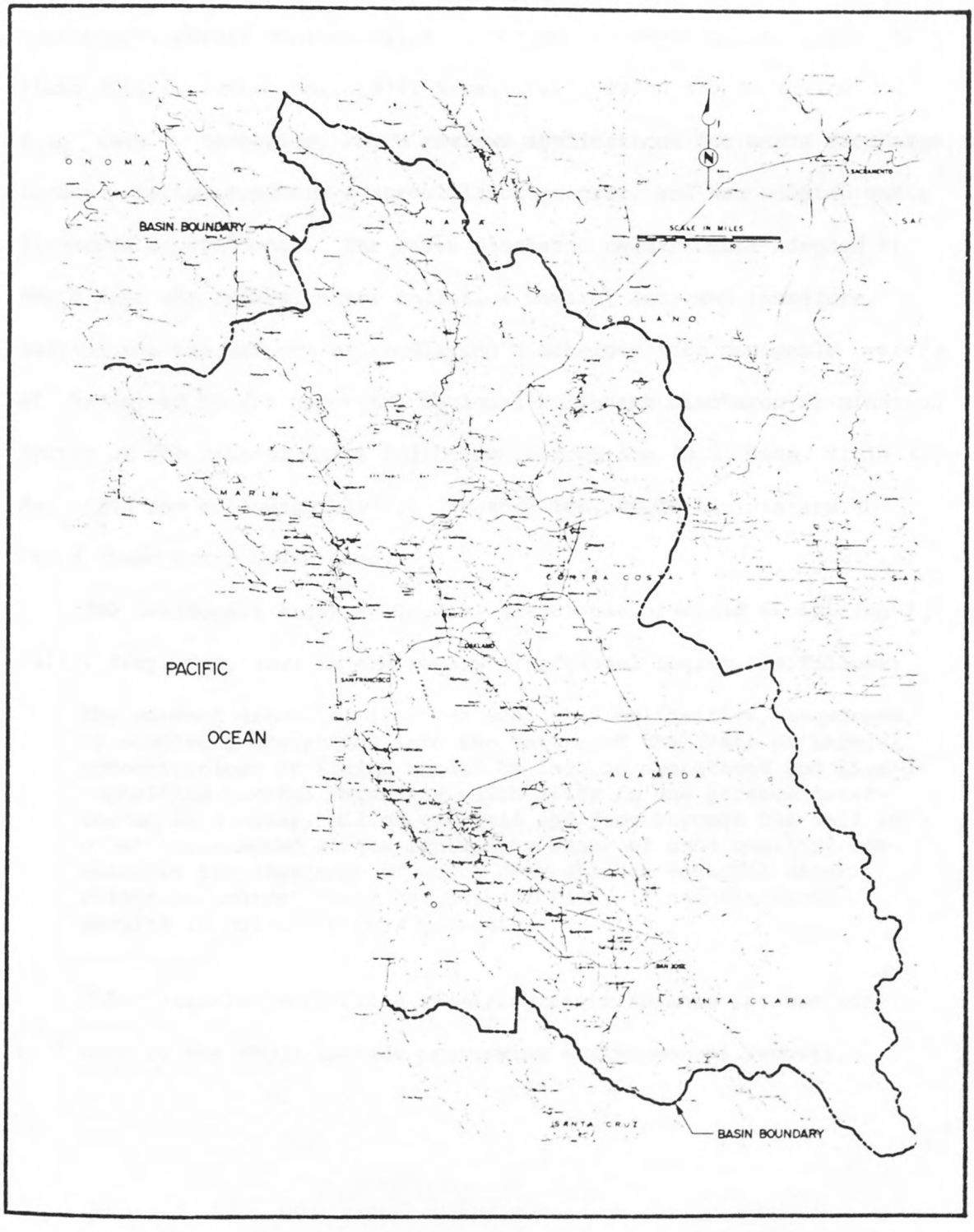
Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto

Water-quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area

Economic considerations

FIGURE 4

Area of Jurisdiction
Regional Water Quality Control Board



Some of the studies conducted by RWQCB have addressed estuary shellfish contamination and lake-water quality.

The California Legislature has provided the regional boards with regulatory, permit monitoring,and enforcement powers to implement their plans (Calif. Water Code, 1977, Secs. 13222, 13260 and following). With this authority, RWQCB reviews applications for waste discharge, issues permits, conducts a surveillance program, and has adopted waste discharge requirements. The waste discharge requirements adopted by RWQCB meet the Federal Water Pollution Control Act, and therefore, suffice for the purpose of regulating discharges into navigable waters of the United States under the National Pollutant Discharge Elimination System of the Federal Water Pollution Control Act (U.S. Code, Title 33, Sec. 1342 and following, 1977). In addition, RWQCB administers the State Clean Water Grant fund.

The California Attorney General (1956) has provided an opinion (27 Ops. Calif. Atty. Gen. 182) on the powers of regional boards, as follows:

> The current drainage, flow, or seepage from inactive, abandoned, or completed operations into the waters of the State of harmful concentrations of [earth eroded by logging operations and liquids containing harmful materials which arise in one stratum intercepted by a water, oil or gas well and flow through the well into other intercepted strata containing water of good quality] constitutes the discharge of waste over which a regional water pollution control board has jurisdiction, if the discharge results in pollution or a nuisance.

Other planning activities requiring earth-science information performed by the RWQCB include reviewing environmental reports.

Selected Planning Activities

Before preparing any general plan or plan element, accurate thorough, and appropriate planning studies must be made. The word "studies" is considered to include the collection, analysis and interpretation of data and the preparation of forecasts and projections for developing and testing plans. For the purpose of this report, the following studies were selected for inventory: geologic hazards, geology, hydrologic hazards, land use, physical resources, potential site evaluation, transportation, and water-quality studies.

The word "plans" is considered to include the development and adoption of goals, principles, and standards; the development and testing of alternate plans; and the adoption and detailing of the selected plan. For the purpose of this report, the following plans were selected for inventory: coastal areas, conservation and development, general regional, open space, solid-waste management, transportation, water-quality management, and water-supply management.

For a plan to be of value, it must be implemented or executed. The term "implementation" is considered to include any method or device available to a regional agency for executing a plan. For the purpose of this report, the following devices were selected for inventory: fund allocation, grant administration, jurisdiction determination, permit regulations, and project review and comment or approval. The use of SFBRS products in the administration of regulations was also inventoried.

In addition to the studies, plans, and implementation devices listed above, the following activities were also inventoried: community assistance, environmental analysis, preparation and review of environmental impact statements (EIS) and reports (EIR), and general reference. The term "community assistance" is considered to include the providing of planning services by an agency to communities within its area of jurisdiction.

The selection of the activities to be inventoried was based upon whether they were required by State law or were customarily performed by one or more of the selected agencies, and the need for earth-scienc information for their satisfactory performance.

METHOD OF INVENTORY AND INTERVIEWING

The method of inventory and interviewing was developed especially for the SFBRS and was first used for the inventory and interviews of the 91 bay region cities and 8 bay region counties. This method can be used for evaluating the effectiveness of applying any earth-science information to planning and decisionmaking and is transferable.

The results of this type of inventory and interview are influenced by the personality, thoroughness, and skill of the interviewer; and the competence, knowledge, and responsiveness of the person interviewed. Efforts to reduce the subjectiveness of the inventory and interview included the use of forms, systematic scheduling and recording, and subsequent review and verification. These efforts are discussed in the report on cities (Kockelman, 1975).

Interviews

A top official in each of the seven agencies was called by telephone, and an initial interview was scheduled with the official and/or his or her designees. The designees were usually the staff persons who were the most experienced in using SFBRS products or had a need for earth-science information. All scheduled meetings were confirmed by letter.

Several persons in each agency were interviewed at their offices. The number in each agency ranged from two to fifteen. Most of the regional officials and employees on the SFBRS mailing list were interviewed. During the interview,other agency personnel were usually identified as using, or having used, SFBRS products. These

persons were then interviewed even if no longer employed by the agency. The name and title of the officials, employees,and consultants interviewed are listed in appendix F by agency.

Inventory and Interview Forms and Records

The forms used for the city and county inventories were modified for use in this inventory. Typical completed inventory and interview forms are shown in figures 5 and 6.

The methods used to record the inventory (fig. 5) and collect, mark, and store selected planning documents were the same as those used for the cities and counties (Kockelman, 1975, 1976). The documents available in the SFBRS files are listed in appendix G. The method used for recording the comments received during the interviews (fig. 6) was the same as the method used for the cities and counties.

Review and Verification

Each completed inventory and interview form was reviewed,and, if necessary, the recorded data were verified or clarified by telephone or a subsequent visit. All seven agencies were asked for additional information or documents by telephone.

Applications of SFBRS products disclosed by previous background interviews with USGS and HUD personnel were logged by agency on the reverse side of the inventory sheets before the inventory and interviews were conducted. In most cases, these applications were confirmed during the inventory or interviews.

FIGURE 5

Typical Completed Inventory Form

AGENCY: Bay Conservation & Development Commission

Map Scales Used:

1:2400; 1:24,000 Work Maps

1:9600; 1:24,000; 1:600; 1:14,400 Implementation Maps

	Study, Plan or Activity	USGS Product Used	SFBRS Product Used	Map or Report Used
STUDIES				
(Copy) "Tides & Currents in South S.F. Bay as They Affect the Hayward Area Shoreline Plan" (1972)	0		X	TR 1
(Copy) "Safety of Fills" (1974)	0		X	BDC 52
(Copy) "The Safety of Fills" (1968)	0	/		Other USGS
(Copy) "Salt, Sand & Shells" (1967)	0	/		7½' quad, Other USGS
(Copy) "Sedimentation Aspects of S.F. Bay" (1966)	0	/		Other USGS
(Copy) "Marshes & Mud Flats of S.F. Bay" (1966)	0	/		7½' quad, Other USGS
PLANS				
(Copy) Updating "S.F. Bay Plan" (1969)	0	/	X	7½' quad; MF 743; BDC 7,9,15,16, 17,52,54,55,62,67; IR 4; TR 2; orthophotos
"Public Access Plan"	*	/	X	7½' quad; BDC 15,16,17,52,62; IR 4; TR 2
(Copy) "Suisun Marsh Protection" (1976)	0	/	X	7½' quad; MF 743; BDC 7,9,54,55,62,67
PLAN IMPLEMENTATION				
Regulation Administration	0	/	X	7½' quad; MF 743; BDC 7,9,25,29, 30,48,52,54; IR 3
Pre-application Discussion	0	/	X	7½' quad; MF 743; BDC 7,8,9,15, 16,17,29,30,48,52,54,62; IR 4; TR 2,6
(Copy) Engineering Criteria Review	0	/	X	7½' quad; MF 743; BDC 7,8,9,29, 30,48,54
Permit Regulations	0			
Determining Area of Jurisdiction	0	/	X	7½' quad; BDC 9
OTHER USES				
General Reference	0	/	X	7½' quad;reg. topo; BDC 9,10,14 22,23,25,26,29,30,32,36,48,54; IR 3,7; TR 1; orthophotos
Environmental Analysis	0	/	X	7½' quad; MF 743; BDC 7,9,11,30 52,54,55,57,60; TR 1
EIS/EIR Preparation (Copy) "Richmond-Antioch Fuel Oil Pipeline" (1974)	0	/	X	7½' quad;reg. topo.; MF 743; Cir. 525; BDC 7,9,11,30,52,54,55,57,60; TR 1
EIS/EIR Review	0	/	X	7½' quad; BDC 7,9,11,22,25,30,52, 54,55,57,60; TR 1
(Copy) Court Case Decision	0	/		7½' quad

* - Indicates "In Process," O - Indicates "Completed," X - Indicates "SFBRS products used," / - Indicates "Other USGS products used," (Copy) - Indicates "A copy of the study, plan or other document in SFBRS files."

FIGURE 6

Typical Completed Interview Form

COMMENTS ON EARTH SCIENCE APPLICATIONS IN THE BAY REGION

1. Staff
(Number of professional planners 6 ; engineers 3 ; geologists 0; total staff 25)
(Geologic, hydrologic,or engineering background of professional staff)

Some geologic background in the engineering staff; none in the planning staff; use geotechnical consultants from the California Division of Mines and Geology and private firms; geologists on the Engineering Criteria Review Board and Citizens Advisory Committee.

2. Receipt, Distribution and Custody of SFBRS Products
Received by Director; routed to planning and engineering staffs; filed in planning staff's library. Engineering staff members have desk copies.

3. Reasons for Failure to Use SFBRS Products
(Not received, not distributed, not accessible, no staff capability, lack of interest, interdisciplinary communication, etc.)

Need a staff biologist to use TR 5
15' flood maps out of print
Unaware of the 1:24,000 slope maps

4. Problems in Using SFBRS Products
(Map scale, legend or text; technical assistance; level of detail; staff capability; planning area coverage; accuracy; etc.)

Developers failed to read and understand assumptions in BDC 52
Lack of staff capability
Incomplete coverage at 1:24,000
Grid lines and enumeration lines confused with land use boundaries (BDC 62)

5. Suggestions or Recommendations for Improving USGS Products
(Scale, legend, text, coverage, detail, etc.)

Update 7½' quads, e.g., dikes shorelines, salt ponds, and tidal marshes
Keep text short and easily readable
Simplify and interpret products so as to be directly useable by developers, decisionmakers, owners, planners, and BCDC commissioners
Complete coverage of BCDC's jurisdiction at same scale
BDC 62 needs reference base and larger scale

6. Contacts with USGS Personnel to Obtain Products or Assistance
(Name, topics, type of assistance)

George Gates; Bay development; advice
Robert Brown; Marsh protection study; review
Brian Atwater; Marsh protection study; review
John Conomos; Bay circulation; explanations and advice
Dave McCulloch; Effects of deepening channel on saltwater intrusion; information and advice
Michael Sety; Mylar separations of 7½' quads; advice

7. Anticipated Use of Published SFBRS Products in Future
(Identify products and use)

Land use (BDC 62) for park and recreation inventory and plan
Land capability study for general reference
High water table (BDC 61) for public access study and plan
Liquefaction for public access study and plan
Sedimentation, transportation,and deposition interpretive report for dredged-waste disposal
Slope stability, geology, flood-prone areas, seismic zonation, flatlands,and land capability interpretive reports for public access study and plan

8. Data or Products Needed or Desired
(Topic, scale, land uses, etc.)

Bay circulation studies
Shorelines, salt ponds, tidal marshes map at 1:24,000
Update land-use inventory (BDC 62) and increase scale to 1:24,000
Slope maps at 1:24,000 if not too costly
Seismic zones at 1:62,500

9. Outstanding Illustrations of the Use of USGS Products
(e.g., maps, methodology, ordinance wording, etc.)

Suisun marsh Protection Plan
Marshland maps (BDC 9) help in negotiation with applicants to increase conservation of baylands in exchange for development
1:24,000 backup maps for BDC 9 are used
Enlarged (BDC 62) to 1:24,000 and supplemented with Army Corps photos and field checks
Regional topographic maps (1:125,000) hang in every professional's office for general reference

10. General Impressions
(Significant or recurring problems and planning issues being addressed; etc.)

Most studies prepared before the SFBRS; however, all pertinent USGS materials available were used.
SFBRS products were used as available, incorporated into revisions, new work, and even amendments to old work. See BDCD Memorandum (Bodovitz, 1971).

11. Officials Interviewed
- George Reed, Senior Planner
- Charles Roberts, Executive Director
- Gordon Oakeshott, Member, ECRB
- Kant Watson, Design Analyst
- Stan Euston, Chief Planner
- L. Thomas Tobin, Senior Engineer

Address: 30 Van Ness Avenue, San Francisco, CA 94102
Telephone: FTS 7/557-3686
Interviewer: W. J. Kockelman
Dates: June 6, 7, 10, 1977

Any additional uses and products identified after completion of the inventories and interviews were recorded on the appropriate inventory forms up to February 28, 1978, and have been included in tables 1, 2, 3, and 4.

INVENTORY OF USES

Six of the seven selected regional agencies inventoried are on the SFBRS mailing list, and all seven agencies have planning staffs who are familiar with SFBRS products. All seven agencies are using SFBRS products in the preparation, administration, or conduct of their planning studies, plans, implementation activities,and other planning activities.

All seven agencies had prepared planning studies, plans, or other documents which cite [1/] or are based upon SFBRS products. A copy of each of these documents was obtained and is listed in appendix G. Fifteen examples of these documents are discussed and illustrated under the Selected Applications section of this report.

The results of the inventory of the regional agencies' planning activities in the San Francisco Bay region are presented in table 1 and are reported here under studies, plans, implementation, and other planning activities.

Studies

All seven agencies indicated the use of SFBRS products in the preparation of 39 planning studies. The types of studies most often used are:

Water quality	7
Potential site evaluation	6
Physical resources	6
Transportation	3
Land use	3
Hydrologic hazards	3
Geologic hazards	3
Geology	3

[1/] The use of the words "cite," "cited," and "citation" in this report refer to specific documentation and not merely verbal identification of a use during an interview.

TABLE 1

Use of SFBRS and Other USGS Products by Regional Agency and Type of Planning Activity

AGENCY	STUDIES									PLANS									IMPLEMENTATION								OTHER ACTIVITIES					
	Geologic Hazards	Geology	Hydrologic Hazards	Land Use	Physical Resources	Potential Site Evaluation	Transportation	Water Quality	Other	Coastal Areas	Conservation & Development	General Regional	Open Space	Solid-Waste Management	Transportation	Water-Quality Management	Water-Supply Management	Other	Fund Allocations	Grant Administration	Jurisdiction Determination	Permit Regulations	Project Review & Approval	Project Review & Comment	Regulation Administration	Other	Community Assistance	Environmental Analysis	EIR/EIS Preparation	EIR/EIS Review	General Reference	Other
Association of Bay Area Governments	X	/	X	X	X	X	X	X	X	X		X	X	X		X	X							X			X	X		X	X	X
Bay Conservation and Development Commission	/	/	X		/	X		/	X		X							X				X	0	X		X			X	X	X	/
Coastal Zone Conservation Commissions[a/]	X	X	X	X	X			X	/	X											/	0	X		X	0	X				X	
Metropolitan Transportation Commission	X	X	X	X	X	X	X		X						X			/	X				X	X				X	X	X	X	X
Regional Water Quality Control Board								X								X				X	X	0			X					X	X	

Explanation

0 Indicates no identified use of SFBRS or other USGS products.

X Indicates identified use of SFBRS products.

/ Indicates identified use of other USGS products.

[X] Indicates those examples illustrated under the Selected Applications section of this report.

a/ The results of the inventories of the State and two regional commissions are combined.

Other studies based upon SFBRS products included population and economic projections, geotechnical study costs survey, BART impact assessment, and earthquake damage cost. The studies based upon SFBRS products are listed in appendix G. Six of these studies are discussed and illustrated under the Selected Applications section of this report.

Plans

All seven agencies indicated the use of SFBRS products in the development of 19 general plans or plan elements. The types of plans most often mentioned are:

Coastal areas	4
Water-quality management	2

Other plans based upon SFBRS products included public access, marsh protection, development policies, water-supply management, general regional, open space, solid-waste management, conservation and development, and transportation plans. The plans based upon SFBRS products are listed in appendix G. Five of these plans are discussed and illustrated under the Selected Applications section of this report.

Implementation

None of the five agencies with regulatory power have incorporated specific references to SFBRS products in their permit regulations; however, all seven agencies use SFBRS products for their implementation activities. The types of activities in which SFBRS products were most often used are:

Project review and approval	4
Regulation administration	4
Jurisdiction determination	3
Project review and comment	2

Other implementation activities based upon SFBRS products included allocating transportation development funds and administering clean-water grants. Implementation documents based on SFBRS products are listed in appendix G. Two of these implementation activities are discussed and illustrated under the Selected Applications section of this report.

Other Planning Activities

All seven agencies indicated the use of SFBRS products for other types of planning activities. The types of activities most often mentioned are:

General reference	5
EIR/EIS review	4
EIR/EIS preparation	3
Environmental analysis	3
Community assistance	2

Planning activities other than those listed above based upon SFBRS products include mapping census tracts and developing a digitized information system. The documents based upon SFBRS products are listed in appendix G. Two of these planning activities are discussed and illustrated under the Selected Applications section of this report.

PRODUCTS USED AND THEIR USES

Of the 71 basic data contributions, six technical reports, eight interpretive reports, three photographic and topographic products, and 15 other products prepared under the SFBRS to date; 60 basic data contributions, 5 technical reports, all interpretive reports, all photographic and topographic products, and 4 other products were identified 803 times by the seven selected regional agencies. The number of applications of each product to a specific study, plan, implementation, or other planning activity are shown on tables 2, 3, and 4.

All seven agencies used other USGS products; that is USGS products not prepared under the SFBRS. These other USGS products are listed in appendix H.

For the purpose of this report, the SFBRS products have been grouped by topic as follows: faults, flood-prone areas, geology [2/], hydrology, landslides, land use, miscellaneous, seismicity and seismology, waste disposal, water quality, water supply, and photography and topography. The topical group of each product is indicated by the letter shown on tables 2, 3, and 4. The title, date, author, scale, and description of each product are included in appendixes A, B, C, D, and E.

[2/] Most of the SFBRS geologic products contain some data on faults.

TABLE 2

Use of Basic Data Contributions by Type of Planning Activity

Basic Data Contribution No.	Group a/	STUDIES										PLANS									IMPLEMENTATION								OTHER ACTIVITIES							TOTAL
		Geologic Hazards	Geology	Hydrologic Hazards	Land Use	Physical Resources	Potential Site Evaluation	Transportation	Water Quality	Other		Coastal Areas	Conservation & Development	General Regional	Open Space	Solid-Waste Management	Transportation	Water-Quality Management	Water-Supply Management	Other		Fund Allocation	Grant Administration	Jurisdiction Determination	Permit Regulations	Project Review & Approval	Project Review & Comment	Regulation Administration	Other		Community Assistance	Environmental Analysis	EIR/EIS Preparation	EIR/EIS Review	General Reference	Other	
1	F		1									2																					2		5
2	G																																		0
3	G																																		0
4	WS								1			1						2																	4
5	WD											1						1										2					1	1		6
6	G					1	2	1		1		5		1		1											1			2	1	1	2	1	1	21
7	F		1			1		1				2	2		1		1					1				2	4	3		1	1	1	2	2		26
8	G		1				2	1		1		2		1		1		1									3			1			2	3	1	20
9	M					2							2											2		1	2	1			2	2	3	3		20
10	M																																1		1
11	L		1			1						1			1			1									1	2		1	2	2	3	4		20
12	G		1			1	2	1		1		2		1		1														1	1	1	2	3	1	19
13	G																																		0
14	WQ																	1															1	3		5
15	FP										1		1		1			1		1							1									6
16	FP										1		1		1			1		1							1									6
17	FP										1		1		1			1		1							1									6
18	FP			1								2			1			1										1						2		8
19	FP			1								3			1			1										1						2		9
20	FP							1				5					1	1										2						2		12
21	WQ																											2					1	1		4
22	H								1									2	1				1					1					3	2		11
23	M																																	1		1
24	WQ																																			0
25	H											1														1		3					1	4		10
26	M		1																															3		4
27	G					1	2	1		2				1		1											1			1	2	1	2	1	1	17
28	G					1	2	2		1				1		1	1										1			1	1	1	2	1	1	17
29	G		1									2														1	2	1						3		10
30	F							1									1					1				2	3	1			1	1	1	1		13
31	L							1									1																			2
32	H					2	1							1		1		1									1	1		1	1	1	2	3	1	17
33	M					1																									1					2
34	L							1									1																			2
35	L																																			0

a/ The letters indicate the following SFBRS product groupings: F-Faults, FP-Flood-prone Areas, G-Geology, H-Hydrology, L-Landslides, LU-Land Use, M-Miscellaneous, WD-Waste Disposal, WQ-Water Quality, WS-Water Supply.

TABLE 2--continued

Use of Basic Data Contributions by Type of Planning Activity

Basic Data Contribution No.	Group a/	STUDIES									PLANS									IMPLEMENTATION							OTHER ACTIVITIES							
		Geologic Hazards	Geology	Hydrologic Hazards	Land Use	Physical Resources	Potential Site Evaluation	Transportation	Water Quality	Other	Coastal Areas	Conservation & Development	General Regional	Open Space	Solid-Waste Management	Transportation	Water-Quality Management	Water-Supply Management	Other	Fund Allocation	Grant Administration	Jurisdiction Determination	Permit Regulations	Project Review & Approval	Project Review & Comment	Regulation Administration	Other	Community Assistance	Environmental Analysis	EIR/EIS Preparation	EIR/EIS Review	General Reference	Other	TOTAL
36	WQ								1								1													1	2		5
37	L	1	2								1																				2		6
38	L					1																			1								2
39	G					1	2	2		1			1		1	1									1		1	1	1	2	1	1	17
40	L																																0
41	G					1	2	1		2	4		1		1										1	2	1	1	1	2	1	1	22
42	L							1			4					1											1				2		9
43	L					1		1		1	4					1												1	1	1	3		14
44	F							1			4										1			1	1	3	1			1			13
45	L										1																						1
46	L																																0
47	WS					1											1									2		1	1	2	2		10
48	G					1	2	2		1			1		1	1								1	3	1	1	1	1	2	2	1	22
49	WD																									1		1		1	1		4
50	WS						1		1				1		1		1								1		1			1			8
51	WQ								1								1									1							3
52	FP	2	2			1				1	3	1					1		1					1	2	2			2	2	4	5		30
53	WS																																0
54	G					2	2	1		1		2	1		1									1	3	1	1	2	2	3	2	1	26
55	F					1						2									1			1	1	1			1	1	2			11
56	G					1	2	1		1			1		1										1		1	1	1	2	1		14
57	L							1								1													1	1		1		5
58	F	1	1								4															2	1			1	2		12
59	L							1								1																	2
60	F																				1			1	1				1	1	1		7
61	LU																									1				1	1		3
62	LU					3		1		1	1	2				1			1						1				1	1	2	2	2	19
63	L																																0
64	G		1				2	2		1	1		1		1	1									1		1			1	2	1	16
65	G																																0
66	L																																0
67	L					1						2																					3
68	G						2	1		1	4		1		1										1	2		1			1	1	16
69	H																									1					1		2
70	WQ								2								1														1	2		6
71	WS																															2	2	2
Total		4	13	2	0	26	26	27	7	20	60	16	14	7	14	14	21	1	5	2	4	2	0	13	40	42	0	20	28	25	60	85	14	614

a/ The letters indicate the following SFBRS product groupings: F-Faults, FP-Flood-prone Areas G-Geology, H-Hydrology, L-Landslides, LU-Land Use, M-Miscellaneous, WD-Waste Disposal WQ-Water Quality, WS-Water Supply.

TABLE 3

Use of Technical and Interpretive Reports,
Orthophotos, and Regional Topographic and Slope Maps
by Type of Planning Activity

Report Number	Group a/	STUDIES									PLANS									IMPLEMENTATION								OTHER ACTIVITIES							TOTAL
		Geologic Hazards	Geology	Hydrologic Hazards	Land Use	Physical Resources	Potential Site Evaluation	Transportation	Water Quality	Other	Coastal Areas	Conservation & Development	General Regional	Open Space	Solid-Waste Management	Transportation	Water-Quality Management	Water-Supply Management	Other	Fund Allocation	Grant Administration	Jurisdiction Determination	Permit Regulations	Project Review & Approval	Project Review & Comment	Regulation Administration	Other	Community Assistance	Environmental Analysis	EIR/EIS Preparation	EIR/EIS Review	General Reference	Other	
TR																																		
1	WQ								3								2	1			1					1			1	1	2	2		14
2	M									1		1							1						1									4
3	H																									1								1
4	LU																																	0
5	M																													1	1			2
6	H								1	1							1								1						1			5
TOTAL		0	0	0	0	0	0	0	4	2	0	1	0	0	0	0	3	1	1	0	1	0	0	0	2	2	0	0	1	1	3	4	0	26

IR																																		
1	LU																															1		1
2	WQ					1																			2									3
3	H							1		1														1	1	1			1			2	1	9
4	FP			1		2	2	3		2	6	1	1		1	1			1						2	4		1	2	1	2	4	2	39
5	WQ										4															2						1		7
6	WD						1						1		1		1								1			1			1	1	1	9
7	H					1																							1		2			4
8	WQ																														1			1
TOTAL		0	0	1	0	4	3	4	0	3	10	1	2	0	2	1	1	0	1	0	0	0	0	1	4	9	0	2	4	1	3	12	4	73

Slope					1		3			1					1														1	1	1	1		10
Ortho	1	1		1	2				1	1	1	1												1			1			2	1	14
Topog				1	1	1	4		1		1	1		1	1							1		1			1	1	2	1	3	3	25
TOTAL	1	1	0	2	4	1	7	0	2	2	2	2	0	1	2	0	0	0	0	0	1	0	0	2	0	0	2	2	3	2	6	4	49

a/ The letters indicate the following SFBRS product groupings: F-Faults, FP-Flood-prone Areas, G-Geology, H-Hydrology, L-Landslides, LU-Land Use, M-Miscellaneous, WD-Waste Disposal, WQ-Water Quality, WS-Water Supply.

TABLE 4

Use of Other SFBRS Products by Type of Planning Activity

Product Designation	Group a/	STUDIES									PLANS									IMPLEMENTATION								OTHER ACTIVITIES						TOTAL
		Geologic Hazards	Geology	Hydrologic Hazards	Land Use	Physical Resources	Potential Site Evaluation	Transportation	Water Quality	Other	Coastal Areas	Conservation & Development	General Regional	Open Space	Solid-Waste Management	Transportation	Water-Quality Management	Water-Supply Management	Other	Fund Allocation	Grant Administration	Jurisdiction Determination	Permit Regulations	Project Review & Approval	Project Review & Comment	Regulation Administration	Other	Community Assistance	Environmental Analysis	EIR/EIS Preparation	EIR/EIS Review	General Reference	Other	
PP 941-A	S						1	1		2			1												1			1					1	8
PP 942	FP																																	0
Bull. 1388	L																																	0
Bull. 1424	L																																	0
Cir. 712	M																																	0
Cir. 721	LU																																	0
I. 909 b/	M								2	1							2								1				2	1	1	1	1	12
MF 677	L																																	0
MF 709	S						2	1		2	1				1										1			1	1				1	11
MF 719	L																																	0
MF 743	F					1						2												1	2	1			1	1	1			10
MF 796	M																																	0
MF 818	F																																	0
MF 881	F																																	0
MF 891	M																																	0
TOTAL		0	0	0	0	1	3	2	2	5	1	2	1	0	1	0	2	0	0	0	0	0	0	1	5	1	0	2	4	2	2	1	3	41

a/ The letters indicate the following SFBRS product groupings: F-Faults, FP-Flood-prone Areas, G-Geology, H-Hydrology, L-Landslides, LU-Land Use, M-Miscellaneous, S-Seismicity and Seismology, WD-Waste Disposal, WQ-Water Quality, WS-Water Supply.

b/ Includes USGS Open-File Report 75-303 "Basic data materials for a report for mineral resources of the San Francisco Bay region, California -- Present availability and planning for the future" by Edgar H. Bailey and Deborah R. Harden, 1975.

The number of products in each group and the total number of times the products were identified were:

17	Geology	237
9	Flood-prone areas	116
10	Faults	97
20	Landslides	66
8	Hydrology	59
3	Photography & topography	49
10	Water quality	48
11	Miscellaneous	46
5	Water supply	24
5	Land use	23
2	Seismicity and seismology	19
3	Waste disposal	19

The following discussions relate to the totals for these SFBRS groups and other USGS products and those applications most often mentioned. (See tables 2, 3, and 4 for specific SFBRS products and applications identified.)

Faults

Of the ten SFBRS products grouped under faults, eight were used a total of 97 times in the agencies' planning activities. The applications most often identified and the number of times used were:

Coastal areas plan	12
Project review & comment	12
Regulation administration	9
EIR/EIS review	8
Project review & approval	8
General reference	6
EIR/EIS preparation	5

Flood-prone Areas

Of the nine SFBRS products grouped under flood-prone areas, eight were used a total of 116 times in the agencies' planning activities. The applications most often identified and the number of times used were:

Coastal areas plan	19
General reference	15
Project review & comment	7
Water-quality management plan	7
EIR/EIS review	6

Geology

Of the 17 SFBRS products grouped under geology, 13 were used a total of 237 times in the agencies' planning activities. The applications most often identified and the number of times used were:

EIR/EIS review	23
General reference	21
Coastal areas plan	20
Potential site evaluation	16
Project review and comment	16
Transportation study	16
Community assistance	13
General regional plan	12
Solid-waste management plan	12
Environmental analysis	11
EIR/EIS preparation	10
Physical resources study	8
Regulation administration	7

Hydrology

Of the eight SFBRS products grouped under hydrology, all were used a total of 59 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	15
Regulation administration	8
EIR/EIS	6

Landslides

Of the 20 SFBRS products grouped under landslides, 11 were used a total of 66 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	12
Coastal areas plan	7
Transportation plan	6

Land Use

Of the five SFBRS products grouped under land use, three were used a total of 23 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	4
Physical resources study	3
EIR/EIS review	3

Miscellaneous Products

Of the 11 SFBRS products grouped under miscellaneous, eight were used a total of 46 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	9
EIR/EIS review	4
Environmental analysis	3
Project review & comment	3

Seismicity and Seismology

The two SFBRS products grouped under seismicity and seismology were used a total of 19 times in the agencies' planning activities. They were most often applied to potential site evaluation.

Waste Disposal

The three SFBRS products grouped under waste disposal were used a total of 19 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	3
EIR/EIS review	3
Regulation administration	3

Water Quality

Of the ten SFBRS products grouped under water quality, nine were used a total of 48 times in the agencies' planning activities. The applications most often identified and the number of times used were:

General reference	9
Water-quality study	7
Regulation administration	6
Water-quality management plan	6
EIR/EIS review	5

Water Supply

Of the five SFBRS products grouped under water supply, four were used a total of 16 times in the agencies' planning activities. The applications most often identified and the number of times used were:

Water-quality management plan	4
EIR/EIS review	3

Photography and Topography

The three easily available SFBRS photography and topography products were used a total of 49 times in the agencies' planning activities. The regional slope map was used a total of 10 times in transportation studies.

The regional topographic map was used a total of 25 times for transportation studies and general reference.

The orthophotoquads were used a total of 14 times in physical resources studies and for general reference.

Other USGS Products

At least 46 differenct USGS products not prepared under the SFBRS were identified by the seven regional agencies as having been used at least 110 times in their planning activities. These products are listed in appendix H.

Quadrangles in the USGS 7½-minute series (topographic) were most often used in the agencies' planning activities. The USGS products most often identified by topic group and the number of times used were:

Geology	11
Water quality	10
Landslides	8
Seismicity and seismology	6
Water supply	6
Hydrology	5

These USGS products were most often used in connection with the preparation of:

Geologic studies	32
Physical resources studies	9
Water-quality studies	7
Water-quality management plans	6

The specific USGS products (appendix H) most often identified were:

Gilbert, 1917 (Hydraulic mining debris)	6
Bonilla, 1960 (Landslides)	4
Hogenson, 1967 (Water resources)	4
Schlocker, Bonilla,& Radbruch, 1958 (Geology)	4
Leopold, 1968 (Hydrology)	3
Poland & Green, 1962 (Subsidence)	3
Radbruch and others, 1966 (Tectonic creep)	3

COMMENTS FROM REGIONAL AGENCY PERSONNEL

In addition to conducting the inventory concerning how SFBRS products were used by the seven regional agencies, certain specific questions were asked by the interviewer of each interviewee. The typical responses from one county are shown on figure 3.

Over 50 regional officials, employees, and consultants were interviewed including 26 planners, 14 engineers, and two consultants. All regional agencies had staffs composed of professional planners, and five agencies had engineers on their staff. Those agency planners and engineers interviewed included three directors, two assistant directors, five coastal planners, four regional planners, four senior engineers, three project leaders, and three chief planners. The regional personnel interviewed are listed in appendix F.

The interviewees were asked about the following subjects: map scales used; size of planning staffs; receipt, distribution, and custody of SFBRS products; reasons, where applicable, for limited use of the products; problems in using the products; anticipated use of the products; information needed or desired; suggestions for improving the products; and services received from USGS personnel. The responses to these questions are reported for each of the subjects.

Map Scales Used

The agencies indicated that the scales most commonly used for their "work" maps were:

1" = 200' to 1,000'	(1:2400-12,000)	4
1" = 2,000'	(1:24,000)	7
1" = 4,000' to 5,000'	(1:48,000-62,500)	4

The agencies indicated that the scales most commonly used in their implementation activities were:

1" =	100'	to 400'	(1:1200-4800)	11
1" =	500'	to 1,000'	(1:6,000-12,000)	5
1" =	2,000'	to 4,000'	(1:24,000-48,000)	5

Size of Planning Staffs

All seven agencies had staffs composed of professional planners or engineers. Their total staff sizes ranged from seven to 100 and averaged 56. Only two agencies had a geologist on their staff; however, another had a geotechnical engineer, and three others had staff members who have had some training or experience in earth sciences or engineering. All agencies had the benefit of geotechnical services either from consultants in engineering geology firms, geologists in their central office, the State Division of Mines and Geology, or advisory committees.

Receipt, Distribution,and Custody of SFBRS Products

Six of the seven agencies are on the SFBRS mailing list and either receive every product released or receive notice of its availability. All agency staffs responded that they are receiving SFBRS products automatically, or they are requesting and receiving them as needed. After receipt, the SFBRS products are usually circulated among staff members,or appropriate staff members are notified. The products are usually placed in the agencies' libraries where they are readily available. In one agency, the SFBRS products are placed in individual desk files, and in another regional agency the library serves as a general source for the products.

Certain products are often posted for convenient reference, for example in one agency (BCDC) a regional topographic map is on the wall of every professional's office.

Failure to Use Certain SFBRS Products

Although all seven regional agencies used SFBRS products, six did not use certain products. The reasons given were: the land-use classification system (BDC 62) was not compatible with the agency's; their staff lacked capability to interpret the information (TR 5); they were unaware of the 1:24,000 slope maps and 1:24,000 landslide maps; some studies were completed before SFBRS products were available; they used other regional and State agencies' materials; they used their own agency's oblique photography; the scale of the regional slope and topographic maps was too small; and products were not at the scale and level of detail needed for administration and enforcement of permit regulations.

Problems in Using SFBRS Products

All seven agencies experienced some problems in using SFBRS products. The problems were:

Scale too small or not detailed enough	6
Difficult to understand	2
Poor graphics	2
Incomplete coverage	2
Lack of staff capability	2

Sometimes the interviewees were able to tie specific problems to specific products. The problems described and their products were:

Scale too small or not detailed enough	BDC 5,42,43;IR 4
Not up-to-date	BDC 62
Poor graphics	BDC 62
Difficult to understand	BDC 52
Inaccurate data	BDC 62
Incomplete coverage	IR 3,7

The graphic problems expressed were "boundaries unclear" or "grid lines and enumeration lines confused with land-use boundaries."

information system, which is based upon numerous SFBRS products, for evaluating alternate transportation corridors.

Information Needed or Desired

All seven agencies expressed a need or desire for additional earth-science, engineering, or other information. The topics of the additional information and the number of times indicated by interviewees were:

Erosion and sedimentation	9
Water quality	8
Land use and land cover	7
Topography	7
Geology	6
Waste disposal	5
Faults	3
Ground water supply	3
Ground response	2
Hydrology	2
Land capability	2

The expression of a need or desire for specific data by the agencies does not lend itself to grouping or weighting. Therefore, only examples of specific data indicated by the agencies are given here:

Coastal erosion and bluff erosion rates at a scale of 1:12,000
Correlation between off-shore and on-shore geology
Deposition rates for lakes especially water supply-reservoirs
Earthquake recurrence intervals
Engineering geology maps at a scale of 1:24,000.
Eutrophication of bay sloughs and creeks
Geologic, hydrologic,and biologic problems of waste disposal
Ground water pollution potential at a scale of 1:62,500
Ground water supplies in developed areas at a scale of 1:24,000
Littoral cell and beach-sand movement research
Marine geology of three-mile State waters at a scale of 1:62,500
Residential and community land capability
Seismic zones at a scale of 1:24,000
Shorelines, salt ponds,and tidal marsh maps at a scale of 1:24,000
Slope maps at a scale of 1:24,000
Silt transportation and deposition rates for marina sites
Urban runoff studies for specific types of basins, namely,
residential, industrial, agricultural
Tidal flow, circulation,and hydrodynamics of the bay
Update land use and land cover annually at a scale of 1:24,000
Update 7½-minute series (topographic) quadrangles

A memorandum from a senior engineer to the director of the California Coastal Commission (fig. 7) illustrates a pressing need for USGS earth-science information in coastal zone management. The director of one agency (BCDC) was quite specific concerning the need for silt transportation and deposition rates for marina sites. The agency has 100 existing and 300 potential marinas in its area of jurisdiction and needs information as a basis for ratings to assist it in avoiding high maintenance costs for dredging to keep the marinas operating. The ratings would also be helpful in locating disposal sites for the material dredged from channels of small marinas. The agency indicated that the Army Corps of Engineers and the Regional Water Quality Control Board were interested, and that State and Federal funds may be available for the work. Priority areas were identified, namely, Carquinez Strait, south of San Mateo Bridge, and the East Bay waterfront.

Suggestions for Improving Products

Six of the seven agencies suggested specific improvements to USGS products. The improvements and number of times suggested are:

Fewer technical or more interpretive reports	5
Larger scale or more detail	4
Add specific data to 7½-minute series (topographic) quadrangles	3
Update 7½-minute series (topographic) quadrangles	3

Examples of specific improvements to the 7½-minute series (topographic) quadrangles are:

Add dikes, shorelines, salt ponds, and tidal marshes
Update highways, hyposography, and urban development
Add names of all coves, points, and headlands

FIGURE 7

Information and Services Needed

October 31, 1977

TO: Joe Bodovitz
FROM: Tom Tobin

SUBJECT: U.S. Geological Survey

Commissioner Andresen asked why the Coastal Commission doesn't rely on the U.S. Geological Survey for assistance when confronted with geological hazard problems. As you know, the Commission has benefited from the efforts of the Survey geologists, and we still consult directly with them. These people, however, are primarily responsible for the Survey's work and can do what we ask only as they have time. Although the Survey provides us with published and unpublished materials, we still need its experts to interpret the technical data, to do limited field work, and to help us use the information in making public policy. Unfortunately, the Survey does not have the funds, or flexibility, to help in more than an ad hoc way.

The Survey recently designated Robert Schoen to serve as the contact with all State coastal zone management agencies. He is attached to the Director's office at Reston, Virginia. This is an important start, but the Survey still does not have the structure or orientation in any of its programs to assist us meaningfully in our day-by-day operations. (Their research programs do not directly emphasize coastal problems, but much of the Geological Survey's data on soils, geology, water and topo mapping is useful to us.) As with other Federal agencies, the Survey is not only authorized, but directed, to cooperate with states in carrying out the Coastal Zone Management Act of 1972.

At one time the Survey conducted the kind of program that we now need; that was the joint USGS-HUD San Francisco Bay Region Demonstration Project which provided geological and other science information badly needed by local and State land use planners. Although our needs along the coast may be slightly different, this program demonstrated the usefulness of such a delivery system. It was experimental and is no longer operating. I understand that the Survey has considered and rejected establishing an internal structure to help direct its work towards coastal problems.

I recognize the importance of the Survey's research, and do not advocate curtailing these efforts. But, obviously, there is much to be gained by increased Survey participation in coastal zone management. Reducing risks to persons and property from geological hazards is an important national and state goal. Our regulatory and planning activities (much of which are funded with Federal money) are among the best tools available for meeting this goal. It is frustrating to me that the Survey, the foremost geological agency in the world, is not able to participate more effectively in California's coastal zone management program.

If asked, I would be glad to provide information on our needs, and to explain the benefits of Survey participation in greater detail.

Part of CCC Memorandum

One agency (BCDC) suggested that the interpretive products should be simple enough to be directly useable by nonscientists -- decisionmakers, developers, landowners, planners, and agency commissioners. Two agencies (BCDC and RWQCB) indicated that they would use their staff and consultants to obtain the more detailed information needed to administer and enforce their regulations.

Services Received from Members of USGS

All seven agencies indicated that they had had contact with, and had received educational, advisory, and review services from at least one USGS scientist or engineer concerning SFBRS products. Thirty-five different scientists and engineers were identified. One agency (ABAG) alone was able to identify 19 different members of USGS. These figures do not include providing SFBRS products in response to verbal, telephone, and written requests. Information and materials were provided on geology, bay circulation, off-shore faulting, earthquake hazards, erosion and deposition, tsunamis, streamflows, flooding, special or new topographic products available, land use, land cover, bay muds, earthquake intensity, surface runoff monitoring, and ground water. Technical advice, interpretations, and engineering data were provided on the effects of channel deepening, earthquake preparedness, separating map overlays, salt-water intrusion, base-map development, earthquake recurrence intervals, unique geologic features, coastal landslide potential, ground response, ground-water recharge, benthic fauna sampling procedures, water-quality monitoring networks, and offshore geology. Review and comments were provided on marsh protection studies, bay development projects, and coastal zone permit applications.

Conferences, seminars, and workshops were held on surface runoff monitoring, earthquake hazards mitigation, and SFBRS products and their applications. Figure 8 illustrates an advisory service provided by USGS.

In addition, members of USGS serve on various regional agency committees or participate as ad hoc advisors to such committees, for example:

Ad hoc Earthquake Preparedness Technical Committee (ABAG)
Technical Advisory Committee for Surface Runoff Program (ABAG)
Citizens Advisory Committee (BCDC)
Engineering Criteria Review Board (BCDC)
San Francisco Bay and Estuary Advisory Committee (RWQCB)
Technical Review Boards (CCC)

The need for continued educational, advisory, and review services by one agency -- the California Coastal Commission -- is illustrated by the memorandum shown in figure 7.

FIGURE 8

Example of an Advisory Service

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Pacific-Arctic Branch of Marine Geology
345 Middlefield Road
Menlo Park, California 94025

June 9, 1976

Mr. Charles Roberts
Executive Director
Bay Conservation and
Development Commission
30 Van Ness
San Francisco, Calif. 94102

Dear Mr. Roberts:

This letter is written in response to a request from Mr. Tom Tobin for an opinion on the possible effects of the proposed deepening of San Francisco Bay on the salinity regime in the Suisun Marsh area. The following is excerpted from our comments of record on the Department of Water Resources Draft Environmental Impact Report (Aug. 1974) on the Peripheral Canal Project:

"COMMENT 3
The DEIR makes no evaluation of the possible effects of the already authorized Corps of Engineers "San Francisco Bay to Stockton (John F. Baldwin and Ship Channels)" project in which the navigation channel in San Pablo and Suisun Bays will be deepened by 12 feet from existing control depths of about 35 feet to depths of 47 feet. This deepening can be expected to have a profound effect on the salinity intrusion, the hydrography and biology of the upper bay and delta. Long term field observations by the Dutch in the Rotterdam waterways and theoretical studies both indicate that small increases in channel depth produce a considerable landward shift in the penetration of the salt wedge. For example, a deepening of 16 feet in the main channel of the Rotterdam Waterway shifted the salinity wedge 13 miles upstream and, this increase of intrusion length has created many difficulties in the regions that are dependent on the river for freshwater supply for agricultural, domestic and industrial purposes. If the inland displacement in the bay is proportional, the salt wedge will move approximately 9.5 miles upstream. The resulting change in salinity in the upper bay would be significant, and would require significantly higher freshwater discharge from the delta to meet decision 1379 criteria."

1. As noted in our previous comment, experience in real cases (as opposed to physical models) has shown a marked increase in salinity intrusion with channel deepening.

2. Very recent work by one of the nations outstanding estuarine physicists (Dr. Donald V. Hansen) whose work has largely formed the rigorous basis for the modern understanding of estuarine hydrodynamics indicates that salinity intrusion in deepened estuaries increases exponentially as fresh water inflow levels approach those proposed for San Francisco Bay. Thus, the bay may be more sensitive to salinity intrusion as a result of deepening than previously assumed.

In summary: There are conflicing views, and it is probably not possible to be sure that any prediction of the salinity in the Suisun Marsh following deepening is valid; however, all agree that it will increase.

Sincerely yours,

Dr. David S. McCulloch

Part of USGS Correspondence

SELECTED APPLICATIONS

Fifteen examples of the application of SFBRS products to various regional planning activities have been selected for discussion and illustration. These examples were selected from the regional agency documents listed in appendix G. The following criteria were used in the selection of these applications:

1. Extensive, intensive, or unique uses of SFBRS products
2. Examples of different types of planning activities
3. Attractive formats and clear presentations
4. An example from each agency

The examples selected include six planning studies, five plans, two implementation activities, and two other planning activities. These examples were selected to illustrate the range and types of applications and do not imply USGS endorsement. The documents were prepared by the agency's staff or consultants, or by an applicant for a permit from an agency. A copy of each document is on file in the USGS Western Region Land Information and Analysis office and is available from the agency.

The examples are presented by group -- studies, plans, implementation activities, and other planning activities. (See table 1, p. 32a.) Figures illustrating the use of the SFBRS products are selected from the documents and reproduced here as close to their original scale, color, and format as possible.

The following descriptions generally identify the document and its authors. They list the USGS products used and assistance provided, describe the methods of application, and comment on the significance of each application. The descriptions are deliberately succinct in order to present various applications in the shortest space.

Earthquake Damage Cost Study (ABAG)

A study entitled "Earthquake Intensity and Expected Cost" was prepared by the Association of Bay Area Governments (1978).[4/] The study documents the way in which both intensity maps and damage maps can be produced.

Use of USGS Data

The study contains 27 references to USGS, its products,and its personnel. The procedure for estimating maximum intensity, the source maps for geologic materials, the selecting of active faults, the estimating of maximum magnitude,and the relating of materials and intensities to distance are based -- in some cases solely -- on SFBRS products. The types of products include geology, seismic zonation, and earthquake intensity prediction.

Method of Application

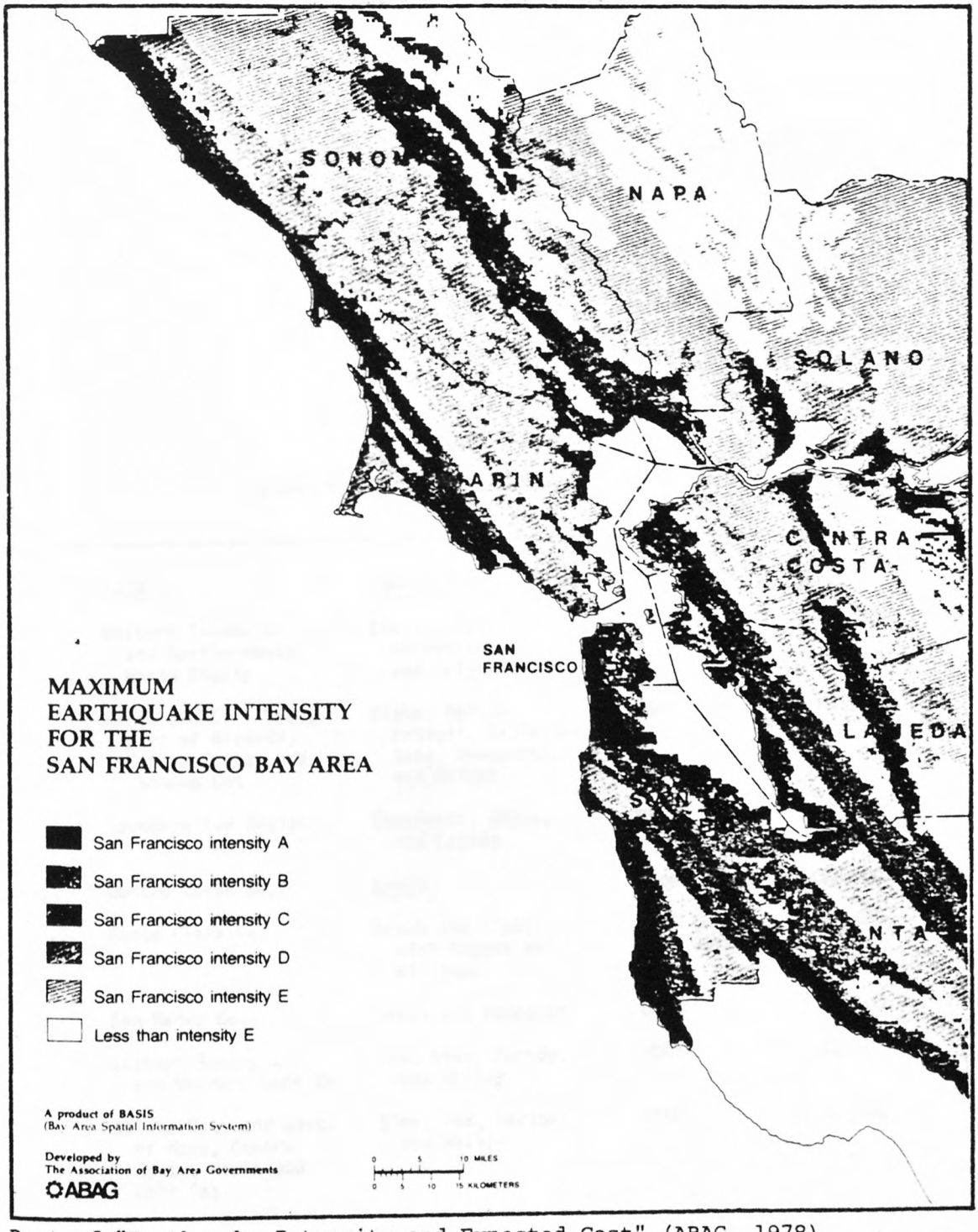
With a few minor changes, the procedure for estimating maximum intensity developed by USGS scientists (MF 709) was used to produce the intensity map (fig. 9). The basic geologic information was obtained primarily from USGS products (fig. 10) and divided into six categories of materials with similar ground shaking amplification characteristics according to the method set forth in an SFBRS product (PP 941-A). The selection of active faults was based on a comparison between a USGS list and a list compiled by the State Geologist.

The maximum magnitudes of major active faults were obtained from an SFBRS product (PP 941-A). The formula used to predict ground-shaking intensity of land underlain by the Franciscan assemblage and the method used for adjusting the formula for land underlain by other formations were developed by USGS scientists (MF 709).

4/ The regional agency documents referred to in this section of the report are listed in Appendix G.

FIGURE 9

Computer Produced Earthquake Intensity Map



Part of "Earthquake Intensity and Expected Cost" (ABAG, 1978)

FIGURE 10

Source Maps for Geologic Materials

AREA	COMPILED BY	AGENCY	SCALE
Western Sonoma Co and Northernmost Marin County	Blake, Smith, Wentworth, and Wright	USGS	1:62,500
Marin and S.F. Cos., part of Alameda, Contra Costa, and Sonoma Cos.	Blake, Bartow, Frizell, Schlocker, Sorg, Wentworth, and Wright	USGS	1:62,500
Southern Bay Region	Borcherdt, Gibbs, and Lajoie	USGS	1:125,000
Contra Costa Co.	Brabb	unpublished	1:62,500
Santa Clara Co.	Brabb and Dibblee with Rogers and Williams	CDMG from USGS data	1:62,500
San Mateo Co.	Brabb and Pampeyan	USGS	1:62,500
Eastern Sonoma Co., and Western Napa Co	Fox, Sims, Bartow, and Helley	USGS	1:62,500
Solano Co., and parts of Napa, Contra Costa, Marin and Yolo Cos.	Sims, Fox, Bartow, and Helley	USGS	1:62,500

Part of "Earthquake Intensity and Expected Cost" (ABAG, 1978)

Maximum intensity maps were then produced for each major fault using ABAG's computer-based information system (see p.109) and combined into a single fault map by indicating the greatest estimated intensity that might occur in any given area (fig. 9).

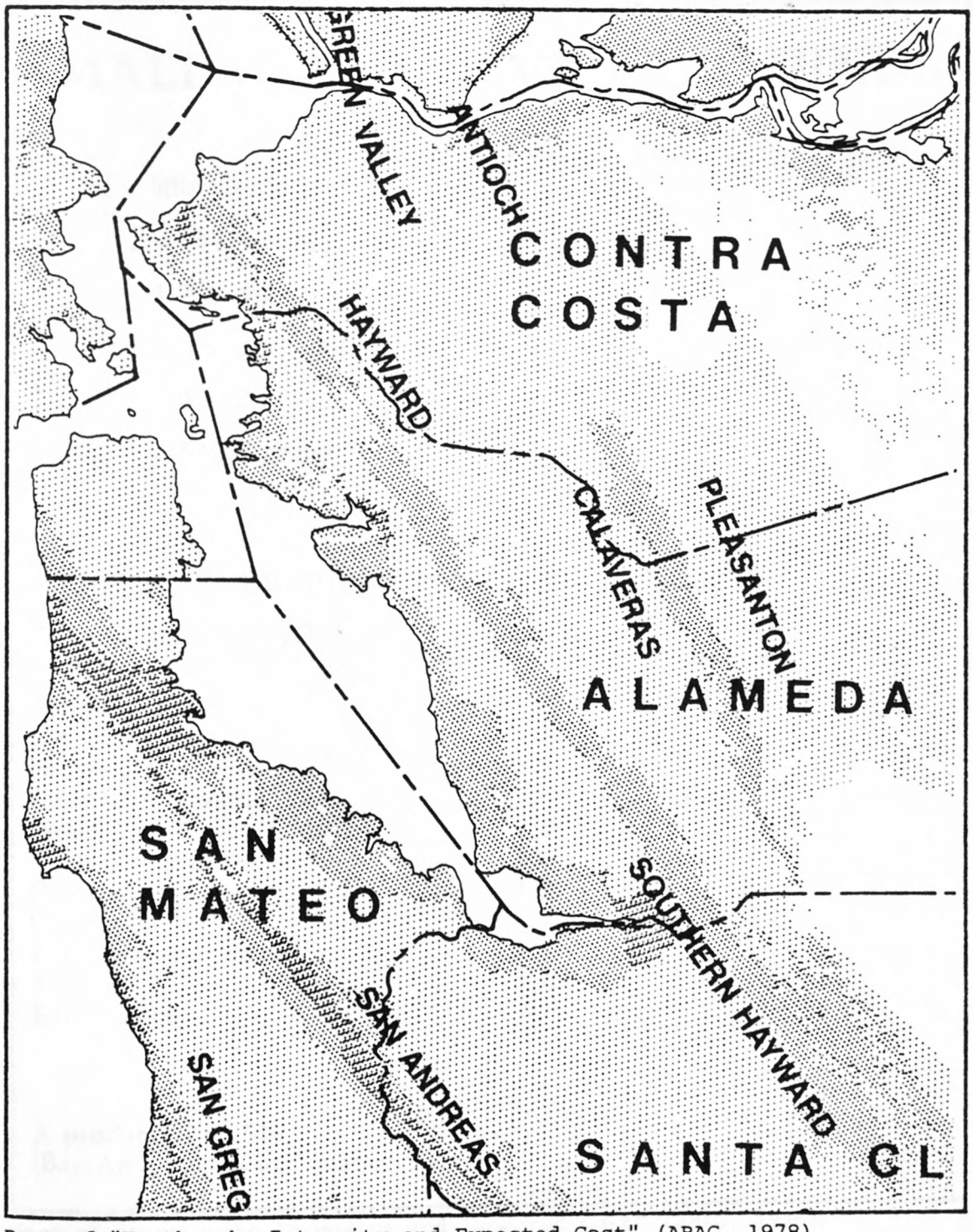
The maximum probable earthquake is assumed, two sets of recurrence intervals are selected,and intensity is related to damage costs for two types of building -- small wood-frame buildings,and other types of buildings. Damage costs are determined and then substituted for the intensity value. The costs are summed for each area to produce a total ground shaking cost-damage map for each type of building. Maps are then produced for each set of recurrence intervals (figs. 11 and 12).

Comment

The intensity map can be used with information on existing buildings to forecast locations of maximum damage for planning emergency response measures and for designating areas of critical concern. The damage maps may be used for evaluating the relative costs due to earthquakes for new buildings throughout the region and for designating areas where special precaution may be needed. However, they are not a basis for engineering decisions at a specific site. The method of land capability analysis used by ABAG to generate these maps was developed by ABAG under a project funded by USGS and HUD as part of the San Francisco Bay Region Study. A report on this method is in press (USGS Prof. Paper 945).

FIGURE 11

Computer-Produced Earthquake Damage Map
(See fig. 12 for explanation)

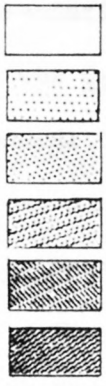


Part of "Earthquake Intensity and Expected Cost" (ABAG, 1978)

FIGURE 12

Legend for Earthquake Damage Map
(Explanation for fig. 11)

SMALL WOOD-FRAME BUILDINGS



little damage

<1% damage

1-2% damage

2-3% damage

3-4% damage

4-5% damage

Assumed Earthquake Recurrence Intervals For Major Active Faults (years)

San Andreas	100
San Gregorio	100
Hayward	100
Southern Hayward	100
Healdsburg-Rogers Creek	100
NE of Alexander	100
Pleasanton	100
Calaveras	100
Concord-Green Valley	100
Antioch	100
Silver Creek	100

A product of BASIS
(Bay Area Spatial Information System)

Part of "Earthquake Intensity and Expected Cost" (ABAG, 1978)

Geologic Hazards Study (CCC)

A study of coastal geology and geologic hazards entitled Geology was completed by the staffs of the State and Central Coast Regional Commissions (1974). The report is one of a series which provided the regional commission with information upon which to base its recommendations for statewide coastal development policies which are part of the California Coastal Plan (see p. 79). The report describes in general terms earthquake hazards, slope stability, tsunamis, shoreline erosion, and various measures to avoid hazards and mitigate damage.

USGS Data

The report is based -- in some cases solely -- upon published and unpublished data of the USGS and contains references to three SFBRS products. These include studies of fault, flood-prone areas, and landslides. In addition, the cooperation of two members of the USGS is acknowledged on the title page.

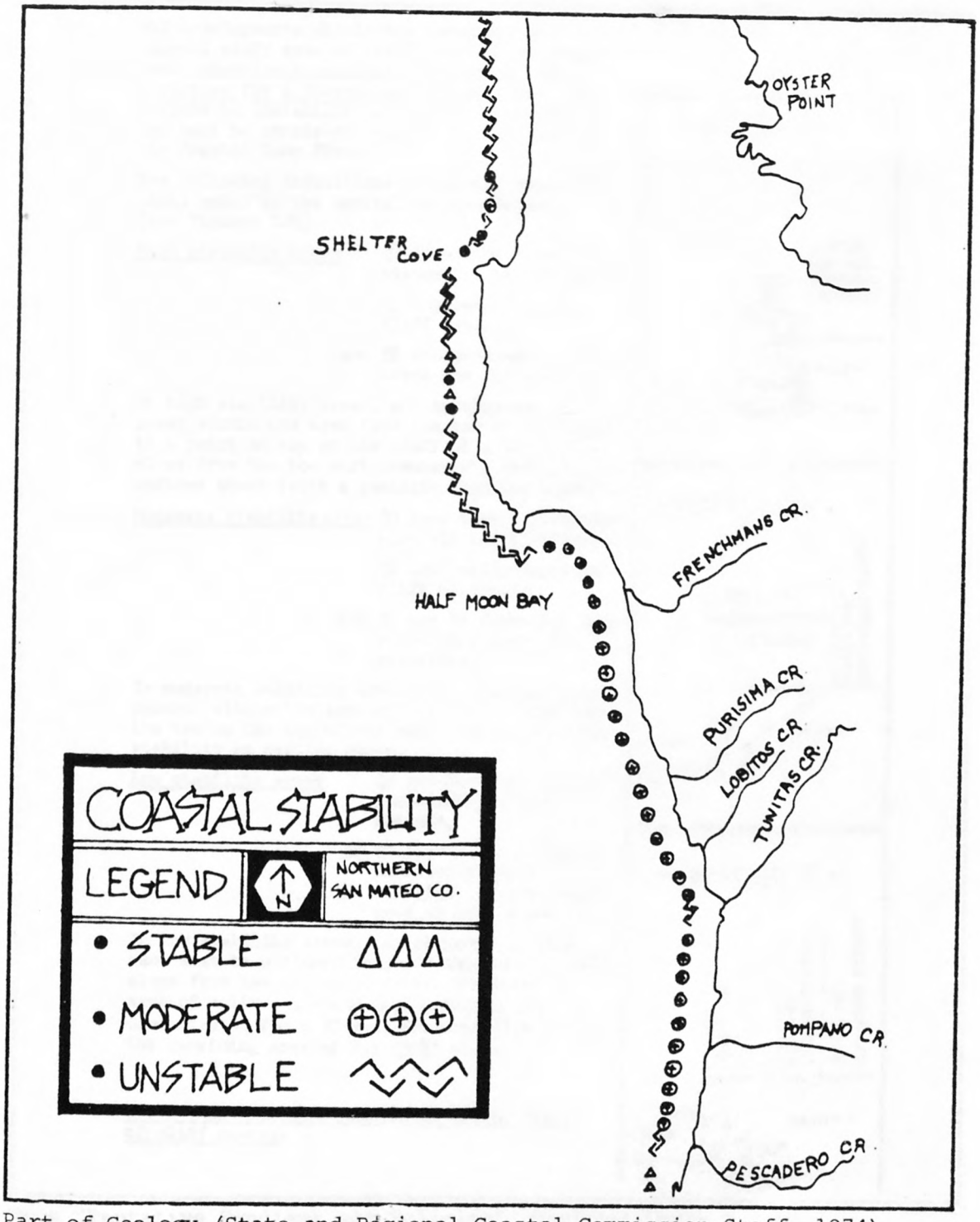
Method of Application

Fault, landslide, and coastal erosion data are discussed in the report. Data on landslides, beach and cliff erosion, and other geomorphic features are placed on a series of "Erosion Data" and "Shoreline Characteristics" sketch maps. Information on coastal erosion, landslides, geology, and faults especially prepared in cooperation with the regional commission was compiled and interpreted on a series of easy-to-read "Coastal Stability sketch maps (fig. 13).

The sketch maps and interim coastal erosion guidelines (fig. 14) developed with the advice and assistance of the USGS were recommended to the State Commissission by the Central Coast Regional Commission (1974) as part of its "Tentative Findings and Policies."

FIGURE 13

Coastal Stability Map



Part of Geology (State and Regional Coastal Commission Staff, 1974)

FIGURE 14

Coastal Erosion Guidelines

All developments within the immediate beach–coastal bluff area of the Central Coast Region must demonstrate geologic stability of the structure for a 50-year period, must not contribute to instability of any cliff or beach, and must be consistent with other policies of the Coastal Zone Plan.

The following definitions of coastal stability shall apply to the Central Coastal Region: (See Figures I–M)

High stability areas (1) less than 1 foot/year historic cliff retreat,

(2) inherently stable cliff material,

and (3) not dependent upon a beach for its stability.

In high stability areas, any development proposed within the area from the toe of the bluff to a point on top of the bluff at a 1:1 (45°*) slope from the toe must demonstrate stability as defined above (with a geologic engineering report).

Moderate stability areas (1) less than 1 foot/year historic cliff retreat,

(2) inherently unstable cliff material,

and (3) may be dependent upon a fronting beach for stability.

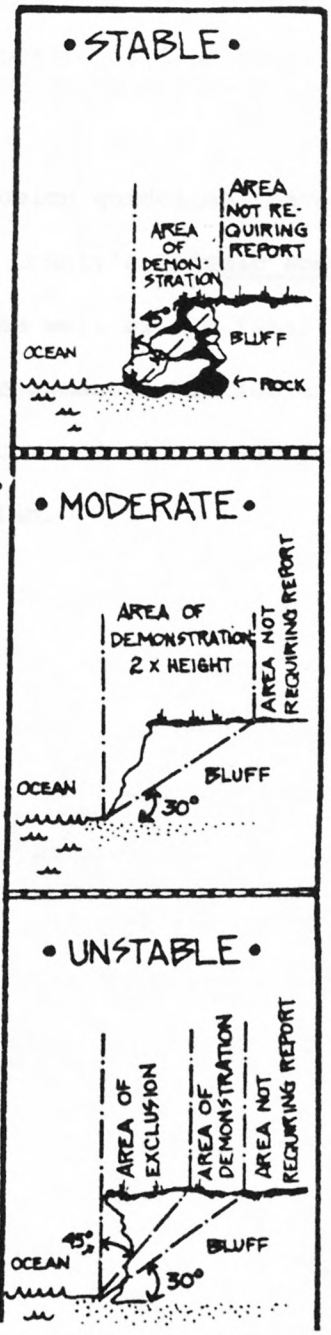
In moderate stability areas, any proposed development within the area of 2:1 (30°*) slope from the toe to the top of the bluff must demonstrate stability as defined above.

Low stability areas (1) greater than 1 foot/year historic cliff retreat,

or (2) landslides or other inherently unstable material (such as beach sand or active dunes).

In low stability areas, any proposed development must be excluded from the area of 1:1 (45°*) slope from toe to top of bluff, and from the area of active movement and stability must be demonstrated for a 50 year economic life within the remaining area of 2:1 (30°*) slope.

*These angles are not related to actual angle of cliff repose.



From "Tentative Findings and Policies" (Central Coast Regional Commission, 1974)

The development and transfer of this unique recommendation for hazard avoidance and damage mitigation was the result of intensive and time-consuming effort on the part of two members of the USGS. These members provided educational, advisory, and review services to San Mateo County and the State and regional commissions over a period of four years.

Comment

The sketch map and recommended coastal erosion guidelines have been adapted to, and interpreted in, San Mateo County's Seismic and Safety Elements (Kockelman, 1976, pp. 98, 99) as well as the final California Coastal Plan policy on blufftop development. Particularly significant is the use of a regional agency recommendation developed by the USGS in both a statewide and a county plan.

Physical Resources Studies (MTC)

Two reports -- one on physiography, geology, hydrology, and vegetation entitled Natural Process Inventory, and the other on archeology, land-use, settlement patterns,and visual amenities entitled Visual Landscape Relationships -- were prepared by Wallace, McHarg, Roberts and Todd (1974) for the Metropolitan Transportation Commission. The reports are two in a series of five describing the San Francisco Bay region as an interacting system. Not available is a set of "one-of-a-kind" maps which is on display at the Commission's offices. Lists of these maps are shown on figures 15 and 16.

The purpose of these reports, together with the other three, is to establish an information base at a regional scale for determining the environmental impact of the adopted regional transportation plan and for assessing the regional consequence of specific transportation projects.

Use of USGS Data

The studies are based -- for some topics, solely -- upon SFBRS products, and all data are recorded on base maps that were prepared from SFBRS products. The contribution of the USGS is acknowledged in each of the five reports, although only two reports contain citations of SFBRS products. Examples of specific acknowledgement given to the SFBRS include clauses and phrases such as "Much of the credit must be given to USGS ...." and some USGS materials "proved indispensable."

FIGURE 15

List of Natural Process Inventory Maps

A. PHYSIOGRAPHY

N-0	Aerial Photo
N-00	USGS Relief Map*
N-000	Generalized Slope Map*

B. GEOLOGY

N-1	Generalized Lithologies *
N-1a	Generalized Lithologies * (Chart Accompanying Map N-1)
N-1b	Generalized Lithologies * (Chart accompanying Map N-1)
N-1c	Surficial Deposits* (Chart accompanying Map N-1)
N-1d	Map-to-Map Stratigraphic Correlation * (Chart accompanying Map N-1)
N-2	Relative Stability During Seismic Activity*
N-3	Relative Landslide Abundance*
N-4	Natural Resources

C. CLIMATE

N-5	Combined Climatic Factors *

D. HYDROLOGY

N-6	Surface Hydrology *
N-7	Ground Water Hydrology

E. SOILS

N-8	Soils Associations
N-9	Engineering Properties of Soils
N-10	Prime Agricultural Lands

F. Vegetation

N-11	Plant Communities*
N-11a	Preferred Habitats of Resident or Nesting Wildlife Species (Chart accompanying Map N-11)
N-11b	Plant Vulnerability to Air Pollution * (Livermore Valley example)
N-12	Relative Wildfire Hazard
N-13	Areas of Unique Value
N-13a	Areas of Unique Value (Chart accompanying Map N-13)

*Based on SFBRS products

Modified from MTC Natural Process Inventory (Wallace and others, 1974)

FIGURE 16

List of Visual Landscape Maps

A. SETTLEMENT PATTERNS

SP 1 ARCHAEOLOGY
Archaeological Resources *

SP 2 URBANIZATION
1900-1970 Urbanization

SP 3 LAND USE
1970 Land Use *

SP 4 SETTLEMENT PATTERNS
Settlement Patterns - 1970 *

SP 5 RECREATIONAL AND CULTURAL RESOURCES

B. VISUAL LANDSCAPE

VL 1 VISUAL AMENITIES
Natural Visual Amenities *

VL 2 VISUAL AMENITIES
Cultural Visual Amenities

VL 3 AMENITIES
Ranking of Amenities

*Based on SFBRS Products

Modified from MTC Visual Landscape Relationships (Wallace and others, 1974)

Over 50 references are made to the USGS, its personnel, or SFBRS products. The products include those on geology, landslides, water supply, precipitation, flood-prone areas, radiocarbon dating, land use, regional slope maps,and topographic maps at scales of 1:125,000 and 1:62,500. Those maps,based upon SFBRS products,are indicated on figures 15 and 16.

Method of Application

Both working and presentation maps upon which data were recorded are SFBRS maps or were developed from SFBRS maps. The SFBRS information was transferred directly to those maps in the set which show archeological resources, land use, settlement patterns, natural visual amenities, contours, drainage basins, lithologies, surficial deposits, active faults, landslide abundance, relative stability during seismic activity, climatic factors, streams and ponded water, water-supply reservoirs, 100-year floodlands, tsunami innundation, and several agricultural land uses.

The extent of urbanization for seven periods between 1897 and 1908 was developed solely from USGS maps. The land-use map shows eight categories taken solely from an SFBRS product (BDC 62).

The settlement patterns were derived from USGS land-use data. One of the key items -- Lands with over 15% slopes affording views -- used in developing a natural visual-amenities map was taken from the regional slope map.

Comment

The sets of Natural Process Inventory and Visual Landscape Relationships maps are well designed, attractively presented, and many are based solely upon SFBRS products. They are being used by the commission in developing their environmental-impact assessment procedures, in analyzing the environmental

impact of transportation projects, and in evaluating transportation corridors such as the San Mateo coast corridor (see p. 73). In addition, the maps were used in the BART Impact Study.

The accuracy of one of the SFBRS land-use products (BDC 62) was questioned, stating it had "numerous errors," was "not consistent," was "too detailed" to map, and had miscategorized marshes as "Primary Industrial" (fig. 17). However, the USGS 1972 update is recognized as correcting some of these errors, and from the application of these products, it may be concluded that land-use maps at a scale of 1:62,500 are adequate for determining the general impact of a regional transportation plan on the land-use and land-cover aspects of the environment.

Another agency (ABAG) has purchased new USGS land-use maps at a scale of 1:100,000 (prepared under the Geography Program) to incorporate into their computer-based information system to be used in developing an industrial siting plan. (See p. 109.) The above criticism of BDC 62 contrasts with ABAG's comments about the new maps. They state, "There is clearly no other source that approaches the quality, classification or timeliness" (fig. 42, p. 110); ABAG notes that although the land-use overlays have not yet been quality checked, the maps are satisfactory for their needs,and they "will assume responsibility" for their use of the products.

FIGURE 17

Discussion of SFBRS Land-Use Product

The 1970 Land Use Study of the San Francisco Bay Area, United States Geological Survey. This map as prepared by USGS is at 1:62,500; in reducing it to 1:125,000, some of the categories were grouped. To discriminate between all the categories at this scale would be too cumbersome and does not reflect the regional concerns of the RTP.

This map shows the following categories of Land Use:	USGS identified these equivalent categories:
-Single-Family Residential	-Single-Family Residence
-Multi-Family Residential	-Multi-Family Residence
-Commercial, Public and Private Services	-Commercial, Public and Private Services
-Strip and Cluster Development	-Strip and Cluster Development
-Industry	-Primary Industry, Extractive Industry
-Transportation	-Transportation
-Improved Open Space (Park, Cemetery)	-Improved Open Space (Park, Cemetery)
-Unimproved Open Space/ Agricultural Areas	-Unimproved Open Space, Wetland, Agriculture with Residence (Field Crop Vineyard, Grassland/ Pasture)
-Water	-Water

B. ACCURACY:

The USGS data have numerous errors

1) Photo-interpretations of different sections of the Bay Area were done by different people. The result of this is that the mapped categories are not consistent from one part of the map to another. The most obvious example of this is residential land use. Multi-family residential in San Francisco was defined by one person (or group) as meaning only hi-rise apartment buildings. Single-family residential was all other residential. Multi-family residential in Santa Clara County was defined as hi-rise apartments, and townhouses. Single-family residential was defined as free-standing single-family residences and mobile homes. Discrepancies exist for other areas of the map as well.

2) Dumps are classified in some areas as commercial and in other areas as industrial.

3) "Strip and Cluster Development" is defined as those areas outside the main body of existing urban land use that have a combination of uses - residential, commercial, and industrial. The breakdown was too detailed for USGS to map. Unfortunately, this catch-all category was used liberally by some photointerpreters, and sparingly by others. The result is inconsistency.

4) None of the other categories are mapped consistently; however, the degree of discrepancy varies.

5) Marshes used for the production of salt are mapped by USGS as "Primary Industry." The result is a land use map which implies extensive industrial land use in the South Bay. It would be more accurate to group salt marshes in the category "Extractive Industry."

This land use map was checked in Washington, D.C. for errors. Sporadic corrections were made at that time. The confusion over the categorization of dumps was one of the difficulties which they tried unsuccessfully to resolve.

C. FUTURE DATA

USGS did a 1972 update of this map. The intention was to show changes in land use from 1970 to 1972. When that was done, some of the errors on the 1970 map were discovered. These discoveries were noted on the 1972 update, as well as the changes in existing land use which had occurred in the two year period.

Part of MTC Visual Landscape Relationships (Wallace and others, 1974)

Potential Waste-Disposal Sites Study (ABAG)

A technical memorandum entitled "Identification of Possible Class I Site Areas" was prepared by the Association of Bay Area Governments in 1977 . The memorandum describes a study of the bay region to identify general areas that might be used as disposal sites for toxic or hazardous wastes. The types of criteria used were divided into "strict," "gradational," and "acceptability."

The phases of the planning and plan-implementation process included (1) determining the amount of hazardous wastes generated and the need for additional site capacity, (2) developing local criteria for site review, and (3) preparing recommendations for ensuring site availability.

Use of USGS Data

The "site criteria" and the numerical suitability ratings assigned to the "gradational criteria" (fig. 18) are based upon, or have been adapted from, an SFBRS interpretive report (IR 6). The sources for four of the five "strict criteria" (fig. 18) are SFBRS products, and the source for the other criterion is developed from the earthquake intensity prediction map (MF 709). The sources for four of the five "gradational criteria" are SFBRS products. The sources for two of the "acceptability criteria" are USGS products (fig. 18) -- the third source was prepared by the USGS.

The products used include those on waste disposal, flood-prone areas, precipitation, earthquake intensity prediction, geology, well yields, and topographic maps. In addition, the interpretive report on relative slope stability (currently in press) was used on an "official-use-only" basis.

FIGURE 18

Solid-Waste Disposal Site Criteria

Strict Criteria	Map Source
Out of flood prone areas	Areas within 100-year flood plains on USGS/SFBRS Map (Limerinos, et al., 1973)
Not in an earthquake hazard area	Areas of San Franciscan intensity A or B, or within .2km. of fault capable of producing groundshaking on ABAG Earthquake Preparedness Program Map (USGS process) - (ABAG, in press)
Not on unstable materials or on greater than 15% slope	Areas shown as Categories 1 or 2 on USGS/SFBRS map (Nilsen, in press)
Gradational Criteria	
Minimize amount of precipitation	Assign "3" to 0 to 20 inches and assign "2" to 20 to 30 inches on USGS/SFBRS map (Rantz, 1971)
Minimize likelihood of significant yield from wells	Assign "3" to Category A, "1" to Category B and "0" to categories C and D on USGS/SFBRS map of well yield (Webster, 1972)
Prefer older rocks that are not granitic or part of the Franciscan Assemblage	Assign "1" to Franciscan Assemblage and granitic rocks and assign "3" to other Tertiary or older rocks on USGS/SFBRS or CDMG geologic maps
Acceptability Criteria	
Not in ecologically sensitive area	USGS Topographic sheets
Prefer shales or oil bearing sandstones and avoid highly sheared materials	USGS/SFBRS or CDMG geologic maps
Setback from waters used for drinking or recreation	ABAG base map

Part of "Identification of Possible Class I Site Areas" (ABAG, 1977)

Method of Application

The USGS map information was digitized, converted into grid cells (¼ square kilometer, approximately 62 acres) and registered to a Universal Transverse Mercator base, resulting in eight computer files. These computer files were combined so that a shaded map representing both the "strict" and "gradational" criteria could be produced by the printer-plotter. Cells with similar characteristics in each county were grouped and the "acceptability" criteria applied. This procedure resulted in a number of cells located in several counties being identified as acceptable for use as potential Class I waste-disposal sites.

Comment

Primary or sole reliance is placed on waste-disposal criteria, suitability ratings, prediction methods, and earth-science information developed or produced by USGS. The study makes use of ABAG's computer-based information system (see p. 109).

The study clearly demonstrates the transfer of the waste-disposal site-evaluation method for Santa Clara County (IR 6) to the entire nine-county Bay region four years later. In addition, the manipulation of data in the study is an outgrowth of the Land-Capability Analysis (Laird and others, 1979) jointly supported by USGS and HUD under the SFBRS.

Transportation Corridor Study (MTC & ABAG)

A study of a highway corridor entitled "San Mateo Coast Corridor Evaluation" was conducted by the Metropolitan Transportation Commission under the direction of a Joint Policy Committee (1975) of the commission and of the Association of Bay Area Governments. The corridor is one of thirteen corridors in the region which have been analyzed by the commission. The purpose of the evaluation is to integrate regional land-use and transportation planning at an early stage of development within a corridor.

Use of USGS Data

The existing land-use map (fig. 19) is based upon the SFBRS land-use maps. The natural hazards map (fig. 20) is based upon four SFBRS products, describing landslides, active faults, flood-prone areas,and slope. Although not identified, both figures have as their base the regional topographic map.

Method of Application

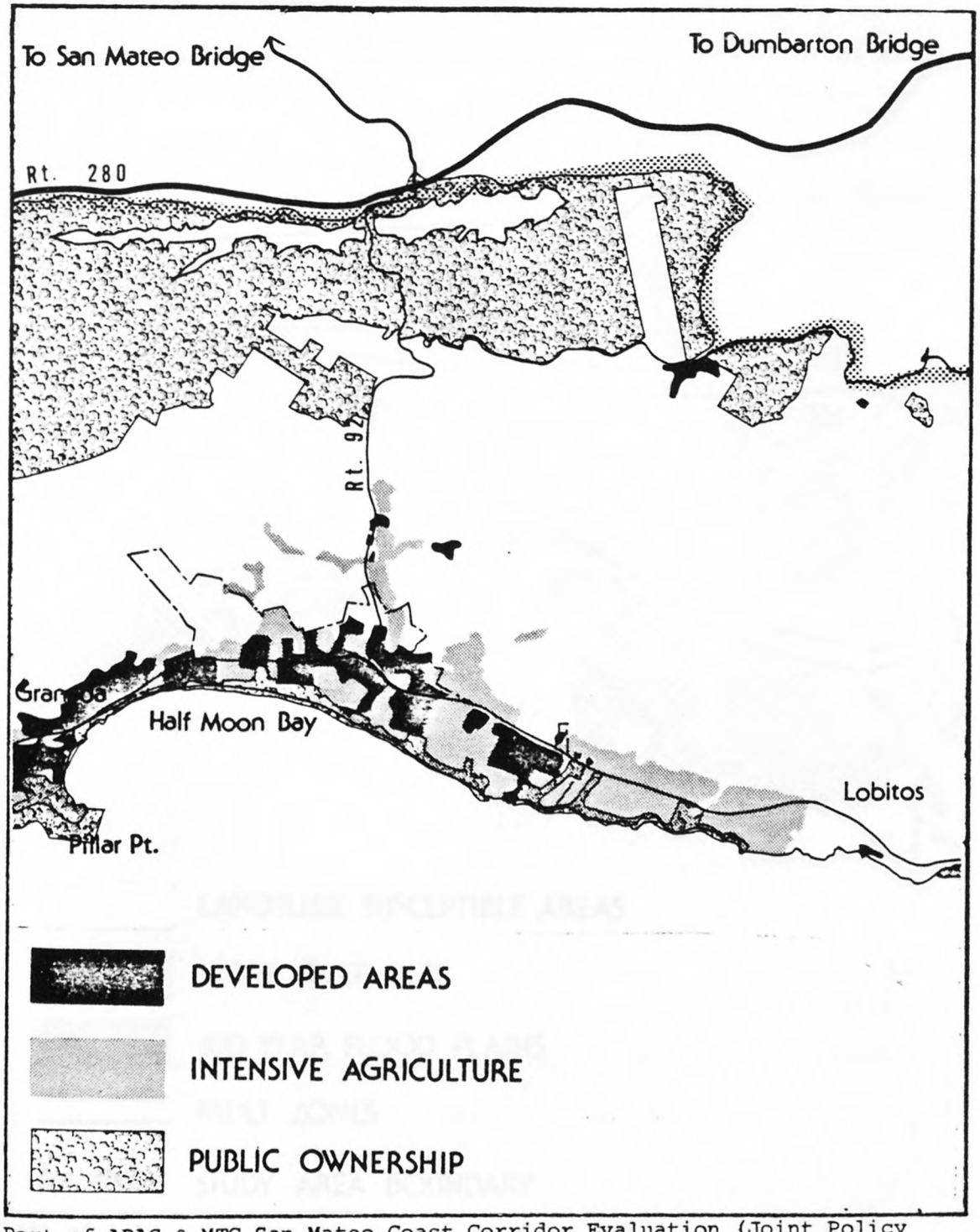
Land uses, landslide-susceptibility areas, active-fault locations, the 100-year flood plains, and slopes in excess of 30 percent have been taken directly from SFBRS products and used to evaluate three possible alternative growth patterns of the communities lying in the corridor.

Comment

The key determinants needed in evaluating transportation corridors, namely land use, natural hazards, and slope, were provided by USGS products.

FIGURE 19

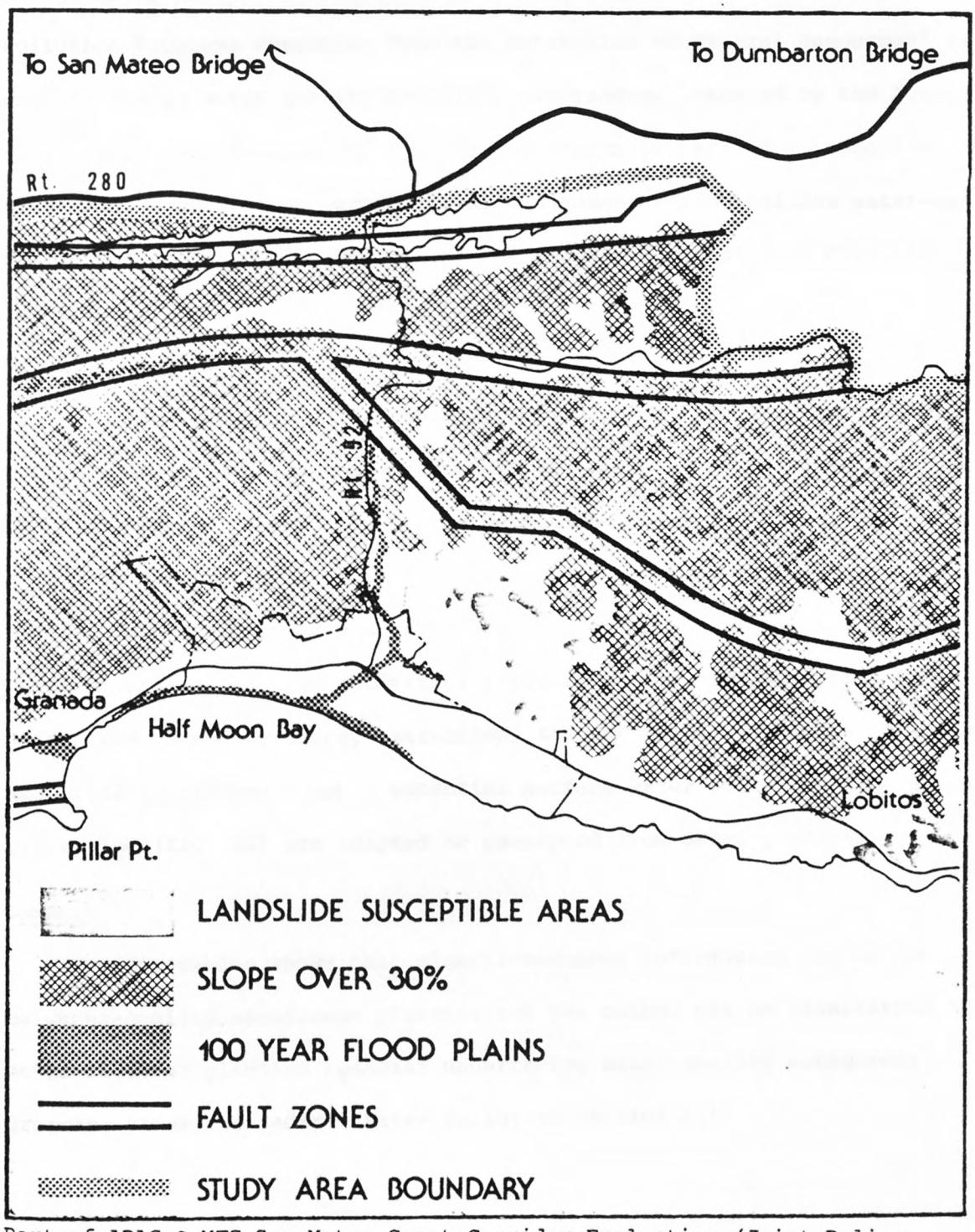
Existing Land Use



Part of ABAG & MTC San Mateo Coast Corridor Evaluation (Joint Policy Committee, 1975)

FIGURE 20

Natural Hazards



Part of ABAG & MTC San Mateo Coast Corridor Evaluation (Joint Policy Committee, 1975)

Water-Quality Study (ABAG)

A study described in a technical memorandum entitled "Significance of Pollution Problems Resulting from the Extraction of Mineral Resources" is one of several water-quality technical memorandums prepared by the Association of Bay Area Governments (1977). The memorandum is part of a council of government's program on environmental management which includes water-quality management under Section 208 of the Federal Water Pollution Control Act (U.S. Code, 1977, Title 33, Sec. 1288 and following).

Use of USGS Data

The discussion of certain mineral resources -- construction materials, energy sources, salines, and mercury -- is based primarily upon two recent SFBRS products (I 909 and Open-File Report 75-303).

Method of Application

The effects of sand and gravel extraction on water quality, a table of major mineral extraction activities (fig. 21), discussions on the land disruption caused by energy extraction, the compatibility of salt marshes and wildlife refuges, and potential surface-water pollution from mercury processing (fig. 22) are adapted or excerpted from SFBRS products.

Comment

The memorandum shows that mineral-resource information can be applied to water-quality management planning,and the method can be transferred to other regional planning agencies undertaking water-quality management programs under the Federal Water Pollution Control Act.

FIGURE 21

Major Mineral Extraction Activities in the Bay Area

Mineral Resource	Type of Operation	Location (By County)	Approximate Value Annually
Construction Materials			$70 million per year
Sand & Gravel	Surface mine Submarine mine	Alameda, Napa, San Francisco, Santa Clara, Solano, Sonoma	
Crushed Stone	Quarry	Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma	
Limestone	Quarry Submarine mine	Alameda, San Mateo, Santa Clara	
Energy Resources			$30 million per year
Coal	Surface mine	Contra Costa (stopped)	
Geothermal	Well	Sonoma	
Oil and Gas	Well	Contra Costa, Solano	
Salines	Pond	Alameda, Napa, San Mateo, Santa Clara, Solano	$16 million per year
Mercury	Underground mine Quarry	Santa Clara (has not been mined since 1973)	Fluctuates ($110 million total to date)

Adapted from Bailey and Harden, 1975.

Part of "Significance of Pollution Problems Resulting from the Extraction of Mineral Resources" (ABAG, 1977)

FIGURE 22

Extent of Mineral Extraction Problems

Energy Sources

Natural gas and some oil are currently the most valuable energy sources in the Bay Area. However, the reserves are expected to be depleted in less than 20 years. Geothermal steam is expected to increase greatly in importance. Coal and peat, although present in limited amounts in the Bay Area, are not expected to be extracted since they are not economically competitive with other energy sources (Bailey and Harden, 1975a). Water percolating through coal mines, such as those near Mt. Diablo, tends to become highly acidic and could carry large amounts of heavy metals. However, no serious problem of this type exists in the Mt. Diablo vicinity (Johnston, 1977).

Extraction of oil, gas, and steam all require the drilling and use of deep wells. Drilling practices are closely regulated by the California Division of Oil and Gas. Drilling involves a fair amount of disruption of the land surface since "roads must be provided for access, a drill rig must be erected, ponds for retention of drilling fluids must be dug, and storage tanks and other temporary structures are generally required" (Bailey and Harden, 1975a). After the drilling has been completed, however, the structures can be removed, the ponds regraded, and most of the land returned to its condition prior to drilling. The actual well heads are small and can be concealed easily.

Salines

Salt is obtained by evaporating Bay water in shallow ponds now covering approximately 35,000 acres of marshland. These ponds are currently concentrated in the southern Bay, with a few ponds located in the northern Bay. The amount of marshland used for this purpose is likely to decrease in the future because of the value of these lands for recreation, wildlife habitat, development, and waste disposal. The existing salt ponds in the southern Bay are considered compatible with the Wildlife Refuge established in that area in 1972 (Bailey and Harden, 1975a).

Mercury

The source of the mercury contamination is believed to be the New Almaden Mining District located in the hills above the reservoirs. There are many shafts and tunnels that were excavated to obtain the mercury ore (chiefly cinnabar). Many tailing piles and dumps also occur in this area. The tailings were produced by the cinnabar processing that took place near the location of the mining activities that have been occurring in this area since 1850.

According to Bailey and Harden (1975a), the cinnabar is "quite insoluable in normal waters." They continue:

> It is doubtful that mercury mining has anywhere raised the natural mercury content of streams flowing from the areas, though the processing of the ore to recover the metal might result in stream contamination. Mercury metal, in contrast to the sulfide (cinnabar ore), can contaminate, and the drainage of water through a dump of rock that has been put through an improperly adjusted furnace could be a source of mercury pollution....Similarly, the mercury exhaust gases from an improperly operated condensing system would cause air pollution, and even ground and (surface) water pollution if in sufficient quantity to settle out...

Part of "Significance of Pollution Problems Resulting from the Extraction of Mineral Resources" (ABAG, 1977)

Coastal Zone Plan (CCC)

A plan entitled California Coastal Plan was prepared by the California State and regional coastal zone conservation commissions (California Coastal Zone Conservation Commissions, 1975). The plan proposed policies that restrict new development in flood plains, require a geologic hazard description as part of residential sales information, place limitations on uses of land within coastal areas of highest risk, prevent public subsidies for hazardous development, and provide setbacks from erosion-prone bluffs.

Use of USGS Data

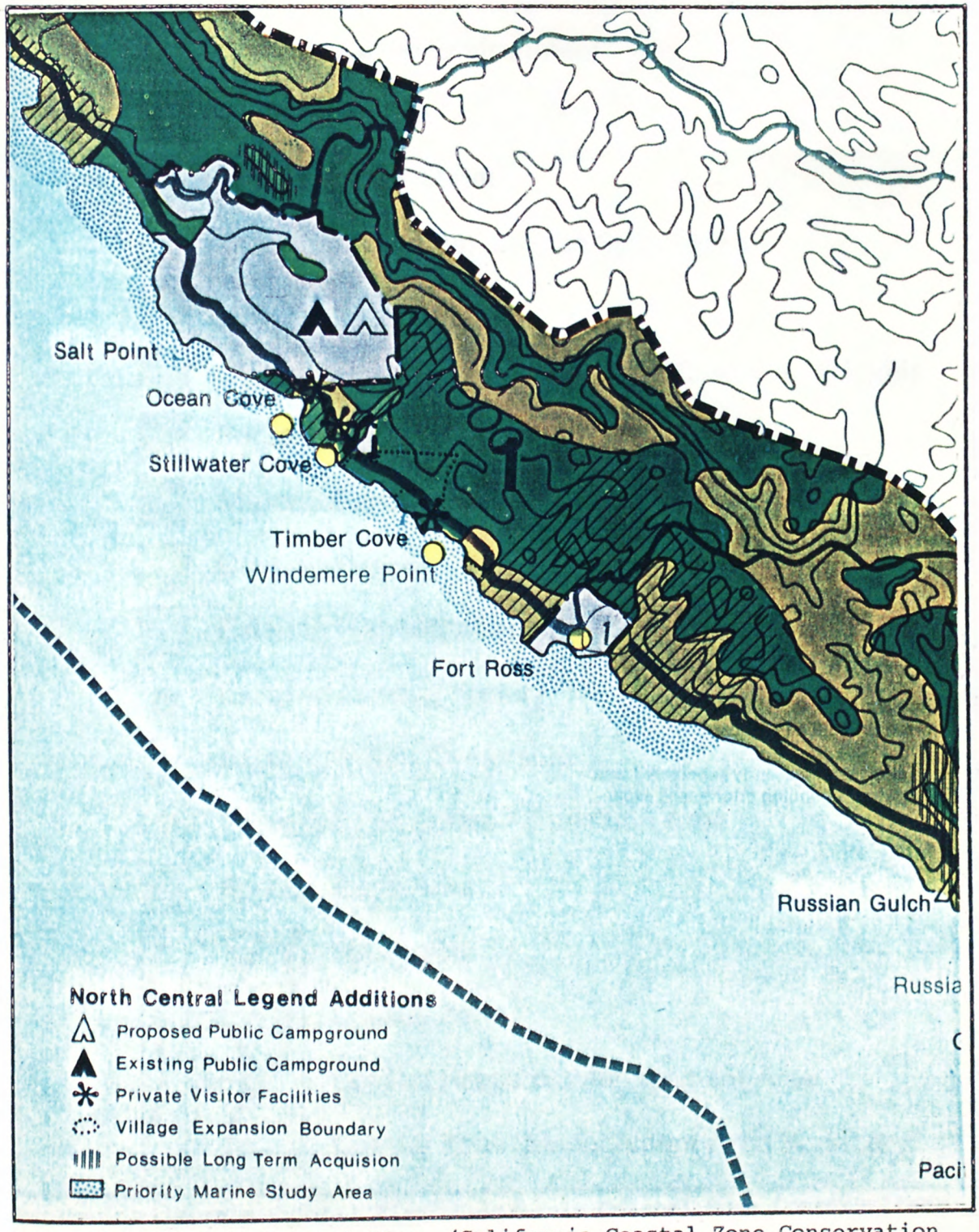
All of the North Central Coast Regional Commission's plan maps (figs. 23 and 24)were based upon 13 SFBRS products and several unpublished products. The products include studies of flood-prone areas, coastal erosion, faults, geology, and landslides (fig. 25). In addition, the Central Coast Regional Commission used SFBRS land-use maps in the development of its plan maps. Both regional commissions' and the State commission's recommendation concerning bluff and cliff development are based upon unpublished data and the assistance and advice of two scientists working on the SFBRS.

Method of Application

Studies of flood-prone areas, coastal erosion, faults, landslides, and geology are applied to the plan's findings and policies regarding flood hazards, geologic hazards, and bluff tops. The coastal erosion products are also incorporated into the State's "Interpretive Guidelines" for administering their coastal zone development regulations (see p. 104).

FIGURE 23

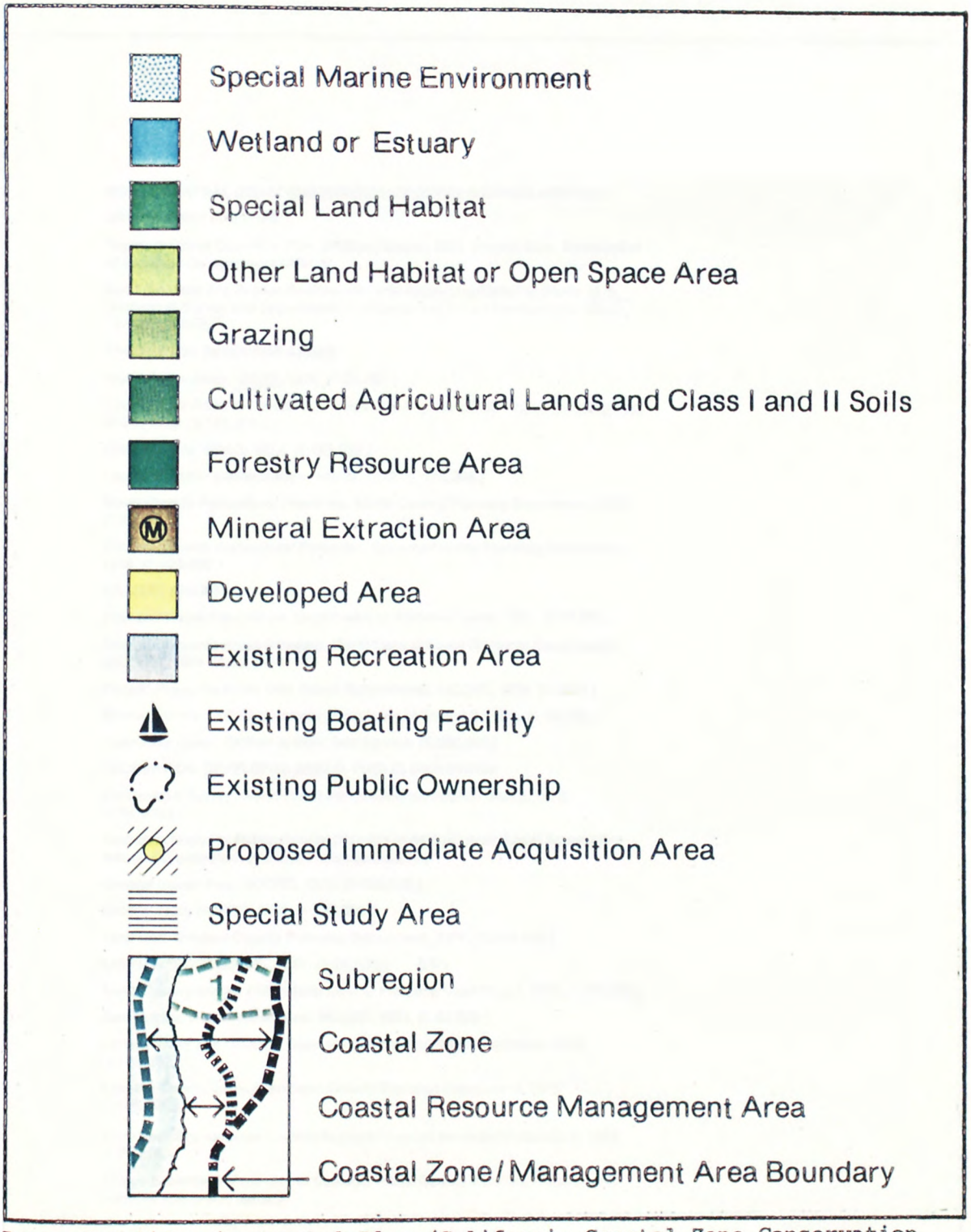
Coastal Zone Plan
(See fig. 24 for explanation)



Part of California Coastal Plan (California Coastal Zone Conservation Commissions, 1975)

FIGURE 24

Coastal Zone Plan Legend
(Explanation for fig. 23)



Part of California Coastal Plan (California Coastal Zone Conservation Commissions, 1975)

Comment

The SFBRS unpublished products and USGS technical assistance were indispensable in the development of the Commission's finding and recommendations regarding coastal erosion and bluff top development. The plan was transmitted to the Governor and Legislature, and incorporated into a new coastal zone conservation act. The method of regulating bluff and cliff development for geologic safety is transferable to any other State preparing coastal zone management plans under the Federal Coastal Zone Management Act (U.S. Code, 1977, Title 16, Sec. 1451 and following).

Marsh Protection Plan (BCDC)

A proposal for the preservation and enhancement of a large aquatic and wildlife habitat, entitled Suisun Marsh Protection Plan, was prepared by the San Francisco Bay Conservation and Development Commission in 1976.

The Commission was directed by the California Legislature to prepare a plan to preserve the integrity and assure the continued wildlife use of the largest remaining wetland around San Francisco Bay. The approximately 85,000 acres of tidal marsh, managed wetland, adjacent grassland, and waterways contain more than 10 percent of California's remaining wetland area and constitute a wildlife habitat of national importance.

Specific findings and policy recommendations concerning marsh environment, water supply and quality, natural gas resources, utilities, transportation, recreation, public access, industry, land use, land acquisition,and management are included in the plan.

Use of USGS Data

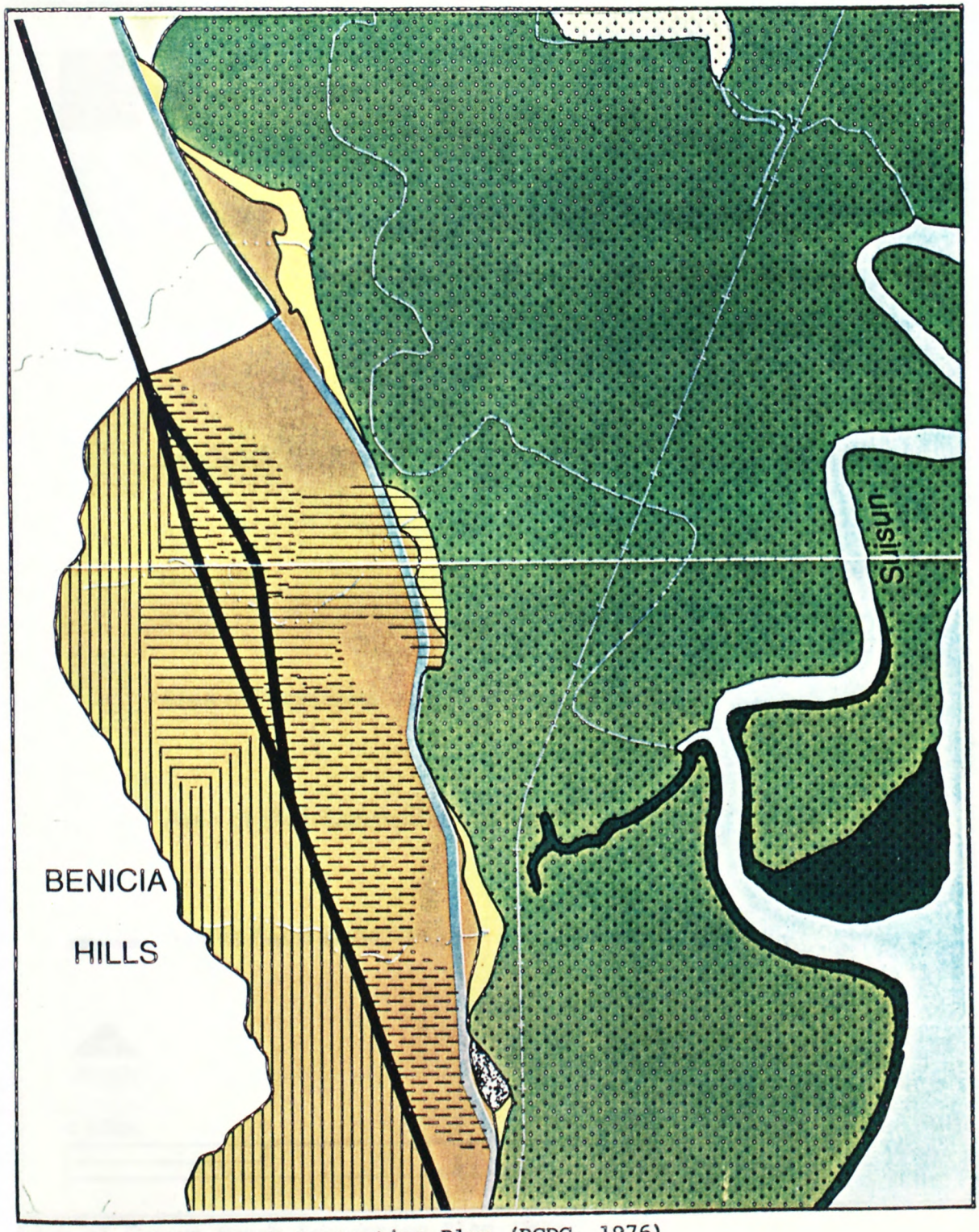
Both the "Natural Factors Map" (figs. 26 and 27) and the "Marsh Protection Plan" (fig. 28) are based upon published and unpublished SFBRS products. The products used include those on historic marshlands, land use, active faults, landslides, and basic geology. In addition, the base maps were from the USGS 7½-minute quadrangle (topographic) series. Although not cited, the source of the maps was acknowledged during the interview.

Method of Application

Delineations of landslide deposits, bay mud, areas of potential landsliding, and locations of active faults on the "Natural Factors Map" have been taken directly or developed from SFBRS products. The seven categories of

FIGURE 26

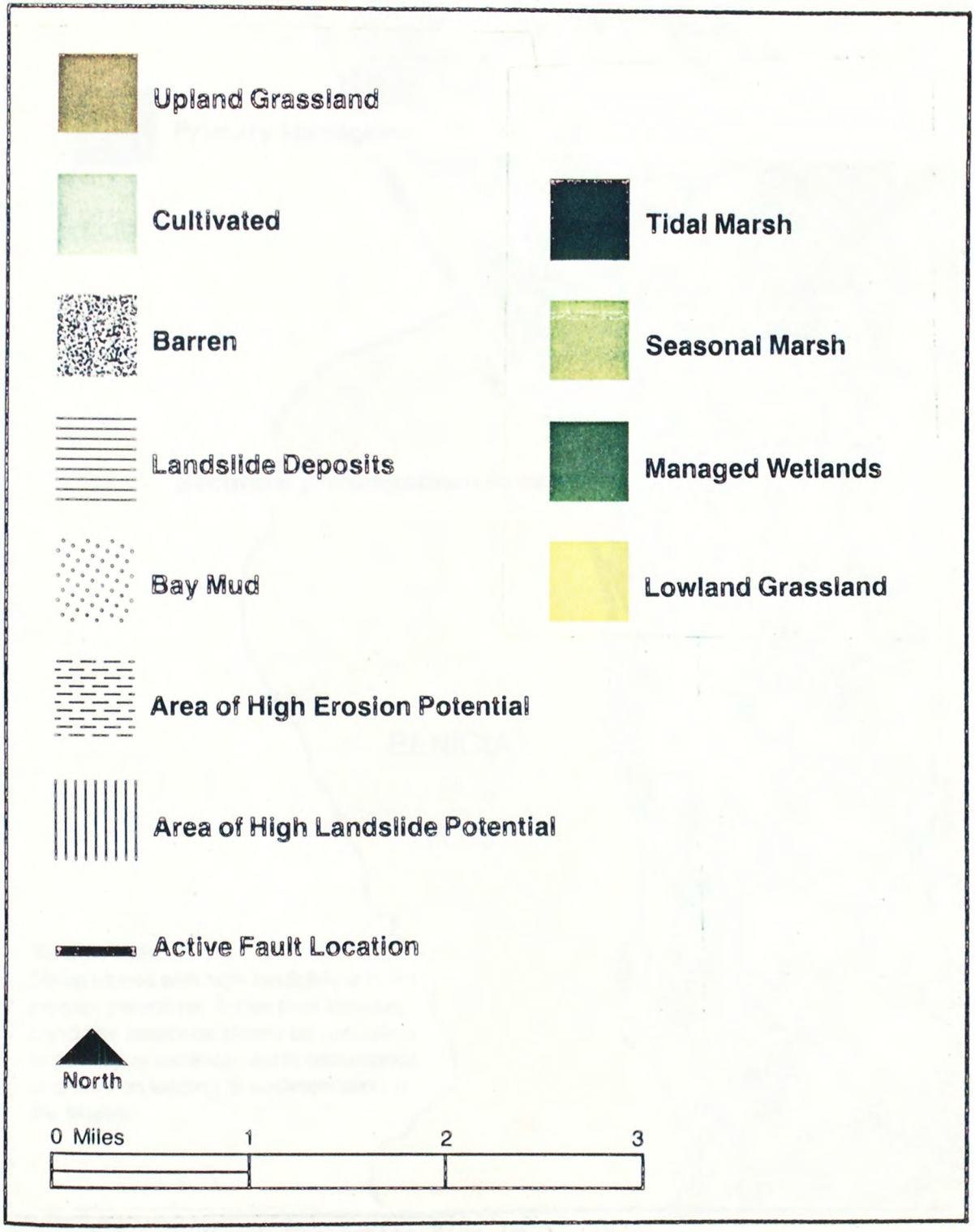
Natural Factors Map
(See fig. 27 for explanation)



Part of Suisun Marsh Protection Plan (BCDC, 1976)

FIGURE 27

Natural Factors Map Legend
(Explanation for fig. 26)



Part of Suisun Marsh Protection Plan (BCDC, 1976)

land use and cover were taken or developed from the SFBRS land-use maps. In addition, the recommendations for land-use practices in the Benicia Hills (fig. 28) part of the marsh are based upon SFBRS products.

Comment

The commission's plan is a statement of policies designed to preserve and enhance the quality and diversity of the marsh's aquatic and wildlife habitat and to assure retention of upland areas adjacent to the marsh that are compatible with its protection.

After holding 17 public hearings, the commission adopted the plan and submitted it to the Governor and Legislature. A new law approving the plan and requiring that local protection plans be consistent with the commission's plan became effective January 1, 1978. In the original Act requiring the commission to prepare the plan, the Legislature appropriated four million dollars for acquisition of land or development rights.

Ocean Coastline Plan (ABAG)

A plan, entitled "Regional Ocean Coastline Plan for the San Francisco Bay Area," was prepared by Sedway/Cooke (1973) for the Association of Bay Area Governments. The plan includes policies regarding conservation and utilization of coastal resources, maintenance and enforcement of environmental quality, and the appropriate use or retention of open spaces.

Use of USGS Data

The plan is based upon published and unpublished USGS data, refers to the USGS and its personnel, and cites ten SFBRS products. The products used are studies of regional slope, waste disposal, water supply, orthophotos, flood-prone areas, tsunami innundation, and geology. All data were shown on USGS base maps at a scale of 1:62,500.

Method of Application

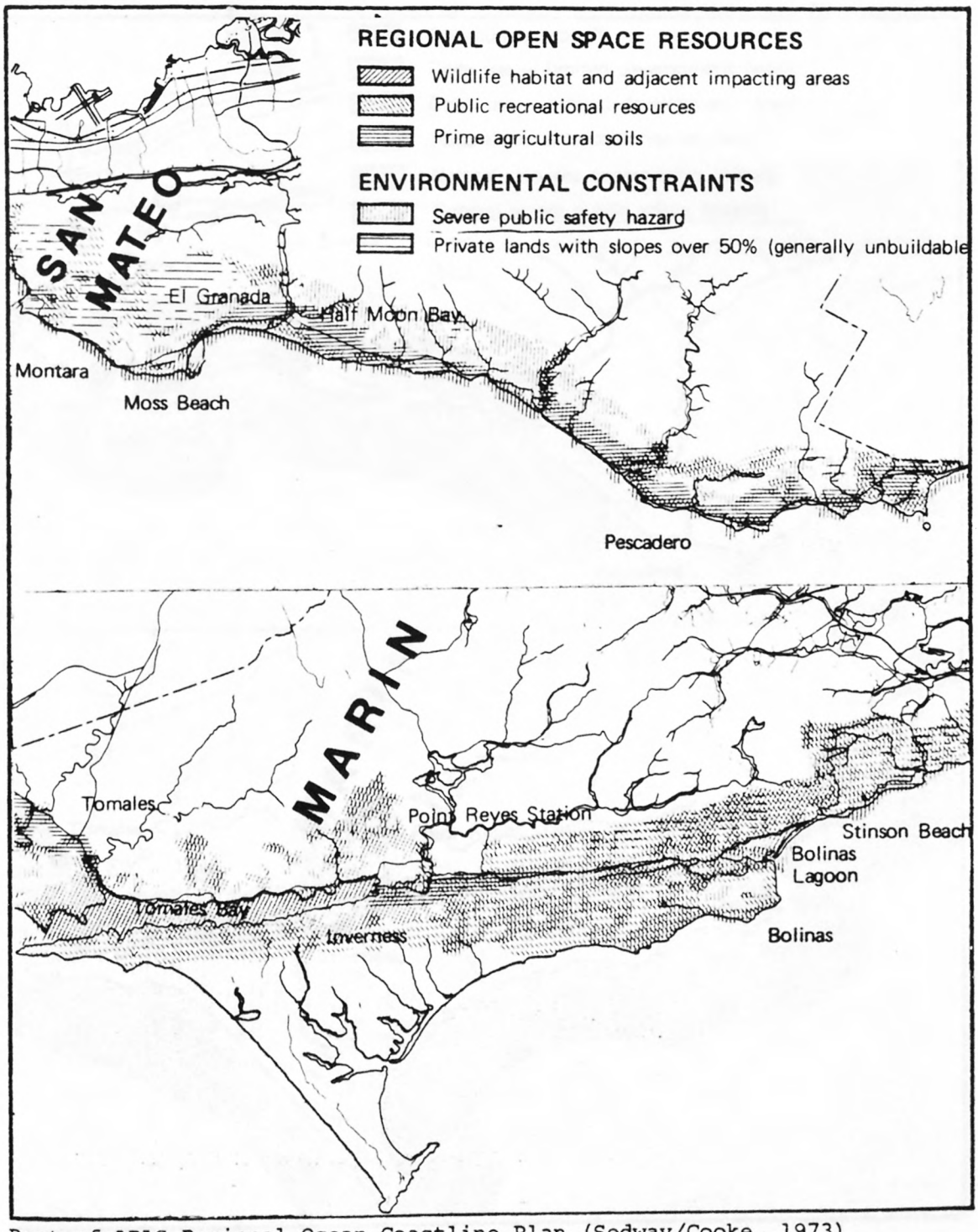
The SFBRS products were analyzed and combined into an environmental-constraint group - severe public-safety hazard (fig. 29). These hazards include steep slopes and lands susceptible to landslides, shoreline erosion, earthquakes, runoff floods, and tsunamis. The hazards were then delineated on a Conservation and Development Policy map (fig. 30) with a recommendation that no building take place in the severe public-safety hazard area.

Comment

The plan was adopted by the ABAG Executive Committee in 1973 and served as a key data source for the California Coastal Plan. (See p. 79.)

FIGURE 29

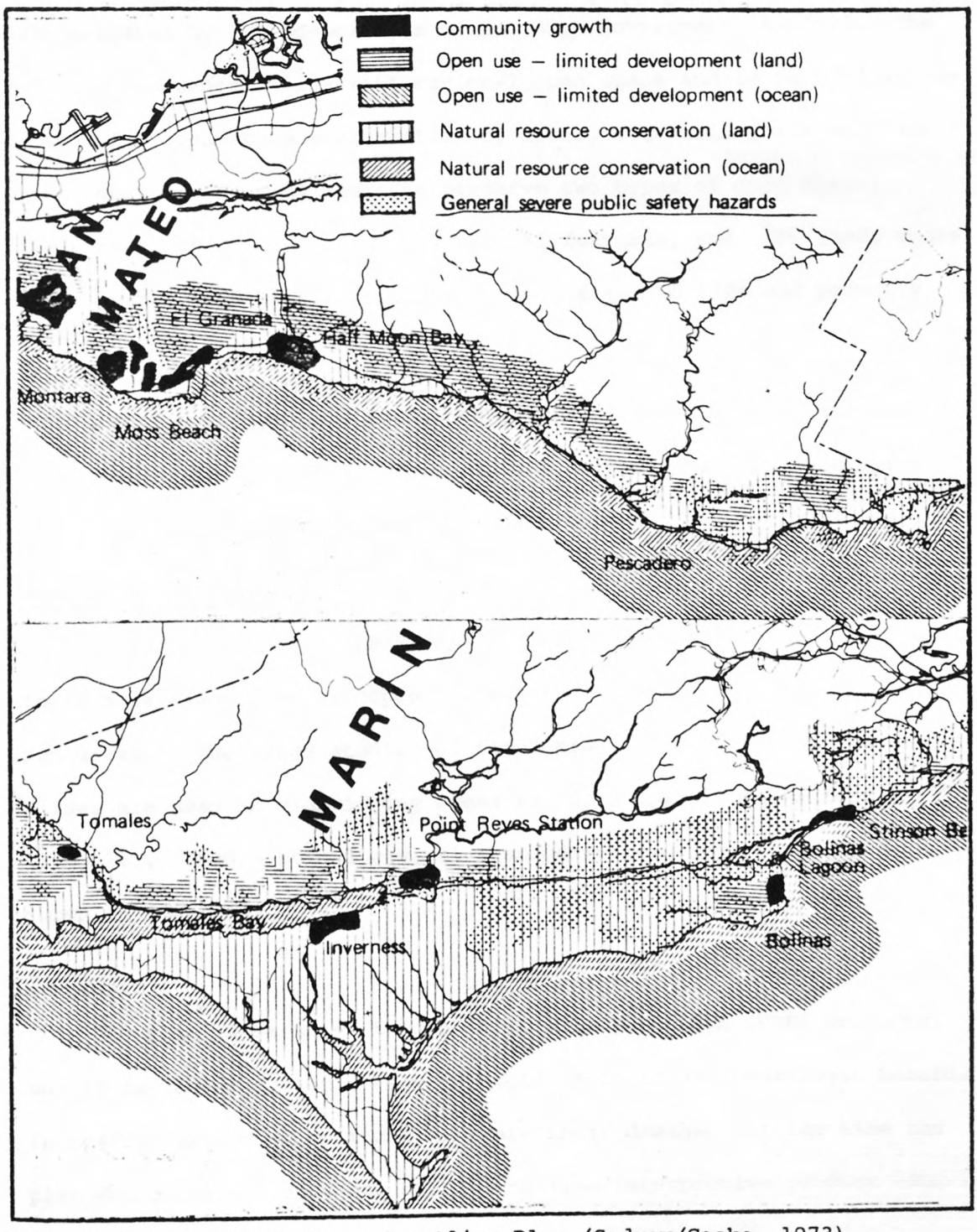
Open-Space Values and Constraints



Part of ABAG Regional Ocean Coastline Plan (Sedway/Cooke, 1973)

FIGURE 30

Conservation and Development Policy



Part of ABAG Regional Ocean Coastline Plan (Sedway/Cooke, 1973)

Open-Space Plan (ABAG)

A summary report, entitled Regional Open Space Plan, Phase II, was prepared by the Association of Bay Area Governments in 1972. The plan is concerned solely with regional open space and is part of an overall system for open-space preservation by local, regional, State and Federal governments. The plan seeks to preserve two types of open space: (1) lands with unique or unusual natural features, and (2) lands whose development would likely create a direct hazard to life and property.

Use of SFBRS Data

The plan relies upon and cites several SFBRS products, and specifically refers to the SFBRS. The products include those on flood-prone areas, landslides, faults, and regional slopes.

Method of Application

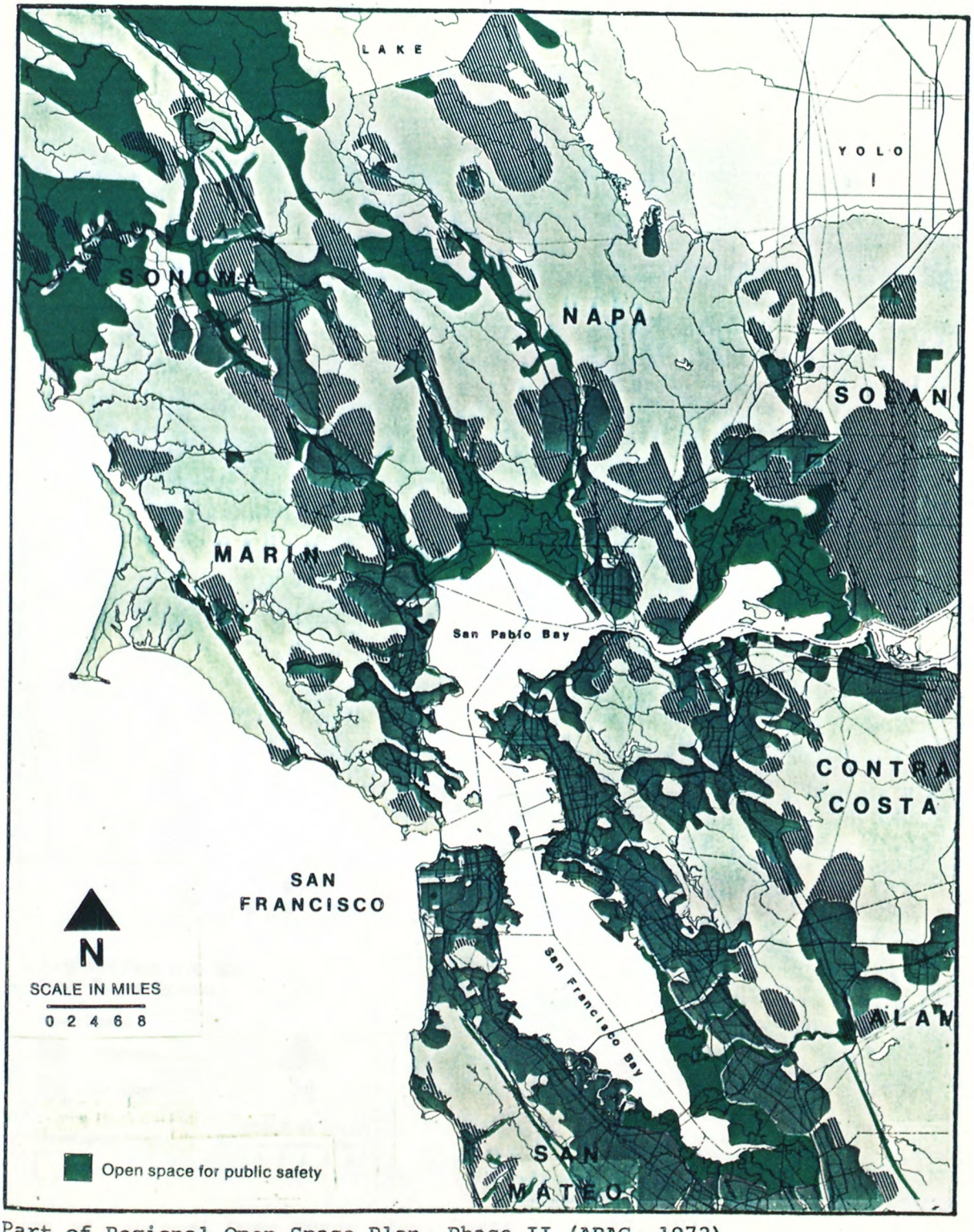
A fault shown on a SFBRS map is cited as a "notable geologic feature" in an area classified as "Open space for preservation of natural and human resources." The SFBRS studies of flood-prone areas, faults, and landslides are used in classifying areas as "Open Space for Public Safety" (fig. 31). ABAG combined several transparent overlays to produce the plan shown in figure 32.

Comment

The plan is based -- in one case, solely -- upon SFBRS products, and if implemented, would help to avoid geologic and hydrologic hazards in the bay region or at least mitigate their damage. At the time the plan was prepared, only one SFBRS landslide interpretive product (BDC 11) was available.

FIGURE 31

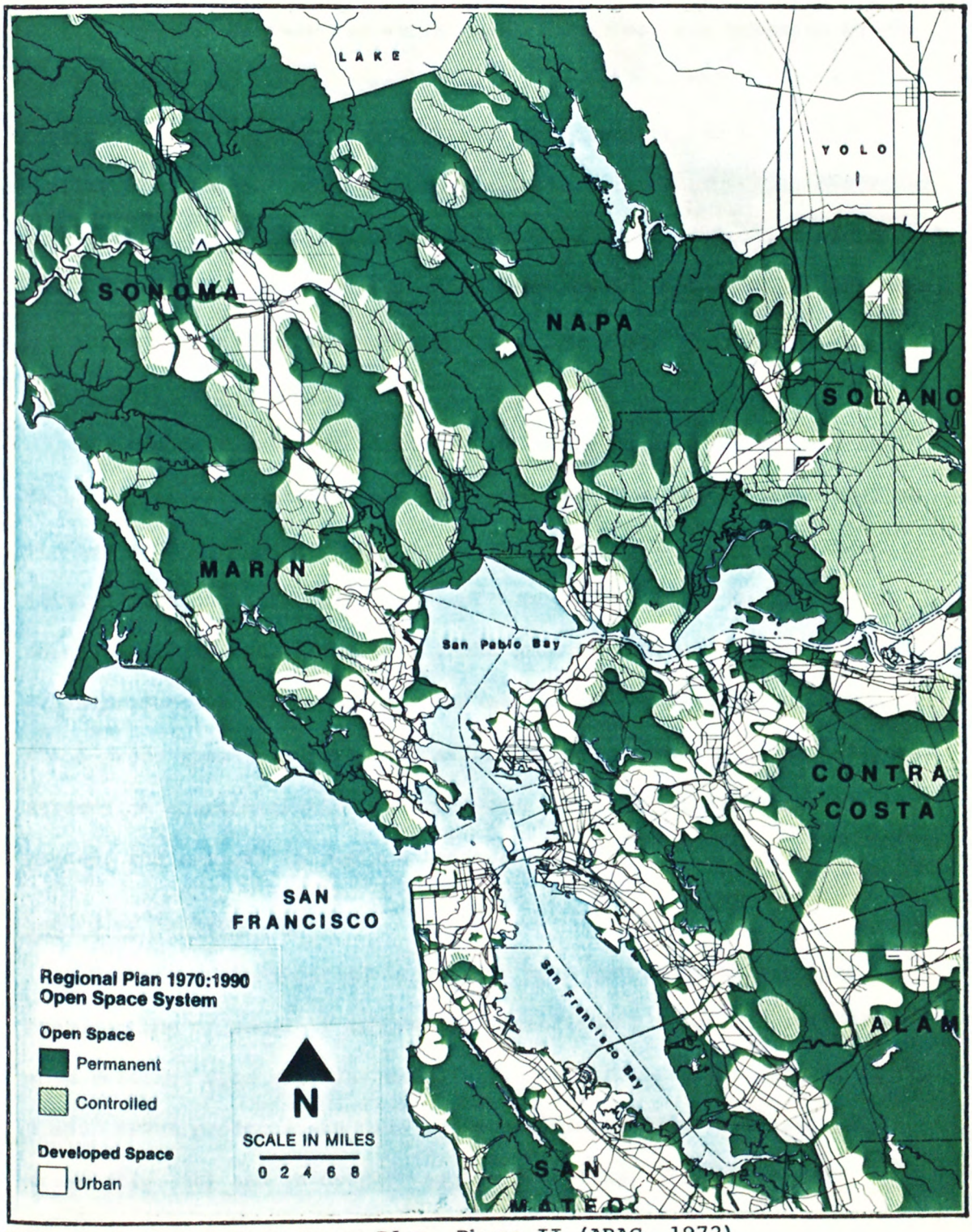
Open Space for Public Safety



Part of Regional Open Space Plan, Phase II (ABAG, 1972)

FIGURE 32

Regional Open-Space Plan



Part of Regional Open Space Plan, Phase II (ABAG, 1972)

Water-Quality Control Plan (RWQCB)

A plan, entitled Water Quality Control Plan, Parts I & II, for the protection of both surface and ground water supplies, was prepared by the San Francisco Bay Regional Water Quality Control Board (1975b,c). The board is required by the California Legislature to formulate and adopt a water-quality plan for all areas within its jurisdiction. The plan describes and assesses water-quality problems, considers and identifies beneficial uses, recommends water-quality objectives and an implementation program, and assesses the environmental impact of the plan.

Use of USGS Data

In the discussion and illustration of estuarine circulation and flushing, significant reliance is placed upon the SFBRS bottom drifter studies (BDC 22) and reports on bay circulation (TR 1). One table (fig. 33) which lists existing water-supply facilities by county and agency is taken entirely from a SFBRS product (BDC 4). Other SFBRS products referred to in the plan include studies of geology, flood-prone areas, tsunami inundation, estuary sampling, waste disposal, streamflow characteristics, ground water, and the distribution of lead, copper, and mercury in surface sediments.

Method of Application

Methods of application range from mere reference,through the reproduction of complete tables or illustrations (figs. 33 and 34), to sole reliance upon specific data (fig. 35) for important aspects of the plan. SFBRS products are used in determining ecologically sensitive areas (fig. 36) and in developing the plan (fig. 37).

FIGURE 33

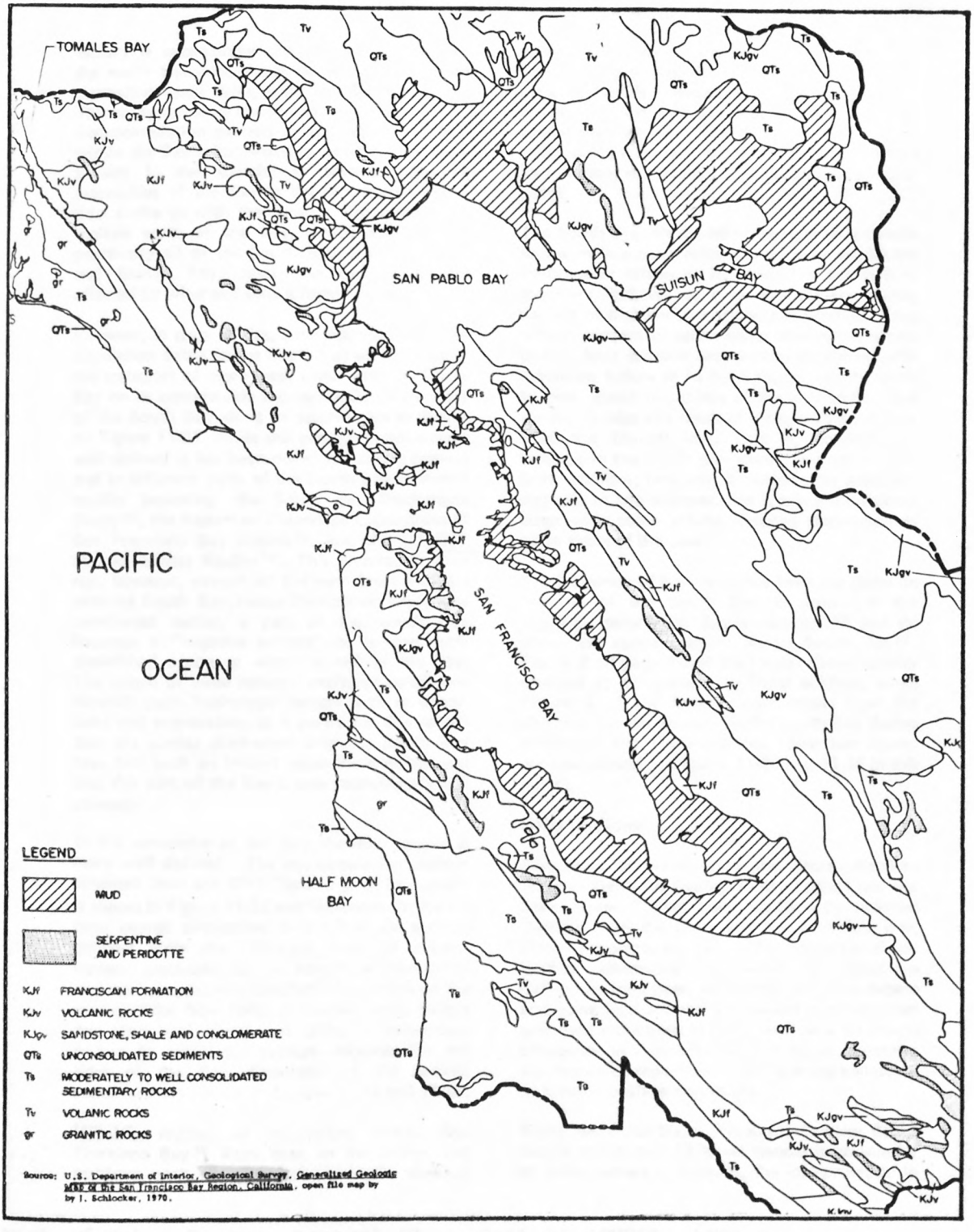
Existing Water-Supply Facilities

County and agency	Source	Population served	Total supplied, mgd
Alameda County			
Alameda County Water District	SFWD,[b] Wells	133,000	19.0
California Water Service Company	South Bay Aqued., Wells	38,000	5.35
Citizens Utilities Company of California	Wells	13,000	1.3
East Bay Municipal Utility District[c]	Mokelumne Aqued., Lake Chabot, Upper San Leandro Res.	1,060,000	218
Hayward, City of	SFWD	80,000	13.1
Livermore, City of	South Bay Aqued.	4,500	0.49
Pleasanton, City of	Wells	20,000	2.99
Valley Community Services District	Wells	16,000	2.29
Contra Costa County			
Antioch, City of	San Joaquin River[d]	28,000	4.58
Bay Water Service System of Southern California Water Co.	San Joaquin River	8,900	0.87
Brentwood, City of	Wells	2,500	0.39
Contra Costa County Water District	San Joaquin River	130,000	20.0
East Bay Municipal Utility District	Mokelumne Aqued., Briones Res., Lafayette Res., San Pablo Res.	See Alameda Co. listing	
Martinez, City of	San Joaquin River	25,000	3.46
Oakley County Water District	San Joaquin River	2,590	0.44
Pittsburg, City of	San Joaquin River	22,000	3.46
Pleasant Hill, City of	San Joaquin River	6,500	1.01
Marin County			
Coast Springs Water Co.	Wells	600	0.01
Marin Municipal Water District	Nicasio, Bon Tempe, Kent, Alpine Res.	166,323	28.7
North Marin County Water District	Stafford Lake, Lake Mendocino	35,000	4.9
Stinson Beach Water Co.	Springs and Creeks	1,500	0.14
Napa County			
American Canyon County Water District	Lake Hennessey, North Bay Aqued.	4,100	0.68
Calistoga, City of	Wells	1,875	0.27
Napa, City of	Lake Hennessey, Milliken Res., Conn Cr. Res., North Bay Aqued.	45,571	10.2
St. Helena, City of	Bell Canyon Res.	4,000	1.24
Yountville, City of	Rector Cr. Res.	1,000	0.08
San Francisco City and County	Hetch Hetchy, Calaveras Res., Sunol Infiltration Galleries, San Andreas Res., Pilarcitos Res., Upper and Lower Crystal Springs Res., San Antonio Res.	754,000	103.6
San Mateo County			
Belmont County Water District	SFWD	24,000	3.56
Brisbane, City of	SFWD	3,000	0.27
Burlingame, City of	SFWD	27,700	4.43
California Water Service Co. Broadmoor-Colma	SFWD	5,000	0.77
Menlo Park, Atherton, Woodside, Portola Valley	Local runoff	34,000	10.9
San Carlos, City of	SFWD	25,924	4.36
San Mateo, City of	SFWD	78,991	12.2
South San Francisco, City of	SFWD, Wells	46,706	8.02
Citizens Utilities Co.	Springs, Wells	2,500	0.35
Coastside County Water District	SFWD, Wells	7,700	0.78

Part of Water Quality Control Plan, Part II (RWQCB, 1975c)

FIGURE 34

Surface Geology



Part of Water Quality Control Plan, Part II (WRQCB, 1975c)

FIGURE 35

Discussion of Estuarine Hydrography and Hydrology

estuary is exceedingly complex and, except for the major channels, shows considerable variation depending upon tides, wind and Delta outflow. This study is mainly concerned with the overall or macrocirculation pattern in the Bay. Circulation within the Bay is important to water quality since it aids in the transfer of waters from the extremities of the Bay to the central part where tidal exchange with the ocean is strongest. In the shallow areas of the Bay, which accounts for practically all of the South Bay, San Pablo Bay and Suisun Bay, circulation can be greatly affected by wind and thus is highly variable.

However, in spite of this, a net counter-clockwise circulation exists in the South Bay which helps in the transport of more fresh water into the South Bay on its western side and carries Bay waters out of the South Bay along its eastern side as shown on Figure 11-31. While this pattern is not always well defined it has been noted to varying degrees and in different parts of the South Bay in several studies including: the South Bay Dischargers Study[12], the Report on Dispersion Capabilities of San Francisco Bay Waters[13], and the U.S.G.S. bottom drifter studies[14]. This circulation does not, however, extend all the way down into the extreme South Bay, below Dumbarton Bridge. As mentioned earlier, a part of the South Bay becomes a "negative estuary" in summer with diminished exchange with the rest of the Bay. The extent of these reduced exchange conditions depends upon hydrologic factors such as winds, tides and evaporation. It is partly for this reason that the wastes discharged into the South Bay have had such an impact upon these waters and that this part of the Bay is now receiving priority attention.

In the remainder of the Bay the flow pattern is more well defined. The net circulation pattern obtained from the WRE "coarse grid" bay model is shown in Figure 11-32 and illustrates the longer term overall circulation in the Bay. On a more detailed scale the USC&GS maps of current vectors, produced for the benefit of yachtsmen and mariners, provide detailed information on the average tidal flow fields at various times before and after slack water and tables of conversion factors to adjust the average velocities for the tides of the Bay. Examples of the average conditions are shown in Figures 11-33 and 11-34.

U.S.G.S. studies of circulation within San Francisco Bay[14] show that, in the central and northern parts, the Bay behaves in the classical estuarine manner: outward fresh
occurs along the surface and a count
ocean water is induced along the
gradually mixes with the outflowing
tidal movement aside. The area in wh
saline bottom current meet is in upper San Pablo Bay which is apparently a sedimentary nodal point.

The South Bay, on the other hand, is an appendix to the main estuary system as it has no significant fresh water inflow at its head. The South Bay, therefore, behaves as a reverse estuary during periods of high Delta outflow; this produces a net bottom current of saline water toward the ocean. During later summer evaporation combined with minimum inflow at its head causes salinity levels to peak about two-thirds of the way south from the Bay Bridge as a result of a net southward flow from the Central Bay. That is, circulation is induced in the South Bay during periods of high Delta outflow; however, it can become relatively stagnant in late summer, and it is in a transitional stage with some tidally induced circulation at other times of the year.

The influence of high outflows from the Delta on flushing of the South Bay is shown in the U.S.G.S. reports on Bay circulation[15] and on phosphate concentrations in the South Bay[16]. Figure 2 on page A4 of the former shows salinity changed in comparison to Delta outflow, while Figure 3 of the latter report shows how the phosphate levels decrease in the South Bay during periods of high Delta outflow. These two figures are reproduced as Figures 11-35 and 11-36 in this report.

Delta Outflows

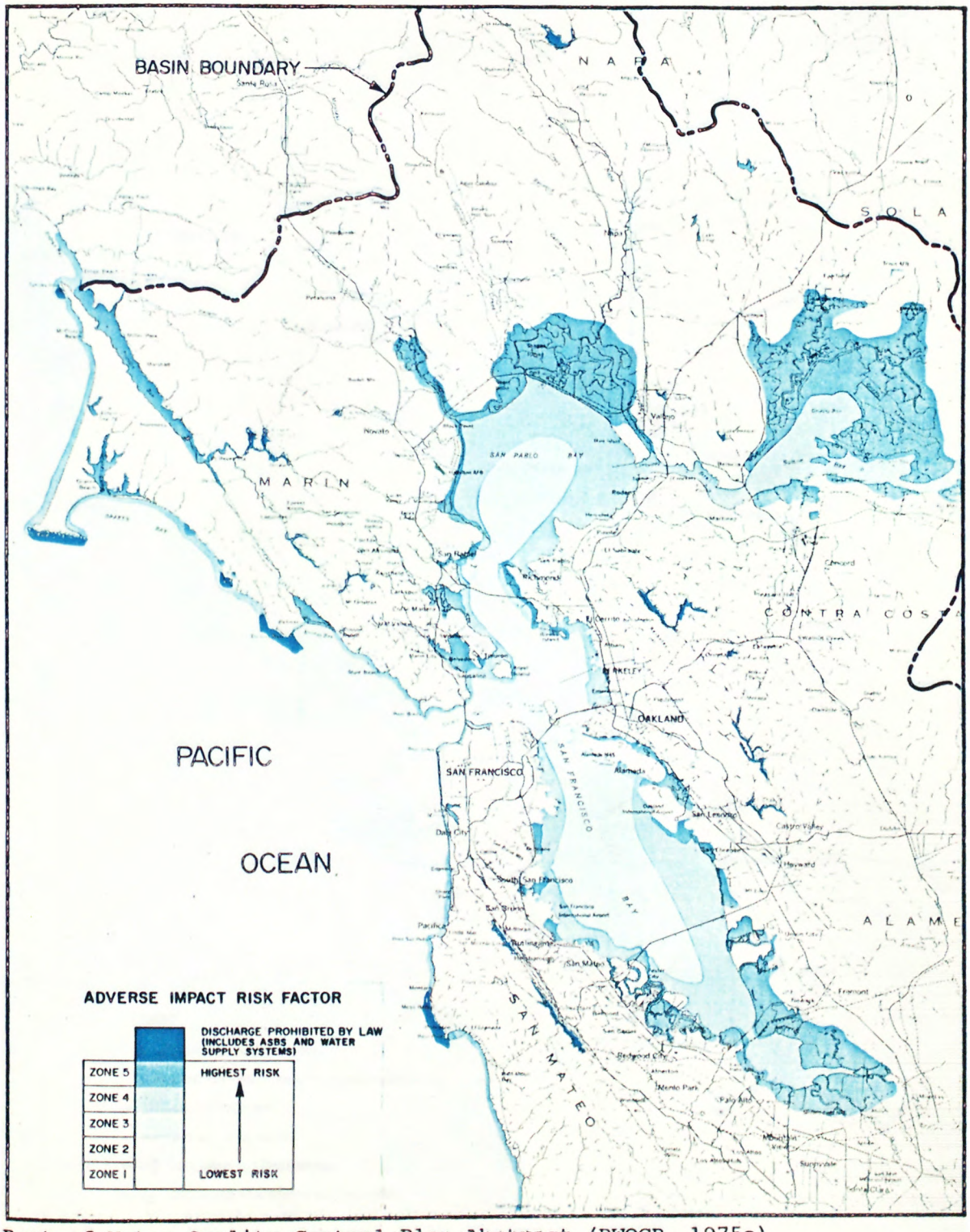
Diversions of water from the Sacramento-San Joaquin Delta for Central Valley Project and the State Water Project have significantly reduced outflow from the Delta into San Francisco Bay. Planned projects, such as the Peripheral Canal and further diversions of water to Southern California, have been the subject of much debate and some legal actions. The extent of present and proposed reductions in Delta outflow were shown previously in Figure 11-30; that figure illustrates the degree of reduction to be expected compared to historic outflow conditions.

While the State Water Resources Control Board has, in its Decision 1379, set standards for salinity of Delta waters at Antioch, the interpretation in

Part of Water Quality Control Plan, Part II (RWQCB, 1975c)

FIGURE 36

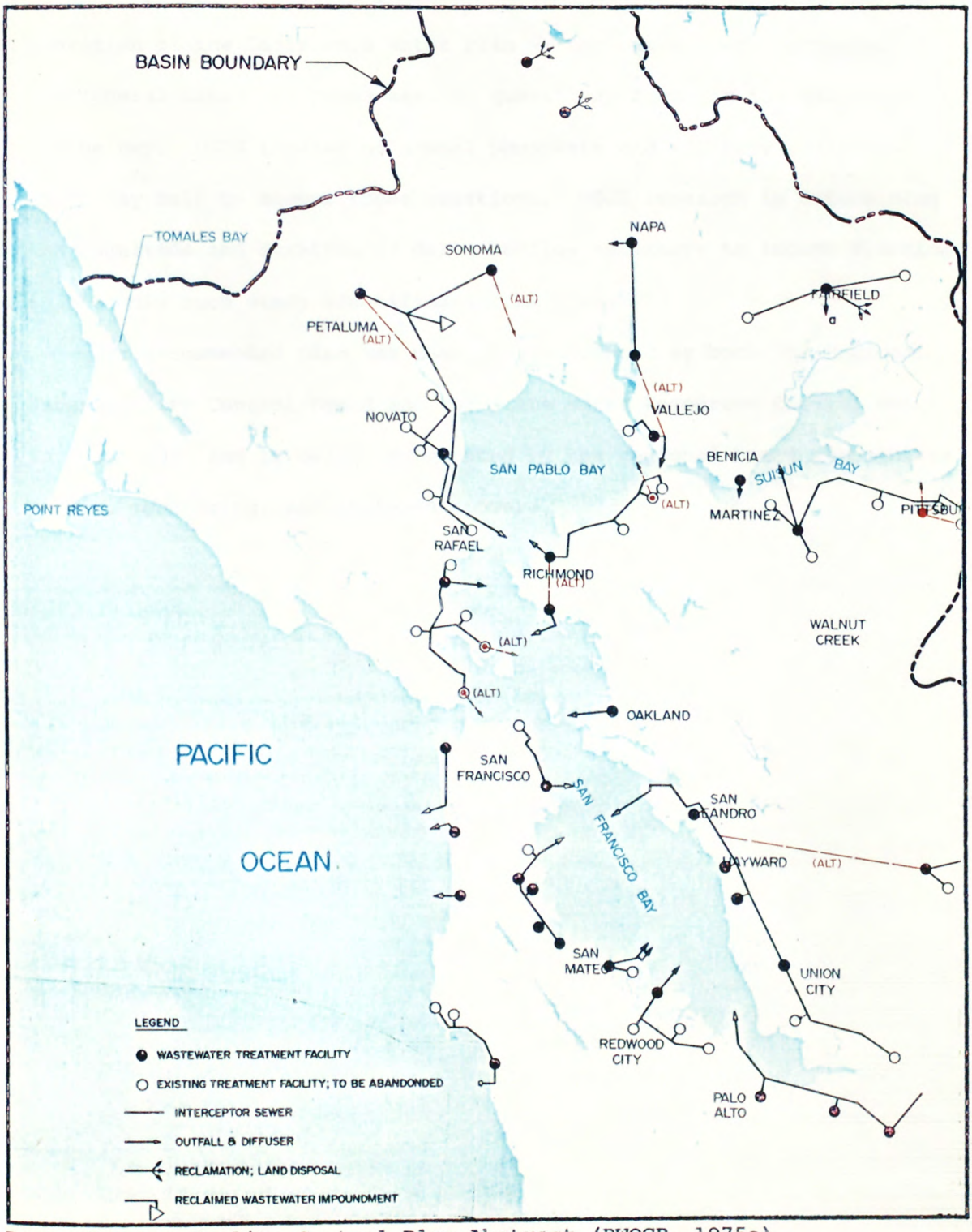
Ecologically Sensitive Areas



Part of Water Quality Control Plan, Abstract (RWQCB, 1975a)

FIGURE 37

Water-Quality Control Plan



Part of Water Quality Control Plan, Abstract (RWQCB, 1975a)

Comment

The prospect of greatly reduced delta outflows as a result of the operation of the California Water Plan -- for example, the proposed "Peripheral Canal" -- poses serious questions regarding the water quality of the bay. USGS studies of annual phosphate and salinity cycles in the south bay help to answer these questions. USGS research in determining the magnitude and duration of delta outflow necessary to induce flushing is the only such study identified in the plan.

The recommended plan was unanimously adopted by both the Regional Water Quality Control Board and the State Water Resources Control Board in April 1975 and is being implemented by the regional board through its permit, monitoring, and abatement powers.

Jurisdiction Determination (BCDC)

A memorandum on the subject of "Measurements of the Size of San Francisco Bay" was prepared by the Bay Conservation and Development Commission's Executive Director (Bodovitz, 1971).

Use of USGS Data

The memorandum (fig. 38) is based solely upon a SFBRS product (BDC 9), and its author's larger scale work sheets which were said to contain the "most accurate figures yet compiled on the present size of San Francisco Bay and the extent of past filling and diking."

Method of Application

The SFBRS map is used to determine the legal boundaries and area of jurisdiction in granting or denying permits to place, fill, extract materials, or make any substantial change in the use of any water, land, or structures within the Commission's jurisdiction. (See fig. 2, p. 13).

Comment

Only one of the seven selected regional agencies has a single area of jurisdiction coterminous with county boundaries. The other six agencies must rely upon other information, such as geography, topography, and hydrology, to determine their legal boundaries and areas of jurisdiction. Such information must be large scale, accurate, and legally defensible when used as a basis for regulating land and water uses -- especially where intensive development may take place.

This example illustrates the use of earth-science information in determining legal boundaries and areas of jurisdiction and is transferrable wherever appropriate information is available.

FIGURE 38

Measurements of the Size of San Francisco Bay

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
30 Van Ness Avenue, San Francisco 94102 557-3686

October 22, 1971

TO: All Commissioners and Alternates
FROM: Joseph E. Bodovitz, Executive Director

SUBJECT: MEASUREMENTS OF THE SIZE OF SAN FRANCISCO BAY

NEW MEASUREMENTS

A recent study by the U.S. Geological Survey* contains the most accurate figures yet compiled on the present size of San Francisco Bay and the extent of past filling and diking. The staff believes these figures should be accepted by BCDC to replace the figures now being used in BCDC publications. The new USGS figures are:

San Francisco Bay System Including
San Pablo and Suisun Bays
(square miles)

	About 1850	1968	Change
Water areas, up to the beginning of marsh vegetation	474	421	- 53 (-11%)
Marshlands, including marshes along sloughs and channels less than a half-mile wide	313	127	- 186 (-60%)
TOTAL BAY SYSTEM	787	548	- 239 (-31%)

The differences between the USGS figures and the figures previously compiled for the BCDC planning program are due in part to revised measurements of the presently-remaining marsh areas and in part to measurements of the water area between mean sea level and mean high tide. The new figures thus indicate that the amount of salt marsh remaining around the Bay is about 125 square miles, compared with earlier estimates of about 75 square miles.

In brief, the new USGS figures show that the exact size of the Bay in about 1850 was somewhat larger than originally estimated, the exact size of the remaining Bay is larger than originally computed, and the amount of the Bay system lost through diking and filling is about 31%, compared with earlier estimates of about 36-41%.

STAFF RECOMMENDATION

The staff recommends that the Commission accept, and use in all future reports, the new USGS estimates of the size of the Bay, as part of the Commission's continuing effort to keep the Bay Plan up to date on the basis of all new research and information.

* Nichols, D. R., and Wright, N. A., Preliminary Map of Historic Margins of Marshland, San Francisco Bay, California, U. S. Geological Survey

Part of BCDC Correspondence

Regulation Administration (CCC)

A set of "Interpretive Guidelines" were prepared and adopted by the California Coastal Commission (1977). They are designed to assist local governments, the regional commissions, the State Commission, and persons subject to the provisions of the Coastal Zone Conservation Act in applying the provisions of the Act. The guidelines also assist in applying various Coastal Act policies to permit decisions.

Use of USGS Data

Those guidelines regarding geologic stability of bluff-top development are based upon unpublished SFBRS data and were developed with the technical assistance and advice of USGS personnel.

Method of Application

The definition of bluffs, the effects of development, the areas of demonstration, and the context of the required geologic investigation -- all determined through the cooperation of USGS personnel -- are included in the guidelines for bluff-top development (fig. 39).

Comment

This example, together with the "Coastal Erosion Guidelines" (fig. 14) and the Coastal Zone Plan (see p. 79), illustrates the effects of providing educational, advisory and review services throughout the planning process -- from the study stage through plan development to plan implementation.

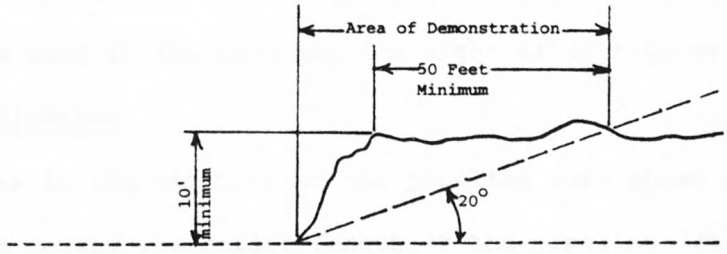
FIGURE 39

Geologic Stability of Bluff-top Development

A bluff or cliff is a scarp or steep face of rock, decomposed rock, sediment or soil resulting from erosion, faulting, folding or excavation of the land mass. The cliff or bluff may be simple planar or curved surface or it may be steplike in section. For the purposes of this guideline, "cliff" or "bluff" is limited to those features having vertical relief of ten feet or more, and "seacliff" is a cliff whose toe is or may be subject to marine erosion. "Bluff edge" or "cliff edge" is the upper termination of a bluff, cliff or seacliff.

A geologic investigation and report will be required when a development is proposed to be sited within the area of demonstration as defined below.

As a general rule, the area of demonstration of stability (Illustration A) includes the base, face and top of all bluffs and cliffs. The extent of the bluff top considered should include the area between the face of the bluff and a line described on the bluff top by the intersection of a plane inclined at a 20° angle from horizontal passing through the toe of the bluff or cliff, or 50 feet inland from the edge of the cliff or bluff, whichever is greater.



Where there is a dispute over the adequacy of the report, the Commission may request that the report be reviewed by a state geologist from the Division of Mines and Geology, the costs of that review and any necessary site inspections to be borne by the applicant. The report should consider, describe and analyze the following:

(2) historic, current and forseeable cliff erosion, including ivestigation of recorded land surveys and tax assessment records in addition to the use of historic maps and photographs where available and possible changes in shore configuration and sand transport;

(3) geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features, such as bedding, joints, and faults;

(4) evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity;

(8) effects of marine erosion on seacliffs;

(9) potential effects of seismic forces resulting from a maximum credible earthquake;

Part of "Interpretive Guidelines" (CCC, 1977)

Environmental Impact Report (BDCD)

A draft environmental impact report on the "Richmond-Antioch Fuel Oil Pipeline" was prepared by the Pacific Gas and Electric Company for the lead agency -- the Bay Conservation and Development Commission in 1974. The proposed project includes the construction and operation of a pipeline (approximately 42 miles long) to deliver an increased volume of fuel oil to two power plants whose natural gas supplies are being curtailed. The pipeline crosses several faults -- some of which are active.

USGS Data

The report is based upon, and refers to, six SFBRS products. The products include studies of basic geology, active faults, tectonic movement, and landslides. In addition, the regional topographic map (1:125,000) is used as the base map for eight illustrations.

Method of Application

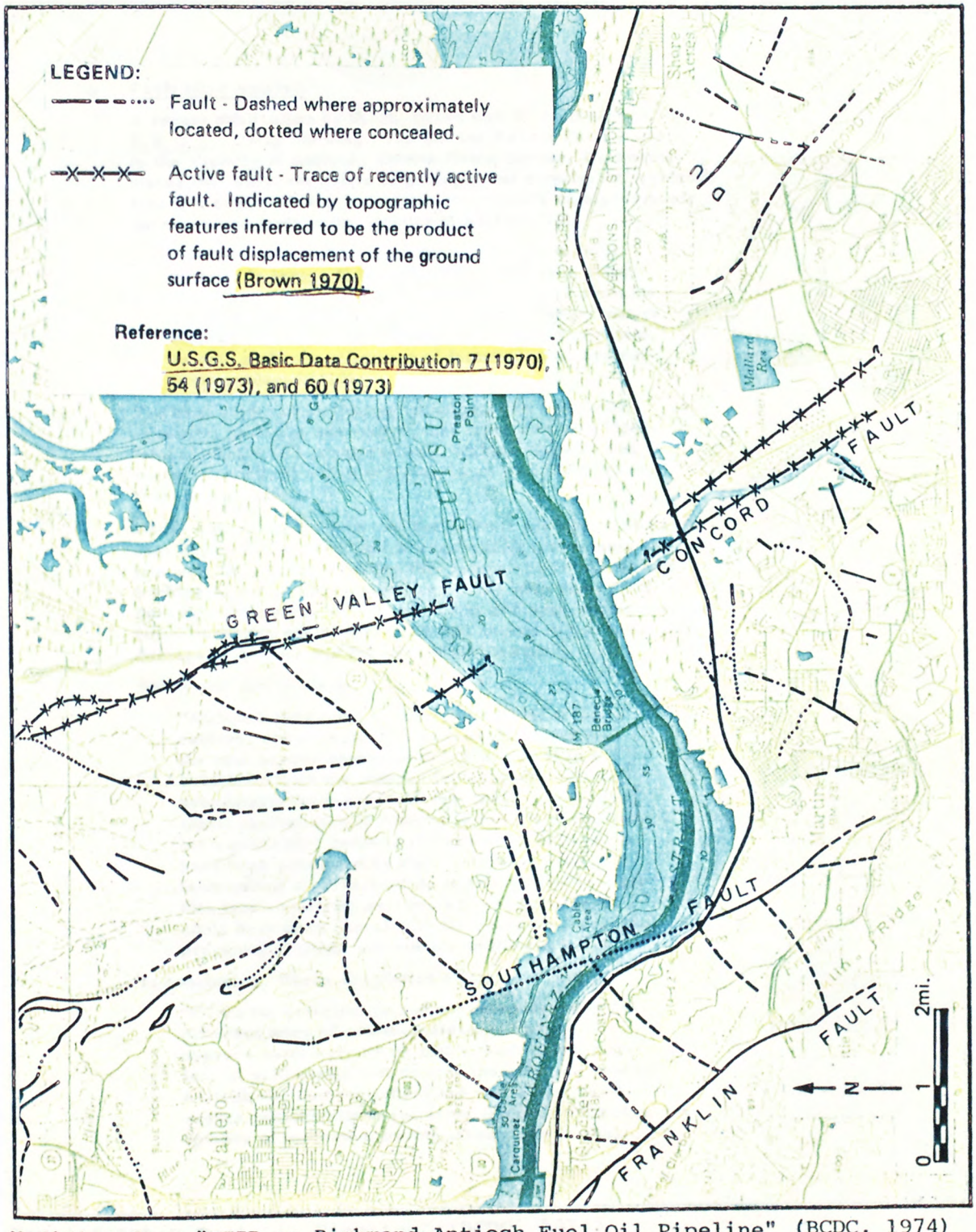
Fault data in the vicinity of the pipeline were shown on the regional base map which covers the entire length of the pipeline (fig. 40). The discussion on faults and seismic history (fig. 41) is based primarily on USGS data with excerpts from SFBRS products. Design criteria, construction practices, and operational procedures to be taken to minimize earthquake or landslide damage, which are directly related to SFBRS information, are proposed.

Comment

The report illustrates that a multistate utility company and a unique regional conservation and development agency have selected specific design criteria, construction practices, and operational procedures which are based upon, and directly related to, earth-science information produced by USGS.

FIGURE 40

Fault Zones near Fuel Oil Pipeline



Modified from "DEIR on Richmond-Antioch Fuel Oil Pipeline" (BCDC, 1974)

FIGURE 41

Faults and Seismic History

- Fault Near Antioch

A recent publication by D. B. Burke and E. J. Helley of the U.S.G.S., "Map Showing Evidence for Recent Fault Activity in the Vicinity of Antioch, Contra Costa County, California," states that different points of geologic and geophysical evidence strongly suggest historic tectonic movements on a previously unrecognized fault in the vicinity of Antioch (10).

> "Although the weight of evidence for recent fault activity is large, it is emphasized that each point of evidence is by itself inconclusive – there remains a remote possibility that the fault is no longer active and that the apparent evidence for recent movement is only a chance alignment of features that are not fault produced" (10).

The best evidence for recent movements on this fault, according to Burke and Helley, are fractures with right-lateral offsets and compressional buckles in walks and curbs (in Antioch) which are coincident with the projected trace of the fault.

Burke and Helley believe that the seismic history of this area also supports the likelihood of recent fault movements and fits well with the observation that anomalous fractures and buckles do not occur on walks and curbs built after 1965. Several earthquakes have occurred in this area during historic time, including one in May 1889 that caused major structural damage in Antioch and the town of Collinsville.

Burke and Helley state:

> "Although they must be interpreted with some caution, plotted epicenters for earthquakes in the past decade appear to define a zone that is coincident with the mapped fault and the zone of presumably fault-produced features. A swarm of small earthquakes in Antioch in 1967 is of particular significance because the swarm is believed to have been generated by right-lateral motion of a fault having a north-northwest strike, and because this last significant seismic activity in the area could have been coeval with the youngest (pre-1966) presumed tectonic movements in the city" (10).

In conclusion, Burke and Helley state:

> "Given the coincidence and correspondence of the different lines of evidence discussed above, it appears extremely likely that a fault having right-lateral strike-slip motion cuts the alluvium beneath Antioch and that movement and associated earthquakes periodically occur along the fault – the last episode of movement having taken place in 1965..."

Part of "DEIR Fuel Oil Pipeline" (BCDC, 1974)

Information System (ABAG)

A computer-based tool designated the "Bay Area Spatial Information System" (BASIS) has been developed by the Association of Bay Area Governments (1977). BASIS runs on ABAG's V76 computer system, which can handle data transfer to or from most other computer systems. The computer configuration includes a digitizer for encoding mapped data, an electrostatic plotter for producing computer maps, and terminals for on-line access to the data base.

Use of USGS Data

BASIS currently contains all SFBRS information regarding precipitation, geology, flood-prone areas, slope stability, well yields, earthquake intensities, regional topography, erosion and deposition, mineral resources, and such other USGS information as liquefaction potential and the 7½-minute quadrangle (topographic) series. In addition, the USGS Geography Program's new land-use maps will be incorporated into the system for developing an industrial siting plan (fig. 42).

Method of Application

BASIS is structured around an array of grid cells, each representing a land area of one hectare (100 meters square in the UTM coordinate system). It requires over two million of these cells to cover the nine-county bay region. Each cell on the ground corresponds to a unit of computer storage; the unit contains data codes representing the characteristics of that cell. The SFBRS map information is digitized and converted into grid cells.

FIGURE 42

Land-Use Mapping Needs

Association of Bay Area Governments

Hotel Claremont • Berkeley, California 94705 • (415) 841-9730

June 16, 1977

Mr. Gene Napier
Geography Program
U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

Dear Gene:

ABAG and the State Office of Planning and Research are jointly developing an industrial siting plan for the nine county San Francisco Bay Area. The project requires as one data base item an up-to-date inventory of existing industrial lands.

There is clearly no other source for this information that approaches the quality, classification or timeliness of the new U.S.G.S. Geography Program land-use maps. Therefore, I would like to obtain from you advance copies of the following completed land-use maps:

NW¼ of Santa Cruz	1:250,000	(at 1:100,000)
SW¼ of San Jose	1:250,000	(at 1:100,000)
NW¼ of San Jose	1:250,000	(at 1:100,000)
NE¼ of San Francisco	1:250,000	(at 1:100,000)
All of Sacramento	1:250,000	(at 1:250,000)

Please produce all sheets on frosted mylar. All base map plates except contours should be included, all screened. Land use should be printed full black.

I have enclosed a purchase order in the amount of $110.00 ($22 per sheet). I understand that the land use overlays have not yet been quality checked. This is satisfactory for our needs and we will assume responsibility for our use of these products.

These map products are precisely the type of technical support needed by a regional agency such as ABAG. I commend you for the Geography Program and very much appreciate your help.

Sincerely,

Donald Olmstead
Director
Office of Information Services

Part of ABAG Correspondence (Olmstead, 1977)

A composite of many data sets can be produced through an overlay process, and can include distance searches or other calculations. Computer-produced maps or tabulations are the usual output of the data manipulation process. Figures 9 (p. 55) and 11 (p. 58) are examples of computer-produced maps under BASIS.

Comment

The BASIS system has been used in three major applications. The first, a component of the Environmental Management Plan, was the location of potential waste-disposal sites. (See p. 70.) The second was the creation of a data file describing the characteristics of vacant industrial sites in the bay area. The third was the generation of earthquake intensity and damage maps. (See p. 54.) Planned uses include a study of airport noise effects, and analysis of potential seaports, aggregation of population data by special geographic area, development of an industrial siting plan, and support of ABAG's project-review activities.

SUMMARY AND ANALYSIS

The staffs of all seven selected regional agencies in the San Francisco Bay region are familiar with SFBRS products and make frequent use of such products in their planning activities. (See table 1, p. 32a.) The formal adoption of plans based upon or citing SFBRS products by the governing bodies of regional agencies indicates familiarity and use by regional decisionmakers. This familiarity and use is to be expected when the population, size, and recent growth and development of the agencies' areas of jurisdiction are considered and the fact that six of the seven selected agencies are the largest special-purpose units of government in the bay region with planning and plan implementation responsibilities.

Types of Planning Applications

All seven agencies have prepared planning studies, plans, or other documents which cite or are based upon SFBRS products. (See appendix G.) All seven agencies are using SFBRS products in the preparation, administration, or conduct of their studies, plans, implementation, and other planning activities.

The types of studies, plans, implementation, or other planning activities most often indicated by agencies as being based upon, making use of, or citing SFBRS products were:

Water-quality study	7
Physical resources study	6
Potential site evaluation	6
General reference	5
Coastal areas plan	4
EIR/EIS review	4
Project review and approval	4
Regulation administration	4

The citing of an SFBRS product in a study, plan, or other planning document does not necessarily indicate that the product plays a major role in the final proposals or decisions made by the agency. A great many other social, political, and economic factors enter into any decision-making process that affects physical development in a regional agency's area of jurisdiction. However, the use of SFBRS products in an agency's implementation activities may indicate that the product is a major determinant in development.

Studies

The frequent use of SFBRS products in the preparation of water-quality studies (see example on p. 76) may be the result of Federal and State laws requiring such studies and the obvious importance of water resources needed to serve a metropolitan area (fig. 37, p. 100). example, ABAG's environmental management program includes the water-quality planning required by Section 208 of the Federal Water Pollution Control Act (U.S. Code, 1977, Title 33, Sec. 1288 and following) and the RWQCB is required to consider water-quality conditions in developing their plan (Calif. Water Code, 1977, Sec. 13241).

The frequent use of SFBRS products in the preparation of physical resources studies and potential site evaluations may be partly the result of State laws requiring resource and ecological studies. Such use indicates the applicability of the products to both the inventory and development of land and water resources. (See examples on p. 64 and 70.) Many SFBRS products are applicable to these studies and, in some cases, are the only earth-science information available.

The less frequent use of SFBRS products in the preparation of geologic and geologic-hazard studies can be partly attributed to the fact that some of the agencies' geologic studies were completed prior to the release of SFBRS products.

The less frequent use of SFBRS products in the preparation of the other studies selected is because six of the seven selected agencies have single-purpose assignments -- bay conservation and development, coastal zone conservation, transportation planning, and water-quality management.

It is significant that the agency (ABAG) having a multi-planning assignment used SFBRS products in all but one of its studies, and all of the other six agencies used SFBRS products in almost all of their studies.

Plans

The frequent use of SFBRS products in the preparation of coastal-areas plans (see examples on p. 79 and 89) may be because Federal and State laws require such plans of four of the seven selected agencies -- Bay Conservation and Development and the three coastal commissions.

The less frequent use of SFBRS products in the preparation of the other plans selected for inventory is because six of the seven selected agencies have single-purpose assignments.

It is significant that the one agency (ABAG) having a multi-planning assignment used SFBRS products in all five of its adopted plans, and all of the other six agencies used SFBRS products in each of their adopted plans.

Implementation

Although none of the agencies have adopted regulations citing SFBRS products, all seven agencies make use of the products in various implementation activities. The frequent use of SFBRS products for regulation administration (see example on p. 104) and project review and approval can be attributed to their applicability to these activities. For example, four agencies (BCDC,and the State and two regional coastal commissions) are particularly concerned with geologic hazards affecting development on the bay and coastal shorelines. In many cases, SFBRS products provide the only earth-science information available. The use of SFBRS products for jurisdiction determination (see example on p. 102 and fig. 2 on p. 13) is significant because in this case large-scale, accurate information and legal dependability are required.

Other Planning Activities

The most frequent use of SFBRS products was for general reference, or was to be expected. Their frequent use for environmental analysis and the preparation and review of EIR's and EIS's indicates their applicability to environmental issues and concerns. (See example on p. 106.)

Types of Products Used

Almost 80 percent of the SFBRS products were specifically identified as having been used at least once for a regional planning activity. They were used in the preparation, administration, or conduct of studies, plans, implementation,or other planning activities or cited in documents by the seven selected regional agencies a total of 803 times. (See tables 2, 3, and 4 on p. 36 and following.)

The incidence of use of an individual product could be affected by many different factors -- release date, availability, topic, type, scale, areal coverage, content, or complexity. These factors were examined to see if there was any correlation.

Generally, no significant correlation was discerned between the use or nonuse of the products and their type, scale, coverage, content, or complexity with two exceptions.

> Both of the products (BDC 52 and IR 4) used 30 or more times were small-scale (1:125,000), region-wide interpretive, hazard-type products.
>
> All of the 11 products (BDC 6,7,8,9,11,41,48,52,& 54; IR 4; and regional topographic map) used 20 or more times were small-scale (1:62,500 or smaller), county, or region-wide products. Most of the 11 were interpretive, hazard-type products.

However, a high correlation was noted between the use or non-use of the products and their release dates, availability and topic. All of the 11 products used 20 or more times were released during or before 1973, and only four of the last 15 products released during or after 1975 were used. (See table 4 on p. 37.)

High correlation was noted between the number of times a product was used and its subsequent lack of availability. Frequent use was made of many of the products that are now "out-of-print." This "out-of-print" status can be attributed to demand for a product which is usually an indicator of frequent use.

High correlation was noted between the number of times a product was used and its topic. The geology, photography, topography, flood-prone-area, fault, and seismicity and seismology products were the ones most often used. The large use of hazard-topic products may be attributed to the development-permit responsibilities of five of the seven selected agencies; the State Legislature's recognition of flood, seismic, and other geologic hazards in California; and the general awareness of earth-process hazards in the bay region.

The very frequent use of products (noted as exceptions on page 116) which cover large areas (and therefore are small-scale) may be attributed to their containing information in the jurisdiction of most of the seven agencies. Four of the seven regional agencies have less than county jurisdiction,and therefore many small area coverage (large-scale) products may be outside their area of jurisdiction.

A summary with pertinent comments for each product group follows:

Faults

Eight of the ten fault studies were identified as having been used a total of 97 times by the regional agencies resulting in the fourth highest average use of any group.

The report (BDC 7) most often identified (26 times) was on active faults. (See fig. 40 on p. 107.) This very frequent use may be attributed to the product's large areal coverage. Holding constant the other factors affecting their use, products covering a small area are used less frequently because four of the seven selected agencies have less than a region-wide area of jurisdiction. (see fig. 2 on p. 13 and fig. 3 on p. 18.)

Two fault studies (BDC 55 and MF 743) had a relatively high use (10 or more times) considering their scale (1:24,000), limited areal coverage, and the recent release date of one (MF 743). (See fig. 26 on p. 85.) Another product (BDC 44) also had a relatively high use (13 times) considering its scale (1:62,500) and that it covered only one county. (See fig. 20 on p. 75.) The nonuse of two fault maps (MF 818 and 881) may be attributed to their recent (1978) release dates.

The fault studies were most often used for coastal-area plans, regulation administration, EIR/EIS review, and project review and comment or approval.

Flood-prone Areas

Eight of the nine flood-prone area studies were identified as having been used a total of 116 times by the regional agencies resulting in the third highest average use of any product group. (See figs. 18 and 20 on p. 71 and 75.)

The regional flood-prone area map (IR 4) and the regional tsunami innundation map (BDC 52) were the products most often used (39 and 30 times, respectively). This very frequent use may be attributed to their large areal coverage and the hazard-type information they contain; and, in the case of the tsunami innundation map (BDC 52), because four of the seven selected agencies have responsibilities for shoreline development. The nonuse of one flood-prone area report (PP 942) can be attributed to its recent (1978) release date.

The flood-prone area studies were most often used by the agencies for coastal-area plans and for general reference.

Geology

Thirteen of the 17 geology publications were identified as having been used a total of 237 times by the regional agencies giving them the highest average use of any group. (See figs. 10 and 34 on p. 56 and 97.) These publications were used between 10 and 26 times. Nonuse of three products (BDC 2, 3, and 13) at a scale of 1:24,000 or larger may be attributed to their limited coverage, and to the fact that they were outside the area of jurisdiction of three of the seven selected agencies. Nonuse of one publication (BDC 65) may be attributed to its rather specialized technical nature; however, the report derived from it (BDC 64) was used frequently (16 times).

The geology publications were most often used for EIR/EIS review, general reference, coastal-area plans, evaluation of potential sites, project review and comment, and transportation studies.

Hydrology

All eight of the hydrology reports were identified as having been used by the regional agencies. The bay drifter study (BDC 22) and precipitation reports (BDC 25 and 32) were most often identified (11, 10, and 17 times, respectively). (See figs. 18 and 35 on p. 71 and 98.) The infrequent use of two hydrology reports -- mean annual runoff study (BDC 69) and hydrologic design criteria report (TR 3) -- is because flood-control responsibilities are primarily at the city and county levels of government. The hydrology reports were most often used by the agencies for general reference, for administering regulations, and for EIR/EIS review.

Landslides

Only 11 of the 20 reports on landslides were identified as having been used (66 times) by the regional agencies. (See fig. 26 on p. 85.) This relatively small number may be partially attributed to the fact that the preliminary regional slope-stability map (1:125,000) was available and was frequently used by at least one of the agencies (ABAG). (See fig. 18 on p. 71.)

The regional landslide-abundance map (BDC 11) was the product used most often (20 times). This frequent use may be attributed to the product's large areal coverage. The infrequent use of six products and the nonuse of five others may be partly because they did not cover the coastal areas, and because the preliminary regional slope-stability map was available. The two landslide reports covering the coastal areas (BDC 42 and 43) were used 9 and 14 times, respectively. (See fig. 20 on p. 75.) The nonuse of four other products (Bull. 1388, Bull. 1424, MF 677 and MF 719) can be attributed to their recent release dates.

The landslide reports were most often used by the agencies for general reference, coastal-area plans, and transportation plans.

Land Use

Three of the five reports on land use were identified as having been used a total of 23 times by the regional agencies. The product (BDC 62) used most often by the agencies (19 times) was perhaps because it was the only one of its kind having regional coverage. (See figs. 15 and 16 on p. 65 and 66.) The author has no explanation for the infrequent use of two products (BDC 61 and IR 1) and the nonuse of one product (TR 4). The nonuse of another product (Cir. 721) may be attributed to its recent release.

The land-use reports were most often used by the agencies for general reference, for studies of physical resources, and for EIR/EIS review.

Miscellaneous Products

Eight of the 11 miscellaneous reports were identified as having been used a total of 46 times by the regional agencies. The product used most often (20 times) was the marshland map (BDC 9). This frequent use may be because of the product's large areal coverage, because of problems involving bay shore-land development, and because of the availability of the information at larger scales. (See fig. 38 on p. 103.)

One product (I 909)was used at least 12 times -- a relatively high incidence of use considering it discusses mineral resources and was only recently released. This frequent use may be explained by its discussion of water pollution and environmental protection in connection with mineral extraction operations. (See figs. 21 and 22 on p. 77 and 78.)

The infrequent use of six products may be attributed to their technical nature and lack of direct relevance to most of the agencies' activities. The nonuse of three products (Cir. 712, MF 796, and MF 891) may be because of their recent release.

Seismicity and Seismology

Both of the seismicity and seismology reports (PP 941A and MF 709) were used a total of 19 times by the regional agencies -- the fifth highest average use of any product group. (See fig. 9 on p. 55.) This is a relatively high incidence of use considering that both reports were recently released. The seismicity and seismology reports were most often used by the agencies for evaluation of potential sites.

Waste Disposal, Water Quality, and Water Supply

Sixteen of the 18 SFBRS reports grouped under the headings of waste disposal, water quality, and water supply were used a total of 91 times by the regional agencies. The reports used most often were the regional water-supply and demand (BDC 47) and bay-circulation reports (TR 1) -- 10 and 14 times, respectively. Interest in these two reports may be attributed to their large areal coverage and to the importance of waste disposal and water supply in a metropolitan region. (See fig. 36 on p. 99.)

The report evaluating pollution potential of land-based waste disposal (IR 6) was used relatively frequently (9 times) considering that it covers only one county. This use may be attributed to its interpretive content and the method of site evaluation it presents. (See fig. 18 on p. 71.)

The less frequent use or nonuse of the other products may be because their scales are too small to be applicable to the point-discharge permit and enforcement responsibilities of RWQCB. In addition, water-supply responsibility is assigned to city and county rather than regional levels of government. However, all of the products except two (BDC 24 and 53) were used at least once by the two agencies (ABAG and RWQCB) responsible for waste-disposal and water-quality planning and management.

The waste-disposal, water-quality, and water-supply reports were most often used by the agencies for general reference, EIS/EIR review, water-quality management plans, regulation administration, and water-quality studies.

Photography and Topography

All three of the SFBRS photography and topography products were identified as having been used a total of 49 times by the regional agencies -- the second highest average use of any group. The regional topographic map was used most often (25 times). This very frequent use may be because it is the only map of that type and coverage available. The frequent use of orthophotos and regional slope maps may be because they are applicable to most regional studies, plans, and other planning activities. (See fig. 20 on p. 75.) These products were most often used for transportation studies and for general reference.

Other USGS Products

At least 46 different published USGS reports (see appendix H) not prepared under the SFBRS were used at least 110 times by the regional agencies. The products most often mentioned were maps in the 7½-minute quadrangle (topographic) series which were used for all types of planning activities. Geology and water-quality reports were frequently used. The geology reports were used primarily for geologic- and physical-resources studies. The water-quality reports were used for water-quality studies and water-quality management plans.

Undercounting

In an inventory or series of interviews of this type, there is always the possibility of receiving incomplete or inadequate responses. The result is that the interviewer does not identify all the applications made or all the products used. There are several other areas where undercounting may have occurred, for example:

1. Many SFBRS products are based upon larger-scale or more-detailed data which are sometimes available on an "official-use-only" basis. Usually, these products were not identified during the interview or cited in the planning documents, even though they may have been used. (See example on p. 102.)

2. Some agencies were able to obtain access to, and make use of, SFBRS data on an "official-use only" basis prior to publication, and often these data were not identified or cited as in the example on page 70.

3. Regional agencies use and cite reports of other agencies or consultants which are based upon, and refer to, SFBRS products. For example, MTC and RWQCB rely upon some of ABAG's studies for transportation or water-quality plans.

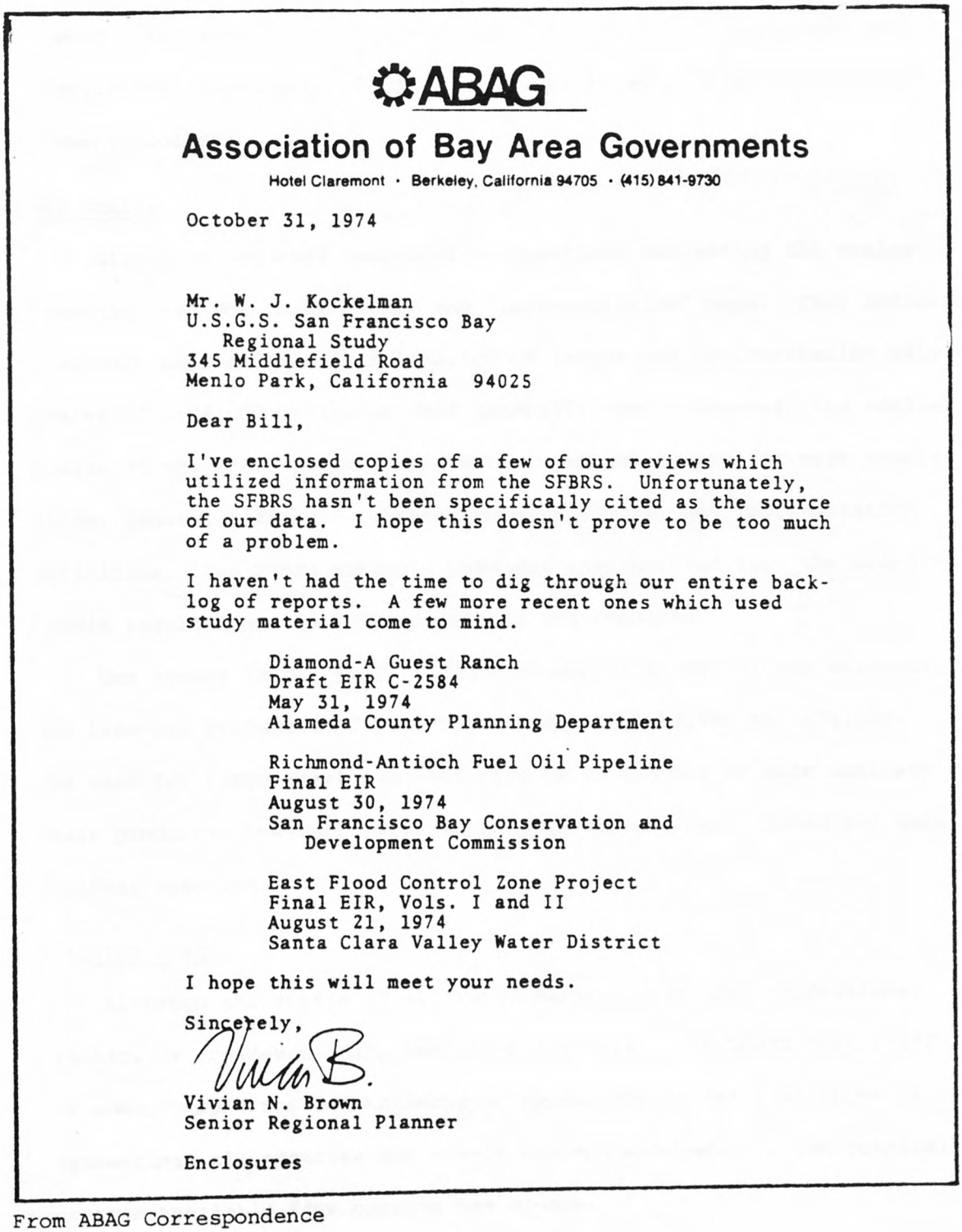
   ABAG uses the State Geologist's "Special Studies Zones" quadrangle maps for fault locations. Of the 56 quadrangles covering the San Francisco Bay region, 38 contain specific references to SFBRS products. Obviously, these products are not specifically cited when an agency uses the maps, and thus were not identified during the inventory or interviews.

4. Regional agencies use SFBRS products without citing or referring to them, for example in EIR/EIS reviews. (See fig. 43.)

5. The source of the 7½-minute series (topographic) quadrangles used by regional agencies for base, reference, index, and location maps is rarely cited and rarely acknowledged as it was in the example on page 84.

FIGURE 43

Use of SFBRS Products for Environmental Impact Report Review



ABAG

Association of Bay Area Governments

Hotel Claremont · Berkeley, California 94705 · (415) 841-9730

October 31, 1974

Mr. W. J. Kockelman
U.S.G.S. San Francisco Bay
Regional Study
345 Middlefield Road
Menlo Park, California 94025

Dear Bill,

I've enclosed copies of a few of our reviews which utilized information from the SFBRS. Unfortunately, the SFBRS hasn't been specifically cited as the source of our data. I hope this doesn't prove to be too much of a problem.

I haven't had the time to dig through our entire backlog of reports. A few more recent ones which used study material come to mind.

Diamond-A Guest Ranch
Draft EIR C-2584
May 31, 1974
Alameda County Planning Department

Richmond-Antioch Fuel Oil Pipeline
Final EIR
August 30, 1974
San Francisco Bay Conservation and
Development Commission

East Flood Control Zone Project
Final EIR, Vols. I and II
August 21, 1974
Santa Clara Valley Water District

I hope this will meet your needs.

Sincerely,

Vivian B.

Vivian N. Brown
Senior Regional Planner

Enclosures

From ABAG Correspondence

Comments from Regional Agency Personnel

Over 50 persons in the seven selected regional agencies were interviewed. Among those interviewed were 26 planners, 14 engineers, and 2 consultants. A summary of their responses to each question and pertinent comments follow.

Map Scales

All seven agencies responded to questions concerning the scales commonly used for their "work" and "implementation" maps. They indicated that work maps at scales of 1:62,500 or larger and implementation maps at scales of 1:24,000 or larger were generally used. However, the smaller scales of the SFBRS products did not prevent their use for most studies and plans, general reference, environmental analysis, and implementation activities. The SFBRS products were not incorporated into the agencies' permit regulations where larger scales are required.

One agency (BCDC) used 1:24,000 backup data (BDC 9) and enlarged the land-use product (BDC 62) from a scale of 1:62,500 to 1:24,000. The need for large areal coverage results in the use of more smaller-scale products; however, large-scale products are also needed and used by regional agencies.

Planning Staffs

Although the staffs of all seven agencies included professional planners or engineers, only two had a geologist. Although most staffs had some members who had training or experience in earth sciences or engineering, all agencies had access to, and made use of, geotechnical services available from outside the agency.

Receipt, Distribution, and Custody

Six of the seven selected agencies are on the SFBRS mailing list, and the staffs of all seven report that they have access to SFBRS products. After receipt, the SFBRS products are usually circulated among staff members and then placed in the agencies' libraries.

Failure to Use Certain SFBRS Products

Six agencies did not use certain SFBRS products. Too small a scale and lack of detail were given as reasons in several cases as to why the products were not found useful.

Problems in Using SFBRS Products

All seven agencies experienced some problems in using SFBRS products primarily because the scale was too small or the detail not great enough. In the case of some of the products, the agencies were dissatisfied with the scale, graphics, complexity, accuracy, coverage, or recency of the information.

Anticipated Use of Future Products

All seven agencies expressed interest in the SFBRS earth-science topical interpretive products now under way and indicated that all of them would be useful for their planning activities (including the coastal geologic processes report which has been dropped from the SFBRS program). The reports on erosion, transportation and deposition, flood-prone areas, and relative slope stability were most often mentioned. The types of uses most often identified for these products were project review and comment or approval, and community assistance.

Information Needed or Desired

All seven agencies expressed a need or desire for additional earth-science, engineering, or other related information, primarily on subjects such as erosion and sedimentation, water-quality, topography, land use and land cover, geology, and waste disposal.

The expressions of a need or desire for specific data by the agencies does not lend itself to weighting. However, the requests were generally for larger-scale maps, more interpretive reports, updating of existing products, and additional research.

Suggestions for Improving Products

Six of the seven agencies suggested specific improvements to USGS products -- primarily fewer technical or more interpretive reports, and larger-scale or more-detailed maps, and updating or adding specific information to the 7½-minute series (topographic) quadrangles. The requests for more interpretive products may indicate a need for educational, advisory, and review services.

Services from Members of USGS

All seven agencies indicated that they had contact with, and had received numerous educational, advisory, and review services from one or more of the 35 different USGS personnel mentioned in the interviews. This figure does not include the various members of the USGS who responded to verbal, telephone, and written requests for SFBRS reports.

Comparison Between City, County, and Regional Use of SFBRS Products

With the completion of the inventory of the seven selected regional agencies and the interviews with their personnel, a comparison with the results of the city and county inventories and interviews (Kockelman, 1975, 1976) can be made. Such comparison should be helpful in confirming the results of each study by noting similarities and analyzing the reasons for any major differences.

The 91 cities, 8 counties, and seven selected regional agencies, which were the subject of the three studies, lie in the same geographic area, experience parallel population growth, rely upon the same natural resources, are affected by the same natural hazards, affect the same environment, and generally have similar community interests and priorities. In addition, the method of inventory and interviewing was generally the same for the cities, counties, and regional agencies except that the planning activities shown on the inventory form for the regional agencies (fig. 5 on p. 29) were not listed so that the varying responsibilities of each regional agency could be accommodated.

The differences between the cities, counties, and regional agencies are generally those of size -- both in area and population -- and the factors related thereto. For example, staff size and capability, financial resources, and exposure to SFBRS products generally increase with the size of the unit or agency of government. The assignments of the regional agencies and the cities and counties are very different. Each regional agency has different satutory powers and duties, whereas each city and county has almost the same powers and duties and is required to conduct almost the same planning activities.

For this reason and various others, some comparisons could not be made. For example, only one regional agency (MTC) is required to prepare a transportation plan; regional agencies do not adopt building, subdivision,and zoning ordinances; city and county boundaries are fixed and do not require a determination of jurisdiction; and nine SFBRS products were released after the city and county studies were completed.

Similarities Noted

In making the comparison between the results of the three studies, the following similarities were noted:

1. Counties and regional agencies are familiar with, and frequent users of, SFBRS products.

2. Some correlation exists between greater use of SFBRS products and the larger size of an agency's staff.

3. Types of planning activities most often indicated as having been based upon SFBRS products were general reference and EIR/EIS review. In addition, the activities most often indicated by counties and regional agencies were the administration of regulations and environmental analyses.

4. Use of SFBRS products was infrequent for detailed plans, permit regulations, and site investigations because larger scales are required.

5. Frequent use of regional topographic and slope maps was made by counties and regional agencies.

6. Very frequent use was made of reports on geology, faults, and flood-prone areas. Less frequent use was made of waste-disposal, water-quality, and water-supply reports.

7. Specific products used most often were small-scale, large areal-coverage, interpretive, hazard-type reports.

8. Numerous USGS products other than SFBRS were used -- primarily the 7½-minute series (topographic) quadrangle maps.

9. Scales most commonly used for "implementation" maps were 1:24,000 or larger. County and regional agencies used scales of 1:62,500 or larger for their "work" maps.

10. Although only two regional agencies and one county have a geologist on their planning staff, all regional agencies and six of the 8 counties have access to geotechnical services.

11. The primary problem in using SFBRS products was that the scale was too small or the detail not great enough.

12. Regional agencies and counties expressed interest in using the SFBRS earth-science topical interpretive reports currently under way.

13. A need or desire for more earth-science, engineering, or other related information was expressed. Geologic studies and updated 7½-minute series (topographic) quadrangle maps were the types of information most often specified.

14. Suggestions for improvements were made -- primarily larger scale or more detail, and fewer technical or more interpretive reports.

15. Numerous and varied educational, advisory, and review services were provided by USGS personnel.

Major Differences Discerned

In comparing the results of the city, county, and regional studies, the following major differences were discerned:

1. The total use of SFBRS products by the counties was greater than the regional agencies (1,259 compared to 803), and the average use was greater (157 per county to 114 per regional agency). The lesser use by regional agencies can be attributed primarily to their having special-purpose assignments -- water-quality management, transportation planning, coastal zone conservation and bay conservation and development -- as compared with the general-purpose assignment of the county units.

2. Types of planning activities (other than general reference and EIR/EIS preparation and review) most often based upon specific SFBRS products were coastal-area plans for regional agencies (73 times) and seismic-safety plan elements for counties (84 times) and for cities (169 times). This addressing of different critical issues

may be attributed to the Legislature's assignment of different responsibilities.

3. Regional agencies' activities based upon SFBRS products differ from city and county activities. This difference can be attributed to the regional agencies' special-purpose assignments which differ from the cities' and counties' general-purpose assignments.

4. Regional agencies used SFBRS products less frequently for geologic and geologic-hazard studies than cities and counties. The less frequent use can be partly attributed to the fact that some of the regional agencies' geologic studies were completed prior to the release of SFBRS products.

5. Six of the seven selected regional agencies and all of the counties were on the SFBRS mailing list compared with only 34 of the 91 cities. None of the regional agencies and counties failed to use the SFBRS products, whereas 21 cities did not use them. These differences may be attributed to the counties' and regional agencies' larger staffs, larger areas of undeveloped lands,and perhaps to a greater awareness or interest in the natural processes and hazards affecting the undeveloped lands.

6. Most regional agencies had some staff members with training or experience in earth sciences or engineering, while most city and county planning-staff members lack training and experience in either earth sciences or engineering.

7. Five of the seven regional agencies and five of the eight counties expressed a need or desire for specific land-use information compared with none of the cities. This difference may be attributed to the fact that cities require land-use information at a scale and level of detail that is more appropriately prepared at the local level.

8. All seven regional agencies and all eight counties indicated contact with USGS personnel compared with only 20 of the 91 cities. This difference may be attributed to the relatively large size of the regional agencies' and counties' jurisdiction and the size of their staffs compared to the smaller size of the cities' jurisdictions and staffs.

9. None of the seven selected regional agencies suggested better liaison with members of USGS compared with this suggestion from four of the eight counties. This difference can be attributed to the large number of contacts that existed with, and the numerous services that were provided to, the regional agencies.

CONCLUSIONS AND SUGGESTIONS

All of the selected regional agencies in the bay region are familiar with, make frequent use of, and will continue to use SFBRS products, including the interpretive reports that are under way. This is not surprising since the regional agencies are the largest units of government in the region for which the products were designed and scaled. The frequent use of different SFBRS products is especially significant when the agencies' various special-purpose assignments are considered -- water-quality management, transportation planning, coastal-zone conservation,and bay conservation and development. The conclusions reported below are grouped under specific conclusions, transfer value, and outlook for the future.

Specific Conclusions

The following specific conclusions can be drawn as a result of the inventory and interviews:

1. SFBRS geology, hydrology, and topography products are being used for all types of regional planning activities -- studies, plans, implementation, and other planning activities, including the analysis of environmental impacts, the administration of development regulations, and the review and approval of projects.

2. SFBRS products are applicable to most regional planning activities and are frequently used for special-purpose planning activities -- water-quality studies, potential site evaluation, coastal-areas plans,and jurisdiction determinations.

3. No significant correlation was discerned between regional agency use of SFBRS products and their type, scale, coverage, content,or complexity. However, the eleven products most often used were small-scale, large-area products, and most were interpretive, hazard-type products.

4. Certain SFBRS product groups, such as reports on geology, photography, topography, flood-prone areas, faults, and seismicity and seismology, are used more frequently because the regional agencies give priority to planning activities required by State or Federal law or to critical regional issues, such as hazard avoidance, damage mitigation, environmental protection, and land- and water-resource conservation.

5. Map scales of 1:24,000 or larger are commonly used for implementation activities. The scale and detail of the SFBRS products does not appear to limit their use by regional agencies for most studies, plans, environmental impact assessments, general reference, and even project review, jurisdiction determinations,and administration of regulations. However, SFBRS products are not used by the agencies for planning activities, such as permit regulations, since these require larger scales.

6. Regional agencies appear to have the geotechnical capability needed for use of SFBRS products through staff geologists, staff members with training or experience in earth sciences or engineering, or access to geotechnical services outside the agency. However, all seven agencies receive numerous and varied educational, advisory and review services from members of the USGS, and five of the agencies suggested fewer technical or more interpretive reports.

7. Additional earth-science information -- primarily interpretive and large scale -- is needed by regional agencies.

8. Plans and jurisdiction boundaries and related regulations based on SFBRS products have been adopted and administered by some regional agencies for over six years without any litigation relating to the products.

Transfer Value

All uses of SFBRS products documented in this report are readily transferable to the other local and regional agencies in the bay region and in some cases to State agencies. For example, the "coastal stability" sketch maps and coastal-erosion guidelines developed by one agency -- the Central Coast Regional Commission -- from SFBRS products have been transferred to a county seismic-safety plan (see Kockelman, 1976, p. 99) and incorporated into the State policy on bluff top development which affects all coastal regions in California. (See example on p. 60.)

However, transfer value outside the region is dependent upon, or affected by, the following factors:

1. Presence of similar geologic and hydrologic environments
2. Availability of similar earth-science information
3. Regional or community interest or priority in addressing earth-science related problems
4. Existence of similar planning and plan implementation assignments
5. Potential user's familiarity with the types of earth-science information available and its applications

The first three factors are unique to each region and are beyond the congressional mandate given to the USGS or the Department of the Interior. In the case of the fourth factor, the transfer value to other States and regions is increased because of the water-quality and solid-waste management planning required by Section 208 of the Federal Water Pollution Control Act (U.S. Code, 1977, Title 33, Sec. 1288 and following) and the coastal zone management program required by the Federal Coastal Zone Management Act (U.S. Code, 1977, Title 16, Sec. 1451 and following).

The last factor is the only one that can be appropriately addressed in this report and will partly depend upon the report's readability, use of appropriate examples, and distribution to potential users of earth-science information. The 15 examples of the application of SFBRS products to various planning activities illustrated in the Selected Applications section of this report (p. 53-112) should contribute to transfer both inside and outside the bay region.

Outlook for the Future

The time consumed in undertaking planning studies, preparing plans, and implementing such plans ranges generally from one to five years; hence our application inventory is made relatively early in the planning and decisionmaking process. Therefore, SFBRS products will probably continue to be applied to planning and decisionmaking by regional agencies in the bay region because:

1. Additional SFBRS products are being released, for example, the interpretive reports on flatlands deposits and relative slope stability.

2. The topical interpretive reports contain new basic and interpretive information, cover larger areas, introduce different types of applications (see Kockelman, 1977), and present examples of applications. (See Blair, 1977.)

3. More effective interpretations and innovative uses of the data continue to be made by regional agencies and other units of government. (See examples on p. 54 and 70.)

4. More regional staffs and their consultants are becoming familiar with the products and how they are being applied by other agencies and units of government.

5. Studies, plans, and regulations prepared prior to release of SFBRS products will be revised.

6. Incorporation of SFBRS products into computer-based information systems makes the data more readily available for studies, plans, implementation, and other planning activities. (See example on p. 109.)

7. Regional coastal commissions will provide assistance to local units of government which are required to prepare and implement a "local coastal program" (Calif. Public Resources Code, 1977, Sec. 30500).

8. The regional agency with general planning powers (ABAG) provides technical assistance in the use of earth-science information and in the development and implementation of local seismic-safety plans as part of an earthquake preparedness program (ABAG, 1976a).

Suggestions

Suggestions offered here are directed to future hazard, resource, and environmental planning and development studies having goals similar to those of the SFBRS. The suggestions are designed to ensure more effective use of earth-science information by planners and decision-makers and are based upon the results of the regional-use inventories and user interviews. The suggestions are discussed under the following headings: critical issues; users advisory committee; interpretive products; impacted areas; scale and detail; information release and distribution; and educational, advisory, and review services. No attempt is made to suggest the staff needed or estimate the funding required, as these would vary according to the specific needs of the users, scope of the study, and capability of the agencies in the study area.

Critical Issues

The enactment of State and Federal laws or regulations and the emergence of critical issues affecting regional agencies should be monitored and analyzed so that the USGS and its scientists, engineers, and planners can better anticipate and respond to regional agency needs.

Priority should be given to the collection, analysis, and interpretation of information relating to earth hazards, resources,and base mapping. Studies should be made of flood-prone areas, topography, slope zones, seismicity and seismology, geology, land use and cover, orthophotos, slope stability, faults, waste disposal, erosion, sedimentation, water quality, and water supply. Products should be designed to address critical issues such as geologic-hazards reduction; resource

conservation, development and management; and environmental protection.[5/]

These suggestions are based upon the selected regional agencies' compliance with State and Federal laws; priority given to critical regional issues; type of planning applications most often made of SFBRS products;topics of the products most often used; and agency responses concerning anticipated use of future products and information needed.

The timely inventory and compiling of USGS program activities in coastal areas (Marcus, ed., 1976) is an example of USGS monitoring of Federal laws, and is a partial response to State needs relating to the critical issue of coastal-zone conservation.

Users Advisory Committee

A committee composed of representatives of selected existing and potential local, regional, State, Federal, conservation, and corporate users should be created prior to the adoption of any preliminary program design or the preparation of any detailed program design. The committee would not act as a coordinator or translator for the users but would act as users, communicating directly with the producers of the information.

5/ Information relating to "energy resources" and products addressing energy development" could be added to these lists because of their critical national importance.

The committee would:

1. Help USGS personnel identify critical issues and user needs
2. Collaborate in the design of the products
3. Provide an immediate and receptive user market
4. Encourage continued application after program termination
5. Assist in avoiding duplication in the data collection and interpretation phases

At least one of the committee members should be a geotechnical engineer, and one of the USGS personnel assigned to assist the committee should be an urban and regional planner. The engineer and planner would facilitate communication and act as negotiators between a user's demands and what scientists can realistically provide.

This suggestion is based upon the frequency of use of the products by the selected regional agencies and their responses concerning: problems in using SFBRS products, anticipated use of future products, information needed, and suggestions for improvements. The A. D. Little report evaluating the SFBRS also recommends the creation of a user panel (1975, p. 91) and specifies actions to be taken before undertaking a new project (1975, p. 85-86).

Effective feedback systems have included use inventories and user interviews by the USGS (Kockelman, 1975, 1976) and outside consultants (A. D. Little, 1975); however, user input before a project is undertaken and during the data collection, interpretation, and product-design phases would be more desirable and effective.

Interpretive Products

More engineering interpretations and land- and water-use capability ratings should be provided for regional agencies. This suggestion is based upon the type of products most often used by the selected regional agencies and their responses concerning: anticipated use of future interpretive products, information needed, suggestions for improvements, and the number and type of services received from USGS personnel.

Ideally, the products should be designed for one common user group -- intelligent and interested citizens -- thereby meeting almost all user needs as to content, scale, detail, interpretation, and providing a common basis for discussion during public hearings. If the products are designed for this one common user group, it is not necessary to select target users and user groups or depend on transfer agents.

The A. D. Little report evaluating the SFBRS contains numerous recommendations concerning improvements in the SFBRS interpretive reports (1975, p. 79-80) and in the organization and presentation of engineering characteristics and suitability ratings of earth-science data (1975, p. 87-90).

These recommendations should be given careful consideration by USGS scientific, engineering, planning, and administrative staffs. Many would contribute toward more effective use of future USGS earth-science information designed for planners and decisionmakers. Part of the need for interpretive products is being met by preparing the SFBRS topical interpretive reports and supporting the development of a method for assigning land capability ratings to eight land use categories (ABAG, 1976b, Laird and others, 1979).

Impacted Areas

Improper use or development of lands and waters often creates national, State, and local issues relating to geologic-hazard reduction, energy development, environmental protection, and resource conservation. The scientific, engineering, and planning staffs of the Federal government should be used to study those areas which are, or will be, impacted by development.

This suggestion is based upon the frequency of use of SFBRS products by the selected regional agencies in an urban and urbanizing area and their responses concerning: map scales most commonly used, information needed,the great disparity between their needs and the limited scientific, engineering, and planning capabilities available to meet those needs; and the number and type of services received from USGS personnel.

Scale and Detail

An effort should be made to provide earth-science information at those scales -- 1:24,000 -- and levels of detail most commonly used by regional agencies. In addition, the large-scale and high-resolution information needed for permit regulations, site investigations, detailed plans, and project review and approval should be recognized.

This suggestion is based upon the uses most often made of SFBRS products by the selected regional agencies and their responses concerning: map scales most commonly used, why certain SFBRS products were not used, problems in using the products, need for additional earth-science information at a larger scale, and suggestions for improvements.

Information Release and Distribution

In addition to the standard USGS products, the earth-science information needed to address critical regional issues should be released early through briefings, seminars, map-type "interpretive inventory" reports, open-file reports, and contributions to reports of cooperating agencies.

At least three copies of each product released should be sent to selected regional agencies, one copy to the chairperson of each agency's governing body, one copy to its executive director, and another to the staff person using,or who is most likely to use,earth-science information. The letter of transmittal should:

1. Describe the product in general terms
2. Suggest uses or applications appropriate to the agency
3. Advise where explanations of the product and assistance in its use for, and adaptation to, regional planning and decisionmaking activities can be obtained

Regional agencies should be made aware of the availability of any information at larger compilation scales.

These suggestions are based upon the frequency of use of SFBRS products by the selected regional agencies; the time ordinarily consumed between receipt, and effective use of the earth-science information; and agency response concerning: receipt, distribution, and custody of SFBRS products, anticipated use of future products, information needed, and the number and type of services received from USGS personnel.

Educational, Advisory, and Review Services

Educational, advisory, and review services should accompany any new earth-science data collection and analyses program designed for planners and decisionmakers. This suggestion is based upon the type of planning applications most often identified, the types of products most often used by the selected regional agencies,and their responses concerning: use of geotechnical services outside the agency, anticipated use of future SFBRS products, information needed,suggestions for improvements, and the number and type of services received from USGS personnel.

Educational services range from: merely announcing the availability of a USGS product; through the publishing and distributing of newsletters and brochures; to sponsoring, conducting, or participating in seminars and workshops for potential users.

Advisory services range from: explaining or interpreting USGS products (fig. 13 on p. 61); through assisting in the design of regulations based upon the products (fig. 39 on p. 105); to giving expert testimony and depositions concerning the products.

Review services include review and comment on studies, plans, regulations, or other planning documents that are based upon, cite, interpret, or apply USGS information.

Numerous examples of, and recommendations concerning, such services are set forth in recent published and unpublished reports by the author (Kockelman, written commun., May 1976), management consultants (A. D. Little, 1975); USGS staff members outside the Earth-Sciences Applications Program (Gary W. North, written commun., 1975; USGS Publication Division Staff, written commun., 1975); University centers (Wissel and others, 1976, p. 2-5; University of Wisconsin, 1975, p. 24); the Council of State Governments (1976, p. 17-18); and the U.S. House Committee on Government Operations (1970, p. 23).

The educational, and advisory services would not supplant ongoing programs of the USGS, activities of educational institutions, and services of private consulting firms or regional and State organizations, but rather supplement them. The review services would not endorse or give approval to the documents reviewed.

Educational, advisory, and review services should only be provided to regional planners and decisionmakers upon request. Many of these services are being provided informally as part of USGS urban area studies, but they should be formally recognized and included as a work element in any future USGS program designed for planners and decisionmakers.

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APPENDIX A

Basic Data Contributions

BDC No. 1 "Map Showing Recently Active Breaks Along the San Andreas Fault Between Point Delgada and Bolinas Bay, California," by Robert D. Brown, Jr., and Edward W. Wolfe (open-file map). Two map sheets plus text and references; scale is 1:48,000.

This map locates the most recently active surface traces of the San Andreas fault north of the Golden Gate, and documents the historic evidence and geomorphic features along its course.

2 "Geologic Map of Palo Alto 7-1/2 minute quadrangle, San Mateo and Santa Clara Counties, California," by E. H. Pampeyan, 1970 (open-file map). One map sheet plus explanation sheet; scale is 1:24,000.

The location of such geologic features as landslides, springs, and the San Andreas fault are documented, and standard geologic units are shown, including bay mud, unconsolidated sediments, and various rock types of the Tertiary and older formations. The area covered is from San Carlos south to Portola Valley and from East Palo Alto south to Los Altos Hills.

3 "Geologic Map of the Southern Part of Redwood Point 7-1/2 minute quadrangle, San Mateo County, California," by E. H. Pampeyan, 1970 (open-file map). One map sheet; scale is 1:24,000.

This map shows the location of bay mud, alluvium, and artificial fill in the marshlands near San Carlos and Redwood City. Former shorelines are indicated, and borehole information with depth of bedrock is given.

4 "Map Showing Areas Serviced by Municipal and Private Water Distributions Agencies, San Francisco Bay Region, 1970," revised and reprinted 1971, compiled by J. T. Limerinos and Karen Van Dine (Miscellaneous Field Studies Map MF-329). One map sheet, plus 5 p. table; scale is 1:500,000.

Boundaries of the various water districts in the nine-county Bay Area are shown on the map, and the table gives "water-use data" for the respective water districts.

5 "Map Showing Areas Serviced by Municipal and Private Sewerage Agencies, San Francisco Bay Region, 1970," revised and reprinted 1971, compiled by J. T. Limerinos and Karen Van Dine (Miscallenaous Field Studies Map MF-330). One map sheet; scale is 1:500,000.

The map shows the boundaries of the various sewage districts and the locations of treatment plants and sewage outfalls in the nine-county Bay Area.

6 "Preliminary Geologic Map of the Central Santa Cruz Mountains, California," compiled by Earl E. Brabb, 1970 (open-file map). Two map sheets plus explanation sheet; scale is 1:62,500 (1 in. = 1 mile).

The location of geologic units is shown for a 28 X 36-mile area from San Carlos to Santa Cruz, and the Pacific Ocean to the San Francisco Bay. The San Andreas fault zone and other faults, many landslides, and the depth to bedrock under thick unconsolidated sediments are indicated.

7 "Faults that are Historically Active or that Show Evidence of Geologically Young Surface Displacements, San Francisco Bay Region; A Progress Report: October 1970," compiled by Robert D. Brown, Jr. (Miscellaneous Field Studies Map MF-331). Two map sheets; scale is 1:250,000.

The map shows the location of known and suspected recent movements along eight major and some minor faults in the nine-county Bay Area. In addition to previously reported earthquake faults, the Healdsburg-Rogers Creek, San Gregorio, and Green Valley faults are indicated as active for the first time.

8 "Generalized Geologic Map of the San Francisco Bay Region, California," by J. Schlocker, 1971 (open-file map). One map sheet; scale is 1:500,000.

The distribution of major groups of consolidated and unconsolidated rock types is indicated for the nine-county Bay Area. A concise description of the nature, engineering behavior, and commercial uses of each group is given.

9 "Preliminary Map of Historic Margins of Marshlands, San Francisco Bay, California," compiled by Donald R. Nichols and Nancy A. Wright, 1971 (open-file map). One map sheet, plus text and references. Scale is 1:125,000.

The location of marshland, sloughs and channels adjacent to the San Francisco Bay in the mid-1800's is indicated on the map, and a summary of the geology and engineering properties of the bay mud, and its regional planning significance are given in the accompanying text.

BASIC DATA CONTRIBUTIONS (continued)

10 "Bedrock-Surface Map of Central San Francisco Bay, California," by Paul R. Carlson and David S. McCulloch, 1970 (open-file map). One map sheet; scale is 1:10,600.

The depth to the bedrock surface in the Bay is shown by contours for an area from Point Bonita to Treasure Island and from Tiburon Peninsula to Point Lobos.

11 "Estimated Relative Abundance of Landslides in the San Francisco Bay Region, California," by Dorothy H. Radbruch and Carl Wentworth, 1971 (open-file map). One map sheet; scale is 1:500,000.

This map of the greater Bay Region has six map units of progressively more average area covered by landslides. The landslide abundances are estimated primarily from characteristics of the various earth materials, and to a lesser degree from average rainfall, slope of the ground, and a limited knowledge of actual landslide distribution.

12 "Preliminary Geologic Map of Western Sonoma County and Northernmost Marin County, California," compiled by M. C. Blake, Jr., Judith Terry Smith, Carl M. Wentworth, and Robert H. Wright, 1971 (open-file map). Five map sheets, scale is 1:62,500.

The location of geologic units is shown for a 51 X 40-mile area that covers most of Sonoma County and part of Marin County. Active and inactive faults including the San Andreas fault are indicated, as well as some landslides in the area.

13 "Geologic map of the Sargent Fault Zone in the vicinity of Mount Madonna, Santa Clara County, California," by Robert J. McLaughlin, 1971 (open-file map). One map sheet plus explanation sheet. Scale is 1:12,000.

The location of geologic units and structures is shown for a 3 X 4-mile area just to the east of Mount Madonna. Complex structural relationships are shown, that were not previously realized.

14 "Distribution of Mercury in Surface Sediments in the San Francisco Bay Estuary, California," by D. S. McCulloch, T. J. Conomos, D. H. Peterson, and K. Leong (open-file map). One map sheet, scale is 1:500,000.

Sample locations and mercury concentrations in parts per million are shown for 199 samples of bottom sediments in the bay and its tributaries. The accompanying text compares mercury values for four major areas of the bay, and for various environments within the bay.

The following six Basic Data Contributions are open-file maps of flood-prone areas, showing areas that would be inundated in a very large but infrequent flood episode (a "100-year flood"). These areas are indicated on 7-1/2-minute quadrangle sheets and grouped according to drainage basins. The scale of all sheets is 1:24,000.

15 "Flood-prone areas in the Napa River Drainage Basin, Napa County, California," including St. Helena, Rutherford, Yountville, Napa, and Cuttings Wharf 7-1/2-minute quadrangles. Five map sheets.

16 "Flood-prone areas in the Sonoma Creek Drainage Basin, Sonoma and Marin Counties, California," including Glen Ellen, Sonoma, Sears Point, and Petaluma Point 7-1/2-minute quadrangles. Three map sheets.

17 "Flood-prone areas in the Petaluma River Drainage Basin and Cotati vicinity, Sonoma and Marin Counties, California," including Cotati, Petaluma and Petaluma River 7-1/2-minute quadrangles. Three map sheets.

18 "Flood-prone areas in the Russian River Drainage Basin, Sonoma County, California," including Sebastopol, Santa Rosa and Two Rock 7-1/2-minute quadrangles. Three map sheets.

19 "Flood-prone areas between Point Reyes Station and Bolinas, Marin County, California," including Inverness and Bolinas 7-1/2-minute quadrangles. Two map sheets.

20 "Flood-prone areas of Coastal San Mateo County, California," including Half Moon Bay, San Gregorio, La Honda, Pigeon Point, and Franklin Point 7-1/2-minute quadrangles. Five map sheets.

21 "Municipal and Industrial Wastewater Loading in the San Francisco Bay, California," 1970, by W. G. Hines and R. H. Palmer, 1971 (Miscellaneous Field Studies Map MF-332). One sheet.

This report describes the approximate volumes and significant pollutional loads of wastewater discharged into the bay from municipal and industrial sources. Wastewater flow, BOD (biochemical oxygen demand), total nitrogen, total phosphate, and relative toxicity loads are indicated for 6 major subdivisions of the bay, and identified as to source, either industrial or municipal. The pollutional significance of these factors is discussed in the brief text.

BASIC DATA CONTRIBUTIONS (continued)

22 "Drift of Surface and Near-bottom Waters of the San Francisco Bay System: March 1970 through April 1971," by T. J. Conomos, D. S. McCulloch, D. H. Peterson, and P. R. Carlson, 1971 (Miscellaneous Field Studies Map MF-333). Two map sheets, with 8 figures at 1:625,000 scale.

The seasonal variation in bottom flow of bay waters is documented through the movement of bottom-drifters for two-month intervals throughout a year's time. In addition, surface-drifters are charted for the last two time intervals. The text includes a summary and discussion of the movement patterns, and tables on the speed of movement of near-bottom waters.

23 "Aeromagnetic Map of the southern San Francisco Bay Region, California," 1971 (open-file map). One map sheet, scale 1:125,000.

Local changes in the total intensity of the earth's magnetic field are shown by contours for a 28 X 35-mile area including the San Francisco Peninsula, the East Bay communities, and most of central and south San Francisco Bay. The data are from continuous flight recording at 1,000 feet above ground.

24 "Water Temperatures of California Streams, San Francisco Bay Subregion," by J. C. Blodgett, 1971 (open-file map). 53 pages.

The monthly maximum, minimum, and mean stream temperatures are given for each of 87 temperature stations. The report covers the drainage area of San Francisco Bay, plus coastal drainage from Russian River to Pescadero Creek. The data were collected over various periods from 1950 to 1969.

25 "Precipitation Depth-Duration-Frequency Relations for the San Francisco Bay Region, California," by S. E. Rantz, 1971 (open-file report), 5 pages, and "Isohyetal Map of San Francisco Bay Region, California, Showing Mean Annual Precipitation," (open-file map). One map sheet, scale is 1:500,000.

The report describes a procedure for quantitatively relating the intensity and duration of a storm and its probable frequency of recurrence to mean annual rainfall. The isohyetal map shows the variation in average precipitation across the nine-county Bay Region, using 2 and 4-inch contours. Values range from 12 inches per year near Sunnyvale to 80 inches per year in Sonoma and Napa counties.

26 "Bedrock-Surface Map of the San Francisco North quadrangle, California," by Julius Schlocker, 1961, and "Bedrock-Surface Map of the San Francisco South quadrangle, California," by M. G. Bonilla, 1964 (Miscellaneous Field Studies Map MF-334). One map sheet, both maps at 1:31,680 scale.

These maps show the elevation of the upper surface of bedrock by contour lines, and the depth to bedrock in boreholes for an area from Tiburon to San Bruno. The thickness of unconsolidated sediment at a given location can be obtained from the difference between bedrock elevation and topographic elevation at that point.

27 "Geologic Map of Late Cenozoic Deposits, Santa Clara County, California," by E. J. Helley and E. E. Brabb, 1971 (Miscellaneous Field Studies Map MF-335). Three map sheets, scale is 1:62,500.

The map shows the distribution of older bay mud, three generations of alluvial fan deposits, and some young volcanic rocks, all in Santa Clara County. The brief text gives the general characteristics, generalized physical properties, and relative ages of the units, and indicates possible uses of the map.

28 "Preliminary Geologic Map of the Mount Diablo-Byron area, Contra Costa, Alameda, and San Joaquin Counties, California," by Earl E. Brabb, Howard S. Sonneman, and John R. Switzer, Jr., 1971 (open-file map). Two sheets. Scale is 1:62,500.

The location of geologic units and structures is shown for a 27 X 17-mile area between Danville on the west and the Old and Middle Rivers on the east, and south of Antioch.

29 "Preliminary Geologic Map of the San Francisco South quadrangle and part of the Hunters Point quadrangle, California," by M. G. Bonilla, 1971 (Miscellaneous Field Studies Map MF-311). Two map sheets, scale is 1:24,000.

The distribution of geologic units and structures is shown for an area from the Sunset District and Hunters Point sections of San Francisco in the north, to Pacifica and San Bruno in the south. The San Andreas fault zone and some landslides are documented, as well as the locations of tidal flats in the 1850's, areas of artificial fill, and many minor faults.

ASIC DATA CONTRIBUTIONS (continued)

30 "Active Faults and Preliminary Earthquake Epicenters (1969-1970) in the Southern Part of the San Francisco Bay Region," by R. D. Brown, Jr., and W.H.K. Lee, 1971 (Miscellaneous Field Studies Map MF-307). One map sheet plus 7 p. text. Scale of map is 1:250,000.

In addition to the location of known and suspected active faults, the approximate magnitude and epicenter location of earthquakes greater than magnitude 0.5 is shown for an area from the Golden Gate, Oakland, and Tracy in the north, to Salinas and Hollister in the south. The relationships between active faults, epicenter distribution and fault creep are discussed in the text, as well as the implication of these relationships.

31 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Mount Diablo area, Contra Costa and Alameda Counties, California," by Tor H. Nilsen, 1971 (Miscellaneous Field Studies Map MF-310). One map sheet, scale is 1:62,500.

The distribution of landslides, alluvium, colluvium, alluvial fan and dune deposits is shown for a 24 X 17-mile area surrounding Mount Diablo. The text describes some of the characteristics of the various deposits that are critical to land-use planning, and indicates particular uses of the map.

32 "Mean Annual Precipitation and Precipitation Depth-Duration-Frequency Data for the San Francisco Bay Region, California," by S. E. Rantz, 1971. (Open-File Report) . 23 pages, plus one map sheet at 1:500,000 scale.

This report presents rainfall data for the Bay Region in a form suitable for use in slope stability and storm-drainage studies. A table gives storm durations, and their frequencies of recurrence. These data are applicable to any site in the region where average annual rainfall is known. A map of average rainfall in the greater Bay Region, and depth-frequency curves for a particular rainfall value are also included.

33 "Map Showing Locations of Samples Dated by Radiocarbon Methods in the San Francisco Bay Region," compiled by Robert H. Wright, 1971. (Miscellaneous Field Studies Map MF-317). One map sheet, scale is 1:500,000.

Forty-six sites with a total of 76 separate radiocarbon dates are shown and briefly described. The data will be useful in studies of sea-level fluctuations, land subsidence, climate changes, sedimentation rates, archaeology, and fault movement.

34 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of Parts of the Altamont and Carbona 15-minute quadrangles, Alameda County, California," by Tor H. Nilsen, 1972 (Miscellaneous Field Studies Map MF-321). One map sheet, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium, and alluvial fan and terrace deposits for a 17 X 11-mile area to the east and southeast of Livermore Valley. The text describes some of the characteristics of the various deposits that are critical to land-use planning, and indicates particular uses of the map.

35 "Preliminary Photointerpretation Map of Landslide and other Surficial Deposits of Parts of the Pittsburg and Rio Vista 15-minute quadrangles, Contra Costa and Solano Counties, California," by J. D. Sims and T. H. Nilsen, 1972 (Miscellaneous Field Studies Map MF-322). Two map sheets, scale is 1:62,500.

The map shows the distribution of marshland and slough deposits, landslides, alluvium, artificial fill, colluvium, and dune and terrace deposits for a 22 X 17-mile area surrounding the towns of Pittsburg and Rio Vista, and adjacent to the San Joaquin-Sacramento River Delta. The text describes some of the characteristics of the various deposits that are critical to land-use planning, and indicates particular uses of the map.

36 "Distribution of Lead and Copper in Surface Sediments in San Francisco Bay Estuary, California," by D. H. Peterson, D. S. McCulloch, T. J. Conomos, and P. R. Carlson, 1972 (Miscellaneous Field Studies Map MF-323). One map sheet, with 2 map figures at 1:800,000 scale.

Sample locations and lead and copper concentrations in parts per million are shown for more than 200 samples of bottom sediments in the bay and its tributaries. The concentrations of 30 elements in deep cores and shallow samples are compared to show the relative contamination due to man's activities. Lead, copper, and mercury are shown to have significantly higher concentrations in the shallow samples. The text also discusses the plausibility of man's activities contributing to the observed lead and copper levels.

BASIC DATA CONTRIBUTIONS (continued)

37 "Maps Showing Distribution and Cost by Counties of Structurally Damaging Landslides in the San Francisco Bay Region, California, Winter of 1968-1969", by Fred A. Taylor and Earl E. Brabb, 1972 (Miscellaneous Field Studies Map MF-327). One map sheet, with maps at 1:1,000,000 and 1:500,000 scale.

One of the maps shows the general location of landslides that damaged man-made structures during the winter of 1968-1969. The report and the second map itemize the cost by county of the landslides, and indicate the public (state highways, county costs, tax loss), private (property depreciation, damage and repair), and miscellaneous expenses. Factors contributing to landslide costs and the availability of cost information are discussed in the text. Documented costs were over $25 million in the Bay Region for the one winter season.

38 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Byron Area, Contra Costa and Alameda Counties, California," by Tor H. Nilsen, 1972 (Miscellaneous Field Studies Map MF-338). One map sheet, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium, marshland, dune, and terrace deposits for a 10 x 17-mile area around Byron. The text describes some of the characteristics of the deposits that are critical to land-use planning, and indicates particular uses of the map.

39 "Preliminary Geologic Map of the Franciscan Rocks in the Central Part of the Diablo Range, Santa Clara and Alameda Counties, California," by William R. Cotton, 1972 (Miscellaneous Field Studies Map MF-343). Two map sheets, scale is 1:62,500.

This map shows the distribution of the various rock types that comprise the Franciscan assemblage, including large units of sandstone, as well as the highly sheared "melange." Numerous large landslides are also shown. The map covers the parts of Santa Clara and Alameda Counties that are south of Livermore Valley and east of the Calaveras and Madrone Springs faults.

40 "Preliminary Photointerpretation Map of Landslide and other Surficial Deposits of the Mount Hamilton quadrangle and parts of the Mount Boardman and San Jose quadrangles, Alameda and Santa Clara Counties, California," by Tor H. Nilsen, 1972. (Miscellaneous Field Studies Map MF-339). Two map sheets, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium, marshland, and terrace deposits for a 28 x 17-mile area from Fremont and San Juan Bautista on the west to the county boundaries on the east. The text describes some of the characteristics of the deposits that are critical to land-use planning, and indicates particular uses of the map.

41 "Preliminary Geologic Map of San Mateo County, California," compiled by E. E. Brabb and E. H. Pampeyan and "Description of Geologic Units, San Mateo County, California," compiled by S. Ellen, C. M. Wentworth, E. E. Brabb and E. H. Pampeyan (Miscellaneous Field Studies Map MF-328), 1972. One map sheet plus 10-page text; scale is 1:62,500.

The map shows the distribution of geologic units in San Mateo County, and geologic structures, including major faults. The text provides a basic description of the rock units in technical terminology.

42 "Preliminary Map of Landslide Deposits in San Mateo County, California," by E. E. Brabb and E. H. Pampeyan, 1972 (Miscellaneous Field Studies Map MF-344). One map sheet, scale is 1:62,500.

The distribution of landslide deposits in San Mateo County is shown on the map. The text describes how the information was obtained, explains the many factors affecting the accuracy of the map, and provides some suggestions for those who use the map.

43 "Landslide Susceptibility in San Mateo County, California," by E. E. Brabb, E. H. Pampeyan and M. G. Bonilla, 1972 (Miscellaneous Field Studies Map MF-360). One map sheet, scale is 1:62,500.

The relative landslide susceptibility of all areas within San Mateo County is indicated by seven ranked units ranging from slopes less than 15 percent with very small landslides to slopes greater than 30 percent with many large and small landslides. Existing landslide areas are indicated as most susceptible to future landsliding. The text explains how the map was prepared and indicates appropriate use of the map. Percent landslide failure is calculated for the various geologic units in San Mateo County, and the data is presented in a table, with breakdown by slope interval.

DATA CONTRIBUTIONS (continued)

44 "Active Faults, Probable Active Faults, and Associated Fracture Zones, San Mateo County, California," compiled by Robert D. Brown, Jr., 1972, (Miscellaneous Field Studies Map MF-355). One map sheet, scale is 1:62,500.
The active faults and fault zones in San Mateo County are delineated on the map. The explanation includes statements on possible movement as well as general guidelines for land-use planning and construction near a fault. In addition to previously documented faults, the Serra fault is indicated as probably active.

45 "Preliminary Photointerpretation and Damage Maps of Landslides and Other Surficial Deposits in Northeastern San Jose, Santa Clara County, California," by T. H. Nilsen and E. E. Brabb, 1972 (Miscellaneous Field Studies Map MF-361). One map sheet, with map scales of 1:24,000 and 1:10,000.

This is a detailed study of landslides in a small area of the San Jose foothills, an example of what has happened and can occur in other parts of the Bay Region. A detailed map shows the distribution of landslide damage in the area. Cost figures are given for loss in valuation and remedial measures taken by the city and the utility companies, with total costs of more than $1,275,000. A second map shows the distribution of landslide deposits in the surrounding area. The text is similar to that of other photointerpretive landslide maps (e.g., #40).

46 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of Parts of the Los Gatos, Morgan Hill, Gilroy Hot Springs, Pacheco Pass, Quien Sabe, and Hollister 15-minute quadrangles, Santa Clara County, California," by Tor H. Nilsen, 1972 (Miscellaneous Field Studies Map MF-416). Two map sheets, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium and terrace deposits for southeastern Santa Clara County. The map covers an area from Coyote and Gilroy on the west to the county boundaries on the east and southeast. The text describes some of the characteristics of the deposits that are critical to land-use planning, and indicates particular uses of the map.

47 "A Summary View of Water Supply and Demand in the San Francisco Bay Region, California," by S. E. Rantz, 1972, 41 pages (open-file report).

This report provides data on existing and potential water supply from various sources for 15 subregions of the 9-county Bay Area. It also gives statistics on the principal uses of water in each subregion. A discussion of future supplementation of the water supply deals with projects under consideration or in progress, as well as less conventional approaches such as desalinization and weather modification.

48 "Geologic Map of Late Cenozoic Deposits, Alameda County, California," by E. J. Helley, K. R. Lajoie and D. B. Burke, 1972 (Miscellaneous Field Studies Map MF-429). One map sheet, scale is 1:62,500.

The map shows the distribution of older bay mud, two generations of alluvial fan systems, and beach sand, all in Alameda County. The brief text gives the general characteristics, generalized physical properties and relative ages of the units, and indicates possible uses of the map.

49 "Solid Waste Disposal in the San Francisco Bay Region," by Joseph Goss, 1972 (Miscellaneous Field Studies Map MF-430). 10-page text plus map sheet at 1:500,000 scale.

The report describes the various methods of solid-waste disposal that are used in the United States, as well as future trends in solid-waste disposal. It delineates some basic requirements for selection and management of landfill disposal sites, and describes the possible effects of a landfill operation on water quality. The map gives the locations and descriptions of 170 existing and proposed solid-waste disposal sites in the San Francisco Bay Region.

50 "Map Showing Ranges in Probable Maximum Well Yield from Water-Bearing Rocks in the San Francisco Bay Region, California," by D. A. Webster, 1972 (Miscellaneous Field Studies Map MF-431). One map sheet, scale is 1:250,000.

This map is designed to provide general information on local supplies of ground water for purposes of water-supply management and planning. The map delineates four ranges of probable well-yield for areas within the 9-county Bay Region. The lowest category of 0.1 to 10 gpm (gallons per minute) would be "marginal to adequate for stock or single family domestic use," whereas the highest range of 100 to 3,000 gpm is "marginal to adequate for irrigation, heavy industry, and municipal uses."

BASIC DATA CONTRIBUTIONS (continued)

51 "Map Showing Areas in the San Francisco Bay Region where Nitrate, Boron and Dissolved Solids in Ground Water may Influence Local or Regional Development," by D. A. Webster, 1972 (Miscellaneous Field Studies Map MF-432). Three map sheets plus 8-page text. Scale is 1:125,000.

The maps provide a general inventory of ground-water mineral content in the 9-county Bay Region. They indicate areas where the amounts of selected critical substances in ground water have exceeded accepted standards at some time in the past. The accompanying text describes the terms used and discusses the significance of the various water-quality factors.

52 "Maps Showing Areas of Potential Inundation by Tsunamis in the San Francisco Bay Region, California," by J. R. Ritter and W. R. Dupre, 1972 (Miscellaneous Field Studies Map MF-480). Two map sheets, scale is 1:125,000.

The maps delineate areas of the San Francisco Bay and the ocean coastline that would be affected by a tsunami (seismic sea wave) that reaches an elevation of 20 feet on the coast. The text discusses the likelihood of occurrence of a tsunami of this size, and gives some tsunami precautions.

53 "Sources of Emergency Water Supplies in Napa Valley, California," by D. A. Webster, 1972 (Miscellaneous Field Studies Map MF-453). One map sheet, scale is 1:125,000.

This report demonstrates an approach to the documentation and evaluation of sources of water that could be available if normal water-supply systems are disrupted by earthquakes, nuclear explosions, floods or acts of civil disorder. The report presents general criteria for emergency water sources, and data for appropriate wells in Napa Valley. The location of emergency water-supply wells in Napa Valley is shown on the map at 1:125,000-scale (one inch = two miles).

54 "Preliminary Geologic Map of Solano County and parts of Napa, Contra Costa, Marin and Yolo Counties, California," compiled by J. D. Sims, K. F. Fox, Jr., J. A. Bartow, and E. J. Helley, 1973 (Miscellaneous Field Studies Map MF-484). Five map sheets, scale is 1:62,500.

The distribution of geologic units and structures is shown for an irregular area from Lake Berryessa, Esparto and Davis in the north and northeast, to Petaluma Point in the southwest and Rio Vista in the southeast. Known active faults are distinguished from other faults, many landslides are shown, and younger deposits are subdivided into sand dunes older fan deposits, younger alluvial fans, terrace deposits, older alluvium, and Bay mud.

55 "Map Showing Recent Tectonic Movement on the Concord fault, Contra Costa and Solano Counties, California," by Robert V. Sharp, 1973 (Miscellaneous Field Studies Map MF-505). One map sheet, scale is 1:24,000.

This map shows the location and characteristics of the Concord fault, which was recently recognized to be active. The fault extends from Ygnacio Valley in the south, through parts of Concord and Avon, and across western Suisun Bay. The text describes the fault segments and the evidence of recent activity. Progressive amounts of offset are shown for streets of varying ages. Much of the movement may be associated with a 1955 earthquake.

56 "Preliminary Geologic Map of Eastern Sonoma County and Western Napa County, California," by K. F. Fox, Jr., J. D. Sims, J. A. Bartow and E. J. Helley, 1973 (Miscellaneous Field Studies Map MF-483). Four map sheets, scale is 1:62,500.

The distribution of geologic units and structures is shown for an area in easternmost Sonoma County and westernmost Napa County and including presently urbanizing areas near Napa and near Santa Rosa; the map extends from the latitude of Napa northward to Clear Lake. Known active faults are distinguished from other faults, many landslides are shown, and younger deposits are subdivided into about 10 categories with different economic and engineering significance.

57 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Concord 15-minute Quadrangle and the Oakland West, Richmond, and Part of the San Quentin 7-1/2-minute Quadrangles, Contra Costa and Alameda Counties, California," by Tor H. Nilsen, 1973 (Miscellaneous Field Studies Map MF-493). Two map sheets, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium and marshland and terrace deposits for westernmost Contra Costa County and the northeasternmost part of Alameda County. The map covers an area from Concord-Walnut Creek and San Ramon Village on the east, to San Francisco Bay on the west. The text describes some of the characteristics of the deposits that are critical to land-use planning and indicates appropriate uses of the map.

DATA CONTRIBUTIONS (continued)

58 "Faults and Earthquakes in the Monterey Bay Region, California," by H. G. Greene, W.H.K. Lee, D. S. McCulloch, and E. E. Brabb, 1973 (Miscellaneous Field Studies Map MF-518). Four map sheets, plus text; scale is 1:200,000.

The maps delineate faults and show earthquake epicenters in the Monterey Bay region. Emphasis is placed upon two seismically active fault zones present there: the Palo Colorado-San Gregorio and the Monterey Bay Fault Zones. The text describes these fault zones and discusses the seismicity in the area and the evidence for recent faulting. Estimates are made of how large an earthquake could occur on the Palo Colorado-San Gregorio Fault.

59 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Livermore and Part of the Hayward 15-minute Quadrangles, Alameda and Contra Costa Counties, California," by Tor Nilsen, 1973 (Miscellaneous Field Studies Map MF-519). Two sheets, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium, marshland, and terrace deposits for the southwestern portion of Alameda County. The map covers the area from Livermore on the east to Hayward on the west and from the Oakland area on the north to Piedmont on the south. The text describes the map, states the characteristics of surficial deposits relevant to land-use planning, and gives suggestions for map use.

60 "Map Showing Evidence for Recent Fault Activity in the Vicinity of Antioch, Contra Costa County, California," by D. B. Burke and E. J. Helley, 1973. (Miscellaneous Field Studies Map MF-533). One sheet, scale is 1:24,000.

The map shows localities where evidence exists that indicate the presence of historic tectonic movement on a previously unrecognized fault in the vicinity of Antioch in northeastern Contra Costa County. A short text on the map sheet discusses this evidence and its relation to the seismicity in the area.

61 "Map Showing Areas Bordering the Southern Part of San Francisco Bay Where a High Water Table May Adversely Affect Land Use," by D. A. Webster, 1973 (Miscellaneous Field Studies Map MF-530)

The map presents information about the depth to the top of the water table, outlines problems that may develop when the water table approaches the land surface, and identifies areas where ground water may cause problems to landowners.

62 "San Francisco Bay Region Land Use Maps: Two samples," by U.S. Geological Survey, 1974 (open-file map). Two map sheets, scale is 1:62,500.

Two maps from a set of 44 that show 1970 land use and census tracts in the San Francisco Bay Region. Fourteen land-use types are subdivided under the three major groupings of livelihood, residential, and open space and agricultural.

63 "Isopleth Map of Landslide Deposits, Southern San Francisco Bay Region, California," by Robert H. Wright and Tor H. Nilsen, 1974 (Miscellaneous Field Studies Map MF-550). 1 map sheet, scale is 1:125,000.

Essentially a contour map of the distribution of landslides, the map was produced to be used with other quantified map data, and it is one of the sources of information used in the preparation of slope stability maps. A short explanation on the map sheet describes how the map was produced. The mapped area includes the area in Alameda, San Mateo and Santa Clara Counties, and the southern portions of Contra Costa and Marin Counties.

64 "Preliminary Geologic Map of Marin, and San Francisco Counties and Parts of Alameda, Contra Costa and Sonoma Counties, California," by M. C. Blake, Jr., J. A. Bartow, V. A. Frizzell, Jr., J. Schlocker, D. Sorg, C. M. Wentworth and R. H. Wright, 1974 (Miscellaneous Field Studies Map MF-574). Two map sheets, scale is 1:62,500.

The map shows the distribution of geologic units and structures within and immediately surrounding Marin County. In addition to showing bedrock units, fourteen different types of younger deposits are delineated including, among others, beach and dune sands, marine and marsh deposits, larger areas of landslide deposits, and artificial fill.

65 "Map Showing the Distribution of Potassium Feldspar and Fossils in Mesozoic Rocks of Marin and San Francisco Counties, and Parts of Alameda, Contra Costa, and Sonoma Counties, California," by Robert H. Wright, 1974 (Miscellaneous Field Studies Map MF-573). One map sheet, scale is 1:125,000.

Title is descriptive of content of map. Data from this map was used in the preparation of Basic Data Contribution 64.

BASIC DATA CONTRIBUTIONS (continued)

66 "Reconnaissance Photointerpretation Map of Landslides in Parts of the Hopland, Kelseyville, and Lower Lake 15-minute Quadrangles, Sonoma County, California," by Virgil A. Frizzell, Jr., 1974 (Miscellaneous Field Studies Map MF-594). One map sheet, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, and terrace deposits for the northern most portion of Sonoma County including the Cloverdale and The Geysers areas. The text describes the map, states the characteristics of mapped deposits and gives suggestions for map use.

67 "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Mare Island and Carquinez Strait 15-minute Quadrangles, Contra Costa, Marin, Napa, Solano, and Sonoma Counties, California," by Virgil A. Frizzell, Jr., John D. Sims, Tor H. Nilsen, and John A. Bartow, 1974 (Miscellaneous Field Studies Map MF-595). Two map sheets, scale is 1:62,500.

The map shows the distribution of landslides, alluvium, colluvium, marsh deposits and artificial fill for the area between Fairfield to Sears Point on the north and Point Pinole to Concord on the south. The text describes some of the characteristics of the deposits that are critical to land-use planning and indicates appropriate uses of the map.

68 "Geologic Map of Unconsolidated and Moderately Consolidated Deposits of San Mateo County, California," by K. R. Lajoie, E. J. Helley, D. R. Nichols, and D. B. Burke, 1974 (Miscellaneous Field Studies Map MF- 575). Explanation sheet plus map sheet, scale is 1:62,500.

The map shows the distribution of unconsolidated deposits in San Mateo County. Mapped deposits include, among others, colluvium, alluvium, young mud, beach and dune sands, marine terrace deposits, the Colma formation, and the Merced formation. An extensive tabular explanation provides information about these young deposits that will be useful to property owners, planners, or engineers. In addition, the explanation sheet contains a summary of the depositional history of the units.

69 "Mean Annual Runoff in the San Francisco Bay Region California, 1931-70," by S. E. Rantz, 1974 (Miscellaneous Field Studies Map MF-613). 24 page pamphlet and two maps. Scale is 1:500,000.

The runoff described on this map represents natural flow derived using data from 76 gaging stations which are on virtually undeveloped streams. The report is a byproduct from a series of reports by Rantz concerning annual precipitation, precipitation depth-duration-frequency relations, and hydrologic design of storm-drainage facilities, and it can be used by engineers and planners in preliminary planning of drainage and flood control facilities.

70 "Limnological Data from Selected Lakes in the San Francisco Bay Region, California," by Linda J. Britton, Rodger F. Ferreira, and Robert C. Averett, 1974 (open-file report). 79 pages.

This is a compilation of data from 21 selected lakes in the San Francisco Bay area. The history of each lake and of its respective regulating agency is presented. Although the type of data presented for each lake differs, physical features, chemical analysis, dissolved oxygen, temperatures, pH, and comparisons of phytoplankton concentrations are presented for many lakes.

APPENDIX B

Technical Reports

TR No. 1 "A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary," (Circular 637-A,B), by D. S. McCulloch, D. H. Peterson, P. R. Carlson and T. J. Conomos, 1970, 35 p.

The report qualitatively demonstrates that high and low seasonal inflows of fresh water to the Sacramento-San Joaquin Delta correlate inversely with salinity and phosphate concentrations in the south bay. It suggests that net fresh-water flow to the bay from this source is a major quality control factor under present conditions.

2 "Land Subsidence in the Santa Clara Valley, Alameda, San Mateo, and Santa Clara Counties, California," by J. F. Poland, 1971 (Miscellaneous Field Studies Map MF-336). One sheet, map scale is 1:125,000.

This report documents the extensive subsidence affecting 250 square miles in the Santa Clara Valley since 1912, and demonstrates that it is caused mainly by clay compaction due to ground-water withdrawal. Procedures are given for determining the ultimate subsidence where the compressibility of the sediments is known, and prediction is made as to the ground-water level necessary to halt subsidence in the valley. About $13 million has been spent by public agencies for levee construction and repair of water well casings that was made necessary by subsidence.

3 "Suggested Criteria for Hydrologic Design of Storm-Drainage Faciilities in the San Francisco Bay Region, California," by S. E. Rantz, 1971, 69 p. (open-file report).

The term "hydrologic design", as used in this report, refers to the computation of design storm discharges, and not to the hydraulic design of the drainage facilities. The report presents criteria for use of the four most widely accepted methods of hydrologic design. Sample problems are worked out for each method, and results are evaluated. The report also discusses the characteristics of urban development that affect storm runoff, and suggests ways to reduce peak discharge in urban areas.

4 "Real-Estate Lakes," by David A. Rickert and Andrew M. Spieker, 1971 (Circular 601-G), 19 p.

This booklet deals with the planning and management of real-estate lakes, and discusses the various factors contributing to pollution, sedimentation, and use problems. Many suggestions are given for avoiding and/or minimizing the undesirable aspects of urban lakes.

5 "A Review of Benthic Faunal Surveys in San Francisco Bay," by Frederic Nichols, 1973 (Circular 677), 20 pages.

This report provides an overview of the various studies done on bottom-dwelling animal life in the Bay, and the general results of the studies. There is also a discussion of past and current study techniques, their general effectiveness and shortcomings. A concluding section delineates directions future research could take in assessing the relative "health" of benthic communities and the effects of man-induced pollution. The report suggests that a joint effort be undertaken by all agencies concerned, using standardized methods.

6. "Effects of Urbanization on Sedimentation and Flood-flows in Colma Creek Basin, California," by J. M. Knott, 1973 (open-file report), 54 pages.

This report deals with the effects of various land uses on stream flow, erosion, and sediment transport in the Colma Creek basin. The area includes Daly City and South San Francisco, and is bounded on the north by San Bruno Mountain. The report documents the sediment transport (and associated erosion rates) through a time of extensive urban expansion (1964-1971), and provides a comparison of erosion rates for areas in urban, agricultural, construction, and open-space land uses. The author uses the data to project future sediment yields for the area, depending on eventual land use.

APPENDIX C

Interpretive Reports

IR No. 1 "Role of Water in Urban Planning and Management," by William J. Schneider, David A. Rickert and Andrew M. Spieker, 1973 (Circular 601-H), 10 p.

The report deals with the application and use of hydrologic factors in land-use planning, and outlines a method for evaluating and ranking the types of water information that should be applied to a particular planning need. The advantages of dealing with water resources planning at a regional level are also discussed. The Washington, D.C.-Baltimore area is used as a case study, but the underlying principles and methods are equally applicable to the Bay Region.

2 "A Review of Wastewater Problems and Wastewater-Management Planning in the San Francisco Bay Region, California," by W. G. Hines, 1973 (open-file report), 45 pages plus Appendices A, B, and C.

The report describes the characteristics of the major pollutional types found in wastewater in the San Francisco Bay Region. The geographical distribution and pollutional loading of wastewater discharges into the Bay are described. The report includes a documentation of water-quality problems attributed to wastewater discharges and a discussion on the planning implications of the wastewater effects on the quality of regional surface water. Future outlook for management of wastewater in the San Francisco Bay region is also discussed.

3 "Erosional and Depositional Provinces and Sediment Transport in the South and Central Part of the San Francisco Bay Region, California," by Bill Brown and Lionel Jackson , 1973 (Miscellaneous Field Studies map MF-515). Three sheets plus a pamphlet text, scale is 1:125,000.

This report deals with the interrelated processes involved in the erosion, transportation, and deposition of sediment in the South and Central part of the San Francisco Bay region. It presents both quantitative and conceptual information on these processes and their relation to man's activities.

4 "Flood Prone Areas in the San Francisco Bay Region, California," by J. T. Limerinos, K. W. Lee, and P. E. Lugo, 1973, (Water Resources Investigation 37-73). Three map sheets; scale is 1:125,000.

The map shows the areas in the San Francisco Bay region that may be inundated by a 100-year flood. A short text discusses the concepts of the 100-year flood and explains the compilation methods involved in the production of the map.

5 "Availability of Data on Surface-Water Quantity and Quality for the San Francisco Bay Region, California," by Joseph Goss, 1973, (Miscellaneous Field Studies Map MF-526). Nine page text, tables, and map with scale of 1:250,000.

The report gives an overview of important aspects of the surface-water resources in the bay region; discusses water-quality criteria and improtant pollutants in relation to the water quality recommended for beneficial uses; outlines water-quality objectives recommended by the California Water Quality Control Board for streams, other water bodies, and drainage basins; and gives examples of the kinds of problems that require decisions by planners and government officials.

6 "Evaluating Pollution Potential of Land-Based Waste Disposal, Santa Clara County, California," by W. G. Hines, 1973, (Water Resources Investigation 31-73). Twenty-one page text and two map sheets, scale is 1:62,500.

The report is intended to aquaint planners and other decision makers with the usefulness of earth-science data when analyzing pollution and waste-disposal problems in relation to land-use planning. In the report the author emphasizes the following topics: 1) an identification and description of factors that interact to form pollution hazards; 2) a presentation of selected examples of, and possible control measures for, pollution hazards typically encountered in the bay region environment; and 3) criteria and methodology needed for the preliminary evaluation of the suitability of land areas intended for waste-disposal sites.

INTERPRETIVE REPORTS (continued)

7. "Sediment Source and Deposition Sites and Erosional and Depositional Provinces, Marin and Sonoma Counties, California," by William M. Brown III and Lionel E. Jackson, Jr., 1974 (Miscellaneous Field Studies Map MF-625). 31-page text and two map sheets; scale is 1:125,000.

   The report is concerned with the erosion, transportation, and deposition of sediment as a process that alters the land surface. It explains what sediment is, where it comes from, and where it goes. The report describes how and why sediment moves from one point to another and defines erosional and depositional provinces. For areas where data are available, it describes rates and quantities of sediment movement.

8. "An Introduction to the Processes, Problems, and Management of Urban Lakes," by L. J. Britton, R. C. Averett, and R. F. Ferreira, 1975 (Circular 601-K) 22 pages.

   This report describes the properties and processes of lakes which govern lake enrichment, and describes possible control measures available to curtail this enrichment. A discussion of lake-basin planning, watershed and lake management, and water-quality control is included as recommended guidelines for managing lakes to insure the highest possible quality of water. A summary of the types and frequency of measurements and sampling equipment and techniques useful in lake reconnaissance studies is also provided.

APPENDIX D

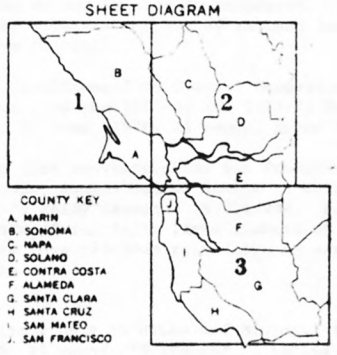
Photography and Topography Products

Topographic Map of the San Francisco Bay Region in 3 sheets, scale is 1:125,000 (2 miles = approx. 1 inch), contour interval is 200 feet with 40-foot intervals in flat land.

Topography, roads, and waterways form the basis of this full-color map of the greater Bay Region. The scale of this map is such that the three sheets will display the entire 10-county San Francisco Bay Region on a wall, and yet every street in the urban areas is clearly visible, allowing points to be located within a city block. Public parks, forests, and reserves, as well as airports, military bases, and cemeteries are distinguished with subtle tints, and marshes, tidal flat areas, and salt evaporators are shown by standard symbols. The sheets measure 35 to 42 inches on a side, covering the areas shown below.

Slope Map of the San Francisco Bay Region in 3 sheets, scale is 1:125,000.

The steepness of the terrain throughout the greater Bay Region is designated on the map by six color-coded slope zones: 0-5%, 5-15%, 15-30%, 30-50%, 50-70% slope, and 70% slope to vertical (a slope of 45 degrees is defined as 100% slope). The map covers the same 10-county area, in the same three-sheet format as the Topographic Map (see diagram below). The printed slope map can be obtained in the same way as the topographic map.



Slope maps for smaller areas within the Bay Region at scales of 1:62,500 or 1:24,000 can be individually made on special request to the Topographic Division in Menlo Park.

Orthophoto Quads covering areas equivalent to the 196 7-1/2 minute topographic quadrangles of the area shown above, at a scale of 1:24,000. On photographic paper $6.50 each and $8.00 with contours; on scale-stable film $20.00 each,

Orthophoto Mosaic of the San Francisco Bay Region in three sheets (see diagram above) covering approximately 3,000 sq. mi. each, at a scale of 1:125,000. On photo paper $16.00/sheet; on scale-stable film $23.00/sheet.

APPENDIX E

Other SFBRS Products

Professional Paper 941-A, "Studies for Seismic Zonation of the San Francisco Bay Region, California." edited by R. D. Borcherdt, 1975, 102 pages, price $2.80.

Professional Paper 941-A outlines the geologic and technical basis for seismic zoning. Using the San Francisco Bay Region as an example, it identifies different kinds of earthquake hazards and compares their relative importance. The subjects examined in the report include: magnitude of future earthquakes, fault displacement at the ground surface, bedrock motion at the ground surface, response of local geologic units to ground shaking, liquefaction potential, and landslides caused by earthquakes. The data and methods of analysis contained in this report will be of particular help to cities and counties of the Bay Region preparing or updating their seismic safety and public safety elements.

Professional Paper 942, "Flood-Prone Areas and Land-Use Planning in the San Francisco Bay Region, California," by A. O. Waananen, J. T. Limerinos, W. J. Kockelman, U.S. Geological Survey, and W. E. Spangle and M. L. Blair, William Spangle & Associates, City and Regional Planners, 1977, 75 pages, price $2.20.

Professional Paper 942 explains basic flood-hydrology concepts, describes the preparation and use of various types of flood maps and flood-information reports, lists sources of information on flooding and flood plains, discusses flood-loss prevention and reduction measures, and discusses the role of comprehensive planning in flood-plain management. The report demonstrates the interaction of Federal and local agencies in flood-plain management by a case study involving Napa County, California.

Bulletin 1388, "Influence of Rainfall and Ancient Landslide Deposits on Recent Landslides, Contra Costa County, California," by Tor H. Nilsen and Barbara Turner, 1975, 18 p., 2 plates, 5 figures, 2 tables. Price $1.90.

Mapping of landslides in Contra Costa County indicates that most damaging landslides occur in areas where ancient landslides are abundant and after periods of intense rainfall, particularly when the ground is already saturated. These studies suggest that landslides could be predicted by accurate mapping of ancient landslide deposits and by maintaining records of cumulative rainfall.

Bulletin 1424, "Natural Conditions That Control Landsliding in the San Francisco Bay Region--An Analysis Based on Data from the 1968-69 and 1972-73 Rainy Seasons," by T. H. Nilsen, F. A. Taylor, and R. M. Dean, 1976, 35 pages, price $1.95.

In the nine counties that constitute the San Francisco Bay Region, 335 landslides reported during the 1968-69 rainy season caused damage to manmade structures amounting to $25,180,956; 411 during the 1972-73 rainy season - $9,716,284. Landslide activity was found to be directly related to the pattern of rainfall; large numbers of landslides are triggered during storm periods in which more than 150-20mm rain falls in areas where 250-380mm has already fallen during a rainy season.

Circular 712, "Earth-Science Data in Urban and Regional Information Systems--A Review," by Victor W. Adams, 1975, 29 pages, 19 figures, 3 tables. Available free from Western Region Representative, LIA, U.S. Geological Survey, Menlo Park, California 94025.

The report reviews the advantages and problems of using earth-science data in geographically based computer systems. Several existing systems are described.

Circular 721, "Earth-Science Information in Land-Use Planning--Guidelines for Earth Scientists and Planners," by William Spangle and Associates; F. Beach Leighton and Associates; and Baxter McDonald and Company, 1976, 28 pages, 12 figures, 4 tables. Available free from Western Region Representative, LIA, U.S. Geological Survey, Menlo Park, California 94025.

This report is intended to acquaint planners and earth scientists with the needs and problems each faces in working with the other. To identify and evaluate these problems, the authors examined earth-science applications in several urbanizing regions in different parts of the United States. Although the problems, methods, and political structures differ in each of these regions, many needs and problems appear to be general in nature and of fundamental importance to communication between planners and scientists. The report is a summary and is structured as a series of recommendations based on current methods and practices in those parts of the United States where earth-science information has been used successfully in planning.

Other SFBRS Products

Map 1-909, "Map Showing Mineral Resources of the San Francisco Bay Region, California," by Edgar H. Bailey and Deborah R. Harden, 1975. Price $1.00. The map is in color at a scale of 1:250,000 and is accompanied by a descriptive text.

The report and map indicate which mineral resources are found in the Bay Area and where these are located. The text examines future Bay Area resource needs in light of present uses and projected growth and suggests steps that may be taken to assure that identified resources will be available when needed. Problems related to the removal of many mineral resources are identified and described, and methods are suggested which can either minimize or avoid these problems.

Map MF-677, "Photointerpretative Maps of Landslides and Surficial Deposits of Northernmost Napa County California," by Robert H. Wright and George O. Reed, 1975. Map scale is 1:24,000 and accompanying text. Price 75¢.

Map MF-709, "Maps Showing Maximum Earthquake Intensity Predicted in the Southern San Francisco Bay Region, California, for Large Earthquakes on the San Andreas and Hayward Faults," by R. D. Borcherdt, J. F. Gibbs, and K. R. Lajoie, 1975, 3 sheets. Scale is 1:125,000 and text. Price $1.50.

Sheet 1, "Maximum Earthquake Intensity Predicted at Specific Sites";
Sheet 2, "Maximum Earthquake Intensity Predicted on a Regional Scale"; and
Sheet 3, "Generalized Geologic Map."

Three maps and a brief text demonstrate a method of predicting the maximum intensity of earthquake shaking in San Francisco and San Mateo Counties and parts of Marin, Alameda, Contra Costa, and Santa Cruz Counties.

Map MF-719, "Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Mount Vaca, Vacaville, and parts of Courtland, Davis, Lake Berryessa, and Woodland 15-minute quadrangles, Napa and Solano Counties, California," by J. D. Sims and V. A. Frizzell, Jr., 1976, scale 1:62,500. Price 75¢ (subject to supply on hand).

Map MF-743, "Map Showing Recently Active Breaks Along the Green Valley Fault, Napa and Solano Counties, California," by V. A. Frizzell, Jr., and R. D. Brown, Jr., 1976. Map scale is 1:24,000. Price 75¢.

The map and a short text locate and describe active segments of the Green Valley Fault between Wooden Valley and the Sacramento River at Concord. Evidence of past and current earthquake activity suggests that earthquakes of magnitude 6.75 are possible on this fault.

Map MF-796, "Contour Map and Interpretive Cross Sections Showing Depth and Configuration of Bedrock Surface, South San Francisco Bay Region, California," by R. M. Hazlewood, 1976, 2 sheets; sheet 1, map 1:62,500. Price $1.50.

Map MF-818, "Faults with Quaternary Displacement, Northwestern San Francisco Bay Region, California," by D. G. Herd and E. J. Helley, 1977. Map is scale 1:125,000. Price 75¢.

Map MF-881, "Faults with Quaternary Displacement, Northwestern San Francisco Bay Region, California," by E. J. Helley and D. G. Herd, 1977. Map is scale 1:125,000. Price 75¢.

These maps show faults with Quaternary displacement in the northern part of the San Francisco Bay region (sheets 1 and 2 of the San Francisco Bay region topographic map). Faults that have been historically active or that show evidence of movement during the last approximately 2 million years are represented and classified according to the age of their last surface displacement.

Map MF-891, "Map Showing Distribution of Granular Sediments Above, Within, and Beneath Holocene Estuarine Deposits, San Mateo County, California," by D. R. Nichols and N. A. Wright, 1977. Map is scale 1:62,500. Price 75¢.

This map is intended to provide a general indication of the possible presence of materials in the young bay muds which might liquify in an earthquake. It may be helpful in the land-use planning process and in the design of subsurface exploration programs; it should not be used as a substitute for site investigations or to predict areas of future liquefaction.

APPENDIX F

Regional Personnel Interviewed

Name	Title
ASSOCIATION OF BAY AREA GOVERNMENTS	
Vivian Brown	Senior Regional Planner
Joseph Eilers	Environmental Engineer
Karen Graser	Regional Planner
Charlene McIntyre	Regional Planner
Margerie Ng	Librarian and Information Specialist
Donald Omstead	Director of Services and Information
Jeanne Perkins	Regional Planner
Yvonne San Jule	Acting Director of Comprehensive Planning
Stephenie Wilson	Regional Planner I
Fred Wolin	Environmental Scientist
BAY CONSERVATION & DEVELOPMENT COMMISSION	
Stan Euston	Chief Planner
Gordon Oakeshott	Member, Engineering Criteria Review Board
George Reed	Senior Planner
Charles Roberts	Executive Director
L. Thomas Tobin	Senior Engineer
Kent Watson	Design Analyst
CALIFORNIA COASTAL COMMISSION	
Ruth Andreson	Regional Commissioner
William T. Davoren	Environmental Specialist, DOI Fish & Wildlife Service
Wendy Locksley	Regional Coordinator
Dave Loomis	Regional Coordinator
Joe Nicholson	Mapping Coordinator
Jack Schoop	Chief Planner
Madge Strong	Coastal Planner
L. Thomas Tobin	Senior Engineer
William Travis	Assistant Executive Director

APPENDIX F--continued

Regional Personnel Interviewed

Name	Title
CENTRAL COAST REGIONAL COMMISSION	
Edward Y. Brown	Executive Director
Les Strnad	Coastal Planner
METROPOLITAN TRANSPORTATION COMMISSION	
Paul Bay	Assistant Director
Christopher Brittle	Airport Planner
Kip Cady	Transportation Planner
Gerald Cox	Personnel Officer
Burt Crowell	Project Leader
Boris Dramov	Consultant, Wallace, McHarg, Roberts and Todd
Emilio Escudero	Assistant Manager, Land Use Project, Bart Impact Study
Dian Gillmar	Librarian
Donald Graff	Consultant, Gruen & Associates
Robert Harrison	Project Manager
John McCallum	Transportation Planner
Vince Petrites	Assistant Planner
Gordon Shunk	Director, Bart Impact Study
Gerry Steere	Environmental Review Officer
Peter Stromberg	Environmental Planner (former employee)
NORTH CENTRAL COAST REGIONAL COMMISSION	
Bob Brown	Executive Director
Kenneth A. Cristofani	Coastal Planner
Gary L. Holloway	Coastal Planner
Laurel Reiterman	Coastal Planner
REGIONAL WATER QUALITY CONTROL BOARD	
Donald Dalke	Senior Water Resources Control Engineer
Griff Johnston	Chief of Planning
Hossain Kazemi	Water Quality Engineer
Hobart Knapp	Senior Water Resources Control Engineer
Larry Kolb	Supervisor, Water Resources Control Engineer
Harold Singer	Associate Water Resources Control Engineer
Richard Whitsel	Environmental Specialist
Teng Wu	Supervising Engineer

APPENDIX G

Regional Agency Documents Based Upon SFBRS Products

ASSOCIATION OF BAY AREA GOVERNMENTS (ABAG)

*Association of Bay Area Governments, 1972, Regional open space plan, Phase II; Summary: Berkeley, California, 15 p.

_____1973, Regional ocean coastline plan: 85 p.

*_____1977, Identification of possible class I site areas, Solid waste management plan: Tech. memorandum 7, 36 p.

_____1977, Salt intrusion into groundwaters, Water quality management plans: Tech. memorandum 20, 25 p.

*_____1977, Significance of pollution problems resulting from the extraction of mineral resources, Water quality management plans: Tech. memorandum 17, 10 p.

*_____1977, Summary description of BASIS: 1 p.

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*_____1978, Earthquake intensity and related costs in the San Francisco Bay area: 11 p.

*Joint Policy Committee of ABAG and MTC, 1975, San Mateo coast corridor evaluation: 120 p.

*Olmstead, Donald, 1977, Correspondence dated June 16, 1977: 1 p.

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*Sedway-Cooke Planning Consultants, 1973, Regional ocean coastline plan for the San Francisco Bay area: 87 p.

BAY CONSERVATION AND DEVELOPMENT COMMISSION (BCDC)

Bay Conservation and Development Commission, 1974, Evaluation of the safety of fills element: San Francisco, California, 23 p.

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CALIFORNIA COASTAL COMMISSIONS (CCC)

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*California Coastal Zone Conservation Commissions, 1975, California coastal plan: 443 p.

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*Joint Policy Committee of ABAG and MTC, 1975, San Mateo coast corridor evaluation: 120 p.

Metropolitan Transportation Commission, 1975, Land use and urban development project, Phase I working papers - Bart Impact Program: ____ p.

*Wallace, McHarg, Roberts and Todd, 1974, Natural process inventory, Part A - Task 1; The region described as an interacting system: 115 p.

*_____1974, Visual landscape relationships, Part A - Task 3; The region described as an interacting system: 75 p.

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*State Water Resources Control Board and Regional Water Quality Control Board, 1975, Water quality contol plan, San Francisco Bay basin, Abstract: Oakland, California, 61 p.

_____1975, Water quality control plan, San Francisco Bay basin (2), Part I: 131 p.

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APPENDIX H

Other USGS Products Identified by Regional Agencies

Atwater, B. F., and Hedel, C. W., 1976, Distribution of seed plants with respect to tide levels and water salinity in the natural tidal marshes of the northern San Francisco Bay estuary, California: U.S. Geological Survey Open-File Report 76-389, 41 p.

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Bonilla, M. G., 1960, Landslides in the San Francisco South quadrangle, California: U.S. Geological Survey Open-File Report, Feb. 9, 1960, 44 p.

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