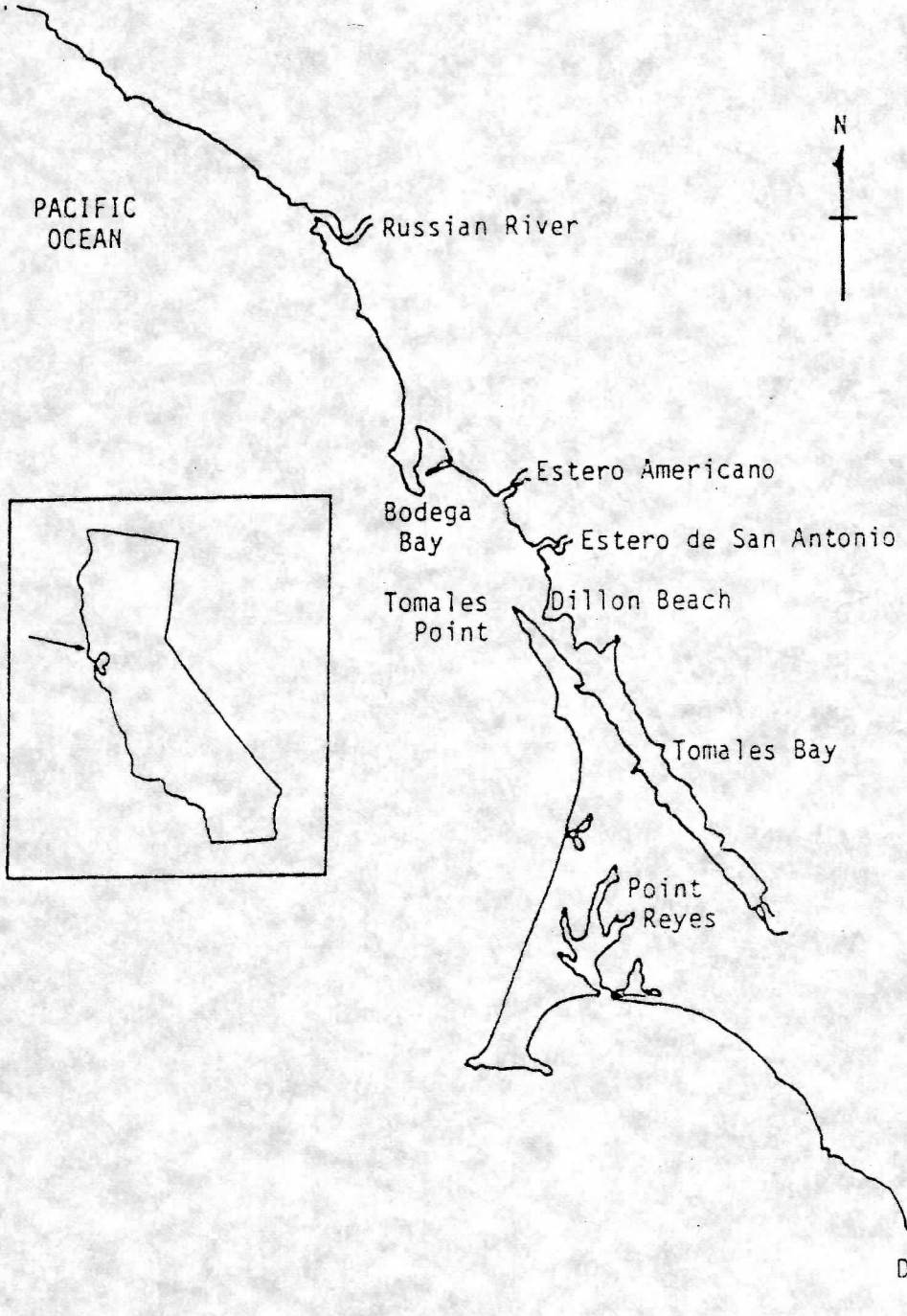
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TOMALES BAY RESOURCES PROJECT –

PHASE I PROPOSAL



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TOMALES BAY RESOURCES PROJECT

PHASE I PROPOSAL

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1.0 INTRODUCTION

Tomales Bay lies in a submerged rift valley along the axis of the northwest-trending, seismically-active San Andreas fault zone (Daetwyler, 1966). The structural framework of Tomales Bay differs markedly from other bays, estuaries or lagoons because of its geological origin. The most comparable structure is Scotland's Greatglen, which includes Loch Ness. During previous interglacial periods, when sea levels were higher than they are today, it was probably a marine bay much like Tomales.

Tomales Bay is exceptionally rich in flora and fauna. Virtually all major types of marine and estuarine habitat occur in or near the Bay, including exposed and protected rocky shorelines, sandy beaches, extensive mud, sand and eelgrass flats, and Salicornia marshes. Besides diverse populations of fish, invertebrates and algae, the bay supports a harbor seal colony and an abundant and varied bird population. Even whales have been reported in Bay waters. Because of these facts and others, there has been wide interest in Tomales Bay for research and educational purposes (Smith, Johnson and Obrebski, 1971).

The shores of Tomales Bay and the Dillon Beach area became easily accessible to scientists and observers after construction of a narrow gauge railroad in 1878. Since then, the area has been important for scientific study and educational field trips. During the 1940's, summer sessions were held in improvised quarters at Dillon beach, by the College of the Pacific (later, University of the Pacfic) and by the University of California. The resulting accumulation of information, including the description of many new species, made valuable contributions to important reference works such as Light's Manual and Between Pacific Tides.

The Pacific Marine Station (PMS) of the University of the Pacific was established in 1947 and operated until 1979 from permanent facilities located at Dillon Beach. During this 32-year period, studies were conducted in the area by PMS staff, students and visiting researchers from all parts of the world. Many college and high school groups visited and studied at the marine station during this time. Information gathered by staff and associates of PMS forms a major contribution to the existing Tomales Bay data base.

More recently, state and federal agencies have shown renewed interest in the Bay and its resources. This interest ranges from public health issues involving aquaculture operations (i.e. commercial oyster farming), to overall management concerns and long-range planning of watershed developments. With few exceptions all of these studies have been of short duration and concentrated on focused issues. From many viewpoints, present and proposed changes affecting the Bay have not been and are not presently being adequately addressed by these short-term studies.

1.1 Tomales Bay's Environmental Database

As mentioned above, a number of scientific studies have been performed in and around Tomales Bay. In order to assure continuity and thoroughness of information about the Bay, the tasks outlined in this proposal are designed to augment data acquired during previous studies. Research performed by Pacific Marine Station staff and students are major sources of historic data, and are described below.

1.1.1 Bibliography of Marine Research on Tomales and Bodega Bays, California

Compiled and first published by the Pacific Marine Station in 1975, this comprehensive bibliography cites scientific pub-

lications and unpublished theses and reports on local biological and oceanographic study topics (Munroe and Blake, 1975). In February of 1983, the Inverness Foundation and ANATEC Laboratories sponsored and produced a revised Bibliography which updates the 1975 document. This revision includes research performed in the study area since 1975, as well as all references given in the original version.

Most of the citations added to the Bibliography in 1983 are unpublished doctoral or master's theses, or reports to regulatory or public service agencies. All references have been entered into a computerized database to facilitate further additions and to expedite the literature search process. As a result, the Bibliography can be accessed in three different ways: alphabetically by author(s), chronologically by year of publication, and by subject(s) covered. The three listings are available from the Inverness Foundation.

1.1.2 Pacific Marine Station Research Reports

Research activities conducted at Pacific Marine Station from 1953 to 1979 include investigations of the biology, geology and hydrography of Tomales Bay. Results have been published as part of the Pacific Marine Station Research Report series, refereed scientific journals, or remain unpublished in the form of student theses (ANATEC Laboratories, Inc., 1983). Data acquired in these studies form an important component of baseline information available for Tomales Bay, and include:

(1) sediment deposition and erosion studies at selected intertidal sites,

(2) tidal fluctuation measurements,

(3) measurements of seasonal build-up and wash-out of Bay mouth sediments which cause changes in configuration,

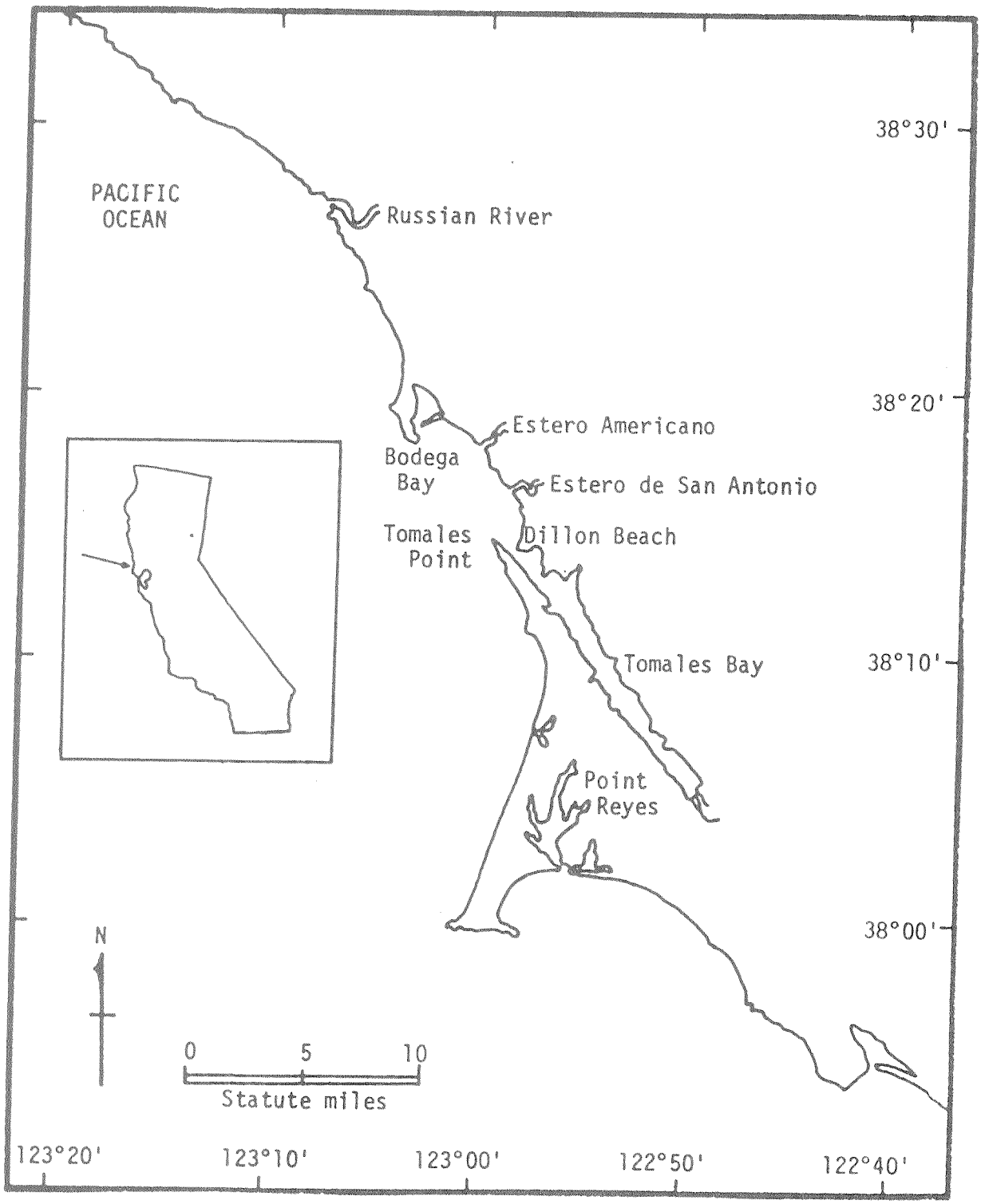
(4) studies of benthic and intertidal community structure, continued over several seasons,

(5) routine water quality surveys, and

(6) over 100 theses on selected topics and species from the Bay and adjacent areas.

Efforts are now underway to collate these and other important sources of information, reduce and analyze the data, and describe the physical and biological history of the Tomales Bay area. To this end, a proposal has been submitted (January 1983) to NOAA, Office of Coastal Management, requesting support for this undertaking. The scope of work outlined in that proposal and its relationship to Phase I of the Tomales Bay Resources Project is discussed in Section 1.2.2.

FIGURE 1-1. MAP OF AREA INCLUDED IN THE BIBLIOGRAPHY OF MARINE REASEARCH OF TOMALES AND BODEGA BAYS.



1.2 Present Study Needs in Tomales Bay

All ecosystems undergo long-term changes; some may be cyclic, others undirectional. Some may be due to natural climatic variation, geological events, and biological processes; others are due to the influence of human activity. At present, few research strategies are available to determine which changes are cyclic and which are undirectional, or to distinguish man-induced changes from natural ones. These and other central ecological issues make clear the need for long-term quantitative data for both theoretical and practical purposes (Botkin, 1978).

It is with these concepts in mind that this proposal has been written. The Tomales Bay Resources Project will provide valuable data on variations in this marine ecosystem over time, provide a data base for comparison through time and, as first proposed for Tomales Bay by Johnson, Bryant and Hedgpeth (1960) would provide:

- Greater insight into the organization of marine communities and how environmental factors influence them.

- A natural laboratory context for testing ecological hypotheses and mathematical methods.

- A basis for developing methods of predicting the course of events following specified changes in a marine ecosystem.

It is important to stress that, in other major estuarine systems, the lack of baseline data has presented real and far-reaching management problems. In San Francisco Bay for example, there is no long-term data base with which to compare the type or magnitude of change resulting from pollutant discharges, alteration of freshwater input or other events with biological impact. Therefore, sound regulatory and management decisions are difficult or impossible to make. State and federal agencies are now

organizing and, to a limited level, funding these long overdue studies in San Francisco Bay. In Tomales Bay we have the chance to establish this baseline before man-made stress reaches major proportions.

1.3 The Tomales Bay Resources Project

The Tomales Bay Resurces Project (TBRP) is composed of two phases, and includes both long-term monitoring and short-term focused studies on current issues of particular importance to the Bay.

Because this proposal is unsolicited, the scope of work and schedule are not constrained by regulatory requirements. Some tasks are basic monitoring surveys which should be continued over time at a regular frequency. Other tasks seek to answer specific questions and need to be repeated only if major physical changes occur. An ideal program would be extensive, complex and expensive; the tasks suggested here have been selected and distilled-down so that essential data can be gathered in a timely and cost-effective manner.

This proposal details the tasks comprising Phase I of the TBRP. Funding for Phase I activities only is being solicited at this time. A brief outline of Phase II tasks (Section 1.3.2) and discussion of potential Phase II funding sources (Section 8.8) are also included, to provide an overview of the entire Project.

1.3.1 Phase I

Phase I study tasks have been designed to characterize the hydrography, water quality, shoreline contours and submarine topography of the Bay. Details of these physical characterisitics provide important baseline information for biological studies and water use management decisions. Also

included is an information networking program which will provide an opportunity for interested parties to stay abreast of Bay study activities and results.

Study task details are presented in Sections 2.0 through 6.0 of this proposal.

Water Quality Monitoring Survey (Section 2.0)

Measurements of water temperature, salinity, pH and other parameters, collected at monthly or quarterly intervals from stations throughout the Bay, will be used to monitor the effects of freshwater runoff rates, the effect of Bay water quality on fisheries and mariculture, and other aspects of the Bay's ecological status. Continuation of this study component is proposed in Phase II of the TBRP.

Aerial Photographic Surveys (Section 3.0)

Aerial photographs provide visual images of water-mass motion as well as shoreline and watershed form, topography and vegetation. Quarterly surveys will characterize seasonal and longer-term fluctuations in the physical shape of the Bay mouth and shoreline, and fluctuations in shoreline habitats (e.g. marshland, riparian areas). This study task will be continued as a part of the TBRP Phase II.

Hydrographic Studies (Sections 4.0 and 5.0)

Water circulation patterns within the Bay, water exchange between Bay and ocean, and freshwater runoff flow rates govern the major ecological properties of Tomales Bay. The study will be conducted during both wet- and dry- weather seasons, and will provide baseline data about these factors for use in future

biological and water quality studies. Components of this Phase I study task will include:

- dye tracer, drifter and current meter investigations, submarine topographic survey
- tidal gauging
- mathematical simulation of water mass movements under various conditions
- freshwater inflow gauging and record review.

Project Documentation and Information Network (Section 6.0)

This program will facilitate the exchange of information between various groups studying the Bay for planning, regulatory or scientific purposes. It also provides a means for reporting results from the Tomales Bay Resources Project, and other investigations, to scientists, planners and the interested public.

1.3.2 Phase II

The Phase II study plan, for work to be performed after the 2-year Phase I study is completed, is necessarily tentative and will be refined based upon the results of Phase I studies and changing information needs. As shown in Table 1-1, some Phase I tasks will be continued into Phase II. These tasks may be altered by reducing the number of stations, changing the parameters measured or the frequency of collection, based on Phase I results.

Phase II tasks emphasize the development of biological baseline data, including plankton surveys, benthic invertebrate and fish population studies. A review and analysis of historic biological, hydrographic and water quality data, particularly data from research conducted at the Pacific Marine Station, is also planned.

TABLE 1-1. TENTATIVE SCHEDULE FOR PHASE I AND II.

TASKS	YEAR 1	YEAR 2	YEAR 3	YEAR 4
ROUTINE MONITORING				
AERIAL PHOTOGRAPHIC SURVEYS				
DYE TRACER, CURRENT METERS, DRIFTER STUDY				
SUBMARINE TOPOGRAPHIC SURVEYS				
ESTABLISHMENT OF TIDE GAUGE				
MATHEMATICAL SIMULATION				
HYDROLOGIC RECORD REVIEW				
MAJOR INFLOW GAUGING				
TOMALES BAY RESEARCH SEMINARS				
TOMALES BAY NEWSLETTER				
BENTHIC SAMPLING				
PLANKTON SURVEY				
SELECTED TOPOGRAPHIC SURVEYS				
REVIEW AND ANALYSIS OF HISTORIC DATA BASE				
PUBLIC LECTURE SERIES				

Biological monitoring will provide early warning of habitat degradation resulting from freshwater retention or from any other controlling factor. The tasks suggested here are intended to be diverse so that a variety of impacts can be sensed. At the same time, biological topics and methods have been chosen which have been studied previously in Tomales Bay and hve been documented in other estuaries.

Plankton Surveys

The phytoplankton survey will include chlorophyll determination as well as the identification and enumeration of species (by the "Uttermohl" or other method). The zooplankton survey will include major species determination, size classing of selected species, and biomass measurements.

Benthic Invertebrate Population Studies

Benthic samples will be made throughout the bay for the first Phase II survey and then concentrated on a few selected areas, probably based on Johnson's (1971) community groups for Tomales Bay. The benthic survey will include replicate samples sieved through 0.5 mm and 1.0 mm sieves. Organisms from the most common groups will be counted, and the data analyzed.

Fish Population Studies

Fish trawls will be considered for some areas of the Bay, to monitor diversity and seasonality of selected groups of fish.

Historic Data Review and Analysis

An historical review of the Bay and evaluation of the existing data will be important in establishing a database and determining the importance of much of the unanalyzed or unpublished data gathered during studies conducted at the Pacific Marine Station. Funding for this task has been requested from the National Oceanic and Atmospheric Administration. If funds are granted, this task will be removed from the Phase II study plan, and will be carried out parallel with Phase I tasks.

1.4 Utilization of Project Data

There is a widespread need for and interest in data which will be gathered by this project. Discussion with various agencies, individuals and universities (Appendix E - Letters of Support) demonstrate their concurrence with the proposed design and the need for this type of study. The agencies which have expressed a need for Project data include:

California Department of Fish and Game
State Health Department
Regional Water Quality Control Board
State Water Quality Control Board
Marine Sanctuary office
National Park Service
Federal Drug Administration
U.S. Geological Survey
State Coastal Commission
Marin Planning Department
Marin Public Health Department
Local Universities
Research Scientists

This list is only partial, but reflects the extent of interest in this project.

1.5 Project Management

Management responsibilities will be held jointly by the Inverness Foundation and ANATEC Laboratories, Inc. The Inverness Foundation provides expertise in public information, fundraising, and management of funds (ranging to $370,000.00) and personnel for Tomales Bay-related projects. ANATEC Laboratories provides the scientific and technical expertise necessary to design and manage the field, laboratory and reporting components of this type of project. A summary of each organization's capabilities, qualifications and specific duties are presented in Sections 7.0 and 8.0 of this proposal.

2.0 WATER QUALITY

2.1 Introduction

Monitoring of water quality parameters provides valuable information about the ecological status of marine and freshwater systems. Fishermen, oyster farmers, those who use Tomales Bay for recreation or depend upon it for their livelihood, are affected by fluctuations in factors such as salinity, temperature, turbidity, nutrients and bacteria levels. These variables are linked to shellfish productivity and potability, finfish population size, the aesthetic appearance of the waterway, and other characteristics important to man. At the present time, these basic environmental measurements are not made and reported regularly for Tomales Bay.

Prior studies which included water quality measurements have been conducted in the Bay (Cooper, Clark & Assoc., 1978; Hultquist, 1982; Musselman, 1980; Sharp, 1974; Smith, Johnson and Obrebski, 1971). The Environmental Study of Tomales Bay, conducted by the Pacific Marine Station, included a water quality monitoring survey which collected data from January 1967 through June, 1970. Sampling station locations appear in Figure 2-1. Results of these measurements include the following summary points:

- Stratification* generally occurs in the Bay when salinities are below 30‰. This is due to freshwater runoff, particularly in the winter months. The lack of stratification in the Bay mouth is probably due to extensive mixing of ocean and Bay waters.

*Water masses of differing salinities form layers in the water column; freshwater forms the topmost layer.

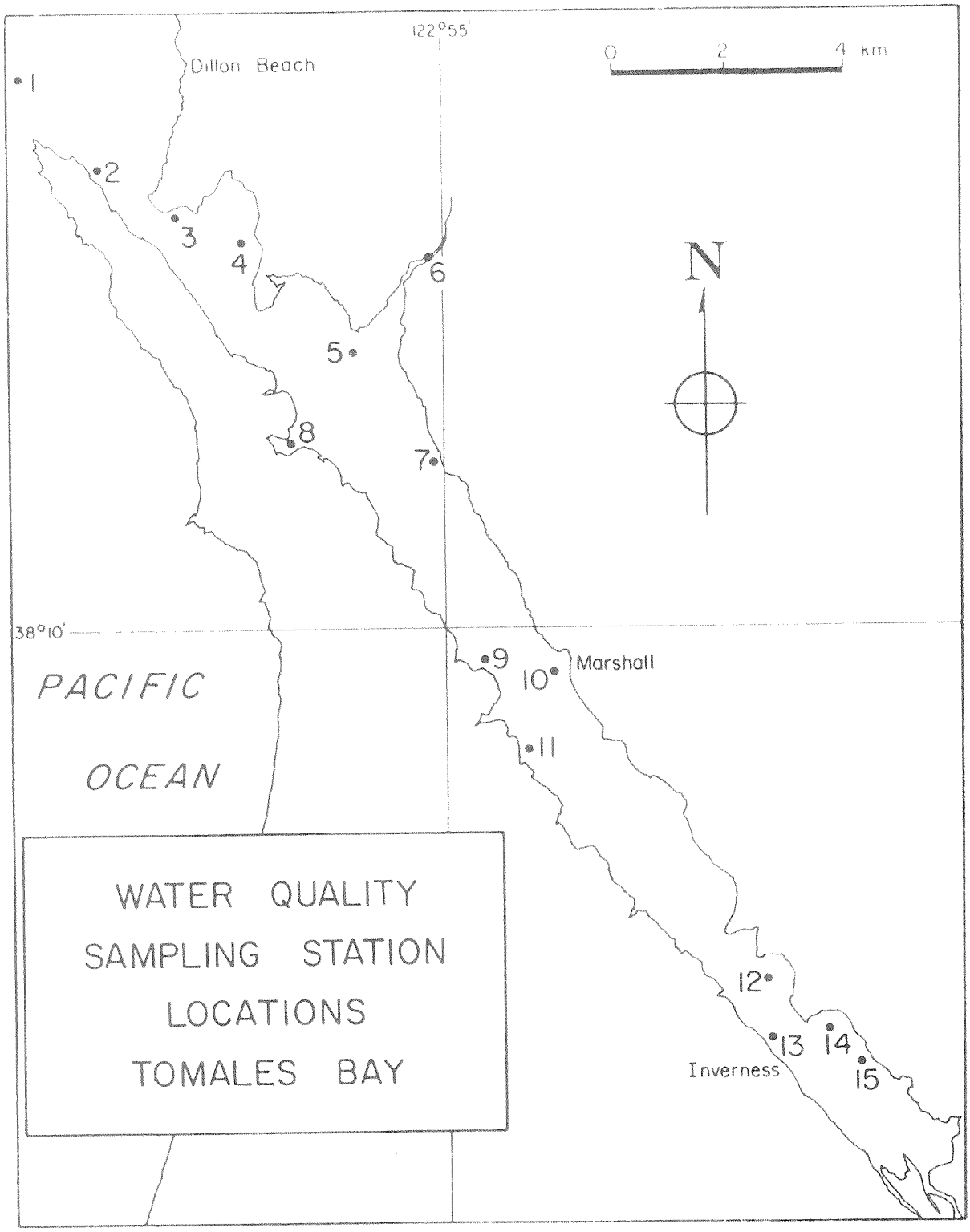

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15
Inverness
WATER QUALITY
SAMPLING STATION
LOCATIONS
TOMALES BAY

FIGURE 2-1.

- As expected, coliform counts are greatest during the winter months when freshwater runoff is greatest. Generally, both shellfish and general health coliform standards in the Bay were satisified only between July and September of the three years studied. The length of time during the year during which coliform standards are acceptable increases towards the mouth of the Bay. High bacteria levels can be controlled by the proper management of human and dairy wastes.

- Water temperature increases from the mouth to the upper end of the Bay, in magnitude and in range of variation. Salinity decreases in magnitude but increases in variation from the mouth to the upper end of the Bay.

- Oxygen content and saturation varied little in the Bay and values below 4 mg/L were only found in the Walker Creek region.

- High turbidities were found during the rainy season in the upper Bay and near the entrance to Walker Creek, and can have detrimental effects on the oyster industry as well as other Bay fauna. High turbidity levels have caused suspension of oyster farming activities for as long as one year.

Later studies (Sharpe, 1974; Musselman, 1980) emphasize assessment of bacterial contamination of Bay waters, and indicate that coliform levels remain high seasonally and continue to hamper oyster farming activities in Tomales Bay. Earlier authors (Johnson, Bryant and Hedgpeth, 1961; Smith, Johnson and Obrebski, 1971) and more recent studies (Sharpe, 1974; Musselman, 1980) have urged that more detailed and long-term studies are needed to gain a better understanding of Tomales Bay so that public health issues, aquacultural development and other factors can be managed in a more enlightened manner based on sound data. It is with these

facts in mind that the following water quality monitoring program has been designed.

2.2 Task 1 - Routine Water Quality Monitoring

Recent flooding may have altered conditions in some Bay locations. While bottom topography and biological communities have undoubtedly been altered severely in some areas, most of the basic water quality parameters should be comparable to levels and ranges experienced previously. The task specified below comprises routine measurements of the basic physical, chemical, and biological characteristics of Bay waters.

Water quality values change rapidly, within wide ranges and in complicated patterns. Because water masses move relatively quickly, evidence of deterioration in the environment as a whole may first appear in routine measurements of these properties. Man-made effects can be subtle and may be difficult to distinguish from natural variability. Long records of these basic data, with frequent regular entries, are the best resource for environmental monitoring. Reliable mathematical techniques are available for isolating specific trends or patterns from an apparently confusing background, provided an adequate number of data points are available. In other words, the longer and more complete a data record is, the easier it is to extract subtle information from it.

Data collected during this task will be gathered by standard methods so they can be compared most easily to earlier records and to future studies.

2.2.1 Task 1 - Field Methods

Sampling stations (Figure 2-2) will be selected to match natural hydrographic features, concentrating to some extent on major

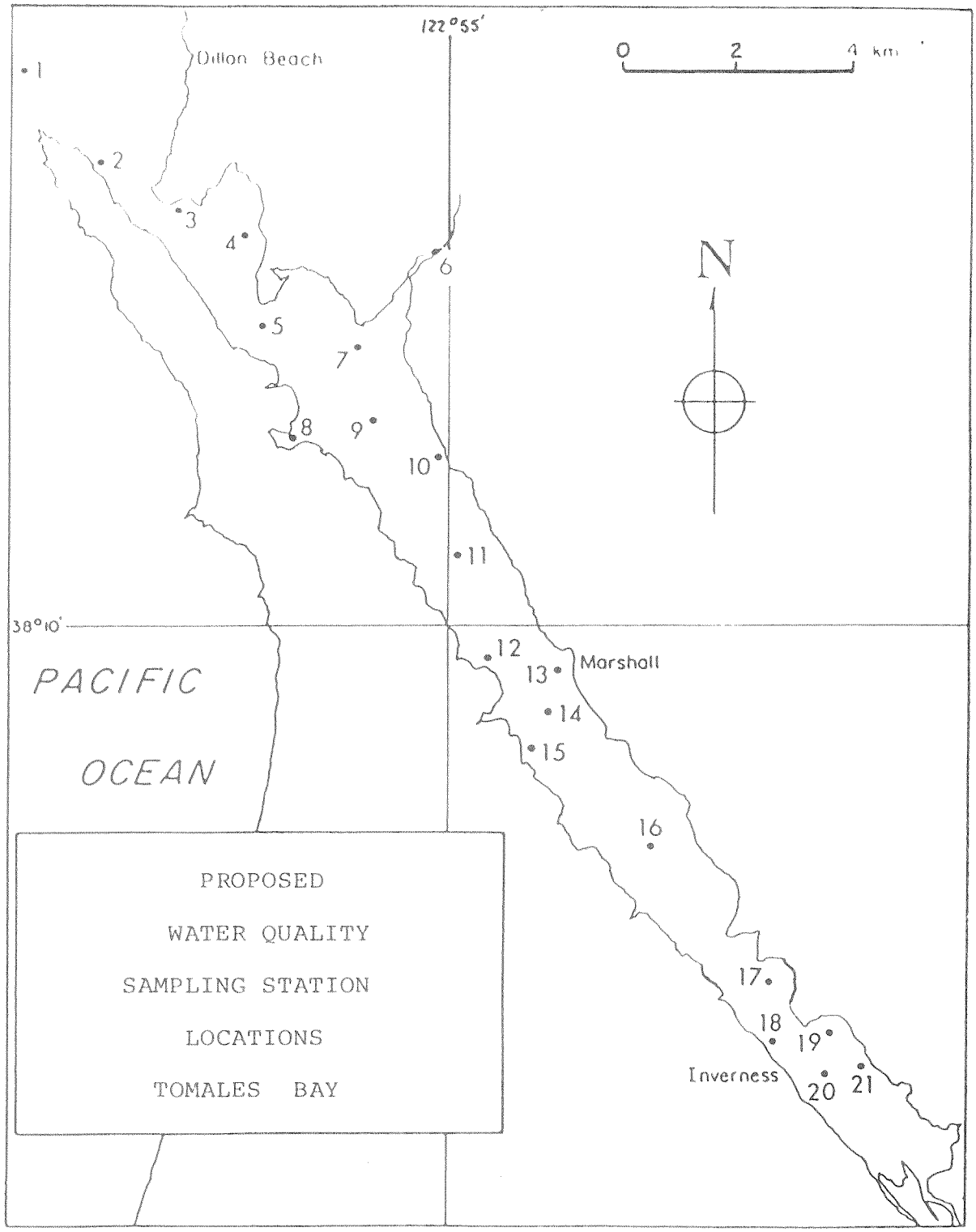

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Marshall
Inverness
PROPOSED
WATER QUALITY
SAMPLING STATION
LOCATIONS
TOMALES BAY

FIGURE 2-2.

inflow points. Twenty-one stations will cover the approximately 30 square kilometers of Bay surface. Seven stations of the twenty-one are designated as mid-channel (Table 2-1) and have been selected for quarterly surveys, including complete profiles through the water column. Fifteen of these stations duplicate those which were monitoring during Pacific Marine Station's Environmental Study of Tomales Bay (Figure 2-1).

Monthly and quarterly surveys will include field measurements and discrete sample collection for laboratory analysis as follows:

Field measurements:

(1) Water temperature - surface and bottom measurements monthly, all stations. Half-meter spaced depth profiles made quarterly, at mid-channel stations.

(2) Salinity - surface and bottom measurements monthly, all stations. Half-meter spaced depth profiles quarterly at mid-channel stations.

(3) pH - monthly surface and bottom readings, all stations. Quarterly profiles at mid-channel. By meter.

(4) Dissolved Oxygen - monthly surface and bottom readings, all stations. Quarterly profiles mid-channel. By meter.

(5) Transparency/Turbidity - monthly transparency evaluations by Secchi disc at all stations. Quarterly turbidity readings at mid-channel stations using flow-through nephelometry method with a Turner Designs Model 10 fluorometer/nephelometer.

(6) Chlorophyll a - surface samples taken monthly at mid-channel stations. Flow-through nephelometry with Turner Designs Model 10, and/or collection of descrete samples for laboratory analysis.

Laboratory Measurements:

(7) Bacteria (total and fecal coliform) - surface samples collected monthly at selected shore and mid-channel stations. Analysis in the laboratory using the multiple-tube fermentation technique.

(8) Nutrients (nitrate, nitrite, ammonia, phosphate) - discrete surface samples collected quarterly. Wet chemical analysis in the laboratory. Ammonia by distillation and nesslerization, nitrate by the Brucine method, nitrite by the colorimetric method, and phosphate by the stannous chloride method.

Table 2-1. TOMALES BAY WATER QUALITY STATIONS

Station Number	Location
1	Tomales Point - Mid channel
2	Great Rock - Mid channel
3	Lawson's Pier
4	Lawson' Flat
5	Tom's Pt. - mid channel
6	Walker Creek Bridge
7	Walker Creek Entrance
8	White Gulch
9	Hog Island - Mid channel
10	Nick's Cove
11	- Mid channel
12	Laird's Landing
13	Marshall Boat Works
14	Marshall - Mid channel
15	Stockton Beach
16	- Mid channel
17	Tomales Bay Oyster Co.
18	Inverness Yacht Club
19	Millerton Creek Entrance
20	- Mid channel
21	Bivalve

3.0 PHOTO IMAGERY

3.1 Task 2 - Aerial Photographic Surveys

Aerial surveying is proposed as an efficient, cost-effective way to accumulate an excellent qualitative overview of Bay processes (North, 1971). The proposed aerial surveys, along with a growing historical sequence of visual imaging, will provide comprehensive synopses of water-mass motions, shoreline and watershed formations, and broad-scale biological processes. Photo maps of Tomales Bay, made by the U.S. Army Corps of Engineers, the U.S. Navy, and by Pacific Marine Station, date back to 1953 and will be useful for comparison. In addition, photo surveys by the Coastal Commission, Satellite sensing (SEASAT, MAP II, RARE IV), and other programs will be reviewed and the data used whenever possible. Remote imagery will also be used to quantify certain physical processes, i.e. sand points, bars, changes in the mouth of the bay, particularly in conjunction with simultaneous ground-truth sampling surveys. Aerial photos supplemented by cross-section fathometer surveys will provide details of Bay mouth geometry and its variability. Analysis of color photographs will be used to clarify and integrate discrete turbidity measurements made during quarterly water quality surveys, and will supplement point-to-point tracer measurements made during circulation experiments (Section 4.1.)

Infrared and visible spectrum photographs will be used to develop accurate maps of eelgrass beds, marshlands, and shoreline habitats. Quantitative assessments, including percent cover and standing crop, can be developed for dominant species such as eelgrass. Comparison of quarter-to-quarter surveys will help characterize seasonal fluctuations and will permit identification of subtle enhancement or deterioration in habitats.

3.1.1 Task 2 - Field Methods

Quarterly flights using subcontracted pilot and small fixed-wing aircraft will be made to photograph Tomales Bay and portions of the watershed, particularly Walker and Lagunitas Creeks. Visible-spectrum and infrared transparencies will be taken from an altitude of 500 feet or higher at 90^{o} to the ground.

Selected transparencies will be printed in large format for quantitative analysis with a Houston Instruments Hipad Digitizer. Such parameters as total area and percent cover will be calculated for dominant vegetation types.

Separate images will be combined to form a single photo mosaic, which will serve as the basis for broad-scale qualitative evaluations of distribution, size and state of various biological habitats. The photo mosaic will be the basis for line-drawn maps of specific physical or biological properties. Single parameter maps will be developed for historical records of biotypes.

Certain quarterly aerial surveys will be scheduled to coincide with circulation studies (Section 4.1). Visual and infrared images will be used to delineate specific water masses during tracer experiments.

Overflights will be scheduled every three months. Specific days chosen for surveys will depend on the weather, safety and visibility being the main concerns.

4.0 CIRCULATION STUDIES

4.1 Introduction

Many of the major ecological properties of Tomales Bay, such as salinity gradients, nutrient distributions, phytoplankton and zooplankton movement, and sediment transport are governed by hydrodynamic forces. Circulation patterns depend on tidal exchange through the Bay mouth, wind velocity and direction, and freshwater inputs, all of which vary seasonally and episodically.

The earliest hydrographic survey, other than those conducted for mapping purposes, was conducted in 1960 by Johnson, Bryant and Hedgpeth. The data obtained from this study pertain to summer conditions only; much of the data gathered for that report has been expanded in a 1971 publication (Smith, Johnson and Obrebski). Certain current studies conducted in 1960 are important as background information, to assist in designing the presently proposed studies in the bay; these older studies have not been repeated to date. Based upon data from the 1960 study, the Bay is divided into three major hydrographic regimes (Figure 4-1):

- Lower Bay, North of Pelican Point- good exchange with ocean
- Mid Bay, Pelican Point to Double Point- moderate exchange with Lower Bay
- Upper Bay, Double Point to Point Reyes Delta- poor exchange with Mid Bay.

The currents in the Bay are predominantly tidal currents. Wind driven currents, except during gales, are negligible due to restricted fetch*. For all but three months of the year, the inflow of freshwater is insufficient to produce significant

*The distance wind travels across a body of water to form waves.

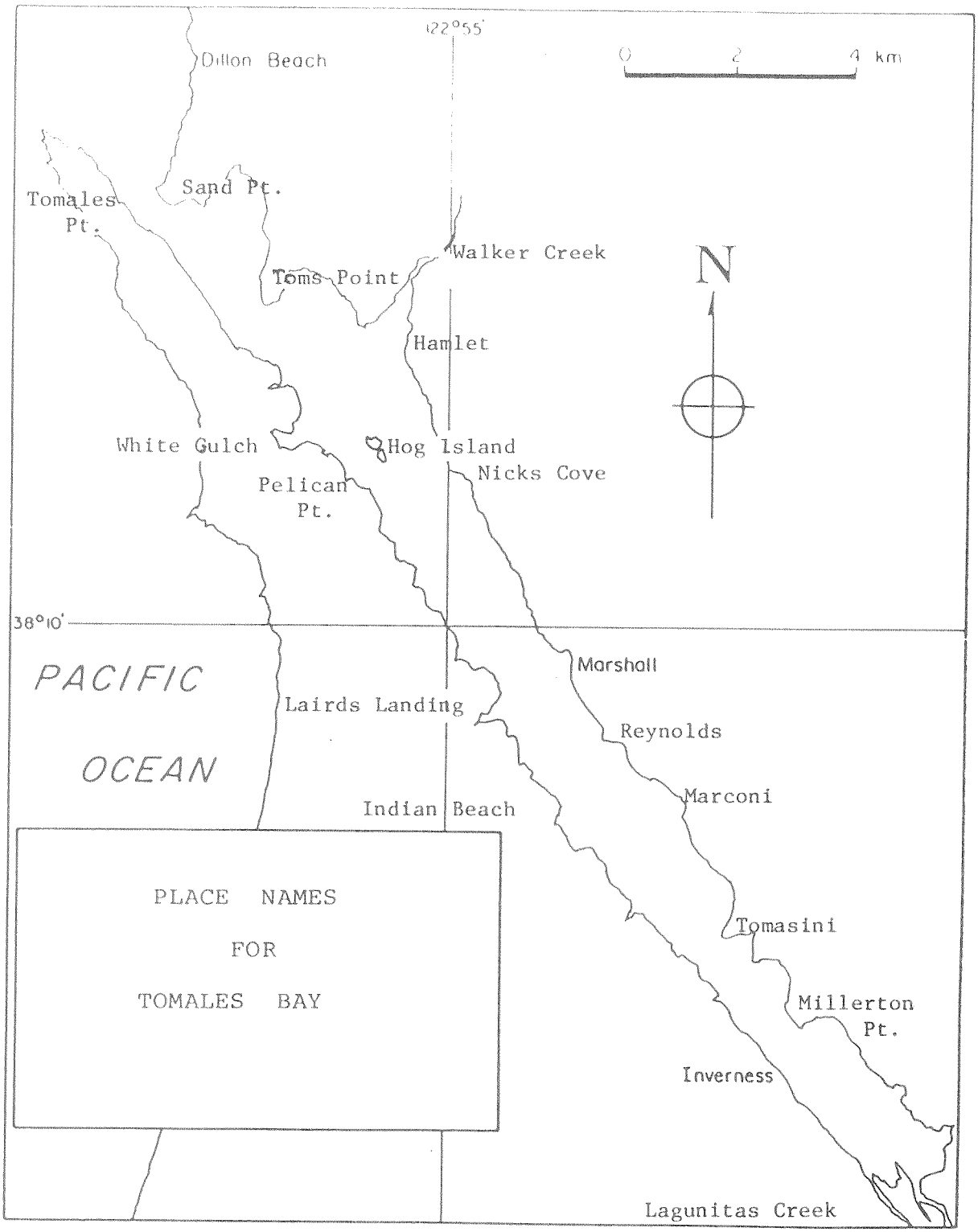

122°55'
Dillon Beach
0 2 4 km
Sand Pt.
Tomales Pt.
Walker Creek
Toms Point
N
Hamlet
White Gulch
Hog Island
Nicks Cove
Pelican Pt.
38°10'
PACIFIC OCEAN
Marshall
Lairds Landing
Reynolds
Marconi
Indian Beach
PLACE NAMES FOR TOMALES BAY
Tomasini
Millerton Pt.
Inverness
Lagunitas Creek

FIGURE 4-1.

currents. No rainy season current measurements are presently available.

The tidal currents of Tomales Bay are of the reversing semidiurnal type. The flow is continuous for about six hours in each direction, with slack water occurring as the current changes direction. Following slack water tidal current velocity increases to a maximum, then decreases to the next slack water period. The current then reverses direction. The relation between time-of-current to time-of-tide in Tomales Bay is that expected for a progressive wave. The time relations between tide and current in the region depart from expected simple wave motions, probably because of many factors, including the effect of the considerable diurnal inequality of the tides along this coast (Disney and Overshiner, 1925). Figures 4-2 and 4-3 show these relations for two stations.

The curves shown in these two figures represent the two basic current conditions found in the Bay. Station 24 (Figure 4-2) is representative of the currents found in channels north of Pelican Point. Station 22 (Figure 4-3) is representative of the currents found south of Pelican Point. Table 4-1 shows the maximum current velocities at mid-depth, relative to tidal stage, for 23 stations. The tidal range between high and low water is given for each station. The maximum current velocity shown in Table 4-1 is that observed for the periods between high and low water.

As a follow-up to the 1960 survey, a number of special studies were conducted between 1966 and 1970 to learn more about the circulation within Tomales Bay and the rate of exchange between the Bay and adjacent offshore waters (Smith, Johnson and Obrebski, 1971).

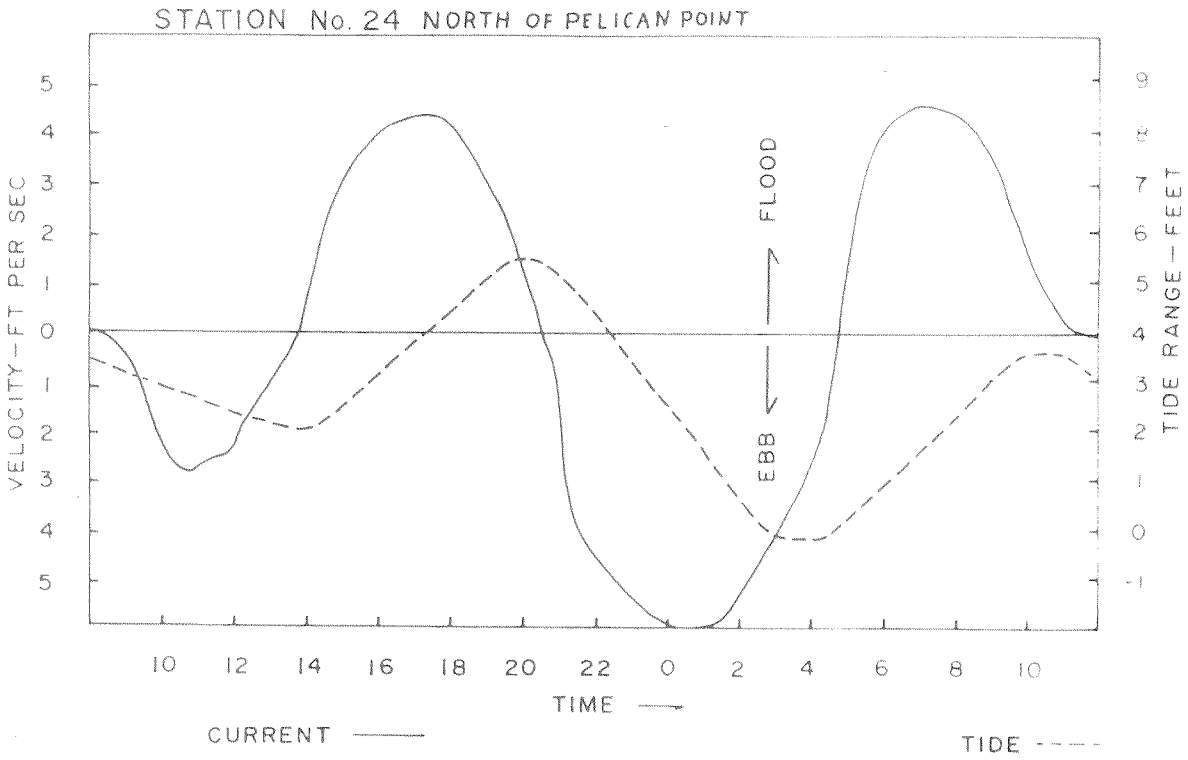


FIGURE 4-2. Current velocities at Station 24. (Time in hours, tide range in feet above or below mean lower low water.)

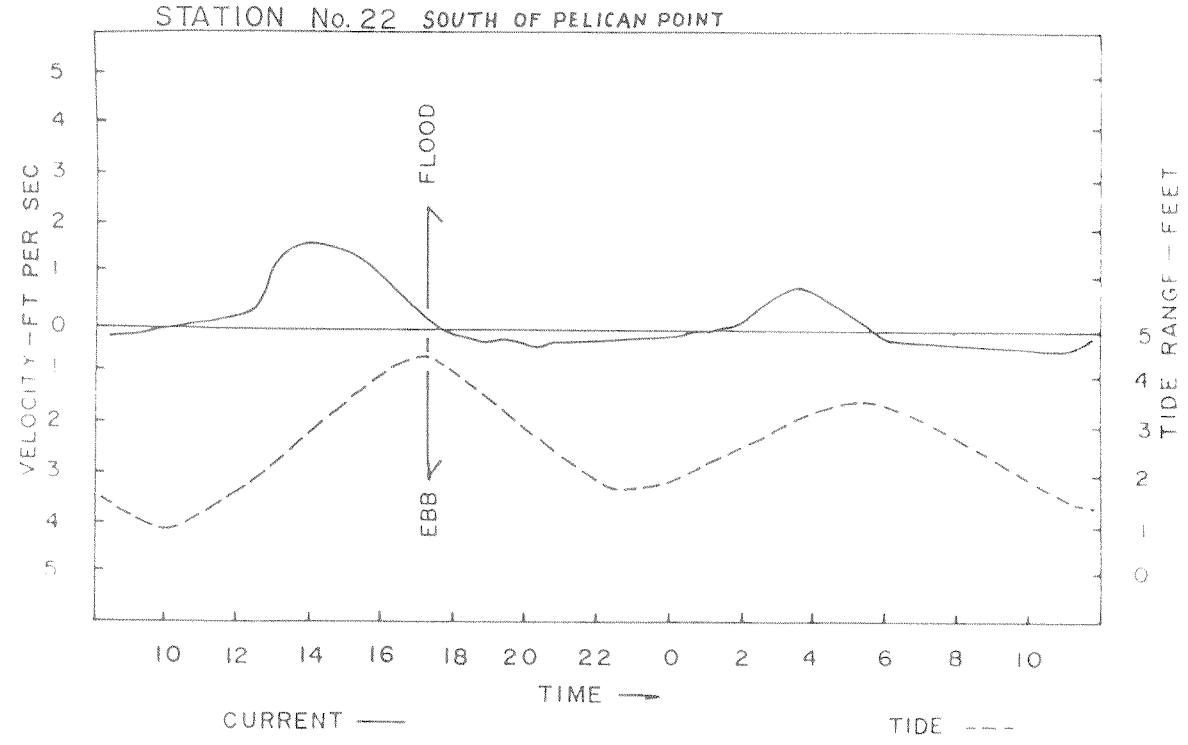


FIGURE 4-3. Current velocities at Station 22. (Time in hours, tide range in feet above or below mean lower low water.)

TABLE 4-1.

Summary of Maximum Tidal Currents
Measured in Tomales Bay

This summary is derived from the maximum mid-depth current measurements obtained at stations in the Bay during varying tidal cycles. These data represent both flood and ebb current values obtained with tides of varying ranges. The measurements were not synoptic and were obtained during June, July and August, 1960.

Area	No. of Observ.	Current, cm/sec.			
		Max.	Min.	Range	Mean
Hydraulic entrance to Tom's Point	22	180	40	143	82
Tom's Point to just south of Pelican Point	25	67	6	61	37
Just south of Pelican Point to southern end of Bay	19	27	0	27	8

During a 24-hour period in the fall of 1967, a slug release of Pontacyl Brilliant Pink B (dissolved in 20 liters of sea water) was followed in the Bay . Utilizing this fluorescent dye, drift bottles and current measurements, it was found that the exchange between the upper and middle Bay is less rapid than expected. Even after six weeks and a major rainstorm, measurable amounts of dye were found at several stations.

Drogue and drift bottle experiments were conducted during the summer and early fall of 1968. These preliminary experiments indicate that the common belief that Tomales Bay flushes completely with each tide cycle is not true.

The Bay consists of three regimes along its long dimension, with the lower portion flushing significantly (if not completely) through the mouth, the upper portion taking a much smaller part in the water exchange process, and only sluggish mixing occurring in the mid-portion. The overall effect in most of Tomales Bay is that a large water mass oscillates over a relatively short reach at the cyclic rate of the tide, carrying with it any pollutants and debris. In the mid-portion, where some mixing does occur, water can eventually escape to the open sea, but in a manner analogous to random diffusion (Smith, Johnson, and Obrebski, 1971).

There is less information on the exchange rate between the Bay and offshore waters. Very preliminary studies indicate that the mouth of the bay is greatly modified seasonally and during major storm events by sediment movement. These changes most likely effect exchange patterns throughout the bay.

Musselman (1980) reported that bacterial concentrations decline after winter rainstorms at a rate suggesting Bay "flushing time" between two and eight days.

Based on a review of the existing data and the importance of a clear understanding of Bay circulation, a study of these patterns is proposed as Task 3 of this proposal. The objectives of this task are to:

- More clearly define basic transport properties including mean detention time, longitudinal and transverse dispersion characteristics, and tidal exchange rates.
- Better understand seasonal variation, since the existing data only address summer and early fall conditions.
- More clearly understand freshwater input into the bay and its mixing characteristics.
- Develop a circulation data base which will serve as a basic building block for better understanding of sediment movement and many of the ecosystems which depend, entirely or in part, on water movements in the Bay.
- Provide data so that Bay management questions such as shoreline changes, marina construction, freshwater diversion and dredging proposals can be realistically evaluated.

4.2 Task 3 - Dye Tracer, Current Meter and Drifter Studies

Two dye-tracer studies, one in winter, the other in summer, are proposed to quantify basic transport properties. The winter study will examine flow conditions when freshwater inputs, siltation from streambeds, and nutrient inputs are most important. The summer effort will then describe conditions when low stream flow and wind mixing can be expected to predominate.

The dye-tracer approach has been chosen as an efficient, cost-effective method for quantifying fundamental flow properties. Limited current meter placement, and surface and bottom drifters released in large quantities will yield more detailed data and provide support information to the dye studies.

The circulation patterns broadly described in earlier works will be evaluated and considerably refined by the continuous-release studies proposed here. Dye will be released at a constant rate from a single point for several days until dye concentrations reach a near equilibrium. Peak concentrations can be controlled to remain below visible levels so that the work does not become an unsightly nuisance. After equilibrium is approached, dye release is stopped, but measurements continue as tagged water continues to mix with new water from the ocean and from the watershed. Details of concentration build-up and relaxation will be used to quantify many of the main hydrodynamic properties of the Bay. Secondary currents may cause pockets of dyed water to remain localized for many days or even weeks after the dye release. Twice-daily monitoring will be required during the release and for the first few days after it has stopped. Monitoring will continue at lower frequency until secondary patterns have been resolved. Two releases of surface and bottom drifters will be made during the course of the study. This approach will give additional insight into circulation patterns, sediment movements and flushing rates. Two to three recording current meters will be placed in strategically located deeper water stations in the bay to help determine net flows.

Interpretation of dye study results will be aided by a detailed description of Bay bottom topography. Bathymetric surveys were made in Tomales Bay in 1957 by the U.S. Coast and Geodetic Survey. Additional cross-sectional measurements were made by Daetwyler (1966) as part of his extensive geologic study of the Bay.

Most of the bottom is sand or mud. Contours have changed dramatically following the January 1982 flood, so new soundings are needed. An ongoing study by USGS (Ed Clifton, 1983) has made some cross-sectional profiles since the 1982 flood. The proposed profiles would be designed to augment and complement those taken in the USGS program. USGS data have not been adjusted to tidal levels as yet. Two submarine topographic surveys, including a number of cross-section profiles covering the entire Bay, will be conducted in conjunction with the two dye-release studies.

Contours will continue to change, particularly at the mouth, where wave forces shift sands and where tidal exchange is controlled. These structural changes will be easier to interpret once a sound understanding of flow patterns is developed. The depth and platform contours of the Bay mouth will continue to be monitored by both aerial surveys (Section 3.0) and by occasional fathometer surveys (Task 4).

The comparatively uncomplicated geometry of Tomales Bay suggests that numerical simulation of circulation patterns could be effective. A one-dimensional transport model in either tidally varying or tidally-averaged form could be used to predict the fate of conservative or decaying pollutants. Such a procedure could also help explain plankton movement or habitat distributions.

Dye study results, water quality data, and freshwater input measurements (see below) will be used to configure and calibrate a one-dimensional mathematical simulation of circulation. The theoretical basis of the model will be the dispersion equations discussed by Fischer et al. (1979).

A successful numerical simulation of this sort will be most useful for cultivating an understanding of the basic hydrodynamic processes at work in the Bay. It may also be useful for general-

ized predictions of change. The model will provide a theoretical or conceptual framework for interpreting other data which might be affected or controlled by fluid motions. A clear identification of the primary mixing and transport properties will furnish a foundation for comparing Tomales Bay to other bodies of water which might suggest areas where special vigilance should be applied in the future. The model will also be a basis for assessing the relative importance of tidal mixing and the major freshwater inputs on Bay water quality.

4.2.1 Field Methods - Dye Tracer Current Meter and Drifter Studies

Two continuous-release dye tracer experiments will be performed in Tomales Bay. One study will be made in January or February to determine wet weather flow characteristics. The second study will be made in August or September to determine dry weather values.

Injections will be at a constant rate from a fixed platform at water quality station 16 (Figure 4-4). Order-of-magnitude calculations indicate that injection of pure dye at a rate of 6 milliliters-per-minute will yield tracer concentration of 2 parts-per-billion in many portions of the Bay. Freshwater inflow upstream of the injection site can be expected to approach 1,000 cfs during rainstorms (Musselman, 1980). Summer inflows are likely to be a tenth or less of these values. Bay volume was reported as 3×10^9 cubic feet with a tidal prism of 1.6×10^9 cubic feet (Smith, Johnson and Obrebski, 1971) . Preliminary calculations using these values indicate that near steady-state tracer concentrations should be achievable with an injection duration of less than seven days.

Dye concentrations will be measured by flow-through and discrete sample fluorometry (Turner Designs Model 10) from aboard Boston

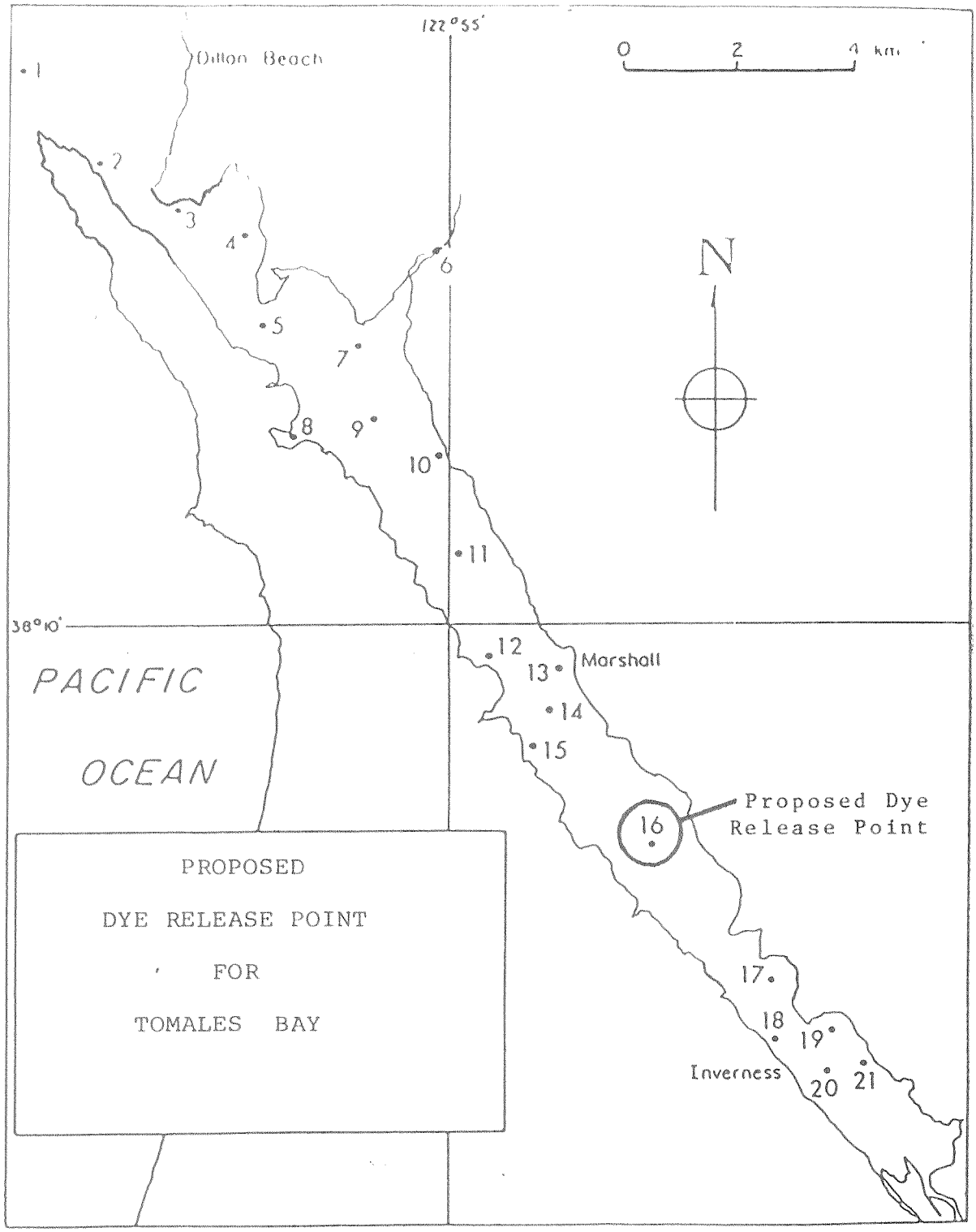

122°55'
Dillon Beach
0 2 4 km
N
38°10'
PACIFIC
OCEAN
Marshall
Proposed Dye
Release Point
PROPOSED
DYE RELEASE POINT
FOR
TOMALES BAY
Inverness
1
2
3
4
5
6
7
8
9
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21

FIGURE 4-4.

Whalers. Samples and profiles will be taken during daylight high and low tides at a network of sampling locations. Grid points will be chosen in mid-channel and in shallow-water shore locations, so that both longitudinal and transverse mixing characteristics can be evaluated.

During these same periods a large number of surface and bottom drifters will be released, and two to three current meters will be set.

4.3 Task 4 - Submarine Topographic Surveys

Bottom contours will be measured at approximately 20 cross-section stations in locations similar to those chosen by Daetwyler (1966), and covering areas not recently surveyed by USGS. Depths will be recorded from a small boat with a continuous-recording fathometer. Locations will be recorded from compass and sextant bearings taken from prominent landmarks. Fathometer records will be corrected for tides against a tide gauge established in Tomales Bay for this study (Section 4.4).

Two sets of contours will be mapped. The first will be recorded in winter in conjunction with the wet-weather dye study. The second survey will be performed in summer, corresponding to the dry-weather dye study.

Additional fathometric surveys will be made of contours at the mouth of the Bay whenever major changes become apparent, either from aerial photos (Section 3.0) or during routine water quality surveys (Section 2.0).

4.4 Task 5 - Establish Tidal Gauge

A recording tidal gauge will be installed at a permanent location, i.e. pier, marina or other stable structure, in the lower

bay. The tidal gauge will be calibrated after three months of operation to establish mean lower low water. A tidal bench mark will then be established as a tidal elevation reference point. A benchmark is important for bathymetric and aerial photographic surveys, and for the study of intertidal and benthic marine communities.

4.5 Task 6 - Mathematical Simulation

A numerical model will be developed to describe flow patterns in Tomales Bay waters. In the initial phases the simulation will describe the major one-dimensional (longitudinal) flow and mixing processes normally affecting Bay circulation. Advective transport calculations will be driven by tidally-induced volume changes and by fresh water inputs. Tracer dispersion will be additionally affected by diffusion considerations.

The mathematical simulation requires a series of choices regarding characteristic geometric and temporal scales which describe Bay processes. This sequence of design decisions forces the analyst to make disciplined investigations into the relative importance of topographic features, freshwater flows (with season), transverse mixing, tidal exchange rates, advective velocities, and diffusion mechanisms. An interplay will develop among dye experiment results, analogous hydraulic studies, model design and calibration. The model can thus serve as a useful framework and focus for understanding flow phenomena in the Bay. After the simulation is operational and satisfactorily calibrated, it can be used to extend predictive capabilities to additional tide and input conditions.

A computer algorithm will be developed following the outline developed by Fischer (1972) in his transport modeling of Bolinas Lagoon. Programs will be composed either on ANATEC's hardware, which is based on a 16-bit microprocessor with 756K dynamic

memory and 96 megabyte hard disk mass storage, or on some other computer with existing software to support the necessary analysis.

All theoretical considerations, assumptions and conclusions will be reported, including the fundamental hydraulic equations used for simulation. Input parameters, comprised of geometric, hydraulic and hydrological data, will be documented for each simulation condition. Resultant output calculations will be presented and interpreted in the context of current fluid mechanics theory and of reported studies in similar water bodies.

Some concern has been expressed about a possible "nutrient trap" in the upper region of the Bay (Kelley, 1981). The uncomplicated geometry of the Bay does not suggest such a phenomenon based on preliminary considerations. The numerical model could, however, be easily expanded to a branched form to account for this condition if tracer experiments and/or water quality data support its existence.

5.0 EFFECTS OF WATERSHED HYDROLOGY ON TOMALES BAY

5.1 Introduction

The flow of freshwater into Tomales Bay affects a variety of water quality parameters, such as salinity, nutrient levels, rate of water mass movement and mixing, the rate and amount of sediment transported into the Bay. These conditions in turn define the biological phenomena the system is capable of supporting. An historic data foundation, consisting of statistical records on the amount and timing of seasonal freshwater flows, is an important component in the analyst's ability to predict future biological limits.

Studies of stream biology and hydrology have been and are being performed in Tomales Bay, particularly with regard to water supply issues affecting Lagunitas Creek (Hecht and Enkeball, 1979; Kelley, 1978; Kelly and Dettman, 1980, 1983a, 1983b; Nolte, 1965; Li, 1981; Eng, 1981). Included are investigations of streamflow and sedimentation rates and corresponding effects on the reproductive success of silver salmon and steelhead populations, and population surveys of Syncaris pacifica, a rare and endangered freshwater shrimp which occurs in Lagunitas Creek.

Data on stream depth, flow velocity and substrate conditions are being collected as part of an ongoing study by D.W. Kelley and Associates (1983 a,b). This study focuses on the maintenance of flows adequate to support salmon and steelhead spawning populations, and will also gather data on benthic fauna, zooplankton and fish smolt populations, and salinity in the southern end of Tomales Bay. Data from this and other Tomales Bay watershed stream studies will complement data gathered for the study tasks proposed below.

5.2 Task 7 - Hydrologic Record Review

Streamflow records from Lagunitas and Walker Creeks have been collected by the U.s. Army Corps of Engineers, the Marin Municipal Water District, the U.S. Geological Survey and others. Rainfall volumes and intensities from throughout the drainage area are available from the U.S. Weather Service.

Annual precipitation-runoff relationships are not usually simple, but predictive models have been developed and applied to other streams and watersheds (Gray, 1970). It may be possible to develop a quantitative formula for the Tomales Bay watershed, and for this purpose, rainfall and stream flow data will be compiled and summarized.

A quantification of the runoff volume resulting from known rainfall volume and intensity can expand the usefulness of historic rainfall data, and improve our understanding of freshwater input patterns in Tomales Bay.

5.3 Task 8 - Major Inflow Gauging

The U.S. Geological survey maintains stream gauges on Lagunitas and Walker Creeks, but data on actual volumes of runoff from each stream into Tomales Bay are not available. The runoff contributions of Lagunitas and Walker Creeks relative to secondary freshwater sources, such as Marshall, First Valley and Second Valley Creeks, will be measured.

Stage recording instruments will be installed at sites near the mouths of Lagunitas and Walker Creeks, the major inputs of fresh water. Charts will be collected and analyzed monthly. Several discharge measurements will be made at the mouth of each creek during various flow conditions to establish the stage-discharge relationships needed to convert stage records to flow data. Several

discharge measurements will also be made at secondary freshwater inputs. These checks will be made during both dry and wet conditions, to estimate the contributions of these smaller streams relative to the larger Lagunitas and Walker Creeks.

Data on actual inflow rates of various tributaries under a variety of weather conditions, combined with water quality, circulation and other data, will provide an improved basis for assessing the importance and effect of each tributary on overall Bay quality.

6.0 PROJECT DOCUMENTATION AND INFORMATION NETWORK

6.1 Introduction

Numerous government agencies, community groups and members of the general public have an interest in Tomales Bay, its present and future ecological status, and the most beneficial ways in which to manage the use of surrounding lands and waterways. Recommendations for planning policy are not a part of the Tomales Bay Resources Project. However, information resulting from baseline studies such as this one are extremely valuable to groups and individuals who must formulate policy and make planning decisions.

The Marin Municipal Water District (with the State Water Resources Control Board and D.W. Kelly and Associates), the Point Reyes Bird Observatory, the Tomales Bay Marine Laboratory, the Inverness Foundation (with the California Coastal Conservancy) the California Department of Fish and Game, and the U.S. Geological Survey are currently planning or carrying out study programs in Tomales Bay and/or the surrounding area. These studies, and others which may also be taking place, are complementary in scope, and information exchange between members of these groups is necessary in order to make the best possible use of study findings.

The program proposed here has been designed to make Bay studies information from all such sources readily available to interested parties. With these considerations in mind, this program will:

1) facilitate the exchange of information between all groups studying, working or otherwise interested in the Bay, and

2) provide several means for communicating the progress of and results from the Tomales Bay Resources Project itself.

6.2 Task 9 - Tomales Bay Resources Project Quarterly and Annual Reports

Once the project gets underway, interim reports containing information about tasks completed and in progress, and data and observations thus far compiled, will be issued on a quarterly basis. At the end of each study year an Annual Report will be compiled, containing study results for all tasks performed during that year. Quarterly and Annual Report contents will reiterate task objectives and methodologies described in this proposal, provide both raw and reduced data in tabular and/or graphic form, present methods and results of data analysis, and discuss results and conclusions obtained from the study effort.

Copies of all reports will be forwarded to the funding agency, and copies will be retained by ANATEC Laboratories and the Inverness Foundation. In addition, a set of all reports generated by this study will be housed at the California Academy of Sciences and at the Inverness Branch of the Marin County Public Library, for access by the scientific community as well as the interested public. Copies will also be made available to other Bay Area institutions and agencies on request.

6.3 Task 10 - Scientific Publications

Information obtained from Tomales Bay studies will be useful to researchers working in other bay and estuarine systems and to those who may be working in Tomales Bay in the future. Because it is important that research results and methodologies be shared

throughout the scientific community, the Tomales Bay Resources Project will generate articles written for publication in peer-reviewed scientific journals.

Reprints of all publications resulting from Project efforts will be forwarded to recipients of Quarterly and Annual Reports, as a part of Tomales Bay Resources Project documentation.

6.4 Task 11 - Tomales Bay Research Seminars

In response to the need for communication between all groups participating in studies of Tomales Bay and its watershed, a research seminar program will be instituted. This series, with a seminar scheduled every other month for the duration of the project, will provide a forum in which scientists, planners and other professionals can meet to discuss research needs, present study results and coordinate complementary study efforts. Each session will feature a guest speaker who will discuss his/her group's activities. During the series, opportunities will be provided for all interested parties to present their own study plans, results or needs, and to compare notes with others involved in Tomales Bay issues. These seminars will be open to the public, but are primarily intended for participation by the professional community.

6.5 Public Education Program

6.5.1 Task 12 - Summer Lecture Series

A summer lecture series especially for the general public will be scheduled during both study years outlined in this proposal. These evening programs will be held at community facilities in

the Inverness-Point Reyes area, and will be offered free of charge. Each series will consist of 8 to 12 sessions, and each session will feature a guest speaker involved in Tomales Bay research. Presentations will be non-technical, with emphasis placed on informing the public about current research activities, results and implications.

The proposed public lecture series is similar to a successful program conducted by Pacific Marine Station researchers between 1957 and 1973, during the Environmental Survey of Tomales Bay. Lectures were held in various communities, including Point Reyes Station, Marshall and Dillon Beach, and were sometimes attended by as many as 400 community members. Scientists now on staff at ANATEC Laboratories are among those who managed the earlier public lecture series, and will be actively involved in organizing this one.

6.5.2 Task 13 - Tomales Bay Newsletter

A newsletter, published bi-monthly and mailed to individuals and institutions who request it, will feature articles on Tomales Bay-related topics. Its primary purpose will be to inform recipients about current activities of the Tomales Bay Resources Project and other studies, publicize the research seminar and public lecture series, and otherwise serve as the hub of a Tomales Bay information network. The newsletter will be edited by members of the Tomales Bay Foundation, and consist of 4 to 10 pages per issue.

7.0 PROJECT MANAGEMENT

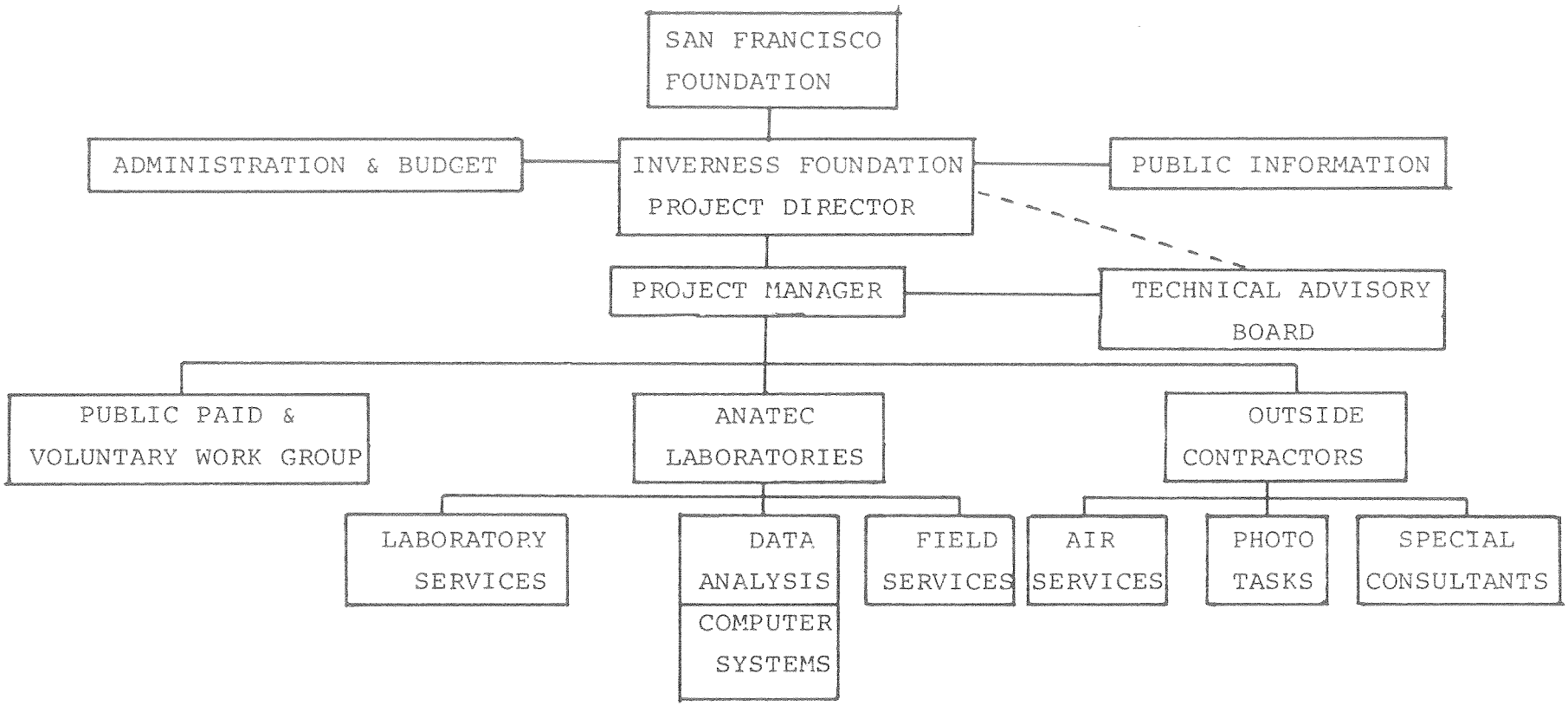
An innovative approach to project management, and to a continuing financial base for program needs, has brought together the private and public sector for this proposal. The search for funding has been a joint effort between the Inverness Foundation and ANATEC Laboratories.

- The Inverness Foundation, with its 30-year history of experience in Bay-related projects, has provided a forum for dissemination of data and exchange of ideas between local community agencies and the scientific community, and supported the literature search and Tomales Bay Bibliography revision.

- ANATEC Laboratories, with extensive staff experience in Tomales Bay, has formulated proposal content, developed the revised bibliography, provided field and laboratory facilities and contacts with traditional funding agencies, attended meetings, made presentations and otherwise assisted in obtaining conceptual support for the project from appropriate agencies and institutions.

This joint effort will continue for the proposed project. Interrelationships between Inverness Foundation, ANATEC and potential contractors are outlined in Section 7.1 and graphed in Figure 7-1.

FIGURE 7-1. ORGANIZATION CHART SHOWING RELATIONSHIPS BETWEEN VARIOUS AGENCIES, FIRMS & CONTRACTORS.



7.1 Project Management Team

An integral part of this proposed project is the Project Management Team. Tasks will be carried out, in whole or in part, by various independent agencies. Therefore, the management group must have experience in working with large multidisciplinary teams as well as public volunteers, state and federal agencies and additional private groups. The Project Manager will assist in organizing the various groups and assuring that data are circulated among all interested parties.

7.1.1 Project Co-Directors

The Inverness Foundation will be responsible for overall project management under the direction of the Steering Committee Co-directors, Bill Howe and Richard Plant. The Inverness Foundation's experience in directing similar projects is outlined in Section 8.0. Its responsibilities will include:

- Accountability to the San Francisco Foundation for project management and project results.
- Accountability to the San Francisco Foundation for financal matters.
- Coordination of community volunteers, public education and project seminars, and dissemination of information to interested parties and agencies.

7.1.2 Project Manager

The project manager, Dr. Edmund Smith, will manage study activities on a day-to-day basis and report directly to the Inverness Founda-

tion Steering Committee (Figure 7-2). The project manager will receive advice from the Technical Advisory Board. Public information from the scientific investigations will be provided by the project manager to the Inverness Foundation for dissemination. Additionally, the manager will be responsible for:

- Project quality control and for laboratory and field services.

- The scope-of-work and the coordination and exchange of information between this project's staff and the staff of other interested agencies.

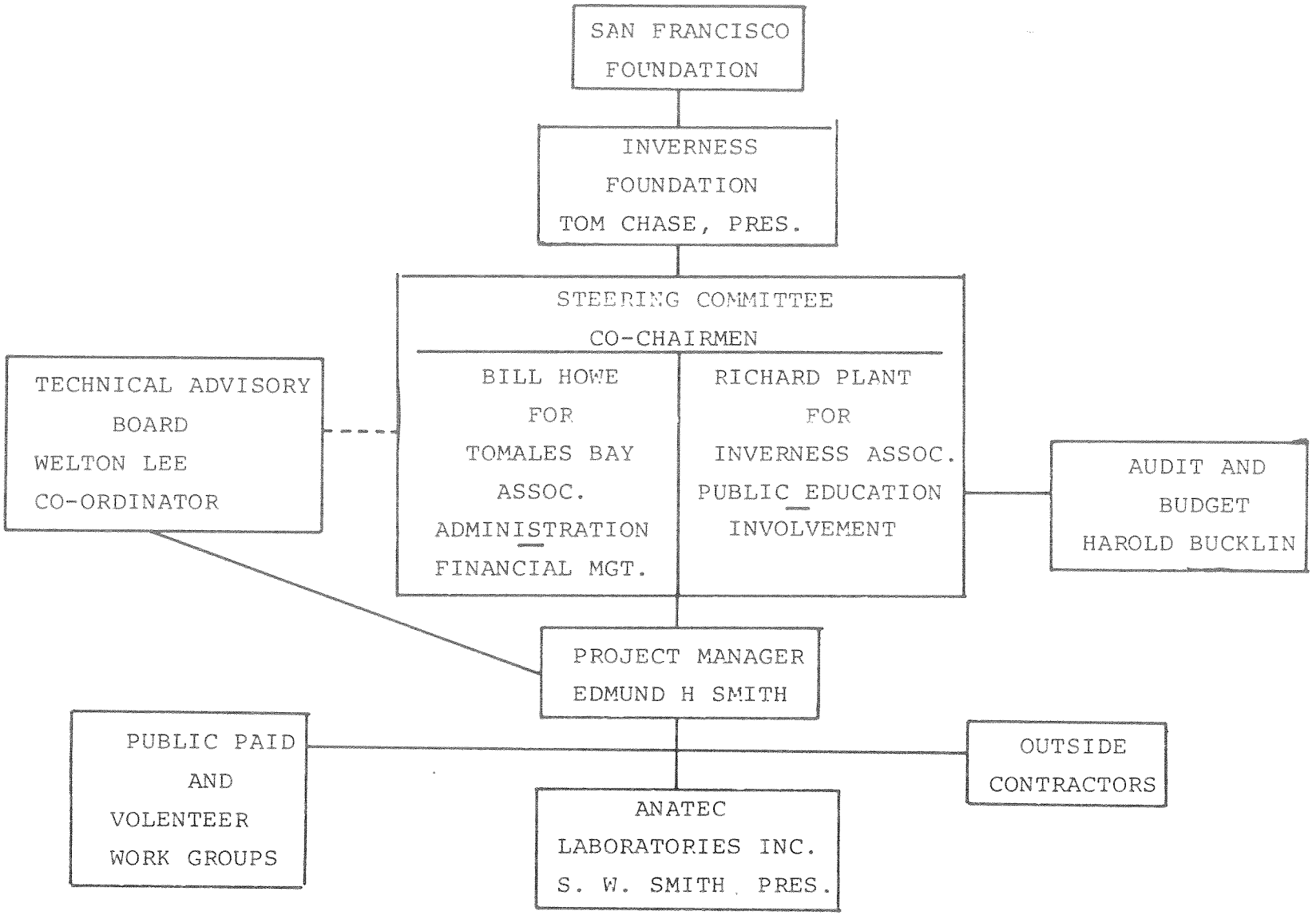
- Monitoring of the project schedule and scientific budget, and accountability to the project's Directors for the timeliness and cost of the project.

- Management of subcontractors, scientific direction and guidance for volunteer and paid community personnel.

7.2 Project Technical Advisory Board

The Technical Advisory Board (TAC) will be responsible for formulation of recommendations on the scientific content of the project and evaluations of the project as a whole, and report these to the Project manager. The data from this project are being gathered with the intention of publication in refereed international journals. The TAC will be helpful in providing peer group review prior to publication. Members of the TAC with a long-term interest in the Bay may participate in selected tasks either individually or as members of their respective organizations. The TAC may assist in suggesting funding sources in their specific area of expertise.

FIGURE 7-2. ORGANIZATION CHART SHOWING KEY MANAGEMENT STAFF.



Members of the steering committee of the Inverness Foundation and ANATEC's management team have jointly agreed upon the membership of the TAC and have already appointed many of the members. In July of 1982, a sub-committee of the TAC met at California Academy of Sciences (supported by the Inverness Foundation) to discuss the direction in which the Tomales Bay Research Project might go. This proposal follows the general agreement of the TAC as to priority projects that should be investigated.

Technical Advisory Board members, affiliation and area of expertise:

William Evans, U.S. Forest Service. Fisheries.

Peter Gogan, Sanctuary Programs Manager, Point Reyes -Farallon Islands Marine Sanctuary. Resource management.

Dr. Cadet Hand, Director, Bodega Marine Laboratory, University of California. Scientific Program management.

Dr. Joel W. Hedgpeth, Professor Emeritus at both the University of the Pacific and Oregon State University. Ecology, Invertebrates.

Judd Howell, Golden Gate National Recreation Area. Reserve management.

Dr. Chris Kjeldsen, Professor of Biology, Sonoma State University. Marine algae.

Dr. Frederic H. Nichols, Geological Survey; Menlo Park; Sampling design. Benthic ecology.

Dr. Steven Obrebski, Tomales Bay Marine Laboratory. Marine Ecology.

Douglas W. Price, Department of Health Services, State of California, Santa Rosa. Shellfish specialist.

Dr. Tom Yocum, National Marine Fisheries Service, Tiburon Laboratory. Fisheries.

7.3 Project Schedule

Phase I of the project is designed to be continued for a twenty-four month period. The Phase I project schedule is presented in Table 7-1 and represents a tentative time frame because receipt of funding will determine when the project will begin. However, the schedule will allow comparison of the level of effort and timing between tasks. Table 7-2 provides an overview of task elements unique to Phase I or Phase II, and those which are part of both phases.

7.4 Public Paid and Volunteer Work Group

The Inverness Foundation has been active in developing a local labor pool of interested and experienced personnel capable of working on the project. It is the intention of the project management team to use both paid and volunteer local citizens whenever possible. Many of the routine tasks such as stream gauging, some boat work, meter reading and general field support can be carried out by supervised local personnel. Therefore, we have made a place in the management structure for the use of this work group.

TABLE 7-1. PROPOSED PROJECT SCHEDULE FOR PHASE I.

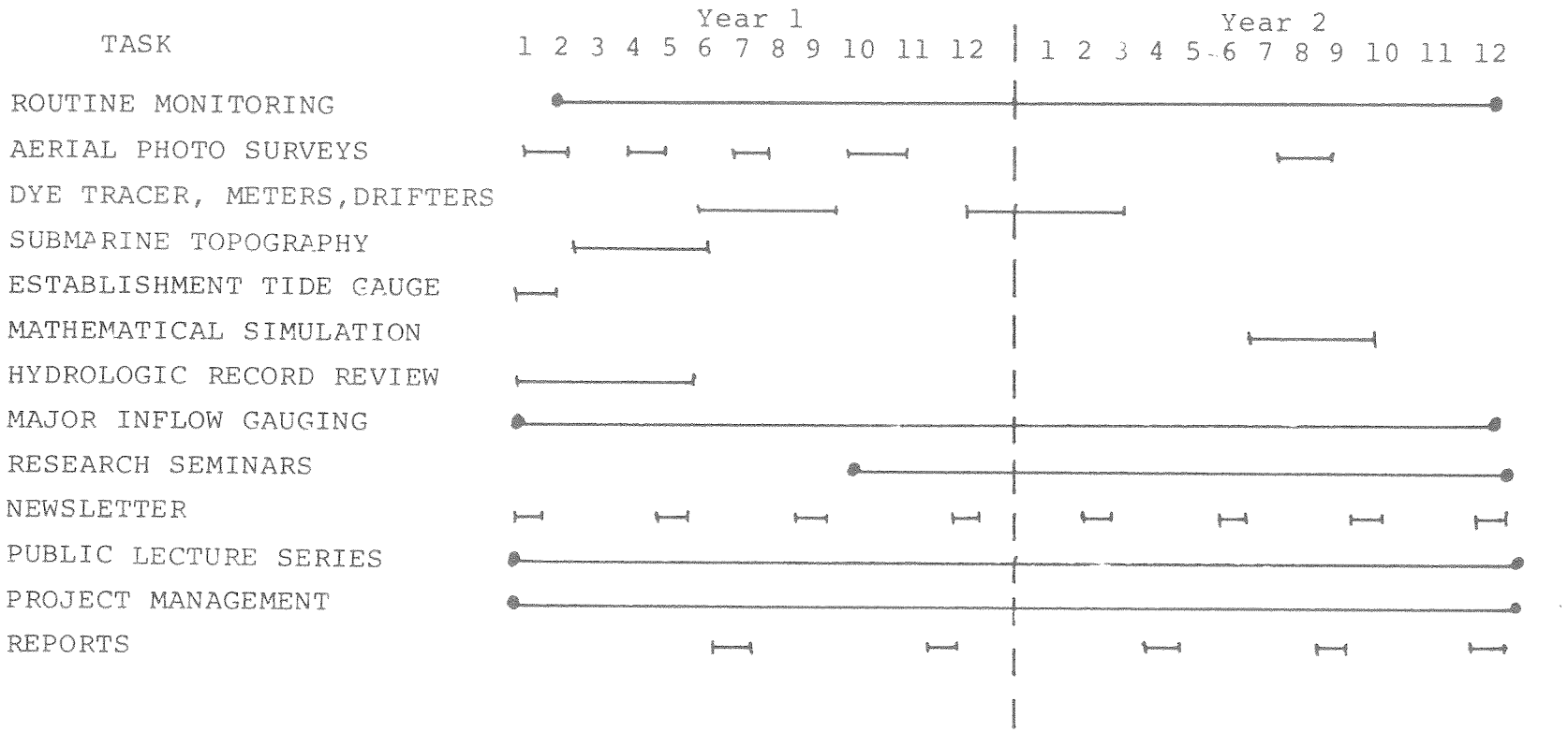


TABLE 7-2 TENTATIVE SCHEDULE FOR PHASE I AND II.

TASKS	YEAR 1	YEAR 2	YEAR 3	YEAR 4
ROUTINE MONITORING				
AERIAL PHOTOGRAPHIC SURVEYS				
DYE TRACER, CURRENT METERS, DRIFTER STUDY				
SUBMARINE TOPOGRAPHIC SURVEYS				
ESTABLISHMENT OF TIDE GAUGE				
MATHEMATICAL SIMULATION				
HYDROLOGIC RECORD REVIEW				
MAJOR INFLOW GAUCING				
TOMALES BAY RESEARCH SEMINARS				
TOMALES BAY NEWSLETTER				
BENTHIC SAMPLING				
PLANKTON SURVEY				
SELECTED TOPOGRAPHIC SURVEYS				
REVIEW AND ANALYSIS OF HISTORIC DATA BASE				
PUBLIC LECTURE SERIES				

7.5 Budget Estimates for Phase I

The Tomales Bay Resources Project has been supported by the Inverness Foundation and ANATEC Laboratories over the last three years (Appendix B). This effort will continue as the project proceeds so that many administrative and management tasks will be provided at no cost to the project.

The budget estimates presented here represent costs that are realistic for the scope of work and based on long experience in conducting these types of studies (Table 7-3).

7.6 Phase II Study Support Possibilities

As explained in Section 1.3, the Phase II program will not be completely defined until results from Phase I can be evaluated. Therefore, Phase II study details are broadly outlined below; final details will be based on Phase I results and/or changing needs for information on the Bay.

This fact, plus the two-year period prior to Phase II start-up, make it difficult to obtain guaranteed commitments of support for the second phase of The Tomales Bay Project. However, there are several possible funding sources which may be available for support of future work:

a) Educational programs and other information dissemination activities, continued from Phase I, could be supported by public donations resulting from fundraising efforts by the Inverness Foundation.

Table 7-3. Budget Estimates Phase I (2 years)

Task 1	Routine Monitoring	35,444.00
Task 2	Photo Imagery	11,106.00
Task 3	Dye Tracer Experiments	
	Summer (Tidal gauge)	39,806.00
	Winter	38,408.00
Task 4	Topographic Surveys	6,471.00
Task 5	Mathematical Simulation	7,880.00
Task 6	Hydrologic Record Review	4,980.00
Task 7	Major Inflow Gaging	5,260.00
Task 8	Public Information Dissemination	
	Tomales Bay Research Seminars	
	Public Education Program	
	Tomales Bay Newsletter	9,573.00
Task 9	Project Management	
	Inverness Foundation	7,840.00
	Total Project Costs	$ 166,768.00

b) Historical documentation of the Bay and review of scientific data may be supported by NOAA through the Marine Sanctuary Program. A proposal has been submitted to that agency for possible funding in the next fiscal year.

c) Long-term monitoring could be funded by state regulatory agencies such as the Regional Water Quality Control Board and/or the State Public Health Department, depending on results of the Phase I program and the availability of state funds.

d) MMWD may be willing to provide some funding for the portions of the project related to watershed management, freshwater flows and long-term changes in Bay salinity.

e) Specialized studies of biological aspects of the Bay could be of interest to NSF, Office of Marine Pollution (NOAA) as a possible control site for San Francisco Bay Studies. Representatives from these agencies have already expressed an interest in this type of program.

We feel confident that continuing interest in the Bay will provide Phase II funding for the more important aspects of the project.

8.0 CAPABILITIES AND QUALIFICATIONS

8.1 Inverness Foundation

The Inverness Foundation was incorporated on March 5, 1965, as a non-profit corporation organized solely for general charitable and eleemosynary purposes under part 3 of Division 2 of Title 1 of the California Corporations Code. The Inverness Foundation also qualifies under Section 501c(3) of the Internal Revenue Service Code as a tax exempt entity entitled to accept tax deductible contributions. Its Articles of Incorporation state that the primary and specific purposes for which it was organized are to 1) maintain and preserve the natural beauty of the Inverness-Sea Haven area of the County of Marin, 2) create and maintain parks and parkways, pathways and trails, and 3) thereby incidentally provide recreational facilities for the benefit of the children of the area.

The Board of Trustees, which constitutes the Corporation, are nine in number, and according to the Articles of Incorporation shall be appointed by the Board of Directors. The names and addresses of the officers and trustees are as follows:

Harry Betaque (Vice President)	P.O. Box 564	Inverness 94937
Howard Benedict	P.O. Box 396	Inverness 94937
Tom Chase (President)	Star Route	Inverness 94937
Barbara Dewey	P.O. Box 634	Inverness 94937
Corwin Mocine	P.O. Box 321	Inverness 94937
Avis Drieschman (Treasurer)	P.O. Box 474	Inverness 94937
Randy Engler	P.O. Box 272	Pt. Reyes Stn. 94956
Elizabeth Zarlengo (Secretary)	Star Route	Pt Reyes Station 94956

One Board position is vacant at this writing.

8.2 Relationship of the Inverness Association and the Tomales Bay Association to the Project.

The Inverness Association and the Tomales Bay Association are two broadly based, environmentally active associations in West Marin which have endorsed the Tomales Bay Resources Project and have requested the Inverness Foundation to act as sponsor of the Project. Both of these organizations offer not only moral support but also whatever limited financial support of which they are capable. Since July of 1979 the Inverness Association and the Tomales Bay Association have acted jointly in a mutual concern over the proposed withdrawal of fresh water from local creeks, ultimately affecting the amount of water entering Tomales Bay. Both of these organizations have worked together for over four years to help resolve potential problems in the affected creeks and to better understand the complex Bay system. These two associations and their previous history of cooperation are discussed below.

8.2.1 The Inverness Association

The Inverness Association is the oldest, continuously active community organization in the Tomales Bay area. Incorporated on October 3, 1929 as the Inverness Improvement Association, it retained that title until 1974 when it was changed to the present name. The association has long been the focus of community civic activity in the unincorporated settled areas of the Inverness Ridge on the west side of Tomales Bay. Membership, currently around 400, is open to summer, weekend and full-time residents as well as to non-residents interested in the Inverness area. The officers and trustees of the Inverness Association are the same as the Inverness Foundation (Section 8.1).

In addition to its natural concerns for the maintenance of pedestrian paths and trails, children's swimming lessons, the physical up-keep of the Village Center around First Valley Creek, and assisting as a liaison between community and county governments, the Inverness Association has had a long history of involvement with Tomales Bay. Examples of projects completed by this organization are presented in Section 8.4.2.

8.2.2 The Tomales Bay Association

The Tomales Bay Association was formed in the 1960's as a loose grouping of East Shore Tomales Bay residents, mainly from the Marshall area, who were concerned about unplanned residential expansion in the ranchlands which border the Bay. The Association was incorporated in 1970 with membership including interested people from all sides of the Bay. Currently there are about 140 members. The Association's stated purpose affirms that it seeks to promote the natural beauty of the Tomales Bay area, from Dillon Beach on the north to Five Brooks on the south, from the ridgeline on the east to the Pacific Ocean on the west. The major objectives of the Tomales Bay Association are to understand and articulate environmental concerns and to be involved with prudent planning both for the bay and the surrounding land areas. The Association has been very active in the Tomales Bay area as can be seen by the list of completed projects presented in Section 8.4.3.

8.3 Tomales Bay Resources Project

8.3.1 History

Continued concern over the lack of baseline information on the cumulative effect of large freshwater withdrawals from Tomales

Bay was the starting point for the Tomales Bay Resources Project. Representatives from the Inverness Association and Tomales Bay Association became aware that a potential threat to the bay was still not being addressed in the efforts to protect and enhance the anadromous fish population of Lagunitas Creek. This baseline information requires scientific investigations, and the responsibility for initiating such studies remained unclear. Most of the available information stemmed from earlier studies performed by the Pacific Marine Station (no longer in operation), and much of that research had been conducted toward the mouth of the Bay. However, contact with the recent Director of the Pacific Marine Station led to an association which gave birth to the Tomales Bay Resources Project.

In 1981 an ad hoc committee, consisting of people who had been working together on the Lagunitas Creek project, as well as other community volunteers of diverse experience, met with Dr. Edmund Smith to set up the Resources Project. Dr. Smith was Director of the Pacific Marine Station from 1965 to 1979 and now serves as Executive Director of ANATEC Laboratories. At this meeting however, it was agreed that the Project should be more wide-ranging in its concerns than merely devoted to the problem of freshwater withdrawals. The project scope was enlarged to include a basic understanding of bay circulation, water quality, bathymetry, total freshwater input and seasonal variation in major features (aerial photography). Thus, the study's overall purpose is to gather scientific data which provide an essential basis for the wide range of planning decisions involving the bay and its watershed.

Having agreed on the need for the project, the ad hoc committee held a public meeting in the Inverness area to introduce the project to the community and seek its support. Having confirmed community interest and support, it approached the Inverness Founda-

tion to act as a sponsor for the project. The Foundation agreed and appointed an official Steering Committee for the Tomales Bay Resources Project.

8.3.2 Current Status

The Steering Committee for the Tomales Bay Resources Project has been appointed by the Board of Trustes of the Inverness Foundation to serve as its agent in dealing with all matters affecting the Project. The committee is responsible to the Foundation and all moneys involved are paid into and out of the Foundation's accounts, at the recommendation of the Steering committee. There are currently ten regular members of the Steering Committee, which is co-chaired by Mr. Richard Plant from the Inverness Association and Mr. William Howe from the Tomales Bay Association. Another member, Mr. Harold Bucklin, acts as Accountant for the committee and coordinates financial transactions with the Treasurer of the Inverness Foundation.

The Steering Committee is composed of the following members:

John Boyce-Smith	P.O. Box 35	Inverness 94937
Harold Bucklin (Treasurer)	P.O. Box 423	Inverness 94937
Vivienne Howe	P.O. Box 466	Inverness 94937
William Howe (Co-Chairman)	P.O. Box 466	Inverness 94937
Corwin Mocine	P.O. Box 321	Inverness 94937
Richard Plant (Co-Chairman)		Inverness 94937
James Scanlon	P.O. Box 44	San Geronimo 94963
S.S. Schweitzer (Secretary)	P.O Box 35	Inverness 94937
Patrick Simpkins	P.O Box 507	Pt. Reyes St.94956
Henrianne Slattery	P.O Box 55	Inverness 94937
Anne West (Honorary Member)	P.O Box 422	Inverness 94937
Tom Chase (Ex Officio)	Star Route	Inverness 94937

Qualifications of Steering Committee members, in the form of short biographies, are presented in Appendix A.

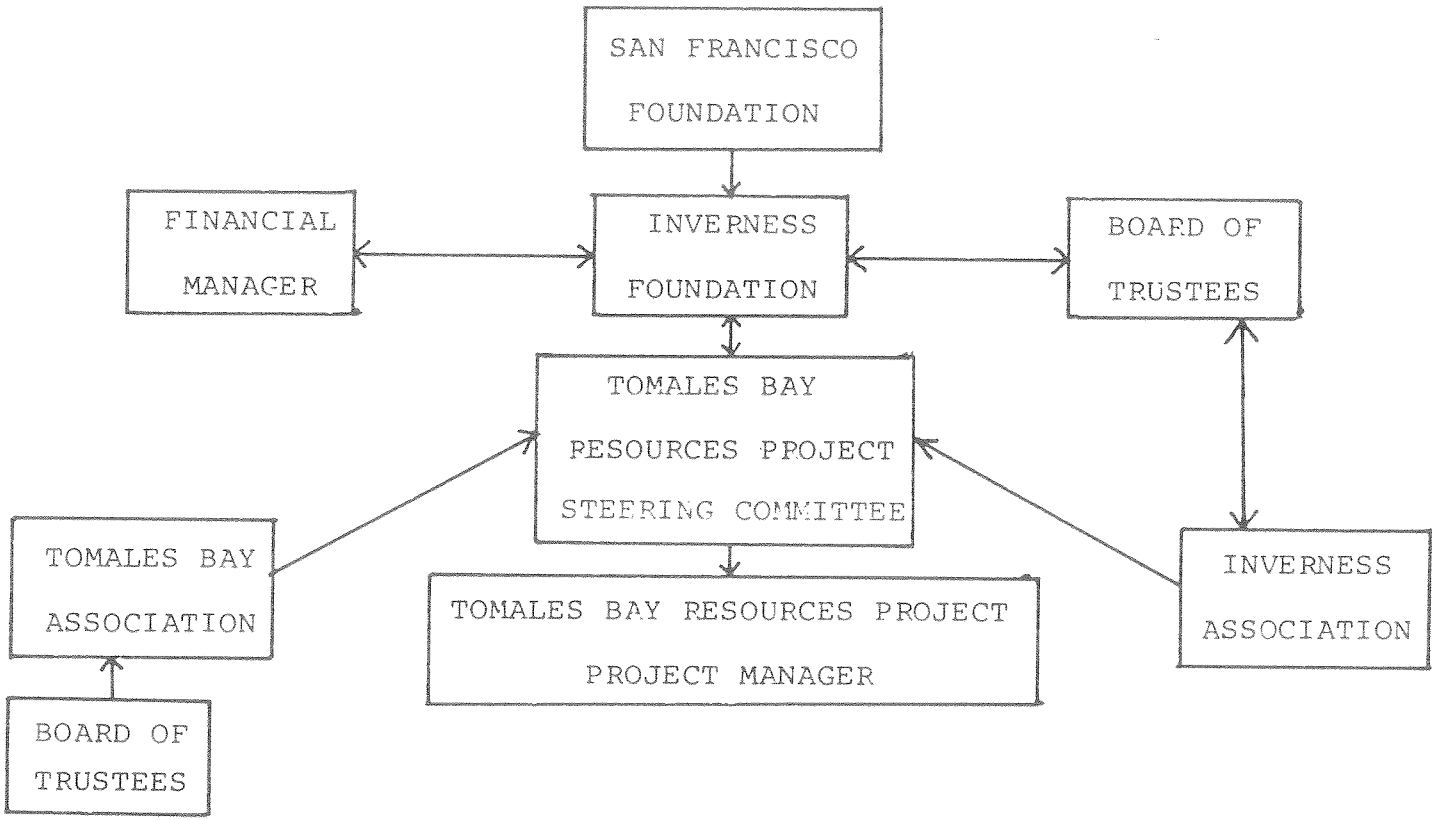
8.3.3 Level of Effort and Support Generated

Having sought and received wide local support for the Project, the Committee initiated a local fund-raising project as evidence of that support. At the same time it was decided that the first step in the project was to use the bulk of the funds raised to contract with ANATEC Laboratories for the updating of a bibliography of research conducted in Tomales Bay and the surrounding coastal areas (Section 1.1). Both of these initiatives have now been successfully completed. Appendix B presents data on financial contributions to the TBRP made by the Inverness Foundation and ANATEC Laboratories.

Dr. Edmund Smith met with a subcommittee of the Technical Advisory Committee in 1982 to establish priorities and outline a scope of work for the first phase of the Project. The co-chairmen of the Steering Committee attended this meeting, held at the California Academy of Sciences in San Francisco. The proposals which are now being submitted to funding agencies are a direct outcome of the decisions reached at that meeting.

A schematic representation of the relationship between the San Francisco Foundation, Inverness Foundation and other organizations involved with the Tomales Bay Resources Project is given in Figure 8-1.

FIGURE 8-1 PROJECT ORGANIZATION AND SUPPORT BASE.



8.4 Selected Project Lists

8.4.1 Inverness Foundation

Restoration of First, Second and Third Valley Creeks and Purchase of Shoreline Land in Inverness.

In June 1983, the California State Coastal Conservancy awarded partial funding ($125,500) for this project, the primary purpose of which is to restore and stabilize stream habitat severely altered or damaged by storm activity in 1982. Project tasks include the removal of logs, large debris and accumulated sediment from the streambeds; slope contour and streambank stabilization; replanting of native species to restore the riparian vegetation damaged by floodwaters. Also included in this project are plans for the purchase of two properties in the town of Inverness, to provide public access to the Tomales Bay shoreline. Mr. Richard Plant, Co-Director of the Tomales Bay Resources Project, is Manager of this Restoration Project. Total project cost: $371,499.00 (matching funds raised by the Inverness Foundation).

Bibliography of Research on Tomales Bay, 1983 Revision

The Foundation funded this preliminary Tomales Bay Resources Project task, which was completed in February, 1983. The 1975 edition of the Bibliography, published by the Pacific Marine Station, was revised to include research reports issued in the past eight years. The entire Bibliography has been entered into a computer database to facilitate record access and future revisions. The work was performed by ANATEC Laboratories staff (see Section 1.1 of this proposal).

Protection of Salmon and Steelhead Fishery in Lagunitas Creek. In 1979, the Inverness foundation, at the request of the Inverness and Tomales Bay Associations, began accepting contributions to fund actions intended to maintain flow rates and water quality adequate to support an anadromous fish population.

Emergency Generator Purchase. In response to the January 1982 storm, the Foundation spearheaded a fundraising effort which resulted in the purchase and installation of a large emergency generator. The generator is located at St. Colombo Church, where it will be used to produce light and refrigeration in the event of an earthquake or other natural disaster.

West Marin Paths. The Inverness Foundation is sponsoring this project to develop pedestrian and bicycle paths in the Inverness-Point Reyes Station Area.

Brock Schreiber Boathouse Purchase. In 1965, funds were raised for the purchase of this building, designated an historic landmark by the federal government, and an adjacent 1000 feet of beachfront known as Children's Beach, both for community use. Volunteers from the community donated labor for the restoration of the building. The boathouse and beach were recently sold, with deed restrictions to ensure compatibility of use with community values and continued public access to Children's Beach.

8.4.2 Inverness Association

First Valley Creek Nature Trail. In 1976, the Association and the Audubon Society funded a project with local school students, and a nature trail was built along First Valley Creek. After the 1982 flood destroyed that trail, the Association led in the effort to restore not only this trail and the surrounding vegetation, but also plans restoration efforts around the other two

principal streams in Inverness. This project implements a portion of the Tomales Bay Estuarine Enhancement Program proposed by the California Coastal Conservancy.

Tomales Bay State Park. The Inverness Association was instrumental in the establishment of Tomales Bay State Park, as well as the more recent additions of parklands south of Inverness.

Public Access to Beaches. The Association acted as a catalyst for environmental concerns in the Marks versus Whitney legal action, thereby playing an important role in the landmark State Supreme Court decision establishing the right of public acccess to beaches below the mean high tide line.

Protection of Anadromous Fish Populations in Lagunitas Creek. In 1978 and 1979, the possibility of increased withdrawals of water from Lagunitas Creek elicited concern for the anadromous fish population which the Creek supports. In 1979, an alliance was formed with the Tomales Bay Association to work with state and government agencies and public utilities to mitigate potential effects of increased Creek withdrawals.

Tomales Bay Resources Project. Initial endorsement of the project was given at a members' meeting in July of 1981. The Board of Directors has authorized financial contributions to the Project for some preliminary tasks and, acting as the Board of Trustees for the Inverness Foundation, has formally undertaken sponsorship of the project.

8.4.3 Tomales Bay Association

Countywide Plan and California Coastal Commission Support. Since the adoption of Marin's Countywide Plan in the early 1970's, the Tomales Bay Assocation has devoted energies to support of the

Plan and of California Coastal Commission activities. These efforts have included:

- Assistance with the creation of a Master Plan for the Golden Gate National Recreation Area, including the Point Reyes National Seashore. Specific activities included efforts to expand the GGNRA, promote development of wilderness areas in the Point Reyes Seashore and develop a connecting trail between Five Brooks and Bear Valley.

- Support for the creation of the Point Reyes-Farallon Islands Marine Sanctuary, which includes Tomales Bay.

- Careful assessment of the effects of potential offshore oil drilling in adjacent areas of the Bodega Basin.

Local Land-Use Planning. The Association is also active in land-use planning programs in the community, specifically issues in the Marshall area, including Marconi Cove, and at Lawson's Landing. A principal goal in its planning programs is the preservation of agricultural land on the east shore of Tomales Bay.

8.5 ANATEC Laboratories, Inc.

A number of the Staff at ANATEC Laboratories have long-term interest and experience in Tomales Bay. Because of this interest, and our strong support of well-established baseline information as a way of more successfully managing resources, our orrganization decided to expend money and time to jointly, with the Inverness Foundation, pursue funding to undertake a study of Tomales Bay.

Our staff and organization has extensive experience in this type

of program, not only in Tomales Bay but in many of the bays and estuaries in California. The following pages provide a brief description of our experience and the staff and facilities available for the Project. It is important to note that some of our staff are Marin residents and live in the Tomales Bay area.

ANATEC is housed in a modern 6,500-square-foot facility located in Santa Rosa, California. The firm was established in 1974, and qualifies under State and Federal guidelines as a woman-owned firm.

The company is staffed by a well-integrated group of 20 highly qualified biological, chemical and engineering professionals who are experienced in conducting:

- Field and laboratory studies involving short- and long-term biological monitoring and environmental assessment, and
- Data management, integration and presentation.

ANATEC has the equipment necessary to execute both field and laboratory investigations. Our facilities include:

- A complete State-approved analytical chemical laboratory with controlled-environment laboratories,
- A complete biological laboratory for sorting, identification and enumeration of samples,
- Three research vessels with complete inshore and offshore collecting equipment,

- A mobile field laboratory,
- Macro, micro, aerial and underwater photographic and high-speed cinematographic facilities,
- A large research library,
- Computer-based data processing, digitizing, and word processing capabilities.

During the seven-year history of the company, ANATEC has developed a management, laboratory, and field work force that specifically addresses the requirements of the contractor, with an interdisciplinary approach to problem-solving. Through our experience we have found that such an approach assures:

- Highest professional standards at all levels and stages of a project, and
- A built-in quality assurance program developed through an interdisciplinary approach.

More detailed descriptions of ANATEC's routine analytical and biological services, support and field facilities, and laboratory equipment can be found in Appendix C.

8.5.1 Representative Biological Projects

Tomales Bay Experience

Staff now employed at ANATEC have extensive experience in Tomales Bay. The particular field and laboratory team assigned to the

project have had a total of 27 years experience on the Bay. Many of the early studies in Tomales Bay were done by members of the ANATEC staff. Seminar series, public meetings and the original Technical Advisory Board for Tomales Bay was organized in 1964-65 by staff at the Pacific Marine Station now associated with ANATEC Laboratories. The early circulation studies, water quality monitoring and many of the biological studies were designed, managed and completed by this same staff.

Shelter Cove ASBS Study. Client: Resort Improvement District No. 1, Whitethorn, California. The project involved an intensive survey of rocky intertidal, gravel beach and terrestrial biomes to provide baseline information on which the State Water Resources Control Board could make decisions relative to an existing discharge to the ocean. Involved were water sampling and analysis, dye studies, intertidal transects, sediment analyses and terrestrial floral and faunal surveys. The conditions were such that new water sampling techniques had to be designed for both nearshore and open-water sampling. ANATEC has been chosen to continue the long-range monitoring of the area prior to a final decision for this environmentally sensitive discharge. A year-long weather collection study emphasizing wind and rainfall patterns and evapotranspiration rates is being conducted. These data will be used to evaluate feasibility of wastewater disposal on land as opposed to present ocean outfall. A biological monitoring program in the intertidal using remote operating cameras is also underwater.

Bodega Harbor Baseline Study. Client: County of Sonoma. The one-year study involved monthly samples of the benthos by Ponar grab, as well as a large intertidal sampling grid of 100 stations. Small bio-cores were used for the intertidal study. Particle-size analysis was conducted on the sediments from each

core. Shoreline and intertidal surveys were performed to complete the baseline study. Water quality analyses for nutrients, bacteria, and B.O.D. were conducted monthly. Dye releases were made and followed through full tidal cycles to establish water movement to determine bay flushing rates.

Water Quality Monitoring Study For San Francisco Bay/Delta. Client: Corps of Engineers, San Francisco. A study to (1) develop a long-term monitoring program for selected contaminants in San Francisco Bay; (2) collect the initial data set for some parameters and sites to be used in the long-term monitoring program. Parameters measured included dissolved oxygen, pH, nutrients, salinity, trace metal elements, and PCBs in the water column, sediment and suspended test organisms: Mytilus edulis and Corbicula fluminea. Corbicula fluminea was used in bioassay experiments to observe effects of varied concentrations of copper, cadmium and zinc and the dependence of those effects on salinity. Long-term chronic effects of trace contaminants on experimental and native invertebrates were also studied. Histological study and physiological tests were conducted on selected organisms to determine stress pathways of trace contaminants.

East Bay Wet Weather Monitoring and Baseline Study. Client: East Bay Municipal Utility District. ANATEC served as project manager for the Joint Venture in a study to assess the environmental impact of wet weather overflows from the EBMUD plant and local street drains. To establish baseline information, monthly samples were conducted for nekton and epifauna; quarterly collections were conducted for deep and shallow water benthics. Long-term chronic effect bioassays with marine invertebrates, bivalve bioaccumulation studies and sediment bacterial surveys were developed to assess the short-term impact of wet weather

events. Hydrographic studies were conducted including dye traces. Special chemical sampling (PCBs, trace metals) and bacterial die-off studies were also undertaken. Wet weather sampling was conducted on short notice and under severe weather conditions and required considerable logistical organization. Special helicopter sampling devices were designed in our machine shop to enable fast and reliable collection of large numbers of samples in shallow water and to make possible the continuous monitoring of dye plumes. ANATEC's chemical laboratory performed analyses of samples collected during the study.

Water Quality and Benthic Fauna Study, South Bay Dischargers Authority. Client: South Bay Dischargers Authority as a subcontract to Bechtel Corporation. A baseline monitoring project in the South Bay required quarterly collection and processing of benthic and water quality samples for 15 permanent South Bay stations. Specific tasks included enumeration and identification of all species collected, particle-size analysis of sediment, analysis of data, and quarterly report compilation. To accrue additional information on size-age distribution of the selected species populations, size measurements were performed on those five bivalve species which had a high frequency of occurrence, a high mean density, and a low coefficient of variation. These aspects of the species enhanced detection of subtle temporal and spatial changes in population densities. This study established the biological baseline data for the EIR-EIS entitled, "Draft Environmental Impact Report and Environmental Impact Statement - South Bay Dischargers Authority Treated Wastewater Disposal Program, November 1978" written by Bechtel Corporation.

Hydrographic and Biological Program in the Petaluma River, San Pablo and San Rafael Bays. Client: East Marin-Southern Sonoma Clean Water Grant Project. The purpose was to establish predis-

charge conditions for two sewage treatment plants and to provide information on the most suitable site for Bay discharges. Photographic analyses of dye releases and chip movements were made prior to the beginning of field work by using the U.S. Army Corps of Engineers' physical model. In the field study, an airplane and two vessels were used to acquire the following data: continuous shipboard measurements of dye concentrations, rates of relative dye and drogue movement, surface current direction and water quality parameters. Aerial photography was used to establish simultaneously the position of drogues used during the study. Dye was discharged over a 5-day period from the Novato plant and followed by employing helicopter sampling for a 10-day period. Dye and salinity movements were plotted over a large area of San Pablo Bay. Quarterly benthic samples were taken in six localities along with one year of fish trawls. Fish size-classing, stomach contents and species composition were determined and analyzed for the six areas. Life history studies on Crangon franciscorum and Crangon nigricauda were conducted including size-classing, egg cluster size, migratory patterns and parasite infestation. At one station the type and frequency of parasite infestations were followed over time in both species of Crangon.

Fish, Benthic, and Macroinvertebrate Infaunal Survey in Sonoma Creek/Hudeman Slough. Client: Sonoma Valley County Sanitation District. A year-long extensive analysis of several sloughs targeted for future outfall by the District involved fish population studies and gut analyses, macro-invertebrate studies, infaunal population life histories and sediment particle-size analyses and water quality testing. These studies were baseline in nature, and the field capabilities of ANATEC were tested by the access and logistic difficulties presented.

City of San Francisco Wastewater Management Program. Client: City of San Francisco. E. H. Smith of ANATEC served on the

Technical Advisory Board for the City of San Francisco for a number of years. Dr. Smith was involved in the review of all the biological and chemical data produced by the City of San Francisco Wastewater Project and in the writing of a position report for the city on whether the Bay discharge or an ocean discharge was the best alternative. Possible impacts on biological populations and beneficial use potential were considered. In addition, on-site investigations were made of the impact of the Lands End Treatment Plant on intertidal fauna and flora. Both of these projects led to the writing of wastewater treatment waiver petitions for ocean and Bay discharges. The waiver petitions were written after review of real and potential impacts of wastewater on the biota and were submitted to the EPA for review and possible action.

Elkhorn Slough Baseline Study. Client: Pacific Gas and Electric Company. The purpose of the investigation was to determine whether thermal discharges from four power plant units at Moss Landing, California, exerted any significant effects on the aquatic ecosystems of Elkhorn Slough. The various sampling programs included phytoplankton and zooplankton collection and identification; sub-tidal and intertidal faunal sampling; adult and larval fish analysis; water quality analyses; and in situ phytoplankton respiration rate determinations. In addition, clam density estimates, coliform and heavy metal determinations in clam tissue, and bird and mammal surveys were conducted.

Benthic Population and Life History Study. Client: Jones and Stokes Associates, Inc. for Richmond Sanitary District. A benthic community and population/life history study of Ampelisca milleri in the Southampton Shoal area off Pt. Richmond, California, was performed. The project required quarterly benthic sampling with sample enumeration for community analysis and

monthly sampling with an epibenthic sled for the amphipod, A. milleri. Amphipods were collected for size-frequency analysis and determinations of fecundity and of growth rates of eggs and juveniles. ANATEC was selected to continue predischarge water quality monitoring and sediment trace element studies in the same area.

Circulation and Flushing Characteristics and Nonpoint Source Contamination of Humboldt Bay. Client: California Water Quality Control Board, North Coast Region. ANATEC, in joint venture, is studying the circulation and flushing characteristics of the Bay and will assess the sources of runoff and the relative sensitivity of major shellfishing areas to runoff-borne bacterial contamination. An intensive field-laboratory study as well as an analysis of control and management strategies will be done. Contamination of the oyster fishery has been linked to wet weather and sewage treatment plant malfunction but little is known regarding contributions by nonpoint surface runoff. Work is being done in connection with the Environmental Protection Agency's California Areawide Waste Treatment Management Planning Program. Findings of both studies will be coupled to formulate management plans for control of nonpoint pollutant sources and the affected beneficial uses.

Dungeness Crab Bioassay Studies. Client: Brown and Caldwell, Inc. for the City of San Francisco. We advised on the City of San Francisco toxicity studies and consulted on the experimental design, laboratory development, actual bioassay experiment and analysis of data. Test organisms (Dungeness crab adults, zoea and eggs) were tested in pilot sewage treatment plant effluents for both acute and long-term effects. Both static and flow-through bioassays were conducted.

Sediment-substratum Studies on Selected Invertebrates. Client: ANATEC staff research project. Studies were conducted on the sediment-substratum relationship for the bivalves Macoma secta, M. nasuta and Tellina carpenteri. These studies included feeding, sediment uptake rates, ciliary beat carrying capacity, movement of sediments on demibranchs and the role of organic material as food found in the interstitial matrix between sand grains. These three clams and others have been studied in the laboratory and in the field in San Francisco Bay, Tomales Bay and Elkhorn Slough. Bioassay studies including trace metal uptake were conducted on Corbicula fluminea and Mytilus edulis. In addition, studies both in the field and laboratory were conducted on numerous polychaetes, including Axiothella rubrocincta, Armandia brevis, Heteromastus filiformis, and Nephtys caecoides. These investigations involved maintaining the polychaetes in aquaria and studying development, survival, sediment change, feeding and movement within the sediment.

Habitat Characterization of the Northern and Central California Coast. Client: Jones and Stokes Associates, Inc. for U.S. Fish and Wildlife Service. ANATEC was responsible for the environmental characterization of the exposed intertidal habitats of the northern and central California coastline. The United States Department of the Interior, Bureau of Land Management (BLM), will use these in the evaluation of lease applications for drilling tracts on the outer continental shelf (OCS). Physical and biological environmental characteristics, energy flow, real and potential impacts, floral and faunal characterizations, and environmentally important organisms were considered in detail. The ANATEC staff also contributed to sections on geology, hydrology and physical oceanography, and generated extensive bibliographic data.

Wildlife Inventory of Northeastern Nevada. Client: Bureau of

Land Management. An inventory of the terrestrial nongame vertebrates of northeastern Nevada, the project involved both literature surveys and museum research and verification. The staff visited or contacted museums, universities, state and federal agencies, and individuals in Nevada, California, Utah, Idaho and Colorado. Nongame sightings were verified and organized into a reference manual by county and BLM district,, with locations given to one-sixteenth of a section. Approximately 6000 entries of 276 species were made in the manual.

Impacts of Agricultural Nonpoint Source Pollutants on Beneficial Uses of the San Joaquin River Basin. Client: California Water Quality Control Board, Central Valley Region. This study is part of a larger program wherein agencies including the CVRWQCB, the California Association of Resource Conservation Districts, the U.S. Department of Agriculture Soil Conservation Service, and the University of California Cooperative Extension Service are evaluating water quality problems affecting beneficial uses as well as developing and implementing mitigating farm management practices through cooperation with farmers and other interested parties. ANATEC is responsible for characterizing the beneficial uses of surface waters of the San Joaquin River Basin; reviewing and analyzing water quality literature and data in terms of agricultural pollution; designing and conducting a pilot study relating farm practices to pesticide movement through the ecosystem; assisting in preparation of a farmer's manual of best management practices; and designing a monitoring program capable of operating at several levels of funding.

Cumulative Impacts of On-Site Waste Disposal Systems on North Coast Surface Waters. Client: RAMLIT Associates for the North Coast Regional Water Quality Control Board. ANATEC reviewed and compiled existing nutrient data for the North Coast Region. A technical report discussed existing and potential aquatic ecosys-

tem problems resulting from nutrient additions to streams, coastal and estuarine waters, and lakes and reservoirs. RAMLIT personnel, with input from ANATEC staff, developed a system for predicting the water quality impacts of various residential developments (at different levels of completion) which are planned in areas dependent on septic tanks.

Experimental Ecological Reserves, Phase II Study. Client: The Institute of Ecology for National Science Foundation. E.H. Smith of ANATEC is a co-principal investigator on the grant. The two-phase project is to update the network of ecosystem reserves for the United States and evaluate new sites designated during the second phase of the project. Emphasis on aquatic sites is stressed in this second phase and ANATEC staff developed the site classification system and recommended marine and estuarine sites. From over 500 sites proposed by agencies and universities contacted during the study, some 280 have been reviewed and evaluated. The project includes site visits, literature evaluations, development of a national aquatic habitat classification system and the evaluation of individual site applications.

8.5.2 Staff - Partial Listing

Anderson, Greg. M.S., University of the Pacific (Marine Science). Analytical Laboratory Director. Trace element methods development, capillary chromatography, software design, project management.

Brook, Kristine. M.P.H., University of California, Los Angeles. (Environmental Health). Chemistry Technician. Health effects of certain organo-phosphate pesticides, toxicological assessments of various compounds, routine water

chemistry.

Digitale, Carol. B.S., University of California, Davis (Food Science). Chemist. Food microbiology, trace organic contaminants of food and feed, soil and tissue analysis.

Hand, William G. Ph.D., University of California, Santa Barbara (Marine Invertebrate Biology). Senior Biologist. Physiology and behavior of invertebrates, computer-assisted behavior analysis of larvae and marine algae.

Hirtz, Paul. B.S. (in progress), University of California, Berkeley. Laboratory Supervisor. Chemical characterization of water, wastewater and sediments.

Ried, Dalene. B.A., San Francisco State University (Biology). Biologist. Invertebrate taxonomy, marine and estuarine ecology, field studies, literature review, report preparation, and editing.

Rock, Robert M. M.S., Washington University, St. Louis, Missouri (Environmental and Sanitary Engineering). Senior Engineer and Marketing Analyst. Pesticides and hazardous materials, bioassays, federal grants and programs, wastewater treatment plant planning and construction.

Rotz, William G. M.S., University of the Pacific (Marine Biology). Biological Laboratory Director. Quality control, life history analysis, benthic ecology, hydrography, and air quality monitoring.

Saunders, Holly. B.A., Whittier College (Biology). Office and Laboratory Manager. Word processing and computer program coordinator, documents security, quality assurance analyst,

clerical supervisor.

Smith, Edmund H. Ph.D., University of Glasgow (Zoology). Principal/Executive Scientific Director. Marine ecology, invertebrate marine zoology, marine law.

Smith, Sue Weinreb. B.A., University of California, Berkeley (Political Science). President/Executive Administrator. General and fiscal management.

Weinreb, Everett. A.A., San Mateo College (Aeronautical Science). Research Associate, Pilot, Photographic Consultant. Aerial surveys and mapping, underwater photography, specialized photographic applications and equipment.

Further discussion of ANATEC Staff qualifications, in the form of short biographies, is presented in Appendix D .

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APPENDICES

APPENDIX A

QUALIFICATIONS

TOMALES BAY RESOURCES PROJECT

STEERING COMMITTEE

APPENDIX A. Qualifications of Tomales Bay Resources Project Steering Committee

John Boyce-Smith of Inverness received his A.B. from the University of California, Los Angeles. He is now retired from Foremost McKesson where he rose to be Vice President and Treasurer. Among his volunter activities, he served as Chairman of the Audit Adivsory Committee for the City and County of San Francisco. He also was President of the Coro Foundation and Treasurer of the Marin Chapter of the American Red Cross. In West Marin he was President of the Inverness Association and of the Inverness Foundation in 1981 at the time the Tomales Bay Resources Project was developed as a project for the Foundation. He served four years on the Inverness Association/Foundation Boards and was Treasurer prior to his Presidency. In 1980 he was Commodore of the Inverness Yacht Club of which he had previously been Treasurer. An amateur cellist, he still plays in the West Marin Community Orchestra. He is also chairman of the Marin County Planning committee of the United Way of the Bay Area.

Harold Bucklin, (Treasurer) of the Steering Committee, of Inverness and now retired, graduated from Armstrong College, Berkeley, in 1930 with a degree in Accounting and Business Administration. In the same year he was employed as an accountant with the Philadelphia Quartz Co. of California (now P.Q. Corp.). In 1958 he was appointed Company Treasurer, and in 1963 became Executive Vice President and general Manager until his voluntary retirement in 1968. Among his activities was membership in the National Association of Cost Accounting. In West Marin he served as Treasurer of the Inverness Association/Foundation from 1969 to 1976. He was a Trail Maintenance Volunteer for the Inverness Association and performed a Trails Survey for the Point Reyes National Seashore, for which he was honored with a "VIPS" (Volunteer in Park Service). In 1982-83 he served as first Chairman of the Marin County Flood District No. 10, newly created by the voters of the Inverness Ridge Area in response to the flood of January 4, 1982.

Vivienne Howe of Inverness reveiced her A.B. from the University of California, Berkeley, in 1944, with a major in Fine Arts. She taught art in the elementary schools of Antioch and Mission San Jose for a number of years before returning to the University of California in Berkeley as a librarian at the School of Education and later at the Boalt Hall Law School Library. She is director and member of the Executive Committee of the San Francisco Chamber Music Society, and has served on the Planning Committee of the First Unitarian Church of San Francisco. In West Marin she is a member of the League of Women Voters, the Inverness Garden Club, and the Tomales Bay Association.

William Howe (Co-Chairman) of Inverness is a native of Boston, Massachusetts. He attended Harvard University, where he received his A.B. in 1951, majoring in History. He attended the University of California, Berkeley, where he received his General Secondary Credential in 1955. After a year of teaching English at Eureka High School, he returned to the Bay Area to attend San Francisco State University where he received his M.A. in General Humanities in 1959. Thereafter, he became self-employed in the field of investments, primarily real estate from about 1961. In 1969 he received his Certificte in Real Estate with a Finance Specialization from the University of California Extension of Berkeley and San Francisco. He has been a member of the First Unitarian Chruch of San Francisco since 1969; served on its Program Committee, 1976-79, the Subcommittee for the Hinckley Lecture, 1977-79 (Treasurer, 1977-78). He is a member of the Harvard Club of San Francisco; has been a Director since 1976; was its Treasurer, 1976-82; Activities Committee since 1982; from 1973 to 1977 was on the Schools and Scholarship Committee. He has been Chairman of the San Francisco Chamber Music Society since 1982; Director since 1977; Member of the Executive Committee since 1978; Member of the Music Adisory Panel since 1979; in 1979-80 he was in charge of the Society's second Young Artists Award, a program which was developed with the assistance of a grant from the San Francisco Foundation. In West Marin he has been a member of the Tomales Bay Association since 1969. He became a Director in 1973 and has been President since 1975. He is also a member of the Inverness Association (since 1968) and of the Environmental Action Committee of West Marin. Since 1979 he has been Co-Chair, representing Tomales Bay Association, of "Save Tomales Bay", a coalition with Inverness Association of West Marin groups and individuals working towards the restoration of the anadromous fish runs in Lagunitas Creek and the preservation of adequate freshwater flows into Tomales Bay. He also represents Tomales Bay Association as a member of the Lagunitas Creek Citizens Advisory Committee to the California Department of Fish and Game. In the same capacity he has been a director (1981-83) of West Marin Paths.

Corwin Mocine, A.I.P, of Inverness recieved his B.S. in Landscape Architecture at the University of California, Berkeley. He has had over forty years experience in city, county and regional planning. He has performed professional work at all levels of government. He was for sixteen years, 1961-76, a professor of city planning at the University of California, Berkeley. His first planning job was as county planner for the Planning and Recreation Department of San Mateo county, involved in site selection and development of that county's first county parks and beaches. After serving during World War II as a Captain in the Marine Corps, he managed, as Director of Planning of Phoenix, Arizona (1946-49), Berkeley (1949-54), and Oakland (1954-61),

California, comprehensive planning programs which included the integration of park and recreation policies and facilities, into the total city planning process. Mr. Mocine has maintained a special interest in the use of zoning and other legislative and regulatory devices to implement general plan policies for the preservation of open space and the protection of environmetal quality. He recently retired from partnership in the planning consultant firm of Williams, Platzek and Mocine. He has long been associated with the community of Inverness. Over a twenty year period he has three times served as a Director of the Inverness Association/Foundation. In the mid 1960's he served a term as President and is currently Secretary. He also is a Director of the Tomales Bay Association for Affordable Housing, which has been the recipient of Community Block Grants and a grant from the San Francisco Foundation, as well as loans from the State Department of Housing and Community Development. He previously served as Chairman of the Inverness Planning Group and was instrumental in the development of the Inverness Area Community plan, which has been incorporated into Marin County's Local Coastal Plan.

Richard Plant, (Co-Chairman), of Inverness was born in Redding, California. He received his A.B. from San Francisco State University in 1962, majoring in Psychology. In 1965 he received his General Secondary Credential from the same institution, with Mathematics and Biology as his Teaching Major and Minor. He has been an Inverness resident since 1962. From 1965 to 1972 he was a science teacher at the Lagunitas School. In 1972-73 he was a commercial fisherman in Tomales Bay. From 1973 to 1977 he was a carpenter and Licensed Building Contractor. He has published Migrations of striped bass ocurring in Tomales Bay, California Fish and Game # 55, 1969. He was a Director of the Inverness Association, 1964-68, and President, 1967. From 1976 to 1981 Mr. Plant served as an elected Director of the Inverness Public Unility District, and was Chairman in 1980. During his terms as Director, the district purchased the local water system from a private company. The Directors successfully solicited $1.2 million worth of bonds and matching federal grants to fund this purchase and necessary improvements to the water system. At the time of the purchase, Mr. Plant was Chairman of the Board of Directors. He is currently a member of the Citizens Advisory committee, Lagunitas Creek, for California Fish and Game. For this group he chaired a subcommittee which produced a five-year interim management plan for the restoration of trout and salmon in Lagunitas Creek and its tributaries. This plan was subsequently adopted by the California Department of Fish and Game. As Co-Chairman of the Steering Committee of the Tomales Bay Resources Project, for which he represents the Inverness Association, he conducted the "fish-in" educational demonstration in November 1981 on behalf of both the Resources Project and "Save Tomales Bay". The demonstration involved visual displays pre-

pared by a local natural history exhibit designer, and helped raise money for the Resources Project's bibliography as well as increase public awareness of project efforts. In the summer of 1982 Mr. Plant chaired a committee for the Inverness Foundation to explore the possibility of purchasing the nine-acre George Ludy parcel on the Inverness shoreline. The committee's efforts led to the purchase of this land, and Mr. Plant has recently been appointed to chair a committee to decide management policies for it. Currently the committee is submitting a proposal on behalf of the Inverness Foundation to the Coastal Conservancy for restoring the pickleweed marsh, improving public access, and creating educational exhibits at the entrance to this property.

James Scanlon of San Geronimo received his B.S. in Psychology from Columbia University, School of General Studies, in 1959. In the early 1960's he worked for the U.S. Defense Intelligence Agencies in Germany. For the past sixteen years he has been a Juvenile Probation Officer for the County of Marin. He is also a consultant in the placement and treatment of troubled and delinquent youth. An amateur naturalist with a lifelong interest in ecology and conservation, he became actively involved in the effort to save Creamery Creek, a tributary to San Geronimo Creek, which faced total destruction during the drought years of the middle 1970's. He continued his ecological interest by organizing and chairing the Friends of Papermill Creek and then by participating in the "Save Tomales Bay" coalition.

S.S. Schwietzer, Secretary is a resident of Inverness. He received his A.B. from Yale University in 1945. During World War II he was a Lieutenant in the Navy. Today he is a freelance television and motion picture screenwriter and television producer. He is a member of the Writers Guild of America, West and has been Chairman of its Strike Study Committee, its Disciplinary committee, and its Social committee. He is also a member of the Motion Pictures Producers, Writers Caucus. He is currently a member of the Yale Club of Northern California. He is well known in west Marin for his adaption and presentation of a staged version of Dickens' A Christmas Carol given annually at the Dance Palace in Point Reyes Station during the Christmas Season. He is a Director of West Marin Paths, where he represents such environmental groups as the Tomales Bay Association, of which he is also a member. He serves on the Inverness Ridge Planning Group, which is currently revising its Community Plan.

Patrick Simpkins is a resident of Inverness Park. He holds a B.A. degree in Accounting and an M.A. in American History. He works as a tax accountant for Fox & Company, San Rafael. He was elected about a year ago as a Director of the North Marin County Water District, which supplies water not only to Novato, but to several of the small West Marin communities including Point

Reyes Station, Olema, Inverness Park, and Paradise Ranch Estates, and maintains sewer districts in the town of Tomales and in Oceana Marin adjacent to Dillon Beach. Mr. Simpkins is the first Director to have come from West Marin. Among volunteer activities he is Trustee-Treasurer of STEPS, which has as its mission the raising of funds for the Shoreline School District. He is a member of the Steering Committee of the Environmetal Action Committee of West Marin and is the representative of that organization to the Tomales Bay Resources Project. He is also the Treasurer of the West Marin Lions Club.

Henrianne Slattery is a resident of Inverness. She received her B.A. in 1945 from the University of Southern California. Retired since 1978, when she moved to Inverness, she previously worked as a librarian for the Oceanview School District in Huntington Beach. She has been a member of the League of Women Voters since 1967 and worked on the League's recently completed Agricultural Land Use Study. She has also represented various West Marin organizations in the hearings on the proposed Sky Ranch Development.

Anne West, Honorary Member, authored the successful letter of solicitation for funds which were used, in part, to pay for the 1983 revision of the Bibliography of Research on Tomales Bay. As Co-Chairman of "Save Tomales Bay", of which effort she has long been recognized as the heart and soul, she was one of the initiators of the Tomales Bay Resources Project and has since been frequently called upon for counsel, even though she is not taking an active role in its administration. She was President of the Inverness Association, and as a member of Tomales Bay Association she has participated in the Resources Project and other matters, even though she is not formally a member of its Steering Committee.

Tom Chase, President of Inverness Foundation, is an ex officio member of the Steering Committee for the Tomales Bay Resources Project. Now a resident of the Seahaven area of Inverness, he grew up in New Hampshire and attended the University of New Hampshire. He served ten years in the U.S. Air Force as an officer and pilot. Since 1967 he has worked as a pilot for Trans World Airlines. He has lived in Inverness since 1967 and he and his wife have actively supported many local institutions such as schools, parents clubs, planning groups, etc. Mr. Chase was responsible for the Seahaven area when the following issues were placed on the ballot: expansion of the fire district, special fire tax, and purchase of the local water company, all of which were acepted by the voters. He has been a volunteer fireman for ten years and is the Lieutenant for the Seahaven area. He was a director of the Inverness Association in the 1970's and has been President since November 1981, a period in which the Association has undertaken a stronger role in the community.

APPENDIX B.

FINANCIAL CONTRIBUTIONS OF
INVERNESS FOUNDATION AND ANATEC LABORATORIES
TO THE TOMALES BAY RESOURCES PROJECT

A. Financial Position of Project on 4/18/83

Total contributions received		5,243.00
Expenses: (1)		
Miscellaneous	394.77	
Honorariums (3)	300.00	
Total:		694.77
Balance on hand:		$4,548.23

(1) A bill for $3,000.00 from ANATEC Laboratories for the completed bibliography has been received subsequent to this statement. The balance on hand after payment will be $1,548.23.

B. Estimated Dollar Value of Volunteer Time Contributed by Steering Committee

April 1981 -- Initial Presentation to West Marin Community at Inverness Yacht Club

Entertain Speaker & Invited Guests	35.00	
Rental Value of donated Auditorium	35.00	
Exhibits & Seafood Samples	25.00	
Letters of Invitation	10.00	
Volunteer time to put on event (15 hrs. @ $15.00/hr.)	225.00	
		330.00

July 1981 -- Report to Inverness Association Annual Meeting, leading to approval of proposal.

Entertain Speaker & Invited Guests	35.00	
Presentation by ad hoc Co-Chairman	30.00	
Total:		65.00

Spring and Summer 1981 -- Organization of Ad hoc Committee; & its presentation to Inv. foundation Board of Trustees, leading to adoption of Project and appointment of Steering Committee.

2 Co-Chairmen (2 @ $15.00 x 5 hrs.	150.00	
Committee (Ave. 7 attendees @ $15.00 x 1 hrs.)	105.00	
Total:		255.00

1981-83 -- Steering Committee Meetings

5 meetings of 2 hrs. duration (7 ave. attendees @ $15.00)			1,050.00
1981-83 -- Miscellaneous work of Co-Chairmen			
Evaluation of proposals with consultant		165.00	
Conferences at ANATEC in Santa Rosa		510.00	
Long distance phone calls		135.00	
Attend Aug. 1982 Meeting, TAC Subcommittee		270.00	
April 1983 -- Prepare IF portion of proposal		660.00	
Total:			1,740.00
1981-82 Fund Raising Campaign			
Prepare and distribute letter of general solicitation		150.00	
Personal letters to institutional donors		30.00	
Receive & record funds received		150.00	
Publicity for newspapers		15.00	
"Fish-in"			
Cost, smoked fish	150.00		
prepare exhibits (Designer's time @ $30.00)	900.00		
Presentation	450.00		
Rental value of space	70.00		
Hand-outs	30.00		
Newspaper ads	17.00	1,617.00	
Total:			1,962.00
Total:			5,402.00

C. Projected Future Inverness Foundation Costs, Including Cash Outlays for Certain Management Tasks and the collar Value of Volunteer Time to be contributed.

Volunteer Work Parties (4 people for 4 hrs./week for 100 months @ $10.00)			16,000.00
Liability Insurance			200.00*
Steering Committee Audit			
Possible Outside Audit			500.00*
Copy Cost			
Complimentary copies of bibliography		200.00	
Misc. management and education		500.00	
Total:			700.00*

*Cash outlays total $5,800.00

Secretarial -- Quarterly Reports (40 hrs./yr. @ $10.00 for 2 yrs.)			800.00*
Honorariums, Technical Advisory Committee management time, Steering Committee, apart from Audit			3,600.00*
Co-Chairmen (2 @ $15.00 for 200 hrs.)	6,000.00		
Steering committee Meetings (7 ave. people @ $15.00 for 4 meetings of 2 hrs. duration)	840.00		6,840.00
Total:			28,640.00

*Cash outlays total $5,800.00

ANATEC CONTRIBUTIONS:

Estimated Dollar Value contributed by ANATEC Laboratories for the periods 1981, 1982, 1983. Based on commercial charge rates.

		Costs
A.	Meetings, public presentations and preparation time	5,300.00
B.	Preparation, organization and presentation of the Technical Advisory Board meeting with the California Academy of Science. 6 person days.	1,272.00
C.	Bibliographic preparation and data reveiw. 10 person days.	2,120.00
D.	Preparation of the formal proposal for the Tomales Bay Project. 45 person days.	9,540.00
TOTAL:		$18,232.00

APPENDIX C

ANATEC Laboratories, Inc.

SERVICES, FACILITIES AND EQUIPMENT

Routine Analytical and Biological Services

Biological. ANATEC Laboratories conducts a wide range of biological studies and research. Staff expertise includes the disciplines of marine, freshwater, and terrestrial biology, geology, fisheries, ecology, ethology, biostatistics, marine law, computer science, environmental and sanitary engineering. The company has undertaken marine biological, limnological and hydrographic studies to establish environmental baseline conditions as well as to monitor long-term changes induced by man-made influences and natural processes. Studies include faunal and water quality monitoring projects, dye and drogue studies, community and population life history studies, stream and marsh surveys, and attached macrofaunal, benthic and fisheries investigations. Biological characterizations, wildlife inventories, literature reviews and natural resources assessments have been conducted to establish regional and national environmental management policies. ANATEC scientists have provided expert testimony on issues involving ocean resources, marine law, and other environmental issues and have assisted in developing sound interpretations of existing and proposed laws. In addition, ANATEC has conducted environmental assessments for general construction, water rights projects, industrial effluents, wastewater treatment facilities and stream alteration studies. The experience of the staff in conducting multidisciplinary studies enables ANATEC to effectively manage large project teams involving qualified organizations from related disciplines such as engineering, oceanography, geology, planning and architecture.

Analytical. The analytical lab at ANATEC is a full-service laboratory with a staff experienced in the analysis of potable, surface, subsurface and waste waters, soils, vertebrate, invertebrate and plant tissues and fluids, environmental particulates and air. Our capabilities include trace level analyses for toxic elements, pesticides and other organic compounds, identification and enumeration of micro-organisms, and nutrient analysis of foods, feeds, plants and soils. Equipment and methodologies are in conformance with requirements embodied in the National Pollutant Discharge Elimination System (NPDES) and the Toxic Substances Control Act (TOSCA).

Many analytical procedures are conducted in connection with projects managed by the staff of our biological research section. Included are contaminant uptake and depuration studies, toxicity studies with invertebrate larvae and fish, and benthic community productivity and respiration investigations.

Certification. ANATEC's laboratory facility has been approved for complete chemical, bacteriological and bioassay analyses by the California State Department of Health. The laboratory has also been evaluated by the California State Water Quality Control Board, the California Department of Fish and Game, the United States Environmental Protection Agency (National Enforcement

Investigations Center, and Environmental Monitoring and Support Laboratories), the U.S. Army Corps of Engineers and the U.S. Food and Drug Administration.

Field Capabilities. ANATEC is extensively equipped to design and conduct quantitative and qualitative field studies. ANATEC can rapidly and cost-effectively carry out large- and small-scale field projects using vessels designed and modified for research activities, over-land vehicles, devices for routine sampling of water, sediment, soil and air, and apparatus designed and built by our personnel to meet specialized sampling requirements. Field work is facilitated by a mobile laboratory used both for on-site analysis of samples and as a base for field work conducted in remote areas.

Helicopter Sampling. Airborne surface and subsurface water sampling is routinely accomplished using a specially designed multiple sampler suspended from a Hughes 300 helicopter. This system is particularly useful where shallow water or adverse weather or water conditions make vessel use impractical, or where a rapid sampling technique over a large geographic area is necessary.

Laboratory Capabilities. Acute and chronic effects of hazardous or potentially hazardous materials on freshwater and marine organisms can be tested using ANATEC's controlled environment rooms. Physiological and histological effects of toxic agents may be examined by employing the histotechnique, optical microscopic, and transmission electron microscopic facilities present in the laboratory.

Sample-Processing Center. The sample-processing center is designed for the collection and processing of an array of floral and faunal samples as well as the analysis of data obtained from these samples. The staff is experienced in the collection and processing of the following qualitative and quantitative sample types: benthic grabs, intertidal and subtidal cores, transects, zooplankton and phytoplankton tows, fish trawls, fish stomach contents, epibenthics, freshwater vertebrates and invertebrates, and life-history studies including size-classing, fecundity and reproductive state.

Quality Assurance

The ANATEC staff operate a comprehensive quality assurance program to provide consistently high-quality analytical results. Our chemistry staff adhere to a rigid protocol which specifies methods for handling labware and reagents. Incompatible analyses are kept physically separated in our custom-designed laboratory areas. Objective checks of analytical performance are an integral part of ANATEC's quality assurance program.

In the sorting center a rigid computer-assisted system of quality control has been implemented. This system insures that biological samples are properly tracked and that the fauna contained are thoroughly sorted and accurately identified and enumerated, and that they are curated according to the specifications of the California Academy of Sciences. Voucher collections are maintained and stored at the ANATEC facility and are available to any qualified investigator.

Through in-house research, ANATEC has developed quality assurance standards for many aspects of field studies, including sampling and subsampling. Many of these protocols, which serve to increase accuracy and precision of sampling techniques and improve condition and recovery of collected fauna, have been incorporated into California and federal guidelines.

Support Facilities

Computer Facilities. ANATEC is equipped with sophisticated word- and data-processing facilities consisting of a minicomputer with CRT and Decwriter terminals and high-speed printer-plotter. Standard and staff-designed software provide broad capabilities in word processing, laboratory quality assurance and efficiency control, and in data management, reduction, and analysis. A digitizer is also on-line for use in rapidly counting and measuring organisms. These data then can be treated statistically directly by computer. This system is also used to calculate area coverage from field plots, photographs and maps.

Library Facilities. ANATEC maintains a large in-house library exceeding 15,000 volumes, including 121 periodicals in biology, chemistry and geology. The firm subscribes to most of the major aquatic and terrestrial periodicals and chemical journals, and maintains interlibrary loan agreements with other firms and university libraries. Microfiche and micro-card readers are available, as well as computer terminal access to federal, state and local library-search facilites.

Photographic Laboratory. A complete photographic laboratory has been developed to process motion and still photographs for documentation, histology and pathology, ground truth analysis, and light and electron photomicrography. Temperature control for color and black-and-white processing is available. Most standard film sizes can be routinely processed. Copy and mapping equipment is available, as well as color-corrected, auto-analyzed color printing and special processing for infrared and ultraviolet photography. Camera equipment includes aerial, ciné, and still cameras as well as remote underwater units.

Machine and Woodshop. A complete fabricating shop for the design and construction of scientific equipment has been developed over the last 5 years. The shop has metal lathes, milling machines, presses and welding equipment as well as a full array of woodworking equipment.

Field Collecting Equipment

Benthic Subtidal Collections. Ponar, Van Veen, Peterson and Smith-McIntyre grabs for quantitative samples; glass, PVC and stainless-steel cores for uncontaminated sediment collections.

Water Quality Samples. One-liter, 3-liter Van Dorn and 5-liter Nisken bottles for discrete samples; submersible pumps capable of pumping 1,400 gallons per hour; Slocum samplers with foam cores for sampling of extremely low levels of suspended particulates and trace contaminants.

Nekton, Plankton and Epibenthic Collections. Eight-foot and 16-foot otter trawls, beach seines, fyke nets; epibenthic sleds with 426-micron nets for the collection of surface and near-surface invertebrates; plankton nets include 1-meter, 1/2-meter and seine replicate nets all with attached flow meters and various mesh sizes.

Ancillary Equipment

Helicopter and Fixed-Wing Planes. Hughes 300 and 500 helicopters are available and modified for field work, photography, personnel and sample transport. A specially-equipped Cessna 152 is used for sample transport and aerial photography.

Vessels. Two 17-foot Boston Whalers, 21-foot outdrive; inflatable rafts, 12-foot skiffs, electric winches, radar, scanning sonar, recording fathometer and VHF-CB radios are installed on the larger vessels; all the above vessels are trailerable. A fully-equipped 85-foot research vessel is also available (lease).

Weather Equipment. Weather Measure Corporation mechanical weather stations can record wind direction, wind speed, temperature, humidity, barometric pressure, rainfall volume and rate, and evaporation.

Vehicles. Four-wheel drive, winch-equipped vehicles with two-way radios are used for field work and vessel transportation. Vans are available for the transportation and field deployment of personnel and sensitive equipment. A mobile laboratory, equipped for microbiological, general physical and chemical, and bioassay analyses, is also available for operation in the western United States.

Field Instrumentation. Yellow Springs Dissolved Oxygen, conductivity, salinity and temperature meters and photometers; survey units include transits, alidades, theodolite, Dunphy levels and all supportive equipment.

Laboratory Equipment

Atomic Absorption Spectrophotometer. Perkin-Elmer Model 370 with deuterium-arc background corrector, wavelength drive, electrode-

less discharge lamps and power supply, cold-vapor analysis system and hydride generation system.

Graphite Furnace. Perkin-Elmer HGA 2200 with Auto Sampler AS-1 for continuous operation, temperature ramping controller, and optical temperature sensor.

Gas Chromatography. Hewlett-Packard 5830A and 5840 with capillary inlets for high resolution chromatography of complex mixtures; electron capture, flame ionization, N-P flame ionization detectors and thermal conductivity detector; processor-mediated parameter control for data reduction and plotting.

Purge and Trap Sampler. Hewlett-Packard 7675A, automatic extraction, collection, and injection of halomethanes, purgeable priority pollutants and other volatile components of aqueous mixtures into gas chromatograph.

Fluorometry. Turner 111 and Turner Designs multirange fluorometers for continuous flow nephelometry, chlorophyll and/or dye tracer measurements in field or lab.

UV-Visible Spectrophotometers. A variety of instruments with high resolution monochromators, long path-length capabilities, scale expansion and differential reading modes for high sensitivity routine and special purpose analyses.

Centrifugation. Beckman J2-21 high-speed refrigerated centrifuge with high-volume and continuous-flow rotors; capable of continuous separation of particles on basis of sedimentation velocities, as well as density gradient separations.

Organic Carbon Analyzer. Oceanography International; aqueous and solid sample introduction; ideally suited for samples with high salt and/or particulate burdens.

Coulter (Particle) Counter. Type ZBI with Coulter MCV computer; allows rapid, precise enumeration of inorganic particles and unicellular algae, characterization of sediments, and other particle-handling tasks.

Transmission Electron Microscope. Siemens Laboratory workhorse for high-power microscopy, such as examination of subcellular components and aquatic, soil, and airborne contaminants.

Microtechnique-Histology Lab. Transmission, surface, phase-contrast, fluorescence and other specialized microscopy; high throughput sectioning-staining lab with two Tissuematon slide processors and micromanipulators.

Sediment Analysis Lab. Apparatus for mechanical sieve and hydrometric analyses of natural sediments, formulations and other products.

Bioassay Incubators. Two walk-in 7- by 10-foot chambers, independently controllable and capable of maintaining temperatures within 1^{o} or less; temperature externally monitored.

Personnel Air Quality Monitoring Devices. Spectrex AS 300 personal air samplers for on-site monitoring of air quality.

8-Sample Helicopter Water Sampler. Designed by ANATEC to perform simultaneous sampling for bacteria (sterile bottle), selected contaminant and routine water chemistry; these segregated 3.5-liter samples are used where standard sampling from a vessel is impractical or not cost-effective.

Remote Sensing Equipment

Underwater Camera Equipment. Underwater cameras and support structures designed by ANATEC to work in water depths up to 180 meters. Still camera with strobe light, time lapse cine and video cameras are available for remote underwater surveillance.

APPENDIX D

ANATEC STAFF BIOGRAPHIES

APPENDIX D. ANATEC Staff Biographies.

Greg Anderson is Director of the Analytical Laboratories at ANATEC. He received an A.B. in Zoology from the University of California at Berkeley and an M.S. degree in Marine Science, with emphasis on physiological and water chemistry, from University of the Pacific, Pacific Marine Station. Mr. Anderson has extensive experience in the Tomales Bay, Point Reyes area, both as a graduate student and later as a staff member of the Pacific Marine Station. His graduate research was the physiology of intertidal organisms from the local areas as well as being involved in station wide studies on long-term ecological changes in benthic and intertidal communities. Mr. Anderson has had experience in designing and carrying out chemical and biological monitoring programs for Tomales Bay, Bodega Bay, Elshorn Slough, and San Francisco Bay. After receiving his Master's degree he developed a state-approved analytical laboratory which was originally designed as an ecological research support facility; it has since evolved into ANATEC's full-service commercial laboratory. Mr. Anderson has published papers on physiological chemistry of marine organisms and written analyses of biological and chemical investigations for federal, state and privately-funded organizations. Mr. Anderson has developed a unique laboratory software package that monitors the status of all aspects of analytical data reduction and quality assurance. His special interests include high-resolution capillary gas chromatography, and relationships between stress in organisms and environmental toxicants.

Kristine Brook is a Chemist with ANATEC. She holds a B.A. in Zoology from the University of California at Berkeley and an M.P.H. (Environmental Health) from the University of California at Los Angeles. Her professional experience includes evaluation of health effects of certain organophosphate pesticides, toxicological assessments of various compounds found in low level wastes, and studies of the environmental effects of coal conversion processes. In addition, she has been involved in review of air quality regulations (specifically, prevention of significant deterioration [PSD requirements) to determine their impact on energy research and development. As part of her graduate studies, she was involved in a field and research project on lead poisoning and the industrial hygiene practices associated with the lead industry.

Carol Digitale is a Chemist with ANATEC. She received a B.S. summa cum laude in Food Science and Technology from the University of California at Davis. Her professional experience includes analysis of foods and feed for nutritional characteristics including trace element and vitamin content. Additionally, she has extensive experience in the microbiological analysis of shellfish, water and foods. Ms. Digitale has authored papers on

enzymatic degradation of fatty acids and causative factors in post-harvest deterioration of vegetables. She currently is responsible for trace element determinations in foods, feed, water and soil.

William G. Hand is a Senior Biologist with ANATEC. He received his Ph.D. in Marine Invertebrate Biology from the University of California, Santa Barbara. For ten years Dr. Hand was an Associate Professor at Occidental College, Los Angeles, directing the invertebrate biology program and teaching in the fields of biochemistry, physiology and behavior of invertebrates, and marine ecology. As a Research Biologist for the EPA Marine Laboratory, Narragansett, Rhode Island, he participated in the development of a computer-assisted method of behavioral analysis of marine invertebrate larvae. Dr. Hand has also conducted extensive research on light-associated behavior of marine algae, mechanisms of stratification of algae, and motility profiles through grants from National Science Foundation, California Institute of Technology, and NASA. This research has resulted in extensive publications in the areas of photobiology, protozoology, and biomedical engineering.

Paul Hirtz is a Laboratory Supervisor at ANATEC. He holds an Associate of Science degree in Chemistry and has a B.S. in Chemistry in progress. He is experienced in graphite furnace and flame atomic absorption, nephelometry, extraction and analysis of organic pollutants, and chemical characterization of water, wastewater and sediments. Mr. Hirtz supervises laboratory technical staff and also manages the soils and sediments physical testing laboratory.

Dalene Ried is a Biologist with ANATEC. She received her B.A. in Biology from San Francisco State University, and came to ANATEC after seven years as Laboratory Manager and Senior Curatorial Assistant for the Department of Invertebrate Zoology, California Academy of Sciences. She has extensive marine and estuarine field experience, including sampling and field observation efforts in the San Francisco Bay and Delta, Tomales Bay, the Farallone and Channel Islands, and the Gulf of California. Ms. Ried's taxonomic expertise includes familiarity with Pacific Coast invertebrates, particularly the Crustacea and Mollusca; fish and marine mammals common to northern California; marine algae; and terrestrial plant communities which occur in the Northern California coastal region. She has participated in the field work, laboratory and data analysis and report preparation components of marine, estuarine, and freshwater baseline and monitoring surveys and aquatic and terrestrial environmental impact assessments. Her responsibilities include the identification and curation of faunal collections, data analysis, report preparation, literature survey and participation in field operations.

Robert M. Rock is ANATEC's Marketing Analyst and Engineering Advisor. He came to the firm after 14 years with the U.S. Environmental Protection Agency and its predecessor agencies. Prior to that he was on the staff and faculty of Washington University in St. Louis, Missouri, where he performed research on the sampling and measurement of trace organics, the use of microelectrophoresis in chemical coagulation and effects of hazardous materials on aquatic biota. Four publications resulted from these endeavors. While in the employ of EPA, he supervised and implemented a variety of major regional programs including: a study of effects of agricultural pesticides used in California's Central Valley on aquatic biota of San Francisco Bay; formulation and implementation of regional and national policy in water resources and wastewater disposal planning for river basins and metropolitan areas; an interagency program whereby the Corps of Engineers coordinated inspection of approximately one billion dollars' worth of EPA's wastewater treatment plant design and construction in the western states (Region IX). Mr. Rock brings an extensive background in scientific, engineering and governmental processes to ANATEC.

William G. Rotz, Biological Laboratory Director, is responsible for the supervision and quality control of the faunal processing laboratory. He received his M.S. degree in Marine Biology from the University of the Pacific. Mr. Rotz' graduate research was conducted on organisms from Tomales Bay. He has worked extensively with faunal samples from intertidal areas of Tomales Bay as well as from nearby coastal sites, including Tomales Point, the Second Sled Road rock, outcrops just north of Dillon Beach, and the Point Reyes peninsula coastline. He supervised taxonomic work and sampling procedures for the Bodega Harbor and rock jetty survey for Sonoma County and the Regional Water Quality Control Board. Mr. Rotz has assisted in the design and has carried out monitoring programs for Tomales Bay, Bodega Bay, Elkhorn Slough, Humboldt Bay and San Francisco Bay. He has been responsible for the coordination of biological water quality and air quality sampling between field crews and the laboratory, and has assisted in the design and construction of specialized water and air quality and biological field samplng apparatus. He has extensive experience in the identification of marine faunal groups, population ecology, and hydrodynamic phenomena. Mr. Rotz also has primary responsibility for data evaluation and statistical analyses for ANATEC's biological projects.

Holly Saunders is ANATEC's Office and Laboratory Manager. She received a B.A. in Biology with a minor in Chemistry from Whittier College. She has pursued post-graduate studies in Wage and Salary Administration and Accounting at the University of San Francisco. For two years she was Executive Secretary and Personnel Director in the School of Nursing, University of San Francisco. She served as an advisor during a feasibility study

for a word processing center at the University, and conducted a study of the salary structure and history of office personnel for the University Personnel Director. Ms. Saunders has utilized mag card IBM processors, an Artec 2000 floppy-disk system, an NBI System 3000, and a component system consisting of an Altos microcomputer with CP/M, a Hazeltine 1510 CRT, and Diablo printer, the present system at ANATEC. The latter system has data analysis as well as word processing capabilities. She was secretary and research assistant for Flow Resources, Inc., a subsidiary of Flow General, Inc., where she co-authored Flow's Document Style Guide which incorporated manuals from Dames and Moore, Bechtel, EPRI and WOGA and the current GPO Style Manual.

Edmund H. Smith is the Executive Director of ANATEC. He received his A.B. in Zoology from Occidental College in Los Angeles, an M.A. in Marine Zoology from the University of the Pacific in Stockton, California, and a Ph.D. in Zoology from the University of Glasgow, Scotland. He held a fellowship in Zoology at the University of Sao Paulo, Brazil, and was a Royal Society Fellow in Marine Zoology at the Statzone Zoologia in Naples, Italy. He held an NIH postdoctoral fellowship in Zoology at the Marine Biological Laboratories, Woods Hole, Massachusetts. For 17 years he was Director of the Pacific Marine Station, Dillon Beach, California, and Professor of Zoology at the University of the Pacific. In addition, Dr. Smith has taught Marine Law and Ocean Resource courses at McGeorge School of Law in Sacramento. His research interests include animal-substratum relationships, feeding behavior of marine invertebrates and long-term chronic effects of trace contaminants. As a research scientist for 20 years both as a graduate student and later as a facility member of the Pacific Marine Station, Dr. Smith has extensive experience in the varied habitats throughout the area now within the boundaries of the National Marine Sanctuary. He has made observations and collections of intertidal and sub-tidal organisms, from Bolinas Lagoon-Duxbury Reef area on the south to Bodega Head at the northern boundaries. He was involved with the early development of the National Seashore and acted as advisor to the park staff. For many years he supervised joint summer educational programs (Pacific Marine Station, Point Reyes National Seashore) to provide information on the natural resources of the seashore for the general public. In support of his research, Dr. Smith has received 21 grants and published more than 25 papers. He has developed and supervised field and laboratory projects which encompass hydrographic studies, benthic surveys, bioassay experiments and morphological studies. He has served on many state and federal commissions involving biological and water quality issues and policy development.

Sue Weinreb Smith is President and majority owner of ANATEC and serves as Executive Administrator in charge of general administration and fiscal management. She has a B.A. degree in Politi-

cal Science/International Relations from the University of California at Berkeley. Ms. Smith has prime responsibility for corporate development, financial systems development, long range planning and marketing strategy. She is a co-founder of Working Women, Inc., a California-based employment consulting firm and served as a Director until her resignation in 1979. She has extensive experience as an independent consultant in contract negotiation and contract management (federal, state and private) and in marketing assessment. Ms. Smith has been actively involved in municipal and county government and has been appointed to commissions and governing boards at the state and county levels.

Everett Weinreb is a Research Associate, photographic consultant, pilot and diver for ANATEC. He has extensive experience, particularly along the California coastline, with underwater and aerial photography including surveys, photo-interpretation, and specialized laboratory work. A variety of projects for ANATEC, the U.S. Army, federal agencies and industry have provided experience in the research, development, and manufacture of specialized apparatus including underwater camera housings and camera adaptations, oceanographic monitoring equipment and aircraft modifications. Mr. Weinreb has taught photography and air navigation at the University of California, Santa Barbara and Santa Barbara City College, and is a founder and President of Underwater Photos and Research. He holds a certified instrument flight rating and an airline transport certificate and is a F.A.A. certified Flight Instructor and a California certified S.C.U.B.A. Diver and Instructor.

APPENDIX E

LETTERS OF SUPPORT

MARIN CONSERVATION LEAGUE

A non-profit corporation founded in 1934

1330 Lincoln Avenue San Rafael, CA 94901
Office telephone: 456-1912

Past and Present

Angel Island
Mt Tamalpais
Samuel Taylor Park
Bolinas Lagoon/Kent Island
Stinson Beach
Drakes Bay Beach
Tomales Bay
Pt Reyes National Seashore
Richardson Bay Sanctuary
Corte Madera Tidelands
Strawberry Tidelands
Bothin Marsh
Heerdt Marsh
The Northridge
Rancho Olompali
Marin's Agricultural Lands
Marin's Dairy Farms
Coastal Protection
Golden Gate National Recreation Area
Offshore Oil Drilling
Marin Planning Issues
Wild and Scenic Rivers

President
Gloria Duncan

Executive Director
Karin Urquhart

Public Education Coordinator
Sallyanne Wilson

Board of Directors

Peter Behr
Jean Berensmeier
Sarah Blauvelt
Barbara Brooks
Donald Dickerson
Gloria Duncan
Dale Elliott
Willis Evans
Leon Garrett
Emma Gimbal
Robert Hehr
Katherine K. Holbrook
Roger Hooper
Susanna Jarosz
Alan Johnston
Warren Levinson
Natalie Lewis
Pamela Lloyd
Alex MacMillan
Jack MacPhail
Willa Marler
Wallace McOuat
Ralph Mead
Frank Morgner
Bill Noble
Iris Perlmar
Bob Raab
Otto Reutinger
Tom Robertson
Anne Marie Shanks
Clifford V. Shireman
Jean Starkweather
Susan Stompe
Gordon Strawbridge
Rosalie Webb
Theodore C. Wellman
Bruce F. Wolfe
Chip Wray

August 25, 1983

The San Francisco Foundation
500 Washington Street
San Francisco, CA 94111

SUBJECT: Tomales Bay Resources Project

Dear Ladies and Gentlemen:

The Marin Conservation League Board of Directors voted to endorse the Tomales Bay Resources Project at its last board meeting.

Recognizing the importance and fragility of Tomales Bay Marin Conservation League believes background information or baseline studies are an increasingly necessary tool for decisions being made which affect the Bay.

Marin Conservation League would strongly suggest that these studies be coordinated in some fashion with other similar studies currently being conducted. We feel an integrated approach with possible agency involvement to be a sound approach.

We urge the Foundation to look favorably upon the Tomales Bay Resources Project proposal.

Sincerely,

Karin Urquhart
Executive Director

/dw
cc: Inverness Association
Tomales Bay Association

bcc: MCL BOD/AP

NORTH MARIN COUNTY WATER DISTRICT
999 RUSH CREEK PLACE • POST OFFICE BOX 146 • NOVATO, CALIFORNIA 94948 • (415) 897-4133

RECEIVED AUG 2 3 1983

August 17, 1983

The San Francisco Foundation
500 Washington Street, 8th Floor
San Francisco, California 94111

SUBJ: Endorsement of Tomales Bay Resource Project, Phase I (proposed by the Tomales Bay Association)

Ladies and Gentlemen:

The North Marin County Water District Board of Directors has reviewed the proposal of the Tomales Bay Association to undertake indepth studies of Tomales Bay. The title of this project is "Tomales Bay Resources Project - Phase I." Please be advised that the Board of Directors endorses this study and believes that Tomales Bay is an important resource which is vital to preserve. In order to achieve this goal we must have knowledge of how the Bay works. The studies proposed by the Tomales Bay Association will greatly add to our storehouse of knowledge of Tomales Bay and will help lay the foundation upon which future decisions can be made to preserve and protect this important resource.

Sincerely yours,

John Olaf Nelson
General Manager

JON:nm

DIRECTORS: WILLIAM W. WRIGHT, President • GEORGE A. AMAROLI • ARTHUR T. KNUTSON • BARBARA B. MUNDEN • PATRICK L. SIMPKINS
OFFICERS: JOHN OLAF NELSON, General Manager • NORMA B. MORRIS, Secretary • SAGE L. MORRIS, Auditor Controller • JAMES O. FRITZ, Chief Engineer

1517 LONGWORTH BUILDING
WASHINGTON, D.C. 20515
(202) 225-5161

DISTRICT OFFICES:
450 GOLDEN GATE AVE.
SAN FRANCISCO, CA 94102
(415) 556-1323

901 IRWIN STREET
SAN RAFAEL, CA 94901
(415) 457-7272

633 MARIN, ROOM 8
VALLEJO, CA 94590
(707) 552-0720

Congress of the United States
House of Representatives
Washington, D.C. 20515

NATURAL RESOURCES
GOVERNMENT ACTIVITIES AND TRANSPORTATION

COMMITTEE ON MERCHANT MARINE AND FISHERIES
SUBCOMMITTEES
COAST GUARD AND NAVIGATION
MERCHANT MARINE
OCEANOGRAPHY

SELECT COMMITTEE ON CHILDREN, YOUTH, AND FAMILIES

July 22, 1983 RECEIVED AUG 15 1983

San Francisco Foundation
500 Washington St. 8th Floor
San Francisco, CA 94111

(ORIGINAL LETTER SENT TO RICHARD PLANT)

Dear Friends:

I want to express my strong support for the proposals of the Tomales Bay Resources Project, regarding several programs designed to provide a better understanding of, enhanced protection for, and increased scientific utilization of Tomales Bay.

The Tomales Bay Resources Project(TBRP) has the support of two respected, established groups with many years of experience involving Tomales Bay. The Inverness Foundation has spent 18 years purchasing, restoring and preserving historic buildings, beaches and nearby streams. The foundation has long had an outstanding staff strongly supported by the active West Marin community.

ANATEC laboratories has been actively involved in scientific research programs throughout northern California for more than twenty years. ANATEC's professionals are highly qualified to carry out the proposals of TBRP.

The program for which TBRP is seeking funding is of utmost importance. It is essential that the unique, unpolluted, undisturbed environment of Tomales Bay be preserved as a natural habitat, a recreational outlet and a center of scientific research. TBRP seeks to provide needed information to government agencies in the decision-making process regarding estuaries and waterways. They seek to inform the public on the value of preserving and understanding the Tomales ecosystem. These proposals constitute the first step in TBRP's plans for an intelligent of all concerns in the Tomales Bay region.

I believe the TBRP is worthy of your kind support. I hope you will give this your favorable consideration.

In Friendship,

BARBARA BOXER
Member of Congress

STATE OF CALIFORNIA—RESOURCES AGENCY George Deukmejian, Governor

DEPARTMENT OF FISH AND GAME
Post Office Box 47
Yountville, California 94599
(707) 944-4460

August 9, 1983

RECEIVED AUG 9 1983

Mr. Richard Plant
Tomales Bay Resources Project
475 Vision Road
Inverness, California 94937

Dear Richard:

We have reviewed your letter of intent to submit a proposal for hydrological/biological study of Tomales Bay to the San Francisco Foundation.

We strongly support the collection of data to improve our understanding of the ecological processes in this important estuarine system. The technicalities of a study in the bay, however, as well as knowledge of what is needed and what is already known, is outside our area of expertise. We understand that you also sent your letter to Phil Swartzell, the Marine Resources Region unit biologist in Menlo Park; we will rely on his technical evaluation of the study proposal.

Sincerely,

Brian Hunter
Regional Manager
Region 3

cc: Phil Swartzell

DEPARTMENT OF FISH AND GAME
MARINE RESOURCES REGION
411 Burgess Drive
Menlo Park, CA 94025
415-326-0324

August 4, 1983

Mr. Richard Plant
Tomales Bay Resources Project
c/o Inverness Foundation
P. O. Box 423
Inverness, CA 94937

Dear Richard:

Thank you for your recent letter regarding the Tomales Bay Resources Project. I always enjoy hearing from you.

I have reviewed your Project's letter to the San Francisco Foundation dated 28 April 1983, in which the Project's accomplishments and objectives are presented. Certainly, I agree that expanding our understanding of physical, chemical and biological systems of Tomales Bay is of value.

While the project's objectives appear broad and somewhat ambitious to me, I have no doubt that the Technical Advisory Board which you have identified is able to provide the consultation needed to develop meaningful and feasible studies and programs. Please accept my best wishes for success in your funding efforts.

Sincerely,

Phillip G. Swartzell
Assoc. Marine Biologist
Manager, Ocean Unit 3

PGS:tb

LAGUNITAS CREEK CITIZENS ADVISORY COMMITTEE

May 2, 1983

RECEIVED MAY 3 1983

Brian Hunter, Regional Manager
Department of Fish and Game
Post Office Box 47
Yountville, California 94599

Dear Mr. Hunter:

The Lagunitas Creek Citizens Advisory Committee has reviewed the Tomales Bay Study proposal advanced by the Inverness Foundation and Anatec Laboratories. We have heard an extensive presentation by Dr. Ed Smith and several experts on the Committee have read the proposal in detail.

On April 25, without dissent, the Committee voted to endorse this important study. We look forward to seeing the base line data developed and are convinced it will enhance knowledge of Tomales Bay and aid us in finding ways to better manage the way we live on the Bay in order to better harmonize with the long term survival needs of this vital and unique resource. We urge the Department of Fish and Game likewise support this proposal as the sponsors pursue the arduous task of raising funds for the study from government and private institutions.

Sincerely yours,

John Olaf Nelson
Chairman
Lagunitas Creek
Citizens Advisory Committee

JON:nm

cc: Bill Howe, Inverness Foundation
Dr. Ed Smith, Anatec Laboratories