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Global Warming: A Blueprint for State Response

Assembly Natural Resources Committee

GLOBAL WARMING

A BLUEPRINT FOR STATE RESPONSE

April 1989

Prepared by the Assembly Natural Resources Committee

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REPORT OF THE ASSEMBLY NATURAL RESOURCES COMMITTEE

APRIL 1989

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SUMMARY.

There is growing evidence that man-made changes to the composition of the atmosphere will lead to a gradual warming of the earth's climate. This report examines the nature of these effects, reviews the status of state preparedness, and recommends courses of action. Some of the significant conclusions include:

- Most scientists researching climate change agree that manmade changes to the atmosphere will cause a temperature rise of 2°C in California by the year 2030.

- Global warming will have significant impacts on California, including damaging shoreline erosion, decline in delta water quality, increased water demand, potential increased flooding and decreased summer runoff and poorer air quality.

- State planning must begin now to minimize environmental and economic costs to California imposed by global warming impacts.

- Many state agencies have not responded to the effect of global warming on their areas of responsibility.

- Legislation is needed to:

  1. Require agencies to assess the impact of global warming.
  2. Bring about coordinated planning and information handling.
  3. Require land use decisions to consider global warming impacts.
  4. Measure the state's contribution to global warming.
  5. Determine how the state could most efficiently reduce its greenhouse emissions.

THE GREENHOUSE EFFECT AND GLOBAL WARMING.

What Is The Greenhouse Effect?

The greenhouse effect is caused by the atmospheric gases which are relatively

transparent to visible light but which absorb radiant heat energy. Visible light from the sun passes through the earth's atmosphere, is absorbed by the surface of the planet, and is converted to heat. Absent the earth's atmosphere this heat would rapidly radiate away from the earth as infrared light. However, the earth's atmosphere is not as transparent to infrared as it is to visible light. Therefore, a portion of the radiated heat is absorbed and retained by the air. This effect is similar to the way that greenhouses are warmed by sunlight, hence the name "greenhouse effect."

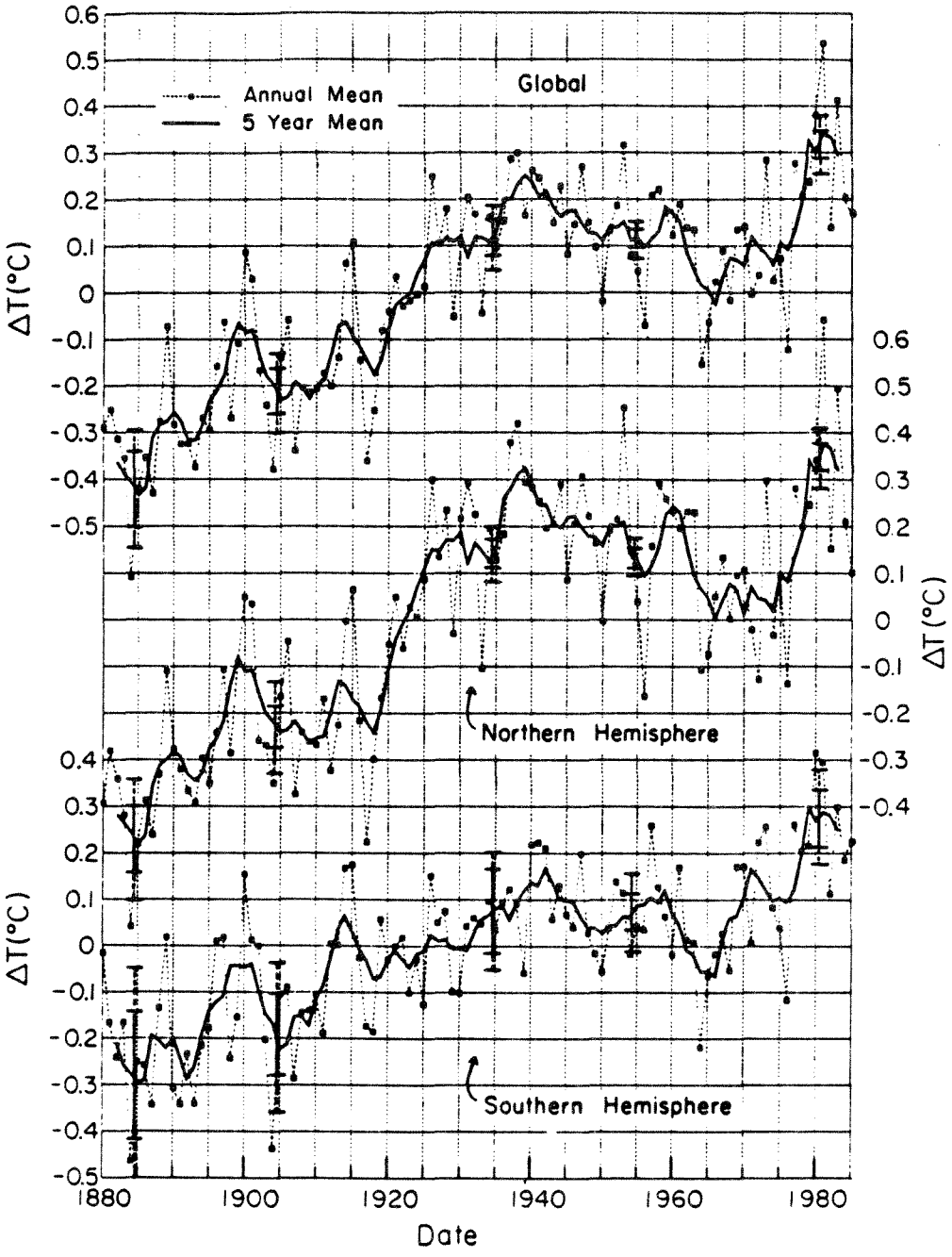
Not all gases which make up the earth's atmosphere have a greenhouse effect - carbon dioxide, nitrous oxide and water vapor are greenhouse effect gases (GH gases) while nitrogen and oxygen are not.

The greenhouse effect is a natural characteristic of the earth's atmosphere. It is partially responsible for the nature of our climate. If the earth's atmosphere did not contain GH gases, the climate would be 30^{o}C cooler and the differences in temperatures between night and day would be much greater. To abuse the old saw: life as we know it would not exist without the greenhouse effect.

Historically, the earth's climate has varied. For the past 2.5 million years, the climate has alternated between the cooler temperatures responsible for ice ages and warmer periods such as we are experiencing now. Current temperatures are thought to be near the peak of the normal warming cycle which occurs between ice ages. Scientists disagree as to the past causes of climatic warming and cooling; some believe that variation in atmospheric GH gases is involved.

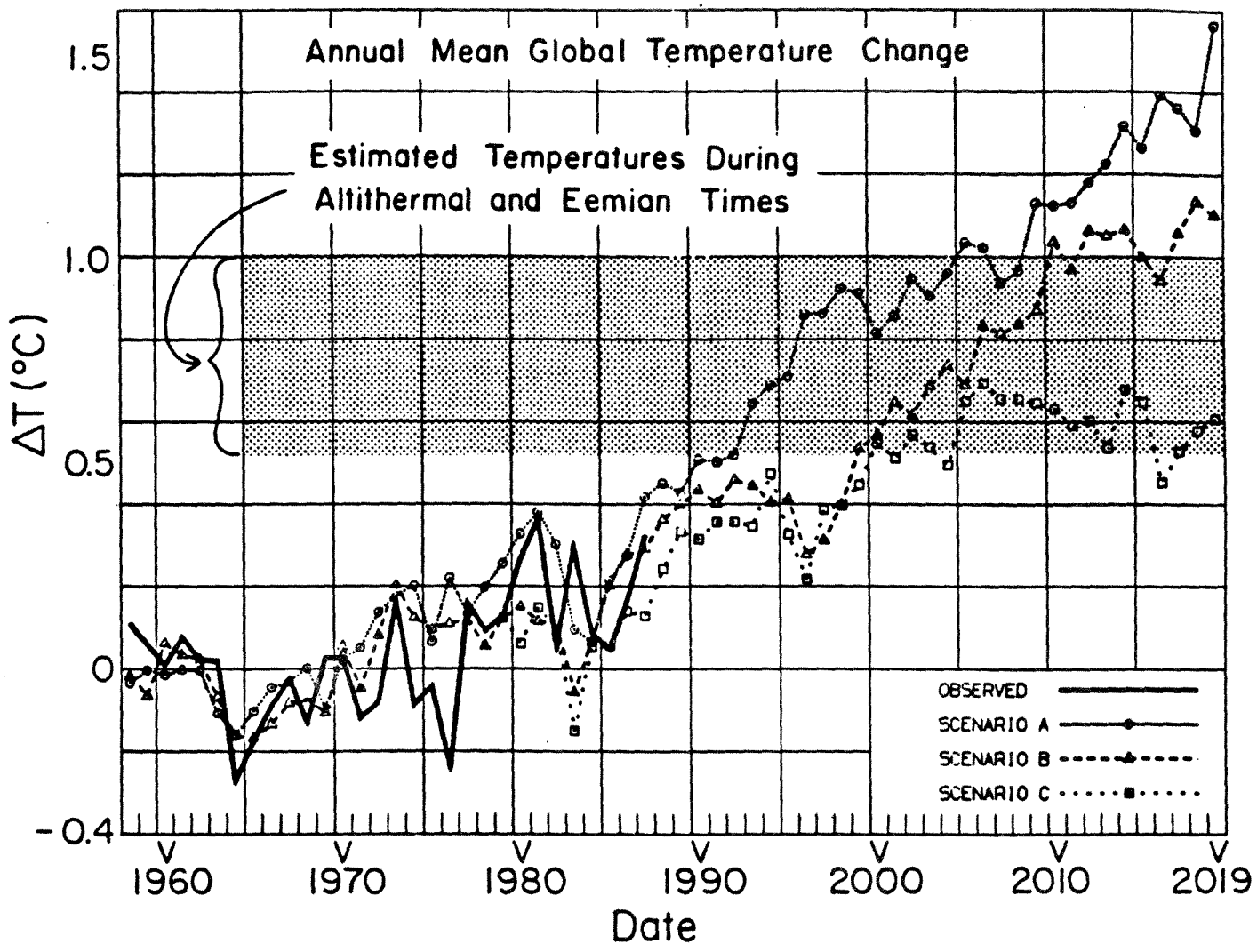
Human Impact on the Greenhouse Effect.

Human activity is increasing levels of the primary, naturally occurring, GH gases - carbon dioxide, methane and nitrous oxide. In addition, manufacture of chlorofluorocarbons has added a new gas with significant global warming characteristics. The rate of increase and the sources of these gases is described in a recent draft Environmental Protection Agency (EPA) report The Potential Effects of Global Climate Change on the United States (hereafter referred to as EPA 1988), from which the following is taken.



Global and hemispheric surface air temperature change estimated from meteorological station records. The northern hemisphere scale is on the right. The 5-year running mean is the linear average for the 5 years centered on the plotted year. The uncertainty bars (95% confidence limits) are based on the error analysis in Section 5; the inner bars refer to the 5-year mean and the outer bars to the annual mean.

Source: J. Hansen, and S. Lebedeff. "Global Trends of Measured Surface Air Temperature." J. Geophys. Res. vol. 92, November 20, 1987:13,351.



Annual mean global surface air temperature computed for trace gas scenarios A, B and C described in reference 1. [Scenario A assumes continued growth rates of trace gas emissions typical of the past 20 years, i.e., about 1.5% yr^{-1} emission growth; scenario B has emission rates approximately fixed at current rates; scenario C drastically reduces trace gas emissions between 1990 and 2000.] Observed temperatures are from reference 6. The shaded range is an estimate of global temperature during the peak of the current and previous interglacial periods, about 6,000 and 120,000 years before present, respectively. The zero point for observations is the 1951-1980 mean (reference 6); the zero point for the model is the control run mean.

From Environmental Protection Agency
adapted from Hansen

Carbon Dioxide (CO_2). The most reliable recent measurements of CO_2 were initiated by Keeling in 1958, when concentrations on Mauna Loa, Hawaii, were found to be 315 part per million (ppm). This compares to a number of ice core studies that generally place the preindustrial concentrations in the range of 270-290 ppm. The mean growth of CO_2 for the period 1850-1958 was about 4ppm/decade, while the growth in recent decades is about 15ppm/decade. The near quadrupling of the growth rate is mainly attributed to combustion of fossil fuel and deforestation.

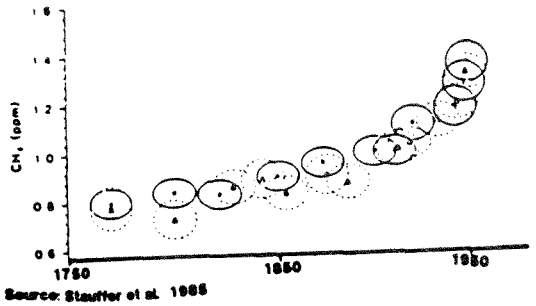
Methane (CH_4). Atmospheric measurements taken since 1979 have established that the concentration of methane is increasing at a rate of approximately 1% per year, although earlier measurements begun in 1965 had suggested a rate of 1.8% per year. Analyses of air trapped in polar ice show that levels of methane have been increasing for the last several centuries. The sources of methane include enteric fermentation, rice paddies, biomass burning, coal and gas production, landfills, wetlands and other natural sources.

Nitrous Oxide (N_2O). Recent measurement suggests that nitrous oxide is increasing in the atmosphere at a rate of 0.2-0.3% per year. The mean global concentration of N_2O is about 300 ppb, with very little geographic variations because of the gas's long lifetime. There currently are no observations providing quantitative data on preindustrial N_2O concentrations, although Weiss (1981) estimated concentration of 281-191 ppb. The sources of N_2O include oceans, fossil fuel and biomass combustion, agricultural fertilizers and land disturbances.

Chlorofluorocarbons (CFCs) Global measurements of halocarbons (CFC-11($CFCl_3$), CFC-12(CF_2Cl_2), CCl_4 and CH_3CCl_3) since 1978 suggest that each gas is increasing with time. Growth rates range from 5% per year for CFC-11 and CFC-12 to 7% per year for CH_3CCl_3 and 1% per year for CCl_4. Since chlorofluorocarbon production began in the twentieth century, there are no preindustrial measurements for comparison. The less abundant chlorine and fluorine compounds are also increasing in the atmosphere, although less is known about changes in atmospheric concentrations.

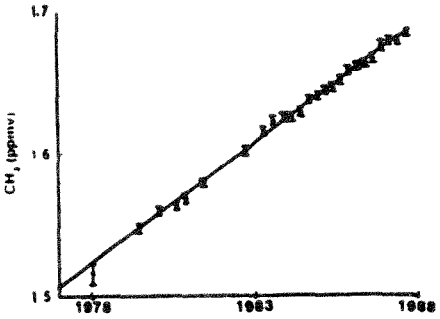
CONCENTRATIONS OF TRACE GASES FROM ICE CORE AND ATMOSPHERIC SOURCES

ICE CORE DATA



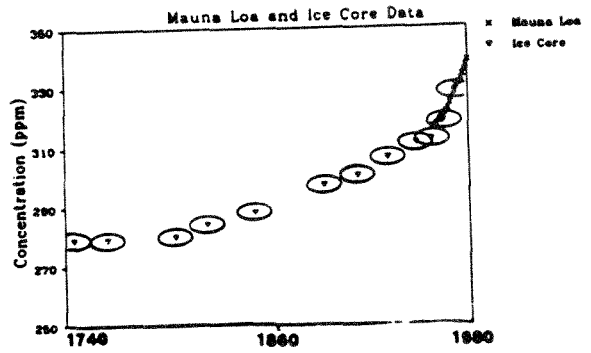
Source: Stauffer et al. 1985

ATMOSPHERIC DATA



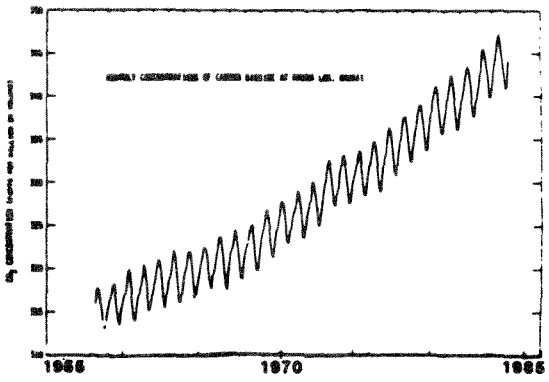
Source: Blake & Rowland, 1988

CH_4



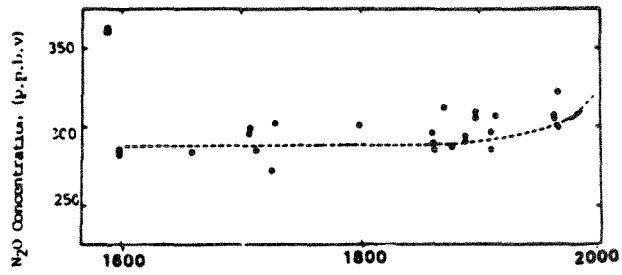
Source: Neftel et al., 1985; Keeling et al., 1982

CO_2

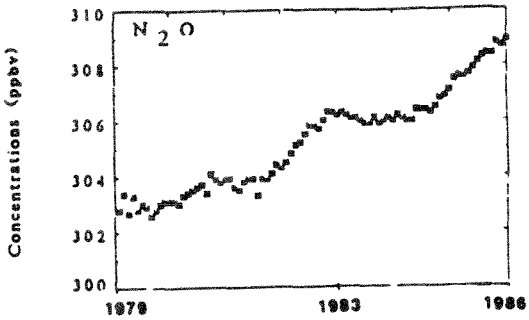


Source: C.D. Keeling, 1984

N_2O



Source: G.I. Pearman et al. 1986

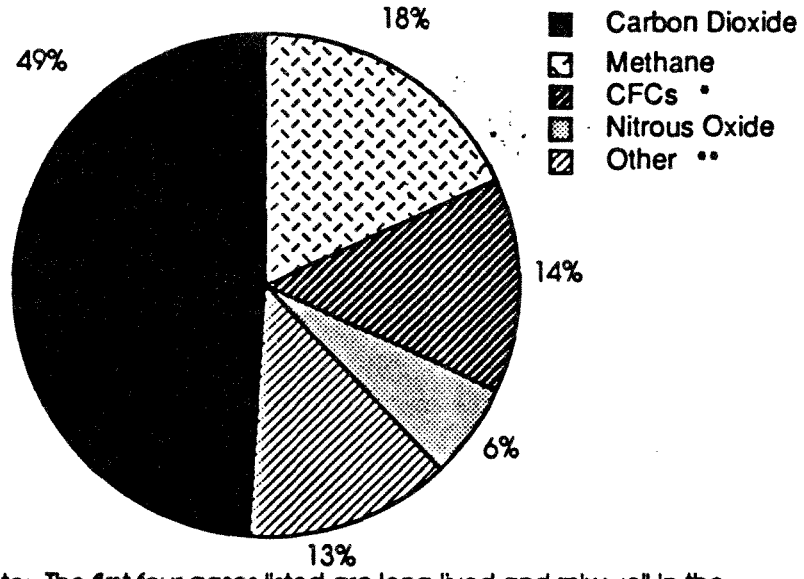


Source: Khalil, 1987

Greenhouse gas trends in ice cores and atmospheric instrument data.

From Environmental Protection Agency (1988)

Estimated Relative Contributions to The Greenhouse Effect in the 1980s



Note: The first four gases listed are long-lived and mix well in the atmosphere, so their concentrations and greenhouse contributions can be measured fairly accurately. The "other" category is more uncertain because the gases are short-lived and their concentrations vary from one area to another.

Source: James Hansen, et al., *Journal of Geophysical Research*, 8/20/88.

• CFC-11 and CFC-12.

•• Tropospheric ozone and other halocarbons.

Chlorofluorocarbon sources include refrigerants, aerosols, sprays, insulating material and solvents.

These gases differ in their respective impacts on global warming. CFCs occur in relatively low concentrations in the atmosphere, but molecule for molecule, CFCs are 10,000 times more effective than CO_2 in causing global warming. This is because of the greenhouse effect of other gases produced by the chemically reactive CFCs.

Global Warming Forecast Methodology.

Forecasting the effects of the increase in atmospheric GH gases is accomplished using computer models and making assumptions about future gas emissions. Both of these elements have great uncertainty associated with them.

General Circulation Models (GCMs) are the principal tools used to predict global warming. These computer models are used to forecast future climate changes which may be brought about by the greenhouse effect. They reduce factors which influence the climate to mathematical calculations. Most predictions are based on using the models to predict the results of effectively doubling CO_2 concentrations. This means that the sum of all GH gas increases will equal the effect of doubling CO_2 alone. There are four GCMs used in global warming predictions. Their results uniformly predict warming but vary as to the intensity and regional effects.

There are several limitations to GCMs. First, some factors affecting climate are not well understood so they cannot be modeled - for example, the influence of oceans is not usually included. Second, predictions for regions cannot be very specific. This is because GCMs divide the world into grids for regional analysis. Each grid is larger than the area of California. Third, while global warming is predicted to cause a general increase in precipitation, local changes are difficult to forecast. Individual storm events are not predicted by GCMs. Variations in present storm tracks are likely to occur and even minor changes will dramatically affect precipitation levels in California.

Future Gas Emissions. The future level of GH gas emissions is difficult to

forecast. Large increases in fossil fuel combustion, which are expected to occur as nations industrialize, could lead to a doubling of atmospheric CO_2 by 2030. If some emission controls are adopted, then CO_2 doubling might be delayed until 2100. While there have been some discussions amongst industrialized nations concerning controls, those countries which are just beginning to industrialize may reject controls which could limit their economic development.

An issue related to future gas emissions is the extent of future adverse impacts on global vegetation. Approximately one quarter of the CO_2 increase now observed is thought to be due to deforestation, particularly the reduction in tropical rain forests. Deforestation causes an increase in atmospheric CO_2 because: (1) the plants would have absorbed CO_2, and (2) the destroyed plants contribute new CO_2 as they decay or are burned. As with gas emissions, continuation of current trends lead to different GCM forecasts than if deforestation is stopped or reversed.

How Warm Will It Get?

Generally forecasts of global warming take two forms - the amount of global warming to which we are "committed," and the temperature change that will occur by a certain date. The term "commitment" refers to the fact that actual temperature change will lag 30 to 40 years behind changes to atmospheric composition. This is primarily because the ocean takes time to respond to atmospheric temperature changes. Before the atmosphere can reach the maximum temperatures which will occur because of increases in GH gases, the ocean must first warm - a process which takes several decades. Some scientists have estimated that even if the GH gas composition of the atmosphere could be kept at its present level, the earth is committed to a further temperature rise of 1-2^{o}C.

Present rates of GH gas emission increases will result in an effective doubling of CO_2 concentration by the year 2030. According to Michael MacCracken of the Lawrence Livermore Laboratory, the four major GCMs predict that the western United States will be committed to a 2^{o}C to 5^{o}C warming with a doubling of atmospheric CO_2. Assuming growth rates in GH gas emissions consistent with the rates which have occurred since 1970, Dr. James Hansen of NASA predicts an

average global warming of 2°C will have occurred by 2030. Preliminary indications are that global warming effects on California will roughly equal global averages. Therefore, a 2°C rise in California's temperatures is a reasonable expectation by 2030, with a greater increase probable after that year.

Other Global Changes Caused by the Greenhouse Effect.

Several climatic and geographical changes can be expected as a result of global warming.

- o Precipitation will increase. Warmer air can hold greater amounts of water vapor which will result in heavier rain and snow. The GCMs conflict as to whether there will be any change in California precipitation.

- o Global weather patterns and ocean currents may change. Thus increases in temperature and precipitation will not be uniform and some locales could see lower readings.

- o Global warming will occur most strongly at the poles. This will lead to a sea level rise from polar ice melt. The sea level rise will also occur because of the thermal expansion of the ocean as the water warms. This rise could equal a meter by 2050.

Other Scientific Opinion on the Global Warming Theory.

It should be noted that while the majority of scientists working in the field believe that the greenhouse effect is real and that global warming is the result, there are those that differ. Recent studies of rural temperatures across the United States and California conclude that there has been no apparent change in temperatures. Other studies suggest that feedback mechanisms such as increased cloudiness will overcome the warming effect of increased GH gas levels. There are even some who believe that the net result of the greenhouse effect is global cooling and the rapid onset of a new ice age.
Global warming adherents respond to these temperature studies by arguing that

global warming will not occur uniformly. Areas as large as the United States may lag behind in feeling the effects. Adherents assert that a temperature rise of about .6°C has been measured on a global basis over the past one hundred years, both at ground stations and more recently with satellite observations. The scientists involved in both the national temperature and the cloud effect studies agree that their work does not disprove global warming. Ice age theorists are substantially in the minority and are not regarded as credible by most other scientists.

It should be noted that there are spectacular theories which forecast global warming impacts more dire than those described in this report. For example, one theory suggests that a collapse of the Antarctic ice field could occur in a period of decades and would raise sea levels by five meters. In developing this report, committee staff has attempted to rely only on theories and models which are most widely supported by the scientific community.

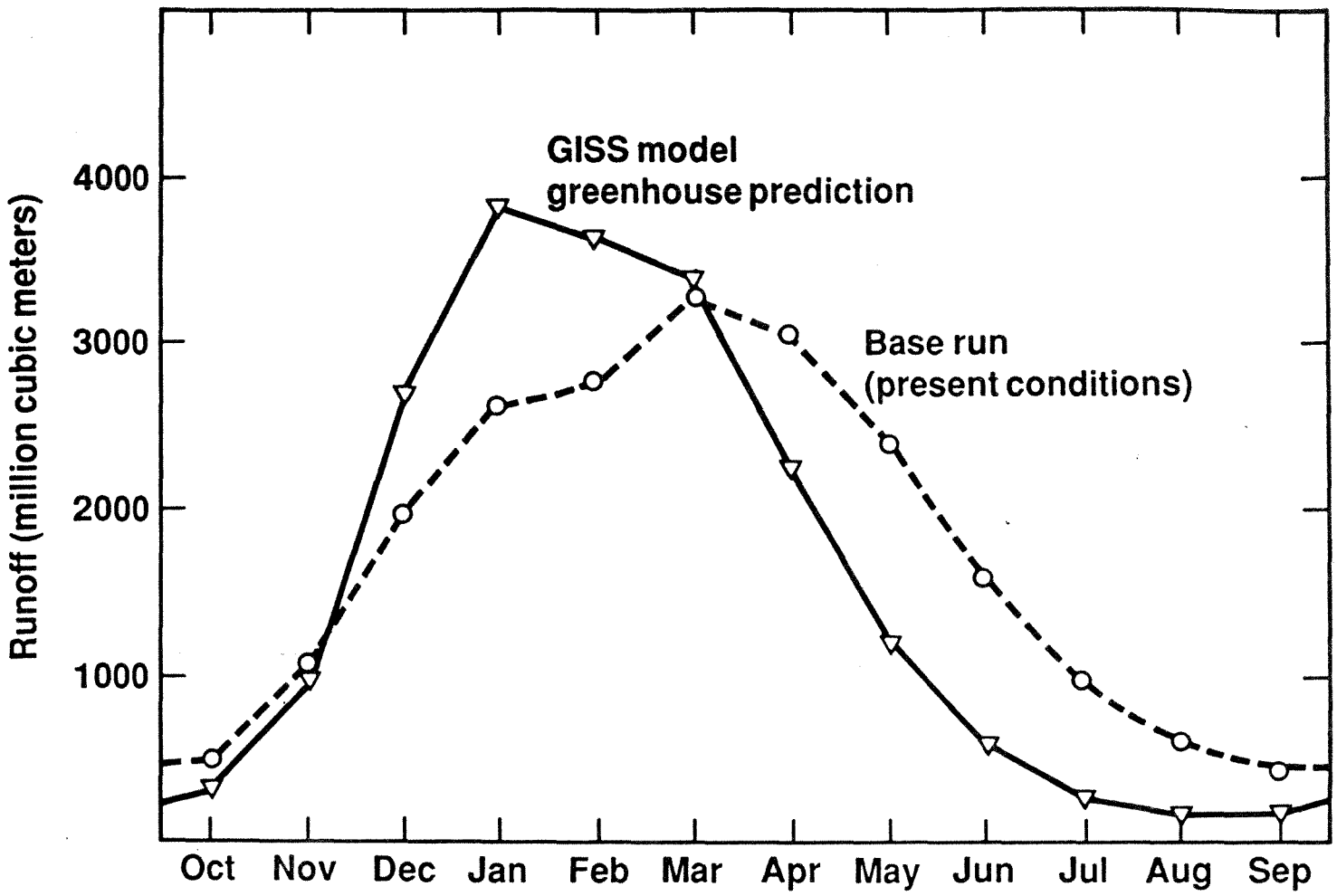
IMPACTS ON CALIFORNIA FROM GLOBAL WARMING

If the theories and forecasts are correct, the impacts to the state from global warming will profoundly affect our economy and society. These impacts will be felt in the areas of water resources, energy production and consumption, agriculture, natural resources and air quality. The following is a brief overview of how these areas will be affected:

Water Resources. The impact of global warming on water in California will be driven by several effects. First, a sea level rise of one meter will push sea water much further upstream in the Delta. Second, temperature increases will decrease snow pack water storage. Third, any temperature rise will likely increase urban and agricultural water demand.

Absent any change in precipitation, these three effects will result in:

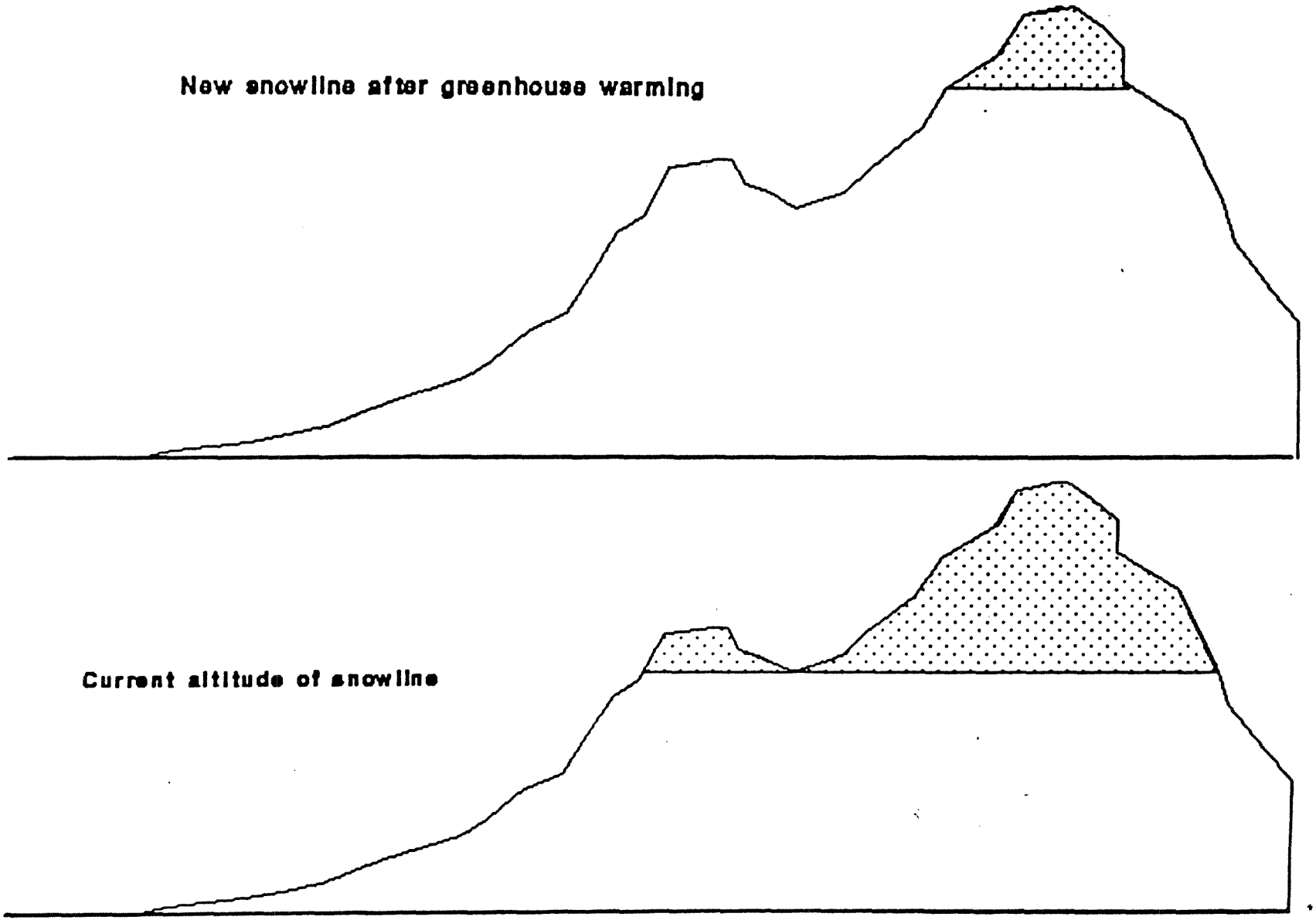
- Delta water quality problems from increased salinity and higher concentrations of drainage water, which will affect water supply for Southern California and the Bay Area. Higher water flows might be



Adapted from Gleick (1987)
from Buddemeier

Hydrologic model comparisons of the Sacramento Basin average monthly runoff patterns for present conditions and for the Greenhouse temperature conditions developed by the GISS (Goddard Institute for Space Studies) General Circulation Model. Present precipitation values are used for both runs. Data adapted from Gleick (1987).

CHANGES IN SNOWLINE DUE TO GREENHOUSE WARMING



Rising snowline due to greenhouse warming.

From Department of Water Reso
after Gleick

required to maintain water quality at delta pumping stations which would reduce water availability for upstream agricultural and urban users.

- o Increase in runoff of 34% in the winter and a decrease in runoff by 62% in the summer, causing floods and diminishing water storage capabilities (based on a temperature rise of 4°C).

- o Increased likelihood of levee failure in the Delta, leading to flooding, diminishing California's agricultural output and further diminishing water quality.

Changes in precipitation which may occur as a result of global warming would exacerbate some of these effects and ameliorate others.

Energy. Capacity requirements are expected to be increased by global warming - by 14% to 20% by 2055 according to one estimate. Some of the specific impacts include:

- o Increased electrical peak demand as more air conditioning is required to respond to higher temperatures. Increased irrigation demand would also lead to greater electrical use for groundwater pumping.

- o Reduced electrical production if reduced snow pack or precipitation decreases hydroelectric yield and potential emission controls reduce fossil fuel plant efficiency and discourage new plant construction.

- o Increased hydroelectric output if precipitation increases.

Agriculture. Impacts to agriculture are more difficult to predict. Higher temperatures could be expected to increase irrigation requirements and eliminate some crops for which the climate becomes too hot. However, the increased levels of carbon dioxide in the atmosphere have a fertilizing effect on plants and cause them to reduce the amount of water lost through evaporation. One study estimates that on balance, agricultural output may remain about the same in the state. Some crops, such as corn, which do not benefit from increased carbon dioxide, may be eliminated. Others, such as cotton may have increased yields.

Effects on individual regions will vary. According to the EPA, crop acreage in the Imperial Valley will be reduced by 40%. If adequate water is available, crop acreage may increase by 20% in the northern San Joaquin Valley.

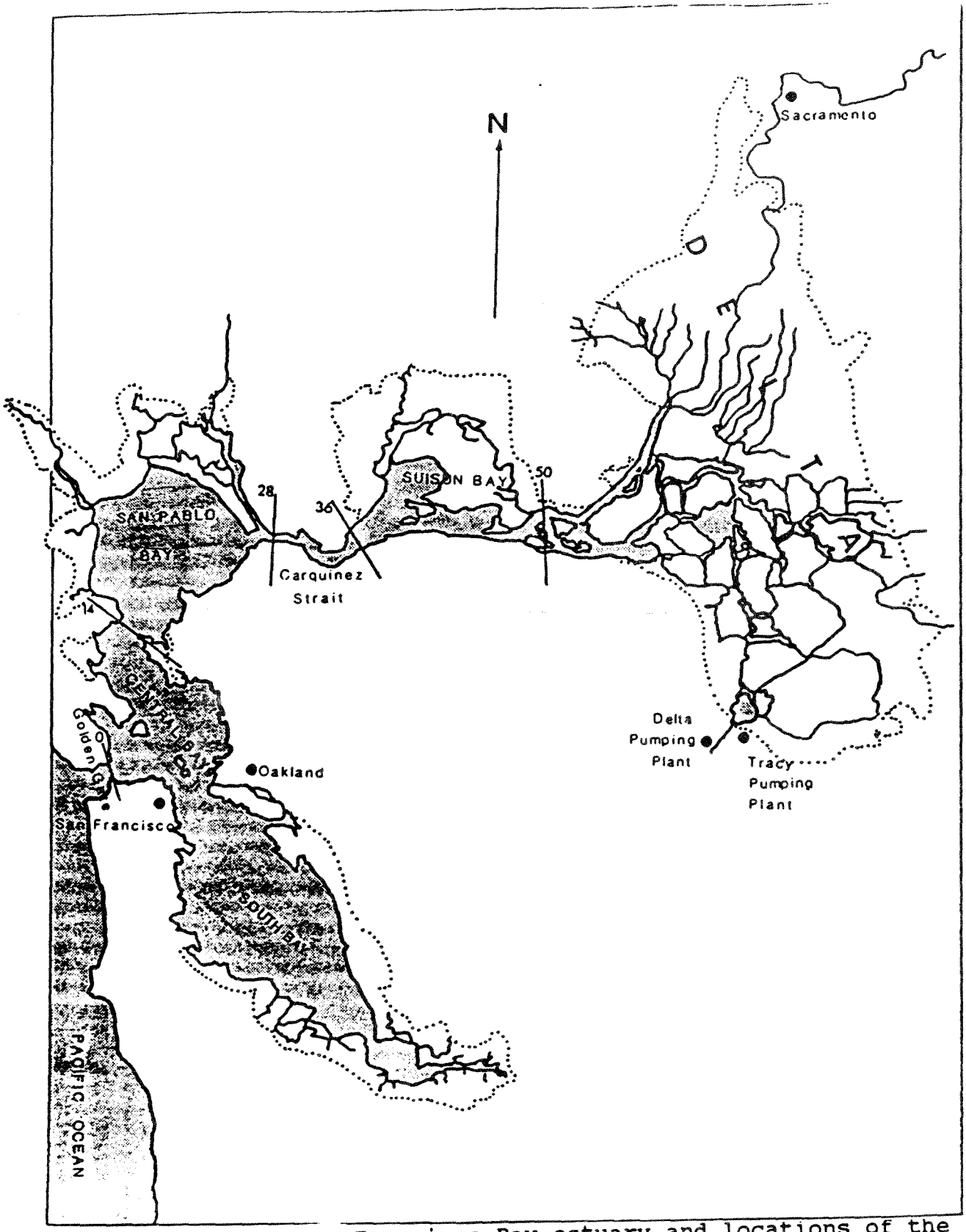
Natural Resources. Wetlands are likely to dry or be flooded by sea level rise and water runoff changes. New wetlands are likely to be created as previously dry land floods, but construction of levees could prevent this. Sedimentation could mitigate flooding of existing wetlands but sedimentation rates may not keep up with sea level rise.

Forest changes brought about by higher temperatures, increased CO_2, and drier summer soils (because of lack of snow pack) may be profound. According to the EPA (1988) report, vegetation density may decrease, species change, and timber harvest yields decline. The report suggests that forests on the west side of the Sierra may resemble the drier, more open forests presently on the east side.

Animal populations are likely to be affected as well with already endangered species being most vulnerable. The climatic changes may occur fast enough that areas will be deforested until new species can move in or are planted. According to Daniel Botkin of the University of California at Santa Barbara, a $2^{o}C$ rise in temperature would cause forest species on flat land to move 120 miles north. Forests can only shift at a rate of 15-20 miles per century.

Coastal Resources. A sea level rise would have a dramatic effect on California's shoreline. Damage to development during storms would become much more widespread. Many recreational beaches would be lost to erosion and replaced with shoreline protective devices. Most of the southern California coast could become a riprap-lined seawall. The cost of installing this protection, and of the loss of tourism and recreational opportunities would be enormous. If large enough, this sea level rise may also require expensive modifications to port facilities.

Air Quality. Air quality is directly affected by temperature change. A rise in temperature will accelerate formation of ozone and sulfuric and nitric acids. One study indicates that ozone levels in the San Francisco Bay area, already a nonattainment area with regard to federal ambient air standards, will increase



The San Francisco Bay estuary and locations of the freshwater pumping plants in the Delta. The numbered bars indicate distance (in miles) from the Golden Gate. The dotted line indicates the maximum area affected by 100-yr high tide with a 1-m (40-inch) sea level rise.

From Environmental Protection Agency

by 20% if average temperatures rise $4^{o}C$.

HOW SHOULD THE STATE RESPOND TO THE THREAT OF GLOBAL WARMING?

This topic is best framed by posing three other questions:

Given the scientific uncertainty over if, when, and how much global warming will occur, should the state take any action at all?

While not unanimous, the clear majority of scientists seem to favor the view that global warming will occur, even if the timing and severity are not certain. The magnitude of the potential impacts suggest that even if there were greater disagreement amongst the experts, the only responsible course for the state is to at least begin contingency planning.

When should the state act?

Ironically, the state must begin to act in order to answer this question. The potential impacts of global warming are so pervasive that study is necessary to determine the problems and solutions. Pursuant to AB 4420 (Sher) the Energy Commission has begun a broad study on how global warming will affect California. Several factors dictate that planning measures should be initiated through legislation this year, without waiting for completion of this study.

- Planning and implementing infrastructure improvements take decades, perhaps approximating the time the major impacts of global warming will need to be addressed. Water transport or energy generation systems are good examples.

- Some work may be needed soon. Damaging effects of global warming will appear incrementally and may already have begun. For example, sea level rise is already occurring.

- For GH gas emission reduction strategies, the sooner the reduction is started, the greater the effect will be to slow global warming.

- California will be less hurt economically if needed changes can occur over a long period of time. If the effort were begun now, energy conservation and emission control could be phased in for new buildings, cars, transit systems and energy production. Retrofitting at a later date would be much more expensive. Decisions made today with knowledge of global warming can, in some cases, entirely avoid future costs. For example, locating a state building on a site outside of areas susceptible to increased flooding will avoid future damage or protection costs.

- One of the major effects of global warming on California will be the intensification of debate over existing environmental issues. Offshore oil, water development and energy planning are all fundamentally affected by global warming. If solutions to these issues are not developed now, a crisis atmosphere may be generated in which programs are adopted which are not the best for California's economy or are damaging in other ways to the environment. Timely planning by the state would help develop the best alternatives for responding to the impacts.

What Actions Should the State Take to Respond to Global Warming?

Potential responses to global warming generally fall into two categories:

- Reducing GH gas emissions to slow global warming.

- Planning for global warming impacts to lessen adverse effects on California.

GH Gas Emission Reduction.

The overarching consideration in determining a state emission reduction strategy is that global warming is a global problem. California will need the help of the rest of the world because the state contributes only about 5% of the emissions that cause it. The solution to global warming will require the participation of most nations, either through international agreement or by

independent action.

An international agreement has already been reached to reduce CFCs in order to stop depletion of the ozone. In comparison with GH gas emission reduction, this agreement was relatively easy to reach. The use of CFCs represents only a small portion of any nation's economy and there are potential substitutes for CFCs. GH gas emission control will be much more difficult to achieve because it requires turning away from burning fossil fuels for energy production. Other methods of energy production are likely to be more expensive. Historically, energy production has been fundamental to economic development. Developing nations are likely to object if industrialized nations attempt to deny them cheap production of energy through burning of fossil fuels.

With or without an agreement, each country will probably develop a unique program for meeting its emission reduction goals. The program for the United States will probably be set by Congress and the Administration. S.324 (Wirth) and HR 1073 (Schneider) are the more comprehensive of several measures introduced this year in Congress which would establish national emission reduction goals and research policies. These measures establish a national goal of 20% reduction in carbon dioxide emissions. These bills revive and further energy conservation as a means to reduce fossil fuel consumption. They also encourage development of alternative energy production. States would be required to develop their own programs to achieve half of the carbon dioxide reduction goal.

Individual states will have some independent responsibility under these proposals but will be able to only influence what elements are included in the national program. Once the national program is established, states may not have the flexibility to substitute state originated programs for federal programs. If national reduction goals are established, emission reductions previously achieved through state programs may not be recognized. If a national program instead mandates methods of reduction which were not the same as those imposed in California, the state would have to either support two programs or phase out the state imposed one.

However, California could advantageously become involved in certain emission control strategies. To insure that they would be included in any national program, California's national representatives need to be aware of existing and

potential emission reduction programs which are uniquely suited to California. Thus, the state should be researching ways to utilize its unique resources to control emissions. The state could begin by inventorying all state GH gas emissions and their sources.

California's existing programs for energy development and conservation, and control of air pollution are already models for the rest of the country and the world. They could provide the state with a head start in meeting national goals. They may also have stimulated business to develop technology which can be profitably marketed to other states. Intensifying these efforts would have immediate dividends for the state in improving air quality and assuring an adequate energy supply and will also help control GH gas emissions. The Air Resources Board and the Energy Commission could determine how these programs should be modified to help carry out a California GH gas reduction program.

As part of what has become an international effort to control CFC emissions, California may want to consider outright bans of foam packaging made with CFC's and a recycling program for CFCs used as refrigerants. Four states have already taken similar actions.

State Preparedness for Global Warming Impacts - a Status Report.

California's state government will likely be much more involved with developing responses to greenhouse impacts rather than controlling the causes. While there may be some federal help, the state will have primary responsibility for addressing sea level rise, water runoff dynamics, water quality, forestry and agriculture impacts.

In the fall of 1988, the Chairman of the Natural Resources Committee wrote to the state agencies whose jurisdictions could be affected by the impacts of global warming (See Table 1 for list of agencies.). In his letter the Chairman requested that each agency describe:

- Studies the agency has undertaken on global warming.

- Plans for future work on global warming.

AGENCY INVOLVEMENT IN GLOBAL WARMING

AS INDICATED IN RESPONSES TO ASSEMBLY NATURAL RESOURCE COMMITTEE SURVEY

	Nothing	Staff Assigned	Monitor	Hearing	Report
Air Resources Board		X	X		
Department of Boating and Waterways		X			X
California Coastal Commission		X			X
Coastal Conservancy			X		
California Conservation Corps	X				
Office of Emergency Services			X		
Energy Commission		X	X	X	X
Department of Finance		X	X		
Department of Fish and Game		X	X		
Department of Food and Agriculture		X	X		
Department of Forestry		X	X		X
Department of General Services	X				
California Museum of Science and Industry		X	X		X
California National Guard	X				
Department of Parks and Recreation	X				
Office of Planning and Research	X				
Public Utilities Commission		X	X		
Resources Agency	X				
San Francisco Bay Conservation and Development Commission		X		X	X
State Lands Commission		X	X		
Department of Transportation	X				
Department of Water Resources		X	X	X	
State Water Resources Control Board			X		

Table 1

STATUS OF AGENCY PLANNING FOR GLOBAL WARMING

(Based on responses from 23 agencies)

LEVEL OF AGENCY ACTIVITY

	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
ACTIVE (a)	XXXXXXXXXXXXXXXXXXXXXXXX
MONITORING (b)	XXXXXXXXXXXXXXXXXXXXXXXX
INACTIVE	XXXXXXXXXXXXXXXXXXXX

BREAKDOWN OF AGENCY ACTIVITIES

AGENCY REPORT (In preparation or complete).	XXXXXXXXXXXXXXXXXX
STAFF ASSIGNED	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HEARING OR WORKSHOP	XXXXXXXXXX
MONITORING (c)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LEGISLATIVE RECOMMENDATIONS	XXXXXXXXXX

(a) "Active" means the agency has conducted a workshop or a hearing, prepared a report or study, or otherwise been more involved with the issue of global warming than monitoring alone.

(b) Agencies which only indicated that they were monitoring, some with staff assigned, were placed in this category.

(c) There are more agencies shown as monitoring in this category then is shown above because this category adds agencies which were monitoring and were also active in other ways.

Table 2

- o Recommendations for legislation to enable the agency to better address the issue.
- o The name of a staff contact who is already working on the subject.

The agency responses exhibited a range of current involvement in planning for global warming (See Appendix for selected agency responses). In general, they fall into three approximately equal groups: agencies that have not responded to the threat, those that are monitoring the issue, and those that are actively involved in research or planning. Table 2 charts these three categories and shows further detail of how some of the agencies are addressing global warming. Table 1 shows how individual agency responses were categorized.

The agencies contacted which presently are doing nothing or only monitoring appear to have statutory obligations and responsibilities which will be challenged by global warming and should have already caused them to be actively planning for global warming. For example:

Office of Planning and Research. The most obvious example of an agency with apparent responsibility for leading state planning on the greenhouse effect but which, according to its letter, has not responded, is the Office of Planning and Research (OPR). Section 65040 of the Government Code, provides that OPR shall "engage in the formulation... of long-range goals and policies for... resource preservation and utilization, air and water quality, and other factors which shape statewide development patterns and significantly influence the quality of the state's environment." This same section also requires OPR to "coordinate the development of a statewide environmental monitoring system... to identify at an early time, potential threats to public health, natural resources and environmental quality."
A leadership role on the issue of global warming appears to be a statutorily assigned responsibility of OPR yet according to its letter, this agency has "not conducted any studies on this subject, as it is not under our purview."

Department of General Services. The Department of General Services is responsible for the planning, acquisition, construction and maintenance of most state buildings. The Department has the opportunity to prevent future global warming related expenses to the state in several ways. State buildings could be

sited so that they will not be affected by flooding from increased runoff or sea level rise. Landscaping and design requirements could reduce air conditioning costs. Yet the Department's response stated that global warming "is not within our scope of responsibility or expertise."

Water Resources Control Board. The state water board has responsibility for administering water rights and water quality programs in the state. The board is required to adopt "water quality principles and guidelines for long-range resource planning..."(Sec. 1342 of the Water Code) and determine "the quantities of water reasonably required for ultimate beneficial use..." and "the quantities of water available for export from the... watersheds" (Section 232 of the Water Resources Code).

As outlined above, global warming is likely to have dramatic impacts on stream runoff. The board should consider whether its decisions on water rights should be influenced by this consideration. The board is also in the process of a three-year hearing process to set long-term Delta water quality standards. Global warming is likely to dramatically affect runoff patterns and raise salinity levels yet, according to board staff, this effect is being ignored in board deliberations.

Resources Agency. According to a Resources Agency publication, the Secretary for Resources is:

- The representative of the Governor in coordinating the activities of the units of the agency with other state, federal and local entities.

- Responsible for long-range planning and policy formation.

These powers suggest that the Secretary of the Resources should be exercising oversight and direction in how its departments and agencies are planning for global warming. However, the agency letter indicates that the Secretary is not involved in any global warming planning.

A case study in responsible issue management.

San Francisco Bay Conservation and Development Commission. In sharp contrast to

the lack of planning by these agencies is the response of the San Francisco Bay Conservation and Development Commission (BCDC). This agency has provided a model for timely and thoughtful action. In 1985, BCDC commissioned a hydrologist to determine the effects of a global warming caused rise in sea level on the Bay and the Delta. This report identified probable impacts, and planning and research needs. In 1987, a second report, prepared by an engineering firm, was released. This report described sea level rise impacts in greater detail and made specific recommendations that BCDC, among other things:

- o Change BCDC development review policies to require that projects on bay fill accommodate potential sea level changes over the anticipated life of the project.
- o Add to BCDC's Engineering Criteria Review Board, a member with expertise in coastal engineering and tidal hydraulics.
- o Provide sea level rise information and recommended actions to each local government within BCDC's jurisdiction.

After several public hearings, on January 19, 1989, BCDC adopted staff recommended changes to the agency's development review policies to address sea level rise. The staff is working with the Association of Bay Area Governments to develop options for local government responses. The staff is also negotiating with the U.S. Geological Survey to expand the present shoreline monitoring network in the Delta to establish new stations in the Bay.

The results of this survey suggest that the state's response to global warming impacts have been uneven and that legislative direction is needed. In particular, an organized interagency approach to planning and information handling is indicated. Finally, statutory mandates would prod relevant agencies to consider global warming in their decisions.

RECOMMENDATIONS FOR GLOBAL WARMING LEGISLATION.

1. GH Gas Emission Inventory. The Air Resources Board should conduct an inventory by gas and source of the GH gas emissions which occur in California.

2. Evaluation of Present Air Pollution and Energy Conservation Programs. The

Air Resources Board and the Energy Commission should evaluate present programs to determine how they could be used or changed to respond to global warming. These agencies should determine what additional research is necessary to develop a state emission reduction strategy which best fits California's needs and resources.

3. Agency Study Mandate. All state agencies should be required to consider the effect of global warming on their areas of jurisdiction and if appropriate, develop contingency plans to respond to the effects. They should report on the results of these studies to the Legislature by January 1, 1991.

4. Interagency Task Force. An interagency task force should be established to coordinate state planning and research. It should be headed by an agency which is centrally involved in global warming issues, e.g. the Resources Agency or the Air Resources Board. Membership should include the agencies contacted for this study and others that may be affected by global warming. The task force would insure that redundant research is not conducted by different agencies. The task force should meet regularly.

5. Informational Clearinghouse. There should be a statewide clearinghouse which will collect and disseminate information on global warming. Its mission would be to actively seek out articles and research reports and distribute them to relevant state agencies. This would be more efficient than the individual agency monitoring which is now occurring. The clearinghouse could also disseminate information developed by individual state agencies. The clearinghouse should maintain a library and could publish a regular newsletter on global warming.

6. Energy Commission Funding. The Energy Commission should be funded for its ongoing study on global warming. Presently three personnel are working full time on the report mandated in 1990 by AB 4420, which means resources for other assigned responsibilities are reduced.

7. General Plan Element/CEQA. Consideration of global warming impacts should be added to local general plans or to CEQA. This would force local and state decision-making bodies to consider global warming when approving projects. For

example, future flood plains could be kept free from development, thereby avoiding costs from damage or the construction of protective systems.

8. State Projects. All state funded projects should be sited and constructed so as to avoid where feasible, impacts from global warming over the life of the project.

CONCLUSION.

Global warming is an insidious challenge to our state's welfare and therefore its government. Nothing in our daily lives indicates that it is real. The scientific prognostications seem vague and uncertain. Yet, like the hurricane that is still 500 miles over the horizon, that it is not yet visible is hardly a measure of its tremendous potential for impact. And like the hurricane, if we wait until we can see it before taking precautions, it will be too late to act to prevent damage. As William Ruckelshaus, former administrator of the Environmental Protection Agency, stated:

> The ultimate danger is that by remaining reliant on the "catastrophe theory of planning" in an era producing catastrophes of a magnitude greater than in the past, we can place our institutions in situations where precipitate action is the sole option - and it is then that our institutions themselves can be imperiled and individual rights overrun.

In recognition that science may be wrong and the hurricane may miss us, the recommendations in this report are not costly to carry out. They are the equivalent to a few sheets of plywood and a full tank of gas, small prices to pay in the face of the enormity of the threat.

APPENDIX

SELECTED AGENCY RESPONSES TO GLOBAL WARMING PREPAREDNESS SURVEY

State of California
GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET
SACRAMENTO 95814
(916) 322-2318

GEORGE DEUKMEJIAN
GOVERNOR

November 30, 1988

Honorable Byron D. Sher, Chairman
Assembly Natural Resources Committee
California State Legislature
State Capitol, Room 2136
Sacramento, CA 95814

Attention: Paul Thayer

Dear Mr. Sher:

This letter will confirm our phone discussion with Paul Thayer of your staff regarding your request for information on "global warming" activities.

The Office of Planning and Reseach (OPR) has not conducted any studies on this subject, as it is not under our purview. However, the California Energy Extension Service and the Office of Permit Assistance (both of which are housed in OPR) are keeping abreast of this issue as it effects energy conservation and the environment.

Should you have questions, please contact me or Maria Schrap of my staff at (916) 322-2318.

Sincerely,

Robert P. Martinez
Director

mls

STATE OF CALIFORNIA—STATE AND CONSUMER SERVICES AGENCY GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF GENERAL SERVICES
EXECUTIVE OFFICE
915 CAPITOL MALL, SUITE 590
SACRAMENTO, CA 95814
(916) 445-3441

November 3, 1988

Byron E. Sher, Chairman
Natural Resources Committee
State Capitol, Room 2136
Sacramento, California 95814

Dear Mr. Sher:

I am writing in response to your letter requesting information on any work or studies we are conducting on global warming. The Department of General Services currently has no projects underway and no plans to study this issue as it is not within our scope of responsibility or expertise; therefore, I am unable to provide you with any information.

If you have questions, you may have your staff contact Judy Balmain, Legislative Coordinator, at 445-3946.

Sincerely,

W. J. ANTHONY, Director
Department of General Services

WJA:sam

cc: Allan Zaremberg, Legislative Secretary to the Governor
Karen Morgan, Assistant Secretary - Legislation, State and Consumer Services Agency
Walt Jones, Assistant Director - Legislation, Department of General Services

STATE OF CALIFORNIA
GEORGE DEUKMEJIAN, *Governor*

STATE WATER RESOURCES CONTROL BOARD
PAUL R. BONDERSON BUILDING
901 P STREET
P.O. BOX 100
SACRAMENTO, CALIFORNIA 95801

(916) 445-3993

DEC . 1988

The Honorable Byron D. Sher
Member of the Assembly
State Capitol, Room 2136
Sacramento, CA 95814

Dear Mr. Sher:

Thank you for including the State Water Resources Control Board in your survey concerning State agency studies of the "greenhouse effect". In response to your questions:

1. The State Water Board has not initiated any studies on global warming trends. The State Water Board staff has, however, monitored the information being released by the scientific community on this potential problem. The State Water Board continues, as it does with other areas of emerging environmental concern, to stay informed as to possible harmful consequences upon the California's water quality and water resources that could result from global warming. The Vice Chairwoman of the State Water Board, Darlene Ruiz, sits on the Environmental Protection Agency's (EPA) State Task Force. This group has been closely following the research being done by EPA on the international problem of global warming.

2. The State Water Board will continue to keep abreast of scientific information on the "greenhouse effect". The State Water Board is, of course, prepared to fully cooperate with international, federal, State, and local agencies in responding to global warming once a coordinated, scientifically formulated, and technically feasible approach has been developed and agreed upon.

3. We offer no recommendations at this time.

4. Though we do not have a specific staff person assigned to global warming, please feel free to contact Robb Van Der Volgen, of our Office of Legislative and Public Affairs, at (916) 322-3132.

I hope you find this information useful. Good luck with your research into the "greenhouse effect".

Sincerely,

W. Don Maughan
Chairman

Resources Building
1416 Ninth Street
95814
(916) 445-5656
TDD (916) 324-0804

California Conservation Corps
Department of Boating and Waterways
Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Parks and Recreation
Department of Water Resources

GEORGE DEUKMEJIAN
GOVERNOR OF
CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

Air Resources Board
California Coastal Commission
California Tahoe Conservancy
California Waste Management Board
Colorado River Board
Energy Resources Conservation And Development Commission
San Francisco Bay Conservation and Development Commission
State Coastal Conservancy
State Lands Division
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards

DEC 2 1988

The Honorable Byron Sher
Chairman, Assembly Natural
Resources Committee
State Capitol
P.O. Box 942849
Sacramento, CA 94249-0001

Dear Mr. Sher:

In your letter of Oct. 25, 1988, you asked for information about any "greenhouse effect" studies being carried out by the Resources Agency. I have since learned that you sent similar inquiries to a number of the Resources Agency's boards, departments and commissions, and that they have replied directly to you.

As you may know, the Office of the Secretary for Resources serves as the coordination point for those units of the Agency that possess qualified staff and adequate resources to conduct such studies on behalf of the Agency and the Administration.

Although you may have already seen them, I am enclosing copies of replies to your request by our departments, boards and commissions.

We appreciate your concerns on this important issue and hope the enclosed information will be useful to you.

Sincerely,

Gordon K. Van Vleck

Gordon K. Van Vleck
Secretary for Resources

Enclosures

STATE OF CALIFORNIA GEORGE DEUKMEJIAN, *Governor*

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
THIRTY VAN NESS AVENUE, SUITE 2011
SAN FRANCISCO, CA 94102-6080
PHONE: (415) 557-3686

NOV 18 1988

November 16, 1988

Honorable Byron E. Sher, Chairman
Natural Resources Committee
State Capitol
P.O. Box 942849
Sacramento, California 94249-0001

Dear Assemblyman Sher:

Commission Chairman Tufts asked that I respond to your letter concerning the greenhouse effect.

We believe that one of the consequences of global warming is an accelerated rise in sea level. While the exact amount of the future rise is not now clear, some rise in the level of the Bay is already measurable. We expect the rate of rise to further accelerate in the future. Also, many land areas around the Bay are subsiding which can compound the risk of tidal flooding, particularly in stormy conditions.

As you will recall from your days on the Commission, under the Commission's law, the McAteer-Petris Act, projects that the Commission authorizes on fill in or over San Francisco Bay, must be "constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of...flood or storm waters...." Typically, the Commission approves residential, commercial, industrial, and recreational projects valued at over $650 million annually. Therefore, the Commission must be concerned with the impact a rising sea level could have on the safety of this substantial public and private investment. Moreover, the Commission has a statutorial duty to assure that development in its Bay jurisdiction is reasonably safe from future tidal flooding, including that arising from an accelerated rise in sea level.

In order to assess the expected impacts of a rise in sea level and to provide expert guidance to Bay Area communities, the Commission has been studying the sea level rise issue over the past few years. In April, 1986, Philip Williams & Associates, the Commission's consultant in hydrology, completed and presented a report (An Overview of the Impact of Accelerated Sea Level Rise on San Francisco Bay) to the Commission. A copy of the report is enclosed. This report analyzes the possible impacts of an accelerated rise in sea level in San Francisco Bay. Dr. Williams concluded that if sea level rises four feet in the next 100 years as predicted by the U. S. Environmental Protection Agency, the following effects on the Bay-Delta system could be expected:

(1) extensive and costly new levee and other flood control systems would be needed to protect existing urban development from tidal flooding;

(2) levees protecting nonurbanized low-lying areas, such as the Bay's extensive salt ponds and diked historical baylands and the Delta islands, would likely fail, doubling the size of the Bay-Delta system and creating an inland sea in the Delta;

(3) salinity levels would increase in Suisun Bay and the Delta;

(4) low-lying shoreline areas would be more frequently flooded and drainage would be impeded; and

(5) existing tidal marshes and most managed wetlands would be significantly reduced due to submersion.

Predictions of future sea level based on computer simulations of possible future climatic conditions, the basis for "greenhouse effect" sea level rise projections, vary widely and are dependent upon the future climatic assumptions of the various researchers; therefore, the predictions are uncertain. Most predictions extend far into the future, and are not directed to the lifetime of projects normally authorized by the Commission. Therefore, in the second phase of its study of sea level rise impacts on the Bay, the Commission retained consultants to study the near-term (20-50 years) rise in Bay sea level.

In December, 1987, Moffatt & Nichol, Wetlands Research Associates, and the Commission's staff presented their report, Sea Level Rise: Predictions and Implications for San Francisco Bay, to the Commission and the public. A copy of the report is enclosed. The report included: (1) a general overview of historical sea level change in the Bay; (2) a discussion of the "greenhouse effect" on change in world climate and sea level; (3) a prediction of sea level change and the height of highest estimated tide with a 100-year reoccurrence in the Bay in 20 and 50 years; (4) an analysis of the effect of sea level change on Bay marshes and diked baylands; and (5) an engineering design review process that can be used by Bay and shoreline project designers, the Commission, and other governmental agencies in designing and reviewing projects proposed for the Bay and shoreline to help assure project and occupant safety from the hazard of tidal flooding.

In January 1988, the Commission began the process of amending its San Francisco Bay Plan to incorporate information on sea level rise, and on October 20 and November 3, 1988, the Commission held public hearings on proposed Bay Plan amendments. A copy of the staff report to the Commission concerning the specific amendments to the Plan is enclosed. The Commission is scheduled to take action on the recommended amendment on January 19, 1989.

At the public hearing, testimony was received that agencies other than the Commission may more appropriately deal with the safety of shoreline structures near the Bay. Some commentors felt that the United States Corps of Engineers or the Federal Emergency Management Agency are better able to establish criteria since the phenomenon is so widespread. However, in our research we discovered that neither of these federal agencies is taking any positive action to deal with the predicted consequences of sea level rise. Current FEMA flood maps do not acknowledge any anticipated sea level rise. The Corps of Engineers is relying on past measured tides in predicting tidal levels. Both agencies appear to believe that because there is insufficient certainty as to the precise rate of sea level rise acceleration and because the ramifications of any acceleration will not be felt for some time, the current criteria need not be changed. In contrast, our staff believes a more conservative approach may be prudent in light of the very large investment in urbanization and the fragile nature of the few remaining wetlands in and adjacent to the Bay.

Another commentor felt that the Department of Water Resources was responsible for assessing the risk arising from tidal flooding and protecting California citizenry from any accelerated change in sea level. Our research indicates that DWR has special responsibilities with regard to flood risk in the Delta but not within San Francisco Bay. Some commentors felt that local government could more easily deal with flood protection when it authorizes individual buildings. Our staff shares the view that local government can incorporate specific criteria into its current review processes to protect property owners from the risk of flooding. However, local government is not in a position to undertake the necessary studies, as the Commission has done, nor do many local governments believe that they currently have the resources to develop criteria individually. As public policy, it seems questionable to the staff whether the 30 some cities and 9 counties in the Bay Area should independently address this complex and far-ranging problem. At the very least, resources should be pooled and model criteria developed for the consideration of all local governments. For these reasons, we see a need for the state to provide leadership, consisting at least of developing basic background information, assessing the scientific differences, and providing some guidance on how the information can be applied conveniently.

Lastly, one commentor felt that the Commission lacked sufficient inland jurisdiction to provide the level of assurance that the public deserves. Due to the very limited nature of the Commission's jurisdiction, that may be true. The Commission's explicit "safety" jurisdiction applies only to projects built on fill in the Bay, not to those built on the existing shoreline. Within the shoreline, the Commission's jurisdiction is limited to the first 100 feet. Unless some other state agency with broader jurisdiction provides leadership in this area, our staff believes that the Commission should take on this role based on the studies it has already completed. It is, of course, up to the Legislature to decide if the Commission should do more than provide local governments, property owners, and the public with information about the serious consequences of accelerated sea level rise. If so, some additional authority will be needed.

If you or your staff have any questions concerning the Commission's work on global warming and accelerated rise in sea level, please feel free to contact Jeffry Blanchfield, our chief of planning, who has been responsible for the studies we have done to date.

Respectfully yours,

Alan R. Pendleton

ALAN R. PENDLETON
Executive Director

ARP/jsb

Enclosures

11/16/88 0052P

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF BOATING AND WATERWAYS
1629 S STREET
SACRAMENTO, CA 95814-7291
(916) 445-6281

NOV 1 4 1988

Honorable Byron E. Sher
Assemblyman, Twenty-First District
California State Assembly
State Capitol
P. O. Box 942849
Sacramento, CA 94249-0001

Dear Mr. Sher:

In response to your request for information concerning our department's activities on the subject of future climate change, we are pleased to provide the following comments.

Our interest in this area stems from our responsibilities in boating facilities financing, boating safety education and beach erosion control. Therefore, the aspects of potential future climate changes that concern us most are those relevant to coastal storminess, water runoff and sea level rise.

Changes in coastal storm intensity, storm path and storm frequency are fundamental to boating safety, rainfall amount and shoreline erosion. Global warming may decrease the number of severe storms affecting the west coast of North America but the effect on their paths is not known. Decreased storm activity would have beneficial effects on shoreline erosion and boating safety. Sand would be stripped from beaches less effectively and boaters would be less likely to encounter dangerous weather.

Large scale warming of the Western United States may impact recreational boating opportunities in rivers, lakes and reservoirs by substantially decreasing precipitation and/or runoff. This would result in lower lake levels and decreased river flow, especially in Southern California.

Large or sudden increases in sea level would have detrimental effects on beach erosion and harbor facilities. The direct impacts are impossible to assess quantitatively at this time because of the large uncertainty in the future rate of sea level rise.

Our department is supporting two study activities in the area of climate change and the consequences thereof. The first study is a four-year effort led by Mr. Daniel Cayan of the Climate Research Group at Scripps Institution of Oceanography. The focus of this study, titled "Regional Weather and Climate Variability Analysis", is on systematically documenting the variation in wind, rainfall, barometric pressure, tide levels, wave height, and ocean temperature

in the highly urbanized Southern California Bight. The program complements a much larger United States Geological Survey supported "Pacific Climate" study. The result will be a much better understanding of how short term, extreme events, such as the 1976-77 drought and the 1982-83 El Nino, fit into the large scale Pacific Ocean wide climate system. Two scientific publications resulting from department sponsored work are enclosed.

The second department supported effort involves original research conducted at Scripps by our staff oceanographer, Dr. Reinhard E. Flick, in the area of tides and sea level. Several papers resulting from this work have also been enclosed for your information.

The department remains very interested in the area of future global warming and the possible consequences of alterations in storminess, sea level rise and beach erosion. Please keep us informed of your deliberations in this area. For further technical information, please feel free to contact Dr. Flick at Mail Code A-009, Scripps Institution of Oceanography, Center for Coastal Studies, La Jolla, CA 92093, telephone (619) 534-3234.

Sincerely,

for WILLIAM H. IVERS
Director

Enclosures