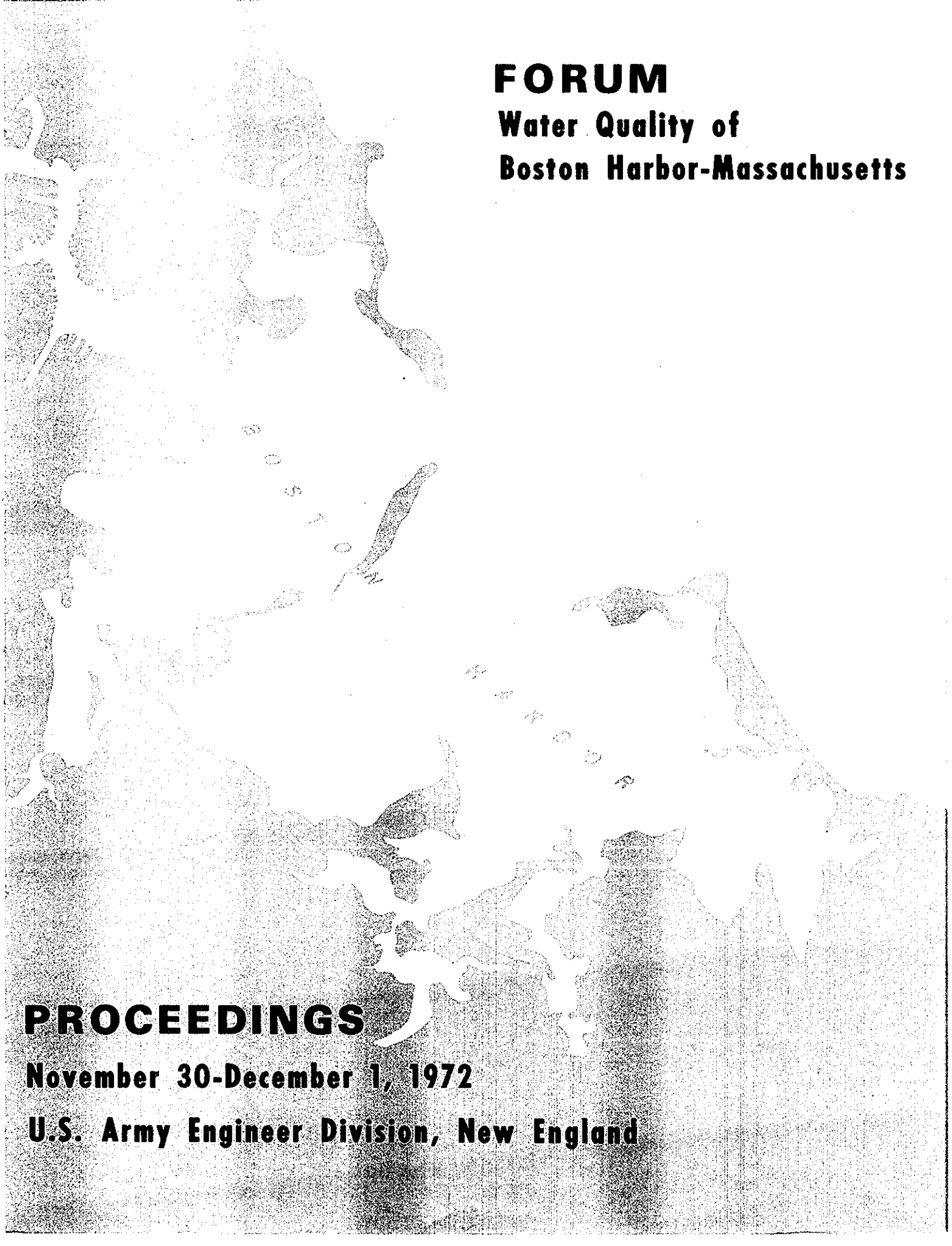

FORUM

Water Quality of Boston Harbor-Massachusetts

PROCEEDINGS

November 30-December 1, 1972

U.S. Army Engineer Division, New England

WATER QUALITY FORUM ON BOSTON HARBOR

NOVEMBER 30 - DECEMBER 1, 1972

TOPIC: What oceanographic study programs are needed to plan improvement of water quality of Boston Harbor?

PURPOSE: To help develop a planning program for a Wastewater Management Study being accomplished by the Corps of Engineers, Commonwealth of Massachusetts and Metropolitan District Commission in cooperation with the Environmental Protection Agency.

PLACE: Reservoir Control Room - Building 115 North
Corps of Engineers, New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

MODERATOR: Carl Hard, Corps of Engineers

BACKGROUND INFORMATION ON THE BOSTON WASTEWATER MANAGEMENT STUDY

The Commonwealth of Massachusetts and U.S. Army Corps of Engineers will conduct a comprehensive joint Federal-State study to determine methodologies for enhancing the water quality of the Metropolitan Boston Region including the eastern portion of Massachusetts. The study will undertake a review of all earlier and on-going efforts with regards to the disposal of waste in the existing systems which in the Metropolitan Boston area are largely operated by the Metropolitan District Commission, and develop plans that will meet the stringent standards of the recently enacted Federal "clean waters" legislations as contained in the Federal Water Pollution Control Act Amendments of 1972. A wide range of wastewater treatment alternatives, including advanced biological, physical-chemical and land disposal techniques will be considered as they relate to municipal and industrial sources of pollution, as well as to undefined sources of pollution such as agricultural and urban runoff.

The U.S. Army Corps of Engineers received its authorization to proceed in this joint undertaking through resolutions from the Public Works Committee of the U.S. Senate and House of Representatives. The resolutions state that the scope of the study shall be established in cooperation and consultation with the Commonwealth of Massachusetts and the Environmental Protection Agency and shall include measures for wastewater management including cleanup and restoration in the interest of water supply, environmental quality, recreation and fish and wildlife.

The overall water resource and wastewater management implementation program previously determined by the Commonwealth and approved by the Environmental Protection Agency will be incorporated.

The study is scheduled to take about 18 - 24 months during which time there will be several public meetings. The planning effort itself will draw upon the technical and professional expertise of both Federal and State personnel providing an integrated Federal-State decision process and joint plan.

The study is an integral part of the on-going Northeastern Water Supply investigations assigned to the Corps of Engineers in response to Title 1 of Public Law 89-298.

PANELISTS

Dr. Raymond Krone Assoc. Prof. of Engineering University of California Davis, California 95616	8-916-239-1435
Mr. John L. Mancini (Dec. 1) Hydroscience, Inc. 363 Old Hook Road Westwood, New Jersey 07675	201-666-2600
Mr. Robert V. Thomann (Nov. 30) Hydroscience, Inc. 363 Old Hook Road Westwood, New Jersey 07675	
Dr. Guy McLeod New England Aquarium Central Wharf Boston, Mass. 02110	742-8830
Dr. John Ryther Dept. of Biology, Senior Scientists Woods Hole Oceanographic Institution Woods Hole, Mass. 02543	548-1400 Ext. 322
Dr. John Schaake 1-280 Massachusetts Institute of Technology Cambridge, Mass. 02139	253-2117
Mr. Henry Simmons Chief, Hydraulics Division Waterways Experiment Station P.O. Box 631 Vicksburg, Mississippi 39180	8-601-636-3111

AGENDA

The format of the Forum calls for discussion of the questions outlined below. On the first day, the panel of scientists will address these questions to arrive at some consensus. The audience is invited to attend the first day of the forum but the comments should be reserved for open discussion between the panel and the audience on the second day.

1. What are the likely consequences from eliminating sewage effluent and sludge from Boston Harbor?

2. Assuming elimination of sewage effluent and sludge from Boston Harbor, how long will it take to reach what degree of improvement of water quality in the harbor? Consider:

a. Residual pollution effects of harbor mud on the water column.

b. Anticipated dissolved oxygen, salinity and nutrient levels after elimination of sewage effluent and sludge.

c. Suitability of resulting water quality for organisms - could aquaculture be established.

d. OTHER.

3. What studies of Boston Harbor are necessary to arrive at reliable answers to question (2)? What time frame is necessary to complete these studies. Consider:

a. Physical oceanography.

b. Circulation and sedimentation.

c. Benthic ecology and bacteriology.

d. Chemistry.

e. Research on inter-relationship of (c) and (d), i.e. nitrogen limitation and redox potential.

f. OTHER

4. How do studies in Boston Harbor relate to outer Harbor or Massachusetts Bay studies, such as New England Ocean Mining Environment Studies (NOMES)?

5. What is the desirability of using analytical tools such as mathematical models to evaluate basic oceanographic data?

INVITED GUESTS

	Attended
David H. Attaway National Oceanic & Atmospheric Administration Office of Sea Grant	x
Frank Bergin Metropolitan District Commission	
Libby Blank Metropolitan District Commission	x
Mark Brickley Metropolitan Area Planning Council	x
David Buelow Corps of Engineers, NED	x
William Butler Environmental Protection Agency	x
James Callahan Corps of Engineers, NED	x
Vincent Ciampa Commonwealth of Massachusetts	
James Clark TCE, Inc.	
David Cobb Marine Minerals Technology Center NOAA, U.S. Dept. of Commerce	x
Saul Cooper Corps of Engineers, NED	x
Martin Cosgrove Metropolitan District Commission	x
Gordon Dean, Physical Scientist Marine Minerals Technology Center NOAA, U.S. Dept. of Commerce	x

	Attended
Richard Dibuono Corps of Engineers	
Richard Doherty Metropolitan Area Planning Commission	
Richard Dyer Corps of Engineers, NED	x
John Elwood Commonwealth of Massachusetts Division of Water Pollution Control	x
Albert F. Ferullo Commonwealth of Massachusetts Division of Water Pollution Control	x
Melvin First Harvard University Dept. of Public Health	
H. L. Goodwin U.S. Dept. of Commerce National Oceanic & Atmospheric Admin.	
Eric Hall Environmental Protection Agency	x
Carl Hard Corps of Engineers, NED	x
Allison Hayes Metropolitan District Commission	x
Joseph L. Ignazio Corps of Engineers, NED	x
Sandra Johnson Corps of Engineers, NED	x
Robert Joseph Metropolitan Area Planning Commission	
Robert Keating New England Regional Commission	

	Attended
David Kenyon Corps of Engineers, NED	x
Lester Klashman New England River Basins Commission	x
Bob Leger Environmental Protection Agency	x
Colonel John H. Mason Corps of Engineers Division Engineer	x
Bill McCarthy Corps of Engineers, NED	x
Dan McGillicuddy Commonwealth of Massachusetts Office of State Planning & Management	
Francis M. McGowan Corps of Engineers, NAD	x
Tom McMahon Commonwealth of Massachusetts Division of Water Pollution Control	
Walter Newman Environmental Protection Agency	x
Joseph Nusser Hydroscience, Inc.	x
Colonel Charles J. Osterndorf Corps of Engineers	
Alan Prucnal Corps of Engineers, NED	x
Melvin Sutterwhite Corps of Engineers, NED	x
Clifford Smith Deputy Regional Administration Environmental Protection Agency	

	Attended
Don Smith Environmental Protection Agency	x
Josh Tolkoff TCE, Inc.	x
Jekabs Vittands Metcalf & Eddy Engineers	x
Demetrius Vlatas OCE HQDA-DAEN-CWP-U	x
Robert Yancey Chief, Ecology Branch CERC	
Martin Weiss Metropolitan District Commission	x

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"BOSTON HARBOR WATER QUALITY FORUM"

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WATER QUALITY FORUM
ON
BOSTON HARBOR

Outline of Abstract

I. Examination of the Status Quo

A. Existing study information

B. Existing areas of major concern

1. Sludges
2. Combined sewers
3. Toxic compounds
4. Pathogens

C. Existing proposals of solutions

II. Objectives and Criteria

A. Objectives

B. Criteria

III. General Discussion

IV. Areas needing Further Study

A. Circulation - hydrodynamics

B. Sediments

C. Biology

V. Proposals for future Study Programs

VI. Recommendations for Immediate Action

WATER QUALITY FORUM
ON
BOSTON HARBOR

Foreword

Following is an abstract of the stenographic recordings of the forum held on 30 November and 1 December 1972.

The format of the abstract is as shown on the attached outline.

The abstract was prepared by personnel of the New England Division.

I. STATUS QUO

A. Existing study information.

The State and EPA have been working on studies for some six years and they believe all the data they need is available to give them the answers they feel they need.

Dr. McLeod's work to date is geared towards water quality monitoring and analytic chemistry of Boston Harbor, further defined as having three zones, inner upper estuarine area, outer zone, and bay area. The work addresses itself to heavy metals, oils and chlorinated hydrocarbons, and the development of a biological model looking at the chemistry of the harbor for use in predicting the frequency of phytoplankton blooms.and general effect of the discharge effluents to these blooms. The bottom benthnic community of the harbor is very limited, essentially made up of tunicate and polychaeta worms. Heavy metals detected are far above the allowable limits. No. 6 oil has been detected in the two to three foot sand and clay cores. Dr. McLeod reports we are very much in the dark as relates to the transport of the heavy metals and that we need bio models to project the impact of these metals on the water quality of the harbor.

Dr. Thomann of Hydro Science, Inc. reported their studies on the magnitude of pollution components, (i.e. the sources, principally being the sludge discharges and combined sewer overflows) and the relative importance of several classes of water quality problems. Primary emphasis of their work was on the water column as opposed to sediments. Dr. Thomann reports a major problem to be coliform bacteria which has effected the closing of beach areas and clam beds. Effluents at Deer Island and Nut Island apparently have a localized effect in the water column. From his view point the combined storm sewers are the priority item. Their condition is aggravated further because of defective tide gate regulators. Deer Island inffluent which is 25 percent sea water supports this finding. Their mathematical model is tidal oriented, with little fresh water inflow involved. Current data was provided earlier by NOAA efforts; there is some concern as to the validity, i.e. some believe that it does not portray the true picture of bottom velocities.

Mr. Henry Simmons reports geometry of the system would dictate the true circulation pattern and no work has been done to obtain bottom currents. Dr. Ryther was concerned with various inputs of pollution i.e. volume of undesirable material versus just a coliform count. Mr. Hard was desirous of knowing the interplay of sediments in the water column. Hydrodynamic model was challenged on two bases, namely that its verification was questionable because of gaps in knowledge of circulation patterns and bottom currents, and secondly failure to present an interplay of pollution from bottom sediments to the water column. Mr. McGowan noted

that Dr. Thomann has a mechanism for understanding the system such as to identify problems.

B. Existing areas of major concern.

1. Sludges

Mr. Weiss reports Deer Island produces 350 m.g.d. of effluent, Nut Island 120 m.g.d. of effluent. Digested sludge is discharged on outgoing tides at the daily rate of 70 tons from Deer Island and 40 tons from Nut Island.

Mr. Weiss stated that the MDC's sludge study will be done in five months. They are planning one of three alternatives: incineration, intermediate air oxidation, or land disposal. Refactory organics and nutrients were acknowledged as a complex problem tied to sludge.

2. Combined Sewers

This summer skin divers obtained water quality samples in and around sewer outfalls and certain tide gates. The 80 year old system designed for three times dry weather flow provides for about 100 regulators, many of which are in poor operating condition.

3. Toxic Compounds

In Dr. Krone's view, the few species observed, in spite of the large nutrients available, suggest that toxic compounds are killing them off. From a biological standpoint the number one priority is removing toxic compounds and certainly from a public health objective. If desirable organisms could live and survive, they in turn would better accommodate organic materials.

When asked what would happen if heavy metals through pre-treatment at industrial sources were eliminated, Martin Weiss answered that toxic metals can be addressed by sewer ordinances to the industry.

4. Pathogens

Dr. Thomann is concerned about heavy metals entering food chains but believes that coliform is the culprit in closing the beaches, and we should look at the problem from a hierarchy of water use. Dr. Thomann pointed out in terms of getting the most out of your expenditures, we should solve combined sewer overflows and chlorinate effluents. Heavy metals, in his view, were a separate problem tied to industrial discharge, and a matter of enforcement. Toxics are deleterious and should be eliminated as quickly as possible, as opposed say to elimination of organic wastes. Mr. Ferrullo noted that solution of combined storm sewer problem would remove the mixture of raw waste with the storm water which goes in now essentially untreated. High coliform figures would still come from urban runoff.

Dr. Ryther countered that coliform count is not a reliable index of anything and certainly not of public safety.

Dr. Ryther sees two ways of looking at the problem. One being a compliance with some standard as set by EPA and the State. The other a compliance with public health. Ms. Johnson reported upon the limited ability of existing chlorination methods to deactivate viruses. Mr. Klashman noted that chlorination of a secondary effluent will have great effect on viruses only if very large amounts must be used. We would still have to deal with badly polluted incoming rivers, such as the Neponset, Charles and Mystic as well as urban runoff on the boundary land.

It was agreed that viruses are a paramount problem and should be subject of a special research study. Dr. Ryther noted that people are working on monitoring viruses in coastal waters at Baylor School of Medicine in Houston, Texas. They have developed a technique to monitor viruses in Galveston Bay. The program is financed by Sea Grant and some other sources. Mr. Klashman noted that the EPA lab at Narragansett is also about to do this type of thing. They might be willing to undertake it for Boston. Mr. Hard suggested perhaps we call upon National Science Foundation for dollar support on the viruses.

Dr. Ryther cautioned everyone that if viruses get concentrated into shellfish, this could be an even larger public health problem than body contact or recreation.

C. Existing proposals of solution.

Mr. Klashman stated that secondary treatment must be implemented and sludge must be removed because agreements have been signed to that effect. He said we ought to set priorities on secondary treatment and then be concerned to what extent we might have to go above secondary treatment.

Dr. Thomann noted only a slight improvement is likely to come from a secondary effluent vs. the existing primary effluent, with some changes in suspended materials, and slight oxygen improvement. As far as 1995 loading and as relates to nitrogen and phosphorus, advanced waste treatment is not necessary in his view.

Mr. McGowan says maybe we should be putting all our money into correcting combined storm sewer and sludge problems as opposed to money in secondary or advanced treatment. Al Ferrullo agreed but noted a political decision has been made for secondary treatment and all monies are being held back by EPA until the State complies. Dollars for interceptor sewers are not provided by EPA without secondary treatment which they consider an acceptable level of treatment.

Mr. Hard questioned how an environmental statement as relates to secondary treatment could be written without having a clear understanding of the natural system.

Mr. Hard asked why weren't they looking at ocean disposal.

Mr. McGowan asked whether we should make preliminary cuts of design alternatives and then take on the natural system i.e. determine what kind of studies we need; or should we go in a different sequence of first looking at the natural system, the land the materials originating and the water into which they are placed. Dr. Krone suggested the second alternative would prove most productive as it would describe the system first.

Jake Vittands was looking for discussion centering around the tools of meeting the objectives, such as Dr. Thomann's work, so that he would have a feedback on alternatives. He is looking for tools to back up his remedial actions. Mr. Hard noted we can't give those type of answers with data on hand. Dr. Schaake disagreed with Mr. Hard. Said M&E's development models are powerful tools but noted needs for some way to test the environmental impacts of alternatives.

II. OBJECTIVES AND CRITERIA

A. Objectives

Dr. Krone urged we establish study objectives, i.e. do we seek to make water quality adequate for aquatic life and human enjoyment, and if so what can we afford. Once objectives are determined we should know what the natural system is like so that we can predict what the effects will be on the various management schemes. Management strategy should seek to establish what can be accomplished and afforded together with the time scale, and whether such plans are in fact feasible strategies.

Mr. Ferrullo is concerned with defining the problem and going from that point. Why can't we swim? What is wrong with fishing? Is the harbor dead? Dr. Ryther questioned whether diversity was attainable or for that matter desirable in Boston Harbor. He believed objectives to be a little hazy. He outlined broad objectives such as the public health, being of high priority with respect to body contact or eating shellfish; the aesthetic problem a second order priority with respect to oil, turbidity sediments loads and nutrients; and the third priority of the eco system and species diversity. He noted we could get area clean and gain high diversity but result with reduction in fisheries thru elimination of nutrients. Decisions are going to have to be made as to a choice for the future.

We should go through those sectors of the natural behavior that we understand and look at the consequences of having alternative control actions. Dr. Krone in the meantime agreed that our first cut at objectives should have the following listing: (1) Public Health, (2) Aesthetics, (3) Biological Aspects (diversity or productivity).

Dr. Schaake suggests a balance sheet based upon water resource council guidelines. He sought a series of indices, i.e. water quality for bathers, vs. water quality for fisheries, etc.

Dr. Krone noted that there are many ways to eliminate heavy metals but what will their elimination do to the rest of the system. This has to be decided on the basis of a nature, and not a session of Federal or State legislators. Dr. Krone noted that studies are necessary to implement priorities which will effect the objectives desired. These are not parallel studies but ones that should be done on top, and to determine the behavior of the system, the estuary and the land drainage into it as well as the runoff system and its collective system and the bay system. These studies should be done in enough detail to predict the effective alternative proposals. Then find one of these proposals which will give you the desired objective at a cost you can afford.

Mr. Ferrullo of the State felt that we should identify the harmful substances in the harbor before we start trying to find out where they come from. He went back to his plea for identifying the goals and what is constraining our uses. Dr. McLeod confessed that it was very tough to determine whether it is economically viable for spending thousands of dollars to bring back shellfish or for that matter bathing. Mr. Ferrullo said we ought to get such answers before we start to spend all this money to bring the harbor back to some historical purity. Mr. Cosgrove believes his charge as an engineer is to produce a waste water system that will serve metropolitan Boston area without fouling up the environment. How we go about doing it is what we are trying to determine.

Dr. Krone countered Mr. Cosgrove's remarks by saying he thought the objective was to achieve the best quality environment we could afford, which was a lot different than trying to do something without harming the environment. Dr. Krone would put everything together in sufficient detail so we can responsibly say, that with the resources we have available, we can produce a harbor that you can live in with a high quality of life. Dr. Krone would like to see MDC raise its sites a little higher. Mr. Cosgrove noted it wasn't a case of leveling our sites vertically but horizontally, and getting the priorities in time as to what we are going to do. To clarify by example Dr. Krone spoke about driving along a field with telephone poles on either side of the road. The ones in the distance look smaller until you get there. It is his feeling that we should be prepared to meet those ones in the distance by doing certain work now.

B. <u>Criteria</u>

Mr. Newman noted basic EPA philosophy is to make no physical changes to the environment unless we are certain that it will not be environmentally damaging, referencing latest policy on ocean dumping. He viewed this as a shift from the past philosophy of go ahead with change until it is found to be environmentally damaging. Water quality criteria and the relationships of various levels of pollutants to the eco system are difficult to determine.

Dr. Krone challenged EPA's philosophy saying it is irrational. He syas we have enough trouble with nature but complicating it by criteria without foundation in nature makes it even more difficult to achieve a given task. Assigning blanket values to nation's waters fails to acknowledge the variabilities that exist from waterway to waterway, from sediment to sediment, from circulation pattern to circulation pattern, and from biological system to biological system. Define what your pollution and your objectives are, know your natural system, then determine how best to achieve desired goals, and don't get hung up on arbitrary standards.

Dr. Ryther believed we would get bogged down if we worry about indices and standards. He would rather approach it on the basis of establishing first general criteria, then assessing the Public Health and aesthetics from such criteria. The so-called Green Brook developed by a group of applied scientists as guidance to water quality standards now giving way to Blue Book done by the National Academy of Sciences which challenges many of the numbers given earlier. It appears from a Federal aspect we are regressing rather than progressing. Mr. Klashman noted our ability to get money to build treatment plants but not to do the basic criteria and research of the natural systems as related to levels of pollutants.

III. GENERAL DISCUSSION

Dr. Krone talked about the need for oceanographic data, circulation of Boston Harbor and a knowledge of the suspended sediment load and its consistency. There is a need for the following:

a. Geology of the harbor.
b. Thickness of sediments.
c. How much of the sediments should be derived.
d. Where is the sludge going.
e. What about viruses.
f. Turbidity studies under storm, and after storm conditions, to be compared with background data.
g. Identify nature of material in suspension.

Mr. Simmons noted that someone as a first step should evaluate the extent of information on hand and then lay out a field data collection program to bridge any existing gaps. Dr. Mancini believed that at this point in time, as relates to technical sophistication with which we can produce engineering solutions, that gaps existing are no worse off than our ability to solve the problems. But he agrees that we should use available information before undertaking any significant data collection program. For problems such as combined sewers he believes all we have to do is look at our solutions, our engineering options, and available data. Such action he feels will remove 80 percent of our problem. Then if we get rid of the obvious problems, we are in a position of strength with respect to knowledge and experience. He felt that immediate problem should be looked at in the contexts of what is available.

Dr. Krone seriously questioned that they have enough information to deal with the combined sewer problems. Dr. Mancini agreed but said what appears to be missing is the land sources as well as some application in their transport. We need then to get additional information on land drainage before we can take the most effective course of action.

There was some discussion and misunderstanding on the term inventory data. Dr. McLeod saw this as being such things as the water coming out of Quabbin Reservoir i.e. its quality, and how it contributes to the harbor versus urban runoff and industrial inputs. He sees it as an output situation.

Dr. Ryther said there are a number of specific pollution problems in the harbor and listed these under four general categories:

(1) The human patrogens.

(2) Heavy metals.

(3) Oil (hydro carbons, pesticides).

(4) Nutrients.

He felt we hadn't enough information on these items and failed to see how we could correct problems until we had such data. Dr. Ryther noted the meaningless of chasing down measurements of oxygen and phosphorous without knowing why you are doing this.

Dr. Ryther stated that first we need an inventory of what is in the harbor. (What is in the water, the sediments, and the animals.) Secondly, are these elements exceeding existing standards. Third, are they biologically dangerous. Fourth, are they interferring with various objectives. Five, how do they get there; and this requires some input as to where they come from and quantities. Six, the various sources. Seven, what effect is their distribution and concentration in different parts of the harbor, for which you would need circulation and sedimentation studies. Dr. Ryther seeks an inventory of the harbor, its waters, organisms and sediments, as being an inventory of what the problem is now (status quo) and first step to be known. Simultaneously we could begin to establish where loads are coming from and begin to study circulation and sedimentation problems.

Mr. Cosgrove noted what the technical sub-committee is doing now; namely faced with these immediate needs trying to stop the dumping of sludge, going to secondary treatment. The MDC is leary about going to secondary treatment at Deer Island until they have a plan that will outline how their system might look in the year of 2050. To Mr. Cosgrove there are types of engineering decisions that have to be made, and why should he know everything that is going on in Boston Harbor before he can make decisions.

Dr. Krone mentioned that if we are trying to do the job which the latest legislation says we should be doing, then we are going to have to know more about what is going on in the system. Mr. Cosgrove agreed that we ought to have a master scheme developed about getting observations in both the harbor and adjacent water bodies.

Mr. Hard noted that there are so many dis-related studies going on in the Mass. Bay and no one is pulling them together. People seem to be following their own restricted assignments. He felt there are enough resources on hand, provided these overlapping interests would pull together. There are in his view at least four agencies on the Federal level and at least that number on the State level that could be pulling their interest together. Carl Hard noted we don't have sufficient oceanographic data to even know whether the sludge, which we are willing to put on land, shouldn't best be put in the ocean. Boston is a maritime city of first order. We are willing to center our recreation and apartment complexes right on the harbor, yet we keep dealing in the dark ages in the way we approach our studies.

IV. AREAS NEEDING FURTHER STUDY

A. Circulation - Hydrodynamics

Mr. Hard believes good oceanographic data should be obtained; a circulation study, and a suspended sediment analysis. Dr. Thomann objected, he believes that circulation patterns are known and observed.

Mr. Simmons noted there would probably not be too much vertical distortion on velocity profiles used in the hydroscience model because of small fresh water inflow, but he believed the tidal system too complicated with many interconnected passages to say we know what the circulation and bottom currents are. These, he said, are a relationship of the geometric pattern of a harbor.

Dr. Schaake's discussion of hydrodynamic modeling accomplished over the past two to three years by MIT revealed they should look at the biological processes and the hydrologic inflows and water quality pollutants in these inflows. MIT has developed pretty good catchment models which will be used by M&E for example in their contract, however, they do not know too much about the pollutants as they are transported.

Mr. Hard questions the confidence we should give the math models as opposed to the actual physical investigation for hard oceanographic data. Dr. Krone defended models for their ability to predict things without which we would end up largely with a book of data.

Dr. Thomann and Mr. Hard discussed for some time the need for oceanographic data in view of the fact that we have a three foot stack of completed reports which Hard doesn't believe are worth too much. Discussion concluded we ought to do both design studies on alternatives, and quasi-scientific studies. Mr. Simmons noted his concern about disfusion and flushing of the waste. He supported Mr. Hard's remarks for a detailed circulation study, and the need for oceanographic data but noted someone should first be assigned the task of assessing and evaluating the information that now exists. He said regardless of what model is used, math or physical, we need the same oceanographic data. Unless the evaluation is carried out, and missing gaps are identified now, and bridged through some future measurements, we would be floundering about. For example, he said what might be a 15 year program to eliminate sewer overflows could be carried out in a right or wrong way. Through circulation study we could identify those areas most adversely affected by storm overflows and then correct these.

Mr. Simmons suggested construction of a physical model which could be used by all participants over the next 25 to 50 years. It could be used to refine math models. It would bring out details of the hydrodynamic forces before we can come out with numerical answers. He estimated $250,000 would be needed to do the monitoring of basic oceanographic data, and 12 months of time. Construction of a physical model would take two-three years of time at a cost of about 1-1/2 million dollars.

Jack Ellworth noted his severe reservations about the need to justify a physical model for water quality alone. Believes the State has spent $150,000 in its math models, and they will do the job.

Dr. Schaake noted needs for a hydrology water quality model at a cost of $100,000. MIT can simulate hydrologic systems as relates to rainfall data, but lacks knowledge of the physical system as far as transport of pollution loads. He is very concerned with urban runoff. Past studies on the monitoring done by the PRI Research Corp. of Cambridge could be intergrated with the prediction models offered by Dr. Krone.

Mr. Hard summarized that the physical data base is inadequate for the Boston Harbor study; a physical model should be considered which would serve multiple purposes over long time frame; such a physical model could be used in conjunction with mathematical models on hand and newer ones to be developed, the area needs an adequate circulation study; a study of suspended sediments and transport of sediments, as well as their composition; and finally that biological models to date do not have the benefit of hydrodynamic considerations noted.

Dr. Mancini noted that the first study done by his firm was concerned with a steady state analysis without circulation and inter-tidal hydrodynamics. A second study is under way. It will include inter-tidal actions and a basis for understanding the hydro-dynamics. He said that depending

on the objectives we desire for Boston Harbor, one could use more detailed hydro-dynamic data. If we are concerned with storm water overflows and some of the more mundane problems of water quality, like DO, coliform, and nutrients, the amount of information on hand is in his opinion adequate to proceed with implementation of solutions.

Dr. Mancini says it is his understanding that a three-dimensional picture of currents, and suspended sediments is available. He was referring to NOAA data which unfortunately is largely surficial with limited information on bottom currents and most field observations are not continuous. There has been no effort to make simultaneous observation at central control points. There might be an imbalance of flow when compared with surficial current. Studies could show urban sludge moving while bottom currents could force it back in. Mr. Simmons spoke about flow imbalance attributable to the geometric configuration of the system.

Dr. Mancini wanted to know what the problems we were trying to solve with a physical model. Mr. Simmons noted that if all you want is a gross approximation of what happens to coliform counts assuming you cut off all combined storm sewer systems then what hydro science has done is perfectly all right, but you would be looking solely at a gross situation. However, if you want to know what is happening in a localized area of the harbor assuming you plan to clean up one spot before another in sequential fashion, then you should zero in on small scale circulation systems within the overall complex. Dr. Mancini countered that his firm has taken the intermediate step and has addressed themselves to defective regulators and combined storm sewers. He believes their second phase of math modeling soon to be published could very well indicate that additional information is needed for point sources. However, he cautioned that as far as the storm water problem is concerned, knowledge of what is going on in the boundary land areas is perhaps even less known than that which is going out in the harbor itself.

Mr. Josh Tolkoff (TCE, Inc.) the firm who recently dived in the harbor for MDC physically examined areas where they expected to find sludge. They didn't always find material where they thought they would. He favored additional information on currents.

According to Mr. Hard we are presently dealing with a specific engineering problem, within a specific framework but when we talk about water quality for Boston Harbor we should broaden the framework and understand what is going on in considerable detail. Mr. Hard said there is no known oceanographic background material for the harbor except for some surficial measurements done in 1950 and of questionable value. There were apparently a few data buoys attempted by MIT which showed various count measurements but MIT acknowledged there was no place in the harbor where you could place a representative buoy array. Obviously there is a complex circulation problem within the harbor that isn't known. This needs to be done if we are going to understand the water quality situation of the harbor.

Dr. Krone noted we are concerned with more than just modifying storm drains and combined sewer outfalls. If there is going to be development of the off shore mining; disposal of dredge spoil; further modification of the harbor through the island causeways; as well as industrial waste disposal that the management of water quality of the whole harbor will require a more comprehensive view of the hydraulics of the tidal harbor and inland flows from the land sources of pollution.

Dr. Krone in response to the extent of modeling needed said that the collection of data without knowledge of the system would be very inefficient. You need to have a picture of what is going on in the harbor to know when and where to take your samples. Such a picture could come from either a conceptual mathematical model, or a physical model that would give you guidance to the sampling effort. Therefore, sampling and modeling must go on concurrently; in such cases the model should continuously improve as better information is available. Dr. Krone continued his understanding of the situation was that a lot of the data is available, however, it hasn't been evaluated in terms of making a description of the system and this should be done first. In his view, to accomplish the broad objectives that are required by the study, there will need to be additional models.

Dr. Krone noted that with the existing system of islands having no regular shape, ocean tides are likely to be unstable. Any small changes in the islands or in the river discharge can modify the hydraulics of the system markedly. Believes winds can play a significant part in the circulation of the harbor. He asked Dr. Mancini to describe in more detail the hydro-dynamics of his harbor model. Dr. Mancini reported on his model noting they did not include wind stresses.

Mr. Hard suggested we begin to look at individual parameters and the system that involves these parameters together with some organization of them. Circulation would be high on the list but here Mr. Cosgrove disagreed, said he would put it way down on the list. Mr. Cosgrove is not sure that a physical model could give us the answers we need in the detail we want them. He doesn't believe man is capable of coping with some of these things. To strengthen his point he spoke about natural storms such as "northeasters" and related past experience of his when he was laying sewer outfalls at the end of Deer Island. These were designed after all sorts of careful detailed bottom surveys and studies. When they finally built the outfall, they got hit with another "northeaster", and this past summer divers have indicated that the outfall is all filled with huge boulders, not necessarily true. Mr. Simmons agreed with Mr. Cosgrove's remarks, noting that in the Delaware model, it had to be updated two or three times just to keep abreast of such natural storms. Mr. Cosgrove agreed that we could get a lot of useful information out of the model but just doesn't see this as a high priority at this time. Mr. Simmons noted we have an 18 to 24 months study, and we couldn't get the model ready within that time frame, however, in future years there will be more studies. He agreed completely with Carl Hard that we presently have to understand the hydraulics, the circulation of the harbor. There is a need for information now if we plan to do a quality job on the study. Circulation information can be in reasonable time frame for about one quarter million dollars

without the physical model. Added to this point and at Dr. Krone's suggestion should be a description of the runoff, quality and quantity.

Ms. Johnson raised a two part question. How can we have an adequate sedimentation study unless we know where the sediments are coming from, particularly as the bottom sediments are moving around. Secondly, how can you do an adequate biological study without knowing where the toxics are coming from and similarly moving around. Answers to both of these items are keyed to a circulation study. Dr. Krone agreed as all material moves with the water, first off the land, and then within the bay. Water surface currents are more easily determined but difficult to describe bottom movements, and it is just that much more difficult to descirbe sediment movement. Dr. Krone said, however, apart from just going out and getting the hard data, one would need some form of a model, to determine how the sediments are moving about. It was pointed out by Dr. Krone that Hydro-science Model is a two dimensional model, assuming uniform vertical flows, and a uniform velocity. But in the case of the sediment motion, you need more than that. You need a velocity profile. A physical model can give you velocity profile not as precisely as field data would but at least a start. This would in effect produce a three dimensional modeling effect for the tidal body of water. The physical model could have a weakness in shallow areas particularly where there is a lot of concern about sediment motion and in mud flat regions akin to Boston Harbor. He concludes a need for both the math models for circulation in shallow areas, and the physical models for the outer deeper areas.

Mr. Cosgrove believes we should inventory pollutants, determine where they are as far as origination, this is the first order of business, and stop them. Then get down to circulation and sedimentation studies, and see what is likely to happen to the stuff already laying on the bottom. Dr. Krone noted you need a circulation study to determine how to stop these pollutants, and which one to stop first, so as not to cause damage to other elements in the bay. New water legislation has already ruled that once we inventory the pollutants they are going to be stopped regardless of whether we know circulation or not. Dr. Krone countered as to which one should we stop first as it is going to be several years before all are stopped. Mr. Cosgrove feels he should stop the biggest ones first as indicated by hydro-science model analysis, namely the river systems, the combined overflows and sludge. Dr. Krone said we should shut off those that are producing the most at the times that are most serious as far as the harbor is concerned so you need to know where and when the worse conditions occur in the harbor. Dr. Mancini submits that the tools are available to get that type of information and to identify differences between engineering alternatives and to establish the priorities.

Dr. Schaake felt that if he had an unlimited budget he would go to a physical model, and also use the fanciest mathematical models available because he felt the more we spend the more we would get out. In case of a limited budget, he believes that investment in hydro-dynamic models should be related to the investment in biological studies and data collection and

would achieve a balance. He said in effect the tools are available but as to whether he has enough data to use such models, he noted a need for more data on velocities and currents that could be used to validate and calibrate math models. Further, he needs information on the wind because velocities will be dependent upon the effects of the wind on the surface. He felt we had to have information on Mass. Bay itself. There was some question in his mind as to where the boundary ought to be located although Hydroscience is reported to have reviewed the boundary conditions.

Dr. Ryther felt if you want to clean up the harbor you have to identify the sources of pollution and stop them. He says if you had enough money and legal pressure put on you, you could do this without understanding a damn thing about the circulation.

Mr. Simmons reinforced two earlier points made by him. One, that the hydro-dynamics of the harbor needs to be firmly established, and is important to a water quality study and to a biological study and also important to a sedimentation study. Once this data is available it can be employed in any of the models that are developed be they mathematical or physical. See if they fit the frame work of the known hydro-dynamics of the harbor. If the models don't fit this framework then they are not worth a damn. Secondly Mr. Simmons sees the need of a physical model for the long term time frame. He bases this on 30 years of experience in working with these things and knowing what can be done with them. He felt that if such a model was constructed there would be uses for it on every day basis, and uses that many do not foresee at the time. In his view he would make his physical model as sophisticated as he could.

B. Sediments.

Dr. Krone was concerned that the information on hand does not provide the characteristics of the sediment and their distribution. We ought to know something about disturbance of the sediment bed by wave action. Turbidity studies were needed to give us some idea of transport of sediemtns and the nature of the material they might release. The effect of wind action upon turbidity was noted as missing gap of information.

Dr. McLeod felt we should look at the harbor as a two dimensional system, the water column down to the sediment, and the sediment itself. Although the outer harbor has presently a super saturation of DO, the inner harbor presents a different problem. The outer harbor is a moderately productive embayment with respect with phytoplankton i.e. the effluent is being taken up by the biological population, and blooms result. In Boston Harbor we are getting limited biological population at the bottom. Tunicates show they can incorporate vanadium and release it back. What is to happen when you cut off the sludge discharges and what is the transport problem? If we reduce all of the nitrogen, will we unstabilize these bottom sediments and bring them back into the column together with their metals. Dr. McLeod felt the problem of low species diversity on the bottom of the harbor has to be dealt with separately. We may have to get rid of two feet of accumulation. Left alone, part of this sediment might undergo decay in a 10-year period.

Dr. Ryther noted experiences in the N.Y. bight study where sludges were very localized and where rich and diverse populations were found around the edges of the sludge piles. Believes conditions in Boston Harbor are not resulting from the D.I. sludge but rather may be the result of sedimentation throughout the whole area, could have a limited bottom diversity even after sources of pollution are removed, therefore, Dr. Ryther urges us to determine what sedimentation rates are naturally, as well as circulation patterns and as the flushing rates. Mr. Ferrullo noted that bottom sludge is representative of 80 years of discharging raw sewage. It should not be viewed as something that has been going on for over the past four years. Mr. Hard suggested that we map sludge, map the harbor mud, then find out where it is going with a circulation study, i.e. how much is in suspension.

Dr. Krone observed that the bottom sedimentation is not necessarily a steady state situation, but accumulations and substractions with biological decomposition going on. Dr. Krone added that a sediment study should be done separate from the physical model, or math model efforts. Dr. Krone said we would need full levels of biological modeling and sediment modeling together with necessary lab studies to define the relationship between the sediments and the water column. Costs for the work as compared with those of the physical model would be about one million dollars and 3-5 years time, but there would be no operating cost for such math models. Sediment mapping would be extra cost but not considered a large item. Turbidity studies are part of Dr. Krone's one million dollar cost estimate. Sediments he feels are keyed in this relationship to heavy metals, organic materials. Clays have strong absorptive properties and these relationships have to be examined experimentally in a lab, not through math models. Should be concerned about suspended sediment transport and its relationship with the water quality. We have to know something about the sediments and the penetration of light as this is important to the item of productivity.

Dr. McLeod indicated they have only a modest baseline. What is needed is an input study, a sedimentation and accumulation study, and a rate study. All these three things have to go on concurrently, because he is not convinced when he makes his cores, that they can go out the next day say following a northeast storm and get same characteristics.

Mr. Dyer asked how long it would take for the heavy metals and other toxics to decay or become inactive once the sources of pollution were dealt with. Dr. McLeod estimated about 10 years, certain bacteria can convert these sediments, from inorganic mercuries, to organic mercuries (which are toxic) and these can come into the water. He referenced the Chesapeake Bay area where studies indicate zinc is released back into the water column. But answers to this type of problem are known, and keyed to circulation and sedimentation studies commonly referred to as transformations or transport processes. They can also be chemical and biological transformations and decays as well as biological and chemical transportation. This is all part of a typical dynamics about sediment suspension. The fact is that when the bottom material is disturbed, one can expect this type of action. This would

in effect bring about release of toxic materials, but such events would likely be of an infrequent nature, and of localized intensity. An unusual storm may disturb material which may in fact impair swimming for a short period of time. The trend would be to continually improve the water quality conditions. A model may not give us this type of answer, but it would tell us how quickly material is moved out when it is disturbed.

Mr. Tolkoff noted that there are some sections of the harbor where raw sewage has been recently cut off but the bottom situations are still horrendous. Could make tests on these areas to see just how much of this material is getting back into the column. This would tell you what has happened at the localized spot but would not necessarily give you information on the rest of the harbor.

C. Biology

It was noted that Hydro-science, Inc. did not address the interaction of toxic substance to phytoplankton growth in Boston Harbor and the question of heavy metals. A bio-model to look at the interaction of two to three nutrient species with the phytoplankton growth together with light extinction was suggested. Dr. Ryther noted that if we eliminate turbidity in the harbor by way of advanced treatment, we would find that we will get back phytoplankton growth in the form of algae.

Dr. Ryther noted one of the objectives of the study to restore the biota to the harbor. As far as he knew there has never been a comprehensive study on this although NOAA's Biome study should afford some perspective on this.

Dr. Ryther concerned with oil in the sediments. Fears they may be more important than heavy metals, and may have a more direct effect on biota and may be aesthetics. Dr. Ryther noted need for a base line survey of fish and benthic organisms at a cost of about $250,000 and one years' time.

Dr. Ryther said that if the pollution problem, as produced by physical and chemical violations, is identified and corrected, the biological problems will take care of themselves. Believed we should be most concerned as to what it is that is affecting the biology including the biology of man. A good example is the emphasis that we are planing on removing the coliform bacteria. For he thinks even if coliform were eliminated, we probably couldn't swim in the harbor, or wouldn't eat its shellfish.

Dr. McLeod doesn't believe coliform will tell him anything about the harbor biota. Jake Vittands noted that he felt most toxic inputs are of industrial nature. But we also have toxins of a biological nature associated with the nutrients and excretion from algae.

Dr. Ryther surfaced the question of nutrients. These could conceivably cause eutrophication, unpleasant blooms of algae, organic sedimentation, Apparently this type of problem is being masked by the current sediment problem.

Dr. Ryther pointed out that just because there are heavy metals in the sediment, doesn't necessarily mean that it is going to be a dangerous level of heavy metals for organisms. He referenced various samples that they took in the Mystic River growing in polluted sediments; somehow the metals are not getting into the clams. Similar experiences were referenced in the Chesapeake Bay. Further, Dr. McLeod noted certain studies which report sediments as useful in holding the heavy metals and chemical compositions intact so that they don't get into animals. He concluded by saying we actually need an inventory of the animals and bioassay of these animals.

Dr. Ryther is concerned that we not delve into how the pollutants effect the various organisms. He believes that if we clean up the chemical environment then the biology will take care of itself.

V. PROPOSALS FOR FUTURE STUDY PROGRAMS

Assuming a million dollars of study money were given to Dr. Schaake, he would place a third of such resources into physical data collecting, not physical modeling, spend about $200,000 in modeling with the remainder going into biological studies and field investigations. Concerning the hydrology of the river flow i.e. the inputs he feels math models do exist and have demonstrated that they work well enough to be depended upon. He noted EPA's model as being adequate. He would suggest augmenting these with MIT's hydrologic models for streams and catchmet designs with possibly some data collection. For example, rain gauges out in the catchmet areas would measure the water levels for short periods of time in the summer, as well as make measurements of the water quality, for a two week period. He thinks he would like to lump everything together as Dr. McLeod suggested into an input/output model. He noted further that regarding engineering solutions of combined storm sewers that someone ought to watch to make certain that the hydro-science work is thoroughly coordinated with M&E contract to see that the best alternatives are derived. Finally, Dr. Schaake would place remainder of effort in the development of an environmental impact statement, so a better assessment can be made of the engineering alternatives that will be brought forth. He felt our strategy should be what is the best thing we can do to get the best possible environmental impact statement, for a given amount of money. In summary, he feels one third of the money should be spent on hydro-dynamics of the harbor both land and water, and that two thirds be spent on biological chemical sediment properties in the harbor, their movements, the turbidity, etc. It was agreed that biology could never be done without the circulation study and that perhaps both of these efforts would need a lot more than three quarters of a million dollars.

Dr. Mancini addressed the question on the basis that he would seek a sum of money between one and two million dollars. Half of the million dollars he would put into land planning i.e. the location of inputs, population, land use patterns and this sort of thing. Further enumeration and identification of planning alternatives and the cost estimate associated with these as well as the public information. Between 100-200,000 dollars he would put in for institutions. He would then put 1/2 to a million into the cause and effect relationships. Initially he would budget one half but he would carry another half in contingencies. The first one half million dollars would be spent on computer or physical modeling, with 35 percent going into the storm water and an identification of solutions of storm water. Another 20 percent would go in the inland waterways for water quality monitoring of classical parameters. About 25 percent of the remainder would be spent on biology based on what he could expect to do in the planning effort, and separating what could logically fall into the research effort. He would concentrate on modeling for eutrophication, with existing data and transfer of harmful substance through the biological food chains. Dr. Mancini noted his doubts with biological studies. They contain a very high degree risk because of biological ignorance. He would keep about 20 percent of his money for cause and effect relationship and perhaps deploy it into the area of storm water and upstream water quality. After he spent this initial $500,000 he would ask himself if it was wise to spend any more on what he viewed as two prong biological and eutrophication problem. He would get an assessment of sediment behavior and the things about nature and their perspective with respect to the biological problem and only then decide whether to go ahead and spend the $500,000 of contingency dollars. He believed that the upstream river problems were a different ballgame from harbor biology but he was leary about spending money on eutrophication modeling as well as food chain modeling. He said that modeling can be done but the output has to be looked to in terms of its usefulness to a decision making tool. In answer to a question about seeking out those areas for research, Dr. Mancini suggusted that we look at the work his firm has done for the Great Lakes Commission, which will be available about the first of the year.

Dr. Krone began by trying to isolate engineering approaches to the problem of taking immediate action versus the academic approach for further study before taking action on certain engineering solutions. He says all of this has to be done on the basis of timeframe. Obviously there are evident problems that need solutions now. The question of toxicity, industrial waste discharge, raw sewage discharge, these are areas of agreement of urgent character and need attention. But the objectives which were farther in the future or not so urgent will be important to all of us and somewhere in the future, they have only been alluded to, but we will need the information. If we delay action on certain things there is a cost to our delaying that action. We have to balance the cost of making a mistake against the cost of not doing it. Making a mistake using presently available knowledge against the cost of not making additional studies. He feels we have an opportunity to look at both the immediate, and the long range needs and incorporate them in overall plans study. He agreed with Dr. Mancini that we need to solve these immediate problems but that there is no reason for us to fail

to get the information for the less urgent one. The benefits will be handsome if we start the research or academic work on the present study now, well in advance, so that we can have a better basis for determining direction of action when these things do become urgent. He feels there will be a time scale that will pay the cost of not putting more money in terms of not gaining benefits for a later period of time. But if we are constrained to the point where we can't think about a dozen things that are needed in the long run then we will be sunk. We will be in the same boat that we are today 10-20 years from now. We have to balance both modeling and field surveys. One should not proceed in advance or consideration of the other. Models themselves ought to show where field data measurement should be made, and the field data necessary to substantiate and develop the research. As far as separating estuaries from the rivers, it is pretty evident to Dr. Krone that they are affected by the rivers; whether or not the rivers are affected much by the estuary is pretty hard to say, but it seems both areas need to be studied. Further information is needed about land drainage and the constituents of the drainage as to their concentration, and in a function of time. Further, Dr. Krone is convinced that storms will have a significant effect on the bay system, the estuary and the bay. The question of having a circulation study and doing this through math or physical models was dependent on the availability of monies, and on what you plan to do with the information that you are going to get. If you desire biological models that are really responsive, you have to know the dilution and circulation very precisely. You have to know the motions of the water rather precisely if you are going to try to determine difficult algae blooms, let alone fish population because these actions are so very sensitive.

Dr. Schaake noted that his estimates assuming he had a million dollars to make the study were on the basis that the engineering studies (MDC-M&E) would proceed, what was of concern to him was the changing of certain things with respect to the harbor which would require biological studies of a research nature in part. For example, if we eliminate sludge in the system then we have a new system. This could bring about a new series of problems.

Dr. McLeod feels we ought to be worried about harbor inputs and determine if these are premissible in order to then use multi-use aspects of the harbor. Further we should look at the chemistry, biology and physical nature of the harbor all the way to the outer Mass. Bay. If we plan to dump in there we ought to know what the bottom is like even if we are successful in cutting off point sources of pollutants. We are not going to shut these off in a hurry. He agreed with Dr. Mancini that there is a planning stage, at which you look at what you have available, and what research can fall out of it.

VI. RECOMMENDATIONS FOR IMMEDIATE ACTION

Dr. Vlatas of OCE saw our problem as having people on two different poles. On the one hand the waste water studies who is concerned about cleaning up pollution, and others concerned about how to take care of

other problems within the harbor such as dredging, and mining and filling etc. Therefore, the people running the waste water study have a reluctance to spend their money for part of an overall harbor study. On the other hand you have these people who have broader concerns, who say we should spend the money. Perhaps its the matter of cost sharing of some waste water funds but one shouldn't expect waste water to support all of it.

Ms. Johnson felt we ought to set up a future conference where people from NOMES and BIOME are invited, people from dredging studies and the waste water people, also others that are familiar with recreation. Bringing this kind of a group together to try to coordinate our efforts and money could save duplication. Certainly the NOMES project will have to do circulation studies and probably a biological study. Why couldn't we make use of this? Attendees agreed with this thought. Such a meeting would surface ideas as to how to put scientific aspects on the long range problems in the proper perspectives. Perhaps the N.E. Regional Commission could find some of this. Perhaps National Science Foundation grants could be applied as was done in Chesapeake Bay.

Mr. Cosgrove liked the idea of getting the people who are interested in the islands and other parts of the harbor together. A pooling of resources for whatever information is needed to solve or get a handle on all known problems to give us one big model instead of four or five little ones.

The panel agreed to start listing items that we should be doing first, in looking comprehensively at the whole harbor problem. The first work item being establishing a group assigned the task of gathering all available past studies and analyzing for its value.

WATER QUALITY FORUM

ON

BOSTON HARBOR

30 November and 1 December 1972

U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts

1 February 1973

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WATER QUALITY FORUM ON BOSTON HARBOR

Reservoir Control Room
Building 115 N
424 Trapelo Road
Waltham, Massachusetts

MODERATOR: Mr. Carl Hard

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P R O C E E D I N G S

MR. HARD: Welcome to the forum on the quality of Boston Harbor. Mr. Joseph Ignazio, the Chief of our Planning Branch, would like to welcome you. Joe?

MR. IGNAZIO: Good morning, ladies and gentlemen. We are very happy that you accepted our invitation to attend this forum; and we are hopeful that the next two days are fruitful to all of us here. The Corps, recently, this past summer, was given authorization to proceed with Phase B, Waste Water Management Studies of the Merrimack, and this was extended to the Boston area. As we proceed with today's and tomorrow's discussions, we will talk some more about the particulars of this. All of you have received handout material which I think explains some of the things we are attempting to accomplish.

I would like to introduce to you at this time our Division Engineer, Colonel John Mason, and he will just welcome you officially and say a couple of words, and then I think we can swing right into action.

COLONEL MASON: Thanks, Joe. This is turning into a big round of introductions here so far; and I will only take a minute, and then we will get to the meat of this whole thing. I would like to welcome all of you.

1 I see some faces out there I'm familiar with.
2 I am very happy to see all of you here. We in the
3 Corps are particularly happy that you are here to
4 assist us in some of our problems.
5 I don't know whether you realize it or not, but
6 what we are doing is taking advantage of all of the
7 expertise that we can get hold of. We have some of
8 our own, and we would like to use every bit we can get.
9 I would like to welcome the panelists. I
10 don't know if you are all familiar with all of them.
11 I have a list of them here, and the first one I have
12 isn't here. He's from M.I.T. I see Dr. Ray Krone
13 all the way from the University of California is one
14 of the early arrivals. We also have Dr. Ryther of
15 Woods Hole, a marine biologist; and Dr. Guy McCleod,
16 Director of Research at the New England Acquarium;
17 and Mr. Henry Simmons of Waterways Experimental Station,
18 one of our own, from Vicksburg; and Dr. Robert Thomann,
19 Hydroscience, Incorporated.
20 We certainly do welcome all of you here today.
21 During the next two days I am sure your discussions
22 will be very valuable to the major efforts of solving
23 the problems of Boston Harbor. I think we all know
24 it is rather polluted, or so they say. We have the
25 problem that we want to make it a viable body of water

so that the people may swim in it and fish in it and dig for clams, or what have you, and, once that has been accomplished, eat those species that have been taken from the bottom of the harbor. We do have problems in that way.

As Joe mentioned, the Corps is very involved in waste water studies. Recently our waste water study was expanded from the original which encompassed New Hampshire and Massachusetts on the Merrimack to include the Boston Metropolitan area; so we are working in concert with the Commonwealth and everyone else we serve in picking up Metropolitan Boston and the Harbor.

I have another pressing problem, so I'll leave you to your discussions. Thank you, Joe.

MR. IGNAZIO: Carl, I think it might be well for the panelists and those in the audience if we all introduced ourselves.

(All participants introduced themselves.)

MR. HARD: I think that we were going to start with two short presentations and then get about our discussions. Dr. McCleod has a presentation first.

DR. McCLEOD: I always have to start by saying that although I am with the New England Acquarium Research Department, that we have very few projects dealing with fish physiology or fish behavior.

The reason for this is we have no space; and so we turn, since we are located on the water, to work in systematic ecology and have concentrated in the areas of water quality monitors and analytical chemistry and in biological models of the environment. Much of the work that I will talk about today has been supported in part by the Division of Water Pollution Control; and I was also told that I have 15 minutes, so I thought I would describe briefly what the laboratory is doing and then go on to show some slides of some of the data that we have collected and recently analyzed on the sediments in Boston Harbor.

Now, we started two years ago under the auspices of the Division of Water Quality, Water Pollution Control and established some 18 stations in Boston Harbor; and these stations were maintained at the Charles and Mystic Rivers, near the Acquarium, near the Deer Island outfall; and there were seven stations in this area of the Presidential Rhodes area and the Deer Island Outfall and Thompson's Island. There were a series of stations in this area; and then we have expanded some of our monitoring station into the Hull-Dorchester-Quincy Bay area. There are approximately 18 stations.

For administrative reasons the program was set

1 up to monitor these stations for water quality
2 and metals about once a week. Over a period of
3 time, as a result of some modelling experiments
4 we had done, we were able to define the frequency
5 of monitoring much more clearly; and we monitor
6 now probably once every 17 days during the winter time
7 and at concentrated times in the spring and summer.
8 During the past two years we have collected considerable
9 water quality monitoring parameters which are you
10 familiar with: dissolved oxygen, PH, salinity, nitrates,
11 phosphates, coliforms and this sort of thing. In
12 addition to that monitoring program we had developed
13 a data bank; so this data is available on punch
14 cards and is available for readout if anybody should
15 have need of it.
16 In addition, we have done substantial work in
17 the laboratory on developing analytical methods for
18 trace metals and some work on oils and chlorinated
19 hydrocarbons. Finally a group in the laboratory
20 became interested in the possibility of putting
21 together a biological model which would address
22 itself to the problems of the biology and chemistry
23 of the harbor; and this model has been used to
24 predict the frequency of phytoplankton blooms in the
25 harbor and to look at the general effect of effluent

discharge on the blooms.

Now, I would like to report some of the work that Dr. Gilbert of our staff has been doing for the last year relative to the heavy metal concentration in the water column and in the sediments.

(Slide shown.)

Let me go through this, and the next three slides show the concentrations of organics, mercury, zinc and chromium that have been analyzed in cores taken at these stations. We have the rivers in this area here, Deer Island outflow which you are familiar with, back up in the Snake Island region; and here the Dorchester Day area, and we have the Neponset River here and the Weymouth River here. What this attempts to depict is the per cent organic content in the sediment core.

FROM THE FLOOR: If there are going to be a lot of slides with numbers, I think it would be worthwhile to back the projector up. Then we can see it. I think that would solve a visual problem.

(The projector was moved.)

DR. McCLEOD: We have taken approximately 154 cores in the area, some of which are represented on this map; and we have analyzed these. The first number represents the per cent organics 10 to 12

1 centimeters; the second 20 to 22 centimeters and the
2 third 30 to 32 centimeters. I think the point we
3 want to make here is in the inner harbor near the
4 rivers we have 22.42 per cent organics. At the
5 Deer Island outflow at the top of the core we have
6 6 per cent, eight per cent here, six per cent there.
7 As we go down in the core, the per cent of organics
8 decreases. Again in this area in the Neponset
9 River we have a rather consistent core with 8 to
10 10 to 13 per cent organics. Around Thompson's Island
11 we have 11 per cent or 12 per cent, so that there is
12 a significant percentage of organics in these cores.
13 The length of the core is approximately 32
14 centimeters. The cores we usually have are black
15 and greasy; and some are anerobic, and we do get
16 down far enough to reach a clay layer.
17 In this slide I want to show just three metals.
18 We analyzed about fourteen; but I think three is
19 enough to give the idea of what we are trying to
20 get across. This slide is where chromium has been
21 analyzed, and this is in parts per million. In the
22 water column it is detectible both in the aqueous
23 and the effluents. Again in the inner harbor 116
24 parts per million, 259. At the Deer Island outflow,
25 179, 400, 104. In Thompson's Island again a high

concentration: 225 parts per million, 274. The effluent from the Neponset River, 166. There is relatively high value here of 189 parts per million and lower values in the Dorchester Bay area; so there seems to be a high concentration from the Deer Island effluent down to this area which may be both from the effluent but also a significant contribution from some of the rivers.

The next slide is a slide of concentration of zinc in the sediment cores taken in parts per million. For reference, I believe the guidelines say that 50 parts per million zinc is an acceptable value. Again we find extraordinarily high values: 1360, 1230, 330, at the outflow 126. In some cores we see a decrease in the concentration of the zinc as we go in the depth of cores, and in others constant throughout the area.

Again, there is a high concentration here at the Neponset River and in this whole area from Thompson's Island or Deer Island to Neponset. There is effluent discharge here, a high concentration in this area; and relatively high values all the way through.

The next slide, I guess everyone is supposed to do some work on mercury, so we are no exception.

1 Here we plotted mercury in parts per million both
2 in the top layers of the cores and about every
3 10 centimeters. The EPA guidelines for mercury, I
4 think, are .5 parts per million; and we have 5.70
5 parts per million, 4 parts per million here, 2
6 parts per million, 2.73, a low value here within
7 the guidelines, 1.4 parts per million going toward
8 Snake Island.
9 Again we have consistent cores with
10 concentrations of mercury at the Neponset River
11 Stations in this area, and 5 parts per million
12 values along in this area. There is also a problem
13 when one attempts to ascertain what has happened.
14 Certainly there must be influence from the discharge
15 from Deer Island. Unfortunatley we don't have good
16 numbers which would define the discharge from
17 combined sewer overflows, nor do we have
18 reasonable numbers on the discharge and what may be
19 carried down through the rivers. This information
20 is simply not available. These numbers are higher,
21 however, than those reported by (Grotz) and others
22 from the New York Bite Dumping area; and we have
23 done a paper calculation for our own amusement of
24 the amount of copper that could be leached from the
25 shipping that takes place in Boston Harbor over a

period of years by computing the gross tonnage and the displacement and using a minimum value of 10 micrograms per centimeter squared of copper leached per day and came up with a value of 61,000 pounds would be in the harbor over a period of a year; and these values match very well the concentration of copper we have measured in some of the cores.

I think that with respect to the trace metals, we are still very much in the dark on the transport problems of the trace metals, how they arrive in the area and how they are deposited, what is the contribution from the river system, from the storm overflows and how this compares with the contribution that one is reasonably getting from the sewerage effluent. We have very little information on the leaching of these metals and transport back and forth in the sediments; and we are putting together an idea of the industrial output and how this would go through the MDC system and what figures we would find.

We need transport models of metals and bio-accumulation models to project the impact of these metals on the remaining parts of the harbor.

That's all I will present at this time. If you have any questions or want another look at the slides,-----

1 MR. HARD: Could we confine the questions to the
2 panel today?
3 DR. RYTHER: You get the high values around
4 the Neponset River? What do you think the origin
5 is?
6 DR. McCLEOD: There is a large discharge from
7 a culprit in that area, a sewerage discharge.
8 I think that's coming from the sewerage system in
9 that area. I haven't been able to get good numbers
10 of the river sediment flow and how this might be
11 picked up.
12 DR. THOMANN: Do you have any information on
13 the heavy metals in Deer Island effluents and in
14 the sludges?
15 DR. McCLEOD: Yes, we have information from
16 there. We have analyzed the sludge and the
17 effluent.
18 DR. THOMANN: Is it sufficient to account for
19 those concentrations on some kind of valumetric
20 basis?
21 DR. McCLEOD: But the problem is that you
22 don't know how much to subtract from just combined
23 sewer overflow or from the river contribution
24 itself. I don't think you can implicate the whole
25 thing. The majority is from the sludge; and they

1 are in both the aqueous and the particulate phase
2 in the effluent discharge.
3 DR. RYTHER: Are there any industrial discharges
4 as distinct from sewerage?
5 DR. McCLEOD: Yes. There are heavy concentrations
6 of zinc coming from both the Gillette Plant and
7 from the Boston Edison plant. There are high values
8 there. Those are two that are conveniently close
9 to our stations. These are coming straight from
10 that area, not from the MDC system.
11 DR. THOMANN: Has anyone analyzed shellfish
12 meats for analysis?
13 DR. McCLEOD: We don't have a complete analysis
14 of that.
15 DR. KRONE: Would you describe the physical
16 characteristics of the sediment?
17 DR. McCLEOD: The cores are two or three
18 feet at the most. Right at the very end of the
19 core there is a sandy clay layer. The remainder
20 of the core is usually black and very greasy. You
21 can detect oil. Some of these are anerobic, and
22 some aren't.
23 DR. KRONE: By oil, is that a visual observation?
24 DR. McCLEOD: No. We have taken these and
25 analysed for oil, and we see the presence of number 6.

We also have, with Mrs. Ladd, an extensive project on vanadium and have detected high concentrations of molybdenum in analyzing for oils in the water column and in the sediment, so there is definitely oil there.

DR. KRONE: Were the heavy metals analyzed by the EPA methods?

DR. McCLEOD: Yes. Let me modify that by saying we started out using the EPA guideline laboratory cookbook and have modified these methods so we have our accuracy about five per cent.

DR. KRONE: Were the samples digested by the nitric acid?

DR. McCLEOD: Yes, and the details of this Dr. Gilbert has and is publishing; and there have been revisions in the mercury method to establish a good accuracy and precision.

DR. KRONE: In the visual observation it appears that the top portion of the cores are organic materials or at least significant?

DR. McCLEOD: Yes, significant.

DR. KRONE: And less at the bottom?

DR. McCLEOD: That's right.

DR. THOMANN: Can you offer any opinion on whether the benthic community has been adversely

1 affected in any way by these concentrations?

2 DR. McCLEOD: Well, tunicates thrive there.

3 There are a number of (policky worms), and we are

4 trying to establish the total bacterial population

5 at the present time. That's it for the benthic

6 community.

7 DR. THOMANN: You think it has been adversely

8 affected?

9 DR. McCLEOD: Yes.

10 DR. RYTHER: What kind of benthic communities

11 do you have here in the black oil?

12 DR. McCLEOD: Tunicates, (Policky worms),

13 bacteria, period. You have a very limited

14 population; and the population classically that has

15 been implicated as a polluted area.

16 DR. KRONE: Have any measurements been made

17 of the release of this material say by shaking a

18 sample?

19 DR. McCLEOD: Dr. Gilbert is starting that now.

20 This is one of his interests, and we don't have

21 any firm numbers on this. There has been one study

22 reported from Chesapeake Bay where they thought they

23 could implicate the release of zinc into the water

24 column, and we are checking their methods there.

25 DR. KRONE: How about bioathates?

1 DR. McCLEOD: We have done extensive work on the
2 bioathates and mercury.
3 DR. KRONE: Using the sediment material?
4 DR. McCLEOD: Yes, and it is an organism that's
5 present in some numbers in Boston Harbor; and we
6 have been looking for the last year on a modified
7 (chemo-staf-op) system arrangement to detect what the
8 pulse and recovery of a population would be from
9 levels of mercury we encounter in a water column;
10 and these studies are still going on.
11 DR. KRONE: Could you give a rough idea of the
12 sulfide content?
13 DR. McCLEOD: I don't have that number. I
14 should have it, but I don't have it. I know they
15 are working with the sulfide electrodes to determine
16 this. I don't have a firm number for that. My
17 recollection is that the sulfide concentration
18 is greatest at about 10 centimeters from the top
19 of the core and decreases.
20 DR. THOMANN: I don't know whether this is the
21 time, but I would like during the morning or afternoon
22 to hear more about your phytoplankton model and
23 predictions.
24 DR. McCLEOD: I have the slides in my briefcase.
25 MR. HARD: Dr. Thomann?

1 DR. THOMANN: I would like to review for you in
2 a brief 15-minute discussion some of the work that
3 we have been doing for the Commonwealth, Division
4 of Water Pollution Control over the last several
5 years on analysis of water quality problems in Boston
6 Harbor, and specifically with reference to the order
7 of magnitude of influence of each of the various
8 components of pollutional load in Boston Harbor;
9 that is, Deer Island, Nut Island, the combination
10 of the sludges in the inner harbor loads, combined
11 sewer overflows; and I would like to review
12 that for you with a series of slides.
13 The first phase of this was completed during
14 the summer of last year; and we are now in the second
15 phase of this work for completion in the early part
16 of next year.
17 Can I have the first slide? As I mentioned,
18 our task was essentially to analyze the data that
19 had been collected over a several-year period for
20 the purpose of drawing some conclusions on the relative
21 magnitude of importance of several classes of water
22 quality problems. Because of the reasonably complex
23 nature of a system like this, with the various
24 types of waste inputs, the combination of the discharge
25 of sludge and a variety of combined sewer overflows
as shown on this mat, together with some storm water

1 overflows, the problem seemed much more amenable to
2 a modelling analysis than most.
3 It is simply not clear from inspection of data,
4 as we were just discussing in the case of the heavy
5 metals, what relative contributions are made by each
6 of the different sources to the water quality problem
7 as observed. Our primary emphasis on this phase
8 of the work was on the water column itself as opposed
9 to a detailed analysis of the sediments as was just
10 gone over by Dr. McCleod. Our emphasis was on water
11 quality in the water column itself.
12 What we did was to construct a steady-state
13 water quality model. As indicated here, the Boston
14 Harbor was divided into in this case a 76-section
15 model. Various inputs were put into the model
16 to represent the different pollutional loads
17 from Deer Island, Nut Island, Deer Island and Nut
18 Island sludges, and then a variety of estimated
19 loads from the inner harbor and from combined sewer
20 overflows.
21 It became quickly apparent after a few relatively
22 simple calculations with this model -- they're not
23 too simple. In this case with 76 sections we are
24 dealing with 76 equations that have to be solved,
25 in this case simple linear algebraic equations, and

a little later on they get a little more complex.

It became clear, however, after a preliminary analysis that the major problem in terms of water quality in the water column was coliform bacteria; and that, of course, is the major problem that's impacting water use directly in the sense of the number of potential beach areas being closed in the Boston Harbor Region and the number of potential shellfish areas being closed because of high coliform concentrations.

What I would like to do is to show you very quickly some of the overall results of that work and to try to estimate the relative impacts of each of those waste sources on the total coliform concentrations as observed at any particular location.

Any model, of course, has to have some degree of verification if one is to use it for a projection; so a variety of verification analyses were carried as the first phase of the study; and a typical result is shown in the next slide.

This was in the summer of '67. The squares are some of the data that were collected. These are logrythmic means of observed data. This is coliform bacteria in thousands of NPN per 100 ML, so here is 53,000, 45,000, 21,000 and so on. The numerical

model was built, and it is primarily a tidally-dispersive model with very little net advection through the system because of the low-river flows with, in this case, a first-order decay for the bacteria and a number of these kinds of contours were generated as part of the modelling verification phase; and the verification in this case was considered complete when the differences between the observed and computed data were within plus or minus one standard deviation.

Here is a typical result, and there are a whole variety of these conditions, going up into the summer of 1970 to cover a range of conditions. This was in the pre-chlorination days up through the chlorination or the initiation of chlorination at Deer Island.

After the model was verified, then we began to carry out a series of analyses of estimated impacts of the different sources contributing to the observed coliform concentrations; and that's shown in the next sequence of slides.

The first slide shows the estimated coliform concentration now in numbers per 100 ML due to the Deer Island and Nut Island effluents themsleves after chlorination. You see here we have about 3 per 100 ML, relatively minor impact of the reasonably-well-chlorinated effluents.

1 The next slide shows the effects of the Deer
2 Island and Nut Island sludges which are discharged
3 in this location. NPN's again in numbers per 100 ML.
4 Here's 1,000 here in a localized spot out to about
5 100 here and out to a region of about 10.
6 DR. RYTHER: Is this in the water?
7 DR. THOMANN: This is in the water column, yes.
8 This is 1,000 NPN per 100 ML in the water column.
9 We are already beginning to see some relative impact
10 of the different sources. The effluents apparently
11 contribute very little; sludges are a fairly localized
12 effect in the water column and a region extending
13 out to those limits of about 100 organisms per 100 ML.
14 The next slide shows the effects of what we
15 call the inner harbor loads, and these were estimates
16 made on the basis of whatever we knew about the
17 distribution of combined sewer overflows here and
18 initially were made in order to begin the first step
19 of the verification so that we could generate a model
20 that had in it a consistent set of loads as well
21 as a consistent set of dispersions, advection and
22 reaction coefficients. This is the estimated effects of
23 those inner harbor loads. By "inner harbor loads," we
24 hypothesize a variety of stuck regulators in the
25 inner harbor which are leaking raw sewerage into the

1 system.

2 These are steady-state results. The odds are
3 that the leakage from these regulators is occurring
4 only on the ebb tides. I will show you some results
5 a little later on of a time-variable analysis that
6 takes that into account, but this is an estimate
7 over a period of time averaged: 44,000, 10,000
8 and 1,000.

9 Now, if you notice, this entire region in here --
10 a little later on I will be zeroing in on the Carson
11 Beach region -- but we are now accounting for somewhere
12 between 1,000 and 10,000 per 100 ML organisms due to
13 the inner harbor loads themselves. This kind of
14 calculation I should mention we consider reasonable
15 to orders of magnitude only. So that's why we plot
16 it that way, tens, hundreds, thousands, ten thousands
17 and on up to hundreds of thousands; and the orders
18 of magnitude, then you can pick any location here.
19 You will recall in the earlier slides we were
20 estimating somewhere around 1,000 due to the inner
21 harbor load, somewhere around 100 due to the
22 Deer Island and Nut Island sludges and somewhere
23 around one due to the effluents.

24 Finally, an estimate was made of the effect
25 due to the combined sewer overflow as shown in the

1 next slide.

2 Now, these are fairly rough estimates because
3 what it requires is a fairly difficult approximation
4 to the estimated contribution over a period of time
5 of combined sewer overflows. Nevertheless, we think
6 the order of magnitude is about correct; and you can
7 see that coming out of a number of these areas where
8 there are combined sewer overflows, orders of
9 magnitude now in the 10,000 to 1,000 per 100 ML.
10 The upshot of that whole stretch of analyses, which
11 went on for a year and a half, was that apparently
12 from the point of view of coliform bacteria pollution
13 on the beaches or over the shellfish beds, the major
14 effect appears to be from combined sewer overflows and
15 stuck regulators or hypothesized open regulators in
16 the inner harbor region of Boston Harbor.

17 The Deer Island and Nut Island effluents don't
18 appear to contribute at all if well chlorinated to
19 the coliform concentrations that might be observed
20 in the beach areas here or elsewhere throughout the
21 outer harbor and the inner harbor; and the sludges
22 have an effect extending out to about here in the
23 water column down to about 100 organisms per 100 ML.

24 It was on that basis that we began to look a
25

1 little more carefully at the whole problem of coliform
2 bacteria pollution in Boston Harbor with the express
3 purpose of saying: "Given that that's the case, namely
4 that no matter what you do over in here, you are
5 probably not going to affect coliform concentrations
6 significantly in let's say an area like Carson Beach
7 unless you do something about the combined sewer
8 overflows and the stuck regulators;" and we began to
9 zero in a little more specifically on the problem of
10 how does one go about analyzing that particular portion
11 of water quality in Boston Harbor.
12 We did look at dissolved oxygen modelling,
13 the nitrogen and phosphorus balances in the harbor
14 using the basic model, most of which in the water
15 column doesn't appear to us to indicate any specific
16 problem. A typical example is shown in the next slide
17 which shows our estimated 1995 projected dissoved
18 oxygen distribution on the present waste load practices.
19 This is with, as I recall, about a doubling of the
20 present waste flow; and you see at no place in the
21 harbor does one really violate at least a steady-state
22 dissolved oxygen standard.
23 We estimate that probably up in here you will
24 violate the minimum dissolved oxygen standard of
25 3 milligrams per liter. It is certainly not a problem

1 in oxygen compression at least in the water column
2 as far as we can determine in the harbor itself.
3 DR. RYTHER: Are you averaging this from top
4 to bottom?
5 DR. THOMANN: Yes, vertically integrated in the
6 water column.
7 DR. RYTHER: This doesn't mean you might not
8 have an anerobic condition in the bottom?
9 DR. THOMANN: That's correct. I don't know whether
10 that is the case for sure; but as I recall, there was
11 some vertical DO's taken. I don't think it is that
12 obvious or a significant gradient close to the bottom.
13 These are vertically averaged and time averaged
14 oxygen conditions.
15 On the basis of that analysis and the fact that
16 the relative impact on water use -- in this case the
17 closing of beaches which most people will respond
18 to initially and the closing of the shellfish beds --
19 is closely related to the coliform bacteria problem
20 and the fact that the coliform bacteria problem
21 appears to be related to a hypothesized distribution
22 of loads coming out of a variety of combined sewer
23 overflows in the inner harbor and a ringing around the
24 harbor and the transient overflow from the combined
25 sewers that we began to look a lot more closely at a

more detailed time variable analysis of the harbor. That is shown in the series of transparencies which will take two minutes for us to set up.

In the meantime, are there any questions on this particular aspect of the work? I'm sorry, I shouldn't look to the audience.

DR. SIMMONS: Do you feel that you had adequate field data to set up the hydrodynamics of this model?

DR. THOMANN: For this kind or for this particular model, yes, because this was a steady-state what we call a long-term average type model to provide precisely the kind of information I just mentioned; namely, what is the order of magnitude of the relative influences of all of the different sources. All you need for that really is the fact in this particular case that this system is almost totally tidally dominated. The amount of river flow coming down is so small that it doesn't influence the circulation patterns at all; and we then assume a variety of dispersion coefficients around Boston Harbor, verified that with observed salinity profiles from three or four different surveys, and that gave us a kind of independent verification of the dispersion/advection transport structure; and we then used that in the quality model. I will go over in a minute the hydro-

1 dynamic model, the numerical model which uses some
2 observed current data.
3 DR. KRONE: Was there enough fresh water river
4 flows to give you salinity variations?
5 DR. THOMANN: Not terribly much, but enough
6 from the inner harbor on out to the Deer Island area;
7 and we imposed a little more stringent verification
8 criteria on that. What it essentially indicated
9 was that the whole system was tidally dominated
10 and goes up and down like a plug; so that the
11 dispersion from a steady-state average point
12 of view is like a well-mixed pot, and everything goes
13 in and mixes around over a period of time.
14 If you go in in a specific hour and start to
15 look at patterns of what happens over a period of
16 hours, then the situation is different.
17 DR. KRONE: This is a steady-state with long-
18 time averaging?
19 DR. THOMANN: Yes. The averaging here we would
20 consider more or less on the order of a month maybe,
21 something like that during the summer conditions.
22 (Pause.)
23 As usual with modelling analyses of this type,
24 you don't know how they are going to turn out in the
25 end. Here is the schematic of the hydrodynamic model

1 we constructed of Boston Harbor. This is approximately
2 a 2,000 foot grid overlying the harbor with a boundary
3 at the Deer Island Region here. Our primary area
4 of interest, as I mentioned, was to further examine
5 the time-variable behavior of the system under the
6 hypothesis that the major influence on areas like
7 Carson Beach is due to the inner harbor and combined
8 sewer overflows.
9 That's a non-linear hydrodynamic model, in
10 this case tidally-driven by stage information at
11 Deer Island. We had a variety of somewhere on the
12 order of 50 or 60 current meter stations that
13 were occupied at various times by NOAA which formed
14 the basis for the verification of this model. We
15 wanted to verify this model on velocity as opposed
16 to stage. The model is very easy to verify on stage.
17 The velocity, however, was what we wanted to verify.
18 So we got that data, and I don't want to review
19 all of that with you. I will pick one of the stations,
20 Station 112, to show you the output of the hydrodynamic
21 model. We ran that for about two tidal cycles; and
22 we pin it up and run it for a tidal cycle and run
23 it for another tidal cycle and make sure of the results
24 over the system.
25 Here is one of our velocity verifications. It is

1 two-pump horizontal velocity model vertically integrated
2 in depth. This is the X component at that Station 112.
3 The hydrodynamic model results at two interfaces
4 of the grid. Velocities are calculated at the interface,
5 and stages are calculated at the center of the grid and
6 are shown by the dots and the triangles indicated here.
7 This is kind of a normalized tidal cycle. Here is
8 the mean of the data collected by NOAA from the current
9 meter data plus or minus one standasd deviation.
10 That's the X component, and we have about 40,000
11 of these.
12 DR. KRONE: Before you leave that, what is the
13 difference between the circles and the triangles?
14 DR. THOMANN: The current meter station was
15 not exactly at an interface of the model; so what
16 we plotted up here are the two interfaces closest to
17 that station.
18 Here is the Y component at that particular
19 location and velocity; and you see that that also
20 does reasonably well. Here again is the observed
21 data from the NOAA survey plus or minus one standard
22 deviation hydrodynamic model output as indicated.
23 Again, the whole idea of that particular exercise
24 which went on for quite some time, again because
25 we wanted to make sure the model was representative

in the region that we were interested in specifically of transport within one or two tidal cycles.

MR. HARD: What depths were the current meters placed at?

DR. THOMANN: They varied. They had a few index stations. I think the surface meters were always somewhere around something like six feet; and then they had a number of index stations and other meters that they varied throughout the entire thing. They went deep also.

DR. KRONE: How did you calculate a standard deviation for the tidal----

DR. THOMANN: Actually we did a variety of statistical analyses on the NOAA data itself including some frequency analysis, spectral analysis. This particular plot was the simplest one. I don't remember exactly, but the average length that we had was somewhere around 20 days. We had 15-minute averages of the current for about a 10-to-20-day period. In this case every 12.4 hours or every tidal cycle was directed back, so each one of the points has about 35 values calculated to get a mean.

There was also a lot of other statistical analysis done on that. We also checked the tidal components of the model, the frequency components

1 of the model with the frequency components of the
2 observed data, superimposed some of the residual data
3 to see how the varification was.
4 DR. KRONE: Did you ever correlate the wind
5 with it?
6 DR. THOMANN: No. This is the verification you
7 get without any wind. It comes in and goes out, so
8 the stage is just beautiful. The velocity profiles
9 are a lot more interesting to verify.
10 MR. HARD: Roughly how many stations were occupied
11 at depths with current meters?
12 DR. THOMANN: I don't recall.
13 MR. HARD: Roughly?
14 DR. THOMANN: At depth?
15 MR. HARD: At depth, say a meter off the bottom.
16 DR. THOMANN: I don't know. They were not that
17 close off the bottom. Probably the closest they
18 would get to the bottom is ten feet.
19 MR. HARD: In what water depth?
20 DR. THOMANN: Probably in the 30-or-40-foot range.
21 MR. HARD: Many of those would you say roughly?
22 DR. THOMANN: They would vary. They were picking
23 them up and moving them all the time.
24 MR. HARD: So they were point observations not
25 synchronized?

1 DR. THOMANN: That's right. Yes, there were a
2 few index stations, but----
3 MR. HARD: When you say an "index station,"----
4 DR. THOMANN: They were kept in for a period
5 of time.
6 MR. HARD: Continuously running for a period
7 of geodynes for a month or something like that?
8 DR. THOMANN: Right.
9 DR. RYTHER: Was there any indication of a non-
10 tidal current?
11 DR. THOMANN: This was done with zero river flow.
12 DR. SIMMONS: Have you analyzed these averages
13 say from point to point to see whether or not
14 there is an indication there are net flows at
15 different locations within the system just resulting
16 from the normal tidal hydrodynamics?
17 DR. THOMANN: The non-tidal drift or something?
18 We were trying to look for it; and it is apparently
19 so small because you are talking several hundred CSF
20 of river flow. Is that what you are trying to get at?
21 DR. SIMMONS: No. In a system like Boston Harbor,
22 take any passage within the system, to my mind
23 it would be unlikely that the same amount of water
24 flows in and out through that passage. The geometry
25 of the system is such that it would probably encourage
more flow in or more flow out.

1 DR. THOMANN: The model generates that. You
2 can see that.
3 DR. SIMMONS: I am wondering if you have analyzed
4 these data for the different sections to indicate
5 whether there are indications of net drift in or out
6 through the different passages.
7 DR. THOMANN: No.
8 DR. SIMMONS: It would be relatively simple to
9 do. You have the data there?
10 DR. THOMANN: Sure, we have the data. Depending
11 on where you are in the harbor, there is a substantial
12 relative shift.
13 DR. SIMMONS: Right, and this makes a tremendous
14 difference whether you're looking at the Deer Island
15 outflow or----
16 DR. THOMANN: Right. Remember, our emphasis here,
17 this particular aspect of the hydrodynamics will not
18 be able to say very much about the Deer Island outflow.
19 The boundary was at Deer Island. You would have to
20 extend that out. One of the reasons for that is a
21 very pragmatic one, that once extended out offshore
22 of Boston Harbor, then we are into a different
23 circulation pattern entirely.
24 DR. KRONE: Did you calculate any paths of motion?
25 DR. THOMANN: Yes. The program itself, we numerically

1 tagged parcels of water, and we watched them go
2 all over the place.
3 DR. KRONE: To show the overall circulation?
4 DR. THOMANN: Yes, and it is quite informative.
5 You release them at various locations, and you watch
6 where they go in the system. That's a reflection,
7 of course, on these kinds of outlets. You just dump
8 a number of particles in the program and watch where
9 they go. I don't have the figures for that here.
10 Well, on the basis of that model we wanted to
11 see the relative effects of some of these problems
12 I mentioned earlier; and here is one of these simulations.
13 The simulation was set up in the following way.
14 Using the hydrodynamic model we just mentioned,
15 our particular area of interest now was in
16 this region of Boston Harbor; and assume that
17 in the inner harbor the regulators are open during
18 ebb and closed during flood so that this is kind of
19 a pulse input of off-six-hours, on-six-hours, off-
20 six-hours, and on-six-hours in this region of the
21 inner harbor.
22 We run that to a periodic steady state, and here
23 is a typical picture of that at the end of ebb tide.
24 This is in numbers per 100 ML of coliform bacteria.
25 There is a decay now incorporated into this particular

1 analysis. You see up in here 100,000, 23,000 and
2 50,000 per 100 ML as a result of that six-hours-on,
3 six-hours-off. That's at the end of ebb.
4 At the end of flood tide, the picture is a little
5 better. Now the regulators are off, and we are
6 down to about 18,000. It is very interesting
7 if you compare these results which run 18,000 to
8 maybe 100,000 oscillations over a tidal cycle, they
9 don't compare too badly to the steady-state results
10 of about 40,000 we calculated in the inner harbor.
11 So at the end of flood tide, one would estimate a
12 pattern like that due to the regulators.
13 You see concentrations here of 250 per 100 ML in
14 the Carson Beach area. I should show you that down
15 in here, and you see about 100 in that region due
16 to the regulators.
17 We also wanted to take a look at the effects of
18 transient storms. Specifically, there are about
19 five or six overflows in the Carson Beach area itself;
20 so we took a look at what the effect of a two-hour
21 storm with a quarter-inch-per-hour rain would have,
22 discharging just from this area alone, not from any place
23 else in the harbor region, and this is a plot of the
24 contours six hours after the beginning of the storm
25 where the storm lasted two hours, so it is a plot four

1 hours after the end of the storm period. We find
2 concentrations of 100,000 on down to 10 in the immediate
3 vicinity of Carson Beach area.
4 After 24 hours -- these are generated every hour,
5 so I'll pick a representative one -- you see that we
6 are down to 7,000 per 100 ML in the immediate
7 vicinity; and we are down here to about 10. You
8 can summarize all those typical kinds of results in
9 the following way. In the Carson Beach area, the
10 coliform concentrations start out somewhere around
11 100,000 after the storm has ended; and you will note
12 here is 2300 median NPN per 100 ML as the monthly
13 standard. Ten per cent of the samples can exceed
14 2300, and 700 is the median. You see, you don't get
15 down to the range of the standard for bathing water
16 until almost two days have passed after a two-hour
17 storm.
18 We also ran, of course, a number of other areas
19 around. Here is a particular area of Deer Island Flats
20 which is a prohibited shellfish area, so we have
21 the effect of the two-hour storm in Carson Beach and
22 on Deer Island flats. The interesting thing there
23 is you will notice there is very little tidal oscillation
24 as time goes on, and that's because at Carson Beach
25 the way that behaves, it is simply pumping up and down.

1 There is no water behind it. It goes up and comes
2 down; and this is essentially a decay phenomenon
3 right in the Carson Beach area itself.
4 That's not what will happen if you discharge
5 a combined sewer overflow in the inner harbor with some
6 flushing water behind it. Then it moves out and comes
7 back in.
8 MR. HARD: I think we're getting down to the
9 smaller mechanics of the thing.
10 DR. THOMANN: One more last slide, the coliform
11 concentrations at Carson Beach due to a combined
12 sewer overflow. What we did was run through a variety
13 of rainfall sequences to try to see whether there
14 was any possibility that under a good predictive
15 scheme you could keep Carson Beach open under a typical
16 rainfall pattern.
17 This was the June 1967 rainfall pattern that
18 was simulated in the model; and for all practical
19 purposes the beach remains closed for most of that
20 time period unless you get the people to respond
21 for two hours to go down to the beach and do a little
22 swimming and go home again.
23 That's the end of the presentation. Are there
24 any questions on that?
25 DR. RYTHER: I hate to admit my ignorance; but

I don't even know what a regulator is or what it does.

DR. THOMANN: This is a very old sewerage system. Regulators are tide-gate regulators to prevent the incursion of harbor water into the sewer system. These are by-passes on the sewer system. The reason we hypothesized this, early in the modelling stage it was not possible to verify the model without a significant load coming in from the inner harbor. Secondly, when you look at the Deer Island waste flow, we estimate about 25 per cent of that is sea water from the chloride concentrations; so it is getting in there somehow. At one of the headworks there is a definite beautiful pattern of chloride concentrations.

DR. RYTHER: Is there any information available as to what the various inputs are in the Boston Harbor from the different sources in terms of volume? This is something that is basic to the whole discussion here. I don't have any feel from what has been said so far as to how much is going out of Deer Island and how much from these other sources and how variable this is.

DR. THOMANN: Well, from the bacterial point of view, that's what I was trying to indicate.

DR. RYTHER: But you have the chlorination.

DR. THOMANN: That's the whole idea of chlorination.

1 DR. RYTHER: I'm talking about volume. There
2 are other aspects of pollution other than coliforms
3 which are not affected by chlorination.
4 DR. KRONE: It really isn't volumes but the
5 mass of undesirable material. I don't think the
6 water part of it is so important. The total pounds
7 of zinc or mercury or so on per day is important.
8 MR. HARD: Has there been any bottom drift?
9 DR. THOMANN: In this area I don't think so.
10 MR. HARD: And as I understood the NOAA data,
11 it is largely surface data.
12 DR. THOMANN: I wouldn't expect a significant
13 circulation or complex cirulation close to the bottom
14 that would really severely alter the transport of
15 material in the water column. At least in our opinion,
16 this system was so dominated by a tidal wave entering
17 the harbor at Deer Island that there doesn't appear
18 to be any evidence of any complex counter current
19 on the bottom.
20 MR. HARD: Looking at the agenda for the first
21 time, we have seen what has been accomplished. I
22 have also heard considerable discussion about what
23 the results in the interplay of the sediments in the
24 water column would be, and then I was tempted to use
25 the term diogenesis; but a friend of mine who is
a marine geologist said "What was that?" Don't you

1 use that word with me," so what I am trying to do
2 is to get the ball rolling here.
3 Do we have enough basic data? I don't feel that
4 we have, and I would be interested in hearing
5 Dr. Krone's opinion and Mr. Simmons'.
6 DR. KRONE: I am in the position of learning
7 about the harbor. I'm behind you. The information
8 I have is that package that was provided me about
9 this particular harbor; and I am concerned, because
10 even the fundamental information at that stage doesn't
11 appear to be available. For example, the only
12 information on the characteristics of the sediment
13 was the cores at the bottom; but we need to know
14 something about their distribution in the harbor.
15 More importantly though, we need additional
16 information on the movement of the water and the
17 conditions throughout the year. For example, is the
18 bed disturbed by wave action during the periods of
19 the storm? If that's true, that would alter the relation
20 or make the relation between the sediments and the
21 water column very different.
22 MR. HARD: Turbidity.
23 DR. KRONE: Turbidity and the release of materials
24 and their transport from the system. I think that's
25 one of our major concerns.

1 The currents shown by Dr. Thomann are very
2 low. I don't know whether the one-foot-per second
3 is a typical current.
4 DR. THOMANN: No, It's higher than that.
5 DR. KRONE: In some of the areas where the sediment
6 accummulates the currents are probably low; and
7 whether bed material stays there or not depends on
8 whether they are re-suspended by wave action; but
9 in the presence of wind-generated waves, even though
10 slow tidal currents can carry material from the
11 harbor. So the second point I would like information
12 about is the currents of winds, their intensity and
13 whether they can suspend bed material in the water.
14 Then I think the third point is the one that
15 Dr. Ryther mentioned a minute ago; and that is, we
16 don't know what the waste discharges are; and I
17 think that there is little doubt that that's the
18 primary concern here, the control and effect of
19 these waste discharges on the system. Those are
20 pretty major items.
21 MR. HARD: Yes, they are, aren't they?
22 DR. SIMMONS: Just in furtherance of what Ray
23 said, I would tend to agree with Dr. Thomann's
24 statement that it is probably not a great distortion
25 of the vertical velocity profiles of the fresh water
input into the system. The harbor is large, and the

total pressure on the input is very small.

On the other hand, this is a complicated tidal system with all sorts of interconnected passages. It is reminiscent in my mind of some of the Gulf Coast Bays with which I am a little more familiar; but if you get out and meter the flow across any of the passages between two islands, it is inevitable that you find more water flowing in one direction than in the other direction during a normal tidal cycle. This is not a density effect; it is a geometric effect. The influences of the geographic features of the harbor on the flood current are different than those on the ebb. It is quite possible you could have a strong net flow coming into the southerly part of Boston Harbor and out the northerly part or vice versa.

As Dr. Krone mentioned, this could be quite prominently influenced by the local wind patterns. It seems to me that any hydrodynamic model in which we are going to predict dispersion has got to be perhaps verified in more detail than has been the case to date. I may be making this statement without full knowledge of what does exist in the way of field information; but just looking at the system suggests to me that it is a very complicated system.

MR. HARD: If you can see this little map here,

1 I would like to start looking at this as a near-shore
2 coastal zone management problem. Just as Boston
3 Harbor situation is only a part of the waste water
4 study overall, the Boston Harbor oceanography is
5 related to the NOMES study area, the National Ocean
6 Mining Environmental Studies, that's an extensive
7 program that would be carried on in this area. The
8 Corps is dredging in this area, and dumping in this
9 dumping ground here. The Commonwealth of Massachusetts
10 wants us to dump materials here; and I am also
11 interested in the materials in the bottom of Boston
12 Harbor because we are putting them here or here.
13 Then we have people interested in exploiting this
14 area for sand and gravel north of the Cape; and I
15 understand that NOAA is doing some work in this area
16 now as part of their BIOME project which is a major
17 study of the fisheries situation; and of course, we
18 are going to be asked to relate the environmental
19 effects of mining here on the fisheries here,
20 mining here on the effects of water quality and
21 fisheries. We're talking about the possibility of
22 dumping solid wastes in a 2,000,000 cubic yard
23 excavation here. We're talking about excavating
24 materials from Boston Edison Mystic Station Number 7
25 here, highly-polluted materials. We're talking

about taking our Charles River Dam Site Foundation materials and putting them out here.

What I am saying is that we have a big back yard here, and we ought to try to put the picture together somehow. We have people experimenting with new types of current meters at MIT trying to develop a new integrated system of understanding the current picture here; but it is largely an instrumentation developmental stage now. I would like to see some good sound oceanography done in this area. Part of my motivation for having this meeting was that I felt that the Boston Harbor water quality study, if I can call it that, lacks a good circulation study, lacks suspended sediment analysis and was just too darned theoretical. This is why these people are gathered here now. If we can hash this thing out today and tomorrow, then I think we will all have a completely different understanding of it, including myself.

DR. THOMANN: I might just as well jump in. Number one, I think the basic data that one is interested in collecting should reflect the kind of problem that he is facing. It is our opinion that for a variety of important water-use interference problems in Boston Harbor, circulation patterns are known

quite well. They are observed. There is a variety of information from that current meter study that we haven't even tapped totally ourselves, and we spent several months analyzing that data.

The circulation within the harbor itself I think there are details that one could explore at some length; and I am not at all indicating that one shouldn't explore them, when the problem that one is confronting is well defined.

For the class of problems of interference of water use by contravention of water quality standards, I think we know enough about the circulation in Boston Harbor to continue with very practical applications of engineering control devices to bring water quality back down to standards so we can open up some beaches.

MR. HARD: All right, that takes care of the coliform picture; but we are concerned about heavy metals in the food chain.

MR. THOMANN: But beaches aren't closed on the basis of heavy metals in the-----

MR. HARD: I understand that, just as the oysters on Long Island Sound aren't closed on the basis of their metals content, just coliform, but this is a new era.

1 DR. THOMANN: But point is not that it is a new
2 era. I understand that. The point is what is the
3 hierarchy of water use interference problems in
4 Boston Harbor and how does one go about correcting
5 them.
6 MR. HARD: Yes. That's the definition of the
7 problem from your point of view. We have some
8 problems here on the agenda, and I don't think we
9 can answer -- it is hard to distinguish between the
10 first two questions: "What are the likely consequences
11 from eliminating sewage effluent and sludge from
12 Boston Harbor," assuming it was possible, and I
13 suppose you would have to look at various degrees;
14 and the second question: "Assuming elimination of sewage
15 effluent and sludge from Boston Harbor, how long
16 will it take to reach what degree of improvement of
17 water quality in the harbor? Consider a.) Residual
18 pollution effects of harbor mud on the water column;
19 b.) Anticipated dissolved oxygen, salinity and nutrient
20 levels after elimination of sewage effluent and sludge;
21 c.) Suitability of resulting water quality for
22 organisms -- could aquaculture be established; and
23 d.) Other."
24 I don't suppose Dr. Ryther is anticipating
25 that Boston will ever become a Tokyo Harbor, but I think

1 we have to come up with some sort of judgment relevant
2 to these; and so I define the problem as broader
3 than your definition, Dr. Thomann.
4 I think the next question, the third question:
5 "What studies of Boston Harbor are necessary to arrive
6 at reliable answers to question 2?," the time frame
7 to complete these studies opens up an area for
8 constructive work. Now, if it is not felt that
9 we require a more extensive program, and if it is
10 not felt that we should do any further oceanography
11 or do any oceanography in Boston Harbor and that
12 we should not attempt to relate this picture in the
13 Harbor to the NOMES Study area, to our dumping
14 ground problems, to our mining problems, to our fowl
15 area problems, then we could wrap up the conference
16 right now.
17 Would anybody comment on it?
18 DR. SIMMONS: Maybe we're strapped to a gree by
19 not knowing what information does exist.
20 MR. HARD: I don't know. Could anybody in
21 our Waste Water Group comment on that?
22 MR. McGOWEN: Would you run that question by
23 again?
24 MR. IGNAZIO: He's quoting question 3 on the
25 agenda.

1 MR. McGOWEN: I'm Frank McGowen, Corps of Engineers.
2 MR. IGNAZIO: Frank is from the North Atlantic
3 Division. When we tried to structure this type of
4 meeting, we looked at it really as a workshop with
5 just six panelists who have each made contributions
6 in their specialized area and then bring together
7 State and Federal people who have been burdened
8 with a whole slew of actions, "get-something-done
9 kind of issues; and we thought we would have you
10 six talk about what you have done and talk about
11 yourselves and cross examine yourselves somewhat;
12 and we out in the audience would have like a kibitz
13 session with you.
14 Carl has just outlined half a dozen or more
15 ongoing activities. I could add another ten to that
16 list. Everyone is planning to do a lot of things
17 in Boston Harbor; that is, the body of water called
18 Boston Harbor; and there are millions of dollars
19 that have already been invested on the land aspect
20 of water pollution as they come through the estuaries
21 and in the outfalls and more millions that are waiting
22 to get off the boards.
23 I think if we can succeed in establishing what
24 needs to be done between now and tomorrow before we
25 leave here, what added work needs to be done, it

would be extremely helpful to us here that have been charged to work with our colleagues in the State and private consultants.

For the first time I see a comprehensive effort that I have never seen before in this region of about 20 years of activity in planning. For the first time I see the sharing of muscles of the Federal camp and the State camps and the private sectors. I see a glorious opportunity to pull it together.

FROM THE FLOOR: Joe, he raises the question, and you throw this out to the audience, and you put a constraint on the audience not to share with the panel any thoughts, so this makes it very difficult. For example, Bob Thomann has just spent a little time going through and has definitely stated that in his opinion in answer to our question 3, he has told you what he thinks the results will be from the studies he has made, except for the question of aquaculture. There are questions that the audience would like to discuss with Bob and the others.

MR. HARD: What we were hoping to do, Lester, was to build up enough anxiety the first day so the questions will be burning tomorrow.

MR. IGNAZIO: Apparently Lester raises a good point. I didn't realize, Bob, that you weren't going

1 to be here tomorrow. I don't want to erupt your
2 proceedings as such, but it seems to me this is
3 a flexible enough meeting if we have burning anxiety,
4 we ought to surface it.
5 MISS JOHNSON: The question was asked as to
6 whether or not we knew what studies were going on
7 in the harbor and what's been done so far; and
8 the best person would be someone from the State,
9 either Marty Weiss or Martin Cosgrove I would imagine.
10 From my own information you could answer that type
11 of thing much better than I could or maybe Bill Butler
12 has been doing work in the Boston Harbor.
13 MR. HARD: Do we have any takers from the State?
14 MR. COSGROVE: There are a number of studies
15 going on in Boston Harbor, both Federal, State, and
16 in the State level, the MDC. Hydroscience just
17 completed a study, and I don't know whether they
18 are still working. Are they still doing work for
19 you on that? That's a state operation. The ones
20 that the MDC are involved in, I will let Marty Weiss,
21 who is more familiar with the details of them, give
22 a rundown of what is going on and also what we plan
23 to do. He wanted to ask a question earlier, so now
24 he has his chance.
25 MR. WEISS: First of all, I think the panelists

1 were looking for an idea of what the discharges are
2 from the treatment plants; and we have two large
3 primary treatment plants. At Deer Island we discharge
4 330,000,000 gallons a day of primary treated effluents.
5 At our Nut Island plant it is 120,000,000 gallons
6 a day of primary treated effluent. We also discharge
7 digested sludge on outgoing tides. The volume from
8 Deer Island is on the order of 70 tons a day; and
9 from Nut Island it is in the order of I think 40
10 tons a day.
11 Now, as far as the projects that we have been
12 involved in, this summer we had our own skin divers.
13 We engaged a firm of T.E.C. to do some skin diving
14 and take some water quality samples and bottom samples
15 in around our outfalls and some other work with
16 regulators or tide gates.
17 You were also looking for a definition of a
18 regulator or a tide gate. The Boston sewer system
19 or our system is about 80 years old; and in the early
20 days it was designed to take about three times the
21 dry-weather flow, and it is a combined system. When
22 the flow reaches more than three times the dry-weather
23 flow, there are overflow pipes with flap gates that
24 swing open and allow the excess to discharge into
25 the harbor. Most of these are on the older parts
of the system; and in the immediate Boston area

there are probably close to 100 such regulators.

As far as other projects which we are doing, right now we are just getting into studying a comprehensive plan for the entire what we are calling the Eastern Massachusetts/Metropolitan Boston area. At present we have about 43 cities and towns in our system; and we are going to look into the possibility of maybe expanding the system so that by the year 2050 there may be 100 or 120 communities in our system. One of the things we are going to be looking into is whether or not we should have a lot more upstream treatment plants or should all of the effluent come down into the harbor. Which is better from an environmental point of view?

FROM THE FLOOR: What did the divers find?

MR. WEISS: We have one of them in the audience now.

MR. HARD: I think before we get into an entire audience show here, let's try working with the panel for a while. If we can systematically go through these impossible questions, which I prepared largely----

MR. IGNAZIO: I think you ought to go back to the very first question.

MR. HARD: That's where I was heading. Let's go through question number 1 with the panel if we

1 may, starting with you again, Dr. Krone.

2 DR. KRONE: I would like to go to question zero.

3 It seems to me we need, before we begin discussing

4 these particular points, to know a little about the

5 objectives of the study or the studies that you

6 are proposing, your objectives; and I would like to

7 propose what I think your objectives are, and you

8 can modify them.

9 It appears, as you pointed out, there are many

10 users of Boston Harbor and that it appears from

11 some of the other comments that it is hopeful there

12 will be additional users, shellfish people who harvest

13 shellfish,----

14 MR. HARD: Campers on all of the islands too.

15 DR. KRONE: And swimmers, and that more than

16 just minimum oxygen levels are desired. You want a

17 water body that is capable of supporting desirable

18 aquatic life.

19 Now, if those are your objectives, to make the

20 quality of the water for aquatic life and for

21 human enjoyment the maximum you can afford -- and

22 I'm putting words into your mouth -- then it seems

23 to me to be necessary to know what the system is like

24 now in enough detail so you can predict what the

25 effects will be of various management schemes or

1 strategies; and then it will be necessary to see
2 which of the management strategies can be accomplished
3 or that we can afford and what the time scale is in
4 accomplishing them, and of course to determine whether
5 they are feasible at all. It is necessary to make
6 a prediction based on knowledge of the system and on
7 knowledge of what is feasible; so I think before
8 we begin answering specific questions, it might be
9 desirable to clarify these objectives. Is what I
10 said correct?
11 MR. HARD: Yes.
12 DR. KRONE: And what kind of qualities are you
13 seeking? How far do you wish to go?
14 MR. IGNAZIO: I will also ask for any help I
15 can get from Frank or anybody else, or Jim Volatus
16 from our OEC office. I would like to think of this
17 initially as a goal which is a very high-level goal
18 which has now been reinforced by reason of the
19 Muskie-Blatnick bill passing. Our friends in EPA
20 should check me, because we are in the embryonic
21 stages of trying to understand what our guidelines
22 are going to be.
23 Essentially we had a program where the State
24 was proceeding on certain standards that have been
25 set up by the State Division of Water Pollution and

1 worked very closely with the EPA people; and now
2 with the birth of the Muskie-Blatnick bill we have
3 now been told to maybe think in terms of an effluent
4 standard instead of a river standard, and that this
5 river standard was maybe keyed before principally
6 for fishery aspects and principally for the hierarchy
7 of use where the people communicate with swimming
8 very easily and they catch on to that.
9 But the long-term goal I think across the country,
10 if I can see what's in this bill, really is a high-level
11 goal to get the aquatic life that you speak of, Dr.
12 Krone, and to bring back the diversities that hive
13 been lost. This is an enormous project. Just to
14 meet this goal is an enormous project.
15 We have been thinking along the following lines.
16 We see the management of water quality to be made
17 up of several aspects of which the first will be
18 planning, and there are others. There is the design,
19 and the implementation and the enforcement; so what
20 we have done is to link hands. The Corps has been
21 asked to come in, because somehow they think we are
22 regional planners on river systems. They have asked
23 us to jump in. This is the Congress, and they say
24 we should bring into this pool our knowledge of
25 comprehensive planning.

1 The second thing they have asked us to do is to
2 think of alternative measures of advanced waste treat-
3 ment and not to be solely based on what some have
4 called disjointed incrementalism, building a treatment
5 plant, building another treatment plant, building
6 another treatment plant; but literally going right
7 back to land disposal if you can do it and recognizing
8 our problems with land scarcity.
9 They have put on us an enormous charge to think
10 in terms of higher levels of treatment perhaps beyond
11 just simply the biological aspects or advanced physical-
12 chemical gains getting into the land aspects, the
13 core, and also to think in terms of regional aspects.
14 When I called on Marty Weiss, he said they already
15 have 42 in the family or whatever the number is, and
16 they can see maybe 100. Should they start? They're
17 already getting a lot of fresh water down to this
18 point.
19 So in hoping to get these answers, we are
20 bringing in a whole series of actors. The Metcalf &
21 Eddy Firm is in the wing and ready to go and determine
22 just what should be done with the investment that's
23 already in the ground here. They're going to try
24 to see just what has to be done with that. Should it
25 be added to, taken away; should they end up with

1 regional or sub-regional units?

2 The Corps of Engineers comes into this water
3 quality from several aspects. I have studies for the
4 dredging of this harbor. I have permit requests
5 from the Airport, another runway, an offshore terminal,
6 a new refinery. Seventy-five per cent of all of the
7 oil comes in here for this area of New England: SO
8 the Corps' interest goes beyond just the water
9 quality, because every time I go to take a bucketful
10 of this stuff and put it some place, we're in court.
11 We're in court right now in New Haven Harbor. Right
12 now my Colonel is in court with the Sierra Club
13 because we want to take some of this stuff and we
14 want to do studies. Our objectives, our goals are
15 many. We look at this thing not only from the point
16 of view of the Muskie-Blatnick bill; but we're
17 looking at this as a day-to-day issue.

18 I have established dumping grounds. Every
19 time I tell somebody I have polluted material that
20 doesn't pass EPA criteria, somebody says "No, you
21 don't dare do that because you're going to upset the
22 situation, and things are already bad enough."

23 I look at a series of objectives. I see the
24 long-term goal is to clean up this harbor for a lot
25 of uses. The Governor, only two weeks ago, unveiled

1 a program for $30,000,000 to take these 30 historically-
2 beautiful islands and to put them into some viable
3 resource where they will take people in the urban
4 areas and put them on a ferry and go anywhere around
5 here and have the wholesphere of recreational
6 aspects, nature, schools, you name it. It's a
7 wonderful plan, $30,000,000; and they already have
8 3.5 or so to go buy the islands. They already own
9 more than half of the islands. They're going to
10 own them all, because they have the eminent domain
11 power to buy them all.
12 If we start moving around thousands of people
13 and we tell them they can go and swim because
14 the coliform is down now and we find them digging
15 clams, so what if it's posted, we're going to have
16 a lot of problems here. There is no reason why these
17 islands shouldn't be used to help urban recreation
18 needs and to keep these urbanites from going west
19 where they're frankly being told to stay the hell
20 out by a lot of different groups.
21 That's what we see; we see an enormous resource;
22 we see an enormous complications of things that have
23 to be dealt with. What I'm hoping to come out of
24 this with is a whole series of objectives, maybe 30
25 different objectives: to get rid of the combined storm
sewer problem, see what you're going to do with the

1 sludge, do you need a secondary or something else
2 up here. Those are all objectives. What about the
3 Corps dredging this to about 40 feet? What about
4 Massport? We have all of these objectives living
5 within the overall goal that says "Clean up; Shape
6 up."
7 Somebody has given us an enormous charge from
8 the Federal standpoint. It's going to work down into
9 the State. Now, I may have gotten off the track
10 and talked about the general item a little too much;
11 but I would like to hear if you would want to add
12 to this or what.
13 MR. McGOWEN: Just one thing: this harbor
14 study is a very mutual effort, and we're struggling
15 to make it that way. When you ask the question of
16 what our objectives are, you're talking from the
17 Corps' standpoint. This is very good and necessary
18 for the panel, and of course people from the Corps,
19 to find out and understand what the objectives are
20 with regard to the State and with regard to EPA. I
21 would like to hear from someone like Jack or Martin
22 Cosgrove what your objectives are for Boston Harbor.
23 FROM THE FLOOR: I think what we're bouncing
24 around here is a matter of basic philosophy; and
25 I think that the basic philosophy in the United States

1 has been that we continue to make physical changes
2 until we find that it is environmentally damaging;
3 and then we stop to some degree, or maybe we don't stop.
4 That's basically the philosophy that has been generated
5 from the whole development in patterns of the United
6 States. Continue to make changes until you find
7 that it is damaging, and then maybe you consider
8 not making the changes.
9 I think what the Congress has said, and I think
10 what is evolving is a national policy and in fact
11 in some areas has already evolved as national policy
12 in ocean dumping; and that is to turn this around
13 and say "Unless we're reasonably certain that it will
14 not be environmentally damaging, let us try to
15 discontinue doing it. That turns the whole question
16 all around; so that now instead of saying okay, "Let's
17 continue to dump material into the ocean until we
18 determine that it's environmentally damaging," now
19 we're saying, "Let's try to discontinue ocean dumping
20 unless we know it is not going to be environmentally
21 damaging." I think that philosophy pervades the
22 environmental mood that's taking place in the
23 United States over the past few years, and I think
24 basically that would be the philosophy of EPA.
25 Now, that boils down to the question of alternatives.

1 If you discontinue or try to discontinue doing something
2 because you might it might be environmentally damaging,
3 what are the alternatives; and then you boil down
4 to the nitty gritty of it of whether society is
5 willing to accept the consequences of not doing
6 something; but I think that our basic understanding
7 of the environment is so -- if you want to put it
8 this way -- lousy. We don't have a basic understanding.
9 As an example, Bob Thomann talks about coliforms and
10 talks about dissolved oxygen. That's fine. Those
11 have been the standard environmental engineering
12 indicators for water quality; but there are a whole
13 host of other elements that we have in water; and
14 we have very little understanding as to what the
15 impact on the environment is and what the impact on
16 the whole eco system is.
17 You can go back to water quality criteria and
18 try to determine what the relationship is between
19 levels of pollutants and the eco system; and I
20 think you'll find that our understanding of that is
21 so poor that we can't get realistic limits. We don't
22 know. We don't have ways of really monitoring
23 changes in the water eco system. As an example, I
24 think Bob Thomann would say that if you tried to monitor
25 the changes that occur in many marine environments

as a result of waste treatment being put into effect, we can't really monitor it because we don't know what parameters to monitor, and we can't monitor them in a sensitive way. We can't really see the changes in terms of DO. You might build a treatment plant and see no change in DO, or you might build a treatment plant and see no change in coliform; yet obviously there are changes that are occurring in our marine environment that we are not able to detect.

Frankly, I think until we start to really put our resources into finding out what some of the answers are, we have no choice but to say "Let's try to discontinue some of the practices that have apparently led us into the stage of environmental deterioration that we are in now."

MR. HARD: Are you talking about discontinuing for the sake of discontinuing?

FROM THE FLOOR: In other words, if you don't know what the effects of dumping hundreds of thousands of yards of material into the ocean environment are, if you can't reasonably understand what the impact of that is going to be, I say don't do it.

MR. HARD: By that same reasoning we would assume

1 that we wouldn't build a sewage treatment plant,
2 right, say for secondary treatment of Boston Harbor.
3 MR. IGNAZIO: That could put us in that box.
4 FROM THE FLOOR: That's right.
5 DR. KRONE: May I emphasize----
6 MR. IGNAZIO: You begin to see the iceberg we
7 have here.
8 DR. KRONE: I think answers to questions are
9 coming out pretty well, but I think the last point
10 that the gentleman from EPA made deserved the
11 attention of the panelists; because he points out
12 some very evident facts that we need to understand
13 nature better; but the conclusion he draws is
14 a difficult one I think for the nation to live with;
15 and that is that rather than say that any action
16 that we take should be investigated to determine the
17 consequences, he pointed out that some action should
18 be taken without investigation, and any others should
19 be investigated. The example you used, if we haven't
20 determined the effect of dumping of dredge spoils
21 in water, then we should stop doing it; but the
22 stopping or the disposal of dredged spoils in any
23 other way can be a harmful thing since it can harm
24 both the water that you had been dumping dredged
25 spoils in and harm wherever else you put the dredged
spoil.

For example, dumping the material that now exists in the inner harbor out in open waters where such material is a foreign substance seems, on the face of it, to be a harmful act to that new water that you are dumping it into and possibly more harmful than dumping it near the place where you found it. In other words, any action should be investigated, including changing from a present system. You can't say that some things are good and some things are bad without investigating the consequences of them as well; so that before any change in the present existing practices are made, the effects of those changes should be investigated so that the most economical and most effect -- that is, the change that will achieve the most with the resources that we have available -- is selected.

To drive home the point I'm trying to make, if we stop dredging harbors because they affect even in the worst case the fish life in the harbor, we would do that at the cost of stopping transportation into the harbor which has vast economic consequences. Even if we multiply the cost of dredge spoil disposal by ten, which happens in a number of harbor if the EPA criteria were strictly applied, that would have very serious economic impact; so that our ability to

1 afford environmental improvement or amenity improvement
2 actions would be diminished as a nation.
3 So we need to understand nature very well in
4 order to select those courses of action that we can
5 afford and that will lead to the objectives we want.
6 That's why I asked question zero. We need to know
7 our objectives and to apply our resources as best
8 we can to achieve them in the shortest possible time;
9 but to take action because it's good without
10 determining what its effects will be is irresponsible.
11 While I'm belaboring it -- and I hope to clean
12 it up at this time -- EPA criteria were used this
13 morning in your presentation as a comparison. We
14 have enough trouble with just nature, but complicating
15 it by criteria without foundation in nature makes
16 it more difficult for us to achieve our task. Those
17 criteria were decided by a group of people sitting
18 around the table who admitted they didn't know what
19 comprises polluted sediment. They just said, "If
20 they're above this, they must be polluted." The
21 difficulty is that the methods of analysis include
22 those that dissolve the clay minerals themselves,
23 that is, the natural erosion products of the land;
24 so that unless you know what particular clay minerals
25 exist in that particular harbor, there is no reason

to say that the zinc level should be 50 parts per million. I don't think any sample has been taken from San Fransisco Bay that didn't have more zinc than that because it is a part of the minerals that are being analyzed which brings me back to my first point.

Assigning blanket values to the nation's waters is, on the face of it, a lack of concern for the variability that exists from waterway to waterway and from sediment to sediment and circulation pattern to circulation pattern and biological system to biological system. There isn't an easy way of saying that sediments are polluted or not polluted unless you define what pollution is and what your objectives are; so I would like to keep our conversations headed to what our natural system is and how best we can achieve our desired goals and not get hung up on arbitrary standards.

MR. HARD: So would I.

FROM THE FLOOR: I think you ought to think that one of the key points that I made was that our understanding of the natural system is behavior and the response to pollutant levels is so poor at this point that we are really flying rather blind I think in terms of the criteria we're using.

1 DR. KRONE: But don't pull back on the wheel
2 until you know what's above you or push forward
3 until you know what's below you.
4 FROM THE FLOOR: But I think you're missing the
5 point that he made, that in the growth of this
6 country the idea was that we had to create jobs,
7 and that whatever you did to create jobs, the people
8 love that smell because when it smelled, they knew
9 their jobs were safe. The point is that we've changed.
10 The national policy has changed, and the responsibility
11 is now on the part of that person that when an industry
12 is developing a new product as part of the development
13 of that product they consider what they're going to
14 do with the waste, and they make sure they're not
15 going to create a problem; and if they are going to
16 create a problem, they don't produce the product.
17 It's that simple.
18 DR. KRONE: I didn't communicate clearly.
19 FROM THE FLOOR: No, you didn't because you
20 started zeroing in on this small thing. The dredging
21 is part of it; but I think the thing is much broader
22 than that. The point is that the national philosophy
23 has changed as demonstrated by the Congress; and the
24 point is that today you're at a point where, for example,
25 if people are smart enough to develop a synthetic fiber,

1 if a little more thought -- this is what the Congress
2 is saying -- if a little more thought is put into it,
3 they think they can figure out what to do with the
4 wastes that they create and not create a problem.
5 DR. KRONE: I think everyone in the room would
6 agree with that. No, I didn't disagree with that.
7 The point I made was that any change -- that is,
8 creating a new product as you describe -- the consequences
9 of that new manufacture and its effect on the environment
10 and on people should be anticipated before it is
11 installed; and I said similarly any change from
12 existing procedures should be investigated.
13 Some of them are obvious: toxic compounds can't
14 have a beneficial effect. Radioactive materials can't
15 have a beneficial effect. Some are not so obvious.
16 For example, the dredged spoil disposal problem,
17 I dwelt on that because it is a case in point,
18 reducing the turbidity of the water without first
19 reducing the toxic compounds in the nutrients can
20 have a very deleterious effect on water quality.
21 It can go from muddy to much worse; so it is not
22 a simple case of saying, "Let's reduce the toxics."
23 FROM THE FLOOR: Obviously this is a very
24 difficult problem; and I don't think anybody knows
25 the answer. The problem today, however, that you have

to face is that there are people today in high places in Government who are not scientists; and because the public is demanding this are taking the popular position; and it is sort of one-ups-manship; and the point is they are demanding things where it can't be achieved. There is no question, it seems to me, that what Joe said, that the new water pollution control law very definitely states that our objectives is for the provision of the recreational contact and a fish and wildlife in the area. That's what the objective is. Whether you can achieve it without chasing all of the people some place else is another question.

MR. HARD: That's the other meeting. I don't see how we can hold the scientific or philosophical scientific meeting and a political meeting and accomplish anything simultaneously.

FROM THE FLOOR: I'm not attempting to do that.

Mr. McGOWEN: Carl, Dr. Krone asked the question as to what the objectives were. He gave a list, and the first one was the thorough elimination of pollutants. EPA gave a statement, and it said essentially "Stop unless we know it won't be environmentally damaging," which is another way of saying the same thing. Before you go on to continue with the agenda, I would like to hear what the State would have to say.

1 MR. FERULLO: I'm Al Ferullo, Division of Water
2 Pollution Control. I think these are all fine
3 objectives, the water contact sports, fishing and
4 all of that; and I would think -- and maybe I'm
5 simple -- that before you start spending a whole
6 lot of money to solve a problem, you first define
7 what the problem is. You would first look at what
8 is causing the problem or the problems and then go
9 on from there.
10 Now, why can't we swim in the inner harbor
11 and various other sections of Boston Harbor?
12 What is wrong with the fishing? Are there not
13 enough fish? Is the Harbor really dead? These are
14 questions that should be addressed before attempting
15 to barrell through spending millions of dollars
16 on Boston Harbor; and I don't think we've discussed
17 it sufficiently here today.
18 MR. HARD: I think we're going to lead into it.
19 This isn't a morning meeting, Al.
20 MR. FERULLO: You're zeroing in at this point.
21 This is the bulls eye. You've been discussing around
22 and around it and not getting to the question.
23 MR. HARD: I'm going to ask Dr. Ryther pretty
24 soon whether he thinks species diversity is attainable
25 in the Harbor or desirable, and I'll try to tell him

1 something about the mud that's there. I know one
2 thing, that there's an awful lot of confusion among
3 the various people looking at the harbor as to what
4 constitutes sludge and what constitutes organic silt
5 and other natural items.
6 DR. RYTHER: I still think that the objectives
7 are a little fuzzy. In stating that you want to
8 improve the environmental quality and these cliche
9 expressions, you still don't define exactly what it
10 is you're trying to achieve; and it might be wise to
11 start thinking more specifically about what does
12 this mean. For example, there is the public health
13 problem; and I think everybody would probably agree
14 that this is one of the more important ones, with
15 respect to body contact sports or eating the shellfish
16 and so on.
17 Second is the esthetics problems which I haven't
18 heard much said about yet. Obviously nobody wants
19 to go swimming in a beach if the sand is all covered
20 with oil or the water is so turbid with sediments
21 and algae that it looks and smells unpleasant; and
22 that's really a separate problem from the public
23 health one.
24 Then the third one is this strange fuzzy area
25 of the eco system and diversity and so on; and here

again this is quite a separate problem. You can clean up an area to the extent where we reduce the fisheries in it and get very high diversity, if that's what you want. It looks nice; but probably it isn't very heavily populated with fish or shellfish. It is taking away most of the nutrients in the process.

If your objective is to get the esthetically most pleasing area such as you might find in the tropics, for example, or if you clean up all of the nutrients and you reduce the fisheries in the process. All of these objectives are not necessarily compatible. Where do you want to draw the line. How diverse do you want your population in Boston Harbor? Does anybody really care what the diversity of the bottom fauna is?

MR. HARD: I think that it's very nice that some of the regional planners are here because I have heard quite a few or read quite a few statements about what was going to be done with the harbor; and someday it was going to be a panacea; and I think that you're indicating that it is considerably limited and decisions are going to have to be made and a choice is going to have to be made for the future, is that correct?

DR. RYTHER: Right, yes; and I think it is a

1 choice of qualitative and quantitative; how far
2 do you have to go before this can be restored to
3 something which will please the people, and in
4 what direction do you want to move.
5 MR. HARD: I think it is pretty clear that the
6 State is investing money in purchasing islands and
7 projecting plans for camps all over the place
8 and water wells; and of course they're going to want
9 sandy beaches on the islands, and it might involve
10 some engineering problems. Are we going to be
11 drawing our water supply from the ocean in 30 years?
12 MR. IGNAZIO: There are some who think we should.
13 Jack, our sixth panelist, has just arrived. Jack,
14 we have a two-hour start on you.
15 DR. SCHAAKE: I'm sorry I had to be late.
16 MR. IGNAZIO: Each panelist has given a 15-minute
17 discussion of what they have done. It seems to me
18 if you would like to make your's now, that would be
19 pretty good timing. I think we would want to break
20 this at quarter of 12.
21 MR. HARD: We have only had two presentations
22 as such; and that was describing the work that had
23 been done. Dr. Schaake, you have a model of the
24 harbor?
25 DR. SCHAAKE: Well, everyone has a model of the

harbor. I'll just take one quick minute. A couple of years ago we were interested in the water quality problems in the harbor as part of a study of the possibilities for a new community development off of Columbia Point. That was proposed as part of the World's Fair/Bicentennial proposal; and that group was interested in the effect that their activities would have on the harbor and the effect that the harbor might have on their activity; so we looked at that problem. I don't feel that we studied this as deeply as we might have had we been an agency like this. We didn't collect any data of any substantial amount. We did go out in the M.I.T. boat and looked around at the Dorchester Bay. We had no systematic data collection program.

We did attempt to model the tidal dynamics with a hydrodynamic model of the harbor; and we did attempt to model the movement of pollutants through some transport type of model; and we did that with the aim of getting some coefficients that would be used in a mathematical programming model to indicate what kinds of improvements might be made either at Deer Island or at Nut Island or to the combined sewer overflows. I feel we looked at the wrong problem in the end after we got done, because we were

1 looking at essentially the dissolved oxygen BOD
2 type of thing and found that you had to make the
3 constraints extremely tight before you found that
4 you had to do anything; and then as we tightened the
5 constraints in the mathematical programming model,
6 we were able to see what kind of decisions would be
7 made.
8 Now, I feel that we learned some general things
9 about the harbor from that. The models are useful.
10 We have some improved models now that have been
11 developed since that time that have not been applied
12 to the harbor but have been applied other places but
13 would apply there. We have a group presently studying
14 the Massachusetts Bay area at M.I.T.; and they're
15 doing some modelling of the currents and of the
16 movements of various substances. This is part of the
17 Sea Grant Program.
18 They're looking at two models. One is a very
19 simple analytical model where they are attempting to
20 get an analytical solution to partial differential
21 equations in which they would account for two-dimensional
22 motions in space with an average vertical component;
23 and then they're looking at a finite element approach
24 to the thing too. That effort has really just gotten
25 under way.

MR. HARD: That's the thing that Mo Christiansen was working with the vertical movements of the buoys and so on?

DR. SCHAAKE: Right. That should summarize my part of it.

MR. HARD: How would you do it if you had it to do over again?

DR. SCHAAKE: Well, I think we need to look at the biological processes there. I think we need to be a little more clear about what we are interested in trying to do there. I think that the bacterial problems were important. I think if you want to talk about swimming that certainly water quality, turbidity and esthetic things are important; and I think we need to spend a lot more attention worrying about other sources of waste input than the ones that come from Nut Island and Deer Island. There is a whole area around there with many hundreds of htousands of acres of drainage from the cities. The whole Neponset River System comes in there, the Charles and the Mystic Rivers; and I think that a combination of the hydrologic and water quality things should be looked at.

We did attempt to do this. We have a catchment model that can handle the hydrologic part of the thing.

And we modelled the Neponset River System. There is no USGS guage there; and we have another model that we have developed that doesn't require that kind of data to use it, and we applied that to it; but to use that kind of thing, you have to add the ability to move the pollutants through the catchment. The state of the art there is to know how to do that. There may be some people who feel they can. We don't have a real good feeling for that.

MR. HARD: Nobody has mentioned nitrogen yet.

MR. IGNAZIO: Do any of the panelists want to ask any questions of Jack?

DR. THOMANN: I wanted to comment on one of the other comments that was made before Jack came in. The notion that our understanding of natural behavior is very poor, and in general I would be the first to agree that our understanding of the fate of pollutants is very poor, toxic chemicals and trace organics and so on; but I don't conclude from that therefore that there isn't sectors of natural behavior that we understand quite well. What I am saying is for those sectors of the natural environment and its behavior that we understand quite well, for those sectors, let's go through the procedures that you're suggesting, look at the consequences of different alternative

1 control actions, fully keeping in mind that there
2 are many sectors that we don't know quite well and
3 in fact we might be totally ignorant of, for those
4 we know well, let's analyze the problem on that basis
5 and continue and see how well we can apply that
6 knowledge to the achievement of specific objectives.
7 I would submit in this case a very high priority
8 is water contact recreation which we talked about.
9 We don't know anything or everything about natural
10 behavior with respect to that water use; but we know
11 sectors of natural behavior. Some of them are
12 related to public health, and some of them are
13 related to sediment. Let's proceed with that at
14 least fully recognizing that there are unknowns.
15 DR. KRONE: Since I got us off on this, may I
16 suggest that we proceed from the philosphical to the
17 pragmatic?
18 MR. HARD: Is Question number 1 pragmatic enough?
19 DR. KRONE: Wait just a minute -- and list
20 for the purposes of our working session here Dr.
21 Ryther's objectives as being in the desirable order.
22 It does seem pretty evident that public health
23 ought to be number one.
24 MR. HARD: Yes, I like that one at the top.
25 DR. KRONE: I don't know whether esthetic or

1 biological would come in next; probably esthetics.
2 In the case of biological I don't think we can resolve
3 that question here of whether diversity or productivity
4 is more important. I have my own opinion as I am
5 sure most of us have.
6 As far as the objectives of a study is concerned,
7 we should perhaps leave that question open to be
8 resolved when we work out the other aspects.
9 MR. HARD: Yes, I think we can meet it coming
10 in the back door.
11 DR. KRONE: Where do we draw the line? I would
12 like to leave that also to the limit of our ability
13 to achieve the best we can with the resources we
14 have available. I think that's going to happen to
15 us; so if we can agree on those objectives, perhaps
16 we can move on to the rest of it.
17 MR. HARD: Let's ask the panel if we can agree
18 on it.
19 DR. SCHAAKE: I would like to comment on the
20 question of objectives and how they might be handled
21 in a rational way. The proposed principles and
22 procedures that have been prepared by the Water Resources
23 Council for water resources planning, if they are
24 accepted, acknowledge that we do in fact wish to plan
25 for more objectives than a simple economic efficiency

type objective and objectives relating to environmental quality and social well being and legitimate and important objectives that should be accounted for in the planning process. This is fine and noble, and we agree to that.

The difficulty comes when you try to do that and do it in a systematic way. This requires that one think clearly enough about what they are to develop some accounting systems for whether or not you have in fact for a given alternative achieved a certain level of improved contributions towards these different objectives.

I feel myself since we have been interested in this problem at the Institute in our program and have attempted to apply the multiple objective criteria to a number of different projects now, that in fact in this case one could identify certain water quality parameters associated with various kinds of goals. There are techniques that exist now that I think would apply here to make it possible to amphasize certain goals over certain others and look at the kind of alternatives that would seem to be preferred for that set of weights on the goals if you will or preferences. In other words, esthetic quality for swimming as compared to how much it costs.

1 There are some tradeoffs there, and one can deal with
2 those tradeoffs invery systematic and explicit ways
3 privided one is willing to engage in an exercise of
4 what one means by those different goals.
5 We need indices, if you will, that in fact
6 measure the contributions toward these different goals.
7 So one of the things I think would be worthwhile to
8 do would be to explore some of the kinds of indices
9 that would make sense. If you want to talk about
10 water quality for bathing or for swimming and for
11 water contact recreation or if you wanted to talk
12 about water quality in terms of oysters,-----
13 MR. HARD: If I could interrupt at this point,
14 I think we're getting into an area that I hadn't,
15 at any rate, planned on, because I think you're talking
16 planning, and I'm here because I'm a geologist, and
17 I don't have any particular axe to grind.
18 DR. SCHAAKE: Where this leads to though is
19 that a variety of kinds of -- if you want to call
20 them models or approaches -- are needed to do that;
21 and you always have your options open, it seems to
22 me; but it is important I think to try to identify
23 some of the indices so that when you engage in this
24 modelling effort, when you engage in the question of
25 data collection, that you are in fact moving towards

1 a rational planning goal.

2 MR. HARD: Now that I have so many modelling

3 people here all together, the term "model" has become

4 the bain of my existence since I heard about the

5 waste water study. Dr. Krone said that we can't

6 go into these areas of the actual effects because

7 we don't have enough knowledge; and this is the

8 problem that I want to attack here; and the purpose

9 of this is to get a knowledgable panel together and

10 see how much weight we should give to the models as

11 opposed to the actual physical investigations; and

12 we have already admitted I think that we don't have

13 sufficiant data. I know at least three who have.

14 DR. SCHAAKE: I agree.

15 MR. HARD: That's my axe. I just don't like

16 fantasizing. I would like to hit what scientific

17 investigations we need. I want to go back to

18 question zero. Let's get the information we need.

19 We can't understand Boston Harbor until we know a

20 lot more. Let's make the best effort. Let's find

21 out how to distinguish between sludge and ordinary

22 silt. I think I can offer a very simple method

23 tomorrow or this afternoon, and let's find out where

24 the sludge is and where the organic silt is and

25 whether nature intended the organic silt to be there

1 and whether we should strive for species diversity,
2 and if we feed these oysters that we have on our
3 rafts Boston sewage, are they going to poison us.
4 I don't know whether I did anything to your question
5 zero.
6 DR. KRONE: You just shot me down. I think, Carl,
7 just to maintain perspective or a different perspective
8 and in defense of models, we'll never have all of the
9 knowledge we would like to have; and models allow
10 us to put togehter what we have and make the best
11 use of it. What we need is more and then to put
12 that into the model and to continue to develop the
13 models with additional information; but without models
14 we'll just have a book of data.
15 MR. HARD: Which we're drowning in here too.
16 DR. RYTHER: I think we would get bogged down
17 if we start worrying about indices and standards
18 and things like that; but what we ought to be
19 looking at first, it seems to me, is criteria, what
20 are the general criteria you're striving for and how
21 do you assess public health and esthetics and so on.
22 MR. HARD: We have to go back to our study team
23 and to the State. I can't answer that.
24 DR. RYTHER: Well, I think we can develop some
25 ideas as we go along.

1 MR. IGNAZIO: Criteria from EPA is coming up.
2 (Laughter.)
3 FROM THE FLOOR: Let me say something about criteria,
4 and this reinforces something I said earlier about
5 our understanding of the behavior of the aquatic
6 system. A few years ago there was theoretically a
7 great step forward in the publication of national
8 water quality criteria called Green Book; and there
9 were a lot of numbers in that green book and it
10 theoretically provided a basis of a step forward to
11 try to identify criteria for specific water uses
12 and to relate them; and everybody felt comfortable
13 that we were really making some progress.
14 Recently that book was subject to revision or
15 proposed revision, and the so-called Blue Book is
16 going to come out. I don't know what the Blue Book
17 revisions are going to be, but from what I have heard --
18 I should note also that the Green Book was done primarily
19 by a group of applied scientists, if you want to
20 call them that, very pragmatic types; and they were
21 willing to put something down to get the numbers and
22 to get the Green Book printed because therewas a
23 great urgency at that time, because the whole national
24 program was predicated on the standards and criteria.
25

1 Now, we went through the revisions for the Blue Book,
2 and it was done by the National Academy of Sciences-
3 type people. My understanding is that many of the
4 numbers that were put in the green book as being
5 reasonably good numbers, the Blue Book now kind of
6 places some tremendous shadows over those numbers
7 and suggests we really don't know as much about these
8 numbers as we thought we did when we published the
9 Green Book. That means it appears that we are regressing
10 instead of progressing. I'm not sure.
11 MR. HARD: We're getting a lot of color into it
12 anyway.
13 FROM THE FLOOR: Again I think the underpinning
14 of the whole Water Pollution Control effort if we
15 are going to approach it on a rational basis so that
16 we know what we're doing in the environment, are these
17 basic criteria, the response of the natural systems
18 to various levels of pollutants; and I would be the
19 first to admit that I think we are not expending
20 anywhere near the amount of resources that we
21 need to be on that sort of thing. We're willing to
22 spend hundreds of millions of dollars on waste treatment
23 plants; but nowhere near that amount on the basic
24 research.
25 MR. HARD: If you look around, you'll find a lot

of work being done that just doesn't get publicized. I think the work at the Milford Laboratory and the National Water Quality Laboratory and Sandy Hook, these programs are essentially launched and underway. The short-term studies have been completed, and they found out they can't tell, and now they're on the long-range studies where they're breeding their own monsters.

FROM THE FLOOR: There's no question about that. It is symbolic to me that the National Marine Water Quality Laboratories which was supposed to have been built in Kingston, Rhode Island several years ago still has not been constructed and is in limbo. I can't see that that's consistent with an overall national program to clean up the rivers in a systematic and effective way.

MR. HARD: That is a national problem, I'm sure; but we here in New England are addressing ourselves to approaching it the way we think it should be. We have always been sort of an independent bunch up here in New England; and we have noticed in the dredged disposal area that we're sort of leading the pack; and I think we should on this t-o. But the idea of some bureaucrat setting up standards when he doesn't know a damned thing about what he's talking about and

then imposing those standards so that it affects society and has severe and immediate impacts is very very disconcerting.

FROM THE FLOOR: I think you have to take the point of view of the bureaucrats and the Legislators, because I think they are completely and totally frustrated with the scientific community, rightly or wrongly, because they haven't come forward with the answers that the Congress and other political leaders felt were needed. We're developing environmental programs by administrative fiat.

MR. HARD: I think you and I ought to carry this on over a drink. It's that time.

MR. IGNAZIO: We don't serve that kind of beverage here, but I was going to suggest we come back close to 1:00 o'clock.

(Whereupon, at 11:45 o'clock a.m., the conference was recessed until 1:00 o'clock p.m.)

AFTERNOON SESSION

MR. IGNAZIO: In the interest of our schedule, ladies and gentlemen, you have all had a chance to enjoy our food here; and I'm sure this afternoon's session is probably going to surface a lot of the questions that might have been in some of your minds as the panelists were talking.

I really don't wish to completely deviate from the agenda; but certain points have been surfaced to me during the lunch break; and some of the audience felt that if they had a little bit more participattion that we might speed up our overall meeting goals; and of course there are at least two people in the group that are not going to be here tomorrow, Dr. Thomann and Frank McGowen and Mr. Klashman. Lester used to be Regional Director of EPA, and these types of people I would certainly want them to offer their perspectives of what we're trying to do here. I hope that we will go until 4:30 today.

As I tried to outline in my remarks a little while ago, a lot of people are looking to us here, the bureaucrats or whatever you want to call us who know the score; and we're going to spend a lot of money. We've spent a lot of money already in a lot of departments. The burning question that seems to

be before my eyes is we don't want to let them down. We want to be able to stand and say in the future that this money was spent in the best possible way to get the most out of it; and recognizing all of the inefficiencies that we now have, the models we now have and the desires for more informaiton and this big question of getting on with something, recognizing all of these limitations and then finally standing before the public and saying, "Yuh, you told us you wanted your children to swim just like you did, and we cleaned up all the combined storm sewers and made better treatment plants; but you still can't swim." I'm hoping that that doesn't happen after all of this effort is expended.

Now, to lead this off, I would just start with one question: Is Boston Harbor polluted? It's a simple question. Some of us here have had the benefit of reading the proceedings, the third proceedings of the enforcement meeting; and certain things surfaced clearly at least to me. I would like to start off by getting some attitudes.

Is Boston Harbor polluted? This morning we heard one model which says that it is certainly as far as DO and coliform. Things aren't too bad except when you get into confined areas where the

1 storm sewers do their deed.

2 So with that in mind, unless Carl or the panel
3 wants to suggest another kickoff point, in my mind
4 or my understanding of this whole question, it is
5 as follows, that Boston Harbor is in fact polluted;
6 that perhaps the biggest single thing on the
7 priority scale is the combined storm sewers; that
8 there are a lot of troubles with tidegates which
9 apparently aren't functioning properly and certain
10 amounts of salt water are corrupting certain activities
11 at the primary plants we now have.

12 When I listen to the large amounts of heavy metals
13 that have been surfaced by Dr. McCleod's work and
14 Dr. Thomann's, I can't help but feel that Boston
15 Harbor is in fact polluted. It gets to the point
16 that if we were to stop the pollution and to stop the
17 combined storm sewers and improve the secondary
18 plants or primary plants, whatever we have, what are
19 we left with? Are we left with a body of water
20 that is going to be able to do certain things for
21 us?

22 I think we still want you, the panel, to work
23 a two-way street; but especially those people who are
24 not going to be here tomorrow, don't feel bashful to
25 raise your hands. Let's start this afternoon's

1 session, and I'll sit down for a while.

2 FROM THE FLOOR: I would like to make one point.
3 I think Joe's question is not fair of anyone who
4 has not become completely familiar with all of the
5 studies and reports that have been generated on Boston
6 Harbor; and I wish we were able to have them all here
7 today; because I think they would make a stack on the
8 floor up to the top of the table. I think it's very
9 unfair to the panel members to try and discuss specific
10 questions on the Boston Harbor without having had the
11 advantage of studying all of these. I know that the
12 Corps at this point in their studies have not had a
13 chance to read them.

14 To answer your question "Is Boston Harbor Polluted,"
15 I don't think any of us could answer it unless we
16 have read all of this data. It was our point that
17 the recent data goes back five years of extensive
18 water quality surveys in '67 by EPA and another one
19 in '68 by the State, Water Pollution Control Studies,
20 Department of Public Health Studies. Then we got
21 into the special studies, a mathematical model
22 development which Bob Thomann explained very well.
23 I think the only comment I would make on that is that
24 the reason for using the mathematical model approach
25 is because we had so much data. It was a very complex

problem; and the only way to make use of all of the data we had and planned to generate was by this approach.

This has been a very large effort for three years, cost-wise probably an expenditure of $150,000. A second study from our viewpoint is the one that Guy McCleod mentioned on his work, basically a monitoring effort, a toxic metals survey and a biological model.

With all of these put together, plus all of the conference reports, there is a heck of a lot of information.

MR. IGNAZIO: Do you think, for example, when we sent certain information to the panel, we recognized we were taking them from some distance, and some of them were completely unaware of the dimensions of our problem here; but we did send the third proceedings because we thought this would kind of bring them up as quickly as possible to an awareness of the large amount of studies which you rightfully note have been done. I think most of the panel people did get this. If you do get any time on your planes and trains, try to read this. I know it was an enormous help to me. I don't understand everything that is going on in Boston as far as the water quality; but I thought it

1 made it quite clear to me that Boston Harbor is
2 polluted; and if I was to set up certain priorities,
3 combined storm sewers would be very high. The tide
4 gates would be very high on the priorities. What
5 the MDC is trying to do on the sludge is very high
6 on the priorities.
7 What I am trying to point out is this: if we
8 spend X millions of dollars to accomplish that, what
9 am I left with? Am I left with a model that says
10 certain things about surface velocities when in fact
11 I don't know the true answer of the bottom velocities?
12 This is what I'm getting at. That's why I raised that
13 question.
14 Now, anybody else, please feel free. This is
15 much like waiting for a baby. You don't know what
16 is going to come; but you know you 're going to
17 love it when it arrives.
18 (Laughter.)
19 FROM THE FLOOR: I wonder if I can ask Bob
20 Thomann to answer that question as to what you're
21 left with in Boston Harbor if you solved the combined
22 storm sewer problem and the sludge. What quality of
23 water would you have?
24 DR. THOMANN: I think on the present water
25 quality criteria as they exist and recognizing that

1 just saying we're going to solve the combined sewer
2 overflows is a very very difficult problem. We can't
3 just wave our hand and say "goodbye." Assuming that
4 we could and given the present water quality criteria,
5 I think there would be a substantial increase in the
6 potential use of Boston Harbor by the general public
7 from the point of view of bathing and from the point
8 of view possibly of shellfish.
9 MR. IGNAZIO: Certainly bathing you feel would
10 be?
11 DR. THOMANN: Yes. The impact on the biological
12 system is uncertain. We have not dealved into that
13 problem in any depth.
14 MR. IGNAZIO: What about the esthetics?
15 DR. THOMANN: You are in essence eliminating
16 the raw sewage discharges.
17 MR. IGNAZIO: What about the scum and the oil
18 and other aspects?
19 DR. THOMANN: Well, unless there are oil
20 discharges from industrial plants.
21 MR. IGNAZIO: I understand there is 4,000 gallons
22 of oil a day that gets in there from some place.
23 DR. THOMANN: I think that's a potential problem.
24 FROM THE FLOOR: I think the 4,000 gallons of
25 oil originated from Guy McCleod, and I think he was

1 talking about oil that gets through the MDC treatment
2 plants and the combined sewers, is that correct?
3 DR. McCLEOD: That's correct.
4 FROM THE FLOOR: All right, so whatever gets
5 through the combined sewers would be eliminated; but
6 there is a lot of oil coming down the inner harbor.
7 There's no question about it from the saturated
8 shoreline. That can be addressed in a different
9 way.
10 DR. THOMANN: I think in terms of maximum
11 impact on improvement of water use in Boston Harbor
12 from the public's point of view, that the route
13 that you suggested is the way to go: combined sewer
14 overflow control, elimination if possible; chlorinatinn
15 of the effluents. Now, the heavy metals problem is
16 a separate problem at least in our mind of an
17 industrial discharge or discharges. As I discussed
18 with some of the people at lunch, I don't see that
19 as a terribly scientific problem in the same category
20 as some of the biological problems we talked about.
21 That is largely an enforcement problem. Toxic metals
22 have a deleterious effect in my view, and the question
23 is one of complete elimination as opposed to the
24 tradeoffs that one has in organic wastes.
25 MR. IGNAZIO: What would be your concerns about

1 the sludge that's already on the floor of the harbor?
2 DR. THOMANN: I haven't seen any hard evidence
3 to date except for the first comments this morning
4 on upset of the benthic population. I haven't
5 seen any hard evidence to date that that has been a
6 problem in the same priority level as the combined
7 sewer overflow problem. I'm not denying in any way
8 that it is not a problem. All I think about when we
9 talk about these problems is a hierarchy of problems.
10 DR. RYTHER: Can we go back for a minute and
11 ask a question about what the correction of the
12 combined sewer overflow problem, if you correct it,
13 what is it supposed to correct? What will it correct?
14 What will it do?
15 MR. IGNAZIO: Eliminate the loads that are
16 coming in.
17 MR. McGOWEN: It will drop your coliform count.
18 DR. RYTHER: Is that a reliable index of anything?
19 MR. FERULLO: Along with the storm water, the
20 term "combined sewer overflow" is implying a mixture
21 of storm water and sewage, so you are getting a
22 certain percentage of raw sewage every time it
23 overflows and all of the materials that you find in
24 raw sewage. It is essentially discharged untreated.
25 Whatever is in the raw sewage is out in the harbor.

DR. SCHAAKE: How much of a pollution problem is simply the urban runoff which comes from the vast area around Boston?

MR. IGNAZIO: Pretty bad from what I understand.

DR. SCHAAKE: When you talk about cleaning up the combined sewer overflow in Dorchester Bay for example, you have the whole Neponset River coming in there too.

DR. THOMANN: I went through the effects of that before you came. There is another slide which shows our estimated effect of the river contributions. Outside the Neponset itself, I think we calculated somewhere around or upwards of 1,000 plus coliforms per 100 ML, just due to that runoff alone.

DR. SCHAAKE: That's the concentration?

DR. THOMANN: Just due to that runoff.

DR. RYTHER: I was under the impression that coliform bacteria are not a very reliable index of public safety. Chlorination doesn't affect viruses for example; and it is the virus problem that's really the critical one here; and just chlorination of primary treated sewage isn't a very great step forward.

MR. FERULLO: I would like to comment on that. There is no data on the virus count, if you will, at

1 the bathing beaches. It is implied that if the coliform
2 count is 1,000, then the virus levels and concentrations
3 are not or would not be harmful. There is no great
4 epidemiological evidence. This is a concern certainly.
5 DR. RYTHER: I think there is really good evidence
6 now that viruses are not killed at the same rate
7 that coliform bacteria are.
8 DR. THOMANN: That's correct, and that's why
9 I carefully phrased my response and prefaced my
10 response by saying given the present water quality
11 criteria under which these beaches are now closed.
12 MR. IGNAZIO: In other words, you don't have
13 a virus restriction.
14 DR. THOMANN: That's right.
15 DR. RYTHER: But I think there are two ways of
16 looking at this: one, complying with standards,
17 and the other is making it safe for people to swim
18 in it.
19 MISS JOHNSON: I would just like to say I have
20 done an extensive survey of viruses versus chlorination
21 and whether or not chlorination does in fact
22 eliminate viruses or deactivate viruses; and it has
23 been proven in a number of research efforts that
24 chlorination does not effectively eliminate or
25 deactivate viruses.

1 DR. THOMANN: At the levels we're talking about.
2 MISS JOHNSON: Certain viruses, depending on the
3 type, have different resistances.
4 MR. KLASHMAN: But at the levels of chlorination
5 we're talking about. The point is that chlorination
6 will affect the viruses of a secondary effluent
7 if you put in enough chlorine; but you have to put
8 in so damned much chlorine that----
9 MISS JOHNSON: That's right, and even certain
10 methods such as radiation will not even remove some
11 of them until you get to the very high level. I think
12 when we talk about coliform, we have to keep in mind
13 it is not really that reliable an index.
14 DR. THOMANN: You know, that's often said, and
15 I agree; but if you gave me a choice of swimming
16 in water of 100,000 per 100 ML coliform or 1,000 per
17 100 ML coliform, on the basis of no other information
18 I would make the judgment that the 100,000 would be
19 a substantially increased public health risk to me;
20 and it is simply on a preventitive public health
21 basis that the State has set those standards.
22 MISS JOHNSON: But it is also a known fact that
23 even when coliform are within considered safe limits
24 of may 300, that you can also have an epidemic
25 break out when the coliform is at that level. I think

1 we have to keep that in mind.

2 DR. THOMANN: Yes, absolutely.

3 MR. HARD: If you reduce the turbidity in the

4 harbor by cutting down the sewage, you have better

5 sunlight penetration, and the coliform die off a

6 lot faster, don't they?

7 DR. RYTHER: I doubt that, because they would

8 only be killed by ultraviolet, and that doesn't

9 penetrate water.

10 MR. HARD: I have some literature from the

11 Sewage Institute of Great Britain where they

12 had actually hard data on the death rate of coliform

13 from the ocean outfalls of the British Isles. They

14 seem to be very very consistent and a lot of data.

15 These are fairly recent papers.

16 DR. RYTHER: I haven't seen them.

17 DR. SHAAKE: This would suggest that somebody

18 should be looking at the whole virus issue then.

19 MR. IGNAZIO: One of the things I am looking

20 for, even though we're going to do the best job

21 we can with the tools we have, is some sort of a list

22 of what are the gaps that we're missing.

23 DR. SHAAKE: The way you asked your question,

24 it seems to me you can do some of the things to

25 eliminate the symptoms and not eliminate the problem;

1 and in addition to that, you may even eliminate
2 part of the problem by rather expensive diversion of
3 those present overflows to some remote place; and
4 at the same time not change things substantially
5 because that urgan runoff is reported to be pretty
6 bad stuff too; so that the Charles and the Mystic
7 and the Neponset still are going to drain into the
8 harbor; and unless you divert all of that, you still
9 have that there. The question is, is what you're
10 left with -- well, are we going to understand
11 what we're going to have, and then we can decide
12 whether we want to spend the money to actually carry
13 out any alternative; but the virus issue would seem
14 to be a paramount thing. What can be done there?
15 DR. THOMANN: That's a research area.
16 MR. IGNAZIO: We're saying there is a piece of
17 work on virus research.
18 DR. THOMANN: Absolutely.
19 DR. RYTHER: A lot of people are working on
20 monitoring viruses in coastal waters now, and there
21 are techniques being developed for this. I think it's
22 important to utilize these techniques as quickly as
23 they become available.
24 MR. McGOWEN: At lunch I was talking to Bob
25 Thomann, and I asked him about what other kinds of

1 parameters did he look at to conclude that the
2 primary one to control was coliform organisms;
3 and indeed he had looked at the OD and COD and solids
4 and according to his results we really don't have a
5 pollution problem in terms of DO; we don't have it
6 in terms of BOD; we don't have it in terms of COD;
7 we do have it in terms of coliforms which are
8 correctible if you attack the storm overflow problem.
9 The question I would like to ask of Dr. McCleod
10 is how you would reconcile that with the condition
11 you observed of very little diversity in the bottom
12 sediment. Is it coming from -- Dr. Thomann says we
13 only have a limited degree of pollution that we can
14 control; and what you said about the condition of
15 the bottom sediments would indicate to me that
16 we have a more substantial pollution problem than
17 that. How do you reconcile these two?
18 DR. McCLEOD: I think you have to consider three
19 areas: the inner harbor area up to this point and
20 then consider this is the outer harbor to the Deer
21 Island and then out. You have three different
22 biological conditions.
23 Then you also have to look at this at least
24 as a two-dimensional system where you're looking at
25 the water down to the point of the water sediment
interface and the sediment itself. I agree with

1 Dr. Thomann. We have taken dissolved oxygen measure-
2 ments over in here, and this shows that the harbor
3 area in this region is supersaturated with respect
4 to dissolved oxygen throughout most of the year. It
5 exceeds normal saturation at the height of the fall
6 bloom and the spring bloom. In the summer it drops
7 slightly below saturation; but you're dealing with a
8 whole area in here which is some 10 parts per million
9 dissolved oxygen which is well within these standards.
10 MR. HARD: Well, you're right in the channel
11 itself though.
12 DR. McCLEOD: No, I'm talking about this whole
13 area here from Deer Island down to the whole Dorchester
14 Bay.
15 In the inner harbor you have a different problem.
16 You have the river runoff; and you have an anerobic
17 condition in pockets where the dissolved oxygen
18 even at the surface is 2 to 3 parts per million
19 at certain times of the year, particularly at the
20 onset of the summer months. I think the point is
21 that we have calculated the productivity of these
22 areas based on the effluent discharge and the
23 assimilation rate from Deer Island, taking Marty
24 Weiss' figure of 300,000,000 gallons per day; and
25 if you look at the productivity of this area, this

1 turns out to be 30 micrograms of carbon, and this
2 turns out to be about 25 micrograms of carbon.
3 What this means in terms of this whole area
4 is that it's a moderately-productive embayment
5 with respect to phytoplankton only. The amount of
6 effluent discharge from the plant is rapidly being
7 taken up by the biological population that is present
8 at the first level of phytoplankton algae.
9 In this area it is much more utrified, and you
10 get different types of things. Now, when you start
11 considering what's happening on the bottom, this is
12 quite a different situation from what's happening
13 in the first 20 to 30 feet. In terms of turbidity
14 and micromeasurements, this is a consistent
15 area with respect to the depth of light penetration.
16 In this area you can put your hand beneath the water
17 and lose sight of it.
18 So we have two problems here. One is if you
19 consider just the effluent discharge from the plants,
20 then you're meeting all of your standards, and you
21 have a productive population in the upper layers of the
22 water; and by upper layers, I mean from say one foot
23 down to 15 or 20 feet; and we're talking about a
24 total area of average depth of 40 feet. You have
25 the phytoplankton that haven't bloomed in the fall

1 but will bloom in the spring, and this has a productivity
2 classified as moderately productive area embayment.
3 You have a large (culpapod) population acting
4 as preditors; but the material that is dropping down
5 in the sediment does two things. One, you have an
6 accummulation here, and we're trying to study this,
7 and our estimate are vague. It is one-tenth to a
8 centimeter per year; but you have in this whole
9 area an extremely limited biological population.
10 Some of the things that startled us in our work
11 with tunicates, Mrs. Ladd found that although they
12 do incorporate vanadium, they release a large amount
13 of vanadium back into the water; so this is flushing
14 vanadium in and incorporating some of it in their
15 own tissue, but even more startling is that they
16 are flushing it right back into the water column
17 again. So vanadium, which can come from oil and
18 which can come out of the effluent and out of the sludge,
19 could indeed go from the bays and go into the
20 tunicate and be flushed out again. If you do cut
21 off some of the discharge, the question I would
22 wonder about is what are the transport problems between
23 your sediments on the bottom and your water column.
24 If you cut this off, this means you're going to reduce
25 in this whole area the available nitrogen. What is

1 going to be the effect of bringing back into the
2 water column some of these metals. Does that answer
3 your question?
4 Mr. McGOWEN: I want to keep going with you for
5 a little bit. I'm trying to figure out where the
6 source of the pollution is that is causing the bottom
7 condition that at least the way you say it strikes
8 me as being a rather polluted situation or a bad
9 situation. Now, if we correct the coliform problem
10 by attacking combined sewage overflows, do we also
11 correct the problem that might be causing your low
12 species diversity on the bottom of the harbor? If
13 we do that, then does that define for us the pollution
14 problem that we should be attacking, or do you have
15 something else in mind that is causing the rather
16 poor bottom condition that we should be attacking
17 other than the combined sewage overflow?
18 DR. McCLEOD: I'm never quite sure when you say
19 you're going to take care of the combined sewage
20 overflow whether you are also considering urban
21 runoff in this and whether you have some way----
22 MR. McGOWEN: Anything that gets into the
23 storm sewer.
24 DR. McCLEOD: Do you have some way of the sludge
25 magically disappearing.

1 MR. McGOWEN: Assume it.

2 DR. McCLEOD: Then you still have two feet of
3 accummulation that you have to get rid of and the
4 possibility of that going back and forth between
5 the water/sediment interface and the water column,
6 and it's still a problem.

7 Mr. MCGOWEN: Let me ask you a question. Assume
8 that you can eliminate the storm water overflow.
9 Assume that you are not going to put the sludge in.
10 You can calculate how long it will take that material
11 already on the bottom to decay naturally. You will
12 know whether you are talking about a few years of
13 putting up with this condition or whether you're talking
14 about decades.

15 MR. IGNAZIO: It's an important answer.

16 DR. McCLEOD: He's assuming two things will happen;
17 one, that you will have a natural decay or biological
18 decomposition, and the other thing is that you are
19 going to have part of these metals rendered insoluble
20 in complex somewhere in the bottom. Okay fine. We've
21 been working on trying to get an estimation of what the
22 rate of decomposition is on the bottom. We haven't
23 got the estimate yet. If we had to guess, probably
24 ten years, and that would be to clear up say from the
25 water/sediment interface down to some 10 or 15
centimeters. Below that you do have complexation.

1 MR. McGOWEN: What I'm trying to get at, Bob
2 Thomann says we don't have a pollution problem that
3 we can't take care of. We can take care of the thing
4 that is causing the coliform problem. We don't have
5 to worry about the BOD, the COD and the solids; we're
6 going to have good DO. If we can take care of the
7 coliforms, fine. Now we're worrying about taking care
8 of the problem that you would be experiencing on the
9 bottom. Now, if correcting that condition takes
10 care of the coliform also takes care over a period
11 of time the problem that you would be experiencing
12 on the bottom, then that would channel us toward
13 the kind of solutions we should be considering designing;
14 namely, correcting the storm water and sewage
15 overflow and eliminating the sludge from going back
16 into the harbor. If you did that and it takes care
17 of your bottom problem over a period of time, we
18 could attack more immediately the water uses that
19 Bob Thomann is getting at; and maybe that's where
20 we should put the money and the resources we've got
21 in designing solutions, as opposed to talking about
22 secondary treatment or advanced waste treatment or
23 something else at Deer and Nut Islands.
24 DR. McCLEOD: If I rephrase the question, you're
25 saying if you solve all of the problems, you won't

1 have a problem.

2 MR. McGOWEN: Just two of them, the storm water

3 overflow and the sludge. I'm not talking about

4 vanadium in the water at Deer and Nut Island.

5 DR. McCLEOD: If you corrected those two problems,

6 my best estimate would be ten years.

7 Mr. McGOWEN: Bob, if we corrected that problem,

8 when would you estimate that we would fix up the

9 coliform? Would we have beaches in five years?

10 DR. THOMANN: Well, I'll play the game; but I

11 think, as you pointed out, Guy, the order of magnitude

12 of the engineering work that you're talking about

13 is gigantic.

14 MR. McGOWEN: I agree, we still have other

15 engineering work, like what we're going to do at

16 Deer Island and Nut Island and with industry.

17 DR. THOMANN: Okay, let's play the game. If you

18 shut off all of the combined storm-sewer overflows

19 and somehow did something with all that and discharged

20 someplace else, not where they're discharging now,

21 from the point of view of coliforms in the overlying

22 water column, about three days.

23 Mr. McGOWEN: Again recognizing or assuming that

24 we're going to take this combined sewer overflow

25 and eliminate it from going raw in but run it through

Deer and Nut Island for primary treatment, let me impose that condition on it too.

DR. THOMANN: You're asking a lot of "if" questions, which are exactly the kind of "what if" questions we ran.

MR. McGOWEN: The reason I'm asking them is because we have to commit a lot of money to some solutions here in the next year.

MR. IGNAZIO: That was question number 1.

DR. THOMANN: We have given estimates on what we think would happen if you eliminated the combined sewer overflows, storm sewers and runoff, chlorinated at the Deer Island and Nut Island plants and took care of the sludge. That estimate indicates that as far as coliform bacteria are concerned, within a very short period of time -- I'll hedge my bet -- a week. If you shut things off, it only takes a certain period of time to flush it out, decay away, and you're okay.

MR. McGOWEN: You're still maintaining the position that the BOD and the COD and the solids are not going to give you a problem as they come out of Deer and Nut Island.

DR. THOMANN: That's right.

MR. McGOWEN: What about things like refractor

1 organics and nutrients? Is there any reason to
2 start to consider these things? If we do, we have
3 to start to think about AWT processes at Deer and
4 Nut Island.
5 DR. McCLEOD: Well, you still have a complex
6 mixture in your sludge if you're going to flow that
7 out. You have chlorinated hydrocarbons there. There
8 are a number of different ones. You have a number
9 of exotic substances. I think the nutrients are less
10 of a problem than we first imagined.
11 MR. KLASHMAN: Are you talking about in the
12 sludges or in the effluents?
13 DR. McCLEOD: The sludges. He was talking about
14 primary treatment.
15 MR. KLASHMAN: But the sludges are out. The
16 sludges are taken care of. Go on from there.
17 DR. McCLEOD: In your effluents, if the MDC
18 system continues to operate as it does and you have
19 industrial discharge into the MDC system, you are
20 going to get a spectrum of industrial compounds, and
21 you'll get your hydrocarbons; and just from your
22 runoff you're going to get hydrocarbons as well.
23 The nutrients we would consider less of a problem
24 because we feel in that outer harbor area, as we define
25 it from Deer Island and the Dorchester Bay area, it

is essentially nitrogen limited.

Mr. McGOWEN: Do you consider them a problem at all?

DR. THOMANN: No, we don't.

DR. McCLEOD: Not at that point.

MR. McGOWEN: The biological systems that you're looking at, you don't consider nutrients to be a problem that somebody ought to be concerned about here in designing waste water treatment?

MR. HARD: How about esthetics?

DR. McCLEOD: The flow out from Deer Island, if you get there at the right moment, is unpleasant.

DR. RYTHER: I can't challenge it on evidence, but it seems unlikely to me that the nutrients would not be a problem, and it doesn't matter whether it is a primary or secondary treatment in that case, because you're still going to get the nutrients, and they will create plankton blooms at least locally; and these can be esthetically displeasing.

DR. SCHAAKE: Did you look at the future wasteloads or just the present?

DR. THOMANN: Future as well.

DR. RYTHER: I would like to comment on the sludge problem. I'm not familiar with the situation here; but in the New York Bite where the sludge is dumped,

1 this is a highly localized situation, so localized
2 in fact, that our divers had difficulty finding it
3 when they dove from our ship. Around the edges of the
4 sludge dumping grounds, the bottom fauna was extremely
5 rich and diverse and very healthy, and the same thing
6 is true in Los Angeles areas. It's very highly
7 localized.
8 I can't believe that the bottom conditions
9 throughout Boston Harbor result from that sludge.
10 I think it's something else doing it. Maybe it's
11 organic sedimentation through the whole area, and maybe
12 this is going to happen whether or not the area is
13 receiving any pollution or any sewage at all.
14 This is something we don't know much about. We don't
15 know what the sedimentation rates are naturally and
16 we don't know enough about the circulation yet and the
17 flushing rates of the bay to know-----
18 MR. FERULLO: Much of the sludge accummulated
19 in Boston Harbor is a result of maybe 80 years of
20 discharging raw sewage into Boston Harbor; and we
21 can't attribute all of that accummulation to the
22 sludge that has been discharged from Deer Island for
23 three or four years. This is where we can say that
24 the sludge has accummulated or the source of the sludge
25 when you talk about two or three feet. That stuff

has been accummulating for a long long time; because before the treatment plant was built, sewage was discharged into the harbor untreated.

MR. HARD: I indicated to you that I have heard considerable confusion over the distinction between sludge and organic silt in the harbor. So I scribbled out a little something here if I can put it on the board.

The annual sediment load of the Charles River based on Bob's formula, which is of dubious value, but that's all we have, gives us 10,000 cubic meters per year. On that basis a rough estimate of the total terrestrial deposition in the harbor is of the general magnitude of 17,000 just based on the relative size of the water sheds going in there. If the harbor area is roughly 21 x 10^6 square meters, then deposition rate in the harbor has averaged 0.08 centimeters per year. Sea level has been stable for approximately 3,000 years; hence terrigenous holothurian deposits would average 2.4 meters of silt. The silts became organic through biological activity and overlie inorganic glacial silts where unconsolidated sediments underlie much of the harbor bottom. The holothurian organic silts can be distinguished from overlying or mixed anthropogenous

1 deposits, sludge; but on the basis of carbon/nitrogen
2 ratios relating to total volume of solids with respect
3 to general order of magnitude roughly so. This is
4 total volatile solids over the nitrogen/carbon ratio
5 which will give you approximately a ratio of 0.5
6 which would be equal to a normal harbor mud nitrogen
7 condition.
8 Now, if you have this relationship here T V S
9 over C over N greater or equal to 5 -- this is 5.0
10 now -- this would indicate your negative valence 3
11 nitrogen condition or the reduced state which would
12 indicate your sewage; and this would be verifiable
13 by correlating T K N with your total nitrogen.
14 Now, I think we ought to find out which is the
15 harbor mud and which is the sludge and map it and
16 find out where it is going with a circulation study,
17 find out how much is in suspension through studies
18 of the suspended sediments, analyze its particulate
19 matter for the metals, and then we can tell what is
20 happening in the harbor. Otherwise we're going to
21 kick this thing around and around in circles.
22 DR. SCHAAKE: Once we do that, what's the next
23 step?
24 MR. HARD: It's up to your decision makers then.
25 They'll tell you what's happening.

1 Mr. McGOWEN: For example, if we could come to the
2 conclusion now that sludges are not a desirable
3 thing to have in the harbor,-----
4 MR. HARD: I'm not sure how much sludge is
5 in the harbor. We have to find out which is the
6 sludge and which is the organic silt.
7 MR. McGOWEN: Why? So we can design systems to
8 remove one or the other, right?
9 MR. HARD: You're not going to devise a system
10 to remove the inorganic silt. That silt is 30 or 40
11 feet deep in places.
12 MR. McGOWEN: If that's it, that's what we're
13 stuck with.
14 MR. HARD: I don't think you've got a sludge
15 problem or an organic silt problem. I think you have
16 a turbidity problem and a nutrient problem.
17 MISS JOHNSON: I would like to ask a question.
18 What if you eliminate your heavy metals through
19 pre-treatment and you continue to put your sludges in
20 the harbor or maintaining the nutrient level that you
21 now have? What if you do that? How will that affect
22 your biology in the harbor?
23 MR. KLASHMAN: You know, I don't understand
24 what you're getting at in all of these theoretical
25 discussions when you know that the very least you're

1 going to have to do under the present law is to put
2 in secondary treatment in these systems. You know
3 you're going to have to take the sludges out. There's
4 agreement on that. Why bang it around? What you're
5 really concerned about is do you have to do any more
6 than that. Do you really have to go to advanced
7 waste treatment some time; and if you do, when? This
8 is what you really have to do; and all of these
9 discussions are leading nowhere. I think if you
10 could address this, it would be much more productive
11 because no matter what you come up with here, the
12 MDC is going to have to take that sludge out. As
13 a matter of fact, you have already signed agreements
14 on this.
15 MISS JOHNSON: What if they find it is unreasonable
16 to take the sludge out and eliminate that amount of
17 nutrients? What if in fact studies find that that
18 is not the thing you have to be doing?
19 MR. KLASHMAN: I'm telling you that they're
20 going to have to do it. The point is you can come
21 up with all of the theoretical arguments you want
22 that there is absolutely no sense to taking that sludge
23 out. There is absolutely no sense to putting in
24 secondary treatment. It doesn't make any sense, and
25 they're still going to have to do it. What is more

1 important is and what I would be concerned about if
2 I were the MDC, are they going to make me do any more.
3 Am I going to be all right for the next 40 years?
4 The point is that that's the point you have to address;
5 and this other question that you're raising, you're
6 just betting your heads against a wall.
7 DR. SCHAAKE: I want to know why, if it is not
8 going to change anything to spend $400 million or
9 $500 million, it isn't important to know that.
10 MR. KLASHMAN: Read the law.
11 DR. SCHAAKE: The law changes every year. If
12 it's going to cost a half a billion dollars to do
13 nothing-----
14 MR. KLASHMAN: Have you followed the New York
15 City situation? You have a situation that answers
16 your question right there where they have had plants
17 designed that supposedly would answer their problems;
18 and they have been forced at the expenditure of
19 vast sums of money to go higher, because politically
20 there is no other way to do it.
21 DR. SCHAAKE: Your point is good. The law says
22 you have to do it, so you plan to do it; but the law
23 changes; the process changes; and if we start spending
24 a half a billion dollars here and more than that in
25 New York and more than that in San Fransisco, people

are going to get tired of spending that with getting nothing back.

MR. KLASHMAN: Why don't I reword this another way. I think the priorities of this discussion should first hit -- suppose you had secondary treatment. Are you going to have to put in an advanced treatment? Having answered that, then I think if you could answer this other question, that would be fine; but the question that the Corps and the MDC is hit with is they know they have to do this. They're going to proceed with it.

MR. HARD: The way this meeting was conceived initially was we were going to call in these people whom we consider experts for the prime and sole reason of counselling us so we would be equipped with the facts, and we're still at that embryonic stage. We're not at the enforcement level at all or the design stage.

DR. THOMANN: That's a valid point. The point is there is another "what if" stage or level. What you're suggesting is let's raise the level of discussion. What you say is correct. Secondary treatment is going to have to go in and something is going to have to be done with the sludge; and I'm willing to accept that point; and I-----

MISS JOHNSON: Is that a contract, or is that the law, because the law doesn't state "secondary treatment."

1 The law states that all alternatives have to be
2 considered. Is that a contract or an agreement or
3 is that the law?
4 MR. KLASHMAN: You haven't read the law!
5 MISS JOHNSON: I have read the law.
6 MR. KLASHMAN: Then you don't understand it,
7 and you haven't read the agreements that they have
8 with EPA.
9 MR. IGNAZIO: Let's hear Dr. Thomann out. Assume
10 it is the law.
11 DR. THOMANN: Assume it is the case. Even though
12 we could provide an awful lot of information that
13 would indicate the effect of secondary treatment,
14 I would guess or estimate at this stage of what we
15 know about Boston Harbor thatif you put in secondary
16 treatment, one, you wouldn't see anything happen in
17 terms of increased water use. You may see changes in
18 suspended material in the harbor because you're
19 reducing some of the suspended loads in the secondary
20 plant. You may see a slight improvement in oxygen
21 as I pointed out in the inner harbor, a couple of
22 tenths of a milligram per liter maybe, maybe even a
23 half a milligram per liter; but in terms of increased
24 usage of the harbor by the public at large, I
25 don't think you would be able to detect it. It's

a guess on our part. That's point number one.

Point number two, in answer to your question "Does MDC have to go any further than that," I would say admittedly these are first preliminary run-throughs on the kinds of models that I explained this morning. When you look at the total nitrogen and the total phosphorus coming out of that plant on the 1995 load, I don't think anything more is going to happen; so that advance waste treatment will probably not produce any significant changes in water use. You will be able to go out and measure things, but I don't think you'll see any significant changes in water use.

MR. FERULLO: I would like to make a comment. I don't think anybody in his right mind would propose nitrification and denitrification at Deer Island and Nut Island in the first place. In the second place, I would like to see Miss Johnson's question answered. Let's take advantage of the experts we have here. I thought, Dr. Krone, you wanted to say something about it.

DR. KRONE: I think Miss Johnson has put her finger right on it. First of all the question was asked a few minutes ago about the sediments and the fact they seem to be deleterious and are limiting the species, and it needs to be answered further; and I would like

to begin there and lead into her point.

The material on the bottom is the result of all of the past experience that that bottom has had. So what you see on the bottom is not necessarily a steady-state situation but rather an accummulation with subtractions from it with biological decomposition going on in it. Very large amounts of material can be supplied to the system from runoff and from overflow during storm periods that will show up on the sediment and will hardly been seen in the water system from sampling surveys on the surface of the water.

So the sediment shows things that happened, even if they happen for a short period of time; whereas a sampling program, unless it was carried out during times of high waste discharges, might not show them.

The second point that was brought out in your presentation this morning is that there are heavy metals in the sediment material and heavy metals in the sludges. That, combined with the very small numbers of species observed in the harbor, in spite of the presence of large amounts of nutrients material, organic material and inorganic nutrients per 1,000, indicates that there are very toxic compounds in the system. We have large numbers of nutrients and no life which means there is something that is killing off

1 all of the species that are not tolerant to the
2 toxic compound.
3 You mentioned one organism that can disspell
4 vanadium. I don't know whether or not other organisms
5 can disspell vanadium; but I know that the requirements
6 by algae for copper and zinc and some of the other
7 compounds are very low and that larger amounts don't
8 necessarily help them and higher organisms suffer
9 from higher metals.
10 I would say that from a biological standpoint,
11 from improving the biological system, the number one
12 priority ought to be eliminating the discharge of
13 heavy metals from a biological point only. I haven't
14 talked about the public health or amenities yet.
15 Doing that would do two things. It would allow desirable
16 organisms to live and survive and allow the system to
17 better accommodate large amounts of organic material,
18 natural decomposition and multiple trophic levels; so
19 that seems like a simple thing to do in concept; but
20 it is something that can be done without an awful lot
21 of studies which seem to be one of the things which
22 is of concern.
23 The second point related to the sediments in your
24 questions about what needs to be done first have to do
25 with amenities and public health aspects. I'm not

1 putting any priority on these because we haven't
2 established one.
3 Discharge of raw sewage to my knowledge are always
4 deleterious to the public health qualities of water,
5 and the discharge of raw sewage from sewers contains
6 both greases and esthetically undesirable compounds
7 and large amounts of coliform organisms and viruses as
8 well as nutrients; and they are in a visibly undesirable
9 form if they accumulate on the beaches.
10 I would say that another thing that needs to be
11 done immediately is to control the discharge of raw
12 sewage from the system, even if it is only ephemeral
13 discharges of raw sewage. I'm talking about large
14 expenditures of money; but I think much more valuable
15 expenditures than secondary treatment on the two
16 large plants, and these would control or improve
17 immediately as shown by the models studies the utiliaa-
18 tion of the water from the standpoint that we have
19 heard about today.
20 Now, I would like to address myself to the point
21 you made that we are going to have to put in
22 secondary treatment plants no matter what. I don't
23 know. I think much more highly of our government officials
24 than that would indicate. I think if we had to do
25 one or another, if it were recognized that one was

far more beneficial than the other legislatively.

MR. FERULLO: As far as you know on the third conference this has been discussed and we lost, so it is a political decision as far as I am concerned to go to secondary treatment, not an engineering or technical one; and the MDC is going to secondary treatment. EPA has held back the funds for all construction in the MDC system and forces the MDC to go to secondary treatment.

MR. HARD: Yes, but Al, don't you have to write an environmental statement?

DR. SCHAAKE: At the same time you plan that, wouldn't it be helpful to look at the case for what the impact as you say----

MR. FERULLO: As the third conference showed, the officials of EPA testified there was no need for secondary treatment. This was a law over and above reason that was generated by politicians who decided to hold back the funds, so the MDC has no choice but to go ahead with the plans for secondary treatment.

MR. KLASHMAN: Have you in California been handling it in a different way that we don't know about?

DR. KRONE: Our problems are just as bad as yours.

MR. KLASHMAN: Are you able to get the primary

1 plants built and yet get the funds for the interceptor
2 sewers to solve these problems? Are you able to
3 solve that there?
4 DR. KRONE: The decisions yet haven't been made
5 there. The studies are still in progress.
6 MR. KLASHMAN: But you must in the whole State
7 of California have situations like he was talking
8 about where you have to put in these very clostly
9 interceptor sewers; but in order to get the funds
10 to put in the interceptor sewers, you have to have
11 what is known as an acceptable waste treatment facility;
12 and the acceptable waste treatment facility by
13 definition, is secondary treatment; and so if you don't
14 have the secondary treatment, you don't get the inter-
15 ceptor sewers.
16 DR. KRONE: The difference between Massachusetts'
17 and California's problems in this regard is that it
18 is more a political one really than a scientific
19 one. Our water quality control program began in 1949
20 at the impetus of the state.
21 MR. KLASHMAN: This one started in 1890.
22 DR. KRONE: And they required for the discharge
23 into most of the waters of the state that primary
24 plants be installed in 1949 so that except for a
25 few bad ones like San Fransisco, for example, which

1 has a storm drain problem like your here but a very
2 different hydraulic situation, the primary plants
3 and many many secondary plants -- in fact, I know of
4 only a few plants that aren't on the coast that are
5 not also secondary plants.
6 MR. KLASHMAN: The question is can you maintain
7 the primary plants and still get money for these
8 interceptors? That's the question that----
9 DR. KRONE: Under the current EPA----
10 MR. KLASHMAN: Yes. Incidentally, I know the
11 answer to my question is what it is. You're doing
12 the same thing there they're having to do here.
13 DR. KRONE: Well, San Fransisco is still in the
14 throws of trying to find a way to solve their combined
15 sewer problem.
16 MR. KLASHMAN: That's not the same problem exactly
17 as this with the inner bay there. I mean that's a
18 separate problem of itself.
19 DR. KRONE: Well, that's more like Boston than
20 any other part of the state.
21 To finish up what I was saying before I got
22 off on that, the observations that there are fewer
23 species of algae in the inner harbor but larger numbers
24 of them, isn't that further indication of presence
25 of toxic compounds?

1 DR. McCLEOD: I think in the inner harbor, yes;
2 because we do find, even though it is in parts per
3 million, we do find concentrations of the metals;
4 and they are deleterious to the growth, and it becomes
5 resistent in the outer harbor. Maybe 20 or 22 different
6 species of algae can be identified. This is a little
7 harder to answer in terms of metals because we have
8 a lot of oil. We have a runoff, and we have some fresh
9 water there, and we have multiple problems here, so
10 we can't identify lack of growth.
11 DR. SCHAAKE: I would like to ask Bob about the
12 toxic thing. Bob, if there were toxic substances
13 present in the harbor and that affected the biological
14 activity, would you change your mind about the
15 conclusion you came to? Does your report or your
16 study or the methods you used rely in any way on data
17 that was collected on the processes that would have
18 been affected by the toxic substances, so if you
19 eliminate the toxic substances, would it change your
20 view of what you would need to have in the way of
21 advance treatment systems?
22 DR. THOMANN: No. We did not address the inter-
23 action of toxic substances and phytoplankton growth
24 in Boston Harbor.
25 DR. SCHAAKE: Was it implicit in your technique?

1 Did you use any kind of measurements of----

2 DR. THOMANN: No. What we did at this

3 particular point in time was to essentially route

4 through the system total nitrogen and total phosphorus

5 and compare that to other areas that we have modelled

6 with the biological model that examines the behavior

7 and interactions of nitrogen and phosphorus,

8 phytoplankton, chlorophyll and so on and drew some

9 inferences from that. The nutrient question, for

10 example, does not appear from the information to be

11 one of the discharges of sludge at Deer Island and

12 Nut Island. That's only about 10 per cent of the

13 nutrients coming out of the Deer Island and Nut Island

14 area. Most of that is in the effluents itself.

15 We looked at the harbor not terribly nutrified, if

16 one compares it to other areas around the country.

17 Chlorophyll concentrations, for example, are probably

18 less than 10 micrograms per liter in the outer harbor

19 and maybe up to 20 or 25 in the inner harbor. Compare

20 that, for example, to something like the Potomac

21 which is classified as a utrified estuary where

22 concentrations of maybe 200 micrograms per liter

23 are found.

24 The system I guess -- because we didn't analyze

25 the problem -- would be that the system is probably

more light limited although the question of toxicity of metals on phytoplankton is still an open question; but it is probably light limited to some degree, maybe even to a good degree.

DR. SCHAAKE: I guess my concern is ----

DR. THOMANN: I can't answer the question. I can't answer the question.

DR. SCHAAKE: To get a management program to do one thing may cause the whole thing to change.

DR. THOMANN: Yes, and I can't answer that question in any definitive way.

DR. SCHAAKE: What should be done to find out the answer to the question?

DR. THOMANN: If you wanted to try and take an estimate or a stab at that question, I think you would have to do some modelling of the biological system, the interaction of two or three nutrient species with phytoplankton growth, with light extinction, with the transport fluxes and so on, interacting with some estimates of metal toxicity on phytoplankton growth.

DR. SCHAAKE: Do you feel that these issues are worthy enough to or questionable enough to make it worth the modelling effort?

DR. THOMANN: That gets back to the objectives.

The reason I'm hedging is I can't precisely now in view of the Corps' objectives place that problem in a proper hierarchy of problems that have to be looked at. I say it is certainly a problem that should be looked at; but where and what priority it has and that's because of the uncertainty of the objectives.

DR. KRONE: Your decay constants include toxicity.

DR. THOMANN: Yes, you can factor it in there, right.

DR. RYTHER: If it is true that the phytoplankton growth is light limited due to the turbidity of the water and you go to a more advanced treatment and reduce the turbidity, you are liable to get it right back in the form of algae.

DR. THOMANN: That's if the turbidity is due to the effluents.

DR. RYTHER: Right.

DR. McCLEOD: We have done measurements of light penetration with respect to intensity and wave length from 380 to 750 nanometers from the Charles River out to Dorchester Bay. In that area of the outer harbor our one per cent limit is around 22 feet. All bets are off as far as the inner harbor area is concerned. That is definitely light limited; and the predominant wave length is 585 -- no, 645 nanometers

1 MR. NEWMAN: It seems to me from the discussion
2 that's going on, we are reaching some agreement as far
3 as if you want to call it an agenda for action for the
4 Boston Harbor. First of all, it seems to me that
5 toxicx in terms of priorities are number one.
6 Sombody ought to do something about controlling
7 toxicx; and something is being done to some extent
8 and how effective that will be through the MDC I am
9 not sure how effective or how vigorously they will
10 pursue that.
11 But in any event, in terms of trying to deal with
12 the most pressing problems of Boston Harbor, I
13 think we could agree that that's number one.
14 Number two seems to be the question of the
15 combined sewer overflows; and I think that probably
16 we could reach the concensus that the combined sewer
17 overflow problem is the second greatest problem after
18 toxics; albeit at the moment there is some action
19 to try to alleviate the overflow problem; albeit that
20 is a very limited program because of lack of financial
21 resources.
22 In any event, that's number two; and perhaps
23 there is a lot of work that needs to be done additionally
24 on the overflow problems; and the third things that
25 we may reach agreement on is the possibility or the

1 requirements for additional treatment, whatever that
2 might be, at either Deer Island or Nut Island or both,
3 and the question relating to that.
4 DR. THOMANN: Were you offering a third one
5 as a concensus item also?
6 MR. NEWMAN: Yes. I would offer that as a concensus
7 item that we ought to look further into what additional
8 treatment, if any, is needed in terms of the treatment
9 plants.
10 MR. FERULLO: Where does secondary treatment fit?
11 Number three?
12 MR. NEWMAN: I am not prejudging that secondary
13 treatment is absolutely essential or perhaps tertiary
14 treatment is needed. I am not saying that's our
15 position. As a body, taking amongst the experts
16 that have made statements, that's the way I interpret
17 it. That's not my position or official EPA's
18 position.
19 MR. HARD: I wish we could disconnect the plumbing
20 from the science somehow and talk about the harbor
21 a little bit more.
22 MR. NEWMAN: The plumbing may not be exactly
23 what you're interested in, but I think that the people
24 here, the gentleman to my right, has a mission to
25 accomplish, and he wanted to try to find out some

answers from people who hopefully will provide him with the answers.

MR. HARD: I am interested in the environmental statement on the phase 2 plumbing.

MR. NEWMAN: Well, the final point I want to make is if we could reach a concensus on these three agendas for action, then the question is how do we go about getting programs to move forward on these three priority items in a rational way.

MR. HARD: Well, I think the rational aspect was brought up by Dr. Krone before when he talked about changing without knowing. I think we ought to study the harbor; and it hasn't been done. There are a lot of studies on the harbor, AE type studies, scientific studies; there was the in-shore study program in 1949 or thereabouts where Woods Hole people were involved. As far as I know, that's the only solid bit of oceanographic data that has been collected on Boston Harbor. There have been buoys largely for technological research placed there. I think Christiansen discovered that there was no ideal place to put a buoy. No matter where you put it, you have the wrong results.

We just don't know the circulation of Boston Harbor. We don't know the suspended sediment load. We don't know what the suspended sediments consist

of. All we have is some knowledge of what is going out of three big pipes and a whole lot of pipes we can't even locate. We know something about the geology of the harbor; we know something about the thickness of the sediment; and we know how much of the sediments should be derived and we don't know where the sludge is going. We don't know what happens to it. Viruses is an area for research as Dr. Ryther indicated and he wished we could stay on top of the thing.

If we're going to talk about contaminants being discharged into the harbor after the sewage, we're still going to have a polluted situation, and the only way to tell is to run turbidity studies under storm conditions and compare them with the background conditions and identify the nature of the material in suspension. Until that stuff is done, as far as I'm concerned, this is an amateur hour as far as I'm concerned.

MR. IGNAZIO: Does anyone want to challenge that?

MR. McGowen: It seems to me we have a problem with pollution, and it doesn't take a lot of scientific study -- just by inspection you know that you have a pollution problem. It has been articulated very well that we have a toxic problem. Where is that coming from? It is coming from our industries. We have a

problem with our beaches. That's indicative of the bad material coming out of our combined sewage overflows, and there may be lots of other things causing the condition on the bottom.

It seems to me we can pinpoint that as a source and attack it. What we do at Deer and Nut Islands is up for debate. That is being debated, and while the material that will come out of the bottom muds can be examined under scientific study, it seems to me these other items which are rather clear, you can almost identify them by inspection, are worthy of consideration right now, not of study but of solution.

MR. HARD: I think what you're saying is that you are setting outer limits now. You're framing the obvious things that you know, the outer limits.

MR. McGOWEN: They are not only obvious; but they are very dominant.

MR. HARD: I guess that's what I really meant when I said "obvious." Now, are we going to stop at that level of sophistication, or are we going to find out how the harbor actually functions?

MR. McGOWEN: I sure as hell would object to saying we need more scientific studies.

MR. HARD: You know, I've been working for the Corps of Engineers for over 23 years, and I've been

1 dealing with civil engineers all this time; and ten
2 years later they come to me with the realization
3 that if they had done some of this more sophisticated
4 research that things would have been a lot better.
5 MR. IGNAZIO: Marty, your hand was up. You're
6 one of the biggest polluters here. Let's hear from
7 you.
8 MR. WEISS: Let me say in this joint study we're
9 doing, we're addressing just about all of the problmes
10 that have been talked about. Number one, we have a
11 preliminary engineering report being done on the
12 elimination of sludge discharge into the harbor; and
13 that is going to be done in about five months.
14 Number two, in the studies that we are doing
15 jointly with the Corps of Engineers, we're addressing
16 the problems of toxic metals by getting into new
17 sewer ordinances, particularly for the industries.
18 We're also going to have an inventory survey done
19 of all of the industries in this area, which includes
20 120 cities and towns.
21 The third thing is that we are addressing the
22 problem of the combined sewer overflows. We're going
23 out with an all-out effort to get at the quantity
24 and the quality of what these discharges are. Maybe
25 it's the concensus of the panelists here that maybe such

1 an oceanographic study isn't needed.

2 DR. SCHAAKE: What is the range of choice that

3 you have for say controlling the combined sewer

4 overflows? Do you have the choice of simply

5 picking them up and moving them from Dorchester Bay

6 area over to the inner harbor, for example, and making

7 things a lot worse in that spot, and then you may

8 have the alternative to do something else that would

9 have some other effect for some other number of

10 dollars.

11 MR. WEISS: Well, we don't know what the number

12 of dollars are on solving the overall problem; but we're

13 going to be looking into about eight alternatives.

14 MR. HARD: Where are you going to dump the

15 additional sludge? That's my problem too in many

16 instances. The permits come in here to dump them

17 in the ocean. I don't know where you're going to

18 dump them on land unless you utilize them. How

19 do you know you're not going to end up with a couple

20 of ocean outfalls outside of the harbor?

21 MR. WEISS: For sludge disposal we're looking

22 at three alternatives. One is incineration; and

23 the second is intermediate wet air oxidation; and

24 the third is land disposal.

25 MR. HARD: Why aren't you looking into deep ocean

1 outfalls?

2 MR. WEISS: Well, for one reason, we applied

3 for a permit from the Corps of Engineers, and they

4 returned it.

5 (Laughter.)

6 MR. KLASHMAN: Regardless, you should spend the

7 money to do the study because you can go to the

8 Congress and get them to change the law.

9 (Laughter.)

10 DR. SCHAAKE: We're going to send you down to

11 represent us to change the law.

12 MR. IGNAZIO: He's retired, and he knows the

13 ropes.

14 MR. KLASHMAN: The point is, I have never heard

15 such naive views expressed, and to think that you

16 can do something under the present system. Here

17 these guys have some real problems and ----

18 DR. SCHAAKE: We've had our hands full, and

19 you've been saying that for some time, Lester.

20 MR. KLASHMAN: You talk about changing the

21 system. Why don't you look into the priorities.

22 Why don't you handle the storm water first instead

23 of doing the stuff on the secondary treatment? The

24 poor guy doesn't have any choice. No matter what

25 he comes up with, for you to say "Oh no, that isn't true;

because the laws are going to change," that's nonsense; and if you don't realize that, you're going to have troubles.

MR. HARD: I guess you don't know where the Boston Tea Party started.

MR. KLASHMAN: I was born here too, son.

(Laughter.)

DR. KRONE: May I respond to the gentleman from EPA? I think he was right on the track. He was suggesting a concensus of an action agenda to control the sewage discharges, and I think the third one was to consider secondary treatment.

MR. NEWMAN: Whether it be secondary or tertiary or what.

DR. KRONE: Laid on top of these is something you alluded to that us civil engineers do too; and that is, in order to know how you're going to do these things and which ones need the priority, which one actually comes first, does require additional study. I think probably what we'll spend the rest of our meeting discussing is how to go about determining them.

There is a study in progress by the State, is that correct?

MR. FERULLO: We have several.

MR. IGNAZIO: Generally one overall study that's

1 made up of a combination of talents between the
2 State, the MDC and the Corps of Engineers.
3 DR. KRONE: So we should be addressing ourselves
4 to the design perhaps of a study that will most effec-
5 tively indicate the way these things should be done
6 in addition to all of these other activities and
7 that will further meet the objectives of water uses
8 beyond elimination of toxicity and immediate public
9 health problems, and that is to make the area
10 productive of things which will require better
11 knowledge of the system. In fact, I don't see how
12 you can contemplate anything responsibly, even as a
13 lawyer or a Legislator in Washington, without knowledge
14 of the system you're affecting; and that's the note
15 I opened up on this morning.
16 Unless you know what you're dealing with, even
17 these obvious things can be dealt with in a too
18 expensive way. Sure, I said we should eliminate the
19 heavy metals. I believe that. That's a desirable
20 thing to do; but there are many ways of doing it and
21 it seems just keeping them from coming into the system
22 and that is providing some other disposal. What is
23 the other disposal scheme going to do? How is it
24 going to affect the rest of the system? These have to
25 be decided on on the basis of knowledge of nature, not

1 just because I want it done in the next session of
2 the Legislature.
3 The studies you recommended are necessary to
4 implement the priorities or the objectives that he
5 indicated.
6 MR. HARD: It seems that way to me.
7 MR. IGNAZIO: You view them as a parallel thing?
8 DR. KRONE: On top of them. It seems to me that
9 it is pretty hard to say that either heavy metals or
10 raw sewage discharge, that one is more important than
11 the other. They are both really important: BUT
12 it is necessary to learn -- let's take the simpler
13 example about the interceptor. You can't just put
14 plugs in the ends of those sewers. Something has
15 to be done to accommodate the need to dispose of that
16 sewage. Now, there are a lot of alternatives; and
17 a conventional study will show some various interceptor
18 sewer arrangements. It has to lead somewhere, and
19 there has to be an additional plant or additional
20 capacity put on the plants, which I understand are
21 overloaded already; so the question of where it
22 should go, which plant it should go to or whether a
23 third plant should be built or whether a third plant
24 or additional plants should be built up the watershed can
25 only be decided on with adequate knowledge of the

1 system. I think establishing these actions as
2 desirable here requires more than that. It requires
3 that we say how we're going to do it, and we can't
4 say that. We have to say what we need to know to
5 find out.
6 MR. McGOWEN: Tell us the additional studies
7 again? You mentioned one of them. I don't know that
8 I got you. I can make a distinction between analytical
9 studies and design studies. I would just like to
10 know what studies they are that you're talking about.
11 DR. KRONE: Well, they're neither. By analytical
12 studies, if you mean just a model study or considering
13 alternatives or a desk study, we need to determine the
14 behavior of the system, the estuary and the land-
15 draining system, the runoff system and the collection
16 system and the bay system or the harbor system in
17 enough detail so that we can predict the effects
18 of alternate disposal schemes on those systems and
19 find the one that will give us our desired objectives
20 at a cost we can afford.
21 MR. McGOWEN: There are two different viewpoints
22 put forth today. Bob Thomann put one of them forth
23 that he has got a mechanism for understanding this
24 system such that we can identify certain things as
25 problems, correct them, and then we'll be able to

1 detect a change through his model.

2 Another point was made that there is so much about
3 a natural system that we don't know and so much about
4 the natural behavior that we don't know; but to my
5 mind, we don't have enough time to really do the
6 studies that might be necessary to understand the
7 impact of everything we do.

8 DR. KRONE: I think what he said was that we
9 do have a lot of things that we know and that we have
10 put together and where we have reached some conclusions
11 from. For example, those regarding dissolved oxygen.
12 There are additional things that haven't been determined
13 that need to be determined and put together so you can
14 make some of these decisions; and I don't think the
15 time -- I don't know what kind of time-frame you're
16 operating in, but if it's less than a year, I'd be
17 very surprised. That's what we're here to discuss
18 today.

19 MR. KLASHMAN: If I understand the question that
20 he is raising is hitting right at the storm water,
21 for example. One alternative would be to build an
22 interceptor way out ten miles and then dump it; but
23 the question he is raising is would that be the best
24 thing for the system to do that or should there be
25 something else. Is there some other way you should

1 handle that that you haven't thought out clearly?

2 DR. THOMANN: That's what Frank means by design.

3 MR. McGOWEN: Let me ask you, would you be willing

4 to suggest that what we do is perhaps go through a

5 few cuts of preliminary design or proposing alternatives

6 and then take our natural system and then determine

7 what kind of studies you would have to do to determine

8 the effect of those alternativeson the natural system,

9 or should we just go in a different sequence looking

10 at the natural system we have to work with here; namely,

11 the land in which the materials originate and the water

12 into which it is going to go. Should we just do

13 scientific studies of those two masses, or should we

14 really wait for our scientific studies until after

15 we have had cuts at what the alternative studies

16 would be? What would you suggest?

17 DR. KRONE: Based on my own experience, limited

18 to one person's experience, that it is far more

19 productive to describe the system, those aspects of

20 the system that are important to the design you're

21 discussing or the entire area of concern rather

22 than to consider a certain few objectives by themselves

23 or a certain few alternatives by themselves. You

24 might be overlooking a real opportunity. The cost

25 isn't that much more.

DR. THOMANN: In this I would generally agree. However, in this case, as I have implied most of the day and in contradistinction to your position, there is a three-foot stack of reports that have been written on Boston Harbor. NOAA has occupied any number of current metering stations -- maybe not in the detail that you want -- but we're not totally ignorant of what is going on in Boston Harbor.

MR. HARD: I feel I am, and I would be after seeing the data.

DR. THOMANN: That might be so. You might be; but what I am suggesting is that that's not the case totally. We know a fair amount of what is happening in Boston Harbor.

MR. HARD: You're not afraid when we go out in the field and get the numbers, they're not going to agree with yours, are you?

DR. THOMANN: Absolutely not.

MR. HARD: I'm quite serious. I'm not putting you down because you put me down, because I set myself up for it; but I'm thinking of some of the remote sensing experiments that have been going on. I won't name any specific ones because there is a record; but where I have an oceanographer going out out in a boat and taking measurements and then a guy

1 flying overhead taking the same measurements; and they
2 pick up the top card and they say "What number have
3 you got?" This is the guy in the airplane. This
4 friend of ours was feeding numbers to the guy
5 in the airplane for quite a while; and then he said,
6 "Well, let me see your numbers first." That's all
7 they had to do with each other. I think we need
8 some hard oceanographic data on Boston Harbor.
9 DR. THOMANN: I was answering the question of
10 Frank McGowen that in view of the fact that there
11 is information available on Boston Harbor, that my
12 answer to your question would be to do both.
13 There are a class of problems that are ready for the
14 design-type studying of looking at alternatives.
15 In fact, that's what you're doing.
16 There is another class of problems in the
17 quaisi-scientific area of the metals and the complexing
18 and so on and the problem is how do you slice the
19 pie up.
20 DR. SCHAAKE: I think that's a good point, Bob,
21 your view of looking to see if I should do this or
22 do that. I don't think you should do just one of
23 either. I think you would be making a big mistake.
24 I think this whole question of the need to assess the
25 environmental effect of these designs is still there

regardless of what you can see by inspection, about what kind of designs you should be beginning to look at.

MR. McGOWEN: I agree with that.

DR. SCHAAKE: I think also the guy who does the design oughtn't be the guy who looks at the environmental impact. There is a basic conflict of interest there. It may be the same agency; but I think that the same engineer who designs the combined sewer system alternative should not be the guy who is responsible for the report on the environmental impact and that that ought to be separated.

MR. IGNAZIO: We structured it that way, by the way, so that the rest of the citizens of the United States would feel secure that we do just that.

DR. SCHAAKE: Good!

MR. IGNAZIO: I was going to suggest we have a break so you can buy some of our good coffee and the circulation can get going.

(A short recess was taken.)

MR. HARD: We have lost a couple of participants.

MR. IGNAZIO: I sensed the last segment of our discussion was beginning to really show some profit, and I hope we can continue the next piece of work; and I would hope we would wind up at about 4:20 to

allow those that are in car pools to make them.

What I was going to suggest was that we continue along the lines we have been. I would like to know, for one thing, how Mr. Simmons and Dr. Ryther feel about some of the research things that you mentioned that should be done almost as a parallel effort to some of these other things. One thing that concerned me this morning when I listened to the presentation by Dr. Thomann was the way they brought the tide in on the model. Is this a fair assumption? It seems to me as this surge of water comes in, it doesn't behave quite like that as the modelling showed it. If that's the case, then are we really getting the results that we can pin our hopes on?

MR. SIMMONS: Well, let me make two or three points. If you will forgive me, I'll go over here because I have to have a map to point at.

If you consider Boston Harbor, it is not as complex as New York Harbor where you have a tremendous volume of fresh water coming in, and you have a large discontinuity of the vertical current patterns and what not; but still it's not a simple system by any means, and I touched on that a little bit this morning. For example, when the tide is coming in and this basin fills, there are two routes through which

1 water can enter this basin. The same two routes
2 exist for water leaving the basin.
3 To me it would be a pure and simple accident if
4 the same volume of water flowed in and out of this
5 entrance and the same volume flowed in and out
6 this entrance. This just doesn't happen in these
7 systems. I'm sure that if detailed measurements
8 were available, they would show that this passage
9 either favors the flood or the ebb, whereas this
10 passage favors the opposite phase of the current.
11 Because of this imbalance in flow, this creates a
12 circulation system within that bay. This applies to
13 the harbor as a whole and also applies to all of the
14 sub-portions of the harbor; and these circulation
15 patterns can have a very strong influence on the
16 diffusion and flushing of whatever waste goes into
17 the system.
18 At the very least, I second wholeheartedly
19 Carl Hard's proposal that there be a detailed
20 circulation study based on hard oceanographic
21 measurements of this harbor for the basic understanding
22 of what exists there. I don't know at the moment
23 what data do exist; and from the conversations that
24 have gone on heretofore today, I don't think anyone
25 else in the room knows. So it would appear to me at

the very least that some individual or some group should be assigned the responsibility of assessing and evaluating what information now exists.

I am in the modelling business. That's my only business, and this applies to both physical modelling and math modelling. We do both types; but regardless of which type one would use for a study of Boston Harbor, you need basically the same oceanographic information as an input to your model. Unless this evaluation is carried out and the missing gaps are identified and bridged through future measurements, I think we will be floundering around in this area from here on.

To me it is just a fact of life that you have got to know the system before you can project the effect of the alternatives that we've been discussing. Just take as an example the interceptor problem which has been discussed at great length here, I notice on some of the maps the many dots that exist all around the perimeter of the bay. It is quite obvious to me that all of these interceptors are not going to be corrected overnight. You're talking about a ten-year program, a fifteen-year program or perhaps a twenty-year program to accomplish this objective.

It would appear to me that that program could be

1 carried out in a right way or a wrong way. The right
2 way would be to identify those areas that are most
3 adversely affected by the storm overflow system and
4 attempt to correct those first; and there might even
5 be an opportunity through diversion from one basin
6 to another in the interim stage of construction to
7 accomplish very definite benefits while this project
8 is being carried out to fulfillment.
9 So I am fully convinced that there needs to be
10 an oceanographic study made to establish the conditions
11 within the harbor, the circulation patterns and
12 currents and so forth. There needs to be either a
13 mathematical or physical models or both that employ
14 that information as verification for these studies;
15 and I would strongly urge that there be serious
16 consideration of a suitable physical model of Boston
17 Harbor located somewhere within this area; because
18 again this is a very long-range problem that you're
19 dealing with. While we may thing that we know all
20 of the things that are required by 1980 or the year
21 2000, the facts are that there will be changes coming
22 about that will require a change in thought on not
23 only the part of the Corps, but on the part of the
24 State and the EPA and other agencies involved.
25 I think there needs to be a permanent model

established; and I think that it should be in this area. Perhaps the New England Division has the space already to accommodate such a model. Perhaps M.I.T. has the expertise to build and operate the model. We at W.E.S. do model studies in remote locations. We're currently designing a model of the entire Chesapeake Bay system which will be built in the State of Maryland. We will operate that model just as if it were at Vicksburg. We don't have to do that. If there is another agency who has the competence to do it, it would probably be more satisfactory to do it that way.

My point is that while broad studies of the type that Bob Thomann talked about this morning are very very valuable, somewhere along the line you have to refine these models and bring out all of the details of the hydrodynamics forces and what not in their real-scale sense before you come up with the final numerical answers to this problem.

That's about all I have to say off the top of my head at this moment unless somebody would like to throw a specific question at me.

MR. IGNAZIO: Could you give us some dimensions on how, time, money, this type of thing?

MR. SIMMONS: I think an adequate field survey

in Boston Harbor would cost on the order of $200,000 to $250,000. It's not a cheap thing to do and monitor the stations over a sufficient period of time.

MR. IGNAZIO: How much time in your mind, two years or three years?

DR. SIMMONS: Probably a one-year period, not continuously. A suitable physical model of the Boston Harbor area by the time you build it, adjust it and put in two or three years of concerted operations, you're talking about a million to a million and a half dollars. These things are not cheap. That would bring your total bill up to say a million and three-quarters or something like that.

MR. IGNAZIO: Guy, you mentioned some modelling. Is there any integration or multi-use type aspect? If such a model were constructed, could we bring in the biological aspects or what?

DR. SIMMONS: That's a point I would like to leave with this group. There are some things that one can do better with math models than with physical models; and there are other things that one can do better with physical models than with math models. We at W.E.S. feel that the most fruitful way of using the two is in a cooperative sense; use one where it is best and the other where it is best. For example,

1 the physical model will give you much better
2 information, we think, on the circulation patterns,
3 the velocities and also on the effect of proposed
4 changes within the system on the hydrodynamic situation.
5 Once that information is developed by the best means
6 possible, which in my mind is a physical model, then
7 you can feed that information into your water quality
8 model, or you may have a whole family of associated
9 models which make use of information from the physical
10 model where you can get those parameters better than
11 you can through the math models and more reliably
12 and then go on from there.
13 MR. IGNAZIO: Do you have any feeling, Guy, about
14 the integration of effort? Do you see this?
15 DR. McCLEOD: I certainly agree with the physical
16 model, and we have worked (Arthur Ipton) and they
17 tell us they can adapt some of their given models
18 and link them to our biological model. However, they
19 caution us that you have to have good circulation
20 patterns of the harbor before you put these two
21 things together. You really need that information;
22 and with respect to the biological models, we need
23 more information on certain of the levels. We think
24 we have a good handle on the algae bacteria count,
25 but this does need development.

DR. SIMMONS: Just let me leave you with this thought in parting, that sometimes it doesn't take a really large change physically to affect a significant change say in the circulation pattern. Again, let's take this embayment. Perhaps through some quirk of fate, maybe the water does flow in and out of the two entrances uniformly. A slight constriction of one of these could completely alter the situation and give you a much more viable flushing system than you have under the present situations. We've seen this happen many many times. We're doing a study right now of Jamaica Bay which employs a physical model at the waterways experiment station and a mathematical water quality model. We're performing this marrying of the two together in the sense we get the hydraulic data from the physical model. He puts this as input to his water quality model and then monitors the BO and the CO and gets the information.

What we're mainly concerned with is improving the circulation characteristics of a bay that has only one entrance, but it has a split channel inside just like this system would be if you eliminated this channel. There is an entrance here with a split channel inside; and what we're trying to do is induce a planned circulation within that bay, taking advantage

of that split-channel situation. In other words, if the water went in and out of the split channel system uniformly, there would be a very slow flushing rate; whereas if we can induce the water to go in one and out the other, then we can improve the flushing characteristics substantially.

There are opportunities all within the system, not only the bay as a whole, but within the many compartments of the bay to improve the flushing characteristics with rather modest changes.

MR. IGNAZIO: That's very interesting. Does anyone have any question for Henry?

FROM THE FLOOR: Henry, did you give a time as to how long it would take to build a physical model?

DR. SIMMONS: The actual building of the model itself would probably not be a major task. I would say it could be built within five months or something like this. The accummulation of the information to build it and adjust it would probably take a year to a year and a half all told. I think you're talking roughly about a two-year timeframe to be ready for testing of such a model. I don't know whether it would be essential to the present program, which I understand has something like a two-year timeframe to it.

MR. IGNAZIO: We have a lot of little events that will take place. It won't be do this and stop doing things after that.

DR. SIMMONS: This won't be the end of the study of Boston Harbor by any means.

DR. SCHAAKE: I am not a physical model advocate; but I think in this case one of the strong arguments for a physical model is that it would lend some legitimacy to the results of the mathematical model. People who aren't willing to have that kind of confidence in the mathematical results are a little reluctant to accept them; and I think also you can show what is going to happen. You can bring somebody in and say, "Look, this is going to happen, and this is going to happen, and you can see the sediments being deposited."

DR. SIMMONS: It works as well as you can with a mathematical model.

(Laughter.)

DR. SCHAAKE: You can use it to communicate with, and that may be as strong an argument for the thing in this problem as any. You're talking about using these mathematical techniques in many of these ways anyways.

DR. SIMMONS: Sure you do.

DR. KRONE: I would like to offer the observation too that two and three-quarters million dollars is nothing compared to the cost of the mistake you might make.

MR. IGNAZIO: I gathered that. I wanted to ask a question of you, though, Dr. Krone; and that is if such a model were built in the physical aspect -- and I am thinking in terms of some of your statements on sediments -- could there be any simulation done on the physical model say with sediments or anything derived from that, or would we have little confidence? Would it be better to attack your sediments as a separate body?

DR. SIMMONS: It is better to attack it separately except in one type of study. If you have recurring shoaling problems within the harbor and you have a good historical record of what has been taking place in the past, there are empirical ways of simulating this type of sedimentation shoaling in a physical model and developing alternatives for reducing shoaling or eliminating shoaling or causing it to deposit here rather than there et cetera; but you have to have good historical data. As far as going into a physical model with no knowledge and conducting separate studies, no. You might just as well do it on a piece

of paper with a pencil.

DR. KRONE: I might add to that. I am not either a physical modeller or mathematical modeller. I'll use anything I can to get the answers; but they both have real advantages in using them together, and it provides not only greater capability, but it gives confirmation as you pointed out, and gives you a way to communicate with non-modellers in a way that's relatively easy.

DR. SIMMONS: I guess I'm one of the few that are neither-nor. I'm both. I have one entire unit of my laboratory that does nothing but physical modelling or rather math modelling; and I have four other units that do nothing but physical modelling.

DR. KRONE: To answer your question about the sediments, in shallow areas where winds are a factor, the mathematical model, provided that the circulations are accurate, has advantages. Here, of course, where we're concerned about the effect of sediments on water quality, then you need to use mathematical modelling. I think you should use both.

MR. IGNAZIO: Do you have any ideas as to dollars, times, a similar type of question which I asked Henry?

DR. KRONE: It's not so large as that for a mathematical model. It depends on how far you want to go.

If you want to do four levels of biological modelling and sediment too, together with the necessary laboratory studies to define the relations between your sediment and the water, it could compare in total amount to that that was suggested for the physical model; but ganerally there aren't maintenance costs to a mathematical model. It's on the shelf while you aren't using it. It is more compact.

MR. IGNAZIO: Money-wise and time-wise you would say----

DR. KRONE: I would say that time is the greater requirement. We may be talking about a million dollars depending on the depth, how far you want to go. A lot can be done for a lot less. A really complementary study might be a million dollars and three to five years. Would that seem reasonable, or would it be longer?

DR. SCHAAKE: Any estimate we make is going to be low.

FROM THE FLOOR: About three or four years ago before we got involved with mathematical modelling, we looked into the possibility of getting involved in a physical model and talked to Don (Harlan) of M.I.T. who does both and Larry Neal from the Alden Labs who is supposed to be a physical modeller. He told me off the top of his head that it would cost something

like six million dollars. To put that in perspective, at the same time he mentioned they were contemplating building a model of the Chesapeake Bay that was going to cost $40,000,000.

DR. SIMMONS: No, No. That model of Chesapeake Bay will cost about six million dollars. There is a Chesapeake Bay study which includes the model which will run around fifteen million; but the model which is ten times the size of the model you need for Boston Harbor would run around six million.

MR. IGNAZIO: Did I understand the price tag for the physical model itself to be what?

DR. SIMMONS: I would say including the field data, somewhere around a couple of million dollars, plus the adjustment and verification and perhaps a year or so of concerted testing. From that point on I wouldn't have any way of estimating it, because I think it would run for a while and then sit idle for a while, and then it would run for a while and sit idle again. I would follow the general course that the New York Harbor model has followed. That model is now 18 years old. It was built for a specific purpose which was fulfilled within the first year or two of operation; but I would guess over the 18 years that model has probably been idle maybe one year.

1 MR. IGNAZIO: So they're getting a lot of wear
2 and tear.
3 DR. SIMMONS: A lot of people are taking advantage
4 of it. For example, when the Interstate Sanitation
5 Commission faced up to this same problem in New York
6 Harbor of what sewer outlets do we clean up first to
7 obtain maximum benefit, they came to us, and we did
8 tests of each individual sewer outfall into New York
9 Harbor to identify the area affected by each outfall.
10 With that information, they could sit down and
11 logically plan their cleanup program. They were
12 starting with no treatment in effect. If we provide
13 primary treatment for this outfall, we'll obtain
14 certain benefits. If we do it for this outfall,
15 we'll obtain certain benefits.
16 DR. SCHAAKE: Henry, your model which you propose,
17 would you model just the harbor, or would you also
18 model some of Mass. Bay?
19 DR. SIMMONS: I'd say a substantial portion of
20 the bay.
21 DR. SCHAAKE: So that you had that idea in mind
22 when you were talking about it.
23 DR. SIMMONS: Right.
24 MR. HARD: And this would bring in the NOMES
25 study area. This is the beauty of it.

DR. SIMMONS: It could easily do that. I haven't thought of the actual dimensions to a large extent.

DR. SCHAAKE: I feel that this is something that ought to be investigated.

DR. SIMMONS: This is still a relatively small area, if I'm reading this scale properly. It's about seven miles out there.

DR. KRONE: My guess on the cost of the mathematical modelling effort presumed that the field data were already taken for the other model.

DR. SCHAAKE: How much was the mathematical model going to cost?

DR. KRONE: About a million dollars. That's for the biological modelling on top of the hydraulic data.

DR. SCHAAKE: To do the mathematical part after the physical stuff had been done.

DR. KRONE: These number ventures take a lot of computer time.

DR. SCHAAKE: I think you're talking about a hydrologic study too.

MR. IGNAZIO: Carl, you mentioned earlier you wanted some mapping. Would that fall out of this type of thing that you were talking about?

1 MR. HARD: I was talking sediment.

2 MR. IGNAZIO: That would be no major effort?

3 MR. HARD: Not in the scale we're talking about.

4 DR. KRONE: Before any real action is taken,

5 careful estimates would have to be made.

6 MR. IGNAZIO: I have one other question on the

7 purchasing of models. You mentioned, Dr. Ryther,

8 about the special study for viruses and a lot of

9 people are doing certain things. Do you have any feel

10 of how we might do something for Boston Harbor that

11 will address itself to the complexities of viruses?

12 DR. RYTHER. Well, there is a group that I am

13 familiar with at Baylor School of Medicine that is

14 developing techniques now for concentrating viruses

15 from dilute solutions in sea water; and they have

16 developed these techniques far enough now so they

17 can go out and monitor viruses in Galveston Bay,

18 which is where they're working. The state of the

19 art is advancing very quickly from what they tell me.

20 I would think that some of these techniques could be

21 used for looking at this problem here.

22 This is not a big deal. The equipment isn't

23 too expensive, and it doesn't take too much manpower

24 to do, but I think it would be well worth doing.

25 MR. IGNAZIO: Baylor, Texas, isn't it?

1 DR. RYTHER: It's in Houston, the Baylor School
2 of Medicine.
3 MR. IGNAZIO: Is it financed, do you know, with
4 National Science or Sea Grant Money?
5 DR. RYTHER: Sea Grant and some other sources.
6 MR. KLASHMAN: The EPA Laboratory down at
7 Narragansett is in the process of expanding, and
8 they've been doing some of this; but it would seem to
9 me that in this area you would be wise to explore
10 with them some type of a joint effort because they've
11 got to get into it.
12 DR. RYTHER: One of the people, incidentally, at
13 the Baylor Group now is Dr. Metcalf who is up at the
14 University of New Hampshire, and he is on leave of
15 absence.
16 MR. IGNAZIO: We bumped into him when we had our
17 Sea Grant review up there.
18 DR. RYTHER: Let me point out there is another
19 problem in addition to the viruses in sea water, and
20 that is the viruses that get concentrated in the
21 shellfish and perhaps other organisms which would be
22 a real public health problem, probably more serious
23 than viruses in the sea water as far as body contact
24 is concerned.
25 MR. HARD: Inasmuch as these problems are related

to dredging, it seems to me we might interest the National Science Foundation Rand Program to pick up----

MR. IGNAZIO: Well, obviously in all fairness we can't use one resource category to solve all of the problems of the world.

MR. HARD: This is why we have this little map here showing proposed ocean mining, or planned ocean mining actually, the environmental studies, solid waste disposal, our dumping ground, our dredging sources. They're all related. I think Henry has indicated that the study we need for the circulation would border on the NOMES study area, and we would be interfacing with what M.I.T. is working on already and the University of New Hampshire and the whole thing. I think it should be treated as broadly as possible.

DR. RYTHER: Let me point out another thing. One of the objectives of this program is to restore the biota; and the fact is that nobody knows what it's like now. As far as I know there haven't been any comprehensive studies of the fauna.

DR. McCLEOD: Just a few limited studies by marine fisheries; and these are usually one-year studies and up the Neponset River; but there hasn't

1 been a comprehensive study of it.

2 MR. HARD: NOAA's biome will give us some

3 indication of the broad sweep.

4 MR. IGNAZIO: This touches into the fisheries

5 aspect. After we take the hurdle of the beaches,

6 we have the question of the fish.

7 MR. HARD: Well, I think our question number 4

8 will take care of that.

9 MR. WEISS: In talking about a million-dollar

10 math model and a two milliond dollar physical model,

11 we're talking about coming back down to earth.

12 We plan to do a study in 18 months pulling the

13 resources together of the Corps and the MDC, and it's

14 about a million and a half dollars.

15 MR. IGNAZIO: Are the two linked?

16 MR. WEISS: Well, doubling that amount and getting

17 into that kind of modelling.

18 MR. IGNAZIO: What we're talking about is a

19 planning effort; and what we're bordering on now

20 is really a charge to the design solution because

21 if we're going to go through a planning effort which

22 says "You need two billion dollars," -- I'll put

23 that out as an opener -- "to construct a whole series

24 of nice black boxes and tubes and collections, it

25 seems to me if you talk in terms of say two billion

1 dollars you have to have a base from which you can
2 show some cause and effect; and that's why I like
3 to think if we are entertaining any thought of these
4 additional models we're talking about here, we wouldn't
5 throw them onto the burden of planning as such. We
6 would probably throw them on the burden of the actual
7 solutions that we're suggesting and make this a part
8 of our O & M of that solution.
9 MR. FERULLO: You mean go ahead with the
10 construction and find out later whether it's doing
11 any good?
12 MR. IGNAZIO: No. You have to go together. When
13 you get through with your planning, you'll have a
14 list which says we have to spend X millions of dollars
15 to do this. You ought to have similarly, the minute
16 you make the decision to start building, somewhere
17 in the timeframe the decision to find out what is
18 going on there. If you can do it before that decision
19 is made, wonderful.
20 DR. SCHAAKE: How much money are you going to
21 have to spend to design $2,000,000,000 worth of
22 hardware?
23 DR. SIMMONS: One of the first recommendations in
24 your planning study is simply that you need a two
25 million dollar physical model and a one million dollar

mathematical model before you go into design.

MR. IGNAZIO: Okay, but you heard that there has been certain decisions made already, so it seems to me that what is bothering Martin and what's bothering me is that we have been given a certain sum of money to do certain planning, and not to go get hard data like this. That doesn't mean you shouldn't go get the hard data. One of the things about planning could be to say----

MR. HARD: You're thinking of a DPR stage.

MR. IGNAZIO: A definite project report. We're hoping, for example, that from this planning study will come authorization report-type recommendations which is equivalent to what we call advanced E & D. At that point, you see, you would say that before the Congress or somebody would give you X million dollars to go and build this, that they would consider an expenditure of some monies to do this other. That's what I'm talking about, if I made myself clear.

FROM THE FLOOR: Joe, I think you're way out in the blue skies.

MR. IGNAZIO: Then take me down and tell me why.

FROM THE FLOOR: You're talking 20 or 30 years' worth of work.

MR. IGNAZIO: Sure. That's what I think the

whole program is. We're not going to get the goals without 15 years of effort. We have a big job to do and you're going to see certain benefits between year one and year fifteen. You don't have to wait for the year 15 to say "Gee, I'm doing everything now." You're going to get certain payoffs. You go out and get your combined storm sewer licked, and you're going to get certain payoffs; but you want other payoffs, and it keeps coming.

FROM THE FLOOR: I think that the biological models are so highly experimental; and a hydraulic model is pretty much of a luxury.

MR. IGNAZIO: I wonder if it is a luxury. We didn't do it in the water systems at Quabbin. I was doing a diversion study, and I'll show you how the model paid off. That model at Alden Lab, which was a crude model, helped us determine how long polluted water coming out of Millers and Connecticut River would short circuit itself and get into certain shafts.

FROM THE FLOOR: They have their place.

MR. IGANZIO: They have a hell of a place. We did it in hurricaine work 15 years ago for Naragansett Bay. I don't like to see anybody say that physical models are not real world.

1 DR. KRONE: Perhaps you have another way to
2 determine what the right course of action is.
3 MR. IGNAZIO: If you have another way of doing
4 either, I think you ought to surface it.
5 FROM THE FLOOR: First I would like to
6 carify the function of the physical model; and at the
7 moment I understand that that is to determine the
8 circulation patterns and only that. Would that be
9 correct assumption?
10 DR. SIMMONS: Well, to be able to look at the
11 effect of alternative changes within the bay itself.
12 FROM THE FLOOR: Are you saying that with a
13 physical model you can reproduce biological processes?
14 DR. SIMMONS: Oh no. We can reproduce the hydro-
15 dynamics situation, the hydraulics as they now exist
16 and would exist with various modifications.
17 FROM THE FLOOR: Well, there really won't be any
18 hydraulic modifications. This is a water quality
19 study as I see it.
20 MR. HARD: There might be.
21 DR. SIMMONS: I don't know whether there will
22 be or whether there will not.
23 DR. RYTHER: As far as inputs there could be.
24 FROM THE FLOOR: You mean as far as eliminating
25 a couple of the islands to improve circulation? Is that

1 the kind of alternative you're talking about?

2 DR. KRONE: Yes.

3 DR. SIMMONS: That would be typical of the kinds

4 of things you could do with such a model.

5 FROM THE FLOOR: I see it as a justification for

6 the physical model. I question whether spending

7 two million dollars on an extensive field measurement

8 program to verify to the non-believer that you can

9 in fact reproduce with a mathematical model the

10 hydrodynamics if the function is not to change the

11 physical features of the estuary. What I am saying

12 is how much return can you get from investing two

13 million dollars in field measurements of the circulation?

14 DR. SIMMONS: I think you misunderstood what I

15 said. The two million dollars would include the

16 field measurements necessary to verify this model.

17 FROM THE FLOOR: What else do you really need

18 then? If you know the circulation patterns of the

19 estuary, what else do you really need?

20 DR. SIMMONS: You get a skeleton of that

21 circulation pattern from your field measurements; and

22 then to fill in the gaps, you either do it by

23 physical modelling or math modelling. You go in the

24 field and get only enough information so that you can

25 set up either kind of model and be assured that it's

operating correctly. Then you use the model itself to fill in the missing portions.

MR. IGNAZIO: How much does that field work cost?

DR. SIMMONS: That's what I said would be between $200,000 and $250,000.

MISS JOHNSON: If you're going from scratch.

MR. HARD: You would go from scratch.

DR. SCHAAKE: What is the incremental cost just for the physical modelling?

DR. SIMMONS: I figure the difference between the two million and the quarter million, a million and three-quarters to build the model.

DR. SCHAAKE: But you also said you were going to do a mathematical model.

FROM THE FLOOR: The million dollars was a mathematical model on top of that.

DR. SIMMONS: Here's about the way it would break down. Don't hold me to these figures. I'm pulling them off the top of my head.

This would be somewhere in the ballpark. Let's see how far I missed the two million. Well, that's somewhere in the ballpark. It would take me two weeks to come up with a better figure (writing on the blackboard.)

DR. KRONE: Mine was pretty much of a guess.

Mathematical models are newer than physical models. I was envisioning a biological model with at least two levels and preferrably three or four, a model that included wave action and sediment motion in the shallow areas and sediment interaction. I think it would take I guess three years and about a million dollars. I might be a little shy.

FROM THE FLOOR: But those are all necessary whether that is implemented or not.

DR. KRONE: If you want to determine the effect of changing the system in any way on biological systems or to put it another way, if you want to determine what the best changes are to achieve the objectives that you wish.

FROM THE FLOOR: You mean to say you would need a physical model to determine what a water quality input is going to do?

DR. SCHAAKE: You need a model of the physical system, whether it is a physical model or a mathematical model.

DR. SIMMONS: You can substitute a mathematical hydrodynamic model for the physical model, or you can use the physical model for that purpose.

FROM THE FLOOR: You essentially need the hydrodynamic model to drive your water quality

constituents through the estuary anyway.

DR. KRONE: The water movements.

FROM THE FLOOR: And you need that model anyway, whether you build the physical model or not.

DR. SIMMONS: Not necessarily. You can use the output of this model as the input to the mathematical model.

FROM THE FLOOR: How much do you consider a realistic effort in hydrodynamics modelling in Boston Harbor would entail in terms of mathematical modelling?

DR. SCHAAKE: You still have the field data. You need that. Gee, it shouldn't cost more than $100,000.

FROM THE FLOOR: I want to ask one more question, sir. Has ever a physical model of this scale been built purely for water quality purposes?

DR. SIMMONS: Yes. One of at least approximately this scale was built for that purpose. The James River model, which is a tributary of Chesapeake Bay we did for the Commonwealth of Virginia.

FROM THE FLOOR: How much did that cost?

DR. SIMMONS: Around $500,000 total.

MR. IGNAZIO: Didn't the Naragansett Bay cost around a million and a quarter?

DR. SIMMONS: I don't think it was that much.

1 Things were a little cheaper back in those days.

2 MR. IGNAZIO: We still have that down there, don't

3 we?

4 DR. SIMMONS: Oh no, it's long since gone.

5 My best recollection was about $300,000 invested in

6 that. Prices have gone up quite a bit in the

7 last 15 years.

8 FROM THE FLOOR: The price on the mathematical

9 model, we had $85,000 for the development of a

10 hydrodynamic model and a time-variable water quality

11 model. This was on top of a previous project which

12 developed a steady-state model.

13 DR. SCHAAKE: Jack, how do you feel about this

14 whole question of modelling?

15 FROM THE FLOOR: I have a lot of confidence in

16 mathematical modelling from our experience with

17 Hydroscience. I think it's the way to go. I think

18 physical modelling for water quality alone, I don't

19 think you can justify it. Moving islands around

20 and sediments studies, it's a different ball game.

21 If we had to do it as a means of regulating

22 water quality, I think we have enough confidence in the

23 mathematical approach. We've spent a total of $150,000.

24 On biological models, we were involved with Guy McCleod;

25 but I think this is in the developmental stage

1 and we talked to Hydroscience on a couple of these,
2 San Fransisco and the Great Lakes, and they
3 don't have a high degree of confidence in them at
4 this point.
5 DR. McCLEOD: We didn't have a high degree of
6 confidence in their models on the biological end.
7 FROM THE FLOOR: It's water quality which includes
8 reactive substances.
9 DR. SCHAAKE: I think there is another area of
10 modelling also that's really important here, and
11 that is in the hydrology water quality aspect of the
12 whole area around the harbor; and that's going to be
13 expensive to do well, because you have to gather data
14 and you have to begin to understand a lot of processes
15 that we know little about.
16 MR. IGNAZIO: This would be the Charles and the
17 Neponset.
18 DR. SCHAAKE: Right, and that's an area we
19 really don't know much about or how to deal with it.
20 The full cost of that certainly isn't justified at
21 a planning level; but when you are talking about a
22 problem, if it is worth a couple of billion dollars
23 that we're talking about, you're only talking about
24 a very small percentage of that to gain a lot of
25 knowledge both of a scientific nature and an engineering

nature about that. But I don't think you could do a decent job for the water quality issue for less than say $100,000 either; and there I feel that we have the ability to stimulate the hydrologic system with only rainfall data and knowledge of the physical system. The fact that we have not had the field guages for a long period of time is not a serious handicap. We could get some data, but we don't need a lot of that, so we don't need a lot of investment there. We could do the hydrologic model of that whole area again for a number that's $100,000 or less. You need to superimpose on that what the heck is in that water and where does it come from and why. What kind of street cleaning would make the Boston Harbor a lot more decent?

MR. IGNAZIO: Or flushing of the pipe.

DR. SCHAAKE: Or something, and the limited information suggests that urban runoff is pretty strong stuff; and one could begin to look at that at a small level and begin to build a case as to why you should go deeper.

MR. IGNAZIO: Is anybody at MDC aware of what Harrington has done? How do you feel about some of the work he did at Lovell Street Station?

FROM THE FLOOR: That was not a modelling effort.

It was applying the EPA storm water model or at least a portion of it to the Boston system. There was no modelling done in the process research.

MR. IGNAZIO: What bothered me was some of the monitoring stations which he developed would seem to say that as the rainfall continued, the pollution was not actually diluted sufficiently but in fact brought on more difficult loads of pollution.

MR. WEISS: I think he's talking about the time between the different rain storms that it was directly proportional to the amount of pollution.

MR. IGNAZIO: I t was more of a monitoring study, but it did seem to surface the need that some of the thoughts we have had about how we would deal with storm water, if we take care of the first few inches of runoff, anything that came after that wouldn't be too potent. The system would have been flushed out. He seemed to be challenging that the system----

FROM THE FLOOR: Some of the data did indicate that. It depends on the system.

MR. IGNAZIO: I think what he was saying that the monitoring devices that we had were really not useful enough in telling us what was taking place. His prototype station gave a better handle on that. I was bringing this up because it ties in with some

of the things that Jack just said about somewhere along the line we have to deal with the urban runoff issue.

FROM THE FLOOR: We're talking about two different processes. One is an actual monitoring process, and the other is a predictive modelling process which you can do with or without your monitoring data.

MR. IGNAZIO: That's what I'm thinking. Monitoring data would verify it.

DR. SCHAAKE: You could say a lot more with a mathematical model.

FROM THE FLOOR: Measurements have no means of prediction; and the fact that pollution exists from overflows we know. The only reason you need measurements are to verify some other tool that you intend to predict.

DR. KRONE: I don't know that I can accept that. Just knowing that there is pollution isn't enough. We want to know which course of action we can afford and how to do it.

FROM THE FLOOR: That's right, but the reason I would go out and spend money to make measurements is to verify my predictive means and not just to go out and measure and say that I have pollution here and the following things are my pollutants. I can

1 show you historic facts that that is going on right
2 now, not only in the past, but today in many areas
3 that people are making measurements and without the proper
4 analysis of their purpose.
5 DR. SCHAAKE: One of the ways that gets started
6 is somebody saying that you can't make a model unless
7 you have the data. You need to work those two things
8 together. You have to simulate the dye study before
9 you go out there so you have some idea if you're
10 going to be able to find the dye; and then you go out.
11 A lot of people couldn't find dye because they didn't
12 put enough in or didn't look in the right place; and
13 they could have gotten an idea from the mathematical
14 model.
15 DR. KRONE: The two efforts should go on
16 simultaneously.
17 FROM THE FLOOR: I still think that the function
18 of measurements is to lend credence to your recommenda-
19 tions or to your method of recommendations. If
20 it's a mathematical model that you're using, then
21 the purpose of the measurement is to verify a model
22 and not just for the fact of going out and-----
23 DR. KRONE: There are two things you make
24 studies for, and one of them you might class as
25 just scientific investigation, but they are essential

as a commodity, and that is planning relations. In a biological model, unless you know what is limiting and what conditions are and the relation between those levels and the rates of multiplication of algae, there is no hope for making a suitable model. So there needs to be a constituentive relation for each of the factors involved in the model. That may look like purely scientific investigation, but----

FROM THE FLOOR: No, but I think before you do go out making that measurement, you have to suspect or believe that you will have a chance of finding that relationship, and if you don't have that knowledge, you will also fail. If you don't suspect that there is going to be a relationship between two parameters which you are trying to settle,----

DR. KRONE: But you can do that in the laboratory. Then the second kind is going out in the field to get data to verify the model. The number of algae per cubic centimeter really has no meaning by itself. It results from the rate of multiplication minus the perturbation minus the depth. You can have an infinity of combinations of those factors and still have the same standing crop of algae. It isn't enough to go out and make the measurements of the algae or the currents unless you know the relations between the

1 ambient conditions and numbers or current or magnitude
2 and all of the factors and what the factors are that
3 affect it and the relationship of the factors.
4 MR. IGNAZIO: You talked about a turbidity model
5 or turbidity studies, didn't you? What do you think
6 the scope of that is, Carl?
7 MR. HARD: I would like to hear Ray Krone's
8 version.
9 DR. KRONE: That was one of the things we included
10 in the model of a million dollars. As John pointed
11 out a few minutes ago, I might be low. The sediment
12 problem has several aspects that I think are important
13 to water quality. First of all is its relations to
14 heavy metal concentrations in the water. As you know
15 organic material and clays have strong absorptive
16 properties. They take up heavy metals from the
17 sollution in water. At least some of that absorptive
18 capacity is reversible, and further as biological
19 decomposition of organic matter takes place, there may
20 be releases of the absorbed material; so it is necessary
21 to establish relationships between the amount of each
22 heavy metal on the material and the amount released
23 in the water or taken up from the water by the
24 sediment. That has to be done experimentally. You
25 can't do that mathematically. You have to determine it,

1 and it can be done from samples taken in the system;
2 but it is not a research project in terms of planning
3 out a method. It is not a terribly difficult job
4 in terms of concept.
5 That could be incorporated in a model of suspended
6 sediment transportation to get the relation between the
7 water quality and suspended sediment; but first of
8 all you have to know what the concentration is and
9 how long it is deposited and so forth.
10 The second reason you're concerned about suspended
11 sediment has to do with the penetration of life.
12 One is that the adsorption of sunlight energy changes
13 its distribution throughout the depths with turbidity.
14 You tend to get more warming at the surface and more
15 uniform warming at the depth if it isn't; and in
16 systems with small excitations like this one, that can
17 turn out to be an important matter, especially in
18 shallow areas.
19 The second reason that light penetration is
20 important has to do with determining productivity. Algae
21 multiply at rates that are very sensitive to ambient
22 light. If the light level is too high, it kills them
23 off. They don't multiply. They just either use up
24 their internal energy or stored energy or just exist;
25 so that knowing the intensity of light at various

depths is essential to a model of algae of biological systems. To describe that you need to know what the concentrations are in a system at various times. In order to do this it is necessary to include in the model the forces that determine the suspended sediment transport which are discharged from the river systems -- not "forces," but factors -- suspension by wind-generated waves and circulation by tidal currents. The model has to include all three of those together with a storage or bookkeeping system that keeps track of what is on the bottom which turns out to be the hardest part of all models.

I don't know if that answered your question.

DR. RYTHER: From the sediments that I have seen from the Boston Harbor and from what Guy McCleod said this morning, I suspect that oil in the sediments may be a much more serious problem than the heavy metals and have a much more direct affect on the biota and maybe the esthetics as well. We haven't said much about this today. It is not clear to me where the oil comes from, if anybody knows this, how it is distributed.

DR. McCLEOD: In the inner harbor regions and particularly the Mystic River you have both some oil spills and some leakage. Everybody has been hauled

1 into court on this one. They are accidental spills;
2 but our calculations on per gallon of oil coming
3 through is based on there was no oil recovery plant
4 in the State of Massachusetts; so what was done with
5 waste oils? Where were they disposed of? In the
6 system. One way is the MDC system. Since nobody
7 is going to pick it up, you can only accumulate so
8 much.
9 DR. RYTHER: I think the other question, what
10 is the fate of this? Suppose you are able to control
11 it to some extent at least. How long is the oil there
12 going to stay there?
13 DR. McCLEOD: There aren't any studies at the
14 present time on how long it takes to decompose this.
15 DR. SCHAAKE: The treatment proposals aren't
16 going to change the oil output.
17 DR. McCLEOD: Well, they're going to remove all
18 the sludge, and the largest faction is in the sludge.
19 DR. RYTHER: But the widespread occurrence of this
20 all through the inner harbor makes me wonder if it
21 is associated with sludge unless it is from the outfalls
22 that are around the perimeter.
23 DR. KRONE: Combined sewers.
24 DR. McCLEOD: And you've had a long history
25 of doing this.

1 DR. RYTHER: But I do think that's a very substantial
2 part of the pollution problem in this whole area.
3 MR. HARD: I think it would dissipate, wouldn't
4 it, provided the sources were cut off? I'm thinking
5 of the work that Yale just finished doing for us on
6 the New Haven dumping grounds where (Don Rhodes)
7 took pictures with his little camera that gives you
8 a highly-detailed picture, a one-to-one scale, and
9 you can see the structure of the sediments from the
10 oxidation zone to the reduction zone, and you could
11 see the fabric of the fecal pellets that have
12 developed; and he estimated about 24 hours in
13 turnover time in sediments to produce this structure.
14 DR. RYTHER: A lot of these sediments are such
15 that there is nothing living in it. This sort of
16 slows down the biological consideration.
17 MR. IGNAZIO: Just to follow up some more on
18 modelling, what about the fishery aspects? We have
19 been told I think that the number of species out there,
20 the flounder for example, should something be done
21 while all of these other things are going on regarding
22 the fishery resource as we now understand it to be?
23 MR. HARD: Well, I think we're talking to the
24 right man with John Ryther.
25 DR. RYTHER: Well, I don't know of any very

1 comprehensive work that has been done to describe
2 this in the first place.
3 MR. IGNAZIO: Does anybody know from the State
4 whether anything has been done?
5 MR. FERULLO: The Division of Marine Fisheries
6 did a survey out in the harbor.
7 DR. McCLEOD: But that was '67 or '65.
8 MR. FERULLO: And I would think if you're going
9 to do anything with the sediments, the main reason
10 that you would want to do that would be that you
11 would want to know the kind of fish in the harbor
12 and the numbers in the harbor before you do that so
13 that if anything is done, you can look back five
14 years from now and see if there is any improvement.
15 DR. RYTHER: The fish and the benthic organisms.
16 That's what the fish will be feeding on .
17 MR. HARD: The swimmers are pretty difficult to
18 keep tabs on.
19 DR. RYTHER: You can at least find out what's
20 there and get some feeling for relative abundance.
21 MR. IGNAZIO: Can you give us any guidance on
22 how something like this may be approached in the way
23 of time?
24 DR. RYTHER: This not very difficult although
25 the area is big. I think it could be done within a

period of one year.

MR. IGNAZIO: This would give us a fishery base line. Do you have any feel for money on this?

DR. RYTHER: A quarter of a million dollars or something like that probably.

MR. IGNAZIO: Since we're spending like drunken sailors, does anybody else have any thoughts that they might want to raise?

DR. SCHAAKE: I have a question. When you speak about eliminating the combined sewer overflows, what are you thinking about when you say that?

MR. IGNAZIO: You mean physically how we would do it?

DR. SCHAAKE: Yes, and are you talking about something that's going to be -- what kind of frequency and why do you think that makes sense? You can't eliminate them fully because sooner or later there is something that will still overflow. Presumably you're talking about a recurrence interval of this. What kind of frequency and why are you thinking about that, and then what does it mean physically to handle whatever it is that you're going to take somplace else?

FROM THE FLOOR: Let me start out by saying I came here very interested in this subject. I saw the

way the study has been shaping up, that everybody was going to get a handle on essentially the main problems existing except the harbor itself and that the discussion today would be to center around what is necessary to get a handle on the harbor to assist this overall effort. The State has done a considerable amount of work; and I believe it's all been valid and good for the purpose that it was designated for, and I see all valid arguments to do much more in time.

I think at the present time we see a study going on on the order of a year and a half where we need further assistance from that kind of analysis; and what we see as some alternatives to the combined sewer overflow which I personally think is the prime problem here. It is the carrier perhaps of your metals too. The alternatives are transporting it away somewhere, ocean, inland, for treatment and reuse, various alternatives available; or partial treatment or treatment up to a certain recurrence which is economically valid and achieves a certain kind of objective.

I think I was looking for the discussion here centering around providing tools of meeting some of these objectives and what tools do we have readily available now such as Bob Thomann's work and your work

1 et cetera thatwould give us a feedback on some of
2 the alternatives that we will be presenting to the
3 problem of solving combined sewer overflows.
4 We find in several other cities where we have
5 approached the combined sewer overflow problem you
6 can achieve a great deal of remedial action with
7 not necessarily a great deal of interception or
8 catchment of the combined sewer overflow.
9 In Saginaw, Michigan, which was discharged into the
10 river system, we're finding that intercepting a
11 very economical alternative and that it did eliminate
12 most of the overflows, 90 per cent of the overflows.
13 They keep carrying a lot of pollution; and this
14 interaction between the harbor quality and the alterna-
15 tives is what I personally was looking for here today.
16 MR. HARD: And now you feel that the tail is
17 wagging the dog?
18 FROM THE FLOOR: I think we perhaps went a little
19 further. We went looking at the remedial action
20 that we have to do in Boston Harbor today. We were
21 looking at something we ultimately want to achieve;
22 and we weren't looking at the tools that are necessary
23 to provide the remedial action we have to take right
24 now.
25 MR. HARD: Yes. You have a specific assignment.

We have this front yard here.

FROM THE FLOOR: I totally agree with you, sir; and I agree with what's being discussed. But I am saying there is this one outstanding thing that hasn't been covered, the question of what is presently readily available in the way of tools to look at some of the alternatives of water pollution control; i.e., overflows in the Boston Harbor.

MR. HARD: I think we have answered that that can't be answered.

DR. SCHAAKE: No, no. I don't agree with that at all. I feel that you already and your company participated in the development of a very powerful tool. There may be some remaining mathematical problems in there that you will probably solve that weren't in the original model because it wasn't designed for Boston Harbor system. I guess my thought was that you need some way to test the environmental impact of the alternatives you do come up with.

FROM THE FLOOR: Yes. Presently the scope does not include Boston Harbor. The State and the things being done by Hydroscience is the interaction; and I came here to discuss those interactions or at least listen to them.

MR. HARD: Joe, maybe you would like to comment

on that.

MR. IGNAZIO: Well, we have another day, tomorrow. I think this day we have covered the waterfront and I'm kind of happy that we did.

MR. HARD: It had to be done.

MR. IGNAZIO: Yes, it had to be done. I feel like the doctor that's looking over the patient that comes in almost dead on arrival; but there are so many things that have to be done, and some have to precede others.

There is no question, I think, that we conclude that the action agenda that Walter spoke of is combined storm sewers. We have certain techniques to deal with them as Jake has outlined. When we were doing the Merrimack, I think we were bold enough to think we would store the stuff in chambers and treat it in the chambers and then release it at low flow. It got ridiculous in cost, and we made certain estimates along that line.

I'm aware of what Harrington has been talking about while it is in the pipe in transit. I think tomorrow we can throw some of these out on the table and get a response back for it. It seems to me we have a couple of things here. We have been given certain instructions to proceed to clean up, shape up

1 and define sources; and so we will go along those lines
2 even though we may not have the full backdrop of
3 knowledge of what the effect is once you do do this.
4 But that doesn't mean that we shouldn't do it.
5 DR. SCHAAKE: It also doesn't mean that you
6 should spend everything you have on----
7 MR. IGNAZIO: We're not going to put all the
8 bullets in one gun. I'm not going to put all of the
9 ammunition in one machine gun. I'm going to spread it
10 out. I think that's what we want to do, to spread it
11 out. We haven't really talked about land treatment
12 at all.
13 DR. SCHAAKE: I think it would be a tremendous
14 thing if the agencies and the Corps and the State
15 and others would in fact feel committed to finding
16 those resources over a period of years to do some of
17 these things that we're talking about. You can't
18 do it all at once. We have some pretty nice mathematical
19 techniques already that are very enlightening and
20 that ought to be used here; and if there was a limited
21 amount of money available to the Acquarium and other
22 places that are doing some pretty nice work to pursue
23 this and that a lot would be learned, and it would
24 be a lot easier to provide those inputs that you
25 came here to see. The model that the State has done

is certainly a fantastic thing; but it was done, and a lot of wise decisions are going to be made because of it; but I don't think myself it ought to end there.

MR. IGNAZIO: I think you're right. I just don't think this commitment of resources is anywhere near in proportion to the bigger picture that we are all embarking on. We have at the moment another dimension. Metropolitan Boston is getting thirstier by the day, and water has to be brought to this area; and we're going through some effort to get water in this area; and we're running into a lot of people who don't believe in diversion; so the question of using this storm water is a very real alternative.

DR. SCHAAKE: Joe, New Englanders won't let you swim in their reservoirs. The idea of drinking this waste water is-------

MR. IGNAZIO: I think the Governor is going to be faced with this dilemna and part of the State is going to say "Don't you take another drop unless you do the following things, that you ration and recycle." This is why we're thinking in terms of some of this storm water. I'm looking at the runoff from other dimensions. I'm looking at flood control. Most of our flood problems in urban areas are indeed flood drainage; and if we can capture some of these things

and if we are able to treat them in some fashion and keep them out of somebody's cellar, that's another dimension to it.

MR. HARD: The way the problems have been accellerating that the next ten years are going to seem like the last one year. I don't think it is just my aging psychology; but I think while we're talking about a physical model study of data on the circulation and an understanding of the circulation, what's happening in the harbor and talking about uses of the harbor that what we think of or have been talking about as projecting ten or twenty years from now is going to happen tomorrow. I think if we take a typical engineering pragmatic expedient solution to this thing, it is going to be too late to do anything else. We'll have to do something else, but we'll be starting late. As Henry said, the model for Naragansett Bay cost $300,000, and now we're talking two and a half million or something like that.

My resources are taxed to the bone at home; and our personnel resources are taxed right here in the office; and now there are so many poeple involved in the common problems and the communication problem is so great, I think we'll end up with some dictators making some decisions.

1 MR. IGNAZIO: That may be, but look at what
2 they've done to the planning environment. They've
3 diluted it to the point where we're all in a goldfish
4 bowl and everybody is looking at everybody and they
5 all want to have an input into whatever the hell you
6 give them. They're look at it this way: "Look, you're
7 spending my money, so don't leave the scene of the
8 crime because I have to O & M the job when you leave
9 the scene of the crime." The interrogation process
10 is enormous.
11 Now, what has been given to us is a planning
12 charge, not only to come up with a whole array of
13 alternatives, but alternative futures which has to
14 go back to the public and get a response back from them.
15 We have a large sum of money going into the hole on
16 planning apart from the technical solutions
17 which we've been talking about today; so all I'm saying
18 as I said earlier this morning, I look at management
19 as made up of about eight categories. It just so
20 happens that the head of the fish is planning; but
21 then the fish gets bigger and tails down; and I
22 don't think planning should be expected to do all
23 of what management is attempting to do, but I
24 think it should open the door. I think it's right
25 for us in planning to say we see a laundry list of

1 costs that in fact not only includes two billion dollars
2 of solutions, but it includes X millions of dollars
3 of control mechanisms and monitoring, cause and
4 effect vehicles, and public relations has to go in
5 too.
6 MR. HARD: We've had economic input into our
7 planning, and we've had engineering input.
8 MR. IGNAZIO: We've had economic and engineering,
9 and now we're getting social.
10 MR. HARD: Even scientific for a change. There's
11 a great distinction between engineering and science
12 and between science and applied engineering, particularly
13 in the United States.
14 DR. SCHAAKE: Joe, I'll be facetious. If we
15 could take all the legal fees for the two billion
16 dollars of construction and put that into a scientific
17 study, we would get something out of it.
18 MR. IGNAZIO: I described a microism of a country
19 that has agreed to spend $25 billion in water
20 quality improvement. I didn't set this goal. I'm not
21 telling somebody to go on secondary treatment either.
22 DR. KRONE: The point I would like to make is
23 that all of that fish and all of the things you included
24 in your description of management has one foundation.
25

One of the foundations anyway is how nature works; and I think we have to have a clear understanding of how nature works, because without it we'll plan the wrong thing; and one of the things I am uneasy about is the nature of the hydraulics in the harbor. It is such an unstable kind of a situation. I have the feeling that with the least change, it's going to have a big effect.

MR. IGNAZIO: I'm out of my field, but I get that uneasy feeling too, and that's why I said that we have a situation if we go down a certain avenue of cost and we in fact cause an eruption of toxicity to come out of the sediments, somebody is going to have to be accountable for this. The public looks at us as know-all and see-all instead of being just men.

I think we have had a lot of thought today, and I am grateful for it; and I hope you will come tomorrow and let's see if we can get into some things.

MR. HARD: Thank you very much.

(Whereupon, at 4:12 o'clock p.m., the conference was adjourned until 9:00 o'clock a.m., Friday, December 1, 1972.)

U.S. ARMY CORPS OF ENGINEERS
New England Division
424 Trapelo Road
Waltham, Massachusetts

WATER QUALITY FORUM ON BOSTON HARBOR

Reservoir Control Room
Building 115 N
424 Trapelo Road
Waltham, Massachusetts

Friday, December 1, 1972
9:30 a.m.

MODERATOR: Mr. Carl Hard

PANELISTS

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1 P R O C E E D I N G S

2 MR. IGNAZIO: I'm happy to say that Dr. Mancini is
3 here from Hydroscience, and we are missing Dr. Ryther. He
4 will be along and the same with Dr. Schaake. We've got four
5 of our panelists so we can at least get a start.
6 What we're hoping to do is wind up our meeting about
7 2:30. This is in the interest of our friends who have
8 flight schedules and also, of course, it's Friday and it's
9 a wet one. That doesn't mean that you all have to leave
10 at 2:30, though. We'll be here until 4:30 for those of you
11 who would like to stay and get into more detailed aspects.
12 Carl will run this thing again today, but I am hopeful
13 we can get into more specifics. I think yesterday we
14 exceeded our agenda as planned. That was my feeling. We
15 started out a little slow, but it seemed to me after the
16 lunch period we really put out some stuff, made pretty good
17 headway. I think the afternoon session was very productive,
18 and I'm hoping that today we can get more response from
19 those of you out there in the group and get a little better
20 interchange.
21 So I won't burden you any further. I think I'll turn
22 this over now to Carl. Does anybody have any announcements
23 or pressing points they want to raise? If so, fine, I'll
24 hear them. If not, Carl, I wonder if you would take it.
25 MR. HARD: For the benefit of Dr. Mancini, yesterday

1 we had presentations of studies to date by Guy McLeod, Dr.
2 Krone. Succeeding that the question of the adequacy of the
3 physical data base was brought up, and we have that experts
4 from the University of California and the Waterways
5 Experiment Station at Vicksburg, and it was felt that from
6 the information that was available at the meeting yesterday
7 the physical data base is inadequate. A physical model was
8 proposed for the Boston Harbor which would serve multiple
9 purposes over a long period of time. It was suggested that
10 this might be constructed and used in conjunction with
11 mathematical models.
12 Finally, what was lacking was an adequate circulation
13 study and a study of suspended sediments and transports of
14 the sediments as well as the composition of them. The
15 biological models to date appear to be related primarily
16 without the benefit of hydrodynamics considerations.
17 So I think if anybody would care to comment at this
18 point. Perhaps you have reaction to this, Dr. Mancini?
19 DR. MANCINI: Let me suggest why don't we just go ahead.
20 I'm not bashful.
21 MR. HARD: Today we're open for questions from the
22 audience and suggestions to make. Who'll jump in. Al?
23 MR. FERULLO: I have a question I would like to address
24 to Mr. Mancini, and that is, in your development of the
25 model in Boston Harbor, did you consider circulation, the

1 various aspects of the Harbor, the various areas of the
2 Harbor, and could you comment on whether or not you think
3 there is a need or how important is there a need for more
4 information on the circulation patterns in various areas of
5 the Harbor to do a good operating model of the Harbor?
6 MR. HARD: Excuse me for a moment. Would you identify
7 yourself for the benefit of the stenographer?
8 MR. FERULLO: Al Ferullo, Water Pollution Control.
9 DR. MANCINI: I believe that Bob Thomann yesterday
10 indicated that there are essentially two modeling studies
11 that have been carried out by our firm. The first one dealt
12 with a simplified study state analysis of the Harbor, and in
13 that model circulation and intertidal hydrodynamics were
14 not included within the modeling effort.
15 I think Bob also covered, however, some of the work that
16 is in progress at this point in time wherein some intertidal
17 work is being done which would include intertidal hydro-
18 dynamics, so there is from our stand point or from our
19 perspective there is a beginning base for understanding the
20 hydodynamics, and there is certainly a significant data
21 base of observed information in three dimensions in terms
22 of the coastal geodetic data collection program which
23 hasn't been analyzed, all right; that is, the data hasn't
24 been analyzed.
25 In specific response, Al, to your questions, however,

1 I'd say this, depending on the problems and objectives that
2 we are trying to solve or accomplish in Boston Harbor, one
3 could used some more detailed hydrodynamics. However, if
4 one is dealing with problems like the storm water overflow
5 and some of the more mundane problems of water quality
6 like dissolved oxygen, coliform, nutrients. The amount of
7 hydrodynamic information presently available, in my opinion,
8 is adequate to formulate plans and to allow proceeding with
9 implementation of solutions.
10 On the other hand, if the kinds of problems that we're
11 looking at or associated with filling portions of the Harbor,
12 as an example, for construction of some facilities, then
13 the kinds of hydrodynamic information available are
14 inadequate. So that it depends on the objectives and the
15 problems and the uses that you want to make of the hydro-
16 dynamic information as to what degree of effort and
17 resources should be put into that area.
18 But again to summarize that, with respect to the
19 normal water quality parameter, it is my opinion that there
20 is sufficient hydrodynamic information available and that,
21 in fact, much of the available data hasn't really been used
22 in Boston Harbor.
23 MISS JOHNSON: I was under the impression that
24 yesterday Mr. Simmons said something about how circulation
25 study would help in solving the combined sewage prob

1 because of being able to determine where to start first
2 because you can't take care of the entire combined sewage
3 problem in one phase. You have to have phase implementation,
4 so that that kind of thing could be enhanced by further
5 circulation study. You fell that what you have now is
6 adequate?
7 DR. MANCINI: Yes, ma'am.
8 MISS JOHNSON: Could Mr. Simmons address that, please.
9 MR. SIMMONS: Well, I'm a little strapped as I said
10 yesterday by not knowing what is available, and I made this
11 point several times that I think some individual or some
12 group should be assigned the responsibility of finding out
13 what does exist and evaluating the data from the standpoint
14 of are there missing gaps within the knowledge, and if
15 so, this would have a very significant impact on any
16 additional field work that was undertaken.
17 Just thinking in terms of what we would do if we
18 were given the responsibility for modeling this area, this
19 would be the first step we would take, find out what's known.
20 Once you've evaluated that, then you would lay out a field
21 data collection program which you would hope would bridge
22 the gaps in the knowledge.
23 I think that effort has got to be done here. John,
24 maybe your group has done it and nobody else is aware of it.
25 DR. MANCINI: I think my point was -- I'm in complete

1 agreement that somebody has to collect the information that
2 is available in Boston Harbor, particularly with respect to
3 the hydrodynamics, and also to a certain extent with some
4 of the water quality and environmental aspects.
5 Really what I was saying was that there is some work
6 available. It forms a basis I think on which engineering
7 judgments can be made. There are certainly gaps in the
8 work that has been done. There are certainly gaps in the
9 data base. It is my judgment at this point in time and
10 the sophistication with which we can bring to bear engineering
11 solutions that the gaps are no worse than our inability
12 to solve problems. You know, we can't clean up the whole
13 Harbor at one time.
14 So that I would say yes, there are gaps, but we
15 ought to take the first application step with what we have,
16 and I would further emphasize and agree with you that when
17 you look at the information that is available on the Harbor,
18 you should also use that information before you mount
19 significant additional data collection programs.
20 MR. SIMMONS: I'm in complete accord with that.
21 MR. HARD: We don't have any three dimensional pictures
22 of the currents or suspended sediments, do we?
23 DR. MANCINI: My understanding is that the data is
24 available.
25 MR. HARD: From whom? You mean from Rockville, from

1 lake surveys?

2 DR. MANCINI: That's right.

3 MR. HARD: That's largely surficial as I understand it.

4 DR. MANCINI: I understood they had---

5 MR. HARD: They had three at 20 foot depths, nothing

6 ammetered off the bottom and largel surficial, and most of

7 these were not continuous observations. There were a few

8 continuous control points.

9 DR. MANCINI: To my recollection there were some hundred

10 points at two depths and there were some much fewer, mayb

11 15, 20 at three depths.

12 MR. HARD: There has been no effor to make some

13 simultaneous observations at critical control points.

14 DR. MANCINI: That is right.

15 MR. HARD: Give you an imbalance of flow with respect

16 to urban sludge.

17 DR. MANCINI: I'm sorry, I don't follow you.

18 MR. HARD: Well, we're talking about whether you get

19 a net movement inshore of bottom material even though you

20 might have a strong surface flow outward or some such thing.

21 As I understand it and I think Henry Simmons brought it out

22 yesterday that this simple picture of an in and out propo-

23 sition was not correct. Couldn't be. It would be a

24 remarkable coincidence if it held. Is this correct, Henry?

25 MR. SIMMONS: Yes. The feeling I have just based on

1 a looksee at the maps of the Harbor is that the system is
2 so complicated geometrically that I think in all probability
3 if one looks at any combination of passages that feed
4 specific portions of the bay, you find the flow imbalance
5 attributable to the geometry of the system. The flood will
6 tend to favor one passageway as the other will likely favor
7 the other passageway.
8 These imbalance flow conditions do generate circulation
9 patterns within the Harbor complex, some of them relatively
10 small scale that are significant to the water velocity.
11 DR. MANCINI: I think reallyit comes down to what are
12 the problems that we're trying to solve with this model,
13 and I'm sorry I missed yesterday's meeting. Have those
14 been identified and enumerated and have objectives been
15 established? What are we trying to do?
16 MR. SIMMONS: Like for example, my feeling is this
17 that if you just want a gross approximation of what happens
18 to the coliform count within the Harbor, if you cut off all
19 of the combined storm sewer systems, then what you're doing
20 is perfectly all right. You're looking at a gross situation.
21 You're dealing with gross numbers. But if you want to find
22 out what happens in this local area of the Harbor as opposed
23 to that local area of the Harbor, if you tend to clean up
24 this area before this one or after this one, in other words,
25 the sequential that would be required to affect this

monumental task, then you need to zero in on the small scale circulation system within the overall complex.

DR. MANCINI: My assessment would be that the intermediate scale would be the appropriate one which is, I think, the one we have taken a shot at; that is, the kinds of questions I would think are significant within Boston Harbor are if I were to mount a program to, say, fix regulators in the inner harbor area, what type of an impact might I have in various general areas of Boston Harbor -- Carson Beach, Neponset, Deer Island Flats, that kind of thing.

If I were to expend X million dollars to pick up an interceptor or provide treatment for storm water from some section of Boston Harbor, what impact then would I have in that area of Boston Harbor and contiguous and adjacent areas of Boston Harbor.

And it's my assessment, Henry, and I apologize because we haven't issued a report on this yet, it's my assessment that the tools are available at least to take a first look at this. Now having looked at this and looked at the engineering solutions that we might wish to examine, it is certainly conceivable that we will say, all right, we need more detailed information. I would be surprised if we needed more detailed information everywhere. We might identify specific beaches where we needed more detailed information, where we needed more detailed modeling, this sort of thing.

1 But let us remember at least with respect to the storm
2 water problem, that our knowledge of what's going on on the
3 shoreline is perhaps even less than our knowledge of what's
4 going on in the body of water.
5 MR. SIMMONS: That's true too.
6 MR. HARD: Yes, Josh.
7 MR. TOLKOFF: Josh Tolkoff, TCE Inc. I'm one of the
8 members of the group of environmentalists and scientists who
9 dove in the Harbor recently, and I guess I want to make a
10 comment for the need for more information. I guess I have
11 a feel for some mathematical modeling techniques. My back-
12 ground is engineering, and I have seen the Hydescience report.
13 We examined some of the areas which were predicted
14 sludge or let's call it soft organic material until we know
15 exactly what it is. You said yesterday perhaps it's silt
16 or whatever. We looked at the areas that they said if there
17 is a soft organic material built up, it will be here, first
18 priority, here as a second possibility, and probably nowhere
19 to the sides or things like that.
20 Now we didn't find it where it was predicted and we
21 weren't surprised. The area though predicted, the currents
22 on the bottom are very strong. It's relatively shallow.
23 Now we looked at the bottom terrain, the picture of the bottom,
24 and we said it would have a much better chance of being in
25 holes in other areas nereby, perhaps, the center of the

1 channel. We were looking in the Presidents Roads, the
2 center of the channel area, and we were able to find this
3 soft sediment or silt or whatever it is.
4 So I think there is certainly a point where more
5 information is needed, and especially if we do have faithful
6 mathematical models and it does not have enough information
7 to really tell us where that information is. So I, therefore,
8 question that there is enough information or that it's all
9 been used. That may be possible, I don't know.
10 MR. HARD: I think what we're seeing here is an
11 approach to a specific engineering problem within a specific
12 framework. When we start talking about the water quality
13 of Boston Harbor, then we're talking about a broader frame-
14 work which does require an understanding of what's going on
15 in considerable detail. It's similar to a medical situation
16 where a certain group of symptoms can indicate either a
17 serious pathological condition or just some sort of a
18 transient minor irregularity. And the idea that we can use
19 this flimsy data that we have on Boston Harbor, we don't
20 have any oceanographic background in Boston Harbor, save a
21 few surficial current measurements and/or survey projects
22 that were done around 1950 that we were told were conducted.
23 That's all the basic data that I know of except a few data
24 buoys that were put out, the data buoy that was put out by
25 MIT, which MIT itself, Professor Christianson, has indicated

1 recently couldn't properly be placed unless you are after
2 some specific situation within the Harbor. He showed varying
3 count measurements that were inputs by the heat discharges
4 of power plants. There just was no place in Boston Harbor
5 where you could put down a representative buoy array. So
6 obviously there is a complex circulation problem within the
7 Harbor. This isn't known.
8 I think as I said yesterday this understanding of
9 Boston Harbor is at a kindgarten level. Unless we get some
10 basic physical oceanography, then I don't see how we can
11 maintain our self respect in this type of a study. If we're
12 going to pretend to understand the water quality situation
13 in Boston Harbor, then we've got to do the spade work.
14 DR. KRONE: I wonder if I might make a few remarks.
15 MR. HARD: Certainly.
16 DR. KRONE: I would like to point out, emphasize a
17 couple of points that both John and Henry made and that were
18 made yesterday that need to be brought up again.
19 First of all, with regard to objectives as you mentioned
20 earlier this morning, the concerns are for more than modifying
21 the storm drains, the combined sewer outfall. It was brought
22 out yesterday there is going to be development offshore;
23 that is, mining studies and disposal of dredge spoil is of
24 concern and that further modification of the Harbor is of
25 interest as well as the immediate problems of the combined

storm drainage and sewer overflow with are without doubt immediate problems, and industrial waste disposal; and that for the management of water quality of the whole Harbor and for the kinds of improvements that are anticipated in view of current governmental regulations that we need to have a more comprehensive view of the Harbor than presently, of the hydraulics of the Harbor and of the flows from the land surface, I'll just combine them all together, than we presently have and that includes storm flows from upstream as well as urban flows.

Our focus has been on what is needed for this larger, I don't want to say planning effort, but consideration of possibilities for enhancing water quality and increasing the use of Boston Harbor. That's the first point that I think needed emphasizing.

The second was with regard to data collection and modeling and the extent of modeling. Collecting data without knowledge, some knowledge of the system would be a very inefficient effort to just go out and thrash the water. It's been shown many times in the past that you can take lots of measurements that are not of subsequent value because they weren't taken at the right place or at the right time or analyses weren't made for the right constituents.

You need a picture of what's going on in the Harbor to know when and where to take samples and what analyses to

1 make, and that picture, of course, is some kind of a model
2 either conceptual model or mathematical model or physical
3 model, some guide for taking samplees. And of course, the
4 better you understand the system, the better can you determine
5 where the samples need be taken. So that sampling and
6 modeling should go on concurrently, and the model should
7 continuously be improved as better information is available.
8 Now I understand the the present situation is that
9 there are lots of data available that have not been evaluated
10 in terms of their value in making such a description; and
11 Henry's point was that this needs to be done, if I get it
12 correctly, needs to be done now in view of the existing
13 models of the Harbor in view of what they tell us and in
14 view of needs for future use of Boston Harbor. So certainly
15 this should be evaluated, but without a doubt, additional
16 models, additional field data will be needed to meet these
17 broad objectives that we have and to improve the quality
18 of the models to the point where we can determine which
19 courses of action are most effective in achieving these
20 objectives. That's a second point.
21 The third one has to do with modeling itself, and maybe
22 we can get down to more concrete matters. The system is
23 one consisting of a number of islands with no regular shape
24 except to say perhaps the main channel, no regular configura-
25 tion, driven by ocean tides. It's a very unstable kind of

1 situation, and small changes in island shapes, for example,
2 or in river discharges can modify the hydraulics of the
3 system very much. In fact, I don't know it for a fact, but
4 I suspect that winds can play a significant part in the
5 circulation of this Harbor. So that when we talk about
6 the adequacy of the models as we just were, it is important
7 to look into the things that are included in the model, in
8 any particular kind of a model, and to evaluate what they
9 can do for us in terms of making decisions and what they
10 can't.
11 So I would like to ask thatyou describe in more detail
12 than Bob did yesterday the method used for describing the
13 hydrodynamics of the Harbor in your model. Now, you don't
14 know what he did yesterday. He just showed a transparency
15 that was marked off in a grid, in a regular grid and said
16 that these were the subdivisions of the Harbor used in our
17 model, and I think that was about the end of it.
18 DR. MANCINI: Well, let me be very specific, the model
19 that we used was an adaptation of the Rand-Lindertsy (phon.)
20 computational program. We did not include wind stresses
21 in the model, and there is a large grid size to the model.
22 As an example, our grid sizes run from, I think, down to
23 a thousand feet, most of them are 2,000 feet. The
24 Lindertsy application of that same model in Jamaica Bay in
25 New York was 500 feet, and he was, of course, concerned with

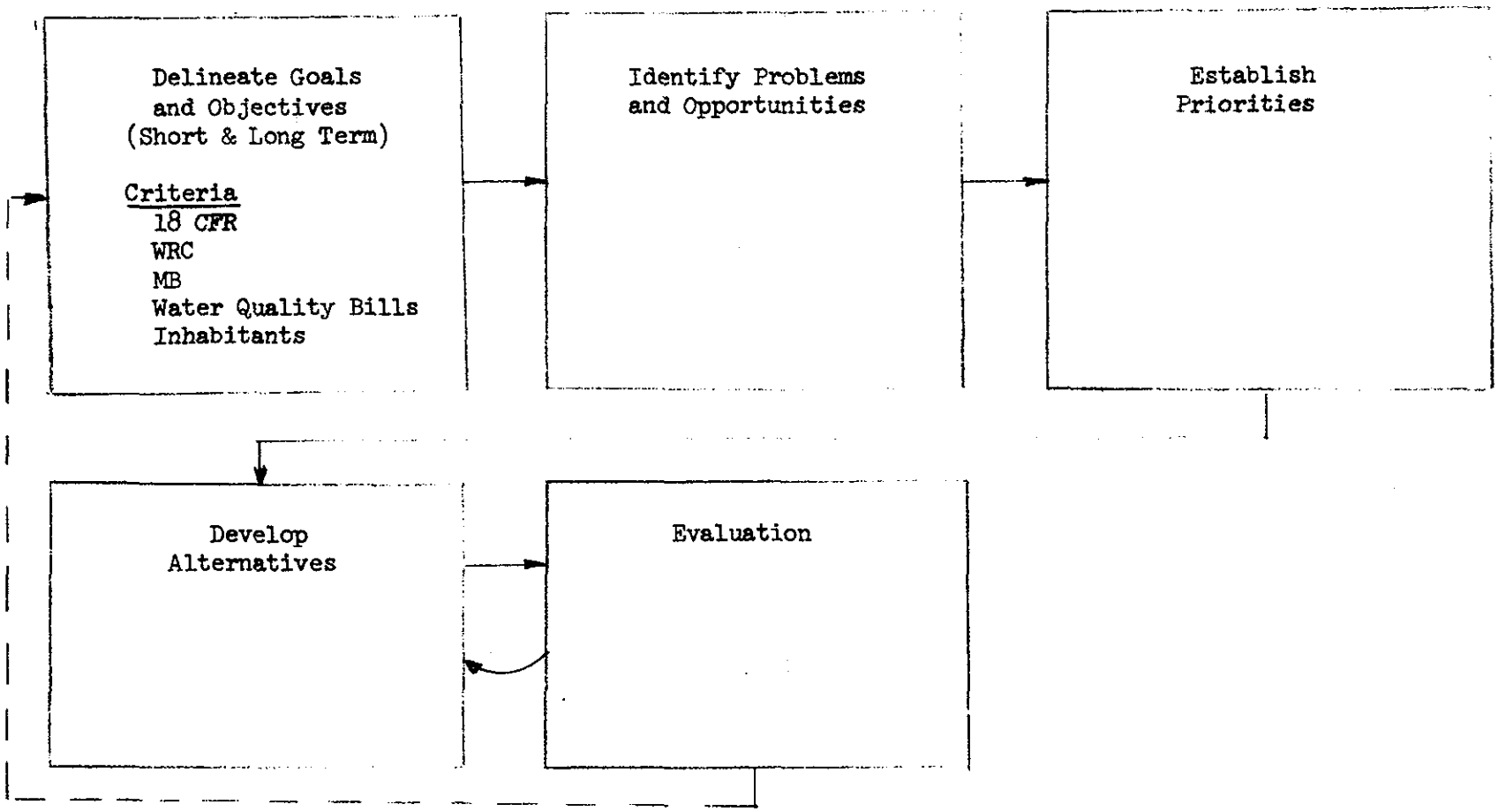
1 flats and deeps and areas that dried out during periods of
2 the tide.
3 DR. KRONE: For the benefit of the audience who aren't
4 familiar with these, would you describe it, take one element
5 or two elements?
6 DR. MANCINI: I'd rather not What essentially it is
7 is a balance of mass and momentum around an element and
8 includes the friction term and is a numerically integrated.
9 But I think the key and I really don't have a quarrel with
10 the things that have been, not a quarrel but disagreement
11 with the things that have been said, but it seems to me
12 that the objectives are still not clear to me in terms of
13 what we're trying to do.
14 I personally respond to the storm water problem, I
15 respond to some of the land drainage problems, and for those
16 the sequence that I would suggest is let's take a look at
17 our solutions and our engineering options and the data
18 available, and on that basis see if what we have in the way
19 of tools are adequate. My initial assessment is they are
20 probably for 80 percent of what we are really going to have
21 to do.
22 I am not trying to suggest that additional work is not
23 necessary in Boston Harbor. I think it might be wise,
24 however, to differentiate between work that should be
25 related to a on-going and active planning effort from that

1 which is related to a more academic view of the Harbor,
2 so that when we sort of reach Round 2 and have gotten rid
3 of some of the obvious problems, we are in a position of
4 strength with respect to knowledge and experience and
5 ultimately data to address some of these mor subtle questions.
6 I think one has to separate these two, or at least I
7 would suggest that for consideration. That is, there are
8 some real immediate problems that can be looked at in the
9 context of what's available. There are a whole host of
10 additional problems which we should as a society be concerned
11 with.
12 Now, I'm not sure that they should be lumped together.
13 I am suggesting that they should be separated, and that one
14 could mount academic -- and I use that term in the broadest
15 sense, not necessarily being accomplished by universities but
16 interested agencies and universities -- to develop our
17 understanding base of the phenomena in Boston Harbor, so
18 that we can then identify both specific problems and
19 specific alternatives and knowledge that we are lacking or
20 have, and we can put things into compartments -- yes, I know
21 this well enough. There's not much I can do about lobster
22 generation, as an example, you know, the thermal work, fine,
23 maybe that doesn't fit in Boston Harbor for the next 40
24 years. Then we put that in a slot, yes, I know something
25 about that but it's not really a problem yet. On the other

1 hand, I don't know anything about what's going to happen
2 if I try and rejuvenate bottom organisms and diversity
3 of those. So I would suggest that it might be of some help
4 to differentiate these two things.
5 DR. KRONE: Well, I think most would agree that we
6 should do the things that evidently need doing based on our
7 present knowledge as soon as we can. There are some pretty
8 obvious things that need doing.
9 I'm not sure because I don't know what is available,
10 what you've done in this area, whether we know which is the
11 most effective course of action to accomplish these objectives
12 for example, in the storm water drainage matter, I don't know
13 that we have enough information to know which way this
14 should be solved to get the most for the dollar or the most
15 per year of time.
16 DR. MANCINI: Let me answer that directly. The answer
17 is no. What appears to be missing is the land as well as
18 some of the application in the water flow.
19 DR. KRONE: That's a case in point. We need to look
20 at what we've got now and say we need this additional
21 information, land drainage in this case, before we can take
22 the most effective, I'll put it that way, course of action
23 to get the best quality water for a year's time for our
24 dollar. But nevertheless we should begin with what we have
25 got and do as much as we can with what we have got, but at

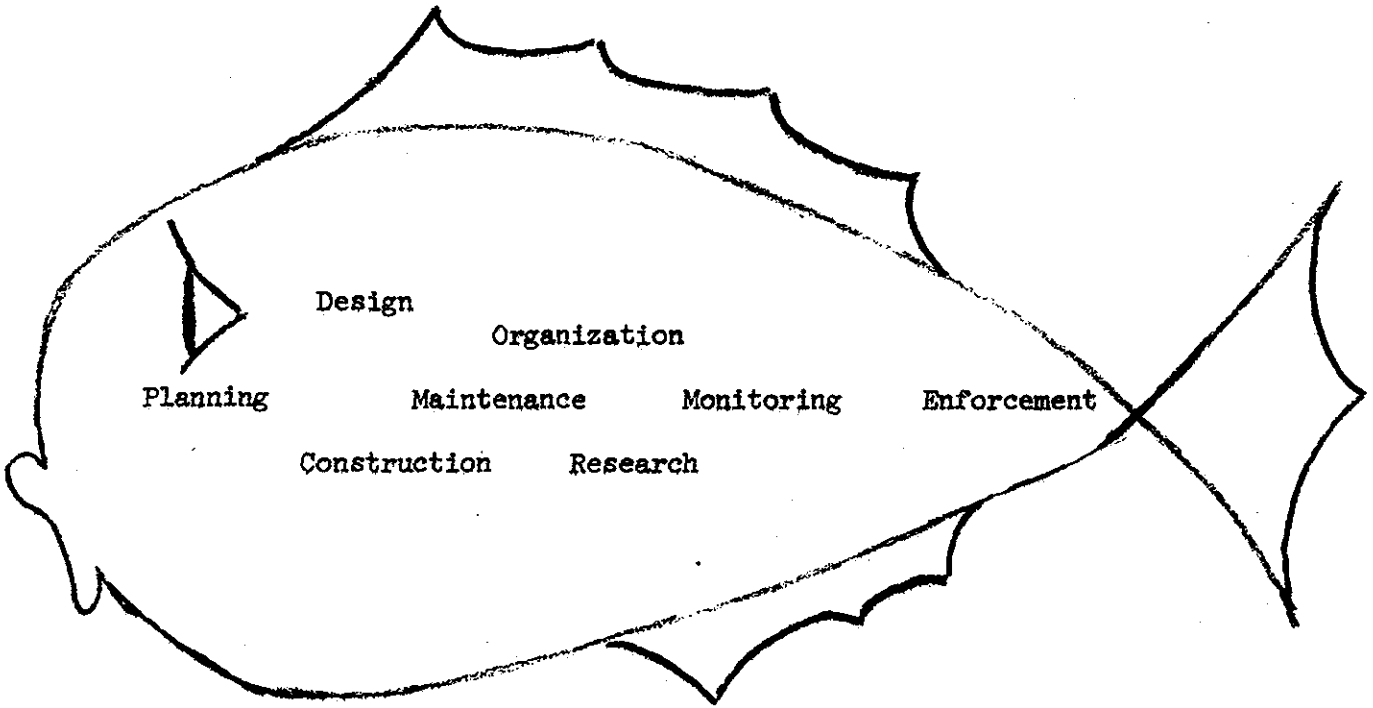
1 the same time, and the point I'm trying to make is that
2 we should take a longer look at our overall objectives and
3 design our studies, field and office studies, computer
4 studies and laboratory studies so that we're meeting our
5 overall objectives as well as we can foresee them at this
6 time and continue to upgrade that foreseeing as we gain
7 more experience.
8 I don't propose that we seek knowledge for knowledge
9 sake, if that's what you implied by academic.
10 DR. MANCINI: No, no, that's not what I meant.
11 DR. KRONE: I'm just not of that ilk, and I don't think
12 too many of us really can afford that now, but we should
13 seek the knowledge that will benefit us in terms of deciding
14 what course of action to take in the future and with an
15 understanding of the problems that we are interested in
16 in the long run as well as the immediate future.
17 So that I see this as a growing effort with a long
18 view; that is, with a view of accomplishing what we need
19 to in the long run, including all these other objectives.
20 Our immediate problem seem to be we don't really
21 know what is available. That hasn't been organized and
22 put in good form.
23 MR. IGNAZIO: When I left here yesterday, last night,
24 I had a rather large head on my shoulders, and all I could
25 think of was God save us from our good works. I'd like to

1 maybe spend five or ten minutes for the benefit of Dr. Mancini
2 I made an attempt to explain what it was we were trying to
3 do with this so-called big comprehensive study. If you
4 will bear with me, it may be well to do this to get the
5 panel a little more interactive, so if I could interrupt.
6 This is essentially a planning effort we're talking
7 about, but I want to start off by calling it a Water Quality
8 Management Program for Metro Boston, and by that I mean all
9 of the land which encompasses maybe 3 million people and
10 the receptacle called Boston Harbor.
11 Now this program is going to have at least eight elements
12 The first element is going to be planning; the second one
13 is design. Some of these things are going on now by the
14 state possibly, construction, there's been a lot of this;
15 maintenance, they're doing a lot of this; organization,
16 they're going to exam the organization to see if there is
17 anything wrong with with it, should it be improved, what
18 needs to be added; research, our friends like Guy McLeod,
19 MIT; monitoring; and enforcement, EPA, where are they.
20 So we've eight things to do. Now, you'll all agree
21 in this room that some of this is being done now in bits
22 and pieces. We've gone through the planning--- I call this
23 the fish, and you know what the fish looks like, it looks
24 like this, with the tail down here and the head up here.
25 That's the fish.



PLANNING PROCESS

WATER QUALITY FORUM ON BOSTON HARBOR



PLANNING EFFORT

WATER QUALITY MANAGEMENT PROGRAM

METROPOLITAN BOSTON

WATER QUALITY FORUM ON BOSTON HARBOR

1 Now, at the sake of being very simplistic, the planning
2 process will look like this -- delineate, goals, and
3 objectives, and I'll get back to this little block in a
4 minute. I've simplified these blocks and generalized them
5 quite a bit, almost like OMB.
6 Identify problems and opportunities, big word.
7 Set priorities -- combine storm sewers, high on the priorities.
8 Develop alternatives, another big term.
9 After we do this, we come down into a block called
10 Evluation. You can see how I've really generalized these
11 terms, and then go back to that block called Evaluation.
12 These have two arrows, of course, because this is the impact
13 analysis. It's got to be done. Go back into here and then
14 put down a criterior. Some of my colleagues yesterday
15 were talking about the law of the land, contracts, EPA.
16 Now, in here you've got 18 CFR; we've got the Water
17 Resources Council guidelines of Jack Schaake, we've got
18 the Muskie-Blatnick Bill, and then we have another thing
19 that maybe bigger than this -- people.
20 So every damn alternative that we're talking about,
21 I don't care if we're picking up a pipe, putting in a
22 tertiary plant, putting the stuff on land, has to go the
23 route. After that alternative is developed, it has to go
24 this route to this interrogation and back to the Criteria.
25 Now the long-term goal is for the moon because the

1 Muskie-Blatnick Bill said it's the moon. It's the biota,
2 it's the living organisms. That's the long-term goal. When
3 will that happen? I don't know, 25 years. YOu give me an
4 estimate.
5 The short-term objectives are these, at least as
6 evidenced -- public health, recreation, fisheries, amenities.
7 The guy in the street says,"I have no place to recreate. These
8 are my reservoirs. I can't go out. They throw me out.
9 I have to have money. I want to swim here." I heard
10 yesterday that he can swim because you're going to take
11 out the bugs, and there is enough fish, enough dissolved
12 oxygen for fish, although there is some question on what
13 these elements were.
14 I also heard yesterday that there is a virus problem,
15 that there is some question whether public health officials
16 will actually permit the simming because of unknowns on
17 viruses.
18 So I said yesterday that I list a whole series of
19 objectives---
20 MR. SIMMONS: There was a photograph in the morning
21 paper.
22 MR. IGNAZIO: I didn't get a chance to look at the
23 morning paper. What did it show, a picture of one of the
24 beaches?
25 MR. SIMMONS: A picture of a virus.

MR. IGNAZIO: We're moving. Now, I could go on on the objectives because I said yesterday we had objectives of water supply -- the city is thirsty, and I keep getting water by going west because it's clean; I could go on to dredging; I could go on the airport expansion, a third runway, off-shore terminals, dredging. I've got to ~~take~~ dredge out this harbor. It's shut right now. I can just about get the ships through the Chelsea Creek. One of these days one of them is going to crack, get hung up in there, then you'll have more sludge for your divers and oil.

I could go on and on on the objectives. All I'm trying to do is present the size of this true iceberg. This is called a planning process. I don't think that ever before has this process been entertained. A lot of people have done a lot of things ad hoc-wise.

Now in order to do this planning process, we've called together the best muscle I know off, and if there are any more we've left out, let's have them. We called in State, we called in MDC and the Corps of Engineers and EPA, and I'm not strying to slight other organizations. This is a big family. If you look at our study management team, there must be 28 players in that group alone, and th~~is~~e MDC ~~guy~~'s got about 80 years of experience and understanding. He knows more about what's happening than anybody. We're called in because we're know something about hydraulics

1 and regional basins, planning, and we think maybe we've
2 got a handle on land treatment; and this guy is called in,
3 of course, because he's got the money and the regulations.
4 He's got the mission.
5 Now, if we can't do a goddam good planning process
6 with these people, I don't know when the hell we'll ever
7 do it.
8 Now, everything that we're going to do on the land,
9 and there's a lot of things we're going to do on the land,
10 ends up in this receptable. When we started to look at this,
11 some of this is already being done, for example, in addition
12 to these players we've got ANE. We've got one outstanding
13 on board or will have, Metcalf & Eddy for one. There's other
14 ANE on sludge contracts, Hassin & Sawyer, so this is a big
15 block too.
16 So what we're seeing here is the need to establish not
17 only a status quo but what I call a cause and effect
18 relationship -- what X has done here, what happens to the
19 receptacle, X times Y, the receptacle, back, forth, back
20 forth, back forth, not a situation where a firm has done
21 this, a college has done this, a research outfit has done
22 this. Somebody says you need circulation.
23 So that's why yesterday as the day wore on, we started
24 throwing some price tags out, and we came up with a lot of
25 different aspects. Maybe the best thing might be to go

1 through a physical model, you know, like they do in the
2 Chesapeake or the Narragansett Bay, this type of thing,
3 so that we understood circulation patterns. Tie this in
4 with a sedimentation model. My friend Carl is concerned
5 about the sediments. Dr. Krone tell us that actually the
6 sediment can tell us a lot more as they lay down on the
7 bottom as can water samples taken at different elevations.
8 So that's what I see happening here. I see the need
9 to do a very good planning process to continue this thing
10 at different steps and to have a receptacle, call it a
11 model, call it a laboratory receptacle where you can go
12 back and say we think this will happen if something is done
13 in here.
14 Now, that I think is the broad picture. If I have
15 left somebody out or something out, I wish guys like Al
16 and Martin would say something, but that's what I see as
17 our effort. Our effort is we've been given a sum of money,
18 money here. Now, I think it's unfair that the money they
19 gave us to do this, to do this -- there are all sorts of
20 people doing this, sea grants, NSF, you name them, and
21 well it should be. Don't expect planning to solve all of
22 that. Just expect planning to give you a cause and effect
23 relationship to stand up to the integrity of your
24 criteria; and finally, the guys who've got to pay the bill.
25 They'll only pay the bill if they can see something come

1 out of there.

2 I told you how concerned I was if we spend X sums of
3 money and then we tell the guy, "We've got the storm sewer
4 so it's not there. We made it invisible, but you know what,
5 you can't swim. You know what, you can't eat that shell
6 fish." Because I don't want to face that guy. I've been
7 facing him for 25 years, and I'm telling you, it's bad
8 stuff. Because he only knows what he can see.

9 I told the boys yesterday there are 30 islands in
10 here. The State has a gradiose plan to purchase all these
11 and make them into little playgrounds and schools. There's
12 talk of making causeways, so there is a physical change to
13 the geometry that's in the wind.

14 And that's the big picture, a very big picture. So if
15 we can keep everybody cooperative, maybe--

16 DR. MANCINI: Joe, how much do you have for your
17 planning effort?

18 MR. IGNAZIO: I've got about as much money as I've
19 ever seen, not that it's a lot. I think when this is all
20 through, this will run over $2 million, but if I told you
21 how that's being spent, you would see that it may not even
22 be enough, because we've got large sums of money going
23 into institutional arrangements. We've got large sums of
24 money going into -- see, I don't know all the time what
25 people's criteria are. It's fluttery like a butterfly.

1 The opening planning process. Large sums of money going to
2 industrial pollution profiles. Large sums of money going to
3 urban runoff, alternative treatment procedures, advanced
4 biological PC, land treatment. It's all got to come out of
5 this pocketbook.
6 Yesterday, I think when I left we said that the
7 modeling that was thrown out, I think, I may be wrong, but
8 this looked like $3 million for modeling. As I recall,
9 Henry's tag was about a million and six, and I think you
10 thought about a million, somebody else said about 200,000
11 for fishery. We have a fishery thing. It looked like about
12 $3 million, and I said, "Well, that's a lot of money, but
13 this whole fish," I said, "is $2 billion worth." The Governor
14 can talk about 1.3 on highway. I suppose I could say 2 billion
15 for the welfare of all these people.
16 Is that about it?
17 DR. KRONE: That's about it, all right. I'd like
18 to ask a few questions before we get away from this. In
19 order to plan adequately, you need information, to gather
20 information.
21 MR. IGNAZIO: Yes, that's what we're here for.
22 DR. KRONE: Is that included in research?
23 MR. IGNAZIO: No, that's over here. Actually you have
24 to examine it. A planning process has more than these
25 blocks. It's an enormous diagram. If you examine status,

1 status quo. Now this develops into two things, this
2 becomes inventory -- data, the stuff that you mentioned
3 somebody has insufficient of; and it becomes study data.
4 Now when we planners get wrapped up hard, no matter
5 what study we do, we have a heck of a time getting everybody
6 to understand the differential here. Many times, this turns
7 out to be gaps, and there just isn't enough dough in here
8 here for that gap. What do you do? You don't stop your
9 plan. You acknowledge it in the first chapter. You say,
10 look at the terrible constraints I'm working under. The
11 inventory data is this and this and there are gaps of that
12 and they can be solved by this. So you do that in a study
13 status quo. There are a lot of things going. You get your
14 status quo because this is going to help you identify your
15 problem and identify your opportunities. The opportunity
16 is to get rid of that storm drainage system and X goes the
17 coliform. If that were done, that gives you a step toward
18 this, but I'm not so sure it will get you there, but it
19 gives you a step toward that so that's good. And then if
20 somebody comes along and says "Halt, virus are running
21 agamic," that's the gap if you can't find it in this.
22 MR. HARD: Well, Joe, as soon as you realize that
23 you have gaps in your study data, isn't that the point where
24 the alarm bell should go off rather loud and clear?
25 MR. IGNAZIO: Well, we do. You see, the trouble with

1 this, the politician, the decision makers, whoever they
2 are, they give you a sum of money to give them a whole
3 series of alternative courses of action, and this is a time
4 frame. This gives you dollars and time, and so you have to
5 have some delivery for them. They have to have some feeling
6 that this $2 million is going to result in pretty good
7 alternatives, be they technical or future. There are two
8 types of alternatives, but the technical alternative is
9 what we have been wrestling with for the moment.
10 If I feel as a planner that the technical alternative,
11 that there is some question about that for lack of these
12 gaps, then you see it won't hold up under the evaluation
13 block. It will show. It will say this technical alternative
14 is pretty good but there is a study gap in viruses that
15 constrains that alternative even though it went through
16 the whole process at got the blessing of everybody.
17 So you don't stop, but you acknowledge these things.
18 It's like a symphony where you hear flat notes. Somebody is
19 off. And that's the way we as planners plan to attack this.
20 Believe me, it should work because this process really has
21 never been entertained. Something like this has been done
22 in river basin systems. We've had about 25 years of
23 experience along those lines, but this is infinitely more
24 of a problem because we're right on the fringe of this heavily
25 urbanized area and this tidal cycle which is so valuable.

1 No question prioritywise of secondary treatment at Deer
2 Island. This surfaced yesterday. Prioritywise the money
3 might very well be spent at the combined storm sewer first.
4 Somebody said toxic -- we had an action diagram yesterday.
5 The first thing that came up was toxic and then combined
6 storm, and that was debated among us.
7 So this process would show that. This process would
8 show the decision even though the law of the land says you
9 will go secondary treatment, you won't get a grant to go
10 into an interceptor sewer. Marx nix, we've got to deal with
11 the people who control the law of the land.
12 DR. KRONE: Would you focus our activities this
13 morning, point out what parts of this we should address?
14 MR. IGNAZIO: If you can tell us that your model, John,
15 will make it possible to swim, that's good. If you can tell
16 us thatyour model will or will not make it possible to
17 fish and eat seafood, that's good. Some of the things that
18 Guy brought out yesterday are going on in here. It appears
19 that if you take the nutrient levels, the nitrogen limited
20 stage here, the erruption of toxics from what is now a
21 stabalized bottom, it seems to me you really challenge this
22 ability severely and it challenges the species aspect of
23 the fisheries.
24 They want everything, the people. They want to be
25 able to see -- they knew this as they grew up. I swam in here.

I wouldn't have -- I give this man credit for going in there with his diving suit. And that's what the people recognize. I swam from one side of Boston over to the Constitution. Why can't my son swim like that?

DR. MANCINI: Can I make an observation, Joe. From some of the numbers you threw on the board in terms of the modeling study, it seems to me that there was roughly $200,000 in the biological modeling and about a million six, I gues it was, for the physical hydrodynamics.

MR. IGNAZIO: And a million for sedimentation which ties in with some of the work that Guy is doing.

MR. SIMMONS: A million six includes about a quarter of a million for field measurements.

DR. MANCINI: I think there is a point here that we ought to be aware of. For a moment let's keep those figures in mind -- a million six, a million for physical processes, 200,000 for biological processes.

MISS JOHNSON: May I make one comment. I think that's 200,000 based on the fact that you first do a physical model.

DR. MANCINI: Yes.

DR. RYTHER: 200,000 wasn't a model in the first place.

MR. IGNAZIO: Fishery base line. That's a guess.

DR. KRONE: The numbers were one and three quarter million for phsical model.

1 DR. RYTHER: My particular model is beyond the state
2 of the art.
3 MR. TOLKOFF: Could we call it biota base line and
4 not fishery?
5 MR. IGNAZIO: I don't think you can call it biota.
6 I think you've got to call it fishery. We can talk about
7 it. It may become a biota but I think we've got to start
8 from A.
9 MR. TOLKOFF: The fish still have to eat.
10 MR. IGNAZIO: Yes, they've got to eat something. I
11 hope they don't eat that toxic algea.
12 MR. TOLKOFF: They don't, I'll tell you.
13 MR. HARD: What we're addressing here is could a model
14 based on existing data predict what the effects of extending
15 Logan runways, say, into the anchorage off President Roads
16 affect the hydraulic characteristics of the dredge channels
17 in such a way that shoaling problems would be greatly
18 increased.
19 DR. MANCINI: And that the specific kind of thing
20 I said there was a lack.
21 MR. HARD: It's a typical problem we have all the time.
22 DR. MANCINI: Can I get back to the point I was trying
23 to make before which was that one of the things that we
24 tned to do, and I'm not sure it's here but I havenoticed it
25 other places so let me transfer that experience, is we tend

1 to spend our money in our well developed scientific areas.
2 So the physical areas, hydrodynamics, where we know
3 essentially the fundamental equation, we spend lots of money.
4 The biological areas where our ignorance far overshadows
5 our knowledge, we tend to slide back a little, and I thought
6 I observed that in this funding here, but I'm not sure
7 that I have a true picture of the funding.
8 That's a real danger associated with the planning
9 effort.
10 MR. IGNAZIO: John, that's the history of our existence.
11 You just look at the research that's being done on electrical
12 energy. It's miniscule in lieu of the $200 million fire-
13 crackers that are thrown in different places in the country.
14 Now, we're not going to change that right away, but that's
15 the way we've gone.
16 DR. MANCINI: But as a planner, it seems to me that
17 that's an opportunity that you have as soon as you start
18 drawing your fish. It's to balance your resources so that
19 you use the well developed sciences to answer problems.
20 MR. IGNAZIO: We try this and it's not that simplistic.
21 DR. MANCINI: You use the biology that we have and be
22 aware and the only real point I'm trying to make, Joe,
23 be aware of overkill in well developed disciplines. I'm
24 not suggesting that you're necessarily doing that here. But
25 that is a problem.

1 MR. IGNAZIO: With the money I get, it's pretty hard
2 to overkill anything. It's an anemic budget because it's
3 a very comprehensive mission, an enormously comprehensive
4 mission. But what I'm concerned with, with a year-to-year
5 accounting system where you do something and you have a
6 payoff -- and what did I spend, $16 million. Oh, you got
7 rid of this. I can swim in Teenan Beach. Wonderful.
8 Carson Beach. Well, continue.
9 DR. MANCINI: Well, that was the way we were pushing.
10 Let me add to that, Joe, if on the other hand you have
11 high priority problems like extensions of runways, I think
12 I mentioned that specifically this morning, extensions of
13 runways, building of causeways, significant dredging
14 operations and this sort of thing, that's another whole
15 class of problem.
16 Then you may want to address that with a physical
17 model, or you may want to put the two mathematical and
18 physical hydrodynamic models together because they have
19 the same problems. You know, Henry has problems with his
20 ocean bay and I have problems with tidal boundary conditions.
21 MR. IGNAZIO: What's the payoff? You've got your
22 model, and you stated clearly to Al's question thatyou kind
23 of felt that circulation studies, although desirable, were,
24 in fact, not necessary to meet the water quality criteria
25 as you understand them to be.

1 DR. MANCINI: Right.

2 MR. IGNAZIO: If I had a public health official -- is
3 there a public health man in here?

4 DR. MANCINI: I think I said to evaluate alternative
5 methods of meeting the DO and coliform standards. There's
6 enough to do that.

7 MR. IGNAZAIO: The point is if we spend the money in
8 some form of solution to the combined storm system, --
9 interceptor, whatever -- are we going to have confidence
10 in being able to recreate in that beach, or are we going to
11 find that either the data that we used didn't have certain
12 dynamic aspects that it should have had in it.

13 DR. MANCINI: I would think, Joe, that there is a
14 reasonably high probability we will have confidence.

15 MR. IGNAZIO: We will succeed.

16 DR. MANCINI: We will succeed. The largest degree of
17 uncertainty will probably not be associated with our
18 knowledge of the water system but probably be associated
19 with our knowledge of what's coming from the land.

20 MR. IGNAZIO: You have more confidence in the tidal
21 aspect than you do on the fresh water?

22 DR. MANCINI: No, I don't have more confidence, Joe.
23 Let me put it this way, my lack of knowledge on the land,
24 I think, will have a greater ability to reduce the confidence
25 I have in the result of this planning effort than does the

1 lack of knowledge that exists with the water body.

2 MR. IGNAZIO: Well, then the next question really, I

3 think, is he has certain work that is accomplished. Can we

4 integrate that with any broader program? Let's give them

5 the benefits. We say, okay, we'll knock out the bugs,

6 satisfy the water quality thing as we know it. A new

7 creteria will come along and we'll examine that. We'll have

8 to answer the question of viruses on a separate basis,

9 a route that we were talking about yesterday that some of

10 our friends in Houston have done, whatever they have done.

11 Is there some way to take what he has and build on it, or

12 can it fit, will that 30 mm. shell fit our cannon?

13 MR. HARD: I seriously question whether it will fit

14 as it's stated. I think the mathematical model has to be

15 developed after the physical data are known.

16 DR. RYTHER: Apropos of what you said about there not

17 being enough input from the biology or enough knowledge

18 about the biology, I think the pollution problems here are

19 physical and chemical, and, if you can identify and correct

20 these, the biological problems will take care of themselves.

21 But I think the biological input comes from identifying

22 what these problems are that you have to know, what it is

23 that is affecting the biology, including the biology

24 of man incidentaly, before you can begin to correct

25 it. And I think a good example of this is the emphasis

1 that's been placed on coliform bacteria.

2 MR. IGNAZIO: It's too strong.

3 DR. RYTHER: Much too strong. You can go in and

4 eliminate all the coliform bacteria in Boston Harbor and

5 you still wouldn't be able to swim in it and you wouldn't

6 be able to eat the shell fish.

7 DR. McLEOD: You don't have an environmental data base

8 that will tell you what's going into the Harbor.

9 MR. IGNAZIO: This is what frightened me. If I can't

10 go before those people and say "Swim" after $50 billion

11 have been spent, that's bad news.

12 DR. MANCINI: There is a risk that we have taken as a

13 society, and what you're really saying is we're going to

14 stop taking that risk. Millions of dollars have been spent

15 trying to relate coliform levels to health in swimming

16 areas, and they have been notoriously unsuccessful.

17 DR. RYTHER: Well, millions of dollars have been spent

18 in measuring and assuming that there is a correlation, but

19 there's not been very much spent trying ---

20 DR. MANCINI: Well, I think the British have made a

21 significant effort to relate coliform concentration and

22 incidence of disease in bathers in water contact sports.

23 DR. RYTHER: I think any responsible public health

24 person today will tell you that coliform bacteria is an

25 outmoded, inefficient and unsatisfactory ---

1 DR. MANCINI: That's right. Even engineers will say
2 that.
3 MR. IGNAZIO: We used to swim in Magazine Beach and
4 have to move the stuff away. We did not turn green then.
5 We didn't have some of the toxics that we are dealing with
6 now.
7 DR. MANCINI: Might I suggest there are other types of
8 questions associated with viruses. I have never seen an
9 indication of what the virus content is in the finished
10 water supply in the Continental United States; that is, after
11 water treatment.
12 Now, it seems to me if we're going to attack the
13 questions associated with viruses, let us start with the
14 water we ingest, because it scares the pants off me.
15 MR. IGNAZIO: That's another story that would take two
16 days.
17 MR. HARD: While we're on this matter of public health,
18 I was talking with the Director of the Maine Sea and Shore
19 Fisheries Laboratory a few weeks ago, and I asked him about
20 the, it wasn't a Red Tide condition but it was similar,
21 associated with the Red Tide condition at Campobello where
22 I was camping this summer with my boy. We couldn't eat
23 shell fish then. We got talking about Frankling Roosevelt
24 and his polio, and there was a question whether his polio
25 was the result of actual polio virus or whether it was

1 produced by a mitonic toxin because the effects of Red Tide
2 poisoning are very similar to the effects of polio.
3 I think if you want to talk about public health in
4 Boston Harbor, then you have got to know quite a lot about
5 what's going to happen to the nutrient situation, and this
6 is being entirely neglected. What we've got here is a cook-
7 book study talking about DO and talking about fecal coliform,
8 not even fecal just lumped coliform, and as far as I'm
9 concerned that belongs in the ten cent store.
10 DR. KRONE? That's kind of tough talk. I think there
11 is something that maybe I could fill in here. Boston Harbor
12 is the focus of our conversation, water quality in Boston
13 Harbor and the future use of Boston Harbor. It seems to me
14 that many of us are looking at it from one side or another,
15 looking at one part of the water quality development of
16 Boston Harbor.
17 In view of the large objectives that you have described
18 and that are not pie in the sky, they're before us, I think
19 what we need to do is take a comprehensive look at the
20 whole jewel; that is, all at one time, combining the looks
21 at the smaller parts that we have. As you pointed out, to
22 build on available knowledge and studies that have been made,
23 take advantage of them where we can, but to provide enough
24 of a description of the whole thing so that we can really
25 achieve these objectives in a reasonable length of time and

1 with the money that can be gotten. So that while you may
2 disclaim the value of DO analyses or coliform organisms,
3 at least they are a start.
4 MR. IGNAZIO: That's a part of the objective.
5 MR. KRONE: If we recognize the limitations of those
6 but take advantage of what we have gotten out of them, then
7 it seems to me we can progress more effectively than if we
8 started from scratch.
9 MR. IGNAZIO: What do I need to do to build on these
10 coliform and DO?
11 DR. MANCINI: Can we take Ray's idea and maybe make a
12 list of things that should be done?
13 MR. IGNZAIO: I like that very much.
14 DR. MANCINI: I think that Henry and Ray had the very
15 first item on the list -- get one group that gathers all the
16 available information. That was the very first thing.
17 DR. KRONE: Find out where we are.
18 MR. SIMMONS: Not only gather but analyze. I don't
19 want to just put it in a pile.
20 MR. IGNAZIO: We have that group, believe it or not.
21 DR. KRONE: And really digest it.
22 FROM THE FLOOR: Is that group in the Corps?
23 MR. IGNAZIO: It's headed up by Martin Weiss. He's the
24 chief of the so-called technical subcommittee that's handling
25 this, and he's reinforced with whole army behind him,

1 including the Corps. Of course, he's the biggest polluter.
2 (Laughter.)
3 MR. IGNAZIO: So we'll get that. So then what? Where
4 else do I go on this road map?
5 DR. KRONE: If I may offer a suggestion to the panel,
6 everything that happens in Boston Harbor depends on the land
7 runoff and the hydrodynamics of the Harbor. So I think
8 the remainder of the studies are only as good as our knowledge
9 of what goes on in the Harbor -- water movement, sediment
10 movement.
11 MR. IGNAZIO: We've got a start on that, too.
12 MR. TOLKOFF: I've a question about that. That may be
13 true, but isn't it also true that we can do a lot to stop
14 that sludge, but when it's there, what happens to it. It's
15 the biology that's going to clean it up. Well, perhaps
16 we could physically dredge the bottom, but if we have any
17 chance of cleaning it out, I mean we're not going to go in
18 with a big screen and clean it out. So that has to be a big
19 question too.
20 DR. KRONE: You're way ahead of us. I want to start
21 at the bottom.
22 DR. McLEOD: Figure the inventory data which will include
23 the land runoff and hydrodynamics but you're also including
24 population movement around this land area.
25 MR. IGNAZIO: I'd like to not lump that in the inventory

1 data, Guy. Inventory data would be that which has
2 been done, whatever way it's been done.
3 DR. RYTHER: Can we back up just a minute and explain
4 what you mean by this inventory data? Is this different kind
5 of pollution?
6 DR. McLEOD: You mean just different studies that have
7 been completed and reported?
8 DR. MANCINI: At least I had something slightly different
9 in mind.
10 DR. McLEOD: I had something different in mind.
11 MR. IGNAZIO: We have study data too.
12 DR. McLEOD: I thought what you observed about inventory
13 data was stuff like Quabbin Reservoir -- what is it going
14 to contribute to the Harbor; what is going to be contributed
15 in runoff in the Greater Boston area. This includes all
16 your industrial input where they're coming in, includes
17 population movement, your new plants being built in the
18 whole city.
19 MR. IGNAZIO: That's identifying your problem really.
20 All right, it doesn't matter. If you want, we can sub-
21 categorize inventory data to do that too. So we're starting
22 off not only with that which has been done but that which,
23 the status quo, that which you know.
24 DR. KRONE: And fill in the gaps on the status quo.
25 MR. IGNAZIO: The money to fill in the gaps on the

1 status quo will have to come from a lot of other little
2 windows.
3 DR. RYTHER: There are a number of specific pollution
4 problems in the Harbor. There is human pathogen. There's
5 heavy metals. There's oil, hydrocarbons. There's pesticides;
6 nutrients.
7 MR. IGNAZIO: Your're identifying the problem.
8 DR. RYTHER: All right, what do we know about these
9 things? What do we know about their sources?
10 DR. McLEOD: That's where I'd be most concerned.
11 MR. IGNAZIO: That's why that block identifying problems.
12 DR. RYTHER: I don't think there is enough information
13 from what I've heard of where these things are even coming
14 from. How are you going to correct them until you at least
15 have good information on where they're coming from.
16 DR. McLEOD: I think your inventory starts with your
17 reservoir system, your MDC system, what's there, and what
18 is the contribution from overflow; what's the contribution
19 from your land runoff. Because in the case of our studies
20 just on a limited course, we really can't say where the
21 stuff is coming from.
22 MR. IGNAZIO: What you're saying is that apart from
23 that which has already been accomplished, which I have been
24 calling inventory data, you would like to see a listing of
25 sources.

1 DR. McLEOD: Well, I think the assumption has been,
2 I think many people make the tacit assumption that Deer
3 Island and Nut Island are the point sources of all pollution
4 of the Harbor, People tend to lump this all together.
5 That's where everything is coming in; that's where the
6 trouble is. This is not at all the case.
7 MR. IGNZAIO: All you're really saying is in defining
8 the problem we just look at the high points of the problem
9 called Deer Island, and other little problems are unknown.
10 So that block called Identification of Problems would be
11 where you do this exercise.
12 DR. McLEOD: It could be. I wouldn't just lump that
13 as reports that are publichsed as the inventory data because
14 I think they're very incomplete.
15 DR. RYTHER: I think you waste an awful lot of time
16 chasing down old measurements of oxygen or PH which are
17 suddenly meaningless unless you know why youre doing this.
18 MR. HARD: You almost have to start from scratch.
19 DR. RYTHER: Is this relevant to what you want?
20 MR. IGNAZIO: Yes, it is very.
21 FROM THE FLOOR: I would like to repeat my statement
22 of yesterday that inventory and data and collecting data
23 can only be done for a certain purpose, and we need the
24 biologists to tell us what data is valid to be collected.
25 We're saying that coliform is no good. We're saying that
DO is no good. Well, we have here the biologists probably

1 most knowledgeable about Boston Harbor. What perameters
2 are the ones that they want before we go collect them?
3 DR. McLEOD: Well, let me address myself by coming
4 back and saying that we find ourselves in the same quandry.
5 That's why we're looking very critically at the Quabbin
6 Reservoir, particularly the input to the Quabbin Reservoir,
7 particularly the industrial input, and looking at the
8 economic trends and so forth. We don't believe that this
9 concentration on coliforms and all the rest of it is really
10 telling us anything about the biota of the Harbor. Until
11 you can find those inputs, it's very hard to do.
12 MR. VITTANDS: There are many, many inputs and much
13 money spent looking at all the inputs. We need to identify
14 which are the important inputs, where they're coming from.
15 DR. McLEOD: You can take one area and address yourself
16 only to the problem of things that are of an exotic or --
17 and/or toxic nature. This we can define. I think you've
18 got to identify those, and then you can have some handle on
19 what is possible to exist in such an environment. That's
20 how you're going to modify that in order to have either a
21 more diverse environment or ---
22 MR. VITTANDS: I think it is fairly safe to say that
23 most toxic inputs are of an industrial nature. They are much
24 more accountable than the other inputs.
25 MR. HARD: We just mentioned toxins of a biological

1 nature associated with nutrients.

2 DR. McLEOD: Your experts are talking about excretion

3 from algae and what have you. This would be in this whole

4 toxic inventory, if you want.

5 DR. HARD: The secretary can't read all of the name

6 cards, so it would be helpful to give our names.

7 MR. VITTANDS: I'm Jekabs Vittands. V-I-T-T-A-N-D-S.

8 DR. KRONE: You have a good point, that is, need to

9 simplify or narrow down the things that we ought to look

10 fro to evaluate.

11 MR. IGNAZIO: If you want to give me a list of that,

12 I'll take anything.

13 DR. RYTHER: As I say, I tried to identify some

14 specific pollutants which result in specific pollution

15 problems in the Harbor. I think you have to realize

16 that these are quite different. Their effects are different.

17 Their origins may be quite different, and they have to be

18 handled separately.

19 DR. McLEOD: I think John identified it. He's quite

20 right, the elements, the metals, the oils, all the classes

21 of chlorinated hydrocells.

22 MR. IGNZAIO: What you're saying, I think, John, is

23 simply is some hard basic data has to be acquired in your

24 view.

25 DR. RYTHER: And this is a beginning.

1 MR. SIMMONS: I think they way this thing is going,
2 maybe I was naive in suggesting that one individual in one
3 group be assigned this whole task. It looks now like it
4 falls under so many different disciplines.
5 MR. IGNAZIO: Can we have these disciplines known?
6 This group is a pretty big group.
7 MR. SIMMONS: What I'm saying is this hydraulic and
8 hydrologic data could well be gathered and analyzed by one
9 group who had the particular competency.
10 MR. IGNZAIO: Form a subcommittee.
11 MR. SIMMONS: Whereas the biological data could best
12 be gathered and evaluated by a completely different group,
13 in fact two groups.
14 DR. KRONE: The MDC might do an inventory of sources.
15 MR. IGNAZIO: Well, how does this set with you, Al? We
16 have certain bio-people in the family.
17 MR. FERULLO: If we don't have them on our subcommittee,
18 we can find them. No problem. I think we have to identify
19 what are the harmful substances in the Harbor before you
20 start trying to find out where they come from. That's a
21 good beginning, and somebody has to list those.
22 But getting back to the uses of the Harbor or goals,
23 we should address ourselves to the goals first. What do we
24 want in the Harbor. We touched on that yesterday. Maybe
25 I'm just repeating myself. We want bathing, water contact

1 sports. This would include good shell fishing and good
2 fishing.
3 Now, what is it that is precluding some of these uses?
4 DR. McLEOD: That's certain localities, I think.
5 MR. FERULLO: We have to look at all the localities.
6 DR. McLEOD: Yes, but in terms of your clam beds that
7 have been closed, it's fairly obvious, the high coliform
8 count which was being mentioned as a public health
9 responsibility.
10 MR. FERULLO: Okay, so we know that coliform ---
11 DR. McLEOD: You know this in certain areas. In certain
12 other areas you have a very anerobic anoxic condition partly
13 generated by the hydrography that's there.
14 MR. IGNAZIO: How much harm are they doing and what
15 should be done about that?
16 DR. McLEOD: This is a very tough thing to answer
17 because you're now really asking for public acceptance
18 of your making those areas either economically viable for
19 shell fishing or for bathing. This is a question I don't
20 feel competent to address myself to because you have taken
21 a small area off one of the outfalls where people have
22 collected clams, and it represents X number of dollars.
23 Now, is it worthwhilte to clean this up? I don't know the
24 answer. I think if you look at the whole Harbor, this is a
25 very tough thing to answer.

1 MR. FERULLO: We ought to get those answers before
2 we spend a fortune trying to bring the Harbor back to the
3 times of the pilgrims. We want to find out what we want
4 to use the Harbor for and spend the money in a way that
5 would bring about those uses and those goals.
6 DR. RYTHER: Take the problem of nutrients, for example,
7 this could conceivably cause eutrophication and unpleasant
8 blooms of algae and organic sedimentation and a lot of other
9 things that are associated with nutrients. A tide flat covered
10 with sea lettuce is usually a result of too much nutrients,
11 and this is an aesthetic value that will affect the use of the
12 beach for swimming. Or if the water is all soupy green colored,
13 things like that. So this I think should be looked at to see
14 whether nutrients are indeed a problem.
15 MR. FERULLO: This has been looked at.
16 DR. RYTHER: I don't believe -- well, you don't have
17 the problem because you have a sediment problem that is
18 probably masking that and making the area unsuitable for
19 the growth of algae. But you have the problem some place.
20 MR. FERULLO: May I ask Mr. Mancini to answer that
21 question? Your report goes into the nutrients and use
22 of the nutrients and using nitrogen as limiting and
23 so forth. You predicted to some extent the kind of bio-
24 populations that you would anticipate.
25 DR. MANCINI: What was done, it was a very simplified

1 approach, but what was done was to take the total nitrogen
2 and total phosphorus within the system under present
3 conditions and under some projected growth in population, and
4 to play the "What if?" game. What if all of this material
5 were converted to plankton, what kind of levels of plankton
6 would I have? And the result of that game indicated that
7 that was not a significant problem within the time frame
8 of population projections which I believe were to the
9 year 2000.
10 DR. RYTHER: Don't you have to have some pretty good
11 knowledge of what the retention time is in the system, in
12 the flushing rate?
13 DR. MANCINI: Right. Now, what was done, what was
14 done prior to that was to take '67, I believe, '68, '69 data
15 and to take the known inputs in that area, compare a
16 calculation of what the profiles were for the nutrients
17 under those conditions, there is reasonable agreement, and then
18 make a projection for future loads increase, I think, by 50
19 percent, and that gave you a different nitrogen and phosphorus
20 concentration and then we played the "what if" game with that.
21 If I might make a comment here, I think a number of
22 comments have led to the point that there are in fact four
23 steps that must be taken simultaneously as part of the
24 first step in the planning. And they are in no order of
25 importance, I think they have to be done together. They are

1 problems and objectives must be identified in Boston Harbor,
2 and some priorities have to be established, but not until
3 you've looked at the rest of these steps.
4 The second step is some indication has to be obtained
5 of the alternatives that are going to be examined with the
6 tools that we're trying to develop. Example, if the heavy
7 metals problem and the toxicant problem is a real one that
8 we're concerned about and has a high priority, then what
9 do we think we can do about it. What are our administrative
10 or structural alternatives to alleviate that problem.
11 The same is true of the sediment problem, airports, this
12 sort of thing. What are those problems and what are their
13 priorities, and then what are the alternatives that we will
14 consider to alleviate those problems?
15 The third thing would be what kind of information
16 is available, and this is the data base sort of thing,
17 what kind of information is available to assist us
18 (1) in quantitizing that problem, (2) identifying the
19 inputs that are causing that problem be they man made or
20 natural, so that the data base as I can see it now must
21 contain the input information. Then we need physical,
22 chemical and biological data on the systems. This means
23 the shore, the water, the current measurements and every-
24 thing else. And also as I would see it in this what's
25 available base, we need information on population, present

1 projected movements, as Guy pointed out. We need information
2 also on the tools that are available to understand the
3 phenomena and to relate the inputs to the problems, and
4 those tools can be, as Ray pointed out, of two types.
5 There are actual things like computer programs.
6 Frankly, those are really minor parts of it. It's
7 our conceptual understanding of the relationship between
8 inputs and effects that are really the important thing, and
9 those have to be identified in this data base.
10 And then finally I think we have to stop before we
11 go plunging ahead and do things and look at whatever needs
12 the study might have. As an example, Joe, you said you
13 have to interface with the people. You may, in fact,
14 need some tools that are not available now to interface
15 with the people.
16 MR. IGNAZIO: That's why I'm going to take a piece of
17 that $2 million to develop tools. I have a very ambitious
18 open-planning program. It will make the Cardinal, the
19 Bishop want to do this type of thing. (Laughter.) This
20 is the type of thing we're going into.
21 DR. MANCINI: That's going to be a good program.
22 MR. IGNAZIO: Fantastic, but that's the type of grass
23 roots thing we're trying to do so that you get this inter-
24 action back and forth. I've got to go to that criteria
25 block.

1 DR. MANCINI: But it seems to me those four things
2 have to be done.
3 MR. IGNAZIO: None of you have talked about the
4 technical criteria. None of you have talked about the 18 CFR,
5 the Muskie-Blatnick Bill criteria. You've done a pretty
6 good job in identifying these questions of looking at
7 alternatives. We have certain alternatives we can use.
8 We know we can identify input, but we have some gaps here.
9 DR. MANCINI: You can probably go with what you've got.
10 MR. IGNAZIO: I think we can go, yes. It's a Model T,
11 but I think we should go. What bothers me is that I wish
12 that I knew the type of thing that my colleague Jake said,
13 what parameters should I put high on the list.
14 DR. MANCINI: The control parameters. We're getting
15 problems and objectives.
16 MR. IGNAZIO: Maybe we ought to stretch for coffee.
17 (A short recess was taken.)
18 MR. IGNAZIO: Can we resume now so we can get another
19 piece of work done before we break for lunch?
20 Let's see if we can get somewhere with this listing
21 of some of these parameters which are of concern and putting
22 the bad ones as high as we can on the top.
23 Who in the panel wants to start that off?
24 MR. HARD: I would like to say that perhaps rather
25 than looking at individual parameters, we should look at

1 systems that involve parameters. I'm thinking of some
2 of the parameter collection lists that don't have any
3 organization, and I think we could use a lot of effort
4 in that direction.
5 MR. WEISS: I kind of agree with that. I don't know
6 if we can get a laundry list of parameters right now, and
7 maybe the point is that part of our study should be to
8 determine what the parameters should be.
9 MR. HARD: I think if you take a system such as
10 circulation, and then you had the right man or men looking
11 at that problem, then they would prepare their own laundry
12 list.
13 MR. IGNAZIO: So you put circulation system high on
14 the list?
15 MR. HARD: I would put that very high.
16 MR. IGNAZIO: How do the rest of you feel about this?
17 MR. COSGROVE: Circulation, I would put that way down.
18 MR. IGNAZIO: Good, let's debate.
19 MR. HARD: That's what we've been doing for the last
20 ten hours.
21 MR. COSGROVE: That's a result of listening to what's
22 been said here. I don't think that circulation is the
23 problem here. It is one of the things that we have to
24 determine immediately in order to solve the problems that
25 we are trying to solve.

1 MR. HARD: If we had a chance to look at the MTA
2 from scratch, I think we would probably design it a little
3 differently, wouldn't we? I'm wondering whether we should
4 go on increments forward, an increment forward, rather than
5 taking a look at the system. When you say low priority,
6 you mean that as it refers to a long range goal or that
7 it is irrelevant?
8 MR. COSGROVE: Not irrelevant but I don't think it is
9 essential, as essential as other factors. Attack the problem
10 that we are primarily concerned with, improving the condition
11 of Boston Harbor due to the pollution that enters.
12 MR. HARD: Are you satisfied with the statements
13 that were made here that regardless of reducing the
14 coliform in the Harbor that that still may not provide
15 suitable bathing?
16 MR. COSGROVE: Oh, yes, I'm satisfied with that. I agree
17 with the general opinion that seems to be prevalent here
18 that coliform is not an indication of the quality of the
19 water for all purposes that man uses it for. I would say
20 that my reaction to a physical model is that the Harbor
21 is so dynamic that the physical model would be helpful
22 but it wouldn't give us answers of the detail that we want
23 to get. I don't think we'll ever get the answers. I
24 don't think that man has the capability of coping with the ---
25 MR. HARD: So that we're not going to settle for the ---

1 MR. COSGROVE: Let me give you a for instance. When
2 we were building the outfalls to the end of Deer Island
3 Flats back in the early '60s, we had 120 inch pipeline that
4 was partially constructed -- by partially constructed, I
5 mean it was constructed about half its length was constructed
6 out into the bottom of the ocean -- was secured, was held
7 for winter operations, winter shutdown. When we came back
8 in the spring, there were 12 lengths of pipe missing.
9 Four of those lengths ofpipe have not yet been found.
10 We had one heck of a good northeaster that came in.
11 When we finally got back into construction, we got
12 the outfall built out to the edge of Presidents Roads,
13 and this was all designed after very careful and detailed
14 bottom surveys, mechanically done not using a chart. We
15 found that there had been a change in the slope of Presidents
16 Roads, so that if we were going out, that the last three
17 lengths of pipe we intended to go out, and the pipes were
18 shorter then, amounted to 20 feet, we would have to have
19 a pylon structure that stuck up 18 feet from the then
20 bottom. To me it was a rather dangerous thing to do
21 since we know the currents there are pretty high. So
22 we cut that back to theplace where the piles, the length
23 of the pile structure was only five or six feet.
24 Now our divers have pictures that show that the end
25 of that outfall today is entirely covered with gravel and

1 huge boulders. So there are so many things going on
2 on the bottom of that Harbor due to these northeast storms
3 that whip right in there that a physical model is going
4 to just give you a very approximation of what goes on in
5 there, and I think we have an approximation now.
6 MR. HARD: I'd like Mr. Simmons to comment on this.
7 MR. SIMMONS: Well, I can't deny what you say. Changes
8 do take place in these systems. I mentioned yesterday
9 I think the Deleware estuary model which now has been in
10 existence 20 years, I think that by now all portions of
11 that model have been updated two or three times just to
12 keep abreast of the sort of thing that you're talking
13 about. So this isnot a static situation. You just don't
14 build a model to an existing survey and use it forever
15 more without keeping it updated when changes take place.
16 MR. IGNAZIO: You simulate northeast storms,
17 hurricanes, this type of thing.
18 MR. SIMMONS: This can be done. I don't know that
19 it's necessary for the kinds of things that we've been
20 talking about here, but these features can certainly be
21 built into a model. We reproduced the hurricane surges
22 in the Narragansett Bay model. That was the basic
23 phenomenon that we were studying.
24 MR. IGNAZIO: I think that's how we got our basic
25 design 15 years ago. What are you saying, that if the

1 model were constructed, there would be with it an updating
2 of the physical form, in other words?
3 MR. COSGROVE: I think that would be necessary. I
4 don't deny that. I don't deny that you could construct
5 a model and get a lot of information out of it. I'm not,
6 again, the model type of a guy, but I don't think that
7 the model should be of a high priority. That's the point
8 I'm trying to make.
9 MR. SIMMONS: Well, I don't either. My recommendation
10 yesterday having to do with a physical model of Boston
11 Harbor was sort of a philosophical sort of a thing.
12 Here's the point I was trying to make. You've got this
13 water quality study right now. You've got an 18-24 month
14 time frame on it. I doubt seriously that you could get
15 this model in a testing state in time to give you much
16 aid during this 18-24 month period. But next year there
17 will be another study, and then next year there will be
18 another study.
19 MR. COSGROVE: Well, yes, in talking about that,
20 this is the second generation for me because I started
21 back when Quabbin was being built, and we got the water
22 for Boston, and then we had to get it the hell out, so
23 we built Deer Island and Nut Island. And these same types
24 of studies were made at that time with less precision
25 and without the excellent tools we have available now,

1 no mathematical models but a lot of float tests and what not,
2 die tests and such things as could be used, and we didn't
3 do too bad a job. They still work.
4 MR. SIMMONS: The thing I was emphasizing yesterday,
5 take the New York Harbor model. It is the example I used
6 yesterday. It was built for a very limited purpose, and
7 within a matter of a year or so, that need was
8 accomplished, that objective was accomplished. An yet now,
9 18 years later, there is a backlog of studies for that
10 model which will keep it busy for the next two or three
11 years.
12 MR. IGNAZIO: People have been using it.
13 MR. SIMMONS: Yes. It hasn't been idle more than one
14 year in the 18 year period it's been in existence.
15 MR. IGNAZIO: You had two parts to your proposal
16 yesterday. You had the part of actually getting the hard
17 data versus the physical construction of the model. How
18 do you feel about the hard data portion?
19 MR. SIMMONS: I am completely in accord with Carl
20 Hard on that.
21 MR. IGNAZIO: You feel that the hard data part of the
22 circulation system is necessary?
23 MR. SIMMONS: I feel exactly as he does that unless
24 you fully understand the hydraulics and circulation of
25 Boston Harbor, then I don't think you can do a high quality

1 study of the kind that you are faced with right now.
2 MR. IGNAZIO: And that could be done for a quarter
3 of a million dollars?
4 MR. SIMMONS: About that, I think.
5 DR. KRONE: I should urge that you add on to that,
6 before you get away from it, the runoff, a description
7 of the runoff.
8 MR. IGNAZIO: How does that set with this side of the
9 room? Can we have some discussion on that?
10 MISS JOHNSON: I'd like to ask a question. With
11 reference to Mr. Cosgrove's remark about his feelings,
12 if I am correct, that we didn't need a circulation study
13 at this point or at least to the extent that was mentioned
14 yesterday. I have a question that has two sections. The
15 first section, I hope, will be answered by Raymond Krone and
16 the second by Dr. Ryther.
17 The first part of it is that I am wondering whether
18 or not you can have an adequate sedimentation study unless
19 you know not only where the sediments are coming from but
20 how these bottom sediments are moving once they are in
21 the Harbor. And, after that, I'm wondering if you can do
22 an adequate biological study without knowing not only
23 where the toxics are coming from but how they're moving
24 around the Harbor. And those kinds of things have to come
25 from a circulation study.

1 MR. IGNAZIO: What you're saying is you support a
2 circulation study as a No. 1 Item.
3 MISS JOHNSON: As a No. 1 Item to carry on sedimentation
4 and biological studies.
5 MR. IGNAZIO: Can we get comments on that?
6 DR. KRONE: I can't help but agree that the material
7 moves with the water, moves off the land with water flow and
8 moves in the bay with the water movement. And further,
9 when you talk about materials that move intermittently -- that
10 is, intermittently with regard to water movement -- the
11 character of the water movement is especially critical.
12 I think Dr. Thomann yesterday pointed out that it's
13 easty to satisfy stage -- that is, water surface elevation --
14 and that it's much more difficult to satisfy, to describe
15 water movement -- that is, current. And it's just about
16 that much more difficult to describe sediment movement
17 if you know the current movement. I feel that if sediment
18 motion is important, as I explained yesterday I believe
19 it is important as far as water quality, that it is
20 necessary to have as good a description of the hydraulics,
21 the water movement as is conceivable.
22 MR. IGNAZIO: And that such a description would come
23 from an expenditure of a quarter of a million dollars?
24 DR. KRONE: A quarter of a million dollars was to
25 gather field data.

1 MR. IGNAZIO: And you need the mathematical model in
2 place of it.
3 DR. KRONE: And you need both field data and some kind
4 of a way to put that data together.
5 MR. IGNAZIO: What you're saying is you need the field
6 data and the model, whether thatmodel is a map or a
7 physical ---
8 DR. KRONE: You can't afford to go out and get all
9 the field data you need. You have to get the field data
10 that is essential to the development of a description.
11 MR. IGNAZIO: Would you support -- can we conclude
12 that either a physical or math model should be used in
13 this instance? What would be the favored situation here?
14 DR. KRONE: I can't answer that.
15 MR. IGNAZIO: Let me say that a different way. Would
16 both a physical or math model do the type of job that we're
17 looking for?
18 DR. KRONE: I'll answer that by pointing out in more
19 detail needs that we have. The mathematical model, as
20 I understand it, as John described it, is a two dimensional
21 model that assumes uniform vertical flows, uniform velocities.
22 In the case of sediment motion, you need more than that.
23 You need a velocity profile, and a physical model can give
24 velocity profiles not as precisely as field data would
25 but at least -- would you agree with me there?

1 MR. IGNAZIO: John?

2 DR. MANCINI: Yes, absolutely. I'm sorry. I thought
3 you were talking to Henry. No question about that. As a
4 matter of fact, from my assessment that's pretty close to
5 the state of the art if not beyond the state of the art,
6 three dimensional modeling of the tidal bodies like this.

7 DR. KRONE: Now physical models have a weakness in
8 that area. They are not very good, even the sewage systems
9 are not very good in shallow areas; that is, in mud flat
10 areas where a lot of our concern of sediment motion is.

11 MR. IGNAZIO: Would you classify this as a shallow
12 area?

13 DR. KRONE: Oh, yes. The numbers I read here are 4,
14 2, 1, 5 and so on. This blue area is all less than, on
15 this map it looks like three fathoms, something like 50
16 or 70 percent ---

17 MR. IGNAZIO: Those are feet and not fathoms.

18 DR. KRONE: I converted. Les than 18 feet.

19 MR. IGNAZIO: In your mind, Dr. Krone, you're saying
20 that the physical model has certain limitations in that
21 shallow configuration?

22 DR. KRONE: I think Henry pointed this out yesterday
23 that you need both. That's my answer, you need both.

24 MR. VITTANDS: I'd like to ask a question. With a
25 movement in the technology that John Mancini has referred

1 to, the effort being exerted towards being able to model
2 velocity solutions, and No. 2, and this I don't know
3 really, the movement in technology in field measurement
4 techniques, whether an investment to a field measurement
5 technique that perhaps may be of a continuous nature even

2-65

1 to, the effort being exerted towards being able to model
2 velocity solutions, and No. 2. and this I don't know
6 for the flow patterns may not be a more wise investment
7 then building of a physical model. You will continuously,
8 knowing that there are changes, natural changes in the
9 estuary, you will continue to have to go and assess those
10 anyway.
11 DR. KRONE: That's true, but the physical measurements,
12 measurements in the estuary, actual field measurements in
13 the estuary will have to be made to keep upgrading the
14 model. But the field measurement cannot enable you to
15 predict the effect of a change in the estuary, change in
16 the system. If you want to make any kind of a change in
17 the system, input or boundary conditions, water inputs
18 or boundary conditions; that is, configurations.
19 MR. VITTANDS: Right.
20 DR. KRONE: Then it's essential that you have a model.
21 MR. VITTANDS: We're not talking about massive water
22 inputs. I don't see an alternative where this would
23 change the hydrodynamics of the estuary. I can't see
24 except for the natural inputs that are occurring now, I

1 the hydrodynamics of the estuary, at least for water
2 quality now.
3 MR. HARD: Just by changing the salinity.
4 MR. VITTANDS: Well, Mr. Mancini, what is the salinity?
5 DR. MANCINI: Very flat.
6 MR. VITTANDS: Precisely. The only thing that will
7 change the salinity ---
8 MR. HARD: Based on how much data at depth? How about
9 these pockets of fresh water that are floating around?
10 DR. MANCINI: I think you are identifying here a
11 problem. What scale of hydrodynamic information do I need?
12 Do I have to know what the currents are every thousand
13 feet apart, every six inches apart? Do I have to know
14 what the currents are in both three dimension? Do I
15 have to know what the current variation is over seconds,
16 fractions of a second, hours, days? What is the scale
17 of the hydrodynamic output that I need to answer my problems?
18 MR. HARD: Rather than put it down. You know, I'm
19 always faced with the problem of a project engineer coming
20 and saying, "We're going to dig a channel here. How many
21 borings am I going to need?" And you know, figuring the
22 whole damn thing out in advance, what you need to do is
23 find out what's happening and as you collect data, you
24 going to find you need to modify and get some other
25 information. You can't just set up a cookbook, and that's

1 what you're asking for.

2 DR. MANCINI: No, I'm asking for the order. Do I

3 need output from a calculated output or a measured output

4 from a physical model every 6 inches in the Harbor, every

5 500 feet, every thousand feet or every 3,000 feet? Do I

6 need information on a time scale of seconds, minutes,

7 hours, days, or weeks? That's significant and different

8 from ---

9 DR. KRONE: Let me answer that. The point is, as you

10 are trying to bring out, the point is you can't afford to

11 go out in the bay and make measurements every thousand

12 feet, just to use your numbers, in a thousand foot grid

13 to determine what's happening there at that portion of it.

14 You can afford to go out and make measurements in critical

15 points in estuaries to determine by our understanding,

16 i.e. our models, conceptual, mathematical or physical,

17 of the movement of the water at particular times; that is,

18 for a short period of time, so as to verify or confirm

19 our concept or physical or mathematical model. Then you

20 can take the mathematical model or the physical model

21 or concept and interpolate between those measures and

22 extrapolate.

23 An important thing I'd like to emphasize is that for

24 particular problems involving particular areas, interpolation

25 is the important thing. For modifying particular areas,

1 extrapolation is the important thing. And for determining
2 what the effects of particular modification of particular
3 areas are on the whole system, then real extrapolation is
4 important and the scale needs to be adjusted in proportion
5 to the kind of affects you're looking at.
6 So the point is there isn't an answer to your question.
7 There is a multitude of them which indicates that if you're
8 worried about the affect of a dock on a shoreline, then
9 you might want a hundred foot grid or a 50 foot grid.
10 If you're interested in the standing crop of algae out
11 in the Presidents Roads area, maybe a half mile grid may
12 be appropriate. The point is you need the capability,
13 you need a capability for interpolating as finally as you
14 need to solve each problem of concern, and you need to
15 develop that capability so that as new problems come up,
16 you can take them up.
17 DR. MANCINI: Let me carry that a step further.
18 As an example, for the sediment transport work, you need
19 vertical velocity distribution. For water quality work,
20 this is really not important at the level of our knowledge
21 today, 1972, in a Boston Harbor. Now it's certainly
22 important in a Lake Erie.
23 DR. KRONE: You have knowledge I don't have.
24 DR. MANCINI: When I say water quality, I mean the
25 classical water quality constituents -- nutrients, DO,

1 this sort of thing. So that the kind of hydrodynamic
2 modeling you need is directly related to the kinds of problems
3 and alternatives that you're trying to evaluate.
4 DR. KRONE: I think a point that Carl is trying to
5 bring out -- if I don't describe it correctly, correct me --
6 is that this is the first cut, you know, what you described
7 is the first look at the problem. You look at the
8 obviously worst aspects of it or obviously most important
9 aspects of it, but suppose -- and I think this is not
10 a "what if" I think it does happen -- suppose that one of
11 these northeaster storms comes in, large amounts of organic
12 material are resuspended from the bottom. What is the
13 DO picture for the following three days. Now your model
14 doesn't answer that kind of question.
15 MR. VITTANDS: No model does.
16 DR. KRONE? Well, I think a model could. I don't
17 know of any that does. That's one kind of a question
18 that you might be concerned about, and I think that's one
19 of the ones listed.
20 DR. MANCINI: As a matter of fact, Ray, if you're
21 willing to take a little liberty, you could take a first
22 cut answer at that question too with existing hardware.
23 DR. KRONE: We have the capability. Another one,
24 and I'll hit closer to your heart with this one, when you
25 model algae blooms, an algae bloom takes place in a two-day

1 or three-day time period, the ones I'm familiar with, and
2 unless your model has a time scale on the order of half
3 a day or a quarter of a day, you're not going to see this
4 bloom, and yet it's the high point, the peek that it kills
5 fish. So we need to refine our biological model -- oh,
6 and the second point was that the standing crop of algae as
7 I elevated it yesterday,depends on the rate of multiplication,
8 on the rate of dillution on the predation and something else, but
9 anyway, there are all these rates involved. In order to describe
10 the algae bloom even approximately, it is necessary that all
11 those rates be known accurately because of difference and
12 differences in rates are very unstable. So that this gets
13 back to answering your question, Sandy, that in order to
14 answer these questions accurately, we need the basic
15 information which is, I think, circulation; and that is,
16 we need to be able to describe the physical problem as
17 accurately as necessary to answer each of these questions.
18 DR. MANCINI: Are you going to hook the panel with
19 recommendations here?
20 MISS JOHNSON: I would like the second answer to my
21 question.
22 MR. IGNAZIO: I'm a man at sea, John. I'm just
23 trying to get to the new world.
24 DR. MANCINI: So long as we're not signing our name
25 to anything.

1 DR. RYTHER: Will you state the question, please?

2 MISS JOHNSON: The first half was in order to do an

3 adequate sedimentation study, if you didn't need to have

4 a circulation study to understand how the bottom sediments

5 were moving, I was wondering if biological studies would

6 also be dependent on circulation studies to understand

7 how the toxic materials were, not only what the sources

8 were but where they would go to in the Harbor or where

9 they would be deposited and also where there might be the

10 most activity with the water column depending upon the

11 circulation and particularity or the quiescent state or

12 whatever.

13 DR. RYTHER: Well, to some extent, sure, you can go

14 out and measure them directly rather than predicting them

15 from a physical circulation model. The easiest way to

16 find out the distribution of pollutants in the Harbor would

17 be to go out and measure them.

18 MR. HARD: This would fall into the same category

19 and turbidity studies.

20 DR. RYTHER: If you want to understand, then you

21 obviously have to know something about the circulation

22 patterns that carried them there and let them deposit there.

23 MR. SIMMONS: Or if physical changes are contemplated,

24 you need that in the prediction.

25 MISS JOHNSON: Or even in cases of combined sewer

1 interceptors, in order to effectively solve the problem,
2 you have to know where to begin, what kind of circulation
3 and which areas are mosti mportant to close off.
4 MR. IGNAZIO: Are you saying that you would support
5 a circulation study?
6 DR. RYTHER: Oh, absolutely.
7 MR. TOLKOFF: I think that circulation studies are
8 important. I think you have to know where things are
9 coming from and also where they are going to go. Another
10 thing that I think you have to know is what's there now,
11 and I don't think you know what's there. What's going to
12 move that is there now?
13 MR. IGNAZIO: Our basic base line ---
14 MR. TOLKOFF: Where is thiss stuff, and that is
15 completely unknown, well almost.
16 DR. RYTHER: The way I see this problem is you have
17 pollutants and I've got four classes of them. I've got
18 pathogens, and I won't argue whether this is coliform
19 bacteria or viruses. They come from the same source and
20 they behave in much the same way and are distributed in
21 the same way too. I've got oil, and hydrocarbons in general;
22 trace metals; and nutrients. That's four general categories
23 of pollutants that I believe are the important ones in
24 Boston Harbor. There may be others.
25 Now these behave in different ways, so they have to

1 be considered separately but you can still list them under
2 pollutants. It seems to me the first thing you need to
3 have is an inventory of what's in the Harbor. Is it a
4 problem or isn't it, in the water, in the sediments, in the
5 animals? Is it exceeding the standards? Is it biologically
6 dangerous? Is it interfering with these various objectives?
7 Then how does it get there, and here you need to have input.
8 You need to know where it comes from and what
9 quantities from all the various sources, and we don't
10 know that yet, and what affects its distribution and
11 concentration in different parts of the harbor. And here,
12 circulation and sedimentation, and I think this is where
13 circulation belongs in this general scheme of things.
14 You need it to understand not only how things got there
15 in the distribution that they are found, but how this would
16 be affected if you changed any of these inputs or changed
17 the circulation in any way, the topography.
18 MR. IGNAZIO: Where is your base line, John, in inputs,
19 the base line he speaks of?
20 DR. RYTHER: I am talking about the inventory of the
21 Harbor, and the water and organisms and sediments as being
22 an inventory of what the problem is now. First you have
23 to know that. Simultaneously you can begin to try to
24 figure out where it's coming from and also begin to study
25 the circulation and sediments problems to understand how

1 it got there.

2 DR. KRONE: I would like to emphasize that not only

3 the amount but the rate. The rates are really crucial.

4 MR. IGNAZIO: When do you do your contribution on that?

5 MR. TALKOFF: As well as changes. I mean over a year's

6 time in a northeaster, does that bottom change? Are the

7 animals swept out? Does that sludge move?

8 DR. RYTHER: You take an inventory over a period of

9 time so that you get a good picture of what the situation is.

10 MR. TOLKOFF: Is that one year? Does every northeaster

11 clean it out? Is it that bad, or is it a long time thing?

12 MR. IGNAZIO: Here's a question for you, Guy, how

13 much contribution would you say you have, if any, toward

14 such a baseline now, the probes, the borings, the data

15 that you have? Would it lend itself to a baseline?

16 DR. McLEOD: We've got two years of data. We've got

17 a very modest baseline, but what you're talking about now

18 is an input study and this sediment accumulation study and

19 rate study.

20 MR. IGNAZIO: You're doing that now?

21 DR. McLEOD: We're trying. I think the one thing is

22 all these three things have to go on concurrently, because

23 I'm not convinced if Gilbert goes out and takes a core

24 tomorrow that he'll find the same depth of core, the same

25 characteristics after we have a storm, and he's not convinced

1 either. This is one of the things that worries him.
2 He's collected 150 cores. He doesn't know if he drops
3 one six inches whether he's going to find the same amount of
4 material or the same rate of composition or accumulation.
5 DR. KRONE: Normally, you don't.
6 DR. McLEOD: That's why you like to scatter the cares.
7 MR. IGNAZIO: This ties in with what Martin said
8 about us being just human.
9 DR. McLEOD: The data we have collected show that it's
10 the same general trend. After a storm,of course, you are
11 going to get increased coliform which is what people have
12 measured. Nobody has measured any viruses.
13 MR. IGNAZIO: Are we saying tought, Guy, that this
14 type of circulation study would give us a handle on what
15 may be taking place whether it's after a storm or normal
16 period of ---
17 DR. McLEOD: I don't think it's going to tell you
18 anything about the water quality itself. It's going to
19 tell you a great deal about ---
20 MR. IGNAZIO: About the bottom.
21 DR. McLEOD: About the bottom.
22 MR. IGNAZIO: About how she moves, how she might
23 behave under the influence of the stuff.
24 DR. McLEOD: We can define right now from our data,
25 I think, maybe three or four meteological events that take

1 place during the year and how they're going to affect
2 what happens to DO, to coliform.
3 MR. IGNAZIO: You have a sketch?
4 DR. McLEOD: We have a sketch on that. This does
5 not apply in any way to accidents like oil spills nor does
6 it apply in any way to sediment distribution or rate of
7 accumulation or what have you.
8 DR. KRONE: I would like to augment that by saying
9 in order to make a predictive model, it's going to be
10 necessary to determine the interaction between the sediments
11 and the heavy metals.
12 DR. McLEOD: We can play with our biological model
13 and we can come within a day of telling what is taking
14 place within the Harbor. This is because we have defined
15 these meteology events and defined over a period of time
16 the standing crop.
17 MR. DYER: My name is Dick Dyer, Army Corps of
18 Engineers, and I'd like to address my question to Dr. McLeod.
19 Yesterday, I believe you alluded to the fact that we put
20 the stipulation on that if, in fact, we do shut off all the
21 faucets that are coming into the Harbor, which, regardless
22 of how absurd it may be, is the technical objective in 1985,
23 whatever. I believe you said that in terms of chromium,
24 mercury, zinc and other parameters you selected, you had
25 been looking, analyzing, that this had ceased to be a

1 problem in ten years.

2 In light of what we've heard this morning, maybe ---

3 DR. McLEOD: I think the way the question was phrased

4 was they wanted to know what would happen if you just shut

5 everything off, and I then addressed myself specifically to

6 the problem of the sediments and indicated that you don't

7 know the degradation or the keelation (Phon.) of such

8 methods, but presumably just from some of the records we

9 covered it would take a substantial period of time, say a

10 ten-year period of time to make sure those metals are in

11 the sediments are rendered insoluble or blocked up by

12 keelation or that you have a map of the biodegradation in

13 order to keep better informed.

14 MR. DYER: This is just your estimate.

15 DR. McLEOD: Very much off the top of the head. I

16 really have no idea because we don't have any estimates, well,

17 we don't know the particular form of the metals in the

18 sediments. We don't know those that are completely keelated

19 versus those that are migrating back and forth between the

20 sediments and the water quality.

21 MR. DYER: My point is that if, in fact, we're going

22 to put X number of dollars into these systems, these

23 treatment plants, etc., that the damage might already have

24 been done. If we're going to tell people that yes, you will

25 be able to swim in Boston Harbor X number of years after

1 we have this system in operation and we can't do it because
2 of a continuing source of pollution, then how does this fit
3 into the picture, into our picture where we might have to
4 go to a dredging operation or some type of thing like this.
5 I was just wondering what your rationale was or what type
6 of approach ---
7 DR. McLEOD: Let's put it another way. I was posing
8 a problem that just because the sediments go on a
9 particular amount of acreage and go into a sediment, this
10 does not mean that there is not a release. If you want
11 to take the case of mercury, you can start with inorganic
12 mercury and you can have bacteria convert this to the organic for
13 which is toxic. You come back out with a water problem. That's
14 a specific example.
15 In the case of Chesapeake Bay, there have been studies
16 done indicating that zinc is released back into the water
17 column.
18 Now, you don't know the answer to the problem, so this
19 is the problem. Until you define that and have some sort
20 of reasonable answer, you can't say anything about what
21 this bottom material is really doing. So you simply pose a
22 problem that has to be solved before you can say what's
23 going to happen if you shut off all the faucets.
24 DR. MANCINI: It defines another item under circulation
25 and sedimentation and that is transformations.

1 DR. McLEOD: Well, transport processes.

2 DR. MANCINI: But there are chemical transformations,
3 biological transformations, decays, etc.

4 DR. McLEOD: Also biological and chemical transportation
5 processes.

6 DR. MANCINI: And I think the point that you're making
7 here is that we have a pretty good handle on the physical
8 transformation or many of the physical transformations --
9 circulation, sedimentation. We even have a pretty good
10 handle on some of the chemical transformations. For
11 instance, one could in a rather crude yet first audo way,
12 take a look at equilibrium, chemical reactions with
13 keelating agents, and heavy metals, this sort of thing.
14 One is not sure one would believe it when you're all done,
15 but you could do that.

16 In a biological area, I would assume though we would
17 have some real problems trying to identify these transformations.

18 DR. McLEOD: I think I'd be more specific than that.
19 I think we know the physical transformations exist. We're
20 not sure which ones take place in certain areas of the
21 Harbor. In the case of chemical transformation, we cannot
22 even at the present time predict how copper is laid down
23 when it does become released into the water column.
24 Biologically we have very little information in terms of
25 transformation or in terms of subsequent effects on another

population.

DR. KRONE: To answer your question in a little different way and including typical dynamics of sediment suspension, probably what would occur in any kind of an improvement procedure would be that at times when the bottom material is disturbed or following times the bottom material is disturbed, there may be more of an effect of toxic materials and sediment than normally occurs. But bottom disturbances are like storms generally or floods, they recur at various periods of time and with varying intensities, so that maybe ten years hence, maybe if the water quality had been improved sufficient to allow swimming for ten years in a row but then there may be an unusual storm that disturbs material that hadn't been exposed or distrubed before. So for a short period of time there is undesirable material in the water, but the trend should be to continually improving water quality conditions, if we improve the quality; that is the system will have to continually improve with intermittent ---

MR. DYER: Do you think a model could give you these answers, Dr. Krone, or are we talking about ---

DR. KRONE: A model will give you one thing for sure and that's how quickly the material is moved out when it's disturbed. You can't tell that now.

MR. DYER: It would take a specific research effort to get a good handle on that problem right now?

1 DR. RYTHER: That's being done right now too. There
2 are studies being made. I don't think because there are
3 heavy metals in the sediment that this necessarily means
4 that there are going to be dangerous levels of heavy metals
5 in the organisms, for example. We did some analyses up
6 in the Mystic River recently of some sediments and some
7 clams that were growing right in the same sediments, and
8 the clams were very low in copper, zinc and most of the
9 other heavy metals, whereas the sediments were quite high.
10 At least this was found in Chesapeake Bay, and somebody
11 wrote a paper quite recently and pointed out that these
12 sediments maybe beneficial to the eco system because they
13 can hold these heavy metals and chemical compositions so they
14 don't get into the animals. So I think you need to have,
15 in addition to the sediment studies, an inventory of what's in
16 the animals as well.
17 MR. DYER: We do have that document and there is
18 some indication that diversity has been extremely upsetting
19 the benthonic community.
20 DR. RYTHER: Not necessarily as a result of heavy metals.
21 DR. McLEOD: That's also a direct result of oil spills
22 which do a wonderful job on heavy metals in the water column.
23 DR. RYTHER: And a lot of organiz reducing sediment
24 which is probably the most important thing of all.
25 DR. KRONE: I personally ma very optomistic about the

1 improvement of the sediments if the inflow is reduced.
2 MR. DYER: You think nature will cure its own.
3 MR. TOLKOFF: I think there are a couple of places
4 where you could look at this right now without changing
5 anything. There are some sections in the Harbor where
6 raw sewerage has been relatively cut off, where the bottom
7 is horrendous, and the input is not cut off way down.
8 So you could monitor that right now without having to go
9 through a tremendous system. One area in particular that
10 I know of is the Moon Head area where I have been told
11 somewhere in the order of 50 million gallons a day,
12 something like that of relatively raw sewerage being
13 pumped out. It's now down to an intermittent up to maybe
14 one million gallons a day which is relatively close to
15 shutting that off. Something like that could be ---
16 DR. KRONE: That will tell you what happens there
17 but not in the rest of the Harbor. You can't generalize.
18 MR. TOLKOFF: No, I'm not saying that. But I'm saying
19 you could get some idea what might happen in our Harbor, in,
20 I agree, a section of the Harbor if the bottom itself, if
21 it cleaned itself up, if it takes that storm to do it,
22 if it decays from the outside, if it decays from the top
23 down, if it becomes anerobic from the top and then moves down.
24 DR. KRONE: I didn't mean to imply that all the
25 accumulated material would move out. That certainly won't

1 happen. But the material that is disturbable will be
2 disturbed and mix with the water column, and the rest will
3 just be buried. And, of course, there may be some
4 transferring.
5 MR. TOLKOFF: That's why it would be nice to know
6 the circulation to know what will move out.
7 MR. IGNAZIO: So, if we can go back just before we
8 lost it. We started off after the coffee break by saying
9 the first order of business was a circulation study. We
10 had certain agreements here and disagreements there.
11 Then we went into the second order of systems, which
12 I take is this little sketch here where we try to
13 establish a base profile and get inputs, and we find
14 that this system will work and is, in fact, keyed to the
15 circulation.
16 MR. COSGROVE: Wait a minute, just being a stupid
17 engineer who will probably have to be building the stuff
18 to do this, I think this diagram brings out the point that
19 I was trying to make, but I couldn't express it as
20 well as Dr. Ryther put it on the board here. You take
21 your pollutants, you're going to inventory them. Then you
22 are going to determine where you inputs are, where those
23 pollutants originate. The first order of business is to
24 stop those inputs as far as the operational thing is
25 concerned. Once you stop those inputs, then you can get

1 down to your circulation and your sediment studies to
2 see what's going to happen to the stuff that already is in
3 there laying there. So I think that this brings out the
4 point that circulation studies are pretty far down in the
5 priority list.
6 MR. HARD: Why wouldn't they all be first priority?
7 MR. COSGROVE: Supposing you start studying your
8 sediments and circulation while you are getting these
9 pollutants in and then you stop the pollutants. Then you
10 have to start over again.
11 DR. KRONE: You need a circulation study to determine
12 how to stop them and which ones to stop first. You
13 can't just say stop the inputs. You have to know which
14 ones you're going to put your energies into first and how
15 you're going to do it so as to not cause other damage.
16 MR. VITTANDS: Gentlemen, one member of your panel
17 who is probably more familiar with the physical features
18 of the estuary has said time and time again that he feels
19 that circulation information to determine these decisions
20 is adequate at this point in time.
21 MR. HARD: Yes, and we have other members who have
22 disagreed, I think.
23 MR. VITTANDS: Well, always qualifying themselves
24 by saying they really don't know what the data is all about.
25 MR. HARD: Always reserving the fact that there may be

1 some data in existence that hasn't been brought out in
2 this meeting, but I don't think the level of competence is
3 very high in that area.
4 FROM THE FLOOR: I would just like to interject a
5 point here going along with what Mr. Cosgrove was saying.
6 According to, at least, my understanding of the current
7 water legislation that has been recently passed, we don't
8 have any choice on the inputs. That's all taken care of.
9 We're going to find out what they are through inventory,
10 and then we're going to stop them.
11 But what you people are discussing here is from the
12 time we shut them off, there are some sediments there now,
13 and until we shut them off, there's going to be some more
14 put in. So you're discussing circulation models here
15 to find out what's going to happen to these. Is that
16 correct?
17 MR. HARD: That's part of it.
18 FROM THE FLOOR: You're asking where they're going
19 and how they're going to be laid down.
20 DR. KRONE: It was pointed out yesterday that it will
21 probably take 20 years to stop them, and it will cost X
22 billions, not millions but billions of dollars to do that.
23 Now, which are you going to stop first? Do you have an
24 answer to that? Which ones are you going to stop first?
25 You need a circulation model to say.

1 MR. COSGROVE: As far as Boston Harbor are concerned?
2 The ones I would start with are the biggest contribution
3 from the mathematical model analysis, at least, your river
4 systems and your overflows from your Boston combined
5 sewer systems. Those are the two that I would attack
6 first, and we are doing that. That's the program that
7 we're on, and those are our first priorities.
8 MISS JOHNSON: Isn't there any order to which combined
9 sewer you shut off first and which rivers are most prevalent
10 to take care of? You can't just cut off all of your sewers
11 at one time. Could you give me some answer as to how much
12 time it would take to shut off all the sewers?
13 FROM THE FLOOR: This is one of the things we're going
14 to be looking into to get a handle on the quantities or
15 qualities of the inputs into the river systems.
16 FROM THE FLOOR: What you ask is which ones do you
17 shut off first. This gest back to the problem of what
18 type of system or what we're trying to create here, and
19 my listening today and half of yesterday, we haven't really
20 established a goal. We have established a bunch of
21 objectives which will fall out once we reach this all
22 encompassing umbrella effect. There is an overriding
23 goal that we're trying to reach, and we're talking down here
24 on the bottom some place. We haven't really stated what
25 the goal is. We've alluded to the fact that we're trying

1 to improve the water quality and improve the biological
2 system in Boston Harbor, and we've talked about what
3 we're going to cut off and what we're going to treat.
4 But before we shut off or whether we stop the oil first
5 or whether we stop industrial or municipal waste first,
6 we've got to decide what type of system it is we want.
7 DR. KRONE: Well, I think something we keep forgetting
8 and maybe I'm the most guilty of all is that when we
9 talk about circulation models, we really mean all the
10 inputs too, which means the hydrological inputs. That's
11 part of this circulation model. It's not a separate thing.
12 From what I've heard, we don't have that kind of information
13 yet.
14 Certainly one of the factors that will determine which
15 we'll shut off first is which ones are producing the most
16 or which ones are producing the most at the times that
17 are most serious as far as the Harbor is concerned. You
18 need to know both, when the worst conditions occur in the
19 Harbor and when the worst conditions occur in the drainage
20 system. I don't think we have that information. Now, I
21 might be wrong.
22 DR. MANCINI: I would submit to you that the tools
23 are available to be applied to getting that information,
24 and they are available here in Boston Harbor, and the
25 state of Massachusetts will have those tools for a first

1 cut engineering identification of those. That is the
2 point that I made, I think, initially in response to Al's
3 question. I'm not trying to indicate that this stuff is
4 ours because it belongs to the state of Massachusetts
5 and it's going to be theirs, and in fact it's going to
6 be their's to use.
7 DR. KRONE: As you pointed out this is the first cut.
8 DR. MANCINI: The first cut and sufficient to identify
9 differences between engineering alternatives and to establish
10 priorities; that is, I should spend $10 million here, here,
11 and here, in that order, if I want to protect something
12 here.
13 MR. HARD: It appears we're at somewhat of an impass
14 here.
15 DR. MANCINI: I'm afraid so.
16 FROM THE FLOOR: You know, I think Joe pointed out
17 the title of the big fish we had on the board was Waste
18 Water Management Strategy, and I think that's what we're
19 going to develop, waste water management strategy.
20 DR. KRONE: Water quality management.
21 FROM THE FLOOR: No, it was waste water management.
22 MR. HARD: It depends on whether you want to talk
23 about this forum or whether you want to talk about the
24 project that the forum is related to. Certainly we should
25 consider both, but that may be a little out of order here.

1 MR. COSGROVE: Probably that's why we're getting off
2 in so many directions; what is the purpose of the forum.
3 I interpret the purpose of this forum is to give some
4 direction to the technical subcommittee as to which problems
5 they should give their attention to first in solving the
6 waste water problem that is polluting Boston Harbor.
7 MR. HARD: Right, but the initial purpose of this
8 was to inform ourselves at the Corps so that we would know
9 how we ought to stand in relation to the problem you
10 just mentioned, and, of course, this thing has expanded into
11 a two-phase thing where the project is just sort of super-
12 imposed on what should be a pure consideration of what actually
13 is going on in the Harbor, do we have enough information.
14 I think it's been clearly established that we don't have
15 enough information in that respect.
16 Now, when you start talking about the cost and
17 engineering decisions, and I know that this is the direction
18 you're oriented in and you're in a position where you
19 have to act firmly and directly under pressure.
20 I've been faced with the same thing all my life,
21 construction schedules and getting foundations in for
22 the New Bedford hurricane barrier, something like that,
23 and being asked should we pull every bit of rotten rock
24 out of the foundation, or should we say pour. And you know
25 you wait right up until the last minute and I can't wait

1 any longer, but I've got to wait, and then you say pour.
2 I did that at 9:00 o'clock one night.
3 MR. IGNAZIO: Just before we break for lunch, I think
4 what John was just talking about, making this cut at which
5 you think the tools are available, would that not be another
6 item on my list? We started off, you said circulation
7 study. Are you saying how that thing evolved was the
8 hydrodynamics of the inflows from these rivers would also
9 be a part of this, high on our list of items of work that
10 the study team should address itself to?
11 DR. MANCINI: Yes.
12 MR. IGNAZIO: Is there unanimity on this? I think
13 there is.
14 DR. MANCINI: I don't think so.
15 MR. IGNAZIO: No?
16 DR. MANCINI: I gathered that there is a fundamental
17 disagreement between the members of the panel here.
18 MR. IGNAZIO: Between whether you could get that with
19 the data that is now at hand?
20 DR. MANCINI: Yes. Whether it's good enough for
21 examination of this problem and identification of engineering
22 solutions, and I think there is a disagreement. Carl says,
23 no, it's not, and I say, yes, it is.
24 MR. HARD: We have an old expression, what we call
25 "Good enough for rivers and harbors." We found in recent

1 years that we always had to pay for that kind of thing in
2 the long run.
3 MR. IGNAZIO: What would it take to bring you two
4 together on your thinking here?
5 DR. MANCINI: I think Solomon.
6 (Laughter.)
7 MR. VITTANDS: I would like to know, since we have
8 another member on the panel who is familiar with Boston
9 Harbor who is knowledgeable about hydrodynamics to also
10 address himself to that subject. Do we have the engineering
11 knowledge presently of the hydrodynamic patterns of the
12 Harbor or the tools to make some engineering decisions?
13 MR. HARD: Could we start with that question at
14 one o'clock?
15 (Whereupon, at 11:55 a.m., a recess was taken, to
16 reconvene at one o'clock p.m. the same day.)
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1 AFTERNOON SESSION

2 MR. IGNAZIO: I suggest we get started in the
3 interest of trying to wind this up at 2:30 or thereabouts.
4 We left off with the thought that we were going to
5 ask Jack Schaake to give us some of this thoughts on
6 hydrodynamics models for river inflows and whether or
7 not we had enough tools. I would suggest after we get
8 comments from Jack that we might also go through a
9 what-if situation where we ask maybe each of the
10 panelists to put themselves in our shoes, the study
11 management group here, and give them a certain sum of
12 money and ask them to strategize that money where it
13 would do the most good. That's all you're going to get
14 and that's the limit.
15 Finally, let's hear Jack.
16 DR. SCHAAKE: I will just make this brief because
17 that my opinions about these hydrodynamic models really
18 depend on that second question about suppose I had so
19 many dollars, where would I put it, and I would really
20 like to make my comments in that context.
21 I think it is important to note first of all that
22 mathematical models themselves come in many sizes and
23 shapes and with different price tags. You get out of it
24 what you put into it, in some sense, and there are a
25 variety of available mathematical models to simulate
the behavior of the Harbor, for example, the physical

1 behavior -- movements of water currents, and so forth.
2 And I think that any of them would provide useful
3 engineering information about the Harbor, and the
4 question of what one would I suggest you do and where
5 you would spend your money for the hydrodynamic stuff,
6 the amount of money you would spend there I think depends
7 on how much I think you should spend other places too.
8 If you had an unlimited budget, I would suggest you
9 go the physical model, I would suggest that you use the
10 fanciest mathematical models you can, and do it that
11 way because the more you spend at this point, the more
12 you're going to get out of it.
13 You can't do that, that's not your choice, and
14 that's not the decision. Therefore, I think you need
15 to look at how much you invest in the hydrodynamic stuff
16 in the light of how much you spend for biological
17 studies, data collection, things like that. It has to
18 be done in balance.
19 I guess the one thing I would like to say is that
20 we do, I feel, have the ability to say an awful lot
21 about what happens in that Harbor just with mathematical
22 models.
23 MR. IGNAZIO: You have the tools available.
24 DR. SCHAAKE: We have the tools available to say----
25 MR. IGNAZIO: Do you have the basic data to gear

1 up the tools? Where do you have links missing, if any?

2 DR. SCHAAKE: Before I would spend more money

3 developing fancier mathematical models -- that is,

4 developing the mathematical model tool itself -- you

5 need to have more data.

6 MR. IGNAZIO: Can you elaborate a little bit about

7 that?

8 DR. SCHAAKE: I think that the information on the

9 velocities, the currents, over----

10 MR. IGNAZIO: You're talking river now?

11 DR. SCHAAKE: No, various locations in the Harbor

12 need to be measured over the cross-section so that you

13 can get good measurements of the average velocity of

14 the flows across different sections in the Harbor. You

15 would use that information to validate or calibrate

16 your mathematical models, and you'd also use it to

17 estimate circulation patterns. At the same time that

18 information is collected, you have to have information

19 on what the wind is doing, because velocities is going

20 to depend in part on the effects of the wind on the

21 surface.

22 I think that you need to have information about

23 what Massachusetts Bay is doing and what the boundary

24 conditions are, and there is a question of where the

25 boundary ought to be located. Now, John Mancini's

1 firm has looked at this, and they probably have some
2 very, very valuable opinions on how that boundary
3 condition question ought to be addressed, but it's an
4 important part of it. We didn't talk about that. It's
5 a detail that you need to look at where should be the
6 boundary between the Harbor and Mass. Bay, and then I
7 think you need to gather some data to help you know
8 that your boundary condition assumptions are reasonable.
9 MR. IGNAZIO: So I can sense you're saying that --
10 before you had come in we were talking about putting
11 together some list of things that one might do, and
12 three or four of the panelists were very strong on a
13 circulation study. Others here were less strong about
14 it, but you're more or less supporting some form of
15 hard data to determine the circulation patterns?
16 DR. SCHAAKE: Some form, yes, but I think that---
17 MR. IGNAZIO: Not necessarily actual physical
18 models but some form?
19 DR. SCHAAKE: I think that unless you're talking
20 about a several million dollar effort, you should not
21 be thinking about a physical model. I think the first
22 million dollars, let's say, if that was the number that
23 I had to think about, out of that first million dollars
24 I'd want to keep the investment in the physical
25 modeling, the modeling of the physical system, the data

1 collection for it, down to a couple of hundred thousand.
2 So that if you had the rest of the money to spend on
3 these biological studies and field investigations, I
4 think that I personally have enough confidence in those
5 physical models that's about the level of effort I
6 would put into it.
7 Given more though than just these few minutes, I
8 might revise that figure up or down a little bit, but
9 I don't think it would change by a great deal of some-
10 where in the neighborhood of a couple of hundred
11 thousand dollars in that area, maybe a little less.
12 MR. IGNAZIO: What about river inflows in your
13 modeling?
14 DR. SCHAAKE: Now the hydrology in the river
15 inflows, that enters into the inputs of I'll say
16 pollutants but various materials in addition to the
17 combined sewer overflows. There I think the
18 mathematical hydrologic models exist, have been
19 demonstrated to work well enough that we can depend on
20 them. You don't have to develop hydrologic models.
21 The EPA model has in it already the mathematical
22 mechanisms to simulate the way in which pollutants are
23 picked up and moved through the system, and I think that
24 the EPA model should be -- the suberteens (phon.) from
25 the EPA model should do a reasonable job together with

1 what I think are slightly better hydrologic models for
2 the streams and the runoffs and things like that, to
3 represent, to try to simulate what's coming out of
4 these tributaries -- the Neponset, the Charles, the
5 Mystic and so forth.
6 I think you need some data collection there to----
7 MR. IGNAZIO: Can you specify that a little bit
8 for us?
9 DR. SCHAAKE: I think it would be good to put a
10 rain gauge out in the catchment, a couple of rain
11 gauges that record; maybe measure the water levels for
12 a short period of time in the summer, for example; and
13 then make some measurements of the water quality for a
14 couple of week periods, for example; so that you have
15 some information to lend credibility to the other
16 calculations. I would like to see a lot more than that
17 done, but if you have got a million dollars to spend,
18 you can't do everything; and therefore, I would want to
19 minimize how much of that you did because I think you
20 want to spend the time looking at, as much time as you
21 can looking at the biological processes that are really
22 taking place out there in the Harbor.
23 So if you spent somewhere in the neighborhood of
24 $200,000 studying the currents in the Harbor, gathering
25 the data for that, and spent perhaps another $100,000

1 looking at the runoff, the urban runoff and gathering
2 some data for that, maybe a little more, you may have to
3 spend more than that. You may not be able to do
4 anything for that amount, but enough for that amount.
5 And then try to use that remaining money to look at other
6 issues that are taking place in the Harbor, and linking
7 those other things with the hydrodynamic model too, for
8 that matter.
9 It's not impossible that, and here I'm getting well
10 on the edge of where I ought to be offering an opinion,
11 but it seems to me it's not impossible that the primary
12 mechanisms that are forcing that Harbor to behave in the
13 way it's behaving can be dealt with and analyzed the
14 whole harbor as a lump system. This is what Guy's
15 group is doing at this point, and the need to investigate
16 the circulation and the time distribution effects may
17 be a second order of importance to other considerations,
18 and we don't even know that yet for sure.
19 MR. IGNAZIO: What would it take us to know that?
20 DR. SCHAAKE: Guy I think is a better guy to answer
21 that, but I would suggest that you spend half your money
22 at least at looking at that issue and maybe more. That
23 would be from what I understand are your problems.
24 Another thing that I feel, too, Joe, on this is
25 after chatting with some of you here at the meeting, I

have the feeling that some of the engineering studies that are going to be done to look at the combined sewer over flow problem and the treatment problem are being done by some of the other agencies who are consulting groups, and I have the feeling that the Corps activities specifically won't be in that area primarily, although they may want to look at that. What I think is needed here too is that early in the engineering studies information that can be gathered from the work that Hydroscience has done and other things that you might begin to do early is needed to give the people who are looking at these engineering alternatives the information they need to look at the best alternatives to begin to formulate their plans, and then there is an initial phase of your work which really should be directed at giving them that information. There is not enough time to be specific about what that means, but we could be.

Then I think you need to plan your study though that you can really do the environmental impact statement on what might be proposed and provide a better assessment of those engineering alternatives and others that you might suggest also. If you're talking about environmental studies, I think they should be looked at as what's the best thing we can do to get the best

1 possible environmental impact statement for a given
2 amount of money for that, and that's really the way I
3 have organized my suggestions to you here, around that
4 question.
5 MR. IGNAZIO: In effect, you have given an insight
6 on how you would spend a million dollars, and you've
7 also said that you feel there are adequate tools to
8 handle the river inputs. You seem to indicate that you
9 want to know a little more about the circulations
10 patterns in the Harbor itself.
11 DR. SCHAAKE: The data needs to be gathered to give
12 you this.
13 MR. IGNZAIO: How do you feel about what Jack has
14 said?
15 MR. COSGROVE: Joe, before you go into that, I'd
16 just like to put a little input into the effect that I
17 think Professor Schaake is looking at this as a
18 Corps effort and a state effort going in separate
19 directions. It's one big ball.
20 DR. SCHAAKE: I hope to look to how they could
21 work together.
22 MR. IGNAZIO: We are working together in the same
23 barrle, sink or swim.
24 DR. SCHAAKE: What I say may have sounded that way,
25 and if it did, I apologize because I feel that----

1 MR. COSGROVE: I'm not offended. I just didn't
2 want you to get the idea that we are separate.
3 DR. SCHAAKE: Indeed, you want to work together,
4 and that's why this early thing that you need in your
5 studies, Martin, if I understand correctly, this input
6 from someone on the impact that this is going to have on
7 the Harbor.
8 MR. COSGROVE: I wanted the other panelists to look
9 at the whole picture.
10 MR. IGNAZIO: What do you think about what Jack
11 said about the tools? When we left, I asked, I think
12 I asked you, John, how you and Carl could get together
13 and you answered Solomon might help. Jake came up and
14 said, "Well, maybe Jack will tell us what tools are
15 available." Do you have comments on what Jack has said?
16 MR. HARD: I don't see how you can understand what's
17 going on in the Harbor without adequate basic data.
18 MR. IGNAZIO: He more or less supports that with
19 the environmental studies.
20 DR. SCHAAKE: I agree that you need some data.
21 MR. HARD: I'm not sure what you said with respect
22 to data. You were talking about going over data in
23 part, I think.
24 DR. SCHAAKE: Let me break it up. I said I felt
25 that you might want to spend -- I would like to keep

1 the total money spent on the hydrology and on the
2 hydraulics and the hydrodynamics of the Harbor and the
3 quality of the inputs down to a total cost of about a
4 third of the project cost, if I could.
5 MR. HARD: Is that a rule of thumb or what?
6 DR. SCHAAKE: It's my idea of where the priorities
7 and efforts ought to be placed. The other two thirds
8 ought to be spent in looking at the biological, the
9 chemical, sediment properties in the Harbor, the
10 movements, the tibidity issue, and things like that.
11 MR. HARD: We've just had some expert opinion on
12 what it would take to do the minimal biological and
13 sedimentlogical approach to the thing, and it's just
14 incompatible. It's just as simple as that.
15 DR. SCHAAKE: Well, it may be but if you've got a
16 million dollars to spend and you ask me how to spend it,
17 I would put as much as I could into that, but you can't
18 neglect these other things. I don't expect that we'll
19 agree on what these percentages ought to be, and I don't
20 know that we should really try to. I think you ought
21 to get the opinions that we have and not necessarily a
22 consensus.
23 MR. HARD: This makes me think of a theme on
24 Paganini, variations on a theme of Paganini. You have
25 a basic theme and you can lead it in so many different

1 directions and come out with that many different
2 opinions. But if you have more notes, then you can----
3 DR. SCHAAKE: If you have more than a million
4 dollars to break up, I'll break that up in another way.
5 MR. HARD: Do we have to look at that restricted
6 a view?
7 DR. SCHAAKE: I don't know. I was asked a question
8 about a million dollars.
9 MR. IGNAZIO: Actually you were asked two
10 questions. One was to what extent are we armed with
11 various tools to do the models, and then I said after
12 we gave you a chance to talk, then we were going to ask
13 one question of all of the panelists, unless they have
14 any objection, and that question would be suppose you
15 were given a sum of money, how would you spend it. We
16 actually didn't give you the sum, but a million dollars
17 is a nice round figure.
18 DR. SCHAAKE: Yes, I picked the sum. But I do
19 think that you need to speak about these models in the
20 context of what kind of an effort you're talking about.
21 For more money you can do a better job. It's almost a
22 continuous spectrum of possibility.
23 MR. IGNAZIO: I'm getting from what you're saying,
24 Jack, is percentagewise you put $2 of every three into
25 this basic biological process and circulation and

1 sedimentation.

2 DR. SCHAAKE: That's because I think that's where

3 we know least.

4 MR. IGNAZIO: I think you have similar ideas.

5 MR. HARD: I do. I think the emphasis should be

6 on biology. I don't think the biology can be done

7 effectively without the circulation study. He called

8 for the circulation study too, but on that budget it

9 won't work.

10 MR. IGNAZIO: Do you want to make any

11 contribution, John?

12 DR. MANCINI: Let me offer my opinions on this sum

13 of money. I chose somewhere between one and two million

14 dollars as a number. I thought that about half of that

15 or a million dollars would go into the land planning --

16 location of inputs, population, land use patterns, this

17 sort of thing; enumeration and identification of

18 planning alternatives, and of course the cost estimates

19 that are associated with those; public information

20 program. About half of the effort would go into that.

21 Between a hundred and two hundred thousand dollars,

22 I thought, might be appropriate for institutions. I

23 don't know how the institution picture is here in any

24 great detail. I thought anywhere from a half a million

25 to a million dollars would go into this cause and effect

1 relationship that we're talking about, and I would
2 initially budget a half a million and have a kicker of
3 a half million.
4 When I talk about cause and effect relationships
5 here, I would include both models that are on computers
6 or physical models, this sort of thing, in conceptual
7 frameworks, and I would break up my allocation of at
8 least the first half million dollars in the following
9 way:
10 As I assess the priorities in Boston Harbor, I
11 would expend about 35 percent of that money with respect
12 to storm water problems and identification of its
13 solution and the appropriate projects for construction
14 of facilities. I would spend an additional 20 percent
15 in what I presume are the upstream, inland waterways for
16 water quality modeling of essentially classical
17 parameters. I would presume that some of the
18 alternatives that would be looked at in the planning
19 effort would involve local treatment plants as opposed
20 to treatment plants which all ended up in the Boston
21 area and that the impact of those plants on local water
22 quality should be looked at, and just a guess would be
23 20 percent of the modeling conceptual money would go for
24 that.
25 I would spend 25 percent of my money on biology,

1 with two essential prongs of spending this 25 percent of
2 my money on biology. The first one is to identify what
3 I could reasonably expect to do in the planning effort
4 in the biological area and what should logically fall
5 into a research effort and not be part of my planning
6 process.
7 Then I would attempt to do that or to make those
8 differentiations in two specific areas that appear to be
9 of concern to this group. The first one is
10 eutrophication. What can I get out of modeling of
11 eutrophication with the existing data, and what type of
12 additional data might I need? The second area would be
13 the transfer of harmful substance through the
14 biological food chain or food waste? What can I hope
15 to do with existing data and existing knowledge?
16 Now I happen to have gone through the exercise for
17 the biological area. I would submit to you my
18 experience tells me the results that I could get from
19 a planning x standpoint contained a high degree of risk
20 because of my ignorance in the biological area. Having
21 done that, then I would take 20 percent of the final
22 cause and effect money and hold that to allocate toward
23 filling data gaps that I might have identified. They
24 may be in any one of these areas -- storm water,
25 upstream water quality, eutrophication or in the food

1 chain.

2 I would do that, and when I got done with the
3 biological assessment, I would essentially ask myself,
4 is it worth $500,000 to take a shot at either or both of
5 the two biological problems. If it were worth that
6 $500,000, if I could get that kind of bang of response
7 from it, and I am including in here an assessment of
8 sediment behavior and things of this nature, in their
9 perspective with respect to the biological problems.
10 Then I would spend that money, if I could get $500,000
11 worth of value for it.

12 If I couldn't get $500,000 worth of value for it,
13 then I frankly would not spend the money. And so that's
14 my $2 million.

15 MR. IGNAZIO: Anybody have any questions?

16 MR. COSGROVE: Just one minor question. You talk
17 about the biological problems and eutrophication and so
18 forth. Are you talking about just the Harbor or the
19 contributing rivers also?

20 DR. MANCINI: I would think in the initial phase
21 the conclusions I drew from the Harbor study or
22 examination could be interpreted in terms of inland
23 water bodies as well. There would be differences
24 between the two systems, significant differences
25 between the two systems, but having assessed what I

1 know about these two phenomena, I think I could say,
2 well, if I can solve the problem in the Harbor, it will
3 give me answers in the upstream areas. Even if I can't
4 solve the problems in the Harbor, upstream areas are so
5 different that I'm not going to be able to solve it.
6 So they are two different problems.
7 But my impression would be specifically that we
8 know so little about those two areas that we could take
9 some first cuts in both the Harbor and the upstream
10 areas, and when we got all done, we would have a lot of
11 numbers and a lot of hypotheses. I'm not sure that one
12 would want to base planning decisions on them though.
13 So I'm a little pessimistic about our understanding and
14 level of knowledge with respect to those two problems
15 specifically. And I say this having done several
16 hundred dollars worth of eutrophication modeling
17 ourselves, and several hundred thousand dollars worth
18 of food chain modeling.
19 You know, one can model these things but the output
20 has to be viewed in terms of is it a useful decision-
21 making tool. Our assessment has been internally and
22 for our clients that it's a little early yet in terms
23 of what we know about these systems to use these as a
24 sole crutch of planning. Certainly they can have input
25 into the total decision-making process, and I think the

1 problems are more complex in the Harbor, and if I could
2 sort out what was going on in the Harbor, I would
3 probably take a shot at what was going on the fresh
4 water by making modifications between the two. But I'm
5 very doubtful that I could do it in the harbor.
6 MR. IGNAZIO: Do you think after you did these cuts,
7 these first cuts that you would be satisfied that
8 perhaps you would set the stage for research? I would
9 like your idea of defining that which should be done in
10 research versus that which should be done in planning.
11 Do you think those first cuts would do that for you?
12 DR. MANCINI: Yes. As a matter of fact, there is
13 information available in some of these areas.
14 Unfortunately it's not in published form. It will be
15 around the first of the year. At least, our firm's
16 assessment of some of these modeling things in fresh
17 water lakes. Now certainly there is not a one to one
18 correspondence between the two. We prepared a report
19 for the Great Lakes Basin Commission which attempted to
20 identify what we thought was appropriate for planning
21 and what could be done for research, and I would think
22 that if you looked at the Harbor situation here, you
23 could make the same kinds of judgments; that is, what
24 can I hope to get from planning.
25 MR. IGNAZIO: Did you finish this work for Leonard

1 Crook up there?

2 DR. MANCINI: Yes.

3 MR. IGNAZIO: That's available now?

4 DR. MANCINI: It will be around the first of the

5 year.

6 MR. IGNAZIO: Very good. Does anybody have any

7 questions?

8 DR. KRONE: I would like to make some comments that

9 are appropriate to both John Mancini's and Professor

10 Schaake's remarks.

11 MR. IGNAZIO: He doubted his figure.

12 DR. SCHAAKE: Yes, he doubted it. If I had another

13 million, why---- (Laughter.)

14 DR. KRONE: I've already offered a figure.

15 MR. IGNAZIO: I think he's accomplished something,

16 regardless of the price.

17 DR. KRONE: There are a couple of aspects about the

18 points of view that both these gentlemen have expressed

19 that needs further clarification in terms of finding a

20 back. One of them has to do with time frames. There's

21 often been an allusion for engineering decisions and

22 for academic, I think is the other extreme, purposes --

23 sometimes the academic has been alluded to as research

24 and those kinds of things. If I could paraphrase those

25 two terms in terms of the engineering approach referring

1 to taking immediate action and the academic to further
2 study before taking action aspects, then to do that is
3 necessary to consider in terms of the time scale of the
4 need.

5 Right now there are evident problems that we need
6 solutions for. We have already talked about toxicity,
7 industrial waste discharges, and raw sewage discharges
8 which I think most of us agree are important matters
9 that are urgent, need action. But then we've talked
10 about objectives farther into the future, or put another
11 way, not so urgent that are also important to us and
12 some way in the future that have only been alluded to,
13 but that will also need information.

14 Now, if it's essential that we take action
15 immediately or, to put it another way, if we delay
16 action on certain things, there is a cost to our
17 delaying the action; there is a cost in not diverting
18 raw sewage input, for example. So we have to balance
19 the cost of making a mistake against the costs of not
20 doing it, making a mistake using presently available
21 tools and knowledge against the cost of not making them.
22 And of course, there's the continuous spectrum in that
23 range.

24 It seems to me that we have an opportunity to take
25 a look at both the immediate, the needed solution to

1 problems, problems that have immediate needs for solution,
2 and those long-range ones and incorporate them in an
3 overall plan of approach to our study, to the planning
4 effort. And for the solution of these immediate things,
5 if we can't afford to wait longer, we can do as John
6 indicated, in fact, probably should do as he indicated,
7 solve those urgently needed things with available tools.
8 But we shouldn't say that we don't also need to get
9 information for the less urgent ones.
10 Put another way, there is a penalty for not taking
11 action; that is, we delay the benefits we achieve by
12 not taking action. But if we start the research or
13 academic or the further study now well enough in advance,
14 then we will have had a better basis for determining
15 the directions of action when those things become urgent.
16 So I think it behooves us to start now those more
17 difficult things.
18 The balance that you spoke of between data
19 gathering, modeling, and application of the models to
20 decision making depends on, I think as both previous
21 speakers pointed out, on the amount of money you get
22 per year on the rate of funding. If small amounts of
23 money are given per year, it will be necessary to
24 stretch out that effort, the research or further study
25 effort as well as the immediate planning effort. In

other words, there will be a time scale that will pay the cost of not putting more money in in terms of not getting the benefits from a later period of time.

So you can change the level of effort in driving toward these goals to meet the needs of the budget you have, always keeping in mind the necessity of rebalancing the allocation of the resources to meet the immediate needs first and the longer term needs second. But if that constrains you to the point where you can't start studying now the things that are needed for the long run, you'll be sunk. You'll be in the same boat you are today ten years from now, 20 years from now. So I think in the balancing it is necessary to keep in mind the necessity of getting these other things.

Now in that balancing both modeling and field surveys are essential and one should not proceed in advance of consideration of the other. Models are necessary to show where field data measurements should be made, and field data are necessary to substantiate and develop and the research, John alluded to such as relating sediments to constituents of water, that's our material on constituents of water, should begin early enough so that they're well established before the subsequent part of the modeling can take place.

The models and field surveys, the two efforts that

1 go on together, should include all the parts of the
2 hydrologic cycle that go on together. Now, John left
3 this in doubt. He said maybe you could separate the two
4 parts into two problems. But it's pretty evident the
5 estuaries are affected by the rivers, whether or not
6 the rivers are affected much by the estuaries is pretty
7 hard to say, except the transition. But I think both
8 areas need to be studied, and those that are weakest
9 need to be filled in first.
10 It appears that information is needed about land
11 drainage very badly. Information on drainage should
12 include both urban and rural drainage, and the
13 constituents of the drainage should include not only a
14 listing of the constituents but their concentrations as
15 a function of time. It will turn out that the concentra-
16 tion as a function of time and the frequency with which
17 they occur will determine the effect on the estuary.
18 Then also in a modeling and field investigation
19 effort, it's important that there be included the
20 affects of storms not only on land drainage, as we
21 mentioned, but also on the estuary, the bay itself.
22 I'm convinced that storms have a significant effect on
23 the bay system.
24 Then finally, the matter of circulation and the
25 determination of whether to have a physical or

1 mathematical or both models should be considered not
2 only in terms of funds, as was pointed out, funds
3 available, but also in terms of the sensitivity, let me
4 say it another way, in terms of what you want to do
5 with the information you get from such models. As I've
6 indicated a few minutes ago, if you want to determine
7 biological models, if you want to make biological models
8 that are really responsive, I'm convinced that it will
9 be necessary to know the dilution and the circulation
10 fairly precisely; in other words, until you do know the
11 motions of the water precisely, it will be difficult to
12 determine algae bloom flow let alone fish populations
13 because I think they are so very sensitive.
14 Now, that doesn't put it out in terms of dollars.
15 MR. IGNAZIO: You kind of wrapped both of the two.
16 Percentagewise, I would like your idea of balancing the
17 immediate and the future. How would you deploy your
18 dollars on that type of thing? We'll give you $2
19 million for it.
20 DR. KRONE: It's very sensitive to how many
21 millions of dollars you have. If you had a hundred
22 thousand dollars, then you would not consider a physical
23 model. If I had a hundred thousand dollars, I would
24 make sure that I knew what material has already been
25 obtained. The least expensive thing you can do is

1 gather existing information and put it together.

2 The next thing would be to try to put it together

3 in a usable form as inexpensively as possible, a crude

4 model that would take a first cut and so on up the line.

5 If your ultimate objective is to develop models of

6 biological systems, if that's really an objective, you

7 can't buy that for a hundred thousand dollars. You can

8 only buy it if adequate information is known about the

9 sediment, circulation and inputs. So I think you faced

10 with obtaining enough money to do the job you want to

11 do, and I think that's on the order of the $2 million

12 that we've been talking about or more.

13 That's not a direct answer to your question. It's

14 sort of skirting around it.

15 MR. IGNAZIO: Does anybody have any question?

16 MR. COSGROVE: I don't know if it's a question or

17 a comment, but Dr. Krone in the first part of his talk

18 would almost read like what our task is. We are faced

19 with just that problem that we have immediate needs, one

20 of which is to stop dumping sludge into Boston Harbor,

21 and the second of which is to go to secondary treatment.

22 We have a desire to meet those immediate needs and in

23 concert with a plan that would be projected for the

24 whole metropolitan area through the year 2020 and

25 eventually an estimate up to 2050. We're looking at a

1 long-range program. But we don't want to go ahead,
2 although we are under orders from EPA to proceed with
3 secondary treatment. We don't want to go ahead with
4 secondary treatment until we get this plan at least
5 developed to a point where, to put it simply, do we want
6 to put secondary treatment at Deer Island or do we want
7 to move Deer Island inland where there is advanced waste
8 treatment.
9 Now that's the kind of a problem you're faced with
10 and the things we have to solve when we get down into
11 the engineering decisions that have to be made.
12 It kind of escapes me as to what the great
13 importance is of knowing everything that goes on in
14 Boston Harbor before we make decisions of that nature.
15 DR. KRONE: I hope you're not persuaded that a model
16 will tell you everything that goes on in Boston Harbor.
17 MR. COSGROVE: I'm firmly convinced that a model
18 will tell us----
19 MR. IGNAZIO: He indicated earlier, he didn't
20 think we were that smart with nature.
21 DR. KRONE: I think one of the points I was trying
22 to make was that if we want to manage water quality in
23 the future as well as has been indicated here, as well
24 as required by the Muskie Bill and also required by the
25 environmental trends depends on environmental quality

1 management, we're going to have to know in much greater
2 detail what's going on in the system.
3 MR. COSGROVE: I don't disagree with that. I
4 think everybody's becoming more conscious of the fact
5 we ought to know more about what's going on in the
6 environment and all aspects of the environment, not only
7 in the Harbor but in our upstream areas and small ponds.
8 Let me put it this way, we are faced with a task that
9 right at the moment centers around Boston Harbor. We
10 don't know that the solution to that task is going to
11 be centered around Boston Harbor. The way that it is
12 now, it has to eventually come into Boston Harbor, so
13 that's what we're trying to sort out, where to put the
14 priorities.
15 My inclination, to be perfectly frank with you,
16 and I guess it's the first step we've taken, is to
17 try to get some master scheme developed where we can
18 start making decisions to carry on some necessary
19 observations in the Harbor and in the water bodies.
20 But the whole concept here seems to be focused on the
21 Harbor. You need to find out what's going on in that
22 Harbor and then decide what you're going to do with it.
23 In other words, we're trying to pull the cart and
24 you guys are trying to push it or vice versa.
25 DR. SCHAAKE: Martin, estimates that I gave are

1 what I thought should be done were based on an
2 assumption that the engineering studies of alternatives
3 were not included in that million dollars, and I agree
4 with you, you need to make those other engineering
5 studies. But it seems to me you are talking about
6 changing some things with respect to the Harbor, and
7 that's why I feel that a substantial effort should go
8 into the studies of the biological things that we don't
9 know much about, and I feel that it is of a research
10 nature in part. There are some things that you might
11 say if you investigated it with what you know now about
12 these processes and the research that has gone on so far.
13 But the money just doesn't exist to learn about
14 these complex biological processes through research
15 and are very much a part of the engineering studies,
16 and I guess what I feel I would like to see happen and,
17 I hope you don't stereotype this as coming from an
18 academic because I'm wearing an engineering hat when I
19 say this, but we are always confronted with not knowing
20 things about these systems where we could be making a
21 decision that would cost us far more to correct than the
22 cost of the decision we're making, and these decisions
23 that we're talking about are costing a lot of money.
24 I know that I've got colleagues, they tell me this
25 about things I want to make, and I'm too practical and

1 I know that when they tell me that, I don't like to
2 listen to that or hear that because I feel like they're
3 being academic, that let's get something done, we've
4 got to make a decision, we only have so much time, and
5 that's true. But at the same time a proportion, and I
6 think a substantial proportion of our effort, at least
7 a substantial amount of our effort where even if it's a
8 small part of the effort, needs to go into these
9 investigations where you aren't sure what you're going
10 to learn, and you let some bright guy sit down and start
11 to worry about these things and see if he can get us
12 better information to know what might happen.
13 I don't like to see things so complex. It's much
14 nicer to try to find independent parts that we can
15 focus on, and to the extent that we can do it, that's
16 what engineering is all about. But sometimes I think
17 we get to a point where the parts really aren't
18 independent. We can try to make them that way and try
19 to analyze them as though they are. In this case I
20 think that you could decide to go ahead with the
21 secondary treatment and clean up all the sediments,
22 reduce the amount of sediments or something like that
23 that are there, if we could move the sludge away
24 somewhere else and just totally change that whole
25 system that it's a new system with new problems that

1 maybe we can't foresee, but with some effort, maybe we
2 can.
3 DR. RYTHER: I would like to have somebody tell me
4 what these biological problems are that you would invest
5 X million dollars in, because I don't know what they
6 are myself.
7 MISS JOHNSON: I think one that you might have to
8 consider, which Dr. Krone was talking about, less
9 urgent problems, I agree that we have a task and not just
10 the MDC but also the Corps has the same task to come up
11 with solutions to the immediate problems. But you have
12 proposals from the state as well as to, not problems
13 but futures of recreational needs on, say, the islands
14 that you're going to have in the Harbor, and I think it
15 was Stein in the EPA proceedings talking about people
16 going out to these recreational islands and digging up
17 clams, that kind of thing; and they, certainly when
18 they are out there digging up these clams wouldn't think
19 that they would have to put them through a depuration
20 period and sterilized water. That's a problem that you
21 need to think of now since it's in the foreseeable
22 future, and it's not the immediate task that you have
23 but it is a problem. That's one of the reasons you
24 need your biological studies.
25 MR. HARD: In three-quarters of an hour we're

1 approaching our closing time. It's a little late to
2 introduce the panel, but I would like to emphasize that
3 Dr. Krone is the sedimentation consultant, to my
4 knowledge, on the tidal hydraulics committee which
5 examines the largest harbor projects in the world; and
6 Henry Simmons is the Director of the Division of
7 Hydraulics, the Hydraulics Division of the Waterways
8 Experiment Station and certainly one of the top
9 estuarine experts in the world; and John Ryther is by
10 reputation one of the outstanding if not the most
11 outstanding experts on this continent on feeding
12 organisms, mean organisms with sewage.
13 Now you have had the opportunity to hear their
14 opinions as to what ought to be done, and I think it's
15 your responsibility to weigh these very seriously
16 against these engineering decisions. I don't believe
17 that you've looked at the alternatives. You have in
18 the traditional engineering sense, but I think as
19 Professor Schaake has indicated that some of his
20 colleagues at MIT consider him rather conservative.
21 This is a different world, operating at a different
22 pace. If you don't believe it, look at the kids.
23 MR. WEISS: Who are the other members on the panel?
24 What is their expertise?
25 MR. HARD: Mathematical modeling primarily.

1 I think what I was trying to say is that we went
2 to considerable effort to bring in people from other
3 parts of the country from specialties that would have
4 some bearing on this mathematical modeling approach.
5 To me the thing is best guess. That's all. You don't
6 know. You're going to go out there and find out what
7 it's all about.
8 I've been making borings in New England for 17, 18
9 years in harbors. I know more, probably, I've seen
10 more mud probably than anybody in New England, and I've
11 got a pretty good idea what Boston Harbor looks like.
12 I didn't need to dive to do it, and I think I've got
13 more analyses of New England mud than anybody. I know
14 it.
15 These are real problems, and you guys who want to
16 fish around in the dark and you want to paint the fish
17 bowl wall black and diddle a line in there, a hook, go
18 ahead, but know the consequence. That's all this
19 meeting is about.
20 MR. COSGROVE: I feel justly chastised, Carl,
21 (Laughter) but just let me say this, I have found, and
22 I have the highest respect for every member of the
23 panel. I think they were very well chosen. I think
24 it's a very good panel, and we've gone through this
25 exercise before, and any questions that I ask are not

1 to criticize or disagree, but rather to try to get the
2 answer to problems that I am concerned with, and basically
3 I am an engineer. Basically these men are scientists,
4 and I have found that if you ask them enough questions,
5 you will get the answer that you're looking for in the
6 language that I find I can understand, and because I
7 say that I don't believe that a physical model is
8 needed for Boston Harbor doesn't mean that there isn't
9 going to be a physical model. It means that I question
10 it in my own mind, and I would like to draw out a little
11 more what are the reasons, why do you need this model.
12 Because ultimately what our charge is is to get a waste
13 water system that will serve Metropolitan Boston without
14 fouling up the environment, and that's our only change.
15 How we go about it is what we're trying to determine.
16 Now, I think this has been helpful. I think it
17 probably could have been more helpful if we had gotten
18 to where we are this afternoon yesterday morning.
19 MR. HARD: That wasn't possible then.
20 MR. COSGROVE: Things are coming out now that
21 should have come out yesterday.
22 MR. HARD: I think back on the days when Bill Slagel
23 used to send one of his engineers down and say, "We're
24 looking for a dam site in this stretch around here.
25 You can have one boring." We have progressed to the

1 point where today we're being criticized for some of
2 the dam sites that we've put in, and the question wasn't
3 the economics of the borings we could have for the dam
4 site which frequently was selected without any
5 environmental consideration other than design criteria
6 in manuals. You know, we don't use the manuals as much
7 as we used to and for good reason. We have come a long
8 way.
9 MR. COSGROVE: We've come a long way. I've come a
10 long way from building Quabbin Reservoir which
11 necessitated wiping out three towns and moving 20
12 cemeteries. So what's going to happen to the shrimp
13 down in the Connecticut River estuary if you take a
14 little water out during flood flows, these are
15 important things, and life changes.
16 MR. HARD: And I have to worry about the oysters in
17 New Haven Harbor before I can have a dredging job done.
18 Then I'm still told I can't have any. I think we've
19 reached a point where some of the dams that were located
20 in those days probably never should have been built.
21 We're being criticized to the effect anyway, and I think
22 that you're in exactly the same position right now with
23 the sewage problem.
24 MR. COSGROVE: What we're trying to find is the
25 path to follow that will give us the answer that will be

1 acceptable 80 years from now.

2 MR. HARD: And 80 years from now, I don't think
3 that any computerized contours of DO values are going
4 to be looked at by anybody.

5 DR. KRONE: If you didn't have disolved oxygen, it
6 would be a pretty important matter. It's only not
7 important here because the levels are fairly high.

8 But you know, you said something there that kind
9 of plucked one of my cords, that we want to do an
10 adequate job without harming the Harbor, words
11 something like that, without harming the environment.
12 I thought our objective was to achieve the best quality
13 environment we could afford. There's quite a difference
14 between those two points of view.

15 I think that we will do that by continuing the
16 trend that you alluded to in your own experience; that
17 is, that we do things better and better, and we learn
18 more and more about nature so that we can select the
19 best alternatives and find the least costly ways to get
20 there.

21 When the first outfall was put out there, I
22 understand they went out there with drogues and sextants
23 or something and followed them around the harbor to
24 describe currents and make their armchair calculations
25 where the best place was to put them. Now we've come

1 at least two orders of magnitude, two orders of
2 sophistication above that. We now have the mathematical
3 models that tell us something about what the
4 concentrations will be as a result of some of these
5 currents.
6 Now our recommendation here seems to be that we
7 ought to go one more step, and that is to put it all
8 together in sufficient detail so that we can
9 responsibly say that with the resources we have
10 available, we can have a harbor that you can live in
11 with the best quality of life.
12 I would like to see you put your sights a little
13 bit higher.
14 MR. COSGROVE: Well, it isn't a case of leveling
15 our sights vertically, it's horizontally; in other
16 words, setting the priorities in time as to what we're
17 going to do. That's where the problem is.
18 DR. SCHAAKE: You mean on your engineering
19 decisions?
20 MR. COSGROVE: I mean on all decisions. Basically
21 they'll all end up in some kind of structure that's
22 going to serve the needs of man regardless how many
23 studies you make in the harbor, that is what the final
24 result is going to be.
25 DR. KRONE: Well, you know, if you drive down a

1 road across fields with telephone poles on the side,
2 even if all the telephone poles are exactly the same
3 size, the same height, the ones closest to you always
4 look biggest, and the ones in the distance look smaller
5 and smaller. Our problem is that we want to be prepared
6 to meet those that come in the distance, and we ought
7 to start preparing now.
8 MR. HARD: Some of them might be bigger.
9 DR. MANCINI: If I may offer a comment on that, if
10 I may as an engineer. Professor Mortimer, who is a
11 limnologist at the University of Wisconsin, commented
12 at a meeting I was at that he had a discussion with a
13 fellow from EPA in the '60's, and the fellow from EPA
14 said, "Professor Mortimer, I have $12 million and
15 three years to solve the problems of Lake Michigan,
16 water resource problems of Lake Michigan." Professor
17 Mortimer looked at him and said, "You know, son, if
18 you were lucky, you'd have $3 million and 12 years."
19 And much of the kinds of research we're addressing
20 here require that kind of time frame and the application
21 of best brains, not only locally but in the country to
22 respond, to determine whether the telephone poles that
23 are in the distance are large or small and whether or
24 not, in fact, they are telephone poles or perhaps nooses
25 that are waiting for us.

1 MR. HARD: Well, everybody is so damned afraid to
2 stick his neck out and do something a little bit
3 different. If you look at that sketch up there, the
4 foul area, why do we have a foul area, a foul area
5 suitable for dumping contaminated material the gimmick
6 to keep from tangling with EPA as we dump the mud in
7 the foul area. We don't know a damn thing about the
8 foul area. All we know is it's deeper. We don't know
9 that it's a good idea to dump the stuff in deeper water.
10 We've got a baseline biological study for the
11 NOMES project, this is a multi-million dollar study,
12 that's right between our dumping ground and where we're
13 dredging right now for Fore River Channel, and this is
14 a biological baseline study.
15 We've got current meter arrays that MIT is running
16 that are not developed yet. We're throwing away what
17 we know as far as obtaining basic current data for the
18 sake of experimenting with instrumentation under the
19 guise of studying the environmental effects of ocean
20 mining in this area. I think what we should do is start
21 getting down to some serious oceanographic work. We've
22 got a whole front yard in Massachusetts Bay. We've got
23 enough people with the capabilities to handle the
24 situation. We have enough money involved, and if we
25 can stop looking at it from the standpoint of just one

1 project.

2 My interest in Boston Harbor is its relationship
3 to the studies going on in Massachusetts Bay. I don't
4 think MIT should be running one type of study or the
5 University of New Hampshire or Raytheon should be
6 running one type of study in Massachusetts Bay, go out a
7 little farther to Jeffrey's Bank and NOMES is running a
8 biom study, and then go into Boston Harbor and we're
9 talking about a model. I think there's certainly
10 enough money in this thing.

11 It's just that people aren't talking to each other,
12 and they're following their own restricted assignments.
13 There is enough resources, I think, in these overlapping
14 interests. We're talking about three agencies on the
15 federal level; we're talking about four agencies on
16 the federal level; we're talking about several state
17 agencies; and we're talking about a variety of projects
18 that are going on that involves many, many billions of
19 dollars. We're talking about whether we can maintain
20 Boston Harbor in the future with maintenance dredging,
21 because we're not allowed to dump.

22 This is this business that Ray Krone was talking
23 about yesterday. We're stopping; you don't stop just
24 for the sake of stopping because you think the way
25 you're doing it may be harming the environment, and I

1 believe this is the position that you're in now, Mr.
2 Cosgrove, when you talk about getting on with the work.
3 MR. WEISS: Yes, but also besides the harbor, we're
4 involved with a few hundred square miles of land area
5 that contributes drainage to the harbor, not the harbor
6 alone.
7 MR. HARD: That's right, and I'm very much concerned
8 about where you're going to put that sludge you're
9 taking out of the harbor. Maybe you want to put it in
10 the ocean. I haven't seen any particular attention
11 being given to deep ocean outfalls for the sludge say
12 off of Nahant or on the south shore. This may be the
13 most intelligent alternative. It might give you a long-
14 term solution, I don't know. But it certainly would
15 relate to the studies that are going on with the NOMES
16 project.
17 We really need a concerted oceanographic effort
18 in our front yard, and this is a maritime province,
19 New England, and this is one of the most maritime cities,
20 and we're talking about centering our recreation and our
21 apartment complexes right on the harbor. And yet I
22 feel we are in the dark ages in the way we're approaching
23 these studies.
24 Ray can see it. Henry can see it, I believe, I
25 mean at least the broader aspects of it.

1 DR. KRONE: I think we have come to a point where
2 we've all exposed our views about this, about the future
3 problems.
4 DR. SCHAAKE: Guy could expose a few of his.
5 DR. McLEOD: I've been sitting here listening, and
6 when John said what are the biological problems, I'd
7 just like to say the way we've looked at the harbor,
8 this is a multi-use type of basin or abayment or what-
9 have you. We know we're going to have shipping, unless
10 there are some very substantial changes in our whole
11 outlook about the way the harbor is going to run. We
12 know that there is a projected plan for a large
13 recreational use of that area and hope this will include
14 bathing, will include fishing, will include all sorts
15 of parkways and whathave you; and we also know that
16 there are substantial problems with the MDC system,
17 just how it operates, and included in this MDC system
18 are the combined sewer overflows, and there's a whole
19 problem of the urban land runoff.
20 I think we have to address ourselves to the input
21 to the harbor system, and say what harbor inputs are
22 permissible in order to maintain the multi-use aspect of
23 the harbor. Now, I think that Metcalf and Eddy and the
24 MDC have now started to find some of those inputs.
25 We've tried to look at some of the problems that

1 relate directly to the dynamics of a harbor or estuary,
2 what sorts of things can go on together, can you have a
3 productive or non-productive area or do you swing from
4 non-productivity to eutrophication or highly eutrophied
5 area. I think these are some of the problems that are
6 yet unanswerable.
7 Normally what we find is we not only have to
8 consider trophic levels as well as exotic substances,
9 pathogens, oils, metals and nutrients, but we also have
10 to spend a lot of time on defining meteorology
11 conditions so the meteorology and the biological and
12 chemical micro processes some how are resolved.
13 I think if we consider this area as a multi-use
14 area, which it will be, and then we have a long time
15 span before we achieve the ideal water quality for the
16 amount of money we're willing to spend, we've got to
17 look at chemistry, biology, and the physical nature of
18 the harbor. And I think this pertains to the outer
19 Mass. Bay, because if you want to dump in certain areas
20 or if you want to remove the bottom and you shut off all
21 the inputs that have been advocated in many questions,
22 it's an impossible question to answer. You're not
23 going to shut them off in a hurry. There's going to be
24 a long time span.
25 I just feel that in order to look, not only at

1 Boston Harbor but to apply such information to other
2 ponds, lakes, other abayments that you might want to
3 develop in the future, you have to have the basic
4 information and not only input but one of the effects,
5 cause and effect relationships, particularly on the
6 chemical and biological microbodies.
7 So I feel there are still some things we don't
8 know about behavior, particularly within the chemistry
9 and biology aspects. I do agree that these are longer
10 term studies. You're not going to solve many of these
11 problems in one year or two.
12 And I agree with John Mancini. There is a planning
13 stage at which you look at what you have available and
14 what research can fall out for that amount of money.
15 I'm heartily in favor of that approach.
16 MISS JOHNSON: It seems likely now that we might
17 suggest for the future conferences or whatever, some
18 kind of group of somebody maybe from the NOMES project,
19 somebody from BIOM and somebody from the dredging
20 studies and our waste water group and also people
21 familiar with the recreation program, and get that kind
22 of a group together and try to coordinate our effort
23 and our money and save duplication of effort, because
24 for the NOMES project they have to do circulation, they
25 have to do biological studies.

1 MR. HARD: Well, I would agree with you. I would
2 like to see state natural resources get together with
3 NOMES people and BIOM people and certainly this group
4 and see what could be done about putting together at
5 least the scientific aspects of the long-range program
6 so that the necessary background is available as these
7 problems arise and develop. Perhaps somebody like the
8 New England Regional Commission could fund it. They
9 have quite a bit of money, I think.
10 CAPTAIN KENYON: Would that stimulate the economy
11 of the region?
12 MR. HARD: Well it certainly would in the research
13 area.
14 DR. SCHAAKE: A source of money might be the
15 National Science Foundation grant program. They
16 started spending a lot of money in the Chesapeake Bay
17 area.
18 MR. HARD: We have a committee now that is
19 answering to the Rand Program and screening research
20 related to dredging and dredge disposal which, of
21 course, includes the ocean mining, and our committee;
22 it's only four men, four agencies -- NOAA, EPA, Interior,
23 and the Corps -- and we're attempting to put together a
24 framework that we've been asked to by people at Rand,
25 and it seems to me that this type of thing would overlap

very strongly, particularly in the Boston area where there are mining activities.

DR. SCHAAKE: It seems to me that the division in the state agencies here might try to generate some proposals with other institutions as well as evaluate the ones they get and make the things go the way they want them to go, get some contributions to some of the more esoteric aspects of these problems. So you don't have to confront them with your design money, planning money.

MR. IGNAZIO: Maybe something got by me, but you asked a question about biological studies, John. I think you said what do you mean by these. Can you elaborate on these?

DR. RYTHER: I think Guy answered, frankly, although I suspect that these are largely problems of hydrography and chemistry and meteorology and all the other things that affect the biology, really. I don't feel that it's necessary to delve deeply into basic biological problems of how various pollutants affect organisms and that sort of thing. As I said earlier, if you can clean up the chemical environment, the biology will take care of itself.

MR. HARD: You did indicate an item of $250,000 for fish baseline data.

DR. RYTHER: Yes, but I wasn't thinking of this for research so much.

DR. McLEOD: Part of your basic inventory, wasn't it?

DR. RYTHER: Yes.

MR. IGNAZIO: Does anyone have any other types of questions? We've had a chance, I think, to see, at least, in three instances or two anyway of how they would spend the money.

Henry, we didn't find out how you would spend the money if it were given to you.

MR. SIMMONS: Well, I'm not accustomed to dealing with figures. I would like to emphasize just two points, both of these I've made already. One is my firm belief that hydrodynamics of Boston Harbor needs to be firmly established. This is important in my mind to the water quality study; it's important to the biological studies; it's important to the sedimentation studies.

I think that this background of hydrodynamic information is needed to compare with any models that are developed -- mathematical, physical, whathave you -- to see whether or not they fit the framework of the known hydrodynamics of the harbor. If they do fit it, this lends a high degree of confidence for the use of these

models for whatever purpose. If they don't fit the framework, as far as I'm concerned, they're not worth a damn. It's just that simple.

The other point I would like to emphasize, and I've said this two or three times, while I don't envision a physical model in the current programs for the short-time frame that you have available, I think it should be considered as a long-term objective for the area. I base this on 30-odd years of experience in working with these things and knowing what one can do with them, and I'm firmly convinced that if such a model did exist that you'd find uses for it every day that nobody in this room foresees right now, and that all these uses would be of value to the long-range planning and development of Boston Harbor.

CAPTAIN KENYON: In considering a model, would it be useful to maybe consider the broader picture thinking of the physical model in that if you were considering Boston Harbor, would it be worth your time to expand it to a larger expanse of abayment?

MR. SIMMONS: Certainly, and if I did go to a physical model, I would go to the most sophisticated model that it is possible to build. Often times they are unfair, I think, comparisons made. We make them ourselves between the cost of doing the physical model

1 versus the mathematical model, and I don't like that
2 term versus. It's not mine. It's hardly ever a case
3 of one or the other, in my mind, but occasionally we'll
4 come up with an estimate of say three-quarters of a
5 million dollars to do a sophisticated three dimensional
6 physical model study of a particular estuary. But
7 somebody comes along and says, "Oh, hell, I can do a
8 mathematical model of that estuary for a hundred
9 thousand dollars." Sure he can. You can also do a
10 physical model study of it for a hundred thousand
11 dollars. If you want to put the two on the same plane
12 of reference, so to speak, so it's usually a case of
13 comparing sheep and goats.
14 So until someone tells me exactly what the
15 mathematical model will do in relation to what the
16 physical model will do, I find it awfully difficult to
17 resolve in my own mind which we should go for. I guess
18 I'm one of the few in both sides of the business.
19 DR. RYTHER: I'm sitting in a hot seat here, but
20 I'll be the Devil's advocate for a minute. What seems
21 to grow on me in this session is a certain tendency
22 toward saying that you need circulation studies to build
23 a model, and then you need a model to understand the
24 physical oceanography. Somehow the solution as to how
25 to clean up Boston Harbor doesn't emerge through some

1 of this, and I think this is bothering some of the
2 other people.
3 I think we shouldn't lose sight of the fact that if
4 you want to clean up Boston Harbor, you identify the
5 sources of pollution and stop them. If you had an
6 infinite amount of money and legal pressure and so on,
7 you could do this without understanding a damn thing
8 about the circulation of Boston Harbor.
9 DR. KRONE: You can't stop them.
10 DR. RYTHER: I know you can't and that's the reason
11 for doing these studies to somehow establish priorities
12 and find out where best to attack the problem. But I
13 don't think we ought to forget the basic problem of
14 identifying what the pollution is that we're trying to
15 correct, and then what the sources are, and this seems
16 to me a pretty basic kind of information before you get
17 into these other problems which are important, I agree,
18 but which are tools to help solve the basic one.
19 MR. IGNAZIO: I think in all fairness, we ought to
20 say at this point, since August, at least August, we in
21 the state and the MDC have been trying to do planning
22 for planning preplanning, and I think a lot of our
23 attentions have gone into the very things that you've
24 just touched upon. I think if we were to call you again
25 together as a group in the future, two months or

1 thereabouts from now, we would be in a position by that
2 time certainly, some of the work would be in gear, and
3 I think we would be in a position to tell you more about
4 some of the things we're doing and how the thing shapes
5 up.
6 I personally feel that today's meeting and
7 yesterday's has given the harbor segment a lot more
8 attention, where up to now we've been putting most of
9 our ideas on the landward section. So from my position,
10 I think this has been very useful to get these views
11 such as they are, and I suspect that maybe we should
12 try this type of thing again a couple of months later,
13 and maybe add some additional skills to our group.
14 MR. HARD: We have a question over here.
15 MR. VLATAS: Not a question. I'm Demetres A.
16 Vlatas, OCE. It seems to me we have gotten people at
17 two poles here. On the one hand, we have the MDC
18 people who are concerned about cleaning up pollution;
19 Carl who is really concerned about how do I take care
20 of other problems within Boston Harbor, such as dredging,
21 the mining, the possibilities of filling in for a third
22 runway and so on. So we have a reluctance on the part
23 of the people who are running the waste water study to
24 spend their money, that part of it, for an overall
25 model study of the harbor. On the other hand, we have

1 these people who have broader concerns who say we
2 should spend this money.
3 I think maybe what it is is a matter of cost
4 sharing, possibly that you could put in a quarter of a
5 million dollars or half a million dollars out of the
6 waste water study for this thing. But you shouldn't ask
7 the people in the waste water aspect of this thing to
8 fund the entire modeling study. And I think this is
9 what the concern is. This is why we've polarized here.
10 We're not saying that research isn't necessary.
11 But I think there is a reluctancy though not expressed
12 that they don't want to pay for the whole thing, I mean
13 the waste water people. I think once we've resolved
14 that point, we may not have a difference.
15 MR. HARD: I think it's emerging, I'm not sure.
16 How do you feel, Mr. Cosgrove?
17 MR. COSGROVE: I think Sandra had the answer to
18 that. Get the people who are interested in the islands,
19 everybody interested in the harbor together, pool
20 their resources and come up with whatever information
21 is needed to solve or get a handle on all the problems
22 of Boston Harbor. She just went through that little
23 exercise.
24 MISS JOHNSON: It's much cheaper to do one big
25 model than it is to do four or five little ones in

1 different sections.

2 MR. VLATAS: That's funny now. We ask the waste

3 water people to do all the funding for that thing is a

4 little out of line. I think that's why we're polarized.

5 MR. HARD: We haven't really done that yet.

6 MR. VLATAS: It's kind of been implied.

7 MR. IGNAZIO: That has always been a big iceberg

8 to me, and I think it's getting bigger, that's all.

9 That's all we did the last two days, make it bigger.

10 DR. SCHAAKE: You've got to keep the size of the

11 panel down so your iceberg doesn't get too big at any

12 one time.

13 MR. IGNAZIO: Even if we did do as Sandy says, and

14 it's a very sound move, going into such a meeting we'll

15 have the benefit of having had these two days.

16 I have a belief that a lot of the research work

17 we've been doing on a national basis, the payoff hasn't

18 been quite, maybe, as big a bang as it could be. I

19 shouldn't say this because I'm not in the research

20 business, but only from the type of relationships I get

21 in meetings that I'm invited to, and some of the things

22 they keep telling us when you go to these things, if we

23 could only get a sponsor for this type of research, we

24 could make a direct application, really bring it down

25 to our day to day solutions, and maybe some of our

1 research people may be receptive to this. Maybe there
2 is planning effort that may cut out the free body
3 diagram, like John is saying. This really is an area
4 for research while other guys do the charges that have
5 been given to them.
6 MR. HARD: I think we've established a need.
7 MR. IGNAZIO: I'm kind of talked out of ideas. I'm
8 about ready to stop. Does anybody have anything? Do
9 we have any other questions?
10 DR. KRONE: I would like to ask you or someone in
11 this organization to sit down and put together the ideas
12 that we've discussed here in some kind of approach that;
13 what do we do next. Certainly one of the things that
14 came up was the need to get all the information that is
15 available together, and perhaps you could send it
16 around the panel to comment.
17 MR. IGNAZIO: We have gone through the pains of
18 getting stenographic service for this type of thing.
19 We're going to get quite a few pages of discussion, and
20 our staff will go through and try to abstract some of
21 this, and didn't intend to take this and give it to the
22 Boston Globe or the Herald, but it's just going to be
23 among ourselves. As we go down our little corridors,
24 we'll have the benefit of looking through it. By all
25 means, this will be available to everyone who is here.

I think you're right. I think it would be worth the time to go through it, even though we've got all the statements. I think we ought to take that upon ourselves yes, sir.

MR. HARD: Shall we close it, Joe?

MR. IGNAZIO: I think we should, and I know you do recognize we have dealt here with scientists of various ilks. We're really going to bring in a lot of social scientists. This study is going to address behavioral patterns, mind you, and alternative futures. We'll deal with such things as population, economic growth, and amenities.

I don't know whether we'll confuse everybody, but this is what we've taken on, a very large chore. I for one want to thank each and all of you for coming. It's been enlightening.

MR. COSGROVE: I'll second that.

MR. IGNAZIO: We may call upon your services in the not too distant future.

We stand adjourned. Thank you very much.

(Whereupon, at 2:23 p.m., the above-entitled matter was concluded.)

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