CONSENSUAL VERSES HIERARCHICAL APPROACHES TO ENVIRONMENTAL DECISION MAKING: THE CASE OF THE MASSACHUSETTS MILITARY RESERVATION

by

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B.S. Environmental Studies
George Washington University, 1991

SUBMITTED TO THE DEPARTMENT OF URBAN STUDIES AND PLANNING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTERS IN CITY PLANNING
AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JUNE 1997

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Submitted to the Department of Urban Studies And Planning
May 14, 1997 in Partial Fulfillment of the Requirements for the
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ABSTRACT

Decision makers at the Massachusetts Military Reservation used two distinct approaches in designing a plan to cleanup plumes of contaminated groundwater. The hierarchical approach used at first consisted of a technical design team working in relative isolation with an inflexible mandate from the public for total simultaneous containment of the plumes. The design that resulted from this effort failed to account for the ecological side effects that satisfying the mandate entailed, leading to a political crisis. In contrast, a second effort used a consensual approach consisting of a multi-disciplinary and inter-institutional group that frequently presented their progress for review by the broader public. This approach lead to a flexible decision-making process that built consensus around politically and technically acceptable recommendations. The disparity between these two approaches is explained by analyzing the institutional design and decision-making approaches.

The importance of stakeholder participation in the decision-making process is discussed in terms of three characteristic challenges of environmental decision making: political plurality, technical disunity, and urgency. The hierarchical approach separated decision making into separate political and technical tasks, limited outside review of proposed plan, and restricted communication between stakeholders and the design team leading to blindspots that contributed to the plan's failure. The consensual approach integrated the consideration of technical and political issues, recognized uncertainty and disagreement, provided multiple channels of communication, encouraged participants to understand and consider alternative perspectives, and allowed parties the ability to renegotiate the goals of the effort as their understanding of the problem changed.

Many environmental problems share these characteristic challenges. This case is illustrative of the practical benefits of inclusive decision making processes in dealing with complex environmental decision-making problems.

Thesis Supervisor: Lawrence Susskind
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Acknowledgments

for Mom and Dad

From whom I was learning about consensus long before
I found out that it was something that could be learnt.

Thank you Larry for your guidance and encouragement on this and many other projects over the past two years. Thanks to David Laws for the many hours you've spent helping bridge the gap between theory and practice.

Special thanks to the folks at CBI, IRP, and all the others who were willing to track down documents and discuss your views of what happened at MMR last year. I hope I did justice to your work and dedication.

Alas, all errors and omissions of fact and grammar are mine and mine alone.

-Eddie

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I have yet to see any problem, however complicated, which,
when you look at it in the right way,
did not become still more complicated.

-Poul Anderson

The potentialities of each individual are
greater than those he can hope to realize; and
they fall far short of the powers among men generally.

-John Rawls

I. INTRODUCTION

1. Overview

On January 22, 1996, Operational Technologies Corporation (OpTec), an engineering firm working for the Installation Restoration Program (IRP) released a partially completed design for the containment of seven plumes of groundwater contamination at the Massachusetts Military Reservation. Though the design was only 60 percent finished, it met with extraordinary opposition from regulatory agencies, the public, and even within the military. The resistance came as a shock to OpTec and the Air National Guard (Guard), the military agency responsible for managing the IRP.

The designers of this 60 Percent Plume Containment Design (60% Design) felt they had done a good job in a very difficult situation. They had utilized all the available information on the plumes and performed further studies of their own. They had adhered to accepted engineering practices and models, and carefully followed the criteria given to them by the Guard. These criteria, as laid out in the Record of Decision for Interim Action, had been approved by the Guard, US Environmental Protection Agency (EPA), and Massachusetts Department of Environmental Protection (DEP). "The community, represented by local elected officials and activist groups,"[1] DEP, EPA, and the Guard had all participated in the preparation of the criteria and had presented clear guidelines for the design process in the Plume Response Plan. Yet the design that emerged was viewed as a "failure" by the same groups that had approved the criteria that guided it. The plan was a technical failure, it had not considered the ecological impacts of pumping, treating, and returning a vast amount of water to the aquifer. The most damaging critique focused on secondary effects that OpTec had not considered; the actions proposed would disrupt the hydrology of the Cape, destroying unique wetland and kettle pond habitats. It was a political failure as well. The gaps and omissions were clear to local residents and the military's credibility with the public sunk to an all-time low. Regulatory agencies threatened legal action, and progress on the design grinded to a halt.

Four months later, in May 1996, the Technical Review and Evaluation Team (TRET), a group formed in response to outcry against the 60% Design, released its Final Report. The TRET's recommendations on how to proceed with plume containment received support from most of the opponents to the 60% Design. Partially on the strength of this support, efforts to clean up groundwater at Massachusetts Military Reservation (MMR) have begun.

One way to account for the disparity in the way the two plans were received is to look at differences in the decision-making process each used, particularly the approach each took to public participation. The military restricted participation in the 60% Design process to the development of goals that were then used by OpTec technical experts to guide the design of the cleanup plan. OpTec limited the involvement of outside participants in the development and review of their design. The TRET process relied on a collaborative multi-disciplinary effort. TRET members interacted with public representatives throughout their decision-making process. The participation of experts from a wide range of technical and institutional backgrounds was central to achieving a better technical outcome. Unlike the 60% Design, the TRET's recommendations acknowledged the technical uncertainty concerning the plumes and treatment methods and tried to balance the goal of remediation with secondary effects like the risk of serious ecological impacts from the remediation effort.

In its design effort, OpTec was following criteria that were initially spelled out in the Plume Response Plan (PRP) and was formally adopted by the Guard, EPA, and DEP in the Record of Decision for Interim Action (IROD). A clear explanation of the political objective of these criteria was elaborated in the PRP;

> Public mistrust of the [Guard] and regulatory agencies can be reversed by 'total' and 'simultaneous' cleanup action at the MMR. In fact, it may be

[1] Plume Response Plan, ES-2.

the only credible way to restore full public confidence...[2]

From the public's and regulatory agencies' view, the goal of total containment guaranteed that the military would clean up the plumes to a level that everyone would accept. From the Guard's perspective, 100% simultaneous containment would ensure public and regulatory support for its efforts. Parties viewed total containment and treatment of contaminated groundwater as a "fail-safe" objective; no matter how the Installation Restoration Program performed, it would be forced to solve the problem. This approach, however, created blind spots. Secondary effects of remediation, such as the ecological impacts of pumping so much groundwater to the surface for treatment, were not adequately considered. The technical complexity of containing and treating the plumes was underestimated, and the interconnection of hydrological and ecological systems went largely unexamined. In tying itself to the mandate laid out in the IROD and PRP, the Guard created a situation in which is was difficult to identify, much less address, side effects of pursuing these goals.

The TRET, on the other hand, explicitly took on the challenge of clarifying and balancing a broader set of goals, recommending that "the MMR depart substantially from the strategy of simultaneous, 100 percent containment and treatment."[3] The TRET's recommendations generated support from all the agencies and public representatives involved. I want to explore the divergence in how these two plans were received. I believe that the reaction to the two efforts was partially a result of the institutional process each used to develop their goals. I want to focus my diagnosis on two questions:

(1) What were the key characteristics of the decision-making approaches used by OpTec and the TRET?

(2) How did group member interaction -- both internally and with the public -- influence the political acceptability and technical quality of their recommendations?

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[2] Plume Response Plan, 3-4.
[3] TRET Final Report, page 1.

2. Itinerary

At MMR, the challenge to the military was to develop a plan that would satisfy political demands and would be workable in light of the technical difficulties of cleaning up groundwater contamination. Public representatives and advocates, as well as local, state, and federal regulatory agencies all had influence over the implementation of the final design. The military understood that they needed a plan that was "politically" acceptable -- one that met each of these groups' interests. The military, consultants, and others involved in the project also recognized that they were confronting a highly science-intensive problem. Identifying the extent and severity of the groundwater contamination, and determining the best remediation strategy, required vast technical expertise. With the Guard/OpTec and TRET efforts, the military took two very different approaches to reaching a "politically" and "technically" acceptable design for the containment of the plumes. I am interested in exploring how each effort attempted to meet the challenges of environmental decision making, and how the process used by each influenced its eventual viability.

The case of the MMR is an example of two distinct approaches to solving the same problem. I will compare the two efforts in light of an understanding of the characteristic challenges of solving scientifically complex, politically divisive environmental problems laid out in Section II. Sections III and IV give the background and then explore how the 60% Design process attempted to cope with these challenges, and why it was unsuccessful in reaching an acceptable plan. Sections V and VI deal with the creation of the TRET and describe the decision-making process that it used. Section VII consists of a comparison of the characteristics of each approach and lessons that can be drawn from the case. The lessons drawn from the story of the MMR are useful in the broader context of solving Superfund and other environment problems that share the characteristic challenges of political disunity, technical uncertainty, and the urgency of a real health threat.

3. A Short History of the Massachusetts Military Reservation

The Massachusetts Military Reservation (MMR) has been used as an armed forces base since 1911.[4] It is presently home to the Otis Air National Guard Base, Army National Guard Camp Edwards, and a US Coast Guard Air Station. The reservation is 34 square miles (approximately 22,000 acres) and borders the towns of Bourne, Falmouth, Mashpee, and Sandwich in Cape Cod, Massachusetts -- approximately 70 miles south of Boston. The first indications of groundwater contamination on the site came in 1979 through a US Geological Survey study of waste-water leaching from the MMR sewage treatment plant.[5] Later that year the Falmouth Water Department had to close a one million-gallon per day public water supply well because of contamination from that plume.[6]

The generation of hazardous waste during the time of the Base's heaviest use, from the 1940's to the 1970's, resulted in 78 identified pollution source areas and ten major plumes of groundwater contamination.[7] Contaminants disposed of by "landfilling, dumping in storm drains, dumping and burning wastes in fire training areas, or just dumping in the ground"[8] subsequently seeped into the aquifer. The list of contaminants includes fly and bottom ash, waste solvents, waste fuels, herbicides, transformer oil, and the effluents from the base sewage treatment plant. The ground water contaminants can be separated into three classes; solvents, metals, and fuels.[9] The enormous challenge to designers of a cleanup plan is to understand the extent and location of contamination

> often without a known source, that happened 10, 20 or even 40 years ago, in an unseen, complex hydro-geologic matrix with a relatively few wells using a model that is never perfect and must constantly be refined with new data. As if this weren't complex enough, you need to predict with some certainty how massive pump and treat systems will simultaneously

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[4] Plume Response Plan, page 2-1.

[5] Rolbein, Seth, The Enemy Within: the Struggle to Clean Up Cape Cod's Military Superfund Site, Association for the Preservation of Cape Cod, page 36-37.

[6] Plume Response Plan, page 1-5.

[7] Massachusetts Department of Environemntal Protection; World Wide Web, MMR Information Page; Originally uploaded May 31, 1996; http://www.mmr.org:80/mmr1/bashist.htm

[8] *Ibid.*

[9] Plume Response Plan, page 4-20

> affect contaminant flows, groundwater flows, as well as surface affects, all, over 10 or 20 years. The uncertainties of time and space are everywhere.[10]

In 1989 the EPA placed the Base on the National Priority List of the Comprehensive Environmental Response, Compensation and Liability Act (Superfund). In January 1994, the Agency for Toxic Substances and Disease Registry formally designated the installation a 'public health hazard.'[11] By June 1994, a 10-year, $80 million study by the Guard had identified 10 distinct plumes of contaminated groundwater. The Guard found that at that time, seven plumes, "continue to migrate unchecked" and "pose a continued threat to public health, the environment, and the quality of life of residents."[12] Though many different Department of Defense agencies have been active at MMR, the Air National Guard was initially given primary responsibility for overseeing the Installation Restoration Project. Management of the Air National Guard is shared by the National Guard Bureau on the Federal level and the State. Responsibility for managing the IRP at MMR was later switched to the Air Force Center for Environmental Excellence (AFCEE), a branch of the Air Force that supports environmental activities.

Cape Cod is dependent on groundwater as its primary source of freshwater, supplied through both private and municipal wells. MMR is located in the recharge area of this unconfined aquifer, which is given the special status by the EPA as a "sole-source" aquifer under the Safe Drinking Water Act. In short, public and private wells, and a single groundwater recharged pond, make up the only sources of fresh water on the Cape. The aquifer is recharged entirely through rainwater infiltration from the surface. The geology of the aquifer, mainly coarse sand, and the geography of the site means that groundwater flows at the high rate of 1.5 to 2 feet per day out from the highest point, which is located on the Base.[13]

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[10] Interview, May 7, 1997.
[11] *Ibid.*, page 4-1
[12] *Ibid.*, page 1-1
[13] MA DEP, Web Page

The main threats posed by the groundwater plumes are contamination of water supplies, ecologically sensitive kettle ponds, and coastal bays. Freshwater from the aquifer discharges into the bay creating the brackish areas crucial to coastal marine life. These marsh areas are highly productive marine ecosystems which support marine life directly (many marine animals spend portions of their life in these less-salty areas) and indirectly (i.e., these areas are a major source of the ocean's dissolved organic matter). Contamination in the aquifer will eventually find its way to surface waters, either freshwater or marine, were wildlife will be exposed. The importance of the aquifer to the health -- human, economical, and ecological -- of the Cape is the central driving force in the effort to remediate the groundwater plumes at MMR.

II. ENVIRONMENTAL DECISION MAKING: Confronting Key Problems

The case of the MMR illustrates the significant challenges that decision makers face in dealing with environmental health risks. Political disunity, technological pluralism and urgency are characteristic challenges that make environmental problems especially difficult to handle. Political disunity is a result of the wide range of stakeholders involved, complicated inter-institutional relationships, and diversity of opinion. Technological pluralism is due to the complexity of natural systems. Understanding an environmental problem requires that decision makers combine the expertise from many different scientific fields. Urgency is a result of the immediate threat that environmental problems pose to public and ecological health. Embedded within each of these challenges is tension over technical uncertainty surrounding the problem and mistrust, along with miscommunication, between the parties involved. This chapter clarifies these challenges as well as some of the specific problems that decision makers face in trying to cope with them. These challenges are used in the following chapters as a framework to understand the decision-making approaches used at MMR.

1. The view of "science" and "politics" as distinct realms

Addressing environmental problems requires making choices that are both technically wise and politically acceptable. This is no easy task. One common approach to addressing environmental problems is to create separate decision making domains. The technical aspects of a decision are handed over to experts, and elected or appointed officials make political choices on the basis of scientific advice. This approach assumes that "objective" technical questions can be defined and handed over to "experts" who will answer them in an "objective" manner. These findings inform or even drive a "value-laden" (and hence subjective and not amenable to discussion) political decision-making process. The view that experts can identify and separate the scientific judgments from the political considerations has increasingly been challenged. As Leiss argues;

> there is simply no basis for assuming that the scientific assessment of risk can be characterized as a 'neutral' or purely objective process. Among

> other things there are too many unresolved (and perhaps unresolvable) uncertainties in risk estimation, requiring too many assumptions that rest on problematic grounds and are subject to challenge and to honest disagreement.[14]

By drawing attention to the ways in which expert judgment is also " value-laden," critics of the conventional approach of separating "science" from "politics" point out the need to integrate technical and political aspects of environmental decision making. Other commentaries show how value judgments are open to deliberation in situations were reasonable people, even with the same information and level of understanding, might still disagree.[15]

2. Legitimacy of the process and outcome

In acknowledging that decisions cannot be grounded "objectively," we must look for another way to establish political legitimacy. Direct participation in the decision making process provides a way to build understanding and acceptance by those affected by the decision. Des Jardins, writing on the importance of public participation in environmental decision making, states that:

> leaving environmental decisions to the 'experts' in science and technology does not mean that these decisions will be objective and value-neutral; it only means that the values that do decide the issue will be the values those experts themselves hold.[16]

Harvey Brooks discusses three main benefits of public participation through consensus building forums in resolving science-intensive disputes. Brooks bases his argument for expanding participation on practical, as well as moral grounds:

> 1) Public participation clarifies societal values to experts, and clarifies the policy choices embedded in the technical decisions.
> 2) Public participation confers political legitimacy on the policy choices

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[14] Leiss, William and Christina Chociolko, 1994, Risk and Responsibility, page 46.
[15] Rawls, John. Political Liberalism, page 55
[16] J Des Jardins, Environmental Ethics, page 5.

that are made and secures public acceptance and cooperation in the actual implementation of these choices.

3) Beyond the above, essentially pragmatic, arguments for public participation is the argument that such a process is an intrinsic political value in its own right -- good for the soul of the citizen -- necessary for the viability of democracy.[17]

3. Achieving technically sound decisions

Broadening the participation of stakeholders is one method of achieving legitimacy in a decision making process. However, in addressing environmental problems the importance of political considerations can not come at the expense of a technically judicious decision. Susskind and Ozawa, in describing criteria for making decisions on science-intensive policy matters, point out that:

> science-intensive disputes require special attention. Merely resolving distributional conflicts without incorporating best scientific judgment will produce unwise and potentially dangerous results.[18]

These two points may seem contradictory. However, the extreme criticism that EPA has endured over the Superfund program (not just at MMR) is evidence that environmental decisions must do both.[19] The use of public participation through consensus building techniques is one approach that is increasingly being used to counter the weakness of the traditional model of environmental decision making. The goal of those consensual processes is that:

> Decision makers and representatives of affected interests, constantly drawing on the scientists, are able to remain at the helm of the dispute, injecting their own value preferences when value judgments are required and gaining a clearer understanding of the variations that are produced by changes in the scientific analyses.[20]

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[17] Brooks, Harvey, *The Resolution of Technically Intensive Public Policy Disputes.* page 39-50.
[18] Ozawa, Connie P., and Lawrence Susskind, *Mediating Science-Intensive Policy Disputes*, page 23.
[19] Harris and Burmaster, *Restoring Science to Superfund Risk Assessment.*
[20] Ozawa and Susskind, page 34.

I want to emphasize that the importance of technical considerations is paramount. However, both the role of experts and the presentation of technical knowledge in a traditional decision-making approach reinforce the false dichotomy between scientific and political aspects of an environmental decision. At MMR, neither the 60% Design or TRET decision-making approach resembled a pure "traditional" process. This traditional model is important here because both processes were, in a sense, reactions to this typical approach. The Guard and OpTec made an effort to include the public by having public representatives participate in determining the goals of the containment effort. However, their effort -- the 60% Design -- met with extraordinary opposition. The TRET went further towards integrating the consideration of "scientific" and "political" aspects of the decision by trying to address both concurrently throughout the decision-making process.

4. Technical pluralism

Environmental decisions frequently require the need to balance different technical considerations. Designing a remediation program for contaminated groundwater, for example, requires modeling of the groundwater and plumes (where they are, where they are going, and what they contain), identifying human and ecological health effects of exposure to the substances in the plumes, and developing and choosing mitigation strategies (containment and remediation). Individually, these endeavors hinge on many "non-objective" judgments and assumptions that constitute value-based decisions. Together they create the need to balance different technical considerations. They also require an understanding of the problem across a broad array of scientific specializations. According to Barke and Jenkins-Smith;

> all experts on an issue are not alike in their expertise; there are many types of specialized knowledge -- biological, economic, physical, engineering, political, and so on -- that are relevant to technical policy-making.[21]

Good decisions cannot be made without understanding and reconciling the different

[21] Barke, Richard P. and Hank C. Jenkins-Smith, *Politics and Scientific Expertise: Scientists, Risk Perception, and Nuclear Waste Policy*, page 425.

perspectives generated by different kinds of expertise. Participation of all stakeholders -- both those representing different "technical" and "value-based" viewpoints -- ensures that the broadest possible number of concerns are brought to the table, reconciled, and accounted for in the final decision.

5. Getting parties to join a "conversation"

The characteristics of environmental problems highlighted earlier and commitments to democracy create a context in which it is necessary to bring the "lay" public together with technical experts from a wide variety of fields. This interaction is crucial to reaching an acceptable decision. This alone, however, will not guarantee success. Stakeholders may get lost in technical jargon, they may not have the communication skills to participate in a public forum, or they may have problems understanding the intricacies of dealing with a group of individuals with differing belief and value systems. Another question that must be answered is; *exactly how should different parties be included*?;

The ideal of political and scientific consensus is quite elusive and building a consensus among the actors is not necessarily adequate. It also requires that the approach to decision making be adequately inclusive and engage the actors to a high degree. According to Fiorino,

> people are the best judge of their interests and can acquire the political skills needed to take a part in governance. Participation engenders civic competence by building democratic skills, overcoming feelings of powerlessness and alienation, and contributing to the legitimacy of the political system.[22]

Laird explains that the public must be included in a way that encourages a deeper understanding of the problem and engages parties in a conversation on the issue.

> [A]nalyzing a problem means being able to challenge the formulation of the problem itself, that is, for people to decide for themselves what the

[22] Fiorino, Daniel J., *Citizen Participation and Environmental Risk: A survey of Institutional Mechanisms*, page 229.

> most important questions are.[23]

A deeper understanding of the problem will allow parties to judge their own interests and those of other participants in light of the limitations on the problem solving effort. These limitations include the scientific uncertainty surrounding the toxicity of the threat, uncertainty concerning the risk posed in that particular instance (the chances, amount, and route of exposure), and the unforeseen effects of the threat and possible negative impacts of the actions taken to reduce the threat.

The ideal of getting people to represent their own ideas, and to re-evaluate them given a changing understanding of the problem, points to the need for a specific kind of interaction in a decision-making process. Participants must be able to interact in a way that allows them to both effect and be affected by the exchange and formation of ideas within the group. They must not only feel that their opinions and ideas are addressed in the discussion, but their own ideas and opinions must be open to re-evaluation based on their participation. This kind of "deliberation" among parties builds trust and open communication -- often the first casualties of the politically charged environment surrounding many environmental decisions. Cohen discusses the deliberation of citizens as a "fundamental political ideal"[24] in a democracy.

I propose that along with its value as an *end* in itself, deliberation is an essential *means* to achieving both public acceptability and technically wise decisions. In my discussion of the MMR I will concentrate on the three ideals of deliberation in democratic decision making cited by Cohen;

> When properly conducted, then, democratic politics *involves public deliberation focused on the public good,* requires some form of *manifest equality* among citizens, and *shapes the identity and interests* of citizens in ways that contribute to the formation of a public conception of common

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[23] Laird, Frank N., *Participatory Analysis, Democracy, and Technological Decision Making*, page 354.
[24] Cohen, Joshua, *Deliberation and Democratic Legitimacy*, page 17.

good.[25]

Choices are heavily influenced by the way members of a group interact with the public and how individuals within the group interact. These ideals are useful for understanding how participants must interact in a decision making process to overcome political plurality, technical disunity, and urgency. In the following sections I will look at how the decision-making processes used by OpTec and the Guard, in developing the 60% Design, and by the TRET, in formulating its recommendations, shaped these interactions and ultimately influenced the acceptability of their respective approaches to containing the plumes at MMR.

[25] *Ibid.*, page 19

III. DECISION MAKING AT MMR

In this chapter I will outline the events that set the stage for the 60% Design and explain how the Guard and OpTec arrived at the process they used to develop the plan. In 1982 the Department of Defense (DoD) created the Installation Restoration Program (IRP) with the mission; "to take appropriate action to eliminate eminent threats to human health regardless of whether or not they are included on the [Superfund] National Priorities List."[26] Each agency within the DoD has its own IRP office responsible for coordinating the cleanup of contaminated sites. Though IRP activities are usually run out of a regional office (in this case Washington, DC), an IRP office was established at the MMR in 1990 because of the large amount of work and permanent staff. The IRP has a dual role as both the responsible party and a government agency in the cleanup of the site. It has overall authority over the Superfund cleanup of the plumes, although both EPA and DEP share regulatory authority.

The IRP began public participation efforts in 1986 with the creation of the Technical Environmental Affairs Committee (TEAC), "to provide a forum for public input on MMR remedial response activities."[27] Although the group included community representatives, along with those from regulatory agencies and the Guard, it was, however, primarily a technically oriented advisory group. Meetings were closed to the general public and news media until the October 1992 meeting.

In 1993, in an effort to expand public input and collaboration, the Senior Management Board (SMB) was created with senior-level regulatory agency representatives, elected officials from the four surrounding communities, the Guard, and representatives from the other DoD agencies operating at MMR.[28] Four Process Action Teams (PAT) were also created to work as advisory groups making recommendations on environmental issues to

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[26] Rolbein, Seth, The Enemy Within: the Struggle to Clean Up Cape Cod's Military Superfund Site, page 41.
[27] Record of Decison for Interim Action (IROD), page 4-1.
[28] Plume Response Plan (PRP), page 4-4.

the SMB. The Plume Management PAT was made up of representatives of public agencies and community organizations. From its establishment, "the most immediate goal, the containment of groundwater plumes, is the responsibility of the Plume Management PAT."[29] The first order of business for the Plume Management PAT was to propose a plan, with technical support from OpTec, that would get the cleanup process started.

1. The Plume Response Plan

In June 1994, the Plume Management PAT released the Plume Response Plan (PRP), a "proposal to redirect and accelerate the effort toward early and simultaneous containment of all plumes."[30] The PRP was an effort to jump-start the implementation of containment of the seven plumes, which were at various stages in the Superfund process.[31] The intention of this plan was fairly explicit.

> Implementation of this plan will stop the advance of seven plumes by using extraction wells and processing of the contaminated water through granular activated carbon. The flow of contaminants into Johns and Ashumet Ponds will be interdicted. At the conclusion of this four-to-five-year effort, all but one of the known plumes will be contained by a cost-effective, integrated containment and treatment system.[32]

The PRP was developed not only to initiate rapid action on all the plumes but to alert the Department of Defense to the seriousness of the groundwater contamination problem and to seek recognition of the MMR as a nation-wide "priority 1, IRP project."[33] The PRP was an ambitious effort to speed up the cleanup at the MMR, both by securing funding and avoiding some time-consuming steps of the usual Superfund process. It did this by splitting the cleanup into an interim "containment" phase followed by full remediation at a later date. The purpose of splitting the cleanup was to avoid getting bogged down in the complex and lengthy process of remediating Superfund sites. To the parties involved,

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[29] PRP., page 4-4.
[30] PRP., page ES -1.
[31] PRP., page 5-1.
[32] PRP., page ES -2.

implementing some interim actions, even without fully understanding the problems, was justified by the need to allay mounting public concern. This, in turn, was acceptable because a more typical Superfund remediation effort would follow.

The desire to speed the cleanup process is understandable from each party's perspective. The public was nervous about the health risks posed by contaminated drinking water as well as exposure through recreational use of surface waters and eating exposed fish and shellfish. Regulatory agencies were anxious not to be viewed as lenient by the public, even though the threats posed by the plumes would not necessarily constitute high a priority without political and public pressure. The military was also eager to restore public trust and viewed MMR as an important location to set precedence. It is one of the first of many bases that require environmental remediation and bad press at MMR could make cleanup efforts at other bases more contentious.

The PRP included a strategy for "fast-tracking" the implementation of the initial containment phase. A "conceptual model" would be substituted for some of the technical evaluative steps in the normal Superfund process. This introduced, quite explicitly, the understanding that the design team would need to make judgments and act on assumptions. This is clear in the instructions the PRP provided for the IRP technical consultant on how to deal with missing information:

> OpTec was not expected to conduct additional investigative studies, but to use available environmental data. When data gaps were encountered, OpTec would interpret available data and complete data gaps with documented assumptions.[34]

Two of the technical evaluation tools usually necessary for a Superfund cleanup were not required in the design of the interim remediation plan. Remedial Investigations (RIs), studies which provide the baseline data and basis for action, were "incomplete." Feasibility Studies (FSs), in which impacts are assessed and design alternatives are

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[33] PRP., page 4-4.

reviewed, "had not yet been accomplished" because "the PAT did not have sufficient technical data to develop the necessary documentation."[35] Yet, there was great public as well as regulatory agency support for getting interim actions started quickly -- regardless of the limited data. The MMR groundwater plumes had now been in the public eye for 14 years with little concrete action taken to cleanup the plumes. The PRP set the sweeping goal of stopping "the migration of the contaminated groundwater plumes emanating from the MMR.[36]

Even though the information on the extent and risk of the plumes was limited, the PRP gave specific technical details on the strategy that the IRP and OpTec would use to attain the goals of the interim action. The specifications for well placement and treatment methods in the PAT illustrate the inflexible and highly technical criteria included in the PRP.

> Plume containment will be accomplished by fences of extraction wells located immediately downgradient of the plumes. The water will be treated at a central treatment facility, then re-injected into the aquifer near extraction wells.[37]

This strong goal and the specific approaches were justified by tying public acceptability and trust to the need for immediate action. The broad claims made by the Plume Containment PAT in the PRP about the need for public acceptability show this connection.

> ***Partial*** cleanup measures probably will not be accepted by residents and tourists as sufficient to ensure public health and the integrity of our sole-source aquifer.[38]
>
> While fears of health and environmental risks have undoubtedly deterred potential tourists and have alarmed local residents, a credible cleanup will

[34] PRP., page 4-7.
[35] PRP., page 4-5.
[36] PRP., page 4-5.
[37] PRP., page 4-28.
[38] PRP., page 3-4.

> reverse these effects. ***Plume containment is vital*** to municipal solvency and a robust local economy.[39]

The PRP contains highly technical directives, supported by these political imperatives, for the design of an interim containment strategy. However, neither the political or technical demands it placed on the IRP turn out to be as sound or certain as the PRP Plume Containment PAT asserted. The PRP emphasized action on immediate concerns: the safety of drinking water supplies, public health risks, property values, and the effects of groundwater contamination on the natural environment. Nowhere in the text, however, does it mention or mandate the consideration of the possible adverse effects of the remediation effort.

2. The Record of Decision for Interim Action

In September 1995, the EPA and Guard, with the concurrence of DEP, issued the *Record of Decision for Interim Action; Containment of Seven Groundwater Plumes at MMR* (IROD). The Record of Decision is the legally binding statement in which the EPA and the Guard (as manager of the IRP) committed to a remediation strategy. The IROD "is based on an evaluation and screening process, the results of which are documented in the Plume Response Plan."[40] Like the PRP, the IROD was intended to begin the containment effort to prevent degradation of the Cape's groundwater while a "permanent solution" to the problem was found. The IROD called specifically for 100% simultaneous plume containment using the "pump and treat" method of extracting and treating contaminated groundwater. Considerations of risk again focused on the human health risk from exposure to contaminated water supplies. With the exception of a reference to the potentially dangerous "eventual discharge to surface waters,"[41] consideration of the ecological impacts of the plumes is limited. However, remedial investigations did "indicate that, if not contained, contaminated groundwater from six of the seven plumes

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[39] PRP., page 3-6. Emphasis added.
[40] IROD., page 10-1. Emphasis added.
[41] IROD., page 7-1.

will eventually discharge to surface water."[42]

The IROD design for interim remediation was based on seven steps:

1. extracting contaminated groundwater at leading edge of the seven plumes and potentially extracting groundwater from hot spots identified during remedial design, if feasible;
2. pumping and conveying the extracted groundwater to a treatment system;
3. removing Volatile Organic Compounds (VOCs) and other compounds using the treatment system;
4. discharging treated water back to groundwater and/or other beneficial use;
5. installing, measuring water levels in, and sampling groundwater monitoring wells downgradient and to the sides of the extraction wells at each pump to monitor the hydraulic performance of the extraction system;
6. sampling the influent between key unit processes, and the effluent of the treatment system(s) to monitor its performance;
7. restricting groundwater use within the contained areas through imposition of institutional controls.[43]

Like the PRP, the IROD is very specific about many of the technical aspects of the containment design. Examples of the assumptions made in the IROD in specifying this approach include: the capability of capturing the edges of the plume and hotspots, the efficiency of using a centralized treatment center, the ability to safely transport contaminated groundwater, and reinjecting groundwater without drawdowns of the aquifer or other flow disruptions. The IROD also contained estimates of the number and spacing of wells and the amount of water that would need to be pumped and treated, "almost 11 million gallons per day."[44] These, and many other assumptions, are embedded in the containment strategy.

The IROD and the PRP together constitute the *mandate* section of the decision making sequence for the 60% Design. A central objective of these documents (for the IRP and

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[42] IROD., page 7-1.
[43] IROD., page 2-1.

the regulatory agencies) was to secure public approval of the plan. The military used advisory committees (both the SMB and the Plume Management PAT) to facilitate public involvement in the development of these documents. These documents not only set out goals for the cleanup but set specific requirements for the approach the IRP and OpTec would use to attain these goals. Both documents were approved and supported by all the major stakeholders involved in the decision-making process at the time.

3. OpTec Plume Containment Plan, 60 Percent Design

OpTec, which had provided technical support for the Plume Management PAT in developing the PRP took this mandate and began designing a comprehensive plan for plume containment in March 1995. Its contract with the IRP called for three reviews during the design phase when the plan was 35, 60, and 95 percent completed. The first review was conducted when the plan was 35 percent complete in October 1996. This review failed to uncover any suggestion of the crisis that would occur only four months later. One participant suggested that this review may not have alerted the designers to the problems because "the design that was presented was closer to 10 percent done, not enough to judge the environmental and hydrological impacts."[45]

One explanation for the incompleteness of the 35% Design was the military's effort to meet community demands for keeping the project moving quickly. IRP "usually takes a stepped approach to this kind of work."[46] The first step is collecting field information, followed by modeling, and then, finally, the plan is designed. However, because of demands for speed by the community and regulatory agencies, all three steps were done at once.

> There were no qualifiers on the 100% simultaneous containment mandate. The only thing that seemed to be important to the public was keeping the project on the fast-track.[47]

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[44] IROD., page 10-5.
[45] Interview, March 4, 1997
[46] Interview, February 27, 1997
[47] Interview, February 27, 1997

OpTec presented the plan for the second required review on January 22, 1996, when the design was approximately 60 percent finished. Additional field work and changes in the modeling scheme led OpTec to revise their estimates of the plumes. They now believed that their size and extent were much greater than what had been understood at the time the PRP and IROD were prepared. To meet the demands for 100 percent simultaneous containment, using the mandated extraction well fences at the leading edges of the plumes, the OpTec plan required pumping 27 million gallons of groundwater per day.[48] This was a huge increase from the 11 million gallons per day estimated in the IROD. Its implications for the hydrology and ecology of the Cape were clear to residents and regulatory agency staff.

The swift and fierce opposition of the public, EPA, and DEP to the 60% Design blind-sided the Guard and OpTec. They were attacked repeatedly in the media and at public meetings immediately following the release of the 60% Design. Regulatory agencies made public statements asking the Guard to relinquish control of the IRP. OpTec was criticized as "inexperienced and technically incompetent."[49] Among other problems, the 60% Design had failed to adequately take in to account the secondary ecological effects of the pump and treat method. TRET Final Report lists six specific technical problems with the approach to pumping and treating contaminated plumes proposed in the 60% Design:

1. Projected aquifer withdraw and discharge volumes could shift or deflect existing plume trajectories causing a stirring effect of the plumes and further mixing the contaminated groundwater.
2. The leading edges of at least four plumes have reached or are close to their discharge point so that 100 percent containment would not be possible without major disruption of the receiving surface water systems and significant ecological impacts.
3. Water table drawdown caused by plume containment could harm critical surface resources.

[48] TRET Final Report, page 9.
[49] Interview, February 7, 1997

4. The treatment process will alter some of the physiochemical parameters of the extracted groundwater (e.g., total dissolved organic carbon, and dissolved oxygen). Direct discharge of the treated water to ponds or indirect discharge through wells near the shorelines could cause adverse impacts to the habitats and organisms. These impacts include disrupting temperature patterns, significantly increasing flushing rate of ponds, and reversing groundwater flux across pond basins.
5. Concentrations of VOCs in portions of the plumes are currently sufficiently elevated to be of concern if groundwater were to be used for drinking water. However, these compounds are readily diluted during mixing with surface water, and concentrations are reduced further by evaporation, ultraviolet light, and biodegradation at marine and freshwater discharge points. The concentrations of metals and semi-volatile compounds in the plumes may be a potential concern in aquatic eco-systems, but a review of existing data suggests many of the metals values are overestimated due to the problems during purging and sampling and do not reflect concentrations actually moving in the aquifer. Some of the semi-volatile values may also be overestimated.
6. Records of occurrence or verified suitable habitat exist within the potential impact zone for 39 species of federal and state rare or endangered plant and animal species. [These] Present ecological concerns and regulatory constraints to potential engineering actions.[50]

In February 1996, only a few weeks after the design had been released, the Guard, with concurrence of EPA and DEP, announced the delay of the issuance of the 95% Design, scheduled for March 18, 1997 "until concerns raised by the 60 percent design document have been resolved."[51]

4. Public Review and Reaction To The 60% Design

On February 7, 1996, OpTec and IRP first released the 60% Design for public review at a public meeting in the town of Falmouth. Though IRP, EPA, and DEP had received the 60% Design on January 22, the plan had not been available for public review. The plan was, according to Dr. Alexander, the OpTec design team leader, "still under regulatory

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[50] TRET Final Report, page 9-10

[51] *Containment Design Delayed to Address Community Concerns,* Mashpee Enterprise, March 15, 96, Paul D. Ott [newspaper article]

review."[52] Alexander also made the point that "information from the ongoing fieldwork continues to be incorporated into the groundwater model and the design, and that significant changes had already been made since the design was submitted."[53] This may have been an early attempt to avert some of the criticism of the plan that was to come.

The meeting consisted of a description of the "concepts of plume containment and a description of the containment systems"[54] proposed in the plan. The OpTec team explained the groundwater modeling, treatment process, monitoring approach, and gave a plume-by-plume description of locations and containment strategy to the crowd of approximately 50 people. During a question and answer period that followed, the participants were able to ask questions and respond to the description of the Plan.

The speed with which citizens produced a list of serious concerns that night is a good indicator of the weakness of the 60% Design. One of the first questions was raised by a citizen who pointed to the "finite amount of water that exists on Cape Cod," and asked if "the amount of water to be extracted exceeds a safe amount?"[55] This was later recognized as the most serious failing of the 60% Design. Concerns were also raised about: the effectiveness of treatment in cleaning the water, the effects of introducing treated water directly into ponds, and the other ecological effects. One person asked about the OpTec design team's level of experience in designing a containment system of this scope and commented that,

> pumping 27 million gallons of water per day is a difficult concept. He stated that no one knows what the effect will be and that we are in a 'state of ignorance.'[56]

The audience at that meeting was fairly sophisticated about the technical issues surrounding the cleanup. The concerns they expressed were by no means limited to a

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[52] Public Meeting minutes, February 7, 1996
[53] Public Meeting minutes, February 7, 1996
[54] Public Meeting minutes, February 7, 1996
[55] Public Meeting minutes, February 7, 1996
[56] Public Meeting minutes, February 7, 1996

general discussion of the goals stated in the PRP. The people in the audience that night made it clear that they expected the IRP and OpTec to respond to the full range of public concerns before the containment plan would be publicly accepted.

On February 13 the Program Implementation Team (PIT) met to discuss the reaction to the 60% Design. The PIT had been created in June 1995 to provide information to the public on the plume containment project. The PIT included representatives of the Guard, regulatory agencies, and each town. It was primarily responsible for preparing the "fact sheets" which were released periodically detailing the project's progress. Participants at this meeting raised more concerns about the technical feasibility of the 60% Design. Questions were also raised about the process the Guard and OpTec had used to arrived at its 60% Design and how the public meetings had been conducted.

The lack of formal technical training of most of the members of the PIT did not prevent them from subjecting the 60% Design to close scrutiny. They raised very specific questions about the approach and equipment chosen to pump, treat, and then return, the groundwater; the level of treatment; the amount and rate of water extraction from the aquifer; and the secondary effects to the environment of the effort. To many, the 60% Design did not adequately address the safety of the piping network that would be used to move contaminated water to the treatment units. It also failed to respond to persistent worries about the treatment of 'hot spots' (areas within plumes with especially elevated levels of contamination).

The approach OpTec had used to make technical determinations was also questioned. One participant suggested that the design team had "not properly explained how they went from the original 11,000,000 gallons to over 20,000,000."[57] Another member questioned the wisdom of pumping treated groundwater into ponds to offset the drawdown because "even though the pollution is below the maximum contaminant level, it still has some contamination. So why dump it into a pond that has no contamination now?"[58] These criticisms highlighted assumptions by OpTec had made in trying to meet the mandated containment goals. Though the PRP called for OpTec to make "documented assumptions" where there were data gaps, the technical flaws in the 60% Design were serious enough, to many to call into question the ability of the Guard and OpTec to manage the cleanup at all.

Members of the PIT also raised questions about the way technical information had been presented by IRP and OpTec at public meetings:

- The meeting went on for too long and people lost interest and started to leave.
- People don't want to wait two hours before they can ask a question. More of a balance between presentation and public involvement is required.
- A lot of people lost interest because the presentation was too technical. A fact sheet may be helpful.
- I believe that this kind of presentation, where you just read the data, solicits overreaction or panic. It's cold and it really doesn't address the real fears that people have.[59]

These comments reflect the view that the public should have a role in the design process. Many in the public felt that IRP and OpTec had a responsibility to provide the public with opportunities to understand the technical aspects of the containment plan and participate in making decisions. This concern for the way information is presented to the public, and the need for better access to information and the design process, became a central concern of the military in their effort to find a way forward.

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[57] Public Meeting minutes, February 13, 1996
[58] Public Meeting minutes, February 13, 1996
[59] Program Implementation Team minutes, February 13, 1997

IV. WHY DID THE 60% DESIGN FAIL?

The key to understanding the political failure of the 60% Design is to appreciate how the IRP and its contractor, OpTec, approached design and decision making. One important aspect, that has been ignored in much of the fallout from the release of the 60% Design, is the efforts IRP made to reach a publicly acceptable proposal. It did this by giving the Plume Management PAT responsibility for determining how the IRP would reach a politically acceptable design. The IRP's mandate was justified in terms of political acceptability and was not held to close technical scrutiny until after the public reaction to the 60% Design. The problem was that achieving 100% simultaneous containment would result in significant secondary negative impacts. In light of the overall goal of the containment process -- to protect the human as well as ecological and economic health of the region -- this mandate was excessive. The problem of cleaning up the plumes demanded adjustments and tradeoffs that neither the mandate nor the Guard and OpTec's design process permitted. The question that then must be answered is -- what were the flaws in the IRP and OpTec's decision-making process that prevented it from recognizing the flaws in its design and attempting to renegotiate the mandate?

1. The Mandate

To appreciate the mandate we must understand where it came from. It emerged from the background of mistrust and lack of communication that characterized relationships between the parties at the MMR. In such an environment, their willingness to commit to the 100% simultaneous containment mandate is understandable. In evaluating the difficulties in making publicly acceptable science-intensive decisions, Laws and Susskind point out that,

> general lack of trust often translates into skepticism, an unwillingness to accept assertions at face value, requirements that extra margins of safety be met, and demands for risk reduction or compensation.[60]

There is a correlation between the amount of trust among stakeholders and the flexibility available in a decision-making process. The public representatives on the Plume Management PAT formulated a risk averse and inflexible mandate for the cleanup process based on their fears of the risk posed by the plumes. The most common portrayal of the problem was a map of the Upper Cape showing darkly colored blotches whose elongated shape suggests an unseen menace stretching ominously towards the surrounding towns.[61] Dealing with this large unexplained threat and a largely faceless and deep-pocketed neighbor (the military) became a political priority for the surrounding towns. The public's fears were driven by uncertainty, incomplete media coverage, poor communication of the risks posed by the plumes, and mistrust of the military's effort to respond to the perceived threat. They were compounded by widespread public mistrust of OpTec due, in part, to the design team's perceived inattention to public concerns.

The inflexibility of mandate can be understood as a sensible precaution given the level of mistrust and the lack of cooperation that prevailed between IRP and the public when consensus was reached on the goal of total simultaneous containment. The public faced a situation in which the development of the mandate might be their only chance to influence the cleanup process. Lacking trust or future opportunities for influence, they were driven to set terms that would ensure that their needs would be met, even under the worst possible circumstances. They were satisfied with the goal of total simultaneous containment, through pump and treat methods, because it met the desire for a safe approach. The inflexibility of the goal was, in fact, one of its virtues; it could not be easily corrupted. In light of most people's understanding of the groundwater contamination problem at that time, requiring that all the plumes be contained immediately and at once, regardless of how that goal was met, was 'erring on the side of caution.' Not until the 60% Design was released did the importance of considering possible negative ecological impacts become a central issue.

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[60] Laws, David, and Lawrence Susskind. *Changing Perspectives on the Facility Siting Process*, page 29-43.
[61] MMR Interperative Goundwater Contamination Map: Hazwrap 07/19/94

The mandate had been very clear in stating "this is your task, this is your focus, do not deviate from the goal."[62] Embedded within this seemingly clear goal, however, were many "implicit" demands; such as the expectations that groundwater levels would be maintained and that there would be no adverse ecological effects. Though the PRP and IROD were very clear on the need for total containment, many aspects of the mandate were vague. How a "plume" was defined was not specified, for instance -- did it begin where the contaminant level was above the maximum allowable limit or where contaminants were simply detectable? -- nor was the level of contamination that determined a "hot spot." The design team, under pressure to meet a strict timetable, made the assumptions they needed to keep the plan moving forward. According to one participant,

> There were no qualifiers on the 100% simultaneous mandate. The only thing that seemed to be important to the public was keeping the project on the fast-track.[63]

The goal of the 60% Design was to make progress on total simultaneous containment by pumping contaminated groundwater to the surface, treating it on the surface, and returning the water either directly or through surface recharge areas. There was no flexibility on whether or how the containment design should reach this goal. As the design team's understanding of the scope and scale of the problem developed, their estimates of the amount of groundwater that would have to be extracted and treated increased. With the rise in the amount of water to be extracted, many of the assumptions made in the PRP and IROD concerning the secondary effects were no longer valid. Chief among these assumptions was that the pump and treat method would not cause unacceptable drawdown of the groundwater levels.

OpTec's ongoing field investigations had improved their understanding of the size of the plumes, and the amount of water that would need to be pumped to capture all the

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[62] Interview, April 3, 1997
[63] Interview, February 27, 1997

contaminated groundwater. The design estimate more than doubled from pumping and treating a predicted 11 million to 27 million gallons of water per day. To the dismay of many, the dynamics of groundwater made it necessary to pump a huge amount of uncontaminated water. Pumping this increased amount of water from the aquifer would have ecological effects that had not been considered.

The process that was set up made it difficult for OpTec's design team to recognize these impacts. Even if they had been aware of these "outside" impacts it would have been difficult for OpTec to re-evaluate the relevance of the design criteria because the parties who helped set the design criteria were excluded from the design process. According to one SMB member, the decision to exclude the public from the design phase was an explicit choice;

> at the onset there was a statement from [the Guard] that the community could not interfere in the details of the design, they were the province of the responsible party [Guard] and contractor [OpTec].[64]

Stakeholders who had been involved in the decision to pursue complete containment were excluded from the ongoing design process. Without adequate channels of communication, OpTec had no way -- even if they had the inclination -- to challenge or renegotiate the consensus on the standard.

The Guard and OpTec either did not recognize the technical problems with the plan, or choose not to confront them because they viewed the political consensus on the mandate as so fragile and important that it had to be treated with extreme deference. Either way they were caught in a 'catch 22' that crippled the plan and brought OpTec under criticism for designing an "irrational" plan. While the designers must bear some responsibility, this result was instigated and sustained by the way the process was sequestered and the constraints placed on communication between the parties. Without outside interaction, the 60% Design moved ahead on the basis of what the public and regulators expected from the goals for the containment plan. This problem was exacerbated because the public and regulators were not able to follow the process (which was based on their mandate) that the OpTec design team used to arrive at the 60% Design.

2. Hierarchical Decision Making

An more general explanation for the limited review of the remediation plan and the flaws which eventually doomed it can be found by characterizing the approach the design team took to planning and decision making. Outside involvement was limited to formal meetings and membership on the design team was restricted to OpTec engineers. The public and agency representatives did have some opportunities to watch the proceedings of the design team. They were treated by the OpTec team as observers, not participants in the design process. To explain how these characteristics became fatal flaws I want to draw on the concepts of hierarchy and groupthink. These two concepts help diagnose the failure of the 60% Design and the political crisis that ensued.

Charles F. Sabel has described hierarchy as a distinctive institutional form.

> [H]ierarchies are composed of bureaucratic units (bureaus, workshops, etc.) and a head or central office. Every bureaucratic unit is directly subordinate to one, but only one, other bureaucratic unit, or to the head office.[65]

In a hierarchy, review of the output of a "bureaucratic unit" is limited to those within the group and their direct supervisor. This would not be a problem, presumably, as long as the group can ground decisions in its technical competence. Any limitations or defects in the competence of the group are likely to be problematic because the "consumers" of the product (i.e. the containment design) are not able to readjust their expectations in light of a changing understanding of the problem and the limitations of a technological solution. The phenomenon of "groupthink" shows how internal flaws are likely to be amplified by a hierarchical structure. As described by Paul 't Hart, groupthink is the "dysfunctional

[64] Interview, March 25, 1997

[65] Sabel, Charles F., *Constitutional Ordering in Historical Context*, page 71.

effect of tightly-knit worker groups,"[66] caused by "excessive concurrence-seeking"[67] and ultimately resulting in "bad decisions."[68] Janis defines groupthink as,

> A mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members striving for unanimity override their motivation to realistically appraise alternative courses of action.[69]

The situation at MMR contributed to the creation of this tight "in-group" at OpTec. There were strongly expressed goals, an imperative for action, limited requirements or opportunities for broader interaction, and sharp boundaries between the responsible party (the military and "experts" on the design team) and the broader public. The combined effects of a hierarchy and groupthink help explain how the 60% Design could diverge so drastically from public expectations and produce the "crisis" that both the IRP and OpTec faced.

The 60% Design was produced in a hierarchical decision making environment. Because OpTec was directly accountable only to the IRP, it failed to recognize other parties who had a stake in the decision and the ability to intervene. Political acceptability was treated as a problem that had been solved by laying out goals in the IROD and PRP. This mandate was treated in technological terms as an input that voided the need to pursue political acceptability on a continuous basis through sustained public participation. The hierarchical nature of the design process was, in fact, incompatible with expanding participation in the creation of the design. The OpTec team was reluctant to solicit feedback from outside the IRP, and would have difficulty handling input that was not entirely consistent with the design criteria outlined in the PRP and IROD.

The makeup of the OpTec design team also contributed to the failure of the plan. Many public and agency representatives feel that the OpTec team did not adequately utilize

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[66] 't Hart, Paut, Groupthink in Government; A Study of Small Groups and Policy Failure, page 6
[67] *Ibid.*, page 7.
[68] *Ibid.*, page 11.
[69] *Ibid.*, page 7. (Quoted from Janis, I.L.).

localized knowledge of the site. "The work was done in a vacuum with a subcontractor based in Tennessee."[70] In fact, the modeling of the 60% Design was done at OpTec's Oak Ridge, Tennessee office and much of the design work was done at a facility in San Antonio, Texas. Scientists from the US Geological Survey, who had done extensive research on the Cape (and first identified the plumes at the MMR), and the Woods Hole Oceanographic Institution (marine research center used by government and university scientists located nearby) played virtually no consultative or direct role. The exclusion of these "local" experts, as well as the public, may help explain why OpTec failed to recognize the importance of fragile and economically important ecosystems such as kettle ponds and cranberry bogs. The design team also failed to understand tacit public concerns that the goal development process had not evoked. Reaction to the 60% Design, for instance, included a clear public preference for considering all possible impacts and balancing the desire to treat the contaminated groundwater with impacts on human and ecological health.

The Guard did make an effort to keep the regulators informed about how the design was taking shape. Beginning in September 1996, OpTec designers met with EPA and DEP for weekly briefings using video-conferencing. These meetings were used, however, to review the field work and modeling that OpTec was doing in preparation for the design rather. Even though some participants may have been aware of the impending problems with the design, this forum did not elicit their concerns. Timing was another problem. The majority of the plan was designed in less than two months -- mostly after the 35% Design review. The schedule left little time for internal (much less external) review before the 60% Design was released on January 22, 1996. The forced pace and the technical focus of these meetings meant participants never had the opportunity to re-examine goals in light of the implications of the proposed design.

By following a narrowly "rational" process, OpTec produced a design that looked decidedly irrational to those not involved in its creation. Many in the public were

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[70] Interview, January 30, 1997

incensed that the 60% Design seemingly "missed" the point of protecting the aquifer.

The development of these blind spots in the design team's reasoning closely parallels two characteristics of groupthink described by Janis -- "overestimation" of the group's ability to solve the problem alone and "closed-mindedness" to other stakeholders.[71] The OpTec team's effort to turn its mandate into an acceptable design with limited interaction with the public, regulatory agencies, and other stakeholders led directly to the oversights that became the major sources of the criticism that OpTec received for the 60% Design. The Guard and OpTec had gone through the design process. To them the chain that led from the 100% simultaneous containment mandate to the 60% Design and from 11 million to 27 million gallons per day was unbroken and understood. To others it appeared that OpTec had performed unsound modeling and hydrological calculations, overlooked ecological effects, and ignored the underlying reasons for the cleanup. The disparity can be attributed in a large degree to the way the hierarchical environment structured communications and insulated the responsible parties.

3. Decide-Announce-Withdraw

The public reaction to the 60% Design process might not surprise those familiar with environmental problems such as cleaning up Superfund sites or facility siting. The pattern of "decide, announce, defend" is often used to describe the sequence of a familiar approach to environmental decision making. Under this model, according to Laws and Susskind, a decision made using a conventional expert-based approach, the decision is announced, and, "once the announcement had been made, agency personnel shift into a defensive mode."[72] This decide-announce-defend model provides a convenient framework for understanding how the process that yielded the 60% Design failed.

The 60% Design process sequence was -- build an initial consensus on a mandate, decide, announce, and withdraw. The main difference between this model and the traditional

[71] 't Hart, page 10.
[72] Susskind and Laws, page 35.

decide-announce-defend model was the substitution of *withdraw* for *defend.* The fact that a broad political consensus was pursued by the Guard complicates the view taken by many critics during the "crisis" that followed the release of the 60% Design. The Guard had taken steps to ensure that the public was informed about the challenges the designers faced and had input into the goals set for the design. In fact, the Guard had given the Plume Management PAT and SMB a free hand in deciding the approach and goals for the containment. Why, then, was this level of participation inadequate?

While it participation, the overall orientation can be characterized as "technocratic". This orientation is based on the (mistaken) belief, whether implicit or explicit, that,

> risk decisions are best left to administrative officials in concert with scientific experts, acting under instructions from elected representatives, and consulting as necessary with interest groups representing aggregated 'public' interests.[73]

In preparing the 60% Design, the Guard and OpTec structured participation in a fashion characteristic of a technocratic orientation. The Guard sought public acceptability through agreement on an overarching standard that would guide subsequent decisions and actions. This standard would then be "plugged in" to a design equation, along with other more technical factors, to achieve the containment plan. The Guard looked for the consensus goal of 100% simultaneous containment as another design standard -- similar to the tolerance of a material or capacity of a piece of equipment. They relied on a conventional notion of the ability of experts to integrate this pre-determined political mandate into their technical formulation of the design and arrive at an acceptable plan. The Guard overestimated the durability of the mandate and failed to appreciate that to understand goals, one needs a vivid sense of their implications that in this case only became clear as the design process progressed.

An interesting twist to the story is that the military did not stand behind the 60% Design

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[73] Fiorino, Daniel J., page 227.

after its flaws were revealed. The very technical nature of the criticisms of the 60% Design is one possible explanation why the Guard's response to outcry over the plan was to *withdraw* instead of *defend.* The technical ground, on which the defense in a decide-announce-defend approach is usually based, was not available to the Guard and OpTec. The plan had been defeated on technical grounds and the Guard had to look for an alternative next step. I turn to this alternative in the next chapter.

V. The Technical Review and Evaluation Team

1. Setting the Stage; Public Comment

At the Senior Management Board meeting on February 22, 1996, the discussion centered on what steps would be taken to review the 60% Design and reach consensus on a new design. Deadlines for awarding contracts to begin containment efforts in the next fiscal year required that the final design be ready for review by the SMB on May 1, 1996.[74] The imperative for action had not faded with criticism of the 60% Design and parties agreed that missing this deadline and waiting another year to begin cleanup efforts would be an error. There was also general agreement, however, that the problems with the 60% Design were too serious to allow OpTec to proceed with its recommendations. This SMB meeting focused mainly on what steps would be taken to have an acceptable design ready by the deadline. Discussion touched on technical questions of plume containment and process questions about the design effort. Participants now recognized that 100% simultaneous containment could only be achieved at the expense of ecological considerations, and so the concept of a "balanced" technical approach was introduced. This meeting laid the groundwork for the consensual approach to plume containment design that was to follow.

In the month between the announcement of the 60% Design and the SMB meeting the problems with the 60% Design had been clearly identified and articulated by both the regulatory agencies and members of the public. An EPA representative stated the kinds of concerns that were prevalent at the time:

> the US EPA is looking to balance the design and is asking the National Guard Bureau (Guard) for a number of items. They include: an assessment of the ecological impacts of the design; a variety of 'scaleback scenarios'; an assessment of what it means if the plumes cannot be fully captured; issues with the Technical Memorandum; issues with the infiltration gallery locations, particularly in Mashpee; long-range water supply issues; and a discussion of the fact that this is an interim action and how this should be

[74] Program Implementation Team, meeting minutes February 13, 1996.

approached.[75]

The EPA was making a step towards substituting the goal of "balance" for the original goal of containment. This statement raised questions about the goal of total simultaneous containment and suggested an alternative approach. This moved discussion back to underlying principles about how and to what extent the cleanup should proceed. From this point forward, finding *balance* by considering the broad range of technical issues and making tradeoffs between the different impacts associated with the plumes and with the containment effort became the central theme of the design effort.

The SMB members were also trying to understand how they got into the position they found themselves in. They were looking for clues about how to design a new process that could take the effort forward. Community leaders understood the need for a design that would respond to a broader range of expert and public concerns. These community representatives also began to recognize the technical complexity of the cleanup design and how their original demands on the Guard implicated them in the present situation. In one instance a Selectperson stated:

> [E]very community around the Massachusetts Military Reservation (MMR) reacted to the 60 percent design the way they should have. She added that two years ago, the public was asking for immediate containment. The [Guard] has proceeded and the situation has not been ideal, conducting the data gap investigation at the same time as the design. [The Selectperson] stated that the data gaps were large and that continual surprises have led to dissatisfaction, although she added that this 'comes with the territory.' She asked the [Guard] to sincerely listen to each town's concerns. Ideally, she added, more time would be available, but with the USGS involved and the US EPA hydrologists, the [Guard] should work with the regulators on the community input.[76]

This Selectperson no longer considered 100% simultaneous containment an inflexible position. She recognized that the design process had moved too fast; they had designed a

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[75] Senior Management Board, meeting minutes, February 22, 1996
[76] *Ibid.*

plan to solve a problem that was not fully understood. The Selectperson added that her constituents "feel that a scaled-back version of the design is appropriate."[77] This concern was echoed by a Guard representative;

> there are pieces of the design that most people are comfortable with, and that these elements can proceed to the final design stage. Other issues will be renewed and integrated into the design as consensus is reached. He suggested that the design move forward on the non-controversial issues.[78]

This was an important airing of the idea that "simultaneous" action on all the plumes was not technically appropriate given the large data gaps. However, the original political reasons for the mandate had to be satisfied before the public would relinquish the mandate of containing all the plumes simultaneously.

The idea of creating a new team of experts to review the 60% Design and to work on completing a plan by the deadline was discussed at the meeting. Agreement was reached on the need to expand the representation on the team to include the regulatory agencies and other government agencies such as the U.S. Geological Survey (USGS). The size, location, and the membership of such a group was also discussed.

Two challenges to the idea of expanding the design process were brought up. One member feared "paralysis by analysis." With continued study of the problem, nothing would ever get done. Another person questioned the competence of the OpTec design team and the commitment of the Guard to include the public in decisions concerning the clean up. Overall, however, there was agreement that what was needed a more consensual process.

Criticisms of the Guard's approach to public involvement were a significant part of the public outcry against the 60% Design. Much of the public criticism focused on the way public advisory boards and other forums had been run and how information was

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[77] *Ibid.*
[78] *Ibid.*

presented. Much of the discussion about the creation of a new review team concerned how the new team would interact with the public.

On March 18 the Plume Containment PAT met "to present the current thinking of the Guard, DEP, EPA, and Senior Management Board regarding how to reach consensus on key design issues related to the plume containment project by May 1."[79] It became obvious at this meeting that the Guard faced a deep credibility gap, even with the groups who had been participating actively in the parts of the process open to them.

The key issues for PAT members presented that night were trust, and how the Guard proposed to move the process forward. PAT members questioned the May deadline for securing contracts, suggested that expanding the process would create an "organizational octopus", and charged that the minutes of the PAT meetings were not being recorded accurately.[80] These comments, and many others like them, were very critical and indicated that lines of communication were not open. In reviewing the proceedings from this meeting one member summarized the needs a new decision-making process would have to meet: "strong technical management; an effective feedback loop; more efficient operations of the teams; more expertise brought in; and independent thinking."[81] Another participant "stressed the need to establish a tone of cooperation and interaction."[82] This meeting, as well as previous criticism of the Guard's public participation efforts set the stage for a more substantial effort to include public representatives in all aspects of the design and review of a new containment plan.

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[79] Plume Containment Team, meeting minutes, March 18, 1996
[80] *Ibid.*
[81] *Ibid.*
[82] *Ibid.*

2. White Paper: Peer Review Team Charter

In response to the 60% Design, and in particular the negative reaction to it, a new design review process was initiated in mid-March 1996. The configuration and groundrules of this new process were worked out by high-level Department of Defense (DoD), EPA, and DEP representatives and drafted in a report called the *White Paper; Peer Review Team Charter*. The decision not to go forward with the 60% Design had been unanimous. The White Paper laid out a new decision-making process and formalized institutional changes that responded to the comments they had received during the public, SMB, PAT, and Program Implementation Team (PIT) meetings. The White Paper rearranged the organizational structure and created two new groups who would participate in the design and review of a containment plan -- a Peer Review Team (PRT) supported by a Technical Review and Evaluation Team (TRET).

The goal of this new structure was to,

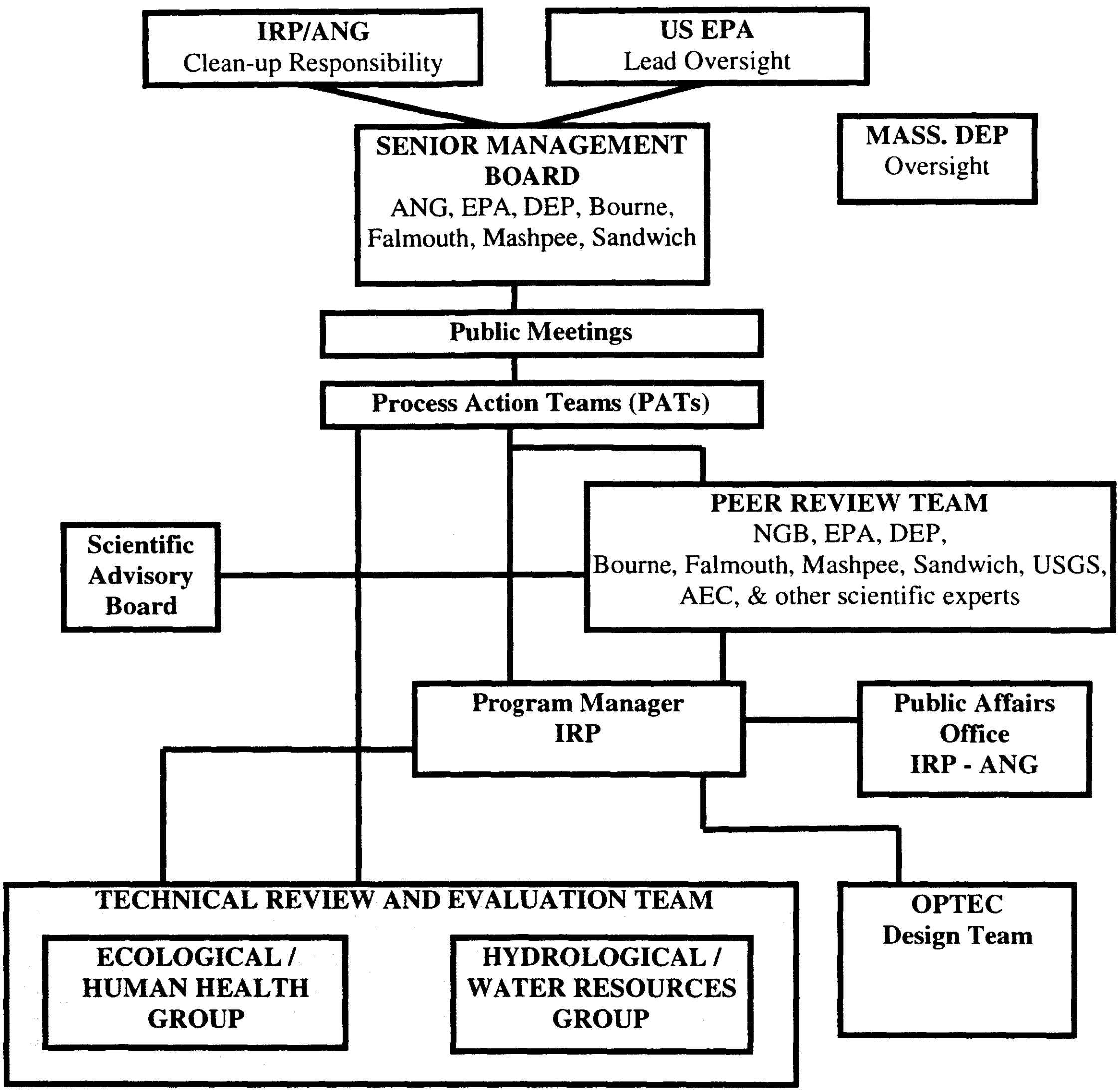
> provide a viable plume containment project that meets Guard regulatory, and community acceptance without delaying the schedule for award of the containment project this summer. The project must clean the plumes to acceptable levels without unacceptable impacts to the environment.[83]

The creation of the PRT and TRET responded directly to public concerns about public involvement and the DoD's desire to get the cleanup process moving. The defining feature of the new approach was its effort to join technical credibility and public acceptability by using experts that were considered both competent and independent and requiring regular public consultation. This was enforced in an important change in the chain of command; the Guard, for the first time, ceded some responsibility for the design process to the SMB. The new arrangement reversed the Guard's earlier exclusion of the community from decision-making authority. Although the Guard retained "final approval authority," the SMB "[had] the lead and will make recommendations to the Guard after

[83] White Paper; Peer Review Team Charter, page 1.

obtaining inputs from the PRT and feedback from the PATs and community."[84]

MMR Plume Response Design Team Organizational Chart



Source: modified from White Paper, page 8.

In the new organizational structure, the PRT and TRET supported the Senior Management Board, which was now responsible for making recommendations to the Guard on how to proceed with the cleanup by the mid-May deadline. The shift in oversight of the design team from the Guard to the SMB changed the way information moved between the design team and the public. Making the new design team accountable

[84] White Paper, page 2.

to the SMB (instead of directly to the Guard) created a feedback loop between technical experts and the SMB and PATs.

Along with the creation of the two new technical bodies another new outside review body was created by local County officials. Along with the PRT and TRET (created by the Guard), the Barnstable County Assembly of Delegates created the Barnstable Scientific Advisory Panel (SAP) made up of scientists from EPA, USGS, the National Oceanographic and Atmosphere Administration (NOAA), as well as Woods Hole Oceanographic Institute, a marine research facility located nearby. There were also local engineers and health officials representing each of the four surrounding towns. This panel was mainly created to focus on the ecological effects of the plumes.

Although three new technical review groups were formed, the TRET quickly became the center of activity, taking on the primary design and review responsibilities. While the other "groups [PRT and SAP] had expertise, neither had the collaborative nature or created knowledge as the TRET did."[85]

The TRET's mission as given in the White Paper was to:

- review the current design;
- investigate other alternatives;
- evaluate real estate requirements;
- identify criteria to evaluate and select the most favorable iteration of the current design, and;
- analyze impacts to the environment, communities, and the current design and construction schedules.[86]

The TRET's pursuit of these goals can be viewed on two tracks. One is the membership and internal workings of the TRET, described by one participants as "50 people in a building one step above an Army barracks with the risk assessment people in one corner

[85] Interview, March 25, 1997
[86] White Paper, page 4.

and the hydrological people in the other. It was very chaotic."[87] The other track was the TRET members' interaction with the broader public and advisory groups and the recognition that "you cannot drive the solution like a nail -- the dynamic of public involvement had to go through the decision-making process to the end."[88] Both of these tracks came together at the TRET. "You got the right technical people who were capable of interfacing with their own and with other technical disciplines, as well as with the public."[89] Another important factor was that many of the individual TRET members had developed reputations for honesty and integrity with the public.

3. Membership and Interaction within the TRET

To its members, the TRET lacked a clear mandate. The general mandate was to "review the 60% Design and make recommendations on how they should proceed."[90] This provided no guidance on who should participate, how the team would work, how TRET would interact with the public, and what kinds of output were expected. According to one participant in the first meeting of the TRET, "these people didn't know why they were there, what they were doing, or why they had been pulled away from other projects."[91] According to another participant, "the TRET was very disorganized, there was no set team and vague goals."[92] Though "chaos" may never have been completely eliminated, the TRET quickly took over from OpTec's role as "design team" and assumed responsibility for much of the effort to get the plume containment plan back on track.

The TRET benefited from strong commitments at the highest levels of the DoD, EPA and DEP, to support a multi-disciplinary team of experts to make recommendations on how the cleanup should move forward. The outcry over the 60% Design had attracted attention at high levels within the Air Force who saw the TRET as a way to regain

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[87] Interview, March 26,1997
[88] Interview, March 25, 1997
[89] Interview, January 30, 1997
[90] Interview, Febrary 27, 1997
[91] Interview, March 20, 1997
[92] Interview, March 26, 1997

credibility and gain public trust. The Air Force, who was now taking an increasingly active role in the management of the cleanup effort, made a huge commitment of resources to support the TRET. One participant estimated that the DoD committed 3,000 man hours in two months to the TRET project.[93] This institutional commitment together with that of individual participants, many of whom worked "almost all full-time six or seven days a week for two months,"[94] was recognized by many in the public. According to one public representative, "the TRET worked because it had funded coordinators, money, space, commitment and top-notch expertise."[95]

The Guard also expanded the role of independent facilitators, who had helped run the Project Action Team meetings, in the TRET. These facilitators were to help keep the TRET focused on the immediate goals, encourage internal leadership, and help support the TRET in anyway they could.[96] This meant helping TRET members in their dealings with the public, finding necessary resources, and helping to keep the team work together as smoothly as possible. The facilitators "actively declined taking a project management role, and tried to inspire self-help management within the TRET."[97] After a short period of "floundering," key members of the different groups, and sub-groups, of the TRET voluntarily began to take on leadership roles.

Membership on the TRET consisted of experts from the Guard, EPA, DEP, as well as "representatives from other interested groups, such as the US Geological Survey (USGS) and Cape Cod Commission."[98] Many of the members had previously been involved in the issue. For instance, one USGS scientist had been studying the aquifer on the Cape since 1977 and was involved in the discovery of the first plume in 1979. According to one participant "these were not entry-level participants, DEP and EPA had high level people

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[93] Interview, February 27, 1997
[94] Interview, March 25, 1997
[95] Interview, March 25, 1997
[96] Interview, March 20, 1997
[97] Interview, March 20, 1997
[98] White Paper, page 5. – note: The Cape Code Commission is a regional planning agency that has regulatory responsibility for land use on the Cape.

spending a day or two or three a week here."[99] There were also consultants brought in by different participating agencies as well as local experts. The goal, says one participant, was for the TRET to be characterized by its members' "independence and unconfrontable expertise."[100]

The group was given space at the IRP office at MMR, support staff, and access to outside experts and consultants. The White Paper split the TRET into three areas of concentration: the ecological, hydrological/water resources, and community outreach groups. In practice, the groups functioned less formally as a Hydrology and Ecological group with the Ecological group split into ecological risk, human risk, and ecological impacts sub-groups. These groups worked independently but met frequently, sometimes two or three times a day, to discuss their work. Representatives of these groups would then participate in as many as five public meetings (SMB, PAT, Plume Containment Team, and others) per week. To a large extent the Hydrological group was trying to support the work of the Ecological group by modeling the alternative containment scenarios and trying to understand the tradeoffs between different risks. This effort was important because of the interaction between different kinds of technical experts. According to one participant,

> I learned so much working under the TRET. I learned about hydrology and human health because we worked together as we hadn't really worked together before. We would sit down and not understand each other at first. The hydrology people would be shocked that the ecological people were interested in something; 'you care about that?' And the same for the ecological and human health people.[101]

The interaction of multi-disciplinary teams meant that technical data was weighed from many different perspectives. For example, assumptions made by engineers about the recharge and drawdowns of ponds that went unquestioned in the 60% Design (ponds levels were held constant in OpTec's models regardless of the amount of water pumped)

[99] Interview, February 27, 1997
[100] Interview, February 27, 1997

were quickly identified as unacceptable by the TRET team.[102] Members also had to deal with the differences in the way each discipline approached problems. The engineers' "can do" approach to solving problems came up against the scientists' more cautionary "look before you leap" approach. By bringing risk assessors, hydrologists, geologists, and engineers together, each with their own demands for information and approaches to dealing with uncertainty, the TRET internalized the conflicts and tensions that characterized the problem. To resolve these, the groups had to rely on the TRET's stated objective -- *balance.*

Another member explains that although the TRET may not have been fully understood by the public or its own members, it functioned as a forum for exchanging ideas.

> The TRET was never a group of independent experts (all of the members came from an organization that was already involved one way or another) and very few of the members had vast experience. Basically the TRET consisted of a bunch of technical people getting together to have a brainstorming session; we could informally 'explain and debate' ideas instead of the formal 'report and comment' format that had been followed.[103]

For the first time people were interacting "face to face" and "off the record." "The nice thing was that it was away from the regulatory process -- people could hash out ideas and talk informally."[104] This informality was the key to building understanding and reconciling the different perspectives of TRET members.

> From a technical point of view, the ability to talk about ideas in an open forum where they can be thrown around and explored from various points of view was the TRET's most important role.[105]

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[101] Interview, January 30, 1997
[102] note: Questions still remain over the recharge rate of the aquifer. The point here is not that OpTec's engineering was incorrect but that the assumptions they made did not have widespread support.
[103] Interview, February 27, 1997
[104] Interview, March 26, 1997
[105] Interview, March 26, 1997

Working closely as a multi-disciplinary team, members began to understand the perspectives of their colleagues and look for ways of meeting everyone's needs. As one participant explained, TRET members were chosen "for their experience, not their institution's agenda. Interaction and frank discussion were what made TRET work."[106] In contrast a hierarchy, the TRET was a technically and institutionally diverse group in which everyone participated as equals. The persuasiveness of an argument with the group was a function of reason and data, not relative to the proponent's position or power. The variety of expertise and perspectives that members brought to the table, in a forum that allowed the testing of ideas outside of the politically charged forums of the PAT and SMB meetings, was central to achieving technical and political credibility.

Throughout their efforts from March to May 1996, the purpose of the TRET remained somewhat unclear to many members.

> TRET makes no final judgments, they have no authority, and should not since they are not clearly accountable to anyone. There is a question about the fact that many of the participants play a regulatory role inside their respective institutions.[107]

But the TRET's lack of authority and accountability was not an impediment. It produced the informality that was crucial to the development of the kinds of multi-disciplinary and inter-institutional interaction that made it successful. Without real decision-making authority the TRET was able to play a role in opening up the discussion of how to approach the cleanup and established enough credibility with the community to get the cleanup process back on track.

> There is a fine balance between grinding away in isolation and exposing yourself to every political whim. What the TRET did was keep technical people away from these extremes by creating a forum that let people hash out ideas informally, without being quoted and, most importantly, without risk of retribution. In this way they could look at not just specific

[106] Interview, February 27, 1997
[107] Interview, February 27, 1997

> technical details but the guiding principles behind the effort. Often this brought up its own problems, but in this forum there were no taboo ideas as there were in more formal meetings.[108]

Another major factor in TRET's success in gaining credibility was the characteristics of some of the its most visible members. "You got the right technical people who were capable of interfacing with their own and with other technical disciplines, as well as with the public."[109] The members were "professionals who learned political context and -- diplomatically -- pulled together a workable plan."[110] This was a result of the combination of people who were chosen to participate, those who took the leadership roles (on their own initiative but with the consent of others), and the type of forum that was created. Public representatives recognized these characteristics.

> They were working in a 'workshop' setting. The interaction among themselves was informal and they had a sense of dedication that was astounding. People gave hours of their own time.[111]

The perception from the public of the dedication of TRET members was crucial. "The public felt the members of the TRET were sincere about what they were doing; they wouldn't be definitive without doing the work they needed to do to back it up."[112]

4. Interaction with the Public

The TRET's credibility with the public was a direct result of the access the TRET provided to its members and the process. The TRET members began participating actively in public meetings starting at a meeting of the combined Process Action Teams on March 25, 1996. This coincided with the decision of the four individual PATs to meet jointly (JPAT). The reorganized PAT meetings reflected the internal character of the TRET -- "much of the work was being done by the containment group," -- and external constraints -- "there wasn't time for four weekly meetings, so they were combined into

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[108] Interview, March 26, 1997
[109] Interview, January 30, 1997
[110] Interview, March 20, 1997
[111] Interview, March 25, 1997

one."[113]

The joint PAT meetings became an important forum for communication between the TRET group leaders and public representatives. The JPAT meetings were well attended, commonly reaching 50 people or more. "These meetings were open to anyone and SMB members often came, although they didn't sit at the table."[114] TRET members also participated in meetings of the Plume Containment Team (the sub-group of the Plume Management PAT that put together the PRP and total simultaneous containment mandate) and the SMB. These meetings were much more than just an opportunity to share data. "The TRET, by the way it did business, caused a whole new view of the process of environmental analysis and decision making."[115]

> Ecological folks were compiling data in the morning that their staffs had obtained from local conservation commissions, boards of health, environmental societies, other government agencies, meeting with each other and then with hydrological people, reassessing what kinds of data they needed and what geographic areas needed to be covered, reanalyzing old risk numbers of human and ecological risk and then preparing for the 5:00 p.m. presentation to the JPAT, all along deciding what to talk about, what to review further, and what messages to communicate. This was going on everyday, all day, seven days a week for a month or more.[116]

Interaction at these public meetings was not limited to TRET members presenting their work and answering questions. Public representatives were anxious to be involved, to the greatest extent possible, even in the most technical aspects of the containment plan design. By March 1996, "the effort to clean up the plumes had created a number of 'educated laymen' in the four-town community surrounding the MMR."[117] These meetings included open discussions of technical and procedural issues. Anyone who attended had a chance to speak directly with the technical experts involved in reviewing

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[112] Interview, March 26, 1997
[113] Interview, March 4, 1997
[114] Interview, March 20, 1997
[115] Interview, May 7, 1997.
[116] *Ibid.*
[117] Interview, March 25, 1997

the plan. These meetings were also used by the TRET members as a forum for exchanging information and brainstorming ideas with the public. According to one member,

> the interaction with the public served two needs for the TRET -- ideas were reviewed and specific questions were answered, also the TRET was able to get an idea of the political needs of the community.[118]

The pattern of interaction that developed at these meetings -- public representatives talking with TRET members, Guard and Air Force managers, and regulatory agency representatives -- was the key to achieving public participation that met Cohen's three criteria -- public deliberation, equality, and shaping the understanding of participants.[119]

The JPAT meetings were facilitated by a member of a mediation/facilitation team from the Consensus Building Institute (CBI) in Cambridge, Massachusetts. One member of the team, Greg Sobel, had been facilitating at the MMR for the Plume Containment Team prior to the TRET. The other members of the team were Larry Susskind, Jack Wofford, Pat Field, and John Glyphis. The group facilitated the JPAT meetings and suggested changes that increased the public accountability of the TRET. For instance, at JPAT meetings not only were minutes taken, but a list of the questions that were brought up during the meeting was generated. A verbal summary of the agenda and list of questions from each meeting was completed by the end of each meeting "so that everyone understands what the main points were and there will be no misunderstanding when they walk away from the table."[120] The relevant TRET sub-group would then try and answer each question by the following meeting. According to one agency representative, "it would be a major benchmark of success to have all the questions answered."[121]

These meetings also represented an important opportunity for the TRET members to get

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[118] Interview, March 26, 1997
[119] Cohen, page 19.
[120] Joint PAT, meeting minutes, March 25, 1996
[121] Joint PAT, meeting minutes, March 25, 1996

information that they needed from the public. This was especially important for the ecological sub-group whose representative at one JPAT meeting stated that they were "very interested in baseline conditions and that they are in search of any and all local information to help them assess the conditions."[122] The benefits of engaging local experts included not only tapping into a new source of data, but countering one of the major problems with public confidence from the 60% Design:

> Using local expertise was smart because people trusted local experts to look out for the Cape -- this was important because most people didn't understand the technical stuff, but when ideas were signed off by someone who they felt really understood and cared about the local situation, they bought it.[123]

By mid-April over 25 different conservation organizations and local experts, such as shellfish wardens and county conservation commissioners, had contributed information to the ecological data-base that the TRET members were organizing.[124]

The Hydrological team, meanwhile, had departed substantially from both the containment approach mandated in the Plume Response Plan and the 60% Design. "They are taking a plume by plume approach, but recognize the interconnection of all the plumes."[125] They were working from the overall goal of the effort to protect human and ecological health on the Cape and the need to get "some recommendations that are to be acted on in weeks."[126] They divided their consideration of the plumes into two tiers,

> 1. those that they are very sure are the right things to do and,
> 2. others that need more careful consideration due to uncertainly of what to do, complexity, the questions aren't well defined or there are trade-offs.[127]

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[122] Joint PAT, meeting minutes, March 25, 1996
[123] Interview, January 30, 1997
[124] JPAT meeting minutes, April 10, 1996
[125] JPAT meeting minutes, April 10, 1996
[126] JPAT meeting minutes, April 10, 1996
[127] JPAT meeting minutes, April 10, 1996

One member called this approach "simultaneous consideration." It was important for the TRET to recognize the reasons for the total containment mandate before it could get away from the expectation that the containment design would allow the public "to flick the switch and solve all the problems."[128] The balanced approach was successful because it responded directly to; the fears expressed by community representatives and the IRP that the project was being rushed, the great amount of uncertainty concerning most of the plumes, and the fear that goal of 100% simultaneous containment would be inappropriately dismissed.

5. The Air Force Center for Environmental Excellence (AFCEE)

It is important to mention another administrative change that occurred, at least in part, as a result of the 60% Design crisis. The Air Force replaced the Guard as the DoD agency with top management responsibility over the Installation Restoration Program at MMR. Although this change did not occur officially until May 1996, beginning in March the Air Force took an increasingly active role in the management of the IRP. The Air Force Center for Environmental Excellence (AFCEE), which usually provides technical and contracting support to another lead agency (in this case the Guard), was put in charge of the cleanup effort.

> AFCEE is a service center that never had IRP responsibilities but assumed control of the project, mainly because of political pressure. They usually provide information and technical support. Here they are project manager.[129]

This change came from high within the Pentagon, where among others the Deputy Assistant Secretary of the Air Force for Environmental Safety, Occupational Health and Environment was aware that the public was dissatisfied with the Guard's management of the MMR cleanup project.[130] AFCEE had already begun to participate at the MMR at that time, but in response to political pressure, including a demand by EPA in an April 17,

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[128] Interview, March 26, 1997
[129] Interview, February 27, 1997
[130] Interview, March 25, 1997

1996 statement by the regional director, the Air Force (AFCEE) took over in the lead management role. The military was anxious to meet community concerns in meeting cleaning up the plumes. According to one IRP member, "one of the biggest goals of the Air Force was to 'make the community whole.'"[131] However, public anger was peaking at the same time, and Air Force officials understood that the "lack of confidence and trust in DoD meant that the public wouldn't have accepted AFCEE as real change, only the TRET had the credibility."[132] The Air Force recognized that the TRET was perhaps their best chance to reestablish the credibility of the military and get the cleanup back on track. Other factors also played a part in the change in management; such as the ability of AFCEE to contract for the much larger amounts than the Guard could and, according to participant, the technical complexity and need for public participation "exceeded the management ability of the Guard."[133]

6. The TRET Final Report

The TRET's recommendations were presented in the TRET *Final Report; Toward a Balanced Strategy to Address Contaminated Groundwater Plumes at the Massachusetts Military Reservation,* released in mid-May 1996. The Final Report included: an evaluation of the 60% Design, recommendations for a new approach to the containment design, recommendations for each individual plume, and a summary of the findings of each of the TRET sub-groups. The Final Report was <u>not</u> a new plume containment design. As one participant pointed out,

> the TRET laid a new framework -- we as scientists and engineers are not going to do work in a couple of weeks that the OpTec design team with a dedicated staff couldn't do in over a year.[134]

The value-added from the TRET's efforts was to open for discussion and clarify some of the guiding principles for the plume containment effort at the MMR. The Final Report

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[131] Interview, February 27, 1997
[132] Interview, February 27, 1997
[133] Interview, March 25, 1997
[134] Interview, March 26, 1997

identified the problems with the total containment mandate and introduces a new strategy of finding a *balance* between toxicological and ecological risks. In doing so, the TRET switched the emphasis from the specifically mandated actions in the PRP and IROD to an approach that takes more measured actions in phased steps. The Final Report made recommendations that acknowledge the shortage of information and the uncertainty of the risks associated with the plumes by weighing all the factors in deciding how to contain the plumes. This meant that the TRET was able to consider alternatives that were not available to the designers of the 60% Design.

The first section of the Final Report is an evaluation of the 60% Design. The TRET's review identified the total containment mandate as the chief culprit in the failure of the OpTec design:

> The primary finding of the TRET's evaluation of the 60 Percent Design is that achievement of the ROD for Interim Action goal of 100 percent capture of all plumes at their leading edges is not possible without significant negative environmental impacts. Tradeoffs will have to be made to reduce toxicological risks while minimizing ecological impacts and advancing toward the goal of aquifer cleanup.[135]

The TRET report was the first real public challenge to the total containment mandate. Up until that point no party had the credibility or political will to point out the role of the mandate in creating the failure of the 60% Design. Until the Final Report "nobody who had credibility with the public would stand up and say that the design process was going too fast."[136] Though the mandate "never officially came off the table,"[137] the need for total and simultaneous containment was reduced by the credibility and trust that developed among stakeholders over the course of the TRET's activities. This was due to the work of the TRET in making all parties, including the public, aware of the technical constraints on the containing plumes.

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[135] TRET Final Report, page 11.
[136] Interview, February 27, 1997

The Final Report recommended a new approach to plume containment. Each plume would be examined individually and criteria set that would try and "balance the design process."[138] Its goals reflect the TRET's return to 'first principles' and a deeper understanding of the complexity of the problem than the Plume Response Plan, or IROD:

- Avoid unacceptable toxicological risk from plume contaminants to human health and biological organisms;
- Avoid unacceptable impacts from the proposed containment strategy to the natural resources, and;
- Avoid undesirable impacts on regional groundwater flow and the paths and spreading of other plumes.[139]

The emphasis of the Final Report is on identifying the underlying goals of the cleanup so that any design can be measured against a clear set of expectations.

The Final Report contained the TRET's recommendations of how to address each of the plumes individually. There were two important characteristics of this new approach. The first was to ask people to look more carefully at the problem and to take a more measured response to the individual risks of each plume. The TRET recognized that "plumes cannot be managed individually without acknowledgment of the inter-connectedness of the aquifer system"[140] but at the same time each plume had distinctive characteristics that should inform design and decision making. It also highlighted the need to balance the desire to solve the problem quickly and comprehensively with the uncertainty that characterizes the substantive challenge. To do this the Final Report called for an "incremental" approach.

> Some recommendations address concepts related to the longer term plume response plan, while a second set of recommendations identifies specific tasks to execute on a plume-by-plume basis.[141]

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[137] Interview, February 27, 1997
[138] TRET Final Report, page 1.
[139] TRET Final Report, page 1.
[140] TRET Final Report, page 13.
[141] TRET Final Report, page 19.

The summaries for each plume include "near-term" and "future actions" as well as suggesting what information is still needed and where innovative technologies and other approaches may be more effective.

The Final Report, according to one TRET participant, was:

> really just a series of recommendations pulled from existing RI's. We were trying to capture a good summary of what the risk was, and what the uncertainty was, where, and how much.[142]

Based to a large extent on the findings presented in the TRET Final Report, the IRP and its contractors prepared the *Strategic Plan* for the cleanup of the MMR groundwater plumes, delivered to the EPA and DEP on May 15, 1996. The central feature of the overall plan is the *Comprehensive Plume Response Plan* which is the direct successor of the work of the TRET and the "unimplementable" 60% Design.[143] This new Strategic Plan specified containment actions for two of the plumes and, for the other plumes, identified data gaps and recommended what needs to be determined before actions can be taken. This new Plan included many of the "guiding principles" identified by the TRET, such as taking a balanced approach by weighing all the impacts of action (and no action) and using an "iterative" approach.

With the release of the Strategic Plan TRET met the goals set out in the White Paper. A review of the TRET by CBI in July 1996 was performed through interviews of TRET members. CBI found that participants credited the TRET with getting the containment effort back on track and rebuilding credibility for the IRP's cleanup effort. It did so by providing independent multi-disciplinary review of technical work coupled by an effort to integrate value-based considerations through public outreach and review. In just two months, the crisis over the 60% Design had given way to a publicly acceptable Strategic

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[142] Interview, January 30, 1997
[143] Comprehensive Plume Response Plan, prepared for IRP, June 1996, page 4.2.4.

Plan and newfound trust in the IRP's effort to contain and cleanup plumes at the MMR. It is impossible to wholly ascribe this movement to the TRET; many crucial technical and political boundaries also shifted during this tumultuous period. What is certain, however, is the credit that is given the TRET by the public, regulatory agencies, and military. The CBI study also found strong support for continuing and expanding the work of the TRET. Perhaps the strongest evidence of its success is that the TRET still meets regularly and continues to play a role in asking, and sometimes answering, the "what if's" in its review of the IRP's containment effort.

VI. THE CONSENSUAL APPROACH TO DECISION MAKING

Brooks and Cohen, among other political philosophers, maintain that pursuing collective decision making is a noble end, even a moral imperative, in a democracy. I believe that the case of the TRET illustrates many practical reasons, as well, for using inclusive processes in environmental decision making. Simply put, consensual processes attempt to reach decisions that satisfy the needs of all stakeholders. They build consensus, not by finding a single "best" solution and convincing parties of it's merits, but by through a conversation in which parties work together to examine their common and individual needs and, based on their joint understanding of the problem, make satisfactory decisions. Consensual processes expand the technical and political competence of participants, making them "better" contributors to the process. These processes develop trust through collaboration of participants who understand not just the final decision but the "how's" and "why's" behind the judgment that are reached.

I believe that the success of the TRET in developing politically and technically acceptable recommendations is a result of the consensus-oriented approach that it took. This approach is evident when examining who participated and how they participated. The TRET was inclusive of all interested parties, responsive to the needs of each, and made the demand on each to understand the problem from many points of view and work cooperatively to find a way forward. Consensual processes require an extensive upfront investment of time and resources. They also require a change in the roles and responsibilities of stakeholders, which often means a difficult transition for those accustomed to more hierarchical methods of decision making. Despite the drawbacks, the consensual process is especially well suited to the challenges of science-intensive decision making in a politically charged atmosphere.

In this section I will address three questions:

- What are the characteristics of a consensual process?
- How do consensual processes achieve "better" outcomes?
- What were the consensual aspects of the TRET?

In my discussion of consensus I am concerned about both the *end* of agreement reached by parties and the *means* or method used to achieve consensus. This is an important distinction, because while few contest the benefits of agreement on a decision, it is not as clear what conditions facilitate reaching consensus. A consensual approach to decision making attempts to harness the diversity of stakeholders' opinions, values, and beliefs. It does this by requiring participants to share their views, recognize the perspective of others, and work jointly to find creative solutions. I believe that the approach taken by the TRET can be characterized as "consensual" in terms of who participated, how they participated, and how the parties interacted -- as well as by the outcome.

1. Who Participated

There is often political disunity surrounding environmental decisions; this is certainly the case at MMR. Many different parties involved, each one with a different constituency and responsibilities -- or stake -- in the decision that is made. Because parties weigh factors differently, each must be involved in the decision-making process. For instance; the public may be mainly concerned with health effects, the responsible party may consider actions and costs most important, and regulatory agencies may focus on standards and legally enforceable mandates. These different perspectives cause political tension that can impede actions to meet the shared goal of cleaning up a site. Consensual processes help parties clarify their underlying interests and find areas of agreement and disagreement. Without giving up their autonomy, stakeholders can work together to develop common guiding principles.

Broad participation is also important in an environmental decision characterized, like the MMR, by scientific uncertainty. While uncertainty is not exclusive to environmental problems, they tend to have a lot of it because they concern complex systems. Understanding the dynamics of such systems requires the convergence of many different disciplines. Taking action requires prescriptive advice that is a combination of technical evaluation of information and value-based judgment (no one ever knows the future).

Containing the plumes at MMR required modeling groundwater and assessing risks -- both of which require many "value-laden" judgments -- and going forward with a containment design. Without perfect information guesses (albeit educated ones) are necessary. To prevent these assumptions from coming back to haunt the decision later, they must be acceptable from both a technical and political point of view. Just as the relevant experts are ultimately responsible for ensuring the validity of very technical decisions, value-laden decisions must be made, or at least affirmed, by all stakeholders.

The pragmatic goal of participation in a consensual process is to, first, get the "best possible" decision, and second, make sure that stakeholders know that it is the "best possible" so they agree. Including all stakeholders in the process has three advantages:

(1) *Shaping understanding* -- Participants in a consensual process have a chance to examine preferences in light of their experience in the process and a changing understanding of the problem.

(2) *Eliminating blind spots* -- Maximize stakeholder inclusion and the consideration of relevant information, perspectives, and values, thereby reducing uncertainty and "blind spots".

(3) *Stability* -- Participants are much more likely to accept and support assumptions made with their involvement. They recognize limitations, trust the scientific and value-based validity of the judgments, and can see the relevance of the assumptions to the underlying principles of the effort.

The TRET depended on all the parties -- public, regulatory, military, and contractors -- involved in the decision-making process on two participatory "tracks." The first was the membership of the group itself, which was both multi-disciplinary and inter-institutional. The second was the use of open forums to interact directly with the broader community. This contact was important in keeping the public informed, ensuring that the TRET responded to the needs of the public, and building credibility for the process and experts.

In determining TRET membership, the military, EPA, and DEP recognized the need for representation of a wide array of technical specializations. Many of OpTec's problems stemmed from the absence of risk assessors and ecologists on their design team. The TRET was comprised of a *hydrological* and *ecological* group, along with ecological risk, human risk, and ecological impacts sub-groups. Though membership changed, a diverse group (approximately 15 experts in the hydrological and 25 members in the ecological group) participated on the TRET.[144] Each member brought a different expertise to the group, and, unlike the OpTec team, the TRET had a permanent presence of ecological and human health risk experts. Another, more subtle point is the difference in perspectives and problem solving approaches of experts depending on their training. This is particularly apparent between engineers and those with a more traditional science background, where the scientists' "reductive" nature comes up against the engineers more "action-oriented" approach. The diversity of expertise on the TRET ensured technical validity in the various aspects of the design process and encouraged an outcome that balanced the orientations of different fields.

The institutional representation on the TRET was also important in meeting the interests of the various parties and building support for the recommendations. The same diversity in opinion that exists between scientific fields exists between institutions -- even between experts in the same field. In reviewing the perspectives on environment risk among 1,011 scientists and engineers, Burke and Jenkins-Smith found, "perceptions of risk and its correlates are significantly associated with the type of institution in which a scientist is employed."[145] The body of literature on risk perception corroborates this finding. Two, among many, possible reasons for these differences are organizational culture (people like to work with like-minded people) and institutional focus (i.e., applied, regulatory, research -or- public, private, non-profit). Limiting the institutional representation in a decision-making process, therefore, can be an impediment to addressing the perspectives of all stakeholders.

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[144] Public Comments Record, page 14.

[145] Barke and Jankins-Smith, page 426. -- study of Lynn, F.M., "The Interplay of Science and Values in Assessing and Regulating Environmental Risks," *Science, Technology, and Human Values* 11, 40-50 (1986)

The TRET members represented over 20 different military, regulatory, and research agencies, as well as various consultants.[146] Each of those institutions, through its representatives on the TRET, had an opportunity to express their interests and review the work of the group. Part of the TRET's success was due to the explicit effort to get their members to check their "institutional agenda" at the door. However, each member was responsible for checking the progress of the TRET against not only their own "expert opinion" but in terms of their institutional constituency. Their presence on the TRET gave others in their institution a direct link to the TRET, building credibility and further expanding the capture of ideas, information, and opinion. From the standpoint of buy-in, the presence of a representative assured institutions that their interests were being addressed. The TRET benefited by having credible advocates who could return to their constituencies and explain the decisions that were made.

Reaching the general public, or choosing adequate public representatives, can be a challenge. The communities in the four towns surrounding the MMR, however, were well organized. This was due in part, perhaps, to the long political struggle surrounding the plumes at the MMR and a regional predisposition towards community activism. Along with elected and appointed public officials, the IRP recognized nine locally based "special interest groups" such as the *Association for the Preservation of Cape Cod* and *Upper Cape Concerned Citizens*.[147] These public representatives participated on various public advisory committees as well as in public meetings. Some of these individuals had an expertise (medical, legal, etc.) that they brought to bear on the problem. Many, through their exposure over the course of time, gained a sophisticated understanding of both the technical and procedural intricacies of cleaning up a Superfund site. Almost all of these people were working voluntarily. These representatives exerted a large amount of influence by publicizing the story and making information available to their constituencies, including a well-read book on the subject.[148]

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[146] Public Comments Record, page 14.
[147] Public Comments Record, figure 1.

The TRET engaged these representatives, as well as the broader public, through open meetings held weekly, or more often, supplemented by press reports and "fact sheets" released by the IRP explaining technical and process issues.[149] TRET members participated in meetings of the various community advisory boards -- such as the Technical Environmental Affairs Committee, Senior Management Board, Plume Containment Team, and four Process Action Teams -- and town meetings. These meetings were very well attended, many with 50 or more people. Through this outreach effort, the TRET was successful in tapping into the political leadership, local knowledge, and technical expertise of the educated "lay" public. As with the group's internal membership, the TRET endeavored to involve the full range of stakeholders, elicit their concerns, and inform them of the TRET's work.

2. The Role of Experts

A consensus approach is based on a respect for parties' equality combined with recognition of the need for decisions to reflect the plurality of views and the collective character of social and political life. Ideally, parties are given equal access to all aspects of the decision and their contributions are given equal consideration. However, when faced with highly technical questions, participants rely on experts to explain technical matters and, at times to use their own "best scientific judgment". *How, then, should experts convey their information, ideas, and beliefs?* It is up to technical experts to fit their expertise into complex problems in a way that acknowledges uncertainty and disagreement and engages all parties in value-laden judgments.[150] The burden on the expert remains the same as that on any participant in a conversation. They must explain their beliefs and defend their ideas in a way that all parties can understand, not just give their opinion but elucidate the reasoning behind it. The goal is to facilitate participation of all parties. Participants should not merely rely on experts but to apply their own knowledge, reasoning, and values to the problem at hand. Experts must find ways to share their knowledge, experience, and opinions and help open to public review value-

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[148] Rolbein, *The Enemy Within, The Struggle to Clean up Cape Cod's Military Superfund Site*
[149] See list of public meetings in *Sources*, page XX.

laden judgments. This requires technical experts to take on the role of "advisor". A consensual process will help to facilitate this role and encourage the open communication and exchange of ideas, beliefs, and values.

I believe that the TRET technical experts' success as technical advisors is apparent in:

(1) the education of participants to understand and accept the tradeoffs involved in balancing competing goals,
(2) the sharing of information and encouraging interaction among participants, and,
(3) the continuous reevaluation of the goals of the effort in light of the high level of scientific uncertainty.

The two "track" approach of the TRET was created in response to the highly technical nature of the plume containment design and the severe time constraints. Those who participated as members of the TRET had specific expertise -- hydrology, ecology, geology, etc. However, in making value-laden judgments there are no experts.[151] A consensus approach calls for a "conversation" in which experts and other parties all participate as equals, and information is both shared and confronted. In dividing the deliberation into an *inner* and *outer* group, the TRET resembled a more hierarchical approach, such as the OpTec design team. However, the relationship between the inner and outer group was distinctly different in the TRET. I believe that we can distinguish some specific characteristics that the TRET members used both in their internal discussions and interactions with the broader public that facilitated the building of consensus.

The different sub-groups within the TRET met daily throughout the development of the Final Report. These meetings were successful, in spite of the heterogeneity of science and experts views, because participants explained the "facts" and their beliefs in a way that everyone understood. The "workshop" atmosphere of the TRET describes a continual dialogue between different members trying to understand each other's

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[150] Woodhouse, E.J., and Dean Nieusma, "When Expert Advice Works, and When it Does Not," page 24.
[151] *Ibid.* page 24-25.

perspectives. For instance, for the first time ecologists were explaining to hydrologists why maintaining groundwater and pond levels were crucial to ecological health. The hydrologists' heightened understanding of ecological concepts, and vise-versa, described by participants was a direct result of the role each member took as both teacher and student. Between TRET members there was no hierarchy; all members were under the same burden to explain their beliefs and convince others of their views based not on their reputation but on their application of sound reasoning to the data.

TRET members extended these practices to public meetings. They not only presented their work and responded to comments, but engaged with participants in a deliberation over the topics they took up. TRET members avoided confusing terminology, explained data and their beliefs and solicited varying opinion. TRET members asked for "help" in finding and understanding data, acknowledging uncertainty and diversity of opinions that existed. This pattern of interaction kept ideas on the table for explanation and re-evaluation. The explicit effort to engage the community challenged the conventional view of knowledge as "linear" and exclusively the domain of formally trained experts. They used these meetings to ask participants questions and to "brainstorm" helped forge a new relationship between technical advisors and the broader public. This opened greater flexibility to the process because participants could bring up issues and elicit responses. Feedback from the public reduced the chances of blindspots (technical or political) and more fully educated **all** participants. Because parties were involved in the development of actions, they understood the tradeoffs and limitations necessary to reach the final collective goal.

Another role that technical advisors commonly play is to lay out alternatives, technical limitations, and areas of uncertainty that non-experts might not be aware of. In the MMR, for instance, there were highly technical questions about what hydraulic models to use, how to interpret the results of analyses, and what technologies would be appropriate. Questions about how much water could be pumped, for instance, required significant modeling of the flow and replenishment rates of the groundwater. TRET members performed this kind of analysis without broad public participation. When the time came to use the analyses to set new standards (such as an upward limit on the amount of water that could be pumped per day) the TRET made clear the assumptions they used and explained the reasoning behind them. The TRET members used their understanding of technical limitations and uncertainty as a starting point in a discussion of the containment design. By giving explicit attention to the "tradeoffs" between ecological and toxicological risks, the TRET acknowledged that the underlying questions extended beyond technically feasibility to political acceptability.

The public, concerned with the health effects of the plumes, saw an immediate need to take action. The 60% Design accepted this demand as given and ended up with an unworkable plan. TRET members conveyed the technical limitations of groundwater cleanup the process also helped communicate their judgment. Members felt that the plan for a problem of this size and complexity must react to plumes individually, set flexible goals, and take iterative steps towards a final goal of clean water. Given the complexity of designing a comprehensive containment plan and the time limitations, the TRET concentrated on clarifying underlying principles to guide iterative technical choices. The TRET's recognition of the need for political acceptability can be seen in the use of the words "unacceptable" and "undesirable" in the development of the TRET's guiding criteria; these terms set political standards that the cleanup must meet, not technical standards such as the exact technology or the timeline. The TRET Plan did not rely on inflexible technically-based goals because all the stakeholders were represented at the decision-making table. This minimized the stakeholders' dependence on severely rigid standards to ensure that their needs were met.

3. Participant Interaction: Deliberation

Reaction to the release of the 60% Design, made it clear that the mandate of total simultaneous containment conflicted with the desire to minimize ecological impacts. Trust developed through the TRET helped parties to accept the idea of relaxing the original mandate. As stakeholders gained confidence in their ability to influence decisions, trust no longer had to be secured through an inflexible mandate. Nor did proponents have to sell the new plan to the public because direct participation had developed a public sense of "ownership" of the proposal. This support for the TRET, and its recommendations, was the outcome of a sustained effort to be accountable to the concerns of all parties. Stakeholders' participation in the decision-making process changed the way they viewed the problem and each other.

Because of the way consensual approaches engage the parties they open the possibility that participants will change their understanding of the problem, both technically and politically. This is a stark contrast to a view of "politics" as a confounding factor in the efforts to reach an otherwise "rational" decision. Consensual approaches recognize each party's expression of their beliefs as legitimate concerns that must be addressed within the process and in the outcome. In the absence of "perfect" knowledge, parties share the responsibility for learning through their participation. All parties must remain open to re-evaluating their own beliefs and understanding in light of what their experience. This can be difficult for parties accustomed to adversarial relationships. It does not, however, present an insurmountable challenge if the process can build on participants' desire to "get the best decision" to develop trust and cooperation. In his discussion of "micro-aspects of democratic theory", Claus Offe discusses a process in which parties learn through their participation as building "competence".[152] Competence can be expressed in terms of the participants' technical understanding of applied science, consideration of the values and beliefs that other parties hold, and deliberation skills -- the mechanics of participating in a consensus-oriented forum.[153]

At the MMR, the various parties' understanding of the dangers posed by the plumes and their expectations for a solution changed through their participation in the TRET. By acknowledging technical uncertainty and political disagreements, a consensus approach puts participants in a different mind-set than a technocratic approach. Instead of

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[152] Offe, Claus. *Micro-Aspects of Democratic Theory: What Makes for the Deliberative Competence of Citizens.*

advocating *positions*, justified in terms of reason, parties cooperated to create a shared understanding of the problem and to find creative solutions. At JPAT, SMB, and other public meetings, the health and ecological threats posed by the plumes were discussed openly, with experts and citizens explaining their beliefs concerning the risks imposed. The goal of this open exchange of ideas was to create a shared understanding of the problem, or at least encourage recognition of the areas of agreement and disagreement between differing points of view. For example, it was important that all parties recognized the difficulties collecting field data on groundwater quality entailed. The military had had little success in communicating the cost, time, and remaining uncertainty associated with drilling the monitoring wells used to identify the location and composition of a plume. During the development of the 60% Design, the public remained outside the decision-making process. They based their judgment of the resulting plan solely on their priority concerns for the cleanup -- eliminating the threat as soon as possible. The lack of mutual understanding was a main contributor to the vilification of the Guard and OpTec in their effort to contain the plumes.

The TRET opened access to technical information and made the reasoning behind their assumptions and decisions explicit. By including stakeholders in a conversation, the TRET was spreading the responsibility for finding an acceptable solution. The TRET made technical experts accountable to the public, through the meetings and the organizational structure, the burden of identifying and solving problems was shared by participants. The technical experts were forced to explain their assumptions and base their recommendations in terms that clearly addressed public concerns. The public was forced to place their demand for an unconditionally clean aquifer in the context of the technical limitations. By sharing information, approaching the decision-making process as an opportunity for all parties to learn, and placing the burden of an acceptable outcome on the stakeholders the TRET broke down barriers between "scientific" and "political," ecology and hydrology, and citizen, military, and regulatory agency perspectives.

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[153] *Ibid.*

In a consensual approach, interaction between parties is an exercise in "thinking together", not a continuation of advocating individual positions. This means that each participant re-evaluates their own interests, priorities and position in light of take what they experience. The contention in consensual processes is that if participants are collaborating, their individual preferences will be informed by the needs and concerns of others and, ultimately, will yield a decision that all parties accept. At MMR, the stakeholders came to understand the complexity of cleaning up groundwater contamination. The public was forced to reconsider their demand for simultaneous action on all plumes. This re-examination of the situation by all parties led to the agreement on pursuing the goal of balance, and allowed the TRET to recommend iterative measures. TRET members recognized that no one had much experience (or expertise) with containing groundwater plumes on the scale of those at MMR. They felt that the containment process needed to allow the flexibility of "learning by doing". This approach acknowledged the great amount of uncertainty and assumed that through cooperation, parties would make decisions as the necessary information became available. In this respect the TRET moved the emphasis away from inflexible positions and engaged parties to find outcomes that met everyone's interests.

4. An Acceptable and Implementable Outcome

The recommendations of the TRET Final Report, and their acceptance by the technical experts on the TRET and the public, demonstrate characteristics of a consensual approach. There were two main consensual aspects to the TRET's recommendations; (1) a focus on finding an acceptable balance between impacts, and (2) the use of iterative steps in taking action. Though the Final Report gives specific findings for each of the plumes, the emphasis of the report is less on specific actions than on how decisions to act should be approached. The adoption of balance as a goal was made possible by using a consensual approach that demanded all parties weigh the impacts of different actions, and addresses the need to integrate technical and value-based judgments. The use of iterative steps indicates that parties were taking a longer view of the decision-making process that hinged on the continued inclusion of all stakeholders. The recommendation for iterative steps could only have been acceptable in an atmosphere of open communication and trust.

Replacing the total simultaneous containment mandate with the goal of balance required a re-evaluation by all parties of their positions in light of a clearer understanding of the technical limitations and their own underlying interests. This new goal placed the burden on stakeholders of reconciling their common aim of clean groundwater with the technical limitations and secondary effects of containing the plumes. It was up to all participants to identify blindspots, question assumptions, and ensure that relevant issues were addressed. This effort is reflected in the TRET's recommendation that the "toes" of the plumes (or the contaminated water on the edges of the plumes) remain untreated when capturing them would disrupt groundwater and pond levels.

The goal of capturing 100 percent of contaminated groundwater was directly challenged by the goal of balance. The success of the TRET in building the parties understanding of the technical limitations on containing all of the contaminated groundwater at the same time allowed was central to finding a way forward. Though seeking balance at the expense of 100% simultaneous containment would have been opposed by many of the same stakeholders four months earlier, parties now recognized that this new goal was in line with their desire to minimize the overall impacts of the plumes and the cleanup effort. Getting parties to accept that total containment without ecological effects was unfeasible required stakeholders and experts to recognize the different value-based and technical perspectives on the problem. All parties were required to adjust their positions on the containment goal in light of technical limitations and political demands.

The consensual approach gave participants in the TRET the ability to re-evaluate and, when necessary, challenge public and technical mandates that were previously viewed as indisputable. The recommendation for an iterative approach to action was directly contrary to the mandate for the simultaneous containment of all plumes. The surrounding towns had originally viewed this mandate as a political imperative because they feared that without this guarantee they would be in competition instead of working cooperatively. The problem was that in practice this goal was unworkable and undesirable. Each of the plumes contained different chemicals and posed different types and levels of risk. There was also great variation in how well each of the plumes was understood. TRET members were able to open the demand for simultaneous containment to scrutiny by building understanding of the problems it posed and trust that the process would not devolve into a competition for places in the cleanup queue. Participation helped build an understanding of the reasons for the experts' preference for addressing each plume separately. Participants became aware of the difficulty of making these decisions because they assumed some of the responsibility for weighing the risks and benefits of taking action in the face of great uncertainty.

The TRET recommendations make explicit three guiding principles that are shared by all parties.[154] These goals were too broad to be applied to specific plume containment action decisions. They were crucial, however, for establishing the cooperation of all parties in working together towards a common goal. Bringing parties together to solve the problems of plume cleanup had many secondary effects that increased the likelihood of acceptable decisions. Because the participation of parties is not limited, the recommendations for short and long-term actions is possible. Parties can agree to immediate actions without giving up their ability to participate in future decisions. Actions can be taken that acknowledge uncertainty and the need for "learning by doing". The TRET's use of a consensual approach allowed the flexibility in the decision-making process that was required from a technical standpoint (because of uncertainty) and from a political standpoint (because of different perspectives and levels of understanding).

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[154] See Chapter V, Section 6

5. Three Democratic Ideals; deliberation, equality, and reevaluation of interests

In addition to being a practical response to a political crisis, the pattern of interaction the TRET developed standup favorably in comparison with a democratic ideal. The TRET encouraged "public deliberation focused on the public good"[155] by opening the decision-making process to all interested parties, as well as enlisting the necessary technical expertise. The TRET endeavored to recognize the "equality"[156] of participants by operating with very little hierarchy and recognizing and responding to all comments and concerns expressed by stakeholders.

Of the three ideals, however, the most important from a practical standpoint was the ability of the TRET to shape the "identity and interests of citizens in ways that contribute to the formulation of a public conception of common good."[157] This outcome was very much a result of the TRET's success in achieving a public deliberation and equality between participants. It, however, went beyond these ideals and addressed the efforts of participants to work together to build a shared understanding of the problem and to explore solutions that would satisfy each parties' needs.

The TRET process built the understanding of the technical limitations and uncertainty. Experts learned to recognize and respond to political demands made by citizens whose health was threatened by the plumes. The demands of the process compelled parties to consider alternative views -- both political and technical -- of the problem and to work together towards solutions that would meet the demands of the whole group. Faced with the complex technical challenge of cleaning up groundwater contamination, and operating in a politically charged atmosphere, the TRET was able to re-focus the containment effort onto common goals. The consensual approach allowed stakeholders at MMR to reach well beyond their own individual positions and "potentialities" and cooperatively find a politically acceptable and technically wise way forward.

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[155] Cohen, page 17., see Chapter II, section 5, page XX.
[156] *Ibid.*
[157] *Ibid.*

VII. HIERARCHICAL VERSUS CONSENSUAL APPROACH

1. Findings

In this final section I juxtapose the Guard/OpTec and TRET decision-making processes, and drawing from my previous analysis, flesh out the differences between the two approaches. I believe that the following comparison is a convenient way to review the story told above, and explore the underlying questions of this thesis;

(1) What were the key characteristics of the decision-making approaches used by OpTec and the TRET?

(2) How did the way the group members interacted -- internally and with the public -- influence the political acceptability and technical quality of their recommendations?

Comparison of the Approaches

Air National Guard/OpTec: 60% Design	*Technical Review & Evaluation Team*
Design Team	**TRET Members**
• Homogeneous composition -- engineers and groundwater specialists, no ecology or human health experts.	• Technical diversity -- expertise from a range of fields.
• All experts employed by OpTec.	• Institutional diversity -- approximately 15 different public agency's and contracted firms represented.
• Local experts excluded.	• Utilized local knowledge -- experts tapped from over 25 different local organizations.
• Limited accountability -- only to client (the Guard).	Broad accountability -- Accountable to stakeholders through direct participation, representation of public officials, and regulatory, as well as state and federal research agencies.

60% Design	*TRET*
• Limited requirements for interaction with outside group -- little opportunity for outside review of design plan.	• Requirement for regular interaction -- constant review of decisions and reasoning behind decisions.
• Mandate not open for review -- 100% simultaneous containment.	• Effort to clarify common underlying principles and achieve more flexible goal -- *balancing* impacts.
• Only demands explicitly expressed in the mandate considered.	• Implicit demands made explicit, all demands reevaluated in light of common understanding of technical and political issues.
Public Participation Forums	
• Public Meetings -- report & comment	• Public Meetings -- discussion & deliberation
• Public Advisory Boards -- much of which were open to members only, closed to press and public. Topics limited to technical details.	• Public Advisory Boards -- open to public, all issues considered.
• Limited access to design team and no assurance that comments or questions would be responded to.	• Multiple opportunities to ask questions, give comment and review. All parties assured fair hearing and a response.
• Public review of plan when at 35%, 60%, and (originally planned) 95% complete.	• Continuous review of issues and decisions as they occurred.
• Public participation informing mandate.	• Public participation throughout.
Design Process	
• Design details specified in advance -- pump and treat.	• Flexibility to explore use of alternative approaches and technologies.
• Information monopolized by design team.	• Open access to information.
• Trust through mandate.	• Trust through understanding.

60% Design	*TRET*
Type of Interaction	
• Episodic	• Continuous
• One-way communication	• Conversation
• Limited opportunities to comment.	• Multiple channels of communication and ability to influence outcome
• Design team "experts" make all decisions internally based on "expertise".	• Deliberation -- people apply their own understanding and "best judgment" to the problem.
• Preferences expressed by public at outset are viewed as static inputs in decision-making calculation.	• Parties encouraged to re-evaluate their own preferences on the basis of changing understanding of the issue, an understanding of the perspectives of other parties, acknowledgment of technical uncertainty, and room for "reasonable disagreement."
• Experts have monopoly on information and competence of public to understand what the design team is doing is not built.	• Competence of public is actively built through clear presentations of information and explanations of reasoning behind assumptions and judgments.
• Political viewed as separate from technical -- need to meet political demands is met through standards-based mandate.	• Simultaneous discussion of facts and values -- integration of technical and political.
• Public support based on the mandate.	• Public support based on consensus over the common guiding principles of the effort.

2. Lessons

The MMR case is illustrative of characteristic challenges shared by a substantial number of environmental problems. The outcomes of the different decision-making approaches that the Guard and TRET took to containing the plumes at MMR show the important role that institutional design plays in overcoming these challenges. These characteristic challenges are: political pluralism, technical pluralism, and urgency. I will clarify how these challenges are apparent in the MMR case and how they are relevant to other environmental problems. I will summarize how the Guard and TRET attempted to meet these challenges through their decision-making processes and specify how the inclusion of stakeholders, the nature of their interaction, and the roles of participants effected the ability of this process to overcome these challenges. I also discuss some *cautions* that should be considered in using a consensual process. These recommendations and cautions are drawn from the case of the MMR, but have wider applicability to many environmental decision-making problems.

The Challenges

Political pluralism -- Environmental problems, by their nature, are public problems. Stakeholders commonly include a responsible party, in this case the military, regulatory agencies, such as EPA and DEP, and the general public represented by public officials, advocacy groups, and individual citizens. There are also paid consultants, such as OpTec, and research-oriented technical advisors, such as experts from USGS or Woods Hole Oceanographic Institution, who have an important role to play in understanding the problem and determining the solution. Each of these stakeholders has the ability to influence the implementation of a solution through their input, in the case of an inclusive process, or, in the case of an exclusive process, through political action, the courts, and other forms of protest. Many (if not all) of these parties can be expected to disagree, at least initially, on how they characterize the problem and in their preferences for a solution. The range of opinion is not a sign of faulty reasoning, but a legitimate result of individuals' different beliefs, values, and perspectives on how they weigh evidence, account for uncertainty, determine acceptable risk levels, and understand technical and political limitations on the solution.

Technical pluralism -- Solving environmental problems requires understanding complex environmental systems and making prescriptions that will reduce impacts. The different technical disciplines and institutional background of experts means that there will inevitably be a range of perspectives on a given problem. At MMR, this is clear in the interaction between the hydrologists and ecologists in the TRET and the different weight that OpTec, regulatory agencies, and public representatives gave to the lowering of groundwater levels. Environmental decision making requires a great number of assumptions and judgments -- especially in making prescriptions but also in determining secondary effects, prioritizing effects, and weighing the impact of actions -- that cannot be justified on "objective" scientific grounds. Like political pluralism, a decision making approach must find a way to reconcile the different viewpoints and find a solution that balances different impacts.

Urgency -- The search for solutions to environmental problems is often driven by political urgency. This urgency is frequently a result of the perception of risk from the public -- which translates into political pressure to solve the problem -- and uncertainty over the probability or severity of the threat. At MMR the threat of contaminated drinking water, as well as the ecological threat to surface waters, was a main source of the 100% simultaneous containment mandate. The challenge is to determine implementable actions that are politically and technically acceptable before threats to human or ecological health became effects.

<u>Recommendations</u>

The confluence of these characteristics places demands on institutional arrangements for decision making. They must find a way to meet these challenges -- if they are to successfully solve environmental problems. Looking at how the institutional approaches used by the Guard and TRET to design a containment plan met these characteristic challenges, we can identify lessons that apply more broadly to other efforts to solve environmental problems.

Who participates: The decision making process should include the extensive involvement of all stakeholders -- including those from the public and different technical and institutional backgrounds. Stakeholders participation will help establish legitimacy in the process, give the process the flexibility required when contending with uncertainty and changing understand, and promote technical validity through the elimination of blindspots.

Some specific points in regards to who participates are:

- Identify all possible stakeholders, stakeholder groups, and their representatives. There should be someone who is directly representing each stakeholder group at the table. This is best done by a neutral party who can perform a conflict assessment to contact effected parties and map the areas of agreement and disagreement before the negotiations begin.

- Involve technical experts from relevant fields should be involved to review actions and impacts from their perspective. The perceived legitimacy and accountability of an expert will vary depending on who they represent, their institutional background, and their own performance in the discussion.

- Each institution should contribute its own technical experts and resources to share the responsibility for technical soundness.

- Included local experts directly in the process to capture indigenous knowledge of the site.

- Working cooperatively tends to build inter-personal and institutional relationships. It is never too late to open up a decision-making process.

Interaction of participants: Forums should promote an informal collaborative atmosphere between parties who represent their own interests, recognize their shared public interests. This informality makes it more likely that participants will be willing to re-evaluate their own perspective in light of their changing understanding of the problem. Stakeholders must work together to identify common underlying principles that all participants support. These may be very broad, but they will allow parties to view the problem as an entity separate from the parties at the table who will work together to find a solution. Stakeholder must, also be willing to explore alternative ideas and try to understand different perspectives of the problem. The conversation must acknowledge plurality and legitimate disagreement and find a solution that is satisfactory by expanding participants' understanding of the issue and searching for creative alternatives. They also must allow that information and proposals for highly uncertain aspects of the problem be considered informal *work in progress.*

Several ways to handle the interaction of participants are suggested by this case:

- Allow multiple opportunities for review and reflection by presenting progress regularly, releasing *drafts*, and making clear the assumptions, limitations, and uncertainty.

- Use advisory groups, open public meetings, fact sheets, and the media, to ensure transparency of the process by reporting regularly on the internal work of a technical group. TRET members participated in meetings daily during the decision-making process.

- Background information, reports, and meeting minutes should be easily accessible (such as the IRP's posting of fact sheets and minutes on the World Wide Web).

- Provide multiple channels of communication including opportunities to ask questions and express concerns at meetings and by submitting written comments with prompt answers and feedback on those comments.

- Make available technical training and assistance for participants, as well as for stakeholders not directly involved at the table. This may include technical workshops and building parties' capacity to participate in the process -- such as how to present or evaluate information.

- Participants must work together face-to-face in a workshop-type setting in which ideas are challenged and alternatives may be explored "off the record".

- Goals should be treated as hypotheses that are subject to re-negotiation as understanding of problem changes -- avoid inflexible mandates.

The role of participants: Stakeholder must participate as equals, explaining their views and the reasoning behind their beliefs. In practical terms, this means a specific role for technical experts in which they contribute their technical expertise while keeping assumptions and judgments explicit. Participants must be able to undertake "free-form" discussion to explore new ideas, sheltered from politics and management. The role of third party interveners is critical in facilitating parties' in this interaction. At MMR the mediators facilitated public advisory meetings, helped develop the institutional design of the TRET process, and kept the internal and external discussions of the TRET operating smoothly.

Some recommendations for how roles should be approached drawn from the case are:

- Neutral facilitators should be included to provide assistance in the communication between parties, process design, and keeping the process on-track.
- Experts must explain their beliefs, findings, and conclusions without relying on technical jargon. This should not be done as an effort to educate the public but as an effort to persuade them of the validity of the supporting argument.
- Identify and acknowledge uncertainty and make explicit the areas of disagreement concerning technical questions. Experts should lay out decision alternatives and help other stakeholders evaluates each on its merits.

<u>Cautions</u>

The following are some obstacles to pursuing a consensual decision making process.

- *Accountability* of participants, especially of technical experts, can be a problem. Participation as a member of a policy dialogue may require that individuals wear two hats. Individuals must be equal participants in the process although they may also be regulators, managers, consultants or decision makers who were hired to advocate the position of their constituency or institution. The TRET overcame this by limiting the authority of the group. The responsibility of the TRET was to make recommendations that were then approved by a review committee and finally by the IRP.
- *Coordination* is difficult because of the large number of stakeholders and institutions involved. Arranging to get the right people in the process, getting them to the site, distributing information, and organizing meetings requires support staff. These staff must be viewed as adequately neutral.

- Consensual processes may be viewed as *resource intensive* because they require a large up-front commitment of time and money. In the end these processes may achieve a more acceptable and stable outcome -- saving litigation costs and building trust with the community -- but there are no guarantees of success.

- Consensual approaches require a large amount of *time* -- this is especially apparent for technical experts who are spending their time explaining themselves instead of doing research. The TRET, however, is evidence that if the commitment and resources are available, decisions can be reached fairly quickly.

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Interviews

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*Meeting Minutes List**

Public Town Meetings
February 7
April 25
April 30
June 10
June 12
June 18

Plume Containment Team (PCT)
March 4
March 18

Joint Team Meeting
April 3
April 8
April 15
May 6
May 8

Program Implementation Team
January 16
February 13
April 9
May 7

Joint Plume Action Teams (PATs)
March 25
March 27
April 1
April 10
April 22
April 29
May 15
May 20
June 3
June 17
July 8

Senior Management Board
February 22
March 26
April 17
May 1
May 22
June 19

Technical Environmental Affairs Committee
March 20

*These minutes are available from the Installation Restoration Program:
ANG/CEVRO, Box 41, 322 E. Inner Road, Otis Air National Guard Base, MA 02542-5028.
They are also available over the World Wide Web: http://www.mmr.org:80/stakhldr/jpat

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