February 4, 1999

Dr. Joan M. Daisey, Chair
EPA Science Advisory Board
Indoor Environmental Program
Lawrence Berkeley National Lab
Berkeley, CA 94720

Dr. Mark A. Harwell, Chairman
SAB Ecological Processes and Effects Committee
Center for Marine and Environmental Analysis
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098

Dear Drs. Daisey and Harwell:

Subject: Response to the Science Advisory Board Ecological Processes and Effects Committee Report: "Evaluation of the Blackstone River Initiative" (SAB Report # EPA-SAB-EPEC-98-011, Dated September 11, 1998)

EPA-New England is pleased to have had the opportunity to bring to the Agency's distinguished Science Advisory Board (SAB) a scientific product for their rigorous peer review and technical evaluation. It was rewarding to work with the SAB's Ecological Processes and Effects Committee (EPEC) which comprised national experts representing a variety of scientific disciplines on our Blackstone River Initiative (BRI). The review was both constructive and informative, and will assist EPA-New England in its mission to develop tools and enhance the technical credibility of our science endeavors for the Agency. Per the SAB's request, we have completed and attached our responses to EPEC's comments for your final review and publication. It is our understanding that our comments will be put on the EPA SAB Internet site with the final report. We are encouraged by the comments that resulted from the review and hope to respond to the SAB's advice that "*strongly recommends that a new phase of the study be initiated.*"

EPEC's review stated, "*the SAB commends Region 1 and the other BRI participants for initiating the study*" and that the "*BRI study represents a significant advance for the Agency as an initial attempt to integrate mult-agency, multi-scale, and multi-environmental stressor considerations*" in a watershed study. In addition, the SAB noted that this 7-year effort was accomplished on a very meager budget; "*. . . that the contribution of volunteer and in-kind services was impressive, and the BRI's accomplishments far surpass the dollars expended by the EPA.*" It has always been a pioneering philosophy in EPA-New England to bring together a strong coalition of scientists and engineers from academia, state and local agencies, industry, and EPA to address important environmental science issues such as the Blackstone River and leverage support wherever possible.

Water quality in New England's watersheds has been and continues to be a priority issue for the Region. EPA-New England has been addressing very serious pollution problems from PCB's to

dioxins in New England's watersheds. As you know, the Blackstone River has recently been designated as a National Heritage River. These contaminants suggest very serious human heath risk issues which require us to better understand the environmental, industrial, and ecological issues and the associated river modeling and data assessment activities to maintain a healthy watershed, and to eliminate exposure to these contaminants. Building the appropriate tools to help us define, characterize, and evaluate the water quality in our rivers is critical if we ever hope to address these historical and persistent problems.

Characterizing water quality in our watersheds requires good science combined with sound modeling principles addressing physical, chemical, and biological parameters. The BRI is our first integrated attempt to model both these parameters under variable watershed flow conditions for dry and wet weather at different times of the year.

We recognize that the SAB's peer review and recommendations are important to the credibility of this product and our future work, and that it fosters the best kind of science. Since we are completing our work for the BRI report, we would like to address a few comments for clarification. We wish to emphasize that the database that was generated from the field sampling of the BRI along with the results expressed from the BRI modeling, are being used to assist the Agency and state governments in addressing management questions and possible remedial options for regulatory decisions. The database could also be used as the basis for designing further studies, if necessary, on watershed characterization. It was not the intention of the BRI to use this as a single, standalone management tool, but as a support document in conjunction with other measurements and information water quality. However, for those parameters measured in the BRI report, we feel the data adequately calibrates and validates the model, and it can be successfully applied to help understand and resolve water quality issues in the watershed.

We also wish to emphasize that the BRI had utilized data sets from seven different wet flow events, not just three as was conveyed by EPEC. We believe this significantly enhances the statistical validation of the BRI model. Four of these data sets were taken from work outside the BRI scope, but integrated into the present study as stated in the report. While we recognize limitations still remain, we are confident in our ability to predict pollution loadings to Narragansett Bay over a greater range of rainfall events than presumed by the SAB.

In addition, we recognize the benefits of adding additional criteria to help better characterize the impacts to water quality, but as noted by the SAB "*these shortcomings appear to be due to budgetary limitations . . . "* If resources were not a constraint, we could have addressed these other concerns and developed what we feel would be a comprehensive watershed management protocol and model for the country. Due to the funding constraints, however, we designed a model that was technically and scientifically valid for the parameters addressed.

We also wish to highlight the fact that the BRI proactively responded to a recommendation given during the March 1998 review which resulted in the measurement of additional dissolved oxygen data in the impoundments which enhanced our confidence level in the model following data verification.

The SAB "*strongly urges the Agency to build on the BRI study . . . to do true watershed management*" and to initiate a second Phase effort that would "*entail working with partners to bring the scientific tools to bear on a broader set of management options, looking well beyond simple chemical management to additional stressors, using multiple endpoints at the watershed and landscape levels.*" EPEC suggested developing a Phase Two effort that would combine (1) greater emphasis on the broader impacts of ecological conditions, (2) incorporation of an ecological risk assessment framework, (3) additional monitoring efforts, (4) inclusion of biological information and land-use/land-cover data for the watershed, and (5) the use of additional existing models for watershed-level analysis. It is our understanding that this effort will not only engage the Region in building a better tool for New England's watersheds, but will assist all regions in protecting the health and management of their watersheds as well.

I personally want to thank the SAB and the EPEC for assisting EPA-New England with our peer review process. With this effort and the sound recommendations from your committee, and the necessary funding support, we hope to continue the good work of the BRI and meet the challenges for a national water quality management tool.

Sincerely,

/S/

John P. DeVillars
Regional Administrator

Enclosure

cc: Carol Browner, Administrator
Peter Robertson, Deputy Administrator
Dr. Noreen Noonan, Assistant Administrator, ORD
Dr. Donald Barnes, Director, Science Advisory Board

EPA NEW ENGLAND/REGION 1
THE BRI'S RESPONSE TO
AN SAB REPORT:
EVALUATION OF THE BLACKSTONE RIVER INITIATIVE
JANUARY 1999

INTRODUCTION

At the request of Regional Administrator John DeVillars, the EPA Science Advisory Board(SAB), Ecological Processes and Effects Committee(EPEC) met on March 24-25, 1998 in Boston, MA to review the Blackstone River Initiative(BRI). The BRI was designed to provide a comprehensive interstate watershed investigation to describe water quality, biology, and toxicity in the river system, under both dry and wet weather conditions. A wasteload allocation model and a toxics model were developed to predict impacts and pollution loadings to the river system. The first day of the review entailed a detailed presentation of the Initiative by the BRI Science Team with substantial followup discussion, questions and answers. On the second day the EPEC discussed the merits of the BRI among themselves. The BRI Science Team was present at these discussions on the second day but did not actively participate. Subsequent to the March review the Science Advisory Board published a document in September titled *An SAB Report: Evaluation of the Blackstone River Initiative* prepared by the Ecological Processes and Effects Committee(EPA-SAB-EPEC-98-011, September 1998). The following are the Blackstone River Initiative's and EPA New England's responses to the comments contained within the evaluation prepared by the SAB. For continuity these are presented and referenced in the order in which they appear in the SAB report.

1. EXECUTIVE SUMMARY

SAB Comment: ".... the Pawtoxic model, which is based on TOXIWASP ..."

BRI Response - Pawtoxic is based on QUAL2E and not TOXIWASP.

SAB Comment: The BRI does not provide sufficient information on the impoundments to make management decisions. " ... important decisions are expected to be made concerning the management of the numerous impoundments along the Blackstone River, affecting river habitat as well as water quality parameters such as DO and metals, yet the BRI study does not provide the type of information needed to evaluate the efficacy of impoundment management options..."

BRI Response: It was never the intent of the BRI to provide management decisions relative to the impoundments along the Blackstone River, but instead to identify which impoundments were considered "hot spots" and had the greatest influence on the water quality of the Blackstone. With respect to this the Rice City Pond (RCP) research (highlighted in Chapter 8) is an excellent example of the success and significance of the BRI. The initial interpretation of the data from the 1991 BRI dry weather surveys showed RCP was the most significant "hot spot" among the 19 impoundments along the Blackstone River. On learning this, the Massachusetts Department of Environmental

Protection (MADEP) proceeded quickly to focus additional resources on this impoundment. This included a detailed monitoring program along the axis of the impoundment, similar to the procedure suggested by the SAB in Section 4.1 of its evaluation. In addition to the field work within the impoundment, the RCP report discussed management strategies including costs and benefits. The results of the RCP study were presented in Chapter 8 of the BRI report and discussed at the SAB/EPEC review. *It is noteworthy that this study was a direct result of the knowledge gained during the BRI.*

2. **BACKGROUND AND CHARGE**

2.1 **Background**

The SAB states that the accomplishment of the study was due to the active participation by EPA Region I, MA and RI agencies and a number of industrial and municipal facilities. The University of Rhode Island Department of Civil and Environmental Engineering also was a major participant and made significant contributions in the field, laboratory, data interpretation, modeling, report preparation and the presentation at the SAB review. It is not clear why the SAB failed to acknowledge this since one of the strengths of the BRI was the multi-agency and academic coalition that it fostered.

3. GENERAL COMMENTS

3.1 Overview

The SAB believes that the authors should "... attend to numerous editorial corrections associated with the text and figures, and provide a thorough edit." The authors of the BRI agree with the SAB. The report will be reviewed and editorial corrections will be made for the final report.

The SAB believes that "... the Executive Summary is too long, yet fails to emphasize some key points..." The authors of the BRI believe that the BRI Executive Summary is an excellent overview of the entire study. They are not aware of a failure to emphasize any key points. They agree to write a new Executive Summary to address the SAB concerns on length. The current Executive Summary will be retained as an overview of the complete report.

SAB Comment: "Further, the BRI report should acknowledge the limitations of the study results in some respects, e.g., the failure of the modeling to adequately predict water column metal concentrations and the uncertainty in the estimates of annual loading rates to Narragansett Bay."

BRI Response: The limitations of the study will be made clear in the final report.

3.2 Use of Ecological Risk Assessment Guidelines

SAB Comment: " ... the ecorisk paradigm can be used to organize the existing BRI data, and the committee recommends that this be done."

BRI Response: During the initiation of this project in 1991, the field of ecological risk assessment was in its infancy and rapidly evolving. The BRI recognizes that the use of the EPA's Guidelines for Ecological Risk Assessment (U.S. EPA, 1998) could have contributed significantly to assisting in identifying the strengths and limitations of the database and what types of additional data would have been necessary to further evaluate the Blackstone River from a whole river perspective. However, at this late stage it is not clear to the BRI how a reformation of the report using ecorisk assessment guidelines could be accomplished in a timely and efficient manner. Rather it is our feeling that an expeditious completion of the current report be made and that the use of ecological risk guidelines be more effectively utilized and better served through future phases of the Blackstone River Initiative. Already, the results of the Blackstone River Initiative have prompted the New England Division of the U.S. Army Corps of Engineers, Rhode Island Department of Environmental Protection and the Massachusetts Department of Environmental Protection to select specific management approaches to improve and restore the aquatic habitats located within Fisherville Pond, Rice City Pond, and Lonsdale Dam. Relying heavily on the results of the BRI , the New England Division of the U.S. Army Corps of Engineers has conducted an Ecological and Human Health Risk Characterization (McLaren/Hart, 1997) for Fisherville Pond within the Blackstone River system. The Ecological Risk Characterization was developed using EPA's ecological risk assessment paradigm (U.S. EPA, 1992, 1996) and the historic data presented within the Blackstone River Initiative were utilized to select contaminants of potential ecological concern and describe a conceptual model to address the potential impacts to fish, benthic invertebrates, plants, and wildlife inhabiting Fisherville Pond. Based on this first stage of the ecological risk assessment, the conceptual model was revised to include further studies (e.g., benthic invertebrate surveys) to fill the data gaps in order to complete the risk assessment. The results of this ecological risk assessment have been transferred to appropriate risk managers and the feasibility of pursuing alternative remedial actions is being considered. EPA New England, Massachusetts DEP, and Rhode Island DEM continue to be involved with these projects that have resulted from the efforts of the Blackstone River Initiative and will support the use of the ecological risk assessment paradigm with future projects in improving the water and sediment quality of the Blackstone River Watershed.

3.3 Water Quality Management and Remedial Options

SAB Comment: The BRI report should devote more pages to the implications of the BRI data for water quality management and possible sediment and water quality remedial actions.

BRI Response: The authors also believe that these are the ultimate goals for use of the data and assessments in the report, however, the inclusion of management questions and evaluation of alternative scenarios for restoration are beyond the original goal or design of the project. However, even though inclusion of management options was not part of the original design, once Rice City Pond was identified in the BRI as being a key location, the USEPA and the Massachusetts DEP designed and funded a study of RCP. This study led to an indepth evaluation of the site, and proposed a set of management options. This project was summarized in the BRI report from the full RCP report and has become an integral part of the project.

The BRI was designed to provide a comprehensive watershed wide database to be utilized by the federal and state agencies for evaluating future management questions and remedial options and as the basis for designing further studies, if necessary. The BRI was also developed to support and implement some of the recommendations for further studies as stated in the Narragansett Bay Management Plan. The BRI focused on an environmental sampling and assessment program to describe interstate water quality, biology, and toxicity in the river system, under both low flow and stormwater conditions, and to develop a wasteload allocation model and a toxics model which could be used to predict impacts of contaminant loadings to the system.

The BRI was not originally designed to report out structural and/or regulatory management options and decisions. Instead, the BRI has become the foundation and steppingstone for a number of additional projects and reports as listed below that are leading to structural and regulatory management actions. Therefore in lieu of providing those management decisions within the report, a summary of some of the projects which are an outgrowth of the BRI, or that utilized the BRI as a steppingstone for further studies or management actions are listed below together with highlights from those projects and the management options being addressed. The projects can be grouped into structural remedial and regulatory options.

Potential Structural Remedial Options

The extensive work being conducted under the BRI umbrella was instrumental in the USACOE selecting the Blackstone River as a site for Section 22 funding to begin the process of the Army Corps involvement in the management and restoration of the river system. The objective of the Corps work is to provide a mechanism through which structural management options can be identified, further evaluated, and proceed to final design, engineering, and implementation through a multi-phase process. The USACOE project has been operating concurrently with the BRI over the last few years. Three reports have been completed with the third phase of the project being scoped. The reports are listed below.

USACOE: Sections 22-Planning Assistance to States Program: Blackstone River Restoration Study, November 1994

USACOE: Blackstone River Watershed Reconnaissance Investigation Volumes 1 and 2, August 1997

These report the results of the USACOE's investigation of the ecology and environment of the watershed in order to further assess the problems, and to propose actions with implementation costs. Selected management actions that are being comprehensively studied by the USACPE are listed below:

The BRI showed that solids and sediments, with their associated nutrients and metals, were moving downstream. Additionally, the BRI identified a system that responds rapidly to

rainfall; the rising and falling of water levels over a short period of time, result in the subsequent movement of contaminants. The watershed is in need of increased wetland areas to moderate flows. The USACOE is proposing: (1) studying the establishment of a sediment capture pond at Singing Dam, Sutton, MA through the dredging of 120,000 cubic yards of sediment with maintenance dredging every 5-10 years to attenuate movement and provide removal of contaminants on a regular basis; (2) studying the effect of stabilizing the eroding embankments in the severely impacted Rockdale Area, in Northbridge, MA. and restoring 15 acres of riparian habitat: (3) studying the restoration and enhancement of Fisherville Pond, Grafton, MA for waterfowl habitat, including repairs to the dam and outlet in order to reflood; revegetate selected areas; dredge 2-25 acres of potholes in wet meadows; and construct riparian buffers; (4) studying the possible creation of a wetland at the Riverdale Gravel Pit in Northbridge, MA with 50% marsh and 50% open water, and habitat restoration at Lonsdale, Lincoln, RI where 15 acres of wetland may be created.

The BRI report indicated that the headwaters were important sources of toxicity and contaminants. The USACOE is proposing investigating unculverting of Beaver Brook in Worcester, MA to provide more stream habitat and protection for this waterway.

The BRI and RCP study showed the importance of Rice City Pond, in Uxbridge, MA as a source of resuspended contaminated sediments. The USACOE proposes studying raising the dam height 5 feet to resubmerge and immobilize sediments and expand wetland habitat.

The BRI identified the toxicity of the sediments in the system. The USACOE will study the ecological and human health risks from sediments.

Additionally, the USACOE will create fish passage at the lower four dams; conduct a comprehensive inventory of ecological resources; and assess ecological and other values of dams.

Potential Regulatory Management Options

The work conducted through the BRI served as the basis for the USEPA and the MADEP Blackstone River Team to begin the development of a resource assessment and management report, the beginning of a phased total maximum daily load plan.

The report produced by this team(The Blackstone River Watershed Resource Assessment and Management Report TMDL Phase 1, 1997 Massachusetts DEP and USEPA) details the management issues driven by the data collected and the analyses conducted through the BRI. Management issues fostered by the BRI and the associated state and federal regulatory actions are summarized below.

Management Issues, and Regulatory Actions:

* **Management Issues identified through the BRI:**
The BRI showed that the river exceeds federal and state criteria for certain parameters in certain stretches under both low flow and stormwater conditions. These contaminants are moving downstream and into Narragansett Bay.

State and Federal Regulatory Actions and Additional Studies:
This TMDL report was produced as a companion report to the BRI to provide additional information to be used with the BRI database for NPDES permitting, water withdrawal permitting, GIS based studies, and public outreach, and to identify various significant sites throughout the watershed to be used as case studies related to water quality improvements.

A monthly fixed station strategic monitoring program is being developed for the MA section of the watershed to evaluate improvement and trends over time. A separate sampling program was conducted in 1998 that focused on areas not covered under the earlier work: specifically headwaters *sub-basins and tributaries in the watershed.*

* ***Management Issue identified through the BRI:***

The BRI showed that point source discharges from municipal and industrial facilities are collectively raising the levels of contaminants in the water column above water quality standards during low flows.

State and Federal Regulatory Actions and Additional Studies:
A cooperative effort is being undertaken by the USEPA, the MADEP and the RIDEM to utilize the QUAL2E wasteload allocation model developed and calibrated in the BRI to develop permit limits for mainstem facilities. A separate report will be produced detailing the effluent limits, the expected water quality improvements, and the river miles that will meet water quality standards at various levels of discharge.

The agencies have worked with the City of Worcester to bring on-line a water supply filtration plant in June 1997. Preliminary results indicate a substantial reduction in the levels of metals going to the UBWPAD and the river since the filtration plant went into operation.

Dechlorination and/or the substitution of UV for chlorination have been added to a number of facilities since the beginning of the BRI to reduce the impacts of chlorine on the river system.

* **Management Issue identified through the BRI:**
The BRI showed that stormwater from the City of Worcester and the CSO facility are impacting the headwaters of the river raising pollutant levels above water quality standards and creating significant toxicity conditions during storm events in the upper reaches. The BRI showed that during storms, runoff from the City, including the CSO produce high levels of bacteria and solids. Also, stormwater impacts from small or individual sites are producing a

large cumulative impact on the river system.

State and Federal Regulatory Actions and Additional Studies:
As a result of the BRI, the agencies are working to reduce stormwater loadings for the City of Worcester and the headwaters area in order to bring the river reaches into compliance with water quality standards, reduce toxicity impacts in the upper reaches, and reduce nutrient and toxic loadings to Rhode Island and the Bay.

The City of Worcester has been issued an NPDES stormwater permit by the USEPA and MADEP that requires identification, mapping, and monitoring of stormwater discharge pipes, and development and implementation of a plan to improve the system and reduce stormwater impacts.

MADEP developed a sampling plan for 1998 that focused on the sub-watersheds of the headwaters to obtain additional information on water quality, toxicity, and biota..

The BRI report will also provide the information necessary for permit modification at the CSO facility.

The USEPA and MADEP hired a stormwater specialist to identify industrial and construction site hot spots in the watershed and to bring these into compliance with federal and state stormwater policy requirements..

* **Management Issue identified through the BRI:**
The BRI showed that flow variations in the river result in the erosion of contaminated streambank materials and resuspension of toxic river sediments into the water column and movement of these contaminated materials and downstream towards Narragansett Bay.

State and Federal Regulatory Actions and Additional Studies:
The RIDEM, MADEP and USEPA have supported the formation of a Blackstone River Flow Task Force to investigate and remediate flow issues in the river system. One aspect of the task force is to moderate artificial flow variations caused by variable operation of hydropower facilities by reviewing the adequacy of FERC permit restrictions and compliance of facilities.

* **Management Issues identified through the BRI:**
Rice City Pond has been identified as a significant contributor to riverine impacts through resuspension of contaminated sediments during both dry weather and storm conditions.

State and Federal Regulatory Actions and Additional Studies:
The USEPA and MADEP funded and conducted a preliminary study on the impoundment. The results detailed in the Rice City Pond Report are included as part of the BRI. The report indicated that a biostabilization project be funded, as well as a project to moderate the height of the spillway to change the flow through the impoundment. The later project will reduce

the resuspension of contaminated sediments by moderating water flow through the impoundment.

A grant proposal was developed and funded to demonstrate bioengineering techniques to stabilize sediments in Rice City Pond, and to reduce flow through redesign of the spillway.

Management Issues identified through the BRI:
The BRI showed that contaminants in the water, sediments and food chain are impacting the fish communities and may produce a human health risk.

State and Federal Regulatory Actions and Additional Studies:
Areas impacted were posted for limited or no "edibility" of fish. Three additional ponds were sampled by the MADEP for fish tissue during the summer of 1998.

3.4 Integrating Biology and Ecology into the BRI

SAB Comment: “the level of biological information incorporated in the analyses of both dry and wet season conditions be increased”.

BRI Response: The BRI intends to do this by merging both the macroinvertebrate and the fish contaminants studies into the main body of the report. Additional data analysis will be done to more effectively use the macroinvertebrate data as an indicator of water quality and to further our understanding of the ecological condition of the watershed. Specifically the SAB recommended that a) graphs of general diversity metrics be made as a function of several water quality variables and b) ratios of functional groups be plotted vs. various environmental parameters to indicate ecosystem attributes. These approaches as well as others will be evaluated by the BRI as part of the additional biological analysis. The committee also recommended using existing data with plots of chlorophyll to establish whether or not the primary source of chlorophyll was of benthic origin. We have evaluated the feasibility of doing this and have determined that the existing data base at present is not sufficient to support this effort. This will be considered as part of future work.

The SAB also recommended the use of fisheries information in the “analyses of dry and wet season conditions”. The present fish study was designed with the following objectives: 1) collect and analyze fish tissue samples from the Blackstone River Watershed to provide data for human health risk assessment and to further define the fate and transport of contaminants in the aquatic ecosystem and; 2) provide fish toxics data for comparisons with the existing statewide database. It is felt that these objectives were accomplished as set forth. Due to the goals of this study, sampling was geared to the collection of targeted species for tissue analysis and not to a fish population study. As a result the existing data is insufficient to provide the information necessary to integrate measures of fish community health into the present report.

We are in agreement that an increased emphasis on fisheries information will be important and extremely beneficial to the understanding of the ecology of the watershed. We also agree that “fish sampling provides important ecological information that integrates across trophic levels”. Due to funding constraints associated with the BRI it was not possible to integrate ecology into the BRI to the level recommended. However, watershed biology and ecology will receive more focus if funding is provided for Phase II efforts in outgoing years.

3.5 Public Education About the Blackstone River

SAB Comment: "...the findings of the BRI should be disseminated in the region to increase public understanding of the environmental condition of the Blackstone River."

BRI Response: From the onset transfer of information from the project to public and private groups was one of the goals of the BRI. In order to promote timely release of information, interim reports were produced, and public information meetings were held at various milestones. Information meetings and data release were intended to keep the public aware of the course of the project and to provide interested agencies and stakeholders with as much of the data as possible as the data became finalized in order that further studies or projects could be facilitated. At the SAB review of the Blackstone River Initiative in March 1998 a list of publications and proceedings were provided to the SAB committee members for their information. The BRI team has also received many requests both from within the watershed and from other states for copies of the reports and data. Attached is a partial listing of the public outreach meetings and reports.

Additionally, the Massachusetts Executive Office of Environmental Affairs (EOEA) established in 1994, during the course of the BRI, a Blackstone River Watershed Team whose objectives include the transfer of information and the coordination of further studies and management projects. The EOEA watershed team draws together representatives from the MADEP, RIDEM, USACOE, USFW, USDA, MADEM as well as citizen watershed groups with the goals of providing information on projects in the watershed and coordinating efforts for further work and restoration.

One of the task forces on the EOEA team is investigating the development of a Web Site through which the team activities and the BRI data and reports would be made accessible to the public. An additional objective of the team is to move forward with the information obtained through the BRI to coordinate and promote management and restoration strategies in the watershed. This team meets regularly and also conducts public meetings in various locations in the watershed to provide information on water quality obtained through the BRI.

The BRI teams feels that the transfer of information and the use of the data and results in this project as a basis for future work and management decisions will in part be carried forward through the groups such as the EOEA Blackstone Basin team.

<u>Selected EOEA Blackstone Team Workshops are listed below:</u>
May 5, 1994: Blackstone Basin Workshop

May 23, 1996: Blackstone Valley NPDES Workshop: A Preview of the Watershed Management Approach
October 23, 1997: Public Forum on the Blackstone River Watershed: Headwater and Upper Blackstone River
October 30, 1997: Public Forum on the Blackstone River Watershed: Middle Blackstone and Tributaries
November 13, 1997: Public Forum on the Blackstone River Watershed: Lower Blackstone and Tributaries
January 26 and February 4, 1999: Wasteload Allocation Model

4. FIELD STUDY DESIGN AND SAMPLING ISSUES

4.1 Spatial and Temporal Variability

SAB comment: "More importantly, the measurement program likely did not capture significant changes along the axis associated with the impoundments, where reductions in flow velocity and increases in water residence time should be reflected in higher concentrations of chlorophyll, lower dissolved oxygen, and greater sedimentation rates. Impoundments may also be more susceptible to resuspension events."

BRI response: As was stated in Section 1. above, the BRI study was not designed to provide a sampling program along the axis of an impoundment. The goal of the study was to provide as much spatial detail over a 48 mile river as time and resources would allow. This included 21 river stations for dry weather and 19 for wet weather. Impoundments were handled by sampling at the nearest access location above the pool area and typically at or just below the dam. Clearly the dry and wet weather data showed higher concentrations of chlorophyll and greater sedimentation rates in the impoundments due to lower velocities and longer residence times. This has been discussed at length in Chapters 5, 6 and 7 of the BRI report..

Impoundments are clearly susceptible to resuspension events. This was discussed in several chapters of the report. It may be best represented by the section describing the calibration of the metal's model (Chapter 6) and the development of the net sediment transport relationships. Those relationships were developed from water column solids data that showed reaches gained solids (net resuspension) at high velocities and lost solids (net settling) at low velocities.

SAB comment: "The additional sampling is important not only in terms of documenting patterns in water quality and sediment contaminants, but also in terms of model validation (e.g., the model generates impoundment effects that cannot be verified by the data because samples were not collected from the impoundments.)"

BRI response: This statement is not entirely true. The authors agree that dissolved oxygen should have been monitored in all impoundments. Safe access was an issue at several locations. The lack of dissolved oxygen data above some of the dams was pointed out by the BRI authors as a

weakness in both Chapters 4 and 5. In Chapter 5 it was recommended that further dissolved oxygen sampling be done to correct this weakness and provide further verification. The problem was identified just after the 1991 dry weather surveys.

However, unlike dissolved oxygen, other constituents including but not limited to dissolved ammonia, nitrate and orthophosphate are not significantly affected by the freefall over the dam. Therefore, the mistake made with regards to the sampling location was not as critical with these constituents. To suggest that none of the impoundment effects can be observed or verified by the data is not true. The model clearly does an excellent job both in calibration and in validation with regards to these and other constituents.

Subsequently additional data at two key impoundments were taken in August 1998 by EPA and MADEP as recommended by the SAB. The data included dissolved oxygen and temperature in the impoundments behind Singing Dam in Massachusetts and Central Falls Dam in Rhode Island. The data was used as a verification check of the model predictions. The only adjustments made to the original calibration data set were adjustments for temperature and flow to reflect conditions on that date. No adjustments to the calibration set were made for point source loadings or solar radiation. The dissolved oxygen comparison was: Singing Dam at 0525 measured equaled 6.24 mg/L and model predictions equaled 6.29 mg/L; Central Falls Dam at 0720 measured equaled 5.41 mg/L and model predictions equaled 5.77 mg/L. These additional data greatly increase our confidence in the model for these critical locations behind the dams.

SAB Comment: "The dynamic interaction of nutrients, trace metals, and dissolved oxygen must be understood to allow proper management of the system. For example, removal of dams could have major impacts on the water quality. An appropriate analysis of the effects of such a modification is necessary prior to such an undertaking."

BRI Response: If dam removal is an option, then the BRI agrees a detailed study is required. As an example of the authors concern for impoundments, the recommendation at the end of Chapter 5 clearly states the need for further study in the dams. It is restated below:

Dams and their current and future role in the Blackstone watershed are a complicated issue. Dams are having a negative impact on the river oxygen profile, as related to the discussion above on productivity and sediment oxygen demand. A ranking of the dams, based on their importance to dissolved oxygen, may be made. Those considered to be significant may require a comprehensive study similar to Rice City Pond (Chapter 8).

SAB Comment: "No data were collected during winter when biological activity is at its annual minimum and relationships between loads from the drainage basin and exports to Narragansett Bay should be least complex."

BRI Response: The BRI authors agree that information in the winter would be very valuable and should be done if resources allow. However, the authors do not agree to the reference that no

data were collected during minimum biological activity. In Chapter 5 a comparison between the summer conditions described by July and August surveys and the late fall conditions in October 1991 was made. Clearly the biological activity had decreased as the season changed, river temperatures dropped and stream flows increased. This reduction in biological activity provided the less complex condition which helped lead to the successful calibration and validation of the dissolved oxygen model.

SAB Comment: "In addition, it is not clear that samples were collected with sufficient temporal resolution to resolve the effects of rainfall on loads from the drainage basin from the effects of increased turbulent flow on resuspension of in situ sediments."

BRI Response: The BRI authors agree that the separation of the wet load contribution into the new (runoff) and old (resuspension) pollutant loadings in any given reach is difficult to accomplish. We do not understand how further temporal resolution will resolve this. The BRI wet weather sampling strategy was intended to determine the wet load contribution. A procedure to separate new and old loadings was given in Chapter 7 of the BRI.

SAB Comment: "To these ends, the selective use of in situ technologies is recommended that employ high frequency measurements and, ideally, real time telemetry. Key variables such as flow, temperature, dissolved oxygen, chlorophyll, and nutrient concentrations should be measured at selected locations."

BRI Comment: We agree that long term measurements have great value and we would implement it immediately if resources became available. We were not aware however, that field technology had reached the level to provide long term measurements for chlorophyll and nutrients at the river concentrations we observed in the Blackstone River.

4.2 Additional Important Parameters

SAB Comment: "The addition of several important parameters to the field program and sample analyses is recommended for future BRI efforts in order to improve the dry and wet season condition assessments and the model results: a) light attenuation; b) dissolved organic matter; c) acid volatile sulfide; d) total phosphorus; and e) long-term BOD."

BRI Response: We agree that these parameters have value and would improve the data base and modeling if resources became available to collect and analyze new samples.

5. ASSESSING TOXICITY

5.1 Aquatic Life Criteria Violations

SAB Comment: "... it is important to remember that water quality criteria are intended to be protective and not predictive."

BRI Response: We agree with the observation that Water Quality Criteria are meant to be protective and not predictive. The objective of the BRI was to provide some additional information as a basis to assess water quality criteria violations for metals relative to real measurements of ambient water column toxicity. As stated by the SAB we also recognize that factors other than hardness such as suspended solids, dissolved organic matter, and pH can effect toxicity. Presently, however, there is no way of adjusting criteria for these factors in the same way that was done with the hardness calculations for metals.

Bioavailability of metals does appear to be important in both the Blackstone water column and sediments, and we agree that a lack of toxicity in any toxicity test may or may not be an indication of ecosystem effects. For this reason not only were direct measurements of sediment toxicity measured on three occasions, but the chemistry of these same sediments were screened and compared against sediment quality guidelines(Long and Morgan, 1991, Persaud, et al, 1992) to assess potential for biological effects. We also agree that the role of binding ligands such as sulfides, mineral oxides, and TOC in sediment toxicity needs to be explored in future work.

For a future phase of the BRI , we agree with the SAB recommendation that more indepth measures of the health of the Blackstone River watershed macroinvertebrate and fish communities need to be assessed in conjunction with various stressors such as chlorine, ammonia and heavy metals. In the present study the macroinvertebrate community assessment was conducted as a follow up to an earlier study conducted by the MADEP as well as to determine the current status of the macroinvertebrate communities. By using the same basic approach and station locations, it was possible to determine the condition of the benthic communities as well as assess improvements over time by comparison with the earlier Massachusetts study. Also it should be noted that the present biological study was conducted during the first summer of the BRI prior to the availability of most of the water quality data.

The recommendation that in the future TIE analysis be performed on storm water and sediments when toxicity is observed is acknowledged. We are in agreement that for sediments, in particular, the role of ammonia in toxicity is important to know, and would be amenable to the toxicity identification protocols. However, for stormwater it may be more difficult to determine the causes of toxicity beyond using a general approach to determine categories of toxicants like oxidants, metals, ammonia, or organics, etc., which could contribute to toxicity for single stormwater samples. For a definitive TIE to be successful, multiple samples which are relatively consistent in chemical makeup are needed over time to successfully trace the probable cause(s) contributing to toxicity. We feel it would be a challenge to do a definitive stormwater TIE because each storm is different and the toxic agents in stormwater may be very different from storm to storm.

5.2 Toxicity Testing

SAB Comment: “the committee felt that this component of the study had produced some important findings that should be given greater emphasis in the final report.”

BRI Response: Subsequent to the March 1998 SAB review and evaluation of the Blackstone River Initiative many of the comments pertinent to this section of the report are being addressed In particular edits of units, typographical errors, and clarification of control or reference sediment locations will be included. Also in accordance with the recommendations we will continue to reassess the report and determine areas that can be strengthened and additional information which can be provided for clarification of the results.

With respect to the test data for Ceriodaphnia survival and reproduction(Table 4.11,page 4-79), all of bench sheets were rechecked and all of the statistics were recalculated. The SAB specifically expressed concern about how reproduction results for Round III -Station 9, are significant whereas those for Station 14 were not. Our check of the data indicated that the mean number of young produced for Station 14 showed a typographical error. This should properly read 15. 3 young per female. This slightly higher result for Station 14 also is not significant. In the presentation of the data it appears that two factors are influencing the test of significance to a great extent. Both the use of 21 separate stations used for comparison and the associated high variability in mean young produced as indicated by the coefficients of variation(CVs) seem to have a pronounced impact on statistical sensitivity. Thus, the inability to distinguish large apparent differences as referenced above by the committee. Also, as recommended, control data will be provided in a revision of Table 4.11.

The SAB review committee also expressed concern with the approach of dechlorinating ambient water which has measurable TRC. The literature and several independent studies conducted within New England/Region I have demonstrated the severe toxicity of total residual chlorine not only at end of pipe but instream as well. To protect aquatic life the Region and New England States have adopted criteria based limits for NPDES permitting of total residual chlorine. In conjunction with this the Region provided whole effluent toxicity(WET) guidance. This guidance specifies dechlorination of chlorinated wastewaters to avoid interferences due to the toxic effects of chlorine which could confound interpretation and control of unexpressed toxicity in regulated wastewater discharges. For consistency the BRI used this procedure to determine the presence of toxicity in ambient waters and stormwater absent the “masking effects” of toxic chlorine.

Note that since the start of the Blackstone River Initiative and as a result of the macroinvertebrate community analysis and ambient toxicity studies, the largest discharger in the basin, Upper Blackstone(UBWPAD), initiated dechlorination of their wastewater. This was one of the first positive improvements in water quality that was prompted by the Initiative.

6. MODELING ISSUES

6.1 Dissolved Oxygen Modeling

SAB Comment: “The Committee noted several deficiencies of the BRI study in the use of models to predict water quality parameters.”

“... as well as additional calibration of the QUAL2E model.”

"Modifying several model kinetic coefficients and constants (e.g., algal settling velocity, non-algal light extinction coefficient, and nutrient half saturation constants) will improve the match between the model results and the field data and this should be done prior to finalizing the current BRI report."

"The Committee recommends instead that a formal measure of goodness-of-fit, such as root mean square (RMS) of the difference between observed and measured DO, be calculated and presented in the BRI report."

"This figure (Fig. 5-35) should be revised and re-done for the final report."

"Since the modeled river reaches are independent of each other except for the boundary condition, one could think of matches of measured and modeled DO by reach to be another way of validating the model."

BRI Response: Additional model calibration and validation as indicated in the SAB review will be completed and included in the final report. RMS will be reported for each calibration and validation model run. Fig. 5-35 will be redone. Additional validation will be done by modeling on a reach by reach basis as described in the SAB review.

6.2 TSS and Metals Modeling

SAB Comment: "The modeling framework TOXIWASP (a module of WASP), used to simulate suspended solids and metals represents a straightforward approach. Model results mimic the spatial trends of concentrations under dry weather conditions. However, additional model calibration in conjunction with model sensitivity runs of partition coefficients of metals and settling velocity of suspended solids is recommended as these two parameters are the most important tuning knobs in the model."

BRI Response: As pointed out in Section 1 of our response Pawtoxic is based on QUAL2E and not TOXIWASP, nonetheless, the BRI authors agree that additional model calibration in conjunction with model sensitivity runs of partition coefficients of metals and settling velocity of suspended solids is valuable and should be done if resources became available.

SAB Comment: "As previously discussed, the model and data collection do not reflect conditions during very high flows or winter flows, and therefore cannot be used to estimate accurately the metals load to Narragansett Bay."

BRI Response: The BRI authors agree that the highest flows used for model calibration and validation were just above the annual average in the river. Additional surveys at other times of year at higher flows would be appropriate and could be used in support of the model calibration and validation. These surveys could be done if resources became available.

SAB Comment: "The data collected were adequate to support the simple model used, with the exception that both dissolved and total metal concentrations might have been measured during storm events."

BRI Response: Collection of dissolved metals along with total metals during wet weather would be of value. If additional resources become available to conduct wet weather sampling, the BRI authors agree that dissolved metals should also be determined.

SAB Comment: "System-specific partition coefficients (using Blackstone River wet weather Kp's for the higher TSS range) or newer inter ecosystem estimates of Kp might improve the existing model."

BRI Response: The BRI authors agree that system-specific partition coefficients would improve the modeling and does have value. However, if the empirical relationships between TSS and Kp are not used, prediction of the partition coefficients cannot be made. If additional resources become available, the BRI authors agree that system-specific partition coefficients will be calculated and used to improve model calibration and validation.

SAB Comment: "Thus, as highlighted by the findings of wet weather toxicity, an important focus of recommended future studies would be more information and data, plus a more complex, non-steady state model, to describe adequately the fate and transport of metals in the river."

BRI Response: The BRI authors agree that a more complex model is appropriate to describe fate and transport of metals on the Blackstone River. However, data collection and cost will be high. It is important to recognize that if significant resources are not available, criticism, similar to that given by the SAB regarding the current models' calibration and validation, the amount and type (spatial and temporal) of water quality data collected and model variable selection and estimation, will occur.

SAB Comment: "... it will be important to understand more fully how historically contaminated sediments and industrial sites are contributing to present day water column contamination. To do this, the geochemistry of those sediments must be studied in more detail, and fuller budgets need to be constructed for important reaches."

BRI Response: We are in agreement with this suggestion. If additional resources become available, future work should include the investigation of the sediment geochemistry and metal geochemistry. The BRI will be a valuable resource in selecting these sites, since the BRI determined system "hot spots" along the river where significant sediment resuspension occurred.

SAB Comment: "... the work done to date is not sufficient to elucidate the mechanism(s) whereby metals are lost from the river, and biotic uptake remains highly speculative. A mass balance for each metal of concern would need to be done in detail for at least one of these reaches, including concentrations in and fluxes to each phase on the system. The Committee felt that the importance

of the slime layers as a loss mechanism should be downplayed, but agreed with the report's authors that the loss process would require further study."

BRI Response: The text will be adjusted to "downplay" the slime layers as requested by the SAB. If additional resources become available, future work should include the investigation of the reaches below the UBWPAD. This will improve metal model calibration and validation.

SAB Comment: "The data are highly suggestive that historically contaminated bed sediments are the source of metals within reaches where these sediments occur. However, it should be made clear that the results are not definitive. "

BRI Response: In response to the SAB's concern, the BRI authors offer the Rice City Pond river reach as an example of the data and its interpretation. Under dry weather conditions water quality parameters typically associated with the bottom sediments increased with an increase of flows and river velocities suggesting resuspension. Further support of this assumption was provided by the fact that pollutants not associated with the sediments did not increase (like chloride and sodium). The river reach was inspected in the field to determine if any sources other than the impoundment sediments could be causing these increases. There were none observed. The recent history of the impoundment shows a reduction of pool elevation of approximately 8-10 ft due to a modification in the dam crest. The result is an exposure of sediments and a creation of stream channels throughout the impoundments length. Aerial photographs of this sight were given in the BRI and the stream channels in the upper impoundment could be seen discharging sediments to the pool area behind the dam even under average flow conditions. This in turn provided the justification to conduct the RCP study discussed in Chapter 8. It was clearly observed in this speciality study that historic sediments were indeed mobilized and were the cause of the higher concentrations at the dam. It appears to the authors that, at least for RCP, there is definitive proof.

Similar efforts leading up to the recommendation to investigate individual impoundments has been made in the BRI. The work underway by the Army Corps of Engineers has taken the results of the BRI and selected two additional impoundments for study.

SAB Comment: "As noted above, the data collection and modeling cannot distinguish between in situ and external sources of metals to each reach. The model cannot separate, for example, contributions from terrestrial runoff from contaminated plant sites from contaminated groundwater flow from resuspension of bed sediments."

BRI Response: The BRI authors agree that the data collected above and below a given reach cannot distinguish between in situ and external sources of metals. However, with regards to the model the statement by the SAB is not accurate. The model does separate between groundwater inflow and resuspension of bed sediments in a river reach. The loading from both sources is in the control of the modeler. It is true that the model cannot handle runoff, however, the model application was at steady-state. Therefore, there was no terrestrial runoff.

Metals modeling and partitioning is a complex process and the BRI encourages future work to enhance the model but the authors also feel that the present model is valid based on the limitations noted.

7. DISTINGUISHING POINT FROM NONPOINT SOURCES

SAB Comment: "In subsequent studies, mass balances should be calculated for each reach to show sources and fates of pollutants entering and leaving each reach. For example, a nutrient budget for each reach of the QUAL2E model should be constructed to itemize the point and nonpoint source loads during the dry weather conditions; the total loading rate for ammonium entering any given segment in the model should be balanced by the sum of the loading rate leaving the segment and the gain/loss of ammonium within that segment under the steady-state condition."

BRI Response: The BRI authors agree that a mass balance can be done by model reach and a gain/loss term determined for each model reach as indicated by the SAB. If additional resources become available, future work should include this model application. However, since the model is being used to generate boundary loads and reach loads, the weakness with this approach is that the estimation of these terms and the subsequent identification of system "hot spots" is subject to interpretation and acceptance that the model is accurately calibrated and verified.

As a point of clarification the BRI used the measured data at each station not the forecasted load from the model to calculate gains/losses in a river reach defined by an upstream and downstream water quality station. The upstream station's load was subtracted from (1) the downstream station, (2) any monitored tributary entering the reach and (3) any monitored point source entering the reach. The resulting load was either a net gain or loss in the reach. These values went into the generation of the ranking tables first presented in Chapter 4. This was also accomplished for wet weather data (Chapter 7). This data analysis identified the system "hot spots" based on the reaches between water quality stations, not the reaches defined in the model.

SAB Comment: "... the report should clearly state that they (UBWPAD and Woonsocket) are not the only point sources. There are numerous small municipal and industrial discharges that were grouped inappropriately into the "nonpoint sources' category. This is an uncoventional and misleading use of the term, and should be changed in the report to "other sources." Nonpoint sources conventionally include those sources whose contribution cannot be traced back to an outfall pipe."

BRI Response: It was never the intention of the BRI to be uncoventional or misleading. The practical problem was that resources were not sufficient to allow monitoring of all point sources. We agree that the term is misleading and will either change the use of the term "nonpoint" to "other sources" where appropriate or we will try to take into account all point source inputs based on the facilities' records for the period of the study.

The BRI authors do believe that they were very clear in the report that the UBWPAD and

Woonsocket WWTF were not the only point sources of pollution along the Blackstone River. This was mentioned in each chapter where it was appropriate. For example, Chapter 4, the first chapter to evaluate any water quality data, has a statement at the end of the first paragraph stating that the smaller dischargers were not evaluated in the loading calculations. *It should be noted that since the smaller point sources were not monitored in this study, they have not been subtracted from the estimate of instream sources.*

SAB Comment: "The analysis of "nonpoint sources" did not distinguish between pollutants derived from sediments .... and pollutants that are new nonpoint source contributions from the watershed. This distinction is important for management purposes because the techniques for reducing these two sources of pollutants are quite different."

BRI Response: The BRI authors are in agreement with the SAB with regards to the relative importance of defining the two sources. This is clearly stated in the BRI report in Section 7-5. What is not clear from the SAB's review is how they would propose the separation between old and new materials. The BRI demonstrated a procedure on the river reach between BWW07 and BWW08 which combined the dry and wet weather data as well as the models to separate the wet weather load into old and new materials. We believe that procedure is an acceptable approach but would require additional time to apply it to all reaches. The SAB did not comment on that procedure.

SAB Comment: "Further the Committee notes that a significant portion of the metal loads ascribed to resuspension of in-stream sediments in certain reaches may be derived from current point sources discharges. For example, the abrupt loss of mass loads of dissolved and total cadmium, nickel, and copper just downstream of the UBWPAD suggests a local sink, hypothesized by the authors to be sediments or attached organisms. The substantial load increases in these constituents in the reaches just downstream during storm events certainly suggests remobilization of these metals. For this reason, when determining responsibility for load reductions in a management scenario, it is important to recognize that some of the resuspended load is a delayed point-source contribution, rather than a true nonpoint-source contribution."

BRI Response: The SAB's comments appear to be directed towards the reaches just below UBWPAD. The BRI stated their case concerning luxury uptake in these reaches due to the high concentrations that are discharged from the UBWPAD in Section 6.6 of the BRI study. Data was collected and tested in the attached biomass above and below the UBWPAD. The results showed significantly higher metal levels (typically one to two orders of magnitude higher) in the biomass below the facility. We realize that the SAB does not agree with this logic, but the SAB and the BRI authors are both in agreement that further study is warranted.

We have recognized that some of the resuspended load is a delayed point-source contribution, rather than a new nonpoint-source contribution. We have stated that the increase of constituents under wet weather conditions in the reaches immediately below UBWPAD may be due to the "... resuspension or sloughing of material off the bottom that may be an end result of the process of luxury metal uptake under steady state conditions." Section 7.1.2.

It is not clear what is meant by the SAB's use of the term *true nonpoint-source contribution*. In the Blackstone River, with the major point source at the headwaters, all sediments in every reach to the mouth of the river will have metals which were originally discharged by the UBWPAD. How does one separate out the *true nonpoint-source contribution* in resuspension loads in these reaches?

SAB Comment: The recommended approach is to use GIS land-use information in conjunction with a watershed model to identify the location of nonpoint source "hot spots".

BRI Response: The BRI authors agree that more modeling could be done and agree that if resources were available it should include a GIS and hydrologic model component.

8. ANNUAL LOADING ESTIMATES

SAB Comment: "The procedure to combine dry weather with wet weather loading rates would not reflect the nonlinear nature of the wet weather loads. "

"Superimposing the weather loads based on the data from the three storms on the dry weather loads neglects the nonlinear nature of the wet weather characteristics. It is highly questionable that such a procedure will have predictive capability."

BRI Response: The SAB is in error. The predictive relationships between wet weather loads and total rainfall are non linear. Page 7-79 Table 7.30: Constituent (lbs) = a(total rainfall)^{b}.

SAB Comment: "As a first step, the river flow rates, e.g., at the USGS gaging station at Woonsocket, should be predicted and verified with the data. Yet, there is no such modeling effort in the BRI study. Further, water quality at the station must be predicted and verified with the data. It is understood that water quality data are not collected at the Woonsocket station."

BRI Response: Flow calibration and verification for the models under steady-state conditions were discussed in detail in Chapter 5. We are confident that the flow profile generation is accurate.

A post audit of the QUAL2E model was completed and referenced on Page 7-72 (Carelli et al. 1995). This modeling effort used the data from the Woonsocket USGS gage, the water quality data from the Manville and Millville USGS monthly water quality monitoring sites and the data from the BWW13 and 21. The success was noted in the report but the details were not provided. They will be provided in the final report.

A comparison of the results of an independent study by Nixon et al (1991) were given and offered as a validation of the equations for metals. It was considered to be the only test of the equations that could be offered with the available data.

SAB Comment: There is insufficient data including number of storms and magnitude of storms. "In addition, the wet weather data collected from the three storms fall far short of quantifying

loading rates during large storms."

"There is a lack of sufficient data on storm events at the higher magnitude-lower frequency portion of the spectrum of storms. ..... include storms such as major Northeasters as well as tropical storms and hurricanes."

".... extrapolating annual pollutant loads into Narragansett Bay based on typical medium-scale precipitation events such as the three storms in the BRI study is simply inadequate and may severely underestimate annual pollutant loading rates."

BRI Response: The BRI did not attempt to extrapolate annual pollutant loads into Narragansett Bay based on the three "medium-scale precipitation events" (0.55, 0.92 and 0.80 inches) of the BRI study as the SAB report indicated. Instead a total of 7 storms were used for 6 of the 8 constituents evaluated. The 4 additional storms were monitored by the URI Civil and Environmental Engineering Department in 1989 and 1990 and provided information for both larger (1.41, 1.56 and 1.94 inch storms) and smaller (0.21 inches) storms. The rainfall totals for all 7 storms were presented in Table 7.29 on page 7-78 and the wet weather predictive equations were presented in Table 7.30 on page 7-79. The largest storm, 1.94 inch, was forecasted before and defined afterwards as a northeaster by professional meteorologists in Rhode Island. We agree that data taken during a hurricane would have some value, but believe that deployment and sampling during hurricanes is a safety risk.

SAB Comment: The spatial time period covered by both the wet and dry weather surveys was inadequate. "The BRI study only examined wet and dry weather conditions in the summer."

"This means that the processes and rates of materials fluxes occurring under normal winter low flow, wet weather flow, winter storm, and snow melt conditions are not captured by the BRI-based estimates."

BRI Response: Dry and wet weather sampling was not restricted to the summer. Dry weather surveys were conducted in the summer (July and August) and the fall (October). Wet weather surveys were conducted in early and late fall (September, October and November). The additional 4 wet weather events sampled in 1989 and 1990 were done in the spring (May) and the summer (June and July). We agree that the BRI did not capture winter low flow, winter storm or snow melt conditions. It did capture or access wet weather flow in the spring, summer and fall.

SAB Comment: Failure to monitor conditions where nitrification was "turned off during the winter".

"As one example of the problem this causes consider that nitrogen inputs differ considerably in the winter, both because the human-engineered system for nitrification is turned off during the winter (thereby allowing ammonia inputs rather than nitrates) and because the natural denitrification processes are suppressed in the winter."

BRI Response: This was seen and monitored in the BRI for three separate surveys including the October dry weather and October and November wet weather surveys when the UBWPAD was not providing nitrification and algae activity in the river had essentially ended. The October dry weather survey was part of the model calibration.

A two year period was used for the development of the steady-state relationships for the end of the river. These relationships were used to estimate the dry weather contribution for the annual loading rates. The relationship includes the application of the model for winter conditions where temperatures would represent the low stream temperature and would essentially stop all biological activity in the river. As far as the UBWPAD release, the ammonia, nitrate and CBOD loading was adjusted depending on whether the month for the simulation was within the nitrification permit period for the UBWPAD.

SAB Comment: There is a need for "... discussion of existing local, long-term climatological data for the watershed."

BRI Response: The BRI authors agree and a discussion of the existing local, long-term climatological data for the watershed will be completed for the final report.

SAB Comment: Continuing monitoring is recommended at the Pawtucket Dam.

BRI Response: The BRI authors agree and if resources are available a long term monitoring program would be of value and should be considered a priority.

9. TRANSFERABILITY TO OTHER WATERSHEDS

SAB Comment: "In order to maximize the utility of the current results, the Committee recommends that the "lessons learned" during BRI program design and implementing be assembled in a single location in the document for easy reference."

BRI Response: This will be completed and included in the final report.

10. THE BRI DATA BASE AS A RESOURCE

SAB Comment: Text should be available as ASCII text and figures as *.gif files linked to an html document. All data information should be made available on the web.

BRI Response: A read me file was provided on the CD that listed the appropriate software packages that were needed: EXCEL, SIGMAPLOT, and WORDPERFECT. If resources are available, some modifications could be made to make the data more easily accessible and the data will be put on the web.

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