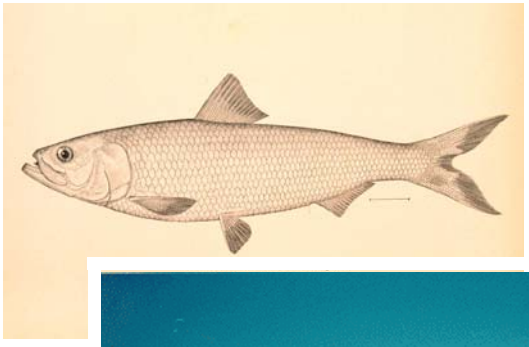
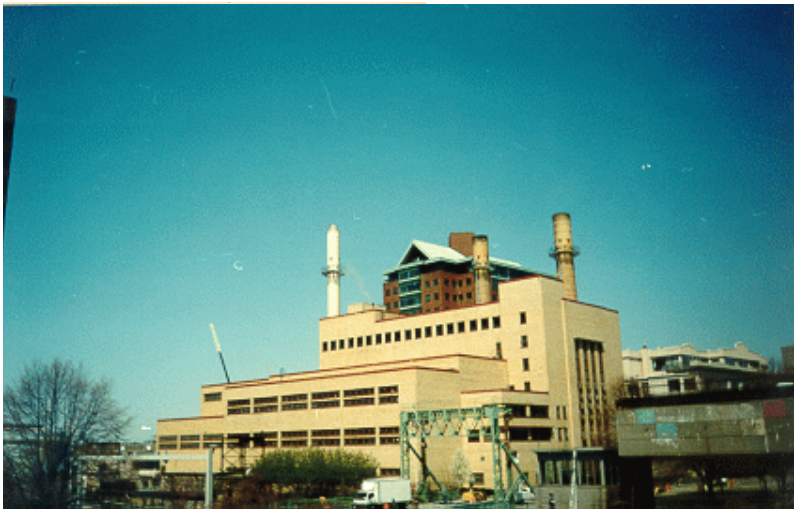
U.S. ENVIRONMENTAL PROTECTION AGENCY

MIRANT KENDALL STATION NPDES PERMIT # MA0004898

RESPONSE TO COMMENTS





EPA Region 1 New England

September 2006

United States Environmental Protection Agency New England

Responses to Comments

Public Review of Mirant Kendall Station
NPDES Permit No. MA0004898

Contents

Introduction . . . . . ***i***

A. Responses to Comments Concerning the Permit Process **A1**

B. Responses to Comments Concerning Mirant Kendall's Operations **B1**

C. Responses to Comments Concerning In-Stream Thermal Limits **C1**

D. Responses to Comments Concerning the Proposed Zone of Passage and Habitat **D1**

E. Responses to Comments Concerning the Proposed New Outfall and Diffuser **E1**

F. Responses to Comments Concerning CWA § 316(a) Variance-Based Thermal Discharge Limits **F1**

G. Responses to Comments Concerning Permanent Hydrological Modifications **G1**

H. Responses to Comments Concerning CWA § 316(b)-Based Cooling Water Intake Limits and Barrier Net Installation **H1**

I. Responses to Comments Concerning Monitoring and Reporting Requirements **I1**

J. Responses to Comments Concerning Other Permit Limits **J1**

K. Responses to Comments Concerning Projected Effects of the Permit on Mirant Kendall's Operations. **K1**

L. Responses to General Comments. **L1**

M. Responses to Comments Concerning the Future of Mirant Kendall Station **M1**

List of Attached Figures and Tables

B1-1 Mirant Kendall Station existing and future cooling water discharge parameters

B1-2 Mirant Kendall Station average daily heatload values from June through September for the years 1998 through 2005.

B1-3 Mirant Kendall Station monthly average heatload for the summer months (June through September) from 1998 through 2005.

B1-4 Number of days each summer (June through September) that the average daily heatload from Kendall Station was recorded within specific heatload ranges, 1998 through 2005.

C3-1 2004 Pushnet, Alewives vs. Distance mean number of alewives captured per pushnet event at each station (July-September, night only) vs. station distance to Kendall discharge

C3-2 2005 Pushnet, Alewives vs. Distance: number of juvenile alewives caught per pushnet event (July - Sept., nighttime only) at each station vs. station distance from the Kendall discharge

C3-3 2005 Pushnet, Alewives vs. Distance: number of juvenile alewives caught per pushnet event (July-Sept., nighttime only) at each station vs. station distance from the Kendall discharge. MIT station (at 0.8 miles) information removed

C3-4 2004 Pushnet, Bluebacks vs. Distance: median number of juvenile bluebacks collected at each pushnet station (nighttime data, August - September) vs. distance (miles) from each station to the Kendall discharge

C3-5 2005 Pushnet, Bluebacks vs. Distance: median number of juvenile bluebacks per station (July-Sept., nighttime only) vs. station distance from the Kendall discharge

C3-6 2004 Pushnet, Temperature and Distance: mean surface water temperature at each station (nighttime data, August - September) at time of pushnet sampling vs. distance from each station to the Kendall discharge

C3-7 2005 Pushnet, Temperature vs. Distance: mean surface water temperature at each pushnet station at time of sampling (July-Sept, night only) vs. station distance from the Kendall discharge

C3-8 2004 Pushnet, Alewives: number of juvenile alewives caught per pushnet sampling event at different water temperatures from July-September (nighttime only), and sampling events per temperature category

C3-9 Pushnet, Alewives: number of juvenile alewives caught per pushnet sampling event at different water temperatures from July - September (nighttime only) and sampling events per temperature category

C3-10 2003-2005 Seine, Alewives vs. Station: number of juvenile alewives caught per 1000 sq. ft. of area seined (nighttime only) at Hyatt and Lagoon stations, 1.6 and 0.6 miles upstream of the Kendall discharge, respectively, vs. year

C3-11 2003 Shoreline Seine, Alewives: number of juvenile alewives caught per 1000 sq. ft. of area sampled from July-September.

C3-12 2004 Shoreline Seine, Alewives: number of juvenile alewives caught per 1000 sq. ft. of area sampled July – September.

C3-13 2005 Shoreline Seine, Alewives: number of juvenile alewives caught per 1000 sq. ft. of area sampled from July-September.

C3-14 2004 Pushnet, Alewives vs. Temperature: mean number of juvenile alewives caught per sampling event at each station (July-September, nighttime only) vs. the mean surface water temperature at each station at time of pushnet sampling

C3-15 2005 Pushnet, Alewives vs. Temperature: mean number of juvenile alewives caught per sampling event at each station (July-Sept., nighttime only) vs. mean surface water temperature at each station at time of pushnet sampling

C3-16 2005 Alewives vs. Temperature: number of juvenile alewives caught per sampling event at each station (July-September, nighttime only) vs. mean surface water temperature at each station over sampling period; MIT data removed

C3-17 2004 Pushnet, Bluebacks vs. Temperature: median number of juvenile bluebacks caught at each station during sampling events (nighttime, August-September) vs. mean surface water temperature at each station at time of sampling

C3-18 2005 Pushnet, Bluebacks vs. Temperature: median number of juvenile bluebacks caught during sampling events (nighttime, July-Sept.) at each station vs. mean surface water temperature (F) at each station at time of pushnet sampling

E19-2 Relative Percent Differences in Algal Counts Between the Upstream and Downstream Portions of the Lower Basin

H14-1 Number of fish impinged and collected, all species combined, at the CWIS of Kendall Station, presented by month and year from 1999 through 2005.

Response to Comments

Introduction

In accordance with the provisions of 40 C.F.R. §124.17, this document presents EPA's and the Massachusetts Department of Environmental Protection's (MassDEP) responses to comments received on the Draft NPDES Permit (MA0004898) for the Mirant Corporation's Kendall Station Power Plant (also referred to in this document as Mirant Kendall, Mirant, Mirant Kendall Station, MKS, the applicant, and the permittee). The responses to comments explain and support the EPA and MassDEP determinations that form the basis of the Final Permit. The Mirant Kendall Station (MKS) Draft Permit public comment period began June 14, 2004 and ended on October 15, 2004. This time period included two extensions of the comment period. Comments from the permittee and several other parties regarding the Draft Permit and Fact Sheet were received. Since the Fact Sheet and the Determination Document (DD) are final documents, no changes were made to these documents. Instead, Fact Sheet and DD comments were noted, and responses to them are included in this document.

Extensive comments were received by Mirant during the pubic comment period. Additional comments were received from the following parties. A cross reference for each party's specific comment and location is provided at the end of this introduction.

Massachusetts Division of Marine Fisheries
Massachusetts Division of Fish and Wildlife
Massachusetts Riverways Program
Conservation Law Foundation
City of Cambridge
Association of Cambridge Neighborhoods
Union Boat Club
Mark Jaquith
Dr. Stephen Kaiser
Jay Avin
National Marine Fisheries Service
Massachusetts Coastal Zone Management:
Charles River Watershed Association
Charles River Conservancy
East Cambridge Planning Team
Stash Horowitz
Rae Steining
Laura Donohue
Roger Frymire
Dr. Raymond Walther

After a review of the comments received, EPA and MassDEP have made a final decision to issue this permit authorizing this discharge. The Final Permit is substantially identical to the Draft Permit that was available for public comment with the addition of the conditions in Massachusetts' 401 Water Quality Certification (WQC). Although EPA's decision-making process has benefitted from the various comments and additional information submitted, the information and arguments presented did not raise any substantial new questions concerning the permit. EPA did, however, improve certain analyses and make certain clarifications in response to comments and these changes are consistent with Massachusetts' 401 WQC. These improvements and changes are detailed in this document and reflected in the Final Permit. A summary of the changes made in the

Final Permit are listed below. The analyses underlying these changes are explained in the responses to individual comments that follow.

The Final Permit and this response to public comments are available on EPA's web site at epa.gov/region01/npdes/mirantkendall/index.html. Copies of the Final Permit also may be obtained by writing or calling EPA's Industrial Permits Branch (CIP), Office of Ecosystem Protection, 1 Congress Street, Suite 1100, Boston, MA 02114-2023; Telephone: (617) 918-1579.
In this response to comments document, EPA has structured the responses using the outline of issues included in the comments from Mirant Kendall, dated October 14, 2004. EPA digested the significant comments received from Mirant Kendall according to this outline. EPA then grouped together supporting and opposing comments concerning each set of issues where EPA received comments in addition to those from Mirant Kendall. (There are a few topics where comments raised only one perspective.) EPA used the convention of starting with Mirant Kendall's comments on a topic and then identifying the other parties and digesting their comments on that topic.

In many cases, EPA has included original comments nearly verbatim for the convenience of the reader. In others, EPA included a brief digest of each comment as a reminder to the reader of the topics being discussed. The particular language used in the summary of each issue presented below may derive primarily from one set of comments, but this formulation does not mean that EPA has not read each of the comments noted under that issue. Many of the details presented in the original comments were not repeated in the digested comments. EPA did not limit its analysis of the comments submitted to the digest presented below, and EPA has reviewed each comment in its entirety. This outline and its digest of the comments are simply designed to structure EPA's responses and make them more accessible to the interested public. No significance should be attached to the form in which EPA cited or summarized the original comment in this response document.

This permit is being jointly issued by EPA and MassDEP. EPA will generally present responses to comments as EPA's, unless there are particular issues in which MassDEP plays a unique role beyond being a co-issuer of this permit. For most responses where EPA is the agency presenting the response, MassDEP's certification and joint issuance of the permit will establish that the Department agrees with EPA's response. This document may refer to Mirant Kendall, LLC variously as Mirant Kendall, Mirant, Mirant Kendall Station, MKS, the applicant, or the permittee.

The following changes have been made from the Draft Permit to the Final Permit. Where applicable, one or more sections of the response document where the following changes have been discussed have been included in parentheses.

1. In Part I.A.1., footnote 4, the acronym HRS has been corrected to HRSG. (J16)

2. A sentence has been added to footnote 5 in Part I.A.1 to note that the TRC limit of 0.1 mg/l does not apply to the TRC requirement at Outfall 009 in Part I.A.3. (J5)

3. In Part I.A.1, footnote 10 (previously footnote 11) has been revised to reflect a correction in the units of "Q". The units have been corrected to read "BTU/hour". (J14)

4. Marine whole effluent toxicity (WET) testing protocol has been included in the Final Permit as Attachment C2. Language has been added to footnote 11 in Part I.A.1 to require the measurement of salinity to determine whether WET testing will be conducted on freshwater or marine organisms. The freshwater WET testing protocol is now labeled Attachment C1. (I22)

5. In Part I.A.1, all references to "once through condenser cooling water", have been changed to "once through cooling water", because not all permitted cooling water discharges pass through the condenser. (J9)

6. In Parts I.A.1 and I.A.14.a.6.(a), the requirement to validate data for transmissivity has been removed. (I15)

7. The temperature monitoring for backwash water through Outfalls 005, 006 and 007 has been removed from Part I.A.2. (J11)

8. The words "or any barrier net" have been removed from Part I.A.2.e. Also in this Part, the words "fish, shellfish and other aquatic organisms" have been changed to "adult and juvenile fish". (H1)

9. The description of the types of discharges authorized from Outfall 009 at Part I.A.3 has been revised. (J3)

10. In Part I.A.3, footnote 1 has been corrected to read "See footnote 5 on Page 4". (J5)

11. There have been language changes in Part I.A.11 of the Final Permit to offer more flexibility to the permittee regarding where the barrier nets system (BNS) may be deployed, such as allowing the BNS to be placed outside of the Broad Canal. Also, language regarding specific maintenance activities associated with the BNS has been removed. (H33)

12. The Draft Permit's numeric entrainment performance goal of a minimum of 60% entrainment reduction as compared to the baseline condition and the requirement that the net shall be designed to meet this goal have been removed from Part I.A.11. Instead, in Parts I.A.11.b.(1) and (2) of the Final Permit, the permittee is required to minimize impacts associated with entrainment consistent with specific requirements in Part 11.b(1) and (2)

from the State's WQC. (H1, H24, H27,H28)

13. Part I.A.11.a.(4) has been clarified to indicate that the 0.5 feet per second (fps) through screen intake velocity requirement only applies when the BNS is in place. (H1)

14. Instead of requiring the BNS to be designed to allow for the maximum of survival of impinged eggs and larvae that are freed from the BNS, the revised language in Part I.A.11.a requires that if practicable, the nets shall be designed and operated to allow for impinged eggs and larvae to be freed in a manner that would increase the probability of their survival. (H23)

15. Language has been added to Part I.A.11.a. to make clear that any permit modifications will follow the process and satisfy the criteria of 40 C.F.R. §§ 122.62 and 122.63, whichever is applicable. (H39)

16. A language change has been made regarding the required deployment of the barrier nets in Part I.A.11.a. The permittee must design and install a barrier net system (BNS) consistent with the impingement and entrainment related conditions in the final permit. The BNS must be deployed year round, except when icing conditions in the river reasonably preclude their deployment. (H1, H32)

17. The language in Part I.A.11 of the Draft Permit that allowed the permittee to bypass the BNS for up to 10% of the time has been replaced by language in Part I.A.11.a.(6) of the Final Permit that requires the permittee to operate the BNS to preclude bypasses due to circumstances within the permittee's control, to the extent practicable (H34)

18. Regarding impingement mortality reduction, there has been a clarification that this standard shall apply to adult and juvenile fish only. See Part I.A.11.b of the Final Permit. (H1)

19. In Part I.A.11.b., the time frame for the permittee to implement the BNS has been modified to reflect a longer schedule and the State WQC requirements. (H32)

20. In Part I.A.12 of the final permit, the phrase "the area of the Charles River impacted by the thermal plume resulting from the discharge from the Facility" has been changed to "the Zone of Dilution". Also in Part I.A.12 a reference and description of the ZD has been added. (I8)

21. In Part I.A.12.a.2, the necropsy requirement has been removed. (I6)

22. In Part I.A.12.a.2, DMR has been changed to MassDEP, as originally intended. (J16)

23. At the end of Part I.A.13, the incorrect reference to Part 14.e.9 has been changed to the

correct reference to Part I.A.14.d.9. (J16)

24. Part I.A.13 now allows the permittee to use a statistical approach to define what constitutes an unusual impingement event (UIE). (I21)

25. Part I.A.14.a.5 has been modified to clarify requirements for analyzing, summarizing and/or describing monitoring data in the Annual Monitoring Report. (I14)

26. The former Part I.A.14.a.6.(b) of the Draft Permit has been removed. This had a provision for the permittee to address EPA and MassDEP comments in a QAPP or QA/QC plans. Reference to a QA/QC plan has also been removed or replaced with a reference to a QAPP (I15)

27. The Draft Permit's requirement for continuous dissolved oxygen (DO) monitoring has been replaced with the requirement for weekly grab sampling of DO to be used for compliance purposes for the next week. See Part I.A.14.b of the Final Permit. (I16)

28. In Part I.A.14.b.2., the language regarding the placement of Monitoring Station 9 has been changed to allow flexibility. (I18)

29. The requirement to monitoring sunlight penetration at Part I.A.14.b.10 has been removed. (I19)

30. The chlorophyll *a* monitoring requirement formerly in Part I.A.14.c. of the Draft Permit and referred to in footnote 10 in Part I.A.1 has been removed from the Final Permit. (I7)

31. Metals monitoring has been removed from Part I.A.14.c. (I2)

32. In Part I.A.14.c.3., footnote 5 instead of footnote 4 has been referred to.

33. Language has been added to Part I.A.14.d. to allow for the possibility that some of the studies which require the taking of fish may not be allowed to be consistent with the river herring moratorium announced by MA DMF in 2006 or other applicable restrictions. In such cases, the permittee shall implement alternative methods, if available, to obtain comparable information. (I28)

34. Push-net sampling has been added to the beach seine sampling requirement in Part I.A.14.d.1. (C3 and I3)

35. In Part I.A.14.d.7, the requirement for 13 sets of samples for the fine mesh barrier study has been changed to allow for fewer than 13 sets. In addition, specific sampling protocol has been removed. (H36)

36. In Part I.A.14.d.7. of the permit, the language has been changed to clarify that the permittee

shall calculate or measure the representative through screen velocity at the barrier nets when the BNS is in place and at the traveling screens when the BNS is not in place. (H1)

37. There has been a surveillance requirement added for Outfall 001 to address concerns about fish congregating in the area of this discharge. See Part I.A.14.d.8. (C7)

38. In Part I.A.14.d.10, the phytoplankton monitoring period has been extended to October 31st from September 30th. (I7)

39. The entrainment sampling formerly at Part I.A.14.d.8 in the Draft Permit has been removed. However, an alternative entrainment sampling program must be submitted by the permittee consistent with the requirement of the WQC, as found in Part I.A.14.d.11 of the Final Permit. (H37)

40. In Part I.A.16 of the final permit, EPA has established a schedule for the permittee to complete the evaluation and application process described in 40 C.F.R. §125.95 of the new Phase II rule. (H1)

41. Permit Attachment A has been revised to reflect a maximum 81 ^{0}F compliance at certain points in the ZPH. (C44)

In addition, formatting changes have been made in places throughout the Final Permit for consistency, as well as the requirement to consider or refer to more recent monitoring efforts. Examples include the use of MassDEP instead of MADEP or DEP; the use of Part rather than Section when referencing locations in the Final Permit; the use of BNS rather than barrier nets (in most cases); and the inclusion of 2004 and 2005 when listing previous years of monitoring data.

Cross Reference for Individual Commenter's Comment and Response Location:

National Marine Fisheries Service (NOAA): C33, H27, H31
Massachusetts Coastal Zone Management (MA CZM): B9(3), C37, C44, C45, E3, H: 26, 27,28, 31, 35, I29
Massachusetts Division of Marine Fisheries (**MA DMF**): C33, C51, D33, H24, H28, I13, I28, I30, J17
Massachusetts Division of Fish and Wildlife (MA DFW): D10, I24
Massachusetts Riverways Program: C29, C38, E1, H27, I1, J4, J5
City of Cambridge: E1, H31
Charles River Watershed Association(CRWA): C3,C16, C19, C47, D25, D32, E1, H17, H31, I5, J24
Conservation Law Foundation (CLF): B9(2), B9(3),C: 2, 3, 7, 13, 15, 16, 18, 19, 25, 26, 29, 35, 37, 42, 44, 45, 49, 52, D17, D18, E1, F3, F4, F6, H: 3, 10, 24, 31, 34, 40, I5, I6, I10, I13
Charles River Conservancy (CRC): D4, E21, H24
Association of Cambridge Neighborhoods (ACN): F6, J18

East Cambridge Planning Team (ECPT): F6, M1
Union Boat Club: D2
Mark Jaquith: B3, C3, D10, E24
Dr. Stephen Kaiser: B10, B11, E15, E19, M1
Jay Avin: J21, J22
Laura Donohue: D2, E1
Stash Horowitz: J19, J20
Rae Steining: B9(1), M1
Roger Frymire: C11, E3, E17, H26, H31
Dr. Raymond Walther: J23

A. Response to Comments Concerning the Permit Process

Comments A1 & A2: In these comments, Mirant Kendall sets forth its comment numbering system, its expectation that EPA fully review and respond to these comments, and the abbreviations and terminology it uses in its comments.

Response to A1 & A2: EPA appreciates the effort Mirant Kendall has put into organizing its voluminous comments, and has adopted Mirant Kendall's numbering system to organize EPA's responses. EPA has also used abbreviations and terminology consistent with Mirant Kendall's where appropriate.

Comment A3: Mirant Kendall notes that its comments and pre-draft permit submissions do not bind Mirant Kendall, and disavows any earlier statements indicating that Mirant Kendall agreed with EPA on any of the requirements of the draft permit. Mirant Kendall reserves the right to argue now for different requirements than it may have been prepared to accept at an earlier time, but only as part of a different overall set of permit provisions.

Response to A3: EPA acknowledges that Mirant Kendall is not bound by statements it made before the issuance of the Draft Permit. That said, there were many instances where suggestions and recommendations by Mirant Kendall (and/or its consultants) led EPA and MassDEP to evaluate or pursue options that Mirant Kendall had recommended. While Mirant Kendall is not bound to accept a proposal now simply because it advanced that proposal before, neither is EPA required to reject that proposal simply because Mirant Kendall has exercised its right to change its mind. Where Mirant Kendall's earlier proposals continue to have merit and be useful for this permit, EPA has evaluated such proposals on their objective merits.

Comment A4: Mirant Kendall states that the permitting documents are ambiguous as to whether the draft renewal Permit No. MA 0004898 and the other permitting documents were issued by EPA alone or by EPA New England and MassDEP acting jointly or severally.

Response to A4: This Final Permit and indeed the Draft Permit were authored by EPA and MassDEP jointly. MassDEP's regulations that are referenced are satisfied by this joint issuance process. As noted in the Introduction, these responses generally refer to the permitting authority as "EPA" for the sake of convenience, but these responses are issued on behalf of MassDEP as well except where specifically noted.

Comment A5: Mirant Kendall expects that DEP will certify the final renewal permit under § 401 of the Clean Water Act, 33 U.S.C. § 1341, and under 40 C.F.R. § 124.53 and 314 C.M.R. 9.09.

Response to A5: The Final Permit has received the State's Water Quality Certification. See WQC letter signed by Glenn Haas of MassDEP.

Comment A6: Mirant Kendall observes that the Massachusetts Office of Coastal Zone

Management (CZM) must certify that the final renewal Permit No. MA 0004898 is consistent with CZM's enforceable policies under the Coastal Zone Management Act.

Response to A6: CZM has made the determination that this Draft Permit is consistent with its policies. CZM has submitted its "Consistency Letter" to EPA.

Comment A7: Mirant Kendall incorporates each of its prior communications and data submissions to EPA New England or MassDEP concerning the renewal or modification of Permit No. MA 0004898 as comments on the draft renewal permit. This incorporation by reference includes all submissions by Mirant Kendall or its predecessors concerning the permit dating from the initial renewal application in 1993 to the date of these comments, whether or not such submissions have been identified as part of the Administrative Record, and whether or not they were fully considered by EPA before issuance of the draft permit.

Response to A7: EPA acknowledges Mirant Kendall's incorporation by reference, and has now fully considered all of Mirant Kendall's submissions that were submitted by the close of the public comment period.

Comment A8: Mirant Kendall notes that it submitted several timely requests to EPA under the Freedom of Information Act during the public comment period, but that EPA did not complete all of its responses by the close of the comment period. Therefore, Mirant Kendall has been unable to complete a full set of comments on the draft permit. Accordingly, Mirant Kendall reserves the right to supplement its comments and to require the Agencies to take such supplemental comments into account prior to issuing a final permit.

Response to A8: The last of four (4) FOIA requests submitted to EPA was closed out on February 16, 2005. There were several partial responses for this FOIA, during the months of September and October of 2004. Although EPA regrets the late provision of some of this information, the scope of what was requested resulted in extensive searches of documents by several individuals and collecting and copying all of the submitted data took much longer than EPA had anticipated. EPA notes that Mirant Kendall did not, in fact, exercise its option to submit supplemental comments based on the responses to its FOIA requests.

Comment A9: Mirant Kendall urges EPA to fully consider all of its submissions.

Response to A9: EPA has reviewed all the data that Mirant Kendall submitted by the close of the public comment period on the Draft Permit and additional information which has been submitted since that time. Where appropriate, EPA has made changes in the Final Permit that reflect the review of any previously unanalyzed submissions. EPA has made every effort to correct any previous errors in the Final Permit and this response. See also Response to A7.

Comment A10: Mirant Kendall objects that EPA did not share a working draft of the permit before issuing the draft permit for public comment.

Response to A10: Neither EPA nor MassDEP are under any obligation to provide a Draft Permit to a permittee prior to the official draft permit being published for comment. In numerous meetings and correspondence with Mirant Kendall and its consultants, EPA disclosed as much information and detail as was reasonable regarding the contents of the evolving draft permit. Factual errors in the draft permit have been corrected in this Final Permit.

Comment A11: Mirant Kendall requests that EPA consider Mirant Kendall's response to EPA's September 1, 2004 Section 308(a) request as a timely comment and submission of data with respect to the draft NPDES renewal permit and, in particular, on the draft permit's denial of Mirant Kendall's diffuser proposal.

Response to A11: EPA has fully considered Mirant Kendall's response in finalizing the permit.

Comment A12: Mirant Kendall notes that EPA has, separately from but somewhat parallel to this NPDES permit renewal process, undertaken development of a Total Maximum Daily Load (TMDL) assessment to address water quality impairments associated with algal blooms in the Lower Charles River.

Mirant Kendall argues that EPA's decision not to authorize the proposed diffuser is based on EPA's work in developing the TMDL. Mirant Kendall objects on the ground that there has been no public review of that work and the administrative record for the NPDES renewal permit contains only very selective portions of the record of the TMDL. Mirant Kendall argues that EPA must supplement the Administrative Record for the NPDES permit to incorporate any records from the TMDL that were used in the NPDES permit renewal process.

Response to A12: The objective of developing the Charles River Basin Nutrient TMDL to address eutrophication is to determine what pollutant load reductions are necessary to address cultural eutrophication of the Basin and attain applicable Massachusetts Water Quality Standards. The initial scoping of the TMDL effort in early 2002 included water quality monitoring and the development of a water quality model to simulate the relationship between pollutant loadings and water quality related to algal growth in the Basin. In order to accomplish the primary objective of the TMDL, it is necessary to consider all sources of pollution that may contribute to algal growth in the Basin. The primary sources of pollution to the Basin that are contributing to eutrophication include discharges from storm water drainage systems, combined sewer overflows, pollutant loadings from the upstream watershed that enter the Basin at the Watertown Dam, and the thermal discharge from the Kendall Station facility. Based on the current assessment of the water quality model, the TMDL will focus on sources that contribute nutrients to the Basin.

During 2002, when plans for the water quality model were being developed, EPA contemplated modeling the proposed diffuser in the event that a permit was issued to the Kendall facility that authorized operation of the diffuser before completion of the TMDL. At that time, EPA intended

to issue the permit during late 2002 or early 2003, which would have preceded completion of the TMDL. As explained more fully in Attachment A to the Fact Sheet and in the responses to comments in Section E, operation of the proposed diffuser would have a reasonable potential to increase nutrient loading to the upper water column and contribute to cultural eutrophication of the lower Basin. Consequently, if the diffuser discharge were to be authorized in Kendall Station's NPDES permit, it would arguably need to be considered in the TMDL modeling work. Conversely, EPA acknowledges that, if TMDL modeling work had been used to develop Kendall Station's NPDES permit, then the administrative record for the NPDES permit would need to include information from the TMDL development process.

In fact, the TMDL development process and the Kendall Station NPDES permit renewal process have intentionally been kept separate. The principal reason is that the TMDL model development and calibration process is intended to simulate existing conditions in the Basin, not potential future conditions. In the context of this NPDES permit renewal, EPA's decision not to permit the diffuser was based on: (1) water quality data from the Charles River Basin; (2) literature information concerning the effectiveness of oxygenation techniques to address excessive algae; and (3) the lack of a quantified demonstration showing that the operation of the proposed diffuser would not increase algal biomass in the lower Basin. To be sure, some of the water quality data considered in the NPDES permit renewal process was collected as part of the monitoring program to support the ongoing development of the nutrient TMDL. For example, water quality data that EPA collected in the lower Basin during the summer of 2002 confirmed concerns that the bottom sediments that underlie the salt wedge represent a significant potential source of nutrients.

However, these data – as with all data that EPA considered in developing Kendall Station's NPDES permit process – was timely provided to Mirant Kendall in the context of the permit renewal process. More generally, EPA has given Mirant Kendall all of the information that EPA used or considered in the permit renewal process, including information in any way associated with the TMDL activities. EPA has not based its decision not to authorize the diffuser proposal on TMDL modeling results. In fact, other than preliminary set up of the diffuser conducted in the early stages of preparing the model, neither EPA nor its TMDL modeling consultants have performed simulations involving Mirant Kendall's proposed diffuser. The development of the water quality model has been focused entirely on simulating existing conditions in the Basin. Mirant Kendall, not EPA, is responsible for determining the optimal diffuser design with respect to minimizing water quality and thermal impacts in the lower Basin, and developing a credible model that can be used to evaluate potential water quality impacts associated with the operation of a diffuser.

With respect to the completeness of the administrative record, all information that EPA considered in evaluating the proposed diffuser has been included in the administrative record for the Draft Permit, with a single exception. That exception, which Mirant Kendall notes, is a letter from Mr. Charles Cooper (TRC) to Kathy Baskin (CRWA), dated February 19, 2003 (AR #563). That letter was written in response to a memorandum from Dr. Steven Chapra.

As context, the development of the Charles River Basin Nutrient TMDL is a collaborative effort by MassDEP, EPA and the Charles River Watershed Association (CRWA). Dr. Chapra, a Professor of Civil and Environmental Engineering at Tufts University, is a member of the four-person expert panel that CRWA (not EPA) convened. The primary purpose of the panel is to provide technical input during model development. In a January 13, 2003 memorandum, Dr. Chapra provided information to the Charles River Watershed Association (CRWA) that identified a number of possible negative water quality conditions that might result from the operation of the proposed diffuser. Dr. Chapra recommended that a detailed evaluation of the diffuser design and likely associated water quality impacts be performed prior to permitting the diffuser (Chapra, 2003, AR #60). Contrary to Mirant Kendall's assertions, this memorandum was not provided expressly to EPA and EPA's TMDL contractors. Rather, the memorandum was addressed to Ms. Kathy Baskin of CRWA. Ms. Baskin provided the memorandum to EPA for consideration during the permit renewal process.

EPA also received, and considered, Mr. Cooper's comments upon Dr. Chapra's memorandum before issuing the Draft Permit. Unfortunately, EPA inadvertently neglected to include Mr. Cooper's letter in the administrative record for the Draft Permit. However, this error was harmless for several reasons.

First, most of the points included in Mr. Cooper's letter are targeted towards the TMDL water quality modeling effort, not the NPDES permit renewal process. Second, all of the points raised in Mr. Cooper's letter that are pertinent to the permit renewal process, including the decision not to authorize the proposed diffuser, were in fact addressed in Attachment A of the Fact Sheet for the Draft Permit. Specifically, Mr. Cooper's letter provides remarks concerning the operation of the diffuser and (1) heat, (2) dissolved oxygen, (3) increased salinity, (4) thermal stress, (5) turbulence, (6) light limitation, and (7) chlorophyll *a* distributions in the lower Basin. These topics, including the points raised by Mr. Cooper, are all discussed in Attachment A of the Draft Permit Fact Sheet, particularly on pages 12 and 18-32. Thus, although the letter itself was not in the administrative record for the Draft Permit, the administrative record (specifically, Attachment A of the Fact Sheet) incorporates all of the points raised by the letter and EPA's considered views on Mr. Cooper's remarks. Third and finally, EPA has added Mr. Cooper's letter to the final administrative record, as item #563.

EPA reiterates that the water quality modeling being conducted for the TMDL has not been used in any way to develop the Draft Permit. Furthermore, the project scope for the TMDL water quality model does not include simulations involving Mirant Kendall's proposed diffuser.

Comment A13: Mirant Kendall argues that EPA has not provided sufficient opportunity for input from Mirant Kendall or other members of the public in developing the eutrophication TMDL and its associated model. Mirant Kendall argues that EPA should not issue the final renewal permit until after it has given Mirant Kendall and the public an opportunity to review the results of the model, and to understand how EPA has used the TMDL and its associated model in evaluating Mirant Kendall's permit renewal application.

Response to A13: As explained above, EPA has not used the TMDL and its associated model in evaluating Mirant Kendall's permit renewal application. See Response to A12.

The model has been developed and calibrated to existing conditions, not analysis of the proposed diffuser, other dischargers' future plans, or any other potential future conditions. Specifically, model development has involved the simulation of Mirant Kendall's existing thermal discharge and other sources of pollutants (i.e, storm water and CSO discharges) for the period between January 1, 1998 and December 31, 2002. The TMDL analysis does not include the proposed diffuser and, therefore, results from the TMDL analysis will not provide new information concerning the feasibility of the diffuser.

Throughout the TMDL development process, EPA has promptly responded to Mirant Kendall's inquiries concerning the status of the model and TMDL development by providing a status update of model development and the anticipated schedule for completing the model. Furthermore, EPA has given the public (including Mirant Kendall) ample opportunity to review and comment upon the model since Mirant Kendall's comments on the Draft Permit were submitted. On December 6, 2005, EPA, in coordination with the Charles River Watershed Association, conducted a public meeting and presented the methodology and results of the hydrodynamic and water quality models developed in the TMDL process. Members of the public, including Mirant Kendall's modeling contractors, orally presented comments to EPA's modeling contractor and to the independent expert review panel. At the meeting, EPA stated that written comments would be due on December 20, 2005. On December 19, 2005, Mirant Kendall's modeling contractor requested a three-day extension of that deadline, which EPA immediately granted. In fact, despite having received an extension granted to no other commenter, Mirant Kendall neither provided the comments within the three days it requested, nor requested an additional extension. Nevertheless, on December 28, 2005, EPA specifically solicited Mirant Kendall's consultant for comments, and EPA sua sponte granted an additional, retroactive 5-day extension to allow Mirant Kendall's consultant an opportunity to comment.

Finally, EPA again emphasizes that the TMDL development process and the Kendall Station NPDES permit renewal process have been, are now, and for the foreseeable future will continue to be separate processes.

B. Response to Comments Concerning Mirant Kendall's Operations

Introduction to Section B

Before delving into the specific comments and responses of Section B, some overall context is helpful. In its February 2001 permit renewal application, Mirant Kendall applied for a thermal discharge variance, which required it to demonstrate that any technology- or water-quality-based thermal effluent limit will be "more stringent than necessary to assure the [protection] and propagation of a balanced, indigenous population (BIP) of shellfish, fish, and wildlife." 33 U.S.C. § 1326(a). In Section B, Mirant Kendall challenges EPA's analysis of Kendall Station's electricity-generating operations. In particular, Mirant Kendall suggests in several places that EPA has erred by analyzing the risk to the BIP by evaluating the quantities of heat and flow that Mirant Kendall, in its own NPDES permit renewal application, requested permission to discharge. Mirant Kendall contends that it will not actually discharge as much as it has requested permission to discharge in its application, presumably due to market conditions and/or other factors not regulated by the NPDES permit. Mirant Kendall urges that EPA estimate how much heatload Kendall Station will actually discharge, and analyze the thermal stress on the Charles River's fish and wildlife assuming this lower number.

Moreover, Mirant Kendall repeatedly (e.g., in comments B1, B2, and B5) assures EPA that its future discharges will approximate those of July 2003, during which the plant "operate[d] at close to full capacity." The average heatload for this month was 394 MMBtu/hr and the maximum heatload possible under the permit in effect in 2003 was 486.5 MMBtu/hr. Despite the repetition and confidence of these assurances, they are contradicted by the plant's recent operational record. Data from the summer of 2005 reveal that Mirant Kendall's heatload far exceeded that of July 2003. For example, the monthly average heatload for June and August 2005 was 20% above what Mirant Kendall claimed to be "close to full capacity," in July of 2003, yet strikingly, just 3% shy of the enforceable NPDES permit limit.

While a heatload value has never been explicitly listed as the maximum value allowed as part of the permit compliance profile for Kendall Station, its components (flow and temperature change across the condenser) are limited. Therefore, throughout the response to comments, when the "maximum permitted heatload" is referenced, it is understood that EPA is referring to the product of the permitted maximum cooling water flow limit and the permitted maximum change in water temperature from the intake to the discharge, which in effect results in a maximum calculated heatload which cannot be exceeded without violating one or both of these two regulated parameters.

In summary, Mirant Kendall appears to argue that EPA should authorize Mirant Kendall to discharge at the levels requested in the permit application, but assume in its biological analysis under CWA § 316(a) that Mirant Kendall will actually (but non-enforceably) discharge at much lower levels. Even without the 2005 data, this thesis was unconvincing. The 2005 data demonstrate that Mirant Kendall's discharge will, when conditions are favorable, very nearly approach the enforceable permit limit. With this in mind, EPA takes very seriously its

responsibility to base its analyses on the lawful maximum discharge that Mirant Kendall has requested and, quite possibly, will produce.

To buttress this argument, Mirant Kendall challenges EPA's description of Kendall Station's electric power production profile. EPA is not a power-licensing agency, and does not generally regulate a facility's output in megawatts. EPA's mandate under the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). To that end, EPA must attempt to reach a long-overdue national goal of "water quality which provides for the protection and propagation of fish, shellfish, and wildlife." Id. § 1251(a)(2).

As explained in Section 4.2.3 of the DD, the permit applicant seeking a thermal discharge variance has the burden of demonstrating that a limit less stringent than that required by water quality standards will nevertheless "assure the [protection] and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." 33 U.S.C. § 1326(a). Mirant Kendall's approach to this demonstration was somewhat oblique. Mirant Kendall did initially submit a hydrothermal model of the Basin. However, as explained more fully in Section 5.5.1 of the DD and the Introduction to Section E of these responses to comments, that model was scientifically inadequate. EPA pointed this out to Mirant Kendall at an early stage. Mirant Kendall elected not to revise its model, but instead requested that EPA rely on an in-situ, real-time water quality monitoring regime. See DD, Section 5.5.1. Since Mirant Kendall did not submit a credible demonstration of the impact of its heat discharge on the Basin, and EPA does not generally develop thermal models for the benefit of dischargers that decline to do so on their own, EPA decided to develop the permit based on actually achieving biologically protective temperatures instream.

Because EPA did not develop permit limits in terms of the facility's production capacity, but rather in terms of sensitive species' heat tolerances, many of Mirant Kendall's arguments in Section B are legally irrelevant. The permit limits are based on the least stringent in-stream temperatures needed to maintain a biologically protective section of the lower Charles Basin. For purposes of this analysis, it is largely irrelevant whether Mirant Kendall is characterized as "peaking" or "base load"; whether, given its historical discharges since December 2002 and expected energy market conditions over the next five years, it can be expected to discharge at or below its permitted limits, and if below, by how much; whether any factors outside of the NPDES program (e.g., electricity and natural gas prices) guarantee that Mirant Kendall will not achieve its maximum permit limits; and so on. Of course, EPA desires the most accurate information about Mirant Kendall's electrical generation operations. But in the context of this permit, based on meeting in-stream temperature limits, precise forecasting of Mirant Kendall's future electrical generation is not particularly relevant to the § 316(a) variance determination.

Comment B1: Mirant Kendall cites 40 C.F.R. § 122.45(b)(2) for the proposition that EPA must develop the permit limitations based on a reasonable measure of the level of thermal discharge Kendall Station is likely to experience, and suggests that, instead of the thermal load authorized by the NPDES permit, EPA focus on the historical monthly average thermal load since

December 2002. Mirant Kendall cites legal precedent involving the interpretation of "potential to emit" under the Clean Air Act for renovation of an existing facility.

Response to B1:
1. The upgrade to the Mirant Kendall Station (MKS) has enabled Mirant to run the facility at close to its maximum flow of 80 MGD for longer periods of time and more economically than that characterized by previous operations. The plant may reasonably be expected to operate at high levels of electrical production for longer periods of time.

2. Although over a particular month, the average flow may be 70 MGD, there could be periods of several days in a given month during which the plant operates close to its maximum of 80 MGD. This flow, combined with high ambient temperatures, would represent conditions of greatest concern with respect to fish and protection of the BIP. Since the permit allows Mirant Kendall to reach its daily maximum of 80 MGD so long as the 70 MGD annual average (or 70 MGD monthly average for April through June) is satisfied, it is entirely appropriate to analyze the impacts of 80 MGD flow.

3. The daily flow limit of 80 MGD was carried forward from the prior permit. Mirant Kendall did not, in its renewal application, request a lower limit. Furthermore, while the prior permit imposed a 70 MGD monthly average 12 months of the year, the new permit only imposes this as a monthly average for three months, and for the other 9 months, allows Mirant Kendall to achieve 70 MGD as a rolling annual average. See DD, Section 4.4.1. Mirant Kendall did not request a lower flow limit and EPA did not see a basis for imposing a lower flow limit. If Mirant Kendall wishes to submit a request to modify the permit to impose a more stringent enforceable flow limit, EPA will consider that request. Absent such a request, EPA cannot rely on Mirant Kendall's avowals that it will not reach its permitted limits.

4. If Wisconsin Electric Power Co. v. Reilly, 893 F.2d 901, 917 (7th Cir. 1990) is at all relevant, then Puerto Rican Cement Co. v. EPA, 889 F.2d 292, 297-98 (1st Cir. 1989) (Breyer, J.), where the facts were closer to those here, is even more relevant. Broadly speaking, that case suggests that EPA may reasonable compare a facility's actual historical production to its potential future production. That said, EPA doubts the applicability of these Clean Air Act cases because they involve interpretation of quite different regulatory programs.

5. Mirant Kendall has suggested at various points during the permit renewal process that its expected thermal discharge after the upgrade will be consistent with past discharge. EPA and MassDEP analyzed historical data to identify whether any meaningful changes to the profile of the Station's thermal discharge over time have taken place since the upgrade. The following final response is the joint product of both agencies.

For the purposes of this historical versus current heatload analysis, the time period associated with historical conditions was identified as from 1988 through 2000, and "current condition" was specified as 2001 through 2005, the time period during which the permit renewal process was

actively proceeding. This must be done to determine whether current station heatload to the lower Basin is consistent with, or at least no higher than, thermal discharge reported in the past (1988 through 2000).

Past Thermal Discharge (1988-2000)

First, a reasonable determination of the Station's past thermal discharge was made. Heatload values for the summer months (defined here as June, July, August and September) were exclusively examined as part of this analysis. The assessment was based in large part on Figure 2-7 of the Mirant Kendall Supplemental Application, Volume I, (February, 2001), also included as Figure 3.1.1-1 of the DD. The graph is included in this document as Figure B1-1. An examination of the monthly average Station heatload showed average monthly values consistently approaching 400 MMBTU/hr in late 1988 and early 1989. The average monthly heatload declined from this level and demonstrated more variability through 1992, but generally remained between 200 and 300 MMBTU/hr. Since 1992, average monthly heatload values generally stayed in the 200 MMBTU/hr range, with some drop in heatload noted in mid to late 1998. Since the graph ended in August of 1999, the last three months of heatload data (June, July and August, 1999) were easily identified. These data points also maintained the same level, at approximately 250 to 260 MMBTU/hr. Subsequent data submissions by the permittee, calculated in the same way that heatload was calculated for Figure B1-1, revealed September 1999 as having an average heatload value of 294 MMBTU/hr. When June, July, August and September of the year 2000 were calculated using the same method used in Figure B1-1, their monthly heatload values were approximately 318, 198, 358, and 295 MMBTU/hr. Upon examining heatload data from approximately mid-1992 through the summer of 1999, the summer of 1999 values could be argued to be slightly higher than the average of other summer months in this time period. However, these levels were seen to be lower than monthly values in 1988 and 1989. When compared with monthly heatload values from Figure B1-1, the June, August and September 2000 monthly average heatloads appeared to be relatively higher than the heatload values of the majority of summertime averages.

Since all average monthly heatload values were calculated in the same way in Figure B1-1 (and for September 1999 and the summer months of 2000), the comparative relationship and relative positions among the historical datasets were considered to be generally correct, although the absolute thermal loading number was overestimated. For this reason, June, July, August and September of 1999 were judged, through visual inspection, to reasonably represent the historical heatload from Kendall Station during the summer months. For reasons that are explained below, the associated heatload values of 250 to 294 MMBTU/hr could not be used as the corresponding heatload numbers for those months.

When the supplemental permit application was originally submitted in February of 2001, thermal discharge data from the Station was estimated in a way that was ultimately seen to overstate the average monthly thermal loading from the Station (MMBTU/hr; Figure 2-7, Mirant Kendall Supplemental Application, Volume I, February, 2001). Later in the permitting process, hourly

and daily values of Station Delta T (difference in water temperature between the intake and the discharge of the Station) and once through cooling water flow - the two operational components needed to calculate heatload - were made available. When this more refined raw data were used to determine heatload, the recalculated, more accurate Station average monthly heatload values were much lower than originally represented in Figure B1-1.

When the average heatload values for these four summer months in 1999 were calculated using the refined raw data, the more exact monthly average values were 115, 131, 137 and 112 MMBTU/hr, for June through September, respectively. An average of these four average monthly values resulted in a summer time historical heatload value of approximately 124 MMBTU/hr.

Current Thermal Discharge (2001-2005)

For the purposes of the historical versus current heatload evaluation, the time period associated with all summer months after the summer of 2000 was identified as representing "current condition." Heatload data representing current conditions and calculated using the more refined, representative raw data, were assembled from the summers of 2001 through 2005. Daily average heatload values from the historical summer (June, July, August and September of 1999) were represented graphically along with the corresponding thermal heatloads (June through September of 2001 through 2005) in Figure B1-2 to provide a visual comparison of heatload over time. Heatload levels from1998 and 2000 were also included in the comparison for information only, as well as providing a continuous view of heatload levels from the summers of 1998 through 2005. Monthly average heatload values for these summer months from 1998 through 2005 were included in Figure B1-3. The interim owner of Kendall Station did not take possession of the Station until December of 1998. Station operation in the summer of 1998 was seen to contribute less heatload to the lower Basin when compared with the historical "average" summer of 1999. Through inspection of Figures B1-2 and B1-3, it appeared that compared to the summer of 1999, overall heatload was slightly less in the summer of 2000, somewhat greater in 2001 and 2002 and greater still in 2003, 2004 and 2005. Of these years, the lower Basin received the greatest summer heatload from Kendall Station in 2003 and 2005.

In order to gain a clearer picture of the number of days the average heatload reached specific ranges of heatload, Figure B1-4 was assembled. Through inspection of these pie charts, it can be seen that when compared to the historical year of 1999, Station heatload to the Basin was notably greater in the summers of 2001 through 2005. In the summer of 1999, Station heatload dropped below 101 MMBTU/hr approximately half of the time. In 2001, the thermal discharge was below 101 MMBTU/hr only about one percent of the time. Similarly, the thermal discharge dropped below 101 MMBTU/hr about 32% of the time in 2002, 9% of the time in 2003 and at no time in the summers of 2004 and 2005 (Figure B1-4).

Based on an examination of the historical heatload versus the "current heatload" of the Station, it appears that heatload rates in the summers of 2001, 2002, 2003 and 2004 did not reflect a discharge that was "consistent with past discharges"or reflected a "normal component " of the

discharge. Based on this analysis, any Station summer heatload to the lower Basin over 124 MMBTU/hr is considered inconsistent with past discharge.

If there was any measure of doubt in this analysis, a closer examination of the data from the summer of 2005 eliminates it. That is because the heatloads in 2005 were, comparing equivalent months from 2004, 66% (August) to 320% (June) higher than those of the previous year (Figure B1-3). Thus, even if 2004 could be said to be "consistent with past discharges" – which, EPA has explained above, it cannot – the same could not be said for 2005. See Response to B2 for a more detailed discussion of 2005 data.

Comment B2: Mirant Kendall argues that EPA has incorrectly characterized the repowering of Kendall Station as a shift from a peaking facility to a base load facility. Moreover, Mirant Kendall argues that, but for the NPDES permit's biologically-based in-stream temperature limits, the plant's future operations will approximate those of July 2003.

Response to B2:
1. Page 4-1 of Mirant Kendall's permit renewal application (Part I of II) stated: "The proposed plant will be run at a design level of 234 MW on a continual basis as opposed to the current partial and peak load operation at a capacity up to 64 MW." EPA interpreted this sentence to mean that Mirant Kendall intended to run the proposed plant "on a continual basis as opposed to the current partial and peak load operation." The permit applicant has a duty to use clear language in its permit application and not conceal within a seemingly unambiguous sentence a hidden or unexpected meaning. EPA is entitled to rely on Mirant Kendall's description of its own operations in its permit renewal application.

2. EPA agrees that there has not been any increase in the plant's physical capacity to withdraw and discharge cooling water, and EPA never stated or implied that there was such an increase. Rather, based on Mirant Kendall's submissions, EPA reasonably concluded that there has been an increase in the plant's electricity output. The upgrade that resulted in this increased output potential allows the plant to operate more efficiently and to therefore produce electricity on a much more continuous basis and at correspondingly high flows, effluent temperatures and delta Ts for longer periods of time than in the past, or prior to the upgrade.

Because this permit is based on a § 316(a) variance application, the permit's thermal discharge regime must protect the aquatic communities that form the BIP. As explained in the Response to C3, the BIP is already stressed from a variety of factors, including, but not limited to, heat. Some of this information is new and was not available when the prior permit was developed. Even if Mirant Kendall's flow and heat discharge were to remain exactly the same as in prior years, Mirant Kendall would have to demonstrate a lack of prior appreciable harm. Mirant Kendall has not made such a demonstration and, in fact, EPA and MassDEP's review of the evidence indicates that there has been appreciable harm. See Response to C3. Given that flow can reasonably be expected to be high for more days and for longer periods of time than those which the river has experienced in previous years, Mirant Kendall's burden is that much steeper.

3. Mirant's web site notes that this facility is operating under a "Reliability Must Run" agreement with NSTAR for local system reliability to address periods of peak demand. See http://www.mirant.com/our_business/where_we_work/kendall.htm (last visited September 6, 2006). As market conditions change, power plants like Kendall Station adjust their operations. Whether or not Kendall Station is characterized as a "base load" plant is unimportant. What matters is that the plant's upgrade has made it more efficient, and allows it to operate at closer to its capacity for longer periods of time.

4. As noted earlier, EPA cannot rely on Mirant Kendall's unenforceable assurances that its heatload will fall well below maximum permit levels. In Comment B2 (submitted in October 2004), Mirant Kendall confidently predicted that operating data for July 2003 provides "a good approximation of the future maximum actual monthly discharge that the Station might expect during the summer months in the absence of the Agencies' proposed in-stream temperature limits." However, data indicates that Mirant Kendall's heatload from the summer of 2005 far exceeded that of July 2003, and very nearly approached the applicable permit load.

The July 2003 monthly average was 394 MMBtu/hr, which did in fact fall well below the facility's maximum heatload of 486.5 MMBtu/hr. Moreover, the heatload during the other summer months in 2003 was well below that of July; the next highest was June 2003, with an average of 267 MMBtu/hr, and in September 2003 the heatload was 148 MMBtu/hr, less than half that of July.

But, the plant's 2005 summer heatloads were far above those of July 2003. The monthly average heatloads for June through September 2005 were, respectively, 474, 460, 474, and 467 MMBtu/hr (see Figure B1-3). July 2003's figure of 394 MMBtu/hr, far from representing a maximum, actually fell well below the minimum summer monthly average heatload in 2005. Moreover, unlike 2002 and 2003, where one month's average was high but the other months experienced significantly less heatload, in 2005 the difference between the highest and the lowest month was approximately 3%. Finally, the summer monthly heatloads in 2005 came perilously close to the maximum heatload the facility is capable of discharging under its flow and facility Delta T limits: June and August were within 3% of this maximum, and even July, the summer month with the lowest heatload, was within 5% of the maximum.

This illustrates that Mirant Kendall's assurances that its discharges will not exceed some hypothetical, unenforceable figure below the allowable maximum cannot be the basis for permit development. Experience indicates that, when conditions are favorable, Mirant Kendall will operate the plant at nearly the maximum permitted load. Therefore, EPA must analyze the impact on the river of the plant operating at maximum permit conditions and, based on its upgrade, for longer periods of time than in the past.

Again, if Mirant Kendall believes that the maximum permit conditions that it requested allow it to draw or discharge too much cooling water, Mirant Kendall may request a permit modification to impose more stringent flow limits.

Comment B3: Mirant Kendall (1) argues that EPA erred by referring to the prior permit as the permit "previously in effect," (2) notes that the existing permit does not regulate Kendall Station as a peaking facility, but rather authorizes Kendall to discharge at its full capacity with a maximum temperature of 105ºF and a temperature rise of 20º F in the discharge pipe, without respect to whether the Station operates all the time or only for portions of a day or month or year, and (3) emphasizes that Kendall Station "will sometimes operate at full capacity but more often will not."

Response to B3:
1. The characterization of the plant's operation as "base load" or "peaking" is not important under the NPDES program. As previously noted, it is reasonable to issue this permit with conditions appropriate for the potential that the plant will operate at high levels and for longer periods of time than in the past. See Response to B2.

2. EPA agrees that, until this final permit becomes effective, the 1998 permit remains in effect.

3. See Responses to B1-B2.

Comment Related to B3 from Mark Jaquith: Mirant has stated its intent to change Kendall from a peak load provider to a constant supplier to the grid. This will vastly increase the overall heat output to the river. It is my request that your final permit not allow Mirant to discharge more heat than was done in years when the plant was run as a peak load provider.

Response to Comment Related to B3 from Mark Jaquith: The increase in permitted heatload is limited to the allowance for an annual average flow limit of 70 MGD, rather than a monthly average flow limit of 70 MGD. (The 70 MGD monthly average limit has been retained in the months of April, May and June only.) This indeed may result in an increased permitted heatload in certain months. In the Final Permit, however, EPA and MassDEP are relying primarily on the in-stream monitoring and temperature compliance limits as a more precise and protective means of monitoring and regulating the plant's thermal discharge in a manner that protects the balanced indigenous population, while allowing operational flexibility to the permittee. See also Responses B1, B2, B8, and B9(3).

Comments B4 and B5: Mirant Kendall argues that EPA has made various misleading comparisons of data from past years.

Responses to B4 and B5: Operations since the upgrade have occurred only for 4 years, and this time period cannot be relied upon exclusively to project future generation and heatloads. In its comments, Mirant Kendall does not discuss whether it would have generated higher levels of electricity if it would have been physically feasible and economically profitable to have done so. Both the price of electricity and the cost of natural gas fluctuate. In an area as unpredictable as energy markets, past performance is not always a predictor of future performance. For purposes of the CWA § 316(a) variance application, it suffices to note that the facility can produce greater levels of electricity for longer stretches of time, resulting in greater heatloads to the river, than it

has done to date since the upgrade.

Finally, while the monthly average figure of 487 MMBTU/hr is not likely to be reached for the months of April, May and June, it could certainly be approached in other months when the monthly average limit of 70 MGD does not apply.

Comment B6: Mirant Kendall argues that analyzing monthly average BTU discharge obscures multiple days of high operational levels. During any month, as Kendall Station responds to the energy marketplace, often there are several days in a row the facility operates at much higher levels than during lower market demand times on other days during the month. Mirant Kendall also claims that "the river has not seen any temperature effects of those higher level operations."

Response to B6:
1. EPA agrees that a given month will typically incorporate some days where the discharge falls below the monthly average, and other days where the discharge rises above the monthly average.

2. EPA and MassDEP do not agree with Mirant Kendall's claim that "the river has not seen any temperature effects of those higher level operations." The biological studies reviewed by EPA and MassDEP scientists have reached the opposite conclusion. See Response to C3.

3. It appears Mirant Kendall is urging EPA to assume, for purposes of biological analysis, that Mirant Kendall's operations will be constrained by unenforceable assurances that Mirant Kendall will not actually do what it is requesting legal permission to do. The only "hard" limits on Mirant Kendall's discharge are the plant's physical capacity and the constraints imposed by the NPDES permit's conditions. Market conditions, other business conditions, and even world events may lead the plant to operate at these physical and legal maxima, or below them. These factors cannot be accurately predicted and cannot be relied upon in developing legally and scientifically defensible permit conditions. Rather, EPA is required to assume, in analyzing the potential operations of the plant, that external conditions may lead the plant to operate at its physical and legal maximum capacity for certain periods of time.

Comment B7: Mirant Kendall asserts that EPA has exaggerated the plant's impact by analyzing the plant's future thermal effects on the basis of discharges at 80 MGD. While the plant's existing permit allows discharges of 80 MGD, in fact Kendall Station's existing pumping capacity is only 77 MGD. At a Delta T of 20˚ F, the plant's maximum actual thermal discharge is 12,828 mmBTUs/day, not 13,328 mmBTUs/day.

Response to B7:
1. EPA based the 80 MGD figure on (a) Mirant Kendall's permit renewal application, (b) its actual reported flow in 2003-04, and (c) a very modest (and, in the end, non-determinative) margin of safety.

a. In its February 2001 re-application, Mirant Kendall listed Outfalls 001 and 002 as having a

maximum flow of 40 MGD each.

b. The permittee is required to estimate discharge flows using pump capacity curves and operational hours. In order to verify the actual or estimated maximum discharge flow, the permittee is required to either directly measure its maximum flow through the facility's discharge or otherwise document, e.g. through pump curves, the estimated maximum discharge flow for its discharge pumps. EPA assumes that Mirant Kendall has correctly applied these requirements and truthfully reported the resulting data to EPA without exaggeration.

In its monthly Discharge Monitoring Reports (DMRs), Mirant Kendall reported a flow of 79.2 MGD for July 2003 and 78 MGD for August 2003 to May 2004, with the exception of October 2003. Consequently, EPA is entitled to assume that the plant's maximum flow is at least as high as its reported July 2003 flow, 79.2 MGD.

c. Allowing a very modest margin of safety to account for any data uncertainty and the possibility that Mirant Kendall may make slight improvements that would not require a permit modification, EPA rounded 79.2 MGD up to 80 MGD for purposes of analysis. However, the impact of this upward rounding is quite modest. The heatload difference between 79.2 MGD and 80 MGD is about 5.6 MMBTU/hr. This value is not significant enough to change any of the analysis or conclusions regarding this permit.

For these reasons, the facility's potential thermal effects have not been exaggerated.

2. If Mirant Kendall is certain that its flow will never exceed its supposed actual pumping capacity of 77 MGD, and is willing to commit to that figure, Mirant Kendall may apply for a permit modification to impose 77 MGD as a legally enforceable daily maximum flow limit. Absent a legally enforceable limitation on its potential to discharge, EPA cannot base its scientific analysis on an unenforceable assurance that Mirant Kendall will not exceed a supposed maximum capacity that it has already, according to its own DMRs, exceeded for portions of 2003 to 2004.

Comment B8: Mirant Kendall argues that plant operations data from 1998 to 2000 are the least representative of recent past years and should not be a basis for analysis.

Response to B8:

1. See Responses B1 and B2 for EPA's detailed heatload analysis.

2. The permitted flow limit has been changed from 70 MGD as a monthly average to 70 MGD as an annual average, with the exception of the months of April, May and June, where the monthly average still applies. Previously, the permittee was limited to a monthly average of 70 MGD for the summer months and would have to limit the amount of time that it operated at its maximum flow of close to 80 MGD. The revised permit, however, allows the permittee to operate near its maximum flow for the majority of days in the months of July, August and

September and still meet its annual average of 70 MGD by operating at lower levels during the lower electricity demand months. Since the summer months are those during which we expect the greatest impacts due to temperature, EPA focused on the potential heatload generating increases during this period.

Comment B9: Mirant Kendall argues that anadromous fish passage coincides with the high flow conditions in the spring, when flows typically are 10-20 times higher than summertime low flow conditions. Mirant Kendall also asserts that "EPA has made no showing that the past discharges or future discharges consistent with past discharges would have any adverse impact or cause 'appreciable harm.'"

Response to B9: EPA agrees that anadromous fish passage is expected to coincide with the high flow conditions that characterize the spring. Response C31 discusses this assumption in more detail. This high flow expectation is taken into account in EPA's approach to setting protective thermal limits. The Final Permit includes flow limits and discharge limits for maximum temperature and maximum delta T through the facility. However, EPA is not relying on these thermal load limits as being environmentally protective of thermal impacts. Rather, in the Final Permit EPA is relying primarily on the in-stream monitoring and temperature compliance limits as a more precise and protective means of monitoring and regulating the plant's thermal discharge in a manner that protects the BIP, while allowing operational flexibility to the permittee.

It is not EPA's burden to demonstrate that there <u>has</u> been prior appreciable harm. It is Mirant Kendall's burden to demonstrate that there <u>has not</u> been prior appreciable harm. See 40 C.F.R. § 125.73 (c)(1)(i).

Based on a review of all the scientific data, EPA and MassDEP have concluded that there has, in fact, been appreciable harm from Mirant Kendall's thermal discharge (taking into account the interaction of that discharge with other pollutants and the additive effect of other thermal sources) to a balanced, indigenous population of shellfish, fish and wildlife in and on the lower Charles Basin. See Response C3.

Comment Related to B9 (1) from Rae Steining: The maximum permissible heatloading of 556 million BTU/hour is approximately equal to the July daily average solar flux on the surface of the Charles bounded by the original dam and the Longfellow Bridge. The maximum pumping rate of 70 MGD permits Mirant to pass the same region of the Charles to a depth of 3 meters through the station's heat exchangers in about a week. These numbers suggest a large environmental impact. I do not believe that the draft permit is compatible with the goal of making the Charles safe and suitable for recreational use.

Response to Comment Related to B9 (1) from Rae Steining: EPA and MassDEP acknowledge that the facility's thermal discharge can cause a significant environmental impact on the aquatic population of the lower Basin. To limit this impact, the Final Permit contains protective limits and monitoring conditions to assure that the BIP is protected and that Federal

and State WQS are met. See Response to B9.

Comment Related to B9 (2) from CLF: The facility has recently undergone an upgrade in its power production, which will allow MKS to increase its generation from 64 MW to 234 MW, an increase of over 350 percent. As a result, MKS is expected to increase thermal load to the river by approximately 400% over historic levels. This increase in thermal load, combined with other existing stresses to aquatic life, will interfere with the seasonal migration and breeding of fishes and diminish the overall ecology of a public resource that the community has worked hard to restore. The specific concerns that CLF has with the development of this proposal include: (1) failure to appropriately utilize the best available science in setting appropriate thermal limits that will protect indigenous aquatic species, (2) failure to rigorously analyze the interaction of new thermal stresses with existing stresses, (3) failure to develop a reliable system for monitoring ongoing impacts to the river and (4) the extreme conditions that would be allowed within a large zone of dilution (ZD).

Response to Comment Related to B9 (2) from CLF: See Responses B2 and B3. There has not been any increase in the design capacity of this plant to withdraw and discharge cooling water, but there has been an increase in electricity output. The upgrade that resulted in this increased output potential allows the plant to operate more efficiently and to therefore produce electricity on a much more continuous basis and at correspondingly high flows, effluent temperatures and delta Ts for longer periods of time than in the past, or prior to the upgrade. Under this operational profile, the resulting thermal discharge closely approximates the heatload limit regulated under the former permit. Regarding CLF's specific concerns:

1. EPA has performed an extensive literature search and considered in-stream conditions and biological monitoring results as outlined in the Determination Document. Based on this evaluation, EPA and MassDEP have established temperature limits appropriate to protect the most sensitive resident and anadromous fish species in the lower Charles River Basin.

2. EPA agrees that the stress caused by the facility's thermal plume interacts with non-thermal stresses, such as organic enrichment/low DO, noxious aquatic plants, contaminated sediments, harmful bacteria, and increased turbidity. In many cases, EPA lacks quantitative data by which to assess the specific impacts of these other stresses to temperature sensitive species. However, pursuant to Section 316(a) of the CWA and 40 CFR 125.73, EPA has considered the cumulative impact of these stresses along with heat when assessing the impacts of high temperatures to the BIP, and crafted a temperature compliance regime that protects the BIP given these other stresses. See Response C7 and related comments, and Section 5.4 of the Determination Document.

3. The Final Permit contains an extensive and thorough in-stream temperature limit regime as well as an appropriate water quality and biological monitoring program. Specific concerns about the temperature monitoring and compliance regime are addressed more fully in the responses to comments in sections D, I, and J1.

4. The Section 316(a) variance indeed permits conditions in the ZD that are inhospitable to fish. However, the permit also contains rigorous real-time temperature criteria to ensure adequate passage and habitat in the Zone of Passage and Habitat (ZPH). The premise of the variance is that degradation of habitat in the narrow confines of the ZD is tolerable if the ZPH is large enough and cool enough, often enough. Taken as a whole, the permit protects the BIP in the lower Basin. See also responses in Section D regarding justification for conditions on the ZD.

Comment Related to B9 (3) from CLF: The draft permit would allow excessive withdrawals from the Basin. The draft permit changes the terms of the original permit, which required a monthly average of 70 MGD, to terms requiring a yearly average of 70 MGD, thus allowing increased usage during critical summer months. Further, EPA and DEP states that MKS has proposed to withdraw up to 80 MGD for longer periods during the critical months of May through August than it has in the past, which would clearly increase entrainment and impingement rates. As the river's 7Q10 flow is only 14 MGD, the plant will take in an amount of water equal to the flow of the Charles River in certain summer months, and up to five times the flow of the river during low flow conditions. In fact, when MKS is operating at full capacity, the draft permit would allow the entire volume of water in the lower Basin to circulate through the plant once every 36 days. In effect, the plant will function as a filter, essentially cleansing a substantial fraction of the Basin volume of aquatic life every day.

Comment Related to B9 (3) from MA CZM: CZM's comment was similar to that of the comment from CLF cited immediately above.

Response to Comments Related to B9 (3) from CLF and MA CZM: Although the 70 MGD limit has changed from a monthly average to an annual average, potentially allowing increased flow for certain months, the permit contains additional conditions that limit this impact. First, the months of April-June retain 70 MGD as a monthly average. Second, the effluent and instream temperature limits are more stringent than in the prior permit (i.e., the permit under which the facility currently operates), and thus will protect the BIP more than the prior permit. Third, the addition of barrier nets on the CWIS will minimize the Station's impingement rate, and thus protect the BIP more than the prior permit. See also Response Related to B3 from Mark Jaquith.

Comment B10 (from Dr. Stephen Kaiser): EPA should clarify those periods when heat dumping is not a priority. I presume these would include the winter months December through March and also October and November. The more steam that is sold (within an effective 3 mile radius of Kendall) the less heat is dumped to the river. EPA should encourage steam sales in the final permit.

Response B10: Although the summer period is the most critical time as far as representing the greatest potential for impact on the BIP and potential for eutrophication, there are temperature requirements established year round which correspond to different conditions related to varying life stages of anadromous and resident fish species. The permittee may use its discretion on how to meet these limits. This permit has been written to be protective of the BIP and to comply with

State and Federal water quality standards. It is generally up to the permittee to determine how it will comply with such permit requirements. To the extent that increased steam sales can result in a decreased heatload to the river, EPA and MassDEP would expect the permittee to consider this among other options to meet the temperature limits of this permit.

Comment B11 (from Dr. Stephen Kaiser): The EPA should identify the difference between energy and power. On Page 4 the plant is identified as a 113 MW per hour plant, and that "All other power figures are per hour, unless otherwise noted." The units of megawatts are already in power terms. Energy is power multiplied by time and would have units of Megawatt-hours or million BTUs.

Response B11: EPA appreciates and acknowledges this clarification. Although the fact sheet cannot be changed after the public comment period, it is noted here for the record that the pre-upgrade plant was rated at 113 MW, not MW per hour.

C. Response to Comments Concerning In-Stream Thermal Limits

Comment C1: Agencies have not made any claim or showing that water temperatures in the Charles River, to the extent that they have been or would be affected by Kendall Station's discharge, have had or would have any of the general effects described in those statements. It is not enough for the Agencies to "have concerns" because water temperatures matter. Rather, the Agencies must make a determination whether the particular water temperatures in these particular water bodies caused by the particular discharges from Kendall Station in fact would interfere with the protection and propagation of a BIP. The permitting documents conspicuously fail to address that central and determinative issue. Instead the Agencies have identified what they consider to be a "reasonable potential" for the discharge to cause or contribute to water quality impairments and then proposed limits so extremely low that they believe they cannot fail to eliminate that potential, as opposed to limits designed to assure the protection and propagation of a BIP.

Response to C1: It appears that EPA's analysis of the company's variance application as presented in the Determination Document (DD) and Mirant's current argument in support of its variance have passed by each other. Contrary to Mirant's implication, however, this mismatch did not occur because EPA intends to shirk any responsibility to make a determination concerning "appreciable harm." Rather, the basis for Mirant's demonstration under section 316(a) has been a long, involved and evolving affair. It appears to EPA that the grounds on which Mirant wishes to argue for its variance have shifted, and EPA will recast its analysis accordingly.

Ultimately, it is important to remember that it is the permittee's responsibility to present information that clearly demonstrates to the satisfaction of EPA and MassDEP that specific temperatures, while above water quality standards, are still protective of the BIP. As described at length in the DD, the permit applicant carries the burden of proof when seeking a variance under section 316(a). The process Mirant, EPA, MassDEP, and the resource Agencies undertook to assess Mirant's 316(a) variance application was long, and Mirant's arguments for a variance may have migrated over time. But under every scenario provided for in section 316(a) and EPA's regulations implementing that provision, Mirant has failed to meet its burden of proof for the variance it appears to want.

When EPA assembled the DD, the approach to the section 316(a) analysis was based primarily on the clear representations in the company's original application that the company expected the operating scenario for Kendall Station to change significantly, from a peaking station to a base-load operation with a more continuous output and discharge (Kendall Application 2001, Section 4). The application was originally filed at a time when natural gas was relatively inexpensive and the newly deregulated energy supply market promised to be lucrative. Therefore, EPA did not focus the analysis on the provision in the 316(a) variance regulations that allows an applicant to demonstrate that "the normal component of the [existing] discharge" would result in "no appreciable harm." It appeared at that time that Mirant's discharge going forward would not reflect the "normal component" of the facility's historic operations.

With these comments on the draft permit, however, Mirant is arguing there is no appreciable harm from the normal component of its existing discharge, and therefore, its existing permit conditions suffice to protect the BIP pursuant to 40 CFR 125.73(c)(1)(i). It appears that the company has implicitly adapted its arguments and variance application to the new economic reality of higher gas prices and stiff competition within the electricity generation market. But even under this scenario, it is the applicant that continues to carry the burden of proof concerning "no appreciable harm." EPA's regulations provide that the applicant must submit a "demonstration" to "show . . . [t]hat no appreciable harm has resulted from the normal component of the discharge . . ." Id.

Mirant arguably is correct that EPA's DD did not explicitly make a formal determination as to appreciable harm. But the approach was taken largely because EPA did not understand that Mirant was relying on this element of the 316(a) regulations to make its demonstration. Nevertheless, there are elements of the findings in the DD which look at Mirant's existing operations and attempt to assess trends revealed by Mirant's recent operations (DD at Section 5.3). Although the DD presents these data as one way to predict the potential impact of the Station when operated as a base-load facility, it is also clear that they represent the beginnings of an assessment of the Station's existing operations. Now that Mirant has chosen to focus on the "no appreciable harm" basis for a 316(a) variance, EPA will assess the data available to determine whether Mirant has demonstrated to EPA's satisfaction that there is "no appreciable harm" resulting from its existing discharge. This assessment is presented at some length in Response to Comment C3 below, which contains a determination whether there is evidence of historical and/or recent appreciable harm to the BIP in the lower Basin.

EPA is unclear regarding the source of Mirant's comment that EPA relied on a "reasonable potential" standard to assess the impacts of Mirant's discharge. In discussing the impacts from the Station's thermal discharge, EPA did not use this standard in the support document entitled "Clean Water Act NPDES Permitting Determinations for Thermal Discharge and Cooling Water Intake." It is possible that Mirant inferred from EPA's extensive discussion of the potential impacts of the new operating scenario Mirant presented in its application that EPA was using a reasonable potential standard. And it might have behooved EPA to be more clear about the standard applied under the regulations, although in fairness, the original application and the shifting arguments put before EPA during the long consultation leading up to the draft permit made it difficult for EPA to focus its analysis with precision. EPA essentially treated Mirant's application as an effort to make a demonstration under section 125.73(a) of the regulations, because the provisions under section 125.73(c)(1) appeared to be irrelevant given the prospect of a dramatic change in the Station's discharge when compared to the historic "normal component of the discharge." Under that scenario, the DD clearly determined that Mirant had not met its burden of proof that existing permit conditions would protect the BIP, and EPA undertook an effort to develop alternative temperature limits that would.

There is no comprehensive historical data set of ambient river temperatures for appropriate locations and depths to correlate with Kendall Station discharge temperatures at various river flows in order to identify under what operational conditions the facility would greatly influence

lower Basin temperatures. There was also no biological monitoring program in place before 1999 to determine if the indigenous population of aquatic organisms was affected by Kendall Station discharge. Limited biological data collected in 1999 and 2000 submitted by the permittee failed to convince EPA and MassDEP that the BIP would be unharmed from proposed future operation. No acceptable thermal model was submitted by the permittee to address the issue of thermal discharge impact in lieu of a comprehensive historical data base. Therefore, the initial submission by the permittee failed to meet the burden of predicting thermal impacts to the receiving water resulting from Station discharge temperatures. Because the thermal conditions in the river were not identified along with information that would support a conclusion that no resultant appreciable harm to the BIP was expected, EPA and MassDEP were forced to identify protective temperature limits in a different manner. EPA and MassDEP relied on site-specific biological and water quality data, in addition to the scientific literature, to select biologically based temperature limits that must not be exceeded in any 50% cross-section area of the Charles River in order for the BIP to be protected.

Now that the company has altered its approach and is focusing on a demonstration under section 125.73(c)(1)(i), EPA will undertake a more specific consideration of appreciable harm. As will become apparent below, Mirant has also failed to meet its burden to demonstrate "no appreciable harm."

Mirant also complains that EPA set these alternative temperature limits "extremely low," and elsewhere contends that they are lower than necessary to protect the BIP. EPA vigorously disputes the contention that these limits are unnecessarily low. But with that said, it is also true that there is considerable scientific uncertainty about precisely what temperatures would protect the BIP while giving Mirant as much operational flexibility as possible to heat the river. In the face of such uncertainty, and in light of the applicant's burden to show "no appreciable harm," it is reasonable for EPA and MassDEP, when relying on incomplete, unclear or conflicting biological or water quality data, to establish permit limits that tend to be more conservative and protective of the BIP.

Comment C2: Among Mirant Kendall's submissions that the Agencies admittedly failed to consider, one stands out above all others. By a letter dated November 13, 2003, and follow-up submissions, Mirant Kendall submitted the results of river monitoring for the summer and early fall of 2003. By then, Mirant Kendall had completed the upgrade to Kendall Station, which operated consistently with its proposed and future operations. The upgraded facility discharged during July 2003 at an average of 394 mmBTU/per hour.

The Agencies should have great interest in the results of the river monitoring from those months that the fully upgraded plant was operating. Instead, even though the submissions of 2003 data are in the Administrative Record, the Agencies admit that they have not fully considered those data. Yet these are the most pertinent data from the Charles River because they are real-world data from the actual discharge operating after the plant was upgraded and operating as it is likely to operate in the future. It was irresponsible for the Agencies to disregard these data while instead relying on unrealistic assumptions and laboratory studies that are largely unrepresentative of Charles River conditions. The Agencies should reconsider the proposed

temperature limits after considering the most pertinent data, along the lines suggested by the further comments below, and re-issue a revised draft permit for public review and comment.

Response to C2: These data have now been considered as part of this response to comments document. All data submitted by the permittee which was collected from 1999 through 2005 have been reviewed to determine if appreciable harm to any populations of resident or anadromous species is evident. EPA and MassDEP have used this data set to investigate whether historical or current appreciable harm to the BIP of the lower Charles River Basin can be identified. This discussion is included in Response C3. The considerable amount of fisheries data collected by Mirant was also used to support permit requirements.

In addition, EPA and MassDEP have carefully considered the site-specific data Mirant has submitted in designing the permit limits, and the Permitting Agencies reject the implication that the permit limits are based solely on unrealistic laboratory studies. There are several elements of the permit design that specifically account for the site-specific data the applicant submitted:

1. during the springtime period, the permit allows the temperature limits to be exceeded 6 times to reflect the wide temperature variations that Mirant documented in the lower Basin in the spring;

2. the averaging time to measure the delta T temperature limit has been changed to 24 hours to reflect the potential time it takes for water to travel from the background monitoring station to the monitoring stations in the ZPH, as supported by Mirant's continuous temperature data collection;

3. with the exception of certain monitors on the edge of the ZPH during the summer period, the in-stream temperature regime includes a 2 degree F margin of compliance to reflect a combination of the diel fluctuations and changes with depth in the lower Basin's temperature profile (documented by Mirant) and the recognition that Kendall Station must operate conservatively to maintain compliance with the in-stream temperature limits; and finally

4. while the Permitting Agencies looked to the scientific literature to understand the tolerance of the indicator species to heat exposure, the permit does not pluck the most conservative, "no effects" numbers from those studies and impose them as permit limits; EPA and MassDEP were careful to determine values from those studies that were necessary, though not necessarily ideal, to protect the ZPH for the BIP.

Therefore, it is not accurate to assert that the Permitting Agencies "disregarded" the data Mirant submitted.

Comment C3: Mirant Kendall continued its voluntary program of temperature and biological monitoring of the Charles River during 2004. The Agencies should consider these results as well as the earlier biological monitoring results, as they continue to show that upgraded operations of Kendall Station have not caused any apparent or appreciable harm to the BIP in the Charles

River.

Response to C3: EPA and MassDEP have decided to respond in some detail to Mirant Kendall's claim that there has been no appreciable harm from Mirant Kendall's thermal discharge. EPA and MassDEP consulted extensively in the preparation of Response C3. MassDEP conducted a scientific analysis and generated a draft response. EPA reviewed this draft de novo and concurred in it, and the two agencies collaborated extensively in its production. The final response is the joint product of both agencies, although, for purpose of simplicity, the response refers primarily to EPA. (One further note: MassDEP developed a large number of figures and charts for analyzing Mirant's field data, all of which have been placed into the administrative record. EPA and MassDEP analyzed and based their decision on the totality of these analyses and charts. Those cited in the Response C3 have been relabeled for conformity with the figure numbering scheme for these responses to comments.)

EPA and MassDEP have determined that Mirant has not overcome the evidence that its recent thermal discharge has caused appreciable harm to the BIP. Briefly, the alewife and blueback populations sampled decrease across space as one approaches Mirant Kendall's discharge. Supporting data suggests that the cause of this phenomenon is that the discharge results in temperatures that the majority of alewife individuals, and even a large percentage of blueback individuals, will avoid. Because of Mirant Kendall's discharge, the bulk of the alewife population, and very substantial numbers of the blueback population, are excluded, for long periods of time, from unacceptably large areas of the lower Basin. This habitat exclusion constitutes appreciable harm.

I. Background

A. Temperature sensitivity of alewife and blueback

Alewife (*Alosa pseudoharengus*) has been identified as the most temperature sensitive anadromous species documented to inhabit the lower Basin in any notable number. American shad is more temperature sensitive, but does not appear to be present in the lower Basin during most surveys. Blueback herring are present in substantially higher numbers than alewives, allowing for more statistically significant conclusions, but are less temperature sensitive. Both alewives and bluebacks are of heightened concern to Massachusetts resource agencies (Due to a major downturn in adult stocks throughout the state, the Massachusetts Division of Marine Fisheries (MA DMF) has issued a moratorium on the take of adult fish of these species. See Response C6). Alewife was selected as the representative anadromous species to reflect the health of the BIP and evaluate whether the entire indigenous fish population was in balance.

As a general principle of biology, a population of organisms exposed to a stress (such as heat) will exhibit a range of response to that stress. Specifically, alewives – like any other fish – exhibit a range of thermal tolerances, with some individuals being particularly temperature-tolerant, others particularly temperature-sensitive, and most in between.

Consequently, one would expect a priori, and in fact research in controlled studies generally

confirms, that some individuals will be captured in the water at temperatures which the majority of individuals cannot tolerate. In other words, the fact that some fish have been captured at a relatively high temperature does not mean that the BIP has not experienced appreciable harm, but rather simply that the temperature is not quite high enough to exclude the most temperature tolerant individuals in the population. Accordingly, the appreciable harm determination must be made with regard to the bulk of the population and, as noted above, in the context of the cumulative impact of all significant impacts on the species affected.

Moreover, the ecology of fish populations is complex and a number of confounding factors can sometimes render the data difficult to analyze. This is certainly true for the Charles River alewife data, where a variety of influences besides Mirant Kendall's thermal discharge – including variations in river flow, reductions of discharge of untreated sewage, natural cycles in the strengths of particular year classes, improvements to the fishways at the Cordingly Dam in October 2004 and the Watertown Dam in April 2005, and so on – can affect the health of the BIP. Furthermore, as is generally true with quantitative observational data from the wild, individual data points sometimes yield anomalous results; data sets collected by slightly different measurement techniques sometimes suggest conflicting conclusions; and low numbers can yield unrepresentative or statistically inconclusive results. Given these limitations, EPA and MassDEP have used the best science available to ascertain whether the BIP in the lower Charles Basin has experienced appreciable harm.

Based on the timing of the permit renewal submission (the permittee's latest application was submitted in February of 2001), the timing of the upgrade to Kendall Station, and the time period bracketing the collection of a sufficient amount of water quality, biological and Station operational data, the analysis for both appreciable harm (discussed in this response) and the thermal discharge profile of Kendall Station (see Response B1) was divided into two time periods. The period from 1988 through 2000 is referred to here and in Response B1 as representing historical or past conditions. The time period from 2001 through 2005, i.e. the recent past, is referred to for purposes of convenience as "current conditions".

Because of the absence of a sufficient body of useful site-specific data for Charles River indigenous fish populations during historical or past conditions (1988 through 2000), a determination of appreciable harm was not possible for this time period. A limited amount of biological data, collected in 1999 and 2000 from the Charles River in the vicinity of Kendall Station, was submitted along with Mirant's permit renewal application in February of 2001. EPA determined, however, that this information was not sufficient to demonstrate that no appreciable harm was being caused by the Station's discharge.

EPA and MassDEP have examined the more complete biological data set submitted more recently by the permittee. This included site-specific Charles River water quality and biological data collected in 2002-05**.** This data set, referred to here and in Response B1 as representing "current conditions" was sufficient for the Permitting Agencies to determine that the thermal discharge from Kendall Station has caused appreciable harm to the alewife and blueback populations in 2004-2005.

B. Ecological importance of lower Charles River Basin habitat

The lower Basin of the Charles, downstream of the B.U. Bridge, is important habitat to all life stages of alewives. Data for the juvenile life stage are most prominent and indicate that this area is especially important as a nursery area for juveniles and deserves protection. The wide section of the lower Charles River Basin, downstream of the Watertown Dam, is important spawning and/or nursery habitat for alewives and bluebacks. The nursery season for these fish extends through the late spring, summer and early fall, and indeed juvenile alewives and bluebacks have been found in the lower Basin, downstream of the B.U. Bridge from mid-June through the fall.

Adult river herring that find their way into the Charles and are able to move past the thermal plume and are not kept from breeding due to the attractive nature of MKS's effluent plume encounter yet another obstacle that inhibits upstream movement, the Watertown Dam. MADMF made extensive repairs to the fish ladder at this site in early April, 2005, which should enhance upstream movement. Because the Watertown Dam restricts upstream movement, the habitat downstream of the dam is especially important to anadromous fish. According to the scientific literature, bluebacks spawn primarily in fast moving water, while alewives prefer slow-moving shoreline areas. Thus, the area downstream of the B.U. Bridge would be the most likely spawning habitat for alewives in river segments downstream of the Watertown Dam. MADMF has observed spawning of river herring at the MIT boathouse. The fish spawning at this site were thought to be alewives due to the low water velocities at this site. Mirant's ichthyoplankton analyses in 1999 and 2000 indicate that the area is likely spawning habitat. River herring larval densities of 1-10 larvae per cubic meter were found at sites near the intake in May and June during those years. These are very high densities and indicate that extensive spawning was probably occurring downstream of the Watertown Dam those same years.

C. Appreciable harm demonstration

Once again, it is not EPA's burden to demonstrate that there has been prior appreciable harm; it is Mirant Kendall's burden to demonstrate that there has not been prior appreciable harm. See 40 C.F.R. § 125.73 (c)(1)(i). Exclusion from unacceptably large areas of spawning or nursery habitat constitutes appreciable harm. See Draft Interagency 316(a) Technical Guidance Manual and Guide for Thermal Effects Section of Nuclear Facilities Environmental Impact Statements, § 3.3.5.1, at 28-29 (EPA, May 1, 1977) ("1977 Technical Guidance Manual").

Another important point bears emphasis. EPA cannot conduct its Section 316(a) analysis – i.e., whether the BIP would be protected by temperature limits less stringent than the water quality standards would otherwise require – in a vacuum. The discharger's Section 316(a) demonstration "must show that the alternative effluent limitation desired by the discharger, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected, will assure the protection and propagation of a [BIP]." 40 C.F.R. §§ 125.73(a) (emphasis added), 125.73(c)(1)(i) ("taking into account the interaction of such thermal component with other pollutants and the additive effect of other thermal sources"); see also 33 U.S.C. § 1326(a) ("taking into account the interaction of such thermal component with other pollutants"). The lower Charles River is impaired by, among other criteria, organic

enrichment/low DO, noxious aquatic plants, contaminated sediments, harmful bacteria, and increased turbidity. Although EPA does not rely on specific impacts of these impairments to temperature sensitive species, this "cumulative impact" requirement is important to keep in the background when assessing the impacts of excessively warm water to the BIP. See Section 5.4 of the Determination Document.

A discharge may be determined to be in a low potential impact area for fish if the following conditions are satisfied:

1. The occurrence of sport and commercial species of fish is marginal;
2. The discharge site is not a spawning or nursery area;
3. The thermal plume will not occupy a large portion of the zone of passage which would block or hinder fish migration under the most conservative environmental conditions (based on 7-day, 10-year low flow or water level and maximum water temperature); and
4. The plume configuration will not cause fish to become vulnerable to cold shock or have an adverse impact on threatened or endangered species.

See 1977 Technical Guidance Manual, § 3.3.5.2, at 29. The receiving area for the Mirant Kendall discharge (i.e., the lower Charles River Basin) does not meet these criteria and hence is not a "low potential impact area." The discharge site has been documented to be a nursery area through Mirant's push-net surveys, shoreline seine surveys and impingement/entrainment evaluations. MADMF has also determined that the discharge area is a spawning area. Consequently, the lower Basin is an area of potential impact for fish.

Accordingly, Mirant's burden in a § 316(a) variance application is to prove that fish communities will not suffer appreciable harm from any of the following:

1. Direct or indirect mortality from cold shocks;
2. Direct or indirect mortality from excess heat;
3. Reduced reproductive success or growth as a result of plant discharges;
4. Exclusion from unacceptably large areas; or
5. Blockage of migration.

See id. § 3.3.5.1, at 28-29.

With that background, EPA has determined that Mirant has not overcome the evidence that its recent thermal discharge has caused appreciable harm to the BIP. Briefly, the alewife and blueback populations sampled decreases across space as one approaches Mirant Kendall's discharge. Supporting data suggests that the cause of this phenomenon is that the discharge results in temperatures that the majority of alewife individuals, and even a large percentage of blueback individuals, will avoid. EPA finds that, because of MKS's discharge, the bulk of the alewife population, and a very substantial portion of the blueback population, are excluded, for long periods of time, from unacceptably large areas of the lower Basin. This habitat exclusion constitutes appreciable harm.

II. Analysis

All data discussed in this review were collected in the lower Charles River Basin, i.e., from the Watertown Dam to the new Charles River Dam at the terminus of the Charles. All data were collected downstream of the BU Bridge where the river greatly widens and deepens.
EPA and MassDEP reviewed several distinct sources of data in assessing the influence of Kendall Station's discharge on alewife abundance. Each source of data has its own advantages and limitations. Day-time and night-time shoreline seine data are available from as far back as 1999 and 2002 respectively, and in some years include data points for a broad range of temperatures. On the other hand, shoreline seining is subject to confounding factors that may be present at specific shore locations (e.g., food supply or cover). Push-net sampling, which is conducted in open water away from the shoreline, minimizes these confounding variables and in theory should produce the most reliable results. On the other hand, push-net sampling began only in 2003, and for these years, the total number of alewives captured is low, which can make it difficult to draw statistically significant conclusions. To some extent that problem can be addressed by examining blueback push-net data, since bluebacks were captured in much higher numbers and therefore exhibit trends with greater statistical significance. On the other hand, as noted above, bluebacks can tolerate higher temperatures than alewives.

Acknowledging these inescapable limitations in the data, EPA and MassDEP have examined these data sets closely. While the results are not always completely consistent, the weight of the evidence indicates that Mirant Kendall's thermal discharge has caused extensive habitat exclusion, and thus appreciable harm to the BIP, in the lower Basin.

A. Push-net data vs. distance from Mirant Kendall discharge

1. Alewife

As noted above, push-net sampling is, as a general matter, a more reliable method of assessing the abundance of river herring. At a number of other sites in the eastern U.S., juvenile river herring have been found to rise to the surface to feed at dusk. Juveniles are caught in open-water areas during low-light periods and are also caught near the surface in the daytime in turbid waters. Because push-net samples are collected in open water, at the surface and away from the shoreline, the effect of temperature avoidance can be directly addressed without the potentially-confounding habitat variables of shoreline food and/or cover.

In 2003, Mirant Kendall initiated push-net sampling to assess abundance of juvenile river herring downstream of the B.U. Bridge. Mirant Kendall followed techniques used in Virginia and conducted push-net sampling in the wide section of the lower Charles River Basin at dusk and at night with a large net mounted on the front of the collection boat. Juvenile river herring were captured near the surface at stations across the lower Basin from the B.U. Bridge down to the Old Locks at the Science Museum (i.e., both upstream and downstream of the discharge). Since each push-net survey lasted 5 minutes, catch per survey is used here to represent catch per unit effort (CPUE).

Although push-net sampling was conducted from 2003-05, the quality and representativeness of the alewife dataset for each year varies. The alewife data from 2004 and 2005 are the most extensive of the three datasets. In 2003, push-net sampling was initiated in late July. Over the July-September period of sampling in 2003, only 2 alewives were captured, which is not enough data to analyze. By contrast, 125 juvenile alewives were captured in July-September in 2004 and 183 were caught over this same time period in 2005. Finally, while push-net sampling took place in the day as well as at night, in both 2004 and 2005, nearly all alewives caught by push-net were caught at night. (This is not surprising because alewife juveniles feed at the surface in dim light.) Consequently, only night-time data are evaluated here.

Total alewife population has been very low in the Charles in recent years. For example, in 2004, which had the most extensive sampling program, a total of 125 juvenile alewife were captured in push-nets; in 2005, the total was 183. These absolute numbers are extremely low in comparison to the number of bluebacks captured in the same surveys, which is demonstrated by the relative catch rates per survey. The overall number of juvenile bluebacks caught per survey (July-September sampling period, total catch all surveys/total number of surveys at all stations) over the years of 2003-2005 ranged from 30 to 148 fish per survey. By comparison, the range in juvenile alewife catch over those same surveys and years ranged from 0.01 to 1.33 fish per survey. Nevertheless, even though there were very low numbers of juvenile alewives (often none) caught on any particular push-net event, the large number of events allows an investigation of patterns in catch rate from station to station.

The push-net data allow an evaluation of whether proximity to Mirant Kendall's discharge played a role in juvenile alewife abundance in the lower Basin. The Agencies examined spatial trends in catch per push-net survey. Typically, when there is substantial variability in the data – which is certainly the case with the catch per push-net survey – the median provides a more accurate metric of central tendency than the mean. However, the catch at stations near the discharge was so low, and so often zero, that the median catch per push-net survey would be zero fish per event for stations near the discharge. Consequently, EPA has used the mean catch per push-net survey for this analysis.

Table C3-1 below lists, for each push-net station, the approximate distance of the station from the Mirant Kendall discharge; the total number of juvenile alewives in all surveys in the months specified (July-September for both 2004 and 2005); the number of sampling events during those months; and the mean number of juvenile alewives per sampling event. It illustrates a general trend of declining alewife abundance as one approaches Mirant Kendall's discharge.

Table C3-1: Juvenile Alewife Densities at Push Net Stations, by Distance to Mirant Kendall Discharge (2004-05)

		Total# alewives		**# sampling events**		**Mean alewives/event**	
Station	**Distance**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**

		Total# alewives		# sampling events		Mean alewives/event	
Hyatt	1.4[1]	52	84	24	22	2.17	3.8
MIT	0.8[1]	26	5	24	14	1.08	0.36
Lagoon	0.6[1]	32	--	26	0	1.23	--
Old Locks	0.5[2]	6	52	24	24	0.25	2.17
A. Fiedler	0.4[1]	4	--	25	0	0.16	--
Boston	0.2[3]	3	19	24	26	0.13	0.73
Mid-Channel	0.1[2]	0	10	26	26	0.00	0.38
Sh. Diffuser	0.05[2]	2	13	26	26	0.08	0.5
Totals		**125**	**183**	**199**	**138**	**0.62**	**1.33**

Key:
1: upstream of discharge
2: downstream of discharge
3: directly across river from discharge
Table C3-1A contains the exact same data as Table C3-1, but instead of being sorted by decreasing distance to the Mirant Kendall discharge, is sorted from upstream to downstream.

Table C3-1A: Juvenile Alewife Densities at Push Net Stations, by upstream to downstream location (2004-2005)

		Total # alewives		#sampling events		Mean alewives/event	
Station	**Distance**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Hyatt	1.4[1]	52	84	24	22	2.17	3.8
MIT	0.8[1]	26	5	24	14	1.08	0.36
Lagoon	0.6[1]	32	--	26	--	1.23	--
A. Fiedler	0.4[1]	4	--	25	--	0.16	--
Boston	0.2[3]	3	19	24	26	0.13	0.73
Sh. Diffuser	0.05[2]	2	13	26	26	0.08	0.5

Mid-Channel	0.1[2]	0	10	26	26	0.00	0.38
Old Locks	0.5[2]	6	52	24	24	0.25	2.17
Totals		**125**	**183**	**199**	**138**	**0.62**	**1.33**

Key:
1: upstream of discharge
2: downstream of discharge
3: directly across river from discharge

Tables C3-1 and C3-1A illustrate the decline in alewife abundance compared to the distance from each push-net station to the discharge. In 2005 CPUE declines by half or more from the Hyatt station to the MIT station. From MIT downstream to the Boston station, the 2004 data show a continued sharp decrease. In 2004, the mean CPUE is at its lowest for the three stations closest to Mirant Kendall's discharge, and then rebounds somewhat at the Old Locks station, half a mile downstream of the discharge.

In general, the 2005 dataset is similar to that of the 2004 dataset: CPUE is highest at the Hyatt reference station and decreases at stations closer to the discharge. These data are presented graphically in Figures C3-1 and C3-2. The axis denoting distance on these and other graphics in this section depicts the distance from the discharge to each station. The thermal plume from Mirant travels both upstream and downstream and has the potential to affect habitat in either direction. Push-net stations were also located both upstream and downstream of the thermal discharge. As a result of this arrangement of stations in the graphics, the greatest distance in miles from the Kendall discharge denoted in the graphics is 1.4 miles (the distance from the discharge to the most upstream station), whereas the total distance between the farthest upstream and farthest downstream stations (one downstream station was located 0.5 miles distant from the discharge) was 1.9 miles. Station distances were arranged in this manner, rather than in linear distance downstream from a certain point, so that regressions based on station distance from the discharge could be generated. 2004 data demonstrate that there is a statistically significant ($p = 0.0005$) decline in mean alewife abundance as station proximity to the discharge increases. That is, at stations closer to the discharge, alewife densities decline. A similar trend also exists in 2005; however, the pattern is not statistically significant at the 0.05 level ($p = 0.10$ for the 2005 alewife dataset).

The trend that is visible, but not statistically significant, in the 2005 data, is confirmed by a more detailed analysis. The 2005 dataset is influenced by a sampling anomaly. One station (MIT) was surveyed about 36-46% less frequently than the other five stations (14 events at this station vs. 22-26 at other stations over the July-September 2005 time period). MIT station also has the poorest fit to the regression line. Because the entire alewife dataset is sparse, with many events yielding no fish, a major difference in the number of sampling events at a particular station could have a large effect on the metric for that station. That is, the probability that an accurate

characterization of alewife densities over time has been produced at the MIT station is reduced compared to other stations. Under the assumption that this station has been inadequately sampled in comparison to the others, the data may be re-analyzed without the data from MIT station. The remaining dataset -- i.e., July-September 2005 juvenile alewife push-net data for all stations except MIT station -- yields a statistically significant ($p = 0.0038$) drop in density of alewives that is highly correlated ($R^2 = 0.957$) with proximity to the discharge. See Fig. C3-3. Thus, in both 2004 and 2005 juvenile alewife densities decreased with nearness to the discharge and the pattern exists both upstream and downstream of the discharge across a linear distance of about 1.9 miles of the lower Basin, downstream of the B.U. Bridge.

These regressions support the hypothesis that proximity to the discharge has negatively affected juvenile alewives' use of the upper water column in the terminal segment of the Charles.

2. Bluebacks

As noted above, bluebacks are both more temperature-tolerant, and more numerous in the lower Basin, than alewives. Notwithstanding this greater temperature tolerance, even bluebacks were adversely affected by Mirant's discharge. Because bluebacks were present in much higher numbers than were alewives, the temperature/distance/abundance analysis for bluebacks is much more robust.

In general, blueback push-net data follow the same spatial pattern as the alewife push-net data. See Figures C3-4 and C3-5. The densities of juvenile bluebacks in push-nets far exceeded those of alewives: in 2004, 8,894 bluebacks were captured in the same surveys that captured only 125 alewives, and in 2005, 12,177 bluebacks were captured compared to only 183 alewives. (Although the bluebacks' greater temperature tolerance is certainly a reasonable hypothesis for their significantly greater total numbers, EPA does not have sufficient data to confirm this hypothesis and does not rely upon it.) Because of these greater numbers, EPA was able to use the median (as opposed to mean) number of fish captured across all sampling events at each station mentioned above for our analysis.

The correlation between median blueback densities at each station and station distance to the Kendall discharge is quite strong in 2004 (see Fig. C3-4; R^2 value = 0.8059) and even stronger in 2005 (see Fig. C3-5; R^2value = 0.9299). Both regressions are statistically significant ($p = 0.0024$ for 2004 and $p = 0.0019$ for 2005) and their slopes are substantial, especially that for the 2005 dataset. Median densities in 2005 were greatly affected: the density at the Boston station (median no. bluebacks/event = 49.5), which is located on the Boston side of the Charles and directly across the river from the Kendall discharge, was only 25% that at the Hyatt reference station (median no. bluebacks/event = 195.5). Densities at the two stations nearest the discharge were even lower (median no. bluebacks/event = 36 and 24 at the mid-channel and shallow-diffuser stations respectively), about 12 to 18% of the median density found at the Hyatt reference station.

In summary, for both 2004 and 2005, as push-net stations got closer to the discharge, juvenile alewife and blueback densities declined. In addition, for both years, the inverse relationship of

juvenile density at each station vs. station distance from the discharge was statistically significantly ($p < 0.05$). Furthermore, this pattern existed throughout the wide section of the lower Charles, from slightly downstream of the B.U. Bridge to a point past the old boat locks adjacent to the Museum of Science, a distance of about 1.9 linear miles.

3. Temperature vs. distance from Mirant Kendall's discharge

EPA examined the relationship between proximity to the discharge and water temperature. Not surprisingly, the temperature increases as one approaches the discharge.

EPA performed regressions on the mean surface water temperature at each station over the time periods in question (July-September 2004 and July-September 2005) vs. station distance from Mirant Kendall's discharge. These regressions, presented in Figures C3-6 and C3-7 for 2004 and 2005 respectively, show a strong positive correlation between temperature and proximity to the Kendall discharge. Indeed, the relationship between distance and temperature for 2005 is essentially linear ($R^2 = 0.9809$). Both regressions are statistically significant (for 2004, $p = 0.0016$; for 2005, $p = 0.000138$. This strongly suggests that the cause of the temperature distribution over the lower Basin is, in fact, Mirant Kendall's discharge.

It is, of course, theoretically possible that the alewives' avoidance of Mirant Kendall's discharge is actually not caused by the discharge, but rather by some other, as yet unknown factor that geographically happens to correlate rather well with the discharge. However, EPA has not identified (and Mirant Kendall has not suggested) a credible alternative explanation for this spatial pattern, and, most likely, Occam's razor points directly to the source.

4. Water temperature vs. juvenile densities

The regressions presented above (Figures C3-1through C3-5) strongly suggest that juvenile alewife and blueback densities in push-nets declined with increasing temperatures caused by Mirant Kendall's thermal discharge. EPA investigated the statistical significance of this potential relationship for both alewives and bluebacks using the 2004 and 2005 datasets (see Figures C3-14 through C3-18). As was done for the 2005 analysis of alewives vs. distance (graphics C3-2 and C3-2), regressions both for alewife density with and without the MIT station information were presented. Note that in regressions for the 2004 and 2005 datasets the following characteristics are apparent for both alewives (when the information for that species at the MIT station is removed for 2005) and bluebacks: a) juvenile densities at each station decline as the mean water temperature measured at each station at time of sampling increases; and that b) the correlations between juvenile densities and water temperatures are statistically significant ($p < 0.05$) in each case.

The spatial analysis of the push-net sampling for juvenile alewives and bluebacks in both 2004 and 2005 indicates that both species' densities declined with proximity to the discharge and that this decline may be attributed to the increased temperature caused by Mirant Kendall's thermal effluent. This pattern existed throughout the widest section of the lower Charles River, from slightly downstream of the B.U. bridge to a point past the old boat locks adjacent to the Museum

of Science – a distance of about two miles This information supports the hypothesis that MKS's thermal discharge negatively affects juvenile alewives' and bluebacks' usage of the upper water column in the terminal segment of the Charles.

B. Juvenile alewife catch in Push-nets vs. temperature

Juvenile alewife presence in push-nets for the 2004 and 2005 sampling seasons (July-September) are presented in Figures C3-8 and C3-9 respectively. These figures present the average number of juvenile alewives captured per survey in each of several temperature ranges along with the number of surveys conducted in that temperature range. Temperature data reported here are the surface water temperature measurements taken at a spot along the sampling transect at the time of push-net sampling.

Figure C3-8 illustrates how the number of juvenile alewives per survey (Catch Per Unit Effort - CPUE) declines with temperature. Most strikingly, even though more than thirty surveys were conducted in 2004 at temperatures at or above 80º F, not one alewife was captured at these temperatures.

Figure C3-9 (the 2005 dataset) does not present as stark a picture, and in fact the CPUEs are, overall, higher in 2005 than in 2004. Moreover, the 2005 data does include a small number of individuals appearing in nets when surface water temperatures at time of catch were as high as 84º F. However, the 2005 data is still consistent with the general trend discernible from the 2004 data: alewives flourish primarily at temperatures below 80 °F, and decline thereafter. The 2005 data reveal a sharp decline in CPUE above 73 °F, and a further decline, to zero, above 84 °F. While the trend is not perfect, the following observations from the 2005 dataset are worth noting:

- The CPUE at 65-66 °F (23 alewives/event) dwarfed that of all higher temperatures; the next closest value is 6.5 alewives/event at 72-73º F, and no temperature above 73 °F yielded even 2 alewives/event.

- While the CPUE at 82-83 °F was 1.75 alewives/event, the CPUE at 83-84 °F was a only 0.5 alewives/event after 10 surveys, and no fish at all were captured in the 28 surveys above 84 °F.

- The low numbers of fish reported at warmer temperatures are not simply due to fewer surveys. More push-net surveys were conducted at 81-82º F than any other temperature range, and yet an average of only 0.78 juvenile alewives were captured per survey in this range.

- The majority of surveys were conducted above 75 °F, and yet fish densities were very low at all temperatures in this range; CPUE exceeded 1.75 alewives/event only in the cooler (< 75 °F) temperatures, which represented a small minority of surveys.

While the 2005 push-net data is probably an inadequate basis from which to draw independent

conclusions, it is generally consistent with, and confirms, the inference from the more extensive 2004 data (and the scientific literature reviewed in the Determination Document) that temperatures above approximately 81º F did not provide suitable habitat for juvenile alewives in the lower Basin. These findings also parallel field data from streams in the Chesapeake drainage where almost all juvenile alewives were captured at temperatures below 80ºF. See section 5.7.3i of the Determination Document.

C. Night-time shoreline seine data vs. location

As noted above, shoreline seine sampling is potentially subject to confounding influences and is thus not as reliable as push-net sampling. Nevertheless, it can be a useful source of data in conjunction with push-net sampling. In this case, the shoreline seine data is generally consistent with the conclusions drawn from the push-net data.

. Mirant reported shoreline seine catch data from sampling events in which two different-length nets were used. In order to estimate the relative densities of juvenile herring captured by shoreline-seine, the catch must be based on the area sampled. Thus, shoreline-seine data presented below are standardized (normalized) to 1000 square feet of littoral zone sampled.

Mirant Kendall conducted shoreline-seining in the lower Basin beginning in 1999. From 1999 to 2000, only daytime sampling was conducted. The permittee sampled two shoreline stations upstream of the facility at night beginning in 2002 and extending through 2005. These are the Hyatt and Lagoon stations. In addition, the Boston station was sampled at night in 2005 but not in previous years. Both the Hyatt and Lagoon stations are upstream of the discharge. The Hyatt station is considered a "reference" station because it is located about 1.4 miles upstream of Mirant's discharge, near the B.U. Bridge. The Lagoon station was located much closer to the discharge, on the Boston side of the Basin, about 0.6 miles upstream from the Kendall discharge. Although this station is well upstream of the facility, based on temperature data provided by Mirant, it was thermally affected by the discharge. Thus, the Lagoon station is considered here to be a “test” station. The Boston station, also a test station, is located across from the Kendall discharge, on the Boston shoreline about 0.3 miles distant from the discharge, and is expected to be more frequently affected by the thermal discharge than the Lagoon station.

The alewife density in the daytime shoreline seine was extremely low. For example, in 2002, after sampling 119,723 ft^2 in the daytime shoreline seine, the average juvenile alewife density was 0.01 alewives/1000 ft^2. In 2003, after sampling 76,391 ft^2, the average density was 0.00. These numbers are so low as to preclude analysis. Since alewife juveniles feed at the surface in dim light, the company initiated nighttime shoreline-seine sampling in 2002 in an attempt to “find” the alewives that were not appearing in the daytime shoreline seine sampling.

As anticipated, the night-time seining found substantially larger numbers of alewives, enabling more reliable analyses. Because only nighttime seining produced juvenile alewives in any considerable numbers, the following analysis focuses on night-time shoreline seine data. Table C3-2 lists the nighttime catch per unit effort of sampling of juvenile alewives at these shoreline beach-seine stations.

Table C3-2. Night-time catch of juvenile alewives at Hyatt, Lagoon and Boston stations, as number of juveniles per 1000 ft^2 of area sampled (Catch Per Unit Effort, CPUE). Periods for which data were collated: 2002: late August through September; 2003: July through September; 2004: July through September; 2005: August through September. These were the only periods each year for which data were available during the July-September period (period of warmest water temperatures in the lower Charles).

Year	CPUE Hyatt Station	CPUE Lagoon Station	CPUE Boston Station
2002	31.2	1.9	n/a
2003	20.8	0.4	n/a
2004	32.4	4.6	n/a
2005	87.5	14.8	9.4

The data from the Hyatt and Lagoon stations are graphically presented in Figure C3-10. Mean temperatures at the Lagoon station were consistently higher than those at the Hyatt station over these periods, and in 2005, the mean temperature at the Boston station was the highest of the three stations listed. The data indicate that the nighttime juvenile alewife CPUE at the Lagoon station is much lower than that at the "reference" Hyatt station, and the CPUE at the Boston station is lower still. This station-to-station drop in catch rates is correlated with proximity to the discharge. Consequently, while the river's overall alewife population appears to have increased somewhat in 2005 (see Other Considerations section below for potential reasons), the night-time shoreline seine data suggest that juvenile alewives displayed a strong preference for the upstream, cooler Hyatt station, or, put differently, a strong preference to avoid the area influenced by MKS's thermal discharge. Of course, as noted above, shoreline seine data may be subject to confounding influences, and if this were the only data available, it might be inconclusive. But viewed in the context of the push-net data, the night-time shoreline seine data supports the general inference that juvenile alewives avoid higher temperatures in the lower Basin.

D. Nighttime shoreline seine data vs. temperature

EPA attempted to analyze the influence of temperature on nighttime shoreline seine data by comparing the CPUE to the surface water temperatures collected at each station when seining took place. The 2003-04 data suggest a fairly straightforward temperature-alewife density relationship, although the 2005 data are inconclusive.

In 2003, only three surveys were conducted at temperatures higher than 80º F; no alewives were found in these high-temperature surveys. See Figure C3-11. In 2004, the data indicates a declining CPUE trend as temperature increases between 71° F and 80º F, although no surveys were conducted at temperatures above 80º F. See Figure C3-12.

In 2005, no clear pattern emerges from the data points. See Figure C3-13. For example, at 79-80 °F, the average density was only 4.8 juvenile alewives/1000 ft^2 were caught; just one degree warmer, in the 80-81º F range, the density was 47 times greater (224 alewives/1000 ft^2). At the hot end of the spectrum, 1,389 ft^2 were sampled at 85-86º F and not one juvenile alewife was found, but between 86-87º F, four fish were found in just 280 ft^2 of sampling. The 2005 data appear to illustrate the influence of confounding variables, and thus no firm conclusions can be drawn. However, it is worth noting that, as a simple visual inspection of Figure C3-13 illustrates, the average densities for temperatures above 81º F were generally lower (in most cases substantially lower) than densities for temperatures below 81ºF and the four temperature categories with the highest CPUE were all found at or below a temperature of 81ºF.

Overall, EPA finds that the night-time shoreline seine data is roughly consistent with the inferences drawn from the push-net data. However, because of the limitations of the data set, no firm conclusions can be drawn from the night-time shoreline seine.

III. Summary

1. Very few alewives are present in the lower Basin.

   A. In 2003, juvenile alewives were essentially absent from the open-water areas sampled by push-nets downstream of the B.U. Bridge in 2003; only 5 juvenile alewives were captured in 237 separate push-net surveys. (By contrast, 6,036 blueback juveniles were captured in the same surveys.)

   B. In 2004, the total number of alewives caught in push-nets increased from 2003 levels, but only to 125 fish. The number of surveys also increased by about 50% from 2003. (By contrast, 8,894 blueback juveniles were caught in the same surveys.)

   C. In 2005, the total number of alewives caught in push-nets increased to 183 fish. (By contrast, 19,926 blueback juveniles were caught in the same surveys.)

2. In 2004 and 2005, the density of both species of juvenile river herring declined with approach to the discharge

   A. Push-net catch of juvenile alewives declined with proximity to the discharge. In both 2004 and 2005, juvenile alewife densities decreased with nearness to the discharge, and the pattern exists both upstream and downstream of the discharge across a linear distance of about 1.9 miles of the lower Basin, downstream of the B.U. Bridge. In 2004, juvenile alewife capture rates at stations within 0.5 miles of the station were less than 13% of the value at the Hyatt reference station; in 2005, capture rates for juveniles alewives at stations within 0.2 miles of the discharge were $\leq$ 20% of the value at the Hyatt reference station.

   B. Push-net catch of juvenile bluebacks also declined with proximity to the discharge. Although bluebacks are more temperature-tolerant than alewives, bluebacks are far more

numerous in the lower Basin, allowing for more robust statistical analysis. The bluebacks exhibited a spatial distribution similar to the alewives, suggesting that even these more temperature-tolerant fish avoid the Mirant Kendall thermal plume.

C. Night-time catch of juvenile alewives in shoreline seines declined with proximity to the discharge. At the Hyatt Station, located about 1.6 miles upstream of the discharge, the night-time catch of juvenile alewives remained fairly constant (20-32 fish/1000 ft^2) for the four years of study (2002-05). However, night-time catch at the Lagoon Station, located only 0.6 miles away from the Kendall Station discharge, was consistently and substantially lower (0.3-14.4 fish/1000 ft^2).

3. Very few juvenile alewives are found above 80º F.
A. 2004 push-net juvenile alewife catch rates of in push-nets declined with increasing temperatures even though fishing intensity increased greatly as temperature approached 80º F. Although more than 30 surveys were conducted at temperatures in excess of 80º F, no juvenile alewives were captured in those surveys.

B. The 2005 push-net data is not as uniform as the 2004 data, but is generally consistent with it. While a small number of juvenile alewives (between 0.5 and 1.75 fish/event) were captured at temperatures above 80 ºF (and indeed as high as 84 ºF), the overall pattern indicates a sharp decline in fish density above 73 ºF, and a decline to zero above 84 ºF. Although 28 surveys were conducted at temperatures in excess of 84 ºF, no juvenile alewives were captured in those surveys.

C. The night-time shoreline seine sampling data are arguably inconclusive, but are not inconsistent with the inference drawn above. The 2003 data indicate a precipitous drop above 80 ºF, with no fish caught above that temperature. However, only 833 ft^2were sampled above 80 ºF, so this may be a data artifact. Similarly, the 2004 data indicate a more gradual decline in CPUE from a peak at 71-72 ºF, but no surveys were conducted above 80 ºF. Finally, the 2005 data indicate generally higher CPUE below 81 ºF, but the data do not display a clear overall trend. Because shoreline seine sampling is subject to confounding factors specific to the particular sections of shoreline sampled, these anomalies are not surprising.

The Charles River data cited above, combined with the scientific literature summarized in the Determination Document, support the inference that the thermal discharge from Kendall Station at levels documented in 2002-05 resulted in alewives and bluebacks avoiding, or being excluded from, large portions of the Basin. Moreover, the areas from which these fish are excluded are, in EPA's technical judgment, unacceptably large. First, alewives and bluebacks are species of heightened concern, so their nursery and/or spawning grounds merit particular attention. Second, the area from which alewives (and, to a lesser degree, bluebacks) are excluded is substantial: about 1.3 linear miles, . Because this exclusion area is located within the widest section of the lower Basin, it occupies a considerable proportion of the surface area of the Basin. Consequently, the above data lead EPA to conclude that both alewives and bluebacks have suffered appreciable harm attributable to MKS's thermal discharge (along with other cumulative

stresses).

EPA judged that the push-net information submitted by the permittee was essential in evaluating appreciable harm that was due to the facility's heated discharge. As such, the continuation of push-net sampling has been included in the biological monitoring section of the final NPDES permit (see Part I.A.14.d.1).

IV. Other Considerations

In 2005, the total alewife population in the lower Basin enjoyed a modest resurgence, after years of decline. (A similar increase was observed in bluebacks.) At the same time, Mirant Kendall's thermal discharge was highest in 2005, which, judging from the data, raised water temperatures well above ambient levels. Additionally, ambient temperatures at the Hyatt station were higher than those in other years, partly due to reduced river flows, but perhaps also due to the Mirant Kendall discharge. Mirant Kendall has suggested that – despite consistent evidence from scientific literature showing thermal avoidance at temperatures like those seen in the Basin -- fish densities increased in 2005 because of the high water temperatures. This "thermal enhancement" argument is erroneous for the following reasons. Cf. Response to C23.

First, as one would predict from the literature, the push-net data (and, to a lesser extent, the shoreline seine data) indicate that alewives display a strong aversion to high temperatures. One would expect the opposite (i.e., that fish would be drawn to high temperatures) if an attraction to high temperatures resulted in increased feeding opportunities, increased vigor, a reduction in predation, or some other variable that increased their ability to survive and produce viable offspring. To the contrary, the density of fish found at push-net stations decreased with proximity to the Mirant Kendall discharge, and decreased with rising temperatures. In other words, while the total number of alewives in the Basin increased in 2005, those fish tended to avoid the area near Mirant Kendall's discharge and, by inference, its thermal plume.

Second, as a general rule, the total population of a given "year class" of anadromous fish can vary for reasons unrelated to river conditions in the particular year in which the class is measured. These can include other environmental stressors, whether natural or man-made; predator-prey cycles; and, for some stocks, fishing. One stressor may decrease as another is increasing, partially or totally masking the effect of the latter. Moreover, the size of an anadromous fish population can be affected by conditions in different places (i.e., the ocean, where the class's parents spent their adulthoods) or in different times (i.e., the same river several years before, when the class's parents were juveniles). All these factors make it hazardous to draw conclusions from one or two years of increasing (or decreasing) total population, particularly when the actual totals are quite low. In this analysis, EPA has not focused primarily on year-to-year changes in the total numbers of alewives. Rather, EPA's appreciable harm determination has focused on the fact that Mirant Kendall's thermal plume appears to exclude juvenile alewives from large portions of the lower Basin – an important nursery ground – for extended periods of time during which those fish need to build strength for the punishing journeys ahead.

Third, moving from the general to the specific, there are explanations for the apparent rise in juvenile alewife stocks in 2005 that are more plausible than Mirant Kendall's hypothesis of an attraction to warmer temperatures. A number of structural improvements to fishways occurred within the Charles River prior to the summer of 2005 which were expected to, and probably did, greatly improve the ability of adults to move upstream to spawn. These include:

- The replacement of the baffles in the fishway at the Watertown Dam in April of 2005, during the period of upstream migration of both alewives and bluebacks. The Watertown Dam is the first obstruction upstream of the New Charles River Dam that fish must pass in order to move to upstream spawning sites. In previous years, fishway baffles had deteriorated at this site. Fishways are engineered to provide a particular range of flows and turbulence that are attractive to anadromous fish. Replacement of the Watertown Dam baffles increased the "attractive flow" of this fishway. In addition, poaching of river herring had become a problem at the Watertown Dam fishway, although the extent of the damage to the populations of river herring was unknown. Steel structures were installed to prevent poachers from accessing the fishway in April of 2005. These actions should have increased the number of fish passing though the fishway.

- Improvements at the Cordingly Dam, located farther upstream from the Watertown Dam. The fishway at Cordingly received new baffles in October of 2004, which was projected to improved fish movement past Cordingly Dam.

- New procedures for locking fish into the Charles, beginning in 2004. The new procedures for allowing fish to enter the system could reasonably be expected to result in a greater number of fish actually moving into the Charles.

One other important fact to consider is that much of the production of juvenile fish within the Charles is expected to take place upstream of the Mirant Kendall facility. High numbers of fish found within the lower Basin in the summer of 2005 would have resulted from increased numbers of adults attempting to enter the Charles before the summer of 2005.

With respect to Mirant Kendall's suggestion that there appears to be a correlation between years of low river flows and years of high production, see Response to C23.

V. Conclusion

EPA has concluded, based on Mirant's field data, that a majority of alewives and bluebacks are excluded from unacceptably large areas of important habitat in the lower Basin, and that this exclusion can be tied to both the location of Mirant Kendall's discharge and the higher river temperatures associated with it. While not every single data point in every single survey points unambiguously in this direction, the weight of the evidence points to large-scale habitat exclusion. Consequently, in EPA's professional judgment, Mirant Kendall's thermal discharge has caused (and continues to cause) appreciable harm to the BIP.

Comment related to C3 from Mark Jaquith: In 2003 the herring run was very healthy. Where are they now? This year (2004) there were very few fish. I do not have the resources to answer that question, but I do believe that it calls Mirant's claim into suspicion.

Response to Comment related to C3 from Mark Jaquith: There are a number of ways to measure the strength of an anadromous fish run in a river. One common way is to count the number of adult fish as they enter the river to spawn. The only measurement of the strength of the adult alewife and blueback herring run in-migration in the lower Basin was conducted as a pilot study by the permittee in 2002. The pilot study estimated that approximately 45,000 river herring entered the Charles River. This permittee listed many problems with the technique used to arrive at this value. EPA agreed that any future study would need refinement before any estimate would be considered reliable. Also, it has been noted at other anadromous fish runs with multi-year adult anadromous fish counts that year to year runs can vary greatly. There is no way to place the 45,000 adult river herring value within this context, even if the number was considered reliable.

EPA and MassDEP do not have sufficient information to document that the herring run in 2003 was "very healthy." According to collection data for blueback herring juvenile and adults, submitted by the permittee and listed in Response to Comment C23, blueback herring catch rates were generally stable and similar in 2002, 2003 and 2004. While alewife catch rates did not follow this pattern, there is sufficient collection information to contradict the assertion that there were very few river herring seen as a whole in 2004.

Comment related to C2 and C3 from CLF: CLF states that (1) fish populations are not thriving and the river is currently impaired, (2) there is a severe conflict of interest that undermines the credibility of any data provided by Mirant Kendall, and most of Mirant Kendall's recent studies lack scientific rigor, (3) observations of an individual fish at some particular high temperature in the Basin provides virtually no insight into the natural biology of the species in question and should not be used, and (4) setting protective limits based only on estimates of lethal temperatures, or avoidance temperatures, is not consistent with promoting the propagation of the indigenous species in question.

Response to Comment related to C2 and C3 from CLF: While EPA and MassDEP have evaluated information that would suggest that the Charles River is below its expected carrying capacity for anadromous fish runs, this information is being treated as a preliminary indicator of the health of the anadromous fish populations. Estimates of resident fish populations in the lower Basin have not been attempted. It is difficult to quantify what measurements would define a "thriving population." It must be pointed out that EPA's regulatory responsibility is to ensure that a balanced indigenous population is maintained.

As noted in the Determination Document (DD), the Charles River is currently listed by MassDEP as impaired for organic enrichment/low DO, noxious aquatic plants, and taste, odor and color problems, along with, contaminated sediments, harmful bacteria, and increased turbidity (Breault *et al.*, 2002; Fiorentino, *et al.*, 2000; MA EOEA, September 2003). The thermal discharge from Kendall Station is not specifically listed as an impairment to the lower

Basin at this time.

Regarding the conflict of interest concern, from the inception of the NPDES program, it has been the responsibility of the permittee (or applicant) to collect and present data used by regulatory Agencies to establish or revise permit requirements and evaluate 316(a) variance requests and 316(b) determinations. It is in the best interest of the permittee to provide clear, correct, and complete data sets for agency evaluation, or risk having a permit application or renewal be denied.

Environmental data collected by NPDES permit applicants are not routinely given rigorous peer review and are not generally submitted for publication. This information is routinely collected using standard operating procedures and submitted along with supporting quality assurance documents such as calibration logs. This data is of value in determining the impact of a facility's discharge on the receiving water. A discussion of the range of temperatures where fish were observed provided site-specific context for the temperature limit discussions in the Determination Document. There is no instance in the formulation of thermal limits for Kendall Station where a small number of fish observed at a high temperature was used as the sole justification for a higher temperature as a permit limit.

Indeed, it was pointed out in several parts of the DD that "Setting temperature limits based only on individuals that may naturally be able to tolerate warmer temperatures is not thought to be an approach that is sufficiently protective of the population as a whole." (Section 5.6.3k of the DD) EPA's assessment of the data submitted by the applicant in the DD and in this response to comments document demonstrates that EPA has reviewed those data and corresponding arguments presented by the permittee with both care and an appropriate regard for the obvious self-interest of the permittee. EPA has diligently scrutinized the materials submitted by the permittee and has not accepted outright the permittee's analysis of the appropriate temperatures necessary to protect the BIP.

Comment related to C3 from CRWA: CRWA states that it is dangerous to extrapolate from avoidance and lethal temperatures to establish thermal conditions under which fish will thrive and successfully reproduce in the long-term. CRWA suggests that a healthy river of the size of the Charles has an estimated carrying capacity of roughly 300,000 river herring, yet recent estimates put the adult population near 45,000 (i.e. only 15% of capacity). Finally, CRWA notes that MADMF has recently committed about $300,000 for renewed efforts to bring back healthy populations of migratory fishes to the Charles, which may be thwarted if Mirant Kendall is allowed to operate under the draft permit proposed by EPA.

Response Comment related to C3 from CRWA: The lower Charles River Basin, prior to the influence of Kendall Station, is among the warmest rivers in Massachusetts. EPA and MassDEP recognize that if the scientific literature was exclusively consulted to set protective temperature limits, these limits would consistently be exceeded by ambient conditions in the lower Charles River Basin. See Response to CLF Comments related to C45 for a detailed illustration of this point. It would be unreasonable to expect the Kendall Station to effectively cool the Basin in order to meet its permit conditions. EPA has used its best scientific judgment to balance the low

temperatures suggested in the literature to avoid long-term chronic impacts with the actual conditions occurring in the Basin.

Estimates of carrying capacity and adult in-migrating populations of anadromous fish in the lower Basin are not believed to be sufficiently refined at this time to be the basis for the major determinations included in the permit. See Article #1 in the Appendix accompanying Response C23 for details of MA DMF's Charles River carrying capacity estimates.

EPA and MassDEP are aware of the new efforts underway to reestablish anadromous fish runs in the lower Basin, particularly for American shad (see Response to C51). Protective temperature limits for American shad have not been established at this time. However, if this restocking effort re-establishes American shad in the lower Basin, the next permit, or a permit modification, may establish temperature limits that are appropriate to protect American Shad.

Comment C4: At several points in the DD, the Agencies refer to the potential past or future effect of the withdrawal and discharge of cooling water to serve the Blackstone Station, which is located in Cambridge upstream from the B.U. Bridge and the Kendall Station. As the Agencies recognize, the Blackstone Station has not operated to withdraw or discharge material amounts of cooling water other than sporadically in recent years. Blackstone Station is owned by Harvard University, which currently operates it to generate on-campus steam but not to generate electricity. The use for on-campus steam does not require the withdrawal or discharge of significant quantities of cooling water (rather, immaterial amounts of river water are now used for cooling of miscellaneous equipment). Further, Blackstone's steam turbine generator is no longer operable and is incapable of generating electricity. Harvard has publicly announced that it does not intend to resume electric generation using a repaired or replaced condensing steam generator system. Further, the Blackstone NPDES permit is in its renewal process, providing a mechanism and process for consideration of its future operating scenarios within that context, rather than in a speculative manner in Kendall Station's permit process. Accordingly, in determining what permit conditions are appropriate for Kendall Station, the Agencies should not assume there will be any additional effects from an upstream power plant.

Response to C4: EPA and MassDEP are in contact with the Blackstone Station's permittee and are aware of their intent to fundamentally change the way Blackstone Station is operated. The permit applicant for Blackstone Station has proposed to eliminate its thermal discharge to the Charles River. However, until a renewed permit for Blackstone Station is finalized, EPA and MassDEP will not predict future Station operation or potential impacts to the river in absolute terms. To avoid speculating about the Blackstone Station, EPA and MassDEP are not assuming any additional effects from the Station in setting permit conditions for Kendall Station that control the biologically based temperatures required to be maintained to protect the BIP. The possible heated discharge from Blackstone was a consideration in deciding on a location for background monitoring. EPA and MassDEP do not expect the Blackstone Station to impact the background monitor measurably. It must be noted, however, that Mirant is required by the permit to collect periodic temperature data in addition to the data collected by the fixed Monitoring Stations (See Part I.A.14.c.1 of the Final Permit). The additional temperature data will be used to generate contour maps of temperature throughout the Basin. This information

will be reviewed to directly assess the appropriate location of all fixed Monitoring Stations, including background Station 1.

Comment C5: Mirant Kendall believes that the Agencies' proposed temperature limits as specified on Attachment A to the Draft Permit are without adequate justification. The permit writers have sought to establish those temperatures mostly by reliance on literature values of highly uncertain applicability to the complex and particular circumstances of the Charles River. By this comment, Mirant Kendall suggests an alternative approach that relies on the ambient temperatures in the Charles River itself and is thereby inherently consistent with the biology of the river.

Mirant Kendall believes this approach will best allow the Agencies to meet their stated goal of determining the "appropriate deviation from ambient or natural temperature conditions without adverse effects to the biota and to the balanced indigenous population." The core of this suggested alternative is to determine the range of temperatures that have supported the BIP of yellow perch and alewives in the Charles River at the times of year corresponding to the in-stream limits in the permit. Although Mirant disagrees with the biological validity of some of the calendar periods designated by the Agencies in the Draft Permit, for purposes of moving forward it bases this alternative approach on those same calendar periods. For all fall, winter and spring periods (through mid June), Mirant agrees with EPA's conclusion in Section 5.9 of the DD that the continuous record of Kendall Station intake temperatures is a reasonable representation of ambient conditions. For each such time period, the historical record of intake temperatures would be analyzed statistically to determine the average temperatures for the time period and also the range of variation from the average (standard deviation, 90% upper confidence bound, and 95% upper confidence bound).

Where there is no finding or evidence that the range of recent ambient temperatures have caused appreciable harm to the BIP, temperature limits derived from that statistical analysis would, by definition and by design, fall within the normal range of the temperatures that the Charles River has experienced without unacceptable harm to the BIP. Discharges consistent with maintaining such temperature limits would accordingly be sufficiently limited to protect and propagate the BIP. The approach of using statistical analysis and standard deviations to determine the range of temperature to consider acceptable is consistent with EPA New England's own approach to considering whether to expect ecological damage from a range of in-stream temperatures. See MK Comment Ex. No. C5, a memo produced in response to Mirant Kendall's public records requests to DEP, in which a member of EPA New England's ecological risk assessment staff indicates that a temperature within 2 standard deviations of the mean should not be considered harmful.

The suggested statistical approach also is consistent with the approach Massachusetts has taken to determining whether a water body segment is in attainment with the Massachusetts WQS for temperature. Under the Massachusetts approach, a water body is in attainment as long as no more than 10% of the temperature readings (24-hour averages) are in excess of the WQS. That approach appropriately recognizes that a range of temperatures around and above the target temperature is consistent with attainment of the standard without causing limitations on the

ability of the water body to support aquatic life.

The suggested use of a statistical analysis of the historical temperatures is not a full compliance system all by itself. The full compliance system also involves determining appropriate targets for the summer, when the intake temperatures are not as representative of ambient conditions, determining just where to measure the determinative temperatures, determining what averaging time to use, and determining the consequences for the plant's operations as a target temperature is approached or exceeded.

To illustrate this approach, Mirant Kendall has analyzed the record of continuous temperature monitoring from 1998 to 2004 at its intake on the Broad Canal. The Agencies acknowledge that these intake temperatures are a reliable indicator of ambient conditions during the fall, winter and spring, provided normal seasonal river flow conditions are present. Mirant Kendall believes the intake temperatures also are useful for illustrating the magnitude of historic variation during the summer months, but can exceed "ambient" by up to 2 ºF or 3 ºF if the plant is operating at high thermal loads during low flow conditions in the summertime

The statistical analysis from 1998 through 2004 – which comprise a full range of cooler and warmer years – shows the following for 24-hour average temperatures at the Broad Canal intake, as compared to the Agencies' proposed temperature limits in Appendix A to the Draft Permit.

Frequency Distribution of 24-hour Average Temperatures (°F) at Kendall Intake, Compared to Agencies' Proposed 4-hour Block Average Temperature Limits in ZPH.

Time of Year	Mean at Intake	Standard Deviation	90% Confidence Upper Bound	95% Confidence Upper Bound	Draft Permit in ZPH
April 2-14	49.38	4.76	57.23	58.90	61
April 15-30	55.37	3.94	61.88	63.26	65
May 1-10	61.21	4.02	67.84	69.24	66.4
May 11-22	63.70	3.57	69.09	70.34	68
May 23-31	64.76	3.44	70.44	71.64	70
June 1-7	67.81	3.74	73.98	75.29	72
June 8-11	68.76	3.85	75.11	76.46	75
June 12-August 31	77.07	4.12	83.88	85.32	83

Those results indicate that for 1998 to 2004, the means of the 24-hour average temperatures at the intake were well below the Agencies' proposed 4-hour average temperature limits in the ZPH. At the 90% confidence upper bound, which is more than one but less than two standard

deviations from the mean, the 24-hour average intake temperature were lower or very similar to the Agencies' proposed limits excepting for early June.[1] At this 95% confidence upper bound, which is two standard deviations above the norm, the 24-hour average intake temperatures again ranged from below the Agencies' proposed limits for some time periods to warmer in others. Mirant Kendall also analyzed the same temperature record using the daily maximum 4-hour block averages instead of 24-hour averages. The following table again compares the results to the Agencies' proposed temperature limits in Appendix A to the Draft Permit.

Frequency Distribution of Maximum 4-hour Block Average Temperatures (°F) at Kendall Intake, Compared to Agencies' Proposed 4-hour Block Average Temperature Limits in ZPH.

Time of Year	Mean at Intake	Standard Deviation	90% Confidence Upper Bound	95% Confidence Upper Bound*	Draft Permit in ZPH
April 2-14	50.03	4.84	58.02	59.72	61
April 15-30	56.14	4.06	62.84	64.26	65
May 1-10	62.15	4.36	69.34	70.86	66.4
May 11-22	64.16	3.59	70.09	71.35	68
May 23-31	65.61	3.53	71.43	72.66	70
June 1-7	68.76	3.78	74.99	76.32	72
June 8-11	69.66	3.89	76.08	77.44	75
June 12-August 31	77.97	4.18	84.87	86.33	83

***2 standard deviations above the mean**

These results indicate that for 1998 to 2004, the means of the daily maximum 4-hour block average temperatures at the Broad Canal intake also were well below the Agencies' proposed temperature limits in the ZPH, but that on some occasions the daily maximum 4-hour block average temperature exceeded the proposed limits. That is unsurprising because contrary to nature, the Agencies' proposed limits apply at all times and do not vary according to the river's daily temperature cycle.

Response to C5: EPA has considered this alternate approach and has decided not to apply it because it does not appear to be a sound means of setting temperature limits protective of the BIP.

Within Comment C5, Mirant refers to a record of an oral communication with a member of EPA's ecological risk assessment staff regarding the use of temperature standard deviations in assessing potential impacts. This communication was a set of notes prepared by Gerald Szal of MassDEP based on a phone interview conducted by Gerald Szal with David McDonald of the EPA Region 1 Laboratory in Chelmsford, MA. The note was prepared for a meeting with

[1] As explained in other comments, Mirant Kendall believes the Agencies' proposed temperature limits for early May and early June are fundamentally mistaken.

Mirant. The statement referenced by Mirant is two sentences long and reads as follows: "Dave McDonald, ecological risk assessment, Region I: use 2 standard deviations from the mean as an upper maximum limit or population will not be protected. This amounts to the 95%-ile figure."

Mirant has taken the interview between Mr. Szal and David McDonald out of context. Properly understood, this approach concerned development of an upper temperature for alewife movement into the lower Charles Basin using field-data from: a) temperatures at which alewives were observed entering freshwater systems; and b) numbers of alewives known to run at those temperatures. Mr. McDonald's suggestion was to use the 95%-ile figure from the frequency distribution of alewife entry and associated temperatures to arrive at an upper maximum temperature. To arrive at that figure, the resource Agencies used the frequency distribution of run strength as it applied to temperatures at which fish were known to run. Mr. McDonald's suggestions did not state that daily average temperature values or daily maximum temperature values would be appropriate to use. The intent was to include (when possible) only temperature data from the hours that fish were documented moving into the freshwater system. Data from three separate rivers were analyzed (see Table 5.7.3c-3 and accompanying text in the DD). Each had an anadromous alewife run. Data from Richkus (1974) were also used. Here, run strength was sharply diminished at temperatures above 64.4 ºF. The exercise resulted in an upper 95%-ile value of slightly higher than 65 ºF. Therefore, the result of the data review showed that about 95% of the alewives entering the freshwater in these systems did so at temperatures lower than about 65 ºF. In fact, most of them entered when water temperatures in the freshwater system were well below this value.

Mirant has used the two sentences from Mr. Szal's note in an inappropriate context. Mr McDonald's idea in the phone conversation was to use the run strength and temperature information when fish were entering the system from a successful run to arrive at an upper maximum temperature. By contrast, Mirant proposes to use temperatures from the system itself, without knowing whether or not fish were moving into the freshwater system during the hours (or days) included in the "statistically-based" frequency distribution of water temperatures. This approach is inappropriate because temperatures will be included when it is not known whether fish are entering the system. Using this method, there will be no correlation of run strength with temperature.

Further, the temperatures identified by Mirant during other times of the year were also left uncorrelated with biological data. Mirant identified a certain high ambient temperature that could be expected in the lower Basin for a short period of time, but provided no supporting information that this temperature resulted in no stress to the resident and anadromous fish in the lower Basin. EPA and MassDEP can not accept this approach and can not justify a protective temperature limit based solely on the fact that the temperature is expected to occur in a water body under ambient conditions. During certain times (heat waves, droughts, etc.) water temperatures in any water body, although considered ambient temperatures, would never the less place stress upon the BIP. Mirant's statistical approach does not take this into account.

Even if this issue could be addressed by Mirant in this particular case, another flaw in this approach is evident. If a maximum temperature limit were to be established using this approach,

EPA and MassDEP would be allowing an infrequent, high temperature to be attained as a result of a man-made thermal discharge for a much longer time period than noted by the statistical assessment. This can not be justified as a protective approach for the BIP. Not only has Mirant misused the guidance proposed by EPA, it has misused its own stated form of the guidance in developing alternate temperature limits:

1) With regard to temperatures appropriate for the alewife run: One of EPA and MassDEPs' primary concerns during the spring is that temperatures at the mouth of the Charles should not run so high that alewives are discouraged from entering the system. Mirant should have used the temperatures from the Charles collected during those times when alewives were known to be entering the system. Only these temperatures should be used to develop a frequency distribution and the Maximum 95%-ile figure for alewife entry into the Charles. This method was clearly not followed in Mirant's tables for Comment C5.

2) With regard to summer ambient temperatures, the data do not support Mirant's contention that the intake temperatures are only 2-3 ºF higher than upstream ambient. Information presented in the DD shows that the intake temperature can be more than 5 ºF higher than ambient upstream temperatures. Although Mirant presents temperatures for June through August that range up to 85.3º F, intake temperatures during these times do not reflect ambient and may be many degrees higher than ambient. Thus, the tables Mirant presents in comment C5 do not reflect ambient river temperatures.

3) With regard to the table presenting 4-hour block average temperatures in Mirant's Comment C5, it appears Mirant has selectively used the temperature data, which has skewed the temperature profile higher. To develop a frequency distribution, and further, to select a particular percentile (e.g., 95th) from that dataset, the researcher must use the entire dataset. Based on the title of this table ("Frequency Distribution of Maximum 4-hr Block Average Temperatures" (emphasis added)), it appears Mirant produced a depiction of temperature information skimmed from the highest 4-hr block temperatures from the 7-year dataset (1998-2004). To accomplish this, Mirant selected the highest 4-hr block temperature from each day in each of the seven years and calculated the mean temperature from this maximum temperature data set. This equates to using only one sixth (approximately 17%) of the available ambient river temperature data rather than the full dataset to arrive at the 90th and 95th percentile figures.

In order to develop a percentile of the type suggested by Mirant in Comment C5, the entire dataset must be used. If it is not, the "95%-ile" estimate is not representative of the data and is of little value.

Based on the assessment above, EPA and MassDEP do not agree with Mirant's suggested alternative approach to developing permit limits for temperature.

Comment C6: The DD cites to several studies of river herring performed by William Richkus,

Ph.D., in Rhode Island waters in the 1970s. Since then, Dr. Richkus has gone on to serve as the Program Manager for the Power Plant Research Program (PPRP) in Maryland. Mirant Kendall retained Dr. Richkus to undertake an independent review of the draft NPDES permit and the permitting documents. In his report, Dr. Richkus makes comments on the bases for EPA and DEPs selection of protective temperatures in the zone of passage and habitat, and also, on alleged errors and over-conservatism of the Agencies' general approach.

Response to C6: EPA and MassDEP note preliminarily that Dr. Richkus did not have available to him the entire administrative record which the Permitting Agencies had assembled as of the date he formulated his comments. And obviously, he could not have considered the material that has come to the permitting Agencies following the date of his comments. Therefore, his analysis is necessarily limited to a subset of the materials EPA and MassDEP considered in developing both the draft and the final permit.

Just as obviously, Dr. Richkus was not involved in the years-long process that EPA and MassDEP undertook to develop this permit and respond to the varying proposals the permit applicant put forward. While his comments bring a fresh perspective to the deliberation, unencumbered by the history behind this permit's development, they also fail to appreciate the extent to which the permit is a product of EPA and MassDEP's efforts to address the applicant's expressed needs for operational flexibility and desire to avoid relying on a model to develop protective discharge limits.

As a general matter, Dr. Richkus finds the draft permit too strict and too complex, complaining of the 230 page long explanation EPA and MassDEP assembled to support the limits in the draft permit. EPA and MassDEP generally find his assessment difficult to reconcile with both his own proposed template for responsible thermal limits and the needs of the applicant. As discussed below, the formula he recommends on which Maryland relies to address thermal discharges would appear to be considerably more restrictive than the limits in this permit. Therefore, it is hard to understand how he concludes that the draft permit is too strict. Moreover, his description of EPA's basis for developing protective in stream temperatures suggests he may not have grasped the entirety of the analysis the permitting agencies presented in those 230 pages. On page 3 of his comments, Dr. Richkus asserts that EPA and MassDEP derived the instream temperatures "[b]ased on literature data." EPA and MassDEP did start with literature data, but then tempered those values considerably based on the ambient characteristics of the lower Basin. Dr. Richkus did not make note of this step in the analysis.

EPA and MassDEP have no quarrel with Dr. Richkus's general observation that this is a complex permit. What Dr. Rickkus is not in the best position to appreciate, however, is that the complexity of this permit is almost entirely the product of the applicant's expressed need to discharge more heat than would be allowed by a simple set of end-of-pipe limits modeled to assure protective in-stream temperatures. In brief, Mirant's desire to use the actual, real-time assimilative capacity of the river, which a model by necessity must underestimate, makes this permit more complex than permits typically issued by EPA New England and MassDEP. If the applicant were prepared to offer a set of simple end-of-pipe discharge limits that were genuinely protective of the BIP, EPA and MassDEP would gladly consider them in an effort to reduce the

monitoring burden on Mirant and the enforcement burden on the Permitting Agencies. But it appears that such limits would further restrict the Kendall Station's operational flexibility.

EPA and MassDEP have selected the most important statements in Dr. Richkus' review and present an assessment of these statements below:

Dr. Richkus: Pg. 3, Par. 4: "One statement made in the Fact Sheet. 'The Facility's operation is believed to have a significant impact on the water quality and aquatic populations that exist in the Charles river from the mouth of the river upstream to where the river passes Watertown' does suggest that some prejudgment on the facility's effects may exist since this specific statement does not appear to be substantiated by the detailed material presented in the determination document."

EPA and MassDEP disagree that pre-judgment took place. First, there is clear evidence that Kendall's discharge has a significant effect on the physical water quality of the basin. The DD substantiates these effects with frequent examples of water temperature impacts. Mirant's data show conclusively, for example, that ambient temperatures found well-upstream of the facility are lower than those downstream of the facility, especially in the summertime during periods of low-flow. Modeling by the permittee, which was not accepted by the agencies but has been used as a general guide, has shown that the facility has a great potential to heat the lower Basin and field data have verified that river temperatures have been pushed well beyond the 83 ºF standard for warm water streams due to releases of heat from the discharge. Numerous field measurements conducted by EPA, USGS, Mirant and a variety of state resource agencies have confirmed that the facility's thermal releases cause water temperatures to be warmer than ambient temperatures. Thus, Dr. Richkus' statement that the agencies have not substantiated the fact that the facility has a significant impact on water quality is not consistent with the data record.

In any case, the Permitting Agencies disagree with Dr. Richkus characterization of the information presented in the DD regarding Mirant's effects on the aquatic community in the Charles and any alleged "prejudgment." Judgments regarding effects were based on data collected and analyzed both by Mirant and the resource agencies. Further, merely because this statement was made early in the Fact Sheet does not mean that it represents a conclusion drawn prior to this analysis. Rather, the statement provided a short overview of the conclusions the permitting agencies had reached after assessing the available data.

Dr. Richkus: Pg. 4, para. 2. Dr. Richkus states that the "context for my general opinion of this draft permit is the thirty years of experience I have had in assessing impacts of power plants in Maryland and making recommendations to Maryland's permitting agency on thermal discharges from those plants." Dr. Richkus goes on to state what the requirements are in Maryland regarding thermal discharges. They are summarized here:

a) the maximum allowable discharge temperature in Maryland is 32 C (89.6 ºF);
b) mixing zones may not exceed 2 ºC (3.6 ºF) above ambient as a 24-hr temperature over more than 50% of the river;

c) the 24-hr. average temperature may not exceed 2 ºC (3.6 ºF) over ambient over more than 5% of the bottom passed by 6 hrs. of streamflow; and
d) the 24-hr average temperature may not exceed 2 ºC (3.6 ºF) above ambient over more than the distance traveled by stream flow in 6 hrs.

Dr. Richkus also states that, based on his experience in dealing with facilities that meet these criteria, his agency found no evidence that fish movements were blocked by thermal plumes in the plant's receiving waters.

These statements bear further examination. Based on the information below, it is fairly clear that permit limits for Maryland thermal discharges are much more restrictive than are those proposed for Kendall in the draft permit:

Variable	**Maryland**	**Mirant Kendall Draft Permit**
Max. Discharge Temperature	89.6 °F	105 °F
Delta Temperature in Mixing Zone	3.6 °F (24-hr avg)	No limit- may be 20° F over ambient due to T of discharge
Cross-Section Allowed to Exceed Bottom area	50%; 3.6 °F > ambient; Over 5% of bottom passed in 6 hrs of stream flow	50%, but at much higher T; No limit in Zone of Dilution; By comparison, 5% of the bottom passed in 6 hrs would be a very small section of the bottom in the summertime

Dr. Richkus states that facilities not meeting the Maryland criteria were required to evaluate the effects of their discharge on the "balanced indigenous population" (actually, the community of organisms) in the receiving waterbody. All the facilities mentioned in Richkus' preamble to his comments had only small, localized effects. Dr. Richkus states that "all studies conducted at Maryland facilities over a period of 30 years have confirmed that the simple thermal mixing zone criteria specified in Maryland's regulations are protective of the biotic communities in the vicinity of the plant discharges."

EPA and MassDEP have demonstrated above that the Maryland mixing zone criteria are substantially more restrictive than those developed for the Kendall draft permit. Therefore, Dr. Richkus' preamble does not appear to support the argument presented in his more detailed comments that follow. This preamble presents the unsurprising observation that when more restrictive permit limits are required, no wide-scale effects were found. EPA and MassDEP agree that more restrictive permit limits would result in less impact. This preamble could be

interpreted to signal Mirant's intent to substitute more restrictive thermal criteria along the lines of the Maryland criteria as outlined in Dr. Richkus' review for those in the Kendall draft permit. However, this more conservative thermal approach does not appear to be included in any other comments or alternative approaches submitted by Mirant.

Dr. Richkus: Page 5, paragraph 2: Dr. Richkus states that the conclusions drawn in Maryland are based primarily, but not exclusively, on results of field studies assessing the status of fish population and communities present in receiving waters.

In response to this comment, see Response C23.

Dr. Richkus: Page 5, paragraph 3: Dr. Richkus states that the draft permit is unnecessarily complex. His example of this complexity is "the specification of four-hour average temperatures as the basis for assessing compliance with temperature limits."
The comment incorrectly implies that four-hour averages are exclusively used throughout the permit to assess compliance. This is not the case. In the permit there are two basic types of temperature requirements. First, there is the delta temperature limit. This is not a 4-hour average limit. It is a 24-hour average value. The second type of limit is the maximum temperature limit for each of a number of different temporal periods. These are calculated as 4-hour averages.

EPA and MassDEP might agree with Dr. Richkus that 4-hour temperatures "at a single horizontal and vertical point with a water body, have little biological meaning for mobile organisms such as fish." EPA and MassDEP disagree vigorously, however, that this is a fair characterization of how the permitting agencies are using the 4-hour temperature limits to protect the BIP. With the possible exception of the monitor on the surface at the Boston side of the lower Basin designed to protect access to the surface for the BIP, no single monitor or 4-hour time period is assigned individual biological significance in the draft permit. The permit is designed to protect a temperature profile across a cross-section of the lower Basin so that the collection of all the temperatures across the grid of monitoring points assures a reasonable zone of habitat and passage for the BIP. The permit becomes complex precisely because it gives the permittee the flexibility, during most of the year, to heat up the Basin in almost any configuration of 50% of the grid points depending on the flow conditions of the river. A single responsibly located monitoring point might well have simplified the permit writer's task, but it would have further curtailed Mirant's ability to add heat to the Basin. The rationale for 4-hour sampling specifically is provided in Section 5.10.3b of the DD and further described in Response D3.

Dr. Richkus also states that in his (1974a) statistical analysis of factors influencing migration patterns over the course of the annual spawning run, 24-hr. average temperatures were used. While this statement is true, were it not for the fact that Richkus also tracked hourly temperatures, he would not have found that there was a substantial drop in movement of adult alewives into freshwater at temperatures higher than 18 C (64.4 F). The following is taken from his 1974 paper, with annotations in brackets provided:

In the Annaquatucket river, very little movement through the fishway was recorded when

> water temperatures were below 8 C [Hourly measurements were presented in the bulk of the Richkus figures]. As a result, fish movement during early portions of the run was recorded only in late afternoon. At the end of both spawning runs, fish movement tended to be low when water temperature exceeded 18 C [Again, hourly temperatures were presented]. Daily peaks of movement then occurred in the morning, at daily temperature minima. These data indicate that temperature acts as a gating factor, determining whether fish present at the entrance to the stream or estuary will enter and move upstream.

Thus, while some of Dr. Richkus' statistical analyses involved 24-hr average temperatures, he used hourly temperature data to find the temperature maximum at which there was a sharp drop in run strength over a daily cycle of temperatures. Information of this sort is vital to development of site-specific temperature limits.

In Richkus' studies, and in many others, alewives were found to move up into freshwater during daylight hours. Because temperatures typically rise during daylight hours and fall at night, the use of a 24-hour average temperature of, for example, 65 F, might only allow a few hours for fish to enter the Charles if most fish avoid moving into water that is higher than 64.4 F. This is because most of the cooler temperatures would occur at night when fish do not typically enter freshwater. Because the locks at the New Charles Dam are only opened on occasion during the day, further reduction in time allotted for the run will occur. As a result, the 4-hr. temperature average seemed appropriate in this particular setting. Different criteria might be more appropriate in other settings, such as those referenced by Richkus in Maryland.

A detailed explanation of the use of 4-hr. averages is provided in EPA and MassDEPs' Response D3.

Dr. Richkus: Page 5, para. 5: Dr. Richkus states that the Agencies have, for the most part, dismissed or discredited certain empirical data submitted by Mirant.

EPA and MassDEP have examined all data presented by Mirant. After consideration, in some cases, valid concerns were raised regarding data presented by the permittee. The rationales associated with the concerns were included. Examples are the tables discussed in EPA and MassDEPs' Response C5. Reasons for these actions are discussed in the DD and elsewhere in these responses to Mirant comments. Dr. Richkus did not specify a particular data set that he felt was unjustifiably dismissed or discounted. Without specific identification of this data, EPA is unable to address this comment effectively.

Moreover, Dr. Richkus's comment seems to ignore completely the extent to which EPA and MassDEP did temper a literal application of temperature values taken from the scientific literature with adjustments designed to reflect empirical observations and data taken from the lower Basin.

Dr. Richkus: On Page 6, Section 5.0 Comments Relating to Citations of Richkus (1974a), Dr. Richkus takes issue with the fact that the DD uses information from his 1974 paper to conclude that many fish appeared to avoid temperatures in excess of 64.4 ºF. Rather, Dr. Richkus concludes that the sharp decline of fish movement into the freshwater system at temperatures

above 64.4 ºF is "simply the beginning of the end of the run," and that he interprets this as "being the temperature that corresponds to the natural end of the seasonal migration period, not an avoidance temperature."

While EPA and MassDEP are cognizant of the consideration the permitting agencies should give Dr. Richkus's current views in citing conclusions from reports of his own research, it is nevertheless reasonable for the permitting agencies to look at the data that he collected to examine the post hoc interpretations he now presents about the meaning of his research. As a result, EPA and MassDEP disagree with Dr. Richkus' current interpretation of his 1974 research for several reasons.

First, if the 64.4 ºF temperature were not an avoidance temperature, there should be no difference in hourly patterns of fish entry in the freshwater system at temperatures higher than 64.4. But there was a difference in hourly patterns, which was pointed out by Richkus in the 1974 paper. As water temperatures rose above 64.4 ºF temperature over the course of each day towards the end of the 1971 and 1972 runs, fish movement into the freshwater system sharply declined.

Second, the patterns of fish movement into three other systems in Massachusetts and New Hampshire were similar to that in the Annaquatucket studied by Richkus (see DD, Table 5.7.Cc-3). In the 19 separate runs (three separate systems) the vast majority (typically 95-99%) of fish moved into these systems at temperatures below 66 F. Fish movement into these systems dropped sharply at temperatures higher than this temperature value. The record further shows that almost all of the 19 runs followed the same thermal pattern seen by Richkus in his two-year study. His statement that "this pattern of arrival is coincidental with a particular temperature regime" could be interpreted as a weak correlation between fish arrival and water temperature. In fact, all the runs for which there is data show the same approximate upper limit. To the permitting agencies, it appears that the strong coincidental nature of this upper thermal limit across so many runs fully supports the reasoning that the upper thermal limit is an avoidance temperature. Dr. Richkus appears to imply that there was a steady climb in temperatures throughout the anadromous fish runs evaluated by the state, and that, serendipitously, fish stocks were essentially depleted on the day that instream temperatures finally climbed to 65 F. This was not the case, however. Temperatures in the streams evaluated by the Agencies did not simply rise over time. Water temperatures rose and fell well above and below the mid-60s over the duration of the run. During those times when temperatures were below this level, many more fish entered the freshwater systems than did when temperatures were above this level. The same phenomenon occurred in the Richkus studies. This is evidence that most fish were avoiding entering the system when temperatures were high.

As described in the discussion included in Response C3 of this document, different individual fish are expected to have slightly different avoidance temperatures. The fact that some fish, though relatively few, entered the system at temperatures higher than 64.4 ºF is evidence of this. More importantly, entry at temperatures above 64.4 ºF in the Richkus studies was sharply curtailed. Runs in Massachusetts and New Hampshire followed the same pattern.

Third, laboratory work conducted by Graham (1956) showed that 50% of adult alewives

acclimated to a temperature of 50 ºF died when transferred to a temperature of 68 ºF. Because of this, avoidance temperatures of fish acclimated to about 50 ºF are expected to be much less than the 68 ºF. This laboratory information complements the field data sets from Massachusetts, Rhode Island and New Hampshire in those streams where there is temperature and run-strength data for fish entering the freshwater systems.

Dr. Richkus: Page 7, 2nd paragraph: Dr. Richkus states that there were several examples of "unsupported speculation" in the DD. EPA and MassDEP address this allegation of speculation as follows, starting with a reference to each of the assertions, in Dr. Richkus's words, that he asserts are unsupported:

1. DD at [page] 92: "a small subset of the total population "[of alewives] "is likely to run at temperatures higher than the 64.4ºF value, but it is assumed that a much larger proportion will refuse entry to the lower Charles at temperatures above this value."
   EPA and MassDEP have explained the reasons for this observation in the response to Dr. Richkus' comments directly preceding this entry, and disagree that the permitting agencies are speculating.

DD at [page] 45: "a statement that fish aggregated at dams experience increased predation and harvest."

The concentration of migrating fish downstream of an obstruction is commonly observed to experience intense predation from birds, predator fish, and man's activities. These predators take advantage of the large numbers of fish "piled up" in one location. In the site-specific example of the lower Charles River Basin, observation of fish aggregated at the mouth of the Charles River have coincided with elevated angling pressure and the activity of predator fish, most notably striped bass (*Morone saxatilis*), feeding on the schools of river herring waiting to enter the river from the locks (J.H. Nagle, personal observation, April, 2002).

Fish aggregated at the base of the Watertown Dam have been observed being removed by a number of fishermen using nets to capture large numbers of river herring to use as bait fish (D. Webster, pers. comm., April, 2002). Indeed, as part of their November 14, 2005, Marine Fisheries Advisory, MADMF has instituted a three year moratorium on the harvest, possession, and sale (322 CMR 6.17) of river herring in response to recent drastic declines of many river herring spawning runs. This applies to river herring in the Commonwealth or in the waters under the jurisdiction of the Commonwealth and these actions are prohibited through 2008. This includes the Charles River.

DD at [page] 46: "fish exposed to stressor of a constricted, man made fish passage may be less able to cope with stress of elevated water temperature."

It is a generally accepted biological principal that stress from one source will likely lower an animal's ability to cope with other stressor. That is one reason why laboratory testing exposes the target organism to varying levels of one environmental stressor while all

other environmental conditions are maintained within an optimal range. When multiple stressors are tested on an organism at the same time, the threshold response to the level of the stress has been documented to be more sensitive than when only one stressor was tested. There are many examples of this type of response in the scientific literature. One example has been included here: Synergistic effects of acidity and aluminum on fish (golden shiners) in Louisiana, Robinson, J.W.and Deano, P.M., January 1985, Journal of Environmental Science and Health, Part A:Vol/Issue A20:2).

DD at [page] 47: "shading from bridges represents stress on fish."

Photoperiodism and sensitivity to light have been documented to be important cues in anadromous fish behavior. One factor that is thought to influence the spawning movement of anadromous fish is the position and duration of sunlight. Shading in a river has been observed to possibly contribute to avoidance behavior in anadromous species. Shading from bridges may interfere with this response to light. Section 5.10.4a of the DD, which referenced Dixon (1996) and Loesch *et al*. (1982), fully support this position.

Dr. Richkus: In paragraphs 4 and 5, page 7, Dr. Richkus takes issue with statements in the DD that fish waiting to move upstream will experience large changes in temperature when moving from Boston Harbor into the Charles. He states that temperature data provided to him by Mirant for the spring months of 2000 indicated that delta temperatures (above and below the Charles Dam) differed by only 2-5 ºF, and data show that there is a shallow lens of warmer, less saline water present near the surface below the dam. He later compares temperature differences seen in 2000 with those that he has seen in Narragansett Bay where fish successfully moved upstream.

EPA and MassDEP considered several interactive factors in evaluating the delta temperature information. First, alewife adults typically enter freshwater systems during the daytime. Second, during daylight hours, alewife adults are expected to be located well below the surface, out of the well-lit area where their predators would be able to track them by sight. Therefore, bottom or mid-water column water temperatures in Boston Harbor are more likely to be determining acclimation than are surface water temperatures.

Delta temperature differences between the river and the surface temperature in Boston Harbor seen in 2000, when the facility was not operating at full power, are not those requested by the facility, nor are they the point of contention.

The question that was addressed by EPA and MassDEP is: what is the upper limit of a delta temperature that should be allowed? In evaluating this question the permitting agencies compared the site-specific temperature limits set for the Charles (i.e., draft permit limits) with temperatures in Boston Harbor during immigration of alewives. Boston Harbor temperatures in April and early May are in the mid-to-high 40s (º F) as outlined in the DD (see Table 5.7.3c-4). The draft permit sets a permit limit of 65 ºF at Station 8 (near the New Charles River Dam Locks) for April 15-May15. This would allow nearly a 20 ºF rise in temperature between the harbor and the Charles, not the 2-5 ºC (3.6-8 ºF) rise supposed by Dr. Richkus. Thus, Dr. Richkus' comments are inconsistent with the maximum allowable temperatures being evaluated.

Dr. Richkus: On page 8, paragraphs 2 and 3, Dr. Richkus appears to take issue with setting an upper maximum temperature for the Charles River during the springtime anadromous fish run. He states that "migration occurs over widely varying temperatures and... it is not possible to predict what a 'suitable' temperature for fish movement is at any given time."

EPA and MassDEP strongly disagree with Dr. Richkus' apparent contention that it is inappropriate to set an upper temperature maximum in the spring. Setting upper thermal maxima for incoming alewives is important to ensuring the maintenance of the balanced indigenous population of this fish species in the lower Charles because of Kendall Station's documented ability to raise water temperatures. Reasons for this concern include: a) the fact that massive adult alewife kills in the Great Lakes have been linked to sudden temperature rises (Graham, 1956 and Otto et al., 1976); b) the laboratory work by Graham (1956) that establishes an LC50 of 68 ºF for alewife adults acclimated to 50 ºF; c) the close correspondence between the 64.4 ºF temperature in the Richkus studies, above which alewife run strength drops substantially (even over a 24 hour time series), and end-of-run temperatures seen in 19 alewife runs in Massachusetts and New Hampshire.

Due to the factors discussed in this response, EPA and MassDEP take the position that setting upper thermal maxima in this system is a reasonable approach to protect the BIP. In addition to the reasons stated above, the lower Charles has been shown to be an impaired waterbody and the Kendall discharge has the potential to increase water temperatures to the level where areas of exclusion and/or toxic effects (to eggs and larvae) would result if no limits were in place. The permittee has failed to present sufficient, compelling information to address this concern. EPA and MassDEP fully understand that it is a difficult task to set appropriate thermal limits, and that there is a complex array of data from which judgments must be made. However, this does not change the contention that limits must be set to protect the BIP in the lower Charles River Basin.

Dr. Richkus: On page 8, paragraphs 4 and 5 through page 9, paragraph 1, Dr. Richkus questions the reasoning presented in the DD pertaining to outward migration of juvenile alewives in the late summer and fall. The DD states that there is a concern that warm water from the discharge has the potential to delay outward migration, and further, that this delay could result in increased predation to juveniles. Dr. Richkus states that outward migration is not triggered by a particular low temperature, but rather, by large downward fluctuations in temperature, such as those that take place during rain events. In addition, Dr. Richkus speculates that predation of juveniles in estuaries would be higher than that seen in the freshwater system. The logical extension of this position, in the view of the Permitting Agencies, is that even if the facility's discharge were to hold back outward migration, survivability might be improved rather than decreased.

EPA and MassDEP maintain that outward migration typically occurs from September through mid-November, and in at least one system, well into December (see Response to C27). Due to low river flows, during much of this time the Kendall Station discharge will have a sizable influence on water temperatures in the lower Basin. Although Dr. Richkus provided information on downward migration occurring in waves being triggered by an abrupt decline in temperature, abrupt declines at sites upstream of the Kendall discharge will be ameliorated by the discharge. Thus, fish exposed to an abrupt decline at upstream sites will encounter a zone of much warmer temperatures. Delta temperatures between upstream and down will run up to about 5 ºF in the

ZPH, but will run much higher on the Cambridge side in the Zone of Dilution. Dr. Richkus' information did not address a situation such as that presented by the Kendall discharge and the Permitting Agencies still have a concern regarding slowed or protracted out-migration.

Regarding survival if outward migration is slowed: Cooper (1961) found extremely high mortality in alewives within the freshwater system prior to seaward migration. He stated that:

> The success of spawning, in terms of numbers of juveniles migrating to the sea, was exceptionally low during the 1959 season. Less than one juvenile entered the sea for every adult that reached the spawning grounds.

Thus, it appears that the potential for high mortality to larvae and juveniles within the freshwater system does exist.

It can not be declared for certain whether a protracted or deferred out-migration has a negative impact on the alewife population. Information from another alosid species, the American shad, does support the assumption that deferred out-migration would lower the survival of juveniles. The following is taken from Klauda, et al. (1991):

> Estimates of juvenile American shad mortality rates in the nursery areas [of the Connecticut River, studies of Crecco, et al. 1983] range from 1.8-2% per day. Thus, if the juveniles remain in the nursery areas for three months before emigrating seaward, their survival rate would be about 30%. Conversely, 70% of the juveniles would perish before reaching the ocean [based on Richkus and DiNardo, 1984] assuming constant mortality rates during the larval and juvenile stages. Longer residence times in freshwater and brackish areas would further reduce first year survival of American shad cohorts.

In contrast, higher temperatures are expected to increase growth rates. This may result in fish becoming larger sooner and possibly leaving the system earlier. On the other hand, if out-migration is primarily stimulated by large temperature fluctuations, and the facility plays a role in ameliorating these fluctuations, juveniles would be expected to remain in the system longer.
Dr. Richkus: In paragraph 2, page 9, Dr. Richkus takes issue with the fact that the DD states that "...Richkus noted that alewives spawn at temperatures much higher than those at which they first enter"

EPA and MassDEP agree that the reference to Richkus (1974) was incorrect. However, it is not agreed that the temperature information is incorrect for two reasons. First, Mullen et al., (1986) states that Cianci (1969) found that the minimum water temperature that spawning begins in alewives is 10.5 ºC (50.9 ºF). Richkus (1974) states that alewives were observed entering the freshwater system at much lower temperatures: 7.5 ºC (45.5 º F) in 1971 and 6 ºC (42.8 ºF) in 1972. In addition, Edsall (1970) states that alewives stop spawning at 27 ºC (80.6 ºF). Since alewives were seen entering the system at temperatures well below those at which they are known to spawn, and have been seen spawning at temperatures well above those at which they have been known to enter freshwater systems, we assumed that it was appropriate to state that "alewives spawn at temperatures much higher than those at which they first enter".

The second reason for this statement, which was not fully explained, applies to systems like the Merrimack. Alewives are known to move over 26 miles upstream to spawn. Because springtime water temperatures continue to rise during the period in which movement upstream occurs (which may take over a month), it appears appropriate to assume that spawning temperatures for any particular fish are typically higher than temperatures at which entry to the system occurs. EPA and MassDEP agree with Dr. Richkus that there may be exceptions to this expected occurrence, especially for alewives that enter during the middle of the run and spawn in a location close to the point of entry.

Comment C7 (Part I): Section 5.4 of the DD lays out several environmental and man-made stressors that are present in the lower Charles River Basin. The EPA then proceeds, without any foundation in the record, to speculate that these stressors adversely impact the ability of the River's population to cope with the additional stress of elevated temperatures. Based upon this speculation, the EPA justifies the development of thermal limits which "incorporate safety factors to account for multiple environmental stressors," resulting in maximum thermal limits that are below limits specified in relevant literature. This approach is unsubstantiated by any record evidence and directly leads to overly stringent thermal limits. EPA should eliminate such safety factors in setting its thermal limits or should identify its specific evidentiary basis for each instance in the permit where a hypothetical basis for historic thermal stress is alleged.

Response to C7 (Part I): In the DD, EPA does not state with certainty that the environmental stressors present in the Charles River adversely impact the ability of the River's population to cope with the additional stress of elevated temperatures. Instead, EPA maintains that "The cumulative effect of these stressors may reduce an organism's ability to cope with any one stress (Leggett and O'Boyle, 1976)." Regulations require EPA to consider all stressors that may affect the indigenous fish populations in a water body when setting thermal limits for a facility's discharge. It would have been useful if the permittee had performed a qualitative and quantitative evaluation of these stressors as part of their 316(a) variance request, but this important issue was not addressed comprehensively in Mirant's permit application. The potential negative impacts of stratification in the lower Basin were identified by the permittee, but only in relation to speculation regarding future benefits of a proposed deep water diffuser. Therefore, a general discussion and listing of likely stressors to the indigenous fish populations was considered appropriate as the draft permit was assembled.

EPA and MassDEP are not sure what the basis is for Mirant's assertion that the discussion of stressors in section 5.4 is "without any foundation in the record." Each of the characteristics EPA describes is documented by reference to either personal field observations or studies of the area. Admittedly, some of the characteristics were not the subject of extensive analytical study; however, it does not require a thorough engineering survey to appreciate that the shoreline of the lower Basin on the Cambridge side of the river near Kendall station has been considerably altered by man-made structures. And in virtually all cases EPA refers to studies in the scientific literature that document why a given characteristic may stress the BIP.

EPA's development of the record concerning these stressors was appropriate given the relatively slight weight they were accorded in our overall analysis of temperatures required to protect the

BIP. These potential stressors combine with several other general factors to lead EPA and MassDEP to err on the side of protecting the BIP in the face of uncertainty about the science. Most notable among these other general factors are 1) the burden of proof Mirant carries and failed to meet to affirmatively demonstrate that its proposed discharge is consistent with protecting the BIP and 2) the significant value EPA and MassDEP place on protecting the lower Basin. Therefore, it is inaccurate to point to this general survey of stressors as the sole or even primary reason EPA and MassDEP chose any particular temperature limit in the permit.
In addition, EPA and MassDEP examined site-specific biological and water quality data and scientific literature to establish the protective temperatures for the permit. These limits did not incorporate a full 100% habitat suitability index as a way to provide a safety factor for the indigenous fish populations. In most cases, the suitability index temperature was in the range of 50% suitability or less. The safety factors considered for the final permit are not "overly stringent thermal limits." The comment made by Tidwell in Comment C8 (below) further supports the contention that one type of stress on a fish may influence the way they cope with temperature sensitivity.

Comment C7 (Part II): Upon reviewing the Draft Permit, Mirant Kendall has investigated whether fish from the Charles River exhibit any generally acknowledged symptoms of overall stress. Specifically, MRI examined the length/weight relationships of the fish compared to the data from other systems for which data were available. For YOY alewives, data from the Charles River were compared to data from North Carolina coastal waters and from Seneca Lake, New York. As documented in MK Comment Ex. No. C7, the Charles River fish compared favorably to both populations. While Mirant Kendall does not suggest these results to be determinative, they provide a good first indication that the Agencies' speculation about multiple stresses is likely exaggerated

Response to C7 (Part II): EPA and MassDEP acknowledge that definitive stress to individual fish has not been clearly documented under the metric of length/weight relationship for fish in the lower Basin. Mirant references an analysis of data conducted by their consultants on early life stage information in which the consultant found that early life stages of alewives in the lower Charles grew at an accelerated rate when compared with other populations. This finding is not necessarily consistent with the idea that the fish in the lower Charles are not stressed. Mirant's findings led EPA and MassDEP to compare this information with data from Kellogg (1982). That researcher found the growth rate of early life stage alewives that survived high temperature exposures increased substantially as the exposure temperature increased. However, the mortality rate of the fish used in the experiment greatly increased with rising exposure temperatures (see Response C44). EPA and MassDEP note that very few juvenile and adult alewives have been captured by Mirant in comparison with bluebacks, a more heat-tolerant, sympatric congener. The potential relationships among a) high growth rates, b) reduced presence of alewives in the lower Basin compared to bluebacks, c) differential heat-tolerance of these congeners, and d) high temperatures in the lower Basin, have not been explored.

In addition to the above, measurements other than length/weight relationships, are also used to evaluate stress on individual fish (e.g., organ weight and color, parasites, stomach contents, lesions and malformed organs and appendages). None of these additional metrics have been sufficiently explored to more fully evaluate physically manifestations of stress on the lower

Basin fish populations. It is clear that potential stressors are present in the lower Charles River Basin. It remains to be shown how the majority of fish respond to these stressors. In the absence of this information, and in light of the other general factors militating toward a conservative approach, it is reasonable for the Permitting Agencies to take a conservative approach in establishing protective temperature limits.

Comment related to C7 from CLF: The proposed conditions for the Lower Basin will add temperature shock to the list of stressors affecting migratory fishes as they are forced to make the abrupt transition from the Basin to the sea at the locks. It is common knowledge that sudden changes in water conditions such as temperature, salinity and pH, stress fishes, often killing them. Due to the absence of well designed fish-ways through the dams in the lower Charles, the fishes that migrate in and out of the river are forced to experience highly unnatural shifts in water conditions. For example, they are not able to move gradually from salt water to freshwater as they did throughout their evolutionary history, but rather are plunged from one environment to the other through the lock system. Under the proposed permit, those that survive the locks will be subjected to massive temperature changes in addition to pH and salinity changes, as well as to a habitat that has been polluted by many sources and is abnormally stratified. Though these cumulative impacts to the migrating fish have not been properly analyzed by EPA, it does not require a lot of new science to recognize that this is a serious problem that undermines efforts to re-establish healthy runs of indigenous fishes in the Charles. Sadly, migrating herring have been observed to swim into the discharge pipe and attempt to spawn. Migratory fishes have a strong, and usually adaptive, behavior that leads them up-stream (rheotaxis). In this circumstance, where the flow of water through the plant is so large compared to the flow of the river, the fishes' natural behavior short circuits its efforts to reproduce in the Charles. This effect of the discharge should be addressed.

Response to Comment related to C7 from CLF: Using the data available, MassDEP performed a considerable analysis of the likely impacts to fish related to the change in water temperature across the New Charles River Dam and Locks during in-migration and out-migration (DD Section 5.4.2 and 5.8.2). Real time continuous collection of water temperatures on both sides of the dam, along with other monitoring efforts required as part of the monitoring program of the permit will better quantify this issue. In addition, information on pH, and salinity are also required to be collected, as a way to further understand the cumulative impacts to fish migrating across the dam. While river herring have been documented swimming into the Kendall Station discharge pipe, it is not known if it is a widespread, continuous occurrence that impacts the health of the entire fish population. Part I A.14.e.8 of the Final Permit has been amended to include regular surveillance of the discharge area to quantify this behavior.

Comment C8: In Section 5.4 of the DD, the Agencies hypothesize that stresses in the wild will be greater than those in the various laboratory studies they consulted. This is speculation contrary to both (a) the generally accepted observation that fish in field studies usually show greater tolerance to stresses than in lab studies for reasons including but not limited to the opportunities for adaptation and avoidance of stress in the field, and (b) the added stress of confinement in lab studies. See, for example, the Tidwell reference at the end of Section 5**,** which states that the lab confinement was believed by the authors to lead to an unrealistically greater sensitivity to water temperature.

Response to C8: As a threshold matter, EPA and MassDEP are not prepared to adopt the approach implied in the comment Mirant makes in clause "(a)," above. The suggestion appears to be that EPA should discount the impact that temperatures studied in the lab might have in the wild, because wild fish can avoid those temperatures in the field. But "avoidance" is precisely the behavior EPA and MassDEP are trying to minimize in the Zone of Passage and Habitat. The Permitting Agencies have already given to the permittee the potential to heat roughly half the width of the lower Basin in the area of the discharge to levels that EPA and MassDEP expect will certainly cause avoidance behavior, and may cause lethality. The Zone of Passage and Habitat is meant to be the portion of the lower Basin to which the fish can retreat to avoid the potentially much higher temperatures in the Zone of Dilution. If EPA and MassDEP were to apply temperatures from lab studies in the Zone of Passage and Habitat using the assumption that an account should be made for the ability of the fish to avoid those temperatures, the assumption would essentially be made that the fish should be avoiding the entirety of the lower Basin in the area of the discharge. This approach would completely defeat the intended design of the temperature regime in the permit.

Another way of making the Permitting Agencies' point is to observe that the permittee's comment "(a)" does not follow the objective of the experiment. Avoidance of stress, in this case elevated temperature, would nullify the objective of the lab experiments. The objective is to determine the physiological responses of fish that are unable to escape the carefully controlled elevated temperature. The experiments are used by the Agencies to provide guidance as to what temperatures, if occurring throughout the habitat, would result in chronic and acute stress, including mortality, when so much of the habitat is affected that avoidance is not possible. EPA and MassDEP acknowledge that when fish are confined in an experimental tank, it is a potential source of stress. EPA and MassDEP still maintain that the assemblage of physical conditions in the lower Basin result in a greater set of stressors upon indigenous fish populations than would be encountered in a more typical free flowing stream or in the reference tank of a controlled experiment. In order to test the response of the fish to a single stressor, peer reviewed toxicity tests generally remove other stressors the fish are exposed to in their natural environment, such as pursuit by predators, poor water quality, sparse food availability, etc. In addition, the remark cited by Tidwell supports the EPA and MassDEP position that one type of stress (lab confinement) that fish are exposed to can lead to greater sensitivity to water temperatures. If one type of stress is believed by researchers to diminish a fish's ability to tolerate higher water temperatures, this should also hold true for stressors in the wild.

Comment C9: In DD Section 5.4.1, the Agencies hypothesize that exposure to water quality in the Harbor may make anadromous fish less able to cope with elevated temperatures once they enter the river. Mirant Kendall encourages the Agencies to revisit this speculation by comparing the specific water quality conditions in Boston Harbor to those in the Charles River. Mirant Kendall believes that the Agencies will find that due to stratification in the river, the parameters they cite (especially low dissolved oxygen and contaminated sediments) in the river will likely be worse (in the absence of the proposed new outfall and diffuser) than the fish will find prevalent in the Harbor. In fact, in Section 5.4.4, the Agency seems to agree.

Response to C9: EPA and MassDEP can find no evidence that naturally occurring thermal

stratification and low dissolved oxygen levels have been routinely documented to be present in the lower Basin "...once they [anadromous fish] enter the river" in the spring. Rather, when migrating fish enter the river in the late winter and spring from Boston Harbor, the lower Basin has been documented to contain sufficient oxygen from surface to bottom, with no pronounced thermal stratification for the majority of the time period (Kendall Hydrographic Data for 2004, Mirant Kendall, October 2004). This evaluation does not take into account the thermal plume from Kendall Station, which may cause certain areas of the basin to contain a warmer layer of water at or near the surface.

Based on its evaluation, EPA and MassDEP do not agree that when anadromous fish are expected to migrate into the Charles River, the water quality of the river will be worse due to stratification, than water quality in Boston Harbor. EPA and MassDEP continue to support the judgments stated in the DD concerning other stressors that anadromous fish must face when moving from Boston Harbor to the lower Charles River Basin.

Comment C9 (continued): In Section 5.4.2 of the DD, the Agencies speculate that "[i]f an anadromous fish successfully passes through the [new Charles River dam and] locks, it is immediately faced with a markedly different group of water quality characteristics. No acclimation period under intermediate mixed water quality conditions is possible." This is clearly contradicted by the vertical profile data Mirant has already supplied the Agencies for 2000, 2002, 2003, and the data submitted herein for 2004, which consistently show that during the spring anadromous runs, the surface waters of the Harbor just below the Dam and the bottom waters just above the Dam provide intermediate, mixed water quality conditions for the entering fish.

Response C9 (continued): EPA and MassDEP do not dispute vertical profile data that show some mixing of river and harbor waters just below and above the dam. The area where these waters mix is a small fraction of the intermediate mixing zone normally seen in an estuary, where incoming and outgoing tides and downstream river flows mix large volumes of water from bank to bank, setting up a gradual gradient of salinity and temperature along a large area that often stretches for miles. Add to this the observation that at certain times every day, under high tide conditions in the harbor, this small mixing zone on the downstream side of the dam (in the harbor) is shut off, as the lock is closed to prevent movement of water from the harbor to the river, and it is doubtful this mixing area provides much of a benefit for anadromous fish attempting to acclimate to water quality conditions in the river.

In addition to this observation, anadromous fish entering the river will likely be found throughout the water column and have been observed occupying a staging area below the dam that is not confined to the area immediately downstream of the open lock which transfers water from the river to the harbor. Not all in-migrating fish will be able to take advantage of this limited surface water mixing zone. Also, to avoid predation from birds and to seek desired light levels during the day, it is unlikely large numbers of fish will remain at the surface of the harbor and therefore would further be restricted from any meaningful benefit from this limited mixing area.

Comment C10: Section 5.4.3 of the DD speculates that inability to pass the Watertown Dam

may make fish less able to cope with the elevated temperatures in the Lower Basin. Mirant Kendall finds this speculation implausible because the Dam is about 6 miles upstream of Kendall Station, and, therefore, fish unable to pass it are nowhere near the thermal influence of the plant. However, Mirant Kendall agrees that the inability of anadromous fish to get upstream of this dam and the subsequent dams is a major impediment to the reproductive potential of the anadromous species in the Charles River, and one that could be mitigated by the Agencies' implementation of plans for passage improvements that have existed but not been acted upon since at least the late 1980s.

Response to C10: Although the Watertown Dam is approximately 6 miles upstream from the thermal influence of the Station, any anadromous fish attempting to move past the Watertown Dam to spawn must first have encountered the thermal influence of the Station on its way upstream and must also navigate past the Station's thermal plume on the way downstream when out-migrating to Boston Harbor. The premise of the discussion at Section 5.4.3 of the DD was that the man-made constriction to passage at the Watertown Dam results in additional stress to anadromous fish. These stressed fish must then move downstream and encounter the elevated temperatures of the thermal plume from the Station as they move to the harbor. The Agencies maintain that fish that were stressed because they were blocked from upstream migration and subjected to increased predation effort may be more sensitive to elevated temperatures once they encounter them further downstream. See Response C3 for a discussion of improvements at the Watertown Dam that may be providing some relief from these stressors.

Comment C10 (continued): In Section 5.4.6, the Agencies also expressed concern that shading from bridges may cause spawning anadromous fish populations to be less able to cope with elevated water temperatures in the Lower Basin. Mirant Kendall's tagging and tracking studies of spawning anadromous fish (alewives and blueback herring) in 2002 and 2003, which were provided to the Agencies in November, 2003 (see Comment C2), lend no support to this speculation. To the contrary, they indicate that both species move easily through the area of elevated water temperature.

Response C10 (continued): EPA and MassDEP recognize the dedicated effort made by Mirant Kendall to attempt to characterize river herring migration patterns through fish tracking studies. EPA and MassDEP reviewed the fish tracking data submitted by the permittee in November, 2003. While the data shed light on the upstream movement of the anadromous fish that were tagged, this data do not fully support the statement that "both species move easily through the area of elevated water temperature." While 42 percent of the tagged alewife made the initial journey between the locks and Harvard Bridge in less than a week, only 20 percent of the tagged blueback herring had the same outcome. The blueback herring study showed that, of the 10 fish successfully tracked, 6 fish took six days or longer to travel initially from the locks to Harvard Bridge and 2 fish never traveled past the Longfellow Bridge. The most recent alewife and blueback studies were conducted to demonstrate the effect of the facility upgrades (see Comment C2) on the anadromous fish. However, with only 19 fish tagged, the N size is judged to be too small to draw definitive conclusions.

Comment C11: Section 5.4.11 of the DD states that "[t]he attraction to the faster moving water of the Kendall Station discharge may delay or completely inhibit the migration of river herring. The percentage of the population that is confused and fails to migrate in time is an unknown." This speculation is contrary to the results of Mirant Kendall's river herring tagging and tracking studies in 2002 and 2003. These studies showed that few, if any herring lingered at all (less than 10 percent of those tagged), and that all passed upriver in less than a week during the four-to-eight week spawning period.

Response to C11: As stated in Response C10, EPA and MassDEP cannot conclude from this data that the Kendall Station discharge does not delay or inhibit to some degree the migration of river herring.

Comment related to C11 from Roger Frymire: Once we got the herring runs back in the late 1990's, the one place where the herring seem to be the thickest is at the outfall pipe into the Charles River and actually trying to swim up the outfall pipe. I don't know if the plant was running at that point, so I don't know if the water was super hot at that point. It doesn't seem to affect the herring the one time I've seen them.

Response to Comment related to C11 from Roger Frymire: EPA and MassDEP are aware of the observation (at least one incident documented with video tape) of river herring attempting to swim into the discharge pipe at Kendall Station to spawn. Since the scope of this potential disruption in anadromous fish spawning has not been quantified, EPA and MassDEP have included a surveillance program in the final monitoring plan to determine the extent of this activity. Part I A.14.e.8 of the final permit has been amended to include regular surveillance of the discharge area to quantify this behavior. See Response Related to C7 from CLF.

Comment C12: Sections 5.4.4 and 5.4.5 of the DD address concerns regarding water quality conditions, including eutrophication in the Charles River, which are believed to adversely impact both fish and zooplankton populations. These are water quality conditions that could be directly benefitted by operation of the new outfall and diffuser, which the draft permit fails to approve. Additional concerns identified in Sections 5.4.10, notably, low dissolved oxygen, could also be mitigated by incorporation of the proposed diffuser.

Response to C12: As previously stated in the permit and supporting documents, EPA and MassDEP believe that there are potential benefits and drawbacks to an outfall diffuser. The diffuser has not been allowed at this time because sufficient data has not been presented to indicate whether the potential negative water quality impacts will predominate over the water quality benefits with the diffuser discharge. See generally the Response to Comments in Section E.

Comment C13: In Section 5.5.2 of the DD, the Agencies note that site–specific data from 2002 and 2003 and amended proposals were "evaluated as time permitted," with the intent to consider fully that information prior to issuance of a final permit. Mirant Kendall believes the choice to defer consideration of this recent, Charles River specific data, and to base the proposed temperature and time limits on non-site specific data and literature sources, makes the Draft Permit so flawed as to require a second draft. The following are a few examples of how failure to consider the more recent information would leave the Agencies without an understanding of (a) how the plant did not cause appreciable harm when operating at levels representative of those proposed for the future, and (b) in situations where river temperatures exceeded, without appreciable harm, proposed limits now evident to have been set too low by the Agencies in the Draft Permit.

Response to C13 (a): A full discussion of appreciable harm is included in Response C3, including an assessment of the affects of Kendall Station's operations since the spring of 2003. EPA and MassDEP dispute Mirant's position that Kendall Station's operation in past years is representative of future operation. Response B1 provided evidence to support EPA and MassDEP's position.

Response to C13 (b): While evidence of appreciable harm is presented in Response C3, EPA and MassDEP acknowledge that it is possible that ambient water temperatures in the lower Basin could exceed the thermal limits in the permit for brief periods without causing measurable harm to the indigenous population of fish. This acknowledgment is clearly demonstrated in the section of the permit that allows the Station to add waste heat to the receiving water under certain conditions when ambient spring time temperatures exceed the temperature limit in effect at the time. The intent of the temperature limits and maximum delta T allowance are to ensure that protective temperatures are not exceeded for unnatural, extended periods of time.

Comment C13 (c): The Station upgrade was completed in late summer 2002 and new market rules for electrical dispatch went into effect in spring 2003. Only thereafter do the plant operations and river monitoring data reflect the higher utilization rates representative of proposed future operations (e.g. 83% of permitted maximum capacity in July 2003, more than 50% overall for the summer of 2003, and about 70% in April 2004). See MK Comment Ex. No. B1.

Response to C13 (c): Station operation and yearly summer heatload values are examined in Response B1.

Comment C13 (d): - Beginning in 2002, continuing in 2003 and 2004, Mirant conducted continuous monitoring of river temperatures upstream and in the proposed ZPH, so that the biological results can be definitively correlated with local temperature histories and demonstrate with confidence whether the organisms likely experienced particular temperatures, and for how long. For example, these data establish with relative certainty that all larval and Young-of-the-Year ("YOY") river herring experienced river-wide exceedances of the Agencies' proposed limits for more than a week in the summer of 2002, and in mid May 2004.

Response to C13 (d): The permit is designed to prevent temperature exceedances from lasting for several weeks as a result of a man-made thermal discharge. EPA and MassDEP agree that some number of Young-of-the-Year ("YOY") river herring were likely exposed to temperatures higher than the permit's proposed limits for more than a week in the summer of 2002, and in mid May 2004. First, it is not clear how this elevated temperature exposure affected the short and long term health of the blueback herring and alewife that came in contact with these elevated temperatures. Second, EPA and MassDEP do not agree that there is relative certainty that <u>all</u> larval and Young-of-the-Year ("YOY") river herring experienced <u>river-wide</u> exceedances during these time periods that would have constituted violations of the permitted limits. The continuous monitors deployed by the permittee did not measure temperatures in all the representative locations and depths specified in the draft permit. It is possible that even under the conditions identified in the summer of 2002, a sufficient number of monitoring points at the cross sectional area of the lower Basin at proposed Monitoring Stations 3, 4, 5 and 6, and at other required monitoring locations, may have met the four hour average temperature limits at sufficient depths to remain in compliance. In this way, a sufficient volume of the lower Basin may have maintained protective temperatures. EPA and MassDEP make this point as a reminder that water temperatures at or above the proposed limits can been observed in parts of the lower Basin without the ZPH being compromised. The Permitting Agencies disagree that mid-May 2004

temperatures affected juvenile river herring, as YOY do not appear until approximately mid-June.

Comment C13 (e): Age composition studies of returning adult river herring in 2002 and 2003 provide definitive evidence that all life stages of the 1999-year class appear to have suffered no appreciable harm from the river conditions in 1999, which included extreme low flows and exceedances of the proposed Draft Permit limits. A. R. Nos. 489 and 470.

Response to C13 (e): Once again, the permittee used a small amount of river temperature data collected in 1999 at selected locations, along with continuous facility intake data collected from a 12-foot thick mixed water column in the Broad Canal to predict whether the permit compliance limits in the ZPH would be exceeded. EPA and MassDEP do not agree this prediction is valid. The permittee is reminded that continuous monitoring points positioned at representative locations and depths within the lower Basin, collecting temperature data, using a four hour average temperature calculation, would have to be exceeded at a sufficient number of points to constitute a permit violation in the ZPH. The 1999 temperature data used by Mirant simply can not make this prediction with confidence.

Also, EPA and MassDEP do not agree that the low number of alewife observed in the lower Basin in 2002 and 2003 constitute definitive evidence that all life stages of the 1999-year class appear to have suffered no appreciable harm. A more extensive analysis of river herring sampling data is discussed in Response C3.

Comment C13 (f): The Agencies have failed to explain how the thermal conditions in 1999 could plausibly be associated with "appreciable harm" when, as detailed in the July 28, 2003 and November 13, 2003 submittals A.R. Nos. 489 and 470, abundance of every life stage from larvae through returning adults was so high compared to the results from the cooler year 2000. For example, the Draft Permit sets a 72 °F 4-hour average block limit to protect alewife reproduction during the first week in June, yet despite 100% exceedance of that threshold in 1999, *Alosa* larval densities in the ZPH of more than 1500 per 100 cubic meters were measured on June 8, followed by greater abundance of juvenile alewives in July 1999 than in any other sampling year. Mirant Kendall does not believe it is appropriate to make the argument that "it might have been better" in the absence of specific supporting data.

Response to C13 (f): The permit requires compliance with specific protective temperatures at specific points in the lower Basin. The only long term continuous temperature data available in 1999 was measured at the intake of the Station, not at the specific points required in the permit. Although it was acknowledged that temperature data from the Station intake could serve as a general approximation of ambient conditions in the river, this data cannot be used with certainty for a retrospective prediction of whether an exceedance of the 50% ZPH compliance limit actually took place downstream of the facility's discharge. See Response C13 (d) and (e) for a further discussion of the problems associated with predicting permit exceedances with limited temperature data.

Comment C13 (g): Refined sampling techniques for quantifying the relative abundance of

YOY river herring at specific temperatures were implemented by Mirant in 2002 and 2003. These include night beach seining and use of push nets, which provide definitive evidence of relative abundance of river herring in portions of the ZPH and near shore habitats at temperatures both above and below absolute and Delta T limits in the Draft Permit. See November 13, 2003 data letter (A.R. No. 470 and MK Comment Ex. No. C3). These data also document the relative absence of alewives from shallow depths in the ZPH where the Draft Permit sets protective temperature limits, presuming they would be present.

Response to C13 (g): An analysis of alewife data from 2003 through 2005 is discussed in Response C3. In short, Mirant seems to suggest that the relative absence of alewives from the ZPH in the vicinity of the discharge indicates that this area is not valuable habitat to support the BIP, or at least that it does not merit protection using the permit's in-stream temperature regime. It is at least equally plausible to conclude that the absence of alewives suggests that heat from the discharge is deterring the species from using valuable habitat. Indeed, EPA and MassDEP have a substantial body of information that argues against Mirant's perspective on the juvenile datasets. Mirant's *daytime* shoreline seining documented catch of juvenile alewives in 1999, but very low levels afterwards. Mirant initiated nighttime seining in late summer, 2002 and began catching alewives along the shoreline at night, but none or almost none during the daytime. A number of factors may have caused this apparent diurnal change in behavior. In addition, two of the shoreline seining stations that were sampled at night (Lagoon and Boston) were closer to the discharge and had much higher temperatures than did the third station (Hyatt) which was located farther upstream. Thus, there is cause to believe that the lowered catch at the Boston and Lagoon stations was due to Mirant Kendall's thermal discharge. Push-net data from 2004 and 2005 show a similar pattern (see Response to C3) of declining juvenile alewife (and blueback) abundance with increasing proximity of sampling stations to the discharge.

Comment C13 (h): Beginning in 2002 and continuing in 2003 and 2004, depth of capture information was recorded for gill-net sampling. This information demonstrates the relative absence of resident species in the upper water column at all times of day and night, the use of the fully oxygenated water column by river herring, and the voluntary distribution of river herring and yellow perch across vertical temperature gradients more than twice those proposed as limits in the Draft Permit.

Response to C13 (h): EPA and MassDEP were concerned that due to boat traffic and other logistic concerns, the first few feet of the water column were not efficiently sampled as part of the gillnet sampling program. Not withstanding this concern, the observation that resident species were not collected in the upper water column was fully considered. That is why the compliance point at a depth of 2 feet at Monitoring Station 4 (near middle of river, closer to the Boston side) was not required to be met at all times as part of the ZPH.

EPA and MassDEP recognize that river herring use the entire oxygenated water column in the lower Basin when temperatures are low enough to allow that use. That is why provisions were made for protection of the entire water column in at least part of the river.

As discussed in the DD, EPA and MassDEP understand that during gill-net sampling, different fish of the same species were taken from depths with different temperature regimes. Finding

individuals of the species caught at different temperatures is consistent with the observation that, within a range, individuals of a species have different levels of tolerance for temperatures. It does not necessarily mean that individuals of the species move freely between large temperature gradients.

Comment C13 (i): The Agencies' failure to fully consider actual data in the record specific to current conditions in the Charles River, with the upgraded facility operating as planned, puts into serious doubt the validity of the temperature and time limits set in the Draft Permit, as well as the definition of the ZPH. The Agencies should conduct a comprehensive assessment of the data previously submitted by Mirant, as well as the supplemental 2004 data provided with these comments prior to finalizing the permit. Further, in the event that the Agencies continue to utilize literature or data from other sources in preference to actual data collected in the Charles River, the Agencies should substantiate the superiority and relevance of such sources.

Response to C13 (i): EPA and MassDEP fully evaluated the data submitted as part of this Response To Comments document. The permit includes provisions supported by both scientific literature from a variety of sources as well as, where appropriate, site-specific data submitted by the permittee. Please see Response to CLF Comment related to C45 for a full discussion of temperature limits that would be considered if the limits were based strictly on scientific literature values.

Comment C13 (j): Based on its review of the Administrative Record and related documents, Mirant Kendall is also concerned that the Agencies did not fairly evaluate some of the information it provided. For example, in A.R. No. 481, Agencies' personnel represented that the researchers at the Virginia Institute of Marine Sciences (VIMS) did not agree with the manner in which Mirant Kendall used VIMS data on water temperatures and abundance of juvenile alewives. However, upon review of the actual correspondence from John Olney of VIMS, (MK Comment Ex. No. C13), one finds that his opinion was "Overall, I see nothing wrong with this approach. Company general temperature trends (as numbers of days in each temperature require during each season) to an integrated index of juvenile production may also be reasonable."

Response to C13 (j): Mirant is concerned that EPA and MassDEP did not fairly evaluate some of the information provided to them. Specifically, Mirant notes that EPA and MassDEP did not agree with the manner in which Mirant used VIMS data on water temperatures and abundance of juvenile alewife information. Mirant states that a memorandum from John Olney of the Virginia Institute of Marine Science (VIMS) stated that "Overall, I see nothing wrong with this [Mirant's] approach."

While the overall approach Mirant used was not of concern to Dr. Olney, there were specific demonstrations made by the permittee that were not judged to be appropriate. Specifically, Mirant took the VIMS dataset and used it to "demonstrate" that alewives did not avoid temperatures when water temperatures were in the mid-80s (F). Dr. Olney was sent the information that Mirant provided to the state. He reviewed it and wrote a memorandum to G. Szal of MassDEP explaining how the data in the VIMS survey were collected. VIMS collected juvenile alewives and river herring along river segments, some of which were about 30 miles long. These trips were initiated near dusk when water temperatures typically are in decline. At

the very beginning of each of these fairly lengthy boat trips, a surface water temperature was taken. A "push-net" mounted at the front of the collection boat was used to collect fish down to about a meter. Mirant used the catch information collected during these trips and the temperature information taken at the beginning of the trip to assert that fish were sometimes caught in great abundance when water temperatures were in the mid-80's. However, unless temperatures were recorded at the time of catch, and at the catch location and representative depth, it is impossible to determine the temperature at which fish were captured. Dr. Olney's response to this particular aspect of Mirant's assertion was:

> The VIMS and Chesapeake Bay monitoring data used in this analysis do not offer sufficient spatial or temporal resolution to answer questions about thermal preferences in alosine fishes. For example, the 2002 cruise-specific catch data provided by my staff to TRC are mean rates from 8-10 stations occupied on each date. Temperature at each station is not provided and temperature/catch rate variability along the 30-mile stretch of river sampled is lost in the averaging. A more robust data set, with temperature-catch rate pairs from this sampling over a number of years, should be a bit more helpful in generally describing temperature preferences. However, these data may not be easily accessed or available from VIMS sampling.

It is evident from Dr. Olney's response that no clear relationship can be identified from the VIMS temperature data vs. juvenile alewife catch. The goal of the Permitting Agencies was to provide temperature limits that did not prohibit use of specific habitats in the Charles River through avoidance of particular temperatures. The permittee's analysis of the VIMS data was not appropriate to address this issue.

Comment related to C13 from CLF: EPA calls into question the value of strong scientific studies on perch (and other species) because they were not conducted in the lower Basin of the Charles, and thus perhaps not applicable to this location. For example, studies on temperature and the developmental biology of yellow perch, carried out in Minnesota, are among the best scientific studies available. EPA suggests that since the summer air temperatures in Minnesota are cooler than those in Massachusetts, the water temperature limits for yellow perch should be correspondingly increased when extrapolating this study to the Charles yellow perch population, yet EPA provides no scientific justification for this. Indeed, the best scientific evidence would lead to the conclusion that the same species of fish in a warmer locale will shift its reproductive biology earlier in the season, maintaining species-typical water temperature for eggs, larvae and young. For example, yellow perch spawn from late January to early March in North Carolina, depending on water temperatures, or roughly 2 months earlier than in the New England region. For a given species, there is much more variation in calendar dates for spawning among localities that in optimal temperature ranges.

Response to Comment related to C13 from CLF: EPA did not intend to call into question the scientific studies on perch and other species, but rather, to evaluate the studies within the context of the wide variety of information used to establish protective temperature limits.

EPA understands that within a population of fish, when an environmental condition is changed,

the majority of the population will likely respond more or less in the same way. However, within limits, the change will produce a variety of responses across the population. The biological responses will generally cover the entire range, from a decrease in survival for some individuals, to avoidance behavior in other individuals, through a no-effects response from some individuals. The rises in resistance of organisms to herbicides, insecticides, or antibiotics are all examples of this natural selection. This general response has been documented in salmon raised in hatcheries (Fleming and Petersson, 2001). In the case of the lower Charles River Basin, elevated water temperatures make up the environmental condition in question. A majority of the fish population will respond in a certain way to elevated temperatures (avoidance behavior, for example), while some smaller percentage of the population will likely have a more severe, detrimental response to the increased temperatures. Another, small percentage of the population at the other end of the spectrum will show fewer ill effects. This assumes that the elevation in temperature is not so severe as to induce mortality to the majority of the population.

CLF concedes that "the same species of fish in a warmer locale will shift its reproductive biology earlier in the season". This response is certainly one example of the overall process EPA attempted to characterize when evaluating scientific literature results from a different region of the country. The Commonwealth of Massachusetts has characterized the lower Charles River Basin as among the warmest rivers in Massachusetts (G. Szal, MassDEP, personal communication, June, 2005). The warm water characterization of the river, the majority of which is outside the influence of the Kendall Station discharge, is likely due to urban development of the watershed and the damming of the mouth of the river, among other influences. EPA assumed the overall warmer characteristics of the lower Basin have probably persisted since the installation of the first dam at the mouth of the river, at the turn of the twentieth century. Over the many generations of fish that inhabited the lower Basin since that time, it seemed likely that those segments of the population more tolerant to the warmer conditions were selected for in succeeding generations. This natural selection process was not a dramatic occurrence that produced fish that would withstand or thrive in water temperatures greatly in excess of the temperature range described for the species in the literature. Further, this ongoing natural selection process was not used by EPA to justify excessive temperature limits. Rather, it was introduced into the DD discussion as a way to further evaluate the site-specific conditions of the lower Basin, better gauge where in the range of published temperatures the maximum temperature limits would be appropriate, and assess the somewhat unique characteristics of the populations of fish that reside in the lower Basin

CLF further supports EPA's approach when they state "For a given species, there is much more variation in calendar dates for spawning among localities that in optimal temperature ranges." This statement acknowledges that there is expected variation in optimal temperature ranges among localities. That is EPA's understanding as well.

EPA does not want to give the impression that an increase in the overall temperature of the Basin has resulted in a simple overall increase in the heat-tolerance of sensitive species such as alewives. Based on recent information (2003-2005) it is evident to the Permitting Agencies that high water temperatures have negatively affected the population of alewives in the Charles (see Response C3). Moreover, the temperature above which there is greatly reduced catch of juvenile alewives in the lower Basin (i.e., 81ºF) matches the temperature that EPA and MassDEP had

determined to be the maximum protective temperature for this species and life stage based on a *previous* review of the scientific literature (see DD section on alewives). It would be expected that if there were a phenotypic drift in the Charles River population to tolerate higher temperatures, the avoidance temperature derived from field data for that population would be higher than that developed from the literature from other populations that were not exposed to high temperatures. However, there was a match between the literature-derived value and the field data which argues against any upward phenotypic drift in temperature tolerance in the Charles River population.

In addition, there are reasons why an upward drift in temperature tolerance might not occur. The driving force behind any shift in a frequency distribution of genotype and resulting phenotypic manifestations is an increase in reproductive success of those individuals with the different phenotype. For the frequency distribution of temperature preference and/or temperature tolerance of a given population to undergo a shift over time, there would have to be an advantage that relates to an increase in reproduction potential of the individuals that are more tolerant of the stressor. In the Charles River, increased fitness may accrue to individuals that actively *avoid* high temperatures if the population size is small enough and the stated behavior results in exposure to a higher abundance or quality of food, or decreases exposure to predation. Of course all the above arguments are hypothetical. At present, there is no evidence of a phenotypic shift in either direction.

Based on juvenile and adult catch information and the one-time adult estimate of stock size conducted by Mirant in 2002, the alewife population in the Charles River appears to be small. This is of concern to EPA and MassDEP. Encroachments on alewife habitat brought about by increases in water temperatures may not simply cause the population to become more heat tolerant. Such encroachments have a potential to result in reductions in stock biomass or in a decreased ability of the population to expand to its potential. This concern of the Permitting Agencies over habitat loss extends to other thermally-sensitive species as well.

Comment C14: Section 5.6 of the DD lays out the Agencies' rationale for the selection of the thermal limits and time periods for resident fish species in the lower Charles River Basin. In Section 5.6.3.a, the Agencies identify the yellow perch as the resident species most sensitive to elevated temperatures. Subsequent sections set out the rationale for the determinations of the temperature and time limits for each stage of the life cycle of the yellow perch, to be applied in the ZPH. As an initial matter, Mirant Kendall has significant concerns regarding the definition of the ZPH for this species for the spawning segment of the life cycle. These concerns are discussed in Section D below.

Mirant also has specific concerns regarding the appropriateness of the specific temperature and time limits established for this species, as detailed in the following comments. Mirant again asserts that the EPA must base the Draft Permit's temperature and time limits on the results of a comprehensive assessment of the actual Charles River data presented to date and supplemented herein.

Response to C14: EPA and MassDEP do not agree that protective temperature limits can be derived by considering only the results of the assessment of the actual Charles River

environmental data. While this site-specific information is important, it must be considered along with scientific literature and associated relevant information collected both in New England and from other parts of the country to gain an overall understanding of the response of fish populations to elevated temperatures. Writing the permit to simply ensure that the lower Basin gets no hotter than it has been in recent history assumes that Mirant's discharge has had no appreciable harm on the BIP to date, a showing on which Mirant has not carried its burden of proof. Moreover, as detailed in response to comment C3, EPA and MassDEP have shown evidence of appreciable harm. Therefore, the permitting agencies need to look to data beyond the actual conditions in the lower Basin in an attempt to assess the conditions necessary to protect the BIP.

Regarding Mirant's concern for considering the needs of yellow perch in defining a ZPH, see Response C15 below.

Comment C15: Sections 5.6.3b and c of the DD address the protective temperature and time period for the egg stage of the yellow perch. The Agencies state that, based on the likely location of yellow perch eggs, a maximum ZPH temperature of 66.4 F would maintain a protective temperature of 64.4 F. As noted above, Mirant has significant concerns with the definition of the ZPH for this species. As described in more detail in section D, Mirant believes EPA should re-focus on a compliance location at or close to the most proximate suitable habitat for yellow perch eggs, above the Longfellow Bridge. The upstream edge of the ZD (see Attachment B to the Draft Permit) is above the Longfellow Bridge and closer to the discharge than any viable perch spawning areas, as described above. Based on the extensive available thermal data on the Kendall Station's thermal plume, Mirant Kendall asserts that maintenance of a sequence of 24-hour average temperatures not-to-exceed the 90-95% confidence values in Table C-5 at a 6-foot depth, at the upstream edge of the ZD from March 20 to May 10 would be adequately protective of the BIP of yellow perch in the Lower Charles.

Response to C15: EPA and MassDEP take the position that all areas along the Boston shore of the lower Basin are suitable habitat for yellow perch eggs. This includes areas downstream of the Longfellow Bridge. EPA and MassDEP are unaware of any site-specific assessment submitted by the permittee as part of the re-licensing process that evaluated the near shore habitat of the lower Basin relating to suitability for yellow perch eggs. In addition, the presence or absence of yellow perch eggs has not been documented in specific locations of the Basin by the permittee. In the absence of any site-specific information, the Permitting Agencies take the conservative position that all near shore habitat in the lower Basin is suitable for yellow perch eggs. Juvenile yellow perch were caught at the Boston Station in 2005, though in low numbers, indicating that the area is used as nursery habitat. It must be further noted that areas of near shore habitat on the Cambridge side of the lower Basin may also be suitable habitat for yellow perch eggs if thermal conditions were suitable. This part of the river has been allocated as part of the Zone of Dilution, however, and is not being considered as suitable yellow perch habitat due to the water temperatures expected to occur in this area of the river as a result of Kendall Station's thermal discharge.

It must also be noted that in its comments, the permittee has criticized the monitoring and compliance plan as being too complicated and extensive. However, the permittee requests a new

compliance location at the upstream edge of the ZD from March 20th to May 10th as part of its comments here, further adding to the complexity of the monitoring and compliance plan. The permittee's comments regarding maintenance of a sequence of 24-hour average temperatures not-to-exceed the 90-95% confidence values in Table C-5 at a 6-foot depth are fully addressed in Response C5.

Comment related to C15 from CLF: In the development of the draft permit and temperature limits based on yellow perch, EPA departs from the data provided in reputable scientific sources to shift its recommendations higher based on limited observation made in the river, without adequately acknowledging that the river is impaired and is not currently supporting a BIP. EPA utilizes water temperatures measured by MKS in the intake pipe to set limits for the protective maximum temperatures above where the science would indicate they should be. Temperature data from the intake pipe are not reliable since the temperature at the intake is elevated due to the nearby discharge point. Spawning temperature limits (Protective Maximum Temperatures ("PMT")) are set over a range from 54 to 63 ºF, extending well outside the ranges considered favorable for normal perch spawning in the published literature. EPA acknowledges that the best available science indicates that their upper limit of 63 ºF corresponds to habitat suitability for spawning in this species of only 20% (i.e. unsuitable habitat; HSI = 0.2). EPA then adds 2 ºF to the range of PMTs in order to arrive at proposed temperature limits for the ZPH. It is argued that by using these higher temperature limits for the ZPH, they will ensure that the PMTs are not exceeded in the locations and time periods used by perch during spawning. This is not well justified and will not adequately protect a balanced indigenous population. There is little justification for setting the temperature limits 2 ºF higher than the already excessive temperatures selected as PMTs, and then guessing that the actual temperature where the fish are spawning will be cooler (e.g. in deeper water). The final permit should rest squarely on the thermal conditions derived from published science for yellow perch, and measurements in the ZPH should ensure that these temperatures are not exceeded due to excess thermal loading by MKS or any other user of this public resource. Since yellow perch has been selected by EPA as a critical indicator species, the temperature monitoring plan should be designed to provide direct measurements of water temperatures in the habitat areas used by this species for all life stages. Temperature monitoring is apparently not being done in locations that are representative of the habitat used by yellow perch. The monitoring plan is thus not adequate and should be modified.

Response to Comment related to C15 from CLF: The lower Charles River Basin is subject to a variety of conditions that EPA and MassDEP expect place stress on the BIP. However, this stretch of the river is not currently listed as impaired for fisheries or fish habitat, in contrast to CLF's inference. Further, EPA and MassDEP did not use intake temperatures recorded at Kendall Station to select protective temperature limits. Instead, EPA and MassDEP used the multi-year continuous ambient temperature database measured at the Station's intake in certain cases to compare protective temperature values from the literature with site-specific values recorded at the intake. EPA and MassDEP clearly pointed out in the DD the shortfalls with the intake temperature data set, including the time period when intake temperatures did not reflect ambient conditions (June 15 - August 31).

EPA and MassDEP do not agree that "There is little justification for setting the temperature limits 2 ºF higher than the already excessive temperatures selected as PMTs, and then guessing

that the actual temperature where the fish are spawning will be cooler (e.g. in deeper water)." In the DD, Figures 5.10.5c-1 through 5.10.5c-5 clearly document a daily temperature fluctuation of at least 2 ºF specifically in the lower Basin. This data was reasonable justification for EPA and MassDEP's reasoning regarding the 2 ºF allowance in the temperature limits. Also, extensive vertical profile data submitted by the permittee and listed in the DD documented cooler water temperatures with depth at various locations in the lower Basin. This site-specific supporting evidence refutes any claim that guess work was involved in the formation of protective temperature limits. The 2 ºF temperature limit allowance is discussed in further detail in the Response to Comment related to C44 from MA CZM and CLF.

While EPA and MassDEP were confident that the 2 ºF higher compliance temperature was protective of the BIP during all times it was incorporated into the draft permit, Charles River "Hydro Data" submitted by the permittee for the summer of 2005 prompted a review of the 2 ºF compliance temperature allowance for the summer time period. A full discussion of this review and subsequent action is also included in Response to Comment related to C44 from MA CZM and CLF.

EPA and MassDEP concede that all relevant habitats are not being specifically monitored as part of the monitoring and compliance plan. However, the monitoring plan is comprehensive and will provide a great deal of valuable temperature data to ensure thermal compliance. Additional continuous monitoring locations are not necessary. Periodic thermal monitoring of the entire Basin will be a valuable supplement to the fixed monitoring stations. This complementary information will provide sufficient detail to fully characterize the thermal profile of all important fish habitats in the Basin. The monitoring plan has been judged to fully meet the objectives of the permit. The Permitting Agencies have maintained this position, taking into consideration comments from the permittee that the monitoring and compliance program is excessive.

Regarding the comment that "The final permit should rest squarely on the thermal conditions derived from published science for yellow perch..." EPA and MassDEP disagree with this approach. There is no doubt that referring exclusively to scientific literature to determine protective temperature limits is one way to arrive at a protective approach to protecting the BIP. However, scientific literature and reference material at best identify a temperature tolerance range and a general time period when a species life stage is expected in a region. Without taking site-specific information into consideration to establish representative acclimation temperatures and spawning timing, for example, the permit limits would be overly conservative. Refer to "Response Related to C45 from CLF" for a full discussion of temperatures based strictly on scientific literature values compared with ambient temperatures. In their comments on the draft permit, the MADFW stated that the protective temperatures established for yellow perch in the permit are acceptable.

Regarding the protective temperature of 63 ºF selected for yellow perch spawning, this temperature was established only for the tail end of the yellow perch spawning period (April 15th through April 30th). Lower temperatures were selected for the beginning (54 ºF) and middle (59 ºF) of the expected yellow perch spawning period. As discussed fully in the DD, the time period at the end of April was characterized by markedly increased ambient temperatures, as documented in 1994, 1996, 2001 and 2002. The "stair-step" approach of increasing maximum

protective temperatures as the spawning season progresses recognized the need for rising temperatures to ensure successful yellow perch spawning.

Comment C16: The Sections 5.6.3d and e of the DD detail the rationale for the protective temperature and time period for the larval stage of the yellow perch. These sections describe EPA's rationale leading to the determination that the WQS of 83 ºF from April 1 through July 15 is adequate to protect larval yellow perch. The target is 80.6 ^{o}F where the fish actually are present. Although Mirant asserts that the supporting studies upon which the target temperature is based are overly conservative (e.g., the Tidwell study indicated that effects were exaggerated by tank confinement), Mirant believes that maintenance of 24-hour average temperatures not-to-exceed 80.6 ^{o}F in 50% of the cross-sectional area of the river running perpendicular to the banks opposite Station 2, from April 1 to July 15, would be adequately protective of the BIP of spawning yellow perch in the Lower Charles.

Response to C16: EPA and MassDEP do not agree that a 24-hour average temperature is appropriate when setting maximum protective temperature limits in the lower Charles River Basin. The permitting agencies are concerned that Kendall Station has the potential to substantially increase the water temperature of the lower Basin under certain conditions within any 24 hour period.

One difficulty the permitting agencies have in analyzing the ability of Kendall Station to change water temperature in the lower Basin is that there is no acceptable thermodynamic model available to assess the potential temperature impacts of this discharge. Typically, EPA and MassDEP would have an applicant do several modeling runs designed to compare the expected impact of the facility over a short term period with the impacts over longer term periods. If there were no significant differences in the thermal profile of the lower Basin when subjected to short term changes in temperature compared with longer term variations, then it would be reasonable for EPA and MassDEP to use a longer averaging period to protect the BIP, because it would be as effective as the more data intensive short term averages in maintaining protective temperatures. In this case, however, that tool is not available.

Therefore, EPA and MassDEP are left to decide how to protect the BIP from potential spikes in temperature that could result from allowing compliance to be averaged over a 24 hour period. For example, the volume of once-through cooling water allowed to be used by the Station (80 MGD) combined with the allowed increase in temperature across the condensers (20 ^{o}F rise in temperature) under certain conditions in the lower Basin, could markedly raise the temperature of the Basin, conceivably above the protective temperature limit for some period. If the Station then lowered the temperature change across the condensers or reduced the volume of once-through cooling water (i.e. curtailed generation), the remaining hours in the 24 hour period would more closely mirror ambient river conditions, especially if the river is maintaining a downstream flow into Boston Harbor. Under these conditions, the calculated 24 hour temperature limit at a compliance point in the river may meet the 81 $^{\circ}$F limit, while in reality, actual conditions in the river were much warmer than the biologically based limits for part of the day. These unprotective higher temperatures would be "hidden" within the calculation of an average temperature over 24 hours.

The Permitting Agencies concede that a suitable thermal model of the lower Basin is necessary to analyze fully how different averaging times might affect temperatures. Until such a model is available, however, EPA and MassDEP are compelled to take a conservative approach when setting protective thermal limits for the lower Basin. Therefore, a 24-hour average was not considered a protective approach to calculate compliance limits in this case.

Another factor that causes the permitting agencies to be conservative about the averaging time is that this permit is designed to enforce actual in-stream temperatures, not modeled in-stream results. Typically, EPA and MassDEP control discharges at the end of the pipe based on modeled predictions of how those temperatures will affect the receiving water. In modeling the discharge, it is common to use so-called reasonable "worst case" episodes when running the model to ensure that the discharge limits would protect water quality even when, for example, the flow in the river is lowest or a heat wave is occurring. This "worst case" design in most modeling has an inherently protective effect on the resulting discharge limits, since most of the time the receiving water will not reflect the "worst case" modeled.

With this permit, however, the real-time continuous nature of the compliance program allows the permittee to take advantage of the actual assimilative capacity of the lower Basin at any given time to absorb heat, and the permit does not include the inherent "buffer" or constraint on heat discharges that end-of-pipe limits derived from worst-case modeling would provide. Kendall Station has the ability to raise temperatures in the lower Basin at any time right up to levels that are necessary to protect the BIP. Therefore, there is the prospect that the BIP could face exposure to temperatures on a continuing basis that are designed to be adequately protective, but, as noted in comments from CLF and others, are not optimal. Whereas a modeled end-of-pipe limit would tend to ensure protection with a margin of safety during normal conditions and expose the BIP to marginal but protective temperatures only during the actual occurrence of worst-case conditions, this permit risks exposing the BIP to more persistent and frequent temperatures that are very close to the levels that cause harm. EPA and MassDEP do not believe it would be advisable to add on top of this scenario a 24 hour average, which gives the facility the ability to maximize generation and raise temperatures several degrees above the protective levels during the afternoon and early evening, only to balance them out against reduced generation and resulting lower temperatures at night and in the morning.

Although Mirant has focused this comment on yellow perch, EPA and MassDEP are obligated to assess the implications of the temperature averaging time for all the most sensitive species that must be protected as part of the BIP. For example, allowing for short term temperature spikes during the day risks interrupting a migratory pulse of anadromous fish attempting to enter the lower Basin or pass the thermal influence of the Station.

Comment related to C16 from CRWA: Yellow Perch Larvae- Permit limitations would allow temperatures to rise to 75 ºF between June 8-11 and 83 ºF between June 12 and October 31. These temperatures approach or are at those that cause between 45 and 100% daily mortality of the larvae. These temperatures are not protective of the larvae nor is there a margin of safety associated with these limits. Additionally, the "no effect" temperature should be used to set temperature limits outside of the Mixing Zone. EPA and MassDEP must state what this temperature is and how it will be used to set protective limits in the ZPH.

Response to Comment related to C16 from CRWA: As stated and supported in the DD, the temperature limits selected in the permit ensure that habitat for yellow perch will likely be cooler in the habitat where the larvae reside. The margin of safety takes into account that the continuous, fixed temperature Monitoring Stations 3, 4, 5 and 6 were established in locations deemed to measure the greatest magnitude of Kendall Station's thermal plume at the highest relative temperatures. This placement ensured that all other areas of the ZPH will be cooler than the measurements taken at these monitoring and compliance points. See also response related to C15 from CLF which notes the supportive comments received from MA DF&W regarding temperature limits to protect yellow perch.

Comment related to C16 from CLF: EPA concludes that the maximum protective temperature for Yellow Perch larvae should be 80.6 ºF. Nevertheless, a precautionary, science-based approach to protecting the propagation of these indigenous fish would dictate halting thermal pollution from MKS at temperatures that are much less than the 80.6 ºF. Even though some of the eggs might be cooled by being close the bottom, spawning and the mobile larvae would still be compromised by the proposed temperature limits. A lower temperature limit is also supported by *Krieger et. al.*, where suitable temperatures (suitability > 90%) for spawning and embryo development were in the 46 to 57 ºF range, and for later stages of development from about 64 to 75 ºF.

EPA apparently adjusted its assessment of the suitable maximum protective temperature upward to 80.6 ºF for larvae on the basis of just two samples taken in the Basin during July 2002, when larval perch were collected at 82.4 ºF and 79.0ºF near the B.U. Bridge. There are several serious problems with the logic used here for larvae and later for setting limits for juvenile perch. There is no scientific justification for using a few observations of larvae at high temperatures as evidence that the larval (or juvenile) perch found were thriving at these temperatures. For example, no data were provided on the condition of the larvae compared with larvae growing at other temperatures and no studies indicating that survival to adulthood was normal compared to other sites where temperatures are lower. Additionally, it appears that there has not been any quantitative assessment of the population of yellow perch in the Basin so it is not even known how abundance of adults compares to an expected carrying capacity for this species.
As pointed out in the Determination Document, 80.6 ºF corresponds to a habitat suitability index of only about 40%. EPA's obligation in permitting is to maintain suitable habitat for indigenous fishes, particularly the selected indicator species. Habitat suitability should be as close to 100% as possible (HSI = 1.0). The available scientific work indicates that 80.6 °F is too high to be protective of larval perch. No explanation is provided for choosing the very low suitability criterion of 40%, and the corresponding marginal conditions for these animals.
Additionally, experimental data show that larval mortality begins to increase rapidly when water warms to about 70 ºF. There is no justification for using a few observations of larval fish living under marginal conditions as a basis for departing from what the best available science tells us. A protective maximum near 75 ºF may be justified for larvae, juveniles and adults, but is still too high for spawning and egg development. EPA's development of a rational for higher limits for juvenile yellow perch (80.6 ºF) is weak for the same reasons presented above.

Response to Comment related to C16 from CLF: EPA and MassDEP did not "...adjust[] its

assessment of the suitable maximum protective temperature upward to 80.6 ºF for larvae on the basis of just two samples taken in the Basin during July 2002, when larval perch were collected at 82.4 and 79.0 ºF near the B.U. bridge." Rather, the DD discussed a statement in the literature by Kreiger, which reported that yellow perch larvae tolerated temperatures up to 28 ºC (82.4 ºF; Krieger *et al.,* 1983). The DD further stated that "While 28 ºC (82.4 ºF) was also recorded as the ambient temperature associated with yellow perch larval collection in early July of 2002, it should not be considered a protective temperature based on that fact alone." Further discussion of the literature and site-specific water quality data were used to justify the protective temperature selected for yellow perch larvae.

A graph showing protective temperatures based solely on literature values compared with ambient temperatures in the Charles River clarifies the problematic nature of relying solely on conservative literature values. This figure (Figure C45 CLF-1) is fully discussed in "Response Related to C45 from CLF"

CRWA and CLF both suggest that EPA and MassDEP should design the permit so that temperatures in the ZPH have no effects on the resident and anadromous species: CRWA uses the term "no effects", while CLF refers to the goal of having 100% "habitat suitability." EPA and MassDEP disagree that the permit should be enforcing temperatures designed to ensure "no effects" on the resident species in the ZPH. While a "no effects" regime in the ZPH would be a highly conservative approach to protecting resident and anadromous fish species in the lower Basin, the Permitting Agencies have concluded that it would be more conservative than necessary to protect the BIP. The goal of the permit, as specified in the CWA 316(a) regulations, is to maintain temperatures in the ZPH at a level that protects the BIP in the lower Basin as a whole. EPA and MassDEP have concluded that the BIP can tolerate some temperature effects in the ZPH, in light of the fact that those effects will diminish with distance from the discharge plume. The goal of the permit is to ensure that the BIP is not completely excluded from the lower Basin in the vicinity of the discharge and that the ZPH is sufficiently hospitable to maintain and protect the BIP in the entirety of the lower Basin. To achieve this goal, it is not necessary to keep the ZPH at levels that ensure "no effects," but rather at levels that avoid such effects large enough to significantly impair the ability of the BIP to occupy the lower Basin.

Comment C17: Protective Temperature and Time Periods for Yellow Perch Juvenile Stage Overly Stringent. Sections 5.6.3f and g of the DD detail the rationale for the protective temperature and time period for the juvenile stage of the yellow perch. The sections describe Agencies' rationale leading to the determination that the WQS of 83 ºF throughout the ZPH is adequate to protect juvenile yellow perch. The target is 80.6 °F where the fish actually are present. This life stage is fully mobile, choosing habitats it prefers and avoiding conditions of stress. Therefore, the field data on capture locations at different temperatures collected and submitted by Mirant Kendall should be given greater weight than laboratory studies upon which the Agencies have relied, both in terms of defining thresholds as well as establishing the appropriate compliance locations. Specific examples are as follows:

- There is no support for an avoidance threshold below 83 °F for this life stage, certainly none in the neighborhood of the 80.6 °F chosen by default by EPA as

the protective threshold from the generic "Habitat Suitability Index" (See also comments in MK Comment Ex. No. C6 on the questionable value of the Index as applied here.)

-

- The Agencies correctly state "yellow perch were collected on many separate occasions above 26.1°C (79.0° F)," but far understates the extent of those collections. Contrary to the implication of "the mere presence of a small number of individual fish" the data demonstrate the consistent regular presence of juvenile and adult yellow perch in the great majority of the 2002 and 2003 beach seine collections at temperatures above 80 °F (up to 86.4 °F) in the preferred shallow vegetated habitats, i.e., upstream of the ZPH. These included the largest catch at the Lagoon station in 2003 (11 individuals at 81.7 °F); three of the larger 2002 catches at the Magazine Beach Station (30 at 81.5 °F, 12 at 81.8 °F, and 14 at 80.2 °F); catches on all three dates over 80 ºF at the Hyatt station in 2002; and additional catches in 2003 at 84.8 °F at the Fiedler Station, and 83.6 °F at the Greenough Station.

The Agencies should revise the target temperatures in the Draft Permit in recognition of the above site-specific data, in preference to reliance on the Habitat Suitability Index to establish default avoidance temperatures (which that index does not provide).

Also, the Agencies should target its compliance points for this life stage to the locations actually occupied by the fish. The data from extensive collections and tagging studies show that these fish are only significantly present in shallow water in the areas upstream of the ZPH. In the ZPH, when they are present, they are less abundant and are in deep water. Extensive gill net and push net results from the ZPH (Boston station and Below Broad Canal) show that this life stage of yellow perch is essentially absent from depths shallower than 12 feet at all times of day and night in the spring and summer. The species is regularly present deeper than 12 feet at these locations, but only when there is salinity less than about 16 ppt at these preferred depths. Mirant asserts that maintenance of 24-hour average temperatures not-to-exceed 83 °F in 50% of the cross-sectional area of the ZPH defined by Stations 3, 4, 5 and 6 in the summer would be adequately protective of the BIP of juvenile and adult yellow perch in the Lower Charles.

Response to C17: EPA and MassDEP weighed both the juvenile yellow perch collection field data as well as the scientific literature information when setting protective temperature limits. The field data collection was part of the justification for selection of a temperature limit, that according to the Habitat Suitability Index for Yellow Perch Juveniles (Krieger, 1983) identified only a relatively low habitat suitability of 40% at 27ºC (80.6 °F).

Evidence that yellow perch (YP) were present in greater numbers upstream of the influence of the Station's discharge and were found primarily in deeper, cooler water in the ZPH can be viewed in several ways. One reason for this observed pattern of distribution could be that the habitat identified by the permittee downstream of the discharge is less suitable for YP for reasons not associated with higher water temperatures. However, no scientific assessment of the quality of yellow perch habit in the lower Charles was submitted by the permittee to support this

position. It is at least as equally plausible that the YP pattern of distribution documented by extensive collections and tagging studies was directly caused by avoidance of otherwise suitable downstream habitat due to the thermal influence from Kendall Station. Temperature data from the lower Basin and literature values for YP habitat suitability for temperature do support this position. The objective of the protective temperature limits is to preserve habitat that will not cause avoidance behavior.

One concern noted in the field data was that a single, surface-water temperature value was presented along with each beach seine collection. A near surface and a near bottom temperature reading at the greatest depth sampled would have confirmed whether near bottom temperatures were cooler in the areas sampled. For example, a beach seine collection site with the deepest point of approximately one meter could reasonably possess a near surface temperature of 81.8 °F, but a near bottom temperature a degree or more cooler (°F). A further confounding factor that must be considered is the overall area sampled in a beach seine collection site. If the field temperature collected along with the fish sampling is going to be proposed for consideration as a permit limit, near surface and near bottom temperatures at several representative locations within the seined area would add additional support to the argument that a proposed temperature coincided with the habitat being used by the yellow perch.

EPA and MassDEP do not view a 24-hour average maximum temperature limit as appropriately protective in the specific case of the lower Charles River Basin for the reasons presented in Response C16.

Comment C18: Protective Temperature and Time Periods for Yellow Perch Adult Reproductive Condition Overly Stringent; Incompatible with Other Species of Concern. Section 5.6.3h of the DD details the selection of the protective temperature and duration for the adult reproductive condition of the yellow perch. This section presents the rationale for the 149-day "chill period" of ZPH temperatures below 50 °F assumed by the Agencies to be required for protection of gonadal maturation in yellow perch. This approach is fundamentally flawed because the threshold was selected based on the assignment of exaggerated importance to one parameter (gonadal maturation), which results in a threshold too low to support other important requirements for that species and another species (alewife). The rationale for this requirement is based on lab experiments controlled to determine optimal temperatures for gonadal maturation for yellow perch from a significantly colder location (Duluth, Minnesota). This approach has several flaws:

- The authors of that study acknowledged that different perch populations in other areas (extending as far south as Alabama) each experienced different chill periods, therefore the 150 days specified in the study for the Minnesota setting is arbitrary and unproven for the warmer Charles River. (EPA acknowledges this likelihood in Section 5.6.3h).

-

- It is also questionable whether optimization of gonadal maturation is a beneficial objective. The Krieger study indicates chill temperatures cold enough to optimize gonadal maturation occurs as a tradeoff with reduced overall growth. The Agencies

have failed to thoroughly assess the chill period tradeoffs. For example, growth is strongly correlated with ability to avoid predation (e.g., in this system, by largemouth bass). Mirant questions whether yellow perch are more limited in this setting by ripening of their gonads or by lack of suitable, preferred low-salinity, well-oxygenated habitat warm enough for survival over winter.

-

- Maintaining temperatures below 50 °F in the ZPH (which is poorly suited for yellow perch overwintering and spawning as described elsewhere in these comments) in the second week in April foreshadows potential conflict with the need for slightly higher temperatures (in the low 50s ºF) to initiate and sustain with vigor the alewife run, something of acknowledged importance in the ZPH. Mirant Kendall's gill net collections show that the run intensified at temperatures in the low 50s in each of the last three years after remaining negligible while temperatures remained in the 40s.

Comment related to C18 from CLF: Yellow perch breed during the spring, as early as February but typically during the period from April through May. Thus, this is a period during which water conditions should be supportive of the development of eggs, larva, and juveniles. Normally, water temperatures for breeding yellow perch are within the 44 to 56 ºF range. In the first half of April, the draft permit indicates a temperature limit of 61 ºF, increasing to 65 ºF in the second half. This period corresponds to the early portion of the spawning period for yellow perch, when temperatures normally would be in approximately 44-50 ºF range. The proposed limits are too high for normal reproduction in yellow perch and need to be adjusted downward in the revised permit.

The proposed chill period temperature limit of 50 ºF is apparently set to be at the upper limit of temperatures that are sufficient for normal ovary development in yellow perch. Use of the absolute upper limit is not precautionary for yellow perch. A winter temperature of 39.2 ºF has been shown to be optimal of ovary development in yellow perch, with females producing eggs at over 75% viability. Viability at the winter temperature proposed by EPA (50º F) was very low (< 25%). The argument put forth by EPA that the Charles Basin does not currently achieve extended periods with water temperatures near 40º F is not compelling. The river was impaired during the time period examined by MKS, with thermal pollution from a number of sources including MKS. This is no justification for setting the limits higher than dictated by the biology. Further, the use of 50º F as an upper temperature limit for winter temperature in a New England river is highly unnatural, and will not support the natural community of an aquatic organism that has evolved to pass through a winter period with water temperatures near freezing. The permit should not allow MKS to elevate water temperatures in the ZPH above 39º F during the chill period. In order to promote the propagation of yellow perch, and other species, EPA must set more protective limits. During the period when perch eggs or larvae would normally be present (i.e. mid March through mid June), the discharge of any heated water should be limited such that water in the shallows of the Basin does not exceed 55 ºF. Even though temperatures may naturally rise above 55º F during this time period and decrease habitat suitability, there is no justification for allowing MKS to stress the perch population further with discharge of heated water. During the fall and winter, the Basin must be allowed to cool at least to the high 30's.

Response to C18 and related comment: The permittee implies that it is in the best interest of the yellow perch population to raise temperatures in the lower Basin to levels higher than 50º F in the wintertime, in part, because the study cited by the Permitting Agencies for this temperature was conducted in Duluth, MN (Hokanson, 1977), where temperatures are typically colder than they are in MA. Thus, the 149-day "chill" period specified in the draft permit (i.e., the requirement that Mirant not raise the water temperature outside the ZD beyond 50º F or release heated water if the temperature at the border of the ZD is 50º F or above) is an invalid requirement. Conversely, CLF asserts that the 50º F chill temperature is not low enough to support spawning, and should be lowered to 39º F.

The following is taken from Hokanson (1977):

> "Maturation requirements - a winter minimum temperature of 10º C (50.0º F) is near the upper limit for maturation of gonads in yellow perch and walleye. Jones et al. (1977) reared adult yellow perch from Minnesota in the laboratory under a natural day-length cycle and 16 thermal regimes from October through June. The maximum percentage of females spawning declined as the winter minimum temperature at which they had been held increased (Fig. 1). Optimal conditions for maturation that terminated in spawning occurred when fish were exposed to 6º C (42.8º F) or lower for 185 days from October 30, whereas no viable spawning occurred when the fish were maintained at a minimum temperature of 12º C (53.6º F) or higher."

It is important to note that at least two items from the quote above:

a) The 50 ºF temperature used in the Draft Permit was not the preferred temperature in the study; i.e., it was not the temperature with the highest success rate in producing spawning. The preferred temperature was about 43 ºF.

b) At a temperature of 50 ºF and a chill-duration of 160 days (temperatures did not exceed 50 ºF), no spawning took place. At the 50 ºF temperature, spawning only took place when the chill period exceeded 160 days (compare this to the 149 days required in the Mirant Kendall draft permit). When the chill period for this 50 ºF experimental chamber was increased beyond 160 days, spawning increased in a fairly linear fashion until the 200-day mark. Still, at this temperature (50 ºF), spawning took place in only 50% of the females. In those experimental chambers where chill temperatures were lower (8, 6 and 4 ºC), spawning percentage rose to a much higher percentage and spawning took place after shorter chill periods.

In summary, Hokanson found that at least 160 days of temperatures at 50 ºF or less were needed to induce spawning in any of the yellow perch studied. Thus, the permit limit of 50 ºF appeared to the Permitting Agencies to be the absolute maximum temperature that would allow any spawning to take place given the short number of days for this chill period (149 days).

Consistent with the approach to enforcing a temperature regime elsewhere in this permit, the

Permitting Agencies have used the scientific literature to set temperatures in the ZPH that do not ensure an ideal habitat for the species, but attempt to ensure that the ZPH is sufficiently hospitable that the BIP will be maintained in the lower Basin taken as a whole. Both variables for the chill period in the permit (temperature and number of days) are less conservative than those in the referenced paper. As CLF observes, these temperatures are well above those naturally found in Massachusetts rivers that typically freeze-over during the winter, such as the lower Basin of the Charles (except, of course, for that area influenced by Mirant's discharge). Therefore, EPA and MassDEP disagree that the permit completely ignores the trade-offs Mirant presents in its arguments that the chill period temperature is set too low. These tradeoffs include the need for low early spring temperatures for sufficient gonadal development in yellow perch and increasing spring temperatures to accommodate alewife migration. In capturing this potential trade off in permit conditions, EPA and MassDEP believes there is sufficient time in the spring, after the YP chill period, to allow for alewife migration.

In conclusion, EPA and MassDEP expect that the chill period temperatures the permit will enforce in the ZPH will yield temperatures in the lower Basin as a whole that should support subsequent spawning for the YP, and it is not necessary for the permit to enforce temperatures in the ZPH that perfectly mimic background temperatures free of any influence from Kendall Station's discharge.

Comment C19: Protective Temperature and Time Periods for Yellow Perch Adult Spawning Stage Overly Stringent, Not Applied in Correct Location. Section 5.6.3i and j of the DD detail the selection of the protective temperature and time period for the adult spawning stage of the yellow perch. Mirant Kendall asserts that the ZPH is not appropriate habitat for yellow perch spawning. Therefore, any limits to protect perch spawning should be re-focused on those upstream areas suitable for that purpose. Further, there are no data in the referenced studies to support the selection of a 4-hour averaging period as applicable or appropriate for perch spawning.
Based on the site-specific data in the record, Mirant Kendall asserts that, from March 20 to April 30, maintenance of 24-hour average temperatures not-to-exceed the 90-95% confidence upper bounds of ambient temperatures (Comment C5) in 50% of the cross-sectional area of the river running perpendicular to the banks opposite the upstream edge of the ZD would be adequately protective of the BIP of spawning yellow perch in the lower Charles.

Comment related to C19 from CRWA: According to Page 68 of the DD, the literature identified yellow perch adults as the resident adult fish stage most sensitive to elevated water temperatures. EPA selected a Habitat Suitability Index of 0.5, which corresponds with an upper temperature limit of 59 F. There is no justification for adopting this HSI and the higher limit. The temperature range for adult breeding extends only to 54 ºF. EPA presents no evidence to show that yellow perch adults can spawn at higher temperatures. With other adjustments, the maximum temperature is set at 65 F, which is 11 degrees higher than the yellow perch's maximum breeding temperature. High temperature limits and a HSI of 0.5 fly in the face of EPA's ten year effort toward a swimmable and fishable Charles River by Earth Day 2005.

Comment related to C19 from CLF: Clearly, the success of the permit in setting temperature limits that promote a BIP is heavily dependent upon using appropriate seasonal dates for the

species evaluated, particularly with respect to critical natural history phases such as migration and spawning. The spawning period indicated for yellow perch is limited to just 5 weeks (20 March through 30 April) and this is not justified by the best available science. Yellow perch begin to spawn when the water has warmed enough and continue to spawn at least into May so long as the water does not get warmer than about 55 ºF. Based on the scientific literature, under improved conditions in the Charles, one would expect these fish to continue to spawn in May, June and possibly into early July. This means that a protective permit would set temperature limits so as to be supportive of spawning, egg and larval development, and the growth and maturation of young through the spring and early summer.

Response to C19 and related comments: The permittee asserts that the ZPH is not appropriate habitat for yellow perch spawning (discussed in section D of the Mirant Comments); that the 4-hr. average is not appropriate for perch spawning and that the 90-95% confidence upper bounds of ambient temperatures should be used as is outlined in Comment C5. EPA and MassDEP address the YP habitat issue in Response C17 and D11. With regard to the 90-95% confidence upper bounds: this question was addressed in the Response to Comment C5 with respect to alewives. The same argument applies for yellow perch.

In response to CRWA and CLF's concerns, EPA and MassDEP agree that the temperatures enforced in the ZPH are not ideally suited to support yellow perch spawning according to the available literature. Again, the goal of the ZPH is to enforce temperatures that are sufficiently hospitable to maintain the BIP in the lower Basin as a whole, not to make the ZPH itself an optimal habitat for the BIP.

The overall concerns EPA and MassDEP have with a 24 hour averaging period for compliance with a protective temperature limit rather than a 4 hour averaging period is discussed in Response C16. Yellow perch, like other species, are characterized as spawning under a relatively narrow range of water temperatures. Taking into account the documented influence Kendall Station has to manipulate temperatures in the lower Basin, allowing a spawning temperature limit to be averaged over a 24 hour period would conceivable allow the facility to raise temperatures beyond expected spawning temperatures for YP for short periods within a day, while still meeting a calculated protective limit over the 24 hour period. It is not considered protective to design a permit where a protective spawning temperature could be consistently exceeded within each 24 hour period and still maintain that the temperature limits is achieving the goal of protecting the BIP. A four hour averaging period is a better mechanism to ensure that protective temperature limits are not consistently exceeded within the averaging period.

Comment C20: Protective Temperature and Time Periods for Yellow Perch Adult Stage Overly Stringent. Sections 5.6.3k and l of the DD detail the selection of the protective temperature and time period for the adult stage for yellow perch. These sections describe the rationale behind selection of the WQS of 83 °F throughout the ZPH as adequate to protect adult yellow perch. The target is 80.6 °F where the fish actually are present.

The Agencies assert there is an absence of site-specific avoidance temperatures for adult yellow perch in the Charles River. Mirant Kendall believes that considerable information exists in the site-specific data it collected and which the Agencies admit they have not fully considered.

Mirant Kendall encourages the Agencies to review the site-specific data it has submitted, with particular attention to the fact that most of the fish captured were in mixed schools comprised of adults and juveniles.

Mirant Kendall asserts that maintenance of 24-hour average temperatures not-to-exceed 83 °F more than three days per month and the 95% confidence upper bound on any day in 50% of the cross-sectional area of the ZPH defined by Stations 3, 4, 5 and 6 in the summer would be adequately protective of the BIP of juvenile and adult yellow perch in the Lower Charles.

Response to C20: As stated in Response C17, evidence that yellow perch (YP) were present in greater numbers upstream of the influence of the Station's discharge and were found primarily in deeper, cooler water in the ZPH can be viewed in several ways. One reason for this observed pattern of distribution could be that the habitat identified by the permittee downstream of the discharge is less suitable for YP for reasons not associated with higher water temperatures. However, no scientific assessment of the quality of yellow perch habit in the lower Charles was submitted by the permittee to support this position. It is at least as equally plausible that the YP pattern of distribution documented by extensive collections and tagging studies was directly caused by avoidance of otherwise suitable downstream habitat due to the thermal influence from Kendall Station. Temperature data from the lower Basin and literature values for YP habitat suitability for temperature do support this position. The objective of the protective temperature limits is to preserve habitat that will not cause avoidance behavior in fish downstream of the discharge.

One concern noted in the field data was that a single water temperature value was presented along with each beach seine collection. A near surface and a near bottom temperature reading at the greatest depth sampled in a few representative locations in the sample area would have provided a better assessment of the actual water temperatures that coincided with the presence of YP. This concern is fully discussed in Response C17. With regard to the 95% confidence upper bounds: this question was addressed in Response C5, Section 2 for alewives. The same argument applies for yellow perch.

It is not clear what justification the permittee relied on to support its proposed permit requirement that a temperature limit, no matter how it is derived or what averaging period is used, can be exceeded up to three days in a month and still be considered protective. EPA and MassDEP will not consider this approach when no reasonable justification is presented to ensure the requirement is protective of the BIP.

EPA and MassDEP did not view a 24-hour average maximum temperature limit as appropriately protective in the specific case of the lower Charles River Basin for the reason presented in Response C16.

Comment C21: Temperature Limits More Stringent than Expected Range of Ambient Conditions. In setting their proposed temperature limits and associated time periods, the Agencies stated that the goal as "to determine the appropriate deviation from ambient or natural temperature conditions without adverse effects to the biota and to the balanced indigenous population." (DD Section 5.1). Further, the Agencies stated that "Kendall Station intake

temperatures seemed to be a reasonable approximation of ambient river conditions in the spring." (DD Section 5.6.3i). The proposed temperature and time limits, however, are less than two standard deviations above the mean temperatures experienced by the resident species for the same calendar periods over the spring and summers of the last six years, and in one case (June 1-7), less than a single standard deviation above the mean. Thus in fact, the Agencies' proposed thermal limits do not fall within the naturally occurring range (2 standard deviations) of ambient temperatures in the river.

Based on more than six years (1998-2004) of essentially continuous monitoring at the Broad Canal intake, the Agencies' proposed 4-hour block average limits compare as follows to the means, Standard Deviations and 90% and 95% upper bounds of ambient temperatures for the respective periods:

Frequency Distribution of Maximum 4-hour Block Average Temperatures (°F) at Kendall Intake, Compared to Agencies' Proposed 4-hour Block Average Temperature Limits in ZPH

Time of Year	Mean at Intake	Standard Deviation	90% Confidence Upper Bound	95% Confidence Upper Bound*	Draft Permit in ZPH
April 2-14	50.03	4.84	58.02	59.72	61
April 15-30	56.14	4.06	62.84	64.26	65
May 1-10	62.15	4.36	69.34	70.86	66.4
May 11-22	64.16	3.59	70.09	71.35	68
May 23-31	65.61	3.53	71.43	72.66	70
June 1-7	68.76	3.78	74.99	76.32	72
June 8-11	69.66	3.89	76.08	77.44	75
June 12-August 31	77.97	4.18	84.87	86.33	83

***2 standard deviations above the mean**

MK Comment Ex. Nos. C.21-1 and C.21-2 graphically illustrate how the upper end of the normal ambient temperature range for some of the periods is higher than the Agencies have set their proposed limits. For both the May 1-10 and June 1-7 periods, the Agencies' proposed limits are about 3 °F below the 90th percentile values for those same periods.

Even assuming that based on monitoring data from upstream areas the Agencies might view "ambient" as up to 2 °F lower than the intake temperature in low flow periods, the Draft Permit limits provide either no deviation at all from the background range (June 8-11), or up 2 °F lower than the background range (June 1-7).

Looking beyond the intake data, the temperatures in the proposed ZPH have frequently exceeded the proposed limits. MK Comment Ex. Nos. C21-3 and C21-4 show the numbers of days and percentage of each period that exceeded the proposed limits from 1999 to 2004 based on continuous measurements at the intake (Table C21-3) and, more recently, at thermistors

throughout the basin (Table C21-4). Those thermistors included one representative of "ambient" at the Harvard Bridge and ones in the ZPH near station 3 on the Boston side ("Boston") and just above the Charlestown Dam. The proposed limits were exceeded for at least a few days in each of the last six years both at "ambient" and ZPH locations. For example, in summer 2002, there were 9 days of exceedances at the Harvard thermistor and more than 30 days with exceedances in the Boston ZPH between June 12 and August 31. However, as discussed extensively in Mirant Kendall's submittals and throughout this section of the comments, the Agencies have set limits below these historic temperatures despite the absence of any evidence from the ongoing river studies that those actual temperatures have caused biological harm.

Response to C21: This comment is similar to other comments by Mirant which urge EPA and MassDEP to peg the maximum temperatures allowed in the permit to the upper end of temperatures as they might have fluctuated historically in the lower Basin. In short, EPA and MassDEP do not believe it would protect the BIP to authorize Kendall Station to heat the lower Basin to levels that represent the upper bound of ambient temperatures. Just because individuals of the BIP have survived occasional temperature spikes does not support the conclusion that the BIP would be protected under a regime where the lower Basin could see those temperatures maintained artificially high on a continuing basis.

As detailed in the DD, EPA and MassDEP reviewed scientific literature and site specific biological data submitted by the permittee to establish protective temperature limits. Only then did EPA and MassDEP compare these limits with approximate ambient water temperatures in the Charles River to obtain an overall picture of how the limits compared with natural conditions in the river.

The permittee provides a frequency distribution of Maximum 4-hr Block Average Temperatures at the Kendall intake and compares these with the draft permit limits. By doing this, the company fails to follow its own advice in presenting the 90 or 95th percentile data. This was discussed in Response C5 (3). Mirant does not develop a 90th or a 95%-ile figure for the available data. To do so, it would have to provide all the 4-hr block averages for the time period in question. Instead, based on the title for the table on page 32 of the Mirant comments, the company has taken the maximum 4-hr block averages from each day and has developed upper bounds of the confidence limits for these. This is not seen as an appropriate use of the dataset which results in temperature values that are much higher than the true 90th or 95th percentile temperatures.

Mirant states that the Agencies "might view 'ambient' as up to 2 ºF lower than the intake temperature" in the table on the same page during low-flow periods. Based on information presented in the DD, ambient temperatures at the B.U. Bridge have been documented more than 5 ºF lower than those at the intake. Thus, Mirant's temperature values for the June - August time period may be flawed.

Mirant also compares thermistor records from the Kendall intake to "ambient" data at the Harvard Bridge. The Harvard Bridge is not the ambient station established in the permit. The "ambient" station is much farther upstream, near the B.U. Bridge. During months of low-flow (e.g., June through September) temperatures at the Harvard Bridge may be substantially increased by the thermal plume from the Kendall discharge. Thermal influence of the plume has

been projected by the permittee to range as far upstream as the B.U. Bridge, (near the permit's "ambient station"), which is well upstream of the Harvard Bridge.

Comment C22: Suggested Revisions to Temperature and Time Periods Based on Site-Specific Field Data from Lower Basin. Mirant asserts that the in-stream limits proposed in the Draft Permit are overly stringent and not supported by site-specific data in the record. Section 5.6.3m of the DD notes that as "more site-specific field data is collected from the lower basin, these temperature limits and time periods may be modified." Mirant further asserts that the data presented in the record to date, supplemented by the additional 2004 data provided concurrent with these comments, is sufficient to support a revision of these temperature and time limits.

Further, the proposed absolute water temperature limits are all based on simultaneous 4-hour averaging at an upstream location of much smaller water volume, which therefore cools much more rapidly than the ZPH when temperatures are at the in-stream limit.

This requirement would arbitrarily force Kendall Station to remain shut down unnecessarily, for example after cool nights when the 4AM to 8AM B.U. Bridge temperature has cooled by about one degree overnight while the larger volume in the ZPH has only allowed the temperature to cool by about half a degree. Finally, as discussed in more detail in Comment D2, Mirant asserts that use of 4-hour block averaging is unreasonable and arbitrary for each of the limits proposed for the protection of resident species.

Response to C22: EPA and MassDEP reviewed all submitted data in assembling responses to the comments and issuing the final permit for Kendall Station, including the 2004 and 2005 data. EPA and MassDEP do not agree that the additional site-specific data submitted with the permittee's comments warrant a less stringent temperature limit approach that relies more extensively on ambient temperatures. To the contrary, based on Comment Response C3, the newly submitted data support EPA and MassDEP's decision to start the design of the ZPH with a survey of the scientific literature for protective temperatures. Having found evidence of appreciable harm from the existing discharge, EPA and MassDEP are not prepared to simply adopt that status quo to protect the BIP. Nevertheless, the permitting Agencies note again that the permit tempers a strict application of the literature values to account for the conditions in the lower Basin, as CLF and CRWA are quick to point out.

EPA and MassDEP agree that the ambient temperature station (Station 1) is located in a smaller water volume than the area of the lower Basin adjacent to Kendall Station. As stated in the DD, it was necessary to place this station at least that far upstream in order to prevent the ambient temperature monitors from coming in contact with the thermal plume from the Station. The Station's thermal plume has been documented to influence water temperatures as far upstream as the B.U. Bridge.

It appears, however, that the permittee has misinterpreted the compliance mechanism that involves the ambient temperature monitor at Station 1. This monitor is primarily used to determine compliance with the maximum delta T of 5 °F between Station 1 and all other monitoring stations. Based on data submitted by the permittee that documented a "lag" in

temperatures from the ambient station to the downstream stations, EPA established a 24-hour average value when delta T compliance is calculated.

It is unclear what unfair penalty the Station is subjected to when the ambient monitor (Station 1) and the downstream monitors are all at the proposed limit (e.g. 70 °F on May 25th) and the Station 1 location cools faster. According to the permit, the maximum four-hour temperatures in the ZPH must not exceed the limit in effect (70 °F in this example) regardless of what the ambient conditions might be. In fact, the ambient temperature monitor at Station 1 will likely always record a cooler temperature when the Station is in operation or has recently operated. The fact that the lower Basin adjacent to the Station has a greater volume of water and takes longer to cool also means that this same larger volume of water takes longer to heat. This capacity to absorb heat is used to great advantage by the Station as it discharges its waste heat. Therefore, EPA and MassDEP believe any effect created by the different rates of cooling and heating for the ambient monitor and the ZPH monitors cuts in both directions and likely cancels itself out over time.

The response to comment that the 4-hour block averaging is unreasonable and arbitrary for each of the limits proposed for the protection of resident species is fully discussed in Response D2.

Comment C23: Temperature Limits and Time Periods for the Most Sensitive Anadromous Species are Overly Stringent, Unsupported by Charles River Experience and Should be Revised.

Section 5.7 of the DD lays out the rationale for the selection of the thermal and time limits for anadromous fish species in the lower Charles River Basin. In Section 5.7.2, the Agencies define the alewife as being the resident species most sensitive to elevated temperatures. Subsequent subsections set out the rationale for the determinations of the temperature and time limits for each stage of the life cycle of the alewife, to be applied in the ZPH.

As an initial matter, Mirant has significant concerns regarding the definition of the ZPH for this species. These concerns are discussed in Section D below. With respect to the temperature and time limits established for this species, Mirant has concerns regarding the appropriateness of the specific temperature limits and time periods established based on the data sources used to set them. These concerns are summarized below, followed by specific examples of errors incorporated in the draft permit.

In general:

- For the targeted anadromous species, river herring (alewife), Mirant Kendall asserts that best available information clearly demonstrates that the BIP in the Charles River is limited by hydrologic modifications, which confine the population to the lower portions of the river, and make the population extremely vulnerable to “washout” of eggs and larvae any time there are flow episodes >~ 400 cfs between mid-May and mid-June.

- Mirant Kendall's sampling program found that larvae and YOY alewives were significantly more abundant and larger in May through August after the two low-flow springs (1999 and 2004) without high flow episodes between mid-May and mid-June as compared to the three other years sampled with such episodes (2000, 2002 and 2003). See MK Comment Ex. No. C23-1.

- Mirant Kendall notes that these data also demonstrate that periodic exceedances of the Agencies' proposed thermal limits for mid May and early June (about 10 days each in 1999 and 2004) were experienced without any evidence of appreciable harm. To the contrary, the results indicate that in the years of lesser relative abundance of alewives and no larval growth until mid-June (2000, 2002 and 2003), there were far fewer thermal exceedances: zero (2002, 2003) to three days (2000) in the mid-May to mid-June timeframe. MK Comment Ex. No. C21-4.

- Mirant Kendall's site-specific monitoring program demonstrates the greater importance of river flows in mid-May to mid-June compared to exceedances of the proposed temperature limits. This demonstration is reinforced by the observation of greater relative numbers of returning adult alewives from the 1999 and 2001-year classes, compared to returns from the 1998 and 2000-year classes. 1999 and 2001 were lower-flow years with frequent exceedances of the Agencies' proposed thermal limits in spring and summer, while 1998 and 2000 were cooler years with very few exceedances of thermal limits, but significant flow events in the critical mid-May to mid-June timeframe for egg and larval retention and growth. MK Comment Ex. Nos. C21-3 and C23-2.

Further, the extensive site-specific data collected by Mirant, yet not fully considered by the Agencies, strongly suggest the absence of harm to the BIP as the upgraded Station operated under its existing permit. For example:

- The data collected by Mirant Kendall on the abundance of alewives in the river demonstrate that despite periodic exceedances of the Agencies' proposed thermal limits for mid-May and early June (about 10 days each in 1999 and 2004), there was actually observed greater abundance and more rapid growth of alewives as opposed to appreciable harm. By contrast, as discussed above, the years of lesser relative abundance of alewives and virtually no larval growth until mid-June (2000, 2002 and 2003), experienced very few thermal exceedances, zero (2002, 2003) to three days (2000) in the mid-May to mid-June timeframe. MK Comment Ex. Nos. C21-3, C21-4, C23-3.

-

- YOY alewives were more abundant in the later summer and fall of the three years (1999, 2002 and 2003) that had frequent exceedances of the Agencies' proposed 83 °F limit for mid-June to October, as compared to 2000, which did not experience exceedances. During one of these years, 2003, Kendall Station operated at heat loads of more than 50% of permitted capacity throughout the summer, including about 83% in July. This heat load profile is typical of that envisioned by Mirant Kendall for

future commercial operation of the facility.

-
- In the spring of 2003, tagged adult alewives from the spawning run moved effectively upstream past the plant and across horizontal Delta T's greater than the 5 °F proposed limit in the Draft Permit.

-
- In the Spring of 2004, mid-May densities and lengths of Alosa larvae, and early to mid-summer occurrence of alewife YOY in beach seine samples MK Comment Ex. No. 23-1, were all significantly greater than in any year since 1999, following more than 70% of permitted heat load discharge by Kendall Station during the spawning run in April, 50-60% of permitted heat load in July/August, and 11 days of exceedance of the Agencies' proposed thermal limits for alewife protection in mid-May.

Response to C23: Mirant asserts, through a number of statements, that the draft permit limits for temperature and time periods are overly-stringent and that they are unsupported by both newly-reported data and formerly-presented site-specific data from the Charles River. In response to comment C44, EPA and MassDEP further discuss refinements to the temperature regime which the permitting Agencies concluded are necessary to protect the BIP. In this comment C23, Mirant basically makes two broad assertions:

1. "Washout" of eggs and larvae during high flow years have a bigger effect on the abundance of river herring than temperature variations; and

2. The presence of alewives during periods of higher temperatures strongly suggests the absence of harm to the BIP from the upgraded Station's operation.

In addition, Mirant makes two more specific points:

3. Tagged alewives moved effectively across horizontal changes in temperature (delta T's) greater than 5 F; and

4. Alosa larvae densities and lengths in the Spring of 2004 appear to be greater during a period of elevated heat output from the Station.

As background to the responses to these points, EPA and MassDEP have extensively reviewed the data Mirant has submitted, including the 2004 and 2005 data. Many of the conclusions that are pertinent to responding to this comment C23 are explained and presented in more detail in Response C3, concerning a finding of appreciable harm from Kendall Station's discharge. Therefore, this response will sometimes refer back to the analysis and conclusions presented in Response C3.

1. Washout

One key component of Mirant's contention is that "For the targeted anadromous species, river herring (alewife), Mirant Kendall asserts that best available information clearly demonstrates that the BIP in the Charles River is limited by hydrologic modifications, which confine the population to the lower portions of the river and make the population extremely vulnerable to 'washout' of eggs and larvae any time there are flow episodes >~400 cfs between mid-May and mid June."

As a threshold matter, it may not remain true that the anadromous species remain largely confined to the lower Basin. None of the sampling to date has fully assessed the degree of adult river herring movement past the Watertown Dam. Improvements were made in the fish ladder at that Dam in 2005, but unless a reliable method of counting river herring that move into the lower Charles, and that move past the Watertown Dam, is developed and implemented, EPA and MassDEP will have no basis for the degree of confinement of the adult population below the Watertown Dam. Prior to 2005, the permitting agencies expect that Mirant's statement that the bulk of the population was confined below the Watertown Dam was a reasonable assessment, based on the fact that the Watertown Dam fish ladder was not functioning properly in past years.

If the hypothesis is true that the population of river herring in the lower Basin is greatly influenced by washout during high-flow years (although the night-time beach-seine data do not support this view), it stands to reason that these may be the years of highest mortality to eggs and larvae. Washout during high-flow years would result in a substantial drop in the production of adults. Since washout rates in the lower Basin are primarily influenced by the amount of rainfall, this environmental variable in the river is beyond the control of the permittee and the regulators. Therefore, EPA and MassDEP must treat such washout as a "significant impact" in the assessment under 40 CFR 125.73(a) of "the cumulative impact of [the] thermal discharge together with all other significant impacts on the species affected" (emphasis added).

Consistent with Mirant's hypothesis, the low flow years would be important to rebuilding populations of alewives, bluebacks and, potentially, American shad in the Charles. It would follow then that EPA and MassDEP must be especially careful to assure that the permit allows alewife to maintain a balanced indigenous population and allow other anadromous stocks to be protected during low-flow years. During the years of high flows, Kendall Station would likely have less operational difficulty in meeting the thermal limits required by the permit, due to the higher level of dilution available in the lower Basin. Ironically, even though it should be easier to meet the permit's thermal limits in high flow years, if Mirant is correct, the generally cooler ZPH will be supporting a smaller population of river herring because of washout.

Following the logic of this premise, it is during the low flow years that preserving the lower Basin as suitable habitat for the BIP emerges as especially important to generate a stronger year class of the species compared with the overall lower recruitment that took place under "washout" conditions in wetter years. Also, it is true that Kendall Station's discharge of heat will have its greatest impact on the lower Basin during times of low flow, because of the lower dilution levels available to absorb the heat. Therefore, it is precisely during the low flow years that the permit's heat limits become especially important to maintain temperatures in the ZPH that will protect the lower Basin as habitat for the BIP. Contrary to Mirant's suggestion that washout somehow minimizes the importance of temperature for protecting the BIP, washout becomes a factor in the

cumulative impact analysis that supports the contention that temperature limits are even more critical in the low flow years, with the potential to support even greater reproductive productivity.

If the bulk of the population of alewives that enters the lower Charles was confined to the segment of river downstream of the Watertown Dam, then the potential cumulative impacts of Mirant's operations resulting in added heat, entrainment and impingement in the lower Basin would be substantial in low-flow years. Habitat for adult alewife spawning is apparently best below the B.U. Bridge in the wide section of the river (see Response to C3 and personal communications to G. Szal). In addition, limited sampling for juveniles by Mirant in segments of the river upstream of the B.U. bridge produced few or no juvenile alewives, while sampling downstream of the B.U. bridge was relatively productive in certain years, depending on how close this sampling was to the Mirant discharge (See Response C3). In addition, river herring larval densities in 1999 and 2000 were quite high in the area downstream of the B.U. Bridge, indicating that spawning took place in the wide section of the river. If it is indeed true, that the alewife population was primarily confined downstream of the B.U. Bridge, then Mirant's negative impacts to the alewife population would be quite substantial.

A review of each of the categories of potential loss due to Mirant's operations is a necessary component of this response to comments, and has resulted in requirements by MassDEP in the State Water Quality Certification (WQC) for modeling and monitoring to determine the extent of impact from each of these categories. By Mirant's own projections (see the Determination Document, Table 8.1.2-2 in Section 8.1.2i) entrainment losses to river herring larvae occurred in 1999 and 2000 amounting to 14% and 23%, respectively, of the total herring larvae population that was produced in the lower Basin. If the entire population of river herring was confined to the lower Basin due to the spawning constraints at the Watertown Dam during those years, these percentage losses of larvae due to entrainment would translate to the same percentage loss of equivalent adults. That is, if there were a loss of 23% of the larval population due to the facility in year 2000, and all other forms of mortality to that population were to remain unchanged, the number of adults projected to have resulted from the year 2000 larval population is expected to be about 23% lower than it would have had entrainment not occurred. The State WQC includes monitoring programs to evaluate population size of anadromous species of interest and the degree of their movement past the Watertown Dam.

In addition to entrainment impacts, Mirant's operations have also been shown to have large-scale negative effects on the nursery habitat of river herring. EPA and MassDEP have shown (see Response C3) that Mirant's discharge, in 2004 and 2005, deterred juvenile alewives (and bluebacks) from utilizing much of the lower Basin as nursery habitat. Impingement losses are of concern as are potential effects of the discharge pipe. Mirant has provided video documentation that the discharge pipe attracted river herring, and some of these fish attempted to breed in the discharge pipe. An assessment of the loss of breeding potential for river herring due to this attraction to the discharge pipe will be possible based on monitoring included in the final permit (See Response Related to C7 from CLF).

If alewives are primarily confined to the lower Basin, the effects of Mirant's operations may be quite severe in low flow years. The permitting Agencies are prepared to agree with Mirant's

hypothesis that years of low river flow may be quite important to the rebuilding of river herring stocks downstream of the Watertown Dam due to low rates of larval washout during these years. Because of Mirant's ability to directly affect all life stages of river herring and certain life stages of other fish of concern in the lower Basin, as well as their habitat, especially in years of low river flow, Mirant's impacts to these populations during these years may be quite severe. Section 316(a) charges EPA and MassDEP to ensure that the permit protects the BIP from those cumulative impacts.

In order to more fully understand the effects of Mirant's operation on the populations of species of concern, MassDEP, through its Water Quality Certification process, has determined that there needs to be a quantification of the potential effects of various components of the plant's operation on these species. If future monitoring leads EPA and MassDEP to find that the facility is continuing to negatively impact the BIP, the modeling and monitoring program will assist the Permitting Agencies in directing attention to the operational components that are of greatest harm to these populations.

2. Temperature and Alewife Presence

In Response C3, EPA and MassDEP present an extended analysis of the data that Mirant uses to assert that the BIP tolerates, or, according to Mirant, arguably enjoys, temperatures that are higher than the limits in the draft permit. The Permitting Agencies here present a brief overview of those conclusions.

The alewife population appears to be much reduced in comparison with the potential of the lower Basin to support the species. While EPA and MassDEP acknowledge that the dams have an obvious impact on the "carrying capacity" of the lower Basin, the permit must protect the BIP in the context of all the stresses that population faces. Therefore, EPA and MassDEP need to be especially careful to protect habitat for the BIP in the lower Basin from the impact of excessive heat, given the fragility of its hold in the area.

It does appear that heat has a negative impact on the species. When EPA and MassDEP disaggregate the data Mirant summarizes in this comment, some patterns become clear which demonstrate that heat from the Kendall Station's discharge has the effect of excluding alewives from habitat in the lower Basin. Samples taken closer to the outfall and closer to the heat of the discharge had fewer alewives than samples taken further away. Also, the catch rate per unit effort of sampling at temperatures above 81ºF was either zero or was generally much lower than that at temperatures lower than 81ºF. Therefore, the sampling provides support for the concern EPA and MassDEP have that elevated temperatures from the plant's discharge can exclude alewives from habitat in the lower Basin.

Finally, as discussed in more detail in Response C3, EPA and MassDEP have concluded that this habitat exclusion is an appreciable harm for this BIP. The permitting agencies confirm this conclusion even in the face of Mirant's argument that the total population of certain species appears to have been higher in some years when the temperatures were higher. Arguably, to some extent, this dynamic may be explained by lower rates of "washout" during the hotter dry summers. Indeed, there are any number a variables that may affect overall potential biomass of

an anadromous year class in any given year, temperature being only one variable, and not necessarily the controlling variable. But two conclusions seem reasonably well supported in the data presented on this record: the alewife population is low in the Charles River Basin,[1] and alewives appear to avoid the higher temperatures from which the permit is designed to protect them. If Mirant is correct that the population increases slightly during low-flow years, it is quite plausible that this rebound would be even more robust if the species had better access to more habitat.

In Comment C13, Mirant dismisses this line of analysis as an "it might have been better" argument. Mirant's point appears to be that the permitting agencies need affirmative proof that heat is the sole or primary factor affecting the survival of the BIP in the lower Basin. Mirant asserts that it is not enough for EPA and MassDEP to conclude that heat is a contributing factor, among many, to depressed BIP populations. But in studies of ecology in the real world, as with empirical but non-laboratory sciences generally, the best science available often involves attempting to discern how a wild population was affected by a stressor without the knowledge of precisely how the population would have fared absent the stressor. In short, the lower Basin does not readily permit EPA and MassDEP to conduct a controlled field experiment isolating the effect of heat on the BIP. To the extent practicable, EPA and MassDEP are able to separate out the impact of temperature from the very complicated multi-variable system naturally operating in the lower Basin to affect the health of the BIP, there is a statistically significant relationship between increased heat and reduced presence of alewife. Therefore, heat does appear to exclude alewives from habitat. If the low river flows and correspondingly low rates of washout during hot years have an ameliorating effect that is greater than the negative effect of the heat in those

---

[1] Only one estimate of the adult alewife population size currently exists for the Charles. This estimate was provided by Mirant and was based on sonar recordings of river herring (i.e., blueback herring and alewives combined) at the entry to the lower Basin in the spring of 2002. Mirant estimated that about 45,000 river herring entered the lower Basin that year. Mirant also conducted gill-netting near the New Charles River Dam near the point of alewife entry to the lower Basin. Based on the relative proportions of alewives to total river herring in these nets, in combination with the total river herring estimate, Mirant estimated that about 8,000 adult alewives entered the lower Basin in 2002.

These fish numbers have been referenced by many interested parties and regulatory agencies to assist in the evaluation of the anadromous fish run in the Charles River, including EPA and MassDEP in this document. It must be clearly understood, however, that these numbers were derived from a pilot study conducted by the permittee in 2002. A list of assumptions, potential sources of error and suggested refinements were documented for future field efforts to better estimate herring runs at that location. Any use of the fish entry estimates from 2002 must take the preliminary nature of these numbers into account.

It is important to note that the permittee's preliminary estimate of 45,000 adult river herring is well below the estimated carrying capacity for the Charles. MADMF provided two estimates of the herring carrying capacity of the Charles. These two estimates were 250,000 and 500,000 fish. Neither estimate considers any issues with respect to herring passage at the New Charles River Dam or at the Watertown Dam; both dams may affect the ability of alewives to move upstream and populate the upper Basin.

The permittee's estimate of the adult run strength as projected by the 2002 pilot study, (i.e., 45,000 fish), although preliminary in nature, is still about 1/6th to 1/11th the MADMF estimates of the system's capacity. Because the 2002 alewife estimate (8,000 fish) of population size was so small, there is potential concern that any downward trend in alewife population size could result in a loss of this population from lower Charles.

years, this observation does not mean that heat is not an appreciable harm to the species. And it certainly does not mean that Mirant should have authority to add even more heat in a hot, low flow year when ambient river conditions alone are likely stressing the BIP.

Mirant is especially poorly positioned in this proceeding to discredit EPA and MassDEP's use of the argument that the company might characterize as "it might have been better." Mirant here carries the burden of proof to show that heat levels it advocates for its discharge will protect the BIP, and is correspondingly required to demonstrate no appreciable harm from its existing discharge, if that is the analysis on which it wishes to rely. EPA and MassDEP have concluded that the effect of habitat exclusion, which heat has caused, would be an appreciable harm to alewives in a hot, low flow year. The permitting agencies are simply saying that this interpretation of the data is at least equally as plausible as Mirant's assertion that the marginally higher number of alewives in hot years must mean that heat does not harm the BIP. Hypothetically, in the unlikely event that the two theories were indeed equally plausible, Mirant's hypothesis does not prevail because the company carries the burden of proof. But EPA and MassDEP conclude that the case is not nearly so close, because the permitting agencies' hypothesis aligns reasonably well not only with the data collected in the lower Basin, but also with the directional indications of laboratory experiments where the effects of heat on the alewife could be isolated and studied in a controlled environment.

3. Tagged alewives and delta T's

As explained in more detail in Response to C33, EPA and MassDEP find that Mirant's tagging study was inconclusive as to the effect of the discharge on migration patterns of alewives. The permitting agencies also address parallel comments about the delta T limits in the permit in Response C6.

4. Alosa larvae densities and lengths in the Spring of 2004

The permittee stated that larvae (both bluebacks and alewives combined) and YOY alewives were larger in May through August after the two low-flow springs (1999 and 2004) than in other years. Mirant also contended that the data indicate that in the years of low flow (1999 and 2004) there were high larval growth rates although there were many alleged exceedances of the draft permit limits for temperatures during those years.

As a threshold matter, EPA and MassDEP do not necessarily concede that the data demonstrate that 1999 and 2004 saw the level of exceedances of the draft permit limits which Mirant asserts. The temperature readings taken in 1999 and 2004 were not collected according to the design of the temperature compliance regime in the draft or final permit. So there is no clear correspondence between this historic data and the limits included in the permit. Response C13 (d) contains a discussion of this issue.

But even if EPA and MassDEP accept Mirant's premise for the purposes of analysis, the permitting agencies do not accept the company's conclusion. EPA and MassDEP understand that it has been shown that the growth rate of alewife larvae is accelerated by warmer temperatures. However, the researcher Kellogg (1982), who did much of the work on

temperature effects to growth rates, demonstrated that larval survival greatly decreases with warmer temperatures. Thus, as temperature increased in these experiments, survival decreased. In Kellogg's experiments, the test chambers with the highest temperatures to which alewives were exposed had the fewest survivors. This is discussed at length in Response C44 and is an important issue to understand for those involved in the Kendall Station permitting process. Mirant's demonstration that the growth rates of early life stage juveniles were greatly increased over that of several other populations may not be indicative of high-quality conditions for the alewives of the Charles. To the contrary, based on Kellogg's research, "super-sized" YOY would be typical of a temperature-stressed population with a low survival rate.

While it is true that river herring larvae were found in high densities on several dates in June of 1999, it is impossible to tell whether these were bluebacks or alewives. The high larval densities in 1999 may have translated into high alewife juvenile densities in that year. Certainly, juvenile alewives were found in comparative abundance in 1999 in day-time beach seines and the rate of capture in 2004 was higher than in 2002 and 2003. The density rise in 2004 must be taken in the overall context of the multi-year sampling data. The daytime capture rate in 2003 was zero; the capture rates in 2000 and 2002 were essentially zero. The alewife juvenile catch rate in 2004 increased from zero, but still, it was only one-tenth of the 1999 catch rate.

Comment C24: The Record Contains Adequate Charles River - Specific Evidence Regarding Impacts to Alewives. Section 5.1 of the DD notes “It can take many years of study for population effects to become apparent.” Mirant Kendall disagrees with the Agencies’ assertion in this regard. Rather, Mirant Kendall believes that if the Agencies had considered the site-specific data on the record, it should conclude that the required periods of time have indeed passed to make a well-informed judgment for the population of the anadromous species of most concern here, alewives. This species completes a reproductive cycle (largely in its river of birth) each year, so that one can readily compare reproductive success in warmer and cooler years based on information in the record.

For example, the Draft Permit specifies that a 72 °F 4-hour block limit is needed to protect alewife reproduction for the first week in June, yet despite 100% exceedance of that threshold in 1999, *Alosa* larval densities in the ZPH of more than 1,500 per 100 cubic meters were observed on June 8, followed by an abundance of juvenile alewives in July 1999 that was greater than in any other sampling year.

Response to C24: The permittee disagrees with Section 5.1 of the DD which states that "it can take many years of study for population effects to become apparent." The permittee states, for example, that Alosa larval densities (i.e., river herring densities) in 1999 were high despite 100% of the 72 ºF threshold in that year. In addition, alewife juvenile densities were high that year.

EPA and MassDEP continue to support the statements made in the DD that it can take many years of study for population effects to become apparent. Please see Response C23 above. In brief, Mirant may be correct that low flow years help support an especially strong class of river herring, while wash-out in high flow years depresses their densities. EPA and MassDEP conclude that it will continue to be critical to assess the health of the BIP across the years as their numbers wax and wane in response to several variables, some of which are beyond

reasonable regulatory control, such as river flow, and some of which are required to be regulated consistent with protecting the BIP, such as Kendall Station's thermal discharge.

Regarding the statement that there was 100% exceedance of the threshold temperature in 1999, it must be pointed out that the temperature information provided by Mirant to predict that permit exceedances took place in the past were based on the intake temperatures at the Station. It has been shown that the intake temperatures, especially during periods of low flow (e.g., early summer, 1999), are greatly influenced by re-entrainment of the discharge. Thus, it is expected that much of the "threshold exceedance" was likely not a permit exceedance in the ZPH (although there is no way to substantiate this either way, since no temperature measurements were recorded in the ZPH), but was simply an elevated temperature period at the intake due to re-entrainment of the discharge. That is, intake temperatures, while used as a surrogate for ambient temperatures until June 15th in the DD analysis, could not be reliably used to predict an exceedance in a Zone of Passage and Habitat. Based on the permit limits, an exceedance would have occurred only if the temperature limits were not being met at a minimum of 50 % of the temperature monitoring points positioned at various depths and locations along the bank-to-bank transect downstream of the discharge (Monitoring Stations 3, 4, 5 and 6) as well as at other Monitoring Points in the Basin. Response C13 (d) also deals with this subject.

Contrary to Mirant's assertion that there is no problem with the alewife population in this Basin, based on the available data, it appears that the alewife population in the Charles has diminished over the past few years and only exists at very low levels and that appreciable harm to the juvenile population has occurred due to Kendall Station's discharge. Please refer to: a) the discussion of the adult gillnet data presented in Response C43 which shows a steady decline in catch per unit effort of both blueback herring and alewives since 2002; b) the discussion of the push-net datasets relative to the finding of appreciable harm in Response C3; c) the discussion of either zero catch or much reduced catch of juvenile alewives at temperatures higher than 81ºF in Response C3; and d) the discussion of daytime vs. nighttime shoreline seine data for both blueback herring and alewives in Response C48.

In addition to the data examination listed above, daytime shoreline seine information for alewives is presented below in Table C24-1.

Table C24-1: daytime alewife catch in beach seines for all years sampled since 1999. Data are collated from all seining stations sampled each year and results are presented as the number of alewives caught per 1000 square feet of area sampled.

Year	Total number of alewives caught	Total number of square feet sampled	Juvenile alewives per 1000 square feet
1999	441	38,888	11.3
2000	2	75,600	0.03
2002	1	119,723	0.008
2003	0	76,391	0.0
2004	67	55,835	1.2

2005	45	77,779	0.58

Juvenile presence showed a modest increase in 2004 compared to the two previous years, but was still only about 10% of the number collected in 1999 based on the daytime beach-seine capture. In 2005 when Mirant's intake volumes were at their highest levels of all years studied, and their discharge caused high temperatures in the lower Basin downstream of the Harvard Bridge, the daytime alewife catch rate dropped to about half the 2004 level.

Although juvenile lengths may have been greater in 1999 and 2004 than in other years, it is possible this was a response to elevated temperatures in the Basin. The increased growth rate in 2004 mentioned by Mirant coincides with high water temperatures. As discussed in Response C44, Kellogg's (1982) research demonstrated that although high temperatures were associated with high growth rates of the juvenile alewives surviving the tests, high temperatures were associated with greatly increased overall mortality of the juveniles used in these tests.

If it is true that low-flow years are important to the rebuilding of alewife stocks, it is imperative that permitted temperature limits protect against habitat loss due to high water temperatures throughout the water column, where D.O. is at least 5 mg/l, during periods of lower river flows in the lower Basin.

Comment C25: Charles River-Specific Record Evidence is Sufficient to Establish Impacts of Plant Discharge on Anadromous River Herring. In Section 5.1 of the DD, the Agencies assert that mortality of anadromous river herring after leaving the system complicates the process of assessing the plant impact. Contrary to the Agencies' assertion, mortality after leaving the system is irrelevant to determining the effects of the discharge. Even in theory, the discharge can only affect the following parameters, all of which take place and have been monitored along with corresponding data on temperatures and river flows by Mirant Kendall wholly within the system:

- Spawning migration of adults, monitored by gillnet and tagging studies in 1999, 2002, 2003 and 2004
- Reproductive success, monitored by ichthyoplankton collections in 1999, 2002, 2003 and 2004
- Distribution and development of YOY fish, monitored by beach seine in 1999, 2002, 2003 and 2004, and gill net and push net in 2003 and 2004
- Exit of YOY from the system, monitored by beach seine in 1999, 2002, 2003 and 2004, and gill net and push net in 2003 and 2004

-

The DD fails to explain how the Agencies considered and weighed the results of the above site-specific monitoring efforts with the various literature studies to derive the proposed thermal limits for alewife protection. Mirant Kendall strongly believes that the those studies suggest that thermal conditions in 1999, summer 2002, summer 2003, and spring 2004 show no evidence of appreciable harm to the BIP despite frequent exceedances of the proposed thermal limits in the Draft Permit, when compared to 2000, when the proposed limits were not exceeded.

Comment related to C25 from CLF: EPA should use the best available science on the indicator species to set guidelines that will promote a balanced indigenous population. We do not agree with EPA's assertion that studies of indicator species under current conditions in the Charles River add crucial new data upon which permitting limits should be based.

Response to C25 and related comment: The permittee asserts that the site-specific record is sufficient to establish impacts of Station discharge on anadromous fish. Conversely, CLF comments that studies of the BIP under current conditions in the Charles are not scientifically useful.

EPA and MassDEP disagree that mortality to fish after leaving the system is irrelevant to determining effects of the discharge. Because the facility has the ability to warm the system, it can greatly affect the change in temperatures encountered by out-migrating adults and juveniles that move from the Charles River to Boston Harbor. This is one reason why a delta T limit in the receiving water is necessary. The likely changes in temperature encountered by out migrating river herring was fully discussed in the DD in Section 5.7.3c. There is also a discussion of this issue in Response C6. The short and long-term effects of this delta temperature on the out-migrating fish of both life stages are unknown. Also, the thermal component of the Station's discharge may modify the timing of when anadromous species enter the Charles River, as well as when they leave. Thus, mortality associated with leaving the system complicates the process of assessing Station impact because the facility's heat affects the Delta Temperature between the Charles River and Boston Harbor and related in-migration and out migration timing. These factors influence survival.

Beyond the question of increased mortality as the fish leave the system, the permittee maintains that mortality to fish after leaving the system is irrelevant to determining effects of the discharge. Mortality to anadromous fish that occurs beyond the influence of the Station's discharge must be taken into consideration in the same manner that the hypothesis of increased mortality from river herring egg and larval "washout" from the lower Basin is considered. Even though this environmental variable is beyond the control of the permittee and the regulators, EPA and MassDEP can not dismiss its impacts. The expected mortality of anadromous fish in the marine environment is viewed as a "significant impact" in the assessment under 40 CFR 125.73(a) of "the cumulative impact of [the] thermal discharge together with all other significant impacts on the species affected" (emphasis added).

Mirant states that the DD fails to explain how the EPA and MassDEP considered the results of site-specific monitoring, such as spawning migration of adults monitored by gill-net and tagging studies; reproductive success monitored by ichthyoplankton studies; distribution and development of YOY fish monitored by beach-seine, gill-net and push-net; and exit of YOY from the system monitored by beach-seine, gill-net and push-net.

Most of Mirant's questions are addressed in the Responses C3, C23 and C44 of this document. Exit of YOY from the system is not directly addressed, although there has been a noticeable depletion in adult alewife presence in the Basin based on adult catch rates in gillnets since 2002. The juvenile information is more variable and does not show a clear trend regarding either a rise

or fall in densities over the years of specific surveys, although most of the surveys show a decrease in numbers. The push-net catch rate for juvenile alewives in daytime is essentially zero. The nighttime catch rate of alewives in push-nets has been very low since sampling began in 2003. This is discussed more fully in Response C3. The daytime catch rate of juvenile alewives in the shoreline seine has dropped substantially since 1999 (see Response C24 above) and rates seen in 2005 are about $1/20^{th}$ those seen in 1999. The nighttime shoreline seine catch rate for juvenile alewives was variable from 2002-2005 and has consistently been much lower at the station closer to the discharge than at the reference station (see discussion of shoreline seine results in Response C3). However, there was a rise in the overall numbers caught at both the test and reference station in 2005 compared to numbers seen from 2002-2004.

EPA and MassDEP have noted this overall rise in nighttime shoreline seine catch rates for juvenile alewife. There have been some substantial changes in the Basin which may have allowed a Basin-wide increase in juveniles in 2005. Substantial changes were made to improve fish passage past the Watertown Dam. By allowing increased fish passage past this obstruction in 2005, the Massachusetts Division of Marine Fisheries greatly increased the potential for alewife breeding upstream of the Watertown Dam that year. Eggs that were deposited at upstream sites, and the resulting larvae, would have encountered more favorable nursery habitat, especially with regard to the thermal component, than that found downstream of the B.U. Bridge. EPA and MassDEP contend, that, due to Kendall Station's discharge and the notably higher temperatures resulting from that discharge over a wide expanse of the lower Basin in 2005, the population of alewives present in the lower Basin in that year was subjected to large-scale habitat exclusion.

Comment C26: The Agencies' "Margin of Safety" Produces Temperature Limits Too Low to Enhance or Support BIP. Section 5.1 of the DD asserts that the temperature limits EPA has selected strive to achieve a margin of safety to ensure a balanced indigenous population." Lowering temperature limits to create an assumed margin of safety, in this case, ignores consideration of the likelihood that temperatures can be too low to enhance or even support the BIP. Specifically, for river herring, including alewives, there is abundant evidence that lower temperatures delay and/or interrupt the spawning run.

Also, a study in the Connecticut by Savoy & Crecco suggest that growth of alosid larvae is delayed by cooler temperatures. The Draft Permit fails to describe fully and account for the potential consequences of enforcing stricter than necessary thermal limits.

Response to C26: Mirant is concerned that the permit limits, if set too low, would in this case delay or interrupt the river herring spawning run in the lower Basin. First, EPA and MassDEP do not agree that an unreasonable margin of safety has resulted in temperature limits that are too low. Second, EPA and MassDEP are unsure as to the foundation of Mirant's argument. For the sake of discussion only, if a temperature limit were set too low, this limit would not prevent the ambient conditions of the river to rise above the limit and allow the natural seasonal temperature cycle to take place. Kendall Station is not in violation of its permit if natural river temperatures exceed the permit limits. On the other hand, if a temperature limit in the permit is set too low in

the view of Mirant and the river does not naturally reach this limit, Mirant seems to be saying that anadromous fish spawning runs would be delayed or interrupted in the lower Basin without the added heat contributed by Kendall Station. EPA and MassDEP do not support the position that completely removing the Station's thermal discharge from the lower Charles River Basin would negatively impact the natural spawning runs of anadromous fish.

There is abundant evidence that larval and juvenile habitat in the warmer months may be limited by high temperatures, that zooplankton communities in the lower Basin may be negatively impacted by warming of the Basin in the summertime, and that adult, larval and juvenile yellow perch and juvenile alewife habitat may be limited due to excessive warming by the facility (see the review of site-specific data in Response C3). Although it has been shown that the growth rate of alewife larvae is accelerated by warmer temperatures, Kellogg (1982) demonstrated that larval mortality greatly increases with warmer temperatures (see Response C44 below). In addition, the frequency of nuisance species may increase (e.g., blue-green algal blooms) with warmer temperature and/or large-scale community alterations may occur (e.g., with zooplankton; see Moore, et al., 1996).

Even if it were true that introducing heat into the system at one time of the year enhanced conditions for a particular life stage of one particular organism, it does not mean that this action would be beneficial for the entire system. The problem with "enhancing" conditions for one organism by addition of a pollutant is that it can have the opposite effect on other organisms in the system. EPA and MassDEP maintain that the more the lower Basin reflects natural conditions, the greater the possibility that the entire community of organisms that has successfully competed in the system will be restored and maintained in a balanced state. Mirant's own push-net and shoreline seine data (see Response C3) from 2003 - 2005 indicated that high temperature (in excess of 81 ºF) are problematic for juvenile alewives. "Enhancing" the thermal regime beyond this value is not seen as protective for this species.

Comment related to C26 from CLF: Animal life indigenous to the Charles will be seriously jeopardized if the permit goes into effect. The planned conditions within the ZPH will not be appropriate to support the indigenous species. Even though the permit includes an intricate system of date-specific temperature limits, and limits based on assessed temperature differential, this permit does not achieve an acceptable margin of safety.

Response to Comment related to C26 from CLF: EPA and MassDEP relied on scientific literature and site specific field collection information to derive protective temperature limits. While an area in the vicinity of the Station discharge will have elevated temperatures expected to cause acute or chronic negative effects on aquatic organisms, this relatively small volume of excessively heated water will not destabilize the BIP.

EPA acknowledges that this permit involves a sensitive balance between two competing demands: first, Mirant's concern that, consistent with the structure of 316(a), the variance for temperature discharges be no more stringent than necessary to assure protection of the BIP; and second, CLF and others' concern that the limits must indeed "assure the protection and propagation" of the BIP. Accordingly, EPA and MassDEP have designed this permit to balance

these interests, while acknowledging that in the face of scientific and technical uncertainty, the permitting agencies have generally erred on the side of protecting the BIP.

Though EPA and MassDEP agree that there are elements of this permit design that do not create an optimal environment for the BIP, the permitting agencies vigorously disagree that no acceptable margin of safety has been incorporated into the protective temperature limits. The permit limits and overall compliance approach have been designed to incorporate a reasonable margin of safety in the following ways:

First, the life stages of the resident and anadromous species most sensitive to elevated temperature (yellow perch and alewife) were selected as the representative species used to determine protective temperature limits. Identifying these species, and then choosing the most sensitive subset of life stage and species deemed to be most sensitive to elevated temperature for a particular time period, ensured that all other species and life stages in the BIP are further protected from threshold temperatures that produce negative effects. See Responses C3 and C44. This approach provided a clear margin of safety for the majority of species in the BIP.

Second, the averaging time period used in the permit for temperature limit compliance is 4 hours. While this averaging period was selected for another reason (see Responses C16 and D3), this time period is less than the acute and chronic time intervals cited in the majority of scientific literature referenced in the permitting documents. This provides another layer of safety for the BIP.

Third, the location of the cross section continuous monitoring stations downstream of the discharge (Stations 3 - 6) will capture the worst case thermal impacts from the discharge. See Response Related to D2 from Riverways. Permit compliance is based on meeting protective temperatures in this critical area. All other upstream and downstream regions of the ZPH will be at least as large as the compliance cross section area. Most areas will be much greater in area and likely cooler with increased distance from the discharge point. The resulting margin of safety that ensures that a Zone of Passage and Habitat will be greater than 50% of any given cross sectional area in the majority of locations in the lower Basin will be periodically verified by required water quality monitoring.

Fourth, the real-time, continuous, in-situ design of the compliance regime that the permittee must meet provides a margin of safety that does not allow the facility to raise temperatures to a level that might cause thermal blockage.

Comment C27: Mischaracterization of time period for basin function as alewife nursery. Section 5.7.1 of the DD includes a statement that the basin serves as a developmental nursery "from the spring to the winter." There is no evidence from Mirant Kendall's sampling programs to indicate that the basin is a nursery for sensitive anadromous species beyond the early fall. The Agencies should provide the evidentiary basis for the assertion that the basin supports that function "to the winter."

Response to C27: EPA and MassDEP based this wording on the fact that juvenile river herring

in other systems in Massachusetts have been known to out-migrate as late as early December (pers. comm. Phillips Brady, MADMF to G. Szal, DEP). If the number of juvenile alewives found in the system were to begin to climb higher, it is expected that the period of out-migration will be extended beyond what the permittee has documented to date. The nursery "season" should not be limited to that currently seen with the alewife population at its current small size.

Comment C28: Mistaken Speculation that Higher Water Temperatures will Halt Alewife Spawning Run. Section 5.7.1a (Adult Spawning Migration) states: "If the river temperature range passing through the lock is higher than the range a particular anadromous species has evolved to seek as part of the trigger to begin the spawning run, fish may not attempt to navigate the man-made structure. Highly reduced or completely halted spawning runs resulting from an 'attractant flow' temperature that is above the range suitable for an anadromous species to initiate a spawning run has the potential to make the propagation of a balanced population impossible".

Richkus (1974), notes that, especially at the beginning of the spawning run and continuing throughout most of the run, movement upstream was stimulated by increased temperatures. The same phenomenon would be expected to occur on the Charles River. Thus, fish would respond positively to increased temperatures at the beginning of the run, not be deterred from moving upstream.

Response to C28: Much of the response to this question has already been outlined in the Response C6 and Response C26 of this document. In part, EPA and MassDEP agree with the permittee. At the beginning and middle portions of the adult alewife run, adults have been documented to respond positively to increases in temperature. However, this is only true as long as the increases in temperature are not so great that they fall outside the temperature "envelope" of the adults acclimated to certain temperatures in Boston Harbor.

There is ample evidence in the literature, for a wide range of poikilothermic (i.e., "cold-blooded") fish species, that an "envelope" of suitable temperatures exists for each life stage. As acclimation temperature increases, so does the maximum temperature of avoidance, up to a point. The same situation exists for toxicity endpoints (see DD, Figure 5.7.3c-2). The use of temperature envelopes in predicting avoidance and/or toxicity endpoints is common in the evaluation of thermal discharges (see Brayton Point, 2002; and Armour, 1991). The agency statement simply refers to temperatures that are outside of the "acceptance envelope" for the particular acclimation temperature of the in-migrating fish.

Although Mirant references the 1974 Richkus study, the permittee failed to also reference the work of Graham (1956), in which fish acclimated at different temperatures were transferred to water of higher temperatures. These data were used in combination with the Richkus dataset to set an upper limit for avoidance temperature of fish acclimated to the mid-40's or low 50's (ºF). The difference between Richkus' study and the situation in the lower Charles is that EPA and MassDEP are allowing the temperature of the lower Charles to be artificially manipulated. It should be remembered that the Charles River is one of the warmest river basins in the state. This is primarily due to anthropogenic alterations (see Response C42) in the Basin. The concern is

that the water temperature in the lower Charles, which is already high, when pushed even higher during low-flow springs and additional heat from Kendall Station, could rise to a level beyond that which induces avoidance in the incoming populations of anadromous fish. Mirant's comment could be interpreted to imply that there is no reason to provide any upper temperature limit for the period during which alewife adults are in-migrating. This position is contrary to the accepted approach that some level of increased temperature would induce avoidance. The temperature that EPA and MassDEP used for setting the avoidance level was based on the work of Graham (1956), Richkus (1974) as well as temperature and run strength information from alewife runs in Massachusetts and New Hampshire (see Table 5.7.3c-3 in the DD)

Comment C29: Mistaken Speculation that Elevated Temperatures will Lead to Earlier Alewife Spawning. In Section 5.7.1 of the DD, the Agencies further state "It must also be noted that elevated water temperatures may cause fish to enter earlier in the year than they naturally would. In this case, spawning may be induced to take place at an earlier date than the species naturally evolved to spawn. This could result in fish eggs hatching to the larval stage at a time before the larvae's food source becomes abundant"

While elevated temperatures may stimulate upstream migration of alewife and other anadromous fish, the overall temperature regime in their spawning area is what determines if they will spawn, not the temperature that may trigger the upstream migration. The migration trigger could not, in turn, induce spawning or the hatching and development of eggs and larvae if the temperature in the spawning area is not suitable. To the extent that elevated temperatures might stimulate egg and larval development, such temperatures would also stimulate the productivity of the planktonic elements of the aquatic ecosystem that serve as the food base for the larvae. Both larvae and food base would respond in a similar fashion to the temperature regime in which they exist. Thus, elevated temperatures could not decouple this relationship, as suggested in this speculative statement.

Comment related to C29 from Riverways: Adult herring begin their run based on several factors including water temperatures and they are keyed on to flows in their upward migration. Have fisheries biologists determined if the constant flow from the facility might disrupt the timing of the alewife and blue back runs leading to reduced success? Might the large discharge in an impoundment also have disruptive consequences to the herring's up-river migration? Consideration should be given to studying these two issues to ensure the already compromised anadromous and other fish populations are not further stressed.

Response to C29 and related comment: Mirant raises a legitimate concern with regard to this assumption. In a natural system, where solar heating causes temperature to rise in a system, it is more likely that large portions of the water body rise in temperature. Thus, where these temperature increases are substantial, one would expect to find a gradual change in zooplankton community structure as one moves from upstream to downstream reaches of the system. Although the downstream reaches may be warmer, there is typically not an abrupt change in temperature.

When a large thermal discharge is introduced to the system, especially one that exists at the

extreme downstream reach of the system, there is no evidence that the community of drifting organisms will undergo a fairly natural change in composition over as great an area as might occur if that system were warmed only by solar heating. There is also no evidence that the springtime community of organisms drifting into water that is 5-10 ºF warmer would undergo an abrupt change to mimic the community that would be seen under the same temperature regime in a natural system. Some travel time would be involved, and the extent of change and area of change would be flow-dependant. Thus, new larvae hatching in areas warmed by the discharge would not be expected to have access to a community of zooplankton that had matured and undergone changes in a temperature regime that was similar to that at the point where these fish were deposited as eggs.

The areal extent of zooplankton community change would be flow dependant. It might be expected that there would be no change in the spring due to higher river velocities, but that wide-spread changes might occur in the summer as river velocity approached extremely low values in areas downstream of the B.U. Bridge. At 7Q10 flows, Mirant has projected that it would take more than 200 days for a particle of water to move from the discharge to the new Charles River Dam.

Spawning periods upstream and downstream of the discharge will probably differ. The measurable heatload from the Station's discharge is expected to bring fish into the basin earlier than usual; the extent to which this would happen depends upon river flows and thermal discharge. The amount of spawning habitat and degree of spawning actually accomplished by river herring downstream of the discharge has not been quantified, but the presence of eggs in ichthyoplankton samples from the lower Basin indicate that some spawning may take place downstream of the discharge; thus, some spawning may take place 1-3 weeks earlier than it would without the discharge in this area if there is a 5-10 ºF change in temperature due to the Station's discharge. Modeling projections submitted by Mirant as well as temperature profile data from the lower Charles River Basin support the observation that the facility's discharge can raise Basin temperatures 5-10 ºF. See Response F4 for a more detailed discussion of this subject.

The permittee, EPA and MassDEP have all been made aware, through photographic evidence, that river herring breeding has been documented to occur in the discharge pipe. The extent to which this activity takes place is not known. If, as Mirant suggests, there is little spawning habitat downstream of the discharge, fish having entered the lower Basin in the early spring may have to wait for temperatures to warm up farther upstream in order to spawn there. The apparent attraction of the discharge has been shown to be great enough to induce spawning, overcoming the normal aversion that fish have to high temperatures (as much as a 20 ºF delta T from the intake), even though the eggs from this spawning event are not expected to survive. Harmful attraction to heated discharges has also been seen in other species (e.g., striped bass and menhaden) at other facilities in Massachusetts. By prematurely bringing fish into the lower Charles with high discharge temperatures and allowing fish access to the discharge pipe, during certain years the Kendall discharge has the potential to repeat its documented attraction of river herring, possibly resulting in additional, unproductive spawning efforts in the discharge pipe. The number of fish "lost" to the breeding population is unknown. The monitoring program has

been amended to include regular surveillance of the discharge area to quantify this behavior. This requirement may be found in Part I.14.e.8 of the Final Permit.

Comment related to C29 from CLF: Migrating herring have been observed to swim into the discharge pipe and attempt to spawn. This effect of the discharge should be addressed.

Response to Comment related to C29 from CLF: While this fish behavior has been documented at the Station discharge, it is not known if it is a widespread, continuous occurrence. The monitoring program has been amended to include regular surveillance of the discharge area to quantify this behavior. This requirement may be found in Part I.14.d.8 of the final permit.

Comment C30: Mistaken Speculation that Early Alewife Spawning Could Make Early Life Stages Unable to Cope with Early Season Temperatures. Section 5.7.1 of the DD continues to state "The early life stages may also be unable to cope with the early season, cooler than expected, water temperatures."

The development time of both eggs and larvae is a well-defined function of water temperature. At lower temperatures, eggs take longer to hatch, and larvae grow at a slower rate. These stages do not "expect" a particular water temperature; their physiology responds to the naturally varying temperature regimes. Sudden drops in temperature have been demonstrated to result in substantial mortality of early life stages of many anadromous species. No such phenomena have ever been demonstrated to occur with respect to sudden increases in temperature, and, in fact, elevated temperatures enhance survival. As an example, American shad larval survival is favored at water temperatures greater than 20^{o}C.

Response to C30: Eggs and larvae that drift with the currents of the Charles River have the potential to mix with the elevated temperatures of the Station's thermal plume and then move out of its influence. This short duration exposure to higher temperatures and subsequent return to more ambient water temperatures by no means represents "naturally varying temperature regimes." In a low flow year, when retention times are long in the lower Basin, the potential rise and fall of water temperatures experienced by these drifting life stages could happen more than once. Leaving the influence of the Station's thermal plume would expose eggs and larvae to sudden drops in temperature, possibly triggering the substantial mortality of early life stages of many anadromous species documented in the scientific literature.

As noted in Response to C44, elevated temperatures have been shown to increase growth rates of larvae, which could be inferred to enhance survival. It cannot be ignored, however, that elevated temperatures also correspond to increased mortality of larval fish.

Comment C31: Misunderstanding of the Characteristics of the Thermal Plume During Alewife Spawning Periods. Section 5.7.1b of the DD states: "If water temperatures are high enough to cause fish to avoid the thermal plume, fish may be blocked from traveling to the upstream area." Plume-related temperature differentials during the high flows inherent during the spawning run are too small to have this effect. For example, running at about 90% load in early to mid-April 2004, temperature differentials between upstream (Harvard thermistor) and the Boston ZPH

thermistor were 1 to 2^{o} F, too small to cause such a blockage. Mirant Kendall's tagging and tracking studies of both alewives and bluebacks revealed no evidence of such blockage in 2002 or 2003.

Response to C31: It must be noted that the permitted limits will be in effect for five years. EPA and MassDEP agree that it is reasonable to expect that high river flows will coincide with alewife spawning periods. However, unusually warm, dry periods do occur, and it is possible this combination of warm weather and low flows could take place during the alewife spawning period on a given year. At this time, the permit limit will ensure that the already stressful conditions being experienced by in-migrating and spawning alewife will not be made worse by the addition of waste heat from Kendall Station to the level that temperatures are no longer protective.

Several aspects of the 2002 sonic tracking studies with alewives raise concerns with EPA and MassDEP with respect to the issue of thermal blockage. There are several ways that thermal blockage could be manifested in the tracking studies if thermal blockage was actually taking place. One way that it might be manifested is if the permittee found that certain fish did not proceed upstream past the facility.

Of 28 fish captured and used in the 2002 tracking studies, there were five that were only detected by the monitors downstream of the facility 0-3 times. Afterwards the fish disappeared and did not trigger a detection in the monitors. EPA and MassDEP expect that these fish moved back out into the Harbor, regurgitated their tags, died, or stayed out of range of the mobile or fixed recorders. While their exact fate is open to debate, it appears from this report that these fish did not travel upstream past the old locks adjacent to the Museum of Science or they would have been detected by the Boston or Cambridge recorders. Additional evidence should be explored to determine whether blockage occurred.

Second, three additional fish never moved upstream of the Museum of Science. These fish may have died, regurgitated their tags or moved back out into the harbor. It is not currently known whether thermal blockage or avoidance behavior played a part with any of these fish, but the potential for blockage can not be ruled out. These eight fish account for about 29% of the total fish in the study. The fact that almost a third of the fish tagged never traveled upstream of the facility should be considered problematic. One potential explanation, which was not fully considered by Mirant, is that a thermal blockage occurred.

Third, many of the tagged fish appear to have spent a large amount of time near the Longfellow Bridge station, which is adjacent to the Kendall Station discharge pipe. This is evidenced by the timing and number of recorded detections by recorders near and downstream of the discharge. Because river herring have been filmed spawning in the discharge pipe, there is a concern that the reason that alewives spent so much time in the vicinity of the Kendall discharge was because they were breeding in and adjacent to the discharge pipe. This breeding behavior is not expected to result in viable offspring (see Response C29 and C30) and may also result in negative physiological effects to the adults.

As was stated in Response C29, the monitoring program has been amended to include regular surveillance of the discharge area to quantify this behavior. This requirement may be found in Part I.14.d.8 of the final permit.

Comment C32: Mischaracterization of Impacts of Thermal Plume on Alewife Out-Migration. Section 5.7.1c of the DD indicates that the adults will be weakened by spawning and exposed to stress as they swim past Kendall Station's plume to the marine environment. Mirant Kendall's tagging studies tracked numerous river herring making this return journey past the plume and showed no evidence of adverse effects, such as a pattern of signal loss between the Longfellow and downstream hydrophones.

Returning adult alewives from the 1999-year class dominated both the 2002 and 2003 spawning runs, and the 2002 run included a period in April when water temperatures exceeded 65^{o} F. Mirant Kendall questions whether this would be likely to occur if the adults were experiencing appreciable harm on their return journey past the plant.

Section 5.7.1c further hypothesizes that the plume may warm the river enough to delay the out-migration of YOY anadromous fish, and that those fish will be subject to greater predation in the basin than in the coastal environment. The plant's discharge changes water temperatures locally by about the same amount as the daily background diurnal variation (5^{o} F), whereas the out-migration of YOY occurs throughout the summer and early fall as temperatures drop over a much larger range of 25 to 35^{o} F. Mirant Kendall's beach seine and push-net sampling of YOY river herring above, in and below the plume throughout the late summer and fall of 1999, 2000, 2002 and 2003 have shown no evidence of such a delaying effect.

Further, the Determination Document fails to explain why the Agencies believe YOY river herring are subject to greater threat of predation in the basin (which has a relative paucity of pelagic predators) than in the coastal environment, which is dominated at this time of year by large schools of aggressive pelagic predators, including, for example, bluefish and striped bass.

Response to C32: The permittee failed to note that there was a substantial decline in the juvenile population of alewives in the Charles in the years 2000, 2002 and 2003 as well as a substantial decline in the relative proportion of adult river herring that were alewives after 2002 These are substantial issues. This data is discussed in detail in Response C3.

As a general response to the permittee, EPA and MassDEP must use the credible information available to predict what water temperatures will be problematic to all aspects of anadromous fish migration into and out of the lower Charles.

With regard to the tagging studies, because the permittee observed certain fish to pass the facility going upstream and downstream does not mean that these fish would have done so at or above permitted limits. Kendall Station's thermal discharge during these years was well below the maximum the Station was capable of discharging. EPA and MassDEP have designed a permit to protect the BIP even during periods of peak Station thermal output and ambient temperatures, including periods with diminished river flows.

Water temperatures exceeded 65 ºF at the intake structure of the Station for a period in April of 2002. As pointed out before, this temperature was not confirmed at precise points in the ZPH or at the entrance to the basin, as specified in the permit. Mirant has presented no accompanying data showing that fish moved into the basin during this atypical time of elevated water temperature. No investigation was presented to see what percentage of the fish refused entry at this temperature. It is reasonable to assume that a natural interruption in anadromous fish movement into a river, if brief, may not have a measurable impact on the overall success of migration and spawning for that year. Even taking this lack of focused analysis into account, the overall issue of periodic ambient temperature increases in the spring was fully discussed and addressed by EPA and MassDEP in the Determination Document. This resulted in allowing up to six temperature-limit exceedances in the spring as part of the permit compliance program.

Issues related to a delay of juvenile herring out-migration possibly attributed to the thermal discharge of the Station and the resulting negative effects on river herring populations are addressed in Response C6 of this document.

EPA and MassDEP acknowledge that during river herring out-migration the coastal environment is expected to contain pelagic predators, including bluefish and striped bass. Striped bass have also been collected in the lower Basin. There are several reasons to support the position that YOY river herring are subject to greater threat of predation in the Basin. First, there is the general observation that the fish in the lower Basin are confined to a relatively small area compared with the coastal area. Predatory fish and birds would likely be more successful when feeding in the confined lower Basin at that time.

In addition, Cooper (1961) found extremely high mortality in alewives within the freshwater system prior to seaward migration. He stated that:

> The success of spawning, in terms of numbers of juveniles migrating to the sea, was exceptionally low during the 1959 season. Less than one juvenile entered the sea for every adult that reached the spawning grounds.

Thus, it appears that the potential for high mortality to larvae and juveniles within the freshwater system does exist.

While it can not be stated for certain whether a protracted or deferred out-migration has a negative impact on the alewife population, information from another alosid species, the American shad, does support the assumption that deferred out-migration would lower the survival of juveniles. The following is taken from Klauda, et al. (1991):

> Estimates of juvenile American shad mortality rates in the nursery areas [of the Connecticut River, studies of Crecco, et al. 1983] range from 1.8-2% per day. Thus, if the juveniles remain in the nursery areas for three months before emigrating seaward, their survival rate would be about 30%. Conversely, 70% of the juveniles would perish before reaching the ocean [based on Richkus and DiNardo, 1984] assuming constant mortality

rates during the larval and juvenile stages. Longer residence times in freshwater and brackish areas would further reduce first year survival of American shad cohorts.

This information serves to explain why EPA and MassDEP believe YOY river herring are subject to greater threat of predation in the lower Basin than in the coastal environment

Comment C33: Adequate Site-Specific Data is in the Record to Establish Temperature Limits and Time Periods of Alewife Adult Spawning In-Migration in Charles River.

The Section 5.7.3c of the DD states "many years of spawning data at a specific river system would be needed to properly characterize the spawning habits of a site-specific spawning school." There is nothing in the literature on anadromous alosine species (e.g., American shad, river herring) to suggest, however, that a "site-specific spawning school" would exhibit responses to primary environmental variables such as temperature in a manner uniquely different from responses exhibited by the same species in other portions of their range, particularly within major geographical regions such as New England. Extensive literature exists, especially for American Shad, that shows that they respond similarly to temperature over much of their range.

Mirant Kendall's data on the age distribution of returning adult alewives in 2002, 2003 and 2004 indicates that the adults from various year classes enter the river and move upriver together over the course of about a month.

Section 5.7.3c states "There have been no long-term, site-specific investigations performed to pin point the temperature range associated with anadromous species spawning in the lower Charles River Basin." To the contrary, Mirant believes that the considerable data it collected provide important information on this topic, which was not fully considered by the Agencies. The site-specific gill net data for adults, and the YOY length distribution data collected in 2002 and 2003 and summarized and submitted to the Agencies in July 2003 (A.R. No. 489) showed that the run of alewives in the lower Charles near Kendall Station began in April, when water temperatures reached the 50s, and that fish captured after the third week in May were "spent," i.e. had completed spawning. In between, the runs continued without interruption across a range of water temperatures in the 50s and 60s, including several days in the third week of April 2002, when water temperatures exceeded 65^{o} F. Essentially all the YOY fish captured were too large to have been born in June.

The same pattern was observed in 2004. This included a 9-day period in mid May when river-wide temperatures remained between 68 and 72^{o} F. Kendall Station's heat load to the river overall averaged about 70% of the permitted maximum in April 2004, including three periods of at least four consecutive days each during the run, in mid and late-April, at about 90% of the permitted maximum. Mirant Kendall believes these levels of operation are representative of how the Station will operate for some periods in the future.

As in 2002 and 2003, length distribution of the YOY alewives in 2004, MK Comment Ex. No. C3, indicates that essentially all were born in April and May. Mirant Kendall believes the

Agencies should carefully considered this data before issuing the Final Permit. Mirant Kendall requests that the Agencies explain why the temperatures experienced without interruption of these runs (i.e., up to 72° F) are not adequate thresholds to protect future alewife runs in lieu of the lower thresholds they have proposed in the Draft Permit.

Section 5.7.3c discusses dates of first appearance of river herring at the Watertown Dam fishway. While dates are specified in these paragraphs, water temperatures are not. Yet, in the next paragraph, the discussion turns to the lack of knowledge of temperatures at the dam when fish first passed into the Basin. Also, the statement is made that the time it takes fish to move from the dam to the Watertown fishway is unknown. However, the Mirant radio tracking study data, discussed on the next page, provides such information. The alewife tracking studies conducted in spring 2003 and submitted to the Agencies in November 2003 (A.R. No. 470) contain definitive site-specific information that the fish released in the ZPH below the Museum of Science moved past Kendall Station through the ZPH to the area above the Longfellow Bridge in one to two days. This would appear to contradict the assertions in section 5.7.3c and elsewhere of the DD that they are significantly distracted by the plant discharge. Seven of the nine tagged alewives released on three dates passed through the ZPH in a day or less, and the other two in less than two days. Mirant Kendall asserts that while some fish may be attracted to the plant discharge, the tagging and tracking studies demonstrate that it is not a significant distraction. The Agencies should fully consider these studies and adjust their findings accordingly prior to issuing the final permit.

Section 5.7.3c discusses at length the 1999 and 2000 sampling results relative to the timing and temperatures associated with the alewife run. Mirant notes that these data are consistent with, but far less definitive than, the data from the 2002, 2003 and 2004 seasons discussed above. Section 5.7.3c discusses the results of the impingement sampling, speculating that the thermal discharge may reduce swim speed and increase impingement mortality. Mirant Kendall asserts that this speculation is counter to observations of river herring behavior in the Broad Canal, and to the fact that the highest intake velocities are just over 1 foot per second, well below the relevant swim speed of the herring. Mirant Kendall suggests that the Agencies consider the alternative explanation that river herring weakened by spawning (many of which die under baseline conditions anywhere) are likely more vulnerable to impingement. This is consistent with the observation that the great majority of impingement occurs in June of each year, when spawning has been underway for one to two months, rather than in April or May, during the early periods of upstream runs. Note also that a major high flow episode raised the river to flood stage during June in the one year of significantly greater impingement (2000).

Section 5.7.3c describes data on runs and corresponding temperatures in other rivers, noting that temperatures of 74 ºF in the Merrimack in 1991 was higher than in other years. The discussion fails to note, however, that 1991 was, by far, the year of the largest river herring run (both alewives and bluebacks) in the Merrimack River during the 1988 to 2000 period under discussion, as well as the largest in the more than 20-year history of the monitoring program. There were sustained counts of about 4,800 to more than 6,200 fish per day at the monitoring point throughout the 10 days of 70-74 ºF temperatures in 1991, more fish than the totals counted over the entire run in some other years. The Determination Document fails to explain how this

largest recorded run could reasonably have been sustained in this manner if the 70-74 ºF temperatures were sufficient to cause avoidance.

Section 5.7.3c states that "[i]t is not advisable to use periodic extreme natural temperature occurrences as the basis to formulate year in and year out temperature limits." The presentation of temperatures that have been recorded as coinciding with river herring spawning runs in a number of New England rivers documents concurrence but not cause and effect. As indicated in prior comments, the beginning and end of spawning runs do not unilaterally coincide with certain temperatures, but rather are functions of when the first and last fish arrive at their spawning stream.

Further, Mirant Kendall asserts that it is precisely from the study of extreme natural temperature occurrences that one can gather the information needed to document absence or occurrence of adverse effects. Hence, the importance of observations of sustained alewife runs in the Merrimack River during 1991 at temperatures of 70-74^{o} F, and likewise in the Charles River this year at temperatures from May 3 to 18 rising from 65 to 70^{o} F, with most of the period above 68 °F.

Response to C33: The permittee's assertions cover a number of topics. Each is discussed below.

Mirant states that the DD makes a statement about data needs for a "site-specific spawning school" which infers that data are needed for fish that particularly return to the Charles. Mirant asserts that there is nothing in the literature on anadromous alosine species to suggest that a site-specific school would exhibit responses to primary environmental variables such as temperature differently from those exhibited by the same species in other portions of their range. Dr. Olney's (Professor of Biology, Virginia Institute of Marine Sciences) memorandum to G. Szal, MA DEP (11/17/2002) states the following:

"As to your other questions, we know that there is latitudinal variation in life history traits of alosine fishes and I would guess this to include variation in temperature preferences and the effects of temperature on vital rates."

This is one of the reasons that EPA and MassDEP were concerned about using information from alosine fishes that are found at very different latitudes. Because of this, and other literature that shows latitudinal differences in temperature tolerances in fish, EPA and MassDEP maintain that if there was specific information on the Charles River alewives, this information would be more appropriate than that from other rivers.

Mirant (pg 39, 3rd and 4th paragraphs) takes issue with the DD which states that there have been no long-term site-specific investigations in the lower Charles which pin-point the temperature range associated with anadromous species spawning. Mirant states that the runs of alewives in 2002 and 2003 began in April and that fish captured after the third week in May had completed spawning. Furthermore, temperatures during this period in both years ranged from the 50s to the 60s (ºF) and included several days in the third week of April 2002 when water temperatures

exceeded 65 ºF.

In order to provide temperature limits that will allow river herring to spawn in the Charles, EPA and MassDEP must not only assure that water temperatures are appropriate for spawning but must also assure that water temperatures in the lower segment of the Charles allow entry of these fish.

Mirant's comments suggest that the permittee feels that it has an exhaustive knowledge of alewife migration in the Charles and that it has information demonstrating that alewives are running through areas with temperatures higher than 65 ºF. EPA and MassDEP maintain that the permittee failed to support its position that temperatures higher than 65º F would protect the alewife run.

First, there is only one preliminary pilot study that estimates the in-migrating adult population: 8,000 fish from a 2002 survey conducted by the permittee. Very few alewives were actually collected in 2002, and the 8,000-fish estimate was made from a combination of the proportion of alewives/total river herring caught in combination with sonar counts of the entire river herring population (about 45,000 fish). A population size of 8,000 is by no means a large population. Estimates of the size of the adult herring run in the Taunton River are upwards of a million or more. In addition, MA DMF estimates of the river herring carrying capacity of the Charles falls in the range of 250,000 to 500,000 adults. With a lack of data to the contrary, EPA and MassDEP must assume that the population of alewives in the Charles does not approach the river's estimated carrying capacity. In addition, the relative run strength of alewives, bluebacks and total river herrings (alewife and blueback herring combined) appears to have dropped substantially since 2002, judging from the gill-net information provided by Mirant in its 2006 data submittal (see discussion of gill-net data in Response C43). A reduction in adult alewife run strength from a preliminary estimate of only 8,000 fish in 2002 to lower levels does not bode well for the alewife population in the lower Charles. Reductions in blueback run strength are also of concern. Although Mirant may be correct that there were alewives running in the Charles at temperatures that were occasionally higher than 65 ºF, it appears these runs were not robust. Therefore, it would not be appropriate to assume that such higher temperatures were actually protective of the BIP. Also, it must be pointed out that temperatures above 65 ºF could be measured in part of the lower Basin without prompting a permit violation.

Second, Mirant has provided temporal information on alewife catches made during some of the spawning runs. Mirant suggests that the run extends for only a month because this is how long it has taken the bulk of the population to move into the Charles over the past few years. Because the population of alewives is currently small, EPA and MassDEP expect that, if the population can increase in size, the temporal duration of the run will expand. Also, the level of sampling effort conducted likely missed the first anadromous fish entrants into the river, if they were in small numbers, as well as the tail end of the spawning run. EPA and MassDEP disagree with the approach of limiting the expected duration of spawning in the Charles River to what was bracketed only by the sampling result under present conditions in the river. This approach would have the effect of assuming that the current population represents a healthy, protected BIP. Mirant has not demonstrated that the BIP is sustainable at these population levels.

Third, Mirant's sampling of adult alewife populations was not exhaustive and sample sizes were quite small. Because EPA and MassDEP expect that much of the past sampling was destructive due to loss of the mucus layer and other trauma to fish that accompanies gill-netting, the Permitting Agencies are not suggesting that this type of sampling be increased. Other data gathering methods to gain information on the fish population size, such as estimates using hydro acoustics, have been suggested. However, with the population size so small, a small catch may simply mean that the fish were not in the sample at the time the sampling took place. Some fish may have migrated prior to or after the time nets were set; since their numbers are so low they may not have appeared in the permittees' subsamples of the river herring (2 species) migrating stock. This is a common problem with subsampling. The subsample, by definition, only comprises a subset of the entire sample. As such, it does not define the actual bounds of the population; in this case, the bounds of the run duration. Mirant discusses its data as if the subsample of the population entering the Basin was not a subsample at all, but that the data collected, in fact, denote the entire temporal duration of the run. This contention is simply not true.

Based on Mirant's data, the fact that these data are a subset of all potential run characteristics, and other information discussed above, EPA and MassDEP expect that the actual temporal duration of the run may include periods not mentioned by the permittee. Thus, as long as water temperatures are appropriate for entry, it is expected that fish may still be attempting to enter the system through the first week of June.

With regard to the upper temperature limit of in-migrating alewives, Mirant states that runs took place while temperatures reached above the 65 ºF limit: "the runs continued without interruption across a range of water temperatures in the 50s and 60s (ºF), including several days in the third week of April 2002, when water temperatures exceeded 65 ºF." First, it is important to remember that Mirant's contention that temperatures exceeded 65 ºF does not mean the permit limit of 65 ºF within the ZPH would have been violated. The reasons EPA and MassDEP do not automatically assume this would be a permit violation relates to the type of temperature data Mirant used compared with the way temperature compliance would be measured and calculated under the permit requirements. This is fully discussed in Response C13 (d). Setting this point aside for the sake of this discussion, the permittee has not submitted adult alewife capture records in waters that were in excess of 65 ºF directly upstream of the dam, nor have they submitted records of alewife capture at the dam that are coincident with water temperatures in excess of 65 ºF at the dam. Thus it cannot be said that the runs continued "without interruption" when water temperatures exceeded 65 ºF. When temperatures exceeded 65 ºF, runs very well may have been interrupted. In addition, records submitted by Mirant show many days when areas were sampled but no alewives were caught. Mirant has not documented that the runs continued in the face of temperatures higher than 65 F.

On Page 39, Mirant states that in 2002 and 2003 the length distribution of juveniles is such that, based on modeling of growth "essentially all" (most?) "were born in April and May." Mirant goes on to ask that the Permitting Agencies explain why "temperatures experienced without interruption" by the adult run (temperatures up to 72 ºF) are not adequate to protect future runs.

The maximum temperature seen during the April-May period must not be the maximum limit allowed for the whole period. EPA and MassDEP recognize that temperatures suitable for entry and/or spawning may not always occur during the April-May period. Sometimes, temperatures may rise above this level, but these occurrences do not establish that persistently high temperatures would protect the BIP.

As explained above, the permittee has not provided information demonstrating that temperatures as high as 72 ºF will not cause avoidance behavior to in-migrants. Although temperatures in the Broad Canal at Kendall Station's intake may have risen to 72 ºF, this does not mean that upstream, ambient temperatures or temperatures at the dam were at this level when fish were migrating through these areas. Nor does it mean that the 72 ºF value should be used as a permit limit. EPA and MassDEP have been unable to find, and the permittee has failed to present, data from any run in the northeastern U.S. that shows that a substantial proportion of a run will enter the freshwater breeding stream when temperatures are as high as 72 ºF. In addition, the permit allows for six separate events where temperatures in the ZPH may exceed ambient temperatures by more than the site-specific limits. Although temperatures within the ZPH may have been as high as Mirant contends during this period, this is not a reason to use the temperature maximum as the allowable temperature for the entire period. This issue is discussed further in Section 5.7.3c of the DD.

On Page 39 in the last paragraph, Mirant takes issue with statements in the DD that deal with alewife movement through the lower Basin of the Charles. The permittee asserts that, contrary to EPA and MassDEP's assertions, there is much site-specific information pertaining to adult alewife movement through the lower Basin. Mirant states that alewife tracking studies of 2003 demonstrated that 7 of 9 alewives tagged on three dates passed through the ZPH in a day or less and the other two in less than two days and states further that the discharge plume is "not a significant distraction." The permittee asserts that EPA and MassDEP should "fully consider these studies and adjust their findings accordingly prior to issuing the final permit."

The extent to which the heated discharge plume is a distraction to the alewife population is currently unknown. No studies have been presented to EPA or DEP which document the extent to which wasteful spawning within the discharge pipe takes place. The Division of Marine Fisheries is conducting a re-stocking program for American shad in the Charles and potential loss of spawning stock to the discharge pipe is a concern to EPA and MassDEP. Another concern is that out-migrating fish may also be attracted to the plume. See Response C29 and C31 for additional information regarding this issue.

With regard to Mirant's references to the 2003 alewife sonar tracking, it appears that Mirant may not have discussed all the information available from these studies. In actuality, 28 adult alewives were ""tagged" (implanted) with sonic transmitters. Five of these had no or very few (0-3) "hits" (receiver actuations) from mobile and fixed receivers scattered throughout the lower Basin. Potential reasons for the lack of hits include a) death; b) regurgitation of the transmitter; and c) movement back into Boston Harbor. Three other tagged alewives did not move upstream of the Museum of Science but were found around the Charlestown Dam (i.e., the New Charles

River Dam). These may also have died, regurgitated their tags or moved back into Boston Harbor. These eight fish account for about 29% of the fish in the survey.

Many of the remaining 20 fish appear to have spent much of their time in the lower Basin near the Kendall discharge. It is not currently known whether they attempted spawning in the discharge, whether they attempted to spawn in the Zone of Dilution or whether they attempted to spawn upstream of the facility. Based on the above, it is difficult to tell the significance of any impacts that the Kendall discharge and temperatures in the Zone of Dilution may have on alewife spawning. The knowledge of specific points in the Basin where alewives currently spawn is poor. EPA and MassDEP conclude that Mirant's tracking study was inconclusive, and therefore does not dispel the Permitting Agencies' concerns about the Station's discharge, which are based on scientific literature and site specific Charles River environmental data.

In paragraph 3 of page 40, Mirant rebuts the Permitting Agencies' assumption in the DD that the thermal discharge may reduce swim speed and increase impingement mortality. It suggests that the Agencies consider the fact that river herring, weakened by spawning are likely more vulnerable to impingement. The impingement sampling conducted by Mirant did not include the reproductive condition of the river herring impinged. Aside from the timing of impingement, there is no direct evidence which Mirant can use to support their argument. As noted above, some of the river herring in-migration behavior documented in the fish tracking study conducted by Mirant described fish that remained in the lower Basin and did not quickly move upstream. This could be a result of contact with the thermal discharge from Kendall Station. However, even if weakened post spawning (spent reproductive condition) adult river herring were primarily impinged, this does not diminish the burden of the permittee to minimize impacts from impingement.

On page 40, Mirant points to the fact that river herring in the Merrimack (both alewives and bluebacks) were found in the river at the "monitoring point" when temperatures ranged up to 74 ºF, and states that the DD fails to explain how this run could have been sustained if the 70-74 ºF temperatures were sufficient to cause avoidance.

Much of the section in the DD that deals with in-migration of alewives documents temperatures recorded at points of in-migration. Because Kendall is located very close to the new Charles River Dam, heated water from its discharge can affect water column temperatures all the way from the facility to the dam. Thus, the focus of much of the literature and field data review was on entry temperatures for alewife adults, i.e., temperatures recorded at points of entry to freshwater systems.

EPA and MassDEP fully expect that the range of spawning temperatures may be higher than the range of entry temperatures. This is due to the following: a) alewives often have to travel many miles upstream to find a spawning site; b) it may take many days or weeks to travel from the point of entry to a stream to the spawning site; and c) in general, water column temperatures continue to rise in the spring when the spawning run takes place. Thus, the temperatures over which river herring spawn may extend to higher temperatures than does the temperature range experienced by in-migrants at the point of entry.

The Merrimack River "monitoring point" referred to by Mirant in this section is the Lawrence dam, located approximately 26 miles upstream of the mouth of the river. This is a considerable distance upstream from the point of entry to the Merrimack. Judging from the data presented by the company on herring movement in the Charles, it could have taken weeks for the fish to move from the mouth of the river up to the Lawrence dam. In addition, at times, fish are "held up" at the dam for several days or more, prior to being lifted and counted, because of problems in operating the fish lift at this location. Finally, there is no information regarding the spawning success of the fish that were counted in 1991 when the high temperatures were seen. It is not known from the data available whether these particular fish were able to successfully spawn, or if successful spawners were only limited to fish that entered earlier that year.

Due to the large difference between the Kendall Station and the Lawrence Dam in proximity to the mouth of their respective rivers (Charles and Merrimack Rivers), EPA and MassDEP did not use data from the Lawrence Dam to establish entry temperatures for alewives in the Charles. All other data (information near points of entry from 19 separate runs from three different rivers) supported the contention that very few fish entered these systems when temperatures were above 65 ºF.

Mirant also states that "it is precisely from the study of extreme natural temperature occurrences that one can gather the information needed to document absences or occurrence of adverse effects." The permittee proceeded to explain the importance of the Merrimack River data, collected 26 miles upstream of the mouth of the river, showing that river herring were at this location when temperatures reached up to the mid 70s (ºF). The company does not, however, allude to any of the other 19 site-specific studies referenced in the DD where runs were essentially over when temperatures reached above 65 ºF. Nor does the facility attempt to discuss the difference between temperatures at point of entry vs. temperatures at migratory way-points or final spawning sites in the Merrimack.

It must also be pointed out that once permitted temperature limits are finalized, these maximum temperatures may be legally reached consistently for prolonged periods over many years by the permitted facility. EPA and MassDEP do not support setting these temperature limits using extreme natural temperature occurrences as the basis. Even natural extreme temperature occurrences may stress aquatic life. The BIP can tolerate such extremes because they are by definition infrequent in duration and are unlikely to take place every year. EPA and MassDEP conclude that allowing this type of temperature to be maintained for extended periods, year after year, is not protective of the BIP.

Comment related to C33 from MA DMF: The Charles River remains listed under Section 303(d) of the CWA as impaired for nutrients and nuisance algae. But effects of the facility thermal discharge should not be ignored. During summer conditions the lower basin exceeds the state water quality standard of 83^{o} F. With the river herring population substantially below the river capacity and our ongoing efforts to enhance their abundance and distribution, we believe temperature limits should provide greater protection for the bulk of the spring run as opposed to the end of the run. To protect the in-migrating river herring, we request the permit include the

upper thermal limit from April 15-30 of 60F and 65 °F from May 1 - May 15. We request the permit include a thermal limit of 80° F within the ZPH in summer for the protection of juvenile American Shad.

Comment related to C33 from NOAA: We recommend that a thermal limit of 80 degrees F in the ZPH from June 15 to October 31 be included in the permit to protect juvenile American Shad.

Response to Comments related to C33 from MADMF and NOAA: Although EPA and MassDEP are aware of the recent American shad stocking program, the permitting agencies did not receive sufficient documentation to establish that American shad were present in the lower Basin in sufficient numbers to qualify as part of the BIP. Indeed, no life stages of American shad were collected during the six years of biological monitoring conducted by the permittee. While the resource agencies did provide evidence that American shad were present in the Charles in colonial times, there is no evidence that American shad have been present in the lower Basin in appreciable numbers since the damming of the lower Charles. Therefore, EPA and MassDEP are not setting limits in the permit designed to protect American shad at this time. Ongoing biological monitoring required by the permit, along with close communication with the resource agencies, will allow EPA and MassDEP to monitor the efforts underway to establish American shad in the Charles. Future protective temperatures will be justified accordingly. Regarding MADMF's request for lower spring temperature limits to protect in-migrating river herring, see Response to Comment related to C37 from CZM.

Comment C34: Inappropriate Generalized Model in Lieu of More Appropriate Literature and Site-Specific Data to Set Temperature Limits for Alewife Adult Spawning Stage and Presumed Avoidance Thresholds.

Section 5.7.3c of the DD states that the EPA utilized a generalized model of temperature effects to fish to aid in the development of site-specific temperature limits for the lower Charles River, notably the USFWS temperature effects model in Armor (1991). Mirant Kendall has extensive comments regarding the use of the model as well as the specific inputs used in the model and its application.

First, notably, the introduction to that publication states:

> "Recommendations derived from these options may be applied to streams that are or will be affected by channel modifications, diversions, reservoir releases, or adjoining land-use practices such as vegetation removal, all of which may alter temperature regimes."

Note that the model is intended to be applied in circumstances where habitat changes alter the overall temperature regime (e.g., where dredging of a river causes alteration of the natural temperature regime), and it was developed for application to free flowing streams (in this specific case, it was applied to chinook salmon). There is nothing in the publication that suggests that the method is applicable to, or appropriate for, assessment of consequences of a

point-source thermal discharge that dissipates in a receiving water body, except to the extent that such a discharge alters the overall temperature regime of the receiving water body (which would be determined by modeling). It does not appear to be applicable to the assessment of biological consequences of spatially specific temperature deviations. It also is presented from the perspective of effect on a fish population, and not on the fate of individual fish that encounter specific temperatures. This is acknowledged in the DD on page 85 ("the temperature causing a specific effect to the population is lower than"), the Agencies have not applied in that way.

The Agencies' application of the model appears to be fraught with errors and misconceptions, but most importantly, is unnecessary and inappropriate to accomplish the stated purpose (para 18) "to predict avoidance temperatures of adult alewives in the Lower Charles River Basin." Mirant Kendall suggests that the Agencies instead consider the work of Lindenberg of the Massachusetts Division of Fish and Wildlife, who studied the distribution of a reportedly balanced population of adult and juvenile alewives for several years in a stratified impoundment with benthic oxygen depletion in central Massachusetts. Lindenberg's publication of that work is included as a reference at the end of Chapter 5, but it is not cited by the Agencies in the discussion. He found that at night more than 200 alewives (85% adults, 15% YOY) were collected in the surface waters while the temperature was 32.2 ºC (89.96 ºF). He explained the consistent night-time presence of the alewives near the surface at temperatures above 25.5 ºC (77.9 ºF) as an adaptation to the lack of suitable deep habitat because of oxygen depletion, and contrasted it to the earlier findings from the Midwest used instead here by the Agencies for their model. Mirant Kendall notes that the Lower Charles is a stratified semi-impounded system of the same depth as studied by Lindenberg, with similar benthic oxygen depletion. It does not resemble the Lake Ontario setting, from which the Agencies attempt to extrapolate Graham's data from 1956. The Determination Document fails to explain why the Agencies expect avoidance at even lower temperatures when it was observed not to occur at higher temperatures by Lindenberg.

Response to C34: It is true that the USFWS model was developed to be applied to streams whose temperature regimes were altered. Nonetheless, the model has seen wide application. In its most simple form, such as that used by the EPA and MassDEP, the model simply pulls together information on the effects of acclimation temperatures on upper toxicity and/or avoidance temperature endpoints. The result is a temperature "envelope." The envelope is bounded by lines described from toxicity and/or avoidance information from the literature. The inside of the envelope describes the range of temperatures, mediated by acclimation temperature, that cause no detrimental effect or behavior for the life stage for which the temperature envelope was developed. Lawler, Matusky and Skelly (LM&S) Engineers, who did much of the modeling for thermal discharges in the Hudson River, recently used temperature envelopes of this same type and applied them to the marine and anadromous species of interest for the Brayton Point 316(a) and (b) evaluation. Although some of the endpoints used in the model were contested by the EPA and MassDEP, the simplified "temperature envelope" describing the effects of acclimation on temperature endpoints was not contested. EPA and MassDEP maintain that this is one of the approaches that is well-accepted among fisheries scientists familiar with thermal evaluations, as illustrated by the contributors to the Brayton Point permit development.

The permittee stated that the model appears to be "fraught with errors and misconceptions, but more importantly, it is unnecessary and inappropriate". The permittee suggested that, instead of using this model, EPA and MassDEP should use the work of Lindenberg (1976) who collected more than 200 alewives (85% adults, 15% YOY) in a Massachusetts lake when the temperature was 32.2 ºC (89.96 ºF). Mirant stated that Lindenberg took these measurements at a stratified impoundment in Massachusetts suffering from oxygen depletion and further stated that the lower Charles is a similar waterbody to the one studied by Lindenberg. Therefore, the permittee maintained that the work of Lindenberg should be considered rather than the model of Armour.

The model of Armour was employed by EPA and MassDEP to evaluate the potential effect of very low acclimation temperatures in Boston Harbor in the springtime on avoidance and toxicity to alewives entering the lower Charles. The "model" temperature envelope described is based on a compilation of data from several literature sources. The permittee's suggestion to use a one-time high temperature summertime observation to set the range of allowable springtime temperatures for alewives (from the Lindenberg study) is completely inappropriate.

The permittee selected a single, high value from the literature to promote the use of high site-specific limits in the Charles. It is true that the Lindenberg paper states that alewives were caught near the surface at night on one occasion when temperatures were in the high 80s (ºF). However, this is the only datapoint in the Lindenberg lake studies where temperatures exceeded 80.1 ºF when fish were captured. Based on Lindenberg's descriptions, it appears that these fish were at the surface to avoid low dissolved oxygen in deeper water. No follow-up evaluation was reported by Lindenberg to determine the effect of this high-temperature event on the alewives in the study area. Lindenberg did not indicate whether this single high temperature data point could be sustained by alewives for long periods of time. Using a single high temperature event to set a permitted temperature limit that is in effect for an extended period is not consistent with EPA or MassDEP's permitting approach. Refer to the Response C33 for additional information.

High-temperature events in other systems have been found to induce stress or be lethal to exposed fish. The Lindenberg observation does not demonstrate that high temperatures are suitable for constant habitation by alewives. Based on the description of the impoundment and the water quality characteristics, alewife likely had no choice to seek a habitat with lower temperatures. Other literature as well as site-specific data from the Charles, shows that, when given other, cooler water for habitation, alewives will avoid temperatures in the low 80s (ºF) (see the EPA/DEP review of Charles River site-specific data for the push-net surveys in Response C3). In addition, sustained high-temperatures have been shown to be toxic to alewives (Otto, et al, 1976).

Issues of alewife toxicity and/or avoidance are not the only concern of regulators with regard to high temperatures. Long-term, basin-wide heating above the 77 ºF mark has been shown to be detrimental to zooplankton, one of the primary food groups of alewives. This information is further detailed in the DD. More than a one-time observation on alewives is necessary to develop a comprehensive temperature regime for the protection and propagation of the different life stages of alewives living in the Charles.

Comment C35: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles; Alewife Temperature Response.

In Section 5.7.3c of the DD, the alewife temperature response is based on Graham (1956) for Great Lakes alewives. At issue here is whether the temperature responses of landlocked alewives are the same as those of anadromous alewives. Mirant Kendall is unaware of any literature that supports or refutes that conclusion. However, because of the extreme environmental changes experienced by migrating anadromous alewives, in both temperature as well as salinity, physiologically they would be more adapted to wider temperature variation than landlocked alewives.

Also, anadromous alewives are larger, which also affects their response to short-duration temperature changes. Mirant Kendall further questions the Agencies' logic, presented on p. 87, for dismissing the EA data on thermal tolerance of anadromous river herring (that the population is more southern); the Determination Document fails to establish the basis for this conclusion. The speculation here and elsewhere in the document that "southern populations" may be less temperature sensitive than New England populations is unsupportable and contrary to basic natural science. The temperature ranges at the geographic extremes of a species range reflect the limits of its sensitivity. In New England, anadromous alewives (and, for that matter, resident yellow perch) are in the geographic middles of their ranges, where they have adapted to the widest spectrum of temperature swings. Canadian populations, at the northern extremes of the range, could be less well adapted to the warmer temperatures regularly seen by Massachusetts fish.

Another factor that places the utility of these literature findings in question is that laboratory studies establish an acclimation temperature by keeping fish at that temperature for an extended period of time. In the natural environment, fish move through waters with substantial differences in temperature, and their acclimation temperature cannot be predicted without knowledge of these movement patterns. Thus, application of the laboratory mortality study results to a free-ranging fish is questionable.

Further, in their application of the model, the Agencies assume abrupt transitions from low Boston Harbor temperatures to temperatures more than 10 ºF warmer in the Lower Charles. This is not a valid assumption. As verified by Mirant Kendall's monitoring above and below the dam in 2000, 2002, 2003 and 2004, the near-bottom temperatures where fish enter immediately above the dam and the surface temperatures in the Harbor immediately below it are very similar – within 1-2^{o} F. The Agencies' use of data from an MWRA station further out in the Harbor, beyond this immediate transition area, is misleading and inappropriate.

Response to C35: In Comment C34, the permittee recommended using data (Lindenberg, 1976) from a landlocked population of alewives to support a high-temperature limit in the Charles. In this comment, the permittee questioned the logic in using data from a landlocked alewife population.

EPA and MassDEP reviewed the available data from the northeastern U.S. as well as other data.

Mirant's reference to data from the "northern extremes of the range" refers to data that the EPA and MassDEP used from the Great Lakes. The dataset used is actually from the same approximate latitude as northern Massachusetts, not from the northern extremes of the range for alewives. Certain types of data, especially that relating to delta temperatures, were not available from the anadromous population in the northeast, but were only available from landlocked populations. EPA and MassDEP are aware that landlocked populations of fish may have somewhat different characteristics than migrating fish, but decided to use data from landlocked populations when data from anadromous populations in the northeast were not available.

On page 42, Mirant questions the permitting Agencies' logic in dismissing the EA (Environmental Analysts) dataset because the information was drawn from a more southern population. Mirant criticizes EPA and MassDEP's logic in speculating that southern populations might be less sensitive to warm temperatures than are more northern populations.

A wide variety of different species, including certain fish, have been shown to have temperature tolerances that vary with the latitude at which segments (i.e., species populations) of that species can be found. Please refer to the Response C33 and Dr. Olney's statement regarding latitudinal variation. While Dr. Olney's statement certainly does not verify any such variability in alosids, his statement, along with other literature sources cited in the DD, prompted EPA and MassDEP to use caution in using thermal-tolerance data from species-populations in the mid-Atlantic states when other data were available from latitudes more similar to the Charles River. When latitudinal differences exist, typically the more southern populations are more tolerant of heat than those found farther north.

On Page 42, Mirant questions the utility of using data from laboratory studies that acclimate fish for long periods of time at a certain temperature to develop field-based temperature limits. The permittee maintains that in the field, fish often move through different water temperatures throughout the day.

EPA and MassDEP agree that this is certainly a shortcoming of using only laboratory data on alewives to set permit limits. Because of this, EPA and MassDEP did not rely solely on laboratory data to develop the permit limits. Information utilized included published literature from field studies at a suite of anadromous fish runs in New England, site-specific catch-rates and temperature data from the lower Charles, thermal tolerance data from alewives taken from the Great Lakes at similar latitudes to Massachusetts, and thermal tolerance data from elsewhere (including field and laboratory data from other important species) to establish temperature criteria for the lower Charles. All this information, and methods used to evaluate these data are described in the DD.

On Page 42, Mirant states the concern that in evaluating the potential Delta Temperatures encountered by anadromous fish entering the lower Charles, EPA and MassDEP used Boston Harbor temperatures rather than surface-water temperatures directly below the dam. In comparing Charles River water temperatures with surface-water temperatures directly below the dam, the permittee found that the two temperatures are fairly similar; very little delta temperature change was seen. By contrast, Mirant asserts that the Agencies speculated that

temperature differences encountered by incoming fish would be quite great.

EPA and MassDEP compared Boston Harbor temperatures from a Boston Harbor station nearby, but not directly below the dam. Surface water temperatures directly below the dam were not considered appropriate for three reasons: 1) alewives have been observed to be at lower depths in the water column during the daytime to seek suitable light intensity and avoid being targeted for predation; 2) alewives in other systems are known to migrate only during daylight hours. Dixon (1996), and others cited by Dixon, noted that alosid fishes move up and down in the water column in a particular "isolume", i.e., a particular range of light intensity, supposedly in order to balance the need to avoid vision-based predators, but still be able to see other alosids in order to maintain a school. 3) River water from the Charles is both warmer and much less saline than Boston Harbor water. Both attributes cause this river water to be much more buoyant (less dense) than the water in Boston Harbor. As a result, EPA and MassDEP expect that the Charles River water will not immediately mix with the Boston Harbor water. Thus, surface water temperatures taken from below the dam are expected to be considerably warmer than bottom temperatures near the dam.

Because of the fact that alewives prefer to be in low-light when migrating, it is logical to assume that alewife movement into the locks is from a deeper location in the harbor, rather than from the surface. Thus, they are expected to encounter larger delta temperatures than if they were migrating from the surface.

EPA and MassDEP are open to reviewing studies that might be able to document the actual delta temperature changes encountered by alewives throughout the in-migration and out-migration seasons. Temperature Monitoring Stations 8 and 9, required by the permit, will provide important, site specific information on this subject.

Comment related to C35 from CLF: This suggestion that species widely distributed throughout Eastern North America (e.g. yellow perch) have evolved adaptations to the very recent (i.e. within 50 years) conditions in the Charles River, is not supported in any way by EPA (i.e. no references to scientific sources provided). Indeed, EPA goes on to explain that this kind of local evolution within a water body is not likely, using an example of how thermal conditions in the Great Lakes (i.e. lake Ontario) cause well known die-offs of alewives, a species that has only recently be introduced to the lakes, and is not adapted to natural temperature extremes. All indications are that the fishes indigenous to the Charles have not undergone major adaptation to current conditions. Had they adapted, they would be flourishing under prevailing conditions, yet their numbers are much lower than expected for a healthy river of this kind (see discussion of carrying capacity for herring below). The species examined (e.g. river herring, yellow perch) are found in many widely distributed bodies of water, do not appear to be isolated populations, but rather appear to enjoy the low rate of gene flow that is required to prevent substantial genetic divergence. Within a species, fundamental aspects of fish biology such as reproductive behavior and egg development are well known to follow regional variation in water temperature, with timing such that the these events usually occur at similar temperatures, but different dates, in various locales. Thus EPA's suggestion that what we have learned about temperature in other parts of a fishes' geographic range may not apply to the Charles is ill founded.

Response to Comment related to C35 from CLF: This issue is addressed in Response Related to C13 from CLF.

Comment C36: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles; Unsupported Assumptions Regarding Avoidance. The avoidance line on Figure 5.7.3c-1 in the DD is based on a misuse of data from Richkus (1974), and on unsupported assumptions about how avoidance is related to other temperature response data. This figure has no valid scientific basis. Further, speculation that "Adult and egg mortality or chronic effect in this location is considered likely" is unjustified and unsupported. For example, how could chronic effects occur at this location when the fish do not remain there?

Response to C36: EPA and MassDEP disagree with the statement that the assumptions used regarding how avoidance is related to other temperature-response data are un-supported. The DD provides literature sources that support the observation that avoidance temperatures are usually lower than temperatures inducing toxicity. It provides LC50 toxicity data from Graham and couples this with information from Coutant to predict a NOAEL. In developing the application, EPA and MassDEP assumed that the slope of the NOAEL parallels the slope of the LC50 data-line. In the absence of specific information on NOAELs for alewives at the range of acclimation temperatures presented in the graphic, assuming parallel slopes is a reasonable approach, or is at least the best the Permitting Agencies can do absent more specific data. A similar approach was used by Lawler, Matusky and Skelly (LM&S) Engineers in the Brayton Point 316(a) and (b) analysis. When there are no alternative datapoints, typically a straight line is drawn to attach data and a linear relationship is assumed between datapoints. The toxicity information was coupled with field information from Richkus; the endpoint taken from the Richkus study is generally supported by 19 other field studies in Massachusetts and New Hampshire.

With regard to the comment on toxicity at the discharge pipe, EPA and MassDEP disagree with Mirant that toxicity to eggs deposited at this location is unjustified and unlikely. It is true that no field studies were submitted by the permittee to gain information on eggs deposited at this site by river herring. However, the Permitting Agencies fully expect that eggs deposited by river herring in the discharge pipe at temperatures that are 15-20ºF above ambient would have a low chance of survival due to both heat and chlorine effects. In addition, if these eggs settled to the bottom during some years, they could possibly encounter deep, isolated pockets of denser water, with higher salinity and lower oxygen levels, especially in the late spring and early summer. Although the highest densities of river herring larvae were captured in the lower Basin by Mirant in May and June, herring larvae were also captured in the lower Basin through mid-August in 2000 (data from Mirant, Vol. 1, NPDES Application, Feb. 2001). The typical duration of the larvae stage in river herring is 2-3 weeks. These data lead the Permitting Agencies to conclude that at least one of the species of river herring (probably bluebacks) is still spawning in June and July, when low oxygen levels begin to become a problem in the lower Basin. Therefore, herring spawning in the discharge pipe can lead to the loss of eggs due to anoxia, depending on when those eggs are deposited.

Mirant questions the idea that short-term effects to eggs and larvae can cause long-term (i.e., chronic) effects. Short-term exposures to certain toxicants have been known to cause negative effects to physiology and/or behavior of fish. Many of these effects occur at some time distant from the exposure. With regard to heat and chronic toxicity to fish, Williams and Coutant (2003) found that modifications of schooling behavior in an atherinid fish (Atherina mochon) resulted when egg and larval stages of that fish were subjected to short-term exposures to sublethal increases in water temperature. Exposures in these experiments were administered to eggs only, larvae only, and both eggs and larvae. Analysis of the behavior of larvae at 10-35 days posthatch revealed that locomotor ability and ability to maintain presence in a school were greatly diminished in heat-exposed fish. Diminished ability to maintain a school is a chronic, negative effect because a decrease in schooling behavior is expected to diminish, or even prevent successful maturation and spawning. With regard to adults, the chronic and/or acute effect to adult alosids that are attracted to the plume is unknown. Based on studies by Graham, however, a 20 ºF rise in temperature due to the discharge could induce death in alewives if the duration of exposure was long enough. Currently, the duration of exposure of those fish attracted to the plume is unknown.

If adult alewife avoid Kendall Station's thermal plume, they are, in effect, being excluded from habitat. This shrinking of habitat, in a healthy population, could result in increased competition among fish in the remaining habitat for food, desirable spawning locations, and less available space for predator avoidance. These stressors could contribute to chronic conditions of low weight, unsuccessful spawning and overall reduced survival. In a depauperate population, with only a small area within which to breed, habitat exclusions may have a greater impact on the survival of the population.

Comment C37: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles; Incorrect Assumptions Regarding Temperature Impact on Alewife In-Migration.

In Section 5.7.3c, the DD states that "[d]ata from studies which evaluate temperatures at entry to the run are the most valuable in developing avoidance temperatures." This statement is incorrect. As discussed in prior comments, higher temperatures enhance upstream migration at the beginning of the run (i.e., fish avoid low temperatures), and at the end of the run, the cessation of the run is most probably related to the absence of additional fish rather than to their avoidance of the temperature at that time. Also, the statement that "temperature on the spawning beds [note the misuse of the term 'spawning beds'; river herring are broadcast spawners and do not employ spawning beds] will have risen to levels higher than those at the mouth of the stream." The discussion presented in this part of the document ignores the very wide diurnal as well as multi-day temperature fluctuations that occur in natural systems, around the long-term seasonal trend that does occur. The speculation about avoidance of "high entry temperatures" being genetically selected against has no scientific basis.

Comment related to C37 from MA CZM: CZM recommends replacing the ambient temperature limits in the permit, which are 61º F from April 2 to April 14 and 65º F with 60º F for the entire month of April. Further, CZM suggests EPA and MassDEP allow the applicant to

evaluate the ability of this temperature limit to protect in-migrating alewife and document the beginning, duration and end of the migration through a study designed in cooperation with EPA, MassDEP, DMF and CZM.

Comment related to C37 from CLF: EPA has determined that the alewife is the most appropriate indicator species to use for its evaluation of river conditions for anadromous fishes because it is judged to be the most sensitive to elevated temperatures at all life stages. One can think of water temperature as a being part of a biological calendar for aquatic species. Exposure to abnormally warm temperatures in a crucial location, such as near the mouth of a river, can result in a misreading of the calendar, and a potentially devastating de-synchronization of reproductive behavior with the availability of suitable habitat and food. As the water temperature increases, the fish that have aggregated near the river mouth are triggered to begin their spring spawning run. If the water is heated by thermal discharge, this natural behavior will be disrupted. If outflow temperatures are too high when migrating fishes arrive, the migration can be blocked. Migration can also be triggered too early leading to spawning under sub-optimal conditions, including the production of eggs and larvae under conditions that are not favorable to their survival.

Alewives typically begin spawning runs when water temperatures are in the 45 to 55 ºF range during April. When spring temperatures reach about 64 ºF, alewives generally will no longer migrate into rivers. However, the ZPH temperature limits proposed by EPA for the April-May spawning run period for Massachusetts will exceed 64 ºF at the beginning of the typical spawning period in mid April. According to a careful analysis of New England spawning runs presented by EPA, runs are essentially finished (i.e. 95% of fish have migrated) by the time water reaches 65 ºF, typically in May. By the end of May, EPA proposes allowing temperature in the ZPH to climb as much as 6 ºF above the behavioral threshold for inward migration (i.e. to 70 ºF). The water in the ZD will be even warmer and it is these thermally loaded waters that migrating alewives will encounter as they reach the mouth of the river. The schedule of proposed limits is not consistent with the available science on alewife behavior and is not supportive of these indigenous migratory fish that have been selected as indicators of habitat suitability. Indeed, the limits proposed by EPA are inexcusable because they will so obviously interfere with the migrations of alewife, and probably other migratory species.

In the section of the Determination Document dealing with protective temperatures for migrating adult river herring, EPA writes that ". . . many years of spawning data at a specific river system would be needed to properly characterize the spawning habits of a site-specific spawning school," suggesting that detailed knowledge of herring behavior in the Charles river is required to best understand the habitat requirements of this species and thus set permit limits. As explained above, we do not agree with this reasoning for herring, or for any other species that currently struggles to maintain its toe-hold in the Charles. EPA provides no support for the notion that temperature, or any of the other cues, regulating behavior of river herring might vary substantially from one river to the next. Indeed, the bulk of the published literature on Alosids would indicate otherwise, with the dates of spawning runs varying with latitude, but being relatively stable with respect to water temperature. As noted in the comments above on Yellow Perch, there is little support for the contention that the sub-populations of herring, or any other

fishes, in the Charles have diverged substantially from members of their species studied in other rivers. The lack of site-specific data on these species, particularly data taken in an impaired waterway such as the Charles, does not represent a pronounced obstacle to our scientific understanding of the biology of these species, and should not be put forth as a justification for departing from the conclusion supported by the published literature for each of the species considered.

Response to C37 and related comments: These issues have been addressed in responses to previous comments in this document (see especially Response C6, Response C33 and Response C34). In addition, Mirant alleges that the analysis in this section ignores "very wide diurnal as well as multi-day temperature fluctuations," whereas CLF asserts that EPA and MassDEP have selected temperatures beyond the upper end of the tolerance of the BIP. At the end of Section 5.7.3c of the DD, however, EPA and MassDEP specifically accounted for the diurnal fluctuations in the lower Basin. The permitting agencies noted that these fluctuations should help ensure that the permit temperature limits actually achieve protective in-stream temperature levels for the BIP, because if Mirant is to maintain compliance with the permit limits, it is reasonable to expect the in-stream temperatures to fluctuate below those maximum allowed temperatures. While Mirant was implicitly arguing that the fluctuations are a basis for setting higher temperatures, EPA and MassDEP decided that the fluctuations should serve as a margin of safety within the river system to help maintain temperatures to protect the BIP.

Regarding the MA CZM recommendation to replace the ambient temperature limits included in the permit (16.1 °C (61 °F) from April 2 to April 14 (in place to protect yellow perch juvenile development) and 18.3 °C (65 °F)) with 15.6 °C (60 °F) for the entire month of April, EPA and MassDEP present the following information. While EPA and MassDEP acknowledge that temperatures below 18.3 °C (65 °F) would also be protective of the onset of alewife in-migration, the limit of 18.3 °C (65 °F) is fully justified by the record. There is evidence that temperatures above 18.3 °C (65 °F) halted the in-migration of alewife. There is no evidence in the record that a temperature just above 15.6 °C (60 °F) resulted in a negative impact to alewife in-migration. The permit limits are not designed to identify optimal temperatures, but rather maximum temperatures above which harm to the BIP would be expected, based on the scientific literature and site-specific data.

Another protective measure in the permit plays a central role in the month of April. The delta T limit of 5 °F above ambient will limit the temperature in the lower Basin in April long before the maximum temperature limit becomes part of the compliance protocol. Figure C37-1 shows hourly temperatures from Kendall Station's Intake, recorded for the month of April from 1994 through 2002. During this time of year, these temperatures are thought to generally represent ambient conditions in the Charles River. The highest hourly temperature from among those 9 years was assembled for the maximum temperature line (green). The average of all 9 hourly temperatures was assembled for the "average" line (gray). The lowest hourly temperature from among those 9 years was assembled for the minimum temperature line (blue).

Based on this information, even when examining the maximum temperatures, the delta T of 5 °F requirement would hold temperatures in the ZPH at or below 60 °F for at least the first two

weeks of April. When the average temperature is examined, Kendall Station heatload would not generally increase ZPH temperatures above 60 °F for approximately the first two thirds of April (until April 22). After that, temperatures would still remain several degrees F below the 65 °F limit due to the maximum delta T of 5 °F. When this information is added to the fact that higher flows usually occur in the Charles River during the month of April, it is reasonable to expect that the ZPH will be well below the maximum limit of 65 °F for the entire month of April in most years. During a hot, dry April, the maximum temperature limit of 65 °F will ensure that the BIP is protected.

Comment C38: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles; Unsupported Assumptions Regarding Alewife Out-Migrations.

Section 5.7.3c of the DD asserts that "out-migrations continue to occur long after in-migrations have ceased." This observation is not support for a temperature difference between entry and spawning temperatures. There may be a lag between in-migration and spawning at the very beginning of a run if upstream migration is triggered by a brief high temperature excursion followed by a drop in temperature. In such an instance, fish may move upstream, but not actively spawn until temperatures rise to appropriate levels. However, during the major portion of any spawning run, temperatures are sufficient for fish to spawn throughout the entire period. Thus, fish entering will spawn when they are present in appropriate spawning locations and do so continuously throughout the run, not at some specific temperature. The fact that out-migrations continue long after in-migrations have ceased is simply a result of spawned-out fish remaining long after completion of spawning. Richkus (1974b) documented spawned out adults moving downstream throughout the summer. While Mirant Kendall offers no specific explanation for the delay in out-migration of these fish, nothing in the literature would suggest a link between that behavior and water temperatures.

Response to C38: EPA and MassDEP agree with the permittee that keeping the lower in-migration temperature limits in place for a longer period, rather than replacing them with the higher spawning temperature limits (as is currently reflected in the permit), would be more protective of the alewife in-migration. However, maintaining the in-migration temperature for a longer period of time is inconsistent with the steady rise in the ambient temperature of the river documented in the majority of years where data is available.

Mirant's comment that there is nothing in the literature to suggest a link between out-migration behavior and temperature suggests that the permit need not include temperature limits to protect out-migration. While EPA and MassDEP do not believe that the highest temperature limit in the permit needs to be lowered to protect out-migration, as explained immediately below, the delta T limit of 5º F in the permit does have the effect of reducing the maximum allowable temperature for the facility in parallel with any natural cooling of the river at the end of the summer.

Comment related to C38 from RiverWays: The need for out migration passages deserves as much attention as adult spawning migration. If the larval fish are unable to traverse the Basin safely in the late summer/early fall, all efforts to protect spawning populations will be wasted.

Larval fish are less tolerant of unfavorable conditions than adult populations.

Response to Comment related to C38 from RiverWays: EPA and MassDEP recognize that temperature limits that will protect a successful out-migration are as important as other temperature limits established in the permit. The maximum temperature limit in the ZPH in the late summer and early fall is 81ºF at certain Monitoring Points at Monitoring Stations 2, 3 and 7. However, during the late summer and early fall, as ambient temperatures in the Charles begin to fall, the delta T limit of 5 ºF in the ZPH will play a more central in ensuring that out-migration temperatures are suitable. When ambient temperatures drop to 73 ºF, for example, the maximum temperature in the ZPH will only be allowed to be 5 ºF above that, or 78 ºF, even though the maximum limit at certain Monitoring Points at Monitoring Stations 2, 3 and 7.is 81 ºF. This delta T limit will serve to maintain protective out-migration temperatures in the ZPH.

Comment C39: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles; Site-Specific Data Excluded, Leads to Incorrect Conclusions Regarding Alewife In-Migration.

Section 5.7.3c of the DD presents selected data on temperatures reached by the end of herring runs. It is misleading and inappropriate to exclude certain relevant data from this material. See for example the discussion of the 70-74^{o} F temperatures in the 1991 Merrimack River run in Comment C33, and the site-specific experience from this year's run in the Charles River.

This year's data from Mirant Kendall's sampling in the Charles River also contradicts the Agencies' assumption that "a much larger proportion will refuse entry to the Lower Charles at temperatures above this value (64.4 ^{o}F)." In this year's run, 75% of the alewives caught below Longfellow Bridge through the third week in May (last date of "ripe" females) were caught when temperatures had been above 64.4 ^{o}F, and as high as more than 69 ^{o}F MK Comment Ex. No. C33-3.

Response C39: Based on the thermographs provided by the permittee, at times, alewives entered the lower Basin after water temperatures above the permit limits were recorded. As described fully in Responses C13 (d) and (e) and C24, there are a number of problems associated with predicting what would have been "permit exceedances" using temperature data that does not approximate the station locations, depths and calculations used to determine temperature compliance in the permit. Based on this, EPA and MassDEP can not determine with certainty if the permit limit would have been violated in the ZPH during the time periods identified by the permittee. The permittee states that alewife continued to enter after these events took place. It must be noted that the permittee does not state that adult entry to the system occurred when temperatures were at or above 65 ºF and the Permitting Agencies have seen no information to support the idea that alewives entered the Basin at times when the water temperatures at the point of entry were equal to or greater than 65 ºF .

Based on the adult gill-net information (see Response C43), the percentage of the adult river herring population comprised of alewives is at low levels. While it is true that adult alewives moved into the system after some high temperature events, neither EPA, MassDEP, nor Mirant

have managed to provide an answer as to why such a dramatic decline has taken place in the abundance of alewives. This is of concern to EPA and MassDEP and lends further support to overall temperature limit approach established in the permit. Results from the monitoring program will provide further information regarding the appropriate, protective temperature limits needed to protect the BIP.

Please see Response C33, where the following issues are discussed: a) the use of the Merrimack data to develop permit limits for entry temperatures in the Charles; b) reasons for not using the highest temperatures reached during the run as the maximum allowable temperature for the run; and c) the use of six days of temperature limit excursions allowed in the draft permit to address occasionally dramatic natural springtime temperature fluctuations.

Comment C40: Erroneous Assumptions and Justifications in Applying the U.S. Fish and Wildlife Model to the Lower Charles: Site Specific Data Excluded, Leads to Incorrect Conclusions Regarding Alewife In-Migration.

Section 5.7.3c of the DD states"[a]t the early part of the run avoidance temperatures will be lower than those for the latter part of the run." This statement is refuted by results in Richkus (1974) and in Collins (1952). Both laboratory and field studies show fish are attracted/stimulated by high temperatures over a wide temperature range. Richkus (1974) showed that during the early portion and most of the entire spawning run, only declines in temperature appeared to inhibit upstream migration. Very high short-term temperature excursions resulted in high upstream migration rates, which is not indicative of avoidance. For this reason, establishing a maximum April temperature of 15.6 ^{o}C does not appear to be necessary to ensure entry of alewives into the Charles River.

Section 5.7.3c of the DD assumes "that in-migration has not been inhibited to threaten the protection of the BIP for alewife in the Charles from 1995 to 2002." This is a crucial point, with which Mirant Kendall agrees. Mirant Kendall further believes the results of its gill-net sampling indicates that the same can be said about the in-migrations in 2003 and 2004. Mirant Kendall strongly suggests that the Agencies also consider the corresponding data on later season temperatures associated with year class success in the same manner, notably the data from 1999, where relative abundance of larvae and alewives as young-of-the-year and as returning adults (in 2002 and 2003) all point to an absence of appreciable harm to the BIP despite frequent exceedances of the temperature limits proposed in the Draft Permit.

Mirant Kendall suggests that a rigorous statistical analysis to identify the means and standard deviations of the corresponding temperatures in each two-week averaging period be applied to inform the Agencies' "Stair Step" approach and to derive appropriate springtime limits corresponding to the historical range of background temperatures. Mirant presented such a statistical analysis in Comment C5 above.

Response to C40: The statement that avoidance temperature will be lower in the beginning of the run than at the end was based on the observation that there is a positive relationship between acclimation temperature and avoidance temperature. Mathur, et al. (1983) found a positive

relationship between acclimation and avoidance temperature in bluntnose minnow, channel catfish, smallmouth bass, spotfin shiner, bluegill, green sunfish, yellow perch and other centrachids and cyprinids. The fact that a positive relationship typically exists between these two factors as well as between acclimation and temperature-based toxicity endpoints is well established in the literature.

Much of the literature supplied to EPA and MassDEP from the permittee supports the fact that a positive relationship exists between toxicity endpoints and acclimation temperature. In many of the toxicity-based evaluations reviewed by EPA and MassDEP, toxicity endpoints from excessive temperature exposure are positively related to acclimation temperature among different fishes. It has also been established in studies of many species of fish in geographical zones outside of the tropics (i.e., outside those areas where temperatures are nearly constant) that avoidance occurs at temperatures lower than those known to induce toxicity. It follows logically, therefore, that avoidance temperatures are also positively related to acclimation temperatures.
EPA and MassDEP assumed that this relationship, established for other species, also existed for alewives. Thus, when the alewife run begins in April in the Charles and acclimation temperatures in Boston Harbor are in the low-to-mid-40s (ºF), EPA and MassDEP assumed that the avoidance temperature would be lower than avoidance temperatures at the end of the run (1st week in June) when acclimation temperatures were much higher (see Table 5.7.3c-4 in the DD). The model assumes that avoidance temperatures follow the same slope that is followed by the toxicity endpoints. The assumption that a positive relationship exists between acclimation temperature and avoidance was employed throughout the Brayton Point Power Plant 316(a) demonstration in sections pertaining to development of temperature envelopes for different fish species.

In the second paragraph of Comment C40, Mirant quotes the DD: "in-migration has not been inhibited to threaten the protection of the BIP for alewife in the Charles from 1995 to 2002", and states that this is a crucial point with which Mirant agrees. The company also believes that "the results of its gill-net sampling indicates (sic) that the same can be said about the in-migrations in 2003 and 2004", i.e., that the runs have not been inhibited.

It was not until Mirant provided EPA and MassDEP with the 2004 data (submitted on August 30, 2005, AR#557) and 2005 data (submitted in April, 2006, AR#560) that the analysis contained in Response C3 was able to be performed. Thus, prior to these comments, EPA and MassDEP had an incomplete picture of the effects of the facility on capture rates of juvenile alewives; nor were EPA and MassDEP fully aware of the decline in the relative abundance (and, it appears, the relative year-to-year run strength) of adult alewives, bluebacks and total river herring (alewife and blueback herring combined) that has taken place since 2002 (see the Permitting Agencies' Response C43 regarding relative year-to-year run strength).

The permittee suggests that a statistical analysis of intake temperatures be used to derive appropriate springtime limits such as that proposed in Comment C5 above. Mirant's proposal in Comment C5 is based on a misinterpretation of EPA's suggestion to use a 95%-ile figure in assessing toxicity data. In addition, Mirant did not follow its own guidance in developing the

information presented in the Tables in Comment C5. Please see Response C5 for a full discussion.

Comment C41: Mischaracterization of Timing of Alewife Adult Spawning Stage. Section 5.7.3d of the DD states "the number of spawning fish entering the lower Charles River Basin will increase, but the duration of the run may also increase." This statement contradicts the concept that temperatures control the run. If fish avoid temperatures above certain levels that establish when the run will occur, the duration of a run could not change in response to the number of fish comprising the spawning run.

This section suggests that there is not sufficient site-specific data to determine the probable expected beginning and end of the alewife in-migration. Mirant's collection data from 1999 to the present indicates that the alewife run begins as early as the first week in April (generally when water temperatures reach the 50s) and continues through the third week in May, at varying water temperatures up to the low 70s.

Response to C41: Based on the preliminary estimate of in-migration from 2002, the current adult alewife spawning run appears to be far below the estimated carrying capacity of the river. EPA and MassDEP assumed that if the run is relatively small, that run would not reach its potential duration. As the number of fish entering the system increases, it is expected that a greater proportion of the appropriate temperature range would be utilized, i.e., that the tails of the frequency distribution of run strength would become more apparent in the sampling.

Based on the permittee's gill net sampling analysis near the dam, the alewife run extends from early April through early June (not the third week in May as stated). So few alewives were captured in each of these years that it is important to recognize all the data when assessing the start and end of in-migration. EPA and MassDEP agree, however, that under current conditions, most of the alewife run has occurred in the period stated by the permittee.

Comment C42: Proposed Temperature Limits for Alewife Adult Spawning Below Historic Ambient. Section 5.7.3d of the DD lists the proposed in-stream limits from April 15 through June 7. As discussed in Comment C5 above, the proposed temperatures are in line with historic background in April, but 2-5 ºF below the range of historic background that has prevailed during successful spawning runs in May and June.

Response to C42: There are several components to EPA and MassDEPs' response to this comment. First, an important qualifier in the permittee's statement is the word "range." It may be true that, at times, temperatures recorded at the Kendall Station intake exceeded the permit limits in May and June during alewife runs. This does not mean that the average temperatures or even the 70th or 90th percentile ambient temperatures are above the temperature limits in the permit. Nor does this mean that alewives were moving into the system when these temperatures were exceeded. This is addressed in the Response C5. Much of the reason for the limits in the springtime is to provide access to the Charles for alewives moving into the system. The other reason for the springtime limits is to allow these fish to continue movement past the narrow constriction near the Science Museum and past the Station.

Second, other water quality variables, such as dissolved oxygen (D.O.), may at times, even in fairly pristine systems, fail to meet state standards, with negligible effects. However, the State D.O. standard has not been set at the lowest values experienced by the system. This is due to the fact that, although downward spikes may be withstood if they are not frequent, sustained low D.O. cannot be withstood by many of the organisms in the system. In addition, if a lower D.O. standard were allowed, localized, downward D.O. spikes would not be the only problem for the resource. Dischargers of substances that lower dissolved oxygen could increase the duration of low D.O. events, the areal extent of these events, the magnitude of any natural declination in D.O. and/or the frequency of such events, all of which will increase the probability that the population of concern will be negatively affected. The same situation exists with temperature.

EPA and MassDEP are confident that there is a substantial dataset based on field and laboratory evaluations to justify springtime temperature limits. Some parties (see Comment related to C42 from CLF) argue that the permit limits are too high to allow continued access of alewives into the Charles during the spring.

Third, six exceedances of the springtime limits have been allowed because EPA and MassDEP recognize that, at times, the ambient water temperature has exceeded the permit site-specific limits. These exceedances were included to provide additional operational flexibility for the Station during changing river temperatures, regularly documented in the spring.

Fourth, the lower Basin of the Charles is already stressed with regard to temperature. According to a statewide analysis of stream temperatures conducted by DEP personnel in concert with USGS, water temperatures in the lower Charles are among the highest in the state. This is probably due to a number of factors, including natural tannins in the water which color the water and increase its potential to absorb infra-red radiation. The river is also greatly expanded and river velocities decreased due to the New Charles River Dam, allowing more surface area and longer retention times to absorb solar heat. There are also large inputs of street runoff, CSOs and other discharges, all of which may at times be much warmer than ambient water temperatures in the Charles.

Fifth, the state of alewife stocks in the Charles appears to be far from robust. As mentioned in response to comments above, the adult alewife stock has been directly estimated only once, in 2002, at 8,000 fish. Since this was a preliminary estimate based on a pilot study, it can not be regarded for certain whether this was a successful run. However, the combined alewife/blueback herring run that year (45,000 fish) was well below the MADMF estimate of carrying capacity for that system (250,000 - 500,000 fish). In addition, EPA and MassDEP have provided an analysis of Mirant's gill-net, daytime beach-seine, night-time beach seine and push-net data, all of which supports the position that the juvenile alewife population descended to very low numbers in 2000, that adults followed in 2003 and that both life stages remain at low levels.

Comment related to C42 from CLF: Indeed, the limits proposed by EPA are inexcusable because they will so obviously interfere with the migrations of alewife, and probably other migratory species.

Response to Comment related to C42 from CLF: According to information submitted by the permittee, as well as some historical data, the profile of the past heated discharge from Kendall Station has not completely blocked the migration of anadromous fish species into or out of the Charles River.

If by interference, the commentor means that migrating fish may avoid a portion of the river near the Kendall Station thermal discharge point, then EPA and MassDEP concedes this to be a probable response. EPA does not feel this response in and of itself will lead to a destabilization of the BIP. Anadromous fish passage, although far lower than estimated carrying capacity of the river, has been documented in the lower Basin under past thermal discharge loads.

Comment C43: Temperatures and Time Periods for Alewife Egg Stage Based on Incorrect Assumptions. Section 5.7.3e of the DD discusses various measured temperatures and laboratory toxicity studies of alewife hatch success rates measured over several days of exposure to different temperatures. Mirant Kendall asserts that these data are not currently applicable to the conditions in the ZPH for two related reasons. First, the spring river flows during alewife spawning (generally well in excess of 400 cfs, and always above about 100 cfs) do not allow alewife eggs in the upper water column to remain within the ZPH long enough to hatch and develop before washing out into the Harbor. Second, if the eggs sink into the lower water column, they will be subject to cooler temperatures, but will likely perish in the anoxic conditions there. This situation could be mitigated for at least some eggs in the lower water column if the proposed new outfall and diffuser are implemented, as discussed in Section E of these comments.

Section 5.7.3f of the DD indicates adult alewives are expected to end their spawning run by June 7, therefore adding four days for incubation and placing last egg hatching around June 11. Site-specific gill net data documenting ripe adults and the site-specific length data for young-of-the-year alewives collected by Mirant Kendall since 1999 indicate that the last alewife eggs would be expected in late May, not the first two weeks in June. The Agencies should review these data and revise accordingly.

Response to C43: There are several interactive components to this issue: placement of eggs, duration of the adhesive stage, duration of the pelagic stage, current velocities and their potential effects on egg and larval wash-out, and anoxic conditions in the water column.

Both blueback and alewife eggs are demersal (on the bottom) in still water and adhesive in lotic waters until they are "water hardened," which typically takes less than 24 hrs (from Mullen, 1986). After that time, eggs of both species lose their adhesive properties and may drift in the water column. Depending on water temperature, alewife eggs may remain in the egg stage for up to two weeks. Depending on where they are spawned, and on water velocities at the spawning site, certainly, eggs may be displaced downstream. If they are placed along the shoreline in weedy areas where velocities are negligible, there may be little displacement downstream. Anoxic conditions typically begin in very deep areas in the summer (after egg deposition for alewives) and progress upstream and higher into the water column as the summer progresses.

Alewife spawning sites that are in shallow to mid-depths should not be affected in the spring by anoxic conditions (see also Response C36 regarding river herring spawning in the discharge pipe).

Most spawning should take place near or on the bottom. The spawning sites in the lower Basin are not likely to be profoundly anoxic in the spring due to high flows, with the exception of some years, where very deep pockets may contain dense harbor water, elevated in saline, and lower in D.O. (according to information presented by EPA and USGS). Adults are not expected to venture to lower D.O. areas to deposit their eggs. The shoreline areas downstream of the B.U. Bridge have the slowest water velocities, and thus, the highest potential for retaining eggs. Because the shallow areas are along the shoreline in the area downstream of the B.U. Bridge, it is important that water near the surface be maintained at temperatures appropriate for egg and larval survival to offer these life stages adequate habitat.

The development of alewife eggs to the larval stage is more rapid with increasing temperature. Because eggs deposited toward the end of the spawning run will hatch the fastest due to the gradual increase in water temperatures as spring progresses, those deposited at the end of the run should have the greatest potential for survival if wash-out rates are a concern because they will be exposed to potential wash-out for the shortest duration of time. In addition, river velocities typically diminish in the late spring and early summer, further lessening the potential for wash-out. Thus, it is important to ensure that temperatures are adequate for survival for those eggs deposited at the end of the run.

As the season progresses, boat traffic through the locks increases thus allowing salt water to flow into the lower Basin. River flows typically decrease as spring nears a close and due to the increase in saltwater and a decrease in the removal of water from the Basin, the anoxic layer lengthens and rises, but only up to a point. EPA and MassDEP are unaware of any data showing that shoreline areas (less than 6' in depth) experience anoxia at any time of the year. Thus the shoreline areas should provide the best habitat for both spawning and egg and larval development for alewives.

Mirant contends that alewife and blueback eggs that are deposited in the lower Basin during high-flow years experience the highest wash-out rates. As a point of operational concern, during years with high springtime flows, the permittee is not expected to need to reduce or curtail generation in order to meet the thermal limits, due to ample dilution. Rather, the permittee contends that years with low springtime flow rates will be most important to re-building alosid populations. The periodic occurrence of low flow years are thought to allow alewife eggs in the upper water column to remain within the ZPH long enough to hatch and develop before washing out into the Harbor. This occurrence is in contrast to the permittee's statement in this comment. Thus, during these low-flow years the shorelines, as well as the water column in the ZPH, must have water temperatures that are amenable to the successful growth of alewife eggs and larvae. From an operational standpoint, these low flow years will likely provide the greatest challenges to Kendall Station regarding temperature limitation.

Concerning the timing of the egg stage, Mirant states that, based on the adult presence during the

spring run, eggs cannot be present through June 11th, the last date at which limits to protect eggs are found in the draft permit. Mirant also states that the adult alewife run only extends through the third week in April. Mirant bases this argument on gill-net data.

The Permitting Agencies reviewed the adult gill-net information to evaluate the temporal duration of the springtime run. A summary of the gill-net and dip-net data is provided below. Data for 1999 and 2000 are not included because sampling was limited to the Broad Canal in those years:

Table C43-1: Relative population size of adult blueback herring and alewives judging from gill-net and dip-net sampling.

Dates of sampling span from the first date of river herring adult capture in the spring to the end of June when blueback catch decreases to near-zero catch. Gill net data were collected in 1984 by MADMF. All other data are transcribed from the April, 2006 data submission from Mirant Kendall. Mirant's gill-net data reported below are only for years when gill-netting was conducted outside the Broad Canal.

Year	Dates of Sampling	Total alewives	Total bluebacks	Total # river herring	% alewives
1984	5/9 - 6/21	49	94	143	34.3
2002	4/4 - 6/28	153	683	836	18.3
2003	4/17- 6/26	65	381	446	14.6
2004	4/21- 6/30	27	346	373	7.2
2005	4/29- 6/30	62	421	483	12.8

* Dates of sampling for 1984 are from MA DMF. Dates of sampling from other years span from the first date in the spring when either bluebacks and/or alewives were capture in gillnets to the last sampling date in June. By the end of June, river herring presence in gill nets tapers off and typically includes only small numbers of bluebacks.

Table C43-2: Year-to-year variability in catch per unit effort of river herring species. Dates of sampling and other information as in Table C43-1 above. The three columns on the right of this table depict "catch per unit effort" as the total number of fish caught over the dates of sampling at all gill-net stations divided by the total hours of gill netting over those dates.

Year	Dates of Sampling*	Total alewives	Total bluebacks	Total hours gill netting	Alewives per hour	Bluebacks per hour	Herring per hour
1984	5/9 - 6/21	49	94	n. a.	n. a.	n. a.	n. a.
2002	4/4 - 6/28	153	683	201.1	0.76	3.4	4.2
2003	4/17- 6/26	65	381	207.3	0.31	1.8	2.2
2004	4/21- 6/30	27	346	274	0.1	1.3	1.4
2005	4/29 – 6/30	62	421	349.4	0.18	1.2	1.4

Several pieces of information are important to the discussion on alewives. First, contrary to what Mirant states in their comments, adult alewives have been caught in gill-nets through the first week in June in 2002 through 2005 (see Mirant's April 2006 data submittal to the Permitting Agencies).

Second, Table C43-1 illustrates that the percent of the total catch of river herring that is comprised of alewives has dropped consistently from 1984 through 2005. The relative percent alewives increased slightly in 2005, but did not reach that seen in 2002 or earlier.

Third, the relative year-to-year run strengths of bluebacks, alewives and total river herring all decrease after 2002 (see Table C43-2). Data in Table C43-2 were compiled as the catch per unit effort (in this case, as catch per hour of gill netting). This allows comparisons of run strength to be made among all years. Because the 1984 data were collected using a different method, data from that year cannot be compared to data from other years using this method.

These data indicate a decline in adult run strength since 2002. Mirant used sonar in the spring of 2002 to estimate the total river herring population entering the Charles River and gill-net sampling to estimate the proportion of these herring that were alewives (although issues have been raised concerning the accuracy of the results). Using this approach, the adult population entering the Charles was estimated at only 8,000 fish in 2002. Further reductions to such a small population are of substantial concern to regulators and underscore the need to curb any additional erosion of this population.

Not shown above is a week-by-week breakdown of sample data. Based on the available data, it appears that the highest adult alewife densities occur from early April through the third week of May as the permittee maintains. However, in all four of the years that gill-netting was conducted outside of the Broad Canal, adult alewives were caught into June, albeit, only seven in 2002, one in 2003, three in 2004 and five in 2005. Because such a small total number of alewives were caught in gill nets over these years, a single adult fish in each year can account for a fairly high percentage of fish. For example, in 2003, a single adult alewife accounts for about 2% of the 2003 adult alewife catch, and about 4% of the 2004 catch.

Mirant has proposed an estimate of the alewife run duration. However, their estimates on run duration are based on a very small dataset. EPA and MassDEP are concerned that because the alewife run appears to be small, the sampling, though fairly rigorous, produces very few adults. This means either that the sampling is inefficient or the adult alewife population size is small.

Making a determination of run duration with only a small subsample of the adult population will lead to wide confidence intervals in the actual run duration (see Response C33).. Mirant provided no confidence intervals for run duration. Because the Charles River alewife run appears to be small, EPA and MassDEP are concerned that if only the bulge in the run is protected, an important portion of the run could be excluded by selecting inappropriate temperature limits. Late migrants may be very important to the success of the run due to the diminution of wash-out rates in the late spring. As Mirant has intimated in a number of comments, the low-flow years may be those most important to rebuilding alosid stocks in the

Charles.

Based on the adult dataset in the tables above, and information from the literature that it takes about 11 days for alewife eggs to hatch to larvae at 70 ºF (and longer for cooler water), EPA and MassDEP assert that they are justified in establishing the permit date of June 11 for the end of the alewife egg stage.

Comment C44: The discussion of mortality rates of eggs and larvae at various temperatures in section 5.7.3g ignores the fact that developmental time and growth rates are also related to temperature, and all these factors combined contribute to the ultimate cumulative larval survival that establishes the year class strength. Kellogg (1982) found that maximum larval growth occurred at 29.1 ^{o}C (84.4ºF). The fact that maximum growth occurred at such a temperature argues against a high level of thermal stress occurring under those conditions. The Agencies discount Mirant Kendall's site-specific data as "informative as a guide," apparently giving more weight to laboratory studies. The Agencies' assertion that temperature data from Mirant Kendall's ichthyoplankton sampling are unrepresentative is misleading and incorrect. A complete, representative, river-wide temperature profile is available from the time series (including continuous readings) made at various locations. These not only include the temperatures measured on the boat at the time of collection, but more importantly, indicate the temperature history to which the collected larvae have been exposed. For example, larvae collected between July 7 and July 10 in 1999, 2002 and 2003 are known to have experienced and survived river-wide temperatures in the upper 80s during the first week in July.

The Agencies incorrectly indicate that the viability of larvae was not evaluated in Mirant Kendall's sampling. While no "condition factor" was (nor could readily be) determined, larvae were measured. The resulting length distributions, along with subsequent measurements of juvenile abundance, together provide an indication of whether conditions (including temperature, flow, etc.) were sufficiently protective for the larvae to develop to the young-of- the-year stage, when their identity as alewives or bluebacks was confirmed. In none of the sampling years of 1999 through 2004 was there any evidence that basin temperatures had curtailed growth or development. Relative abundance of young alewives and length distribution of larvae correlated well with river flow conditions during May and June, but did not correlate with temperature differences between warm and cool years.

Finally, the Agencies state that "[u]sing the presence of river herring larvae (made up of both alewife and blueback larvae) to formulate upper temperature limits may result in a maximum temperature limit that exceeds the temperature limit best suited for alewife larvae alone." Does this comment indicate that it is the Agencies' intent to optimize the temperature for alewife larvae alone or to protect the BIP of both alewives and bluebacks? Mirant Kendall believes it is likely that the optimum temperatures for blueback larvae may be slightly higher than those for alewife larvae, but still low enough to protect alewife larvae. The Agencies should clarify their objectives. It is Mirant Kendall's understanding that the CWA requires protection of the BIP rather than optimization for a single species. The Agencies discuss 24-hour laboratory studies of mortality at different acclimation temperatures. Mirant Kendall notes that in those studies, conditional mortality only occurred at Delta Ts of about 14 ^{o}F. Mirant Kendall further notes that

whatever acclimation temperature is chosen, drifting yolk-sac larvae will not experience a Delta T of more than 6 °F passing through the ZPH in 24 hours. Section 5.7.3h (time for larval stage) concludes that the period extends to July 7. Based on the sizes of YOY alewives collected in Mirant's sampling, this estimate appears to be about two weeks too late.

Response to C44: It is important to understand the Kellogg dataset because the study results clearly demonstrate the effect of high temperatures to alewife larvae. The results of this published scientific literature contradict the permittee's contentions regarding heat effects.

Kellogg's experiment was a fairly straightforward evaluation of the effect of different temperatures on survival and growth of alewife larvae. He transferred alewife larvae to 7 different test vessels; water in each test vessel was kept at a different temperature for a 12-day test. Tests were begun with 500 larvae in each test vessel. Eight separate water temperatures were evaluated (see table below) ranging from 12.9 ºC (55.2 ºF) to 29.1 ºC (84.4 ºF). Kellogg evaluated toxicity at two different salinities: a) water with a slight degree of salinity (1-1.3 parts per thousand [seawater is about 32 parts per thousand]); and b) freshwater with no added salts. At the end of each test he counted and weighed the surviving fish. His results are transcribed below.

Transcribed from Table 2 in Kellogg (1982)

	Salinity 1.0 - 1.3 ppt				Fresh Water	
	Replicate 1		Replicate 2			
Mean Temp. F[1] + SD[2]	No. Fish surviving	Dry weight per fish (mg)	No. Fish surviving	Dry weight per fish (mg)	No. Fish surviving	Dry weight per fish (mg)
55.2 + 1.1	124	0.06	108	0.05	113	0.05
59.4 + 0.4	71	0.09	64	0.1	11	0.09
64.8 + 0.5	133	0.14	38	0.22	120	0.14
69.4 + 0.7	71	0.26	61	0.24	27	0.28
74.7 + 0.5	44	0.34	16	0.4	14	0.53
79.5 + 0.5	31	0.86	24	0.85	19	0.56
84.4 + 0.2	14	1.12	11	0.95	0	0.00

1: degrees Fahrenheit
2: standard deviation of temperatures during toxicity tests

Note that as temperature increases, survival decreases in each of the tests, but the mean dry weight of the survivors (which were sacrificed at the end of the test and weighed) increases with temperature. Although the body weight of the fish that survived the 12-day exposure increased dramatically with temperature, the percent survival plummeted at temperatures above 64.8 ºF in all three experiments (i.e., the two replicate experiments conducted in low-salinity water and the one experiment conducted with freshwater only). The permittee, in their review of the paper, did not include this second aspect of the experiment, i.e., that as temperature increases, survival of

the test organisms drops dramatically.

The data from the 84.4 ºF test exposures, in which a high rate of growth in the few surviving fish occurred, was purported by Mirant to "argue against a high level of thermal stress." Mirant refers to the increased growth rate but neglects to mention the survival levels at this temperature: 2.8% and 2.2% in the low-salinity experiments and zero in the experiment with freshwater only. In the freshwater tests, no larvae survived the 84.4 ºF test exposure; survival at this temperature only occurred in the group that was tested in slightly saline water. In fact, survival of the 12-day exposure in freshwater tests was only seen at 79.5 ºF or below. Even at this temperature (79.5 ºF), larval survival in the freshwater experiments was only 3.8%.

The permittee's discussion of the Kellogg temperature/growth information did not incorporate the results that survival was either at or near zero in the high-temperature (84.4 ºF) tests. Clearly EPA and MassDEP are unable to allow temperatures to persist that would promote 98-100% mortality in alewife larvae, even though the few larvae surviving these temperatures would have extremely high growth rates.

Mirant (paragraphs 1-3 under Comment C44) also asserts that EPA and MassDEP did not consider the Charles River site-specific temperature vs. larval river herring data in setting temperature limits. Mirant's statement is true. It is important to know the justification EPA and MassDEP used to support the decision not to use the river herring larval catch data to set temperature limits for alewife larvae.

First, EPA, MassDEP and the permittee have no information as to whether the larvae collected were alive, stressed or dead. The manner of collection prevented the permittee from determining this. Larvae were collected in a plankton net and the contents of the net were immediately transferred to formalin prior to being examined in the laboratory. Secondly, the researchers collecting the larvae were unable to determine whether or not the larvae collected were alewives or blueback herring. Extreme measures would have had to be taken to separate the two species at this life stage. Because there are substantial differences in temperature tolerance between these two species, larvae collected at the higher temperatures may all have been bluebacks. In addition, juvenile and adult blueback herring dramatically dominated river herring collections. As a result, it is likely that most of the larvae collected were probably blueback herring rather than alewives. By using temperature-larvae count data, EPA and MassDEP would be biasing temperature information in favor of the species that was more heat-tolerant. Because of these issues, EPA and MassDEP were unable to compare in a meaningful way the alewife larval catch numbers with water temperature at time of catch.

Mirant (third paragraph under Comment C44) stated that information in blueback larvae should be used to formulate "upper temperature limits." The company questions whether EPA and MassDEP are attempting to "optimize the temperature for alewife larvae alone" rather than protecting the BIP which would include bluebacks.

EPA and MassDEP agree that the BIP includes bluebacks, but it also includes alewives. EPA and MassDEP clearly articulated in Section 5.7.2 of the DD that alewives were used as the

anadromous indicator species. Prior to finalization of the re-stocking program for American shad, the alewife are the most temperature-sensitive of the anadromous fish species present in the Charles River. It is a species of considerable concern to the resource agencies, because there has been a decrease in the number of streams along the coast that support alewife runs. In addition, based on the juvenile catch statistics, and the small adult population size estimate in 2002 (the only year that an adult estimate of population size, based on adult catch, is available), the Charles River alewife population appears to be small. The resource agencies that commented on the framework of the permit agreed that by protecting the species most sensitive to high temperatures, the other species in the community will also receive protection. As a result both bluebacks and alewives are protected as part of the BIP.

Mirant asserted that EPA and MassDEP discuss 24-hr acute toxicity studies conducted in the laboratory in which exposed larvae experience mortality at a Delta T of about 14 ºF. Fish drifting into the ZPH would only be expected to experience a Delta T of about 5 ºF. Mirant also stated that the larval period extends to July 7. Based on the sizes of YOY alewives collected in Mirant's sampling, the company alleges that this estimate appears to be about 2 weeks too late.

EPA and MassDEP reviewed the laboratory studies of both Environmental Analysts (EA) as well as that of Kellogg (1982). The EA studies cited in the DD were 24-hr studies in which fish were transferred from one temperature (the acclimation temperature) to another. These resulted in a 24-hr TL05 (5% kill) at 82.2 ºF. As we noted above, in the Kellogg laboratory tests in freshwater, the highest temperature at which any larvae survived in a 12-day exposure, when kept in freshwater, was 79.5 ºF and maximum survival was at 64.8 ºF. Not all the Kellogg data were discussed in the DD. However, the Kellogg data were based on continuous exposures and appear to be the more pertinent for this discussion. EPA and MassDEP have established a permit to ensure the overall survival of the alewife larval population. EPA and MassDEP realize that temperatures in the lower Basin naturally exceed this level for brief, infrequent periods, but assert that additional and more continuous increases well beyond this level must be minimized.

Mirant also uses the alewife YOY size information to back-calculate the period that is likely that of alewife larval presence in the basin. There appear to be problems with this approach. First, the permittee has shown that alewife YOY are much larger than are alewife larvae from farther south in the U.S. and are also larger than a landlocked population in the mid-west. Because the YOY in the Charles are larger than expected, they would "appear" to be older than they actually are, based on growth simulations that use data from other populations as a model. Thus, based on YOY growth lines that are developed from other populations, Mirant would have back-calculated the fish to have left the larval stage in approximately the third week of June, when it is equally plausible that they might not have left this stage until the second week in July.

Second, the fact that YOY fish have been shown to be much larger than the same age fish in other populations may point to the fact that they grew in water that was at a higher temperature than the fish from other sites. In Kellogg's work (see the chart at the beginning of the Response C44) as growth rate increased, survival of the test population decreased noticeably. Often, a high growth rate is associated with an abundance of food. However, it can also be due to increased metabolic rate, which as Kellogg has shown, may result in greatly decreased survival of the

population at large.

It is unclear whether or not the "super-sized" Charles River YOY are representative of a thermally-stressed population, with relatively few, large YOY, or whether they are representative of a healthy population that grows larger more quickly than its southern counterparts. Judging from the daytime catch of alewife juveniles, the stock has declined markedly since 1999 (see Comment C3). Based on the EPA and MassDEP review of the 2004 push-net data, there appears to be an extremely large area of reduced alewife abundance in the vicinity of the Station discharge. Alewife catch rate in push-nets increased greatly at increasing distance from the discharge; mean temperature over the period of push-net operation (July-September) decreased at increasing distance from the discharge. Thus, catch rate decreased both with nearness to the discharge and decreased with increasing temperatures. In addition, the catch rate of juvenile alewives was generally reduced or zero at temperatures > 81 ºF. All this information provides support for the contention that the surviving juveniles caught well-downstream of the B.U. Bridge in the last three years were thermally-stressed.

Many of the juveniles that were used by Mirant to assess the relative size of juveniles from different rivers were taken from this "thermally-enhanced" area of the Charles. Based on the preceeding discussion, it is possible that the small juvenile alewife population, made up of juveniles that exhibit very high growth rates, may fit the Kellogg model of a thermally-stressed population. Other considerations, such as food availability and survival rates, would have to be considered to fully evaluate this relationship.

Comment related to C44 from MA CZM: In light of the site-specific information and published data from the literature, CZM recommends using 27.2º C (81º F) as the ambient limit in that it is protective of alewife larvae. CZM disagrees with EPA that the documented summertime daily temperature change of 1.1º C (2º F) in the Charles River is a valid reason to set the permitted ambient temperature limit 1.1º C (2º F) above the temperature that EPA has judged to be protective of alewife larvae.

Comment related to C44 from CLF: There is little justification for setting the temperature limits 2 ºF higher than the already excessive temperatures selected as PMTs, and then guessing that the actual temperature where the fish are spawning will be cooler (e.g. in deeper water).

Response to Comments related to C44 from MA CZM and CLF: EPA agrees with MA CZM that establishing 27.2 ºC (81 ºF) as the ambient limit would be protective of alewife larvae. However, based on the site-specific continuous temperature data from the lower Basin, the likely habitat that will be used by larval alewife, and the operational realities of Kendall Station, allowing the compliance limit to remain 1.1 ºC (2 ºF) above the temperature that EPA has judged to be protective of alewife larvae would still generally be protective of the species. EPA and MassDEP expect that under most conditions, enforcing 83 ºF at the required monitoring points which establish the ZPH will likely achieve sufficient areas with 81 ºF to protect the BIP. This is based on analysis of the following Charles River temperature data available at the time the Draft Permit was issued. First, the temperature in the river naturally varies by about 2 ºF during a typical day. Second, vertical profile data revealed a general decrease in temperature with

depth. Added to this is the reality that if the facility is to reliably comply with its permit limits in a natural system like the lower Basin, with multiple temperature variables over which the permittee exercises no control (for example, unexpected rain events or sudden clearing of clouds), it will have to operate with a conservative margin of compliance below the designated compliance limit of 83 ºF. Therefore, it is reasonable to predict that the actual temperature in most of the ZPH will be below 83 ºF during the periods when that is the maximum allowable temperature.

Regarding CLF's comment, EPA and MassDEP do not agree that "There is little justification for setting the temperature limits 2 ºF higher than the already excessive temperatures selected as PMTs, and then guessing that the actual temperature where the fish are spawning will be cooler (e.g. in deeper water)." In the DD, Figures 5.10.5c-1 through 5.10.5c-5 clearly document a daily temperature fluctuation of at least 2 ºF specifically in the lower Basin. This data was reasonable justification for EPA and MassDEP's reasoning regarding the 2º F allowance in the temperature limits. Also, extensive vertical profile data submitted by the permittee and listed in the DD documented cooler water temperatures with depth at various locations in the lower Basin. This site-specific supporting evidence refutes any claim that guess work was involved in the formation of protective temperature limits.

Moreover, the permit requires real-time, continuous, in-situ temperature data from the lower Basin, along with additional temperature profiles to construct thermal contour maps of the lower Basin. EPA and MassDEP will evaluate the 1.1 ºC (2 ºF) allowance over the protective temperature once this comprehensive temperature database has been analyzed to confirm whether past environmental data reasonably predicted the expectation that enforcing 83 ºF will yield sufficient habitat at 81 ºF.

As stated previously, EPA and MassDEP continue to believe that the 2 ºF compliance margin on which the temperature regime relies outside the summer season is fully supported by the water quality datasets examined. But after EPA and MassDEP received and fully reviewed temperature data for the summer of 2005, the Permitting Agencies concluded that it was necessary to include a safeguard set of compliance points required to meet the 81º F limit during the summer to ensure that protective temperatures for the BIP are not exceeded in the ZPH.

The Draft Permit established 83 ºF as the compliance temperature within the ZPH based on evidence that the hydrodynamics of the river and the operating practices at the facility would ensure that the protective temperature of 81 ºF would be maintained most of the time in the majority of the ZPH, providing an adequate thermal refuge for alewife. While that assessment may remain valid in most circumstances, the results of the analysis of the 2005 hydrologic data (Hydro Data) submitted by the permittee, as discussed in detail below, raised concerns that under certain lower-flow, thermal water quality conditions and during high levels of output from Kendall Station, there would be insufficient healthful refuge absent a requirement that a maximum temperature of 81 ºF be maintained for certain ZPH stations.

EPA and MassDEP acknowledge that, during the times in question in 2005, temperature readings at a number of these stations were not continuous. Therefore it is possible that temperatures

lower than 81 ºF may have occurred at these stations between readings and that, because temperature readings were not obtained throughout the ZPH, temperatures lower than 81 ºF may have occurred at these times elsewhere in the ZPH. However, based on the 2005 temperature and oxygen profile dataset, either temperatures exceeded 81ºF and/or dissolved oxygen values were below 5.0 mg/L (the Massachusetts Water Quality Standard for Class B waters) at all depths at which these variables were measured at many of the temperature monitoring stations downstream of the Longfellow Bridge in 2005. Judging from the Hydro Data for 2005, this condition frequently existed at monitoring stations in the summer of 2005:

After reviewing recent datasets from Mirant, and from EPA, the Permitting Agencies have determined that a limit of 27.2 ºC (81ºF), at certain ZPH Monitoring Stations, is needed to provide habitat for juvenile alewives during the warmest months of the year. Presented below is the Permitting Agencies' reasoning for increased protection at ZPH Stations 2, 3 and 7.

A review of the available scientific literature was conducted by the Permitting Agencies and results were published in the Determination Document for this permit. In that document, the Permitting Agencies had stated that to provide habitat for juvenile alewives, a maximum temperature of 81ºF would be needed. Due to ordinary temperature fluctuations known to occur in the lower Basin, the Permitting Agencies had stated that a limit of 83ºF at ZPH Stations from June 12 through October 31 would result in water temperatures of 81ºF or below throughout the majority of the ZPH Stations most of the time during the warmer months of the year. EPA and MassDEP expected that the 83ºF limit would provide adequate habitat within the ZPH for both juvenile alewives as well as for the most sensitive inland species, the yellow perch.

The importance of the 81 ºF temperature to alewives was underscored through the Permitting Agencies' review of Mirant's field studies. An analysis of the 2003-2005 datasets on shoreline seining and push-net sampling for juvenile alosids (see Response C3) demonstrated that, based on the 1977 Federal Guidance, Mirant's thermal discharge had caused "appreciable harm" to juvenile alewives and bluebacks. Upon a more-detailed review of those data, the Permitting Agencies found that the juvenile alewife catch per unit effort of sampling in the lower Basin either greatly diminished or was zero at water temperatures in excess of 81ºF. This analysis of the local, juvenile alewife population and the response of that population to heat, reinforced the Permitting Agencies original findings from the scientific literature that 81ºF was a critical temperature for this species and life stage.

As stated above, the summer time compliance temperature of 83ºF set in the Draft Permit was based on the assumption this limit would yield viable thermal habitat of 81ºF for juvenile alewives throughout most of that area much of the time. The Permitting Agencies have now concluded after analyzing Mirant's 2005 "Hydro" dataset and other relevant information, that it would not be sufficiently protective of the BIP to rely solely on the assumption that a compliance temperature of 83ºF in the ZPH would result in a protective temperature of 81ºF being achieved in a large portion of the ZPH for a majority of the time. Two of the key components of the Permitting Agencies' goals in setting warm-weather permit limits for this facility are to: a) maintain habitat for anadromous and resident fish species within the ZPH; and b) maintain a passageway of viable habitat along the Boston shoreline and through the old boat locks that lie

adjacent to the Museum of Science so that fish passage throughout the lower Charles is not blocked by Kendall Station's thermal plume. Mirant's 2005 dataset, in combination with the other findings reviewed above, demonstrated to the Permitting Agencies that a temperature limit of 81ºF at key ZPH stations, was necessary to meet these goals. A review of some of the findings from the Permitting Agencies' analysis of the 2005 Hydro dataset follows.

Temperatures greater than 84.2ºF were seen at the following stations, all of which are beyond the ZD (information taken from Mirant's 2005 Hydro dataset): **a)** at the **Above Locks** Station on July 21 at depths of 6 ft and above; **b)** at the **Museum** Station on that same date at depths of 9 feet and above; and at the same station on August 9 at depths of 3 feet and above; **c)** at the **Old Locks** Station at all depths monitored (i.e., surface to 9 ft.) on July 21; at that same station on August 9 for depths of 12 feet and above (i.e., 12 ft., 9 ft., 6 ft., 3 ft., 2 ft. and surface) and on August 11 at that same station at depths of 6 ft. and above; **d)** at the **Old Channel** Station on July 21 at monitored depths of 6 ft and above; at that same station on August 9 at monitored depths of 12 ft. and above**;** on August 15 at that same station at monitored depths of 6 ft. and above; **e)** at the **Boston** Station, July 19, at depths of 3 ft and above; at that same station on July 20 at monitored depths of 9 ft and above; on August 9 at that station at the 2 ft. depth, the only depth monitored that date; on August 11 at that station at all monitoring depths from the surface down to 9 ft.

At issue here are two items. First, temperatures higher than the NOAEL temperature for juvenile alewives of 84.2 ºF were measured at stations within the ZPH. Second, on certain occasions, there appeared to be no refuge for juvenile alewives from potentially toxic temperatures and/or low oxygen concentrations (i.e., oxygen concentrations below the Massachusetts Water Quality Standard for warm waters of 5.0 mg/L for oxygen) at certain stations. On these occasions, temperatures exceeded the 84.2 ºF value at each depth for which monitoring occurred (monitored depths were typically distributed at the surface and at depths below the surface of 2 ft., 3 ft., and at three foot intervals below this level as well as a near-bottom depth) and/or oxygen concentrations at monitored depths fell below 5.0 mg/l.

This apparent loss of any refuge for juvenile alewives may have occurred frequently at stations within the ZD, but also appears to have occurred within the ZPH. For example, on about 44% of the monitored dates between June 30 and August 29, conditions at the Shallow Diffuser Station (a station within the ZD) fell into this category, although at this particular station, monitoring was only conducted at depths down to six or nine feet. The apparent loss of any refuge also occurred at the Museum and Old Channel Stations, both of which are located within the ZPH. In stark contrast to this are the data from two stations located far upstream from the discharge, the B.U. Station and the Hyatt Station. Water temperature measurements taken at these stations never reached the 84.2ºF level, providing evidence that temperatures causing acute or chronic impacts within the lower Basin were a result of the Kendall Station thermal discharge and not due to ambient conditions in the lower Basin. There should be no argument that the high temperatures described above, which were primarily found downstream of the Longfellow Bridge and which were not found upstream, were caused by Kendall Station's release of very warm water into the Basin.

Beyond raising toxicity concerns for stations outside the ZD, Mirant's 2005 Hydro dataset also leads the Permitting Agencies to believe that there was little viable habitat for juvenile alewives at critical ZPH stations throughout the warmest months. Over much of the July-August 2005 period at the stations monitored, no refuge to juvenile alewives appeared to be available from: a) temperatures above 81ºF; and b) oxygen concentrations below 5.0 mg/L, at any of the monitored depths. A list of stations and dates during which there appeared to be no refuge from these conditions is provided below:

Table C44_CZM_CLF-1 sets out the locations at which temperature and dissolved oxygen readings were taken by Mirant in 2005. The "A" stations are located within the area delineated within the permit as the Zone of Dilution (ZD). The "B" stations are located within or on the border of the area delineated as the Zone of Passage and Habitat (ZPH). The "C" stations are substantially upstream of the facility's cooling water discharge. Water temperatures in the lower Basin in 2005 were so high that they exceeded the juvenile alewife NOAEL temperature (84.2ºF; see discussion of the Otto, *et al*., research in Section 5.7.3c of the DD) at stations within the ZD (temperatures above 100ºF were measured by EPA in 2005 and 2006; see Table F4.P2.CLF-1 and -2 in "Response to F4 (part 2) and Related Comment"), but also at stations in the ZPH. Although the permit grants a variance from the state water quality regulations that allows Mirant to raise temperatures inside the ZD to levels known to induce toxicity, the data documents that during 2005 Mirant's operations regularly pushed temperatures to toxic and avoidance levels in the ZPH.

Table C44_CZM_CLF-1. List of monitoring stations, number of monitoring dates and percentage of those dates in the July-August sampling period for which, at each monitoring depth, the following condition existed: a) temperature exceeded 81ºF; and/or b) dissolved oxygen concentration (D.O) was below 5.0 mg/L. Data were taken from the "Hydro 2005" dataset sent to regulators by Mirant in April, 2006.

Monitoring Station	# dates with all depths monitored > 81ºF and/or D.O. <5 mg/l	# of dates with monitoring during July-Aug.	% of events with >81ºF &/or < 5mg/L D.O at all depths
A. (Stations Expected Within The Zone of Dilution)			
Shallow Diffuser	12	15	80%
Deep Diffuser	3	9	33%
Mid-Channel	2	5	40%
Station C	5	9	56%
B. (Stations Expected Within or On The Edge of The Zone of Passage and Habitat)			
Above Locks	2	9	22%
Museum	3	9	33%
Old Locks	6	13	46%
Old Channel	6	9	66%

Boston	9	15	60%
C. (Stations Substantially Upstream of Kendall Station's Discharge)			
MIT	1	13	8%
Hyatt	0	14	0%

At two stations, the Boston and Old Channel Stations, refuge from high temperatures and low oxygen did not appear to exist on 60% or more of the occasions when monitoring was conducted. By contrast, levels of these two important habitat variables at the MIT Station, located about 0.8 miles upstream of the discharge (but still influenced by the thermal plume, judging from the Hydro dataset) were poor on only one of the thirteen dates when monitoring was conducted. Note also that the Hyatt Station, the "ambient" reference station farthest removed from the discharge, had no dates in which temperature and dissolved oxygen conditions would have been considered unacceptable at all depths. Temperatures at the Hyatt Station exceeded 81ºF on only one of the monitored dates and this occurred only at one of the monitored depths (the surface) when the water temperature there rose to 81.1ºF. Similarly, temperatures reported for the B.U. Station only surpassed the 81ºF point on one of the monitoring dates when temperatures rose to 82.2ºF and 82.3ºF at the surface and at the 2 ft. depth, respectively, in 2005. On these occasions when high temperatures were measured in the upper water column at the Hyatt and B.U. Stations, a refuge with adequate dissolved oxygen concentrations was available at both stations at depths below those with the high temperatures. These data demonstrate that thermal habitat conditions improved as station distance from the thermal discharge increased during the summer of 2005.

The Permitting Agencies contend that temperatures in excess of 81ºF and/or low oxygen conditions (i.e., below the State Standard of 5.0 mg/l for warm waters) would have been stressful to the bulk of the juvenile alewife population. This condition would have been especially problematic for juvenile alewives that were in the early portion of this life stage and were small in size due to their relative inability to swim long distances in a short time and thus escape widespread conditions of poor habitat. The Permitting Agencies also contend that these conditions would have limited the free movement of juvenile alewives from areas downstream of the Old Boat Locks to areas upstream of the Longfellow Bridge. Conditions such as those seen at many of the ZPH stations over the summer of 2005 are also expected to have eliminated the thermal refuge for yellow perch, the resident, most thermally-sensitive fish species, in areas downstream of the Longfellow Bridge and are expected to have blocked their movement to areas at upstream sites.

Conditions outlined in the Final Permit for Stations 2, 3 and 7 address several of the physical and behavioral realities regarding juvenile alosids, American shad and yellow perch. Alosids, American shad and yellow perch all feed well below the surface in the daytime. These fish need a thermal refuge below the surface that has dissolved oxygen levels that are adequate for growth and survival. At night, juvenile alosids and American shad rise to the surface to feed. (See the DD, Section 5.7.3i,). In order to do so, they need temperatures at the surface that will not induce

avoidance. Due to their relatively small size (about 1 inch in length) when they are in the early portion of the life stage, juvenile alosids are not able to travel great distances to feed in one section of the lower Basin in the daytime and a different section at night. Thus, adequate habitat must be available at each of the ZPH stations throughout the day and night to allow these fish to move up and down in the water column throughout the summer season.

Water quality conditions should also allow fish passage upstream and downstream past the Kendall discharge. The only route that will allow this passage, without mandating movement across Kendall Station's thermal plume, is through the old boat locks adjacent to the Museum of Science and along the Boston shoreline. Juvenile alewives (and/or fish of other thermally-sensitive species) that find themselves downstream of the old boat locks adjacent to the Museum of Science should not be prevented from moving upstream because they are repulsed by Mirant's buoyant thermal plume and the low dissolved oxygen concentrations found below it. The 81ºF temperature limit at Monitoring Stations 3 and 7 will ensure a thermal passageway throughout the warmest months of the year. By establishing an 81 ûF temperature compliance limit at either the six or twelve- foot depth during all of the four-hour daytime periods, the Permitting Agencies will ensure that a thermal refuge is available during those periods at depths normally inhabited by juvenile alosids during the daytime. The 81ºF nighttime limit at the 2 ft. depth during at least one of the two four hour night time blocks will ensure that juvenile alewives are able to access the surface to feed throughout the ZPH during at least half the night. In addition, by requiring the permittee to meet the 81ûF temperature for one of the four-hour night time periods, EPA and MassDEP expect that a thermal refuge from temperatures in excess of 81ûF will be provided at lower depths during the other night time period at the identified monitoring stations.

Therefore, EPA and MassDEP have added the 81 ºF compliance points to ensure that the permit achieves the in-stream temperatures which the biology indicates are necessary to protect the BIP. The new hydrological data raised enough of a concern about how the lower Basin might respond to extended periods of Kendall Station operating at high capacities, that the Permitting Agencies concluded these refined compliance values are advisable to ensure that the BIP has a reliable refuge from inhospitable conditions. As explained at the beginning of this response, EPA and MassDEP expect that this new set of targeted temperature requirements will largely track what would happen as a result of enforcing 83 ºF across the ZPH. If the compliance points in the ZPH closer to the discharge plume are at 83 ºF or below, the compliance points along the outer margin of the ZPH will likely meet the 81 ºF temperatures now provided for in the permit. So EPA and MassDEP do not expect these new compliance temperatures to make a substantial change in the effect of enforcing the 83 ºF temperature on which the draft permit exclusively relied during the summer to achieve 81 ºF. But these new limits will ensure that some refuge is available if an unusual combination of events arise that confounds the assumptions EPA and MassDEP made in assuming that enforcing 83 ºF would consistently protect the BIP.

Comment C45: Temperature Limits for Alewife Juvenile Stage Based on Incorrect Data. Section 5.7.3i and j of the DD suggests that a protective temperature would be expected to be below 84.7º F., based on 24-hour exposure tests in the lab. This is inconsistent with the results of the Lindenberg study referenced at the end of Section 5, which found a thriving alewife

population in central Massachusetts where juveniles voluntarily occupied waters up to 32.2 °C (89.9 °F). Given these data, the Determination Document fails to justify why both a lower threshold and a 4-hour averaging period are necessary to protect the BIP.

Response to C45: The 84.7 ºF value is a toxicity endpoint derived from a 24-hr. test exposure conducted by Ecological Analysists (EA, 1978). EA derived estimated that about 5% mortality would occur to young-of-the-year alewives at that temperature. The Permitting Agencies state in the DD that this temperature is too high for the ZPH because it was shown to induce toxicity. In addition, the DD states that this temperature was expected to induce avoidance in juveniles and, as a result, is too high for the ZPH.

The Lindenberg (1972) work is discussed in Response C34. Briefly, no-follow-up information was collected by Lindenberg to evaluate the result of the one-time, high-temperature event on the population. Nor did Lindenberg suggest that temperatures in the high-80s (ºF) could be sustained by the alewife population. Use of the phrase "voluntarily occupied" is misleading, because dissolved oxygen below those areas occupied was very low; the fish may have been responding to a habitat squeeze and had no choice. The title of this paper is "Seasonal depth distribution of landlocked alewives, Alosa pseudoharengus (Wilson), in a shallow, eutrophic lake." The key term here is "eutrophic". The author states that dissolved oxygen levels in the cool, hypolimnetic waters were at or near zero in the summertime. The author had only one capture event at a temperature above 80.7 ºF, but concludes that "The fact that Congamond alewives could be caught consistently in surface waters of 25 to 32 ºF (Table 1) indicates that they have been forced to adapt by lack of oxygen at cooler levels during the summer."

Another interpretation of the Lindenberg one-time observation is that the lack of oxygen forced these fish into extremely warm water, which was stressful, and may have resulted in acute or chronic toxicity. Only once was there a recorded incident at a temperature in excess of 26.7 ºC (80.1 ºF) in the Lindenberg field observations. No follow-up information was collected regarding the physiological or behavioral effects of this one-time high exposure.

Comment related to C45 from MA CZM: In light of the site-specific information and published recommendations in the literature, CZM recommends using 27.2º C (81º F) as the temperature limit within the ZPH that will be protective of the normal development and biological needs of juvenile alewife. This temperature limit should be met at all points in the ZPH that are to be considered viable habitat for juvenile alewife.

Response to Comment related to C45 from MA CZM: See Response Related to C44 from MA CZM and CLF for details concerning the 2 ºF compliance buffer and how that is being applied in the Final Permit. As discussed in C44, EPA and MassDEP are adding compliance requirements to enforce 81 ºF at key points and times to assure refuge for the BIP along the Boston side of the Basin.

Comment related to C45 from CLF: Peer reviewed habitat suitability models have been developed by scientists with the US Fish and Wildlife Service for juvenile river herring and American Shad. During the summer and fall, optimal temperatures for juvenile alewife were

determined to be in range of 59 to 68 ºF, and for shad 50-77 ºF. Blueback herring were found to be more temperature tolerant, with optimal temperatures between 68 and 86 ºF. The temperatures proposed in the draft permit are not suitable based upon these careful determinations of habitat suitability. The temperature limit of 83 ºF, from June 12 through October coincides with the period during which juvenile river herring and shad should be feeding and growing as they make their way to the sea. Juvenile alewives normally exhibit a pattern of behavior in which the surface waters are used near dawn and dusk. However, under the permit the surface water in the Basin could be at least 15 ºF above the optimal range in the ZPH (83 ºF , 4 hour average) and even higher in the ZD. Thus, juvenile alewife will clearly be subjected to marginal habitat conditions if they enter the surface waters of the lower Basin; temperatures of 77 ºF and above are also known to result in avoidance behavior in alewives.

Response to Comment related to C45 from CLF: EPA disagrees with this approach. There is no doubt that relying exclusively on scientific literature to determine protective temperature limits is one way to arrive at a protective approach to protecting the BIP. However, scientific literature and reference material at best identify a range of temperature tolerance limits and a general time period when a species life stage is expected in a region. Without taking site-specific information into consideration to establish representative acclimation temperatures and spawning timing, for example, the permit limits could be overly conservative or not sufficiently protective.

In order to fully respond to CLF's comments and evaluate the range of protective water temperatures and time periods proposed by CLF, EPA graphically represented the limits and time periods from their comments alongside the limits and time periods from the draft permit. Figure C45_CLF-1 shows a year long maximum temperature of 75 ºF for yellow perch larvae and adults, as opposed to the 83 ºF limit in the draft permit. Adult spawning and egg development temperatures, as well as adult reproductive temperatures, were at times 10 ºF lower than the permit limits.

Figure C45_CLF-2 also shows that limits proposed by CLF were from 4 to 17 ºF lower than those included in the draft permit.

When the lowest temperature limit from CLF for either the resident species or the anadromous species was assembled into one year figure, these CLF limits were consistently below the draft permit values (Figure C45_CLF-3).

In order to compare the CLF limits to approximate ambient conditions in the lower Basin, the CLF temperature limits were next graphed alongside the maximum, average, and minimum hourly average intake temperatures from Kendall Station from 1994 through 2002 (Figure C45_CLF-4). As fully discussed in the DD (Section 5.9.2), these temperature values were the only available proxy for a general approximation of ambient temperature conditions in the Basin, with the exception of the time period from June 15 through August 31. The Permitting Agencies wish to note that during this summertime period (June 15 through August 31) there may be substantial re-entrainment of the thermal plume into the Broad Canal. During this time intake temperatures have been documented to be above ambient river temperatures recorded upstream

(see Response C5).

A visual inspection of the graph shows that with the exception of a two week time period in January, a three week time period in February and the majority of the month of October, the limits proposed by CLF were always below the highest hourly average ambient Basin temperatures seen from 1994 through 2002. When looking at average hourly ambient temperatures from 1994 through 2002, the CLF limits are below average ambient conditions from approximately mid-March through mid-June, with the exception of a brief time period in mid-April. Late June through mid-September also showed limits below ambient conditions, as well as all of November and the first half of December. Even when the lowest recorded ambient temperature among any of the years from 1994 through 2002 is examined, there are still considerable periods of time (May through the middle of June, late August through mid-September and the majority of November) where the CLF proposed temperature limits are lower than minimum ambient temperatures (Figure C45_CLF-4).

During time periods when the limits are below documented ambient water temperature conditions, under the current compliance regime, Kendall Station would be unable to add any waste heat to the ZPH. In many other circumstances, the CLF temperature limits are similar enough to the ambient conditions to require Kendall Station to maintain Δ T levels well below the 5 ºF limit.

There is no question that the temperature limits proposed by CLF, if enforced, would be protective of the BIP. The question EPA must evaluate is whether such low temperatures are "necessary" to protect the BIP. If the higher temperatures EPA and MassDEP have analyzed would still be protective of the BIP, Mirant has the right to a variance under section 316(a) of the CWA at those temperatures. EPA and MassDEP are satisfied that the temperature limits established in the Final Permit are fully protective of the BIP.

Comment C46: Summary of Temperature Limits and Time Periods for Anadromous Species Protection. Section 5.7.3k of the DD summarized the temperature and time limits proposed for protection of the selected anadromous species. As described in the detailed comments above, these temperature and time limits are based on inappropriate data or analyses, overly stringent and inconsistent with ambient data and should be revisited.

Response to C46: The detailed responses to Mirant's general Comment C46 are provided in previous sections of this document.

Comment C47: Proposed Maximum Temperature and Time Limits, Combined with Refusal to Authorize Proposed Diffuser Fail to Ensure Desired Goal of Protection and Propagation of BIP. Section 5.5.2 of the DD states "[t]he establishment of maximum water temperatures in the permit for the receiving water meets the desired goal of protection and propagation of the balanced indigenous fish populations." The Determination Document fails to explain how the proposed temperature and time limits meet this desired goal in the absence of approval of the proposed new outfall and diffuser. For example the permit does not ensure:

- Maintenance in the winter of sufficiently warm, well–oxygenated deep water with salinity below 14 ppt to support a balanced indigenous population of yellow perch;
- Maintenance of the Permit-mandated 50 ^{o}F chill period for yellow perch gonadal maturation through mid-April without jeopardizing the timely start and build-up of the temperatures in the 50s that appear associated in this system with vigorous progression of the alewife run;
- Maintenance of early June temperatures in the mid to upper 70s that were associated in 1999 with high-end larval densities and growth, YOY abundance, and returning adult year class strength of alewives; and
- Maintenance of adequate overall algal biomass to support the food base for the river herring BIP.

In each of these instances, EPA should analyze whether the temperature limits in the Draft Permit, combined with the refusal to authorize the proposed new outfall and diffuser, would make it more difficult to achieve the objective of maintenance of the targeted BIP.

Response to C47: The permittee takes the position that the diffuser is needed to allow for specific temporal habitats to occur with regard to salinity and dissolved oxygen. EPA and MassDEP do not embrace a fundamental assumption implicit in this comment. Mirant appears to believe that the heat discharge from the Kendall Station can be used to orchestrate a man-made temperature regime to enhance conditions for the BIP. Not surprisingly, all of Mirant's "enhancements" involve adding heat to the lower Basin. But EPA and MassDEP believe that the goal of this permit is to try to protect as much of the natural temperature regime of the lower Basin as possible, consistent with the best science available to determine how much additional heat the Station can add while still protecting the BIP.

The first man-made habitat Mirant recommends is the "maintenance in the winter of sufficiently warm, well-oxygenated deep water with salinity below 14 ppt to support a balanced indigenous population of yellow perch." Please see Response C18. Yellow perch do not need warm water in the wintertime. They need water below 50 ºF. Although the diffuser would purportedly assist in lowering the salinity and increasing oxygen, EPA and MassDEP have other concerns with the diffuser that are addressed elsewhere in Section E of this document.

Mirant asks how the <50 ºF chill period is to be maintained without jeopardizing the timely start and build-up of temperatures in the 50s that appear associated with vigorous progression of the alewife run. Mirant's comment seems to suggest that it is necessary to heat the lower Basin in the spring to jump-start the herring migration with warmer temperatures than the river would reach without anthropogenic influence. EPA and MassDEP support actions which allow natural ambient conditions to influence the aquatic habitat as much as possible, rather than attempt to artificially warm or cool the lower Basin.

The permittee questions how the maintenance of early June temperatures in the mid-to-upper 70's (ºF) will be achieved. These temperatures were associated in 1999 with high-end larval densities and growth, YOY abundance, and returning adult year class strength of alewives. A discussion of larval densities and temperature has been presented in the DD and in Response

C44. EPA and MassDEP plan neither to heat or cool the Basin, but to allow temperatures to fluctuate in as natural a manner as possible.

The permittee questions how an adequate overall algal biomass will be maintained to support the food base for the river herring BIP. There is a concern by EPA and MassDEP that warm temperatures combined with high phosphorus in the lower Basin have been associated with cyanobacteria (blue-green algae) blooms. This occurrence can negatively affect zooplankton populations (see discussion of zooplankton in Section 5.8.2l of the DD). Zooplankton are one of the primary foods of river herring and American shad larvae and juveniles. The concern of EPA and MassDEP is not how to maintain an adequate biomass, but how to limit excess algal growth in the lower Basin to protect the food supply for the BIP. The lower Charles Basin is already considered an impaired waterbody by DEP and EPA and has been listed as such for organic enrichment, noxious aquatic plants, low dissolved oxygen and other constituents (see Section 2.5 of the DD).

Comment related to C47 from CRWA: With respect to a BIP, CRWA does not agree that these temperatures are protective. CRWA is very concerned that the high temperature limits proposed in this permit will result in death or disruption/prevention of breeding of these organisms. EPA and MassDEP should explain how the areal extent and temperatures of the mixing zone/zone of dilution are protective of aquatic life. A population dynamics model should be constructed to evaluate Mixing Zone impacts in combination with intake effect and habitat loss due to the high temperatures.

Nor do we feel that the aquatic life in the lower Charles is "balanced". There is virtually no benthic community, there are blue-green algal blooms and the system is highly eutrophic. The Massachusetts DMF estimates the carrying capacity of the Charles River for river herring to be 400,000 fish per year, much higher than the 45,000 (including 8,000 alewife) counted in 2002 by the permittee. Comment C47, Comment C26 (CRWA)

Response to Comment related to C47 from CRWA: For all the reasons explained in response to previous comments, EPA and MassDEP maintain that based on the full body of information available, the temperature limits included in the Final Permit are protective of the BIP going forward. A comprehensive monitoring program will document the extent to which the Station influences the habitat of the lower Basin.

Comment C48: EPA Misapplication of Scientific Literature in Characterizing Biological Effects Associated with Temperature Changes in Lower Basin. In several instances in the Determination Document, the EPA appears to have misapplied data in the literature cited in characterizing biological effects associated with temperature changes in the lower Basin. Several examples follow.

Section 5.8.2e of the DD discusses laboratory studies and field observations of landlocked populations of Great Lakes alewives. As noted elsewhere in these comments, anadromous

alewives, such as those of the Charles River, would have adapted to wider ranges of Delta T than landlocked populations in the Great Lakes. The attempted extrapolation of the Great Lakes results is inappropriate and misleading.

Section 5.8.2i of the DD speculates that during low flows out-migrating fish may experience cold shock. This is unlikely to be significant, if it occurs at all, for several reasons. First, under low flows the fish can only out-migrate voluntarily. This occurs when the dam operators allow mixing in the sluices between the river and the harbor. This only occurs for brief periods each day when flows are low. When flows are higher (lessening the Delta Ts), the sluices are opened for longer periods and more mixing of the waters and out-migration take place. In addition, out-migration occurs over a wide range of temperatures (about 25°F) spanning the period from mid-summer to mid-fall.

The Agencies should evaluate how the successful runs of alewives are sustained in the Monument River when those out-migrating fish upon exiting the river to the Cape Cod Canal may encounter not only a Delta T leaving the river, but a second up-to-20°F Delta T when the tide stage is such that they encounter the abrupt front of Cape Cod Bay water that is up to 20°F colder than the Buzzards Bay water it replaces.

Section 5.8.2k of the DD states that there is a lack of data ("little or no evaluation") regarding impacts of Kendall Station's discharge on adult and young alosids in the Charles River. Mirant disagrees. While there is little "pre-operational" data before Kendall Station commenced operating in the 1950s, there is an abundance of recent data, which directly address the impacts in question by comparing abundance and distribution of the fish at different temperatures and under different flow conditions. Specific opportunities for comparison, some of which have been highlighted by Mirant Kendall in past correspondence on this record include:

- Spawning migration of adults, monitored by gill net and tagging studies in warm springs 1999, 2002, and 2004 compared to cool springs 2000 and 2003.

- Reproductive success, monitored by ichthyoplankton collections in 1999, 2002, 2003 and 2004.

- Distribution and development of YOY fish, monitored by beach seine in 1999, 2002, 2003 and 2004, plus gill net and push net in 2003 and 2004.

- Exit of YOY from the system, monitored by beach seine in 1999, 2002, 2003 and 2004, gill net and push net in 2003 (ongoing in 2004).

- Evidence of year class success based on age distribution of returning adults, including fish from the 1998, 1999, 2000, and now 2001 year classes.

Based on these studies, Mirant would assert:

1. Despite numerous temperature exceedances throughout 1999, Mirant Kendall's sampling demonstrated an abundance of every life stage from larvae through returning adults relative to any other year after river-wide exposure to temperatures in the mid- to-upper 70s throughout early June and about 15-20% exceedances of 83 ^{o}F (up to 85 ^{o}F) in the ZPH between June 12 and August 31.

2. The Draft Permit specifies that a 72 ^{o}F 4-hour block thermal limit is needed to protect alewife reproduction for the first week in June. The Determination Document fails to explain how 100% exceedance of that threshold in 1999 could plausibly be associated with *Alosa* larval densities in the ZPH of more than 1,500 per 100 cubic meters on June 8, followed by greater abundance of juvenile alewives in July 1999 than in any other sampling year.

3. Age analysis of 2004's returning adult alewives shows much greater percentage abundance of three-year-old fish from the 2001-year class than of 4-year-old fish from the 2000 year class. MK Comment Ex. No. C23-2. The Determination Document fails to explain how the 2001-year class could so predominate over the 2000-year class, given the number of thermal exceedances that would have occurred in 2001 compared to the much cooler 2000. Thermal conditions during the usual peak timeframe of the alewife run in 2001 included 11 days in early May with temperatures between 68 ^{o}F and 72 ^{o}F at the Broad Canal intake; only 3 days were that warm in 2000. Between June 12 and August 31 in 2001, there were about 10% exceedances of 83^{o} F at the Kendall intake (up to 86 ^{o}F). There were no such exceedances in 2000.

Like 1999, the other relatively abundant year class, the alewives born in 2001 had a prolonged period (in this case 6 weeks from end of April to mid June) to remain in the basin and grow without a major flushing event of sustained flows greater than 400 cfs. The 2000 year class experienced a major flushing event at what was likely the worst time, early to mid June, when alewife spawning was likely complete but the fish were too young to resist advection. As shown in the Table below, larval densities in the Harbor increased by tenfold, from about 5% to more than 50% relative to those in the lower river before and after this June episode. The increase would be even greater after accounting for the dilution in the Harbor due to the Tidal water exchange.

Alosa Larval Densities in the Lower Charles and Boston Harbor Before and After June 2000 High Flow Event

Time Period	Avg. Waltham Flow For period (cfs)	Mean Alosa density at Museum at end date (#/100m3)	Mean alosa density at Harbor at end date (#/100m3)

May 16 - 23	431	91.4	4.8
May 24 - 31	429	106.7	0.7
June 2 - 7	391	167.7	18.7
June 8 - 20	597	43.9	27.5

- The thermal conditions (including Kendall Station heat loads over 50% in 2003) between June 12 and August 31 in 2002 and 2003 exceeded the proposed thermal limits in the Draft Permit on a number of days, yet abundance of alosid larvae and YOY alewives compared favorably to that of the much cooler similar flow year, 2000. As stated above, the year 2000 had no exceedances of 83° F at the plant intake the entire summer, between June 12 and August 31. The year 2002 had exceedances of 83° F on 37% of the days in the proposed ZPH (up to 88° F) and 11% (river-wide) of the days between June 12 and August 31. The year 2003 had exceedances of 83° F on 20% of the days in the ZPH (up to 86° F) between June 12 and August 31.

- The densities and lengths of larval alosids at specific points in the season (early June 1999 and mid-to-late May, 2004) were greater than in all the other sampling years (2000, 2002, 2003) in contrast to the Draft Permit thermal limits' implication that the heat loads (e.g., 90% in mid April 2004) and/or temperatures immediately prior to those collections were high enough in early June 1999 and mid-May 2004 to cause appreciable harm.

- The frequency of occurrence of YOY alewives in early summer beach seine collections (July early August) were much greater in 1999 and 2004 than in any of the other sampling years (2000, 2002, 2003), despite the Draft Permit thermal limits' implication that the heat loads in April 2004 and temperatures prior to those collections in early June 1999 and mid-May 2004 were high enough to cause appreciable harm.

Response to C48: The permittee asserts that in a number of places in the DD, EPA appears to have misapplied data from the literature in characterizing biological effects associated with temperature changes. The first of these is that anadromous alewives would have adapted to wider ranges of delta temperatures than those in the Great Lakes. Thus, it is inappropriate to use data from the Great Lakes populations to evaluate delta temperatures. This is unsupported conjecture on the part of the permittee. Reasons for using the Great Lakes toxicity data are outlined in Section 5.8.2e of the DD. Notably, EPA and MassDEP are concerned that, while migrating herring may appear to be more robust than their land-locked counterparts in the Great Lakes, it is equally possible that the combined stress of going through both the abrupt temperature change and abrupt salinity change measured on either side of the New Charles River Dam and Locks would stress the migrating population as much or more than a land-locked population experiencing a possibly less severe temperature change without any accompanying salinity change.

Mirant states that in Section 5.8.2i on Cold Shock to out-migrating fish, there is speculation that during low flows, out-migrating fish may experience cold shock. However, Mirant asserts this is likely to be insignificant because fish can only out-migrate voluntarily. Mirant contends that during high flows, there will be much mixing in Boston Harbor, mitigating the abrupt change in temperature. Mirant instructs EPA and MassDEP to evaluate how the alewives in the Monument River adjust to large temperature changes from Buzzards Bay and Cape Cod Bay.

EPA and MassDEPs' concern is that out-migration occurs throughout the late summer and fall. If there is a great difference between Boston Harbor temperatures and those to which juveniles are acclimated in the lower Charles, as water and fish are discharged to the Harbor, the warm water will rise. River water from the Charles is both warmer and much less saline than Boston Harbor water. Both attributes cause this river water to be much more buoyant (less dense) than the water in Boston Harbor. As a result, EPA and MassDEP expect that the Charles River water will not immediately mix to a great extent with the Boston Harbor water. However, both juvenile and adult alewives seek a relatively dark "isolume" (range of light concentrations). They are thought to do so to avoid visual predators. This behavior brings them well away from the warm surface waters into the much cooler depths of Boston Harbor. Thus, the concern for cold shock from too great a temperature difference is a real concern to EPA and MassDEP. Although it might be said that the fish out-migrate voluntarily, these fish have no estuary in which to gradually become acclimated to cooler temperatures. They simply move through the dam structure into the waters of Boston Harbor. The minimal amount of mixing of river water and Boston Harbor water which has been observed immediately downstream of the dam in no way replicates the wide expanse of mixing that takes place in a healthy estuary. The permittee did not present a tracking study accompanied by a chronic toxicity evaluation on alewife juveniles existing in the Monument River, and the Permitting Agencies have found none in the literature. Therefore, EPA and MassDEP have no basis for evaluating alewives in the Monument River.

Mirant disagrees with the statement (in Section 5.8.2k of the DD) that there is a lack of data regarding impacts of Kendall Station's discharge on adult and young alosids in the River. Mirant states that, despite numerous exceedances throughout 1999, there was a greater "abundance of every life stage from larvae through returning adults relative to any other year." The company states that the determination document fails to explain how large exceedances of the 72 ºF threshold in June could be associated with high alosa larval densities followed by greater abundance of juvenile alewives in July 1999 than in any other year. Mirant continues with other documentation that exceedances of certain permit limits occurred, yet there appears to be no problem with alewife populations in the lower Basin. Mirant uses the term "relatively abundant year class" to refer to alewives born in 1999, 2001 and also states that the frequency of occurrence of YOY alewives in "early summer" beach seine collections were greater in certain years when a number of temperature exceedances occurred. A number of other field data are referenced.

Year-class success is not simply a function of one variable. Models used by the U.S. Fish and Wildlife Service to assess habitat require evaluation of many variables. A decrease in a particular variable during one of the life stages may be accompanied by an increase in that same variable

during the same year. Mirant attempts to show that although there were exceedances of temperature limits during a particular period in June or August, the success of a particular age-group was affected differently than expected.

In order to evaluate temperature effects on the population of alewives in the lower Basin it is best to begin with an overview of population trends over time as measured in the field monitoring program conducted by Mirant.

Larval data: The permittee failed to present information on alewife larval stage densities to EPA and MassDEP. Although Mirant discusses Alosa densities, which includes bluebacks and alewives in the lower Basin, without information specifically on alewife densities, it becomes difficult to tease-out any temperature relationships. This is especially a problem because alewives appear to be present in much-reduced numbers compared to blueback herring. Thus, although the Alosa densities may be correlated with different flow regimes or temperature regimes, the densities of alewife larvae may not, because bluebacks are so much more numerically dominant. Mirant was unable to distinguish between the larvae of alewives and bluebacks. It is true that there were relatively high densities of river herring larvae in 1999, but Mirant was unable to discern whether these were bluebacks or alewives. Thus, it cannot be said that there was an abundance of larval alewife larvae during any particular year.

It must also be pointed out that the 100% exceedance referred to by Mirant is based on the Station intake data. Mirant did not specify in the comment if additional temperature data were used in its assessment. EPA and MassDEP do not agree that there is enough evidence to support the statement that the 72 ºF, 4-hour block thermal limit was actually exceeded 100% of the time for the first week in June, 1999. The intake temperature data used by the permittee to reach this judgment could not accurately reflect the temperatures in all the representative locations and depths specified at the Monitoring Stations in the Final Permit. It is possible that even under the conditions identified in 1999, a sufficient number of Monitoring Points at the cross sectional area of the lower Basin at proposed Monitoring Stations 3, 4, 5 and 6, and at other required monitoring locations, may have met the four hour average temperature limits at sufficient depths to result in Kendall Station remaining in compliance. In this way, a sufficient volume of the lower Basin may have maintained protective temperatures. EPA and MassDEP make this point as a reminder that water temperatures at or above the maximum temperature limits can been observed in parts of the lower Basin without the ZPH being compromised. This issue is also discussed in Response C24 of this document. In addition, as discussed in Section 5.9.2 of the DD, up to a 9 ºF rise in temperature has been noted between intake temperatures and temperatures at the Watertown Dam, and up to a 5 ºF rise in temperature has been seen between stations near the B.U. Bridge and the intake. During low-flow years, intake temperatures are greatly influenced by re-circulation of the discharge plume. Thus, the 100% exceedance figure given by Mirant is also not fully credible until an analysis of the thermal plume re-circulation effects on intake temperature has been presented to EPA and MassDEP. Because 1999 was a low-flow year, EPA and MassDEP expect that there was much re-introduction of discharge water into the intake which may have greatly raised temperatures over the true ambient, upstream temperatures in the Charles.

Mirant suggests that the Permitting Agencies have not given adequate consideration to specific datasets that deal with adult, larval and juvenile river herring. EPA and MassDEP respond that they have thoroughly analyzed each of the datasets available that deal with these life stages, but have come to a much different conclusion than Mirant has regarding the interpretation of these data. Although many of the datasets that Mirant points to in Comment C48 have been discussed elsewhere in the response to Mirant's comments, the Permitting Agencies review and expand on some of those responses below.

Adult data: Based on the gillnet catch over the years 2002 through 2005 (see Tables C43-1 and C43-2 in Response to C43), it appears that the overall entry of bluebacks and alewives into the Charles has declined substantially since Mirant conducted a sonar estimate of stock size in 2002. Mirant estimated in 2002 that approximately 45,000 river herring entered the lower Basin. This was a preliminary assessment by Mirant, and there were a number of questions regarding methods that have not yet been resolved (see Response to C51 Related to American shad from MA DMF and Footnote 1 in Response C23). If the gillnet catch rate is an index of the population size in the lower Basin, which seems a logical assumption, and Mirant's sonar estimate is even a very general approximation of the 2002 river herring stock, then the river herring population has declined from about 45,000 fish in 2002 to about 15,000 in 2005. Both figures are *extremely* low for river herring entry to a major river system. Even taking into consideration that Mirant's stock estimate for 2002 is in error, the gillnet information still indicates substantial declines since 2002.

The river herring population decline roughly follows Mirant's operational increases in heatload to the lower Basin documented each summer from 2002 through 2005 (see Figure B1-3 in Response B1). The Permitting Agencies feel that this interpretation of the adult gill net information is at least as appropriate as that which Mirant has suggested (i.e., that between-year differences in abundance are influenced by warm and cool springs).

Juvenile data: Juvenile river herring can be identified to the level of species, i.e., juvenile alewives can be distinguished from juvenile bluebacks. Response C3 includes a discussion of the alewife juvenile life-stage field data. Based on the analysis of juvenile datasets, the Permitting Agencies determined that both alewives and bluebacks have been subjected to appreciable harm attributable to MKS's thermal discharge.

Over the years that the beach seine sampling program was conducted, alewives essentially disappeared from the daytime samples after about 1999. Nighttime beach seining began in 2002, but only at two stations (Hyatt and Lagoon), and alewives were present in the nighttime samples collected at these stations. A third station (Boston) was added to the nighttime beach seine program in 2005. The alewife catch from these stations is presented in Response to C3 (see Table C3-2 and Figure C3-10).

It is discussed in Response to C3 that nighttime catch per unit effort (CPUE) of alewives at the Lagoon Station, located about 0.6 miles from the discharge, was always much lower than that at

the Hyatt reference station, located much farther upstream (about 1.6 miles upstream from the discharge). In addition, when the Boston Station was added in 2005, the CPUE at that station was even lower than that at the Lagoon Station. The Boston station, at only 0.3 miles distant from the discharge, was nearer to the discharge than the Lagoon Station. Thus, in 2005, when water temperatures in the vicinity of the discharge were at their highest, the CPUE of alewives in shoreline seines decreased substantially with station proximity to the discharge across all three beach seine stations. This pattern mimics that seen in the 2004 and 2005 push-net datasets (also presented in Response to C3), where the density of juveniles for both river herring species declined with station proximity to the discharge.

Juvenile blueback herring collected in the shoreline beach seine samples were typically found in greater numbers during the daytime than at night, which is the opposite diurnal pattern to that seen for juvenile alewives. Therefore, only the daytime shoreline seine data for bluebacks are discussed here. In addition, unlike the clear pattern seen in the push-net data, juvenile bluebacks captured in shoreline beach seine samples showed no particular pattern of increase or decrease in numbers with nearness to the discharge, with the exception of the 2005 beach seine samples. Juvenile bluebacks are more tolerant of high temperatures than are alewives, and mean shoreline seine temperatures measured at times of sampling over the warmest months (July-September) were not exceptionally high (all less than 78ºF) in years prior to 2005.

In 2005, the summertime thermal regime in the lower Basin, in the vicinity of Kendall's discharge, changed substantially. Mean water temperatures over the July-September period at all shoreline seine stations, except for the Hyatt reference station, exceeded 80 ºF. The range in mean temperatures over the time period mentioned at stations downstream of Hyatt was 80.1 ºF to 83.3 ºF. Short-term excursions in temperature at stations near the discharge far exceeded these values. By comparison, the mean temperature at the Hyatt Station was only 78.7 ºF over the July-September period in 2005 and the highest temperature measured at the Hyatt Station over the entire 2005 summer was only 81.1 ºF.

In 2005 the juvenile blueback density pattern from the shoreline seine dataset also changed. Although there was no distinct distance vs. density relationship as that seen in the push-net data, the highest mean density of juveniles (40.2 fish per 1000 square feet of area sampled) over the July-September 2005 sampling period was found at the Hyatt Station, the station farthest from the discharge. In addition, the station closest to the discharge (Boston Station, only 0.3 miles distant from the discharge) had the lowest mean density of juvenile bluebacks (8 fish per 1000 square feet of area sampled) over the time period specified. The patterns of blueback and alewife densities in 2005 suggest to the Permitting Agencies that herring presence was adversely affected by high water temperature.

The Permitting Agencies mention in Response to C3, that the pattern of declines in density seen in the shoreline seine surveys could have been due to differences in shoreline habitat variable such as abundance and quality of food and/or cover. However, the alewife pattern seen in the 2004 dataset and similar patterns in 2005 for both species led the Permitting Agencies to take a closer look at the push-net catch dataset. Push-net data was judged to provide a better signal of

thermal influence than the shoreline seine data because the push-net stations were located in deeper water and were thus much less apt to be influenced by inter-station differences in shoreline habitat.

An extensive review of the push-net dataset is presented in the Response to C3. Briefly, the Permitting Agencies have demonstrated that when the data are collated over the months of highest water temperature (July-September), densities of juvenile bluebacks and alewives decline with proximity to the discharge. In addition, the regression analyses conducted on the data were statistically significant and show that the declines in densities were significantly correlated with increases in water temperature. Based on these analyses, EPA and MassDEP assert that the facility caused appreciable harm to the alewives and bluebacks in the lower Charles over the years 2004 and 2005.

The Permitting Agencies also note in Response to C3 that the total catch of alewives at push-net and beach seine stations was highest in 2005. The Permitting Agencies discuss potential reasons for this. These include the fact that in the early spring of 2005, repairs were made to the fish ladder at the Watertown Dam, and this increased the potential movement of alewives past this barrier, increasing the spawning potential of the population in 2005. The Permitting Agencies contend that, because of Mirant's discharge in 2005, large-scale habitat exclusion occurred and the overall push-net catch could have been much higher in 2005 were it not for the habitat impacts from the Kendall Station discharge. Please refer to Response to C3 for a more detailed discussion of both operational changes at the MDC Dam with regard to fish passage in 2005 and structural changes made at upstream sites in 2004 and 2005.

Although there are some anomalies in the complete juvenile dataset, the weight of evidence leads EPA and MassDEP to conclude that Kendall Station's discharge was responsible for large-scale habitat exclusion to river herring in 2004. Based on these data, Mirant's discussions of differing thermal exceedances during different years appear somewhat moot. Additional analysis by the Permitting Agencies has resulted in field support for the independent finding in the DD that a temperature of 81 ºF is the maximum protective temperature for juvenile alewives. Based on a review of all the field data for juvenile alewives, it is evident that catch rates of juvenile alewives are either greatly reduced or zero at water temperatures greater than 81 ºF.

Based on the discussion above, EPA and MassDEP assert that, contrary to Mirant's contentions, the Permitting Agencies have conducted a thorough analysis of the available juvenile data.

With this background information in place, specific components of Comment C48 by Mirant can be more easily addressed. Mirant provides a list of "recent data" which "directly addresses the impacts in question", i.e., impacts of Kendall Station's discharge on adult and young alosids in the Charles, "by comparing abundance and distribution of the fish at different temperatures and under different flow conditions. Each of these is addressed in turn below:

Mirant: "Spawning migration of adults, monitored by gill net and tagging studies in warm springs 1999, 2002 and 2004 compared to cool springs 2000 and 2003.

Response: Spawning migration, as evidenced by the adult gill-net data, declined sharply in 2003 and remained low in 2004 and 2005.

Mirant: "Reproductive success, monitored by ichthyoplankton collections in 1999, 2002, 2003 and 2004"

Response: As stated in other comments, ichthyoplankton data cannot be used to address impacts to alewives, the target anadromous species, because a) the permittee did not differentiate between blueback and alewife larvae; b) blueback larvae are expected to be more tolerant of heat than are alewife larvae; c) the ratio of alewife juveniles to blueback juveniles caught in daytime beach seines and push-net surveys was so low that at times it was well below 0.1%. Thus, any trends seen in temperature and larvae counts most probably only applies to bluebacks, the more abundant and heat-tolerant of the two species.

Mirant: Distribution and development of YOY fish, monitored by beach seine in 1999, 2000, 2003 and 2004, plus gill net and push net in 2003 and 2004.

Response: Please see discussion above and that in Responses to C3 for the analysis of juvenile river herring distributions in the lower Basin and Response to C44 for a response to Mirant's analysis of juvenile development data.

As explained in Response C3, EPA and MassDEP have found the diminution of habitat as evidenced by the push net datasets for 2004 and 2005 to be an appreciable harm to the juvenile alewife and blueback populations.

Mirant: Exit of YOY from the system, monitored by beach seine in 1999, 2002, 2003 and 2004, gill net and push-net in 2003 (ongoing in 2004).

Response: Alewife catch in push-nets has been extremely low over all years that the sampling program has been conducted. In approximately 237 push- net events in 2003, only five juvenile alewives were captured. These events occurred at stations throughout the lower Basin, from the B.U. Bridge down along both sides of the river, as well as below the discharge and into the Old Locks. By contrast, 6,036 bluebacks were captured. A station-by-station breakdown of push-net data in 2004 and 2005 is presented in Response to C3 (see Table C3-1). Over the July-September period for those two years, the catch rates of juvenile alewives increased slightly, but were still extremely low. Juvenile alewife catch in 2004 was 125 fish over 199 surveys; by comparison, 8,894 juvenile bluebacks were caught in the same surveys. In 2005, the total alewife catch over the 138 surveys conducted in July-September was 183 fish compared to 12,177 bluebacks. Catch rates in the beach seine is discussed above.

Contrary to Mirant's contentions, it appears to the Permitting Agencies that there is reason for *great* concern regarding the alewife population in the Charles and the impacts of Kendall Station operation. The extremely low juvenile alewife catch rate in push-nets over the years that the

program has been conducted is troubling to the Permitting Agencies and generally mimics the low catch rates of adults in gillnets. Habitat losses due to Kendall Station's discharge exacerbate an already difficult situation. The Permitting Agencies are hopeful that the structural repairs to dams and fishways in 2004 and 2005 (discussed in Response to C3), the operational changes implemented by the MDC Dam operators, combined with intake and discharge limitation at Kendall Station will all help the alewife stocks in the Charles to increase.

Mirant: Evidence of year class success based on age distribution of returning adults, including fish from the 1998, 1999, 2000 and now 2001 year classes.

Response: This has been discussed above. Briefly, based on the gillnet catch rate information, the Permitting Agencies contend that both the alewife and blueback populations have declined substantially since 2002. If the catch rate is compared in gillnets during the months of April-June over the 2002-2005 period to the one-time preliminary estimate of adult river herring entry to the Charles (about 45,000 fish in 2002), the results are of concern. The overall catch rate has declined from about 4.2 fish/hour in 2002 to 1.4 fish/hour in 2005. If the gill net catch rate is an index of the population size in the lower Basin, which seems a logical assumption, then the river herring population has declined from approximately 45,000 fish in 2002 to about 15,000 in 2005. Both figures are *extremely* low for river herring entry to a major river system. The decline roughly follows Kendall Station's operational increases in heatload, as reflected by summer heatload values from 2002 through 2005.

Mirant: Based on the studies outlined above, Mirant asserts that they have demonstrated an "abundance of every life stage from larvae through returning adults…after river-wide exposure to temperatures in the mid-to-upper 70s throughout early June and about 15-20% exceedances of 83 ºF (up to 85 ºF) in the ZPH between June 12 and August 31."

Response: EPA and MassDEP have judged that the data do not support Mirant's characterization that "an abundance" of juvenile or adult bluebacks or alewives has been found in the lower Charles at any time since 1999. With regard to the temperature dataset, as described above (see Response to C3), the permittee collected only surface temperature data during these collection events. Stomach content analyses of these fish showed that they were feeding on the bottom along the shoreline. Because the surveys were conducted at depths up to 4 feet, and water temperatures in the summertime often drop with depth (as documented in vertical profiles of water temperature in the lower Basin), it is probable that the actual water temperatures at the depths where alewife juveniles were captured was some value lower than that recorded at the surface. This would lend support to the findings of the push-net surveys, that temperatures above 81 ºF were generally avoided by alewives. No juvenile alewives were captured in any of the 31 push-net sampling events that occurred at temperatures > 80 ºF in the 2004 surveys and catch rates of juvenile alewives in 2005 were greatly diminished at temperatures greater than 81ºF. The permittee is directed to a more in-depth discussion of the shoreline seine and push-net surveys in Responses to C3 and C44. Mirant uses the term "river-wide exposure" and couples this with temperatures in excess of 83ºF (to 85ºF). However, the fish density information coupled with instantaneous temperature measurements show a consistent pattern: the bulk of

juvenile alewives avoided temperatures in excess of 81ºF. Please refer to Responses to C3 and C44 for a more extensive discussion of this information.

Mirant: The DD "fails to explain how 100% exceedance of the 72 ºF threshold" in 1999 could plausibly be associated with Alosa larval densities in the ZPH or more than 1,500 per 100 cubic meters on June 8, followed by greater abundance of juvenile alewives in July 1999 than in any other sampling year".

Response: See Response to C24 and the discussion in this response regarding the potential difficulty in determining with certainty whether the prediction of a "retroactive" temperature exceedance of the ZPH is meaningful in the absence of temperature data collected from relevant Monitoring Points and time averaging utilized (exceedances at more than 50% of the river transect Monitoring Points of Monitoring Stations 3 – 6 or at other Monitoring Stations using a four hour average).

The issues that Mirant goes on to discuss in paragraphs numbered 2-5 in Comment C48 are essentially variations on the arguments Mirant included in the paragraph numbered 1, that Mirant found herring at temperatures which would allegedly violate the permit. EPA and MassDEP believe that the analysis above responding to paragraph 1 adequately refutes the conclusions Mirant presents in paragraphs 2-5.

Comment C49: Speculation Regarding Impacts on Zooplankton is Contradicted by Field Data. In Section 5.8.2l of the DD, the Agencies extrapolate from research by Moore in other northeast region lakes and apply it to the Charles River as support for asserting that zooplankton populations may be adversely affected by the thermal discharge and thereby less of a viable food source for the YOY river herring. This speculation is contradicted by the site-specific data collected by Mirant, and is incorrect for the following reasons:

- The lower Charles River Basin cannot be assumed comparable to the other northeast lakes because it is periodically estuarine, and it is stratified with higher salinity and lower DO as one proceeds to greater depths in the water column.

- Zooplankton densities in Mirant Kendall's collections in the Charles River in the plume area near Kendall Station and at background locations are similar (about 200 organisms per liter); and that number is similar to the densities documented to support the river herring BIPs in other east coast estuaries, including the James, the Hudson, and the Potomac.

- Zooplankton species favored by YOY alewives and bluebacks (based on analysis of stomach contents), i.e., rotifers, cladocerans, copepods, were similarly present in both collections within the influence of and collections not influenced by, the heated discharge. However, only shallow upstream locations contained larvae of benthic insects and clams, which are preempted from the ZPH by the absence of sufficient dissolved

oxygen to support a viable benthic community.

- Feeding YOY bluebacks were consistently captured in comparable densities, whether far from or close to the discharge, at the several push-net stations located between the Harvard Bridge and the Museum of Science at temperatures up to 85° F. This indicates that neither the temperature nor the zooplankton densities at these locations were sufficiently influenced by the discharge to affect the feeding distribution of the fish.

- There was no evidence from cell counts that the numbers of Cyanobacteria (blue-greens) was correlated with heat from the discharge, nor sufficient at any time to adversely affect food availability for the herring.

- Blue-greens were among the stomach contents of the herring. Given these data, and that the temperatures were below the 30-35° C range the Agencies indicate to favor blue greens, the Determination Document fails to explain how the data from the field does or does not support the Agencies' speculation about impact.

Response to C49: Mirant asserts that the EPA and MassDEP discussion on Zooplankton (Section 5.8.21 in the DD) is speculative and contradicts site-specific data collected by Mirant and is incorrect for a number of reasons. EPA and MassDEP cite studies by Moore et al. (1996) that review temperature effects to Zooplankton communities in northeastern U.S. lakes. Mirant outlines six reasons why it feels that EPA and MassDEPs' conclusions regarding temperature effects are invalid for the lower Charles.

1. The first reason is that temperature effects from the Moore et al., studies cannot be extrapolated to the lower Charles because the lower Charles is periodically estuarine as it is stratified and has higher salinity and lower D.O. (at depth).

Response: Fresh water continually moves over the lower Basin even when the system is stratified by salinity and temperature. Within this upper layer, zooplankton and other drifting organisms continue to persist, as evidenced by the plankton sampling conducted by the permittee. Thus, although the lower layer of the Basin has been shown to increase in salinity during most years as the summer progresses, the upper portion remains as freshwater. It is this upper layer that is most important to alosid juveniles, as evidenced by both shoreline seine-sampling and push-net surveys. Moreover, the lower Basin is not "estuarine" in the sense that it behaves like most esturaries. There is no gradual shift of salinity and temperatures in a progression from a marine to a riverine environment. The lower Basin sometimes behaves much more like a lake into which salt water intrudes.

2. Mirant asserts that zooplankton densities in Mirant's collections in the plume area and at background stations are similar (about 200 organisms per liter) and that number is similar to densities documented to support river herring BIPs in other east coast estuaries including the James, Hudson and the Potomac.

Response: EPA and MassDEP's concern regarding the zooplankton communities was not the quantity of the zooplankton as a food source but the quality. Moore et al.'s research found that zooplankton communities that were characterized by large zooplankters, when subjected to temperatures in excess of 77 ºF for 7-10 consecutive days, experienced a substantive change in community structure. Large forms, preferred by alosids for food, were replaced by smaller forms. Thus, the food base of alosids is expected to deteriorate when subjected to temperatures in excess of 77 ºF for 1-1.5 weeks. During the summer, when the lower Basin is a nursery for alosids larvae and juveniles, low river flows become common. It is during these times that the Kendall Station thermal plume can exert the greatest effect on the zooplankton community. The areal extent, duration, magnitude and frequency of high-temperature events in the lower Basin in the vicinity of the discharge may all be increased due to the thermal load released into the Charles River from Kendall Station. Thus, the potential for negative effects to the food base of alosids will also increase.

3. Mirant states that zooplankton species favored by YOY alewives and bluebacks, based on stomach contents, were similarly present in both collections within the influence of and out of the influence of the plume. However, shallow areas preempted from the ZPH by the absence of sufficient oxygen contained benthic insects and (fingernail) clams which are also important to alosids.

Response: It should be remembered that, at the time these studies were conducted, Kendall Station's summertime BTU output was far-below the permitted level (see the graphic depiction of summertime BTU output in Response to B1). Thus, the full thermal impact of the Station at maximum generation was not being discharged to the lower Basin when these studies were conducted. In addition, zooplankton are expected to slowly respond to high temperatures. Effects of the thermal plume on the zooplankton community are expected to vary with both temperature and duration of exposure.

With regard to dissolved oxygen effects, low dissolved oxygen (less than 5.0 mg/L) sometimes occurs in the upper water column in the lower Charles River Basin. This does not mean, however, that oxygen levels below 5.0 should be used as the new water quality standard for the lower Basin. The Basin can be characterized as stressed, based on a fairly wide number of water quality variables, and benthic communities have been severely affected by the poor water quality in the Basin (USGS 2000).

Mirant's field work has established that the shoreline areas are important in providing food for alosid juveniles. Although the benthic community has been shown to be severely impacted in the deeper sections of the Basin with low dissolved oxygen levels and contaminated sediment, benthic communities in the shallow shoreline areas have not been as greatly affected. In certain areas, directly upstream and across from the facility, fingernail clams and other benthic organisms persist. Mirant has reported that alosid juveniles captured in beach-seines along these shorelines have had benthic insects and fingernail clams in their guts.

4. Mirant states that YOY bluebacks that were feeding were consistently captured in

comparable densities whether far from or close to the discharge, and at push-net stations at temperatures up to 85 ºF. Mirant feels that this indicates that neither temperature nor zooplankton densities were sufficiently influenced by the discharge to affect the feeding distribution of the fish.

Response: Blueback juveniles are known to tolerate much higher temperatures than alewives. The latter were chosen as the anadromous species most sensitive to temperature. Permit limits from June 12-October 31 were set to protect juvenile alewives.

In the Response to C3, the Permitting Agencies have shown that Mirant's contention regarding "comparable densities" of juvenile bluebacks at stations both near and far from the discharge was not supported by the data for the 2004 and 2005 sampling seasons. Mirant's comments imply that fish were captured at approximately equal rates at high and low temperatures up to 85 ºF. The Permitting Agencies demonstrate in the Response to C3 that the push-net catch rates for both juvenile alewives and juvenile bluebacks declined significantly with proximity to the discharge in 2004 and 2005. In addition, these declining densities were associated with increasing temperatures.

Whether or not the size distribution of zooplankton was affected by periods of time when temperatures were above 77 ºF is unknown. However, fish densities are often associated with food quantity and quality. The push-net surveys were designed to capture alewife and blueback herring away from the shoreline. It would be expected that river herring densities in different areas of the Basin would correspond to the quantity/quality of food present and/or other aspects of habitat quality (e.g., temperature). Due to the relative paucity of the benthos and emerging insects in areas away from the shoreline in the lower Basin, fish captured in push-nets would be expected to be feeding primarily on zooplankton. This expectation has not been fully evaluated, however. Whether the statistically-significant drop in capture rates of juvenile bluebacks and alewives was a direct effect of temperature or was also an effect of decreasing zooplankton food quality has not been assessed, although, based on the discussion above (item 2), the latter is also an expected effect of temperature increases.

5. Mirant states that the numbers of Cyanobacteria did not appear to be correlated with heat from the discharge, nor were they sufficient to adversely affect food availability for the herring.

EPA and MassDEP do not agree that no correlation exists between the number of Cyanobacteria in the Basin and the heat from the Station's discharge. Response E19 discusses this issue in detail and provides support for the permitting agencies' position.

In addition, EPA and MassDEP never intended to infer that blue-green algae do not occur when temperatures are below the 30-35 ^{o}C range. What is clear is that as river temperatures rise above 30 ^{o}C, blue-greens display an increased growth rate. See Figure 5.1-1 of the DD for an illustration of this occurrence.

Comment related to C49 from CLF: The habitat in the Basin will be further degraded because elevated temperatures are likely to reduce the availability of crucial invertebrate prey. It is well known that the precise timing of reproduction in fishes with respect to peaks in plankton availability is a critical determinant of the survival of juvenile fishes of many species, or year class strength. Zooplankton are essential as food for juvenile fishes, including perch and herring, and are also a dominant part of the diet for adult herring. Research on herring indicates that reproduction has evolved to produce synchrony with zooplankton population cycles. With increasing temperatures, the timing and composition of the available zooplankton will change in the Charles. Under the proposed permit, water temperature will approach the thermal tolerances some of the temperate zooplankton species and the algae that these invertebrates require for their food will decrease in availability. The warmer waters will favor blue-green algae which can be toxic to zooplankton and fishes. When waters are warmed to 77 ºF or higher for a protracted period of time, the species makeup of the zooplankton assemblage shifts to smaller species, and the species that form the principal food sources for Alosid fishes are lost. The combined effects of elevated temperatures changing the timing of migrations both in and out of the river, the thermal stress caused by high temperatures in the Basin, the effects on invertebrate prey populations could be devastating for the indigenous species EPA is responsible for protecting. These stresses will interact in a complex fashion with the already marginal conditions in the Basin to produce habitat that will not promote the successful passage of young fish into the sea.

Response to Comment related to C49 from CLF: EPA and MassDEP share the concern that elevated water temperatures may have an impact on the availability and make-up of crucial invertebrate prey residing in the Basin. The Permitting Agencies have lowered the temperature limits at key ZPH Monitoring Stations for the warmest months and have concluded that the temperature regime in the permit should provide for a mix of zooplankton adequate to support the BIP. A discussion of zooplankton in the lower Basin is contained in Response C49. See Section E (particularly Response E19) of the Response to Comments for information regarding phytoplankton in the lower Basin.

Data from the lower Basin phytoplankton summer community sampling program was also examined. Table E19-2 in Section E of the Response to Comments showed the relative percent of blue-green algae in the lower Basin summer community, based on a limited dataset. EPA and MassDEP are concerned about the potential impact of the thermal discharge on the blue-green populations because of the relationship between growth rates for blue greens and increasing temperature. See Figure 5.1-1 of the DD for an illustration of this occurrence. As a result, the final permit has retained the monitoring first proposed in the draft permit requiring algal monitoring during the growing season in order provide a more complete data set.

Comment C50: Agencies' Proposed Allowances are Impractical Because they Fail to Reflect River Temperature Patterns. The Draft Permit proposes to allow up to six 24-hour periods between April 15 to June 7 each year when temperatures may exceed the otherwise applicable in-stream limits by 2°F, but those periods must be non-consecutive and only three could be used over any consecutive four weeks. The Agencies explain those allowances as appropriate

recognition of the insignificance of some short term rises in temperatures during the spring, which due to quite variable flow and weather conditions naturally exhibits great and unpredictable variability in water temperatures for any particular date.

The proposal does not adequately reflect the circumstances and, as a result, does not actually provide any practical allowances for the operations of the Kendall Station. First, prohibiting use of consecutive allowance days ignores that during typical springtime warm spells (e.g., June 1-7, 1999 and May 11-22, 2004), temperatures rise naturally above the proposed limits for several consecutive days at a time.

Second, the thresholds at which these proposed allowances are capped are too low. Allowing 2° F above 72° F from June 1-7 (i.e., a limit of 74° F) still would have shut the plant in 1999 when the temperatures were consistently above 74° F, yet the strongest year class of alewives in Mirant Kendall's monitoring was developing during that time. Third, a restriction to no more than three allowance days in 4 weeks is arbitrary and inconsistent with river temperature patterns in a year like 2004, where exceedances in the May 1-14 period were followed by exceedances in the May 15-22 period, a time period when Mirant Kendall's monitoring program shows that the second best (over the 5 years of monitoring) standing crop of YOY alewives was developing.

Mirant Kendall believes the concept of allowing slightly higher temperatures for brief periods is very important, and suggests the Agencies carefully consider incorporating an approach as described in Comment C5 above. This approach would limit higher temperature periods to 3 days per month, but would tie the thresholds more formally to the historic range of temperatures in the river by establishing the allowance range as the range between the 90th and 95th percentiles of the historic river temperatures.

Response to C50: As stated in the DD, the temperature allowances in excess of springtime protective temperature limits were an appropriate recognition of the insignificance of some short term rises in temperatures during the spring, which due to quite variable flow and weather conditions, naturally exhibits great and unpredictable variability in water temperatures for any particular date. These brief spikes in temperature were documented for the majority of years examined. However, when ambient temperatures rise for extended periods to values not normally seen, (only in 1999 and 2004 in the two examples cited by the permittee) it places stress on the fish that is likely harder to deal with than a brief spike in temperature. That is why these temperature allowances were not permitted to be grouped together. EPA and MassDEP concluded that allowing consecutive days of exceedances would add further stress, in the form of even higher temperature levels, to fish coping with an unusual period of elevated water temperatures.

Thermal limits were not designed to maximize Station operation. The protection of the BIP was the objective of the permitting process. Any allowances developed as part of the spring temperature limits were not based on the warmest spring years recorded, but took into account all years where temperature data was available. EPA and MassDEP do not support basing thermal limits on extreme conditions only. This was never part of the permitting design.

EPA and MassDEP explored in detail the approach contained in Comment C5 in Response C5.

Comment C51 related to American Shad (from MA DMF): We maintain an anadromous fish program to improve the abundance and distribution of river herring and American Shad in the Charles River. Much of our stocking effort has been relocating blueback herring up river to improve fish passage. The alewife population is too scarce to support any removal from the (Charles) river system. The permittee's estimates of 45,622 river herring (of which an estimated 8000 are alewife) from sonic tracking confirm the population level for both species is extremely low. The permittee's figure of 203,000 adult river herring used for an equivalent adult entrainment loss estimate may also underestimate the carrying capacity for the river. Beginning in 2005, Marine Fisheries will begin a three year program of stocking fingerling American Shad in the Charles River. We believe the draft permit should provide control measures and effluent limitations that serve to protect these resources.

Response to C51: As described in Response C3, the 2002 estimate of adult alewife has been referenced by many interested parties and regulatory agencies to assist in the evaluation of the anadromous fish run in the Charles River. It must be clearly understood, however, that these numbers were derived from a pilot study conducted by the permittee in 2002. A list of assumptions, potential sources of error and suggested refinements were documented for future field efforts to better estimate herring runs at that location. Any use of the fish entry estimates from 2002 must take the preliminary nature of these numbers into account.

The Permitting Agencies are fully aware of MA DMF's concerns regarding American shad and note that a cooperative re-stocking effort between MA DMF and the U.S. Fish and Wildlife Service began in the Charles in 2006. Adult fish are expected to return to the Basin in 2011. EPA and MassDEP discussed protective temperature values for American shad, in the event restoration efforts for this species were to re-establish this species in the lower Basin. This is documented in Section 5.7.4 and Figure 5.8.1-1 of the DD. Based on a description of the detailed restoration effort included in a February 16, 2006 letter from MA DMF to EPA (AR# 561), potential temperature limits to protect American shad have been again considered. The objective of ensuring protective temperatures of 78 ºF (American shad larval stage protective temperature) from June 12 through June 30, and 80 ºF (American shad juvenile stage protective temperature) from July 1 through October 30 would be incorporated into the temperature compliance profile of the permit. At this point, EPA and MassDEP have been unable to obtain evidence that American shad are sufficiently present in the lower Basin to constitute an element of the BIP that requires specific protection under the permit. The Permitting Agencies believe that the temperature compliance regime in the Final Permit will certainly help maintain the Basin at lower temperatures than are currently allowed in Kendall Station's permit, and the this Final Permit is directionally consistent with the American shad restoration project. Moreover, with the combination of the 83 ºF temperature limits during the summer and the new targeted limits to protect certain areas at 81 ºF along the Boston shore, EPA and MassDEP expect that the natural variability and compliance margin with which Mirant must operate the facility will likely result in temperatures in the ZPH much of the time which will not exceed the levels necessary to

protect American shad.

Comment C52 related to American Shad (from CLF): Alteration of natural temperature cycles will interfere with migrations in and out of the river, and elevated winter temperatures will compromise natural strategies for surviving this period of the year for fishes and other aquatic animals.

The timing of spawning runs of American shad are similar to the river herring, typically taking place from late April through June, when spring water temperatures reach about 50 ºF. Migration comes to an end when the water reaches about 68 ºF. Again, the temperature limits proposed by EPA are too high and would curtail shad spawning runs by early May, when the ZPH would be allowed to reach the 68 ºF behavioral threshold for upstream migration. This species has been documented in the Charles River system in the past. MA DMF attempted to reintroduce this species into the system in greater numbers in the 1980's and into the early 1990's. The population has not rebounded and fisheries biologists have been unable to determine the reason(s). Fish sampling by the permittee did not collect adult American shad in 1999, 2000 or 2002." The temperature limits put forth in EPA's draft permit are not consistent with supporting a shad population in the Charles River, and will undermine ongoing efforts by MA DMF to re-establish this species. A renewed DMF shad stocking program is scheduled to begin this year, but will fail if this permit is not revised so as to hold temperatures in the natural range for these migratory fishes.

Juvenile shad remain in the natal river through the summer on into fall. Seaward migrations are triggered when falling water temperatures reach about 66 ºF during September through early November. Blueback herring exhibit a similar behavioral pattern, with the young fish beginning their seaward journey when fall temperatures reach 69 ºF. If this draft permit goes into effect as written, these young fish will begin the migration out of the upper reaches of the river in cool water, and then will encounter much higher temperatures in the ZPH of the Basin, and even higher if they venture into the ZD. With a maximum protective limit of 83 ºF during this period, water could reach this very high temperature if the system of measuring ambient temperature failed due to local thermal loading near the BU bridge. The unnatural spatial temperature regime is likely to interrupt the temperature-triggered migration to the sea and thus will result in higher mortality among the young of the year.

*Discussion of warmest temperatures permitted for the ZPH***.**
Although the specific time periods and temperature limits are laid out in the draft permit, the discussion in the Determinations Document is at times confusing as to which limits will actually be enforced (e.g. Fig 5.6-1). Multiple references are made to 83 ºF, apparently because this is a water quality standard for a Class B body of water. However, as written, it is at times difficult to know whether EPA is proposing to use 83 ºF as some kind of overall limit for the ZPH for all seasons, or only during the 12 June through 31 October period. For example, on page 61, EPA writes "Based on the discussion above, the temperature limit of 28.3ºC (83ºF) must be in place in the ZPH from April 1 through July 15 to protect yellow perch larvae, unless replaced by a lower temperature limit to protect a more sensitive life stage or species occurring in the Basin at the

same time." However, the draft permit clearly indicates that a standard substantially lower than 83 ºF is being proposed during all but the last portion of this period. Fig. 5.6-1 shows the stair-step series of limits developed in the Determinations Document, and presented in Attachment A, but also includes a limit line at 83 ºF that extends to through the entire year. The intent of this graph, and the text, needs to be made clear.

Response to C52: Revised, protective temperature limits for the protection of American shad have not been included in the permit at this time. See Response C51 Related to American shad from MADMF. A discussion of temperature limits taken exclusively from the literature, proposed by CLF.

D. Response to Comments Concerning the Proposed Zone of Passage and Habitat

Comment D1: Mirant contends that the definition of the Zone of Passage and Habitat (ZPH) and the compliance system to maintain temperatures in the ZPH are flawed.

Response D1: The necessity of the ZPH was articulated in Section 5.8 of the DD and Section 4.4.3 of the Fact Sheet. The ZPH was also displayed on Attachment D of the Draft Permit. The definition and specific requirements corresponding to the ZPH have clear rationales and are further discussed in the responses below.

Comment D2: The proposal to enforce the proposed in-stream temperature limits at a group of fixed, in-stream monitoring points that collectively comprise an in-stream compliance zone, the Zone of Passage and Habitat ("ZPH"), is overbroad.

It is not a sufficient answer for the Agencies to respond that it is necessary to maintain strict compliance at all points and times in the ZPH because the proposed permit would allow the Zone of Initial Dilution ("ZD") on the Cambridge side of the river to exhibit higher temperatures. There is no physical possibility for the whole Cambridge side of the river to exhibit dramatically different temperatures than the whole Boston side of the River; if most of the temperature recordings in the ZPH are in compliance then most of the ZD also will be in compliance, and certainly some of it will. The problem is that the proposed permit establishes two regulatory zones that bear no relationship to biological reality.

In order to assure that it remains in compliance, Mirant Kendall must seek to anticipate when river flows and ambient temperatures, combined with its own anticipated discharges, may tend to cause an exceedance at any one of the in-stream monitoring points for any 4-hour block of the coming days, and then must anticipate curtailments in order to avoid causing an exceedance. As a result, the overbreadth of the compliance scheme will be substantially magnified by Mirant Kendall's necessary anticipatory behavior. It is not a sufficient response for the Agencies to applaud that anticipatory behavior on the ground that it will induce lower discharge of heat, and help to prevent excessive temperatures, because nothing about the Agencies' establishment of the temperature limits or the proposed compliance scheme takes account of Mirant Kendall's need or ability to anticipate in-stream temperature effects.

Comment related to D2 from Union Boat Club: The proposed locations of the testing equipment may obstruct safe traffic flow of various craft. The Charles River basin as described by the rowing community covers that stretch of river from the BU Bridge to the Longfellow Bridges. The only straight stretch of the river, it contains Boston's only full 2000 meter race course and as such is used daily for practice and races by all programs. Thus, the areas of the Basin where the testing sites are proposed are heavily used by rowing shells. The most challenging sites are those that require the permanent canister buoys on the race course: Stations 1, 2/B and A, as described in Sections 14.e.1, 14.c.1 and 14.e.10. Other testing stations are

located in the middle of other heavily used traffic lanes. It is not clear to the lay reader if these sites are permanent or temporary, but are described as nets suspended below the surface. If permanent, this setup could be hazardous to fins and rudders, as well as motors of accompanying coaching safety launches. Unless these nets were sufficiently deep to avoid impact, these locations would need to be marked with buoys. We hope that once the stations are located, formal GPS locations can be measured to assist in maintaining the agreed on locations.

Comment related to D2 from Laura Donohue: Rowers would like to participate in deciding where monitoring buoys are placed. Stations 1 and 2 basically define the start and finish lines of the race course that is often used. It would be best if stations 1 and 2 were not at the start and finish lines of the race course. I am assuming that the other testing stations that were mentioned are not permanent. If these buoys are anywhere near the shore and the water level drops dramatically (due to the operation of the dam), you need to be aware that that may affect your testing equipment, as well as people's ability to get around them.

Response to D2:

1. The thermal plume from Kendall Station will cause mortality and will be too large to meet the requirements of a formal Mixing Zone, as defined in the State's Water Quality Standards. Therefore, a state mixing zone could not be granted. In establishing a suitable variance that would be protective of the BIP, EPA carefully studied both the scientific literature concerning the temperature tolerance of key indicator species and data about the existing conditions in the lower Basin. In addition, EPA compared its' conclusions about temperatures necessary to protect the BIP with Massachusetts' State Water Quality Standards, where possible, to make the framework for protective temperatures and compliance as consistent with those standards as possible.

Since the permittee failed to submit an acceptable model of the lower Charles River Basin (see Introduction to Section E), it can not be stated with certainty what temperature relationship there will be between the ZD and the ZPH. It is reasonable to anticipate that during times of sufficient river flow, the thermal plume from Kendall Station would stay more toward the Cambridge side of the river and move downstream. The ZPH would be comprised largely of ambient temperature river water. Certainly under these conditions, there will be a stark contrast between the ZD and the ZPH.

EPA does not dispute Mirant's assertion that the regulatory structure of the permit may not always perfectly reflect the conditions one might observe in the lower Basin. But acknowledging this truism does not lead to the conclusion that the permit is structurally flawed or arbitrary. Regulatory compliance regimes nearly always have to draw bright lines to define compliance requirements in clear, enforceable terms. A clearly articulated compliance regime inevitably does not correspond perfectly to the dynamic, ever-changing environment it is designed to protect. It would be extremely impractical, if not impossible to draft or enforce a permit that accurately represented the approach suggested by Mirant's comment, where a violation at one or another compliance point should be

ignored as a legal matter because, on balance, it appears enough other compliance points are at temperatures sufficient to protect the BIP. EPA has exercised its best judgment about how many compliance points must meet required temperatures to protect the BIP. Mirant's comment suggests the permit should provide that this judgment must be continually revisited and revised every time compliance with the permit becomes inconvenient for the facility at a particular point. If during the term of the permit Mirant demonstrates based on actual experience with the permit that a particular compliance requirement or scenario is unnecessarily restrictive, EPA and MassDEP can consider a permit modification supported by a demonstration that the modified permit would continue to protect the BIP.

As pointed out in the DD as well as in this Response to Comments document, if Mirant had submitted an acceptable hydrodynamic model, there would not be the uncertainty related to Kendall Station's thermal plume in the Basin as well as the overall thermal profile of the Basin. This uncertainty compels EPA to require these compliance points as the minimum necessary to demonstrate protection of the BIP.

2. All facilities using once through cooling water and permitted with a maximum discharge temperature must anticipate changes in ambient water conditions (intake water temperature) over the course of a day, especially as the discharge temperature approaches the maximum temperature limit. The procedure Kendall Station must follow is more complicated than monitoring only the discharge temperature, because no suitable model was provided by the permittee to identify discharge temperatures that EPA would establish as protective limits, based on their impact to the lower Basin. EPA agrees that the structure of this permit places a considerable monitoring burden on the permittee. But if Mirant wants the flexibility to discharge as much heat as possible on any given day consistent with protecting the BIP, this more sensitive, and therefore complex, compliance monitoring regime is the trade-off. If Mirant wants a simpler permit, the reasonable worst-case assumptions EPA would have to make to have reasonable assurance that the permit would still protect the BIP would likely result in further restrictions on the facility's thermal discharge. This issue is discussed in Response D5 of this Section and in Response I2 in Section I of this response to comments document.

Response to Comments related to D2 from Union Boat Club and L. Donohue: EPA and MassDEP are aware of the potential hazards that fixed buoys in the Charles River may cause to sailing and rowing activities in the lower Basin. Based in part on discussions that took place during the writing of the Draft Permit (Charles River Rowing Committee, August 2002), the number of fixed monitoring stations proposed by the permittee was reduced from 12 to 9, partly to address navigational issues. Only Monitoring Stations 1 through 6 will remain in the lower Basin year round and be made up of fixed buoys (6 fixed buoys in all). Monitoring Station 7 will be attached to the wall of the Museum of Science Lock, requiring no buoy. Although Monitoring Stations 8 and 9 will each be made up of a buoy, they will only be deployed from April 1 through October 31. The stations proposed in the Draft Permit to measure chlorophyll (Stations A, B and C) are not included in the Final Permit as fixed stations which would require

buoys in the Basin. The only other sampling method that may present an obstacle to navigation would be gillnets or other nets that would be deployed in the river and be left unattended for a number of hours. These nets will be clearly marked. EPA and MassDEP will continue to encourage Mirant to communicate with river users when deploying fixed monitors or sampling equipment that will only be left in the river for a short time.

Comment D3: Mirant asserts that the proposed use of 4-hour block averages for maintenance of the temperatures in the ZPH at all times is unjustified and inappropriate for several reasons.

1. The proposed 4-hour blocks have no biological significance to the two species, alewives and yellow perch, which the Agencies have selected to establish the temperature regime.

2. The Agencies have not provided any plausible or even coherent explanation of why 4-hour block averages are necessary or appropriate. Further, the Agencies provide no biological basis for selecting 4-hour averaging as opposed to any other, and documenting temperatures in 4-hour blocks can be achieved without using those blocks as the compliance measure.

3. None of the scientific studies used by the Agencies to set the proposed temperature limits focused on the effects of short, 4-hour exposures

4. It appears that the use of 4-hour block averaging to enforce in-stream limits is both unprecedented and contrary to other precedent. Specifically, for purposes of determining whether Massachusetts waters are in attainment of the temperature portions of its Water Quality Standards, DEP uses 24-hour averages.

Mirant Kendall suggests that 24-hour averaging, consistent with the Mass. Water Quality Standards, is sufficiently conservative and is the appropriate approach.

Response to D3: In the first section of this comment, Mirant takes issue with the proposed 4-hr temperature limit and uses summertime field information to substantiate its comments. Although the field data presented by Mirant are limited to the summertime, Mirant's comments appear to address the 4-hr limit throughout the year.

First, EPA agrees that alosids exhibit a diurnal pattern in resource use. In the springtime, alosid adults are known to move into freshwater systems primarily in the daytime. As a result, a 24-hr limit does not make sense for use in the spring because, as Mirant mentions above, cooler temperatures are expected at night. Therefore, the daytime target temperature needed for alosid passage into the system may not be met if EPA and MassDEP allow cooler nighttime temperatures to be averaged along with warmer daytime temperatures.

Second, the summertime Draft Permit limits were developed to protect the nighttime use of the waterbody's surface by juvenile river herring. During the summer, when air temperatures are

warm, the use of air conditioning can reach very high levels in the afternoon and evening. Peak hours of summertime electricity demand often extend from 2:00 pm to about 9:00 pm. Because electric rates over the course of the day reflect this use EPA expects that peak BTU input from the facility will be during the period of peak demand. Under this scenario, water temperatures across the basin's surface will be highest over the first part of the night when alosid juveniles need this habitat.

In addition to the above, EPA is concerned that if daytime temperatures across much of the lower Basin are near or above the target temperature for habitat use by juvenile alosids, a substantial portion of the populations of these fish will stay away from those areas at night as well. Juvenile fish do not have an ability to a) sense that temperatures at a remote location are within a usable range; and b) quickly move themselves across to remote areas that suddenly become usable habitat. If they are excluded from certain areas by day, they are more likely to be absent from those areas at night as well because they are unlikely to move great distances to reach available habitat well downstream from their daytime location in the few hours available for them for nighttime feeding.

For example, it is unclear how fish near the B.U. Bridge would know to move 1.5 to 2.0 miles downstream to feed at night near the Museum of Science if daytime temperatures in these areas have excluded them from points downstream of Monitoring Station 2. EPA expects that these fish will be unaware that downstream habitat is available at night if these same habitats are unavailable during the day. In other river systems it might be expected that fish would simply remain below the surface in the day, at cooler depths. However, judging from the hydrographic information for 2005 submitted to EPA and MassDEP by Mirant for July and August, this may not be possible throughout much of the summer. Water temperatures exceeded the target temperature of 81ºF from the surface down to depths of 9 and sometimes 12 ft. for several concurrent weeks (or longer) at certain stations in the lower Basin. Thus, there appears to be little daytime refuge at depth during the daytime for alosid juveniles in some areas.

Third, some of the apparent confusion on the part of the company on issues it has raised can be addressed by drawing a distinction between toxicity and avoidance. All of the literature studies referenced by Mirant (Otto, et al., and others) deal with toxicity and the length of time that was used in these experiments to induce toxicity. Many of the permit limits are based on the concern that either adults or juveniles will avoid certain temperatures and either decline to enter the basin (e.g., alewife adults), refuse to breed (e.g., yellow perch adults) or refuse to use certain areas as habitat (e.g., alewife and American shad juveniles).

As a point of clarification, the permit does not require that a particular maximum temperature be maintained. This would require both warming and chilling. Rather, EPA has set maximum allowable temperatures, as measured by 4-hour averages, and have also set a delta temperature maximum, as measured by 24-hour averages. The intent of the permit is that these maximum limits not be exceeded as a result of additional heat discharged from the Kendall Station.

As an additional point of clarification, MassDEP specifies in the Water Quality Certification of

this permit that for purposes of determining whether Massachusetts waters are in attainment of the temperature portions of its Water Quality Standards, MassDEP uses an instantaneous maximum temperature rather than a 24-hour average. See MassDEP section 401 certification at 1, sec. I, par.1.

Also see Response L2 for a discussion as to why a maximum temperature limit calculated from a 24 hour average in the vicinity of a facility with a pronounced thermal discharge would not be protective.

Comment D4: Alternative Approach to Setting In-Stream Temperature Targets – Expect 50% of the Cross-Sectional Area of the River to Remain Within the Range of Ambient Temperature. Mirant Kendall's discharge raises river temperatures somewhat over what they otherwise would be. The extent of the increase varies enormously depending on the quantity of river flow, the level of the discharge, wind and weather conditions, and other factors. As long as those increases do not cause more than 50% of the Charles River affected by the plant to exceed the normal range of ambient temperatures, however, the discharge will be consistent with the goals of the Massachusetts Mixing Zone Policy and with the absence of appreciable harm. Accordingly, Mirant Kendall suggests that the final permit should establish a set of in-stream temperature targets based on that standard.

Specifically, Mirant Kendall suggests that the final permit should seek to assure that 24-hour average temperatures in at least 50% of the cross-sectional area of the Charles River affected by the plant do not exceed the 90% confidence upper bound of the ambient 24-hour average temperatures in the intake at the Broad Canal, with the proviso that on 10% of the days (i.e., three days per month) the allowable temperature would be set at the 95% confidence upper limit.

The reasoning behind this statistically based approach is that the permit limits should be flexible enough to allow temperatures to reach the higher levels within the normal range of ambient temperatures, given that allowing temperatures to reach such levels, in fact, is not tantamount to causing those higher temperatures to occur continuously due to the plant's operations. As described in other comments, the actual operations of the plant combined with the actual conditions of river flows and weather mean that those upper limits will very rarely be reached.

Also, this suggested approach is only addressing the temperature targets for the river. Additional comments address the consequences for the plant's operations as these target temperatures would be approached or exceeded. The utility of these temperature targets should not be judged apart from a consideration of those other suggestions.

Comment related to D4 from CRC: We believe it is unacceptable for one half of the river in the lower Basin to be allowed to reach temperatures that are lethal to native fish and other biota throughout the summer months.

Response to D4 and related comment: The plan Mirant proposes would allow for much higher

temperatures to be reached than the 5 ^{O}F Delta temperature (a 24-hr limit) allowed in the Draft Permit. There are two reasons for this. First, due to limited dilution in the summertime, the Delta T limit in the summer is more quickly reached than during other seasons when river flows are higher. Thus, the summertime Delta T is primarily at issue. Although not specifically stated in this comment, Mirant has commented elsewhere (in Mirant's Comment C5, for example) that intake data has been used to evaluate the profile of the river temperatures. In the summertime, as described in the DD, temperatures at the intake (within the Broad Canal) may be more than 5 ^{O}F higher than river temperatures at the ambient station. Thus, temperatures in the Broad Canal at the Station Intake are not good indicators of ambient river temperatures and are best not used to set allowable Delta temperatures.

Second, it is unclear what Mirant is asking with regard to the "90% confidence upper bound of the ambient 24-hour temperatures." If the permittee is suggesting that the historical record be used for the day in question, this approach is problematic. For example, the facility may be unnecessarily restricted when ambient temperatures are exceptionally high on a particular day. This approach could be harmful for the biota in those cases when the historical record as recorded at the Station's intake shows high temperatures, but the true ambient temperature of the river is much lower. In any case, the 90th percentile figure should not be used for two reasons: a) the lower Basin has water temperatures that are among the highest in the state already, and using the 90th percentile figure would push temperature even higher; and b) there are no biological data to support using temperatures that are far above the 50th percentile. See also Response C5 regarding the manner in which Mirant proposed to use statistics to set upper water temperature limits.

EPA has based the temperature limits on biological data, rather than a physical/statistical relationship, in order to support the goals of the Federal Clean Water Act and to satisfy 316(a) requirements. Suggestions for deriving permit limits must take into account the biological effects of the proposed changes. Mirant's proposal in this comment has not addressed the biological effects of using the Broad Canal as the ambient station; it has not addressed the biological effects of using the 24-hr average temperature data (see Responses C3); and it has not addressed the biological effects of using the 90th percentile data as targets.

Mirant recommends that a combination approach be used to assure compliance with in-stream temperature limits which would include statistically based temperature limits and a revised BTU loading approach. See Comments C5 and D5. The original BTU loading approach was recommended by Mirant in its December 23, 2002 letter to the Permitting Agencies. For the Draft Permit, it was determined that Mirant's BTU proposal would not be protective of the BIP as it would allow for extended periods of temperature violations before the Station would be required to curtail operations to pre-determined levels of maximum heat load discharge. The Draft Permit offered a revised BTU loading approach in the Determination Document for comment and only the permittee commented on this revised approach.

The recommendation for setting in-stream temperature limits based on a statistical approach is a new proposal. Mirant states that using the continuous temperature monitoring at the intakes

would allow for a calculation of 1 and 2 standard deviations above these temperatures that would result in temperatures that would be consistent with the biology of the river. Mirant cites a portion of a MassDEP record that Mirant submitted as an exhibit to comment C5 that states that EPA's Dave McDonald suggests the use of up to 2 standard deviations from the mean as an upper maximum limit for the protection of a population, which is equivalent to a 95% percentile figure. This exhibit is only a portion of a document and text preceding this statement was not included in the permittee's comments. Taken out of context, a reader might conclude that the statement was made in the context of setting temperature limits for this permit. This is not the case. Please see Response C5 to understand Mr. McDonald's recommendation, which was misunderstood by Mirant.

Mirant also uses the 90% and 95% confidence levels and compares these to the Draft Permit temperature limits. This analysis by Mirant was conducted for 24 hour average and 4 hour average temperatures. The results show that the statistically based temperatures were always within a few degrees of the proposed temperature limits. For April, they were 2-4 degrees below the proposed temperatures and for May through August, they were 2-4 degrees above the proposed limits. As mentioned above, EPA and MassDEP do not believe that this statistical approach has direct significance to the biology of fish in the river and should not be used to set temperature limits.

But EPA does not completely reject all consideration of this analysis. This statistical analysis may be useful in characterizing the range of temperatures one would expect to find in the area of the intake structures (absent the influence of the thermal plume). The resulting temperatures could be used to estimate how many days on average during certain times of the year that intake temperatures could exceed any established instream temperature limits. This information in turn could be used to evaluate whether this permit's allowance of six (6) days in the spring during which instream temperature limits may be exceeded is reasonable and consistent with the temperature variations experienced at the intakes. The biological consequences of increasing the number of exceedances would have to be considered by the Permitting Agencies.

Further, EPA has fundamental concerns with applying the permittee's statistical approach to setting temperature limits for this permit. At the core of the permittee's proposal is the assumption that ambient temperatures in the Charles River are inherently protective. Since the evidence indicates that increased thermal loading in 2003, 2004 and 2005 were not protective of the BIP, limits based on a statistical conformance to historical temperatures would not be protective. See also Response C3. The biologically based temperature limits are preferable to the statistical based limits, which do not have direct biological significance. The permittee has not offered any specific evidence that this statistical approach considers the biology of fish species that the permitted limits must be designed to protect. The literature information on toxicity in combination with the appreciable harm information and the finding that alewives in the lower Charles in most years generally avoided temperatures greater than about 81ºF (see Response C3) show clearly that the statistical approach to setting permit limits proposed by Mirant is not protective of the biological community and would result in large-scale habitat alterations, especially in years with low river flows.

Contrary to the permittee's proposal, the proposed temperature limits in the permit have clear, biological rationales. These limits have also taken into consideration ambient conditions by allowing certain days of exceedances during the spring, based on an analysis of past ambient temperatures. The permittee has shown that its statistical numbers are similar to those proposed temperature limits and likely within the margin of error. However, they are based on a standard deviation from recorded intake temperatures which might, at best, predict what instream temperatures would be, but which have no biological basis relative to the species that EPA must protect.

Comment D5: BTU Loading Approach – Mirant Kendall's December 2002 Proposal. By a letter dated December 23, 2002, Mirant Kendall proposed a temperature compliance program that it termed the BTU Loading Approach. The key idea behind the BTU Loading Approach, as summarized on p. 2 of the referenced letter, was to recognize that day–to–day operation of a power generating station cannot be stop-started, stop-started on short notice. Rather, both for physical operating reasons and due to its role in the competitive market place for power in New England, Kendall Station must have some advance reliable understanding of how it will be able to operate the facility over the immediate planning horizon of 24-48 hours.

Accordingly, Mirant Kendall's BTU Loading Approach would include temperature thresholds which, if surpassed, would require the Plant to cut back its operations by pre-established amounts over the next operating day. Also, Mirant Kendall proposed that, if it made those cut-backs according to the terms of the permit, it would not be held responsible for temperature exceedances in the river that might occur notwithstanding the cut-backs.

The Agencies appear to have given little detailed consideration to Mirant Kendall's BTU Loading Approach, and certainly the approach in the draft permit entirely disregards Kendall Station's operating need for advance certainty. Were the compliance scheme in the draft permit to become final, Kendall Station would be forced to curtail its operations severely for several reasons, including the need to curtail its operations in anticipation of rising temperatures irrespective of whether the plant's discharge would have caused an exceedance. That approach is overbroad, arbitrary and capricious and should not be included in the final permit.

Rather, Mirant Kendall urges the Agencies to give full consideration to the December, 2002 BTU Loading Approach and work with Mirant Kendall to develop a compliance system based on those principles. Mirant Kendall recognizes that the Agencies have sought public comment on a version of the BTU Loading Approach, Determination Document, Section 5.11, and looks forward to working with the Agencies to elaborate on that or a similar approach to find a workable compromise.

Response to D5: EPA has suggested an alternative BTU loading approach to that which was recommended by the permittee in its December 23, 2002 letter to the Permitting Agencies. This alternative approach may be found in Section 5.11.3 of the Determination Document. In its Comment D5, the permittee does not endorse the alternative BTU approach that EPA put forth

and argues that it is not workable for this facility. EPA has given careful consideration to the permittee's proposal. EPA modified the permittee's proposal as reflected in the DD because the permittee's proposal allowed for excessive periods of time during which temperature limits would be exceeded before the facility would have to curtail production to pre-specified BTU loading levels. EPA cannot endorse the permittee's BTU loading approach or the statistically based temperature limits approach with which it was proposed to be coupled. Other facilities that use once through cooling water and must comply with a permitted instantaneous maximum discharge temperature limit accept the very real prospect of modifying their operation in anticipation of rising temperatures, irrespective of whether a given facility's discharge would have caused an in-stream exceedance of a temperature criterion. These facilities do not have some advance reliable understanding of how they will be able to operate the facility over the immediate planning horizon of 24-48 hours. They must plan their generating capacity based in part on their best prediction of how hot the background temperature of the cooling water will be as it comes to the plant. This challenge of predicting the impact of ambient conditions on generating capacity is faced by all generating facilities that use once through cooling water, especially during dry, hot summertime conditions, and in this manner, Kendall Station's situation is not unique.

In Comment D6, Mirant proposes an "enhanced BTU loading approach." As explained in the Response to D6, that proposal shares most of the flaws as its original 2002 proposal. Therefore, EPA does not endorse and does not intend to incorporate any aspect of the permittee's BTU heat load approaches or statistically based temperature approach into this permit.

Although EPA and MassDEP are not prepared to adopt Mirant's proposed BTU Loading Approach for the reasons given above, the permitting agencies are sensitive to the company's expressed concern that it would "be held responsible for temperature exceedances in the river that might occur notwithstanding the cut-backs." Mirant's proposal is not acceptable because it improperly insulates the company from responsibility for maintaining the protective in-stream temperatures necessary to protect the BIP, while granting the company the opportunity to take advantage of the lower Basin's actual assimilative capacity. But EPA and MassDEP agree that Mirant should not be liable under the permit for in-stream temperature exceedances which the Kendall Station did not cause or contribute to. Temperature in the lower Basin can be influenced by a variety of factors. It is conceivable, though not likely, that despite appropriate curtailments or cessation of the Station's operations, temperatures in the lower Basin might exceed the in-stream limits. In that case, it would not be appropriate to hold the permittee strictly liable for those exceedances beyond its control. Therefore, the permit has been modified in footnote 7 on Page 4, to state that the permittee shall not cause or contribute to conditions that cause exceedances of the temperature limits provided for in the seasonal profile of protective temperatures.

Comment D6: This comment suggests an enhanced variation to the BTU Loading Approach using some principles from Mirant Kendall's December 2002 BTU Loading Approach and some from the Agencies' alternative BTU loading approach in section 5.11 of the Determination Document. It also builds on the alternative approaches to in-stream limits described in Comment

C5.

Specifically, the Agencies should consider a combination of a refined BTU Loading Approach and the statistical analysis of ambient temperatures at the Broad Canal intake described in Comment C5. Under this suggestion, at 8:00 a.m. of each operating day Mirant Kendall would evaluate the average temperature for the prior 24 hours at the intake. If a specified trigger temperature had been reached, the plant would be required to reduce its BTU loadings in the current 24-hour period or adequately document why it did not. For example, if the 24-hour average trigger temperature had been reached as a carry-over from too warm temperatures during the prior afternoon and evening, but the river was cooling rapidly due to a change in weather, Mirant Kendall could proceed without being subject to thermal caps on the current day.

The suggested reduction protocol is to reduce to no more than 50% of the maximum daily allowable loading of 13,344 mmBTU/day, averaged over the 24 hours from 8:00 a.m. that day to 8:00 a.m. of the following day. These thermal discharge limits would continue for as long as the daily 8:00 a.m. evaluation showed expected same-day exceedances of the trigger temperature. Should Mirant Kendall determine to discharge at levels above the thermal discharge limit, it would do so at its own risk of failure to correctly predict that temperatures would not exceed the in-stream temperature limits.

Under this enhanced approach, the trigger temperatures would derive from the statistical analysis of ambient temperatures at the Broad Canal intake in the fall, winter and spring, and from the Massachusetts Water Quality Standard of 83 ^{o}F in the summer. Specifically, maximum daily allowable BTU loadings would be reduced to prevent the 24-hour temperature at the intake from exceeding the 90% confidence upper limit during the fall, winter and spring, except for up to 3 days per month when the 95% confidence upper limit would apply. During the summer this approach might be varied to account for the fact that the 90% confidence upper limit exceeds the Massachusetts Water Quality Criterion of 83 ^{o}F, so that the WQS might be used as the trigger temperature instead. Up to three days per month in June, July and August could be allowed within the still protective 90% to 95% confidence upper bound range, consistent with the Region 1 Ecological Risk Assessment suggestion.

There are two improvements in this refined approach as compared to Mirant Kendall's December, 2002 BTU Loading Approach. Both of these changes reflect the feedback Mirant Kendall received from the Agencies about that approach. First, action upon a triggering event would be taken the same business day, whereas it was taken the following day in the earlier proposal. Second, the action decision would be made at temperatures lower than the in-stream temperature limits. In the earlier proposal, action was taken only upon reaching the limits.

A key feature of this approach, as with the December 2003 proposal, is that it allows Mirant Kendall to anticipate the expected temperatures in the river and adjust its conduct accordingly, but does not lock Mirant Kendall into unnecessary curtailments. By contrast, under the alternative BTU Loading Approach described by the Agencies in Section 5.11 of the Determination

Document, Mirant Kendall would still anticipate the expected temperatures in the river and adjust its operations, but would be forced to overcompensate (by reducing to 3^{O} F below the limits) in order to be sure of avoiding in-stream exceedances.

Response to D6: The permittee has proposed a system where BTU heat load reductions would occur consistent with whether or not the statistically based temperature limits are exceeded. For the summer, the facility would not use these figures but would revert to the State temperature standard of 83 ºF. For the other seasons, the facility would curtail operations if the 90% percentile temperatures (between 1 and 2 standard deviations) were exceeded, but would be allowed up to 3 days per month to reach the 95% percentile temperatures, or 2 standard deviations from ambient. Even if EPA agreed with this BTU loading approach, this approach would not protect the BIP. The approach would require an analysis of the previous 24 hours of intake temperatures at 8 AM every day. If a specified trigger temperature is reached, the permittee proposes that the facility would be required to reduce its BTU loadings in the current 24 hour period to 50% of the maximum heat load, averaged over the 24 hour period of 8AM to 8 AM, or document why it did not. Thus, the permittee would be out of compliance for temperature for some portion of the previous 24 hours, and it could operate from 8 AM to 8 PM at 90% heat load (likely with continued temperature violations) and then cut down to the rate of 10% heat load (the minimum necessary for steam production) from 8 PM to 8 AM and be in compliance once the BTU loadings were averaged over 24 hours. As with Mirant's previous proposal, EPA believes this would allow for extended periods of in-stream temperatures which would not be protective of the BIP. EPA's Draft Permit is flexible in allowing for 4 hour block averages, but having exceedances of these temperatures for potentially a good portion of 2 consecutive days would not be in keeping with the requirement to protect the BIP.

EPA has concluded that the statistical approach endorsed by the permittee does not adequately take into account the biology of the aquatic life in the lower Charles basin. This approach would allow the permittee to continue operating for an extended period after threshold temperatures had been reached. See Response to D4.

In addition, as discussed in Response L2 and Response D3, temperature limits based on a 24 hour average are not protective when a large thermal discharge is involved.

Also, EPA and MassDEP do not agree that the 90% confidence upper limit exceeds the Massachusetts Water Quality Criterion of 83 ºF in the summer. Based on the summertime ambient temperature data that is available for the Charles River near the BU Bridge (see Section 5.9.2 of the DD), the use of a 24 hour average temperature of 83 ºF as the trigger temperature is not an accurate representation of ambient temperatures in the lower Basin from June 15 through October 31.

One further problem with Mirant's proposal is that it applies the risk of managing the Kendall Station's heat load in the lower Basin in an asymmetrical manner. The asymmetry appears to lift the risk off Mirant and place it on the environment. If the statistical temperature trigger in

Mirant's proposal is reached, and it appears the lower Basin will remain hot, Mirant is only required to curtail its operation by a pre-agreed amount that may bear no relation to the full level of curtailment actually needed to protect the BIP. On the other hand, if the trigger is reached, but Mirant concludes the lower Basin is cooling, Mirant is able to increase its thermal discharge, at its own risk, to whatever level the company concludes will stay below the in-stream temperature limits. As a result, Mirant is able to take full advantage of warming up the lower Basin to the in-stream temperature limits, but the company does not bear the corresponding risk of having to curtail its thermal discharge to levels consistent with protecting those temperature limits.

Comment D7: The ZPH is more properly considered a "ZP" (Zone of Passage). The Agencies have been overly broad in characterizing the area downstream of the Longfellow Bridge as a "Zone of Passage and Habitat," or ZPH. For the reasons discussed below, the area is not habitat for spawning or for the early egg and larval stages of the target fish species (alewives and yellow perch).

The area is only visited a minority of the time by the older life stages of these species. Specifically, adult alewives pass through the area on their spring spawning run in April and May and again when they leave the river in May and June. In the summer, the upper water column is used only occasionally. For the most part, this use consists of visits by feeding and out-migrating juvenile alewives in the evening and at night. The same takes place throughout the rest of the lower river, with numbers of fish everywhere below the Harvard Bridge comparable to those in the ZPH. Mirant Kendall's monitoring data indicates that the upper water column of the area is essentially never used by yellow perch. MK Comment Ex. No. D7. Yellow perch were found in the lower water column in the ZPH in small numbers, and only about 30% of the time.

These findings lead to the conclusion that full-time compliance with four-hour block in-stream limits at two-foot depth anywhere in the ZPH, and specifically at proposed Monitoring Station 3 is inappropriate, because it is not significant habitat most of the time. The BIP is dependent on other, deeper habitat, further upstream, which can be protected appropriately by limits and measurements at their respective locations. As discussed elsewhere in these comments, Mirant Kendall believes the data demonstrate that the appropriate compliance locations are the upstream edge of the ZD just above the Longfellow Bridge, and 50% of the cross-sectional area of the river throughout the ZPH.

Response to D7: See Responses D9 through D12. EPA disagrees that the ZPH is "more properly considered a 'ZP' (Zone of Passage)." Mirant correctly notes that the zone supports passage for adults in the spring and passage for juveniles in the late summer and fall. However EPA disagrees with Mirant's habitat characterization. Both the pushnet and the beach seine sampling have shown that much of the area downstream of the B.U. bridge is used as habitat for juvenile alosids. The series of graphics included in Response C3 strongly supports the position that habitat use by both blueback and alewife juveniles is influenced by Mirant's discharge and the temperature increases that it causes. Arguably, were it not for Kendall's discharge, habitat use by alosids in the area of the Basin downstream of the B.U. Bridge would likely be increased. This area was "impaired" as habitat for juvenile alosids in the summers of 2004 and 2005. In addition to

anadromous species, resident species expected to be present in the lower Basin will have their habitat protected by the thermal limits established for the ZPH. Juvenile and adult yellow perch, identified as the resident species most sensitive to temperature, were collected by the permittee in the lower Basin and would be part of the BIP found in the ZPH.

Comment D8: A Compliance point at two foot depth in the ZPH is inappropriate. Section 5.8.1c of the DD presents the Agencies' rationale for applying the limits in 50% of the cross-sectional area of the ZPH and at the 2-foot depth at Station 3 near the Boston Shore to prevent high temperatures near the surface "for long periods of time."

Mirant Kendall agrees that a ZP defined as 50% of the cross sectional area of the river is appropriate, but disagrees concerning the validity of a 4-hour block average 2-foot depth compliance point at proposed Monitoring Station 3. Four hours is not "a long period of time." This compliance point is offered by the Agencies as a proxy to protect uses that are negligible or non-existent at the location. As described in the rest of this section of the comments, the important shallow habitat for resident species is negligible to non-existent at proposed Monitoring Station 3, but is abundant between the Longfellow and Harvard Bridges, upstream of Station 2.

Response to D8: EPA and MassDEP addressed the issue of the 2 foot monitoring depth in the Response to D11. The 4-hour block average issue is addressed in Responses to D3 and L2.

Comment D9: ZPH is Unsuitable Spawning Habitat. There are two reasons for the lack of suitability of the ZPH for spawning and early development for both yellow perch and alewife:

First, the area is too far downstream for eggs and young larvae in the upper water column to remain in the basin. The residence time of water in the upper water column in the ZPH, before entering Boston Harbor, is less than 3 days at normal springtime flows of 500 cfs. Even at extreme low flows for the spawning period (i.e., 100 cfs for May), the residence time is only about 8 days. See table of residence times in Volume II of the February 2001 Supplemental Application (A.R. No. 454). Moreover, the values for the upper water column would be about half the values shown in the table, which are for the overall water column. For early life stages to reach the size where they can swim well enough to remain in the river, a residence time after spawning of at least 3 weeks (21 days), and more likely 4 weeks (28 days), would be needed.

Second, for those eggs and larvae which sink into the lower water column, there is too little dissolved oxygen for survival. As shown by the vertical profile measurements made at the various stations in the ZPH since 1999, the area has become more frequently and more severely stratified, with DO generally below 2 mg/l and salinity generally above 14 ppt. See MK Comment Ex. No. D9.

Response to D9: According to data provided to EPA and MassDEP in a February 2001 submission by Mirant, in both 1999 and in 2000 the geometric mean densities of river herring larvae collected within the intake canal reached 1-10 larvae per cubic meter in mid-May to the

end of June. This is consistent with the juvenile information as juveniles began to appear in the seine nets in late June to early July. The 10 larvae per cubic meter value is a high concentration of larval fish. The location and density of these fish may provide information as to where the fish were spawned. A lower concentration would be expected if they had been spawned well upstream. Because these herring larvae were not keyed to species, it is not known whether they were alewives or bluebacks. Bluebacks are expected to spawn in faster water than alewives and should be more inclined to utilize habitat upstream of the wide, slow section of the Charles. Alewives are more likely to spawn in the slow, shallow areas along the banks. In addition, MA DMF personnel have observed river herring spawning downstream of the B.U. bridge along the Cambridge shoreline. Because bluebacks are not expected to spawn in this type of habitat, these fish were probably alewives.

The residence time information is not a good indicator of retention time of larval fish within the wide section of the lower Basin if those fish are primarily located along the shoreline. Rugosity, or roughness coefficient, greatly alters water velocities, and water velocities along the banks of the Charles are well below velocities in the mid-channel where there is essentially laminar flow. Thus, larvae spawned along the shoreline would be expected to have a much longer residence time than the general residence time calculated by average river flows. The data on larval presence in the basin are at odds with Mirant's implied statement regarding the period of larval presence. Mirant states that the residence time at normal springtime flows in May is only about 8 days, intimating that this should be the most important period regarding larval presence in the lower Basin. However, as mentioned above, peak densities of larvae were not found in May, but in early June of 1999 and 2000. Thus, the residence time of larvae during the period of highest densities should be longer than that in May because June river flows are typically lower than those in May. The median flow figure for June 1999 was 83.5 cfs. This was the second lowest June flow for the 9-years period from 1994-2002. This is below the 100 cfs figure given by Mirant that yielded the 8-day residence time.

Mirant has also stated in other comments that the years of highest juvenile river herring densities appear to be correlated with years of low springtime flows and that this is because the "washout" rate of larvae during years of high flow is controlling juvenile densities, i.e., that water temperature during the summer is playing only a secondary role. As indicated in Response C23, if, during years of low river flows, the washout rate is much reduced and during these years a higher percentage of larvae is retained within the Basin, these low-flow years become extremely important to the river herring population. This is because it is during these years that the population has the greatest opportunity to rebuild stocks. Stocks of river herring are currently at very low levels along the coast of Massachusetts (MA DMF Advisory, November 14, 2005). The agencies responsible for attending to these resources should do all they can during these low-flow years to allow these larval fish to grow to the juvenile stage and exit the system in the late summer and fall. Unfortunately, low-flow years are those with the highest potential for negative impacts due to thermal releases from the Mirant facility. This is due to the fact that there is less river water moving past the facility to assist in diluting Kendall's thermal discharge. See also Response C23 regarding Mirant's "washout" hypothesis.

EPA does not agree that there is too little oxygen in the lower water column for the sinking eggs and larvae to survive. Fish eggs and larvae occur in the lower Basin in the spring and early summer. Water quality data does not identify this time as a period when a large layer of water is absent of dissolved oxygen in the lower Basin. For example, in mid-May of 2004, when river herring egg and larval density was at a peak at the Charles River Station, DO levels at this Station were greater than 5.0 mg/l from the surface to the bottom (approximately 15 feet). Even at the Deep Diffuser Station, the bottom depth of 36 feet recorded a DO of 5.4 mg/l (Mirant Kendall Exhibit C3, October 14, 2004: May 18, 2004 Field Data). See Response H22. Vertical profile data does not show bottom depths that have become more frequently and more severely stratified since 1999. The initial onset, duration, and severity of the deep water anoxic layer is influenced by many factors, including river flow, storm events and the timing and degree of use of the New Charles River Dam Locks. Because of the variability of these factors, the characteristics of the deep waters of the lower Basin change from year to year, but have not exhibited a discernable trend since 1999.

Comment D10: Upper Water Column of ZPH is not Viable Habitat for any Life Stages of Yellow Perch. In Section 5.6.3b of the DD, the Agencies indicated that the Boston side of the river in the vicinity of Kendall Station is "more suitable habitat for the presence of yellow perch eggs."

The habitat in the ZPH is, however, a predominantly deep channel without sufficient contiguous shallow vegetated habitat for yellow perch. As shown in MK Comment Ex. No. D10-1, the area between the Longfellow Bridge and Museum of Science, especially on the Boston side, has negligible contiguous shallow habitat (i.e., less than 6 feet deep). Further, the narrow strip along the Boston shore that is less than 6 feet deep is not well vegetated. In combination, the lack of suitable depth and the lack of suitable vegetation make the shallow portions of the Boston portion of the ZPH of negligible habitat value for yellow perch.

Mirant Kendall's gillnet sampling and pushnet sampling captured no yellow perch in the upper water column on the Boston side of the ZPH. See MK Comment Nos. C3-1, C3-2.1 (2004 Data). On a minority of occasions, yellow perch were present in the lower water column. Three of the gillnet stations were in the ZPH: "Below Museum", "Boston" (near proposed monitoring station 3), and "Below Broad Canal,(on the Cambridge side between the existing discharge and the Longfellow Bridge). Yellow perch were only present in 25% (3 of 12) of the gillnet collections at the "Below Museum" Station, all of which were spring collections. Yellow perch were only present in 32% overall (44% through July) of the collections at the "Boston" station near proposed compliance Station 3, and only at depths below 12 feet.

By contrast, yellow perch were present more frequently on the Cambridge side at the "Below Broad Canal" station near the plant and the Longfellow Bridge. This area is proximate to more extensive shallow habitat than is present on the Boston side. When near-bottom salinity remained generally below 12 ppt in 2004 (through July), yellow perch were present in almost 70% of the collections (17 out of 25) at the Below Broad Kendall Canal station. As shown in MK Comment Ex. No. D10-2. Mirant Kendall's 2004 gillnet collections, despite nets deployed

at higher salinity, captured no yellow perch at salinities above 14 ppt. Most fish were caught at salinities below 10 ppt, and a few were caught between 10 and 14ppt.

Comment related to D10 from Mark Jaquith: I am also concerned about the ZPH as discussed in the fact sheet and as depicted in Attachment D of the Draft Permit. The zone is along the south bank of the river, the Boston shore. The reason that this troubles me is that there are so very many more fish near the north bank. I base this assertion on the following personal observations. When walking the banks during the herring run, you will see many times more fish along the sea wall in Cambridge than along the Esplanade. When walking the banks or boating you will see more fish breaking the surface near or from the Cambridge side. I do not fish the Charles, but those who do gravitate to the wall in Cambridge despite the relative difficulty of retrieving any fish caught. I have seen herring, eel and striped bass taken along the (Cambridge) wall.

Comment related to D10 from MA DFW: The proponent is proposing a maximum temperature of 28.3 °C in the mixing zone and certain other maximum temperatures during critical life stages of yellow perch. The optimal habitat for yellow perch is the Boston side of the river. This is the farthest point away from the station and is expected to experience temperatures on average 1.1 °C less than the proposed maximum. Therefore, this should not significantly impact the yellow perch population in this reach of the Charles River.

Response to D10 and related comments: Mirant is suggesting that the area along the Cambridge side is more important habitat for fish in general, and yellow perch specifically, than the area along the Boston shore. This is unfortunate because much of this area is within the "Zone of Dilution" (or is not monitored by a nearby monitoring station) where the facility is allowed to discharge temperatures that are toxic to many species of fish.

It must be pointed out that no qualitative and quantitative habitat assessment has been submitted by the permittee to properly characterize the two banks of the Charles River and their suitability for yellow perch habitat. While it is open to debate whether shoreline habitat on the Cambridge side would be of more value to the yellow perch population than the habitat on the Boston side, this does not mean that EPA should sacrifice habitat on both sides of the river.

Mirant's comments that perch were not found in pushnets and gillnets in the upper water column along the Boston side of the Basin, near Monitoring Station 3, exclude the information from the shoreline seines which only sample the upper water column. The shoreline seining program in 2004 did not have any stations downstream of the Longfellow Bridge; however, seining just upstream at the "Lagoon" station produced yellow perch in July, August and September that year. Thus, shoreline habitat slightly upstream of Longfellow must be at least somewhat appropriate for yellow perch. Shoreline seining in 2005 produced yellow perch at the "Boston" station, which is located directly across from the discharge, on the Boston shoreline, downstream of the Longfellow Bridge. Thus, yellow perch habitat there must also be at least somewhat

appropriate for this species. This station is near Monitoring Station 3.

Mirant's comments regarding the quality of habitat are pertinent, however. They may lead EPA and MassDEP to ultimately consider the relocation of Monitoring Station 2 in the future. The present location of Monitoring Station 2, in the middle of the river, will not provide a real time mechanism to evaluate the temperature profile of the shoreline habitat on the Cambridge side of the river upstream of the Longfellow Bridge. Placement of this station closer to the Cambridge shoreline would provide real time protection of the Cambridge shoreline from the facility's thermal plume. Early modeling by Mirant predicted that temperature effects along the Cambridge shoreline upstream of the facility's discharge would be greater than those along the downstream shoreline, possibly due to on-shore winds that partly push the plume, which travels both upstream and downstream during low-flow periods, along the Cambridge shore. Once a sufficient amount of biological and water quality data have been collected and analyzed under this permit, EPA and MassDEP will evaluate the placement of this monitor as well as all the real time fixed monitoring stations in the lower Basin.

A discussion of gill net collection of yellow perch and associated salinity values is included in Response E20.

Comment D11: The Upper Water Column of the ZPH is Not Significant Habitat for Any Lifestages of Alewife. Mirant Kendall's gillnet data for spring 2004 confirm the findings of 2002 and 2003, that adult alewives fully utilize all oxygenated depths in the water column. Roughly equal numbers of fish were captured above and below 6 feet. The upper six feet of the water column have no special significance that would justify other than a 50% cross-sectional area Zone of Passage for this life stage.

Likewise, Mirant's beach seine and pushnet sampling of YOY alewives and bluebacks has shown extensive, preferential use of shallow vegetated areas rather than the upper water column of the ZPH. Abundance of YOY river herring in both 2003 and 2004 was generally much higher at the Hyatt station above the Harvard Bridge than in the lower river (including the ZPH) throughout the summer. Abundance at Hyatt was often greater than all of the downstream stations by an order of magnitude whether or not the temperatures in the ZPH were elevated by the plant discharge. (See MK Comment Ex. No. C3).

The pushnet and gillnet data from both 2003 and 2004 show negligible daytime use of the upper 6 feet of the ZPH. Matching day/night pushnet collections were conducted throughout the July to September period in 2004 to expand the data base on this topic. Like the 2003 results, these comparative collections showed negligible numbers of YOY alewives and bluebacks near the surface at all stations (fewer than 30 fish total per day throughout July and August). By contrast, the numbers at night were ten to fifty times greater. The 2004 gillnet data from the ZPH show that 85% of the YOY fish caught in the daytime were deeper than 6 feet.

Response to D11: Based on Mirant's beach-seine data, the surface along the shorelines was used by juvenile alewives and bluebacks during 1999 in the daytime (see MKS Permit

Application, February 2001). Night-time sampling in later years along the shoreline appeared to be best for alewives, as alewife juveniles were found both near the Hyatt Station (1.6 miles upstream of the discharge) and in much smaller numbers at the Lagoon station (about 0.6 miles across the river and upstream from the discharge). Most alewives were found far upstream of Mirant's plume at the Hyatt Station near the B.U. Bridge.

Push-net sampling was initiated in 2003. Only 5 juvenile alewives were found that year in 237 separate surveys (July-October). However, in 2004 juvenile alewives were found throughout the lower Basin, albeit in extremely low numbers. See Response to C3. Most were found upstream of Mirant's plume at the Hyatt Station, in-between the Harvard and B.U. Bridge. They were also found, but in lower numbers, across the basin from Mirant at the Fiedler and Lagoon Stations, as well as in very low numbers, downstream of the Longfellow Bridge. Push-net sampling is conducted by boat and was conducted to capture juveniles away from the shoreline. The push-net data from 2004 is important because it establishes that the surface of the water column, away from shore, is important habitat for juvenile alosids throughout the summer and fall.

Thousands of juvenile bluebacks (about 15,000 in two years of sampling in the July-September period) were found throughout the lower Basin downstream of the B.U. Bridge (including areas within the ZPH) in push-net sampling at the surface. This indicates that, at least for bluebacks, the ZPH was viable habitat, although a comparison of the relative length/weight of bluebacks upstream and downstream of the discharge has not been presented. Were it not for excess heat, it appears that this area should also be viable habitat for juvenile alewives because blueback and alewife juveniles feed on similar food items. According to the analysis presented in Response C3, it appears that proximity to the discharge and the higher temperatures associated with nearness to the discharge were highly correlated with a decrease in juvenile alewife as well as juvenile blueback capture rates. Thus, Mirant's contention that the ZPH is "not significant habitat" for alewives, a contention apparently based on capture rates, may be due to the fact that juveniles were avoiding the area because of high water temperatures.

Temperature limits, if only monitored at the 6 foot depth and as currently configured in the permit, would not be protective for juvenile alewives. Push-net data shows that the mid-basin surface is extremely important for both bluebacks and alewives at night. Based on the 2004 push-net sampling, juvenile alewives and bluebacks use the surface of the water column ten to fifty times more at night than during the day, proving that the surface is crucial habitat for juveniles. Therefore, the surface of the water column is extremely important during the period when alosid juveniles are present, i.e., from late June through the end of the fall, and needs protection via a permit limit at the surface to ensure that temperatures are not so high that juvenile alewives avoid this area from dusk to dawn.

Since Mirant’s comment contended that the upper water column is not significant habitat for any lifestage of alewife, the importance of this layer to the larval stage is also discussed. Temperature limits set at the 6-foot depth in the early summer will not be protective for alosid larvae. River herring larvae were captured throughout the water column. If protective temperatures were only specified at depths of 6 feet and below, there would be no assurance that

protective temperatures would be maintained for those larvae that are at the surface. The thermal plume is buoyant. In the late spring and early summer, when herring larvae are present, temperature limits at the six-foot depth will not protect larvae that are found higher in the water column because the water above the 6 foot depth will have higher temperatures.

Thus, to address these needs to ensure sufficiently protective near-surface temperatures, EPA has retained the two foot monitoring depth in the Final Permit.

Comment D12: For adult alewives, the ZPH is only important as a Zone of Passage. Section 5.7.1 of the DD states that the "lower Charles River Basin serves as a passage way and spawning location in the spring, and a development nursery area for eggs, larvae and juveniles from the spring to the winter." Mirant Kendall agrees that the ZPH is a passageway, as shown by its tagging studies of adult alewives. However, Mirant Kendall believes that its field data show that without the restoration of oxygen to the ZPH, the Agencies' proposed ZPH is really just a zone of passage. This is because any alewife spawning that occurs this far downriver results in one of two outcomes. First, eggs in the upper water column are already too far downstream to remain in the river. Second, eggs which reach the lower water column have little or no chance of survival because the lower water column has insufficient oxygen.

Section 5.7.3c, regarding alewife, states that "out-migrations continue to occur long after in-migrations have ceased." This is true, but it does not provide support for a temperature difference between entry and spawning temperatures. There may be a lag between in-migration and spawning at the very beginning of a run if upstream migration is triggered by a brief high temperature excursion followed by a drop in temperature. In such an instance, fish may move upstream, but do not actively spawn until temperatures rise to appropriate levels. However, during the major portion of any spawning run, temperatures are sufficient for fish to spawn throughout the entire period. Thus, fish entering will spawn when they are present in appropriate spawning locations and do so continuously throughout the run, not at some specific temperature. The fact that out-migrations continue long after in-migrations have ceased is simply a result of spawned-out fish remaining long after completion of spawning. In Richkus' thesis (Richkus 1974b), he documented spawned out adults moving downstream throughout the summer. He offered no specific explanation for the delay in out-migration of these fish, but found no link between that behavior and water temperatures.

Response to D12: EPA disagrees that for adult alewife, the ZPH is only vital as a zone of passage. There is not sufficient evidence that eggs in the upper water column are already too far downstream to remain in the river. This is discussed in Response D9.

In addition, eggs which reach the lower water column in the spring are not expected to be exposed to a water layer with greatly depleted oxygen. Please see Response H22 for a full discussion of expected dissolved oxygen levels in the lower Charles River Basin when alewife eggs are present in the spring.

Mirant's statement that "The fact that out-migrations continue long after in-migrations have

ceased is simply a result of spawned-out fish remaining long after completion of spawning." seems to support the position that the ZPH provides habitat for adult alewife. If the spawned-out fish spawn in the ZPH, the fish likely remain in this part of the Basin before leaving the Charles River, thus using the zone as habitat.

Comment D13: Yellow Perch do not Move Enough to Require a Zone of Passage. Mirant Kendall's tagging studies have shown that yellow perch and their offspring are more abundant elsewhere in the lower Basin, in areas with littoral habitat, compared to the deep water of the ZPH, regardless of temperature. Further, the tagged fish remain in the same areas and do not move into the ZPH.

Response to D13: Yellow perch, characterized as a resident species, typically spend most of their lives in the lower Basin and do not use the ZPH as a zone of passage in the same manner as the anadromous alewife. Although this is referred to as a ZPH in the yellow perch discussion in Section 5.6 of the DD, the same term is still used when discussing the anadromous species, the alewife, for consistency, as it is designated as the same area in the lower Basin. In addition, it is not consistent with the objectives of the permitting process to separate fish downstream of the Museum of Science from those upstream by an area that is thermally unfit for habitation by resident species. Indeed, Massachusetts WQS for Class B waterbodies, such as the Charles, state that there shall be no changes to background conditions that would impair any of the designated uses of the waterbody. The thermal blockage of any segment of riverine areas to upstream/downstream movement by resident species would constitute an impairment of a designated use and is inconsistent with a healthful habitat of a Class B water. While the terms of the Massachusetts WQS do not control the terms of a variance from those standards under section 316(a), it is sometimes useful to understand the biological values recognized in the applicable standards in determining what is necessary to protect the BIP. In Response C3, EPA and MassDEP have determined that the effect of habitat exclusion caused by the Kendall Station's thermal discharge is an appreciable harm to the BIP. EPA and MassDEP have designed the variance to avoid segmentation caused by thermal blockage. The shoreline areas have already been shown to be used by yellow perch as habitat and the shoreline and open water areas adjacent to the Boston shoreline downstream of the Longfellow Bridge have been already demonstrated to be used by juvenile bluebacks and alewives as nursery habitat (see Responses D10 and D14).

Comment D14: In-Stream Limits for Yellow Perch Should Focus on the Upstream Boundary of the ZD. Based on physical characteristics and sampling, and the tagging and tracking of yellow perch since 1999, Mirant Kendall believes that the significant areas of suitable habitat for yellow perch spawning are distributed upstream of the Longfellow Bridge, where extensive areas of vegetated shallows are present. Further, the area above the Longfellow Bridge exhibits decreasing near-bottom salinity as one proceeds upstream, so that areas between 15 and 20 feet deep are generally more suitable for yellow perch above than below Longfellow. Therefore, any limits to protect perch spawning should be re-focused to apply to only those upstream areas suitable for that purpose.

Based on the likely location of the viable subset of yellow perch eggs in suitable habitat above the Longfellow Bridge, Mirant Kendall believes the Agencies should re-focus on a compliance location at or close to that habitat. Station 2 (see Attachment B to the Draft Permit) is above the Longfellow Bridge and closer to the discharge than the viable perch spawning areas described above. Specifically, EPA should examine the extensive available thermal data on the Kendall plume and explain how maintenance of 24-hour average temperatures below the values specified in Comment C5 at 6 foot depth at the upstream boundary of the ZD above the Longfellow Bridge from March 20 to May 10 would not protect the propagation of the BIP of yellow perch in the Lower Charles. The explanation should include the specific evidence for any claim of likely appreciable harm.

Response to D14: Please see Responses D10 and D13 relative to yellow perch and Response to C3 with respect to appreciable harm.
Mirant appears to link increasing salinities at 15 and 20 ft. water depths with declining spawning habitat for yellow perch. However, Scott and Crossman's Freshwater Fishes of Canada (1973), a standard text on freshwater fishes used in the northern U.S., states that yellow perch adults, when found in brackish water, move into freshwater to spawn. In addition, they typically spawn along the shoreline and are known to spawn in a variety of habitats, not just in weedy areas. As a result, salinity at 15-20 foot depths should not interfere with yellow perch spawning.

In addition to the above, the Boston shoreline appears to already provide nursery habitat for yellow perch, bluebacks and alewives, although the habitat in these areas may not be the same quality as in other areas. Yellow perch (assumed here to be juveniles) were captured along the Boston shoreline, by seine, downstream of the Longfellow Bridge in 2005 at the Boston seining station. These captures identify the seining area at the Boston station as a nursery area for yellow perch. In addition, both juvenile bluebacks and juvenile alewives have been caught in the upper water column in push-nets well off the shoreline downstream of the Longfellow Bridge as well as in shoreline seining in 2005 at the Boston Station. Moreover, juveniles of both species were caught in 2005 and in previous years in or near the old boat locks at the Museum of Science.

The information above indicates that a) adult yellow perch should be able to use the Boston shoreline as spawning habitat; b) shoreline areas downstream of the Longfellow Bridge have been documented as nursery habitat for yellow perch, bluebacks and alewives, and c) the upper water column downstream of the Longfellow Bridge, adjacent to the Boston shoreline, has been used as nursery habitat for juvenile alewives and bluebacks.

While Mirant's comment that areas above the Longfellow Bridge may also be suitable habitat for yellow perch has merit, this does not allow EPA to abandon temperature limits that are protective of yellow perch in areas below the Longfellow Bridge.

In response to Mirant's suggestion to "refocus" monitoring stations to protect yellow perch upstream habitat, the current location of Monitoring Stations 3 on the Boston side should provide assurance that the Boston shoreline downstream of the Longfellow Bridge, as well as adjacent areas upstream, will both be afforded protection. Moreover, Mirant's proposal to

"refocus" on the upstream habitat compromises the continuity of yellow perch habitat along the extent of the lower Basin above and below the Longfellow Bridge. See Response D13 for a further discussion of the importance of avoiding thermal blockage in yellow perch habitat.

Comment D15: In-Stream Limits for Alewife Should Focus on 50% of the Cross-Sectional Area of the ZPH. Based on the above discussion of physical characteristics and sampling of adult and YOY alewives since 1999, Mirant Kendall believes that maintenance of 24-hour average temperatures not-to-exceed the values specified in Comment C5 in 50% of the cross sectional area of the ZPH would prevent appreciable harm to the BIP of alewives in the Lower Charles. If the Agencies disagree, their explanation should include the specific evidence for any claim of likely appreciable harm.

Response to D15: Please see Response D3 with respect to the 4-hr average temperature, and Responses C3 and C23, with respect to appreciable harm from Kendall's discharge.

Comment D16: The chill period limit for yellow perch is of little, if any relevance in the ZPH. Impact on yellow perch gonadal development would only be relevant if fish resided in the location where temperature was continuously elevated. As noted above, yellow perch are currently not abundant in the ZPH because it is too saline and anoxic at their preferred depths. Therefore, the chill period standard is overly broad and of limited applicability as long as the basin is stratified.

Response to D16: EPA disagrees that lower than anticipated abundance of yellow perch in the lower Basin is due to high salinity and low DO levels in the deeper waters of the Basin. See Response to D14. No credible carrying capacity or population estimate for yellow perch in the lower Charles River Basin has been submitted by Mirant, so discussion of the abundance of this species is open to debate. Regardless of the actual abundance of yellow perch, protective temperatures cannot be relaxed for a BIP species because its abundance is claimed to be low due to other stressors. Indeed, EPA is required to take such cumulative stressors into account when establishing protective temperatures.

During most years in the winter, when the Chill Period Limit for yellow perch is in effect, the saline stratification in the lower Basin disappears. This is due to three reasons: a) a lessening of the use of pleasure boats towards the end of the summer cuts down on boat traffic through the New Charles River Dam and Locks, which results in a concomitant decline of salt intrusion due to locking these boats into the Charles; b) increased river flows during the early fall drive out the salt water in all but the deepest portions of the Basin in most years; and c) the lower Basin has been documented to become generally mixed in the winter and maintain a relatively uniform temperature from surface to bottom, where not impacted by Kendall Station's thermal plume. For example, Kendall's 2005 hydrographic data show the change in mid-depth salinity quite clearly. For example, at the Boston Station, at the 15 ft. depth, salinities in the middle of the summer reached to above 15 parts per thousand (ppt), but by the middle of October the levels were below 0.5 ppt at that depth and remained there throughout the duration of sampling which

ended November 8th, 2005, at that station. Thus, during the winter chill period for yellow perch, the salinity levels in the lower Basin at depths apparently preferred by adult yellow perch should not be problematic to those fish.

Mirant also states that the dissolved oxygen levels at the mid-depth layer would also be problematic. The 2005 hydrographic dataset from the Boston Station indicates that dissolved oxygen at 15-foot depth was sufficient for the winter chill period: it remained above 7.0 mg/L from mid-October onward. The rise in dissolved oxygen levels at the Boston Station in mid-October happened the same day that salinity levels at that station dropped. This was likely a result of the sharp increase in river flow during this time period, as recorded at the USGS Gauging Station at Waltham. According to this station, the daily flow in the Charles River increased from approximately 53 cfs on October 9, 2005, to approximately 313 cfs on October 10th, and continued to increase to over 1,100 cfs by October 15th, 2005. The increased river flow likely drove out the salt water and low dissolved oxygen levels at the 15 foot depth of the lower Basin.

Comment D17: Mirant asserts that the temperatures in the Zone of Dilution (ZD) do not reach acute effects threshold levels. Section 5.8.1c, and other parts of the DD discuss a Zone of Dilution (ZD) where "biologically based, protective water temperatures are exceeded." Throughout the document (see Section 6 for example), it is assumed that temperatures up to the maximum authorized discharge temperature (105^{O} F) are experienced in the ZD.

The State's Mixing Zone Policy, for use in conjunction with the Water Quality Standards, defines the temperature limit to apply within a Zone of Dilution as not to exceed 90 ^{O}F. Based on monitoring as closely to the discharge as possible since 2001 (MRI's "Shallow Diffuser" station), Mirant found that temperatures have not exceeded this 90^{O}F threshold even at full heat load on the warmest days (e.g., August 22, 2003).

Comment related to D17 from CLF: The permit allows the plant to discharge large amounts of heated water (105 ºF), and this will be lethal to most of the aquatic life that approaches the discharge point within the zone of dilution (ZD). The discharge water is a full 15 ºF over lethal temperature limit for the fish species. EPA's administrative record indicates that the thermal plume may extend 3 miles up river to the Boston University Bridge, covering approximately 67% of the surface area of the Basin (450 acres). Thus EPA is proposing to allow impact to a massive portion of the Basin. The conditions proposed for the ZD will result in high mortality for aquatic animals that enter this zone, including larval fishes and eggs which have little control over their distribution within the Basin. The added thermal load allowed under the draft permit would stress the biology of the Charles River beyond the conditions to which the fauna has adapted over millions of years and is not consistent with the goal of supporting a BIP. High temperature excursions do occur naturally, but they are rare and generally brief. Even these naturally occurring extremes can stress the indigenous fauna causing mortality, reduced reproductive output, and increased susceptibility to disease. The added thermal stress that would be allowed under the draft permit would be frequent and prolonged, producing conditions that

will not be tolerated well by indigenous fauna. Under the proposed permit (Attachment A), the water temperatures in the ZPH could be held near 83 ^{o}F for almost 5 months (from 12 June through 31 October). This condition would be highly unnatural, and there is no justification for an agency tasked with environmental protection to suggest that it would be supportive of a balanced indigenous population.

Response to D17: Temperatures in the ZD do in fact reach acute effects thresholds, particularly for drifting eggs and larvae. EPA's conclusion is based on species life stage acute effects levels and chronic effects, which are discussed below. Evidence that temperatures in the ZD exceed 90 °F is found in "Response F4 (part 2) and Response to Related Comment from CLF" and Response L2. However, temperatures above the 90 °F threshold are not the only elevated temperatures of concern. Mirant's reference to the 90 ºF value comes from a June 9, 1992 MassDEP memorandum that was written to assist permit writers in conducting screening evaluations of NPDES permits. This memorandum mentions that "the following should be considered for inland waters" and suggests limiting the mixing zone temperature to a 90 ºF maximum to "avoid short term adverse effects within a mixing zone". The subsequent, actual MassDEP Implementation Policy for Mixing Zones (January 8, 1993) states that "To protect swimming and drifting organisms the in-zone quality must be such that these organisms can pass through the mixing zone without acute exposure to toxicants". As explained in MassDEP's Water Quality Certification, the intent of the above referenced provision of the Mixing Zone Policy is to assure that organisms can pass through the mixing zone without being exposed to toxic conditions, including thermal impacts. In this case, site-specific information was obtained for specific organisms (see below) which demonstrates that temperatures lower than 90 ºF are toxic to indigenous organisms that inhabit the lower Charles. Because toxicity thresholds for various life stages of organisms vary, and because the presence of these different life stages within the lower Basin varies with season of the year, it follows that toxicity thresholds will also vary with season of the year. These thresholds typically change with: a) the acclimation temperature of the test organisms; and b) the duration of the exposure to the test temperature.

Toxicity thresholds for juvenile alewives are appropriately compared to water temperatures in July and August because juveniles are present in the lower Basin at this time and water temperatures are typically highest during those months. The NOAEL (No Observable Acute Effect Level) for alewife juveniles, based on research by Otto, *et al*. (1977), is 84.2ºF for juveniles acclimated to a temperature regime of 75.2 – 78.8ºF. In addition to No-Effect levels, Otto, *et al*., also reported that a mortality of 10% resulted when juvenile alewives were exposed to 86ºF and that 40% mortality resulted among fish exposed to a temperature of 89.6ºF. Temperatures higher than the NOAEL would be expected to elicit mortality if exposure duration is the same or greater than that in the test. Because water temperatures at the 90-100ºF level would not be expected to fall well-below the NOAEL temperature of 84.2ºF, or even below the 10% toxicity temperature (86 ºF) over the 500 minute range found by Otto *et al*. to induce acute effects, the Permitting Agencies contend that it is logical to assume that toxic conditions existed within the ZD in the summer of 2005.

Ambient temperatures in the lower Basin over the July-August period in 2005 were in the 70s (ºF). The mean of all temperatures reported in Mirant's 2005 Hydro dataset for the Hyatt and B.U. Stations (both located well upstream of Kendall's discharge) during the July-August period were 77.4 and 77.5, respectively. Thus, the NOAEL of 84.2 ºF developed from the Otto, *et al*., research is based on acclimation temperatures (75.2 – 78.8 ºF) that are in the same range as those at the "ambient" stations in the lower Basin during the July-August period.

Information submitted by Mirant as part of the 2005 Hydro dataset strongly suggests that temperatures exceeding the toxicity threshold for alewives juveniles (i.e., the NOAEL of 84.2 ºF) appeared to persist at some sites for periods longer than those expected to induce toxicity. Because temperature readings were not continuous, temperatures lower than the 84.2 ºF may have occurred at these stations between readings. However, temperatures at the surface of the water column exceeded the 84.2ºF value on all five dates when monitoring was conducted at the Shallow Diffuser Station from August 9 – August 22 and for all three dates that monitoring was conducted from August 29 through September 6.

There is also concern that fish exposed to high temperatures will suffer from chronic effects. Williams and Coutant (2003) published an article on heat exposure of eggs and larvae of an atherinid fish, *Atherina mochon* (Williams, M.A. and C.C. Coutant. 2003. Modification of schooling behavior in larval atherinid fish *Atherina mochon* by heat exposure of eggs and larvae. Trans. Amer. Fish. Soc. 132:: 638-645). The authors studied effects of short, daily exposures to sub-lethal temperatures in simulation of a transient thermal plume. Evaluation of larval fish at 10-35 days posthatch showed "significant modification or retardation of schooling behavior". These behavioral modifications, due to sub-lethal heat exposures, are of concern to regulators. Schooling behavior is a common behavior in certain fish and has been found to be a primary defense against predators.

In addition to the problems noted for alewives, other problems are expected with zooplankton. Daphnia pulex, one of the common zooplankters expected in the Charles, has a reported TL50 value of 80.6 °F (Craddock, 1976) and the No-Effect temperature of this species would be at a temperature lower than 80.6 ºF. Thus, assuming this TL50, lethal effects to D. Pulex are likely in the ZD when thermal areas are not avoided. In general, temperatures sustained above 77 °F for more than 7-10 days are detrimental to zooplankton communities in the northeast (Moore et al., 1996). With a 5 °F delta T, Kendall's discharge is expected to increase the number of weeks greater than 77 °F from 0-1 without the discharge to 8-12 weeks with the discharge (see Section 5.8.2l of the DD).

There is sufficient direct and indirect evidence that acute toxicity to aquatic life in the lower Charles is likely to occur. ZD temperatures are expected to have the greatest Delta temperature compared to ambient river temperatures when river flows are low and it is during these times that acute toxicity to aquatic life has the greatest potential of occurrence. The areal extent, frequency, duration and magnitude of any naturally occurring high temperature events are all expected to be increased by Mirant's discharge.

Response related to D17 comment from CLF:

1.) One likely characterization of the Zone of Dilution may generally predict this area to follow along the Cambridge shoreline, out to Monitoring Station 7, over to Monitoring Station 4, then to the middle of the Basin where Station 2 is currently configured, and then along a line perpendicular to the river flow back to the Cambridge shoreline. This is about 60 acres in size. The total size of the segment of the water body where the B.U. Bridge begins to the new Charles River dam is about 430 acres. Thus, the allowed Zone of Dilution is about 14% of the river segment surface area.

2.) Although the Final Permit end-of-pipe discharge temperature limit is 105 °F, other permit conditions prevent continuous high-volume discharge at that temperature for long periods of time. Based on an analysis of ambient temperature conditions in the lower Basin, the ΔT limit of 5 ºF, the placement of the individual temperature monitors in the ZPH, and the operational profile of Kendall Station, it would be highly improbable for any portion of the ZPH to be held near 83 ºF for long periods of time. Assuming that Mirant complies with the conditions of the permit, the prospect of the entire ZPH being near 83 ºF without abatement for almost five months is extremely unlikely.

As discussed in the Kendall Station Determination Document (DD, Section 5.7.3g), when continuous ambient temperatures in the lower Basin are reviewed from 1995 to 2002, it is evident that a temperature of 83 ºF could not be maintained in the ZPH for any appreciable length of time. Both diurnal temperatures and the temperature record over the course of any 10 day period show very few instances with stable, constant temperatures for any length of time. Rather, changes as great as 8 to 10 ºF can be seen over the course of two weeks (September 1996, 1997, 1999, 2000 and 2001; Figures 5.9.2-17, -18, -20, -21, -22).

These ambient temperature readings were taken after a wedge of water representing the upper eleven feet of the water column was mixed and withdrawn into the Station. The permit requires individual temperature monitors placed at various depths, including a depth of two feet. Temperatures measured in this way have been shown to document even greater temperature variability than the eleven foot mixed water column temperature. Ambient temperatures recorded near the B.U. Bridge in the summer of 1999 and 2002 also show changes in temperature over approximately a two week period of approximately 7 ºF (DD Figure 5.9.2-3,and 5.9.2-4).

Thus, the Delta T limit of 5 ºF plays an important role in ensuring that the receiving water does not reach and maintain maximum temperature limits for prolonged periods of time. The natural variability in ambient temperature, as discussed above, coupled with a ΔT limit of 5 ºF over ambient conditions in the ZPH, make it a permit violation for temperatures in the ZPH to remain at 83 ºF when, for example, temperatures drop more than 5 ºF below this limit.

The number and position of real time, in-situ temperature monitors required for the ZPH will

almost certainly have only one or two monitors that approach the maximum temperature allowed at any given time. The Station will be required to take action to reduce their thermal discharge when only one of the identified monitors in the ZPH reach the maximum temperature allowed. The remainder of the monitors will likely not come in contact with the higher temperatures before action is taken at the Station. This is especially likely as Kendall Station maintains a near surface discharge point on the Cambridge side of the Charles River. Temperature monitors deeper than two feet and closer to the Boston side of the river will not likely be the first compliance monitors to come in contact with the Station's surface thermal discharge plume. Based on vertical profile data submitted by the permittee (Mirant Kendall, September 2005) temperature compliance points below two feet and closer to the Boston shore of the ZPH should never be warmer than compliance points at a depth of 2 feet that are closer to the Cambridge side of the Charles River.

Finally, the reality of Kendall Station operation makes it nearly impossible to maintain a ZPH with water temperatures consistently at or near maximum limits for extended periods of time. Kendall Station's present operation does not have the ability to make small changes in discharge temperature to react to changes in ambient river conditions with the goal of maintaining, but not exceeding, a certain target temperature in the ZPH. Once a maximum temperature limit is approached, the Station only has the option to modify operation to noticeably reduce the discharge temperature (see Section 5.11 of the DD). Modifying Station operation in graduated, refined increments to stay within a one degree Fahrenheit target in the ZPH is not feasible in order to be consistent with Mirant's participation in the energy supply market.

For all the reasons listed above, it is not realistic that "…the water temperatures in the ZPH could be held near 83 ºF for almost 5 months (from 12 June through 31 October)." This statement does not take into account many interrelated aspects of ambient river conditions in the lower Basin, the design of the permit requirements, or the operational realities of Kendall Station.

Comment D18: Delta T Issues - Misunderstanding and Mischaracterization of Data in Record Regarding Response of Various Species to Delta T from Thermal Plume. Section 5.8.2 of the DD presents a series of discussions regarding the potential biological effects to fish associated with the spatial and temporal temperature changes potentially resulting from Facility operation. Mirant Kendall believes that this section is heavily flavored by misunderstanding and misconceptions concerning the shape of the thermal plume and Mirant Kendall's past proposals. Those misconceptions are reflected most directly in Section 5.8.2b-1, but if reconciled, affect the entire section and its endpoints.

Specifically, it appears that the Agencies seek a 5 ºF "horizontal" Delta T requirement to prevent exposure of fish swimming horizontally upstream to rapid temperature changes. They wish to maintain a 5 ºF Delta T component at the edge of the ZD. Mirant Kendall disagrees with the necessity for those requirements in view of contrary biological evidence, but believes the objectives can be accomplished as described below.

Comment related to D18 from CLF: The method proposed by EPA for determining delta T is flawed because the intake can be contaminated by the discharge – corrupting the delta T measurement for facility *temperature rise* and for other uses of delta T. EPA discusses this "re-entrainment" problem on page 81 of the Determination Document. This problem will cause an underestimate of delta T for facility *temperature rise* and this will translate into a corresponding underestimate of the thermal load. The baseline temperature for determining this and other delta T values should be based on a series of up-stream monitoring stations as discussed above.

Response to D18 and related comment: The submission of a validated hydrodynamic model would have greatly assisted EPA in evaluating the shape of the thermal plume from Kendall Station's discharge. Perceived inaccuracies in the expected shape of the thermal plume cannot be challenged with any degree of confidence using only the information submitted by the permittee. The permittee does not state in this comment what biological evidence there is that is in disagreement with the need for a Delta T of 5 °F. As a result, EPA cannot comment on the validity of the evidence. Additional discussion of the biological basis for the Delta T of 5°F is provided in Response D19.

It is not clear from CLF's comment whether it addresses the Delta T limit of 5 °F across the lower Basin or the Delta T limit of 20 °F within the plant. As to the limit in the lower Basin, EPA has attempted to place the background monitor used to implement this Delta T requirement in a location that will not likely be affected by the discharge plume from the facility. As to the limit in the plant, it is possible that the intake for the Kendall Station might be influenced by the discharge plume under certain conditions. Ultimately, however, that discharge cannot exceed a maximum temperature of 105 °F and the in-stream temperature compliance must be attained. These permit requirements limit the effects of a rising intake temperature. The Delta T limit of 5 °F in the lower Basin will also help prevent extreme effects from the Station's intake re-entraining the discharge.

Comment D19: The Agencies' Contention that Individual Fish in a School are Traveling in Different Isothermal Lines is Not Plausible. Section 5.8.2b-2 of the DD focuses on data from Mirant Kendall's November 5, 2002 correspondence, (A.R. No. 244) to argue that fish may have been traveling linearly rather than across the observed Delta T of 8 °F.

This supposition is wholly inconsistent with the principles of natural selection (which would rapidly extinguish any estuarine fish which traveled that way). It is also inconsistent with years of observation of schooling behavior of alosids, which shows them to move throughout the water column. Further site-specific data demonstrating the same type of distribution pattern, across greater Delta T's of at least 12 ºF, was submitted in 2003. A.R. No. 489. Those data were collected from gillnets set for only 1-2 hours, casting doubt that multiple schools of fish were involved or that water temperatures changed during capture. In fact, water temperatures were measured several times on those dates, and did not change by more than 1-2 ºF at the involved depths.

Response to D19: Mirant maintains that because fish were gill-netted at different depths, and

because temperatures from the upper waters where fish were captured to the lower depth where fish were captured were up to 8°F different, that it follows that the fish captured in the gill-net must routinely move across a delta temperature of 8°F. EPA disagrees that the capture location of a fish within a column of water that also displays vertical changes in temperatures with depth is evidence that the fish routinely moves vertically through the differences in temperature. Mirant fails to provide documentation that the fish actually moved routinely through the vertical thermal gradient. It is just as plausible that the fish captured at a certain temperature had remained within this preferred temperature and depth gradient until it was gillnetted. In addition, much of EPA's concern over delta temperatures is linked to travel from Boston Harbor into the Charles and from the Charles out to Boston Harbor. Concerns over delta T's greater than 5 °F within the Charles and their effect on the delta temperatures experienced by fish moving between Boston Harbor and the Charles are discussed in Sections 5.8.2d - 5.8.2k of the DD.

Several other issues are of great concern to EPA with regard to increases in the allowable delta temperature: effects to zooplankton and to juvenile alewives.

Increases in allowable delta temperatures will protract the duration, areal extent, frequency and magnitude of high-temperature events in the lower Basin. This is discussed at length in Section 5.8.2l of the DD. Negative effects to zooplankton are also discussed in this section of the DD. Protracted high-temperature events above 77 ºF are known to negatively affect zooplankton. See Response to D17.

Surface temperatures that exceed 81 °F appear to present problems in the lower Basin of the Charles for juvenile alewives. This is evidenced by the near-complete lack of juvenile alewives in Mirant's beach-seine and push-net datasets in the lower Charles over the years 1999-2004 and much-reduced catch-per-unit-effort of juvenile alewives above 81 ºF in 2005. American shad have been shown to be even more temperature sensitive than alewives, and EPA is concerned that delta temperatures induced by the facility will create a wide margin of poor quality habitat for American shad at the surface downstream of the B.U. Bridge during low-flow summers. See Responses to C51 and C52 regarding American shad restoration efforts being conducted in the Charles River. As mentioned above, the magnitude, frequency, areal extent and duration of these events all will be increased with increasing delta temperatures.

Comment D20: Mirant Kendall Does Not Change the Severity of Vertical Thermal Stratification. The thermistor data provided to the Agencies show that the severe vertical stratification of temperature in the ZPH occurs independent of Kendall Station's operations. At whatever heat load the plant is discharging, the abrupt thermocline creating vertical Delta Ts of more than 10 °F in the ZPH always occurs below the depth of influence of Mirant Kendall's thermal plume. Importantly, Mirant Kendall's proposed diffuser would alleviate the chronic severe vertical stratification in the ZPH by its mixing of the water column.

Response to D20: Again, a validated hydrodynamic model would have assisted EPA in evaluating the influence of Mirant's discharge. That said, EPA believes that the discharge does affect the thermal stratification present in the lower Charles Basin. Although it appears that

natural stratification would be expected in the absence of Kendall Station's thermal discharge, the thermal discharge accelerates the degree of stratification. The warmer, and thus more buoyant water discharged near the surface of the river at Kendall Station Outfall 001 has been documented to float, or remain near the surface, as it is discharged. This prevents deeper, ambient temperature river water from moving to the surface as a result of wind or wave action. This process is thought to accelerate the overall stratification in the lower Basin. EPA and MassDEP have commented that this stratification could be diminished with the introduction of a deep water diffuser, but as stated in the supporting documents of the Draft Permit as well as this response document, there are other coincident concerns with the operation of a diffuser that must be addressed before the diffuser discharge is allowed. See Section E.

Comment D21: The Agencies Misunderstood Delta T Characteristics of the Thermal Plume. Section 5.8.2b-2 of the DD hypothesizes that a combined Delta T of 15 °F could result from an approach proposed by Mirant. This is impossible. It has been mistakenly assumed that the temperature pattern could go from lowest at the upstream location (Station 1) to highest at the downstream location (Station 8). To the contrary, the pattern is one of progressive cooling in all directions from the discharge, so that an overall Delta T of 5 ºF between the upstream and downstream borders of the ZPH (Stations 2 and 8) would be maintained.

Response to D21: Although theoretically allowable, based on the proposed permit provisions, a 15 ºF Delta T would not likely occur, at least horizontally, as under most conditions there is progressive cooling in all directions from the discharge. A suitable hydrodynamic model would provide the necessary information to clarify this point.

Under this description, and in the absence of a model, the overall Delta T of 10 ºF from ambient conditions could result – a Delta T of approximately 10º F or higher (see Tables F4.P2.CLF-1 and -2) within the vicinity of the outfall, and a Delta T of approximately 5 ºF at upstream and downstream borders where the thermal plume has dispersed and cooled somewhat. A sustained Delta T of 10 ºF or greater is not considered protective of the BIP. See Response D23 for further information regarding the potential biological effects of a Delta T greater than 5 ºF.

Comment D22: Agencies have Exaggerated Delta T Seen by Fish Entering the River. Section 5.8.2d of the DD states that "[h]eated water, discharged from Mirant Kendall's facility, increases the temperature differences between the two bodies of water and increases the potential for thermal shock to anadromous fish."

Continuous monitoring during spring 2004 showed Delta T's of only about 1 ºF between the Harvard Bridge and the Charlestown Dam in April when the plant was running at 90% heat load for days at a time. Because of high spring flows, the Agencies' assumptions of 5 ºF Delta T's during the spawning run are wrong. Even under seasonal extreme low flows in the spring (40 year minimum about 100 cfs), Delta T's of 5 ºF would not be approached. Maximum Delta T's of only about 3 ºF or less would occur at the dam, too small to have the exaggerated effects discussed throughout Section 5.8.2.

The severity of the interface at the dam is mischaracterized and exaggerated by the Determination Document, invalidating many conclusions in this section. Mirant's vertical profile data, collected and forwarded to the Agencies in 2000, 2002, 2003 and 2004, show that the near surface water just below the Charlestown Dam in the harbor and lower depth water just above the Dam in the river are at virtually the same temperatures and salinity. These waters mix when the fish enter. The speculation about stress is therefore unsupported.

Response to D22: These comments are addressed in Response C6 . Additionally, MassDEP and EPA note that Mirant's observations about the low level of Delta T observed in the lower Basin when the Station was operating at high capacity suggests that the Station should have little trouble complying with the Delta T limit in this permit. Therefore, to the extent that there is a dispute over the biological necessity of avoiding extreme shifts in temperature across the lower Basin, it is reasonable to err on the side of including the limit to assure protection of the BIP in the event that such temperature shifts are biologically significant. If Mirant's understanding of Delta T in the lower Basin is correct, this limit should constrain the facility only in the most extreme circumstances, which is likely precisely when the BIP will most be in need of protection.

Comment D23: Agencies' Discussion of Acclimation to Delta T Compounds Speculation. Section 5.8.2f of the DD quotes from Cooper (1961) regarding the inability of the alewife to acclimate readily to rising or fluctuating temperatures. Here, the Determination Document is employing speculation by Cooper, not any specific scientific finding, as the basis for support for their own further speculation. On p. 131, Cooper's speculation is presented as virtually fact "and is at least 5.6 ºC higher than the temperatures associated with large-scale adult mortalities witnessed by Cooper in RI fish." Cooper did not observe mortalities, he assumed that they must have occurred.

Response to D23: The DD cited Cooper's study and its findings as one of several studies showing that delta T's of 5 °F or more present lethal and sub-lethal consequences to fish. The weight of evidence, along with the State's delta T requirement, points to the appropriate delta T limit of 5 °F to protect fish in the lower Charles River Basin. The DD clearly lays out the adverse effects of elevated delta Ts and provides a clear rationale for the need to impose this limit.

Regarding a Delta T of 5 °F, in "Temperature Criteria for Freshwater Fish: Protocol and Procedures," a National Technical Advisory Committee (EPA 1977) recommended "To maintain a well-rounded population of warmwater fishes…heat should not be added to a stream in excess of the amount that will raise the temperature of the water (at the expected minimum daily flow for that month) more than 5 ºF." EPA (1977) further states that, "A casual reading of this requirement resulted in the unintended generalization that the acceptable temperature rise in warmwater fish streams was 5 ºF. This generalization was incorrect. Upon more careful reading the key word 'amount' of heat and key phrase 'minimum daily flow for that month' clarify the erroneousness of the generalization. In fact, a 5 ºF rise in temperature could only be acceptable

under low flow conditions for a particular month and any increase in flow would result in a reduced increment of temperature rise since the amount of heat added could not be increased."

Response D31 lists some other states where a Delta T limit has been incorporated into regulations for the protection of aquatic life.

Comment D24: Agencies' Speculation on Avoidance Behavior is Contradicted by Field Data. Section 5.8.2g of the DD citing Dixon (1996), suggests that alewives and bluebacks both seek to stay at light levels allowing them to maintain a school. Dixon's observations with regard to this behavior were of juveniles of these species, not of adults undertaking spawning migrations.

Mirant Kendall's gillnet data since 2000 and biosonic monitoring in 2002 show that the river herring are fully distributed throughout the oxygenated portions of the water column, with as many or more caught at depths of 6 feet or deeper than at shallower depths.

These data also show that horizontal Delta Ts lower than the ranges of concern to the Agencies have always been available to the fish, even when the plant ran at 90% heat load in mid-to-late April 2004. During each year's run, alewives have been captured equally or more often in gill nets set just off the Cambridge shore upstream of Kendall (MRI's Below Broad Canal Station) than at any other station. The speculative avoidance behavior described here by the Agencies is contradicted by these results. The Agencies should reconcile these data with the discussion in 5.8.2 and revise the discussion to reflect the data.

Response to D24: Mirant is correct in specifying that Dixon's work pertained to juveniles, not adults. However, the citation by Bigelow and Schroeder describes the same behavior pattern for adults that Dixon found for juveniles, i.e., that adult alewife have a vertical, diurnal movement in the water column.

Regarding delta temperatures above and below the New Charles River Dam, EPA currently lacks information regarding what percentage of alewives or bluebacks or other species of anadromous fish are held back by the dam due to delta temperature differences between a) water temperatures at which fish attempting to enter the Charles have acclimated to; and b) water temperatures in the Charles. Movement of fish past dams, even those without a large delta temperature difference, has been known, at times to be limited to a small percentage of the population of migrants, especially if the fish ladder at the dam, or dam operation is faulty (Dick Quinn, U.S. Fish and Wildlife Service, pers. comm. to Gerald Szal, May, 2006; also see Sprankle, 2005. Interdam movement and passage attraction of American shad in the lower Merrimack River main stem. North American Journal of Fisheries Management. 25: 1456-1466. AR #633)). An additional drop in the percentage of fish moving into the Charles could result in a substantial, negative impact to populations already at extremely low stock sizes. The review of delta temperature differences presented in the Determination Document was conducted to determine the potential for high delta temperature effects in the Charles, effects that are predicted from studies reported in the literature.

Mirant's information from the gill-netting does not address the questions for which the delta temperature analysis was conducted in Section 5.8.2g. These questions include what percentage of fish are potentially held back by delta temperature differences between the two waterbodies at the New Charles River Dam, and how an increase in the permitted Delta T would affect these fish. The primary issue addressed in Section 5.8.2g is that of temperature differences above and below the dam and entry into the Charles, not movement upstream once entry has been achieved. Regarding other Sections of 5.8.2 and potential avoidance, Mirant's biosonic monitoring data were somewhat disturbing to EPA because a number of the fish in the survey did not move past the facility's discharge. Some of the fish did not move past the old boat locks at the Museum of Science and others appeared to have spent a lot of time in the vicinity of the facility's discharge (see Response C10 (continued) and Responses D26 and D27). This is not avoidance, but an attraction to the discharge, probably because of the increased velocity of water near the discharge rather than an attraction to any temperature difference. Mirant also provided a video to regulators that clearly showed river herring exhibiting spawning behavior *inside* Kendall's discharge pipe.

Fish drawn to discharges can be lost to the population at large. This behavior has been observed at Brayton Point Station, where striped bass congregate within the discharge canal in large numbers, and overwinter there rather than continuing their migration farther south. Spawning inside the discharge pipe at the Kendall station is not expected to result in viable offspring for a number of reasons discussed in the Determination Document. In addition, the simple attraction of fish to the discharge can keep them from moving upstream. These are of considerable concern to EPA. Mirant's gillnet data that show that alewives have been captured equally or more often in gill nets set just off the Cambridge shore upstream of Kendall does confirm that alewife can move past the Station's thermal plume. However, it may also indicate that their full migration well upstream could be interrupted from other facility impacts.

Comment D25: Avoidance Would be Expected to Mitigate Potential for Lethal Effects. The speculative presentation of the major temperature change that upstream migrating fish encounter, and the lethality of the thermal plume of the plant ignores the fact that fish will avoid lethal temperatures, as was noted by Klauda for juvenile shad.

Comment related to D25 from CRWA: Documentation supporting the permit states that, "A key aspect of the Massachusetts WQS subject to this variance is the mixing zone policy which calls for no lethal affects (sic) in the Zone of Initial Dilution." The permit appears to waive this requirement. It also appears that the requirement in DEP's Mixing Zone Policy stating that, "to protect swimming and drifting organisms, the in-zone quality must be such that these organisms can pass through the mixing zone without exposure to toxicants." has been waived. EPA should explain how adding so much heat to the system is protective. CRWA believes that this permit will violate the anti-degradation provisions of the Massachusetts SWQS by eliminating or impairing existing uses.

Response to D25: A discussion of river herring avoidance is found in Response C3. Avoidance

is an effect that must be accounted for in protecting the BIP. To the extent that avoidance due to absolute temperatures or delta Ts cause excessive habitat to be lost or avoided, EPA and MassDEP have established permit conditions to protect against such eventualities. EPA and MassDEP believe that the combination of instream temperature limits and delta T limits will minimize such occurrences.

Mirant is at least partly correct in stating that avoidance should mitigate for lethal effects. However, there are conflicting issues here. First, if fish at the New Charles River dam "sense" that temperatures are too warm, based on Mirant's statement, these fish would avoid entry to the system. Thus, avoidance at the dam will reduce the entry of fish to the Charles.
Second, avoidance of high temperatures, when other stimulants such as increased water velocity are present, can apparently be "over-ridden" by the attraction to a second stimulant. When there are conflicting stimuli, river herring – such as those attempting to spawn in Kendall's discharge pipe – do not appear to always act in a fashion that benefits their own reproductive success.

Third, if fish are driven to avoid unacceptably large areas of the Basin, that in itself constitutes appreciable harm to the BIP and is not consistent with EPA's obligations under CWA 316(a).

Response to Comment related to D25 from CRWA: EPA agrees with CRWA that Mirant's discharge does not qualify for a mixing zone pursuant to MassDEP's Mixing Zone Policy. This Permit is not based on a mixing zone. It is based on a CWA 316(a) variance. See also Response to C1. As explained extensively in this document and in MassDEP's certification, the permitting Agencies acknowledge that the permit will allow for potentially toxic thermal conditions in the mixing zone. But EPA and MassDEP have concluded that permit enforces conditions in the ZPH that are consistent with protecting the BIP, and therefore, the Permitting agencies are authorized under 316(a) and Massachusetts' WQS to vary from the MassDEP's Mixing Zone Policy.

EPA and MassDEP do not agree with CRWA's contention that "this permit will violate the anti-degradation provisions of the Massachusetts SWQS by eliminating or impairing existing uses". First, the protective temperature limits and other provisions included in the Final Permit are far more protective than provisions in the former permit. This determination is consistent with the CWA and State WQS antidegradation requirements. The core requirement is that "[i]n all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." 314 CMR 4.04. The protective provisions included in the permit will only improve the Basin as a habitat for fish. Massachusetts has provided a CWA 401 certification specifying the conditions on protective temperatures and the cooling water intake, including the specified entrainment reduction requirements, which are required to satisfy the Commonwealth's WQS, including the antidegradation provisions. EPA has included these conditions in the Final Permit.

Comment D26: Mirant contends that tracking studies show that the fish are not significantly

distracted and that Section 5.8.2h of the DD speculates that the thermal plume distracts the fish and delays migration. Mirant Kendall's tracking studies show that there is no significant effect, if any.

Response to D26: Mirant's tracking studies were limited and inconclusive. During the permittee's tracking studies, although many fish traveled upstream, there were several that lingered below the area of the discharge or were presumed dead. In one study, covering the period of May to July of 2001, 9 out of 80 tagged fish did not move above the Museum of Science and were presumed to have died or regurgitated their tags. The specific operating conditions at Kendall Station during the days when these fish were released were not assessed as part of the overall study. In general, June of 2001 had monthly heat load discharges of 183 million BTU/hour. The study does not clearly show that migrating herring were not distracted, even with heat loads well below what they could be during certain months and at higher generating periods. It may be possible that fish simply swam at lower depths near the discharge where temperatures were generally several degrees lower than at the surface. Depth tracking did not provide reliable information, so this possibility can not be evaluated using the data collected. Response D27 provides additional information on Mirant's fish tagging studies.

Comment D27: Agencies' Speculation about Fish Navigational Difficulties is not Plausible. Section 5.8.2j of the DD describes a variety of hypothetical difficulties of detection and navigation of migrating river herring around the horizontal Delta Ts in the ZPH. The Agencies should explain what, if any evidence, they see of significant effects of this type for each of the tagged and tracked fish in Mirant Kendall's studies. Also, they should explain why all of these hypothetical concerns are focused on horizontal Delta T's that only reach 2 ºF to 3 ºF over distances of 1,000 feet or more in the spring migration, yet these fish are almost always swimming within less than 20 feet of vertical Delta Ts (caused by stratification, not the plant) in excess of 10 ºF.

Response to D27: EPA and MassDEP acknowledge the substantial effort undertaken by the permittee in conducting fish tagging and tracking studies in 2001 and 2002. However, it is not appropriate to characterize the behavior of a subset of tagged and tracked fish as "significant," primarily because the overall number of tracked fish that yielded sufficient tracking data (16 blueback herring total in May and early July of 2001; 28 fish in 2002, with complete tracking records for 20 of those fish) was relatively low. (Mirant Kendall NPDES Permit Application, 2001, Volume II, Appendix 5-7; MRI Charles River Sonic Tracking Study, February 6, 2003). It is reasonable, however, to use the information gained from the tracking results, along with information from other sources, to support a "plausible" position regarding the effect of the thermal plume.

As detailed in the DD, most fish that were tracked in 2001 swam past the thermal plume from Kendall Station without displaying obvious behavior that would indicate their movement was disrupted. However, a small number of fish were observed meandering in the basin, between the Museum of Science and the Harvard Bridge, for two weeks to a month. Because the overall number of the tagged fish was small, it is difficult to say with certainty whether or not the

behavior of this subset of fish was a significant indicator of fish passage disruption from the Station's thermal plume. Similarly, sonar-tracking of a small number of blueback herring in 2002 appeared to show that some bluebacks may have had trouble negotiating passage upstream of the portion of the basin generally influenced by the Kendall Station discharge. Some of the fish released above the New Charles River Dam wandered in the area downstream of the Mirant discharge for weeks. Once again, it is unknown what percentage of alosid in-migrants are affected in this manner, so a determination of a significant disruption can not be made given the sample size. It is plausible, however, that thermal plume from the station may play a leading role contributing to this observed behavior. Bluebacks are supposedly more tolerant of heat effects than the closely-related alewife. If bluebacks had problems navigating past the Mirant discharge due to the effects of the thermal plume, there is a concern that alewives would also have problems. Therefore, the documentation that some river herring did not proceed past the thermal plume to spawn upstream remains a concern of EPA and MassDEP. The agencies hope to work more closely with Mirant in the future to develop information from sonar tracking to address some of these issues.

As highlighted in Response H22, pronounced stratification that would be expected to cause large vertical temperature differences as well as low DO levels in the deeper water is generally not observed during spring in-migration of anadromous fish into the Charles River. When these conditions do occur in the late summer, Mirant has offered no evidence that river herring routinely travel to deep, cooler water that is low in oxygen and back to the epilimnion, thus experiencing delta T's in excess of 5 °F. In fact, one of Mirant's most often repeated arguments in favor of the deep water diffuser has been to open up this deep water habitat to fish that Mirant contends, and EPA agrees, are excluded from these waters now. Please see Responses to E1(3) and E5 regarding the quality of this habitat.

Comment D28: Outmigration of YOY Herring Occurs Over Large Temperature Range. In Section 5.8.2m of the DD, the Agencies extrapolate Crecco's study on juvenile shad survival in the Connecticut River to assume that the longer that YOY alewives and bluebacks remain in the Lower Charles, the less likely they are to survive. The assumption is then compounded with another assumption, that Kendall Station's discharge increases the duration that alosid juveniles remain in the Charles, to conclude "Delta T from Mirant's discharge in the final few miles of the Charles would likely have a negative effect on alosid recruitment to the system."

There are several fundamental flaws in this sequence of speculative, unsupported assumptions and conclusion. First, the YOY herring leave in waves throughout the summer and fall over about a 25 ºF range of declining temperatures. Given this fact, how can the Agencies conclude that a 5 ºF difference on a given day is likely significant?

Second, there is no evidence to support the assumption that YOY alosids in the Charles are worse off the longer they remain in the system. The shad nurseries in the Connecticut which are referred to by the Agencies are not comparable to the Lower Charles. The Connecticut nurseries are hundreds of miles further upriver than the nursery area in the Charles.

The agencies should discuss how the successful runs of alewives are sustained in the Monument River when those out-migrating fish, upon exiting the river to the Cape Cod Canal, may encounter not only a Delta T leaving the river, but a second up-to-20 ºF Delta T when the tide stage is such that they encounter the abrupt front of Cape Cod Bay water that is up to 20 ºF colder than the Buzzards Bay water it replaces.

Response to D28: EPA agrees that YOY river herring leave the Basin as temperatures decline. With a maximum temperature limit in effect in the absence of a Delta T limit, it is possible that portions of the lower Basin could be kept at an artificially high temperature for a longer period of time than would be seen with a Delta T limit of 5 °F. That is why EPA and MassDEP agree once again with Mirant that a 5 °F difference on a given day is not likely significant. However, Delta Ts above 5 °F for extended periods of time would disrupt the timing of out-migrating YOY river herring that are keyed to certain natural temperatures as part of their cue to leave the lower Basin.

EPA does not agree with Mirant's statement that the shad nurseries in the Connecticut are not comparable to the lower Charles. Setting this point aside, it must be noted that one objective to support the protection of the BIP involves the maintenance of the natural seasonal cycles in the lower Basin. Elevated temperatures in the ZPH as great as 5 °F above ambient conditions resulting from Kendall Station's thermal discharge likely disrupt the natural seasonal cycle to some extent. Limiting the Delta T to 5 °F ensures this disruption does not have a large impact on the BIP. Response C32 discusses the negative impact associated with delayed out-migration of river herring, in contrast to Mirant's assertion.

Mirant discounts shad nurseries in the Connecticut River as not comparable to the lower Charles River Basin, but in the same comment, Mirant challenges EPA to discuss why conditions in the Monument River are not also applied to the lower Charles River Basin. Without additional specific information on the amount of mixing that takes place at the mouth of the Monument River and at what point in the tidal cycle, if any, periodic out-migration takes place, what types of temperature changes these fish undergo, whether or not they spend time in a thermally mixed area, follow outgoing currents or travel upstream against these currents, EPA is unable to fully address Mirant's request for a discussion of alewife runs in the Monument River and how they relate to out-migration in from the Charles River.

Mirant also submitted juvenile alewife data from a river in Virginia (see Comment C13(j)). This is another case where the permittee offered data they maintained had a bearing on Charles River alewife, while discounting Connecticut River information discussed by EPA and MassDEP. Rather than discounting the Virginia data outright, EPA and MassDEP reviewed the data to determine its usefulness when applied to the Charles River (see Response to C13(j)).

Comment D29: Summertime Impacts to Zooplankton, Larval and Juvenile Fish are based on Inappropriate Comparison. The foundation for the Agencies' discussion of this topic is incorrect because of differences between the stratified semi-estuarine lower Charles and the freshwater lakes studied. The Agencies should explain how this speculation could be valid when all the

site-specific studies of zooplankton, larval abundance from year-to-year, and juvenile abundance from year to year completed and entered into the record by Mirant Kendall show no evidence of this effect in the Charles.

Response to D29: EPA does not agree that the freshwater, impoundment-like characteristics of the lower Basin are so dissimilar from the lakes studied that appropriate comparisons cannot be made. The hydrologic nature of the lower Basin changes dramatically over the course of the year. During higher flows, the lower Basin acts like a river, with short-duration retention times. By contrast, during most summers, as river flows are lessened, retention time in the lower Basin increases and the lower Basin becomes much more lacustrine. Indeed, the permittee argues that the lower Charles River Basin should be characterized as a lake in Comment H1. This is addressed in Response H1.2.a. It is these summer periods which are most important to river herring juveniles as they begin to appear in the Basin in late June and use the area as a nursery throughout the summer and into the fall. During this period the quality and quantity of zooplankton is most important to river herring. With the recent release of over a million American shad fry into the Charles in 2005, this area is also expected to be important as a nursery to juvenile American shad which also prey on zooplankton. In the summer, the epilimnion of the lower Basin is very low in salinity and with the notable exception of Kendall Station's thermal plume, is comparable with a freshwater lake. Moreover, the lower Basin does not behave like most estuaries. There is no gradual shift of salinity and temperatures in a progression from a marine to a riverine environment. The lower Basin sometimes behaves much more like a lake into which salt water intrudes.

EPA's concern regarding the zooplankton communities was not the quantity of the zooplankton as a food source but the quality. Moore et al.'s research found that zooplankton communities that were characterized by large zooplankters, when subjected to temperatures in excess of 77 ºF for 7-10 consecutive days, experienced a substantive change in community structure. Large forms, preferred by alosids for food, were replaced by smaller forms. Thus, the food base of alosids is expected to deteriorate when subjected to temperatures in excess of 77 ºF for 1-1.5 weeks. See Response to D17. In addition, EPA and MassDEP do not agree that juvenile abundance from year to year has been similar. On a catch per unit effort basis, juvenile alewife abundance has changed substantially from 1999 to later years. In addition, in 2004 and 2005, juvenile abundance drops significantly with increasing proximity of stations to the discharge. See Responses C3 and C49 for additional information.

Comment D30: Data on Length/Weight of YOY alewives Casts Doubt on Agencies' Speculation about "Multiple Stressors". The Agencies' discussion of Effect of Multiple Stressors on Populations is speculative and contradicted by field evidence of fish behaviors and year class successes in the Charles. Also, initial examination of length/weight relationships for YOY Charles River alewives indicates that this measure of the condition the Charles River fish compares favorably with that of coastal fish from other areas.

Response to D30: There is evidence of river herring attempting to spawn at Kendall Station's discharge pipe and there is also tracking evidence of river herring halting upstream movement to

natural spawning areas above Kendall Station. This behavior could be considered a result of stress to these organisms (Responses C29 and D27). The low numbers of alewife collected, especially in 2003 and 2004, reflect very poor recruitment for some year classes as well.

Regarding the metric of length/weight ratios of YOY alewife as a way to evaluate potential stress, EPA exercises caution when evaluating this measurement. Mirant's demonstration that the growth rates of early life stage juveniles was greatly increased over that of several other populations may not be indicative of high-quality conditions for the alewives of the Charles. A high growth rate can be associated with an abundance of food. However, based on Kellogg's research, "super-sized" YOY would be typical of a temperature-stressed population with a low survival rate.(see Responses C23 and C44)

Comment D31: The Agencies' Compliance Approach to Delta T is Unjustified and Overbroad - Suggested Alternative Approach. For the reasons identified in the preceding comments, Mirant Kendall submits that a Delta T of 5 ºF is biologically irrelevant to the species of concern in these waters because the species are adapted to prosper across much larger temperature Deltas. The Agencies' discussion of Delta T in the Determination Document focuses on the general effects of much larger temperature differences, but does not show that temperature differences of slightly over 5 ºF between the ZPH and some specified background point – specifically, the approximately 6 ºF that Kendall Station's discharge would cause at maximum would have any biological significance whatsoever. The Agencies should grant a variance under section 316(a) of the Clean Water Act allowing Mirant Kendall occasionally to cause a Delta T of somewhat over 5 ºF, as it requested in its February 2001 Supplemental Application.

But if the Agencies determine to include a system to enforce a Delta T of 5 ºF in the final permit, they should substantially revise the compliance approach proposed in the draft permit. For several reasons, the approach in the draft permit is flawed and overbroad.

The Agencies propose to use a 24-hour block average of the temperatures at two depths at a monitoring station near the B.U. Bridge to establish the ambient conditions in the Charles River from which no more than a Delta of 5 ºF is allowable for the same 24-hour block average of the temperatures at the same two depths at the separate monitoring points in the ZPH, excepting that a third depth may be substituted at Monitoring Station 7. See Draft Permit Attachment A at p. 5. The apparent goal is to keep temperatures in the ZPH within 5 ºF of the temperatures at the B.U. Bridge location, which apparently was selected because it is the first upstream location that is almost always unaffected by Kendall Station's discharge.

But the Agencies have not examined whether keeping 24-hour average temperatures across the entire ZPH within 5 ºF of the 24-hour average temperatures at the B.U. Bridge, a mile upstream, is a useful or appropriate goal for any biological reasons. In fact, there is no biological significance to that difference in these waters.

Nor do they address whether 24-hour average temperatures between the area of the B.U. Bridge and the area of the ZPH can naturally differ by more than 5 ºF for reasons unrelated to Kendall

Station's discharge. In fact, the area near the B.U. Bridge is quite different than the area of the ZPH: it is shallower there and the River is narrower, so the volume of water in that area is much smaller. The smaller volume makes it much more responsive to changes in flow and weather, whereas the larger volume at the ZPH will change temperatures much less quickly. As a result, in any one 24-hour block, midnight to midnight, the temperatures in the ZPH will lag the differences occurring at the B.U. Bridge and temperature differentials of more than 5 ºF are likely whatever is occurring at Kendall Station.

Nor do the Agencies address the fact that surface temperatures in the middle of the Charles River Basin naturally increase as the Basin deepens and widens below the B.U. Bridge, even without the influence of the Kendall Station. By selecting an upstream reference location without allowing for any intervening natural increases, the Agencies have ensured that the ZPH will be out-of-compliance even if Kendall Station's discharge is causing much less than a 5 ºF change from temperature changes in the intervening waters unaffected by Kendall's discharge. Note that Kendall Station's actual discharge typically is at far less than its maximum thermal load, does not affect those intervening upstream waters, and does not cause a 5 ºF change even within the waters of the ZPH; yet Kendall Station would be forced to curtail its operations anyway as those intervening waters and the ZPH become warmer than the waters at the B.U. Bridge.

The Agencies' proposed approach also is overbroad for another reason. By requiring compliance with the 5 ºF Delta at each of the monitoring stations in the ZPH, the Agencies' approach unnecessarily magnifies the likelihood that natural temperature variations would cause exceedances of the 5 ºF Delta. An exceedance at even one of the monitoring stations in the ZPH would constitute a permit violation even if the entire rest of the ZPH was in compliance. But if the rest of the ZPH has less than the 5 ºF Delta, there is no reason to conclude that any biological harm, significance or risk occurred.

The Agencies have not adequately justified the proposed Delta T compliance approach or using the area of the B.U. Bridge as the reference location for Delta T compliance. Mirant Kendall suggests that a more appropriate location for determining the Delta effect of its discharge is the upstream edge of the ZD, which is in the vicinity of proposed Monitoring Station 2 in the broad area of the lower Basin between the Harvard and Longfellow Bridges. From the 24-hour average temperatures at that point at a depth of 6 feet, the Agencies should consider a requirement that 24-hour average temperatures in the proposed ZPH at the same depth should not be more than 5 ºF warmer. That would ensure that any fish passing through the ZPH do not experience any abrupt temperature change due to the Plant, which, after all, is the principal goal of a Delta T requirement. To the extent that another potential goal of a Delta T requirement is to assure that in-stream temperatures are not pushed beyond the range of variability present in the ambient waters, the application of absolute in-stream temperature limits based on the statistical analysis suggested on Comment C5 will provide the assurance; there is no need for a separate Delta T requirement.

Response to D31: The location of the background station (Station 1) is not perfect in every respect, but necessary due to the documented "upstream" movement of the Kendall Station

thermal plume under certain flow and meteorological conditions. This is fully discussed in Section 5.10.2a of the DD. Many aspects of the calculation of the Delta T, including the averaging of temperature information based on the 2 foot and the 6 foot depth, and the calculation of a 24 hour average to demonstrate compliance, were included in the permit to address the points raised by Mirant in this comment.

New Mexico, Washington, Florida, Mississippi, Colorado, Georgia, Virginia, Vermont and Michigan, in addition to Massachusetts, recognize that a limit to the change in temperature above ambient must be controlled from a man-made discharge. A Delta T of approximately 5 °F, less in some cases, has been included in those states' water quality regulations.

Mirant has not submitted information to support the position that natural temperature variation between the background station (Station 1) and the ZPH would violate the Delta T limit of 5 °F, even without the thermal discharge from Kendall Station. Section 5.10.5 of the DD characterized the differences in temperature between the background station (Station 1) and a monitoring point within the ZPH, using continuous temperature data collected by Mirant. Unfortunately, Kendall Station was discharging heated effluent during the time period studied (July 23 to August 23, 2002). The influence of the thermal discharge from Kendall Station could not be factored out when temperature data from the two locations was compared. Section 5.10.5 of the DD also listed the many challenges resulting from the necessity of the placement of the background station near the B.U. Bridge. Temperature data collected to satisfy the Final Permit will be summarized as part of the Annual Monitoring Report and this information can be used to assess the appropriate location of all continuous monitors.

EPA acknowledges that as fish move, they may naturally experience changes in water temperature. The change in temperature generated by an industrial discharge such as Kendall Station's results in an increase in temperature that has the potential to exacerbate any natural change experienced by the fish. The fact that the fish might naturally see variations in temperature does not mean that they will thrive in the face of larger temperature changes made artificially high or pronounced by a thermal discharge. The Delta T limit in the permit is designed to avoid such amplification of existing temperature shifts in the lower Basin.

Comment D32 (from CRWA): ZPH definition, MASWQWS- Since Station 4 is located 60% of the distance from Cambridge to Boston and is therefore, only protective of 20% of the surface area, this seems to violate the DEP's requirement that "The ZPH must make up a minimum of 50% of any cross-sectional area, bank to bank area of the Charles River Basin." The permit and supporting documents should indicate the boundaries of the Mixing Zone under various conditions.

Response to D32: EPA acknowledges that there may be brief periods when less than 50% of the surface area is part of the ZPH, as monitored by the 2 ft depth cross-section of the river at Monitoring Stations 3, 4, 5 and 6. EPA does not judge that this occurrence will destabilize the BIP or violate the objective of the ZPH, which must occupy a minimum of 50% of any cross-sectional area, from bank-to-bank and surface-to-bottom. When measured in this way, the 2 ft

monitors along the transect could meet the ZPH temperature limit at only Station 3, nearest the Boston shore (which is required at all times), but also meet the temperature limits at a sufficient number of monitoring points at lower depths to maintain an overall cross-sectional area of 50% or greater of the transect. Also, river temperature data collected by the permittee throughout the year from 2002 through 2005 demonstrate that for substantial periods of time, far greater than 50% of any cross sectional transect will meet the requirements of the ZPH. Again, this Permit is not based on a mixing zone but rather on a CWA 316(a) variance. See also Response to comment related to D25 from CRWA and Response to C1.

Comment D33 (from MA DMF): We recommend the relocation of the Station 2 monitoring point closer to the Cambridge shore at approximately 20% of the cross-river width to better estimate the temperature in the thermal plume. We also recommend that the Station 7 monitor be placed on the Cambridge side of the Museum of Science passageway to better estimate any increase in temperature. We recommend that continuous temperature and DO monitoring be collected beginning March 1st to account for smelt spawning activity and this time period is also relevant to the migration of other diadromous species.

Response to D33: Under certain river flow and meteorological conditions, the thermal plume from MKS has been documented to travel "upstream" adjacent to the Cambridge side of the Charles River. The placement of a fixed monitor in this area is not necessary to confirm this periodic occurrence. Temperature data collected through required monitoring using vertical profiles for temperature and a towed array of temperature monitors will fully characterize the thermal profile of the lower Charles River Basin on a monthly basis for two years and quarterly thereafter (see Part I.A.14.c.1). This temperature profiling will further document temperatures along the Cambridge side of the river.

EPA and MassDEP have not stipulated which side of the Museum of Science Boat Lock that Monitoring Station 7 must be attached to in order to provide the permittee flexibility when installing the monitor. Information that will influence the ultimate location of Monitor 7 may include as yet unknown factors such as access to a potential power source as well as the features and condition of the sides of the boat lock. Temperature data collected in the Museum of Science Boat Lock do not present a compelling argument that one side of the lock is more thermally influenced than the other.

E. Response to Comments Concerning the Proposed New Outfall and Diffuser

Introduction to Section E

In order to provide context for the responses that follow, EPA briefly summarizes the relevant history underlying the permit renewal and variance application process, and outlines in broad strokes the responses to some of the points that appear under different rubrics in multiple comments.

Mirant Kendall submitted a permit application which requested permission to discharge heated water from (1) its existing outfalls and (2) a proposed diffuser to be constructed at the river bottom. Pursuant to CWA § 316(a), Mirant Kendall also requested a variance from the applicable temperature water quality standards for both in-stream temperature and ΔT.

In advocating its diffuser proposal, Mirant Kendall postulated that the physical force of the water discharged from the diffuser would mix the deep saline layer with the fresh water above and thus destratify the Basin. For this reason, EPA was initially receptive to the diffuser proposal, pending appropriate modeling of the diffuser's impact. EPA recognizes that, if the proposed diffuser would in fact destratify the Basin – which, as explained below, Mirant Kendall has not established – some environmental benefits would result, principally the oxygenation of portions of the water column that are presently anoxic.

However, EPA expressed concerns that the same physical forces, and the same mixing, could also yield negative impacts on the Basin that might well outweigh the benefits. Specifically, as EPA communicated to Mirant Kendall on numerous occasions, EPA's preliminary analyses indicated that the proposed diffuser's operation could result in liberation of phosphorus currently trapped beneath the pycnocline (top of the deep salt water layer), and that the dispersion of this phosphorus into the upper water column could result in accelerated eutrophication. In addition, the effect on fish and zooplankton of increased salinity due to mixing of the salt layer with overlying water was not adequately addressed.

EPA asked Mirant Kendall to model the impacts of the proposed discharge with respect to nutrient flux and eutrophification in order to assess the potential for increased severity of algal blooms. While Mirant Kendall did submit some modeling results, EPA's scientific and engineering staff concluded that the modeling programs were in some cases plainly inadequate, and in other cases potentially acceptable but not a reliable source of information without validation from known data. Specifically, EPA expressed the following concerns:

- Mirant Kendall's eutrophication model was technically deficient and could not be calibrated to existing data. EPA specifically asked Mirant Kendall to calibrate the model to 1998 and 1999 data, produce transient model simulations of future conditions using 1999 data, and use the model to evaluate whether reductions in heat loads are necessary to achieve various target chlorophyll *a* levels. See Letter from Michael Hill, Office of Ecosystem Protection, EPA, to Norm Cowden,

Project Director, Mirant Kendall (July 9, 2001). Mirant Kendall never did this.

- Mirant Kendall's dissolved oxygen model was calibrated using unrepresentative data collected at times when algae were producing oxygen and had in fact supersaturated the water column. As a result, the model overpredicts dissolved oxygen levels during conditions of less or no photosynthetic activity (e.g., less sunlight, less algae, or pre-dawn conditions). Moreover, the model assumes, contrary to EPA's explicit goal (through the ongoing TMDL process, not this permit renewal) of eventually reducing the severity of algae blooms in the Basin, that the high algae levels necessary to supersaturate the water column with dissolved oxygen will continue indefinitely. Furthermore, Mirant Kendall's model did not account for the increase in water temperature that would result from the bottom thermal discharge. An increase in temperature will cause higher oxygen demand which will result in lower dissolved oxygen in the lower water column. EPA specifically asked Mirant Kendall to recalibrate the dissolved oxygen model with more representative data, test it with an independent data set, and run the recalibrated model taking the potential increase in temperature into account. See Letter from Michael Hill, Office of Ecosystem Protection, EPA, to Norm Cowden, Project Director, Mirant Kendall (July 9, 2001). Mirant Kendall never did this.

- Mirant Kendall's thermal model consistently underpredicted observed temperatures by approximately 2° F at almost all monitoring stations. Rather than recalibrate the model by adjusting input parameters to better match observed data, Mirant Kendall simply added 2° F to the model output for all cells. After consulting with MA DEP, MA DMF, MA CZM, and NMFS, EPA concluded that this was scientifically inappropriate because the factors controlling the temperature in the Basin are most likely nonlinear. EPA specifically asked Mirant Kendall to adjust the input parameters to reflect site conditions more accurately and to model certain conditions. See E-mail from Mark Voorhees, Office of Ecosystem Protection, EPA to John Reynolds, Mirant Kendall (January 15, 2003); Letter from Michael Hill, Office of Ecosystem Protection, to Norm Cowden, Project Director, Mirant Kendall (July 16, 2001). Mirant Kendall never did this.

- Mirant Kendall's model of the diffuser's discharge and mixing effect used a novel, unvalidated technique to compute vertical momentum. (Most hydrodynamic transport models involve nearly horizontal discharge.) While EPA does not necessarily disagree with the technique, until the model is adequately validated EPA holds serious reservations about the accuracy of the model's predicted impacts. Under the present circumstances, EPA found it inappropriate to rely on a novel, unvalidated modeling technique and therefore had no reliable diffuser model. EPA timely expressed these reservations to Mirant Kendall (AR #169, 209, and 314).

Although EPA communicated these concerns to Mirant Kendall, Mirant Kendall elected not to revise, recalibrate, or validate its models, nor to propose alternative designs that might reduce the risks described by EPA. Indeed, Mirant Kendall eventually acknowledged that "the eutrophication model has fundamental inaccuracies in its prediction algorithms (especially related to the effects of temperature on algal growth in the lower Basin) that will not be eliminated through more refinement of the model." Letter from Norm Cowden, Project Director, Mirant Kendall, to Michael Hill, Office of Ecosystem Protection, EPA (December 20, 2001); see also Letter from Robert W. Varney, Regional Administrator, EPA, to John P. Reynolds, Mirant Kendall (October 6, 2003). Instead, Mirant Kendall requested that EPA abandon relying on models for permit development, and instead develop a permit based on monitoring real-time compliance. See Letter from Norm Cowden, Project Director, Mirant Kendall, to Michael Hill, Office of Ecosystem Protection, EPA (December 20, 2001); see also E-mail from Mark Voorhees, Office of Ecosystem Protection, EPA to John Reynolds, Mirant Kendall (January 15, 2003).

Thus, the available evidence suggests that the proposed diffuser would increase circulation of phosphorus through the water column, and that this in turn would increase algal blooms – particularly of noxious blue-green algae that tend to displace other, less objectionable species some of which contribute to the food web that supports fish such as river herring. Mirant Kendall's failure to develop reliable models meant that EPA had no reason to doubt its own analyses. Accordingly, EPA determined that the operation of the proposed diffuser would have a reasonable potential to cause or contribute to excursions above the eutrophication related state water quality standards and lead criteria. For that reason, EPA denied the diffuser proposal.

In parallel to, but distinct from this permit renewal process, the lower Charles River Nutrient TMDL effort produced a model of existing conditions in the lower Basin in late 2005. EPA determined that this model could be appropriately modified to model the proposed diffuser. Mirant Kendall has chosen to incorporate the diffuser into the model developed for the eutrophication TMDL, and EPA has provided assistance to Mirant Kendall in initializing the model. In response to Mirant Kendall's decision to pursue performing the diffuser modeling analysis, EPA has outlined its expectations for the diffuser modeling analysis, including scenarios that should be performed. As noted repeatedly throughout the Determination Document and these responses, EPA is willing to consider a renewed application for permission to discharge through a proposed diffuser if and when Mirant Kendall submits credible modeling results. Until that time, however, EPA is proceeding on the basis of available information. (See also responses A12 and A13).

Starting in February 2006, Mirant Kendall began work on a modeling analysis for the proposed diffuser. EPA has provided written guidance to Mirant Kendall on the required scope of the analysis as well as identifying key interim steps in the analysis that will require EPA review and approval. Based on initial work, Mirant Kendall has provided some limited and preliminary results of the modeling analysis to EPA and MassDEP and has requested that this information be considered by EPA and MassDEP prior to issuing the final NPDES permit. EPA has reviewed

the information and has found it to be cursory and insufficient to evaluate the impacts of the operation of the proposed diffuser on water quality in the lower Charles River. The information provided falls far short of the technical documentation requirements that EPA had previously identified to Mirant Kendall as being necessary to fully evaluate the proposed diffuser. Therefore, EPA considers the recent modeling results provided by Mirant Kendall to be premature and unsupported for evaluating the diffuser impacts. EPA understands that Mirant Kendall intends to continue to work on the diffuser analysis. EPA will continue to communicate with Mirant Kendall concerning the diffuser modeling analysis and the content of information needed by EPA to fully evaluate the proposed diffuser.

Common themes in Mirant Kendall's Section E comments

The following points surface in multiple comments under Section E, and while EPA provides detailed individual responses to each comment, the following brief summary may provide a helpful overview.

- Mirant Kendall argues in several comments (especially E4-E12) that its proposed diffuser would have certain environmental beneficial effects. EPA has two general responses. First, EPA is not yet convinced, in part because of Mirant Kendall's failure to produce an acceptable model, that the diffuser actually would achieve these effects. Second, if it actually would achieve these effects, EPA agrees that the effects would be beneficial, but has concluded that these benefits are outweighed by the reasonable risk of increased dispersion of phosphorus and consequent increased eutrophication.

- Mirant Kendall argues in several comments (especially E13-E23) that EPA has misanalyzed the dynamics of algal blooms, and suggests alternative explanations. As explained in detail in Attachment A to the Draft Permit, multiple interdependent parameters influence algal growth and these variables sometimes move in opposite directions, making the problem complex. Furthermore, each year is unique. However, EPA's analysis (as documented in Attachment A) indicates that, during mid-to-late summer, phosphorus is typically the limiting factor in algal growth. Mirant Kendall's data and competing hypotheses are problematic and unpersuasive.

- Ultimately, EPA has denied the diffuser proposal because Mirant Kendall failed to dispel well-founded concerns that the proposed diffuser would distribute phosphorus to the upper water column and aggravate an existing algae problem that already violates Massachusetts water quality standards. The reason Mirant Kendall has failed to dispel these concerns is largely of Mirant Kendall's own doing. EPA remains open to the theoretical possibility that scientifically acceptable computer models, based on accurate data and sound methodologies, could demonstrate that the diffuser proposal (or a modified design) would not have these effects. But Mirant Kendall's actual submissions to EPA do not

inspire confidence and are not an adequate basis upon which to allow a massive source of vertical hydrodynamic transport from the base of a river in contact with phosphorus-heavy sediments to an upper water column already plagued with phosphorus-limited algae. Until Mirant Kendall provides a scientifically sound predictive model that shows the operation of the proposed diffuser will not result in increases in algal levels in the lower Charles River, EPA finds that the proposed diffuser has a reasonable potential to cause or contribute to an excursion above the eutrophication related state water quality standards.

Specific comments and responses follow.

Comment E1: Mirant Kendall asserts that EPA is arbitrarily and capriciously denying the proposed diffuser, and thereby foregoing the environmental benefits of destratification, on the basis of exaggerated concerns about eutrophication. Mirant Kendall raises numerous distinct subpoints, but chiefly argues that (1) the regulatory agencies earlier agreed that eutrophication in the lower Basin is principally caused by low flow and high nutrients, which Kendall Station does not affect; (2) other permitting agencies, recognizing this fact, have already approved the proposed diffuser; (3) stratification in the Basin is a major stressor to the BIP, and therefore destratification would achieve significant environmental benefits; and (4) EPA has adopted contradictory objectives in that it aims to maintain the BIP, which depends in part on sufficient algae, and yet also aims to reduce that algae.

Response to E1: Mirant Kendall makes a number of inaccurate statements that mischaracterize EPA's position concerning eutrophication of the lower Basin and possible benefits associated with disruption of the salt wedge and destratification of the lower Basin.

1) Mirant Kendall incorrectly states that there was a consensus among the regulatory agencies and Mirant Kendall that eutrophic conditions in the lower Basin were principally a function of low flow and high nutrients. EPA is not aware of any document in the record supporting Mirant Kendall's recollection of a "consensus" among regulatory agencies and Mirant Kendall on this issue. At any rate, EPA – the regulatory agency charged with implementing the CWA in Massachusetts – never adopted such a position. To the contrary, EPA has maintained throughout the permit development process that eutrophication of the Basin is likely due to elevated nutrient levels, high river temperatures, and sufficiently long water residence time in the Basin (not just associated with low-flow conditions) (Tetra Tech, 2002).

Mirant Kendall has mischaracterized the extent of eutrophic conditions in the Basin by describing the perceived problems as "the occasional existence of eutrophied conditions during low flow events in late summer." First, low flow is not a phenomenon of a few isolated "events," but rather a persistent, recurring characteristic of the lower Basin. Second, water quality data demonstrates that eutrophication in the Basin is <u>not</u> limited to periods of low flow – it occurs during periods of average and even high seasonal flow.

First, the Basin typically experiences water residence times throughout most of the summer and into

early fall that are sufficiently long to allow algal blooms to become established. Generally, annual high flows at Watertown Dam occur during the spring thaw period and annual low flows occur during the summer season, when growth conditions for algae (e.g., light intensity and temperature) are optimal. The decline in river flows that occur in the Basin during the summer period also favor algal growth because of the associated increase in water residence time and water clarity. The impounded lower Basin maintains a water volume of approximately 370 million cubic feet (Cowden, 2001) and tends to have relatively long water residence times (typically 4 to 10 weeks) during the summer months when river flow rates decline. As flows decline, the amount of time a unit volume of water spends in the Basin increases. Increased water residence time allows algae populations more time to grow and take advantage of the favorable sunlight, temperature, and nutritional conditions. Specific growth rates of algae are species and size dependent. However, algal doubling times (the time needed for the population to double in size) are typically on the order of a half day to a few days and may range from a few hours to several days (Kalff, 2001). As evidenced by the elevated chlorophyll *a* concentrations observed in the Basin during a variety of flow conditions (high, normal and low), water residence times in the lower Basin have been more than sufficient to allow algal blooms to become established.

Table E1-1 presents a summary of the average daily flows entering the Basin at Watertown Dam for the main summer and early fall growing season (July 1-Sept 30) of 1997-2004. Also included are two columns of estimated summer average water residence times of the lower Basin: one column assuming completely mixed conditions (i.e., without stratification), and another column assuming stratification based on an average observed pycnocline depth of 15 feet. When the water column of the lower Basin is vertically stratified, which occurs during the summer period, the water residence time is reduced by approximately 10 percent because there is less volume to be displaced by the incoming fresh water. The seven-day low-flow at the Watertown Dam that occurs approximately once every 10 years (7Q10 flow) and the historical average flow for this period along with the calculated residence times are also shown in Table E1-1.

Table E1-1. Summer average daily flow at Watertown Dam and water residence time of the lower Charles River Basin (July 1-September 30)

Year	Average Daily Flow At Watertown Dam (cfs)	Average Water Residence Time in lower Basin	
		Assuming no stratification (days)	Assuming stratification (days)
1997	37	118	104
1998	408	11	9
1999	165	26	23
2000	183	24	21
2001	202	22	19
2002	64	68	60
2003	311	14	12
2004	244	18	16
Historic average	229	19	14
7Q10	18	242	213

As indicated in Table E1-1, there is considerable variation in average summer flow conditions from year to year. The summers of 1997 and 2002 had drier weather and low-flow conditions (37 and 64 cfs, respectively), while 1998 and 2003 had more wet-weather and high-flow conditions (408 and 311 cfs, respectively). July through August of 1999 was also a very dry period and resulted in very low flows in the Basin until early September, when a series of larger rain events occurred and river flows increased substantially. Summer growing season average water residence times, assuming stratification, ranged from 9 days in 1998 to 104 days in 1997.

During the wetter years (1998, 2003, and 2004) the actual flows passing through the Basin were higher than shown in Table E1-1 because of the runoff from the tributary streams and drainage systems that directly enter the Basin below Watertown Dam. The effect on water residence time of the Basin during storm events is complicated by the operation of the New Charles River Dam. As part of its flood control procedures, operators of the Dam lower the water level of the Basin before a forecasted rain event to provide storage for the anticipated runoff from the watershed.

Moreover, the figures in Table E1-1 are not the result of occasional low flow "events" or outliers that drag down the seasonal average. Rather, extended periods of low flow are characteristic of the lower Basin during the summer growing season. In the Boston area, it is not uncommon to have extended low flow periods during dry weather in the summer months, during which the actual water residence times in the lower Basin exceed 70 days even when the Basin is vertically stratified. That happened in 1997, 1999, and 2002. Table E1-2 illustrates this. Table E1-2 summarizes average flows that occurred in the Basin for various extended periods of time during the summer growing season for each of the monitoring years. It also shows the maximum estimated actual water residence time (assuming stratification) that occurred in the lower Basin during the July 1 to September 30 period of each year based on the daily flow data. These results illustrate that it is normal for the Basin to experience long periods during the summer growing season when flows are noticeably less than the seasonal average flows.

Table E1-2. Charles River running average daily flow (cfs) at Watertown Dam for specified periods (July 1-September 30)

Year	20 Day	30 Day	40 Day	60 Day	Seasonal average cfs	Actual water residence time lower Basin days
1997	21	23	26	33	37	110+
1998	240	265	291	299	408	14
1999	24	27	27	46	165	75
2000	40	66	89	152	183	41
2001	36	58	85	125	202	40
2002	23	27	31	40	64	75
2003	194	205	219	292	311	20
2004	109	127	165	186	244	30

Notably, for every single year from 1997-2004, the 60-day running average daily flow was less – in some cases dramatically so – than the seasonal average. That means that low flow, far from being a phenomenon of occasional "events," is a persistent, recurring feature of the Basin in late summer.

Moreover, the chlorophyll *a* data collected from the Basin demonstrate that eutrophic conditions and algal blooms are not limited to low flow periods. Existing river flow and chlorophyll *a* data collected by the EPA and the MWRA show that high chlorophyll *a* levels that are indicative of eutrophic conditions have consistently occurred throughout most of the summer and into early fall (typically mid July to the end of October) under a wide range of flow conditions, including above average summer flow conditions (EPA, 1998-2004; MWRA, 1997-2004). These data are summarized in Tables E1-3 and E1-4. Elevated levels of chlorophyll *a* that are indicative of eutrophic conditions have been observed in the lower Basin during every summer monitoring season, including the very high-flow season of 1998. For example, on August 13, 1998 when the water residence time in the lower Basin was approximately two weeks, the observed chlorophyll *a* at MWRA station 166, located just upstream from the Museum of Science, was 37 µg/l. Tables 2, 3, and 4 in Attachment A of the Fact Sheet include literature values of chlorophyll *a* concentrations that are commonly used for evaluating the trophic status of surface waters. Both the seasonal mean and maximum chlorophyll *a* values for the lower Basin fall within the eutrophic classification for every monitoring season (1997-2004).

Table E1-3. Summary of EPA seasonal (July - October) chlorophyll *a* data for the Charles River Basin (1998-2004)

	Chlorophyll *a* (µg/l)						
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Lower Basin							
mean	15.1	27.1	23.5	24.6	18.4	18.4	24.0
median	10.9	16.1	26.7	25.4	16.4	19.4	26.6
min - max	4.5- 46.6	7.2- 97.0	5.0 - 41.0	4.7 - 47.7	1.5 - 41.5	3.3 - 47.7	4.4 - 55.4
number of surveys (s)	4	7	7	5	7	4	6
number of samples (n)	20	34	31	23	73	22	28

Notes: Lower Basin values represent data from EPA stations CRBL06, 07, 8A, 09, 10, and 11.

In 2002 the Lower Basin values also represent data from EPA stations TMDL21, 22, 23, 24, 25, 26, and 28.1. Chlorophyll a data have been corrected for pheophyton

Table E1-4. Summary of MRWA seasonal (July- October) chlorophyll *a* data for the lower Charles River Basin (1997-2004), as measured at MWRA Station 166 (upstream of Museum of Science)

Season	**Chlorophyll *a* µg/l**			**Number of observations**
(July-October)	**Min - Max**	**Median**	**Mean**	
1997	17.6 - 88.2	37.8	44.8	18
1998	4.7 - 48.0	16	18.3	18
1999	5.1 - 87.6	19.2	25.7	17
2000	3.4 - 42.2	19.9	19.5	17
2001	5.3 - 45.5	26.8	25.3	18

2002	3.4 - 35.7	20.5	21.7	16
2003	7.4 - 39.1	21.8	22	8
2004	2.6 - 45.7	17	20	9
1997 - 2004	2.6 - 88.2	22.1	25.3	121

Mirant Kendall argues that because the Station's discharge does not add nutrients, eutrophic conditions in the lower Basin are not solvable by any changes that can be made to the Station's discharge, including its elimination. However, addressing eutrophic conditions in the Basin requires controlling a broad range of pollutants and other contributing factors. While nutrients are clearly an important factor that will require controls to address eutrophication in the Basin, they are not the only factor. Extensive water quality data collected in the lower Basin show that thermal pollution from Mirant Kendall's discharge raises temperatures in the downstream portion of the lower Basin by several degrees Fahrenheit during the critical summer months (July-October) and is, therefore, likely to be a contributor to excessive algal growth. Also, higher temperatures favor the growth of noxious blue-green algae species, some of which are toxic and capable of outcompeting other algal species. Algal data collected from the lower Basin show that blue-greens become the predominant species of algae in the river between Longfellow Bridge and the Museum of Science during the later portion of the summer season (see response to E19). A very severe blue-green algal bloom (consisting of over 1 million cells per milliliter of microcystes, a blue-green species known to be potentially toxic) occurred in this segment of the river during an extended period of warm weather in August of 2006. During this period, surface water temperatures were very elevated because of the facility's thermal discharge.

Similarly, dispersing phosphorus that has been released from the bottom sediments and is presently trapped beneath the pycnocline would likely contribute to excessive algal growth. See Attachment A to the Draft Permit Fact Sheet. Consequently, limits on the thermal load discharged to the lower Basin, and the manner in which the load is discharged, may be necessary during certain periods of the growing season to reduce the severity of eutrophic conditions in the lower Basin.

2) Mirant Kendall notes that other regulatory agencies implementing different permit programs have granted approval to construct the proposed diffuser. However, the agencies issuing these permits did not purport to evaluate the proposed diffuser's potential long-term effects on water quality. In fact, the Army Corp of Engineers deferred consideration of potential water quality issues associated with operation of the proposed diffuser to EPA and the NPDES permit renewal process by conditioning the Final Permit to prohibit construction of the diffuser until EPA issued a draft NPDES permit for the facility (Godfrey, 2002). Similarly, MA DMF asked the Corps not to issue the Final Permit until outstanding water quality issues related to the proposed diffuser were satisfactorily addressed (Schwartz, 2002; Malkoski, 2002). NOAA Fisheries (formerly NMFS) supported MA DMF's request (Hutchins, 2002).

Mirant Kendall claims that "several of those approvals mandate construction and use of the proposed outfall" and cites approvals from the Cambridge Conservation Commission and the Energy Facilities Siting Board as examples. These approvals did not "mandate" that the diffuser be constructed and used, but required, in the event a diffuser was to be installed, that construction be done so in accordance with the conditions of the permits and based on the plans and information submitted by Mirant Kendall during the permit application process. In fact, the Order of Conditions issued by the Cambridge Conservation Commission required that Mirant Kendall submit a NPDES permit before starting construction authorized by its permit (Cambridge Conservation Commission, 2000). Furthermore, in the City of Cambridge's October 14, 2004 comment letter on the draft NPDES permit, the City did not object to EPA's decision to deny the diffuser proposal. Rather, the City simply requested that EPA revisit the proposed diffuser in the future, when information and modeling capabilities become available, and to permit the operation of the diffuser if a future evaluation determined that the system would have a positive impact. See Comment related to E1 by City of Cambridge. EPA has carefully emphasized that its denial of the diffuser proposal at this time is without prejudice to a future application supported by credible modeling and/or a design aimed at minimizing water quality impacts.

3) Mirant Kendall argues that the proposed diffuser would eliminate the stratification of the lower Basin caused by salt water intrusion. Mirant Kendall argues that the stratified conditions are "a major stressor for the BIP," and claims that EPA "fully recognize[s]" this. EPA acknowledges that the water quality conditions within the salt wedge are generally unsuitable for supporting aquatic life uses. However, EPA disagrees with Mirant Kendall's analysis for three independent reasons: (1) the salt wedge occupies a relatively small portion of the total volume of the Basin and its unsuitability for aquatic life does not present a "major" stress to the BIP; (2) because of the characteristics of the benthic sediments, the regions currently affected by the salt wedge would still provide poor habitat even if dissolved oxygen levels were substantially increased; and (3) it is not even clear that the proposed diffuser actually would result in increased dissolved oxygen in the deep water pockets to levels that would inhibit the release of nutrients from the benthic sediments. Put simply, the problem upon which Mirant Kendall focuses (unsuitability of deep water pockets for habitat) affects a relatively small area; the problem probably would not be solved even if a diffuser fully oxygenated the deep water as Mirant Kendall speculates; and there is significant reason to doubt that the diffuser would do even that.

First, the salt wedge occupies a relatively small portion of the total volume of the Basin. Its dimensions change throughout the year based primarily on the number of boat lockages at the New Charles River Dam. As a result, the salt wedge reaches its maximum size during the summer when boat passage through the locks is highest. Conversely, the salt wedge is diminished or even absent during other times of the year when boat use declines and river flows are high or following large storm events (Breault et. al., 2000). Most importantly, even during worst case conditions, which are limited to the summer, the volume of water that typically has low dissolved oxygen due to the salt wedge is a relatively small portion of the lower Basin – approximately 15 percent of the total volume (Breault et al., 2000; EPA, 2001). This relatively

small diminution in habitat does not appear to have a substantial adverse effect on aquatic life. In particular, there is no evidence that the salt wedge has interfered with the in- or out-migration of anadromous species.

Furthermore, while EPA acknowledges that significantly oxygenating the bottom waters typically affected by the salt wedge would make this relatively small volume of water accessible to finfish, EPA disagrees that such an improvement would constitute a "great" improvement in the overall habitat of the lower Basin, as Mirant Kendall claims. To the contrary, it is unlikely that destratification would result in a benthic habitat capable of supporting a healthy macroinvertebrate community that would provide a viable food source for finfish. First, the lower water column where the dissolved oxygen levels could be improved under complete mixed conditions would likely provide less suitable habitat than the upper water column because of the lack of light penetration and its impact on the ability for key fish species (e.g., river herring) to see food. Even more important, however, are the physical and chemical characteristics of the benthic sediments that lie under the salt wedge. These sediment deposits typically range in depth from 2 to 5 feet, are finely textured (made up of mostly silt and clay), and have a fluid or "soupy" composition (have low concentrations of total solids) (Breault et al., 2000). These sediments contain high levels of toxic contaminants (Breault et al., 2000) and were found to be toxic to amphipods and midges during toxicity testing conducted by EPA (EPA, 1997). Such sediments are not likely to support a viable and healthy macroinvertebrate community that would in turn provide sustainable food source for finfish. As a result of the degraded sediments, the value of the deep water habitat for resident species is marginal at best. Extensive sediment remediation, most likely involving dredging, would be necessary in order for the Agencies to consider the oxygenation of the deep water affected by the salt wedge to constitute a "great" improvement in habitat.

Finally, there is considerable uncertainty over exactly how much the proposed diffuser actually would raise dissolved oxygen levels in the bottom waters. Mirant Kendall has made an unsupported assumption that operation of the proposed diffuser would sufficiently raise dissolved oxygen levels in the lower water column typically affected by the salt wedge to levels that would support aquatic life uses consistent with Massachusetts' Water Quality Standards. However, for reasons presented in Attachment A of the Draft Permit Fact Sheet (see page 28), Mirant Kendall's dissolved oxygen model of the lower Basin is seriously flawed and unreliable for predicting post-diffuser dissolved oxygen levels.

4) Mirant Kendall inaccurately characterizes the following two points as EPA's objectives with respect to the NPDES permit:

- maintenance of a thriving BIP, including river herring, which depend on restoring dissolved oxygen to the Basin and on a thriving algal community to provide the necessary food for the herring, and

- a desire to limit the extent of that very algal community.

One of EPA's primary objectives is to protect and propagate the BIP. However, EPA has not stated that protecting the BIP depends on restoring dissolved oxygen to the relatively small portion of the lower Basin (at most about 15 percent) that is typically affected by the salt wedge during the summer months. Restoring dissolved oxygen to the relatively small volume of bottom water for only a portion of the year is not essential for protecting the BIP. As noted in part 3 of this Response, the lower water column where the dissolved oxygen levels could be improved under complete mixed conditions is relatively small, and would likely provide less suitable habitat than the upper water column because of the lack of light penetration and the extremely limiting physical and chemical characteristics of the benthic sediments.

Mirant Kendall also mischaracterizes EPA's goals with respect to algae. The Draft Permit does not propose any conditions, including the proposal to not authorize use of the proposed diffuser, that aim to reduce algal biomass in the lower Basin. Rather, EPA's more modest objective with respect to algal biomass is to ensure that operation of the facility does not increase algal biomass and further contribute to excursions from applicable Massachusetts Water Quality Standards. This objective has been clearly stated in correspondence to Mirant Kendall (EPA July 9, 2001 letter) and at meetings with Mirant Kendall throughout the permit development process.

Comment related to E1 from CRWA: CRWA supported the EPA's decision to exclude the diffuser from the NPDES permit at this time. We feel that it is prudent for the regulators to wait until the basin model, being configured by Tetra Tech for the EPA, can be applied to evaluate use of the diffuser so that EPA can predict impacts related to eutrophication and algal blooms.
Comment related to E1 from Riverways: The argument put forward by the EPA against the installation of a diffuser is a sound one. It seems likely the facility would actually exacerbate poor water quality in the basin by increasing nutrient levels in the upper water column if diffusers were installed. The information and data provided offers a compelling argument that phosphorus limits growth during the later summer period, a period when recreational demands on the basin are at a peak, and diffusers would likely circulate nutrient laden bottom waters currently disinclined to mix with less dense, freshwater overlying waters.

Comment related to E1 from City of Cambridge: The City requests that the agencies revisit the proposed diffuser in the future, when information and modeling capabilities become available from the ongoing Charles River TMDL studies and that the permit provide for the installation of the diffuser should a future evaluation determine that the system would have a positive impact.

Comment related to E1 from Laura Donohue: If there is a bottom diffuser installed, it would need to be clearly marked. Water swirling around could create whirlpools, a potentially hazardous situation, especially for an unwitting single boat or inexperienced person.

Comment related to E1 from CLF: CLF supports EPA's decision to not include the diffuser in the permit at this time. Initial review of the proposed diffuser indicates that there are many unanswered questions about the effects the diffuser will have. There is the potential for serious negative effects due to dispersal of heated water, liberation of toxic materials from the bottom

(e.g. metals), and mixing of nutrients from the deep parts of the Basin with oxygenated water. These impacts could decrease the availability of habitat for aquatic life in the lower Basin, and increase the frequency of algal blooms that reduce the value of the Basin as a recreational resource. The value of the diffuser to the permittee is clear, as it would allow the plant to discharge more heat while remaining within the temperature limits of the permit. However, the potential harm of a diffuser to the balanced indigenous population of fish, shellfish, and wildlife is too great to justify its use before studies are complete.

Response to Comments related to E1: EPA agrees that Mirant Kendall has failed to resolve the main issues of potential impacts associated with the proposed diffuser operation. The modeling of the diffuser and the evaluation of water quality and safety impacts is Mirant Kendall's responsibility and will not be conducted by EPA as part of the TMDL modeling work. EPA has informed Mirant Kendall that further evaluation of the diffuser by EPA will be contingent upon Mirant Kendall providing supporting information and a technical analysis specific to its proposed diffuser based on a credible linked hydrodynamic water quality model. See also Responses to C1, C3 and F1 through F6.

Comment E2: Mirant Kendall argues that, in denying Mirant Kendall's diffuser proposal, EPA has incorrectly applied the test of whether Mirant Kendall's proposed discharge has a "reasonable potential to cause, or contribute to an excursion above any State water quality standard," rather than the test of whether that discharge is "consistent with the protection and propagation of a BIP." Furthermore, Mirant Kendall suggests that EPA must ascertain whether Mirant Kendall's diffuser proposal "in fact would interfere with the protection and propagation of the BIP." (Emphasis added).

Response to E2: Mirant Kendall misapprehends both the applicable legal test and the burden of proof. As explained below, EPA is not denying Mirant Kendall's diffuser proposal solely based on concerns that the thermal component of the discharge from the diffuser would violate the Massachusetts water quality standards for temperature and/or interfere with the protection and propagation of a BIP. Rather, EPA is denying the diffuser proposal for reasons independent of concerns about the thermal component of the discharge. Under these circumstances, the procedure specified in CWA § 316(a) for a variance from otherwise applicable heat limitations does not control the question before EPA. Furthermore, both the statute and regulations make clear that EPA does not have the burden to demonstrate that the applicant's proposed discharge "in fact would" fail to meet the applicable legal test. Finally, even assuming that the CWA § 316(a) test controls the determination of whether to permit the diffuser, Mirant Kendall does not meet its burden.

Applicable legal framework

In evaluating the permit application and variance request as submitted by Mirant Kendall, EPA must set appropriate conditions not just for the permitted facility as a whole, but rather "for each outfall or discharge point of the permitted facility." 40 CFR § 122.45(a). The resulting permit must include requirements necessary to achieve water quality standards, including state narrative

criteria such as the narrative aesthetic criteria impacted by algal blooms. See 40 CFR § 122.44 ("[E]ach NPDES permit shall include conditions meeting the following requirements when applicable . . . . (d) . . . . [A]ny requirements in addition to or more stringent than promulgated effluent limitations guidelines or standards . . . necessary to: (1) Achieve water quality standards established under section 303 of the CWA, including State narrative criteria for water quality.").

As an initial matter, Mirant Kendall misunderstands the applicable legal framework. Under the thermal variance procedure, an applicant may attempt to demonstrate "that any effluent limitation proposed for the control of the thermal component of any discharge from [the] source will require effluent limitations more stringent than necessary to assure the projection [sic] and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." CWA § 316(a). If the applicant can demonstrate this, then the permitting agency "may impose an effluent limitation . . . with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population." Id. Crucially, in each step the focus is on the thermal component of the discharge: the applicant must show that an effluent limitation "proposed for the control of the thermal component of [the] discharge" is more stringent than necessary to protect the BIP, and the permitting agency may then impose a less stringent effluent limitation "with respect to the thermal component of such discharge." Id. (emphases added).

However, § 316(a) analysis is not the only standard that applies to a discharge that may contain a thermal component. EPA's denial of Mirant Kendall's diffuser proposal is based on concerns that, independent of (although somewhat exacerbated by) the thermal component of the discharge, the physical force of the discharge water mixing the water column will distribute phosphorus into the upper water column. This concern is independent of the thermal component of the discharge, which can be illustrated in two ways. First, at least in principle, the same concern would apply if the discharge water were unheated. Second, EPA remains open to alternative design proposals that could discharge an equivalent amount of heat but might mitigate this concern.

Rather, EPA's denial of the diffuser proposal is based on EPA's independent obligation under CWA § 301(b)(1)(C) to ensure that its NPDES permit conditions satisfy all applicable state water quality requirements. Such conditions include, inter alia, the location of point sources such as an outfall or diffuser. EPA may thus deny a permit application, or issue a permit on terms different from those requested by the applicant, on the grounds that the discharge at the proposed discharge point would not satisfy the CWA. The appropriate standard for such an evaluation in this context is whether the proposed discharge of pollutants has "the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality." 40 CFR § 122.44(d)(1)(i) (emphasis added). That is precisely the standard that EPA applied. See Attachment A to Draft Permit Fact Sheet, page 34. Moreover, contrary to Mirant Kendall's comment, the relevant question is whether the proposed discharge presents a "reasonable potential" to cause or contribute to an excursion

above a state water quality standard, not whether the discharge is "likely" to do so, let alone that it "in fact would" do so.

In summary, EPA has not denied the diffuser proposal on the grounds that it would contribute to excursions above the water quality standards for the thermal component of the discharge. Rather, EPA has denied the diffuser proposal on the grounds that the location and operation of the diffuser, independent of the thermal component of its discharge, presents a reasonable potential to cause or contribute to excursions above the eutrophication-related water quality standards. Under such circumstances, "protection and propagation of a balanced, indigenous population" under CWA § 316(a) is not the only applicable legal standard.

Although EPA has denied permission for the exact discharge requested by Mirant Kendall, EPA has, consistent with established practice, granted a permit with effluent limitations and other conditions different from those requested, rather than simply denying the application. In this context, EPA has in fact granted a CWA § 316(a) variance to allow Mirant Kendall to discharge heated water from its existing outfalls at temperatures that violate the Massachusetts water quality standards for temperature and ΔT. However, this does not mean that the CWA § 316(a) standard controls EPA's evaluation of the diffuser on eutrophication related grounds. Analytically, EPA has denied one proposal (the one submitted by Mirant Kendall) and granted another (one not submitted by Mirant Kendall but which complies with the requirements of the CWA). The fact that § 316(a) applies to one does not mean it controls the determination of the other.

That said, because much of the BIP analysis had to be conducted in this context anyway, and out of an abundance of caution, EPA has also analyzed Mirant Kendall's diffuser proposal as if CWA § 316(a) and its implementing regulations defined the applicable legal framework. In so doing, EPA emphasizes that CWA § 316(a) does not provide the applicable framework for the eutrophication related water quality standards, and that EPA provides the following analysis only by way of explaining why EPA's decision to deny the diffuser proposal does not turn on this legal question.

Alternative analysis under CWA § 316(a)

Even under the less stringent "protection and propagation of a balanced, indigenous population" standard, EPA would deny the diffuser proposal because Mirant Kendall has not met its burden. To receive a CWA § 316(a) variance, an applicant must make two distinct demonstrations. First, the applicant must "demonstrate to the satisfaction of the Administrator" that technology or water quality based limitations on the diffuser's discharge are more stringent than necessary to assure the protection and propagation of a BIP. Id.; see also 40 CFR § 125.73(a) (thermal variance available "if the discharger demonstrates to the satisfaction of the director" that limitations are more stringent than necessary). Second, the applicant "must show that the alternative effluent limitation desired by the discharger, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected, will assure the protection and propagation of a [BIP]." 40 CFR § 125.73(a). As explained in the

Determination Document, the applicant's burden is "stringent." Draft Permit Determination Document § 4.2.3, pages 33-36.

As described above, Mirant Kendall did not meet this burden because it neither produced credible predictive studies nor demonstrated, pursuant to 40 CFR § 125.73(c)(1), an "absence of prior appreciable harm" from its existing outfalls. (In fact, the "absence of prior appreciable harm" test is inappropriate for the diffuser proposal because the diffuser would be a new type of discharge, and the attendant environmental concerns turn largely on precisely those facts – its location and the vertical momentum of its discharge – that make it new. However, out of an abundance of caution, EPA has considered the information that Mirant Kendall submitted as if the "absence of prior appreciable harm" test were applicable, and still finds it insufficient with respect to eutrophication. See also Responses to B1, B2, B3, C1 and C3.)

Specifically, EPA expressed concerns that operation of the proposed diffuser would increase circulation of phosphorus through the water column, and that this in turn would increase algal blooms – particularly of noxious blue-green algae that tend to displace other, less objectionable species some of which contribute to the food web that supports fish such as river herring. Of course, the legal burden of a CWA § 316(a) demonstration lies entirely on the applicant – the statute, regulations, and cases make that clear. That said, it is worth noting that EPA's concerns, as documented in Attachment A to the Draft Permit, constitute a "prima facie case" that the limits contained in Mirant Kendall's diffuser proposal would not assure the protection and propagation of a BIP.

Moreover, contrary to Mirant Kendall's comment, it is not EPA's burden to show that the proposed discharge "in fact would interfere with the protection and propagation of the BIP." Rather, it is Mirant Kendall's burden to demonstrate that the proposed discharge, operating under effluent limitations that would violate water quality standards, "will assure the protection and propagation of a [BIP]." 40 CFR § 125.73(a) (emphasis added). Mirant Kendall has not made such a demonstration. Quite the contrary; its data are questionable and its models are flawed and/or unvalidated, and consequently EPA has little or no confidence in Mirant Kendall's analyses. Accordingly, even under the less stringent test of CWA § 316(a), EPA would deny the diffuser proposal.

Comment E3: Mirant Kendall argues that it initially proposed a eutrophication monitoring program so that the diffuser could be started up, monitored and operationally proven or restricted as appropriate. The draft permit denies the diffuser proposal but requires a costly monitoring program. Mirant Kendall argues that it would be arbitrary and capricious for EPA to impose the eutrophication monitoring program unless it also approves the proposed diffuser.

Response to E3: The basis for including the monitoring requirements is independent of concerns associated with the proposed diffuser. Because the permit allows Kendall Station to discharge thermal loads through its existing outfall at levels that are far above levels that have been discharged when algal-related water quality impairments existed in the Basin, and because Mirant Kendall has not submitted a credible demonstration of the impact of its potential thermal

discharge nor responded to EPA's repeated requests to provide such a demonstration, EPA has required a eutrophication-related monitoring program in the Draft Permit. The purpose of the monitoring program is to provide the water quality data and information necessary for EPA to assess the impacts of the increased thermal load associated with the operation of the upgraded facility on algal biomass and community structure in the lower Basin. Published scientific research involving controlled studies has convincingly shown that algal growth rates increase with increasing temperature. See Attachment A to the Draft Permit Fact Sheet, pages 17-18. The monitoring requirements are necessary to track algal growth under different operating conditions at the plant during the critical summer/early fall period when high thermal loading conditions from the facility have the greatest potential to exacerbate existing water quality impairments in the lower Basin.

Mirant Kendall's statement that the monitoring program was developed "partly because, as EPA has found in their TMDL modeling, it is not readily feasible to develop a fully certain model of the diffuser's effects in this very complex water body" is incorrect. EPA has never made such a statement. EPA continues to believe that it is feasible to develop a representative and credible model that can be used to simulate the operation of the diffuser and its potential impacts on water quality and has requested that Mirant Kendall prepare such a model to support its diffuser proposal. As discussed in responses A12, A13, E1 and E23, EPA has not modeled, and does not view it as EPA's responsibility to model, Mirant Kendall's proposed diffuser and its impacts. As a general principle, EPA does not use public resources to provide modeling services for private NPDES permit applicants seeking to introduce new point sources with unknown hydrodynamic effects. Mirant Kendall has the responsibility of modeling its own proposal, and such modeling is certainly beyond the scope of the TMDL project because that project aims to model the river system as it is now.

Even though Mirant Kendall has failed to provide a credible water quality model, EPA has not relied solely on existing water quality data to show that Mirant Kendall's existing thermal discharge is causing or contributing to eutrophication-related water quality impairments in the lower Basin. There are too many factors, several of which vary within the Basin, that are important to algal growth (e.g., temperature, water clarity, nutrient availability, light intensity, sedimentation rates) and which make it virtually impossible to isolate temperature as the sole influencing factor on algal growth. See Attachment A to the Draft Permit Fact Sheet, page 19. Therefore EPA has been careful not to draw conclusions based solely on available data. Rather, EPA has focused on well-established and generally applicable scientific research that is consistent with the data that are, in fact, available.

Under the circumstances described in the Introduction to Section E and the Responses to E1 and E2, it would be inappropriate to authorize the operation of the proposed diffuser without credible supporting information, including a detailed water quality analysis that considers pertinent chemical and biological processes specific to the operation of the proposed diffuser. Mirant Kendall has declined to submit such an analysis to EPA and has instead relied on the presumption that destratification of the lower Basin, regardless of how it is accomplished, would result in the deeper part of the water column becoming well oxygenated. EPA disagrees with the

basis of this presumption. The Army Corp of Engineers reviewed projects where oxygenation techniques were used to oxygenate the hypoliminions of stratified waters and to reduce algal blooms (ENSR, 2004). The results of this review indicated that water quality conditions were made worse in approximately half of the projects and that the greatest risk from artificial circulation involves transport of nutrients and other substances from the bottom to the surface of the waterbody. Furthermore, temperature increases in the bottom waters, as would occur with operation of the diffuser, may counteract the redox reactions that bind phosphorus in the benthic sediments and stimulate decomposition rates and phosphorus release (EPA, 1990). EPA's 1990 guidance document, *The Lake and Reservoir Restoration Guidance Manual*, gave artificial circulation practices a "poor" confidence ranking for addressing eutrophication.

It appears that Mirant Kendall's primary objective in the design of the proposed diffuser was to distribute the thermal discharge more broadly throughout the lower Basin. While this goal is laudable in isolation, the complexities of the lower Basin require EPA to consider other objectives, particularly the prevention of additional excursions from state water quality standards. Mirant Kendall has not adequately addressed the identified water quality impacts. Mirant Kendall did not develop a credible water quality model to evaluate water quality impacts associated with the proposed diffuser, and did not evaluate alternative diffuser system designs with the goal of minimizing potential eutrophication-related water quality impacts. Because of the potential negative impacts associated with Mirant Kendall's diffuser proposal, a credible water quality model is required to identify the characteristics of diffuser designs that would be protective of water quality in the lower Basin.

In summary, EPA is not authorizing operation of the proposed diffuser in the Final Permit because (1) there is a reasonable potential that operation of the proposed diffuser would result in degradation of surface water quality in the lower Basin; (2) Mirant Kendall has not provided the necessary supporting information and water quality analysis to show that the operation of the proposed diffuser will not increase algal biomass in the lower Basin; and (3) Mirant Kendall has not evaluated design alternatives to identify the characteristics of diffuser designs that would minimize eutrophication-related water quality impacts of the diffuser. To the contrary, Mirant Kendall's monitoring and contingency proposal would clearly allow for further degradation of the lower Basin which would be inconsistent with attaining Massachusetts Water Quality Standards. See Attachment A to the Draft Permit Fact Sheet, page 31. In any event, EPA will only consider a monitoring/contingency proposal as the means for justifying authorization of a diffuser after Mirant Kendall has performed, to EPA's satisfaction, the diffuser water quality modeling and design analyses discussed above.

Comment related to E3 by Roger Frymire: The (proposed) diffuser appears to have been postponed because it may be prone to release more nutrients to go along with the higher temperatures that are already expected, and further exacerbate the algae blooms. I believe the diffuser needs to be built and the amount of monitoring should be used to closely monitor temperature and biological parameters and make sure that a new regime was reached that is stable again and isn't releasing a constant stream of nutrients.

Response to Comment related to E3 by Roger Frymire: See Introduction to Section E and Response to E3 above for reasons for EPA deciding to deny the diffuser proposal at this time even with close monitoring. .

Comment related to E3 from MA CZM: MA CZM suggests that the list of constituents analyzed for in the grab sample program outlined in Section I.A.14.d.2 be expanded to include all chemicals known to occur in the sediments of the Charles River basin and are therefore likely to be present in the water column under certain meteorological or operational conditions that might resuspend sediments.

Response to Comment related to E3 from MA CZM: EPA is not aware of conditions associated with operation of the facility, other than the rejected diffuser proposal, that would result in the resuspension of benthic sediments. Therefore, it is unnecessary to include such monitoring requirements at this time.

Comment E4: Mirant Kendall argues that EPA has not adequately considered the benefits of restoration of dissolved oxygen to the deeper layers of the Basin, particularly with respect to how reduction of stratification by the diffuser could affect and improve the available habitat for yellow perch, alewives and other species comprising the BIP.

Response to E4: EPA has fully considered the potential benefits and drawbacks of the proposed outfall diffuser, as explained in the Draft Permit and Fact Sheet. Mirant Kendall has overstated the potential benefits that might result from operation of the proposed diffuser and has not considered other factors such as increased temperature, salinity, poor visibility and sediment characteristics that would limit the value of this habitat even if dissolved oxygen was improved. See Response to E1, part 3. At this time, Mirant Kendall has not met its burden of establishing that the benefits of this discharge will outweigh the drawbacks. Before authorizing such a discharge, EPA will require a detailed analysis of the proposed diffuser and its potential impacts in order to ensure that (1) water quality will not be degraded and (2) the diffuser system is designed to minimize water quality impacts.

However, Mirant Kendall has provided neither the necessary documentation, nor a credible water quality model, to support its assertions that the benefits associated with the operation of the proposed diffuser will likely occur, or to what extent they might occur. EPA has not received credible evidence that dissolved oxygen levels along the bottom of the river and in the deep water pockets would increase to levels that will fully support aquatic life uses or be sufficient to prevent the release of nutrients from the bottom sediments. See Introduction to Section E; see also Attachment A to the Draft Permit Fact Sheet, pages 19-28. Moreover, even if dissolved oxygen is significantly increased, the chemical and physical characteristics of the sediments in the lower Basin, particularly in the deeper areas of the Basin where the salt wedge usually exists, are extremely limited with respect to supporting a healthy and viable macroinvertebrate community. See Response to E1, part 3.

Comment E5: Mirant Kendall quotes Section 5.1 of the Determination Document, in which EPA states that "[i]t is important to note here that EPA and others in the last decade have made steady progress in improving Charles River water quality and habitat for aquatic organisms." Mirant Kendall then states that "the habitat for aquatic organisms in the lower Charles River actually has declined in recent years because prolonged and increasing stratification has made benthic habitat less suitable for species such as the Agencies' target resident species, yellow perch, that prefer such habitat." Mirant Kendall argues that EPA has not fully considered the potential benefits of the diffuser with respect to destratification.

Response to E5: See responses to E1, part 3, and E4. There has, in fact, been steady progress in improving the water quality of the Basin during the last decade. However, the primary improvements that EPA referred to in Section 5.1 of the Determination Document were elimination and reduction of untreated sanitary sewage discharges to the Basin.

The reduction in bacteria sources has resulted in an increase in the frequency and duration that indicator bacteria concentrations in the Basin are in attainment with MA Water Quality Criteria. As a result of these improvements, the Basin, and particularly the lower Basin is able to support designated primary and secondary contact recreational uses more often. EPA is not aware of significant documented improvements in the habitat of the lower Basin during the recent past.

Moreover, EPA disagrees with Mirant Kendall's assertion that habitat has declined "in recent years" due to stratification. As explained below, the habitat decline in the Basin is not "recent," and is largely due to factors other than stratification.

Salt water intrusion into the Basin (and the resulting stratification and depletion of dissolved oxygen in the lower water column of the lower Basin) is not a recent phenomenon or one that has been increasing in severity each year. Salt water intrusion has been occurring in the Basin since 1908, when the Old Charles River Dam was built next to the Museum of Science, and has continued even after the construction of the new Charles River Dam in 1979 (Breault et al., 2000; MDC, 1981). The more recent intensive data collection efforts conducted by the USGS, EPA, and Mirant Kendall that document the presence and extent of the salt wedge began in 1998. It should be noted that the Basin was essentially flushed out of salt by two very large storm events during the summer of 1998, which could partially explain the apparent increasing trend from early 1999 and early 2000 shown in Figure D-9. Also, information for several winter, spring and fall months are notably absent in Figure D-9. Typically, based on the USGS observations, the salt wedge is diminished during these months. Earlier water quality data from the lower Basin collected by the EPA (1997) and the MWRA (1997) show elevated salinity levels of similar magnitude as well. The information presented in Figure D-9 fails to support Mirant Kendall's position that the magnitude of salt water intrusion is increasing each year. To evaluate whether any trends exist concerning salt water intrusion, EPA would need calculations of total salt mass in the lower Basin and salinity and dissolved oxygen data from earlier years (1982-1997).

Regardless of salt water intrusion into the Basin, the benthic habitat in the lower Basin is severely degraded because of contaminated sediments which have been accumulating nearly 100 years in the lower Basin since construction of the Old Charles River Dam (Breault et al., 2000). During the past century, urban runoff, atmospheric deposition, inadvertent spills, combined sewer overflows, and illegal sewage connections have contributed to the Basin fine-grained sediments and both inorganic and organic compounds. These contaminants have degraded the quality of the water, biota, and sediment (Breault et al., 2000). Furthermore, inorganic elements and organic compounds are present at sufficiently high concentrations at many surficial-sediment sampling sites to cause potentially severe biological effects to benthic organisms living in and on the bottom sediment (Breault et al., 2000). For example, in 1997 EPA performed toxicity tests on the sediments of the lower Basin and found them to be toxic to amphipods and midges (EPA, 1997).

Mirant Kendall has not provided adequate evidence to support its statements concerning the benefits of the proposed diffuser nor to show that the operation of the proposed diffuser would not degrade the surface water quality and increase the severity of use impairments in the lower Basin. See Introduction to Section E and Response to E1. Many millions of dollars have been spent to eliminate CSOs and illicit sewage discharges in order to reduce bacteria sources and increase the frequency that recreational uses are supported in the Basin. Based on the information submitted by Mirant Kendall, EPA is not persuaded that possible benefits of the diffuser outweigh potential water quality problems that could occur from the operation of the diffuser. EPA must be persuaded that the operation of the proposed diffuser will not reverse the trend of improving water quality and increased support for recreational uses, which have come at great cost to the communities in the greater Boston area. Furthermore, Mirant Kendall has failed to demonstrate that the proposed diffuser is designed to minimize potential water quality problems. As EPA has repeatedly informed Mirant Kendall, a credible modeling analysis is necessary to determine whether a diffuser is appropriate for the lower Basin.

Comment E6: Mirant Kendall argues that EPA's efforts to limit overall algal growth could adversely affect river herring, which depend directly on algal production to create their food base. Mirant Kendall requests that EPA determine the minimum amount of algae necessary to support the river herring BIP in the Charles. Finally, Mirant Kendall urges EPA to find that a chlorophyll *a* level up to 45 µg/l would be acceptable.

Response to E6: EPA has considered the information submitted by Mirant Kendall concerning algal levels and river herring. However, as the Draft Permit does not propose any limits or conditions that would expressly reduce algal biomass in the lower Basin, this issue is not relevant to this permit. EPA has emphasized to Mirant Kendall throughout the permitting process that the goal of all eutrophication-related conditions considered and proposed in the Draft Permit was to prevent the operation of the facility from increasing algal biomass and making existing water quality impairments worse in the lower Basin. See Response to E1, part 4. This goal is the reason for EPA's decision to deny the diffuser proposal.

Mirant Kendall appears to suggest that the potential for the operation of the proposed diffuser to increase algal biomass in the lower Basin should not concern EPA because increased algal biomass will contribute to the food base for herring. Mirant Kendall has incorrectly assumed that increases in algal biomass above current typical levels will result in a proportional increase to the food base for herring. In natural systems, phytoplankton food composition usually does not remain the same as phytoplankton biomass increases to high levels. Harmful blue-green species (poor food quality) tend to increase in predominance as chlorophyll *a* concentrations increase, while the fraction of diatoms and other taxa (good food quality) decrease (USEPA, 2003). Furthermore, Mirant Kendall suggests that EPA allow an average summer chlorophyll *a* concentration of 45 µg/l. Based on data collected by the EPA, this value represents approximately twice the summer chlorophyll *a* averages observed in the lower Basin for summers of 1998 to 2004 which ranged from 15.1 µg/l (1998) to 27.4 µg/l (1999). Thus, Mirant Kendall appears to be suggesting that it should be permissible for the operation of the diffuser to double the amount of algal biomass in the lower Basin causing hypereutrophic conditions (USEPA, 1990) and making existing eutrophication-related impairments far worse.

Mirant Kendall asserts that the peak abundance of both larval and juvenile stages of river herring observed in 1999, followed by the greatest returning year-class strength 2000, is correlated to EPA's reported highest average chlorophyll *a* concentration (1999) shown in Table 1 of Attachment A. This assertion is speculative and not supported by a more thorough review of the chlorophyll *a* data. First, the chlorophyll *a* data reported in Table 1 of Attachment A have not been corrected for pheophytons. Also, the 1999 chlorophyll *a* data set are log-normally distributed. For log-normal distributions, the median is a better statistical indicator of central tendency than the average as it is less affected by extreme high values. As indicated in Tables 1-3 of Response E1, the EPA median chlorophyll *a* (corrected for pheophytons) values for 2000 (26.7 µg/l), 2001 (25.4 µg/l), 2002 (16.4 µg/l), 2003 (19.4 µg/l), and 2004 (26.6 µg/l) are all higher than the EPA median value for 1999 (16.1 µg/l). The statistics for the MWRA chlorophyll *a* data (corrected for pheophytons) presented in Table E1-4 of Response to E1, which represent data from many more sampling events than the EPA data, show similar results with the median chlorophyll *a* values for 1997 (37.8 µg/l), 2000 (19.9 µg/l), 2001 (26.8 µg/l), 2002 (20.5 µg/l), and 2003 (21.8 µg/l) all being higher than the median value for 1999 (19.2 µg/l). These data do not indicate that overall algal biomass in the lower Basin was higher during the growing season of 1999 than in other years. The apparent higher numbers of larvae and juvenile river herring in 1999 and the returning-year class in 2000 may be a function of other factors.

The Charles River Basin is currently not supporting designated uses specified in Massachusetts Water Quality Standards because excessive algae have led to violations of several criteria. See Attachment A to the Draft Permit Fact Sheet, pages 2-3, 13-15. Increasing algal biomass in the lower Basin will increase the severity of these impairments which are already preventing the full support of designated uses in the lower Basin. Also, increasing phytoplankton biomass beyond existing levels will not necessarily increase the food base but will likely increase the fraction of harmful species (e.g., blue-greens) that have little to no food value. EPA is unaware of any evidence that shows that the herring populations in the Basin are limited because of the lack of

food or that increases in phytoplankton biomass beyond existing levels would add more food. Consequently, the benefits (if any) of increased algae to the herring population are outweighed by the disadvantages of aggravating existing violations of water quality standards.

Comment E7: Mirant Kendall argues that EPA failed to consider the potential benefits of the proposed diffuser insofar as it might improve habitat for benthic macroinvertebrates, particularly at intermediate depths of periodic oxygen depletion.

Response to E7: EPA has fully considered the potential benefits and drawbacks of the proposed diffuser and has determined, based on available information presented in Attachment A to the Draft Permit Fact Sheet (see pages 20-31), that the potential negative water quality impacts (i.e., increased algal biomass) associated with the proposed diffuser outweigh the undefined potential benefits.

Mirant Kendall has not provided adequate evidence to support its presumption that the operation of the proposed diffuser would add structure and improve habitat for benthic macroinvertebrates. First, considerable uncertainty remains regarding how much the proposed diffuser would increase dissolved oxygen (DO) levels in the lower water column, and whether improvement would be seen at the sediment/water interface in particular. See Attachment A to the Draft Permit Fact Sheet, page 29; Response to E1, part 3. Second, Mirant Kendall has failed to consider the extremely limiting physical and chemical characteristics of the benthic sediments that lie under the deep water pockets where the salt wedge typically exists. As discussed in the responses to E1 and E4, these sediment deposits typically range in depth from 2 to 5 feet, are finely textured (made up of mostly silt and clay), and have a fluid or "soupy" composition due to low concentrations of total solids (Breault, et al., 2000). Additionally, the sediments contain high levels of toxic contaminants (Breault et al., 2000) and were found to be toxic to amphipods and midges during toxicity testing conducted by EPA (EPA, 1997). Such sediments are not likely to provide the necessary structure or chemical environment to support a viable and healthy macroinvertebrate community that would in turn provide a sustainable and healthy food source for finfish.

Comment E8: Mirant Kendall argues that the proposed diffuser would restore dissolved oxygen to the lower water column and that this could significantly enhance populations of at least two preferred benthic prey items: larval sphaerid clams and larval chironomids.

Response to E8: See Response to E7.

Comment E9: Mirant Kendall notes that Section 5.4.9 of the Determination Document states: "This dense wedge of salt water…usually is low in dissolved oxygen." Mirant Kendall states that the entering salt water is usually high in dissolved oxygen, and only becomes oxygen-depleted after some time in the basin. Mirant Kendall argues that EPA should consider the proposed diffuser's potential to mitigate the problem by not allowing stratification to remain in place long enough for the depletion to occur.

Response to E9: EPA concurs with Mirant Kendall's observation that the incoming salt water to the Basin from Boston Harbor is well oxygenated and becomes oxygen-depleted only after time in the Basin. With respect to the claim that the operation of the proposed diffuser will mitigate low DO levels that occur in the lower water column, see Response to E7.

Comment E10: Mirant Kendall argues that EPA has underestimated the extent of the "habitat squeeze" between surface water of unsuitable temperature and bottom water devoid of oxygen. Mirant Kendall asserts that, in addition to the warm weather "temperature/oxygen squeeze" described in Section 5.4.10 of the Decision Document, habitat is squeezed for species like yellow perch when bottom salinities become too high even when enough oxygen is present. Mirant Kendall suggests that this cold weather "squeeze" in this basin may be even more limiting, because, unlike the summer situation, the fish may literally have nowhere to go to avoid it. Mirant Kendall argues that EPA should consider the potential benefits of the proposed diffuser's mixing and the elevated temperature of the discharge with respect to both dimensions of this winter "squeeze."

Response to E10: EPA has not underestimated the extent of the habitat squeeze. It is important to clarify that the upper boundary of the habitat squeeze is due to elevated temperatures caused at least in part by Mirant Kendall's thermal discharge. EPA acknowledges that use of an outfall diffuser would likely reduce the habitat squeeze caused in part by Kendall Station's discharge, but have not stated, as implied in Mirant Kendall's comment that the proposed diffuser would "significantly" mitigate this squeeze. The critical question facing EPA is to what degree the habitat squeeze would be reduced and whether the other potential benefits would outweigh the potential negative consequences of diffuser use. Based on available information presented in Attachment A to the Draft Permit Fact Sheet (see pages 20-31) and discussed in EPA's responses, EPA has found that the potential negative water quality impacts (i.e., increased algal biomass) associated with the proposed diffuser outweigh the potential benefits. Moreover, before authorizing discharge from a proposed diffuser in the future, EPA will require Mirant Kendall to conduct a detailed analysis of the diffuser and its potential impacts to ensure that water quality will not be degraded. See Response to E4.

Comment E11: Mirant Kendall argues that EPA has failed to consider the potential benefits of the proposed diffuser with regard to increasing the assimilative capacity of the Basin to distribute heat (from any source, not just Kendall Station's discharge), thus reducing the maximum exposure temperatures experienced in the Basin.

Response to E11: EPA acknowledges that the proposed diffuser would probably increase the thermal assimilative capacity of the lower Basin. However, this is not a significant environmental benefit. The primary sources of heat in the Basin are Kendall Station's discharge and the sun. EPA is unaware of any other significant heat sources that could take advantage of an increased thermal assimilative capacity. Furthermore, Mirant Kendall has not presented evidence that other heat sources to the Basin (i.e., excluding Mirant Kendall's thermal discharge to the lower Basin), are sufficient to cause non-attainment of Massachusetts temperature standards or temperature-related aquatic life impairments in the lower Basin. To the contrary,

the primary (or perhaps even sole) beneficiary of increasing the thermal assimilative capacity of the Basin is Mirant Kendall itself, by allowing the facility to discharge a greater amount of thermal load while still meeting the proposed temperature limits. Nevertheless, EPA has considered this benefit to Mirant Kendall in its decision not to authorize the proposed diffuser in this permit.

Comment E12: Mirant Kendall argues that the proposed diffuser would improve conditions for yellow perch.

Response to E12: See responses to E1 through E11, especially E7 and E23.

Comment E13: Mirant Kendall asserts that EPA has misattributed wide swings in DO in the Basin to algal blooms. Mirant Kendall argues that the oxygen deficit in the ZPH has nothing to do with algal blooms. Rather, Mirant Kendall insists, stratification above sediments high in oxygen demand is the "long acknowledged" cause of the oxygen deficit in the ZPH.

Response to E13: Mirant Kendall's analysis is incorrect. Evidence that the algae in the Basin are excessive includes, but is not limited to, diurnal DO swings and supersaturated DO levels observed in the Basin. Typically, surface water DO concentrations are directly proportional to the partial pressure of oxygen in the atmosphere. However, during photosynthesis, algae use energy from sunlight and dissolved carbon dioxide from the water to create cell mass. A byproduct of this process is oxygen. The pure oxygen being released from the algal cell causes DO concentration in the surrounding water to rise as a result of the higher partial pressure of DO (Thomann, 1987). High levels of DO supersaturation in waters are of concern because they can contribute to gas bubble disease in fish (EPA, 1986). In the Basin, DO data collected during the summer period when chlorophyll *a* levels were elevated reveal that the upper water column was frequently supersaturated with DO during the daylight hours (EPA data 1998-2004).

While algae produce oxygen through photosynthesis during the daylight hours, algae also consume DO through respiration. Usually, the minimum DO concentration occurs in the early morning hours after the algae have respired throughout the night and prior to the onset of photosynthesis. In some cases, the minimum DO will drop below a critical threshold or criterion value that would not be protective of aquatic life. In the Basin, diurnal DO variations typically range between 1 and 5 mg/l (EPA 1998-2004). Fortunately, the minimum DO concentrations in the upper water column appear to rarely drop below the Massachusetts minimum DO criterion of 5.0 mg/l set for the Charles River Basin. However, diurnal DO variations of this magnitude are indicative of excessive productivity from algae (i.e., eutrophic conditions).

Although the Basin experiences very high (supersaturated) concentrations of DO in the upper water column, it also has very low DO concentrations (0 to 3 mg/l) in the lower layer of the water column when the lower Basin becomes stratified. However, it is not uncommon for eutrophic waters that stratify to have low DO in the hypolimnion (bottom layer) because of the lack of exchange with the atmosphere, algal respiration, and the decomposition of the increased organic load from dead algae. EPA agrees that stratification in the lower Basin is caused

primarily by salt water intrusion and that high DO demand is associated with the sediments. Algal respiration, and particularly the decomposition of the organic load associated with the settled algae, are important factors that contribute to the low DO in the lower water column of the lower Basin. This analysis is supported by the sediment data collected by the USGS from the Basin which found the sediments to have a high organic content (Breault, 2000, AR#151; Breault, 2003, AR#387).

Mirant Kendall cites purportedly contrary data from the Hudson River system. However, the study of algal respiration in the Hudson River system is not directly relevant to the Charles River Basin. The relative importance of factors affecting DO in a water is typically very site-specific. For example, the segment of the Hudson River referred to in the paper submitted by Mirant Kendall is a much larger river system that is affected by tidal action and is considered to have low primary productivity (Howarth, et. al., 1992). Clearly, as indicated by the chlorophyll *a* data and the eutrophic status of the Charles River Basin (see Attachment A to the Permit Fact Sheet), the Basin cannot be considered to have low primary productivity during the growing season. Furthermore, in a system that experiences low DO and does not attain DO criteria, EPA considers any component (including algal respiration) that constitutes 25% of the total DO demand to be a significant component of DO demand.

Mirant Kendall's comment that the proposed diffuser would destratify the area and restore oxygen to the lower water column, as did the MDC aerators 4 and 5 when they were operational, is unsupported. Mirant Kendall has not provided the necessary supporting analysis to show how the diffuser would likely affect DO in the lower water column. Moreover, Mirant Kendall has not demonstrated that the proposed diffuser would have the same effects on the lower water column as did the MDC aerators. See Responses to E1, E7, E16; Attachment A to the Draft Permit Fact Sheet, pp. 21-24, 28-29.

Comment E14: Mirant Kendall argues that, even if the operation of its proposed diffuser would increase the levels of phosphorus above the pycnocline, this would not increase the potential for algal growth. Mirant Kendall asserts the following three major points: (1) algae in the lower Basin are not phosphorus-limited, (2) EPA's own data indicate that river flows, which lead to extended residence times that allow algae to proliferate before being washed out of the system, are by far the most important factor in algal growth in the lower Charles and are a much more likely and plausible explanation for the rise in chlorophyll levels than phosphorus fluctuations; and (3) the elevated chlorophyll a levels shown in EPA's data are "not . . . particularly high."

Response to E14: For reasons presented in Attachment A of the Fact Sheet and summarized below, phosphorus limits algal growth during portions of the summer period when algal blooms are typically most severe in the lower Basin.

Algal growth is primarily a function of nutrient availability, light, and temperature (Chapra, 1997). Of all the nutrients that are needed by algae (i.e., carbon, oxygen, nitrogen, phosphorus, silica, sulfur, and iron), phosphorus and nitrogen are typically in limited supply. The relative amounts of phosphorus and nitrogen in aquatic systems determine which of these nutrients are in

more limited supply for algal growth. Depending on the time of year and other environmental factors (i.e., water clarity, temperature and flushing rate), either phosphorus or nitrogen may limit algal growth.

In the Basin, based on measured amounts of nitrogen and phosphorus, phosphorus is the more limiting nutrient for algal growth. A typical ratio of nitrogen to phosphorus in algae is 7.2:1 (Chapra, 1997). Thus, TN:TP ratios less than 7.2 typically indicate nitrogen limitation while TN:TP ratios greater than 7.2 indicate phosphorus limitation (Chapra, 1997). An analysis of paired TP and TN data collected at MWRA station 166 (July - October, 1998 - 2004) found that mass TN to TP ratios ranged from 7.8 to 26.0 with a mean and median of 14.0 and 13.8, respectively.

Although phosphorus appears to be more limiting than nitrogen, other water quality data from the Basin indicate that algal growth may be limited by other factors during the early summer period. Typically, during June and early July, chlorophyll *a* concentrations are often low while corresponding TP and orthophosphate concentrations are elevated at levels that would otherwise typically indicate excessive algal growth. During this time, it is likely that algal levels are limited by other factors, such as light attenuation, consumption by zooplankton, hydraulic residence time, and/or water temperature. Orthophosphate concentrations in the Basin are an indicator of whether phosphorus is limiting algal growth at the time of the sampling because it is the form of phosphorus that algae use for growth. If algae levels are low but orthophosphate levels are high, it is likely that other factors are controlling algal levels. Conversely, during the mid to late summer, when conditions are typically more favorable for algae growth in the Basin, algae levels are typically elevated and orthophosphate concentrations are low, usually below detection, indicating that phosphorus is in demand.

During the early summer, water in the Charles River is highly colored or "stained" by dissolved organic matter. The presence of dissolved organic matter and color in the Charles River reduces light transmission through the water column and thus impedes algal growth. A likely source of the color (staining) is the dissolved organic matter from decaying vegetation from the extensive wetland areas adjacent to the river in the upper watershed. As the summer progresses, watershed contributions of flow and pollutants (including nutrients and dissolved organic matter) to the Charles River decline, resulting in improved water clarity and reduced nutrient levels in the Basin. Consequently, phosphorus, rather than light and possibly hydraulic residence time, typically becomes the limiting factor on algal growth during the mid to late summer period.

Usually the most severe algal blooms occur in late July, August and September when environmental conditions are most favorable for algal growth (i.e., higher water temperatures, improved water clarity, and longer hydraulic residence times). Under these conditions, available water quality data supports the contention that phosphorus availability limits algal growth. The increase in bloom severity coincides with declines in water color (increased water clarity) and increases in water temperatures. Decreases in TP and increases in bloom severity also coincide with declines in river flow, which increases the water residence time in the lower Basin and allows for more time for algae to grow and accumulate in the Basin. Seasonal

reduction in TP and water color are likely due to reductions in flow and pollutant load contributions from the watershed.

Figure 2 from Attachment A of the Fact Sheet presents the seasonal trend of several water parameters and river flow observed in the lower Basin during the sampling season in 2002. The seasonal trends depicted for the summer of 2002 are generally consistent with seasonal trends observed for the same parameters during the other years that EPA has monitored the Basin (1998-2004). As indicated, true color (a measure of color caused by dissolved compounds), TP, and orthophosphate are higher while chlorophyll *a* is lower during the early summer period. As the summer progresses, true color, TP, and river flow decline and chlorophyll *a* increases markedly. Figure 2 also illustrates the portion of the summer when phosphorus becomes the limiting factor to algae growth in the lower Basin. As the summer progresses, orthophosphate concentrations typically fall below the analytical detection level used by EPA (5-8 ug/l), indicating that algae were readily consuming available phosphorus. This pattern of orthophosphate dropping below the minimum detection limit during mid to late summer when algae blooms are typically most severe has occurred in every year (1998-2004) that EPA has monitored the Basin.

Mirant Kendall mischaracterizes a statement on page 29 of Attachment A to the Fact Sheet concerning levels of phosphorus that are likely to limit algal growth. The statement in question reads in full: "In general, when TP concentrations are less than 0.05 mg/l phosphorus is likely to be controlling growth; between 0.06 and 0.08 mg/l phosphorus might be controlling growth; and above 0.1 mg/l, phosphorus is not likely to be limiting algal growth (Wagner, 2003)." This statement was provided to show that the phosphorus levels that typically occur in the lower Basin during mid to late summer period are at levels that could control algal growth. Mirant Kendall, however, selectively quotes the statement and claims in comment E14 that "the Agencies' [sic] acknowledge at p.29 that phosphorus 'is likely to be controlling growth' only when phosphorus levels are less than 0.05 mg/l," implying (contrary to the rest of the quoted sentence) that levels above 0.05 mg/l are of no concern.

As discussed in Attachment A and above, the most compelling evidence that phosphorus limits algal growth during the mid to late summer period is revealed in the orthophosphate data that has been collected from the lower Basin every summer since 1998. Mirant Kendall's Figures E14-2 to E14-6, which depict some representation of EPA's orthophosphate data for the summers of 1999 to 2002, also illustrate this point, although it is unclear what data are represented by these Figures. A review of Mirant Kendall's Figures submitted to support comment E14 indicates that Mirant Kendall has made errors in the representation of certain critical data. Figure E14-1 indicates a orthophosphate concentration of 88.33 ug/l on 8/11/98, when in fact the following data were collected; CRBL07 - 5 ug/l; CRBL09 - non detect (8.2 ug/l); CRBL10 - 13.6 ug/l; and CRBL11 - 5 ug/l. In fact, although Mirant Kendall's Figure E14-1 is labeled "Eutrophication Water Quality Data for the lower Charles Basin for Summer 1998," the data points are all dated from 1999. Since Figure E14-2 also contains data dated 1999, it is unclear whether Mirant Kendall has mislabeled the data itself or merely the chart.

The actual data indicate that phosphorus was limiting algal growth in the Basin at that time. EPA has noted other discrepancies in these figures. For example, Figure E14-3 shows a TP concentration of 101.88 ug/l on 7/18/00, while the actual data indicate a TP concentration of 73 ug/l (average of TP data from CRBL07, 09, 10, and11). The three chlorophyll *a* points shown on Figure E14-4 for the sampling events around the 9/21/01 storm event, 10.40 ug/l, 8.02 ug/l and 0.03 ug/l, do not represent the actual chlorophyll *a* data collected. The correct data values are 31 ug/l, 29 ug/l, and 25 ug/l (averages of chlorophyll *a* data from stations CRBL07, 09 and 11). Because of these and other errors in Mirant Kendall's figures, no justifiable conclusions may be drawn from the shapes of curves based on Mirant Kendall's questionable data.

In addition to simple errors of data reporting, Mirant Kendall also appears to have made a scientifically inappropriate methodological choice in that it apparently included EPA's wet weather data in its Figures E14-1 to E14-6. EPA does not agree with including wet weather data for the purpose of evaluating algal responses in an impounded river system that receive such high inflows during rain events. EPA has observed that phosphorus levels are temporarily elevated during and following rain events, while chlorophyll *a* levels often decline. It is likely that chlorophyll *a* levels decline because of transport out of the system due to high inflows and pumping at the New Charles River Dam. Furthermore, EPA does not expect that chlorophyll *a* levels would increase immediately in response to the increased TP levels during and shortly after rain events, because the algae need time to grow. In addition, other environmental conditions such as reduced water clarity and less direct sunlight may reduce algal growth rates during this time. Including the representation of wet weather data in Figures E14-1 to E14-6 will tend to mask trends and possible relationships that are evident using the more representative dry weather data.

Despite these discrepancies, EPA has examined Figures E14-1 to E14-6 together with EPA's actual data. This examination supports the position that several of the water quality trends observed during the 2002 summer (true color, TP, orthophosphate, chlorophyll *a,* water clarity) are evident in the other monitoring years (1998-2004), and that phosphorus limits algal growth during portions of the critical summer period. EPA used the 2002 summer data in Figure 2 because it represented greater temporal and spatial coverage in the Basin during an extended dry period. For example, the 2002 monitoring included 6 dry-weather sampling events conducted between June 13 and September 10 at 12 monitoring stations in the lower Basin, compared to 3 dry-weather sampling surveys at 4 monitoring stations in the other years. As a result of the greater temporal and spatial coverage, the 2002 data may be more illustrative of seasonal water quality variations in the lower Basin than data from other years. For example, 6 dry weather sampling events were collected during an extended dry period, and data from 4 of these events indicate phosphorus was limiting algal growth. In the other years, when the dry weather surveys were conducted approximately once per month (July-September), wet weather sampling events often occurred between the dry weather surveys. Also, typically 1 of the 3 dry weather sampling events was conducted when other factors were likely limiting algal growth. In general, fewer points make it more difficult for possible trends to emerge.

EPA agrees that river flow and the resulting hydraulic residence time appears to be an important factor that limits the amount of algal biomass in the Basin at certain times of the year, typically spring, early summer, and sometimes early fall. Also, certain large rain events appear to have a flushing effect on chlorophyll *a* levels. However, the effects of flushing from rain events on algal biomass appears to be short lived. In general, EPA finds that flushing rates during the critical summer period are not sufficient to prevent algal blooms from becoming established, as evidenced by the high chlorophyll *a* data collected from the Basin (1998-2004). As discussed in the Response to E1, the hydraulic residence time of the lower Basin during the summers has been sufficient, even during the relatively high flow summer of 1998, to allow blooms to occur. Thus, other factors such as nutrients are likely to have controlled algal growth during periods when there was sufficient hydraulic residence times to allow algal blooms to become established in the lower Basin.

With respect to Mirant Kendall's claim that the observed chlorophyll *a* levels are acceptable, both the data and the generally accepted guidelines are to the contrary. First, Mirant Kendall focuses on the 30 ug/l chlorophyll *a* observed in October, but neglects to point out a chlorophyll *a* value of almost 60 ug/l at the end of July in addition to the 30 ug/l chlorophyll *a* observed in October. See Figure 2, Attachment A of the Fact Sheet. Moreover, as discussed in Attachment A and notwithstanding Mirant Kendall's unexplained assertion to the contrary, both of these levels are indicative of excessive algal levels or "nuisance bloom levels" in the lower Basin. In December 2001, EPA recommended ambient water quality criteria for TP, TN, chlorophyll a, and secchi depth for lakes and reservoirs. The nutrient-related criteria were developed for 14 ecoregions within the continental United States. EPA's ecoregional nutrient criteria address cultural eutrophication and are considered protective of aquatic life and recreational uses. These criteria are intended to be used by states as a starting point as they move towards adopting nutrient-related numeric criteria in their Water Quality Standards (EPA, 2001). The Charles River Basin is located in subecoregion 59 of Nutrient Ecoregion XIV, the Eastern Coastal Plain. Based on a regional analysis of summer (July-September) chlorophyll *a* data from lakes within subecoregion 59, the New England Coastal Plain, the Regional Technical Assistance Group for nutrient criteria development in New England has proposed a preliminary criterion for average summer chlorophyll *a* of 2.63 ug/l (ENSR, 2000, AR#395).

Furthermore, these high chlorophyll *a* values coincide with TP concentrations of approximately 60 ug/l and 75 ug/l, respectively. The orthophosphate data for the July sampling event indicates that phosphorus is limiting algal growth, while temperature (58 degrees F) and water clarity may have been limiting factors in mid-October.

Finally, with respect to Mirant Kendall's insistence that EPA "identify just what level of increased phosphorus would make any significant difference in nuisance algal blooms," EPA reiterates that it is not the agency's responsibility to develop a credible water quality model to support Mirant Kendall's permit application.

Comment E15: Mirant Kendall argues that whatever the phosphorus levels, the determinative factor in the algal growth in the lower Charles River actually is the amount of flow.

Response to E15: See responses to E1 and E14. Hydraulic residence times are sufficiently long during the critical summer periods to allow algal blooms to become established in the lower Basin. Every summer since EPA began its monitoring of the Basin, including the relatively high flow summer of 1998, chlorophyll *a* levels have indicated bloom conditions in the lower Basin resulting in excursions from Massachusetts Water Quality Standards. During these bloom periods other factors, not flow, have controlled algal growth rates in the lower Basin. The ample data available indicate that nutrients, and in particular phosphorus, limit algal growth rates during those periods when the most severe blooms occur.

Mirant Kendall again suggests that a chlorophyll *a* value of 40 ug/l is an acceptable threshold for the lower Basin. To the contrary, this value far exceeds a value that would protect all designated uses. See response to E14.

Comment related to E15 and E19 from Dr. Stephen Kaiser: The key objection raised by EPA to the diffuser is the potential for algae growth given the advanced eutrophic state of the Charles River. The issue of algae problems was not adequately dealt with in the MEPA review. EPA's comment letter of 1999 raised the concerns about algae growth and should have been highlighted in the permit discussions. The draft permit should have explicitly discussed the problems with the diffuser pipe and its possible contribution to algae growth.

Response to Comment related to E15 and E19 from Dr. Stephen Kaiser: Throughout the permit development process, EPA, DEP, and other regulatory agencies have expressed concerns about the potential for increased algal growth associated with the operation of the proposed diffuser and the increased thermal load from Mirant Kendall's facility. Attachment A to the Draft Permit Fact Sheet discusses these concerns and the basis for EPA's decision not to authorize use of the diffuser in the Draft Permit and to require extensive eutrophication-related monitoring.

Comment E16: Mirant Kendall argues that experience from the MDC aerators in the Charles River shows that the proposed diffuser would destratify the Basin and improve water quality without increasing phosphorus levels in the upper water column. Mirant Kendall argues that EPA, in Attachment A to the Fact Sheet of the draft permit, improperly rejected the MDC aerators as an appropriate analogue.

Response to E16: Mirant Kendall has mischaracterized EPA's basis for not relying on the results of MDC aerator study. EPA did not, as Mirant Kendall claims, "dismiss that past experience on the ground that destratification did not … reduce nutrients in the surface layer of the Basin." EPA's basis for not relying on the MDC study as supporting evidence for use of the proposed diffuser is clearly presented on page 21 of Attachment A to the Fact Sheet. Regardless of the results of the MDC aerator study, a technical analysis specific to the operation of the proposed thermal diffuser is needed to evaluate potential impacts on water quality for the following reasons.

First, EPA has not relied on the results of MDC aerator study to address concerns with the operation of the proposed diffuser because, unlike the MDC aerators, use of the proposed diffuser would introduce a large thermal load into the lower water column which would significantly increase water temperatures and, consequentially, biological and chemical reaction rates. Mirant Kendall has given EPA information that indicates that bottom water temperatures in areas of the downstream portion of the lower Basin would increase by more than 5.6 degrees C (10 degrees F) during operation of the proposed diffuser (TRC, 2001, AR#458). A general rule of thumb is that rates of most reactions in natural waters will approximately double for a temperature rise of 10 degrees C (Chapra, 1997). Increases in the rates of chemical and biological processes in the bottom waters and at the surface of the benthic sediments will increase the consumption of DO and benthic nutrient flux rates and must be considered for the lower Basin.

Secondly, the proposed thermal diffuser would act to destratify the lower Basin in a very different way than did the MDC aerators. Dr. Eric Adams of the Massachusetts Institute of Technology, under contract to TRC (Mirant Kendall's consultant), also concludes that the proposed thermal diffuser is significantly different than the MDC aerators with respect to how destratification would be accomplished (Adams, 2003). While EPA agrees that the proposed thermal diffuser discharge would act to destratify the lower Basin, Mirant Kendall has not provided a credible water quality model that would justify the conclusion that the operation of the proposed diffuser would not degrade the water quality of the lower Basin. Mirant Kendall has failed to provide the necessary technical analysis and evidence specific to the operation of the proposed diffuser to support Mirant Kendall's presumption that the operation of the proposed diffuser would sufficiently raise DO levels in the bottom waters and not increase nutrient loading to the upper water column.

Finally, EPA's position that technical analysis specific to the proposed thermal diffuser is needed before authorizing such a discharge is supported by the inconsistent results of other artificial circulation projects. As discussed earlier in the response to E3, ENSR's evaluation of artificial circulation techniques designed to oxygenate the hypolimnions of stratified waters and control algal blooms found that not all projects were successful (ENSR, 2004). In fact, a review by Pastorok et al. (1982, as cited in ENSR, 2004) of many whole lake artificial circulation treatments found that, in more than half the cases, conditions became worse. Finally, ENSR reports that the greatest risk from artificial circulation involves transport of nutrients and other substances from the bottom to the top of the lake – precisely EPA's concern here.

Comment E17: Mirant Kendall argues that the proposed diffuser's oxygenation of the deeper waters would facilitate the binding of phosphorus to the abundant iron, aluminum and calcium and reduce phosphorus "flux" from the benthic sediments into the water column. Mirant Kendall maintains that higher DO in the water column suppresses nutrient flux to the surface even if some flux occurs at the sediment interface.

Response to E17: EPA has reviewed the permittee's 2004 nutrient/DO profile data and has determined that there is insufficient information to support Mirant Kendall's assertion that

raising DO in the water column will be sufficient to suppress overall phosphorus flux rates that might result from operation of the proposed diffuser. Mirant Kendall has not provided the supporting quality assurance/quality control (QA/QC) data and documentation that is needed to verify that the data are acceptable. It appears that at least one data value is erroneous. See the MIT June 23, 2004 TP and orthophosphate data collected at a depth of 8 feet. The orthophosphate value of 0.31 mg/l exceeds the TP value of 0.08 mg/l, which is not possible. Orthophosphate is a component of TP and must always be less than or equal to the corresponding TP value. Also, the phosphorus and DO data collected at both stations on July 9 and July 23 at the 15 foot depth appear inconsistent. While the upstream station, MIT, has elevated phosphorus levels and low DO at the 15 foot depth, the downstream station does not have elevated phosphorus levels despite DO being low. This pattern is inconsistent with EPA's 2002 profile data. EPA would expect to see the elevated phosphorus values at both stations if the low DO was due to the salt wedge.

Moreover, the lack of salinity profile data make it difficult to interpret the data provided and to determine whether the data were collected within, above, or below the pycnocline. The pycnocline in the lower Basin is a narrow transition zone that separates the upper and lower water column and that is characterized by high salinity, temperature and pollutant gradients. It appears possible that some or all of the 15 foot data were collected within the pycnocline and are therefore, not representative of either the lower or upper water column. Setting aside for the moment questions concerning the quality of the data, the profile data collected by Mirant Kendall lack the necessary vertical detail to characterize nutrient gradients throughout the water column. EPA's 2002 profile data, which were collected above and below the pycnocline based on salinity and DO observations, indicate that the salt wedge is effectively trapping much of the phosphorus that is released from the sediments in the lower water column. EPA's data indicate that the upper water column, above the pycnocline, is well mixed with relatively uniform nutrient concentrations.

Finally, Mirant Kendall's phosphorus analysis does not consider the effects of increased advective transport between the bottom waters and the upper water column that would result from the operation of the proposed diffuser. Increased advective transport associated with the operation of the diffuser could readily transport orthophosphate that has been released from the benthic sediments up into the photic zone of the water column where algae can grow.

Comment related to E17 from Roger Frymire: Once you get an oxygen environment established at the bottom of the river, that alone will prevent a high nutrient flux from coming out of the sediments. At the same time, we'll have oxygen to allow clams and bacteria in the bottom sediment to begin some much needed bioremediation.

Response to Comment related to E17 from Roger Frymire: As discussed in the Responses E1-E16, EPA has determined that the potential negative consequences associated with the operation of the proposed diffuser more than offset the potential benefit associated with increasing dissolved oxygen levels in the lower water column. Moreover, EPA has not been presented with convincing evidence that the operation of the proposed diffuser to discharge

thermal waste heat to the bottom of the lower Charles River would result in raising dissolved oxygen to levels that are sufficient to oxygenate the bottom sediments, improve the benthic habitat, and inhibit the release of nutrients. A thorough and credible modeling analysis of the operation of the proposed diffuser is needed to demonstrate what the likely impacts on water quality would be to the lower Charles River.

Comment E18: Mirant Kendall contends, citing various data, that there is little or no risk of increases in algal growth and of nuisance blue green algae due to increased thermal output from the plant.

Response to E18: Every summer from 1998 to 2004, water quality monitoring of the Basin shows there have been water quality impairments related to excessive algae in the Basin, even when the facility's thermal load was less than 20% of the allowable permitted load, which occurred during August 1998. Although water quality monitoring data appear to indicate that algal-related water quality problems occur in the lower Basin regardless of the facility's thermal discharge, the important question concerning the facility is how much the discharge has contributed or will contribute (under full permitted thermal load) to the severity of algal blooms and related water quality impairments. EPA has included eutrophication-related monitoring requirements in the permit to provide the necessary information to more fully evaluate these concerns.

EPA disagrees with Mirant Kendall's assertion that the chlorophyll *a* and temperature data from the lower Basin show that Mirant Kendall's thermal discharge is not contributing to increased algal levels in the downstream portion of the lower Basin. Mirant Kendall's evaluation of the effects of thermal discharge on algal growth using only temperature and chlorophyll *a* data from the lower Basin is inappropriate because it ignores the effects of many other factors that are known to influence algal levels in the Basin. As discussed extensively in Attachment A to the Fact Sheet and in other responses, algal levels at any given location are affected by several factors (light, nutrient availability, settling, retention time, and temperature). Mirant Kendall has interpreted existing data collected during the summer of 2002 by assuming that these other factors were constant throughout the lower Basin and between sampling events. Mirant Kendall also has assumed that conditions reflected by data collected at monitoring stations located in close proximity to one another are identical and ignores flow circulation patterns within the lower Basin. Mirant Kendall has not provided evidence to support these assumptions.

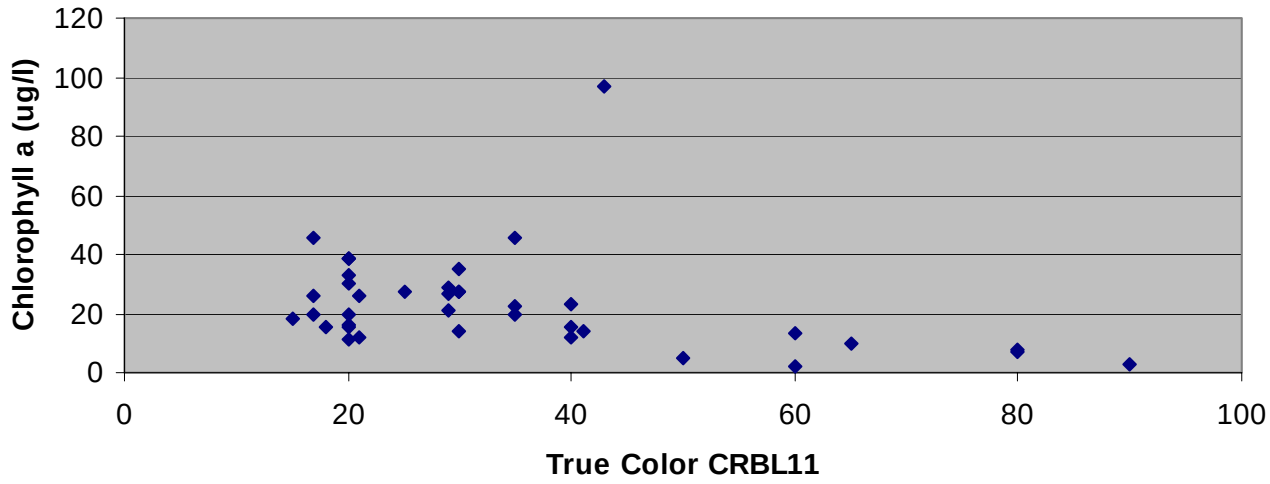
On any given day, water quality and flow circulation conditions vary in the lower Basin. Mirant Kendall's thermal discharge has a major influence on flow circulation patterns in the Lower Basin, as evidenced by temperature data collected from the lower Basin. Measurements of surficial sediment deposits, chlorophyll *a*, and water clarity data in the lower Basin all indicate this spatial variability and show that more algae settle out of the upper water column in the downstream portion of the lower Basin than in the upstream portion. Also, monitoring data show that there is often considerable variability in nutrient concentrations within the lower Basin for a given monitoring day. Furthermore, EPA disagrees with Mirant Kendall's assumption that all conditions with the exception of temperature are constant between summer season sampling

events. Water clarity, retention time (i.e. river flow), circulation patterns, and climatic conditions such as cloud cover, wind speed, sunlight intensity and the angle of incidence vary considerably throughout the summer. The spatial and temporal variability of factors that affect algal growth in the lower Basin make it impossible to isolate the effects of temperature alone on algae using ambient water quality data.

Mirant Kendall notes that some of the available water quality data coincide with periods of plant operation near the plant's full permitted thermal load. EPA acknowledges that some of the available data reflect near-full permitted load conditions, albeit only for brief periods of time, and EPA has reviewed that data. However, as explained below, EPA does not agree with Mirant Kendall's usage and interpretations of that data.

Mirant Kendall observes that chlorophyll *a* levels were lower during the early to mid summer of 2003, when the facility was running at 90% of its highest permitted load, compared to late summer chlorophyll *a* levels when the facility was running at 30% of its permitted load. Based on this fact alone, without reference to any potentially interacting or confounding factors, Mirant Kendall contends that its fully-permitted thermal load has little or no influence on algal growth. However, this pattern can be explained by EPA's true color data collected during the summer of 2003. During the July 8 and August 19 sampling surveys, true color values were high, at 90 units and 60 units, respectively, while during the September survey true color dropped to 35 units. True color at the July and August levels indicate that algal growth in the Basin was light limited.
An analysis of true color and chlorophyll *a* data collected in the lower Basin show that when true color values are above 50 units, algal growth appears to be generally depressed (light limited)

Figure E18-1. Chlorophyll a vs. True Color, Lower Charles River Basin (CRBL11 1999-2004)



(see Figure E18-1). EPA credits the considerable research that has been conducted by the scientific community to evaluate the effects of temperature on algal growth rates. This peer-reviewed published research clearly shows that when other factors are held constant, algal growth rates increase with increasing temperature (see pages 16-17 of Attachment A to the Fact Sheet). Mirant Kendall has failed to provide any credible evidence that the results of this research are not applicable to the algal community in the Charles River Basin. Mirant Kendall's approach is rather to assume that the other factors in the lower Basin are constant, and then to conclude from the lack of observed correlation between temperature and chlorophyll *a* that there is, in fact, no relationship between temperature and algal growth. This is erroneous because it ignores the complex interactions in a multivariate analysis and, as the true color data show, the assumption is factually incorrect.

Based on existing thermal discharge and water temperature data, it is readily apparent the permitted discharge has the potential to increase water temperatures in the downstream portion of the lower Basin by more than 5 degrees F. The magnitude of the temperature increase associated with the discharge and the results of the research on the effects of temperature on algal growth rates justify the eutrophication-related monitoring requirements in the Final Permit.

Comment E19: Mirant Kendall disagrees with EPA's concern that additional heat load from the facility could result in an undesirable shift to nuisance species (cyanobacteria, also known as "blue-greens"). Mirant Kendall challenges EPA's computation of a "500% +" potential increase in heat load as misleading. Moreover, according to Mirant Kendall, there is no apparent significant positive correlation to temperature between relative abundance of cyanobacteria and elevated water temperatures at either upstream or downstream stations of varying water temperature. Mirant Kendall further asserts that Kendall Station's discharge essentially never causes nor would it cause the ZPH (or even the ZD) to reach levels associated with dominance by cyanobacteria (blue-greens).

Mirant Kendall contends that the diffuser would reduce the competitive advantage of the more buoyant and less salinity-tolerant blue-greens in favor of species more tolerant of brackish water, notably the diatoms essential as the foundation of the river herring food web.

Response to E19: First, the 500 %+ potential increase in heat load was <u>not</u>, as Mirant Kendall claims, determined by comparing the lowest past load from the mid 1990's with maximum allowable load. Rather, the value was determined by taking the average of the potential increase for each July to September period for 1998 through 2000. The potential increase was determined by comparing the monthly average heat load discharged by the facility during the July to September period to the monthly average permitted load (486.5 MM btu/hr). The average potential percent increase for the July to September period of these three years is 514%. Comparison to these periods were chosen because the chlorophyll *a* data collected from the lower Basin during each of these summers were high and indicate algal-related water quality impairments existed in the lower Basin.

Figures E19-1, E19-2, and E19-3 below present the limited algal taxonomic data collected from the lower Basin (summers of 2001, 2002 and 2003). Although the data sets are not representative of the entire summer growing season for these years, each data set indicates a trend of increasing blue-green presence and predominance as the summer progresses. This predominance of blue-greens occurs when temperatures in the lower Basin are between 25 and 30 degrees C. Also noteworthy is the variation in cell counts among the three years. Cell counts were high in 2001 and moderate in 2002 and 2003. As indicated, the 2002 algal sampling was conducted only once per month and did not coincide with peak bloom conditions that chlorophyll *a* data indicate occurred in the lower Basin during late July and again in late September/early October. Mirant Kendall has claimed that the diffuser would reduce the competitive advantage of the more buoyant and less salinity-tolerant blue-greens. EPA finds this claim to be speculative and unsupported. In fact, existing algal data collected as part of the MDC aerator study, prior to and during the operation of the aerators, show that blue-greens were present, and in several cases represented the predominant group, when salinity levels were elevated (see Table E19-1 below for examples). With these data and the lack of evidence provided by Mirant Kendall to support its claim, EPA will not consider the potential lowering of blue-greens by the operation of the proposed diffuser as a potential benefit of the diffuser.

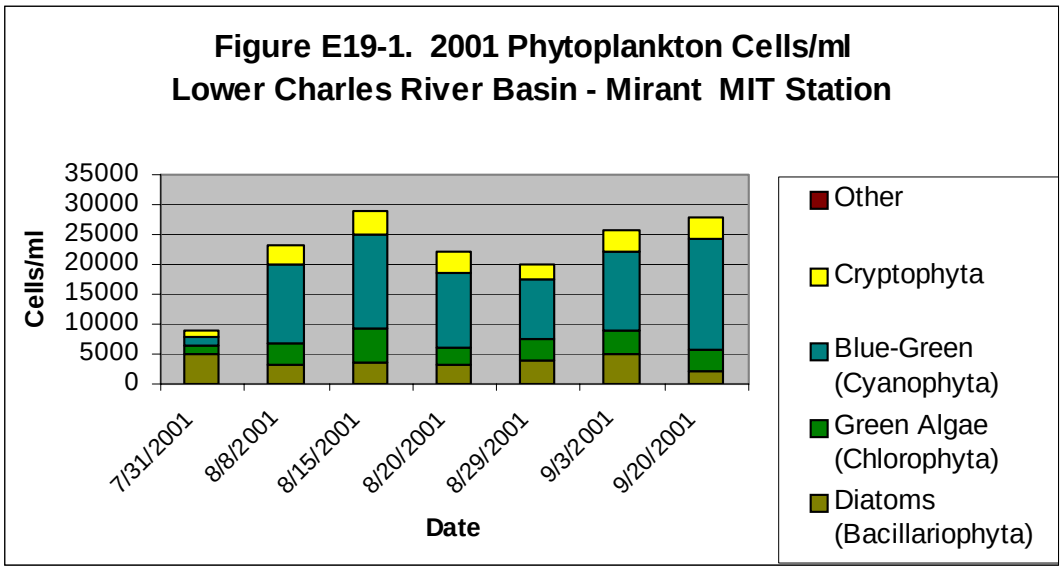


Figure E19-3. 2003 Phytoplankton Cells/ml
Lower Charles River Basin - Mirant Station C

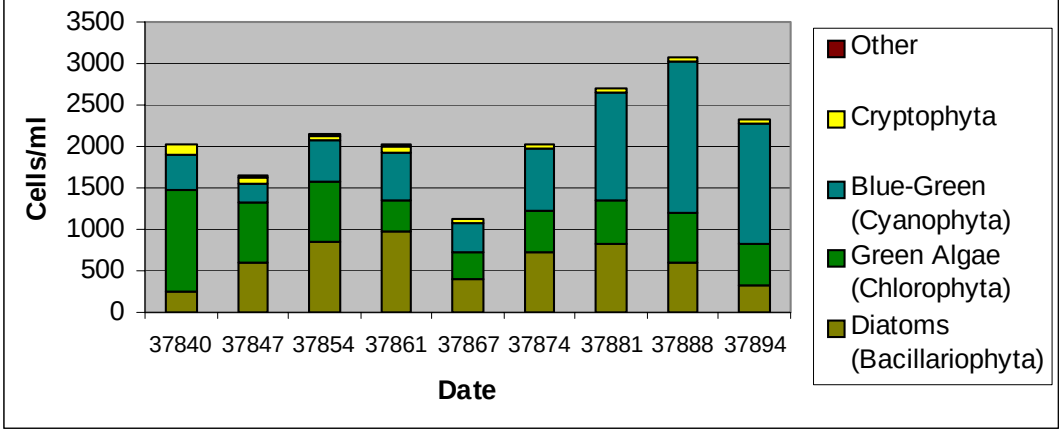


Figure E19-2. 2002 Phytoplankton Cells/ml
Lower Charles River Basin - EPA CRBL11

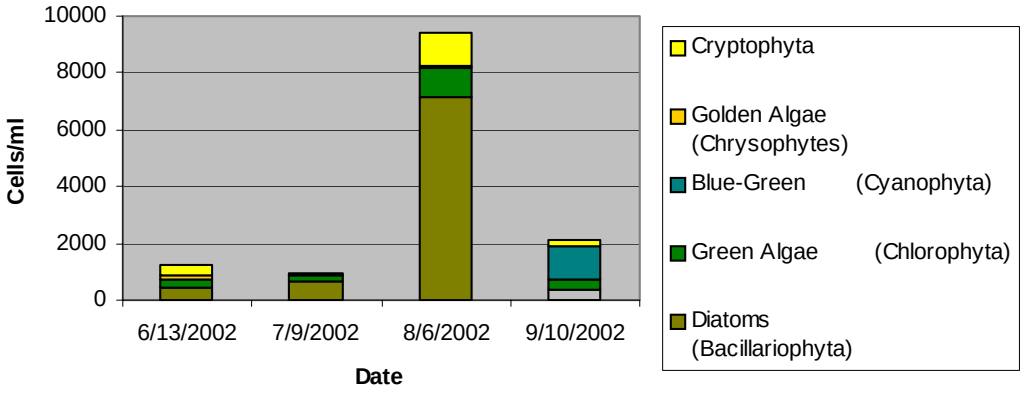


Table E19-1. Example Blue-

green Counts, relative abundance, and salinity measurements from the lower Charles River

Date	MDC Station	Blue-green (count/ml)	% Relative Abundance of Blue-greens	Salinity (ppt)
8/26/1977	5	4180	93	6
8/9/1978	3	2600	58	8
7/23/1979	5	9220	75	5
9/8/1980	3	4200	74	10

Source: MDC Charles River Artificial Destratification Project, Boston, MA, June 1981

Concerns with Mirant Kendall's increased thermal discharge (compared to recent historic levels) and the possibility of the increased proliferation of blue-greens is directly supported by peer-reviewed published research, which indicate that the growth rate of many blue-green species increases more rapidly than other algal groups when temperature rises above 25 degrees C (see Figure 3 in Attachment A to the Fact Sheet). Generally, blue-greens favor conditions with higher temperatures, lower TN:TP ratios, and high pH compared to other algae groups (Mattson et al., 2003). Many blue-greens, particularly the undesirable species, can "fix" nitrogen. While other algae must obtain their nitrogen from ammonium or nitrate in the water, the blue-greens can use atmospheric nitrogen that dissolves into the water. A shortage of inorganic nitrogen or a reduction in TN:TP ratios can give nitrogen-fixing blue-greens a competitive edge. Furthermore, some of the most undesirable blue-greens have other characteristics, such as the ability to float, which furthers their competitive edge. Thus, if other conditions exist that favor blue-greens, then increased temperatures associated with the thermal discharge would likely give blue-greens an additional competitive edge over other algal groups. A very severe blue-green bloom consisting of very high counts of microcystes (known for its potential toxicity to animals and humans) occurred in the downstream portion of the lower Basin during a prolonged period of warm weather in August of 2006. During this period, river temperatures were noticeably elevated from Kendall's thermal discharge. Cell counts of over 1 million cells per milliliter were observed in the river between the Longfellow Bridge and the Museum of Science causing the Massachusetts Department of Public Health to post notices warning people and pets to avoid contact with the water.

In evaluating potential water quality impacts, EPA must consider the impacts of the thermal discharge at permitted loads for extended periods of time. Such conditions have not occurred in the past during the critical season for algal growth while frequent water quality monitoring was

conducted. Based on EPA's data, the critical season typically begins in mid-July when true color levels drop and extends to the end of October.

Algal and temperature data collected upstream in the lower Basin and downstream in the vicinity of the discharge were compared to identify any obvious trends between river temperature and algal cell counts. Table E19-2 (attached) summarizes the upstream and downstream blue-green and total algal cell counts measured during the summers of 2001, 2002, and 2003. Due to the influence of other factors (i.e., water clarity, nutrient availability, and settling) that affect algal concentrations, it is virtually impossible to isolate temperature as a sole influencing factor on algal growth in natural waters (Goldman, 1981). The variability of water quality within the lower Basin has already been discussed in this response above and generally shows improvement in the downstream direction. It is probable that environmental conditions, other than temperature, differed between the upstream and downstream stations, which may have affected algal concentrations. Mirant Kendall provided no data to confirm that all other environmental factors (including flow circulation and sedimentation rates) that potentially affect algal concentrations were consistent.

Not surprisingly, the results do not indicate a clear trend with respect to temperature across the three years. The magnitude of the blooms in the lower Basin among these three years appeared to vary considerably, as did river flow (see Table E1-1 from Response E1). However, when data from individual years are examined, trends between blue-green counts and temperature become apparent for two of the three years. The 2001 data (four sampling events) show higher blue-green and total algae counts at the downstream station for two of the four sampling events. These two events correspond with the two highest positive increases in temperature (delta T) observed. In contrast, despite the high delta Ts recorded for all three sampling events in 2002, total algae counts were lower at the downstream station for each sampling event and the blue-greens increased only slightly on one event, September 10, 2002, when the delta T was 4.2 degrees F. The 2003 algal data set was the most extensive, consisting of eight sampling events over a two month period. For all eight sampling events, the blue-green counts were significantly higher (26% to 942 %) at the downstream stations, while total algae counts were higher five of the eight sampling events at Station B and six of the eight sampling events at Station C. For all eight 2003 sampling events, temperatures at the downstream stations (Mirant stations B and C) were higher than at the upstream station, with delta Ts ranging from 0.9 deg. F to 4.5 deg. F .

The 2003 data are of special interest for three reasons: (1) the thermal load discharged by the Kendall Square Station facility was noticeably higher than the previous two summers; (2) the relative differences (i.e., increase) in blue-green counts between the downstream and upstream stations were notably higher than the relative percent differences of total algae between the downstream and upstream stations; and (3) the results are somewhat inconsistent with the typical water quality trend of improving water quality in the downstream direction that has been observed in the lower Basin. The trend of improving water quality in the downstream direction of the lower Basin usually applies to chlorophyll *a*. EPA compared the dry weather chlorophyll *a* data collected by EPA (1998 to 2002) at monitoring stations CRBL06 (upstream - 400 meters downstream of BU Bridge) and CRBL11(downstream - between Longfellow Bridge and the

Museum of Science), and found that chlorophyll *a* concentrations were higher at the upstream station, CRBL06, for 72% (21 of 29) of the paired observations. On average, the chlorophyll *a* concentration at CRBL06 was 39% (15 ug/l) higher than the corresponding value at CRBL11 for those sampling days when CRBL06 had a higher chlorophyll *a* concentration. This trend is diminished in the summer of 2003 when Kendall Station was discharging a greater thermal load. The 2003 algal data collected by Mirant indicate that algal levels in the upstream portion of the lower Basin were higher for only 38% (3 of 8) and 25% (2 of 8) of the sampling events at Stations B and C, respectively. Although increases in temperature may appear to be a primary reason for the increase in blue-green and chlorophyll *a* levels in the downstream portion of the lower Basin, caution must be exercised when interpreting these results since other site-specific factors may have partially contributed to the higher levels in the downstream end of the Basin.

In summary, every summer from 1998 to 2004, water quality monitoring of the Basin has shown that there have been water quality impairments related to excessive algae in the Basin, even during the one month (August 1998) when the facility's thermal load was less than 20% of the allowable permitted load. Although water quality monitoring data appear to indicate that algal-related water quality problems occur in the lower Basin regardless of the facility's thermal discharge, the important question concerning the facility is how much the discharge has contributed or will contribute (under full permitted thermal load) to the severity of algal blooms and related water quality impairments. After considering: (1) the relationship between temperature and algal growth; (2) existing documented water quality impairments in the lower Basin; (3) the 2003 algal data analysis; and (4) the magnitude of the potential increase in thermal load from the Kendall Square Station facility, EPA concludes that the thermal discharge from the Kendall Square Station facility has the continued potential to contribute to excessive algae levels in the downstream portion of the Basin during critical periods of the growing season (i.e., mid to late summer). Therefore, EPA has determined that the eutrophication-related monitoring requirements included in the Final Permit are justified (and in fact necessary) to provide additional information to evaluate the impacts of the facility.

As explained in several of the previous responses, EPA has not received credible evidence to support Mirant Kendall's assertions that the operation of the proposed diffuser will not exacerbate algal blooms in the lower Basin. See, e.g., Response to E1. Based on available information, EPA finds that the operation of the proposed diffuser represents a reasonable potential to contribute to algal blooms in the Basin, and will not permit its operation at this time.

Comment E20: The Agencies' Incorrect Speculation Regarding Increased Salinity. Section 5.1 of the DD states that "[i]ncreased salinity throughout the water column in the lower basin [from the diffuser operation] may pose an environmental stress to resident fish populations." This speculation is restated in Section 5.4.9.

This is unsupported speculation with ample evidence to the contrary. The Agencies estimate the maximum mixed salinity with the diffuser will be 6.5 ppt (Fact Sheet Attachment A, p. 22). Mirant Kendall expects it would be less, especially with time as the salt is mixed and exported from the basin. As documented on Table 5 of Attachment A, however, 6.5 ppt is a value

characteristic of historic conditions in the basin. Further, both Mirant Kendall's extensive field collections of resident species at salinities up to 14 ppt in the basin and the available literature data submitted by Mirant Kendall on salinity thresholds for adverse impact on the basin species (see Final Environmental Impact Report (EOEA No. 11754), Response to Comments, §8.2.43, AR#456) indicate the general absence of adverse effects at up to 5 ppt. Precisely what resident species does EPA believe will be impacted and how? Further, how will this redistribution not provide net benefits to those resident species such as yellow perch or largemouth bass which would no longer be pre-empted from their preferred benthic habitats under stratified conditions? Mirant Kendall's gill net data consistently shows that these fish vacate previously preferred locations when salinities reach at or above about 14 ppt.

Response to E20: In order to address the permittee's comment related to the overall health of fish species present in the lower Basin, EPA reviewed relevant salinity information in the scientific literature for two resident species that were also previously evaluated for their sensitivity to temperature (white perch and yellow perch) and one anadromous species (alewife). Optimal salinity ranges (ppt) for these species by life stage are: white perch - 0-2 (eggs), 0-3 (juveniles), and 5-18 (adults); yellow perch - 0-2 (eggs), 0-5 (juveniles), and 0-13 (adults); alewife - 0-2 (eggs), 0-5 (juveniles), and 0-30 (adults). See Funderbunk et al. (1991) AR#364; USFWS, 1983, AR#573 (stating that white perch "spawn in nature generally at less than 4.2 ppt"). It is clear from these data that salinities as high as 6.5 ppt could impact the early life stages of all three of these species.

EPA disagrees with Mirant Kendall's claim that a salinity value of 6.5 ppt reflects historic conditions in the Basin. The table Mirant cited (Fact Sheet Attachment A, p. 22) to support this statement contained surface salinity readings on only six selected days from 1976 through 1980, during the MDC Artificial Destratification Project. It is not accurate to describe this five year time period during a destratification project as a fair depiction of surface salinity values in the lower Charles River Basin.

Contrary to Mirant Kendall's claim that 6.5 ppt is typical of the Basin, water quality profile data from 1999-2005 indicates that, in general, salinity levels in the lower Basin remained below 1 ppt from the surface to approximately a depth of nine feet for the majority of the time in most years. By the end of the summer, when stratification and saline intrusion were most pronounced, salinities from the surface to nine feet were recorded as high as approximately 2.2 ppt (August 20, 2002, Deep Diffuser Station). In general, however, even when salinity levels were most pronounced in the Basin, levels for the most part remained very low (less than 2 ppt) to a depth of at least nine feet (for example: September 27 and October 4, 2005; maximum salinity 1.6; Boston Station). Below this layer, under the fully stratified conditions of late summer, salinity values were seen as high as approximately 38 ppt (August 1, 2003 at 33 ft; Old Channel Station).
To be sure, these data (collected by Mirant Kendall) indicate that salinity from year to year varied depending on rainfall, river flow and the timing and frequency of the New Charles River Dam operation. Furthermore, EPA acknowledge that isolated atypical readings have been recorded as part of these profiles. For example, at the Deep Diffuser Station on May 24, 2002, at a depth of 9

ft, the salinity was recorded as 32.8 ppt. On May 29, only five days later, salinity levels were below 1 ppt to a depth of 15 feet at that same station.

However, despite these variations and occasional anomalous data points, the overall trend remains the same: salinity less than 2 ppt to a depth of at least nine feet. Nowhere in this broad overview of salinity conditions in the lower Charles River Basin was a value of approximately 6.5 ppt consistent with historic conditions in the Basin. Thus, the consistently low salinity environment present in the upper layer would be eliminated if the diffuser mixed the stratified layers of the Basin to 6.5 ppt.

Mirant's assertion that it has captured individual fish in salinities up to 14 ppt is not compelling evidence to the contrary. First, it can be problematic to state with confidence that a fish was captured in a gill net at a certain depth, under specific water quality conditions. Gill nets deployed by the permittee in the lower Charles River Basin were sometimes set for over 24 hours. River currents and wind can alter the configuration of the net, as well as influence the depth of temperature, DO or salinity boundary layers over the course of a day. Second, these fish could be transient, i.e., moving through (or specifically trying to exit) the saline area at the moment of capture.

Third, and most importantly, a general principle of biology is that a population exhibits a range of responses to a stressor, classically along a bell-shaped curve. Thus, even at levels of a stressor that would cause avoidance by a majority of the population, a minority of exceptionally resistant individuals will be capable of tolerating the stressor. As discussed at length in the DD, regulatory agencies do not make judgments based on the fact that some individual fish can be found under conditions that would stress the majority. The capture of individuals within an area of high salinity does not demonstrate that large numbers of the species regularly occupy that habitat. See generally Response to comment related to C2 and C3 from CLF. In the case of the lower Basin, the evidence is clear that optimal salinity ranges for eggs of all three species discussed fall well below 5 ppt.

With respect to the benefits of mixing the 14 ppt saline layer, EPA acknowledges that if a deep water discharge diffuser mixes the lower Basin in the manner described by the permittee, the benthic layer currently occupied by the salt wedge would have a reduced salinity (possibly as low as 6.5 ppt). However, as stated above, (1) the salt wedge occupies a relatively small portion of the total volume of the Basin in most years and, consequently, any incremental benefit of reducing the salinity in these regions through mixing would be more than offset by the adverse impact of increasing the salinity throughout the rest of the lower Basin as the same mass of salt is dispersed over a larger volume, and (2) because of the characteristics of the benthic sediments, the regions currently affected by the salt wedge would still provide poor habitat even if salinity were reduced to approximately 6.5 ppt. See Response to E1, part 3.

In the absence of verifiable hydrodynamic models (see Introduction to Section E), Mirant Kendall failed to provide sufficient information to predict the salinity changes that can be expected from the diffuser. The 6.5 ppt estimate for the lower Basin's salinity after mixing by the proposed

diffuser was an estimate that EPA made based on available information. However, the salinity in the lower Basin, once mixed by the proposed diffuser, could in fact reach much higher levels for certain periods of the year. For example, Mirant Kendall itself estimated that surface-to-bottom salinity under the proposed diffuser could range as high as 10 ppt for certain parts of the year. See E-mail from John P. Reynolds, Mirant, to Todd Callaghan, MA CZM (Apr. 18, 2003). This uncertainty in the resulting fully mixed salinity value must be taken into account when evaluating the impact of the diffuser on the fish habitat of the lower Charles River Basin.

Comment E21: Mirant Kendall disputes EPA's determination that there is a potential for release of pollutants (including nitrogen, phosphorus, cadmium, lead, mercury, pesticides, PCBs and PAHs) from contaminated sediments due to oxidation and fluxing as a result of operating the proposed diffuser. First, Mirant Kendall argues the levels of contaminants in the deoxygenated area generally are much lower and never higher than the levels throughout the rest of the lower Charles River Basin, which is adequately oxygenated and currently provides habitat for the BIP.

Second, Mirant Kendall states that the experience before and during the operation of MDC aerators 4 and 5 between 1978 and 1981 showed that water column levels of these contaminants did not increase. Third, Mirant Kendall asserts that its flux modeling indicated that there would not be any significant increase on diffuser startup. Finally, Mirant Kendall contends that the sediment levels of iron and aluminum in the Charles are very high and would promote phosphorus reduction.

Comment related to E21 from CRC: We are very concerned that potential eutrophication effects and chemical changes that could destabilize toxic sediments have not yet been adequately predicted and controlled.

Response to E21 and related comment: Mirant Kendall has misrepresented the nature of sediment contamination in the area of the proposed diffuser. The USGS sediment data collected from the Basin indicate that the levels of the contaminants mentioned (e.g., lead, copper, cadmium, mercury and nickel) are above some of the levels observed elsewhere in the lower Basin, and are in fact approximately equal to or above the median concentrations of all the sediment samples collected from the Basin. Also, the USGS data show that the sediments in the "deoxygenated" area have the lowest total solid percentages (i.e, most fluid sediments) throughout the Basin. The high pore water volume of these sediments increases the opportunity for chemical diffusion between sediment pore water and the overlying water column. Furthermore, the fluid sediments would likely be easily disrupted during start up of a bottom diffuser.

While the levels of the contaminants are similar to those in sediments of other areas in the lower Basin, EPA has not been sufficiently convinced by information presented by Mirant Kendall that increased vertical mixing associated with the proposed bottom diffuser above these highly porous sediments would not effectively mix contaminants that have been released from the benthic sediments into the water column and not cause toxicity to aquatic life.

Mirant Kendall has also mis-characterized the results of the MDC study by implying that data from the aerator study showed "that water column levels of these contaminants did not increase." The MDC aerator study did not involve monitoring of trace metals or other toxicants, and therefore, did not show that these contaminants decreased in the water column following destratification.

EPA has reviewed Mirant Kendall's submission concerning the fate of trace metals in the lower Basin (AR #296). While EPA appreciates Mirant Kendall's efforts to evaluate the potential fate of metals in the lower Basin related to the operation of the proposed diffuser, the submission fails to adequately address EPA's concerns. The first component of Mirant's evaluation, which relies on EPA surface DO and metals data at CRBL12, does not provide convincing evidence that the diffuser will not result in an increase in metals concentration in the water column. The data were collected at the surface during stratified conditions, when vertical mixing between the lower and upper water column was minimal to non-existent.

The modeling analysis performed on behalf of Mirant Kendall also fails to satisfactorily address EPA's concerns. In fact, with respect to lead criteria exceedances, Mirant Kendall's modeling analysis actually exacerbates those concerns. Although some assumptions used in the modeling, such as the complete liberation of the metals from the sediments to the pore water, can be considered conservative (i.e., likely to result in over-predictions), other key assumptions are not conservative and would likely result in under predictions. For example, the sediments were assumed to be 20 percent solids in Mirant's model (i.e., pore water volume of 80 percent) while the USGS data indicates the sediments are approximately 8 percent solids (station no. 14). Also, Mirant's model assumed that the active sediment depth for diffusion is 12 inches. This estimate is likely to be low for such fluid sediments. The modeling also assumes that only a sediment area of 20,000 square feet (½ acre) would be oxidized. This assumption fully contradicts Mirant Kendall's claims that the proposed diffuser would effectively oxygenate most of the benthic sediments in the downstream portion of the lower Basin. Finally, even setting aside these inappropriate assumptions, the model results for all scenarios indicate that chronic criterion for lead (~ 2 ug/l) would still be far exceeded.

Based on this analysis alone, EPA cannot authorize the operation of the diffuser because Mirant's own model predicts that the operation of the diffuser would cause and/or contribute to violation of Massachusetts Water Quality Standards.

With respect to the flux of nutrients, the Agencies have addressed this topic in several other responses. See Responses to E1, E3, E14, E16, E17 and E19.

Comment E22: Mirant Kendall disagrees with Section 5.1 of the DD, which states the increase in bottom water temperature with the diffuser in operation will be "significant", "not part of normal seasonal habitat", and result in a "…reduction in cool water refuge." Mirant Kendall argues that there is no existing cool water refuge to reduce - rather there is only a cool, saline water zone that cannot be used. The conservative/reasonable worst case increase in bottom temperatures (April, 2001 Supplemental Modeling Report - 1999 cases defined by the Agencies,

A.R. No 458) showed no increases beyond the bottom water temperatures voluntarily occupied by the species in question (e.g., low 80s, comparable to the temperatures repeatedly occupied by resident yellow perch at upstream beach seine sites). As a result, deep water habitat will increase with the diffuser rather than be reduced

Moreover, in the winter, when absence of warm enough oxygenated deep water habitat now squeezes resident populations, the added heat and oxygen together will benefit the BIP of yellow perch and the other resident species. The diffuser also will reduce severe vertical Delta T, and thereby eliminate the potential stress of rapid vertical position change by fish, e.g., when pursued by predators. EPA should specify just which species and what temperatures justify this speculation in view of the contrary evidence cited here.

Response to E22:

1. During the later part of the summer, the deep water layer often becomes anoxic due to saline intrusion from Boston Harbor and a lack of mixing. However, EPA's observation pertained to the early summer. As stated in the DD (Section 2.5), in the early summer, deep water that still contains sufficient oxygen is sometimes 9 ºC (~16.2 ºF) cooler than surface waters (example: July 5, 2000; Museum Station). This deeper, cooler water is available as a cool water refuge for fish when surface temperatures rise. If the Basin were to undergo the mixing proposed by diffuser operation, the difference in temperature between surface and deeper waters is projected to be much less. This mixing effect may substantially reduce the cool water refuge currently available to fish when surface temperatures rise and deeper water has not yet been depleted of oxygen.

Water quality data made available by the permittee in April 2006 also document this condition. As late in the summer as July 20, 2005, for example, vertical profile data from the Boston Station records temperatures between 85.9 and 85.6º F in the upper nine feet of the water column. The temperature recorded at a depth of 15 feet at this location was 77.3º F, with an associated salinity of 0.8 ppt and a DO of 5.78 mg/l (Mirant Kendall 2006). This 15 foot depth represented a potential cool water refuge with acceptable salinity and DO that was available to fish seeking to escape the very warm temperatures from the surface to nine feet deep. If Mirant Kendall is correct in stating that the proposed diffuser would fully mix the lower Basin, the diffuser would also prevent the formation of this cool water refuge. Fish species that have been shown to use cool water refuges include yellow perch, common shiner, and striped bass.

In short, EPA's statement regarding loss of deep water refuge habitat pertained to those time periods – typically in early summer, but sometimes as late as mid-July – when oxygen levels are still high enough to provide habitat for fish species, and thermal stratification ensures cooler temperatures in these deep waters. Mirant's proposed diffuser would eliminate this habitat.

2. While EPA acknowledges that resident yellow perch have been collected at upstream beach seine sites at temperatures in the low 80's ºF, this does not appear to be the preferred temperature of this species in the lower Basin.

3. The limited gill net data collected in the winter of 1999 and 2000 in the Broad Canal does not contain a sufficient number of locations or quantity of data to support Mirant Kendall's statement that resident species are impacted by an absence of warm enough oxygenated deep water habitat that squeezes resident populations during winter. Gill net data sampling from 2002-2005 is also insufficient to address winter conditions. This data set began no earlier than April and ended in October. Consequently, Mirant Kendall has not provided sufficient fish collection data from the winter that would support this statement.

Comment E23: Throughout the Fact Sheet Attachment A of the Fact Sheet, EPA calls for numerical modeling of the diffuser to evaluate potential eutrophication impacts. EPA has been conducting such modeling for the overall Basin as part of their development of a Total Maximum Daily Load (TMDL) for nutrients. Mirant is willing to work with EPA's modeling team to refine its model and simulate the diffuser. Mirant is concerned, however, that the subject matter necessitates "instructing" the model about how to handle some of the key variables where the basis for "prediction" is inadequate and posed several questions concerning the development of the model.

Response to E23: See Responses to A12, A13, E1, and E3. EPA has no plans to carry out the modeling simulations of the operation of the diffuser. Mirant Kendall has been informed of its responsibility to develop a credible model of the diffuser and to perform the necessary simulations of the diffuser. Consequently, Mirant Kendall has chosen to incorporate the diffuser into the model recently developed by the Agencies for the lower Charles River nutrient TMDL. Mirant Kendall has begun the process of performing this work. EPA has offered and provided assistance to Mirant Kendall in initializing the model. Also, EPA has outlined in a letter to Mirant Kendall (letter to Shawn Konary from Mark Voorhees dated January 11, 2006) its expectations for the diffuser modeling analysis, including scenarios that should be performed.

EPA has met twice with representatives of Mirant Kendall (on February 2, 2006 and April 18, 2006) to discuss the diffuser modeling analysis and the process that would yield results and expedite the review process. This process involves Mirant Kendall performing the analysis in a stepwise manner, such that technical reviews can be performed on key components of the work before subsequent work which builds on these components is performed. Key components of the analysis requiring interim technical reviews and approvals by EPA are: (1) calibration and verification of the high spatial resolution (i.e., fine grid) hydrodynamic model of the lower Charles River; (2) calibration and verification of the linked water quality-fine grid hydrodynamic model; (3) proposed approach to model operation of the diffuser; and (4) prediction of hydrodynamic and water quality impacts of the proposed diffuser.

Prior to the April 12 meeting, Mirant Kendall provided some initial results of model simulations using the fine grid model and with the proposed the diffuser. Mirant Kendall's representatives indicated that the results were preliminary and that additional work would be performed. EPA reviewed these results, which were again submitted in a letter to EPA and MassDEP (letter to David Webster and Philip Weinberg from Shawn Konary dated July 12, 2006). With the latter submission, Mirant Kendall requested EPA and MassDEP to consider the results prior to issuing

the Final Permit. EPA has found the results to be preliminary and insufficient to allow EPA to determine how the hydrodynamic and water quality models are performing or what impacts the proposed diffuser might have on the water quality of the lower Charles River. EPA understands from discussions with representatives of Mirant Kendall at the April 12, 2006 meeting that additional documentation and model results will be provided by Mirant Kendall that are consistent with level of detail outlined in EPA's January 11, 2006 letter.

The modeling questions posed by Mirant Kendall are not relevant to this Final Permit as the model has not been used to develop the permit. However, as part of the public participation process for the Charles River Basin nutrient TMDL, Mirant Kendall will have an opportunity to review the model and pose questions.

Comment E24 (from Mark Jaquith): My final objection is with the proposed diffuser pipe. While the use of a diffuser of this type may in fact be a better way to disperse their waste heat, this placement (as proposed) cannot be used because it runs right through a mooring and anchorage area administered by the DCR and would be in direct conflict with a historic and highly cherished use in this section of the basin.

Response to E24: EPA is not authorizing the use of the proposed diffuser in the Final Permit, but notes Mr. Jaquith's concern. If Mirant Kendall elects to submit a credible diffuser modeling analysis in the future that would support an application for a permit modification to allow construction and operation of the proposed diffuser, members of the public, DCR, and other state and local agencies will have an opportunity to comment as part of any permit modification process. At this time, analysis of this issue would be premature given EPA's decision not to permit the proposed diffuser.

F. Response to Comments Concerning CWA § 316(a) Variance -Based Thermal Discharge Limits

Comment F1: Mirant Kendall argues that EPA has not addressed whether the existing discharge has caused appreciable harm.

Response to F1: With respect to the relation between Mirant Kendall's current (i.e., post-upgrade) thermal discharge as opposed to its historical thermal discharge, see Responses B1 through B3. With respect to appreciable harm, see Responses C1 and C3.

Comment F2: Mirant Kendall argues that (1) the daily maximum permitted heat load is not a sound basis for evaluating the potential heat load to the Basin because "the permitted monthly limit is only 487 mmBTU per hour and the actual discharge is far below that"; (2) there has been no appreciable harm from Mirant Kendall's discharge; and (3) EPA used the wrong standard in finding that Mirant Kendall's heat load has "a reasonable potential to cause or contribute to eutrophication-related and aesthetic and aquatic life impairments in the Charles River."

Response to F2:
1. Under the permit during the summer months, when thermal impacts are the greatest, Mirant Kendall would be allowed to discharge water with a heatload of 556 million BTUs per hour for a period of weeks, as long as the overall average for the month is 487 million BTUs per hour. This is an extended period of time and can exacerbate existing water quality impairments. Another possible option would be for the permittee to discharge for close to its maximum temperature with a discharge flow of 80 MGD (resulting in 556 million BTUs per hour) for the hottest portion of the day with the greatest electricity demand and then reduce electricity loads, discharge temperature and flows during later hours in such days, when electricity demand is reduced. This pattern could be followed for an entire month and the permittee could still achieve its monthly average or annual average flow limit of 70 MGD. The upgraded Station has the potential to operate at high flows for longer periods of time and more efficiently than in the past. Mirant Kendall's claim that "the actual discharge is far below that" cannot be relied on, as the summer of 2005 thermal discharge data reveal. See Responses to B1 through B3. Consequently, EPA has based its analysis on what Mirant Kendall will be lawfully authorized to discharge.

2. With respect to appreciable harm, see Response to C3.

3. The "reasonable potential" standard was cited in the context of eutrophication concerns, and is applicable in that context. See Response to E2.

Comment F3: Mirant Kendall argues that the Charles River meets the Massachusetts Water Quality Standards for temperature. To support this thesis, Mirant Kendall observes that MassDEP's most recent CWA §§ 303(d) and 305(b) lists determined that the Charles River segment that receives Kendall Station's discharge complied with the Massachusetts Water Quality Standards for temperature.

Comment related to F3 from CLF: CLF argues that the Charles River does not meet the Massachusetts water quality standards. CLF notes that Massachusetts has designated the lower Basin Class B, which means that all permits must be consistent with its use as designated habitat for fish, other aquatic life, and wildlife, for primary and secondary contact recreation (which includes swimming, boating and fishing), and ensure consistently good aesthetic value. CLF argues that the proposed variance does not support habitat or recreation; creates a habitat that does not support certain indigenous fish, including game fish such as American shad, alewife and yellow perch; exacerbates ongoing problems with eutrophication, thereby compromising aesthetics; and, by failing to protect existing uses, the draft permit violates the anti-degradation standards of the MA WQS as well as the Clean Water Act.

Response to F3 and related comment:

1. The river is known to exceed the State's 83º F temperature criterion. For example, water quality data collected by EPA on August 11, 2005 documented ambient temperatures at the reference station (Station 1 - just downstream of the B.U. Bridge) which were near the protective limits identified in the permit. The maximum temperature recorded at Station 1 was 81.1° F at the surface. Surface temperatures at monitoring locations downstream ranged from a low of 85.2° F (Station 8 - just upstream of New Charles River Dam) to a high of 89.6° F (Station 6 - Cambridge side of In Zone Transect). The surface water temperature measured in close proximity of the discharge was approximately 9° F higher than the Station 6 reading. See Table F4.P2.CLF-1. See also Response to F4 (Part 2) regarding August 2006 temperatures.

2. Whether the state lists a segment on its CWA §§ 303(d) and 305(b) lists is a similar, but not identical, question to whether the relevant water quality standard was violated. Massachusetts interprets the temperature criterion for 303(d) impairment of a stream segment or waterbody by comparing the average of maximum daily temperatures for a month to the criterion to determine impairment. By contrast, an NPDES permit violation for temperature would occur if the instantaneous temperature of the waterbody receiving a thermal discharge was either: (a) raised more than 5 °F above ambient as a result of the discharge; or was (b) raised above the 83 °F warm water Class B criterion as a result of the discharge. Furthermore, all fixed Monitoring Stations established in the permit are not located directly in Kendall Station's thermal plume. Finally, the §§ 303(d) and 305(b) lists are based on data from several years before and hence do not always reflect current conditions.

3. EPA agrees with CLF that the designated habitat uses are not being achieved, and that the thermal discharge exacerbates eutrophication.

4. EPA developed the permit's temperature limits independently of the Massachusetts State WQS, by considering literature and empirically derived values of temperature effects to the most sensitive resident and anadromous species. See Responses C1- C52. The temperature regime in this permit will both protect and maintain the BIP, as required under CWA § 316(a), and maintain and protect the existing instream water uses and the level of water quality necessary to protect those existing uses, as required by 40 C.F.R. § 131.12(a)(1) and 314 C.M.R. § 4.04(1).

5. EPA and MassDEP do not agree with CLF's statement that "by failing to protect existing uses, the Draft Permit violates the anti-degradation standards of the MA WQS as well as the Clean Water Act." The core requirement in the anti-degradation provisions of the MA WQS is that "[i]n all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." 314 CMR 4.04(1). First, the limits in the Final Permit on temperature and the cooling water intake activity are far more protective than the provisions in the former permit. These permit provisions will only improve the existing conditions in the Basin associated with its designated use as a fish habitat. Second, as set forth in Massachusetts' Section 401 Water Quality Certification ("WQC"), the thermal discharge limits established by EPA and MassDEP in the permit will assure compliance with the BIP standard, as required by Section 316(a) of the CWA, and by the state's parallel thermal variance standard (314 CMR 3.12) and state WQS. Massachusetts' WQC also specifies additional conditions on the cooling water intake activity to address entrainment impacts, that are required to satisfy the MA WQS. EPA has included these WQC conditions in the Final Permit. In summary, the Final Permit, as conditioned by Massachusetts' WQC, assures compliance with the WQS, including the anti-degradation standards.

Comment F4 (part 1): Mirant Kendall argues that EPA misunderstands the reason Mirant Kendall requested a variance.

Comment related to F4 (part 1) from CLF: In its original 2001 NPDES permit application, and subsequent requests, Mirant requested a section 316(a) variance. The variance would have allowed noncompliance with MA WQS and mixing zone standards during certain summer and fall months and allowed a T of 5°F on the edge of the ZPH. In November 2002, the permittee modified its initial submission and requested a T of not less than 8 °F. The permittee based this request on field data it had collected showing river herring distribution based on temperature variation. Due to the scientific methodology employed, neither EPA nor DEP were convinced by this science and did not increase the proposed T. Mirant then submitted additional information showing that fish have been observed in parts of the river where they would experience a surface to bottom (i.e. vertical) temperature gradient of 15-18 ˚F in the Lower Basin. Again, DEP and EPA questioned the conclusions reached by this study and properly refused to increase the proposed T. Then, in January 2003, Mirant proposed a T gradient that separated the Basin into separate thermal temperature blocks. According to EPA, theoretically the proposal's designs would allow a T of 15°F between the first and last thermal blocks. Mirant attempted to justify the monitoring arrangement by arguing that fish are unlikely to swim past all monitoring stations in a short period, and thus unlikely to experience the T of 15˚F in its entirety. EPA and DEP both correctly rejected this proposal. There are a variety of sound biological reasons why large thermal gradients will interfere with the goal of promoting a balanced indigenous population of fishes and other animals. This is particularly true for migratory fish species.

Response to F4 (part 1) and related comment: EPA agrees in broad terms with CLF's recitation of the history of the various rationales and substantive elements of Mirant Kendall's

requests and modifications of those requests. (EPA also agrees with CLF that scientific data supports the premise that large thermal gradients would interfere with the goal of promoting a balanced indigenous population of aquatic organisms.) With respect to Mirant Kendall's claim that EPA incorrectly determined that a variance was required with respect to the Massachusetts Water Quality Standards' Mixing Zone Policy, see part 2 of Response F4 below.

Comment F4 (part 2): Mirant Kendall argues that the facility's proposed discharge would comply with the MA mixing zone policy. Mirant Kendall argues that (1) just because the discharge at the Outfall is authorized to be 105° F does not mean the River ever experiences that temperature, (2) monitoring "at full heat load on the warmest days (e.g., August 22, 2003)" in the immediate vicinity of the outfall have not recorded temperatures above 90° F, and (3) 90° F is not a lethal temperature.

Comment related to F4 (part 2) from CLF: CLF argues that that the facility's proposed discharge would not comply with the MA mixing zone policy. Under MA WQS, the maximum allowable mixing zone temperature is set at 90° F to avoid short-term adverse effects to aquatic life within the mixing zone. To ensure 90° F is not exceeded, the MA DEP recommends an end of pipe temperature limit of 95° F. CLF notes that EPA set no specific temperature limits for the ZD and an end of pipe temperature limit of 105° F. Further, MA WQS also require mixing zone areas to have a "safe and adequate passage for swimming and drifting organisms [causing] no deleterious effects on their populations." CLF argues that the draft permit fails to meet these requirements as well. Finally, CLF argues, EPA did not comply with Massachusetts policy urging site-specific studies to show the adequacy of the zone of passage in waterways used by anadromous and catadromous fishes.

CLF further argues that these inconsistencies with the MA mixing zone policy cannot be permitted under a CWA § 316(a) variance because § 316(a) only allows variances from federal thermal effluent limitations.

Response to F4 (part 2) and related comment: EPA agrees with CLF, and disagrees with Mirant Kendall, with respect to MA mixing zone policy compliance: the facility's proposed discharge would not comply with the MA mixing zone policy. However, EPA disagrees with CLF's position that a § 316(a) variance cannot be granted with respect to this policy.

Mirant Kendall raises three reasons why its proposed discharge would comply with the MA mixing zone policy. All are incorrect. River temperatures near the outfall are projected to exceed 90º F and approach 100º F; monitoring indicates that actual temperatures near the outfall do in fact exceed 90º F; and 90º F is in fact a lethal temperature. Each of these issues is discussed in turn below:

1. To determine the temperatures in the river near the outfall, water temperature projections and historical data were submitted by the permittee as part of the document Supplemental Surface Water Modeling Report In Support of Kendall Station NPDES Permitting (May, 2001). As

explained in Section 5.5.1 of the DD, EPA determined that the model was not acceptable for evaluating receiving water conditions because of concerns with the permittee's approach to calibrating the model and the absence of documentation to validate the method used to interface the near field and far field mixing associated with operation of the proposed diffuser. However, model results excluding the use of the deep water diffuser (all wall discharge scenario) were examined as a general guideline of water temperatures in the receiving Basin. Specifically, the Transverse Cross Section, In-Discharge Zone MP-7-MP4A Cross Section was reviewed. Historical 1999 temperatures at 0.25 meters were above 90º F at position 13 and 12 (Cambridge side near discharge, Tab 4) on July 6th and at position 13 on July 19th. More importantly, when the Future Transient All Wall Discharge (the only discharge configuration allowed by the permit) model results at this station were reviewed, temperatures above 90º F were routinely projected at points 0.25 meters deep and sometimes seen at 0.75 meters deep in several positions from the Cambridge side out toward the middle of the lower Basin. Temperatures above 90º F were seen at 0.25 meters on all days the model was run for All Wall Discharge (July 6, 19, 27, 31, August 1, 2, 3). Temperatures as high as 98.38º F were projected near the discharge, in the ZD.

2. In order to prepare a meaningful response to Mirant Kendall's comment claiming that monitoring "at full heat load on the warmest days (e.g., August 22, 2003)" in the immediate vicinity of the outfall have not recorded temperatures above 90˚ F, EPA found it prudent not just to rely on the general guidance provided by the model, but also to collect in-stream data to verify Mirant Kendall's claim. The data collected did, in fact, confirm that water temperatures in the Zone of Dilution exceed 90º F. For example, on August 11, 2005, and August 3, 2006, EPA personnel measured Charles River water temperatures at stations that coincided with the continuous, real time compliance locations selected in the Draft Permit. Sampling was conducted after noon, in order to measure lower Basin waters that had been exposed to several hours of solar radiation in addition to Kendall Station thermal discharge. During the August 11, 2005, monitoring event, the highest temperature recorded at the Background Station (Station 1 of the permit) was 81.1 ºF. In the vicinity of the discharge (noted as "Discharge" on the Table, but this location was actually about 150 meters downstream of the Broad Canal), temperatures were 98.7 º F at the surface, 100.0º F at 0.6 meters and 100.6º F at one meter (Table F4.P2.CLF-1). The hourly average heatload recorded at the Station for the entire day of August 11, 2005 at Kendall Station was approximately 504 MMBTU/hr (Mirant Kendall, April 2006). The maximum daily heatload allowed by the permit in effect on August 11, 2005 was 556 MMBTU/hr. Therefore, when these in-situ water temperature readings were taken, the Station was operating at approximately 91% of capacity. See also Response L2. While not all stations were visited on August 3, 2006, temperatures in the vicinity of the discharge were recorded from 95.9 ºF at the surface to 101.4 ºF at 1.3 meters deep (Table F4.P2.CLF-2).

Both modeling information and field data confirm that temperatures over the 90º F threshold occur in the ZD. Therefore, this exceedance of the temperature criterion would not qualify as a Mixing Zone under the Massachusetts Water Quality Standards.

Table F4.P2.CLF-1. Water Chemistry Profiles Collected from the Charles River								
		Page 1 of 2. (EPA, August 11, 2005)						
Time (hours)	Depth (m)	Temp Deg C	Temp Deg F	SpCond (uS/cm)	DO % (%)	DO Conc (mg/L)	pH	Total Depth (m)
Station 1								
14:41	Surface	27.3	81.1	1061	111	8.8	8.2	4.6
14:42	0.6	27.2	81.0	1063	111	8.8	8.2	
14:43	1.0	27.1	80.8	1073	110	8.7	8.2	
14:44	2.0	26.5	79.8	1260	100	8.0	8.0	
14:46	3.0	26.0	78.8	1175	84	6.8	7.6	
14:49	4.0	23.8	74.9	2122	3	0.3	6.9	
14:50	4.6	22.7	72.9	8749	3	0.3	6.9	
Station 2								
15:14	Surface	30.0	86.0	1554	127	9.5	8.7	6.7
15:15	0.6	30.0	86.0	1554	126	9.5	8.7	
15:16	1.0	30.0	86.0	1553	126	9.5	8.8	
15:18	2.0	29.3	84.8	1528	120	9.2	8.7	
15:19	3.0	27.4	81.3	1387	112	8.9	8.5	
15:20	4.0	26.7	80.0	2179	61	4.9	7.4	
15:22	5.0	20.8	69.5	23764	2	0.1	7.1	
15:24	6.0	20.5	68.8	29700	2	0.1	7.1	
Intake								
15:35	Surface	30.2	86.3	1541	151	11.3	8.9	2.4
15:36	0.6	29.9	85.7	1536	154	11.6	8.9	
15:37	1.0	29.7	85.5	1531	152	11.5	8.9	
15:39	2.0	29.1	84.4	1530	131	10.0	8.7	
Discharge								
15:51	Surface	37.1	98.7	1635	126	8.4	8.6	3.0
15:55	0.6	37.8	100.0	1642	126	8.3	8.6	
15:56	1.0	38.1	100.6	1640	128	8.4	8.6	
Station 3								
16:10	Surface	30.7	87.2	1595	118	8.8	8.6	4.8
16:11	0.6	30.8	87.4	1603	121	9.0	8.6	
16:12	1.0	30.7	87.2	1598	120	8.9	8.6	
16:14	2.0	30.7	87.3	1601	120	9.0	8.6	
16:16	3.0	27.8	82.1	1470	106	8.3	8.3	
16:18	4.0	26.3	79.4	6677	11	0.9	7.1	
16:20	4.8	21.2	70.1	30217	1	0.1	7.2	

Table F4.P2.CLF-1. Water Chemistry Profiles Collected from the Charles River								
		Page 2 of 2. (EPA, August 11, 2005)						
Time (hours)	Depth (m)	Temp ©	Temp Deg F	SpCond (uS/cm)	DO % (%)	DO Conc (mg/L)	pH	Total Depth (m)
Station 4								
16:29	Surface	30.5	86.9	1596	125	9.3	8.6	8.4
16:30	0.6	30.4	86.8	1596	124	9.3	8.6	
16:31	1.0	30.5	86.9	1593	124	9.3	8.6	
16:32	2.0	30.2	86.4	1587	120	9.0	8.6	
16:33	3.0	27.8	82.1	1480	110	8.6	8.4	
16:34	4.0	27.0	80.7	4864	38	3.0	7.3	
16:35	5.0	21.7	71.0	26165	1	0.1	7.2	
16:35	6.0	21.7	71.0	26154	1	0.1	7.2	
16:37	7.0	19.6	67.3	34171	3	0.2	7.3	
Station 5								
16:43	Surface	31.1	88.0	1612	131	9.7	8.6	7.6
16:43	0.6	31.1	88.0	1612	132	9.7	8.6	
16:44	1.0	30.8	87.5	1614	129	9.6	8.6	
16:45	2.0	30.7	87.3	1615	128	9.5	8.6	
16:46	3.0	30.4	86.8	1616	125	9.4	8.6	
16:47	4.0	27.7	81.9	1529	108	8.5	8.2	
16:49	5.0	27.1	80.7	4911	58	4.5	7.4	
16:51	6.0	21.3	70.3	29570	2	0.1	7.2	
16:52	7.0	20.0	68.0	34949	17	1.3	7.3	
Station 6								
17:00	Surface	32.0	89.6	1614	144	10.5	8.8	3.2
17:01	0.6	31.6	88.8	1611	148	10.9	8.9	
17:03	1.0	31.5	88.8	1611	145	10.7	8.9	
17:03	2.0	30.6	87.0	1614	135	10.0	8.8	
17:04	3.0	28.4	83.1	1918	97	7.5	8.0	
Station 7								
17:18	Surface	30.0	86.0	1794	118	8.9	8.7	7.2
17:19	0.6	30.0	86.0	1804	118	8.9	8.6	
17:20	1.0	29.9	85.9	1819	117	8.8	8.6	
17:21	2.0	29.3	84.8	1980	101	7.7	8.2	
17:22	3.0	28.8	83.8	1900	92	7.1	8.0	
17:23	4.0	26.7	80.1	9810	60	4.7	7.5	
17:24	5.0	21.8	71.2	27914	24	1.9	7.3	
17:25	6.0	19.5	67.2	37635	37	2.9	7.4	
17:26	7.0	18.9	66.1	39527	50	4.0	7.5	
Staion 8								
17:36	Surface	29.5	85.2	1734	121	9.2	8.7	5.7
17:37	0.6	29.5	85.2	1732	121	9.2	8.7	
17:38	1.0	29.5	85.1	1733	121	9.2	8.7	
17:39	2.0	29.2	84.5	1743	108	8.2	8.4	
17:40	3.0	28.8	83.8	1767	96	7.4	8.1	
17:42	4.0	27.0	80.7	9877	89	6.8	8.0	
17:44	5.0	21.8	71.2	30212	61	4.8	7.7	
17:45	5.7	19.4	66.8	37993	50	4.0	7.6	

Table F4.P2.CLF-2.			Water chemistry profiles collected from the Charles River. (EPA, August 3, 2006)				
	Time (hours)	Depth (m)	Temp (°C)	Temp (°F)	SpCond (us/cm)	pH	Total Depth (m)
Station 1							
	15:30	Surface	28.7	83.6	702	7.2	5
	15:40	0.5	28.7	83.6	702	7.2	
	15:49	1	28.7	83.6	702	7.2	
	15:52	2	28.1	82.7	690	7.1	
	15:56	3	27.6	81.6	748	7.0	
	16:01	4	25.9	78.6	863	6.7	
	16:07	4.7	24.2	75.5	727	6.7	
Station 2							
	16:27	Surface	30.2	86.3	757	8.0	4.5
	16:31	0.5	30.1	86.2	755	8.0	
	19:47	1	30.0	86.0	770	7.5	
	16:34	2	29.8	85.7	744	7.8	
	16:38	3	28.8	83.8	708	7.4	
	16:44	4	28.4	83.1	784	7.3	
	16:54	4.3	27.1	80.7	2797	7.0	
Intake							
	17:07	Surface	30.6	87.2	780	7.8	1.5
	17:10	0.5	30.6	87.1	780	7.8	
	17:12	1	30.6	87.1	780	7.8	
Discharge							
	17:38	Surface	35.5	95.9	793	7.5	1.5
	17:42	0.5	37.0	98.7	808	7.5	
	17:45	1	38.1	100.7	810	7.5	
	17:50	1.3	38.6	101.4	817	7.4	
Station 4							
	18:58	Surface	30.8	87.4	802	7.7	8.5
	19:01	0.5	30.8	87.4	801	7.7	
	19:06	1	30.7	87.2	797	7.6	
	19:12	2	29.6	85.3	772	7.5	
	19:15	3	28.9	84.0	762	7.4	
	19:18	4	28.2	82.7	1479	7.2	
	19:21	5	22.9	73.1	24517	7.1	
	19:24	6	18.7	65.6	32885	7.0	
	19:27	7	17.4	63.3	33505	7.1	
	19:28	8	18.0	64.3	34196	7.2	

3. For purposes of enhancing compliance with those standards the Massachusetts WQS

forbid a temperature above 90° F in a mixing zone, it is irrelevant whether 90º F is or is not a lethal temperature. That said, it is not controversial that 90° F is, in fact, a lethal temperature for species of concern. The upper incipient lethal temperature limit for juvenile yellow perch, defined as the temperature where mortality is observed for 50% of the organisms tested, is given as a range between 29.2 ºC (84.6º F) and 34 ºC (93.2º F) (Hokanson, 1977). Krieger *et al*., (1983) placed the upper lethal limit for adult yellow perch at 32.2 ºC (90º F), based on work by Ferguson (1958). The upper lethal limit is typically defined as the 50% survival figure and toxicity to a portion of adults tested would have taken place at temperatures below 90 ºF Hokanson reported that upper incipient lethal temperatures for summer tests using juvenile yellow perch at the acclimation temperature of 25 ºC (77º F) resulted in an ultimate upper incipient lethal temperature of 32.3 ºC (90.1º F). Based on the definition of incipient lethal, this result implies that mortality to a portion of the organisms tested also occurred at temperatures lower than 90.1 ºF, i.e. lower than 90 ºF. The habitat suitability model (Pardue, 1983) lists optimal habitat temperatures for juvenile alewife. Under this model, 30 ºC (86 ºF) was assigned a zero suitability value, or completely unsuitable (Table 5.7.3i-3 of DD). In addition, Otto, et. al. (1977) found a 10% reduction in survival to juvenile alewives in short-term tests when fish acclimated to 24-26 ºC (75.2 - 78.8 ºF) were transferred to 30 ºC (86 ºF) water.

Based on the information above, EPA and MassDEP assert, contrary to Mirant's contention that 90 ºF is not a lethal temperature, that temperatures even below 90 ºF have been shown to induce toxicity to alewife juveniles, adult yellow perch and juvenile yellow perch when these organisms were acclimated to typical, warm water, summertime temperatures and transferred to higher temperatures. For these reasons, EPA agrees with CLF that a mixing zone could not be granted under the Massachusetts Water Quality Standards.

However, CLF argues that § 316(a) precludes a variance from these state WQS. CLF argues that § 316(a) only allows variances from federal thermal effluent limitations. Cf. In re Dominion Energy Brayton Point, L.L.C., NPDES Appeal No. 03-12, 12 E.A.D. __ (Feb. 1, 2006), slip op. at 142 (noting that CLF raised this argument but not deciding it because it was untimely raised).

By its terms, § 316(a) allows a variance whenever the permit applicant can demonstrate "that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the [protection] and propagation of a [BIP]." 33 U.S.C. § 1326(a). When Congress uses the word "any" in a statute, it is generally interpreted expansively. See New York v. EPA, 443 F.3d 880 (D.C. Cir. 2006). See also CWA §§ 301(b)(1)(C), 502(11).

Of course, a § 316(a) variance is only available "for the control of the thermal component of any discharge"; in other words, § 316(a) does not provide a mechanism for varying from effluent limitations (whether technology or water quality-based) that do not directly relate to the thermal component of the discharge. See Response E2 of this document.

Admittedly, CLF cites legislative history which, at first glance, appears to support its view. The Senate Report on the 1977 CWA amendments stated:

> The Congress intended that there be a very limited waiver for those major sources of thermal effluents which could establish beyond any question the lack of relationship between federally established effluent limitations and that water quality which assures the protection of public water supplies and the protection and propagation of a balanced, indigenous population of fish, shellfish, and wildlife, and allows recreational activities, in and on the water. That limited exemption has been turned into a gaping loophole.
>
> The cumbersome process which the Agency initiated resulted in part in a decision to avoid any application of 1977 regulatory requirements for steam electric power plants. There is no basis for that decision in the law. The committee does not expect, however, that the Agency will now impose any additional 1977 requirement other than State water quality standards. The Agency also concluded that the 1972 act was preemptive with respect to the application of State water quality standards and effluent limits for heat. This is a determination for which there is no substance in law and which is wholly contrary to the committee's long-held view that the States are free to establish any more strict standards or effluent limitations, as specifically set forth in section 510 of the act.

S. Rep. No. 95-370 (1977), reprinted in 1977 U.S.C.C.A.N. 4326, 4334 (emphases added). However, the influence of this report should not be overstated. Obviously, the Senate's intent in 1977 is poor authority for construing the CWA as enacted in 1972. Indeed, the 1977 Senate did not actually propose to amend section 316(a). See id. Moreover, in the 1977 amendment process, the House bill was passed in lieu of the Senate bill after amending its language to contain much of the text of the Senate bill. See id. at 4326; H.R. Conf. Rep. No. 830(1977), reprinted in 1977 U.S.C.C.A.N. 4424, 4424. The House Conference Report specifically stated that "[t]hese amendments do not in any way change statutory requirements for the control of the discharge of heat or affect any pending administrative or judicial proceedings under provisions of this Act addressing heat, including but not limited to, sections 301, 303, 304, 306, and 316." Id. at 4460. Most importantly, the 1977 CWA amendments did not amend § 316(a) at all. See Pub. L. No. 95-217, 91 Stat. 1566.

For these reasons, the plain language of § 316(a) trumps any possible contrary intent, never enacted into law, of the Senate in 1977. Consequently, EPA adheres to its position that § 316(a) authorizes variances from state water quality standards for heat.

Comment F5: Mirant Kendall argues that the temperature limits proposed for the ZPH are more stringent than the state's numeric temperature standard for the Charles River, or temperatures actually experienced elsewhere in the river. Thus, Mirant Kendall argues, there is no meaningful "variance" under § 316(a).

Response to F5: EPA is not misapplying the requirements of 316(a) in its design for the ZPH in this permit. Rather, EPA is simply implementing the provision with a permit that has a unique design for how to assure compliance with the requirements of 316(a).

As a threshold matter, the assertion that the variance provided in this permit is more strict than Massachusetts' Water Quality Standards (WQS) is unfounded. The permit provides for a Zone of Dilution that both EPA and Mirant agree will experience temperatures substantially above the water quality criterion of 83 °F. As detailed in Response L2, modeling submitted by Mirant shows that discharges under the "All Wall Discharge" scenario, the only configuration currently allowed by the permit, will predictably yield temperatures in the ZD above 90 °F. While there is provision in the state's WQS for a mixing zone to allow for dilution of heat concentrations after they leave the outfall, the applicant and EPA have undertaken a variance analysis under 316(a) precisely because neither Mirant, MassDEP, nor EPA expect the Station to be able to meet the requirements for a mixing zone under the state's policy. See 314 CMR 4.03(2). The state requires that the mixing zone shall not diminish the existing or designated uses of the segment of water disproportionately. 314 CMR 4.03(2)(c). The EPA and Commonwealth interpret this requirement to provide that the mixing zone should not create temperatures that result in lethal effects that are significant to the biological community in the receiving water. See Massachusetts Surface Water Quality Standards Implementation Policy for Mixing Zones, IV(b) (January 8, 1993) and EPA's Water Quality Standards Handbook, 5-1 (September 15, 1993). Again, both EPA and MassDEP expect temperatures in excess of 90° F in the ZD with temperatures as high as 98° F in the area of the discharge. Indeed, on August 11, 2005, and August 3, 2006, EPA monitored temperatures of approximately 100 °F in the lower Basin approximately 150 meters down stream from the Broad Canal. EPA has concluded that temperatures this high would cause lethality in the Zone of Dilution. As discussed in more detail in Response F4, juvenile yellow perch suffer 50% mortality at temperatures between 85° F and 93° F, and water above 86° F is "completely unsuitable" as habitat for juvenile alewife. It is the permitting agencies' judgment that the 90° F temperatures predicted in the zone of dilution would have a significant effect on the biological community in the lower Basin. Therefore, EPA undertook the development of the 316(a) variance to accommodate the fact that Mirant's thermal discharge will violate this provision of state WQS by creating lethal conditions in the Zone of Dilution around the discharge point.

It is true that the permit implements the variance by enforcing specific temperatures in the Zone of Passage and Habitat, and many of those temperatures are lower than the highest temperature allowed under the state's WQS, 83° F. But these temperatures are designed to assure that some portion of the lower Basin in the area of the discharge provides suitable habitat to support the BIP and provide a Zone of Passage and Habitat, after having ceded a portion of that area to temperatures in the Zone of Dilution that will exceed both the temperature criterion in the State's WQS and the temperatures EPA has determined are required to support all life stages of the BIP.

It is the unique design of the compliance requirements in this permit which cause EPA to require the facility to meet in-stream temperature limits below the maximum spelled out in the state's thermal criterion. Normally, EPA would rely on a model to project in-stream temperature levels that would result from a higher temperature discharge limit which the permit would enforce at the point of discharge. With such a traditionally designed permit, the resulting in-stream temperatures that EPA would be seeking to protect outside the Zone of Dilution would be at or

below the state's WQS. But because the permit would be implicitly relying on the model to demonstrate the correlation between the higher temperature limit enforced at the outfall with those lower in-stream numbers, the permit itself need not present in an enforceable form what the lower in-stream target temperatures would be, although they would typically be discussed in the fact sheet and record supporting the permit.

This permit does not rely on a model to assure in-stream temperatures that protect the BIP, because Mirant failed to provide an acceptable verified model. Pursuant to Mirant's suggestion, the permit instead relies on a real-time in-stream monitoring network to ensure that temperatures in the Zone of Passage and Habitat protect the BIP. What makes this permit uniquely structured is that it protects the BIP by enforcing temperatures outside the Zone of Dilution and in the Zone of Passage and Habitat. Therefore, the permit sets forth temperatures to define the conditions that will protect the BIP in the ZPH that are below the highest numeric criteria specified in the state's WQS because of this unique structure for assuring compliance with the requirements of 316(a). The result is not a permit that is more strict than the WQS. Indeed, if Mirant were to submit a showing using an acceptably verified model that it could operate the facility consistent with a requirement that there be no significant lethal effects within the Zone of Initial Dilution, as the Commonwealth defines and implements that term, the permit might be considerably simpler and easier to enforce.

In addition, it is not accurate to claim that any temperature lower than 83° F imposes a requirement that is more strict than the criteria in Massachusetts' Water Quality Standards. The criterion for temperature in Class B inland waters provides that:

> There shall be no changes from background conditions that would impair any use assigned to this Class, *including site-specific limits necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms*.

314 CMR 4.05(3)(b)(2)(b) (emphasis added). Massachusetts' water quality standard effectively requires a permit to include site-specific limits to protect values in the water segment that are functionally very similar to the standard EPA is implementing under section 316(a) - assuring the protection and propagation of the BIP. Where EPA has concluded pursuant to 316(a), and with the Massachusetts' concurrence, that it is necessary to provide for temperatures in the Zone of Passage and Habitat that are lower than the maximum temperatures enumerated in the state's temperature criterion, that conclusion does not result in temperature requirements that are more stringent than the standard. At most, these lower temperatures simply implement the standard's narrative requirement for site-specific temperature limits to protect normal species diversity, successful migration, reproductive functions, or growth of aquatic organisms. Therefore, it is not correct that EPA is being more strict under this 316(a) variance than would be required under the Massachusetts' water quality standard. MassDEP has confirmed EPA's analysis of its water quality standards.

EPA also does not agree that the limits in the permit enforce temperatures that are well below "temperatures that have been regularly experienced in the Charles River at locations not

influenced by the Kendall discharge." When EPA configured the site-specific temperature limits, it analyzed a large body of background temperature information to ensure that the prescribed limits were appropriate and reasonable for a water body considered one of the warmest in Massachusetts. As a threshold matter, historic background temperatures during the summer are not often above the 81 to 82° F range and winter temperatures have generally been well below the 50° F required during the "chill period" provided for in the permit. Therefore, EPA disagrees with implication of this comment that the levels in the permit are "regularly" below background levels in the sense that this happens frequently.

It is true that there are times background temperatures have occasionally exceeded the levels set in the permit and these spikes in temperature are "regular" in the sense that the area experiences heat wave conditions occasionally during most summers. The permit provides for an increase in temperature of up to 5° F above background levels when the background temperatures are lower than the levels required for the zone of passage and habitat. This authorization to increase temperatures above background levels is capped ultimately by the temperatures EPA is requiring in the zone of passage and habitat. EPA acknowledges that there will likely be instances where the temperature regime in this permit will effectively cap or limit Mirant's ability to add further heat to the basin when background temperatures occasionally peak. But agreeing that there are instances where background temperatures expose the BIP to heat levels above those provided for in the permit does not lead to the conclusion that the temperatures in the permit are too low. These are precisely the days when the totality of the conditions in the river is most severely stressing the ecosystem supporting the BIP. EPA's regulations direct the Agency to consider "the cumulative impact of [the applicant's] thermal discharge together with all other significant impacts on the species affected." 40 CFR 125.73(a). Therefore, EPA must consider the potential cumulative impact of both existing high background temperatures and the additional heat that could be added from the Station's discharge. Even if we accept Mirant's apparent premise that the BIP has survived, though not necessarily flourished, during some days with high background temperatures, EPA finds that there is no adequate basis for concluding that the BIP would be adequately protected when exposed to even higher temperatures during the most stressful days of the summer. And based on the extensive review of the scientific literature detailed in our Determination Document, EPA concludes that there is significant risk that the BIP would be impaired if the Station added yet more heat on days when the river was already relatively hot.

EPA also recognizes that this control regime may require Mirant to curtail its operations on certain hot summer days. Section 316(a) directs EPA to set thermal discharge limits that assure protection of the BIP, and it provides no authority for EPA to set lower permit limits because of electricity demand or economic impact on the discharger.

Comment F6: Mirant Kendall argues that EPA has failed to consider that Massachusetts has designated the Charles River for use for industrial cooling.

Comment related to F6 from ECPT: The Charles River should not be used as an industrial cooling pond.

Comment related to F6 from ACN: The use of the (Charles River) basin as a cooling pond is not the best long term use of this space.

Comment related to F6 from CLF: The Charles is a public resource that is valued by the community for its wildlife, aesthetic values, and for fishing, boating and other recreational activities. The plant uses antiquated technology: once-through, open cycle cooling, that discharges millions of gallons of heated water into the river every day. Facilities in other locations have adopted modern technologies that allow power generation with much lower environmental impact, such as closed cycle systems, helper cooling towers, or the use of the heat-energy by-product for heating (i.e., co-generation). The proposed permit would allow unacceptable degradation of a critical public resource for private gain.

Response to F6 and related comments: According to the Massachusetts surface water quality standards, Class B waters such as the Charles River "are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. . . . They shall be suitable for . . . compatible industrial cooling and process uses." 314 C.M.R. § 4.05(3)(b) (emphasis added). Nothing in this regulation suggests that the water quality standards would be satisfied by putting the river to industrial cooling use that is incompatible with fish habitat. Moreover, EPA is unaware of any provision of Massachusetts or federal law which places a ceiling on the level of water quality that can be achieved.

Mirant Kendall seems to suggest that the standard of "suitab[ility] for . . . industrial cooling and process uses" means that industrial cooling and process uses must be allowed, even if other uses would thereby be precluded. Under this view, the standard of "suitab[ility] for . . . industrial cooling and process uses" places a ceiling on the river's water quality: neither Massachusetts nor EPA could ever seek to improve water quality if it would inconvenience an industrial discharger.

But this appears to be a gross misreading of the standard. Rather, EPA interprets "suitab[ility] for . . . industrial cooling and process uses" not to mean that those uses must trump all others, but rather simply that (1) those uses are not inherently undesirable in the river, and may be permitted where compatible with other designated uses, and (2) the water must be of sufficiently good quality to serve as inputs for those uses. In the case of the lower Basin, Mirant Kendall's desired thermal discharge would not be compatible with other designated uses, such as fish habitat.

With respect to Mirant Kendall's arguments about lack of prior adverse impact, see Responses to B1-B3 and C3.

G. Response to Comments Concerning Permanent Hydrological Modifications

Comment G1: Failure to consider and grant a variance due to permanent hydrologic modifications. The Agencies' permitting documents acknowledge that the water quality of the Lower Charles River Basin is impaired for many reasons entirely unrelated to Kendall Station's thermal discharge, including hydrologic modifications. Those hydrologic modifications – the channelization, the bridges, and most importantly, the impounded water caused by the dams, locks, and fishways, create the Lower Charles River Basin as we know it, and certainly are not feasible or desirable to modify to restore the water body to its original estuarine condition of tidal mudflats.

Instead of a natural tidal cycle, the former estuary is now more riverine or, during low flow conditions, characteristic of an impoundment. Due to the impounded water, water temperatures different and higher than would be seen from the natural seasonal and daily variations required by the Massachusetts WQS are normal in the Lower Charles River Basin even without Kendall's thermal discharge, and are a principal factor in causing the occasional eutrophic conditions.

Accordingly, in its February 2001 supplemental application, Mirant Kendall specifically requested that the Agencies grant a water quality variance, partial use designation, or site-specific standard that would account for the fact that the Massachusetts WQS are not fully attainable in the Charles River Basin due to the permanent impacts of those hydrologic modifications on water temperatures and other parameters. Such relief is explicitly authorized under 314 C.M.R. 4.03(4)(d), which provides that DEP may grant a variance to authorize the discharge if "Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use…" Such relief also is authorized by EPA pursuant to 40 C.F.R. § 131.10.

A variance or other relief under these provisions is appropriate because there is no realistic prospect that the Massachusetts WQS will be fully attained in the Lower Charles River Basin for as long as the dams and other hydraulic modifications are present. Forcing curtailments of Kendall Station's operations will not produce attainment; the Agencies do not claim otherwise. Nor do the Agencies claim or demonstrate that curtailing Kendall Station's operations will lead to any material improvement in attainment, or that the curtailments actually bring any other material benefit or effect.

Response to G1: Section 4.03(4) of 314 CMR states that MassDEP *may* remove a national goal use that is not an existing use, designate a segment as partial use, or grant a variance to authorize a discharge, provided that the applicant demonstrates that certain naturally occurring or anthropogenically-induced situations exist that prevent the attainment of the use or that the controls required would result in "substantial and widespread economic and social impact".

It is true that anthropogenic alterations of the system preclude attainment of original aquatic life

uses of the system. The lower Basin is no longer an estuary, and salt water intrusion through the New Charles River Dam and Locks has caused widespread anoxia along the bottom of the wide section of the lower Charles, downstream of the B.U. Bridge during the summer. Anthropogenic modifications to the watershed of the lower Basin and the impoundment-like retention times of Basin waters under lower river flow conditions can raise instream temperatures in the lower Basin. Due in large part to these factors, this river has been described as among the warmest rivers in the Commonwealth of Massachusetts. The permittee's discharge adds to this elevated temperature regime and has been documented to further elevate water temperatures to levels which are not protective of the BIP. See Response to F4.P2.

Notwithstanding the anthropogenic alterations cited above, the system has shown enormous improvements in water quality due to the efforts of volunteer as well as federal, state and private institutions. The introduction of large amounts of federal and state aid to build sewage treatment plants, construct CSO controls, and fund state and private environmental groups has led to substantial improvements in water quality within the Charles. Further improvements are certainly needed.

The attainable aquatic life uses within the Charles continue to expand from those available 30 years ago and the agencies have no wish to limit further expansion. To the contrary, state and federal agencies (Massachusetts DMF and the U.S. Fish and Wildlife Service) are cooperating to re-introduce American shad into the Charles and a stocking program was initiated in June of 2006. Moreover, structural improvements, such as those to fish ladders, and changes in methods used to move anadromous fish into the Charles, have recently been made which should allow these fish greater potential for stock expansion in the Charles. Suggested methods to control seawater input to the system also need attention by the agencies.

Neither the state nor EPA wish to downgrade this waterbody, or to curtail the progress that state and federal agencies, environmental advocates and other citizens of the Commonwealth have achieved in improving both its aquatic life and recreational potential. EPA has shown (see Responses to C3 and C44) that Mirant's thermal discharge has caused appreciable harm to bluebacks and alewives in both 2004 and 2005. This is a condition that must be addressed through the NPDES permitting process. The final NPDES for MKS allows a limited variance to WQS with respect to the Massachusetts Mixing Zone Policy and its requirements regarding toxicity within that zone. The permit limits established for this permit and conditions outlined in the Massachusetts Section 401 Certification are considered by EPA to be the least stringent needed that will still allow the promotion of the BIP within the lower Charles.

H. Response to Comments Concerning CWA § 316(b)-Based Cooling Water Intake Limits and Barrier Net System Installation

Comment H1: Mirant asserts that the draft permit includes a mix of new requirements arbitrarily based in part on Best Professional Judgment (BPJ) and in part on the final Phase II Rule under CWA § 316(b). Mirant also states the view that such a hybrid approach is inconsistent with the final Phase II Rule, which allows each permittee to select it own compliance option, and is beyond EPA authority or otherwise flawed.

Response to H1:

A. Introduction

EPA disagrees with Mirant's comment. The cooling water intake structure (CWIS) limits in EPA's Draft and Final Permits for Mirant Kendall Station (MKS) are derived from a BPJ-based determination of technology-based limits under CWA § 316(b), and from a determination of water quality-based limits needed to satisfy Massachusetts water quality standards (WQS). The permit requirements needed to satisfy state water quality requirements are specified in the Massachusetts Department of Environmental Protection's (MassDEP) water quality certification under CWA § 401(a)(1). EPA's approach to the MKS permit is entirely consistent with the CWA, the final Phase II Rule, and EPA's NPDES permitting regulations. Thus, EPA's approach to the permit neither exceeds the Agency's authority nor is otherwise flawed.

As explained in Section 7 of the Determination Document, CWA § 316(b) governs the development of technology-based NPDES permit requirements for CWISs and requires "that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." In addition to satisfying these technology-based requirements, NPDES permit limits for CWIS must also satisfy any more stringent provisions of state water quality standards or other state legal requirements that may apply, see CWA § 301(b)(1)(C), as well as any applicable conditions of a state certification under CWA § 401. See also 33 U.S.C. § 1370.

The response below proceeds as follows: (1) first, justification is provided for developing technology-based CWIS limits on a BPJ basis; (2) second, the rationale for the Draft Permit's limits, including the consideration of the new Phase II Rule, is explained; and (3) third, the rationale for the Final Permit's limits, including the consideration of the new Phase II Rule, is explained. In explaining the Final Permit's limits, the response addresses the determination of technology-based requirements for the reduction of impingement mortality and entrainment, the determination of water quality-based limits for reducing these adverse impacts, the inclusion of a schedule for information submissions to support future permitting under the Phase II Rule, and the specification of monitoring requirements.

B. EPA Correctly Set Technology-Based CWIS Limits on a BPJ Basis

Turning first to the technology-based requirements under CWA § 316(b), in the absence of applicable regulations, EPA has long developed such requirements on a case-by-case, Best Professional Judgment (BPJ) basis. See CWA § 402(a) and 40 C.F.R. §§ 401.14, 125.90(b). See also, e.g., *Riverkeeper v. United States Environmental Protection Agency*, 358 F.3d 174, 191 (2d Cir. 2004). Although EPA has now promulgated regulations under CWA § 316(b) that are *generally* applicable to Mirant Kendall Station (MKS) – namely, EPA's new Final CWA § 316(b) Phase II Rule for large, existing power plants, 69 Fed. Reg. 41576 (July 9, 2004) (regulations promulgated at 40 C.F.R. Part 125 Subpart J) (referred to hereinafter as either the "Phase II Rule" or the "Phase II Regulations") – EPA has nevertheless properly developed technology-based CWIS limits for the MKS permit by applying § 316(b) on a BPJ basis. Relying on BPJ in this case is consistent with the express terms of the Phase II Regulations, EPA's general NPDES regulations, and CWA § 402(a).

The Phase II Regulations did not govern MKS's *Draft* Permit because they were not in effect when the Draft Permit was issued. EPA issued the Draft Permit to Mirant Kendall Station (MKS) on June 14, 2004. Although the final Phase II Regulations were signed by the Administrator on February 16, 2004, they were later modified in certain respects, were not published in the Federal Register until July 9, 2004, and did not become effective until September 7, 2004. Since the Phase II Regulations were not in effect at the time the Draft Permit was issued, EPA's general NPDES program regulations dictate that the Phase II Regulations were not "applicable requirements" that governed development of the permit's limits. See 40 C.F.R. §§ 122.43(a) and (b). As a result, EPA was correct to develop CWIS limits for the Draft Permit based on a BPJ application of CWA § 316(b).[1]

Of course, the Phase II Regulations are in effect now, but the Phase II Regulations themselves clearly indicate that it is also proper for EPA to develop CWIS limits for MKS's Final Permit based on a BPJ application of CWA § 316(b). Specifically, 40 C.F.R. §§ 125.95(a)(2)(i) and (ii) of the Phase II Regulations explain to permit applicants that (emphasis supplied):

> (i) You must submit your NPDES permit application in accordance with the time frames specified in 40 C.F.R. 122.21(d)(2);
>
> (ii) If your existing permit expires before July 9, 2008, you may request that the Director establish a schedule for you to submit the information required by this section as expeditiously as practicable, but not later than January 7, 2008. *Between the time your existing permit expires and the time an NPDES permit containing requirements consistent with this subpart is issued to your facility, the best technology available to minimize adverse environmental*

[1] As discussed further below, EPA is also not required under 40 C.F.R. § 122.43(b) to reopen the MKS permit proceeding merely because the Phase II Regulations became effective after issuance of the Draft Permit but before issuance of the Final Permit.

> *impact will continue to be determined based on the Director's best professional judgment.*

Applying these regulations to the MKS permit, it is clear that CWIS limits under CWA § 316(b) should be developed on a BPJ basis. The existing permit for MKS expired in 1993 and, consistent with 40 C.F.R.§ 122.21(d)(2), the permittee applied for permit reissuance before such expiration. In addition, the permittee has yet to submit permit application material containing all the information required by the Phase II Regulations, so a permit containing requirements consistent with this subpart could not be developed at this time. The Phase II Regulations plainly address this type of situation by allowing the ongoing permitting process to be completed by applying CWA § 316(b) on a BPJ basis.

Therefore, EPA is issuing the Final Permit to MKS with CWIS limits under § 316(b) based on a determination of the Best Technology Available (BTA) for minimizing adverse environmental impacts that "continue[s] to be determined based on the Director's best professional judgment." Contrary to Mirant's comment, EPA's approach to permit development is consistent with the express terms of the new Phase II Regulations.

The above conclusions regarding how to develop limits under CWA § 316(b) for MKS's Final Permit in light of 40 C.F.R. § 122.43(b) and the new Phase II Regulations is further supported by the discussion provided by EPA in the August 19, 2004, set of "Questions and Answers" related to the Phase II Regulations posted on EPA's website (www.epa.gov/waterscience/316b/Phase2-q-and-a.pdf). In Section 2.A, Q2 of this document, EPA addresses a hypothetical scenario involving the precise sequence of events presented by the MKS permit. EPA describes the situation as follows (emphasis in the original):

> The draft permit is <u>proposed</u> <u>before</u> the 316(b) Phase II Rule takes effect, but the final permit would be <u>issued</u> <u>after</u> the Phase II Rule takes effect. At the time of the final permit issuance by the State or the Region (as the case may be), the facility has <u>not</u> submitted the comprehensive demonstration study and other information needed to determine limitations under the 316(b) Phase II Rule.

EPA indicates that in such a case, the 316(b) limits in the final permit would be based on BPJ for either of two reasons. EPA explains that a draft permit issued prior to the new regulations becoming effective would be based on BPJ because 40 C.F.R. § 122.43(b) states that only regulations that are actually in effect are applicable requirements that govern a permit's limits. At the same time, however, EPA explains that 40 C.F.R. § 122.43(b) further indicates that "the Director has the discretion to reopen the permit proceedings when he or she determines prior to issuance of the final permit, based on information in the record, that the new Phase II Requirements . . . are of sufficient magnitude to make additional proceedings desirable (e.g., re-proposing the draft permit to reflect the new Phase II Requirements)." EPA goes on, however, to

specifically state that the "Director could reasonably determine that the Phase II Requirements are not of sufficient magnitude *at that time* to justify reopening the proceedings to consider new limitations when, as here, the facility has not provided the permit writer with the comprehensive demonstration study or other information needed to determine limitations based on one of the compliance alternatives in the Phase II Rule" (emphasis in original).[2] EPA explains that in such a case, "[t]he 316(b) limitations would be based on BPJ whether or not the Director reopens the permit, because under § 125.95(a)(2)(ii) for the Phase II Rule, a BPJ-based permit limit is required for facilities that have not submitted the information required under the Phase II rule" (emphasis in original). This is exactly the situation with respect to the Final Permit for MKS.

EPA's approach in 40 C.F.R. § 122.43(b) makes sense because it prevents ongoing permitting from being unduly delayed as a result of new regulations. Consistent with that approach, instead of delaying permits by requiring them to go through all the new procedures of the new Phase II regulations, EPA promulgated 40 C.F.R. § 125.95(a)(2)(ii) to provide for a reasonable transition from permitting on a BPJ basis to permitting based on the information requirements of the new regulations. By enabling expired permits to be reissued without extended delay because of the new regulations, EPA's approach is consistent with the CWA's goal of maintaining progress toward the elimination of pollutant discharges and the restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters. *See* 33 U.S.C. § 1251(a)(1).

Therefore, for the final MKS permit, EPA has decided to exercise its discretion not to reopen the permit proceedings due to the Phase II Regulations because the new requirements are not "of sufficient magnitude to make additional proceedings desirable." For this permit, as in the example from the EPA Questions & Answers document, the facility has yet to provide the Agency with the permit application information required by the Phase II Rule. Therefore, EPA could not presently apply the substantive CWIS requirements of the Phase II Regulations to the new permit. Under these circumstances, the Rule expressly states that BTA limits will be determined on a BPJ basis. See 40 C.F.R. § 125.95(a)(2)(ii). See also 40 C.F.R. §§ 125.90(a) and (b). Thus, as EPA states in the Questions & Answers, technology-based intake limits would be based on BPJ "whether or not" the permit proceeding was reopened due to the Phase II Rule.

C. EPA Reasonably Considered the Material in the Record, Including the Final Phase II Rule, In Applying CWA § 316(b)'s BTA Standard on BPJ Basis to Determine Technology-Based CWIS Limits for the Permit

In developing a technology standard on a BPJ basis, it is necessary to apply the factors required

[2] EPA also states that the discretionary decision as to whether or not to reopen the proceedings to revise the draft permit should be explained in the permit record, as Region 1 is doing here.

by the statute for the standard in question to the specific case at hand (e.g., for the BTA standard it is necessary to consider technological alternatives and if and how they might be applied to the facility seeking a permit). The CWA sets no limit on what sources of information may be considered in conducting that BPJ analysis, but also does not require that any particular source of information be considered. Given all the circumstances at hand, EPA considered the permit record and the Phase II Regulations in a reasonable and appropriate way in developing BPJ limits for this permit.

1. Draft Permit

In developing the Draft Permit's technology-based limits under CWA § 316(b) on a BPJ basis, EPA considered the permit application and supporting information, as well as other information collected for the permit record. EPA also considered the already signed, though not yet effective, Phase II Regulations as part of informing our BPJ determination. EPA found this to be reasonable because these regulations were developed to apply § 316(b)'s BTA standard to existing power plants with intake volumes of 50 MGD or more, such as MKS. Moreover, EPA (correctly) anticipated that the new regulations were likely to become effective soon after EPA issued the Draft Permit and well before we issued the Final Permit.[3] Indeed, it might have been unreasonable *not* to consider the Final Rule once it had been signed by the Administrator.[4]

The Final Phase II Regulations, 40 C.F.R. Part 125 Subpart J, identify five different options for achieving compliance with the regulations from which a Phase II facility may choose an approach. 40 C.F.R. § 125.94. Application requirements vary based on the compliance alternative selected and, for some facilities, include development of a Comprehensive Demonstration Study. 40 C.F.R. § 125.95. The main adverse environmental impacts associated with the CWIS operations are the impingement and entrainment of fish, fish larvae, fish eggs, and other aquatic organisms. Impingement and entrainment kill or injure the vast majority of the organisms involved. The Rule's performance standards require all regulated facilities to reduce impingement mortality (by 80 to 95 percent) and some regulated facilities to reduce entrainment

[3] EPA discussed the expected timing and effective date of the future § 316(b) Phase II Regulations in Section 7.2 of the Determination Document for the Draft Permit. As discussed above, at the time the Draft Permit was issued, the final rulemaking package for the Final Phase II Rule, including the preamble and regulations, had been signed by EPA's Administrator and posted on the Agency's website, but had neither been published in the Federal Register nor become effective.

[4] Not considering the Final Rule would have been different from issuing a permit without considering the requirements of the Proposed Phase II Rule. The Proposed Rule was clearly subject to potentially substantial changes and expressly indicated that it was not to be used as guidance in the development of permits to be issued prior to the Rule's finalization.

(60 to 90 percent). See 40 C.F.R. 125.94(b). Whether or not entrainment must be reduced turns on several factors, including the type of water body on which the facility is located, the facility's capacity utilization rate, and the proportion of the water body's volume that is withdrawn by the facility. Id.

The Rule's performance standards can be met by design and construction technologies, operational measures, restoration measures, or some combination thereof. Id. The Rule also specifies that if a facility reduces its through-screen intake velocity to 0.5 fps or less, it will be deemed to comply with the Rule's impingement mortality reduction standard. 40 C.F.R. § 125.94(a)(1)(ii).

The greatest, most certain reduction in adverse environmental impacts would be achieved by the large-scale (i.e., as much as approximately 95%) intake flow reductions that would be associated with converting the power plant's open-cycle cooling system to a system using closed-cycle cooling. See, e.g., 69 Fed. Reg. 41601 (text and n. 44), 41612 (second column). Reductions in intake flow achieve proportional reductions in entrainment and impingement. Id. Thus, the Phase II Rule deems facilities using closed-cycle cooling to meet the Rule's impingement mortality and entrainment reduction standards without additional requirements. 69 Fed. Reg. 41601; 40 C.F.R. § 125.94(a)(1)(i).

For MKS, however, conversion to closed-cycle cooling has been ruled out as technologically impracticable due to space constraints at the facility. This is discussed in the Draft Permit Determination Document. The preamble to the Phase II Rule indicates that while closed-cycle cooling may yield the greatest reduction in adverse environmental impacts, cooling system conversion will not likely be practicable at all locations and space constraints are likely to be a problem in some cases. 69 Fed. Reg. 41605. Indeed, the preamble explains that this is one of the reasons that the Rule does not declare closed-cycle cooling to be the BTA for all existing power plants. Id.[5]

---

[5] In its permit application, the permittee discussed the option of installing a "helper (cooling) tower" for cooling the heated once-through cooling water discharge. Although helper towers would require only a fraction of the space of a full-scale cooling tower, MKS also concluded that inadequate space was available for this option. Based on the record before the agencies, EPA and MassDEP also concluded that helper towers would not be feasible. In any event, it should also be understood that helper towers are not a technology for complying with CWA § 316(b) because they are useful only for reducing the temperature of thermal discharges and do not reduce cooling water intake volume. To the extent that any future decommissioning of one or both of MKS's jet engine peaking units freed up space on the permittee's property to accommodate one or more helper towers (or even full-scale cooling towers) these technologies could be reconsidered in the future, as appropriate.

Another reason that EPA did not make closed-cycle cooling a mandatory requirement of the Phase II Rule for all power plants is that the Agency concluded that certain types of screening systems could, in some cases, achieve a similar level of impingement mortality and entrainment reduction as closed-cycle cooling, but at less cost. See 69 Fed. Reg. 41599-600, 41602, 41605. One of these types of screening systems involves placing fine-mesh "barrier nets" in front of the CWIS to block organisms from being entrained and potentially make the process of being impinged and then returned to the water body gentle enough not to kill the organisms involved. See 69 Fed. Reg. 41602, 41605.

In its permit application, and supporting materials, Mirant indicated that it believed that its proposed barrier net technology could potentially reduce both impingement mortality and entrainment. The record for the Phase II Rule also suggested that the barrier net technology could potentially be effective enough to meet these standards. See 69 Fed. Reg. 41599, 41602.

Evaluating the information in the permit record, EPA also concluded that using the barrier net technology at MKS *might* enable the facility to meet the Rule's performance standard for reducing impingement mortality and achieve at least some level of entrainment reduction. EPA concluded generally that barrier nets can in some cases significantly reduce impingement mortality by reducing intake velocity so that adult and juvenile fish can avoid entrainment by swimming away, and by gently blocking organisms that do not swim away so that they are not drawn into the CWIS and can be gently removed from the nets and returned to the river. EPA concluded that barrier nets should be able to work in this way at MKS. The barrier nets also appear capable in some situations of significantly reducing entrainment. Their success in this regard turns on the relative size of the organisms in question and the openings in the mesh of the net. EPA's analysis for MKS determined that the barrier nets may be capable of reducing entrainment of fish larvae (and adult and juvenile fish), but that most or all fish eggs in the Lower Basin of the Charles River are likely to be too small to be blocked by the nets and would continue to be entrained.

While EPA concluded that the barrier net technology should yield reductions in both impingement mortality and entrainment, EPA also concluded that the exact percentage of the reductions that could be achieved could not be predicted for MKS in light of the limited available data (and the ambiguous results of MKS's pilot testing). Not only did it appear that the smallest organisms (e.g., fish eggs and certain larvae) were likely to pass through the barrier net mesh and continue to be entrained, but to the extent that the nets block eggs and larvae from being entrained, these organisms are necessarily impinged and the survival of these delicate organisms after impingement is uncertain.[6] Thus, reduced larval entrainment might simply lead to their

[6] MKS's comments on the draft permit suggest that the impinged larvae would not survive and should be "counted as lost to entrainment." MKS Comment H36. See also MKS

death by impingement.[7] See 69 Fed. Reg. 41599. Additional data will be needed to reasonably assess this issue and, as discussed below, the Final Permit seeks to require suitable monitoring to support such an assessment.

Finally, the record does indicate that use of the barrier net technology should reduce intake velocities sufficiently to meet the Phase II Rule's standard of 0.5 feet per second (fps) or less for through-screen intake velocity. Mirant has estimated that its proposed barrier nets will reduce the intake velocity to about 0.04 fps at the CWIS, but it is unclear whether this estimate represents through-screen velocity or some other metric. Nevertheless, EPA's assessment of the technology as it would be applied at MKS indicates that the 0.5 fps standard should be attainable. As discussed above, this should enable adult and juvenile fish to escape the intake flow and avoid being impinged.

That being said, Mirant did not propose that barrier nets would be implemented year-round at MKS. Mirant concluded that barrier nets could not be used when icing conditions prevailed in the river. EPA agreed with Mirant that it would be technologically impracticable to use the barrier nets under such conditions. Therefore, the Draft Permit did not require that the barrier nets remain in place at all times, and without the barrier nets in place, MKS's through-screen intake velocity was likely to be greater than 0.5 fps. There are still resident fish in the river that would be subject to impingement during these times (at the traveling screens) and the absence of the barrier nets would clearly increase the threat of impingement mortality during those periods.

In light of the above considerations, the Draft Permit included performance *goals* for the reduction of impingement mortality and entrainment that matched the standards included in the Phase II Rule, and included monitoring to define actual facility performance. The Draft Permit indicated that if the data showed that these performance goals were not being met, then steps would need to be taken at MKS to try to improve performance to meet the goals. Thus, failing to meet the goals would not be a violation of the permit, but would have consequences for MKS. The Draft Permit also required that the barrier net technology proposed by Mirant be implemented at least from February 15 (or as soon as icing conditions would allow) through

---

Comment H31. If even the larvae blocked by the barrier nets should be counted as lost to entrainment, then no entrainment reductions would have been achieved. EPA and MassDEP have concluded, however, that it is *possible* that impinged larvae could be safely removed from the barrier nets and returned to the Charles River and are requiring that to be evaluated. *See* Comment/Response H31 and discussion of water quality-based requirements further below in Response H1.

[7] The impinged organisms could die either from the impingement itself or from the process of being removed from the nets after being impinged.

November 1 of each year. In addition, the Draft Permit EPA required that through-screen intake velocity be limited to 0.5 fps or less on the grounds that it appeared from the record that MKS could meet that standard with the barrier net technology installed. Finally, the Draft Permit also limited intake flow to no more than 70 MGD from April through June (the key anadromous fish spawning season), a flow level matching the facility's past average intake flow. EPA concluded based on BPJ that this approach represented the BTA for MKS under the current circumstances.

The Draft Permit's impingement mortality and entrainment monitoring requirements were developed under CWA §§ 308 and 402 and the Phase II Rule. In addition to providing data to measure performance against the permit's performance goals, EPA also intended that the monitoring results would provide necessary data to support the next permit renewal which would involve application of the Phase II Rule's substantive standards. This data would, therefore, support specification of actual compliance performance standards for the next permit renewal. Consistent with 40 C.F.R. § 125.95(a)(2)(ii), the Draft Permit also provided a schedule for development and submission of the required material to support future permit renewal under the Phase II Rule. Furthermore, EPA included the monitoring provisions to provide information that would support future permit determinations concerning limits required to meet state water quality requirements and limits needed to meet thermal discharge requirements in light of cumulative effects of such discharges viewed together with intake effects.

EPA's approach did not represent the actual application of the Phase II Rule to the Draft Permit, but EPA determined that this approach would be compatible with application of the performance standards of the Phase II Rule in future permits. EPA's BPJ was that this was a reasonable application of CWA § 316(b) to the Draft Permit taking into account that the Phase II Rule was not yet in effect, but had recently been signed by the Administrator and was expected to become effective in the near future and prior to issuance of the Final Permit.

2. Final Permit

In rendering its BTA determination for this Final Permit, EPA again considered the information in the permit record. This included public comments on the Draft Permit, the final Phase II Rule, which became effective on September 7, 2004, and other materials. As discussed below, this evaluation led to certain changes from the conditions included in the Draft Permit.

Having appropriately considered the Phase II Regulations in developing the § 316(b) limits for the Draft Permit, it is also proper for EPA to consider the now effective Phase II regulations in developing the BPJ-based § 316(b) limits for the Final Permit. While Mirant characterizes this as an improper "hybrid approach," there is nothing improper or arbitrary about it. Although the substantive requirements of the Phase II Rule are not *determinative* of the technology-based CWIS requirements for permit, it is reasonable for EPA Region I to *consider* both the substantive

requirements of the new Phase II Rule, and relevant information supporting those requirements from the rulemaking record, in shaping the BPJ-based limits for the MKS permit under CWA § 316(b). This consideration enabled the Region to inform its BPJ determination with relevant aspects of EPA's final national assessment of potential BTA technology alternatives. For example, as discussed above, this national evaluation provided additional support for conclusions regarding the potential effectiveness at MKS of the barrier net technology proposed by Mirant. See, e.g., 69 Fed. Reg. at 41599, 41602 (barrier net efficacy). See also Response H2, below. Indeed, in other comments, as discussed below, Mirant urges EPA to give close consideration to the performance standards and definitions of the new Phase II Rule in making its BPJ determination of BTA.

a. **Technology-Based Entrainment Reduction Requirements**

Mirant argues that it would be inappropriate to include entrainment reduction requirements in the Final Permit. Mirant's argument is based on the source water type classification applicable to the lower Charles River Basin under the Phase II Rule. Mirant argues that the lower Charles River Basin meets the criteria of a "lake or reservoir" as specified in 40 C.F.R. § 125.93 and points out that CWISs on such water bodies are required to meet performance standards for reducing impingement mortality, but not for reducing entrainment. See 49 C.F.R. § 125.94(b)(1) and (2). If, however, the water body were instead classified as an "estuary" or "freshwater river," then entrainment reduction standards would apply.

Determining whether the lower Charles River Basin should properly be classified as a "lake or reservoir" under the Phase II Rule presents a close question. This is because the lower Basin meets certain characteristics of more than one of the types of water bodies classified under the Rule, see 40 C.F.R. § 125.93 (definitions of "lake or reservoir," "estuary," and "freshwater river or stream"), and does not neatly fit into any single classification. (See Responses to C49 and D29). Moreover, because of the recent promulgation of the Phase II Rule, EPA does not yet have a significant basis of experience applying these water body classifications. EPA believes this leaves the Agency with the discretion to reasonably select one of the classifications for consideration in the context of this BPJ-based permit, but also believes that this classification could be subject to change in the context of future permits if an appropriate basis for such a change is identified.

Having noted the difficulty of the issue, EPA has decided that it agrees with Mirant that the lower Basin is best classified as a lake or reservoir at this time. The lower Basin is created by the downstream dam and locks that have been placed between the Charles River and its connection to Boston Harbor and the ocean beyond. At the same time, tidal effects and the periodic opening of the locks do result in the presence of salt water in the lower Basin. The Phase II Rule defines a lake or reservoir as follows:

> *Lake or reservoir* means any inland body of open water with some minimum surface area free of rooted vegetation and with an average hydraulic retention time of more than 7 days. Lakes or reservoirs might be natural water bodies or impounded streams, usually fresh, surrounded by land or by land and a man-made retainer (e.g., a dam). Lakes or reservoirs might be fed by rivers, streams, springs, and/or local precipitation.

40 C.F.R. § 125.93. The lower Basin seems to meet this definition because (1) it is an inland body of open water free of surface vegetation, (2) it is created by an impounded stream, (3) although it does not include solely fresh water, the definition only says that the water should "usually" be fresh, (4) the lower Basin is bordered by land on two sides and a downstream man-made retainer, while there is also an upstream dam in Watertown, and, thus, can be considered to be surrounded," (5) it is fed by a river (and the ocean), and (6) it has an average hydraulic retention time of more than 7 days (calculated on an annual basis).

While the lower Basin's average hydraulic retention time is greater than 7 days on an annual basis, EPA's analysis indicates that if calculated on a monthly basis, the average retention time would be less than 7 days in some months. EPA has decided at this time that it is reasonable to use the straightforward approach of calculating an average retention time on an annual average basis. Two significant (though potentially manageable) problems could arise with using a different averaging approach. EPA would have to decide whether the fact that the hydraulic retention time is less than 7 days in some months would mean that the Lower Basin should fall under a different classification only in those months or should do so throughout the year. Because the alternative classifications as an estuary or freshwater river would require imposition of entrainment reduction standards while the lake or reservoir classification does not, see 40 C.F.R. § 125.94(b)(2), the former approach would lead to different permit conditions applying during different parts of the year. While permits do in some instances include seasonal limits, such an approach would make the permit more complex, might result in the permittee fairly wanting to use technology during only some parts of the year which could raise implementation difficulties, and could alter and complicate the relevant costs and benefits that might need consideration in the permit development if site-specific limits were sought on a cost/benefit basis. See 40 C.F.R. § 125.94(a)(5). Alternatively, defining the water body as an estuary or freshwater river all year even though it met the lake or reservoir retention time criterion during some part of the year might be regarded as inequitable.

Meanwhile, the lower Basin also does not neatly fit into the other water body classifications in the Phase II Rule. First, the Rule defines an estuary as follows:

> *Estuary* means a semi-enclosed body of water that has a free

> connection with open seas and within which the seawater is measurably diluted with fresh water derived from land drainage. The salinity of an estuary exceeds 0.5 parts per thousand (by mass) but is typically less than 30 parts per thousand by mass.

40 C.F.R. § 125.93. EPA's analysis indicates that the salinity content of the water present in the lower Basin would meet this definition. Moreover, the lower Basin does provide spawning and nursery habitat and at certain times is home to free-floating icthyoplankton, which is a key biological characteristic of an estuary, see 69 Fed. Reg. 41599. The lower Basin does not, however, have a free connection to the open sea because of the downstream dam and locks.

Second, the Rule defines a freshwater river or stream as follows:

> *Freshwater river or stream* means a lotic (free flowing) system that does not receive significant inflows of water from ocean or bays due to tidal action. For purposes of this rule, a flow-through reservoir with a retention time of 7 days or less will be considered a freshwater river or stream.

40 C.F.R. § 125.93. The lower Basin does not appear to fit this definition completely, in part, because it has a retention time greater than 7 days on an annual average basis or in at least some months. However, while the lower Basin does receive contributions of water from ocean or bays due to tidal action, this is limited to when the locks are opened. On an annual basis the percentage of flow entering the Charles from Boston Harbor is low compared to the total flow from the upstream contributing watershed. Based on the USGS salinity study conducted for the period between June 19, 1998 and July 19, 1999, harbor water infiltration represented just 2 % of the total flow into the lower Charles. Because of the dam and locks the lower Charles is at times not a free flowing system. On the other hand, the lower Charles does become a free flowing system to Boston harbor every day when the tidal elevation in the harbor drops below the elevation of the inverts of the sluice gates and during storm events.

Thus, as stated above, EPA currently agrees with Mirant that the lower Basin should be classified as a lake under the Phase II Rule and has not set entrainment reduction performance goals and standards in the permit on a technology basis. EPA agrees that it would be unreasonable to impose entrainment reduction requirements as part of the BPJ application of BTA given that the Phase II Rule national determination of BTA does not require entrainment reduction by facilities located on lakes or reservoirs. (As discussed below, however, the Final Permit contains various entrainment reduction-related provisions based on state water quality requirements.) While EPA has not, strictly speaking, applied the full Phase II Rule compliance alternatives process to the MKS permit, it has concluded that it would be unfair, and therefore inappropriate, to impose

requirements under a BPJ-based application of the relevant technology standard to MKS when the fully effective and applicable Phase II Rule, which predates this permit, would likely not require such limits.

This is clearly an unusual circumstance. In most cases, a BPJ permit is developed in the *absence* of an applicable national standard. Here BPJ must be applied in the shadow of an effective, applicable national standard. The good reasons for developing the permit on a BPJ basis have been explained, but EPA also believes it makes sense to take the national standard into account in applying BPJ. Under these circumstances, it is one thing to render a BPJ determination believed to align fairly closely with the requirements for the national standard – as is the case here for impingement mortality controls – but it would be quite another thing to impose a limit that likely goes beyond the requirements in the national standards, as would be the case if EPA imposed an entrainment reduction requirement in the MKS permit. Doing so would subject the facility to technology-based compliance requirements that EPA on a national basis has concluded are not required for facilities situated on water bodies like the lower Charles River Basin. In issuing this permit, that fact cannot be ignored. EPA also believes that its discretion to take these issues into account in making BPJ determinations is supported by the decision of the U.S. Court of Appeals for the Ninth Circuit in NRDC v. EPA, 863 F.2d 1420, 1428 (9th Cir. 1988).

b. Technology-Based Impingement Mortality Reduction Requirements

Turning from entrainment reduction to impingement mortality reduction, EPA also reasonably considered the Phase II Rule, and other material in the record, in delineating technology-based conditions for the Final Permit. The Phase II Rule's substantive performance standards require *all* facilities covered by the Rule, including MKS, to reduce impingement mortality by at least 80-95 percent (unless the facility qualifies for alternative site specific standards). 40 C.F.R. § 125.94(b)(1). As discussed above, the preamble to the Final Rule indicates that barrier net technology may be capable of meeting this performance standard in some cases. As also mentioned above, Mirant itself has indicated that the barrier net technology may be able to meet the Rule's standard at MKS.

Yet, for several reasons already discussed above, unavoidable uncertainty remains about exactly how well the technology will perform at MKS. First, the record does not include a robust data set demonstrating barrier net performance under actual operating conditions at MKS. The data from pilot testing barrier nets at MKS yielded ambiguous results. Second, the barrier nets will not be able to be deployed during winter icing conditions in the river, but water will continue to be withdrawn by MKS's CWIS and impingement of fish residing in the water would be expected to occur. Given this fact, it is even more unclear what level of impingement mortality will be achieved at MKS on an *annual* basis. Third, it is unclear whether the barrier nets may increase impingement mortality by blocking small, delicate fish larvae from being entrained, or whether

these organisms will be able to be safely returned to the river.

In its comments on the Draft Permit, Mirant stated as follows:

> [a]s the data indicate, and as EPA acknowledges, the barrier net is highly effective at preventing impingement mortality, virtually eliminating impingement of organisms that otherwise could have been impinged on the traveling screens. It also reduced entrainment of organisms over approximately 6 mm for the representative species assessed. Over the three-month testing period, when the barrier net was being properly operated, it reduced entrainment of entrainable-sized organisms by 60-90%. The percentages of organisms not protected by the barrier net are largely reflective of the earliest life stages, as to which natural mortality is highest, and which the barrier net is not designed to protect. Although there were some days on which performance anomalies occurred, this happened primarily (1) during initial deployment of the net, when entrainable organisms remained "inside" the net, and (2) thereafter, on occasions when the anchoring system failed and the net shifted position, allowing intake water to come over, under, or around the net. Mirant Kendall understands that its final design, which does not incorporate the same type of anchoring system used during the test period, will need to address this type of issue.

Thus, Mirant also seems to be of the view that the barrier nets may well be able to achieve the Phase II Rule's impingement mortality reduction standard, but also seems to note some uncertainty about exactly how well they will perform.

Mirant also objected to EPA including in the Draft Permit an impingement mortality reduction goal of 80 to 95 percent, consistent with the Phase II Rule, coupled with the requirement that Mirant would have to make changes at the plant if the performance goals were not being achieved. Mirant felt that this was unfair in that it, in essence, enforced the Phase II Rule's impingement mortality standard without allowing MKS to avail itself of all the procedural options of the Rule, including the possibility of seeking alternative site-specific standards. See 40 C.F.R. § 125.94.

The Phase II Rule also dictates that a facility that maintains a *through-screen* intake velocity of 0.5 fps or less is deemed to have met the impingement mortality reduction standard and will not be required to further demonstrate that it meets that standard. 40 C.F.R. § 125.94(a)(1)(ii). As stated above, the permittee estimated that its proposed barrier nets would reduce "intake velocity"

to about 0.04 fps, but it is not clear whether the permittee's estimate is for a through-screen velocity or some other measure. In any case, EPA's review of the record indicates that the barrier net technology *should* result in through-screen intake velocities meeting the 0.5 fps standard in the Phase II Rule. Therefore, the Draft Permit included a requirement that through-screen intake velocities of 0.5 fps or less be maintained at all three CWISs at MKS. The Draft Permit also required that during the life of the permit the permittee measure or estimate to EPA's satisfaction that the through-screen velocity is equal to or less than 0.5 fps, consistent with the barrier net study required in Part I.A.14.d.7 of the Final Permit. Mirant did not object to these conditions in its comments on the Draft Permit.

In light of the above considerations, EPA's BPJ determination of technology-based impingement mortality reduction requirements for MKS under CWA § 316(b)'s BTA standard specifies the following requirements:

(1) implement a fine-mesh "barrier net" system ("BNS") in front of each of the three CWISs and locate the BNS within the Broad Canal, at the entrance to the Broad Canal, or outside of the Broad Canal; the barrier nets must remain in place except when icing conditions in the river reasonably preclude their deployment;

(2) design, install and operate the barrier nets so as to minimize impingement mortality to the extent practicable, recognizing that adjustments may be needed over time to optimize performance based on experience, with the ultimate performance goal being to reduce annual impingement mortality for adult and juvenile fish by at least 80% from a calculated baseline;

(3) monitor and report year-round on the impingement mortality reduction performance at each of the three CWISs;

(4) restrict the effective through-screen intake velocity at all three CWISs to 0.5 feet per second (fps) or less when the barrier nets are in place, including a requirement to demonstrate what the actual through-screen intake velocity is under both conditions (i.e., at the barrier nets when the BNS is in place and at the traveling screens when the BNS is not in place);

(5) restrict non-contact cooling water flow to a monthly average rate of 70 MGD during each of the primary spawning months of April, May and June; and

(6) design, install and operate the BNS to preclude bypasses due to circumstances within the permittee's control, to the extent practicable. If the permittee encounters unforeseen clogging or other operational difficulties with the BNS, or if

necessary to perform routine maintenance, the permittee may pass water through its intakes without all of the water passing through the BNS for the shortest period of time sufficient to alleviate the problem.

EPA has determined on a BPJ basis that the above conditions represent technology-based CWIS requirements reflecting the BTA for minimizing adverse impacts at MKS. Given all of the above-discussed information, it is appropriate to require installation of the barrier net technology and to set a performance *goal* of reducing annual impingement mortality for adult and juvenile fish by at least 80% from a calculation baseline. In response to Mirant's comments, however, EPA has eliminated the provision *requiring* Mirant to make changes if the performance goal is not achieved. EPA was not intending to directly enforce the Rule's requirements in the way it had constructed the Draft Permit. Therefore, EPA agrees with Mirant's comment that it could be unfair to mandate changes to try to achieve the standard when the Phase II Rule might not ultimately require the same changes, such as if alternative site-specific standards were applied. EPA has added to the Final Permit, however, the requirement that Mirant design, install and operate the barrier nets to optimize their performance to the extent practicable. EPA concludes that this is entirely consistent with the BTA standard of § 316(b) and appropriately, on a narrative basis, puts the onus on MKS to do what it can to minimize adverse environmental impacts in the form of impingement mortality. By affirmatively recognizing that adjustments may be needed over time in light of operating experience, the Permit recognizes current uncertainties regarding precise performance levels while also reasonably requiring appropriate steps to improve performance in light of actual experience. At the same time, if the intake velocity is reduced below 0.5 fps during the times when the barrier net is installed, as both EPA and Mirant predict, then EPA agrees with Mirant that the facility is likely to be able to meet the performance goal for reducing the impingement mortality of adult and juvenile fish.

In addition, while the Draft Permit only required that the barrier nets be in place from February 15 (or as soon thereafter as icing conditions in the river would allow) to November 1 of each year, the Final Permit has been changed to require that the barrier nets be utilized at all times *except* when icing conditions in the river preclude their deployment. This provision continues to recognize that icing conditions are likely to render use of the barrier nets impracticable at times, but requires the facility to use the nets when they are actually able to do so. The Draft Permit allowed the nets to be removed as of November 1, despite the fact that icing conditions in the river do not always occur that early in the cold weather season. The condition in the Final Permit recognizes the icing issue, but is better tailored to require that impingement mortality is minimized (i.e., reduced as much as possible) as required by CWA § 316(b). Furthermore, because the Final Permit requires that CWIS performance be optimized toward the goal of reducing *annual* impingement mortality for adult and juvenile fish by at least 80% from a calculation baseline, MKS has an incentive to do the best it can to prevent mortality to impinged organisms even when the barrier nets are not in place.

Although the Phase II Rule does not require facilities that demonstrate that their through-screen intake velocities are no more than 0.5 fps to do anything more to show that they satisfy the impingement mortality reduction standard, EPA believes the set of requirements it has included in the Final Permit are appropriate. This permit is based on BPJ and is not strictly controlled by the requirements of the Phase II Rule. Moreover, while EPA believes that the barrier net technology may result in through-screen intake velocities of less than 0.5 fps, this has not yet been demonstrated based on empirical data. In addition, EPA's decision in the Phase II Rule that a facility meeting the through-screen intake velocity requirement need not do anything more to show that it is meeting the 80-95 percent impingement mortality reduction standard was based on the view that the data collected for the national rule indicated that this would be true. It is perfectly appropriate to impose performance goals and standards, and monitoring requirements on a BPJ basis, that will verify if this is true at MKS. Additional bases for requiring impingement mortality monitoring are discussed below.

Furthermore, as stated above, the barrier nets cannot be kept in place when icing conditions prevail in the river. Without the nets in place, the facility will likely not meet a through-screen intake velocity of 0.5 fps. Therefore, EPA has clarified the intake velocity limit to provide that it applies only when the barrier nets are in place. MKS will, however, need to demonstrate what its actual through-screen intake velocities are under both conditions (i.e., with or without the barrier nets in place).

Finally, EPA included the 70 MGD monthly average intake flow limit for April through June because it would help to limit the extent of impingement and impingement mortality, especially to spawning fish that may be in the water at that time of year (as well as reduce the threat of entraining fish eggs in the water). Furthermore, the record indicates that MKS can maintain such intake flows without operational problems, especially in light of the fact that peak electricity demand levels are not typically experienced during these months. Mirant did not object to this limit.

c. **Water Quality-Based Impingement and Entrainment Reduction Requirements**

In the Final Permit, EPA has included the conditions for design and operation of the CWIS that are discussed below based on the requirements of the MassDEP's CWA § 401 certification. These conditions are included in order to assure compliance with state WQS. The CWA and the Phase II Rule require that in addition to satisfying technology standards under CWA § 316(b), permits limits for CWISs must also include any more stringent provisions needed to satisfy state water quality requirements. See CWA §§ 301(b)(1)(C), 401(a)(1) and (d); 40 C.F.R. §§ 122.4(d), 122.44(d), 125.84(e) and 125.94(e). This means that permit conditions must satisfy any applicable water quality criteria and protect any relevant designated uses, including those for fish habitat, that may be set forth in the state's WQS. The CWA authorizes states to impose more

stringent water pollution control standards than dictated by the federal statute. See CWA § 510. See also 40 C.F.R. §§ 125.80(d) and 125.90(d). Therefore, the limits in EPA-issued NPDES permits that address CWISs must satisfy both CWA § 316(b) and any applicable state WQS, and whichever standards are more stringent ultimately determines the final permit limits.

The MassDEP has issued its water quality certification and has certified that the Final Permit's impingement mortality reduction-related limits identified above are consistent with state WQS. In addition, the Commonwealth's water quality certification also requires that the Final Permit contain certain entrainment reduction-related conditions in order to comply with state WQS. These conditions, and the rationale for them, are outlined in the state's certification letter and are hereby incorporated by reference into this Response to Comments. On the basis of this certification, these water quality-based entrainment reduction-related requirements are also included in the Final Permit in Parts I.A.11 and 14.d.11. See CWA §§ 401(a)(1) and 401(d).

d. **Schedule**

Under the Phase II Regulations, 40 C.F.R. § 125.95(a)(2)(ii), a final permit with BPJ-based limits under CWA § 316(b) should also include a schedule by which the permittee would provide the complete information submission required by the regulations as expeditiously as practicable, but not later than three years and 180 days from publication of the regulations. EPA's Questions & Answers document also indicates that the Director has the discretion to include a specific schedule in the final permit setting deadlines for submission of the required Phase II Rule information to support *the next* permit application submission. In the Final Permit for MKS at Part I.A.16, EPA has included a schedule for the permittee to complete the information gathering and permit application process described in 40 CFR § 125.95 of the new Phase II Rule.

e. **Monitoring**

There are several bases for the entrainment and impingement monitoring provisions in the permit independent of whatever the CWA § 316(b) Phase II regulations might require. These independent bases include (a) the need to assess cumulative adverse impacts, including those from the cooling water intake, in order to support analysis of the effects of the Station's thermal discharges and to support future permit determinations regarding thermal discharge limits under CWA § 316(a), and (b) the need to ensure that impingement and entrainment do not contribute to violations of applicable state water quality standards. In addition, in applying CWA § 316(b) on a Best Professional Judgment (BPJ) basis, as EPA has done for this permit, it is appropriate to set monitoring requirements for entrainment and impingement, especially given the dearth of existing data for the Station. Finally, these monitoring requirements are also authorized by CWA §§ 402(a)(1) and (a)(2), and 308(a). EPA notes that after adequate data is collected and assessed, it may be possible to reduce these data collection requirements in the future.

Comment H2: Mirant comments that it has not been given an opportunity to evaluate and select compliance options, including the use of a TIOP, under the Phase II Rule; rather, EPA has used a hybrid approach, guided largely by the 1977 Draft 316(b) Guidance, to develop draft permit requirements that are not consistent with the final Phase II Rule. Mirant seems to suggest that EPA has applied the Phase II Rule on a BPJ basis and complains that EPA did not apply the entire rule but rather picked and chose, considering some but not other aspects of the Rule by not giving the facility all the compliance options. Meanwhile, CLF comments that the permit's limits are not stringent enough to satisfy CWA § 316(b)'s standard of ensuring the CWISs reflect the BTA for minimizing adverse environmental impacts, noting that because of renovations at the facility, MKS could end up increasing its water withdrawals by as much as 40% due to facility renovations.

Response to H2: In addition to the response presented in H1, EPA offers the following response to this comment by Mirant. First, Mirant seems to misapprehend the nature of EPA's BPJ analysis. Rather than engaging in a BPJ application of the Phase II Rule, EPA has properly developed a BPJ-based determination of what CWA § 316(b)'s BTA technology standard requires at MKS. In the process of applying the statute, EPA has looked to certain aspects of the Phase II Rule to inform our BPJ evaluation (such as the performance standards in the regulations and the evaluations of practicable technologies, as discussed in the preamble to the final Rule). EPA believes its approach was entirely reasonable. (See also Response H8, below, discussing impingement mortality and entrainment reduction requirements).

Second, Mirant asserts that our approach to setting a BTA requirement in this permit for the CWIS somehow violates the letter and spirit of the Phase II Rule. As explained above, the letter of the Phase II Rule explicitly provides for EPA to issue this permit based on a BPJ determination of BTA for the intake structure. As to the spirit of the rule, EPA does not accept Mirant's suggestion that promulgation of the rule following notice of this draft permit should suspend progress toward setting a BTA requirement for this CWIS. Indeed, the *letter* of the Phase II Rule specifically contradicts Mirant's suggestion as to its "spirit" – 40 C.F.R. § 125.95(a)(2)(ii) specifically provides the basis for EPA to finalize a BPJ determination. Clearly the terms (and spirit) of the Phase II Rule intend that progress be maintained toward applying the BTA standard to CWISs, providing that BPJ will be utilized to develop permits for facilities whose existing permits will expire before they have time to submit a full demonstration to support a permit developed under the terms of the new Rule. Such facilities would be given sufficient time to develop such demonstrations for their next permit renewal. This approach is exactly what EPA is pursuing for this permit. While Mirant might prefer an approach that delayed permit reissuance until all the new procedures set forth in the Phase II Rule could be undertaken first – which would also have the effect of delaying development of a new permit and progress toward addressing the impacts on the Charles River ecosystem of MKS's water withdrawals and discharges of heat and

other pollutants – that is not the result EPA required or intended with the issuance of the Phase II Rule.

Mirant also appears to be troubled that EPA is looking to several sources of information and guidance in formulating its BPJ determination for BTA on this CWIS. Mirant chides EPA for looking to the Phase II Rule, looking to the 1977 Draft 316(b) Guidance, and looking to Mirant's submissions concerning its CWIS for guidance in support of its BPJ determination. Where Mirant indicts this approach as being a "hybrid," EPA would describe it as a responsible way to implement a BPJ determination. Indeed, most BPJ determinations are necessarily the result of culling relevant data and guidance from a variety of sources, precisely because the BPJ determination is necessary when there is no promulgated standard available to determine the technology required. EPA would be remiss if we did not examine the 1977 Draft Guidance, the predecessor to the Phase II Rule, for relevant information about applying the BTA standard here.

EPA also looked to elements of the rulemaking record supporting the Phase II Rule to inform our BPJ assessment; we are not *applying* parts of that rule selectively. The Agency did an extensive survey of CWIS technologies in developing the Phase II Rule, and it is reasonable for the Region to examine the materials and information collected in that survey as part of our BPJ determination. Finally, we evaluated, and did our best to factor in, all relevant information Mirant gave us as part of its permit application so that our BPJ determination would be as fully informed as possible and tailored to the specific circumstances of this facility and its CWISs. Calling this multi-part assessment a "hybrid" does little more that describe the process a permitting authority must undertake to make a responsible BPJ determination.

In response to CLF's comment, EPA notes that CLF is correct that the existing permit allowed MKS to operate at a monthly average of 70 MGD and a daily maximum flow of 80 MGD, despite the fact that it often did not actually operate at that level as electricity generation and associated cooling water flows have varied widely over the years. CLF is correct that if the plant ran at full capacity all the time, its actual flows would increase over actual historical levels. In our response to comments in section B, above, we extensively discuss the possibility that MKS will operate close to capacity for longer periods of time than in the past, especially prior to the upgrade. This prospect for increased operation is another reason we have included specific instream temperature requirements under section 316(a), as well as measures to reduce effects associated with impingement mortality under section 316(b), along with extensive water quality and biological monitoring. All of these new requirements apply regardless of whether MKS's actual intake flows increase. As explained extensively below, EPA believes it has correctly imposed BTA on the Station's CWIS using a BPJ determination. And in developing those requirements for the intake structure, we have taken into account the potential for increased cooling water intake noted in this comment. Furthermore, information will be gathered for future permit renewals that will reveal the nature of the actual intake flows through, and adverse impacts from,

MKS's CWISs. Thus, future permit conditions can take any increases into account, as appropriate.

Comment H3: Mirant asserts that it should be able to evaluate all compliance options available under the final Phase II Rule since BPJ requirements must be as close as possible to national, technology-based standards (i.e., Phase II standards) and EPA does not have carte blanche to impose requirements that vary from Phase II without justification.

Comment related to H3 from CLF: When making a section 316(b) determination, the Region must first look to EPA promulgated guidelines. Where EPA has not yet published such regulations or the regulations are not yet effective, the Region must, on a case-by-case basis make the determination using its best professional judgment ("BPJ"). Natural Resources Defense Council v. United States Environmental Protection Agency, 863 F.2d 1420, 1424-25 (9th Cir. 1988). Recent EPA Guidance on the application of the Phase II regulations clearly requires that in the present case, where the draft permit is proposed before the Phase II rule takes effect, but the final permit would be issued after it takes effect, and the applicant has not submitted the requisite information under the Phase II rule, BPJ is applicable.

In the present case, at the time of review there were no 316(b) regulations in effect. Therefore, EPA decided to use a BPJ standard for ensuring that the location, design, construction, and capacity of the CWIS reflect the best available technology ("BTA") for minimizing adverse environmental impact. *Id.* Anticipating the publication of the rule, EPA also determined the BTA for MKS's CWIS by applying the unofficial version of the Phase II section 316(b) regulations.

Response to H3 and related comment: EPA disagrees with Mirant's comment. Again, as discussed above, the Phase II Rule itself directs that CWA § 316(b) is to be applied on a BPJ basis for a permit such as MKS's. Such application must be reasonable and consistent with § 316(b). EPA Region I considered the Phase II Rule in a reasonable manner, as discussed above. EPA has provided justification for all of the requirements it has imposed in MKS's permit. At the same time, there is no requirement that Mirant be given the opportunity to evaluate all the options, and undertake all the procedures, in the Phase II Rule. That would be applying the Phase II Rule, rather than undertaking a BPJ review. EPA's permitting approach applied § 316(b) on a BPJ basis and is fully consistent with 40 C.F.R. § 125.95(a)(2)(ii).

In addition to our response to the comments in H1, EPA notes that CLF has mischaracterized EPA's use of the Phase II regulations in this permit. The Agency is not "applying the unofficial version of the Phase II section 316(b) regulations," as suggested at the close of CLF's comment. Rather, EPA is looking to the Phase II Rule's performance standards and the data and information the Agency used in developing those standards to help inform our BPJ in developing BTA requirements for this intake structure.

Comment H4: Mirant asserts that neither the final Phase II Rule or the Q&A Guidance requires EPA to impose new BPJ-based requirements at this time, and it would be far more reasonable to reissue the existing permit with no changes other than to include a schedule for MKS to complete the evaluation and application process specified in the Phase II Rule.

In a related comment, CLF asserts that, based on EPA guidance, BPJ is the appropriate basis for the permit's requirements. However, the BPJ-based requirements, and any Phase II-based requirements in the permit, should be more stringent than proposed in EPA's Draft Permit for MKS. Furthermore, CLF states that if EPA intends to alter conditions of the Draft Permit based on information not available during the public comment period (i.e., further material submitted pursuant to final Phase II Rule requirements), EPA should reopen the public comment period to ensure stakeholders have an opportunity to review and comment on such new information.

Response to H4: Developing permit limits governing MKS's CWISs is a necessary component of reissuing the facility's NPDES permit. This requires the determination of technology-based standards under CWA § 316(b), and any more stringent requirements necessary to satisfy state water quality standards or other state legal requirements, in light of current information at the time of permit reissuance. As discussed above, EPA is applying § 316(b) on a BPJ basis for MKS's permit, consistent with 40 C.F.R. § 122.95(a)(2)(ii). While Mirant is correct that the Phase II Rule does not *per se* require that the BPJ application of § 316(b) under 40 C.F.R. § 122.95(a)(2)(ii) lead to new, more stringent permit requirements, it is implicit that such BPJ determinations will be made based upon a reasonable consideration of any available new information. To ignore such information would be arbitrary and capricious and would not result in a proper BPJ application of § 316(b).

In this case, EPA has considered information made available since the last permit was issued in 1993. This includes information regarding adverse environmental impacts and threats to aquatic resources from CWIS operation at MKS. It also includes information regarding potentially available technological improvements that could reduce adverse environmental impacts from MKS's CWIS. On the basis of this consideration, EPA has concluded that the existing CWISs at MKS do not reflect the BTA as required by CWA § 316(b). EPA has determined, instead, that more stringent permit limits are needed to ensure that the design, capacity, location and construction of the CWISs at MKS reflect the BTA for minimizing adverse environmental impacts and satisfy applicable state water quality requirements. Indeed, the state's water quality certification imposes conditions requiring more stringent permit limits and such conditions must be included in the NPDES permit in accordance with CWA § 401(d).

In light of the above conclusions, EPA does not agree that it would be reasonable, or lawful, to simply reissue the permit by deeming the existing CWISs to represent the BTA under § 316(b) and including a schedule for the future application of the Phase II Rule requirements. Rather,

EPA believes that the proper approach is to include new, more stringent permits requirements for CWISs that reasonably apply CWA § 316(b) in light of new information and will satisfy applicable state law requirements, and to include a schedule by which Mirant will submit the information required by the Phase II Rule to support reissuance of the next future permit. Indeed, this is exactly what 40 C.F.R. § 125.95(a)(2)(ii) directs the permitting agency to do, and the Final Permit contains such a schedule in Part I.A.16.

In its DD (sec. 7.2.3), EPA also detailed several policy reasons that it made sense for EPA to properly reissue MKS's permit at this time, rather than simply delay any permit until such time as the company was ready to go through the permit development process under the Phase II Rule. These include preventing undue further delay of what has already been a very protracted permitting process (the permit expired in 1993), catching up to already expired deadlines for CWA technology-based requirements, addressing non-cooling water permit issues, and avoiding any reduced environmental protection due to potential Phase II Rule litigation-related delays. Moreover, this approach is also consistent with the CWA's goal of continued progress toward achieving the restoration and maintenance of the chemical, physical and biological integrity of the Nation's water bodies. *See* 33 U.S.C. § 1251(a)(1).

In making the BPJ determination for BTA for this Final Permit, EPA has considered many sources of information about technology for intake structures, including the information in the rulemaking record supporting the substantive requirements of the new, recently effective Phase II Rule. Notably, however, in this permit renewal EPA has also considered the requirements of the Massachusetts Surface WQS. As described more fully in response to H1 and elsewhere, EPA must ensure that operation of the CWIS is consistent with Massachusetts WQS. There are several elements of our BTA determination which are required not only as a result of EPA's BPJ determination as to the technology available to address the impacts of the intake, but also as a result of the requirement to protect the use of this water as a habitat for fish and other aquatic life. These water quality based requirements on the intake would apply to any permit that EPA issued now whether or not that permit left past technology-based determinations under CWA § 316(b) unchanged. Therefore, EPA saw no reasonable basis for further delaying the development and imposition of these intake requirements as Mirant suggests.

With respect to CLF's comments, EPA has developed the permit based on a BPJ application of CWA § 316(b) and believes that the permit's limits are appropriately stringent. EPA is not reopening the record on our BPJ determination for the CWIS, and we are not now reviewing a full information submittal from Mirant under the new Phase II regulations. Any potential future permit modifications will proceed according to EPA procedures and regulations, including any applicable public participation requirements. Also, see Response to H1.

Comment H5: Mirant does not agree with Region 1 that implementing the final Phase II Rule

requirements would result in a delay in the permitting process and suggests EPA should continue to use the existing BPJ requirements until information to support the final Phase II Rule is developed. CLF, on the other hand, comments that because key aspects of the final Phase II Rule have been challenged and may be overturned or stayed, reliance on the final Phase II Rule is inappropriate.

Response to H5: See responses to H1, H4 and H6.

In addition, with respect to Mirant's comment, it seems obvious to EPA that delaying the permit until the Phase II Rule requirements can be fully implemented *would* delay reissuance of the permit given that Mirant has yet to develop and submit all the information that would be required under the new Rule. With respect to CLF's comment, EPA disagrees that the Phase II Rule should not be relied upon *in appropriate ways* because of the litigation concerning the Rule. To date, neither EPA nor the courts have stayed the Rule pending resolution of the litigation and no part of the Rule, or the record supporting it, has been withdrawn by the Agency or remanded by the courts. As explained in other responses above, EPA has undertaken a BPJ application of CWA § 316(b) for this permit, consistent with 40 C.F.R. § 125.95(a)(2)(ii), and has supported this BPJ determination with a reasonable consideration of the requirements in the Phase II Rule and information from the rulemaking record.

Comment H6: Mirant asserts it has much of the information required under the final Phase II Rule but concedes that its submissions to date do not fully satisfy the requirements of the Rule. Mirant goes on, however, to state that it could develop the remaining information according to a reasonable schedule. Mirant identifies what it regards to be potentially reasonable time-frames for developing the necessary information – i.e., 3-6 mos. for submitting the Proposal for Information Collection (PIC); 8-18 mos. for conducting information collection (IC); 4-6 mos. for submission of the Comprehensive Demonstration Study (CDS) – but at the same time makes clear that it would want to further discuss scheduling issues with the regulatory agencies before any schedule would be set and that it believes that no schedule should commence until the effective date of the Final Permit.

Response to H6: See responses to H1, H4 and H5.

Mirant appears to suggest that EPA issue a new permit that addresses CWA § 316(b) by imposing nothing more than a schedule for information collection and submission under the Phase II Rule.[8] This suggestion is untenable, however, because EPA cannot issue a new NPDES permit to a

[8] This suggestion is evident from Mirant's view that the schedule would commence upon the effective date of the new, final permit.

facility with regulated CWISs without establishing permit limits for those CWISs under CWA § 316(b) and applicable water quality requirements in light of the information in the permit record. As 40 C.F.R. § 122.95(a)(2) indicates, for facilities such as MKS, the permitting agency should determine the BTA under § 316(b) on a BPJ basis *and* include a schedule for submitting the information required by the Phase II Rule to support the next permit reissuance. EPA cannot issue a permit that does nothing more than set a schedule for the future information submissions.[9] In this case, EPA's BPJ application of the BTA standard to the record at hand has concluded that certain CWIS-related permit conditions are necessary to satisfy CWA § 316(b) and applicable state water quality requirements.

To the extent that Mirant is not suggesting that EPA fail to make a BTA finding, but rather is suggesting that EPA find the *status quo* to represent the BTA at MKS,[10] this suggestion is also untenable because it would be inconsistent with EPA's conclusions based on the record at hand. As discussed above, EPA has found that the steps beyond the *status quo* represent the BTA in this case. Moreover, apart from EPA's conclusions regarding technology-based limits under § 316(b), Massachusetts water quality requirements also necessitate CWIS limits beyond the *status quo*.

Even if EPA could issue a permit that did nothing more than set a schedule for future CWIS-related information submissions, such as Mirant suggests, the Agency notes that Mirant's suggestion is unattractive because it would likely lead to substantial delays in achieving any real progress in addressing the impacts of the plant's intake. First, it is not clear to EPA how seriously the Agency should be taking Mirant's projected time frames for its information collection, since this comment itself includes the perplexing caveat that "[t]his is by no means a suggested schedule" and emphasizes that, at a minimum, Mirant would want to further discuss any schedule with the agencies. Thus, under Mirant's suggestion, additional time would be needed to discuss (or negotiate) any such schedule and then Mirant might decide to challenge the schedule in a permit appeal. Second, making the effective date of any permit the event that triggers

---

[9] In this regard, EPA notes that while the Agency's goal is to reissue permits every five years, it is unable to meet this goal for many permits, especially complex ones. For example, MKS's permit was last issued in 1988. Moreover, new permits can get tied up in litigation for years at a time. Therefore, there is a risk that a permit that included nothing but a schedule for information submissions to support setting limits for the next permit could end up remaining in effect for significantly longer than 5 years.

[10] EPA could reach such a conclusion if, for example, the record demonstrated that the *status quo* represented the BTA or at least failed to support the conclusion that any set of conditions other than the *status quo* constituted the BTA. In such a case, a permit finding the *status quo* to represent the BTA and including a schedule for the required information submissions would satisfy 40 C.F.R. § 125.95(a)(2)(ii). That, however, is not this case.

commencement of this non-schedule would effectively delay the schedule by the amount of time it would take to complete any litigation surrounding the other elements of the permit beyond the 316(b) requirements. EPA must consider that, despite our best efforts, there may be issues, especially related to thermal discharges, that Mirant and/or other parties may choose to challenge in a permit appeal even if we were able to defer final action on a BTA requirement under section 316(b). Finally, EPA's experience with Mirant and our cooperating agencies to date in collecting and assessing the technical and biological information necessary to formulate the permit conditions required under section 316(a) suggests to EPA that the Agency should not plan on the somewhat similar process of information collection and assessment under 316(b) being as rapid or easy to predict as Mirant's comment suggests. In making this observation, EPA in no way means to impugn the good will of any party commenting on this permit or any consulting agency. Nevertheless, EPA's experience with the process of collecting and reviewing the extensive data necessary to support complicated technical and policy judgments about sensitive biological resources of great public interest, such as the Charles River Basin, makes it clear to us that the full review process under 316(b) will likely take longer than Mirant's optimistic suggested time frame.

Comment H7: Mirant comments that even though it proposed the barrier net technology, and such technology is expected to achieve compliance with the final Phase II Rule performance standards, it is entitled to an opportunity to evaluate other options under the final Phase II Rule. Mirant further asserts that re-evaluation of the walkway configuration, and issues concerning the screen face alignment, require additional time. Mirant also argues that:

> [a]s the data indicate, and as EPA acknowledges, the barrier net is highly effective at preventing impingement mortality, virtually eliminating impingement of organisms that otherwise could have been impinged on the traveling screens. It also reduced entrainment of organisms over approximately 6 mm for the representative species assessed. Over the three-month testing period, when the barrier net was being properly operated, it reduced entrainment of entrainable-sized organisms by 60-90%. The percentages of organisms not protected by the barrier net are largely reflective of the earliest life stages, as to which natural mortality is highest, and which the barrier net is not designed to protect. Although there were some days on which performance anomalies occurred, this happened primarily (1) during initial deployment of the net, when entrainable organisms remained "inside" the net, and (2) thereafter, on occasions when the anchoring system failed and the net shifted position, allowing intake water to come over, under, or around the net. Mirant Kendall understands that its final design, which does

not incorporate the same type of anchoring system used during the test period, will need to address this type of issue.

Response to H7: In many respects, EPA agrees with the underlying factual premises Mirant presents in this comment, but the Agency reaches a different conclusion about the appropriate course to take in the permit. As Mirant's comment indicates, EPA agrees that the barrier net is a promising technology which, when properly operated, should substantially ameliorate the I&E impacts of the Kendall Station's cooling water intake. It is EPA's BPJ that a barrier net is well suited to serve as BTA for the intakes at this particular facility on this particular type of waterway. EPA also agrees with Mirant that there are some refinements in the design and placement of the net that need to be worked out, both for the purposes of addressing any new security concerns the facility may have and to maximize the net's ability to meet the environmental goals of the permit. For example, in light of this, in the Final Permit EPA has clarified that the placement of the Barrier Net System (BNS) shall be in front of each of the three cooling water intake structures within the Broad Canal, at the entrance of the Broad Canal, or outside the Broad Canal. See Part I.A.11.a(1) of the Final Permit. It should be noted that, as required in the State's WQC, EPA and MassDEP have included in the permit a process to review the location, design, and operation of the BNS. See Part I.A.14.d.11. This process will provide an opportunity to derive the final details of the BNS. Furthermore, EPA has put impingement mortality reduction "goals" in the permit, rather than compliance standards, in light of the fact that the maximum performance capabilities of the barrier nets will be better able to be assessed after their implementation and operation is optimized based on experience at the facility.

That being said, EPA believes that Mirant's assessment of the likely capabilities of this technology supports EPA's permit limits. EPA does not agree with Mirant, however, that there is so much uncertainty about the value of the barrier net as BTA that the decision to require its installation should be postponed for what may prove to be many years. EPA also does not agree that the new Phase II Rule creates some sort of "entitlement" for a several years long delay in implementing BTA at this facility in this case. As discussed extensively in response to comment H1, above, the Phase II Rule specifically provides for the Agency to proceed with a BPJ determination where appropriate. The Agency has been studying the potential for a barrier net to address the impacts of this intake for several years, and it is EPA's best professional judgment that this permit should initiate that process for installing this technology. It is also worth noting that the CWA limits the term of an NPDES permit to five years, then requiring its reissuance. This contemplates that permit terms may require adjustment or alteration based on new information. Moreover, the Phase II Rule itself contemplates that technologies may be implemented with some remaining uncertainty regarding their performance and that future adjustments or changes may be needed to address any deficiencies. See 40 C.F.R. § 125.95(b)(4)(ii)(C) and (D) (Phase II Rule's CWIS technology efficacy assessment and adaptive management requirements). Thus, the possibility that alterations or changes to the permit

requirements may be necessary in the future after facility performance is assessed does not render the proposed permit conditions inappropriate or require, on the basis of this record, that permit issuance be delayed for still additional study.

Comment H8: Mirant comments that by imposing requirements for the reduction of impingement mortality and entrainment the Draft Permit is more restrictive than authorized under the final Phase II Rule, which would define the Charles River Basin as a "lake or reservoir" subject only to standards for the reduction of impingement mortality. Further, there are practical reasons why Mirant has limited flexibility to revisit in any meaningful way the requirements imposed in a BPJ-based permit (e.g., investment commitment, restrictions on backsliding, the burden of changing of "in place" technology). Therefore, Mirant argues that it is inappropriate to impose BPJ requirements beyond those that the Phase II Rule would impose.

To the contrary, CLF comments that even if the final Phase II Rule requirements are applicable, the impacts of MKS upon the already degraded lower basin warrant impingement mortality and entrainment reduction standards of 95 percent and 90 percent, respectively, and that an appropriate BPJ analysis supports stricter standards as well.

Response to H8: See response to H1. In addition, EPA responds to the comments with the following discussion.

As discussed above, the Phase II Rule at 40 C.F.R. § 125.95(a)(2)(ii) directs that a permittee situated like MKS should be issued a permit on a BPJ basis with a schedule for compliance with the information submission requirements of the Rule to support the next permit reissuance. BPJ permits represent a case-specific application of the CWA's technology standards which is not generally limited or controlled by future rulemakings; BPJ determinations may lawfully end up imposing more stringent limits based on a site-specific application of the CWA's general technology standards than the Agency might later develop in an industry-wide guideline. See NRDC v. EPA, 859 F.2d 156 (D.C. Cir. 1988) ("... in establishing BPJ limits, EPA considers the same statutory factors used to establish national effluent guidelines . . . [and] BPJ limits thus represent the level of technology control mandated by the CWA for the particular point source."). In this case, the Phase II Rule has been promulgated and is now effective, but the Rule itself directs EPA to issue this permit with a BTA finding on BPJ basis. Thus, the BPJ determination is not strictly governed by the Phase II Rule.

That being said, EPA believes it is entirely reasonable for the Agency to have considered the *already signed* Phase II Rule in making BPJ-based BTA findings for the Draft Permit, and now to be considering the *effective* Phase II Rule in making BPJ-based BTA findings for the Final Permit. See NRDC v. EPA, 863 F.2d 1420, 1426-28 (9th Cir. 1988). EPA notes that its final BPJ determination agrees with Mirant's proposed classification of the Charles River Basin as a "lake"

solely for the purposes of applying the Phase II Rule. Therefore, EPA is not including any entrainment performance goals *as part of our BPJ determination of technology-based standards under CWA § 316(b)*. This is because the Phase II Rule would not require such a facility to meet entrainment performance goals as an technology-based requirement. Given that the Rule is now in effect, EPA does not believe it would reasonable in this case to impose technology-based compliance requirements that the Rule would not require.[11]

The permit, however, must also assure attainment of applicable state WQS and, according to CWA § 401(d), must include conditions required by a state water quality certification under CWA § 401. In this case, MassDEP has included performance requirements for the CWIS in its 401 certification that go beyond EPA's determination of technology-based requirements under the BTA standard of CWA § 316(b), including measures to address entrainment. These water quality based requirements do not derive from EPA's BPJ determination and are not derived from the technology requirement of § 316(b). Notably, these water quality based requirements would apply whether or not the BTA requirements for the intake were derived from a BPJ determination or a direct application of the Phase II Rule. Nothing in the final Phase II Rule alters such state certification requirements where EPA issues a NPDES permit. Section 125.94(e) provides authority for a Director to impose more stringent requirements when compliance with applicable requirements would not meet applicable state and tribal, or other federal law. Therefore, it is not accurate to claim that this permit is "more strict" than would be required under the Phase II Rule. This permit is enforcing all the Act's requirements, both a BTA technology standard and limits to protect water quality, consistent with the Phase II Rule.

EPA understands Mirant's hypothetical concern that proceeding with the Agency's BPJ based determination of BTA might somehow limit the compliance options Mirant could explore by undertaking the review process in the Phase II Rule. But the Phase II Rule specifically provides for EPA to proceed with permits situated like this one, without waiting for a full analysis under the rule. In deciding whether to proceed, the Agency must balance the utility that further analysis under the Phase II Rule might yield against the need for a prompt amelioration of environmental impacts from the intake and other aspects of facility operations, such as the thermal discharge, that would be addressed by a new permit. It is EPA's technical and policy judgment, in light of the considerable time the parties have devoted to analyzing this issue to date, that the balance here

[11] The Phase II Rule *does* impose impingement mortality reduction requirements for facilities such as MKS. Therefore, EPA's determination of technology-based requirements for the permit does include various provisions that EPA concludes on a BPJ basis will represent the BTA for reducing impingement mortality. In so doing, EPA is not directly applying the Phase II Rule requirements and requiring compliance with them in this permit; rather, EPA is setting limits on a BPJ basis recognizing the requirements that will later be applied under the Phase II Rule.

tips in favor of proceeding with permit issuance based on our BPJ-based BTA determination, among other things. This conclusion to proceed with our determination of the best technology is further bolstered by the fact that several of the most important permit conditions governing the intake derive from water quality based requirements that would not change as a result of Mirant first completing the full review process under the Phase II Rule.

With respect to CLF's comment, EPA disagrees with CLF on how to structure the performance provisions in our BTA determination for the intake. The Agency has concluded that as a technical matter, the performance standards articulated in the draft permit for impingement and entrainment should be treated as performance goals. While the Agency is reasonably confident that a barrier net is the best technology to require for this intake – in light of information pertaining to use of the technology at MKS specifically, as well as information from the national rulemaking record indicating in general that barrier nets can be effective for facilities located on water bodies like the Charles River Basin – EPA also believes it will require further study of the performance of the system at MKS before we are prepared to impose an enforceable performance standard in the permit. The Agency will require that MKS measure the performance of the barrier nets to determine the levels of impingement mortality the system can reliably achieve and expects that these data will provide a solid basis for imposing specific performance standards pursuant to the Phase II Rule at the next renewal. Therefore, for the purposes of this permit, the issue of the exact percentage that EPA chooses to apply to MKS from the performance range suggested by the Phase II Rule is not relevant.

Comment H9: Mirant is concerned that after it complies with the draft BPJ-based permit it may be required to develop additional information and/or comply with additional requirements to meet the final Phase II Rule requirements and believes this is wasteful, inefficient, unfair and unnecessary.

Response to H9: See Responses H1 and H8.

EPA believes that Mirant's comment identifies no flaw or problem with the new permit for MKS. The Phase II Rule clearly contemplates that under some circumstances, such as those applicable to MKS, facilities would receive BPJ permits, would then have to develop additional information under the Phase II Rule, and then might receive additional permit requirements. Once again, this is evident in the terms of 40 C.F.R. § 125.95(a)(2)(ii). The CWA is a technology-forcing statute with a goal of continued progress toward restoring and maintaining the biological, chemical and physical integrity of the Nation's waters. The statute also requires that permit terms be limited to five years and that new technology standards be applied to permit renewals, unless specifically exempted in some way. Moreover, the Act also allows the possibility that a BPJ permit could be more stringent than a later-issued permit under a subsequently applicable regulation. Thus, there is nothing unusual or improper about the fact that Mirant will have to develop new information

under the Phase II Rule for its next permit and that later permit requirements could be somewhat different than the requirements in the current permit. Nevertheless, given the material in the record here, and the nature of the requirements included in the permit, we believe the chance of the facility undertaking wasteful expenditures now has been reasonably minimized. First, there are significant impingement and entrainment issues that are being addressed by this permit. Second, there is substantial information in the record, including information submitted by Mirant, that suggests that the barrier net technology should have significant beneficial effect at MKS. Third, on a technology basis, the permit imposes only an impingement mortality reduction goal, which aligns the permit's technology-based requirements with the requirements that would apply under the Phase II Rule given that the Rule would not require entrainment reductions of MKS and that there is still some actual uncertainty regarding the exact performance that the barrier nets will achieve at MKS.

Finally, regardless of what the CWA § 316(b) requires now, or may require in the future, on a technology basis for MKS, the permit's CWIS requirements (including those directed at reducing entrainment) are required by state WQS. Therefore, EPA could not decline to include these permit requirements at this time even if it wanted to. The permit's CWIS limits are simply not unfair, inefficient, wasteful or unnecessary. Indeed, it is worth noting that MKS is still operating under a permit issued in 1988 and that expired in 1993. The company cannot reasonably complain that regulators have not waited long enough to develop this new permit.

Comment H10: Mirant disagrees with the following aspects of EPA's interpretation of its authority under 316(b):

- In the absence of the final Phase II Rule, EPA is not authorized to look to the best performing plant in the industry to establish BTA because, given the goal of 316(b), it is not possible to identify the best performance for a particular facility;

- EPA lacks the authority to restrict the flow or operation of a facility since neither restriction involves CWIS technology;

- Applying new plant technology to existing plants ignores the limitations such plants encounter in adopting new technology;

- EPA incorrectly presumes any impact is adverse and only asks whether costs are wholly disproportionate to benefits. Some impacts benefit other organisms, some species have high natural mortality (e.g., advection), compensatory effects protect populations, and one relevant judicial decision looked at population level impact alone.

– Mirant agrees that 316(b) compels consideration of costs (and benefits), but asserts the "significantly greater" cost test is applicable here, not the wholly disproportionate test.

– EPA lacks authority to define capacity as the volume of cooling water withdrawn over time (i.e., a rate) , instead of as the volume the CWIS can hold at one time.

Comment related to H10 from CLF: The Costs of Requiring a Technology Superior to Once Through Cooling are not Wholly Disproportionate to the Environmental Benefits: In light of the significant environmental improvement that would result, the public uses protected, and the public and private investments that have been directed toward the protection of the Charles River over the last decade, $14 million is a relatively small price to pay. Only where the costs of the technology are wholly disproportionate to environmental benefit can cost even be considered. In this instance, there is no question that the costs of even the most expensive technology (closed-cycle cooling) are insignificant compared to its environmental benefits.

Response to H10 and related comment: EPA addresses the several elements of these comments in turn:

Best performing plant: MKS's permit requirements are not based on the best performing plant in the industry; rather they are based on a BPJ application of the BTA standard to MKS specifically. As discussed above, that BPJ determination was informed by a variety of factors, including an appropriate consideration of the Phase II Rule. Nevertheless, EPA is well within its authority in applying CWA §§ 316(b) to look to CWA §§ 301 and 306 for guidance in discerning the factors Congress intended the EPA to consider in determining BTA. See, 69 Fed. Reg. 41,582/3 - 41,583/2, and *Riverkeeper v. EPA*, 358 F.3d 174 (2nd Cir. 2004). In setting BAT standards under CWA § 301, EPA looks to the "best performing plant" in the industry for a benchmark for setting national effluent guidelines. Thus, it is also appropriate to consider that factor in setting BTA limits under § 316(b). At the same time, however, in setting BPJ limits for a particular existing facility it is also necessary to consider individual plant circumstances that might affect whether a particular technology is practicable (or available), or will achieve a level of performance that minimizes adverse environmental impacts, for that facility. EPA's discussion in the preamble to the Phase II Rule simply noted this point. See 69 Fed. Reg. at 41,600. This preamble discussion did not state, as Mirant implies, that the Agency was ruling out any consideration of the best performing plants. Indeed, EPA did consider the best performing plants in promulgating the Phase II Regulations. See 69 Fed. Reg. 41601, 41606 (Rule considered closed-cycle cooling but did not require it as BTA on a national basis because implementation problems may exist in some instances and other, less costly technologies can achieve comparable performance).

In any event, at present, EPA has not imposed CWIS limits in the MKS permit based on the best performing plants in the industry. First, intake flow reductions based on closed-cycle cooling have been ruled out at MKS on impracticability grounds, based on EPA's current understanding of facility space constraints. Second, numeric performance compliance standards have not yet been set for MKS because it is not yet clear exactly what actual performance levels will be achieved by the barrier nets. For impingement mortality reduction, the permit requires the installation of barrier net technology and limits intake flow velocity. This is exactly the technology that Mirant proposed. While it appears that this technology will be able to meet the performance standards in the Phase II Rule, and thus achieve performance on par with the best performers in the industry, no numeric performance requirement has yet been set in the Final Permit. Instead, the permit requires the barrier nets to minimize impingement mortality to the extent practicable, with the ultimate performance goal being to reduce annual impingement mortality for adult and juvenile fish by at least 80% from a calculated baseline. This approach recognizes that adjustments may be needed over time to optimize performance based on experience. In addition, the impingement mortality reduction provisions of the permit could not be relaxed without running afoul of state WQS. Finally, with respect to entrainment reduction, the permit's requirements are based on state water quality requirements. Thus, Mirant's comment is essentially irrelevant to the current permit.

Flow curtailment: With regard to the assertion that EPA lacks the authority to restrict the flow or operation of a facility, EPA disagrees. EPA's longstanding interpretation of CWA § 316(b) has been that authority to ensure that CWIS capacity and design reflect the BTA encompasses the authority to regulate the intake flow. See 66 Fed. Reg. 65256, 65273 (December 18, 2001) (preamble to Final Phase I Rule); *Decision of the General Counsel No. 41 (In re Brunswick Steam Electric Plant)*, at 197, 20001 (June 1, 1976). See also 69 Fed. Reg. 41,630 - 31 ("EPA is authorized to set performance standards for intake flow based on closed-cycle cooling technology, as it did in the Phase I rule, which was upheld in *Riverkeeper v. EPA* [358 F.3d 174 (2nd Cir. 2004)]").

New source performance standards as a transfer technology: Mirant's comment seems to assume that EPA was proposing blindly to impose technology suited for a new facility to an existing facility without examining any of the issues presented by retrofitting that technology to the existing plant. This argument is a strawman that targets a position EPA never took. EPA readily acknowledges that there may be limitations encountered by existing facilities in some cases. In this particular case, however, MKS has not demonstrated that the proposed technology cannot be implemented because of MKS's status as an existing facility. Indeed, MKS itself proposed the use of a barrier net, which can be used in the existing configuration and does not require the acquisition of new land or significant construction, and only minimally affects the surrounding area. Thus, the permit requirements based on this technology obviously and reasonably accommodate MKS's status as an existing facility. Furthermore, EPA also accounted

for the most important argument Mirant made concerning the limitations presented by the existing configuration of the Kendall Station. EPA agreed that the significant space limitations and the crowded urban fabric around the plant ruled out a requirement for closed-loop technology.

Adverse environmental impact: EPA sees no reason for revisiting the approach to assessing "adverse environmental impacts" which we articulated in the Determination Document. This precise issue was not squarely before the EAB in the Dominion Energy appeal, because there appeared to be no dispute that was adequately preserved on the record over whether the environmental impact of the intake was substantial. Nevertheless, the EAB generally upheld the Region's approach to interpreting the Seabrook case in the context of a section 316(b) BPJ determination. See Dominion Energy at 228-230. Furthermore, in the litigation over the Phase I CWA § 316(b) Rule, the Second Circuit upheld EPA's focus on entrainment and impingement as *per se* adverse environmental impacts to be minimized without requiring the sort of evaluations that Mirant appears to suggest. The court explained as follows:

> [w]e think that the EPA's focus on the number of organisms killed or injured by cooling water intake structures is eminently reasonable. *See* Final Rule, 66 Fed. Reg. at 65,262-63, 65,292. As discussed above with respect to restoration measures, Congress rejected a regulatory approach that relies on water quality standards, which is essentially what UWAG urges here in focusing on fish populations and consequential environmental harm.

Riverkeeper, 358 F.3d at 196. In any event, while Mirant is free to speculate about the possibility that there may exist a level of adverse environmental impact so low, or "de minimis," that it would merit no further response or analysis under section 316(b), this case does not present such a de minimis scenario.

EPA will respond more extensively below to Mirant's technical arguments that the impact of Kendall Station's intakes is not adverse, or only minimally adverse. Here, it suffices to note that Mirant's argument that the impacts of its intakes may actually be beneficial appears hypothetical in nature and not supported by any substantial evidence. As a general response, EPA cautions that this type of active management of an aquatic system through removal or reduction of a species should only be attempted after rigorous study of the many interactions among co-existing species. There is no evidence on the record that the plant's intake entrains less beneficial species to the advantage of more beneficial species. And there is very little reliable evidence on the record that there are compensatory effects at the overall population level that offset the "cropping of organisms" through the intake. One can speculate equally that the loss of organisms to the intake, as well as to high temperatures in the Zone of Dilution resulting from MKS's thermal discharge, threatens to use up or eliminate any compensatory reserve that resident species

maintain to deal with natural fluctuations in populations or environmental conditions. See 69 Fed. Reg. 41589. Indeed Mirant's remaining argument about the minimal impact of its intake cuts against any speculation that "compensatory effects at the population level" make the intake's impacts unimportant. Mirant notes that advection to Boston Harbor of species in their early life stages causes high mortality rates and argues that any impact from the intake will have little effect on the already high mortality rates that exist in the Basin. This issue is discussed in Responses C23 and C25. If anything, this observation inclines EPA to be especially diligent in addressing the impacts of the plant's intake, given the already stressed state of the populations in this ecosystem. A smaller impact from an intake on a stressed population may be more important to address under section 316(b) than a larger absolute impact on an otherwise robust population.

Economic considerations: Mirant argues that EPA should not be using the "wholly disproportionate test" for weighing the costs and benefits of a technology, but should instead be applying the "significantly greater"cost-benefit test included in the new Phase II regulations. The EAB in the Dominion Energy case squarely addressed the Region's use of the "wholly disproportionate" test in making a BPJ-based BTA determination under section 316(b), and the EAB clearly upheld the continuing validity of this approach. Dominion Energy at 230-232. Here, EPA has considered whether permit requirements are economically practicable, and whether costs would be wholly disproportionate to benefits. The permit requirements, elements of which were proposed by the permittee and do not constitute the most expensive alternative considered, meet both tests. That being said, EPA also concludes that given the importance of the public environmental resources at stake here, and the relatively modest costs involved in complying with the permit's CWIS technology-based limits, the cost of such compliance is not significantly greater than the benefits it will provide. Finally, Mirant's argument here is essentially moot because EPA cannot make the intake limits less stringent due to state water quality requirements, which are not limited by any comparison of costs and benefits.

Capacity: Finally, regarding defining capacity, the Phase I section 316(b) rule requires a reduction in flow commensurate with closed-cycle cooling, in part based on a dynamic definition of capacity, and such requirements were not disturbed in the Phase I litigation. See 65 FR 49,078/2-3 for proposed Phase I rule discussion of EPA authority to impose limits on the volume of flow of water withdrawn through a cooling water intake structure as a means of addressing capacity. The Phase II Rule similarly identifies reducing flow as an acceptable compliance alternative. Also see response to "flow" comment above.

Comment H11: Mirant asserts that EPA's assessment of impingement and entrainment is flawed because in this permit MKS's flow will not increase appreciably over historical levels, the relationship between power generation and cooling water use is not strictly linear (MKS must withdraw cooling water when not generating power to maintain its pumps and condensers), and EPA has focused on MKS's periods of peak operation when entrainment and impingement are

concentrated due to the seasonal presence of river herring.

Response to H11: EPA and MassDEP disagree with the permittee's depiction of their expected once through cooling water usage. Monitoring data collected for Kendall Station since the permit application was submitted support EPA and MassDEP's position that cooling water usage at the facility has increased over historical levels. In Section 5.3 of the DD, it is noted that "The observed historical monthly average water use from 1992 through 1998 was 50 MGD", based on Figure 3.3.1-1 of the DD. Data complied from Kendall Station's Discharge Monitoring Reports documented an average monthly water use of 65.3 MGD from January through December of 2005. This is an increase of water use of approximately 31% over historical levels. The average monthly water use for April through August of 2005, the warmer spring and summer months highlighted in Mirant's comment, was 68.4 MGD. Based on an inspection of Figure 3.3.1-3 of the DD, average monthly water use for the spring and summer months from 1992 through 1998 appeared to remain in the 50 MGD range, which is contrary to Mirant's position that historical water use increased at Kendall Station during the spring and summer months. The 50 MGD monthly average range in the spring and summer did not approach the appreciable increase in cooling water use of approximately 37% reported in the spring and summer of 2005.

It must be noted that in Kendall Station's permit application, the permittee requested a change in the water usage calculation from a monthly average of 70 MGD to a yearly average of 70 MGD. This request, which was granted by EPA and MassDEP, but accompanied by protective limits during spawning season, effectively allows the facility to increase their monthly average water use up to 80 MGD during some months (excluding the spawning months of April, May and June), as long as their overall 12 month average is 70 MGD or less. EPA and MassDEP maintain that if the permittee did not expect to use more cooling water, then their request for the revised water use calculation would not be necessary.

As indicated in the Phase II Rule, the withdrawal of a large volume of cooling water has the potential to affect a large numbers of aquatic organisms and increase environmental impacts associated with a CWIS (See 69 Fed. Reg. 41,586 – 41,590). In this permit, EPA has focused on the level of cooling water use reasonably expected, and documented to date, based on upgrades at the facility. Further, EPA has examined periods of peak operation during spawning periods because any increase in cooling water use beyond historical rates during these months is expected to further increase impingement rates and the total number of organisms entrained at the CWIS for a given year.

Finally, an analysis of impingement rates at Kendall Station from 1999 through 2005 revealed that impingement takes place during most months and is not concentrated in the spring and summer months, as Mirant stated in their comment. See Response H14 for a detailed review of impingement at Kendall Station. For example, in a ranking of average monthly impingement

from 1999 through 2005, the month of February ranked as the third highest.

Based on this analysis, likely impingement and entrainment effects characterized by EPA and MassDEP are fundamentally reasonable.

Also, see Responses B1, B2, B3, C1 and C3 for further information related to this comment.

Comment H12: Mirant asserts that EPA's concern regarding impacts to benthos lacks supporting data, that white suckers are not resident in the Broad Canal, and that from 1999 through November 2000 only eight benthic fish were impinged.

Response to H12: EPA and MassDEP maintain that the location and design of the CWIS (withdrawing water within three feet of the bottom of the canal) has the potential to impact benthic fish. Based on Kendall Station impingement data collected in 1999 and 2000, as well as impingement data from 2001 through 2005 (submitted in April 2006), resident benthic species were impinged in every year that impingement sampling was conducted. While as Mirant points out in its comment, no white suckers were collected during impingement sampling events, other benthic species collected included channel catfish, white catfish, brown bullhead and yellow bullhead catfish, carp, and goldfish. While no species appeared in large numbers in the impingement sampling record, this data set clearly documents the presence of benthic species in the Broad Canal (Mirant Kendall Application 2001; Mirant Kendall 2006). Kendall Station's CWIS withdraws water to a depth of 12 feet, which is approximately within three feet of the bottom of the Broad Canal. Considering the available information and the location and design of the CWIS, there is a reasonable opportunity for continued impingement of benthic species. This remains a legitimate point of concern to EPA and MassDEP. EPA and MassDEP would note, however, that the permit requirements do not focus solely or primarily on reducing impacts to benthic organisms. Rather, they focus on reducing total impingement mortality at the facility.

Comment H13: Mirant asserts that there is no evidence that approach velocities at MKS are attracting fish to the CWIS and suggests that the data indicate the fish in the canal are neither concentrated near the intake nor more abundant than fish outside the canal in nearby habitat.

Response to H13: In the Determination Document, EPA and MassDEP make the following statement: "Typically, the greater the approach velocity, the greater the potential for impingement. Some species of fish actually cue to water movement and will be attracted to fast moving water." (DD, Section 8.1.1b) Migratory fishes in particular possess a strong behavior that leads them 'up-stream' (rheotaxis). In the case of the MKS CWIS, where the flow of water into the Station is so large compared to the flow of the river, the fishes' natural behavior may lead them to water movement caused by the 80 MGD withdrawal of water into the CWIS, and short circuit the fishes' upstream migration. Thus, while there is no direct evidence that fish are

attracted to the Kendall Station CWIS as Mirant contends, an interruption in upstream migration likely due to increased water movement has been documented at the discharge from Kendall Station in an underwater video provided by the permittee. This indirect evidence in the lower Basin suggests that fish have been attracted to moving water. Therefore, it is possible that intakes with high approach velocities may artificially attract fish to the CWIS. In addition, high approach velocities reduce the ability of a fish to escape, once it is pulled into the structure. Once impinged, the pressure of the high flowing water holds the fish and other organisms in place against the screens, causing injury and possibly death." This was intended as a general statement regarding the nature of impingement at CWISs, not as a statement regarding the nature of impingement at this particular facility. The available gill net data, with the exception of the limited sampling effort in 1999 and 2000, was not collected in the Broad Canal. Because of this, it is not possible to state with confidence whether or not fish densities in the Canal are greater than in surrounding areas of the river.

It is debatable whether, in the absence of sufficient data collected with gillnets or other means, impingement mortality data is a reasonable indicator of the relative concentration of fish in the Broad Canal. In June of 2000, a large number of blueback herring (1428) were impinged at the Station's intake and this coincided with a time of low flow in the Charles River. Other low flow periods did not, however, coincide with impingement events of this magnitude.

The permittee also stated that EPA and MassDEP provided no citation to support the position that the approach velocities for the existing CWIS are "considered well within the likely approach velocity range to result in fish impingement." Kendall Station operates three intake structures in the Broad Canal, each with an approach intake velocity (estimated by the permittee) at between 0.57 to 0.76 feet per second (fps). This is considered well within the likely approach velocity range to result in fish impingement. This position is based on available fish swim speed data noted below that indicate approach intake velocities higher than 0.5 fps would likely not be protective of most fish. The Phase I and II Rule set an intake velocity performance standard of 0.5 fps. These studies are discussed in the 316(b) Phase II Rule as follows: "As EPA discussed in the proposed rule at 67 FR 17151 and Phase I final rule at 66 FR 65274, intake velocity is one of the key factors that can affect the impingement of fish and other aquatic biota, since in the immediate area of the intake it exerts a direct physical force against which fish and other organisms must act to avoid impingement and entrainment. As discussed in that notice, EPA compiled data from three swim speed studies (University of Washington study, Turnpenny, and EPRI) and these data indicated that a 0.5 fps velocity would protect at least 96 percent of the tested fish. As further discussed, EPA also identified federal documents (Boreman, DCN 1–5003–PR; Bell (1990); and National Marine Fisheries Service (NFS)(1997)), an early swim speed and endurance study performed by Sonnichsen et al. (1973), and fish screen velocity criteria that are consistent with this approach (FR 69 Page 41601)." As a result, EPA set an intake through-screen velocity performance standard in the Phase I and Phase II Rules such that a facility with an intake velocity

at or below 0.5 fps is considered to satisfy the impingement mortality reduction standard. 40 C.F.R. § 125.94(a)(1)(ii).

Thus, the current Mirant Kendall Station intake velocities of 0.57 to 0.76 fps are within the range of approach velocities expected to result in impingement. In its application, Mirant estimated that the approach velocity with the installation of barrier nets would be about 0.043 fps. However, the velocity that is discussed in the Phase II Rule is the through-screen velocity, which will be higher than the approach velocity as the water passes through the small openings in the screen's mesh.

As a State Certification requirement, Part 11 of the Final Permit restricts the effective through-screen intake velocity at all three CWIS to 0.5 fps or less when the barrier nets are in place, including a requirement to demonstrate what the actual through-screen intake velocity is under both conditions (i.e., with and without the barrier nets in place).

Comment H14: Mirant asserts that some inter-annual variability is to be expected since it is a function of several factors that affect the number of organisms near the CWIS, including high flow. Mirant also states that a large percentage of the impingement of adult river herring occurs during its annual spring spawning run. EPA's concern about assessing the impingement of juvenile river herring is misplaced, according to Mirant, since juvenile river herring have not been impinged in any significant numbers since 1999. (Mirant also states that if EPA meant to refer to *adult* river herring, its concern is not well-founded and likely results from an error in taxonomic identification during the early 1999 sampling that was later identified and corrected.)

Response to H14: EPA and MassDEP recognize that the seasonal abundance of fish and other creatures affects the quantity of organisms impinged. Impingement numbers may increase during certain times of the year for select species (or select life stages) as a result of seasonal peaks in abundance (e.g., due to movements or migrations) or seasonal stressors. For example, juvenile fish may be more susceptible to impingement than adults because they are generally present in greater numbers than adults and are weaker swimmers. Also, fish that are stressed upon the completion of spawning (spring), or are exposed to abnormally cool (winter) or abnormally warm (summer, industrial thermal discharge) water conditions are more susceptible to impingement. This variation warrants monthly sampling requirements for impingement characterization studies.

Factors that influence impingement can also vary between years (i.e., inter-annual variation) due to natural environmental variation (e.g., flow, temperature), fish population dynamics (e.g., recruitment), and facility operations (e.g., increased or decreased withdrawals). This fact is acknowledged by the permittee in the above comment. As EPA and MassDEP reviewed impingement mortality at Kendall Station, both adult and juveniles life stages impinged are of concern. Furthermore, the level of impingement documented at MKS in 1999 is of concern even

after the misidentification of the life stages of river herring was taken into consideration.

The first impingement data collection occurred in 1999. Mirant Kendall's impingement data for 1999 and 2000 show very high levels of variation between the two years. Impingement totals in 2000 were more than 5 times greater than those recorded for 1999. Furthermore, in 1999, river herring and white perch accounted for 53% of all impinged fish, whereas in 2000, 86% of all impinged fish were blueback herring. Although life stage data was not provided by the permittee, considering the time of year that these fish were impinged, EPA and MassDEP assumed that they were juveniles. Even if these fish were adult herring (as suggested by Mirant Kendall), it would not eliminate EPA and MassDEP's concern for impingement impacts on river herring. Furthermore, given the various reasons for inter-annual variability in impingement numbers noted above, the fact that impingement totals have decreased since 1999 does not mean that impingement of river herring is not a concern or that monitoring of such impingement is not appropriate.

In April 2006, the permittee provided impingement sampling data collected at Kendall Station from the years 2001 through 2005. During this time period, the highest number of fish impinged was in 2001 (970 fish) and the lowest number was in 2004 (129 fish), with the average number of fish per year being approximately 641. This variability is much less than the overall inter-annual variability documented in the 1999 – 2000 impingement data set initially submitted by the permittee. A seven year dataset of site-specific MKS impingement information allows a better record of the overall impingement profile at the facility compared with the two years submitted initially. During the 2001 to 2005 time period, impingement of river herring ranged from a high of 385 fish in 2002 (approximately 53% of all fish impinged that year) to a low of 6 fish in 2005 (approximately 1%). In all cases, the majority of river herring were made up of blueback herring. While alewife were impinged every year, the highest number of alewife impinged between 2001 and 2005 was 31 fish in 2002 (approximately 4 % of all fish that year). It is interesting to note that the number of river herring impinged in 2004 and 2005 was noticeably lower than in previous years (12 fish in 2004 and only 6 in 2005). Impingement of all fish was relatively lower in 2004 (129 fish), which may explain the 2004 river herring total, but total impingement in 2005 (519 fish) approached the average number seen from 2001 through 2005. Impingement data from 1999 through 2005 are presented in Table H14-1 and summarized in Figure H14-1.

During the same period of low river herring impingement, Mirant Kendall Station has withdrawn more water, based on an examination of monthly average water withdrawal, in 2004 and 2005, compared with historical operation. It is uncertain why river herring were generally absent from Station impingement in 2004 and 2005, despite higher water withdrawals. See Response C3 for more information about the distribution of river herring in the lower Basin.

Although the additional impingement data submitted in April 2006 does not reveal large spikes in impingement (especially related to river herring), the data set does document ongoing impingement at the Station. CWA § 316(b) requires that the design, location, capacity and

Table H14-1 Number of fish impinged at Kendall Station Circulating Water Intake Structure by month and year. 1999 through 2005. (Source: Mirant Kendall Station)

Year	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Yearly Totals	Monthly Average
1999				7	120	135	22	19	3	1	1	3	311	34.6
2000	4	12	15	19	529	1485	9	5	1	0	2	64	2145	234.9
2001	90	104	130	84	287	201	16	37	11	5	2	3	970	71.8
2002	15	26	9	33	137	367	31	28	15	9	17	47	734	76.0
2003	110	82	123	44	65	344	9	40	20	3	2	13	855	60.0
2004	0	12	9	24	49	12	5	6	9	2	1	0	129	12.0
2005	23	312	66	41	43	20	7	4	1	2	0	0	519	13.1
Total # of Fish	242	548	352	252	1230	2564	99	139	60	22	25	130	5663	
Average # of Fish	40.3	91.3	58.7	36.0	175.7	366.3	14.1	19.9	8.6	3.1	3.6	18.6	69.7	
Monthly Rank	5	3	4	6	2	1	9	7	10	12	11	8		

Total Number of Fish = 5663 fish Monthly Average = 69.7 fish Yearly Average = 809.0 fish

construction of the facility's CWIS reflect the BTA for minimizing adverse environmental impacts, including impingement mortality. In addition the permit's limits must satisfy applicable water quality standards. As explained in various responses above, the permit's requirements with respect to reducing impingement mortality and monitoring for impingement are needed to satisfy the technology requirements of CWA § 316(b) and state WQS, and are also authorized by CWA §§ 402(a)(2) and 308(a).

Comment H15: Mirant comments that it should be no surprise that many impinged fish are on the Kendall Station List of Priority Species given that the list is comprised of fish that are important to and abundant in the Charles River Basin. Relying on a population estimate in the range of 200,000 adult river herring, Mirant further asserts that EPA's concern regarding the total number of impinged organisms is misplaced, given that there is impingement of only 1 percent of the river herring population. Based on this analysis, Mirant maintains that such impacts would not have a meaningful effect on this population.

Response to H15: In this comment, Mirant uses an estimated river herring population value to project the percentage of the fish population impinged. At the outset, EPA does not consider the population estimate used by Mirant as reliable. EPA and MassDEP point out that Mirant's comment is inconsistent with its Comment I11, also included in this document. In Comment H15, Mirant relies on a specific river herring population estimate to support its point, whereas in Comment I11, Mirant asserts that it is not possible to develop a reliable fish population estimate. While EPA and MassDEP do not agree that it is not possible to develop a reliable fish population estimate (see Response I11), the permitting agencies have determined based on the information submitted by the permittee that reliable population estimates for river herring or other fishes in the lower Charles River have not been developed yet. Estimates vary widely, and the monitoring data provided by the permittee to EPA and MassDEP to date do not provide sufficient information upon which to base firm conclusions regarding the proportion of a given species' population that is being impacted by impingement at this facility.

In any event, the technology standard requirement of CWA § 316(b) requires that the design, location, construction and capacity of the cooling water intake structure reflect the BTA for minimizing adverse environmental impact, including impingement mortality. This requirement applies generally and is not limited to cases where some threshold is crossed regarding the percentage of a species population that is being affected by impingement. See *In re Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2),* 10 ERC 1257, 1261-62 (NPDES Permit Application No. NH 0020338, Case No. 76-7; June 17, 1977) (Decision of the Administrator); *Decision of the General Counsel No. 63*, pp. 381-83; *Decision of the General Counsel No. 41*, at 203. Furthermore, the adverse effects of impingement must also be considered in the context of the overall effects of the power plant, including its effect from its thermal discharge and entrainment. See *Public Service Company of New Hampshire*, 10 ERC at 1262. Finally, although this permit is being based on a BPJ application of § 316(b) rather than a strict application of the performance standards in the CWA § 316(b) Phase II Rule, it is worth noting that the Phase II Rule sets a performance standard requiring that impingement mortality be reduced by 80-95 percent without regard to whether any particular percentage of a species population has been harmed (i.e., there is no population percentage threshold).

EPA and MassDEP continue to be concerned with the impingement mortality rates at this facility. The CWA Section 316(b) Phase II Rule states that, "EPA continues to believe that any impingement or entrainment would be an adverse environmental impact, but has determined that 316(b) does not require minimization of adverse environmental impact beyond that which can be achieved at a cost that is economically practicable" (FR 69 Page 41627). Impingement mortality is an easily quantified measure of CWIS impact on source waters. As indicated in the Phase II Rule, "As in the Phase I rule, EPA is setting performance standards for minimizing adverse environmental impact based on a relatively easy to measure and certain metric—reduction of impingement mortality and entrainment. Although adverse environmental impact associated with

cooling water intake structures can extend beyond impingement and entrainment, EPA has chosen this approach because impingement and entrainment are primary, harmful environmental effects that can be reduced through the use of specific technologies. In addition, where other impacts at the population, community, and ecosystem levels exist, these will also be reduced by reducing impingement and mortality. Using impingement mortality and entrainment as a metric provides certainty about performance standards and streamlines, and thus speeds, the issuance of permits" (69 Fed. Reg. 41600). Reducing impingement mortality from the facility's cooling water intake structures will also improve the quality of the Lower Charles River basin as a habitat for fish and, thus, contribute to the water body attaining its designated use under state water quality standards. EPA and MassDEP believe that the barrier nets required in the permit, and proposed by Mirant, will significantly reduce impingement mortality and, in any event, the permit requires that impingement mortality be minimized to the extent practicable.

Comment H16: Mirant comments that given its through-plant temperature differential and the densities of larvae in the ichthyoplankton samples near the discharge, assuming 100 percent entrainment mortality is highly conservative and provides a wide margin of safety.

Response to H16: The basis for the assumption of 100% mortality of entrained organisms is found in the supporting documentation for the Phase II Rule (See 69 FR 41620). The presence of larvae in ichthyoplankton samples near the discharge is not convincing evidence of larval survival without addressing the condition of the collected larvae or providing evidence that these larvae had previously been entrained. Ichthyoplankton samples collected near the discharge could have captured some drifting larvae that did not pass through the Station's cooling water system at all, but rather, drifted downstream directly into the collection nets. The permittee did not submit a well-constructed, site-specific entrainment survival study. Absent such data, the survival of organisms entrained at this facility must be assumed to be zero.

Comment H17: Mirant asserts that EPA has no basis or authority for requesting additional site-specific ichthyoplankton data. The affects of advection have not been considered and must be considered to apply an entrainment standard under the final Phase II rule. EPA has not established a basis for an entrainment standard given the Basin is a freshwater lake under the Phase II rule.

Comment related to H17 from CRWA: The Charles River Watershed Association (CRWA) assert that authorizing Mirant to withdraw 80 MGD will kill millions of organisms and be contrary to making the river fishable by 2005. In addition, according to CRWA, under the draft permit thermal pollution would be five times greater than historic levels and have dramatic impacts on aquatic life.

Response to H17 and related comment: Based on data submitted by the permittee, Kendall

Station has entrained millions of fish eggs and larvae. EPA and MassDEP have received comments that likely future entrainment of ichthyoplankton is in conflict with the overall goal of protecting the Charles River fish community. As explained above, EPA cannot reasonably impose on a BPJ basis entrainment reduction requirements in the permit as technology-based requirements under CWA § 316(b), in light of the requirements set forth in the Phase II regulations for facilities located on water bodies like the lower Charles River Basin. See Response to H1. As also discussed above, however, the Commonwealth of Massachusetts' certification under CWA § 401 requires certain permit conditions geared to reducing entrainment in order to ensure that the permit limits are consistent with state WQS. There is a monitoring, sampling and modeling plan submission required under the State's Water Quality Certification (WQC). Mirant will be required to provide quantitative data on the magnitude and diversity of icthyoplankton in the Broad Canal and the effectiveness of the BNS or alternative entrainment reduction system in minimizing entrainment and maximizing the survivability of fish larvae and eggs. The protocol for conducting the sampling and analysis will be developed in the course of the plan review to generate data related to the WQC's performance standards and entrainment reduction system evaluation. To the extent feasible, the data collection and submission requirements under the WQC and the permit have been integrated and are compatible. These required conditions have been included in the permit and should result in reduced entrainment and foster conditions that will allow the Class B designated use of "fish habitat" to be attained in the river in the vicinity of the power plant.

In addition to the WQS as a basis for the ichthyoplankton monitoring, such monitoring is also included in the Final Permit to document that the river is not impacted by the thermal discharge to a degree that it affects the protection and propagation of the BIP. These effects include blocking fish passage, disrupting spawning and lethal effects on ichthyoplankton. See also Response to H1. Therefore, the ichthyoplankton monitoring required in this permit is warranted and within the authority of EPA and MassDEP under CWA §§ 308(a) and 402(a)(2).

EPA and MassDEP's consideration of advection of ichthyoplankton in assessing adverse environmental effects is discussed in Responses to H18, C23 and C25.

Comment H18: According to Mirant, all of the entrainment analyses fail to properly account for advection of eggs and early life stages of larvae from the basin to the harbor. Mirant states that the 2000 year-class experienced a major flushing event. Mirant argues that since organisms subject to advection are unlikely to remain in the basin and are less likely to survive, they are not properly part of the calculation baseline and the baseline must be further adjusted.

Response to H18: This comment assumes that mortality due to entrainment at MKS is the ecological equivalent of these same organisms traveling out of the lower Charles River and into the Boston Harbor. However, the permittee has not provided evidence that organisms subject to

removal from the lower Charles River to the Harbor experience similar (e.g., 100%) mortality to those entrained by the facility. Further, the action of natural processes that may move plankton out of the lower Charles River are not ecologically equivalent to entrainment of those same organisms by the MKS. Eggs and larvae flushed out of the Charles River are likely available as a food source for aquatic organisms present in Boston Harbor and some may survive to become juvenile or, ultimately, adult fish. Thus, they still are of value to the ecosystem. Once eggs and larvae are entrained by MKS, subjected to sheer stress from the intake pumps, heated up by 20˚ F, and discharged back to the river, not only are they killed but it is far from clear if they would be identified as a food source by aquatic organisms. When an ichthyoplankton entrainment baseline calculation is required, it would be appropriate to include in the entrainment baseline calculation any organisms that drift past the facility and could potentially be entrained.

Finally EPA maintains that it is not protective to diminish or discount entrainment mortality from Kendall Station based on the premise that greater ichthyoplankton mortality occurs from other sources, such as the advection. It is the permittee's responsibility to minimize impacts from entrainment even if there are other stressors on fish populations. Simply because eggs and larvae may be flushed out of the Basin without first being entrained is not a valid reason to lessen this responsibility. This issue of advection is discussed in Response C23 and C25.

In any event, the permit does not contain technology-based entrainment reduction requirements under CWA § 316(b) or the Phase II regulations. As a result, the calculation baseline requirements of the Phase II regulations do not apply here. The permit does, however, have entrainment reduction and monitoring requirements based on MassDEP's interpretation of the state WQS as specified in their Water Quality Certification.

Comment H19: Mirant asserts that, with regard to the entrainment assessment, EPA erred in adding the estimated number of eggs entrained for river herring and white perch to the estimated number of larvae entrained, and then comparing this total to number of larvae in the basin to assess entrainment effects. According to Mirant, since there is high natural mortality (exceeding 90 percent) between the egg and larval stage (compounded here by advection), it is inappropriate to include eggs in this analysis.

Response to H19: EPA and MassDEP agree that fish eggs should not be considered equivalent to fish larvae for the purpose of assessing impacts on populations. In making such an assessment, the rate of survival of the species in question between the egg and larval stage should be considered and the number of eggs adjusted accordingly. However, the entrainment assessment cited by Mirant in this comment and the data used by EPA and MassDEP were provided by Mirant and simply included in the DD's analysis (Table 8.1.2-1 in the Determination Document). The DD specifically states, "This table was presented in its entirety from the permit application (Table 5-4; Mirant Kendall, February 2001)." Thus, any data-use errors made in summarizing

these data were made by Mirant and simply cited by EPA and MassDEP without suggesting that the importance of eggs and larvae to protecting a population are equivalent.

Regardless of these distinctions, EPA and MassDEP have determined that the data presented in Table 8.1.2-1 of the Determination Document were presented appropriately. The data summary clearly distinguished the differing abundance of fish eggs and larvae in the entrainment samples. These values were combined to estimate the percent species composition for all entrained organisms in a given year. This use of the data is appropriate as it is simply a summary of entrainment and not an adult-equivalent analysis of impacts to a population in the source water body.

Comment H20: Mirant reasserts the comment in H19, and further asserts that EPA's analysis of entrainment effects as a percentage of equivalent adults is flawed because EPA provides no basis why entrainment effects of 3.41-12.88 percent (white perch) and 0.00 - 5.5 percent (rainbow smelt) are of concern given the life history and population status of these species.

Response to H20: Contrary to Mirant's statement, EPA and MassDEP did not perform an analysis of entrainment as a percentage of Equivalent Adults of white perch and rainbow smelt. Once again, the analysis regarding white perch and rainbow smelt was provided by Mirant. The DD states, "To further assess the environmental impacts of entrainment from Kendall Station, adult equivalent analysis was also submitted by the permittee as part of their permit application. Table 8.1.2-3 is based on the information submitted by Mirant Kendall. The entire adult equivalent analysis and protocol used can be found in Section 5 of the permit application (Mirant Kendall, February, 2001)." Any flaw in the data presentation identified by the permittee is from its own document.

The DD goes on to point out that a more refined estimate of adult fish populations in the lower Basin is necessary and that the white perch and rainbow smelt adult equivalent losses, as presented by the permittee, are of concern and these impacts should be addressed in the determination of BTA. Furthermore, entrainment losses are not only a direct concern, but are a concern in light of their interaction with other adverse effects on affected organisms, such as from impingement and habitat alteration from thermal discharges.

This approach to adverse effects is entirely consistent with CWA § 316(b) and the approach taken in the Phase II Rule. EPA has not set a limit or threshold to identify entrainment losses that are "of concern" and losses that do not merit concern, as the permittee implicitly demands in this comment. Neither the statute nor the Rule compels EPA to do this. Consistent with CWA § 316(b), EPA has identified killing aquatic life as a result of entrainment or impingement as adverse environmental impacts that must be minimized to the extent practicable consistent with the application of the Best Technology Available. This requirement is subject to the limitation

under the longstanding BPJ analytical framework that the costs of minimizing impacts not be wholly disproportionate to their benefits. The Phase II Rule sets a cost/benefit comparison standard indicating that steps need not be taken if their cost would be significantly greater than their benefits.

Regarding entrainment effects, the preamble to the Phase II Rule is clear that, "[w]ith the implementation of today's final rule, EPA intends to minimize the adverse environmental impacts of cooling water intake structures by minimizing the number of aquatic organisms lost as a result of water withdrawals associated with these structures [CWISs]…" (FR 69 Page 41586). Further, "EPA has selected reductions in impingement and entrainment as a quick, certain, and consistent metric for determining performance at Phase II existing facilities" (FR 69 Page 41586). Thus, the abundance of a given species in the source water relative to the proportion of that population entrained or impinged by the operation of the CWIS does not directly factor into determining the required performance standards for impingement mortality or entrainment reductions, except to the extent that the issue came up in considering the potential development of site-specific standards on cost/benefit grounds. See 40 CFR § 125.94.

In any event, the permit does not impose any technology-based entrainment reduction requirements. The entrainment reduction requirements are, instead, based on state water quality standards, which are not subject to the type of cost/benefit criteria discussed above. Instead, the state has based these water quality-based requirements on the need to reduce impacts in order to allow for the attainment of the Class B designated uses of the Charles River, including the provision of a quality fish habitat.

Comment H21: Mirant comments that EPA erred in comparing the river herring equivalent adult entrainment estimates from 1999 and 2000 with the adult river herring entrainment estimate for 2002. According to Mirant, this approach is flawed because (a) instream values of river herring vary widely from year to year, (b) it compares hydro-acoustic pilot sampling with the results of a back calculation based on larval densities, and (c) anadromous fish returning to the Basin via two (other) boat locks at the dam were not included in the estimate.

Response to H21: EPA and MassDEP did not intend for the discussion of river herring estimates (between 1999/2000 and 2002) to be construed as a comparison, but rather as a discussion of the divergent estimates that have been made for river herring populations. Issues associated with comparing the data between years, as pointed out by the permittee in the comment above, are explicitly noted and discussed in the DD. These data issues support the statement by EPA and MassDEP that, "although adult alewife have been collected in the lower basin, the population size of this anadromous species has not been determined with confidence." The DD explicitly points out that the 2002 estimate was based on a hydro-acoustic pilot study sampling protocol that requires revision and refinement. It was also noted that anadromous fish potentially entering the

river from two smaller boat locks at the dam were not included in the estimate. The DD also states that information from anadromous fish in-migration counting programs from nearby rivers reflect a wide degree of variability in the number of returning adult fish from year to year. In light of these limitations in the data, it is especially clear that the monitoring requirements included in the Final Permit designed to provide estimates of in-migrating river herring are necessary to establish a more reliable population estimate and characterize year-to-year variability.

Comment H22: Mirant Kendall comments that because of the position EPA proposes to take with respect to the diffuser, EPA declines to include in its BPJ analysis any consideration of the potential benefits to fish populations of that diffuser (DD at p. 214). Mirant Kendall reiterates here its arguments in favor of the diffuser and its objections to EPA's current rejection of the diffuser. See Section D of these comments. In particular, the diffuser would, according to Mirant, enhance the survival prospects for those eggs and larvae that sink below the upper water column (where advection takes place) but today die near the bottom in the absence of dissolved oxygen.

Response to H22: EPA and MassDEP have clearly documented the substantial concerns that remain to be addressed before the deep water diffuser can be approved. These are fully discussed primarily in Response to comments E1 through E4 and E7. As a result, it is entirely appropriate that EPA's development of permit limits has not been based on the assumption that the diffuser will be installed and will achieve the benefits suggested by Mirant Kendall.

In the DD, EPA and MassDEP acknowledged certain potential improvements to the aquatic habitat if the diffuser was installed and it performed in accordance with the assumptions made by the permittee.(Sections 2.5, 5.4.9, and 5.4.10). In this comment, however, the permittee specifically suggests a potential increase in survival of fish eggs and larvae if the diffuser reduced or eliminated a near-bottom layer of the lower Charles River Basin deficient in dissolved oxygen. Yet, while fish eggs and larvae occur in the lower Basin in the spring and early summer, water quality data does not identify this as a time period when a large layer of water in the lower Basin is devoid of dissolved oxygen (DO). For example, in mid-May of 2004, when river herring egg and larval density was at a peak at the Charles River Station, DO levels at this Station were greater than 5.0 mg/l from the surface to the bottom (approximately 15 feet). Even at the Deep Diffuser Station, the bottom depth of 36 feet recorded a DO of 5.4 mg/l (Mirant Kendall Exhibit C3, October 14, 2004: May 18, 2004 Field Data).

It may be the case that during some years of unusually low flows in the Charles River there may be sufficient pronounced early stratification or a remnant area of water that did not fully mix during the previous winter to result in a measurable layer of near bottom water devoid of DO. However, under most conditions, the loss of river herring eggs and larvae to deeper waters devoid

of DO is not considered an important source of ichthyoplankton mortality. Therefore, the specific example of a potential benefit of a diffuser to fish eggs and larvae that would offset the peril to these organisms from entrainment is not particularly persuasive.

Comment H23: *Evaluation of BTA Alternatives*
(a) **Introduction:** Mirant argues that after EPA concluded without any meaningful substantive analysis that current levels of impingement mortality and entrainment were of concern and incorrectly assumed that they were likely to increase, the Agency went on to evaluate alternative cooling water intake structure technologies for application at Kendall Station, but that Mirant's comments in H2 demonstrate that the final Phase II Rule makes this analysis unnecessary. Assuming for the sake of argument, however, that this was not the case, Mirant goes on to comment on EPA's assessment of alternatives.

(b) **Re-circulating Cooling System**: With respect to EPA's analysis of the potential applicability of either wet or dry re-circulating cooling to Kendall Station, Mirant agrees with EPA's conclusion that neither technology is technologically practicable due to site constraints (DD at pp. 217-222). Mirant also argues that EPA specifically concluded, as part of its Phase II rulemaking, that retrofitting re-circulating cooling should not be used as the basis for setting BTA performance standards. Mirant further submits that, based on the data in the record, such technologies are not economically justified for this site, because their costs are significantly greater than their benefits.

(c) **Generation Curtailment**: Mirant comments that although it does not plan to withdraw more than a monthly average of 70 MGD during April, May and June, and would find a 70 MGD monthly average discharge limit acceptable for this period, it wishes to note for the record that EPA has not identified any "cooling water intake structure technology" on which it bases this proposed permit limit. Determination Document at p. 222. Mirant argues that EPA's proposed flow limit targets not the intake structure, but the generating facility as a whole, and that EPA has identified no CWIS "technology" that will be used to meet it. Thus, according to Mirant, EPA lacks authority to impose this type of intake limit.

(d) **Location**: Mirant indicates its belief that neither the statute nor the Phase II Rule allow EPA to dictate the location of the MKS CWIS, as Mirant feels EPA's analysis of issues regarding CWIS location appears to assume (DD at p. 227). Rather, Mirant concludes that the Phase II Rule makes clear that EPA's charge is to set standards for minimizing adverse environmental impact and base those standards on the "best technology available" with respect to location and the other statutory factors. Permittees may then, according to Mirant, meet those standards in any way they choose.

Still, Mirant agrees with EPA's conclusion that the location of the Kendall Station CWIS in the

Broad Canal reflects BTA. Id. Mirant comments that EPA's own analysis shows that any attempt to move the CWIS to another location outside the Canal, such as the Boston Inner Harbor, would involve not only high costs, but construction effects and other adverse environmental effects that are likely to far outweigh any environmental benefits of such a change.

In response to the suggestion that the BNS could be installed across the entrance to the Broad Canal, so as to prevent aquatic organisms from entering the Canal in the first instance, Mirant indicates that it considered this option but rejected it for the following reasons. First, it would effectively preclude any public access to the Broad Canal. Second, it would make the Broad Canal unavailable for use by aquatic organisms, even those which are not, according to Mirant, particularly vulnerable to the CWIS. Those include apparently viable sub-populations of centrarchids (sunfish and largemouth bass) which reproduce in the Canal, and other species which feed there, such as carp, none of which are adversely affected by the CWIS. Third, it would expose any technology to greater risk of damage from passing vessels. Fourth, Mirant argues that the proponents of such a change provide no support for their key assumptions, which include the following points: (1) if the net is located in the Broad Canal, a substantial number of organisms will become impinged on the net; (2) of those organisms, many will remain long enough to be freed; (3) moving the net to the mouth of the Broad Canal would allow deployment of an "airburst" system for cleaning the net; and (4) using an airburst system at that location would result in the organisms' long term survival. Mirant submits that none of these assumptions is likely to prove true.

(e) **Economic Consideration:** Mirant argues that in evaluating alternatives, EPA incorrectly applied a "wholly disproportionate" test for assessing the relationship between compliance options and their costs (DD at p. 227-228). According to Mirant, EPA should have used the "significantly greater" test that was utilized in the final Phase II Rule, since that test reflects the Agency's latest interpretation of the statute, informed by a rulemaking, as well as over 30 years of precedent and experience. *See* 125.94(a)(5), 69 Fed. Reg. at 41,685. Mirant further states that although EPA does not appear to have given cost considerations much weight, or to have attempted to place an economic value on the environmental benefits likely to be attained, it remains important for EPA to apply the appropriate standard.

Response to H23:

(a) To begin with, EPA disagrees with Mirant's conclusory claims about the inadequacy of EPA's assessment of entrainment and impingement impacts. These issues are discussed in more detail in Response H1 and in other responses in Section H, but it is sufficient here to reiterate that entrainment and impingement of aquatic organisms are adverse environmental impacts and that CWA § 316(b) requires the location, design, construction and capacity of CWISs to reflect the Best Technology Available for minimizing these (and other relevant) adverse environmental impacts. EPA's Phase I and Phase II CWA § 316(b) regulations are consistent with this

understanding of adverse environmental impact under § 316(b), which was expressly upheld by the Second Circuit Court of Appeals in Riverkeeper, 358 F.3d at 196. See also 69 Fed. Reg. 41612 (stating in preamble to Final Phase II Rule that "EPA believes that it is reasonable to interpret adverse environmental impact as the loss of aquatic organisms due to impingement and entrainment"). Furthermore, it is entirely reasonable to assume that if Mirant increases its intake flows, as it is proposing to do, it will result in increased impingement and entrainment. Even if future intake flows remain approximately the same for some months, there are no reductions in flow proposed for any months that would offset the times when increased flow is expected. That said, EPA will turn to Mirant's more specific concerns.

(b) Recirculating Cooling System: EPA notes that Mirant agrees with EPA's conclusion that conversion of Kendall Station's cooling system to a recirculating system using cooling towers would be impracticable due to site constraints. As a result, Mirant's additional arguments related to recirculating cooling systems are moot and do not need to be addressed. Nevertheless, EPA offers the following responses to these points. Mirant incorrectly asserts that EPA specifically concluded in the Phase II rulemaking that retrofitting re-circulating cooling should or could not be used as the basis for setting BTA performance standards. EPA's rulemaking concluded that retrofitting closed-cycle cooling to existing power plants would not be required *on a national basis* as BTA for all plants. At the same time, however, EPA specifically recognized that closed-cycle cooling would be practicable and might constitute BTA at some plants and there is nothing in the Rule that expressly precludes the use of closed-cycle cooling to meet the Rule's performance standards for the reduction of impingement mortality and entrainment. Indeed, the Rule specifies that facilities that use recirculating systems are automatically deemed to satisfy the Rule and its performance standards because this technology is the clearest, most certain way to meet those standards. Of course, as discussed above, this permit is being developed on a BPJ basis and is not strictly based on the substantive provisions of the Phase II Rule. Therefore, these issues regarding the interpretation of the Phase II Rule's substantive requirements do not determine the appropriate limits for this permit. Finally, Mirant also argues that conversion to a recirculating system would be inappropriate for Kendall Station because the cost of such a conversion would be significantly greater than the value of the benefits it would provide. During development of the Draft Permit, EPA ruled out such a cooling system conversion on grounds of impracticability and, as a result, did not need to reach the question of weighing the costs of such a conversion against its benefits. There is similarly no need to reach that issue to support the Final Permit.

(c) Generation Curtailment: Since Mirant indicates that the permit's monthly average water withdrawal limit of 70 MGD during April, May and June is acceptable to it, EPA regards the rest of its comments on this topic to be essentially moot. That being said, we offer the following responses to the points raised by the company.

Mirant argues that EPA has improperly failed to identify a "cooling water intake structure technology" upon which it has based the proposed permit intake flow limit. Mirant argues that EPA's proposed flow limit targets not the intake structure, but the generating facility as a whole, and that EPA lacks authority to impose an intake limit on this basis. EPA disagrees with Mirant's characterization of the basis for EPA's permit limit and the company's apparent view of EPA's authority under CWA § 316(b). Under § 316(b), the "capacity" of a facility's CWIS is supposed to reflect the BTA for minimizing adverse environmental impact. The term "capacity" as used in this context has long been understood to encompass the volume of water withdrawn through or by the CWIS. See 66 Fed. Reg. 65256, 65273 (December 18, 2001) (preamble to Final Phase I Rule); *Decision of the General Counsel No. 41 (In re Brunswick Steam Electric Plant)*, at 197, 200-01 (June 1, 1976). EPA has also long held the view that it can impose operational restrictions on CWIS use to ensure that the standard of § 316(b) is satisfied. *See, e.g.,* 40 C.F.R. § 125.94(a)(2); 125.93 ("operational measures" is defined to include "reductions in cooling water intake flow . . . and seasonal flow reductions"). Furthermore, Kendall Station uses pumps and related technology to withdraw water from the Charles River through the facility's CWISs. See 40 C.F.R. § 125.93 (definition of "cooling water intake structure" pumps" includes the "intake pumps"). Thus, MKS can use its CWIS pumps to meet the permit's intake flow limits.

The permit sets a flow (or capacity) limit on withdrawals through the CWIS based on several factors to ensure that the CWIS capacity will reflect the BTA for minimizing adverse environmental impacts. While this limit was set on a BPJ basis for this permit, this is exactly the type of operational restriction that the Phase II Rule authorizes EPA to impose. Furthermore, the limit is appropriate because it will help prevent any increase in adverse impacts from entrainment and impingement, as compared to what would occur under higher intake flows. This is especially true because the three-month period when the flow limit applies coincides with the period of maximum egg and larvae entrainment. Moreover, the impacts will be reduced, but not eliminated, by the deployment of the barrier nets. (Impacts will not be eliminated by the nets because they will not block all aquatic life from being entrained (e.g., fish eggs and some larvae), and because drifting organisms blocked from entrainment will, instead, be impinged and the extent to which these impinged organisms may be injured or killed still needs to be assessed.) It is also clear that EPA *did* set this "operational measure" requirement taking into account the facility's current CWIS technology, including the facility's pumps, as well as the barrier net technology. See 40 C.F.R. § 125.93 (definition of "cooling water intake structure" pumps" includes the "total physical structure" including the "intake pumps"; and definition of "operational measure" includes intake flow restrictions). Finally, EPA took into account that meeting the proposed limits would be practicable, given existing technology and operations at Kendall Station.

(d) Location: Mirant argues that neither the statute nor the Phase II Rule allow EPA to dictate the location of that CWIS. EPA disagrees with Mirant's comment. CWA § 316(b) indicates that

the "location" of a CWIS must reflect the BTA for minimizing adverse environmental impacts. Thus, if necessary, the location of a CWIS *can* be specified in a permit if a particular location is necessary to reflect the BTA. See, e.g., 40 C.F.R. § 125.93 and 125.94(a)(2) and (3) (adequate "design and construction technologies" are one way to comply with the Phase II Rule's performance standards and "[d]esign and construction technologies include, but are not limited to, location of the intake structure . . .."). While it is true that a facility may meet the test of § 316(b) in any way it chooses, it does not have the option of failing to meet that test. Thus, EPA may specify a location for the intake if necessary to ensure that the BTA test is met.

For the Draft Permit, EPA concluded that the barrier net system should be located within the Broad Canal. While Mirant's comments indicate agreement with this conclusion, other commenters disagreed. Some commenters, such as CLF and CRWA, argued that a barrier net system inside the Broad Canal, where Mirant's intake is located, will not be effective for reducing impingement and entrainment of river herring and/or American shad eggs and larvae. In addition, some commenters stated that a barrier net system deployed within the canal would be ineffective unless a counter-current system was installed within the canal to move fish eggs and larvae past the front of the intake and back out to the river. These commenters point out that the canal is a dead-end projection of the Charles River and contend that, when the station is operating, the current location of the intake results in water flowing into the canal (and from there into and through the plant) and allows no egress to larvae and/or eggs. They also point out that these life stages are not able to move against the current and out of the entrance to the canal. According to this analysis, the uni-directional flow into the canal (and the facility) results in a constantly increasing egg and larval population within the canal, until it is reduced either by predation from the centrarchid community within the canal or by impingement or entrainment by Mirant. As a result, these commenters do not believe that a barrier net system would be successful if located within the Broad Canal.

Mirant argues that EPA's own analysis shows that any attempt to move the CWIS to another location outside the Canal, such as the Boston Inner Harbor, would involve not only high costs, but construction effects and other environmental effects that are likely to far outweigh any environmental benefits of such a change. This is discussed in Section 8.2.6 of the DD. EPA agrees that this would be the case for some, but not necessarily *all*, alternative locations.

The Draft Permit required the installation of a BNS, proposed and pilot tested by the permittee, and established a 60% entrainment reduction objective. These technology-based requirements were based on EPA's BPJ derived, in part, from the entrainment metrics set out under the BTA standard of the Phase II Rule (see Response to H10). At that time, limited and highly variable field information from 1999 and 2000 sampling and analysis was available for estimating the magnitude of the facility's entrainment of eggs and larvae and its potential impact on adult fish populations was indeterminate. Given EPA's CWIS technology alternatives analysis, the lack of

any existing impingement or entrainment controls, and the absence of data necessary to model the CWIS's impacts, MassDEP concluded that the installation of a BNS, a 60% entrainment reduction objective, and other conditions relating to the survival of impinged eggs and larvae would be adequate to protect the lower Basin's designated use.

For the Final Permit, EPA has determined that in light of the terms of the Phase II Rule, it will not impose a technology-based quantitative entrainment reduction standard. See Response to H1. The CWIS requirements of the Final Permit, however, must also assure compliance with Massachusetts WQS and include any conditions required by MassDEP in its WQC. The MassDEP has concluded in its WQS determination that the uncontrolled entrainment of river herring and perch larvae associated with the current design and operation of the CWIS is inconsistent with maintaining the designated use of the lower Charles River Basin as a healthful fish habitat. By killing the larvae, or substantially reducing their potential to mature into breeding adults, entrainment contributes to the other adverse and cumulative impacts to the lower Basin, affecting the viability of this habitat as a fish spawning area and nursery.

Since issuance of the Draft Permit, updated and reliable icthyoplankton entrainment and adult population data, or an approved model that would project the impact of the facility's cooling water activities on the life stages of river herring and perch, is still lacking. Furthermore, the Draft Permit's 60% entrainment reduction objective was based on EPA's application of the CWA § 316(b) Best Technology Available ("BTA") standard. In comparison, MassDEP has no state BTA technology standard that it applies to a CWIS. Instead, MassDEP evaluates the impact of the CWIS on the receiving waters as it relates to their designated use as a healthful fish habitat and determines whether the CWIS permit requirements will allow for the attainment of the designated uses. Taking into account the above referenced information gaps, and consistent with the requirements of the WQS, the WQC addresses the need to protect the lower Basin's designated use as a healthful fish habitat by requiring Mirant to design and operate the BNS, or alternative entrainment prevention system, in a way that minimizes larvae entrainment and maximizes their survival to the extent practicable.

As noted above, comments were received on the extent to which the permit should specify the details of how the entrainment prevention system should operate and where it should be located. MassDEP has determined that the best means to achieve both its impingement and entrainment reduction objectives is to use the plan review process to work with its federal and state agency partners and the permittee to determine the details of how the entrainment reduction system can be effectively and efficiently located, designed and operated. A barrier net study conducted by the permittee in 2000 for its permit application provided some data on how such a system would function and led to preliminary follow-up technical discussions between the permittee and state agencies that can be built upon. This process will allow the parties to consider issues such as the most recent biological and hydrologic data, technological innovations, and the physical

constraints of the Canal, while balancing public access, system effectiveness, facility security and integrating the impingement-related permit requirements. The plan approval process also facilitates revisions in light of operational experience and technological advances.

A specific concern was expressed by several commenters related to entrainment prevention systems with integrated mechanisms designed to free impinged eggs and larvae and return them to receiving water. While there are clear advantages to such systems, several factors led MassDEP not to mandate this specific type of technology at this time in the WQC. First, at the draft permit stage, EPA concluded that there was insufficient experience with such systems at other locations to determine it was BTA for the CWIS at this site. Second, through the plan review process, MassDEP can revisit the technological feasibility of incorporating such mechanisms into the final design and placement of the system. While the barrier net system piloted by the permittee in 2000 lacked mechanisms to automatically free impinged icthyoplankton, it is anticipated to function extremely well in preventing the impingement of juvenile and adult fish. MassDEP considered the near term environmental gains of juvenile and adult fish impingement reduction to be achieved by being able to promptly install the BNS to offset the potential advantages of a more complex system that could take appreciably longer to design and obtain all the necessary approvals for allowing installation at that location. MassDEP also believes that before determining whether the permittee's approach to addressing entrainment of larvae complies with the WQC, sufficient information should be available to relate the performance of an innovative technology for preventing adverse impacts or improving icthyoplankton survivability to the environmental quality and designated use of the receiving water. The current lack of adequate information will be addressed through the monitoring program required through the final permit and WQC, which can be used to better evaluate the facility's environmental impact and determine whether the entrainment reduction system needs to be modified.

Several other concerns regarding the location of the BNS were raised and are addressed below.

Concern of Public Access: Flexible materials are available that could be attached to the top of the BN that would allow passage for non-motorized, small boats into and out of the canal.

Concern of the increased risk from passing vessels: EPA and MassDEP agree that there would be an increased risk to the BN from motorized vessels, but feel strongly that these risks would be more than offset by the environmental benefits of such a system. This risk could be minimized by design features that allow for clear identification and avoidance of the BNS.

Concern, expressed by Mirant, that the agencies have no support for the assumption that a substantial number of organisms will be impinged upon the net within the canal.

There is a general problem with the absence of significant and reliable data relating to the relative

density of eggs and larvae in the Canal, the magnitude of potential future entrainment and potential impingement on a BNS. The information gap was compounded by operational problems that occurred during the BNS pilot. However, icthyoplankton sampling data associated with the pilot documented substantial levels of entrainment of both eggs and larvae. See Section 8.1.2i and Section 8.2.5.(B).i.a of the DD. It is a reasonable assumption that even with anticipated reduction in the through screen velocity from the BNS, the intake flow is sufficient to carry and impinge or entrain free floating icthyoplankton on a BNS functioning as required by the final permit. MassDEP intends to examine the issues related to impingement and survivability of as part of the design and operational plan review process for the BNS or alternative entrainment reduction system.

Concern, expressed by Mirant, that the agencies have no support for the assumption that if the BN is within the canal, of those organisms impinged, many will remain long enough to be freed.

EPA and MassDEP are unsure what is being asked in this question, but will address the general concepts involved in BNS design. In general, impingement rate depends on a number of factors including the area of the net, the size of the pores in the net, the size and buoyancy of the larvae and/or eggs, their abundance, the flow of the intake and the flow of the river past the net. All these factors are considered in a well-designed net system. If the flow from the river moves in one direction, into the Canal and through the barrier nets and CWIS into MKS's cooling system, then it is reasonable to assume that drifting organisms that are impinged on the barrier nets will remain there long enough to be freed. This would be so unless the impinged organisms are ultimately pulled through the net and entrained as a result of the intake water or they are removed from the net and Canal in some other way.

Concern, expressed by Mirant, that the Agencies have no support for the assumption that moving the net to the mouth of the Broad Canal would allow deployment of an "airburst" system for cleaning the net.

The permittee seems to be discounting its experience at its own facility at Lovett Station (NY) on the Hudson River, which employs an airburst system. Gerald Szal, MassDEP (personal. communication to Larry Wilson, NY Division of Fish, Wildlife and Marine Resources, Albany, NY) spoke with NY state personnel involved with intake screening systems in the Hudson River. Lovett Station (which was owned by Mirant at the time of the communication) has an airburst system that is in a much more challenging environment than that in the Charles. Although there were initially problems with the deployment, these problems have apparently been worked out to the satisfaction of NY state personnel. Because of the relatively large intake (390 MGD) at the Lovett Station, the Gunderboom Net System at that site is 1400 feet in length. A much shorter system would be needed in the Charles. In any event, the details of the BNS, including any

components intended for the safe removal of impinged larvae, will be resolved in the MassDEP plan approval process.

(e) **Economic Considerations:** EPA disagrees with Mirant's comment that EPA incorrectly applied a "wholly disproportionate" test and should, instead, have used the "significantly greater" test that was utilized in the final Phase II Rule for assessing the relationship between compliance options and their costs. The EAB in the Dominion Energy case squarely addressed the Region's use of the "wholly disproportionate" test in making a BPJ-based BTA determination under section 316(b), and the EAB clearly upheld the continuing validity of this approach. Dominion Energy at 230-232. While the Dominion Energy permit was issued on a BPJ basis prior to the Phase II Rule taking effect, the Kendall Station permit's § 316(b) limits are also based on BPJ and the Draft Permit was issued before the permit took effect, and EPA concluded that it made sense to continue to apply the existing wholly disproportionate test used in BPJ permitting for decades, rather than to apply the new undefined "significantly greater than" test from the new regulations. Here, EPA has considered whether permit requirements are economically practicable, and whether costs would be wholly disproportionate to benefits. The permit requirements, elements of which were proposed by the permittee and do not constitute the most expensive alternative considered, meet both tests. While Mirant notes that EPA did not estimate a monetary value for the benefits of reducing entrainment and impingement in this case, neither did Mirant, and it is perfectly appropriate for EPA to consider such benefits in a qualitative sense under CWA § 316(b). See In re Dominion Energy Brayton Point. LLC, NPDES Appeal No. 03-12, slip op. at 259 - 60 (EAB, Feb. 1, 2006).

Moreover, EPA does not believe using that test in this case would result in any change to the permit. EPA concludes that given the importance of the public environmental resources at stake here, and the relatively modest costs involved in complying with the permit's CWIS technology-based limits, the cost of such compliance is not significantly greater than the benefits it will provide.

Finally, Mirant's argument here is essentially moot because EPA cannot make the intake limits less stringent due to state water quality requirements, which are not limited by any comparison of costs and benefits. See Response to H1.

Comment H24: Mirant comments that having selected the fine mesh barrier net as "BTA," EPA went on to develop permit requirements which it says are based on Mirant Kendall's proposal, but which, in fact, go far beyond a simple requirement that Kendall Station install and properly operate and maintain the barrier net proposed by Mirant Kendall. Instead, according to Mirant, EPA proposes to apply a variety of performance standards to the barrier net, including: (1) a maximum through-screen velocity limit of 0.5 fps; (2) a 10% limitation on the amount of time during the required deployment period (February 15 to November 1) that water may bypass the

nets; (3) an impingement mortality reduction goal of 80%, compared to a baseline condition; and (4) an entrainment reduction goal of 60%, compared to a baseline condition. Mirant further states that the Draft Permit also includes numerous other provisions governing the design, operation, and maintenance of the barrier net, the methods for calculating the baseline and assessing technology performance, and the requirements for monitoring and reporting.

Comment related to H24 from CRC: CRC expresses concern that seasonal deployment of barrier nets may not do enough to reduce the already alarming rates of impingement and entrainment that occur even at current intake levels and which already result in significant mortality to fish and other species.

Comment related to H24 from MA DMF: MA DMF comments that it believes that the barrier net (BN) design, with a specified approach velocity of 0.05 fps and through-net velocity of 0.5 fps, no passive return system for impinged organisms, the net location within Broad Canal which does not prevent re-impingement, along with the absence of a safe, alternative method to return impinged organisms to the water column other than spray washing the panels, does not constitute BTA. Instead, MA DMF recommends that the draft barrier net requirement be replaced with the mandate to deploy a Gunderboom Marine Life Exclusion System (MLES), including airburst technology to passively dislodge impinged organisms, at a location beyond the Broad Canal. MA DMF states that the BN performance standard should be an 80% reduction for both impingement and entrainment and should be designed to meet the reduced approach velocity and through net velocity seen at Mirant's Lovett (New York) station.

MA DMF further argues that based on the results of a test program by the applicant, a previous BN design was unable to prevent entrainment of fish eggs and larvae. According to MADMF, the proposed modified design that EPA considers BTA in this draft permit has not been field tested and effects on ichthyoplankton, normally discussed in the context of entrainment through the plant, have not been adequately addressed for impingement and re-entrainment on the BN. Therefore, MA DMF concludes that the BTA determination is premature.

Comment related to H24 from CLF: CLF comments that aquatic filter barriers with booms may be a potential solution for minimizing impingement and entrainment from Mirant Kendall's CWISs. According to CLF, these booms may minimize or completely eliminate the impingement and entrainment of aquatic organisms and may also address the concerns about public boat access expressed at the Cambridge public hearing on September 13, 2004. Gunderboom Inc., a firm that builds and installs boom apparatuses, has communicated to CLF that it has encountered boat access issues before and has designed both submerged boom systems and boom systems that can be raised and lowered.

Response to H24: See Response H1 and H29 through H34 below for further information regarding the barrier net. As explained in various responses in Chapter H, the Final Permit contains certain changes to the Draft Permit's CWIS-related permit requirements. As also explained, however, EPA has concluded that any remaining requirements in the Final Permit that may go beyond Mirant's original barrier net proposal by specifying more detailed conditions concerning the system's implementation are necessary to ensure that Kendall Station's CWISs will meet the requirements of CWA § 316(b). The goal of the Final Permit's technology-based requirements is to assure that the BNS reflects the BTA for minimizing impingement mortality. While these requirements should also reduce entrainment, the Final Permit's conditions requiring entrainment reduction steps are based on Massachusetts WQS.

Response to Comments related to H24 From CRC and MA DMF: EPA maintains that the barrier net requirements are a component of BTA for MKS. The permit allows the permittee flexibility regarding the location of net deployment because of uncertainty regarding the optimal location for minimizing impingement mortality and entrainment. In addition, the WQC notes that there is insufficient technical feasibility data to mandate the installation of an entrainment prevention and return system at the entrance to or outside of the Canal at this location.

While the Final Permit does not specify a specific numeric requirement for impingement mortality or entrainment reduction, again due to uncertainty regarding the exact performance levels that will be practicable with this technology at MKS, the Final Permit identifies at least an 80 percent impingement mortality reduction as a performance *goal* and specifies a narrative requirement that the system be optimized to minimize impingement mortality to the extent practicable. Response H18, among other responses in Section H, details that the permit does not contain technology-based entrainment reduction requirements under CWA § 316(b) or the Phase II regulations. The permit does, however, have entrainment reduction and monitoring requirements based on MassDEP's interpretation of the state WQS as specified in its WQC.

While the barrier net is not required to be deployed at all times due to the infeasibility of such deployment when the river is frozen, the permit does require that the barrier nets be deployed when it is practicable to do so. When the BNS is not deployed or there is a reasonable expectation that adult and juvenile fish have the potential to be impinged on the traveling screens of the Kendall CWIS, a method must be employed to return these fish back to the receiving water in a manner that prevents re-impingement on the intake screen. Finally, EPA has also concluded that it would not be appropriate for the permit to command that the Gunderboom technology be used at MKS. Barrier net (or boom) systems, including this particular use of the Gunderboom system, are clearly emerging technologies which have been only rarely deployed and whose performance capability at various locations is unclear. The sole large-scale application of the Gunderboom technology for the reduction of CWIS impingement mortality and entrainment is at Mirant's Lovett Station power plant, and even this installation has required continued

modification and assessment to overcome operational problems (Presentation by A. McCusker of Gunderboom, May 2, 2005 in Gloucester, MA). Due to the uncertainty associated with this technology, MassDEP has determined that the best means to achieve both its impingement and entrainment reduction objectives is to use the plan review process to work with its federal and state agency partners and the permittee to determine the details of how the entrainment reduction system can be effectively and efficiently located, designed and operated. In Response H31, EPA and MassDEP discuss the BNS submitted by the permittee and how it was considered when determining the barrier net component of BTA.

Response to Comment related to H24 from CLF: EPA and MassDEP have included permit requirements that give the permittee the flexibility to install a BNS that would minimize impingement mortality and entrainment as well as to accommodate boat traffic in the Broad Canal. The details of the BNS will be determined through the MassDEP plan approval process.

Comment H25: Mirant asserts the relevant source waterbody, the Charles River Basin, meets the Phase II definition of "lake or reservoir" and, thus, MKS should be required to meet performance standards for reducing impingement mortality only.

Response to H25: See Response H1 for a complete discussion of how the Phase II 316(b) Rule was involved in the writing of the permit. The permit does not contain technology-based entrainment reduction requirements under CWA § 316(b) or the Phase II regulations. The permit does, however, have entrainment reduction and monitoring requirements based on MassDEP's interpretation of the state water quality standards as specified in their Water Quality Certification. With respect to the "lake or reservoir" definition issue, see Responses to H1 and H8.

Comment H26: Mirant comments that the Phase II Rule also provides that a permittee may demonstrate compliance with impingement mortality standards by showing that it has reduced, or will reduce, its maximum design velocity (defined by § 125.93 as the through-screen velocity) of 0.5 fps or less. According to Mirant, EPA developed this alternative because it believed it had developed a clear record on the relationship between reduced velocity and reduced risk of impingement showing that a through- screen velocity of 0.5 fps would protect at least 96 % of the tested fish, thus clearly meeting the performance standard. In light of this record, Mirant states that it would have been unnecessary and unreasonable for EPA to impose additional monitoring and administrative costs. Mirant further states that EPA Region I itself has drawn the connection between reduced velocity and reduction in impingement. DD at pp. 202, 223. In this case, Mirant argues that straightforward engineering calculations, which can easily be confirmed upon construction, indicate installation of the barrier net (assuming that design issues can be appropriately addressed) reduce the through-screen velocity not to 0.5 fps (EPA's safe threshold), but to about 0.07 fps, which is more than seven times lower than EPA's threshold.

Mirant concludes that under the circumstances, assuming EPA were to proceed with permit conditions based on the barrier net, it would be inappropriate for the Agency to impose any conditions beyond the requirement that Kendall Station demonstrate that it has in fact achieved a design (i.e., through-screen) velocity of 0.5 fps or less. Yet, Mirant objects that the Draft Permit includes not only a requirement that the barrier net achieve a through-screen velocity of 0.5 fps or less, but also a host of other requirements that EPA does not have authority to impose.

Comment related to H26 from Roger Frymire: If there is any problem with velocities going through the net as planned, simply making the net itself wider should be able to present a large enough area to reduce flow velocities adequately.

Comment related to H26 from MA CZM: MA CZM comments that EPA states that the applicant's proposed BN system is predicted to reduce approach velocity in front of the intakes to 0.04 fps. MA CZM further states, however, that EPA also correctly states that the applicant has not completed a comprehensive test of the BN and the intake velocity across it. MA CZM expresses discomfort with the precedent that might be set by allowing permit applicants to propose technology based on intake velocity reductions which have not been validated and to have them accepted by EPA as BTA. MA CZM strongly recommends that future BTA assessments be made only after the applicant has documented that its proposed technologies reduce intake velocities and rates of I&E to appropriate levels.

Response to H26: EPA and MassDEP understand that the through screen intake velocity at the barrier net may indeed meet the estimate of 0.07 fps as the permittee describes in this comment. EPA and MassDEP look forward to the permittee's complete assessment in this regard once the BNS has been installed. EPA and MassDEP have the authority in the BPJ-based CWIS limits of this permit to include other operating and monitoring conditions regarding the BNS in order to assure that it is performing as designed and that when the BNS is installed it filters all intake water for the greatest amount of time practicable. EPA believes that these conditions are critical components of the BNS, which is one element of the BTA determination for MKS. It also should not be forgotten that the barrier nets will not be in place throughout the year – as they will be removed when precluded by icing conditions in the river – and that the performance capabilities of the barrier net system have yet to be fully documented or established. See Responses H29 through H35 for a full discussion of the rationale for the additional barrier net conditions included in the permit.

Response to Comment related to H26 from Roger Frymire: EPA and MassDEP also recognize the relationship between the surface area of any barrier net system and the resulting through net velocity. Based on direct communication with the permittee, EPA and MassDEP are confident that the permittee is aware that, assuming the amount of water being withdrawn and the pore size of the net remain constant, increasing the amount of barrier net used to filter the intake

water will reduce flow velocities. At the same time, of course, there are limits to how broad the barrier net system can be without creating potentially problematic impediments to navigation in the river.

Response to Comment related to H26 from MA CZM: MA CZM is concerned that the performance of the barrier net system has not been adequately demonstrated. EPA agrees that it is preferable to rely on well-proven technology where possible. Given the constraints of the MKS site, and the difficulty of using closed-loop cooling at this plant, EPA has concluded that the barrier net appears to be the most promising technology available for minimizing adverse environmental impacts from impingement mortality (as well as entrainment) at this specific facility. When implementing a "technology-forcing" provision like 316(b), there may often come a point when the Agency will not be able to rely on well-proven systems for meeting applicable requirements. The identification of new technologies for meeting these requirements may be necessary and serves to advance the evolution of the relevant compliance technologies. In this case, EPA has studied similar microfiltration systems to the proposed barrier net and, based on admittedly limited information (e.g., the Lovett Station power plant's system in New York), has concluded that they show promise, especially in environments like the Lower Basin of the Charles River that are not subject to major tidal effects and are relatively sheltered. Given that conversion to closed-cycle cooling has been determined infeasible at MKS for the present time, the other option for achieving significant impingement mortality and entrainment reductions would be to require substantial generating unit shutdowns to enable cooling water withdrawal reductions. While EPA did not conduct a detailed economic analysis of this option, it appears likely that the costs of such shutdowns would likely be wholly disproportionate to their benefits, and EPA decided that given the promise of the barrier net system at MKS it was not necessary to give more detailed consideration to the shutdown option at this time.

At the same time, the Final Permit will require a monitoring regime to assess the effectiveness of the barrier net, and for its next permit renewal the facility will be undertaking the full process under the Section 316(b) Phase II rule to assess BTA. Therefore, although EPA expects the BNS to perform well in this setting, EPA should be in a good position to assess and adjust the intake requirements if necessary. EPA believes this approach is reasonable, appropriate, and well supported.

Comment H27: Mirant asserts that 316(b) performance standards must be applied to appropriate biological metrics, over an appropriate averaging period, and that EPA has not provided clear and reasonable guidance (rather, the permit provisions are confusing) on the metrics MKS may use or a sufficient averaging period for assessing performance (Mirant suggests a 5-year averaging period). Further, Mirant argues that the impingement and entrainment reduction goals must be applied cumulatively, and for entrainable organisms, the goal should apply to equivalent adults (accounting for advection of eggs and young larvae).

With respect to performance assessment, Mirant states that EPA clearly acknowledges that the barrier net performs well for larger larvae but will not exclude eggs and very small larvae (*i.e.,* those smaller than about 6mm). DD at p. 225. Nevertheless, Mirant expresses concern that EPA has included a confusing welter of provisions requiring Mirant Kendall to produce data and analysis that could be interpreted (or misinterpreted) to require application of the performance standard individually to each life stage of each species.

Comment related to H27 from MA Riverways: The requirements for barriers to reduce impingement and entrainment (I/E) of fish and other organisms is also a necessary addition to permit requirements. With the substantial increase in operating times, both spatially and temporally, that are expected by the facility, the possibility of significant fish mortality rises. The fish barriers and requirements to reduce I/E are a sound addition to permit requirements and are definitely justified. While the operation, inspection, and maintenance requirements appear adequate, it would be wise to review data as it is received to assess the actual functionality of the barrier system.

It is unclear how the percentage reductions of 80% and 60% were derived for I/E reductions. While these numbers might be reasonable targets for the Charles River system, much would depend on the size of the fish and aquatic species populations. MA Riverways hopes that there will be some level of review and consideration given to the strength of the anadromous fish runs over time relative to I/E. If the fish populations in the system see further reductions, even a 20 % to 40% mortality related to the intakes will be too large a taking and further discussion on how to reduce mortality at this facility should occur.

Comment related to H27 from NOAA: In order to further reduce adverse impacts on river herring (from the effects of I/E), we recommend that entrainment should be reduced by 80 percent, equal to the reduction in impingement.

Comment related to H27 from MA CZM: MA CZM recommends that the applicant be held to a standard at the higher end of the range of 60-90% entrainment reductions required by the Phase II rule. Kendall's intake structures are, according to MA CZM, located in an area of the Charles River that is a documented spawning and nursery ground for river herring species which are of commercial, recreational and ecological importance, as well as harboring seventeen other important species. MA CZM states that the station's withdrawal will equal the flow of the entire Charles River basin in August and may be close to five times the river's flow rate under low flow conditions.

Response to H27 and related comments: Mirant requests clarity, reasonableness and consistency in the methods Kendall Station will use to assess performance in achieving

impingement and entrainment goals. In addition, Mirant and other commenters suggest changes and/or interpretations regarding the specific numeric performance standards for the impingement mortality and entrainment reductions specified in the Draft Permit.

EPA and MassDEP have modified the Draft Permit to remove the specific numeric performance standards for the reduction of impingement mortality and entrainment. See response to H1. Instead, for impingement, the Final Permit contains BPJ technology-based conditions requiring installation of a BNS to minimize impingement mortality to the extent practicable, while working toward a *goal* of reducing annual impingement mortality for adult and juvenile fish by at least 80% from a calculated baseline. For entrainment, the Final Permit does not impose a technology-based entrainment reduction requirement, but does include certain water quality-based conditions related to entrainment reduction. These conditions also do not, however, impose a numeric entrainment reduction performance requirement. Rather, these conditions provide that the BNS, or an alternative system, minimize the entrainment of river herring and perch larvae to the extent practicable.

Regarding guidance specifying which life stage of each species must be considered in accessing impingement mortality reductions and entrainment (I/E) reductions, the requirement in the Draft Permit that "the permittee shall calculate a baseline of aquatic species of every life stage to use in calculating the I/E value in each ARM at a minimum," has been modified. For impingement mortality reductions, the Final Permit specifies in Part I.A.11.a.2 that the impingement mortality reductions are to be measured as annual impingement mortality of adult and juvenile fish with the ultimate performance goal of reducing impingement mortality by at least 80% from a calculated baseline. Thus, all adult and juvenile species are to be considered. Further, in Part I.A.11 the Final Permit clarifies that for the purposes of impingement reduction, only juvenile and adult life stages of fish are to be considered. For entrainment reductions, in Part I.A.11.b.1, the Final Permit specifies that the BNS, or an alternative system, minimizes the entrainment and impingement mortality (i.e., maximizes the survival) of river herring and perch larvae to the extent practicable. Thus, consideration of larvae impingement shall be assessed and factored into measuring the effectiveness of entrainment reductions.

The details of the BNS and associated monitoring that are not directly addressed in the specific provisions of the Final Permit, including the appropriate averaging period for evaluating entrainment reductions, will be addressed in the MassDEP plan approval process described on Parts I.A.11 and I.A.14.d.11 of the Final Permit.

In comments related to H27 from MA Riverways, NOAA and MA CZM, EPA and MassDEP note that the numeric technology-based impingement mortality reduction and entrainment reduction performance standards have been deleted from the permit. See Response to H1 and the Massachusetts WQC statement. Technology-based narrative impingement mortality reduction

requirements have been retained, while the permit's narrative entrainment reduction-related requirements are now based solely on state water quality requirements. Numeric impingement mortality and entrainment reduction performance standards may be required in future permit reissuances to the extent required by the application of the specific, detailed requirements of the Phase II § 316(b) Rule. Meanwhile the permit does require impingement mortality reductions and entrainment reductions to the extent practicable as well as monitoring to inform the development of future permit limits, and other relevant information, such as the future condition of fish runs and populations, which will also be taken into account. The details of the BNS monitoring requirements will be addressed in the MassDEP plan approval process. See Part I.A.14.d.11 of the Final Permit.

Comment H28: Mirant asserts that it is difficult to understand what EPA intends regarding calculation of the baseline. Mirant believes that it is required to determine the number of organisms it would entrain without the net by measuring the number organisms within the canal and the percentage of entrainment absent the net (e.g., 100 organisms, 80 percent entrained, results in 80 percent entrainment), and that this percentage is then to be applied to the densities in the canal once the net is put in place (e.g., 500 organisms, 400 would be entrained absent the net). Mirant asserts that if this is correct, it is problematic because not all organisms are susceptible to entrainment and accurate assessment of entrainment is burdensome. A better approach, according to Mirant, is to compare entrainment levels inside and outside the net.

Comment related to H28 from MA DMF: MA DMF comments that the method used to calculate the annual aggregated exclusion rates (% reduction) for impingement and entrainment (I&E) should be refined to include an exclusion rate for individual species and life stages on a weekly and monthly basis. MA DMF indicates that it is concerned that smaller eggs and larvae may be selectively entrained and/or impinged and urges that EPA should reserve the authority to require BN modifications should the exclusion rate not be met for an individual species at any life stage.

Comment related to H28 from MA CZM: MA CZM recommends that in calculating the impingement reduction attributable to the installation and operation of the BN, the applicant be required to discount the calculated benefit of the BN by an amount equal to any impingement of juveniles, eggs and larvae on the BN. According to MA CZM, EPA's Phase II Rule clearly states that impingement mortality reductions must be made for all stages of fish and shellfish.

MA CZM also recommends that reductions in I&E be calculated on a weekly basis, that they be calculated for each species that has the potential to be entrained at Kendall Station, and that the applicant be required to meet reductions of 80%. MA CZM states that there is great disparity among species in the size of the eggs and larvae and the burst speed required to escape Kendall Station's intakes. Given that the applicant will be quantifying the abundance of larvae at the

species level, MA CZM suggests that it will be relatively easy to calculate species-specific reductions in I&E. Because previous sampling has shown that the density of eggs and larvae, as well as the abundance of adult fish, can vary quite extensively on a weekly basis, MACZM also comments that the most rigorous, protective and biologically meaningful evaluations of impact reductions will be those that occur on a weekly basis.

MA CZM further urges that while a more rigorous O&M plan and evaluation of the applicant's proposed BN is needed, the net's ability to reduce entrainment by greater than 60% should not be ruled out. MA CZM strongly recommends that a reduction in entrainment of 80%, commensurate with the reduction in impingement mortality, be required.

Response to H28 and related comments: EPA and MassDEP received a number of different and contradictory comments regarding how to assess Mirant Kendall Station's impingement mortality reduction and entrainment reduction performance. For example, while Mirant opposes species-by-species standards, MA CZM supports them.

As discussed in other responses in Section H, such as H1 and H27, the Final Permit does not contain numeric performance standard requirements for the reduction of either impingement mortality or entrainment. Rather, the permit includes a technology-based narrative performance requirement under CWA §316(b) for reducing impingement mortality and a water quality-based requirement for reducing entrainment under Massachusetts WQS. This does not rule out that the Barrier Net System might achieve greater than a 60% reduction in entrainment, but it also does not require it at this time. Specific numeric standards may be imposed for future permit renewals under the Phase II Rule and state water quality standards.

See Response to H27 for clarifications in the means required in the Final Permit to assess the permittee's performance in achieving impingement and entrainment goals. For example, in the absence of numeric performance standards, it is not currently necessary that EPA and MassDEP take a position on MA CZM's proposal that impingement reductions resulting from the barrier net be "discounted" by any larvae and eggs that get impinged on the barrier nets. At present, it is sufficient to indicate that EPA and MassDEP agree that the mortality of impinged larvae and eggs (that were formerly entrained) should be assessed and factored into the assessment of the entrainment reduction effects of using the Barrier Net System. This assessment will then influence future permits. Also, see Response H17, which discusses the requirement pursuant to the State WQC for the permittee to submit information regarding the effectiveness of the BNS or alternative entrainment reduction system in minimizing entrainment and maximizing the survival of larvae and eggs.

Regarding Mirant's concern with the difficulty understanding what the Draft Permit requires for the calculation of baseline entrainment, the Final Permit no longer references a calculation of

baseline entrainment. Rather, the details of evaluating the performance of the BNS are required in a plan to be submitted by Mirant and approved by MassDEP as described in the State's Water Quality Certification statement and Part I.A.14.d.11 of the Final Permit. Monitoring and performance evaluations associated with the BNS that are not directly addressed in the specific provisions of the Final Permit will be addressed in the MassDEP plan approval process described on Parts I.A.11 and I.A.14.d.11 of the Final Permit.

Comment H29: Mirant comments that a point that requires some clarification is the requirement that Mirant Kendall install the net "prior to or upstream of all three intake structures." Given the configuration of the CWIS within the Broad Canal and the proposed design of the barrier net, Mirant suggests that it would be more appropriate to describe the barrier net as "in front of or surrounding" the CWIS.

Response to H29: EPA and MassDEP deliberately chose the language cited by the permittee to describe the placement of the barrier nets in order to provide the permittee with the necessary flexibility needed to choose the best location for the placement of the net. Thus, instead of being limited to installing the Barrier Net System directly in front of the intakes, as more restrictive permit language would require, the permittee is granted the flexibility to consider, for example, installing the Barrier Net System at the entrance to the Broad Canal. This location, where the Broad Canal meets the Charles River, could be chosen by the permittee and still meet the requirements specified in the permit. To clarify that this flexibility is included in the permit, the provision that "the barrier nets shall be installed prior to or upstream of all three intake structures..." has been changed in the Final Permit, omitting "prior to or" and including "within the Broad Canal, at the entrance to the Broad Canal, or outside of the Broad Canal." See Part I.A.11 of the Final Permit. As stated previously, the details of the Barrier Net System will be addressed in the MassDEP plan approval process.

Comment H30: Mirant asserts that the requirement to "preclude any pass through of water around, or under the nets" is too absolute to be technically reasonable. Mirant suggests nets should be designed to preclude by-passes "due to circumstances within the permittee's control, to the maximum extent practicable."

Response to H30: The language that the barrier net should be designed to preclude by-passes "due to circumstances within the permittee's control, to the maximum extent practicable" is consistent with EPA and MassDEP's intent in the draft permit and has been inserted in the final permit. The allowance in the Draft Permit for the net to bypass water up to 10% of the time was included to provide for precisely the relief from the absolute nature of the requirement that the permittee has identified. However, the Final Permit has been revised to eliminate the specific 10% bypass requirement. A full discussion of the bypass provision of the Final Permit is found in Response to H34.

Comment H31: Mirant comments that the permit's requirements for the facility to evaluate, remove from the net, and safely return to the Basin eggs and larvae that have the potential to survive are unreasonable because such organisms are few in number and are not likely to survive, even absent CWIS effects. Furthermore, Mirant states both that EPA has not identified any feasible method for safely removing and returning such fragile organisms to the Basin and that no such method exists.

Comments related to H31 from CRWA, CLF, NOAA and MA CZM: These organizations comment that the barrier net should be placed at the mouth of the Broad Canal to allow eggs and larvae a better chance to be freed from the net, to avoid re-impingement, and to use Basin flow to help reduce impingement. CRWA adds that a mechanism to safely dislodge organisms should be added. CLF adds that the net is not BTA given data that is inconclusive at best (only 52 percent of larvae and eggs were excluded across all species and sampling dates; more eggs and larvae were identified behind the nets than in front of them). Furthermore, CLF argues that if the nets are to be used, they should be kept in place all year.

Comments related to H31 from the City of Cambridge and Roger Frymire: These commenters assert that the location of the barrier net specified in the draft permit is appropriate and they favor it because it will maintain public access to the canal.

Response to H31 and related comments: EPA and MassDEP agree that the safe removal and return of impinged eggs and larvae to the river presents a challenge, particularly in the lower Charles River Basin, where there is little or no lateral current to "wash" the organisms off the barrier nets. EPA and MassDEP do not, however, agree with the permittee that current information clearly demonstrates that no method exists to meet this challenge. Indeed, an air burst system is reportedly incorporated into the barrier net installation at Mirant's Lovett Station (NY) on the Hudson River for the purpose of safely dislodging impinged eggs and larvae from the net. Thus, it is possible that this may be one suitable method for addressing this issue.

Ultimately, survival of the organisms that are impinged and then removed from the nets is likely to depend on many site specific factors. These may include the following: (1) the type of eggs and larvae impinged and how fragile they are; (2) the length of time they are impinged; (3) the quality of the water they are exposed to during the time they are impinged and once they are returned to the river (e.g., water temperature, chemical concentrations); (4) the hydrodynamics of the area around the nets, which may influence whether the eggs and larvae can be washed off the nets and allowed to drift to safe habitat, or whether they end up being re-impinged; (5) whether ecological factors, such as the presence of predators or unfavorable water quality conditions (e.g., the presence of chemicals or sub-optimal temperatures), make it less likely that damaged eggs or larvae will survive their injuries; and (6) other factors. The details of the barrier net system,

including any components intended for the safe removal of impinged larvae, will be addressed in the MassDEP plan approval process.

Specifying that the BNS be located at the entrance of the Broad Canal, as advocated in comments by CRWA, CLF, NFS and MA CZM, is another potential modification that may help to address the challenge of maximizing impingement survival. The permit does not, however, specify a particular location for installation of the barrier net. Rather, the permit provides for a plan approval process required by the state's WQS. This process will evaluate the most appropriate location of the BNS.

At present, EPA and MassDEP simply do not believe the record demonstrates that one location is clearly superior to another for the purpose of minimizing adverse environmental impacts from the CWIS. If EPA and MassDEP did think so, the agencies could prescribe a location for the nets as part of the permit's technology-based requirements under CWA § 316(b) (the "location" of the CWIS is one of the factors that must reflect the BTA) and its water quality-based requirements, in order to ensure attainment of the water body's designated uses. EPA also notes that the comments of the City of Cambridge and Mr. Frymire favor the currently proposed location for the barrier nets, rather than placing them at the mouth of the Canal, in order to maintain public access to the Canal. Such recreational interests are also relevant to the MassDEP's consideration of appropriate permit requirements necessary to attain designated uses, since primary and secondary recreation are also designated uses of the River. Of course, if a particular location is required as a regulatory matter by another agency, such as the MA CZM office acting pursuant to the Coastal Zone Management Act, then the permit will need to include permit conditions consistent with those requirements.

EPA and MassDEP have also received comments noting concern over the performance of the barrier net at Kendall Station. In particular, CLF pointed out the inconclusive nature of the Barrier Net Study conducted by the permittee and submitted as part of their permit application (Mirant February 2001). EPA and MassDEP acknowledge that performance of the net detailed in the study was inconsistent. For example, one test recorded more ichthyoplankton within the area protected by the barrier net compared with the area outside of the barrier net. EPA and MassDEP also recognize, however, that this study was designed to deploy the net in a short term, temporary manner. The permittee detailed the failure of this temporary net to maintain a "tight seal" around the CWIS, especially along the bottom, which may have led to the performance issues noted above. While the main objective of this study was to determine the site-specific performance of the net under full operations, a pilot study of this kind also may identify weaknesses in the original design and the need for particular adjustments. Mirant documented the problems encountered in this study and has discussed steps to strengthen the barrier net design to correct these deficiencies. Indeed, the permit requires that the nets be deployed to filter all water entering the CWIS, except under strictly limited conditions. EPA and MassDEP maintain that, when in

place, the barrier nets appeared capable of preventing impingement of adult and juvenile fish and entrainment of some fish larvae, and that the Barrier Net Study was useful for confirming this fact and for identifying design problems to be corrected.

EPA and MassDEP also acknowledge, of course, that the permit does not require the barrier nets to be in place year-round. This is because it was not deemed practicable to keep the nets in place when the river freezes over. CLF comments that the barrier net should be kept in place all year. This comment is understandable when one recognizes that non-trivial impingement has been documented in the winter months (See Responses to H14 and H31). For example, in a ranking of average monthly impingement from 1999 through 2005, the month of February ranked as the third highest. The need to reduce impingement, however, cannot overcome the practicability problems associated with keeping the barrier nets in place during times when ice forms in the Charles River during the winter. The formation and movement of ice in the Broad Canal could seriously damage the barrier nets and make routine maintenance impossible and even dangerous. Based on comments from CLF, language in the permit has been clarified to better address these competing concerns. While the Draft Permit had specified that the barrier nets only needed to be in place from February 15 to November 1 of each year, the Final Permit has been revised to specify that the barrier nets must remain in place except when icing conditions in the river preclude their deployment. (See H1 above.) This condition recognizes the practicability issue but also recognizes both the variability of when icing conditions will occur in the river from year to year and the fact that impingement occurs even during cold weather months (see Table H14-1 and Figure H14-1). EPA and MassDEP believe that the Final Permit's requirement is better tailored to comply with CWA § 316(b).

Comment H32: Mirant asserts the schedule for installation of the barrier net and walkway (60 days after effective date of final permit) is unreasonable and without basis. Mirant suggests that, instead, it should submit a schedule within 60 days and install the net in an expeditious manner.

Response to H32: MassDEP has determined that the best means to achieve both its impingement and entrainment reduction objectives is to use the plan review process to work with its federal and state agency partners and the permittee to determine the details of how the BNS can be effectively and efficiently located, designed and operated. This process is specified in the State's WQC. Additional time has been included in the permit language to allow for this review process and BNS installation. The Final Permit has been changed to require the permittee to install a BNS no later than one hundred and twenty (120) days after the effective date of the permit, or consistent with the time frame included in the MassDEP plan review process described in the Part 11.b.(1) and (2) of the Final Permit, whichever is later, unless icing conditions preclude such deployment.

Comment H33: Mirant comments that the permit includes several confusing and apparently inconsistent provisions governing deployment and maintenance of the barrier net. To the extent

these provisions are authorized at all, Mirant states that they must be clarified and streamlined so that they make operational sense.

Mirant first points to Part I.A.11, on p. 12, which provides that each barrier net must have several removable panels, but that before a panel may be removed for cleaning or other maintenance, an impermeable barrier must be placed behind the section to be removed, thereby limiting the amount of flow that may come through the intake without first going through the barrier net. Mirant then states that later in this same section, the Draft Permit requires that all intake water must pass through the nets for the entire deployment period, unless the permittee encounters unforeseen clogging or other operational difficulties. In that case, Mirant comments that the permit provides that Kendall Station may pass water through the intake "without the use of the nets" for the shortest period of time necessary to alleviate the problem, but not more than 10% of the time the facility is drawing intake water in any calendar month for all intake structures combined.

Later in the same section, the Draft Permit lays out yet another set of design, operating, and maintenance requirements for the barrier net. See Draft Permit pp. 13-14. Mirant states that that paragraph instructs Kendall Station to "minimize the amount of time that a barrier net is not in place, as described above," and goes on to say that the permittee shall remove one barrier net section at a time under normal replacement and maintenance conditions, so as to minimize any increase in velocity of water deflected off the barrier that then passes through the remaining screens.

Mirant suggests that it is clear that the 10% restriction applies only during the deployment period (Feb.15-Nov. 1), but that it is not clear whether the phrase "without the use of the nets" in the second provision is intended to refer to (1) any circumstance in which all of the net panels are not in place (as, for instance, where one or more impermeable panels is in place to allow for routine cleaning or maintenance of the barrier panels), or (2) only to those circumstances in which the entire barrier net assemblage for one or more Units has been removed and cooling water is reaching the Unit(s) without passing through the barrier net system. If the phrase were interpreted broadly, as in the first interpretation, the 10% restriction would encompass even routine maintenance activities, when water in fact is passing through the barrier net, but one or more panels is not in operation. Mirant Kendall does not believe this is reasonable, nor does it believe that this is what EPA intends.

Thus, assuming a restriction of this kind is reasonable, Mirant Kendall requests that EPA clarify the requirements to ensure that routine maintenance events in which the barrier net is in use with one or more impermeable panels do not fall within the circumstances contemplated by this provision, nor are reportable under it.

Response to H33: EPA and MassDEP disagree that there was an inconsistency between the various provisions cited it the comment above. The permitting agencies do agree with Mirant that the agencies' intent for these provisions is consistent with the interpretation of the permit Mirant offers at the end of the comment. EPA and MassDEP's intent is that to the extent practicable all intake water must first pass through the barrier nets before being withdrawn by the facility intake during periods when barrier net deployment is practicable. The 10% barrier net bypass allowance that was included in the Draft Permit has since been revised as described in response to H34 below.

EPA and MassDEP have removed from the Final Permit any specific reference to removable barrier net panels (and associated maintenance procedures) – though Mirant proposed such a design, *see also* "Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule," Chapter 4, Attachment A (Fact Sheet 11) – in order to allow Mirant more flexibility in the final design of the BNS. Further explanation of this requirement is found in Response H34.

Comment H34: Mirant asserts the 10 percent monthly limit on intake water bypassing the barrier nets (when the nets are deployed) lacks any technical or biological foundation. According to Mirant, EPA has not shown this is needed to meet the applicable performance standards and Mirant requests that it be deleted. In addition, Mirant questions the need for the barrier net 10% restriction for all months during which the net is required when in Mirant's estimation all of the record data indicate that the vast majority of the impingement mortality and entrainment are likely to occur between May and July.

Comment related to H34 from CLF: The provision in the draft permit that would allow MKS to operate without barrier nets for 10 % of the year, is most likely to be utilized when impingement is highest. This provision should be eliminated, being replaced by engineering that will ensure that barriers are in place at all times.

Response to H34 and related comment: In the Final Permit, EPA has changed the language relative to bypasses of the BNS. The revised language requires that MKS operates the BNS to preclude bypasses due to circumstances within its control, to the extent practicable. If the permittee encounters unforeseen clogging or other operational difficulties with the BNS, or if necessary to conduct routine maintenance, the permittee may pass water through its CWIS without all of the water passing through the BNS for the shortest period of time necessary to alleviate the problem. This language recognizes that there are times when components of the BNS may need to be removed for cleaning, maintenance or repair, but also recognizes that during such times, the BNS will not be performing their function of reducing the adverse environmental impacts of impingement mortality and entrainment. Thus, in place of the Draft Permit's

conditions allowing bypass of the BNS for up to 10% of the time that the BNS is deployed, the Final Permit limits the time when water could bypass the BNS and be drawn directly into the CWIS to the times when such bypass is actually necessary due to technological problems or issues, including the need for periodic routine maintenance. As the final design for the BNS is worked out through the BNS plan review process specified in the MassDEP WQC and the Permit, practicable measures for minimizing bypass conditions will be identified and required.

Thus, the condition in the Final Permit does not actually provide an allowance for a regular monthly bypass of the BNS, but rather allows water to be bypassed around the BNS when it cannot reasonably be prevented for the above reasons. With daily intake flows between 70 and 80 MGD, bypassing the BNS could result in significant levels of impingement (and entrainment), especially if bypasses occur for more than a few days in a short period of time. Impingement events are typically concentrated and sporadic so that a relatively large number of fish are impinged over the course of a few days, which are then followed by periods of relatively low fish impingement. The short-lived but intense nature of impingement events has been evidenced at other power plants utilizing once-through cooling systems. Site-specific impingement data from Kendall Station in 2003, for example, recorded 344 fish impinged (approximately 81% were blueback herring) in the month of June. Summary impingement data submitted by the permittee in April of 2006 did not present raw numbers of fish impinged each day, but it is likely these 344 fish were not impinged at a constant rate throughout the month. A periodic high impingement event coinciding with a net bypass period could, therefore, allow a sizable level of impingement mortality to occur over a relatively brief period. Considering the intake flows of this facility and the importance of the source water body, net bypass for extended periods (e.g., beyond just a few days) could result in significant impingement (and entrainment).

EPA and MassDEP have also concluded that precluding bypasses due to circumstances within the permittee's control to the extent practicable will both allow adequate time for performing necessary operational maintenance on the nets or managing a breech in the nets or other unanticipated problems, while still providing a high level of fish protection and precluding bypasses when it is practicable to do so. Mirant has neither commented or demonstrated that meeting the draft permit’s 10% limit on bypasses would have been impracticable nor proposed any alternative limit on BNS bypassing, appearing to prefer *no limit* on its ability to bypass the BNS. EPA and MassDEP have concluded, however, that providing no limitation on BNS bypasses would be unreasonable in light of the adverse environmental impacts that could occur, the technological capacity to avoid bypasses in many circumstances through sound design and operation of the BNS, and would not comply with CWA § 316(b). By including an enforceable requirement in the permit that prohibits BNS bypassing to the extent practicable, the Final Permit puts an upper limit on the adverse impacts that could occur from bypasses and creates an incentive for Mirant both to closely address its regular maintenance needs and to institute any needed repairs as promptly as possible.

It should also be pointed out that the permit's "General Requirements" in Part II include provisions addressing both "bypass" and "upset." See Part II.B. 4 (bypass) and Part II.B.5 (upset). Bypass refers to the "intentional diversion of waste streams from any portion of a treatment facility," whereas upset refers to an "exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee." Neither of these provisions directly applies to the BNS issues, however, because, among other reasons, both provisions are written to address effluent discharges rather than cooling water intake structure screening technologies. Nevertheless, these provisions address analogous issues for effluent discharges and EPA and MassDEP will look to them by analogy in addressing the issue of bypasses of the BNS. First, Part II.B.4.b requires that effluent treatment equipment may be bypassed if it does not cause effluent limitation violations and the bypass was needed for "essential maintenance to assure efficient operation." Similarly, EPA and MassDEP would expect to allow maintenance-related bypasses of the BNS only if it is necessary for "essential maintenance to assure efficient operation" of the BNS. Second, with respect to other types of anticipated or unanticipated bypasses, Part II.B.4.d prohibits them unless various conditions are met, including that "bypass was unavoidable to prevent loss of life, personal injury, or severe property damage," there were "no feasible alternatives to the bypass," and specific notice provisions are satisfied. Again, EPA and MassDEP will use these provisions by analogy to determine when bypasses (i.e., the intentional diversion of the intake stream around the BNS) may be acceptable. Upsets refer to unintentional failures of treatment equipment. An example of an upset of the BNS might be, for example, if a boat ran into the BNS and breached the net so that water flowed through the BNS without being filtered by the net. EPA and MassDEP intend to use the "upset" provisions in Part II, Section B.5 of the Final Permit by analogy to help define when a bypass of the BNS that is beyond the permittee's control has occurred and what steps the permittee should take to minimize any such bypass and inform the regulatory agencies of its occurrence. See Conditions II.B.5.a, II.B.5.c.4, II.B.3, and II.B.5.c.3. For example, if the permittee does not take reasonable steps to terminate a bypass of the BNS that was initially beyond the permittee's control, then as of the time such reasonable steps could have been implemented, the continued bypass would no longer be beyond the permittee's control.

Meanwhile, CLF comments that no bypassing of the BNS should be allowed and that, instead, the permit should require that the BNS be engineered to prevent all bypasses. Identifying a design and operational measures that would prevent all bypassing of the BNS will, of course, be a goal of the plan review process for the BNS. It may, however, be impracticable to achieve that result. The BNS system is an emerging technology likely to have many site-specific implementation issues. The previous pilot testing of a BNS system at Kendall Station was not able to prevent all BNS bypassing, though this experience is expected to contribute to design improvements that will reduce the problems encountered in the pilot testing. Thus, EPA and MassDEP cannot now conclude that it would be practicable for the permittee to achieve a standard that prevented *all*

bypasses. The condition in the Final Permit, however, should limit such bypasses to those that could not practicably be avoided.

Finally, EPA and MassDEP disagree with the permittee's statement that "all of the record data indicate that the vast majority of the impingement mortality and entrainment are likely to occur between May and July." Response to H14 contains a table and figure of impingement data from 1999 through 2005 (Table H14-1, Figure H14-1). Impingement in the month of February ranked third overall, and non-trivial impingement occurred in other months besides May, June and July. Based on this data, the requirement to pass water through the BNS to the maximum extent practicable for any time that the BNS is deployed is reasonable and necessary.

Comment H35: Mirant comments that the Draft Permit (at p. 12) requires that Kendall Station operate the traveling screens for a given unit "[f]or any continuous period during which intake water does not pass through any of the barrier nets for any intake structure for more than four hours . . . ." Mirant states that this provision suffers from the same ambiguity as the provisions the company discussed in Comment H33.

Mirant also comments that Part I.A.2 of the Draft Permit (at p. 8), like Part I.A.11, requires that "[a]ll live fish, shellfish, and other aquatic organisms collected or trapped on the intake screens or any barrier net shall be returned back to the receiving water in a manner that prevents re-impingement on the intake screens, except for those that need to be enumerated as part of the impingement sampling detailed in Section 14.e.9." Mirant states that it has in other comments explained its objections to this provision as it applies to the barrier nets, and that for several reasons it is equally objectionable when applied to the traveling screens. According to Mirant, EPA has not met its burden of identifying a technology capable of achieving this requirement and it is unlikely that this could be accomplished at a cost that is not significantly greater than any environmental benefit. Mirant also states that unlike the provisions in Part I.A.11, the requirements in Part I.A.2.e are not clearly limited to the period during which the nets otherwise would have been deployed, which Mirant argues fully encompasses, and indeed exceeds, the period during which virtually all impingement is likely to occur. At the very least, this inconsistency would need to be resolved in favor of limiting application of such requirements to the barrier net deployment period.

Comment related to H35 from MA CZM: MA CZM recommends that the permit establish a strict timeline during which the applicant is required to consult with the resource agencies to design an appropriate return system for impinged organisms and a schedule for testing and implementing the proposed system.

Response to H35 and related comment: As discussed in other responses to comments in Section

H, it is understood that the barrier nets will be in service much, but not necessarily all, of the time that Kendall Station is withdrawing water from the Charles River. When the barrier nets are in place and operating properly, assuming that the traveling screens were also operating, no impingement of organisms on the facility's traveling screens (which have a larger mesh size than the barrier nets) would be expected because either the barrier nets would block the organisms prior to their reaching the traveling screens or the organisms would have been small enough to pass through the barrier nets, in which case they would also be small enough to pass through the traveling screens. (Such very small organisms would, therefore, be entrained rather than impinged by the facility's cooling system.)

EPA and MassDEP do not agree that the permit provision quoted above by Mirant is ambiguous. The requirement for continuous operation of the traveling screens is clearly intended to address periods when Kendall Station is withdrawing water from the Charles River that bypassed the barrier nets. If a barrier net panel has been removed and replaced with an impermeable barrier (for example), then water is not being withdrawn through that location. If water *is* being withdrawn without first passing through the barrier nets either because the nets are not deployed (e.g., due to river ice) or because of a bypass of the barrier nets, then the traveling screens must be operated. The requirement to rotate the traveling screens within four hours of a particular barrier net section being bypassed has been changed. The Final Permit now requires that the rotation of the traveling screens for any such affected CWIS begin as soon as practicable after the permittee becomes aware that intake water is bypassing the barrier net and that such screen rotation be conducted at least once per eight hour shift and for a time sufficient to dislodge any impinged organisms.

EPA and MassDEP have addressed the issue of measures for safely returning organisms impinged on the barrier nets to the Charles River in other responses to comments, including Response to H31. During periods when any BNS components are not in place, only the larger organisms, such as the adults and juveniles of various species of fish, are likely to be impinged on the traveling screens, given their larger mesh size. Since these life stages should be less fragile and delicate than the egg and larval life stages, depending on the extent of the damage done to the organism by the impingement event, it should generally be easier to return these larger organisms impinged on the traveling screens to the River in a manner that permits their survival. EPA has determined that a "fish return" system that maximizes the survival of organisms impinged on the traveling screens – which includes returning fish to the river in a manner that prevents or minimizes their re-impingement – is a component of a CWIS design reflecting the BTA for minimizing adverse environmental impacts under CWA § 316(b). MassDEP has determined that such a system is also needed to ensure that applicable WQS are satisfied.

Thus, while it is clear that effective fish return systems are an important component of the BTA for minimizing the adverse environmental impacts of cooling water intake structures generally,

see 69 Fed. Reg. 41599, 41602,[12] it is also clear that optimal fish return systems for particular power plants must be designed taking into account the particular characteristics of that power plant, such as the location of the intake structure screens relative to the source water body and the features of that water body (e.g., currents, depths, etc.). It is understood that the location of the CWIS at Kendall Station and various man-made obstacles, such as roads and sidewalks, raise certain challenges that a system for the safe return of impinged organisms to the Charles River at Kendall Sation must address. While the burden is on EPA under CWA § 316(b) for selecting the BTA, EPA also prefers to set performance standards based on the existence of practicable technologies rather than to mandate the use of a specific technology. This leaves the facility the discretion to develop alternative methods of achieving or bettering the applicable performance standards. With respect to fish return systems, an array of different technologies exists to minimize adverse environmental impacts. These include low pressure spray washes to more gently remove impinged organisms from the traveling screens, fish buckets to transport fish from the screens, and various types of troughs for facilitating the return of the fish to their source water. *See, e.g.,* "Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule," Chapter 4 § 2.1 and Attachment A.

Rather than specify precise technologies for Kendall Station, EPA believes it is adequate and appropriate to set narrative standards on a BPJ basis designed to minimize impingement mortality effects and then leave it to Kendall Station to select technologies and design a system, subject to regulatory agency approval, that achieves the narrative standards of the permit. *See, e.g.,* 69 Fed. Reg. 41612-613. The standard set by EPA requires that "live" organisms be returned to the Charles River in a manner to prevent their re-impingement. This is both reasonable and appropriate. Organisms already killed by the impingement event are not covered by this requirement. And for the live organisms, it makes sense to have them returned to the river in a manner that minimizes the chance that they will be injured again or killed by being impinged repeatedly by the facility's CWIS. Mirant Kendall's comments do not provide specific information establishing that it is impracticable to meet the permit's requirements in this regard, and EPA concludes that available technologies should make this possible.[13]

---

[12] It should be noted that EPA's Phase II Rule sets a performance standard for reducing impingement *mortality* by 80 to 95 percent, rather than for reducing impingement *per se*. *See, e.g.,* 40 C.F.R. § 125.94(b)(1). This reflects the Agency's view that it should be possible in many cases to return impinged organisms safely to the source water body.

[13] If it was impossible to take fish that have been impinged on the traveling screens but are still alive, and return them to the Charles River in a manner that prevents their re-impingement, then it would mean that all fish impinged on the traveling screens would essentially be killed as a result since they could not ultimately be expected to survive the injuries of repeated re-impingement.

EPA and MassDEP also disagree with the permittee's statement that the time period the BNS is likely to be deployed fully encompasses, and indeed exceeds, the period during which virtually all impingement is likely to occur. A review of impingement data from Kendall Station from 1999 through 2005 reveals that non-trivial impingement can be expected when the BNS may not be in place. For example, it is possible that due to icing conditions, the BNS would not be in place for some part of the month of February. Yet, February ranked as the third highest month of overall impingement, according to the impingement monitoring program conducted by the permittee. See Response to H14 for a full discussion of impingement data from 1999 through 2005 from Kendall Station. This data supports EPA and MassDEP's position that the return of all live fish, shellfish, and other aquatic organisms collected or trapped on the intake screens back to the receiving water in a manner that prevents re-impingement on the intake screens must not be limited to only the deployment period of the barrier net.

Finally, Mirant offers the conclusory comment that it is "unlikely" that the permit's fish return requirements could be satisfied at a cost that is not significantly greater than any environmental benefit. EPA disagrees. Given the relatively low cost of fish return technologies, *see* "Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule," Chapter 2 §§ 2.1, 2.2, 2.3, and the importance of enhancing the survival of impinged fish in the Charles River, as discussed in other responses to comments as well as the Massachusetts water quality certification, EPA is confident that the costs of the necessary measures will neither be significantly greater nor wholly disproportionate to their benefits.

Regarding MA CZM's comment to establish a schedule for the permittee to consult with the resource agencies regarding a fish return system, this activity will take place within the schedule for the plan review process established in the permit to meet impingement reduction objectives.

Comment H36: Mirant comments that the Draft Permit includes a separate Fine-Mesh Barrier Study (Part I.A.14.e.7, Draft Permit p. 31), as well as entrainment and impingement sampling programs discussed below, and that the Barrier Net Study, which applies during the first year of the permit only, must commence within sixty (60) days after the effective date of the permit. Mirant Kendall objects to this study arguing that it duplicates other studies EPA is proposing and that an unreasonable deadline has been proposed for it. Mirant suggests that EPA appears to have based this deadline on the assumption that Kendall Station would be able to complete construction of the barrier net within sixty (60) days of the permit's effective date, but, as Mirant has commented previously, it does not agree that this is appropriate. Mirant states that it would be more reasonable for EPA to require Mirant Kendall to submit a study plan for review and approval by the Agencies within sixty (60) days after the permit's effective date.

Mirant also expresses the view that some of the elements of the proposed study are simply infeasible. One example cited by Mirant is the requirement to develop a technique "to enumerate

and evaluate the condition of fish eggs and larvae impinged on the barrier net. . . ." According to Mirant, the organisms are too small and too fragile for an evaluation of their condition, though their numbers can be estimated and counted as lost to entrainment. Mirant also comments that the specifications regarding equipment and sampling methods need to be revisited and that this is particularly the case with respect to the specification of pumped samples, as opposed to net tows. Mirant states that pumped samples bring with them biases that should be avoided when alternatives are available. Once the final configuration of the net and supporting structures, or other compliance option(s), has been established, Mirant Kendall indicates a willingness to work with EPA to develop an appropriate protocol for any required study of the efficiency of the net or other compliance option.

Response to H36: See Response H32 concerning the deadline for the Barrier Net System installation.

The Barrier Net Study requirement has been retained in the Final Permit with less specificity as to its details. As part of the monitoring, sampling and modeling plan submission required under the State WQC, Mirant will be required to provide quantitative data on the effectiveness of the BNS or alternative entrainment reduction system in minimizing entrainment and maximizing the survivability of larvae and eggs. The protocol for conducting the sampling and analysis will be developed in the course of the plan review to generate data related to the WQC's performance standards and entrainment reduction system evaluation.

In consideration of Mirant's comment and changing in the timing requirements for the installation of the BNS (see H32), the schedule for starting and submitting the Barrier Net Study has been modified in the Final Permit without altering the intent of the Study or its timing. The Final Permit (Part I.A.14.d.7) requires that the Barrier Net Study begin within the May through July period following the installation date of the BNS and be submitted in the annual monitoring report for that period.

Comment H37: Mirant comments that the entrainment sampling proposed in the permit appears excessive and inappropriate. According to Mirant, a well-designed study of exclusion by the barrier net should provide all the necessary information on ichthyoplankton losses and would be more defensible without attempting to reconcile it with samples collected in the discharge. Mirant states that EPA proposes to require discharge samples as the basis for assessing entrainment, but that such samples always contain a mix of discharged water and ambient river water entrained by the initial mixing of the plume. Mirant states that the larval densities in such samples are, therefore, likewise mixed.

Response to H37: MassDEP, in the state's WQC, has established a plan review process to work with its federal and state agency partners and the permittee to address the specific issues raised by

the permittee regarding entrainment sampling. During this process, Mirant will have the opportunity to offer their entrainment study for review.

Comment H38: Mirant comments that Part I.A.14.e.9 of the Draft Permit establishes an unreasonable schedule for commencing impingement sampling, requiring establishment of an impingement sampling program within 90 days of the permit's effective date. Mirant states that this schedule is too short and requires modification for the same reasons explained above in the discussion of barrier net study requirements.

Mirant also comments that the proposed impingement sampling requirements are excessive. Mirant states that if their purpose, as stated, is "to provide an estimate of the number and species of finfish impinged," then that is all that should be measured. Mirant states that life stages can be described, but measurement to the nearest millimeter is excessive, as is internal examination of each river herring to determine gonad condition. According to Mirant, EPA simply cannot provide any plausible need for such data which would justify their cost, and can provide no justification for imposing the impingement monitoring requirements throughout the entire permit term, regardless of the initial sampling results. Mirant Kendall believes that once the barrier net is installed, a two-year impingement sampling period should provide sufficient information on which to base an assessment of the barrier net's performance.

Response to H38: EPA and MassDEP are aware that Mirant conducted a continuous impingement sampling program at Kendall Station from 1999 through 2005. While it is unclear whether this program is ongoing in the year 2006, it is reasonable to expect that an impingement monitoring program that has been conducted for several years at a facility and does not involve a large investment in new equipment can be restarted within the total 150-day time period from the signing of the final permit (60 days before permit becomes effective) to the requirement for impingement sampling (additional 90 days). See Response H32 for a discussion of the timeliness for BNS installation included in the permit. Therefore the impingement sampling schedule has not been modified.

EPA and MassDEP maintain that once a fish is collected in an impingement sample, obtaining a total length measurement of the organism is a reasonable and appropriate data collection activity. This information will provide documentation of whether the impinged fish was a juvenile or adult, or document if all impinged fish over a given time period were from the same size class, for example. Also, depending on the condition of the impinged fish, a field description of gonadal condition (for example: ripe female, spent male, immature) is a routine data collection activity in the hands of biologists with even the most rudimentary level of training. This will provide important information regarding the impact of the impingement. For example, if impinged fish are documented to have already spawned, their removal from the lower Charles River Basin has a different impact than impinged fish determined to be removed before spawning. EPA and

MassDEP do not judge the cost of this routine and minimal data collection to be excessive relative to the amount of important information obtained.

The impingement program must be conducted for the entire permit term in order to document impingement levels over the life of the permit. Over the five years of the permit term, it is expected that a range of flow conditions, fish species densities (strong and weak year classes), and even facility operating conditions will provide a range of conditions over which the performance of the barrier net will be documented.

Based on this response, all requirements of the impingement program have been maintained in the Final Permit.

Comment H39: Mirant asserts that in authorizing the Commissioner to make changes to the permit, EPA has improperly ceded NPDES authority to a non-delegated entity. In addition, Mirant states that the permit neither requires EPA or MassDEP to show cause to change the nets nor provides for public participation with respect to any such proposed changes, which violates the APA and MGL c 30A and is inconsistent with EPA's NPDES regulations concerning permit modifications.

Mirant Kendall therefore requests that this provision be revised to ensure that EPA (1) provides a reasoned basis for any proposal to require a change in the CWIS technology, and (2) provides Mirant Kendall an opportunity to be heard and to raise other relevant factors that the law and the Rule require the Agencies to consider.

Response to H39: EPA and MassDEP agree that the Draft Permit's provisions regarding permit modifications related to the barrier nets were confusing. First, Condition I.A.1.e provides that permit conditions may be modified based on various types of information and consistent with the provisions of 40 C.F.R. § 122.62. Second, Condition I.A.11 provides that under certain circumstances, "the Regional Administrator and the Commissioner may direct the permittee to alter the barrier nets . . .." Consistent with Mirant's comment, EPA has revised the language for the Final Permit to make clear that any permit modifications will follow the process and satisfy the criteria of 40 C.F.R. §§ 122.62 and 122.63, whichever is applicable. EPA and MassDEP disagree that the Draft Permit in any way has improperly "ceded" EPA authority over permit conditions to the MassDEP, a non-delegated state agency. Instead, EPA will retain its authority over any permit modifications within its jurisdiction. At the same time, mentioning that the state may also need to approve proposed permit modifications is appropriate for at least three reasons: (1) any changes to the permit still must satisfy state WQS and the MassDEP is responsible for applying these state standards in the first instance; (2) in addition to being an NPDES permit under the federal CWA, this jointly issued permit is also a state permit under the Massachusetts Clean Waters Act, so that for a permit change to have effect under state law, the MassDEP would

also need to approve the change; and (3) the item in question, the design of the BNS, is the subject of specific conditions in the state's WQC.

Comment H40: Mirant comments that at p. 179-180 of the DD, EPA explains that the Commonwealth may determine that more stringent CWIS requirements are needed, based on state water quality standards, and that EPA anticipates that MassDEP would address that issue in its certification under CWA §401.

Mirant indicates that it does not believe that the Massachusetts has any applicable laws that govern the Kendall Station CWIS and that, as a result, the MassDEP has no law to apply to the CWIS via § 401 certification. Mirant further states that even if that were not the case, that is not the end of the inquiry. According to Mirant, even if Massachusetts could show that its water quality standards, for example, could be interpreted so broadly as to authorize it to regulate CWIS (as EPA implies), the Commonwealth also must show that it has an applicable standard that applies to the CWIS and before it could impose a more stringent standard, it would have to show that the technology requirements are insufficient to assure attainment of the state standard. See § 125.94(f), 69 Fed. Reg. at 41,687; compare 40 C.F.R. § 122.44(d)(1)(vi). Mirant Kendall submits that no such standard exists, nor could such a showing be made, even if EPA were not to require the proposed barrier net.

Comment related to H40 from CLF: CLF comments that the CWA and its regulations are clear that section 316(b) cooling water intake requirements for a NPDES permit must comply with state WQS. According to CLF, the requirement that permits comply with state WQS allows no exceptions for cost or technological feasibility. CLF states that pursuant to section 401 of the CWA, Massachusetts's certification of the permit must include any conditions necessary to ensure compliance with state WQS. CLF also states that it is well established that MassDEP has authority under state law to impose conditions based on narrative WQS on Petitioner's non-discharge related activities.

CLF suggests that EPA generally defers to all conditions imposed during the certification process, but where the conditions imposed are not sufficiently stringent to meet state WQS, EPA must independently impose conditions to ensure that the permit complies with state WQS. CLF points to the EPA Environmental Appeals Board's decision in *In re City of Moscow, Idaho,* which stated that "when the Region reasonably believes that a state water quality standard requires a more stringent permit limitation than that specified by the state, the Region has an independent duty under section 301(b)(1)(C) of the CWA to include more stringent permit limitations." This independent obligation, CLF asserts, has been widely upheld. Moreover, CLF states that the Phase II regulations also require compliance with state WQS when setting NPDES permit conditions.

CLF comments that this Class B water must support habitat for fish, other aquatic life and wildlife, as well as primary and secondary contact recreation. CLF asserts that the impingement and entrainment impacts associated with the draft permit would result in a degraded habitat for resident and anadromous fish (including game fish) as well as other aquatic species. CLF further states that the draft permit violates the anti-degradation standards of the MA WQS and the Clean Water Act.

CLF goes on to state that EPA has consistently held that the assessment of the significance of adverse environmental impact must take the condition of the ecosystem into account. Accordingly, CLF argues, losses from a stressed ecosystem like the Lower Basin are considered more environmentally significant than greater losses from a healthy ecosystem. CLF further states that another important factor is the biological value of the source water – including the presence of spawning grounds, migratory pathways, and nursery and feeding areas – and that the Lower Basin has significant biological value. CLF expresses the view that EPA must also consider cumulative impacts, that is, other stresses in addition to the CWIS in making BTA determinations, but in the Determinations Document, EPA acknowledged that the "overall cumulative effects of multiple CWIS withdrawals, increased thermal discharges at MKS and existing impairment in the lower Basin are not assessed in any detail or quantitatively in the current section 316(b) analysis for the MKS permit".

Finally, CLF comments that EPA has estimated that implementation of closed-cycle cooling, the most expensive of the several superior technologies considered, would cost $14 million. In light of the significant environmental improvement that would result, the public uses protected, and the public and private investments that have been directed toward the protection of the Charles River over the last decade, $14 million would be a relatively small price to pay, in CLF's view. It is well established, according to CLF, that cost should not be a primary factor in a section 316(b) determination. CLF states that only where the costs of the technology are wholly disproportionate to environmental benefit can cost even be considered. In this instance, CLF believes that there is no question that the costs of even the most expensive technology (closed-cycle cooling) are insignificant compared to its environmental benefits. CLF argues that the Charles (River) is clearly a highly valued public resource, as evidenced by the significant amount of public investment in its protection, and that the environmental benefits associated with virtually eliminating entrainment and impingement, and thereby helping to establish a healthy fishery, would dwarf the costs of such measures.

Response to H40 and related comment: Mirant does not dispute the proposition EPA spelled out in the DD that EPA is obligated under CWA section 301(b)(1)(C) to ensure that a cooling water intake associated with a permitted discharge must meet state WQS. Nor does Mirant dispute the proposition that if the state properly applies its WQS to impose a requirement on a cooling water intake, it may do so as a condition on the activity as a whole associated with a

discharge requiring a state certification under section 401. *See also* 33 U.S.C. 1341(a)(1), 1341(d), and 1370(a). It is clear that both sections 301(b)(1)(C) and 401 authorize the Region to ensure that cooling water withdrawals are consistent with Massachusetts' water quality standards, because the permit must assure that the overall "activity" associated with a discharge will not violate applicable WQS. PUD No. 1 of Jefferson County v. Washington Dep't of Ecology, 511 U.S. 700, 711-12 (1994). EPA has recently reaffirmed this approach to applying WQS to cooling water intakes. See In re: Dominion Energy Brayton Point L.L.C., NPDES Permit No. MA 0003654, EPA EAB NPDES Appeal No. 03-12 at 175 n. 205 and 185 (Feb. 1, 2006). *See also* 40 C.F.R. §§ 125.80(d), 125.84(e), 125.90(d) and 125.94(e); *Riverkeeper v. EPA,* 358 F.3d 174, 200-02 (2nd Cir. 2004). Therefore, the Region will not elaborate upon the framework of federal law under the Clean Water Act that gives EPA and the state authority to impose conditions on Mirant's cooling water intake based on the state's WQS, because Mirant has not preserved those issues for challenge.

Instead, Mirant disputes whether Massachusetts has any applicable laws that give MassDEP authority to govern cooling water intakes, whether there is any standard in Massachusetts law that applies to an intake, and finally, whether Massachusetts has made a finding that the technology requirements in EPA's 316(b) determination are insufficient to assure attainment of that standard.

Mirant is mistaken if it is asserting that Massachusetts' WQS must specifically address cooling water withdrawals in order to assert Ssection 401 certification authority over those withdrawals. The Supreme Court has held that Section 401 may be invoked to protect designated uses. PUD No. 1, 511 U.S. at 723 (upholding state certification conditions to protect designated use of fish habitat). See also id. at 714-718 (rejecting arguments that a state may only require compliance with specific criteria). Thus protecting the designated uses in the Basin is an appropriate basis for intake limits under Ssection 401, even if cooling water withdrawals are not explicitly mentioned in the Massachusetts WQS. Again, EPA's Environmental Appeals Board recently confirmed that cooling water intakes may be regulated to protect designated uses. Dominion at 186-188.

In the litigation leading up to the EAB's opinion in Dominion, the MassDEP carefully explained how state water quality law applies to cooling water intake structures. See Amicus Brief of the MassDEP in Support of EPA NPDES Permit No. MA003654 at 5-11 (Dec. 22, 2003) and Supplemental Amicus Brief of the Massachusetts Department of Environmental Protection in Response to Briefs Filed by USGen and UWAG in Support of USGEN's Appeal of EPA NPDES Permit No. MA003654 at 5-8 (June 24, 2004). First, the Massachusetts Clean Water Act provides that "no person shall engage in any other activity which may reasonably result, directly or indirectly, in the discharge of pollutants to waters of the [state] without a currently valid permit from the Department. " M.G.L. c. 21, s. 43(2) and 314 CMR 3.04. MassDEP's position is that the cooling water withdrawal associated with a once-through cooling water operation is an integral component of the "activity" that directly results in a thermal discharge. Therefore, the cooling

water withdrawal is an activity subject to regulation under the permit that MassDEP must issue to authorize the discharge of thermal pollution under the Commonwealth's Clean Water Act. Second, the state's CWA provides that MassDEP water permits may specify "technical controls and other components of treatment works to be constructed or installed . . . which [DEP] deems necessary to safeguard the quality of the receiving waters." M.G.L. c. 21, s. 43(7). "Treatment works" is broadly defined to include "any and all devices, processes and properties, real or personal, used in the collection, pumping, transmission . . . recycling . . . or reuse of waterborne pollutants." M.G.L. c. 21, s. 26A and 314 CMR 3.02. MassDEP concluded that a cooling water intake structure constitutes an integral component of a facility's once through cooling water "treatment works," and therefore, MassDEP has further authority to regulate such structures.

In its water quality certification letter issued under CWA § 401(a)(1), MassDEP has reiterated the above reasoning in support of its conclusion that its water quality standards may be applied to govern CWIS limits in the permit (see Massachusetts WQC). EPA sees no reasonable basis for disregarding MassDEP's considered interpretation of the scope of its authority under Massachusetts law to regulate or condition the operation of a cooling water intake structure.

In its water quality certification, MassDEP also explained how it derives the appropriate regulatory standard from its water quality standards to use in developing requirements for cooling water intakes. MassDEP has designated the Basin as a Class B water. Under the state's water quality standard regulations

> [e]ach class is identified by the most sensitive, and therefore governing, water uses to be achieved and protected. Surface waters may be suitable for other beneficial uses, but shall be regulated by the Department to protect and enhance the designated uses.

314 CMR 4.05(1). Thus the state's water quality standards include designated uses which must be protected in a NPDES permit, or correspondingly, in any state certification the Department makes under section 401 of the federal CWA. For Class B waters, the applicable standard includes the following designated uses: "These waters are designated as a habitat for fish [and] other aquatic life . . .." 314 CMR 4.05(2)(b). Though the standard for Class B waters does not include any specific numerical criteria that apply directly to cooling water intakes, it is nevertheless clear that MassDEP must impose the conditions it concludes are necessary to protect the designated uses for the Basin and ensure that it remains a "habitat for fish [and] other aquatic life."

The fact that the Class B standard also includes "compatible industrial cooling and process uses" does not override the requirement to protect the Basin's use as a "habitat for fish." First, by its terms, the Class B standard requires that any industrial cooling use be "compatible." This qualification is most naturally read as a requirement that industrial cooling uses must be

compatible with the other uses included in the standard, including the use as a fish habitat. Therefore, it is consistent with the Class B standard to operate a cooling water intake in the Basin, but that intake must not impair the ability of the Basin to provide a "habitat for fish." Second, section 4.05(1) of the Massachusetts standards provides that each water classification "is identified by the most sensitive, and therefore governing, water uses to be achieved and protected." This provision is most naturally read to require that where a standard lists several uses, the most sensitive of those uses will effectively govern the permit requirements necessary to protect that use and achieve the water quality standard. Again, the state's water quality certification letter spells out this line of reasoning.

MassDEP has included in its Section 401 state certification requirements that the permit contain certain conditions requiring Kendall Station to reduce mortality to aquatic organisms from both impingement and entrainment. The impingement-related provisions essentially mirror the technology-based requirements already included in the permit by EPA. The requirements of the water quality certification related to entrainment reduction, however, go beyond the federal technology-based requirements already included in the permit by EPA. MassDEP has concluded that the permit must address entrainment by the CWIS because the permit conditions EPA has imposed pursuant to 316(b) to address impingement would be insufficient to ensure that the waters in the Basin would continue to provide an adequate habitat for fish and other aquatic life consistent with the state's water quality standards. MassDEP bases this conclusion on the nature of the entrainment effects of the Kendall Station CWIS, as discussed in the state's water quality certification letter. EPA is including these entrainment-related requirements in the Final Permit as water quality-based requirements.

As outlined above, CLF is correct that the permit must protect the applicable WQS. EPA agrees that the permit must address any conditions the state includes in its 401 certification to protect water quality and that EPA must make an independent determination that the permit's limits are adequate to protect WQS, even if the state does not include any conditions in its certification. In this case, the MassDEP's water quality certification specifies permit conditions for controlling impingement and entrainment that the state deems necessary to satisfy its water quality standards applicable to the Lower Basin of the Charles River. Consistent with the discussion above, EPA has included these water quality-based provisions in the permit consistent with CWA § 401.

With respect to the technology identified as BTA at Kendall Station – namely, a barrier net system – in connection with the Phase II Rule, EPA has studied the efficacy of various technologies designed to minimize the impact of cooling water intakes. The Technical Development Document for the Section 316(b) Phase II Final Rule (TDD) includes a discussion of aquatic microfiltration barriers similar to the system this permit requires. The TDD can be found at http://www.epa.gov/waterscience/316b/devdoc/final/ch4.pdf , see sec. 2.5 at 4-15 and 16, and pp. A-30 to A-32 of Attachment A to Chapter 4. There is evidence these systems can

reduce intake velocities to very low levels and, as a result, greatly reduce (perhaps nearly eliminate) impingement of juvenile and adult fish. It also appears that, depending on the relative sizes of the net's mesh and the eggs and larvae of concern, barrier nets may be able to reduce the entrainment of eggs and larvae. In the case of Kendall Station, given the mesh-size proposed by the facility, it is expected that when it is deployed, the barrier net would prevent the entrainment of some species' larvae but not others and would not prevent the entrainment of fish eggs. It also appears that the proposed setting for Mirant's barrier net system should avoid the difficulties of using the technology in a marine setting that were noted in the TDD. Therefore, EPA and MassDEP have concluded that this system shows promise for helping to protect the Basin's use as a habitat for fish. The system's performance and the health of the ecosystem will have to be further assessed over time to determine if different or additional conditions are needed in future permits to satisfy CWA § 316(b) and state WQS.

EPA disagrees that this determination is inconsistent with the Clean Water Act and state water quality standard antidegradation requirements. The core requirement here is that "[i]n all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." 314 CMR 4.04. Installing the BNS will only improve the Basin as a habitat for fish, by reducing entrainment and impingement mortality. Massachusetts has provided a 401 certification specifying the conditions on the cooling water intake, including the specified entrainment reduction requirements, that are required to satisfy the Commonwealth's WQS, including the antidegredation provisions. EPA has included these conditions in the Final Permit. With respect to cooling towers, as EPA explained in Response H1 above, EPA has determined that converting the facility's cooling system to closed-cycle cooling would not be practicable at this site, at least at this time.

Finally, CLF expresses concern about the lack of a quantitative analysis of cumulative impacts on the ecosystem. While it is true that EPA did not conduct a quantitative analysis of the cumulative impacts on the fish habitat in the Basin from this permit and other stresses on the ecosystem, EPA did consider those impacts. This permit carefully limits the temperature impacts of the discharge. Furthermore, if the comments of Mirant prove to be accurate, those temperature limits will have the effect of limiting the amount of heated water the facility can discharge precisely during those times when the Basin is most stressed by heat. That heat limitation will have the corresponding effect of limiting the amount of cooling water the facility can withdraw. EPA has concluded that the cumulative effect of the permit conditions, the combination of the BNS and the heat discharge limitations, should substantially improve the Basin as a habitat for fish as compared with the current permit requirements and should protect that use consistent with the Massachusetts WQS.

I. Response to Comments Concerning Monitoring and Reporting Requirements

Comment I1: Mirant asserts that the monitoring requirements in the draft permit are excessive and unnecessary, providing specific examples in later comments.

Comment related to I1 from Riverways: MA Riverways is not supportive of this large variance in maximum temperature and delta T but agrees with EPA's suggestions to develop an extensive monitoring program.

Response to I1 and related comment: EPA has received a number of comments regarding the scope and nature of the monitoring program, with some commenting that the requirements are excessive and others that it is appropriate or lacking in some aspects. Because Mirant Kendall elected to discontinue modeling efforts in favor of an approach based on real-time compliance, in-stream temperature limits and real time monitoring are essential to providing a means to detect and react to temperature increases above protective limits in a timely manner. Biological monitoring of fish species impacted by the Mirant Kendall facility location and operations are appropriate in order to document that established limits are sufficient to protect the BIP in this water body. EPA has considered each comment, and in consideration of a number of the comments, EPA has altered the monitoring requirements in the permit (see response to comments I8, I10, I14, I16, I19 and comment related to C7 from CLF).

As explain in the response to C3 and elsewhere, the documented thermal heatload discharged from Kendall Station has degraded the habitat for alewife, resulting in appreciable harm. EPA has worked closely with the permittee, incorporating many of its suggestions (see Mirant Correspondence, May 11, 2001, AR #286 and Mirant In Stream Water Quality And Biological Monitoring During Project Operation, Draft Discussion Document, August 30, 2001, AR #288) to tailor the biological monitoring plan requirements to gather the necessary data to ensure that the fish species, discharge effects and cooling water intake structure (CWIS) impacts in the receiving water are adequately monitored and that aquatic life is protected from the long term and short term consequences of changing environmental conditions.

In developing this monitoring plan, EPA has also consulted the U.S. EPA NPDES Permit Writers' Manual (December, 1996; AR #579) on this topic, which indicates that "the frequency of monitoring pollutants should be determined on a case-by-case basis." (page 119) Among the factors to consider in determining monitoring conditions include effluent data for the facility and the variability of the discharge, with a variable discharge requiring more intensive monitoring. In this regard, EPA has also fully considered all data (from both field and laboratory studies) submitted by the permittee, as well as the characteristics of the water body. EPA has also considered costs and other consequences of monitoring.

Characterizing the impacts of the thermal discharges from this particular facility is not straightforward for the following reasons. First, Mirant Kendall has not submitted a verified hydrodynamic model to predict in-stream temperatures in the lower Basin with changes in

thermal loading from the Station. Without an acceptable model to predict with reasonable confidence the Station's impact on the receiving water under a variety of conditions, there is greater uncertainty regarding the facility's impacts to the Charles River. Second, the amount of thermal discharge is large for the size of the receiving water body. Third, the facility discharges to a confined area so that the intake water temperature can be influenced by the facility's own thermal discharge, causing a continuing increase in the discharge temperature. Fourth, EPA expects that the facility will potentially increase capacity utilization to approach full load for longer periods of time, so past performance and impacts are not reliable indicators of future impacts. The permittee's permit renewal application (Mirant, February 2001, AR #453) stated the intent of the facility to increase electricity generation. Heatload data subsequently submitted by the permittee for the summers of 2004 and 2005 confirmed this increase in production. Since this facility is highly dependent on market demand for power, EPA cannot be confident of future estimates of reduced levels of generation. (See responses in Section B.) And finally, this water body provides habitat to ecologically and recreationally important species. Protective technologies such as cooling-water towers and/or a well developed, verifiable hydrodynamic model might reduce the need for some of the required biological monitoring. However, with the continued and variable thermal discharge, and in consideration of the previously listed factors, the level of biological monitoring required in this permit is appropriate.

Mirant Kendall mistakenly claims that the permit requires biological monitoring that "far exceeds any monitoring or sampling requirements in any other NPDES Permit." A few examples of NPDES permits in the region that in the past required or currently require approximately the same level of biological monitoring as well are: Pilgrim Nuclear Power Station (MA0003557), Brayton Point Station (MA0003654) and Seabrook Nuclear Power Station (NH0020338). Finally, legal authority for all monitoring requirements in this permit derives from sections 308 (monitoring, reporting and entry) and 402 (National Pollutant Discharge Elimination System) of the Clean Water Act.

EPA acknowledges the Riverways comment indicating agreement with scope of the monitoring program developed by EPA in the Draft Permit. EPA's responses to other Section I comments provide the rationale for the noted reductions in monitoring in the Final Permit.

Comment I2: Mirant asserts that it is unnecessary to install an expensive and elaborate monitoring network as a long-term permit requirement, particularly if Mirant receives authorization to use the proposed new outfall and diffuser. If use of the new outfall and diffuser is allowed by the final permit or in the future, Mirant Kendall acknowledges that intensive monitoring of the type that has been in use since 2001 is appropriate for a period of initial operations, but there is no need or reason to require the program as an indefinite permit requirement.

Response to I2: Mirant Kendall misstates the reason for the network of real-time, in-stream monitoring buoys and related requirements. The real-time continuous temperature monitoring program was not established in order to address uncertainties about the horizontal and vertical dimensions of Kendall Station's thermal plume. As supported by the record, explained in the

Final Permit, the DD, and in this response, this monitoring program was originally proposed and is required because the permittee failed to submit a hydrodynamic model which predicted with confidence the relationship between the end-of-pipe discharge temperatures from Kendall Station and the resultant temperatures at key locations in the receiving water. Resultant receiving water temperatures at key locations (i.e., the ZPH) must remain at or below protective temperature limits in order to assure that the BIP is protected. Other aspects of the monitoring program are essential to properly document that the established permit limits do not allow appreciable harm. As explained in the permit and DD, monitoring information from the temperature stations will assess compliance with the in-stream temperature limits, the delta Ts and the maintenance of the ZPH. The real-time component of the program is essential because it is the only way to allow Kendall Station to modify operation in a biologically meaningful time period when permit limits are exceeded. This real-time monitoring program is a common feature at power plants which have effluent temperature monitoring requirements, such as Brayton Point Station in Somerset, MA (MA0003654) and Sithe Mystic Station in Everett, MA(MA0004740). The MKS permit has additional instream monitoring because a reliable model for temperatures was not available, as there was for the Brayton Point Station permit.

If the permittee can supply predicted temperatures for key areas of the lower Basin (ZPH), based on Station discharge temperature and river flow, as would be generated from a verifiable hydrodynamic model, EPA would work with the permittee to substitute this information for the real-time continuous monitoring program now necessary to obtain this information with confidence. This could be accomplished by a permit modification after Mirant has produced such a verifiable model.

Monitoring that was proposed for metals in Part I.A.14.d. has been removed. The purpose of this monitoring was to assess the potential release of metals from the sediments into the water column resulting from the installation and operation of the proposed outfall diffuser. If the outfall diffuser is approved at a later date, then periodic monitoring for metals, as well as other parameters, will be established at such time.

Comment I3: Mirant asserts that the Agencies should reconsider the amount of monitoring and reporting they propose and scale it back to a level commensurate with Kendall Station's size and actual impacts. Further, they should also consider the extensive biological monitoring Mirant Kendall submitted to the Agencies showing that the discharge has not had any significant adverse effects.

Response to I3: In response to this and other comments, EPA has considered each monitoring requirement and have made appropriate adjustments. See response to comments I8, I10, I14, I16, and I19 regarding these adjustments. See the response to Comment I1 and other individual responses in Section I for factors used in maintaining most monitoring and reporting requirements. See response to comment C3 and elsewhere regarding EPA's finding of appreciable harm and adverse impacts. In recognition of the value of push-net data as described in response to C3, the requirement for continued annual collection of push-net data has been included in Part 14.d.1 of the Final Permit.

Comment I4: Mirant asserts that in-stream, real-time monitoring around the intake using monitoring buoys is unnecessary. Mirant asserts that 24-hour average temperatures measured by the existing continuous monitors in the Broad Canal intakes are adequate. Further, continuous, periodically downloaded thermistor data from elsewhere in the ZPH can also provide the necessary in-stream data.

Response to I4: It is not clear from the comment which monitoring buoys Mirant is referring to, as no monitoring stations are required in the Broad Canal around the intake. However, monitoring at the locations required in the permit is appropriate as described in the DD and as modified in the Final Permit. With the approach that EPA has used to delineate the ZPH, EPA has justified that monitoring at these points is necessary to verify compliance with the permit limits. In fact, the reason there are no monitors required at the intake is because this area is not representative of current ambient conditions. Historic water quality information (DD Section 5.9.2b) demonstrates that the thermal plume from the discharge periodically travels to the Broad Canal Intake and is partially re-entrained, which results in intake temperatures that do not accurately reflect ambient, background temperatures. In addition, the thermal plume from the Station has been documented upstream of the Station, upstream of the Longfellow Bridge, and has been measured as far upstream as the Harvard Bridge and beyond. Thus, the establishment of a background monitoring location near the Boston University Bridge is necessary to adequately characterize background temperatures.

Continuous monitoring of the temperature and real-time access to those data in the ZPH is a core requirement of the established monitoring program. This requirement is necessary so that the facility will become aware of exceedances of protective temperatures and will act in a biologically meaningful time period to stay in compliance, thereby limiting adverse effects to the balanced populations of aquatic species in the lower Charles River Basin. The ability of Kendall Station to use the real-time monitoring information to moderate its discharge quickly, when necessary, is a key capability that cannot be duplicated with the temperature system proposed by the permittee. Its periodically downloaded thermistor system contains time delays in data availability which would result in an unacceptable risk that protective temperatures would be exceeded for long periods between data downloads.

Also, as EPA understands the existing continuous monitor at the CWIS, the water temperature at this location is measured after a column of water approximately 12 feet deep (from the surface to near the bottom of the canal) is first mixed and pumped into the Station. A water temperature taken from an "average" of this column of water is not appropriate for habitat characterization in the ZPH.

A 24 hour averaging period is neither sufficient nor scientifically justifiable for maximum temperature compliance. Instead, it is more justifiable to average temperature data over six discrete four hour blocks per day (00:00 [midnight]-03:59, 04:00-07:59, 08:00-11:59, 12:00-15:59, 16:00-19:59, 20:00-23:59) at discrete locations in the water column. Time averaging the water quality data in this manner will dampen the typically observed natural fluctuations in water temperature caused by solar radiation and overnight cooling in the lower Basin. Not only will the

four-hour averaging period provide the permittee with a more stable temperature basis to predict trends, but will also allow sufficient time for the permittee to take operational action to reduce thermal input to the river when necessary to comply with established temperature limits. Based on a review of historical continuous temperature data collected in the lower Charles River Basin from 1994 through 2002, granting a four hour average temperature for the purpose of permit compliance will not compromise the protection and propagation of a balanced population in this water body. See also response to D3 concerning 4-hour averaging.

Comment I5: Mirant asserts that continuous monitoring far upstream is inappropriate and unnecessary. Areas upstream have very different stratification patterns than the waters in the proposed ZPH, so that comparison between those areas is an unreliable basis for evaluating the effects of the discharge. Further, Mirant asserts that due to confounding environmental conditions, it is inherently arbitrary to propose that temperatures in the ZPH should never have more than a 5º F difference from upstream monitoring points.

Mirant Kendall suggests that protection of the BIP can be accomplished by monitoring the area and boundaries of the ZPH. Conditions at an upstream point in the river having different physical characteristics than the ZPH should not define "ambient" conditions.

Comment related to I5 from CRWA: CRWA states that temperatures measured at the Background Station (Station 1) will not represent ambient conditions, due to the presence of MWRA's Cottage Farm CSO Facility, and recommends that Station 1 be moved upstream to avoid the influence of Cottage Farm.

Comment related to I5 from CLF: CLF asserts that it is not sufficient to use just one station to establish background temperatures. Therefore, a minimum of four background temperature monitoring points, including 3 above the BU bridge, should be used and compared at all times so that aberrant measurements can be detected, and so a clear picture of the inflowing thermal conditions can be obtained.

Response to I5 and related comments: EPA has received conflicting comments regarding background temperature monitors. The permittee raises concerns with the concept, need, and applicability of background temperature monitoring anywhere outside the ZPH. CRWA recommends that the background station be placed even further upstream to avoid interferences with other possible thermal sources. CLF suggests increasing the number of background monitoring stations from one to four.

As discussed in Response I4, the periodic upstream movement of the thermal plume and potential for re-entrainment of that plume by the intake requires that an upstream monitoring station be established and located to allow characterization of the ambient, background temperatures outside of the influence of the thermal plume. Based on available data, establishment of a background location near the B.U. Bridge, taken as 24 hour average, is necessary to adequately characterize background temperatures. Although there could be other factors that may periodically affect the data collected at this station, such as CSOs or other

thermal discharges, for the majority of the time, this station is the best option for characterizing background conditions. The disadvantages to moving the station upstream is that there is a change in flow and stratification patterns as the Charles River assumes more riverine characteristics upstream of the B.U. Bridge. The disadvantage to moving the station downstream is that there is a greater chance that the temperature is influenced by the facility's thermal discharge. The location selected in the Draft Permit represents the best location, balancing these factors. Regarding depth, the Charles River near the B.U. Bridge has sufficient depth (approximately 15 feet compared to the Station's intake which withdraws from about the top 12 feet of the water column) to serve as a useful background station. Regarding the number of background stations, one background station for temperature monitoring in this case is necessary and sufficient based on the expected variation in the river temperature. Furthermore, river users who provided feedback regarding floating buoys in the river, recommended installing the fewest number of monitors possible to reduce navigational obstructions to the boating community. If evidence is found that any of the fixed Monitoring Stations were not placed in the appropriate location, there is a mechanism in the permit to correct this situation. Please see Response C4 for additional information.

The Delta T of 5˚F for establishment of monitoring stations along a transect was used in the permit to reflect the intent of state temperature and mixing zone regulations. ("Transect", in this case refers to the permit's requirement for "Four fixed monitoring stations, spaced at equidistant points along a bank-to-bank transect that coincides with the location where the thermal plume impacts the greatest cross-section with a delta T of 5 ˚F or greater, as indicated by the permittee's predictive model. Stations 3 through 6 will be equally spaced along the transect, with Station 3 being closest to the Boston side and Station 6 being on the Cambridge side. (see Part 14(b)(2) and Attachment B)." A Delta T of 5˚F as compliance for this monitoring is well supported and has been generally accepted as a reasonably protective thermal limit and has been included in several NPDES permits and is consistent with state WQS. Under the Massachusetts water use classification system, MassDEP has designated the lower Charles River Basin as a Class B water (314 CMR 4.00). Class B waters are designated as a habitat for fish, other aquatic life, and wildlife and for primary and secondary contact recreation. The state WQS provide that, for such a warm water fishery, the temperature shall not exceed 28.3 ºC (83 ºF), and the rise in temperature due to a discharge shall not exceed 2.8 ºC (5 ºF), based on the minimum expected flow for the month. Because the permittee would likely be unable to meet a Delta T of 2.8 ºC (5º F) at the point of discharge or at the boundary of a mixing zone conforming to WQS, a Section 316(a) thermal variance has been requested by the permittee and granted under the conditions of this NPDES permit. See also responses concerning the 5 ˚F Delta T in Section D.

The 5 ˚F maximum Delta T required in this permit is taken from a 24 hour average of the 2 foot and 6 foot depth temperatures combined at the background station (Station 1) compared with the same time period and depth averaging at Stations 2, 3, 4 and 8. An exception applies to the depths used for Delta T compliance at Station 7. Any concern regarding different depths of stations compared with the background station is not well founded, as the target of the Delta T compliance is the 2 foot to 6 foot water depth column, which makes up a portion of the water column withdrawn by the Station's CWIS. The 2 foot to 6 foot deep water column of the river

also contains most of the thermal plume of the Station's discharge.

Comment I6: Mirant Kendall asserts that there is no basis for the proposed requirements to conduct daily, year round inspections of the Broad Canal and Charles River nor do they feel the required responses if 25 or more dead fish are observed in a 24 hour period are justified. Mirant agrees that it is reasonable to report unusual impingement events and to report the fish caught in its rotating screens, but there is no warrant for imposing a separate requirement for Mirant Kendall to conduct inspections of the Broad Canal and the Charles River for impacts related to the thermal discharge.

Further, Mirant Kendall asserts that there is no reason to expect fish kills from unit chlorination operations or the thermal component of the discharge. Mirant Kendall claims that there is no evidence that the plant's discharge has been or would be responsible for any fish kills in the past. Therefore, the proposed requirements would mandate plant curtailments even if a fish mortality event clearly was not related to the plant's operations.

Mirant Kendall also disagrees with the vaguely defined term "dead fish", and that a more biologically accurate definition of a dead fish is: "a fish that shows no body or opercular movement and that does not respond to gentle prodding."

Comment related to I6 from CLF: CLF asserts that this standard should be set based on what one expects to observe as a significant fish kill in a healthy portion of a river. Observation of 5 dead fish within a 24 hour period is a more realistic standard.

Response to I6 and related comment: EPA is requiring Mirant to monitor and react to fish kill events in part because Mirant's discharges have the potential to compound the impacts of other environmental stressors. This could potentially lead to mortality events when weakened fish enter the discharge area. (CFR 40 CFR 125.73(a) requires EPA to consider "the cumulative impact of [the applicant's] thermal discharge together with all other significant impacts on the species affected"). Upon observing fish mortalities sufficient to require notification, the permittee is required to suspend all unit chlorination operations, and if the discharge temperature is greater than 95 ˚F, the permittee must reduce the discharge temperature to no more than 95 ˚F within two hours of such observation. The quick reduction of heat and chlorine loads to the river (when the threshold number of dead fish is observed) is designed to allow for recovery of stressed individuals and help to minimize the length and severity of such an event, even if Kendall Station is not thought to be directly or solely related to the initial fish kill.

EPA has evidence that discharge temperatures have, in the past, exhibited lethal levels for certain life stages of fish (see Response to F4 (part 2) and related comment from CLF). Furthermore, since there was previously no requirement for routine monitoring of these areas, and since the permittee has presented no data on fish kill monitoring, the permittee cannot state with certainty that no fish kills have occurred as a result of facility discharges. One fish kill was documented on May 27, 1995 by the Massachusetts Division of Fisheries and Wildlife that was characterized as alewives during a spawning run. This fish kill occurred on the Cambridge side of the river in

the location of the first bridge below MIT, and extended one half mile up and down the river. Even if such events may not be directly or solely related to the facility operations, the potential cumulative effects on fish warrant monitoring and action. Thus, EPA is requiring fish kill monitoring in the lower Charles River Basin in the vicinity of the Station.

EPA acknowledges that levels of chlorine are expected to meet in-stream water quality standards under most conditions, but at flows approaching the 7Q10 flow of 22 cubic feet per second (cfs), the chronic WQS for total residual chlorine is likely to be exceeded. This exceedance could contribute to fish stress and increase mortality. This determination was based on the permittee's chlorine modeling discussed on Page 26 of the Fact Sheet. In addition, as discussed in various sections of the DD and the records of 2004 and 2005, EPA has evidence that the permittee's operation has increased to approach full load and has been maintained for longer periods of time than during previous operation (see also Responses to B1, B2 and C3). This level of operation results in high effluent temperatures for longer periods of time and increases thermal stress on various life stages of fish. Therefore, it is appropriate to have the permittee inspect the discharge areas daily for fish kill incidents so that the circumstances related to these events can be thoroughly investigated.

EPA used BPJ to determine the threshold for fish kill reporting (i.e., "25 or more dead fish within a 24 hour period"). This number is large enough to avoid small, localized or natural mortality factors, yet is sufficiently protective to avoid a large number of fish being killed by facility discharges before operations are reasonably modified and the kill is investigated. EPA agrees with the CLF comment that the threshold for action should be based on what would clearly distinguish a significant fish kill from a healthy river, and EPA has attempted to do this in the permit. The number of fish likely to be observed during a mortality event is expected to be some percentage below 100%, as dead fish sink into the limited visibility of the Charles or move downstream with the current. Therefore, an observation of 25 dead fish in 24 hours would likely be indicative of a moderate to large fish kill. This threshold will act as an important trigger that would alert facility personnel that an unusual mortality event is occurring. This facility is located on an important and heavily used water body that provides habitat for recreationally and ecologically important fish species. In addition to the harm to the fish themselves, such a fish kill would also impair the public's ability to use the water for recreation. 25 or more dead fish floating down a narrow, highly visible, recreationally-active segment of the Charles River would interfere with, and possibly render the segment unsuitable for, recreation.

The permit's definition of a "dead fish" (as one that exhibits a loss of equilibrium) will serve as a reasonable trigger that an unusual event is in its early stages. The earlier a fish kill event is detected, the greater the chances that the cause can be determined and appropriate action be taken to minimize the duration and severity of the event. In the case of Kendall Station, reducing the impacts of thermal stress and chlorination at the onset of a fish kill event would likely minimize the number of fish killed, regardless of the primary cause of the fish kill. The ecological function of a fish is severely limited when it is stressed to the point to lose equilibrium and it is not likely that such fish will recover unless the stress is reduced or the stressor is eliminated. Therefore, setting the mortality threshold at the point where 25 or more

fish are sufficiently stressed to lose equilibrium will provide sufficient protection to the fish community by alerting facility personnel that a fish kill event is occurring.

Comment I7: Mirant Kendall contends that the fluorometric methods proposed will yield data that have no consistent correlation with actual chlorophyll *a* levels. Mirant Kendall has submitted data to the agencies showing comparative results which indicate a wide variance between noncorresponding fluorometric and the spectrophotometric results. Therefore, Mirant Kendall asserts that the fluorometric method fails to consistently provide meaningful data. Absent the diffuser, the Agencies must justify why this sampling is necessary.

Response to I7: Mirant Kendall's analysis of the relationship between fluorometric and spectrophotometric chlorophyll *a* data is inconclusive because the fluorometric data were reflective of chlorophyll *a* from both dead and live algae, while the spectrophotometric data were corrected for phaeophytin and represent chlorophyll *a* from only live algae. EPA has learned from reviewing MWRA's chlorophyll *a* data collected from the Basin that the relative percentage of live algae to total algae varies considerably in the Basin (MWRA data 1997-2004). Therefore, it is not surprising that Mirant Kendall's analysis would yield such inconsistent results.

In-situ fluorometric chlorophyll *a* monitoring is credible and could provide reliable data to evaluate algal levels in the lower Basin under a variety of environmental conditions. Moreover, the Draft Permit proposes that the fluorometric data would be collected by identical instrumentation and would be used to make relative comparisons of chlorophyll *a* between an upstream station, where the thermal impacts from the facility are minimal, and a downstream station that is located near the discharge.

EPA has evaluated the ambient temperature and chlorophyll *a* data from the lower Basin and notes that a consistent relationship between temperature and chlorophyll *a* at upstream and downstream stations in the lower Basin is not evident. Other factors including settling, wind induced flow circulation patterns, and the monitoring stations proximity to local nutrient sources are likely causes for the apparent lack of a consistent relationship between chlorophyll a and temperature in the lower Basin. However, after reviewing EPA's 2005 data which were collected during prolonged periods of high thermal loading from the Kendall facility, EPA has reconsidered and removed the requirements in the Final Permit for continuous in-situ chlorophyll *a* monitoring of the lower Basin. The ambient data reviewed are inconclusive for evaluating the effects of the thermal discharge on chlorophyll *a* levels in the downstream portion of the lower Basin. Despite the consistent increase in temperature moving from the upstream to the downstream station, the chlorophyll *a* concentrations are sometimes higher and sometimes lower at the downstream station. At present, other factors, such as nutrient availability, are likely to be more important for algal growth in the lower Basin than temperature. However, as nutrient reductions continue to be made from watershed sources, temperature may become more important and requirements for continuous in-situ chlorophyll *a* monitoring will be re-evaluated for future permitting decisions for this facility. In near future, during the life of this permit, EPA will evaluate the monitoring data collected under other requirements of the Final Permit along

with data from other sources to assess whether the thermal load from the facility is causing chlorophyll *a* to increase noticeably in the downstream portion of the lower basin. EPA has noted from water quality data reviews collected from the Basin that algal blooms consistently occur in the Basin through most of October. As a result, the monitoring period for weekly nutrient and phytoplankton monitoring requirements is extended in the Final Permit to include the month of October. The October data are needed to assist in the assessment of whether the thermal discharge is contributing to algal-related water quality impairments during this period of the growing season.

Comment I8: Fish Mortality Requirements – Mirant Kendall asserts that Agencies' description of inspection area is vague. The more well-defined term "Zone of Initial Dilution" should be used to describe the area that the permittee must visually inspect. As understood by both the Agencies and the permittee, the "Zone of Initial Dilution" contains the area bordered by proposed Monitoring Station 2 at the upstream edge, and proposed Monitoring Stations 3 to 6, at the downstream edge.

Response to I8: This description of the area to be inspected for fish mortality is agreeable to EPA. Therefore, the permit has been modified to delineate the required fish mortality inspection area as the "Zone of Dilution", defined as follows in Part I.A.12 of the Final Permit: "the area bordered by proposed Monitoring Station 2 at the upstream edge, and proposed Monitoring Stations 3 to 6, at the downstream edge."

Comment I9: Mirant Kendall asserts that the proposed responses to finding 25 dead fish in the inspection area would have significant impact on the plant's operations, which means the Agencies must justify why they have selected 25 dead fish/day as the threshold for imposing those impacts on the plant. Further, the Agencies should reconsider use of an absolute number of dead fish as the basis for requiring a response from the plant, and develop a more biologically based approach that accounts for the seasonal variations in the presence of fish in the Charles River or significant departures above a baseline, similar to impingement reporting requirements.

Response to I9: As previously outlined in response I6, EPA selected "25 or more dead fish per day" in this and other permits because this number of dead fish represents a level of mortality that is unlikely to be due to small, localized events and/or natural phenomena, and therefore should be reported as required in the permit. EPA has used BPJ in determining that "25 or more dead fish per day" should be reported to provide adequate protection of the fish community, and to also allow the facility and agencies to follow up accordingly. EPA is not opposed to the concept of setting a more "biologically based approach." However, the permittee has provided no evidence or fish kill monitoring information at this facility to establish baseline levels of mortality or the seasonal deviations suggested by the permittee. Daily monitoring data for fish kill events over the course of several years is required to describe a baseline over a range of conditions. EPA will be open to suggestions, based on the community ecology of the Charles River and the number of dead fish documented as a result of this required surveillance program, once this type of data is gathered and analyzed.

Comment I10: Due to the variation in past studies, the Agencies must be explicit in defining the sampling time, frequency, location, and methods for annual biological monitoring. Furthermore, Agencies must justify the permit requirement for an ongoing monitoring program of the scale that Mirant Kendall voluntarily conducted as it sought to document the condition of the Charles River during 1999 to 2003.

Mirant Kendall is not opposed to conducting biological monitoring but the permit should require an annual biological monitoring program for approval by the Agencies, commensurate with a need for new information due to changes in the facility's operations and a biologically defensible assessment of the potential effects.

Comment related to I10 from CLF: CLF asserts that there is such an obvious conflict of interest in allowing the permit holder to conduct monitoring that any biological, or other environmental, monitoring data collected by the permit holder will be of little scientific value. Data generated in this fashion, with no peer review or other rigorous system for checking its fidelity, is not credible. The permit should require that the applicant provide the funds required for sound scientific monitoring by MassDEP, or another neutral party to be selected by MassDEP.

Response to I10 and related comment: On one hand the permittee appears to be requesting more specificity in explicitly defining sampling times, frequencies, locations, and methods, while on the other hand the permittee appears to be seeking the flexibility to adapt the monitoring plan to changes, including changes in facility operations. EPA has used the data submitted by the permittee, other information and BPJ to develop and tailor a monitoring program which is appropriate to effectively characterize the effects of the discharge and intake as well as ensure compliance with permit limits. It also attempts to address these concerns of the permittee for providing an annual assessment of possible changes as provided in Part I.A.14.f of the permit. Specific sampling frequencies, locations, and methods are not identified by the permittee in this comment. See response to I1 for an overview of the justification for the monitoring program, and, for more responses to more concrete comments, see responses to other comments in this section.

In consideration of the permittee's comment regarding an "excessively vague" proposal to require annual biological monitoring under similar sampling time, frequency, location, and methods used in past sampling conducted by the permittee in 1999, 2000, 2002, and 2003, EPA agrees this requirement is not clear, as there were many significant variations in the sampling conducted by Mirant in 1999, 2000, 2002, and 2003. The applicable permit provisions in Section 14 have been clarified.

In addition, allowances are outlined in permit Section I.A.14.f for monitoring modifications which can be proposed and justified by the permittee and reviewed by EPA and MassDEP. Changes must be approved by EPA and MassDEP, however, before these changes may be adopted by the permittee.

Adopting the changes suggested by CLF would be a notable departure from standard NPDES program practice. The program relies on information collected by the permittee as part of its permit obligations. EPA recognizes the need for establishing and following protocols for data quality assurance and quality control and have including appropriate QA/QC provisions in the permit. Further, there are significant penalties for falsifying information and a required certification for reporting each discharge monthly report. Permit oversight is provided by the two permitting agencies with assistance from state and federal resource agencies. In this particular case, EPA, MassDEP and other state and federal agencies have spent significant time reviewing both the data generated by the permittee and the methods used in data collection. As a practical matter, EPA and MassDEP do not have adequate resources to conduct the monitoring required by NPDES permittees.

Comment I11: Mirant asserts that it would be more effective and meaningful to measure relative abundance, as opposed to estimating population size, as suggested by the Agencies. Standing crop could be estimated, but the significant imprecision and assumptions embedded within those techniques would cause the estimates to be entirely meaningless.

Response to I11: As stated in the permit, a primary objective of the annual biological sampling program is to identify any changes in fish populations and migration patterns resulting from facility operation. Preliminary surveys of in-migrating adult river herring in 2002 were likely of low accuracy due to problems that EPA recognizes; therefore, these data should only be used as a general estimate of population size. This estimate, however, was far below the estimated 203,000 adult river herring used by the permittee as part of an equivalent adult entrainment loss estimate at Kendall Station for 1999 and 2000 (see Table 8.1.2-3 in the DD), implying the potential for a marked impact by this facility on these populations. In order to make any determinations on the impact (or lack of impact) of the facility on fish populations, EPA requires more reliable population estimates. Alewife and yellow perch are the most temperature sensitive species that are presently found in Charles River sampling. Protecting these two species from harmful temperatures will allow for all other resident and anadromous species to be protected in the Charles River.

EPA does not agree that fish populations cannot be estimated in this waterbody in any meaningful manner. With improvements which build upon lessons learned from the 2002 population sampling, this is achievable. Population estimates do have inherent imprecision, as do all measurement techniques of natural phenomena, but population estimates are more useful than relative abundance data because both size and composition are considered in these methods. Relative abundance data could mask mortality problems that are occurring for a certain age class or sex within a population. Knowledge of such information could reveal an impact leading to a population decline that must be managed early in order to avoid a population crash. Also, there is precedent for estimating the populations of these species by the Massachusetts Division of Marine Fisheries. The approximate number of alewives and blueback herring, their size composition, age and sex ratios have been estimated as part of the Anadromous Fish Dynamics Program since 1984. This program was initiated due to the recognition that such estimates are a necessary and basic part of the development of fish stock assessments. Sampling of in-migrating

river herring and yellow perch for the purpose of making reasonable population estimates of these species is, therefore, a permit requirement. The accompanying assumptions associated with the methodology used by the permittee should be acknowledged and discussed in the Annual Monitoring report (AMR). The potential difficulties and variability associated with calculation of fish population estimates do not preclude the validity of this portion of the biological sampling program.

Comment I12: Mirant asserts that the Agencies must explain why installation of costly data buoys, capable of real-time transmittal of data is necessary for measuring compliance given that the thermistors currently in use are equally capable of measuring continuous water quality data for purposes of compliance. Further, the permit writer should consider the costs of sampling that are imposed upon the permittee.

Mirant does concur that some form of the currently proposed real-time, continuous monitoring and reporting could be reasonable if the Agencies authorize operation of the proposed new outfall and diffuser.

A single response is provided below for comments I12 and I13 and other comments related to real-time temperature monitoring and reporting.

Comment I13: Mirant asserts that the proposed real-time data transmission is a significant departure from other permits – not just the permits for water. The Agencies must demonstrate why this proposed real-time transmittal is warranted for this Permit, given the lack of any evidence of adverse impacts from Kendall's discharge, and given the lack of any demonstrated need for real-time transmission of data where thermistors are adequate for continuous measurement of real-time water quality.

Comment related to I13 from MA DMF: MA DMF asserts that EPA and MassDEP should consider having real-time water quality data available in public domain from a web site maintained by the permittee.

Comment related to I13 from CLF: CLF asserts that scientists, and other interested citizens of the Commonwealth, must be allowed timely access to any and all scientific data collected under this permit.

Response to I12, I13, and related comments: EPA has received several comments related to the requirement for real time temperature monitoring and reporting. Elements of this comment are also addressed in responses to Comments I1, I4 and I5.

EPA has determined that the real-time monitoring described in the permit is necessary and appropriately comprehensive in order to allow the permittee and the Agencies to react to permit exceedances in a biologically meaningful time period. This is not possible with monthly DMR reporting or discontinuous reporting. Because various life stages of fish species have been shown to be negatively impacted by exceedances of the permit limits, it is critical that any

violations are identified quickly, and appropriate measures are taken to ensure that such violations and associated harm to the BIP are minimized. With real-time monitoring, the facility is compelled to take immediate action to minimize impacts of exceedances. In making this determination EPA has considered a number of factors, including cost, uncertainties, equipment capabilities, the accessibility of web-based technology, and the facts and discussions presented in responses to Comments I1, I4 and I5.

As described in the response to Comment C3, data provided by Mirant demonstrates that numbers of alewife in the vicinity of the Station are reduced compared to those found in more distant and cooler portions of the lower Charles. Mirant has also provided EPA and MassDEP with site-specific data demonstrating that juveniles of this species avoid using areas as habitat when the water temperature in that habitat exceeds approximately 81° F. As a result of Kendall Station's discharge, portions of the lower Basin are periodically excluded as habitat for juvenile alewives.

Additionally, MA DMF has recently developed plans to re-introduce American shad into the lower Basin. This species has even lower tolerance to elevated temperatures than does the alewife. In order for this species to propagate and become re-established in the Charles, exceedances of the permitted temperature limits must be immediately addressed. Temperature exceedances are one form of impact to aquatic life that can be identified and minimized in a biologically meaningful time period by the real time monitoring program. EPA has determined that real-time monitoring data is necessary for the protection of the aquatic resource.

Although thermistors can be used to collect comprehensive and accurate temperature data in the field, they do not provide real-time temperature data that allow for timely operational responses. Further, the data collected by thermistors must be manually downloaded by a technician on site. Thus, a considerable time-lag exists (at least 24 hours under the best circumstances) between the collection of data and the reporting of that data and any potential actions that may then be taken to mitigate negative impacts associated with elevated temperatures. Thus, while thermistors are equally capable of collecting continuous temperature data, they are not equally capable of reporting real-time continuous data in order to best respond to impending and actual permit exceedences.

As discussed throughout several responses to comments, there is a significant amount of uncertainty with regards to expected water quality impacts associated with this facility. The response to Comment I1 further describes these uncertainties as facility-specific factors contributing to the need for robust monitoring program requirements.

EPA has received several comments on the need for greater access to the real time data. EPA acknowledges the high degree of public interest in the water quality and aquatic resources of the Charles River. Indeed, EPA received comments from more than 20 parties on the Draft Permit. While there is no restriction in the permit to prevent the permittee from making the real time data available in the public domain, EPA has decided that it is appropriate to require the permittee to report this real time information only to the permitting agencies. As with other monitoring data

collected as part of the NPDES permit requirements, to the extent allowable by law, EPA anticipates making data submitted under this permit publicly available within a reasonable time frame.

Comment I14: Mirant asserts that draft permit proposals regarding accepted statistical design are vague and ambiguous (i.e., "where practicable"). Further, the Agencies are too explicit in the requirements dealing with this subject. This proposal represents an unjustified amount of minutia that makes it unprecedented and unnecessarily burdensome. The Agencies should reconsider the draft permit and issue a final permit without burdening the permittee or themselves with such unnecessary details.

Response to I14: During the course of permit development, the permittee has, in many cases, presented data in a disconnected fashion, rather than with appropriate and accepted statistical descriptions of the significance of the data, taking into account study design or factors such as sample size. This permit requirement is intended to ensure that data required by the permit itself is presented with attention to these concerns. EPA agrees that this requirement can be stated with more clarity and in a less explicit manner. However, it is not unjustified or burdensome. In studies dealing with populations, behavior, and probabilities, standard statistical tests must be considered to properly evaluate the data. In consideration of the permittee's comment, EPA has edited this requirement in the Final Permit to provide more clarity and flexibility without sacrificing the intent for scientifically valid presentations when required. Thus, Section I.A.14.a.5 has been modified to state, "In analyzing, summarizing, and/or describing monitoring data in Annual Reports and other reports that interpret environmental data, the permittee shall apply and report accepted, appropriate, and reasonably available statistical tests related to sampling frequency, study design, and the representative nature of the observations."

Comment I15: Mirant asserts that the Agencies exceed their authority by treating the failure to comply with Agencies' comments on the QAPP or QA/QC plans as a permit violation. The proposal to make Agencies' comments on the QAPP and QA/QC a permit requirement without public comment does not comply with the law. Further, the Agencies fail to justify why it is necessary to propose development and submission of a QAPP and QA/QC as a permit requirement.

Response to I15: EPA is requiring a QA Project Plan (QAPP) for this project involving environmental data to ensure the project is documented and reviewed before the work is started. A QAPP (as defined in EPA Order 5360.1 A2) is required in the applicable Federal Regulations when EPA conducts a project directly or when a non-EPA organization conducts a project for EPA under a grant, contract or negotiated agreement. In this case, where information is being submitted to EPA as part of a requirement under a statute, regulation, permit, order or other mandate, EPA is requiring a QAPP to ensure QA/QC procedures are used to generate data of known quality. Other examples of this type of information include required test data for pesticides or chemicals and Toxics Release Inventory (TRI) submissions.

EPA ensures quality control of such information through regulatory requirements, such as

requiring samples to be analyzed by specific analytical procedures and by certified laboratories. Due to the facility-specific circumstances in the permit (described in the response to I1) and the multi-faceted biological and water quality monitoring required by this permit, EPA used BPJ in determining that a QAPP is necessary in order to assure that reliable data are collected pursuant to this permit. In order to use data collected by Mirant Kendall to justify future permit decisions, including reductions in monitoring requirements, EPA must be assured of the quality of the data being collected and reported. The development and submission of a QAPP is an effective way for both EPA and the permittee to ensure that data of adequate quality are being collected and reported. The burden of ensuring that valid data are collected and presented is the responsibility of the permittee. A QAPP will detail sampling procedures, quality control sampling requirements, data quality objectives, and data review and reporting requirements. This will ensure that there is a documented and transparent QA/QC program to support the results and conclusions of the environmental monitoring required in this permit. There have been instances during the development of this permit, that data submitted to EPA and MassDEP by representatives of Mirant Kendall were modified at a later time or found to be incorrectly reported (e.g., see response to E14). Development and adherence to a QAPP, therefore, will give EPA, MassDEP and the public more confidence in the data submitted.

The Final Permit requires the permittee to prepare a QAPP that follows applicable EPA guidance and to submit the QAPP to EPA and MassDEP for review and comment. See http://www.epa.gov/QUALITY/qs-docs/r5-final.pdf for this guidance. Thus, while development and submission of a QAPP remains a permit requirement, EPA has made several minor changes in the Final Permit in consideration of the permittee's comments. First, EPA has removed the language on conducting field audits of the monitoring procedures from the permit, but recommends internal field audits be planned as part of the QAPP. Second, because light penetration measurements have been removed from water quality monitoring requirements in the permit, QA/QC of measurements of the transmissivity in the river has also been removed from the QAPP requirements. Third, EPA has removed explicit language that a permit violation will result from failure to comply with the Agency's comments on the QAPP.

Comment I16: Mirant asserts that the Agencies have failed to provide any justification for why continuous, rather than periodic, dissolved oxygen monitoring is necessary. This requirement should be removed in the final renewal permit.

Response to I16: In the Draft Permit, EPA established continuous real-time DO monitoring as part of the ZPH compliance program, but stated a willingness to consider alternatives to this monitoring requirement, which could be submitted during the public comment period. The permittee did not submit a detailed alternate proposal for DO monitoring. Upon further consideration, EPA has determined that real-time continuous monitoring of DO is not necessary to ensure compliance with the ZPH requirements. Instead, EPA has instituted the following DO monitoring program, which in this case is designed to document whether there is sufficient DO (greater than or equal to 5.0 mg/l) at a Monitoring Point for it to be considered part of the ZPH. At a minimum, the permittee will be required to conduct DO monitoring at least once a week at each real-time continuous temperature Monitoring Station. Samples must be taken at the surface

and at depths of 2 feet, 6 feet, and every three feet from 6 feet to the bottom. All DO monitoring must be conducted on the same day within a reasonable time period. The permittee may conduct DO monitoring more than once a week at the prescribed Monitoring Stations but, if so, must collect samples at all required Monitoring Stations and depths. The most recent DO data collected at the Monitoring Stations will be used to document whether there is sufficient DO (greater than or equal to 5.0 mg/l) for a Monitoring Point to be considered part of the ZPH. When a real-time continuous temperature Monitoring Station is not required (for example, Monitoring Station 8 from November 1 through March 31), then DO monitoring at that station is not required. The permit has been modified to reflect this change.

Comment I17: Mirant asserts that monitoring Station 9 is unnecessary because placement of a Monitoring Station at or around this location provides no additional, material information about water conditions that could not be inferred or predicted from the data gathered at the other monitoring stations. Further, the Agencies have failed to explain why a fixed, 24-hour a day 365-day a year continuous real-time monitoring station is necessary at that point if the station's sole purpose is to measure temperatures during the short time associated with in-migration.

Response to I17: EPA has determined that monitoring at Monitoring Station 9 (MS9) is necessary for a portion of the year because this is the only proposed monitoring station capable of monitoring the saltwater conditions at the mouth of the river and downstream of the New Charles River Dam and locks. As described on Page 20 of the permit, monitoring at Station 9, as well as Stations 7 and 8, are required for the period of April 1 to October 31 only, not for the entire year. Further, as explained in the DD at Section 5.10.2f, this station will provide information to ensure that water with excessive temperature or degraded water quality characteristics are not part of the attractant flow from the dam. Finally, MS9 will not be used as a compliance point for temperature limits.

Comment I18: Mirant asks the Agencies for clarification on placement of MS9. Placement just downstream of the dam necessarily results in the monitoring station being in the direct influence of the Charles River water while placing the Station outside the direct influence of Charles River water, would require it to be so far out in the Harbor that it would be meaningless and could not possibly be described as "just downstream from the dam."

Response to I18: The language in the permit regarding the location of MS9 has been modified to help clarify the intended location of this monitoring station. The word "just" was removed to alter the original sentence of "A fixed monitoring station just downstream of the New Charles River Dam, in Boston Harbor" to "A fixed monitoring station downstream of the New Charles River Dam, in Boston Harbor." MS9 shall be placed on the harbor side of the lock, but not mid-channel. Such placement will allow the data collected at this station to be representative of conditions in Boston Harbor outside of the direct influence of the Charles River.

Comment I19: Mirant believes that absent the diffuser, any measurement of light penetration is unnecessary. Further, the Agencies have failed to explain how light penetration should be measured or justify why light penetration readings must be taken every hour, 365 days a year.

Response to I19: EPA agrees and is not requiring light penetration measurements. The relevant language has been removed from Part I.A.14.b.10 of the permit.

Comment I20: Mirant Kendall asserts that it did not and does not accept the use of an in-situ, real-time continuous water quality monitoring and compliance program in lieu of end-of-pipe limits. Further, Mirant Kendall asserts that the Agencies proposal of a set of in-situ monitoring requirements and compliance temperatures is not justified and disregards the several in-situ monitoring proposals submitted by Mirant Kendall during permit development communications.

Further, the Agencies have no basis for claiming that Mirant Kendall either proposed or accepted the Agencies proposed in-situ compliance approach. The in-situ program in the draft permit is wholly unacceptable to Mirant Kendall and must be justified without any reliance on supposed acceptance by the permittee.

Response to I20: The permittee submitted a draft Discussion Document on May 11, 2001 (AR #452) describing a continuous monitoring program comprising in-stream monitoring stations. EPA understood that this program would remove some of the uncertainty caused by the permittee's decision to abandon its efforts to submit an acceptable hydrodynamic model. This in-stream monitoring approach was discussed throughout the permitting process and all parties proceeded with the understanding that some form of this monitoring program was appropriate and would be established in the permit. The permittee has the option to develop an acceptable hydrodynamic model to describe the potential impacts of the discharge on the lower Charles River and Boston Harbor. This model would lead to the establishment of real time end-of-pipe limits that would continually ensure the attainment of the in-stream compliance temperatures. This would reduce the monitoring required in this permit. However, in the absence of any such model, EPA has determined that the proposed monitoring program is essential, reliable, and reasonable given the complexity of this system.

Setting aside the history, the goal of this program is to collect pertinent information and measure compliance with permit limits and is necessary to ensure the propagation and protection of balanced populations of aquatic species in the lower Charles River Basin. The monitoring data collected not only will allow the permittee to take timely operational action to reduce thermal input to the river when necessary to comply with established permit limits, but also will provide the Agencies with a more stable basis from which to characterize trends and assess predictive models.

See also responses to I1, I4, I5, I12 and I13.

Comment I21: Mirant asserts that there is need for clarification of the unusual impingement events reporting. This proposal needs to be clarified so that it does not apply while the barrier nets are in place because when the nets are in place, there will be no impingement of fish at all on the screens. The proposal also needs to be clear that it is not changing the current frequency for inspecting the screens, which is every eight hours on the shift-change. To the extent that the

Agencies propose something different than the current practice for unusual impingement event reporting, Mirant objects on the grounds that the Agencies failed to justify why the past practice is no longer acceptable.

Response to I21: EPA understands that Mirant Kendall has been recording impingement events, including types and number of fishes, from 1999 through 2005. Initially, the permit has set the number of 25 or more total fish per hour impinged as an "unusual impingement event" (UIE) value which would require reporting. This number reflects the same number of dead fish that triggers the fish mortality notification. The permit requires the permittee to review all historical impingement data and propose an appropriate "unusual impingement event" value. The Final Permit has added additional language to this effect, also suggesting that the permittee may use a statistical approach, whereby a UIE may be a number above the 90% or 95% confidence level of past data. The permittee's comments on impingement reporting while the barrier nets are in place are not relevant to this reporting requirement. If the nets are functioning properly, then no impingement on the intake screens will occur and no unusual impingement reporting would be required. Additionally, the level of impingement that constitutes an unusual event does not impact the screen inspection frequency.

Comment I22: Mirant asserts that daphnids (*Ceriodaphnia dubia*) and fathead minnows (*Pimephales promelas*) are inappropriate organisms to use for testing the toxicity of a discharge that draws from and discharges to waters with higher levels of salinity than freshwater.

Response to I22: In the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001), EPA recommends that freshwater organisms be used in WET testing when the receiving water salinity is less than 1 ppt, and that marine organisms are used when the receiving water salinity equals or exceeds 1 ppt. If the salinity in the lower Charles River at the time of sampling does indeed exceed 1 ppt (salinity levels have been documented at 2 ppt during the late summer; See Response E20), the use of *C. dubia* and fathead minnows is inappropriate. The osmotic stress on the test organisms resulting from exposure to salt water is likely to act as a test interference and prevent accurate measurement of potential toxicity related to the intake and discharge of cooling water. EPA recommends a scaled approach whereby marine organisms would be used when salinity levels in the epilimnion equaled or exceeded 1 ppt and freshwater organisms would be used when salinity levels were less than 1 ppt. Attachment C, the WET testing protocol for freshwater species included with the Draft Permit, is now Attachment C1. The marine species WET testing protocol has been included in the Final Permit as Attachment C2.

Comment I23: Mirant states that the Agencies have failed to justify why they need comprehensive chlorophyll a data given the fact that Mirant Kendall has already provided the Agencies with this data from the Lower Charles River Basin for 2002 and 2003.

Further, the Agencies have failed to justify why Mirant Kendall should be responsible for this monitoring given the fact that the data EPA and Mirant Kendall have gathered fails to provide any evidence that the Kendall Station discharge makes any material contribution to the nuisance

blooms.

Response to I23: See responses for Comments I7, E3, E18 and E19. Weekly nutrient and phytoplankton monitoring conducted during the growing season (June 1 - October 31) will aid EPA in determining whether the facility's thermal discharge is contributing to algal-related water quality impairments in the Basin and whether additional controls on the thermal discharge are needed.

Comment I24: Mirant asserts that the term "fish" should be defined. Mirant assumes because these fish must be observable from a visual inspection that "fish" refers to free swimming, readily observable fish and not larvae or other life stages that cannot swim or that are not readily observable by a visual inspection.

Comment related to I24 from MA DFW: MA DFW asserts that they, as the lead agency for fish kill investigations, should be the first agency contacted in the event of a fish kill as well as DEP and EPA.

Response to I24 and related comment: EPA agrees that for the purposes of this requirement, in Paragraph 12 of the Final Permit, fish will refer to juvenile and adult fish, but not eggs or larvae. The Final Permit requires that the MA DFW shall be contacted regarding any fish kills.

Comment I25: Mirant asserts that the Draft Permit proposes an unprecedented and incredibly broad array of biological monitoring and sampling that is not authorized by the Clean Water Act or its implementing regulations. The Agencies fail to explain why it is reasonable, as a matter of law, for the current Draft Permit to contain a substantial increase in monitoring from the previous Permits without a showing of any adverse effects on the BIP, or any other relevant changes in the Lower Charles River Basin. Further, the Agencies fail to consider or justify the substantial costs of monitoring and sampling.

Mirant asserts that not only is the extensive monitoring proposed by the Draft Permit unauthorized by law, but it is also rendered unnecessary by the other provisions in the Draft Permit itself. Throughout the Determination Document, the Agencies have stated in great detail why they believe the temperature limits proposed by the Draft Permit are fully protective of the BIP. But if the temperature limits in the permit are in fact fully protective of the BIP, as the Agencies claim, then extensive monitoring to study the effects of the discharge on the BIP cannot be justified. Mirant asserts that the Agencies must explain why Mirant is required to gather more field data when previously submitted data have already been ignored or discounted by the Agencies.

Mirant asserts that the level of monitoring and sampling proposed by the Draft Permit, listed above, far exceeds any monitoring or sampling requirements in any other NPDES Permit. The Agencies have failed to explain this different and unprecedented treatment.

Mirant asserts that the agencies must justify their unauthorized and unprecedented departure

from the well-accepted interpretation of the NPDES Program especially considering in the present case where: (a) Mirant is an existing discharger not seeking an increase from its existing permit limits, (b) there is no evidence suggesting the discharge is having any adverse effects on the BIP, and (c) heat is not a novel, mysterious, unknown, or unstudied pollutant.

Response to I25: In-stream temperature limits and biological monitoring of populations impacted by the Mirant Kendall facility location and operations are appropriate in order to assure the protection of the BIP in this waterbody. In consideration of the permittee's comments, however, EPA has altered the permit to reduce some of the biological monitoring requirements. EPA has expended substantial effort to tailor the required biological monitoring plan to provide the necessary data to ensure that the fish species in the lower Basin are adequately monitored and protected, without requirements for unnecessary monitoring. In developing this biological monitoring plan, EPA fully considered all data (from both field and laboratory studies) submitted by the permittee, the characteristics of the waterbody, and also consulted the U.S. EPA NPDES Permit Writers' Manual (December, 1996, AR #579) on this topic.

1. Authority for monitoring: The legal authority for all monitoring requirements in this permit derives from sections 308 (monitoring, reporting and entry) and 402 (National Pollutant Discharge Elimination System) of the Clean Water Act, 40 CFR 122.44(i) (which authorizes, inter alia, "To assure compliance with permit limitations, requirements to monitor . . . [o]ther measurements as appropriate"), and 40 CFR 122.48 (which authorizes, inter alia, continuous monitoring). Moreover, as noted in the responses to I1 and I20, the in-stream monitoring regime became necessary because the permittee elected to discontinue modeling efforts in favor of an approach based on actual in-stream compliance. Under 40 CFR 122.44(d)(1), EPA must impose effluent limits that will achieve state water quality standards, including narrative criteria. Typically, a permittee of Mirant Kendall's size and impact provides a verifiable hydrodynamic model that enables EPA to work backwards from a desired in-stream compliance temperature and determine end-of-pipe effluent limits that will achieve that temperature sufficiently often. In this case, because Mirant Kendall discontinued its modeling efforts for several years, EPA requires actual measurement to ensure the attainment of state water quality standards.

With respect to the increase in monitoring from the prior permit, the facility has substantially increased its production and correspondingly has a much greater impact on the lower Basin. See Responses B1-B3 and C3.

With respect to costs, neither the CWA nor the regulations require EPA to evaluate costs when establishing monitoring conditions in a permit. Moreover, Mirant Kendall is in a poor position to complain about the costs of the compliance regime, because the regime stems directly from Mirant's own decision to abandon modeling and proceed based on in-stream compliance monitoring. Most large thermal dischargers develop, in some cases at considerable expense, high-quality predictive models that enable the permitting agency to select an end-of-pipe temperature that will satisfy all permit requirements – thus, such dischargers spend on modeling but save on monitoring. Mirant elected not to develop a verifiable model for this renewal permit, perhaps saving money on modeling, but incurring greater costs in monitoring than it would have

if it had developed a usable model in the first place. Nevertheless, in evaluating this comment, EPA has carefully considered the impact of Mirant Kendall's discharge on the lower Charles River, the need for additional data to characterize that impact more precisely, the need to assure compliance with permit limits, and the costs to the facility as represented by Mirant Kendall, and has concluded that the monitoring program is justified despite such costs.

With respect to the temperatures deemed protective of the BIP, EPA's best scientific judgement, in light of literature and available field data, is that the final permit's temperature limits will protect the BIP. That said, the monitoring data is needed to characterize the facility's impact more precisely and to ensure that protective temperatures are actually achieved.

2. Mirant's claim that the Agencies ignored Mirant's field data: EPA and MassDEP recognize the substantial effort undertaken by the permittee to collect, analyze and present a substantial amount of environmental data from the Charles River. This data has been extremely useful in the permitting process. Many aspects of the Final Permit were supported by data submitted by the permittee. Specific examples of where Mirant data were used in developing this permit are: 1) determining that a 2˚ delta T buffer in excess of thermal limits was protective under certain conditions, 2) allowing for a 24 hour mean delta T at the BU site vs. the ZPH, 3) discussion sections (e.g., response to C3) regarding appreciable harm to alewife, 4) establishing thermal limits for different life stages of alewife and yellow perch, 5) establishing the appropriate time periods when thermal limits must be in place to protect different life stages of alewife and yellow perch, 6) the development of several allowances of spring exceedances over the facility's maximum temperature, and 7) documentation of the increase in heatload and water usage from Kendall Station over the past several years compared with historical operation of the facility. Characterizing Mirant Kendall's discharge and its effect is complex for reasons described in the response to comment I1. With the continued thermal discharge, and in consideration of the factors described in the response to I1 and the DD, the level of biological monitoring required in this permit is appropriate.

3. Precedent for similar biological monitoring: As a legal matter, EPA is not required to justify a requirement in a NPDES permit that is necessary to attain water quality standards by showing that an unrelated permit contains a similar condition. That said, Mirant Kendall errs in claiming that the permit requires biological monitoring that "far exceeds any monitoring or sampling requirements in any other NPDES Permit." A few examples of NPDES permits in EPA Region 1 that in the past required or currently require approximately the same level of biological monitoring as well are: Pilgrim Nuclear Power Station (MA0003557), Brayton Point Station (MA0003654), and Seabrook Nuclear Power Station (NH0020338).

4. Use of in-stream monitoring to measure compliance: In order to know whether a discharge will violate state WQS, the permitting agency must have a firm basis for characterizing the impact of the effluent on the receiving water. Most large permittees provide a predictive computer model that characterizes the relationship between the end-of-pipe concentration or quantity of the effluent, and the concentration in the receiving water. Mirant began down this path, but then abandoned it. Without a reliable model, the only other reasonable basis available

to a permitting agency is actual measurement. As noted above, on May 11, 2001, Mirant proposed to pursue exactly this option, via a continuous monitoring program consisting of in-stream monitoring stations. See response to I20, and paragraph 1 of this response.

With respect to Mirant's prior permit limits and historical discharge, see responses B1-B3. With respect to Mirant's claim that it has not caused any adverse effects to the BIP, see response to C3.

Comment I26: Section 5.10 (Specific Monitoring In Permit Necessary To Comply With Zone of Passage and Habitat Limits) details the comprehensive monitoring plan proposed in the draft permit. The plan as proposed is excessive, unnecessary, based on outdated and incomplete data and should be revised. Mirant Kendall proposes an alternative compliance monitoring concept.

Response to I26: EPA has considered the alternative compliance monitoring concept proposed by Mirant Kendall in this comment, as well as Mirant Kendall's commitment to refine the details in consultation with EPA. Many of the elements of Mirant's proposed alternative compliance monitoring concept are consistent with the provisions of the Draft and Final Permit. These include real-time, continuous temperature monitoring at the intake and discharge; continuous in-stream temperature monitoring at multiple levels at certain locations; and postponing more intensive monitoring if and when the diffuser is installed. Furthermore, EPA has adopted at least one element of Mirant's concept (reduction of DO monitoring requirements) as a change in the Final Permit and generally appreciates Mirant's "commitment to refine the [monitoring] details in consultation with the Agencies."

However, much of the overall concept is not being adopted in the Final Permit. The overall rationale for requiring, at this facility, a more intensive monitoring program than proposed by Mirant, is described in the response to comment I1. Additional reasons are provided below.

The need for reporting real-time data collection and reporting is described in the response to comment I4. Real-time reporting is not a component of Mirant's proposal, which provides for continuous monitoring of river temperatures at multiple fixed thermistors which would be downloaded weekly and reported monthly.

Mirant proposes two years of weekly vertical profiling and reporting of temperature, DO, pH and salinity at seven fixed locations. EPA agrees with the intent of this monitoring to supplement continuous monitoring with more detailed profiles obtained on a less frequent basis. The Draft Permit's provision to address this need is primarily captured in the requirement for periodic water quality monitoring for contour mapping. See Part I.A.14.c.1. EPA has retained this more flexible approach which does not prescribe fixed locations for vertical profiling. This requirement is necessary for several reasons, including to confirm that the real time monitoring at fixed points is capturing a realistic characterization of the water quality in the Basin, and to evaluate patterns in variations among related parameters. EPA acknowledges that Mirant's proposal allows for "additional profiling to be conducted on an as-needed basis if there is a demonstrated need based on the above results." However, in this case, EPA is retaining the

Draft Permit requirement based on obtaining the necessary result which is to "complete, periodic water quality contour maps of the lower basin" (Part I.A.14.c.1), rather than based on future "demonstrations" of data needs as proposed by Mirant. Also, rather than Mirant's proposal for two years of weekly vertical profile sampling, EPA has retained monitoring for contour mapping as a monthly requirement for two years (weather permitting), followed by quarterly. EPA sees this duration as necessary to fulfill the objectives described in the response to I1. However, in light of the likelihood of changing circumstances as data is collected, EPA has provided a mechanism for reducing monitoring requirements in Part I.A.14.f of the Final Permit.

Finally, Mirant has proposed for monitoring in general, and in some cases specifically for biological monitoring, a) that further monitoring be undertaken on "an as-needed basis in consultation with the Agencies", b) that EPA accept as a permit condition Mirant's "commitment to refine the details in consultation with the Agencies", and c) that additional monitoring be limited to situations where "there is a demonstrated need based on past or on-going results." EPA is not including these provisions because EPA does not see that such provisions would provide sufficient certainty for EPA, MassDEP, the permittee or the interested public. Mirant itself objected to similar indefinite provisions in its comments. For example, see Comment I10. EPA's approach is to establish the need and certainty in the monitoring requirements to the degree possible in the Final Permit, while allowing for unforeseen circumstances through the provisions of Parts I.A.14.f, I.A.15, and I.A.16.a.

Comment I27: Mirant asserts that the permit should also allow the flexibility for the permittee to make other adjustments to the Toxicity Test Procedure and Protocol, after consultation with and the approval of, EPA New England, if the results of the WET testing program show such adjustments to be necessary in the future.

Response to I27: Beyond decisions as to the appropriate dilution water for use in testing water used in cooling at this facility, modification of the EPA WET methods is not appropriate. These methods were developed and intended to be used as described in the appropriate method manual (e.g., *Short-term Methods for Estimating the chronic Toxicity of Effluents and Receiving waters to freshwater Organisms*, EPA-821-R-02-013).

Comment I28 (from MA DMF): MA DMF asserts that the statistical basis for one duplicate beach seine among all other single net samples is unclear. We request clarification on this, or recommend single or duplicate net samples at all stations.

Further, we advise that the fyke net mesh of 0.5 inch will not adequately sample for American eel escapement as well as other small anadromous fish species, and recommend a net mesh of 0.375 or 0.25 inch..

We request receiving a copy of the proposed monitoring plan in advance of this study with time to review and comment to reduce excessive fish mortality resulting from the use of a gill net at Lock Number 3 at the Charles River Dam. Further, we request the opportunity for review and comment on this effort prior to use of the gill net.

The method used for suction sampling of ichthyoplankton should be more clearly defined to prevent re-sampling of previously filtered water. Any fine-mesh barrier study should collect samples under a full range of actual operating conditions including full withdrawal of 80 MGD.

Response to I28: Many of the specifications included in the permit's biological sampling requirements are included to provide the necessary standardization so that future results will be comparable to the results of past data collection efforts. In the case of the fyke net mesh size, the 0.5 inch net mesh was selected in order to allow a meaningful comparison with the gillnet sampling. Gillnet mesh size used in past sampling and specified in the permit are identified as 0.5 inch, 0.75 inch, 1.0 inch and 1.5 inch bar mesh.

The stated rationale for two hauls at the Hyatt Station as opposed to single hauls at the other stations is not based on statistics, but rather, "since previous sampling showed that the bottom at the Hyatt Station was generally free of obstruction during previous sampling events." (Part I.A.14.e.1) Thus, Hyatt Station is a sampling station relatively free from the sampling bias that bottom obstructions can present in sampling.

EPA agrees with the concern raised by MA DMF regarding excessive fish mortality as a result of gill netting. In consideration of this concern for all biological monitoring, a condition has been added to Part I.A.14.d of the Final Permit which requires that this monitoring be consistent with any State or Federal efforts to limit the collection of certain fish species, such as the current recreational moratorium on taking river herring from the Charles River. In this regard, the use of gill netting and other sampling methods will be subject to MA DMF review and conditions. Regarding the method used in ichthyoplankton sampling, including suction sampling, these sampling methods will be selected based on the plan review process defined in the State Water Quality Certification and stipulated in Part I.A.14.d.11 of the Final Permit.

Comment I29 (from MA CZM): CZM recommends that the "refinements and quality assurance of the hydroacoustic program" (Section I.A.14.e.5) utilized to monitor migrating river herring include a thorough calibration of the hydroacoustic monitoring technique.

CZM suggests that impingement monitoring described in Section I.A.14.e.9 occur on the same three-times-per-week schedule as required for the entrainment sampling.

Response to I29: EPA recognizes the importance of proper calibration of the hydroacoustic monitoring equipment. The requested requirement for the calibration of the hydroacoustic monitoring technique standard operating procedures is covered by the general requirement for a Quality Assurance Project Plan. Guidance on documenting sampling methods is included in EPA QA/R-5 which is referenced in Part I.A.14.a.6 of the Final Permit. Regarding the scheduling of entrainment sampling, the schedule will be determined based on the plan review process defined in the State Water Quality Certification and stipulated in Part I.A.14.d.11 of the Final Permit.

Comment I30 (from MA DMF): MA DMF recommends beginning weekly nutrient sampling

on March 1st, during the period of the spring peak in nutrient loading.

Response I30: EPA acknowledges that peak nutrient loading to the Basin occurs during the spring period when river flow is high and the wastewater treatment facilities in the upper watershed are providing less treatment for removing phosphorus. However, critical conditions for algal blooms in the Basin occur during July, August, and September, several months after the typical high-flow spring season. Spring conditions are not typically a concern for algal blooms in the Basin because of several factors including lower temperatures, shorter water residence times, lower water clarity, and lower light intensity. The purpose of the proposed nutrient monitoring requirements is to supplement the chlorophyll *a* and algal data collected during the critical growing season in order to be able to more fully evaluate the effects of the thermal discharge on algal levels in the lower Basin. Water quality data collected by the MWRA and EPA from the upstream and downstream ends of the Basin show that much of the nutrient loading that enters the Basin during high flow conditions pass through the Basin to Boston Harbor. Therefore, the weekly nutrient monitoring will continue to be required beginning in June.

J. Response to Comments Concerning Other Permit Limits

Comment J1: Mirant Kendall claims that EPA has proposed an extraordinarily detailed and complex temperature regime, and argues that there is no basis for defining protective limits with that level of precision. Mirant Kendall contends that it is neither feasible nor appropriate to attempt to establish a compliance regime with this level of precision. Mirant Kendall also complains that the in-stream temperature limits will force the shut down of the Station. Mirant Kendall requests that EPA develop a system that will not force the Station to shut down.

Response to J1: As explained in the DD and the Introduction to Section E, Mirant Kendall elected not to submit a technically sound thermal model for evaluation. Instead, Mirant Kendall asked that EPA develop an in-stream compliance monitoring regime. Because Mirant Kendall declined to propose an acceptable temperature model, EPA therefore established variable instream temperature limits to protect the BIP. These temperatures are based on the most sensitive anadromous and resident species, taking into consideration their various life stages and seasonal conditions, among other critical factors. Sections 5.6 and 5.7 of the DD lay out the step by step, life stage by life stage, time period by time period approach used to justify protective temperatures for the life stages of resident and anadromous species, respectively. Section 5.8 compares all of these analyses to determine the most conservative temperature for each time period, and Section 5.9 and 5.10 tie in ambient conditions, averaging periods, the area needed for protection, and the exceptions to the compliance monitoring (e.g., allowances above maximum limits in the spring). With respect to the precision of the temperature limits, these temperature limits were established in whole degrees Fahrenheit, and the tenths of a degree Centigrade limits were a result of conversion.

With respect to the complexity of the overall regime, it would certainly have been simpler for EPA to impose a temperature compliance scheme with less variability, e.g., by selecting the temperature that would be maximally protective of all relevant species at all relevant stages, and applying that limit at all times. Such an approach would be biologically protective, and would not require an "extraordinarily detailed and complex temperature regime." However, it would also, at some times and in some parts of the Basin, be more stringent than necessary. Since Mirant Kendall requested a CWA 316(a) variance, EPA developed a system that was not more stringent than necessary to protect the BIP. This required making the regime more complex. (See Response to D2).

Mirant Kendall's claim that EPA is seeking "directly to control the operations of a power plant" is unfounded. EPA is seeking to achieve temperatures in the lower Basin that will enable the protection and propagation of a BIP.

Mirant Kendall also requests that EPA revise the temperature limits so as not to "force the Station to shut down." Whether, or how much, the Station curtails its operations is a function of a variety of factors -- including the price of electricity, the cost of natural gas, and Mirant's own economic considerations – that are neither within EPA's control nor legally proper considerations under CWA 316(a), which focuses on protection and propagation of a BIP. (See

Response K1).

Comment J2: Mirant Kendall notes that the draft permit imposes monitoring requirements and enforceable limitations on discharges from a new internal outfall enumerated as 009. Mirant Kendall argues that, under 40 C.F.R. § 122.45(h), flow limitations and standards may be imposed on internal waste streams before mixing with other waste streams or cooling water systems only if it is impracticable or infeasible to impose such standards at the point of ultimate discharge, and only when the Fact Sheet issued with the permit sets forth the "exceptional circumstances" which makes such limitations necessary. Mirant Kendall also argues that, with respect to total suspended solids, Kendall Station is not materially adding any solids above what it receives.

Response to J2: Sections 308(a) and 402(a)(2) of the CWA provide EPA with the authority to require monitoring of outfall 009. 40 C.F.R. § 122.45(h) only applies to limits on internal waste streams, and is inapplicable to the permit's monitoring regime. Moreover, it is appropriate and necessary to monitor this internal waste stream in order to characterize it prior to its mixing with non-contact cooling waters (NCCW). Since there would be considerable dilution to this stream by the NCCW prior to discharge, this is the only location at which this discharge could be effectively characterized. See Fact Sheet at p. 8.

With respect to added solids, Reverse Osmosis (RO) reject waters tend to highly concentrate solids and other parameters that are in the intake water to the RO system. Since Mirant has not provided specific data on this internal stream, this monitoring will provide an understanding of whether some of these parameters may be discharged at levels which could cause or contribute to an excursion from WQS. This is especially important for those parameters which are not monitored at any outfall. See also Response to J6.

With respect to the flow and effluent limits, 40 C.F.R. § 122.45(h)(2) authorizes such limits on internal waste streams where "the wastes at the point of discharge are so diluted as to make monitoring impracticable." This is the case for Outfall 009 and the basis for setting technology based limits for this outfall. See Fact Sheet at p. 8. This response also serves as a partial response to those other comments, e.g., J5 and J6, that challenge the imposition of monitoring and/or effluent or flow limits at outfall 009.

Comment J3: In Part I.A.3, on pg. 9, the Draft Permit proposes that Outfall 009 contains "UF & RO water treatment system reject waters, other low-volume waste streams and boiler blowdown from the new HRSG." To correct a potential ambiguity, Mirant Kendall suggests that the clause should read "Boiler blowdown from the new HRSG, UF & RO water treatment system reject waters, and other low-volume waste streams."

Response to J3: This change has been made to the Final Permit.

Comment J4: Mirant Kendall notes that the limitation on total suspended solids from outfall 009 does not account for the occasional significant flushing events in the river (i.e., an extremely

heavy rainfall in a short period of time) that can cause levels of total suspended solids at the intake to experience a dramatic short-term increase. Mirant Kendall contends that the TSS limit should (a) provide for such unusual circumstances, and (b) be tied to the levels of total suspended solids measured at the intake, or the ambient levels in the lower Charles River Basin.

Comment related to J4 from Riverways: The Basin is on the impaired list of waters for many reasons including turbidity. The facility is allowed a TSS daily limit of 100 mg/l using a 24 hour composite probably based on industry standards developed nationally. Given the problems with turbidity in the receiving water and the sampling type, it seems reasonable to adjust TSS requirements to reflect water quality issues in the receiving water. Using the TSS requirement typically imposed on a POTW, 50 mg/l daily TSS maximum, would be a reasonable compromise and will help in efforts to get the Charles River "fishable and swimmable."

Response to J4 and related comment: Mirant requests less stringent TSS limits; Riverways requests more stringent TSS limits.

The TSS limits are based on the effluent limitation guidelines for the Steam Electric Power Generating category at 40 CFR 423 and apply to the low volume wastewaters which are discharged at internal outfall 009. This discharge consists of boiler blowdown and test water and UF and RO reject water. The 100 mg/l limit is established at internal outfall 009 and is necessary to control the solids which will be generated by the UF and RO wastewaters and other miscellaneous discharges that were previously described. If the permittee has difficulty complying with these TSS limits, it must devise a way to treat for and limit the discharge of TSS during such "flushing events."

EPA does not have evidence to suggest that a more stringent limit for TSS is necessary. The NCCW flows, which comprise the majority of the discharge, do not have any appreciable solids component that would require a more stringent effluent TSS limit.

Comment J5: Mirant Kendall notes that a reference on pg. 9 of the Draft Permit to"Footnote 4 on Page 3" should be corrected to "Footnote 5 on Page 4." Mirant Kendall also argues that there is no reason to monitor for total residual chlorine at outfall 009 because there is no reasonable basis for concern that excessive levels of residual chlorine from the RO will reach the Charles River.

Comment related to J5 from Riverways: The Total Residual Chlorine (TRC) limit should be reconsidered to take into account the negligible dilution in this impounded waterbody and the acute criteria. TRC can prove lethal in small quantities and in a short time span. The facility is limited to only two hours of chlorination per day but two hours is enough time to result in mortality to the juvenile fish and other species. The TRC of 0.1 mg/l based on studies for the Canal Electric Permit do not seem applicable in an impounded waterway versus marine waters. The toxic effect was tested on Menhaden, not on juvenile herring who would be in contact with the receiving waters for potentially extended times as they tried to negotiate the locks and barriers at the mouth of the 'river.' Lowering the TRC maximum will help protect juvenile fish

who may be in the Basin waiting to out-migrate when during the lowest flow, most stressed water quality periods of the year.

Response to J5 and related comment: As explained in the Fact Sheet, the chlorination of the NCCW discharge and the permit limit of 0.1 mg/l could lead to certain excursions of the instream, chronic water quality criteria for total residual chlorine (TRC), especially when flows are approaching 7Q10 levels. Therefore, since the NCCW flows may already contain TRC levels that may result in instream water quality excursions within the mixing zone, it is appropriate to also analyze for TRC at the internal outfall 009 in order to assure that there is sufficient dechlorination occurring as any additional TRC levels from the RO system would possibly contribute to such WQS violations. EPA appreciates Mirant Kendall's representations that the wastewater is "enormously diluted" after dechlorination, but such declarations are no substitute for actual data. (See also Response to J2).

That said, these occurrences are expected to be short term and typically allowed in the mixing zone, consistent with Massachusetts SWQS. Instream TRC monitoring has been established in order to quantify instream TRC levels under varying flow conditions.

For these reasons, no substantive change has been made to the permit's TRC limits or monitoring requirements. The typographical error in the footnote referencing has been corrected.

Comment J6: Mirant Kendall argues that EPA has failed to provide any reason why monitoring of the 126 Priority Pollutants is required at outfall 009 given that the Kendall Station does not add, or have the potential for adding, any of these pollutants to any of the water it withdraws from and then discharges into the Lower Charles River Basin.

Response to J6: RO systems tend to highly concentrate the water that passes through them, resulting in high total dissolved solids counts. This may result in the concentration of toxic substances that may not have been detectable in the influent. Moreover, this RO system will also undergo periodic cleaning and likely have other chemicals added for bacteria or corrosion control purposes. Consequently, monitoring at this point is appropriate and, since it is only required once per year, not unduly burdensome. Mirant Kendall is welcome to apply for a permit modification to reduce the scope of the testing after acquiring sufficient data to establish that priority pollutants are not present in this waste stream or are present at levels below which there would be any water quality impact. (See also Response to J2).

Comment J7: Mirant Kendall agrees with EPA's finding that the anti-backsliding requirements of 40 C.F.R. § 122.44(l) are satisfied, but disagrees with the basis for that finding presented on pp. 17-18 of the Fact Sheet. Specifically, Mirant Kendall argues that the required installation of the barrier net and the retention of a 70 MGD monthly average for April through June mean that the overall set of requirements in the draft permit are at least as stringent as the relevant limitations in the previous permit.

Response to J7: The material and substantial changes that have taken place at the facility are precisely the reason why there is concern that effluent flows will remain higher than historical levels and for longer periods of time, as discussed earlier. See Introduction to Section B and Responses to B1, B2 and B3. These changes have made the plant able to discharge continuously at high flows more efficiently than before the upgrade.

With respect to Mirant Kendall's claim that a 70 MGD annual average with a 70 MGD monthly average for three months of the year is at least as stringent as a 70 MGD monthly average for twelve months of the year, EPA adheres to the explanation on page 18 of the Fact Sheet.

Comment J8: Mirant Kendall requests that EPA precisely define outfall serial numbers 001, 002, 003, and 004 in the permit.

Response to J8: The Fact Sheet defined these outfalls and their locations and Figure 2 of the fact sheet showed these outfall locations. These outfall numbers and their locations have not changed from the previous permit.

Comment J9: Incorrect Description of Outfalls 001-004. The Draft Permit frequently proposes an incorrect description of the discharge from Outfalls 001-004. For example, in Part I.A.1, on p. 2, the Draft Permit proposes that the discharge from Outfalls 001-004 consists of "once-through condenser cooling water, ultra-filter and reverse osmosis (UF & RO) treatment system reject waters and boiler blowdown." In Part I.A.1, in fn. 4 on p. 3, the Draft Permit proposes that the "flow rate is the total condenser cooling water flow from the new heat recovery steam generator [HRSG] unit…" In Part I.A.1, in fn. 9 of p. 5, the Draft Permit proposes the "hourly average discharge temperature shall be measured by temperature probes representing all once-through condenser cooling water…"

This is not an accurate description of the discharged water. An accurate description would read "once-through cooling water," eliminating the word "condenser," because an additional auxiliary cooling water stream, which is separate from the condenser cooling streams, also becomes part of the discharge at Outfalls 001-004. All such places in the permit documents that make this misidentification should be corrected in addition to the three specific spots identified above. To the extent that this incorrect description was intentional, the Agencies have failed to provide any justification or explanation for defining the discharge in this manner.

Response to J9: EPA acknowledges these inconsistencies and has changed the Final permit to address them. Changes were made to pages 2, 3 and 5 as suggested.

Comment J10: Mirant Kendall observes that footnote 9 of page 5 of the Draft Permit could be read to imply that Kendall Station should measure the discharge temperature at the actual point of outfall into the Charles River. Mirant Kendall notes that it is impractical to place the temperature probes directly in the outfalls due to the flow, but that the probes are and have been located as close to the outfalls as possible.

Response to J10: The permit does not require changes to the current temperature probe configuration. The current temperature probe locations are acceptable if the temperature that Mirant Kendall reports for these outfalls effectively approximates the actual discharge temperature to the receiving water. With respect to the phrase "condenser cooling water", see Response to J9.

Comment J11: Mirant Kendall challenges as unnecessary the permit's monitoring requirements for temperature and pH at Outfalls 005, 006, and 007. Mirant Kendall argues that this screen backwash water is not exposed to anything that would materially change its temperature or pH.

Response to J11: Since the purpose of backwashing is to remove accumulated material that has become debris from the screens, solids in the discharge are not representative of the intake water. The backwashing of these screens has the potential to introduce floating solids into the discharge location. Therefore, monitoring is necessary to verify that the discharge of such solids from the intake screens does not result in floating solids, oil sheen or visible foam in other than trace amounts, or temperature or pH changes. The pH requirement is necessary in order to assure the Massachusetts WQS are met. It is irrelevant that the intake water is essentially the same water that is discharged, albeit it with some solids that are washed off the screens.

EPA has determined that the temperature monitoring for this outfall is not required, because the backwashing procedure does not contribute any heat to the intake water. Therefore, this requirement has been removed.

Comment J12: Mirant Kendall argues that quarterly whole effluent toxicity tests ("WET tests") during the winter months should not be required because the station only chlorinates the condenser cooling water in the summer in order to help reduce and eliminate algae growth.

Response to J12: All WET samples are dechlorinated prior to testing. EPA is concerned about possible synergistic effects of the combination of parameters present in the effluent which otherwise may not be monitored. In addition, there are many chemicals that are used for bacteriological and corrosion control, in addition to the concentrating effects of the RO reject water. These chemicals, which are listed on Page 23 of the fact sheet, need to be characterized for toxicity potential.

Comment J13: Mirant Kendall proposes that EPA modify page 10 of the Draft Permit to articulate that the only fish passage requirements are those that appear on and are described in Attachment A.

Response to J13: EPA intends to use the definition of the ZPH in Attachment A, including the maximum temperature limits, the delta T, and the monitoring points specified, as well as the changes made in the Final Permit, to judge whether fish passage has been blocked or severely restricted. When these requirements are met, including any exceptions listed in the Final Permit, and as long as no additional information to the contrary is available, EPA has concluded that the

discharge from the facility will not block or severely restrict fish passage. While EPA anticipates these requirements as being the sole test for this determination, it is inappropriate for EPA and DEP to preclude the consideration of unforeseeable circumstances in its responsibility to make this determination in the future. Therefore, no change has been made to this permit language.

Comment J14: Mirant Kendall observes that the heat formula in footnote 11 on page 5 of the Draft Permit contains an error.

Response to J14: The equation should have listed the terms of heat load, "Q" as millions of BTUs per hour, not BTU/day. Since the permit requires that the permittee report the hourly and daily heat load values, the permittee shall calculate the hourly heat load with this equation by using the average hourly flow rate (in MGD) and the average hourly delta T. The cumulative total of the 24 individual hourly heat load values for each calendar day shall also be reported. These changes have been made to the Final Permit.

Comment J15: Mirant Kendall observes that in footnote 2 on pg. 3, the Draft Permit proposes a method for determining the Average Monthly Discharge Limitation that could potentially be inconsistent with the default definition of Average Monthly Discharge Limitation in Part II.E.1, on pg. 11.

Mirant assumes that the more specific definition in Part I.A.1 should be used instead of the default definition in Part II.E.1.

Response to J15: Mirant's assumption is correct. The flow shall be calculated and reported as described in footnote 2 on Page 3 of the permit.

Comment J16: Mirant Kendall raises three minor, miscellaneous errata.

Error 1

In Part I.A.3, in footnote 4 on p. 3, "(HRS) unit" should read "(HRSG) unit."

Error 2

In Part I.A.12.a.2, on p. 14, "DMR" should read "DEP."

Error 3
In Part I.A.13, on p. 16, "Section 14.e.7" should read "Section 14.e.9."
Response to J16: These three errors are acknowledged and have been corrected in the Final Permit.

Comment J17 (from MA DMF): Because of significantly increased thermal loading as well as impacts from I&E, we seek clarification as to how EPA considers this draft permit supportive of

the antidegradation provisions of the CWA for the protection of fishery resources, particularly as we work to restore fish species to the river. We recommend that EPA reconsiders permitting this facility to require measures that substantially reduce the amount of water removed from the Charles River. By not doing so, we expect the habitat we rely on to support our enhancement efforts will become more unsuitable and conflict with our restoration efforts.

Response to J17: The increase in permitted heat load is limited to the allowance for an annual average flow limit of 70 MGD, rather than a monthly average flow limit of 70 MGD. (The 70 MGD monthly average limit has been retained for the months of April, May and June only). This indeed may result in an increased permitted heat load in certain months. In the Final Permit, however, EPA and DEP are relying primarily on the in-stream monitoring and temperature compliance limits as a more precise and protective means of monitoring and regulating the plant's thermal discharge in a manner that assures that there is no degradation to designated uses, while allowing operational flexibility for the permittee. See also responses B1, B8, and B9(3). Regarding the CWIS, the provisions of the Final Permit represent the first, specific best technology available (BTA) requirements for this facility and are thus improving rather than degrading the designed uses.

Comment J18 (from ACN): The power plant also creates the hazards of a million gallon tank of jet fuel and a million and a quarter tank of fuel oil. Both of these flammable liquids are brought in by truck through the inhabited areas of East Cambridge.

Response to J18: The transportation of such materials falls under the purview of City, State and/or Department of Transportation regulations. The EPA or MassDEP does not control or regulate the shipment of these fuels to the facility. However, the facility has implemented a Spill Prevention Control and Countermeasure (SPCC) plan regarding the storage of these fuels. In addition, the permittee has coverage under EPA's multi-sector general permit (MSGP) for storm water. This permit requires an implemented storm water pollution prevention plan (SWPPP) which must address best management practices regarding the storage, loading and unloading of such fuels on the property in ways that would minimize any release of such fuels into surface waters or the drainage system. (This response's references to Mirant's SPCC and SWPPP plans are not intended to express any view on the adequacy of those plans, but rather simply to note their place in the regulatory regime in order to respond to the comment.)

Comment J19 (from Stash Horowitz): We urge you to carefully weigh the environmental costs against the benefits and exercise care and caution in the issuance of any NPDES permit, whether temporary (which we urge), or an extension of the existing one.

Response to J19: EPA has thoroughly considered all the aspects of these discharges and all public comments received and has permitted them accordingly. The Final Permit expires five years from the effective date. At the end of this period, or earlier if appropriate, EPA will again review the permittee's application and available information in order to reissue the permit. Extensions to NPDES permits are not necessary because after the expiration date a permit is administratively continued and still in effect.

Comment J20 (from Stash Horowitz): Any help that you or the DEP can give the citizens of Cambridge in securing from Mirant the already agreed upon benefits of a public walkway and a floating dock, or benefits similar in effect and quantity, would be appreciated.

Response to J20: EPA agrees that these projects could enhance the public use of this area and would encourage Mirant to reach agreement with local groups on how best to accomplish these projects. However, EPA cannot require any such projects through this NPDES permit. Citizens may contact the City of Cambridge, the Massachusetts Department of Conservation and Recreation, and/or other appropriate local, regional, or state agencies regarding this request.

Comment J21 (from Jay Avin): How can a Chapter 11 company be concerned about getting a permit and upgrading a facility if they filed Chapter 11?

Response to J21: The facility upgrade occurred in 2002 and since that time, even under bankruptcy proceedings, the permittee has operated this facility at average flows ranging from 40 to 70 MGD and has often approached its maximum flow limit of 80 MGD. As of January 2006, the Mirant Corporation has emerged from bankruptcy protection.

Comment J22 (from Jay Avin): I read in the Boston Herald that they (Mirant Kendall) don't even have a sprinkler system in their plant.

Response to J22: EPA does not regulate sprinkler systems or other fire prevention equipment. Thus, EPA generally cannot impose conditions in a NPDES permit regulating fire safety and has not done so in this permit. This issue also falls under the purview of City and/or State regulations.

Comment J23 (from Dr. Raymond Walther): The excess warmth of the additional power reverses these projects which have improved the biologic and recreational capacities of a viable Charles River over the years.

Response to J23: See Response to comments related to C2, C3, C7 and response to comment related to C15 from CLF.

Comment J24 (from CRWA): Although we support the use of natural gas over dirtier sources like coal and oil, the environmental benefits to our air should not come at the expense of the Charles River's aquatic ecosystem.

Response to J24: Mirant Kendall is subject to State and Federal air emission requirements. The NPDES permit requirements were established independent of the air requirements and are conditioned to protect the BIP in the lower Charles River and meet Federal and state WQS.

K. Response to Comments Concerning Projected Effects of the Permit on Mirant Kendall's Operations

Comment K1: Curtailments as Flexibility. At p. 2, the Summary Fact Sheet states:

"Assuming favorable energy market conditions, maintaining [the proposed in-stream thermal limits] may require [Mirant Kendall] to curtail peak capacity operations on certain days, particularly in the summer. However, these permit conditions provide [Mirant Kendall] flexibility in its operations to continue to generate electricity for the New England market while not over taxing the environment".

Mirant Kendall has demonstrated to the Agencies that permit limitations such as contained within the draft Permit will force Mirant Kendall during any normal summer to curtail operations at Kendall Station to such an extent that the plant's economic viability will cease, and Kendall Station will be forced to shut down. Yet the Agencies have not addressed that showing; their only response is to claim that the permit provides Mirant Kendall with "flexibility."

Mirant Kendall acknowledges that the Agencies are not obligated to take Mirant Kendall's economic issues into direct account for purposes of determining permit limitations under § 316(a) of the Clean Water Act. However, the Agencies are obligated to issue a permit that contains provisions that make sense, that are only as stringent as necessary to ensure the protection and propagation of a BIP, and that do not impose unnecessarily stringent provisions where these provisions would certainly cause grievous harm to the operations of Kendall Station.

Response K1: EPA and MassDEP have not been cavalier in addressing Mirant's concerns about the possible economic impact of these permit conditions and the flexibility provided for in the permit. First, EPA confirms the critical point that Mirant concedes in passing: section 316(a) makes no provision for EPA to factor cost into the determination of permit limits necessary to protect the BIP. Therefore, the only legally cognizable argument this comment makes is that the permit limits EPA has developed are more strict than necessary to protect the BIP, and are therefore, the argument goes, unreasonable in light of the potential impact these limitations may have on operations at Kendall Station.

EPA has carefully considered the many points Mirant has made challenging the necessity of the permit's 316(a) limits to protect the BIP and has already addressed them in some detail in Sections C, D and F of this document. To summarize briefly, EPA has not simply imposed the most conservative assumptions available, thereby unnecessarily over-protecting the BIP. There are many elements of the design of this permit that give Mirant flexibility to add heat to the Basin that will add some degree of stress to the BIP, and EPA has done its best to accommodate Mirant's discharge of heat consistent with the requirement that EPA has a reasonable assurance that the permit will protect the BIP.

EPA has essentially ceded the Cambridge side of the Basin in the vicinity of the Kendall Station discharge to heat levels that will not support the BIP, including heat levels that will have acute effects in violation of the Massachusetts' mixing zone requirements (see Response to F4 (part 2) and Response to Comment related to F4 from CLF). In exchange, requirements have been developed for the Zone of Passage and Habitat on the Boston side of the Basin to protect the BIP. Even in the Zone of Passage and Habitat, as a scientific and technical matter EPA has not relied on the most conservative assumptions available. As discussed above, many of the critical temperatures developed for this permit were derived by weighing temperature levels indicated by the scientific literature with generally higher levels suggested by observation of ambient water temperatures in the Basin. Although it would provide more certain protection to the BIP simply to have adopted the temperatures derived solely from the literature, EPA has factored in actual conditions in the Basin. For example, in a variety of instances the compliance regime in the permit allows the Station a two degree Fahrenheit "buffer" when enforcing these critical temperatures. The permit states that to achieve a 59 ºF in-stream temperature in the Zone of Passage and Habitat to protect yellow perch spawning, a 61 ºF temperature limit is enforced at the monitors (see Section 5.6.3i of the DD). There is a large body of site-specific water quality data from the lower Charles River Basin that justify the allowance of this buffer (see Response Related to C44 from MA CZM and CLF). In addition, based on information submitted by Mirant, it is assumed that Kendall Station will manage its heat discharge in such a way that temperatures will remain below the 61 ºF limit (see Section 5.11 of the DD). The permit assumes Mirant will operate with a margin of compliance, and the permit makes that margin of compliance available to Mirant as an element of operational flexibility. After further consideration of the two degree buffer during the summer months, EPA and MassDEP have refined the compliance regime during the summer to ensure that there remains a consistent refuge at 81º F, at least on the margins of the ZPH. This issue is also discussed in Response Related to C44 from MA CZM and CLF.

Comment K2: In May 2003 the Agencies asked Mirant Kendall to project the results for the operations of Kendall Station were the final NPDES renewal permit to include in-stream temperature limits such as they have now proposed. The Agencies' request identified several alternate in-stream temperature scenarios. In Mirant Kendall's RFI Response (AR# No. 472), the company projected the results using 1999 river flows and background temperatures as the base conditions for the Agencies' scenarios and several others.

Among the scenarios projected in the RFI Response were several that are very similar to what the Agencies have now proposed, which is to require compliance with 4-hour average temperature limits in the proposed Zone of Passage and Habitat and not to allow use of the proposed new outfall and diffuser. Under those conditions, the RFI Response showed that Kendall Station would have been curtailed to its most minimal level of operations (10% heat load) on 90% or more of the summer days in 1999. Further, the RFI Response showed that curtailments at that level, indeed, even less onerous curtailments,

would make the Station economically inoperable because it would lose so much revenue that it could not cover its fixed and variable costs. Mirant Kendall also provided alternative approaches in the RFI Response that would still be protective but would allow the Station to operate, and requested the opportunity to cooperate with the Agencies to develop a workable approach.

Even though it was a response to their request, there is no evidence that the Agencies have given any consideration to the information or alternatives in the RFI Response. The projections in the RFI Response are not even mentioned in the permitting documents, much less discussed. It is irresponsible, arbitrary and capricious for the Agencies to propose permit terms, in the face of evidence that they will force the closure of Kendall Station, without any acknowledgment or discussion of that evidence.

Response to K2: EPA and MassDEP believe that the permittee used a worst case year for this analysis, a different year than that which MassDEP requested, which tended to show a worst case scenario for potential plant shutdowns, particularly during the more profitable summer months. (See Comment K3, where Mirant acknowledges that 1999 was not representative of typical summer conditions). It appears that the use of an outfall diffuser would allow the permittee to operate appreciably more than operation without the diffuser. However, as EPA and MassDEP described in the introduction to Section E comments, the burden on the permittee dating back to at least the permit application in 1999 required a full evaluation of the diffuser potential benefits and drawbacks. This evaluation has not been completed to the permitting Agencies' satisfaction. Therefore, a determination was made to not allow a diffuser discharge at this time. See the introduction to Section E for a complete discussion regarding the diffuser issue.

EPA and MassDEP have fully taken into account the permittee's RFI response and understand that Mirant will be faced with the potential for significant days of curtailed operation in the summer. Despite that potential, the permit must require the protection and propagation of the BIP, the attainment of water quality standards and minimizing the effects of the cooling water intake structures.

Regarding the permittee's BTU heat load approach as described in Comments C5 and D5, EPA and MassDEP determined that this approach was ultimately not protective of the BIP and thus, it has not been offered as an alternative compliance approach in this permit. See Responses to C5 and D5 and responses concerning alternative compliance approaches.

Comment K3: Mirant Kendall also has projected the impacts of the now-proposed permit terms on the operation of Kendall Station. These new projections differ from the projections in the RFI Response in several ways:

1. The new projections used the ZPH and in-stream temperatures actually

proposed by the Agencies as Attachment A to the draft NPDES renewal permit. The projections for the RFI Response had used the somewhat different in-stream temperature limits provided in the Agencies' 2003 RFI.

2. The new projections are based on actual river flows and background river temperatures for 2001 whereas projections in the RFI Response were based on similar data for 1999. The river flows and temperatures for 2001 are considered more representative of typical summer conditions.

3. The new projections assumed that the Station, if not curtailed due to the NPDES permit, would run pursuant to a forecasted load dispatch profile based on simulated market conditions.

4. Mirant Kendall then applied the same thermal and hydrodynamic model used throughout these permit proceedings to determine the extent to which Kendall Station would be required to curtail its market-based operations in order to avoid any exceedance of the proposed in-stream limits.

5. For comparative purposes, Mirant Kendall also substituted the proposed permit terms for the scenarios the Agencies' had described in the May, 2003 RFI and re-applied the model under the 1999 conditions, still assuming the Station was unconstrained by market forces.

The resulting number of days the Kendall Station's operations would exceed applicable in-stream temperature limits are summarized and compared in MK comment Ex. No. K3. They show that were the proposed in-stream temperature limits applied to 1999 river conditions, the Station would be curtailed from operating at its maximum capacity for a total of 63 days during the summer months of June, July and August. The Agencies' modification of the averaging time for Delta T resulted in about a 20 day decrease in curtailments as compared to the RFI Response results. The overall result, however, curtailing the plant two-thirds of the summer, is consistent with the results described in the RFI response for the scenarios requested by the Agencies in their 2003 RFI.

The results show that even under the more realistic and market-based case (2001 river conditions and the reduced, market-based Capacity Factor), the Station's operations under the proposed permit limits would still be curtailed from operating at its expected capacity for 43 days, almost half of the available operating days during the summer months.

Response to K3: EPA disagrees that the permitting Agencies did not carefully consider the implications of Mirant's original RFI submittal. The new scenarios Mirant modeled as part of the company's comments on the Draft Permit have also been carefully considered. Mirant appears to conclude that EPA did not consider its submissions because Mirant disagrees with the conclusions EPA reached after studying them. But the record of this permit indicates EPA thoroughly examined the issues raised by the RFI

submittal and Mirant's comments.

The RFI made it clear that it would be much easier for Mirant to comply with the temperature regime required in the permit if Mirant were allowed to construct and discharge through the proposed diffuser. EPA takes this point seriously, and is prepared to consider an application to install the diffuser. The reason the diffuser has not been approved as part of this permit renewal is not to force Mirant to curtail operations unnecessarily in the summer. Rather EPA concluded that operating the diffuser could exacerbate the eutrophication problem in the Basin and could cause other water quality problems, as described more thoroughly in Section E of this document. If Mirant can demonstrate that it can operate the diffuser in a manner that addresses that risk, and other risks to the aquatic community that could result from the installation and operation of the diffuser, to the satisfaction of the permitting agencies, EPA has no objection to Mirant using the diffuser to redistribute its heat discharges in the Basin consistent with the conclusions Mirant derived from its RFI response.

Mirant notes that EPA adjusted the Delta T averaging period in the permit and that one resulting effect of this adjustment was the likely reduction of the potential for curtailments in the summer. This change, the reasons for which are explained in Response K4, is further evidence that EPA considered Mirant's RFI submittal and the company's concerns about the operational limits this permit would impose during the summer.

EPA is obligated under CWA 316(a) to protect the BIP, and there is no authority to relax the temperature limits that are necessary to protect the BIP based on economic considerations such as the potential curtailments presented in the RFI response. While it is useful as a policy matter to understand the possible operational consequences of different compliance requirements in the permit, as a matter of law EPA must evaluate whether to adjust those compliance requirements based on the requirement to protect the BIP, not based on the desire to maximize the plant's capacity to operate in the summer.

Comment K4: Impact on Station Curtailments of Potential Refinements to Permit Conditions. Mirant Kendall used the thermal and hydrodynamic model to evaluate the impact on curtailments to Kendall Station's projected market-based level of operations under several potential refinements to the proposed permit limits and ZPH, assuming 2001 river conditions. The results are discussed below.

1. Using the same in-stream temperatures and ZPH proposed in the Draft Permit, use of the proposed new outfall and diffuser for up to 50% of the cooling water discharge. The results indicate a projected reduction in the number of curtailment days from 43 to 20 days, thereby reducing the curtailment impact of the proposed in-stream temperature limits by one-half.

2. Use a 24-hour averaging period instead of a 4-hour averaging period to determine compliance at the monitoring points in the ZPH. This refinement results in a projected reduction in the number of curtailment days from 43 to 27 days.

3. Provide a certain number of "allowance" days when in-stream temperatures could exceed the established in-stream limits in recognition of the natural variability of river temperatures. If this approach was adopted for the summer time months, the projected number of curtailment days would be reduced by 15 and foreseeable springtime curtailments would likely be rare.

4. Delete the requirement to meet the temperature limit at two feet at proposed Station 3 because that depth at that Station is not located within the significant habitat of the largest species. This refinement results in a projected reduction in the number of summertime curtailment days by 8.

5. Designate the upstream boundary of the ZD (running through proposed monitoring Station 2) as the reference for compliance with Delta T limits and delete the requirement for comparisons to proposed Station 1. This refinement results in a projected reduction in the number of curtailment days by 7.

The Agencies should take the above recommendations into consideration and cooperate with Mirant Kendall to devise a compliance system that appropriately balances adequate protection of the BIP with the operational needs of Kendall Station.

Response K4: EPA has addressed elsewhere in this document each of the items in the "portfolio" of operational refinements that Mirant proposes. The basic flaw in the presentation of this portfolio here is that they are presented largely as means to avoiding potential curtailments. As discussed above, however EPA must evaluate these proposals based on their potential impact on the BIP (or in the case of the diffuser, its impact on water quality standards). Although this evaluation is discussed in more detail elsewhere, in summary the conclusions are:

1. As discussed above, once Mirant can demonstrate that the diffuser will not likely contribute to eutrophication of the Basin and will not contribute to the other water quality problems discussed at length in section E, EPA will permit it, unless other effects of the installation and/or operation of the diffuser unduly compromise the aquatic community when considered in concert with other impacts to that community.

2. The temperature extremes that could be employed and still meet a 24 hour average of the critical temperature requirements would subject the BIP to

unacceptably high temperatures. The stress created by those temperatures will not be somehow remediated by the lower nighttime temperatures 12 hours later. Kendall Station has the capacity to create short term spikes in temperatures during the hot summer days with high power demand during times when the BIP is already stressed. This would likely seriously degrade already stressful conditions for the BIP. EPA has shown flexibility on the issue of averaging time, however, by agreeing to measure delta T on a 24 hour basis because it can be reasonably justified that averaging the temperatures over 24 hours is necessary to account for the time lag of water moving in the Basin. See also Responses I4 and L2.

3. EPA partially addressed this comment by providing that springtime temperatures in the ZPH could rise 2 degrees above ambient to account for the large variability of temperatures during the spring. EPA believes that the methodology MassDEP uses to determine attainment of the temperature criteria in its WQS is not directly applicable or analogous to the problem this permit is trying to address. Using 24 hour averages with a 10% allowance makes sense when assessing the natural seasonal and diurnal variation in water temperatures. Here, however, EPA has to decide how to regulate temperature to protect the BIP where a single facility has the capacity to dramatically alter the temperature regime of this portion of the Basin. Mirant's heat input is capable of creating temperature spikes that bear no resemblance to the sort of natural variation the MassDEP methodology is designed to address. Among other impacts, avoidance behavior by adult and juvenile fish can result from such short term temperature spikes. Therefore, EPA concludes it is necessary to use an averaging time less than 24 hours to ensure that temperature spikes do not cause fish to avoid the ZPH.

4. The record documents that juvenile alewife and blueback herring are found throughout the water column and typically come to the surface at night to feed. EPA and MassDEP, therefore, have concluded that juveniles must be allowed some suitable habitat near the surface to feed. Thus, it is necessary to ensure that the temperatures at the 2 foot depth are not so high as to deter that surface feeding. In addition, a study has shown that herring and shad appear to prefer to use surface waters during passage up and down a river (AR# 542, Crecco, et. al.1983). One of the key biological functions EPA and MassDEP are trying to protect in the ZPH is the use of this part of the Basin as passage for migrating fish.

5. The proposal to move the monitor for the background temperature downstream, closer to the outfall, runs the risk of placing that monitor in a location where it would be measuring temperatures elevated by Kendall Station's discharge rather than measuring temperature levels that reflect a

more true background condition. EPA cannot agree to place this monitor in a location where the Kendall Station may in effect be setting its own background temperature, thereby effectively relaxing the delta T limit by raising the background level against which the delta T would be measured. See also response to I5.

L. Response to General Comments

Comment L1: Mirant Kendall as Largest Industrial Discharge to the Charles River. At p. 1, the Summary Fact Sheet states:

> this permit is an important component of continuing broader public and private efforts to restore the health of the Charles River Basin and Boston Harbor. Since [Kendall Station] is the largest industrial discharger impacting the habitat and water quality of the Charles River Basin, appropriate permit requirements are critical to this larger effort.

Mirant Kendall respects the efforts by the Agencies and others to improve water quality in the Charles River and Boston Harbor and acknowledges that the quantity of its cooling water discharge makes the Kendall Station the largest single discharger, in terms of flow quantity, to the Charles River. Mirant Kendall also acknowledges that its long permitted discharge inevitably raises water temperatures somewhat in a limited area of the Lower Charles River Basin, as it has done for fifty years, as compared to what the temperatures would be otherwise.

By themselves, however, those facts do not begin to justify the assertion that the proposed new limits on Kendall Station's discharge, which would severely reduce the Station's existing limits, are "critical" or even relevant to making improvements in the Charles River Basin. In fact, nowhere in the Agencies' permitting documents do they make any showing that in-stream temperature increases from the past, current or proposed discharge from the Kendall Station have any significant impact, much less that it is "critical" to drastically reduce the Station's thermal limits.

It is clear that other factors – the CSOs, the impacts of man-made hydrologic alterations, and storm water discharges, among others – are much more critical to water quality in the Charles River than its "largest industrial discharger." The Agencies have been blinded by their commendable efforts on other issues into believing that they must cut every discharge to the maximum extent it is conceivable to justify whether or not the discharge is actually causing problems.

The Agencies have failed to make the required determinations whether this discharge in this location will have any actual impact that requires reduced limits going forward.

Response to L1: EPA and MassDEP listed the fact that MKS is the largest industrial discharger to the Charles River Basin as a point of fact. In the permit record, concerns were identified with the upgraded operation of the Station (increased electricity generation). Increased Station operation has the potential to increase the thermal heatload to the lower Basin above the discharge profile of the Station recorded over the past fifty years, to elevated levels much closer to the maximum permitted thermal discharge. This new operating scenario has the potential to exacerbate existing water quality standards impairments.

In Section 5.3 of the DD, there was a detailed discussion regarding the past and proposed uses of once through cooling water and heatload discharged to the lower Basin at historical levels and as a result of the proposed increase in Station generation. Without the submission of an acceptable hydrodynamic model to translate the higher heatloads into resulting temperatures in the receiving water under various river flow conditions, detailed temperature impacts to the river could not be predicted. The permittee did not meet its burden to credibly identify proposed temperatures in the receiving water and demonstrate that these temperatures would still be protective of the BIP. Therefore, EPA and MassDEP decided to use biological and environmental information to set protective temperatures in an appropriate portion of the river (the ZPH) to protect the balanced indigenous population under the new generating profile. The scientific literature and site specific field data used to determine the protective water temperatures were clearly referenced in the DD.

In a reversal of statements included in the permit renewal application submitted by the permittee in February of 2001, the permittee now contends that future thermal discharge will not exceed historical thermal discharge. The elevated summer heatload discharge from Kendall Station since the upgrade of the facility conflicts with this position (see Responses to B1, B3 and C3). Even if the Station does return to a thermal discharge profile consistent with historical discharge and well below the currently permitted maximum thermal discharge, EPA and MassDEP must address potential impacts from the facility based on maximum permitted discharge limits. When a biology-based approach was used to establish protective temperature limits for the ZPH, it became clear that past temperature limits were not fully protective of the Charles River BIP.

Response B1 discusses the in-stream thermal profile from the past, current and proposed discharge from the Kendall Station and Response C3 identifies the adverse impact to the alewife and blueback populations in the lower Basin from Kendall Station operation. This assessment is a further justification for the temperature limits placed in the permit.

While the DD identified a range of other factors that also negatively influence water quality in the Charles River, EPA and MassDEP do not agree that it is clear these other factors are much more critical to water quality than the impact of the Kendall Station discharge. Different components of water quality are affected by the various factors, and EPA and MassDEP made no attempt to rank the severity of these other factors, nor was a ranking of the factors required.

EPA and MassDEP maintain that these permit requirements are critical to the protection of water quality in the Charles River.

Comment L2: Allowance of Theoretically Lethal Temperatures Near the Plant. At p. 2, the Summary Fact Sheet states:

> the [draft] permit allows one half of the Charles River in the vicinity of the power plant and Longfellow Bridge to reach temperatures which can be lethal, exclusionary or otherwise harmful to the various life states of indigenous fish, as long as at least one half of the River's cross-section maintains temperatures that

protect fish populations, including fish migration and reproduction.

The Agencies appear to draw much justification for the proposed temperature limitations in the proposed zone of passage and habitat (ZPH) from the claim that the other half of the Charles River in the vicinity of the plant would be allowed to reach lethal temperatures. Actually, in-stream temperatures on the Cambridge side of the river have not and will not reach lethal temperatures. Indeed, during the past four years of monitoring in-stream temperatures directly in front of the outfall, at the 3' depth where the temperatures peak, temperatures have not exceeded 90º F. See MK Comment Ex. Nos. D17-1 through D17-4. These data reflect the fact that the thermal discharge, even at its maximum flow rate, is not large relative to the Charles River and at most is 20º F warmer in the outfall pipe. It is then immediately cooled to temperatures 6º F to 7º F above the ambient temperatures; there is no zone of extremely different water temperatures. While temperatures in that area certainly are sometimes higher than the temperatures proposed by the Agencies for the ZPH, there is no evidence that those temperatures have been lethal or have caused any adverse impacts.

Indeed, Mirant Kendall has submitted voluminous data to the Agencies showing the regular occurrence of river herring and other species throughout the lower Charles River Basin, including the areas on the Cambridge side of the river adjacent to the plant, at temperatures well above the Agencies' proposed in-stream limits. The Agencies disregarded those data by invoking the unevidenced possibility that the fish actually in the river might be "stressed." By that side-step, the Agencies have chosen to ignore the existence of a balanced indigenous population in the vicinity of the plant and co-existing with higher temperatures than the Agencies would now require.

Having side-stepped the lessons from the Charles River itself, the Agencies draw their proposed in-stream protective levels from laboratory studies that generally isolate the effects on biota of prolonged chronic exposure, which is far longer than the acute chronic 4-hour exposure that permit compliance is based upon. Those laboratory conditions are completely uncharacteristic of the actual conditions of biota in the real world, where in-stream temperatures rise and fall during the course of days. The Agencies should refocus their determinations away from laboratory studies and focus instead on the telling evidence from this complex river system itself.

Response to L2: EPA and MassDEP have collected data that refutes the claim of the permittee that "in-stream temperatures on the Cambridge side of the river have not and will not reach lethal temperatures." Further, the permittee is not correct in asserting that heated water discharged from Outfall 001 of Kendall Station is then immediately cooled to temperatures 6 ºF to 7 ºF above the ambient temperatures. These statements are contradicted by modeling results as well as actual temperature readings taken in the Zone of Dilution.

Water temperature projections and historical data were submitted by the permittee as part

of the document entitled *Supplemental Surface Water Modeling Report In Support of Kendall Station NPDES Permitting* (May, 2001). As listed in Section 5.5.1 of the DD, EPA and MassDEP determined that the model was not acceptable for evaluating receiving water conditions for two main reasons. First, there was concern with the permittee's approach used to calibrate the model. Second, no documentation was submitted to validate the method used to interface the near field and far field mixing associated with operation of the proposed diffuser. However, model results excluding the use of the deep water diffuser (all wall discharge scenario) were examined as a general guideline of water temperatures in the receiving Basin. Specifically, the Transverse Cross Section , In-Discharge Zone MP-7-MP4A Cross Section was reviewed. Based on this model run, historical 1999 temperatures at 0.25 meters were above 90 ºF at position 13 and 12 (Cambridge side near discharge, Tab 4) on July 6th and at position 13 on July 19th. More importantly, when the Future Transient All Wall Discharge model results at this station were reviewed (the only discharge configuration allowed by the permit), temperatures above 90 ºF were routinely predicted at points 0.25 meters deep and sometimes seen at 0.75 meters deep in several positions from the Cambridge side out toward the middle of the lower Basin. Temperatures above 90 ºF were seen at 0.25 meters on all days the model was run for All Wall Discharge (July 6, 19, 27, 31, August 1, 2 , 3). Temperatures as high as 98.38 ºF were predicted near the discharge, in the Zone of Dilution.

In addition to the general guidance provided by the model, site-specific data confirmed that water temperatures in the Zone of Dilution exceeded 90 ºF and were more than 6 ºF to 7 ºF above the ambient temperatures. Monitoring conducted by EPA on August 11, 2005, and August 3, 2006, recorded Charles River water temperatures at stations that coincided with the fixed, real-time continuous temperature monitoring locations established in the permit (Table F4.P2.CLF-1). Sampling was conducted after noon, in order to measure lower Basin waters once they had been exposed to several hours of solar radiation in addition to Kendall Station's thermal discharge. During the August 11, 2005, monitoring event, the highest temperature recorded at the Background Station (MS1 of the permit) was 81.1 ºF. In the vicinity of the Kendall Station discharge, temperatures were 98.7 ºF at the surface, 100.0 ºF at 0.6 meters and 100.6 ºF at one meter (TABLE F4.P2.CLF-1). The hourly average heatload recorded at the Station for the entire day of August 11, 2005 at Kendall Station was approximately 504 MMBTU/hr (Mirant Kendall, April 2006). The maximum daily heatload allowed by the permit in effect on August 11, 2005 was 556 MMBTU/hr. Therefore, when these insitu water temperature readings were taken, the Station was operating at approximately 91% of capacity. While not all stations were visited on August 3, 2006, temperatures in the vicinity of the discharge were recorded from 95.9 ºF at the surface to 101.4 ºF at 1.3 meters deep (Table F4.P2.CLF-2). See also Response to F4.

Mirant presented data showing the occurrence of river herring and other species in the lower Charles River Basin at temperatures above the in-stream limits. The permittee states that EPA and MassDEP ignored field data and only considered laboratory

experiments when formulating protective temperature limits. This statement is not correct. EPA and MassDEP acknowledged the field data and considered this site-specific information when the permit temperature limits were developed. The observation of fish at water temperatures above the established protective temperature limits in no way invalidates the selected limits. There are several reasons why Mirant's interpretation of the higher temperature fish collection data is flawed. (See Response to C3).

First, it is generally understood that when a population of fish encounters an environmental condition (the temperature of the water, in this case), while the majority of the population will likely respond more or less in the same way, the condition will produce a variety of responses across the population. The biological responses may span the entire range, from a severe stress and mortality response for some weakened individuals, to avoidance behavior in other individuals, through a no-effects response from other individuals. Fish that are infrequently collected or observed in low numbers in the Charles River at these higher water temperatures likely represent the minority of individuals that are less sensitive to water temperatures which have been demonstrated to cause harm or avoidance to the population as a whole. It is inappropriate in this case to set temperature limits based on water temperature data coinciding with only a fraction of fish collections at the highest relative temperatures observed. This practice would likely only protect the segment of the fish population least sensitive to elevated water temperatures, rather than be protective of the population as a whole.

Second, the temperature data submitted with the fish capture data were instantaneous readings taken in the vicinity of sampling. The temperature limits designed for the permit must be viewed in the 4 hour average format and the station locations specified as part of the compliance plan.

Third, the spatial characteristics of the Kendall Station thermal plume are dependent on many factors, including Station operation, river flow, and meteorological conditions. When collecting fish as part of a long transect run (large distance), the collection net could likely pass through several pronounced changes in temperature as a single transect is run. Therefore, the exact water temperature coinciding with the capture of a fish or group of fish is difficult to determine with certainty. In addition, EPA and MassDEP agree with the permittee that in the lower Basin, in-stream temperatures rise and fall during the course of many hours. When collecting fish during an overnight (at least 8 hour) gillnet set, the exact temperature when a fish or group of fish were captured is also difficult to know for sure. Even in the case of a relatively small distance, short time, collection method, such as beach seining, a near surface temperature reading may not reflect the near bottom temperature where the juvenile fish may have been captured.

EPA and MassDEP disagree that there is no evidence that higher water temperatures caused by Kendall Station discharge have caused no adverse impacts to fish populations. EPA and MassDEP have reviewed data that indicate that the thermal discharge from

Kendall Station has resulted in appreciable harm to alewife in the lower Basin. See Response C3.

EPA and MassDEP have incorporated the actual site-specific conditions of biota in the lower Basin together with controlled laboratory studies. For example, continuous temperature data collected in the Charles River by the permittee provided the justification for the appropriate 2 ºF buffer, which was added to protective temperatures (excluding certain summertime limits and monitoring points- see Response Related to C44 from MA CZM and CLF) to take into account the documented rise and fall of in-stream temperatures throughout the course of a day during much of the year. In addition, the spring-time river temperature data set, assembled over many years, was also provided by the permittee and fully considered by EPA and MassDEP as part of the permitting process. Temperature limit exceedances allowed in the spring by the permit are a direct result of the understanding and accommodation of these site-specific spring river conditions by EPA and MassDEP.

The following responses address the permittee's contention that the prolonged chronic exposure laboratory experiments used to support protective temperatures are not compatible with the compliance time interval of 4 hours used in the permit.

EPA and MassDEP acknowledge that laboratory studies cited in the DD generally isolate the effects on biota of prolonged chronic exposure, which is far longer than the 4-hour exposure that permit compliance is based upon. Under these controlled laboratory conditions, the fish are held in a tank at a constant, carefully controlled temperature, and mortality is documented over an extended period (24-hours). In developing protective temperature limits for this permit, EPA and MassDEP started with the results from these experiments to establish chronic temperature effects so that the permit would ensure that mortality is not induced from the long term influence of a thermal discharge. But EPA's analysis did not rely solely on these long term mortality effects. EPA also considered additional information about acute, short term effects. For example, information addressing avoidance of a species to certain water temperatures under much shorter time periods was also incorporated into a protective temperature for those life stages that were able to avoid the thermal plume (DD Section 5.6.3 and 5.7.3). This is clearly required in the case of the lower Charles River Basin in the vicinity of Kendall Station, where large changes in water temperature can occur several times within a 24-hour period as a result of the Station's heated discharge and operational profile.

Some of the literature and certain water quality regulations use a daily, or 24-hour average temperature value as a temperature limit for the maintenance of different life stages of fish species. Implicit in the use of such 24-hour average water temperatures is the assumption that the fish inhabits a water body with more or less natural thermal variance over the 24-hour period (perhaps 2 to 4 ºF changes over 24 hours). In the lower Charles River Basin, the significant impact of the Station's thermal discharge could cause pronounced short term swings in temperature beyond the natural variance that these 24

hour average measurements assume. This potential to spike temperatures in the lower Basin would be especially likely to occur if the Station operated near full capacity for a number of hours (high discharge temperature) and then operated at a reduced capacity (lower discharge temperature) in order to meet a 24 hour average temperature. EPA and MassDEP set the time interval for averaging temperatures at 4 hours so that the Station could not artificially cause temperature spikes in the lower Basin well above protective levels.

In addition, certain aspects of fish behavior vital to the maintenance of a suitable habitat and fish passage are not consistent with an extended (24-hour) average temperature limit. The avoidance behavior of a fish, for example, is not a reaction to a 24-hour average temperature, but a response to conditions the fish senses over a very short time period. For example, based on Mirant's shoreline sensing and pushnet datasets, alewife catch during some years was either zero or much-reduced at "instantaneous" temperatures greater than 81 ºF. The temperatures recorded during these studies were simple measurements of the water temperature at the time of the study. It would not be advised to extrapolate such short-term duration results to a 24-hour permit limit.

In conclusion, while longer term chronic laboratory experiments were one important factor in the examination of protective temperatures, the key support for a 4-hour average temperature limit is the realization that Kendall Station has the capacity to sharply raise temperatures in certain areas of the lower Basin over a relatively short period of time. The need for this protection against sharp temperature swings is especially evident when compared with the generally gradual changes in ambient temperature conditions used as a basis for laboratory experiments or state water quality criteria. Taking this potential into consideration, especially under low flow conditions, setting a compliance interval greater than 4 hours would not be protective of the BIP. Therefore, evidence from the river system was used to establish appropriate protective temperature limits and time periods.

M. Response to Comments Concerning the Future of Mirant Kendall Station

Comment M1: Due to adverse energy market conditions, Mirant Kendall has formally deactivated more than three quarters of Kendall Station's generating capacity as of October 1, 2004. Mirant Kendall has negotiated a cost-of-service agreement with ISO New England ("ISO-NE") and expects to operate Kendall Steam Unit Nos. 1 and 2 and Jet No. 1 under such agreement for a period of approximately one year. At the end of that one year period, it is anticipated that Kendall Steam Unit Nos. 1 and 2 and Jet No. 1 will be deactivated and Kendall Station will cease all electric production for an undefined period of time. Jet No. 2 has been retired and has been removed from the site. Accordingly, the Station is operating at less than a quarter of its generating capacity now, with current diminishment and eventual cessation of its cooling water discharge for an undetermined time. The Agencies should consider those circumstances in determining how quickly to proceed to issuance of a final renewal permit and how to schedule any new requirements in the permit.

Comment related to M1 from ECPT: As NSTAR will soon be able to provide all the electricity locally needed from its new substation on the Mirant site, we would prefer that no permit be issued.

Comment related to M1 from Rae Steining: The NEPOOL Reliability Committee has noted that NSTAR's objection to the deactivation of all power generation capability at Kendall would be moot once the construction of a new NSTAR substation on the Kendall site has been completed. The continued pollution of the Charles River by the Kendall Station cannot be supported on the grounds that operation of the station is required for reasons related to the reliability or cost of the local supply of electric power. I think it is best that no new discharge permit be approved. Instead, a temporary permit should be given to Mirant so that Kendall 1 and 2 steam turbines can operate until the NSTAR substation is ready for use. At that time, Mirant should cease production of electric power at Kendall.

Comment related to M1 from Dr. Stephen Kaiser: The Kendall plant is now being operated at only 35 MW – 15% of maximum capacity. This appears to be all the energy that Nstar needs and by next summer when the new transformer is complete, there will be no grid demand on Kendall. I support Rae Stiening's proposal that any comprehensive new permit should be deferred. Once Mirant (or any future owner) decides to restart major power generation they should reapply to EPA for a permit – for a plant that would be fully used.

Response to M1 and related comments: At this point, Mirant's plans for operation of the Kendall Station appear in flux. EPA does not believe that there is a basis for denying the permit entirely based on the operational status of the plant because the applicant has not abandoned its permit application or ceased power production. The permittee

submitted a letter to George Papadopoulos of EPA on June 2, 2005 which provided an update on the MKS operations for the foreseeable future. In its June 2005 letter, Mirant contended that it was likely that MKS will be mothballed, or put completely out of service, except for the production of steam, some time in late 2005 or 2006. However, Mirant allowed that there were contingencies which may necessitate the facility's operation beyond these dates and into the foreseeable future. In fact, since January of 2005, when Mirant had restarted its main generator, and through the summer of 2006 the facility has operated at moderate to high levels of capacity and is operational as of the date of this permit. Therefore, EPA is issuing this permit on the premise that generation at the facility would continue in the range of past generation levels.

The construction of a substation on the property has apparently been completed. This substation was put in place to alleviate transmission difficulties in the area of East Cambridge, which had led MKS to run as a "reliably must run unit" (RMR), as determined by ISO-New England. It is not clear when this substation will be fully operational and therefore it is not clear whether or not MKS will continue operating under its RMR status. At this time, it is not known whether it will be determined by ISO whether or not Mirant must enter into another agreement to run the facility. If the RMR contract is not extended or renewed, the permittee will likely be required to bid for power production in the open market with other power providers during the time period previously encompassed by the RMR contract.

If Mirant loses its RMR status, the plant will operate as a competitive supplier in the ISO energy market. The Station's viability will then depend on its ability to sell electricity at competitive rates. The proposed NPDES permit conditions are only one of many factors that would impact the plant's ability to compete in the New England power market.

Finally, EPA notes that Mirant Kendall's 2005 operations involved by far the highest thermal discharge in the plant's entire history. See Introduction to Section B and Responses to B1 through B3. This illustrates why EPA cannot confidently rely on Mirant Kendall's projections of its future electricity generation or thermal discharge.

Comment M2: Specifically, by a letter dated April 28, 2004 and its attachments Mirant Kendall notified the Agencies that it had filed applications in April 2004 with ISO-NE to deactivate Kendall Station. Under those applications, Mirant Kendall provided notice of its plans to deactivate all three steam units and the combustion turbine at Kendall Station effective October 1, 2004 and until further notice. By a letter dated June 24, 2004, ISO-NE approved the deactivation of one of the three Steam Units and concluded that the deactivation of the remaining two Steam Units "would place the loads served by [NSTAR's] Kendall Substation at risk until such time as [NSTAR's] proposed Kendall Substation distribution improvements are completed." These distribution improvements include the completion by NSTAR of a new substation that is under construction and is

scheduled to go into service during 2005. In its June 25, 2004 letter to Mirant Kendall, ISO-NE directed Mirant Kendall and NSTAR "to concur on the selection of two of the three [Steam Units] to remain in operation thus allowing the remaining [Steam Unit] to deactivate as requested." Mirant Kendall and NSTAR agreed that Steam Unit No. 3 is the Steam Unit that ISO-NE should approve for deactivation. By a notice to ISO-NE dated September 22, 2004, Mirant Kendall withdrew Steam Unit No. 3, effective October 1, 2004.

Response to M2: See Response M1 which describes a submittal from the permittee updating the permittee's latest understanding of future plant operations. Since there is the possibility that this facility will be operated to produce power in addition to steam through 2006 and beyond, this permit must be written to take this prospect into account unless and until Mirant withdraws its application to operate the facility at full capacity. See also Introduction to Section B and Responses to B1 through B3.

Comment M3: The total generating capacity of Kendall Station prior to the Section 18.4 proceedings was 283 MW at peak, of which 40 MW came from the two jets and the remainder came from the several units affecting the use and discharge of cooling water. As of October 1, 2004, Mirant Kendall is operating Kendall Station with a nominal generating capacity of only 61 MW at peak, comprising 19 MW from Steam Unit No. 1, 22 MW from Steam Unit No. 2 and 20 MW from Jet No. 1. As a result, Kendall Station's use and discharge of cooling water has been much reduced from its full operating capability.

Due to these deactivations, Kendall Station will not be operating during the foreseeable future at levels of electrical generation or cooling water discharges or impacts that are anything like the Agencies project in the permitting documents. Rather, the discharges for the balance of 2004 and into 2005 will be much more like the levels experienced at the facility prior to the upgrade. Once the Station is fully deactivated in the later part of 2005, for an indefinite time there will be no use or discharge of cooling water.

Response to M3: As explained in the responses M1 and M2, the permittee has changed its assessment of likely future operations at the facility and actually operated at a relatively high level during some periods in 2004 and 2005. The Final Permit has been written based on the application EPA has before it in which Mirant proposes that the facility will operate at moderate to high utilization levels.

Comment M4: Consequences of the Deactivations for the Renewal of the NPDES Permit. Due to the deactivations, there is no immediate need or justification for the Agencies to issue the final renewal permit. The expected operations into 2005, and the likely full deactivation in 2005, ensure that the Station will not have any increased impacts over what has occurred in the past without any apparent harm. That means that the Agencies should take the time to provide full consideration to the biological information Mirant Kendall has provided previously and with these comments, to the

results of the TMDL modeling discussed in other comments, and to the submissions Mirant Kendall is required to make under the new Phase II rules for cooling water intake structures.

In the event that the Agencies issue a final NPDES renewal permit to become effective at a time when Kendall Station is partly or fully deactivated, the Agencies should adjust the effective date of any major new requirements to account for the Station's reduced operations.

Response to M4: This comment effectively contradicts itself and leaves it to EPA to sort through the regulatory implications of the various options Mirant wishes to keep open concerning operation of this plant. On the one hand, Mirant declines to withdraw its application to discharge heat into the Basin at its full capacity, presumably anticipating the prospect that Mirant or a subsequent owner might find it profitable in the future to use the plant's full capacity. On the other hand, Mirant does not want EPA to issue a permit that addresses the full extent of the Station's potential heat discharge, presumably because the company prefers to avoid the increased compliance costs during a time when the currently prevailing economics of power generation mean that the plant will not be operating near full capacity.

EPA declines to further postpone this already long-delayed permit renewal, and the Agency has concluded that issuing the permit now is appropriate and necessary. Since the future prospects for how the Station might be operated are unclear, we will proceed to issue the permit for which Mirant applied so that it can be in place to address potential impacts at any level of operation, to collect important water quality and biological data, and to assess whether the BIP is being protected.

It is notable that Mirant's comments at no point commit the facility to limiting its capacity, and the company states that it does not want EPA to "shelve the permit renewal." So it is clear Mirant wants to receive a permit that authorizes and addresses the full range of Kendall Station's operating capacity. The practical result of Mirant's suggestion that EPA put off issuing this renewal is that the facility would continue to discharge under its existing permit, which allows for appreciable harm to the BIP. If Mirant believes that EPA should consider its reduced operations as a basis for narrowing or limiting the compliance requirements for the facility, EPA invites the company to submit an application for a permit modification under which the company agrees to take enforceable conditions limiting the capacity of the facility, along with a demonstration that those limits will assure compliance with WQS or a demonstration that they will protect the BIP.