THE COMMONWEALTH OF MASSACHUSETTS

WATER RESOURCES COMMISSION

100 CAMBRIDGE STREET, BOSTON MA 02114

Meeting Minutes for January 12, 2012

One Winter Street, Boston, MA, 1:30 p.m.

Minutes approved February 9, 2012

Members in Attendance:

Kathleen Baskin	Designee, Executive Office of Energy and Environmental Affairs (EEA)
Marilyn Contreas	Designee, Department of Housing and Community Development (DHCD)
Jonathan Yeo	Designee, Department of Conservation and Recreation (DCR)
Ann Lowery	Designee, Department of Environmental Protection (MassDEP)
Gerard Kennedy	Designee, Department of Agricultural Resources (DAR)
Todd Richards	Designee, Department of Fish and Game (DFG)
Joseph E. Pelczarski	Designee, Massachusetts Office of Coastal Zone Management (CZM)
Bob Zimmerman	Public Member

Members Absent

Thomas Cambareri	Public Member
John Lebeaux	Public Member

Others in Attendance:

Bruce Hansen	DCR
Duane LeVangie	MassDEP
Charles Cooper	TRC
Kerry Mackin	Ipswich River Watershed Assn.
Michele Drury	DCR
Dave Armstrong	U.S. Geological Survey (USGS)
Tom Lamonte	MassDEP
Linda Hutchins	DCR
Alisa Richardson	R.I. Dept. of Environmental Management
Richard Friend	MassDEP
Peter Weiskel	USGS
Marilyn McCrory	DCR
Stephen Estes-Smargiassi	Massachusetts Water Resources Authority
Lexi Dewey	Water Supply Citizens Advisory Committee
Heidi Ricci	Massachusetts Audubon Society
Brian Wick	Cape Cod Cranberry Growers Assn.
Tricia Pries	Back River Watershed Assn.
Roger Frymire	Citizen
Margaret van Deusen	Charles River Watershed Assn.
Nancy Wells	Citizen
Paul Lauenstein	Neponset River Watershed Assn.
David Kaplan	Cambridge Water Dept.
Rebecca Cutting	MassDEP
Alison Bowden	The Nature Conservancy

Steve Pearlman	Watershed Action Alliance
Heidi Davis	MassDEP
Peter Dillon	Tetra Tech/ Norwell Water Commission
Michelle Craddock	DFG/Div. of Ecological Restoration
Andrew Magee	Epsilon Associates
Bill Hinkley	EEA
Andrea Traviglia	U.S. EPA
Ralph Abele	U.S. EPA
Margaret Callanan	EEA
Geoffrey Tam	Massachusetts Audubon Society
Jennifer Pederson	Massachusetts Water Works Assn.
Alison Field-Juma	Organization for the Assabet, Sudbury, and Concord Rivers
Elizabeth McCann	MassDEP
Vandana Rao	EEA
Eric Hooper	Massachusetts Water Works Assn.
Douglas DeNatale	AECOM
Alan Cathcart	Concord Public Works
Selene Victor	Citizen
Paul Boyd	Citizen
David Glater	Greater Boston Trout Unlimited
Phil Guerin	Worcester Public Works
Neil Fennessey	University of Massachusetts, Dartmouth
Steve Kaiser	Citizen

Baskin called the meeting to order at 1:35 p.m.

Agenda Item #1: Executive Director's Report

Baskin briefly described the composition and purpose of the Water Resources Commission as a water policy-setting commission that is an inter-agency body and includes public members. She noted that this meeting's primary agenda item would be the presentation and discussion of the final USGS report on factors affecting riverine fish assemblages in Massachusetts. She added that the next meeting of the Technical Subcommittee of the Sustainable Water Management Committee on January 17 would focus on how EEA agencies are using results from the report to inform development of streamflow criteria, biological categories, and flow levels.

Hansen provided an update on the hydrologic conditions for December 2011. Rainfall was near normal during December, while stream flows, groundwater levels, and reservoir levels were all above normal.

Agenda Item #2: Vote on the Minutes of December 2011

Baskin invited motions to approve the meeting minutes for December 8, 2011.

VOTE	A motion was made by Zimmerman with a second by Kennedy to approve the meeting minutes for December 8, 2011. The vote to approve was unanimous of those present.

Agenda Item #3: Vote on WRC Work Plan, CY2012

Baskin noted that a detailed discussion of the Water Resources Commission 2012 Work Plan had taken place at the December 2011 commission meeting. She invited a motion to approve the work plan.

VOTE	A motion was made by Contreas with a second by Zimmerman to approve the Water Resources Commission Work Plan for calendar year 2012. The vote to approve was unanimous of those present.

Agenda Item #4: Presentation and Discussion: USGS Report on Factors Influencing Riverine Fish Assemblages in Massachusetts

Baskin introduced David Armstrong and Peter Weiskel of the U.S. Geological Survey (USGS) and Todd Richards of the Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife (DFW).

Armstrong thanked the agencies providing funding for the study, including the Massachusetts Departments of Conservation and Recreation, Environmental Protection, and Fish and Game, and USGS. He noted that the report is available at http://pubs.usgs.gov/sir/2011/5193/; printed copies will be available in February. He acknowledged coauthors Sara Levin of USGS and Todd Richards. He added that the report is one of a number of USGS reports that have informed the deliberations of the Sustainable Water Management Initiative (SWMI) on streamflow, habitat, and environmental flow issues. He noted that the current report is the first to look in depth at fish data.

Armstrong provided an overview of the study, including data, methods, analysis, and a comparison to the results of the preliminary study published in 2010. The study's objective was to better understand the influence of flow alteration on fish communities in Massachusetts, in relation to the effects of natural basin characteristics, such as drainage area and channel slope, and other human stressors, such as impervious cover, water returns, and impoundments. The scope of the study was to look at the data at a statewide scale. He outlined new data sources and tools that made this study possible. The Sustainable Yield Estimator (SYE) tool, developed by USGS in cooperation with MassDEP, provided the ability to simulate altered and unaltered streamflows at all the fish sampling sites in the Division of Fisheries and Wildlife (DFW) fish database. The Massachusetts water indicators report (USGS 2009, Indicators of Streamflow Alteration, Habitat Fragmentation, Impervious Cover, and Water Quality for Massachusetts Stream Basins) identified areas where streams are depleted and surcharged. In addition, new GIS coverages – including one-meter impervious cover data and other data on topography, sand and gravel, land use, and dams – became available.

Armstrong reviewed the data used in the study. Data in DFW's fish database were screened to identify approximately 700 fish sampling sites that were appropriate for use in the study. Sites were well distributed across the state, with the exception of southeast coastal Massachusetts and Cape Cod, where differences between groundwater and surface water contributing areas did not allow estimation of flows at those sites. The study generated a contributing drainage area for each fish sampling site, and land uses and physical basin characteristics in each contributing area were identified through a GIS analysis. A GIS buffer analysis also generated variables for a 120-meter buffer adjacent to streams to understand the effects of adjacent areas on fish communities. He added that the sampling sites generally represent a range of basin characteristics across the

state, in terms of elevation, drainage area, slope, and percent of forest, wetland, and sand and gravel coverages.

Armstrong described the streamflow data, noting that daily flows were simulated for each fish sampling site using the SYE, and these daily data were used to calculate medians of monthly median flow and annual mean flow statistics. Water-use data were also summed for the contributing areas to each fish sampling site and used to calculate a suite of percent flow alteration variables. The fish sampling sites represent a range of flow alteration conditions and a range of impervious cover conditions across the state.

Armstrong reviewed the study's analytical methods. The study analyzed 150 variables and found that many variables were correlated. Because highly correlated variables could not be used together in the same regression equation, the study's authors used statistical methods to identify variables that contributed the most to variability in the data set. This analysis reduced the data set to 15 candidate variables for use in regression models.

He outlined the 15 variables and grouped them into categories, including three variables representing natural basin characteristics, four variables representing land use, four flow alteration variables, and four dam variables. The next step in analysis was a step-wise screening process to identify the most important variables.

Armstrong also described the analysis of fish data. Rather than analyzing data on individual fish species, fish were grouped into fluvial and generalist habitat-use classes based on the habitat the fish need for parts of their life cycle. A multivariate analysis of the fish data provided justification for using the habitat-use classes in the models.

He explained that two analytical methods were used to associate fish assemblages and environmental factors. Quantile regression looks at the relation between fish metrics and stressors one stressor at a time, while generalized linear modeling is a regression approach that takes multiple explanatory variables into account.

Armstrong then reviewed the results of these two analysis methods. He explained that quantile regression is often used for ecological data, which may be explained by a number of factors other than the factor of interest. The study's quantile regression analysis used the ninetieth quantile regression line to define the upper bound of the data. The ninetieth quantile approximates the expected change in the fish metric that would occur if the stressor on the plot were the limiting factor.

He reviewed examples of quantile regression results for several response and explanatory variables. The relative abundance of individual fish species decreases as percent alteration of August median flow from groundwater withdrawals increases. Results were similar for fluvial-fish relative abundance and fluvial-fish species richness. Quantile regression also showed that the relative abundance of individual fish species and the fluvial-fish class, as well as fluvial-fish species richness, decrease as percent impervious cover increases. Quantile regression analysis of one of the impoundment metrics showed that both fluvial fish relative abundance and species richness decrease as percent open water in the contributing area increases.

Armstrong then discussed the use of generalized linear models (GLMs) for relating multiple explanatory variables to fish-response variables. He explained that GLMs are the appropriate analytical tool for analyzing non-normally distributed data, count data, and data sets with large

numbers of zero values. He added that GLMs predict the mean response for the fish metric. The study developed GLM equations for fluvial-fish species richness, fluvial-fish relative abundance, and brook trout relative abundance. One model indicated that fluvial fish relative abundance is predicted by channel slope, percent of August median flow from groundwater withdrawals, percent wetland in the buffer, and impervious cover. He also discussed various statistical tests for the models.

The results of the models indicate how the fish community changes in response to different variables. The models quantify the decline in various fish metrics as flow alteration and impervious cover increase. Armstrong also discussed the differences between the preliminary report and final report in methods and variables selected. He noted that the results were similar.

An extensive question-and-answer period followed Armstrong's presentation. Pederson requested an opportunity to submit questions and receive replies after the meeting. Questions addressed the difference in numbers of fish sampling sites between the preliminary and final studies, whether the analysis could look at all variables at the same time, why the August median flow variable was selected, and whether the correlations among the variables point to solutions that might mitigate impacts of impervious cover on fish assemblages. Weiskel explained that much information is embedded in the impervious cover variable and further research is needed to "unpack" this variable to better understand its effects as well as the kinds of mitigation options that might be appropriate.

Other questions addressed why certain variables were eliminated in the final study, spatial variation in fish assemblages, why fish smaller than 40 mm were excluded, and the source of data on water withdrawals from private wells. Guerin requested clarification on how the models will be used. Richards explained that the study demonstrates that there is a significant relationship between fish assemblages and the flow alteration and impervious cover variables statewide, but the models should not be use to predict fish assemblages at a particular site. In response to a question about a reference to "unpublished" SYE data, Hutchins explained that the version of the SYE used in this study included data on private well withdrawals and septic system returns, while the published version of the SYE does not include these data.

There was some discussion of correlation coefficients and measures of statistical significance. Hooper asked for interpretation of the significance of the relationship between alteration of August median flow (from groundwater withdrawals) and two fish metrics. Armstrong explained that, for this data set, those variables did not come into the equations. He added that this does not mean they do not have an effect, but that they should be looked at on a site-specific basis. Fennessey commented on the high correlation between watershed drainage area and some flow statistics, suggesting that flow statistics could be substituted for drainage area in model equations. Armstrong added that the same could be true for impervious cover, which represents some flow alteration. He noted that these were good questions but that the study did not provide answers to them.

There was some discussion about the comparison of results from the quantile regression analysis and the GLM. Guerin referred to page 36, figure 12 of the USGS report and noted that the GLM for brook trout relative abundance indicates that August groundwater withdrawals are not a significant variable, while the quantile regression shows a significant relationship between the two variables. He asked for clarification on whether the quantile regression or the GLM would be used in policy. Richards responded that the two graphs were developed for different purposes and do not illustrate contradictory results. Policy will try to integrate both results, he added.

Weiskel noted that the GLM predicts a mean, while the quantile regression represents the ninetieth percentile, so that the quantile regression may show a stronger relationship. Richards added that the quantile regression plots one variable against one other variable, while the GLM looks at how all the different variables interact.

Pederson asked for an explanation of a decrease, between the preliminary and final reports, in the impact of impervious cover. Armstrong responded that the final report used different equations with slightly different variables, and therefore would not produce the same result. He added that the variables are on the same order of magnitude. Richards suggesting revisiting the question on January 17, when the third coauthor, Sara Levin of USGS, would be present to provide clarification.

Kaiser asked if the study looked at how fish populations are affected by extreme events, such as drought. Armstrong responded that the data set included data from the 1965 and 1981 droughts. Richards added that, since median flow was used in the analysis, the study did not look specifically at extreme events. He added that the intent of the study was not to look at site-specific impacts to fish communities from these variables, but to develop a statewide screening tool. He added that, in developing policy, other factors will be brought in to account for drought.

Pederson asked if statewide correlations would work in smaller subbasins or regions of the state. Richards responded that it would first be necessary to determine if region is a significant variable. He explained that grouping of data is an important decision, and it is important to let the data speak for itself in the process of developing regression equations. The regression analysis identifies variables and relationships that are significant. Armstrong added that spatial variation is a topic of interest for further investigation.

Cooper asked why fluvial fish were not found in several specific sites where alteration of August median flow and percent impervious cover were at the low end of the scale on the statewide map. Richards responded that fluvial fish were not found in many sites, and Armstrong added that historical anthropogenic activities could have extirpated fish from those particular sites.

Mackin asked for clarification of the significance of surface water withdrawals. Armstrong responded that, for this dataset, those variables did not come into the equation. He added that this does not mean that the variable is not important.

Hooper asked why septic system returns are correlated with percent impervious cover. Weiskel explained that the correlation may be a function of the dataset, where exurban and rural fish sampling sites are better represented than urban areas with high impervious cover. He added that the septic system question is important, and its effects, particularly on water quality, remain to be resolved.

Pederson asked if the way fish sampling was conducted could have excluded fish that would be found in deeper pools. Richards responded that the study considered whether the fish sampling method was appropriate for the habitat. He added that, if anything, these sites bias toward higher numbers of fluvial fish because sampling took place in habitats that are more likely to be inhabited by fluvial fish. He referred to the report section on how sampling sites were selected.

In response to a question from Kaplan, Weiskel and Hutchins explained that infiltration and inflow were not considered as explanatory variables because the data is not consistently available statewide.

Pries expressed concern about applying an analysis that takes into account variability across the state to a specific local area, when other variables might be more highly correlated in that area. She added that there are few fish sampling sites in her location of concern. Baskin responded that the SWMI committees have discussed how to introduce site-specific information in particular projects. She added that questions about how this scientific report will be incorporated into state agency decision-making and how streamflow criteria and flow levels will be used is beyond the scope of this technical presentation. These questions but would be addressed at future meetings of the SWMI committees. She invited those interested to attend meetings of the SWMI committees on January 17 and February 3. She added that a comment period after February 3 will provide further opportunity for questions and comments.

In response to a question from Richardson about why direct surface water withdrawals from rivers were excluded, Weiskel explained that only surface water withdrawals from reservoirs were excluded. He added that there are not that many direct withdrawals from rivers in the state.

Kaiser commented that looking at the effect of groundwater withdrawals on fish populations has implications for a definition of safe yield.

Baskin thanked USGS for its presentation. She added that the presentation will be posted on the web sites of both the Water Resources Commission and the Sustainable Water Management Initiative.

Meeting adjourned, 3:30 p.m.

Documents or Exhibits Used at Meeting:

- WRC Meeting Minutes for December 8, 2011
- WRC Work Plan, CY 2012
- USGS Scientific Investigations Report 2011-5193: *Factors Influencing Riverine Fish Assemblages in Massachusetts*. Available at http://pubs.usgs.gov/sir/2011/5193/
- Interbasin Transfer Act project status report, 28 December 2011
- 2012 Meeting Schedule, Water Resources Commission
- Current Water Conditions in Massachusetts, January 12, 2012
- USGS Scientific Investigations Report 2009-5272: *Indicators of Streamflow Alteration, Habitat Fragmentation, Impervious Cover, and Water Quality for Massachusetts Stream Basins*. Available at http://pubs.usgs.gov/sir/2009/5272/
- USGS Presentation to the Water Resources Commission, January 12, 2012: Factors Influencing Riverine Fish Assemblages in Massachusetts. Available at http://www.mass.gov/eea/docs/eea/wrc/fishhabitat-jan13-2012.pdf