EEA Sustainable Water Management Initiative Framework
Ipswich River Watershed Association
Analysis and Comments

Biological Categories and Streamflow Criteria:

The Sustainable Water Management Initiative builds upon the past decade of scientific advances by USGS, working in collaboration with the state environmental agencies. Notable among the prior work, the development of the Sustainable Yield Estimator (originally proposed as the "Safe Yield Estimator") provided an excellent tool to estimate natural flows where baseline flow data pre-dating human alterations did not exist. SYE was used to evaluate "Water Indicators" including a range of flow statistics, impervious cover, dam density and other factors, at a fine sub-basin resolution.

SWMI has added to that foundation some excellent new scientific findings that, on a statewide basis, identify the impacts of water withdrawals and impervious cover on the integrity of river ecosystems, as represented by fluvial fish populations. The SWMI scientific studies used fisheries data and sophisticated analytical techniques to identify changes in biological integrity of fish communities and to correlate those with variables that best explained the changes, notably percent imperviouness and percent depletion of monthly median streamflows. This is outstanding work that has been carefully vetted and peer-reviewed.

Among the key scientific outcomes:

- Streams and rivers were categorized from 1 (most pristine) to 5 (most degraded). Biological Category 3 represents the limits of acceptable alteration of the fish (ecological) community. Categories 4 and 5 represent degraded to severely degraded ecological communities.
- The biological categories were analyzed with flow data to determine the limits of acceptable alteration of normal (median) flows associated with each biological category; these establish Flow Levels 1-5. According to those findings, the maximum acceptable alteration (Category 3) of normal (median) streamflows in August is 25%. Beyond this limit, rivers fall into Category 4 or 5, which are unacceptably degraded. For October the maximum acceptable alteration for Category 3 is 15% and for January and April, the maximum alteration is 10%. [1]
- Impervious cover is also a key variable; for each 1% increase in IC, there is a corresponding 3.7% decrease in relative abundance of fluvial fish.

SWMI used these findings to identify "streamflow criteria" – numeric criteria identifying the range of % alteration of seasonal median flows, along with "feasible mitigation and improvement" for FL 4-5. We believe that these criteria are an important step forward. However, we strongly believe that the explicit goal for FL 4-5 sub-basins should be to reach FL 3, and that there should be criteria aimed at preventing extreme low-flow and zero flow periods.

IRWA is very grateful to the staff of USGS, DFG and the other agencies for the huge effort and excellent work they have done to answer two key questions that bedeviled prior attempts to evaluate "safe yield" and manage rivers sustainably: 1) what was the natural (unimpacted) flow regime and 2) how much flow alteration can ecosystems tolerate before they become unacceptably degraded. With the answers to these questions and the tools available, we are at the cusp of finally being able to manage our rivers sustainably. Now, we have to apply this knowledge appropriately in the policy and management arenas.

IRWA strongly supports the proposed biological categorization and streamflow criteria, except that the explicit goal for FL 4-5 sub-basins should be restoration to FL 3 and there should be explicit criteria triggering action to prevent extreme low-flow and zero flow conditions.

[1] Because the SYE treats both groundwater withdrawals and direct surface water withdrawals as if they came directly from rivers, the SWMI Framework would more accurately reflect the science if it distinguished between "non-reservoir" and "reservoir" withdrawals rather than "surface water" and "groundwater" withdrawals.

Safe Yield: By law, safe yield is the maximum amount of water that can be pumped continuously from a water source, without fail, even during the driest period.[2] DEP acknowledges that safe yield includes environmental protection factors, including the ecological health of river systems, as well as hydrologic factors.[3] DEP also considers safe yield to be "the fundamental concept" of the Water Management Act.

Safe yield is important because it sets a limit on the amount of water that can be withdrawn, so that water supplies will not be at risk of failure during dry periods and so that rivers will not be depleted beyond safe levels due to water withdrawals.

EEA's proposed safe yield methodology is inconsistent with current science, contrary to the law and conflicts with DEP's clarification on safe yield, which states that safe yield includes protection of the ecological health of rivers. If the EEA safe yields were actually continuously withdrawn from rivers:

- 24 out of 25 rivers in Massachusetts would be pumped dry for 3-5 months during a drought year (based on MQ90 flows[4]). (See Attachment A)
- 16 out of 25 rivers would be pumped dry for ~1-3 months even in normal years; some of the rivers would be dry for half to two-thirds of the summertime. (See Attachment A)
- Flows in every river in Massachusetts would fall below the EEA "Environmental Protection Factor" for 6-8 months during a drought year (based on MQ90). (See Attachment A)
- All the rivers in Massachusetts would be in Flow Category 5 (Severely Degraded), based on the SWMI flow criteria.

EEA's safe yield figures are up to five times higher than any reasonable interpretation of the current science would support. The methodology is inconsistent with the scientific findings of SWMI and with the conclusions of DEP's own internal technical analysis regarding safe yield.

The EEA safe yield methodology is not credible. EEA should withdraw it immediately and assign the development of a scientifically-based safe yield methodology to USGS, in an objective, independent, peer-reviewed process, to solve this long-standing problem without political interference.

The following evaluation highlights the ways in which EEA's proposal is inconsistent with science and law.[5]

1. The EEA safe yields cannot be withdrawn continuously without depleting Massachusetts rivers to unsafe levels. EEA identified maximum allocations based on monthly median flows and translated those to Q90 drought flow values.[6] The Framework Summary states (p. 3, section 4), "It is important to remember that 90% of the time, a higher portion of monthly streamflows would remain in the river…" This statement is false for every river in the state from June through November, and for some rivers for eight out of twelve months, as shown in Attachment A. For the Ipswich and Parker, as well as the Deerfield, Chicopee, Connecticut, Hudson, Merrimack, Millers, Nashua and Shawsheen Rivers, the statement is untrue for eight out of twelve months, based on the SYE-generated streamflow data used by EEA.

---

[2] "Safe yield", the maximum dependable withdrawals that can be made continuously from a water source including ground or surface water during a period of years in which the probable driest period or period of greatest water deficiency is likely to occur; provided, however, that such dependability is relative and is a function of storage and drought probability.
"Water source", any natural or artificial aquifer or body of surface water, including its watershed where ground and surface water sources are interconnected in a single hydrological system.M.G.L. Ch. 21G § 2.

[3] http://www.mass.gov/dep/water/resources/safeyield.htm

[4] MQ90 are the monthly flows that are exceeded 90% of the time; 10% of the flows are lower.

[5] This analysis is based on simulated flow data provided by MA DCR, uses SWMI's assumption that streamflow depletion represents groundwater depletion, treats groundwater withdrawals as equal to direct withdrawals from rivers, and does not assume universal optimal storage, since that does not exist.

[6] This is shown on slide 11, page 6 of SWMI Technical Q&A presentation, dated 2/17/2012.

The fact that less water than the EEA "safe yield" is available for at least half of the MQ90 drought year is illustrated by the following graph (Figure 1). This graph of the Parker River shows that, using EEA assumptions, less water is available for allocation from June-January than the EEA safe yield, which is expressed as an annual average. In this case, only 0.05 cfsm[7] flow is "allocatable" in the lowest-flow period of summer, but EEA says the safe yield is 0.28 cfsm. How can 0.28 cfsm be withdrawn continuously, when only 0.05 cfsm is available in the river in summer?[8]

Despite EEA's claims that streamflow criteria will address this glaring deficiency in the safe yield methodology, nothing in the SWMI Framework would stop withdrawals or trigger any action when EEA safe yield exceeds the amount of water available in the rivers. A similar pattern results for all Massachusetts rivers. (See Attachment A(4).)

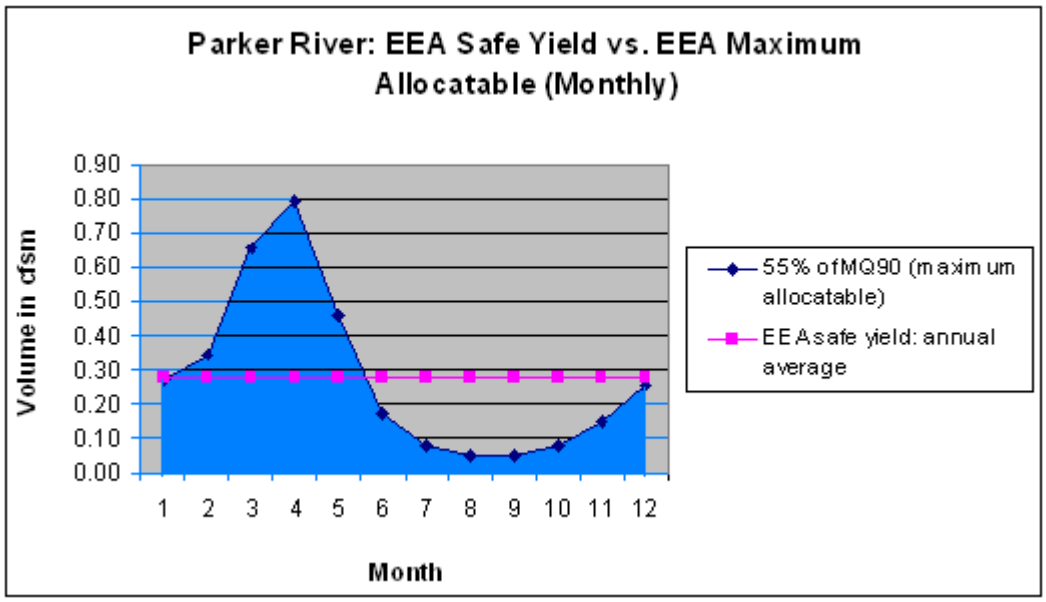

Figure 1: EEA Safe Yield for the Parker River compared to 55% of monthly Q90 flows.

MassDEP previously acknowledged that an annual average is not appropriate for safe yield: "An annually averaged consumptive loss rate is not an appropriate unit of measure to regulate withdrawals…" "With one basin yield number, the method fails to take natural flow variation into account…" [9] This is clearly shown in the graph above and similar graphs for other rivers, found in Attachment A(4).

2. Water demand is highest when flows are lowest. The EEA safe yield methodology also ignores the fact that water demand is highest from late spring to early fall, as shown in Figure 2[10]. (The graph highlights the period of flow deficit in red.) Actual peak demand is more than 40% higher than average annual demand in some cases. This is also when less water than EEA safe yield is available, causing rivers to be pumped dry.

Safe yield should establish a maximum withdrawal, but it does not do so. Instead, it in effect pretends that both withdrawals and flows are accurately represented by annual averages, but neither is true and the actual data curves are opposite each other. The safe yield methodology does not reflect this reality.

---

[7] Cubic feet per second per square mile; used in EEA safe yield calculations.

[8] You can't assume reservoirs exist where they don't. Reservoirs are not easy to site. Even where they do exist, they are not designed and operated to optimally capture and store water without damaging the environment, as is discussed below.

[9] DEP memo on Safe Yield, September 11, 2003, pp. 6 and 9 (See Attachment B).

[10] This graph is based on Table 2 from the USGS Water Indicators Report: Weiskel, P.K., Brandt, S.L., DeSimone, L.A., Ostiguy, L.J., and Archfield, S.A., 2010, Indicators of streamflow alteration, habitat fragmentation, impervious cover, and water quality for Massachusetts stream basins: U.S. Geological Survey Scientific Investigations Report 2009–5272.

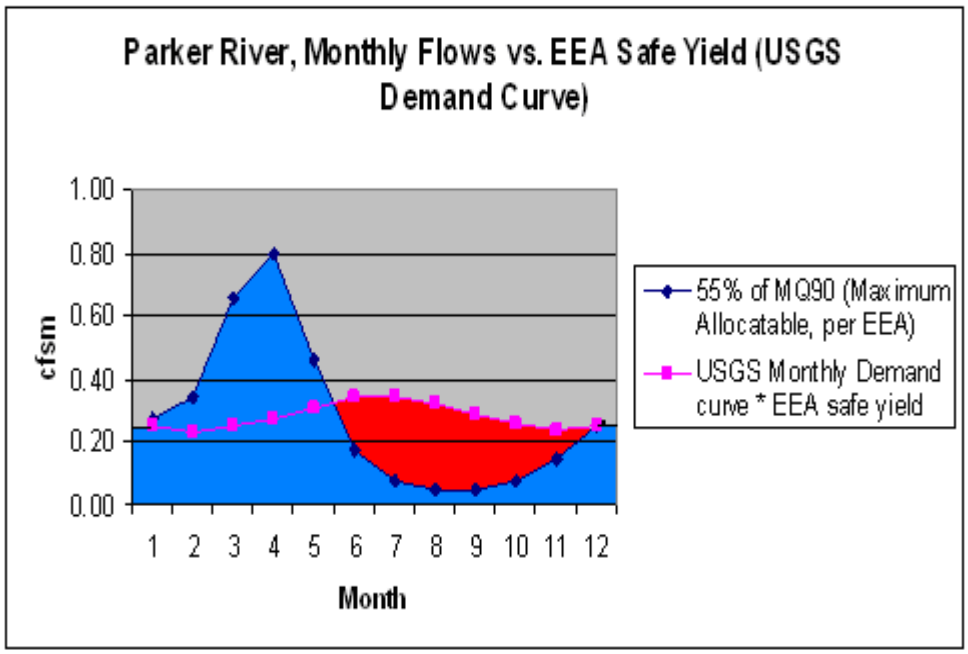

Figure 2: Monthly demand vs. Monthly Q90 drought flows, Parker River (red represents withdrawals exceeding flow)

3: The EEA safe yield methodology is inconsistent with scientific findings about streamflows needed to protect the ecological integrity of river systems and the limits of acceptable alteration of streamflows.

As noted above, SWMI includes some excellent new scientific findings identifying the impacts of water withdrawals and other factors on the integrity of river ecosystems, represented by fluvial fish populations. Biological Category 3 and/or Flow Level 3 represent the limits of acceptable alteration of the ecological community and BC/FL 4 and 5 represent degraded to severely degraded ecological communities.

a) **25% of August median represents the maximum acceptable alteration of normal August flows; EEA safe yield is 3-5 times higher and exceeds the <u>total</u> August median in most cases.** SWMI establishes a 25% limit of acceptable alteration of normal (median) August streamflows.[11] However, the proposed EEA safe yields far exceed 25% alteration, as shown below. In fact, they exceed the <u>total</u> August median (and September median) for 16 of 25 Massachusetts rivers. (See Attachment A(2) and (4).)

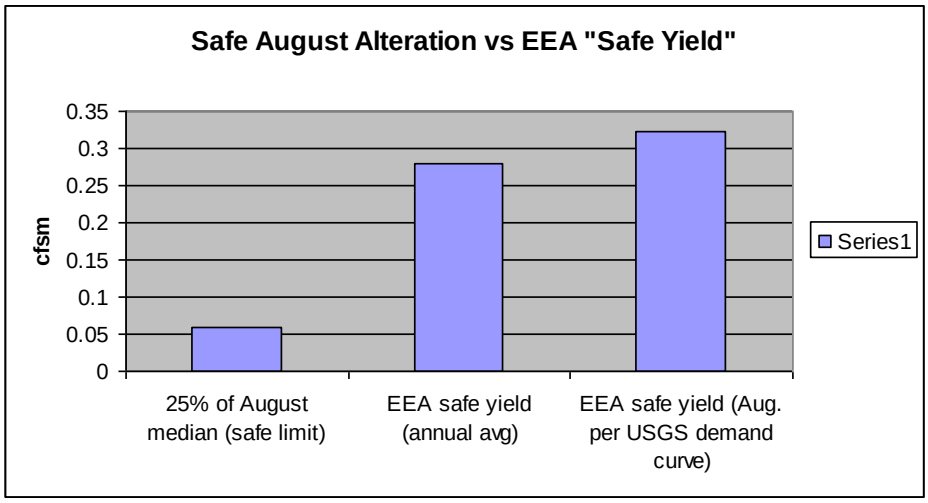

Figure 3: Parker River 25% of August median vs. EEA safe yield (as ann. average and based on actual demand curve)

[11] The limits of alteration in other seasons are: January 10%; April 10%, and October 15%; discussed further below.

If the EEA safe yield volumes were withdrawn from groundwater or directly from Massachusetts rivers in August, the alteration of August streamflows would be consistent with Category 5: Severely Degraded conditions. This would be the case throughout the summer/low-flow months.

This graph is particularly applicable in cases where groundwater withdrawals are made continuously, typically pumping the most in summer to meet high demand because these systems do not have large-scale water storage capacity. In these cases, there can be no assumption that high flows can be captured for use during low-flow periods, because reservoir storage does not exist.[12]

EEA's safe yield methodology compounds this problem in several ways.

b) **The SWMI identified the following seasonal limits of acceptable alteration** of normal (median) streamflows: January: 10%; April 10%; August 25% and October 15%. Putting aside for the moment the dispute about using an annual average, this averages to a maximum of 15% alteration on an annual basis, meaning that at least 85% of the flow would be reserved in the river in a normal year.

Despite these findings, the EEA safe yield methodology is based on a 25% alteration of the median flows for all months, reserving only 75% for the river, based on normal (median) flows.

	January	April	August	October
SWMI Limits of Acceptable Alteration	**10%**	**10%**	**25%**	**15%**
Limits Applied in EEA safe yield	**25%**	**25%**	**25%**	**25%**

According to the scientific findings of SWMI, such a large flow alteration is associated with **Category 5: severe degradation of the fish community**. Thus, according to the SWMI project's streamflow criteria, if the proposed safe yields were directly withdrawn from each river in the state, it could be expected that all the rivers would become severely degraded. Considering this discrepancy alone, the EEA safe yields are twice as high as they would be if the 10%/10%/25%/15% seasonal streamflow thresholds of acceptable alteration were applied instead of 25% for every month. This difference is shown in the following graph.

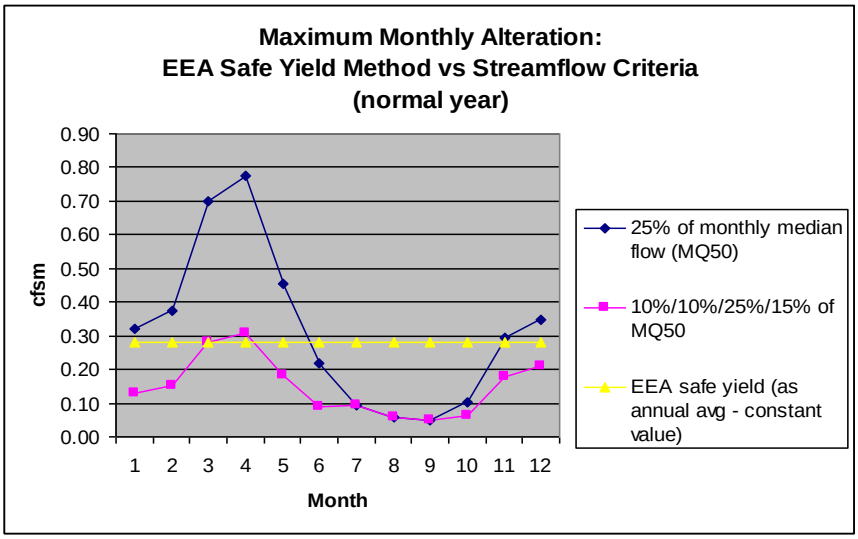

Figure 4 : Parker River, SWMI maximum acceptable flow alteration vs. flow alteration used in EEA safe yield methodology (monthly alterations based on median flows)

[12] Even where reservoirs exist, many reservoirs also capture flow continuously throughout the summer, without flow releases downstream. Most, and possibly all, reservoir systems capture flow beyond the safe limits identified by SWMI and other studies of acceptable alteration of streamflow.

c. EEA erroneously assumed you could take the same volume of water in a drought as in a normal year, rather than the same (or lower) percentage. The calculations above are based on monthly median flows which represent normal conditions. However, by definition, safe yield is the maximum amount of water that can be pumped dependably, even in the driest periods; this implies that it cannot be an annual average and must be based on drought statistics. The EEA methodology uses monthly Q90 drought statistics, which is a reasonable approach. However, EEA erroneously assumes that the same volumes of water can be taken during droughts, even though the total amount of water in the rivers is less than half of the annualized median flow. As a result, the EEA safe yield methodology assumes that it is acceptable to take out 55% of the flow during a drought, theoretically (but not actually) reserving a 45% "Ecological Protection Factor" in the rivers.

Calling 45% the "Ecological Protection Factor" does not mean it would actually be sufficient to protect the river ecosystem. By the information currently available to EEA, the opposite is true; nor would it actually remain in the river (as discussed further below).

Recent studies of the range of hydrologic alteration that ecosystems can tolerate indicate that the volumes of water that can be safely removed in a drought year are much lower than during a normal year. At most, the percentages of acceptable alteration should be applied to the drought flow statistics to derive volume, whereas here, the volume was used to derive percentages – that is backwards. The Range of Variability Approach, Index of Hydrologic Alteration and a recent study on setting Presumptive Standards[13] for flow alteration all indicate that acceptable alterations of drought flows should not exceed 20-25% and arguably should be even lower percentages during droughts.

Applying lower percentages of acceptable alteration to the MQ90 flows would result in safe yield values that are ~20-50% of the EEA safe yields.[14]

An empirical indication that the correlation approach that EEA used is problematic is that for the Ipswich, Parker and Shawsheen Rivers, 25% depletion of the November median flow exceeds 100% of the November Q90. Expressed as an annual average, the EEA safe yield exceeds the total monthly drought flow for up to 5 months for the MQ90 drought and up to 9 months for more severe drought scenarios. This level of depletion would destroy the ecological health of rivers, not protect it. See Attachment A(4); these months are color coded as described in the attachment.

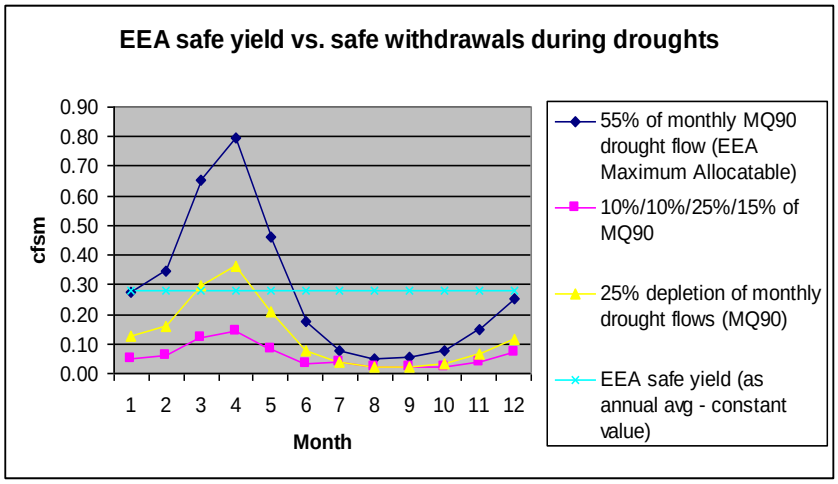

Figure 5: Comparison of % depletion of drought flows: 55% used by EEA vs. 25% vs. applying SWMI seasonal streamflow criteria to drought flows.

[13] Richter, B.D., Davis, M.M., Apse, C. and Konrad, C, Short Communication: A Presumptive Standard for Environmental Flow Protection, John Wiley & Sons Ltd., 2011.

[14] 25% depletion of the annualized MQ90 is roughly equivalent to 10%-10%-25%-15% depletion of monthly medians.

Figure 5 compares 55% of monthly drought flows (dark blue line, the "monthly allocatable" basis of EEA safe yield) and the EEA safe yield as an annual average (turquoise line) to maximum acceptable levels of depletion of drought flows based on the current science. As it shows, EEA's allocations are much higher than the current science supports.

d. The "Environmental Protection Factor" flows are not sufficient to protect the environment and will not remain in the rivers.

The EEA methodology sets 45% of the annualized drought flows as the "Environmental Protection Factor" (EPF). As noted above, this figure is too low to represent the flows needed to protect the environment. In addition, when flows fall below this level, as they will certainly do based on the information and analysis available, no action is triggered. Falling below "safe yield" volumes does not result in any reductions or restrictions on the use of the water source or even outdoor watering restrictions. It is an EPF in name only. If the safe yield were withdrawn continuously from Massachusetts rivers, every one of them would fall below the EPF for 6-8 months of the MQ90 drought year scenario. (See Attachment A(2) and (4).)

Maine, Florida and the United Kingdom[15] have established "hands off" flows, below which no water withdrawals can be taken. If an accurate EPF triggered such action, this could achieve the statutory intent that DEP "shall not" permit any withdrawals that exceed safe yield. However, no such action is proposed under SWMI. EEA and DEP are not even proposing to trigger restrictions on non-essential water use when flows go below the EPF, let alone shutting off water withdrawals. That no action whatsoever is required when flows go below the EPF indicates that it is an EPF on paper only, and suggests a lack of seriousness in regard to DEP's clarification that safe yield includes "the ecological health of river systems."

Recommendation: "Safe yield" should represent a "hands-off flow." When flows fall below safe yield, it must trigger use of alternative water sources; where alternatives are not available, it must trigger bans on non-essential water use, tight summer caps, lower maximum day withdrawal limits,additional effective drought management measures and measures to obtain alternative sources as soon as possible.

4: Calculating safe yield at a basin-wide scale does not address water withdrawals from sub-basins that are greatly over-allocated; by ignoring this issue as part of safe yield, SWMI explicitly allows additional withdrawals from sub-basins whose safe yield is exceeded.

In many cases, withdrawals at the sub-basin level exceed the safe depletion limits or safe yield calculated in cfsm. This is clearly shown in the maps of FL 4 - 5 sub-basins; 292 or 21%[16] of 1378 sub-basins in Massachusetts are severely flow-depleted. According to the USGS Water Indicators Report[17], some of these sub-basins are 100% depleted – AKA dry -- for months, yet under SWMI, DEP can still permit "new withdrawals" from these sub-basins. Small rivers and headwater streams are especially vulnerable.

A good illustration of this scale problem is that EEA's safe yield would allow 6 times more water to be pumped than current withdrawals from the Parker River Watershed.[18] However, the Upper Parker River is already repeatedly pumped dry, as are Mill Brook and the Egypt River (see Figure 6). This problem is not limited to one location; the photos are taken in four different towns. None of the occasions was a declared drought, yet these sections of the watershed were dry. This empirical evidence proves the failure of the

[15] Richter et.al., *Op. cit.,* pp. 4-6.
[16] From slide 33, page 17 of SWMI 2/3/12 ppt. There is some confusion about different numbers in different tables, but EEA staff indicated that 292 out of 1378 is correct.
[17] Weiskel et.al., *Op. cit.,* Appendix Table 1.
[18] The safe yield of the Parker is not only a scale issue; the safe yield is also too high even when re-scaled; for example, even if the safe yield were expressed in cfsm or mgd/mi2, it would allow 4 times as much water to be withdrawn than the withdrawal volumes that currently pump the Upper Parker River dry.

safe yield methodology to properly include "the ecological health of river systems." This case exemplifies why, due to the geographic scale issue, lack of storage and empirical evidence of severe degradation, safe yield must be determined based on August flows and must be expressed on a per-square-mile basis. [19]

MassDEP recognized this problem in 2003, but ignored its own analysis in devising the new methodology: "At the very least, it means that with safe yield expressed as one number, the safe yield withdrawal may not be equally distributed throughout the basin as impacts are more likely in the basin headwaters. The [old safe yield] methodology fails to allow for and distinguish between a safe yield for a head waters subbasin as opposed to the overall downstream watershed. When considering basin yield, the issue of scale matters. Thus one size does not fit all."[20] (See Attachment B.)

Parker River, Georgetown

Parker River, Byfield

Egypt River, Ipswich

Mill Brook, Rowley

Figure 6: Photos from Parker River Watershed; photos courtesy of the Parker River Clean Water Association except the Egypt River photo (Ipswich River Watershed Association).

While EEA claims that the proposed streamflow criteria will address this issue, this is not true. The WMA prohibits new withdrawals where safe yield is exceeded, but the proposed streamflow criteria, "baseline" and Tier system expressly allow DEP to allocate additional water, even from sub-basins that are severely degraded due to flow depletion. In fact, the proposed "baseline" allows 5-8% additional allocations without even triggering mitigation. This is contrary to the WMA's firm prohibition against allocating water beyond the safe yield of the water source. (Additional comments on "baseline" are below.)

[19] It appears that salt marsh, estuarine and barrier beach areas are included in the drainage area for the Parker River basin; these areas should be excluded from the safe yield calculation as they are not suitable for water supply.
[20] DEP Memo on Safe Yield, *Op. cit.,* p. 6.

The photo below and the highlighted permit condition illustrate that DEP continues to encourage additional water allocations, even when it knows that water withdrawals result in a dry river.

Byfield Water District, PWSID 3205001
WMA Permit #9P2-3-16-205.01

Draft Modified Permit, September 6, 2011
Page 4 of 6

- Present reasons why specific measures are not cost effective because the cost would exceed the costs of alternative methods of achieving the appropriate standard; and
- Propose specific conservation measures that would result in equal or greater system-wide water savings or equal or greater environmental benefits than the conservation measures included in the MassDEP Functional Equivalence Plan(s).

MassDEP will review permittees' detailed, written cost effectiveness analysis to determine whether unique circumstances make specific Best Management Practices (BMPs) less cost-effective than alternatives, or not feasible for a particular PWS when developing the compliance plan.

The reporting requirements added in Permits that have been modified were included to standardize the information submitted to the Department to assess compliance with the Permit and the Basin Performance Standards. Modified permits specify that Basin Performance Standards are to be met by 2017.

Finding of Fact for Special Permit Conditions

In issuing permits, the Department looks primarily at site-specific impacts and other issues specific to the system, such as impacts to nearby streams, wetlands, or other water users, justification of long-term demand projections and the capacity of permitted withdrawal points. The conditions are intended to ensure the efficient use of water and to mitigate the potential impact of withdrawals.

Special Conditions 1, Maximum Authorized Annual Average Withdrawal Volume, reflects a registered volume of 0.17 million gallons per day (MGD) through the remainder of the term of the permit. BWD should consider applying for an increase in their permitted volume, as BWD's withdrawals since 2006 have slightly exceeded their registered and permitted volume (0.179 MGD for 2009; 0.177 MGD for 2008; 0.20 MGD for 2007). Water use above the 0.17 MGD Baseline for BWD will require offsets where identified as feasible. (refer to Special Condition #7, below). BWD's permitted withdrawal volumes will be reviewed and revised, as necessary, prior to the Parker River Basin's WMA permits expiring in 2017.

Figure 7: Parker River, Byfield, August 2010 and Byfield Draft Modified Water Withdrawal Permit

The problem attributable to geographic scale could be largely rectified by explicitly expressing safe yield in cfsm (or mgd/mi2) and incorporating maps of the flow-depleted sub-basins (Flow Levels 4-5) with a statement that they are in exceedence of safe yield, cannot support new withdrawals and the impacts of existing withdrawals must be (truly) minimized and mitigated. **Doing so would address some of the most serious problems with the SWMI Framework.**

5. The SWMI Framework improperly assumes and credits water storage.

The SWMI Framework presents a complicated evaluation to determine whether reservoirs should receive a reservoir credit, to be added to EEA safe yield. This is unwarranted because:

1) the EEA safe yield methodology already accounts for water storage (even where it doesn't exist);
2) the EEA safe yield methodology already accounts for the maximum acceptable depletion of normal flows;
3) the reservoir credit methodology is based on storage capacity without regard to the ecological impacts of water withdrawals.

Storage of peak flows for use in dry periods is already accounted for: If safe yield were based on the lowest flows (summer drought), as it should be, it might make sense to have a reservoir credit to account for the capacity to store peak flows for use in dry periods. However, this storage is already accounted for by using an annual average. In fact, it is accounted for even where it doesn't exist. Use of the annual average ignores low-flows as a limiting factor and suggests that peak flows can always be optimally captured and used in the low-flow periods.

- This is a false assumption. Large-scale reservoirs do not exist for many water supplies. For many systems that pump groundwater, storage capacity is limited to a few days water demand, at most. As a result, pumping must occur continuously to meet water demand, which is highest in summer, when flows are lowest. This causes many rivers and streams to be pumped dry. This is why safe yield must be based on the lowest-flow conditions that represent the limiting factor for these systems, not an annual average.
- Where reservoirs do exist, they typically dam up rivers and capture water throughout the year without controlled releases downstream, drying up the rivers. There are few requirements for flow releases, and those that do exist are generally not based on the health of the natural ecosystem. There are few, if any, water systems in Massachusetts that are optimized to capture and release water in such a way as to maintain flows needed for healthy native fish populations and minimize

adverse impacts on the environment. Also, in most cases, it is not physically possible or feasible to store water optimally.

Storage of normal year flows for use in droughts is already factored in. If safe yield were based on 25% depletion of drought flows, then it might make sense to allow for a reservoir credit to account for storing flows during normal periods for use during droughts. But Page 3 Section 3 of the Framework Summary explains that the basis of safe yield is 25% depletion of monthly medians.[21] Thus, the EEA safe yields already account for maximum acceptable depletion of normal flows according to all recent scientific studies, and excessive depletion of drought flows. It is not reasonable to provide an additional credit for the ability to capture and store normal period flows to weather a drought, because that is already factored into safe yield.

Reservoir storage credit: There are a number of problems with the calculation of the reservoir storage credit.[22] **The biggest problem is that the reservoir credit ignores environmental impacts.** The credit is based on reservoir capacity, without any consideration of the environmental impacts on the source river ecosystems of filling the reservoirs. Reservoirs with high storage ratios have a greater impact on instream flow than ones with a low storage ratio,[23] yet here, these impacts are ignored and those reservoirs receive the highest credit.

The reservoir credit formula assumes that the total flow of a river can be captured, which is completely inconsistent with the current science on ecohydrology.[24] **This does not conform to DEP's clarification that safe yield includes the ecological health of river systems.**

- By adding the reservoir credit to the safe yield, the method would allow a far higher annual withdrawal limit than the current science of ecohydrology indicates is safe.
- For most of the systems, the proposed reservoir credit exceeds the maximum depletion limits of monthly medians. In fact, most of the credits exceed the total annualized drought year inflow, even though the safe yield methodology says that 45% of the annualized drought flow has to be reserved for environmental protection. The Fitchburg-Mare Meadow credit is almost 3 times the total drought year inflow and Fall River-Copicut is 1.7 times the total drought year inflow.[25]
- For the MWRA system, the credit is the total average annual flow, which equals 143% depletion of the annualized monthly medians – far in excess of acceptable depletion limits of SWMI or any other credible ecohydrology study.
- How can it be that in one part of the safe yield determination, EEA says that 75% of normal flows and 45% of annualized drought flows have to stay in the rivers as an "Ecological Protection Factor," but in calculating the reservoir credit EEA assumes capture of 100% of the annual flows, or more than 100% capture of the annual drought flows? It doesn't make sense.
- The Mass Water Indicators report includes maps of areas with high annual net water demand ratios, high water use intensity and high storage ratios. Reservoirs with a high storage ratio have a greater impact on instream flow than ones with a low storage ratio. Greater protective measures, including ecologically-based flow releases, should be developed for the rivers affected.

[21] In fact, as discussed above in section 3(b), the percent depletion in winter, spring and fall should be lower.
[22] The assumptions that reservoirs are full at the onset of the drought-year calculation and the drought only lasts one year are questionable or demonstrably untrue.
[23] Vogel, R. M., J. Sieber, S. A. Archfield, M. P. Smith, C. D. Apse, and A. Huber-Lee (2007), Relations among storage, yield, and instream flow, Water Resour. Res., 43, W05403, doi:10.1029/2006WR005226.
[24] While SWMI focuses on the impacts of groundwater withdrawals, the limits of acceptable alteration of streamflow are similar to findings pertaining to surface water withdrawals in other studies.
[25] See Attachment C for reservoir calculations.

MWRA: The MWRA system receives special treatment, which may be appropriate as it is a unique system with operational rules that include, among other things, flow releases. However, it is important to step back and look at what the numbers really show. Without considering the reservoir credit, the (geographically scaled) EEA safe yield of the Quabbin/Ware and Wachusett reservoir drainage areas is 57.9 mgd. That, according to EEA, is the maximum safe depletion of the Swift, Ware and Nashua Rivers at the reservoirs. Remember, this figure is already based on 25% maximum acceptable depletion of normal flows and 55% depletion of annualized drought flows.

To this so-called safe yield, EEA proposes to add a system-wide reservoir credit of 348.5 mgd. This equals the total average annual flow to the reservoir system. It represents 143% capture of the annualized monthly median flows feeding the Quabbin and Wachusett Reservoirs.[26] How does this include "the ecological health of river systems"? Answer: it does not. Remarkably, the total authorized system use (water demand and flow releases) actually exceeds the average annual inflow. How is this "sustainable water management"? Answer: it is not.

Summary regarding reservoirs: The proposed reservoir credits are completely inconsistent with the SWMI and other ecohydrology findings that river ecosystems cannot tolerate more than a fraction of the level of depletion proposed, without becoming seriously degraded. It also makes no sense that so-called "safe yield," including the reservoir credit, exceeds total annual inflow. That there is reservoir storage capacity does not mean that there is sufficient water to fill the reservoirs to capacity, without damaging the rivers.

We urge EEA to abandon this methodology in favor of one that bases safe yield on August flows, and allows a credit for storage only where it exists, calculated using the SWMI flow-depletion limits or other appropriate limits based on scientifically-validated ecohydrology studies. Recognizing the importance of the MWRA system, a negotiated approach should take place, including the watershed associations working to protect the Swift, Ware and Nashua Rivers, to examine safe water capture limits and agree upon flow releases to better protect the river ecosystems.

One of the greatest ironies of SWMI is that **some of the foremost experts on the subject of reservoir storage and yield are sitting on the advisory committees and/or work and teach in the Boston area** and have acted as advisors to EEA in the past.[27] How is it possible that SWMI is not using their expertise to help resolve these technical issues? How can it be that SWMI would put forth such a weak proposal, without peer review, when we have some of the world's foremost experts right here? I urge EEA to work with these experts to develop a credible methodology to evaluate the storage and yield relationship, and safe yield as a whole. This would be a far better use of taxpayer dollars than relitigating the science that was already reviewed.

6. Empirical evidence shows that the safe yield methodology is invalid:

As DEP recognized in its 9/11/2003 memo on safe yield, "Since allocated permitted withdrawals are less than [old safe yield] today, the Ipswich River should be sustainable and healthy, when, in fact, the Ipswich River is severely impacted by low flow. Therefore, the safe yield methodology is not valid because it does not measure what it purports to measure." And: "According to the methodology, since permitted withdrawals are within the determined …safe yield, the assumption is that the Ipswich River is healthy and sustainable, when in fact, there is documented evidence that the Ipswich River is severely impacted by low flows and considered in a constant state of recovery. Consequently, the method is ineffective and not

[26] EEA does not explain why it switched from using monthly medians, on which SWMI is based, to using means here.
[27] See http://www.weap21.org/downloads/relationsamongstorage.pdf. The authors include several people who are already acting as advisors to SWMI.

valid." That is still true. The Ipswich River is still severely impacted by low-flow throughout its entire course, at withdrawals that are ~5 million gallons a day less than EEA safe yield.

The Parker River offers more empirical evidence proving that the EEA safe yield is invalid. EEA says safe yield is 14.8 mgd, but actual withdrawals are only 2.3 mgd. However, the Upper Parker River, Batchelder Brook, Mill Brook, Bull Brook and the Egypt River are all pumped dry for extended periods in summer – even during normal summers, let alone droughts. The problems in this case are that 1) the EEA safe yield is 5 times higher than the safe summer allocation limits; 2) withdrawals are taken disproportionately from small areas of the basin; and 3) EEA's method presumes the ability to capture and store water, but there is no reservoir storage capacity available in most of the basin. (The only reservoirs are in the Egypt-Rowley Basin, which is a coastal sub-basin that flows directly into the Plum Island estuary and is "hydrologically distinct" from the rest of the Parker River Basin, according to DEP.)

Also, it appears that the 81.79 sq.mi. drainage area used in the safe yield calculation includes about 19 sq. miles of salt marsh and barrier beach – most of which are part of the Parker River National Wildlife Refuge. Does EEA seriously think it is appropriate to include this area? By coincidence, I happened to be at the Refuge just today, taking part in a program on water resources; USFWS staff told me that water from a well on Plum Island corroded stainless steel pipes in a matter of a few months, because of the high salt content.

The actual safe yield for the Upper Parker Basin at the Byfield gage should be approximately 0.82 mgd, representing the maximum safe summer groundwater withdrawal scaled to the Byfield gage drainage area.

Idlewild Brook Sub-basin is another interesting case study.[28] According to the Massachusetts Water Indicators Project, these are the flow-depletion levels for Idlewild Brook sub-basin:

Idlewild Brook	**August median**	**October median**	**January median**	**April median**	**7-day low-flow**	**Annual rel. net demand**
flow depletion	-100%	-100%	-30.03%	-11.00%	-100%	-18.66%

This makes Idlewild Brook sub-basin one of the most flow-depleted sub-basins in the entire state. All of the seasonal flow-depletion levels are higher than the maximum acceptable alterations identified by the SWMI science and streamflow criteria – even January and April. Notably, this sub-basin does not have high impervious cover and would be BC 3 were it not for the flow-depletion problems; much of the sub-basin is part of MassAudubon's Ipswich River Wildlife Sanctuary, their largest sanctuary in the state. If sustainable water management were taken seriously, the potentially high ecological values of this sub-basin should warrant every attempt to restore it to health.

Despite the extraordinarily high flow-depletions, the "baseline" for Hamilton is 51% higher than its 2000-2004 use. This is based on a registered volume that DEP has testified is flawed, and which is applied to an new well (illegally, in our opinion). The result is that under the proposed SWMI Framework, substantially more water could be pumped from Idlewild Brook Sub-basin, without mitigation, than amounts that result in 100% flow-depletion for ~6 months a year. This leads me to ask: at what point would DEP say "no" to water withdrawals? How much worse would the condition of our rivers have to be than this? How much worse could they be? It is disingenuous to claim that the safe yield of Idlewild Brook sub-basin is not exceeded, or to ignore this problem in the SWMI Framework and yet claim it represents "sustainable water management." Instead, it represents more of the same unsustainable approach that degrades our rivers.

These are not the only examples, of course. The Jones River, Sudbury River, Billings Brook, Poor Farm Brook and many other Massachusetts rivers and streams are pumped dry for extended periods. Based on EEA

[28] Even more so because the Town of Hamilton argued all the way to the Massachusett Appeals Court that **safe yield should be calculated at the sub-basin level**.

data, 292 sub-basins are severely degraded due to flow depletion, and more than 200 more are in FL 3. This is the major problem that SWMI was meant to solve, but it does not do so. We need a paradigm shift to ecologically-based management, and SWMI does not provide that paradigm shift.

A brief comment on process: The SWMI process failed to use the expertise of the Technical Advisory Committee to help resolve the safe yield question. EEA staff took over the process themselves, without seeking advice. EEA assured members that the safe yield question would be brought back to the TAC after streamflow criteria were considered, but this did not happen. That is truly unfortunate, because several members of the TAC (and Policy Committee as well) are experts whose knowledge could have helped EEA avoid the errors and pitfalls described above.

In summary: The proposed EEA safe yields are not safe for our rivers. If these volumes of water are withdrawn continuously, it will result in severe degradation of every river in Massachusetts. Nothing in the SWMI Framework will prevent this from happening. In fact, as discussed below, far from prohibiting over-allocation of basins or sub-basins, the baseline proposal and Tiers Table expressly allow additional withdrawals from FL 4-5 sub-basins, in some cases without mitigation. This is not a credible approach, as DEP's 2003 analysis of safe yield recognized.

EEA/DEP's pre-conception that existing allocations cannot exceed safe yield[29] corrupted the process of developing a scientifically-valid safe yield methodology. The empirical evidence is that existing allocations exceed safe yield in many cases, yet DEP's refusal to consider methods that so indicated resulted in a flawed method that does not meet the statutory requirements and DEP's own interpretation of safe yield.

The deficiencies in the safe yield methodology must be addressed. In particular, annualized averages are invalid for systems that pump or capture water continuously, even during the summer; in those cases, safe yield must be based on summer drought flows because these months represent the limiting factors for water withdrawals and aquatic habitat. The issue of geographic scale must also be addressed. Safe yield must become meaningful by triggering action when flows fall below "safe yield," including requiring use of alternative sources, bans on non-essential water use and effective drought management measures.

IRWA requests independent expert review of the proposed safe yield methodology and assignment of the task to USGS. Because EEA/DEP have failed to develop a credible, scientifically-valid safe yield methodology after almost three decades, the task needs to be assigned to the U.S. Geological Survey, working in consultation with expert ecohydrologists in our area. USGS originally proposed a "Safe Yield Estimator" which evolved into the Sustainable Yield Estimator. Now, we have the information about acceptable limits of alteration, which can be applied through the SYE. With the tools currently available, we can finally resolve this long-standing dilemma and derive safe yield values that are valid and safe for our rivers. This would be a very worthwhile use of taxpayer dollars, to address a part of SWMI that did not receive the attention it needs and deserves.

Baseline:

1) In the "baseline" proposal, EEA refers to withdrawals that took place from 2003-05[30] as "existing" withdrawals/uses and proposes to confer upon them a special status under which they would not be required to meet as many requirements as withdrawals exceeding "baseline." It refers to withdrawals

[29] DEP/EEA refused to consider methodologies that would result in finding that numerous basins were in exceedence of safe yield. Only after IRWA showed that their prior proposal (safe yield=60% depletion of annualized MQ90) implied that the Ipswich River in the late 1990s would represent optimal allocation did EEA decide to "conservatively" reduce the depletion percentage to 55%. This resulted in two basins where current allocations exceed EEA safe yield.

[30] The EEA "baseline" is the average use from 2003-05, or the 2005 use, or the registered volume, whichever is higher. The registered volume is the only "baseline" for water withdrawals under the WMA.

above "baseline" as "new [or increasing] withdrawals." This proposal is contrary to the explicit language of the WMA, which specifies that only withdrawals that took place from 1981-1985 are "existing withdrawals."[31] By law, everything that is not an "existing withdrawal" as defined in the WMA must be treated as a "new withdrawal." These new withdrawals are subject to all permitting requirements, including the requirement that DEP must impose conditions necessary to minimize the impacts of these withdrawals on protected interests, which include (but are not limited to) fisheries. If the regulatory requirement is to "minimize impacts" for all new withdrawals, then it is contrary to law to allow some new withdrawals to meet less stringent requirements than others, especially when the impacts are greater.

2) The baseline proposal would add 5-8%[32] more water, above the amounts used from 2003-2005. There is no scientific or rational basis for the extra 5-8%; it is an arbitrary and unwarranted addition to the allocation, regardless of current need, performance or the condition of the resource. The additional allocation is available even in sub-basins or watersheds where current withdrawals cause exceedence of the safe depletion limits established in the streamflow criteria. These additional allocations are explicitly allowed to cause "backsliding" (falling to a worse biological or flow category) without triggering additional mitigation, although in those cases the additional allocation is "only" 5% instead of 8%. This is contrary to the WMA regulations, which require that MassDEP impose conditions necessary to achieve reasonable protection of fisheries and to minimize impacts on protected interests; instead, the "baseline" would allow additional impacts without any justification nor commensurate mitigation[33].

3) The proposed formula for baseline results in very inequitable treatment of water withdrawals. The baseline proposal provides the greatest percentage increase in allocation to those permittees who did not conserve water – in fact, the more they used, the more water they will get without triggering commensurate mitigation. Those that saved the most will get the least benefit from the formula. In effect, the baseline formula rewards the failure to conserve water, thus violating the WMA requirement to impose conditions necessary to promote reasonable water conservation (one of the interests of the Act). This baseline proposal is the antithesis of responsible and sustainable water management and should be abandoned in favor of using the registered volume as the baseline. Here is an example of how the baseline proposal would reward increased water use and "penalize" communities that have done the best job conserving water:

"Baseline" scenarios	Initial Value	RegVol- or 2005 or 2003-05	Plus 8%	Change
1: Community A saves 10%	10	9	9.72	-2.8%
2: Community B uses 10% more	10	11	11.88	+18.8%

The baseline proposal is unnecessarily complicated, inequitable, undermines the effectiveness of the streamflow criteria and tier system and hides the fact that some of these increases (according to information presented by EEA) will result in backsliding to a lower flow/biological category, yet will be exempt from implementing mitigation based on impacts required by the Tier system. That is unacceptable.

[31] The statute does not say or imply that even the threshold volume above the existing registration can be exempted from permitting, although DEP allows this by regulation. 310 CMR 36.03.

[32] Registered volumes do not get the additional 5-8%; those withdrawals that would result in slipping a flow or biological category would "only" get 5% more, rather than 8%. If a withdrawal is already in a severely impacted Category 5 sub-basin, it is impossible to slip to a lower category, so the formula would allow an additional 8% withdrawal in these sub-basins.

[33] It also conflicts with the anti-degradation provisions of the Clean Water Act.

Recommendation: The baseline proposal is arbitrary, capricious and contrary to law. Conditions to minimize impacts must be required for all withdrawals, and mitigation should be commensurate with impacts, without unequal treatment of some "new withdrawals" (as legally defined) compared to others.

Tiers Table:

IRWA appreciates and supports EEA's intent to provide greater clarity about how permitting decisions will be made. Clarifying what is meant by "minimizing" and "mitigating" impacts is an important component of improved water management (discussed further below). However, the Tiers Table fails to achieve clarity. It is so complicated and confusing that many people reviewing it do not have a clue what it really means. Even more troublesome, the permitting proposal would actually weaken protection of many rivers -- even more so when combined with "baseline."

It would be clearer and more rational and legally defensible if the permitting requirements were strictly based on minimizing and mitigating impacts. IRWA is especially concerned that the Framework would serve as a legal justification to limit the actions that DEP could require to address impacts of current withdrawals, even when those impacts are extremely severe. Also, it appears from the Table that withdrawals in many FL 1-3 sub-basins would be exempt from the current requirement to minimize impacts. "Backsliding" is not only allowed, but institutionalized, as are further withdrawals from the most flow-depleted sub-basins. This result is diametrically opposed to the goals of SWMI; it was never intended to weaken protection of rivers.

For FL 1-3 and CFRs:

- There are no requirements other than Conditions 1-8, so long as the allocation does not exceed "baseline." Thus, suppliers could receive 5-8% more water, while meeting only Conditions 1-8, even if it caused dropping a flow level or biological category. This explicitly allows "backsliding," contrary to one of the core goals of SWMI, and does not meet the current regulatory requirement to minimize impacts of permitted withdrawals. Far from protecting our most pristine rivers, this proposal unacceptably weakens river protection.
- If an increased allocation exceeds "baseline" by less than 5% of August median, and doesn't drop a category or FL, those in BC 1 or CFR have to meet Conditions 1-8 and consult with EEA to "explore" options to minimize impacts. What are the measures, and do they have to be implemented? Any other sub-basins in FL 1-3 must only meet conditions 1-8, with no further requirements to minimize or mitigate. Since the current regulations already require that all permitted withdrawals must minimize impacts, this represents weakened protection for healthy rivers, which is unacceptable, and it is also needlessly complicated. Our rivers would be better off with the current regulation.
- If the new allocation exceeds baseline by more than 5% of unimpacted August median, mitigation commensurate with impact is (finally) required, except for BC 4-5 sub-basins, which apparently are deemed unworthy of protection beyond the meager requirements of conditions 1-8.
- A higher level of review is required, along with commensurate mitigation, if there is a drop in flow level or biological category, except if this is part of "baseline" or if it is a BC 4-5 sub-basin, which as mentioned above, is apparently deemed unworthy of bothering to minimize and mitigate impacts.

For FL 4-5:

- IRWA disputes the premise of further permitting of water withdrawals from FL 4-5. These sub-basins are already allocated beyond their safe limits, according to SWMI's scientific findings. In some cases, 100% of monthly median flows are depleted. This should certainly mean that safe yield is exceeded and no "new withdrawals," as defined under the WMA, can be permitted. Nevertheless, the Tiers Table presents an elaborate scheme to circumvent the law's prohibition and permit new withdrawals from these sub-basins. This is contrary to the intent of the WMA and

belies EEA's claim that the SWMI Framework and streamflow criteria would address the glaring deficiencies in the safe yield methodology regarding seasonal variability and geographic scale.

- IRWA appreciates EEA's intent that all permitted withdrawals in FL 4-5 will have to minimize impacts to the greatest extent feasible. This is essential and is already necessary under the existing regulations for all permitted water withdrawals. However, the Framework does offer more clarity[34] about what the requirement means for FL 4-5. This clarification is an important step forward.
- Conditions 1-8 should not be the same for all flow categories; standard permit conditions and performance standards (rgpcd, UAW, restrictions) should be stricter for FL 4-5. In particular, higher flow triggers should be used to ban non-essential water use during low-flow periods (discussed further below). A seasonal cap is necessary to limit water withdrawals in the low-flow season. A water bank with at least a 2:1 ratio should be required.
- Staying at the "baseline" level requires a desktop pumping evaluation if CFR's are present and implementation of a plan to minimize impacts to the greatest extent feasible. The value of the desktop evaluation is questionable; what is really needed is a thorough alternatives and optimization analysis.
- Increased use (Tier 2) requires implementation commensurate with impacts, and Tier 3 also requires demonstrating that there is no less harmful alternative. This is confusing, because the "minimization" factors already require the use of alternative sources. It is unclear that Tier 4 requires anything new. IRWA flatly believes that new withdrawals from FL 4-5 sub-basins are contrary to law.
- As noted elsewhere, the Demand Management measures that are listed in the mitigation menu should be required under "minimization," at least for FL 4-5.

Other comments:

- "Functional equivalence" is an oxymoron. The whole point is that the measures taken are <u>not</u> functionally equivalent. DEP's requirements do not represent the full suite of potential actions that could be taken to achieve the performance standards. If the standards are not met, additional actions, such as a summer cap, more effective conservation rates and restrictions should be required, rather than blessing something as "functionally equivalent" that has failed to meet the standard. At the least, "functional equivalence" should not be allowed in FL 4-5 sub-basins.
- The term "feasible" is a huge wild card. It appears to mean anything that doesn't cost more money than DEP thinks is reasonable (based on what?), along with consideration of some other vaguely defined factors. Water pricing can almost always be adjusted to better promote conservation. Also, failure to curtail high water use can result in higher costs to source supplementary water or to treat water quality issues resulting from over-pumping wells, in addition to the costs or mitigating environmental impacts (or the opportunity costs of lost ecosystem services). At the least, feasibility must fairly evaluate these costs and the environmental costs of degrading our rivers and the loss of fluvial fish. However, given that the safe yield methodology did not deliver on DEP's written commitment to include the "ecological health of river systems," IRWA is not confident that these factors will be fairly valued in the feasibility analysis.

Minimizing and Mitigating Impacts:

IRWA applauds the intent of the SWMI Framework to clarify what is meant by minimizing impacts and to require mitigation of impacts of withdrawals, especially in flow-stressed areas. The list of required actions to "minimize impacts" is an excellent start. However, we have some concern that "minimizing impacts" may be interpreted to exclude actions that can be taken to reduce water demand. For example, it is

[34] However, some measures are too vague; for example, are the streamflow triggers required under #5 the same as those mentioned on p. 15 of the Framework Summary? If so, they are inadequate. We recommend using the term "without limitation" to indicate that items that are not specifically mentioned are not excluded from consideration.

unclear whether the proposed outdoor restrictions on Framework page 15 are applicable to FL 4-5. If so, IRWA objects because they are not adequate to minimize impacts – much more can be done. There is no proposal for a summer cap, even though DEP knows that a summer cap is a very effective way to limit summer demand. Also, certain demand management measures and water system management measures (Enterprise Accounting) are inappropriately considered "mitigation"; they should be required to minimize impacts, at least in FL 4-5 sub-basins.

Measures to mitigate impacts should be measurable, quantifiable, implemented and proven effective prior to authorization of increased withdrawals. We support the idea that the first priority of mitigation must be to return clean water to the flow-depleted sub-basins. At a minimum, a water bank with a 2:1 ratio should be required for all withdrawals in flow-depleted basins and for those in FL 3, to prevent becoming more degraded. IRWA supports the concept, presented in the 3/20/2006 "Offsets Credits" memo developed by a subcommittee of the WMA Advisory Committee, to limit "soft credits" to 20% and require "hard" or quantifiable credits to make up at least 80% of mitigation.

We are strongly opposed to considering compliance with the requirements of MS4 permits to be mitigation that would allow increased water withdrawals.

On a positive note, IRWA is happy to see this under the mitigation table: "Establish and/or contribute into a mitigation fund for aquatic habitat restoration." This is an important component that can make a major difference. There should be a minimum value attached to make this meaningful and effective. (Viki Zoltay has done research in this area and it may be helpful to have her input as to how to best implement this.) We would like to see this as a requirement for all FL 4-5 sub-basins.

Transition Rule for Surface Water:

The Framework proposes to treat surface water withdrawals through a "transition rule," because the scientific findings focus on groundwater withdrawal impacts[35] and the tools do not precisely evaluate reservoir operations and impacts.

IRWA does not agree with the idea that we don't have sufficient knowledge to apply right now to improve reservoir management. The thresholds used in the SWMI criteria could be applied. There is a body of scientific knowledge from ecohydrology studies upon which SWMI could draw; several of these studies have focused on reservoir withdrawals, including studies that were co-authored by SWMI advisory committee members. We believe that there is sufficient knowledge to recommend eco-flow releases needed to sustain ecological functions. The TNC members of the advisory committee (and others including Stacey Archfield and Richard Vogel) have particular expertise in this area, and EEA should seek their recommendations.

One of IRWA's concerns is that reservoirs with high storage ratios have a greater impact on rivers than small systems, but this is not reflected in SWMI. The USGS Water Indicators Project shows areas with high storage ratio and high long term net demand; at a minimum, these systems should be required to use some of that capacity for flow releases.

At the very least, EEA/DEP should apply the knowledge it already has in its permitting decisions. In the Ipswich River Watershed, for example, DEP still permits water withdrawals for the Salem-Beverly Water Supply Board, even though DEP has known for almost a decade that the registered volume alone exceeds firm yield, according to the USGS firm yield study. SBWSB does not even have an approved drought management plan, to the best of IRWA's knowledge; DEP should not be issuing permits for increased withdrawals in these circumstances. In the case of Peabody, which "surrendered" its water withdrawal

[35] Groundwater withdrawals are treated as instantaneous surface water withdrawals directly from rivers.

permit, the City nevertheless has continued to exceed its registered volume and the firm yield of its reservoir system repeatedly, with (to the best of our knowledge) no consequences. (We would be happy to be proven wrong regarding "no consequences.") DEP continues to allow a "normal variation" provision for the Lynn Water & Sewer Commission, despite the fact that the USGS firm yield study showed that the system safe yield was exceeded, and normal variation cannot be applied in that case.

While we are glad that the transition rule will include compliance with conditions that include watering restrictions, we remain concerned that the proposed restrictions are weak. As a strict rule, flow releases should take precedence over lawn watering.

Outdoor Watering Restrictions:

EEA proposes to use real-time flows to trigger watering advisories, rather than the state drought declarations that are known to be a poor measure for the purposes of water management. In this one respect, the proposal represents an improvement. However, the proposal does not minimize impacts of water withdrawals. As has been proven repeatedly, the prior year water use has little if any bearing on current year watering, which is very weather-dependent. Further, the proposal to allow 1-7 days of watering regardless of the impact is unacceptable; the new proposal actually increases the number of days that watering is allowed for communities that exceed 65 rgpcd and use the streamflow trigger. That's an inexplicable step backward.

Most importantly, the proposed triggers for outdoor watering restrictions are too low to minimize impacts of water withdrawals on the environment, as the WMA regulations require.[36] Also, using the 7-day low-flow[37] based on gage data results in higher trigger flows for those basins which don't have summer low-flow problems and the lowest triggers for the basins with the greatest flow problems; that is arbitrary, illogical and counterproductive. Instead, IRWA recommends that DEP should not allow outdoor watering in Flow Category 4-5 sub-basins and should use the simulated monthly medians, or at least the simulated August median, as the trigger for action elsewhere.

By the science on which SWMI is based, there are defined limits of acceptable alteration to August flows. These limits are: 3% for Category 1; 10% for Category 2; and 25% for Category 3. Anything beyond Category 3 is considered to be degraded or altered beyond acceptable limits. These limits are incorporated into streamflow criteria. They imply that 97%/90%/75% of the August median flow should remain in the river to provide reasonable protection of fisheries. (Higher flows should remain in the river during other months.)

However, nothing in SWMI actually requires that these flows remain in the rivers ("hands off" flows[38]). The SWMI framework does not require any real-time action to prevent flows from falling below acceptable limits, nor any real-time action to try to stop flows from dropping further once they actually do fall to the threshold.

Only when flows reach a much more extreme low-flow level – the 7-day low flow[39] or 7Q – must any action occur to address the situation. Adding to the problem, the EEA proposal is to use gage data, meaning those rivers that are flow-depleted will have the lowest triggers and those that have unimpacted flows or surcharged flows will have the highest, most stringent triggers.

---

[36] 310 CMR 36.28(f); see also subsections (h) and (j).

[37] The SWMI Framework document and EEA staff variously referred to the trigger as the 7Q10, median 7-day low flow (7Q2) and the annual 7Q low-flow (7Q1) in explaining this requirement. These are different numbers. EEA staff did not seem to be clear themselves on what the actual requirement is.

[38] Richter et.al., Op. cit., pp. 4-6.

[39] In surcharged basins, it is possible for the gaged 7-day low flow to exceed the August median.

In flow-depleted sub-basins, the 7Q is much lower than the threshold of acceptable alterations. In flow-depleted areas, the impacted 7Q approaches zero flow. For the Ipswich River at South Middleton, the annual 7Q is 0.02 cfsm at the South Middleton gage, whereas the (HSPF-simulated) August median is almost 20 times higher at that gage. If the 7Q were the action trigger, the river would be almost dry before any action would be required.

On the other hand, in areas with normal or surcharged flows, the trigger would be much higher, representing the most stringent flow trigger in the areas with the least flow-depletion. Here are some figures calculated by Linda Hutchins of the Department of Conservation and Recreation:

Comparison of Flow-Triggers

	7Q	AugQ50 (from HSPF)[40]	AugQ50 (SYE)	75% AugQ50
Ipswich at South Middleton	0.02	0.39	0.26	0.20
Neponset at Norwood	0.19		0.29	0.22
Quinsigamond Grafton (Blackstone)	0.07		0.31	0.23
East Branch Housatonic	0.32		0.37	0.28
Charles River at Dover	0.16		0.30	0.23
Charles River at Medway	0.12		0.30	0.23

all values in cfsm

Applying such an extreme low-flow threshold as the 7Q to trigger mandatory outdoor watering restrictions conflicts with the SWMI streamflow criteria and science, and the legal requirement to minimize the impacts of water withdrawals on protected interests.

Also, these restrictions only apply to what DEP defines as "non-essential" outdoor watering. Because all water uses would be allowed even when flows are far below those identified as safe for fisheries, the proposed trigger would in effect give priority to all water withdrawals, including non-essential uses, over keeping sufficient water in the rivers to protect fisheries. Only when flow-depleted rivers and streams are practically dry and fish are either dead or dying would any action take place, and then it would be too late. This is not a hypothetical scenario, as these photos of the Ipswich River illustrate.

[40] Note USGS HSPF hydrological model indicates August median at S. Middleton gage is .39 cfsm: Armstrong, D.S., Richards, T.A., and Parker, G.W., 2001, Assessment of Habitat, Fish Communities, and Streamflow Requirements for Habitat Protection, Ipswich River, Massachusetts, 1998-99: U.S. Geological Survey Water-Resources Investigations Report 01-4161, Table 16, p. 55.

Another issue is that flows can drop very quickly. Days matter. It is not unusual for flows to drop by 50% or more in a few days. This is common during dry summers when lawn sprinklers are used – typically the drier the weather, the more water is used on lawns unless there are effective restrictions. The lower the flows, the greater the impact. Just one of many examples: from July 5th-9th, 2010 the Parker River at the Byfield gage dropped from 0.91 cfs to 0.30 cfs, a drop of 67% in 4 days. The Middleton Stream Team calculated that in one summer, flows dropped 13% per day on average during dry weather.

Summer is the time of highest water demand, and it's also the most vulnerable time for fluvial fish populations. If truly sustainable water management and reasonable protection of fisheries are SWMI goals, it would be wise from a management perspective to set triggers based on fisheries needs and build in a margin of safety. This indicates the need to trigger action earlier, before damage is occurring. Given the fact that DEP also requires that the flows are below the trigger for 3 consecutive days, it is all the more important to set a higher, more protective trigger.

DEP knows from experience that higher flow thresholds are effective and not onerous. In the Ipswich basin, after being sued for its failure to properly implement the WMA in 2003, DEP imposed permit requirements that use a flow threshold roughly equivalent to the natural August median[41]. This threshold triggers outdoor watering restrictions in several communities, and the condition – along with others including a summer cap – has been upheld by the Superior Court and Appeals Court. The communities have become accustomed to implementing them; the customers have become accustomed to complying with them; and they have saved a lot of water. If anything, the threshold could be higher to allow for situations where the flow drops so rapidly that, by the time the 3-day waiting period and notification requirements occur, flows have sometimes dropped to half or less of the trigger flow. (Note that these communities also have summer caps; the two requirements work effectively together.)

Recommendation: In flow-depleted basins (Flow Categories 4-5), outdoor watering should not be allowed except by hand-watering or use of cisterns or rain barrels. In other sub-basins, DEP should use the simulated natural monthly median flows as a trigger for restrictions, which should at a minimum require no non-essential water use (indoor or out).

Redundant Wells:

The proposal to allow redundant wells (or to expand the distance for replacement wells) to be exempt from conditions that apply to permitted withdrawals is an inappropriate attempt to expand the scope of "registered" withdrawals. The law is quite explicit that registered withdrawals must have been in operation in the period from 1981-85. Registrations cannot be extended to wells that don't exist yet; that is contrary to the letter and spirit of the WMA. DEP should decline to do this as it could potentially limit the agency's authority to properly manage the state's water resources. Furthermore, this issue was never part of the scope of SWMI. It is inappropriate to throw an issue like this into SWMI, which has enough challenging problems to deal with and should focus its attention on the tasks that were defined at the outset of the process. The same comments apply to the proposal to expand the allowance of "replacement wells."

DEP also signals its abandonment of efforts to condition registrations; this is inappropriate and undermines sustainable water management. This is discussed below.

Registered Withdrawals:

[41] The flow-trigger was established through a site-specific aquatic habitat study by the USGS and Mass Division of Fisheries and Wildlife, using an average of 4 flow-standard-setting methods, including instream measurements.

While registered withdrawals are not explicitly a topic of SWMI, the fact that many withdrawals are subject to registration has come up repeatedly. The WMA clearly defines only documented withdrawals from 1981-1985[42] as "existing withdrawals" that enjoy a "grandfathered" status.

Mass DEP imposed conditions when it reissued registration statements in December 2007; however, it did so without having issued regulations authorizing the conditions. Upon appeal, the Supreme Judicial Court clarified that MassDEP has the authority to condition these withdrawals, but must promulgate regulations authorizing this before doing so.

This effort seems to have stalled, but SWMI should provide the impetus to address the need for regulations authorizing DEP to impose conditions on registered withdrawals. DEP now has a strong basis to impose effective conditions to reduce the impacts of withdrawals, especially those from depleted basins and sub-basins. A scientifically-valid determination of safe yield would provide an additional legal basis for doing so.

Efforts to expand the protected status of registered withdrawals to withdrawals that did not take place between 1981-85 should stop. DEP continually suggests it is powerless because so many withdrawals are registered, but then it makes this problem worse by attempting to expand the scope of registrations and not conditioning them. Registered volumes should not be able to be pumped via wells or out-takes that were not in use during the registration period. In addition, where DEP has credible information about defects in prior registrations, such as in the Hamilton case, corrections should be made.

Pilot Projects:

IRWA likes the concept of pilot projects, but we have some concerns. We believe the pilots should be used to demonstrate how best to balance the water budget to prevent degradation of healthy rivers and restore those that are degraded, to the maximum extent feasible. Balancing the water budget should be the priority, and other mitigation approaches should not be used to validate additional withdrawals from flow-stressed sub-basins. We also object to the idea that the pilots might be used to try to invalidate the scientific findings.

Having attended a meeting in Danvers on the subject of pilots, here are some concerns:

- IRWA is eager to work with the Town of Danvers; in fact, we have been working with the Town on this project for several years. However, we are very concerned that the Curtis Pond Dam removal project will be used to justify additional water allocations to Danvers, which we do not support.
- The Curtis Pond Dam will be removed this year, whether or not it is part of a pilot project. Therefore, it is very important that there is added value to the project, if state funds are to be used. In fact, there are no large water withdrawals on Boston Brook, so this will not mitigate water losses.
- One of the ways in which this project could add value is to demonstrate establishment of a fund for aquatic habitat restoration, and also to evaluate Danvers' existing water demand mitigation program. That is, the pilot should explicitly tie water withdrawal revenues to water conservation and river restoration funding. It should also evaluate the water demand mitigation program to see how effective it is – is it raising enough revenue and spending it in appropriate ways to really offset demand? This would be very valuable information to have, to see if mitigation programs really work; that is the whole idea of the pilot, as we understand it. The state funding contribution toward the dam removal project could include a review of how to establish an aquatic habitat restoration fund – what funding level would be appropriate, and how to fund it in the long-term (from rates, for example).

[42] DEP can change registrations if credible information indicates that the registration was based on erroneous information. DEP has amended registration volumes in the past.

- Finally, based on the meeting in Danvers today, IRWA is even more concerned that DEP will allow compliance with MS4 permits as mitigation for water withdrawals. We strenuously object. The MS4 regulations are a mechanism to begin dealing with the impervious cover aspect of SWMI, but since the WMA permitting issues were separated from the imperviousness issues, it would not be at all appropriate to allow this as mitigation for increased water withdrawals. It would be a step backward if compliance with long-overdue regulations to address stormwater impacts were used as justification to increase water withdrawal impacts; that should not be an outcome of SWMI. Having said that, where communities go beyond the requirements and implement more proactive measures, we do not object to those being evaluated as mitigation.

Incentivizing water conservation:

Saving water is a major win-win approach that should be central to SWMI. Saving water will help save our rivers, but it will also save money and energy. A first priority has to be reducing system water losses, which in some cases have exceeded one-third of the total water pumped. (See: Lynn Water and Sewer Commission.) This costs the community money to pump and treat water that is lost before it can be sold to customers. While it is expensive to get the leaks out, it is truly essential. Another huge priority is reducing outdoor watering, because that water use spikes during the very dry summer periods when rivers are at greatest risk. It is truly "non-essential," and SWMI should do more to make sure that this use is effectively curtailed, especially in flow-depleted sub-basins, but also in health ones. We would like to see clear standards for water rates that effectively encourage conservation, as part of the SWMI Framework.

A note on climate change:

Climate change poses significant threats to water sustainability that are not addressed in SWMI. Climate change models predict larger, more intense storms, as well as more extreme droughts. These extreme conditions are already taking place. The droughts are a particular concern from a water sustainability standpoint, because drought not only limits supply but often leads to increased water demand; the Ipswich, Parker and many other rivers have been pumped dry repeatedly in summer as a result of this deadly combination. Of course, droughts are not restricted to summer. The drought of 2001-02 led to more severe low-flows than the drought of record, although for a shorter time, for some rivers. This is a concern for water supplies that rely on capturing peak flows; it is also damaging to the rivers, which end up supplying the same volumes of water even during droughts, resulting in extreme low-flow conditions even in winter and spring. This happened on the Ipswich River in 2001-02 and again in the spring of 2006 (ending dramatically with the Mothers Day flood).

Even as I write this (on March 27th), the Ipswich River at South Middleton is experiencing the lowest flow ever recorded on this date – only 21 cfs, when the prior low was 31 cfs; these new-record low-flows have occurred several times this week. As a point of comparison, 21 cfs is lower than the Q99 flow for March and less than half of the March Q90 flow on which EEA "safe yield" is based. This is important, because the safe yield methodology relies so heavily on peak flows to average out the low-flows, so when the peak flows don't happen, then there is little hope of meeting the safe yield volume, even on an annual average.

This year, the early spring could exacerbate the problem further. We are experiencing an abnormally early spring, with temperatures in the past week that were up to 30-40 degrees higher than normal for this time of year. Trees are already leafing out. This means that evapotranspiration rates are likely to be higher than normal earlier this spring, further reducing streamflows. If such early springs become a pattern (as is predicted), then assumptions about peak flows from March – May will have to be modified.

These factors, together, could mean that the peak flows that are normal for March and April may not materialize this year. This would represent a demonstration in real-time of some of the flaws in the SWMI safe yield assumptions, but more importantly, it would threaten protection of the Ipswich River as we head

into the peak demand/low-flow months. The implications for sustainable water management in Massachusetts are serious, and not adequately addressed by SWMI.

A final note on climate change. EEA has done an excellent job in promoting energy savings and renewable energy. Saving water is one of the best ways to save energy. It takes a lot of energy to pump, transport and treat water and wastewater; and heating water is one of the biggest energy users at the household level. Thus, measures to save water would also help meet some of EEA's more proactive and laudable work to reduce energy consumption. It is unfortunate that SWMI was not at all integrated into the energy sustainability work at EEA.

Other issues:

As noted in an email to EEA, there seems to be a significant mathematical error in the safe yield calculation for the Nashua River basin; even using EEA's methodology, the "base" safe yield is 104.1 mgd (without the reservoir credit).

It appears that EEA is including salt marshes, barrier beaches and estuaries in the drainage area calculation for coastal rivers. This is inappropriate, as these areas are not suitable for water withdrawals. These areas should be deducted from the drainage areas.

While we are generally very supportive of the scientific effort, we question some of the specific categorizations, based on our knowledge of particular areas. For example, several areas are shown with higher IC and/or water withdrawals than we believe exist. We would like to have the opportunity to ground-truth some of these areas. We also learned that Clark University has developed very fine resolution land use cover maps of the Parker and Ipswich River Watersheds; we would like to compare these maps to the IC maps. Finally, we would like to take part in any pilot projects in our area.

In summary:

SWMI provides a solid, credible scientific basis for managing Massachusetts water resources sustainably. For the first time, Massachusetts has access to the key tools that have been under development for years – the Sustainable Yield Estimator (originally called the Safe Yield Estimator) to estimate the natural flow regime at most locations in Massachusetts; thresholds indicating acceptable limits of alteration to river ecosystems (represented by fluvial fish); and the ability to combine these tools to determine how much water can be safely withdrawn, and when, to provide water for people's needs while protecting the environment. We also know that impervious cover is a major factor affecting rivers, although SWMI does not avail itself of this information toward the long-standing state goal of integrated water resource management. SWMI has done outstanding work in the scientific area, but fails to apply the science effectively in establishing policies to manage our rivers sustainably.

Unfortunately, the failures of SWMI are greater than the successes.

- The safe yield is demonstrably unsafe for rivers; the methodology glosses over the crucial fact that the EEA safe yield is not physically available for half the year and ignores the problem of concentrating too many withdrawals in too small an area. The safe yield proposal is arbitrary and capricious, contrary to law, and disregards DEP's written commitment that safe yield includes environmental protection factors, including ecological health of river systems.
- The reservoir credit is excessive, ignores environmental impacts completely, and gives credits to systems with large storage ratios, despite scientific studies that show these large reservoirs have the largest environmental impacts.
- The permitting proposal seeks to provide clarity, but is so complicated and confusing that it does the opposite. Many of those reviewing the proposal don't really understand what it requires and what it implies.

- The baseline proposal exempts some permitted withdrawals from current regulatory requirements to minimize their impacts; allows some water withdrawals with large impacts to meet less stringent requirements than withdrawals with lesser impacts; and is arbitrary and capricious.
- The proposed Tiers Table exempts still more withdrawals from complying with the current regulatory requirement to minimize impacts and would illegally allow additional withdrawals from sub-basins whose safe limits for flow depletion are already exceeded. It is also needlessly complicated; permitting should be based on avoiding, minimizing and mitigating impacts, and no permitted withdrawals should be exempt from this requirement.
- The consistently reiterated goal of "no backsliding" will not be achieved; in fact, backsliding is explicitly allowed and institutionalized in the baseline proposal and the Tiers Table.
- The goal of protecting pristine rivers could be achieved, were it not for the baseline proposal and the weak requirements for BC 1-3 rivers in the Tiers Table.
- The goal of restoring degraded rivers will not be achieved, and even the requirement to "improve" them is debatable because the proposed baseline and Tiers Table would allow increased withdrawals, even from sub-basins that are severely degraded. IRWA believes this is illegal.
- Registered withdrawals are generally ignored, despite the fact that they make up a large percentage of water withdrawals in the state; we cannot achieve sustainability without addressing registered withdrawals.
- The actual requirements are far weaker than the 2004 WMA Policy and Guidance; this result is not adequate. In fact, some of the requirements set forth in the 2004 Policy and Guidance are not even required for the most severely degraded sub-basins.

Please contact me if you have questions or would like to discuss IRWA's comments. Please notify me if you believe any of the analysis or comments are in error.

Thank you for your consideration.

Kerry Mackin
Executive Director
Ipswich River Watershed Association
Member of SWMI Technical Advisory Committee and Water Management Act Advisory Committee

Acronyms:

EEA: Massachusetts Office of Energy and Environmental Affairs
DEP: Massachusetts Department of Environmental Protection
DCR: Massachusetts Department of Conservation and Recreation
DFG: Massachusetts Department of Fish and Game
USGS: United States Geological Survey
SWMI: Sustainable Water Management Initiative
WMA: Water Management Act
CFR: Coldwater Fisheries Resource
BC: Biological Category
FL: Flow Level
SYE: Sustainable Yield Estimator