Memorandum

To: *Workshop Participants (see page 2 for list of attendees)*
From: *Kirk Westphal, Beth Rudolph (CDM)*
Date: *June 17, 2004*

Summary of Stakeholder Workshop:

Building an Evaluation Framework for the Merrimack River

Merrimack River Watershed Assessment Study

Date: June 10, 2004

Background and Objectives: The Merrimack River Basin Community Coalition and the U.S. Corps of Engineers (USACE) are undertaking a detailed assessment of the Merrimack River, including an evaluation of existing and future water quality conditions. Projections of future conditions will include an assessment of various pollution abatement alternatives. CDM, the consultant engineer, is developing detailed computer simulation models of the watershed, its hydrology and hydraulics, and its instream water quality that will be used for the assessments.

Computer programs selected for this effort include SWMM, HSPF, and WASP. The developed models will be used to evaluate the sources and impacts of bacteria and nutrients from various sources at hourly and seasonal timescales, as well as the likely instream effects of both general (watershed-wide) and specific (individual community's Combined Sewer Overflow [CSO] Long-Term Control Plans) management strategies.

A stakeholder workshop was held on June 10, 2004 to review the study results to date and to discuss the modeling plan and output. The workshop was designed to help ensure that the output from the simulation models is appropriate for making planning and regulatory decisions about CSO abatement and other river restoration opportunities. Specifically, the objectives of this workshop were to:

- Agree on the fundamental questions driving the study
- Prioritize the ways in which model output ("performance measures") can be presented such that it can adequately support planning and policy-level decisions
- Agree on simulation scenarios likely to produce the most useful output

The workshop was attended by stakeholders from a variety of state, federal, and local agencies with interests in the Merrimack River watershed; a list of attendees is provided in Table 1. **A summary of important areas of consensus is included on page 6.**

Table 1: Workshop Attendees*:

Sponsors	Regulatory/Stakeholder Agencies	Consulting Team
US. Army Corps of Engineers Barbara Blumeris John Kennelly Townsend Barker Chris Hatfield	**U.S. EPA** Nora Conlan Dave Gray	**CDM** Gary Mercer Beth Rudolph Kirk Westphal Bill Pauk
City of Manchester Rick Cantu	**Massachusetts DEP** Bill Dunn Kevin Brander	
City of Nashua Rick Seymour Mario LeClerc	**New Hampshire DES** Paul Currier Paul Piszczek	
City of Lowell Mark Young	**USGS** Gene Parker Chris Waldron	
City of Haverhill Robert Ward Paul Jessel	**Merrimack Valley Planning Commission** Peter Phippen	
	Merrimack River Watershed Council Elizabeth Coughlin Christine Tabak Patricia McGovern (Patricia McGovern Eng)	

**Note*:A complete list of attendees and contact information will be distributed by the USACE Study Manager*

Summary of Workshop

Background Presentations

1. CDM presented findings from the screening level modeling analysis, which suggested that 80% of the annual bacterial loads in the river may be attributable to sources other than CSOs.

2. CDM presented a broad overview of monitoring results for three dry weather surveys and two wet weather surveys conducted between June and September 2003. The draft data report (containing all of the monitoring results to date) is being reviewed by the USACE and the sponsor communities; it will then be reviewed by EPA, MADEP, and NHDES. Following concurrence on data usability, it will be made available for public distribution.

3. CDM presented the simulation modeling plan to provide context for the remainder of the workshop.

Building the Evaluation Framework

1. Consensus on Primary Questions

The group agreed on the definition of the fundamental questions driving the study:

- Are planned expenditures in CSO infrastructure commensurate with expected benefits?

- At what level of investment do benefits from CSO abatement diminish?

- Are there other pollution sources where money might be spent to provide a greater return on investment?

2. Prioritization of Performance Measures

The simulation models used in this study will be capable of outputting information in terms of pollutant concentrations and flows in 150 reaches of the mainstem Merrimack River, and over various time intervals. The group was presented with a list of suggested ways in which to aggregate this data into "performance measures" for evaluating river improvements under various restoration/abatement strategies (including the CSO Long-Term Control Plans).

The performance measures were grouped into a matrix of four categories (See Table 2):

a) Evaluating water quality improvements using water quality standards (discrete scale – Yes/No) – *Upper left quadrant of Table 2*

b) Evaluating water quality improvements using comparative or relative measures (continuous scale) - *Upper right quadrant of Table 2*
c) Evaluating attainment of beneficial uses using compliance with water quality standards (discrete scale – Yes/No) – *Lower left quadrant of Table 2*
d) Evaluating attainment of beneficial uses using comparative improvements in water quality (continuous scale) – *Lower right quadrant of Table 2*

Naturally, many of the performance measures were included in multiple categories, as a way of distinguishing not only what key measures are important, but *why* they are important. In other words, the workshop was aimed at identifying the ways in which people will use the results of this study to make decisions regarding the restoration and abatement strategies basin-wide.

Using a non-binding exercise, each participant was given eight "votes" to prioritize the performance measures that would be most useful for their organizations to examine. Each person could use up to three votes for any single measure. The votes were tracked by the nature of the participants' organizations (CDM facilitated this process, but did not cast votes):

Blue:	Project Sponsors (48 total votes)
Green:	Regulatory Agencies (47 total votes)
Red:	State and Federal Scientific Agencies (16 total votes)
Yellow:	Other Stakeholders (32 total votes)

The matrix of alternative performance measures (as modified by the stakeholder group during the workshop) is provided as Table 2; and the results of the prioritization exercise (displayed cumulatively and comparatively) are included as Figures 1 and 2. The results are non-binding (due to the imbalance in representation among participant groups, and because the funding sponsors must provide ultimate decisions on which measures receive highest priority), but they provide some valuable insight into certain areas of consensus regarding the usefulness of particular performance measures.

<u>Summary of Institutional Preferences:</u>

- **Project Sponsors:** The two performance measures receiving the highest priority from the project sponsors were:

    - #1 - River segments/duration below state thresholds or EPA guidance limits in the context of water quality

    - #6 - River segments/duration below state thresholds or EPA guidance limits in the context of recreational uses of the river

  Other measures receiving comparatively high priorities from project sponsors were river segments/ duration below other public health levels for bacterial indicators (#2), and bacterial flux into the estuary in the context of impacts to shellfishing (#20).

- **Regulatory Agencies**: The two performance measures receiving the highest priority from the regulatory agencies were:

    - #6 - River segments/duration below state thresholds or EPA guidance limits in the context of recreational uses of the river

    - #7 - River segments/duration above state thresholds for dissolved oxygen in the context of aquatic habit as a beneficial use.

  Other measures receiving comparatively high priorities from the regulatory agencies were estuary segments/duration below state thresholds or EPA guidance limits for bacterial indicators in the context of supporting shellfishing (#9), daily and monthly river flows as a comparative measure of relative improvement in the support of aquatic habitat (#18), and the comparative risk of pathogens affecting water supply via proximity (#23a).

- **State and Federal Scientific Agencies (USGS):** As the only state/federal scientific agency represented at the meeting, the USGS divided its priorities equally among eight alternatives (#11, #13, and #18 – #23). The first two deal with relative improvements in bacterial and nutrient concentrations, in the context of improved water quality. The other six deal with comparative improvements in the ability of the river to support aquatic habitat, shellfishing, and water supply.

- **Other Stakeholders** The two performance measures receiving the highest priority from the other stakeholders were:

    - #7 - River segments/duration above state thresholds for dissolved oxygen in the context of aquatic habitat as a beneficial use.

    - #16 – Relative improvements in dissolved oxygen concentrations in the context of aquatic habitat as a beneficial use.

  Other measures receiving comparatively high priorities from the other stakeholders were river segments/duration below state thresholds or EPA guidance limits in the context of recreational uses of the river (#6), transparency relationships in the context of supporting recreational uses (#15), and bacterial flux into the estuary in the context of impacts to shellfishing (#20)

The areas of consensus are summarized on the following page.

Summary of Apparent Consensus

- Generally, the participants placed more emphasis on performance measures targeted at evaluating the attainment of beneficial uses than on evaluating water quality for its own sake, with the exception that project sponsors ranked the evaluation of compliance to bacterial standards for water quality improvement as the top priority. This does not suggest a significant divergence in thinking, however, as evidenced by the following bullet (bacterial indicators as a top priority can be considered in both contexts – compliance with standards and attainment of uses).

- By far, the greatest overall consensus was on the use of performance measure #6: River segments/duration below state thresholds or EPA guidance limits for bacterial indicators in the context of recreational uses of the river. This performance measure was given high priority by project sponsors, regulators (highest priority), and other stakeholders.

- Regulatory agencies and other stakeholders also ranked #7 as a high priority: River segments/duration above state thresholds for dissolved oxygen in the context of aquatic habitat as a beneficial use (though this was not a high priority for project sponsors).

- Project sponsors indicated that the flux of pollutants into the estuary in the context of shellfishing impacts was also a relatively high priority (#20 and #21). These measures also received votes from each other type of organization, though the vote count was comparatively small from the regulatory participants. This is significant because only two other measures received votes from all four types of organization (#11 and #13), and those votes were minimal.

Table 2: Proposed Units of Measure for River Improvement (as modified by the stakeholder group during the workshop)

Study Objective	Specific Drivers	Output Measure (based on hourly and seasonal analyses)	
		Compliance/Threshold Indicators	Comparative Output Measure (relative to existing conditions)
Recommend CSO and non-CSO abatement strategies that will provide the most significant return on investment with respect to **water quality**	Fecal coliform, E.Coli, and Enterococcus levels	1. River segments/duration below state thresholds or EPA guidance limits	11. By reach: Reductions in peak conc, avg conc, and total mass load for bacterial indicators (and visual comparison of traces)
		2. River segments/duration below other public health thresholds (1,000, 10,000...)	
	Dissolved oxygen levels	3. River segments/duration above state thresholds	12. By reach: Increase in peak DO conc, avg DO conc, and min DO conc (and visual comparison of traces)
	Nutrient/chlorophyll-a levels	4. River segments/duration below national guidance limits	13. By reach: Reductions in peak conc, avg conc, and total mass load for nutrients and chlor-a (and visual comparison of traces)
		5. River segments/duration below other incremental thresholds	
Recommend CSO and non-CSO abatement strategies that will provide the most significant return on investment with respect to **beneficial uses.**	Recreation (primary and secondary contact)	6. River segments/duration below state thresholds or EPA guidance limits for bacterial indicators	14. Flow by river segment and seasonally
			15. Transparency relationships (e.g: chlor-a vs. secchi depth)
	Aquatic Habitat	7. River segments/duration above state thresholds for DO	16. By reach: Increase in peak DO conc, avg DO conc, and min DO conc (and visual comparison of traces)
		8. River segments/duration below EPA guidance limits for Enterococcus	17. By reach: Reductions in peak conc, avg conc, and total mass load for Enterococcus (and visual comparison of traces)
			18. Daily and Monthly flow
			19. Extent of tidal influence
	Shellfishing	9. Estuary segments/duration below state thresholds or EPA guidance limits for bacterial indicators	20. By estuary reach: Reductions in peak conc, avg conc, and total mass load for bacterial indicators (and visual comparison of traces)
		10. Estuary segments/duration below national guidance limits for nitrogen	21. By estuary reach: Reductions in peak conc, avg conc, and total mass load for nitrogen (and visual comparison of traces)
			22. Seasonal mass flux of nitrogen into estuary
	Water Supply	No compliance thresholds	23. Percentage of river withdrawn during low flow compared with existing conditions
			23a. Risk of pathogens affecting water supply
	Hydropower	No compliance thresholds	24. Compliance with state water quality standards and USEPA nation guidance by river segment and seasonally
	ALL USES		25. Projected use attainability for all applicable uses in each segment
	Aesthetics		26. Transparency relationships (e.g: chlor-a vs. secchi depth)

Shaded performance measures were added by the stakeholder group. Hatched performance measures were omitted by the stakeholder group.

Figure 1: Results of Performance Measure Prioritization by Stakeholders: Cumulative Display

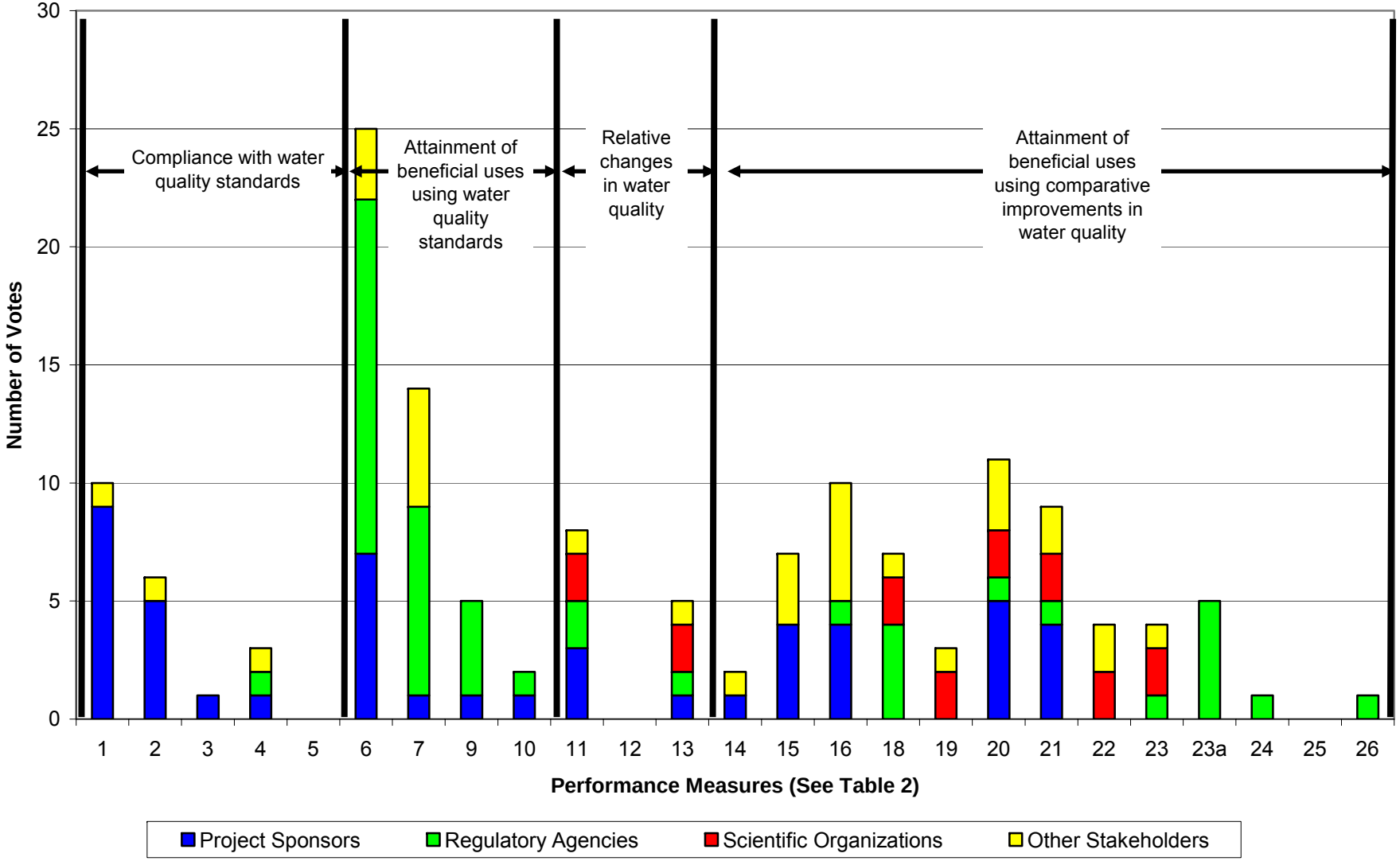
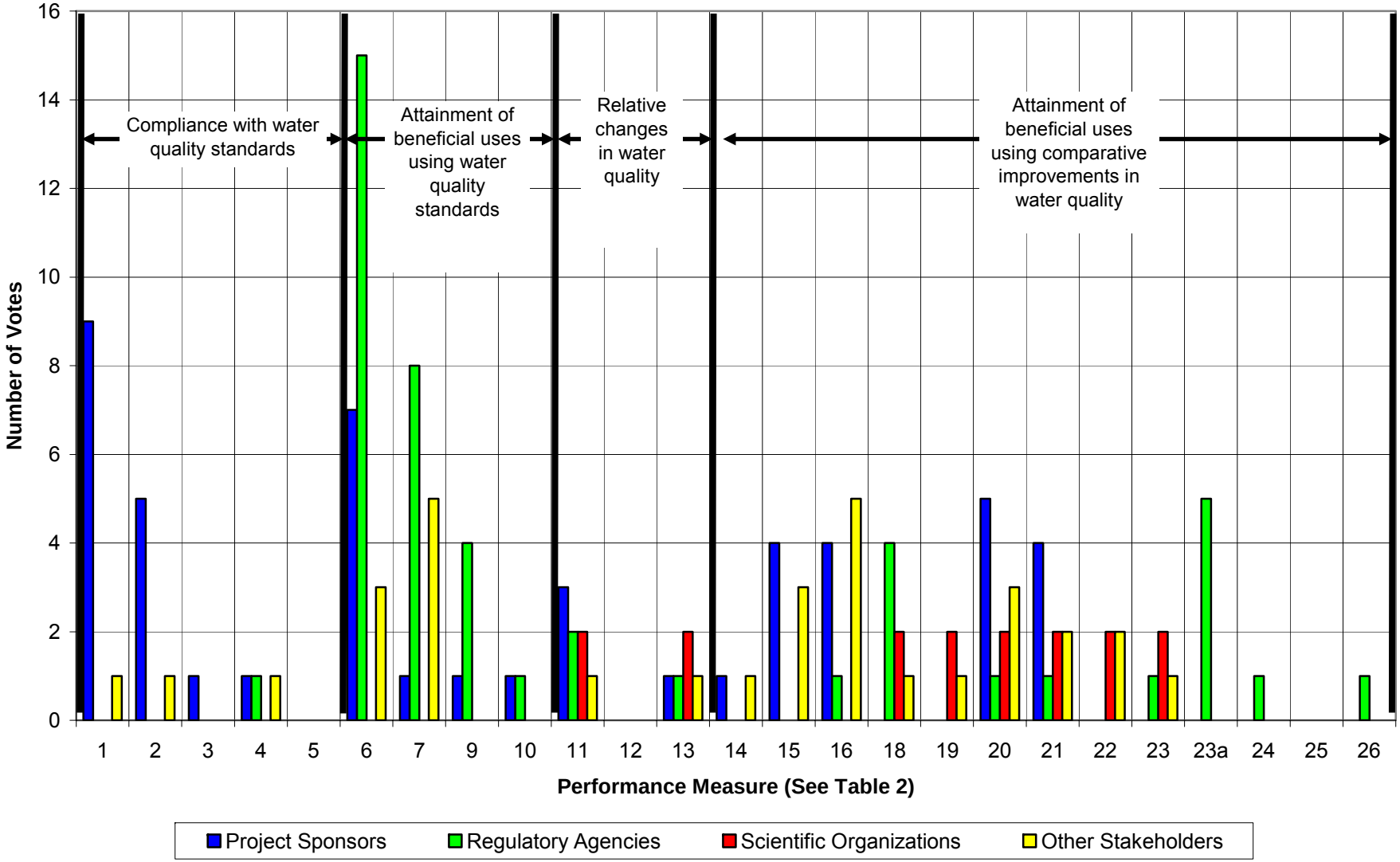


Figure 2: Results of Performance Measure Prioritization by Stakeholders: Comparative Display



3. Discussion of Appropriate Model Scenarios

The group agreed that the model scenarios listed in Table 3 would be effective in addressing the fundamental questions driving the study (presented above, and for which consensus was reached).

Time constraints prohibited detailed discussions involving the definition of a design event and a dry summer. However, it was suggested that the representative design event be significant enough to yield CSO discharge in all five cities, yet not so significant that its frequency renders it irrelevant in the short-term planning context. Also, it was recommended that the selected design event not be a duplication of events that will be simulated during the longer seasonal simulations. The group generally concurred with these recommendations.

A request was made for multiple design events, but CDM explained that budgetary constraints limited the analysis to a single design event and a seasonal analysis for each management/restoration scenario. CDM also explained that additional events similar to design storms of specified return frequency will likely be included in the seasonal analysis. The group generally agreed that it would be better to use the same design event for all scenarios than to use different design events for different scenarios in order to maintain a common comparative framework.

CDM also proposed that the seasonal analysis be representative of the 10th percentile of total precipitation between May and October, based on the period of record. The complete basin-wide records for climate and streamflow are available from 1993 – 2003, so the proposal suggests that we select the driest summer period from this ten-year record. This recent ten-year record is diverse in its cumulative precipitation values, and also representative of current land use patterns. For these reasons, and because full data sets for all required input values are not available prior to 1993, it is recommended that we limit the period of record to these 10 years when selecting a representative dry summer season. While there were no objections, there was not sufficient time to discuss this proposal in detail.

Offline comments (via email or telephone calls) were solicited from the group on the selection of a design event and the representative dry season, since time constraints prevented full resolution of these issues during the workshop.

Table 3: Proposed Model Scenarios

Study Objective	Type of Scenario	Description	Scenario Detail	Design Event	Dry Summer	Wet Summer
Evaluate the relative contribution of pollutants from various sources	Existing Conditions	Full Basin	Seasonal		●	●
			Annual			
			Design Event	●		
Recommend CSO and Non-CSO abatement/ restoration strategies that will provide the most significant return on investment with respect to water quality, and benefits to recreation, aquatic habitat, and Shellfish beds	Sensitivity	CSO Reduction	Incremental Reductions throughout basin	●	●	
		Stormdrain Red.	Incremental Reductions throughout basin	●	●	
		Mainstem WWTP Red.	Incremental Reductions throughout basin	●	●	
		Trib WWTP Red.	Incremental Reductions throughout basin	●	●	
		NPS Load Red.	Incremental Reductions throughout basin	●	●	
		Mainstem Dam Ops	Full Run of River	●	●	
			Minimal Ponding per current regs	●	●	
			Other dam operation scenarios?	●	●	
	Planned Improve-ments	Manchester LTCP	Specific short term improvements	●	●	
			Specific long term improvements	●	●	
		Nashua LTCP	Specific short term improvements	●	●	
			Specific long term improvements	●	●	
		Lowell LTCP	Specific short term improvements	●	●	
			Specific long term improvements	●	●	
		GLSD LTCP	Specific short term improvements	●	●	
			Specific long term improvements	●	●	
		Haverhill LTCP	Specific short term improvements	●	●	
			Specific long term improvements	●	●	
		All Cities' LTCPs	Specific short term improvements	●	●	
		All Cities' LTCPs	Specific long term improvements	●	●	
		WWTP Upgrades	Specific plant improvements	●	●	
		Phase II Stormwater	Specific municipality BMPs	●	●	
		Future Water Supply WD	All potential existing/future water supply withdrawals		●	

Follow-Up Activities:

1) Inclusion of Biological Indicators: Massachusetts DEP and the Merrimack River Watershed Council voiced an interest in expanding the biological scope of the study to evaluate fish consumption as a use. The group determined that the monitoring and modeling programs have not been targeted at indicators that could adequately evaluate the ability of the river to support fish consumption, but that measures of flow and dissolved oxygen can be used as partial measures of aquatic habitat suitability. However, as one of the USACE's primary objectives is ecological restoration, the inclusion of biological indicators was identified as an important possibility for work during subsequent phases of the study, and CDM will review this with the project sponsors.

2) "Beneficial" and "Designated" Uses: The scope of work for Phase I requires the project team to consider the impacts of pollutants on "beneficial uses" of the water. The workshop discussion highlighted the difference between "beneficial uses" and "designated uses." New Hampshire DES suggested that its decisions about the watershed and the priorities of restoration initiatives will consider the impacts on "designated uses," but not necessarily on the broader group of "beneficial uses." An example of the difference is that hydropower is recognized by the USACE to be a beneficial use, but is not recognized by the states as a designated use. The prioritization exercise clearly indicated that broad-based support centered heavily on "designated uses" and not as much on other "beneficial uses." Hence, the workshop provided guidance to the project team to focus primarily on impacts to designated uses, but not to exclude impacts on other beneficial uses. CDM will review this guidance with the project sponsors.

3) Hydropower as a Beneficial Use: Following the workshop, a suggestion was made by a project sponsor that perhaps a more meaningful performance measure for hydropower production as a beneficial use would be "potential power production", or "water available for power production". Using this performance measure, we can evaluate whether or not the implementation of restoration and abatement measures throughout the basin would likely have a positive or negative impact on the potential for power generation. Though power production can be viewed as causing impairments to water bodies due to the impoundments and possible temperature alterations of the water, its presence in the watershed in the context of this study is that of a beneficial use. Simulation scenarios will evaluate whether or not alternative operating policies at the dams could help improve water quality or other beneficial uses in the river. CDM will evaluate the suggestion of this alternate performance measure with the project sponsors.

4) Reconvening: The group agreed that it would be appropriate to reconvene in smaller groups during the modeling program to review progress and issues, and again as a

larger group at the conclusion of the modeling program to review and discuss findings and recommendations.

5) Final Prioritization of Performance Measures: CDM will meet with the project sponsors to review the outcome of the prioritization exercise and agree on a final set of model outputs (which will ultimately be suitable for public dissemination) aimed at supporting the broad needs of the sponsors and other stakeholders.