Exploration of the Potential for the CPB to apply RDM

Modeling Workgroup Meeting

2 December 2014

Susan Julius and Tom Johnson

I. Background on RDM case studies

- Report results illustrate the importance of considering uncertainty in climate change decisions. EPA/RAND conducted two pilot case studies—Patuxent River, MD and North Farm Creek, Ill.Patuxent study shows that the Phase II WIP often did not meet the nitrogen, phosphorous and sediment stormwater targets when a nonstationary climate and potential future changes in population or development patterns were considered.
- North Farm Creek study shows that future climate change could significantly increase pollution loads in North Farm Creek, and the two biggest factors affecting attainment were average annual rainfall and BMP effectiveness.
- In both cases, monitoring and responding with additional investments in enhanced green infrastructure or other BMPs could improve the ability to meet load targets.

- Advantages of the RDM approach:
  - Best response to deeply uncertain conditions is to pursue strategies that are robust and adaptive using the concept of iterative risk management.
  - Shifts focus from uncertainty quantification to <u>a broader focus on uncertainty management.</u>
  - Provides an accountable, transparent, and objective process.
  - Enables systematic exploration of potential future conditions in which proposed management strategies do or do not meet goals
  - Helps identify specific milestones and midcourse corrections to help strategies adapt over time.
  - Identifies tradeoffs among alternative robust adaptive strategies—within a process designed to facilitate stakeholder input and deliberation.
- Disadvantages of the RDM approach:
  - Computationally and resource intensive - requires simulation models appropriately configured and sufficiently fast to enable running many cases.
    - Ability to handle multiple climate scenarios as inputs
    - Automatable handling of model inputs and outputs
    - Physical process-based models to allow modification of BMPs and estimates of their interactions with various uncertainties
    - Appropriate temporal resolution (daily or even sub-daily time steps)
  - Water quality endpoints analyzed in isolation for different BMP strategies

II. Discussion about inclusion of climate change in TMDL analysis for the CBP

- Questions to consider for CBP use of RDM (framed around XLRM diagram):

Uncertain Factors (X)	Policy Levers (L)
Hydrology and climate change Land use • Population growth (2010-2050) • Infill, sprawl, and forest conservation BMP effectiveness Evapotranspiration model parameters	MDE Phase II Watershed Implementation Plan Best Management Practices (BMPs), including: • Stormwater management-filtering practices • Stormwater management-infiltration practices • Urban stream restoration • Urban forest buffers
Systems Model Relationships (R)	**Performance Metrics (M)**
Phase 5.3.2 Chesapeake Bay Watershed Model • Airshed model • Land use change model • Watershed model • Chesapeake Bay model	Metrics • Nitrogen delivered loads • Phosphorus delivered loads • Sediment delivered loads • Implementation costs (extended analysis only) Targets • Phase I WIP total maximum daily loads (TMDLs) • Phase II WIP TMDLs (2017 interim; 2025 final)

- Can RDM be used watershed-wide, or should uncertain factors be specified at a subwatershed level (tailored versus broadly applicable), and if so, at what level?
    - e.g., climate factors (sea level rise in tidal states and flooding in upstream states)
    - e.g., other uncertainties (stressors), such as population growth, development patterns, etc.
- Can the number of uncertain factors (either climate scenarios or other uncertainties) be cut down to save time/resources and still get usable/actionable results?
- How should endpoints (performance metrics) be handled – separately by subwatershed, looking at a key pollutant or looking at the same suite of pollutants across the watershed?
- How do we deal with multiple endpoints (nitrogen, phosphorous, sediment targets) from a management and modeling standpoint?
- Is there any way (other than cutting down on scenarios) to reduce the modeling effort?
- Who decides on the different suites of management practices to test?
- What process/approach for incorporating consideration of climate change from a (technical) methods perspective stands up to potential legal
- Who are the stakeholders that need to be involved in the analytic design(s) to maintain credibility with partners across the Bay (e.g., selection of scenarios, performance metrics, etc.)
- Other questions?

- One final reminder: TMDL implementation plans can employ adaptations designed to unfold over time according to a pre-negotiated, predetermined set of observations and responses to the observations (e.g., moving up implementation of a BMP or expanding a BMP in response to observations of higher than anticipated increases in precipitation and runoff, and monitored increases in sediment inputs into a river).