

Fifth Meeting of Science Advisory Panel

April 26, 2013 at VCU Rice Center

Meeting notes prepared by Cathy Viverette and Paul Bukaveckas



- 10:00 am Opening Remarks by Paul Bukaveckas
- 10:15 Highlights of Year-1 Findings (P. Bukaveckas)
- 11:00 Panel Discussion of Year-1 Results
- 11:15 Year 2 Data Collection Activities (Anne Schlegel)
- 11:45 Panel Discussion of Year-2 Activities
- 12:00 Lunch Break
- 12:30 Primer on the Phytoplankton Model (Jim Fitzpatrick)
- 1:15 Overview of Modeling Report (Dave Jasinski)
- 1:30 Watershed Inputs and Critical Conditions (Andrew Parker)
- 2:15 Historical Water Quality Data Analysis (Jian Shen & Harry Wang)
- 3:00 Reference Curves (Jim Fitzpatrick)
- 3:30 Panel Discussion of Modeling Report
- 4:00 Wrap-Up & Adjourn Meeting

Paul Bukaveckas (VCU) provided a review of the project status:

A new website has been developed to provide background information on the project (wp.vcu.edu/jamesriver/). This web site includes links to the DEQ web site (where meeting presentations are posted) and a companion site devoted to the modeling effort. Paul Bukaveckas explained that prior SAP meetings were largely devoted to data collection efforts (planning and review of results). Today's meeting will include a review of 2012 findings and plans for 2013 data collection in the morning, the afternoon will be devoted to modeling activities and focused on the Task 2 report recently submitted by the modeling group to DEQ.

Question from John Kennedy (DEQ) – are there independent peer reviews of primary data reports being submitted by the PIs to DEQ? No, the reports are reviewed internally by DEQ staff who provide comments to the PIs prior to submission of final reports. Paul Bukaveckas emphasized that these reports are authored by the PIs and are not considered products of the Science Advisory Panel. The SAP may subsequently incorporate sections of these reports into their own document submitted to DEQ. At that stage, there is likely to be a review of the SAP-authored document by the CB Science and Technical Advisory Panel (STAC). Kevin Sellner (CRC Director and member of STAC) indicated that they would focus on the recommendations made by the SAP, see if there are data to support these recommendations, and look at PI data reports only if needed. Arthur Butt (DEQ) pointed out the advantage of submitting the PI reports in the format of a scientific paper that can be submitted for publication (thereby providing an opportunity for peer review). Having published manuscripts from the PIs involved in this project will facilitate STAC and EPA approval of SAP recommendations as being scientifically defensible, laid out sensibly, and transparent.

Melanie Davenport (DEQ) raised the question as to what is the role of the STAC and how it's review influences EPA's decision-making. Kevin Sellner pointed out that the STAC only reviews the scientific basis for the SAP's report and makes a recommendation to EPA (who is not obligated to accept the STAC recommendation). A question was raised regarding the timing over which data and reports generated by PIs working on this project became publically available. Arthur Butt (DEQ) responded that as soon as a report was finalized (i.e., approved and accepted by DEQ) the report is put on the DEQ website at which point it is available for public viewing. The PIs are

encouraged to submit their findings for publication in peer-reviewed journals at any stage; neither the SAP nor DEQ play a role in reviewing these PI-authored papers prior to their submission for publication. Dr. Bukaveckas suggested that further questions along this line would be more appropriately discussed in a meeting of project PIs with DEQ.

Paul Bukaveckas provided summary highlights of 2012 results focusing on three key mechanistic linkages: nutrient inputs and algal utilization, algal blooms and harmful algae, and harmful algae and their effects on living resources.

John Kennedy (DEQ) asked whether display of CHLa data should not include specific reference to current CHLa standards to provide a frame of reference for panel members. Paul Bukaveckas suggested that since there is a specific protocol for processing the data to be compared against the standard, that this should be the domain of the DEQ to avoid potential errors in application of this protocol. Arthur Butt added that much of the current data collection is to address specific questions regarding the causes and effects of algal blooms, rather than for addressing compliance issues (i.e., comparison to the existing standard).

A question was asked whether historical data were available on Microcystin level in the James (e.g., from 1970's). Paul Bukaveckas explained that the ELISA test is very recent so historic data are not likely to exist, though there are long-term data on phytoplankton community composition including the abundance of cyanobacteria

Kevin Sellner asked if there is literature that shows dose responses to HABs in lower James. Kim Reece and Margie Mulholland replied that data on mortality effects were already published for oysters in both field and culture.

Claire Buchanan (ICPRB) asked how anticipated improvements in water clarity arising from reductions in sediment loads would affect toxin production. Paul Bukaveckas responded that the answer to this question is not known. Results from the genetics analyses performed in 2012 suggest that the amount of toxin produced is largely controlled by the abundance of cyanobacteria (which varies by several orders of magnitude) and secondarily by variation in the proportion of cyanobacteria that are toxin producers (which varies from 10-40%). Thus future toxin levels will depend on the contribution of cyanobacteria to phytoplankton abundance which will be affected by light availability, nutrient concentrations and ratios, as well as grazing effects.

Ken Moore (VIMS) raised a question about the design of dose-response experiments with algae and their toxins – how do we gauge appropriate exposure levels? In the lower estuary blooms are mobile and therefore organisms occupying a fixed location (e.g., oysters) may experience only transient exposure. Arthur Butt responded that the first goal of these experiments is to determine whether there is a detrimental impact on living resources. There are numerous challenges to linking effects observed in the lab with those occurring in the field which include not only the magnitude of exposure but also the duration of exposure and response time.

Anne Schlegel (DEQ) gave a presentation on proposed data collection activities for 2013. Their emphasis is on quantifying negative impacts to aquatic life, but also include:

1. Continued weekly monitoring of CHLa and MC in tidal freshwater segment.
2. Continuation of weekly dataflow monitoring during spring bloom and monthly monitoring of summer blooms in the oligohaline.

3. Dataflow monitoring and deployment of sentinel oysters in mesohaline.
4. Dataflow monitoring in polyhaline James as well as Elizabeth and Lafayette.
5. Efforts to estimate fish abundance in tidal fresh to model top-down effects (grazing) on CHLa.
6. Monitoring of storm water inputs on nutrients and algae in Lafayette.

James Fitzpatrick (HydroQual) gave a presentation on phytoplankton models.

James Fitzpatrick provided a primer on phytoplankton models to provide background information to the panel. The models depict changes in phytoplankton biomass (as C) based on growth rates minus loss processes that include advection, sedimentation, respiration and grazing. This component of the model works in conjunction with the watershed loading and hydrodynamics models that simulate nutrient inputs and water movements.

There was a question as to whether the model could be used to simulate anticipated reductions in suspended sediments. Jim acknowledged that this would be problematic given that there is a large store of legacy sediment in the system which is subject to tidal re-suspension. Thus the effects of reduced sediment inputs on suspended sediment concentrations in the estuary are difficult to predict.

There was a question as to the suitability of the model for depicting water quality conditions in shallow areas. Jim Fitzpatrick replied that in most systems where the models have been applied there is little difference in application among systems of different depths.

Kevin Sellner asked about modeling the effects of pH in affecting ammonia toxicity and triggering release of phosphorous from sediment. It was noted that we do not see large upward excursions of pH in the James even during algal blooms (as is observed in the Potomac) and therefore this issue was not deemed to be of concern from a modeling standpoint.

Clifton Bell (B&C) raised the issue discussed at the previous SAP meeting regarding the timing of the data collection and modeling efforts noting that the model inputs are older data which may not represent current conditions in the James, particularly with respect to harmful algae. It was previously discussed that the timing of the project is such that the data collection and modeling efforts must proceed concurrently which limits the potential for using new data in the model. There are cases, for example in modeling grazing effects, where data generated by the project can be used to parameterize the model. Jim Fitzpatrick indicated that running the model with realtime data to see how well the model performs would be advantageous as it would increase confidence in the model with respect to predicting future water quality conditions under simulated nutrient reduction scenarios..

Ken Moore asked about the potential importance of nitrogen fixation in supporting algal blooms in the tidal fresh segment. Margie Mulholland (ODU) replied that they have measured rates of N fixation in conjunction with N uptake assays and found that fixation was detectable but low. Paul Bukaveckas mentioned that analysis of N isotopic ratios in seston suggest that fixation of atmospheric N is not an important source of N supporting phytoplankton blooms in the tidal fresh James. In the lower estuary inputs from nitrogen fixation in wetlands were not found to be important.

Dave Jasinski (CEC) provided an overview of the modeling report.

The modeling team has recently completed its Phase 2 report which is currently under review by the DEQ. Aspects of this report include a consideration of critical conditions, a historical data analyses and development of biological reference curves. Dave provided an overview of these findings to be followed by more detailed presentations from members of the modeling team.

A question was asked regarding critical conditions and the time frame used in the modeling analyses. Water quality conditions are highly dependent on climate, particularly run-off, and since future climate is unknown, past climate is used as a basis for testing system responses to nutrient reduction scenarios. Dave explained that the ten year period from 1991 to 2000 is used as a basis for modeling. Thus the model simulations ask the question: If nutrient load reduction were implemented prior to 1991 what would water quality conditions in those years have been?

A question was asked about climate change and whether this factor could be incorporated into the future scenarios. The modeling team has committed to running ~10 scenarios and if DEQ asked to explore climate change, this can be done. Arthur Butt mentioned that one of the constraints to choosing scenarios is the need to mirror CBP procedures so they are as comparable as possible, but a climate scenario is possible if the SAP members deem it necessary.

Andrew Parker (Tetra Tech) gave a presentation on the watershed loading component of the model

Andrew Parker described the data which were assembled to depict nutrient loading to the James. A key point is to ensure compatibility with modeling approaches used by the CBP, though there is a desire to be able to model watershed inputs at a smaller spatial scale for the James. This may be especially useful in the lower James where it is thought that localized inputs of nutrients may act as triggers for dinoflagellate blooms. Andrew reported that there were low correlations between criteria exceedence and flow at various locations within the estuary. He suggested that the results from this analysis support the need for deterministic modeling of CHLa, since the empirical models did not find strong relationships for univariate models (e.g., based on flow).

Paul Bukaveckas asked about the apparent discrepancy between modeled and observed nutrient loads noting that for phosphorus the model over-predicted inputs by two-fold. This was surprising because the observed and modeled water fluxes agreed well, suggesting that the model over-predicted nutrient concentration in water delivered to the estuary. The modeling team did not have an explanation for this discrepancy and indicated that they would look further into this issue.

A question was asked about performing lag analysis on CHLa-discharge relationships – if these yielded better correlations, would that change the conclusion that we need a deterministic model? It was suggested that lag effects are likely important and these would operate over shorter time scales in the tidal fresh (e.g., 3 – 7 d) in comparison to the lower estuary.

A question was asked as to whether wind effects were incorporated into the model. These were thought to be important in the lower bay where dinoflagellates are capable of vertical migration leading to vertical discontinuities under stagnant conditions. Jim Fitzpatrick suggested that these effects may be important in the HAB model. Harry Wang asked about the availability of wind data in the tidal fresh segment. Paul Bukaveckas mentioned that there are several years of wind monitoring data from the Rice station which could be analyzed in relation to the longer-term record (e.g., at the Richmond airport).

Jian Shen & Harry Wang (VIMS) presented an Historical Data Analysis

The analyses focused on univariate and multivariate models to predict CHLa based on parameters which included discharge, temperature, nutrients, etc. Harry emphasized that these relationships, particularly for discharge, differ in various segments of the James. Both presenters suggested that the empirical models had very limited utility with respect to predicting CHLa though there was no explicit analysis of model performance (e.g., in comparison to the current deterministic model).

A question was asked as to why only linear models were tested as CHLa might be expected to behave in a non-linear fashion when plotted against a number of parameters.

Peter Tango mentioned the importance of analyzing both CHLa and lo-Chla when testing for model performance.

Jim Fitzpatrick (HydroQual) presented on Reference Curves

A point was raised that when you have infrequent sampling (e.g., monthly) a more protective standard is needed because of the expected variability. Can more frequent data available through dataflow or continuous monitoring be used to assess actual variability in the system? Dataflow and continuous monitoring results will not be used in modeling but could be accessed to address specific questions about variation in CHLa and smaller spatial and temporal scales than is captured in the current CBP monitoring. Kevin Sellner suggested that remote sensing data could also be used for this purpose, particularly in the lower James where blooms are patchy.

Arthur Butt emphasized the importance of the dose-response data to be collected in 2013 as a means of linking the presence of HABs to detrimental effects on living resources. Paul Bukaveckas mentioned that in the tidal fresh this will involve exposing native species to Microcystin dissolved in water as well as dietary exposure. The latter is technically difficult but we are hoping to have data on zooplankton, Rangia (clams) and selected fish species.

Arthur Butt mentioned the work being done by Harold Marshall (ODU) looking at current phytoplankton communities across a range of CHLa concentrations in relation to similar data from the 90's when models have been calibrated. He indicated that the threshold CHLa concentrations at which community shifts are apparent line up quite well with the existing standards. It is also apparent that many of the HABs which are common today, particularly in the lower James, were not present historically.

List of Panel Attendees(*) and Guests

Alex Barron (DEQ)
Clifton Bell (Brown & Caldwell)*
Brian Nenham (VT)*
David Bernard (Sierra Club)
Jamie Brunkow (JRA)
Claire Buchanan (ICPRB)*
Paul Bukaveckas (VCU)*
Melanie Davenport (DEQ)
Catherine Eichel (Brown & Caldwell)
Todd Egerton (ODU)
KC Filippino (ODU)
Will Hunley (HRSD)*
Dave Jasinski (CEC)

John Kennedy (DEQ)
Rebecca LePrell (VDH)*
Harold Marshall (ODU)
Chris Moore (CBF)
Ken Moore (VIMS)*
Margie Mulholland (ODU)*
Andrew Parker (Tetra Tech)
David Parrish (VIMS)
Kim Reece (VIMS)*
Anne Schlegel (DEQ)
Kevin Sellner (CRC, STAC)
Jian Shen (VIMS)
Ellen Snyder (Altria)
Peter Tango (USGS)*
Harry Wang (VIMS)*
David Whitehurst (DEQ)
Joe Wood (VCU)

Panel Members not attending: Garman, Hoffman, Lung.