Compiled Questionnaire for WQ Monitoring Workshop Meeting

29 July 2015

In order to gather information to help guide our discussions at the July 30th workgroup meeting, we ask that you provide answers to the following questions about your own agency/organization's monitoring programs in the Inland Bays, as well as your thoughts about improving the Center for Inland Bays (CIB) monitoring plan[1].

Attendees/Responders

- BR: Bill Richardson, EPA Region 3, Office of Standards, Assessment and TMDLs
- DW: Dave Wolanski, DNREC, Watershed Assessment
- HM: Hassan Mirsajadi, DNREC, Division of Watershed Stewardship, Watershed Assessment and Management Section
- RG: Rick Greene, DNREC, Division of Watershed Stewardship, Watershed Assessment Section
- RT: Robin Tyler, DNREC, Division of Water/Environmental Laboratory Section
- JY: Joanna York, University of Delaware, School of Marine Science and Policy
- SA: Scott Andres, Delaware Geological Survey/Chair CIB STAC
- BU: William (Bill) Ullman, University of Delaware, School of Marine Science and Policy, Oceanography Program
- JF: Joe Farrell, University of Delaware, Delaware Sea Grant, UD Citizen Monitoring Program
- EW: Edward Whereat, University of Delaware, UD Citizen Monitoring Program

[1]Per email from Chris Bason on 22 July: Is there anyway EPA can communicate its desire to have citizen science data operationally included into the determination of water quality impairment (or lack thereof)? Important role for EPA to encourage States to do this. Maybe there will still be ways in which EPA can support our effort to do this in DE and I think it would be fantastic if DE and Region III could be a national leader in this. Nancy Laurson [EPA HQ]: Monitoring Plan should fit the local needs.

Per Bill Richardson: It would be EPA's preference for any data collected by the citizen scientists working with CIB be used in DE's Integrated Reports (IRs).

1. **What areas, based on your experience/expertise, are the most important to focus on in a water quality monitoring plan for the Inland Bays and (very briefly) why?**
   - BR:
     - Eutrophication; habitat and wetland loss.
     - Bacteria for protection of recreation.
   - DW: The DNREC monitoring stations are pretty extensive and cover the largest waterbodies with enough stations to give us big picture conditions, provide some modelling data and track trends in the watershed as a whole.
   - HM:
     - Water quality monitoring at headwaters and smaller streams.
     - Groundwater quality and movement.
     - Ecological conditions including habitat and biology.
     - Wetland assessment.
     - Since we have an acceptable level of water quality monitoring of larger streams and Bays that is currently conducted by DNREC and Citizen groups, the above four areas may need additional attention.
   - RG:
     - Nutrients and algal productivity (Why: Eutrophication, dissolved oxygen, fisheries, benthic habitat and aesthetics).
     - Bacteria (Why: Shellfish harvesting and primary contact recreation).
   - RT: I think that the most important areas (factors/variables) to focus on within the water quality element of the Inland Bays Monitoring Plan are those presently being focused upon – dissolved oxygen, nutrients, chlorophyll, and pathogen indicator bacteria.
   - JY: Monitoring of chlorophyll, DO, and nutrients. Potentially also biomass of macroalgae, depending on balance between micro- and macro-algal primary producers. Could also consider light—even via Secchi disk.
   - SA:
     - Spend monitoring dollars wisely. This can be accomplished if you:
       1) Clearly articulate the goals and objectives of monitoring.
       2) Develop protocols (including QA/QC) and document metadata consistent with the protocols.
       3) Communicate 1) and 2) to the monitoring program staff and volunteers
     - Recognize and avoid mission creep. This dilutes the effort and spreads staff too thin.
     - Do what is necessary to have monitoring data incorporated in or linked to larger state, regional, or national datasets. "Spending monitoring dollars wisely" will guide the program to this objective.
   - BU:
     - Monitoring needs to yield data in a form that can be usefully related to both status and fluxes. Fluxes are harder to determine on ecologically relevant time scales, but these fluxes are needed to appropriately set goals for long term

preservation. Spot samples are easy to collect, but much harder to use as these spot analyses need to be integrated into flow models to yield fluxes.
    - We have been successfully using continuous automated sensors in the Indian River, Nanticoke River and Murderkill River watersheds to supplement spot measurements for a number of years and have been using these data to estimate fluxes and to answer specific scientific questions in these systems.
- JF:
    - Dissolved oxygen as good overall indicator of living resource and Bay health.
    - Nutrients (N and P) load and concentration - as long term indicator of whether Bay conditions are improving.
    - Pathogen indicator – for recreation water quality and safe shellfish consumption.
- EW:
    - Causes of eutrophication, i.e. nutrient levels - needed to assess trends.
    - Biological responses to eutrophication, i.e. low dissolved oxygen levels, reduced water clarity, high chlorophyll levels, (harmful algae blooms?) - needed to assess trends.
    - Recreational contact safety - total Enterococcus levels - recreational use and public interest.
    - Habitat conditions are important, but difficult to address.

2. **What monitoring activities/data collection is your organization undertaking in the Inland Bays that could be part of the CIB WQ monitoring network?**
    - BR: EPA's national survey may collect Inland Bay sites, but the survey is only conducted every five years. The data may not be sufficient to supplement CIB needs.
    - DW:
        - DNREC publishes the monitoring plans online: http://www.dnrec.delaware.gov/swc/wa/Pages/WaterQualityMonitoring.aspx
        - In lieu of Table 1, I am attaching our most up to date monitoring plan[2] which is being updated now. No significant changes are expected at this time.
    - RG:
        - Routine monitoring of selected metals at multiple stations (see monitoring plan provided by Dave Wolanski for details).
        - Toxics: Work is done when a specific need arises and is justified scientifically.

[2] State of DE Ambient Surface Water Quality Monitoring Program – FY 2015. Available online at: http://www.dnrec.delaware.gov/swc/wa/Documents/WAS/State%20of%20Delaware%20FY%202015%20Ambient%20Surface%20Water%20Quality%20Monitoring%20Program%20.pdf.

        - Toxics in Biota Monitoring Program collects and tests fish tissue and shellfish samples for chemical contaminants.
        - Toxics in Sediment Monitoring Program assesses toxic contaminants in sediment samples (mostly collected by other programs).
- SA: I cannot overstress the importance of collecting good quality data on the flow of water. Water flow is the single most important variable in computing pollutant loads.
    - Coordinate and pass funding to U.S. Geological Survey
    - Being done with DEOS/DEMAC
    - Being done with DEOS
- BH: Our group does not have any present monitoring efforts in the Inland Bays watershed.

PLEASE COMPLETE TABLE 1 AT THE END OF THE QUESTIONNAIRE. Feel free to provide additional comments here.

3. What water quality monitoring programs are planned for the future that might be applicable to the Inland Bays?

- BR: EPA funds a National Coastal Conditions Assessment (NCCA) every five years. The NCCA is ongoing this summer in 2015. The NCCA is a probabilistic survey and there are normally a few sites located within the DE Inland Bays. DNREC staff are provided grant funding to collect DE samples.
- DW: See response to question #2.
- RG: The Watershed Approach to Toxics Assessment and Restoration (WATAR) might be applicable to the Inland Bays in the future.
- RT: No knowledge of new programs.
- BU: We have no current plans for the Inland Bays watershed, although, we have submitted a proposal with Scott Andres, Delaware Geological Survey, to instrument and monitor the effects of the Wolfe Neck Regional Wastewater Treatment Plant on nutrient concentrations and loads leaving this site for surface waters of the Lewes-Rehoboth Canal. This work, if funded, would begin in Spring 2016.
- EW: Nothing applicable at this time.

PLEASE COMPLETE TABLE 2 AT THE END OF THE QUESTIONNAIRE. Feel free to provide additional comments here.

4. What areas, based on your experience/expertise, are missing from the current Inland Bays WQ monitoring plan?

- BR: EPA would recommend CIB coordinating with DNREC to ensure adequate data are collected for use in DE's biannual Integrated Report (305(b) and 303(d)). EPA can assist with DNREC-CIB discussions if needed.
- HM: The 4 areas mentioned in question #1 above.
- RG:
    - Continuous monitoring of dissolved oxygen, temperature, pH and conductivity.

    - Habitat types and quality.
- RT: Establishing bacterial source tracking as a routine element of water quality monitoring would seem to have value because it may dampen much of the present accusation/denial conflict regarding such sources and give more pointed and effective direction to pollution abatement efforts. Also, if bacteria contributions are linked to human sources then it is reasonable to assert that those sources are also accountable for some larger proportion of the loading of other factors of interest such as organic matter and associated nutrients (i.e., actions corrective to the input of pathogen indicator bacteria are also likely to yield improvements in the levels of organic matter and nutrients).
- SA: The current plan relies almost entirely on DNREC action and political pressure. There is an overwhelming influence of the TMDL, PCS, and 305b programs on monitoring and the data that are regularly assessed and reported on by DNREC staff. Changing any aspect of monitoring or assessment has consequences for hard-won progress with the TMDL and PCS. The fear of consequences has stopped ideas for new ways to collect or assess data.
- BH: I think that too little is known about the variable impacts of agricultural and domestic wastewater on total nutrient loads to the Inland Bays. With population increases, I am concerned that total loads to surface waters will increase, even as better treatment and disposal options are put into place. I think that we need to have better estimates of these loads and develop robust models for estimating future loads from these sources as population increases in the future.
- JF: Not sure.
- EW:
    - In general, inadequate frequency and spatial coverage.
    - Episodic events (extreme rain, wind and tide events).
    - Winter conditions.
    - Targeted sampling to address specific issues or determine effectiveness of BMPs.
    - Toxicity studies of fish, shellfish, and sediments are limited

5. **What additional WQ monitoring activities would your organization benefit from if CIB could include in their monitoring plan? Please feel free to think outside of the box, without regard to availability of funding, including new or innovative technologies.**
    - BR: Continuous monitoring of DO and pH to evaluate nutrient impacts (if not on-going).
    - BR: Research on possible impacts from ocean acidification.
    - DW: Continuous monitors might be valuable for evaluating DO criteria in tributaries.
    - RG: An innovative study of engineered denitrification of groundwater.
    - RT: The DNREC Laboratory is exploring the efficacy of doing bacterial source tracking testing as one of its services. The feasibility of successfully doing so is contingent upon having a steady enough flow of samples (work) to make the venture viable. Establishing

bacterial source tracking as a routine test within long-term monitoring and special project sampling efforts is essential and a commitment from the Inland Bays Monitoring Plan would be helpful in advancing this.

- JY: Nutrient monitoring. Perhaps in situ monitoring instrument - similar to the LOBO instrument that is installed at Bowers Beach (Bill Ullman) or the instruments maintained by the DNERR. Expensive, but provides LOTs of data.
- SA: Deployment of automated WQ sensors. In addition to standard physical sensors, nitrate sensors provide invaluable data.
- BU: We have considerable and growing expertise in the use of continuous water quality monitoring devices for coastal watersheds and estuaries. I think that it is more likely that we could assist the CIB and the State than vice versa, but we would be interested in expanding the use of these systems and developing automated applications of these data for managers.
- JF: Phytoplankton/HAB monitoring plan for recreational and commercial shellfish harvesting/aquaculture.
- EW:
    - Continuous monitoring in some tributaries.
    - Bacterial source tracking.
    - Toxicity of harmful algae.

6. **Does your organization have historical WQ or other monitoring data that were not included in the original monitoring plan that would be useful for future WQ monitoring activities or for use as State of the Bays indicators?**
    - BR: Possible NCCA data, but for only a few sites.
    - DW: DNREC publishes all its data through STORET, online at: http://www.epa.gov/storet/
    - HM: We have several years of high frequency water quality and nutrient data from Millsboro Pond outlet.
    - RG: Possibly.
    - RT: Yes.
    - JY: Probably not. I assume folks from UD have been engaged with plans at the CIB and State level and would have given input.
    - SA: The Monitoring Plan does not include a concise bibliography, database, or list of data. It is possible that data held by the Delaware Geological Survey are missing, but I don't have enough time to do this detective work by July 28.
    - BU: I believe all of our data were made available to DNREC and CIB. Not all of the data collection was part of the initial Monitoring Plan. Much of the data that we collected historically, have also been published.
    - JF: More than a decade of comprehensive phytoplankton/harmful algal bloom (HAB) data for Inland Bays.
    - EW:
        - Bacteria (TE) levels.
        - Select harmful algae species.

7. **Does your organization anticipate having sufficient future funding to carry out WQ monitoring activities that CIB has included in the monitoring plan to date? Do you anticipate future funding for additional data collection parameters beyond the current monitoring criteria included in CIBs plan?**
   - BR: No.
   - DW: Funding is always challenging. The State budget is going to be interesting the next few years.
   - HM: Our surface water quality monitoring program has changed from what is in the CIB plan based on our emerging and changing needs. However, our current level of monitoring is much more than what is in the CIB plan. And, we expect to have sufficient funding to continue our current level of monitoring into the future.
   - RG: Unknown.
   - RT: The "Priority Basin Monitoring" (aka General Assessment for 305(b) Water Quality Inventory reporting) is anticipated to continue at least at the level of effort of the past 25 years. Biological (macroinvertebrate) monitoring is likely to continue, probably at five-year intervals. Other Clean Water Act mandated monitoring such as NPDES will also continue as will other permit-related programs in the Division of Water.
   - JY: Funding is dependent on successful grant applications. It is hard to anticipate beyond a two-year timespan.
   - SA: The plan has NO activities for my agency only work that might be done if resources were available. Table 2 lists potential data collection efforts.
   - BU: All of our work required extramural funding. Other than the proposal described in item 3, above, we have no additional plans for monitoring activities in the Inland Bays.
   - JF: We will need support to continue some of our past monitoring efforts that are no longer funded e.g. nutrients.
   - EW:
     - To some degree, depending on scope.
     - Doubtful at this time.

8. **Do you have any recommendations for additional funding sources for WQ monitoring activities?**
   - BR: None at this time.
   - DW: No.
   - HM: EPA, NOAA, NSF.
   - RG: No.

- RT: Increases in environmental monitoring funding levels via the government sector seem unlikely in the present economic and political climate, absent a crisis such as that triggered by Pfiesteria almost 20 years ago. More productive perhaps would be grants from the private sector, particularly large foundations or endowments.
- JY: Collaborative funding proposals to the EPA/NSF/NOAA for longer term funding, potentially including the CIB, academic researchers, and citizen groups.
- SA:
    - Private entities could purchase monitoring equipment for CIB to use or borrow for monitoring (see question #5).
    - EPA NEP funds could potentially fund migration of the CMP data into STORET. From there, the data are accessible to everyone through multiple channels.
- BU: There is very little funding available for just monitoring. However, data collected as part of scientific research can also serve a secondary monitoring objective. Both DNREC and Sea Grant have funded such dual-use projects in the past.
- JF: I wish we did.
- EW:
    - DNREC/State should devote more funds to monitoring.
    - CIB should devote more funds to monitoring.

9. **Other than the University of Delaware Citizen Monitoring Program, are you aware of any volunteer organizations/programs that are currently active and could be included in future Inland Bays WQ monitoring for supplemental information?**
    - BR: No.
    - DW: No.
    - HM: No.
    - RG: No.
    - RT: No.
    - JY: No.
    - SA: No.
    - BU: No.
    - JF: South Bethany Water Quality Committee.
    - EW: I am not aware of other volunteer organizations/programs, perhaps with exception of the South Bethany Water Quality Committee, which falls under our umbrella, but has certainly become semi-independent and has been involved in CIB BMP projects.

10. For the data you discuss in this document, is your organization just collecting raw data or are you also processing the data and developing trends from the data?

- BR: Raw data only. Reports from the NCCA are written at a national scale.
- DW: We collect and process the data for a number of programs and purposes.
- HM: Our Section develops the monitoring plan and reviews and analyzes the data.
- RG: Watershed Assessment has compiled and assessed toxics data generated through its own monitoring and monitoring performed by others to produce a better understanding of an issue (e.g., arsenic in surface water, ground water, soils, sediments, fish tissue and air).
- RT: Mostly data collection, with some analysis.
- JY: I also process the data and interpret mechanisms and trends.
- SA: We also process and interpret data.
- BU: We are only interested in projects where monitoring data can be put to scientific use.
- JF: We provide semi-monthly summary reports during summer and are working on providing trend information, but we need additional staff support and resources to develop and maintain trend data in more accessible form.
- EW: Our organization has tended to focus on collection of raw data, but we do process and report data (reports issued regularly during summer, and data summaries submitted for 305b report), and have participated in prior CIB's State of the Bays reports.

Table 1

Attendee	Program/Monitoring Activity	Purpose/users	Where? (bay(s), stream(s), watershed(s), etc.)	Years collected, frequency of sampling	Parameters measured	Current/future status	Funding Status/ Sources
HM	Surface water quality monitoring – Fixed Station, grab samples	Assessment of surface water quality conditions	About 24 stations in the tributaries and main Bays	30+ years of data with different frequencies Monitoring frequency during FY 2016 is monthly	About 30 parameters including nutrients, organic, physical, bacteria, etc.	Will monitor monthly for 2 yrs, then will monitor 6 times/yr for the next 3 yrs	State General Fund, EPA 106 grant
HM	Continuous WQ monitoring (datasonde)	To monitor short term changes of dissolved oxygen and other parameters	Millsboro Pond outlet Massey Ditch	3+ yrs 15 minutes data collection	DO, temp, salinity, pH	Will continue monitoring during FY 2016	EPA 106 grant
HM	Stream gages	Measuring stream discharge	Millsboro Pond outlet Beaverdam ditch near Millville	20+ yrs	Stream discharge	Will continue during FY 2016	State General Fund, EPA 106 grant
HM	Tide gages	Measuring	Rosedale Beach	20+ yrs	Tidal elevation	Will continue	State General

		tidal elevations	Indian River Bay near Bethany Beach Beaverdam ditch near Millville			during FY 2016	Fund, EPA 106 grant
RG	Toxics in Biota Monitoring (i.e., testing of fish and shellfish for chemical contaminants)	To determine need for fish consumption advisories	Indian River Bay Rehoboth Bay Millsboro Pond	Infrequent	PCBs, dioxins/furans, OC pesticides, PAHs, arsenic, and mercury	Low priority compared to State waters with known toxic impacts	State & Federal
RG	Toxics in Sediment Monitoring & Assessment (data collection leveraged through dredging projects and EPA Coastal Assessment Program)	Assess ecorisk to benthic aquatic life and potential human health risk through sediment to biota transfer	Indian River Bay Rehoboth Bay	Infrequent	PCBs, OC pesticides, PAHs, and metals	Low priority compared to State waters with known toxic impacts	State & Federal
RT	General water sampling	Environmental Modeling and Trend analysis – Watershed Stewardship Section.	Tidal and Nontidal waters of Indian River Bay, Rehoboth Bay and Little Assawoman Bay	Over 30 years of sampling. Frequency varies from monthly to quarterly depending upon Statewide needs of the	General Water chemistry, Field parameters, bacteria, and chlorophyll	Ongoing - stable	EPA via Watershed Stewardship

				overall Surface Water Monitoring Plan			
RT	Biology sampling (macroinvertebrates)	Status of environmental condition Environmental Laboratory Section	Nontidal waters of Indian River Bay, Rehoboth Bay, and Little Assawoman Bay	25 years of sampling Sporadic, present intent is to sample random sites within the watershed every 5 years	Macroinvertebrates, general water chemistry, field parameters, and chlorophyll	Sporadic - unstable	EPA via Watershed Stewardship
JY	Water column sampling	Research projects	Guinea Creek	1 year, sporadic	NO3, NH4, PO4, chlorophyll a	Project ends 1/31/16	DE Sea Grant/ NOAA
JY	Ground water sampling	Research projects	Indian River Bay	2 years, sporadic	NO3, NH4, PO4, N isotopes	Project ended 1/31/15	DE Sea Grant/ NOAA
SA	1) Stream and tide gaging	Ambient hydrologic monitoring	IRB, RB, LAB, tributaries	1980's - present	Tide height, stream discharge	Always a challenge to acquire funds	State and federal pass through sources
SA	2) Coastal flooding	DNERR, DEMA, DEOS,CIB	IRB, RB	2014 - 2016	Tide height	One and done	NERR
SA	3) WQ portal	DNREC	Statewide		WQ	?	DNREC
SA	4) Evapotranspiration	DEOS	RB watershed at Warrington Farm	2015-	Atmospheric Water flux	?	DNREC/DEOS/DGS

SA	5) Groundwater level and salinity	DNREC/DGS	Multiple wells	1980's - present	Water level, temperature, and salinity	?	DNREC/DGS
JF	UD Citizen Monitoring Program	DNREC, CIB, public	Inland Bays	Since 1991, year round, weekly in summer	DO, Secchi, salinity, nutrients, Chlorophyll a, and TSS	Continued nutrients is contingent on CIB or other funding support	DNREC
JF	Phytoplankton (HAB) monitoring	Public health, DNREC	Inland Bays	Since 2001	Screen and enumerate potentially harmful algal species	Continuing	DNREC
JF	Recreational Water (BEACH) monitoring	Public health, DNREC	Inland Bays	Since 2003	Total enterococcus	Continuing	DNREC/EPA
EW	Volunteer field data	Impairment in DO and water clarity/DNREC, CIB, and public	Inland Bays and tributaries	25 years	DO and Secchi depth	Ongoing	Funded/DNREC
EW	Nutrient samples	Impairment in nutrient, chlorophyll and TSS levels DNREC, CIB, volunteers, and UD researchers	Inland Bays and tributaries	20 years	Nitrate plus Nitrite Ammonium DIP Chlorophyll TSS	Ongoing, but cutting back on sites and outsourcing analysis	Funding for analyses on year to year basis/CIB

EW	Bacteria samples	Recreational contact safety/public, CIB, DNREC, and UD	Inland Bays and tributaries	11 years	Total Enterococcus	Ongoing, expect to continue	Funded/DNREC & EPA
EW	Harmful algae samples	AULS and public safety/DNREC, UD, public	Ocean beach, Inland Bays and Tributaries	14 years	HAB species, fresh and marine General phytoplankton community	Ongoing, expect to continue	Funding limited/DNREC & EPA

Table 2

Attendee	Program/Monitoring Activity	Purpose/users	Where? (bay(s), stream(s), watershed(s), etc.)	Duration, frequency of sampling	Parameters measured	Anticipated Start Date	Funding Status/ Sources
RG	Watershed Approach to Toxics Assessment and Restoration (WATAR)	See attached Work Plan	Watersheds with known toxics impacts (does not include the IBs)	One-time, comprehensive synoptic survey, with follow-up investigation if justified	PCBs, dioxins/furans, OC pesticides, PAHs, and mercury in surface water, sediment, and biota	Not scheduled within next 2 years	State & Federal
SA	DE Sea Grant proposal	Ullman, Andres	Groundwater project in RB watershed	2 yrs – multiple/day	Hydrology, nutrients, and DOC	Jan 2016	DE Sea Grant
SA	Groundwater salinity	DGS/DNREC	Multiple wells	ongoing	salinity	?	State of DE capital budget or see Table 1, SA reponse 5)